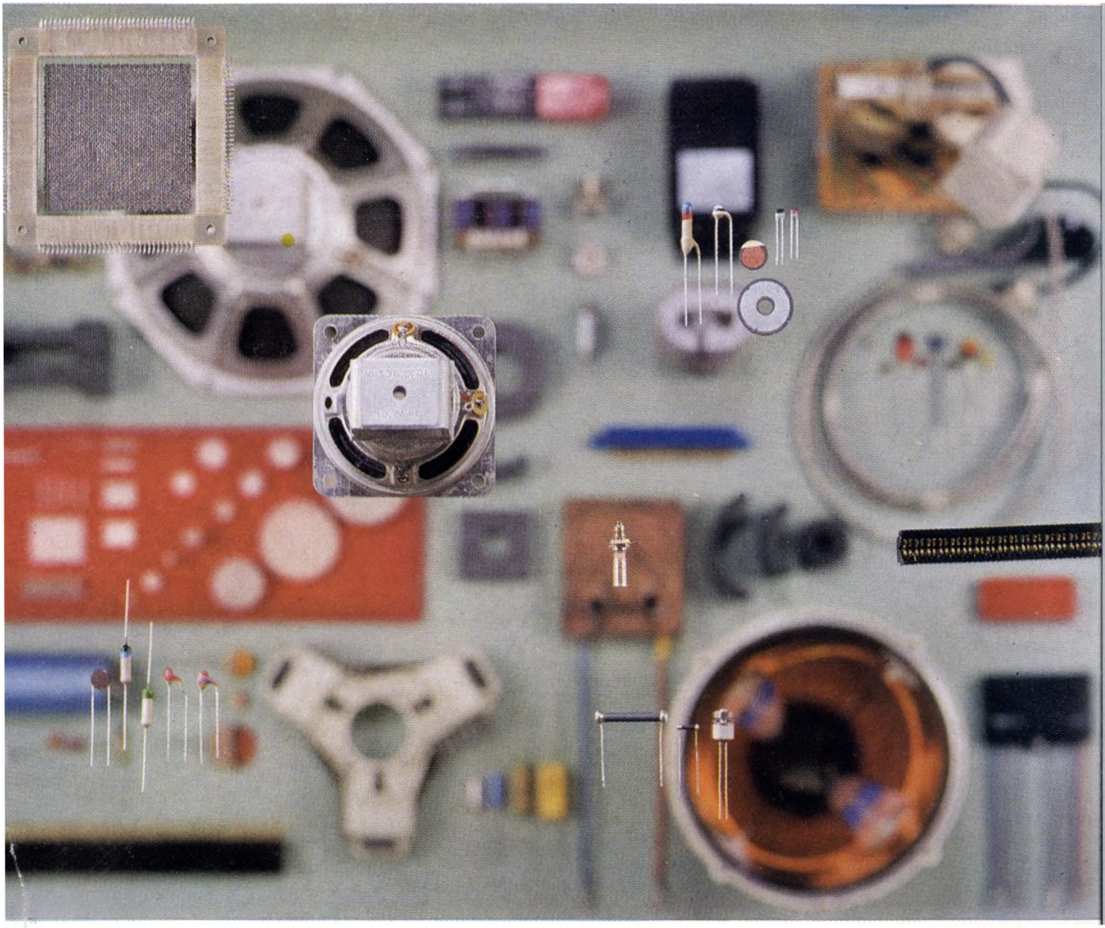
PHILIPS

COMPONENTS AND MATERIALS CATALOGUE

1966



INDUSTRIAL COMPONENTS AND MATERIALS DIVISION

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INTRODUCTION

This 1966 edition is a completely revised and enlarged version of the preceding one, containing data on all our products.

For a number of these products, separate booklets are available giving all necessary information and replacing the previous 'EP catalogue sheets'.

Generally, the type numbers indicate preferred types; however, the fact that a certain type is entered in this book does not necessarily imply its immediate availability.

As our research and development departments are engaged on continually perfecting our components and materials, the specification of a certain product may be found to have improved during the currency of this book.

We are sure that this book will be a useful guide to all who want to make a quick and correct choice from the great variety of products that we offer to the electronic industry, *products that form the basis of the economic manufacture and maintenance of highly reliable electrical and electronic equipment*

Industrial Components and Materials Division

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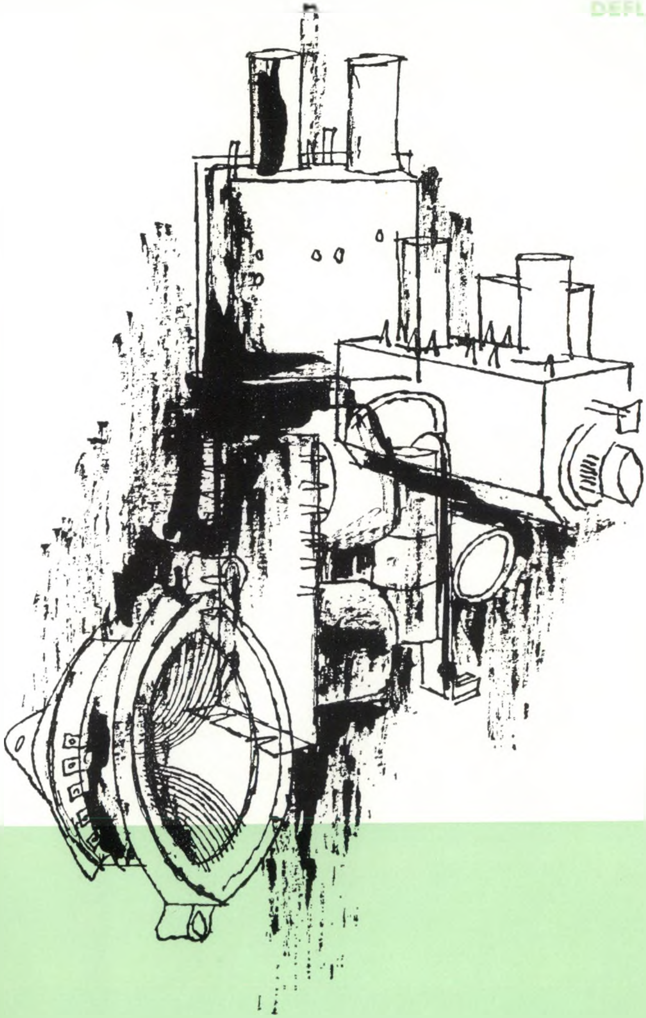

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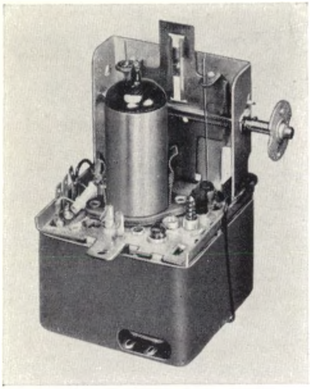
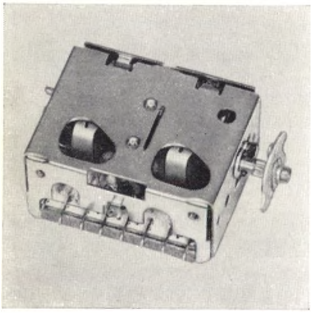
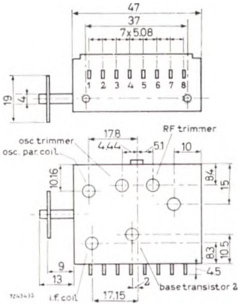
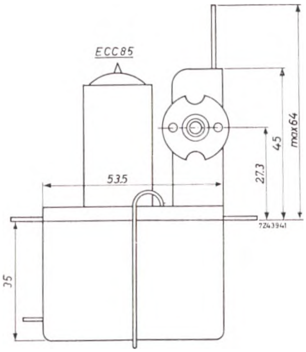
FM TUNERS FOR RADIO



tube types	*type number*
FM tuner with tube ECC85 for European band	AP2110/03
FM tuner with tube ECC85 for American band	AP2110/01
AP2110/01 with AFC	AP2110/02
AP2110/01 with AVC	AP2138
transistor type	***type number***
FM tuner with transistors for European band with AFC	AP2150/00







		tube types			*transistor type*
		AP2110/03	*AP2110/01* *AP2110/02*	*AP2138*	*AP2150/00*
wave range	Mc/s	87–104.0[1]	87–108.5[2]	87–108.5[2]	87.0–104.5
padding deviation	Mc/s	0.5	≤0.5	0.5	0.5
total gain		125×	90×	90×	4-6×
IF frequency	Mc/s	10.7	10.7	10.7	10.7
IF bandwidth (3dB)	kc/s	180–220	180–220	180–220	min. 200
max. frequency drift	kc/s	30	30	30	300[3]
radiation:					
fundamental oscillation	μV/m	150[4]	150[4]	1000[5]	1000[5]
second harmonic	μV/m	20[4]	20[4]	300[5]	300[5]

AP 2110/02: AFC 70–130 kc/s per V: AFC bias 9V
AP 2138: AGC at −8V: the gain is at least 20× lower

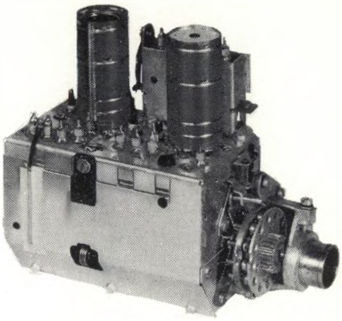
[1] Tolerance ± 150 kc/s; [2] tolerance ± 250 kc/s; [3] as V_b falls from 6V to 4V; [4] measured at a distance of 30 m; [5] measured at a distance of 3m (IEC norm)

VHF TUNERS FOR TV

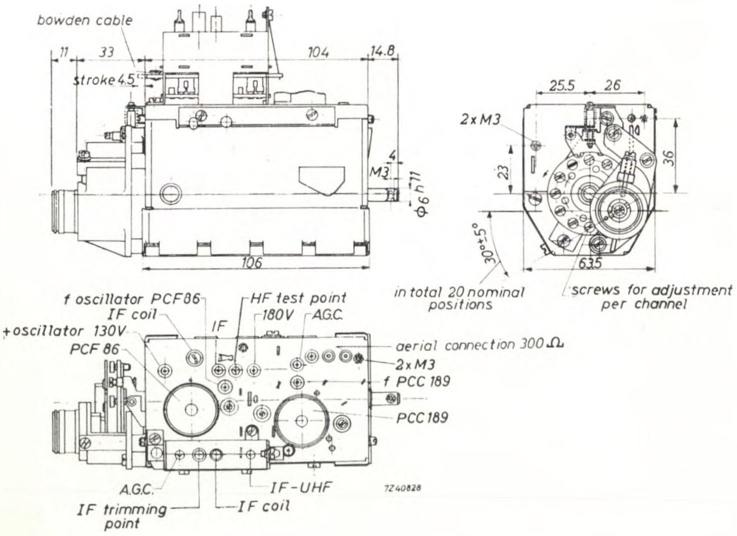
TYPE AT7638, AT7639, AT7640, AT7641

This turret type tuner has been developed for reception of television signals in bands I and III (41–68 Mc/s and 174–223 Mc/s resp.) The standard CCIR tuner has 10 channels with printed coil strips. During manufacture it is possible to replace these by any desired range of channels. When a special transmitter must be received, there is the possibility of inserting this particular channel, e.g. channel 2a for Austria or OIR2 for Finland, etc. For this purpose, the turret has two spare positions.

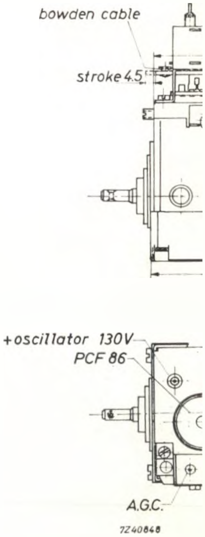
Not to be used for first equipment design.



The tuner is provided with the low-noise tube PCC189 operating as an RF cascode amplifier with excellent cross-performance. In the oscillator and mixer stage a PCF86 is used. Due to the high mutual conductance of the pentode section of the PCF86, the IF gain is increased by about a factor of 2, the total overall gain of the tuner now being 40 dB.



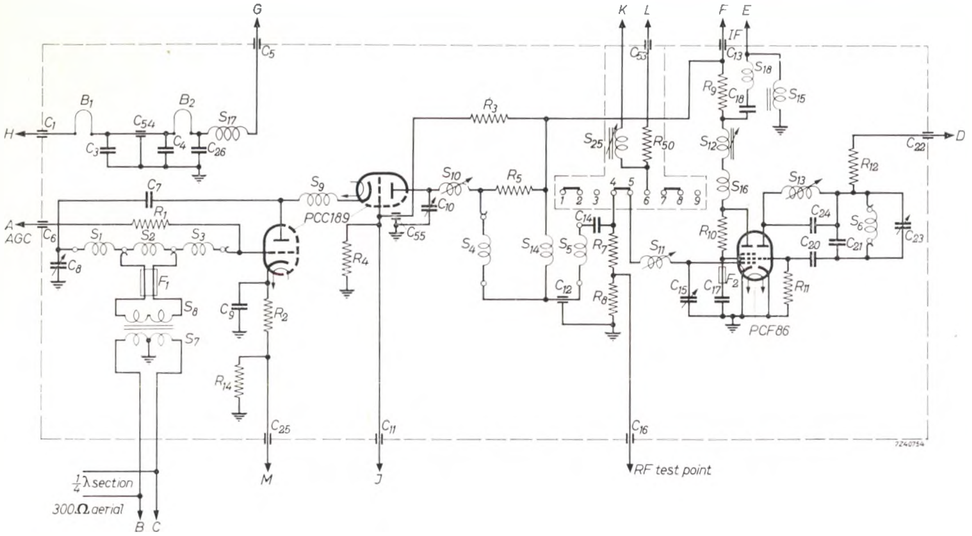
AT7638, AT7639



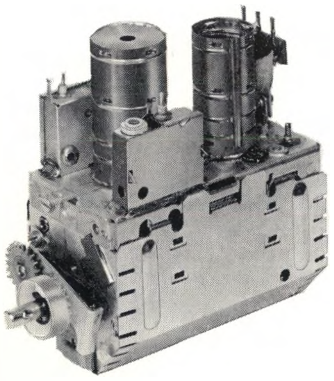
AT7640, AT7641

VHF TUNERS FOR TV

TYPE AT7639, AT7641 (WITH CASCADE SWITCH)



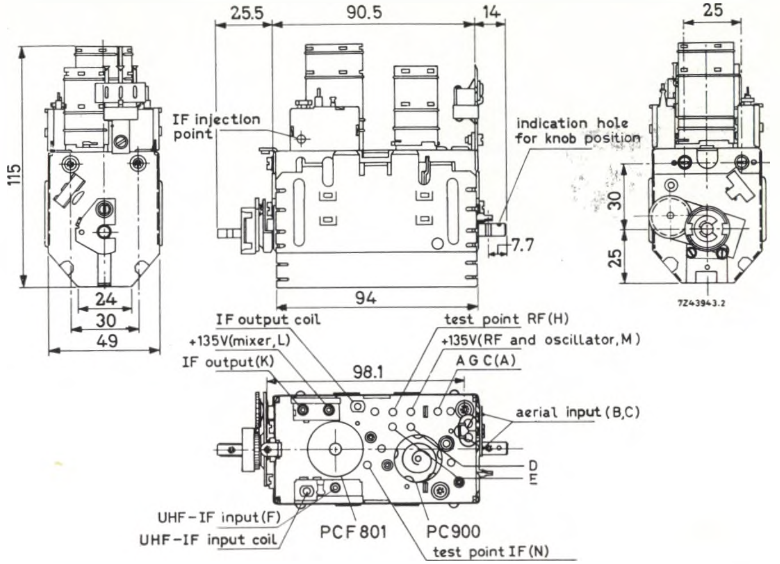
TYPE AT7650

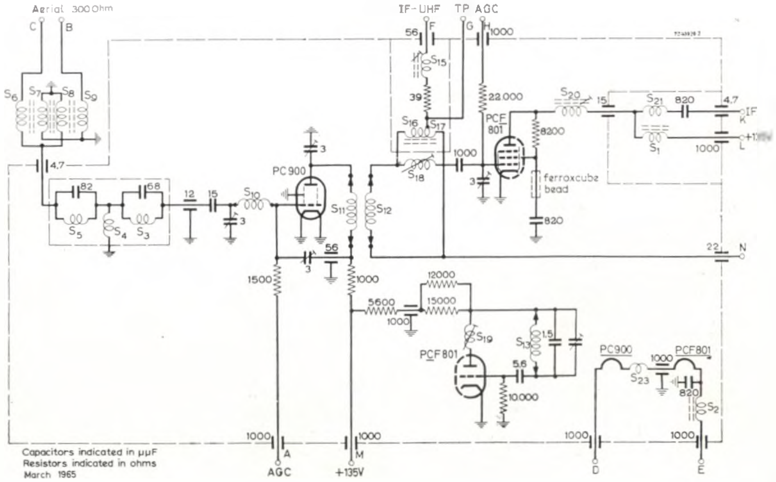


This very small VHF tuner has a 13-position turret switch equipped with 10 VHF-CCIR channel strips (channels 2–11), covering the frequency bands I and III (41–68 Mc/s and 174–223 Mc/s resp.)
The tuner has a memo-matic system which can be adjusted to each individual channel.
The tubes used are type PC900 (RF stage) and type PCF801 (oscillator/mixer). Due to a careful design this tuner meets the German Post Office requirements as regards radiation.
Life tests carried out on the reset stability revealed that $\triangle f_{osc} < 150$ kc/s when the tuner is switched from one channel to another and back again.
Provision is made for UHF-IF injection on the grid of the mixer pentode. The influence of this circuit on the shape of the RF bandpass curve is negligible.
The gain is approximately 50 times (for a 3dB IF bandwidth of 6 Mc/s).

VHF TUNERS FOR TV

TYPE AT7650

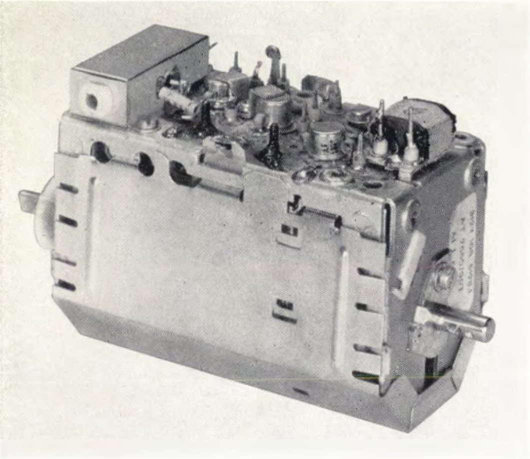




Capacitors indicated in µµF
Resistors indicated in ohms
March 1965

VHF TUNERS FOR TV

AT7650T, AT7651T and AT7652T

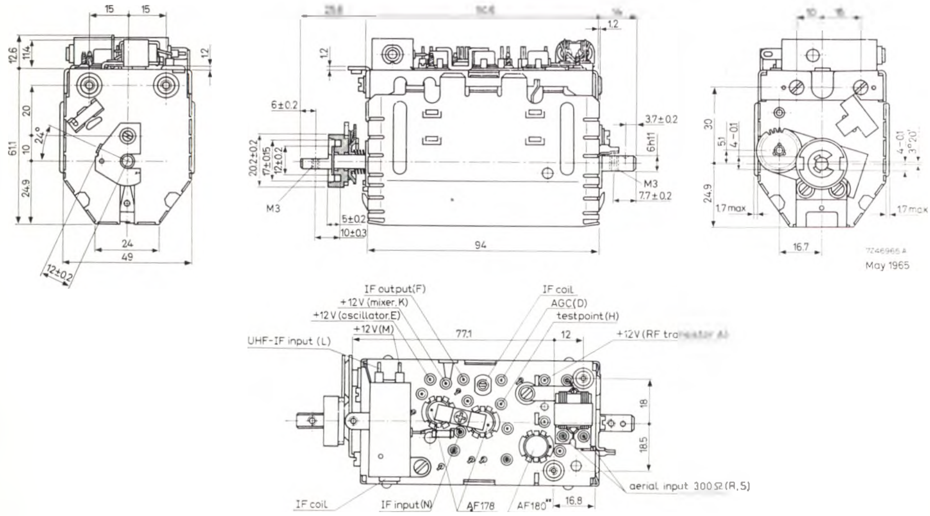


These transistorized VHF tuners have a 13-position turret switch equipped with up to 11 VHF-CCIR channel strips (channels 2–12), covering the frequency bands I and III (41–68 Mc/s and 174–223 Mc/s). The tuners have the same memomatic system as used in the VHF tuner AT7650; each individual channel can be adjusted. The RF stage is equipped with a transistor AF180; the mixer and the oscillator are both equipped with an AF178. Forward AGC can be applied to the RF stage; a gain reduction of approximately 40 dB can thus be obtained.

Differences between the types:

AT7650T has no VHF-bridge in circuit.

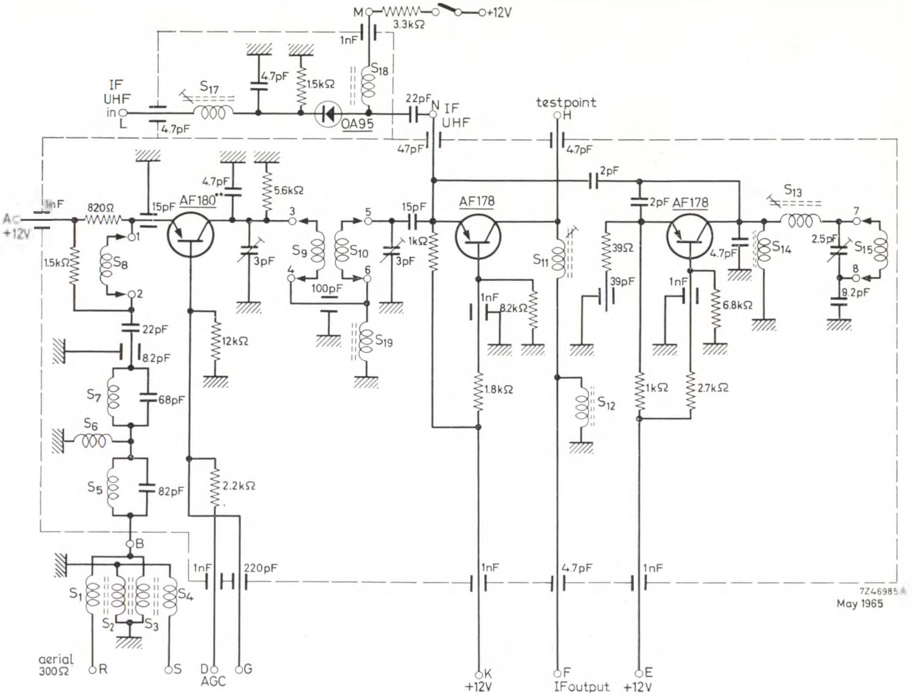
AT7651T and AT7652T are equipped with a UHF-bridge in circuit (extra IF gain approximately 10 dB). The total gain from the antenna to the first IF amplifier exceeds 26 dB at 3 dB IF bandwidth of 6.5 Mc/s and is flat within 5 %.



7Z46965 A

May 1965

AT7650T, AT7651T AND AT7652T



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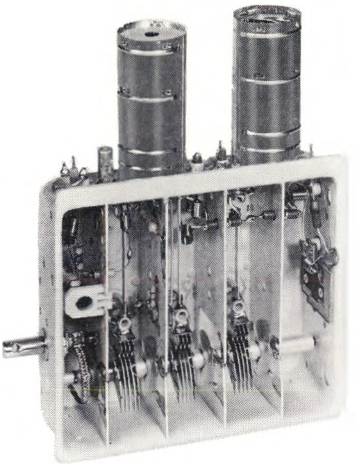
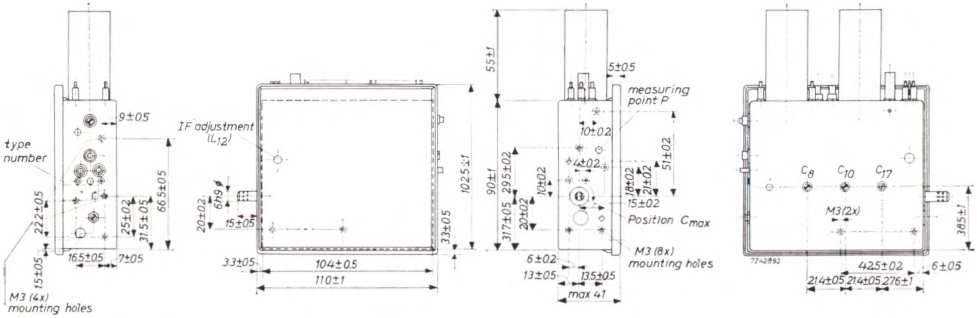
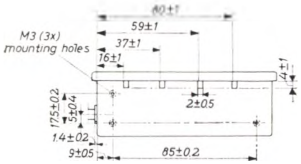
UHF TUNERS FOR TV

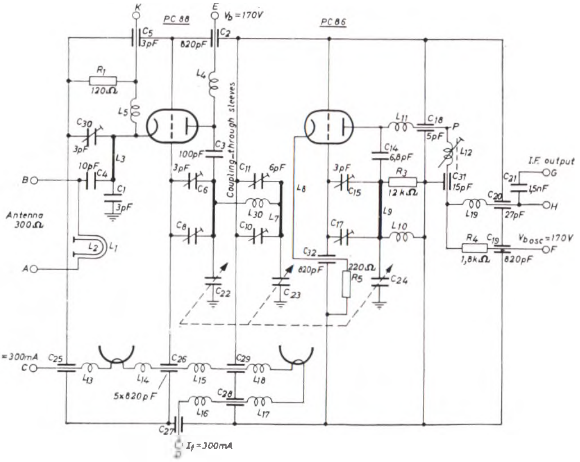
TYPE AT6354

This tuner has been developed for the reception of television signals in bands IV and V (470–862 Mc/s). Standard CCIR-IF frequency: sound 33.4 Mc/s, picture carrier 38.9 Mc/s.
The RF stage is equipped with a PC88 in grounded-grid circuit; the oscillator/mixer employs a PC86. The gain is approximately 10 dB (for a 3dB IF bandwidth of 6 Mc/s).



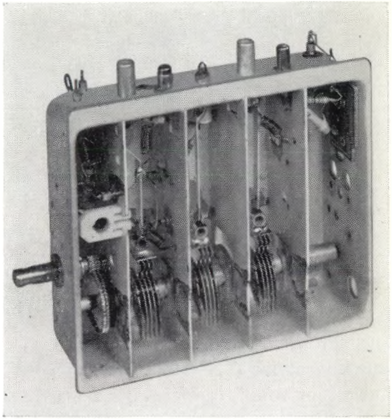


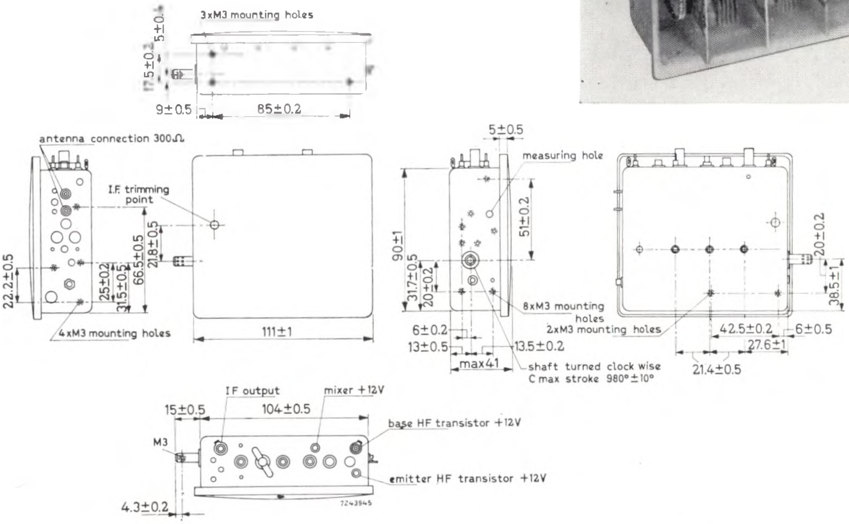


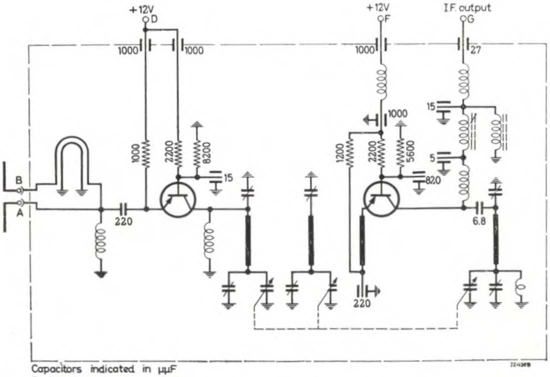


TYPE AT6370

This tuner is a transistorized version of type AT6354. The gain is approximately 14 dB (at a 3 dB bandwidth of 6 Mc/s).

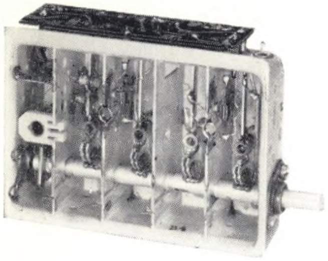




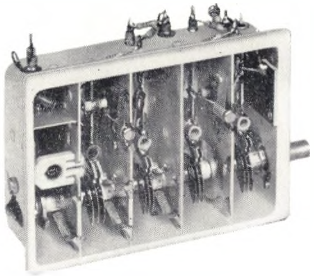


Capacitors indicated in µµF
Resistors indicated in ohms

TYPE AT6380 AND AT6381

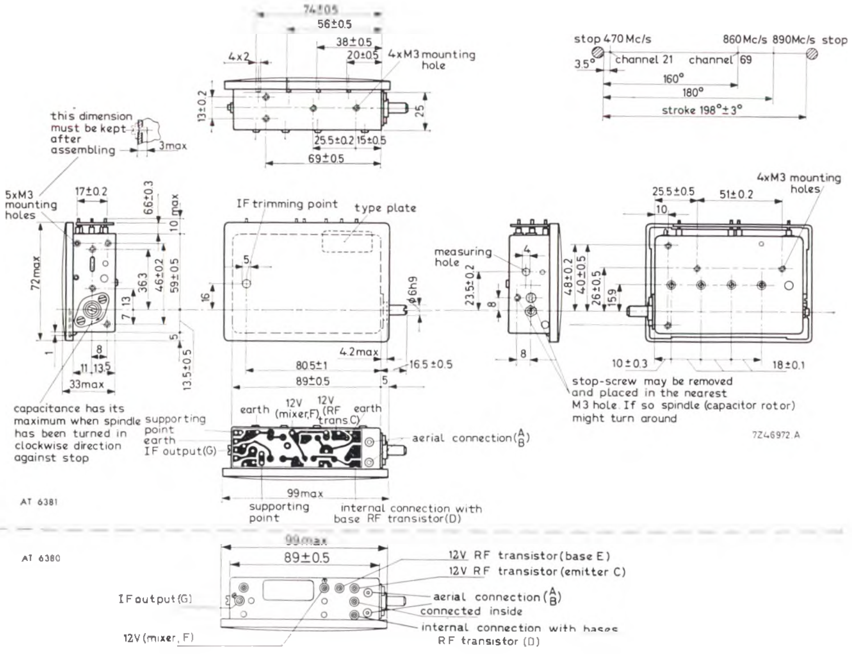


AT6381



AT6380

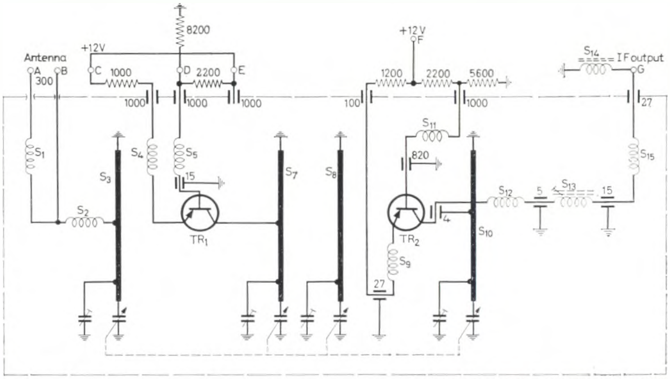
This tuner, which is continuously tunable, has been developed for the reception of television signals in bands IV and V (470–890 Mc/s).
The tuner should preferably be provided with a gearing to obtain a total ratio of about 1 : 40.
The maximum permissible axial torque on the tuner spindle is 7 kg.cm. The gain is approximately 14 dB (for a 3 dB bandwidth of 6 Mc/s).
These two types of tuner are electrically identical, the mere difference being that the resistors of tuner AT6381 are mounted on a printed-wiring board. The figure shows both the printed-wiring board on top of tuner AT6381 and the terminals on top of tuner AT6380.



capacitance has its maximum when spindle has been turned in clockwise direction against stop

stop-screw may be removed and placed in the nearest M3 hole. If so spindle (capacitor rotor) might turn around

TYPE AT 6380 AND AT6381

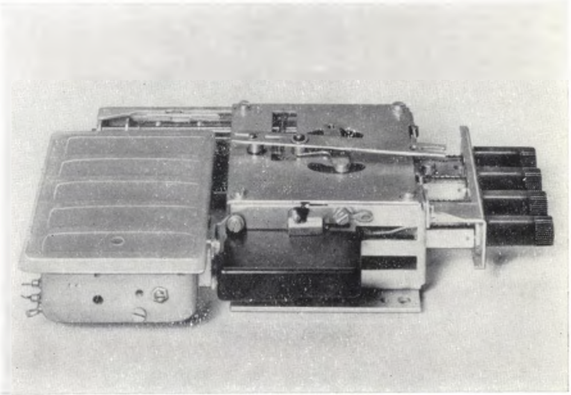


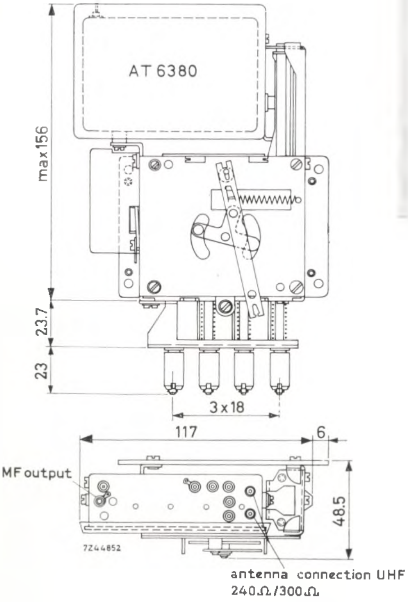
all resistances and S14 located on printed wiring board
April 1965

Capacitors indicated in µµF
Resistors indicated in ohms

7Z46973

TYPE AT6385



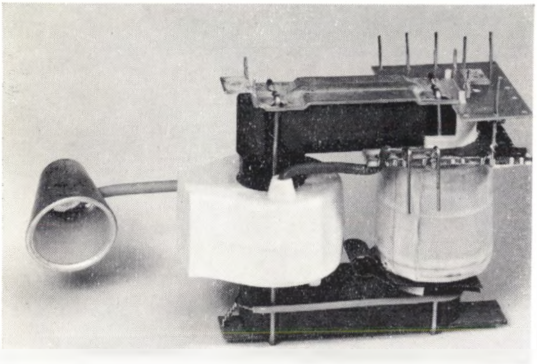


This tuner is the push-button version of the AT6380 and AT6381 types.
Tuner type AT6386 differs from type AT6385 in that the switch for the B+voltage and AGC-line has been omitted.

DEFLECTION COMPONENTS FOR TV

LINE OUTPUT TRANSFORMER TYPE AT2025

Preferred type for tube sets with either conventional or printed wiring with non-inflammable coils.



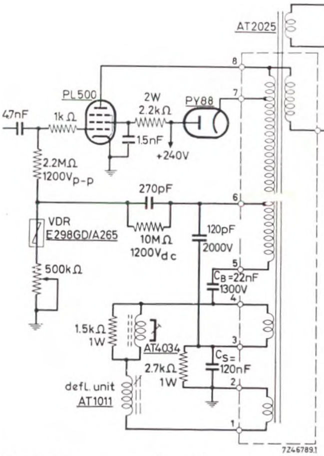
(supply voltage 240 V)
System 525/625 lines
Deflection 110° or 114°
EHT 18kV stabilized
Deflection unit AT1011, AT1019 or AT1030
Linearity control AT4032 or AT4034
Line output tube PL500
Booster diode PY88
EHT rectifier DY87
VDR resistor E298 GD/A265

Two circuits are shown.

In Fig. 1 the S-correction capacitor C_S is connected between the two halves of the secondary. In Fig. 1a C_S is connected directly in series with the deflection unit. The advantage of the first circuit is that the booster capacitor C_B requires a much lower value.

Moreover, a 90 V p-p parabola-shaped voltage is available from terminal 3.

The table below gives measured results obtained with a 120 pF ceramic capacitor C_1 connected between (6) and (3). The capacitance between terminals (1) and (4) is 100 pF.



AT2025 Fig. 1

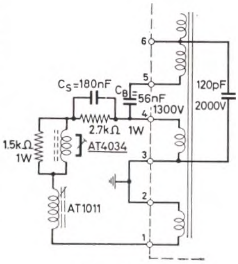


Fig. 1a

supply voltage[1]	240 V	225 V
beam current[2]	35 μA	400 μA
EHT	18.1 kV	16.4 kV
booster voltage adjusted to	650 V	618 V
flyback time	17.5 %	17.5 %
stabilisation range	195 V	205 V
overscan[2]	+9 %	—

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[1] Internal resistance of power supply = 250 Ω

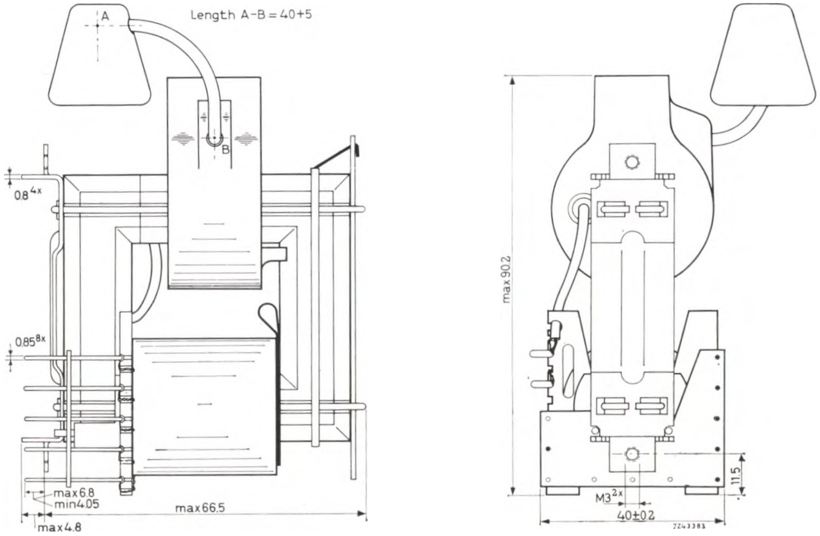
[2] A beam current increase of 200 μA results in an amplitude increase of max. 2%.

LINE OUTPUT TRANSFORMER TYPE AT2025

In the design of type AT2025 special attention has been paid to mounting (and dismounting) facilities. Its mounting height is less than that of its predecessor, type AT2023/01.

The transformer can be mounted on metal chassis or on printed-wiring boards. There are four pins and two threaded holes available for the mechanical mounting. The pins can be bent or soldered for fixing the transformer to the chassis.

The electrical connections are made to wire pins which in this design lie in straight lines.



This transformer satisfies the most stringent safety requirements. Both the primary and the EHT coils are made self-extinguishing by a special impregnation technique.

LINE OUTPUT TRANSFORMER TYPE AT2026 AND AT2031/01

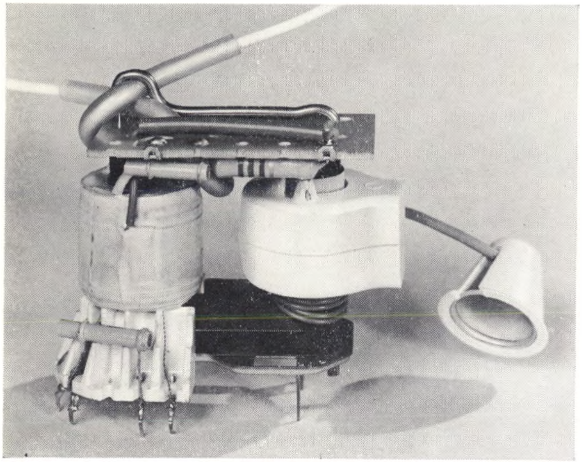
Type AT2026 is mechanically identical to type AT2025, but was specially developed for 625/819 lines in multistandard tube sets (EHT 18 kV).

Type AT2031/01 is mechanically identical to type AT2023/01, but was specially developed for 625/819 lines in multistandard tube sets (EHT 17 kV).

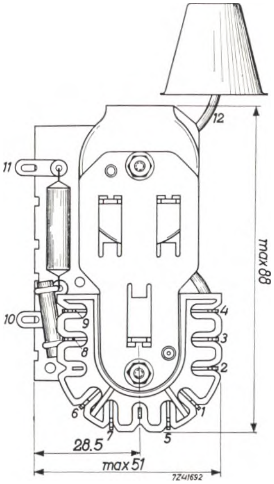
DEFLECTION COMPONENTS FOR TV

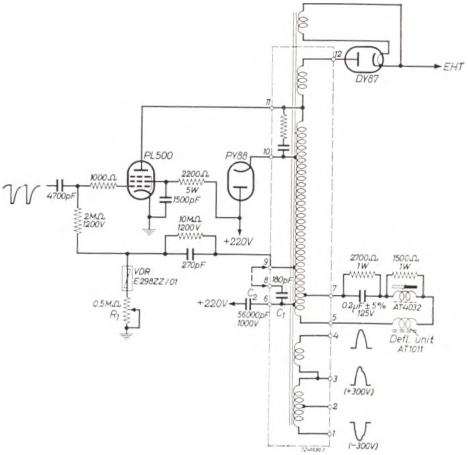
LINE OUTPUT TRANSFORMER TYPE AT2023/01.

This type of transformer is designed for tube sets and is suitable for both conventional and printed wiring. (It should not be used for new designs.)

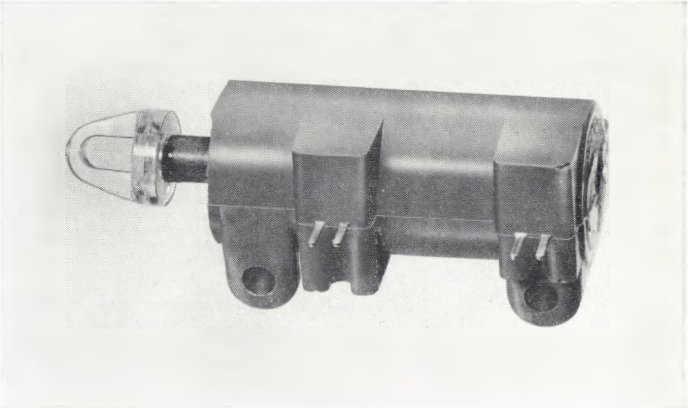


System 525/625 lines
EHT 17.5 kV stabilized
Deflection unit AT1011, AT1019 or AT1030
Linearity control AT4032 or AT4034
Line output tube PL500
Booster diode PY88
EHT rectifier DY87





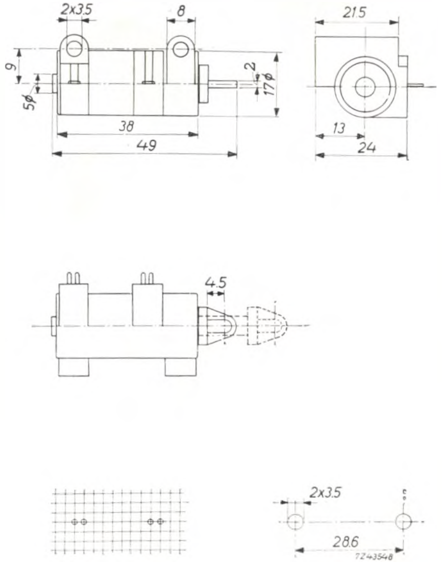
ADJUSTABLE LINEARITY CONTROL TYPE AT4032



This control unit designed for tube sets consists of a coil located in a biasing field between two ferroxdure ring magnets. To adjust the linearity, a ferroxcube core can be moved axially in the coil and magnetic rings, thus controlling the degree of saturation of the inductance. The ferroxcube core has been provided with an insulating grip and is held in position by means of a silicon-rubber ring.

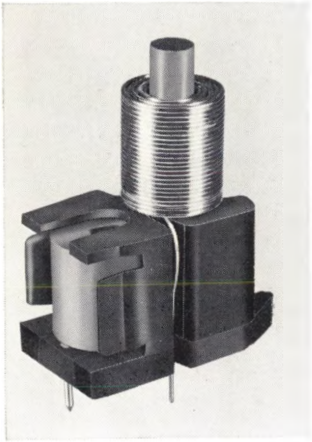
The unit has been designed for use in combination with deflection unit AT1011 and line output transformer AT2023 or AT2025.

The unit can be mounted either on printed-wiring boards, by means of its connecting pins, or on conventional panels, by means of two screws through the holes in the pads.



ADJUSTABLE LINEARITY CONTROL TYPE AT4034

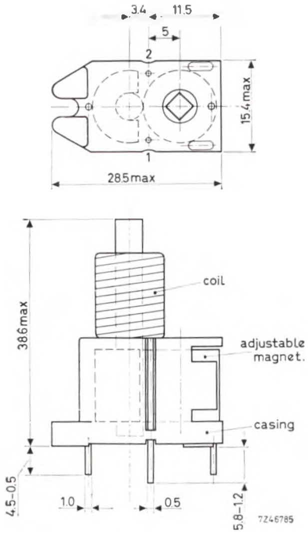
This unit is designed for use in TV sets equipped with tubes, to adjust the linearity of the line deflection. It can be used in combination with deflection unit AT1011, AT1019 or AT1030 and line output transformer AT2023/01, AT2025, AT2026 or AT2031/01.

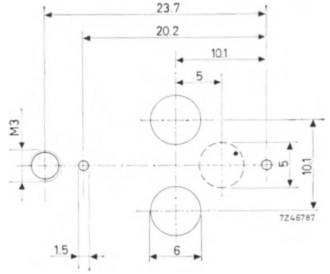


The control unit consists of a coil wound on a ferroxcube rod, and two ferroxdure magnets. One of these magnets had the shape of a half ring placed around the ferroxcube rod under the coil. The second magnet is cylindrical and is positioned parallel to and clamped against the ferroxcube rod opposite the first one. It is provided with a square hole to facilitate turning of the magnet to adjust the biasing field and so the linearity of the line deflection.

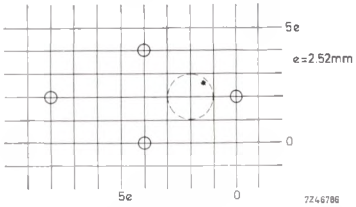
Mounting

The unit can be mounted both on printed-wiring boards, by means of its two connecting pins and two mounting pins, and on conventional panels, by bending of the two mounting pins and/or by means of a screw through an aperture in the casing. To prevent distortion of the magnetic field, any iron parts should be at a distance of at least 3 mm from the magnetic parts. The coil should be shunted with a 1 W carbon resistor of 1500 Ω to damp ringing phenomena.



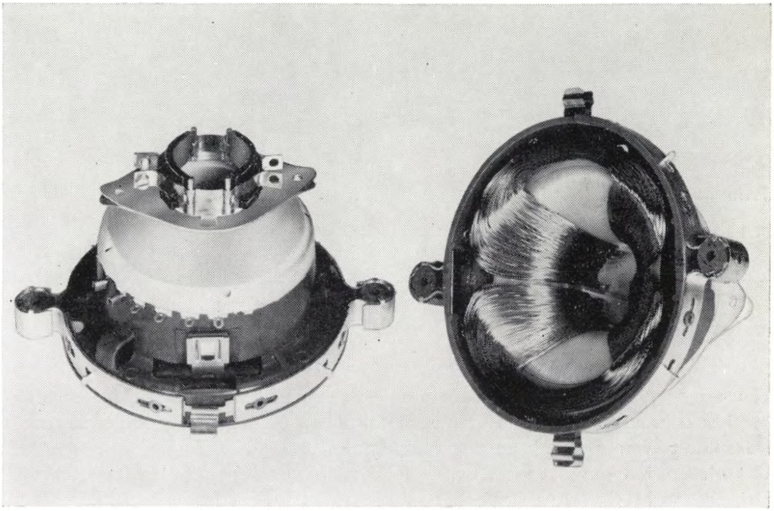


Hole pattern for mounting on a chassis



Hole pattern for mounting on a printed-wiring board
* hole only necessary for bottom adjustment.

DEFLECTION UNIT TYPE AT1011

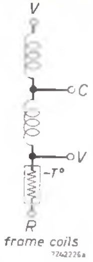
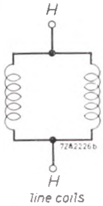


This deflection unit is designed for tube receivers; it can be used for 19″ and 23″ 110° rectangular picture tubes. The windings of the coils of the unit have been constructed so as to minimize raster distortion on the screen of a 19″ or 23″ rectangular tube. This unit offers several possibilities for fine adjustment of the raster shape, but for the convenience of the setmakers it is adjusted before delivery for optimum raster shape on an average picture tube. The various adjustments, summarized below, are achieved by:

1. Two sliding magnets for the compensation of horizontal pin-cushion distortion, i.e. for straightening the upper and lower sides of the raster.
2. Two adjustable cylindrical magnets for the compensation of vertical pin-cushion distortion, i.e. for straightening the left- and righthand sides of the raster. These magnets are diagonally magnetised and can be turned between pole shoes for the correct magnetic field distribution.
   The adjustment is marked with paint.
3. The pole shoes are also adjustable, that is to say, they slide on the cap of the deflection unit. This adjustment allows compensation of certain non-symmetric errors (trapezium distortion).
   The pole shoes are adjusted before delivery for optimum raster shape on a test tube; this position is indicated by a dot.
4. Small rubber magnets can be attached to the pole shoes. These flat square magnets are provided with a hole in the centre which fits the lips of the pole shoes that are bent outward. By turning these magnets the shape of the corners of the rasters can be adjusted. They are supplied separately under type number AT7114.
5. Centring magnets for centring the raster on the picture tube face.

DEFLECTION COMPONENTS FOR TV

DEFLECTION UNIT TYPE AT1011

	frame coils		*line coils*	
inductance	82 mH		2.9 mH	
resistance	48 Ω[1]		4.6 Ω	
deflection current (peak-to-peak)	455 mA		2.2 A	
at 18 kV for a deviation of . . .	380 mm		500 mm	

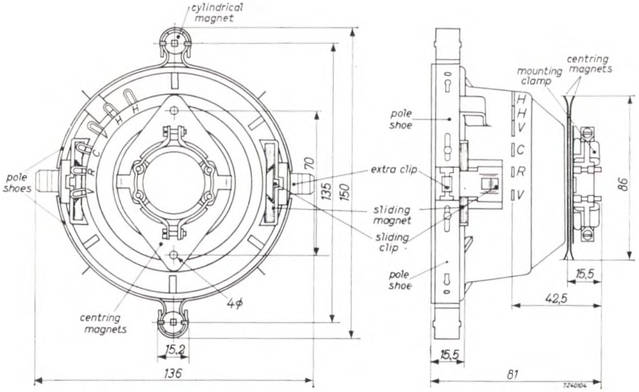
---

[1] Including NTC-resistor R.

The component parts of the deflection unit are embedded in polyester resin. The horizontal and vertical coils are adjusted for minimum coupling before being embedded, so that the "cross talk" from line to frame coils is kept to a minimum.

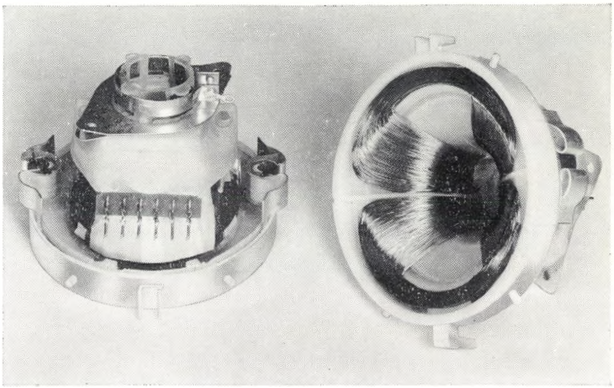
The picture height must remain constant even in frame-output circuits with voltage feedback. For this purpose, an NTC-resistor is connected in series with the frame coils. For optimum heat transfer this resistor is contained in the same casting as the frame coils. So the coils and the NTC-resistor have practically the same temperature under all conditions which is especially important during the warm-up period.

If a frame-output circuit with current feedback is used, the NTC-resistor can be left out by using the soldering tag *V* between frame coil and NTC-resistor.



DEFLECTION UNIT TYPE AT1019

This unit, designed for tube receivers, is electrically identical to deflection unit AT1011

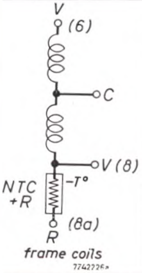
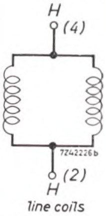


The windings of the coils of deflection unit type AT1019 have been designed for minimum raster distortion on the screen of a 19″ and 23″ rectangular tube. In addition, this unit offers several possibilities for fine adjustment of the raster shape. The various adjustments, summarized below, are achieved by:

1. Two plastoferrite rod magnets for the compensation of horizontal pin-cushion distortion, i.e. for straightening the upper and lower sides of the raster. (Mounted inside the rim.)
2. Two adjustable cylindrical magnets for the compensation of vertical pin-cushion distortion, i.e. for straightening the left- and right hand sides of the raster. These magnets are diagonally magnetised and can be turned between pole shoes for the correct magnetic field distribution.
3. The pole shoes are also adjustable, that is to say, they slide in a groove of the rim of the deflection unit. This adjustment allows compensation of certain non-symmetric errors (trapezium distortion).
4. Small rubber magnets can be attached to the rim. These flat square magnets are provided with a hole in the centre which fits the pins on the rim. By turning these magnets the shape of the corners of the rasters can be adjusted. They are supplied separately.
5. Centring magnets for centring the raster on the picture tube face.

DEFLECTION COMPONENTS FOR TV

DEFLECTION UNIT TYPE AT1019

	frame coils		line coils	
				
inductance	82 mH		2.9 mH	
resistance	48 Ω[1]		4.6 Ω	
deflection current (peak-to-peak)	455 mA		2.2 A	
at 18 kV for a deviation of . .	380 mm		500 mm	

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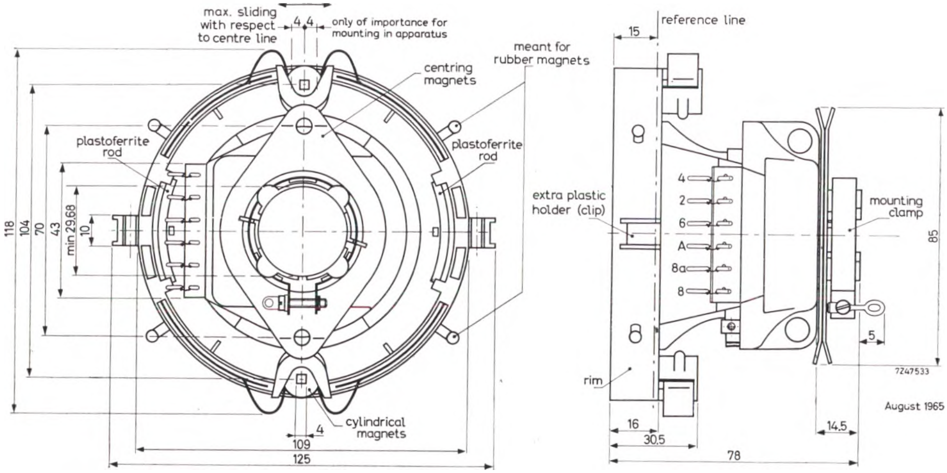
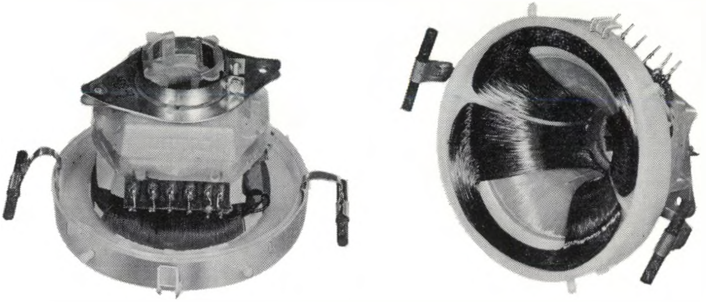
[1] Including NTC-resistor.



August 1965

DEFLECTION UNIT TYPE AT1030



This deflection unit is designed for tube receivers; it can be used for 19″ and 23″ 110° rectangular picture tubes.
The unit offers some possibilities for fine adjustment of the raster shape.
The adjustments, summarised below, are achieved by:

1. Two rod magnets, mounted on brackets, for compensating vertical pin-cushion distortion. Asymetrical pin-cushion distortion can also be corrected to some extent by bending the rod magnets asymmetrically.

2. Small rubber magnets which can be attached to the rim. These flat square magnets are provided with a hole in the centre which fits the pins on the rim. The shape of the corners of the raster can be adjusted by rotating these magnets. They are supplied separately.

3. Two plastic ferrite rod magnets which can be mounted in plastic slips on the rim. These magnets can be used to compensate horizontal (pin-cushion) distortion, i.e. to straighten the upper and lower edges of the raster. Each clip contains two slots of different size to accomodate rods with different diameters. It is also possible to use two plastoferrite rods inside the rim as in Type AT1019.[1]

4. Centring magnets for centring the raster on the picture tube face.

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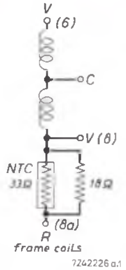
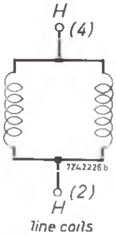
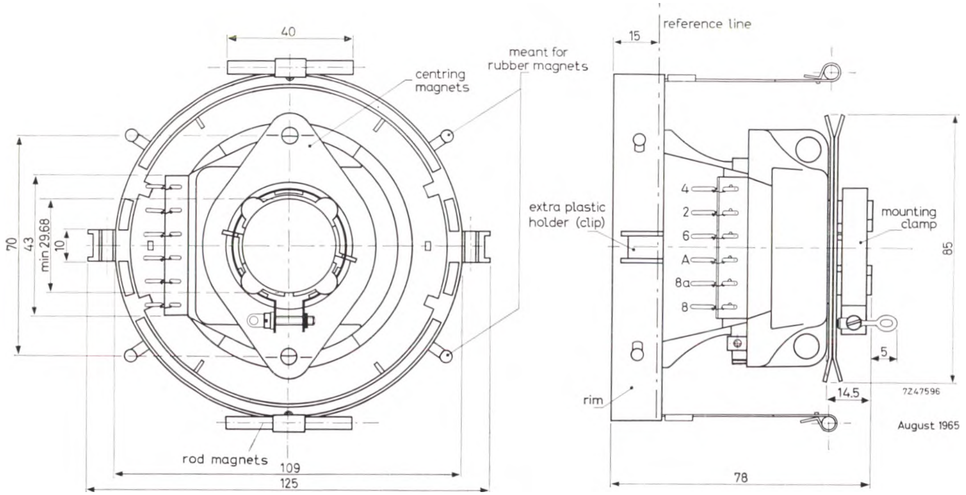
[1] With 19″ tubes these rods are always necessary to get optimum raster shape.

DEFLECTION UNIT TYPE AT1030

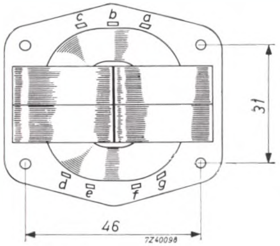
	frame coils		line coils	
inductance	82 mH		2.9 mH	
resistance	48.5Ω		4.6Ω	
deflection current (peak to peak) . . .	0.4 A		2.25 A	
at 18 kV for a deviation of	380 mm		500 mm	

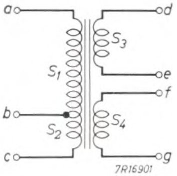


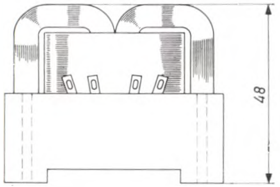
August 1965

FRAME OUTPUT TRANSFORMER TYPE AT3507

The core of the transformer consists of two O-shaped yokes, formed by a number of bent laminations, with the coils wound around the two inner legs. The lower part of the transformer is embedded in polyester resin, in which apertures are left for mounting purposes. The maximum height and the relative positions of the apertures are shown in the figure.
The primary winding between the connections a and *c* is designed for a supply voltage of 220 V, whilst the connections *a* and *b* should be used if the supply voltage is 200 V.







FRAME OUTPUT TRANSFORMER 625/819 LINES, TYPE AT3508

The data are identical to those of type AT3507, but an extra winding has been provided for flyback suppression.

ACCESSORIES

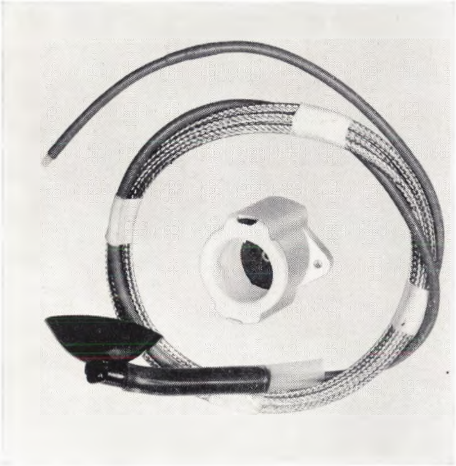
Screened EHT cable type AT7116 with built-in 220 kΩ resistor.
Unscreened EHT cable type AT7117, without resistor.

EHT RECTIFIER SOCKET TYPE AT7108 WITH BUILT-IN 1.2 Ω RESISTOR

Designed for use in tube receivers.

EHT RECTIFIER SOCKET TYPE AT7108/02.

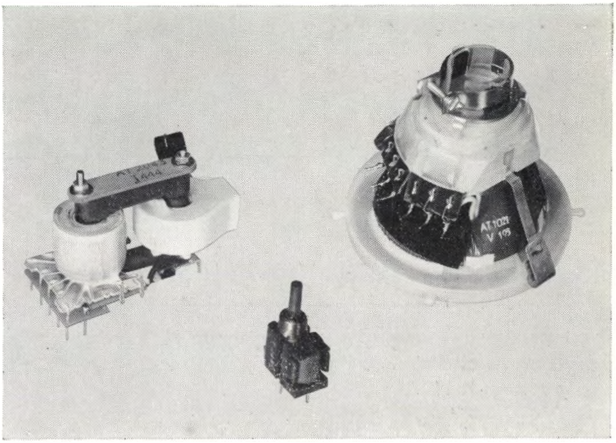
Designed for use in transistorized receivers.
This type number covers:



EHT cable	AT7116
Rectifier socket	AT7108

FOR 11 INCH "TINYVISION" TRANSISTOR AND TUBE RECEIVERS

(These components are designed around picture tube A28–13W).
Two sets of components are available, one for tube receivers and one for transistorised receivers. They differ merely in the winding data.



A. For tube receivers the set comprises:

- Deflection unit AT1021/01
- Line output transformer AT2043
- Linearity control unit AT4037

The essential data of the deflection unit are given below. To achieve temperature compensation, an NTC-resistor (cold resistance 32 Ω) shunted by a 12 Ω carbon resistor, is connected in series with the 30 Ω frame coils. In this way the total effective resistance (about 38 Ω) remains substantially constant over a wide temperature range.

AT1021/01	*Line coils*	*Frame coils*
Inductance	1.7 mH	42 mH
Resistance	3.6 Ω	38 Ω
Sensitivity	108 μV s/cm	9 mW/cm²

The design of the line output transformer AT2043 is based on the use of the tubes PL81, PY81 or DY51 (or a semiconductor diode). The nominal supply voltage is 240 V_{dc}; the transformer has to be used with VDR-stabiliser E298 GD/A265 in order to keep the anode voltage of the PL81 well above the knee so as to prevent the occurrence of Barkhausen oscillations.

Further data

EHT voltage (no load)	11 kV
Booster voltage	240 + 440 = 680V
Flyback time	17.5 %
Average current	32 mA (38 mA with DY51)
Overscan	+5 %
Extra windings	a. 7–8 for heater supply of the picture tube: 11 V_{rms} (or 38 $V_{p\text{-}p}$) b. 5–6: 28 $V_{p\text{-}p}$ for power supply of transistors in hybrid sets

DEFLECTION COMPONENTS FOR TV

FOR 11 INCH "TINYVISION" TRANSISTOR AND TUBE RECEIVERS

(These components are designed around picture tube A28–13W).

B. For transistorized receivers the set comprises:

Deflection unit AT1020/01
Line output transformer AT2042
Linearity control AT4036

The essential data of deflection unit type AT1020 are given below. The AT1020 has separate connections for both frame coils. Thus it is possible to connect them in series (30 Ω) or in parallel (7.5 Ω).

AT1020/01	*Line coils*	*Frame coils*
Inductance	81 μH	42 mH
Resistance	0.15 Ω	30/7.5 Ω
Sensitivity	23 μV s/cm	9 mW/cm^2

The design of the line output transformer AT2042 is based on the use of the line output transistor AU103, the parallel diode BY118 and the EHT rectifier DY51 (or a semiconductor diode). The stabilized supply voltage is 11 V.

Further data:

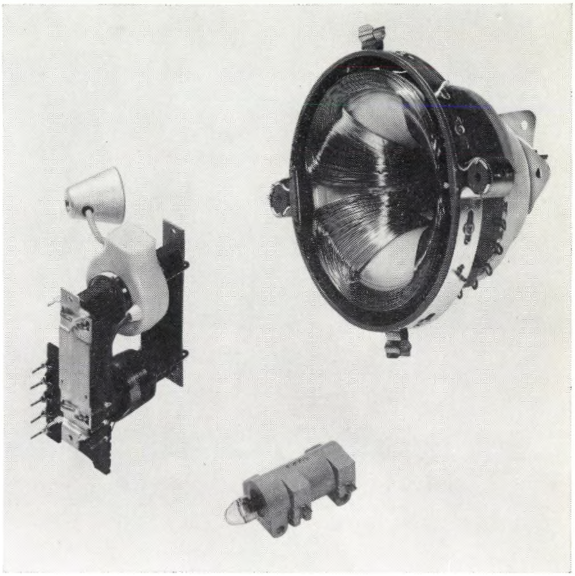
EHT voltage (no load)	11 kV
Current	0.52 A
Flyback time	17.5 %
Overscan	+5 %

The data were, measured at a load of 0.9 W on the extra winding and including 0.77 W heater power for the DY51.).

More details on request.

DEFLECTION COMPONENTS FOR TV

DEFLECTION SYSTEM FOR TRANSISTORISED RECEIVERS



Line output transformer AT2038	Linearity control AT4035	Deflection unit AT1018

General design considerations

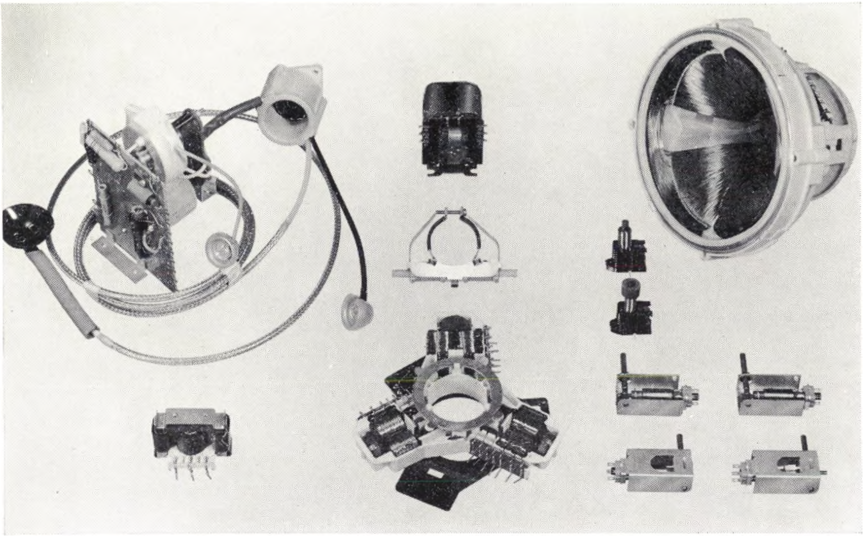
These deflection components have been designed for transistorised full-performance mains receivers having the additional feature that a 12 V battery can also be used for the power supply.

System	525/625 lines
Picture tube	19 inch
Deflection angle	110 degrees (or 114)
Extra high tension	16 kV
Flyback time	19.5 %
Line output transistor	AU104
Driver transistor	AC128
Booster diode	BY118
Parallel diode	BY118
EHT diode	DY87
Deflection unit	AT1018
Line output transformer	AT2038
Linearity control	AT4035
EHT socket	AT7108/02

More details on request

DEFLECTION COMPONENTS FOR COLOUR TV

90° RECTANGULAR TUBES



From 1.8.'65 on the package comprises the following components:

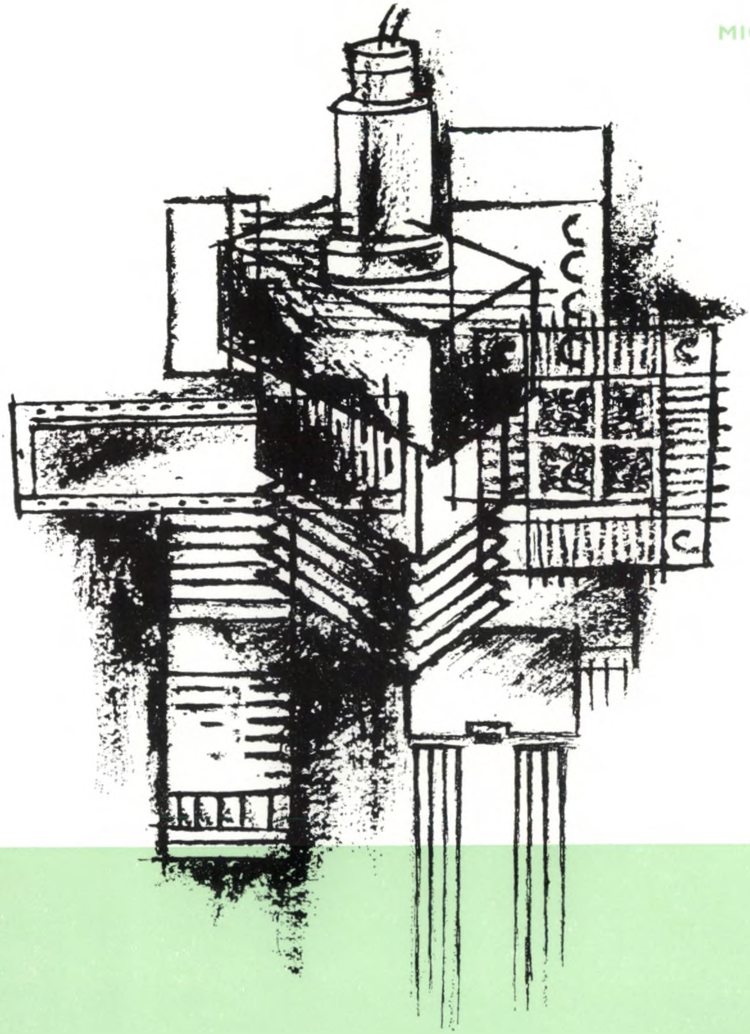
AT1022/01	Deflection unit
AT1023/01	Convergence unit
AT1025/01	Blue lateral convergence unit
AT2044/01	Line output transformer complete with EHT rectifier socket and cables
AT3512/01	Vertical output transformer
AT4041/01	Transductor for raster correction
AT4042/01	Linearity control

Set of adjustable coils for convergence adjustment:

AT4040/01	R/G par. bal.
/06	B par.
/07	B correction
/08	R/C par.
/10	For raster correction

More details on request.

CIRCUIT BLOCKS
NORBITS
MEMORY CORES
MICROWAVE UNITS
MISCELLANEOUS

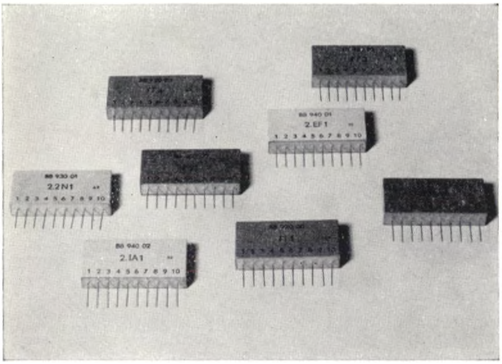


Electronic subassemblies for professional applications

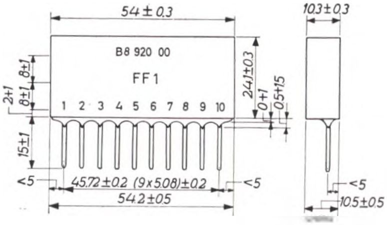
CONTENTS

100 series - CIRCUIT BLOCKS

STANDARD UNITS FOR MEDIUM SPEED (max. frequency 100 kc/s)



Circuit blocks can in general be used in all digital data handling equipment such as for signalling, computing, controlling, measuring and testing, data handling, laboratory uses etc.



A circuit block is a small encapsulated unit containing basic electronic components, designed to accept and operate upon a specific type of input signal and to produce a specific type of electrical output. A number of different blocks can be combined to form larger parts of a reliable electronic digital system. The dimensions of all circuit blocks are approximately 54 mm × 24 mm × 11 mm.

Out of one side of 54 mm × 11 mm emerge ten wire terminals of 0.7 mm diameter and 15 mm length. The distances between the wires are 5.08 mm (0.2 in.) in accordance with the I.E.C. standard hole grid for printed-wiring boards. The blocks are colour-coded, a different colour being used for each group of functions.

standard supply voltage	+6V and −6V (±5%)
power dissipation	20–100 mW
operating temperature	−20 °C to +60 °C
storage temperature	−25 °C to +75 °C
housing	synthetic resin, rectangular, flat, colour-coded
terminals	10 in one row
test specifications	MIL-Std. 202 and IEC68

Composition of the type number:

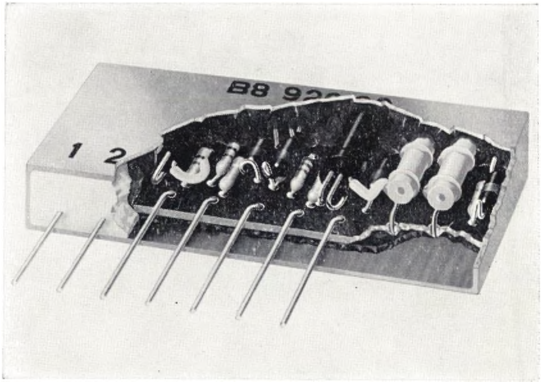
B8 . . . . .

▶serial number

▶mechanical design

▶main circuit function:
2 memory
3 gating (AND, OR)
4 amplifying and inversion
5 signal generating and pulse shaping
6 miscellaneous

▶8 special circuits
9 standard circuits



CIRCUIT BLOCKS - 100 series

STANDARD UNITS FOR MEDIUM SPEED (max. frequency 100 kc/s)

Available types

function	*colour code*	*description*	*type*	*type number*	
memory	red	bi-stable multivibrators (Flip-Flops) with internally connected trigger inputs	FF1	B8 920 00	18,–
			FF3[1]	B8 920 02	20
		with gated trigger inputs	FF2	B8 920 01	18
			FF4[1]	B8 920 03	20
signal generating and pulse shaping	green	monostable (One-Shot) multivibrators	OS1	B8 950 01	15.70
			OS2[1]	B8 950 03	25,–
		pulse shaper	PS1	B8 950 00	20.25
		pulse driver	PD1	B8 950 04	26,50
gating (AND, OR)	orange	twin 2-input negative gate	2.2N1	B8 930 01	6,75
		twin 2-input positive gate	2.2P1	B8 930 03	8.50
		twin 3-input negative gate	2.3N1	B8 930 00	8.15
		twin 3-input positive gate	2.3P1	B8 930 02	10.50
		twin pulse logic trigger inputs for FF1, FF2	2.PL1	B8 930 04	11.50
		twin pulse logic trigger inputs for FF3, FF4	2.PL2	B8 930 07	12.–
amplifying and inversion (NOT)	yellow	twin emitter followers	2EF1	B8 940 01	12.90
			2EF2	B8 940 03	17.50
		twin inverter amplifier	2IA1	B8 940 02	13,50
		twin inverter amplifier	2IA2	B8 940 05	16,–
		emitter follower/inverter amplifier	EF1/IA1	B8 940 00	12,95
	—	power amplifier	PA1	B8 900 00	30,–
counter and shift register	—	decade counter (1–2–4–2 code – 4 × FF1)	DC1	B8 850 00	90,–
	—	twin decade counter (1–2–4–8 code – 2 × 4 × FF3)	2DCA2	B8 850 01	200,–
	—	reversible shift register or ring counter (5 × FF4 + 5 × 2.PL2)	RCA1	B8 850 02	200,

Available types for ferrite-core memory drive

function	*colour code*	*description*	*type*	*type number*	
ferrite-core memory drive	yellow	read amplifiers	RA2A	B8 940 07	51,–
			RA2B	B8 940 08	34–.
			RA1	B8 940 06	32,5
	green	pulse generator	PG1	B8 950 02	30,–
	orange	selection gate	SG1	B8 930 05	12,7
	blue	twin selection switch	2SS1	B8 960 00	32,5

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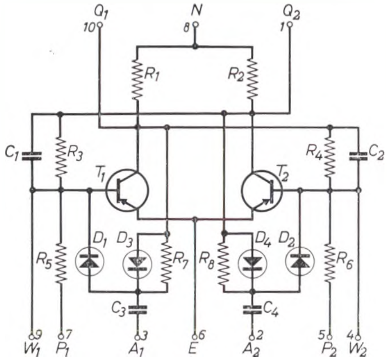
[1] Improved performance such as: improved loadability, improved insensitivity to disturbing signals, improved applicability, improved economy, improved reliability.

UNITS WITH A MEMORY FUNCTION

FF1 – FLIP-FLOP with internally connected trigger inputs

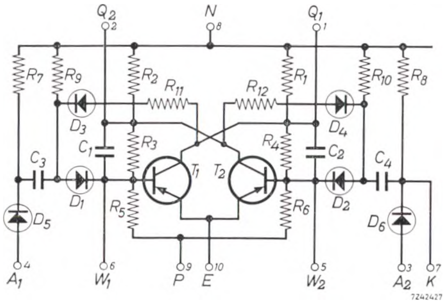


Type number: B9 920 00
Colour: red

The circuit performs a memory function when driven by means of a d.c. level or a positive-going trigger signal (a.c. input signal). It can also be used as a scaler-of-two, driven by a positive-going trigger signal.

Terminals:
1. Q_2 = output 2
2. A_2 = a.c. input 2
3. A_1 = a.c. input 1
4. W_2 = d.c. input 2
5. P_2 = supply +6 V
6. E = common supply 0 V
7. P_1 = supply +6 V
8. N = supply −6 V
9. W_1 = d.c. input 1
10. Q_1 = output 1

FF3 – FLIP-FLOP with internally connected trigger inputs



Type number B8 920 02
Colour: red

The circuit performs a memory function when driven by means of a d.c. level or a positive-going trigger signal, and it can also be used as a scaler-of-two when the trigger inputs are interconnected.

Terminals:
1. Q_1 = output 1
2. Q_2 = output 2
3. A_2 = trigger input 2
4. A_1 = trigger input 1
5. W_2 = d.c. input 2
6. W_1 = d.c. input 1
7. K = for external trigger input
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V

UNITS WITH A MEMORY FUNCTION

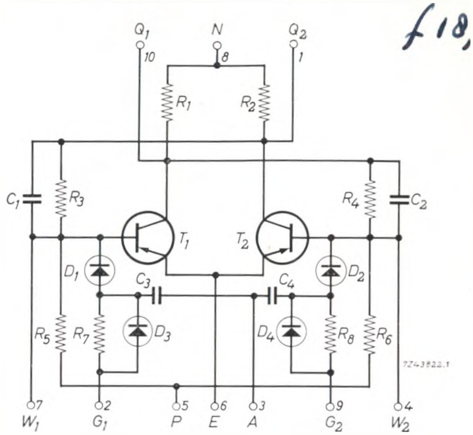
FLIP-FLOP with gated trigger inputs - FF2

f 18,-

Type number: B8 920 01
Colour red:

The circuit performs a memory function when driven by means of a d.c. level or a positive-going voltage step (a.c. input signal). In the case of a.c. drive, the switching of the flip-flop can be controlled by a d.c. level supplied to the built-in gate circuits (e.g. in shift registers).

Terminals:
1. Q_2 = output 2
2. G_1 = gate input 1
3. A = a.c. input
4. W_2 = d.c. input 2
5. P = supply +6 V
6. E = common supply 0V
7. W_1 = d.c. input 1
8. N = supply −6V
9. G_2 = gate input 2
10. Q_1 = output 1



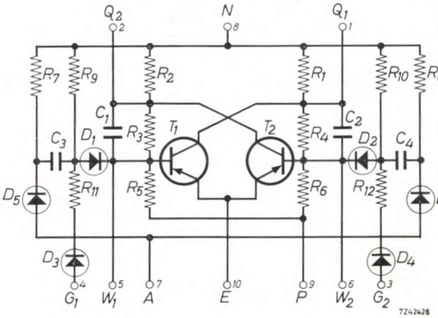
FLIP-FLOP with gated trigger inputs - FF4

f 20,-

Type number: B8 920 03
Colour: red

The circuit performs a memory function when driven by means of a d.c. level or a positive-going trigger signal. In the case of trigger drive, the switching of the flip-flop can be controlled by a d.c. level applied to the built-in gate circuits (e.g. shift registers).

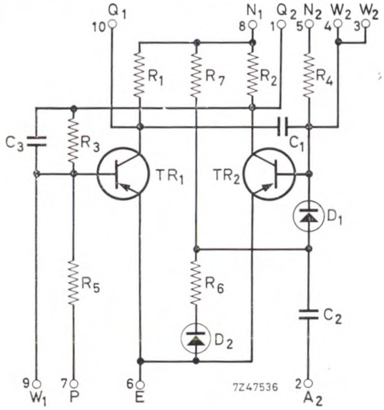
Terminals:
1. Q_1 = output 1
2. Q_2 = output 2
3. G_2 = gate input 2
4. G_1 = gate input 1
5. W_1 = d.c. input 1
6. W_2 = d.c. input 2
7. A = trigger input
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V



UNITS WITH A SIGNAL-GENERATING AND PULSE-SHAPING FUNCTION

OS1 – ONE-SHOT MULTIVIBRATOR

f 15,70



Type number: B8 950 01
Colour: green

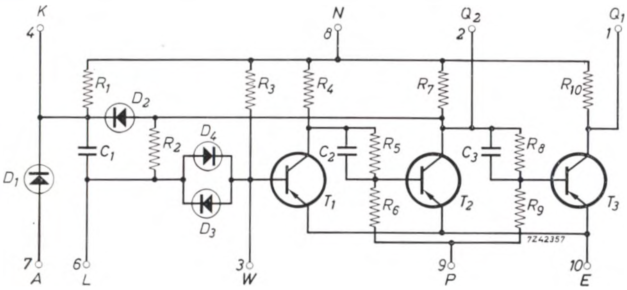
When a positive-going voltage step is applied to terminal A_2 of this monostable multivibrator the circuit generates a pulse at the Q-terminals. The duration of the output pulse is determined by the value of the external capacitance between the terminals W_2 and Q_1.

Terminals:
1. Q_2 = output 2
2. A_2 = a.c. input 2
3. W_2 = d.c. input 2
4. W_2 = d.c. input 2
5. N_2 = supply −6V
6. E = common supply 0V
7. P = supply +6V
8. N_1 = supply −6V
9. W_1 = d.c. input 1
10. Q_1 = output 1

OS2 – ONE-SHOT MULTIVIBRATOR

f 23,-

When a positive-going voltage step is applied to terminal A of this monostable multivibrator the circuit generates a pulse at the Q-terminals. The duration of the output pulse is determined by the value of:
the external capacitance C between K and L (for pulses longer than the intrinsic value);
the external resistance between Q_1 and W (for pulses shorter than the intrinsic value).



Type number: B8 950 03
Colour: green

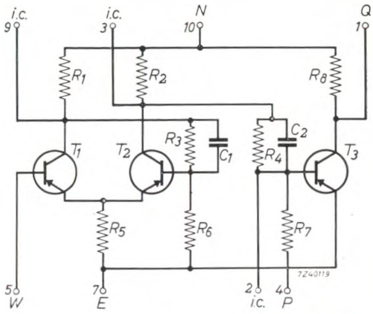
Terminals:
1. Q_1 = output 1
2. Q_2 = output 2
3. W = d.c. input
4. K = for external capacitor
5. not connected
6. L = for external capacitor
7. A = trigger input
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V

UNITS WITH A SIGNAL-GENERATING AND PULSE-SHAPING FUNCTION

PULSE SHAPER – PS1

Type number: B8 950 00
Colour: green

A d.c. input signal of a magnitude exceeding the input tripping level of this squaring amplifier and inverter circuit, is re-shaped and inverted into the standard d.c. level at the output. The output voltage transients are very short and can be used for driving other circuit blocks, multivibrator circuits included.



ƒ 20,25

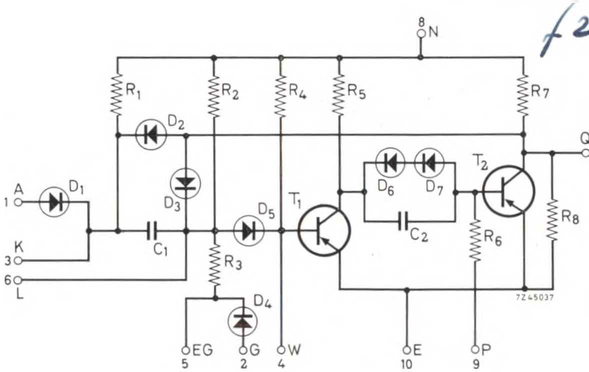
Terminals:
1. Q = output
2. internally connected
3. internally connected
4. P = supply +6V
5. W = input
6. not connected
7. E = common supply 0V
8. not connected
9. internally connected
10. N = supply −6V

PULSE DRIVER – PD1

ƒ26,50

Type number: B8 950 04
Colour: green

The unit is mainly designed to operate as a clock source, delivering trigger pulses for a great number of flip-flops FF1, FF2, FF3 and FF4 or as a counter driver.



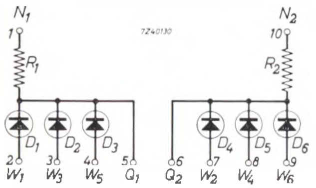
Terminals:
1. A = trigger input
2. G = gate input
3. K = for external capacitor
4. W = d.c. input
5. EG = extension gate input
6. L = for external capacitor
7. Q = output
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V

UNITS WITH A GATE FUNCTION

TWIN GATES

ƒ8.15

2.3N1 - THREE NEGATIVE INPUTS

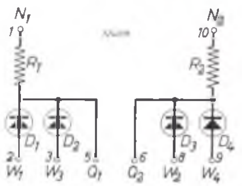


Type number:
B8 930 00
Colour: orange

Terminals:
1. N_1 = supply −6V
2. W_1 = input 1
3. W_3 = input 3
4. W_5 = input 5
5. Q_1 = output 1
6. Q_2 = output 2
7. W_2 = input 2
8. W_4 = input 4
9. W_6 = input 6
10. N_2 = supply −6V

ƒ6.75

2.2N1 - TWO NEGATIVE INPUTS

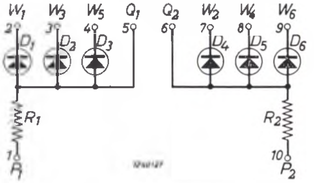


Type number:
B8 930 01
Colour: orange

Terminals:
1. N_1 = supply −6V
2. W_1 = input 1
3. W_3 = input 3
4. not connected
5. Q_1 = output 1
6. Q_2 = output 2
7. not connected
8. W_2 = input 2
9. W_4 = input 4
10. N_2 = supply −6V

The two gates of circuit blocks 2.3 N1 and 2.2 N1 are identical.
They can be used separately, or in combination by interconnecting the output terminals Q_1 and Q_2. In this latter case only one negative-supply terminal should be used.

2.3P1 - THREE POSITIVE INPUTS

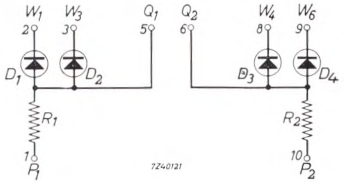


ƒ10.50

Terminals:
1. P_1 = supply +6V
2. W_1 = input 1
3. W_3 = input 3
4. W_5 = input 5
5. Q_1 = output 1
6. Q_2 = output 2
7. W_2 = input 2
8. W_4 = input 4
9. W_6 = input 6
10. P_2 = supply +6V

Type number:
B8 930 02
Colour: orange

2.2P1 - TWO POSITIVE INPUTS



ƒ8.50

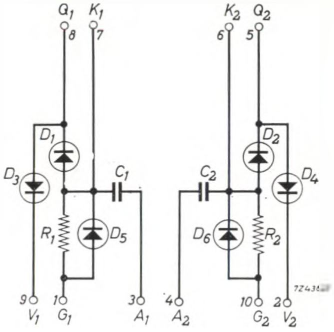
Terminals:
1. P_1 = supply+6V
2. W_1 = input 1
3. W_3 = input 3
4. not connected
5. Q_1 = output 1
6. Q_2 = output 2
7. not connected
8. W_4 = input 2
9. W_6 = input 4
10. P_2 = supply+6V

Type number:
B8 930 03
Colour: orange

The two gates of circuit blocks 2.3 P1 and 2.2 P1 are identical.
They can be used separately, or in combination by interconnecting the output terminals Q_1 and Q_2. In this latter case only one positive-supply terminal should be used.

UNITS WITH A GATE FUNCTION

TWIN PULSE LOGIC – 2PL1



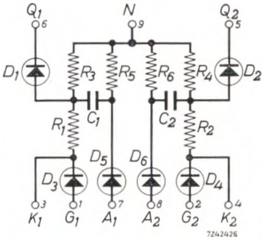
Type number: B8 930 04
Colour: orange

f 11,50

The circuits are normally used in conjunction with flip-flop circuits. With the twin pulse logic a second pair of a.c. inputs is formed for a flip-flop type FF1, or in combination with flip-flops type FF2 a bi-directional shift register can be made. The twin pulse logic output terminals are to be connected directly to the flip-flop d.c. input terminals for this application.

Terminals
1. G_1 = gate input 1
2. V_2 = reset input 2
3. A_1 = a.c. input 1
4. A_2 = a.c. input 2
5. Q_2 = output 2
6. K_2 = normally not used
7. K_1 = normally not used
8. Q_1 = output 1
9. V_1 = reset input 1
10. G_2 = gate input 2

TWIN PULSE LOGIC – 2PL2



Type number: B8 930 07
Colour: orange

f 12,-

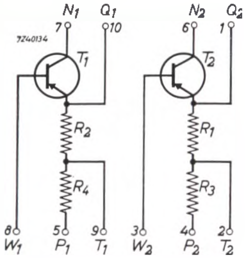
The circuits are normally used in conjunction with flip-flop circuits. With the twin pulse logic a second pair of a.c. inputs is formed for a flip-flop type FF3, or in combination with flip-flops type FF4 a bi-directional shift register can be made. The twin pulse logic output terminals are to be connected directly to the flip-flop d.c. input terminals for this application.

Terminals
1. G_1 = gate input 1
2. G_2 = gate input 2
3. K_1 = for external gate input
4. K_2 = for external gate input
5. Q_2 = output 2
6. Q_1 = output 1
7. A_1 = trigger input 1
8. A_2 = tripper input 2
9. N = supply —6V
10. not connected

UNITS WITH AN AMPLIFYING FUNCTION

f 12,90

2EF1 – TWIN EMITTER FOLLOWER



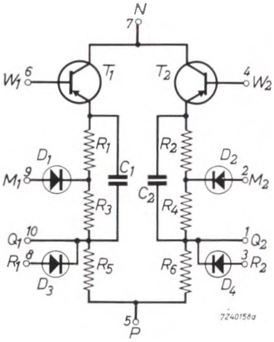
Type number: B8 940 01
Colour: yellow

The unit B894001 contains two identical transistor emitter-follower circuits that perform a non-inverting buffer-amplifier function with a low output impedance.
The unit is equipped with a tapping on the output resistor for cases in which a level shift towards the positive supply line is required.

Terminals
1. Q_2 = output 2
2. T_2 = tap output 2
3. W_2 = input 2
4. P_2 = supply +6V (2)
5. P_1 = supply +6V (1)
6. N_2 = supply −6V (2)
7. N_1 = supply −6V (1)
8. W_1 = input 1
9. T_1 = tap output 1
10. Q_1 = output 1

2EF2 – TWIN EMITTER FOLLOWER

f 17.50



Type number: B8 940 03
Colour: yellow

The unit B894003 contains two identical EF2 emitter-follower circuits that perform a buffer amplifier function.
The unit has been especially designed to amplify the weak output signals originating from a diode gate circuit.
The output signal is normally taken from the Q-terminal.
When a flip-flop is to be set or reset by an EF2, normally the diode output R is used, the memory function of the flip-flop then being maintained.

Terminals:
1. Q_2 = output 2
2. M_2 = clamp diode 2
3. R_2 = diode output 2
4. W_2 = input 2
5. P = supply +6V
6. W_1 = input 1
7. N = supply −6V
8. R_1 = diode output 1
9. M_1 = clamp diode 1
10. Q_1 = output 1

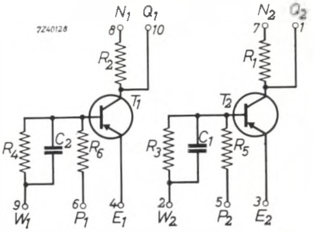
UNITS WITH AN AMPLIFYING FUNCTION

TWIN INVERTER AMPLIFIER -2IA 1

Type number: B8 940 02
Colour: yellow

f 13,50

The unit contains two identical inverter circuits. The circuits constitute an inverting (NOT) function when driven by a signal on the input terminal W.



Terminals:

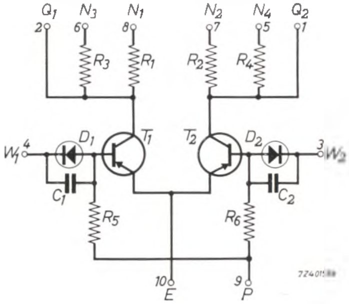
1. Q_2 = output 2
2. W_2 = input 2
3. E_2 = common supply 0V
4. E_1 = common supply 0V
5. P_1 = supply +6V
6. P_1 = supply +6V
7. N_2 = supply −6V
8. N_1 = supply −6V
9. W_1 = input 1
10. Q_1 = output 1

TWIN INVERTER AMPLIFIER – 21A2

Type number: B8 940 05
Colour: yellow

f 16,-

This unit, which has been specially designed to amplify the weak output signals originating from a diode gate circuit, can also be used as a driver for power stages.



Terminals:

1. Q_2 = output 2
2. Q_1 = output 1
3. W_2 = input 2
4. W_1 = input 1
5. N_4 = supply −6V[1]
6. N_3 = supply −6V[1]
7. N_2 = supply −6V[1]
8. N_1 = supply −6V[1]
9. P = supply +6V
10. E = common supply 0V

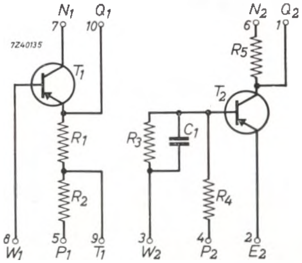
[1] Use dependent on application.

EMITTER FOLLOWER/INVERTER AMPLIFIER – EF1/IA1

Type number: B8 940 00
Colour: yellow

f 12,95

The two circuits, an emitter-follower circuit and an inverter circuit, can be used independently or in combination.



Terminals:

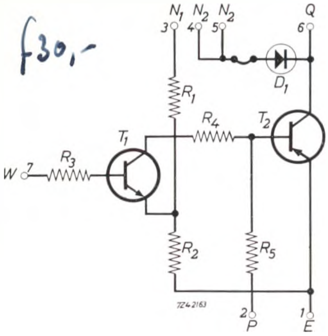
1. Q_2 = output 2
2. E_4 = common supply 0V
3. W_2 = input 2
4. P_2 = supply +6V
5. P_1 = supply +6V
6. N_2 = supply −6V
7. N_1 = supply −6V
8. W_1 = input 1
9. T_1 = tapped output 1
10. Q_1 = output 1

Note: EF1 terminals with index 1; IA1 terminals with index 2.

UNITS WITH AN AMPLIFYING FUNCTION

PA1-POWER AMPLIFIER

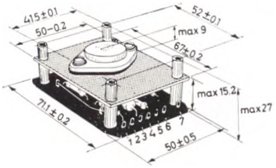
f30,-



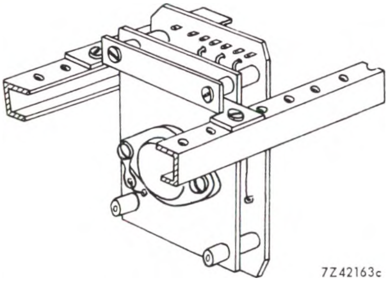
Type number: B8 900 00
Colour: yellow

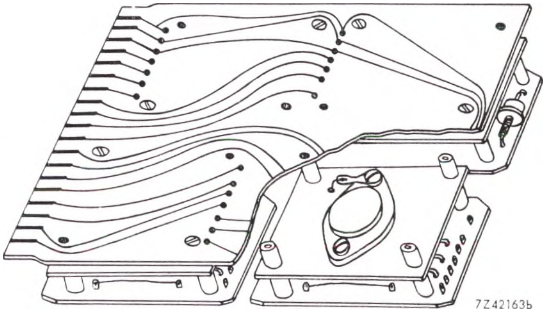
The amplifier is non-inverting, and can be driven directly by the circuit blocks FF1, FF2, FF3, FF4, 0S2, IA1 and IA2. The absolute max. output loadability is 600 mA at —60V.

Terminals
1. E = common supply 0V
2. P = supply +6V
3. N_1 = supply −6V
4. N_2 = supply max. —60V
5. N_2 = supply max. —60V
6. Q = output
7. W = input



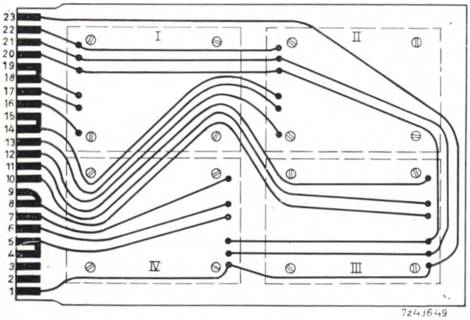
Mounting instructions





For mounting on the chassis B871609 (page B22) use is made of a metal bracket as indicated in the figure. The PA1 occupies the width of three circuit blocks.

On a standard printed-wiring board, for use in the chassis B871610 (page B22), up to four PA1's can be mounted, the next position in the chassis being left empty.



STANDARD P.W. BOARD, TYPE P8 906 40 FOR 4 PA1'S

For use in the mounting chassis B871610 a standard p.w. board, type number P890640, is available. Its outside dimensions are 121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″). It can be used directly with the aid of the mating connector type F045CC/025.

UNITS WITH A COUNTER AND SHIFT REGISTER FUNCTION

(1-2-4-2 code - 4xFF1) DECADE COUNTER - DC 1

f 90,–

Type number: B8 850 00

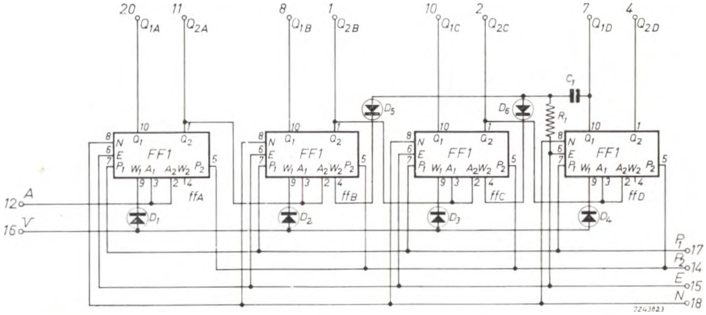
The unit B8 850 00 consists of four flip-flops type B8 920 00 mounted on a printed-wiring board and connected as a counter, working in the 1–2–4–2 code.

The counter is provided with pulse feed-back to achieve that six of the sixteen possible positions are skipped. The flip-flops can be reset by means of a common positive signal.

The reset diodes D_1, D_2, D_3, D_4 and the feed-back network D_5, D_6, R_1 and C_1 are mounted on the printed-wiring board.

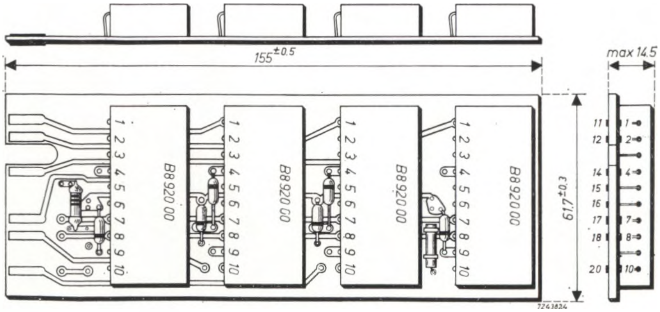
The printed-wiring board type P8 905 59 is provided with plated-through holes, double-sided printed-wiring and double-sided gold-plated contacts.

The mating connector type F 042 ZZ/03 is normally not supplied with the counter.



Terminals:

1. Q_{2B} = output 2 flip-flop B
2. Q_{2C} = output 2 flip-flop C
4. Q_{2D} = output 2 flip-flop D
7. Q_{1D} = output 1 flip-flop D
8. Q_{1B} = output 1 flip-flop B
10. Q_{1C} = output 1 flip-flop C
11. Q_{2A} = output 2 flip-flop A
12. A = a.c. input
14. P_2 = supply +6V
15. E = common supply 0V
16. V = reset input
17. P_1 = supply +6V
18. N = supply −6V
20. Q_{1A} = output 1 flip-flop A



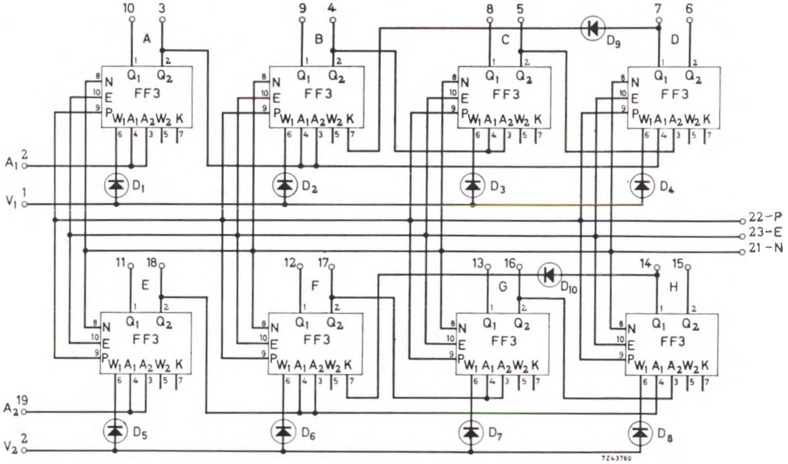
UNITS WITH A COUNTER AND SHIFT REGISTER FUNCTION

ƒ 200,-

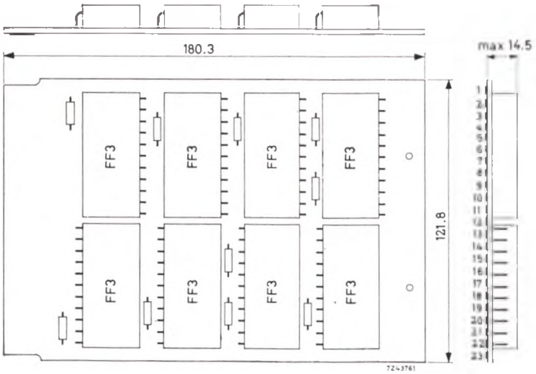
2DCA2 - TWIN DECADE COUNTER (1-2-4-8 code - 2×4×FF3)

The unit B885001 contains two identical decade counter units, mounted on a printed-wiring board. Each counter consists of four flip-flops FF3 (type B892002), connected to operate in the 1-2-4-8 code. With the mating connector type F045CC/025, the printed-wiring board of standard dimensions (121.8 mm × 180.3 mm × 1.6 mm) can be used directly in the standard mounting chassis, type B871610.

Type number:
B8 850 01



Terminals:
1. V_1 = reset input counter 1
2. A_1 = a.c. input counter 1
3. Q_{2A} = output 2 flip-flop A
4. Q_{2B} = output 2 flip-flop B
5. Q_{2C} = output 2 flip-flop C
6. Q_{2D} = output 2 flip-flop D
7. Q_{1D} = output 1 flip-flop D
8. Q_{1C} = output 1 flip-flop C
9. Q_{1B} = output 1 flip-flop B
10. Q_{1A} = output 1 flip-flop A
11. Q_{1E} = output 1 flip-flop E
12. Q_{1F} = output 1 flip-flop F
13. Q_{1G} = output 1 flip-flop G
14. Q_{1H} = output 1 flip-flop H
15. Q_{2H} = output 2 flip-flop H
16. Q_{2G} = output 2 flip-flop G
17. Q_{2F} = output 2 flip-flop F
18. Q_{2E} = output 2 flip-flop E
19. A_2 = a.c. input counter 2
20. V_2 = reset input counter 2
21. N = common negative supply −6V
22. P = common positive supply +6V
23. E = common supply 0V



UNITS WITH A COUNTER AND SHIFT REGISTER FUNCTION

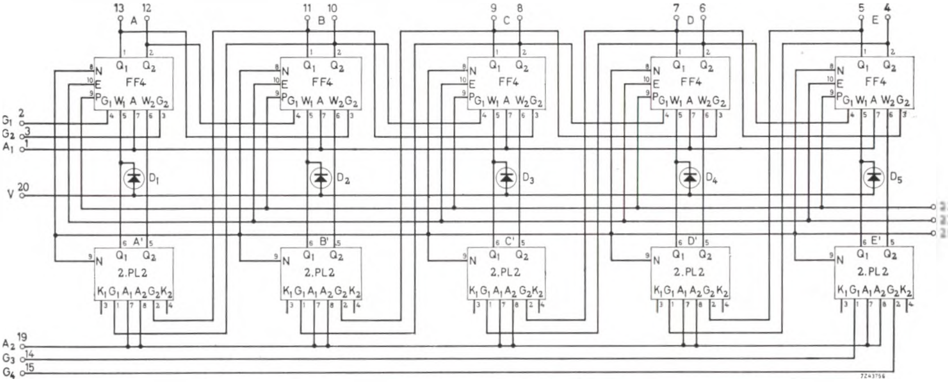
(5×FF4 + 5×2.PL2) REVERSIBLE SHIFT REGISTER OR RING COUNTER – RCA1

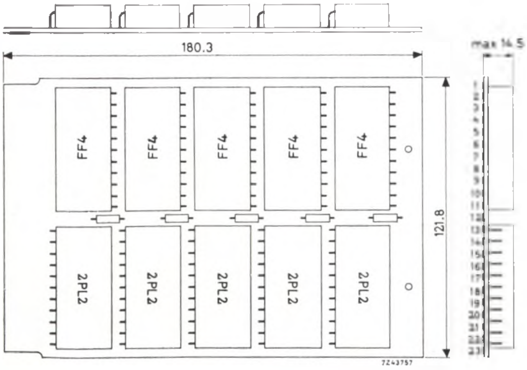
Type number: B8 850 02

f 200,–

The unit B885002 consists of five flip-flops FF4 (type B892003) and five twin pulse logics 2PL2 (type B893007), mounted on a printed-wiring board, interconnected to operate as a bi-directional shift register. A bi-directional decade counter can be realized by interconnecting the gate terminals G of the first flip-flop with the output terminals Q of the fifth flip-flop and the gate terminals G of the fifth twin pulse logic with the output terminals Q of the first flip-flop.

With the mating connector type F045CC/025, not supplied with the reversible counter, this printed-wiring board of standard dimensions (121.8 mm × 180.3 mm × 1.6 mm) can be used directly in the standard mounting chassis type B8 71610.





Terminals:

1. A_1 = a.c. input forward direction
2. G_1 = gate input (G_1) flip-flop A
3. G_2 = gate input (G_2) flip-flop A
4. Q_{2E} = output 2 flip-flop E
5. Q_{1E} = output 1 flip-flop E
6. Q_{2D} = output 2 flip-flop D
7. Q_{1D} = output 1 flip-flop D
8. Q_{2C} = output 2 flip-flop C
9. Q_{1C} = output 1 flip-flop C
10. Q_{2B} = output 2 flip-flop B
11. Q_{1B} = output 1 flip-flop B
12. Q_{2A} = output 2 flip-flop A
13. Q_{1A} = output 1 flip-flop A
14. G_3 = gate input (G_1) twin pulse logic E′
15. G_4 = gate input (G_2) twin pulse logic E′

16, 17, 18. not connected

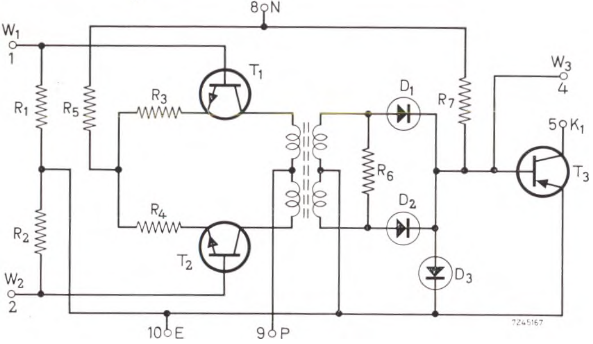
19. A_2 = a.c. input reverse direction
20. V = reset input
21. N = common negative supply −6V
22. P = common positive supply +6V
23. E = common supply 0V

UNITS WITH A FERRITE-CORE MEMORY DRIVE FUNCTION

READ AMPLIFIER

This read or sense amplifier, consisting of two circuit blocks of standard dimensions, types RA2A and RA2B, is designed to amplify the signals originating from the sense wire of ferrite-core memories. The input is balanced, so either positive-going or negative-going input signals can be applied. The sensitivity of the RA2A can be adjusted to the signal levels of the memory plane by means of an external resistor. The output of the RA2B can be used directly to set a flip-flop of the 100 kc/s range on its input terminal W.

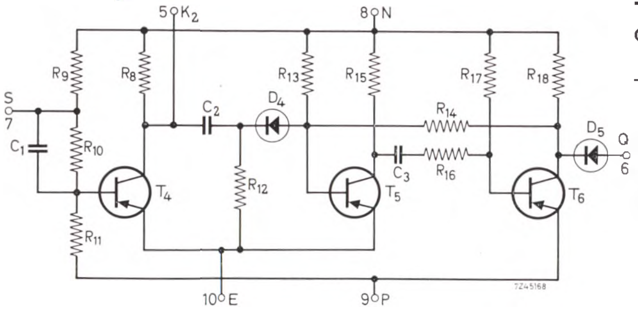
RA2A f51,-



Type number B8 940 07
Colour: yellow

Terminals:
1. W_1 = input
2. W_2 = input
3. not connected
4. W_3 = for external resistor
5. K_1 = to be connected to terminal 5 of RA2B
6. not connected
7. not connected
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V

RA2B f34-



Type number B8 940 08
Colour: yellow

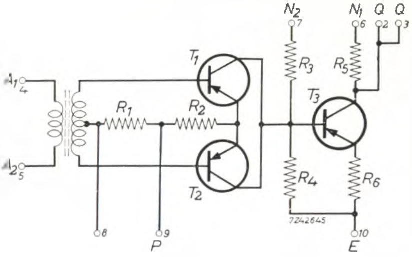
Terminals:
1. not connected
2. not connected
3. not connected
4. not connected
5. K_2 = to be connected to terminal 5 of RA2A
6. Q = output
7. S = input STROBE pulse
8. N = supply −6V
9. P = supply +6V
10. E = common supply 0V

UNITS WITH A FERRITE-CORE MEMORY DRIVE FUNCTION

READ AMPLIFIER – RA1

Type number: B8 940 06
Colour: yellow

ƒ 32,50



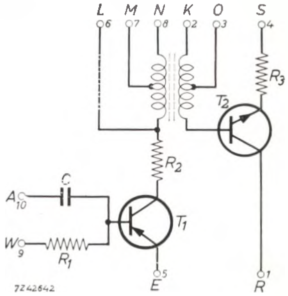
The unit is designed to amplify the signals originating from the sense wire of a small ferrite-core memory plane equipped with cores type 6B2, FX2423 or equivalent types. The maximum plane size is 16 × 16 cores.
The circuit consists of a two-stage amplifier; the first stage is balanced, so that the circuit can deal with either positive-going or negative-going input signals.
Ambient temperature 0 to +60° C.

Terminals:
1. not connected
2. Q = output
3. Q = output
4. A_1 = input
5. A_2 = input
6. N_1 = supply −6V
7. N_2 = supply −6V
8. internally connected
9. P = supply +6V
10. E = common supply 0V

PULSE GENERATOR – PG1

Type number: B8 950 02
Colour: green

ƒ 30,-



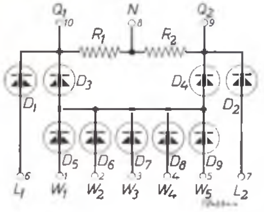
The unit is designed to operate as a "short-interval" switch for ferrite-core memory operation in combination with other standard circuit blocks. The switching is controlled by an input level change applied to a pre-amplifier stage.

Terminals:
1. R = switch in
2. K = transformer terminal
3. O = transformer terminal
4. S = switch out
5. E = common supply 0V
6. L = transformer terminal
7. M = transformer terminal
8. N = supply −6V
9. W = d.c. input
10. A = trigger input

UNITS WITH A FERRITE-CORE MEMORY DRIVE FUNCTION

SG1 – SELECTION GATE

f12,75



Type number: B8 930 05
Colour: orange

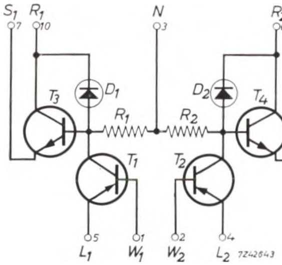
The first five input AND gates which decode the selection register information, if followed by a twin two-input AND gate, can perform the read/write control function. The unit is normally used for ferrite-core memory operation, in combination with other standard circuit blocks.

Terminals:
1. W_1 = selection input 1
2. W_2 = selection input 2
3. W_3 = selection input 3
4. W_4 = selection input 4
5. W_5 = selection input 5
6. L_1 = read/write control input 1
7. L_2 = read/write control input 2
8. N = supply —6V
9. Q_2 = output 2
10. Q_1 = output 1

The selection input terminals W are connected to the flip-flop in the Selection Register. Depending on the size of the memory, this connection may be direct or via adequate amplifier stages.

f32,50

2SS1 – TWIN SELECTION SWITCH



Type number: B8 960 00
Colour: blue

The unit 2SS1 contains two identical circuits designed to operate as current switches in series with the drive wires of a ferrite-core memory.

Terminals:
1. W_1 = control input 1
2. W_2 = control input 2
3. N = supply —6V
4. L_2 = current input 2
5. L_1 = current input 1
6. R_2 = switch 2 in
7. S_1 = switch 1 out
8. not connected
9. S_2 = switch 2 out
10. R_1 = switch 1 in

LOADING TABLE

If not otherwise indicated the N and P terminals of each unit are connected to V_n and V_p respectively. ($V_n = -6V \pm 5\%$, $V_p = +6V \pm 5\%$; $V_n/V_p = \pm 5\%$).

preceding unit or preceding chain of units		driving unit		via	maximum number of driven units																					
					FF1		FF2			FF3			FF4			N1	EF1	IA1	EF2	IA2	PS1	OS2	OS1	PA1	PD1	
		type	output		W	A	W	A	G	W	A1/A2	A1+A2	W	A	G	W	W	W	W	W	W	A2	A	W	A	G
		FF1	Q		$1^{1)}$	$4^{9)}$	$1^{1)}$	$4^{9)}$	$2^{10)}$	$1^{1)}$	$2^{10)}$	$2^{10)}$	$1^{1)}$	$2^{10)}$	$2^{10)}$	5	1	1	2	0	$6^{9)2)}$	$4^{9)}$	$2^{10)}$	1	$1^{10)}$	$1^{10)}$
		FF2	Q		$1^{1)}$	$1^{10)}$	$1^{1)}$	$1^{10)}$	$2^{10)}$	$1^{1)}$	$1^{10)}$	$1^{10)}$	$1^{1)}$	$1^{10)}$	$2^{10)}$	5	1	1	2	0	$2^{10)2)}$	$1^{10)}$	$2^{10)}$	1	$1^{10)}$	$1^{10)}$
		FF3	Q		$1^{1)}$	$5^{9)}$	$1^{1)}$	$5^{9)}$	$2^{10)}$	$1^{1)}$	$3^{10)}$	$3^{10)}$	$1^{1)}$	$3^{10)}$	$3^{10)}$	12	1	1	2	0	$7^{9)2)}$	$5^{9)}$	$4^{10)}$	2	$3^{10)}$	$3^{10)}$
		FF4	Q		$1^{1)}$	$5^{9)}$	$1^{1)}$	$5^{9)}$	$2^{10)}$	$1^{1)}$	$3^{10)}$	$3^{10)}$	$1^{1)}$	$3^{10)}$	$3^{10)}$	12	1	1	2	0	$7^{9)2)}$	$5^{9)}$	$4^{10)}$	2	$3^{10)}$	$3^{10)}$
	IA1	N1	Q		0	$4^{4)3}$	0	$4^{4)3)}$	0	0	$2^{3)}$	$1^{3)}$	0	$1^{3)}$	0	0	0	0	1	$1^{5)}$	1	$4^{4)3)}$	$1^{3)}$	0	0	0
	FF1$^{10)}$ OS1$^{b)}$				0	$4^{4)}$	0	$4^{4)}$	0	0	2	1	0	1	0	0	0	0	1	$1^{5)}$	1	$4^{4)}$		0	1	0
PS1	IA2																									
	FF2$^{10)}$				0	$1^{4)}$	0	$1^{4)}$	0	0	1	1	0	1	0	0	0	0	1	$1^{5)}$	1	$1^{4)}$		0	2	0
	PS1				0	$2^{4)}$	0	$2^{4)}$	0	0	1	0	0	0	0	0	0	0	1	$1^{5)}$	1	$2^{4)}$	0	0	0	0
	FF3$^{10)}$ FF4$^{10)}$				0	$5^{4)}$	0	$5^{4)}$	0	0	3	2	0	2	0	0	0	0	1	$1^{5)}$	1	$5^{4)}$	3	0	3	0
	OS2$^{d)}$				0	6	0	6	0	0	6	5	0	5	0	0	0	0	1	$1^{5)}$	1	8	12	0	10	0
	OS2$^{e)}$				0	5	0	5	0	0	5	3	0	3	0	0	0	0	1	$1^{5)}$	1	6	4	0	3	0
	N1	P1	Q		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	$1^{8)}$	1	0	0	0	0	0
		EF1	Q		$4^{1)}$	▨	$4^{1)}$	▨	0	$3^{1)}$	0	0	$3^{1)}$	0	0	4	▨	4	▨	0	$18^{2)}$	▨	0	0	0	0
			T		$1^{6)}$	▨	$1^{6)}$	▨	0	$1^{6)}$	0	0	$1^{6)}$	0	0	▨	▨	0	▨	1	0	▨	0	0	0	0
		IA1	Q		$2^{1)}$	$4^{3)}$	$2^{1)}$	$4^{3)}$	3	$2^{1)}$	$2^{3)}$ $3^{3)7)}$	$2^{3)}$ $3^{3)7)}$	$2^{1)}$	$2^{3)}$ $3^{3)7)}$	2	7 $16^{7)}$	2	2	5	1	$8^{2)}$	$4^{3)}$	$4^{3)}$ $7^{3)7)}$	1	$2^{3)}$	2
	N1	EF2	Q	ASY27$^{c)}$	$2^{1)}$	4	$2^{1)}$	4	3	$1^{1)}$	2	2	$1^{1)}$	2	10	50	2	2	5	1	$8^{2)}$	4	4	1	4	6
N1	P1			ASY27$^{c)}$	$2^{1)}$	4	$2^{1)}$	4	3	$1^{1)}$	2	2	$1^{1)}$	2	10	27	2	2	5	1	$8^{2)}$	4	4	1	4	6
	N1		R		1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
N1	P1																									
	N1$^{5)}$	IA2	Q		$2^{1)}$	0	$2^{1)}$	0	0	$2^{1)}$	0	0	$2^{1)}$	0	0	0	2	2	5	1	$8^{2)}$	0	0	0	0	0
N1	P1$^{8)}$																									
	IA1 IA2				$2^{1)}$	4	$2^{1)}$	4	3	$2^{1)}$	4 $5^{7)}$	4 $5^{7)}$	$2^{1)}$	4 $5^{7)}$	10	60	2	2	5	1	$8^{2)}$	6	7 $9^{7)}$	10	7 $9^{7)}$	8
	PS1 OS2$^{d)}$				$2^{1)}$	4	$2^{1)}$	4	3	$2^{1)}$	2 $3^{7)}$	2 $3^{7)}$	$2^{1)}$	2 $3^{7)}$	10	60	2	2	5	1	$8^{2)}$	4	3 $6^{7)}$	6	3 $6^{7)}$	4
	N1$^{5)}$	IA2$^{a)}$	Q		0	0	0	0	1	0	0	0	0	0	2	6 $9^{7)}$	1	1	1	1	$4^{2)}$	0	0	1	0	2 $3^{7)}$
N1	P1$^{8)}$																									
		PS1	Q		0	2	0	2	2	0	1	1	0	1	1	2	1	1	2	1	$6^{2)}$	2	1	0	1	1
		OS1	Q1		$2^{1)}$	4	$2^{1)}$	4	3	$2^{1)}$	2	1	$2^{1)}$	1	1	3	2	2	5	0	$8^{2)}$	4	1	0	1	1
			Q2		$1^{1)}$	0	$1^{1)}$	0	▨	0	0	0	0	0	0	0	1	1	2	0	$3^{2)}$	0	0	0	0	0
		OS2	Q1		$1^{1)}$	6	$1^{1)}$	6	6	$1^{1)}$	6	5	$1^{1)}$	5	10	12	1	1	2	1	$6^{2)}$	6	13	6	10	10
			Q2		0	5	0	5	2	0	5	3	0	3	3	4	1	0	1	0	$3^{2)}$	5	4	2	3	3
		PD1	Q		0	20	0	20	0	0	20	20	0	20	0	10 $100^{11)}$	0	$25^{12)}$	0	0	0	20	25	0	20	0

▨ not recommended

a) IA2 with only terminals N1 or N2 connected to V_N.
b) OS1 Q1 output only.
c) ASY27 common emitter stage with 1 kΩ collector resistor.
d) OS2 Q1 output only.
e) OS2 Q2 output only.

Note: A driving unit N_1 preceded by an FF1 or an OS1, can drive up to 2 units OS2.
A driving unit N_1 preceded by an FF2, can drive 1 unit OS1 maximum.

P1. Unless specified otherwise a P1 may be inserted between two units without great influence upon the loadability. AC inputs of FF1, FF2, FF3, FF4, OS1 and OS2 cannot be driven from it.

2PL1. The 2PL1 is normally used in conjunction with FF1 or FF2. In this case the input data are equivalent to those of the similar FF2 inputs. The output terminals are directly connected to the d.c. input terminals of the FF1 or FF2.

2PL2. Ditto for FF3 and FF4.

1. Each via a 4.7 kΩ ±5% resistor in series with a separating diode OA 200, anode to driven unit.
2. Each via a 12 kΩ ±5% resistor, bypassed by a 330 pF capacitor.
3. Only if the chain of units indicated is driven by an FF1, FF2, FF3, FF4, PS1 or by terminal Q1of an OS1 or OS2.
4. The maximum speed of operation is $\dfrac{30\ \text{kc/s}}{\text{number of units driven by the N1 gate}}$
5. Via a diode OA200, cathode to N1, anode to IA2, and bypassed by a 1500 pF capacitor.
6. Via a separating diode OA85, cathode to driven unit.
7. Only if the N-terminals of the driving unit are floating.
8. The P-terminal of the P1 gate floating.
9. Total number for both Q-outputs together.
10. Total number per Q-output.
11. Up to 100 only with a 390 Ω ±5% resistor between the terminals Q and N.
12. For each stage of IA1 connect 2,7kΩ ± 5% between Q and N of PA1 up to 25; min. resistance between Q and N 100Ω worst case.

MOUNTING AIDS AND ACCESSORIES FOR THE 100 SERIES

Mounting chassis

Two standardized types of chassis for the mounting of circuit blocks are available, both designed to be fitted in 19″ racks.
The chassis of Fig. 1 can contain up to 24 standard printed-wiring boards (see Figs 3, 4, 5, 6 and 7) together with their mating connectors type F045CC/025 (for single-sided contacts) and F045DC/025 (for double-sided contacts), and can be mounted directly in a 19″ rack.

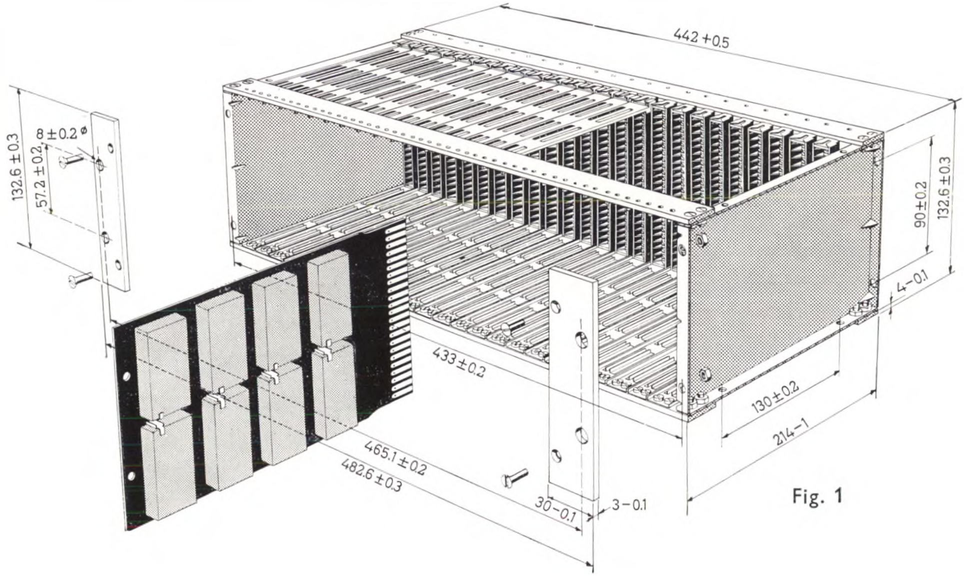


Fig. 1

Type number: B871610
Chassis for circuit blocks mounted on printed-wiring boards

Type number: B871609
Chassis for circuit blocks mounted side by side

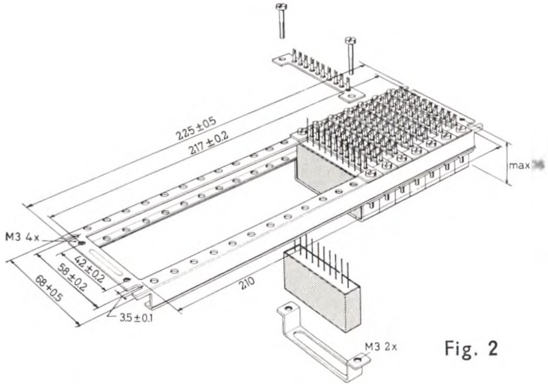


Fig. 2

The chassis of Fig. 2 can contain up to 19 circuit blocks mounted side by side.
A number of these chassis can be mounted in a metal frame. Fitted in a standard 19″ rack, six of these chassis can be mounted side by side.

PRINTED-WIRING BOARDS FOR THE 100 SERIES

Three types of printed-wiring boards are available for use in the chassis B8 71610 (Fig. 1) all with the same outside dimensions as indicated in the Figs 3, 4, 5, and 6. The thickness of these boards is 1.6 mm, and they are provided with 23 single-sided gold-plated contacts. The lay-out of these boards is in accordance with the I.E.C. standard grid of 2.54 mm (0.1″).

Two larger types of experimenters' printed-wiring boards are available, both with 38 gold-plated contacts at the short sides of the board: type P8 900 79 with single-sided, and type P8 900 89 with double-sided contacts. Both are provided with the same copper pattern as the board illustrated in Fig. 3.

description	*outside dimensions*	*figure*	*type number*	
experimenters' printed-wiring board (with punched holes)	121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″)	3	P8 906 11	f 6,-
universal printed-wiring board (with punched holes)	121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″)	4	P8 091 46.2	
universal printed-wiring board (with plated-through holes)	121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″)	5 6	P8 906 15 P8 906 33	
universeel printed-wiring board (with plated-through holes)	121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″)	7	736.1 D	8,75
experimenters' printed-wiring board (with punched holes)	200 mm × 396 mm × 1.6 mm	8	P8 900 79	
experimenters' printed-wiring board (with double-sided contacts)	200 mm × 396 mm × 1.6 mm	8	P8 900 89	

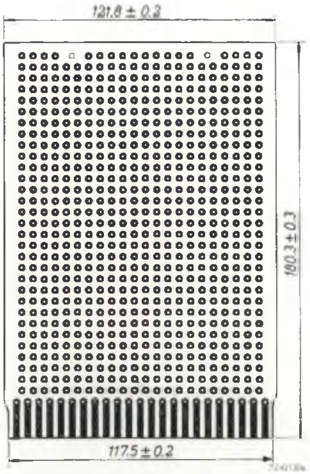


Fig. 3

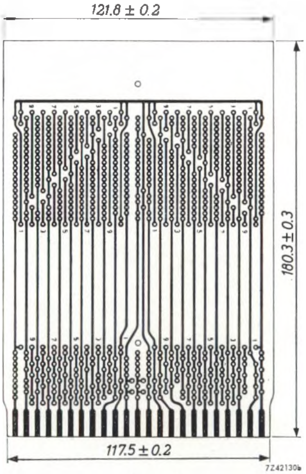


Fig. 4

PRINTED-WIRING BOARDS FOR THE 100 SERIES

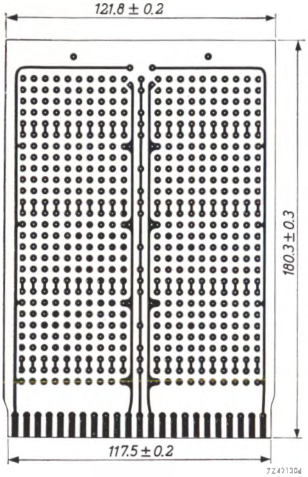


Fig. 5

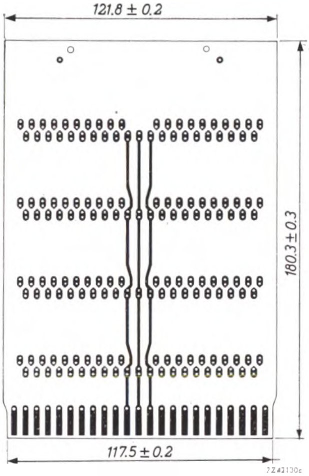


Fig. 6

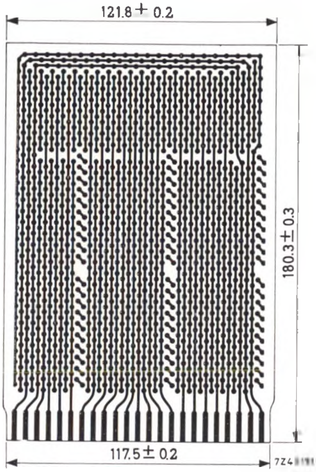


Fig. 7

EXAMPLE OF AN EXPERIMENTER'S PRINTED-WIRING BOARD WITH COMPONENTS

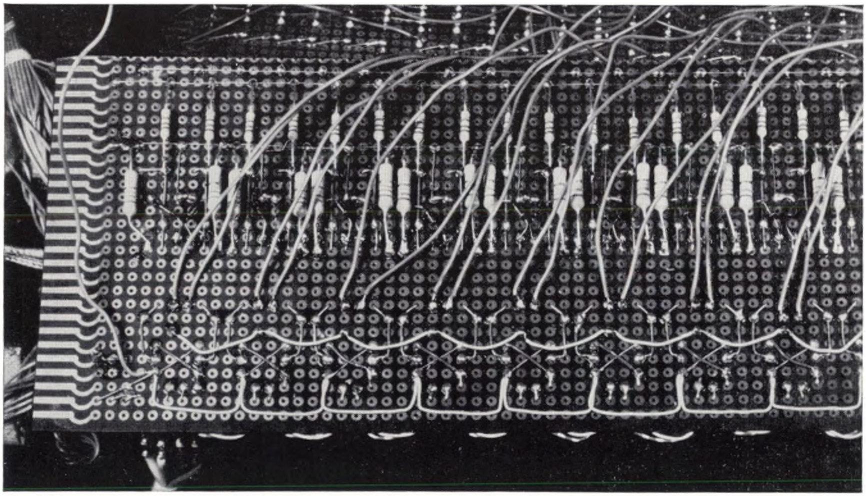


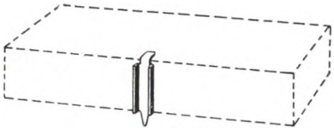
Fig. 8

STANDARD MASTER DRAWING SHEET

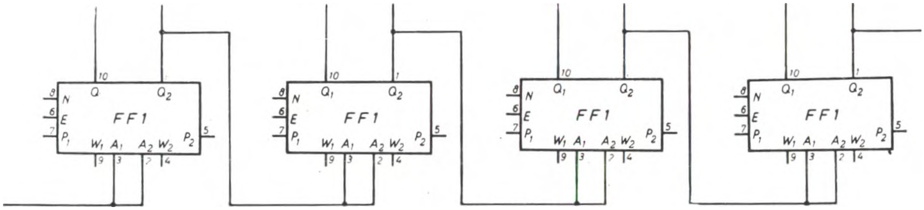
To facilitate the design of printed-wiring boards with a non-standard pattern for use in the chassis of type B871610, drawing sheets can be supplied on which the soldering pads, the plug-in contacts and some reference points are pre-printed (scale 2 : 1). They are made of special material that is dimensionally stable. The type number of this drawing sheet is P8 901 56.

LOCKING TAG

Circuit blocks mounted parallel to printed-wiring boards can be secured rigidly by means of a small tag, type number B8 431 58, which permits soldering in a standard 1.3 mm hole.



STICKERS 100 SERIES

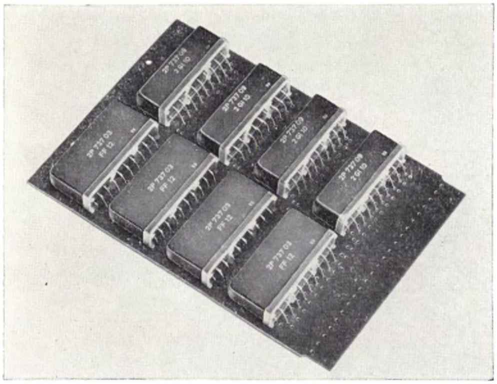


For quick setting-up of master drawings on transparent tracing material as used e.g. for dye-line printing, a series of self-adhesive stickers with circuit-block symbols, as given in the relevant data sheets, is available. The stickers are delivered on rolls of 1000 pieces per type. Type numbers can be taken from the table given below.

circuit block	*sticker type number*	*circuit block*	*sticker type number*	*circuit block*	*sticker type number*
FF1	B1 530 84	PD1	....	2EF1	B1 530 92
FF2	B1 530 85	2.2N1	B1 530 87	2EF2	B1 530 94
FF3	B1 531 17	2.2P1	B1 530 89	2IA1	B1 530 93
FF4	BI 531 18	2.3N1	BI 530 86	2IA2	B1 530 95
OS1	B1 530 97	2.3P1	B1 530 88	EF1/IA1	B1 530 91
OS2	B1 531 21	2.PL1	B1 530 90	PA1	B1 531 22
PS1	B1 530 96	2.PL2	B1 531 19		

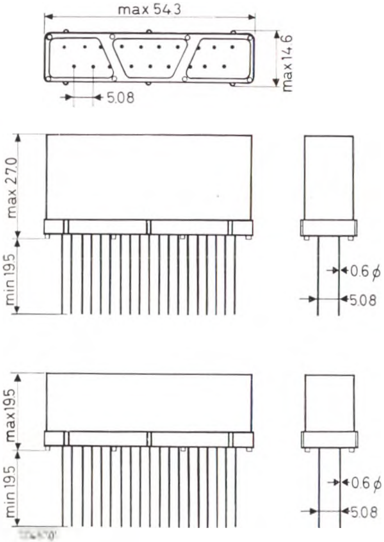
10 series - CIRCUIT BLOCKS

STANDARD UNITS FOR LOW SPEED (frequency 30–70 kc/s)

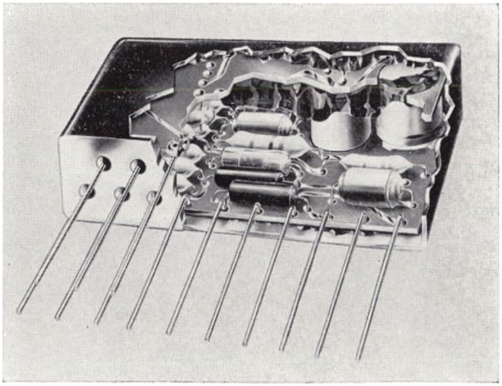


These highly compact units have been designed for low speed applications; the maximum clock frequency for triggered logic applications is 30 kc/s. Operation in a d.c. logic mode of various units up to a frequency of 65 kc/s is possible.

This range of circuit blocks is a logical extension to the existing range for medium-speed applications. It combines the general advantages of the approved circuit block conception with the following specific features:
high circuit density; combination of different circuits in one unit, e.g. gates and inverters; ease of application by extremely simple loading rules; increased versatility and improved mutual loadability; consequently possibilities of designing more compact equipment; high switching level; high built-in thresholds against electrical interference; wide storage temperature range.
This range of units is designed as part of a complete system, also comprising the new high-frequency 20-series (see page B45).



Dimensions: The units are available in two standard cases, dimensions of which are given in the drawing.



STANDARD UNITS FOR LOW SPEED (frequency 30 kc/s)

supply voltages	+12V and −12V (±5%)
operating temperature	−25 °C to +55 °C
storage temperature	−55 °C to +75 °C
house	metal, rectangular, flat, colour black
terminals	19 in two rows
test specification	according to MIL Std. 202 and IEC68

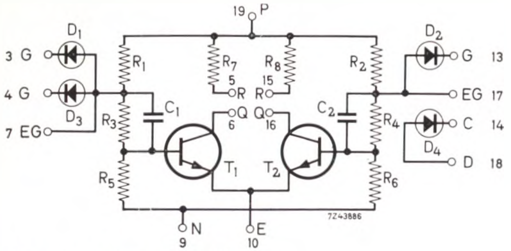
Available types

function	*colour code*	*description*	*type*	*type number*
gate inverter and amplifier	yellow	twin gate inverters	2.GI10 2.GI11 2.GI12	2P 737 09 2P 737 17 2P 737 10
		non-inverting gate amplifier (70mA, 20V)	GA11	2P 748 29
memory	red	bistable multivibrators:		
		set flip-flop	FF10	2P 737 01
		flip-flop with trigger gate	FF11	2P 737 02
		set flip-flop with trigger gate	FF12	2P 737 03
gate	orange	twin trigger gates	2.TG13 2.TG14	2P 737 18 2P 737 19
		quadrupple trigger gate	4.TG15	2P 748 18
pulse shaper	green	one-shot multivibrator	OS10	2P 737 05
		timer unit	TU10	2P 737 06
		pulse driver	PD10	2P 737 14
		pulse shaper	PS10	2P 737 13/10
power amplifier	blue	relay driver (100mA, 55V)	RD10	2P 737 16
	*	power amplifier (2A, 55V)	PA10	2P 737 07

* no colour code

UNITS WITH A NAND AND NOR FUNCTION

2.GI10 – TWIN GATE INVERTER AMPLIFIER



Type number: 2 P 737 09

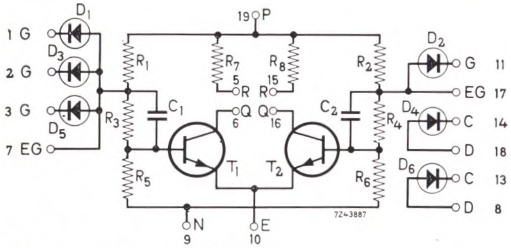
Colour insulating sleeve: yellow

The unit contains a single input and a double input positive diode gate-inverter combination, together with one separate diode which can be used to extend the number of gate inputs G on either of the two circuits at the extension gate inputs EG.

The collectors Q of the two transistors are not connected with their corresponding collector resistors R. Therefore with the two transistors a logical operation can be performed by interconnecting the two collectors Q with one collector resistor R. The second collector resistor R must be left disconnected.

Terminals:
1. not connected
2. not connected
3. G = gate input
4. G = gate input
5. R = connection collector resistor
6. Q = output
7. EG = extension gate input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. not connected
12. not connected
13. G = gate input
14. C = cathode separate diode
15. R = connection collector resistor
16. Q = output
17. EG = extension gate input
18. D = anode separate diode
19. P = supply +12V

2.GI11 – TWIN GATE INVERTER AMPLIFIER



Type number: 2 P 737 17

Colour insulating sleeve: yellow

The unit contains a single input and a triple input positive diode gate-inverter combination, together with two separate diodes which can be used to extend the number of gate inputs G on either of the two circuits at the extension gate inputs EG.

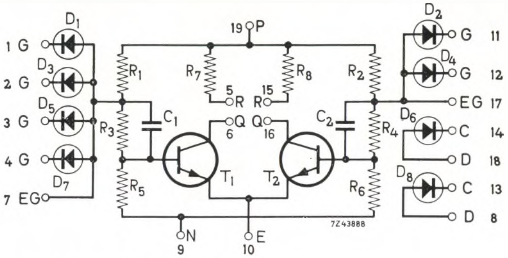
The collectors Q of the two transistors are not connected with their corresponding collector resistor R. Therefore with the two transistors a logical operation can be performed by interconnecting the two collectors Q with one collector resistor R. The second collector resistor R must be left disconnected.

Terminals:
1. G = gate input
2. G = gate input
3. G = gate input
4. not connected
5. R = connection collector resistor
6. Q = output
7. EG = extension input
8. D = anode separate diode
9. N = supply −12V
10. E = common supply OV
11. G = gate input
12. not connected
13. C = cathode separate diode
14. D = anode separate diode
15. R = connection collector resistance
16. Q = output
17. EG = extension gate input
18. D = anode separate diode
19. P = supply +12V

UNITS WITH A NAND AND NOR FUNCTION

TWIN GATE INVERTER AMPLIFIER – 2.GI12

Terminals:
1. G = gate input
2. G = gate input
3. G = gate input
4. G = gate input
5. R = connection collector resistor
6. Q = output
7. EG = extension gate input
8. D = anode separate diode
9. N = supply −12V
10. E = common supply 0V
11. G = gate input
12. G = gate input
13. C = cathode separate diode
14. C = cathode separate diode
15. R = connection collector resistor
16. Q = output
17. EG = extension gate input
18. D = anode separate diode
19. P = supply +12 V

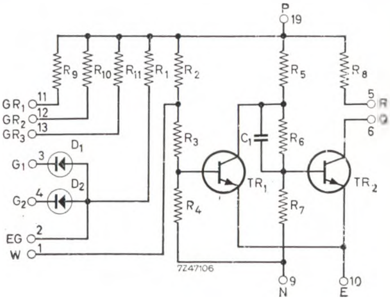


Type number: 2 P 737 10
Colour insulating sleeve: yellow

The unit contains a double input and a quadruple input positive diode gate-inverter combination, together with two separate diodes which can be used to extend the number of gate inputs G on either of the two circuits at the extension gate inputs EG.
The collectors Q of the two transistors are not connected with their corresponding collector resistors R. Therefore with the two transistors a logical operation can be performed by interconnecting the two collectors Q with one collector resistor R. The second collector resistor R must be left disconnected.

NON-INVERTING GATE AMPLIFIER-GA11

Terminals:
1. W = input amplifier
2. EG = extention gate input
3. G_1 = gate input 1
4. G_2 = gate input 2
5. R = collector resistor
6. Q = output
7. not connected
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. GR_1 = gate resistor 1
12. GR_2 = gate resistor 2
13. GR_3 = gate resistor 3
14. not connected
15. not connected
16. not connected
17. not connected
18. not connected
19. P = supply +12V

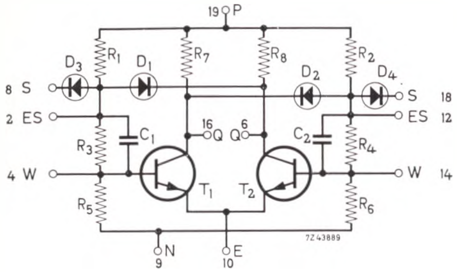


Type number: 2 P 748 29
Colour insulating sleeve: yellow

The unit contains a gate circuit and a two-stage non-inverting amplifier. The gain is appreciable and the output of 70mA, 20V is sufficient to drive a relay. Three gate resistors are provided for a one- and a two-level gate input, allowing AND operation in a one-stage, AND-AND or AND-OR operation in a two-stage logic.

UNITS WITH A MEMORY FUNCTION

FF10 – FLIP-FLOP



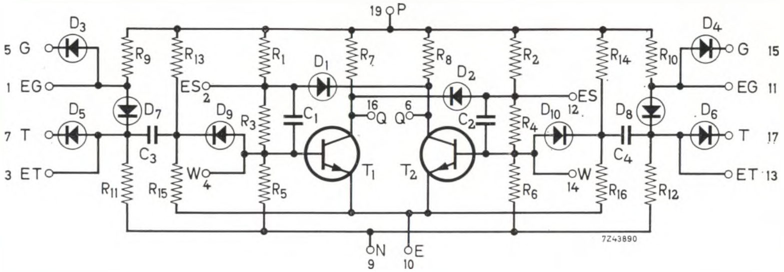
Type number: 2P 737 01
Colour insulating sleeve: red

The unit comprises a set/reset bistable multivibrator circuit. The number of set/reset inputs S can be extended with the aid of external diodes at the extension inputs ES.
The circuit constitutes a memory function, driven by means of a d.c. level at the set/reset inputs S. In conjunction with the twin trigger gates 2TG13, 2TG14 or the quadruple trigger gate 4TG15 an a.c. -driven (triggered) flip-flop can be formed, normally used in binary counters and shift registers.
In these applications the output terminals Q of the trigger gates are connected to the input terminals W of the flip-flop.

Terminals:
1. not connected
2. ES = extension set/reset input
3. not connected
4. W = extension trigger gate
5. not connected
6. Q = output
7. not connected
8. S = set/reset input
9. N = supply −12V
10. E = common supply 0V
11. not connected
12. ES = extension set/reset input
13. not connected
14. W = extension trigger gate
15. not connected
16. Q = output
17. not connected
18. S = set/reset input
19. P = supply +12V

UNITS WITH A MEMORY FUNCTION

FLIP-FLOP – FF11



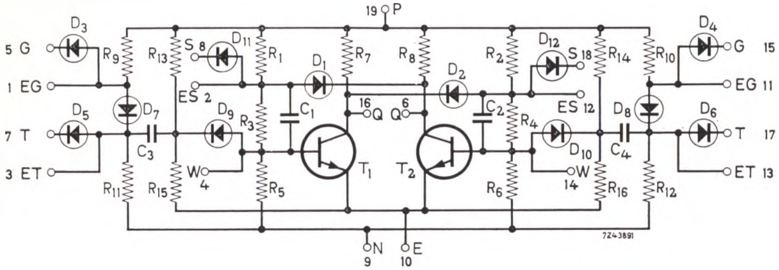
Type number: 2P 737 02
Colour insulating sleeve: red

The unit contains a set/reset bistable multivibrator circuit with built-in trigger gates. The number of gate inputs G and trigger inputs T can be extended with the aid of external diodes at the extension inputs EG or ET.
The circuit performs a memory function when driven by means of a d.c. level at the extension set/reset input ES or a negative-going trigger signal at the trigger inputs T. In the case of trigger drive, the switching of the flip-flop can be controlled by a d.c. level applied to the built-in gate inputs G (e.g. in shift registers), whilst the trigger inputs T are interconnected. It can also be used as a divider, when the gate inputs G are connected to the corresponding outputs Q. With the aid of trigger gates 2TG13, 2TG14 or the quadruple trigger gate 4TG15, extra triggering facilities can be made by connecting their outputs Q to the trigger gate inputs W of the flip-flop (e.g. in bi-directional shift registers and counters).

Terminals:
1. EG = extenstion gate input
2. ES = extension set/reset input
3. ET = extension trigger input
4. W = extension trigger gate
5. G = gate input
6. Q = output
7. T = trigger input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. EG = extension gate input
12. ES = extension set/reset input
13. ET = extension trigger input
14. W = extension trigger gate
15. G = gate input
16. Q = output
17. T = trigger input
18. not connected
19. P = supply +12V

UNITS WITH A MEMORY FUNCTION

FF12 – FLIP-FLOP



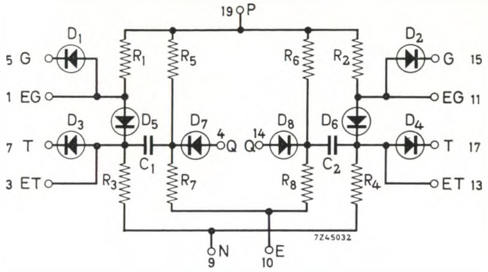
Type number: 2P 737 03
Colour insulating sleeve: red

The unit comprises a set/reset bistable multivibrator circuit with built-in trigger gates. The number of set/reset inputs S, gate inputs G and trigger inputs T can be extended with the aid of external diodes at the extension inputs ES, EG or ET. The circuit constitutes a memory function when driven by means of a d.c. level at the set/reset inputs S or a negative-going trigger signal at the trigger inputs T. In the case of trigger drive, the switching of the flip-flop can be controlled by a d.c. level applied to the built-in gate inputs G (e.g. in shift registers), whilst the trigger inputs T are interconnected. It can also be used as a binary divider, when the gate inputs G are connected to the corresponding outputs Q.
With the aid of trigger gates 2TG13, 2TG14 or the quadruple trigger gate 4TG15, extra triggering facilities can be made by connecting their outputs Q to the corresponding trigger gate inputs W of the flip-flop (e.g. in bi-directional shift registers and counters).

Terminals
1. EG = extension gate input
2. ES = extension set/reset input
3. ET = extension trigger input
4. W = extension trigger gate
5. G = gate input
6. Q = output
7. T = trigger input
8. S = set/reset input
9. N = supply −12V
10. E = common supply 0V
11. EG = extension gate input
12. ES = extension set/reset input
13. ET = extension trigger input
14. W = extension trigger gate
15. G = gate input
16. Q = output
17. T = trigger input
18. S = set/reset input
19. P = supply +12V

UNITS WITH A PULSE GATING FUNCTION

TWIN TRIGGER GATE – 2TG13



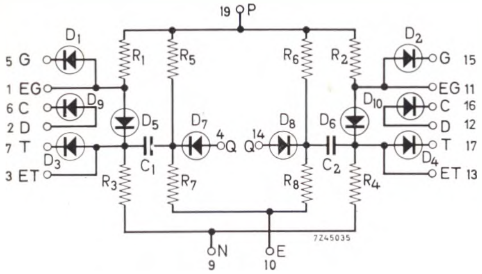
Type number: 2P 737 18
Colour insulating sleeve: orange

The unit comprises two identical trigger gate circuits, which are normally used in conjunction with flip-flop units FF10, FF11, or FF12.
With the twin trigger gate a second pair of trigger inputs is formed for the flip-flops FF11 or FF12, to make one stage of a bi-directional counter or shift register. In these applications the output terminals G of the 2TG13 are to be connected directly to the input terminals W of the flip-flop. The trigger gates are controlled by a d.c. voltage level, applied to the input terminals G.
The number of gate inputs G or trigger inputs T can be extended with the aid of external diodes at the extension inputs EG or ET.

Terminals:
1. EG = extension gate input
2. not connected
3. ET = extension trigger input
4. Q = output
5. G = gate input
6. not connected
7. T = trigger input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. EG = extension gate input
12. not connected
13. ET = extension trigger input
14. Q = output
15. G = gate input
16. not connected
17. T = trigger input
18. not connected
19. P = supply +12V

UNITS WITH A PULSE GATING FUNCTION

2TG14 – TWIN TRIGGER GATE



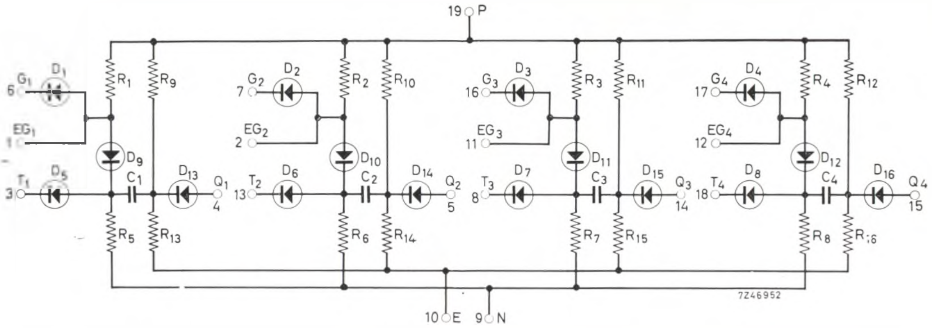
Type number: 2P 737 19
Colour insulating sleeve: orange

The unit comprises two identical trigger gate circuits, which are normally used in conjunction with flip-flop units FF10, FF11, or FF12.
With the twin trigger gate a second pair of trigger inputs is formed for the flip-flops FF11 or FF12, to make one stage of a bi-directional counter or shift register. In these applications the output terminals Q of the 2TG14 are to be connected directly to the input terminals W of the flip-flop.
The trigger gates are controlled by a d.c. voltage level applied to the input terminals G.
Two separate built-in diodes can be used to extend the number of gate inputs G at the extension inputs EG

Terminals:
1. EG = extension gate input
2. D = anode separate diode
3. ET = extension trigger input
4. Q = output
5. G = gate input
6. C = cathode separate diode
7. T = trigger input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. EG = extension gate input
12. D = anode separate diode
13. ET = extension trigger input
14. Q = output
15. G = gate input
16. C = cathode separate diode
17. T = trigger input
18. not connected
19. P = supply +12V

UNITS WITH A PULSE GATING FUNCTION

QUADRUPLE TRIGGER GATE – 4TG15



Type number: 2P 748 18

Colour insulating sleeve: orange

The unit comprises four separate identical trigger gate circuits, which are normally used in conjunction with flip-flop units FF10, FF11, or FF12.

By connecting the output terminals Q of the 4TG15 directly to the appropriate input terminals W of a flip-flop FF10, one stage of a bi-directional counter or bi-directional shift register is formed. When, however, the output terminals Q of one 4TG15 are connected to the appropriate input terminals W of two units FF11 or FF12, two stages of a bi-directional counter or bi-directional shift register are formed. The trigger gates are controlled by a d.c. voltage level, applied to the input terminals G.

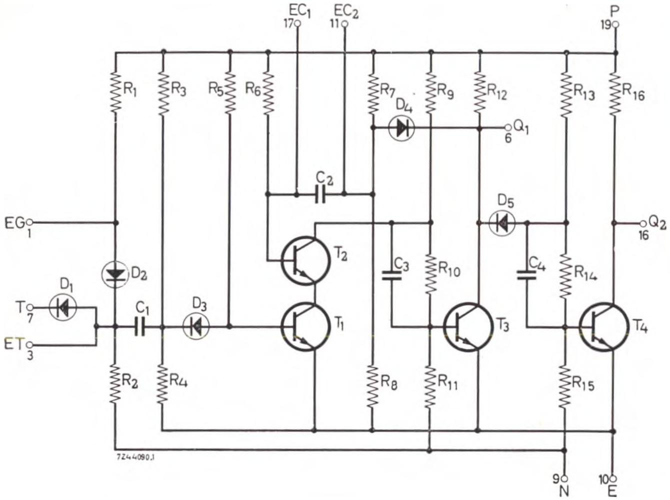
The number of gate inputs G can be extended with the aid of external diodes at the extension inputs EG.

Terminals:

1. EG_1 = extension gate input
2. EG_2 = extension gate input
3. T_1 = trigger input
4. Q_1 = output
5. Q_2 = output
6. G_1 = gate input
7. G_2 = gate input
8. T_3 = trigger input
9. N = supply −12V
10. E = common supply 0V
11. EG_3 = extension gate input
12. EG_4 = extension gate input
13. T_2 = trigger input
14. Q_3 = output
15. Q_4 = output
16. G_3 = gate input
17. G_4 = gate input
18. T_4 = trigger input
19. P = supply +12V

UNITS WITH A PULSE GENERATING AND PULSE SHAPING FUNCTION

OS10 - ONE-SHOT MULTIVIBRATOR



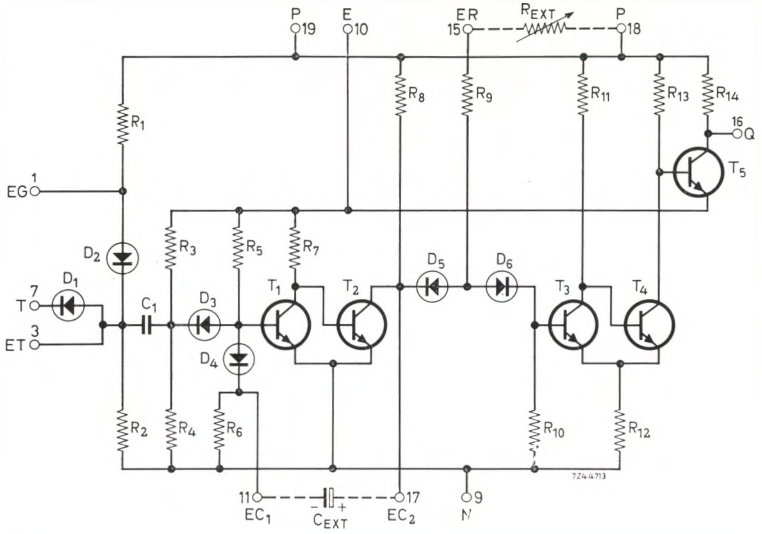
Type number: 2P 737 05
Colour insulating sleeve: green

The unit OS 10 contains a monostable multivibrator circuit with a built-in trigger gate.
The trigger gate can be controlled by a d.c. voltage level applied via a diode to terminal EG. The number of trigger inputs T can be extended with the aid of external diodes at the extension input ET.
When a negative-going voltage step is applied to terminal T, the circuit generates a pulse at the output terminals Q, provided the gate is open. The duration of the output pulse can be increased by an external capacitor to be connected between the terminals EC$_1$ and EC$_2$. Output pulse duration 4 μsec to 30 msec.

Terminals:
1. EG = extension gate input
2. not connected
3. ET = extension trigger input
4. not connected
5. not connected
6. Q$_1$ = output 1
7. T = trigger input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. EC$_2$ = for external capacitor
12. not connected
13. not connected
14. not connected
15. not connected
16. Q$_2$ = output 2
17. EC$_1$ = for external capacitor
18. not connected
19. P = supply +12V

UNITS WITH A PULSE GENERATING AND PULSE SHAPING FUNCTION

TIMER UNIT – TU10



Type number: 2P 737 06
Colour insulating sleeve: green

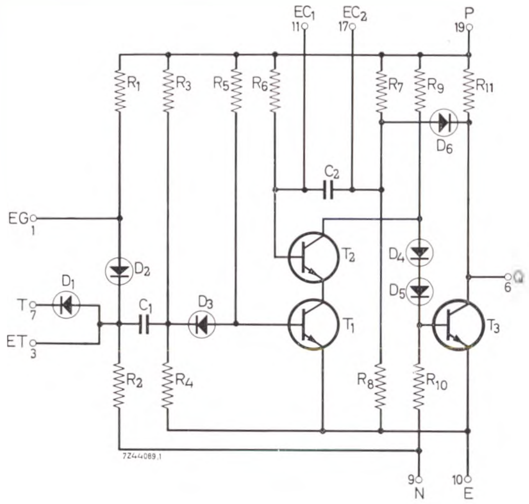
The unit TU10 contains a timing circuit followed by a Schmitt trigger circuit and an inverting amplifier. It also comprises a built-in trigger gate. The trigger gate can be controlled by a d.c. voltage level applied via a diode to terminal EG. The number of trigger inputs T can be extended with the aid of external diodes at the extension input ET.
When a negative-going voltage step is applied to terminal T, the circuit generates a positive-going pulse at the output terminal Q, provided the gate is open. The duration of the output pulse is determined by the value of the external capacitor to be connected between the terminals EC_1 and EC_2 and of the external resistor between the terminals ER and P. Output pulse duration max. 60 sec.

Terminals:

1. EG = extension gate input
2. not connected
3. ET = extension trigger input
4. not connected
5. not connected
6. not connected
7. T = trigger input
8. not connected
9. N = supply –12V
10. E = common supply 0V
11. EC_1 = for external capacitor (— terminal)
12. not connected
13. not connected
14. not connected
15. ER = for external resistor
16. Q = output
17. EC_2 = for external capacitor (+ terminal)
18. P = supply + 12V (internally connected to terminal 19)
19. P = supply +12V

UNITS WITH A PULSE GENERATING AND PULSE SHAPING FUNCTION

PD10 – PULSE DRIVER



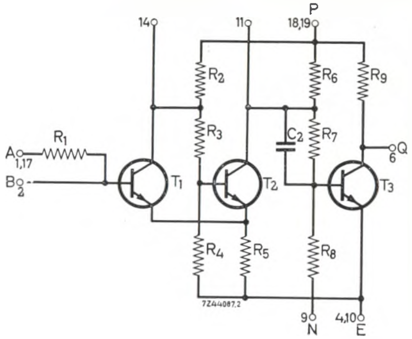
Type number: 2P 737 14
Colour insulating sleeve: green

The unit PD10 contains a monostable multivibrator circuit with a built-in trigger gate.
The trigger gate can be controlled by a d.c. voltage level applied via a diode to terminal EG. The number of trigger inputs T can be extended with aid of external diodes at the extension input ET.
When a negative-going voltage step is applied to terminal T, the circuit generates a pulse at the output terminal Q, provided the gate is open.
The duration of the output pulse can be increased (max. 5 msec.) by an external capacitor to be connected between the terminals EC_1 and EC_2.
The unit is well suited as clock or reset source by virtue of its considerable output power.

Terminals:
1. EG = extension gate input
2. not connected
3. ET = extension trigger input
4. not connected
5. not connected
6. Q = output
7. T = trigger input
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. EC_1 = for external capacitor
12. not connected
13. not connected
14. not connected
15. not connected
16. not connected
17. EC_2 = for external capacitor
18. not connected
19. P = supply +12V

UNITS WITH A PULSE GENERATING AND PULSE SHAPING FUNCTION

PULSE SHAPER – PS10



Type number: 2P 737 13/10
Colour insulating sleeve: green

The unit PS10 contains a Schmitt trigger (squaring) circuit followed by an inverting amplifier.
An input signal of a magnitude exceeding the tripping level of the unit is reshaped and inverted into the standard d.c. level at the output. The output voltage transients are short and suitable for driving the multivibrator circuits at their trigger inputs T.
The input terminals A and B are provided in order to be able to use the PS10 for the following purposes:

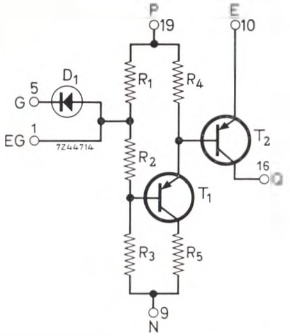
1. as a pulse shaper, driven by an external source;
2. as a relaxation oscillator circuit;
3. as a pulse shaper, driven by circuit blocks of the 10-series.

Terminals:
1. A = resistor input (interconnected to terminal 17)
2. B = direct base input
3. not connected
4. E = common supply 0V (interconnected to terminal 10)
5. not connected
6. Q = output
7. not connected
8. not connected
9. N = supply −12V
10. E = common supply 0V (interconnected to terminal 4)
11. internally connected
12. not connected
13. not connected
14. internally connected
15. not connected
16. not connected
17. A = resistor input (interconnected to terminal 1)
18. P = supply +12V
19. P = supply +12V

Terminals 18 and 19 interconnected

UNITS WITH AN OUTPUT FUNCTION

RD10 – RELAY DRIVER

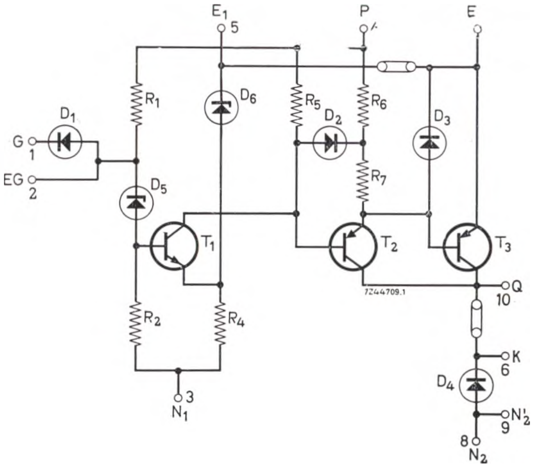


Terminals:
1. EG = extension gate input
2. not connected
3. not connected
4. not connected
5. G = gate input
6. not connected
7. not connected
8. not connected
9. N = supply −12V
10. E = common supply 0V
11. not connected
12. not connected
13. not connected
14. not connected
15. not connected
16. Q = output
17. not connected
18. not connected
19. P = supply +12V

Type number: 2 P 737 16
Colour insulating sleeve: blue

The unit comprises a single input positive diode gate followed by a non-inverting amplifier, intended for driving relays. The number of gate inputs G can be extended by means of external diodes to be connected to the extension gate input EG. The absolute max. output loadability is 2A, −55V.

PA10 – POWER AMPLIFIER



Terminals:
1. G = gate input
2. EG = extension gate input
3. N$_1$ = supply −12V
4. P = supply +12V
5. E$_1$ = common supply 0V
6. K = cathode of diode D 4
7. E$_2$ = common supply 0V
8. N$_2$ = supply abs. max. 55V
9. N$_2'$ = supply abs. max. 55V
10. Q = output

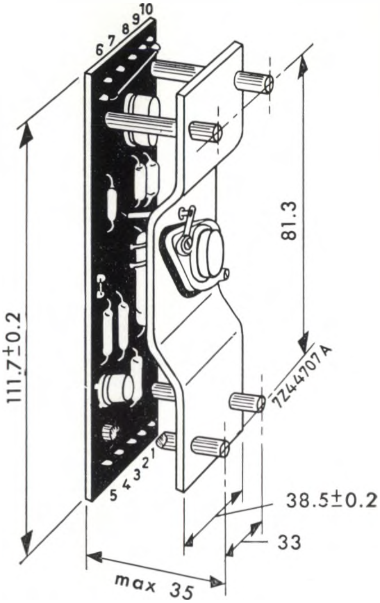
Type number: 2P 737 07

The PA10 consists of a transistor amplifier circuit, designed to be used as a power amplifier with max. loadability of 2 A, −55.5V. The amplifier can be driven directly by the circuit blocks FF10, FF11, FF12, 2GI10, 2GI11, 2GI12, OS10, PD10, PS10, GA11 and TU10.

UNITS WITH AN OUTPUT FUNCTION

POWER AMPLIFIER – PA10

Mechanical construction

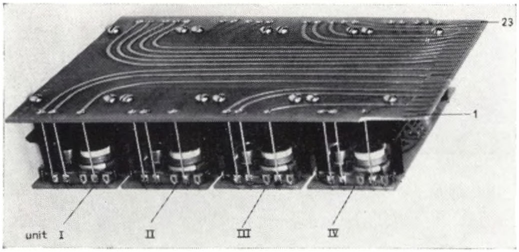


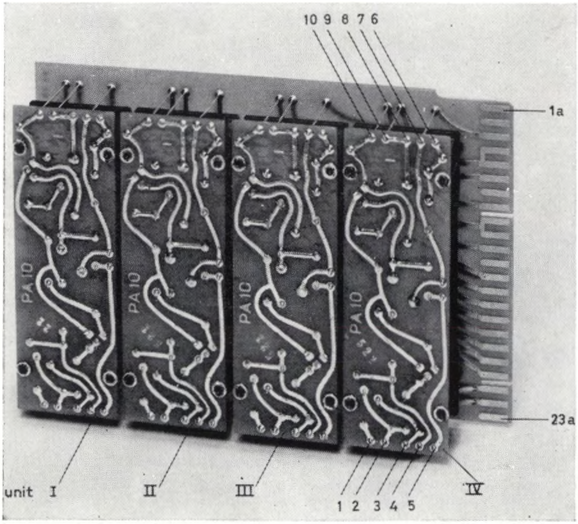
Printed-wiring board for PA10

Type number: 2P 175 10

For use in the mounting chassis B8 716 11, a glass-epoxy standard printed wiring board, 2P 175 10 is available. Its outside dimensions are 121.8 mm × 180.3 mm × 1.6 mm (4.8″ × 7.1″ × 0.0625″) and it can be used directly with the aid of the mating connector, with double-sided contacts type F 045 DC/025.

On this standard printed-wiring board up to four PA10's can be mounted, the next position in the chassis being left empty.





INPUT AND OUTPUT DATA

Input data

unit	terminal	note	direct current	transient charge
FF10, FF11, FF12	G		1.1 mA	1.2 nC
2. TG13, 2.TG14, 4TG15	T	gate open	1.1 mA	3.4 nC
FF10, FF11, FF12	S		1.95 mA	2.8 nC
2.GI10, 2.GI11, 2.GI12	G		1.1 mA	2.1 nC
GA11	G		1.1 mA	1.2 nC
OS10	G		1.1 mA	1.2 nC
	T	gate open	1.1 mA	2.3 nC
TU10, PD10	G		1.1 mA	1.2 nC
	T	gate open	1.1 mA	3.2 nC
RD10	G		4.7 mA	3.4 nC
PA10	G		5.3 mA	5.2 nC

Output data

unit	terminal	direct current	transient charge
FF10, FF11, FF12	Q_1, Q_2	8.2 mA	27 nC
2.GI10, 2.GI11, 2.GI12	Q	8.2 mA	9 nC
GA11	Q	62 mA	75 nC
OS10	Q_1	8.6 mA	24 nC
	Q_2	12.8 mA	29 nC
TU10	Q	32 mA	27 nC
PD10	Q	100 mA	185 nC
PS10	Q	10 mA	39 nC
RD10	Q	200 mA	
PA10	Q	2 A	

Loading rules

1. Verify that the sum of the required d.c. input currents of the driven units does not exceed the available d.c. output current of the driving unit.
2. When, however, T-inputs are incorporated in the driven units, the transient charges must also be verified.
3. Only driven units of which all inputs are high, do load the driving stage during the negative-going transient.
4. The wiring capacitance consumes an extra charge of 0.007 nC/pF.
5. T-inputs of closed gates do not require any current or charge.
6. The verifications mentioned above hold for operations at the worst combination of supply voltage tolerance (12V ±5%) and ambient temperature, between 0 and +55 °C. For temperatures below 0 °C, derating data are given in the data sheet.

MOUNTING AIDS AND ACCESSORIES FOR THE 10 SERIES

Mounting chassis type number B8 716 11

This standardised type of chassis for assembling circuit blocks mounted on printed-wiring boards is designed to be fitted in 19 inch racks.
The chassis shown in Fig 1 can contain up to 21 standard printed-wiring boards with outside dimensions of 121.8 mm × 180.3 mm × 1.6 mm(4.8″ × 7.1″ × 0.0625″). Together with the printed-wiring boards and their mating connectors type F 045 CC/025 (for single-sided contacts) or F 045 DC/025 (for double-sided contacts) it can be mounted directly in a 19 inch rack.

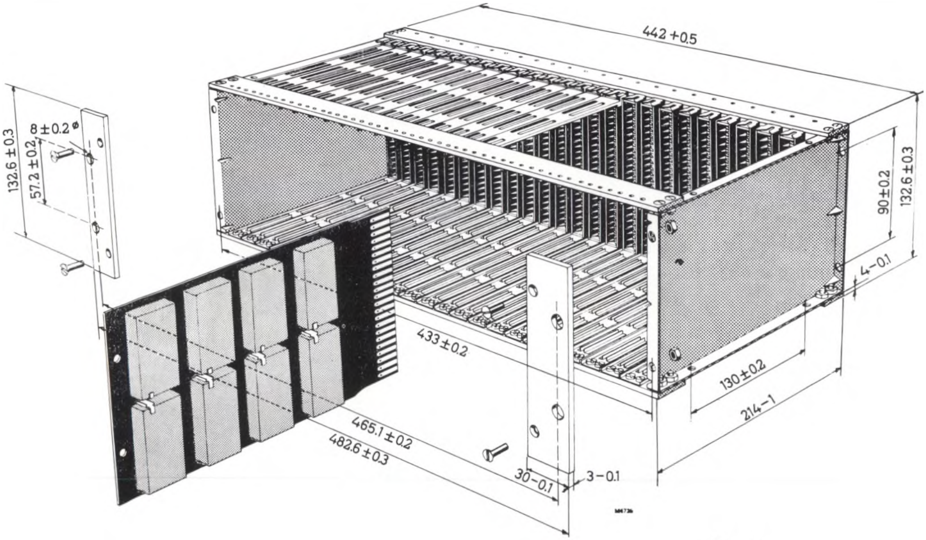


Fig. 1

Experimenters' printed-wiring board

For mounting in the chassis B8 716 11 an experimenters' printed-wiring board is available, provisional type number PRR 23–3–556. It is a board with plated-through holes, to be used with the mating connector F 045 DC/025. The outside dimensions are 121.8 × 200.6 × 1.6 mm, (4.8″ × 7.9″ × 0.0625″) and they are provided with 2 × 23 gold-plated contacts. The lay-out is in accordance with the I.E.C. standard grid of 2.54 mm (0.1″).
The print pattern on both sides of the board, shown in Figs 2 and 3, is chosen in such a way that it is applicable for horizontal as well as vertical mounting of the circuit blocks on the board.
The boards are provided with two marks to indicate the place at which they should be cut off, to obtain the standard length of 180.3 mm (7.1″).

MOUNTING AIDS AND ACCESSORIES FOR THE 10 series

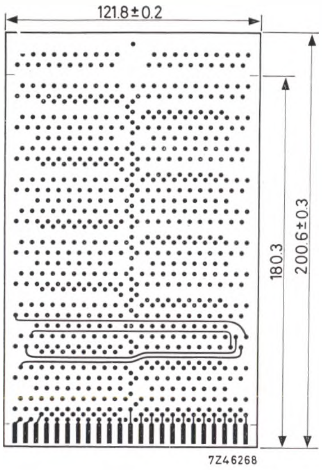


Fig. 2

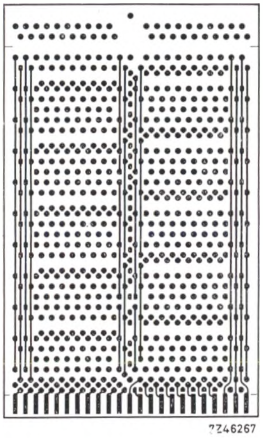


Fig. 3

Standard master drawing sheet

To facilitate the design of printed-wiring boards with a non-standard pattern for use in the chassis type B8 716 11, drawing sheets can be supplied on which the soldering pads, the plug-in contacts and some reference points are preprinted (scale 2:1). They are made of material that is dimensionally stable. The type number of this drawing sheet is P8 901 56.

Locking caps

For better securing circuit blocks mounted parallel to a printed-wiring board (horizontal mounting), window-shaped locking caps (Fig 4), type number 4322 026 32151, are available. They fit the top of a circuit block.

The locking caps are provided with two holes and recesses to lodge two soldering tags, with which the caps can be secured to the board.

The soldering tags, type number 4322 026 32141, have to be ordered separately.

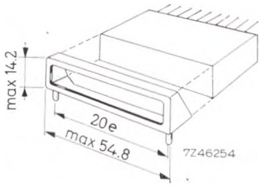
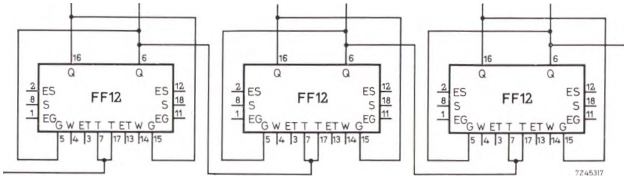


Fig. 4

Stickers

For quick setting-up of master drawings on transparent tracing material, as used e.g. for dyeline printing, a series of self-adhesive stickers provided with circuit block symbols, as given in the individual data sheets, is available.



The stickers are delivered on rolls of 1000 pieces per type. The type numbers can be found in the table below.

circuit block	*sticker type number*	*circuit block*	*sticker type number*	*circuit block*	*sticker type number*
FF10	4322 026 07611	2.GI12	4322 026 07661	PD10	4322 026 07721
FF11	07621	2.TG13	30561	GA10	07731
FF12	07631	2.TG14	30571	TU10	07741
2.GI10	07641	PS10	07701	PA10	07751
2.GI11	07651	OS10	07711	RD10	07771

STANDARD UNITS FOR HIGH-SPEED APPLICATIONS (frequency 1.1 Mc/s)

This new series of circuit blocks, the 20-series, forms part of the same system as the 10-series and is based upon the same technology.
This series is intended for high-speed applications: The maximum clock-frequency for triggered logic applications is up to 4 Mc/s. Operation in a d.c. logic mode is possible up to a frequency of approx. 2.5 Mc/s.
In these highly compact units use is made of double-diffused silicon planar epitaxial transistors. The blocks have a hermetically sealed metal can; the terminals are brought out via glass compression seals.

supply voltages	+12V ±5%; +6V ±10%; —12V ±5%
operating temperature	—25 °C/+85 °C
storage temperature	—55 °C/+85 °C
house	metal, rectangular, flat, colour black
terminals	19 in two rows (glass)
test specifications	MIL Std. 202 and IEC 68

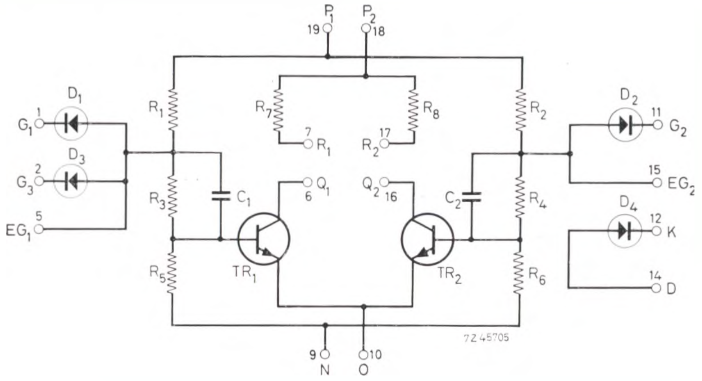
Available types:

function	*colour code*	*description*	*type*	*type number*
gate inverter	yellow	twin gate inverter	2.GI20	2P 737 23
		twin gate inverter	2.GI21	2P 737 36
		twin gate inverter with high loadability	2.GI22	2P 737 29
memory	red	bistable multivibrators:		
		set/reset flip-flop	FF20	2P 737 35
		triggered and gated flip-flop	FF23	2P 737 22
gate	orange	twin trigger gate	2.TG23	2P 737 25
pulse shaper	green	one-shot multivibrator	OS20	2P 737 26
		pulse shaper	PS20	2P 737 27
		twin line receiver	2.LR22	2P 748 09
amplifier	yellow	twin line driver	2.LD21	2P 748 08

The units FF22 and PD20 are under development.

UNITS WITH A GATE INVERTER FUNCTION

2.G120 – TWIN GATE INVERTER



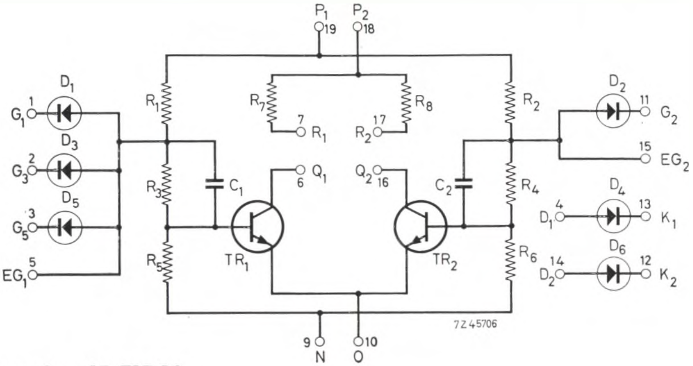
Type number: 2P 737 23
Colour insulating sleeve: yellow

The unit contains a single input and a double input diode gate-inverter combination. The separate diode can be used to increase the numbers of gate inputs of either of the two circuits at the extension gate inputs EG.
Together with the inputs G they form an AND function on the positive level. The desired output Q is to be connected to its collector resistor R. A logic function can be obtained by connecting several outputs Q to one common resistor R.

Terminals
1. G_1 = gate input
2. G_3 = gate input
3. not connected
4. not connected
5. EG_1 = extension gate input
6. Q_1 = output
7. R_1 = connection collector resistor
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. G_2 = gate input
12. K = cathode separate diode
13. not connected
14. D = anode separate diode
15. EG_2 = extension gate input
16. Q_2 = output
17. R_2 = connection collector resistor
18. P_2 = supply +6V
19. P_1 = supply +12V

UNITS WITH A GATE INVERTER FUNCTION

2.GI21 – TWIN GATE INVERTER



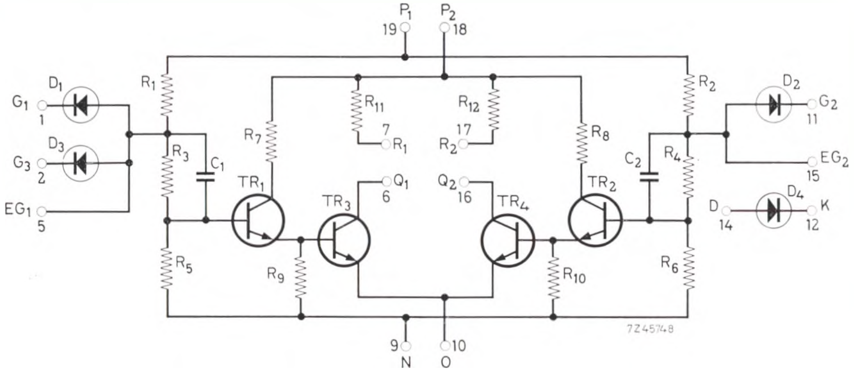
Type number 2P 737 36
Colour insulating sleeve: yellow

The unit contains a single input and a double input diode gate-inverter combination. The separate diodes can be used to increase the number of gate inputs of either of the two circuits at the extension gate inputs EG. Together with the inputs G they form an AND function on the positive level. The desired output Q is to be connected to its collector resistor R. A logic function can be obtained by connecting several outputs Q to one common resistor R.

Terminals:
1. G_1 = gate input
2. G_3 = gate input
3. G_5 = gate input
4. D_1 = anode separate diode
5. EG_1 = extension gate input
6. Q_1 = output
7. R_1 = connection collector resistor
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. G_2 = gate input
12. K_2 = cathode separate diode
13. K_1 = cathode separate diode
14. D_2 = anode separate diode
15. EG_2 = extension gate input
16. Q_2 = output
17. R_2 = connection collector resistor
19. P_2 = supply +6V
19. P_1 = supply +12V

UNITS WITH A GATE INVERTER FUNCTION

2.GI22 - TWIN GATE INVERTER



Type number: 2P 737 29

Colour of insulating sleeve: yellow

The unit contains two gate inverters with a high loadability. The separate diode can be used to increase the number of gate inputs of either of the two circuits at the extension gate inputs EG.

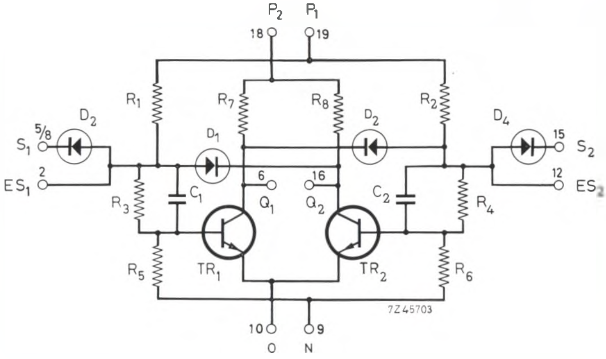
Together with the inputs G they form an AND function on the positive level. The desired output Q is to be connected to its collector resistor R. A logic function can be obtained by connecting several outputs Q to one common resistor R.

Terminals:

1. G_1 = gate input
2. G_3 = gate input
3. not connected
4. not connected
5. EG_1 = extension gate input
6. Q_1 = output
7. R_1 = connection collector resistor
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. G_2 = gate input
12. K = cathode separate diode
13. not connected
14. anode separate diode
15. EG_2 = extension gate input
16. Q_2 = output
17. R_2 = connection collector resistor
18. P_2 = supply +6V
19. P_1 = supply +12V

UNITS WITH A MEMORY FUNCTION

FLIP-FLOP – FF20



Type number: 2P 737 35
Colour of insulating sleeve: red

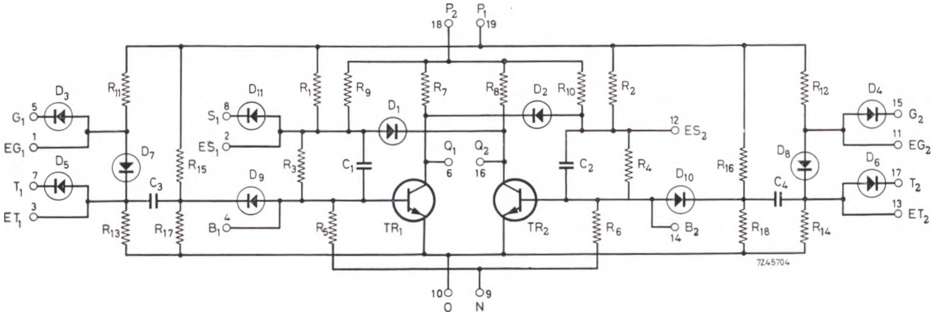
The unit contains a latch flip-flop for d.c. logic operations. Upon application of the 0V level to one of the set inputs S, the corresponding output Q resumes the positive level and the other output the 0V level.
The positive level applied to a set input has no effect.
A logic function is obtained by connecting external diodes to an extension set input ES; the diodes form an OR function on the 0V level.

Terminals:

1. not connected
2. ES$_1$ = extension set/reset input
3. not connected
4. internally connected
5. S$_1$ = set/reset input
6. Q$_1$ = output
7. not connected
8. S$_1$ = set/reset input
9. N = supply −12V
10. O = common supply 0V
11. not connected
12. ES$_2$ = extension set/reset input
13. not connected
14. internally connected
15. S$_2$ = set/reset input
16. Q$_2$ = output
17. not connected
18. P$_2$ = supply +6V
19. P$_1$ = supply +12V

UNITS WITH A MEMORY FUNCTION

FF23 – FLIP-FLOP



Type number: 2P 737 22
Colour of insulating sleeve: red

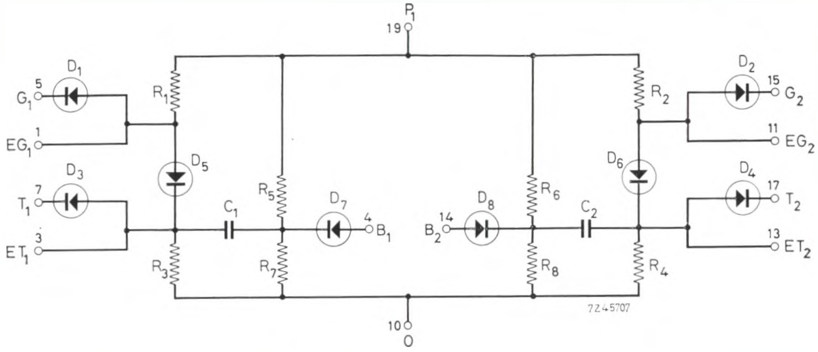
The unit contains a general-purpose triggered flip-flop. Trigger pulses are applied to trigger inputs T.
The built-in trigger gates are opened by a positive level applied to the gate inputs G and are closed by a 0V level. A binary counter is made by connecting G$_1$ to Q$_2$, and G$_2$ to Q$_1$.
A shift register is made by connecting G$_1$ and G$_2$ of one circuit block to the terminals Q$_1$ and Q$_2$ respectively of the preceding flip-flop.
Applied as binary counter or as shift register the trigger inputs T$_1$ and T$_2$ have to be connected.
A twin trigger gate 2.TG23 may be connected to the base inputs B to obtain more triggering facilities (e.g. for bi-directional shift registers and counters).
A logic function is obtained by connecting external diodes to an extension set input ES and/or extension gate input EG.
Multiple clock lines may be applied via diodes connected to the extension trigger input ET.

Terminals:

1. EG$_1$ = extension gate input
2. ES$_1$ = extension set/reset input
3. ET$_1$ = extension trigger input
4. B$_1$ = extension trigger gate
5. G$_1$ = gate input
6. Q$_1$ = output
7. T$_1$ = trigger input
8. S$_1$ = set/reset input
9. N = supply −12V
10. O = common supply 0V
11. EG$_2$ = extension gate input
12. ES$_2$ = extension set/reset input
13. ET$_2$ = extension trigger input
14. B$_2$ = extension trigger gate
15. G$_2$ = gate input
16. Q$_2$ = output
17. T$_2$ = trigger input
18. P$_2$ = supply +6V
19. P$_1$ = supply +12V

UNITS WITH A PULSE GATING FUNCTION

TWIN TRIGGER GATE – 2.TG23



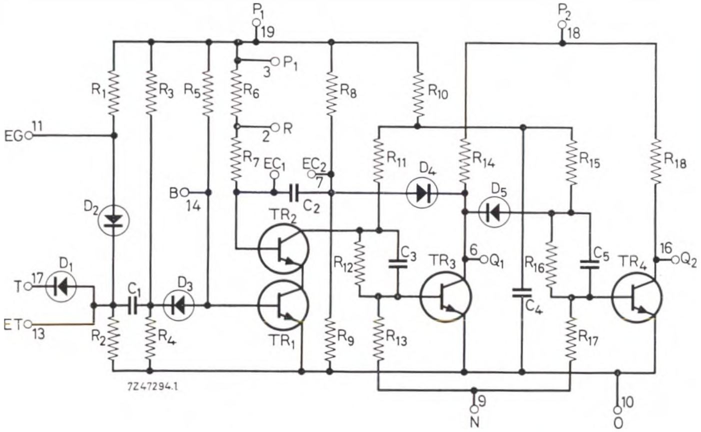
Type number: 2P 737 25
Colour of insulating sleeve: orange

The circuit is identical to the trigger gate in the general-purpose triggered flip-flop FF23.
When the outputs B_1 and B_2 of the trigger gate 2.TG23 are connected to the inputs B_1 and B_2 of the flip-flop FF23 respectively, the inputs G and T of the 2.TG23 operate in the same way as the corresponding inputs of the FF23. Thus with this trigger gate a second pair of trigger inputs are formed for the flip-flop FF23, to make one stage of a bi-directional counter or shift register.

Terminals:
1. EG_1 = extension gate input
2. not connected
3. ET_1 = extension trigger input
4. B_1 = extension trigger gate
5. G_1 = gate input
6. not connected
7. T_1 = trigger input
8. not connected
9. not connected
10. O = common supply 0V
11. EG_2 = extension gate input
12. not connected
13. ET_2 = extension trigger input
14. B_2 = extension trigger gate
15. G_2 = gate input
16. not connected
17. T_2 = trigger input
18. not conected
19. P_1 = supply +12V

UNITS WITH A PULSE SHAPING FUNCTION

OS20 - ONE-SHOT MULTIVIBRATOR



Type number: 2P 737 26

Colour insulating sleeve: green.

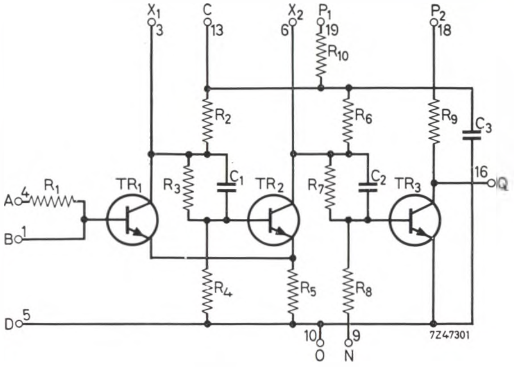
This unit contains a triggered monostable (one-shot) multivibrator. Trigger pulses are applied to trigger input T. A limited number of diodes connected to extension trigger input ET can provide further trigger inputs.
The built-in trigger gate is opened by a positive level applied to the gate input EG and is closed by a 0 V level. A diode is required to separate each gate source from input EG.
The duration of the output pulse can be decreased by a resistor connected either between terminals R and P_1 (3) or R and EC_1. In order to increase the duration a capacitor can be connected between EC_1 and EC_2.
A twin trigger gate 2.TG23 connected to input B can provide more trigger facilities.

Terminals:

1. EC_1 = external capacitor 1
2. R = external resistor
3. P_1 = external resistor
4. not connected
5. not connected
6. Q_1 = output 1
7. EC_2 = external capacitor 2
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. EG = extension gate input
12. not connected
13. ET = extension trigger input
14. B = extension trigger gate
15. not connected
16. Q_2 = output 2
17. T = trigger input
18. P_2 = supply +6V
19. P_1 = supply +12V

UNITS WITH A PULSE SHAPING FUNCTION

PULSE SHAPER PS20



Type number: 2P 737 27

Colour insulating sleeve: green

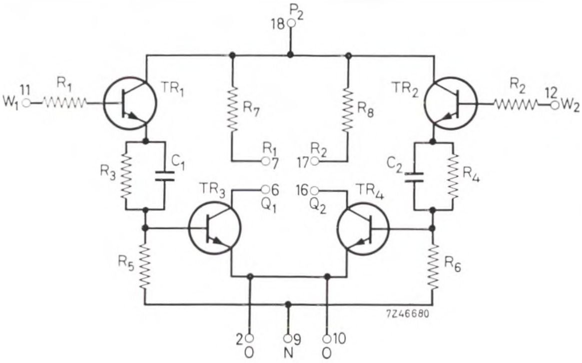
The unit PS20 contains a Schmitt trigger (squaring) circuit followed by an inverting amplifier.
A voltage in excess of the ON-threshold voltage at input terminal B gives a 0V level at output terminal Q; a voltage below the OFF-threshold voltage at terminal B gives a positive level at output Q. The output voltage transients are suitable for driving multivibrator circuits at the trigger inputs T.
The pulse shaper can be driven by external sources as well as by circuit blocks of the 20-series.

Terminals:

1. B = direct base input
2. not connected
3. X_1 = internally connected
4. A = resistor input
5. D = common supply 0V (interconnected with terminal 10)
6. X_2 = internally connected
7. not connected
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. not connected
12. not connected
13. C = internally connected
14. not connected
15. not connected
16. Q = output
17. not connected
18. P_2 = supply +6V
19. P_1 = supply +12V

UNITS WITH A PULSE SHAPING FUNCTION

2RL22 - TWIN LEVEL RESTORER



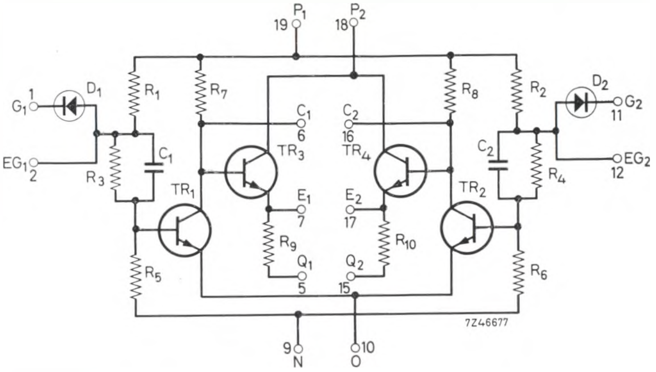
Type number: 2P 748 09
Colour insulating sleeve: green

This unit is intended to convert 3V signal levels on lines to standard signal levels used in the "20 series" of circuit blocks. It is normally used in conjunction with the twin line driver 2LD21. The input impedance is high. The unit is suited for multiple receiving.

Terminals:
1. not connected
2. O = common supply 0V
3. not connected
4. not connected
5. not connected
6. Q_1 = output
7. R_1 = connection collector resistor
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. W_1 = input
12. W_2 = input
13. not connected
14. not connected
15. not connected
16. Q_2 = output
17. R_2 = connection collector resistor
18. P_2 = supply +6V
19. not connected

UNITS WITH AN AMPLIFYING FUNCTION

TWIN LINE DRIVER - 2LD21



Type number: 2P 748 08
Colour insulating sleeve: yellow

This unit is intended to apply a signal level of 3V to a line or other termination of 75Ω. The line terminals, in such case, are Q and O.
The line driver is generally fed from a line receiver 2.LR22,
To match a cable to the circuit an appropriate resistor is to be connected between E and the signal leg of the pair, while leaving Q floating.
A gate inverter (2.GI20, 2.GI21, or 2.GI22) can feed into the control input C, so performing a logic function. The collector resistance (terminal R) is not connected for this application.

Terminals:
1. G$_1$ = gate input
2. EG$_1$ = extension gate input
3. not connected
4. not connected
5. Q$_1$ = output 75Ω
6. C$_1$ = logic gate input
7. E$_1$ = output
8. not connected
9. N = supply −12V
10. O = common supply 0V
11. G$_2$ = gate input
12. EG$_2$ = extension gate input
13. not connected
14. not connected
15. Q$_2$ = output 75Ω
16. C$_2$ = logic gate input
17. E$_2$ = output
18. P$_2$ = supply +6V
19. P$_1$ = supply +12V

The units FF22 and PD20 are under development.

INPUT AND OUTPUT DATA

Input data

unit	terminal	note	direct current (mA)	transient charge (pC)
FF20	S		2	160
FF22	T			
	S			
FF23, TG23	G		2	100
	T	gate open	2	290
FF23	S		5	360
GI20, GI21	G		2	150
GI22	G		2	150
OS20	G		2	100
	T	gate open	2	240
PD20	G		2	
	T	gate open	2	
LD21	G		2	150

Output data

unit	terminal	note	direct current (mA)	transient charge (pC)
FF20	Q		17	645
FF23	Q		14	1400
GI20, GI21	Q		15	540
GI22	Q		32	3600
OS20	Q_1		14	1500
	Q_2		15	1500
LR22	Q		15	540
PS20	Q		20	600
PD20	Q			

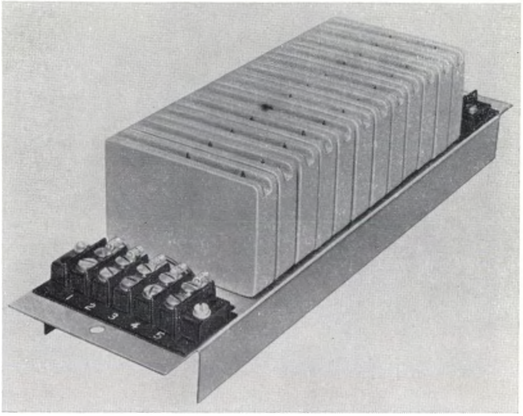
Loading Rules

1. Verify that the sum of the required d.c. input currents of the driven units does not exceed the available d.c. output current of the driving unit.
2. When, however, T-inputs are incorporated in the driven units, the transient charges must also be verified.
3. The wiring capacitance consumes an extra charge of 3.5 pC/pF.
4. T-inputs of closed gates do not require any current or charge.
5. The verifications mentioned above warrant reliable operation at the worst combination of supply voltage tolerances and ambient temperatures between 0 and +85 °C. For operation at lower temperatures, the data for each type are given in the individual data sheets.

NORBITS FOR INDUSTRIAL CONTROL

(MAX. FREQUENCY 1kc/s)

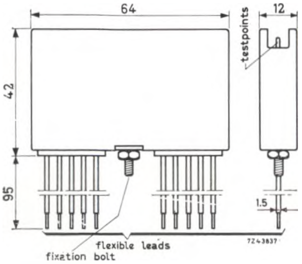
Norbits[1] are standardised static switching elements of special design and with the following features: high reliability, long life, easy mounting, dust-proof, etc. They can be used in industrial control systems, such as lift control, traffic control, machine control, process control, recording control, transfer line control, alarm and annunciator systems.



It is possible to perform a large number of control functions with a small number of types.
The basic element, the NOR-unit, is capable of performing the logical function AND/OR and NOT, whilst sequential logic circuits such as flip-flops can be built up from two or more of these NOR-units. The series Norbits further includes ancillary elements for adaptation to industrial equipment.

temperature range	−10 °C up to +50 °C
frequency	0 to 1 kc/s
supply voltages	$+24V_{dc}$ and $-24V_{dc}$ (tolerance ±5%)

Dimensional drawing of the basic Norbit case



Colour code of flexible leads

slate	S	= input
violet	V	= output
red	R	= +24V
blue	Bl	= −24V
black	Bk	= earth
pink	P	= miscellaneous
white	W	= miscellaneous
yellow	Y	= miscellaneous
blue/brown	Bl/Br	= miscellaneous

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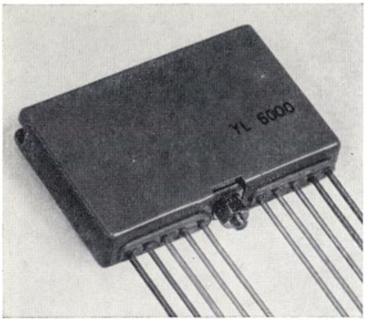
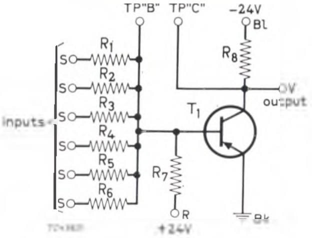
[1] Electronic elements replacing conventional electromechanical devices.

NORBITS

SINGLE NOR-UNIT TYPE YL6000





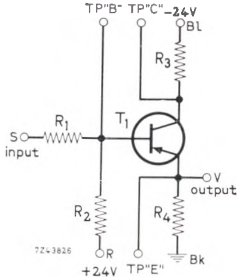
Colour: red

The unit is capable of performing the basic logic functions AND, OR and NOT. The input signals can be derived either from a previous unit or from a suitable transducer. The unit can drive 6 other NOR-units.

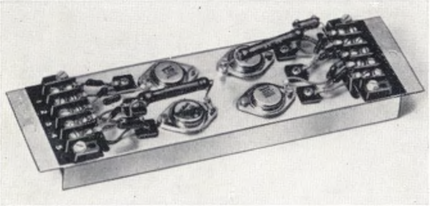
EMITTER FOLLOWER UNIT YL6001

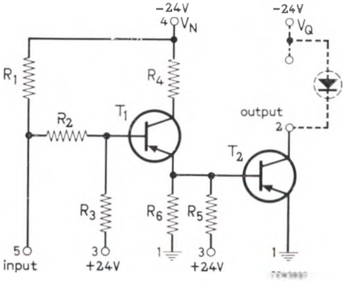
Colour: yellow

The unit comprises a transistor current amplifier in common-collector connection for use as driver for medium power unit YL6008; it can also drive 17 standard Norbits.



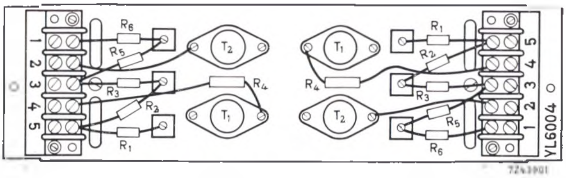
DOUBLE HIGH-POWER OUTPUT UNIT YL6004





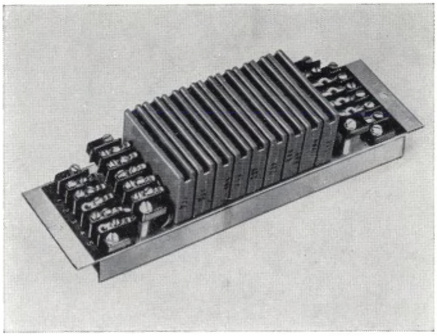
Colour: not coded

The unit consists of two high-power amplifiers which may be used separately. The input of each amplifier must be driven by an YL6009. Load resistance is 4.3 Ω min. Available output current max. 6 A.



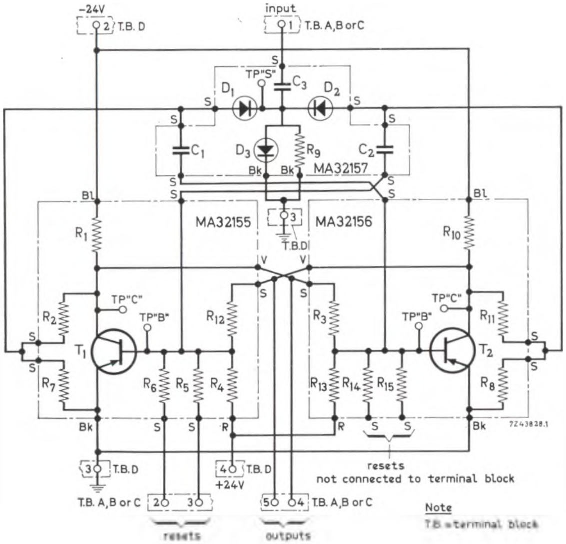
Overall dimensions: 255 mm × 70 mm × 40 mm

TRIPLE BINARY COUNTER UNIT YL6005/01

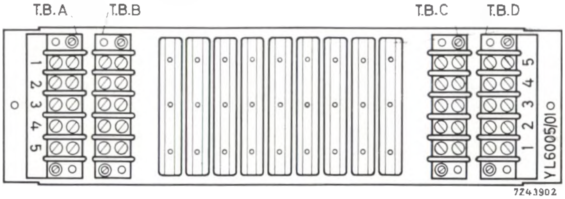


Colour: violet

Unit YL6005/01 consists of 3 single binary counters YL6005/05 (bistable multivibrator; see diagram)

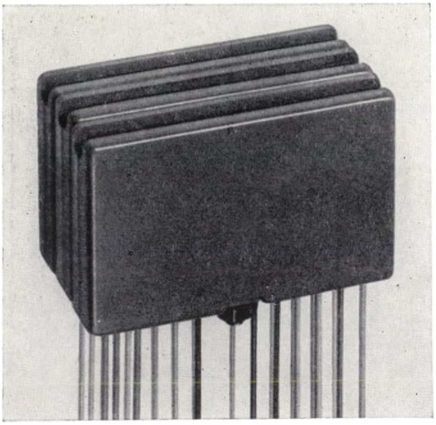


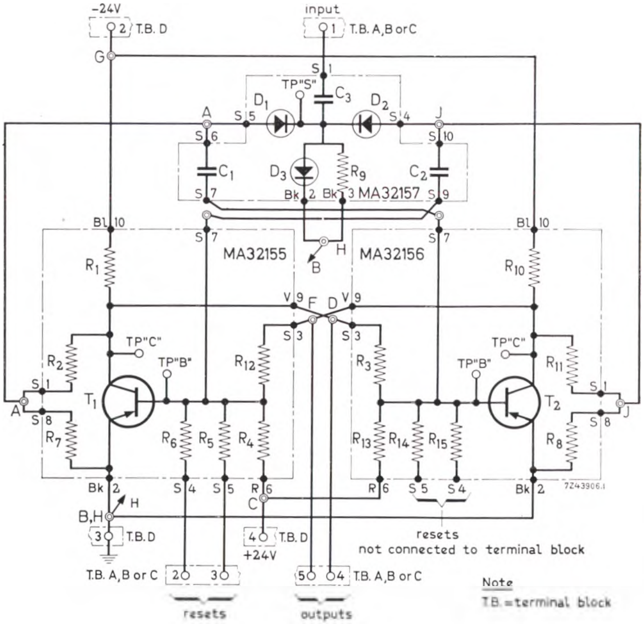
TB A: counter A terminals
TB B: counter B terminals
TB C: counter C terminals
TB D: supply for all 3 counters



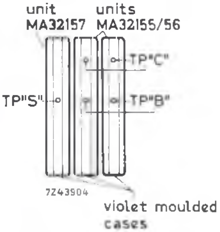
Overall dimensions:
255 mm × 70 mm × 62 mm

SINGLE BINARY COUNTER UNIT YL6005/05





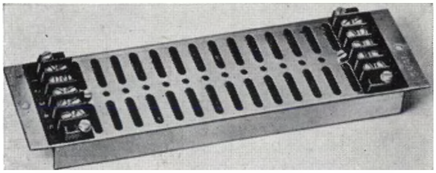
Top view of 3 plastic cases
Colour: violet

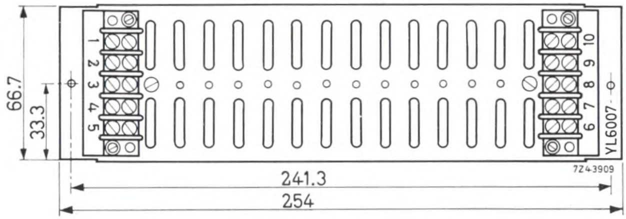


Dimensions: 3 units, each 64 mm × 42 mm × 12 mm

MOUNTING CHASSIS YL6007

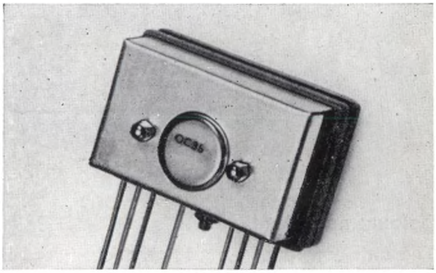
The aluminium chassis can be used for mounting 12 units, it is equipped with 2 terminal blocks each having 5 contacts.



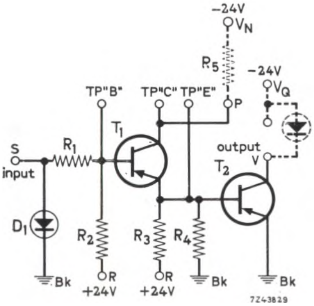


Overall dimensions: 254 mm × 70 mm × 31 mm

MEDIUM-POWER OUTPUT UNIT YL6008

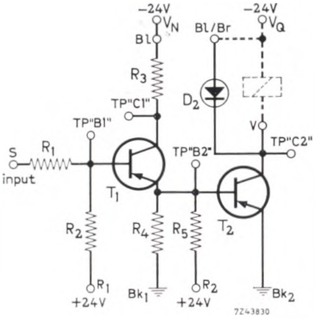


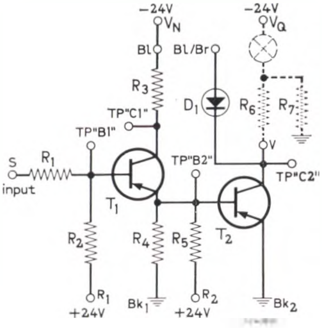
Overall dimensions: 64 mm × 42 mm × 32 mm



Colour: orange
The unit must be driven by an emitter-follower YL6001 and has been designed to drive relays; load resistance 16Ω min. Available output current max. 1.5 A.

LOW-POWER AMPLIFIER UNIT YL6009

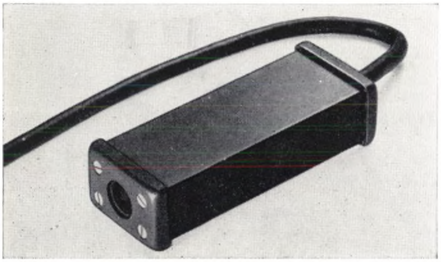


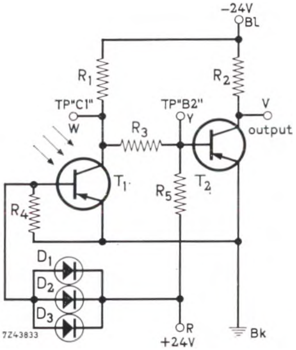


Colour: white

This unit has been designed as low-power amplifier to drive lamps or relays (load resistance 300Ω min.). Available output current max. 125 mA.

PHOTO-ELECTRIC DETECTOR HEAD YL6030





Colour: not coded

The unit consits of a photo-transistor used in a temperature-compensated circuit. The light enters the unit via a lens with an adjustable diaphragm. The unit operates satisfactorily with lamphead YL6011 at distances up to 2.40 m.

Dimensions:
112 mm × 44.2 mm × 34.6 mm

LAMP HEAD YL 6031

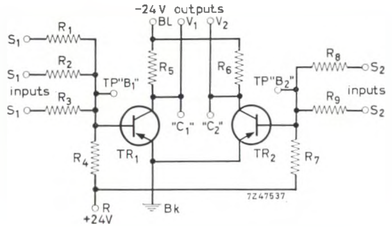
Colour: not coded

The unit has the same type of housing as YL6030 and contains a 6V lamp which can be used for various distances.

DOUBLE NOR-UNIT YL6018

Colour: black

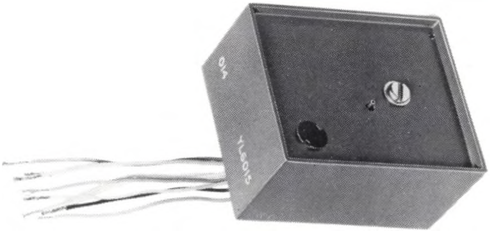
The unit is complementary to the standard NOR-unit YL6000 and comprises two NOR-circuits. One circuit has three, the other two inputs. Either circuit can drive 6 NOR-units.



TIMER UNIT YL6015

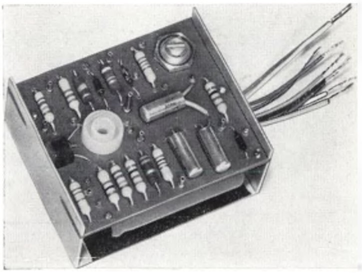
Colour: brown

The unit consists of a RC delay circuit, coupled to a Schmitt trigger, and can provide delays in 3 ranges from 0.02 to 60 s, which can be realised by different interconnections outside the unit.

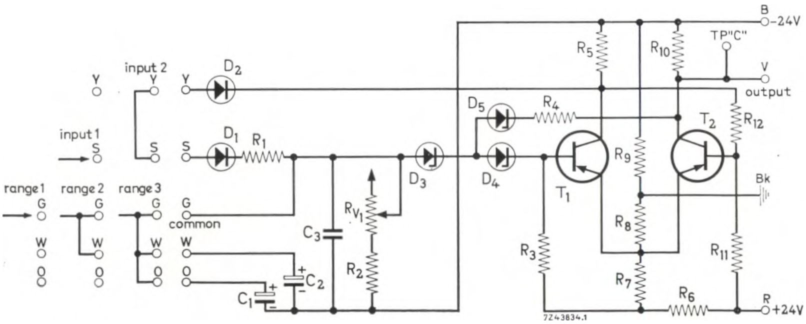


Connections:

Red	+24V
Blue	−24V
Black	earth
Slate	input 1
Slate+yellow	input 2
Violet	output
Green	common
White+green	range 2
White+orange+green	range 3



Dimensions:
64 mm × 40.4 mm × 75 mm



LOADING TABLE

The inputs and outputs of the different units may be interconnected directly. The power required to drive one of the six inputs of a NOR-unit YL6000 is defined as one "DRIVE UNIT" (abbreviated to D.U.).

The amount of power which can be delivered by the YL6000 is 6 DRIVE UNITS. The following loading table is based on the above-defined "DRIVE UNIT" which is additive.

type	*input power required*	*output power available*
NOR-UNIT YL6000	1 D.U.	6 D.U.
Emitter follower unit YL6001	6 D.U.	17 D.U.
Double high-power unit YL6004	output of YL6009	24V, 6A
Counter units YL6005/01 and YL6005/05 .	4 D.U.	each output may drive: 1 YL6005 + 1 YL6001 or YL6005 + 2 YL6009 or 1 YL 6001 or 2 YL6000/YL6018
Medium-power output unit YL6008 . . .	14 D.U.	24V, 1.5A
Low-power output unit YL6009	3 D.U.	24V, 125 mA
Photo-electric detector head YL6030 . . .	from light source YL6011	6 D.U.
Double Nor-unit YL6018	1 D.U./circuit	6 D.U./circuit
Timer unit YL6015	input 1 : 6 D.U. input 2 : 6 D.U.	6 D.U.

Example:

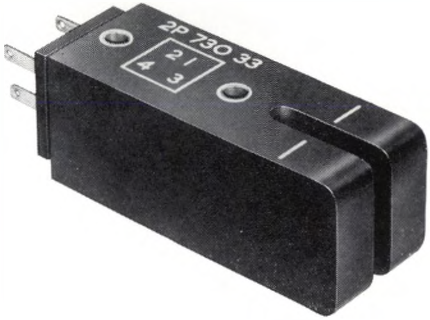
One NOR-unit YL6000 is just able to supply the power (6 D.U.) for one Emitter Follower Unit YL6001. The YL6001, in turn, is capable of driving up to 17 NOR-units YL6000 or one medium-Power Output Unit YL6008 plus 3 NOR-units YL6000 etc.

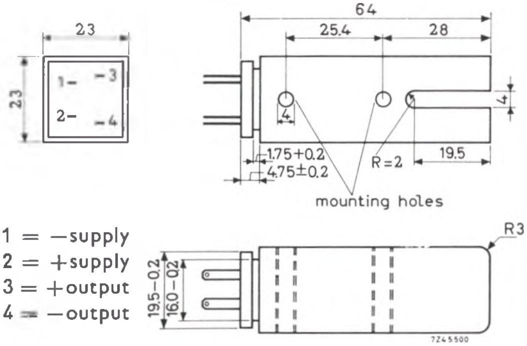
VANE-SWITCHED OSCILLATOR

The vane-switched oscillator unit consists of an oscillator and a diode rectifier. The latter is connected to a separate coupling winding of the oscillator coil, thus providing an isolated d.c. output.

The lay-out of the oscillator is such that upon inserting a suitable piece of metal (vane) in a gap between the oscillator coil windings, the oscillation stops and the d.c. output of the unit will drop to zero. The complete circuit is encapsulated in epoxy resin. The VSO can be applied as a static switching device, the switching action being determined by the position of the vane. For the vane any metal can be used.

The unit may be mounted in any position; two mounting holes allow the use of 4 mm bolts. Stacking of units is permitted. Connection can be made by 0.110 Faston tabs or by soldering.



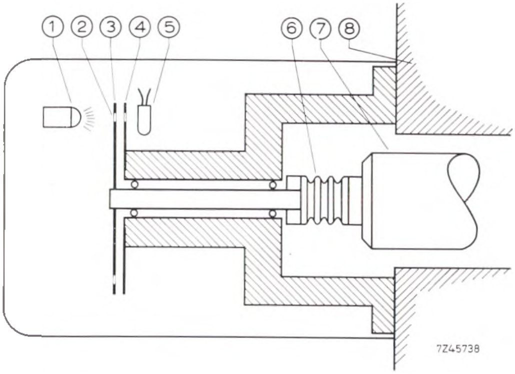


1 = −supply
2 = +supply
3 = +output
4 = −output

supply voltage	$12V_{dc}$ ±10% or: $+6V_{dc}$ ±10% and $-6V_{dc}$ ±10% (with common 0V)
consumed current (in both oscillating and non-oscillating condition)	12 mA ±10%
output voltage	5.75V ±15% isolated, open circuit, suited for driving PS1, PS10, PS20, YL6000 and YL6018.
output impedance (without vane)	4.1 kΩ ±10%
maximum detection frequency	1 kc/s
operating temperature	—25/+85 °C
storage temperature	—40/+85 °C

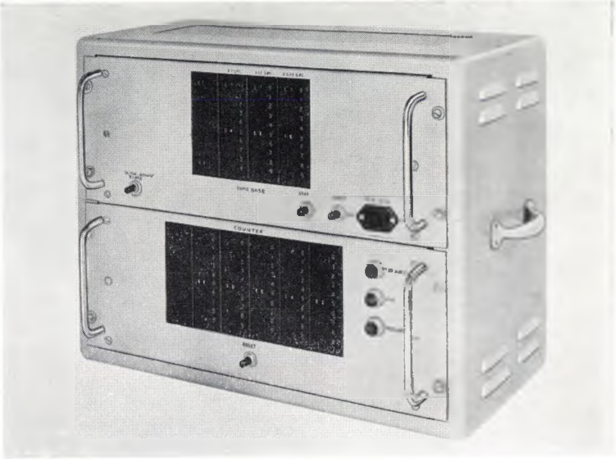
ANGULAR DISPLACEMENT TRANSDUCER PE2270

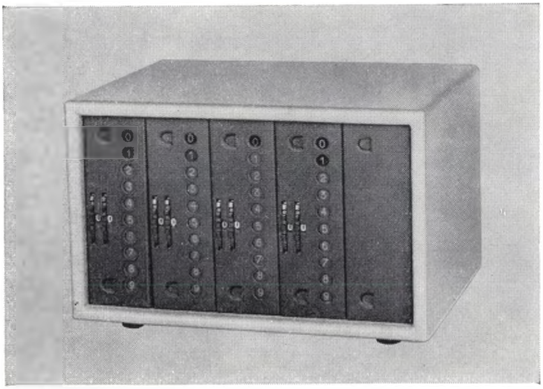
The transducer converts the angular displacement of a shaft into electric signals. The robust casing of the transducer is so mounted that its expanding bellows presses against the shaft whose displacement is to be ascertained. Any rotation of the shaft is thus accompanied by a corresponding rotation of a slotted disk. The standard disk is provided with 250 radial slots. When this disk is turned, the partitions between the slots intercept the light directed by a self-focusing lamp onto a photo-transistor. Due to the presence of a mask with four slots, 4 × 250 output signals are produced per complete revolution of the shaft. These signals can be fed to a pulse shaper PS1 which may, for example, control a digital positioning system.



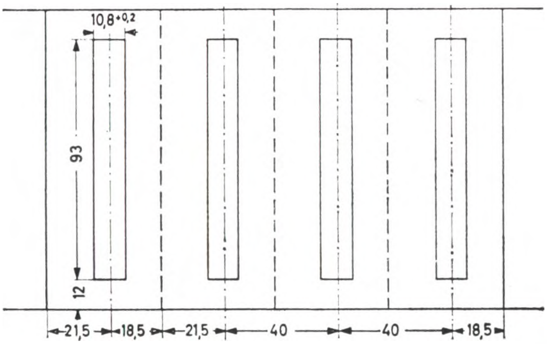
1. self-focusing lamp
2. slots
3. slotted disk
4. mask
5. photo-transistor
6. bellows
7. machine shaft
8. machine.

COUNTING UNITS FOR PROGRAMMED CONTROL



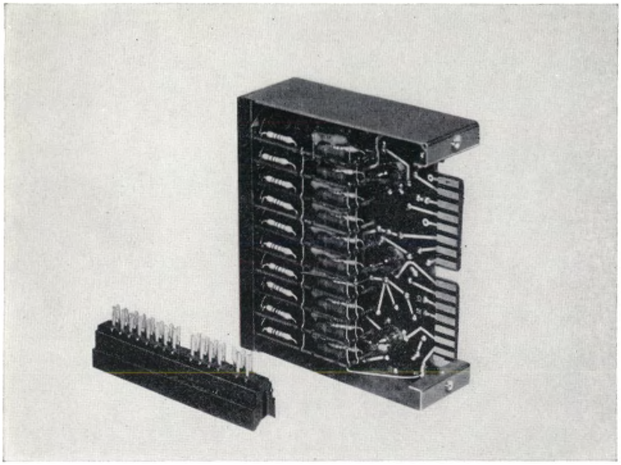


In the booklet "Counting units for programmed control" examples are given of the application of counting units in automatic number machines, time control equipment, and automatic distribution installations.



Dimensions and arrangement of the connectors on a chassis with four units.

COUNTING UNITS FOR PROGRAMMED CONTROL

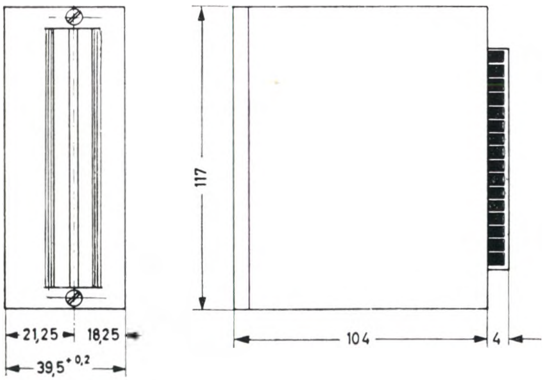


The series 88930 comprises a total of eight main units and three sub-units. The latter, the functions of which are also included in those of the main units, can be built in separately, if required.

frequency range	0–2 kc/s
maximum ambient temperature	+ 45 °C
counting pulse	V = 135 ± 5V; duration = 25 ± 10 μs
reset pulse	V = 280V; duration approximately 100 μs
output signal of relay tubes . .	approx. 100V at 100 kΩ
output power of relay amplifier .	0.8 VA at 600 Ω

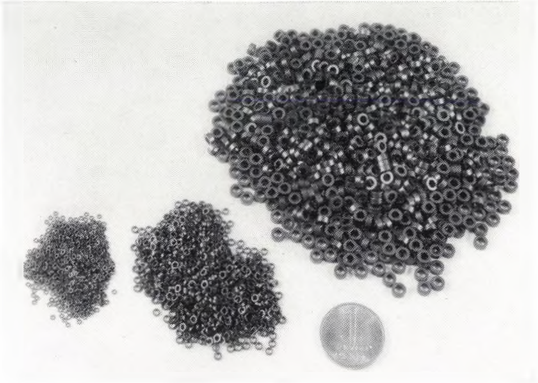
description	*type number*
input/output unit	88930/30
preset counter	88930/33
two-programme unit	88930/36
four-programme unit	88930/37
output unit	88930/39
electronic reset unit	88930/54
relay unit	88930/60
power supply unit	88930/64

sub-units (without housing)	*type number*
pulse-shaper unit.	88930/48–1
programme initiator unit . .	88930/51
relay amplifier unit	88930/57



MAGNETIC MEMORY CORES

GENERAL



All data-handling systems employ some sort of device for the storage of information. Such a "memory" can accept, store and supply the information at any required moment. For this purpose a magnetic core memory is very often used.

The storage capacity of a magnetic core is the result of its property to assume either of two stable magnetic states. One magnetic state is maintained, until it is made to change into the other.

The main features which can be distinguished are as follows:

(1) read/write cycle time of only a few microseconds;

(2) random access;

(3) the information can be stored for an indefinite period;

(4) storage of large quantities of information in a small volume.

The properties of the cores described below are such that the cores are specially suited for use in coincident current memories.

We draw your attention to the low-temperature-coefficient (LTC) cores, the electrical properties of which are substantially constant over a wide temperature range.

DEFINITIONS OF TERMS AND SYMBOLS

I_m = peak value of the drive current.

The peak value of the drive current is the maximum amplitude of the pulse, disregarding overshoot and ripple.

I_w = full write pulse.

The full write pulse will switch the core – when in the ZERO state – into the ONE state.

I_{pw} = partial write pulse

I_r = Full read pulse.

The full read pulse will switch the core – when in the ONE state – into the ZERO state

I_{pr} = partial read pulse

The partial read pulse will **not** switch the core – when in the ONE state – into the ZERO state

D.R. = disturb ratio,

the ratio of the partial drive current to the full drive current (I_{pw}/I_w; I_{pr}/I_r).

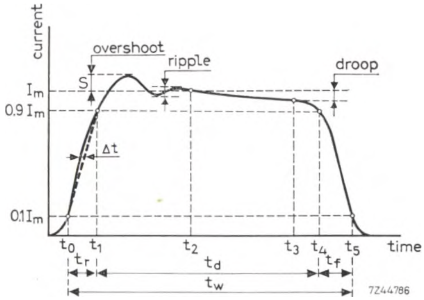
t_r = rise time.

Time interval between 0.1 I_m and 0.9 I_m points of the leading edge of the current pulse.

t_d = pulse duration.

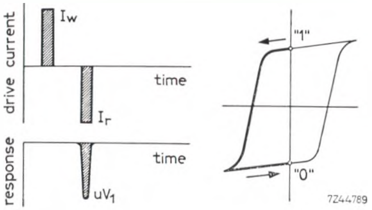
Time interval between 0.9 I_m points of the current pulse.

Drive current pulses



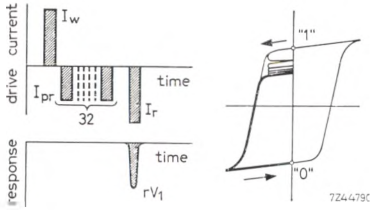
DEFINITIONS OF TERMS AND SYMBOLS

Responses.

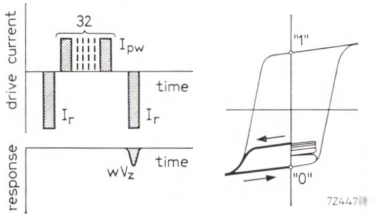


uV_1 = peak value of the undisturbed ONE response voltage.
The uV_1 is obtained at a full read pulse (I_r) when this pulse is preceded by a full write pulse (I_w).

rV_1 = peak value of the disturbed ONE reponse voltage.
The rV_1 response is obtained at a full read pulse (I_r) preceded by a full write pulse followed by 32 partial read pulses (I_{pr}).

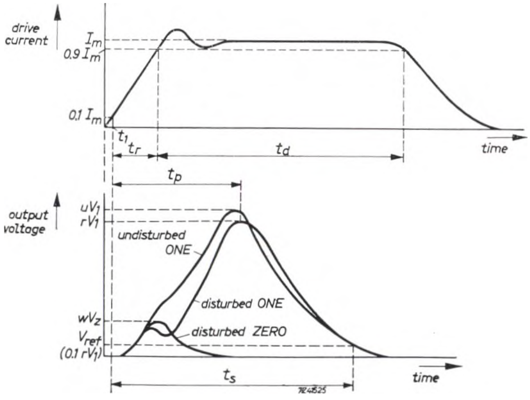


wV_z = peak value of the disturbed ZERO response voltage.
The wV_z is obtained at a full read pulse (I_r) preceded by a full read pulse (I_r) followed by 32 partial write pulses (I_{pw}).



UR = uV_1—rV_1.
The difference between the peak values of the uV_1 and rV_1 responses of the individual cores. This value is a measure for the rectangularity of the hysteresis loop.

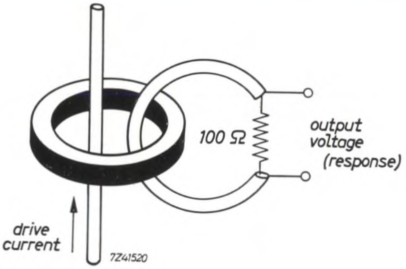
V_{ref} = the reference voltage that is usually, defined as 10% of the quaranteed rV_1 value of each individual core.

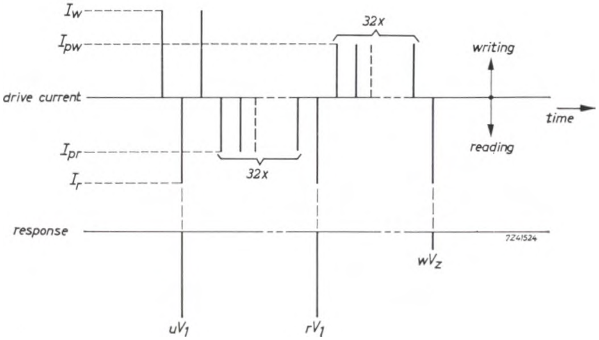


t_p = peaking time.
t_p is the core peaking time as measured from the time at which the leading edge of the rV_1 response reached the reference value (V_{ref}).

t_s' = switching time
t_s is the time interval between 0.1 I_m point of the leading edge of the current pulse and the time at which the trailing edge of the rV_1 response reached the reference value (V).

TESTS





Test conditions

Tests are carried out on each individual core threaded with a single drive wire and a sense wire loaded with 100 Ω (see figure above).

The cores are tested according to the test pattern given above. They are tested at an ambient temperature of 40 °C, except the low-temperature-coefficient (L.T.C.) cores, which are measured at the minimum and maximum permissible temperatures.

To provide for a 10% tolerance on the drive current, the tests are carried out with full write- and read-pulses of 0.9 I_m and with partial write- and read-pulses of 0.55 I_m, corresponding to a disturb ratio of 0.61.

Measured values

All cores must meet the requirements of minimum rV_1 and maximum permissible wV_z. The values of rV_1 and wV_z are read after 32 partial read pulses and 32 partial write pulses respectively.

The uV_1 value is measured after one write pulse followed by one read pulse. Each core is, moreover, tested on its peaking time, switching time and UR value. In addition to the individual cores being tested, the distribution curves of the different parameters within a lot are checked.

MAGNETIC MEMORY CORES

SURVEY

Core type		**150 mil**		**80 mil**	
material		**6E1**		**6B2**	
type number		56 591 40		4322 020 32501	
O.D. = outer diameter	(mm)	3.8		1.95	
I.D. = inner diameter	(mm)	2.2		1.30	
H = height	(mm)	1.5		0.58	
Measuring Conditions		*nominal conditions*	*test conditions*	*nominal conditions*	*test conditions*
I_m = drive current	(mA)	345	310	450	405
D.R. = disturb ratio		0.5	0.61	0.5	0.61
t_d = pulse duration		12	25	2.5	≥ 5
t_r = pulse rise time linear	(μs)	0.8	0.8	0.3	0.3
V_{ref} = reference voltage	(mV)	8	5	9	7.2
T = ambient temperature	(°C)	40	40	40	40
Responses		*typical*	*guaranteed*	*typical*	*guaranteed*
rV_1 = disturbed ONE output	(mV)	115	≥ 45[1]	104	≥ 72
wV_z = disturbed ZERO output	(mV)	30	< 6[2]	18	≤ 24
t_p = peaking time	(μs)	3.5	–	0.8	0.75–1.0
t_s = switching time	(μs)	8	≤ 10.5	1.8	≤ 2.1
Status		**Maintenance**		**Maintenance**	

Core type		**50 mil**			
material		**6C1**		**6C2**	
type number		4322 020 32541		4322 020 32551	
O.D. = outer diameter	(mm)	1.27		1.27	
I.D. = inner diameter	(mm)	0.76		0.75	
H = height	(mm)	0.30		0.40	
Measuring Conditions		*nominal conditions*	*test conditions*	*nominal conditions*	*test conditions*
I_m = drive current	(mA)	500	450	755	680
D.R. = disturb ratio		0.50	0.61	0.50	0.61
t_d = pulse duration	(μs)	1.50	≥ 2	1.50	≥ 2.5
t_r = pulse rise time linear	(μs)	0.20	0.20	0.25	0.25
V_{ref} = reference voltage	(mV)	4	3.6	5.	4.5
T = ambient temperature	(°C)	40	40	0–65	0–65
Responses		*typical*	*guaranteed*	*typical*	*guaranteed*
rV_1 = disturbed ONE output	(mV)	60	≥ 36	65 °C	≥ 33
wV_z = disturbed ZERO output	(mV)	8	≤ 12	7	≤ 11
t_p = peaking time	(μs)	0.50	0.41 – 0.57	0.50	0.44–0.61
t_s = switching time	(μs)	0.90	0.80 – 1.05	0.95	≤ 1.15
Status		**Preferred**		**Preferred**	

---

[1] Valid from 2.6 up till 4.4 μs. [2] At 2.3 μs.

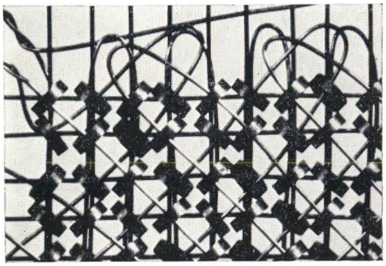
Core type		**50 mil**		**30 mil**	
material		**6D5**		**6F2**	
type number		4322 020 32511		4322 020 32571	
O.D. = outer diameter	(mm)	1.27		0.80	
I.D. = inner diameter	(mm)	0.80		0.50	
H = height	(mm)	0.38		0.165	
Measuring Conditions		*nominal conditions*	*test conditions*	*nominal conditions*	*test conditions*
I_m = drive current	(mA)	365	330	655	590
D.R. = disturb ratio		0.50	0.61	0.50	0.61
t_d = pulse duration	(μs)	1.5	$\geqslant 4$	0.50	1.5
t_r = pulse rise time linear	(μs)	0.20	0.20	0.10	0.10
V_{ref} = reference voltage	(mV)	6	4.5	5	3.5
T = ambient temperature	(°C)	40	40	40	40
Responses		*typical*	*guaranteed*	*typical*	*guaranteed*
uV_1 = undisturbed ONE output	(mV)			54	–
rV_1 = disturbed ONE output	(mV)	60	$\geqslant 42$	50	$\geqslant 35$
wV_z = disturbed ZERO output	(mV)	10	$\leqslant 14$	8	$\leqslant 9$
U.R. = $uV_1 - rV_1$	(mV)			4	$\leqslant 4.5$
t_p = peaking time	(μs)	0.60	0.55 — 0.70	0.20	0.19 — 0.25
t_s = switching time	(μs)	1.30	$\leqslant 1.60$	0.40	0.35 — 0.45
Status		**Preferred**		**Preferred**	

Core type		**30 mil**		**20 mil**	
material		**6F3**		**6H1**	
type number		4322 020 32581		4322 020 32611	
O.D. = outer diameter	(mm)	0.82		0.55	
I.D. = inner diameter	(mm)	0.50		0.35	
H = height	(mm)	0.16		0.10	
Measuring Conditions		*nominal conditions*	*test conditions*	*nominal conditions*	*test conditions*
I_m = drive current	(mA)	740	665	835	750
D.R. = disturb ratio		0.50	0.61	0.50	0.61
t_d = pulse duration	(μs)	0.6	1.5	0.25	0.45
t_r = pulse rise time linear	(μs)	0.15	0.15	0.05	0.05
V_{ref} = reference voltage	(mV)	5.0	3.5		
t = ambient temperature	(°C)	10–70	10–70	40	40
Responses		*typical*	*guaranteed*	*typical*	*guaranteed*
rV_1 = disturbed ONE output	(mV)	50 (10 °C)	$\geqslant 25$	55	$\geqslant 30$
wV_z = disturbed ZERO output	(mV)	10	$\leqslant 11$	6	$\leqslant 10$
U.R. = $\mu V - rV$	(mV)	0.1 rV_1	$\leqslant 0.1\ rV_1$	0.080	–
t_p = peaking time	(μs)	0.25	0.26 — 0.32	–	–
t_s = switching time	(μs)	0.50	$\leqslant$ 0.60	0.17	$\leqslant 0.20$
Status		**Preferred**		**Preferred**	

MATRIX PLANES AND STACKS

GENERAL

The matrix planes and stacks mentioned in this booklet are specially designed for coincident current operation. They consist of a number of magnetic cores arranged in rows and columns through which four copper wires are threaded according to the MIT system, namely:
2 drive wires ("X" wire, "Y" wire)
1 inhibit wire ("Z" wire)
1 sense wire ("S" wire)



Magnification of part of a coincident current matrix plane exposing the 4 wires passing through each core

The matrix planes contain one, two or four matrices, for example 4 × 16 × 16. Each matrix of the multiplex planes has a separate sense and inhibit wire. Each type of plane is available in two versions: a left-hand and a right-hand version. These two planes have a mirror-symmetrical tag lay-out.
Matrix planes with 80 mil, 50 mil, 30 mil and 20 mil cores are available in standard executions. On request matrices with 150 mil cores and matrices differing from the standard types can be supplied.
A stack is composed of left-hand and right-hand planes, stacked alternately. In this way the tags of the adjacent planes are just above each other, which facilitates an easy interconnection of the drive wires. The stacks are delivered with the drive wires interconnected. Plates are added at the top and bottom of the stack for protecting the upper and lower planes. The total assembly is secured by bolts which pass through the corner holes of the planes.

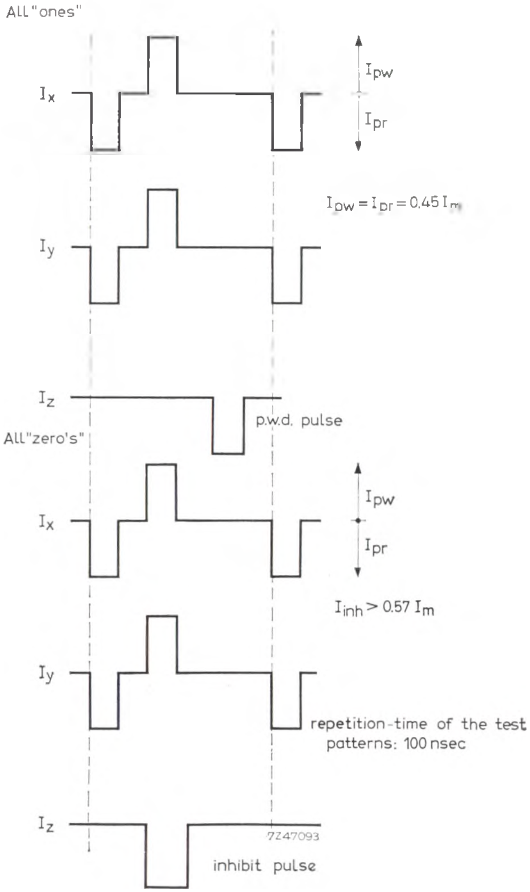
Testing method

All cores in each plane are tested to make sure that the cores satisfy the specification. Planes are tested at 23 °C with marginal drive currents (disturb ratio 0.62–0.63).
Each core is tested with the pulse patterns given on next page.

The "1" output of each core is measured with all cores in the "1" (best pattern).
The cores are tested to guarantee a minimum permissible "1" output at maximum and minimum values of "t_s" and "t_p".
Furthermore the cores are tested for disturb sensitivity by increasing the disturb ratio from 0.5 to 0.63 or higher values. This is done to measure the output with and without p.w.d. pulse. If the difference of these values exceeds a given limit, the cores are rejected. It is also checked whether the sense wire passes through all cores.

GENERAL

The "0" output of each core is measured with all cores in the "0" state (best pattern). The cores are tested to guarantee maximum permissible "0" output. At the same time it ensures that the inhibit wires pass through all cores and that the noise cancelation of the sense wire is adequate.
Sample tests are carried out with all the cores set in checkerboard pattern (worst pattern), for the peak value of the "0" output (peak delta noise) and the "0" output at peaking time of the "1" output. Besides the electromagnetical testing, the planes are tested on insulation resistance and on the d.c. resistances of the X-, Y-, Z- and S-wire. After assembly the stacks are functionally tested.



MATRIX PLANES AND STACKS

WITH 80 MIL CORES

Ferroxcube memory cores type 6B2 are threaded in two types of standardised frame, type A for maximum 32 × 32 cores and type B for maximum 64 × 64 cores. Both frames are made of special synthetic resin. The frames are provided with grooves to hold the wires that run to the soldering tags. The matrix planes are wired with copper enamelled wire SWG 36. (0.2 mm diameter).
The types of the standard range are listed below.

Standard range of planes

number of cores	*wiring*				*frame*	*type number*
	X	Y	Z	S		*6B2 core*
32 × 32	1	1	1	1	A	B1 669 13
32 × 32	1	1	1	1	A	B1 669 14
64 × 64	1	1	1	1	B	B1 669 26
64 × 64	1	1	1	1	B	B1 669 27
4 × 16 × 16	1	1	4	4	A	B1 669 28
4 × 16 × 16	1	1	4	4	A	B1 669 29
4 × 10 × 10	1	1	4	4	A	B1 669 16
4 × 10 × 10	1	1	4	4	A	B1 669 17
16 × 16	2	2	1	1	A	B1 669 24
16 × 16	2	2	1	1	A	B1 669 25
32 × 32	2	2	1	1	B	B1 669 21
32 × 32	2	2	1	1	B	B1 669 22

Dimensions

frame	*outer dimensions (mm)*	*pitch of mounting holes (mm)*	*diameter mounting holes (mm)*	*stacking height (mm)*
A	112 × 112	80 × 80	4.3	7
B	202 × 202	170 × 170	5.3	8.5

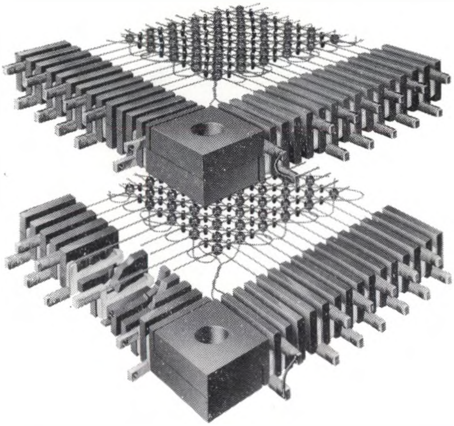
Please indicate in your order whether the planes must be delivered separately or in stacks.

Stacks with 80 mil matrix planes are delivered with two protective covers of methacrylate.
The drive wires of the various matrix planes are connected in series.
The soldering tags are easily accessible for soldering.

MATRIX PLANES, STACKS AND BOXES

WITH 50 MIL CORES

Matrix planes



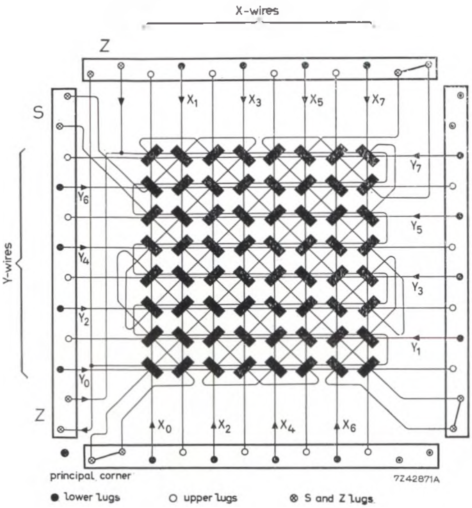
The frames in which the matrices are mounted consist of 8 Standard Resin Bonded Fibre strips (S.R.B.F.) in 4 pairs. Between each pair of strips, gold-plated bronze tags for terminating the wires are inserted. The strips have grooves spaced at 50 mil (1.27 mm) in which the wires run to the soldering tags. On these tags the wires are wrapped and dip-soldered. The matrices are wired with enamelled copper wire S.W.G 40 (0.12 mm diameter). The cores are arranged according to the "closed" pattern configuration (see figures below). The sense wire consists of four parts: these are series-connected by interconnecting the corresponding soldering tags.

The inhibit wires run parallel to the "X" wires in the left-hand planes, and parallel to the "Y" wires in the right-hand ones. The planes containing one matrix are provided with extra parallel connections so that the inhibit-wire terminals are located above each other when the planes are stacked.

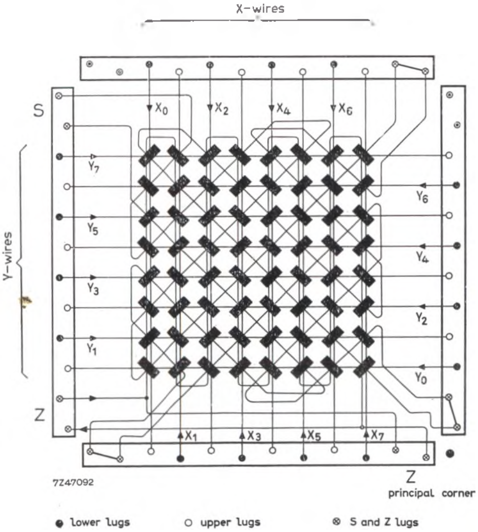
As can be seen from the figures a left-hand plane can easily be transformed into a right-hand one by turning it over 90°; only two interconnections of the sense wire must be changed.

The principal corner marked by a yellow dot indicates the crossing of the "X_0" and "Y_0" drive wires.

For those cases where special requirements are imposed on the electrical and mechanical properties, lacquered matrices are available.



Left-hand matrix plane

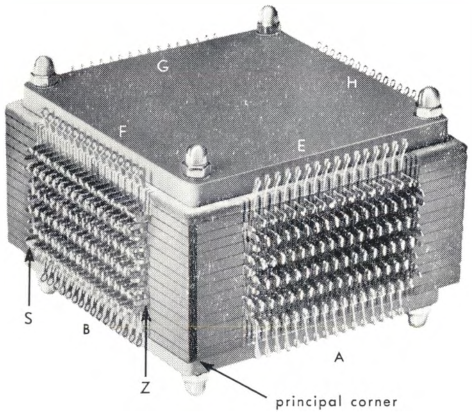


Right-hand matrix plane

MATRIX PLANES, STACKS AND BOXES

WITH 50 MIL CORES

Matrix stacks



The stacks are built-up of left-hand and right-hand planes, stacked alternately. The tags of two adjacent planes are so near to each other that they can be dip-soldered. In this way all "X" and all "Y" drive wires of the stacked planes are series-connected. The "X" and "Y" drive lines thus obtained end on rigid terminals which are inserted in the termination planes at the top and bottom of the stack. On demand the stack can be provided with connection leads for the X-, Y-, Z- and S-wires.

For stacks built-up from matrix planes containing two or four matrices, the termination plane at the top of the stack can be replaced by an interconnection plane. Interconnection wires in the latter connect one half of the "X" drive lines to the other half of the "X" drive lines; similar wires connect one half of the "Y" drive lines to the other half. The beginnings and ends of all drive lines are thus accessible on tags in the bottom frame only.

Example: A stack with 5 matrix planes, 4 × 16 × 16 cores, provided with an interconnection plane functions as a stack of 20 planes with 16 × 16 cores. The above-mentioned solution is attractive to obtain with the same number of bits a smaller stack height at a lower cost.

To identify the soldering tags of the stack, the bottom protection plate is marked A, B, C, D, the top plate with E, F, G, H. The principal corner is indicated by a yellow dot (see photo).

This corner is determined by the crossing of the X_0 and Y_0 addresses. For testing the stack with the most unfavourable "1" and "0" outputs, the cores must be set in the worst-case pattern. It should be recognised that the worst-case patterns for the left-hand and right-hand planes in the stack are not identical.

Worst-case pattern left-hand planes

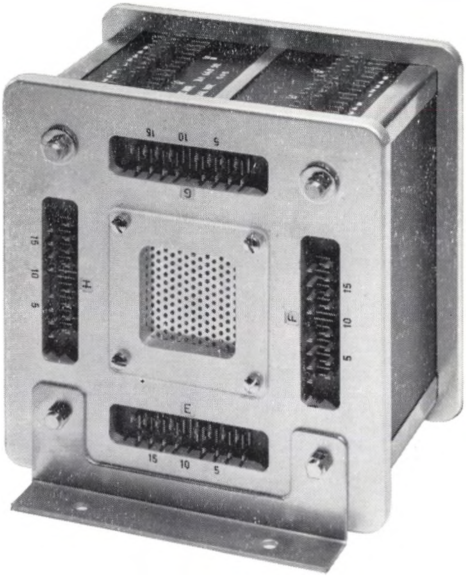
1	1	0	0	1	1	0	0
0	0	1	1	0	0	1	1
0	0	1	1	0	0	1	1
1	1	0	0	1	1	0	0
1	1	0	0	1	1	0	0
0	0	1	1	0	0	1	1
0	0	1	1	0	0	1	1
1	1	0	0	1	1	0	0

Worst-case pattern right-hand planes

1	0	0	1	1	0	0	1
1	0	0	1	1	0	0	1
0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	0
1	0	0	1	1	0	0	1
1	0	0	1	1	0	0	1
0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	0

WITH 50 MIL CORES

Boxes

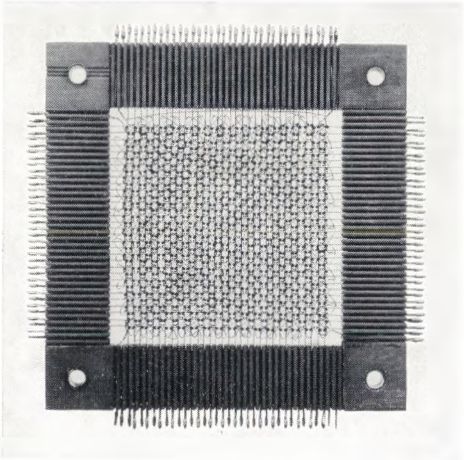


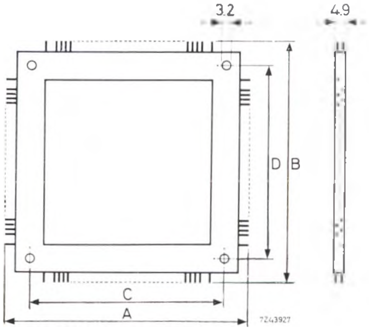
Stacks mounted in boxes have the advantage of being protected against damage and dust. These boxes contain two identical aluminium end plates with apertures for the connection of the "X" and "Y" wires. The connections for the "S" and "Z" wires are on the side panels. All connections of the boxes are provided with taper-tab receptacles (AMP serial no. 78).
Two types of box are available: for matrix planes with up to 32 × 32 cores and for those with a maximum of 64 × 64 cores. The outer dimensions of these boxes are 145 × 145 mm and 180 × 180 mm respectively.
Up to 100 matrix planes can be housed in one box.

MATRIX PLANES, STACKS AND BOXES

WITH 50 MIL CORES

A number of current types has been standardised (see table below).
Each type can be supplied in three different executions, depending on the type of core requested.
The matrix planes are defined by the number of cores, the wiring and the type of core. In the table below the different standard types with the more important dimensions are indicated.





Matrix plane with 50 mil cores

Standard range

plane indication	wiring				number of cores	outer dimensions planes in mm		pitch of mounting holes in mm	
	X	Y	Z	S		length A	width B	length C	width D
02	1	1	1	1	32 × 32	80	80	59.5	59.5
03	1	1	1	1	64 × 64	120	120	110.2	100.2
06	1	1	4	4	4 × 16 × 16	85	85	64.5	64.5
07	1	1	4	4	4 × 32 × 32	125	125	105.2	105.2
08	1	1	4	4	4 × 64 × 64	208	208	186.7	186.7
09	1	1	2	2	2 × 16 × 32	80	85	59.5	64.5
10	1	1	2	2	2 × 32 × 64	120	125	100.2	105.2
13	2	2	1	1	16 × 16	80	80	59.5	59.5
14	2	2	1	1	32 × 32	120	120	100.2	100.2
17	2	2	1	1	4 × 8 × 8	85	85	64.5	64.5
18	2	2	1	1	4 × 16 × 16	125	125	105.2	105.2
20	2	2	1	1	2 × 8 × 16	80	85	59.5	64.5
21	2	2	1	1	2 × 16 × 32	120	125	100.2	105.2

Planes indicated in bold print are preferred types.

Composition of the type numbers

Matrix planes . . . . **B8 620../...**

plane indication see p. 80 ←
C = 6C1 core ←
D = 6D5 core
L = 6C2 core

→ 22 = left-hand plane
23 = right-hand plane
24 = left-hand plane, lacquered
25 = right-hand plane, lacquered

Stacks . . . . **B8 749../....**

Stack in box . . . . **B8 751../....**

plane indication see p. 80 ←
C = 6C1 core ←
D = 6D5 core
L = 6C2 core

→ number of planes
→ 2 = unlacquered
3 = unlacquered with interconnection plane
4 = lacquered
5 = lacquered with interconnection plane

Examples

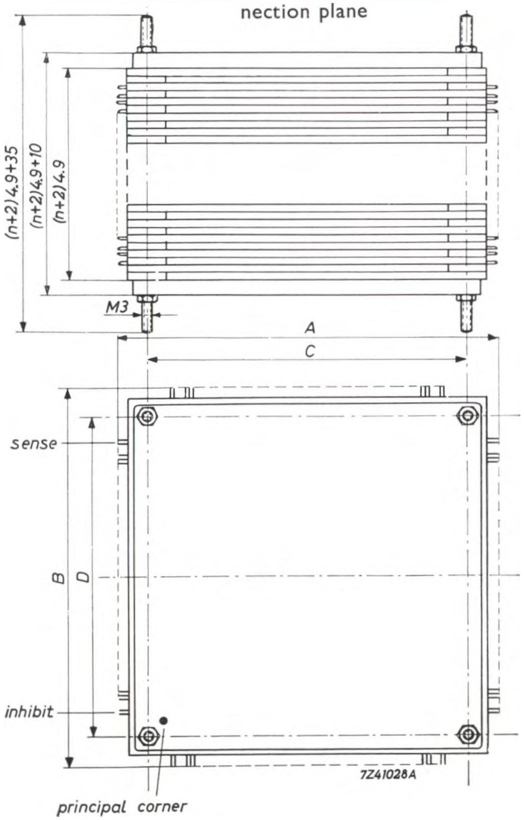
The type number of a left-hand matrix plane, lacquered, with 32 × 32 cores of ferroxcube 6C1 and wiring 1-1-1-1, is B8 620 02/C24

The type number of a unlacquered stack containing 8 planes with 32 × 32 cores of ferroxcube 6C2 with interconnection plane is B8 749 02/308.

The type number of the same stack in box is B8 751 02/308.

Stack height is determined by (n + 2) 4.9 + 10 mm, where *n* is the number of planes.

Box height is determined by (n + 2) 4.9 + 50 mm.

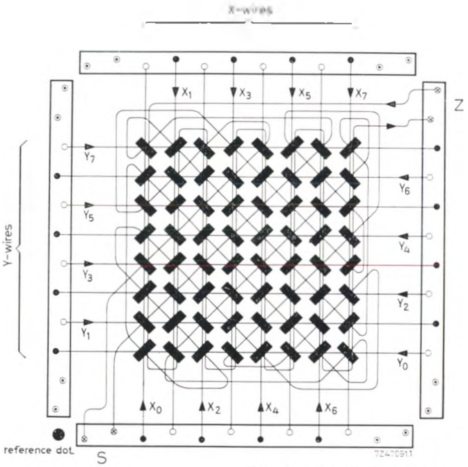


MATRIX PLANES AND STACKS

WITH 30 MIL CORES

The mechanical design is similar to that of the matrix planes and stacks with 50 mil cores.
The frames are made of glass-epoxy of 4.9 mm thickness, the pitch of the grooves is 1.0 mm instead of 1.27 mm. The diameter for the "X", "Y" and "S" wires is 0.08 mm; the inhibit wire has a diameter of 0.1 mm. The matrices are provided with 6F2 cores and the L.T.C. cores 6F3.

All the matrices of the 30 mil standard range are lacquered, to reduce the magnetostriction of the cores caused by the steep leading edge of the inhibit pulse.
Unlacquered planes will be delivered on request only.
Each type of matrix plane has one execution (in contrast to the matrices with 50 mil cores). To obtain a very low noise level special attention is paid to the sense wiring. This has resulted in a new type of sense wire, which differs from the normal MIT sense wire. Consequently the worst-case pattern differs from that of the 50 mil type. Moreover, the "open" core configuration is applied instead of the "closed" core configuration used for the 50 mil matrices (see p. B77 and the figure below).



○ upper lugs ⊗ S and Z lugs
● lower lugs ⊙ spare lugs
Write current flows with the arrows

In a stack the reference dot is always up, in the lower left corner for odd planes, and in the lower right one for even ones.

To reduce the crosstalk between the inhibit and sense wire, their connections are kept far apart, differing in this respect from the 50 mil planes.
In a stack, built up from standard planes, the adjacent planes are at 90° with respect to each other. In stacks built-up from four-fold planes the matrices are at 180° with respect to each other. In both cases the inhibit wires run parallel to the "X" wires in the one plane and to the "Y" wires in the adjacent plane.
For the stacks built up with four-fold planes, the termination plane at the top can be replaced by an interconnection plane. On request the stack can be delivered with connection leads.
For testing the stack with the most unfavourable "1" and "0" outputs, the cores must be set in the worst-case pattern indicated below.

Worst-case pattern

1	0	0	1	1	0	0	1
0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	0
1	0	0	1	1	0	0	1
1	0	0	1	1	0	0	1
0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	0
1	0	0	1	1	0	0	1

MATRIX PLANES AND STACKS

WITH 30 MIL CORES

Standard range

plane indication	*wiring*				*number of cores*	*outer dimensions of planes in mm*		*pitch of mounting holes in mm*	
	X	Y	Z	S		*length* A	*width* B	*length* C	*width* D
02	1	1	1	1	32 × 32	71	71	50.2	50.2
03	1	1	1	1	64 × 64	104	104	82.3	82.3
06	1	1	4	4	4 × 16 × 16	75	75	51.5	51.5
07	1	1	4	4	4 × 32 × 32	108	108	86.3	86.3
08	1	1	4	4	4 × 14 × 64	173	173	151.3	151.3
09	1	1	2	2	2 × 16 × 32	75	71	51.5	50.2
10	1	1	2	2	2 × 32 × 64	108	104	51.5	50.2
24	1	1	4	4	128 × 128	173	173	151.5	151.5
25	1	1	2	2	2 × 64 × 128	173	173	151.5	151.5

Planes indicated in bold print are preferred types.

Composition of the type numbers

Matrix planes . . . **B8 629 . ./. 1**
Stacks . . . . **B8 758 . ./. 4 . .** without interconnection plane
B8 758 . ./. 5 . . with interconnection plane
Box . . . . **B8 761 . ./. 4 . .** with interconnection plane
B8 761 . ./. 5 . . without interconnection plane

plane indication ◀
(see Table above)
▶ number of planes
▶ K = 6F2 cores
M = 6F3 cores

Examples: The type number of a matrix plane with 4 × 32 × 32 cores of Ferroxcube 6F3 and wiring 1–1–4–4, is B8 629 07/M1.
The type number of a stack containing 10 planes with 128 × 128 cores of Ferroxcube 6F2 with interconnection plane, is B8 758 24/K510.
Stack height is determined by (n + 2) 4.9 + 10 mm.

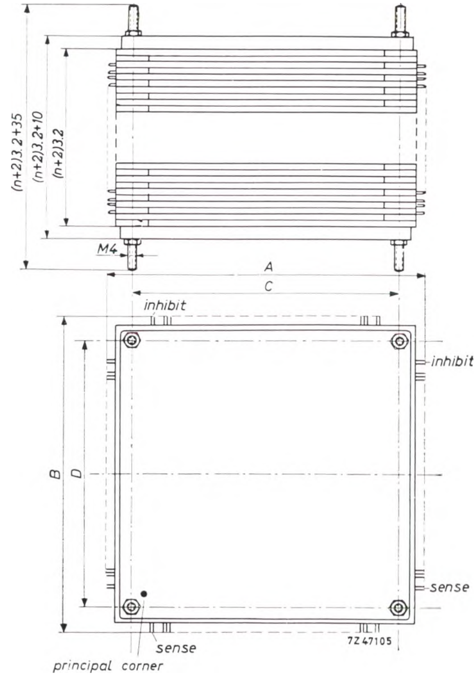
If desired 30 mil stacks can be supplied with connection leads.

MATRIX PLANES AND STACKS

WITH 20 MIL CORES

The matrices are provided with 6H1 cores and are lacquered. The mechanical design is similar to that of the 50 mil and 30 mil planes and stacks. The frames are made of glass-epoxy of 3.2 mm thickness, the pitch of the grooves is 0.635 mm (25 mil). The diameter for the wires is 0.06 mm. Special attention is paid to the sense wire configuration. The applied sense wire differs from the one used in the 30 mil planes.

For that reason the worst-case patterns of both are different. The tag lay-out and the connections for the sense and inhibit wires are identical to the 30 mil matrix planes (see figure). Also the composition of the 20 mil stack is the same as for the 30 mil stack, namely built-up with only one type of plane. For testing the stack with the most unfavourable "1" and "0" outputs, the cores must be set in the worst-case pattern which is indicated below.



Worst-case pattern

1	0	1	0	0	1	0	1
0	0	1	1	1	1	0	0
1	1	0	0	0	0	1	1
0	1	0	1	1	0	1	0
0	1	0	1	1	0	1	0
1	1	0	0	0	0	1	1
0	0	1	1	1	1	0	0
1	0	1	0	0	1	0	1

MATRIX PLANES AND STACKS

WITH 20 MIL CORES

Standard range

plane indication	wiring				number of cores	outer dimensions of planes in mm		pitch of mounting holes in mm	
	X	Y	Z	S		length A	width B	length C	width D
03	1	1	1	1	64 × 64	76	76	55.7	55.7
07	1	1	4	4	4 × 32 × 32	76	76	55.7	55.7
08	1	1	4	4	4 × 64 × 64	117	117	96.9	96.9
09	1	1	2	2	2 × 16 × 32	56	53	35.4	35.4
10	1	1	2	2	2 × 32 × 64	76	76	55.7	55.7
24	1	1	4	4	128 × 128	117	117	96.4	96.4
30	1	1	4	4	2 × 64 × 128	117	117	96.4	96.4

Planes indicated in bold print are preferred types.

Composition of the type number

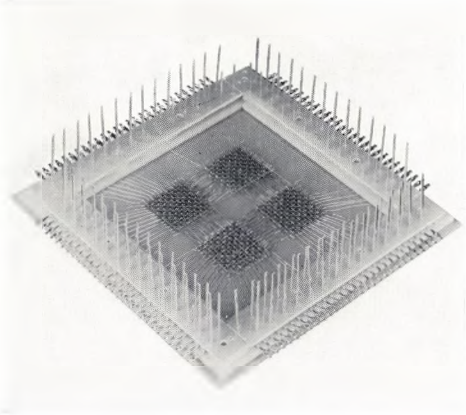
Matrix plane . . . . **B8 640 . . / N1**
Stack . . . . **B8 770 . . / N1 . .**

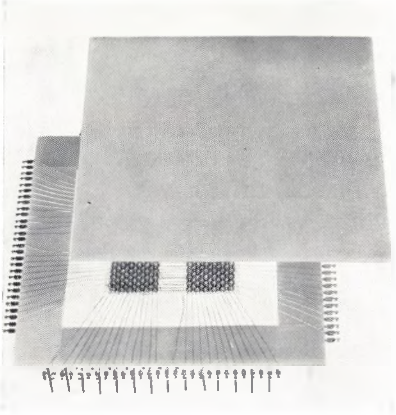
plane indication ◀ (see Table above)
▶ number of planes

Examples. The type number of a matrix plane with 4 × 64 × 64 cores (core type 6H1) and wiring 1–1–4–4, is B8 640 08/N1.
The type number of a matrix stack containing 8 planes with 2 × 64 × 128 cores, is B8 770 30/N108.
Stack height is determined by (n + 2) 3.2 mm.

If desired 20 mil stacks can be supplied with connection leads.

PLATRICES





If a matrix plane with cut frames contains a small number of cores, the cost of the frame forms an important part of the total price. For that reason we have introduced a new range of small matrix planes in an inexpensive frame, called a plate matrix or PLATRIX. The platrices are provided with LTC cores type K5 28146/6C2 only, in a capacity range from 256 up to 1024 bits.

The wiring is according to the MIT-system. To reduce the required drive currents by a factor of two, each drive wire is threaded through the cores twice. In this manner matrix planes are obtained which can be used within a wide temperature range without need of current compensation. Comparatively low drive currents are neccessary for these matrices.

To keep the price of the platrices as low as possible, we have standardised them to 4 types, having different mechanical dimensions. Non-standard types can be supplied in large quantities only.

Construction

The cores and wires are affixed to a paper-base laminate plate by means of a special lacquer, which withstands wide temperature variations. This construction is highly shock- and vibration proof. The platrices are provided with special L-shaped tags on the edges of the plate. This construction facilitates the assembly of the platrices in the grid of a printed-wiring board.

Application

It is very attractive for applications in small bookkeeping-machines, invoice-machines, desk calculators, cash registers and machine-tool equipment, that the platrix can be provided with diodes and selection circuits on the same printed circuit board.

Technical data

The tags are mounted with the standard pitch of 0.1″ (2.54 mm), but on request the platrices can be supplied with a pitch of 2.50 mm in accordance with the German DIN. The platrices meet the MIL-specifications STD202. The maximum permissible inter-winding voltage is 80 V.

The insulation resistance exceeds 100 MΩ. Each core is tested with marginal drive currents for a minimum rV_1 value of 28 mV. The wiring diagram for the single and four-fold designs are shown in Figs. 1 and 2 respectively.

Standard range

Standard platrices with code numbers are tabled below.

type number	*number of cores*	*outer dimensions*
B8 62601/L2	16 × 16	82 × 82 mm
B8 62620/L2	2 × 8 × 16	82 × 82 mm
B8 62617/L2	4 × 8 × 8	82 × 82 mm
B8 62625/L2	4 × 10 × 10	102 × 102 mm
B8 62620/L2	4 × 12 × 12	100 × 102 mm
B8 62604/L2	16 × 32	82 × 122 mm
B8 62629/L2	2 × 16 × 16	82 × 122 mm
B8 62602/L2	32 × 32	122 × 122 mm
B8 62609/L2	2 × 16 × 32	122 × 122 mm
B8 62606/L2	4 × 16 × 16	122 × 122 mm

Platrices with a pitch of 2.5 mm bear the same type number, but the indication behind the oblique becomes L1 instead of L2.
Stacks with platrices up to 4 pieces maximum can be supplied with series-connected drive wires.

single version

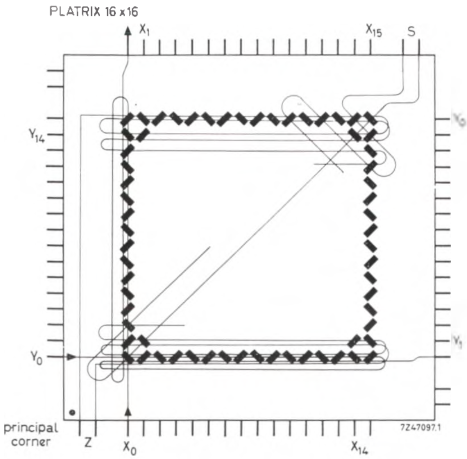


Fig. 1

four-fold version

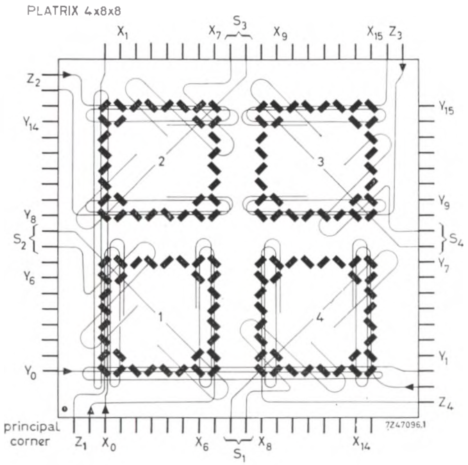


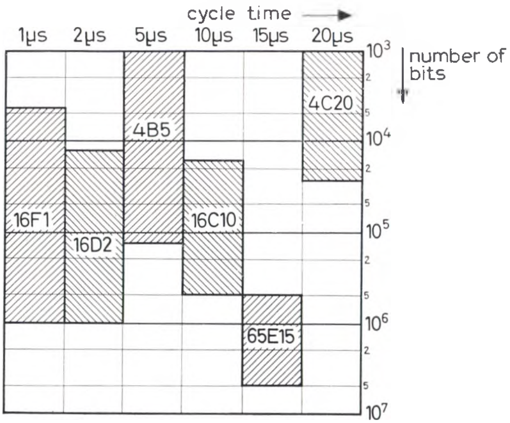
Fig. 2

COMPLETE MAGNETIC CORE MEMORIES

SURVEY

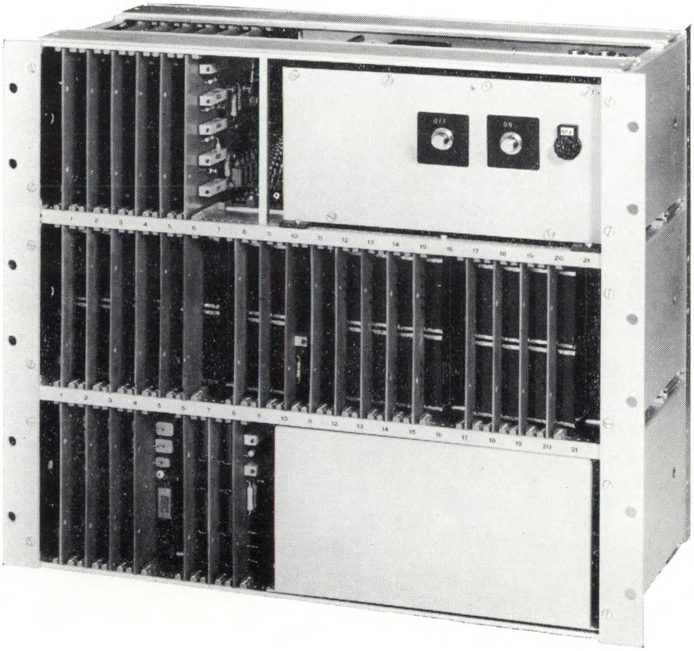
A magnetic core memory is a device for the storage of digital information, such as is intended for use in data-handling systems. A complete magnetic core memory contains a memory stack and the associated circuits to drive it, e.g. current drivers, read amplifiers, timing unit, selection system, address register and input/output register. It may also comprise the required power supplies. The systems mentioned below are all assembled in a standard mounting chassis, use being made of plug-in printed circuit boards to mount all the circuitry. The range of systems comprises the following types.

memory type	*capacity*		*cycle time* (μs)	*access time* (μs)	*core type*	*circuit blocks*	*ambient temperature range* (°C)
	words	*bits/word*					
4B5	256 1024 2048 4096	8....40	5	1.4	6F3	20 series	0...+65
4C20	256 1024 4096	≤ 24 ≤ 12 ≤ 8	20	8	6D5	100 series	+10...+40
16D2	4096 8192 16384	4....60 4....60 4....50	2	0.8	6F3	20 series	0...+50 °C
65E15	65536	76	15	2	6D8	20 series	+10...+40
16F1	16384	32	1	0.35	6H1		+10...+40



MEMORY TYPE 4B5

1. *Main characteristics*
   - a. cycle time: 5 μs
   - b. access time: 1.4 μs
   - c. capacity:
     - 256 words, 1024 words, 2048 words, 4096 words: 8 up to 40 bits
   - d. circuit blocks of the 20-series (equipped with silicon semiconductors)
   - e. core type used: 6F3 (LTC core)
   - f. ambient temperature: 0–65 °C
   - g. modes of operation:
     - read/restore
     - clear/write new information
     - split cycle, read/write new information
   - h. mechanical dimension (independent of the number of words and bits)
     - height 400 mm
     - depth 275 mm
     - width 444 mm
   - i. required power supplies: +12 V; max. 9A — −12 V; max. 2.5A — + 6 V; max. 2.2A



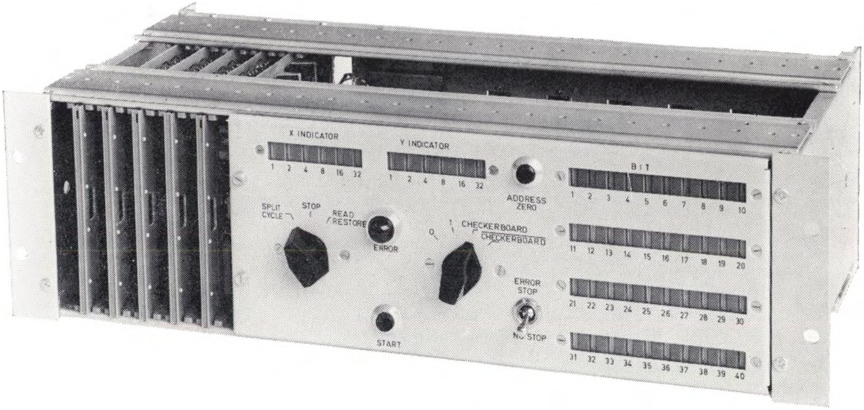
MEMORY TYPE 4B5

2. *Special characteristics*

a. logic levels: "1" = +6 V
"0" = 0 V
b. Switch core matrices are used for the selection of the X and Y lines of the stack.
c. A protection circuit is included in all systems to prevent damage to the electronic circuits or faulty operation if the supplied voltages are 10% higher or lower than nominal. This protection circuits also prevents the information stored in the system from being destroyed when the equipment is switched on or off.
d. Optionally a memory exerciser (minitester) can be supplied, which checks the system according to the following four patterns:
all "1"
all "0"
double checkerboard
double checkerboard complement

In the event of an error, the faulty address and bit will be indicated by a combination of lamps.

Mechanical dimensions of the tester:
height 133 mm
depth 275 mm
width 444 mm



memory exerciser 4B5 store

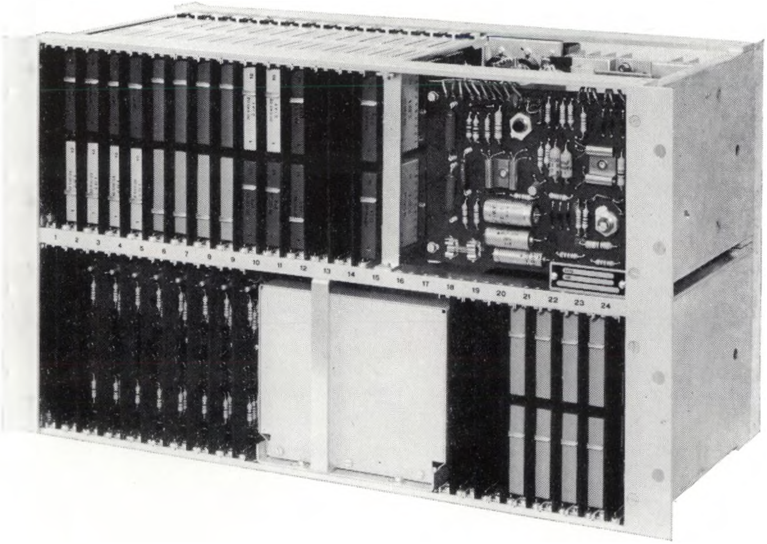
MEMORY TYPE 4C20

1. *Main characteristics*
   - a. cycle time: 20 μs
   - b. access time: 8 μs
   - c. capacity:
     - 256 words up to 24 bits
     - 1024 words up to 12 bits
     - 4096 words up to 8 bits
   - d. circuit blocks of the 100-series (equipped with germanium semiconductors)
   - e. core type used: 6D5
   - f. ambient temperature: 10–40 °C
   - g. modes of operation:
     - read/restore
     - clear/write new information
     - split cycle, read/write new information
   - h. mechanical dimensions:

256 words, 20 and 24 bits stores	*all other types*
height 400 mm	height 266.6 mm
depth 252 mm	depth 252 mm
width 444 mm	width 4444 mm

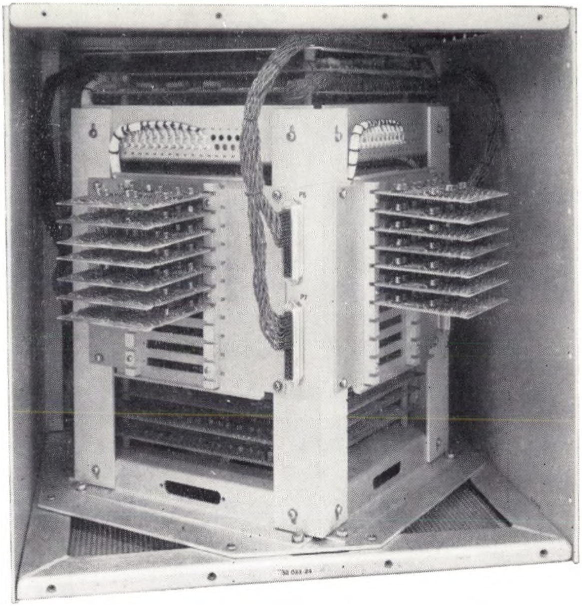
   - i. required power supplies:
     - +6 V; max. 1.5 A
     - +6 V; max. 5 A

2. *Special characteristics*
   - a. logic levels: "1" = −6 V
     "0" = 0 V
   - b. group selection system is used to select the cores.



COMPLETE MAGNETIC CORE MEMORIES

MEMORY TYPE 16C10

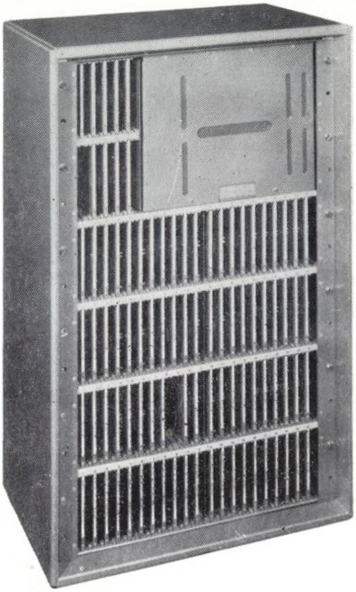


1. *Main characteristics*
   - a. cycle time: 10 μs
   - b. access time: 3.5 μs
   - c. capacity:
     - 16 348 words up to 32 bits
     - 8 192 words up to 32 bits
   - d. open circuits (equipped with silicon semiconductors)
   - e. ambient temperature: 0–50 °C
   - f. modes of operation:
     - read/restore
     - clear/write new information
     - split cycle
     - split cycle, read/write new information
     - read only (in 4 μs)
     - write only (in 4 μs)
   - g. mechanical dimensions:
     - height 850 mm (for largest store)
     - depth 485 mm
     - width 444 mm
   - h. this system is delivered with the required power supplies (power consumption: max. 220 V, 3 A).

2. *Special characteristics*
   - a. logic levels: "1" = +6 V
     "0" = 0 V
   - b. optional extras:
     - level shifting circuits
     - memory exerciser
     - sequential addressing and sequential interlace

MEMORY TYPE 16D2

1. *Main characteristics*



a. cycle time: 2 μs
b. access time: 0.75 μs
c. capacity:
    4096 words } 4 up to 60 bits
    8192 words }
    16384 words 4 up to 50 bits
d. circuit blocks of the 20-series (equipped with silicon semiconductors)
e. core type used: 6F3 (LTC core)
f. ambient temperature: 0–50 °C
g. modes of operation:
    read/restore
    clear/write new information
    split cycle, read/write new information
h. mechanical dimensions (dependent on the number of words and bits):
    height 1300 mm } for the 16384 words
    depth 275 mm } 50 bits store
    width 444 mm }
i. required power supplies:
    +12 V; 16.5 A }
    −12 V; 10.3 A } for the 16384 words,
    + 6 V; 7.0 A } 50 bits store
    +48 V; 10 A }
    +10 V; 2.75 A }

2. *Special characteristics*

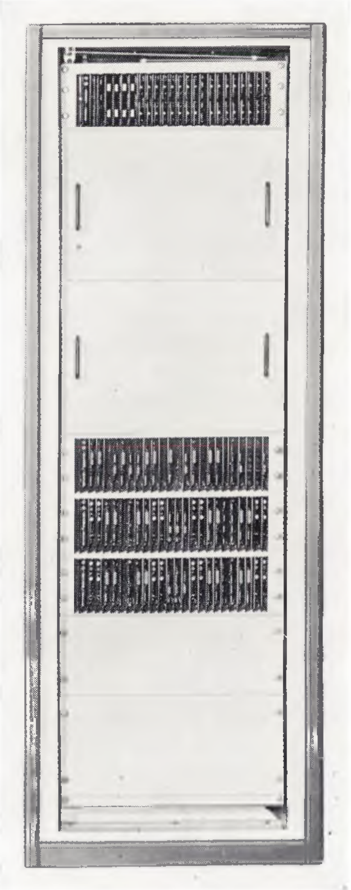
a. logic levels: "1" = +6 V
    "0" = 0 V
b. The system is provided with a transformer selection system
c. All printed circuit boards are provided with monitoring points (test points)
d. Optional extras:
    1. power supply control unit:
        to avoid loss of information during switching on and off;
        to switch off the system if any voltage or current exceeds its specified values
    2. integrated tester for fault-finding according to the following patterns:
        all "1"
        all "0"
        double checkerboard
        double checkerboard complement

COMPLETE MAGNETIC CORE MEMORIES

MEMORY TYPE 65E15 (mass memory)

1. *Main characteristics*

   a. cycle time: 15 μs
   b. access time: 2 μs
   c. capacity:
      65536 words of 76 bits
   d. circuit blocks of the 20-series (equipped with silicon semiconductors)
   e. core type used: 6D8
   f. ambient temperature range: +10 to +40 °C
   g. modes of operation:
      read/restore
      clear/write new information
      split cycle, read/write new information
   h. mechanical dimensions: the dimensions of a complete store, including power supplies, integrated tester control panel, are: 192 × 80 × 66 cm
   i. power supplies: power supplies are incorporated in the store input: 110/125/145/200/220/245 V_{ac}, 50/60 c/s, power consumption: approx. 800 VA



2. *Special characteristics*

   a. logic levels:

input:	"1":	2.5 V over 75Ω
	"0":	1 V over 75Ω
output:	"1":	40 mA (in 75Ω)
	"0":	1 mA (in 75Ω)

   b. Switch core matrices are used for the selection; type 6S2 core is used.
   c. The store comprises:
      1. power supplies (+12V; −12V; +6V; −50V)
      2. check panel (to check voltages and currents)
      3. memory exerciser testing the system according to the following patterns:
         all "1"
         all "0"
         double checkerboard
         double checkerboard complement
   d. All printed circuit cards are provided with monitoring prints.

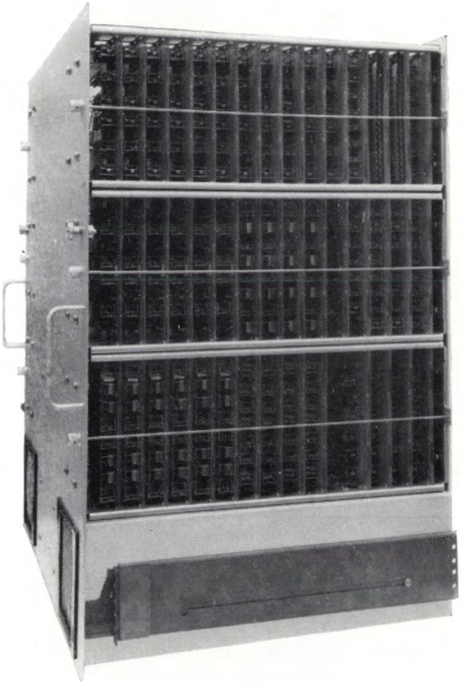
MEMORY TYPE 16F1

1. *Main characteristics*

   a. cycle time: 1 μs
   b. access time: 350 ns
   c. capacity:
      16384 words of 32 bits
   d. core type used: 6H1
   e. ambient temperature: 10 to 40 °C
   f. modes of operation:
      read/restore
      clear/write new information
      split cycle, read/write new information
   g. the mechanical dimensions for a 16384 word 32 bit system are:
      height: 820 mm
      depth: 500 mm
      width: 600 mm
   h. required power supplies: +12 V; 5 A, −12 V; 6 A, +26 V; 14 A } for the 16384 words 32 bits store

2. *Special characteristics*

   a. logic levels:
      input: logic "1": 12 V: ± 2V
      logic "0": 0 V; ± 1.5V
      output: logic "1": 10 V; + 30mA
      logic "0": +1.5 V; − 36mA
   b. transformer selection is used.
   c. Optional extras:
      level shifting circuits
      memory exerciser



MOUNTING AIDS

MOUNTING AIDS AND ACCESSORIES FOR CIRCUIT BLOCKS

Mounting chassis

Two standardised types of chassis for the mounting of circuit blocks are available, both designed to be fitted in 19″ racks.
The chassis of Fig. 1 can contain up to 21 standard printed-wiring boards together with their mating connectors type F045CC/025, and can be mounted directly in a 19″ rack.

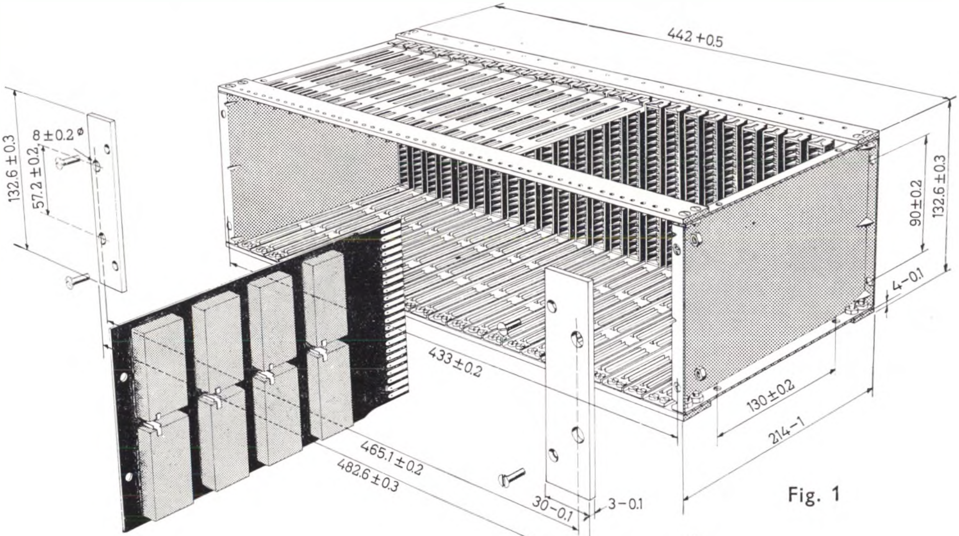


Fig. 1

Type number B8716 10, fig. 1
Chassis for circuit blocks mounted on printed-wiring boards

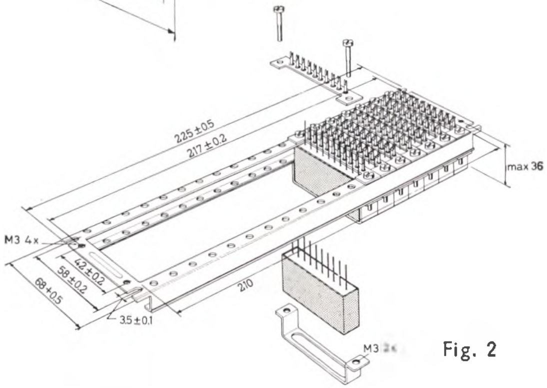


Fig. 2

Type number B8716 09, fig. 2
Chassis for circuit blocks mounted side by side

The chassis of Fig. 2 can contain up to 19 circuit blocks mounted side by side.
A number of these chassis can be mounted in a metal frame. Fitted in a standard 19″ rack, 6 of these chassis can be mounted side by side.

MOUNTING AIDS AND ACCESSORIES FOR THE 10 SERIES AND 20 SERIES

Type number B8716 11 fig. 1

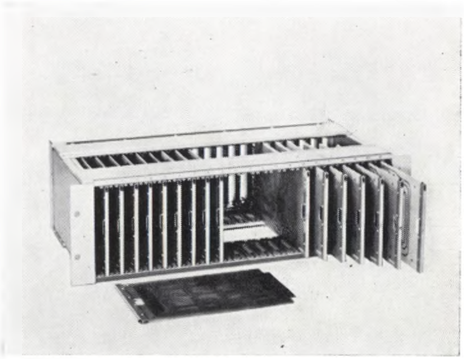
This chassis can contain up to 21 standard p.w. boards together with their mating connectors, type F045CC025 (single-sided contacts) or type F045KC/025 (double-sided contacts).

MOUNTING AIDS AND ACCESSORIES FOR CIRCUIT BLOCKS

Mounting chassis

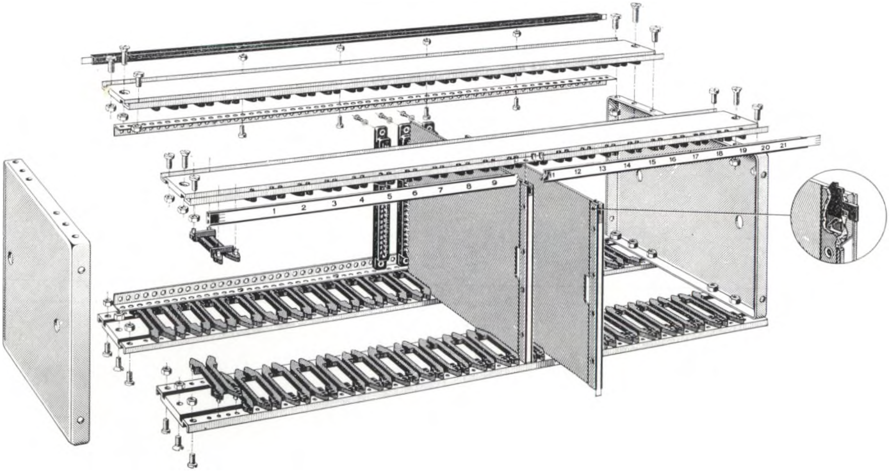
This universal type of chassis for mounting circuit blocks of the 100 series, 10 series and 20 series and many other components is designed to be fitted in 19″ racks.
The chassis can contain 21 printed-wiring boards with a length of 204 mm. Connector types F045 and F047 can be used.
A latch firmly locks the p.w. boards and prevents dislodgement due to vibration.
A number of these chassis (height 133 mm) can be mounted in a metal frame. Six chassis can be mounted side by side in a standard 19″ rack.

Storage temperature range	−55 °C to +85 °C
Operating temperature range	−25 °C to +85 °C

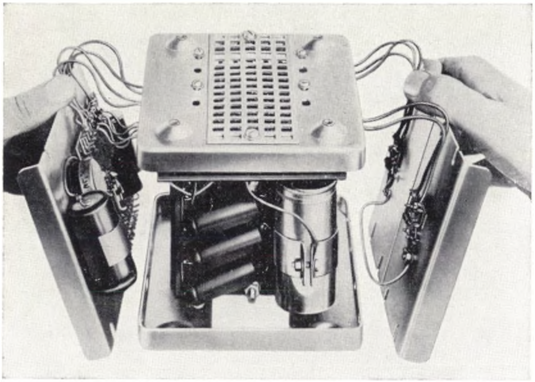


Mounting chassis

Type B871613 for connector 2422 020 52591
Type B871615 for connector F047



TRANSISTORIZED POWER SUPPLY UNITS



These units permit a quick assembly of a variety of power supplies delivering unstabilised as well as stabilised output voltages between 1 and 39V, at currents ranging between 0.25 and 5A

Available types

description	*dimensions (mm)*	*type number*
1–39 V, 1 A unstabilized power supply unit	165 × 127 × 140	YL6101
1–39 V, 5 A unstabilized power supply unit	317 × 165 × 165	YL6102
6–30 V, 250 mA stabilizer unit	159 × 121 × 51	YL6103/00
1– 6 V, 250 mA stabilizer unit	159 × 121 × 51	YL6103/01
500 mA series regulator unit	121 × 76 × 25.4	YL6104
+6 V, 150 mA stabilizer unit	121 × 76 × 25.4	YL6105

Tentative data +24 and −24 Volts supply unit

mains voltage	200 – 220 – 240V +10% – 15%
mains frequency	45 – 60 c/s
dimensions	25 × 7 × max 9 cm.

positive output		*negative output*	
voltage	+24V ± 10%[1]	voltage	−24V ± 5%[1]
current	50mA[2]	current	250 mA[2]
ripple	$<$200 mV$_{rms}$	ripple	$<$100 mV$_{rms}$

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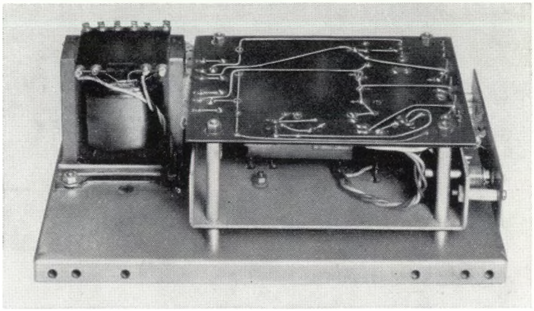
[1] including temperature effect (−10 to +50 °C) and load changes.
[2] at maximum operating temperature.

TRANSISTORIZED POWER SUPPLY UNITS

The new power supply units both for +6/−6 V and +12/−12 V are designed for use with circuit blocks and for universal supply of transistorised circuits. The supply units fit into the 19″ mounting chassis B8 71610, B8 71611, B8 71613 and B8 71615.



Data	+6/−6 V supply type number B8 910 00	+12/−12 V supply type number B8 910 03
mains voltage	220 V and 235 V +10% −15%	95–125 V ⎫ in steps 190–250 V ⎭ of 5 V
mains frequency	50–60 c/s	45–65 c/s
fusing	1 A fuse in primary	automatic
storage temperature	−20° to +75 °C	−20° to +75 °C
operating temperature	−20° to + 60 °C	−20° to +65 °C
	positive output	
voltage	+6 V, adjustable ±5%	−12 V
current	150 mA	1 A
stability ratio	>200 : 1	>500 : 1
ripple	<50 $\mathrm{mV_{rms}}$	0.35 $\mathrm{mV_{rms}}$
internal resistance	0.5 Ω	<55 mΩ, 0–100% load
internal impedance		
at 10 kc/s	<0,5 Ω	
at 100 kc/s	1 Ω approx.	
temperature coefficient		+0.075 mV per deg.C[1]
at no load	+6 mV per deg.C	+0.038 mV per deg.C[2]
	negative output	
voltage	−6 V, adjustable ±5%	−12 V
current	600 mA	400 mA
stability ratio	>300 : 1	30 : 1
ripple	<50 $\mathrm{mV_{rms}}$	1 $\mathrm{mV_{rms}}$
internal resistance	<0.3 Ω	<0.2 Ω, 0–100% load
internal impedance		
at 10 kc/s	<0.2 Ω	
at 100 kc/s	1 Ω approx.	
temperature coefficient		−0.45 mV per deg. C[1]
at no load	−3 mV per deg. C	−0.1 mV per deg. C.[2]

The units can be mounted into the 19″ mounting chassis B8 716 10, B8 716 13 and B8 716 15. The base plate of the power supplies serves as a side panel in the 19″ mounting rack. One of the side panels of the mounting rack is therefore replaced by the base plate of the power supply.

[1] Full load [2] Half load

UNIVERSAL MODULAR POWER SUPPLIES

TRANSISTORIZED POWER SUPPLY UNITS

A new series of power supply modules is being developed. Several modules can be assembled to a power supply unit to suit requirements of voltage (from 5 V up to 60 V), current (up to 10 A) and stability.

Tentative data

Internal resistance	$<5\ \mathrm{m}\Omega$
Internal impedance at 500 kc/s	$<50\ \mathrm{m}\Omega$
Ripple	$<1\ \mathrm{mV}_{\mathrm{rms}}$
Stability ratio	1000 : 1 (10% input change gives 0,01% change in output)
Temperature coefficient	<0,001% per deg. C
Temperature range	−10 to +65 °C
Fusing	automatic electronic overload protection
Sensing	provisions for local and remote sensing

The supply units can be mounted in standard 19″ racks.

A few types of professional high-quality switch have been developed.

The following types are available:

FC21051 (Fig. 1)

Simple normal ten-position switch with two desks.
Colour code: yellow

FC21060 (Fig. 2)

Decade decoding switch, code 1.2.4.2. containing:
- a thumb-driven 10-position switch with 0–9 indication
- a decoding circuit incorporated
- a negative gate with 4 inputs

Colour code: red.

FC21061 (Fig. 2)

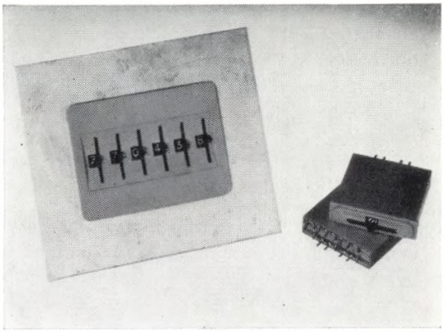
Decade decoding switch, code 1.2.4.8. containing the same as type FC21060.

Colour code: grey

Under development:

FC21062

12-position switch with two desks.



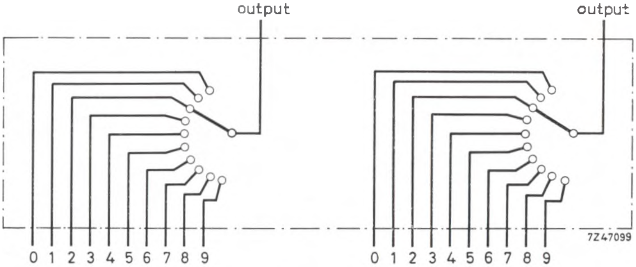


Fig. 1.

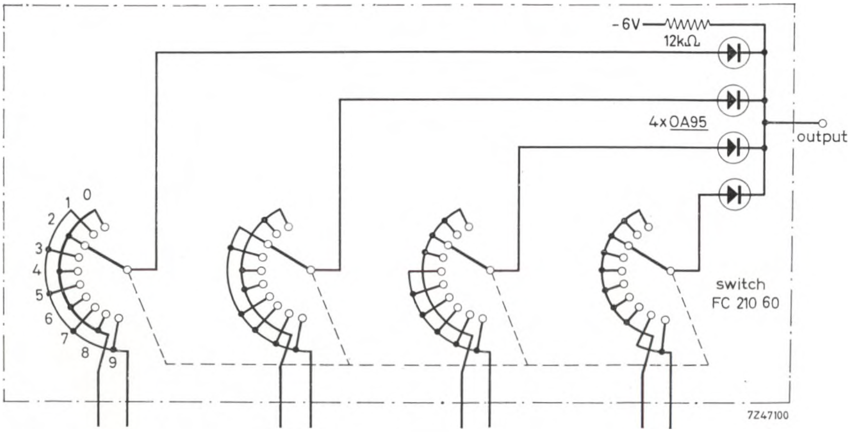


Fig. 2.

DECADE SWITCHES

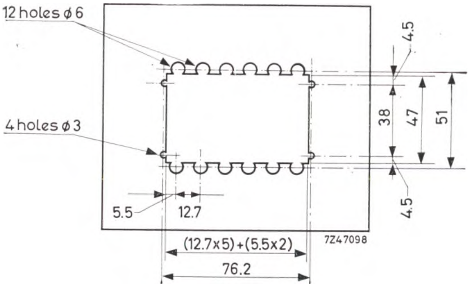
Fixing

The switches can easily be mounted on front panels up to 2 mm thickness without tools or screws. Up to six switches can be clicked into a grey nylon mounting plate (see figure) which is mounted on the front panel. The output tags can be soldered directly into a 2 inch-grid printed-wiring board.

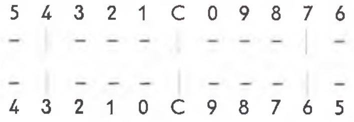
Nylon fixing plates

Available for 1 up to and including 6 switches.

Development type numbers: 1 switch	FC00155
2 switches	FC00156
3 switches	FC00157
4 switches	FC00158
5 switches	FC00159
6 switches	FC00160

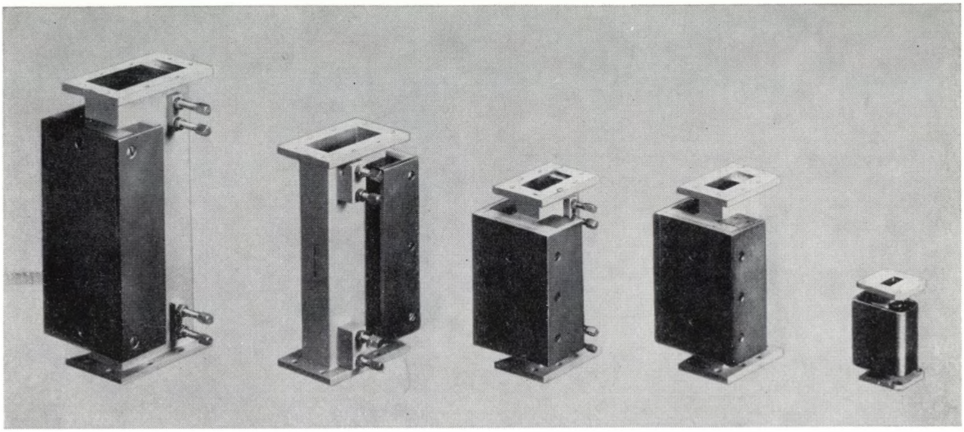


Connections



Nominal current	0.5 A
Maximum permanent current	1 A
Over-current during 5 s	5 × nominal load
Maximum voltage	500 V_{dc}
Insulation resistance at 100 V	$R_i > 1$ kΩ at 100 V
Contact resistance at 1 Mc/s	$R_c < 25 \times 10^{-4}$
Capacitance at 1 Mc/s (one contact against all others earthed)	$C_p < 15$ pF
Minimum current for guaranteed R_c	10 mA
Tested lifetime	> 200,000 full turns
Operating force for switching	250–750 grammes
Test voltage during 1 minute: (a) between any connection and ground and (b) between any two adjacent connections	500 V_{dc}

FERRITE ISOLATORS



In the microwave field many components are available, others are under development.
Due to the fact that the tubes, the ferrites, the magnets and all the necessary materials have been developed and are produced in the same factory, their quality and reliability are really outstanding.
Components are available in a wide frequency range: about 400 to 40.000 Mc/s.

1. Ferrite components as isolators, circulators, 3-ports, 4-ports, switches, etc.
2. Amplifiers and oscillators as well as power output stages.
3. Hardware as bends, twists, coaxial lines for waveguide transitions, tapers, etc.

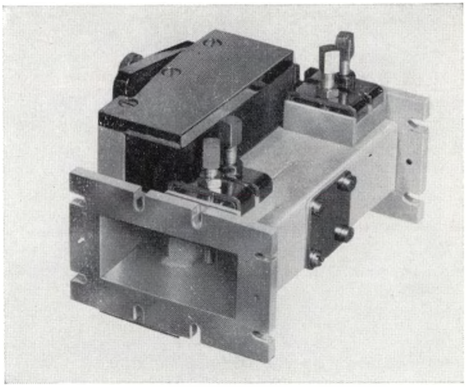
As a rule the following guaranteed specification for isolators e.g. is given:
Insertion loss < 0.5 dB
Attenuation > 30 dB

VSWR over the whole band 1.05 and less than 1.02 over a bandwidth of 50 Mc/s around any centre frequency in the band. All the components have the standardized JAN, WR or IEC waveguides. IEC flanges are standard.

The finishing is silver-plated plus gold-plated and in the standard G.P.O. (P.T.T.) grey colour.
Mixers, parametric amplifiers, masers and suchlike will soon be available.
The photographs show a few samples of units and components.

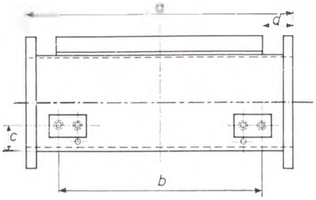
More types of integrated building bricks such as amplifiers plus isolators plus coaxial line-to-waveguide adaptor are also available.

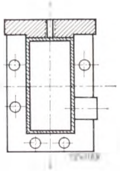
For further details, technical advice etc. please contact the professional group of the Icoma division.



MICROWAVE UNITS

FERRITE ISOLATORS





Type	dimensions (mm)			
	a	b	c	d
B873240	180	146	16.7	16.9
B873200	180	132	16.7	24
B873201	140	119	13.4	10.5
B873202	140	132	13.4	14
B873203	140	108	13.4	16
B873206	115	105	11.0	17
B873208	115	88	11.0	17
B873209	115	88	11.0	17
B873210	115	—	—	$17^{4)}$
B873211	100	—	—	—
B873215	80	61	7	14.8
B873217	60	45	4	10.3
88936/00	102	70	18	14.5

Some types of isolators

type	frequence (Mc/s)	atten-uation (dB)	loss (dB)	VSWR	waveguide	
					IEC	RETMA/MIL WR/RG
Field-displacement types						
B873200	3400–3800	>30	<0.8	$<1.05^{1,2}$	R40	229/—
B873240	3800–4200	>30	<0.8	$<1.05^{1,2}$	R40	229/—
B873201	3800–4200	>30	<0.8	$<1.05^{1,2}$	R48	187/49U
B873202	4200–4600	>30	<0.5	$<1.05^{1,2}$	R48	187/49U
B873203	4600–5000	>30	<0.5	$<1.05^{1,2}$	R48	187/49U
B873206	5925–6425	>30	<0.5	$<1.05^{1,2}$	R70	137/50U
B873208	6825–7125	>30	<0.5	$<1.05^{1,2}$	R70	137/50U
B873209	7125–7425	>30	<0.5	$<1.05^{1,2}$	R70	137/50U
B873210	7425–8025	>30	<0.5	$<1.03^{1,4}$	R70	137/50U
B873211	7700–8500	>30	<0.5	$<1.05^{1,2}$	R84	112/514
B873215	10700–11700	>30	<0.8	$<1.05^{1,2}$	R100	90/52U
B873217	12500–13500	>30	<0.5	$<1.05^{1,2}$	R140	62/92U
Resonance types						
88936/00	3800–4200	$>30^{3}$	1^{3}	$<1.10^{1}$	R48	187/49U

---

[1] In the specified frequency range.

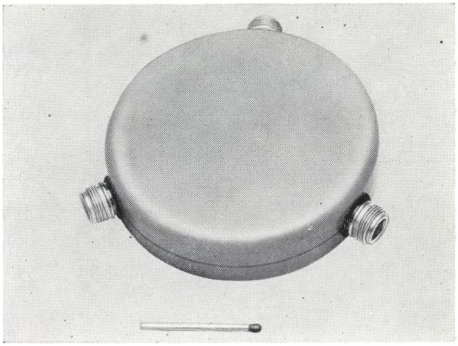
[2] The VSWR in a band of 40 Mc/s around each centre frequency can be matched to <1.02.

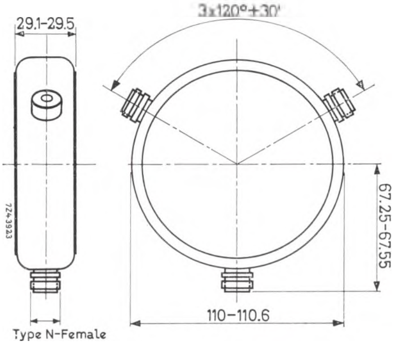
[3] In a band of 50 Mc/s around each centre frequency in the specified frequency range. To be adjusted by a magnetic shunt.

[4] The type B873210 has no matching screws.

All isolators have standardised IEC flanges.
Isolators for high-power on request.

3-PORT COAXIAL CIRCULATORS



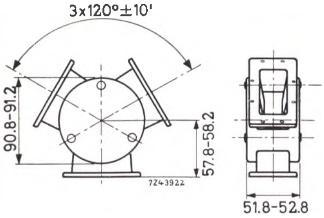


frequency Mc/s	atten-uation (dB)	loss (dB)	VSWR	type connector	type number
1900–2300	>20	<0.75	<1.15	N	4322 020 5001
1900–2100	>20	<0.75	<1.10	N	4322 020 5002
2100–2300			<1.20	N	
2100–2300	>20	<0.75	<1.10	N	4322 020 5003
1900–2100			<1.20	N	
2500–2900	>20	<0.6	<1.10	N	4322 020 50041
2200–3000	>20	<0.6	<1.20	N	4322 020 50051

Three-port circulators are also available for the frequency ranges 450–470 Mc/s and 470–860 Mc/s (high power). Other types on request.

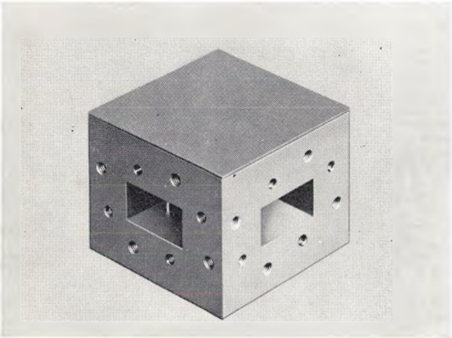
MICROWAVE UNITS

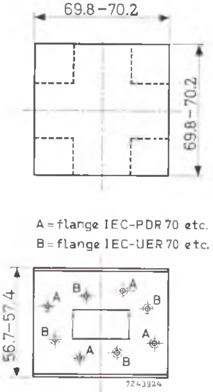
3-PORT CIRCULATOR



Specification: 3600–4200 Mc/s; >25/<0.4 dB; VSWR <1.08, in WR229 (=R40)

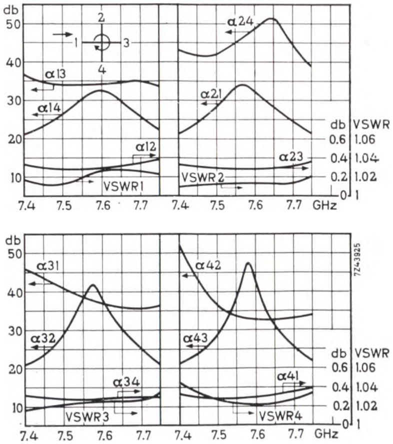
4-PORT CIRCULATORS



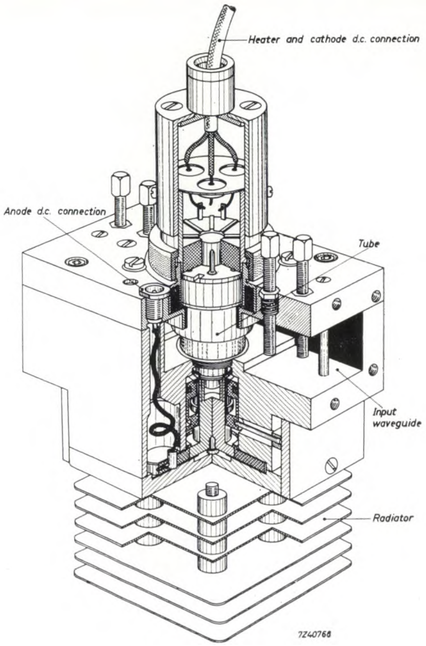


These circulators are available in the frequency range of about 6000 Mc/s–13500 Mc/s with a bandwidth of 4%
Specification: > 25/< 0.4 dB; VSWR <1.10

Other frequency ranges on request, for instance about 3500–4500 Mc/s in one range, etc.



Typical curves of a 4-port circulator in the frequency band 7425–7725 Mc/s.



Cut-away view of a 4000 Mc/s amplifier

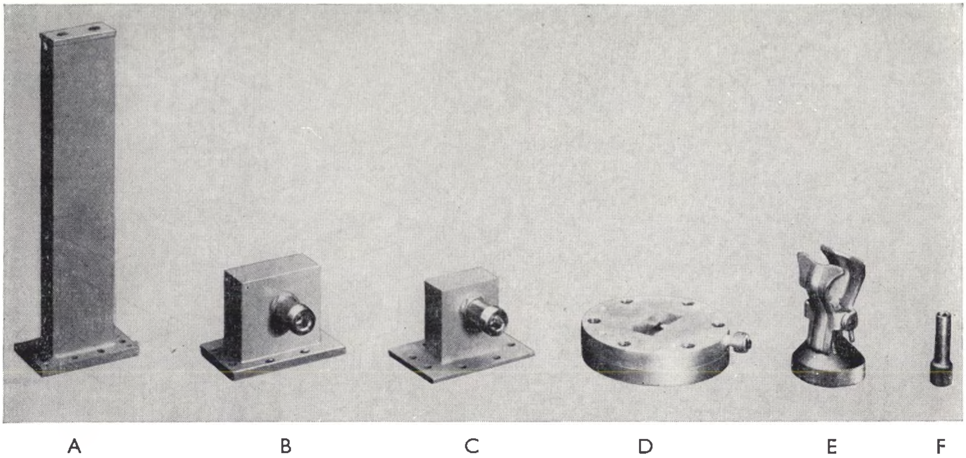
The amplifiers are available under the following type numbers:

Amplifier block without radiator .	B873300
Amplifier block with radiator . .	B873301
Radiator	K399512

Microwave triodes EC157 and EC158

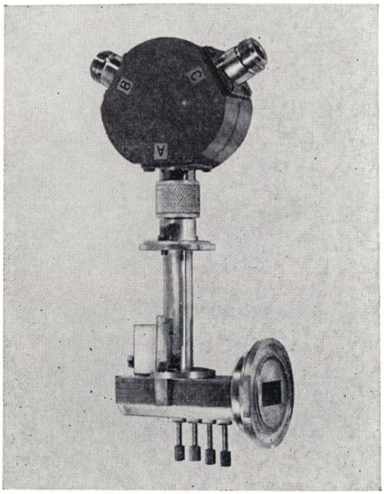
Frequency	3700–4200 Mc/s
Output with EC158	about 5 W
Gain	14 dB
Bandwidth 0.1 dB	32 Mc/s
G × B	800
Filament	6.3 V ± 2%
Anode Voltage	180 V

OTHER COMPONENTS FOR MICROWAVE EQUIPMENT



Apart from the microwave building bricks mentioned, a great variety of microwave components is available or under development, such as:

Loads (any waveguide) VSWR <1.03 (A); matchable short-circuit; transitions (coaxial to waveguide) VSWR about 1.10 (B and C); gas shutters VSWR <1.03 (D); waveguide bends E and H; quick-release waveguide clamps B873401 (E); tuning key for isolators and amplifiers K399619 (screw head 5.1 mm square) (F).
Moreover, under development: mixers; switches for up to 13500 Mc/s; filters (tunable); parametric amplifiers and mixers, hybrids, attenuators, etc.



LABORATORY MODEL OF AN S-BAND PARAMETRIC AMPLIFIER PLUS CIRCULATOR

Varactor diode

Overall noise figure . . .	3.2 dB
Bandwidth	20–35 Mc/s
Pump frequency	9000 Mc/s
Pump power	5 mW
Tunable from	2700–3300 Mc/s by varying the pump frequency and level only.

These data are provisional.

TYPE 88931 RECEIVER INSET

Sensitivity

54 dB at 1000 c/s with reference to $1(\mathrm{N/m^2})^2/\mathrm{W}$; measured in combination with a suitable ear-piece and an artificial ear having a chamber volume of 6 cm^2.

Frequency response

A typical frequency response curve is shown in Fig. 3 indicating also the limits in between which the response curves are guaranteed.

Impedance

350 Ω ±20% at 1000 c/s.

Main constructional features

Nickel-plated brass case, rigid magnetic circuit and adequate protection against moisture and dust. Dimensions are given in Fig. 2.

Weight

80 grammes

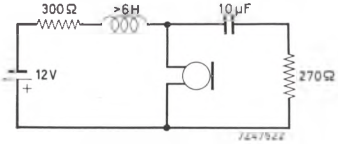


Fig. 1. Test circuit

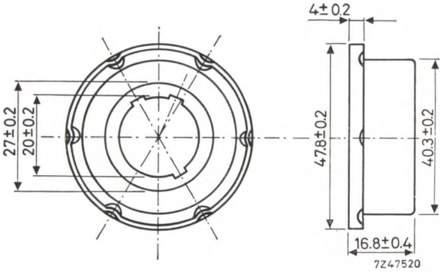


Fig. 2

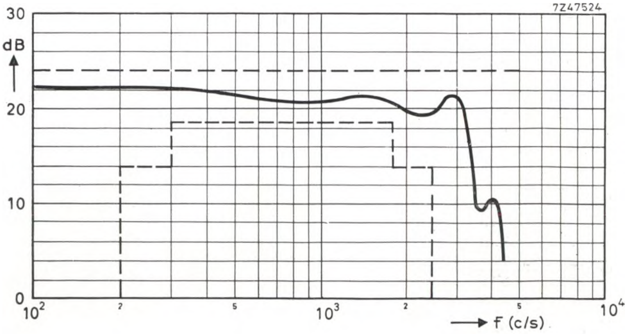


Fig. 3

TRANSMITTER INSET TYPE 88932

Sensitivity
20 mV/μB
at sound pressure of 80 phon and a frequency of 1000 c/s.

Frequency response
A typical frequency response curve is shown in Fig. 3, indicating also the limits in between which the frequency response curves are guaranteed.

Resistance
100 Ω (70–150 Ω) at approximately I = 30 mA.

Stability
EMF generated at noise of 80 dB (absolute) will vary less than 2 dB if 1000 c/s sound pulses of 100 dB are superimposed.

Main constructional features
Nickel-plated brass case; metal diaphragm; carbon chamber consisting of insulating ring, gold plated lower and upper electrodes. Excellent moisture protection. Dimensions are given in Fig. 2.

Weight
35 grammes

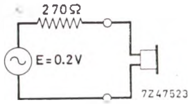


Fig. 1. test circuit

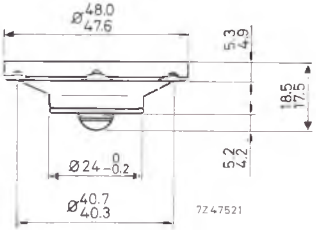


Fig. 2.

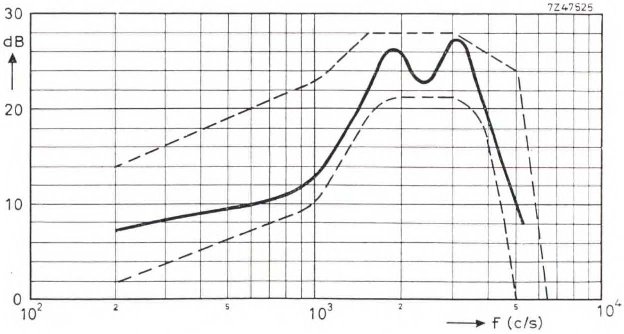
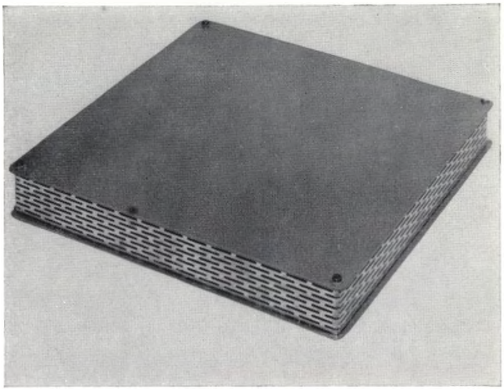


Fig. 3.

ULTRASONIC DELAY LINES



Ultrasonic delay lines provide storage of analogue and digital information for periods up to several milliseconds. The lines consist of a transmitting transducer, an acoustic transmission medium and a receiving transducer. The electrical input is converted into an ultrasonic wave which is propagated through the medium and then converted again into an electrical signal. The speed of the ultrasonic wave is slow compared with that of an electromagnetic wave, so that comparatively large delays can be accommodated in a convenient size.

Several types of delay lines are in our programme:

1. **Fused quartz lines,** acoustic bandwidth approximately 0.5 of the carrier frequency.
   Standard carrier frequencies are e.g. 7, 15 and 30 Mc/s.
   Temperature coefficient of the delay: 70 parts per 10^6 per °C.

2. **Mercury lines** are important for frequencies above 20 Mc/s.
   Available in fixed and variable (25–330 μsec. e.g.) versions.
   Temperature coefficient —3 parts per 10^4 per °C.

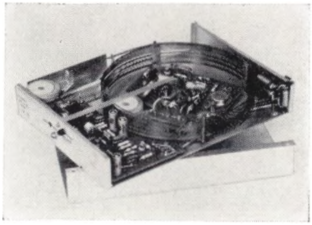
3. **Wire lines** for applications with multiple transducers and a large range of adjustment (by using torsional modes up to several milliseconds and storage capacity of over 1000 bits—equivalent to a bandwidth of approximately 1 Mc/s for a 1 ms line).
   Temperature coefficient 10 parts per 10^6 per °C.

DELAY MODULE

The YL2108 delay module contains an ultrasonic delay line and associated transistorised input and output electronics. It is suitable for use with existing circuit block systems or is directly adaptable to fit other requirements; either n-p-n or p-n-p logic systems are catered for in the input, output and power supply requirements.

The delay is within the range 100 µs to 3200 µs as specified by the customer, with a fine adjustment in value by a preset control. For lines with the shorter delay the maximum pulse repetition frequency is 400 kc/s falling to 250 kc/s for the 3200 µs delay line.

The input circuit of the unit is a voltage-level discriminator with the trigger level set at 1.5 V. Negative-going edges in the range 20–350 nanoseconds per volt will result in reliable operation. The negative-going output pulse is of constant amplitude and the width is preset to one of three values dependent on the p.r.f. in use.



Delay:	100 µs to 3200 µs Fine adjustment ±10 µs
Pulse Repetition Frequency:. .	400 kc/s maximum for short delay lines 250 kc/s maximum for long delay lines
Temperature Range:	−10 °C to +60 °C
Temperature Coefficient of delay: . . .	From −5 parts per million deg.C for long lines, to +50 parts for very short delay lines
Supply:	12 V ±5%, including ripple load current 100 mA at maximum frequency falling to 50 mA quiescent
Input Drive Current:.	Not to exceed 25 mA peak, 5 mA average over any 50 ms period
Output Signal Amplitude:. . .	Unloaded 6.5 V nominal from a source impedance of 700 Ω
Output Pulse Width:.	1.3 µs, 400 kc/s

Pulse width		*Max. P.R.F.*
1.3 µs	at	400 kc/s
2.6 µs	at	200 kc/s
4.0 µs	at	150 kc/s

Logic Output

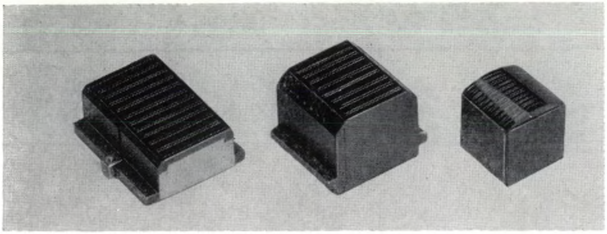
Current at logic 0: 1.2 mA$_{dc}$ with +6 V supplies
Amplitude at logic 1: not less than 5 V

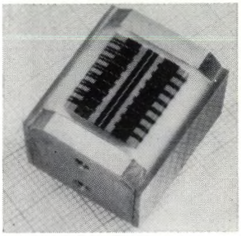
Dimensions:

24.5 × 17.3 × 4.1 cm

supply	*terminal*			*output pulse excursions*
	+	−	0	
+12 V	+12 V	0	to ext. +6 V supply	+6 V to 0
−12 V	0	−12 V	to positive terminal	0 to −6 V
+6 V/0/−6 V	+ 6 V	− 6 V	0	0 to −6 V

FERRITE RECORDING HEADS





For these heads a very high-density ferrite is used. The gaps are made by a glass bonding technique which guarantees sharply defined gap edges. This technique gives also the possibility of making multi-track heads with well-aligned gaps.
Ferrite recording heads offer the advantage of low losses and great wear resistivity.

The heads are potted in a metal case. The coil connections as well as an earth-connection to prevent static charge of the head are accessible at the under side; they are designed as solder tags.

Standard gap lengths are 2, 3.5, 6.5, 12, 20 microns. The gap height depends on the application and can be for instance 50–200 microns.

A range of heads in the following fields is available: Audio, analog data recording, digital recording with either single or dual gap per track, video, floating heads for drums and discs, modulating heads in static recording. All these heads are available in single or multi-track version, for instance:

1/4 inch 1, and 2 tracks, also 1–3 or 2–4 stereo
1/2 inch 3, 4, 7 and 8 tracks
1 inch 7 (or 7+1) and 17 tracks

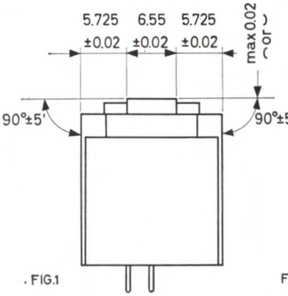


FIG.1

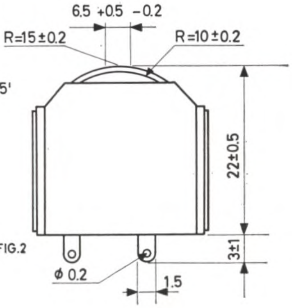


FIG.2

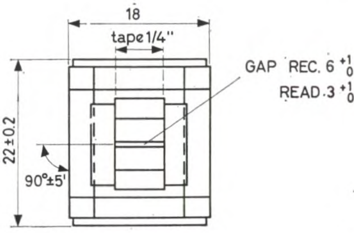


FIG3

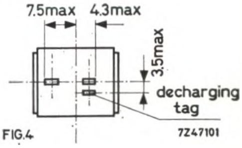


FIG.4

Record-head 4322 020 4027

bias current	4.5 mA ± 1
modulation for full modulation	0.85 mA ± 0.1
gaplength	6.0 µm + 1–0
inductance (1 kHz, 100 mV)	7.0 mH ± 15%
Q-factor at 1 kHz	15
Q-factor ay 10 kHz	45
d.c. resistance	1.35 Ω ± 0.2
isolation (200 V)	1000 MΩ
resistance tape-contact headfront	20 MΩ

Replay-head 4322 020 4028

output at 1 kHz and reference level 32 mH/mm .	3.8 mV ± 10%
gap length	3 µm + 1–0
inductance (1 kHz–100 mV . .	75 mH ± 15%
Q-factor at 1 kHz	20
Q-factor at 10 kHz	45
d.c. resistance	13 ± 2 Ω
insulation (200 V)	1000 MΩ

The output voltage of 3.8 mV ± 10% applies to the whole tolerance range of L = 75 mH ± 15% (abt 65–85 mH).

PROFESSIONAL FERRITE RECORDING HEADS

For reference sake some tentative data of typical heads are given below:

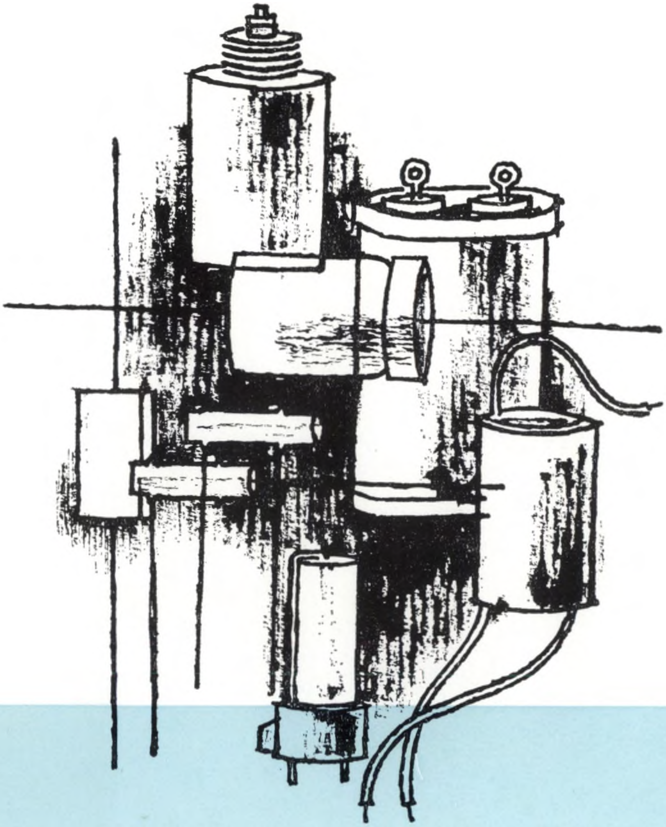
Description		Tape (inch)	No of tracks	Track width (mm)	Gap (micron)	Ind. (mH)	Bias (mA)	Output (mV)	Write curr. (mA)
Digital,	dual gap								
	write	½	7	1.2	12	0.2			35
	read	½	7	0.8	6	0.8		30	
	write	1	8	2	12	0.1			35
	read	1	8	1.27	6	1.5		50	
Audio full track									
	write	¼	1	6.25	6	7	4.5		0.85
	read	¼	1	6.25	3	75		3.8	
,, halftrack									
	write	¼	2	2.2	6	7	3.2		0.6
	read	¼	2	2.2	3	75		2.3	
,, 1–3 stereo									
	write	¼	2	2.75	6	7			
	read	¼	2	2.75	3	40(75)			
,, four track									
	write	¼	4	0.5	6	7			
	read	¼	4	0.5	3	75			
,, eight track									
	write	½	8	0.5	6	7			
	read	½	8	0.5	3	75			
,, seventeen track									
	write	1	17	0.5	6	7			
	read	1	17	0.5	3	75			
Analog Instr.									
	write	½	4	1.27	3	0.1	80		20[1]
	read	½	4	1.27	1.5	2		8	
	write	1	7(+1)	1.27/0.5	3	0.1	80		20[2]
	read	1	7(+1)	1.27/0.5	1.5	2		8	
Video									
	write/read	1	1	0.15 or 0.27	1.5	0.012		10	50
Flying									
,,	write/read	drum	8	0.7	20	0.13		200	100[3]
,,	write/read	disc	9	0.5	6	0.084		27	115
,,	write/read	disc	12	0.35	6	0.015		15	150

[1] The 4 tracks on ½" tape is also available with 3 tracks plus a clock track. These heads can also be used interlaced, to obtain twice the number of tracks on the same tape width of ½".

[2] Can also be used interlaced.

[3] Heads with 6 microns gap available; 16-track flying heads also available.

ELECTROLYTIC
POLYESTER
PAPER
POLYSTYRENE
MICA
CERAMIC



Fixed capacitors

CONTENTS

ELECTROLYTIC CAPACITORS

INTRODUCTION

The electrolytic capacitors listed can be subdivided into the following groups according to their principal applications.

1. **wet aluminium capacitors**

1a. *the general-purpose programme*

C426 series – miniature type
C437 series – small type
C431 series – large type

1b. *the extended–voltage programme*

C436 series – small type
C433 series – large type
AC series – large type

2. **wet long-life capacitors**

C428 series – small aluminium type
C432 series – large aluminium type
C420 series – ultra small tantalum type

3. **solid aluminium and tantalum capacitors**

C415 series – solid aluminium type
C421 series – solid tantalum type

Group 1a: the general-purpose programme
This programme includes a large group of capacitors for low working voltages in an extended capacitance range. In connection with the low working voltages and high capacitance values these types will fulfil all requirements of transistorised equipment. The permissible ambient temperature range is −40 to +70 °C, which is suitable for these applications.

The **economy range** of the C426 series consists of types with the same capacitance and voltage range as the standard C426 series but in can sizes 4 and 6 only. Compared to smaller types they have better characteristics, which make this range preferable for those cases where utmost miniaturisation is not required.

Group 1b: the extended voltage programme
These types can be used if high working voltages are required and also at higher working temperatures up to 85 °C (C436, C433 series). Moreover in this range different mechanical versions are available.

Group 2: wet long-life capacitors
These types have a special construction resulting in better properties such as long service life and high reliability for application in computers, telephone and other industrial equipment, where these properties are of primary interest.
The C428 series have a limited capacitance range and are therefore specially suitable for coupling and decoupling applications.
The C432 series have very high capacitance values and are therefore specially suitable for use in power supplies of professional equipment. The admissible ambient temperature range is −40 to +70 °C.
A special group of capacitors which, regarding their properties, can also be arranged in group 2, are the miniature wet tantalum types: the C420 series. These types combine excellent properties, long service life and reliability with ultra small dimensions. Typical applications are hearing aids and other very small transistorized equipment. The admissible ambient temperature range is −40 to +55 °C.

INTRODUCTION

Group 3: solid aluminium and tantalum capacitors
The C415 series are of cheap design and have good properties, the most important being unlimited service life, high reliability, high stability; they are tested according to MIL-STD202. The permissible ambient temperature ranges from −80 to +85 °C at full voltage.
The C421 series have about the same properties with very small dimensions. They are therefore very suitable for miniaturised professional and military equipment. The permissible ambient temperature range is −40 to +85 °C (125 °C with derated voltage). C421 capacitors are conform MIL-C26655B, styles CS12/CS13.

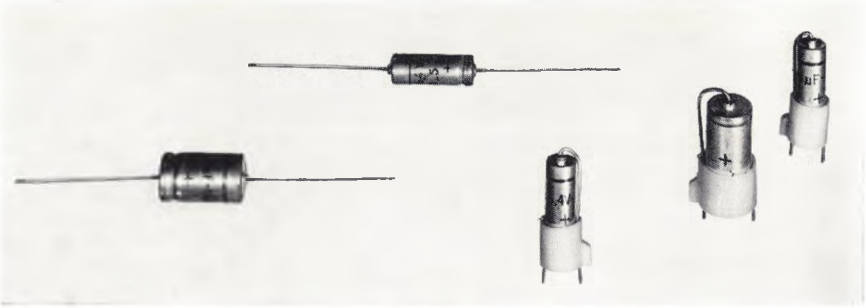
SELECTION GUIDE

application	*capacitance range* (*μF*)	*voltage range* (*V*)	*maximum operating temperature* (*°C*)	*type*	*type number*	*page*
For general purposes **(economy range)**	0.32 up to 400	4 up to 64	70/85	miniature[2]	C 426	C 4
For general purposes	0.64 up to 500	2.5 up to 64	70[1]	miniature[2]	C 426	C 8
	64 up to 4000	2.5 up to 64	70	small[2]	C 437	C 12
	320 up to 25000	4 up to 64	70	large[2]	C 431	C 16
If a high operating temperature is required	40 up to 2000	2.5 up to 64	85	small[2]	C 436	C 22
	200 up to 10000	4 up to 64	85	large[2]	C 433	C 26
For high voltages	2.5 up to 80	100 up to 400	70	small[2]	C 436	C 22
	8 up to 500	100 up to 500	70	large[2]	C 433	C 26
	12.5 up to 250	64 up to 500	70	screw-base[2]	C 441	C 34
	8 up to 500	100 up to 500	70	large[2]	special series	C 36
For long service life and high reliability	2.5 up to 320	4 up to 64	70	small[2]	C 428	C 38
	900 up to 31500	6.4 up to 100	70	large[2]	C 432	C 42
For severest requirements, long service life and high reliability	2 up to 100	4 up to 40	85	solid aluminimum	C 415	C 46
	0.33 up to 330	6 up to 35	125	solid tantalum	C 421	C 52
For ultra small dimensions	0.64 up to 40	2.5 up to 25	55	wet tantalum	C 420	C 56

[1] 85 °C with reduced ratings [2] Wet aluminium

C426 series - ELECTROLYTIC CAPACITORS

MINIATURE TYPE, FOR GENERAL PURPOSES (ECONOMY RANGE)

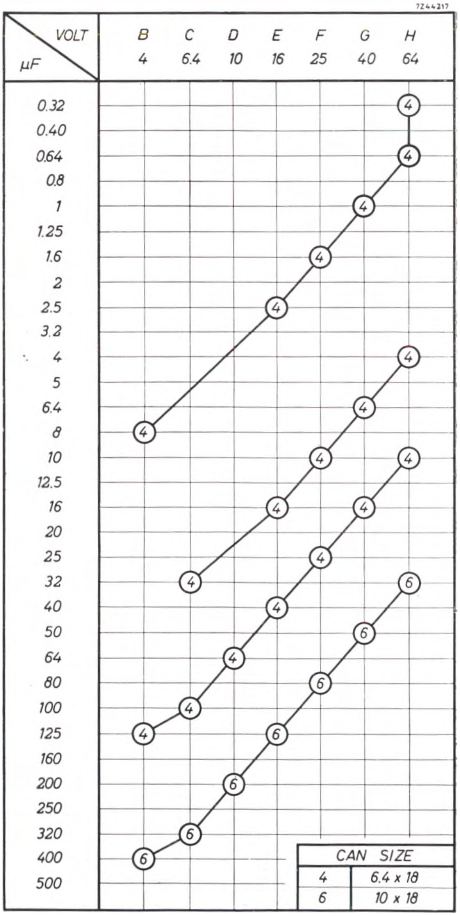


The economy range covers the whole capacitance and voltage range of the standard C426 series, but in can sizes 4 and 6 only, which offers the cheapest possible solution. Moreover, these capacitors offer, compared to smaller types:

(a) better low-temperature characteristics;
(b) lower losses and impedances;
(c) longer service life and higher reliability.

They are therefore preferable in all cases where utmost miniaturisation is not required.

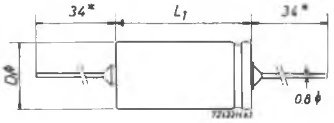
These capacitors are designed for operation between −40 and +70 °C. They may also operate at 85 °C for 12 hours per 24 hours.



CAN SIZE	
4	6.4 x 18
6	10 x 18

ELECTROLYTIC CAPACITORS - C426 series

MINIATURE TYPE, FOR GENERAL PURPOSES (ECONOMY RANGE)



* 37mm for can size 6

Fig. 1

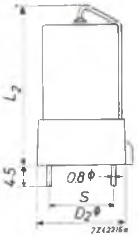


Fig. 2

Dimensions (mm)

can size	*insulated version with axial leads*			*printed-wiring version*			
	fig.	D_1	L_1	*fig.*	D_2	L_2	S
4	1	6.7	18.5	2	8.7	25	7.62
6	1	10.4	18.5	2	12.9	25	10.16

tolerance on capacitance	−10/+50%
temperature range	−40/+70 °C
peak temperature (12 hours per 24 hours)	85 °C
peak voltage during 1 minute per hour: at +70 °C	1.125 × working voltage +0.5 V
at ≤ +40 °C	1.25 × working voltage +0.5 V
climatic group number	40/70/56 (IEC)

Composition of the type number C426../..

insulated: AR ◀—

p.w. version: CB ◀—

—▶ capacitance value (μF)

—▶ voltage indication (V)

Example: The type number of a 25 μF/25 V capacitor, p.w. version, is C426CB/F25

MINIATURE TYPE, FOR GENERAL PURPOSES (ECONOMY RANGE)

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
4	4	8	4.1	16	0.15	5	B8
4	4	125	30	40	0.30	6	B125
6	4	400	73	125	0.30	1.8	B400
4	6.4	32	15	16	0.15	6	C32
4	6.4	100	37	40	0.30	6	C100
6	6.4	320	85	125	0.30	1.8	C320
4	10	64	37	40	0.25	6	D64
6	10	200	85	125	0.25	1.8	D200
4	16	2.5	4.1	16	0.10	5	E2.5
4	16	16	18	16	0.20	6	E16
4	16	40	37	40	0.20	6	E40
6	16	125	85	125	0.20	1.8	E125
4	25	1.6	4.1	16	0.10	6	F1.6
4	25	10	18	16	0.15	6	F10
4	25	25	37	40	0.15	6	F25
6	25	80	85	125	0.15	1.8	F80
4	40	1	4.1	16	0.10	10	G1
4	40	6.4	18	16	0.10	6	G6.4
4	40	16	37	40	0.10	6	G16
6	40	50	85	125	0.10	1.8	G50
4	64	0.32	2	16	0.10	18	H0.32
4	64	0.64	4.1	16	0.10	12	H0.64
4	64	4	18	16	0.10	6	H4
4	64	10	37	40	0.15	6	H10
6	64	32	85	125	0.15	1.8	H32

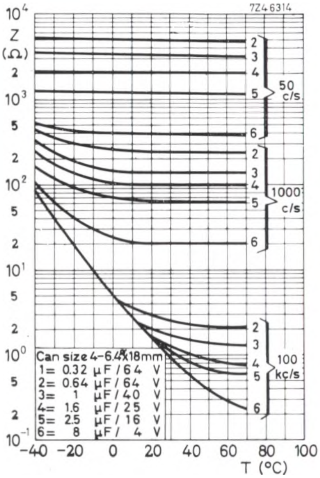
[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

MINIATURE TYPE, FOR GENERAL PURPOSES (ECONOMY RANGE)

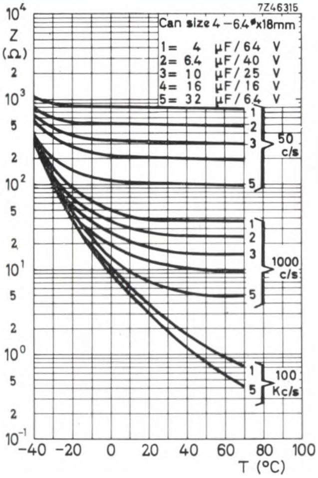
Impedance graphs

The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.
Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.

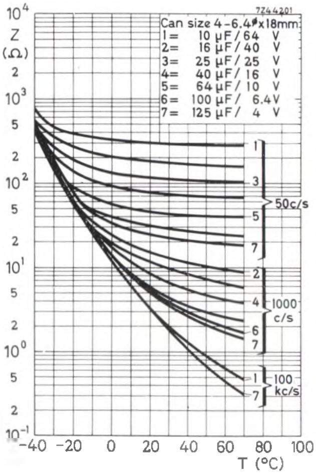
Can size 4



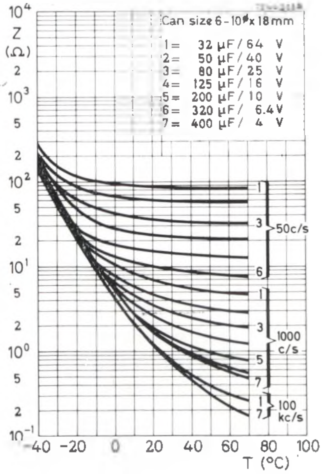
Can size 4



Can size 4

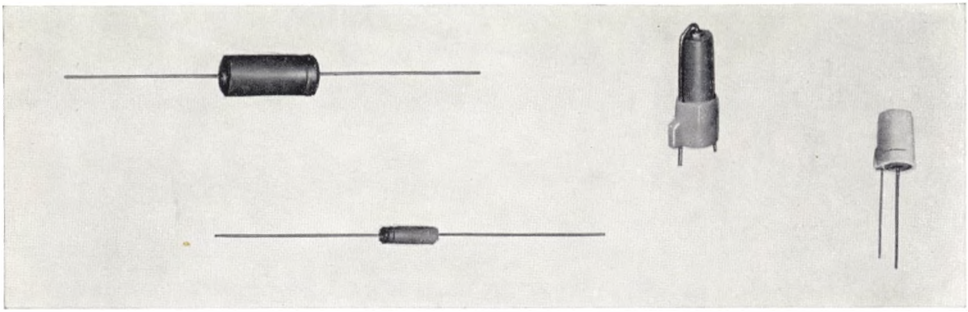


Can size 6



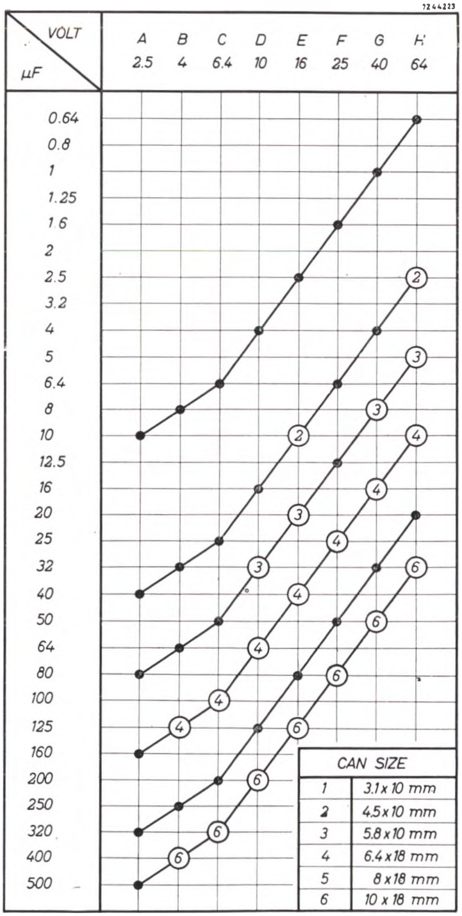
C426 series - ELECTROLYTIC CAPACITORS

MINIATURE TYPE, FOR GENERAL PURPOSES



These capacitors are specially suitable for coupling and decoupling in miniaturised electronic equipment, such as transistorised pocket radio receivers, personal tape recorders and similar applications.
They are available in an insulated version with axial leads for conventional wiring and in a version for vertical mounting on printed wiring boards. The two smallest cans are also available in a non-insulated version with axial leads.

Maximum d.c. working voltage



CAN SIZE	
1	3.1 x 10 mm
2	4.5 x 10 mm
3	5.8 x 10 mm
4	6.4 x 18 mm
5	8 x 18 mm
6	10 x 18 mm

For applications in which utmost miniaturisation is not required we refer to the economy range (see preceeding pages).

● non-preferred type

ELECTROLYTIC CAPACITORS - C426 series

MINIATURE TYPE, FOR GENERAL PURPOSES

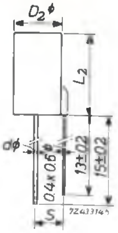


Fig. 1b

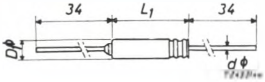


Fig. 1a

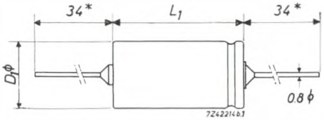


Fig. 2a

* 37mm for can size 6

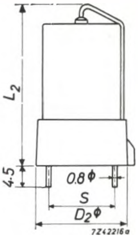


Fig 2b

Dimensions (mm)

	insulated version with axial leads				*printed-wiring version*			
can size	d	fig.	D_1	L_1	fig.	D_2	L_2	S
1	0.5	1a	3.4	10.5	1b	3.8	10.8	2.54
2	0.6	2a	4.8	10.5	1b	5.2	10.8	2.54
3	0.6	2a	6.1	10.5	1b	6.4	10.8	3.59
4	0.8	2a	6.7	18.5	2b	8.7	25	7.62
5	0.8	2a	8.3	18.5	2b	10.3	25	7.62
6	0.8	2a	10.4	18.5	2b	12.9	25	10.16

tolerance on capacitance: can size 2–6	−10/+ 50%
can size 1	−10/+100%
temperature range: can size 2–6	−40/+ 70 °C
can size 1	−40/+ 60 °C
a.c. voltage, without d.c. voltage	2.5 V types: 0.25 V_{rms} 4 V types: 0.4 V_{rms} 6.4 V types: 0.6 V_{rms} 10–64 V types: 1 V_{rms}
peak voltage during 1 minute per hour: at + 70 °C	1.125 × working voltage +0.5 V
at ≤ + 40 °C	1.25 × working voltage +0.5 V
climatic group number	40/70/56 (IEC)

Composition of the type number **C426 . . / . .**

insulated AR (AS for can size 1) ◄—— . . ——► capacitance value (μF)

p.w. version CB (CA for can size 1) ◄—— / ——► voltage indication (V)

Example: The type number of a 10 μF/16 V capacitor, insulated, is C426AR/E10

C426 series - ELECTROLYTIC CAPACITORS

MINIATURE TYPE, FOR GENERAL PURPOSES

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
1	2.5	10	3.1	2.5	0.35	100	A10
2	2.5	40	8	10	0.35	24	A40
3	2.5	80	14	20	0.35	12	A80
4	2.5	160	25	40	0.35	6	A160
5	2.5	320	45	80	0.35	3	A320
6	2.5	500	63	125	0.35	1.8	A500
1	4	8	3.5	2.5	0.3	100	B8
2	4	32	10	10	0.3	24	B32
3	4	64	18	20	0.3	12	B64
4	4	125	30	40	0.3	6	**B125**
5	4	250	55	80	0.3	3	B250
6	4	400	73	125	0.3	1.8	**B400**
1	6.4	6.4	4.1	2.5	0.3	100	C6.4
2	6.4	25	12	10	0.3	24	C25
3	6.4	50	21	20	0.3	12	C50
4	6.4	100	37	40	0.3	6	**C100**
5	6.4	200	63	80	0.3	3	C200
6	6.4	320	85	125	0.3	1.8	**C320**
1	10	4	4.1	2.5	0.25	100	D4
2	10	16	12	10	0.25	24	D16
3	10	32	21	20	0.25	12	**D32**
4	10	64	37	40	0.25	6	**D64**
5	10	125	63	80	0.25	3	D125
6	10	200	85	125	0.25	1.8	**D200**
1	16	2.5	4.1	2.5	0.2	100	E2.5
2	16	10	12	10	0.2	24	**E10**
3	16	20	21	20	0.2	12	**E20**
4	16	40	37	40	0.2	6	**E40**
5	16	80	63	80	0.2	3	E80
6	16	125	85	125	0.2	1.8	**E125**
1	25	1.6	4.1	2.5	0.15	100	F1.6
2	25	6.4	12	10	0.15	24	F6.4
3	25	12.5	21	20	0.15	12	F12.5
4	25	25	37	40	0.15	6	**F25**
5	25	50	63	80	0.15	3	F50
6	25	80	85	125	0.15	1.8	**F80**
1	40	1	4.1	2.5	0.10	100	G1
2	40	4	12	10	0.10	24	G4
3	40	8	21	20	0.10	12	**G8**
4	40	16	37	40	0.10	6	**G16**
5	40	32	63	80	0.10	3	G32
6	40	50	85	125	0.10	1.8	**G50**
1	64	0.64	4.1	2.5	0.15	100	H0.64
2	64	2.5	12	10	0.10	24	**H2.5**
3	64	5	21	20	0.10	12	**H5**
4	64	10	37	40	0.10	6	**H10**
5	64	20	63	80	0.10	3	H20
6	64	32	85	125	0.10	1.8	**H32**

Types of which the type number suffix is printed in bold letters are preferred.

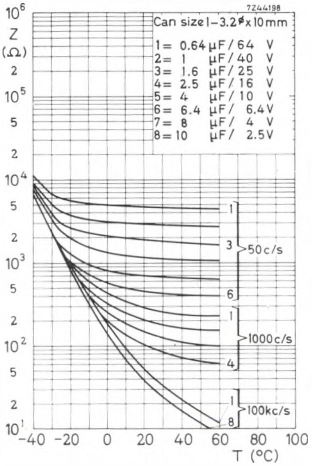
---

[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100c/s
[3] Maximum impedance at 20 °C and 100 kc/s

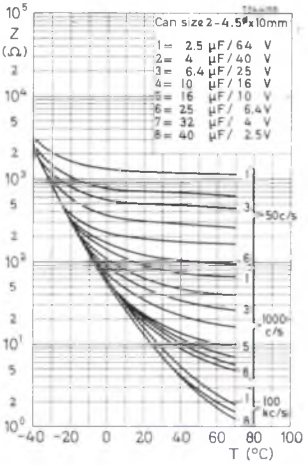
Impedance graphs

The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.
Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.

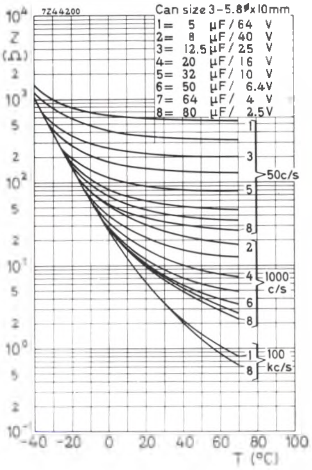
Can size 1



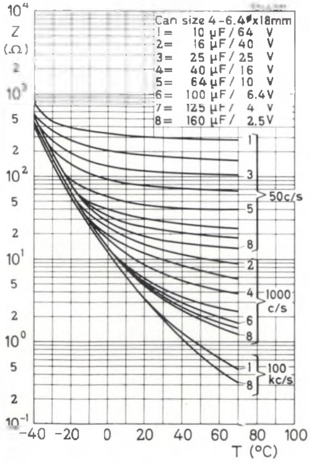
Can size 2



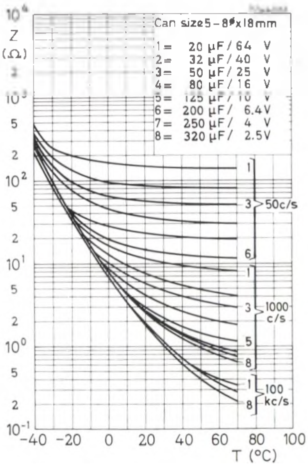
Can size 3



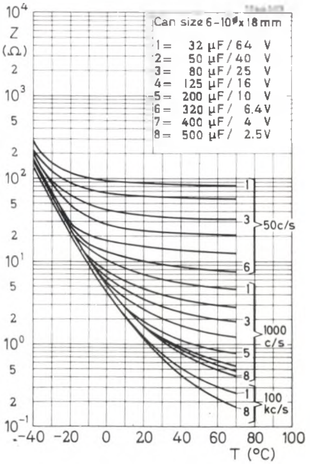
Can size 4



Can size 5

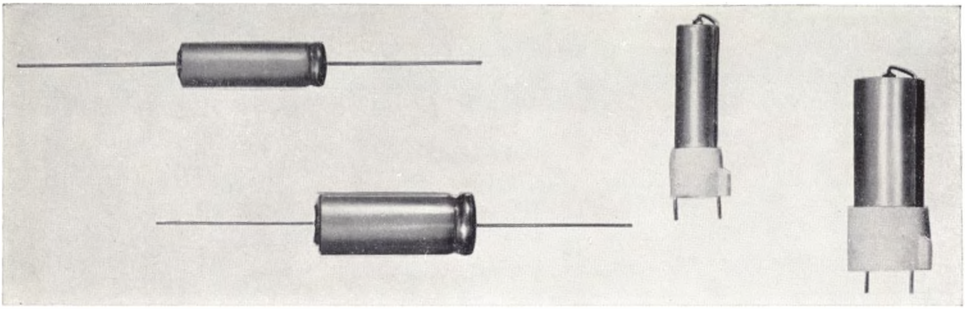


Can size 6



C437 series - ELECTROLYTIC CAPACITORS

SMALL TYPE, FOR GENERAL PURPOSES

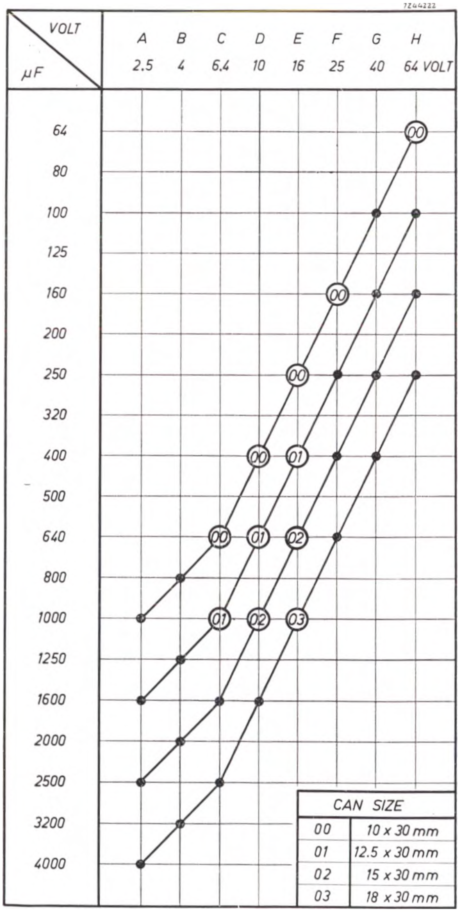


These capacitors are specially suitable for coupling and decoupling in small transistorised equipment, such as portable radio receivers and personal recorders, and similar applications where high capacitance values are needed.

This new range of electrolytic capacitors, to be considered as an extension of the miniature C426 series, is characterised by interesting features: small size, high capacitance values and a long service life.

The sturdy mechanical construction – with welded terminals – ensures long and reliable operation. Low leakage currents could be achieved by employing highly purified material and by a carefully controlled manufacturing process.

Maximum d.c. working voltage

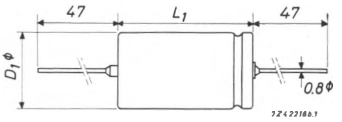


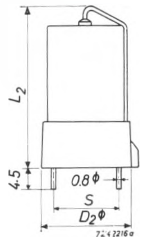
CAN SIZE	
00	10 x 30 mm
01	12.5 x 30 mm
02	15 x 30 mm
03	18 x 30 mm

● **non-preferred type**

ELECTROLYTIC CAPACITORS - C437 series

SMALL TYPE, FOR GENERAL PURPOSES





Dimensions (mm)

can size	*insulated version*		*printed-wiring version*		
	D_1	L_1	D_2	L_2	S
00	10.4	30.5	12.8	39.3	10.16
01	12.9	30.5	15.2	39.3	10.16
02	15.4	30.5	17.8	39.3	12.70
03	18.5	30.5	20.8	39.3	15.24

tolerance on capacitance	−10/+50%
temperature range	−40/+70 °C
peak voltage during 1 minute per hour: at +70 °C	1.125 × working voltage +0.5 V
at ≤ +40 °C	1.25 × working voltage +0.5 V
climatic group number	40/70/56 (IEC)

Composition of the type number **C437 . . / . .**

insulated: AR ◀
p.w. version: CB ◀
▶ capacitance value (μF)
▶ voltage indication (V)

Example: The number of a 1000 μF/6.4 V capacitor, insulated, is C437AR/C1000.

C437 series - ELECTROLYTIC CAPACITORS

SMALL TYPE, FOR GENERAL PURPOSES

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance (Ω)	type number suffix
00	2.5	1000	100	200	0.35	1.0	A1000
01	2.5	1600	145	300	0.35	0.8	A1600
02	2.5	2500	215	400	0.35	0.8	A2500
03	2.5	4000	325	550	0.35	0.8	A4000
00	4	800	120	200	0.30	1.0	B 800
01	4	1250	175	250	0.30	0.8	B1250
02	4	2000	265	350	0.30	0.8	B2000
03	4	3200	400	500	0.30	0.8	B3200
00	6.4	640	145	200	0.25	1.0	**C640**
01	6.4	1000	215	250	0.25	0.8	**C1000**
02	6.4	1600	325	350	0.25	0.8	C1600
03	6.4	2500	500	500	0.25	0.8	C2500
00	10	400	145	200	0.20	1.0	**D400**
01	10	640	215	250	0.20	0.8	**D640**
02	10	1000	325	350	0.20	0.8	**D1000**
03	10	1600	500	500	0.20	0.8	D1600
00	16	250	145	150	0.15	1.0	**E250**
01	16	400	215	250	0.15	0.8	**E400**
02	16	640	325	300	0.15	0.8	**E640**
03	16	1000	500	450	0.15	0.8	**E1000**
00	25	160	145	125	0.15	1.0	**F160**
01	25	250	215	200	0.15	0.8	F250
02	25	400	325	250	0.15	0.8	F400
03	25	640	500	350	0.15	0.8	F640
00	40	100	145	125	0.1	1.2	G100
01	40	160	215	200	0.1	1.2	G160
02	40	250	325	250	0.1	0.8	G250
03	40	400	500	350	0.1	0.8	G400
00	64	64	145	100	0.1	1.0	**H64**
01	64	100	215	150	0.1	1.2	H100
02	64	160	325	200	0.1	1.2	H160
03	64	250	500	250	0.1	0.8	H250

Types of which the type number suffix is printed in bold letters are preferred.

[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

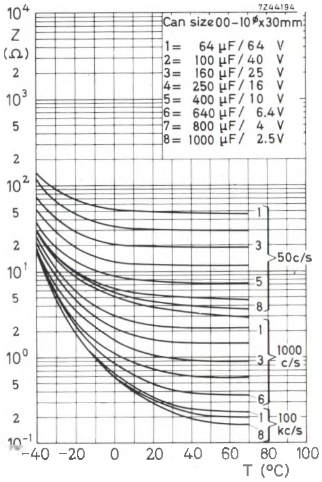
SMALL TYPE, FOR GENERAL PURPOSES

Impedance graphs

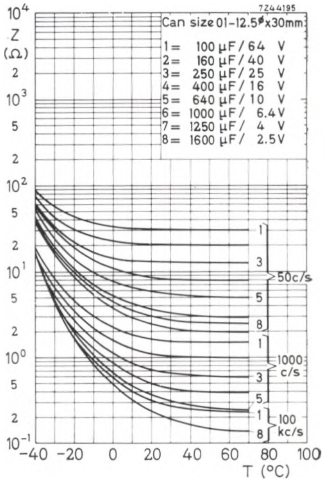
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.

Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.

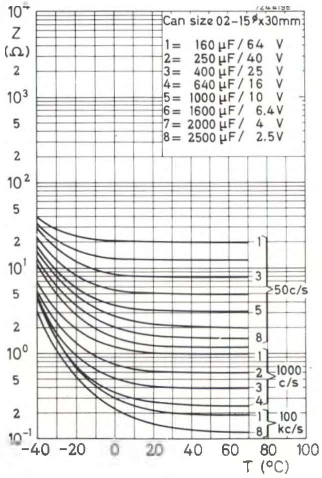
Can size 00



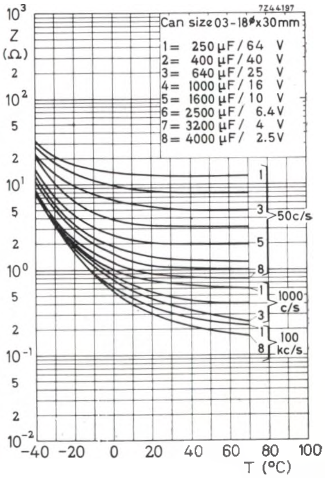
Can size 01



Can size 02

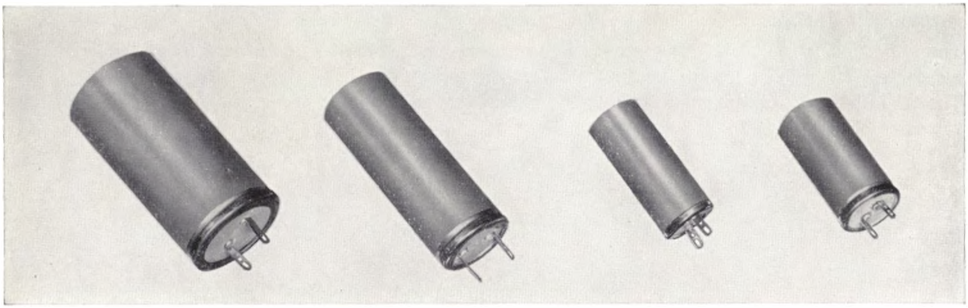


Can size 03



C431 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR GENERAL PURPOSES



This range of high-capacitance electrolytic capacitors has been developed for coupling and decoupling applications in mains-operated transitorised equipment, and their design makes them particularly suitable for television receivers. In applications of this type high alternating currents are often involved; therefore, special attention has been given to the current rating of these capacitors.

A special construction guarantees a very low equivalent series resistance which makes them suitable for high ripple currents.

The capacitors are insulated, whereas a non-insulated version is available upon request.

The five can sizes cover a range of capacitance of from 320 to 25000 μF with working voltages between 4 and 64V_{dc}.

Double versions are available in can size 7, triple versions in can sizes 9 and 10.

The construction is such that one section may be loaded with a very high ripple current, whereas the ripple voltages of the other sections, due to parasitic capacitances, remain very low.

Maximum d.c. working voltage

7Z44219

VOLT / μF	B 4	C 6.4	D 10	E 16	F 25	G 40	H 64
320							5
400							
500						5	6
640							
800					5	6	7
1000							
1250				5	6	7	
1600							9
2000			5	6	7		
2500						9	10
3200			6	7			
4000		2,75 6			9	10	
5000	6		7				
6400		3,50 7		9	10		
8000	7						
10 000			9	10			
12 500		5,50 9					
16 000	9		10 V				
20 000		7,50 10					
25 000	10						
32 000							

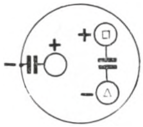
CAN SIZE		
5	21 x 49mm	f 2,25
6	25 x 49mm	2,75
7	25 x 80 mm	3,50
9	35 x 80 mm	5,50
10	40 x 80 mm	7,50.

levertyd 2 à 3 mnd.

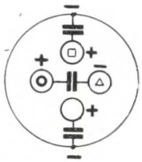
ELECTROLYTIC CAPACITORS - C431 series

LARGE TYPE, FOR GENERAL PURPOSES

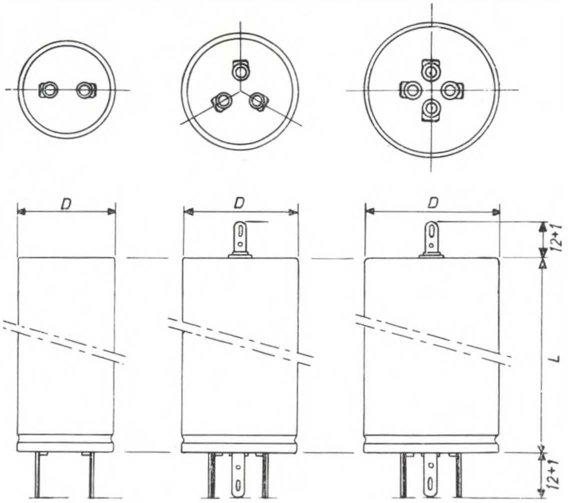
Single version
Can sizes 5, 6, 7, 9, 10



Double version
Can size 7



Triple version
Can sizes 9 and 10



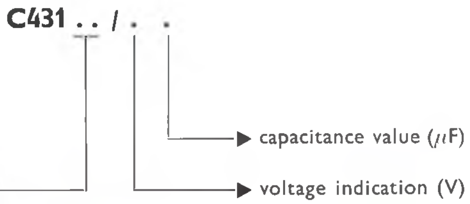
Dimensions insulated version (mm)

can size	5	6	7	9	10
D	22	26	26	36	41
L	51	50	81	81	81

The insulated version is preferred. The dimensions given should be decreased by 1.0 mm for the non-insulated version.

tolerance on capacitance		−10/+50%
temperature range		−40/+70 °C
peak voltage during 1 minute per hour:	at +70 °C	1.125 × working voltage +0.5 V
	at ≤ +40 °C	1.25 × working voltage +0.5 V
climatic group number		40/70/56 (IEC)

Composition of the type number



Example: The type number of a 10000 μF/16 V capacitor, insulated, is C431 BR/E 10000.

C431 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR GENERAL PURPOSES

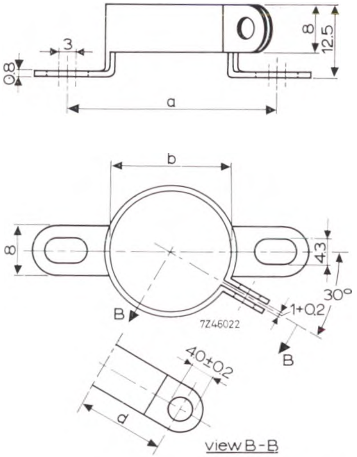


Fig. 1

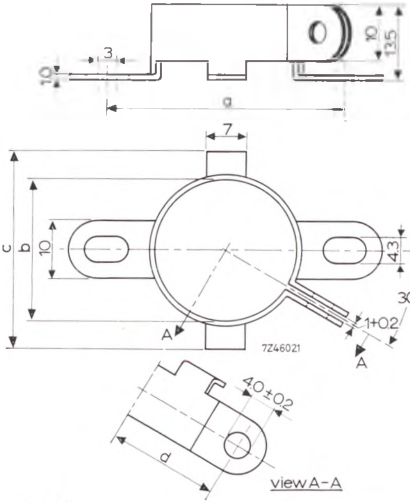


Fig. 2

Mounting brackets

To facilitate vertical mounting, a series of rigid brackets made of cadmium-plated steel are available. They can easily be slid over the capacitor and then fixed to it with a bolt and nut. They are provided with two mounting lugs and, except the smallest version, with two supports to give stability in the cross direction.

Four types are available, one for each can diameter of the capacitor range. They are delivered without bolts and nuts.

can size	*dimensions (mm)*				*figure*	*type number*
	a	b	c	d		
5	37.0 ± 0.2	21	—	15.5	1	B1 271 21
6, 7	41.5 ± 0.2	25	35	18.5	2	B1 271 22
9	51.5 ± 0.2	35	45	23.5	2	B1 271 24
10	56.5 ± 0.2	40	50	26	2	B1 271 25

C431 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR GENERAL PURPOSES

version	*can size*	*working voltage (V)*	*capa-citance (μF)*	*leakage current[1] (mA)*	*ripple-current[2] (mA)*	*dissi-pation factor (tan δ)*	*impedance[3] (Ω)*	*type number suffix*
single	6	4	5000	0.6	1000	0.50	0.25	B5000
	7	4	8000	1.0	1300	0.50	0.16	B8000
	9	4	16000	2.0	2100	0.50	0.16	B16000
	10	4	25000	3.0	2500	0.50	0.16	B25000
single	6	6.4	4000	0.8	1000	0.45	0.25	C4000
	7	6.4	6400	1.0	1300	0.45	0.16	C6400
	9	6.4	12500	2.4	2100	0.45	0.16	C12500
	10	6.4	20000	3.8	2500	0.45	0.16	C20000
single	5	10	2000	0.6	850	0.3	0.40	D2000
	6	10	3200	1.0	1000	0.4	0.25	D3200
	7	10	5000	1.5	1300	0.4	0.16	D5000
	9	10	10000	3.0	2100	0.4	0.16	D10000
	10	10	16000	4.8	2500	0.4	0.16	D16000
single	5	16	1250	0.6	700	0.25	0.40	E1250
	6	16	2000	1.0	1000	0.25	0.25	E2000
	7	16	3200	1.5	1200	0.35	0.16	E3200
	9	16	6400	3.0	1800	0.35	0.16	E6400
	10	16	10000	4.8	2200	0.35	0.16	E10000
single	5	25	800	0.6	650	0.2	0.40	F800
	6	25	1250	1.0	800	0.2	0.25	F1250
	7	25	2000	1.5	1100	0.2	0.16	F2000
	9	25	4000	3.0	1700	0.25	0.16	F4000
	10	25	6400	4.8	2000	0.25	0.16	F6400
single	5	40	500	0.6	650	0.15	0.40	G500
	6	40	800	1.0	850	0.15	0.25	G800
	7	40	1250	1.5	1100	0.15	0.16	G1250
	9	40	2500	3.0	1700	0.15	0.16	G2500
	10	40	4000	4.8	2000	0.15	0.16	G4000
single	5	64	320	0.6	500	0.10	0.40	H320
	6	64	500	1.0	800	0.10	0.25	H500
	7	64	800	1.5	1100	0.10	0.16	H800
	9	64	1600	3.0	1700	0.10	0.16	H1600
	10	64	2500	4.8	2000	0.10	0.16	H2500
double	7	4	2 × 4000	2 × 0.5	2 × 650	0.50	2 × 0.40	B4000 + 4000
	7	6.4	2 × 3200	2 × 0.6	2 × 650	0.45	2 × 0.40	C3200 + 3200
	7	10	2 × 2500	2 × 0.75	2 × 650	0.40	2 × 0.40	D2500 + 2500
	7	16	2 × 1600	2 × 0.75	2 × 600	0.35	2 × 0.40	E1600 + 1600
	7	25	2 × 1000	2 × 0.75	2 × 550	0.20	2 × 0.40	F1000 + 1000
	7	40	2 × 640	2 × 0.75	2 × 550	0.15	2 × 0.40	G640 + 640
	7	64	2 × 400	2 × 0.75	2 × 550	0.10	2 × 0.40	H400 + 400
triple	9	4	3 × 5000	3 × 0.6	3 × 700	0.50	3 × 0.25	B5000 + 5000 + 5000
	10	4	3 × 8000	3 × 1.0	3 × 800	0.50	3 × 0.16	B8000 + 8000 + 8000
triple	9	6.4	3 × 4000	3 × 0.8	3 × 700	0.45	3 × 0.25	C4000 + 4000 + 4000
	10	6.4	3 × 6400	3 × 1.2	3 × 800	0.45	3 × 0.16	C6400 + 6400 + 6400
triple	9	10	3 × 3200	3 × 1.0	3 × 700	0.40	3 × 0.25	D3200 + 3200 + 3200
	10	10	3 × 5000	3 × 1.5	3 × 800	0.40	3 × 0.16	D5000 + 5000 + 5000
triple	9	16	3 × 2000	3 × 1.0	3 × 600	0.35	3 × 0.25	E2000 + 2000 + 2000
	10	16	3 × 3200	3 × 1.5	3 × 700	0.35	3 × 0.16	E3200 + 3200 + 3200
triple	9	25	3 × 1250	3 × 1.0	3 × 550	0.25	3 × 0.25	F1250 + 1250 + 1250
	10	25	3 × 2000	3 × 1.5	3 × 650	0.25	3 × 0.16	F2000 + 2000 + 2000
triple	9	40	3 × 800	3 × 1.0	3 × 550	0.15	3 × 0.25	G800 + 800 + 800
	10	40	3 × 1250	3 × 1.5	3 × 650	0.15	3 × 0.16	G1250 + 1250 + 1250
triple	9	64	3 × 500	3 × 1.0	3 × 550	0.10	3 × 0.25	H500 + 500 + 500
	10	64	3 × 800	3 × 1.5	3 × 650	0.10	3 × 0.16	H800 + 800 + 800

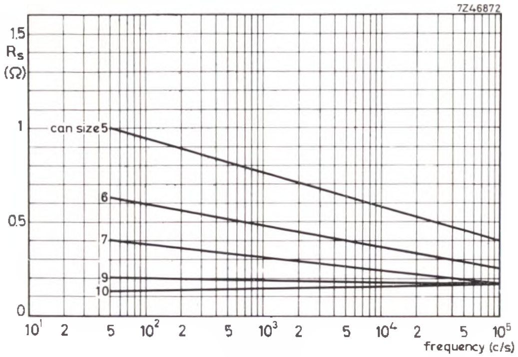
[1] Maximum leakage current at 20 °C after 5 minutes

[2] Maximum permissible ripple current at 100 c/s

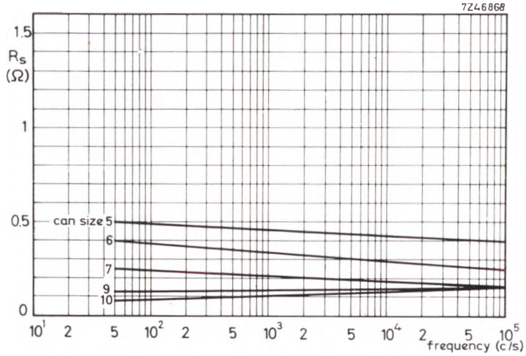
[3] Maximum impedance at 20 °C and 100 kc/s

C431 series - ELECTROLYTIC CAPACITORS

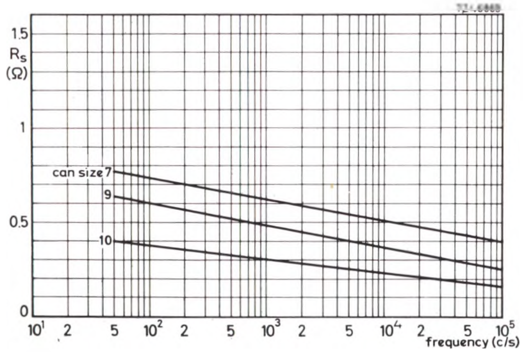
LARGE TYPE, FOR GENERAL PURPOSES



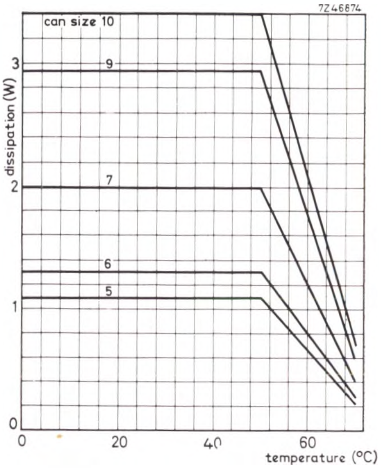
Series resistance of a 16–64 V single capacitor as a function of frequency.



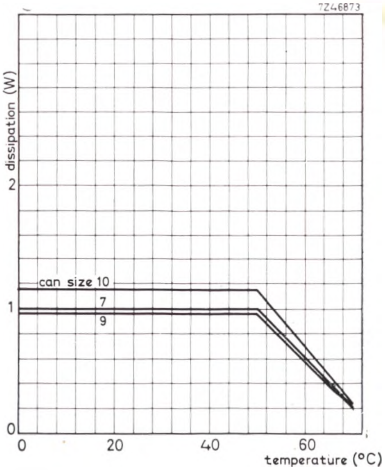
Series resistance of a 16–64 V double capacitor as a function of frequency



Series resistance of a 16–64 V triple capacitor as a function of frequency



Dissipation factor of a single capacitor as a function of temperature



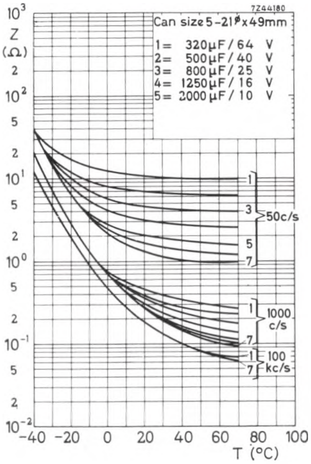
Dissipation factor of a double capacitor as a function of temperature

Impedance graphs

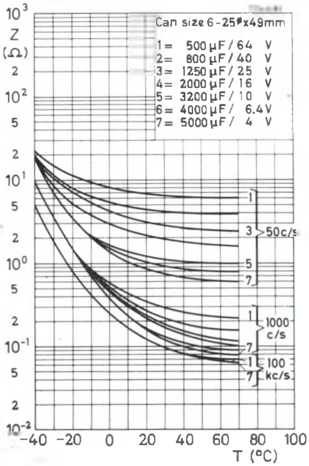
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.

Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.

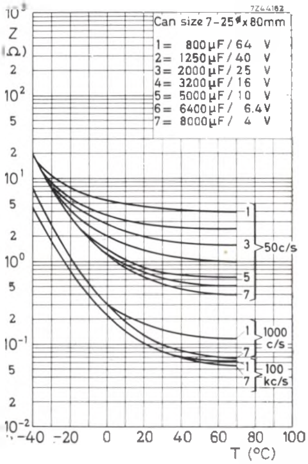
Can size 5



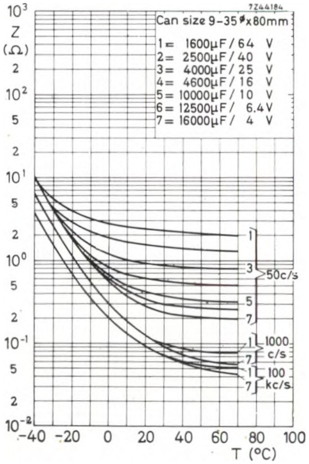
Can size 6



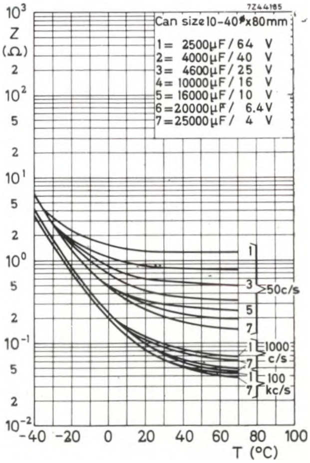
Can size 7



Can size 9

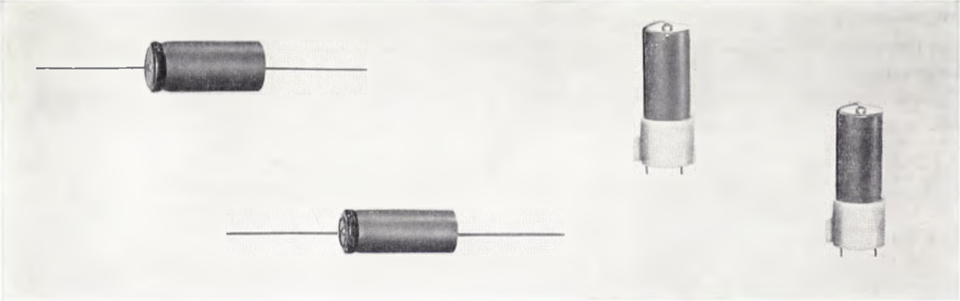


Can size 10



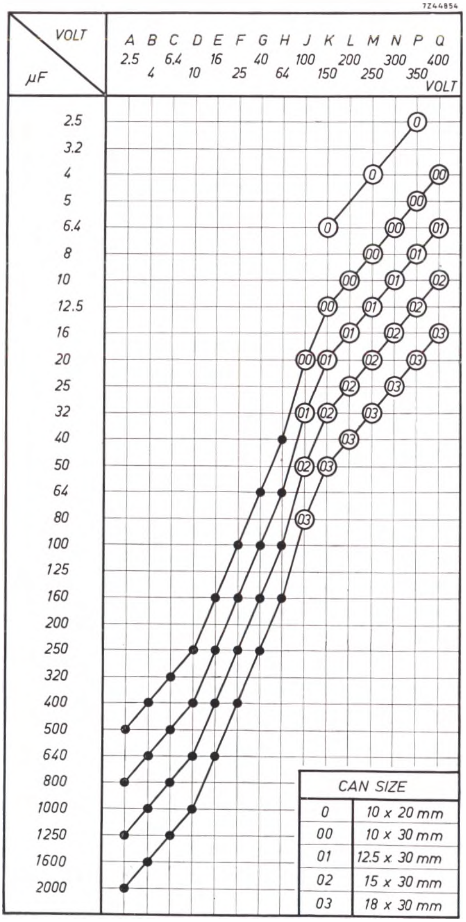
C436 series - ELECTROLYTIC CAPACITORS

SMALL TYPE, FOR HIGH AND LOW VOLTAGES



Due to the high working voltages and permissible temperature these small size capacitors are suitable for decoupling in all kind of tube equipment such as radio and television receivers and similar applications.
They have been designed for operation between −40 and +70 °C.
However, the capacitors with d.c. working voltages up to and including 100 V may also operate at +85 °C for 12 hours per 24 hours provided that the applied d.c. voltage is not higher than 64% of the nominal working voltage.

Max. d.c. working voltage

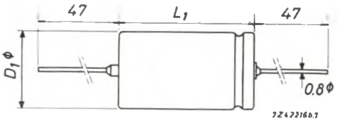


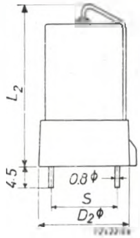
CAN SIZE	
0	10 x 20 mm
00	10 x 30 mm
01	12.5 x 30 mm
02	15 x 30 mm
03	18 x 30 mm

● **non-preferred type**

ELECTROLYTIC CAPACITORS - C436 series

SMALL TYPE, FOR HIGH AND LOW VOLTAGES





Dimensions (mm)

can size	*insulated version*		*printed-wiring version*		
	D_1	L_1	D_2	L_2	S
0	10.4	18.5	12.8	26	10.16
00	10.4	30.5	12.8	39.3	10.16
01	12.9	30.5	15.2	39.3	10.16
02	15.4	30.5	17.8	39.3	12.70
03	18.5	30.5	20.8	39.3	15.24

tolerance on capacitance: for working voltage $\leq$ 64 V	−10/+50%
for working voltage $\geq$ 100 V	−10/+30%
temperature range	−40/+70 °C
peak temperature for working voltage $\leq$ 64 V (12 hours per 24 hours)	85 °C
peak voltage during 1 minute per hour: at +70 °C	1.125 × working voltage +0.5 V
at $\leq$ +40 °C	1.25 × working voltage +0.5 V
climatic group number	40/70/56 (IEC)

Composition of the type number **C436 . . / . .**

insulated: AR ◀
p.w. version: CB ◀
▶ capacitance value (μF)
▶ voltage indication (V)

Example: The type number of a 12.5 μF/150 V capacitor, insulated, is C436AR/K12.5

C436 series - ELECTROLYTIC CAPACITORS

SMALL TYPE, FOR HIGH AND LOW VOLTAGES

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
00	2.5	500	65	200	0.35	2.0	A500
01	2.5	800	85	300	0.35	1.6	A800
02	2.5	1250	120	400	0.35	1.2	A1250
03	2.5	2000	180	550	0.35	1.0	A2000
00	4	400	75	200	0.3	2.0	B400
01	4	640	100	250	0.3	1.6	B640
02	4	1000	145	350	0.3	1.2	B1000
03	4	1600	215	500	0.3	1.0	B1600
00	6.4	320	85	200	0.25	2.0	C320
01	6.4	500	120	250	0.25	1.6	C500
02	6.4	800	180	350	0.25	1.2	C800
03	6.4	1250	265	500	0.25	1.0	C1250
00	10	250	100	200	0.20	2.0	D250
01	10	400	145	250	0.20	1.6	D400
02	10	640	215	350	0.20	1.2	D640
03	10	1000	325	500	0.20	1.0	D1000
00	16	160	100	150	0.15	2.0	E160
01	16	250	145	250	0.15	1.6	E250
02	16	400	215	300	0.15	1.2	E400
03	16	640	325	450	0.15	1.0	E640
00	25	100	100	125	0.15	2.0	F100
01	25	160	145	200	0.15	1.6	F160
02	25	250	215	250	0.15	1.2	F250
03	25	400	325	350	0.15	1.0	F400
00	40	64	100	125	0.1	2.0	G64
01	40	100	145	200	0.1	1.6	G100
02	40	160	215	250	0.1	1.2	G160
03	40	250	325	350	0.1	1.0	G250
00	64	40	100	100	0.1	2.0	H40
01	64	64	145	150	0.1	1.6	H64
02	64	100	215	200	0.1	1.2	H100
03	64	160	325	250	0.1	1.0	H160
00	100	20	85	50	0.15	6.4	J20
01	100	32	130	75	0.15	4.0	J32
02	100	50	180	100	0.15	2.5	J50
03	100	80	270	125	0.15	1.6	J80
0	150	6.4	55	25	0.15	15.0	K6.4
00	150	12.5	85	50	0.15	8.0	K12.5
01	150	20	130	75	0.15	5.0	K20
02	150	32	180	100	0.15	3.0	K32
03	150	50	270	125	0.15	2.0	K50
00	200	10	85	25	0.15	8.0	L10
01	200	16	130	50	0.15	5.0	L16
02	200	25	180	75	0.15	3.0	L25
03	200	40	270	100	0.15	2.0	L40
0	250	4	55	25	0.15	20.0	M4
00	250	8	85	25	0.15	10.0	M8
01	250	12.5	130	50	0.15	6.4	M12.5
02	250	20	180	75	0.15	4.0	M20
03	250	32	270	100	0.15	2.5	M32
00	300	6.4	85	25	0.15	20.0	N6.4
01	300	10	130	50	0.15	15.0	N10
02	300	16	180	75	0.15	8.0	N16
03	300	25	270	100	0.15	5.0	N25
0	350	2.5	55	25	0.15	60.0	P2.5
00	350	5	85	25	0.15	30.0	P5
01	350	8	110	25	0.15	20.0	P8
02	350	12.5	160	50	0.15	15.0	P12.5
03	350	20	240	75	0.15	8.0	P20
00	400	4	85	25	0.15	45.0	Q4
01	400	6.4	110	25	0.15	30.0	Q6.4
02	400	10	160	50	0.15	20.0	Q10
03	400	16	240	75	0.15	12.5	Q16

[1] Maximum leakage current at 20 °C after 5 minutes

[2] Maximum permissible ripple current at 100 c/s

[3] Maximum impedance at 20 °C and 100 kc/s

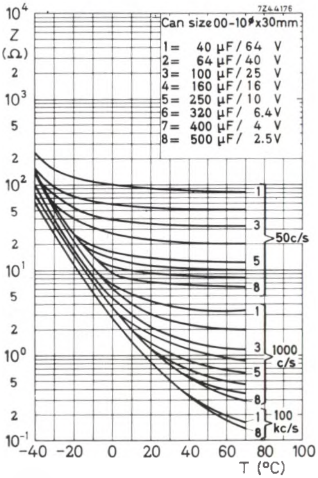
SMALL TYPE, FOR HIGH AND LOW VOLTAGES

Impedance graphs

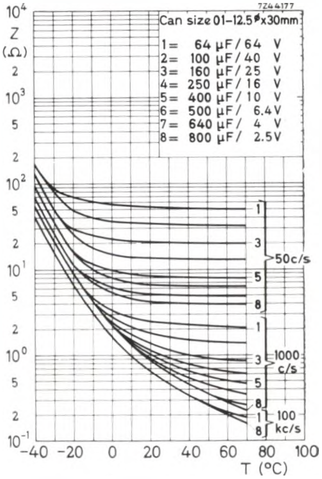
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.

Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table

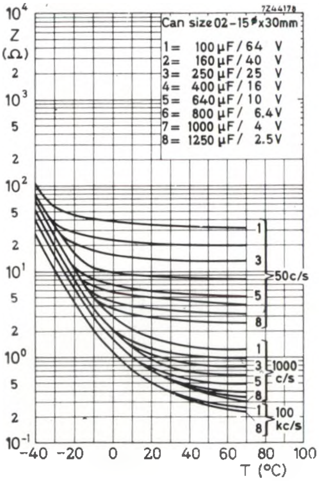
Can size 00



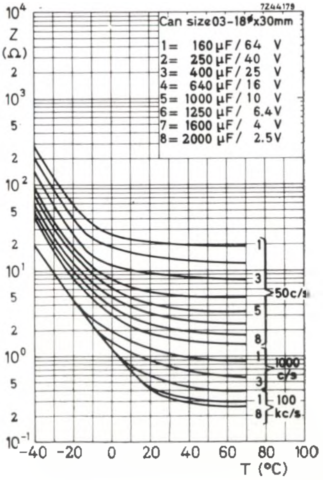
Can size 01



Can size 02

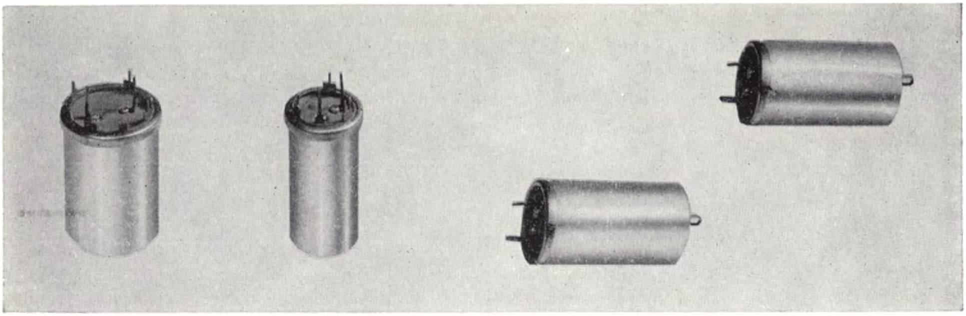


Can size 03



C433 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR HIGH AND LOW VOLTAGES



Due to the high working voltages and high permissible temperature these capacitors are suitable for use in power supplies of tube equipment.

There are ten can sizes and three mechanical versions.

(a) Capacitors with soldering terminals acting as positive and negative terminals either suspended in the wiring of the equipment or fixed by means of a bracket.

(b) Capacitors in a can the edge of which is provided with three or four twistable terminals for fixing the capacitor and acting as negative terminals. One or two soldering tags on the seal serve as positive terminals.

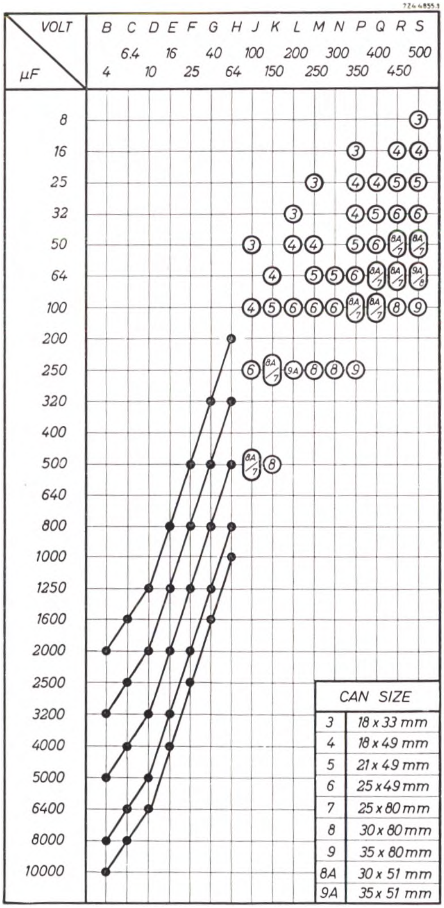
(c) Printed-wiring capacitors. The can is equipped with a built-in metallic base which contains three or four soldering terminals for the attachment and acting as negative terminals. One or two pins through the seal serve as positive terminals.

These capacitors are not insulated. Insulated versions are available upon request.

Capacitors in can size 6 are also available in can size 6T

● non-preferred type

Maximum d.c. working voltage



CAN SIZE	
3	18 x 33 mm
4	18 x 49 mm
5	21 x 49 mm
6	25 x 49 mm
7	25 x 80 mm
8	30 x 80 mm
9	35 x 80 mm
8A	30 x 51 mm
9A	35 x 51 mm

ELECTROLYTIC CAPACITORS - C433 series

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

tolerance on capacitance: 4–64 V types	−10/+50%
100–150 V types	−10/+30%
temperature range	−40/+70 °C
peak temperature (12 hours per 24 hours) for types ≤ 64 V	85 °C
peak voltage during 1 minute per hour:	
for types ≤ 64 V, at +70 °C	1.125 × working voltage +0.5 V
at ≤ +40 °C	1.25 × working voltage +0.5 V

for types > 64 V	100	150	200	250	300	350	400	450	500 V
peak voltage	110	170	225	280	340	395	450	500	550 V

climatic group number	40/70/56 (IEC)

construction	*can size*	*type indication*	
		4–64 V	*100–500 V*
soldering terminals	3	—	BB
	4	BF	BB
	5	BF	BB
	6	BF	BB
twistable terminals	6T	DF	DB
	7	DF	DB
	8	EF	EB
	9	EF	EB
printed-wiring terminals	4	MF	MB
	5	MF	MB
	6T	MF	MB
	A8	NF	NB
	9A	NF	NB

Composition of the type number **C433** . . / . .

type indication ◀ see table

▶ capacitance value (μF)

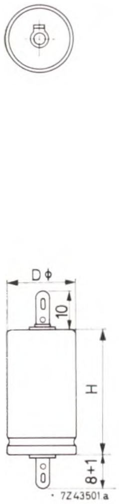
▶ voltage indication (V)

Example: The type number of a 50 μF/350 V capacitor, p.w. version, non insulated, is C433MB/P50.

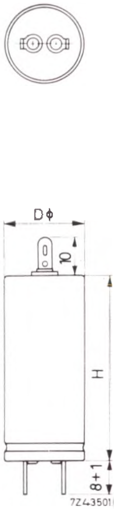
C433 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

Capacitors with soldering terminals

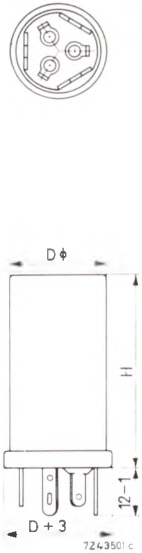


Sizes 4, 5, 6

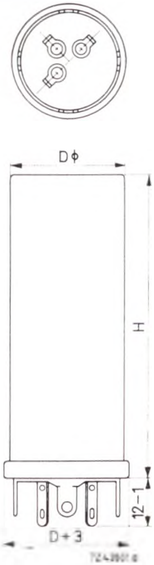


Sizes 3, 4, 5, 6

Capacitors with twistable terminals

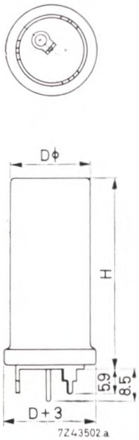


Sizes 6T, 7

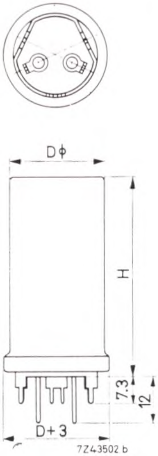


Sizes 8, 9

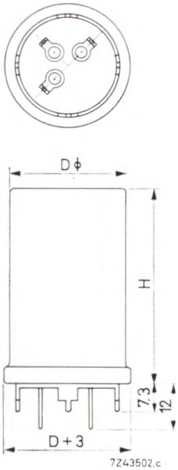
Capacitors with printed-wiring terminals



Sizes 4, 5



Size 6T



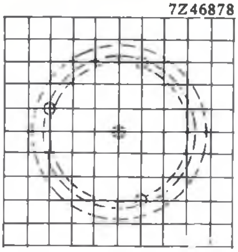
Sizes 8 A, 9 A

Dimensions (mm)

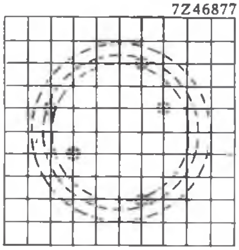
can size	*D*	*H*
3	18	33
4	18	49
5	21	49
6	25	49
6T	25	51
7	25	80
8	30	80
8A	30	51
9	35	80
9A	35	51

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

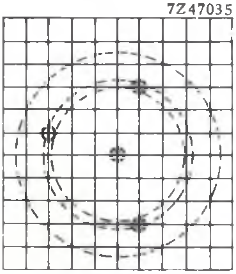
Hole patterns for types with printed-wiring terminals



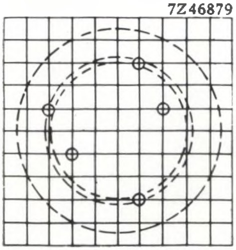
Can size 4, single type, 3 p.w. terminals.



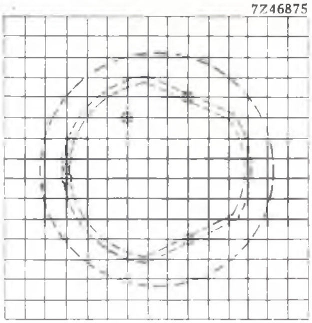
Can size 4, double type, 3 p.w. terminals.



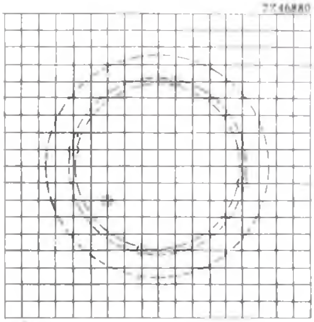
Can size 5, single type, 3 p.w. terminals.



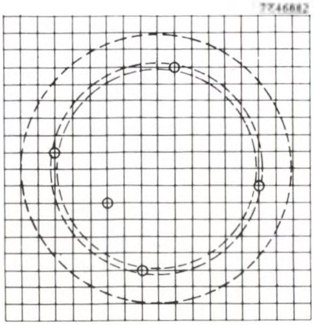
Can size 5, double type, 3 p.w. terminals.



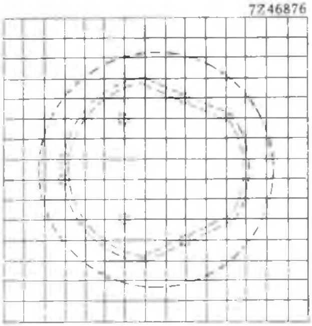
Can size 6T, single type, 3 p.w. terminals.



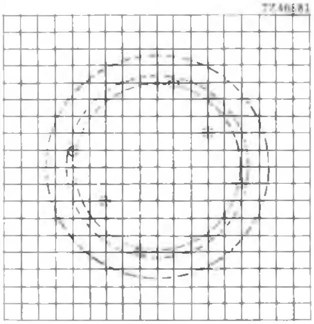
Can size 8A, single type, 4 p.w. terminals.



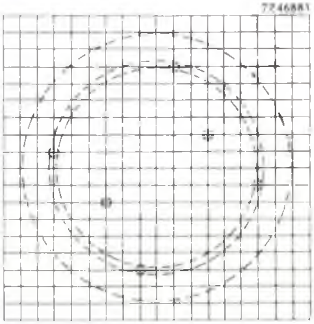
Can size 9A, single type, 4 p.w. terminals.



Can size 6T, double type, 3 p.w. terminals.



Can size 8A, double type, 4 p.w. terminals.



Can size 9A, double type, 4 p.w. terminals.

C433 series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

High voltage types, single version

can size	*working voltage (V)*	*capacitance (μF)*	*leakage current[1] (mA)*	*ripple current[2] (mA)*	*impedance[3] (Ω)*	*type number suffix*
4	100	100	0.33	250	1.25	J100
6	100	250	0.78	450	0.63	J250
6T	100	250	0.78	450	0.63	J250
7–8A	100	500	1.5	650	0.63	J500
4	150	64	0.33	200	1.5	K64
5	150	100	0.5	250	1.0	K100
7–8A	150	250	1.15	450	0.63	K250
8	150	500	2.3	650	0.63	K500
4	200	50	0.33	150	1.25	L50
6	200	100	0.63	300	0.75	L100
6T	200	100	0.63	300	0.75	L100
9A	200	250	1.5	450	0.63	L250
4	250	50	0.4	150	1.5	M50
5	250	64	0.5	200	1.25	M64
6	250	100	0.78	250	0.75	M100
6T	250	100	0.78	250	0.75	M100
8	250	250	1.9	450	0.63	M250
4	300	32	0.33	100	4.0	N32
5	300	50	0.5	200	2.5	N50
5	300	64	0.6	200	2.0	N64
6	300	100	0.93	250	1.25	N100
6T	300	100	0.93	250	1.25	N100
8	300	250	2.3	450	0.63	N250
4	350	25	0.3	100	5.6	P25
4	350	32	0.36	100	4.5	P32
5	350	50	0.55	150	2.8	P50
6	350	64	0.7	200	2.3	P64
6T	350	64	0.7	200	2.3	P64
7–8A	350	100	1.1	250	1.38	P100
9	350	250	2.65	500	0.63	P250
4	400	25	0.33	100	7.0	Q25
5	400	32	0.41	150	5.6	Q32
6	400	50	0.63	200	3.5	Q50
6T	400	50	0.63	200	3.5	Q50
7–8A	400	64	0.8	200	2.8	Q64
7–8A	400	100	1.2	200	1.75	Q100
4	450	16	0.24	100	11.3	R16
5	450	25	0.36	100	7.0	R25
6	450	32	0.46	150	5.6	R32
6T	450	32	0.46	150	5.6	R32
7–8A	450	50	0.7	200	3.5	R50
7–8A	450	64	0.9	200	2.8	R64
8	450	100	1.3	200	1.75	R100
4	500	16	0.27	100	15.0	S16
5	500	25	0.4	100	10.0	S25
6	500	32	0.5	150	7.9	S32
6T	500	32	0.5	150	7.9	S32
7–8A	500	50	0.78	200	5.0	S50
8-9A	500	64	1.0	200	4.0	S64
9	500	100	1.5	300	2.5	S100

Dissipation factor (tan δ) is 0.15 for all types.

[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

ELECTROLYTIC CAPACITORS - C433 series

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

High voltage types, double version

can size	working voltage (V)	capacitance (μF)	leakage current[1] (mA)	ripple-current[2] (mA)	impedance[3] (Ω)	type number suffix
3	100	25 + 25	2 × 0.1	2 × 50	2 × 5	J25+25
4	100	50 + 50	2 × 0.18	2 × 125	2 × 2.5	J50+50
6	100	125 + 125	2 × 0.4	2 × 225	2 × 1.25	J125+125
6T	100	125 + 125	2 × 0.4	2 × 225	2 × 1.25	J125+125
7–8A	100	250 + 250	2 × 0.78	2 × 325	2 × 1.25	J250+250
4	150	32 + 32	2 × 0.12	2 × 100	2 × 3	K32+32
5	150	50 + 50	2 × 0.27	2 × 125	2 × 2	K50+50
7–8A	150	125 + 125	2 × 0.65	2 × 225	2 × 1.25	K125+125
8	150	250 + 250	2 × 1.15	2 × 325	2 × 1.25	K250+250
3	200	16 + 16	2 × 0.13	2 × 50	2 × 4.50	L16+16
4	200	25 + 25	2 × 0.12	2 × 75	2 × 2.50	L25+25
6	200	50 + 50	2 × 0.33	2 × 150	2 × 1.50	L50+50
6T	200	50 + 50	2 × 0.33	2 × 150	2 × 1.50	L50+50
9A	200	125 + 125	2 × 0.75	2 × 225	2 × 1.25	L125+125
3	250	12.5 + 12.5	2 × 0.1	2 × 50	2 × 6.3	M12.5+12.5
4	250	25 + 25	2 × 0.1	2 × 75	2 × 3.0	M25+25
5	250	32 + 32	2 × 0.25	2 × 125	2 × 2.5	M32+32
6	250	50 + 50	2 × 0.4	2 × 125	2 × 1.5	M50+50
6T	250	50 + 50	2 × 0.4	2 × 150	2 × 1.5	M50+50
8	250	125 + 125	2 × 0.95	2 × 225	2 × 1.25	M125+125
4	300	16 + 16	2 × 0.17	2 × 50	2 × 8	N16+16
5	300	25 + 25	2 × 0.25	2 × 100	2 × 5	N25+25
5	300	32 + 32	2 × 0.33	2 × 100	2 × 4	N32+32
6	300	50 + 50	2 × 0.5	2 × 125	2 × 2.5	N50+50
6T	300	50 + 50	2 × 0.5	2 × 125	2 × 2.5	N50+50
8	300	125 + 125	2 × 1.15	2 × 225	2 × 1.25	N125+125
3	350	8 + 8	2 × 0.1	2 × 25	2 × 18	P8+8
4	350	12.5 + 12.5	2 × 0.15	2 × 50	2 × 11.3	P12.5+12.5
4	350	16 + 16	2 × 0.2	2 × 50	2 × 9	P16+16
5	350	25 + 25	2 × 0.3	2 × 75	2 × 5.5	P25+25
6	350	32 + 32	2 × 0.36	2 × 100	2 × 4.5	P32+32
6T	350	32 + 32	2 × 0.36	2 × 100	2 × 4.5	P32+32
7–8A	350	50 + 50	2 × 0.55	2 × 125	2 × 2.75	P50+50
9	350	125 + 125	2 × 1.35	2 × 250	2 × 1.25	P125+125
4	400	12.5 + 12.5	2 × 0.17	2 × 50	2 × 14	Q12.5+12.5
5	400	16 + 16	2 × 0.2	2 × 75	2 × 11.2	Q16+16
6	400	25 + 25	2 × 0.33	2 × 100	2 × 7.0	Q25+25
6T	400	25 + 25	2 × 0.33	2 × 100	2 × 7.0	Q25+25
7–8A	400	32 + 32	2 × 0.41	2 × 100	2 × 5.50	Q32+32
7–8A	400	50 + 50	2 × 0.63	2 × 100	2 × 3.50	Q50+50
4	450	8 + 8	2 × 0.12	2 × 50	2 × 23	R8+8
5	450	12.5 + 12.5	2 × 0.18	2 × 50	2 × 14	R12.5+12.5
6	450	16 + 16	2 × 0.24	2 × 75	2 × 11.2	R16+16
6T	450	16 + 16	2 × 0.24	2 × 75	2 × 11.2	R16+16
7–8A	450	25 + 25	2 × 0.36	2 × 100	2 × 7.0	R25+25
7–8A	450	32 + 32	2 × 0.46	2 × 100	2 × 5.50	R32+32
8	450	50 + 50	2 × 0.7	2 × 100	2 × 3.50	R50+50
3	500	4 + 4	2 × 0.08	2 × 25	2 × 62.5	S4+4
4	500	8 + 8	2 × 0.14	2 × 50	2 × 30	S8+8
5	500	12.5 + 12.5	2 × 0.2	2 × 50	2 × 20	S12.5+12.5
6	500	16 + 16	2 × 0.27	2 × 75	2 × 15.6	S16+16
6T	500	16 + 16	2 × 0.27	2 × 75	2 × 15.6	S16+16
7–8A	500	25 + 25	2 × 0.4	2 × 100	2 × 10	S25+25
8–9A	500	32 + 32	2 × 0.5	2 × 100	2 × 8	S32+32
9	500	50 + 50	2 × 0.78	2 × 150	2 × 5	S50+50

Dissipation factor ($\tan \delta$) is 0.15 for all types.

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[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

LARGE TYPE, FOR HIGH AND LOW VOLTAGES

Low voltage types

version	can size	working voltage (V)	capacitance (μF)	leakage current[1] (mA)	ripple-current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
Single	4	4	2000	0.27	600	0.50	0.63	B2000
	5	4	3200	0.4	850	0.50	0.40	B3200
	6	4	5000	0.63	1000	0.50	0.25	B5000
	6T	4	5000	0.63	1000	0.50	0.25	B5000
	7–8A	4	8000	1.00	1300	0.50	0.15	B8000
	8–9A	4	10000	1.25	1500	0.50	0.15	B10000
Single	4	6.4	1600	0.22	600	0.50	0.63	C1600
	5	6.4	2500	0.50	850	0.45	0.40	C2500
	6	6.4	4000	0.77	1000	0.45	0.25	C4000
	6T	6.4	4000	0.77	1000	0.45	0.25	C4000
	7–8A	6.4	6400	1.22	1300	0.45	0.15	C6400
	8–9A	6.4	8000	1.55	1500	0.45	0.15	C8000
Single	4	10	1250	0.4	600	0.30	0.63	D1250
	5	10	2000	0.63	850	0.30	0.40	D2000
	6	10	3200	1.00	1000	0.40	0.25	D3200
	6T	10	3200	1.00	1000	0.40	0.25	D3200
	7–8A	10	5000	1.50	1300	0.40	0.15	D5000
	8–9A	10	6400	2.00	1500	0.40	0.15	D6400
Single	4	16	800	0.4	500	0.25	0.63	E800
	5	16	1250	0.6	700	0.25	0.40	E1250
	6	16	2000	1.0	1000	0.25	0.25	E2000
	6T	16	2000	1.0	1000	0.25	0.25	E2000
	7–8A	16	3200	1.50	1200	0.35	0.15	E3200
	8–9A	16	4000	2.00	1300	0.35	0.15	E4000
Single	4	25	500	0.4	450	0.20	0.63	F500
	5	25	800	0.6	650	0.20	0.40	F800
	6	25	1250	1.0	850	0.20	0.25	F1250
	6T	25	1250	1.0	850	0.20	0.25	F1250
	7–8A	25	2000	1.5	1100	0.20	0.15	F2000
	8–9A	25	2500	2.0	1200	0.20	0.15	F2500
Single	4	40	320	0.4	450	0.15	0.63	G320
	5	40	500	0.6	650	0.15	0.40	G500
	6	40	800	1.00	800	0.15	0.25	G800
	6T	40	800	1.00	800	0.15	0.25	G800
	7–8A	40	1250	1.50	1100	0.15	0.15	G1250
	8–9A	40	1600	2.00	1200	0.15	0.15	G1600
Single	4	64	200	0.4	400	0.10	0.63	H200
	5	64	320	0.6	500	0.10	0.40	H320
	6	64	500	1.00	800	0.15	0.25	H500
	6T	64	500	1.00	800	0.10	0.25	H500
	7–8A	64	800	1.50	1100	0.10	0.15	H800
	8–9A	64	1000	2.00	1200	0.10	0.15	H1000
Double	4	4	1000+1000	2×0.15	2×300	0.50	2×1.25	B1000+1000
	5	4	1600+1600	2×0.2	2×425	0.50	2×0.8	B1600+1600
	6	4	2500+2500	2×0.33	2×500	0.50	2×0.5	B2500+2500
	6T	4	2500+2500	2×0.33	2×500	0.50	2×0.5	B2500+2500
	7–8A	4	4000+4000	2×0.50	2×750	0.50	2×0.3	B4000+4000
	8–9A	4	5000+5000	2×0.63	2×750	0.50	2×0.3	B5000+5000
Double	4	10	640+ 640	2×0.2	2×300	0.30	2×1.25	D640 +640
	5	10	1000+1000	2×0.33	2×425	0.30	2×0.8	D1000+1000
	6	10	1600+1600	2×0.50	2×500	0.40	2×0.5	D1600+1600
	6T	10	1600+1600	2×0.50	2×500	0.40	2×0.5	D1600+1600
	7–8A	10	2500+2500	2×0.75	2×650	0.40	2×0.3	D2500+2500
	8–9A	10	3200+3200	2×1.00	2×750	0.40	2×0.3	D3200+3200
Double	4	25	250+ 250	2×0.2	2×225	0.20	2×1.25	F250 +250
	5	25	400+ 400	2×0.3	2×325	0.20	2×0.8	F400 +400
	6	25	640+ 640	2×0.75	2×425	0.20	2×0.5	F640 +640
	6T	25	640+ 640	2×0.75	2×425	0.20	2×0.5	F640 +640
	7–8A	25	1000+1000	2×0.78	2×550	0.20	2×0.3	F1000+1000
	8–9A	25	1250+1250	2×1.00	2×600	0.50	2×0.3	F1250+1250
Double	4	64	100+ 100	2×0.2	2×200	0.10	2×1.25	H100 +100
	5	64	160+ 160	2×0.3	2×250	0.10	2×0.8	H160 +160
	6	64	250+ 250	2×0.5	2×400	0.10	2×0.5	H250 +250
	6T	64	250+ 250	2×0.5	2×400	0.10	2×0.5	H250 +250
	7–8A	64	400+ 400	2×0.75	2×550	0.10	2×0.3	H400 +400
	8–9A	64	500+ 500	2×1.00	2×600	0.10	2×0.3	H500 +500

For footnotes see preceding pages.

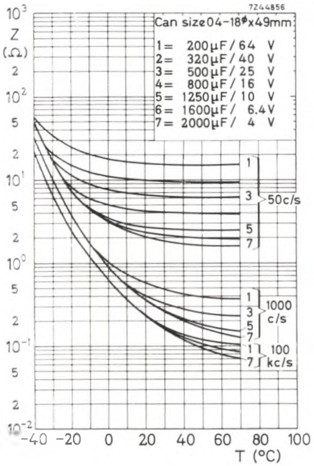
LARGE TYPE, FOR HIGH AND LOW VOLTAGES

Impedance graphs

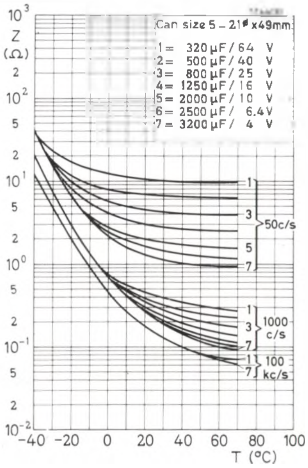
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.

Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the tables.

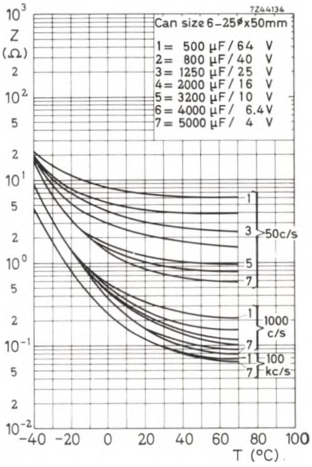
Can size 4



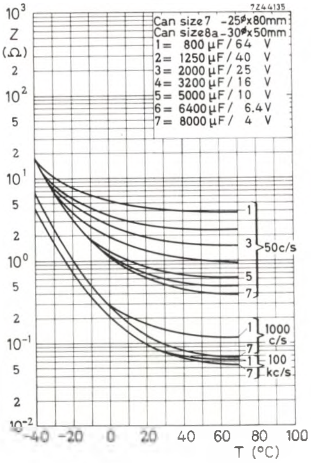
Can size 5



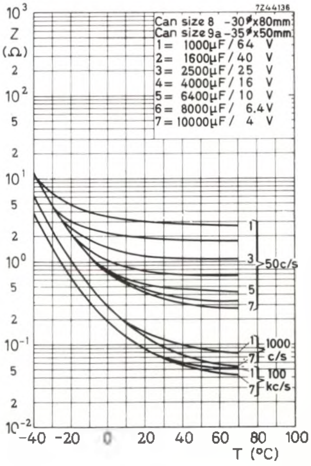
Can sizes 6, 6T



Can sizes 7, 8A



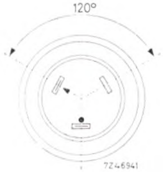
Can sizes 8, 9A



C441 series - ELECTROLYTIC CAPACITORS

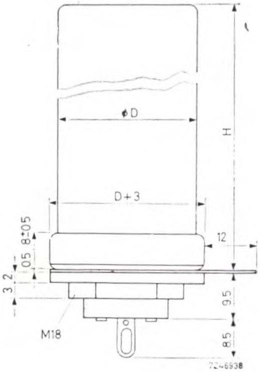
LARGE SCREW BASE TYPE, FOR HIGH VOLTAGES

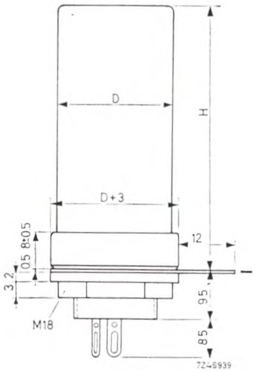
These capacitors are used as smoothing capacitors in cases where a special design is required. They are used as replacement types or for experimental work by the amateur and in laboratories.



Dimensions (mm)

can size	D	H
1	26	54
2	26	83
3	31	83





ELECTROLYTIC CAPACITORS - C441 series

LARGE SCREW BASE TYPES, FOR HIGH VOLTAGES

tolerance on capacitance . . . . −10/+50%
temperature range . . . . −40/+70 °C

working voltage (V)	64	100	150	200	250	300	350	400	450	500
peak voltage at 70 °C (V)	72.5	115	175	230	290	350	400	450	500	550

Single version

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
1	500	25	530	140	0.15	2	S25C
2	450	50	700	200	0.15	3.5	R50C

Double version

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
1	500	12.5 + 12.5	280 + 280	70 + 70	0.15	20 + 20	S12.5+12.5C
1	450	16 + 16	240 + 240	75 + 75	0.15	11.2 + 11.2	R16+16C
1	400	25 + 25	330 + 330	100 + 100	0.15	7 + 7	Q25+25C
2	500	25 + 25	400 + 400	100 + 100	0.15	10 + 10	S25+25C
3	500	32 + 32	500 + 500	100 + 100	0.15	8 + 8	S32+32C
1	200	50 + 50	330 + 330	150 + 150	0.15	1.5 + 1.5	L50+50C
1	300	50 + 50	500 + 500	125 + 125	0.15	2.5 + 2.5	N50+50C
2	400	50 + 50	630 + 630	100 + 100	0.15	3.5 + 3.5	Q50+50C
3	450	50 + 50	700 + 700	100 + 100	0.15	3.5 + 3.5	R50+50C
1	100	125 + 125	350 + 350	300 + 300	0.15	12.5 + 1.25	J125+125C
1	64	250 + 250	500 + 500	400 + 400	0.10	0.5 + 0.5	H250+250C

[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

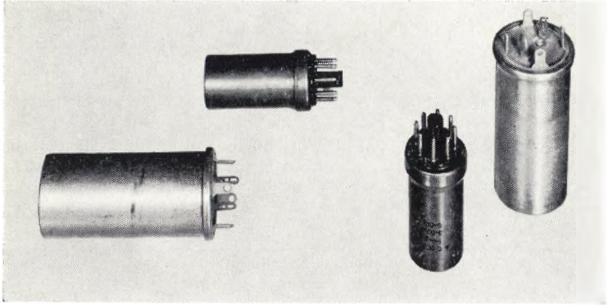
Composition of the type number **C441GR/. .C**

→ capacitance value (μF)
→ voltage indication (V)

Capacitors are delivered with a nut, insulating ring, and ring provided with a soldering lug.

Special series - ELECTROLYTIC CAPACITORS

LARGE TYPE, FOR HIGH VOLTAGES



High ripple-current capacitors

The capacitors can stand extra high ripple currents. In the case of multiple versions, one section (the one for the high ripple currents) has a separate cathode connection.
They are mainly used as smoothing capacitors in television receivers.
Special attention is drawn to the quadruple types which are ideal for the above application.

High discharge-current capacitors

For applications in which the capacitor is discharged periodically in short periods of time, special construction measures have to be taken. A few types, designed for special purposes, are available.

Bipolar electrolytic capacitors

Contrary to normal electrolytic capacitors, bipolar capacitors may be loaded continuously with small a.c. voltages or with reversed voltages for short periods of time. A d.c. voltage may be applied in either direction. They are used e.g. in voltage-doubler circuits, in single-ended push-pull output stages or as phasing capacitors with small a.c. motors.

Octal-base capacitors

In case a very quick replacement of the electrolytic capacitor should be possible, octal-base capacitors are to be used.

ELECTROLYTIC CAPACITORS - Special series

LARGE TYPE, FOR HIGH VOLTAGES

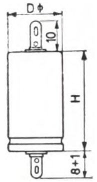


Fig. 1

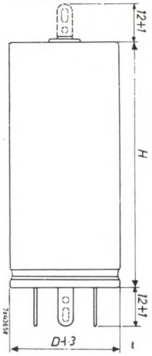


Fig. 2

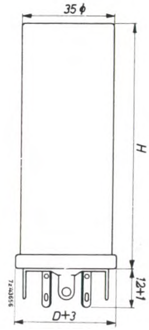


Fig. 3

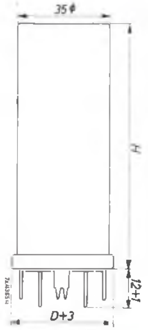
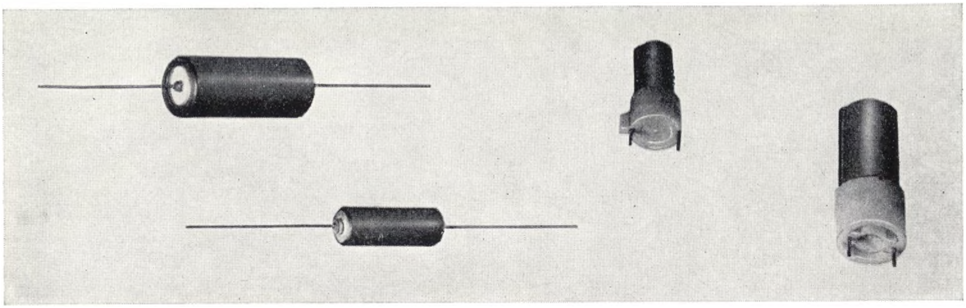


Fig. 4

type	*capacitance (μF)*	*voltage (V)*	*construction*	*dimensions (mm)*		*type number*
				D	H	
High ripple current	200	300	fig. 2	35	80	AC5856/200
	200	325	fig. 2	35	80	AC5858/200
	50+ 50+ 50	300	fig. 3	30	80	AC5481/50+50+50
	50+ 50+ 50	350	fig. 3	35	80	AC5482/50+50+50
	100+ 50+ 50	300	fig. 3	35	80	AC5407/100+50+50
	100+100+ 50	300	fig. 3	35	80	AC5853/100+100+50
	100+100	300	fig. 3	35	80	AC5850/100+100
	200+100+ 50+ 25	300	fig. 2	35	80	AC5862/A
	200+100+ 50+ 25	300	fig. 3	35	80	AC5862/B
	200+100+ 50+ 25	300	fig. 4	35	80	AC5862/C
High discharge current	50	450	fig. 3	30	80	AC5800/50
	25	100	fig. 1	18	33	AC5801/25
	50	100	fig. 1	18	49	AC5803/50
	100	100	fig. 1	25	49	AC5805/100
	500	40	fig. 3	25	51	AC5806/500
Bipolar	200	150	fig. 3	35	80	AC5953/200
	200	150	fig. 2	35	80	AC5954/200
	100	150	fig. 2	30	80	AC5953/100
	100	15	fig. 2	18	33	AC5950/100
	50	30	fig. 2	18	33	AC5951/50
	50	350	fig. 2	30	80	AC5955/50
	10	300/500	fig. 3	25	51	AC5900/10
	14	80/400	fig. 3	25	51	AC5901/14
Octal base	50—1000	25–500				AC5000

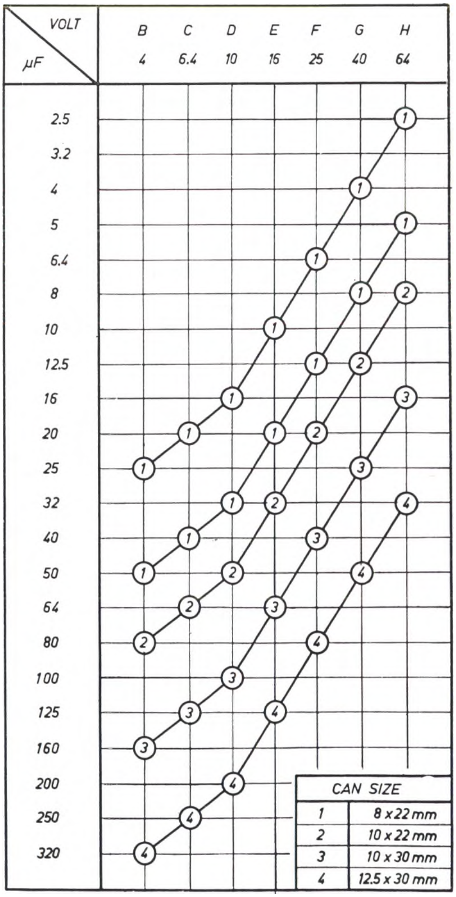
C428 series - ELECTROLYTIC CAPACITORS

SMALL LONG LIFE TYPE (Supersedes C427)



This range of electrolytic capacitors has been specially developed for industrial apparatus where long service life and high reliability are essential, e.g. computors, telecommunication and telephone equipment.
High grade materials, an extra reserve of electrolyte and close quality control during manufacture ensure that these capacitors have a life expectancy far superior to normal grade electrolytic capacitors.

Maximum d.c. working voltage



VOLT / μF	B 4	C 6.4	D 10	E 16	F 25	G 40	H 64
2.5							①
3.2							
4						①	
5							①
6.4					①		
8						①	②
10				①			
12.5					①	②	
16			①				③
20		①		①	②		
25	①					③	
32			①	②			④
40		①			③		
50	①		②			④	
64		②		③			
80	②				④		
100			③				
125		③		④			
160	③						
200			④				
250		④					
320	④						

CAN SIZE	
1	8 x 22 mm
2	10 x 22 mm
3	10 x 30 mm
4	12.5 x 30 mm

ELECTROLYTIC CAPACITORS - C428 series

SMALL LONG LIFE TYPE

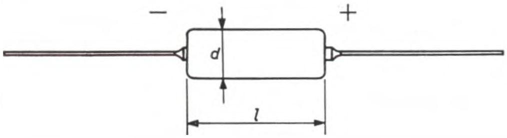


Fig 1.

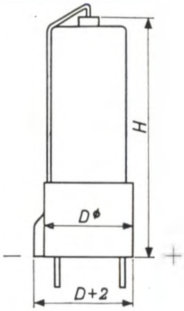


Fig 2.

Dimensions (mm)

can size	figure 1		figure 2		
	d	l	D	H	S
1	8.3	22.5	11.3	30	10.16
2	10.5	22.5	12.9	31	10.16
3	10.5	30.5	12.9	39	10.16
4	13	30.5	15.3	39	10.16

tolerance on capacitance . . . . −10/+50%
temperature range . . . . −40/+70 °C
peak voltage: during several hours . . . . 1.2 × working voltage
during several days . . . . 1.1 × working voltage
max. permissible alternating voltage at 50 and 100 c/s . . . . $1.5\ V_{rms}$
climatic group number . . . . 40/70/56 (IEC)

Composition of the type number **C428 . . / . .**

insulated: AR ◀
p.w. version: CB ◀
▶ capacitance value (µF)
▶ voltage indication (V)

Example: The type number of a 50 µF/10 V capacitor, insulated, is C428AR/D50.

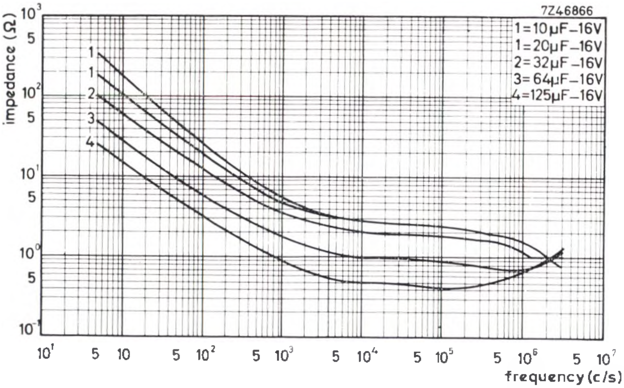
SMALL LONG LIFE TYPE

can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)	type number suffix
1	4	25	6	15	0.20	6	B25
1	4	50	7	30	0.30	6	B50
2	4	80	8	20	0.30	4	B80
3	4	160	11.5	96	0.30	2	B160
4	4	320	18	192	0.30	1	B320
1	6.4	20	6.5	12	0.20	6	C20
1	6.4	40	7.5	24	0.25	6	C40
2	6.4	64	9	38	0.25	4	C64
3	6.4	125	13	76	0.25	2	C125
4	6.4	250	21	152	0.25	1	C250
1	10	16	6.5	10	0.15	6	D16
1	10	32	8	20	0.20	6	D32
2	10	50	10	32	0.20	4	D50
3	10	100	15	64	0.20	2	D100
4	10	200	25	128	0.20	1	D200
1	16	10	6.5	10	0.15	6	E10
1	16	20	8	20	0.15	6	E20
2	16	32	10	32	0.15	4	E32
3	16	64	15.5	64	0.15	2	E64
4	16	125	25	128	0.15	1	E125
1	25	6.4	6.5	10	0.10	6	F6.4
1	25	12.5	8	20	0.10	6	F12.5
2	25	20	10	32	0.10	4	F20
3	25	40	15	64	0.10	2	F40
4	25	80	25	128	0.10	1	F80
1	40	4	6.5	10	0.10	6	G4
1	40	8	8	20	0.10	6	G8
2	40	12.5	10	32	0.10	4	G12.5
3	40	15	25	64	0.10	2	G25
4	40	50	25	128	0.10	1	G50
1	64	2.5	6.5	10	0.10	6	H2.5
1	64	5	8	20	0.10	6	H5
2	64	8	10	32	0.10	4	H8
3	64	16	15.5	64	0.10	2	H16
4	64	32	25.5	128	0.10	1	H32

[1] Maximum leakage current at 20 °C after 5 minutes

[2] Maximum permissible ripple current at 100 c/s

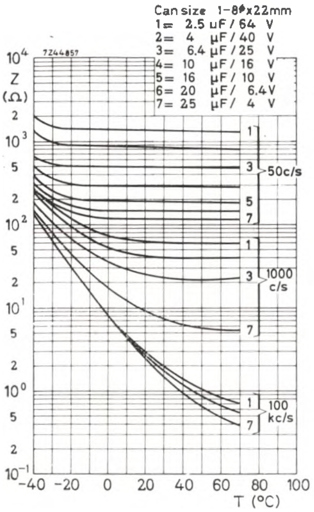
[3] Maximum impedance at 20 °C and 100 kc/s



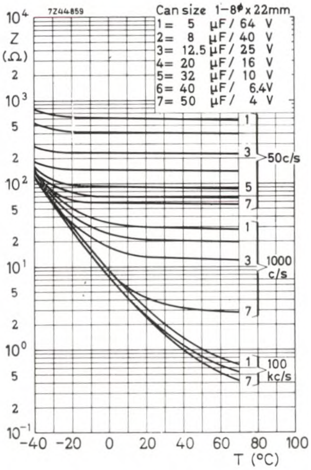
Typical curves of impedance, measured at 20 °C, against frequency.

Impedance graphs

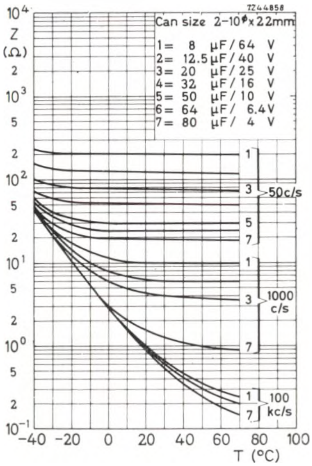
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.
Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.



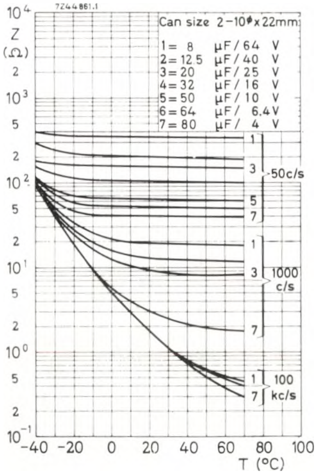
Can size 1



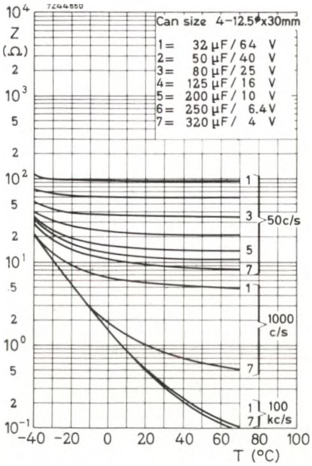
Can size 2



Can size 3

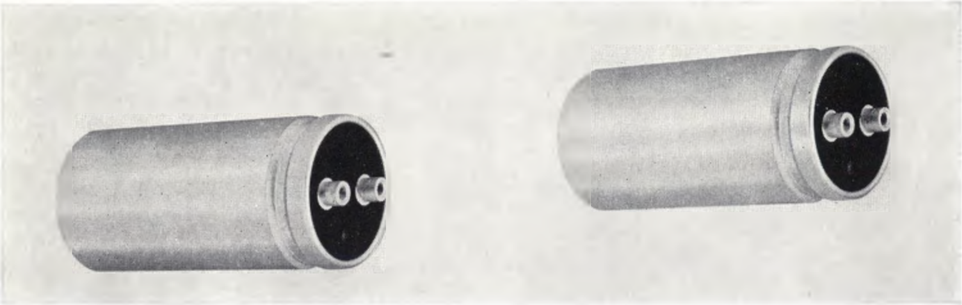


Can size 4



C432 series - ELECTROLYTIC CAPACITORS

LARGE LONG LIFE TYPE



These high-capacitance, low-voltage capacitors, having a high quality, a long service life and an extreme reliability, are suitable for use as filter and energy-storage capacitors for the power supplies of professional equipment, as for instance computers.

Maximum d.c. working voltage

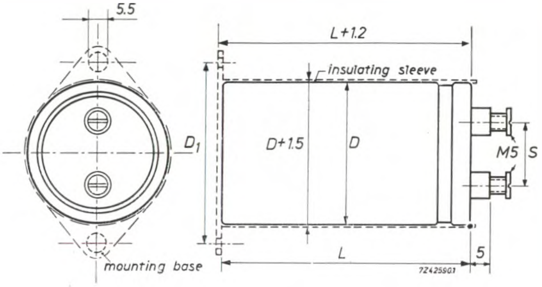
VOLT / µF	C 6.4	D 10	E 16	F 25	G 40	H 64	J 100
900							11
1000							
1120							
1250							12
1400						11	
1600							
1800							
2000						12	
2240					11		14
2500							
2800							15
3150				11	12		
3550						14	
4000							
4500				12		15	
5000			11				
5600					14		
6300							
7100			12		15		
8000		11		14			
9000							
10 000	11			15			
11 200		12					
12 500			14				
14 000	12						
16 000			15				
18 000							
20 000		14					
22 400							
25 000	14	15					
28 000							
31 500	15						

CAN SIZE	
11	35 x 86 mm
12	35 x 108 mm
14	50 x 86 mm
15	50 x 108 mm

LARGE LONG LIFE TYPE

Dimensions (mm)

can size	S	insulated		
		D	D₁	L
11	15	35	48	86
12	15	35	48	108
14	22	50	63	86
15	22	50	63	108



tolerance on capacitance	−10/+50%
temperature range	−40/+70 °C
peak voltage during 1 minute per hour: at + 70 °C	± 1.15 × working voltage
at ≤ + 40 °C	± 1.25 × working voltage
max. impedance at 100 kc/s	0.1Ω
climatic group number	40/70/56 (IEC)

Composition of the type number **C432 . . / . .**

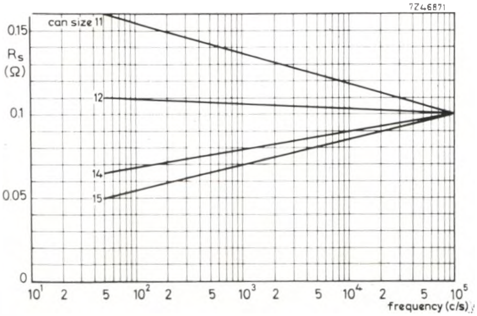
insulated, with mounting base: MR

insulated: FR

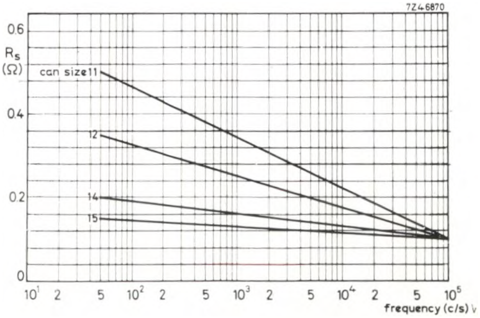
capacitance value (μF)

voltage indication (V)

Example:The type number of a 5000 μF/16 V capacitor, insulated, is C432FR/E5000.



Series resistance of a 6.4–40 V capacitor as a function of temperature.



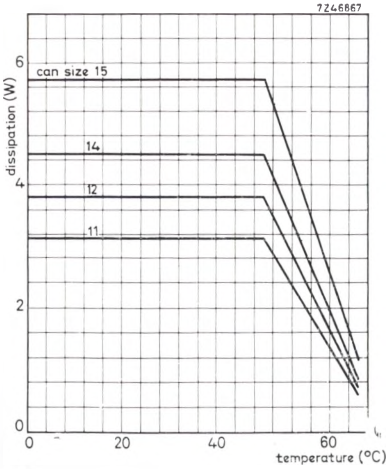
Series resistance of a 64–100 V capacitor, as a function of temperature.

C432 series - ELECTROLYTIC CAPACITORS

LARGE LONG LIFE TYPE

can size	working voltage (V)	capacitance (μF)	leakage current[1] (mA)	ripple current[2] (A)	dissipation factor (tan δ)	type number suffix
11	6.4	10000	1.9	2.1	0.45	C10000
12	6.4	14000	2.7	2.8	0.45	C14000
14	6.4	25000	4.8	3.2	0.45	C25000
15	6.4	31500	6.1	4.9	0.45	C31500
11	10	8000	2.4	2.1	0.35	D8000
12	10	11200	3.4	2.8	0.35	D11200
14	10	20000	6.0	3.2	0.35	D20000
15	10	25000	7.5	4.9	0.35	D25000
11	16	5000	2.4	2.1	0.25	E5000
12	16	7100	3.4	2.8	0.25	E7100
14	16	12500	6.0	3.2	0.35	E12500
15	16	16000	7.7	4.9	0.25	E16000
11	25	3150	2.4	2.1	0.15	F3150
12	25	4500	3.4	2.8	0.15	F4500
14	25	8000	6.0	3.2	0.15	F8000
15	25	10000	7.5	4.9	0.10	F10000
11	40	2240	2.7	2.1	0.10	G2240
12	40	3150	3.8	2.8	0.10	G3150
14	40	5600	6.7	3.2	0.10	G5600
15	40	7100	8.4	4.9	0.10	G7100
11	64	1400	2.7	1.1	0.10	H1400
12	64	2000	3.8	1.5	0.10	H2000
14	64	3550	6.7	2.2	0.10	H3550
15	64	4500	8.4	2.6	0.10	H4500
11	100	900	2.7	1.1	0.10	J900
12	100	1250	3.8	1.5	0.10	J1250
14	100	2240	6.7	2.2	0.10	J2240
15	100	2800	8.4	2.6	0.10	J2800

[1] Maximum leakage current at 20 °C after 5 minutes
[2] Maximum permissible ripple current at 100 c/s



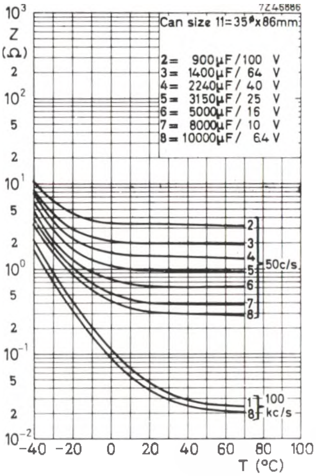
Dissipation (W)
as a function of temperature.

Impedance graphs

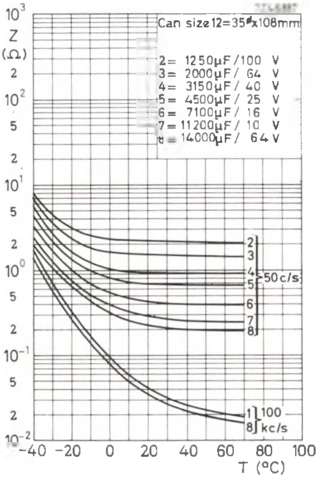
The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.

Typical impedance/temperature curves for the different can sizes are given below. The maximum value at 20 °C and 100 kc/s is 0.1 Ω.

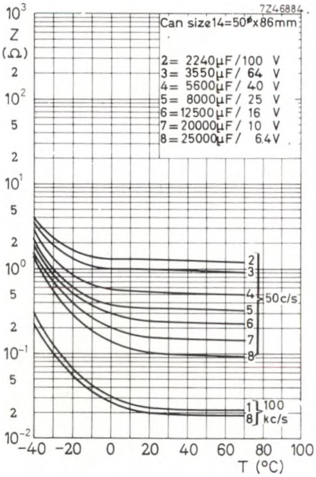
Can size 11



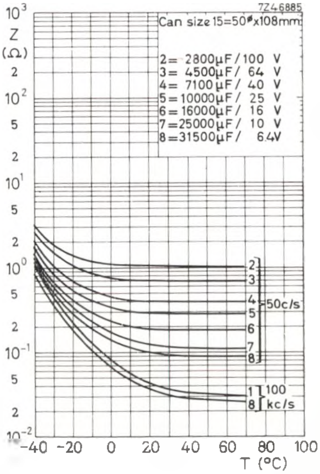
Can size 12



Can size 14

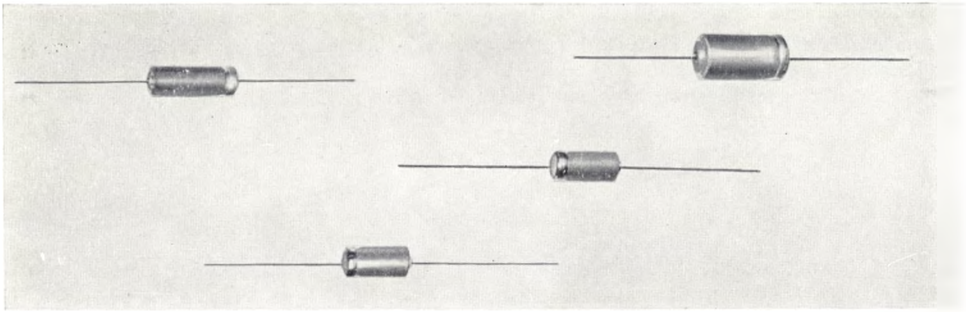


Can size 15



C415 series - ELECTROLYTIC CAPACITORS

SMALL SOLID ALUMINIUM TYPE



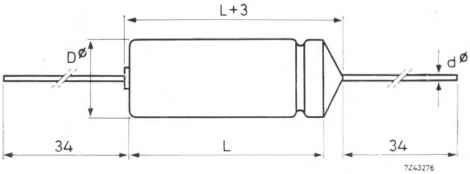
Solid electrolyte capacitors offer great advantages over wet types as regards service life, reliability, stability during life, temperature range etc. They are therefore preferable for all kinds of professional and military equipment.
The C415-type is the only solid-electrolyte aluminium capacitor available now.
Although its dimensions are larger than those of solid tantalum types, the electrical performance is almost the same.

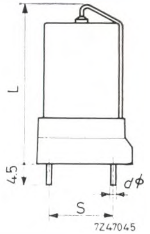
Maximum d.c. working voltage.

VOLT μF	B 4	C 6.4	D 10	E 16	F 25	G 40
2						3
2.5						
3.2					3	
4						4
5				3		
6.4					4	
8			3			5
10				4		
12.5		3			5	6
16	3		4			
20				5	6	
25		4				
32	4		5	6		
40						
50		5	6			
64	5					
80		6				
100	6					

CAN SIZE	
3	6.6 x 14.5 mm
4	6.6 x 21 mm
5	8.3 x 21 mm
6	10.3 x 21 mm

SMALL SOLID ALUMINIUM TYPE





Dimensions (mm)

can size	insulated version			p.w. version		
	D	L	d	S	L	d
3	6.6	14.5	0.6	—	—	—
4	6.6	21	0.6	7.62	27.5	0.6
5	8.3	21	0.6	7.62	27.5	0.6
6	10.3	21	0.8	10.16	27.5	0.8

tolerance on capacitance . . . . −10/+50%
long-term stability . . . . ΔC≤5%
temperature range . . . . −80/+85 °C
peak voltage during 1 minute per hour: at + 85 °C . . . . . 1.125 × working voltage +0.5 V
at ≤ + 50 °C . . . . . 1.25 × working voltage +0.5 V

Composition of the type number **C415 . . / . .**

insulated: AP ◀——
p.w. version: CC ◀——
——▶ capacitance value (μF)
——▶ voltage indication (V)

Example: The type number of a 20 μF/16 V capacitor, p.w. version, is C415CC/E20.

C415 series - ELECTROLYTIC CAPACITORS

SMALL SOLID ALUMINIUM TYPE

Test specification

General

The capacitors considered have been subjected to extensive electrical, climatic and mechanical tests. As no standard test specification for solid-electrolyte aluminium capacitors exists up till now, a special specification has been made up from the severest tests that could be found in existing specifications. The most important tests are given below.

Life test

The capacitors are submitted to a 5000-hours life test at full voltage and a temperature of 85 °C. After the test the capacitance, leakage current and impedance shall not exceed the values listed in columns 4, 5 and 8. (See table page C49).
The maximum change in capacitance shall not exceed 5% of the initial measurements. The leakage current shall not exceed the initial leakage current requirements. The impedance shall not exceed the initial requirements.

Moisture resistance

a. The capacitors are tested in accordance with test C, severity IV of IEC publication 68–2 (56 days at 40 °C and 90–95% r.h.).
   After the test the capacitance, leakage current and impedance shall not exceed the values listed in columns 4, 5 and 8. The change in capacitance shall not be more than 5% of the initial value, d.c. leakage and impedance shall not exceed the initial requirements.

b. The capacitors are tested in accordance with method 106 of MIL-STD-202.
   After the test the capacitance shall not change more than 5% of the initial value, d.c. leakage and impedance shall not exceed the initial requirements.

Temperature and immersion cycling

The capacitors will withstand temperature and immersion cycling as per MIL-STD-202, Methods 102 and 104 respectively (including 5 cycles between −55 °C and +125 °C). After these tests, the capacitance shall not change more than 5% of the initial value, d.c. leakage and impedance shall not exceed the initial requirements.

Charge and discharge

The capacitors may be charged and discharged unrestrictedly. In particular they may be submitted to test 3.2.8 of the specification CCTU 02-10 of 15.11.1962. The capacitors are subjected to 10^6 cycles, each cycle comprising a charge and discharge time of 0.5 sec., and an RC-time of 0.1 sec.
After the test the change in capacitance shall not exceed 3% of the initial value.

Storage

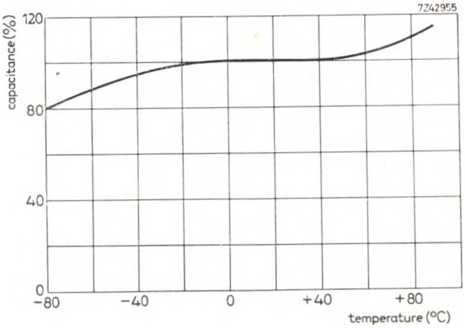
The capacitors may be stored for any length of time. After a storage of one year at a temperature below 40 °C the change in capacitance shall not exceed 5% of the initial value, d.c. leakage and impedance shall not exceed the initial requirements.

ELECTROLYTIC CAPACITORS - C415 series

SMALL SOLID ALUMINIUM TYPE

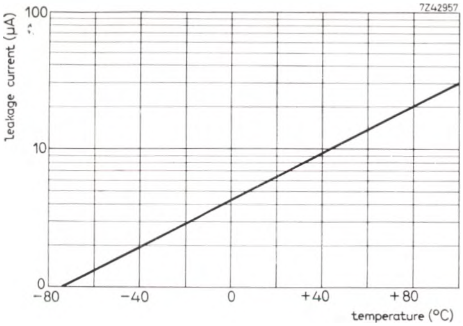
section	2	4	5	6	7	8		
can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	ripple current[2] (mA)	dissipation factor (tan δ)	impedance[3] (Ω)		type number suffix
						+20°C	—80°C	
3	4	16	12.5	4	0.15	2.5	10	B16
4	4	32	32	10	0.15	1.0	4	B32
5	4	64	64	20	0.15	0.5	2	B64
6	4	100	100	32	0.15	0.3	1.2	B100
3	6.4	12.5	12.5	4	0.15	2.5	10	C12.5
4	6.4	25	32	10	0.15	1.0	4	C25
5	6.4	50	64	20	0.15	0.5	2	C50
6	6.4	80	100	32	0.15	0.3	1.2	C80
3	10	8	12.5	4	0.1	2.5	10	D8
4	10	16	32	10	0.1	1.0	4	D16
5	10	32	64	20	0.1	0.5	2	D32
6	10	50	100	32	0.1	0.3	1.2	D50
3	16	5	12.5	4	0.1	2.5	10	E5
4	16	10	32	10	0.1	1.0	4	E10
5	16	20	64	20	0.1	0.5	2	E20
6	16	32	100	32	0.1	0.3	1.2	E32
3	25	3.2	12.5	4	0.1	2.5	10	F3.2
4	25	6.4	32	10	0.1	1.0	4	F6.4
5	25	12.5	64	20	0.1	0.5	2	F12.5
6	25	20	100	32	0.1	0.3	1.2	F20
3	40	2	12.5	4	0.1	2.5	10	G2
4	40	4	32	10	0.1	1.5	4	G4
5	40	8	64	20	0.1	0.75	2	G8
6	40	12.5	100	32	0.1	0.48	1.2	G12.5

[1] Maximum leakage current at 20°C after 1 minute
[2] Maximum permissible current at 100 c/s
[3] Maximum impedance at 20 °C and 100 kc/s

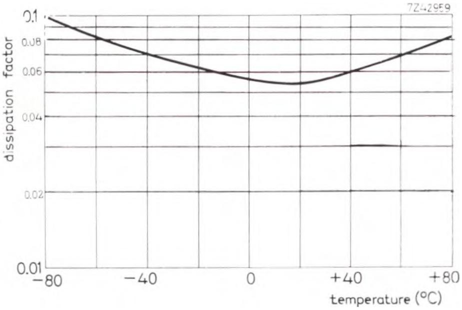


Typical curve of capacitance against temperature

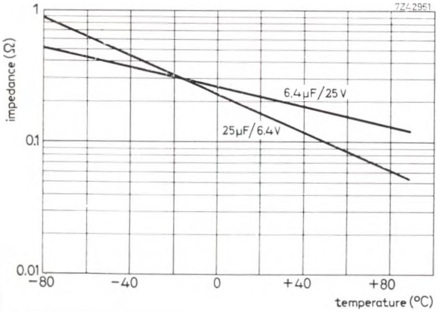
SMALL SOLID ALUMINIUM TYPE



Typical curve of leakage current against temperature



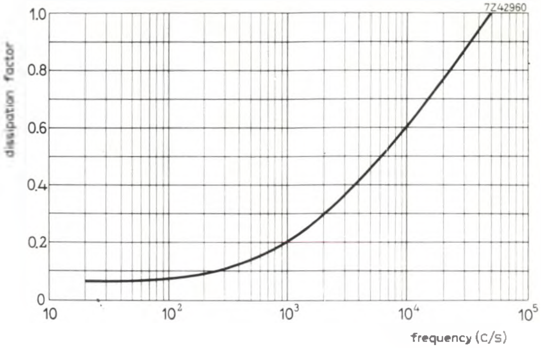
Typical curve of the dissipation factor as a function of temperature

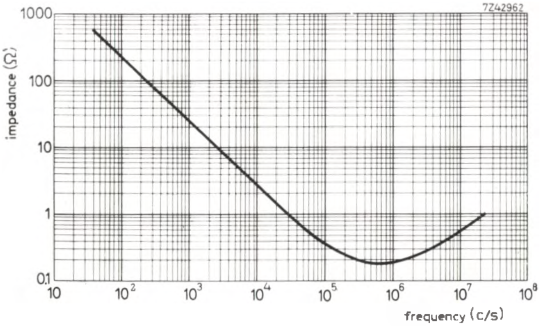


Typical curve of the impedance against temperature

SMALL SOLID ALUMINIUM TYPE

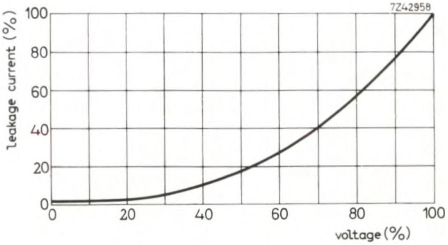
Typical curve
of the dissipation factor
as a function of frequency





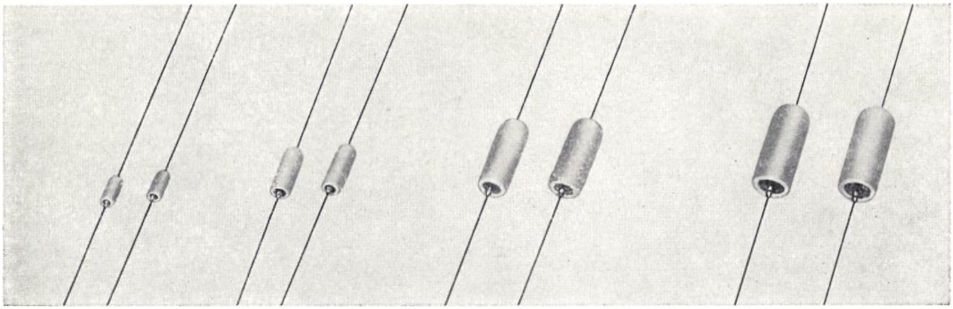
Typical curve
of the impedance,
measured at 20 °C,
against frequency

Typical curve
of leakage current
against applied d.c. voltage



C421 series - ELECTROLYTIC CAPACITORS

SOLID TANTALUM TYPE



Solid electrolytic tantalum capacitors offer great advantages over wet types as regards service life, reliability, stability during life, temperature range etc. Apart from this, very small dimensions are achieved. They are therefore preferable for all kinds of miniaturised professional and military equipment. C421 capacitors are conform Mil-C26655B

Maximum d.c. working voltage

7244235

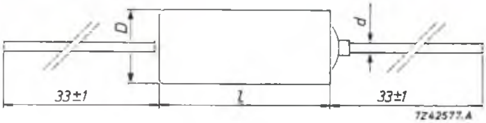
VOLT μF	B 6	C 10	D 15	E 20	F 35 VOLT
0.33					**①**
0.39					①
0.47					**①**
0.56					①
0.68					**①**
0.82					①
1					**①**
1.2				①	②
1.4				①	**②**
1.8				①	②
2.2				**①**	**②**
2.7			①		②
3.3			**①**		**②**
3.9		①			②
4.7		**①**			**②**
5.6	①				②
6.8	**①**				**②**
8.2				②	③
10				②	**③**
12				②	③
15				**②**	**③**
18			②		③
22			**②**		**③**
27		②		③	④
33		**②**		③	**④**
39		②		③	④
47	**②**			**③**	**④**
56	②		③	④	
68			**③**	④	
82		③		④	
100		**③**		**④**	
120		③	④		
150	**③**		**④**		
180	③	④			
220		**④**			
270	④				
330	**④**				

CAN SIZE	
DT 1	3.4 x 7.8 mm
DT 2	4.7 x 12.6 mm
DT 3	7.4 x 18.0 mm
DT 4	8.9 x 20.4 mm

Preferred types in bold print

ELECTROLYTIC CAPACITORS - C421 series

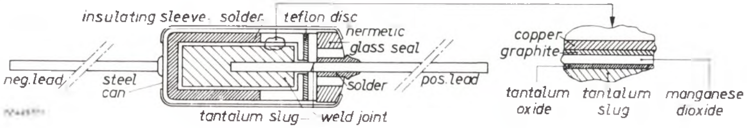
SOLID TANTALUM TYPE



Dimensions (mm)

can size	insulated version		
	D	l	d
DT 1	3.42	7.8	0.5
DT 2	4.70	12.6	0.5
DT 3	7.35	18.0	0.63
DT 4	8.9	20.4	0.63

Construction



tolerance on capacitance . . . . ±20% (10% on request)
temperature range with rated voltage . . . . . −55/+85 °C
with derated voltage . . . . 125 °C
standard MIL specifications . . . . MIL–C 26655B, styles: CS 12/CS 13; MIL STD–202

voltage indication	permissible d.c. voltage (V)		peak voltage[1] (V)	
	at 85 °C	at 125 °C	at 85 °C	at 125 °C
B	6	4	8	5
C	10	7	12	9
D	15	10	17	12
E	20	13	23	16
F	35	20	41	24

[1] AC voltage superimposed.

Composition of the type number **C421 AM / . . .**

voltage indication (V) ◀

▶ capacitance value (μF)

▶ capacitance tolerance
P = 20%; A = 10%

Example. The type number of a 15 μF/20 V capacitor is C421AM/EP15.

C421 series - ELECTROLYTIC CAPACITORS

SOLID TANTALUM TYPE

Test specification

Load test

After 2.000 hours of loading at 65 °C and the full rated voltage, the capacitance and leakage current are measured acc. to MIL specs. The capacitance shall not have changed by more than 10% of the initial value, the leakage current shall not exceed the listed value by more than 25%.

Shock and vibration

The capacitors shall withstand an 8-hour vibration test as per MIL–STD–202, method 204 test frequency 55—2,000 c/s.

Temperature and immersion cycling

After a temperature and immersion cycling test as per MIL–STD–202 (methods 102 and 104 respectively) the capacitance, leakage current and dissipation factor are measured acc. to MIL specs. The capacitance shall not have changed by more than 5% of the initial value; the leakage current and the dissipation factor shall not exceed the listed values.

Salt spray

After a test as per MIL–STD–202, method 101, the capacitors shall show no corrosion or harmful effects.

Moisture resistance

After a test as per MIL–STD–202, method 106, the capacitance, leakage current and dissipation factor are measured acc. to MIL specs. The capacitance shall not have changed by more than 5% of the initial value; the leakage current and the dissipation factor shall not exceed the listed values.

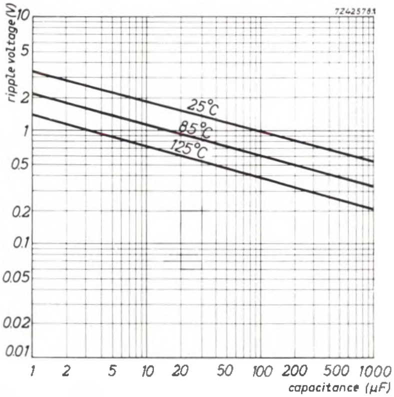
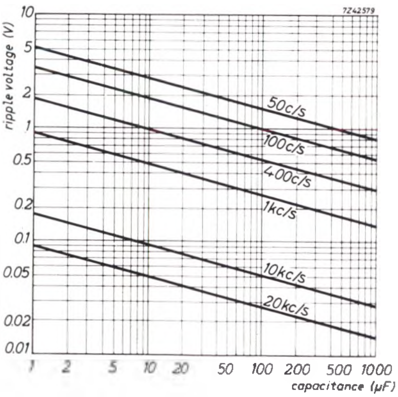


Fig. 1

Fig. 2



Ripple current

The capacitors may be operated at a superimposed a.c. ripple voltage, provided that this does not cause the limit of the heat dissipation to be exceeded. This limit depends on the ripple frequency, ambient temperature and capacitance.

The ripple current I_r, permissible at 25°C and 100c/s, is calculated from the equation $I_r = 2\pi f E_r C$, where f = the ripple frequency in c/s; E_r = the ripple voltage (see graph 1); C = the capacitance in F.

The ripple voltage E_r, permissible at any temperature T and frequency f, is calculated by means of the graphs 1–2 and the equation $E_r = E_{100} \times E_{25}/R_r$, where

E_r = the ripple voltage at 25 °C and 100 c/s, see fig. 1.

E_{100} = the ripple voltage at T °C and 100 c/s, see fig. 1.

E_{25} = the ripple voltage at 25 °C and f c/s. see fig. 2.

SOLID TANTALUM TYPE

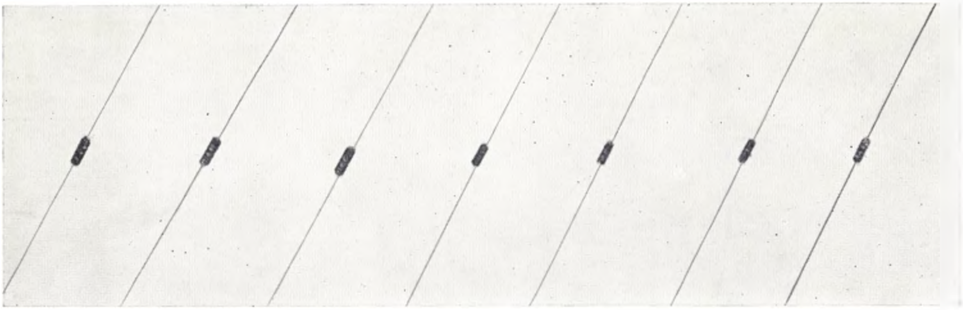
can size	working voltage (V)	capacitance (μF)	leakage current[1] (μA)	impedance[2] (Ω)	type number suffix
DT1	6	6.8	1	8.7	BP6.8
DT2	6	47	6	2.5	BP47
DT3	6	150	18	0.8	BP150
DT4	6	330	40	0.4	BP330
DT1	10	4.7	1	11.2	CP4.7
DT2	10	33	7	1.9	CP33
DT3	10	100	20	0.5	CP100
DT4	10	220	44	0.25	CP220
DT1	15	3.3	1	8.8	DP3.3
DT2	15	22	7	1.3	DP22
DT3	15	68	20	0.4	DP68
DT4	15	150	45	0.25	DP150
DT1	20	2.2	1	8.8	EP2.2
DT2	20	15	6	1.3	EP15
DT3	20	47	19	0.5	EP47
DT4	20	100	40	0.25	EP100
DT1	35	0.33	1	29	FP0,33
	35	0.47	1	20	FP0,47
	35	0.68	1	14	FP0,68
	35	1	1	10	FP1
DT2	35	1.5	1	6.3	FP1.5
	35	2.2	2	5	FP2.2
	35	3.3	2	3.8	FP3,3
	35	4.7	3	2.5	FP4.7
	35	6.8	5	1.9	FP6.8
DT3	35	10	7	1	FP10
	35	15	11	0.7	FP15
	35	22	15	0.5	FP22
DT4	35	33	23	0.4	FP33
	35	47	33	0.25	FP47

[1] Maximum leakage current at 25 °C after 5 minutes
[2] Maximum impedance at 25 °C and 100 kc/s

Other capacitance values are available on request, provided acceptable quantities are ordered.

C420 series - ELECTROLYTIC CAPACITORS

ULTRA SMALL WET TANTALUM TYPE



Wet tantalum capacitors are the smallest electrolytic capacitors with the highest CV-product now available. These characteristics are combined with excellent properties and a good service life and reliability.
Typical applications are hearing-aids and other very small transistorized equipment.

Maximum d.c. working voltage

VOLT µF	A 2.5	B 4	C 6.4	D 10	E 16	F 25
0.64						①
1					①	
1.6				①		②
2.5			①		②	
4		①		②		③
6.4	①		②		③	
10		②		③		
16	②		③			
25		③				
40	③					

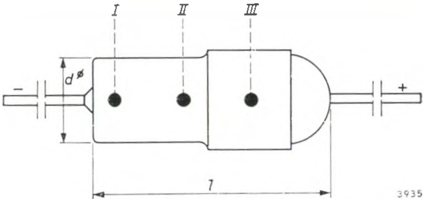
CAN SIZE	
1	1.8 x 5mm
2	2.6 x 7mm
3	3.3 x 9mm

ELECTROLYTIC CAPACITORS - C420 series

ULTRA SMALL WET TANTALUM TYPE

Dimensions (mm)

can size	*d*	*l*
NT1	1.8	5
NT2	2.3	7
NT3	3.3	9



Colour code

colour	*I* *(μF)*	*II* *(multiplicand of I)*	*III* *(V)*
black	1	1	2.5
brown	1.25	10	4
red	1.6	100	6.4
orange	2	1000	10
yellow	2.5	—	16
green	3.2	—	25
blue	4	—	—
violet	5	—	—
grey	6.4	—	—
white	8	—	—
silver	—	0.01	—
gold	—	0.1	—

For example, a 0.64 μF/25 V tantalum capacitor is marked as follows:

I = grey (6.4 μF)
II = gold (x0.1)
III = green (25 V).

tolerance on capacitance . . . . −10/+100%
temperature range . . . . −40/+55 °C
peak voltage during 1 minute per hour: at 55 °C . . . . 1.125 × working voltage +0.5 V
at ≤ 30 °C . . . . 1.25 × working voltage +0.5 V

Composition of the type number **C420 AN/ . .**

▶ capacitance value (μF)
▶ voltage indication (V)

Example: The type number of a 10 μF/10 V capacitor is C420AN/D10

ULTRA SMALL WET TANTALUM TYPE

can size	working voltage (V)	capacitance (μF)	ripple current[1] (mA)	dissipation factor (tan δ)	impedance[2] (Ω)	type number suffix
1	2.5	6.4	0.5	0.2	24	A6.4
2	2.5	16	1.2	0.25	12	A16
3	2.5	40	3.2	0.3	6	A40
1	4	4	0.5	0.2	25	B4
2	4	10	1.2	0.25	13	B10
3	4	25	3.2	0.3	6	B25
1	6.4	2.5	0.5	0.15	26	C2.5
2	6.4	6.4	1.2	0.2	15	C6.4
3	6.4	16	3.2	0.25	7	C16
1	10	1.6	0.5	0.15	29	D1.6
2	10	4	1.2	0.2	16	D4
3	10	10	3.2	0.25	7	D10
1	16	1	0.5	0.1	29	E1
2	16	2.5	1.2	0.15	18	E2.5
3	16	6.4	3.2	0.2	8	E6.4
1	25	0.64	0.5	0.1	31	F0.64
2	25	1.6	1.2	0.15	19	F1.6
3	25	4	3.2	0.2	9	F4

Maximum leakage current at 20 °C after 5 minutes is 1 μA for all types.

[1] Maximum permissible ripple current at 100 c/s

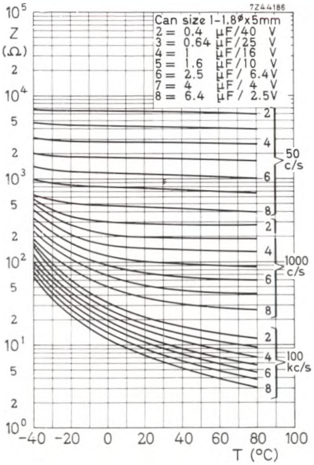
[2] Maximum impedance at 20 °C and 100 kc/s

ULTRA SMALL WET TANTALUM TYPE

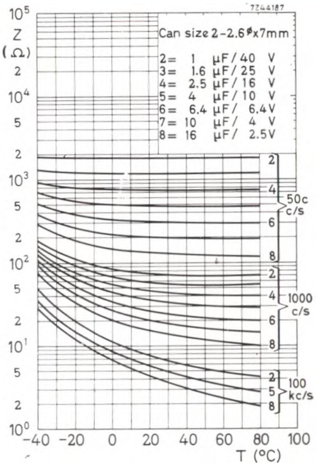
Impedance graphs

The impedance at e.g. 100 kc/s rises at low temperatures, which has to be considered when choosing a capacitor for a given application.
Typical impedance/temperature curves for the different can sizes are given below. The maximum values at 20 °C and 100 kc/s are stated in the table.

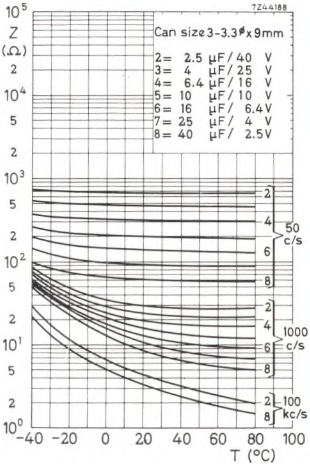
Can size 1



Can size 2

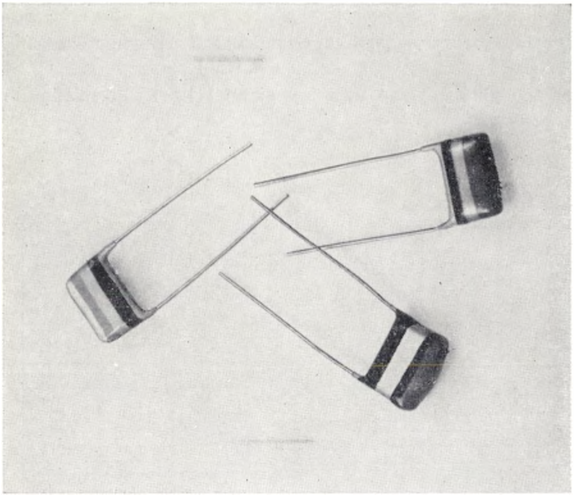


Can size 3



C280 series - METALLISED POLYESTER CAPACITORS

FLAT FOIL TYPE



Permissible overvoltage:
Special attention is drawn to the fact that the allowed 40% overvoltage for the C280AE range (250 V) permits these capacitors to be employed instead of previously used 400 V capacitors in anode and screen grid circuits.

These capacitors are designed primarily for use as coupling and decoupling capacitors for electronic circuits employing printed wiring.
Due to the almost negligible temperature dependency they offer in many cases essential advantages over ceramic disc capacitors.
The dielectric material used in this range of capacitors is metallised polyethyleneterephtalate for the $250V_{dc}$ types and metallised polycarbonate for the $400V_{dc}$ and 630 V_{dc} types.

Specification. For specification and characteristics see pp. C66–C69.

Composition of the type number C280../....

dielectric ◀
A = polyethyleneterephtalate (250 V_{dc})
C = polycarbonate (400 V_{dc} and 630 V_{dc})

working voltage ◀
E = 250 V_{dc}; F = 400 V_{dc}; G = 630 V_{dc}

▶ capacitance code

▶ capacitance tolerance
A = ±10%
P = ±20%

Example: The type number of a 0.033 μF/400 V capacitor with a dielectric of polycarbonate, tolerance ±10%, is C280CF/A33K.

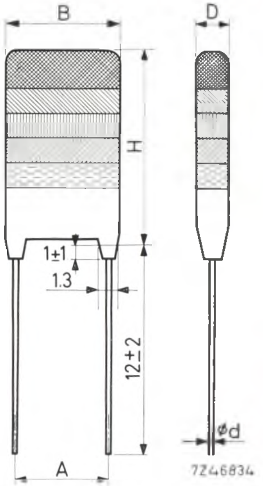
METALLISED POLYESTER CAPACITORS - C280 series

FLAT FOIL TYPE

VALUE INDICATION

1st figure of capacitance value
2nd figure of capacitance value
multiplying factor
capacitance tolerance
working voltage
body colour

colour					
black	–	0	1	±20%	
brown	1	1	10		
red	2	2	10^2		250 V
orange	3	3	10^3		
yellow	4	4	10^4		400 V
green	5	5	10^5		
blue	6	6			630 V
violet	7	7			
grey	8	8			
white	9	9		±10%	



Dimensions (mm)

if B = 12.5	d = 0.6	A = 10.2 ± 0.5
17.5	0.8	15.2 ± 0.3
22.5	0.8	20.3 ± 0.3
30	0.8	27.9 ± 0.3

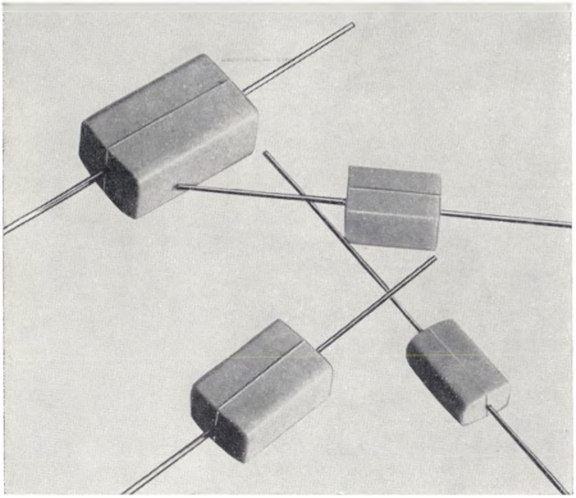
Temporary the lead length may be longer than the specified length of 12 mm.

capacitance (μF)	*capacitance code*	*max. dimensions (mm)*								
		250V$_{dc}$ – **C280AE/...**			*400V$_{dc}$* – **C280CF/...**			*630V$_{dc}$* – **C280CG/...**		
		D	*B*	*H*	*D*	*B*	*H*	*D*	*B*	*H*
0.010	10K				4	12.5	10	4	12.5	10.5
0.015	15K				4	12.5	10	5.5	12.5	11.5
0.022	22K	4	12.5	10	4.5	12.5	10.5	6.5	12.5	12.5
0.033	33K	4	12.5	10	5.5	12.5	11.5	6.5	17.5	12.5
0.047	47K	4	12.5	10	6.5	12.5	12.5	7.5	17.5	13.5
0.068	68K	5	12.5	11	6	17.5	12	6.5	22.5	13
0.10	100K	6	12.5	12	7	17.5	13	8	22.5	14.5
0.15	150K	6.5	17.5	11.5	6.5	22.5	13	10	22.5	16.5
0.22	220K	7.5	17.5	12.5	8	22.5	14.5	10	30	16.5
0.33	330K	7	22.5	13	10	22.5	16.5	11.5	30	20.5
0.47	470K	8.5	22.5	14.5	10	30	16.5	13.5	30	22.5
0.68	680K	10.5	22.5	16.5	11	30	20			
1.0	1M	10.5	30	16.5	13	30	22			
1.5	1M5	11.5	30	20						
2.2	2M2	14	30	22.5						

Intermediate values according to the E12 range are available on request. The dimensions are identical to those of the next higher value in the standard E6 range. The capacitance tolerance is either ±10% or ±20%. The preferred tolerance is ±20% up to and including 0.22 μF and ±10% from 0.33 μF onwards.

C281 series - METALLISED POLYESTER CAPACITORS

MOULDED TYPE



Permissible overvoltage:
Special attention is drawn to the fact that the allowed 40% overvoltage for the C281AB range (250 V) permits these capacitors to be employed instead of previously used 400 V capacitors in anode and screen grid circuits.

These capacitors are designed for use as bypass and general-purpose capacitors in electronic equipment, both in the entertainment field and for industrial purposes. The high permissible a.c. voltage makes these types also appropriate for use as anti-interference capacitor in small electric appliances. The throughout rectangular shape of these capacitors renders them most suitable for wobble-free mounting on printed-wiring boards, either upright or level. The dielectric material used in this range of capacitors is metallised polyethyleneterephtalate for the 250 V_{dc} types and metallised polycarbonate for the 400 V_{dc} and 630 V_{dc} types.

Specification. For specification and characteristics see pp. C66–C69.

Composition of the type number C281../....

dielectric
A = polyethyleneterephtalate (250 V_{dc} and 400 V_{dc})[1]
C = polycarbonate (400 V_{dc})[1]
working voltage
B = 250 V_{dc}; D = 400 V_{dc}

capacitance code
capacitance tolerance
A = ±10%
P = ±20%

Example: The type number of a 2.2 μF/250 V capacitor with a dielectric of polyethyleneterephtalate, tolerance 20%, is C281AB/P2M2.

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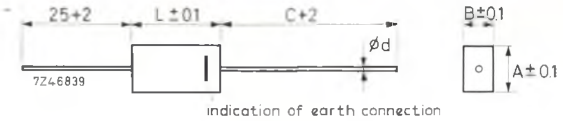
[1] Since the autumn of 1965 the V_{dc} series with polyethyleneterephtalate dielectric, type C281AD, has been replaced by a new 400 V_{dc} series with polycarbonate dielectric, type C281CD, with greatly reduced dimensions.

METALLISED POLYESTER CAPACITORS - C281 series

MOULDED TYPE



Dimensions (mm)

at L = 14	C = 40	d = 0.8
17.5	40	0.8
23	40	0.8
30	50	1.0

capacitance *(μF)*	*capacitance code*	*max. dimensions (mm)*								
		$250V_{dc}$ – **C281AB/...**			*$400V_{dc}$* – **C281AD**[1]			*$400V_{dc}$*–**C281CD/...**[1]		
		A	*B*	*L*	*A*	*B*	*L*	*A*	*B*	*L*
0.010	10K				8.7	4.7	14	8.7	4.7	14
0.015	15K				9.4	5.5	14	8.7	4.7	14
0.022	22K				10.4	6.5	14	8.7	4.7	14
0.033	33K	8.7	4.7	14	10.4	6.5	17.5	9.4	5.5	14
0.047	47K	8.7	4.7	14	11.5	7.6	17.5	10.4	6.5	14
0.068	68K	9.4	5.5	14	11.5	7.4	2.3	10.4	6.5	17.5
0.10	100K	10.4	6.5	14	12.8	8.7	23	11.5	7.6	17.5
0.15	150K	10.4	6.5	17.5	14.4	10.4	23	11.5	7.4	23
0.22	220K	11.5	7.6	17.5	14.6	10.4	30	12.8	8.7	23
0.33	330K	11.5	7.4	23	16.4	12.4	30	14.4	10.4	23
0.47	470K	12.8	8.7	23	18.4	14.5	30	14.6	10.4	30
0.68	680K	14.4	10.4	23				19.5	12.4	30
1.0	1M	14.6	10.4	30				22	15	30
1.5	1M5	19.5	12.4	30						
2.2	2M2	22	15	30						

Intermediate values according to the E12 range are available on request. The dimensions are identical to those of the next higher value in the standard E6 range.
The capacitance tolerance is either ±10% or ±20%.
The preferred tolerance is ±20% up to and including 0.22 μF and ±10% from 0.33 μF onwards.

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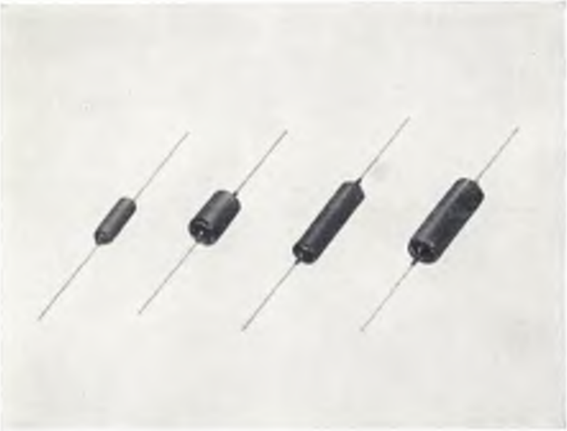
[1] See footnote p. C62.

C296 series - POLYESTER CAPACITORS

TUBULAR FOIL TYPE



This capacitor is a very reliable general purpose capacitor for electronic circuits. It has found widespread acceptance not only in the radio and television industry, but also in industrial electronics. The dielectric is polyethyleneterephtalate foil.

Specification. For specification and characteristics see pp. C66–C69.

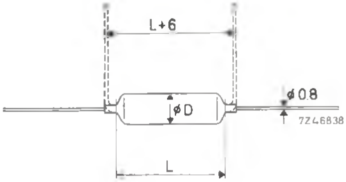
Composition of the type number **C296A./A...**

working voltage ◀ (.) ; ... ▶ capacitance code
A = 160 V_{dc} ; A ▶ A = 10%
C = 400 V_{dc}

Example: The type number of a 2200 pF/400 V capacitor is C296AC/A2K2.

POLYESTER CAPACITORS - C296 series

TUBULAR FOIL TYPE



capacitance	capacitance code	max. dimensions (mm)			
		160 V_{dc} **C296AA/A...**		400 V_{dc} **C296AC/A...**	
		D	*L*	*D*	*L*
1000 pF	1K			7.5	18
1500	1K5			7.5	18
2200	2K2			7.5	18
3300	3K3			7.5	18
4700	4K7			7.5	18
6800	6K8			7.5	18
0.010 μF	10K	7.5	18	7.5	18
0.015	15K	7.5	18	7.5	18
0.022	22K	7.5	18	8.5	18
0.033	33K	7.5	18	10	18
0.047	47K	8	18	11.5	18
0.068	68K	9	18	9.5	32
0.10	100K	10.5	18	11	32
0.15	150K	12	18	12.5	32
0.22	220K	10	32	14.5	32
0.33	330K	12	32	17	32
0.47	470K	14	32	19.5	32
0.68	680K	16	32		
1.0	1M	18.5	32		

Intermediate values according to the E12 range are available on request. The dimensions are identical to those of the next higher value in the standard E6 range.
The standard capacitance tolerance is ±10%.

POLYESTER CAPACITORS

SPECIFICATION

Type	**C 280**
Working temperature range	$-40/+85$°C
Working voltage	without derating up to 85 °C
Permissible overvoltage during 1 min. per hour	250 V_{dc} types: 40% 400 V_{dc} and 630 V_{dc} types: 25%
Permissible alternating voltage (50–60 c/s)	250 V_{dc} types: 160 V_{ac} 400 V_{dc} types: 250 V_{ac} 630 V_{dc} types: 300 V_{ac}
Permissible alternating voltage at other frequencies	250 V_{dc} types: page C69, fig. 7 400 V_{dc} types: page C69, fig. 8 630 V_{dc} types: for the time being the same as for the 400 V_{dc} types
Maximum capacitance drift during life:	
d.c. loaded	Δ C max $\pm 5\%$
a.c. loaded	for B = 12.5 mm: Δ C max = 25% B = 17.5 mm: Δ C max = 20% B = 22.5 mm: Δ C max = 15% B = 30 mm: Δ C max = 10%
Test voltage (d.c.) during 1 minute	2 × rated d.c. voltage
Breakdown voltage of encasing	—
Insulation resistance at 20°C:	
for $C \leqslant 0.33\ \mu F$	$R \geqslant 30.000\ M\Omega$
for $C > 0,33\ \mu F$	$RC \geqslant 10.000$ sec.
Losses (tan δ) at 1 kc/s	250 V_{dc} types: $\leqslant 75 \times 10^{-4}$ 400 V_{dc} and 630 V_{dc} types: $\leqslant 30 \times 10^{-4}$
Climatic group number	40/085/21 (IEC)
Pulse loads	steepness $< 10V/\mu$sec
Resonance frequency	page C69, fig. 6
Capacitance versus temperature	page C68, fig. 1: 250 V_{dc} types: curve I 400 V_{dc} and 630 V_{dc} types: curve II
Losses versus temperature	page C68, fig. 2: 250 V_{dc} types: curve I 400 V_{dc} and 630 V_{dc} types: curve II
Insulation resistance versus temperature	page C68, fig. 3: 250 V_{dc} types: curve I 400 V_{dc} and 630 V_{dc} types: curve II
Capacitance versus frequency	page C68, fig. 4
Losses versus frequency	page C69, fig. 5: 250 V_{dc} types: curve I 400 V_{dc} and 630 V_{dc} types: curve II

SPECIFICATION

C 281	C 296
−55/+85 °C	−40/+85 °C
without derating up to 85 °C	without derating up to 85 °C
250 V_{dc} types: 40%	—
400 V_{dc} types: 25%	—
250 V_{dc} types: 160 V_{ac}	160 V_{dc} types: 90 V_{ac}
400 V_{dc} types: 250 V_{ac}	400 V_{dc} types: 150 V_{ac}
250 V_{dc} types: page C69, fig. 7	160 V_{dc} types: page C69, fig. 7
400 V_{dc} types: page C69, fig. 8	400 V_{dc} types: page C69, fig. 8
ΔC max ± 3%	ΔC max ± 5%
for L = 14 mm ΔC max = 25%	ΔC max ± 5%
L = 17.5 mm ΔC max = 20%	
L = 23 mm ΔC max = 15%	
L = 30 mm ΔC max = 10%	
2 × rated d.c. voltage	2 × rated d.c. voltage
$>$ 2500 V_{ac}	—
R $\geq$ 30.000 MΩ	R $\geq$ 50.000 MΩ
RC $\geq$ 10.000 sec	RC $\geq$ 16.500 sec
250 V_{dc} and 400 V_{dc} types with polyethyleneterephtalate dielectric: $\leqslant 75 \times 10^{-4}$	$\leqslant 60 \times 10^{-4}$
400 V_{dc} types with polycarbonate dielectric: $\leqslant 30 \times 10^{-4}$	
55/085/56 (IEC)	40/085/21 (IEC)
steepness $<$ 10V/μsec	—
page C69, fig. 6	page C69, fig. 6
page C68, fig. 1 – 250 V_{dc} and 400 V_{dc} types with polyethlene-terephtalate dielectric: curve I 400 V_{dc} types with polycarbonate dielectric: curve II	page C68, fig. 1, curve 1
page C68, fig. 2 – 250 V_{dc} and 400 V_{dc} types with polyethlene-terephtalate dielectric: curve I 400 V_{dc} types with polycarbonate dielectric: curve II	page C68, fig. 2, curve 1
page C68, fig. 3 – 250 V_{dc} and 400 V_{dc} types with polyethylene-terephtalate dielectric: curve I 400 V_{dc} types with polycarbonate dielectric: curve II	page C68, fig. 3, curve I
page C68, fig. 4	page C68, fig. 4
page C69, fig. 5 – 250 V_{dc} and 400 V_{dc} types with polyethylene-terephtalate dielectric: curve I 400 V_{dc} types with polycarbonate dielectric: curve II	page C69, fig. 5, curve I

CHARACTERISTICS

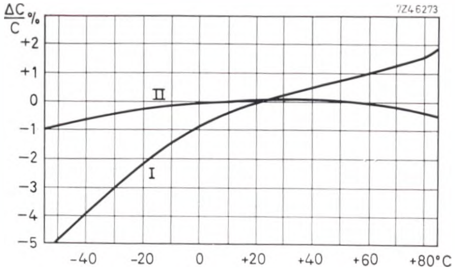


Fig. 1
Capacitance
versus temperature

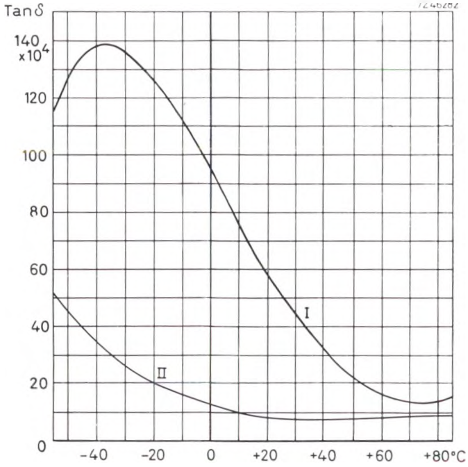


Fig. 2
Losses versus temperature
at 1 kc/s

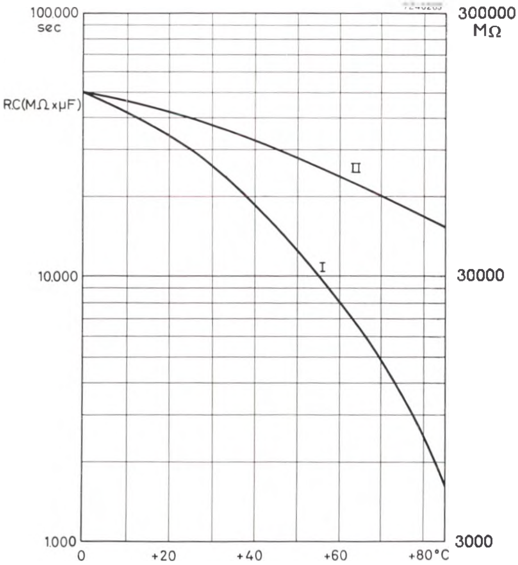


Fig. 3
Insulation resistance
versus temperature

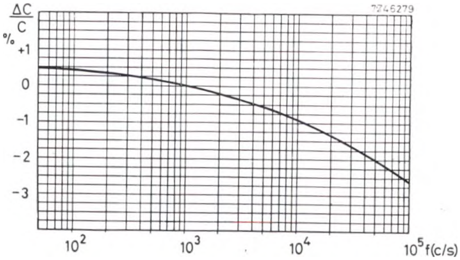


Fig. 4
Capacitance
versus frequency

CHARACTERISTICS

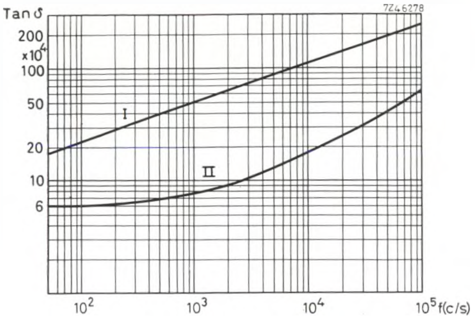
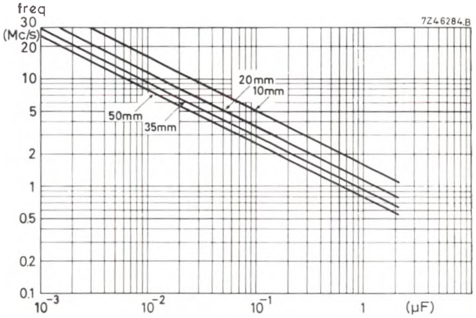


Fig. 5
Losses versus frequency

Fig. 6
Resonance frequency
versus capacitance
at different total wire lengths.



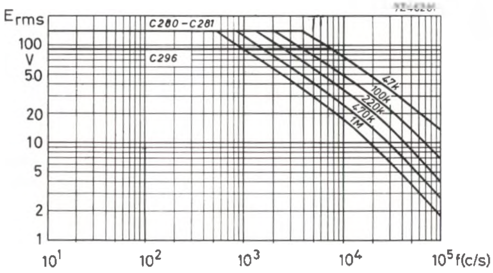
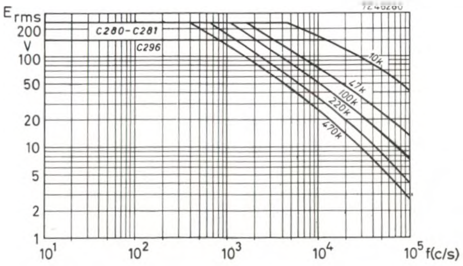


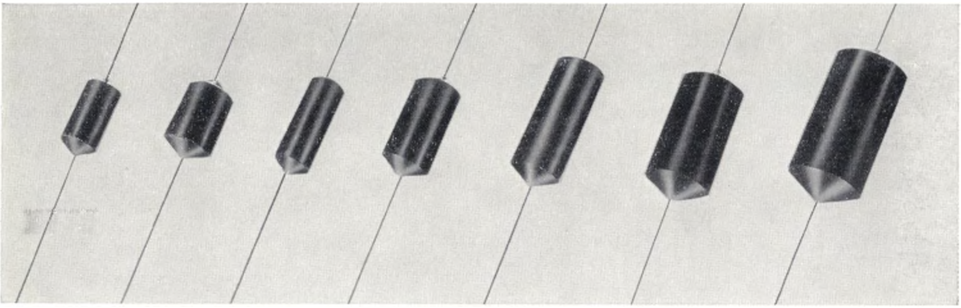
Fig. 7
Permissible alternating voltage versus frequency for capacitors rated 250 V_{dc} (160 V_{dc} for the C296 series)

Fig. 8
Permissible alternating
voltage versus frequency
for capacitors rated
400 V_{dc}



532. series - PAPER CAPACITORS FOR DIRECT CURRENT

INSULATED TUBULAR TYPE



These capacitors are meant for special applications in radio and television circuits such as booster capacitors.

working temperature range		$-25/+85$ °C
test voltage during 1 minute	type 5326/..	1800 V_{dc}
	type 5328/..	3250 V_{dc}
insulation resistance at 20 °C	for $C \leqslant 20000$ pF	$R \geqslant 25000$ MΩ
	for $C > 20000$ pF	$RC \geqslant 500$ sec
losses (tan δ) at 1 kc/s	for $C < 0.1$ μF	$\leqslant 80 \times 10^{-4}$
at 50 c/s	for $C < 0.1$ μF	$\leqslant 40 \times 10^{-4}$
climatic group number		25/085/21 (IEC)

Composition of the type number 532../...

working voltage ◀ — capacitance code ▶

6 = 600 V_{dc}

8 = 1300 V_{dc}

capacitance tolerance ◀

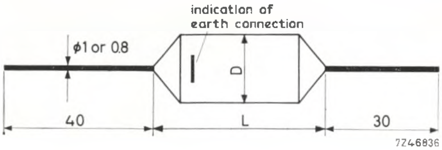
A = ±10%

P = ±20%

Example: The type number of a 2200 pF/600 V capacitor, tolerance 20%, is 5326P/2K2.

PAPER CAPACITORS FOR DIRECT CURRENT - 532. series

INSULATED TUBULAR TYPE



		600 V_{dc} – **5326./...**			1300 V_{dc} – **5328./...**		
capacitance	*capacitance code*	*standard capacitance tolerance (%)*	*max. dimensions (mm)*		*standard capacitance tolerance (%)*	*max. dimensions (mm)*	
			D	*L*		*D*	*L*
1000 pF	1K	±20	12	35	±20	12	35
1500	1K5	±20	12	35	—	—	—
2200	2K2	±10/±20	12	35	±20	14	35
3300	3K3	±10/±20	12	35	—	—	—
4700	4K7	±10/±20	14	35	±20	16	35
6800	6K8	±10/±20	14	35	—	—	—
0.010 μF	10K	±10/±20	14	35	±20	18	35
0.015	15K	±10/±20	16	35	—	—	—
0.022	22K	±10/±20	16	35	±20	18	45
0.033	33K	±10/±20	18	35	—	—	—
0.047	47K	±10/±20	18	45	±20	21	55
0.068	68K	±10/±20	18	45	—	—	—
0.10	100K	±10/±20	21	45	±20	24	55
0.15	150K	±10/±20	21	55	—	—	—
0.22	220K	±10/±20	24	55	—	—	—

On request 600 V_{dc} types with intermediate values according to the E12 series can be supplied.

Types the dimensions of which are given above the dividing lines have a wire diameter of 0.8 mm; the other types have a wire diameter of 1 mm.

C101/C102 series - PAPER CAPACITORS FOR DIRECT CURRENT

TUBULAR TYPE IN ALUMINIUM CASING

These cylindrical capacitors with impregnated paper dielectric are used in a great variety of equipment (e.g. measuring apparatus) and installations (e.g. for telecommunications) where severe demands have to be met as regards quality, dependability and durability.
The extra-sealed version C102 is in accordance with R.C.S. specification 11, class H1. These capacitors are thus excellently suited for use at high altitudes and under the most adverse climatic conditions.

working temperature range		$-40/85$ °C
working voltage		above 40 °C derating 0.9% per °C
permissible alternating voltage (50–60 c/s)	180 V_{dc} types	130 V_{ac}
	350 V_{dc} types	220 V_{ac}
	700 V_{dc} types	265 V_{ac}
	1000 V_{dc} types	330 V_{ac}
maximum capacitance drift during life		$\Delta C \leqslant 5\%$
test voltage (d.c.) during 1 minute both between terminals and between interconnected terminals and casing	180 V_{dc} types	530 V_{dc}
	350 V_{dc} types	870 V_{dc}
	700 V_{dc} types	1470 V_{dc}
	1000 V_{dc} types	1940 V_{dc}
insulation resistance at 20 °C	for $C \leqslant 0.33\ \mu F$	$R \geqslant 6000\ M\Omega$
	for $C > 0.33\ \mu F$	$RC \geqslant 2000$ sec
losses ($\tan \delta$) at 1 kc/s	for $C \leqslant 0.1\ \mu F$	$\leqslant 80 \times 10^{-4}$
at 50 c/s	for $C > 0.1\ \mu F$	$\leqslant 40 \times 10^{-4}$
climatic group number	for C101 series	40/085/21 (IEC)
	for C102 series	40/085/56 (IEC)

Composition of the type number C101../....

construction ◀ — A = non-insulated; C = insulated

working voltage ◀ — A = 180 V_{dc}; B = 350 V_{dc}; C = 700 V_{dc}; D = 1000 V_{dc}

▶ capacitance code

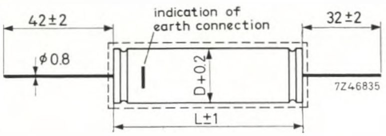
▶ capacitance tolerance — P = ±20% for C < 3300 pF; A = ±10% for C ⩾ 3300 pF

Example: The type number of a 8200pF/700 V capacitor, non-insulated, is C101AC/A8K2.

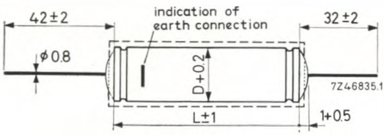
The same composition of the type number applies to the C102 series; however, the C102 version can be supplied only as an insulated type.

PAPER CAPACITORS FOR DIRECT CURRENT - C101/C102 series

TUBULAR TYPE IN ALUMINIUM CASING



C101 – Insulated or non-insulated



C102 – Extra-sealed, insulated

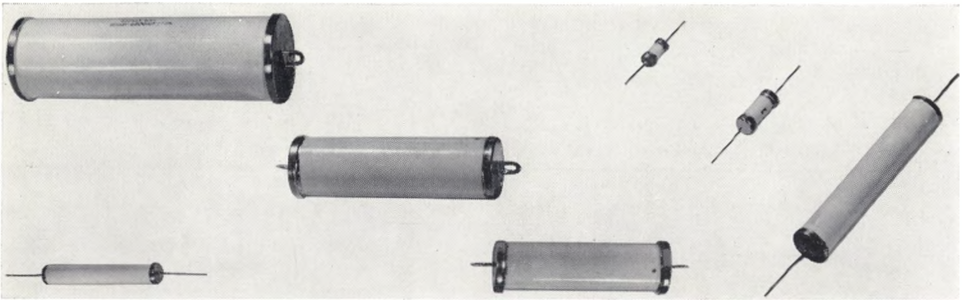
Note. For the insulated types the dimensions D and L should be increased by 1.4 mm

capacitance	capacitance code	dimensions in mm							
		180 V_{dc}		350 V_{dc}		700 V_{dc}		1000 V_{dc}	
		D	L	D	L	D	L	D	L
1000 pF	1K	—	—	—	—	7.6	26	11.1	26
1200	1K2	—	—	—	—	7.6	26	11.1	26
1500	1K5	—	—	—	—	7.6	26	11.1	26
1800	1K8	—	—	—	—	7.6	26	11.1	26
2200	2K2	—	—	—	—	7.6	26	11.1	26
2700	2K7	—	—	—	—	7.6	26	11.1	26
3300	3K3	—	—	—	—	7.6	26	11.1	26
3900	3K9	—	—	—	—	7.6	26	11.1	26
4700	4K7	—	—	—	—	7.6	26	11.1	26
5600	5K6	—	—	—	—	7.6	26	11.1	26
6800	6K8	—	—	7.6	26	—	—	11.1	26
8200	8K2	—	—	7.6	26	—	—	11.1	26
0.010 μF	10K	7.6	26	—	—	—	—	11.1	26
0.012	12K	7.6	26	—	—	—	—	11.1	26
0.015	15K	—	—	—	—	11.1	26	11.1	33
0.018	18K	—	—	—	—	11.1	26	11.1	33
0.022	22K	—	—	11.1	26	—	—	11.1	33
0.027	27K	—	—	11.1	26	11.1	33	15.9	33
0.033	33K	11.1	26	—	—	11.1	33	15.9	33
0.039	39K	11.1	26	11.1	33	—	—	15.9	33
0.047	47K	—	—	11.1	33	—	—	15.9	33
0.056	56K	11.1	33	—	—	—	—	15.9	33
0.068	68K	11.1	33	—	—	15.9	33	19.2	33
0.082	82K	11.1	33	—	—	15.9	33	19.2	33
0.10	100K	—	—	15.9	33	19.2	33	15.9	53
0.12	120K	—	—	15.9	33	19.2	33	15.9	33
0.15	150K	15.9	33	19.2	33	15.9	53	19.2	53
0.18	180K	15.9	33	19.2	33	15.9	53	19.2	53
0.22	220K	19.2	33	15.9	53	—	—	19.2	53
0.27	270K	19.2	33	15.9	53	19.2	53	25.6	53
0.33	330K	15.9	53	—	—	19.2	53	25.6	53
0.39	390K	15.9	53	19.2	53	—	—	25.6	53
0.47	470K	—	—	19.2	53	25.6	53	—	—
0.56	560K	19.2	53	—	—	25.6	53	—	—
0.68	680K	19.2	53	25.6	53	—	—	—	—
0.82	820K	—	—	25.6	53	—	—	—	—
1	1M	25.6	53	—	—	—	—	—	—

All types the dimensions of which are given below the dividing lines, are wound with extended foils and are also suitable for low working voltages (smaller than 1 mV).

826.. series - PAPER CAPACITORS FOR DIRECT CURRENT

TUBULAR TYPE IN CERAMIC CASING FOR HIGH VOLTAGES



These capacitors are intended for high-voltage d.c. applications. Due to their hermetic sealing they are proof against atmospheric influences for an indefinite length of time. They are suited for use at high altitudes, as well as in polar and tropical regions.
The earthing end of the capacitor is marked with a silver-coloured dot (A in the dimensional drawing).

tolerance on capacitance	±10%
working temperature range	−40/+70 °C
working voltage	above 40 °C to be derated by 0.9% per °C
permissible alternating voltage (50/60 c/s)	33% of working voltage
maximum capacitance drift during life	$\Delta C \leqslant 2\%$
test voltage during 1 minute	2.25 × max. working voltage
insulation resistance at 20 °C	$R \geqslant 20.000\ M\Omega$
losses ($\tan\delta$) at 1 kc/s, for $C < 0.1\ \mu F$	$\leqslant 80 \times 10^{-4}$
at 50 c/s, for $C \geqslant 0.1\ \mu F$	$\leqslant 40 \times 10^{-4}$
climatic group number	40/070/56 (IEC)

Composition of the type number 826..A/....

→ capacitance code

code for capacitor length:

31 if L = 28 mm
32 if L = 48 mm
48 if L = 71 mm
49 if L = 91 mm
50 if L = 116 mm
51 if L = 131 mm
52 if L = 171 mm
53 if L = 216 mm

→ working voltage:

N = 2000 V_{dc}
M = 4000 V_{dc}
R = 6000 V_{dc}
U = 8000 V_{dc}
L = 10000 V_{dc}

Example: The type number of a 2200pF/2000V capacitor with a length of 28 mm is 82631A/N2K2

PAPER CAPACITORS FOR DIRECT CURRENT - 826..series

TUBULAR TYPE IN CERAMIC CASING FOR HIGH VOLTAGES

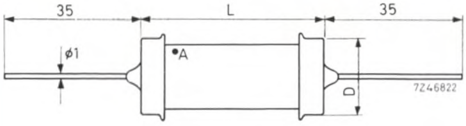


Fig. 1

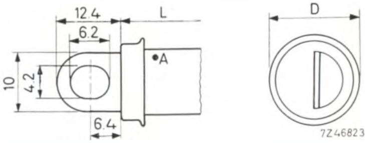


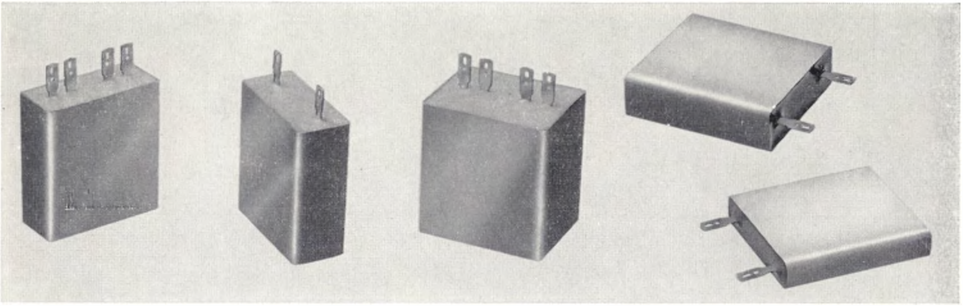
Fig. 2

capacitance	capacitance code	max. dimensions (mm)									
		2000 V_{dc}		4000 V_{dc}		6000 V_{dc}		8000 V_{dc}		10000 V_{dc}	
		D	L	D	L	D	L	D	L	D	L
470 pF	470E	11.4	28	11.4	48	11.4	71	11.4	91	11.4	116
680	680E	11.4	28	11.4	48	11.4	71	11.4	91	11.4	116
1000	1K	11.4	28	11.4	48	11.4	71	17.7	91	17.7	116
1500	1K5	11.4	28	11.4	48	17.7	71	17.7	91	17.7	116
2200	2K2	11.4	28	17.7	48	17.7	71	17.7	91	21.8	116
3300	3K3	11.4	28	17.7	48	21.8	71	21.8	91	27.4	116
4700	4K7	17.7	28	17.7	48	21.8	71	27.4	91	27.4	116
6800	6K8	17.7	28	21.8	48	27.4	71	34.8	91	21.8	216
0.01 μF	10K	21.8	28	27.4	48	34.8	71	21.8	171	27.4	216
0.015	15K	21.8	28	34.8	48	21.8	131	27.4	171	27.4	216
0.022	22K	27.4	28	21.8	91	27.4	131	34.8	171	34.8	216
0.033	33K	21.8	48	27.4	91	34.8	131	43	171	43	216
0.047	47K	21.8	48	34.8	91	43	131	43	171	53.4	216
0.068	68K	27.4	48	43	91	53.4	131	53.4	171	—	—
0.10	100K	34.8	48	53.4	91	53.4	131	—	—	—	—

These capacitors are available in two types:
(a) with axial connecting wires (fig. 1); the dimensions are given above the dividing lines;
(b) with connecting lugs (fig. 2); the dimensions below those lines pertain to this type.

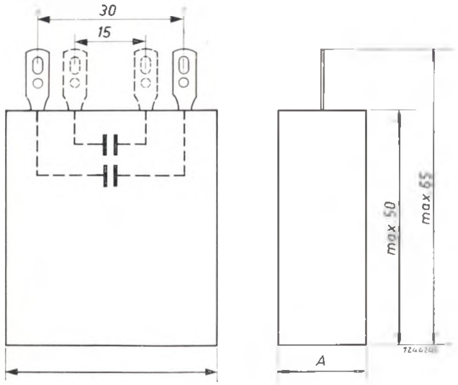
C113 series - PAPER CAPACITORS FOR DIRECT CURRENT

BOX TYPE FOR TELEPHONY



These capacitors are designed and especially shaped for multiple assembly in the bays of standard European. telephone exchanges, where they are intended for general purposes.

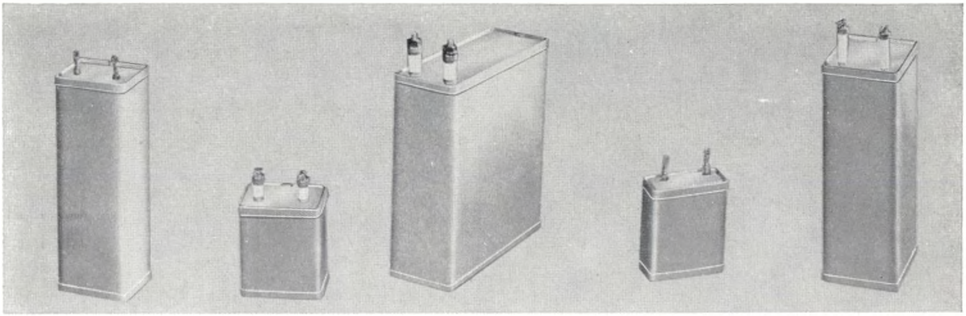
tolerance on capacitance	±10%
working temperature range	−40/+70 °C
working voltage	250V; above 40 °C to be derated by 0.9% per °C
maximum capacitance drift during life	$\Delta C \leqslant 5\%$
test voltage during 1 minute:	
(a) between terminals	2.5 × working voltage
(b) for multiple-section types between sections	2.5 × working voltage
(c) between interconnected terminals and casing	1000 V_{dc}
insulation resistance at 20 °C	RC $\geqslant$ 2.000 sec
losses (tan δ) at 1 kc/s	$\leqslant 60 \times 10^{-4}$
climatic group number	40/070/21 (IEC)



capacitance	*dimensions A (mm)*	*type number*
50000 pF	10 ± 0.5	C113AA/A50K
0.1 μF	10 ± 0.5	/A100K
0.25	10 ± 0.5	/A250K
0.4	10 ± 0.5	/A400K
0.5	10 ± 0.5	/A500K
0.8	10 ± 0.5	/A800K
1	10 ± 0.5	/A1M
2	20 ± 0.5	/A2M
4	35 ± 0.5	/A4M
6	45 ± 0.5	/A6M
2 × 0.25	10 ± 0.5	/A2×250K
2 × 0.5	10 ± 0.5	/A2×500K
2 × 1	20 ± 0.5	/A2×1M
2 × 2	35 ± 0.5	/A2×2M

PAPER CAPACITORS FOR DIRECT CURRENT - 8228. series

RECTANGULAR BOX TYPE



These capacitors are suitable for apparatus and installations on which the severest demands are imposed such as stationary and mobile telecommunication installations and measuring apparatus (e.g. for coupling, decoupling and smoothing in transmitters and amplifiers, as separating capacitors in filter circuits and suchlike).

tolerance on capacitance		$\pm 10\%$
working temperature range		$-40/+70$ °C
working voltage		above 40 °C to be derated by 0.9% per °C
permissible alternating voltage (50–60 c/s)	$250\ V_{dc}$ types	$175\ V_{ac}$
	$500\ V_{dc}$ types	$250\ V_{ac}$
	$1000\ V_{dc}$ types	$330\ V_{ac}$
	$2000\ V_{dc}$ types	$484\ V_{ac}$
	$3400\ V_{dc}$ types	$825\ V_{ac}$
maximum capacitance drift during life		$\Delta C \leq 5\%$
test voltage during 1 minute:		
(a) between terminals	$250\ V_{dc}$ types	$650\ V_{dc}$
	$500\ V_{dc}$ types	$1300\ V_{dc}$
	$1000\ V_{dc}$ types	$1940\ V_{dc}$
	$2000\ V_{dc}$ types	$3500\ V_{dc}$
	$3400\ V_{dc}$ types	$5400\ V_{dc}$
(b) between interconnected terminals and casing		$4 \times V_{nom}$ (min. $2800\ V_{dc}$)
insulation resistance at 20 °C	for $C < 0.2\ \mu F$	$R \geq 10000\ M\Omega$
	for $C \geq 0.2\ \mu F$	$RC \geq 2000$ sec
losses ($\tan \delta$) at 50 c/s		$\leq 40 \times 10^{-4}$
climatic group number		40/070/56 (IEC)

Composition of the type number 8228.A/....

capacitance code

code for construction

working voltage

0 = fig. 2, height 50 mm
2 = fig. 2, height 125 mm
3 = fig. 3, height 50 mm
5 = fig. 3, height 125 mm
8 = fig. 4, height 125 mm

C = $250\ V_{dc}$
E = $500\ V_{dc}$
V = $1000\ V_{dc}$
M = $2000\ V_{dc}$
S = $3400\ V_{dc}$

Example: The type number of a 3 μF/1000V capacitor with a height of 125 mm according to fig. 3, is 82285A/V3M.

8228. series - PAPER CAPACITORS FOR DIRECT CURRENT

RECTANGULAR BOX TYPE

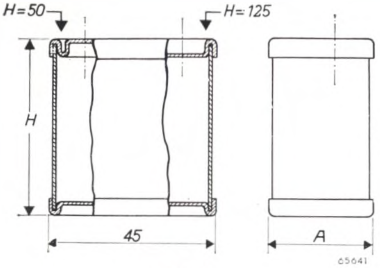


Fig. 1

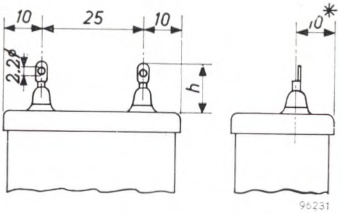


Fig. 2

* 7.5 mm when A (fig. 1) = 15 mm

capacitance (μF)	capacitance code	construction and dimensions (mm)							
		250 V_{dc}				500 V_{dc}			
		fig.	A	H	h	fig.	A	H	h
0.1	100K								
0.12	120K								
0.16	160K								
0.2	200K								
0.25	250K								
0.3	300K								
0.4	400K								
0.5	500K								
0.6	600K								
0.8	800K					2	15	50	14
1	1M					2	20	50	14
1.2	1M2	2	15	50	14	2	20	50	14
1.6	1M6	2	20	50	14	2	25	50	14
2	2M	2	20	50	14	2	30	50	14
2.5	2M5	2	25	50	14	2	40	50	14
3	3M	2	30	50	14	2	45	50	14
4	4M	2	40	50	14	2	60	50	14
5	5M	2	45	50	14	2	30	125	11.5
6	6M	2	55	50	14	2	35	125	11.5
8	8M	2	30	125	11.5	2	45	125	11.5
10	10M	2	35	125	11.5	2	55	125	11.5
12	12M	2	45	125	11.5	4	75	125	17.5
16	16M	2	55	125	11.5	4	90	125	17.5
20	20M	4	75	125	17.5	4	120	125	17.5
25	25M	4	90	125	17.5				

PAPER CAPACITORS FOR DIRECT CURRENT - 8228. series

RECTANGULAR BOX TYPE

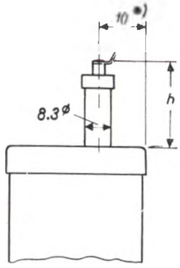


Fig. 3

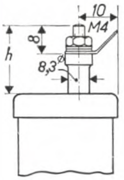
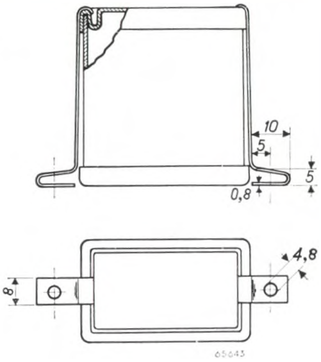


Fig. 4

Fig. 5



* 7.5 mm when A (fig. 1) = 15 mm

construction and dimensions (mm)												capacitance code
1000 V_{dc}				2000 V_{dc}				3400 V_{dc}				
fig.	*A*	*H*	*h*	*fig.*	*A*	*H*	*h*	*fig.*	*A*	*H*	*h*	
				3	15	50	16	3	25	50	21	100K
				3	15	50	16	3	25	50	21	120K
				3	15	50	16	3	35	50	21	160K
				3	20	50	16	3	45	50	21	200K
				3	20	50	16	3	55	50	21	250K
				3	25	50	16	3	60	50	21	300K
3	15	50	12	3	30	50	16	3	25	125	18.5	400K
3	15	50	12	3	35	50	16	3	35	125	18.5	500K
3	20	50	12	3	40	50	16	3	35	125	18.5	600K
3	25	50	12	3	50	50	16	3	50	125	18.5	800K
3	30	50	12	3	25	125	13.5	3	60	125	18.5	1M
3	35	50	12	3	25	125	13.5	4	75	125	26.5	1M2
3	45	50	12	3	35	125	13.5	4	90	125	26.5	1M6
3	50	50	12	3	45	125	13.5	4	120	125	26.5	2M
3	60	50	12	3	50	125	13.5					2M5
3	30	125	9.5	3	60	125	13.5					3M
3	40	125	9.5	4	90	125	21.5					4M
3	45	125	9.5	4	105	125	21.5					5M
3	55	125	9.5	4	120	125	21.5					6M
4	75	125	17.5									8M
4	90	125	17.5									10M
4	105	125	17.5									12M
												16M
												20M
												25M

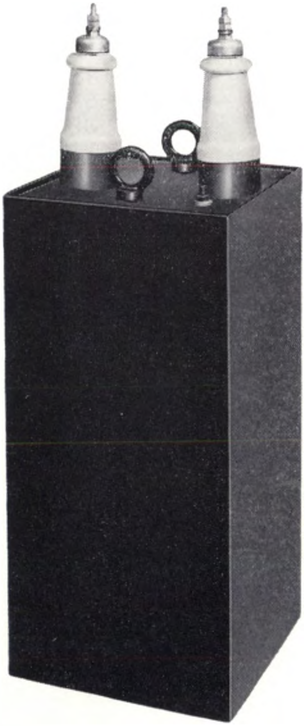
If desired use can be made of mounting brackets as illustrated in fig. 5: two if A (fig. 1) is smaller than 60 mm, four if A is 60 mm or larger. The type numbers of the mounting brackets are:
88480/00 for *H* (fig. 1) = 50 mm, 88480/02 for *H* (fig. 1) = 125 mm.
Two wires of max. 0.75 sq.mm can be connected to each soldering tag in the case of glass lead-ins, and two wires of max. 1.5 sq.mm in the case of ceramic lead-ins.

PAPER CAPACITORS FOR DIRECT CURRENT

HIGH-VOLTAGE TYPE FOR SMOOTHING PURPOSES

These capacitors are designed for smoothing high direct voltages but they have also an extensive field of application as coupling and decoupling capacitors. They are proof against atmospheric influences.

tolerance on capacitance	±10%
working temperature range	−40/+70%
working voltage	above 40 °C to be derated by 0.9% per °C
max. capacitance drift during life	$\Delta C \leqslant 5\%$
test voltage during 1 minute:	
(a) across the terminals	see table
(b) between interconnected terminals and casing	2.5 × working voltage
insulation resistance at 20 °C	$RC \geqslant 2000$ sec
losses (tan δ) at 50 c/s	$\leqslant 40 \times 10^{-4}$

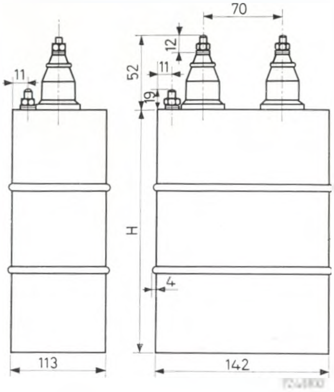


Test voltage across the terminals

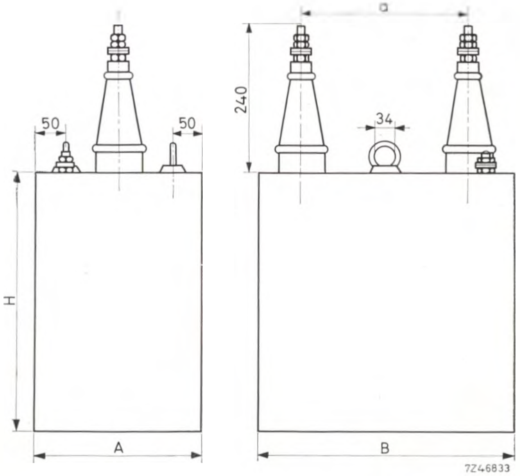
type 82570./...		**type 178../179..**	
working voltage (kV)	*test voltage (kV)*	*working voltage (kV)*	*test voltage (kV)*
2	4.2	8	17
2.7	4.5	9.5	20
3.4	5.4	11	23
4.4	8.4	13.5	28.5
5.5	9	16	34
6.6	11	20	45.5
		24	53
		27	57

HIGH-VOLTAGE TYPE FOR SMOOTHING PURPOSES

max. voltage (kV)	*capacitance (μF)*	*(mm)*	*weight (kg)*	*type number*
2	8	95	2.4	82570A/N8M
2.7	4	95	2.4	82570A/H4M
	6	95	2.4	82570A/H6M
	8	125	3.2	82570A/H8M
3.4	4	125	3.2	82570A/S4M
	6	210	4.8	82570A/S6M
	8	260	5.7	82570A/S8M
4.4	1	65	1.6	82570A/W1M
	2	95	2.4	82570A/W2M
	4	210	4.8	82570A/W4M
	6	310	7.8	82570A/W6M
	8	410	9.2	82570A/W8M
5.5	1	95	2.4	82570A/X1M
	2	125	3.2	82570A/X2M
	4	310	7.8	82570A/X4M
	6	410	9.2	82570A/X6M
	8	510	11.4	82570A/X8M
6.6	1	125	3.2	82570A/Z1M
	2	260	5.7	82570A/Z2M
	4	460	10.4	82570A/Z4M
	6	610	13.8	82570A/Z6M



Type 82570./...



Type 178../179..
See table on next page.

PAPER CAPACITORS FOR DIRECT CURRENT

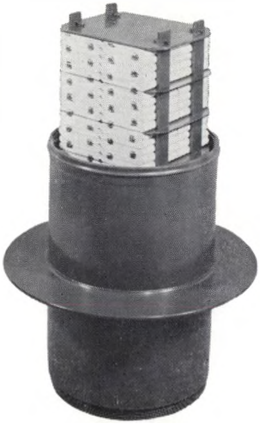
HIGH-VOLTAGE TYPE FOR SMOOTHING PURPOSES

max. voltage (kV)	capacitance (µF)	max. dimensions (mm)				weight (kg)	type number
		A	B	H	a		
8	2	200	300	470	200	43	17812
	4	200	300	470	200	43	17814
	6	300	350	470	230	75	17816
	8	300	350	470	230	75	17818
	16	400	400	470	270	120	17819
9.5	2	200	300	470	200	43	17832
	4	300	300	470	200	65	17834
	6	300	450	470	330	95	17836
	8	400	450	470	330	130	17838
	16	500	500	470	330	175	17839
11	2	200	300	640	200	64	17852
	4	300	300	640	200	90	17854
	6	300	400	640	370	120	17856
	8	400	400	640	270	160	17858
	16	500	500	640	330	240	17859
13.5	2	200	350	750	230	75	17872
	4	300	350	750	230	120	17874
	6	400	350	750	230	160	17876
	8	400	400	750	270	180	17878
	16	400	600	750	430	250	17879
16	2	300	300	850	200	100	17892
	4	300	350	850	230	130	17894
	6	400	350	850	230	180	17896
	8	400	400	850	270	200	17898
	16	400	600	850	480	300	17899
20	2	300	400	750	270	150	17932
	4	400	450	750	330	200	17934
	6	500	500	750	330	240	17936
	8	500	600	750	430	320	17938
24	2	400	350	750	230	160	17952
	4	400	600	750	430	250	17954
	6	600	600	750	430	350	17956
	8	600	700	750	500	420	17958
27	2	400	450	750	330	200	17972
	4	500	600	750	430	320	17974
	6	600	600	750	430	350	17976
	8	750	800	750	560	600	17978

PAPER CAPACITORS FOR DIRECT CURRENT

HIGH-VOLTAGE TYPE IN INSULATED CASING

These high-tension capacitors are used e.g. in apparatus for X-ray research, nuclear research and testing of high-voltage installations. In these applications the capacitors may be charged either continuously by a direct current (e.g. in a cascade generator) or only during a short period of time and then discharged again (e.g. in a pulse generator). Various other modes of operation are possible.



Types and construction

In view of the many charging conditions which have to be covered, the capacitors are classified into three groups:

(a) for continuous d.c. operation;
(b) for intermittent d.c. operation (30% averaged over 24 hours);
(c) for surge operation (the maximum direct voltage is applied only for short periods, in the order of minutes or even less).

The paper dielectric has been chosen so as to combine optimum performance under the relevant operating conditions with minimum dimensions and low price.

The casing is composed of a high-grade synthetic pot enlarged, if necessary by a number of rings screwed onto this pot to obtain the total volume required.

The top is closed by a cast-iron cover which is connected to one side of the capacitor element, the other connecting terminal being present in the centre of the bottom. For some types the pot and extension rings are provided with flanges of the same material so that the distance between the two terminals is increased and a higher working voltage can be applied. There are two standard diameters of the casing.

tolerance on capacitance	$\pm 10\%$
test voltage:	
types for continuous operation during 1 sec	2.5 × working voltage
types for intermittent operation during 30 minutes	1.5 × working voltage
types for surge operation during 10 minutes	1.2 × working voltage
insulation resistance at 25 °C	$RC \geqslant 2000$ sec

PAPER CAPACITORS FOR DIRECT CURRENT

HIGH-VOLTAGE TYPE IN INSULATED CASING

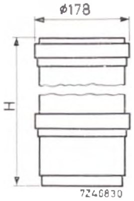


Fig. 1

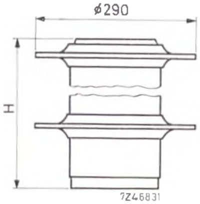


Fig. 2

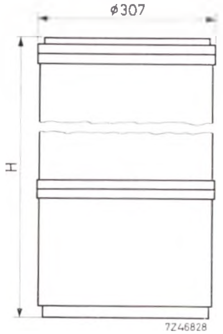


Fig. 3

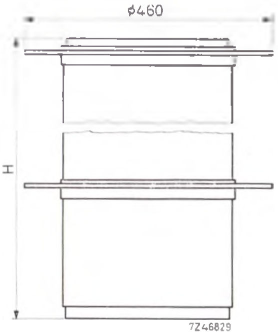


Fig. 4

In the following table the maximum permissible direct voltage and the maximum static energy content expressed in terms of joules are given for the various combinations of pot and rings either with or without flanges and for the three different modes of operation.

max. working voltage (kV)	*output for the different types (Wsec)*			*number of rings*	*construction according to fig.*	*dimensions (H) in mm*
	continuous operation	*intermittent operation*	*surge operation*			
20	15	50	65	1	1	145
30	15	50	65	1	2	145
45	40	135	200	2	1	255
60	40	135	200	2	2	255
60	155	525	760	1	3	245
75	60	220	300	3	1	365
75	155	525	760	1	4	245
100	60	220	300	3	2	365
100	80	310	400	4	1	475
120	320	1100	1850	2	3	465
150	80	310	400	4	2	475
150	100	400	500	5	1	585
150	320	1100	1850	2	4	465
180	530	1800	2800	3	3	685
200	100	400	500	5	2	585
200	120	500	600	6	1	695
225	530	1800	2800	3	4	685
250	120	500	600	6	2	695
250	140	590	700	7	1	805
300	140	590	700	7	2	805

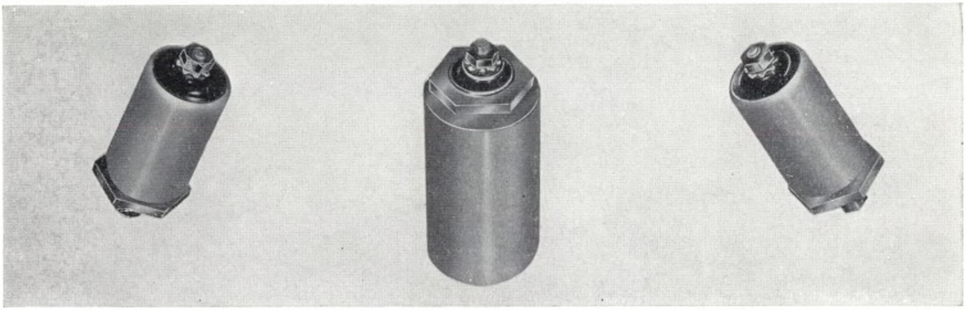
The static energy content is calculated in joules as:
$\frac{1}{2}CU^2$, where C = capacitance in microfarads
U = direct working voltage in kilovolts.

The table serves only as a guidance to illustrate the possibilities of this high-voltage capacitor programme. Quotations can be made only if full details of the requirements are stated, viz.:

1. capacitance;
2. maximum working voltage;
3. maximum temperature if higher than 40 °C;
4. mode of operation (unless continuous d.c. operation is required):
    - A. for intermittent d.c. operation; average number of operating hours per day;
    - B. for surge operation: a. discharge time or discharge frequency; b. repetition frequency;
5. any other information that may be of value for the design of the capacitor.

PAPER CAPACITORS FOR DIRECT CURRENT - B8 002..series

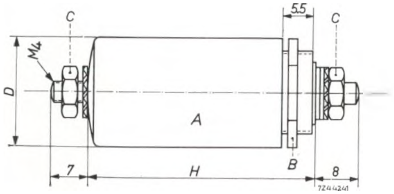
TYPE FOR INTERFERENCE SUPPRESSION IN MOTOR CARS



These tropic proof metallised paper capacitors have been developed for suppressing interference from various electrical car accessories.

Because of the feed-through type of construction, the inductance of these capacitors is very low as is required for use in short-wave and f.m. car radios.

The capacitors consist of a low-inductively wound and impregnated strip of paper upon which a very thin film of metal has been deposited. It is contained in a cylindrical aluminium can (A) having a hollow screw-base with a mounting nut (B). Both ends of the can are sealed with an impermeable layer of synthetic resin, and provided with a terminal nut (C) and a spring washer.



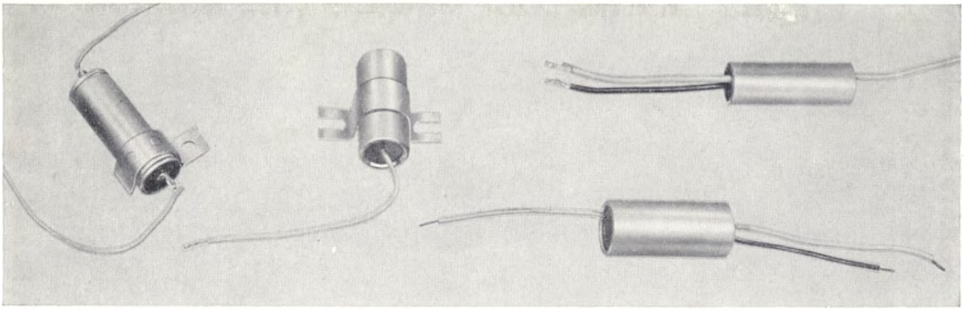
type number		B800203	B800202
capacitance	(μF)	$\geqslant 0.5$	$\geqslant 2$
insulation resistance	(MΩ)	$\geqslant 4000$	>1000
R at 100 Mc/s	(Ω)	$\leqslant 0.3$	$\leqslant 0.5$
X at 100 Mc/s	(Ω)	$\leqslant 2.5$	$\leqslant 3.3$
weight	(g)	36	64
H	(mm)	42	60
D	(mm)	21	23
mounting bracket		B1 02006	B1 02007

Impedance at 100 Mc/s can be calculated from the series resistance R and the reactance X given in the table.

working temperature range	$-40/+85$ °C (temporarily up to + 100 °C)
working voltage: at 40 °C	500 V_{dc}
at 85 °C	300 V_{dc}
beyond 40 °C	to be derated by 0.9% per °C
test voltage during 1 minute	1000 V_{dc}
losses (tan δ) at 50 c/s	40×10^{-4}

PAPER CAPACITORS FOR ALTERNATING CURRENT

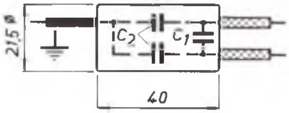
TYPE FOR INTERFERENCE SUPPRESSION IN ELECTRICAL APPLIANCES



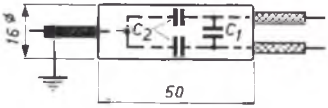
These capacitors are widely used for eliminating radio and television interferences, caused by small motor-operated tools, household appliances such as vacuum cleaners, washers, refrigerators, kitchen-aids, and by gas-discharge lamps.

tolerance on capacitance	$-10/+20\%$ (type 62931 $\pm 20\%$ for C_2)
working temperature range	70 °C
working voltage	250 V_{ac} 70 V_{ac}(only for type 7350)

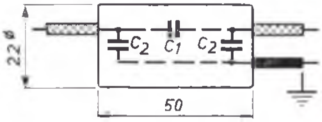
capacitance		*type number*
C_1 (μF)	C_2 (pF)	
0.1	5 000	62 931
0.1	3 000	5 573
0.05	2 500	5 571
0.5	—	7 350
0.2	5 575	5 575
0.2	10 000	5 568



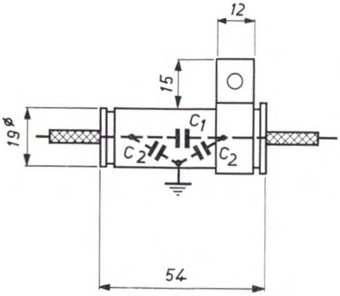
5573



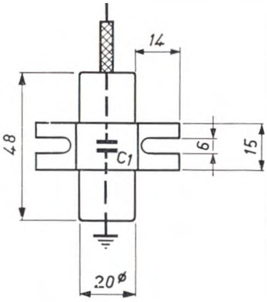
5571



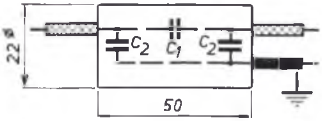
5575



62931



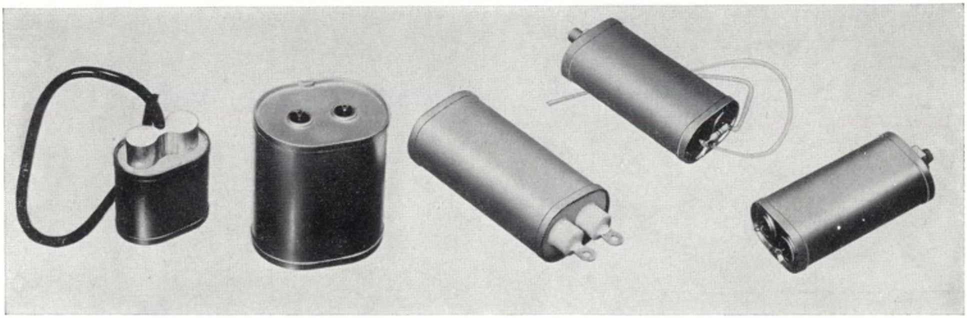
7350



5568

PAPER CAPACITORS FOR ALTERNATING CURRENT

C120/C124/C125 series - **BOX TYPE**



These capacitors are specially designed for ballasts of luminous-discharge lamps but are also extensively used with single-phase asynchronous motors, and for power-factor correction in low-power devices. They represent the latest stage in the development of paper capacitors in all-metal cans for low a.c. powers

working temperature range: for C120/124 series	$-20/+80$ °C
for C125 series	$-20/+70$ °C
working voltage	max. $1.1 \times V_{nom}$
working frequency	40–60 c/s; beyond 50 c/s V_{nom} or working temperature should be derated by 10% or 10 °C resp.
maximum capacitance drift during life	ΔC max $\pm$ 5%
test voltage during 1 minute:	
(a) between the terminals	$2.15\ V_{nom}$
(b) between terminals and can	2500 V_{ac} or 3500 V_{dc}
insulation resistance at 20 °C: between terminals	$R \geqslant 12000\ M\Omega$
between terminals and can	$RC \geqslant 2000$ sec
losses (tan δ) at 50 c/s	$\leqslant 50 \times 10^{-4}$

Type Approvals

A large part of our capacitor programme has been approved by official testing institutes:

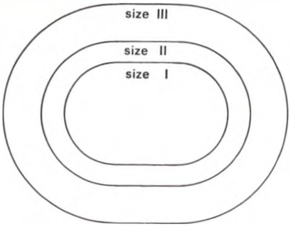
Belgium – CEBEC
Denmark – DEMKO
Germany – VDE
Norway – NEMKO
Sweden – SEMKO
Switzerland – SEV

Besides, our capacitors comply with the British BSI specification, and the relevant IEC and CEE recommendations. If required, detailed information is available.

PAPER CAPACITORS FOR ALTERNATING CURRENT

250 V BOX TYPE - C120/C124/C125 series

Dimensions (mm)



	a	b	c
size I	26	43	18
size II	38	55	22
size III	57	75	25

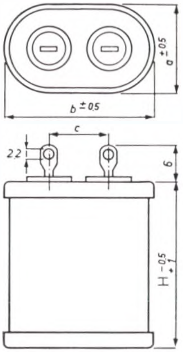


Fig. 1

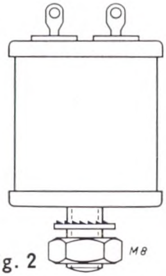


Fig. 2

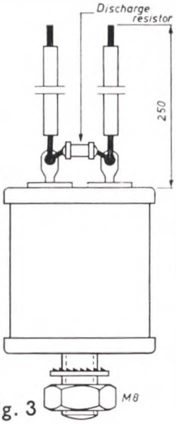


Fig. 3

Style designation

	fig. 1	fig. 2	fig. 3	fig. 4	fig. 5	fig. 6	fig. 7
size I	C124AA	C124CA	C124EA	C124GA	C124JA	C124LA	C124NA
size II	C124BA	C124DA	C124FA	C124HA	C124KA	C124MA	C124PA
size III	C125AA	C125CA	C125EA	C125GA	C125JA	C125LA	C125NA

250V Range (preferred types)
(for capacitance values below 3 μF see higher voltages)

Capacitance in μF ± 10%	**3**	**3,5**	**4**	**4,5**	**5**	**6**	**7**	**8**	**9**	**10**	**12**
L max (in mm)	50	57	57	62	71	86	86	99	109	124	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C124AA-C124CA-C124EA-C124GA										

Capacitance in μF	**8**	**9**	**10**	**12**	**13,5**	**15**	**18**	**20**	**25**	**30**	**35**
L max (in mm)	57	62	71	86	86	99	109	124	148	148	148
Size	**Size II** (cross section 38 × 55 mm) **Style designations** C124BA-C124DA-C124FA-C124HA									**Size III** **Styles C125**	

Composition of the type number: a capacitor 8 μF ± 10%, 250 V, cross section 26 × 43 mm and designed according to fig 3: C120GA/A5M.

The special programme 250 V capacitors for sodium and HPF gas discharge lamps for public lighting is mentioned on page C94.

C120/C124/C125 series - 300 V BOX TYPE

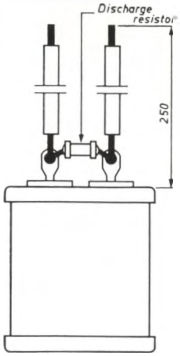


Fig. 4

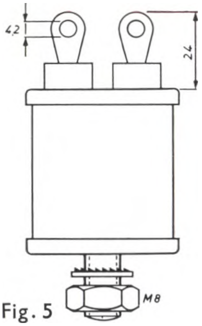


Fig. 5

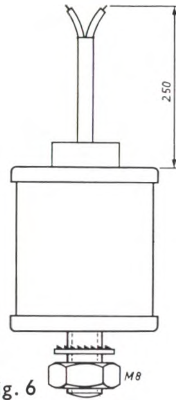


Fig. 6

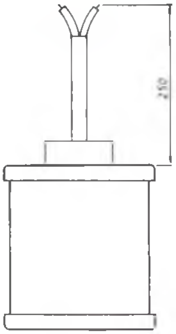


Fig. 7

Style designation

	fig. 1	*fig. 2*	*fig. 3*	*fig. 4*	*fig. 5*	*fig. 6*	*fig. 7*
size I	C120AA	C120CA	C120EA	C120GA	C120JA	C120LA	C120NA
size II	C120BA	C120DA	C120FA	C120HA	C120KA	C120MA	C120PA

300V Range (preferred types)
(for capacitance values below 2 µF see higher voltages)

Capacitance in µF ± 10%-	**2**	**2,5**	**3**	**3,5**	**4**	**4,5**	**5**	**6**	**7**	**8**
L max (in mm)	50	62	71	86	86	99	99	124	148	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C120AA-C120CA-C120EA-C120GA									

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[1] For Fluorescent Lamp "Instant-Start Circuit" purposes 5% tolerance values can be offered.

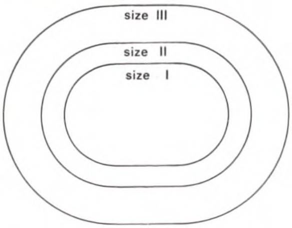
Capacitance in µF ± 10%	**8**	**9**	**10**	**12**	**14**
L max (in mm)	86	86	99	109	124
Size	**Size II** (cross section 38 × 55 mm) **Style designations** C120BA-C120DA-C120FA-C120HA				

Composition of the type number: a capacitor 5 µF ± 10%, 300V, cross section 26 × 43 mm and designed according to figure 4: C124EA/A8M

PAPER CAPACITORS FOR ALTERNATING CURRENT

380 V BOX TYPE - C120/C124/C125 series

Dimensions (mm)



	a	b	c
size I	26	43	18
size II	38	55	22
size III	57	75	25

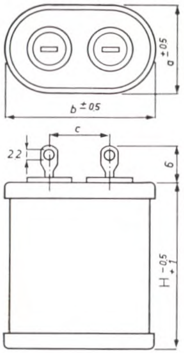


Fig. 1

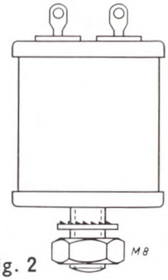


Fig. 2

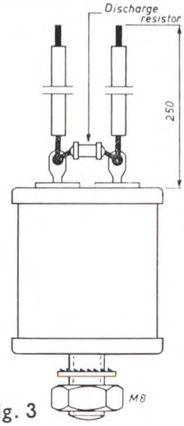


Fig. 3

Style designation

	fig. 1	*fig. 2*	*fig. 3*	*fig. 4*	*fig. 5*	*fig. 6*	*fig. 7*
size I	C120AB	C120CB	C120EB	C120GB	C120JB	C120LB	C120NB
size II	C120BB	C120DB	C120FB	C120HB	C120KB	C120MB	C120PB
size III	C125AB	C125CB	C125EB	C125GB	C125JB	C125LB	C125NB

380V RANGE (preferred types)

Capacitance in μF ± 10%	**1,5**	**2**	**2,5**	**3**	**3,5 . . .3,8**	**4**	**5**	**5,7 . . . 6**
L max (in mm)	50	62	86	86	99	109	124	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C120AB-C120CB-C120EB-C120GB							

[1] **For Fluorescent lamp series compensation 5% tolerance available, also for capacitance values between standard range.**

Capacitance in μF ± 10%	**7**	**8**	**10**	**12**	**16**	**20**	**25**
L max (in mm)	99	109	124	86	99	124	148
Size	**Size II** (38 × 55 mm) C120BB-C120DB- C120FB-C120HB			**Size III** (57 × 75 mm) C125AB-C125CB-C125EB-C125GB			

Composition of the type number: a capacitor 6 μF, 380V, cross section 26 × 43 mm and designed according to fig 4:

- with capacity tolerance ± 10%: C120GB/A6M
- with capacity tolerance ± 5%: C120GB/B6M

PAPER CAPACITORS FOR ALTERNATING CURRENT

C120/C124/C125 SERIES - 440 V BOX TYPE

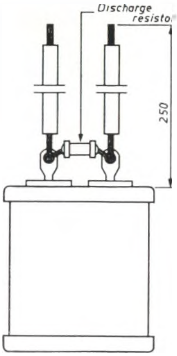


Fig. 4

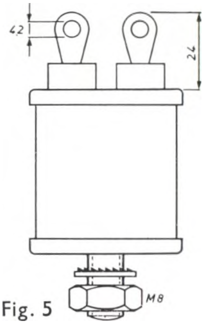


Fig. 5

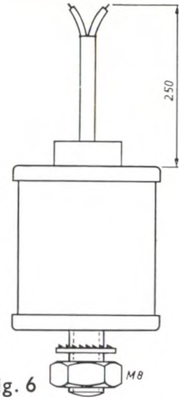


Fig. 6

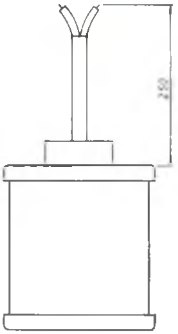


Fig. 7

Style designation

	fig. 1	*fig. 2*	*fig. 3*	*fig. 4*	*fig. 5*	*fig. 6*	*fig. 7*
size I	C120AC	C120CC	C120EC	C120GG	C120JC	C120LC	C120NC
size II	C120BC	C120DC	C120FC	C120HC	C120KC	C120MC	C120PC
size III	C125AC	C125CC	C125EC	C125GC	C125JC	C125LC	C125NC

440V Range (preferred types)

Capacitance in μF ± 10%	**1**	**1,5**	**2**	**2,5**	**3**	**3,5**	**4**
L max (in mm)	50	71	86	99	109	124	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C120AC-C120CC-C120EC-C120GC						

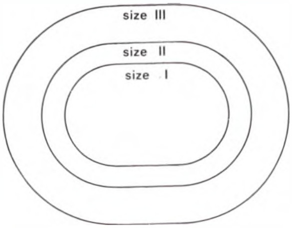
Capacitance in μF ± 10%	**5**	**6**	**8**	**10**	**12**	**16**	**20**
L max (in mm)	99	109	71	86	99	124	148
Size	**Size II** C120BC-C120DC-C120FC-C120HC		**Size III** (cr. sect. 57 × 75 mm) **Style des.** C125AC-C125CC-C125EC-CZ25GC				

Composition of the type number: a capacitor 3 μF ± 10%, 440V, cross section 26 ± 43 mm and designed according to fig. 1: C120AC/A3M

PAPER CAPACITORS FOR ALTERNATING CURRENT

500 V BOX TYPE - C120/C124/C125 SERIES

Dimensions (mm)



	a	b	c
size I	26	43	18
size II	38	55	22
size III	57	75	25

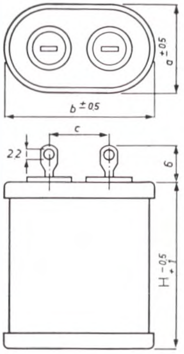


Fig. 1

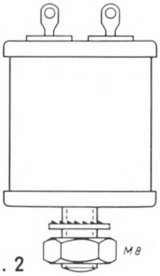


Fig. 2

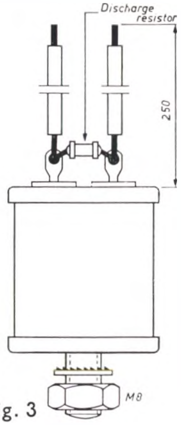


Fig. 3

Style designation

	fig. 1	*fig. 2*	*fig. 3*	*fig. 4*	*fig. 5*	*fig. 6*	*fig. 7*
size I	C120AD	C120CD	C120ED	C120GD	C120JD	C120LD	C120ND
size II	C120BD	C120DD	C120FD	C120HD	C120KD	C120MD	C120PD
size III	C125AD	C125CD	C125ED	C125GD	C125JD	C125LD	C125ND

500V Range (preferred types)

Capacitance in μF ± 10%	**0,75**	**1**	**1,5**	**2**	**2,5**	**3**	**3,5**
L max (in mm)	50	57	71	86	109	124	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C120AD-C120CD-C120ED-C120GD						

Capacitance in μF ± 10%	**4**	**5**	**6**	**8**	**10**	**12**	**15**
L max (in mm)	99	109	124	86	109	124	148
Size	**Size II** (38 × 55 mm) C120BD-C120DD- C120FD-C120HD			**Size III** (57 × 75 mm) C125AD-C125CD- C125ED-C125GD			

Composition of the type number: a capacitor 3 μF ± 10%, 500V, cross section 26 × 43 mm and designed according to fig. 1: C120AD/A3M

PAPER CAPACITORS FOR ALTERNATING CURRENT

C120/C124/C125 SERIES - 660 V BOX TYPE

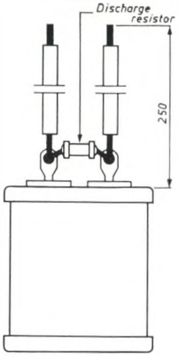


Fig. 4

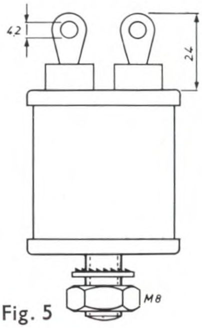


Fig. 5

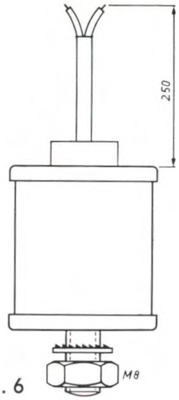


Fig. 6

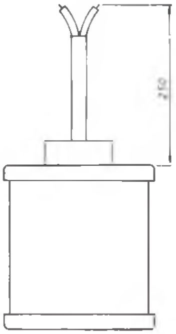


Fig. 7

Style designation

	fig. 1	*fig. 2*	*fig. 3*	*fig. 4*	*fig. 5*	*fig. 6*	*fig. 7*
size I	C120AE	C120CE	C120EE	C120GE	C120JE	C120LE	C120NE
size II	C120BE	C120DE	C120FE	C120HE	C120KE	C120ME	C120PE
size III	C125AE	C125CE	C125EE	C125GE	C125JE	C125LE	C125NE

660V Range (preferred types)

Capacitance in μF ± 10%	**0,5**	**0,75**	**1**	**1,5**	**2**
L max (in mm)	57	71	86	124	148
Size	**Size I** (cross section 26 × 43 mm) **Style designations** C120AE-C120CE-C120EE-C120GE				

Capacitance in μF ± 10%	**2,5**	**3**	**3,5**	**4**	**5**	**6**	**8**
L max (in mm)	99	109	124	86	99	109	148
Size	**Size II** (38 × 55 mm) C120BE-C120DE-C120FE-C120HE			**Size III** (57 × 75 mm) C125AE-C125CE-C125EE-C125GE			

Composition of the type number: a capacitor 1 μF ± 10%, 660V, cross section 26 × 43 mm and designed according to fig. 1: C120AE/A1M

SPECIAL TYPE - C124ZZ SERIES

These capacitors are specially designed for power-factor correction of gas-discharge lamps for public lighting. They are painted grey.

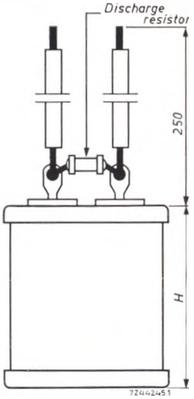


Fig. 1

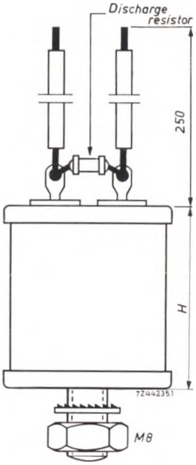


Fig. 2

max. capacitance (μF)	type number		H[1] (mm)
	fig. 1	fig. 2	
8	C124 ZZ/80	C124 ZZ/81	57
10	/100	/101	71
13	/130	/131	86
15	/150	/151	99
18	/180	/181	109
20	/200	/201	124
25	/250	/251	148

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[1] At cross-section of 38 mm × 55 mm

C126 SERIES - TYPE FOR POWER-FACTOR CORRECTION

These capacitors are used for raising the power factor of alternating-current installations by neutralising or reducing the wattless current originating from inductive loads.
Unfavourable power factors arise mainly from underloaded asynchronous motors, transformers (welding apparatus), induction furnaces, and so forth.

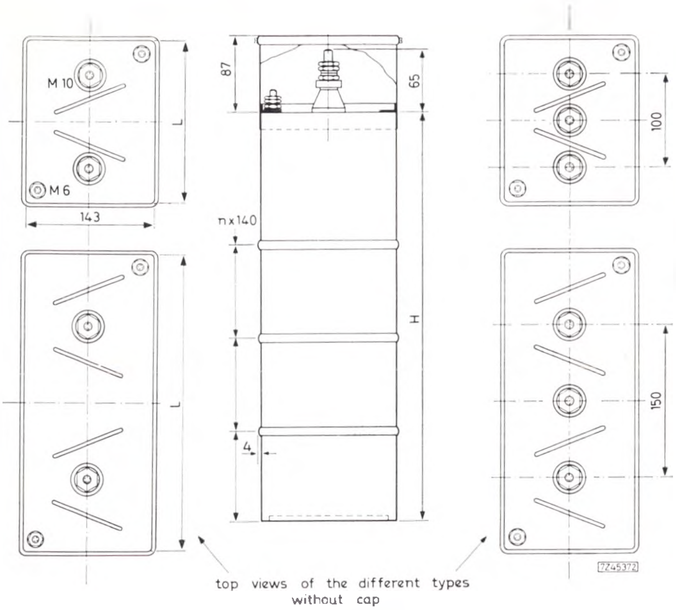
tolerance on capacitance	−5/+15%
working temperature range	−20/+70 °C
ambient temperature range	−20/+40 °C
working frequency	50 c/s
maximum capacitance drift during life	< 5%
test voltage during 1 minute:	
(a) across the terminals	2.15 × working voltage
(b) between interconnected terminals and can	2500 V_{ac}
losses (tan δ) at 50 c/s	$< 33 \times 10^{-4}$

Composition of the type number **C126../...**

single-phase A
three-phase B
working voltage
A = 220 V
B = 380 V
C = 440 V
D = 500 V
type number suffix

PAPER CAPACITORS FOR ALTERNATING CURRENT

TYPE FOR POWER-FACTOR CORRECTION - C126 SERIES



nominal working voltage (V)	wattless power (kVAr)	capacitance		current I_n		dimensions (mm)		type number suffix
		single phase (μF)	three-phase[1] (μF)	single phase (A)	three-phase (A)	L	H	
220/230	6/ 6.5	396	198	27/29	16/16	175	558	H6
	9/10	594	297	41/43	24/25	333	483	H9
	12/13	792	391	55/57	31/33	333	558	H12
	15/16.5	990	495	68/72	39/41	333	708	H15
380/400	10/11	220	110	26/28	15/16	175	483	H10
	13.3/15	294	147	35/37	20/22	175	558	H13.3
	20/22	440	220	53/56	30/32	333	483	H20
	26.7/30	585	293	70/74	41/43	333	558	H26.7
	33.3/37	735	368	88/90	51/53	333	708	H33.3
440/460	10/11	165	83.5	23/24	13/14	175	483	H10
	13.3/15	220	110	30/33	17/19	175	558	H13.3
	20/22	330	115	45/48	26/28	333	483	H20
	26.7/30	440	220	61/65	35/38	333	558	H26.7
	33.3/37	550	275	76/80	44/46	333	708	H33.3
500/525	10/11	127.5	64	20/21	12/12	175	483	H10
	13.3/15	170	85	27/29	15/16	175	558	H13.3
	20/22	255	128	40/42	23/24	333	483	H20
	26.7/30	340	170	53/57	31/33	333	558	H26.7
	33.3/37	425	213	67/70	38/41	333	708	H33.3

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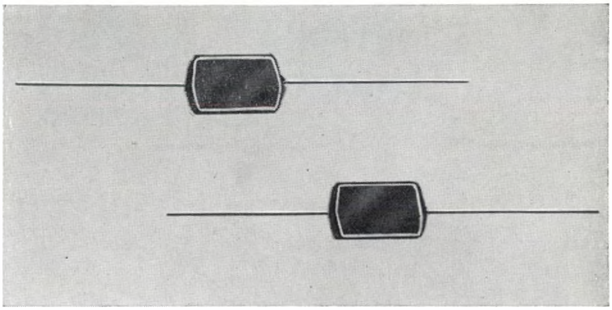
[1] These values are the capacitance values measured between the terminals

MICA CAPACITORS – 82 057 series

MOULDED MIDGET TYPE



These mica capacitors are especially recommended for communications equipment, measuring instruments, military devices, etc. They can be mounted in the wiring of the apparatus and, owing to their insulated body and their flat shape, be placed close together or against a metal plate.

working temperature range		$-40/+85$ °C
temperature coefficient of the capacitance		$(0 \text{ to } +60) \times 10^{-6}$ pF per pF and per °C
working voltage		500 V_{dc}
maximum capacitance drift during life	for $C > 100$ pF	$\pm 1\%$
	for $C \leqslant 100$ pF	± 1 pF
test voltage during 1 minute		1350 V_{dc}
insulation resistance at 20 °C		100000 MΩ
losses ($\tan\delta$): parallel damping	for $C < 40$ pF	$\geqslant 4$ MΩ
at 1 Mc/s	for $C = 40 - 1000$ pF	$\leqslant 10 \times 10^{-4}$
at 100 kc/s	for $C > 1000$ pF	$\leqslant 7 \times 10^{-4}$
climatic group number		45/085/21 (IEC)

Composition of the type number **82 057./...**

capacitance tolerance ◀ ▶ capacitance code

A = ±10%[1] for $C \geqslant$ 22 pF
B = ±5% for $C \geqslant$ 93 pF
C = ±2% for $C \geqslant$ 100 pF
D = ±1% for $C \geqslant$ 100 pF
M = ±1 pF for $C \leqslant$ 91 pF

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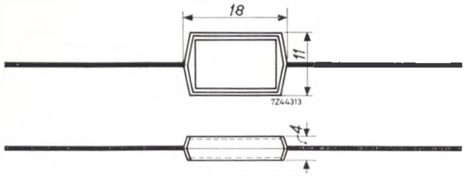
[1] In the tolerance class ± 10% the capacitance values are scaled according to what is known as the E12 series (12 values between 1 and 10 progressing in steps of approximately the same percentage), in the other classes they are scaled according to the E24 series (24 values between 1 and 10) but E12 values are preferred types.

Example: The type number of a 1800 pF capacitor, tolerance ±5% is 82057B/1K8.

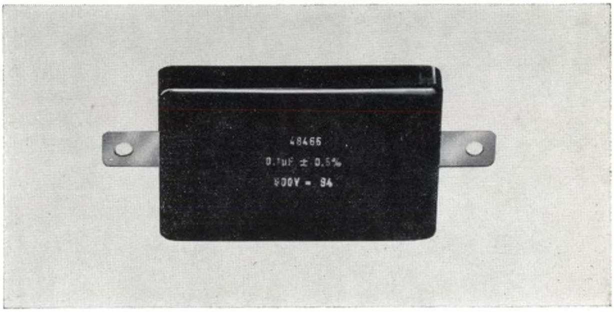
MOULDED MIDGET TYPE



capacitance value (pF)	capacitance code	capacitance value (pF)	capacitance code	capacitance value (pF)	capacitance code	capacitance value (pF)	capacitance code
		10	10E	100	100E	1000	1K
		11	11E	110	110E	1100	1K1
		12	12E	120	120E	1200	1K2
		13	13E	130	130E	1300	1K3
		15	15E	150	150E	1500	1K5
		16	16E	160	160E	1600	1K6
		18	18E	180	180E	1800	1K8
		20	20E	200	200E	2000	2K
		22	22E	220	220E	2200	2K2
		24	24E	240	240E	2400	2K4
		27	27E	270	270E	2700	2K7
		30	30E	300	300E		
		33	33E	330	330E		
		36	36E	360	360E		
		39	39E	390	390E		
		43	43E	430	430E		
		47	47E	470	470E		
		51	51E	510	510E		
5.6	5E6	56	56E	560	560E		
6.2	6E2	62	62E	620	620E		
6.8	6E8	68	68E	680	680E		
7.5	7E5	75	75E	750	750E		
8.2	8E2	82	82E	820	820E		
9.1	9E1	91	91E	910	910E		

MICA CAPACITORS

MOULDED PRECISION TYPE



These mica capacitors are designed with the aim of obtaining optimum performance as regards accuracy, stability and low losses. Therefore, they are suitable for applications which impose the highest requirements in this respect, such as e.g. measuring, control and communications equipment. The programme contains six series of capacitors.

working temperature range		−40/+85 °C
temperature coefficient of the capacitance	for C < 12000 pF	⩽ 75 × 10^{-6} pF per pF and per °C
	for C ⩾ 12000 pF	⩽ 50 × 10^{-6} pF per pF and per °C
maximum capacitance drift during life	for C <91 pF	±0.5 pF
	for C = 100 — 1000 pF	±0.4%
	for C = 1100 — 6800 pF	±0.2%
	for C ⩾ 6800 pF	±0.15%
test voltage during 1 minute		3 × working voltage
insulation resistance at 20 °C		⩾ 50000 MΩ

losses (tan δ): parallel damping	for C <50 pF	⩾ 3 MΩ
at 1 mc/s	for C = 50–200 pF	< 10 × 10^{-4}
	for C = 200–400 pF	< 7.5 × 10^{-4}
	for C = 400–1000 pF	< 4 × 10^{-4}
at 100 kc/s	for C > 1000 pF	< 5 × 10^{-4}
climatic group number		40/085/21 (IEC)

Composition of the type numbers

C399AA/. ...	5.1 – 1800 pF (500 V_{dc})
C399AB/. ...	2000 – 2700 pF (250 V_{dc})
B802002/. ...	2000 – 6800 pF (500 V_{dc})
82058 ./...	7500 – 12000 pF (250 V_{dc})
82059 ./...	7500 – 100000 pF (500 V_{dc})
82069 ./...	110000 – 300000 pF (500 V_{dc})

B = 5%
C = 2%
D = 1%
E = 0.5%
M = 1 pF

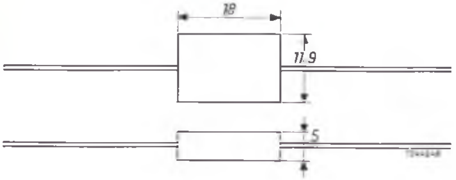
capacitance tolerance

capacitance code

Example: The type number of a 10000 pF/500 V_{dc} capacitor, tolerance ±5%, is 82059B/10K.

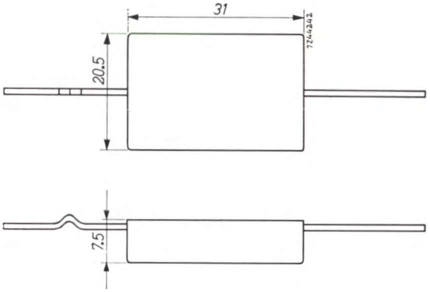
MICA CAPACITORS

MOULDED PRECISION TYPE



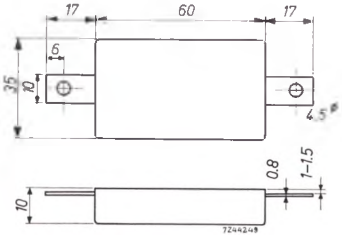
Series C399AA
5.1–1 800 pF
500 V

Series C399AB
2000–2700 pF
250 V

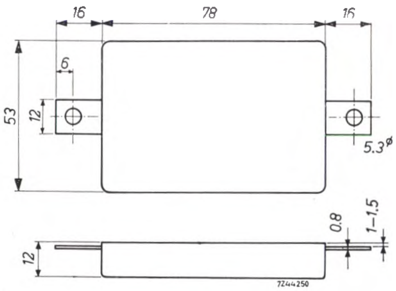


Series B802002
2000–6800 pF
500 V

Series 82058
7500–12000 pF
250 V



Series 82059
7500–100000 pF
500 V



Series 82069
110000–300000 pF
500 V

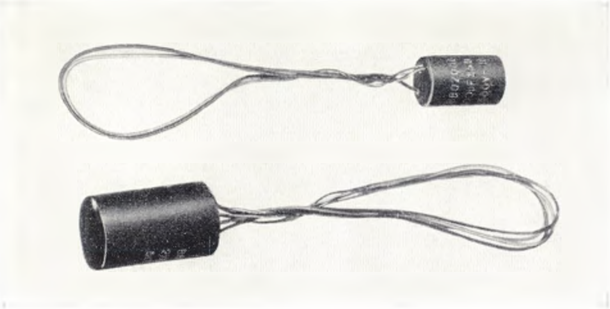
MICA CAPACITORS

MOULDED PRECISION TYPE

capacitance value (pf)	capacitance code	capacitance value (pf)	capacitance code	capacitance value (pf)	capacitance code	capacitance value (pf)	capacitance code	capacitance value (pf)	capacitance code	capacitance value (pf)	capacitance code
		10	10E	100	100E	1000	1K	10000	10K	0.10	100K
		11	11E	110	110E	1100	1K1	11000	11K	0.11	110K
		12	12E	120	120E	1200	1K2	12000	12K	0.12	120K
		13	13E	130	130E	1300	1K3	13000	13K	0.13	130K
		15	15E	150	150E	1500	1K5	15000	15K	0.15	150K
		16	16E	160	160E	1600	1K6	16000	16K	0.16	160K
		18	18E	180	180E	1800	1K8	18000	18K	0.18	180K
		20	20E	200	200E	2000	2K	20000	20K	0.20	200K
		22	22E	220	220E	2200	2K2	22000	22K	0.22	220K
		24	24E	240	240E	2400	2K4	24000	24K	0.24	240K
		27	27E	270	270E	2700	2K7	27000	27K	0.27	270K
		30	30E	300	300E	3000	3K	30000	30K	0.30	300K
		33	33E	330	330E	3300	3K3	33000	33K		
		36	36E	360	360E	3600	3K6	36000	36K		
		39	39E	390	390E	3900	3K9	39000	39K		
		43	43E	430	430E	4300	4K3	43000	43K		
		47	47E	470	470E	4700	4K7	47000	47K		
5.1	5E1	51	51E	510	510E	5100	5K1	51000	51K		
5.6	5E6	56	56E	560	560E	5600	5K6	61000	61K		
6.2	6E2	62	62E	620	620E	6200	6K2	62000	62K		
6.8	6E8	68	68E	680	680E	6800	6K8	68000	68K		
7.5	7E5	75	75E	750	750E	7500	7K5	75000	75K		
8.2	8E2	82	82E	820	820E	8200	8K2	82000	82K		
9.1	9E1	91	91E	910	910E	9100	9K1	91000	91K		

B8 020 00 series - MICA CAPACITORS

BALANCING TELEPHONE CABLE TYPE



These capacitors have been specially designed for balancing the pairs of loaded telephone cables in order to reduce the cross-talk to a value below the permissible limit.

The capacitors are supplied either single, double or quadruple.

Single balancing capacitors consist of a midget mica capacitor which has been moulded in a reddish brown thermo-setting synthetic resin.

The capacitors are provided with two connecting wires of tinned copper (0.5 mm Ø) having a length of about 180 mm which are, except for the last 30 mm, insulated with an uninflammable plastic (0.9 mm Ø) see fig. 1. One wire (the one connected to the outer electrodes) is red, the other yellow.

Double balancing capacitors (see fig. 2) are composed of two single units arranged according to fig. 3.

Quadruple balancing capacitors (see fig. 4) are composed of four single units in a bridge arrangement according to fig. 5.

This application imposes the highest requirements regarding precision, stability, insulation resistance and resistance to moisture.

tolerance on capacitance	for $C \geqslant 20$ pF	±5%
	for $C = 10$ pF	±10%
working temperature range		−40/+85 °C
working voltage	for $C \leqslant 2000$ pF	500 V_{dc}
	for $C \geqslant 2000$ pF	250 V_{dc}
permissible alternating voltage	500 V_{dc} types	350 V_{ac}
	250 V_{dc} types	175 V_{ac}
test voltage during 1 minute:		
(a) between terminals		3 × working voltage
(b) for double capacitors between sections		1500 V_{dc}
(c) between interconnected terminals and casing		$>$ 2000 V_{ac}
insulation resistance at 20 °C		$\geqslant$ 100000 MΩ
losses ($\tan \delta$) parallel damping at 1 Mc/s	for $C \leqslant 100$ pF	$\geqslant$ 1 MΩ
at 1 Mc/s	for $C = 100$–1000 pF	$\leqslant 15 \times 10^{-4}$
at 100 kc/s	for $C \geqslant 1000$ pF	$\leqslant 15 \times 10^{-4}$
climatic group number		40/085/21 (IEC)

Composition of the type number B8 020 00./...

capacitance tolerance ◀—— ——▶ capacitance code

A = 10%
B = 5%

BALANCING TELEPHONE CABLE TYPE

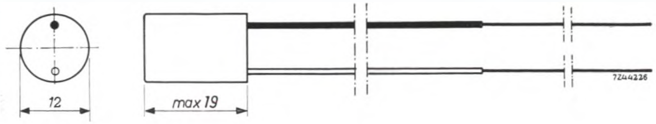


Fig. 1

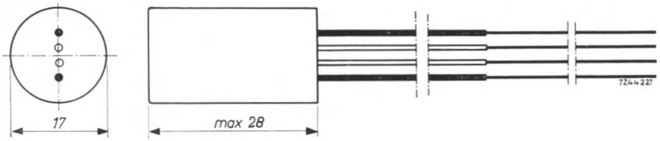


Fig. 2

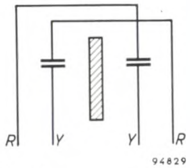


Fig. 3

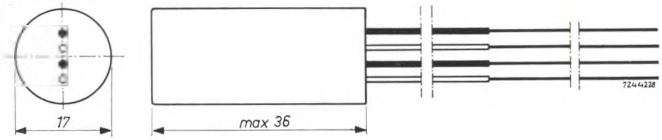


Fig. 4

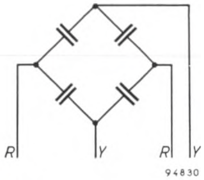


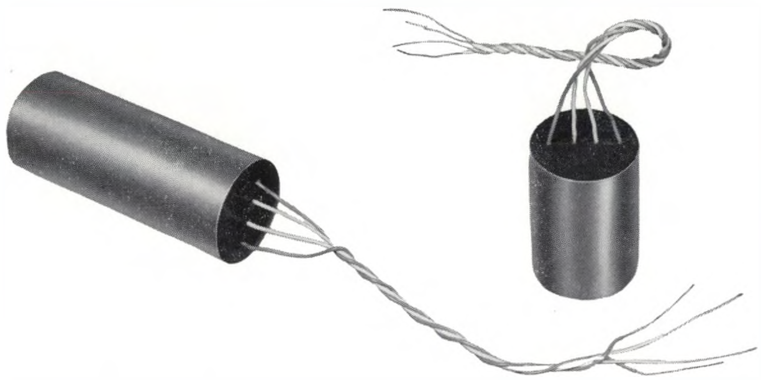
Fig. 5

BALANCING TELEPHONE CABLE TYPE

capacitance (pF)	capacitance code		
	single version	double version	quadruple version
10	10E	—	—
20	20E	2 × 20E	—
30	30E	2 × 30E	4 × 30E
40	40E	2 × 40E	4 × 40E
50	50E	2 × 50E	4 × 50E
60	60E	2 × 60E	4 × 60E
70	70E	2 × 70E	4 × 70E
80	80E	2 × 80E	4 × 80E
90	90E	2 × 90E	4 × 90E
100	100E	2 × 100E	4 × 100E
120	120E	2 × 120E	4 × 120E
140	140E	2 × 140E	4 × 140E
160	160E	2 × 160E	4 × 160E
180	180E	2 × 180E	4 × 180E
200	200E	2 × 200E	4 × 200E
250	250E	2 × 250E	4 × 250E
300	300E	2 × 300E	4 × 300E
350	350E	2 × 350E	4 × 350E
400	400E	2 × 400E	4 × 400E
450	450E	2 × 450E	4 × 450E
500	500E	2 × 500E	4 × 500E
600	600E	2 × 600E	4 × 600E
700	700E	2 × 700E	4 × 700E
800	800E	2 × 800E	4 × 800E
900	900E	2 × 900E	4 × 900E
1000	1K	2 × 1K	4 × 1K
1100	1K1	2 × 1K1	4 × 1K1
1200	1K2	2 × 1K2	4 × 1K2
1300	1K3	2 × 1K3	4 × 1K3
1400	1K4	2 × 1K4	4 × 1K4
1500	1K5	2 × 1K5	4 × 1K5
1600	1K6	2 × 1K6	4 × 1K6
1700	1K7	2 × 1K7	4 × 1K7
1800	1K8	2 × 1K8	4 × 1K8
1900	1K9	2 × 1K9	4 × 1K9
2000	2K	2 × 2K	4 × 2K
2100	2K1	2 × 2K1	4 × 2K1
2200	2K2	2 × 2K2	4 × 2K2
2300	2K3	2 × 2K3	4 × 2K3
2400	2K4	2 × 2K4	4 × 2K4
2500	2K5	2 × 2K5	4 × 2K5
2600	2K6	2 × 2K6	4 × 2K6
2700	2K7	2 × 2K7	4 × 2K7

POLYSTYRENE CAPACITORS - B8 006 12 series

BALANCING TELEPHONE CABLE TYPE



These capacitors are made as an extension of our range of cable-balancing mica capacitors B802000. They are polystyrene capacitors mounted in cylindrical aluminium casings and sealed with a synthetic resin. A double and a quadruple version is available, arranged as shown in fig. 1 and fig. 2 respectively.

working temperature range	$\leqslant$ 85 °C
working voltage	$\leqslant$ 60 V_{dc}
permissible alternating voltage	$\leqslant$ 30 V_{dc}
maximum capacitance drift during life	$\leqslant$ ±1%
test voltage during 1 minute	700 V_{dc}
insulation resistance at 20 °C	$\geqslant$ 100000 MΩ
losses (tan δ) at 1000 c/s	$\leqslant 5 \times 10^{-4}$
climatic group number	40/085/21 (IEC)

Composition of the type number B8 006 12 . / . . .

capacitance tolerance ◀—— ——▶ capacitance code

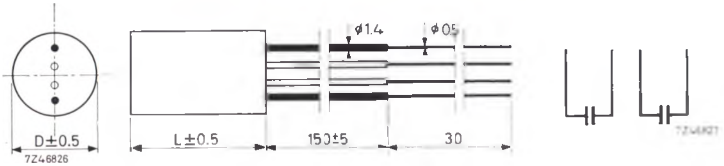
$\leqslant$ 10000 pF: C = ±2%
$>$ 10000 pF: D = ±1%

Example: The type number of a 13000 pF capacitor according to Fig. 2, tolerance 1%, is B800612 D/4 × 13K

B8 006 12 series - POLYSTYRENE CAPACITORS

BALANCING TELEPHONE CABLE TYPE

Fig. 1



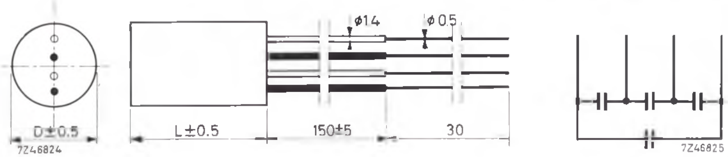


Fig. 2

capacitance	double version (fig. 1)		quadruple version (fig. 2)	
	capacitance code	dimensions D × L (mm)	capacitance code	dimensions D × L (mm)
3000 pF	2 × 3K	30 × 27	4 × 3K	35 × 27
4000	2 × 4K		4 × 4K	
5000	2 × 5K		4 × 5K	
6000	2 × 6K	30 × 37	4 × 6K	35 × 27
7000	2 × 7K		4 × 7K	
8000	2 × 8K		4 × 8K	
9000	2 × 9K		4 × 9K	
0.010 μF	2 × 10K		4 × 10K	
0.011	2 × 11K		4 × 11K	
0.012	2 × 12K		4 × 12K	
0.013	2 × 13K		4 × 13K	
0.014	2 × 14K		4 × 14K	
0.015	2 × 15K		4 × 15K	
0.016	2 × 16K		4 × 16K	
0.017	2 × 17K	35 × 37	4 × 17K	35 × 70
0.018	2 × 18K		4 × 18K	
0.019	2 × 19K		4 × 19K	
0.020	2 × 20K		4 × 20K	
0.021	2 × 21K		4 × 21K	
0.022	2 × 22K		4 × 22K	
0.023	2 × 23K		4 × 23K	
0.024	2 × 24K		4 × 24K	
0.025	2 × 25K		4 × 25K	
0.026	2 × 26K		4 × 26K	
0.027	2 × 27K		4 × 27K	
0.028	2 × 28K		4 × 28K	
0.029	2 × 29K		4 × 29K	
0.030	2 × 30K		4 × 30K	
0.031	2 × 31K		4 × 31K	
0.032	2 × 32K		4 × 32K	

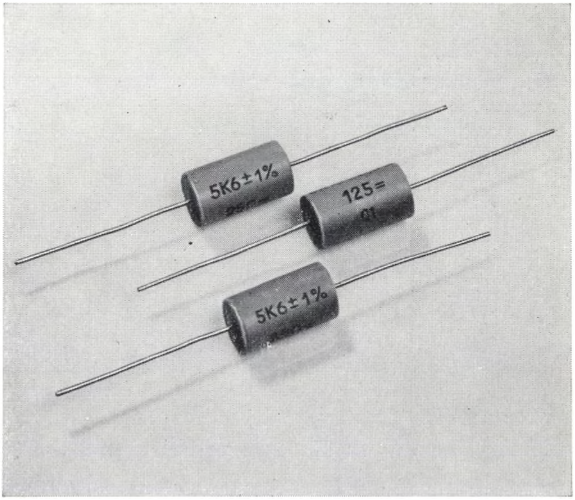
POLYSTYRENE CAPACITORS - C295 series

TUBULAR MOULDED TYPE

These capacitors are very suitable for use in tuned circuits and filters of electronic equipment of all kinds, especially of carrier telephony equipment where high requirements are imposed as regards precision, stability and low losses at high frequencies. The fairly small negative temperature coefficient is advantageous for most applications.

They can be incorporated in the wiring of the equipment and are also suitable for vertical mounting on printed-wiring boards, the length of connection leads always being sufficient.

15 mm



working temperature range		$-40/+85$ °C
for 63 V_{dc} range		$-40/+70$ °C
temperature coefficient $\Delta C/C$ per °C		$-(100 \pm 50) \times 10^{-6}$
permissible alternating voltage	63 V_{dc} types	30 V_{ac}
	125 V_{dc} types	63 V_{ac}
	250 V_{dc} types	125 V_{ac}
	500 V_{dc} types	250 V_{ac}
maximum capacitance drift during life	at max. temp. 85 °C	$\Delta C \leqslant 1\%$
	at max. temp. 70 °C	$\Delta C \leqslant 0.5\%$
test voltage during 1 minute		2 × max. working voltage
breakdown voltage of encasing		>1000 V_{ac}
insulation resistance at 20 °C	for $C < 0.1$ μF	$> 10^6$ MΩ
	for $C > 0.1$ μF	$> 10^5$ MΩ
losses ($\tan \delta$) at 1 kc/s		$< 2 \times 10^{-4}$
at 100 kc/s		$< 5 \times 10^{-4}$
at 1 Mc/s		$< 10 \times 10^{-4}$
climatic group number		40/085/21 (IEC)
for 63 V_{dc} range		40/070/21 (IEC)

Composition of the type number C295A./....

capacitance code

working voltage ◄ ► capacitance tolerance

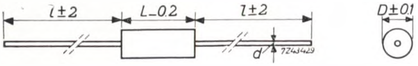
H = 63 V_{dc}
A = 125 V_{dc}
B = 250 V_{dc}
C = 500 V_{dc}

A = ±10%
B = ± 5%
C = ± 2%
D = ± 1%

Example: The type number of a 6200 pF/125 V capacitor, tolerance 5%, is C295AA/B6K2.

C295 series - POLYSTYRENE CAPACITORS

TUBULAR MOULDED TYPE



Dimensions (mm)		
at L = 15 at L = 25	l = 35 l = 45	d = 0.7 d = 0.8

capacitance	capacitance code	dimensions in mm (D × L)			
		63 Vdc	125 Vdc	250 Vdc	500 Vdc
680 pF	680E				7.5 × 15
750	750E				
820	820E				
910	910E				
1000	1K				
1100	1K1				
1200	1K2				
1300	1K3			7.5 × 15	9 × 15
1500	1K5		6 × 15		
1600	1K6				
1800	1K8				
2000	2K				
2200	2K2				
2400	2K4		7.5 × 15		10 × 15
2700	2K7			9 × 15	
3000	3K				
3300	3K3				
3600	3K6	6 × 15			12.5 × 15
3900	3K9				
4300	4K3				
4700	4K7		9 × 15		
5100	5K1			10 × 15	
5600	5K6				
6200	6K2	7.5 × 15			10 × 25
6800	6K8			12.5 × 15	
7500	7K5				
8200	8K2		10 × 15		
9100	9K1				12.5 × 25
0.010 μF	10K				
0.011	11K		12.5 × 15		
0.012	12K	9 × 15		10 × 25	
0.013	13K				
0.015	15K				
0.016	16K				
0.018	18K		10 × 25	12.5 × 25	15 × 25
0.020	20K				
0.022	22K	10 × 15			
0.024	24K				
0.027	27K		12.5 × 25		
0.030	30K			15 × 25	
0.033	33K	12.5 × 15			
0.036	36K				
0.039	39K				
0.043	43K	10 × 25			
0.047	47K				
0.051	51K				
0.056	56K	12.5 × 25	15 × 25		
0.062	62K				
0.068	68K				
0.075	75K				
0.082	82K				
0.091	91K				
0.10	100K	15 × 25			
0.11	110K				
0.12	120K				
0.13	130K				
0.15	150K				
0.16	160K				

The table lists the capacitance values according to the E24 range. For ± 1% and ± 2% tolerance intermediate values can be supplied on request. The dimensions are identical to those of the next higher values given in the table.

CHARACTERISTICS

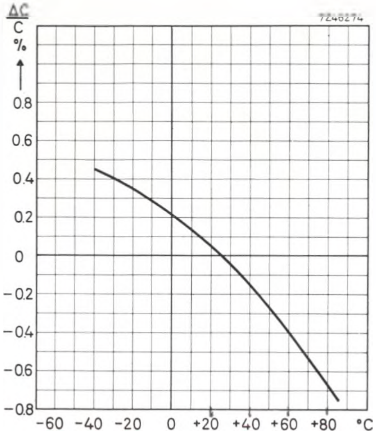


Fig. 1 Capacitance versus temperature

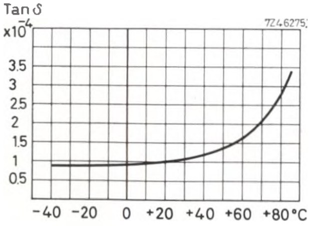


Fig. 2 Losses at 1 kc/s versus temperature

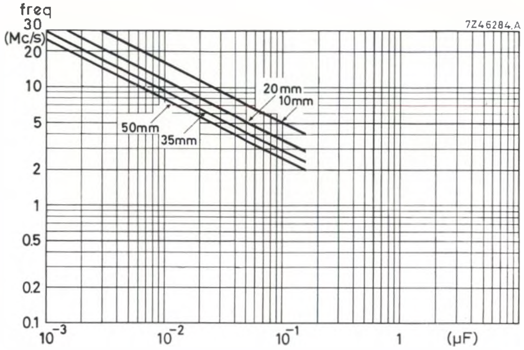


Fig. 3 Resonance frequency versus capacitance at different total wire lengths.

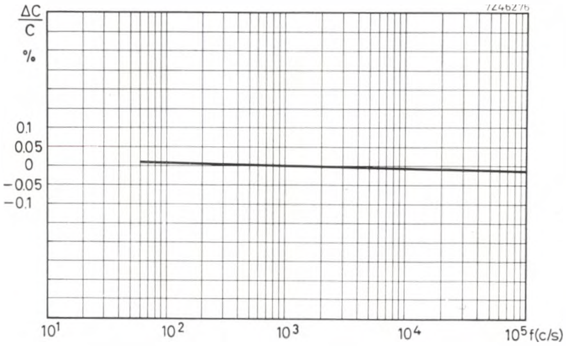


Fig. 4 Capacitance versus frequency

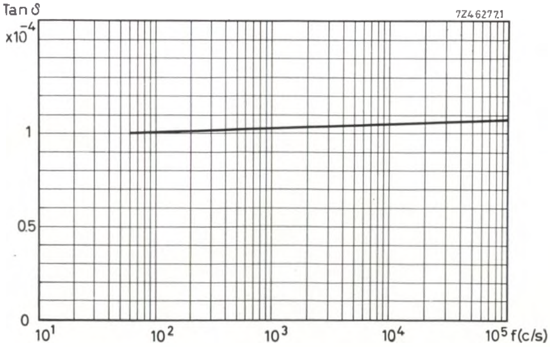
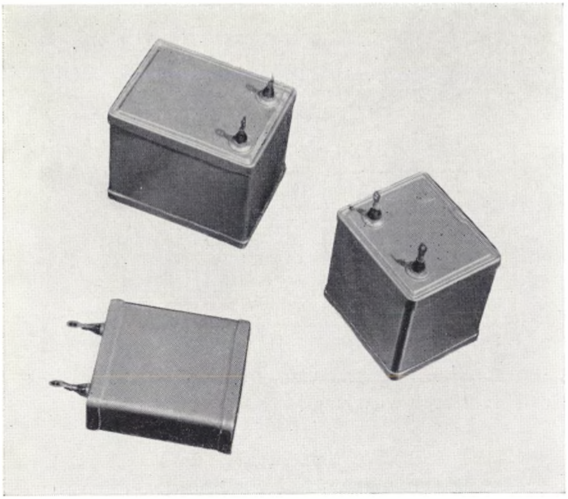


Fig. 5 Losses versus frequency

C299 series - POLYSTYRENE CAPACITORS

BOX TYPE



These box-type capacitors are extremely suitable as capacitance standard in measuring equipment and for RC network.
Inside the box the pack is absolutely proof against atmospheric influences, so that the excellent properties are maintained under the most adverse climatic conditions.

tolerance on capacitance		1%
working temperature range		$-40/+85$ °C
temperature coefficient of the capacitance		$(-100 \text{ to } -150) \times 10^{-6}$ pF per pF and per °C
maximum capacitance drift during life		$\pm 0.5\%$
test voltage during 1 minute:		
(a) across the terminals		$2.6 \times$ working voltage
(b) between the terminals		2800 V_{dc}
insulation resistance at 20 °C	for $C \leqslant 0.33\ \mu F$	$R \geqslant 750000\ M\Omega$
	for $C > 0.33\ \mu F$	$RC \geqslant 250000$ sec
losses (tan δ) at 1 kc/s		$\leqslant 5 \times 10^{-4}$
climatic group number		40/085/56 (IEC)

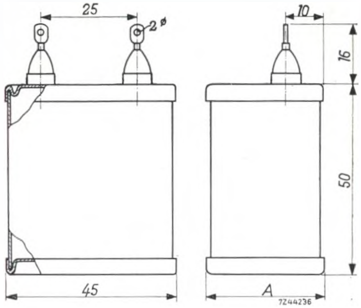
Composition of the type number **C299A./D...**

working voltage ← → capacitance code

A = 125 V_{dc}
B = 350 V_{dc}
C = 500 V_{dc}

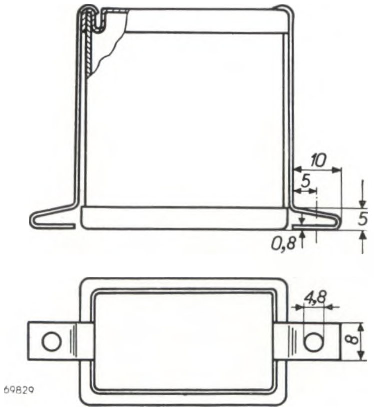
Example: The type number of a 33000 μF/350 V capacitor, is C299 AB/D33K

BOX TYPE



capacitance (μF)	capacitance code	dimensions (A) in mm		
		125 V_{dc}	350 V_{dc}	500 V_{dc}
0.022	22K			20
0.033	33K			20
0.047	47K			20
0.068	68K			20
0.10	100K			20
0.15	150K	20	25	25
0.22	220K	20	35	35
0.33	330K	20	40	50
0.47	470K	25	50	60
0.68	680K	35	75	90
1	1M	50	105	120
1.5	1M5	75	120	
2.2	2M2	105		
3.3	3M3	120		

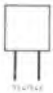
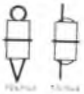
Intermediate capacitance values with a tolerance of 1% are available on request



The capacitors can be used in any position.
If desired, use can be made of mounting brackets as illustrated in the figure; two if A is smaller than 60 mm, and four if A is 60 mm or larger.
The type number of the mounting brackets is 88480/00.
A wire of max. 2.5 sq.mm can be connected to each soldering tag.

CERAMIC CAPACITORS

APPLICATION

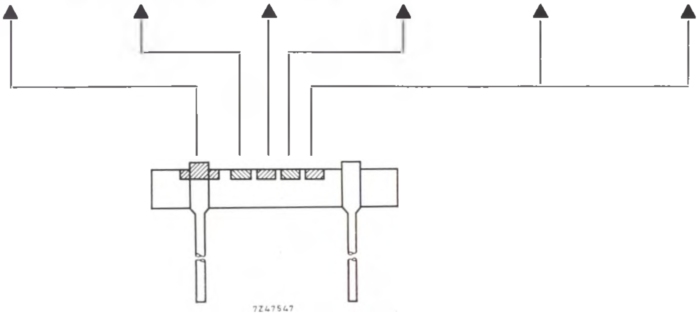
construction	*class I*				*class II*			
	for tuning and other applications where low losses and a linear temperature dependence are required				*for all coupling and decoupling purposes*			
	type number	*capacitance range*	*working voltage*	*page*	*type number*	*capacitance range*	*working voltage*	*page*
	C304	0.8–820 pF	500 V_{dc}	C114 C115 C116	C301 C318	680–22000 pF 1000–10000 pF	500 V_{dc} 500 V_{dc}	C124 C125
	C306	0.5– 47 pF	500 V_{dc}	C117 C118				
					C322 C325	1.5–10000 pF 2200–10000 pF	500 V_{dc} 125 V_{dc}	C126 C127
	C333	1.0–150 pF	40 V_{dc}	C122 C123	C330 C331 C332	22000–100000 pF 1000–10000 pF 180–1800 pF	6 V_{dc} 30 V_{dc} 40 V_{dc}	C130 C131 C128 C129
	C309BG	2.5– 56 pF	350 V_{dc}	C134 C135 C136	C309BH C309UA	68–2200 pF 2.5–4700 pF	350 V_{dc} 350 V_{dc}	C134 C135 C136

	special types			
construction	*for special applications e.g. safety and filter capacitors*			
	type number	*capitance range*	*working voltage*	*page*
	C321 (safety)	10–560 pF	700 V_{dc}	C132 C133
	C302 (filter) cap.)	3.9–180 pF	70 V_{da}	C119 C120 C121

CERAMIC CAPACITORS

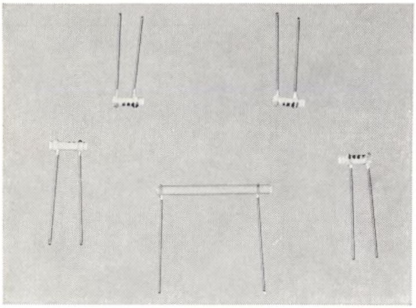
COLOUR CODE

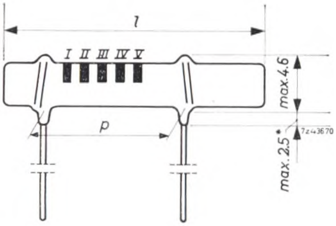
	temperature coefficient	*first digit*	*second digit*	*multiplier for the capacitance*	*tolerance on capacitance*	
					$C_n \leq 10$ pF (*pF*)	*$C_n \geq 10$ pF* (%)
red/violet	P100					
black	NP0		0	1		± 20
brown		1	1	10	± 0.1	± 1
red		2	2	10^2	± 0.25	± 2
orange	N150	3	3	10^3		
yellow		4	4	10^4		
green		5	5		± 0.5	± 5
blue		6	6			
violet	N750	7	7			
grey		8	8	10^{-2}		
white		9	9	10^{-1}	± 1	± 10



C304 series - CERAMIC CAPACITORS

CLASS IB, TUBULAR TYPE, FOR 500 V_{dc}





Application

Owing to the use of low-K ceramic material, these capacitors have low losses, a high stability and display a linear temperature dependence of the capacitance. These features render the capacitors ideally suited for application in high frequency equipment, especially in resonant circuits in which advantage can be taken of the linear temperature coefficient to compensate the temperature dependence of the other components.
These capacitors have connecting leads of 0.6 mm Ø with a pitch of a multiple of one tenth of an inch, so that they are suitable for printed wiring circuits.

Construction

The capacitors consist of a ceramic tube, partly metallised on the outside, and – except for the smallest capacitances – internally metallised. A coating of special grey lacquer protects the capacitors against atmospheric influences. The temperature coefficient, the capacitance and the tolerances are indicated by means of a colour code (see page C113). The inner electrode is connected to the lead at the side of the first colour strip (that of the temperature coefficient).

Electrical specification

Unless otherwise specified, all electrical values apply to a temperature of 20 + 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

maximum working voltage at 85 °C		500 V_{dc}
test voltage (during 1 minute)		1250 V_{dc}
maximum current (in the case of a.c. loads)		500 mA
insulation resistance at 20 °C and 500 V_{dc}		$>$ 10000 MΩ
dissipation factor at 1 Mc/s		
measured at a voltage $< 3.5\ V_{ac}$:	for $C > 10$ pF	$\leq 10 \times 10^{-4}$ (average $< 5 \times 10^{-4}$)
	for $C \leq 10$ pF	$\leq \frac{0.01}{C(pF)}$
permissible working temperature		−40/+85 °C
climatic group number		40/085/21 (IEC)

CLASS IB, TUBULAR TYPE, FOR 500 V_{dc}

Capacitance and tolerance

The table on next page gives the E12 capacitance series with a tolerance of 0.25 pF, 0.5 pF and 5%, depending on the capacitance value. On request values appertaining to the E24 series can be supplied, provided acceptable quantities are ordered. This also applies to capacitors with tolerances of 20% of the E6 series, of 10% of the E12 series and with 2% and 1% tolerances for higher capacitance values. Further technical data upon request.

Temperature coefficients

	temperature coefficient	*tolerance*	*type number prefix*
NP0	$0 \times 10^{-6}/°C$	for $C_n \leqq 20$ pF: -40 to $+120 \times 10^{-6}/°C$ for $C_n > 20$ pF: $\pm 40 \times 10^{-6}/°C$	C304GB/. . .
N150	$-150 \times 10^{-6}/°C$	for $C_n \leqq 20$ pF: -40 to $+60 \times 10^{-6}/°C$ for $C_n > 20$ pF: $\pm 40 \times 10^{-6}/°C$	C304GC/. . .
N750	$-750 \times 10^{-6}/°C$	for $C_n \leq 20$ pF: -120 to $+250 \times 10^{-6}/°C$ for $C_n > 20$ pF: $\pm 120 \times 10^{-6}/°C$	C304GH/. . .

Capacitors with a temperature coefficient according to P100, N033, N075, N220, N330, N470 and N1500 can be supplied, provided acceptable quantities are ordered.

Composition of the type number

C304G ./.

temperature coefficient code ◀ (first .)
(second .) ▶ type number suffix

Example:

The type number of a 0.8 pF capacitor with a temperature coefficient N750 and a tolerance of 0.25 pF, is C304GH/NE8.

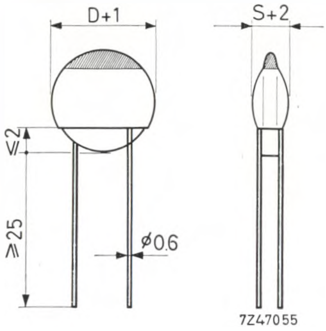
C304 series - CERAMIC CAPACITORS

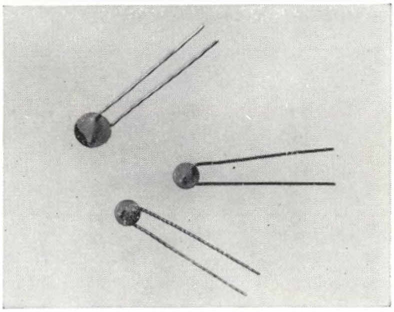
CLASS IB, TUBULAR TYPE, FOR 500 V_{dc}

temp. coef.		*NP0*			*N150*			*N750*		
cap. (pF)	*tolerance*	*l (mm)*	*p (mm)*	*type no. suffix*	*l (mm)*	*p (mm)*	*type no. suffix*	*l (mm)*	*p (mm)*	*type no. suffix*
0.8	± 0.25 pF							12	7.6	GH/NE8
1	,,							12	7.6	/N1E
1.2	,,							12	7.6	/N1E2
1.5	,,							12	7.6	/N1E5
1.8	,,	12	7.6	GB/N1E8				12	7.6	/N1E8
2.2	,,	12	7.6	/N2E2				12	7.6	/N2E2
2.7	± 0.5 pF	12	7.6	/L2E7				12	7.6	/L2E7
3.3	,,	12	7.6	/L3E3				12	7.6	/L3E3
3.9	,,	12	7.6	/L3E9				12	7.6	/L3E9
4.7	,,	12	7.6	/L4E7				12	7.6	/L4E7
5.6	,,	12	7.6	/L5E6	12	7.6	GC/L5E6	12	7.6	/L5E6
6.8	,,	12	7.6	/L6E8	12	7.6	/L6E8	12	7.6	/L6E8
8.2	,,	10	5.1	/L8E2	10	5.1	/L8E2	10	5.1	/L8E2
10	,,	10	5.1	/L10E	10	5.1	/L10E	10	5.1	/L10E
12	± 5%	10	5.1	/B12E	10	5.1	/B12E	10	5.1	/B12E
15	,,	10	5.1	/B15E	10	5.1	/B15E	10	5.1	/B15E
18	,,	10	5.1	/B18E	10	5.1	/B18E	10	5.1	/B18E
22	,,	10	5.1	/B22E	10	5.1	/B22E	10	5.1	/B22E
27	,,	12	7.6	/B27E	12	7.6	/B27E	10	5.1	/B27E
33	,,	12	7.6	/B33E	12	7.6	/B33E	10	5.1	/B33E
39	,,	12	7.6	/B39E	12	7.6	/B39E	10	5.1	/B39E
47	,,	14	7.6	/B47E	12	7.6	/B47E	10	5.1	/B47E
56	,,	14	7.6	/B56E	14	7.6	/B56E	12	7.6	/B56E
68	,,	16	10.2	/B68E	16	10.2	/B68E	12	7.6	/B68E
82	,,	18	12.7	/B82E	16	10.2	/B82E	12	7,6	/B82E
100	,,	20	12.7	/B100E	18	12.7	/B100E	12	7.6	/B100E
120	,,	22	17.7	/B120E	20	12.7	/B120E	14	7.6	/B120E
150	,,	26	20.3	/B150E	24	17.7	/B150E	16	10.2	/B150E
180	,,	30	30.3	/B180E	26	20.3	/B180E	18	12.7	/B180E
220	,,	34	25.4	/B220E	30	20.3	/B220E	20	12.7	/B220E
270	,,				36	25.4	/B270E	22	17.7	/B270E
330	,,							24	17.7	/B330E
390	,,							28	20.3	/B390E
470	,,							32	25.4	/B470E
560	,,							38	30.5	/B560E
680	,,							44	35.6	/B680E
820	,,							52	40.6	/B820E

CERAMIC CAPACITORS - C306 series

CLASS IB, HIGH VOLTAGE DISC TYPE





Application

Owing to the use of low-K ceramic material, these series of disc capacitors have low losses, a high stability and display a linear temperature dependence of the capacitance. These features render the capacitors ideally suited for application in high frequency equipment, especially in resonant circuits in which advantage can be taken of the linear temperature coefficient to compensate the temperature dependence of other components.

Construction

The capacitor consists of a ceramic disc, provided with a silver plating at both sides to which the connecting leads are soldered. In order to avoid lacquer on the leads the capacitor is only partly lacquered, after which the whole is covered with a solderable film which protects the unlacquered part against atmospheric influences.

Electrical specification

Unless otherwise specified, all electrical values apply to a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

Maximum working voltage	500 V_{dc}
Test voltage (during 1 minute)	1250 V_{dc}
Maximum permissible current	
for the 5 mm discs	600 mA
for the 8 mm discs	1000 mA
Insulation resistance at 500 V_{dc}	$> 10.000\ M\Omega$
Dissipation factor at 1 Mc/s	
(measured at a voltage of 3.5 V_{ac})	
for $C \leq 10$ pF	$\leq \frac{0.01}{C(pF)}$
for $C > 10$ pF	$\leq 10 \times 10^{-4}$
Permissible working temperature	−40/+85 °C
Climatic group number	40/085/21
Capacitance and tolerances	see table

C306 series - CERAMIC CAPACITORS

CLASS IB, HIGH VOLTAGE DISC TYPE

Temperature coefficient

	temperature coefficient	*type number prefix*
P100	$+100 \times 10^{-6}/°C$	C306 SA/...
NP0	$0 \times 10^{-6}/°C$	C306 SB/...
N150	$-150 \times 10^{-6}/°C$	C306 SC/...
N750	$-750 \times 10^{-6}/°C$	C306 SH/...

Capacitors with temperature coefficients according to N075, N220, N470 and N1500 can be supplied, provided acceptable quantities are ordered.

Composition of the type number **C306 S./...B**

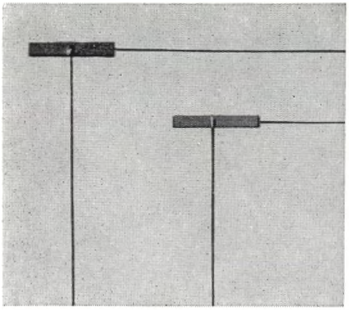
temp. coeff. ◀ ▶ type number suffix

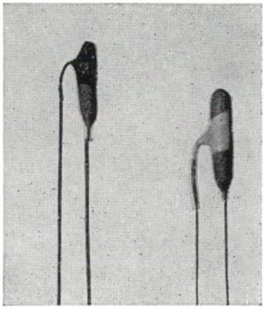
Example

The type number of a 12 pF capacitor with a temperature coefficient NP0 and a tolerance of 5%, is C306 SB/B12EB.

temp. coefficient		*P100*		*NPO*		*N150*		*N750*	
cap. (pF)	*tolerance*	*d (mm)*	*type no. suffix*	*d (mm)*	*type no. suffix*	*d (mm)*	*type no. suffix*	*d (mm)*	*type no. suffix*
0.5	0.25 pF	5	SA/NE5B						
0.75	0.25 pF	5	/NE75B						
1	0.25 pF	5	/L1EB						
1.2	0.25 pF	5	/L1E2B						
1.5	0.25 pF	5	/L1E5B						
1.8	0.5 pF	5	/L1E8B	5	SB/L1E8B			5	SH/L1E8B
2.2	0.5 pF	5	/L2E2B	5	/L2E2B	5	SC/L2E2B	5	/L2E2B
2.7	0.5 pF	5	/L2E7B	5	/L2E7B	5	/L2E7B	5	/L2E7B
3.3	0.5 pF	5	/L3E3B	5	/L3E3B	5	/L3E3B	5	/L3E3B
3.9	0.5 pF	8	/L3E9B	5	/L3E9B	5	/L3E9B	5	/L3E9B
4.7	0.5 pF	8	/L4E7B	5	/L4E7B	5	/L4E7B	5	/L4E7B
5.6	0.5 pF	8	/L5E6B	5	/L5E6B	5	/L5E6B	5	/L5E6B
6.8	0.5 pF			5	/L6E8B	5	/L6E8B	5	/L6E8B
8.2	0.5 pF			5	/L8E2B	5	/L8E2B	5	/L8E2B
10	0.5 pF			8	/L10EB	5	/L10EB	5	/L10EB
12	5 %			8	/B12EB	8	/B12EB	5	/B12EB
15	5 %			8	/B15EB	8	/B15EB	5	/B15EB
18	5 %					8	/B18EB	5	/B18EB
22	5 %							8	/B22EB
27	5 %							8	/B27EB
33	5 %							8	/B33EB

CLASS IC, MIDGET TUBULAR TYPE





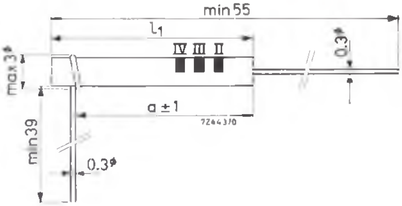


Fig. 1

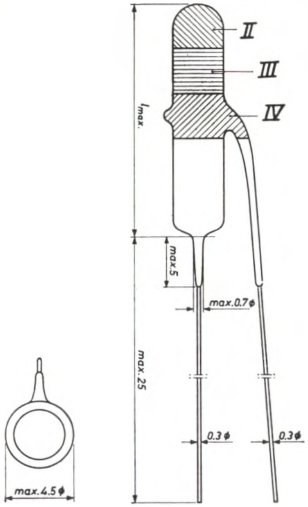


Fig. 2

Application

These midget-type ceramic capacitors are characterised by their low HF losses, high stability and a very low inductance. Therefore they are widely used in RF tuned circuits. The capacitors have been specially designed for use in small filters such as miniaturized IF transformers, bandpass filters, for radio and television receivers, discriminators, noise limiters, etc.

Construction

The capacitors consist of a tiny ceramic tube, covered internally and externally with a fired-on silver electrode, each electrode being provided with a tinned copper connecting lead. The insulated version is covered with a coating of tan-coloured lacquer which permits these capacitors to be mounted close together or against a metal plate.
The capacitors are colour-coded according to IEC (see page C113), with the exception of those with the values of 3.9–8.2 pF and 39 pF for the non-insulated version, which are marked in black script. The connecting leads can withstand a strain of at least 450 grammes.

Electrical Specification

Unless otherwise specified, all electrical values apply to a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

C302 series - CERAMIC CAPACITORS

CLASS IC, MIDGET TUBULAR TYPE

Max. working voltage at a frequency of 100 kc/s	70 V_{ac}
Test voltage during 1 second	300 V_{dc}
Test voltage against coating of insulated type (1 second)	300 V_{dc}
Insulation resistance measured within 1 minute	
at 100 V_{dc} at RLH = 75 %	$\leq$ 10000 MΩ
at RLH between 75 % and 95 %	$\leq$ 100 MΩ
Losses at 1 Mc/s ± 10%, measured at 1 V_{ac}:	
parallel damping for $C < 10$ pF	$\leq$ 5MΩ
$\tan \delta$ for $C \geq 10$ pF	$\leq 10 \times 10^{-4}$
Change of capacitance after humidity test	
acc. to NT 14–5–3.1 non-insulated capacitors	< 1% or 0.5 pF
acc. to NT 14–4–3.1 insulated capacitors	< 1 %
Permissible working temperature	−25/+85 °C
Climatic group number	25/85/4 (IEC)
Capacitance and tolerances	see table

Temperature coefficient of capacitance

Approx. $+100 \times 10^{-6}$/°C for $C_n \leq 8.2$ pF
approx. 0 for C_n = 10–27 pF;
approx. -150×10^{-6}/°C for $C_n \geq 33$ pF.

Composition of the type number **C302../....**

→ type number suffix

Example

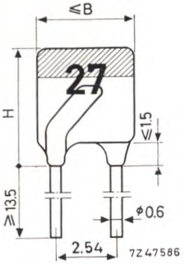
The type number of a non-insulated 18 pF capacitor with a tolerance of ± 1 pF is C302 AB/M18E.

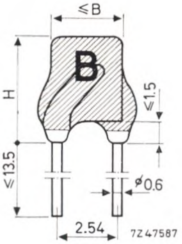
CLASS IC, MIDGET TUBULAR TYPE

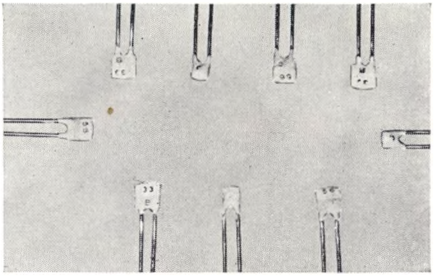
version			*non-insulated (Fig. 1)*			*insulated (Fig. 2)*	
cap. pF	*tolerance*	*temp.coef. ...x10^{-6}/°C*	L_1 *(mm)*	*a (mm)*	*type number*	L_{max} *(mm)*	*type number*
3.9	± 0.5 pF	+ 100	9	5	C302AA/L3E9	12	C302CA/L3E9
4.7	,,	,,	,,	,,	/L4E7	,,	/L4E7
5.6	,,	,,	,,	,,	/L5E6	,,	/L5E6
6.8	± 1 pF	,,	,,	,,	/M6E8	,,	/M6E8
8.2	,,	,,	,,	,,	/M8E2	,,	/M8E2
10	,,	0	,,	,,	AB/M10E	,,	CB/M10E
12	,,	,,	,,	,,	/M12E	,,	/M12E
15	,,	,,	,,	,,	/M15E	,,	/M15E
18	,,	,,	,,	,,	/M18E	,,	/M18E
22	,,	,,	,,	,,	/M22E	,,	/M22E
27	,,	,,	,,	,,	/M27E	,,	/M27E
33	± 3%	— 150	,,	,,	AC/K33E	,,	CC/K33E
39	,,	,,	,,	,,	/K39E	,,	/K39E
47	,,	,,	,,	,,	/K47E	,,	/K47E
56	,,	,,	,,	,,	/K56E	,,	/K56E
68	,,	,,	,,	,,	/K68E	,,	/K68E
82	,,	,,	,,	,,	/K82E	,,	/K82E
100	,,	,,	11	7	/K100E	14	/K100E
120	,,	,,	13.5	7	/K120E	16.5	/K120E
150	,,	,,	16.5	11	/K150E	19.5	/K150E
180	,,	,,	20	11	/K180E	23	/K180E

C333 series - CERAMIC CAPACITORS

TYPE IB, PLATE CAPACITORS FOR $40V_{dc}$







Application

These plate capacitors are especially designed for use in all kinds of small transistorised equipment, for tuning and other purposes where low losses are required.
Owing to the use of low K-ceramic material, these capacitors have low losses, a high stability and a linear temperature dependence of the capacitance. Their extremely small dimensions and pitch distance with a close tolerance, adapted to the standard pattern of printed wiring boards, makes them most suitable for those applications where miniaturisation and easy mounting are required.

Construction

The capacitor consists of a thin rectangular ceramic plate, both sides of which are metallised. The capacitor is fully insulated by a special coating, which ensures an excellent behaviour under unfavourable atmospheric conditions. The temperature coefficient of the capacitors is indicated by a colour code which covers the capacitor fully or partly. The capacitor has a width of 5 mm maximum.

Electrical specification

Unless otherwise specified, all electrical values apply to a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 75%.

Working voltage	$40\ V_{dc}$
Test voltage (during 1 minute)	$120\ V_{dc}$
Test voltage against coating (during 1 minute)	$120\ V_{dc}$
Insulation resistance, measured at $10\ V_{dc}$ within 1 minute	$< 1000\ M\Omega$
Dissipation factor at 1 Mc/s, measured at a voltage of $3.5\ V_{ac}$ for $C_n < 50$ pF	$\leqq 15\left(\frac{15}{C(pf)} + 0.7\right) \times 10^{-4}$ (max 55×10^{-4})
for $C_n > 50$ pF	$\leqq 15.10^{-4}$
Permissible working temperature	−25/+85 °C
Climatic group number	25/085/21 (IEC)
Capacitance values and tolerances	see tables

Composition of the type number **C333../..**

BA for 0.6 mm Ø leads
CA for 0.4 mm Ø leads

type number suffix

TYPE IB. PLATE CAPACITORS FOR 40V_{dc}

Temperature coefficient

temperature coefficient	*tolerance*	*temp. coef. colour*	*type number*
P100 = + 100 × 10^{-6}/°C	(−40/+120) × 10^{-6}/°C	red violet	C333 BA/...
NP0 = 0 × 10^{-6}/°C	for $C_n \leq$ 20 pF: (−40/+120) × 10^{-6}/°C for $C_n >$ 20 pF: ±40 × 10^{-6}/°C	black	C333 BB/...
N150 = − 150 × 10^{-6}/°C	for $C_n \leq$ 20 pF: (−40/+60) × 10^{-6}/°C for $C_n >$ 20 pF: ±40 × 10^{-6}/°C	orange	C333 BC/...
N750 = − 750 × 10^{-6}/°C	for $C_n \leq$ 20 pF: (−120/+250) × 10^{-6}/°C for $C_n >$ 20 pF: ±120 × 10^{-6}/°C	violet	C333 BH/...

Mounting

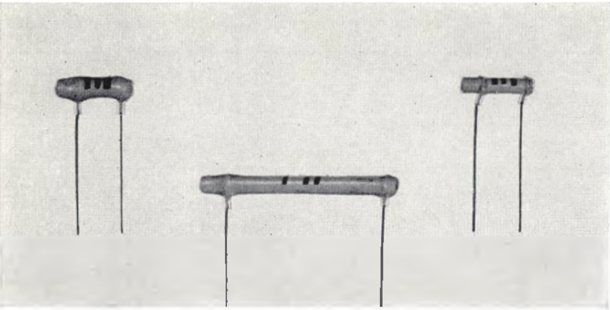
When the leads have to be bent, cut or flattened, they should be relieved of the applied load at the body of the capacitor. For dip-soldering on printed wiring boards, a temperature up to 250 °C and a soldering time of up to 5 seconds is permissible.

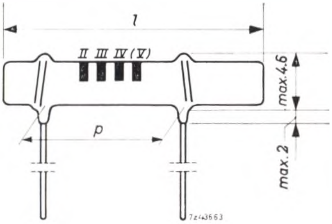
Class IB, C333 series

temperature coefficient		*P100*			*NPO*			*N150*			*N750*		
cap. (pF)	*tolerance*	*B mm*	*H mm*	*type no. suffix*	*B mm*	*H mm*	*type no. suffix*	*B mm*	*H mm*	*type no. suffix*	*B mm*	*H mm*	*type no. suffix*
1.0	± 0.5 pF	3.7	5.2	BA/L1E									
1.2	± 0.5 pF	3,7	5.2	/L1E2									
1.5	± 0.5 pF	3.7	5.2	/L1E5									
1.8	± 0.5 pF	3.7	5.2	/L1E8									
2.2	± 0.5 pF	3.7	5.2	/L2E2									
2.7	± 0.5 pF	3.7	5.2	/L2E7									
3.3	± 0.5 pF	3.7	5.2	/L3E3	3.7	5.2	BB/L3E3						
3.9	± 0.5 pF	5	6.5	/L3E9	3.7	5.2	/L3E9						
4.7	± 0.5 pF	5	6.5	/L4E7	3.7	5.2	/L4E7						
5.6	± 0.5 pF	5	6.5	/L5E6	3.7	5.2	/L5E6						
6.8	± 0.5 pF	5	6.5	/L6E8	5	6.5	/L6E8				3.7	5.2	BH/L6E8
8.2	± 0.5 pF				5	6.5	/L8E2	3.7	5.2	BC/L8E2	3.7	5.2	/L8E2
10	± 0.5 pF				5	6.5	/L10E	3.7	5.2	/L10E	3.7	5.2	/L10E
12	± 0.5 pF				5	6.5	/L12E	3.7	5.2	/L12E	3.7	5.2	/L12E
15	± 0.5 pF				5	6.5	/L15E	3.7	5.2	/L15E	5	6.5	/L15E
18	± 0.5 pF				5	6.5	/L18E	3.7	5.2	/L18E	5	6.5	/L18E
22	± 0.5 pF				5	6.5	/L22E	5	6.5	/L22E	5	6.5	/L22E
27	± 2%				5	6.5	/C27E	5	6.5	/C27E	5	6.5	/C27E
33	± 2%				5	6.5	/C33E	5	6.5	/C33E	5	6.5	/C33E
39	± 2%				5	6.5	/C39E	5	6.5	/C39E	5	6.5	/C39E
47	± 2%				5	6.5	/C47E	5	6.5	/C47E	5	6.5	/C47E
56	± 2%							5	6.5	/C56E	5	6.5	/C56E
68	± 2%										5	6.5	/C68E
82	± 2%										5	6.5	/C82E
100	± 2%										5	6.5	/C100E
120	± 2%										5	8.5	/C120E
150	± 2%										5	8.5	/C150E

C301, C318 series - CERAMIC CAPACITORS

CLASS II, TUBULAR TYPE





C301, C318 versions

Application

Class II tubular ceramic capacitors are made of high-K dielectric materials. They are suitable for bypass and coupling purposes in all kinds of equipment where a high capacitance and small dimensions are of importance and the losses need not be minimized. These capacitors can be supplied in the C301 and in the C318 range. If small dimensions are essential, preference is given to the former range, but if a linear temperature dependence is of greater importance, the latter range is recommended. The temperature dependence of the ranges C301 and C318 is illustrated by the graphs 1 and 2 respectively, the latter of which conforms to the class II-A requirements.

Construction

The capacitors of both ranges consist of a ceramic tube, internally and partly externally covered with a fired-on coating of silver. Two leads of tinned copper, wound around the tube, are soldered to these coatings. A coating of special lacquer protects the non-insulated types against atmospheric influences. The coating of the insulated types allows them to be mounted close together or against a metal frame.

Electrical specification

Unless otherwise specified, all electrical values apply at a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

Max. working voltage at 85 °C	500 V_{dc}
Test voltage (during 1 minute)	1250 V_{dc}
Test voltage against coating (insulated capacitors) during 1 second	750 V_{dc}
Max. current for a.c.-loads	500 mA
Insulation resistance at 500 V_{dc}	
for $C \leqslant 10000$ pF	$> 10000\ \text{M}\Omega$
for $C > 10000$ pF	$> \frac{10000 \times 10^{10}}{C(\text{pF})}\ \Omega$
Dissipation factor at 1 kc/s measured at a voltage of 3.5 V_{ac}	$< 350 \times 10^{-4}$
Temperature dependence	
for C301	see graph 1
for C318	see graph 2
Permissible working temperature	−40/+85 °C
Climatic group number	40/085/21(IEC)

CERAMIC CAPACITORS - C301, C318 series

CLASS II, TUBULAR TYPE

Capacitance and tolerance

The table gives the E-6 capacitance series.
Capacitance values out of the E12 series are available on special order subject to minimum order release requirements. The C318 series is available upon request only, with a 10% tolerance on the capacitance and in acceptable quantities.

Class II tubular type C301

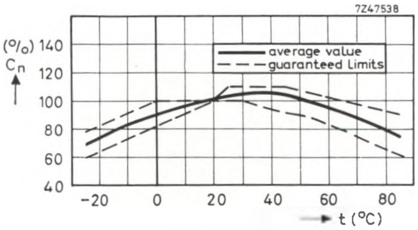
capacitance (*pF*)	*tolerance* (%)	*l* (*mm*)	*p* (*mm*)	*type number suffix* (*lacquered*)	*type number suffix* (*insulated*)
680	−20/+50	12	7.6	GA/H680E	BA/H680E
1000	,,	12	7.6	/H1K	/H1K
1500	,,	12	7.6	/H1K5	/H1K5
2200	,,	12	7.6	/H2K2	/H2K2
3300	,,	12	7.6	/H3K3	/H3K3
4700	,,	16	10.2	/H4K7	/H4K7
6800	,,	20	12.7	/H6K8	/H6K8
10000	,,	22	17.7	/H10K	/H10K
15000	,,	30	20.3	/H15K	/H15K
22000	,,	40	30.5	/H22K	/H22K

Class IIA tubular type C318

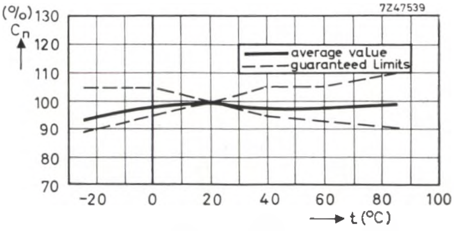
capacitance (*pF*)	*tolerance* (%)	*l* (*mm*)	*p* (*mm*)	*type number suffix*
1000	± 20	12	7.6	BA/P1K
1500	,,	12	7.6	/P1K5
2200	,,	14	7.6	/P2K2
3300	,,	18	12.7	/P3K3
4700	,,	22	17.7	/P4K7
6800	,,	28	20.3	/P6K8
10000	,,	38	30.5	/P10K

Composition of the type number **C301../..** **C318../..**

type number suffix ◄ (C301) type number suffix ► (C318)



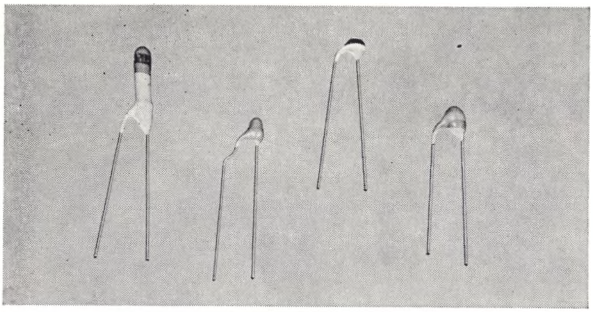
graph 1.

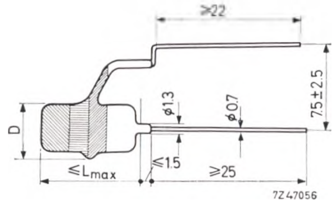


graph 2.

C322, C325 series - CERAMIC CAPACITORS

CLASS II, PIN-UP TYPE FOR 500 V_{dc} AND 125 V_{dc}





Application

These ceramic capacitors are suitable for bypass, coupling and general purposes, where low losses and high stability of capacitance are not of major importance. They feature a high insulation resistance and a low inductance. The configuration of the terminals is adapted to the printed wiring technique; when mounted in a vertical position, the capacitors occupy but a minor area.

The C325 series of pin-up capacitors have been designed for application where high voltages are not required, e.g. transistor equipment.

Construction

The capacitor consists of an internally and externally fully metallised ceramic tube. The connecting leads of tinned copper, soldered to the metal layers, have a pitch of 7.5 mm.

The capacitors are coated with a tan-coloured insulation lacquer, which acts as a seal against moisture and mechanical damage, and permits the capacitors to be mounted close together, or against a metal plate. The capacitors are colour coded.

Electrical specification

Unless otherwise specified all electrical values apply at a temperature of 20 ±5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% up to 75%.

Maximum working voltage	500 V_{dc} (125 V_{dc} for C325)
Test voltage during 1 minute)	1250 V_{dc} (375 V_{dc} for C325)
Test voltage against coating (during 1 minute)	1250 V_{dc} (375 V_{dc} for C325)
Maximum current in the case of a.c. loads	500 mA
Insulation resistance at 500 V_{dc} (C322 series)	
Insulation resistance at 100 V_{dc} (C325 series)	> 10000 MΩ
for $C_n \leq 2500$ pF	> 10000 MΩ
for $C_n > 2500$ pF	$\frac{2500 \times 10000\ M\Omega}{C_n(pf)}$
Parallel damping for $C_n < 10$ pF	5 MΩ
Dissipation factor for $C_n \leq 200$ pF	
at 100 kc/s (measured at a voltage of 3.5 V_{ac})	see table
for $C_n > 200$ pF at 1 kc/s	
(measured at a voltage 3.5 V_{ac})	see table
Temperature dependency of the capacitance	see table and graphs
Permissible working temperature	
for C322	−40/+85 °C
for C325	−25/+85 °C
Climatic group number for C322	40/085/21 (IEC)
for C325	25/085/21 (IEC)

Capacitance values and tolerances are stated in the table

Capacitance values according to E12 series are available on special order subject to minimum order release requirements.

CERAMIC CAPACITORS - C322, C325 series

CLASS II, PIN-UP TYPE FOR 500 V_{dc} AND 125 V_{dc}

C322 series for 500 V_{dc}

capacitance (pF)	tolerance	class	$\Delta C/C = f(T)$	parallel damping	tan δ $\times 10^{-4}$	l (mm)	type number (insulated)
1.5	± 1 pF	II	< 10%	≥ 5 MOhm	—	6.5	C322DD/M1E5
2	,,	,,	,,	,,	—	7.5	/M2E
3	,,	,,	,,	,,	—	7.0	/M3E
4	,,	,,	,,	,,	—	6.5	/M4E
5	,,	,,	,,	,,	—	7.5	/M5E
6	,,	,,	,,	,,	—	7.5	/M6E
7	,,	,,	,,	,,	—	7.5	/M7E
8	,,	,,	,,	,,	—	8.0	/M8E
9	,,	,,	,,	,,	—	8.0	/M9E
10	,,	,,	,,	,,	—	7.0	/M10E
15	± 20%	,,	,,	—	≤ 25	8.0	/P15E
22	,,	,,	,,	—	25	7.5	/P22E
33	,,	,,	,,	—	25	8.5	/P33E
47	,,	,,	< 25%	—	100	8.5	C322DC/P47E
68	,,	,,	,,	—	100	7.0	/P68E
100	,,	,,	,,	—	100	7.5	/P100E
150	,,	,,	,,	—	100	7.5	/P150E
220	,,	,,	,,	—	100	8.0	/P220E
330	,,	,,	,,	—	350	9.0	/P330E
470	,,	,,	,,	—	350	7.5	/P470E
680	,,	,,	,,	—	350	8.0	/P680E
1,000	−20/+50%	,,	<40%	—	350	8.0	C322DA/H1K
1,500	,,	,,	,,	—	350	8.0	/H1K5
2,200	,,	,,	,,	—	350	10.5	/H2K2
3,300	,,	,,	,,	—	350	14.0	/H3K3
4,700	,,	,,	,,	—	350	19.0	/H4K7
6,800	,,	,,	,,	—	350	23.0	/H6K8
10,000	,,	,,	,,	—	350	29.0	/H10K
1,000	±20%	,,	<25%	—	350	8.5	C322DC/P1K
1,500	,,	,,	,,	—	350	11.0	/P1K5
2,200	,,	,,	,,	—	350	15.0	/P2K2
3,300	,,	,,	,,	—	350	21.0	/P3K3
4,700	,,	,,	,,	—	350	29.0	/P4K7

C325 series for 125V_{dc}

capacitance (pF)	tolerance	class	$\Delta C/C = f(T)$	tan δ $\times 10^{-4}$	l (mm)	type number (insulated)
2,200	−20/+50%	II	<40%	350	8.0	C325DA/H2K2
3,300	,,	,,	,,	,,	9.0	/H3K3
4,700	,,	,,	,,	,,	9.5	/H4K7
6,800	,,	,,	,,	,,	12.0	/H6K8
10,000	,,	,,	,,	,,	16.5	/H10K

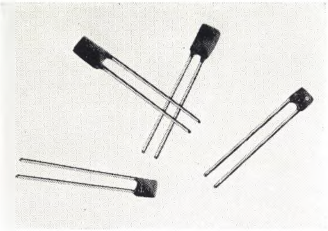
Composition of the type number

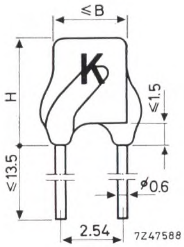
C322D./.. **C325D./..**

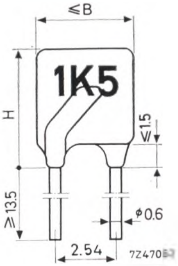
type number suffix ◀ ▶ type number suffix

C331, C332 series - CERAMIC CAPACITORS

TYPE II, PLATE CAPACITORS FOR 40 V_{dc}







Application

These "microplates" are especially designed for use in all kinds of small transistorised equipment, for coupling and decoupling purposes. Their extremely small dimensions and pitch distance (with a close tolerance) adapted to the standard pattern of printed wiring boards, render them very suitable for those applications where miniaturisation and easy mounting are required. The capacitance of the C332 range depends little on temperature (graph 1). The C331 range has higher capacitance values at the same dimensions, but its temperature dependence is somewhat greater (graph 2).

Construction

The capacitor consists of a thin rectangular ceramic plate of high-K material, both sides of which are metallised. The capacitor is fully insulated by a special coating, which ensures an excellent behaviour under infavourable atmospheric conditions. The capacitor width is 5 mm maximum.
The capacitors are marked in black script.

Electrical specification

Unless otherwise specified, all electrical values apply at a temperature of 20 ±5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 75%.

Working voltage	40 V_{dc}
Test voltage (during 1 minute)	120 V_{dc}
Test voltage against coating (during 1 minute)	120 V_{dc}
Insulation resistance, measured at 10 V_{dc} within 1 minute	$\geq$ 1000 MΩ
Dissipation factor at 1 kc/s (measured at a voltage $\leqslant$ 3.5 V_{dc})	
for C331	$\leq 500 \cdot 10^{-4}$
for C332	$\leq 350 \cdot 10^{-4}$
Voltage dependency of the capacitance between 0 and 40 V for C332	max. 5%
Permissible working temperature for C331	−10/ +55 °C
Permissible working temperature for C332	−25/ +85 °C
Permissible storage temperature for C331	−40/ +55 °C
Permissible storage temperature for C332	−40/ +85 °C
Climatic group number for C331	10/055/21 (IEC)
Climatic group number for C332	25/085/21 (IEC)
Capacitance values and tolerances	see tables

Mounting

When the leads have to be bent, cut or flattened, they should be relieved of the applied load at the body of the capacitor. For dip-soldering on printed wiring boards, a temperature up to 250 °C and a soldering time of up to 5 seconds is permissible.

TYPE II, PLATE CAPACITORS FOR 40 V_{dc}

Composition of the type number

C331../..
AA for 0,6 mm Ø leads
CA for 0,6 mm Ø leads
type number suffix

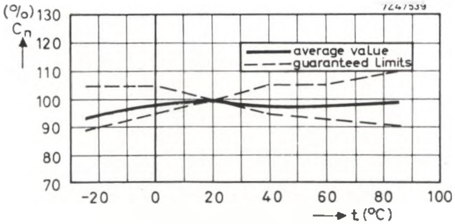
C332../..
BA for 0,6 mm Ø leads
CA for 0,4 mm Ø leads
type number suffix

C331 series, class II

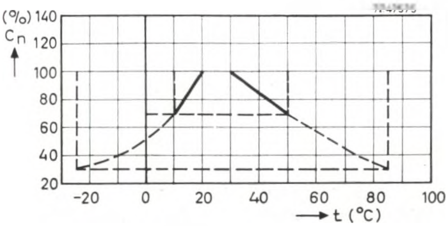
capacitance (*pF*)	*tolerance* (*%*)	*dimensions*			*marking*	*type number suffix*
		B (*mm*)	H (*mm*)	*fig.*		
1000	−20 + 100	3.7	5.2	1	T	/R1K
2200	−20 + 100	3.7	5.2	1	X	/R2K2
4700	−20 + 100	4.5	6.0	2	Z	/R4K7
10000	−20 + 100	5.0	8.5	2	10K	/R10K

C332 series, class IIA

capacitance (*pF*)	*tolerance* (*%*)	*dimensions*			*marking*	*type number suffix*
		B (*mm*)	H (*mm*)	*fig.*		
180	± 10	3.7	5.2	1	J	/A180E
220	± 10	3.7	5.2	1	K	/A220E
270	± 10	3.7	5.2	1	L	/A270E
330	± 10	3.7	5.2	1	M	/A330E
390	± 10	3.7	5.2	1	N	/A390E
470	± 10	3.7	5.2	1	P	/A470E
560	± 10	3.7	5.2	1	Q	/A560E
680	± 10	5.0	6.5	2	680	/A680E
820	± 10	5.0	6.5	2	820	/A820E
1000	± 10	5.0	6.5	2	1K	/A1K
1200	± 10	5.0	6.5	2	1K2	/A1K2
1500	± 10	5.0	6.5	2	1K5	/A1K5
1800	± 10	5.0	6.5	2	1K8	/A1K8



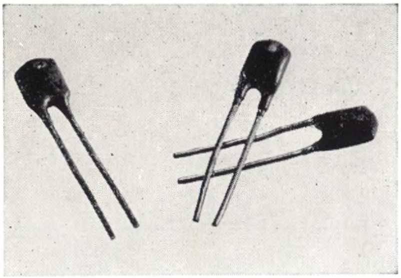
graph 1



graph 2

C330 series - CERAMIC CAPACITORS

BARRIER LAYER CAPACITORS FOR 6V$_{dc}$



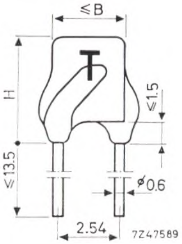


fig. 1

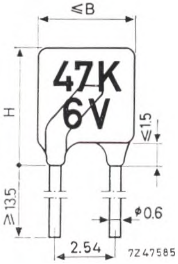


fig. 2

Application

Owing to the use of a new technique of manufacturing, these capacitors have a very high capacitance and a low working voltage at very small dimensions.
Therefore they are very suited for coupling and decoupling purposes in small transistorised equipment, for example in IF stages of radio receivers.

Construction

The capacitor consists of a thin rectangular plate, which has been given semiconducting properties by a reducing process. The surface is oxidised on both sides, thus forming a barrier layer. Thus two capacitances with a series resistance in between are formed (see Fig. 1).
The whole is covered with a blue insulating lacquer. The distance between the leads is fixed at 2.5 mm, with a close tolerance, adapted to the standard pattern of printed-wiring boards. The 22000 and 47000 pF capacitors are marked in black script as shown in Figs 1 and 2 respectively. The 100000 pF type is marked with: 0.1; 6V.

Electrical specification

Unless otherwise specified, all electrical values apply to a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

Maximum working voltage at 55 °C	6 V$_{dc}$
Test voltage against coating (during 1 minute)	15 V$_{dc}$
Insulation resistance at 6 V$_{dc}$ (within 1 minute)	$>$ 150,000 Ω
at 3 V$_{dc}$ (within 1 minute)	$>$ 500,000 Ω
Impedance at 10 Mc/s for 47000 and 1000.000 pF	$\leqslant$ 5 Ω
for 22000 pF	$\leqslant$ 10 Ω
Max. working temperature	−10/+55 °C
Max. storage temperature	−40/+55 °C
Climatic group number	10/055/21 (IEC)
Capacitance values and tolerances	see table

Mounting

When the leads have to be bent, cut or flattened, they should be relieved of the applied load at the body of the capacitor. For dip-soldering on printed wiring boards, a temperature up to 250 °C and a soldering time of up to 5 seconds is permissible.

BARRIER LAYER CAPACITORS FOR 6V$_{dc}$

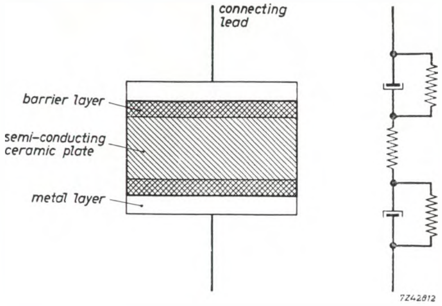


fig. 3

Barrier layer C330-series

capacitance (pF)	tolerance	dimensions			type number suffix
		B (mm)	H (mm)	fig.	
22000	−20/+100%	3.7	× 5.2	1	R22K
47000	−20/+100%	5.0	× 6.5	2	R47K
100000	−20/+100%	5.0	× 10.5	2	R0,1

Composition of the type number

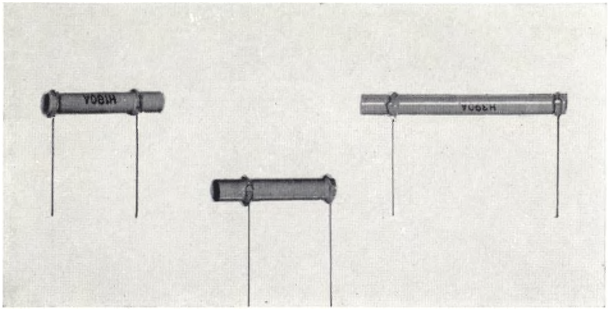
C330../..

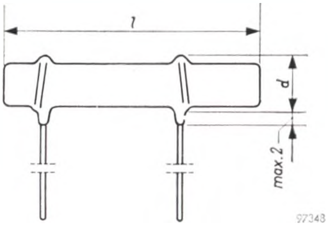
BA for 0,6 mm Ø leads ◄
CA for 0,4 mm Ø leads

► type number suffix

C321 series - CERAMIC CAPACITORS

SAFETY CAPACITORS, TUBULAR TYPE FOR 700V$_{dc}$





Application

These ceramic capacitors withstand a test voltage of 2000 V$_{rms}$ for 1 minute, the international requirement for capacitors connected between the mains and conductive parts which might be touched. Therefore, they are very suitable for use in radio and television sets.

Construction

The capacitor consists of a ceramic tube internally and partly externally covered with a fired-on coating of silver. The connecting leads are soldered to the silver electrodes. A coating of special grey lacquer protects the capacitors against atmospheric influences. The capacitors are marked in black script with an H followed by capacitance value in pF and a letter indicating the tolerance.

Electrical specification

Unless otherwise specified, all electrical values apply at a temperature of 20 ±5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%.

Working voltage	700 V$_{dc}$
Test voltage (during 1 minute)	2000 V$_{dc}$
Insulation resistance measured at a voltage of 500 V$_{dc}$	$\geqslant$ 50000 MΩ
Dissipation factor at 1 Mc/s measured at a voltage $<$ 3.5 V$_{ac}$	$\leqslant$ 10×10^{-4}
Permissible working temperature	$-40/+85$ °C
Climatic group number	40/085/21 (IEC)

Composition of the type number

C321GA/..

→ type number suffix

SAFETY CAPACITORS, TUBULAR TYPE FOR 700V$_{dc}$

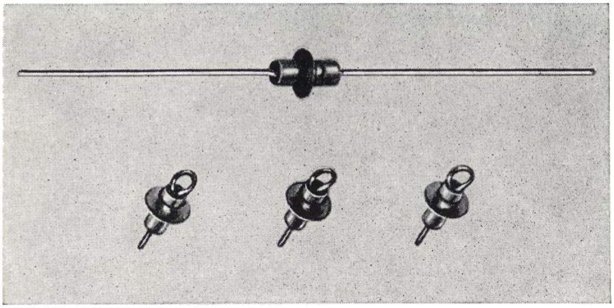
cap. (pF) tol. ± 10%	*dimensions (mm)*			*type number*
	d	*l*	*p**	
10	3	18	10.2	C321GA/A10E
12	3	18	10.2	/A12E
15	3	18	10.2	/A15E
18	3	18	10.2	/A18E
22	3	18	10.2	/A22E
27	3	18	10.2	/A27E
33	3	18	10.2	/A33E
39	3	18	10.2	/A39E
47	4	18	10.2	/A47E
56	4	18	10.2	/A56E
68	4	18	10.2	/A68E
82	4	18	10.2	/A82E
100	4	20	10.2	/A100E
120	4	20	10.2	/A120E
150	4	22	12.7	/A150E
180	4	24	12.7	/A180E
220	4	28	17.7	/A220E
270	4	32	20.3	/A270E
330	4	36	25.4	/A330E
390	4	40	30.5	/A390E
470	4	46	35.6	/A470E
560	4	52	40.6	/A560E

* p is the distance between the leads.

C90

C309 series - CERAMIC CAPACITORS

CLASS I, CLASS II; MINIATURE FEED-THROUGH CAPACITOR FOR 350V



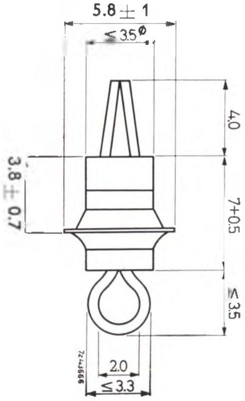


Fig. 1.

Application

Ceramic feed-through capacitors are designed for decoupling the supply leads of high-frequency equipment, for instance in T.V. tuners. However, due to their extremely low inductances, they might also be used in frequency-determining circuits in similar equipment. Since in this application (e.g. in VHF/UHF tuners) low losses are required, class I types should be chosen. The version with a central pin is provided with sufficient soldering tin to facilitate mounting.

Construction

The capacitors consist of a ceramic tube provided with silver electrodes. The outer connection is formed by a flange, and the inner one by a split pen (Fig. 1) or an axial lead (Fig. 2). The split-pen version is provided with sufficient soldering tin, which facilitates mounting.
The capacitors are marked in black script or with a colour dot. The lead feed-through type is not marked.

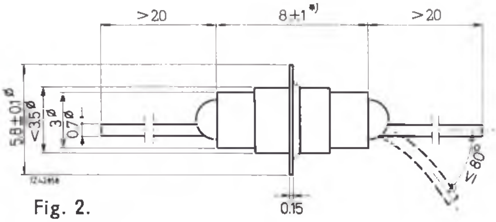


Fig. 2.

*12 mm for the 4700 pF capacitor

Electrical specification

Unless otherwise specified all electrical values apply at a temperature of 20 ± 5 °C, an atmospheric pressure of 930–1060 mbar and a relative humidity of 45% to 75%

Working voltage at 85 °C	350 V_{dc}
Test voltage (during 1 minute)	1050 V_{dc}
Dissipation factor	see table
Insulation resistance measured at 100 V_{dc}	$>$ 10000 MΩ
Temperature dependence of the capacitance	See table
Permissible working temperature	−40/+85 °C
Climatic group number	40/085/21
Capacitance and tolerance	See tables

CLASS I, CLASS II; MINIATURE FEED-THROUGH CAPACITORS FOR 350 V_{dc}

Mounting

The following soldering procedure is advised:
Heat and cool gradually (approximately 50 °C/s). The time during which the soldering tin is fluid should be kept as short as possible. The central lead should not be soldered within 1 mm from the tube. A soldering alloy of 60% tin, 36% lead and 4% silver, or 50% tin, 46% lead and 4% silver is recommended.

Table I

capacitance values (pF)		*tan δ × 10^{-4}*	*measuring frequency*
range 1	2.2– 47	$10 \times \frac{141-2C}{47}$	100 kc/s
	68– 100	40	100 kc/s
	150	100	100 kc/s
	220– 330	100	1 kc/s
	470–2200	350	1 kc/s
range 2	2– 47	25	1 Mc/s
	68–4700	500	1 kc/s

Class IC, C309 series, split-pen type

capacitance (pF)	*tolerance*	*temp. coeff. (10^{-6}/°C)*	*type number suffix*
≤ 2.5		+ 100	BG/2E5
3.3	± 0.5 pF	+ 100	BG/L3E3
4.7	+ 0.5 pF	+ 100	BG/L4E7
6.8	+ 1 pF	0	BG/M6E8
10	+ 1 pF	0	BG/M10E
15	± 10 %	0	BG/A15E
22	± 10 %	0	BG/A22E
33	± 10 %	– 750	BG/A33E
47	± 10 %	– 750	BG/A47E

C309 series - CERAMIC CAPACITORS

CLASS I, CLASS II; MINIATURE FEED-THROUGH CAPACITORS FOR 350 V_{dc}

Class II, C309 series, split-pen type

capacitance (pF)	*tolerance*	*temp. dependency C between −25/+85 °C*	*type number suffix*
68	± 20%	10	BH/P68E
100	± 20%	10	BH/P100E
150	± 20%	20	BH/P150E
220	± 20%	20	BH/P220E
330	± 20%	20	BH/P330E
470	± 20%	10	BH/P570E
680	± 20%	10	BH/P680E
1000	−20/+50%	40	BH/H1K
1500	−20/+50%	40	BH/H1K5
2200	−20/+50%	40	BH/H2K2

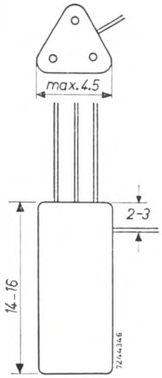
Class II, C309 series, lead feed-through type

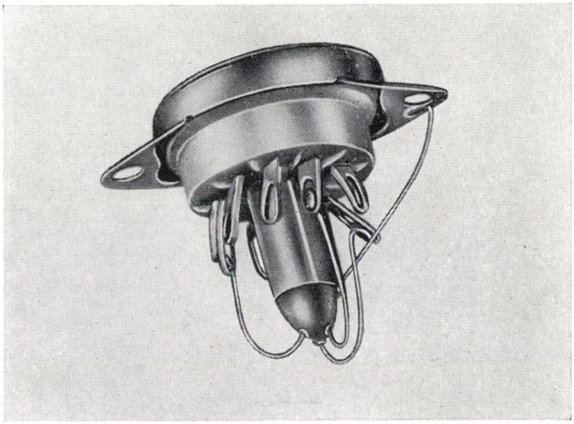
capacitance (pF)	*tolerance*	*type number suffix*
2	± 0.5 pF	UA/L2E
3	,,	UA/L3E
4	,,	UA/L4E
5	,,	UA/L5E
6	± 1 pF	UA/M6E
8	,,	UA/M8E
10	,,	UA/M10E
15	± 10%	UA/A15E
22	,,	UA/A22E
33	,,	UA/A33E
47	,,	UA/A47E
68	± 20%	UA/P68E
100	,,	UA/P100E
150	,,	UA/P150E
220	,,	UA/P220E
330	,,	UA/P330E
470	,,	UA/P470E
680	−20/+50%	UA/H680E
1000	,,	UA/H1K
1500	,,	UA/H1K5
2200	,,	UA/H2K2
3300	,,	UA/H3K3
4700	,,	UA/H4K7

Capacitance values according to the E12 series are available on special order subject to minimum order release requirements.

CERAMIC CAPACITORS - B8 600 01/02

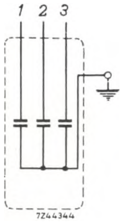
TUBULAR TRIPLE BY-PASS TYPE





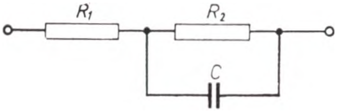
This multiple tropic-proof component meets the demand of the TV industry as regards simplification of receiving sets with tubes. Its compactness and efficient shape permit it to be mounted in the centre screen of tube sockets.
The component is also very suitable to be used in combination with printed wiring.

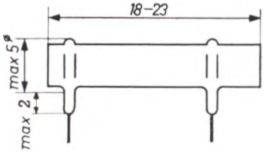
capacitance.	3 × 500 pF
tolerance at 20 °C	−20/ +100%
maximum working voltage.	250 V_{dc}
test voltage	up to 500V_{dc}
maximum permissible ambient temperature	85 °C
insulation resistance at 20 °C.	> 5,000 MΩ
maximum losses at 1 kc/s	3%



E555 series - RC COMBINATIONS

This miniature type of RC combination can be used as partly decoupled cathode resistor.





Working voltage of $(R_1 + R_2) = \sqrt{P_w \times R_{nom}}$

resistance		*capacitance*	
R_1 [1] (*Ω*)	$R_1 + R_2$ [2] (*Ω*)	*(tolerance—20/+50%)* *(pF)*	code
47	150	2700	/01
47	120	1000	/02
39	180	1500	/03
39	120	2700	/04
47	120	2700	/05
39	150	2700	/06
39	180	2700	/07
47	180	2700	/08
39	220	2700	/09
47	220	2700	/10

[1] Tolerance ± 20%

[2] Tolerance ± 20% or ± 10%

Composition of the type number

E555A./..

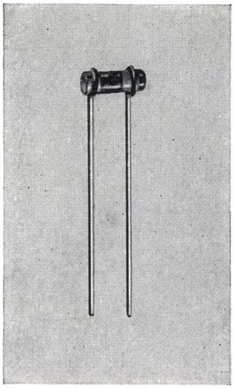
tolerance of resistance $(R_1 + R_2)$ ◄ ──┘ └──► code (see table)

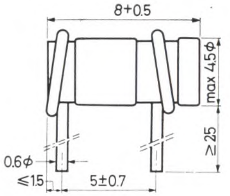
A = ± 10%

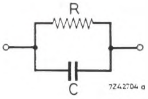
P = ± 20%

RC COMBINATIONS - E559 series

MINIATURE VERSION

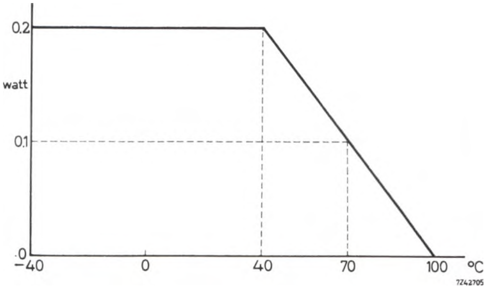






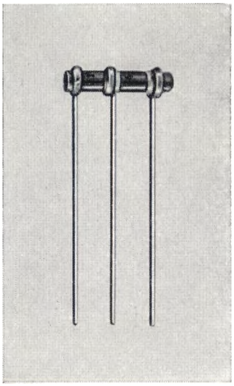
resistance (tolerance ±10%)	capacitance		type number suffix E559AA/[1]
	pF	tolerance	
150 Ω	1,500	−20/ +50%	/26 + 38
180 Ω	1,500	−20/ +50%	/26 + 38
220 Ω	1,500	−20/ +50%	/28 + 38
270 Ω	1,500	−20/ +50%	/29 + 38
18 kΩ	47	±10%	/51 + 20
18 kΩ	1,500	−20/ +50%	/51 + 38
22 kΩ	470	±20%	/52 + 32

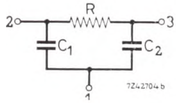
* Preferred types

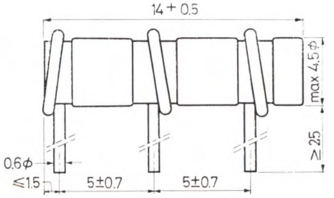


Maximum permissible dissipation of the resistor as a function of temperature.

E560 series - RC COMBINATIONS



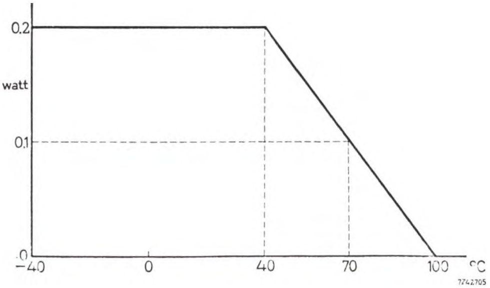




resistance (tolerance ±10%) (Ω)	capacitance		type number[1] suffix E560AA/[2]
	(pF)	tolerance (%)	
1,000	2 × 1,500	−20/ +50	/36 + 38
10,000	2 × 1,500	−20/ +50	/48 + 38
47,000	2 × 820	−20/ +50	/56 +35
47,000	2 × 47	±10	/56 +20
47,000	2 × 100	±10	/56 +24
47,000	2 × 150	±20	/56 +26

[1] Preferred types

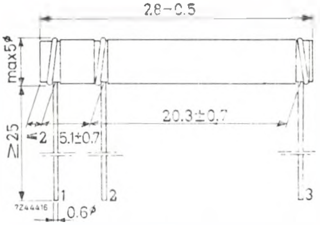
[2] Miniature version.

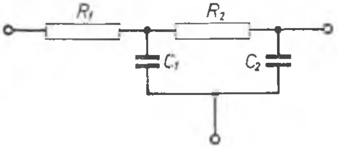


Maximum permissible dissipation of the resistor as a function of temperature.

RC COMBINATIONS - E556 series

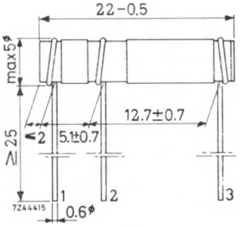
VERTICAL INTEGRATOR CIRCUIT

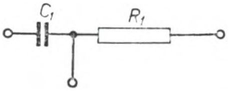




type number	E 556AA/56 + 35
resistance value (± 10%) R1	47 kΩ
R2	47 kΩ
capacitance value (—20/ + 50%) C1	820 pF
C2	820 pF

general purpose - E554 series

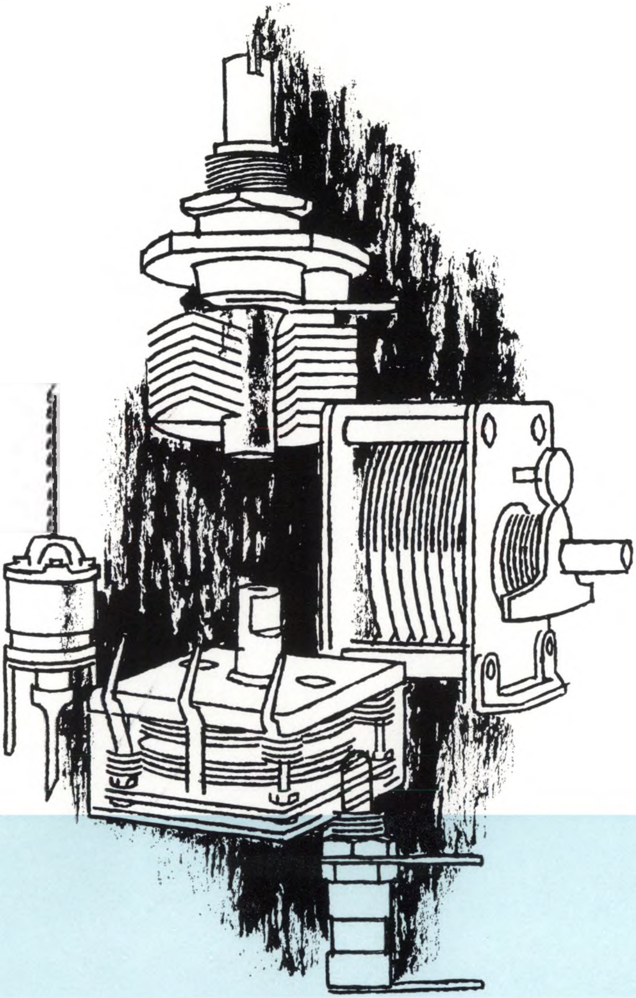




resistance tol. ± 10%	*capacitance tol. —20/+ 50% (pF)*	*type number suffix* [1] *E 554AN*	*resistance tol. ± 10%*	*capacitance tol.—20/ +50%*	*type number suffix* [1] *E 554AA/*
100 Ω	1,500	/24 + 38	22 kΩ	1,500	/52 + 38
100	4,700	/24 + 44	22	4,700	/52 + 44
220	1,500	/28 + 38	47	1,500	/56 + 38
220	4,700	/28 + 44	47	4,700	/56 + 44
470	1,500	/32 + 38	100	1,500	/60 + 38
470	4,700	/32 + 44	100	4,700	/60 + 44
1 kΩ	1,500	/36 + 38	220	1,500	/64 + 38
1	4,700	/36 + 44	220	4,700	/64 + 44
2.2	1,500	/40 + 38	470	1,500	/68 + 38
2.2	4,700	/40 + 44	470	4,700	/68 + 44
4.7	1,500	/44 + 38	1 MΩ	1,500	/72 + 38
4.7	4,700	/44 + 44	1	4,700	/72 + 44
10	1,500	/48 + 38			
10	4,700	/48 + 44			

[1] Preferred types

SYNTHETIC FOIL
CERAMIC
AIR



Variable capacitors

CONTENTS

SYNTHETIC FOIL TUNING CAPACITORS

SURVEY

The capacitors included in this range have a dielectric consisting of laminated synthetic foil and air. In addition to being of relatively small size they are of a remarkably high quality and compare very favourably with similar components of other manufacture.

The capacitors are particularly suitable for miniature personal radios and the larger portable variety, and may also be employed in all-wave receivers of the battery driven type.

The moving vanes rotate freely between the fixed stator vanes, ensuring good tracking at different frequencies. Clockwise rotation of the tuning shaft will produce an increase in capacitance.

In the interests of performance, adherence to the appropriate mounting plan given for each type is strongly recommended.

To avoid undue stress within the capacitor base plate when mounting, it is advisable to use screws having cylindrical heads rather than those of the counter-sunk type.

type number	*AC1033*	*AC1034*	*AC1034/01* *AC1034/03*	*AC1035*	*AC1036/01*	*AC1037/01*	*AC1038*
angle of rotation °	170 + 5	174 + 5	174 + 5	170 + 6	170 + 5	170 + 5	174 + 5
law tolerance[1] . % (nominal law)	± 5	± 3	± 5	± 5	± 3	± 3	± 3
FM part . . . . pF						0.7	0.7
ganging tolerance[2] . . %	± 5	± 3	± 5	± 5	± 3	± 3	± 3
operating torque gcm	400	400	400	400	450	450	500
torque against end stop . . . gcm	2000	2000	2000	2000	3000	3000	2000

insulation resistance	> 10000 MΩ
parallel damping.	> 3 MΩ at 1.5 Mc/s
test voltage	300 V_{dc}
direction of rotation for cap. increase	clockwise
radial torque of 400 gcm on shaft causes	⩽ 0.2 % change in capacitance
temperature range	−25 to +70 °C

application	*variable capacitances 10°–180° (pF)*	*trimmers (pF)*	*dimensions (mm)*	*type number*
Midget LW/MW personal sets	55 + 155	2 × 5	15 × 15 × 10	AC1035
LW and MW personal sets .	80 + 180	2 × 9	20 × 20 × 16	AC1033
All-wave personal sets . . .	195 + 195	—	20 × 20 × 13	AC1036/01
All-wave portable sets . . .	275 + 275	—	25 × 25 × 16	AC1034
All-wave portable sets . . .	335 + 335	—	25 × 25 × 16	AC1034/01 AC1034/03
AM/FM personal sets. . . .	77 + 198 + 9.5 + 9.5	4 × 5.5	20 × 20 × 18	AC1037/01
AM/FM portable sets. . . .	280 + 280 + 14 + 14	4 × 9	25 × 25 × 21.5	AC1038

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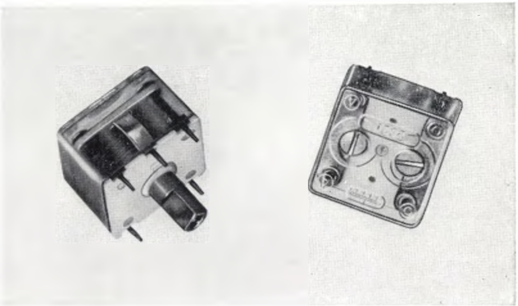
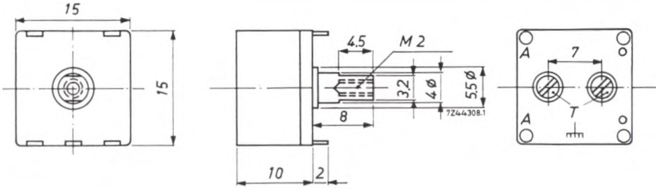
[1] The capacitance law of the oscillator section is adjusted to be within the stated tolerance of the nominal value. At a rotation of α°, the tolerance is calculated from the sum of the total circuit capacitance at 10° and the capacitance swing between 10° and α°.

[2] The capacitance law of the aerial section is adjusted to the nominal value at a rotation of α°. This nominal value is obtained by adding to the measured total circuit capacitance of the oscillator section the nominal difference between aerial section and oscillator section. The tolerance is calculated on this sum.

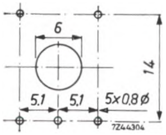
TYPE AC1035

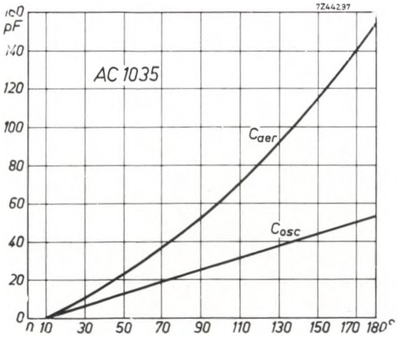
Suitable for tuning midget LW and MW personal radio sets.





The capacitor can be soldered on to the print panel by means of the five terminal tags.





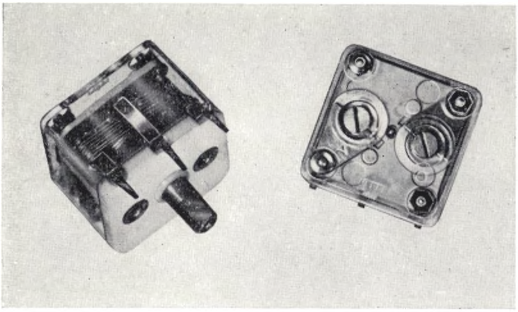
angle of rotation	capacitance swing	
	aerial section	oscillator section
10°	0 pF	0 pF
20°	4.9	3.24
40°	16	9.7
60°	28.9	16.2
90°	52	25.9
120°	80.1	35.6
150°	114.1	45.3
180°	155	55
total circuit capacitance[1]	17 pF	15 pF

[1] I.e. the value needed at 10° to obtain the required frequency ratio and padding curve. It is made up as follows: the capacitance swing at 10°; the stray capacitance of the circuit; any additional capacitance required.

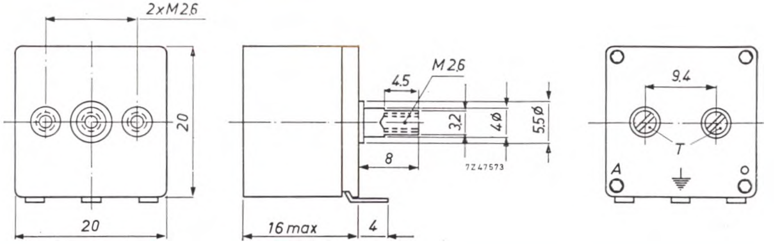
The cut oscillator section is suitable for an IF of 452, 460 or 470 kc/s (optimum values for waveband limits and total circuit capacitance will gladly be supplied on request).

SYNTHETIC FOIL TUNING CAPACITORS

TYPE AC1033



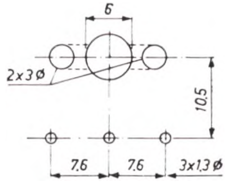
Suitable for tuning pocket-size LW and MW radio sets.

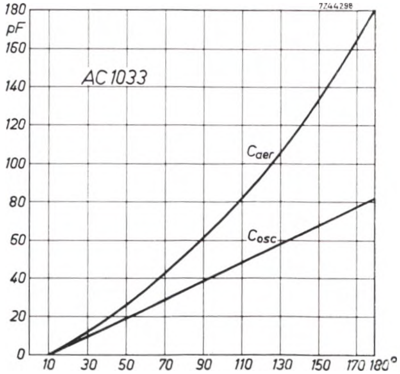


Use two type M2.6 cylindrically-headed screws, which should not protrude by more than 2 mm into the capacitor.

angle of rotation	*capacitance swing*	
	aerial section	*oscillator section*
10°	0 pF	0 pF
20°	5.8	4.8
40°	18.9	14.3
60°	34.2	23.9
90°	61.6	38.2
120°	91.9	51.3
150°	131.8	65.7
180°	180	80
total circuit capacitance[1]	20 pF	22 pF

[1] I.e. the value needed at 10° to obtain the required frequency ratio and padding curve. It is made up as follows: the capacitance swing at 10°; the stray capacitance of the circuit; any additional capacitance required.



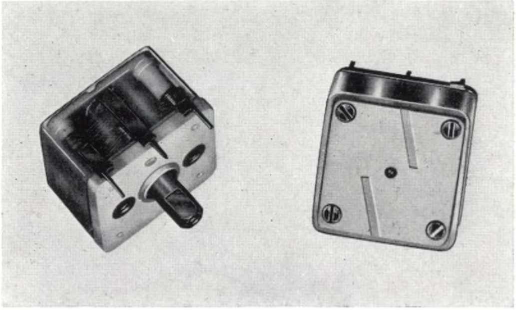


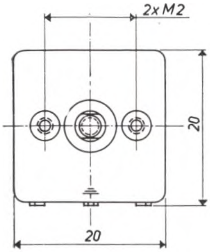
The cut oscillator section is suitable for an IF of 452, 460 or 470 kc/s (optimum values for waveband limits and total circuit capacitance will gladly be stated on request).

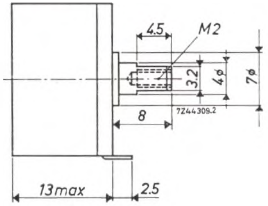
SYNTHETIC FOIL TUNING CAPACITORS

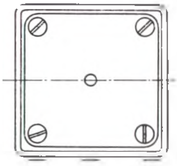
TYPE AC1036/01

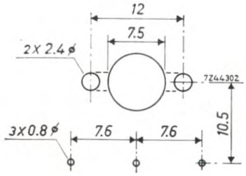
This type may be used for tuning pocket-size all-wave radio sets.





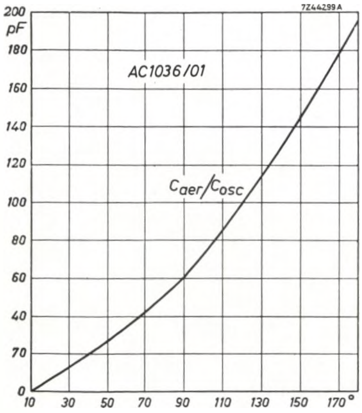






Use two type M2 cylindrically-headed screws, which should not protrude by more than 2 mm into the capacitor.

angle of rotation	*capacitance swing*
10°	0 pF
20°	5.8
40°	20.2
60°	36.8
90°	66.1
120°	102.0
150°	145.0
180°	195.0
total circuit capacitance[1]	25 pF



The capacitance law of the aerial section is adjusted relative to the oscillator section.

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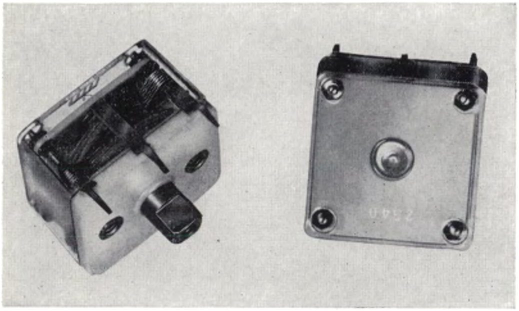
[1] Dependent on the values of IF, frequency ratio and applied padding capacitor. The stated figures are given to permit calculation of law and ganging tolerances.
When IF and band limits have been decided on, optimum values can be determined for trimming frequencies, padding capacitors and padding deviation.

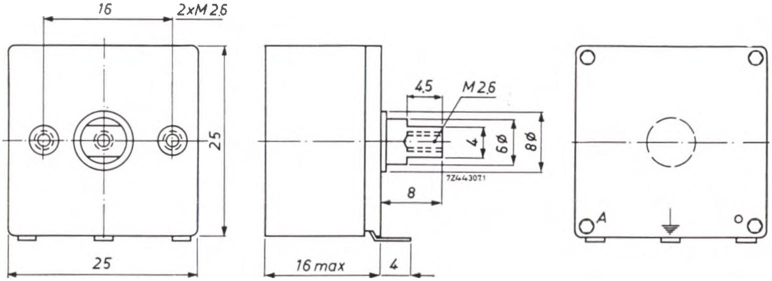
SYNTHETIC FOIL TUNING CAPACITORS

TYPES AC1034, AC1034/01 and AC1034/03

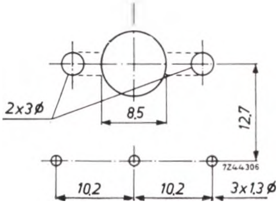


Suitable for all-wave AM or AM/FM battery-driven radio sets.

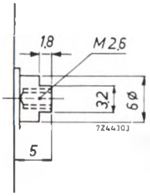
TYPE AC1034



Use two type M2.6 cylindrically-headed screws which should not protrude by more than 2 mm into the capacitor.

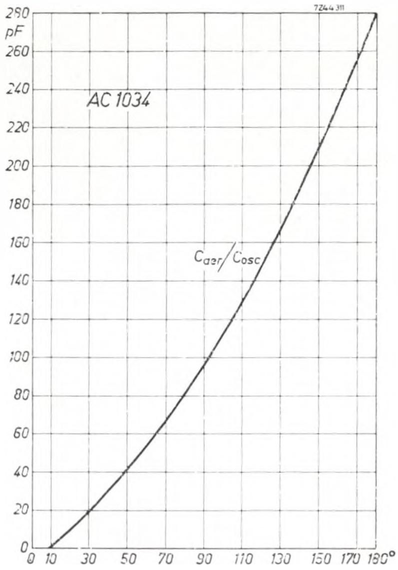


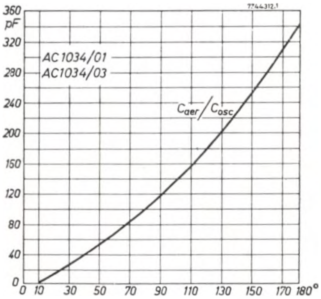
Mounting pattern or types AC1034 and AC1034/03. Type AC1034/01 is equipped with soldering tags for use in conventional wiring.



Spindle end section of types AC1034/C1 and AC 1034/03

TYPES AC1034 and AC1034/01





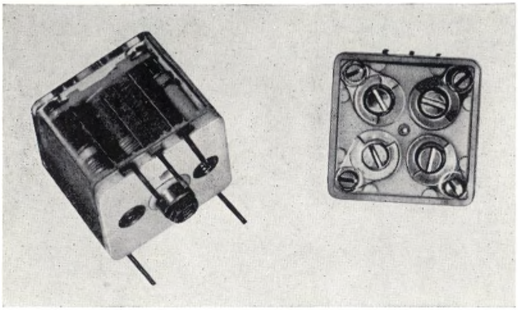
angle of rotation	*capacitance swing*	
	AC 1034	*AC 1034/01/03*
10°	0 pF	0 pF
20°	8.4	9.9
40°	27.9	33.0
60°	51.1	60.4
90°	92.3	109.1
120°	142.6	168.5
150°	203.4	240.4
180°	275	325
total circuit capacitance [1]	35 pF	37 pF

[1] Dependent on the values of IF, frequency ratio and applied padding capacitor. The stated figures are given to permit calculation of law and ganging tolerances.
When IF and band limits have been decided on, optimum values can be determined for trimming frequencies, padding capacitors and padding deviation.

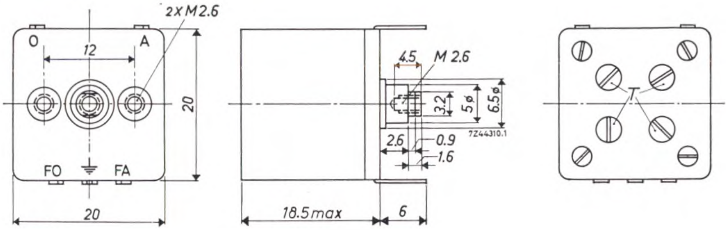
The capacitance law of the aerial section is adjusted relative to the oscillator section.

SYNTHETIC FOIL TUNING CAPACITORS

TYPE AC1037/01



Appropriate for tuning camera-size AM/FM battery-driven radio sets.

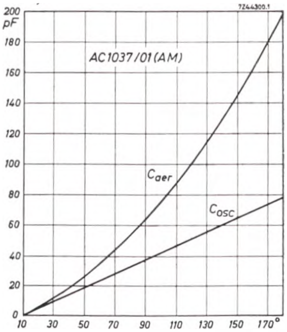


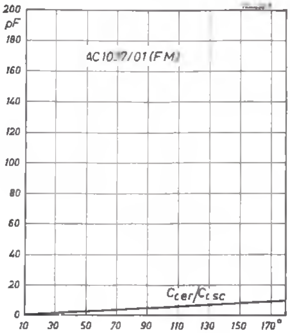
Use two type M2.6 cylindrically-headed screws, which should not protrude by more than 2 mm into the capacitor.

angle of rotation	capacitance swing			
	aerial section		oscillator section	
	AM	FM	AM	FM
10°	0 pF	0 pF	0 pF	0 pF
20°	5.75	0.57	4.3	0.57
40°	19.0	1.82	13.3	1.82
60°	35.2	2.90	22.4	2.90
90°	64.4	4.62	36.2	4.62
120°	100.7	6.36	49.9	6.36
150°	145.5	8.02	63.5	8.02
180°	198.0	9.50	77.0	9.50
total circuit capacitance [1]	21 pF	60 pF	21 pF	60 pF

[1] I.e. the value needed at 10° to obtain the required frequency ratio and padding curve. It is made up as follows: the capacitance swing at 10°; the stray capacitance of the circuit; any additional capacitance required.

The cut oscillator section is suitable for an IF of 452, 460 or 470 kc/s (optimum values for waveband limits and total circuit capacitance will gladly be stated on request).

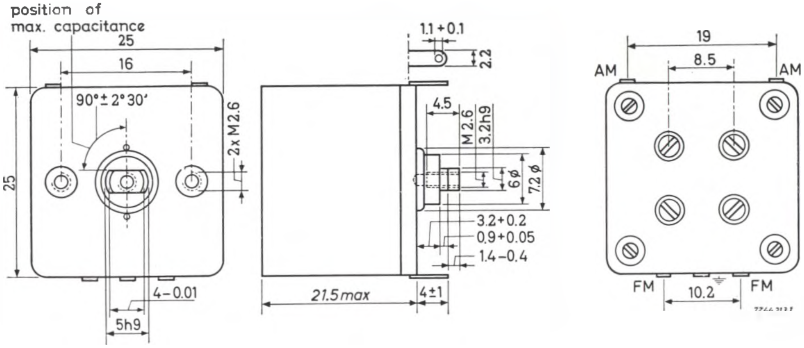


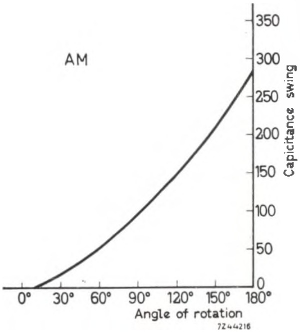


SYNTHETIC FOIL TUNING CAPACITORS

TYPE AC1038

For tuning all-wave AM/FM battery-driven radio sets. The spindle is shaped to fit a back-lash free gear drive.

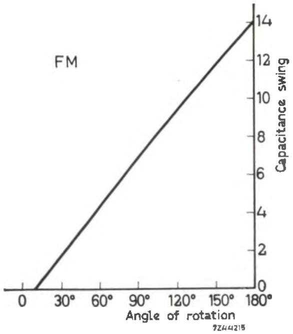




angle of rotation	*capacitance swing*	
	AM	*FM*
10°	0 pF	0 pF
20°	9.05	1.0
40°	29.45	2.79
60°	53.15	4.35
90°	95.6	6.95
120°	146.8	9.36
150°	208.8	11.86
180°	280.0	14.0
total circuit capacitance[1]	35 pF	60 pF

---

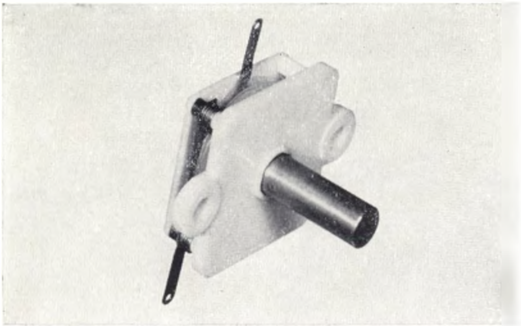
[1] Dependent on the values of IF, frequency ratio and applied padding capacitor. The stated figures are given to permit calculation of law and ganging tolerances. When IF and band limits have been decided on, optimum values can be determined for trimming frequencies, padding capacitors and padding deviation.



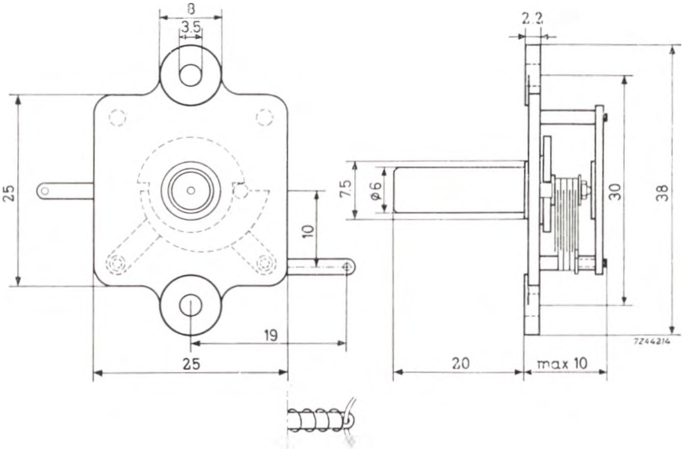
The capacitance law of the aerial section is adjusted relative to the oscillator section.

SYNTHETIC FOIL TUNING CAPACITORS

TYPE AC1039



For toy radio sets and similar simple TRF receivers.



capacitance swing	200 pF ± 10%
effective angle of rotation	174° + 5°
minimum capacitance	5 pF
test voltage	300 V_{dc}
parallel damping at 1.5Mc/s	> 3 MΩ
insulation resistance	10000 MΩ
operating torque	25 to 500 gcm
permissible torque against end stop	2 kgcm
permissible axial thrust	1 kg
temperature range	–25 to + 70°C

CERAMIC TRIMMERS - C004 series

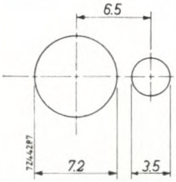
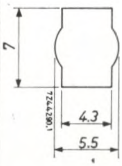
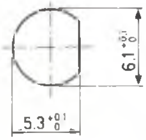
SURVEY

The trimmers are designed for use in radio and television receivers as well as industrial equipment. All types, except the C004FA, consist of an internally ground ceramic tube, in which an invar rotor is guided by a phosphor-bronze wire spring. Both ends of the rotor (one end only of C004EB) are slotted for screwdriver operation.
In certain applications the negative temperature coefficient characteristic of the components ensures adequate compensation for the effects of different temperatures.

type number	*application*
C004AA, C004BA, C004CA, C004HA, C004JA, C004ZZ, (UHF) .	radio and television
C004FA (for printed wiring).	radio and television
C004EB, C004EB.	industrial applications

		types C004. .			
characteristics		*AA, BA, CA, EA, ZZ/04, ZZ/07*	*FA*	*EB*	*JA ZZ/115 ZZ/116*
max. working voltage	(V_{dc})	400	400	500	300
max. test voltage	(V_{dc})	800	800	1000	650
temperature range	(°C)	−40 to +85	−40 to +85	−40 to +85	−40 to +75
max. contact resistance	(mΩ)	3	3	3	10
min. parallel damping (1.5Mc/s, C_{max})	(MΩ)	10	10	10	3
min. insulation resistance	(MΩ)	10000	10000	10000	10000
operating torque	(gcm)	40 to 500	15 to 700	50 to 250	20 to 200

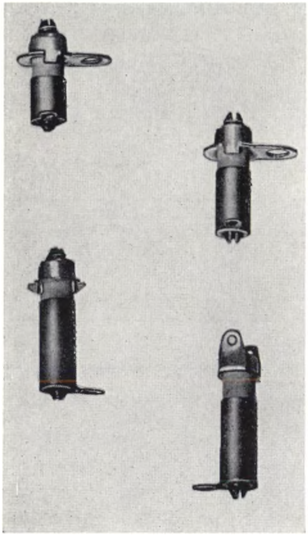
Mounting holes (mm)

types C 004. .						
AA	*BA*	*CA, ZZ/04 ZZ/07*	*EA*	*EB*	*FA*	*JA, ZZ/116 ZZ/115*
		7ø	5.5ø		see p. D16	4.1ø

For more details see following pages

C004 series - CERAMIC TRIMMERS

TUBULAR TYPES C004AA, BA, CA



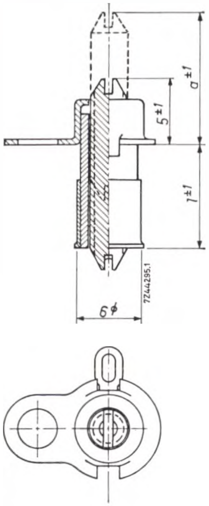


Fig. 1

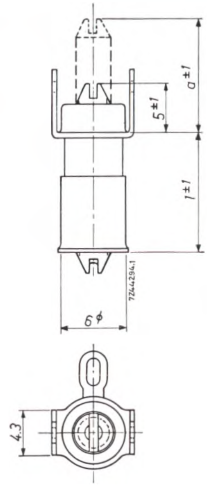


Fig. 2

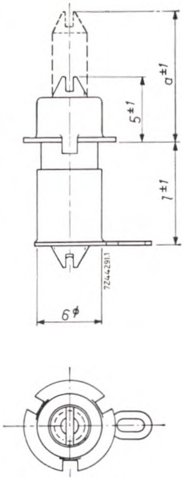
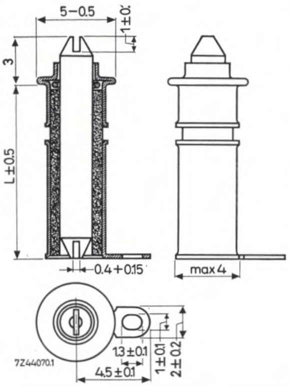
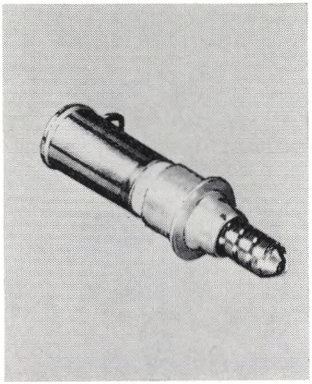


Fig. 3

figure	*capacitance (pF)*		*angle of rotation*	*dimensions (mm)*		*type number*
	C_{var}	C_{min}		*l*	a	
1	3	0.8	approx. 3 × 360°	5.5	13.5	C004AA/3E
1	6	0.8	approx. 5 × 360°	8.5	16.5	/6E
1	9	0.9	approx. 7 × 360°	11.5	19.5	/9E
1	12	1.0	approx. 9 × 360°	14.5	22.5	/12E
2	3	0.8	approx. 3 × 360°	6.5	12.5	C004BA/3E
2	6	0.8	approx. 5 × 360°	9.5	15.5	/6E
2	9	0.9	approx. 7 × 360°	12.5	18.5	/9E
2	12	1.0	approx. 9 × 360°	16	21.5	/12E
3	3	0.8	approx. 3 × 360°	5.5	13.5	C004CA/3E
3	6	0.8	approx. 5 × 360°	8.5	16.5	/6E
3	9	0.9	approx. 7 × 360°	11.5	19.5	/9E
3	12	1.0	approx. 9 × 360°	14.5	22.5	/12E

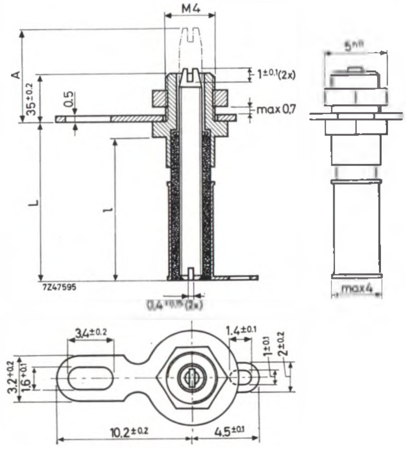
C004JA,ZZ-MIDGET TUBULAR TYPE





The design of these trimmers is similar to the type C004AA, the several variations of which have proved reliable in countless TV tuners and radio sets. A thin, internally ground ceramic tube closely fits a threaded invar spindle. The spindle is guided by a U-shaped spring fixed by the silver plated brass cap. The JA type cap is to be soldered to the chassis thus providing excellent contact and also a sturdy mechanical mount. ZZ-types are secured by a mounting nut.

The stator is a silver-plated sleeve, fitted over the ceramic tube, which possesses a soldering eyelet.

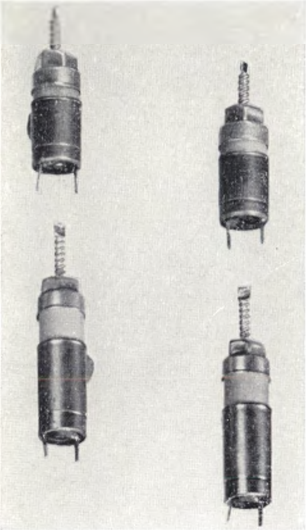


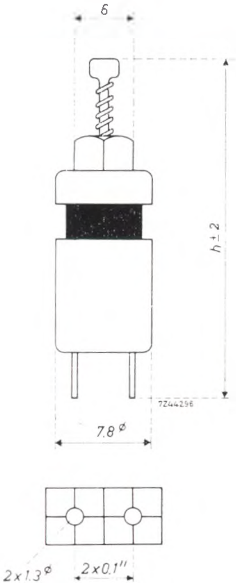
test voltage	650 V_{dc}
parallel damping at 1.5 Mc/s	
C004JA.	> 3 MΩ
C004ZZ	> 10 MΩ
contact resistance	< 10 mΩ
insulation resistance	> 10,000 MΩ
operating torque	10–200 gcm.
temperature coefficient	
C004JA/6E, C004ZZ	$(-200\pm200)\times10^{-6}$pF/pF/$_{o}$C
C004JA/3E	$(-200\pm100)\times10^{-6}$pF/pF/°C

C_{var} (pF)	C_{min} (pF)	L (mm)	L (mm)	type number
3	0.8	7.8 ± 0.5		C004JA/3E
6	0.8	10.8 ± 0.5		/6E
3	0.8	7.3 ± 0.5	8.3 ± 1	ZZ/115
6	0.8	10.3 ± 0.5	11.3 ± 1	/116

C004 series - CERAMIC TRIMMERS

TUBULAR TYPE C004FA FOR P.W. BOARDS



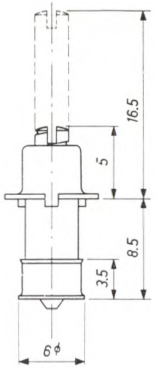


These trimmers are especially suitable for automatic insertion onto printed-wiring boards. They are equipped with two terminal pins spaced 5.08 mm apart to fit the most widely used grid i.e. holes of 1.32 mm ∅ and a pitch of 2.54 mm (0.1″).

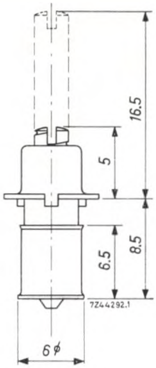
capacitance (pF)		*angle of rotation*	*dimensions (mm)*	*type number*
C_{var}	C_{min}		*h*	
6	2.5	approx. 3 × 360°	26.5	C004FA/6E
10	3.5	approx. 3 × 360°	26.5	C004FA/10E
20	3.5	approx. 5 × 360°	35.5	C004FA/20E

CERAMIC TRIMMERS - C004 series

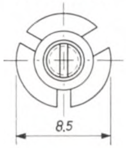
TUBULAR TYPES C004ZZ

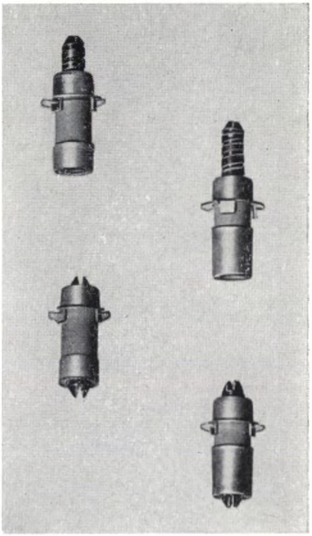


C004ZZ/07



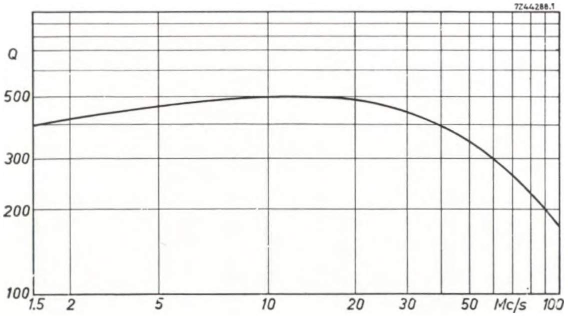
C004ZZ/04





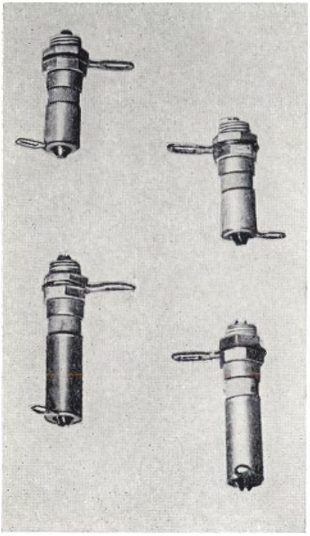
These trimmers are derived from the well known C004CA series. Being intended for very high frequencies, they are particularly suitable for UHF tuners and other electronic circuits operating in the higher frequency ranges.

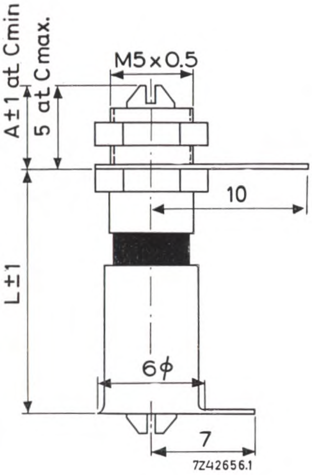
type number	C004ZZ/07 - C004ZZ/04
variable capacitance	min. 3 pF - min. 6 pF
zero capacitance	max. 0.7 pF - max. 0.8 pF
accuracy of adjustment	better than 0.05 pF.
temperature coefficient	—(150 ± 100) × 10^{-6} pF/pF °C.
test voltage	650 V_{dc}
contact resistance	≤ 3 mΩ
insulation resistance	≥ 10 000 MΩ
parallel damping (at 1.5 Mc/s)	≥ 3 MΩ



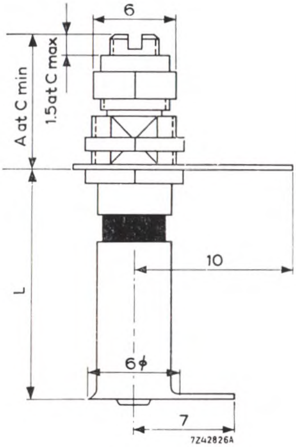
C004 series - CERAMIC TRIMMERS

TUBULAR TYPE C004EA, EB





C004EA



C004EB

These capacitors have been designed for the precision trimming of professional equipment which operate at the higher frequencies.
Their simple form of construction guarantees high reliability and facilitates, moreover, a high breakdown voltage, good stability and high adjustment accuracy.
For many applications the negative temperature coefficient characteristic results in adequate compensation at various temperatures.
The small dimensions contribute to the miniaturization of electronic equipment.

capacitance (pF)		*temp. coeff. pF/pF/°C × 10⁻⁶*	*angle of rotation α° (approx.)*	*max. dimensions (mm)*		*type number*
var. ≥	*min.* ≤			A	L	
3	0.8	−200 ± 200	3 × 360°	13.5	10	C004 EA/3E
6	0.8	−200 ± 200	5 × 360°	16.5	13	6E
9	0.9	−200 ± 200	8 × 360°	19.5	16	9E
12	1.0	−200 ± 200	9 × 360°	22.5	19	12E
18	1.5	−500 ± 200	9 × 360°	22.5	19	18E
3	0.5	−10 ± 60	7 × 360°	23.5	13	C004 EB/3E
4.5	0.6	−10 ± 60	9 × 360°	26.5	16	4E5
6	0.7	−10 ± 60	11 × 360°	29	19	6E
9	0.9	−200 ± 60	9 × 360°	26.5	19	9E
12	1.0	−200 ± 60	11 × 360°	29	19	12E

Band E = connecting wire
G = colour dot

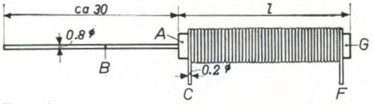


Fig. 1

Band C = connecting wires
F = adjusting wire

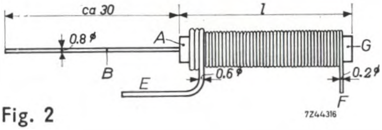
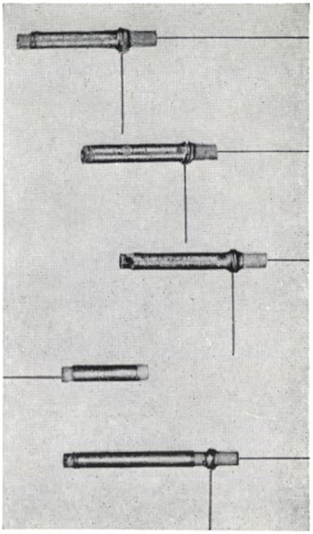


Fig. 2



Wire-wound trimmers have, over many years, proved to be very suitable for the trimming of radio sets and for use as adjustable capacitors in filters (e.g. as a padding capacitor).

Because of the high adjustable capacitance values available, they sometimes can replace the expensive combination of fixed capacitor and rotary trimmer.

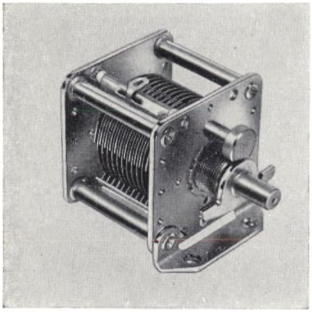
The considerable advantages in price and volume serve to outweigh the one drawback of wire trimmers, namely, that their capacitance value can be decreased but not increased.

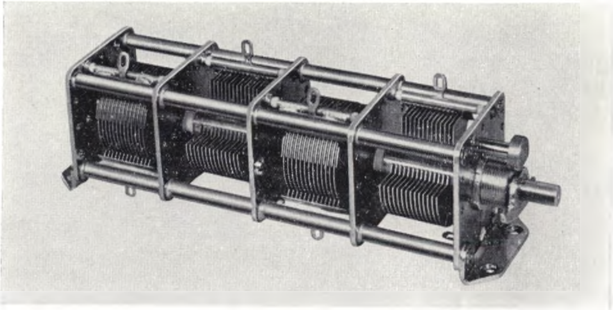
tolerance on capacitance	+40%
maximum voltage	500 V_{dc}
test voltage (1 sec.)	1500 V_{dc}
temp. coefficient of the cap. (per pF, per °C)	
C_{total} = 6 pF	max. +200 × 10^{-6} pF
C_{total} = 12.5–50 pF	0 to 100 × 10^{-6} pF
C_{total} = 100–575 pF	1000 to 1100 × 10^{-6} pF
insulation resistance (at 20 °C)	>10 000 MΩ
dissipation factor (at 1 Mc/s)	
C_{total} = 0–100 pF	$\leq 10.10^{-4}$
C_{total} = 100–575 pF	$\leq 15.10^{-4}$
temperature range	—40/+85 °C

capacitance		*fig.*	*dimensions (mm)*		*colour code*	*type number*
C_{total}	C_{zero}		*diameter*	*l*		
6	max. 1	1	2	16	none	C015 BB/6E
12.5	max. 1.5	1	2	16	black	BB/12E5
25	max. 2	1	2	22	brown	BB/6E
25	max. 10	2	2	22	brown	AB/25E
50	max. 12.5	2	3	25	red	AB/50E
100	max. 25	2	3	25	orange	AB/100E
175	max. 50	2	3	28	yellow	AB/200E
275	max. 60	2	3	28	green	AB/300E
400	max. 70	2	3	34	blue	AB/400E
575	max. 70	2	3	45	white	AB/575E

C001, C002 series - AIR TUNING CAPACITORS

Type C001: **40 × 40 mm**
Type C002: **60 × 60 mm**





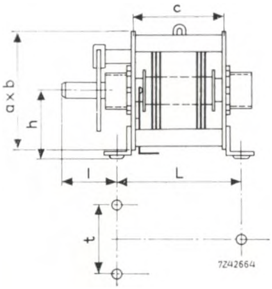
These capacitors are designed for industrial electronic equipment e.g. HF heating devices, radar and measuring equipment, etc.

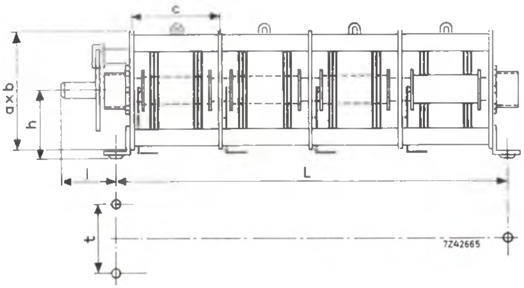
Angle of rotation	0 to 180° (15 to 175° between stops at removable lock) or 0 to 360°; for logarithmic laws 0 to 180° only;
Direction of rotation	clockwise to increase the capacitance; anti-clockwise types available to special order;
Tolerance to law (curve)	$\pm$ 0.7% between 15 and 175°;
Torque	$\leq 200 + (n-1)\ 50$ gcm (n = number of ganged units); 200 to 500 gcm for heavy torque C001 single types (short shaft, with slot for screwdriver);
Frame	brass plates and nickel-plated bars, riveted and soldered together
Shaft	ball bearings on both ends a) none-insulated: one piece brass rod b) insulated: brass and ceramic rods alternately linked;
Shaft end	6 mm diam., for C001 protruding 10 mm, for C002 protruding 14.5 mm; one end or both ends protruding up to 50 mm available to special order;
Rotor	plain brass vanes soldered to the shaft;
Stator	plain brass vanes soldered to rod and these suspended and insulated by means of ceramic pearls dipped in silicon;
Options to special order	a) other than standard capacitance law curves; b) other than standard voltages;
Contact resistance	$<$ 5 mΩ;
D.C. insulation resistance	$>$ 10000 MΩ;
Parallel damping	$>$ 10 mΩ at 1.5 Mc/s, C_{var} = 50 pF or C_{max} whichever is smaller;
Climatic conditions	tropic and arctic proof
Temperature coefficient	in 10^{-6}pF/pF/°C

gangs	1	2	3	4
C001	20 ± 20		30 ± 30	50 ± 50
C002	30 ± 30		50 ± 50	

Dimensions

number of gangs			*1*	*2*	*3*	*4*
distance between mounting holes in mm (± 0.5).	L	C001	45	76.5	108	139.5
		C002	67	117.5	168	218.5
	t	C001	22			
		C002	35			
compartment length in mm (± 0.2)	c	C001	31.5			
		C002	50.5			
shaft length in mm (± 0.5) .	l	C001	16			
		C002	18			
shaft height in mm (± 0.5) .	h	C001	22.5			
		C002	32.5			





Type numbers

	single stator		*split stator*		*differential*[1]	
	non insulated	*insulated*	*non insulated*	*insulated*	*non insulated*	*insulated*
C001 linear law, standard torque	AA	DA	BA	EA	CA	FA
linear law, heavy torque[1].	AE	DE	BE	EE	CE	FE
C002 linear law	AA	DA	BA	EA		
logarithmic law	AC	DC	BC	EC		

[1] Single-gang version only.

Example of a type number: triple version 60 × 60, logarithmic, 160 pF, insulated single stator:
C002 DC/3 × 160E.

C001, C002 series - AIR TUNING CAPACITORS

Type number C001. ./. ., size a × b = 40 × 40 mm, linear capacitance law

single-stator or differential type[1]	C_{var} (pF)	16	25	40	64	100	160	250
	C_o (pF) ± 1 pF[2]	8	8.5	9	9	10	11	11.5
	V_{test} (V_{dc})[3]	2500	2000	1500	1000	1000	800	650
split-stator type	C_{var} (pF)	6.4	10	16	25	40	64	
	C_o (pF) ± 1 pF	3	3	3.6	4	4	4	
	V_{test} (V_{dc})[4]	4000	3000	2000	2000	1600	1300	

Type number C002. ./. ., size a × b = 60 × 60 mm, linear capacitance law

single-stator	C_{var} (pF)	100	125	160	200	250	320	400	500	640
	C_o (pF) ± 1 pF[2]	14.5	15	15.5	16	16	17.5	19	20.5	21.5
	V_{test} (V_{dc})[3]	2000	2000	1500	1250	1250	1000	1000	1000	800
split-stator type	C_{var} (pF)	25	32	40	50	64	80	100	125	
	C_o (pF) ± 1 pF	5	5	5	5	5.5	5.5	5.5	6	
	V_{test} (V_{dc})[4]	4000	3000	3000	2500	2000	2000	2000	1600	

Type number C002. ./. ., size a × b = 60 × 60 mm, logarithmic capacitance law

single-stator	C_{var} (pF)	100	125	160	200	250	320	400	500
	C_o (pF) ± 1 pF[2]	13	13	14.5	14.5	14	14	14	14
	V_{test} (V_{dc})[3]	1500	1250	1000	1000	1000	800	800	650
split-stator type	C_{var} (pF)	25	32	40	50	64	80	100	125
	C_o (pF) ± 1 pF	5	5	5.5	5.5	5.5	5.5	5.5	5.5
	V_{test} (V_{dc})[4]	2500	2500	2000	2000	1600	1600	1600	1300

[1] Differential type only C001 ./. . version up to and including Cvar=160 pF.

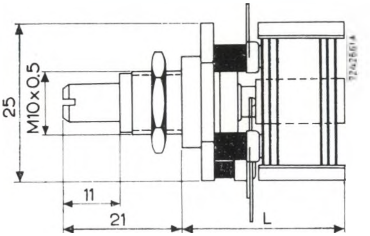
[2] For the differential version the C_0 values are 1 pF less than the tabulated values.

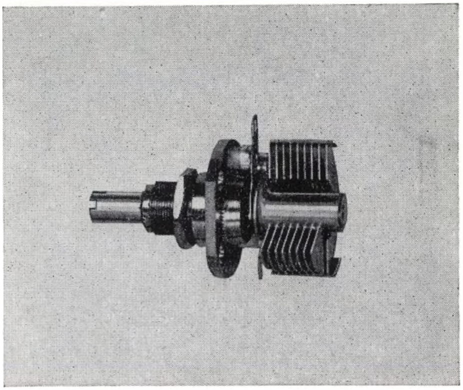
[3] Between rotor and stator

[4] Between the two stators

CORRECTING AIR CAPACITORS - C003 series

Type for industrial application





Base	nickel-plated brass with pressed-in siliconized ceramic stator supports.
Rotor	brass vanes soldered on a shaft, which has a double-track ball-bearing and is slotted for screwdriver operation (0.8 mm width, 1.2 mm depth). Friction springs ensure a stable setting; insulated or non-insulated rotor optional. The 6 mm ø shaft can also be fitted with a control knob.
Stator	brass vanes soldered to brass studs which are fixed to the ceramic stator support of the base.
Mounting	in a 10.5 mm hole in a 4 mm max. thick panel by means of a nut, supplied with each capacitor.
Climatic conditions . . .	tropic and arctic proof.
Available on request types with	a. different operating voltages; b. variations of capacitance; c. different shaft lengths.

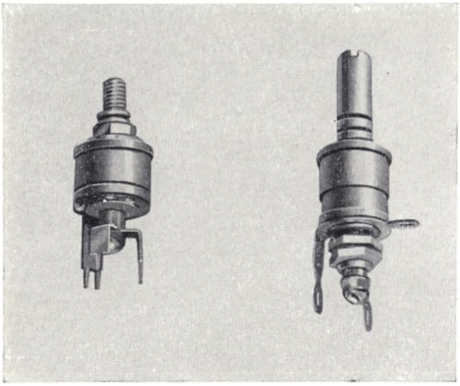
Capacitance range, type numbers and dimensions

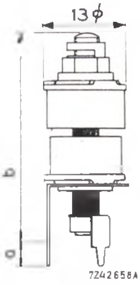
	type no. single-stator type								
non-insulated.	C003AA/ . .								
insulated.	C003DA/ . .								
variation of capacitance . (pF)	2.5	4	6.4	10	16	25	40	64	100
max.zero capacitance . . (pF)	2.5	2.5	3	3	3	4	4	4	4
test voltage[1] . . . . . . (V_{dc})	1500	1500	1500	1000	1000	1000	800	800	650
length L . . . . (mm)	23	23	23	23	23	28	28	28	28

	type no. split-stator type			differential type		
non-insulated.	C003BA/ . .			C003CA/ . .		
insulated	C003EA/ . .			C003FA/ . .		
variation of capacitance . (pF)	1.6	4	10	2.5	10	40
max. zero capacitance . (pF)	1.5	2	2.5	2.5	3	4
test voltage[1] . . . . . . (V_{dc})	2000	2000	1600	1500	1000	800
length L . . . . (mm)	23	28	28	23	23	28

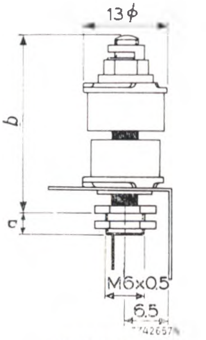
[1] For single-stator and differential types between rotor and stator; for split-stator type between two stators.

C005 series - CONCENTRIC AIR TRIMMERS





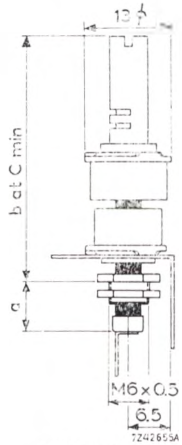
C005BC



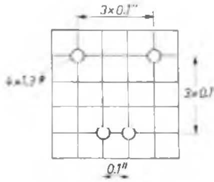
C005BA

version	type number	maximum dimensions (mm) below chassis (a)	maximum dimensions (mm) above chassis (b)
non-insulated	C005 BA/ . .	4 ± 0.2	28
insulated	C005 AA/ . .	9.5 ± 2	28
non-insulated; screwdriver-operated	C005 BB/ . .	9.5 ± 2	41.5
insulated; screwdriver-operated	C005 AB/ . .	9.5 ± 2	41.5
mounting on printed-wiring board	C005 BC/ . .	4 ± 0.2	34
mounting on printed-wiring board; screwdriver-operated	C005 BD/ . .	4 ± 0.2	47.5

Example of indication: 6.4 pF trimmer for printed-wiring mounting: C005 BC/6E4



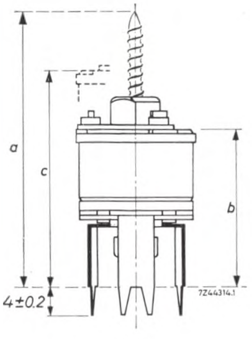
C005AB



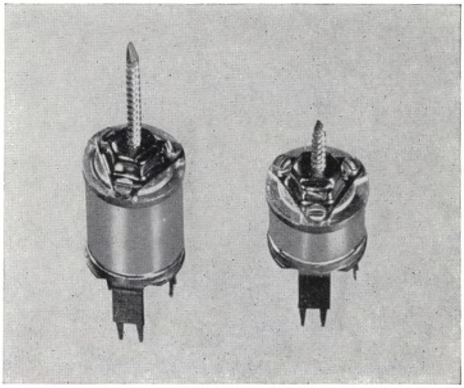
For C005BC and BD

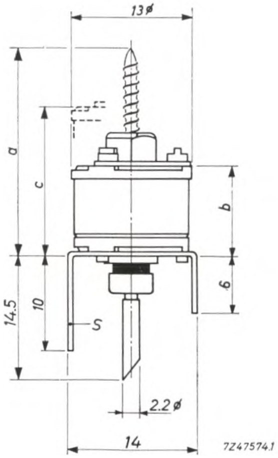
Variation of capacitance (pF)	6.4	10	16	25
Maximum zero capacitance (pF)	4	4	4	4
Test voltage (V_{dc})	1000	650	500	500

Climatic conditions . . . . . tropic and arctic-proof, according to MIL and IEC requirements



CC

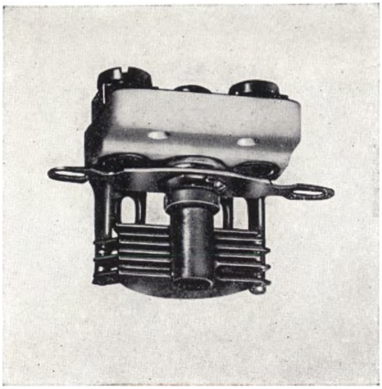




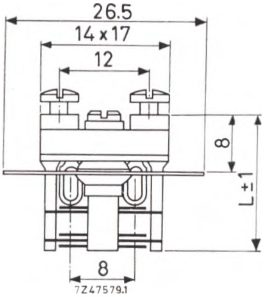
CA/CC versions

type number	C005CA/30E	C005CA/60E	C005CC/30E	C005CC/60E
variable capacitance. .	min. 27 pF	min. 58 pF	min. 27 pF	min. 58 pF
zero capacitance . . .	max. 3 pF	max. 3.5 pF	max. 3 pF	max. 3.5 pF
parallel damping . . .	min. 3 MΩ	min. 3 MΩ	min. 3 MΩ	min. 3 MΩ
dimensions (mm)				
a	25.5	37	32.5	44.5
b	10	16	15	21
c	16	27	22.5	33.5

C012 series - AIR TRIMMER



Type for industrial application.



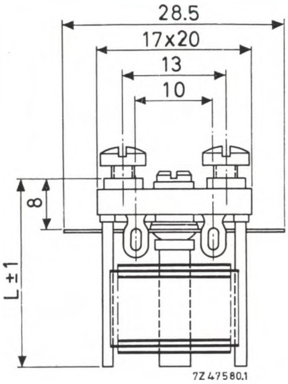
Base	high-quality siliconized ceramic.
Rotor	silver-plated brass vanes, soldered on a shaft which is slotted for screw-driver operation; slide bearing.
Stator	silver-plated brass vanes, supported by bars which are soldered onto the ceramic base.
Mounting.	by two M2.6 screws spaced of 12 mm apart in a 3 mm max. thick panel.
Climatic conditions . . .	tropic and arctic proof.

Capacitance range, type numbers and dimensions

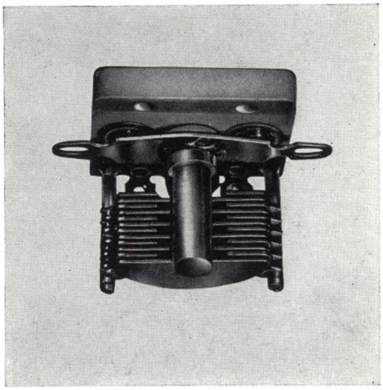
version	*variation of capacitance (pF)*	*max. zero capacitance (pF)*	*test voltage (V_{dc})*	*dimension L (mm)*	*type number without locking device*
single-stator type	2.5	3	1250	17.5	C 012AA/2E5
	4	3	1000	17.5	C 012AA/4E
	6.4	3	800	17.5	C 012AA/6E4
	10	3	800	21	C 012AA/10E
	16	3	800	21	C 012AA/16E
split-stator type[1]	1.6	2	1600	17.5	C 012BA/1E6
	2.5	2	1600	21	C 012BA/2E5
	4	2.5	1600	21	C 012BA/4E
differential type	10	3.5	800	21	C 012CA/10E
	16	3.5	800	21	C 012CA/16E

[1] Measured between the two stators

AIR TRIMMER - C006 series



Not fitted with locking device.



Base	high-quality siliconized ceramic material.
Rotor	silver-plated brass vanes, soldered on a shaft which is slotted for screwdriver operation, with or without a locking device; slide bearing.
Stator	silver-plated brass vanes, supported by sturdy bars, which are soldered onto the ceramic base.
Mounting.	by two M3 screws spaced of 13 mm apart in a 3 mm max. thick panel
Climatic conditions . . .	tropic and arctic proof.

Capacitance range, type numbers and dimensions. Preferred types in bold print

version	*variation of capacitance (pF)*	*max. zero capacitance (pF)*	*test voltage (V_{dc})*	*dimension L (mm)*	*type number*	
					without locking device	*with locking device*
single-stator type	6.4	3	1000	16	**C006AG/6E4**	**C006AH/6E4**
	10	3	800	16	**C006AG/10E**	**C006AH/10E**
	16	3.5	800	19.5	**C006AG/16E**	**C006AH/16E**
	25	3.5	800	19.5	**C006AG/25E**	**C006AH/25E**
	40	4	650	19.5	**C006AG/40E**	**C006AH/40E**
split-stator type [1]	2.5	2	1600	16	**C006BG/2E5**	**C006BH/2E5**
	4	2.5	1600	19.5	**C006BG/4E**	**C006BH/4E**
	6.4	2.5	1600	19.5	**C006BG/6E4**	**C006BH/6E4**
differential type	6.4	3	1000	16	C006CG/6E4	C006CH/6E4
	10	3	800	16	C006CG/10E	C006CH/10E
	16	3.5	800	19.5	C006CG/16E	C006CH/16E
	25	3.5	800	19.5	C006CG/25E	C006CH/25E

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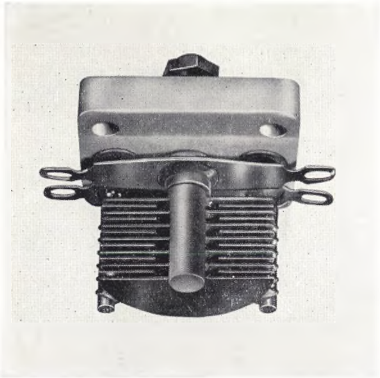
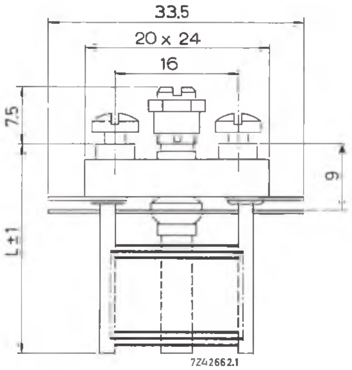
[1] Measured between the two stators.

C009 series - AIR TRIMMER





Not fitted with locking device.

Base	high-quality siliconized ceramic material.
Rotor	silver-plated brass vanes, soldered on a shaft which is slotted for screwdriver operation, with or without a locking device; slide bearing.
Stator	silver-plated brass vanes, supported by sturdy bars, which are soldered onto the ceramic base.
Mounting.	by two M3 screws spaced of 16 mm apart in a max. thick 3 mm panel.
Climatic conditions . . .	tropic and arctic proof.

Capacitance range, type numbers and dimensions. Preferred types in bold print

version	*variation of capacitance (pF)*	*maximum zero capacitance (pF)*	*test voltage (V_{dc})*	*dimension L (mm)*	*type number*	
					without locking device	*with locking device*
single-stator type	10	3.5	1500	23	C009AF/10E	**C009AG/10E**
	16	3.5	1000	23	C009AF/16E	**C009AG/16E**
	25	4	1000	23	C009AF/25E	**C009AG/25E**
	40	4.5	1000	26.5	C009AF/40E	**C009AG/40E**
	64	5	800	26.5	C009AF/64E	**C009AG/64E**
	100	5.5	800	36.5	C009AF/100E	**C009AG/100E**
split-stator type[1]	2.5	2	2500	23	C009BF/2E5	**C009BG/2E5**
	4	2	2500	26.5	C009BF/4E	**C009BG/4E**
	6.4	2	2000	26.5	C009BF/6E4	**C009BG/6E4**
	10	2.5	1600	26.5	C009BF/10E	**C009BG/10E**
	16	3	1600	36.5	C009BF/16E	**C009BG/16E**
	25	3	1600	36.5	C009BF/25E	**C009BG/25E**

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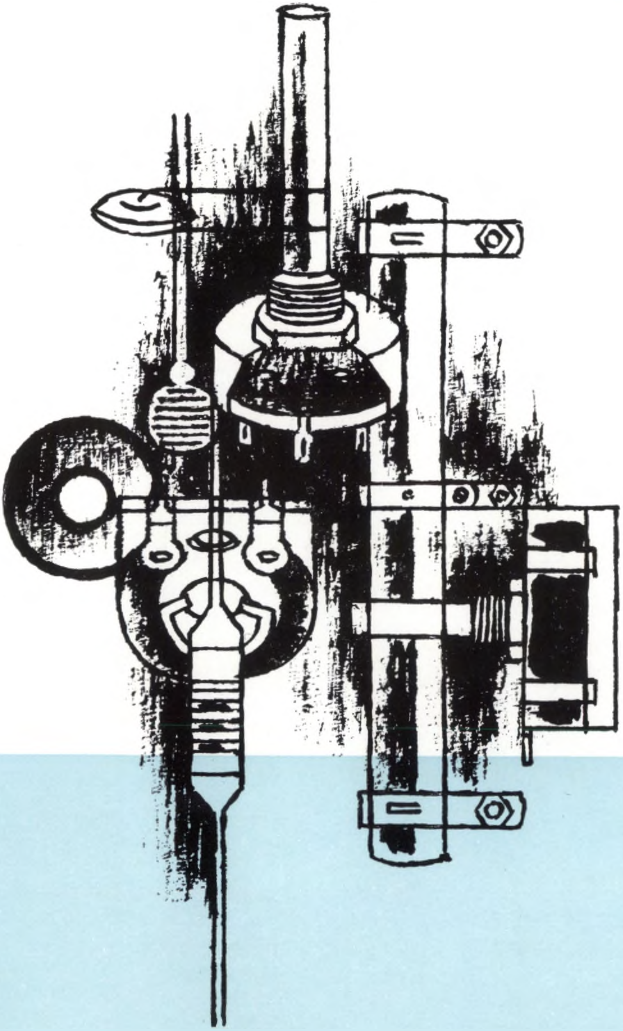
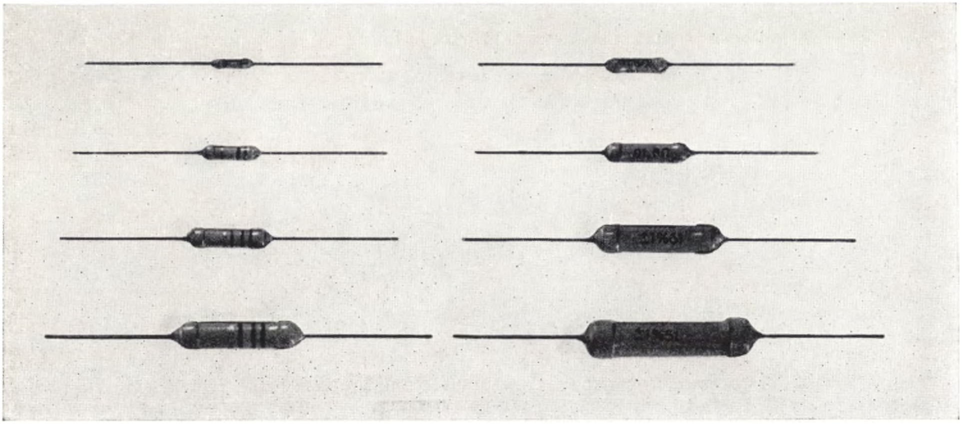
[1] Measured between the two stators.

CARBON
WIRE-WOUND
LIGHT-DEPENDENT
NEG.-TEMP.-COEFFICIENT
VOLTAGE-DEPENDENT
POS.-TEMP.-COEFFICIENT



Linear and non-linear resistors

CONTENTS



At the left, insulated carbon resistors; at the right high-stability types. From top to bottom 0,125W, 0,25W, 0,5W, and 1W types.

Resistors of the cracked-carbon film construction have superior figures for stability of resistance, noise level and temperature coefficient as compared with resistors of carbon-composition construction.

Two classes of carbon resistors are available:

1. **insulated types,** resistance tolerance 5%, 10%
   power rating at 70 °C: 0,1W, 0,125W, 0,25W, 0,5W, 1W, 2W
2. **high stability types,** resistance tolerance 1%
   power rating at 70 °C: 0,125W, 0,25W, 0,5W, 1W

resistance range	*tolerance* (%)	*power rating at 70 °C* (W)	*type number*
insulated types			
10 Ω – 10 MΩ	± 5, ± 10	0.10	B8 305 00
1 Ω – 220 kΩ	± 5, ± 10	0.125	B8031 04N
3.3 Ω – 10 MΩ	± 5, ± 10	0.25	B8031 05
10 Ω – 22 MΩ	± 5, ± 10	0.50	B8031 06
10 Ω – 22 MΩ	± 5, ± 10	1	B80 31 07
10 Ω – 10 MΩ	± 5, ± 10	2	B8 305 08
high-stability types			
10 Ω –0.62 MΩ	± 1	0.125	E00 3A B
10 Ω – 1 MΩ	± 1	0.25	E00 3AC
10 Ω – 1.6 MΩ	± 1	0.50	E00 3AD
10 Ω – 1.6 MΩ	± 1	1	E00 3AG

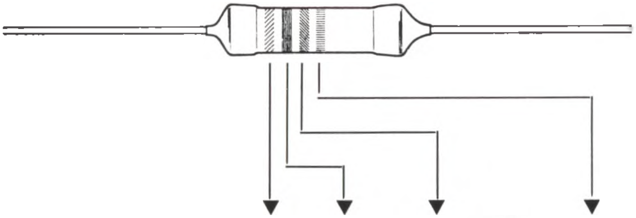
Resistance ranges

E12 range; tolerance ± 10% (multiplicand 0.1, 10, 100, etc.)

	R_{nom} (Ω)	10	12	15	18	22	27	33	39	47	56	68	82
code	(× 1)	10E	12E	15E	18E	22E	27E	33E	39E	47E	56E	68E	82E
	(× 10)	100E	120E	150E	180E	220E	270E	330E	390E	470E	560E	680E	820E
	(× 100)	1K	1K2	1K5	1K8	2K2	2K7	3K3	3K9	4K7	5K6	6K8	8K2
	(× 1 000)	10K	12K	15K	18K	22K	27K	33K	39K	47K	56K	68K	82K
	(× 10 000)	100K	120K	150K	180K	220K	270K	330K	390K	470K	560K	680K	820K
	(× 100 000)	1M	1M2	1M5	1M8	2M2	2M7	3M3	3M9	4M7	5M6	6M8	8M2

E24 range; tolerance ±5% (multiplicand 0.1, 10, 100, etc.)

	R_{nom} (Ω)	10	11	12	13	15	16	18	20	22	24	27	30
code	(× 1)	10E	11E	12E	13E	15E	16E	18E	20E	22E	24E	27E	30E
	(× 10)	100E	etc.										
	R_{nom} (Ω)	33	36	39	43	47	51	56	62	68	75	82	91
code	(× 1)	33E	36E	39E	43E	47E	51E	56E	62E	68E	75E	82E	91E
	(× 10)	330E etc. see E12 range											



Colour code
(insulated types only)

	tens	units	multiplicand	resistance tolerance
black . . .	0	0		silver ±10%
brown . . .	1	1	10	gold ±5%
red	2	2	100	
orange . . .	3	3	1,000	
yellow . . .	4	4	10,000	
green . . .	5	5	100,000	
blue . . .	6	6	1,000,000	
violet . . .	7	7		
grey . . .	8	8		
white . . .	9	9		

Insulation resistance: this is measured at 500 ± 50 V_{dc} for 1 min ± 5 sec, in accordance with section 2.4.2. of the IEC Publication No. 109.

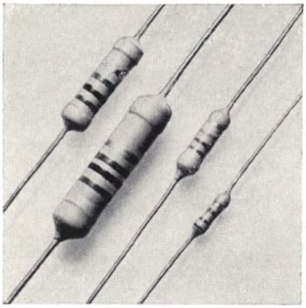
Stability test: a direct voltage is applied in cycles of 90 min. on and 30 min. off, at an ambient temperature of 70 ± 2 °C, throughout an endurance test of 42 days. The voltage applied is the maximum permissible voltage.

Damp-heat test (long-term exposure): the resistors are subjected to the test-C procedure of the IEC Publication No. 68. Insulated types for 21 days, high-stability types for 56 days.

Guarantees: $\Delta R = 1\%$ for R_{nom} = max. 100 kΩ; $\Delta R = 2\%$ for R_{nom} = between 100 kΩ and 1 MΩ; $\Delta R = 3\%$ for R_{nom} = beyond 1 MΩ.

B8 305, series - CARBON RESISTORS

INSULATED TYPES 0.1W, 0.125W, 0.25W, 0.5W, 1W, 2W



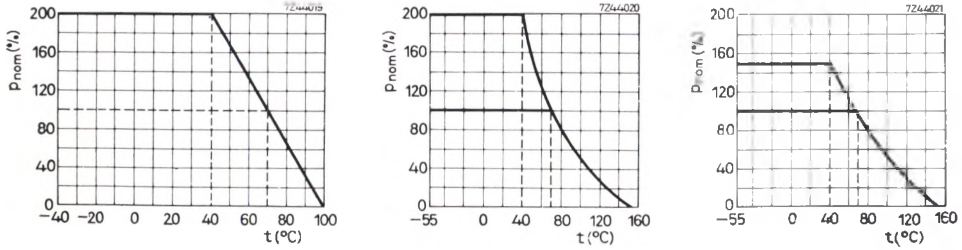
Noise at resistance values
3.3 Ω – 1 MΩ: ≤ 2μV/V
1 MΩ – 10 MΩ: < 3μV/V
10 MΩ – 22 MΩ: < 5μV/V

resistance range[1]	maximum dissipation at:		maximum continuous operating voltage (V) (d.c. or a.c.)	dimensions (mm)			tolerance	type number
	70°C[2] (W)	40°C[2] (W)		D_{max} ø	L_{max}	d ø	(%)	
10 Ω – 120 kΩ	0.1	0.2	100	1.6	7	0.4	± 5	B8 305 00B/...
10 Ω – 10 MΩ							± 10	B8 305 00A/...
3.3 Ω – 220 kΩ	0.125	0.25	250	2.5	9	0.6	± 5	B8 031 04NB/ .
1 Ω – 2.7 kΩ							± 10	B8 031 04NA/ .
10 Ω – 1 MΩ	0.25	0.5	350	3.7	13	0.7	± 5	B8 031 05B/...
3.3 Ω – 10 MΩ							± 10	B8 031 05A/...
10 Ω – 1.5 MΩ	0.5	1.0	500	5.2	20	0.8	± 5	B8 031 06B/...
10 Ω – 22 MΩ							± 10	B8 031 06A/...
10 Ω – 2.2 MΩ	1	1.5	750	6.8	28	1.0	± 5	B8 031 07B/...
10 Ω – 22 MΩ							± 10	B8 031 07A/...
10 Ω – 10 MΩ	2	3	1000	9.3	39	1.0	± 5	B8 305 08B/...
10 Ω – 10 MΩ							± 10	B8 305 08A/...

Values: tolerance ± 5% E 24 series; tolerance ± 10% E 12 series; [2] ambient temperature.

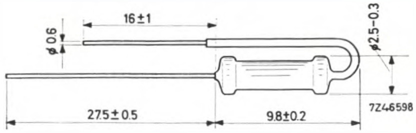
general data		dissipation					
		0.1W	0.125W	0.25W	0.5W	1W	2W
critical resistance	(Ω)	100	—	490	500	560	500
insulation resistance	(×1000 MΩ)	50	50	1000	1000	1000	20
stability after 2000 hours	(ΔR at P_{nom}) (%)	1	3	4	4	6	6
maximum rise in surface temperature at P_{nom}	(°C)	30	30	30	55	70	85

Derating curves (power rating as a function of ambient temperature)


0.1W
0.125/0.25/0.5W
1 and 2W

CARBON RESISTORS - B8 405 series

STAND-UP TYPE 0.125W



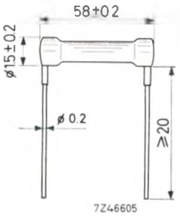
The properties are the same as for type B8 031 04NB/...

resistance range[1]	max. dissipation at		maximum continuous operating voltage (d.c. or a.c.) (*V*)	*tolerance* %	*type number*
	70 °C[2] (W)	40 °C[2] (W)			
3.3Ω–220kΩ	0.125	0.25	250	± 5%	B8 405 04B/...

[1] Values E 24-series; [2] ambient temperature.

CARBON RESISTORS - B8 306 31 series

WITH TANGENTIAL LEADS - 0.1W



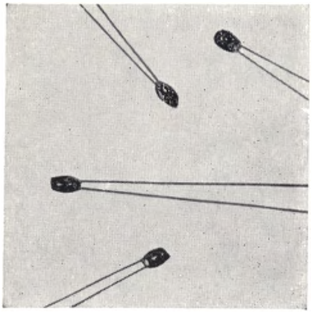
The properties are the same as for type B8 305 00A/... (see preceding page)

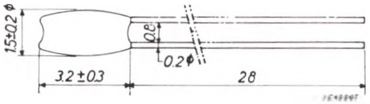
resistance range[1]	max. dissipation at		maximum continuous operating voltage (d.c. or a.c.) (*V*)	*tolerance* (%)	*type number*
	70 °C[2] (W)	40 °C[2] (W)			
10 Ω – 10M Ω	0.1	0.2	100	10	B8 306 31A/...

[1] Values E24-series; [2] ambient temperature.

E011 series - CARBON RESISTORS

INSULATED PIN-HEAD TYPES 0.05 W





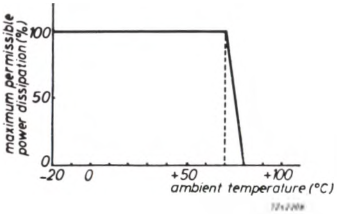
Noise: $< 10\ \mu V/V$

This resistor is as small as a pin's head; it consists of a pellet of carbon composition which ensures a high reliability; its stability, however, is less favourable than that of our cracked-carbon standard resistors; main application in miniature apparatus, such as hearing aids, small-distance calling sets, weather radio-probes, etc.

resistance range[1]	*maximum dissipation at 70 °C*[2] *(W)*	*max. continuous operating voltage (d.c. or a.c.) (V)*	*tolerance* %	*type number*
47Ω–120 kΩ	0.05	50	±20	E 011 AB/P

Values E12 series; [2] ambient temperature.

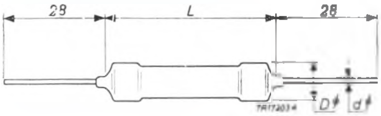
Derating curve

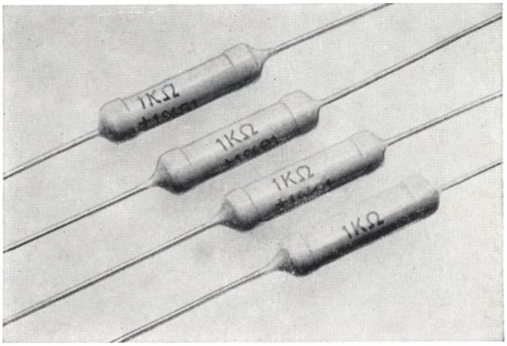


Resistance variation after 1000 hours: $\Delta R < 10\%$
After moisture test I.E.C., publication 68, test C (21 days exposure to damp heat at 40 °C and a relative humidity of 90–95% without drying) $\Delta R < 10\%$

CARBON RESISTORS - E003 series

HIGH STABILITY TYPES — 0.125W, 0.25W, 0.5W, 1W



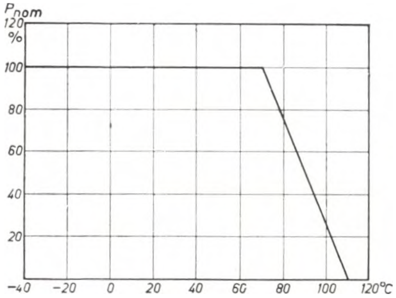


Noise max. 0.5 μV/V;
at resistance values
beyond 150 kΩ for E003AB–E003AC:
max. 1 μV/V
beyond 470 kΩ for E003AD–E003AG;
max. 1 μV/V

resistance range[1]	*maximum dissipation at 70 °C*[2] *(W)*	*maximum continuous operating voltage d.c. or a.c. (V)*	*dimensions (mm)*			*tolerance (%)*	*type number*
			D_{max} Ø	L_{max}	d Ø		
10 Ω – 620 kΩ	0.125	350	3.9	13	0.7	± 1	E003AB/D...
10 Ω – 1 MΩ	0.25	500	5.2	20	0.8	± 1	E003AC/D...
10 Ω – 1.6 MΩ	0.5	750	6.8	28	1.0	± 1	E003AD/D...
10 Ω – 1.6 MΩ	1.0	1000	9.3	39	1.0	± 1	E003AG/D...

[1] Values E24 series; [2] ambient temperature

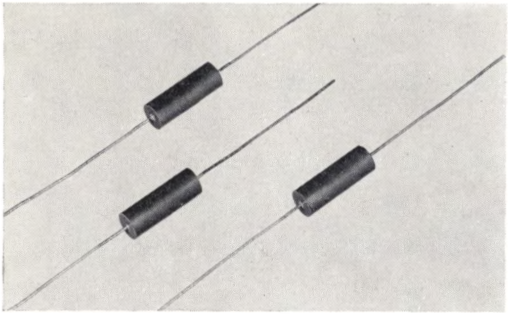
Derating curve (power rating as a function of ambient temperature)

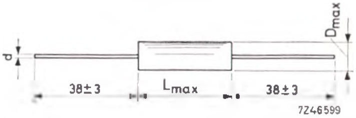


general data	*dissipation*			
	0.125W	*0.25W*	*0.5W*	*1W*
insulation resistance (× 100 MΩ) . . .	1000	1000	1000	20
stability (after 1000 hours) ΔR at P_{nom} = max. 91 kΩ . (%)	0.5	0.5	1	1
ΔR at P_{nom} min. 100 kΩ . . . . (%)	1	1.5	1.5	2
maximum rise in surface temperature at P_{nom} . . . . (°C)	15	30	35	40

MOULDED METAL-FILM RESISTORS

CONFORM MIL-R-10509E - RN60 - RN65 - RN70

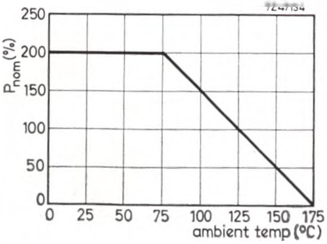




Noise: less than 0.5 μV/V
Stability: after 1000 hours of loading at P_{nom} at an ambient temperature of 125 °C, the resistance variation is max. ± 0.5%

resistance range	*maximum dissipation at:*		*dimensions (mm)*			*tol.*	*type number*
	125 °C (W)	*75 °C* (W)	D_{max} (Ø)	L_{max}	*d* (Ø)	(%)	
49.9Ω – 499kΩ	0.125	0.25	3.9	11.15	0.6	1	RN60E/. . . F
49.9Ω – 499kΩ	0.125	0.25	3.9	11.15	0.6	0.5	RN60E/. . . D
49.9Ω – 499kΩ	0.125	0.25	3.9	11.15	0.6	0.25	RN60E/. . . C
49.9Ω – 499kΩ	0.125	0.25	3.9	11.15	0.6	0.1	RN60E/. . . B
49.9Ω – 1MΩ	0.25	0.5	5.8	16.7	0.6	1	RN65E/. . . F
49.9Ω – 1MΩ	0.25	0.5	5.8	16.7	0.6	0.5	RN65E/. . . D
49.9Ω – 1MΩ	0.25	0.5	5.8	16.7	0.6	0.25	RN65E/. . . C
49.9Ω – 1MΩ	0.25	0.5	5.8	16.7	0.6	0.1	RN65E/. . . B
24.9Ω – 1MΩ	0.5	1	8.1	20.6	0.8	1	RN70E/. . . F
24.9Ω – 1MΩ	0.5	1	8.1	20.6	0.8	0.5	RN70E/. . . D
24.9Ω – 1MΩ	0.5	1	8.1	20.6	0.8	0.25	RN70E/. . . C
24.9Ω – 1MΩ	0.5	1	8.1	20.6	0.8	0.1	RN70E/. . . B

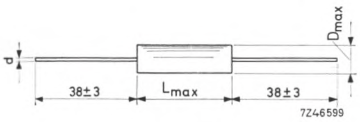
Derating curve

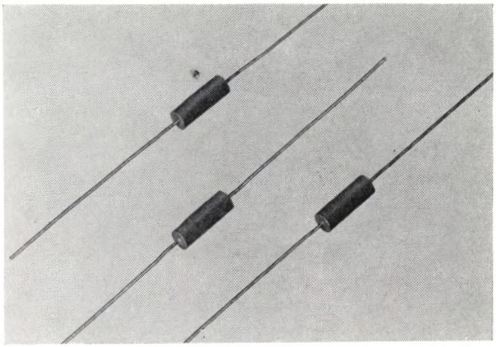


All RN. .E resistors have a temperature coefficient of ± 25 ppm. They are also available with a temperature coefficient of ± 50 ppm (RN. .C/. . .) and with a temperature coefficient of ± 100 ppm (RN. .A/. . .).
The RN. .A series with a temperature coefficient of 100 ppm are only available in tolerances of 1% (F) or 0.5% (D).

WIRE-WOUND RESISTORS - E114EB series

CHARACTERISTICS CONFORM MIL-R-10509E-RN60





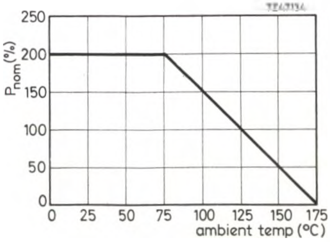
Noise level less than 0.1 µV/V

Properties and dimensions are identical to those of the metal-film resistors RN60E/. . . .
These resistors have been developed to be used as a complement to the metal-film series as regards the low-ohmic values.

resistance range	maximum dissipation at:		dimensions (mm)			tol.	type number
	125 °C (W)	75 °C (W)	D_{max} Ø	L_{max}	d Ø	(%)	
1Ω – 50Ω	0.125	0.25	3.9	11.15	0.6	1	E114EB/F. . .
1Ω – 50Ω	0.125	0.25	3.9	11.15	0.6	0.5	E114EB/D. . .
10Ω – 50Ω	0.125	0.25	3.9	11.15	0.6	0.25	E114EB/C. . .
50Ω – 50Ω	0.125	0.25	3.9	11.15	0.6	0.1	E114EB/B. . .

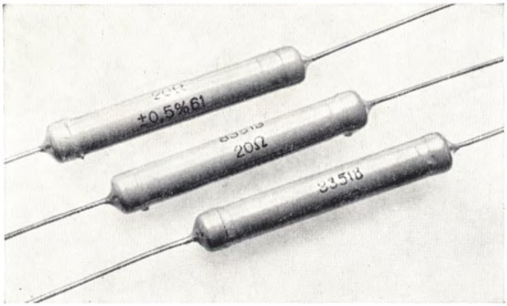
[1] E24 range [2] E96 range [3] E192 range

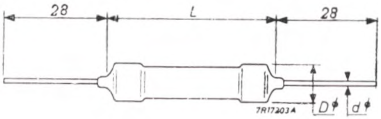
Derating curve



8351 series - WIRE-WOUND RESISTORS

PRECISION TYPES - 0.4W, 0.6W, 0.7W, 1.2W, 1.8W





These small low-power resistors are eminently suitable for applications requiring dependable, accurate and highly stable resistances, as e.g. in telecommunication installations, measuring apparatus and other professional equipment. They are particularly suited for use in low-frequency filters. Owing to their lightness, the resistors can be mounted in the wiring of the apparatus. The resistors are tropic proof, and are coated by a red lacquer.

resistance range[1]	*maximum dissipation at 40 °C*[2] *(W)*	*maximum dimensions (mm)*			*tolerance (%)*	*type number*
		L	*D*	*d*		
1Ω–3200Ω	0.4	13	4	0.8	± 0.25 ± 0.5	83510./. . .
3Ω–6800Ω	0.6	19	5	0.8		83511./. . .
2.2Ω–12000Ω	0.7	28	5	0.8		83512./. . .
18Ω–33000Ω	1.2	43	7	1		83513./. . .
27Ω–56000Ω	1.8	67	7	1		83514./. . .

[1] E24 series; [2] ambient temperature

dissipation (W)	*temperature coefficient*	
	$-25 \times 10^{-6}/°C$	$+25 \times 10^{-6}/°C$
0.4	1–250	251–3200
0.6	3–670	671–7000
0.7	6–1340	1350–12500
1.2	17–3650	3660–33000
1.8	25–6300	6310–57000

Composition of the type number

83510./. . .

tolerance ◀ ▶ resistance value

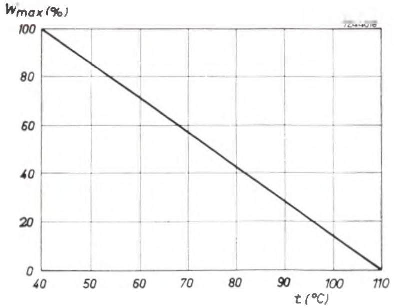
F = ± 0.25%
E = ± 0.5 %

Stability.

After 1000 hours of continuous loading at W_{max} at an ambient temperature of 40 °C, the resistance variation is max. ± 0.25%, even under adverse climatic conditions.

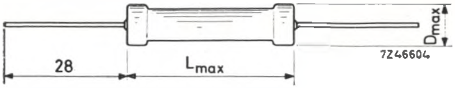
Minimum permissible temperature −55 °C

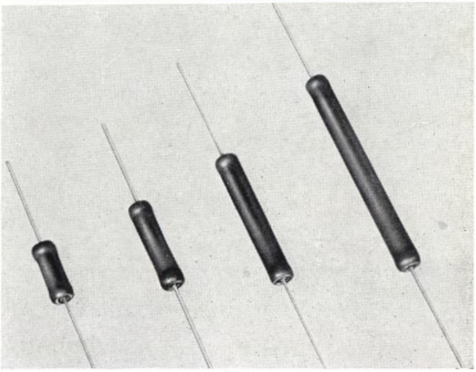
Derating curve (power rating as a function of ambient temperature)



WIRE-WOUND RESISTORS - 8354 series

BROWN ENAMELLED TYPES - 5.5W, 8W, 10W, 16W

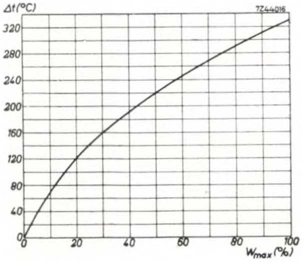


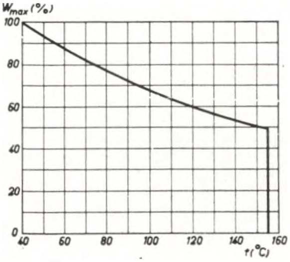


These light-weight, brown enamelled, wire-wound resistors have been designed with the main object of obtaining maximum reliability and great mechanical strength. As a consequence of their small dimensions, these resistors can be mounted in the wiring of the apparatus. The resistors are tropic proof.

resistance range[1]	maximum dissipation[2] at 40°C (W)	maximum permissible voltage (V)	maximum dimensions (mm)		tolerance (%)	type number
			diam.	max		
4.7 Ω – 180 Ω	5.5	400	8	19	± 10	83540A/...
200 Ω – 15 kΩ	5.5	400	8	19	± 5	83540B/...
4.7 Ω – 47 Ω	8	725	8	28	± 10	83541A/...
51 Ω – 33 kΩ	8	725	8	28	± 5	83541B/...
10 Ω – 56 kΩ	10	1050	8	42	± 10	83542B/...
15 Ω – 100 kΩ	16	1800	8	65	± 5	83543B/...

[1] Tolerance ± 5%: E24 series; [2] tolerance ± 10%: E12 series; ambient temperature





Permissible load

For resistors mounted horizontally in a free space without draught and with a temperature of 40 °C, the temperature rise is max. 330 °C when being loaded at W_{max}.

Permissible temporary overloads:
2 W_{max} for 15 minutes;
10 W_{max} for 10 seconds.

Minimum permissible temperature: —55 °C

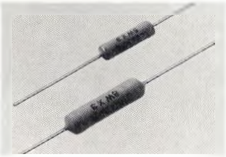
Temperature coefficient: —50 to +140 × 10^{-6} Ω per ohm and per °C. This amounts to a change of the resistance between —0.5 and +1.4% per 100 °C temperature rise

Derating curve: see figure.

The resistors can be mounted with the aid of mounting brackets or be connected to the wiring.

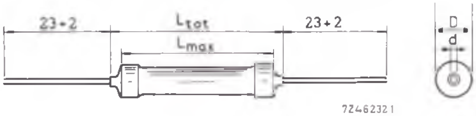
E112 series - WIRE-WOUND RESISTORS

GREEN CEMENTED TYPE 5W - 8W

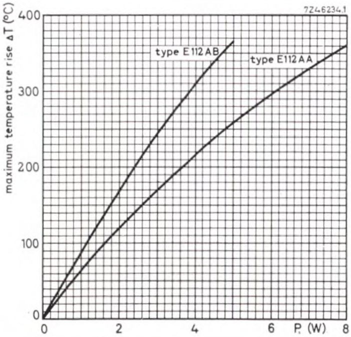


Because of their small dimensions these load resistors are very suitable to be included in the wiring of electric and electronic apparatus, e.g. in T.V. sets.

The cement protection is non-inflammable.

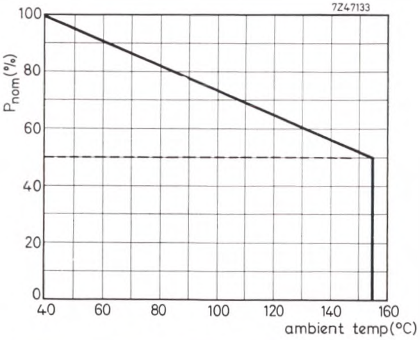


resistance range	maximum dissipation at 40 °C (W)	maximum dimensions (mm)				tol. %	type number
		D_{max} ∅	L_{tot}	L_{max}	d ∅		
6.8Ω – 27 Ω	8	7	30	25	1	10	E112AA/A . . .
30 Ω – 10 kΩ	8	7	30	25	1	5	E112AA/B . . .
5.6Ω – 47 Ω	5	5	22	17	0.8	10	E112AB/A . . .
56 Ω – 4.7kΩ	5	5	22	17	0.8	5	E112AB/B . . .



△ T – curve

Derating curve



WIRE-WOUND RESISTORS
E108AA-series (tentative)

LOW-OHMIC, GLASS SEALED - 1W

(see also page E15)

These resistors have been specially developed for application in transistorized circuits with very low resistance values.

resistance range	maximum dissipation at 40 °C (W)	dimensions (mm)		tolerance %	type number
		D_{max}	L_{max}		
0.1Ω – 6.8Ω	1	2.25	24	10	E108AA/ . . .

For derating curve and △ t-curve see next page.

GENERAL SURVEY

Survey of adjustable and non-adjustable types

These green enamelled wire-wound resistors have been designed to obtain maximum reliability and great mechanical strength. They are made of top-grade materials and are subjected to severe tests. The resistors are tropic-proof; they are available in adjustable and non-adjustable versions, both with soldering taps or with screws on the side terminals. Climatic group number 55/155/56 according to IEC68.

Permissible voltage between resistor and metal mounting plate

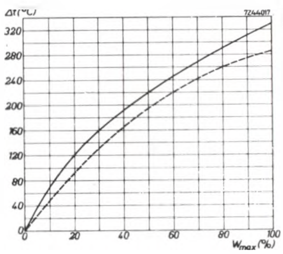
Adjustable (with movable connecting strap)	
10W–40W	1400 V for B8 300 42 to B8 300 45
60W–250W	1800 V for B8 300 46 and B8 300 47
Non-adjustable	
8W–40W	1100 V for B8 300 31 1400 V for B8 300 32 to B8 300 35
60W–250W	1800 V for B8 300 36 and B8 300 37 2000 V for B8 300 38 and B8 300 39

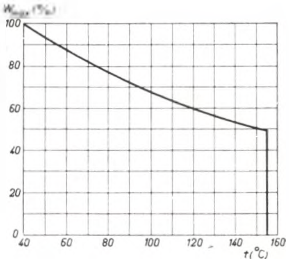
Max. dissipation (see following pages)
Permissible temporary overloads: $2W_{max}$ for 15 minutes, $10W_{max}$ for 5 seconds.
Minimum permissible temperature: –55 °C (maximum dissipation at 40 °C ambient temperature)
For resistors mounted horizontally in a free space without draught and with a temperature of 40 °C, the temperature rise is max. 330 °C when being loaded at W_{max}. For higher ambient temperature, see figure.

Temperature coefficient –50 to +140 × 10^{-6} Ω per ohm and per °C. This amounts to a change of the resistance between — 0.5% and + 1.4% per 100 °C temperature rise.

Mounting.
The resistors should preferably be mounted by means of a rod passed through the tube. Suspension to the terminals is permissible for 8W types only.

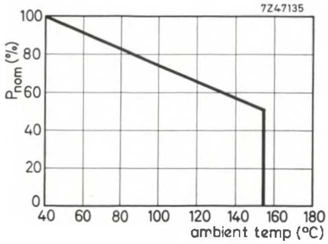
Derating curve: see figure





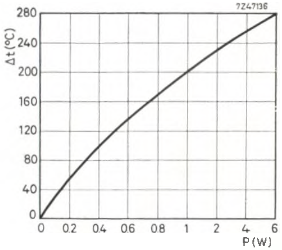
(see also page E14)

WIRE-WOUND RESISTORS - E 108AA series



Derating curve

△t-curve

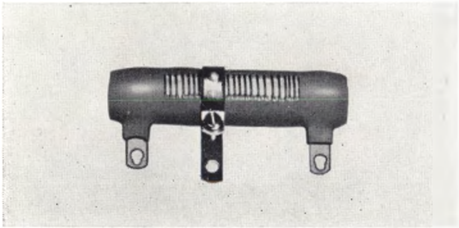


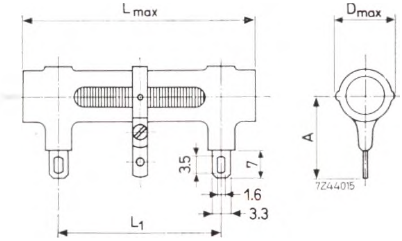
B8 300 series - WIRE-WOUND RESISTORS

ADJUSTABLE TYPES

Maximum dissipation is only permissible if the full length of the resistance wire is used. If only part of it is used, the permissible load is a proportionate part of W_{max}. For example, an adjustable resistor of 120Ω, 100W, of which only 90Ω is used, may be loaded up to 90/120 × 100 = 75W.

10W, 16W, 25W, 40W - enamelled





The resistors are provided with soldering tags and an adjustable connecting strap.

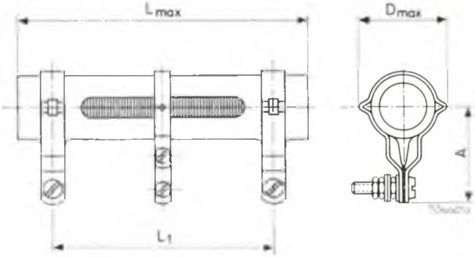
resistance range[1]	maximum dissipation[2] at 40 °C (W)	dimensions (mm)				tolerance (%)	type number
		L_{max}	L_1	D_{max}	A		
1.2Ω – 27Ω	10	42	29	11.5	17	± 10	B830042A/..
30Ω – 3300Ω						± 5	B830042B/...
1.5Ω – 2.7Ω	16	65	52	11.5	17	± 10	B830043A/...
3Ω – 6800Ω						± 5	B830043B/...
2.7Ω – 15Ω	25	65	52	16	18.5	± 10	B830044A/...
16Ω – 9100Ω						± 5	B830044B/...
4.7Ω – 18000Ω	40	103	89	16	19	± 5	B830045B/...

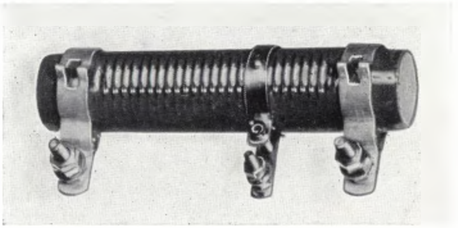
[1] Resistance values: tolerance ± 5%: E24 series; tolerance ± 10%: E12 series; [2] ambient temperature

WIRE-WOUND RESISTORS - B8 300, B8 302 series

ADJUSTABLE TYPES

60W, 100W, 160W, 250W - enamelled



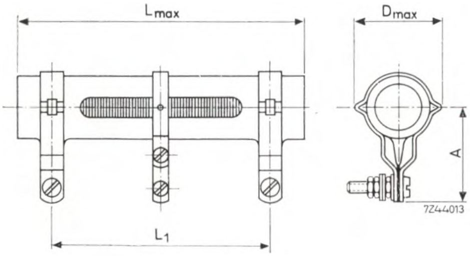


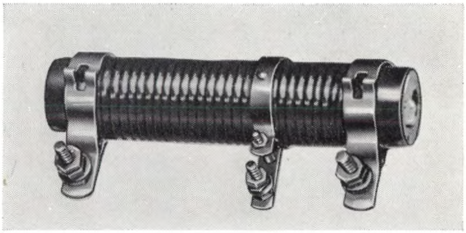
The resistors are provided with screws on side terminals and an adjustable connecting strap
For low-ohmic resistance values see B8 302 4.series

resistance range[1]	maximum dissipation[2] at 40°C (W)	dimensions (mm)				tolerance (%)	type number
		L_{max}	L_1	D_{max}	A		
2.4kΩ–24 kΩ	60	103	78	32	30	± 5	B8 300 46B/...
4.7kΩ–47 kΩ	100	165	138	32	30	± 5	B8 300 47B/...
7.5kΩ–75 kΩ	160	165	132	44	37	± 5	B8 300 48B/...
12 kΩ–130kΩ	250	256	222	44	37	± 5	B8 300 49B/...

[1] Resistance values: E24 series; [2] ambient temperature

60W, 100W, 160W, 250W-cemented





Properties of these resistors are similar to those of the enamelled types B8 300 4.B/...

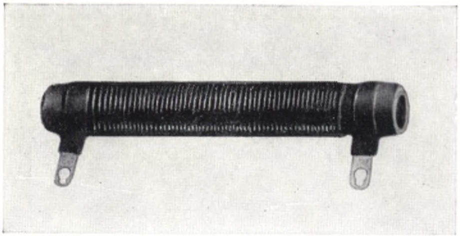
resistance range[1]	maximum dissipation[2] at 40 °C (W)	dimensions (mm)				tolerance (%)	type number
		L_{max}	L_1	D_{max}	A		
3 Ω– 2.2kΩ	60	103	78	32	30	± 5	B8 302 46B/...
6.8Ω– 4.3kΩ	100	165	138	32	30	± 5	B8 302 47B/...
10 Ω– 6.8kΩ	160	165	132	44	37	± 5	B8 302 48B/...
16 Ω– 11 kΩ	250	256	222	44	37	± 5	B8 302 49B/...

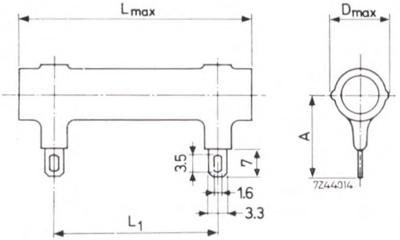
[1] Resistance values: E24 series; [2] ambient temperature.

B8 300 series - WIRE-WOUND RESISTORS

NON ADJUSTABLE TYPES

8W, 10W, 16W, 25W, 40W-enamelled





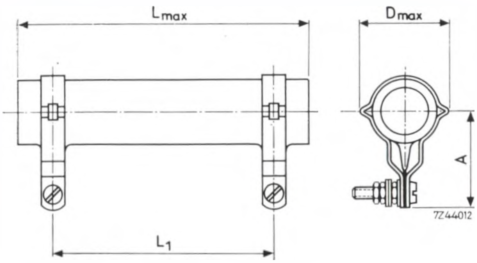
The resistors are provided with soldering tags on the side terminals.

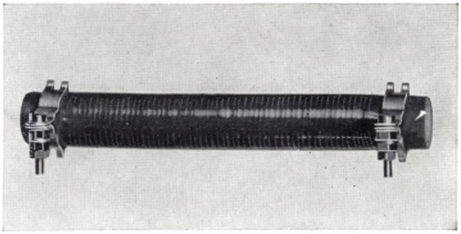
resistance range[1]	*maximum dissipation*[2] *at 40 °C (W)*	*dimensions (mm)*				*tolerance (%)*	*type number*
		L_{max}	L_1	D_{max}	A		
1Ω – 100Ω	8	26	17	11.5	16.5	± 10	B830031A/...
110Ω – 6800Ω						± 5	B830031B/...
1.2Ω – 27Ω	10	42	29	11.5	17	± 10	B830032A/...
30Ω – 15000Ω						± 5	B830032B/...
1.5Ω – 2.7Ω	16	63	52	11.5	17	± 10	B830033A/...
3Ω – 33000Ω						± 5	B830033B/...
2.7Ω – 15Ω	25	65	52	16	18.5	± 10	B830034A/...
16Ω – 47000Ω						± 5	B830034B/...
4.7Ω – 82000Ω	40	103	89	16	19	± 5	B830035B/...

[1] Resistance values: E24 series tolerance ± 5%; tolerance E12 series ± 10%; [2] ambient temperature

NON ADJUSTABLE TYPES

60W, 100W, 160W, 250W-enamelled



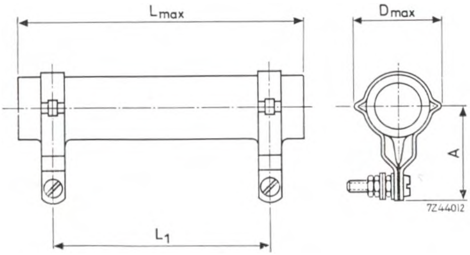


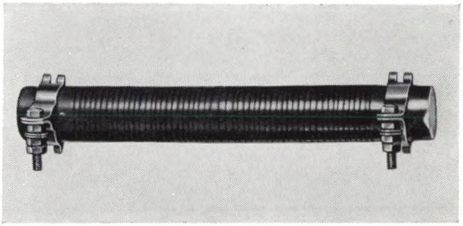
The resistors are provided with screws on the side terminals.

resistance range[1]	maximum dissipation[2] (W) at 40 °C	dimensions (mm)				tolerance (%)	type number
		L_{max}	L_1	D_{max}	A		
2.4kΩ – 68 kΩ	60	103	78	32	30	± 5	B830036B/...
4.7kΩ – 120kΩ	100	165	138	32	30	± 5	B830037B/...
7.5kΩ – 180kΩ	160	165	132	44	37	± 5	B830038B/...
12 kΩ – 330kΩ	250	256	222	44	37	± 5	B830039B/...

[1] Resistance values: E24 series; [2] ambient temperature

60W, 100W, 160W, 250W-cemented





Properties of these resistors are the same as those of B83003.B/...

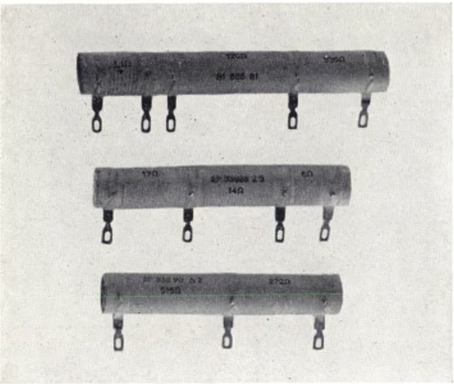
resistance range[1]	maximum dissipation[2] (W) at 40°C	dimensions (mm)				tolerance (%)	type number
		L_{max}	L_1	D_{max}	A		
3 Ω – 2.2kΩ	60	103	78	32	30	± 5	B830236B/...
6.8Ω – 4.3kΩ	100	165	138	32	30	± 5	B830237B/...
10 Ω – 6.8kΩ	160	165	132	44	37	± 5	B830238B/...
16 Ω – 11 kΩ	250	256	222	44	37	± 5	B830239B/...

Resistance values: E24 series; [3] ambient temperature

B8 301 series - WIRE-WOUND RESISTORS

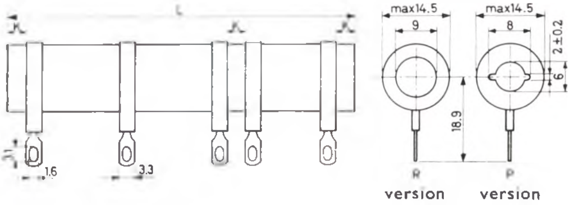
CEMENTED SECTION TYPES, MADE TO CUSTOMERS SPECIFICATION

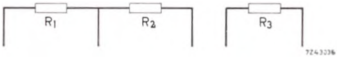
24 — 52 W



These space-saving load resistors consist of a resistor body on which two or more (maximum nine) wire resistor elements can be wound, either separately or interconnected. They can be used to advantage in electric and electronic apparatus in which more than one load resistor is applied, e.g. in TV sets. The resistors must be loaded with at least 60% of the nominal load to protect them against humidity influences. Features: low price, simple mounting, space saving, high permissible loading, non-inflammable.

Resistance values: minimum 3Ω, maximum see table. Resistance tolerance $\pm 10\%$.
Temperature coefficient -50 to $+160 \cdot 10^{-6}/C$





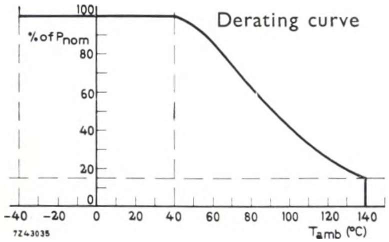
K = normally $4^{+0.5}$ mm
L = minimum 63 mm
maximum 140 mm

maximum total resistance value[1] *(kΩ)*	*maximum permissible total load P_{max}*[4]		*standard tube length (mm)*	*maximum number of sections*
	version R (W)[3]	*version P (W)*		
20	24	28	75	4
30	32	37	100	6
35	35	41	110	7
30	38	44	120	8
48	44	52	140	9

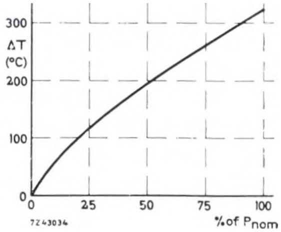
[1] Maximum values to be obtained with standard tube lengths

[2] P_{max} is the maximum permissible total load with the resistor mounted horizontally by means of mounting supports and at an ambient temperature of 40 °C; [3] preferred version

[4] Max. permissible overload: during 15 minutes $2 \times P_{nom}$, during 10 seconds $10 \times P_{nom}$ (P_{nom} is the maximum permissible load of a section at an ambient temperature of 40 °C).



Temperature rise $\Delta T = f(P)$.

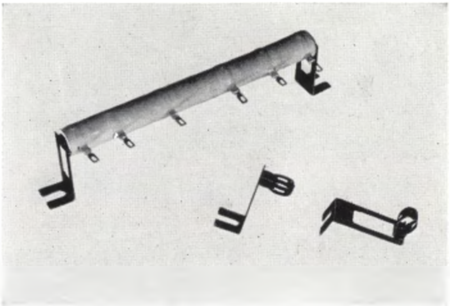


WIRE-WOUND RESISTORS - B8 301 series

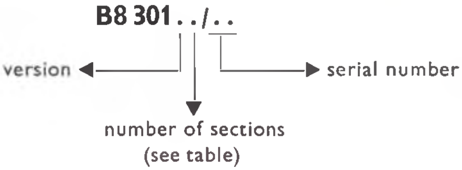
CEMENTED SECTION TYPES, MADE TO CUSTOMERS SPECIFICATION

Two or more resistor elements are wound in one layer on a ceramic tube version R or P (see figure). The ends of the windings are provided with connecting tags. When the windings are interconnected a common tag is used between the two resistors concerned, functioning as a tapping. The windings are coated with a layer of green cement; the connecting tags are tinned.

The resistors can be mounted by means of a bolt or a tapped rod passed through the ceramic tube, or by means of mounting supports. Mounting supports for resistors of the R-version are available under type number B1 455 13; supports for resistors of the P-version are not available.



Composition of the type number

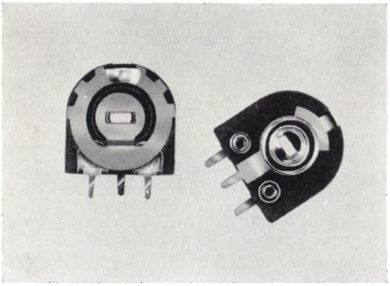


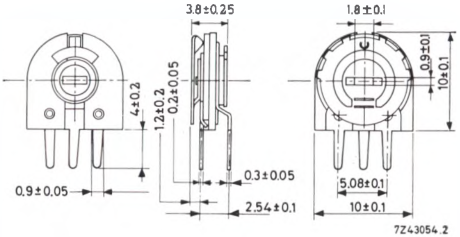
When ordering, please state:
1. basic type number B8301...
2. number of sections
3. resistance of each section
4. load P_{nom} of each section
5. interconnections, if required
6. version R or P

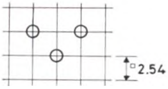
The resistor will be designed according to these data and with a minimum standard length (unless otherwise specified).

E086 series - CARBON TRIMMING POTENTIOMETERS

MINIATURE TRIMMER



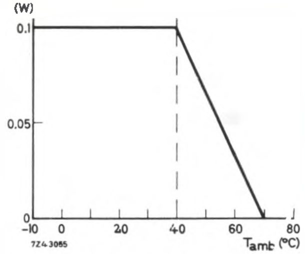




This miniature version of the E097 series will find its application mainly in transistorized equipment.
It is intended for pre-set resistance control with provision for re-adjustments, and has a high degree of reliability in spite of its small dimensions.
Only one version is available, namely that for mounting on printed-wiring boards.
The resistance values are between 100 Ω and 1 MΩ, the maximum permissible load at 40 °C ambient temperature is 0.1W (0.25W for the E097 series).
The annular carbon track is riveted on a base plate of resin-bonded paper.
The stop is formed by the terminal for the runner. Adjustment is done by means of a small screwdriver or trimming tool. The angle of rotation is 240° ± 5°. The terminals will fit a printed-wiring board with a pitch of 2.54 mm.

Resistance tolerance	± 20%
Resistance value as a function of the rotation angle	linear
Effective angle of rotation	240° ± 10°
Maximum permissible load (of total resistance) at an ambient temperature of 40° C	0.1W

MINIATURE TRIMMER



Derating curve

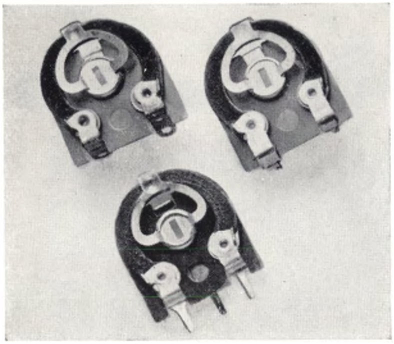
Permissible ambient temperature between −10 and +70 °C
Humidity test at $R_{nom} \leqslant 2.2\,k\Omega$ . . $\Delta R < 5\%$
at $R_{nom} \geqslant 4.7\,k\Omega$ . . $\Delta R < 25\%$
test according to IEC, i.e. during 56 days at 40 °C,
90 to 95% relative humidity, loaded with $0.1P_{nom}$

R_{nom}	R_{min} (Ω)	V_{max} (V)	I_s max (mA)	type number
100 Ω	10	3.2	10	E086BC/100E
220 Ω	10	4.5	7	/220E
470 Ω	10	7	4.5	/470E
1 kΩ	20	10	3.2	/1k
2.2kΩ	40	14	2.2	/2K2
4.7kΩ	100	22	1.4	/4K7
10 kΩ	200	32	1.0	/10K
22 kΩ	400	45	0.7	/22K
47 kΩ	1 000	70	0.45	/47K
100 kΩ	2000	70	0.32	/100K
220 kΩ	4000	70	0.22	/220K
470 kΩ	10000	70	0.22	/470K
1 MΩ	20000	70	0.22	/1M

R_{min} is the remaining resistance at either end just before the slider shorts to the respective terminal.
V_{max} is the max. voltage (d.c. or r.m.s.) permissable between the ends of the resistance element at T_{amb} = 40 °C.
$I_{s\,max}$ is the maximum permissible current through the slider contact.

E097 series - CARBON TRIMMING POTENTIOMETERS

STANDARD TRIMMER, SCREWDRIVER-OPERATED



These stable and reliable carbon trimming potentiometers of simple construction are particularly suitable for use in radio and television receivers, for preset resistance control, with facilities for casual adjustments.

The following versions are available:

1. type A – for direct mounting in the wiring;
2. type C – for vertical mounting, 3-pins (printed-wiring);
3. type D – for horizontal mounting, 3-pins (printed-wiring);
4. type E – for horizontal mounting, 3 tags (on enlarged base);

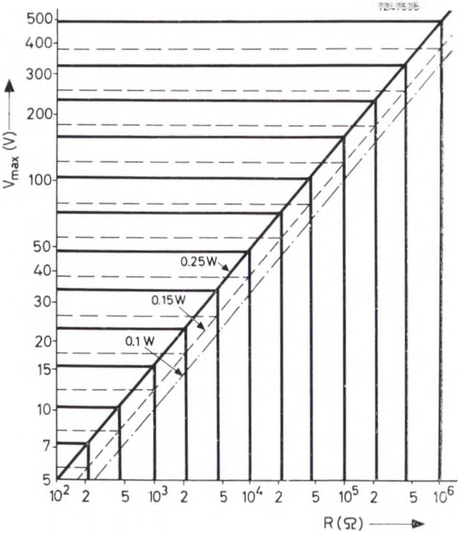
Permissible load

Maximum 0.25W at an ambient temperature of 25 °C, and maximum 0.15W at 70 °C.
The voltages E_{max} corresponding with these loads at any actual resistance value can be found by means of the figure.

Permissible temperature

The ambient temperature may lie between —10 and +70 °C.

Tolerance ± 20%



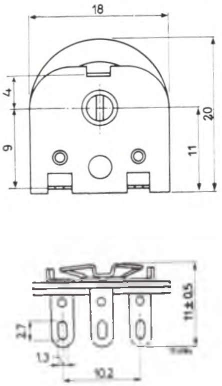
CARBON TRIMMING POTENTIOMETERS - E097 series

STANDARD TRIMMER, SCREWDRIVER-OPERATED

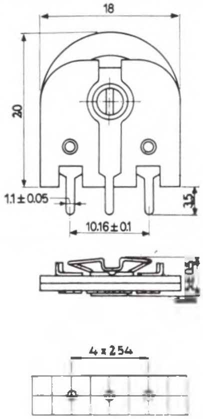
Composition of the type number **E097 A./....**

A, C, D or E version ◀ ▶ standard resistance values

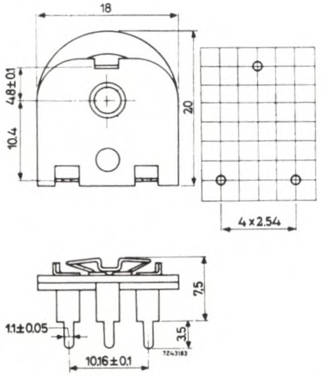
A



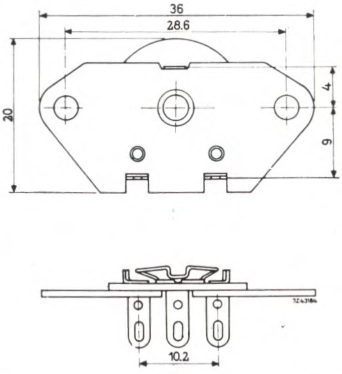
C



D



E

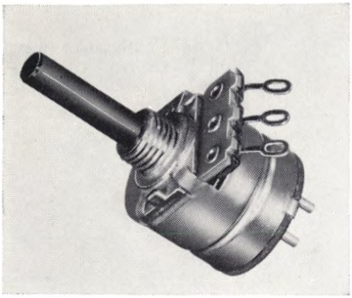


Standard resistance values

value	*code*	*value*	*code*	*value*	*code*	*value*	*code*	*value*	*code*
100Ω	100E	1 kΩ	1K	10kΩ	10K	100kΩ	100K	1 MΩ	1M
220Ω	220E	2.2kΩ	2K2	22kΩ	22K	220kΩ	220K	2.2MΩ	2M2
470Ω	470E	4.7kΩ	4K7	47kΩ	47K	470kΩ	470K	4.7MΩ	4M7

E088 series - SINGLE CARBON POTENTIOMETERS (16 mm)

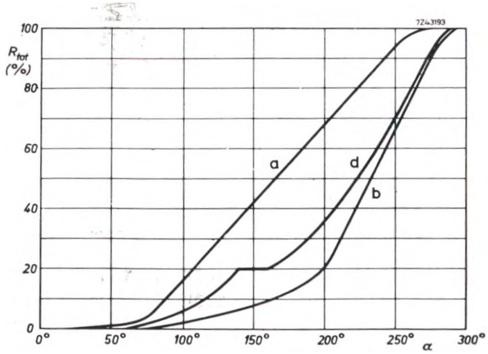
WITH OR WITHOUT SWITCH



The application of these potentiometers is volume and tone control in small-size battery-powered sets. Types are available for conventional panel mounting, and also for use on p.w. boards (with or without fixing nut). The potentiometers can be supplied with a reliable, single-pole rotary switch, which makes them particularly suitable for use in transistorised equipment.

General Data

resistance range R_{nom}	1 kΩ...470 kΩ
tolerance of total resistance	± 20 %
ambient temperature	−10 / +70 °C
climatic conditions	tropic proof
insulation resistance after IEC humidity test	> 1 MΩ
contact resistance, linear	$< 6\ \%\ R_{nom}$
logarithmic	$< 10\ \%\ R_{nom}$
test voltage	500 V_{rms}, 50 c/s
torque, operating	50 – 200 gcm
at stops	$\leq$ 2 kg cm
axial force on spindle	$\leq$ 3 kg



Switches

Breaking capacity	12 V/2 A_{dc}
Switching angle	24° ± 2°

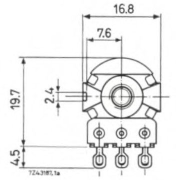
SINGLE CARBON POTENTIOMETERS (16 mm) - E088 series

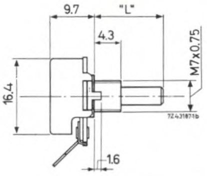
Composition of the type number E088../....

Standard resistance values

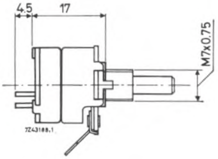
R_{nom}	linear curve a code	logarithmic curve b code
1 kΩ	01	26
2.2 kΩ	02	27
4.7 kΩ	03	28
10 kΩ	04	29
22 kΩ	05	30
47 kΩ	06	07
100 kΩ	08	09
220 kΩ	10	11
470 kΩ	12	13
tapped	*curve*	*code*
2 + 8 kΩ	d	34
4 + 16 kΩ	d	25

(with soldering tags) **C** | **G** (without switch)

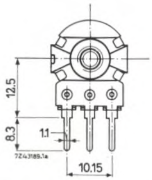


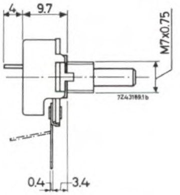


A (with switch)

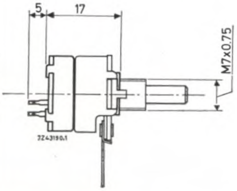


(for printed wiring) **D** | **G** (without switch)

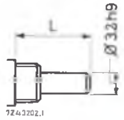
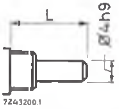
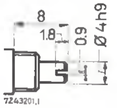


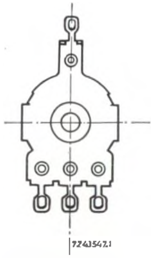


A (with switch)

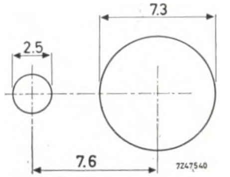


Spindle

length L			type
10 mm	**10**	**A**	
15 mm	**15**		
20 mm	**20**	**B**	
8 mm	**08**	**C**	



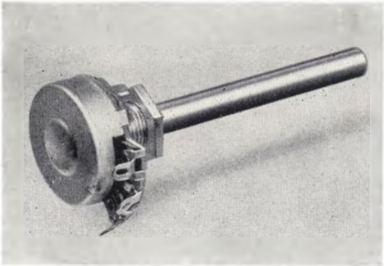
Model with tap



Mounting holes

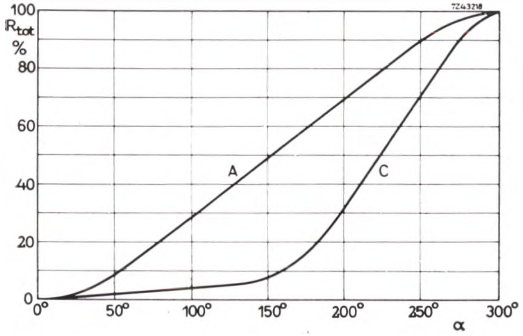
E087 series - SINGLE CARBON POTENTIOMETERS (23 mm)

WITHOUT SWITCH



These single carbon potentiometers (23 mm outer diameter) are particularly suitable for use in military and industrial equipment. The type fulfils MIL-R 94-A and CCTU-05-01 requirements.
On request resistance values according to MIL-R-94-A can also be supplied.

Permissible load
linear potentiometer: 1/4W
logarithmic potentiometer: 1/8W.

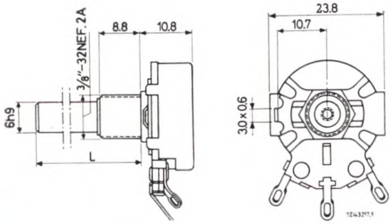


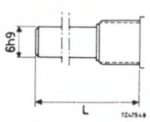
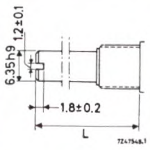
Standard resistance values

R_{nom}	*linear curve A code*	*logarithmic curve C code*
2.2kΩ	02	
10 kΩ	04	
22 kΩ	05	
47 kΩ	06	07
100 kΩ	08	
220 kΩ	10	
470 kΩ	12	13
1 MΩ	15	16
2.2MΩ	18	19

Composition of the type number E087.G/.....

A (without fixing nut)
C (with fixing nut)



	L			Shaft type
	17 mm 30 mm 60 mm	17 30 60	G	
½" ⅛" 1¼" 2¼"	12.7 22.2 31.8 63.5	04 07 10 20	E	

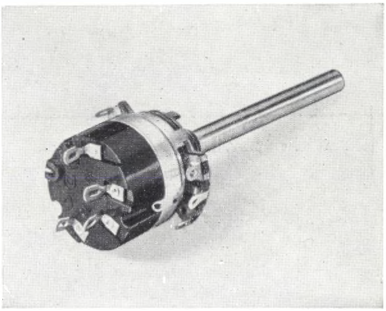
SINGLE CARBON POTENTIOMETERS (23 mm) - E098 series

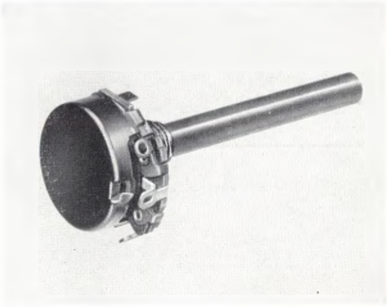
WITH OR WITHOUT SWITCH

These potentiometers, developed for panel mounting, are supplied with linear or logarithmic grading, fixing nut, with or without switch. Preferred spindle length: 60 mm, diameter 1/4 inch or 6 mm.

Permissible load: for linear grading	0.25W at 25 °C
	0.125W at 70 °C
for logarithmic grading	0.125W at 25 °C
	0.063W at 70 °C

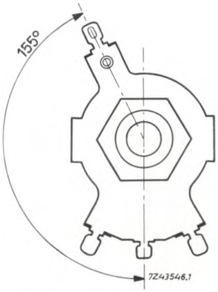
Carbon potentiometers with a diameter of 23 mm are available for the nominal resistance values R_{nom} listed in the table.
The tolerance on R_{nom} is ± 20%.



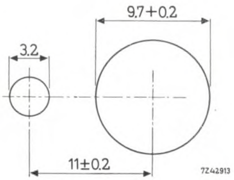


The potentiometers have been tested at 1000 V (50c/s) between terminals and metal cover; the switches have been tested at 2000 V (50c/s).

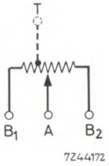
The ambient temperature may lie between −10 and +70 °C. The potentiometers are tropic proof.



Model with tap



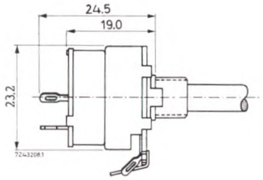
Mounting holes

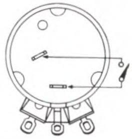


Circuit

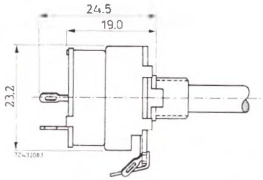
E098 series - SINGLE CARBON POTENTIOMETERS (23 mm)

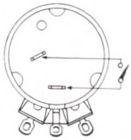
G without switch



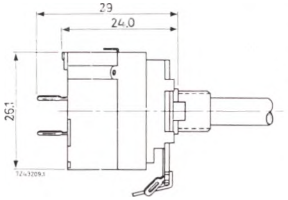


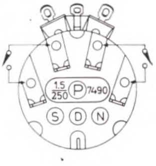
H with single-pole rotary switch rated 250 V/0.5 A



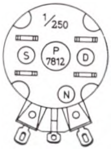


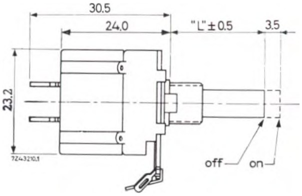
D with double-pole rotary switch, 26 mm Ø, rated for 250 V/1.5 A



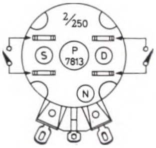


K with double-pole push-pull switch rated for 250 V/1 A operating force 200 p





L with double-pole push-pull switch rated for 250 V/2 A operating force 400 p

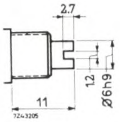
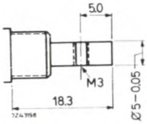
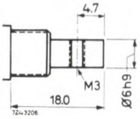
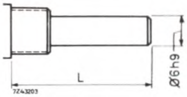
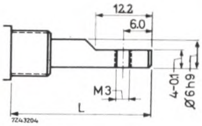
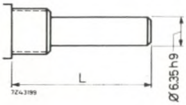


SINGLE CARBON POTENTIOMETERS (23 mm) - E098 series

Composition of the type number

E 098 C./.....

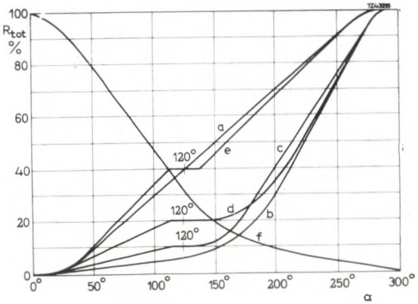
(G, H, D, K, or L)
see preceding page ◄
Spindle

length			*type*
11 mm	**00**	**A**	
18 mm	**00**	**B**	
18 mm	**18**	**F**	
17 mm 30 mm 60 mm	**17** **30** **60**	**C**	
30 mm 60 mm	**30** **60**	**D**	
30 mm 60 mm	**30** **60**	**E**	

Standard resistance values

R_{nom}	*linear curve a code*	*logarithmic curve b code*
300 Ω	21	
470 Ω	33	
1 kΩ	01	26
2.2 kΩ	02	27
4.7 kΩ	03	28
10 kΩ	04	29
22 kΩ	05	30
47 kΩ	06	07
100 kΩ	08	09
220 kΩ	10	11
470 kΩ	12	13
1 MΩ	15	16
2.2 MΩ	18	19
4.7 MΩ	96	

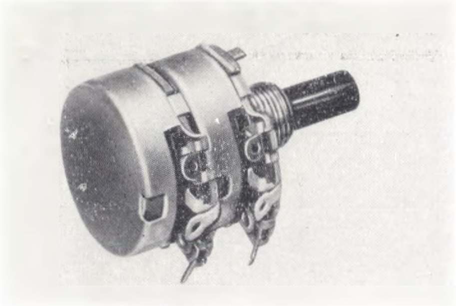
tapped	*curve*	*code*
5 + 17 kΩ	d	25
50 + 170 kΩ	d	23
50 + 420 kΩ	c	14
0.1 + 0.9 MΩ	c	22
0.2 + 0.8 MΩ	d	17
0.4 + 0.6 MΩ	e	24
0.2 + 2.0 MΩ	c	32
0.5 + 1.7 MΩ	d	20
special		
300 Ω	f	31
1 MΩ	f	66
2.2 MΩ	f	77

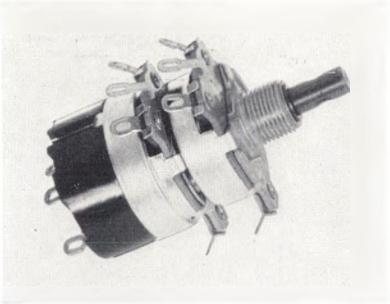


Characteristic curves of resistance between slider and left terminal (R_s/R_{tot} in %) relative to angle of clockwise rotation.
Customer's values and curves can be made to order under certain conditions.

E091 series - TANDEM CARBON POTENTIOMETERS (23 mm)

WITH OR WITHOUT SWITCH





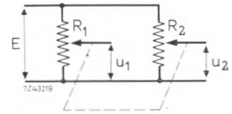
Tandem potentiometers are suitable for stereophonic recording and reproduction; the potentiometers ensure adequate equality of the two signals, both in volume and tone, within the range of from 1kΩ to 2.2 MΩ. Tandem potentiometers are composed of two single potentiometers which are ganged; their resistance values and gradings are as identical as possible.

Disparity of potentiometers with identical nominal values of R_1 and R_2:

a. $|R_1 - R_2| < 25\% \ R_{nom}$.

b. attenuation matching of ganged potentiometers:

the error is defined in dB $= 20 \left| \log \frac{E}{u_1} - \log \frac{E}{u_2} \right|$

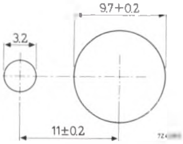


for linear types:
from 10% – 50% of $R_{tot} < 2$ dB
from 90% – 50% of $R_{tot} < 2$ dB

for logarithmic types: see table

attenuation				error
logarithmic	*tap at 10% R_{tot}*	*tap at 20% R_{tot}*	*tap at 40% R_{tot}*	
0 — 20 dB	0 — 20 dB	0 — 20 dB	0 — 20 dB	< 2 dB
20 — 30 dB	20 — 30 dB	20 — 30 dB	20 — 28 dB	< 3 dB
30 — 40 dB	30 — 34 dB	30 — 34 dB		< 4 dB

Tandem potentiometers with identical values of R_1 and R_2 satisfy stereo requirements, except when R $<$ 1kΩ.



Mounting holes

TANDEM CARBON POTENTIOMETERS (23 mm) - E091 series

Composition of the type number

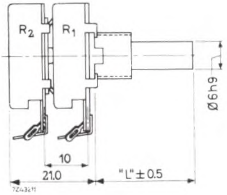
E091C./....

Standard resistance values

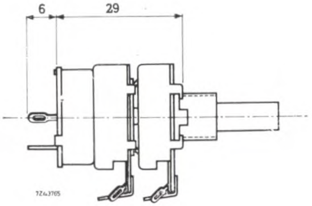
R_{nom}	*linear curve a code*	*log. curve b code*	R_{nom} *tapped and special types*	*curve*	*code*
1 kΩ	01	26	5 + 17 kΩ	d	25
2.2kΩ	02	27	50 + 170 kΩ	d	23
4.7kΩ	03	28	50 + 420 kΩ	c	14
10 kΩ	04	29	0.1 + 0.9MΩ	c	22
22 kΩ	05	30	0.2 + 0.8MΩ	d	17
47 kΩ	06	07	0.4 + 0.6MΩ	e	24
100 kΩ	08	09	0.2 + 2.0MΩ	c	32
220 kΩ	10	11	0.5 + 1.7MΩ	d	20
470 kΩ	12	13			
			300 Ω	f	31
1 MΩ	15	16	1 MΩ	f	66
2.2MΩ	18	19	2.2MΩ	f	77

for reference curves see page E31

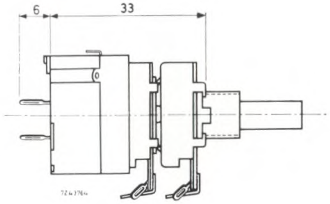
G without switch



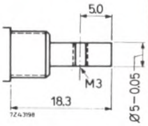
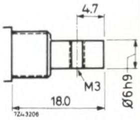
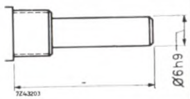
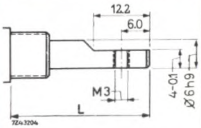
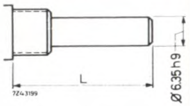
H with single-pole rotary switch



D with double-pole rotary switch (26 mm)

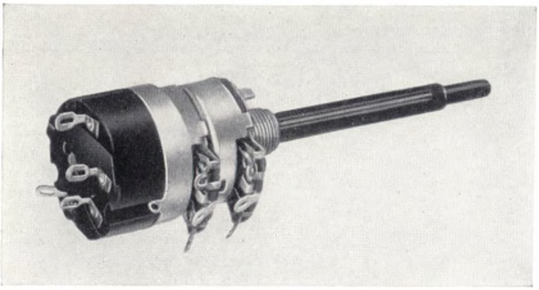


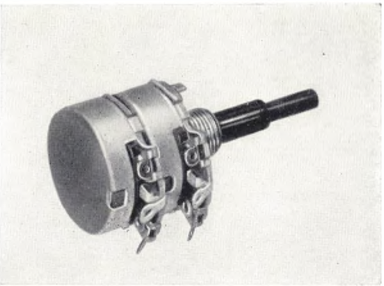
Spindle

length			*type*
18 mm	**00**	**B**	
18 mm	**18**	**F**	
17 mm 30 mm 60 mm	**17** **30** **60**	**C**	
30 mm 60 mm	**30** **60**	**D**	
30 mm 60 mm	**30** **60**	**E**	

E090 series - TWIN CARBON POTENTIOMETERS (23 mm)

WITH OR WITHOUT SWITCH



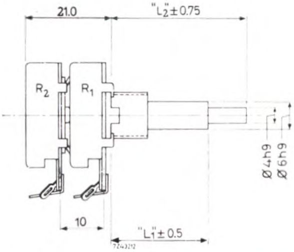


These twin potentiometers are composed of two individual types of the E098 series with coaxial spindles and meet the demand for controls with duplex knob operation.

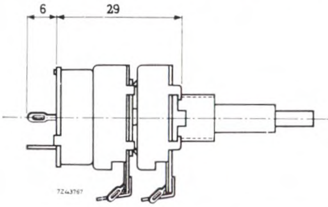
Composition of the type number E 090C./.. R_1+R_2

spindle → see E098 series page E31

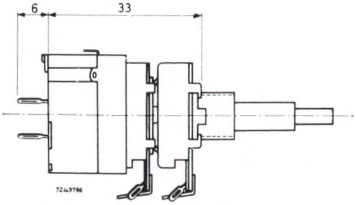
▶ G without switch

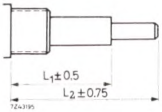
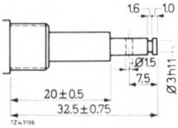
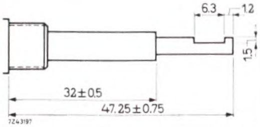


▶ H with 23 mm single-pole rotary switch

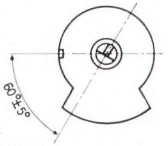


▶ D with 26 mm double-pole rotary switch



	length (mm)		*type*
	L_1	L_2	
AA	20	32.5	
AB	32	47.25	
AC	47.5	60	
AD	77.5	90	
AE	20	32.5	
AF	32	47.25	

Position of flat sides (spindle in extreme anti-clockwise position)

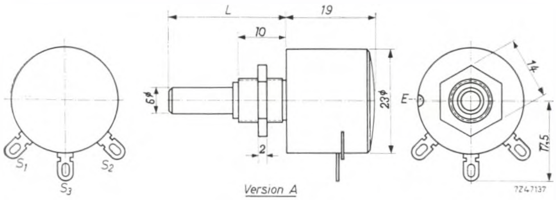


Without switch

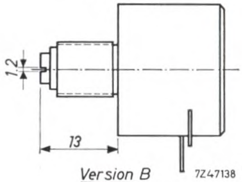
With rotary switch; switch-off

WIRE WOUND POTENTIOMETERS 1W - E199AA series

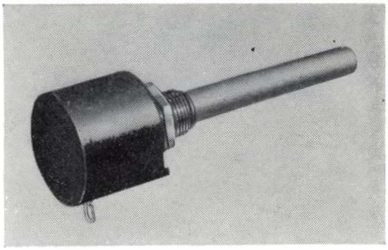
DUST PROOF, SIDE TERMINALS



Version A

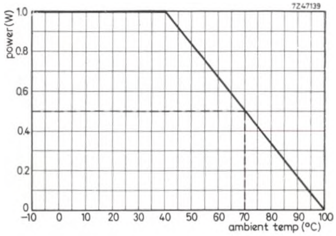


Version B



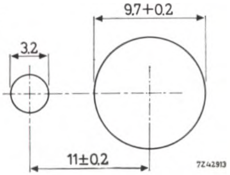
The resistor element is enclosed in a dust-proof casing of black synthetic resin.

Permissible load	1W at 40 °C ambient temperature
Resistance range	1 Ω – 25 kΩ
Resistance tolerance	$R_n \leq 50\Omega \pm 10\%$ $R_n > 50\Omega \pm 5\%$ and $\pm 10\%$
Working temperature	−10 °C to +100 °C
Test voltage between spindle and contacts	2000 V_{ac}
Operating torque	30 – 100 gcm



derating curve

mounting holes



Composition of the type number **E199AA/.......**

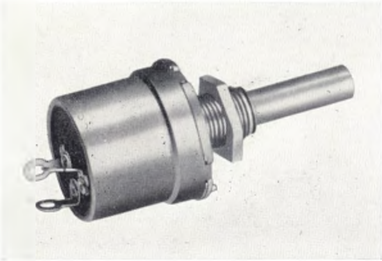
spindle		resistance tolerance
version	length (mm)	
A25	25	A = 10%
A50	50	
B13	13	B = 5%

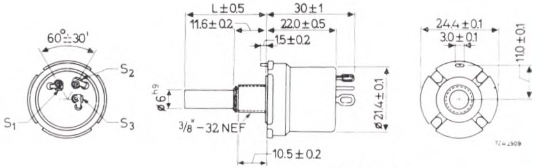
Example: resistance value 2.5 kΩ, tolerance 10%, screwdriver adjustment, type number E199AA/B13A 2K5

resistance value									
R_{nom} Ω	Indication	R_{nom} Ω	Indication	R_{nom} Ω	Indication	R_{nom} kΩ	Indication	R_{nom} kΩ	Indication
1	1E	10	10E	100	100E	1K	1K	10	10K
1.5	1E5	15	15E	150	150E	1.5	1K5	15	15K
2	2E	20	20E	200	200E	2	2K	20	20K
2.5	2E5	25	25E	250	250E	2.5	2K5	25	25K
3.5	3E5	35	35E	350	350E	3.5	3K5		
5	5E	30	50E	500	500E	5	5K		
7.5	7E5	75	75E	750	750E	7.5	7K5		

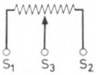
E199AB series - WIRE-WOUND POTENTIOMETER 3W

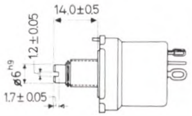
DUST PROOF TERMINALS UNDERNEATH





Version A

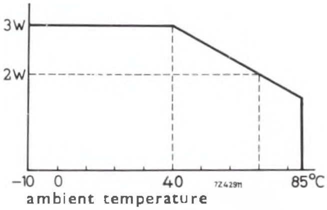


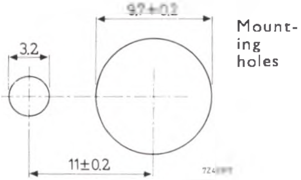


Version B14

This dust-free sealed potentiometer type is most suitable for professional electric and electronic equipment where accurate and gradual resistance regulation and high stability are required.

Permissible load	3 W at 40 °C, 2 W at 70 °C ambient temperature
Resistance range.	2.2 Ω – 22 kΩ
Resistance tolerance . . .	$R_n \leqslant 50\ \Omega$: ± 10% $R_n > 50\ \Omega$: ± 5% and ± 10%
Effective angle of rotation . .	275° ± 10°
Resistance value as a function of the rotation angle . . .	linear within ± 2%
Working temperature . . .	–10 °C to +85 °C
Test voltage between spindle and contacts	1000 V_{ac}
Operating torque	$\geqslant$ 200 gcm
End stop torque	$\geqslant$ 10 kgcm
Service life	min. 25,000 cycles





Composition of the type number **E199AB/......**

spindle		resistance tolerance
version	length (mm)	
A17	17	A = 10%
A30*	30	
A60	60	
B14	14	B = 5%

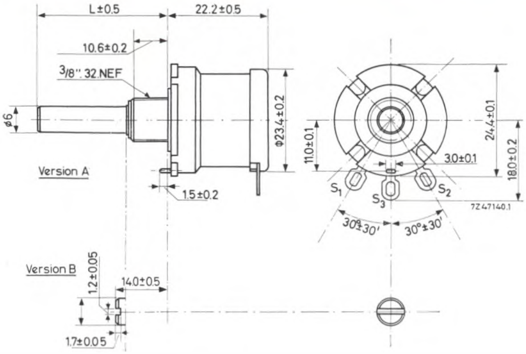
*Preferred

resistance value (ohm)					
value	code	value	code	value	code
2.2*	2E2	68	68E	1500	1K5
3.3	3E3	100*	100E	2200*	2K2
4.7*	4E7	150	150E	3300	3K3
6.8	6E8	220*	220E	4700*	4K7
10*	10E	330	330E	6800	6K8
15	15E	470*	470E	10000*	10K
22*	22E	680	680E	15000	15K
33	33E	1000*	1K	22000*	22K
47*	47E				

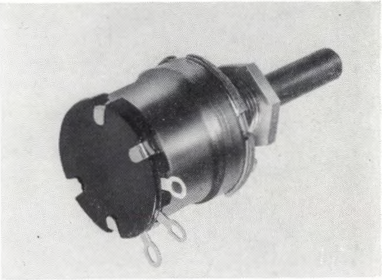
*Preferred resistance values

Example: resistance value 3.3 kΩ, tolerance 10%, screwdriver adjustment, type number E199AB/B14A3K3

WIRE WOUND POTENTIOMETERS 3W - E199BB series

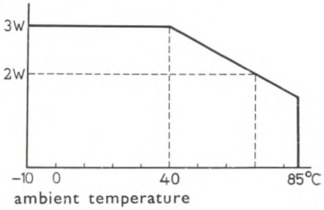


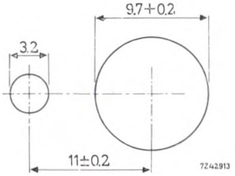
DUST PROOF, SIDE TERMINALS



This dust-free sealed potentiometer type is most suitable for professional electric and electronic equipment where accurate and gradual resistance regulation and high stability are required.
Properties of this potentiometer are the same as those of type E199AB (see page E36).

Permissible load	3 W at 40 °C, 2 W at 70 °C ambient temperature
Resistance range	2.2 Ω – 22 kΩ
Resistance tolerance	$R_n \leqslant 50\ \Omega$: ± 10% $R_n > 50\ \Omega$: ± 5% and ± 10%
Effective angle of rotation . .	275° ± 10°
Resistance value as a function of the rotation angle	linear within ± 2%
Working temperature	−10 °C to +85 °C
Test voltage between spindle and contacts	1000 V_{ac}
Operating torque	$\geqslant$ 200 gcm
End stop torque	$>$ 10 kgcm
Service life	min. 25,000 cycles





Moun-ting holes

Composition of the type number **E199BB/......**

spindle		resistance tolerance
version	*length(mm)*	
A17	17	A = 10%
A30*	30	
A60	60	
B14	14	B = 5%

* Preferred

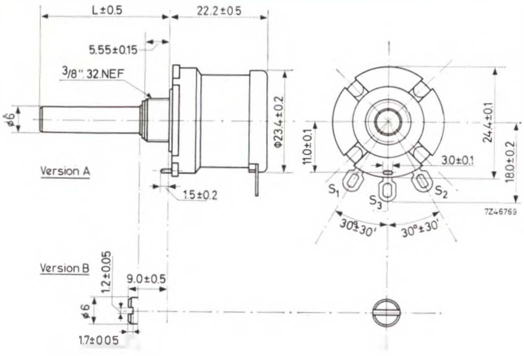
Example: resistance value 3.3 kΩ. tolerance 10%, screwdriver adjustment, type number E199BB/B14A3K3

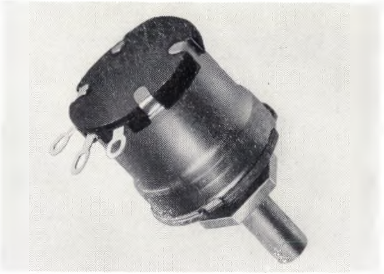
resistance value (ohm)					
value	*code*	*value*	*code*	*value*	*code*
2.2*	2E2	68	68E	1500	1K5
3.3	3E3	100*	100E	2200*	2K2
4.7*	4E7	150	150E	3300	3K3
6.8	6E8	220*	220E	4700*	4K7
10*	10E	330	330E	6800	6K8
15	15E	470*	470E	10000*	10K
22*	22E	680	680E	15000	15K
33	33E	1000*	1K	22000*	22K
47*	47E				

*Preferred resistance values

E196AA-series - WIRE-WOUND POTENTIOMETERS 3W

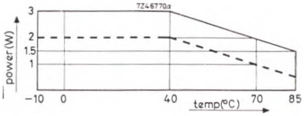
HIGH-STABILITY TYPE



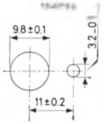


The use of high-quality material and gold-plated contacts for this potentiometer ensures a high stability.

Permissible load	3W at 40 °C, 2W at 70 °C ambient temperature
Resistance range	47 Ω to 3.3 k Ω
Resistance tolerance	± 5%
Effective angle of rotation	275° ± 5°
Resistance value as a function of the rotation angle	linear within ± 2%
Working temperature	−40 °C to +100 °C
Test voltage between spindle and contacts	1000 V_{ac}
Working voltage	500 V_{peak}
Temperature coefficient	$+100 \times 10^{-6}$/°C
Contact resistance	⩽ 50 mΩ
Change of contact resistance	⩽ 10 mΩ
Operating torque	200 to 500 gcm



The dotted line indicates the permissible load of an insulated potentiometer.



Mounting hole

Composition of the type number **E199AA/.......**

spindle	
version	length (mm)
A15	15
A20	20
B 9	9

Resistance tolerance

B = ± 5%

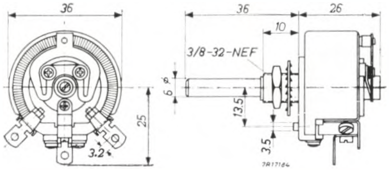
resistance value (ohm)					
value	code	value	code	value	code
3.3	3E3	100*	100E	2200*	2K2
4.7*	4E7	150	150E	3300	3K3
6.8	6E8	220*	220E	4700*	4K7
10*	10E	330	330E	6800	6K8
15	15E	470*	470E	10000*	10K
22*	22E	680	680E	15000	15K
33	33E	1000*	1K	22000*	22K
47*	47E				

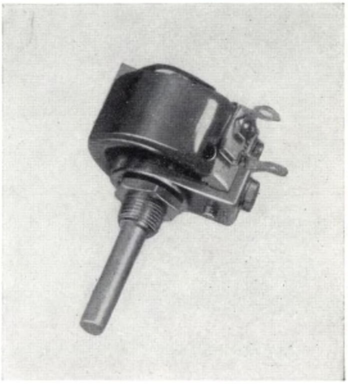
* Preferred resistance values

WIRE-WOUND POTENTIOMETERS - E198 series

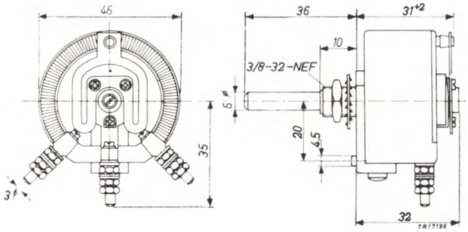
CEMENTED — 30W, 50W, 120W

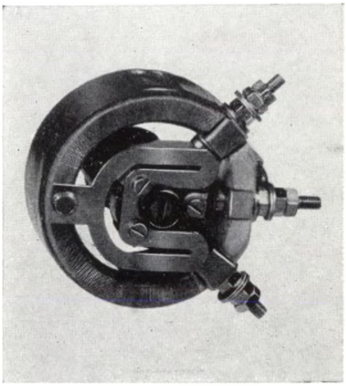
Type number E198AB / 30 W



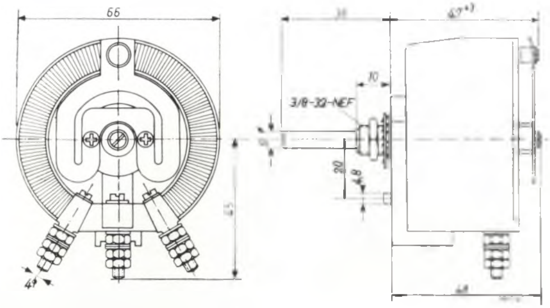


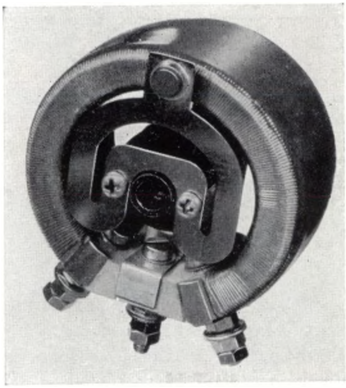
Type number E198AC / 50 W





Type number E198AE / 120 W





For data see overleaf

E198 series - WIRE-WOUND POTENTIOMETERS

CEMENTED — 30W, 50W 120W

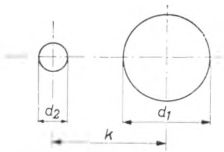
These cemented wire-wound potentiometers meet the severest requirements which may be imposed on variable power resistors under greatly divergent conditions.

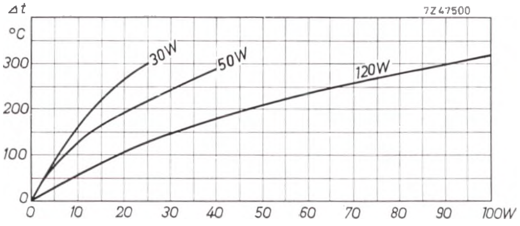
resistance tolerance	± 10%
resistance values .	according to standard potentiometer resistance range: 1—1.5—2—2.5—3.5—5—7.5—1

resistance range (*Ω*)	*max. dissipation at 40 °C ambient temperature (W)*	*maximum peak voltage*[1] *(V)*	*angle of rotation* (°)	*weight* (*g*)	*type number*
1–7500	30	1250	270	60	E198AB/A36A/. . .
0.5–10000	50	1400	270	95	E198AC/A36A/. . .
0.75–10000	120[2]	1300	300	240	E198AE/A36A/. . .

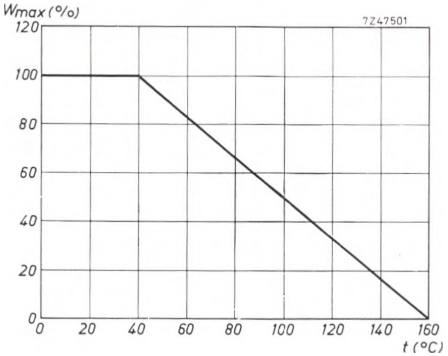
[1] Maximum peak voltage between contacts and spindle. [2] Higher power types, up to 630 W, are available on request.

Mounting holes

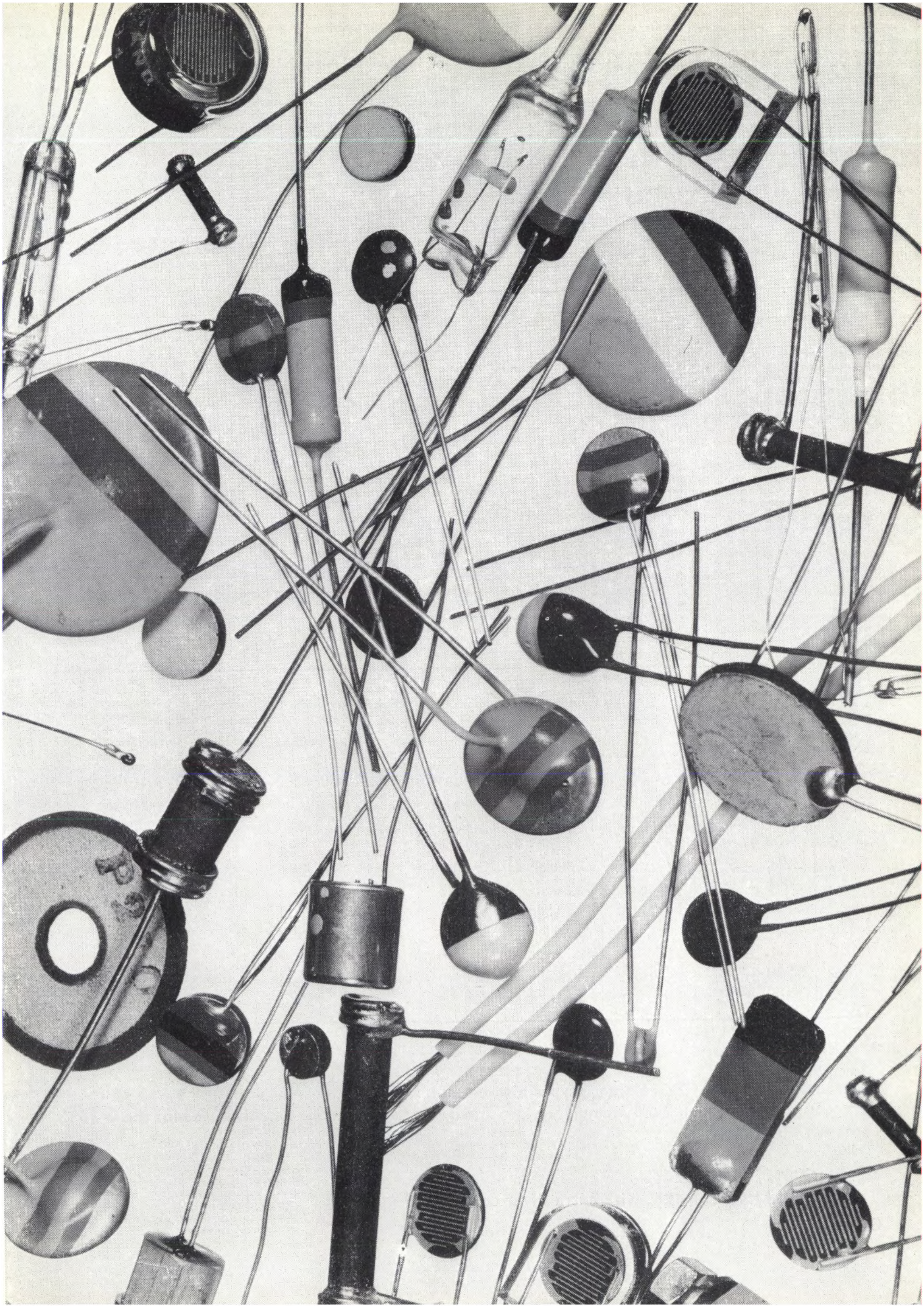




	d_1 mm	d_2 mm	K mm
E198 AB/A36A	10.5	3.5	13,5
AC/A36A	10.5	4.8	20
AE/A36A	10.5	4.8	20



Loading at W_{max} is only permissible if the full length of the resistance wire or ribbon is used. If only part of it is used, the permissible load is a proportional part of W_{max}.

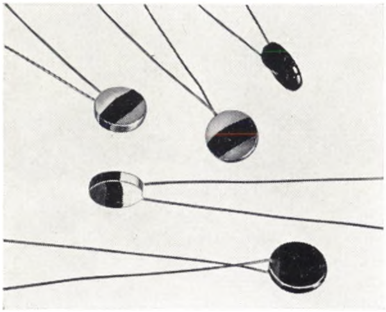


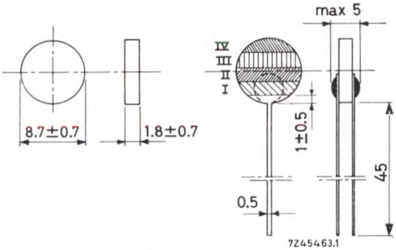
NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

Our range of NTC thermistors consists of the following types:

1. standard disc types series B;
2. standard disc types series E;
3. standard rod types;
4. mounted disc types;
5. miniature types;
6. indirectly heated types;
7. special types for motor cars and household appliances;
8. special types for radio and television.

STANDARD DISC TYPES SERIES B





In the course of 1966 the lead diameter will be increased to 0.6 mm.

R_{25} (Ω)	*B-value at 25 °C ambient* (°K)	*colour code for types with leads*			*type number*	
		I	*II*	*III*	*without leads*	*with leads*
2.2	2650 ± 5%	red	red	gold	B832000P/2E2	B832001P/2E2
4	2800 ± 5%	yellow	black	gold	P/4E	P/4E
6	2800 ± 5%	blue	black	gold	P/6E	P/6E
8	2900 ± 5%	grey	black	gold	P/8E	P/8E
10	2950 ± 5%	brown	black	black	P/10E	P/10E
15	3000 ± 5%	brown	green	black	P/15E	P/15E
33	3250 ± 5%	orange	orange	black	P/33E	P/33E
50	3300 ± 5%	green	black	black	P/50E	P/50E
130	4400 ± 5%	brown	orange	brown	P/130E	P/130E
500	5200 ± 5%	green	black	brown	P/500E	P/500E
1300	5450 ± 5%	brown	orange	red	P/1K3	P/1K3

W_{max} = 1W dissipation constant approx. 10 mW/°C

T_{max} = 120 °C time constant approx. 60 sec.

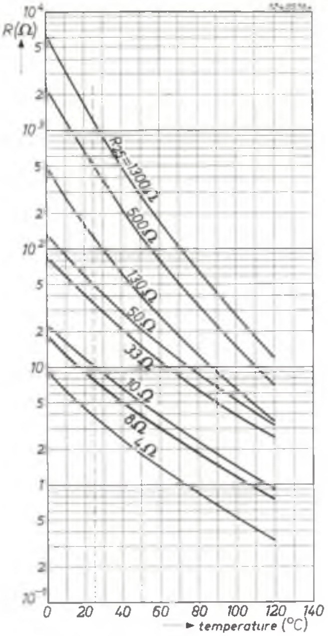
Tolerance ± 20%; ± 10% tolerance types also available.

For ± 10% types change P of type number into A; an extra silver colour band is added for the ± 10% types with leads.

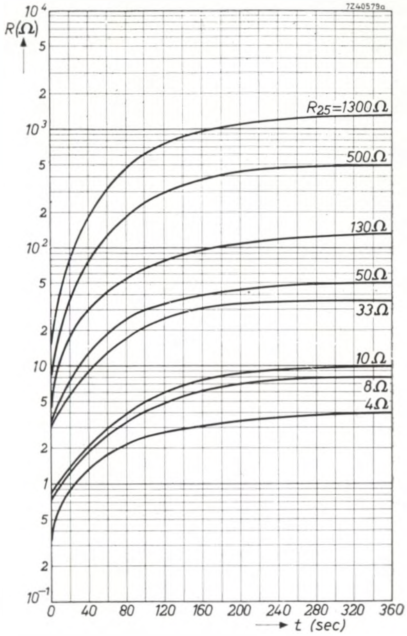
e.g. B832001 P/... is ± 20%
B832001A/... is ± 10% with extra silver colour band

NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS - NTC

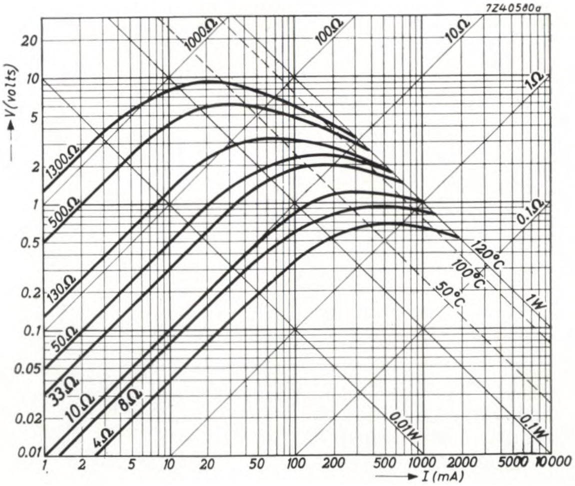
STANDARD DISC TYPES SERIES B



Resistance/temperature characteristics



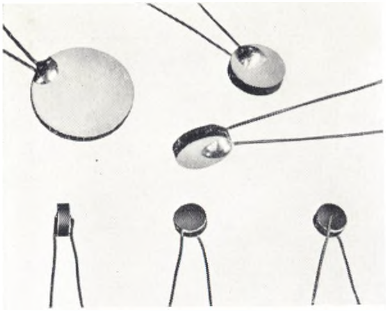
Cooling characteristics



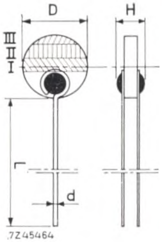
Voltage/current characteristics

NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

STANDARD DISC TYPES SERIES E



These discs are extremely stable and can be used for critical professional and industrial applications.



Dimensions (mm)

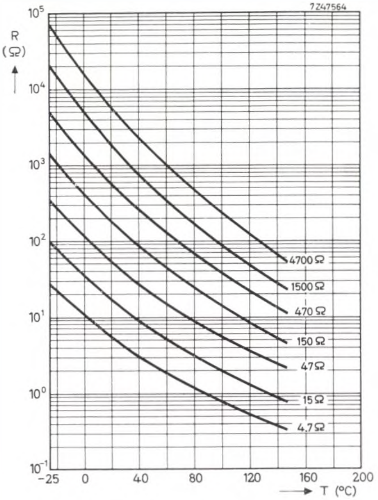
type number	D	H_{max}	d
E213BB/...	5 ± 0.3	5.5	0.5 (0.6)[1]
E213BC/...	9 ± 0.3	5.5	0.6
E213BD/...	16 ± 1.0	5.5	0.6 (0.8)[1]

[1] In the course of 1966.

Tentative data

R_{25} (Ω)	*B-value at 25 °C* (°K)	W_{max} at *25 °C amb* (W)	*dissipation constant (approx)* (mW/°C)	*time constant (approx)* (sec)	*colour code*			*type number*
					I	*II*	*III*	
4.7	2625	0.6 W	6	25	yellow	violet	gold	E213 BB/P4E7
15	2825				brown	green	black	/P15E
47	3100				yellow	violet	black	/P47E
150	3150				brown	green	brown	/P150E
470	3450				yellow	violet	brown	/P470E
1500	3725				brown	green	red	/P1K5
4700	4050				yellow	violet	red	/P4K7
150	3425	1 W	10	55	brown	green	brown	E213BC/P150E
470	3650				yellow	violet	brown	/P470E
1500	4075				brown	green	red	/P1K5
4700	4250				yellow	violet	red	/P4K7
150	3900	1.5 W	13	120	brown	green	brown	E213BD/P150E
470	4200				yellow	violet	brown	/P470E
1500	3900				brown	green	red	/P1K5
4700	4200				yellow	violet	red	/P4K7

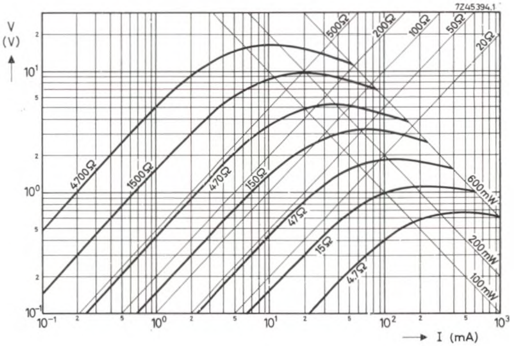
Standard tolerance ±20%; ±10% on request.
Maximum temperature: 150 °C
Stability: after 1000 hours at W_{max} $\triangle R < 5\%$
after 1000 hours at $^2/_3$ W_{max} $\triangle R < 3\%$



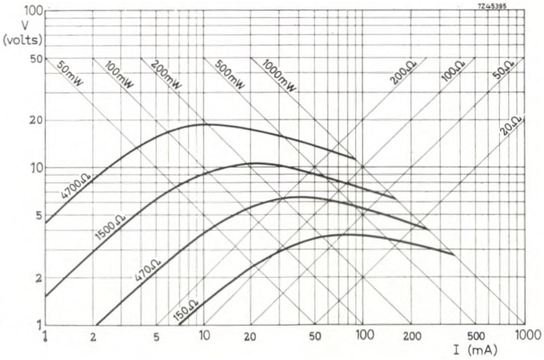
Resistance/temperature characteristics

0.6 W and 1 W series

Voltage/current characteristics



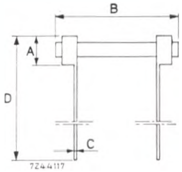
0.6 W series



1 W series

NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

STANDARD ROD TYPES



Dimensions (mm)

type number	*A*	*B*	*C*	*D*
B832007	3.2 ± 0.5	11 ± 1	0.4	31 ± 3
B832008	4.7 ± 0.5	21 ± 1	0.8	33 ± 3
B832009	6.2 ± 0.5	31 ± 1	0.8	34 ± 3

These rods are extremely stable and can be used for critical professional and industrial applications.

R_{25} (kΩ)	*B-value at 25 °C ambient tolerance ± 5%* (°K)	W_{max} *at 25 °C ambient* (W)	*dissipation constant approx.)* (mW/°C)	*time constant (approx.)* (sec)	*colour code*	*type number*
4.7	3250	0.6	5.5	28	orange	B832007P/4K7S
15	3550				green	/15KS
47	3925				blue	/47KS
150	4075				white	/150KS
4.7	3250	1.5	12	55	orange	B832008P/4K7S
15	3650				green	/15KS
47	4000				blue	/47KS
150	4150				white	/150KS
4.7	3250	2.3	17	105	orange	B832009P/4K7S
15	3675				green	/15KS
47	4050				blue	/47KS
150	4200				white	/150KS

Standard tolerance ±20%; ±10% on request.

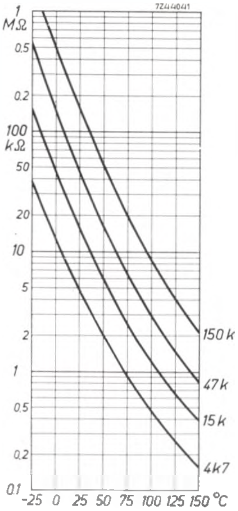
Maximum temperature: 150 °C
Stability: after 1000 hours at W_{max} $\Delta R < 5\%$
after 1000 hours at $^2/_3$ W_{max} $\Delta R < 3\%$

Remark

The present range supersedes the old range. The lower values (150 Ω to 1500 Ω) are disc shaped. See standard disc types series E.

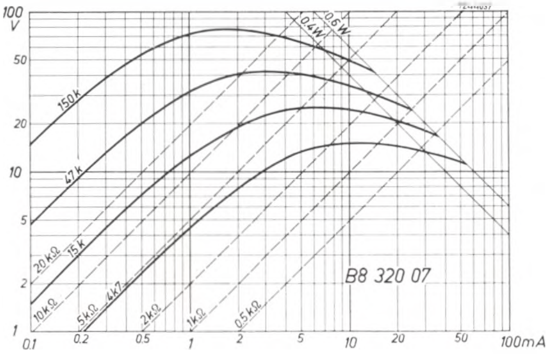
STANDARD ROD TYPES

Resistance/temperature characteristics

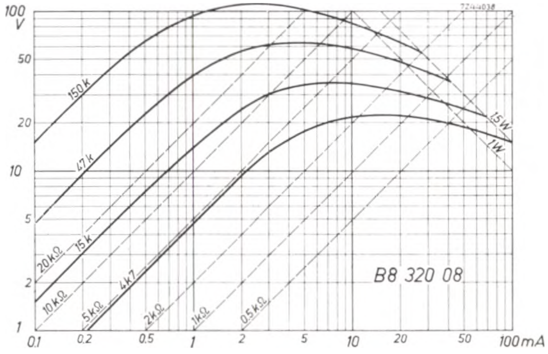


B832007
B832008
B832009

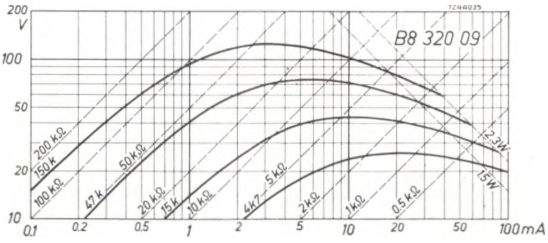
Voltage/current characteristics
B832007



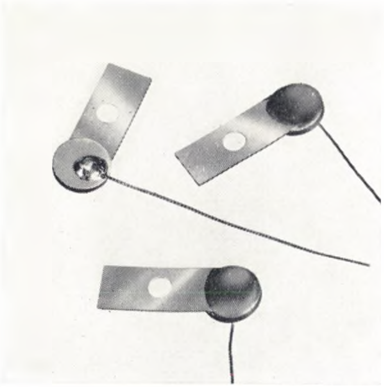
B832008



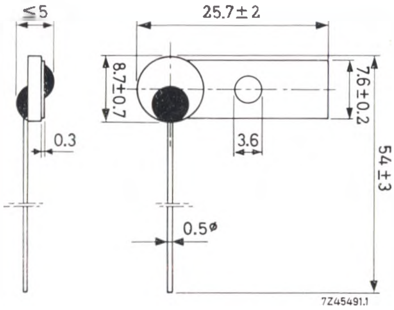
B832009



MOUNTED DISC TYPES



Standard discs, series B, soldered on a metal strip.



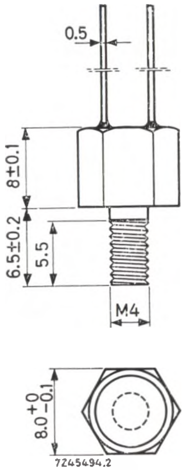
For simple mounting with nut and bolt, discs of the standard series B are available soldered on a metal strip.

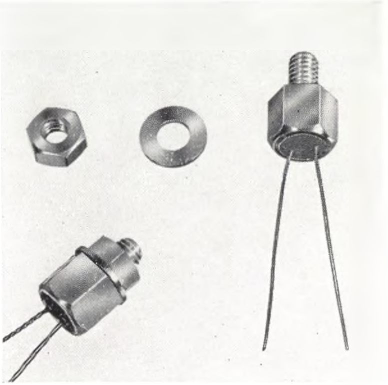
R_{25} (Ω)	*type number*
4 ± 20%	E201ZZ/27
8 ± 20%	/30
50 ± 20%	/31
130 ± 20%	/11
500 ± 20%	/32
1300 ± 20%	/33

The resistance/temperature characteristics are the same as those of the standard discs B (see page E42).

MOUNTED DISC TYPES

Standard discs, series E, screw-mounted.





For *insulated* mounting and to ensure good thermal heat contact between NTC and chassis, the standard discs series E213BB/... with mounting stud is available.

R_{25} (Ω)	*type number*
4.7	E215AB/P4E7
15	/P15E
47	/P47E
150	/P150E
470	/P470E
1500	/P1K5
4700	/P4K7

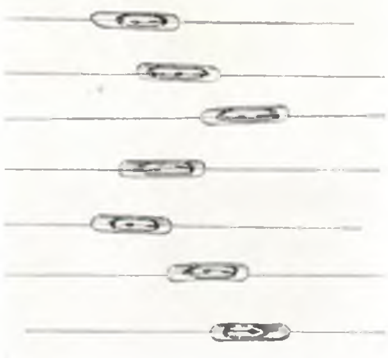
Standard tolerance ±20%; ±10% on request.

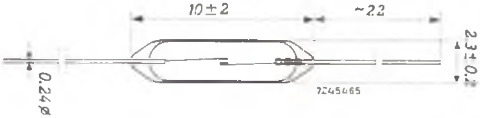
Maximum temperature	100 °C
W_{max} at 25 °C ambient	0.5 W
Dissipation constant	approx. 9.5 mW/°C; when mounted on a heat sink (1 dm², 1.5 mm. thickness) approx. 19 mW/°C
Thermal time constant	approx. 80 sec.; when mounted on a heatsink (1 dm², 1.5 mm. thickness) approx. 18 sec.
Dielectric strength	min 100V
Insulation resistance	> 100 MΩ

Resistance/temperature characteristics as E213BB series (see page E44).

NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

MINIATURE TYPES



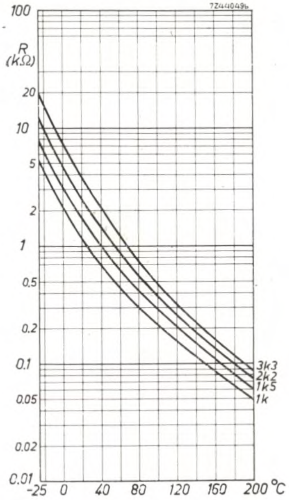


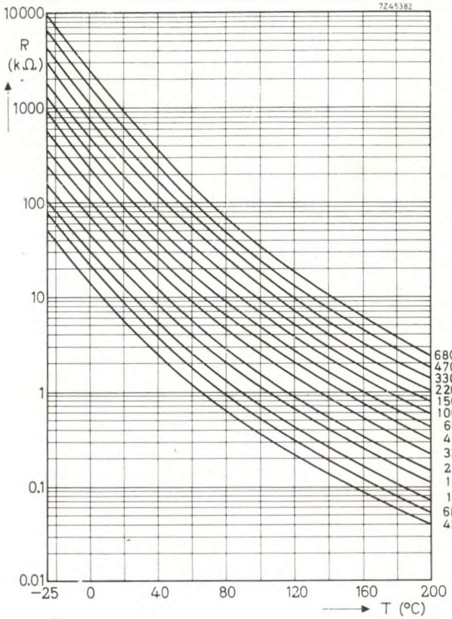
W_{max}	60 mW
T_{max}	200 °C
stability	after 1000 hours at T_{max} $\Delta R < 1\%$
dissipation constant	approx. 0.4 mW/°C

R_{25} (Ω)	*B-value at 25°C ambient tolerance ± 5%* (°K)	*colour code* I	II	III	*type number*
1 000	2350	brown	black	red	B832003P/1KS
1 500	2450	brown	green	red	/1K5S
2 200	2600	red	red	red	/2K2S
3 300	2775	orange	orange	red	/3K3S
4 700	3650	yellow	violet	red	/4K7S
6 800	3725	blue	grey	red	/6K8S
10 000	3800	brown	black	orange	/10KS
15 000	3750	brown	green	orange	/15KS
22 000	3800	red	red	orange	/22KS
33 000	3750	orange	orange	orange	/33KS
47 000	3800	yellow	violet	orange	/47KS
68 000	3850	blue	grey	orange	/68KS
100 000	3900	brown	black	yellow	/100KS
150 000	3975	brown	green	yellow	/150KS
220 000	4075	red	red	yellow	/220KS
330 000	4175	orange	orange	yellow	/330KS
470 000	4225	yellow	violet	yellow	/470KS
680 000	4300	blue	grey	yellow	/680KS

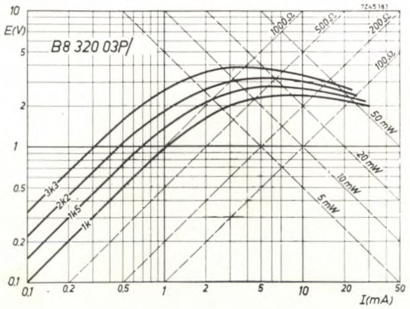
Standard tolerance ±20%; ±10% on request.

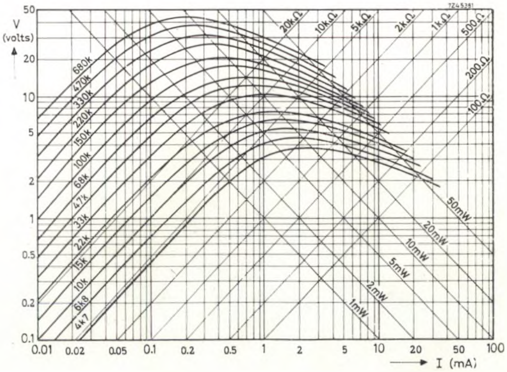
Resistance/temperature characteristics
for all miniature types





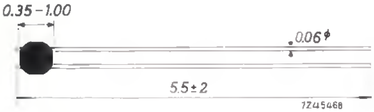
Voltage/current characteristics
(B8 320 03 types only)



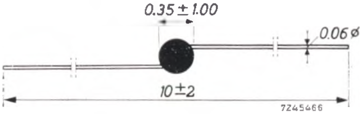


MINIATURE TYPES

More versions are available, all built around the NTC bead E209CE/P. The range of resistance values and the resistance temperature characteristics for all types are the same as for version B8 320 03 P/...

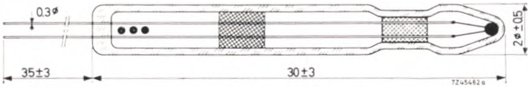


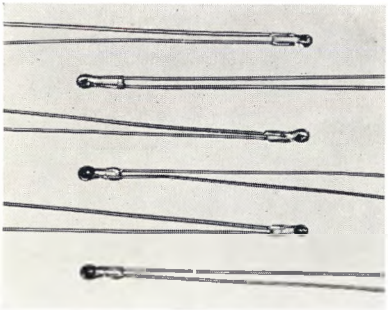
E209CE/P...
"Naked bead"



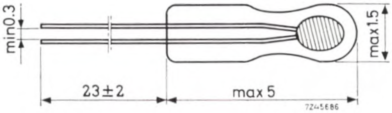
B8 32002/P....
"Naked bead"

E205CE/P...
"Thermometer"





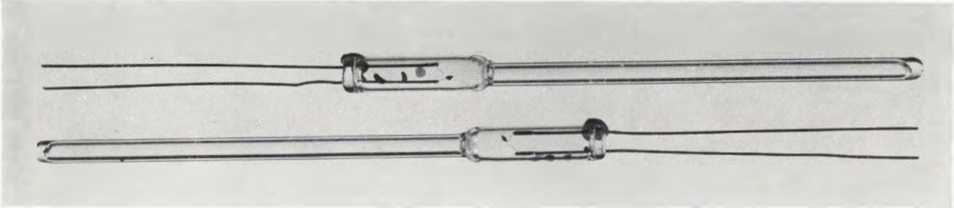
E 214 AE/P...
"Micro thermometer"

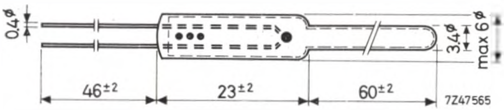


Remark:
B-value tolerance for values lower than 4.7 kΩ is ± 10% instead of ±5%.

NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS - NTC

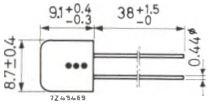
MINIATURE TYPES

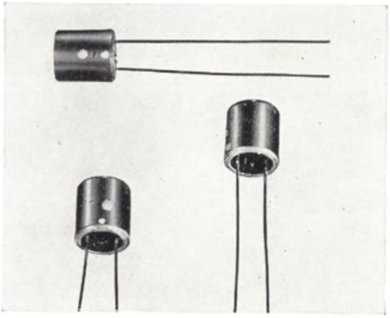




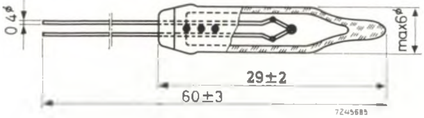
B832006P/...
"Vacuum gauge"

E211AE/P...
"Metal casing"

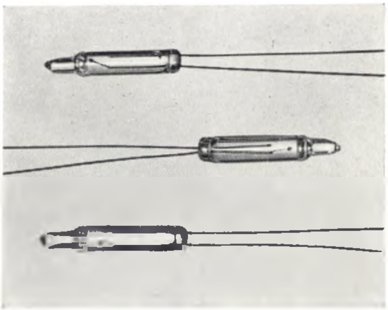




B8 320 04P/...
"Vacuum mounted"

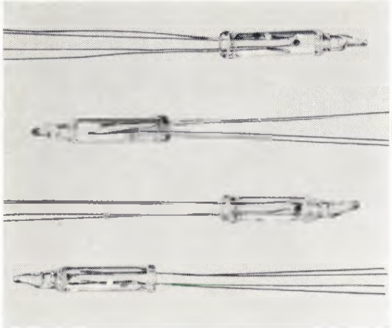


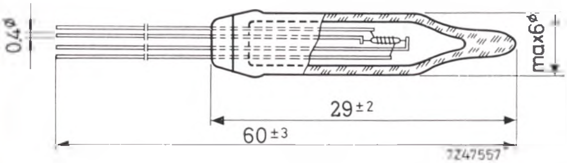
Dissipation constant: 0.11 mW/°C



NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

INDIRECTLY HEATED TYPES

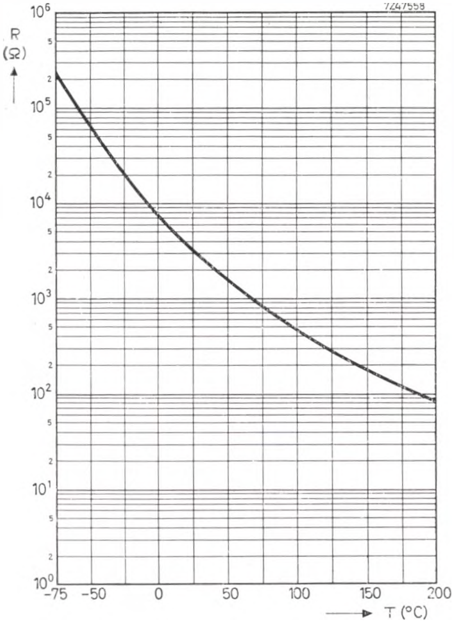




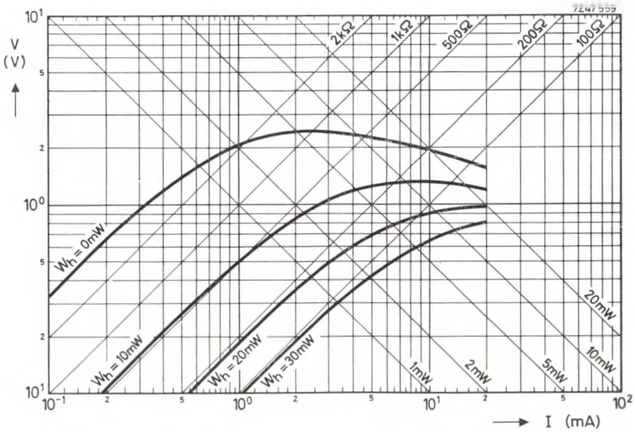
This vacuum mounted indirectly heated thermistor is an improved version of the old type B832015P/3K3

Type number	E207 AC/P3K3
R_{25}	3300Ω ± 20%
B-value	2775 °K ± 5%
Colour code	orange-orange-red
W_{max} (heater)	30 mW
T_{max}	200 °C
Resistance heater	100Ω ± 10%
Dissipation constant	approx. 0.18 mW/°C
Heater efficiency[1]	approx. 97.5%
Time constant[1]	approx. 2.2 sec.
Capacitance heater/bead	approx. 1.6 pF
Dielectric strength heater/bead	min. 200V
Isolation resistance heater/bead	> 10 MΩ at 50V

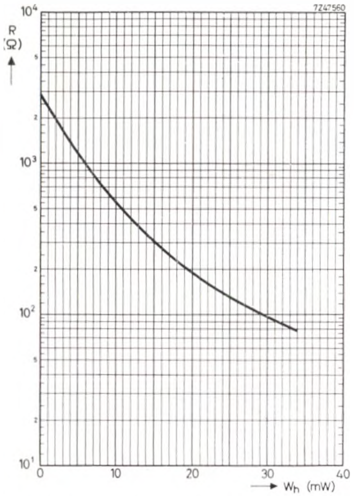
[1] Defined according to CCTU 11-01



Resistance/temperature characteristic

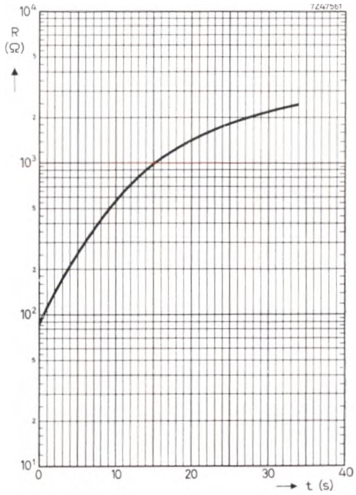


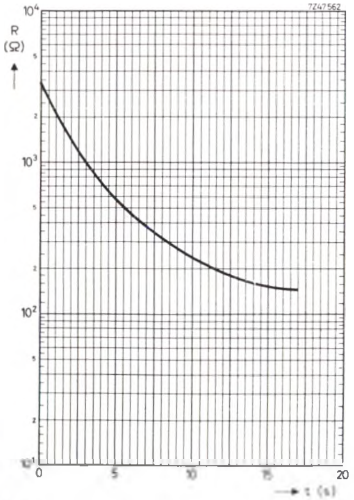
Voltage/current characteristics



Resistance/power characteristic

Cooling characteristic

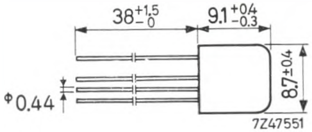


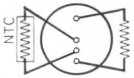


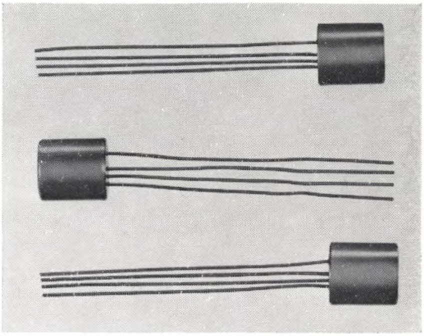
Response time characteristic (W_{heater} = 30 mW)

NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS - NTC

INDIRECTLY HEATED TYPES



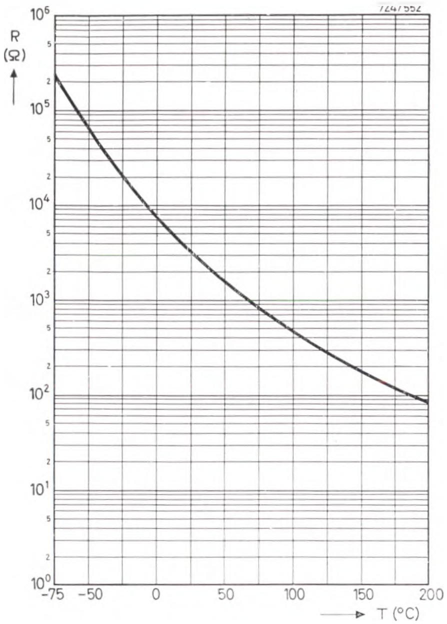




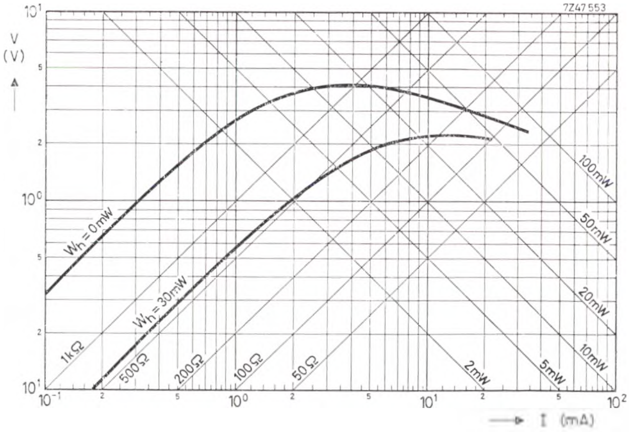
This indirectly heated thermistor is mounted in an air-filled metal casing. Compared with type E207AC/P3K3 it has a much higher heater power due to the higher dissipation constant; therefore the time constant, defined as per CCTU 11–01, is lower.

Type number	E207BD/P3K3
R_{25}	3300Ω ± 20%
B-value	2775 °K ± 5%
Colour code	orange-orange-red
W_{max} (heater)	80 mW
T_{max}	200 °C
Resistance heater	100Ω ± 10%
Dissipation constant	approx. 0.50 mW/°C
Heater efficiency[1]	approx. 90%
Time constant[1]	approx. 1.2 sec.
Capacitance heater/bead	approx 1.1 pF
Dielectric strength heater/bead	minimum 200 V
Isolation resistance heater/bead	10 MΩ

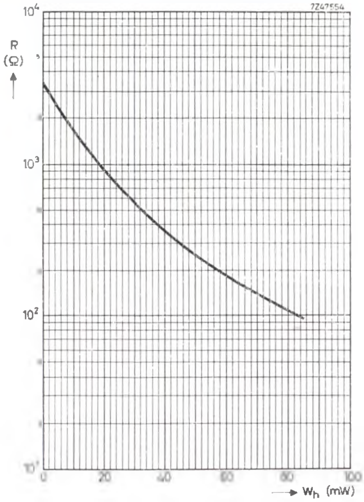
[1] Defined according to CCTU–11–01



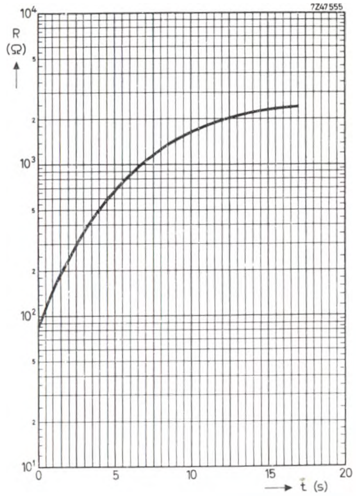
Resistance/temperature characteristic



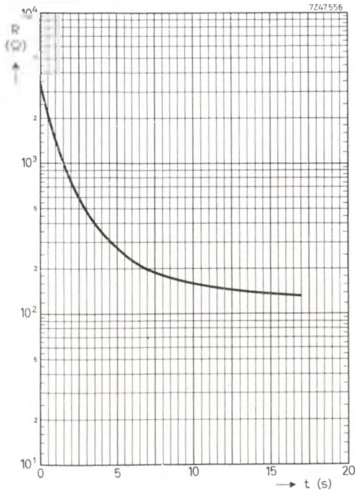
Voltage/current characteristics



Resistance/power characteristic



Cooling characteristic



Response time characteristic (W_{heater} = 80 mW)

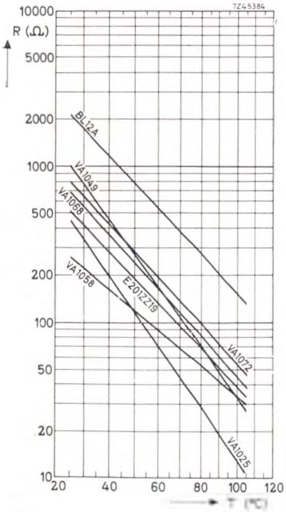
NTC - NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS

SPECIAL TYPES FOR MOTOR CARS

This special range discs has been developed for temperature sensors for the cooling water in motor cars. The NTC's are specified at a medium temperature (40–50 °C) and a higher temperature (96.5 to 100 °C), so that a high accuracy at the working temperature is obtained.

They are also suitable for temperature control in household appliances, such as washing machines.

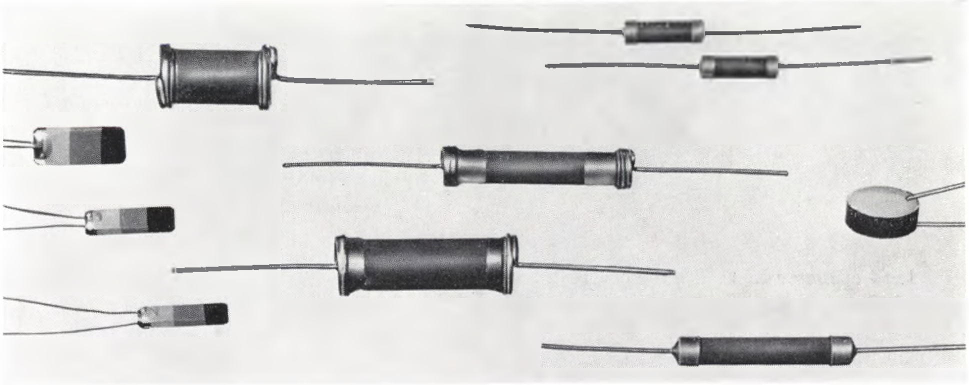
R_{25} (appr.) (Ω)	R_{40} (Ω)	R_{50} (Ω)	$R_{96.5}$ (Ω)	R_{100} (Ω)	diameter (mm)	type number
2200	1030–1310		147–173		7.0 ± 0.3	BL12A
500		175 –215		35 –43	6.9 ± 0.2	E201ZZ19
500		92.5–134		12 –15	6.9 ± 0.2	VA1025
1000		221.5–318.5		30 –36	6.9 ± 0.2	VA1049
270		97 –143		29.5–36.5	6.9 ± 0.2	VA1058
700		207 –264		41.4–48.6	6.9 ± 0.2	VA1068
800		244 –315		48.0–58.6	6.9 ± 0.2	VA1072



Resistance/temperature characteristics

NEGATIVE-TEMPERATURE-COEFFICIENT THERMISTORS - NTC

SPECIAL TYPES FOR RADIO AND TELEVISION

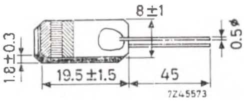


application	R_{25}	*B at 25°C approx.*	W_{max}	*normal operating conditions*		*dissipation constant (approx.)*	*type number*
	(Ω)	*(°K)*	*(W)*	*(mA)*	*(Ω)*	*(mW/°C)*	
compensation positive temperature coeff. of deflection coils	1.1 ± 20%	2650	1	2200	0.15–0.25	14	B832020
	32 + 30%/—20%	4200	1	1000	0.7 –1.1	14	B832030
	6 ± 20% *	2800	1	1000	~1	10	B832001P/6E
	10 ± 20% *	2950	1	900	~1.1	10	B832001P/10E
	12 ± 20%	2950	1	800	~1.2	10	B832001P/12E
	15 ± 20% *	3000	1	800	~1.2	10	B832001P/15E
	33 ± 20% *	3250	1	700	~1.4	10	B832001P/33E
protection of switch and Si-diode	125 ± 20%	4300	2	800	2–4	18	BL 28
	60 ± 20%	4300	2	1300	0.7–1.3	18	BL 39
heater chain protection	645 – 1210	3600	5	300	35–48	60	VA1015
	300 – 500	3700	2.5	300	25–32	30	VA1026
	800 – 1315	3800	2	200	36–52	16	VA1006
	2470 – 5370	4000	4	300	38–50	24	100102
	1750 – 3250	3000	3	100	200–250	20	100026/01
	6700 – 12600	3000	3	100	200–280	10	100092
shunt dial lamp	3870 – 7750	3000	3	200	60–90	10	83922

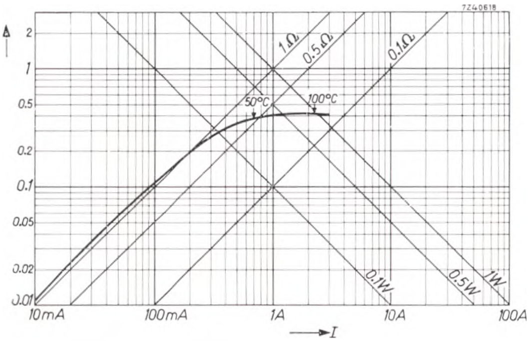
* For more information see disc thermistors series B (page E42).

For dimensions and characteristics see following pages.

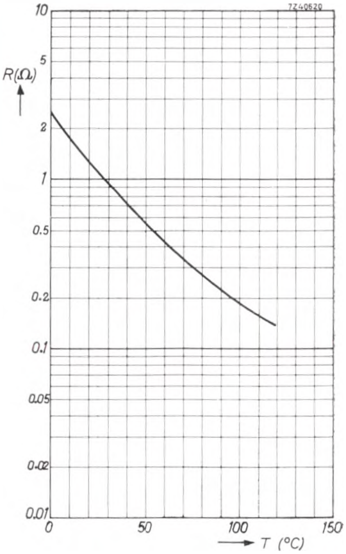
Type number B8 320 20



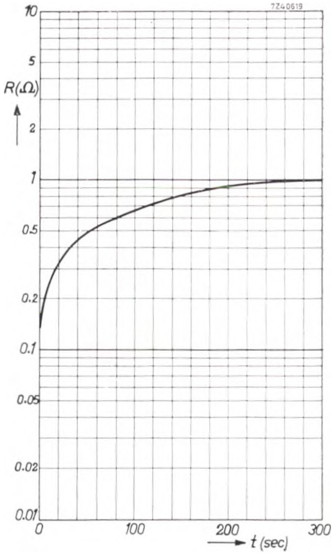
Lead diameter 0.6 mm in the course of 1966.



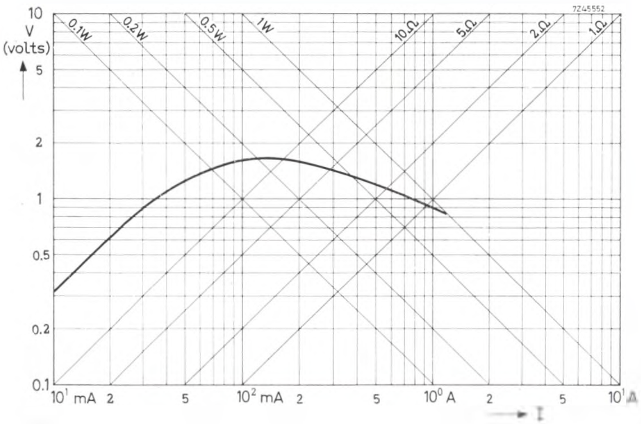
Voltage/current characteristics



Resistance/temperature characteristic

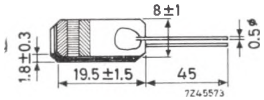


Cooling characteristic



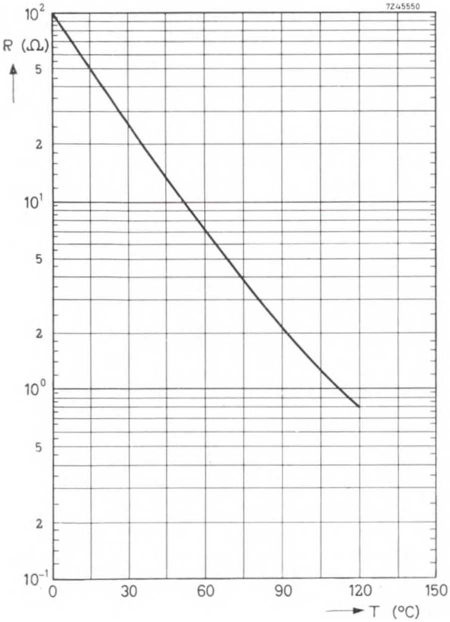
Voltage/current characteristic

Type number B8 320 30

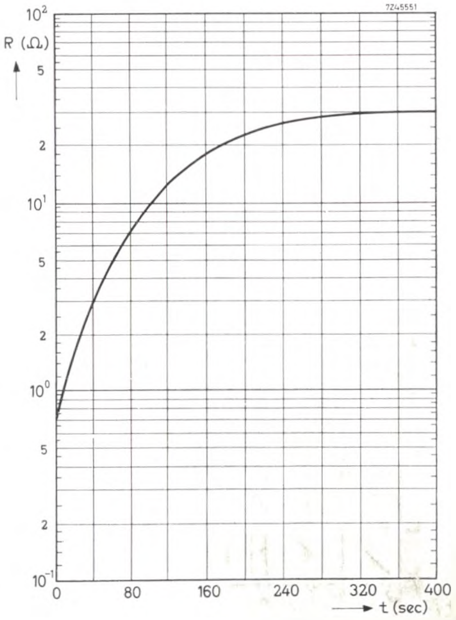


Lead diameter 0.6 mm in the course of 1966.

Resistance/temperature characteristic



Cooling characteristic

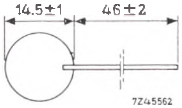


SPECIAL TYPES FOR RADIO AND TV

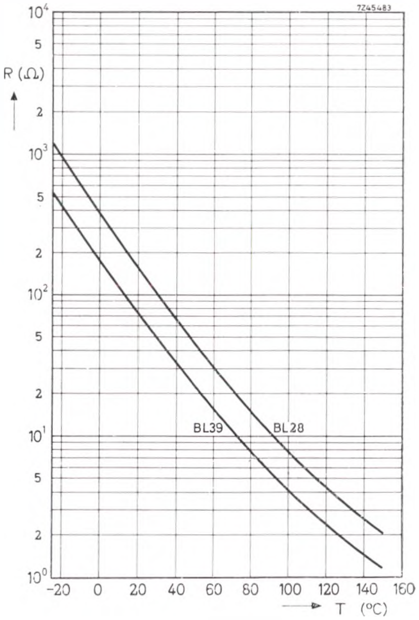
Type number B8 320 01P/...

For data see page E42.

Type numbers BL28 and BL39

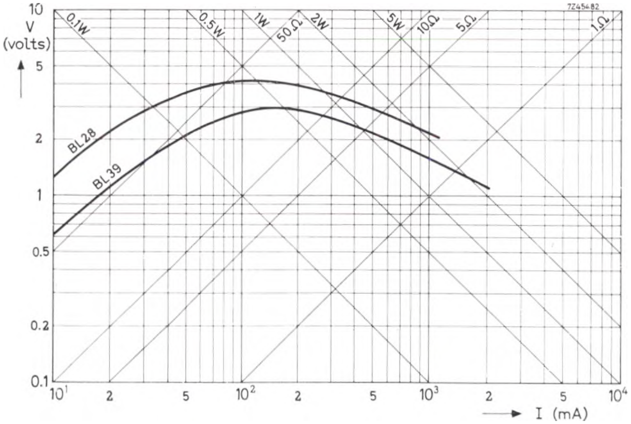


Dimensions will be changed in the course of 1966.

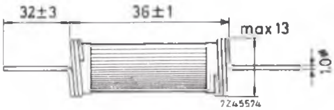


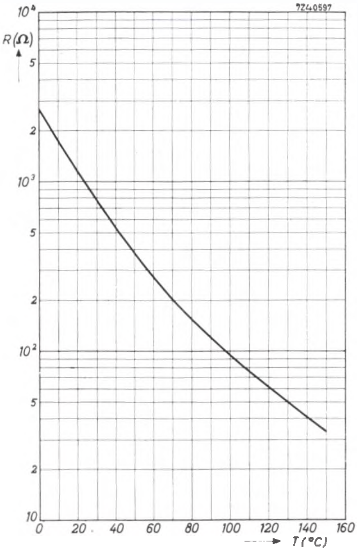
Resistance/temperature characteristics

Voltage/current characteristics

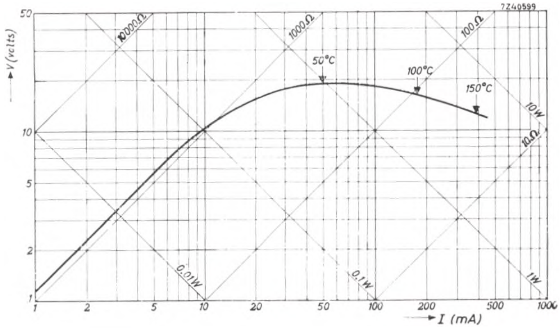


Type number VA1015

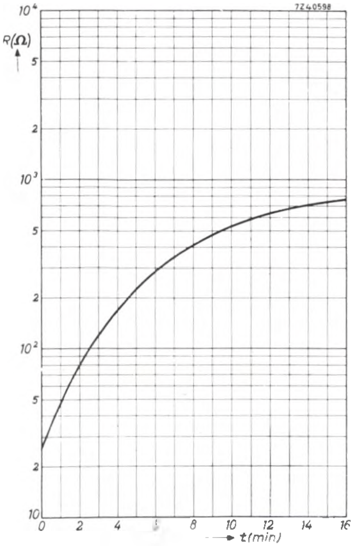




Resistance/temperature characteristic



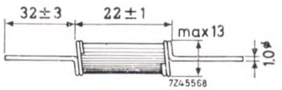
Voltage/current characteristic

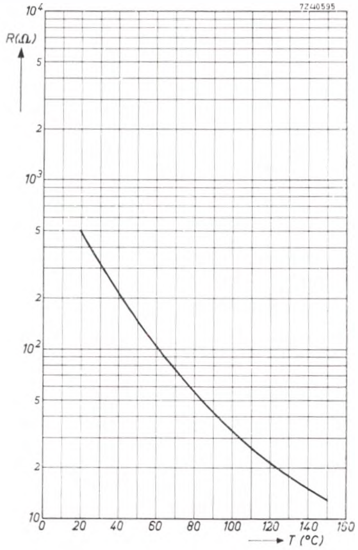


Cooling characteristic

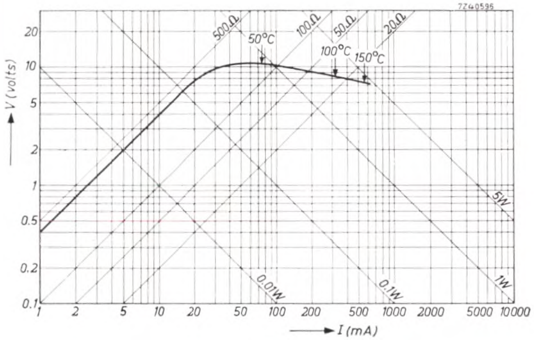
SPECIAL TYPES FOR RADIO AND TV

Type number VA1026

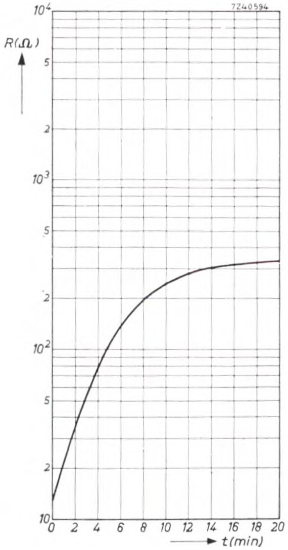




Resistance/temperature characteristic

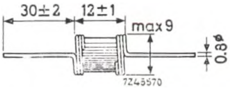


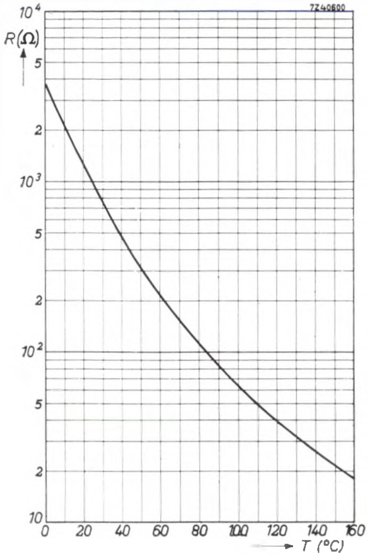
Voltage/current characteristic



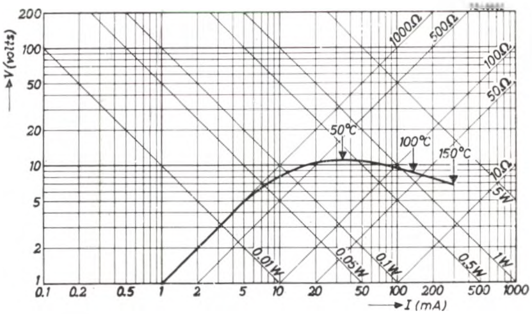
Cooling characteristic

Type number VA1006

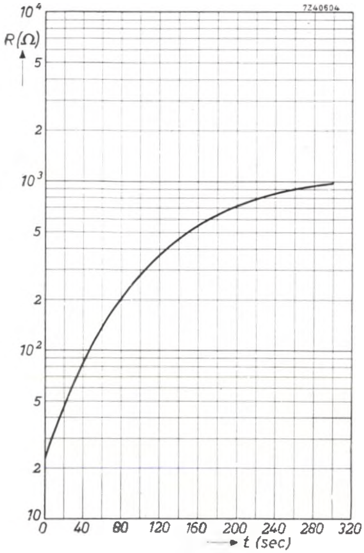




Resistance/temperature characteristic



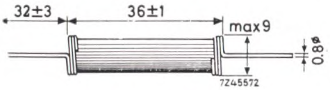
Voltage/current characteristic

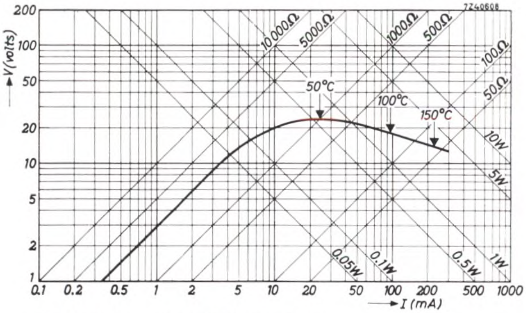


Cooling characteristic

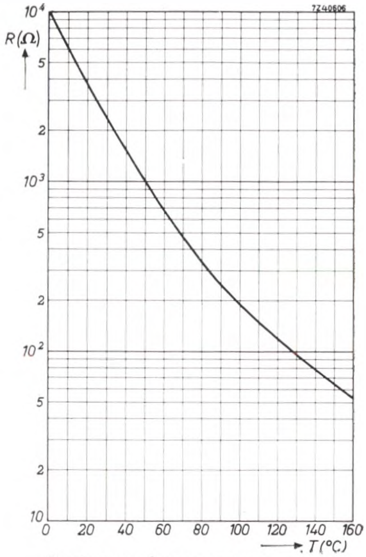
SPECIAL TYPES FOR RADIO AND TV

Type number 100102



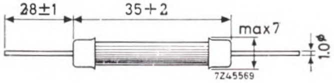


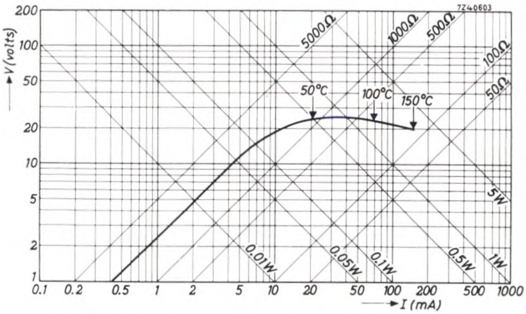
Voltage/current characteristic



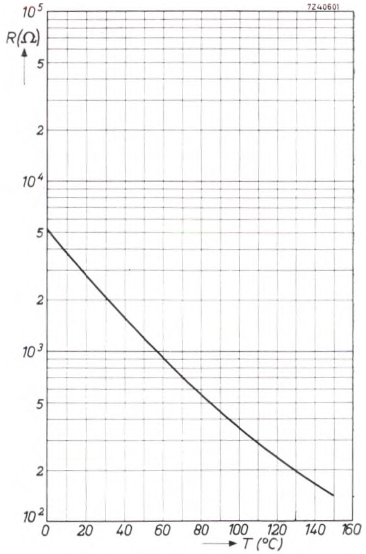
Resistance/temperature characteristic

Type number 100026/01





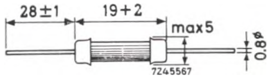
Voltage/current characteristic

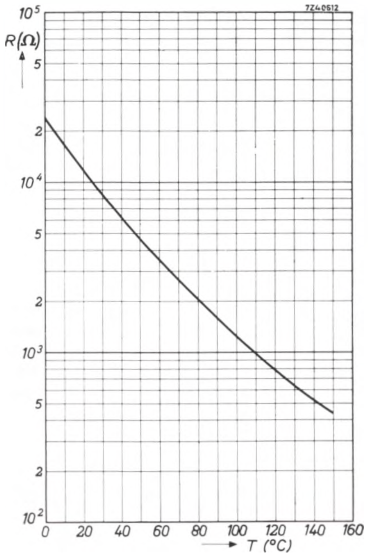


Resistance/temperature characteristic

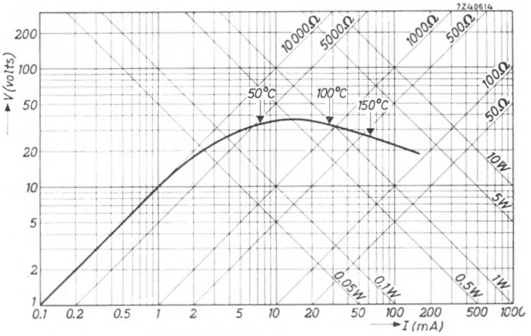
SPECIAL TYPES FOR RADIO AND TV

Type number 100092



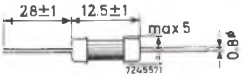


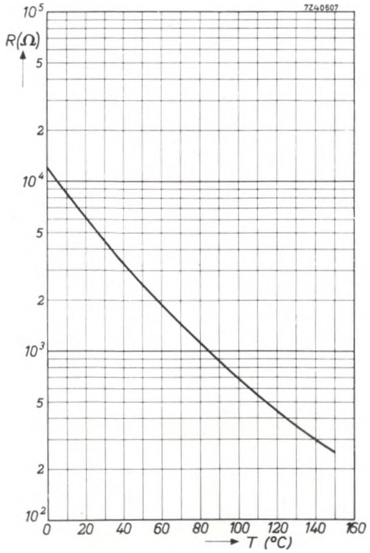
Resistance/temperature characteristic



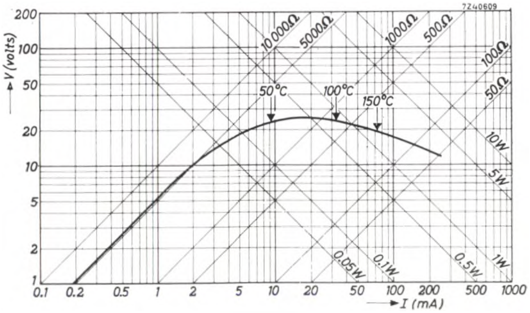
Voltage/current characteristic

Type number 83922





Resistance/temperature characteristic



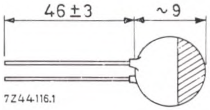
Voltage/current characteristic

PTC - POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS

The range of PTC thermistors consists of the following types:

1. standard discs 1W, 40–50 V;
2. standard discs 0.5 W, 25 V;
3. special types.

STANDARD DISCS 1 W, 40–50 V SERIES



R_{25} ±15%(Ω)	R at other temp.		switch temp.[1] (approx.) (°C)	max. temp. coeff. (%/°C)	V_{max}[2] (V)	colour code	type number
50	100 °C	3-20 kΩ	+35	+7	40	red	E 220 ZZ/01
30	40 °C 100 °C	< 90 Ω > 10kΩ	+50	+15	50	orange	/02
50	60 °C 100 °C	<100 Ω > 1kΩ	+80	+30	50	yellow	/03
40	95 °C 130 °C	< 80 Ω > 10kΩ	+110	+60	50	green	/04

[1] Defined as the temperature at which the resistance value is twice the value at 25 °C.
[2] Breakdown voltage.

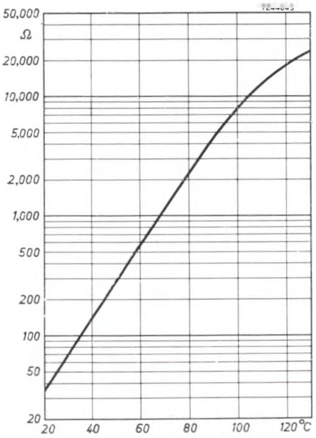
Dissipation constant for all types approx. 10 mW/°C.

Important.

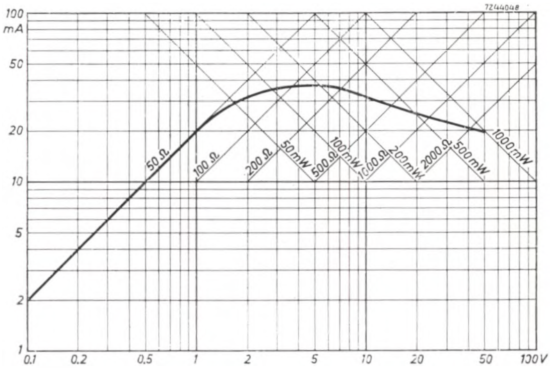
The above resistance values are measured at 1.5 V. Higher voltages may yield different values due to self-heating and voltage-dependency.

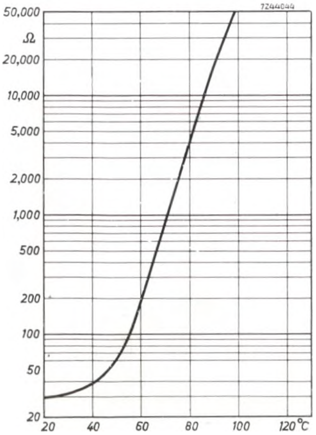
Resistance/temperature characteristics

Voltage/current characteristics

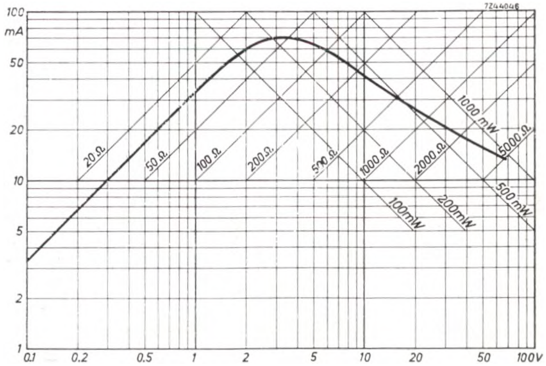


E220ZZ/01





E220ZZ/02

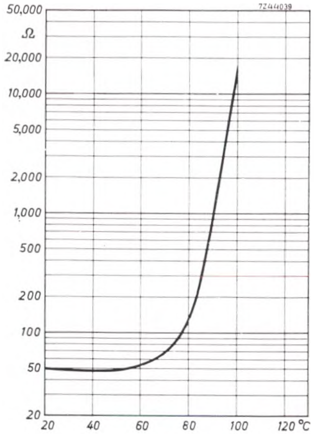


PTC - POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS

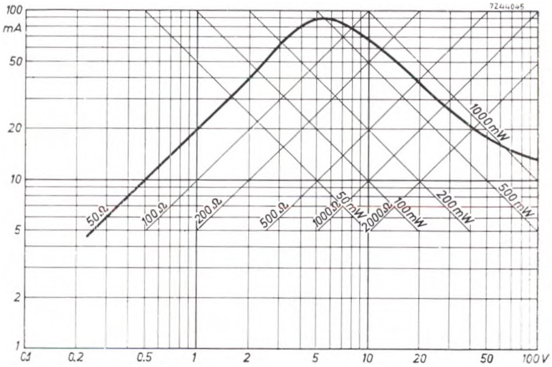
STANDARD DISCS 1 W, 40–50 V SERIES

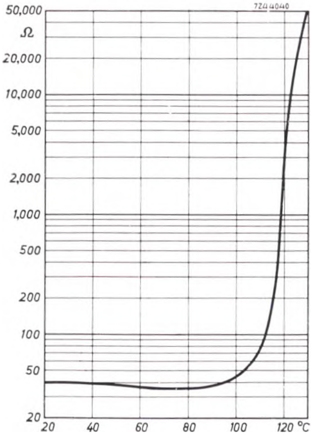
Resistance/temperature characteristics

Voltage/current characteristics

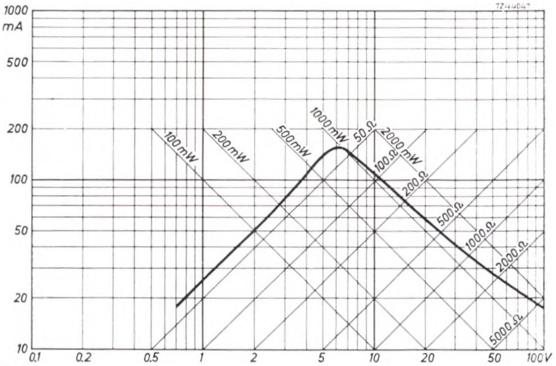


E220ZZ/03



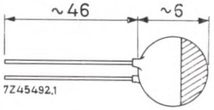


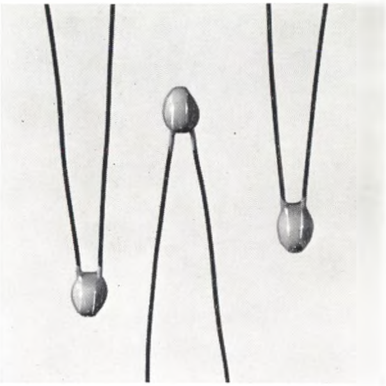
E220ZZ/04



POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS - PTC

STANDARD DISCS 0.5 W, 25 V SERIES





R_{25} ±30% (Ω)	R_{125}	R_{150}	switch temp.[2] (approx.) (°C)	max. temp. coeff. (%/°C)	V_{max} (V)	colour code	type number
60	3 kΩ < R < 15 kΩ		+ 35	+ 6	25	red	E 220 ZZ/11
50	100 kΩ < R < 500 kΩ		+ 50	+15	25	orange	/12
50	50 kΩ < R < 500 kΩ		+ 80	+25	25	yellow	/13
50	—	100kΩ < R < 1.2MΩ	+110	+35	25	green	/14

---

[1] Defined as the temperature at which the resistance value is twice the value at 25 °C.

[2] Breakdown voltage.

Dissipation constant for all types approx. 6 mW/°C.

Important

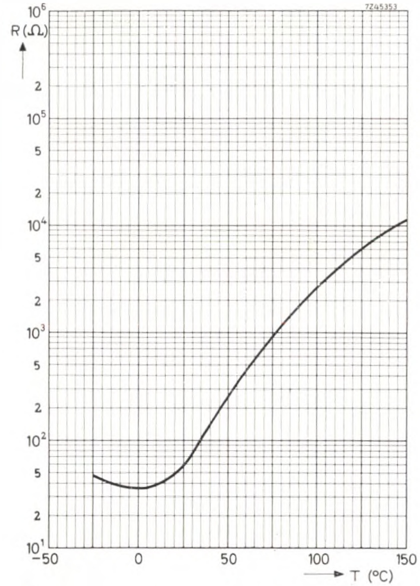
The above resistance values are measured at 1.5 V. Higher voltages may yield different values due to self-heating and voltage-dependency.

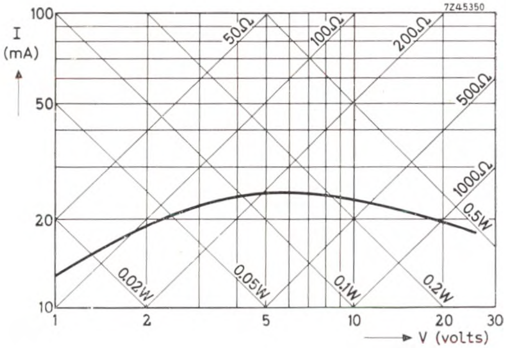
STANDARD DISCS 0.5 W, 25 V SERIES

Resistance/temperature characteristics

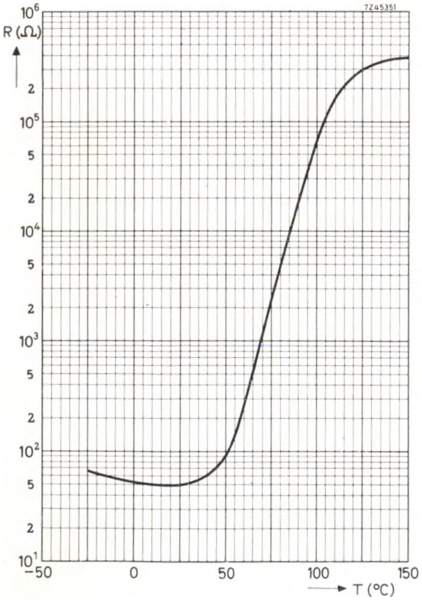
Voltage/current characteristics

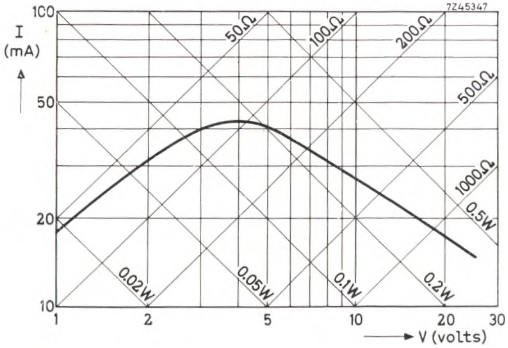
E220ZZ/11





E220ZZ/12



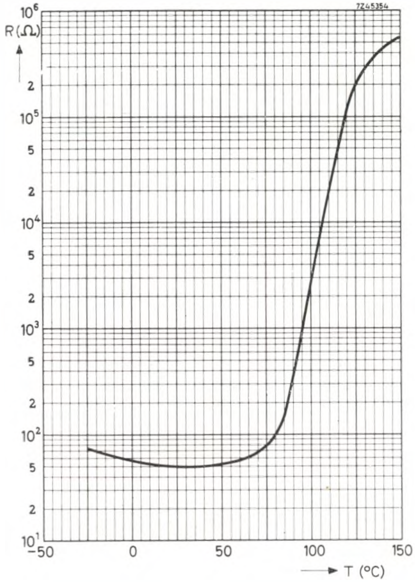


POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS - PTC

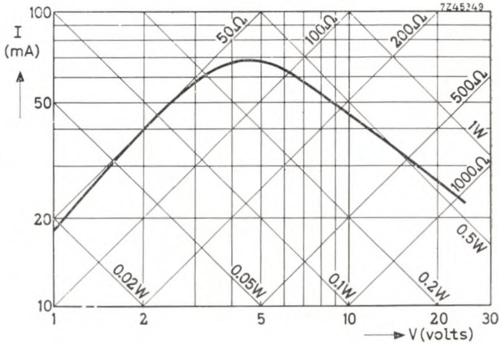
STANDARD DISCS 0.5 W, 25 V SERIES

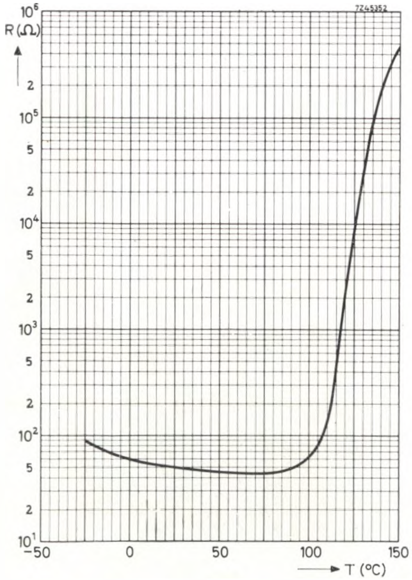
Resistance/temperature characteristics

Voltage/current characteristics

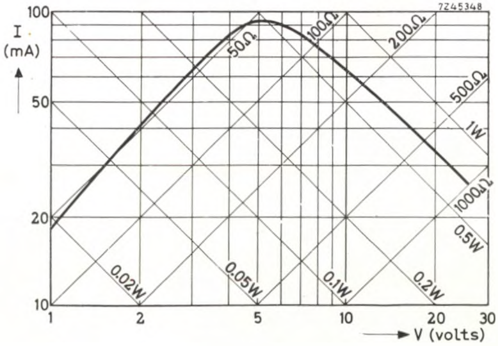


E220ZZ/13



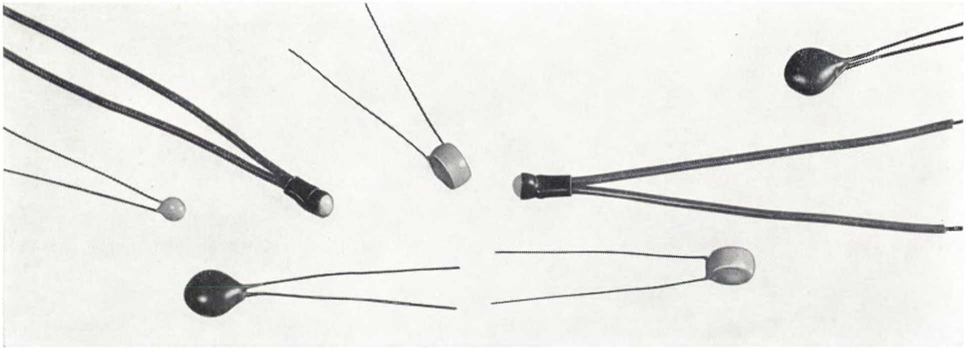


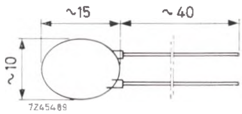
E220ZZ/14



PTC - POSITIVE-TEMPERATURE-COEFFICIENT THERMISTORS

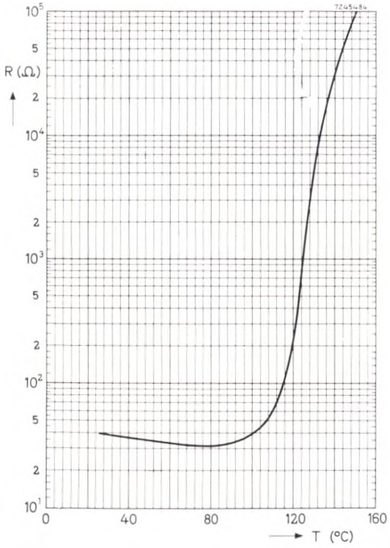
SPECIAL TYPES





Special types for high voltage applications up to hundreds of volts or low Curie temperatures (to —40 °C) can be made on request. For use as a motor protection device types have been developed with a special insulation against high voltage.

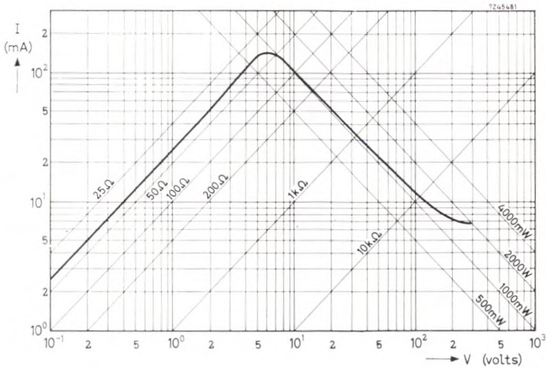
A typical example is the E220ZZ/06 which is used as a current limiting device in telecommunication apparatus.



Resistance/temperature characteristic

Data E220ZZ/06

R_{25}: 36–50Ω
V_{max}: 180 V_{dc}
Current at 180 V: <10 mA

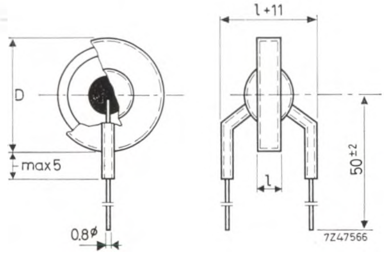


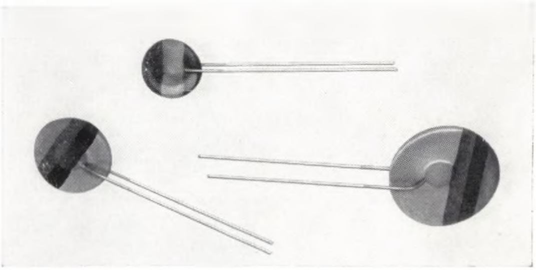
Voltage/current characteristic

The range of VDR resistors consists of the following types:

1. standard disc types with leads;
2. standard disc types with a hole;
3. standard rod types;
4. small disc types for special purposes;
5. special disc types for contact protection;
6. asymmetric types.

STANDARD DISC TYPES WITH LEADS





Most types are lacquered, inpregnated and colour-coded. Only some of the most important types are mentioned in this survey. Special types can be made on request. Values preferable according to I.E.C.-E12 series.

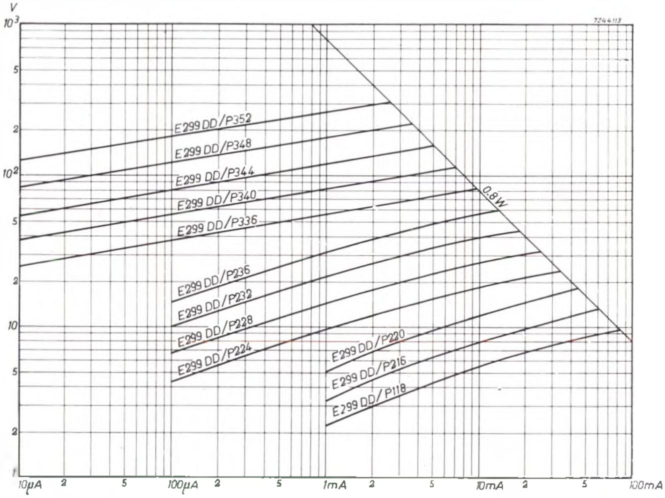
Tolerances: normal tolerance on voltage ± 20%; VDR's with a tolerance of ± 10% can also be supplied. For ± 10% tolerance change P of type number into A.
The lacquered ± 10% types have an extra silver colour band.

E.g. E299DD/P. . . : ± 20% tolerance on voltage
E299DD/A. . . : ± 10% tolerance on voltage and extra silver colour band

VDR - VOLTAGE-DEPENDENT RESISTORS

STANDARD DISC TYPES WITH LEADS

Voltage/current characteristics, type E229DD

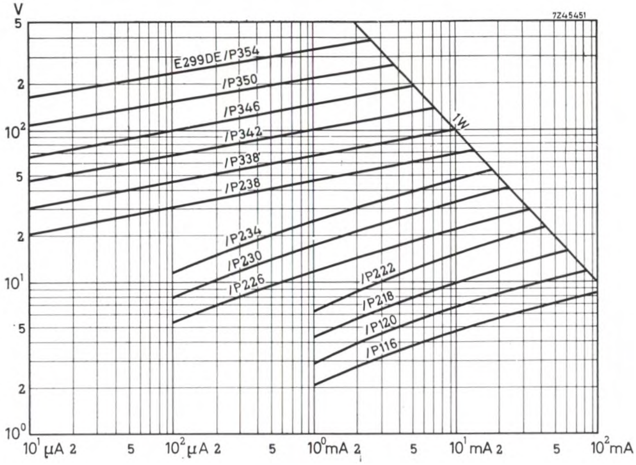


$W_{max} = 0.8$ W
$D_{max} = 14.5$ mm

I	E	β	C	l_{max}	colour code			type number
(mA)	(V)		(approx)	(mm)	I	II	III	
100	8	0.25–0.40	14	5	brown	brown	blue	E299DD/P116
100	10		18	5	brown	brown	grey	/P118
100	12		21	5	brown	red	black	/P120
10	8		25	5	red	brown	blue	/P216
10	10		32	5	red	brown	grey	/P218
10	12		40	5	red	red	black	/P220
10	15		48	5	red	red	red	/P222
10	18	0.21–0.35	57	5	red	red	yellow	/P224
10	22		60	5	red	red	blue	/P226
10	27		70	5	red	red	grey	/P228
10	33	0.18–0.25	85	5	red	orange	black	/P230
10	39		100	5	red	orange	red	/P232
10	47		130	5	red	orange	yellow	/P234
10	56		150	5	red	orange	blue	/P236
10	68		180	5	red	orange	grey	/P238
1	56	0.14–0.23	190	5	orange	orange	blue	/P336
1	68		230	5	orange	orange	grey	/P338
1	82	0.14–0.21	300	5	orange	yellow	black	/P340
1	100		350	5.5	orange	yellow	red	/P342
1	120		400	6	orange	yellow	yellow	/P344
1	150		500	6.5	orange	yellow	blue	/P346
1	180		600	7	orange	yellow	grey	/P348
1	220		750	7.5	orange	green	black	/P350
1	270		900	8	orange	green	red	/P352
1	330		1100	9	orange	green	yellow	/P354

STANDARD DISC TYPES WITH LEADS

Voltage/current characteristics, type E299DE



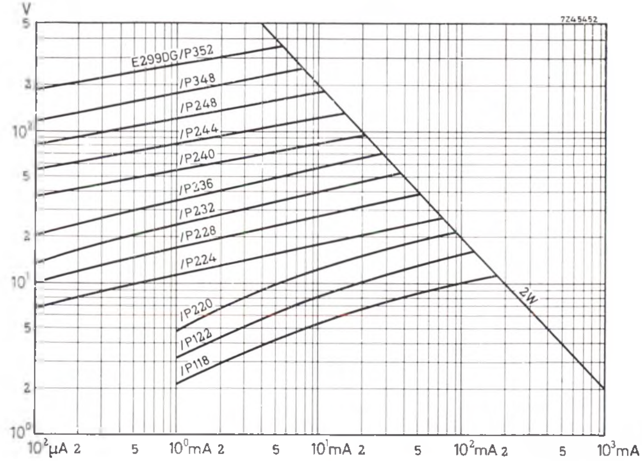
W$_{\max}$ = 1 **W**
D$_{\max}$ = 20 **mm**

I (*mA*)	*E* (*V*)	*β*	*C* (*approx*)	*l*$_{\max}$ (*mm*)	*colour code* *I*	*II*	*III*	*type number*
100	8	0.25–0.40	14	5	brown	brown	blue	E299DE/P116
100	10		18	5	brown	brown	grey	/P118
100	12		21	5	brown	red	black	/P120
100	15		26	5	brown	red	red	/P122
10	10		32	5	red	brown	grey	/P218
10	12		40	5	red	red	black	/P220
10	15		48	5	red	red	red	/P222
10	18	0.21–0.35	57	5	red	red	yellow	/P224
10	22		60	5	red	red	blue	/P226
10	27		70	5	red	red	grey	/P228
10	33	0.18–0.25	85	5	red	orange	black	/P230
10	39		100	5	red	orange	red	/P232
10	47		130	5	red	orange	yellow	/P234
10	56		150	5	red	orange	blue	/P236
10	68		180	5	red	orange	grey	/P238
10	82	0.14–0.23	190	5	red	yellow	black	/P240
1	68		230	5	orange	orange	grey	/P338
1	82	0.14–0.21	300	5	orange	yellow	black	/P340
1	100		350	5.5	orange	yellow	red	/P342
1	120		400	6	orange	yellow	yellow	/P344
1	150		500	6.5	orange	yellow	blue	/P346
1	180		600	7	orange	yellow	grey	/P348
1	220		750	7.5	orange	green	black	/P350
1	270		900	8	orange	green	red	/P352
1	330		1100	9	orange	green	yellow	/P354

VDR - VOLTAGE-DEPENDENT RESISTORS

STANDARD DISC TYPES WITH LEADS

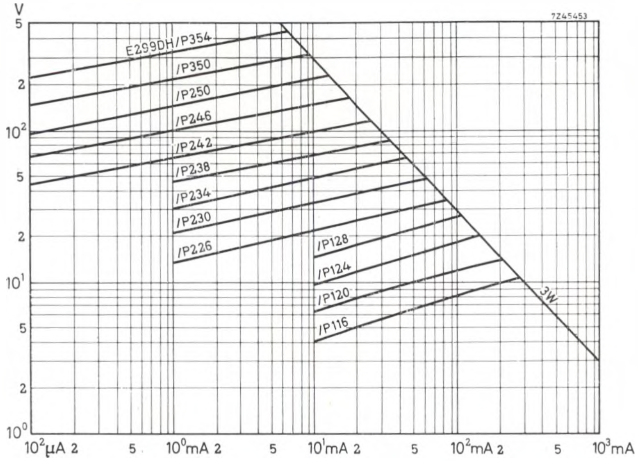
Voltage/current characteristics, type E299DG



W_{max} = 2 W
D_{max} = 27,5 mm

I	*E*	*β*	*C*	*l*max	*colour code*			*type number*
(mA)	*(V)*		*(approx)*	*(mm)*	*I*	*II*	*III*	
100	8	0.25–0.40	14	5	brown	brown	blue	E299DG/P116
100	10		18	5	brown	brown	grey	/P118
100	12		21	5	brown	red	black	/P120
100	15		26	5	brown	red	red	/P122
100	18		32	5	brown	red	yellow	/P124
10	12		38	5	red	red	black	/P220
10	15		47	5	red	red	red	/P222
10	18	0.21–0.35	57	5	red	red	yellow	/P224
10	22		60	5	red	red	blue	/P226
10	27		70	5	red	red	grey	/P228
10	33	0.18–0.25	84	5	red	orange	black	/P230
10	39		97	5	red	orange	red	/P232
10	47		125	5	red	orange	yellow	/P234
10	56		140	5	red	orange	blue	/P236
10	68		175	5	red	orange	grey	/P238
10	82	0.14–0.23	170	5	red	yellow	black	/P240
10	100		210	5	red	yellow	red	/P242
10	120	0.14–0.21	250	5	red	yellow	yellow	/P244
10	150		320	5.5	red	yellow	blue	/P246
10	180		380	6	red	yellow	grey	/P248
1	150		450	6.5	orange	yellow	blue	/P346
1	180		540	7	orange	yellow	grey	/P348
1	220		660	7.5	orange	green	black	/P350
1	270		810	8	orange	green	red	/P352
1	330		980	9	orange	green	yellow	/P354

Voltage/current characteristics, type E299DH

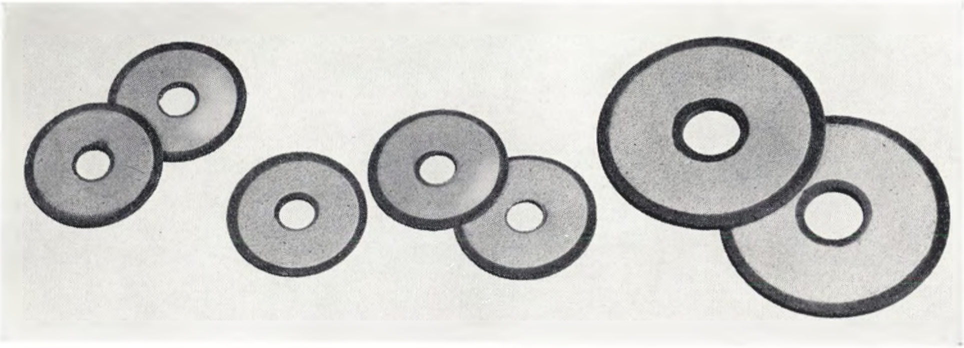


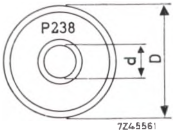
W_{max} = 3 W
D_{max} = 42,5 mm

I (*mA*)	*E* (*V*)	*β*	*C* (*approx*)	*l*max (*mm*)	*colour code* *I*	*II*	*III*	*type number*
100	8	0.25–0.40	14	5	brown	brown	blue	E299DH/P116
100	10		18	5	brown	brown	grey	/P118
100	12		21	5	brown	red	black	/P120
100	15		26	5	brown	red	red	/P122
100	18		32	5	brown	red	yellow	/P124
100	22		34	5	brown	red	blue	/P126
100	27		48	5	brown	red	grey	/P128
100	33	0.21–0.35	53	5	brown	orange	black	/P130
10	22		60	5	red	red	blue	/P226
10	27		70	5	red	red	grey	/P228
10	33	0.18–0.25	84	5	red	orange	black	/P230
10	39		97	5	red	orange	red	/P232
10	47		125	5	red	orange	yellow	/P234
10	56		140	5	red	orange	blue	/P236
11	68		175	5	red	orange	grey	/P238
10	82	0.14–0.23	170	5	red	yellow	black	/P240
10	100		210	5	red	yellow	red	/P242
10	120	0.14–0.21	250	5	red	yellow	yellow	/P244
10	150		320	5.5	red	yellow	blue	/P246
10	180		380	6	red	yellow	grey	/P248
10	220		460	6.5	red	green	black	/P250
10	270		550	7	red	green	red	/P252
1	220		660	7.5	orange	green	black	/P350
1	270		810	8	orange	green	red	/P352
1	330		980	9	orange	green	yellow	/P354

VOLTAGE-DEPENDENT RESISTORS - VDR

STANDARD DISC TYPES WITH A HOLE



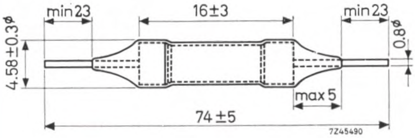


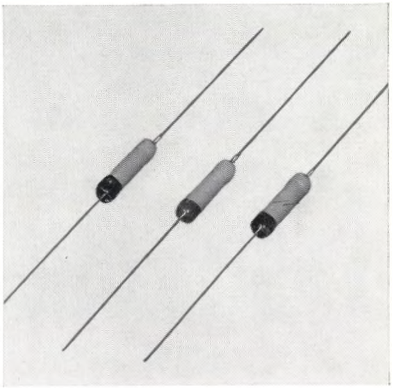
For mounting purposes VDR's with a hole can be supplied.
The electrical characteristics of these VDR's are identical to those of the equivalent lacquered types.
The discs are marked with the type number suffix.

I (*mA*)	E (*V*)	β	*C* (*approx*)	W_{max} (*W*)	*dimensions* (*mm*)		*type number*
					D	*d*	
10	27	0.21–0.35	70	2	25	6	E299AG/P228
10	39	0.21–0.30	100				/P232
10	56		150				/P236
10	82	0.14–0.23	170				/P240
10	120	0.14–0.21	250				/P244
10	180		400				/P248
1	180		600				/P348
1	270		800				/P352
10	22	0.21–0.35	70	3	40	10	E299AH/P226
10	33	0.18–0.25	90				/P230
10	47		120				/P234
10	68		180				/P238
10	100	0.14–0.23	200				/P242
10	150	0.14–0.21	300				/P246
10	220		500				/P250
1	220		700				/P350
1	330		1000				/P354

VDR - VOLTAGE-DEPENDENT RESISTORS

STANDARD ROD TYPES

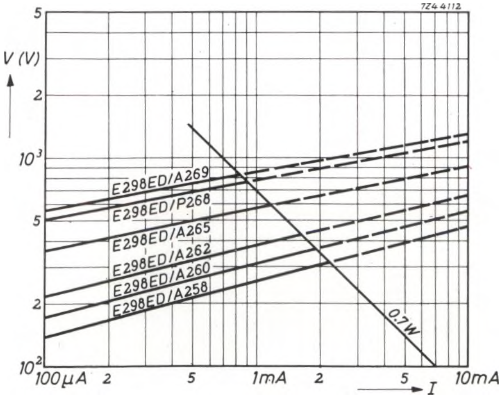




W$_{\text{max}}$ 0.7 W

I (mA)[1]	E (V)[1]	tolerance	β	colour code	type number
10	470	± 10%	0.20–0.25	green	E298ED/A258
10	560	± 10%	0.18–0.23	blue	/A260
10	680	± 10%	0.18–0.23	violet	/A262
10	910	± 10%	0.18–0.23	white	/A265
10	1200	± 20%	0.17–0.22	grey	/P268
10	1300	± 10%	0.16–0.21	red	/A269
1	300	± 20%	0.18–0.25	yellow	/P353
2	950	± 10%	0.16–0.21	black/blue	E298 ZZ/06

Measured under pulse conditions

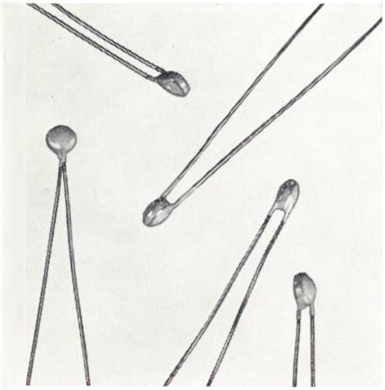


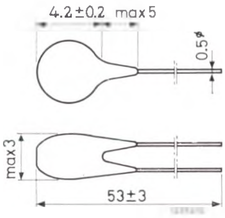
Voltage/current characteristics

The characteristic of type E 298 ZZ/06 can be compared with that of type E 298 ED/A269. The same holds for types E 298 ED/P353 and E 298 ED/A260.

VDR - VOLTAGE-DEPENDENT RESISTORS

SMALL DISC TYPES FOR SPECIAL PURPOSES





For use in e.g. small battery motors (to protect the collector and to suppress interferences in radio and TV) type E297ZZ/01 has been developed which can be mounted in the rotor.

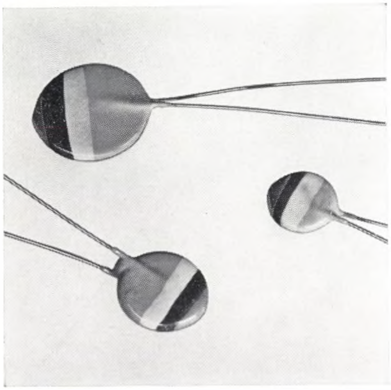
Data E297ZZ/01:
current at 6 $V_{dc} \leq$ 1 mA
current at 25 $V_{dc} \geq$ 10 mA
W_{max} 0.1 W

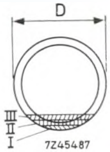
For use in colour television a special range of VDR discs has been developed:

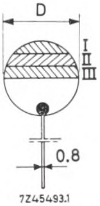
Tentative data

I (*mA*)	E (*V*)	*tolerance on voltage*	*type number*
1	6	±20%	E297 ZZ/02
1	9	±20%	/03
1	12	±15%	/04
1	15	±15%	/05
1	18	±12%	/06

SPECIAL DISC TYPES FOR CONTACT PROTECTION







Colour code:

For all types:
colour band I is grey
colour band III is white

Colour band II indicates the last digit of the type number:

0 = black
1 = brown
2 = red
3 = orange
4 = yellow
5 = green
6 = blue

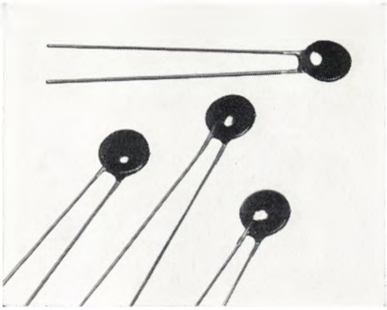
This range is specially developed for contact protection of relays in telephone exchanges. These VDR's are extremely stable and can stand current surges of decimals of Amps without changing their characteristics perceivably.
Two versions are available: the VAP-SF series without leads in a non-lacquered, fully impregnated version and the VAP-AF series with leads in a lacquered and also impregnated version.
These resistors meet the severe specifications of official inspection offices for telephone equipment.

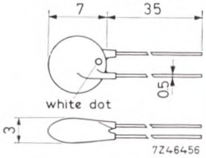
V (V)	I (mA)	V1) (pulse)	I1) (mA)	W_{max} (W)	diameter (D) (mm)	type number	
						without leads	with leads
48	<0.5	150	> 42	1	17	VAP11SF 0	VAP11AF 0
48	<0.9	150	> 76	1	17	1	1
48	<1.7	150	>115	1	17	2	2
48	<3	150	>180	1	17	3	3
48	<5	150	>268	1	17	4	4
48	<9	150	>430	1	17	5	5
48	<15	150	>455	1	17	6	6
48	<0.5	150	> 27	0.4	12.5	VAP21SF 0	VAP21AF 0
48	<0.9	150	> 34	0.4	12.5	1	1
48	<1.7	150	> 65	0.4	12.5	2	2
48	<3	150	> 91	0.4	12.5	3	3
48	<5	150	>152	0.4	12.5	4	4
48	<1.7	150	> 52	0.25	9.5	VAP31SF 2	VAP31AF 2
48	<3	150	> 72	0.25	9.5	3	3
48	<5	150	>121	0.25	9.5	4	4

1) These measurements are based on a combination of the VDR and a coil. Full test conditions will be sent on request.

VDR - VOLTAGE-DEPENDENT RESISTORS

ASYMMETRIC TYPES





Based on a barrier-layer effect, the asymmetric voltage-dependent resistors differ in many aspects from the well-known voltage dependent resistors made of silicon carbide. Its characteristic is asymmetric; in the forward direction, the characteristic shows a very low β-value and C-value while in the reverse direction β- and C-values are much higher. Its parallel capacitance in forward as well as in reverse direction is relatively high.

They can be used for instance for stabilisation of the supply current in transistorised battery receivers.

For the time being two types are available.

Tentative data

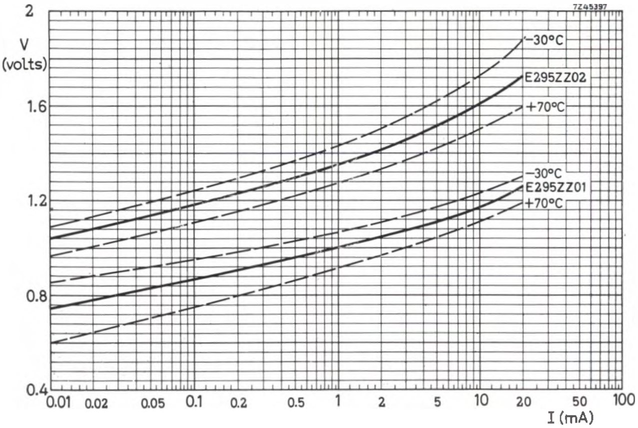
	at $T_{amb} = 25\ °C$	*type number*	
		E295ZZ/01	E295ZZ/02[1]
forward direction	voltage at 1 mA	1.0V ± 10%	1.35V ± 10%
	temp. coeff.	$>-0.2\%/°C$	$>-0.2\%/°C$
	β	0.05–0.08	0.06–0.09
	capacitance at 0 mA	~0.15 μF	~0.15 μF
	at 5 mA	~10 μF	~10 μF
	max. permissible current	25 mA	20 mA
reverse direction	current at 5V	<20 μA	<20 μA
	capacitance at 0V	~0.15 μF	~0.15 μF
	at 5V	~0.05 μF	~0.05 μF
	max. permissible voltage	5V	5V

In the course of 1966 the colour code will be changed as follows:
E295ZZ/01: black and brown band
E295ZZ/02: black and red band

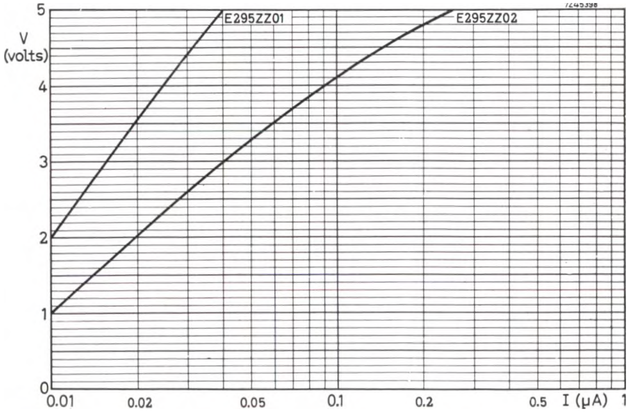
[1] The E 295ZZ/02 has an extra orange colour dot.

temperature range: −30 to +70 °C
cathode is indicated by a white colour dot

Voltage/current characteristics of the E295 series



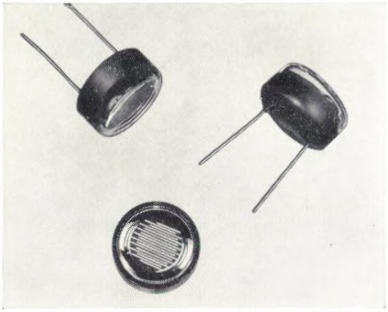
Conduction direction

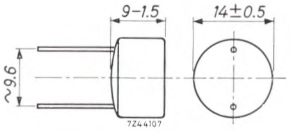


Reverse direction

LDR - LIGHT-DEPENDENT RESISTORS

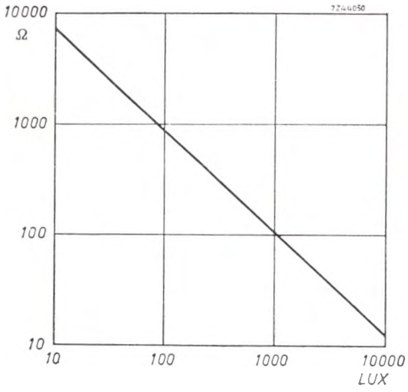
TYPE NUMBER B8 731 03





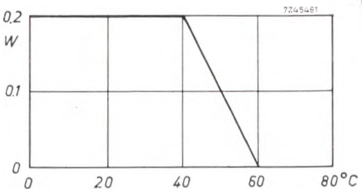
Light-dependent resistors are virtually small photoconductive cells, encapsulated in glass and special synthetic resin, and provided with two tinned copper connecting leads (0.6 Ø × 15 mm)

dark value	R_D = min. 10 MΩ (measured after 30 min. in total darkness)
light value	R_L = 75–300 Ω (measured at 1,000 lux)
recovery rate	v = min. 200 kΩ/sec. (i.e. the resistance rise per second at falling light intensity)
permissible voltage. . .	E_{max} = 150 V_{peak} (provided that W_{max} is not exceeded)
ambient temperature . .	—20/+60 °C
capacitance	max. 6 pF



Resistance value
as a function of light intensity

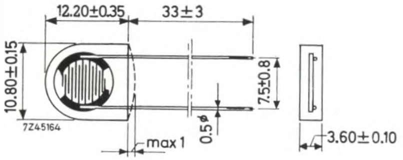
Derating curve

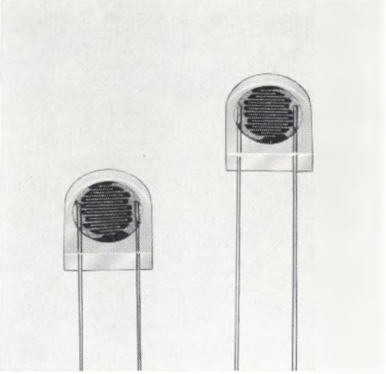


A special version (LDR03/05) with a lower light value is also available.
Type number: B8 731 03/05
Dark value: $R_D \geqslant$ 1 MΩ (measured after 30 sec. in total darkness)
Light value: $R_L <$ 150Ω
Other data and dimensions are the same as those of the LDR03

LIGHT-DEPENDENT RESISTORS - LDR

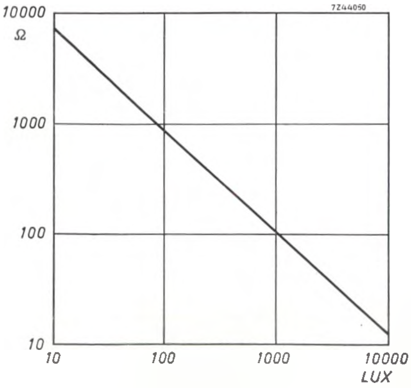
TYPE NUMBER B8 731 05





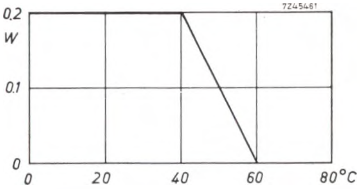
Like type B8 731 03, the LDR05 (B8 731 05) is virtually a small photoconductive cell. However, it has a different shape and is substantially smaller and lighter. The cell is sealed by means of a special, plastic coating.

dark value . . . . . . R_D = min. 10 MΩ (measured after 30 min. in total darkness)
light value . . . . . . R_L = 75–300 Ω (measured at 1,000 lux)
recovery rate . . . . . v = min. 200 kΩ/sec (i.e. the resistance rise per second at falling light intensity)
permissible voltage. . . E_{max} = 150 V_{peak} (provided that W_{max} is not exceeded)
ambient temperature. . —30/+60 °C



Resistance value
as a function of light intensity

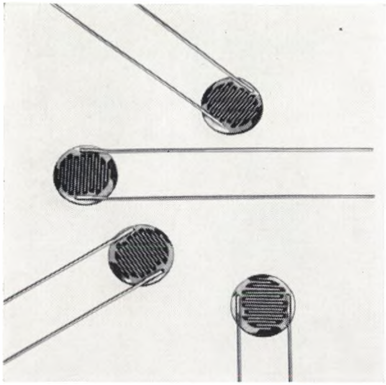
Derating curve

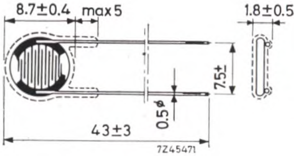


A special version (LDR05/05) with a lower light value is also available
Type number: B8731 05/05
Dark value: $R_D \leqslant$ 1 MΩ (measured after 30 sec. in total darkness)
Light value: $R_L < 150\Omega$
Other data and dimensions are the same as those of the LDR05
Important: Do not solder closer than 10 mm to the body. Complete soldering and handling instructions available on request.

LDR - LIGHT-DEPENDENT RESISTORS

TYPE NUMBER B8 731 07

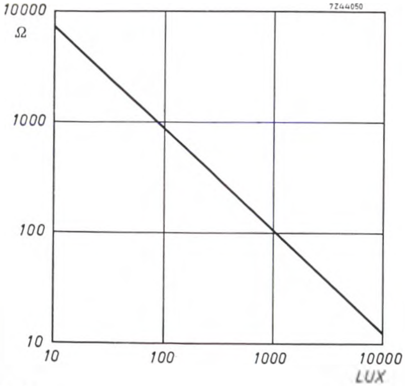




The LDR07 is identical to the LDR05 but has no plastic casing. The cell is covered with a special lacquer.

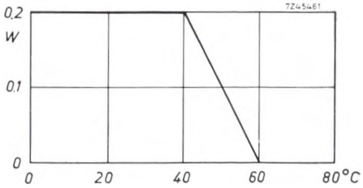
dark value	R_D = min. 10 MΩ (measured after 30 min. in total darkness
light value	R_L = 75–300 Ω (measured at 1,000 lux)
recovery rate	v = min. 200 kΩ/sec. (i.e. the resistance rise per second at falling light intensity)
permissible voltage. . . .	E_{max} = 150 V_{peak} (provided that W_{max} is not exceeded)
ambient temperature . .	—30/+60 °C

Important: Soldering and handling instructions available on request.

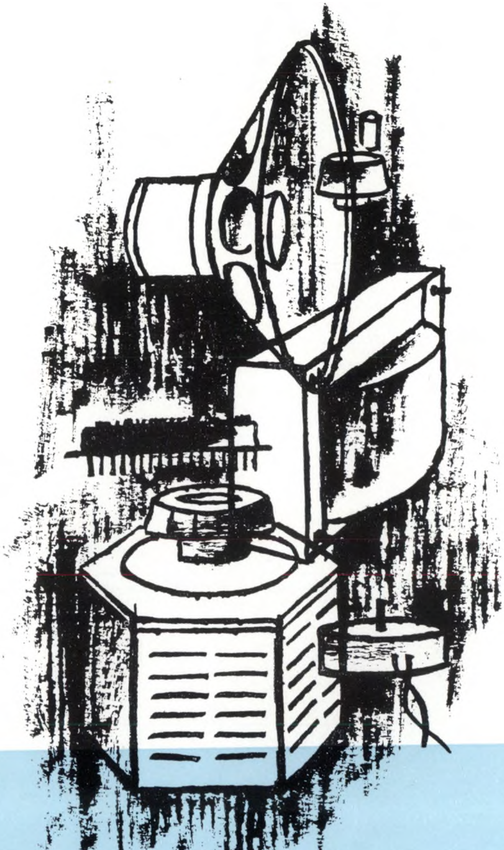


Resistance value
as a function of light intensity

Derating curve



ELECTRO-MECHANICAL
COMPONENTS
QUARTZCRYSTALS
LOUDSPEAKERS
COILS AND TRANSFORMERS

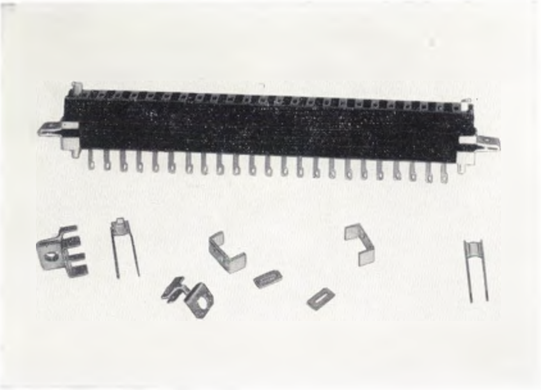


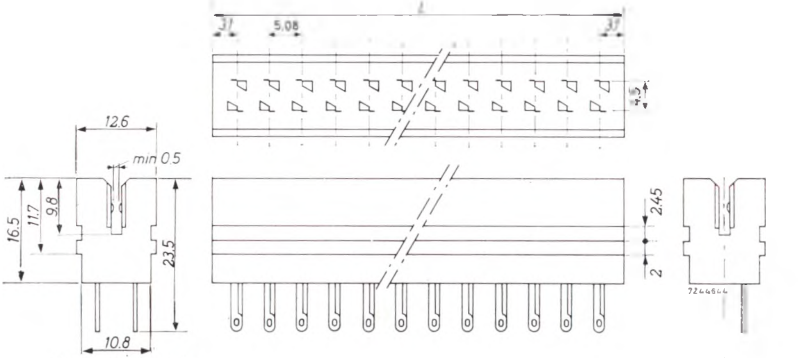
Miscellaneous

CONTENTS

0.2″ series - PRINTED-WIRING CONNECTORS

TYPE F045





L = 21–179 mm

double sided version

single sided version

Other contact arrangements available on request.
Contact identification marks can be incorporated.

PRINTED-WIRING CONNECTORS - 0.2″ series

TYPE F045

connector body	moulded black synthetic resin
contact springs	1μ gold upon 5μ nickel plated phosphor bronze, bifurcated
contact termination	soldering eyes
contact pitch	0.2″ = 5.08 mm
contact resistance	max. 8 mΩ per contact (inclusive material resistance)
permissible current	max. 5 A
board thickness	1/16″ (1.4—1.8 mm)
working voltage	1400 V (50 c/s)
working temperature	—40 +100 °C
insulation resistance	min. 10^4 MΩ
mounting	on rails or panels
polarity	accessories for polarised mounting, without loss of contact positions, are available.
number of contacts, single sided	max. 54
number of contacts, double sided	max. 108

Composition of the type number **F045.C/0..**

▶ number of positions

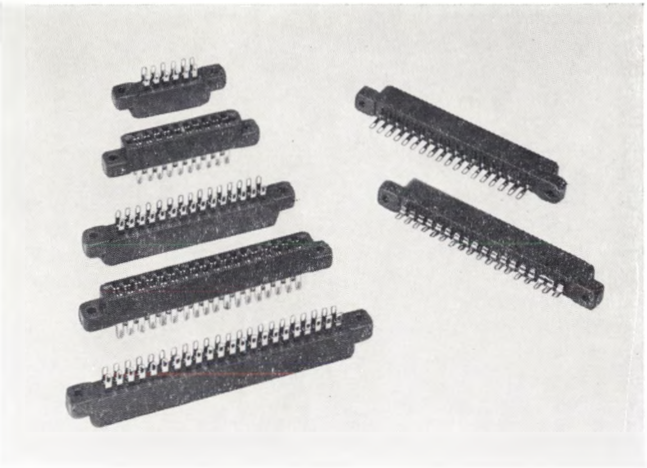
Versions

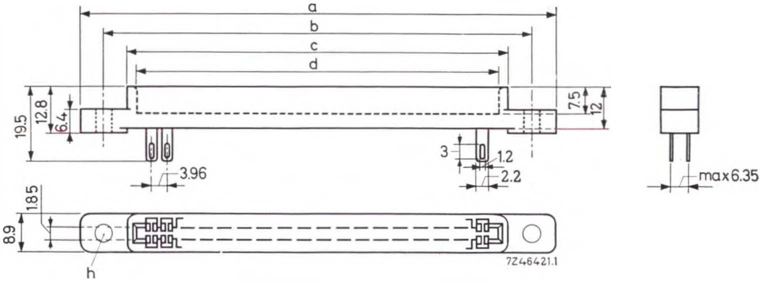
	single or double sided	*positions with contact springs*
A	single	all
B	double	all
C	single	all but the two outermost
D	double	all but the two outermost

Example:
The type number of a connector with 15 contacts, all singlesided, all with contact springs, is F045 AC/015.

0.156″ series - PRINTED-WIRING CONNECTORS

TYPE F047





number of contact springs per row	*dimensions (mm)*			
	a	b	c	d
06	46.2	38.9	31.8	27.80
10	62.1	54.8	47.7	43.63
15	82.0	74.7	67.6	63.45
18	93.9	86.6	79.5	75.34
22	109.8	102.5	95.4	91.14

PRINTED-WIRING CONNECTORS - 0.156″ series

TYPE F047

connector body	glass fibre filled diallyl phalate, blue
contact springs	1.3μ gold upon 5μ silver plated phosphor bronze, bifurcated
contact termination	soldering eyes
contact pitch	0.156″ (3.96 mm)
contact resistance	max. 6 mΩ (inclusive material resistance)
permissible current	5 A
board thickness	1/16″ (1.4–1.8 mm)
working voltage	354 V peak
test voltage	1800 V_{rms}
working temp.	−65°/+125 °C
insulation resistance	min. 10^6 MΩ
Mounting	on mounting plates or rails
polarity	keys for polarised mounting, without loss of contact positions, are available.
number of contacts	a) single sided: 6–10–15–18–22 b) double sided: 12–20–30–36–44
marking	according to MIL-C-21097B

Composition of the type number **F047.C/0..**

→ number of position

Versions:

	single or double sided	*mounting holes*
A	single	plain 3.2 mm
B	double	plain 3.2 mm
E	double-bridged	plain 3.2 mm
F	double	threaded bush[1]
G	single	threaded bush[1]
H	double-bridged	threaded bush[1]

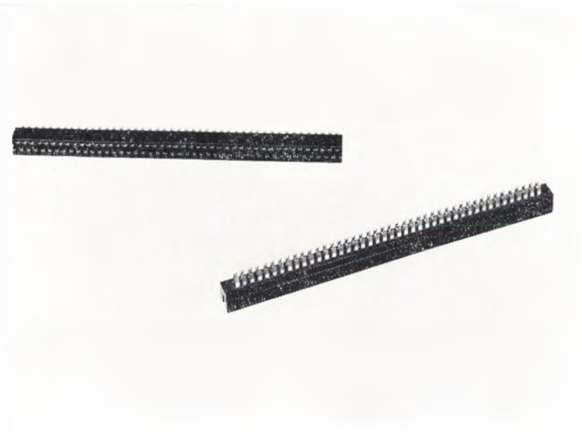
[1] 4-40NC-2B

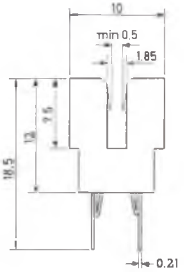
Example:

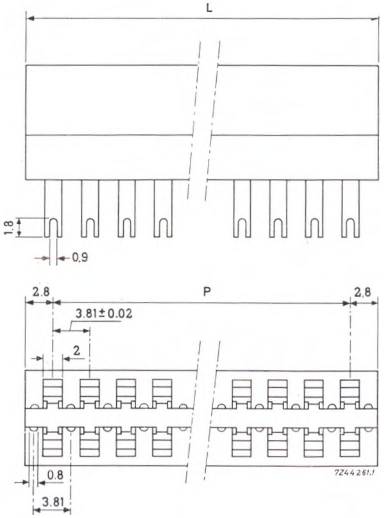
The type number of a connector with 22 contacts, all double-sided, all with contact springs and plain mounting holes, is F047 BC/022.

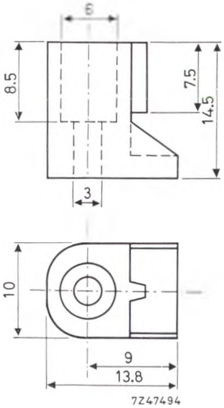
0.15" series - PRINTED-WIRING CONNECTORS

Type F046









mounting bracket

Type F046

connector body	moulded black synthetic resin
contact springs	1μ gold upon 5μ nickel-plated phosphor bronze, bifurcated
contact termination	open soldering lug
contact pitch	0.150″ (3.81 mm)
contact resistance	max. 8 mΩ (inclusive material resistance)
permissible current	max. 3 A
board thickness	1/16″ (0.055–0.071″ or 1.4–1.8 mm)
working voltage	max. 354 V_{peak}
test voltage	1400V (50 c/s)
working temperature	−40°/+100 °C
insulation resistance	min. 10^4 MΩ
mounting	on mounting plates, brackets or rails by means of plastic brackets
polarity	accessories for polarised mounting, without loss of contact positions, are available.
number of contacts single sided	max. 45
number of contacts double sided	max. 90

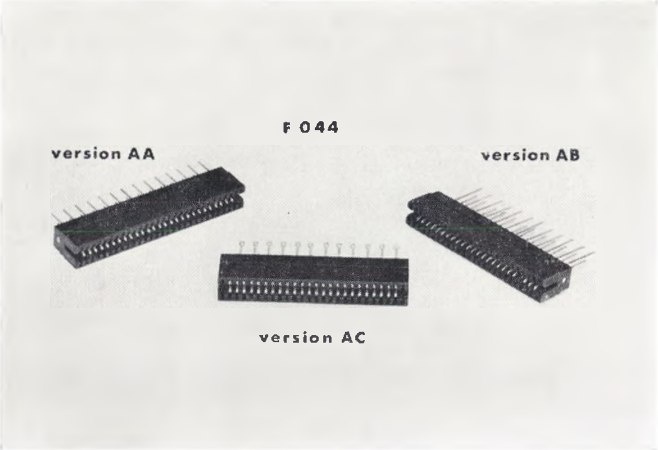
Composition of the type number **F046.C/0..**

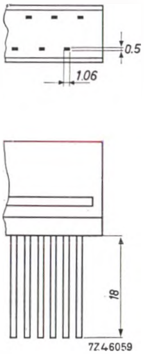
→ number of positions

	single or double sided	*positions with contact springs*
A	single	all
B	double	all
C	single	all but the two outermost
D	double	all but the two outermost

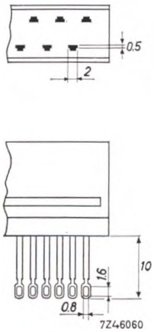
Example:
The type number of a connector with 31 contacts, all doublesided but for the two outermost ones, all with contact springs, is F046DC/033.

Type F044



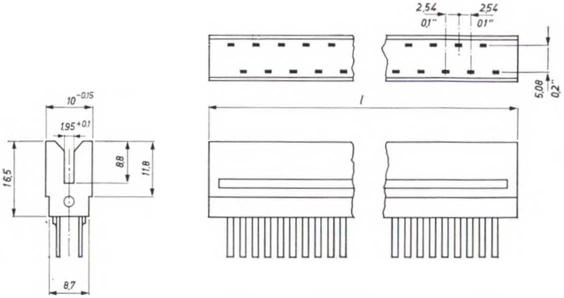


Type F044 AB
for wire-wrap



Type F044 AC
for soldering

l = 22–100 mm



Type F044AA for dip-soldering

Type F044

connector body	moulded black synthetic resin
contact springs	1μ gold upon nickel-plated phosphor bronze double wire springs, bridged
contact termination	soldering eye, wire-wrap or dip solder pins
contact pitch	0.1″ (2.54 mm)
contact resistance	max. 8 mΩ (inclusive material resistance)
permissible current	max. 3 A
board thickness	1/16″ (1.4–1.8 mm)
working voltage	max. 100 V_{peak}
test voltage	900 V_{peak} (50 c/s)
working temperature	−40°/+70 °C
insulation resistance	min. 10^4 MΩ
mounting	a) on mounting plates, brackets or rails b) on p.w. boards
polarity	by inserting a key over a contact mounting and polarizing accessoires are available.
number of contacts	max. 37

Composition of the type number **F044A./0..**

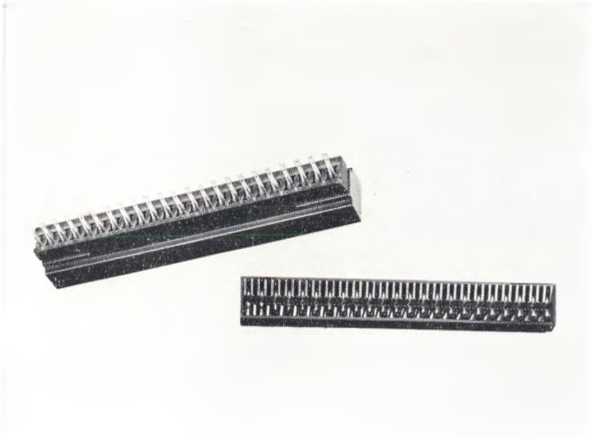
number of positions

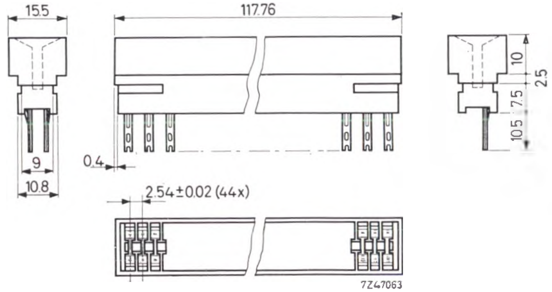
	kind of terminals	*positions with contact springs*
A	dip-solder	all, but the two outermost
B	wrip-wrap	
C	solder	

Example:
The type number of a connector with 11 contact springs and wire-wrap terminals is F044AB/013.

0.1″ series - PRINTED-WIRING CONNECTORS

TYPE ZE021

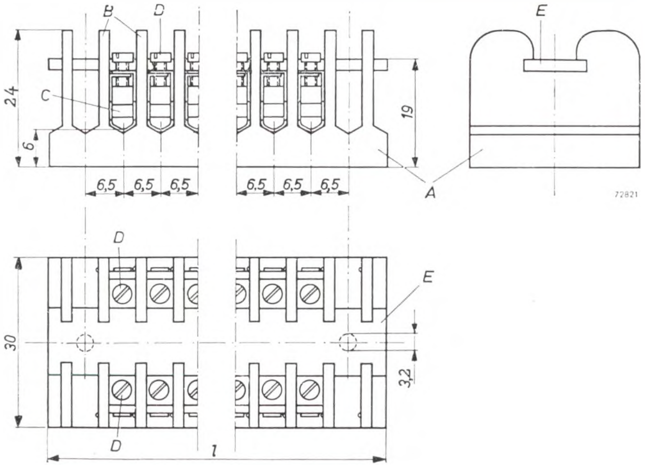




connector body	moulded black synthetic resin
contact springs	2μ gold upon 5μ nickel-plated phosphor bronze, dual contact guarantee
contact termination	soldering eyes
contact pitch	0.1″ or 0.2″
contact resistance	max. 8 mΩ (inclusive material resistance)
permissible current	max. 3 A
board thickness	1/16″ (1.4–1.8 mm)
test voltage	500 V_{dc}
working temperature	$-40°/+100$ °C
insulation resistance	min. 10^4 MΩ
mounting	on panels
polarity	by inserting a key over one position
number of contacts single sided	0.1″: max. 45
	0.2″: max. 23
double sided	0.1″: max. 90
	0.2″: max. 46
type numbers	will be indicated upon request

MIDGET CONNECTING BLOCKS - 88029 series

These connecting blocks are used in apparatus and installations where high requirements are imposed both on the quality of the connection and on the appearance.



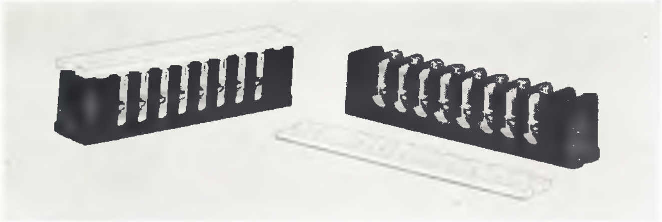
The 2- to 12-fold connecting blocks can be fixed on to a panel of any desired thickness by means of two screws 3 mmø

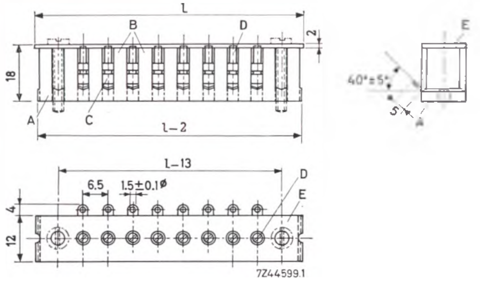
permissible voltage,	
contact clamps connected to the mains	$500\ V_{peak}$
contact clamps not connected to the mains	$1000\ V_{peak}$
mains voltage	250 V, 50 c/s
permissible current	max. 25 A
permissible temperature	max 70 °C
insulation resistance	$\geq 5000\ M\Omega$
parallel damping	$\geq 2\ M\Omega$
capacitance between two arbitrary contact clamps	~5pF

Further details on request.

connecting block	*l (mm)*	*type number*
2-fold	32	88029/02
3-fold	38.5	88029/03
4-fold	45	88029/04
5-fold	51	88029/05
6-fold	58	88029/06
7-fold	64	88029/07
8-fold	71.5	88029/08
9-fold	78	88029/09
10-fold	84.5	88029/10
11-fold	91	88029/11
12-fold	97.5	88029/12
14-fold	97.5	88029/14

88073 series - MINIATURE CONNECTING BLOCKS





block body	moulded black synthetic resin
contacts	nickel-plated brass clamps, insertion of connecting wire on one side, soldering connection on other side
permissible current	max. 6 A
permissible voltage between adjacent contacts	from mains: max. 354 V_{peak} from other sources: 630 V_{peak}
test voltage	2000 V_{rms}
working temperature	−25°/+70 °C
insulation resistance	min. 50.000 MΩ
capacitance between to arbitrary clamps:	approx. 5 pF

connecting block	*l (mm)*	*type number*	*order number*
2-fold	32.5	88073/02	2422 012 00406
3-fold	39	/03	00506
4-fold	45.5	/04	00606
5-fold	52	/05	00706
6-fold	58.5	/06	00806
7-fold	65	/07	00906
8-fold	71.5	/08	01006
9-fold	71.5	/09	01091
10-fold	71.5	/10	01005

Further details on request

The 2- to 8-fold connecting blocks can be fixed on to a panel of any desired thickness by means of two screws 3 mm Ø.

CONTROL KNOBS - F111 series

BLACK

AA

AB

AC

These knobs have been specially designed for professional equipment. Their star feature is the fact that they are fixed by means of a clamping collet. This method renders it superfluous to machine the shaft; it greatly facilitates the fixing and removal of the knobs, and ensures a permanently reliable attachment.

Round knobs

outer diameter (mm)	height (mm)	spindle ø (mm)	type number	spindle ø inch	type number
14	20.5	4	F111AA/14 × 4	3/16	F111AA/14 × 3/16
14	20.5	4	AB/14 × 4	3/16	AB/14 × 3/16
14	20.5	6	AA/14 × 6	¼	AA/14 × ¼
14	20.5	6	AB/14 × 6	¼	AB/14 × ¼
22	21	4	AA/22 × 4	3/16	AA/22 × 3/16
22	21	4	AB/22 × 4	3/16	AB/22 × 3/16
22	21	6	AA/22 × 6	¼	AA/22 × ¼
22	21	6	AB/22 × 6	¼	AB/22 × ¼
22	21	6	AC/22 × 6	¼	AC/22 × ¼
22	21	6	AD/22 × 6	¼	AD/22 × ¼
22	21	6	AE/22 × 6	¼	AE/22 × ¼
30	23	6	AA/30 × 6	¼	AA/30 × ¼
30	23	6	AB/30 × 6	¼	AB/30 × ¼
30	23	6	AC/30 × 6	¼	AC/30 × ¼
30	23	6	AD/30 × 6	¼	AD/30 × ¼
30	23	6	AE/30 × 6	¼	AE/30 × ¼
40	23	6	AA/40 × 6	¼	AA/40 × ¼
40	23	6	AB/40 × 6	¼	AB/40 × ¼
40	23	6	AC/40 × 6	¼	AC/40 × ¼
40	23	6	AD/40 × 6	¼	AD/40 × ¼
40	23	6	AE/40 × 6	¼	AE/40 × ¼
60	25.5	6	AA/60 × 6	¼	AA/60 × ¼
60	25.5	6	AB/60 × 6	¼	AB/60 × ¼
60	25.5	6	AC/60 × 6	¼	AC/60 × ¼
60	25.5	6	AD/60 × 6	¼	AD/60 × ¼
60	25.5	6	AE/60 × 6	¼	AE/60 × ¼
60	25.5	8	AA/60 × 8	5/16	AA/60 × 5/16
60	25.5	8	AB/60 × 8	5/16	AB/60 × 5/16
60	25.5	8	AC/60 × 8	5/16	AC/60 × 5/16
60	25.5	8	AD/60 × 8	5/16	AD/60 × 5/16
60	25.5	8	AE/60 × 8	5/16	AE/60 × 5/16
80	38.5	10	AA/80 × 10	⅜	AA/80 × ⅜
80	38.5	10	AB/80 × 10	⅜	AB/80 × ⅜
80	38.5	10	AC/80 × 10	⅜	AC/80 × ⅜
80	38.5	10	AD/80 × 10	⅜	AD/80 × ⅜
80	38.5	10	AE/80 × 10	⅜	AE/80 × ⅜

AD

AE

F111 series - CONTROL KNOBS

BLACK

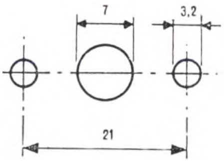
Round knobs with crank

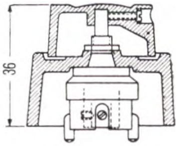
version	outer diameter (mm)	height (mm)	spindle ø	type number
BA	40	40	6 mm ¼"	F111BA/40 × 6 F111BA/40 × ¼"
BC	40	40	6 mm ¼"	F111BC/40 × 6 F111BC/40 × ¼"
BA	60	42	6 mm ¼"	F111BA/60 × 6 F111BA/60 × ¼"
BC	60	42	6 mm ¼"	F111BC/60 × 6 F111BC/60 × ¼"

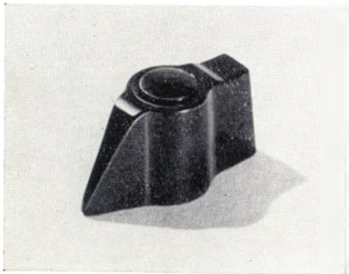
Vernier knobs

provided with	spindle ø (mm)	type number	spindle ø (inch)	type number
centre points	6	88150/00	¼"	88150/10
screws	6	88150/01	¼"	88150/11

Reduction drive 1 : 9.







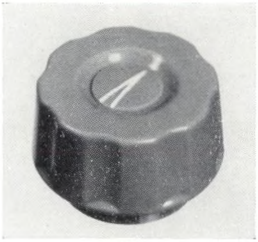
Switch knobs

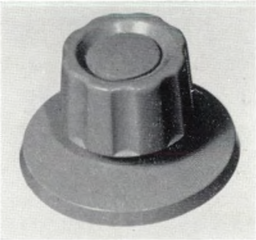
version	max. length (mm)	height (mm)	spindle ø	type number
CA	40	23	6 mm ¼"	F111CA/40 × 6 F111CA/40 × ¼"
CA	60	25	6 mm ¼"	F111CA/60 × 6 F111CA/60 × ¼"

CONTROL KNOBS - F112 series

THREE DIFFERENT COLOURS


AA


AB


AC

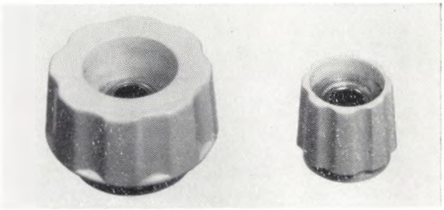

AD

The control knobs series F112 have been designed for use with equipment in a great variety of classes. Among their main features we mention:

— modern styling;

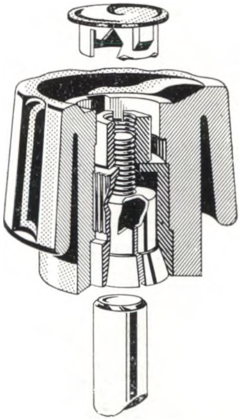
— perfect mounting by means of clamping collet;

— available in black, grey or white.


DA

Round knobs

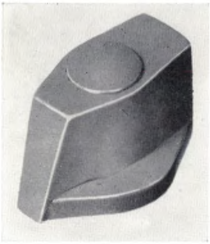
outer diameter (mm)	height (mm)	spindle ø (mm)	type number	spindle ø (inch)	type number[1]
10	13	3.2	F112AA/–10 × ⅛	⅛	F112AA/–10 × ⅛
10	13	3.2	F112 AB/–10 × ⅛	⅛	F112AB/–10 × ⅛
10	13	4	F112AA/–10 × 4		
10	13	4	F112 AB/–10 × 4		
13	15	4	F112AA/–13 × 4		
13	15	4	F112 AB/–13 × 4		
13	15	4	F112AD/–13 × 4		
13	15	6	F112AA/–13 × 6	¼	F112AA/–13 × ¼
13	15	6	F112 AB/–13 × 6	¼	F112AB/–13 × ¼
13	15	6	F112AD/–13 × 6	¼	F112AD/–13 × ¼
17	16.5	4	F112AA/–17 × 4		
17	16.5	4	F112 AB/–17 × 4		
17	16.5	6	F112AA/–17 × 6	¼	F112AA/–17 × ¼
17	16.5	6	F112 AB/–17 × 6	¼	F112AB/–17 × ¼
17[2]	15.3	6	F112DA/–17 × 6		
22	17	4	F112AA/–22 × 4		
22	17	4	F112 AB/–22 × 4		
22	21.5	4	F112AC/–22 × 4		
22	21.5	4	F112AD/–22 × 4		
22	17	6	F112AA/–22 + 6	¼	F112AA/–22 × ¼
22	17	6	F112 AB/–22 + 6	¼	F112AB/–22 × ¼
22	21.5	6	F112AC/–22 + 6	¼	F112AC/–22 × ¼
22	21.5	6	F112AD/–22 + 6	¼	F112AD/–22 × ¼
22[2]	17	6	F112DA/–22 + 6		
22[2]	21.5	6	F112DC/–22 + 6		
22[2]	21.5	6	F112DD/–22 + 6		
30	19	6	F112AA/–30 + 6	¼	F112AA/–30 × ¼
30	19	6	F112 AB/–30 + 6	¼	F112AB/–30 × ¼
30	22.5	6	F112AC/–30 + 6	¼	F112AC/–30 × ¼
30	22.5	6	F112AD/–30 + 6	¼	F112AD/–30 × ¼
30[2]	19	6	F112DA/–30 + 6		
30[2]	22.5	6	F112DC/–30 + 6		
30[2]	22.5	6	F112DD/–30 + 6		



[1], [2] See next page

F112 series - CONTROL KNOBS

THREE DIFFERENT COLOURS



CA

Switch knobs

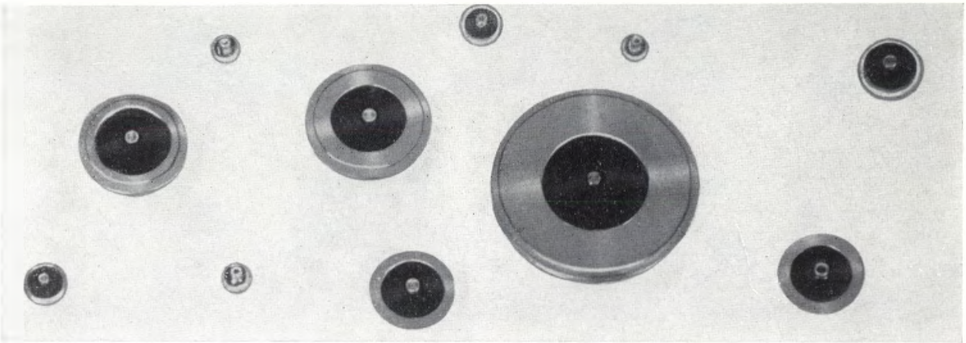
max. length (mm)	*height (mm)*	*spindle Ø*	*type number*[1]
31	17.5	6	F112 CA/–30 × 6
31	17.5	$\frac{1}{4}$	F112 CA/–30 × $\frac{1}{4}$

---

[1] The dash in the type number stands for: A(black), B(grey), C(white).

[2] These "open knobs" are to be used in combination with a "closed" type for operating two concentrical spindles. Preferred combinations are 13 ø upon 17 ø; 17 ø upon 22 ø; 17 ø upon 30 ø and 22 ø upon 30 ø.

COMPRESSION TYPES



Compression seals are used for hermetically sealing of components. They consist of a tube embedded in the insulating material glass around which a metal outer ring is compressed. The connecting wire has to be led through and soldered to the tube. The compression seal has to be soldered on to the concerning component.

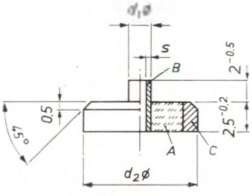


Fig. 1

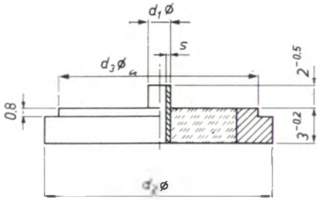


Fig. 2

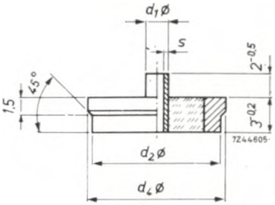
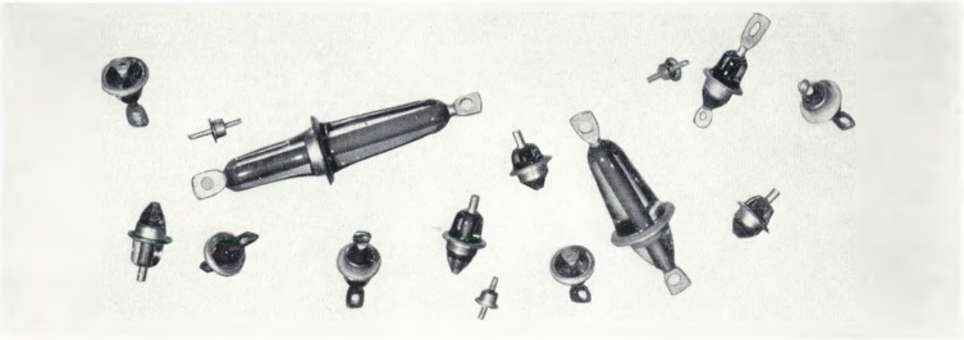


Fig. 3

flash-over voltage (kV)	*dimensions (mm)*						DIN	*fig.*	*type number*
	C.D.[1]	s	d_1	d_2	d_3	d_4			
2	0.75	0.35	1.5	4.2	—	—	DA0,75–4,2	1	F043AA/001
2.8	1.5	0.35	1.5	6.2	—	—	DA1,5 –6,2	1	/002
5	4	0.40	2	13.2	—	—	DA4 –13,2	1	/004
5	4	0.40	2	14.2	—	—	DA4 –14,2	1	/005
5	4	0.40	2	15.2	12.8	—	DB4 –15,2	2	/006
5	4	0.40	2	17.2	14.8	—	DB4 –17,2	2	/007
6.2	6	0.40	2	19.2	16.8	—	DB6 –19,2	2	/008
6.2	6	0.40	2	23.8	21.4	—	DB6 –23,8	2	/009
6.2	6	0.40	2	28.8	26.4	—	DB6 –28,8	2	/010
4.5	3	0.40	2	10.7	—	11.7	DC3 –10,7	3	/013

[1] C,D, represents the minimum creeping distance between the live parts.

MATCHED TYPES



Glass-to-metal seals are used for leading a conductor insulated through the metal envelope of a unit, and, at the same time for hermetically sealing the unit. External influences such as gases, moisture and dust are excluded, and prevalent conditions in the unit as regards vacuum, gas atmosphere or any liquid are rigorously maintained.

Matched-expansion glass-to-metal seals are widely used in both professional equipment and the entertainment sector. Particularly the easy-fitting smaller types are often used as inexpensive feed-throughs, e.g. for channel selectors, without full exploitation of the sealing function. A few further fields of application are: hearing-aids; capacitors; transformers; filters; quartz-crystal units; measuring equipment; computers, and so on.

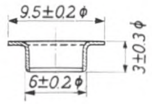
creeping distance		*peak voltage in volts*				*max current (A)*	*type number*
top (mm)	*bottom (mm)*	a	b	c	d		
3	2	354	1100	34	800	5	88012/03
3	2	354	1100	34	800	10	88013/03
5	3.3	800	1600	354	1100	10	88013/05
3	2	354	1100	34	800	5	88014/03
5	3.3	800	1600	354	1100	5	88014/05
10	6.7	1600	2200	1000	1800	10	88014/10
15	10	3200	4000	1600	2200	10	88014/15
15	6.7	3200	4000	1000	1800	10	88015/15
4	3	500	1400	354	1100	10	88016/04
1	0.8	34	34	34	34	2	88017/00
1	0.8	34	34	34	34	1	88017/02
3	2	354	1100	34	800	5	88018/03
5	2	800	1600	34	800	5	88018/05

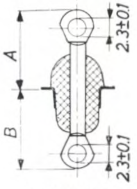
a = bottom in oil, lead-in directly connected to the mains
b = bottom in oil, lead-in not directly connected to the mains
c = bottom in air (min. 700 mm mercury), lead-in directly connected to the mains
d = bottom in air (min. 700 mm mercury), lead-in not directly connected to the mains.

GLASS-TO-METAL SEALS - 880.. series

MATCHED TYPES

dimensions (mm)		*type number*
A	*B*	
8.3 ± 0.4	3.9 ± 0.4	88012/03
6.2 ± 0.4	4.1 ± 0.4	88013/03
8 ± 0.4	5.1 ± 0.4	88013/05
10.1 ± 0.4	7.1 ± 0.4	88014/03
11.9 ± 0.4	9 ± 0.4	88014/05
16.8 ± 0.4	12.5 ± 0.4	88014/10
22.3 ± 0.4	15.9 ± 0.4	88014/15
22.3 ± 0.4	12.5 ± 0.4	88015/15
10.2 ± 0.3	10.3 ± 0.3	88016/04
6.2 ± 0.4	4.8 ± 0.4	88017/00
3.2 ± 0.4	3.8 ± 0.4	88017/02
12.3 ± 0.4	3.9 ± 0.4	88018/03
14.3 ± 0.4	3.9 ± 0.4	88018/05





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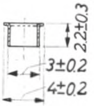

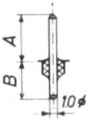

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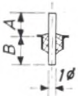

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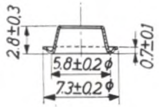
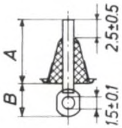
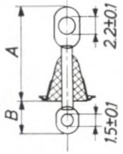




88012/03



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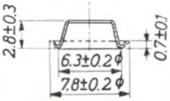

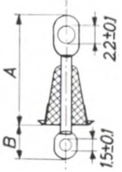

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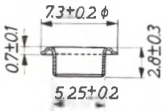

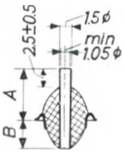

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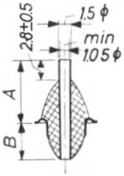

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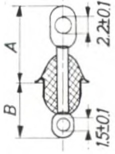

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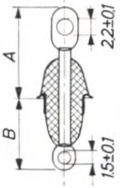

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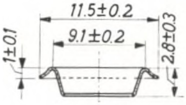

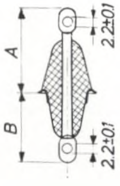

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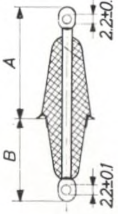

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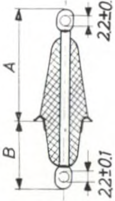


88015/15

8800. series - SCREENED PLUGS AND SOCKETS

These rigid plugs and sockets have been basically designed for use with microphones and amplifiers. They consist of a moulded synthetic resin body with pins or sockets which are fixed in a strong die-cast aluminium can. The contact springs are double acting, offering a four-fold contact guarantee and are of a self-cleaning contact design.

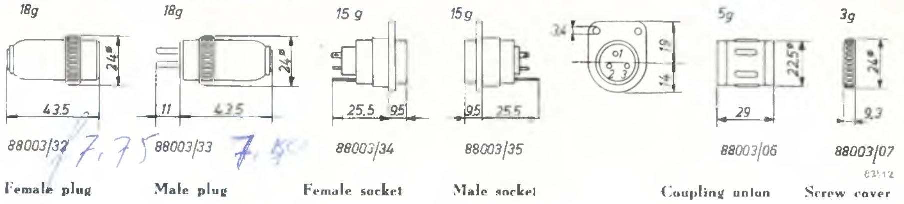
The plugs and sockets are available in three series:
88003 – three-pole according to Fig. 1; I_{max} 6 A
88004 – three-pole according to Fig. 2; I_{max} 15 A
88005 – six-pole according to Fig. 3; I_{max} 6 A

Permissible voltages:

E_{peak} (between two arbitrary contacts) . .	500 V (except between contacts 1 and 2 of series 88003 where $E_{peak} = 350$ V. Series 88004 are also suitable for connection to three-phase mains of 3 × 350 V
Permissible temperature range	−40/+70 °C
Contact resistance	max. 3 mΩ
Insulation resistance	min. 15 000 MΩ
Parallel damping	min. 0.5 MΩ at 1500 kc/s
Capacitance between contacts and casing .	3–6 pF

SCREENED PLUGS AND SOCKETS - 8800. series

30021 40022/264 40037



7,75 7,50

Fig. 1

8022./266.

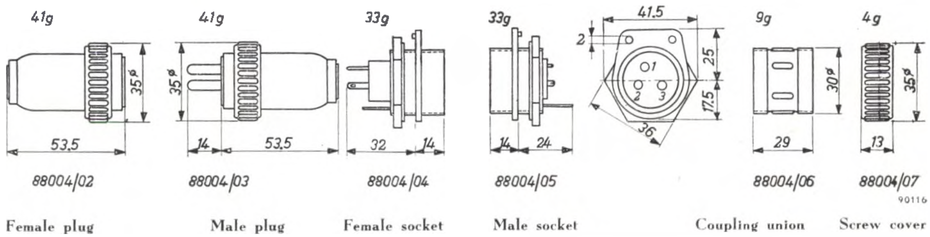


Fig. 2

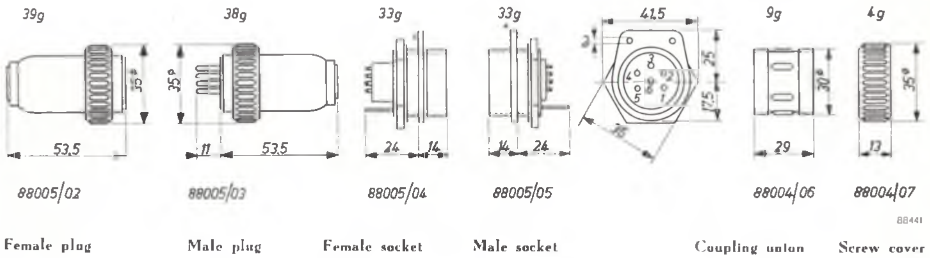


Fig. 3

Grote plug 6-polig teflon isol.

centrale pen – huis : 2,5 kV

pennen onderling : 200 V

pennen – huis : ≈ 400 V

SOCKETS FOR TUBES AND TRANSISTORS

GENERAL

To ensure the reliability of any electronic equipment, a permanently good electrical contact between tubes or transistors and the circuit is of paramount importance. It is the task of the sockets to provide adequate and lasting contacts. Therefore, very high requirements have to be imposed on their design and qualities, both electrical and mechanical. Even the best tube or transistor will not behave better than its socket will allow it to do!

In service, inferior or wrongly chosen sockets may cause crackling and unduly high losses; when tubes are being inserted into or removed from such sockets, they may even be damaged. Moreover, the dynamic expansion of electronic applications has resulted in a fairly great number of new tube constructions which are used under very divergent and often adverse conditions.

For all these reasons, we have developed a range of first-rate sockets for current tubes and transistors, devoting our best attention to requirements such as high insulation resistance, low capacitance, low losses and ability to withstand high temperatures, shocks and vibrations.

The *sockets for radio and TV applications* have been designed with the aim to obtain optimum performance at an attractive price. According to the application, the insulating material is either resin-bonded paper, synthetic resin or ceramics. Sockets with resin-bonded paper or synthetic resin are suitable for frequencies up to 50 Mc/s. Sockets with ceramic insulating material are suitable for use in humid surroundings; they will give satisfactory results at frequencies up to 500 Mc/s.

All types have been designed for top-chassis mounting. During soldering operations, the sockets should contain either a dummy tube or a wire jig. Earthing of the centre screen greatly reduces the capacitance between contacts. Suitable screen cans are available for miniature and noval sockets.

The *sockets for professional applications* are employed inter alia in transmitters, telecommunications and industrial equipment. Their construction is extra rigid and provides maximum resistance to arcing and flashovers. A few types have been designed for bottom-chassis mounting. If more than one type of socket is available for a given tube base, the choice depends on the application of the tube.

For transistors, three types of socket are available viz. with 3, 4 and 5 contacts. These sockets are made of a synthetic resin which can withstand an ambient temperature of 100 °C.

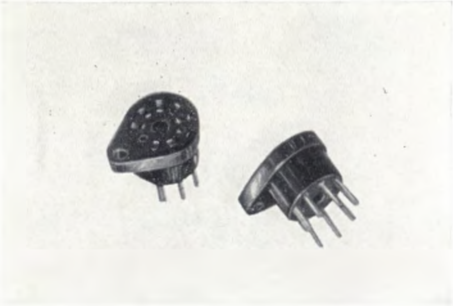
SURVEY

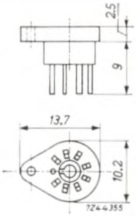
application	*type*	*insulating material*	*number of contacts*	*type number*	*page*
tubes	subminiature (B8D)	synthetic resin	8	5907/23	F26
	octal (K8A)	synthetic resin	8	5903/12	F26
		ceramic	8	5903/13	F26
	miniature (B7G)	resin bonded paper	7	B8 700 46 (p.w.)	F27
		ceramic	7	5909/36	F27
	noval (B9A)	resin bonded paper	9	B8 700 49 (p.w.)	F28
		ceramic	9	B8 700 28 (p.w.)	F28
		ceramic	9	B8 700 19	F29
	decal	ceramic[1]	10	B8 702 24	F30
		ceramic[2]	10	B8 700 22	F30
		ceramic[1]	10	B8 702 23	F30
		resin bonded paper[1]	10	B8 702 11 (p.w.)	F30
	magnoval	ceramic	9	B8 700 86	F31
	eightar	resin bonded paper	8	B8 700 63	F31
colour TV (90°)	12p. base	mica-filled	12	2422 504 01001	F32
11″ tinyvision TV	7p. base	synthetic resin	7	2422 500 03001	F32
		resin bonded paper		2422 500 03002 (p.w.)	F32
special tubes	superjumbo	ceramic	4	40403	F33
	medium N base	ceramic	5	40219	F33
	medium base	special plastic	7	40222	F34
	13 p. base	synthetic resin	13	B8 700 67	F34
transistors	3 p.	synthetic resin	3	BB 700 01/00	F35
	4 p. (TO18)		4	BB 702 12	F35
	5 p.		5	Z9 012 30	F35

[1] Silver plated; [2] Gold plated; (—) BVA registration number; (p.w.) printed wiring version, 50 pcs

TUBE SOCKETS

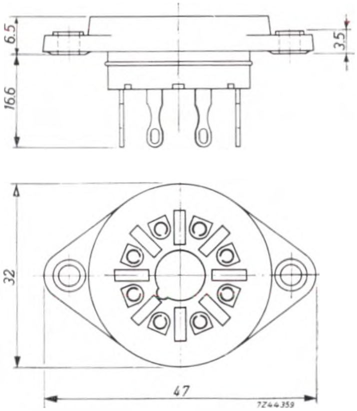
SUBMINIATURE TYPE (B8D)



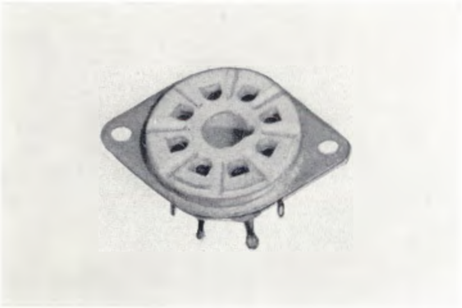


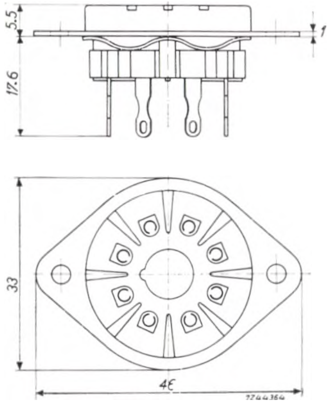
Type 5907/23
Insulating material: synthetic resin
Number of contacts: 8

OCTAL TYPES



Type: 5903/12
Insulating material: synthetic resin
Number of contacts: 8



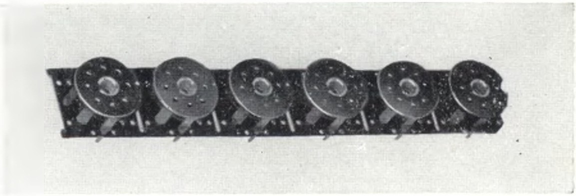


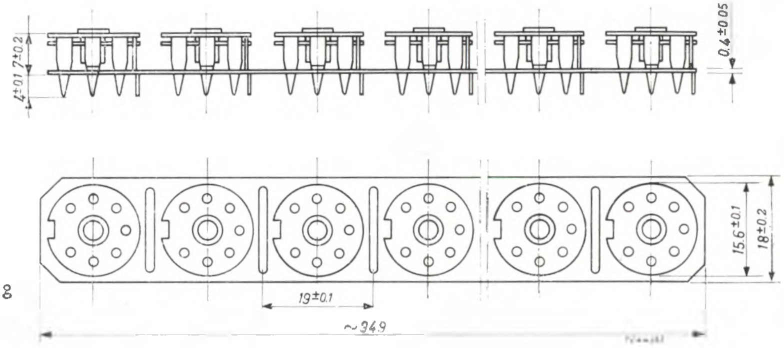
Type: 5903/13
Insulating material: ceramic
Number of contacts: 8

MINIATURE TYPES (B7G)

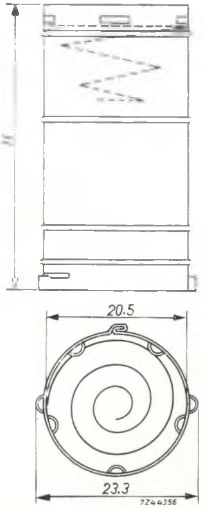
Type B8 700 46 for p.w.

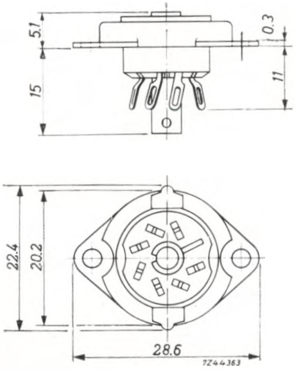
Insulating material: resin-bonded paper.
Number of contacts: 7





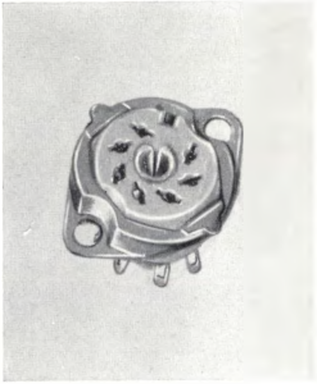
Strips each containing 50 sockets type B8 700 46





Shielding can

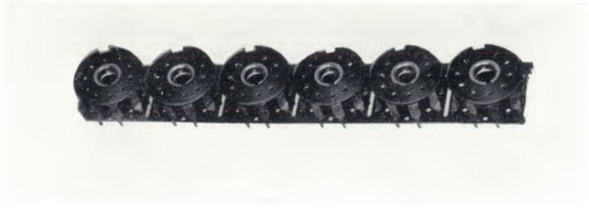
dimensions H (mm)	type number
14	B8 700 06
52	B8 700 07
57.5	B8 700 08
63	B8 700 09



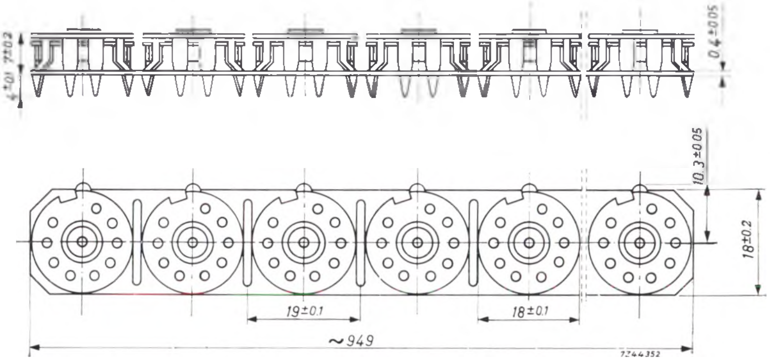
Type 5909/36

Insulating material: ceramic
Number of contacts: 7

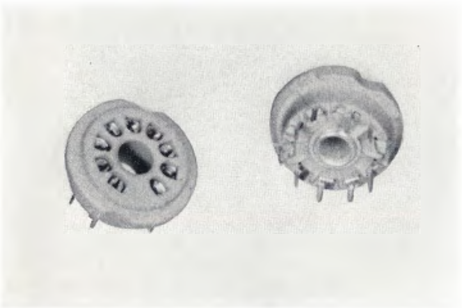
NOVAL TYPES

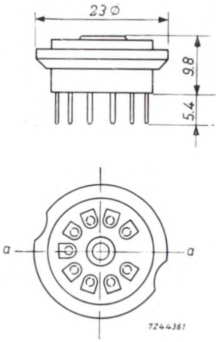


Type B8 700 49 for p.w.
Insulating material: resin-bonded paper
Number of contacts: 9



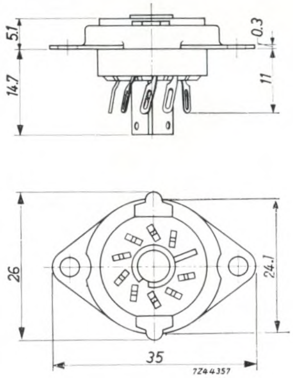
Strips each containing 50 sockets type B8 700 49

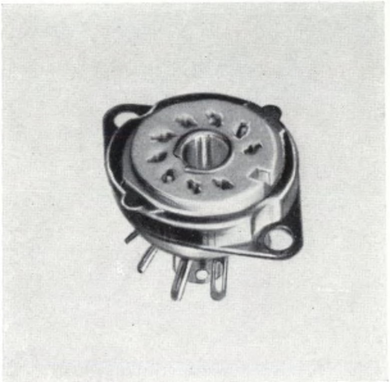




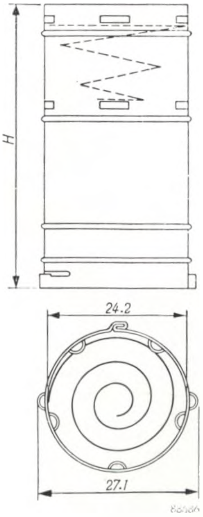
Type: B8 700 28 for p.w.
Insulating material: ceramic
Number of contacts: 9

NOVAL TYPE (B9A)





Type: B8 700 19
Insulating material: ceramic
Number of contacts: 9

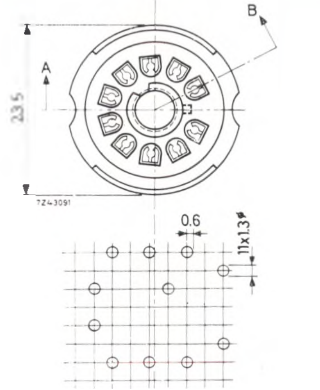


Shielding can

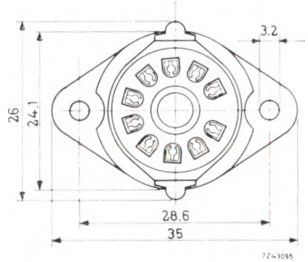
dimensions H (mm)	*type number*
41	B8 700 54
52	B8 700 55
57.5	B8 700 56
63	B8 700 57
74	B8 700 58

TUBE SOCKETS

DECAL TYPES

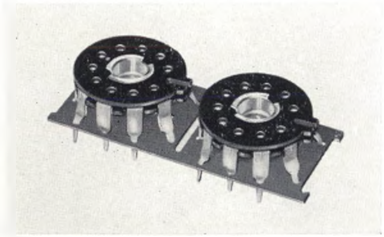


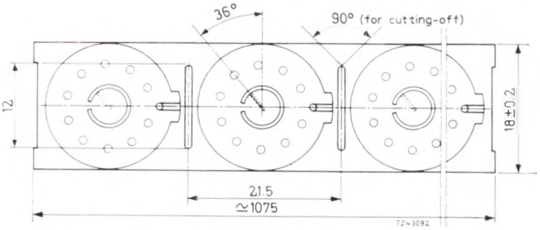
Type B8 702 24
Insulating material: ceramic
Number of contacts: 10, silver-plated



Type B8 702 22
Insulating material: ceramic
Number of contacts: 10, silver-plated

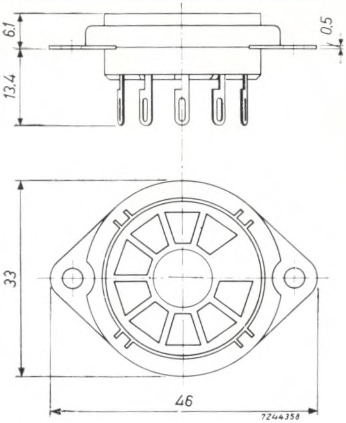
Type B8 702 23
Insulating material: ceramic
Number of contacts: 10, gold-plated





Type B8 702 11 for p.w.
Insulating material: resin-bonded paper on strips each containing 50 sockets type B8 702 11
Number of contacts: 10, silver-plated

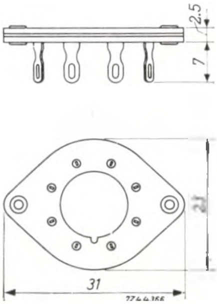
MAGNOVAL TYPE

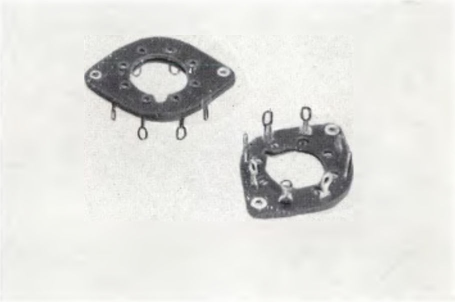


Type B8 700 86
Insulating material: ceramic
Number of contacts: 9

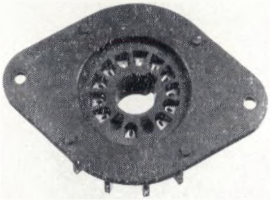
EIGHTAR TYPE

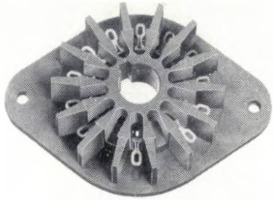
For TV picture tubes, 110° deflection

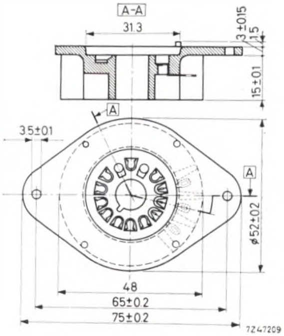




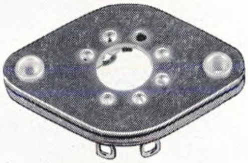
Type: B8 700 63
Insulating material: resin-bonded paper
Number of contacts: 8



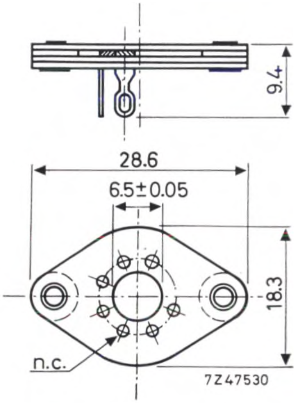


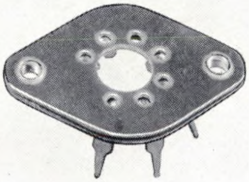


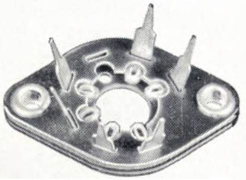
12p TYPE
Colour TV (90°)
Type: 2422 504 01001
Insulating material: mica-filled synthetic resin.
Number of contacts: 12

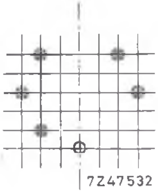


7p TPE
11″ tinyvision TV
Type 2422 500 03001
Insulating material: resin-bonded paper
Number of contacts: 7

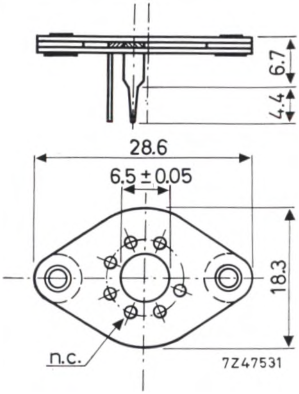




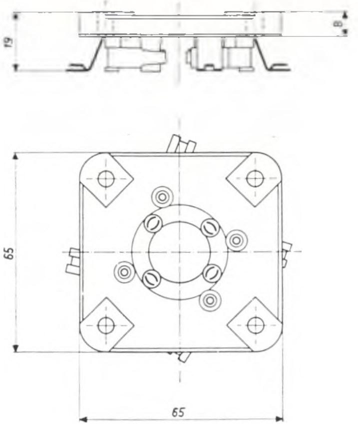


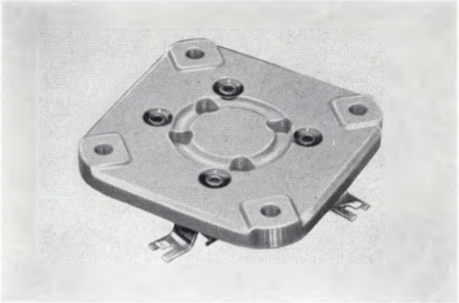


Type 2422 500 03002
P.w. version



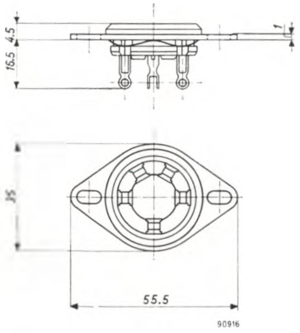
SUPER JUMBO BASE TYPE

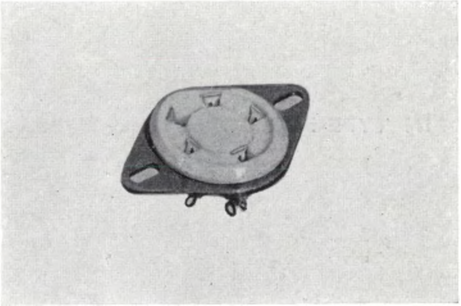




Type 40403
Insulating material: ceramic
Number of contacts: 4

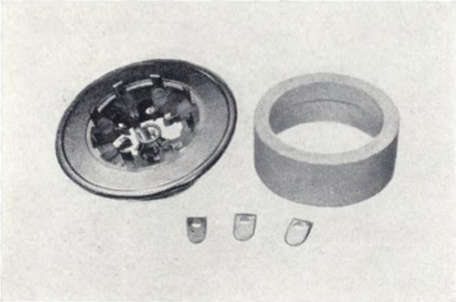
MEDIUM N BASE TYPE

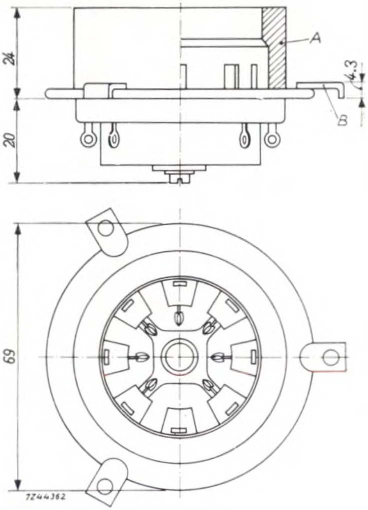




Type 40219
Insulating material: ceramic
Number of contacts: 5

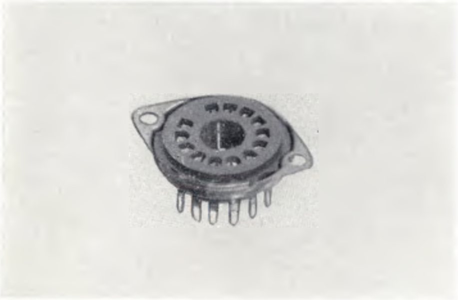
MEDIUM BASE TYPE FOR TRANSMITTING, INDUSTRIAL AND SPECIAL TUBES

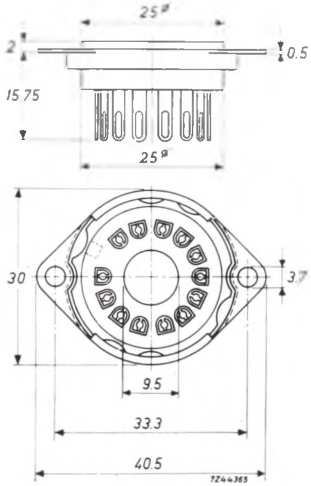




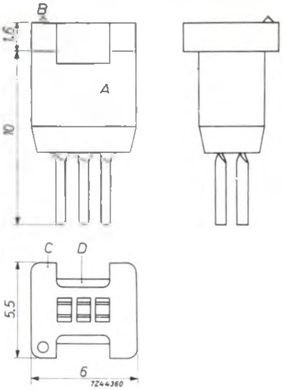
Type 40222
Insulating material: special plastic
Number of contacts: 7

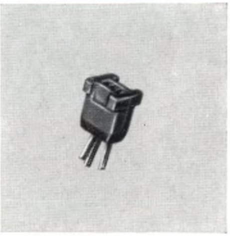
13-PIN TYPE FOR COUNTING TUBES



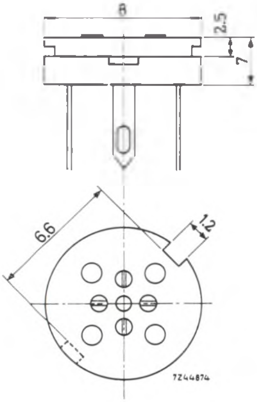


Type B8 700 67
Insulating material: synthetic resin
Number of contacts: 13

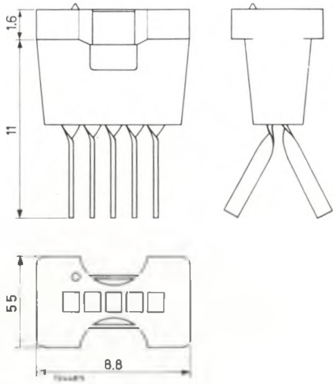


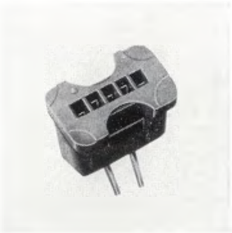


Type B8 700 01/00
Insulating material: synthetic resin
Number of contacts: 3



Type B8 702 12 (TO18)
Insulating material: synthetic resin
Number of contacts: 4

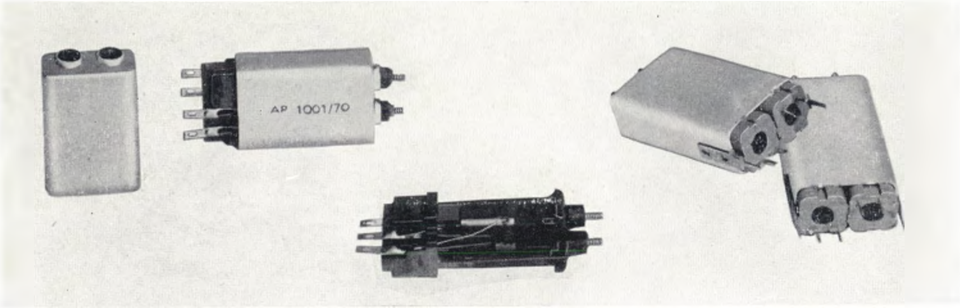




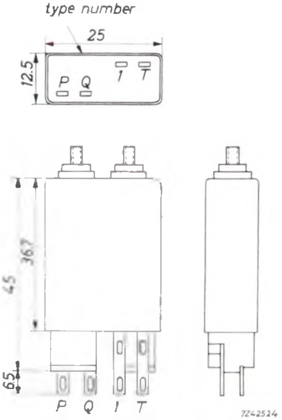
Type Z9 012 30
Insulating material: synthetic resin
Number of contacts: 5

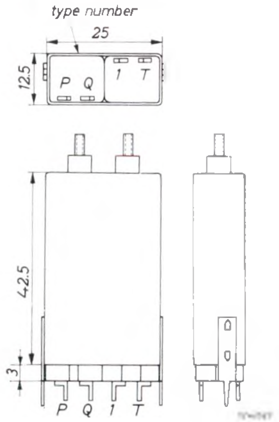
AP1001/2 series - IF COILS FOR RADIO (tube sets)

MINIATURE TYPES FOR AM



The AM coils are adjusted to an IF frequency of 452 or 470 kc/s. There are versions for conventional wiring and for printed wiring. The latter items fit a grid of $\varepsilon = 0.1''$ or 2.50 mm and a hole diameter of 1.3 mm.

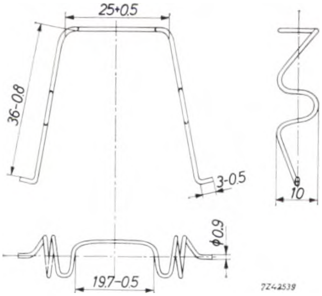




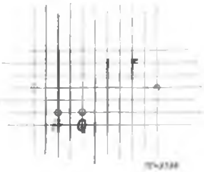
Available types

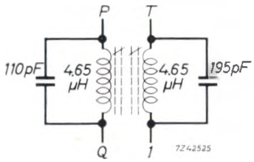
AP1001/52, 452 kc/s convent. wiring
AP1001/70, 470 kc/s convent. wiring
AP1002/52, 452 kc/s printed wiring
AP1002/70, 470 kc/s printed wiring

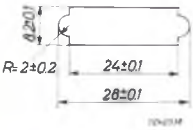
range of adjustment	446—483 kc/s
quality factor Q	140
quality factor kQ	1
maximum working temperature	85 °C



The coils for conventional wiring are fixed by means of a wire spring shown in the adjacent figure, which also gives the required mounting aperture; the printed-wiring types are mounted by means of two earthing tags.



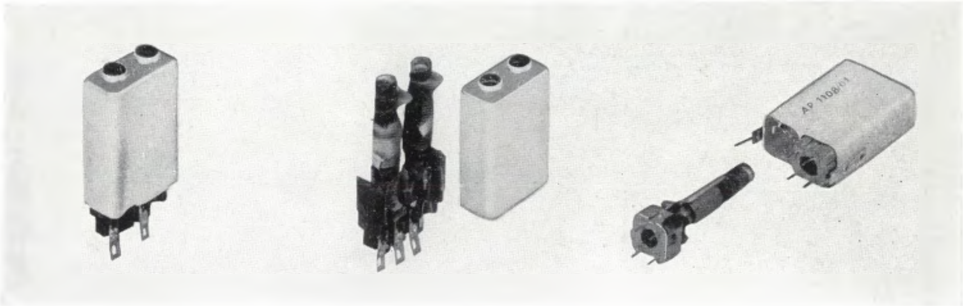


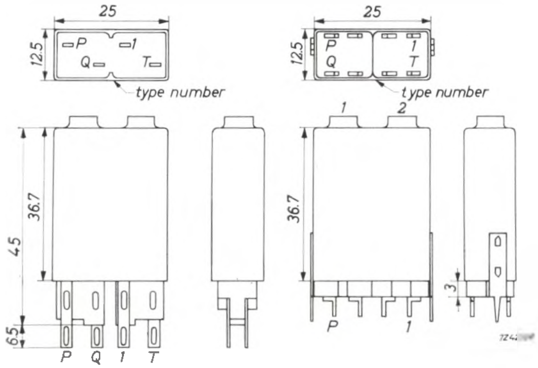


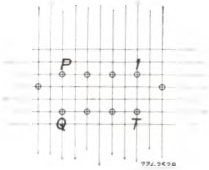
Mounting spring and aperture for conventional-wiring versions.

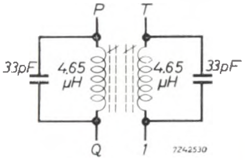
IF COILS FOR RADIO (tube sets) - AP1108 series

MINIATURE TYPES FOR FM





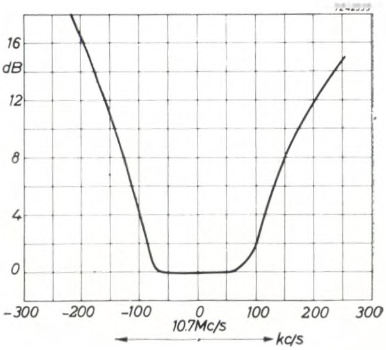




Available types

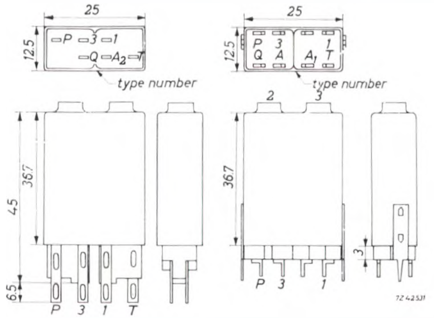
AP1108/00 (conventional wiring)
AP1108/01 (printed wiring)

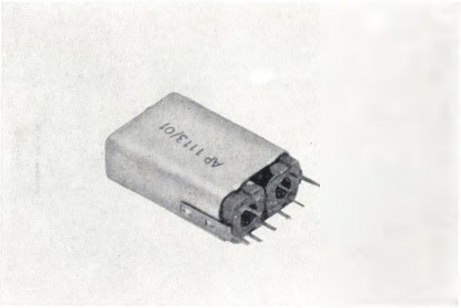
Adjustment range . . . . 10.7 Mc/s ± 7.5%
At 10.7 Mc/s. . . . . $Q_1 = Q_2 = 110$
$kQ = 1.2 \pm 20\%$

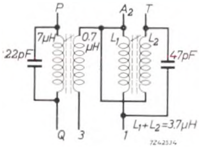


AP1113 series - RATIO DETECTOR COILS FOR RADIO (tube sets)

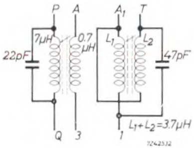
MINIATURE TYPES FOR FM





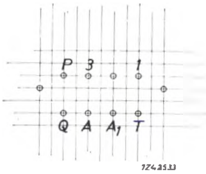


AP1113/00
(conventional wiring)

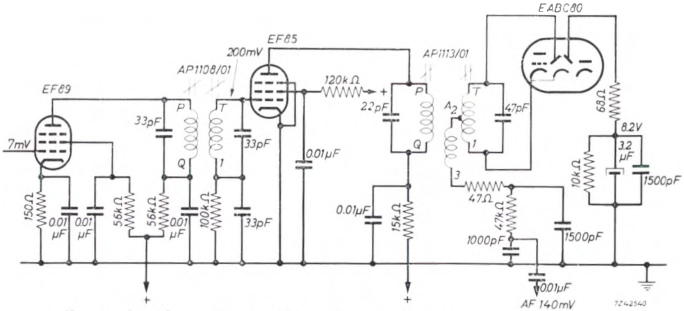


AP1113/01
(printed wiring)

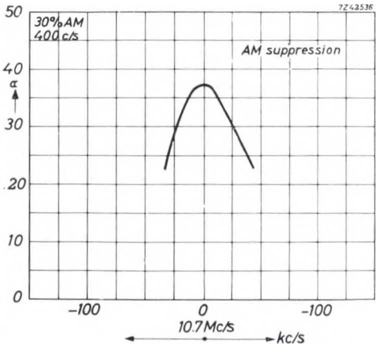
Adjustment range	10.7 Mc/s ± 7.5%
At 10.7 Mc/s	$Q_1 = 100$, $Q_2 = 90$
	kQ = 1.65 ± 15%

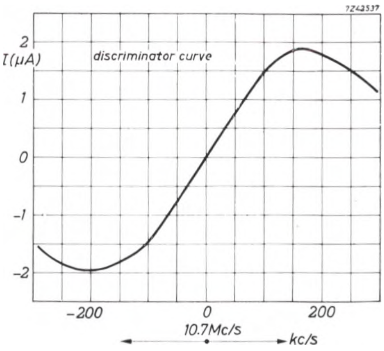


Hole pattern



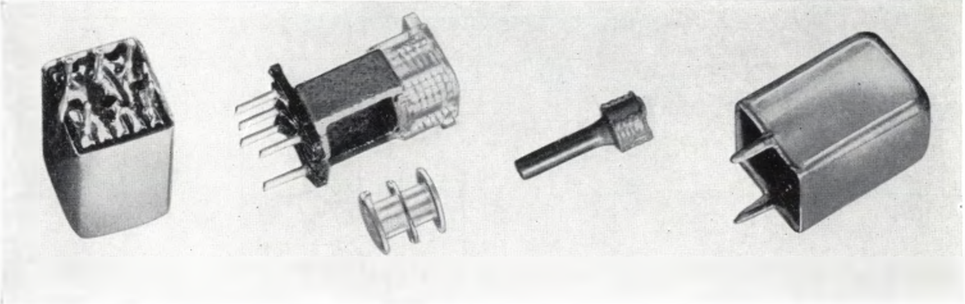
Example of an appropriate circuit diagram

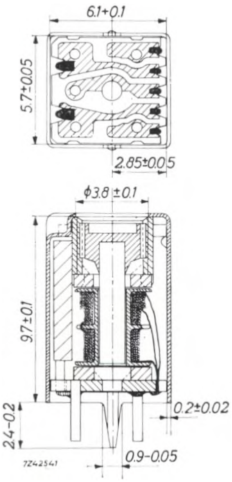


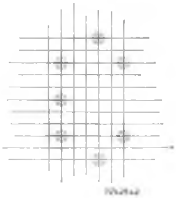


IF COILS FOR RADIO (transistorized sets) - AP1051 series

SUBMINIATURE TYPES FOR AM, FM AND AM/FM







The coils are designed for mounting on printed-wiring boards with an ε-grid = e/4 = 0.635 mm.
They can be supplied with a built-in capacitor (capacitance values 47, 82, 100 or 150 pF).

intermediate frequency.	450–470 kc/s (AM) 10.7 Mc/s (FM)
quality factor Q	100–140
inductance adjustment range	±10% - ±15%
temperature coefficient.	100.10^{-6}–400.10^{-6}/°C

Production quantities can be supplied according to specification.

PIECE PARTS FOR SUBMINIATURE IF COILS

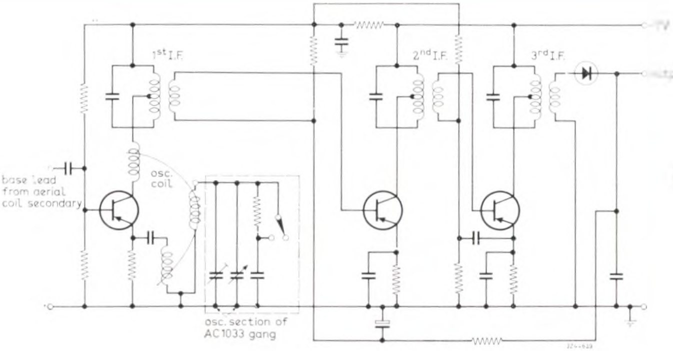
The frame core for the coils of the AP1051 series can be supplied separately. For setmakers who wish to make there own miniature (Lilliput) IF coils (series AP1040–AP1045) an assortment of loose piece parts is available.
These piece parts are described in section "Soft magnetic materials" pages G15, G16.

AP1051 series - IF COILS FOR RADIO (transistorized sets)

SUBMINIATURE TYPES FOR AM

Available types:

AP1051/11	Osc. coil
AP1051/15	1st IF
AP1051/13	2nd IF
AP1051/14	3rd IF



Application

The following performance can be obtained with these coils in the above-given circuit, measured with a supply voltage of −7 V.

a. Sensitivity: Input 2 μV ± 6 dB at 1 Mc/s for 50 mV audio output. The input is modulated 30% at 400 c/s. The output is measured across a 5 kΩ load.

b. Bandwidth: 5.1 kc/s ±500 c/s at 6 dB. Measured under similar conditions with a centre frequency of 470 kc/s.

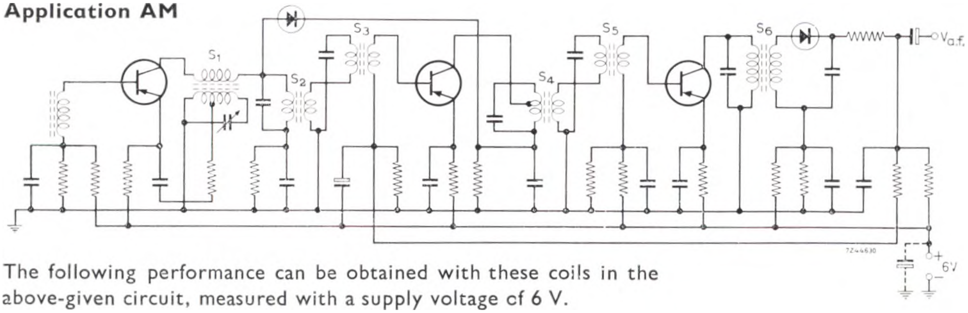
c. Attenuation: 26 dB ±3 dB at ±9 kc/s from centre frequency.

d. Consumption: approx. 3.3 mA.

SUBMINIATURE TYPES FOR AM FM AND AM/FM

Available types: **AM**– AP1051/20 AP1051/21 AP1051/22 AP1051/23 **FM**– AP1051/17 AP1051/18 AP1051/19

Application AM



The following performance can be obtained with these coils in the above-given circuit, measured with a supply voltage of 6 V.

a. Sensitivity: Input 1.6 μV ± 6 dB at 1 Mc/s for 10 mV audio output. The input is modulated 30% at 400 c/s. The output is measured unloaded.

b. Bandwidth: 4.8 kc/s ± 500 c/s at 6 dB. Measured under similar conditions with a centre frequency of 460 kc/s.

c. Attenuation: 77 × at 9 kc/s from centre frequency.

d. Consumption: approx. 3.3 mA.

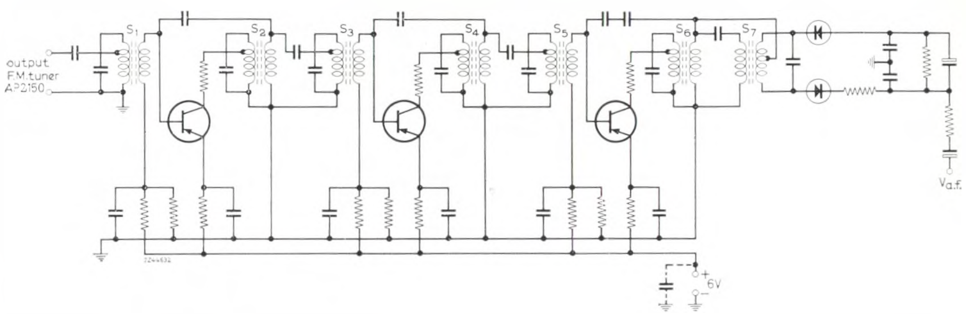
e. Max. input: V_b on first transistor 20 mV (1 MHz)

S_1 = oscillator AM
S_2 = AP1051/20
S_3 = S_5 = AP1051/21
S_4 = AP1051/22
S_6 = AP1051/23

IF COILS FOR RADIO (transistorized sets) - AP1051 series

SUBMINIATURE TYPES FOR AM, FM AND AM/FM

Application FM

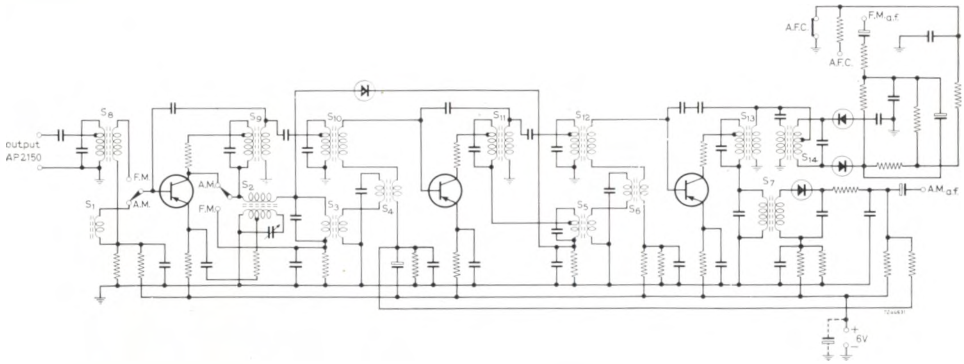


S_1, S_2, S_3, S_4, S_5, =AP1051/17-IF coil
S_6 =AP1051/18-Detector coil
S_7 =AP1051/19-Detector coil

The following performance can be obtained with these coils in the above-given circuit, measured with a supply voltage of 6V.

a. Sensitivity: Input 44 μV for 10 mV audio output. The output is measured unloaded. $\Delta f = 15$ kc/s.
b. Bandwidth: 160 kc/s at 6 dB.
c. Attenuation: 450 × at 300 kc/s from centre frequency.
d. Consumption: approx. 3.3 mA.

Application AM/FM



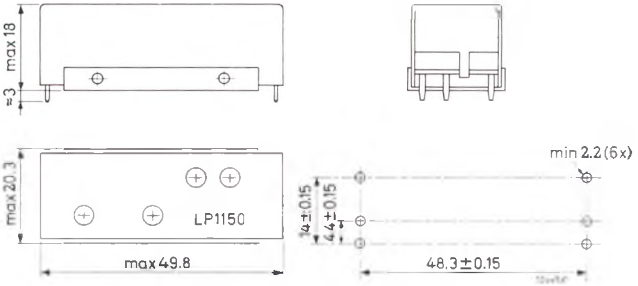
S_1 = aerial coil AM
S_2 = oscillator coil AM
S_3 = AP1051/20
S_4, S_6 = AP1051/21
S_5 = AP1051/22

S_7 = AP1051/23
S_8, S_9, S_{10}, S_{11}, S_{12} = AP1051/17
S_{13} = AP1051/18
S_{14} = AP1051/19

LP1150 series - RF/IF COIL FOR RADIO (transistorized sets)

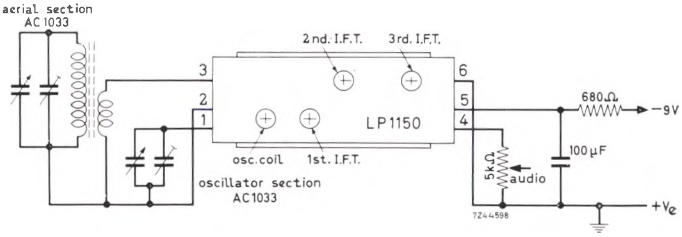
MODULE TYPE FOR AM

The module type LP1150 is a miniature fully screened frequency changer and I.F. amplifier designed to cover the medium and long wave bands. It is primarily intended for use in small size radio receivers, but its performance is such that it can be used with advantage in larger receivers.
The first transistor is used as a self oscillating mixer. The second and third transistors provide two stages of I.F. amplification at 450–470 kc/s using single-tuned circuit I.F. transformers. An OA90 diode provides the A.F. output into a 5 kΩ load, (normally the volume control of the receiver). An R.F. filter capacitor is provided across this A.F. output.



Associated circuits

To complete the radio frequency side of a receiver it is necessary to add the aerial circuit, tuning capacitor and wave range switching. The audio output may be applied direct to the volume control whilst the supply voltage is obtained from a 9 V battery, via a decoupling network. The circuit below has been simplified by omitting the wave range switch.



Connections

1. Oscillator section of tuning gang AC1033
2. Earth
3. Aerial coil secondary
4. Audio output
5. −7 V input
6. Earth

Performance

These figures are based on initial production and may be amended. They are based on a supply voltage, measured at the module, of −7 V.

a. Sensitivity: input 2 μV ± 6 dB at 1 Mc/s for 50 mV audio output. The input is modulated 30% at 400 c/s. The output is measured across a 5 kΩ load.

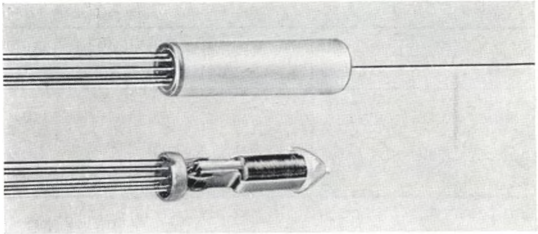
b. Bandwidth: 5.1 kc/s ± 500 c/s at 6 dB.
Measured under similar conditions with a centre frequency of 470 kc/s.

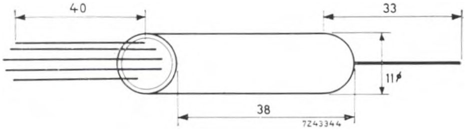
c. Attenuation: 26 dB ± 3 dB at ± 9 kc/s from centre frequency.

d. Consumption: approximately 3.3 mA.

POLARIZED RELAY - SZC series

MINIATURE TYPE





These relays are especially designed for applications which require small dimensions, high reliability, long life, low power and short switching times.
They are in particular suitable for use in telephonesystems, computers, remote-control, data switching and telegraphsystems, measuring apparatus, logiccircuits, television, etc. The relays are housed in a hermetically sealed metal can, switch in a well defined gas atmosphere and have good shock and vibration properties.

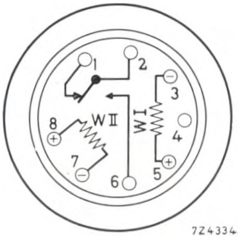
They can be supplied in two versions:

Type SZC7122. A bistable type with one change-over contact. This version has two normal positions.

Type SZC7123. A monostable type with one change-over contact. This version has one normal position. To keep the make-contact closed, the relay must be energized.

When relay type SZC7122 is energised according to the figure, terminals 2 and 6 are interconnected; in the opposite direction terminals 2 and 1 are interconnected.

When relay type SZC7123 is energised, terminals 2 and 6 are interconnected.



SZC series - POLARIZED RELAY

MINIATURE TYPE

Winding data

version	*winding*	*terminals*		*number of turns*	*wire diam.*	*resistance 25 °C(Ω)*	*type number*
		begin	*end*				
bistable	I	5	3	2400	0.05 mm	290	SZC7122
	II	8	7	2400	0.05 mm	400	
monostable	I	5	3	2400	0.05 mm	290	SZC7123
	II	8	7	2400	0.05 mm	400	

The tolerance on the winding resistance is ±15%.

Ampere turns

	bistable relay	*monostable relay*
operate	35 AT	45 AT
release.	—	6 AT
non operate	10 AT	20 AT
hold	—	22 AT

Life of contacts . . . . . $>10^7$ contact operations.

Switching times.

1. Operate time of closed contact.
   This time depends on the energizing AT, operate AT and the total power in the energizing circuit and may vary from

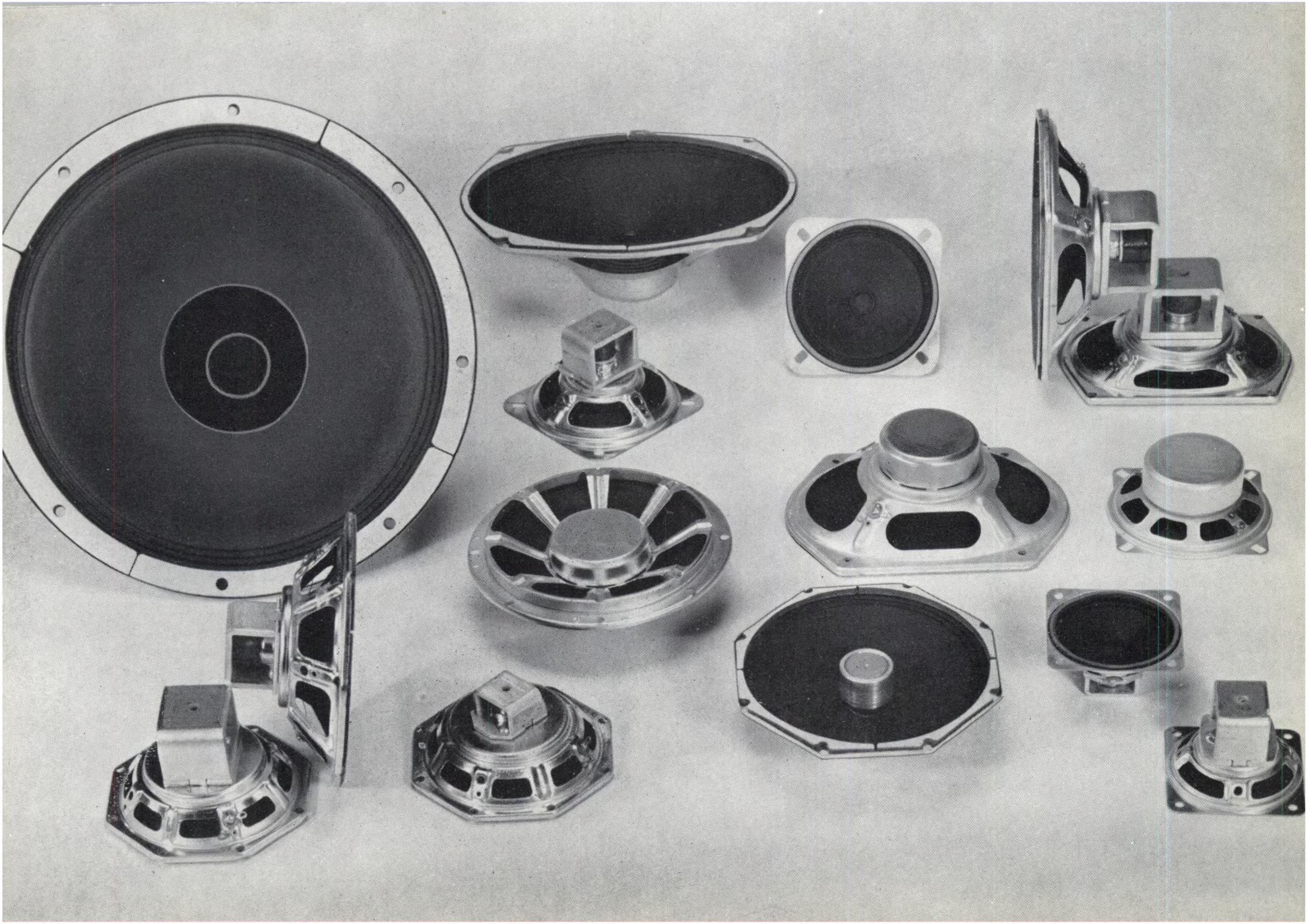
   0.3 – 1.5 msec (monostable type)
   and 0.15 – 0.6 msec (bistable type),

e.g.

circuit dissipation	*500 mW*	*100 mW*
$\frac{\text{energizing AT}}{\text{operate AT}}$	*2*	*1.1*
monostable type . . .	approx. 0.3 msec	approx. 1.5 msec
bistable type	approx. 0.15 msec	approx. 0.6 msec

2. Change-over time. This time also depends on the energizing AT, operate AT and the total power in the energizing circuit, and lies between 0.25 and 0.6 msec.

3. Bounce time $\leq$0.3 msec at 90% of the relays of a batch.



INTRODUCTION

CLASSIFICATION

A correctly chosen loudspeaker is essential to obtain adequate acoustic results from electro-acoustic equipment. The following factors should be considered.

Shape, size and attachment, with reference to the available space.

Quality and sensitivity, which compromise between fidelity of reproduction and price.

The frequency-response characteristic in relation to the kind of application.

Impedance and power-handling capacity, which should be adapted to the output stage of the equipment.

Appearance and finish.

To facilitate your making a choice from our programme of loudspeakers, all the basic types are tabulated on page 51. The explanations given in the rest of this introduction apply to the entire programme and, therefore, they are not repeated in the specifications.

Midget speakers

As their name indicates, the midget speakers have minor dimensions and, particularly, very small depth. Nevertheless they have a remarkable sensitivity and, thanks to this circumstance and to the special Z-version frequency-response characteristics, they are extremely suitable for transistorised radio sets such as portable, pocket-size and personal equipment.

Standard speakers

The standard speakers are by far the most extensive group. As a consequence of the diversity in characteristics and size, they are suitable for sets of all kinds, AM, FM, TV, car radio, electrophones, tape recorders, sound columns, consoles, etc. in all the various price classes.

Almost any size is available in two or more sensitivity classes (I, II, III and IIIA) according as a magnet system of 6800, 8500 or 9500 gauss is used; the difference in acoustic output between consecutive classes is 3 dB.

The TICONAL magnet systems class I, II and III have remarkably weak leakage fields.

The classes III and IIIA are identical as regards their high quality, but the IIIA speakers have a smaller depth thanks to the use of flat ferroxdure magnet rings. Therefore, they are appropriate for larger-size transistor equipment such as table-type radio sets, car-radio sets, gramophones and tape recorders.

The fairly appreciable difference in price between the various classes allows of choosing the required compromise between price and quality for any individual application.

High-quality speakers

The high-quality speakers have been specially designed for use in Hi-Fi equipment, where a high power-handling capacity, a very wide frequency-range and a negligible distortion level are required. Examples of application: acoustic boxes, bass-reflex boxes, juke boxes, Hi-Fi enclosures, with and without cross-over network and stereo columns.

Special speakers

The special speakers have specific applications. (see page F85)

ATTACHMENT

All the loudspeakers conform to the recommendations of the E.I.A. (Electronic Industries Association, formerly RETMA).

QUALITY LEVEL

Thanks to the use of superior TICONAL or ferroxdure magnets of outstanding materials for cone and centre ring, as also to the rugged construction featuring a close-tolerance air-gap, the quality of each type of speaker complies with the most exacting requirements.

FINISH

The loudspeakers are tropic-proof and they are cadmium-plated so as to prevent any corrosion.

DERIVATIVE TYPES

Each basic type may have one or more derivative versions as regards acoustic characteristics and voice-coil impedance.

M-VERSION (bicone speakers)

These speakers are equipped with an extra high-note cone inside the normal one. This results in remarkable perfection of reproduction, the frequency range being expanded from about 10 kc/s to some 20 kc/s, and the spatial sound-distributions being made more uniform.

At high frequencies the normal cone suffers from the "breaking-up" effect, which means that not all parts vibrate in phase any longer: the entire cone area cannot follow the quick vibrations as a consequence of inertia; several parts will vibrate out of phase and so counteract each other. At rising frequency the effective area is even more restricted to the apex region of the cone, and a steadily decreasing acoustic output is the result.

Glueing a small and fairly stiff extra cone inside the apex of the normal cone enlarges the radiating surface at high frequencies, and hence improves the high-note reproduction.

The extra cone furthermore acts as a sound diffuser at frequencies up to about 10 kc/s, the range of the normal cone. Beyond this frequency the small cone gradually takes over from the larger one, the latter then acting as a high-note reflector.

Applications are, inter alia, Hi-Fi equipment, stereo enclosures, TV receivers and FM radio sets.

INTRODUCTION

X-VERSION

The speakers of this version have been specially designed for medium-class receivers that can reproduce only a limited frequency range.

By employing special cone-techniques, it was found possible to obtain an increased sensitivity in the region of maximum earsensitivity (1–4 kc/s). Between 1.4 and 6 kc/s the frequency characteristic shows a so-called forwardness or presence peak of about 5 dB, making the sound very clear and open.

Y-VERSION

For less powerful AM/FM receivers such as battery sets, where high-note distortion is likely to occur, the speakers of this version are very suitable.

The sensitivity in the region of 1–4 kc/s is further increased, and frequencies beyond 6 kc/s are suppressed. A presence peak of 7–8 dB improves the sound quality to a fair level.

Z-VERSION

These speakers have a major sensitivity in the medium range and, for cone diameters up to 4″, a frequency cut-off at 3.5–4 kc/s so as to avoid the noise that accompanies the higher frequencies. In the case of a larger cone diameter, the reproduction of the higher frequencies is attenuated.

Z-version speakers are extremely suitable for transistorised sets.

IMPEDANCE

In addition to the low-ohmic basic types, the loudspeakers are available in high-ohmic versions which may be desirable in the case of a transformerless output stage.

Standard high-ohmic versions are the following.

A (800 Ω),
C (150 Ω),
G (100 Ω),
K (60 Ω),
H (25 Ω),
P (15 Ω),
S (8 Ω),
R (4 Ω).

PREFERRED TYPES

Speakers with type numbers in bold print are as a rule available at shorter notice than the other types.

Non-listed items can be supplied on request.

GENERAL

On the following pages you will find the frequency-response curves of all low-ohmic types. These curves are measured under the following conditions:

1. recorded in anechoic room;
2. without baffle;
3. microphone in axis of loudspeaker at a distance of 50 cm;
4. input 50 mW at 400 c/s;
5. constant voltage.

Comparing a constant-current characteristic of any loudspeaker with a constant-voltage one, we find the latter flatter in the region of the resonance frequency, whereas it drops more abruptly at the higher frequencies. The reason is as follows.

The power which moves the coil and the cone is proportional to the current through the coil. In the case of constant voltage, the current will decline in the neighbourhood of the resonance frequency and at higher frequencies as a consequence of rising coil impedance. The result is dropping sound pressure in these frequency regions.

The frequency ranges indicated on the obsolete EP-sheets relate to older constant-current measurements and, hence, do not relate to the response curves depicted here.

THE USE OF RESPONSE CHARACTERISTICS

First of all we wish to emphasise that these curves should be used exclusively for comparison.

Never compare curves which are not based on one and the same measuring method (identical measuring equipment, measuring room, distance, power input and, even, identically mounted speakers). Only experienced experts are able to compare response curves not based on exactly identical conditions. Also the condition of the anechoic chamber may greatly affect the results.

Contrary to many other manufacturers, frequency characteristics for loudspeakers were determined without a baffle.

THE FREQUENCY CHARACTERISTICS FOR MAKING COMPARISONS

The response curve does help us to disclose differences in reproduction quality. The comparison of curves determined under identical conditions may give a picture of a few acoustical aspects. A difference in level means a difference in sensitivity (efficiency) in various frequency regions. A difference in width means a difference in frequency range.

We should never forget, however, that the curves represent the sound pressure only in the centre of a circular plane. Since the sound pressure is not uniformly distributed over the plane and not in the same manner in various cases, the sound impression may differ more than the response curves suggest.

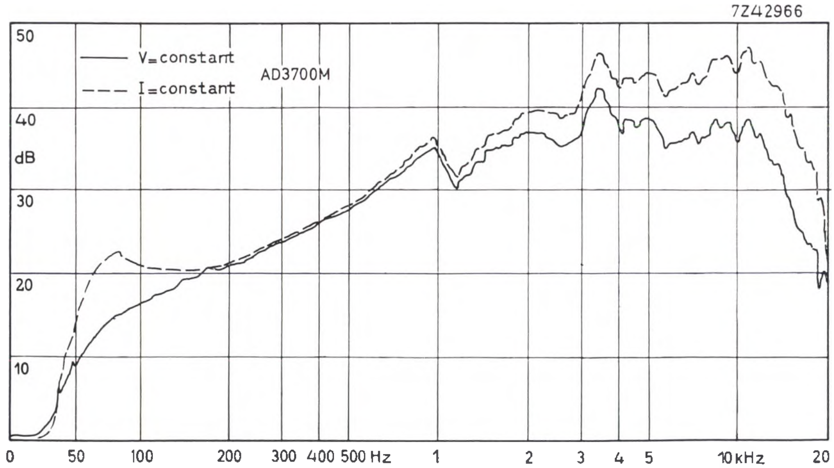
It will be evident that a high degree of expertness is required to interpret the differences in response curves. For the greater part, this expertness is gained through experience.

FREQUENCY CHARACTERISTICS AN AID FOR MANUFACTURERS

Response curves play a great part in the development of loudspeakers, pinpointing their acoustic characteristics, their manufacture and production checks.

For a major part, the acoustic characteristics are bound up with the moving parts of a speaker, i.e. the coil, centring ring and cone. For the development engineer it is but a small problem to establish what response curve is required for an equipment under development. Furthermore, if the acoustic reproduction is not yet up to the requirements, it is a fairly simple matter for them to subject the speaker to slight modifications, based on the frequency curve, and to examine the effect with the help of the curve.

For loudspeakers in production, the frequency characteristic is an excellent means to check the reproduction quality and, at the same time, the sensitivity of the magnet system. As regards less experted customers, great caution should be exercised as for use and interpretation of the curves.



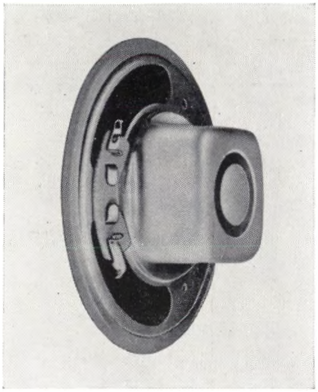
SURVEY OF BASIC TYPES

cone size Ø	shape of flange	midget speakers	standard speakers				special speakers	high quality speakers
			class I	*class II*	*class III*	*class III A*		
2″	round	AD2218						
2.25″	round	AD2209						
2.5″	round	AD3207						
3″	square	AD3316	AD1300	AD2300				
4″	square	AD3416	AD1400	AD2400				
4″	round	AD3417						
4″	special	AD3414						
4″	round	AD3415						
5″	octagonal		AD1500	AD2500	AD3500	AD3514		
6.5″	octagonal		AD1700	AD2700	AD3700	AD3714	AD3701	
6.5″	round-wafer						AD3721	
6.5″	round-						AD3725	
6.5″	round-wafer						AD3729	
8″	octagonal			AD2800	AD3800	AD3814		AD4800
8.5″	round							9710
10″	round							AD4000
12″	round						AD4201	AD4200
12″	round							AD5200
3 × 8″	oval				AD3380			
4 × 6″	oval			AD2460	AD3460	AD3464		
5 × 7″	oval			AD2570	AD3570	AD3574		
6 × 9″	oval			AD2690	AD3690	AD3694		
standard cones . .		Z-Y-X	Z-O-X	Z-O-X-M	Z-O-X-M	Z-X-M	O-X-M	O-M
standard impedance (low-ohmic) . . .		3-4-8Ω	3Ω	3-5Ω	4-5Ω	5Ω	5Ω	7Ω

Woofer loudspeaker **AD5201 Hi-Fi** (see page F96)

2″ MIDGET LOUDSPEAKERS

AD2218



Primary applications:

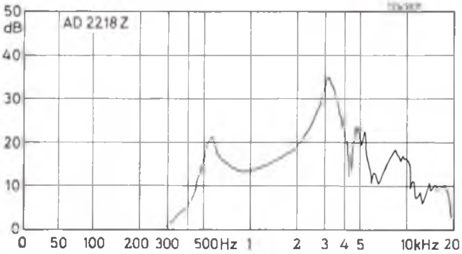
pocket radios and other transistorised sets of minor dimensions.

Specific property:

Extremely flat magnet of TICONAL X.

Main dimensions:

outer diameter	51.7 mm
total depth max.	17.2 mm

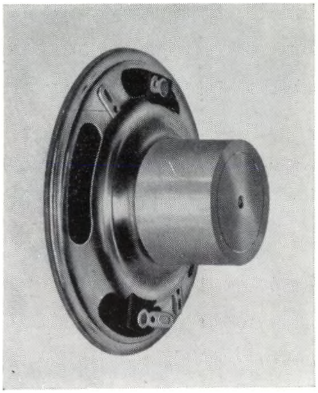


power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
0.3	3	590	6000	6000	40	AD2218Z

AD2209

Primary applications:

pocket radios and other transistorised sets of minor dimensions.

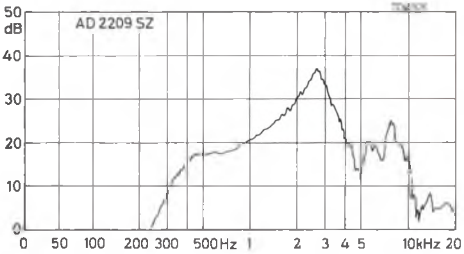


Specific properties:

1. Extra-powerful magnet of TICONAL GG and a pot of sintered iron.
2. Negligible stray field (at 1 mm distance from the magnet system, the stray field is hardly measurable).

Main dimensions:

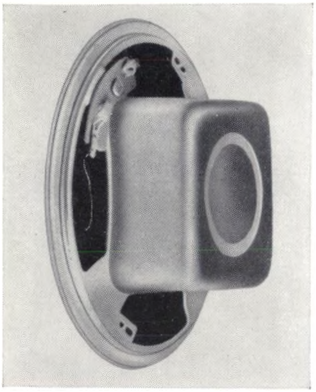
outer diameter . . . . 58 mm
total depth max. . . . . 23 mm



power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
0.5	8	420	11 500	7100	55	**AD2209SZ**
0.5	70	420	11 500	7100	55	AD2209KZ

2.5" MIDGET LOUDSPEAKERS

AD3207



Primary applications:

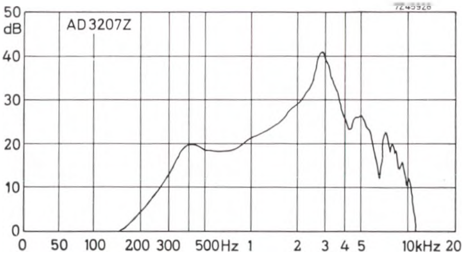
personal sets and other transistorised cordless radio receivers.

Specific property:

High sensitive magnet of ferroxdure 300.

Main dimensions:

outer diameter	63.9 mm
total depth max.	20.1 mm

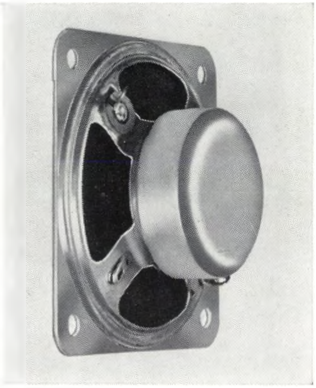


power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
0.5	3	350	8500	8500	85	AD3207Z
0.5	150	350	8500	8500	85	AD3207CZ

AD3316

Primary applications:

portable radios and other transistorised cordless sets.

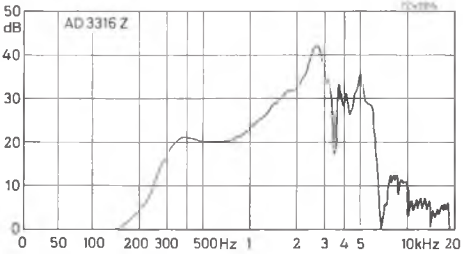


Specific properties:

1. Small depths owing to a flat magnet of powerful ferroxdure.
2. The frequency-response curve displays a pronounced presence peak in the region of maximum ear sensitivity.

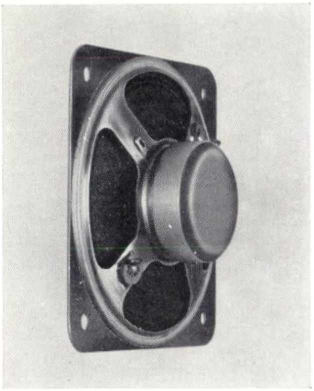
Main dimensions:

mounting diameter	92 mm
outer diameter	80.2 mm
total depth max.	27.2 mm



power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
1	3	285	9500	9500	130	AD3316Z
1	8	285	9500	9500	130	AD3316SZ
1	150	285	9500	9500	130	AD3316CZ

AD3416



Primary applications:

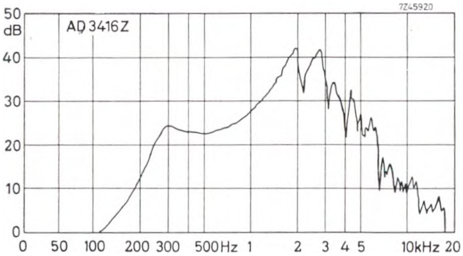
cordless radio sets;
small tape recorders.

Specific properties:

1. Favourable compromise between features such as high acoustic output, reduced mounting depth and low weight.
2. Powerful ferroxdure magnet.
3. The frequency-response curve displays a pronounced presence peak in the region of maximum ear sensitivity.

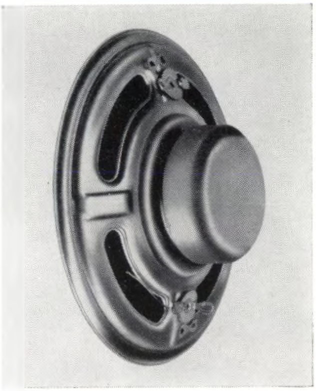
Main dimensions:

mounting diameter	119 mm
outer diameter.	105.2 mm
total depth max.	29.3 mm



power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
1	3	250	240–6000	9500	9500	150	AD3416Z

AD3417



Primary application:

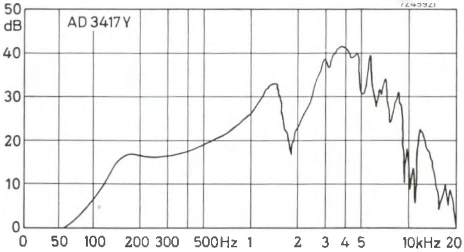
AM/FM transistor sets.

Specific properties:

1. Frequency range suitable for both AM and FM reception in transistorised sets. They combine the advantages of our Z-type cones with a frequency limit of 7.8 kc/s, which was found to be the best compromise to ensure satisfactory results in both systems.
2. Small depth owing to flat ferroxdure magnet.

Main dimensions:

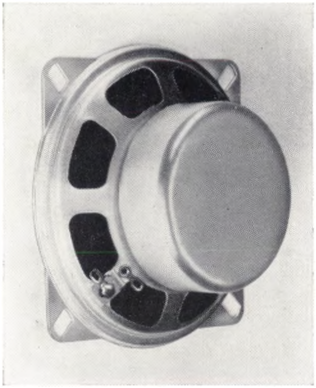
outer diameter	105.2 mm
total depth max.	30 mm



power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
1.5	3	155	135–8000	9500	9500	150	AD3417Y

4" MIDGET LOUDSPEAKERS

AD3414



Primary application:

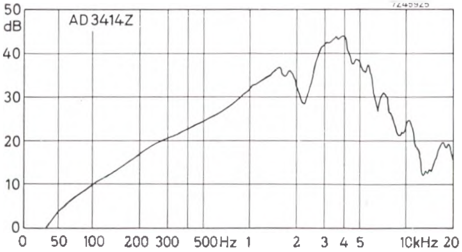
high-quality cordless radio sets

Specific properties:

1. These class-IIIA speakers are particularly suitable for high-performance cordless radio sets.
2. Extremely sensitive ferroxdure magnet, which converts even small output signals into a sound of fair volume.
3. The resonance frequency has been adapted to the average size of smaller sets so as to obtain optimum bass reproduction.

Main dimensions:

mounting diameter	115 mm
outer diameter.	95.2 mm
total depth max.	42.2 mm

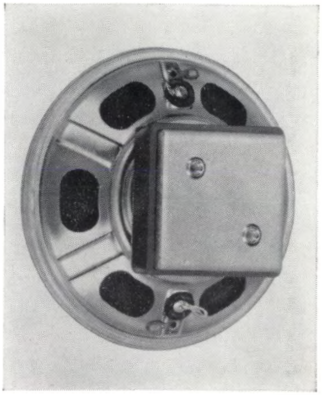


power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
3	3	165	170–7000	22300	12000	400	**AD3414Z**
3	15	165	170–7000	22300	12000	400	AD3414PZ

AD3415

Primary application:

cordless radio sets
(in particular for AM/FM reception)

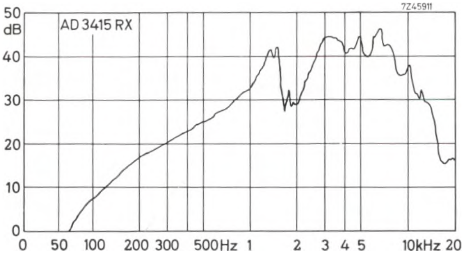


Specific properties:

1. Owing to the large and flat square magnet of ferroxdure and the X-version cone, these speakers combine high sensitivity and appreciable presence with a small depth.
2. Sensitivity equals that of type AD3414Z, but the wider frequency range renders these speakers suitable for AM/FM sets.

Main dimensions:

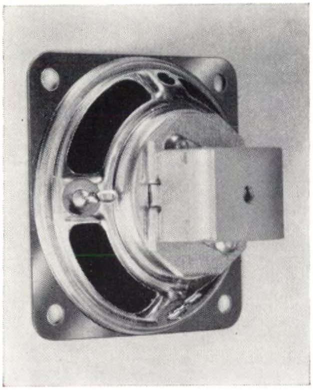
outer diameter . . . . 105.2 mm
total depth max . . . . 41.1 mm



power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
3	4	160	150–10000	25000	10400	250	AD3415RX

3" STANDARD LOUDSPEAKERS

AD1300-06



Primary applications:

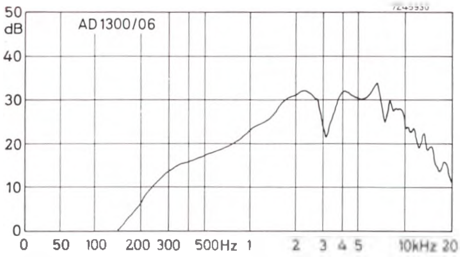
small radio receivers;
intercoms; TV tweeters.

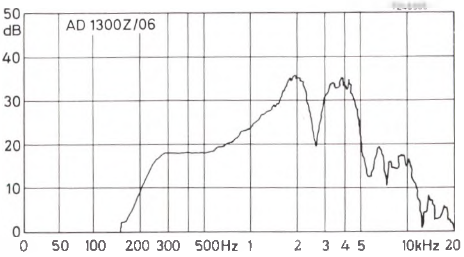
Specific properties:

1. Thanks to the pronounced high-note reproduction the AD1300 is quite suitable for use as high-note projector at the front of receivers.
2. The Z-version is outstandingly suited to obtain clear reproduction of the human voice.

Main dimensions:

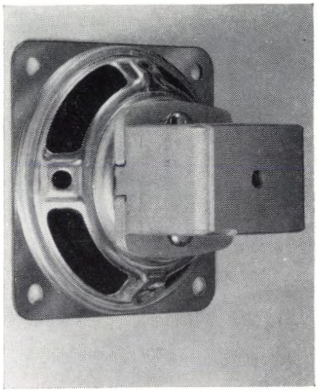
mounting diameter	92 mm
outer diameter.	80.2 mm
total depth max.	42.8 mm





power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
2	3	230	9500	6800	130	AD1300-06
2	3	275	9500	6800	130	**AD1300Z-06**

AD2300–06



Primary applications:

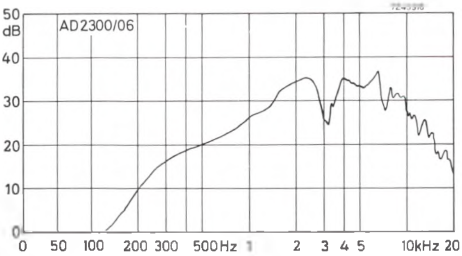
small radio receivers;
intercoms; TV tweeters.

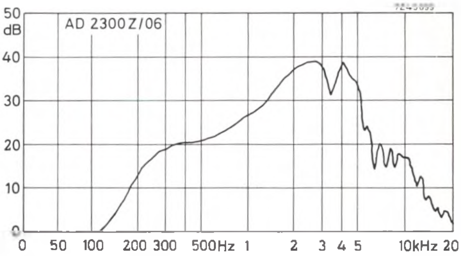
Specific properties:

1. Thanks to the pronounced high-note reproduction the AD2300 is quite suitable for use as high-note projector at the front of receivers;
2. The Z-version is outstandingly suited to obtain clear reproduction of the human voice.

Main dimensions:

mounting diameter	92 mm
outer diameter.	80.2 mm
total depth max.	54.8 mm

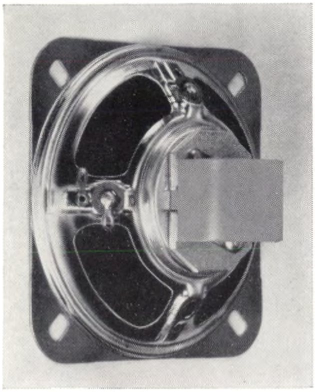




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
2	3	230	15800	8500	230	AD2300–06
2	3	275	15800	8500	230	AD2300Z–06
2	150	275	15800	8500	230	AD2300CZ–06

4″ STANDARD LOUDSPEAKERS

AD1400–06



Primary applications:

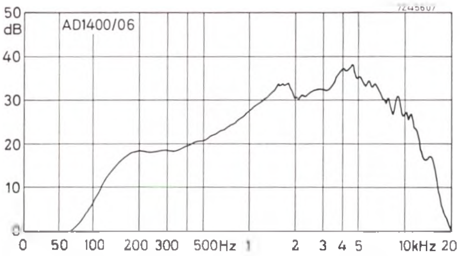
AM/FM radio sets;
tape recorders; electrophones.

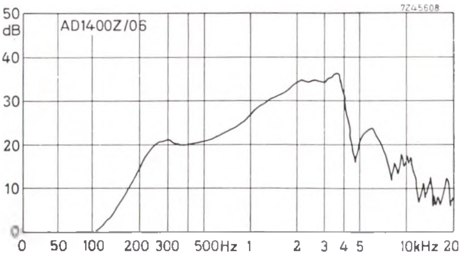
Specific property:

As a consequence of the raised response in the medium-note region, the Z-version items are outstandingly suited to obtain clear reproduction of the human voice. Therefore, they are widely used for dictaphones.

Main dimensions:

mounting diameter	115 mm
outer diameter.	105.2 mm
total depth max.	50 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	3	165	9500	6800	160	AD1400–06
3	3	202	9500	6800	160	**AD1400Z–06**
3	25	202	9500	6800	160	AD1400HZ–06

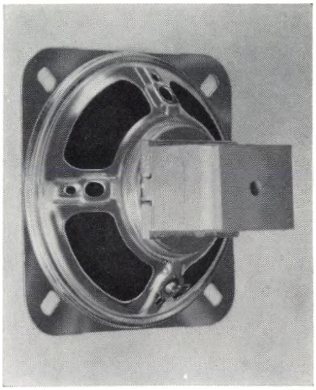
AD2400-06

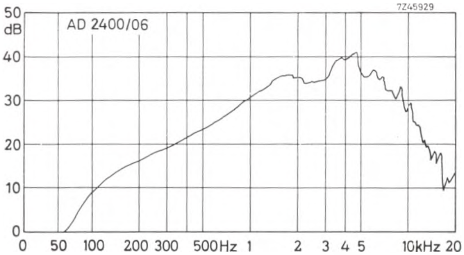
Primary applications:

AM/FM radio sets; tape recorders; electrophones; TV tweeters (AD2400M–06).

Specific property:

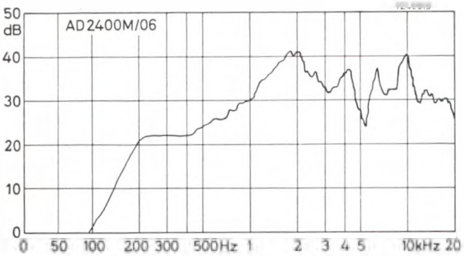
Type AD2400M/06 is particularly suitable for use as a high-note projector (tweeter) at the front of radio- and TV-receivers.

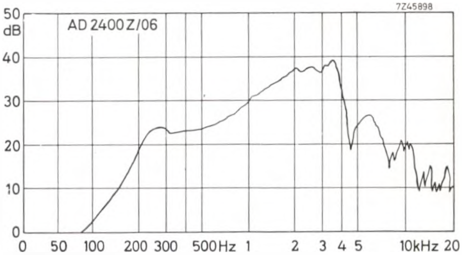




Main dimensions:

mounting diameter	115 mm
outer diameter	105.2 mm
total depth max.	62 mm

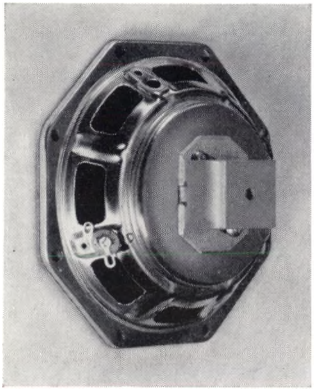




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	3	170	15800	8500	260	**AD2400–06**
3	3	165	15800	8500	260	AD2400M–06
3	3	205	15800	8500	260	**AD2400Z–06**
3	60	205	15800	8500	260	AD2400KZ–06

5" STANDARD LOUDSPEAKERS

AD1500–06



Primary application:

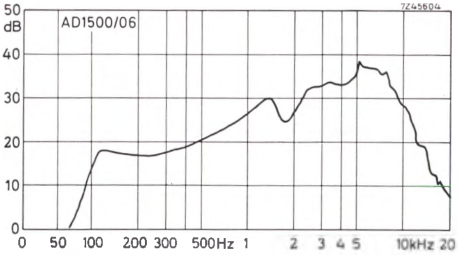
all kinds of radio and TV sets.

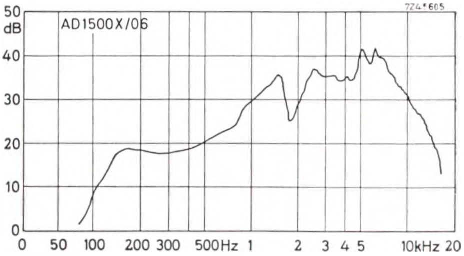
Specific properties:

See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter	119	mm
outer diameter.	121	mm
total depth max.	51.5	mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	3	130	9500	6800	150	AD1500–06
6	3	130	9500	6800	150	**AD1500X–06**

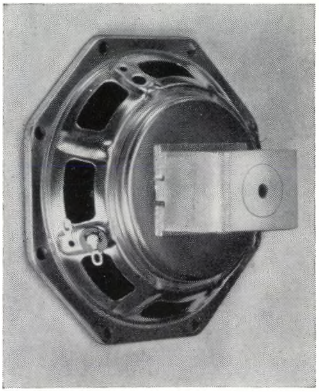
AD2500–06

Primary application:

all kinds of radio and TV sets

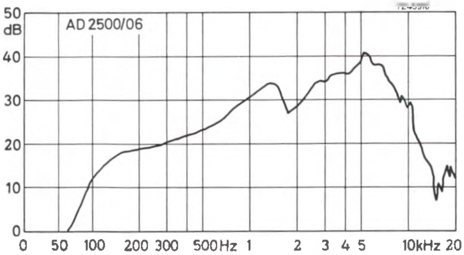
Specific properties:

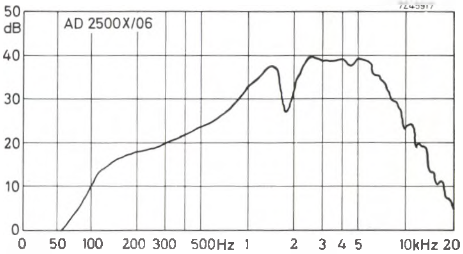
See section "Introduction", standard speakers.



Main dimensions:

mounting diameter	119	mm
outer diameter	121	mm
total depth max.	63.5	mm

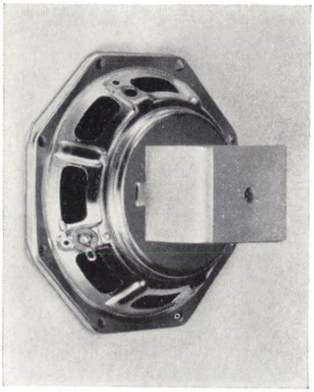




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	3	130	15800	8500	250	AD2500–06
6	3	130	15800	8500	250	**AD2500X–06**

5″ STANDARD LOUDSPEAKERS

AD3500–06



Primary applications:

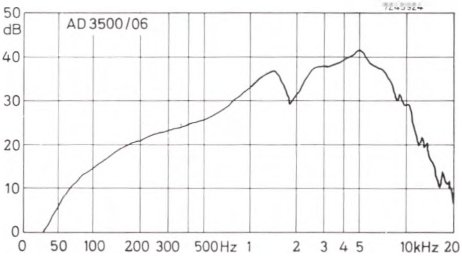
all kinds of radio and TV sets

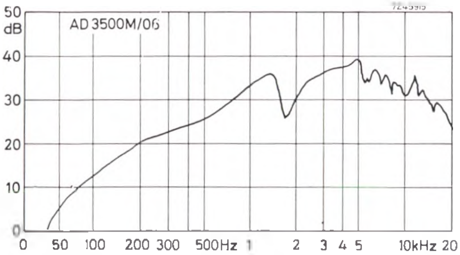
Specific properties:

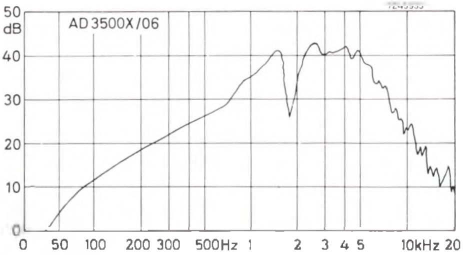
1. The 800 Ω type, obtained by applying a special method of winding the voice coil, can be used in conjunction with a single-ended transformerless output stage.
2. High sensitivity.
3. See section "Introduction", standard speakers p. 46.

Main dimensions:

mounting diameter	119 mm
outer diameter	121 mm
total depth max.	68 mm





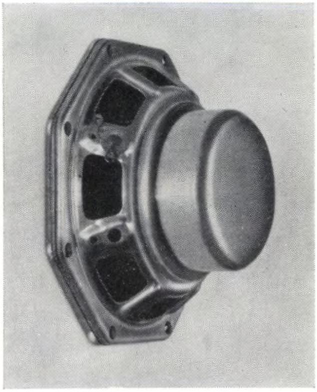


power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	130	28000	9500	400	AD3500–06
3	5	124	28000	9500	400	AD3500M–06
3	800	124	28000	9500	400	AD3500AM–06
6	5	130	28000	9500	400	AD3500X–06

AD3514

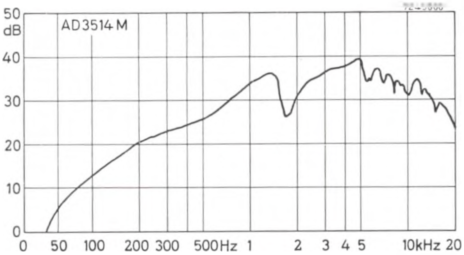
Primary applications:

equipment in which little space is available, such as tape-recorders, car radios and gramophones.



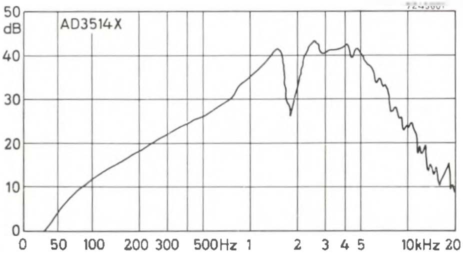
Specific properties:

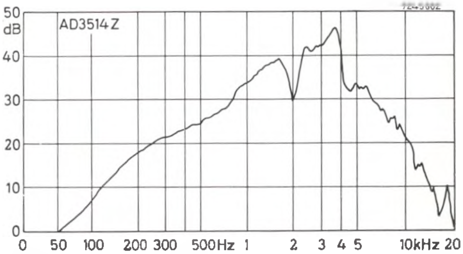
1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3514 equals that of the class-III types AD3500–06 provided with a TICONAL magnet.



Main dimensions:

mounting diameter	119 mm
outer diameter.	121 mm
total depth max.	52.5 mm

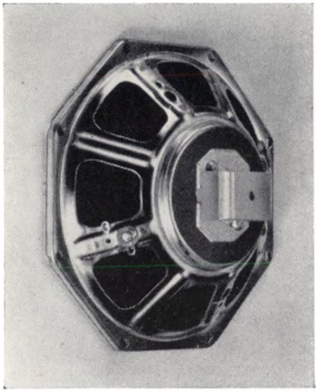




power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (G)	type number
3	5	124	95–18000	28200	9500	445	AD3514M
6	5	130	100–11000	28200	9500	445	**AD3514X**
3	5	155	150–10000	28200	9500	445	AD3514Z

6.5″ STANDARD LOUDSPEAKERS

AD1700–06



Primary application:

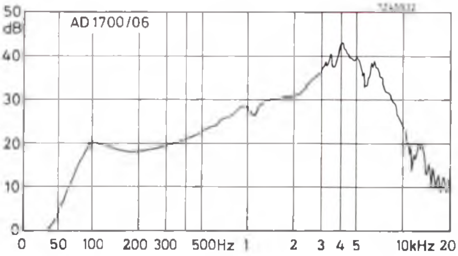
all kinds of radio and TV sets

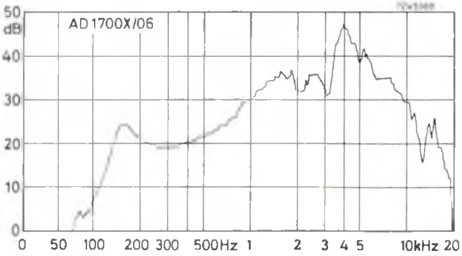
Specific properties:

See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter	156 mm
outer diameter.	155.2 mm
total depth max.	61.4 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	3	90	9 500	6 800	190	**AD1700–06**
6	3	110	9 500	6 800	190	AD1700X–06

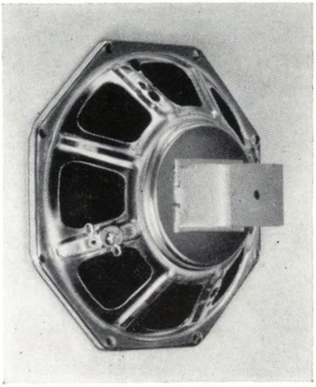
AD2700–06

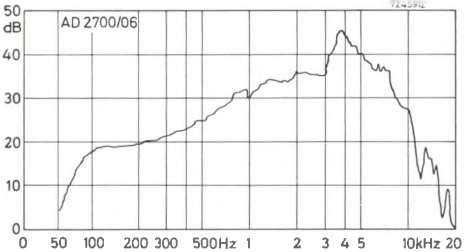
Primary application:

all kinds of radio and TV sets

Specific properties:

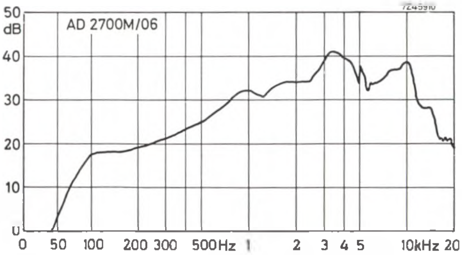
See section "Introduction", standard speakers, p.46.

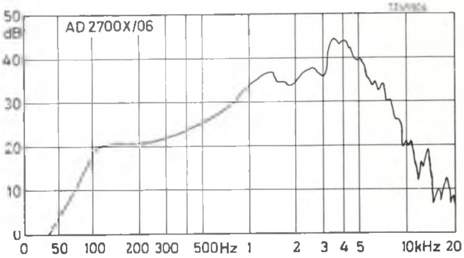




Main dimensions:

mounting diameter	156 mm
outer diameter.	155.2 mm
total depth max.	72.4 mm

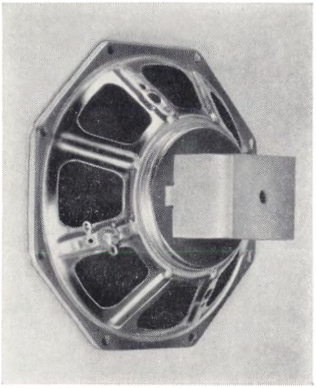




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	90	15200	8500	290	AD2700–06
3	5	85	15200	8500	290	**AD2700M–06**
6	5	110	15200	8500	290	**AD2700X–06**

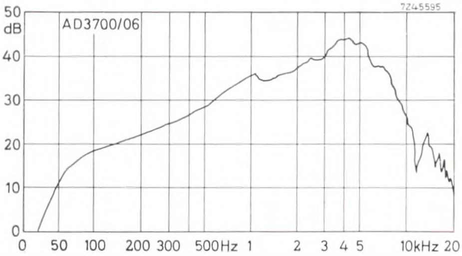
6.5" STANDARD LOUDSPEAKERS

AD3700–06



Primary applications:

all kinds of radio and TV sets

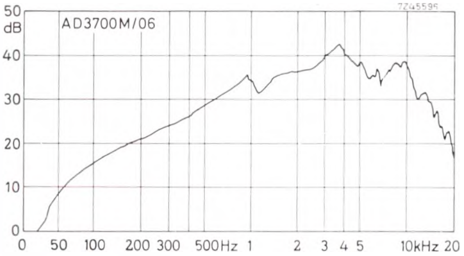


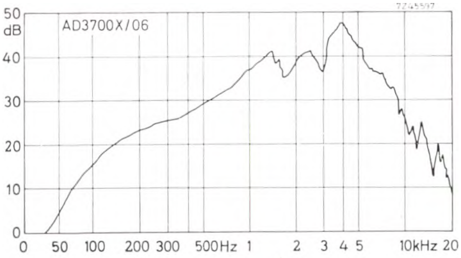
Specific properties:

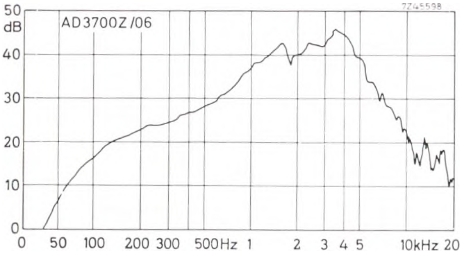
1. The 800 Ω type, obtained by applying a special method of winding the voice coil, can be used in conjunction with a single-ended transformerless output stage.
2. High sensitivity
3. See "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter	156 mm
outer diameter	155.2 mm
total depth max.	77.9 mm

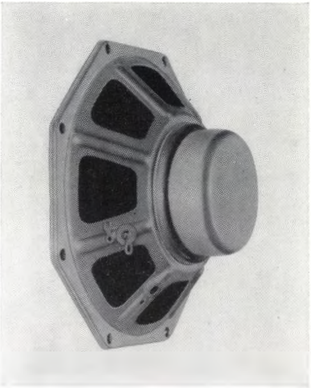






power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	90	28000	9500	440	AD3700–06
3	5	85	28000	9500	440	**AD3700M–06**
3	800	85	28000	9500	440	AD3700AM–06
6	5	110	28000	9500	440	AD3700X–06
3	5	135	28000	9500	440	AD3700Z–06

AD3714



Primary applications:

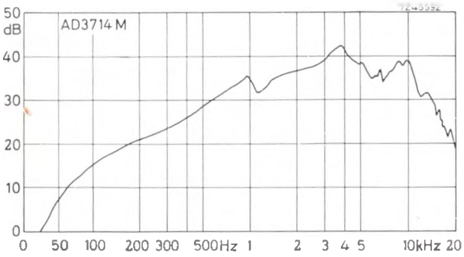
equipment in which little space is available, such as tape-recorders and magnetophones.

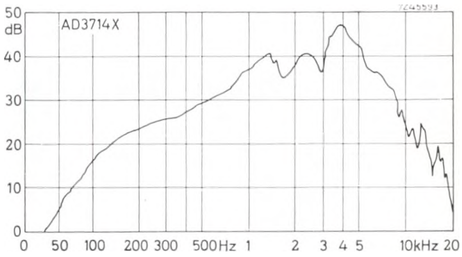
Specific properties:

1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3714 equals that of the class-III types AD3700–06, provided with a TICONAL magnet.

Main dimensions:

mounting diameter	156 mm
outer diameter	155.2 mm
total depth max.	62.4 mm

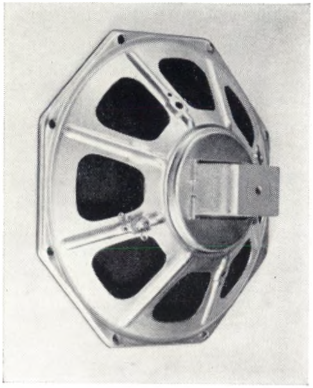




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	85	28 200	9 500	475	AD3714M
6	5	110	28 200	9 500	475	AD3714X

8″ STANDARD LOUDSPEAKERS

AD2800–06



Primary applications:

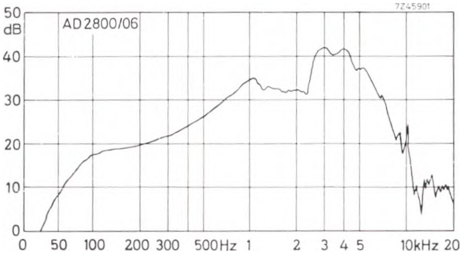
all kinds of radio and TV sets

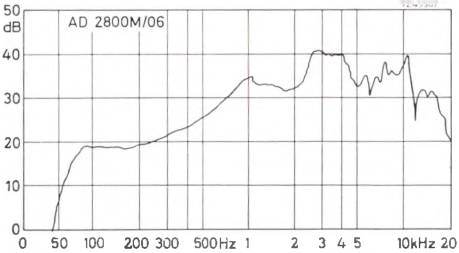
Specific properties:

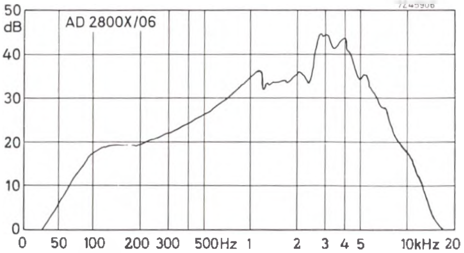
See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter	194 mm
outer diameter	191.6 mm
total depth max.	82.8 mm





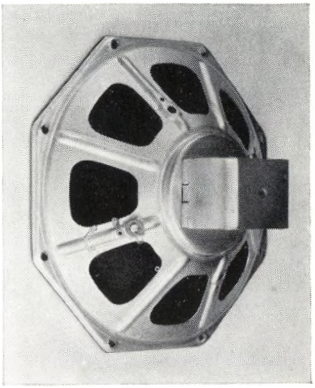


power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	75	65–11000	15200	8500	370	AD2800–06
6	5	72	60–18000	15200	8500	370	AD2800M–06
6	5	95	70–10000	15200	8500	370	AD2800X–06

AD3800-06

Primary applications:

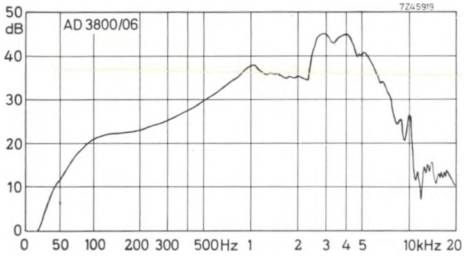
all kinds of radio and TV sets.



Specific properties:

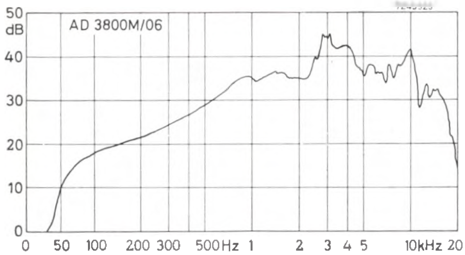
1. The 800 Ω type, obtained by applying a special method of winding the voice coil, can be used in conjunction with a single-ended transformerless output stage.
2. High sensitivity.
3. See section "Introduction", standard speakers.

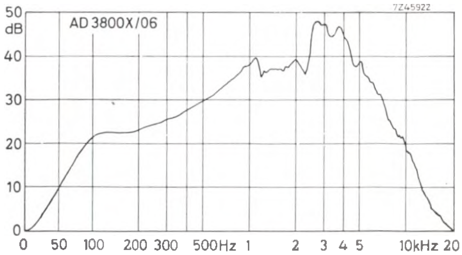
Note: In 1966 this loudspeaker will be replaced by type AD3806, which has identical proporties.



Main dimensions:

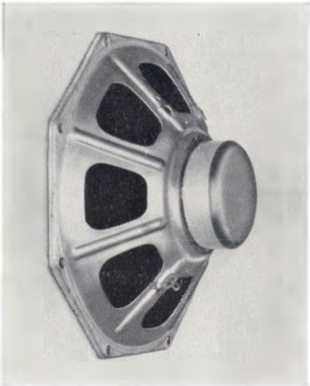
mounting diameter	194 mm
outer diameter	191.6 mm
total depth max.	88.3 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	75	65–11000	28000	9500	520	**AD3800-06**
6	5	72	60–18000	28000	9500	520	**AD3800M-06**
6	800	72	60–18000	28000	9500	520	**AD3800AM-06**
6	5	95	70–10000	28000	9500	520	AD3800X-06

AD3814



Primary applications:

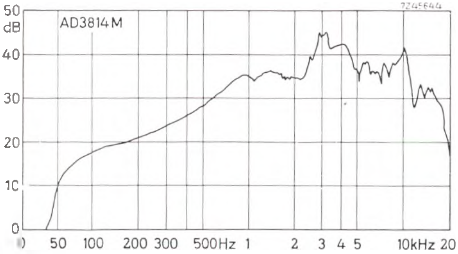
AM/FM receivers;
equipment in which little space is available, such as tape-recorders and magnetophones.

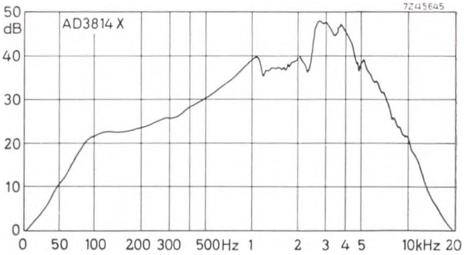
Specific properties:

1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3814 equals that of the class-III types AD3800–06 provided with a TICONAL magnet.

Main dimensions:

mounting diameter	194 mm
outer diameter.	191.6 mm
total depth max.	72.8 mm



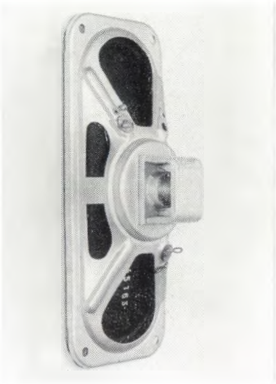


power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	72	28 200	9 500	535	AD3814M
6	5	95	28 200	9 500	535	AD3814X

AD3386RX

Primary applications:

TV sets; portable radios; tape recorders.

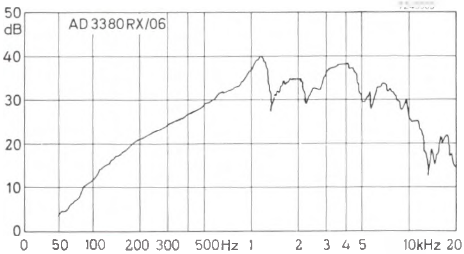


Specific properties:

1. Stretched oval speakers of the class-III type.
2. Extremely good acoustic performance notwithstanding its asymmetry.

Main dimensions:

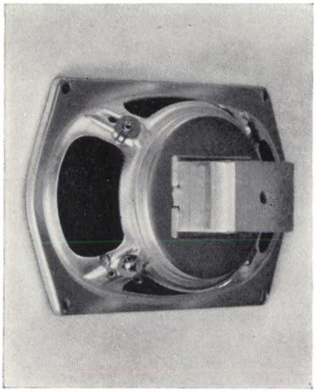
mounting diameter	184 × 62 mm
outer diameter.	205 × 82 mm
total depth max.	67.5 mm



power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
3	5	130	120–12 000	28 000	9 500	450	AD3386RX

4" × 6" STANDARD LOUDSPEAKERS

AD2460–06



Primary applications:

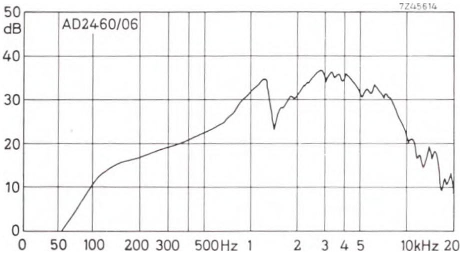
small radio sets; electrophones;
tape recorders.

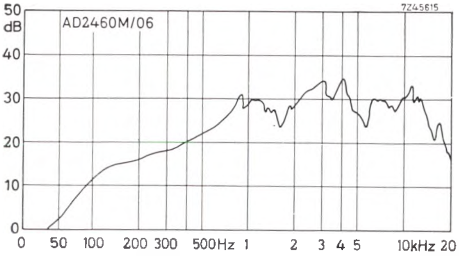
Specific properties:

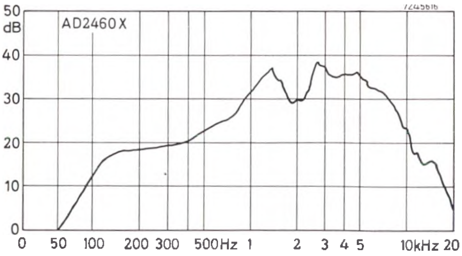
See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter . . . 117.5 × 92 mm
outer diameter. . . . . 155 × 103 mm
total depth max. . . . . 62,8 mm





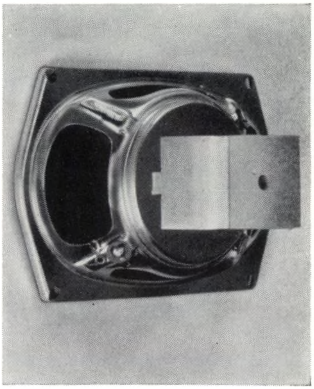


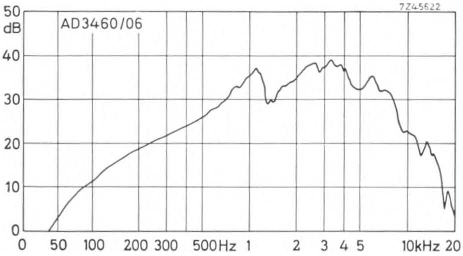
power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	130	15 200	8 500	290	AD2460–06
3	5	124	15 200	8 500	290	AD2460M–06
6	5	130	15 200	8 500	290	**AD2460 X–06**

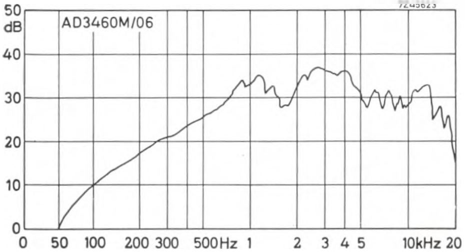
AD3460–06

Primary applications:

small radio sets; electrophones; tape recorders.





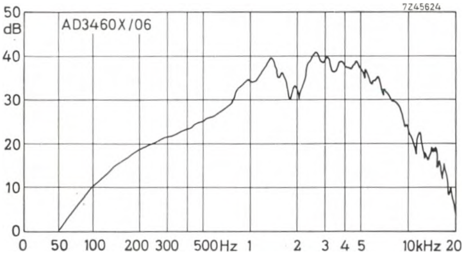


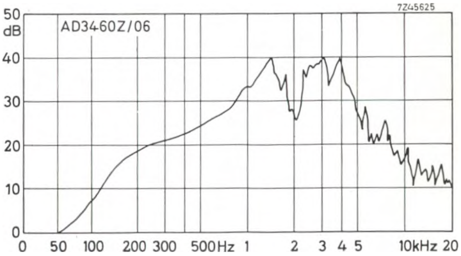
Specific properties:

1. High sensitivity;
2. See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter . . .	117.5 × 92 mm
outer diameter.	155 × 103 mm
total depth max.	68.3 mm

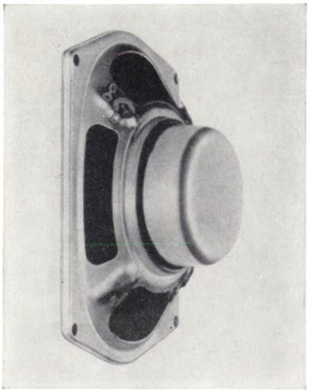




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	130	28000	9500	440	AD3460–06
3	5	124	28000	9500	440	**AD3460M–06**
6	5	130	28000	9500	440	AD3460X–06
3	5	155	28000	9500	440	AD3460Z–06

4″ × 6″ STANDARD LOUDSPEAKERS

AD3464



Primary applications:

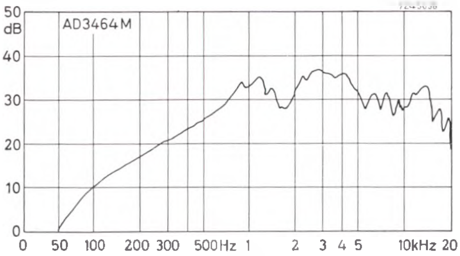
equipment in which little space is available, such as tape-recorders, magnetophones and car radios.

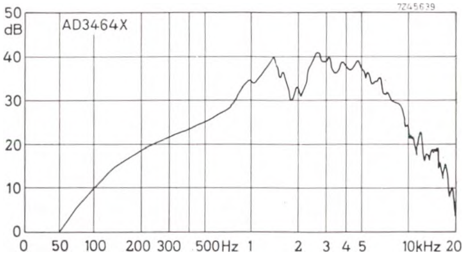
Specific properties:

1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3464 equals that of the class-III types AD3460–06 provided with a TICONAL magnet.

Main dimensions:

mounting diameter . . .	117.5 × 92 mm
outer diameter.	155 × 103 mm
total depth max.	52.8 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	124	105–18 000	28 200	9 500	480	AD3464M
6	5	130	110–11 000	28 200	9 500	480	**AD3464X**

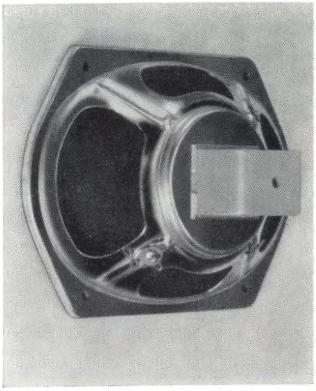
AD2570–06

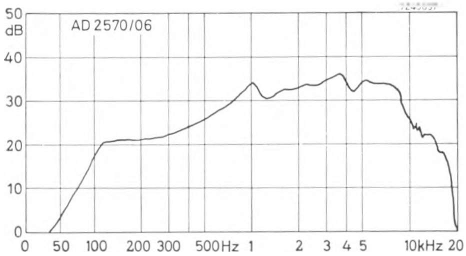
Primary application:

all kinds of radio and TV sets.

Specific properties:

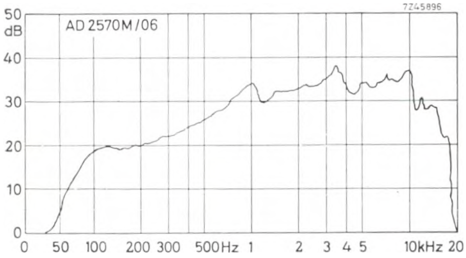
See section "Introduction", standard speakers, p. 46.

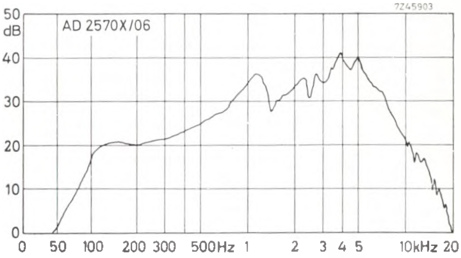




Main dimensions:

mounting diameter	110 × 110 mm
outer diameter.	183 × 133 mm
total depth max.	72.8 mm

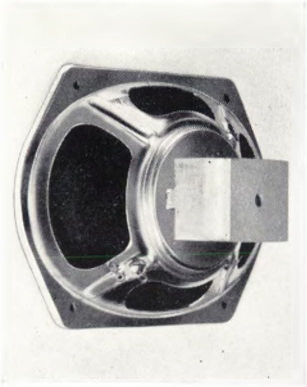




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	90	15 200	8 500	320	**AD2570–06**
3	5	90	15 200	8 500	320	AD2570M–06
6	5	110	15 200	8 500	320	AD2570X–06

5″ × 7″ STANDARD LOUDSPEAKERS

AD3570–06

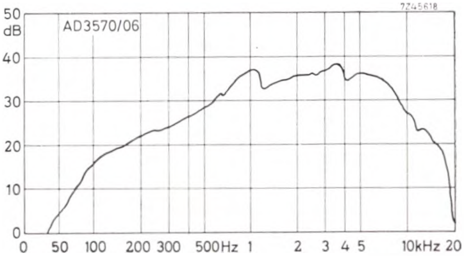


Primary application:

all kinds of radio and TV sets.

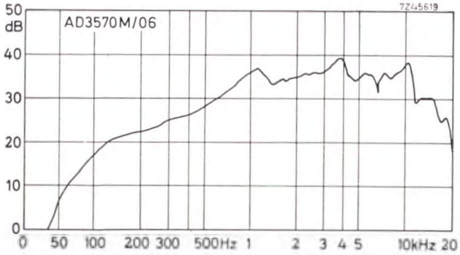
Specific properties:

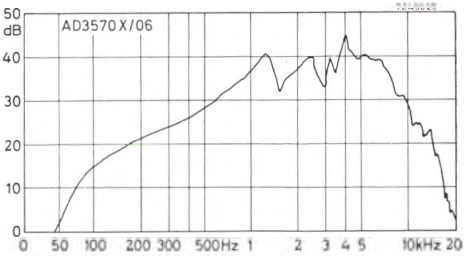
1. Oval class-III types designed for use in those cases where the available space prohibits the accommodation of round class-III speakers AD3700.
2. High acoustic output owing to the powerful TICONAL magnet.



Main dimensions:

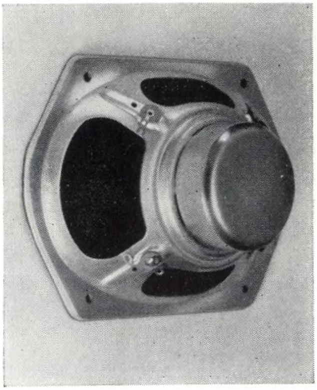
mounting diameter	110 × 110 mm
outer diameter.	183 × 133 mm
total depth max.	78.3 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	90	28000	9500	470	AD3570–06
3	5	90	28000	9500	470	AD3570M–06
6	5	110	28000	9500	470	AD3570X–06

AD3574



Primary applications:

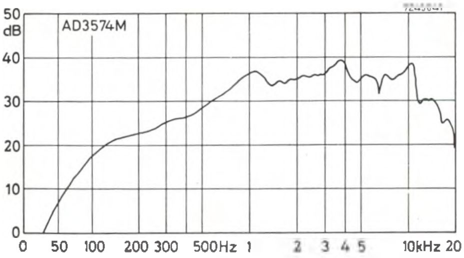
radio and TV sets;
equipment in which little space is available, such as tape-recorders and magnetophones.

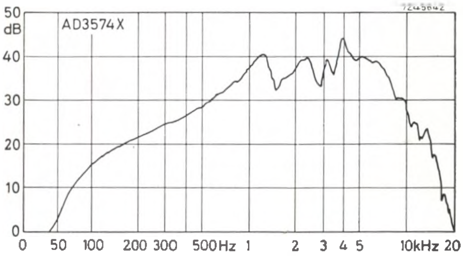
Specific properties:

1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3574 equals that of the class-III types AD3570–06 provided with a TICONAL magnet.

Main dimensions:

mounting diameter	110 × 110 mm
outer diameter.	183 × 133 mm
total depth max.	62.8 mm

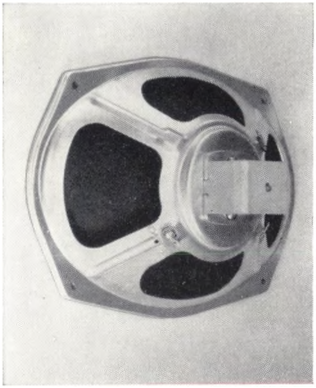




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	90	28 200	9 500	520	AD3574M
3	5	110	28 200	9 500	520	AD3574X

6″ × 9″ STANDARD LOUDSPEAKERS

AD2690–06



Primary applications:

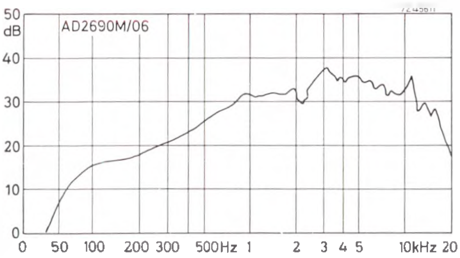
AM/FM and TV sets;
radiogramophones.

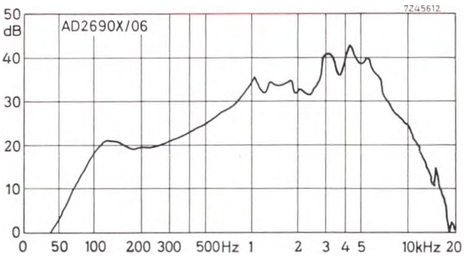
Specific properties:

See section "Introduction", standard speakers, p. 46.

Main dimensions:

mounting diameter . .	166.7 × 117.5 mm
outer diameter. . . .	233.6 × 160.6 mm
total depth max.	82.8 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	77	65–18 000	15 200	8 500	375	**AD2690M–06**
6	5	100	90– 9 000	15 200	8 500	375	AD2690X–06

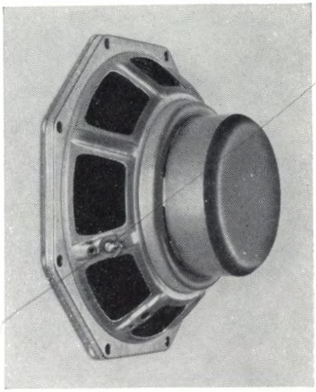
AD3690–06

Primary applications:

AM/FM and TV sets; radiogramophones.

Specific properties:

1. The 800 Ω type, obtained by applying a special method of winding the voice coil, can be used in conjunction with a single-ended transformerless output stage.
2. High sensitivity.
3. See section "Introduction", standard speakers, p. 46.



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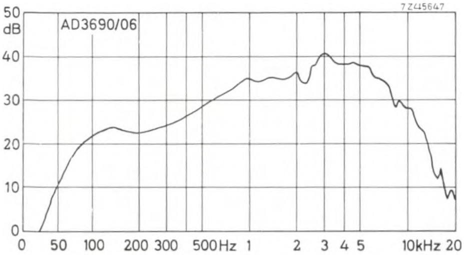
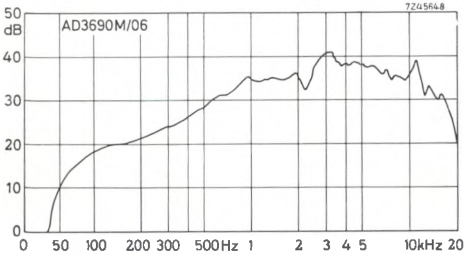
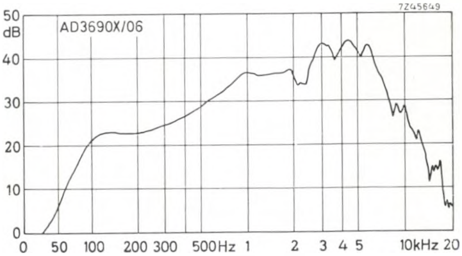


Main dimensions:

mounting diameter . . .	166.7 × 117.5 mm
outer diameter. . . .	233.6 × 160.6 mm
total depth max.	88.3 mm

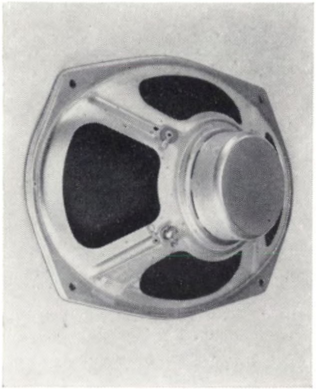




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	80	70–11 000	28 000	9 500	525	AD3690–06
6	5	77	65–18 000	28 000	9 500	525	**AD3690M–06**
6	800	77	65–18 000	28 000	9 500	525	AD3690AM–06
6	5	100	90– 9 000	28 000	9 500	525	AD3690X–06

6″ × 9″ STANDARD LOUDSPEAKERS

AD3694



Primary application:

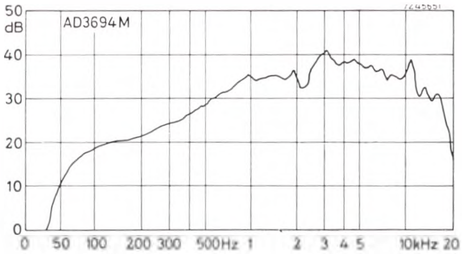
equipment in which little space is available, such as tape-recorders magnetophones and carradios.

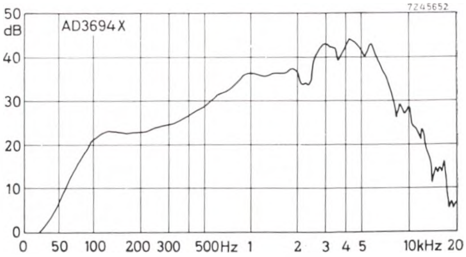
Specific properties:

1. Flat but, nevertheless, very sensitive loudspeaker magnet system owing to the small height of its annular ferroxdure magnet.
2. The acoustic output of the class-IIIA speakers AD3694 equals that of the class-III types AD3690–06 provided with a TICONAL magnet.

Main dimensions:

mounting diameter . .	166.7 × 117.5 mm
outer diameter. . . .	233.6 × 160.6 mm
total depth max.	72.8 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
6	5	80	28 200	9 500	565	AD3694M
6	5	100	28 200	9 500	565	AD3694X

AD3701

Primary application:

small closed cabinets for monophonic and stereophonic reproduction (see page F95).

Specific properties:

1. Hi-Fi reproduction over a very wide frequency range owing to the use of a special double cone which has a very low resonance frequency and reproduces even the highest tones so as to ensure a true timbre.
2. Great power-handling capacity when placed in a closed cabinet having a volume of about 25 litres.
3. Very high sensitivity owing to the use of a large annular ferroxdure magnet.

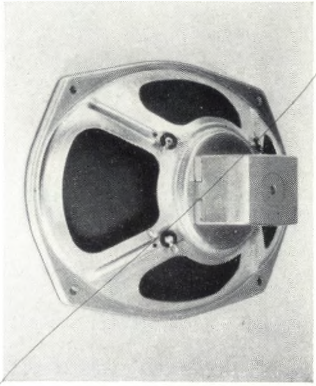
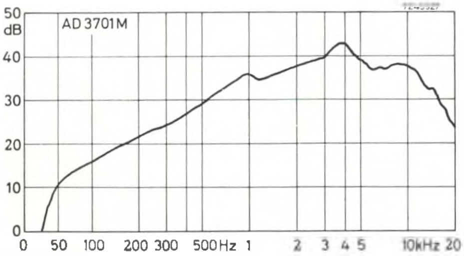


Foto van pag F83

Main dimensions:

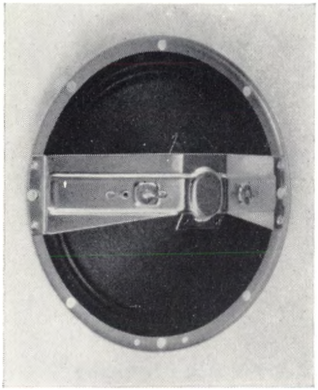
mounting diameter	156	mm
outer diameter.	155.2	mm
total depth max.	67	mm



power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
10	5	55	42600	9500	525	**AD3701M**
10	800	55	42600	9500	525	AD3701AM

6.5" SPECIAL LOUDSPEAKERS

AD3721



Primary application

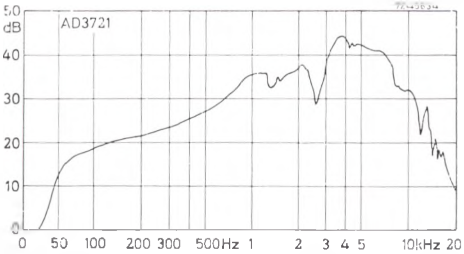
equipment in which little space is available, such as tape-recorders and electrophones.

Specific properties:

1. These wafer types have a space-saving shape and a small mounting depth.
2. High acoustic efficiency nothwithstanding the small mounting depth owing to the sensitive flat ferroxdure magnet.
3. Flat wafer design

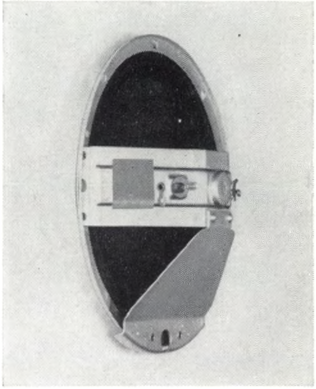
Main dimensions:

mounting diameter	156 mm
outer diameter.	166.6 mm
total depth max.	41.1 mm



power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
3	5	110	28 200	9 500	500	AD3721

AD3725



Primary application:

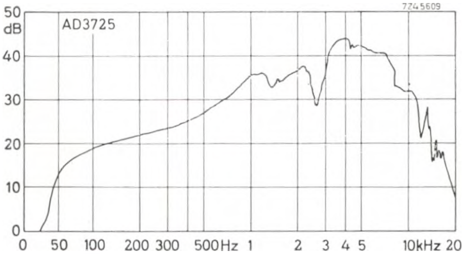
TV sets.

Specific properties:

1. These speakers (otherwise identical to type AD3721) are equipped with a leakage-compensation assembly composed of a screening bracket and two compensation magnets, which almost completely neutralise the leakage field of the loudspeaker magnet. In view of the compactness of TV receivers this is of paramount importance to prevent the speakers – close to the picture tube – from affecting the image quality.
2. Flat wafer design, greatly facilitating accommodation of these speakers in TV sets.
3. The sensitive flat ferroxdure magnet ensures a high efficiency.

Main dimensions:

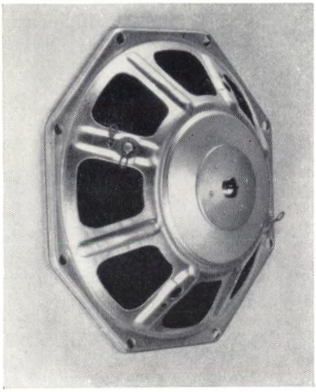
mounting diameter	156	mm
outer diameter.	166	mm
total depth max.	41.1	mm



power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	5	110	23 200	9 500	530	**AD3725**
3	800	110	28 200	9 500	530	AD3725A–02

6.5" SPECIAL LOUDSPEAKERS

AD3729



Primary application:

TV sets.

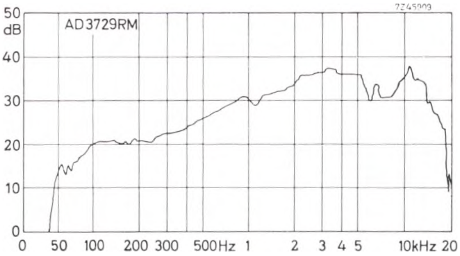
Specific properties:

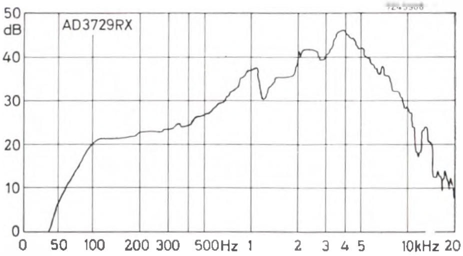
1. Small mounting depth as a result of the inverted construction.
2. High sensitivity (class III) owing to the use of a TICONAL GG magnet.
3. Absence of a stray field, an essential condition to obviate any influence on the picture tube.
4. The M-version speakers have a wide frequency range.

When the speakers, which are supplied in a plastic envelope, are built in, the front must be covered with a piece of muslin so as to prevent dust from entering the air gap.

Main dimensions:

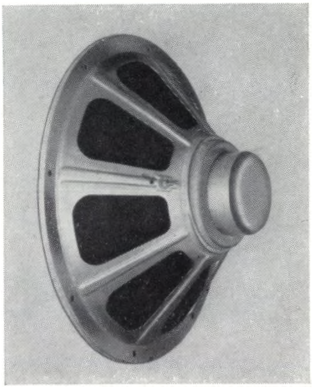
mounting diameter	156	mm
outer diameter	155	mm
total depth max.	46.9	mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (g)*	*type number*
3	4	80	18900	7000	250	AD3729RM
3	800	80	18900	7000	250	AD3729AM
3	4	100	18900	7000	250	**AD3729RX**

AD4201



Primary applications:

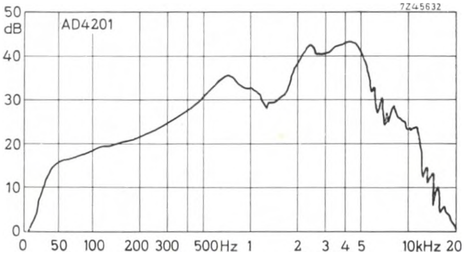
juke boxes;
acoustic boxes for musical installations.

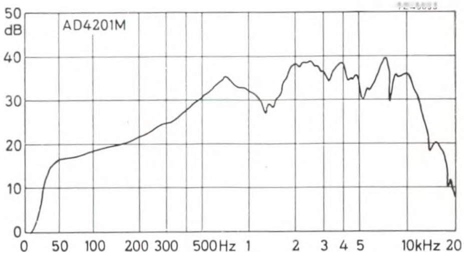
Specific properties:

1. New type of inexpensive speaker with a reasonably good efficiency, well suitable for those installations where both cost and quality are factors of importance.
2. The M-version is suited to stereo reproduction because of its wide frequency range.

Main dimensions:

mounting diameter	294 mm
outer diameter.	314.3 mm
total depth max.	122.7 mm

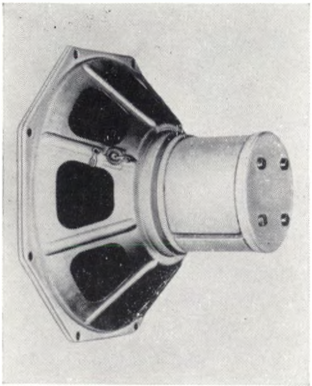




power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (g)	type number
10	5	45	40– 7000	42600	9500	850	AD4201
10	5	45	40–18000	42600	9500	850	AD4201M

8" HIGH-QUALITY LOUDSPEAKERS

AD4800



Primary applications:

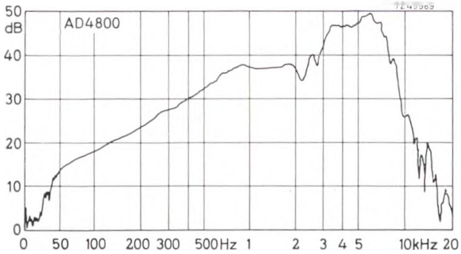
Hi-Fi and stereo equipment;
type AD4800 is suitable for low-note reproduction, such as required for acoustic and bass-reflex boxes, and for low and medium note reproduction in cross-over networks.

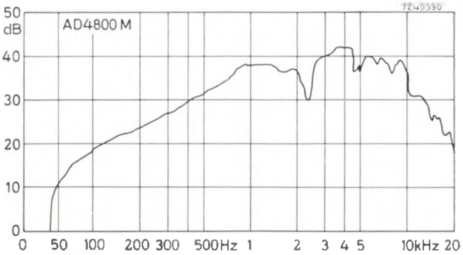
Specific properties:

1. When these speakers are placed in an acoustic box or any other enclosure, their sensitivity and response qualities result in an almost constant sound pressure over the entire audible frequency range.
2. Optimum sound volume.
3. Practically undistorted sound reproduction.

Main dimensions:

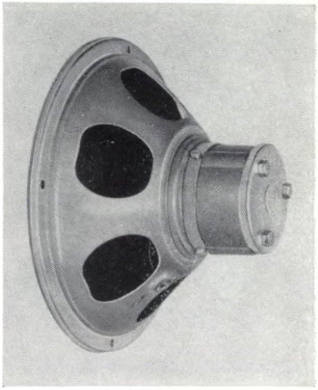
mounting diameter	194 mm
outer diameter	205.6 mm
total depth max.	118.3 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (kg)*	*type number*
6	5	60	55–10000	58300	13000	1.5	AD4800
6	5	60	55–18000	58300	13000	1.5	**AD4800M**

9710-01



Primary application:

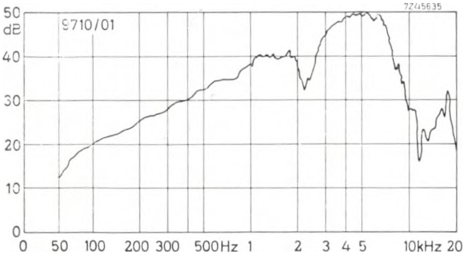
Hi-Fi equipment.

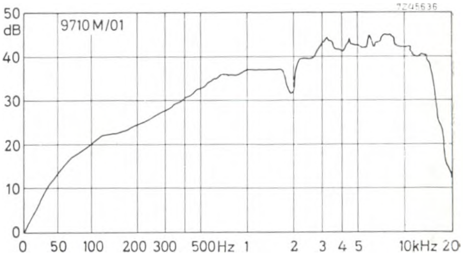
Specific properties:

1. Eminently suitable for use in all kinds of Hi-Fi equipment owing to their outstanding reproduction of world-wide fame.
2. Particularly large air gap, resulting in the voice coil being completely enclosed by a uniform magnetic field even at the largest amplitudes. No distortion will thus be experienced due to the coil amplitude being disproportional to the current.
3. Constant voice-coil impedance throughout the entire frequency range, so that the output stage always has a perfectly matched load.
4. Very smooth response curves owing to the improved cone design.
5. Clear bass response without boom effects, because of the mechanical damping at low frequencies.

Main dimensions:

mounting diameter . . .	203.2 mm
outer diameter	216.5 mm
total depth max.	111.6 mm

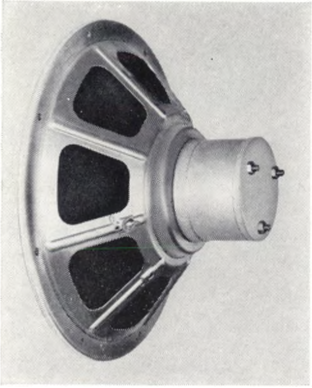




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (kg)*	*type number*
10	7	50	40–10000	97600	8000	1.8	9710–01
10	7	50	40–19000	97600	8000	1.8	**9710M–01**
10	800	50	40–19000	97600	8000	1.8	9710AM–01

10" HIGH-QUALITY LOUDSPEAKERS

AD4000



Primary applications:

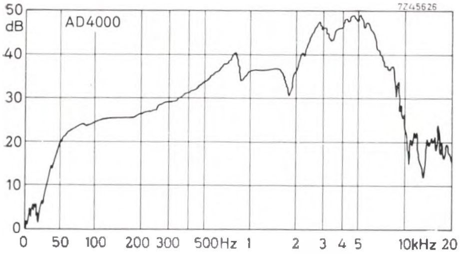
Hi-Fi and stereo equipment;
radiograph consoles.

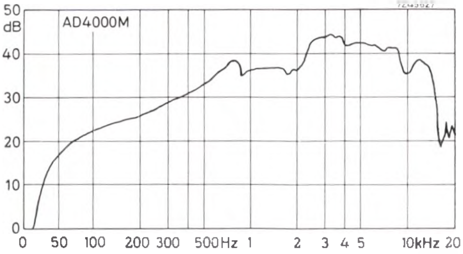
Specific properties:

1. Outstanding quality of reproduction, rendering these types suitable for use in all kinds of Hi-Fi equipment.
2. Particularly large air gap, resulting in the voice coil being completely enclosed by a uniform magnetic field even at the largest amplitudes. No distortion will thus be experienced due to the coil amplitude being disproportional to the current.
3. Constant voice-coil impedance throughout the entire frequency range, so that the output stage always has a perfectly matched load.
4. Very smooth response curves owing to the improved cone design.
5. Clear bass response without boom effects, because of the mechanical damping at low frequencies.

Main dimensions:

mounting diameter . . .	244 mm
outer diameter	261.3 mm
total depth max.	136.5 mm





power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (kg)*	*type number*
10	7	50	45– 7000	98000	8000	1.77	AD4000
10	7	50	45–18000	98000	8000	1.77	**AD4000M**
10	800	50	45–18000	98000	8000	1.77	AD4000AM

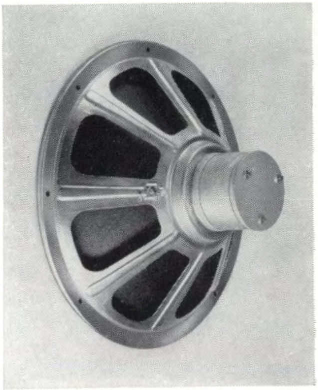
AD4200

Primary application:

Hi-Fi installations.

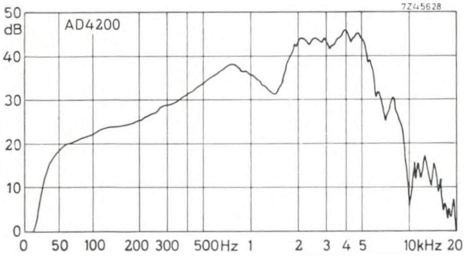
Specific properties:

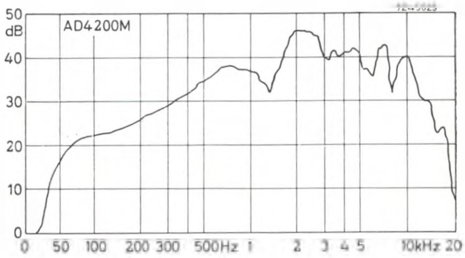
1. High power-handling capacity.
2. Particularly large air gap, resulting in the voice coil being completely enclosed by a uniform magnetic field even at the largest amplitudes. No distortion will thus be experienced due to the coil amplitude being disproportional to the current.
3. Constant voice-coil impedance throughout the entire frequency range, so that the output stage always has a perfectly matched load.
4. Very smooth response curves owing to the improved cone design.
5. Clear bass response without boom effects, because of the mechanical damping at low frequencies.
6. The acoustic output of types AD4200 is 3 dB lower than that of types AD5200.



Main dimensions:

mounting diameter . . .	294 mm
outer diameter.	314.3 mm
total depth max.	155.6 mm

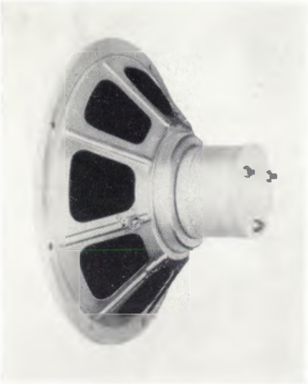




power-handling capacity (W)	*impedance at 1 kc/s (Ω)*	*resonance frequency (c/s)*	*frequency range (c/s)*	*total magnetic flux (Mx)*	*flux density (G)*	*weight (kg)*	*type number*
20	7	45	40– 7000	98000	8000	1.8	AD4200
20	7	45	35–17000	98000	8000	1.8	**AD4200M**
20	800	45	35–17000	98000	8000	1.8	AD4200AM

12" HIGH-QUALITY LOUDSPEAKERS

AD5200



Primary application:

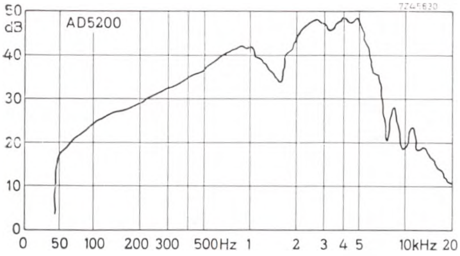
Hi-Fi installations.

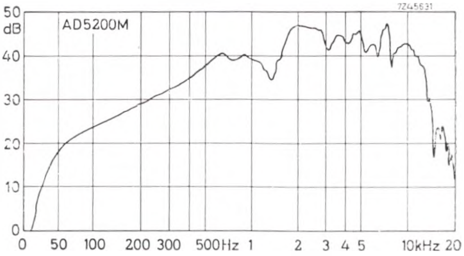
Specific properties:

1. High power-handling capacity.
2. Particularly large air gap, resulting in the voice coil being completely enclosed by a uniform magnetic field even at the largest amplitudes. No distortion will thus be experienced due to the coil amplitude being disproportional to the current.
3. Constant voice-coil impedance throughout the entire frequency range, so that the output stage always has a perfectly matched load.
4. Very smooth response curves owing to the improved cone design.
5. Clear bass response without boom effects, because of the mechanical damping at low frequencies.
6. The acoustic output of types AD5200 exceeds that of types AD4200 by 3 dB.
7. Type AD5200(M) has an extremely high sensitivity thanks to the use of a very powerful TICONAL magnet.

Main dimensions:

mounting diameter . . .	294 mm
outer diameter	314.3 mm
total depth max.	165.6 mm

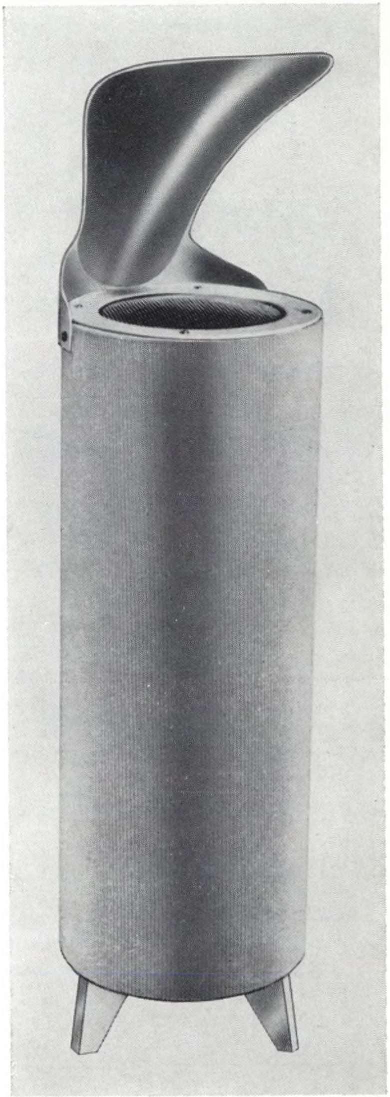




power-handling capacity (W)	impedance at 1 kc/s (Ω)	resonance frequency (c/s)	frequency range (c/s)	total magnetic flux (Mx)	flux density (G)	weight (kg)	type number
20	7	45	40– 7000	134,000	11000	3.5	AD5200
20	7	45	35–17000	134000	11000	3.5	**AD5200M**
20	800	45	35–17000	134000	11000	3.5	AD5200AM

APPLICATION OF TYPE AD3701M

ALL-ROUND ACOUSTIC BOX WITH SOUND REFLECTOR



Technical data

The *all-round* acoustic box is supplied in two styles, suitable for any interior: in smart pearl grey imitation leather, and elegant beech veneer.

Frequency range . . .	60–18000 c/s
Bass-resonance	70 c/s
Power-handling capacity of the loudspeaker	10 W without audible distortion if mounted in a closed cabinet having a volume of approx. 25 litres

Type numbers:

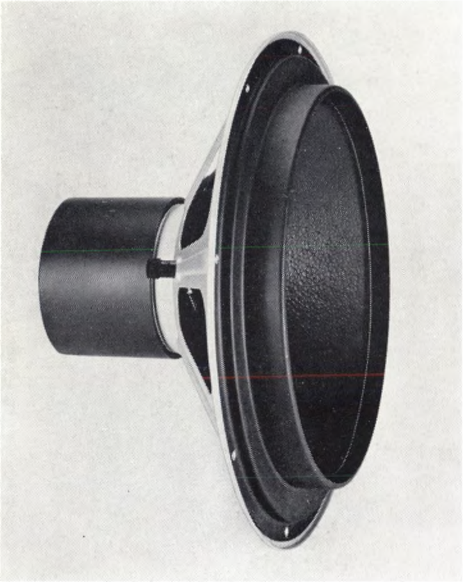
AD5043/S (3–8 Ω). . .	in pearl grey imitation leather
AD5043/M (3–8 Ω) . .	in beech veneer

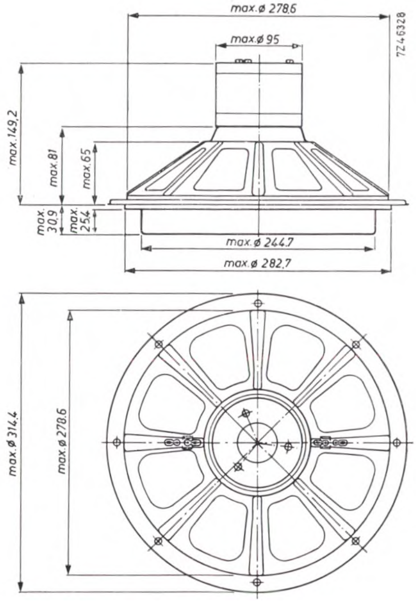
The only tool you need

In order to avoid damage to the various components, the *all-round* acoustic box is supplied only partially assembled. Assembly is very simple. Clear instructions are enclosed. You can assemble a complete, ready-to-use *all-round* acoustic box in a few minutes without any special tools. All you need is a screwdriver to fix the seventeen supplied screws into pre-drilled holes.

WOOFER LOUDSPEAKER

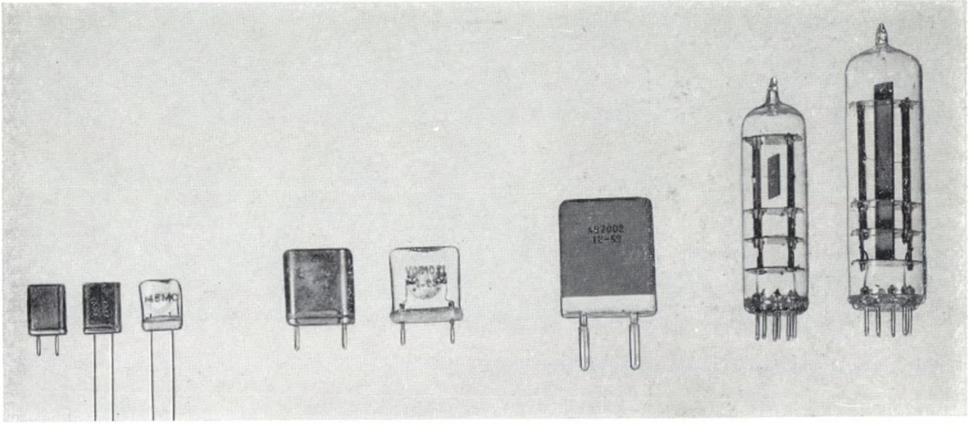
AD5201





Notwithstanding the design of the AD5201 being based on the normal electrodynamical principle, a number of striking features make it unique in its kind. The use of new materials and techniques allowed the development of a Hi-Fi speaker which, in conjunction with high and medium-note speakers and housed in an acoustically adequate enclosure, will be found a major contribution towards natural sound reproduction.
Because of its specific design and characteristics, this speaker is a solitary in our programme.

power-handling capacity (*W*)	*impedance at 1 kc/s* (*Ω*)	*resonance frequency* (*c/s*)	*frequency range* (*c/s*)	*total magnetic flux* (*Mx*)	*flux density* (*G*)	*weight* (*kg*)
25	8	26	25–1 000	134 000	9 300	3.5



The AT crystals in HC–6/U and HC–18/U holders mentioned in the tables satisfy the requirements of the military specification **MIL-C-3098B**.

The crystals in all-glass holders HC-27/U satisfy **MIL-C-3098C.**

They have the following outstanding properties:

a. reduced liability to aging effects;
b. close frequency tolerances at the nominal temperature can be achieved;
c. lower series resistance, thanks to the crystal's working in vacuum.

When applying for quotation or when ordering, please state:

1. nominal frequency ...kc/s, mode of vibration: fundamental / third / fifth

2. a. frequency tolerance ... $\times 10^{-6}$, or
   b. adjustment tolerance ... $\times 10^{-6}$, and
   frequency drift ... $\times 10^{-6}$.

3. temperature range.

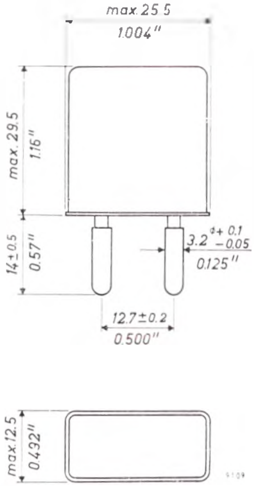
4. a. parallel resonance, capacitance parallel to unit:...pF, or
   b. anti-resonance, capacitance in series to unit:...pF, or
   c. series resonance.

5. type of holder.

For non-listed types, please apply in the same manner and submit oscillator circuit with description.

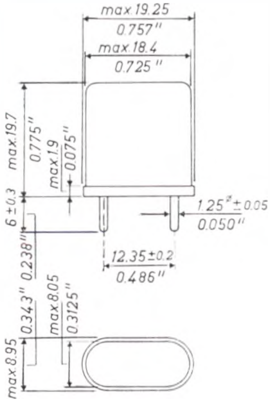
HOLDERS FOR QUARTZ CRYSTAL UNITS (preferred types)

Metal



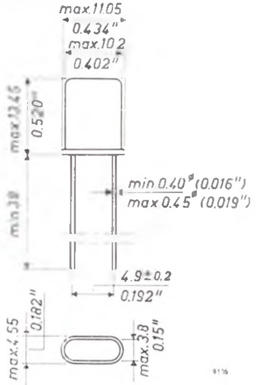
H–2

Metal



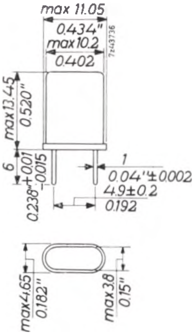
HC–6/U

Metal



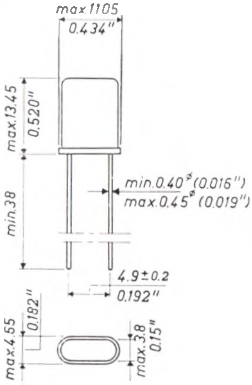
HC–18/U

Metal



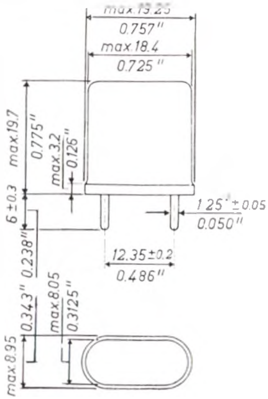
HC–25/U

All-glass



HC–26/U

All-glass



HC–27/U

QUARTZ-CRYSTAL UNITS

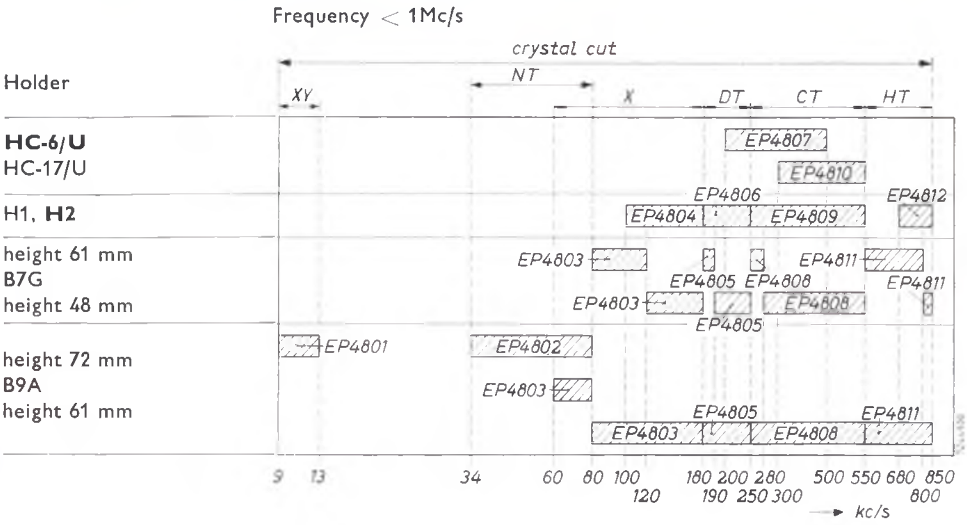
TYPES FOR GENERAL APPLICATIONS

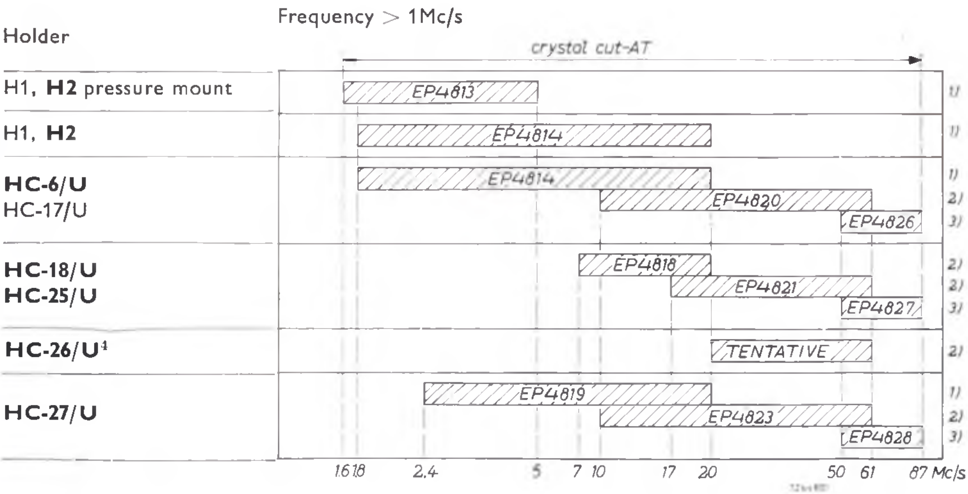
crystal cut	*frequency range*	*holder*	*sheet number*
XY	9– 13 kc/s	glas – noval B9A, height 72 mm	EP 4801(3)
NT	34– 80 kc/s	glass – noval B9A, height 72 mm	EP 4802
X	60–180 kc/s	glass – noval B9A, height 72 mm	EP 4803
	80–180 kc/s	– noval B9A, height 61 mm	
	80–120 kc/s	miniature B7G, height 61 mm	
	120–180 kc/s	miniature B7G, height 48 mm	
	100–180 kc/s	metal – H1, **H2**	EP 4804
DT	180–250 kc/s	glas – noval B9A, height 61 mm	EP 4805
	180–190 kc/s	miniature B7G, height 61 mm	
	190–250 kc/s	miniature B7G, height 48 mm	
	180–250 kc/s	metal – H1, **H2**	EP 4806
	200–500 kc/s	metal – **HC–6U/,** HC–17 U	EP 4807
CT	250–550 kc/s	glass – noval B9A, height 61 mm	EP 4808
	250-280 kc/s	miniature B7G, height 61 mm	
	280–550 kc/s	miniature B7G, height 48 mm	
	250–550 kc/s	metal – H1, **H2**	EP 4809
	300–550 kc/s	metal – **HC-6/U,** HC–17/U	EP 4810
HT	550–850 kc/s	glass – noval B9A, height 61 mm	EP 4811
	550–800 kc/s	miniature B7G, height 61 mm	
	800–850 kc/s	miniature B7G, height 48 mm	
	680–850 kc/s	metal – H1, **H2**	EP 4812
AT (pressure mount)	1.6– 5 Mc/s	metal – H1, **H2**	EP 4813
AT (metal-plated, fundamental)	1.8– 20 Mc/s	metal – H1, **H2, HC–6/U,** (HC–17/U)	EP 4814
	7– 20 Mc/s	metal – **HC-18/U, HC25/U**	EP 4818
	2.4– 20 Mc/s	all-glass-**HC-27/U**	EP 4819
AT (metal-plated, 3rd overtone)	10– 61 Mc/s	metal – **HC-6/U,** (HC–17/U)	EP 4820
	17– 61 Mc/s	metal – **HC-18/U, HC25/U**	EP 4821
	10– 61 Mc/s	all-glass-**HC-27U**	EP 4823
AT (metal-plated, 5th overtone)	20– 61 Mc/s	all-glass-**HC-26/U**	EP 4823A
	50– 87 Mc/s	metal – **HC-6/U,** (HC–17/U)	EP 4826
	50– 87 Mc/s	metal – **HC-18/U, HC25/U**	EP 4827
	50– 87 Mc/s	all-glass – **HC-27/U**	EP 4828

preferred holders in bold print

QUARTZ-CRYSTAL UNITS

TYPES FOR FREQUENCY STABILIZATION





Preferred holders in bold print

[1]) fundamental; [2]) 3rd overtone; [3]) 5th overtone; [4]) For data see EP 4823A

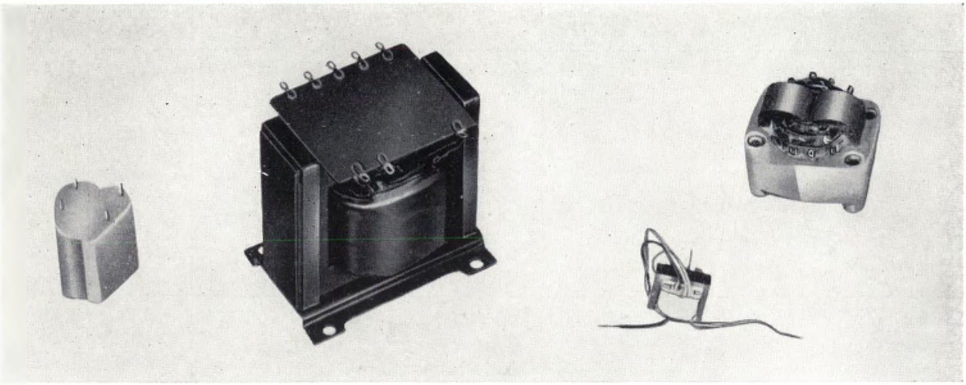
TYPES FOR SPECIAL APPLICATIONS

application	*holder*	*frequency*	*crystal cut*	*sheet number*
steering of models	HC-6/U	27.125 Mc/s[1] total tolerance $\pm 1000 \times 10^{-6}$ series resonance 40.68 Mc/s[1] total tolerance $\pm 500 \times 10^{-6}$ series resonance	AT	EP4820
		13.56 Mc/s[1] total tolerance $\pm 500 \times 10^{-6}$ $C_\mu = 30$ pF		EP4814
SSB systems or secondary standards	HC-27/U	10 Mc/s[4] 3_{11} overtone total tolerance $\pm 5 \times 10^{-6}$ $C_\mu = 75$ pF series resistance 40 Ω (—40 °C to +75 °C)	AT	EP4825
measuring equipment	HC-6/U	4.5 Mc/s[2]; 5.5 Mc/s[2] 6.75 Mc/s[2]; 10.7 Mc/s[2] total tolerance $\pm 100 \times 10^{-6}$ $C_\mu = 30$ pF	AT	EP4814
decade counting unit type 88929/09.1	B9A	10 kc/s[3] total tolerance $\pm 100 \times 10^{-6}$ series resistance max. 1500 Ω	XY	EP4801
measuring and telecommunication equipment	B9A	100 kc/s[1] total tolerance $\pm 100 \times 10^{-6}$ $C_\mu = 75$ pF series resistance $\geq 1000\ \Omega$	X	EP4803

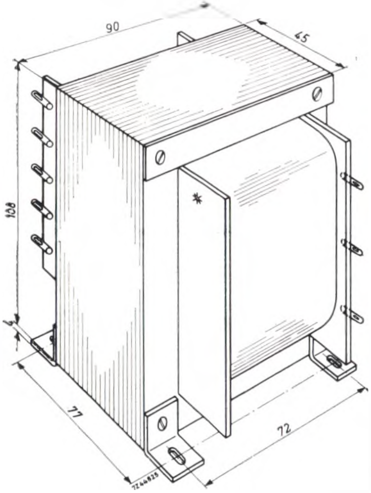
Temperature range: [1]) 0 — +60 °C; [2]) —20 — +70 °C; [3]) +10 — +70 °C; [4]) +69 °C to 71 °C.

AD90.. series - AUDIO TRANSFORMERS

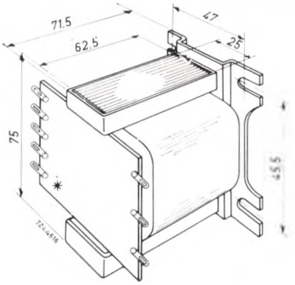
FOR PUSH-PULL CIRCUITS WITH TUBES



type number	*AD 9030/03*	*AD 9032*	*AD 9047*	*AD 9058*
primary impedance . . . . (Ω)	9,000	6,600	6,600	9,000
secondary impedance . . . . (Ω)	7–14	7–14	7–14	7–14
power . . . . (W)	15	15	35	15
efficiency at 400 c/s . . . . (%)	90	88	86	
transformation ratio	36–25	30–22	31–22	
primary inductance . . . . (H)	28	28	70	67
DC bias magnetization . . . . . . (mA)	5	5	5	5
primary resistance . . . . (Ω)	350	335	180	320
frequency response between –3dB points (c/s) (reference 1 kc/s)	20–60,000	20–60,000	10–60,000	10–100,000
distortion is 1% at . . . . (c/s)	60	60	30	
	2 × EL84 2 × UCL82 2 × ECL82	2 × EL84	2 × EL34	2 × ECL86 2 × EL84



AD0497



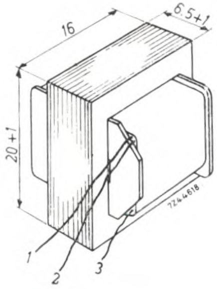
AD9030/03

AD9032

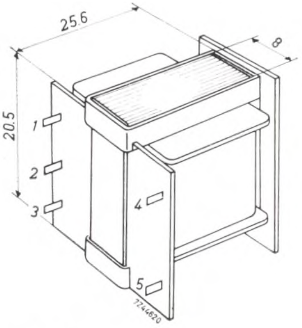
AUDIO TRANSFORMERS - AD90.. series

FOR PUSH-PULL CIRCUITS WITH TRANSISTORS

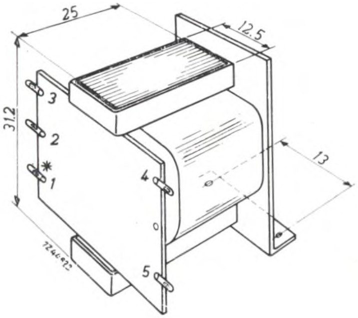
type number	*AD 9015*	*AD 9049*	*AD 9051*	*AD 9054*	
				$V_S = 7$ V	$V_S = 14$ V
primary impedance . (Ω)	360	52	98	7	41
secondary impedance . (Ω)	3	3	3	3–5	
power . . . . . (W)	0.2	0.3	0.75	8	
efficiency at 400 c/s . (%)	85	85	80	70	
transformation ratio . .	11	4.2	5.7	1.6–1.25	3.65–2.85
primary inductance . (H)	0.6	0.3	0.48	0.2	
DC bias magnetization . . . . (mA)	—	—	—	—	
primary resistance . (Ω)	16	2.6	9.5	2.13	
frequency response between –3dB points . . . . (c/s) (reference 1 kc/s)	45–35,000	50–10,000	50–10,000	10–10,000	
distortion is 1% at . (c/s)	160	—	—	90	
	2×OC72	2×OC74	2×OC74	2×OC26	



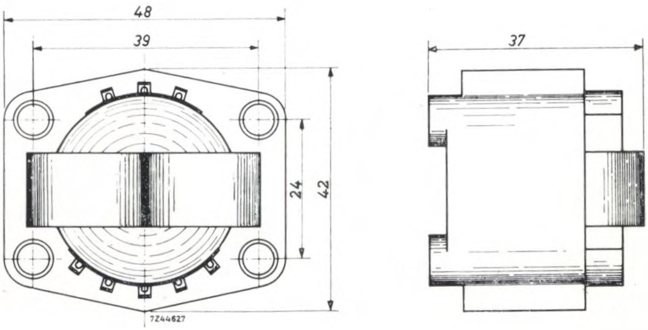
AD9015



AD9049



AD9051



AD9054

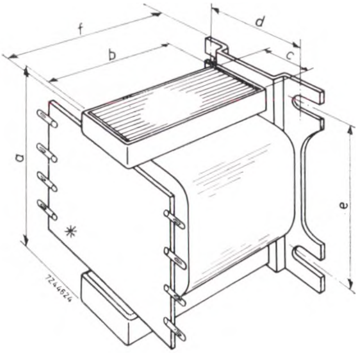
AD90.. series - AUDIO TRANSFORMERS

FOR SINGLE-ENDED CIRCUITS WITH TUBE OR TRANSISTOR

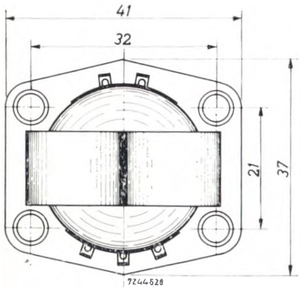
type number	*AD 9008*	*AD 9018*	*AD 9020*	*AD 9022*	*AD 9056*	*AD 9057*
primary impedance . . (Ω)	5,400	2,400	5,400	2,400	8	7000
secondary impedance . . (Ω)	3–5	3–5	3–5	3–5	3–5	3–5
power . . . . (W)	3	6	6	3	2	3
efficiency at 400 c/s . . (%)	75	75	76	82	80	—
extra windings:						
anti-hum . . (% of N_{prim})	10	2.3	—	—	—	—
feed-back . (% or N_{sec})	—	74	112	77	—	
transformation ratio . . .	45–34	31–22	46–33	29–22	1.67–1.3	—
primary inductance . . (H)	10	6.5	10	2.5	0.019	10,5
DC bias magnetization (mA)	36	70	40	65	570	36
primary resistance. . . (Ω)	550	320	540	200	0.75	495
frequency response between –3dB points . (c/s) (reference 1 kc/s)	50–10,000	45–10,000	40–20,000	60–15,000	10–6,000	10–100,000
distortion is 1% at . . (c/s)	60	55	65	75	70	
	ECL 82 UCL 82 EL 84	UL 84	ECL 82 UCL 82 EL 84	UL 84	OC 26	ECL 86

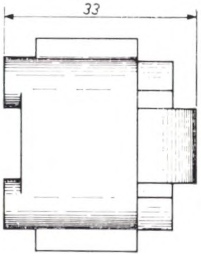
Dimensions (mm)

type number	a	b	c	d	e	f
AD 9008	40	32	16	36.5	38	41
9018	50	40	20	41	45.5	49
9020	50	40	20	41	45.5	49
9022	40	32	16	36.5	38	41



AD9008
AD9018
AD9020
AD9022



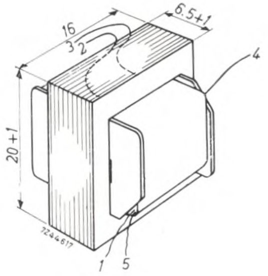


AD 9056

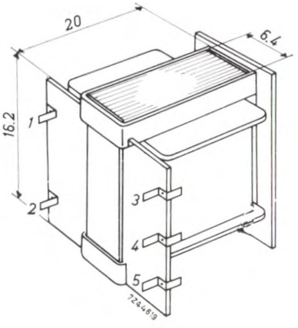
AUDIO TRANSFORMERS - AD90.. series

FOR DRIVER-CIRCUITS WITH TRANSISTOR(S)

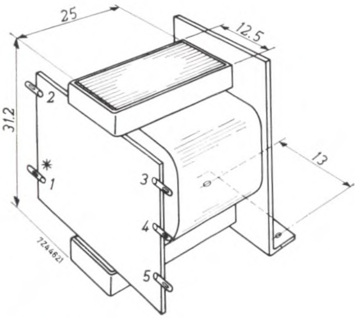
type number	*AD 9014*	*AD 9048*	*AD 9050*	*AD 9053*	*AD 9055*
efficiency at 400 c/s . . . (%)	70	70	75	95	95
transformation ratio	1	0.65	1.15	1.24	6.45
primary inductance . . . (H)	10	1.1	3.4	0.44	1.6
DC bias magnetization . (mA)	1	4.5	4	75	15
primary resistance . . . . (Ω)	400	106	123	4	60
frequency response between –3dB points . . . . . (c/s) (reference 1 kc/s)	20–40,000	50–10,000	50–10,000	10–60,000	10–10,000
distortion 1% at . . . . (c/s)	70	—	—	—	—
	OC 71	OC71 or OC 75		OC 79	OC 72
	2×OC 72	2×OC 74		2×OC 26	OC 26



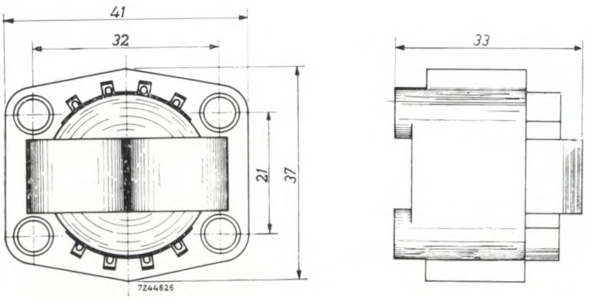
AD 9014



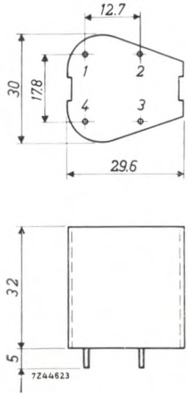
AD 9048



AD 9050

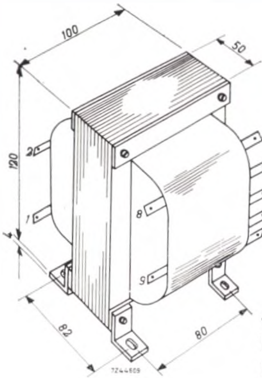


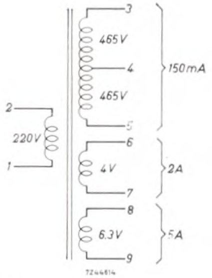
AD 9053

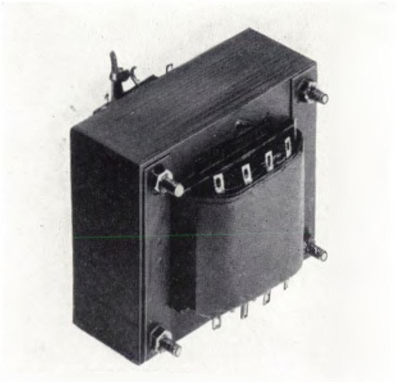


AD 9055

AD90.. series - MAINS TRANSFORMERS

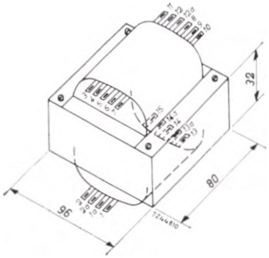


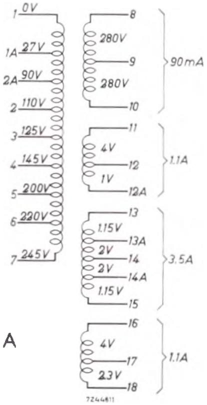




AD 9024

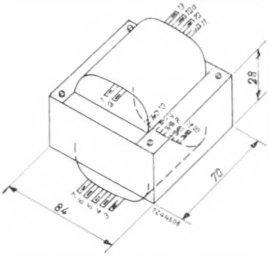
No-load current: max. 200 mA
No-load losses: max. 14 W

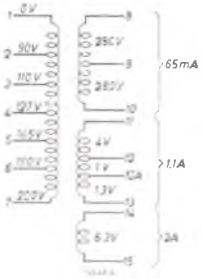




AD 9026

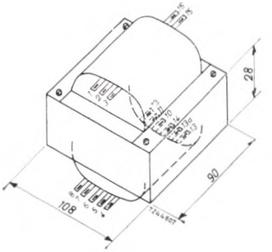
No-load current: max. 130 mA
No-load losses: max. 7.5 W

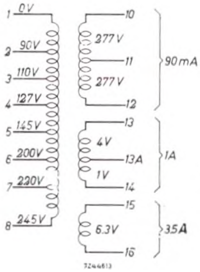




AD 9027

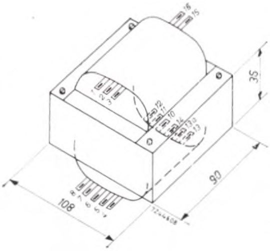
No-load current: max. 90 mA
No-load losses: max. 6 W

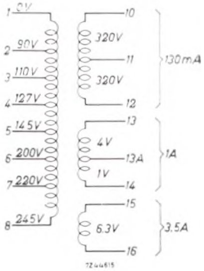




AD 9028

No-load current: max. 120 mA
No-load losses: max. 7 W



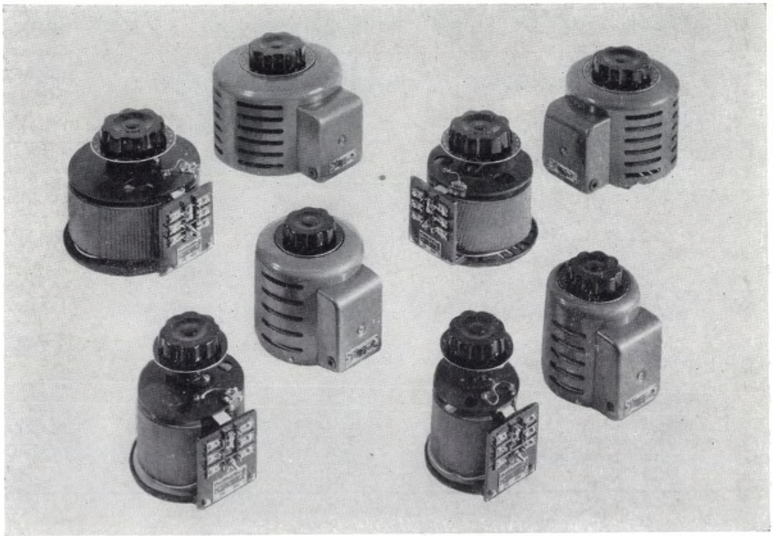


AD 9029

No-load current: max. 175 mA
No-load losses: max. 10 W

VARIABLE TRANSFORMERS - E401 series

GENERAL



These transformers have been designed for controlling line voltages.
The output can be varied from zero to approximately 15% above the line voltage.
They consist of a toroidal coil wound on a laminated annular core. The insulation of each turn is partly stripped to form a contact track for the slider. The coil has up to three taps: one at each end at 18% of the total turns and one centre tap.
The slider contact can be easily removed.

General Data:

Rated input voltage	130, 220 and 240 V_{ac} +5 %
Frequency	50...400 c/s
Rated current	1–90A
Angle of rotation	approx. 320°
Ambient temperature	−20 to +40 °C
Rise of coil temperature at max. load	$\leq$ 55 °C average
Insulation between frame and coil (after climatic test: 21 days at 40 °C, 90 to 95% r.h. IEC 68-C)	$\geqslant$ 5 MΩ
High voltage test (1 minute)	2000 V_{rms}
Air gap between hot and cold parts	$\geqslant$ 4 mm
Leakage path between hot and cold parts	$\geqslant$ 5 mm
Operational life	> 250000 complete turns
Shock test, worst case mounting position	1500 falls from 25 mm
Vibration test (24 hours)	0.5 mm amplitude, 50 c/s

E401 series - VARIABLE TRANSFORMERS

SURVEY OF STANDARD RANGE

panel models		bench models		laboratory models	
with knob **B** model	*without knob* **K** model	*with knob* **A** model	*without knob* **C** model	*with binding posts* **G** model	*with earthed output socket* **H** model
E401BA/023	E401KA/023	E401AA/023	E401CA/023		
045	045	045	045		
090	090	090	090	E401GA/090	
B/010	B/010	B/010	B/010		E401HB/010
020	020	020	020		020
040	040	040	040	B/040	040
080	080	080	080	080	080
200	200	200	200		
E/010	E/010	E/010	E/010		
020	020	020	020		
040	040	040	040	C/040	
080	080	080	080	080	
200	200	200	200		

Composition of type number

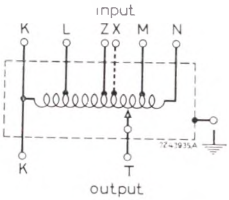
E401 ../...

→ model (B, K, A, C, G, or H)

K-L = M-N = 18% of K-N

Z = centre tap

X = optional tap

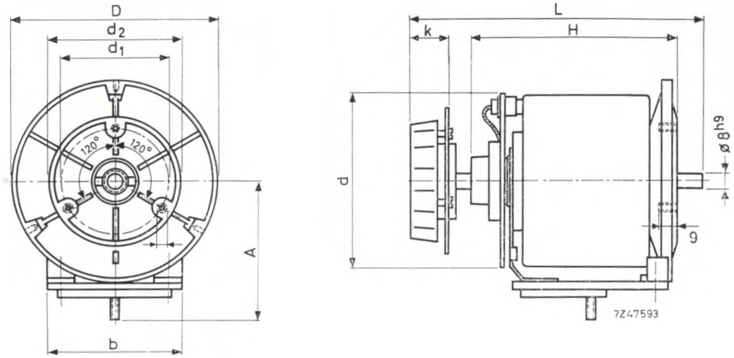


rated input (V)	output voltage (V) at $I_0 = 0$	I_{nom}			output current I_0 = (A) I_{nom}	I_{max}	losses at $I_0 = 0$ (W)	voltage per turn (V)	operating torque (kgcm)	appr. weight (kg)
130	0..150	0..145	A/	023	2.5	3.2	5	0.4	1.5	2.6
				045	5	6.3	5.7	0.5	2.0	3.8
				090	10	12.6	8.5	0.65	2.5	6.3
220	0..260	0..255	B/	010	1	1.4	4.0	0.38	1.5	2.6
				020	2.5	2.8	6.2	0.48	2.0	3.8
				040	5	5.6	7.0	0.63	2.5	6.9
				080	8.5	11.2	12.5	0.81	3.0	9.2
				200	20(23)[1]	28(30)[1]	40	0.90	15	21
240	0..270	0..265	E/	010	1	1.4	4.2	0.39	1.5	2.6
				020	2.5	2.8	6.6	0.51	2.0	3.8
				040	5	5.6	7.9	0.66	2.5	6.9
				080	8.5	11.2	13.7	0.85	3.0	9.2
240	0..260	0..255	E/	200	20(23)[1]	28(30)[1]	40	0.90	15	21

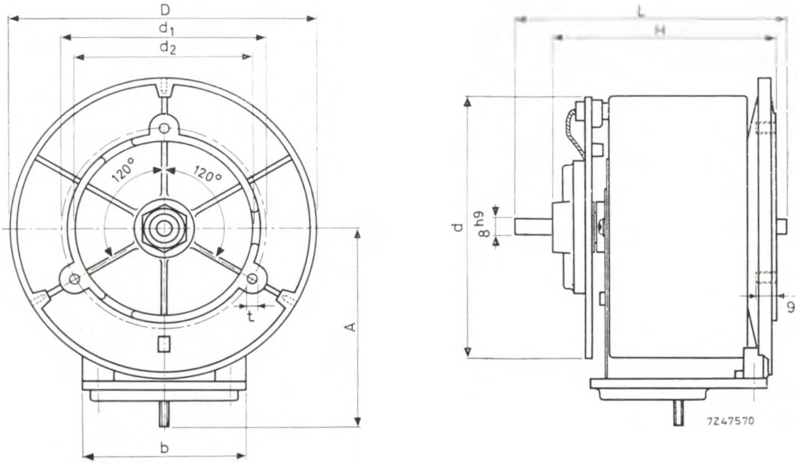
[1] Panel models (B and K models) are designed for the current indicated in parenthesis.

1-10A - VARIABLE TRANSFORMERS - E401 series

PANEL MODELS



Panel model B with knob



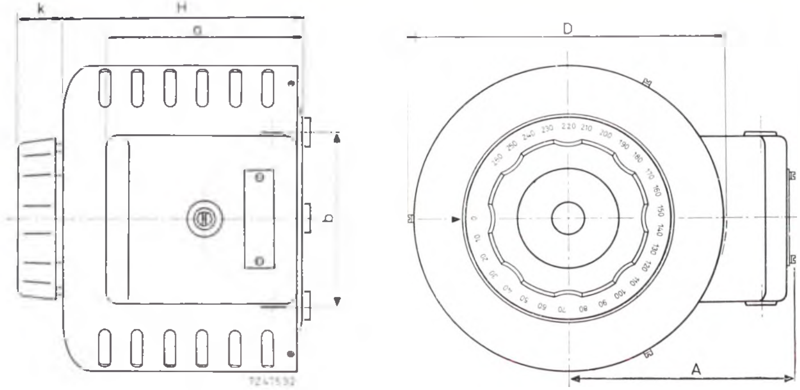
Panel model K without knob

Type:			Dimensions:									
E401B./... E401K./...			*H*	*D*	*A*	*d*	d_1	d_2	*t*	*b*	*k*	*L*
A/023	B/010	E/010	110	106	63	93	56	67	M4	71	21	153
045	020	020	112	127	74	110	56	67	M4	71	21	153
090	040	040	117	158	92	140	106	93	M6	84	24	157
	080	080	120	185	106	168	106	93	M6	84	24	157

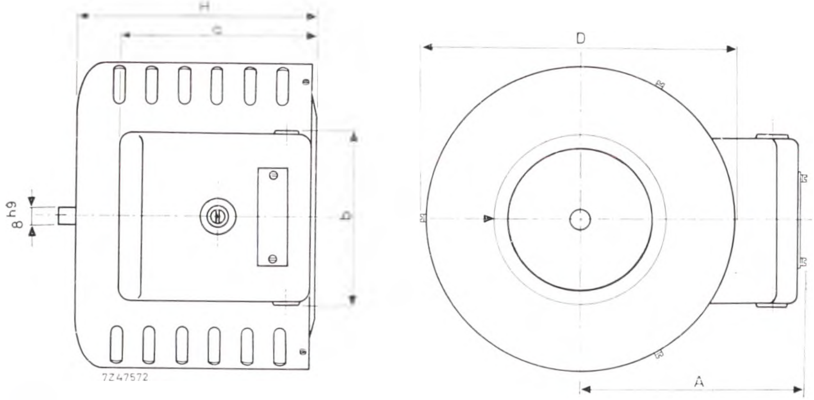
The standard spindle with knob is 139 mm long
Any spindle length of 8 mm diameter (fit h9) can be used

E401 series - VARIABLE TRANSFORMERS - 1-10A

BENCH MODELS



Bench model A with knob and resilient pads



Bench model C without knob and pads

Type *E401A./..., E401C./...*			*Dimensions*					
			H	*D*	*A*	*a*	*b*	*k*
A/023	B/010	E/010	122	113	79	99	77	21
045	020	020	123	134	93	100	77	21
090	040	040	131	166	117	106	92	24
	080	080	133	193	134	106	92	24

The resilient pads protrude approximately 5 mm. The spindle can be set to protrude up to approximately 30 mm above the cover.

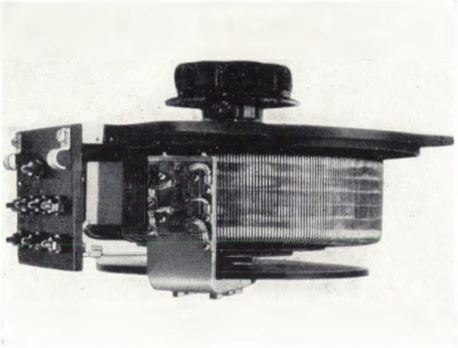
LABORATORY MODELS

Laboratory model H with
earthed socket and secundary fuse

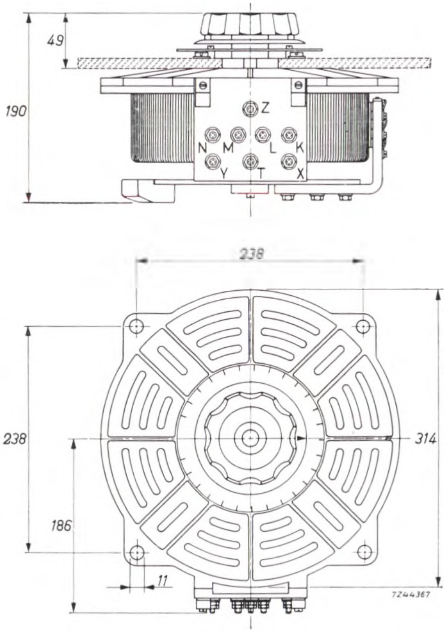
Laboratory model G
with binding posts

20A-E401 series - VARIABLE TRANSFORMERS

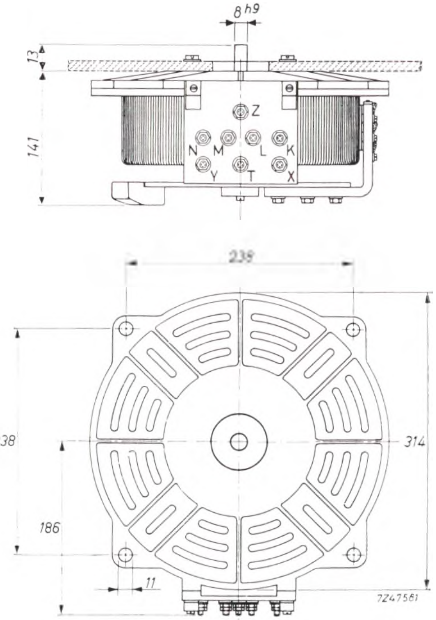
PANEL MODELS



Panel model E401B./200 with knob



Panel model B with knob

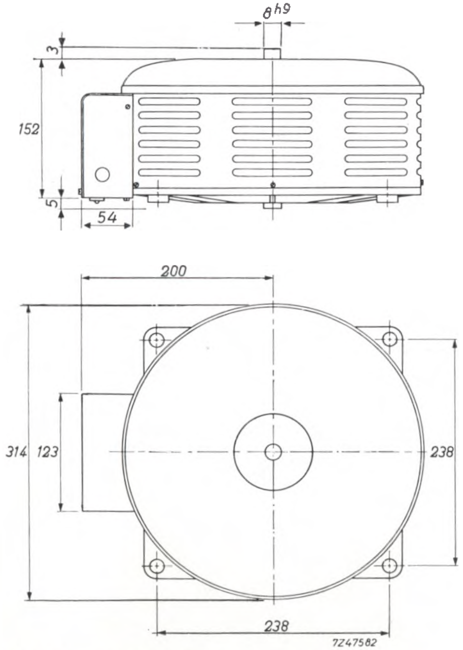


Panel model K without knob

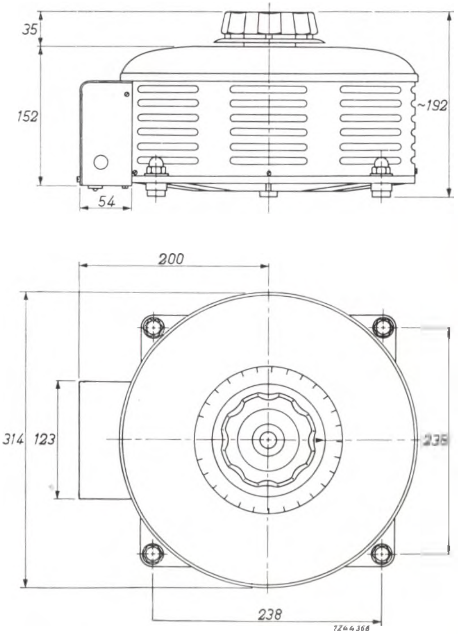
20A-VARIABLE TRANSFORMERS - E401 series

BENCH MODELS

Bench model A with knob and feet

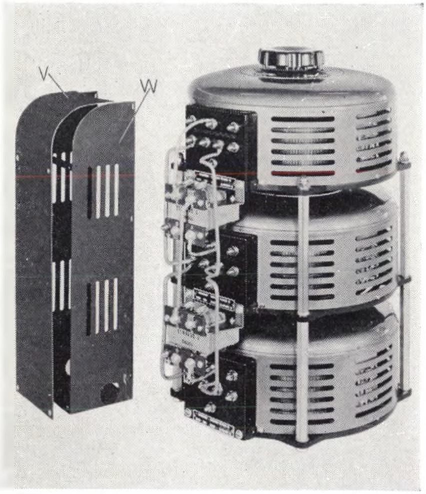


Bench model C without knob and feet

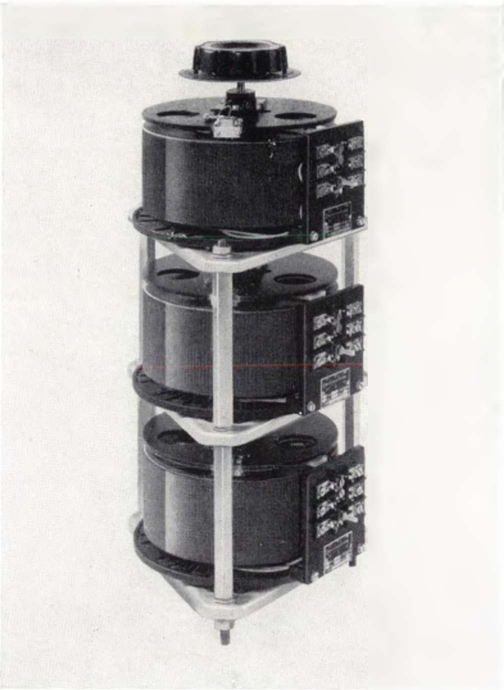


Bench model A with knob and feet

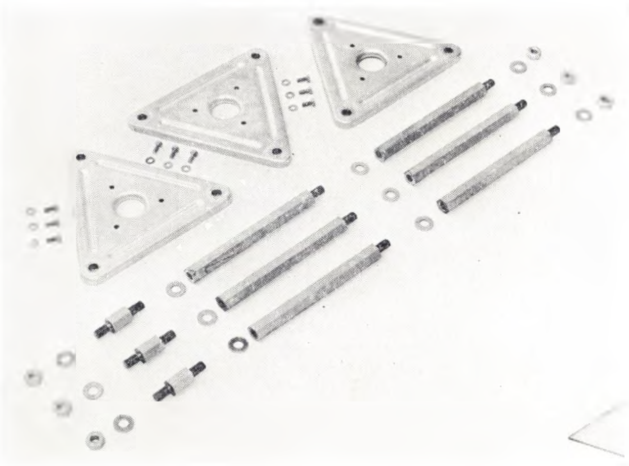
STACKING SETS



Three bench models 220V/20A (B/200 types) stacked and paralleled, using 2 chokes.



Three panel models 220V/8.5A (B/080 types) stacked for 3 phase Y-operation



Stacking set B8 709 63

STACKING SETS

transformer types	*number of transformers stacked*	**bench** *model*[1]	**panel** *model*[1]
E401 A/203 **045** **B/010** **020** **E/010** **020**	2 in series (or 3-phase open Δ)	1 × A + 1 × C models 1 × B8 709 72 stacking set	1 × B + 1 × K models 1 × B8 709 73 stacking set
	3 in 3-phase Y	1 × A + 2 × C models 1 × B8 709 62 stacking set	1 × B + 2 × K models 1 × B8 709 62 stacking set
E401 A/090 **B/040** **080** **E/040** **080**	2 in series (or 3-phase open Δ)	1 × A + 1 × C models 1 × B8 709 66 stacking set	1 × B + 1 × K models 1 × B8 709 67 stacking set
	3 in 3-phase Y	1 × A + 2 × C models 1 × B8 709 64 stacking set	1 + B + 2 × K models 1 × B8 709 65 stacking set
E401 A/090 **B/080** **E/080**	2 in parallel	1 × A + 1 × C models 1 × B8 709 66 stacking set 1 × B8 709 69 cover 1 × B8 709 71 choke	1 × B + 1 × K models 1 × B8 709 67 stacking set 1 × B8 709 71 choke
	3 in parallel	1 × A + 2 × C models 1 × B8 709 64 stacking set 1 × B8 709 68 cover 1 × B8 709 70 choke 1 × B8 709 71 choke	1 × B + 2 × K models 1 × B8 709 65 stacking set 1 × B8 709 70 choke 1 × B8 709 71 choke
E401 A/200 **B/200**	2 in series (or 3-phase open Δ)	1 × A + 1 × C models 1 × B8 709 60/06 stacking set 1 × B8 709 60/03 cover	1 × B + 1 × K models 1 × B8 709 60/07 stacking set
	3 in 3-phase Y	1 × A + 2 × C models 2 × B8 709 60/06 stacking set 1 × B8 709 60/04 cover	1 × B + 2 × K models 2 × B8 709 60/07 stacking set
	2 in parallel	1 × A + 1 × C models 1 × B8 709 60/06 stacking set 1 × B8 709 60/03 cover 1 × B8 709 60/02 choke	1 × B + 1 × K models 1 × B8 709 60/07 stacking set 1 × B8 709 60/02 choke
	3 in parallel	1 × A + 2 × C models 2 × B8 709 60/06 stacking set 1 × B8 709 60/04 cover 2 × B8 709 60/02 choke	1 × B + 2 × K models 2 × B8 709 60/07 stacking set 2 × B8 709 60/02 choke

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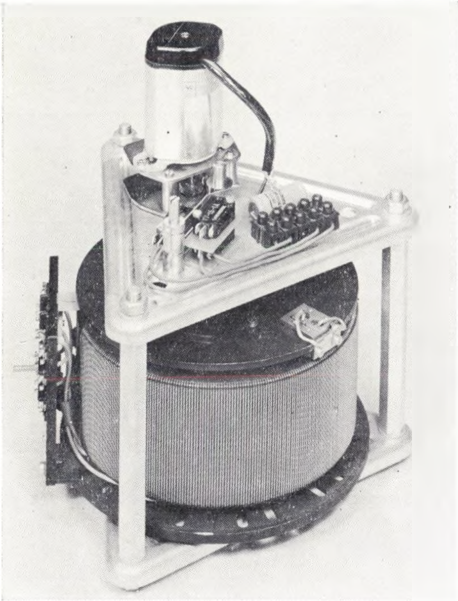
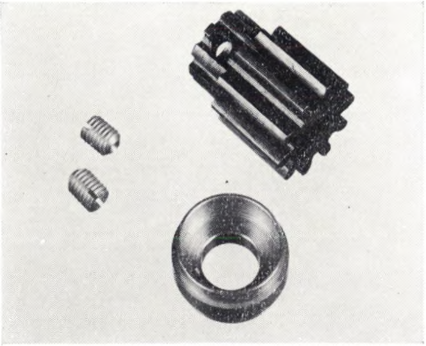
[1] Spindles are available in two lengths: 300 mm for 2 transformers, type number 4322 026 08351
450 mm for 3 transformers, type number 4322 026 08361

MOTOR DRIVE MODULE

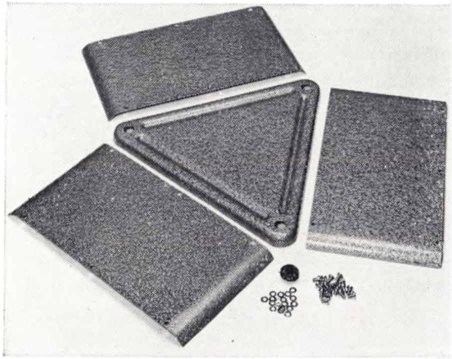




Pinion set type 84543 for matching the entire AU5300/80. . series of gearboxes to the motor drive.

Panel model E401KB/080 with motor drive.

A motor drive module is available for most of the E401 series variable transformers, either stacked or individual. Two types of motor combined with a choice of gearboxes can rotate the variable transformers over 320°, from limit to limit, in 6, 15, 30, or 60 sec.



Protective-cover set.

MOTOR DRIVE MODULE

A motor-driven variable transformer, either stacked or individual, can be build up of the following parts:

transformer(s)	see page F108
transformer stacking set	see page F115
top plate (for mounting of motor) plus accessories	84 538
stacking set for motor drive (see table below)[1]	84 539/..
gearbox (see table below)	84 540/...
or	AU5300/80...
switch set	84 541[2]
cover for motor AU5050/22	84 542/01
AU5100/22	84 542/02
pinion set (for gearbox AU5300/80... only)	84 543
motor (according to table below)	o = type AU5050/22 x = type AU5100/22

Transformers E401../...	*rotation time (limit to limit)*					*stacking set 84 539/..*	
	6 sec	*15 sec*	*30 sec*	*60 sec*	*120 sec*		
	number of transformers						
	1 2 3	*1 2 3*	*1 2 3*	*1 2 3*	*1 2 3*	*1*	*more*
	use motor						
A/023	x x	o x x	o o x	o o o	o o o	/04	/04
/045	x x	o x x	o o x	o o o	o o o	/04	/04
/090	x x	o x x	o x x	o o o	o o o	/03	/02
B/010 E/010	x x	o x x	o o x	o o o	o o o	/04	/04
/020 /020	x x	o x x	o o x	o o o	o o o	/04	/04
/040 /040	x x	o x x	o x x	o o o	o o o	/03	/02
/080 /080	x	o x x	o x x	o o x	o o o	/03	/02
with gear box type 84 540/... or AU5300/80...[3]	/6	/15	/30	/60	/120		
	see booklet "Small synchronous motors and gearboxes"						

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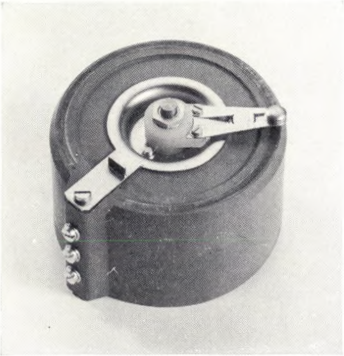
[1] Serves to mount the motor drive on the transformer. The number of parts in the set depends on whether it concerns a single or a stacked transformer.

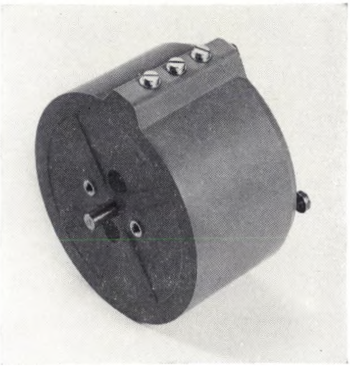
[2] Additional switches to rotate the transformer to certain pre-determined intermediate positions. Set 84 538 contains two switches for the two extreme positions.

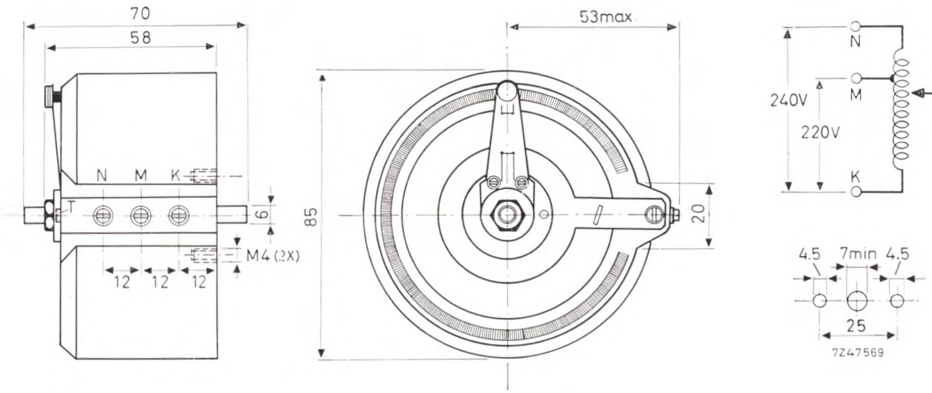
[3] To calculate the rotation time (limit to limit) when using the AU5300/80.. series of gearboxes, multiply their gear reduction i by 1/50, which yields the time in minutes.

E401 series - VARIABLE TRANSFORMERS

MINIATURE TYPE 0.7 A







The miniature transformers are molded in reinforced polyester resin. The construction is rugged and professional. The mounting hole pattern is simple, the support area is relatively wide, and the transformers are light enough to be mounted on thin chassis or panels.

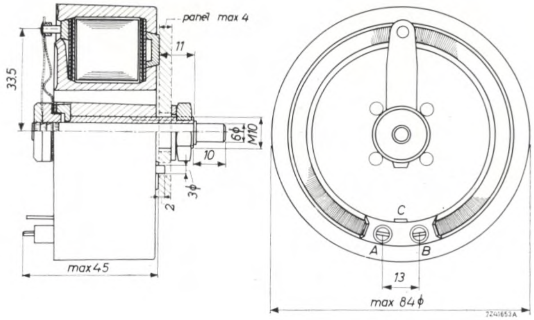
Type number: 2P 250 50

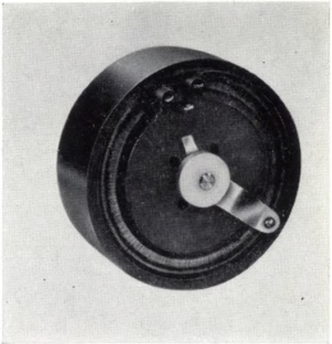
The spindle of this model is adjustable in length protruding at both sides. A different spindle of suitable length can be fitted.

Max. input voltage.	240 V + 5% (connected to K—N) 220 V + 5% (connected to K—M)
No-load output voltage . . .	0—240 V (Input connected to K—M)
Nominal current	0.7 A over the whole range
Frequency	50–500 c/s
No-load losses	2 W
Test voltage	2000 V during 1 minute
Temperature range	—15 to +40 °C without derating
Climatic conditions	Conform I.E.C.68, test C – 21 days
Max. permissible temp. rise at any point.	70 °C

E401 series - VARIABLE TRANSFORMERS

MINIATURE TYPE 0.5 A





frequency . . .	50–400 c/s
insulation resistance	10,000 MΩ between winding and spindle
test voltage . .	2 kV_{rms}– 50 c/s during 1 min
life	in excess of 500,000 complete revolutions
climatic conditions	conform to IEC 68, test C
mounting . . .	threaded bush
operating torque.	max. 500 gr

Type E 401 ZZ

Some of these transformers are wound in two layers. The slide contact tracks only the upper layer and so only one half of the primary voltage is tapped.

max. input voltage (V)	*output terminals*	*voltage (V) ($I_{out} = 0$)*	*turn*[1]	*rated current I_{nom} (A)*	*voltage*[2] *A-C at I_{nom} (V)*	*loss at $I_{out} = 0$*	*type number*
240	CB	120. . .240	CW	0.5	20	0.8	E 401 ZZ/01
	CA	0. . .120	CCW				
220	CB	120. . .240	CW	0.5	20	0.9	02
120	(one layer)	0. . .120	—	0.6	14	0.8	03
60	(one layer)	0. . .60	—	1.2	6	0.6	04

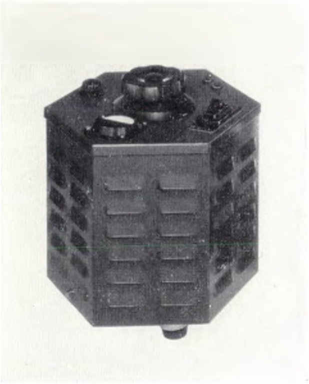
---

[1] Turn shaft end CW (clockwise) or CCW (counter-clockwise) to increase output voltage.

[2] This is the voltage drop from A to the slider C when C-B is loaded with I_{nom}.

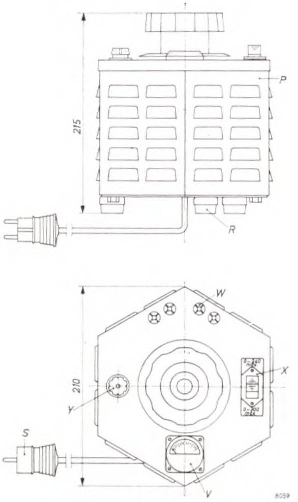
B870... series - VARIABLE TRANSFORMERS

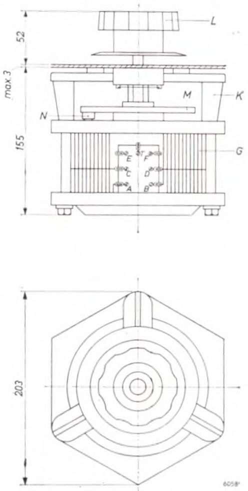
MODELS WITH SEPARATE WINDINGS, ELECTROSTATICALLY SCREENED



B8 709 00/02

B8 709 50/01



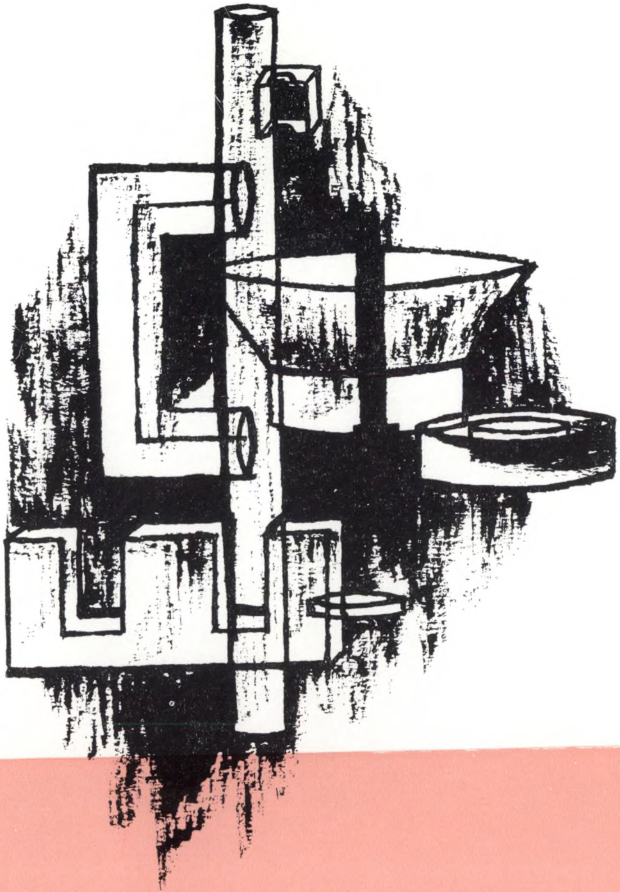


input voltage (V)	output voltage		range	max. output current I nom. (A)	max. no-load losses (W)	voltage per turn (V)	operating torque (kg cm)
	no-load (V)	nominal (V)					
180	260	240	I	1.5	5	0.58	2
	215	196	II	1.5	3.5	0.48	2
220	320	300	I	1.5	7.5	0.71	2
	265	240	II	1.5	5	0.58	2
240	350	330	I	1.5	11	0.77	2
	285	265	II	1.5	6	0.63	2

Range I. Line voltage connected to terminals A–C for panel mounting type B8 709 50/01 or laboratory type B8 709 00/02 at "0-300 V" position.
Range II. Line voltage connected to terminals A-B for panel mounting type B8 709 50/01 or switch-off type B8 709 00/02 at "0–240 V" position.
Output terminals E–T

For further electrical and climatic data see page F71

FERROXCUBE 3 & 4
FERROXCUBE 6
FERROXCUBE 7
FERROXPLANA
POWDER IRON



Soft magnetic materials

CONTENTS

Ferroxcube 3 & 4

SURVEY OF SYMBOLS

l_e	length of the magnetic path in cm
A_e	cross-section of a homogeneous part of the core in cm^2
μ_i	relative initial permeability, defined by: $\mu_i = \lim\limits_{H \to 0} \frac{B}{H}$
μ_e	relative effective permeability, defined by $\mu_e = \frac{\Sigma \frac{l}{A}}{\Sigma \frac{l}{\mu_i A}}$
V_e	effective volume of a potcore in cm^3 = volume of an ideal toroid in the same material grade and with the same magnetic properties as the potcore. V_e is calculated by: $V_e = \frac{\left(\Sigma \frac{l}{A}\right)^3}{\left(\Sigma \frac{l}{A^2}\right)^2} \; cm^3$
Δ	length of the air gap in mm
α	turns factor = number of turns for 1 mH
A_L	inductance factor = inductance for one turn in nanohenry (10^{-9} H)
$\hat{H}$	peak field strength in oersted
$\hat{B}$	peak induction in gauss
AT	amperes × turns
$T.F. = \frac{1}{\mu^2} \cdot \frac{d\mu}{dT}$	temperature factor = value for a certain ferroxcube material over a certain temperature range. In order to calculate the temperature coefficient per °C of a coil the temperature factor has to be multiplied by the effective permeability. So $\quad t.c. = \frac{\Delta\mu}{\mu_i} \times \frac{\mu_e}{\mu_i} = \frac{\Delta\mu}{\mu_i^2} \times \mu_e$ per °C

SURVEY OF SYMBOLS

$\mathrm{D.F.} = \dfrac{\mu_1 - \mu_2}{\mu_1^2 \log \dfrac{t_2}{t_1}}$ . . . disaccommodation factor, which gives the permeability variation of the core, measured between 10 and 100 minutes after demagnetization.

Curie point . . . . . critical temperature in °C above which the ferromagnetic body is paramagnetic.

$\dfrac{\tan \delta}{\mu_i}$ . . . . constant for eddy current and residual losses together at a certain frequency, determined at $\hat{B} \leq 1$ gauss through the coil. The resulting R/L value for eddy current and residual losses is:

$$\frac{R}{L} = \frac{\tan \delta}{\mu_i} \times \mu_e \times 2\pi f \quad \Omega/H \qquad (f \text{ in c/s})$$

$q_{2-24-100}$ . . . . . . constant for hysteresis losses standardized for an effective volume of 24 cm³, $\mu_e = 100$ and measured between two currents, corresponding to two B_{max} values, stated in the ferroxcube catalogue.

At 800 c/s, for a given volume V_e, and for an equivalent permeability μ_e, we obtain:

$$q_{2-V-\mu} = q_{2-24-100} \times \left(\frac{\mu_e}{100}\right)^{3/2} \times \sqrt{\frac{24}{V_e}} \; \Omega/H^{3/2}mA$$

$$\frac{R_h}{L} = q_{2-V-\mu} \times \sqrt{L} \times i \times \frac{f}{800} \; \Omega/H$$

(L in henry, f in c/s and i in mA)

ϱ . . . . specific resistance in Ω.cm measured with d.c.

FERROXCUBE 3 & 4

MAIN APPLICATIONS

Ferroxcube is the name given to the ceramic soft magnetic core material produced by our factories. Owing to its excellent properties, this material more and more supersedes metallic core materials. Thanks to the high electrical resistivity the eddy current losses in the material are extremely low, even at high frequencies, so the troublesome process of laminating the core can be avoided. Hence ferroxcube is supplied as ready-shaped piece parts the forms of which have been adapted to the required magnetic circuit.

grade	*application*
3B2, 3B3	frames for IF transformers, potcores, rods, screw cores
3B5	potcores
3B7	potcores
3C2	yoke rings, erasing heads
3C4	U-cores
3C6	U-cores
3D3	antenna rods, potcores, screw cores
3E1	E- and I-cores, toroids, potcores
3E2	H-cores , small toroids
3H1	potcores, E- and I-cores, small toroids, cross cores
4A1	potcores, E-cores, small toroids
4A3	antenna rods (long and medium wave)
4B1	antenna rods, frames for IF transformers
4C3	antenna rods
4C4	small potcores and small toroids
4D1	frames for IF transformers, screw cores
4E1	frames for IF transformers, screw cores

Mechanical data

specific weight	3.5–5	g/cm^3
specific heat	appr. 0.17	cal/g/°C
thermal conductivity	appr. 8 × 10^{-3}	cal/cm sec/°C
coefficient of linear expansion	appr. 10^{-5}	/°C
modulus of elasticity	appr. 15,000	kg/mm^2
tensile strength	appr. 1.8	kg/mm^2
crushing strength	appr. 7.3	kg/mm^2

MAXIMUM LOSS FACTOR

Ferroxcube 3 grades

		3B2	3B3	3B5	3B7	3C4
frequency (kc/s)	at	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	mW/cm³
4	≦ 1 gauss; 25 °C	7×10^{-6}		2.5×10^{-6}	1×10^{-6}	
16	1000 gauss; 25 °C					65
16	1000 gauss; 85 °C					65
16	2000 gauss; 85 °C					230
100	≦ 1 gauss; 25 °C	18×10^{-6}	15×10^{-6}	10×10^{-6}	5×10^{-6}	
250	≦ 1 gauss; 25 °C		27×10^{-6}			
450	≦ 1 gauss; 25 °C		50×10^{-6}			

		3C6	3D3	3E1	3E2	3H1
frequency (kc/s)	at	mW/cm³	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$		$\frac{\tan \delta}{\mu_i}$
4	≦ 1 gauss; 25 °C			2.5×10^{-6}		1×10^{-6}
16	2000 gauss; 25 °C	150				
16	2000 gauss; 100 °C	120				
100	≦ 1 gauss; 25 °C		8×10^{-6}	15×10^{-6}		5×10^{-6}
500	≦ 1 gauss; 25 °C		14×10^{-6}	90×10^{-6}		
1000	≦ 1 gauss; 25 °C		30×10^{-6}			

Ferroxcube 4 grades

	4A1	4A3	4B1	4C3	4C4	4D1	4E1
frequency (Mc/s)	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$	$\frac{\tan \delta}{\mu_i}$
0.450	65×10^{-6}						
0.700	100×10^{-6}		70×10^{-6}				
1	150×10^{-6}		90×10^{-6}				
1.5		40×10^{-6}	140×10^{-6}				
2		60×10^{-6}			40×10^{-6}		
3						180×10^{-6}	
5					60×10^{-6}	210×10^{-6}	
10				100×10^{-6}	100×10^{-6}	300×10^{-6}	300×10^{-6}
15				150×10^{-6}			
20				200×10^{-6}			300×10^{-6}
40							360×10^{-6}

FERROXCUBE 3 & 4

PROPERTIES

		3B2	3B3	3B5	3B7
initial permeability	μ_i	900±20%	900±20%	1400±25%	2300±20%
temperature factor of initial permeability	$\frac{1}{\mu_i^2} \cdot \frac{d\mu}{dT}$				
between +23 and +55 °C		(0 to + 2) $\times 10^{-6}$	(0 to + 2) $\times 10^{-6}$	$+0.5 \times 10^{-6}$ to $+2.3 \times 10^{-6}$	
between +23 and +70 °C		—	—	—	-0.6×10^{-6} to $+0.6 \times 10^{-6}$
curie temperature (°C)	T_c	≥ 150	≥ 150	≥ 150	≥ 170
disaccommodation between 10 and 100 min. after demagnetization at 23 °C	$\frac{\mu_1-\mu_2}{\mu_1^2 . \log \frac{t_2}{t_1}}$[1]	$\leq 11 \times 10^{-6}$	$\leq 11 \times 10^{-6}$	$\leq 7.5 \times 10^{-6}$	$\leq 4.3 \times 10^{-6}$
magnetic induction at H(Oe) =		10	10	10	10
at 25 °C (gauss)	(B_{sat}) 25	3650	3500	3950	4350
at 70 °C (gauss)	(B_{sat}) 70	2800	2800	3150	3500
hysteresis factor	$q_{2\text{-}24\text{-}100}$				
at 4 kc/s $\left(\frac{\Omega}{H^{3/2}mA}\right)$	—	≤ 12	≤ 12	≤ 2.5	≤ 1.8
specific d.c. resistance (Ω.cm)	ϱ	≥ 80	≥ 120	≥ 20	≥ 100

---

[1] t_1 = 10 minutes, t_2 = 100 minutes

PROPERTIES

		3C2	3C4	3C6	3D3
initial permeability . . .	μ_i	900 ±25%	—	—	750 ±20%
amplitude permeability	μ_{ap}				
at B = 1000 gauss; T = 23 °C		—	3000±25%	—	—
B = 1000 gauss; T = 85 °C		—	≥2000	—	—
B = 2000 gauss; T = 85 °C		—	≥1500	—	—
B = 2000 gauss; T = 100 °C		—	—	≥1000	—
temperature factor of initial permeability	$\frac{1}{\mu_i^2} \cdot \frac{d\mu}{dT}$				
between +23 and +55 °C		0to$+4.5 \times 10^{-6}$	—	—	—
between +23 and +70 °C		—	—	—	0 to$+2 \times 10^{-6}$
curie temperature (°C)	T_c	≥150	≥150	≥150	≥150
disaccommodation between 10 and 100 min. after demagnetization at 23 °C	$\frac{\mu_1-\mu_2}{\mu_1^2 . \log \frac{t_2}{t_1}}$	—	—	—	$\leq 5 \times 10^{-6}$
magnetic induction:					
at H (Oe) = ...		10	10	6.4	10
at 25 °C	(B_{sat}) 25	3650	4600	—	4200
at 70 °C gauss	(B_{sat}) 70	2800	3550	—	3550
at 100°C	(B_{sat}) 100	—	—	≥5800	—
hysteresis factor at 100 kc/s $\left(\frac{\Omega}{H^{3/2}mA}\right)$	$q_{2\text{-}24\text{-}100}$	—	—	—	≤3
specific d.c. resistance (Ω.cm)	ϱ	≥10	—	—	≥150

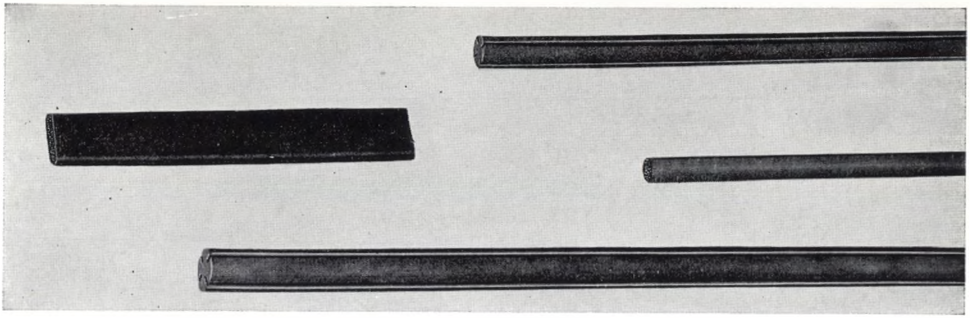
FERROXCUBE 3 & 4

PROPERTIES

		3E1	3H1	4A1	4A3
initial permeability	μ_i	2700±20%	2300±20%	600±20%	450±20%
temperature factor of initial permeability	$\frac{1}{\mu_i^2} \cdot \frac{d\mu}{dT}$				
between +23 and +55 °C . . .		(0 to +4) $\times 10^{-6}$	—	(0 to +6) $\times 10^{-6}$	$<10 \times 10^{-6}$
between +23 and +70 °C . . .		—	$+0.6 \times 10^{-6}$ to $+1.8 \times 10^{-6}$	—	
curie temperature (°C).	T_c	≥125	≥170	≥125	
disaccommodation between 10 and 100 min. after demagnetisation at 23 °C	$\frac{\mu_1 - \mu_2}{\mu_i^2 . \log \frac{t_2}{t_1}}$	$\leq 5.9 \times 10^{-6}$	$\leq 4.3 \times 10^{-6}$	—	
magnetic induction at H (Oe) =		10	10	10	
at 25 °C gauss	(B_{sat}) 25	3550	4350	2250	
at 70 °C gauss	(B_{sat}) 70	2450	3500	1650	
hysteresis factor at 4 kc/s $\left(\frac{\Omega}{H^{3/2} mA}\right)$	$q_{2\text{-}24\text{-}100}$	≤4	≤1.8	—	
specific d.c.resistance . . (Ω.cm)	ϱ	—	≥100	≥100,000	≥100,000

		4B1	4C3	4C4	4D1	4E1
initial permeability	μ_i	250±20%	80±20%	120±20%	50±20%	15±20%
temperature factor of initial permeability	$\frac{1}{\mu_i^2} \cdot \frac{d\mu}{dT}$		—	—	(0 to +15) $\times 10^{-6}$	(0 to +15) $\times 10^{-6}$
between +23 and +55 °C .		(0 to +8) $\times 10^{-6}$				
between +5 and +55 °C			0 to −10 $\times 10^{-6}$	0 to −10 $\times 10^{-6}$	—	—
curie temperature (°C) . .	T_c	≥250	≥350	≥350	≥400	≥500
disaccommodation between 10 and 100 min. after demagnetisation at 23 °C	$\frac{\mu_1 - \mu_2}{\mu_i^2 . \log \frac{t_2}{t_1}}$		—	$\leq 10 \times 10^{-6}$	—	—
magnetic induction at		20	30	30	40	100
H (Oe) = at 25 °C	(B_{sat}) 25	3250	3900	3300	2200	1750
at 70 °C gauss	(B_{sat}) 70	2800	3600	3100	2100	1650
specific d.c.resistance (Ω.cm)	ϱ	≥100,000	≥100,000	≥100,000	≥100,000	≥100,000

ANTENNA RODS AND PLATES



RODS[1]

Grade 4A3

dimensions	*type number*
(Ø 9.8 ± 0.3) × $\left(240 {}^{+1}_{-8}\right)$	4311 020 52621
× $\left(220 {}^{+1}_{-7}\right)$	4311 020 52741
× $\left(200 {}^{+1}_{-7}\right)$	4311 020 52581
× $\left(180 {}^{+1}_{-6}\right)$	4311 020 52751
× $\left(160 {}^{+1}_{-5}\right)$	4311 020 52611
× $\left(150 {}^{+1}_{-5}\right)$	4311 020 52771
× $\left(140 {}^{+1}_{-5}\right)$	4311 020 52601
× $\left(130 {}^{+1}_{-3}\right)$	4311 020 52781
× $\left(100 {}^{+1}_{-3}\right)$	4311 020 52591
(Ø 7.8 ± 0.2) × $\left(190 {}^{+1}_{-6}\right)$	4311 020 52701
× $\left(140 {}^{+1}_{-5}\right)$	4311 020 52691
× $\left(100 {}^{+1}_{-3}\right)$	4311 020 52791
(Ø 6.35 ± 0.2) × $\left(130 {}^{+1}_{-3}\right)$	4311 020 52801

Grade 4B1

dimensions	*type number*
(Ø 9.7 ± 0.3) × (240 ± 8)	4311 020 52331
× $\left(200 {}^{+9}_{-3}\right)$	3122 104 91251
× (175 ± 5)	4311 020 52241
× (140 ± 5)	3122 104 91241
× (130 ± 2)	4311 020 52231
(Ø 7.8 ± 0.2) × (190 ± 4)	4311 020 52551
× (140 ± 3)	4311 020 50251
× (100 ± 2)	4311 020 52171
(Ø 6.5 — 0.3) × (130 ± 05)	3122 104 91801

[1] Preferred types

ANTENNA RODS AND PLATES

RODS

Grade 3D3

dimensions	*type number*
(Ø 9.7 ± 0.4) × (240 ± 6)	4311 020 51521
× $(200\,^{+8}_{-2})$	4311 020 51051
× (175 ± 4)	4311 020 51131
× $(160\,^{+2}_{-4})$	4311 020 51351
× (150 — 4)	4311 020 52001
× (140 — 4)	4311 020 51931
× (100 ± 2)	4311 020 51211
(Ø 7.5 ± 0.3) × (140 ± 3)	4311 020 51271
× (125 ± 2.5)	4311 020 51831
(Ø 6.35 ± 0.3) × (130 ± 3)	4311 020 51641

Grade 4C3

dimensions	*type number*
(Ø 9.8 ± 0.3) × $(200\,^{+10}_{-2})$	4311 020 52351
× (155 — 4)	4311 020 52341

PLATES[1]

Grade 4B1

dimensions	*type number*
(19 — 1) × (3.8 — 0.3) × (150 — 6)	4311 020 52411
× (125 — 5)	4311 020 52401
× (100 — 4)	4311 020 52391
× (75 — 3)	4311 020 52381
(13.4 — 0.8) × (4.15 — 0.3) × (120 — 2)	3122 104 92141
× (94 — 1)	3122 104 92121
× (62 — 1)	3122 104 92151

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[1] Preferred types

RODS AND TUBES FOR SMALL COILS (E.G. IF TRANSFORMERS)

Ferroxcube rods and tubes are used as cores in RF and HF inductances with an open magnetic circuit such as in IF transformers.

RODS[1]

diam. (mm)	*length (mm)*	*grade*	*type number*
0.95—0.15	10 —2.5	3B	56 680 21/3B
1.25—0.04	6.2—0.4	3B	4322 020 32081
1.65—0.05	9.2—0.4	3B	3122 104 91071
	9.2—0.4	4B	3122 104 91061
	11.5—0.4	3B	4322 020 32101
	11.5—0.4	4E	4322 020 32111
	12.2—0.4	3B	56 680 36/3B
	12.2—0.4	4B	3122 104 91111
	19.2—0.4	3B	3122 104 91231
	25.2—0.4	3B	3122 104 91171
	25.2—0.4	4B	3122 104 91181
	28.2—0.4	3B	3122 104 91091
	28.2—0.4	4B	4322 020 32091
1.7—0.15	15.2—0.4	4D	4322 020 32171
1.7—0.1	28.2—0.4	4C	4322 020 32121
	28.2—0.4	4D	4322 020 32131
	28.2—0.4	4E	4322 020 32141
1.7—0.15	30.5—1	3B	3122 104 91201
1.75—0.2	10.2—0.4	3B	3122 104 91131
	18.5—1	3B	3122 104 91141
	18.5—1	4B	3122 104 91151
	18.7—0.4	3B	3122 104 91141
4 —0.5	63 —1	3C	56 680 63/3C1
6 —0.075	46.2—0.4	3C	3122 104 91311
6.65—0.3	40.4—0.8	3B	4322 020 32161

[1] Preferred types

FERROXCUBE 3 & 4

RODS AND TUBES FOR SMALL COILS (e.g. IF transformers)

Ferroxcube rods and tubes are used as cores in RF and HF inductances with an open magnetic circuit such as in IF transformers.

TUBES[1]

outer diam. (mm)	*inner diam. (mm)*	*length (mm)*	*grade*	*type number*
2.8 −0.03	1.2 +0.1	8.2−0.4	3B	4322 020 34341
3.7 −0.4	1.2 +0.2	3.5−0.5	3B	4322 020 34401
			4B	4322 020 34421
		6.5−0.5	3B	4022 101 80011
3.7 −0.3	1.7 +0.2	13.7−0.4	4E	4322 020 34331
4.15−0.05	2 +0.2	7.2−0.4	4A	4322 020 34441
		12.2−0.4	4B	4322 020 34451
			4C	4322 020 34461
			4D	4322 020 34471
		15.2−0.4	4B	4322 020 34381
			4C	4322 020 34371
		21.2−0.4	4A	4322 020 34391
			4B	4322 020 34481
4.3 −0.2	2 +0.2	7.2−0.4	3B	3122 104 92901
		12.5−1	3B	4322 020 34491
		15.2−0.2	4D	4322 020 36761
		15.4−0.8	3B	4322 020 36751
		18.5−1	3B	4322 020 36771
		25.5−1	3B	4322 020 36781
			4B	3122 104 90811
			4C	56 060 75/4C
			4D	56 060 75/4D
			4E	56 060 75/4E
		30.2−0.4	3B	4322 020 36791
		40.5−1	3B	3122 104 90801
		55.5−1	3B	4322 020 36801
4.95−0.1	1.3 +0.2	40.5−1	3C3	3122 104 93111
5.3 −0.2	3 +0.2	22.4−0.8	3B	4322 020 36811
6.2 −0.4	2.85 +0.3	30.2−0.4	4C	4322 020 36821
6.4 −0.4	3 +0.2	14.3−0.6	4D	K5 000 85
8 −0.4	4.2 +0.6	51.4−2.8	3B	4322 020 34311
			4B	4322 020 34321

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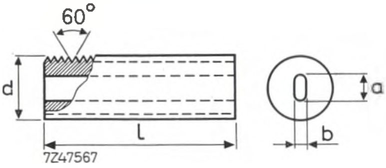
[1] Preferred types

SCREW CORES AND CUP CORES FOR SMALL COILS (e.g. IF transformers)



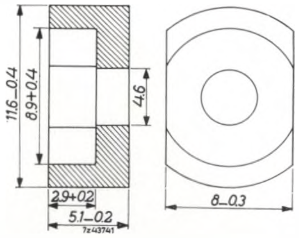
SCREW CORES[1]

The standard cores are available in ferroxcube 3D3 with an initial permeability of 750 ±20%.

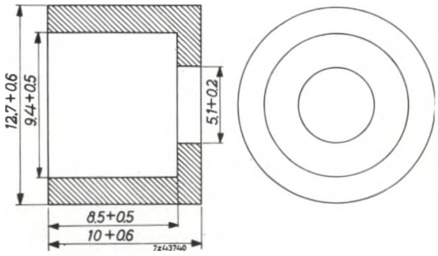
screw thread	*l* (mm)	*d* (mm)	*a* (mm)	*b* (mm)	type number
M4 × 0.50	12 ± 0.3	3.65 + 0.05	1.6 ± 0.1	0.7 ± 0.1	4312 020 32041
M4 × 0.50	7 ± 0.2	3.65 + 0.05	1.6 ± 0.1	0.7 ± 0.1	4312 020 32141
M5 × 0.75	12 ± 0.3	4.55 + 0.05	2.15 ± 0.15	0.8 ± 0.1	4312 020 32051
M5 × 1	20 ± 0.3	5.0 – 0.1	2.35 ± 0.15	1.1 ± 0.1	4312 020 32131
M6 × 0.5*	12 ± 0.2	5.9 – 0.04	2.45 + 0.3	1.2 + 0.2	4312 020 32011
M6 × 0.75	25 ± 0.5	5.55 + 0.05	2.65 ± 0.15	1.1 ± 0.1	4312 020 32071
M6 × 0.75	13 ± 0.3	5.55 + 0.05	2.65 ± 0.5	1.1 ± 0.1	4312 020 32061
M6 × 1	25 ± 0.5	5.5 ± 0.02	2.75 ± 0.25	1.3 ± 0.1	4312 020 32031
M6 × 1	12 ± 0.3	5.5 ± 0.02	2.75 ± 0.25	1.3 ± 0.1	4312 020 32021
M7 × 1	18 ± 0.5	6.45 + 0.05	3.15 ± 0.15	1.3 ± 0.1	4312 020 32091
M7 × 1	12 ± 0.3	6.45 ± 0.05	3.15 ± 0.15	1.3 ± 0.1	4312 020 32081
M8 × 0.75	16 ± 0.5	7.55 + 0.05	3.65 ± 0.15	1.3 ± 0.1	4312 020 32101
M8 × 1.25	25 ± 0.5	7.35 + 0.05	3.65 ± 0.15	1.3 ± 0.1	4312 020 32121
M8 × 1.25	16 ± 0.5	7.35 ± 0.05	3.65 ± 0.15	1.3 ± 0.1	4312 020 32111

* Grade 3B

CUP CORES[1]



Type number 132210492221, Grade 3B1



Type number 432202020954, Grade 3B1

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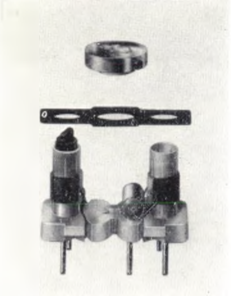
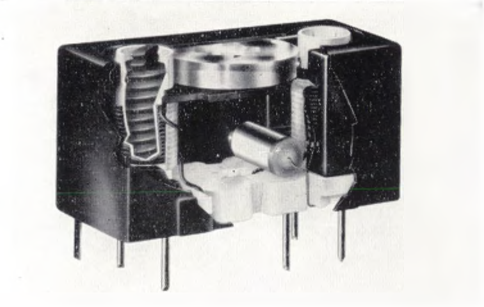
[1] Preferred types

FERROXCUBE 3 & 4

PIECE PARTS AND MOUNTING PARTS FOR SMALL IF-COILS

LILLIPUT COILS (complete IF-coils for 452 kc/s: AP 1040–AP 1045 etc.)





The complete range of piece parts comprises:

Screw core (ferroxcube)

max. frequency (Mc/s)	*grade*	*type number*[1]
0.6	3B1	312210493011
2	4B1	93021
12	4D1	93041
40	**powder iron**	K4 725 10

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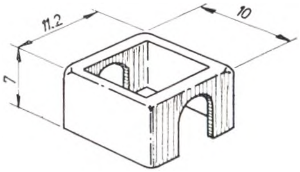
[1] A version with a trimming grip on both sides is also available.

Frame (lacquered)

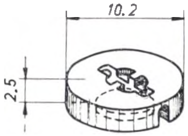


max. frequency (Mc/s)	*type number*
0.6	AP 3014/00/3B1
2	AP 3014/01/4B1
12	AP 3014/02/4D1
ratio detector	AP 3014/03/4D1

Coupling rod (3B1) Type number 3122 104 91131

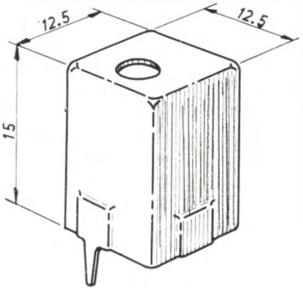
For coupling between primary and secondary windings, to be inserted in disc AP 3018.

Coupling disc Type number AP 3018



PIECE PARTS AND MOUNTING PARTS FOR SMALL IF-COILS

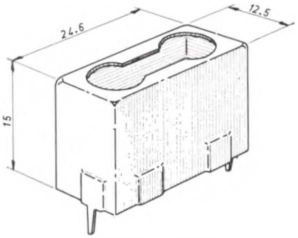
LILLIPUT COILS



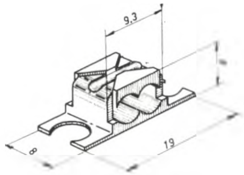
For one coil

Mechanical shielding (polystyrene)	– type number AP 3015/00 to be used when screening is not required; the Q-factor is not affected.
Mechanical shielding (copper)	– type number AP 3015/01 (symmetric hole) type number AP 3015/02 (asymmetric hole)

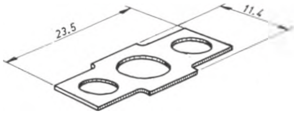
For two coils
Type number AP 3015/03



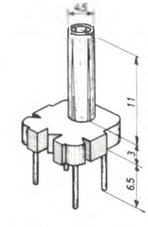
Block
Type number AP 3019
(for ratio detector only)



Spacer plate
Type number AP 3017

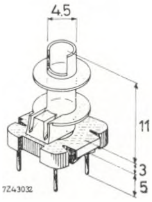


Coil formers (polyethylene)

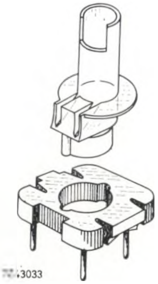


7Z40821

	version	type number
symmetric; for use without ferroxcube frame	4 pins 5 pins	AP 3016/00 AP 3016/01
asymmetric; for use with ferroxcube frame	4 pins 5 pins	AP 3016/02 AP 3016/03



7Z43032

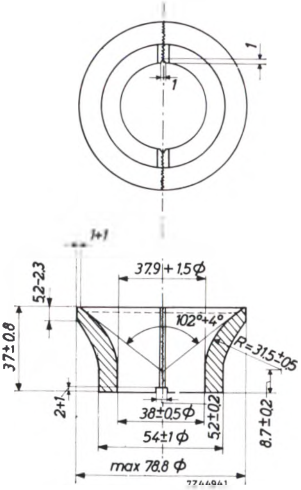


7Z43033

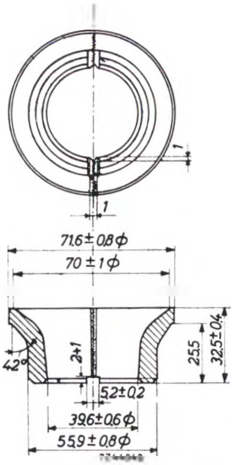
	version	type number
asymmetric; for use with ferroxcube frame	2 flanges	AP 3016/05
base with	4 pins	AP 3016/04

YOKE RINGS FOR USE IN DEFLECTION COILS FOR 110° PICTURE TUBES

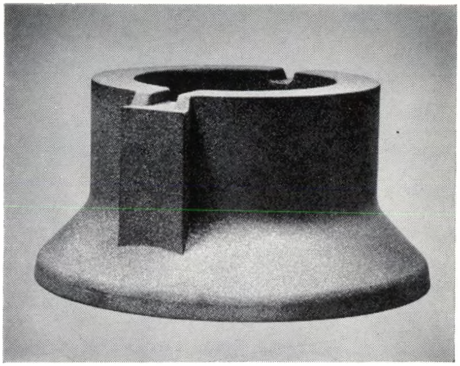
European technique
Type number 3122 104 92181
(preferred type)



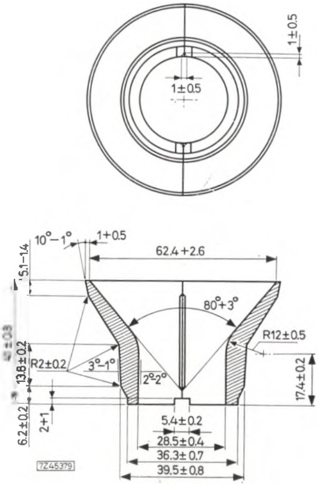
American technique
Type number 4322 020 35011



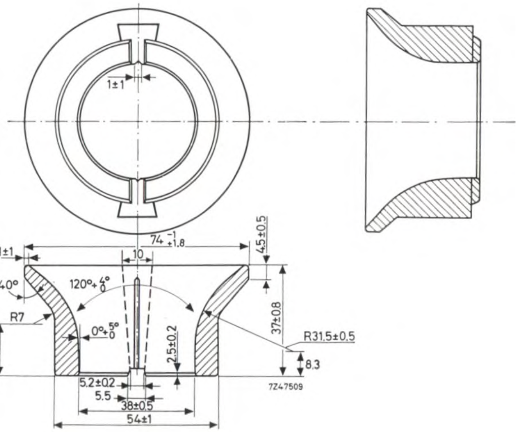
YOKE RINGS FOR USE IN DEFLECTION COILS FOR 110° PICTURE TUBES



Type number 3122 104 90511

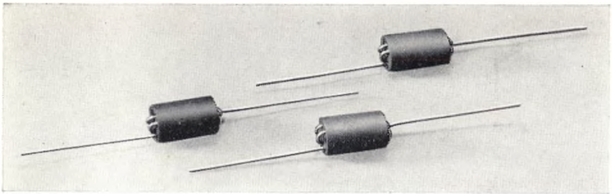


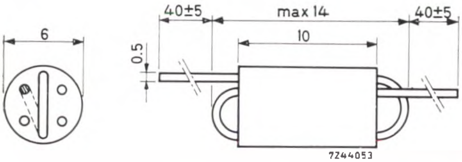
Type number 4322 020 35071



FERROXCUBE 3 & 4

DAMPING BEADS AND WIDE-BAND CHOKES (for anti-interference applications)





Beads and wide-band chokes are available in ferroxcube grades 3B1 and 4B1.
The chokes are supplied with six axial holes through which 1.5, 2.5 or 2 × 1.5 turns of tinned copper wire are threaded.
The table gives the types of chokes that are currently available.

Detailed information can be given on request.

4B1 groen.

number of turns	Z_{max} (kΩ)	f (at Z_{max}) (Mc/s)	decrease of impedance in the frequency range (Mc/s)	dB	grade	type number
1.5	0.35 ± 20%	120	10–300	≤7	3B1	4312 020 36631
1.5	0.45 ± 20%	250	80–300	≤3	4B1	4312 020 36691
2.5	0.75 ± 20%	50	10–220, 30–100	≤7, ≤3	3B1	4312 020 36641
2.5	0.85 ± 20%	180	50–300, 80–220	≤6, ≤3	4B1	4312 020 36701
2 × 1.5	0.90 ± 20%	50	10–220, 30–100	≤7, ≤3	3B1	4312 020 36651
2 × 1.5	1.00 ± 20%	110	50–300, 80–220	≤7, ≤3	4B1	4312 020 36711

Beads without wire[1]

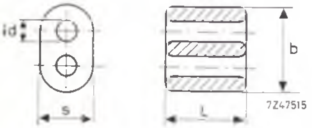


Fig. 1

Fig. 2

L (mm)	outer ø or b (mm)	inner ø (mm)	s (mm)	Grade	fig.	type number
10 ± 0.5	6 ± 0.3	0.7 + 0.2	—	3B1	2	4312 020 31501
14 ± 0.4	14 ± 0.5	3.5 + 0.5	8.5 — 0.5	4B1	1	4312 020 31521
10 ± 0.5	6 ± 0.3	0.7 + 0.2	—	4B1	2	4312 020 31551
7.5 ± 0.5	6 ± 0.3	0.7 + 0.2	—	3B1	2	VK 211 18
8 ± 0.3	14 ± 0.5	3.5 + 0.5	8.5—0.5	4B1	1	4312 020 31571

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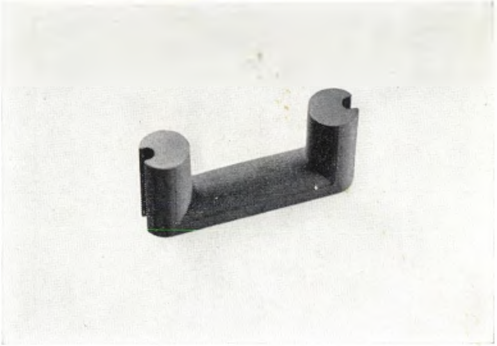
[1] For single hole beads see under tubes, page G. 14

U-CORES FOR LINE-OUTPUT TRANSFORMERS



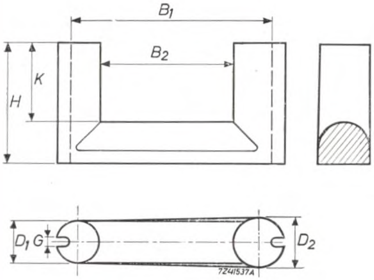


Fig. 1

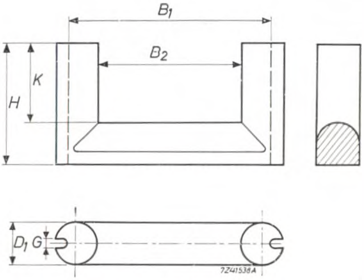


Fig. 2

Available types

All types of core are available in ferroxcube grades 3C4 and 3C6. The difference in splay between two U-cores taken at random from one packing will never exceed half the total tolerance on dimension B_1.

dimensions (mm)						*grade*	*type number*
B_1	B_2	D_1	G	H	K		*Fig. 1*
49.8 ± 0.8	26.9	15.5 ± 0.4	4.8 ± 0.2	28.4 ± 0.2	15.5 + 1	3C4 3C6	4312 020 33201[1] 33301[1]
							Fig. 2
56.7 ± 0.75	36.1	13.8 ± 0.2	3.6 ± 0.2	29.5 ± 0.2	17.6 + 1	3C4 3C6	33221 33321
60.35 ± 0.9	37.05	15.9 ± 0.4	4.8 ± 0.2	28.75 ± 0.2	15.55 + 1	3C4 3C6	33211 33311
60.35 ± 0.9	37.75	15.9 ± 0.4	4.8 ± 0.2	31.8 ± 0.2	18.55 + 1	3C4 3C6	33231 33331

[1] $D_2 = 15.9 \pm 0.2$.

U-CORES FOR LINE-OUTPUT TRANSFORMERS

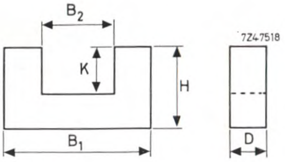


Fig. 1.

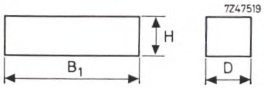


Fig. 2.

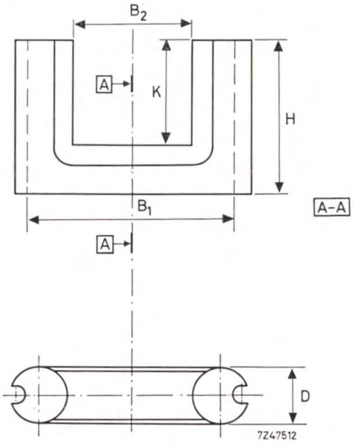


Fig. 3.

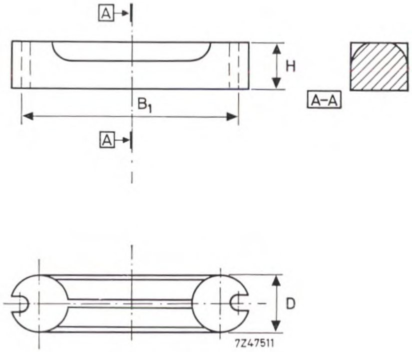


Fig. 4.

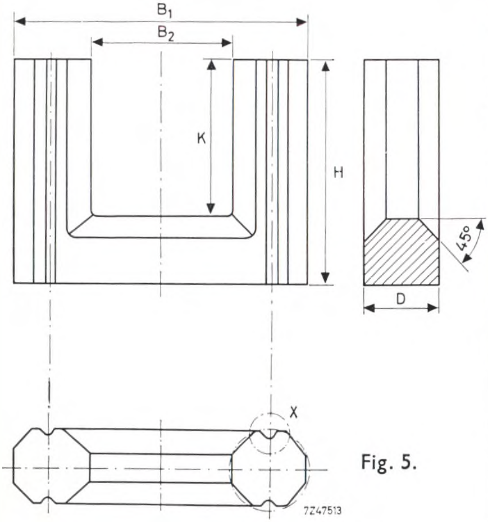


Fig. 5.

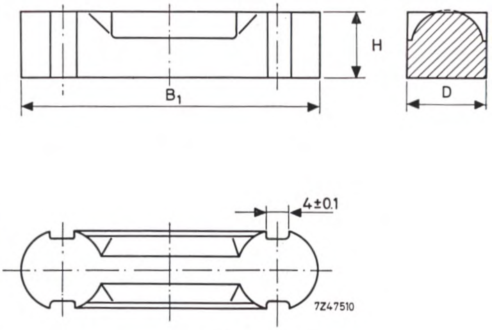


Fig. 6.

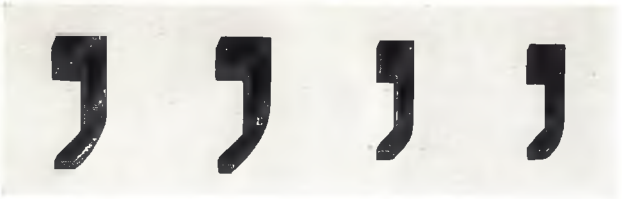
U-CORES FOR LINE-OUTPUT TRANSFORMERS

MATERIAL 3C6

B_1 (mm)	B_2 (mm)	H (mm)	K (mm)	D (mm)	fig.	type number
40.7 ± 1.3	24.4 + 1.2	33 ± 0.2	23.1 + 0.9	11.4 — 0.5	3	3122 104 90481
39.6 ± 0.4		9.5 ± 0.2		11.4 — 0.5	4	3122 104 90471
49.6 ± 0.8	27 ± 1	44.2 ± 0.2	>31	15.6 ± 0.4	3	4312 020 33381
50 ± 0.8		12.6 ± 0.2		15.6 ± 0.4	4	4312 020 33391
58 + 1.3	28 ± 1	44.6 ± 0.5	31.5 ± 0.5	15 ± 0.4	5	4312 020 33341
58 + 1.3	28 ± 1	34.6 ± 0.5	21.5 ± 0.5	15 ± 0.4	5	4312 020 33351
59.4 ± 0.8		13.5 ± 0.2		15 ± 0.4	6	4312 020 33361
72 ± 1	44 ± 1.4	33.1 ± 0.15	19 ± 0.4	14.1 ± 0.3	1[1]	4312 020 33001
93 ± 1.8	36.2 + 1.6	52 ± 0.5	24 0.45	30 ± 0.6	1	4312 020 33102
93 ± 1.8		27.5 ± 0.5	±	30 ± 0.6	2	4312 020 33112
93 ± 1.8	36.2 + 1.6	76 ± 0.5	48 ± 0.9	30 ± 0.6	1	4312 020 33092
93 ± 1.8	36.2 + 1.6	76 ± 0.5	48 ± 0.9	16 ± 0.5	1	4312 020 33072
93 ± 1.8		27.5 ± 0.5		16 ± 0.5	2	4312 020 33082
101.6 ± 2	>47	57.1 ± 0.4	31.7 ± 0.75	25.4 ± 0.8	1	4312 020 33122

[1] Notches in back.

PIECE PARTS FOR ERASING HEADS (material grades 3C1 and 3C2)



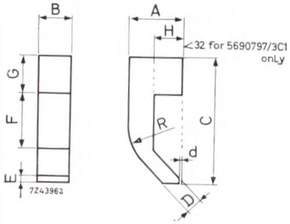


Fig. 1

For good erasing of magnetic tape at a low noise level, a frequency is required that is several times higher than the maximum frequency to be recorded. That is why, for use in erasing heads a core material with low eddy current losses is recommended. Low eddy current losses imply low heat dissipation, and consequently less power for the erasing procedure.
Ferroxcube cores possess this property in a much higher degree than laminated metal cores, so that they are plainly indicated for this application.
The tables below contain data of ferroxcube cores in the material grades 3C1 and 3C2.

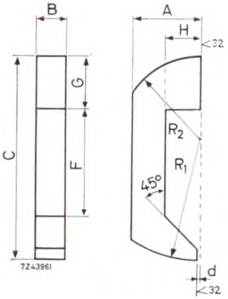


Fig. 2

Properties

Low eddy current losses at frequencies up to 500 kc/s.
The initial permeability is approximately 900.
The saturation flux at 23 °C is
of ferroxcube 3C1 approx. 3300 gauss,
of ferroxcube 3C2 approx. 3800 gauss.

Survey of cores

Ferroxcube grade 3C1, shape according to Fig. 1.

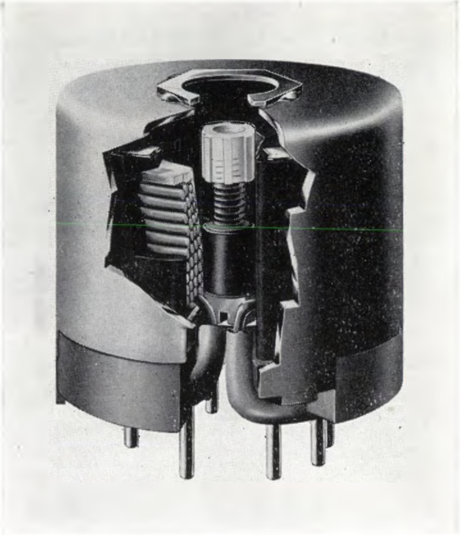
dimensions (mm)										*type number*
A	*B*	*C*	*D*	*d*	*E*	*F*	*G*	*H*	*R*	
4.7−0.4	1.7−0.4	11±0.2	1.4±0.2	0	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	5690727/3C1
4.7−0.4	3.6−0.2	11±0.2	1.4±0.2	0	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	5690733/3C1
4.7−0.4	7.1−0.2	11±0.2	1.4±0.2	0	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5+0.2	5690773/3C1
4.7−0.4	1.2−0.4	11±0.2	1.4±0.2	0	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	5690780/3C1
4.7−0.4	3.5−0.3	11±0.2	1.4±0.2	0	0.55±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	5690797/3C1
4.7−0.4	2.8−0.2	11±0.2	1.4±0.2	0+0.2	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	K550090
4.7−0.3	1.4−0.2	11±0.2	1.4±0.2	0+0.2	0.5 ±0.1	4.8+0.4	3.2−0.4	2.4+0.2	5±0.2	K550015
3.1−0.3	1.6−0.2	9.2±0.2	1.4±0.1	0+0.1	0.5 ±0.1	3.8+0.4	3.2−0.4	1.4+0.2	2±0.2	K550035

Ferroxcube grade 3C2, shape according to Fig. 2.

dimensions (mm)									*type number*
A	*B*	*C*	*d*	*F*	*G*	*H*	R_1	R_2	
5.8−0.4	3.6−0.2	18±0.4	0.1±0.05	9.4+0.4	4.5−0.4	3+0.2	11±0.2	7±0.2	K550000
5.8−0.4	1.6−0.2	18±0.4	0.1±0.05	9.4+0.4	4.5−0.4	3+0.2	11±0.2	7±0.2	K550025
5.8−0.4	2.6−0.2	18±0.4	0.1±0.05	9.4+0.4	4.5−0.4	3+0.2	11±0.2	7±0.2	K550045

POTCORES OF THE P-SERIES

Introduction



Ever since ferroxcube potcores were first introduced some fifteen years ago, they have proved to be among the best cores for inductors and transformers and have been used in ever-increasing quantities. Originally developed for carrier telephone equipment, potcores are nowadays also used successfully in loading coils, tuned circuits, chokes, and many other applications where highly reliable inductors are required.

One of the great advantages of ferroxcube potcores over the conventional powder-iron or spiral cores is that *it is possible to adapt their effective permeability to the specific requirements of the inductor for a certain application. In this way, high quality factors and high stability of inductance can be obtained with cores of small volume*. This also results in a small volume of the whole equipment, the more so as no additional external shields are required. Metal parts in the vicinity of the coil do not cause losses, since the stray magnetic field around the potcores is extremely small.

A great variety of potcore types is available to suit the widest diversity of requirements in a frequency range extending from audio frequencies to approximately 20 Mc/s.

Contrary to the custom of the early days of ferroxcube, when a type of core was designed for a specific application, to-day ranges of internationally standardized cores are available (see the tables), which can be used in the majority of applications. In this way, the creation of a great variety of core shapes is avoided, and all the advantages of largescale production, constant quality level and reasonable prices are fully exploited.

The entire problem of the construction of a coil or a transformer can be reduced to the following points. Around a core of magnetic material, a number of windings of conducting wire must be arranged in some way or other. This arrangement must be such that winding and core are not only kept together in a stable way, but also that the coil can be easily inserted into a circuit. A further requirement is that the assembly should preferably be suitable for conventionally wired circuits as well as for mounting on printed-wiring boards. Finally, coils for tuned circuits should be provided with means of adjusting their inductance, so that the circuit of which they form part can be tuned inductively, and bulky capacitive trimmers avoided.

Apart from the complete range of ferroxcube potcores, a comprehensive survey of coil formers, mounting parts and adjusting devices is given that eminently match the range of potcores.

POTCORES OF THE P-SERIES

Electrical properties

On the following pages the values of relative effective permeability, μ_e, are given. This characteristic is the most important factor to be considered when designing a coil with a ferromagnetic core. The relative effective permeability is defined as

$$\mu_e = \frac{\sum \frac{l}{A}}{\sum \frac{l}{\mu_i A}}$$

where μ_i = the relative initial permeability of the material used;
l = the length of the lines of force of the part of the magnetic circuit considered, in cm;
A = the cross-section through the core, perpendicular to the direction of the lines of force, in cm^2.

For a certain required inductance L, the necessary number of turns N is calculated either from

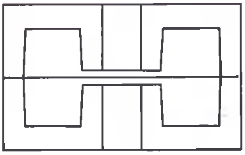
$$N = a\sqrt{L}$$

or from

$$N^2 = \frac{L}{A_L}.$$

in which:

a = the turns factor, that is, the number of turns for 1 mH when the coil former is completely filled;
A_L = the inductance factor, that is, the inductance in nH per turn, also calculated for a completely filled coil former.



If no adjustment is carried out by introducing an air gap, the limits between which the inductance of the assembled coil may vary are determined by the guaranteed properties of the core material and the mechanical tolerances of the core.
The values of μ_e, a or A_L mentioned are to be used for the potcores without the adjusting mechanism.
The most important electrical properties of a coil are the total losses at low induction, the hysteresis losses and the stability of the inductance with time and temperature. They are determined to a great extent by the proper choice of the effective permeability μ_e. It should always be kept in mind, however, that in the case of the maximum quality factor, about one half of the total losses is still made up of losses in the copper and insulating material. When designing coils, it is, therefore, most important to select the right kind of winding wire and insulating material. For low-frequency coils the winding space should be used to the full extent, and for high-frequency coils care should be taken that the stray capacitance does not become excessive.
It is impossible to give here hard and fast rules for the optimum design of potcored coils. More detailed information will be gladly supplied on request.

POTCORES OF THE P-SERIES

Grades of material

Potcores can be obtained in different grades of ferroxcube. Each grade has specific advantages in a certain frequency range and for certain applications. For example, grade 3H1 has been developed to match the temperature coefficient of polystyrene capacitors; grade 3B7 is meant for coils in combination with mica capacitors.

The table below indicates the purpose for which the different materials are most suitable. A survey of material properties that gives more detailed information can be found on page G7.
Not all potcore sizes are available in each of the material grades mentioned in the table. Since the choice of a certain core size depends on, amongst others, the frequency of the application concerned, a selection has been made for the most frequent requirements. Subsequent tables contain the grades of material in which the various types of core are normally available.

main application	*approximate frequency range*	*ferroxcube grade*
filter coils	from 0.1 to 200 kc/s	3B7, 3H1
	200 kc/s to 2 Mc/s	3D3
	2 Mc/s to 20 Mc/s	4C4
loading coils, transformers, chokes	up to 60 kc/s	3H1
	200 c/s to 10 Mc/s	3H1

POTCORES OF THE P-SERIES

Available types

Potcores are generally supplied in three versions:

(a) potcore halves without air gap

These cores are of interest to large-quantity consumers who are doing their own adjustments, and who in this way are offered all the advantages of simple stock keeping and a free choice of the effective permeability.

Preferred types of potcore halves (P-series)

material	*3H1*	*3B7*	*3D3*	*4C4*
P 11/7	K5 352 16	K5 352 15	K5 352 17	K5 352 19
P 14/8	K5 351 82	K5 351 81	K5 351 80	K5 351 84
P 18/11	K5 351 52	K5 351 53	K5 351 51	K5 351 54
P 22/13	K5 352 01	K5 352 00	K5 352 02	K5 352 03
P 26/16	K5 351 57	K5 351 58	K5 351 56	K5 351 59
P 30/19	K5 352 05	K5 352 06	K5 352 07	K5 352 09
P 36/22	K5 351 61	K5 351 62	K5 351 63	K5 351 64
P 42/29	K5 352 22	K5 352 21	—	—

Potcore halves are only supplied without an air gap.

Two parts are required for one complete core.

(b) pre-adjusted potcores with μ_e-values following the E6 progression

The advantage of this range of pre-adjusted potcores is that for each potcore size the same effective permeability may be chosen. Narrow limits of inductance after assembly can be realised.

(c) pre-adjusted potcores with A_L-values following the R5 and R10 progression

Like the pre-adjusted types mentioned under (b), these potcores have narrow inductance limits.

Accessories and mounting parts

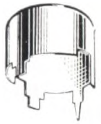
Coil formers

The type numbers of the standard (I.E.C) coil formers are given with their nominal dimensions. The rigid insulating material can amply withstand the stresses that occur during winding. It has an adequate moisture resistance, and will endure the conventional impregnating temperatures.

Adjustors

The inductance of a pre-adjusted potcore can be increased by inserting an adjustor. In practice, an adjustment range of 10% is generally sufficient to cope with the tolerances of capacitors and inductors, and with the parasitic capacitances and inductances that occur when components are incorporated in a circuit.
On pages G34–G38 for each type of potcore the corresponding type of adjustor is given which will increase the published μ_e-value by a minimum of 8%, and a maximum of 14% approximately.
When optimum stability is of prime importance, the type of adjustor that matches a certain potcore should be chosen. If it is desired to widen the adjustment range, however, an adjustor indicated for a potcore with a high μ_e-value may be used in a potcore with a low μ_e-value.

Mounting parts

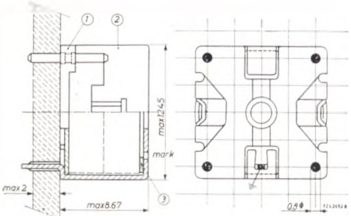


Potcored coils can be mounted on conventional panels (see below), as well as on printed-wiring boards; the location of the soldering tags being matched to the 0.1 in. as well as to the 2.50 mm grid. The insulating material of the tag plate can fully withstand the temperatures occurring during dip-soldering.
After placing the spring in the container, the core is brought under the correct pressure by pressing the tag plate down to the rim of the container. It will be held in place after the three ears have been folded over. For conventional panel mounting, a fixing bush and nut are separately available. Type P 11/7 does not possess this mounting facility.
Further information on the design of simple tools for potcore assembly will be gladly supplied on request.

FERROXCUBE 3 & 4

POTCORES OF THE P-SERIES

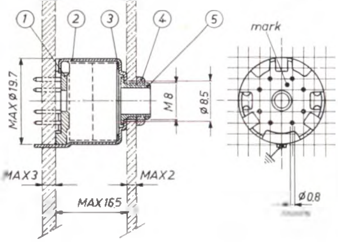
Mounting parts and coil formers



accessories	type number
coil former	
1 section	P5 055 71
container	B1 410 46
spring	B1 480 31
tag plate	4322 021 30180

For mounting on printed-wiring boards only

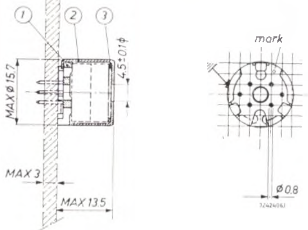
Type P 18/11



accessories[1]	type number
coil former	
1 section	P5 055 75
2 sections	P5 055 76
3 sections	P5 055 88
container	B1 410 48
spring	B1 480 20
tag plate	P4 057 26

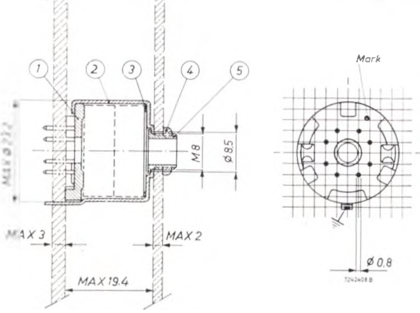
For mounting on conventional panels as well as on printed-wiring boards

Type P 14/8



accessories[1, 2]	type number
coil former	
1 section	P5 055 72
2 sections	P5 055 73
container	B1 410 47
spring	B1 480 21
tag plate	P4 057 25

Type P 22/13



accessories[1]	type number
coil former	
1 section	P5 055 78
2 sections	P5 055 79
3 sections	P5 055 89
container	B1 410 49
spring	B1 480 31
tag plate	P4 057 27

For mounting on conventional panels as well as on printed-wiring boards

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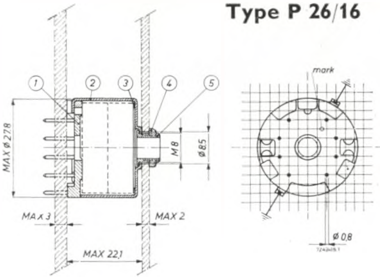
[1] For panel mounting use fixing bush B1 391 85 and nut B1 436 53.

[2] For panel mounting the container 4322 021 30600 has to be used.

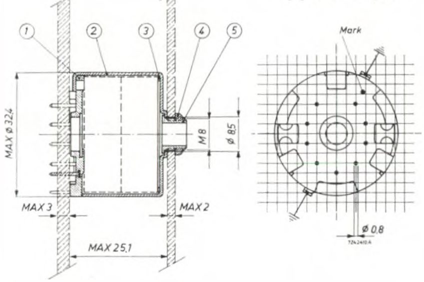
Mounting parts and coil formers

Type P 26/16



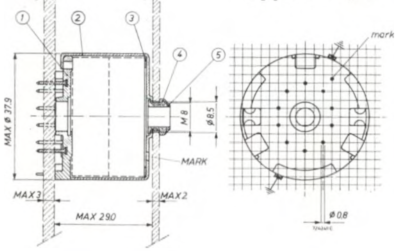
accessories[1]	type number
coil former	
1 section	P5 055 81
2 sections	P5 055 82
3 sections	P5 055 90
container	B1 410 50
spring	B1 480 22
tag plate	P4 057 28

Type P 30/19



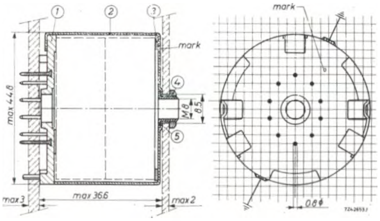
accessories[1]	type number
coil former	
1 section	P5 055 84
2 sections	P5 055 85
3 sections	P5 055 91
container	B1 410 51
spring	B1 480 23
tag plate	P4 057 29

Type P 36/22



accessories[1]	type number
coil former	
1 section	P5 055 86
2 sections	P5 055 87
3 sections	P5 055 92
container	B1 410 52
spring	B1 480 24
tag plate	P4 057 30

Type P 42/29



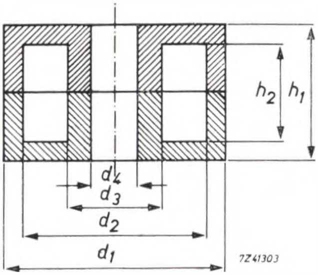
accessories[1]	type number
coil former	
1 section	P5 055 60
2 sections	P5 055 61
container	B1 410 53
spring	B1 480 33
tag plate	P4 057 47

[1] For mounting on conventional panels as well as on printed-wiring boards. For panel mounting use fixing bush B1 391 85 and nut B1 436 53.

POTCORES OF THE P-SERIES

Survey of potcore and coil former dimensions

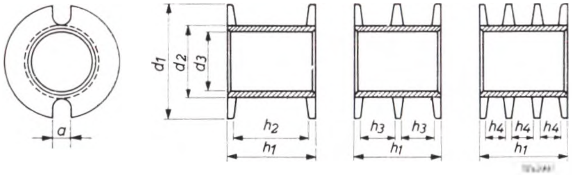
POTCORES



The main dimensions of the potcores are in conformity with the following standardization specifications·
IEC publication 133
CCTU 06–02 (France)
DIN 41 293 (Germany)

core type	nominal dimensions (mm)					
	d_1	d_2	d_3	d_4	h_1	h_2
P11/7	11.1	9.20	4.60	2.05	6.50	4.55
P14/8	14.0	11.8	5.90	3.10	8.40	5.80
P18/11	17.9	15.1	7.45	3.10	10.6	7.40
P22/13	21.5	18.2	9.25	4.50	13.4	9.40
P26/16	25.5	21.6	11.3	5.50	16.0	11.2
P30/19	30.0	25.4	13.3	5.50	18.9	13.2
P36/22	35.5	30.4	15.8	5.50	21.9	14.8
P42/29	42.4	36.3	17.4	5.50	29.4	20.5

COIL FORMERS



The dimensions of the coil formers are in conformity with the following standardization specifications:
IEC publication 133
CCTU 06–02 (France)
D.I.N. 41 294 (Germany)

core type	nominal dimensions (mm)								type number
	d_1	d_2	d_3	h_1	h_2	h_3	h_4	a	
P11/7	8.9	5.7	4.8	4.2	3.5	—	—	2.2	
P14/8	11.5	7.1	6.1	5.4	4.5	2.08	—	2.7	
P18/11	14.8	8.7	7.7	7.0	6.1	2.88	1.80	3.0	
P22/13	17.8	10.7	9.6	9.0	7.9	3.72	2.35	3.2	
P26/16	20.9	12.8	11.7	10.8	9.7	4.62	2.93	3.2	
P30/19	24.7	15.0	13.7	12.8	11.5	5.42	3.40	3.7	
P36/22	29.6	17.9	16.5	14.4	12.9	6.07	3.80	4.2	
P42/29	35.4	19.6	18.0	19.8	17.8	—	—	—	P5 055 60
P42/29	35.4	19.6	18.0	19.0	—	8.0	—	—	P5 055 61

POTCORES OF THE P-SERIES

Pre-adjusted type P11/7 with effective permeability (μ_e) following the E6 progression[1])

application	*grade of ferrox-cube*	*effective perme-ability (μ_e)*	*number of turns for 1mH (α)*	*tolerance on induc-tance (%)*	*type number*
coils in tuned circuits and equalisers	4C4	15	225	±1	K3 003 17
	4C4	22	186	±1	3 18
	4C4	33	152	±1	3 19
	3D3	33	152	±1	3 11
	3D3	47	127	±1	3 12
	3D3	68	105.8	±1	3 13
	3B7	68	105.8	±1	2 91
	3H1	68	105.8	±1	3 01
	3B7	100	87.2	±1.5	2 92
	3H1	100	87.2	±1.5	3 02
	3B7	150	71.2	±2	2 93
	3H1	150	71.2	±2	3 03
pulse transformers	3D3	660	33.9	±25	3 10
	3B7	1300	24.2	±25	2 90
	3H1	1300	24.2	±25	3 00

Pre-adjusted potcore type P11/7 with A_L-values following the R5 (R10) progression

application	*grade of ferrox-cube*	A_L	*correspon-ding μ_e*	*tolerance on induc-tance (%)*	*type number*
coils in tuned circuits and equalisers	4C4	25	19.0	±1	K3 006 38
	4C4	40	30.5	±1	6 39
	3D3	40	30.5	±1	6 31
	3D3	63	48	±1	6 32
	3D3	100	76	±1	6 33
	3B7	100	76	±1	6 21
	3H1	100	76	±1	6 11
	3B7	160	122	±1.5	6 22
	3H1	160	122	±1.5	6 12
	3B7	250	190	±3	6 23
	3H1	250	190	±3	6 13

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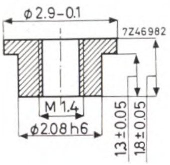
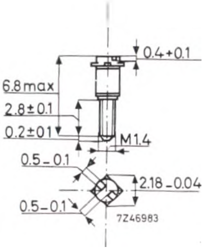
[1] Preferred types

CONTINUOUS INDUCTANCE ADJUSTORS OF POTCORES P11/7

The tolerances on inductance of the pre-adjusted potcores (without adjustor) are given on the pages G38–G45. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy $< 0.3^0/_{00}$ by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil by maximum 8 to 14%.
The adjustor is screwed in the centre hole of the potcore by means of a matching nut and is held in position by the corner edges on the top of the adjustor.
For special requirements a bigger or smaller adjustment range may be obtained by using an adjustor belonging to the next higher or lower effective permeability. The influence of these adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.

Recommended adjustors for the pre-adjusted potcores are given below.





Adjustor

Nut for adjustor type number 4322 021 31230

potcore P11/7		*material grade 3B7/3H1/**3D3** adjustor*	
μ_e	A_L	*type number*	*colour*
33	40	4322 021 31250	green
47	63	4322 021 31260	red
68	100	4322 021 31270	yellow
100	160	4322 021 31540	brown
150	160	4322 021 31540	brown
220	250	4322 021 31280	grey

CONTINUOUS INDUCTANCE ADJUSTORS OF THE P-SERIES

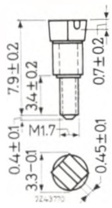


Fig. A

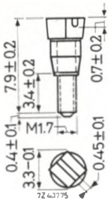


Fig. B

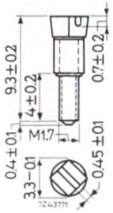


Fig. C

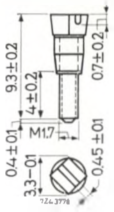


Fig. D

P14/8

potcore		material grade		
μ_e	A_L	3B7/3H1	3D3	4C4
15				P5 056 03
	25			P5 056 03
22				P5 056 03
	40	P5 056 04	P5 056 04	P5 056 58
33		P5 056 04	P5 056 04	P5 056 59
	63	P5 056 03	P5 056 03	P5 056 58
47		P5 056 03	P5 056 03	
	100	P5 056 58	P5 056 58	
68		P5 056 58	P5 056 58	
100		P5 056 59	P5 056 59	
	160	P5 056 59	P5 056 59	
150		P5 056 94	P5 056 94	
	250	P5 056 94	P5 056 94	
220		P5 057 38	P5 057 38	

adjustor		
type number	colour	fig.
P5 056 03	red	A
P5 056 04	green	A
P5 056 58	yellow	B
P5 056 59	white	B
P5 056 94	brown	A
P5 057 38	grey	B

P18/11

potcore		material grade		
μ_e	A_L	3B7/3H1	3D3	4C4
15				P5 056 05
	25			P5 056 05
	40			P5 056 06
22				P5 056 06
	63	P5 056 05	P5 056 05	
33		P5 056 05	P5 056 05	P5 056 61
	100	P5 056 06	P5 056 06	
47		P5 056 06	P5 056 06	
68		P5 056 60	P5 056 60	
	160	P5 056 60	P5 056 60	
	250	P5 056 61	P5 056 61	
100		P5 056 61	P5 056 61	
150		P5 055 93	P5 055 93	
	400	P5 056 95	P5 056 95	
220		P5 056 95	P5 056 95	

adjustor		
type number	colour	fig.
P5 056 05	green	C
P5 056 06	red	C
P5 056 60	yellow	D
P5 056 61	white	D
P5 055 93	brown	C
P5 056 95	grey	D

CONTINUOUS INDUCTANCE ADJUSTORS OF POTCORES P22/13 and P26/16

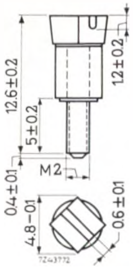


Fig. A

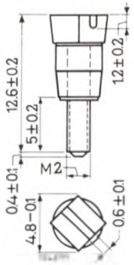


Fig. B

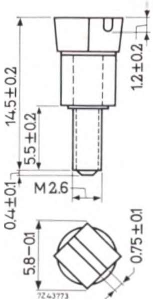


Fig. C

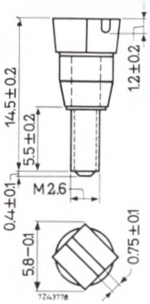


Fig. D

P22/13

potcore		*material grade*		
μ_e	A_L	*3B7/3H1*	*3D3*	*4C4*
15				P5 056 91
	40			P5 056 91
22				P5 056 76
	63	P5 056 88	P5 056 88	P5 056 76
33		P5 056 88	P5 056 88	P5 056 78
	100	P5 056 91	P5 056 91	
47		P5 056 91	P5 056 91	
68		P5 056 76	P5 056 76	
	160	P5 056 76	P5 056 76	
	250	P5 056 78	P5 056 78	
100		P5 056 78	P5 056 78	
150		P5 056 97	P5 056 97	
	400	P5 056 97	P5 056 97	
220		P5 056 97	P5 056 97	
	630	P5 056 97	P5 056 97	
330		4322 021 31240	4322 021 31240	

adjustor		
type number	*colour*	*fig.*
P5 056 76	yellow	B
P5 056 78	white	B
P5 056 88	green	B
P5 056 91	red	B
P5 056 97	brown	A
4322 021 31240	black	B

P26/16

potcore		*material grade*		
μ_e	A_L	*3B7/3H1*	*3D3*	*4C4*
15				P5 056 07
22				P5 056 07
	63			P5 056 07
33		P5 056 07	P5 056 07	P5 056 08
	100		P5 056 07	P5 056 08
47		P5 056 09	P5 056 09	
	160	P5 056 09	P5 056 09	
68		P5 056 62	P5 056 62	
	250	P5 056 62	P5 056 62	
100		P5 056 62	P5 056 62	
150		P5 056 10	P5 056 10	
	400	P5 056 10	P5 056 10	
220		P5 056 10	P5 056 10	
	630	P5 056 10	P5 056 10	
330		P5 056 96	P5 056 96	
	1000	P5 056 96	P5 056 96	

adjustor		
type number	*colour*	*fig.*
P5 056 07	green	C
P5 056 08	yellow	C
P5 056 09	red	C
P5 056 10	brown	C
P5 056 62	white	D
P5 056 96	grey	D

CONTINUOUS INDUCTANCE ADJUSTORS OF POTCORES P30/19, P36/22 and P42/29

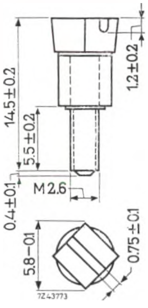


Fig. A

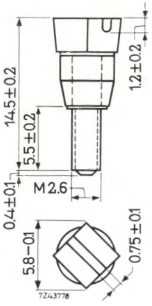


Fig. B

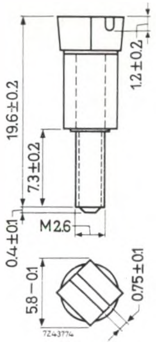


Fig. C

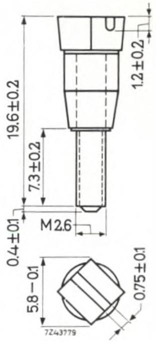


Fig. D

P 30/19

A_L	adjustor		
potcore	type number	colour	fig.
100	P5 056 07	green	A
160	P5 056 09	red	A
250	P5 056 62	white	B
400	P5 056 62	white	B
630	P5 056 10	brown	A
1000	P5 056 96	grey	B
1600	P5 056 99	blkac	C

μ_e	adjustor		
potcore	type number	colour	fig.
33	P5 056 07	green	A
47	P5 056 09	red	A
68	P5 056 62	white	B
100	P5 056 62	white	B
150	P5 056 10	brown	A
220	P5 056 96	grey	B
330	P5 056 99	black	D

P 36/22

A_L	adjustor		
potcore	type number	colour	fig.
160	P5 056 08	yellow	A
250	P5 056 62	white	B
400	P5 056 10	brown	A
630	P5 056 10	brown	A
1000	P5 056 96	grey	B
1600	P5 056 99	black	D

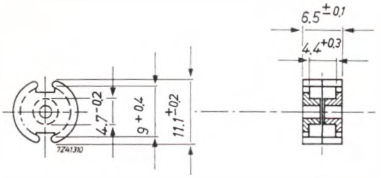
μ_e	adjustor		
potcore	type number	colour	fig.
33	P5 056 08	yellow	A
47	P5 056 62	white	B
68	P5 056 62	white	B
100	P5 056 10	brown	A
150	P5 056 98	grey	C
220	P5 056 96	grey	B
330	P5 056 99	black	D

P 42/29

A_L	adjustor		
potcore	type number	colour	fig.
250	P5 056 62	white	B
400	P5 056 10	brown	A
630	P5 056 10	brown	A
1000	P5 056 96	grey	B
1600	P5 056 99	black	D

μ_e	adjustor		
potcore	type number	colour	fig.
68	P5 056 62	white	B
100	P5 056 10	brown	A
150	P5 056 96	grey	B
220	P5 056 96	grey	B
330	P5 056 99	black	D

POTCORES OF THE P-SERIES-P11/7



Pre-adjusted potcores of the μ_e range

Preferred types

μ_e	α_{mH}	tolerance on inductance (%)	potcores assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
15	225	± 1				K3 003 17
22	186	± 1				3 18
33	152	± 1			K3 003 11	3 19
47	127	± 1			3 12	
68	105.8	± 1	K3 002 91	K3 003 01	3 13	
100	87.2	± 1.5	2 92	3 02		
150	71.2	± 2	2 93	3 03		
660	33.9	± 25			3 10	
1300	24.2	± 25	2 90	3 00		

Number of turns for L mH is $N = \alpha\sqrt{L}$
The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		1.8	grams
Mean length of lines of force	l_e	= 1.55	cm
	$\Sigma \frac{l}{A}$	= 9.56	cm^{-1}
Effective volume	V_e	= 0.251	cm^3

Non-preferred types

A_L	corresponding μ -value	tolerance on inductance (%)	potcore assembly number[1]			
			Ferroxcube grade			
			3B7	3H1	3D3	4C4
25	19.0	± 1				K3 006 38
40	30.5	± 1			K3 006 31	K3 006 39
63	48	± 1			K3 006 32	
100	76	± 1	K3 006 21	K3 006 11	K3 006 33	
160	122	± 1.5	K3 006 22	K3 006 12		
250	190	± 3	K3 006 23	K3 006 13		

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2A_L$

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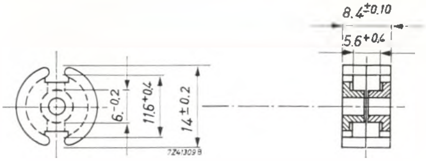
[1] For pre-adjusted potcores provided with the nut 4322 021 31230, the type number should be extended by the addition /01.

POTCORES OF THE P-SERIES-P14/8



Pre-adjusted potcores of the μ_e range.

Preferred types

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
15	205	± 1				K3 002 27
22	169	± 1				2 28
33	137.9	± 1		K3 002 15	K3 002 23	2 29
47	115.5	± 1		2 11	2 21	
68	96.1	± 1	K3 002 02	2 12	2 22	
100	79.2	± 1.5	2 03	2 13		
150	64.6	± 2	2 05	2 14		
220	53.3	± 3	4322 022 02080	2 16		
680	30.3	± 25			2 20	
1400	21.2	± 25	2 00	2 10		

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		3.2	grams
Mean length of lines of force	l_e	$= 1.98$	cm
	$\Sigma \frac{l}{A}$	$= 7.89$	cm^{-1}
Effective volume	V_e	$= 0.495$	cm^3

Non-preferred types

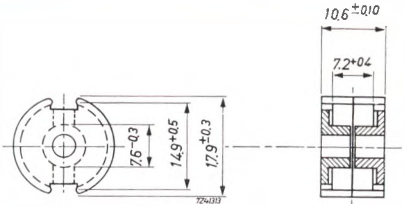
A_L	corresponding μ -value	tolerance on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
25	15.7	± 1				K3 005 77
40	25	± 1			K3 005 71	K3 005 78
63	39.5	± 1			K3 005 72	[2]
100	63	± 1	K3 005 61	K3 005 51	K3 005 73	
160	100.5	± 1.5	K3 005 62	K3 005 52		
250	157	± 2	K3 004 63	K3 005 53		
315	198	± 2		K3 005 54		

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2A_L$

[1] For pre-adjusted potcores provided with the nut 4322 02130140, the type number should be extended by the addition /01.

[2] type number 432202203630

POTCORES OF THE P-SERIES-P18/11



Pre-adjusted potcores of the μ_e range

Preferred types

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
15	178	± 1				K3 002 57
22	147	± 1				2 58
33	120.0	± 1	K3 002 36	K3 002 46	K3 002 51	2 59
47	100.5	± 1	2 31	2 41	2 52	
68	83.6	± 1	2 32	2 42	2 53	
100	68.9	± 1.5	2 33	2 43		
150	56.3	± 2	2 34	2 44		
220	46.5	± 3	2 35	2 45		
705	25.9	± 25			2 50	
1750	16.5	± 25	2 30	2 40		

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight	6.4	grams
Mean length of lines of force	$l_e = 2.58$	cm
	$\Sigma \frac{l}{A} = 5.97$	cm^{-1}
Effective volume	$V_e = 1.12$	cm^3

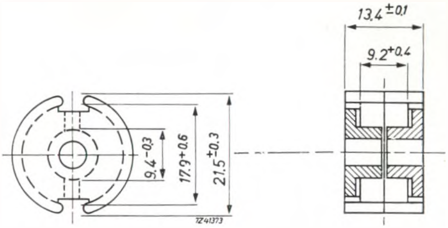
Non-preferred types

A_L	corresponding μ_e-value	tolerance on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
25	11.9	± 1				K3 006 08
40	19.0	± 1			432202205420	K3 006 09
63	30	± 1	432202205030		K3 006 01	432202205030
100	47.5	± 1	432202205040		K3 006 02	
160	76	± 1	K3 005 91	K3 005 81	K3 006 03	
250	119	± 1.5	K3 005 92	K3 005 82		
315	149	± 2		K3 005 84		
400	190	± 2	K3 005 93	K3 005 83		
630	298	± 3		K3 005 85		

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2A_L$

[1] For pre-adjusted potcores provided with the nut 4322 021 30140, the type number should be extended by the addition /01.

POTCORES OF THE P-SERIES-P22/13



Pre-adjusted potcores of the μ_e range

Preferred types

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
15	162	± 1				K3 003 47
22	134	± 1				3 48
33	109.4	± 1			K3 003 41	3 49
47	91.7	± 1			3 42	
68	76.2	± 1	K3 003 21	K3 003 31	3 43	
100	62.8	± 1.5	3 22	3 32		
150	51.3	± 2	3 23	3 33		
220	42.4	± 3	3 24	3 34		
330	34.6	± 3	3 25	3 35		
720	23.4	± 25			3 40	
1840	14.6	± 25	3 20	3 30		

Number of turns for L mH is $N = \alpha \sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		12	grams
Mean length of lines of force	l_e	= 3.15	cm
	$\Sigma \frac{l}{A}$	= 4.97	cm^{-1}
Effective volume	V_e	= 2.00	cm^3

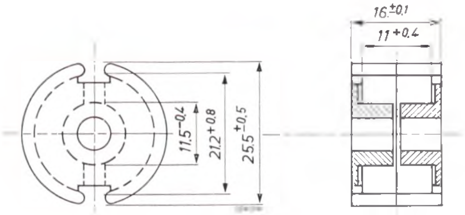
Non-preferred types

A_L	corresponding μ_e-value	tolerances on inductance (%)	potcore assembly number[1]			
			ferroxcube grade			
			3B7	3H1	3D3	4C4
40	15.8	± 1				K3 007 28
63	25	± 1			K3 007 21	K3 007 29
100	39.5	± 1	K3 007 15		K3 007 22	
160	63.5	± 1	K3 007 11	K3 007 01	K3 007 23	
250	99	± 1.5	K3 007 12	K3 007 02		
400	158	± 2	K3 007 13	K3 007 03		
630	249	± 3	K3 007 14	K3 007 04		

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2 A_L$

[1] For pre-adjusted potcores provided with the nut 4322 021 30150, the type number should be extended by the addition /01.

POTCORES OF THE P-SERIES-P26/16



Pre-adjusted potcores of the μ_e range.
Preferred types.

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1] ferroxcube grade 3B7	3H1	3D3	4C4
15	146	± 1				K3 002 87
22	120	± 1				2 88
33	98.2	± 1	K3 002 61	K3 002 71	K3 002 81	2 89
47	82.3	± 1	2 62	2 72	2 82	
68	68.4	± 1	2 63	2 73	2 83	
100	56.4	± 1.5	2 64	2 74		
150	46.1	± 2	2 65	2 75		
220	38.1	± 3	2 66	2 76		
330	31.0	± 3	2 67	2 77		
730	20.8	± 25			2 80	
1910	12.9	± 25	2 60	2 70		

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		20 grams
Mean length of lines of force	l_e	= 3.76 cm
	$\Sigma \frac{l}{A}$	= 4.00 cm^{-1}
Effective volume	V_e	= 3.53 cm^3

Non-preferred types

A_L	corresponding μ_e-value	tolerances on inductance (%)	potcore assembly number[1] ferroxcube grade 3B7	3H1	3D3	4C4
63	20	± 1				K3 006 68
100	31.8	± 1			K3 006 61	K3 006 69
160	51	± 1			K3 006 62	
250	79.5	± 1	K3 006 51	K3 006 41	K3 006 63	
400	127	± 2	K3 006 52	K3 006 42		
630	200	± 3	K3 006 53	K3 006 43		
1000	318	± 3	K3 006 54	K3 006 44		

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2 A_L$

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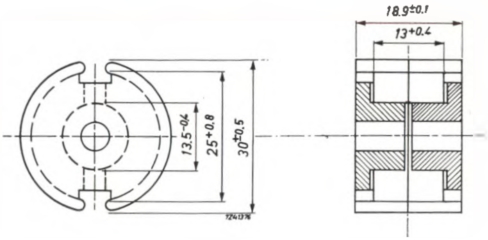
[1] For pre-adjusted potcores provided with the nut 4322 021 30160, the type number should be extended by the addition /01.

POTCORES OF THE P-SERIES-P30/19



Pre-adjusted potcores of the μ_e range
Preferred types.

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]		
			ferroxcube grade		
			3B7	3H1	3D3
33	89.2	± 1			K3 003 73
47	74.7	± 1			K3 003 71
68	62.1	± 1	K3 003 51	K3 003 61	K3 003 72
100	51.3	± 1.5	K3 003 52	K3 003 62	
150	41.8	± 2	K3 003 53	K3 003 63	
220	34.6	± 3	K3 003 54	K3 003 64	
330	28.2	± 3	K3 003 55	K3 003 65	
1990	11.5	± 25	K3 003 50	K3 003 60	
740	18.9	± 25			K3 003 70

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		34	grams
Mean length of lines of force	l_e	= 4.52	cm
	$\Sigma \frac{l}{A}$	= 3.30	cm^{-1}
Effective volume	V_e	= 6.19	cm^3

Non-preferred types

A_L	corresponding μ_e-value	tolerance on inductance (%)	potcore assembly number[1]		
			ferroxcube grade		
			3B7	3H1	3D3
100	26.2	± 1			K3 005 41
160	42	± 1			K3 005 42
250	65.5	± 1	K3 005 31	K3 005 21	K3 005 43
400	106	± 1.5	K3 005 32	K4 005 22	
630	165	± 2	K3 005 33	K3 005 23	
1000	263	± 3	K3 005 34	K3 004 24	
1600	420	± 3	K3 005 35	K3 005 25	

A_L is the inductance per turn in nanohenrys (10^{-9}H), $L_{nH} = N^2A_L$

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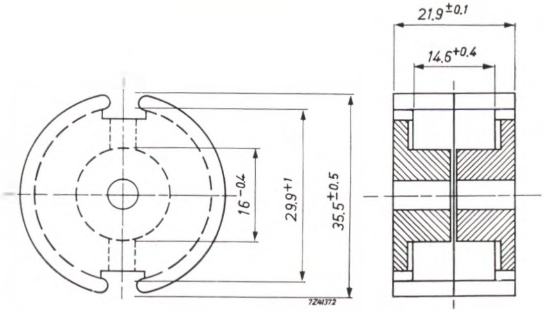
[1] For pre-adjusted potcores provided with the nut 4322021 30160, the type number should be extended by the addition /01, e.g. K3 005 41/10.

POTCORES OF THE P-SERIES-P36/22



Pre-adjusted potcores of the μ_e range

Preferred types.

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]		
			ferroxcube grade		
			3B7	3H1	3D3
33	79.7	± 1			K3 004 11
47	66.8	± 1			K3 004 12
68	55.6	± 1	K3 003 81	K3 003 91	K3 004 13
100	45.8	± 1.5	K3 003 82	K3 003 92	
150	37.4	± 2	K3 003 83	K3 003 93	
220	30.9	± 3	K3 003 84	K3 003 94	
330	25.2	± 3	K3 003 85	K3 003 95	
750	16.7	± 25			K3 004 10
2030	10.2	± 25	K3 003 80	K3 003 90	

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight		74	grams
Mean length of lines of force	l_e	= 5.32	cm
	$\Sigma \frac{l}{A}$	= 2.64	cm^{-1}
Effective volume	V_e	= 10.7	cm^3

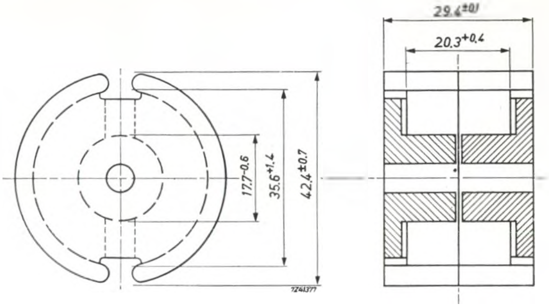
Non-preferred types

A_L	corresponding μ_e-value	tolerance on inductance (%)	potcore assembly number[1]		
			ferroxcube grade		
			3B7	3H1	3D3
160	33.6	± 1			K3 006 91
250	52.5	± 1	K3 006 81	K3 006 71	K3 006 92
400	84	± 1.5	K3 006 82	K3 006 72	K3 006 93
630	132	± 2	K3 006 83	K3 006 73	
1000	210	± 3	K3 006 84	K3 006 74	
1600	336	± 3	K3 006 85	K3 006 75	

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2A_L$

[1] For pre-adjusted potcores provided with the nut 4322 021 30160, the type number should be extended by the addition /01.

POTCORES OF THE P-SERIES-P42/29



Pre-adjusted potcores of the μ_e range.

Preferred types.

μ_e	α_{mH}	tolerance on inductance (%)	potcore assembly number[1]	
			ferroxcube grade	
			3B7	3H1
33	78.4	± 1	–	–
47	65.7	± 1	–	–
68	55.0	± 1	–	K3 004 35
100	45.0	± 1.5	K3 004 21	K3 004 31
150	36.8	± 2	K3 004 22	K3 004 32
220	30.4	± 3	K3 004 23	K3 004 33
330	24.8	± 3	K3 004 24	K3 004 34
2120	9.85	± 25	K3 004 20	K3 004 30

Number of turns for L mH is $N = \alpha\sqrt{L}$

The inductance will only be within the guaranteed limits if the winding space of the coil former is completely filled with the number of turns determining the desired inductance.

Approximate weight 104 grams

Mean length of lines of force $l_e = 6.86$ cm

$$\Sigma \frac{l}{A} = 2.59 \text{ cm}^{-1}$$

Effective volume $V_e = 18.2$ cm³

Non-preferred types

A_L	corresponding μ_e-value	tolerance on inductance (%)	potcore assembly number[1]		
			ferroxcube grade		
			3B7	3H1	3B5
250	51	± 1	K3 007 41	K3 007 31	K3 007 51
400	81	± 1	K3 007 42	K3 007 32	K3 007 52
630	130	± 2	K3 007 43	K3 007 33	K3 007 53
1000	205	± 3	K3 007 44	K3 007 34	K3 007 54
1600	325	± 3	K3 007 45	K3 007 35	K3 007 55

A_L is the inductance per turn in nanohenry (10^{-9}H), $L_{nH} = N^2A_L$

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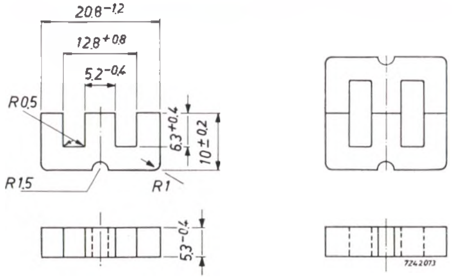
[1] For pre-adjusted potcores provided with the nut 4322 021 30160, the type number should be extended by the addition /01.

FERROXCUBE E-CORE-E20/10/5 (E20)



Preferred type

The dimensions are according to German specification D.I.N. 41295.

Ferroxcube grade	3E1
Approximate weight	4 grams
Type number of E-core	56 907 45/3E1

A transformer core can be built up by combining an even number of E-cores. A shape that is often chosen is the shell type transformer 20/20/5 composed of two cores type E 20/10/5.

shell type transformer			**20/20/5**	
Dimensional quantities:				
mean length of lines of force	l_e	=	4.28	cm
	$\Sigma \frac{l}{A}$	=	13.7	cm^{-1}
effective volume	V_e	=	1.34	cm^3
Electrical properties:				
at $\Delta = 0$	μ_e	=	1650–2760	
	A_L	=	1515–2520	
	α	$\leq$	25.7	
at 23 + 10 °C between 15 and 30 gauss	$q_{2-24-100}$	$\leq$	7	$\Omega/(\text{H}^{3/2}.\text{mA})$

Mechanical pressure at which the electrical properties are determined is 5.5 kg.

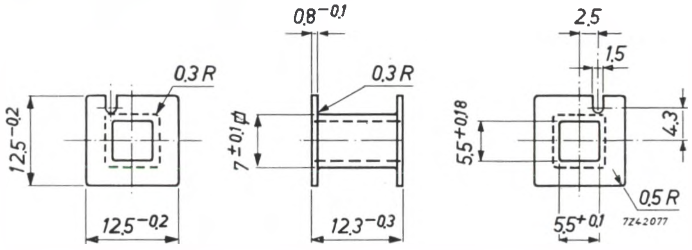
Number of turns for L_{mH}: $N = \alpha \sqrt{L}$.

The following E-core can be delivered with an air gap (ground in each E-core):

type number	*air gap length in mm*
5690746/3E1	0.15 ± 0.015

FERROXCUBE E-CORE-E20/10/5 (E20)

Coil former for shell type transformer 20/20/5 (M20)

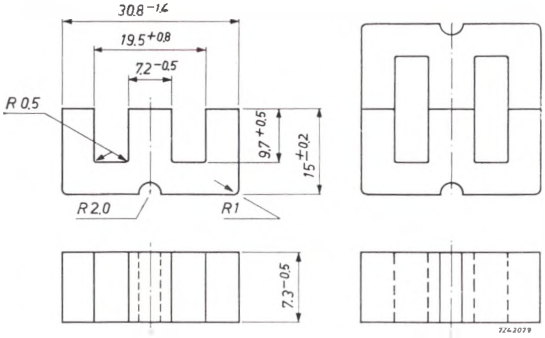


type number	VA 901 01
material	Philite
minimum window area in mm²	27
mean length of turn in cm	3.8
approximate weight in grams	0.5
maximum temperature in °C	130

The dimensions are practically according to German specification D.I.N. 41303.
The material is according to German specification D.I.N. 7708 Typ 31.5.

FERROXCUBE E-CORE-E30/15/7 (E30)

Preferred type



The dimensions are according to German specification D.I.N. 41295.

Ferroxcube grade 3E1

Approximate weight 11 grams

Type number of E-core 56 907 47/3E1

A transformer core can be built up by combining an even number of E-cores. A shape that is often chosen is the shell type transformer 30/30/7 composed of two cores type E 30/15/7.

shell type transformer **30/30/7**

Dimensional quantities:

mean length of lines of force $l_e = 6.69$ cm

$\Sigma \frac{l}{A} = 11.2$ cm^{-1}

effective volume $V_e = 4.00$ cm^3

Electrical properties:

at $\Delta = 0$

$\mu_e = 1795–2990$

$A = 2010–3350$

$\alpha \leq 22.3$

at 23 ± 10 °C between 15 and 30 gauss $q_{2-24-100} \leq 7$ $\Omega/H^{3/2}$.mA)

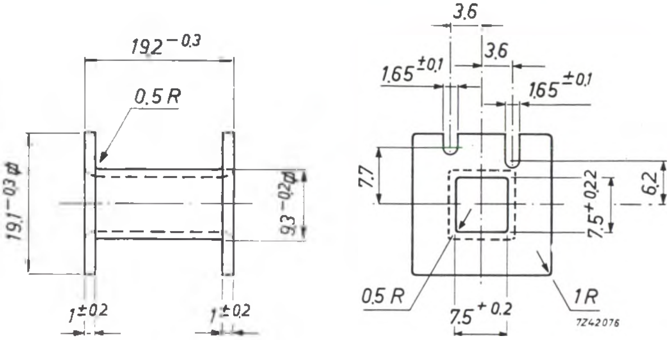
Mechanical pressure at which the electrical properties are determined is 11 kg.

Number of turns for L_{mH}: $N = \alpha \sqrt{L}$.

The following E-cores with an air gap (ground in each E-core) can be delibered:

type number	*air gap length in mm*
5690748/3E1	0.15 ± 0.015
4322 020 34660	0.30 ± 0.015

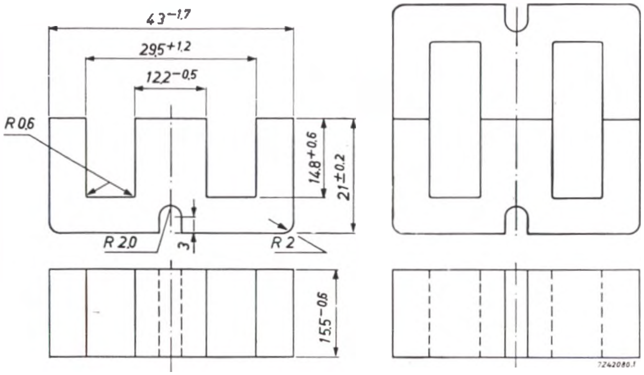
Coil former for shell type transformer 30/30/7 (M30)



type number	VA 901 11
material	Philite
minimum window are in mm²	80
mean length of turn in cm	5.6
approximate weight in grams	1.3
maximum temperature in °C	130

The dimensions are practically according to German specification D.I.N. 41303.
The material is according to German specification D.I.N. 7708 Typ 31.5.

FERROXCUBE E-CORE-E42/21/15 (E42)



Preferred type

The dimensions are according to German specification D.I.N. 41295.

Ferroxcube grade	3E1
Approximate weight	42 grams
Type number of E-core	5690749/3E1

A transformer core can be built up by combining an even number of E-cores. A shape that is often chosen is the shell type transformer 42/42/15 composed of two cores type E 42/21/15.

shell type transformer **42/42/15**

Dimensional quantities:

mean length of lines of force $l_e = 9.70$ cm

$\Sigma \frac{l}{A} = 5.34$ cm^{-1}

effective volume $V_e = 17.6$ cm^3

Electrical properties:

at $\Delta I = 0$ $\mu_e = 1910\text{–}3140$

$A_L = 4425\text{–}7380$

$\alpha \leq 15.0$

at 23 ± 10 °C between 15 and 30 gauss $q_{2-24-100} \leq 7$ $\Omega/(H^{3/2}.mA)$

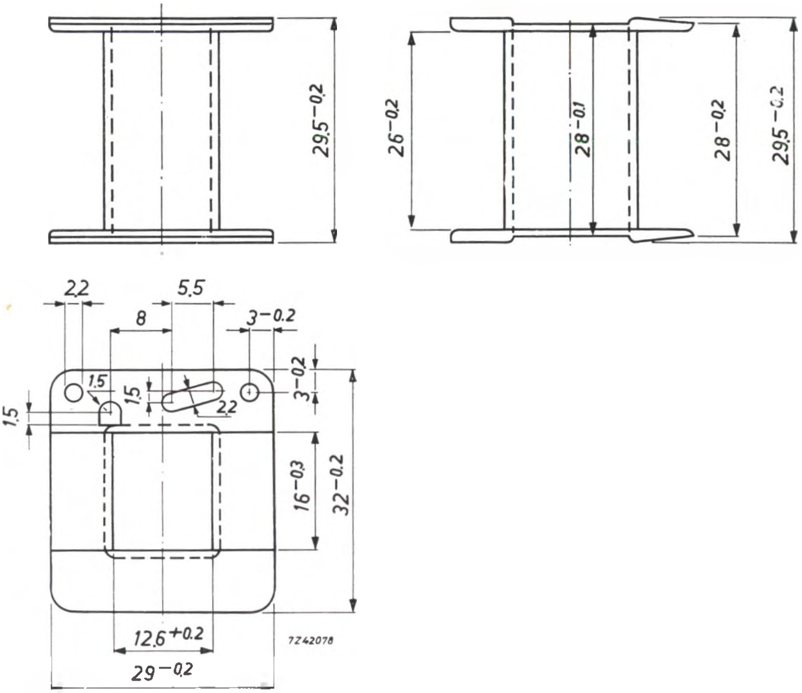
Mechanical pressure at which the electrical properties are determined is 28 kg.

Number of turns for L_{mH}: $N = \alpha \sqrt{L}$.

The following E-cores can be delivered with an air gap (ground in each E-core)

type number	*air gap length in mm*
5690750/3E1	0.25 ± 0.015
5690751/3E1	0.5 ± 0.015

Coil former for shell type transformer 42/42/15/(M42)

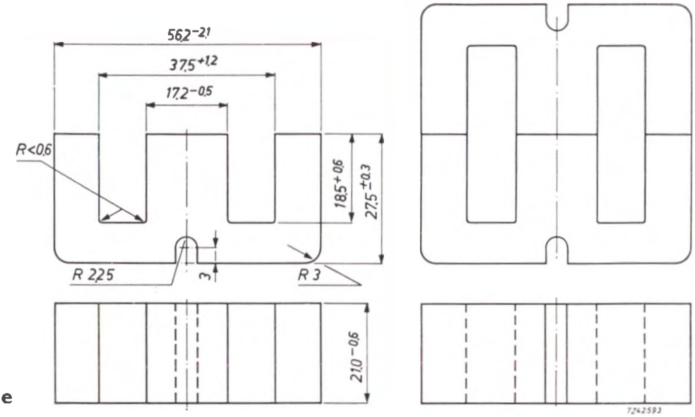


type number	VA 901 21
material	Philite
minimum window area in mm²	178
mean length of turn in cm	9.3
approximate weight in grams	4
maximum temperature in °C	130

The dimensions are practically according to German specification D.I.N. 41303.
The material is according to German specification D.I.N. 7708 Typ 31.5.

FERROXCUBE E-CORE-E55/28/21 (E55)

Preferred type



The dimensions are according to German specification D.I.N. 41295.

Ferroxcube grade	3E1
Approximate weight	115 grams
Type number of E-core	K5 401 25

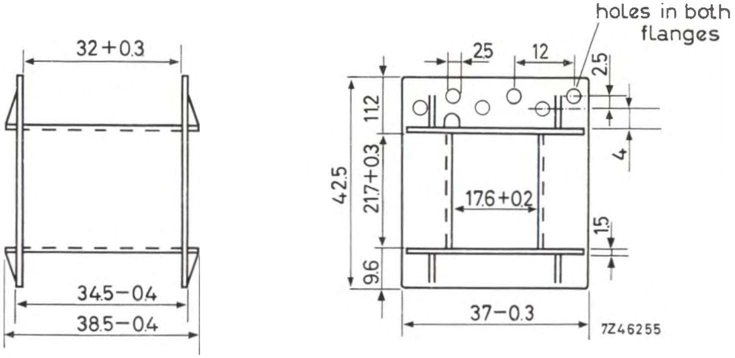
A transformer core can be built up by combining an even number of E-cores. A shape that is often chosen is the shell type transformer 55/55/21 composed of two cores type E55/28/21.

shell type transformer			**55/55/21**	
Dimensional quantities:				
mean length of lines of force	l_e	$=$	12.3	cm
	$\Sigma \frac{l}{A}$	$=$	3.48	cm^{-1}
effective volume	V_e	$=$	43.7	cm^3
Electrical properties:				
at $\Delta l = 0$	μ_e	$=$	1950– 3250	
	A_L	$=$	7050–11700	
	α	$\leq$	11.9	
at 25 ± 10 °C between 15 and 30 gauss	$q_{2-24-100}$	$\leq$	4	$\Omega/(H^{3/2}.mA)$

Mechanical pressure at which the electrical properties are determined is 55 kg.

Number of turns for L_{mH}: $N = \alpha\sqrt{L}$.

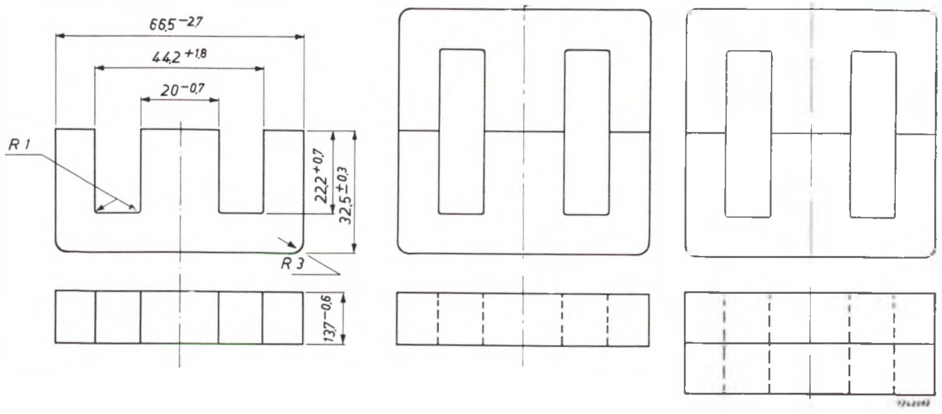
Coil former for shell type transformer 55/55/21



type number	*VA 901 36*
material	*Hostalene PPN*
minimum window are in mm²	250
mean length of turn in cm	11.6
approximate weight in grams	9
maximum temperature in °C	100

The dimensions are according to German specification D.I.N. 41303.

FERROXCUBE E-CORE-E55/32/13 (E65)



Preferred type

The dimensions are according to German specification D.I.N. 41295.

Ferroxcube grade	3E1
Approximate weight	76 grams
Type number of E-core	K5 400 60

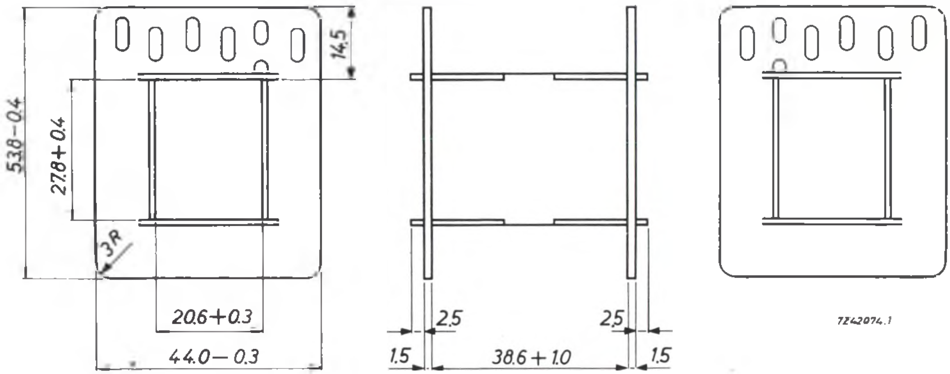
A transformer core can be built up by combining an even number of E-cores. Shapes that are often chosen are the shell type transformers 65/65/13 composed of two cores type E65/32/13, and 65/65/27 composed of four cores type E65/32/13.

shell type transformer			**65/65/13**	**65/65/27**	
Dimensional quantities:					
mean length of lines of force	l_e	=	14.7	14.7	cm
	$\Sigma \frac{l}{A}$	=	5.51	2.75	cm^{-1}
effective volume	V_e	=	39.1	78.2	cm^3
Electrical properties:					
at $\Delta = 0$	μ_e	=	1980–3290	1835–3050	
	A_L	=	4500–7500	8400–14000	
	α	≤	14.9	≤ 10.9	
at 23 ± 10 °C between 15 and 30 gauss	$q_{2-24-100}$	≤	7		$\Omega/(H^{3/2}.mA)$

Mechanical pressure at which the electrical properties are determined is 40 kg.

Number of turns for L_{mH}: $N = \alpha\sqrt{L}$.

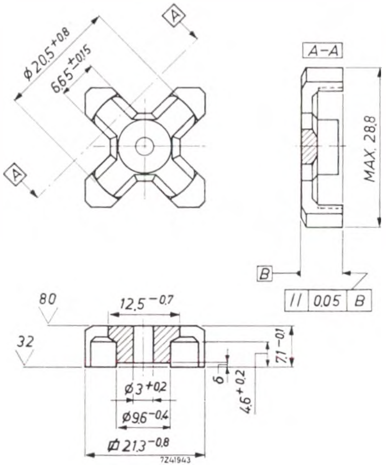
Coil former for shell type transformer 65/65/27 (M65)



type number	VA 901 31
material	fuller board
minimum window area in mm²	394
mean length of turn in cm	15
approximate weight in grams	13
maximum temperature in °C	130

The coil former is according to German specification D.I.N. 41304; it is delivered in parts.

FERROXCUBE CROSS CORES - X22



These cores have been developed especially for transformers to be mounted on printed-wiring boards. Two versions of core halves can be supplied:

(1) without an air gap, and

(2) with air gap. Standardised air gap lengths in each core half are: 0.02, 0.05, 0.15 and 0.25 mm.

The material grades are ferroxcube 3H1, 3E1 and 4C4.

When ordering, the desired core half should be indicated by its type number.

The numbers for separate core halves are:

K5 351 90 for fxc 3E1
K5 351 92 for fxc 3H1
K5 351 93 for fxc 4C4

They are supplied without air gap.

For the combination of two cross-core halves, chosen at random from a lot, the following properties are guaranteed at 25 ± 10 °C.

	$\hat{B}$ (gauss)	frequency (kc/s)	type number		
			K5 351 90	K5 351 92	K5 351 93
μ_e	≤ 1	4	≥ 1490	≥ 1440	≥ 98
α	≤ 1	4	≤ 17.5	≤ 17.8	≤ 68.0
$\frac{\tan\delta}{\mu_i}$	≤ 1	4		$\leq 1.2 \times 10^{-6}$	
	≤ 1	100		$\leq 5 \times 10^{-6}$	
	≤ 1	2000			$\leq 40 \times 10^{-6}$
	≤ 1	5000			$\leq 60 \times 10^{-6}$
	≤ 1	10,000			$\leq 100 \times 10^{-6}$
$q_{2-24-100}$	15–30	4	≤ 6	≤ 1.8	

The mechanical pressure at which above mentioned values are determined is 12 kg.

FERROXCUBE CROSS CORES - X22

The following X-core halves are available with an air gap:

type number	*material*	*air gap length in mm*
K5 352 53	3H1	0.02 ± 0.01
K5 352 50	3H1	0.05 ± 0.015
K5 352 51	3H1	0.15 ± 0.015
K5 352 52	3H1	0.25 ± 0.015

Approximate weight of two halves 12 grams

Mean length of lines of force $l_e = 3.80$ cm

$A_e = 1.23$ cm²

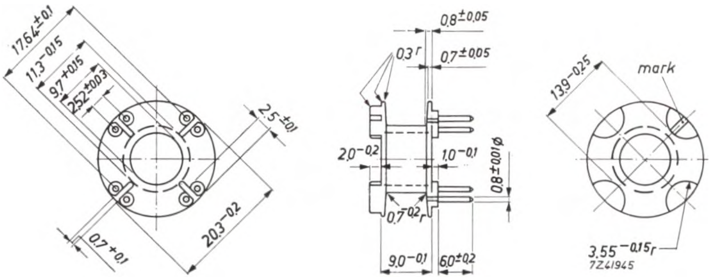
$\Sigma \frac{l}{A} = 5.75$ cm⁻¹

effective volume $V_e = 2.51$ cm³

This X-core meets the following specifications:

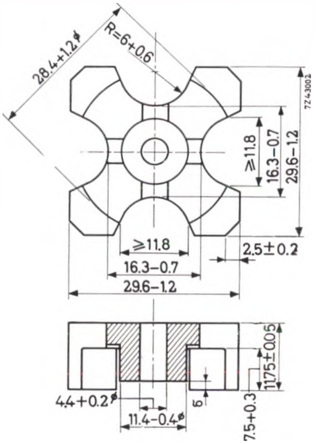
International: I.E.C
France: C.C.T.U. 06 – 10
Germany: D.I.N. 41299

COIL FORMER - X22



type number	*VA 901 54*
Material	reinforced polyester
Window area in mm²	33.5
Mean length of turn in cm	4.9
Max temperature for dipsoldering during 5–6 sec in °C	280
Max working temperature in °C	130
Force for pulling out pins during 1 min at 25 °C in kg	≥ 1.5
Max test voltage (50 c/s) between pins during 2 min in V_{rms}	500

FERROXCUBE CROSS CORES - X30



These cores have been developed especially for transformers to be mounted on printed-wiring boards. Two versions of core halves can be supplied:

1) without air gap
2) with air gap

Standardized air gap lengths in each core half are: 0.02, 0.05, 0.15 and 0.25 mm. The material grade is fxc 3H1
When ordering, the desired core half should be indicated by its type number.
The type number for the separate core half without air gap is:

K5 352 55 for fxc 3H1

For the combination of two cross-core halves, chosen at random from a lot, the following properties are guaranteed at 25 ± 10 °C.

	$\hat{B}$ (gauss)	*frequency* (kc/s)	*type number*
			K5 352 55
μ_e	≤ 1	4	≥ 1525
α	≤ 1	4	≤ 15.9
$\frac{\tan\delta}{\mu_i}$	≤ 1	4	$\leq 1.2 \times 10^{-6}$
	≤ 1	100	$\leq 6 \times 10^{-6}$
$q_{2-24-100}$	15–30	4	≤ 1.8

The mechanical pressure at which above mentioned values are determined is 25 kg.

FERROXCUBE CROSS CORES - X30

The following X-core halves are available with an air gap:

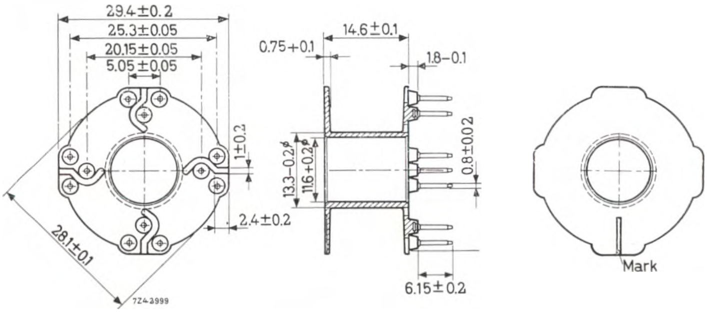
type number	*material*	*air gap length in mm*
K5 352 65	3H1	0.02 ± 0.01
K5 352 66	3H1	0.05 ± 0.015
K5 352 67	3H1	0.15 ± 0.015
K5 352 68	3H1	0.25 ± 0.015

Approximate weight of two halves		38 grams
Mean length of lines of force	l_e =	5.58 cm
	A_e =	1.14 cm^2
	$\Sigma \frac{l}{A}$ =	4.90 cm^{-1}
effective volume	V_e =	6.36 cm^3

This X-core meets the following specifications:

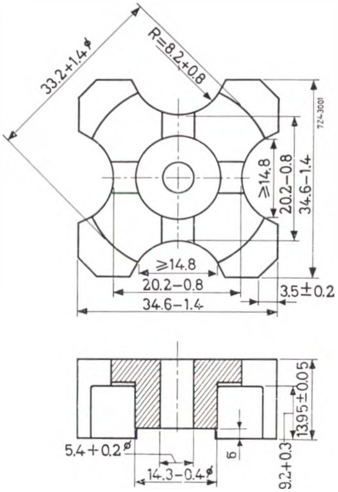
International: I.E.C.
France : C.C.T.U. 06 – 10
Germany : D.I.N. 41299

COIL FORMER - X30



type number	*P4 057 50*
Material	reinforced polyester
Window area in mm^2	97
Mean length of turn in cm	6.5
Max temperature for dipsoldering during 5–6 sec in °C	280
Max working temperature in °C	130
Force for pulling out pins during 1 min at 25 °C in kg	$\geq$2
Max test voltage (50c/s) between pins during 2 min in V_{rms}	$\geq$2000

FERROXCUBE CROSS CORES - X35



These cores have been developed especially for transformers to be mounted on printedwiring boards. Two versions of core halves can be supplied:

1) without air gap
2) with air gap

Standardized air gap lengths in each core half are: 0.02, 0.05, 0.15 and 0.25 mm.

The material grade is fxc 3H1
When ordering, the desired core half should be indicated by its type number.
The type number for the separate core half without air gap is:

K5 352 60 for fxc 3H1

For the combination of two cross-core halves, chosen at random from a lot, the following properties are guaranteed.

	$\hat{B}$ (gauss)	*frequency* (kc/s)	*type number*
			K5 352 60
μ_e	≤ 1	4	≥ 1580
α	≤ 1	4	≤ 14.4
$\frac{\tan\delta}{\mu_i}$	≤ 1	4	$\leq 1.2 \times 10^{-6}$
	≤ 1	100	$\leq 7 \times 10^{-6}$
$q_{2-24-100}$	15–30	4	≤ 1.8

The mechanical pressure at which above mentioned values are determined is 33 kg.

FERROXCUBE CROSS CORES - X35

The following X-core halves are available with an airgap:

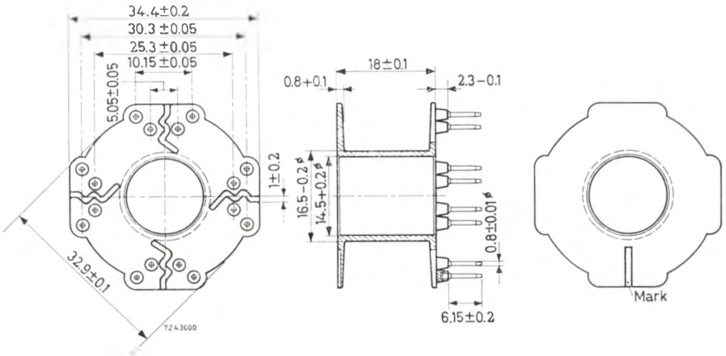
type number	*material*	*air gap length in mm*
K5 352 70	3H1	0.02 ± 0.01
K5 352 71	3H1	0.05 ± 0.015
K5 352 72	3H1	0.15 ± 0.015
K5 352 73	3H1	0.25 ± 0.015

Approximate weight of two halves		58 grams
Mean length of lines of force	l_e =	6.73 cm
	A_e =	1.64 cm^2
	$\Sigma \frac{l}{A}$ =	4.10 cm^{-1}
effective volume	V =	11.0 cm^3

This X-core meets the following specifications:

International: I.E.C
France : C.C.T.U. 06 – 10
Germany : D.I.N. 41299

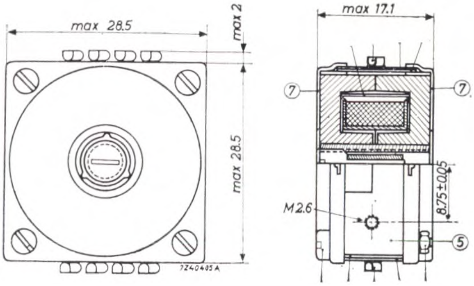
COIL FORMER - X85



type number	*P4 057 51*
Material	reinforced polyester
Window area in mm^2	134
Mean length of turn in cm	7.75
Max temperature for dipsoldering during 5–6 sec in °C	280
Max working temperature in °C	130
Force for pulling out pins during 1 min at 25 °C in kg	≥ 2
Max test voltage (50c/s) between pins during 2 min in V_{rms}	≥ 2000

POTCORES OF THE S-SERIES

Pre-adjusted types



Type S25/16

type of potcore	application	grade of ferroxcube	effective permeability (μ_e)	number of turns for 1mH (α)	tolerance on inductance (%)	type number
S14/8	pulse coils; transformers	3E1	1230	21.4	±25	K3 000 29
		3B1	600	30.6	±25	40
		3B1	74	85	±3	41
	coils in filters and equalizers	3B1	49	106	±2	42
		3B1	36	122.5	±2	43
		3B1	29.5	135	±2	44
	pulse coils; transformers	4B1	225	48.5	±25	K3 000 30
		4B1	55.6	94.4	±3	31
	coils in filters and equalizers	4B1	35.9	115.2	±2	32
		4B1	29	128.5	±2	33
		4B1	23.9	141.4	±2	34
	pulse coils; transformers	4C1	128	64.5	±25	K3 000 35
		4C1	51.5	102	±3	36
	coils in filters and equalizers	4C1	34.4	118	±2	37
		4C1	27.1	133	±2	38
		4C1	23.1	144	±2	39
S18/12	transformers	3E1	1700	19.1	±25	K3 000 48
		3B2	160	64	±2.5	87
		3B2	100	79	±2	49
	filter coils and chokes	3B2	65	96	±1	46
		3B3	46	113	±1.5	47
		3B3	28.5	142	±1.5	45
S25/16	chokes and transformers	3E1	1860	14.2	±25	K3 000 60
		3B2	150	49	±3	61
		3B2	100	60	±2.5	62
		3B2	80	67	±2	63
	filter coils and chokes	3B3	60	77.5	±1.5	64
		3B3	45	89.4	±1	65
		3B3	20	134	±1	66

POTCORES OF THE S-SERIES

Pre-adjusted types

type of potcore	*main application*	*grade of ferroxcube*	*effective permeability (μ_e)*	*number of turns for 1mH (α)*	*tolerance on inductance (%)*	*type number*
S35/23	chokes and transformers	3E1	2250	9.7	±25	K3 001 06
		3B5	200	32	±3	04
		3B5	150	37	±2	03
	loading coils and chokes	3B5	125	41	±2	02
		3B5	100	46	±1.5	01
		3B5	80	51	±1	00
S45/25	chokes and transformers	3E1	2420	8.65	±25	K3 001 26
		3B5	1330	11.5	±25	25
		3B5	200	30	±3	24
		3B5	160	33	±1.5	23
	loading coils and chokes	3B5	125	38	±1.5	22
		3B5	100	42.5	±1.5	21
		3B5	80	47.5	±1	20

HALF-CORE TYPES OF THE S-SERIES (preferred types)

These core halves are supplied only without an air gap.
Two parts are required for one complete core.

core type	*type number*	*core type*	*type number*
S14/8 –3B1	56 580 06/3B1	S25/16–3B2	56 580 40/3B2
–3E1	K5 351 25	–3B3	56 580 40/3B3
		–3E1	K5 350 00
		S35/23–3B5	K5 350 20
S18/12–3B2	56 580 34/3B2	–3E1	K5 350 21
–3B3	56 580 34/3B3		
–3E1	K5 350 66	S45/25–3B5	K5 350 55
		–3E1	K5 350 56
		S66/56–3E1	K5 350 11

POTCORES OF THE D-SERIES

Still available, details on request

H-SERIES FOR MINIATURIZED TRANSFORMERS - MATERIAL GRADE 3E2

According to the construction, two kinds of transformer should be distinguished:

> those whose coils are wound around the core, and those where separately wound coils are applied to the core.

Toroidal transformers and items made of two-hole beads belong to the first kind, and E and U cores are used for the second one.

A toroid is the most simple form of a coil, and the absence of an air gap allows the full profit of the permeability. In the second case, well-defined windings can be made even automatically, and the wire leads can be directly connected to tags on the coil former.

When ferrites came into use, at first the existing core shapes were taken over, but soon round legs were introduced. Later on, also potcores were used for transformers. The printed-wiring technique led to arranging every component in a rectangular space. To utilize that space to the full, transformers should be designed so as to fill the entire space with core material, copper, insulating material and mounting parts, and this brought us to FXC cross and butterfly cores.

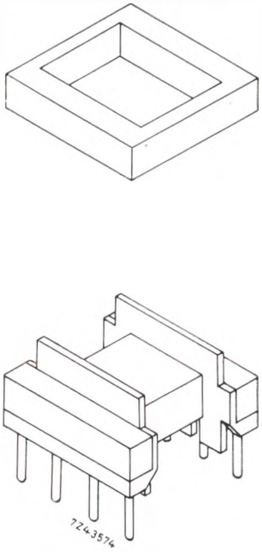


Fig. 1

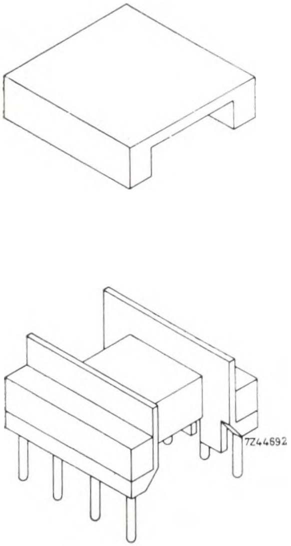


Fig. 2

H-SERIES FOR MINIATURIZED TRANSFORMERS – MATERIAL GRADE 3E2

Technical data

The overall dimensions and the pattern of connections of the three core types indicated above are shown in Figs 3, 4 and 5.

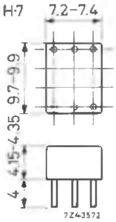


Fig. 3

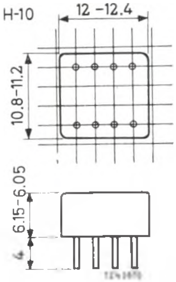


Fig. 4

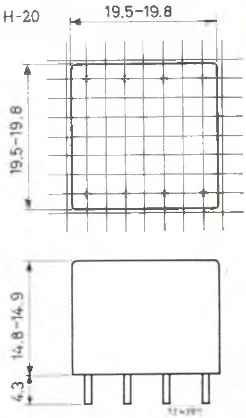


Fig. 5

The dimensions are valid for the cores assembled with the screening cans. If the requirements for the cross talk attenuation are moderate or low the cores may be used without screen.

Information for the calculation of transformers as well as typical examples of applications are supplied on request.

Assembly

As mentioned above, the number of component parts has been reduced to the bare minimum. With two parts in all a complete transformer can be produced ready for mounting on a printed circuit. The screening can (Fig. 8) for meeting severe cross talk requirements adds up to three parts:

1. fxc 3E2 H-shaped part moulded in a coil former with terminals
2. fxc 3E2 rectangular window for the H7 and H10 core (Fig. 1 and 6) or a U-shaped part for the H20 core (Fig. 2 and 7)
3. brass screening can

When the winding space has been used completely, it is advised to apply an insulating washer in the screen.

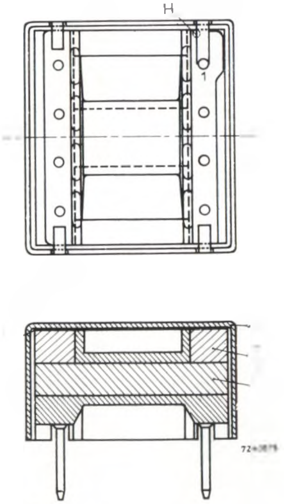


Fig. 6

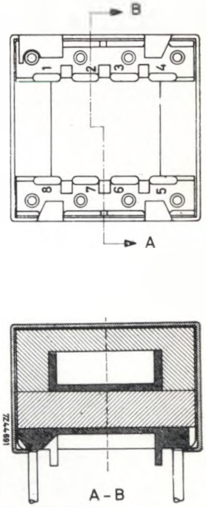


Fig. 7

H-SERIES FOR MINIATURIZED TRANSFORMERS – MATERIAL GRADE 3E2

The assembly operation is very simple indeed:

1. wind the copper wire on the H part. For speeding up the soldering operation of the winding wire to the terminals, the use of self fluxing wire is advised. In case a terminal of the winding must be connected to the screening can it should be soldered to tag 1. The side of the coil former where the soldering tags protrude is asymmetrical providing a means for numbering the connections (see Fig. 6 and 7);
2. take care that the joining surfaces of the two core parts are clean and free from dust;
3. place the 0 part respectively U part on top of the H under slight pressure;
4. apply a suitable adhesive in the four corners of the H7 and H10 core near the contact surface of H and O, for the H-U construction apply the adhesive around the joint of the assembled H and U. Remove the pressure after the curing of the adhesive.
   The spots where the adhesive is to be applied should be degreased thoroughly.
   As a suitable adhesive for instance Araldite, type D with harder type HY 951 may be used (1 part harder to 12.5 parts Araldite D).
   The curing time should not be less than 15 hours at room temperature. This time may be shortened at higher temperatures. Reference should be made to the instructions issued by the manufacturers of adhesives.
5. in case a can is used (for H10 see Fig. 8) place the core assembly in the can in such a way that the marked pin 1 is situated over the hole H in the bottom of the can (Figs. 6 and 7).
   When the screen must be connected to earth fold-over the four ears and solder the longest ear to pin 1. When the screen must not be connected to earth before folding over, cut off approximately 1 mm from the longest ear.

When the screening can is properly placed on the assembled core, terminal 1 is located near hole H in the can (see Figs. 6 and 7); this facilitates the correct positioning of the transformer during assembling the equipment in which the transformer is used.

The coil former material withstands the usual dipsoldering temperatures.

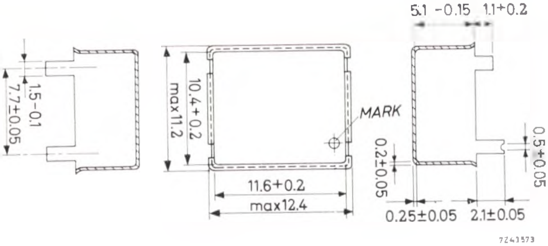


Fig. 8

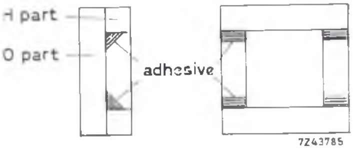


Fig. 9

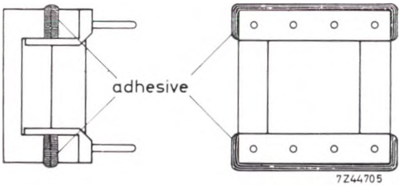


Fig. 10

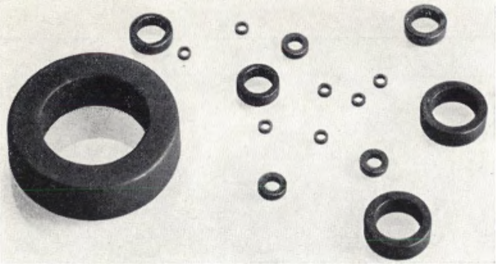
H-SERIES FOR MINIATURISED TRANSFORMERS – MATERIAL GRADE 3E2

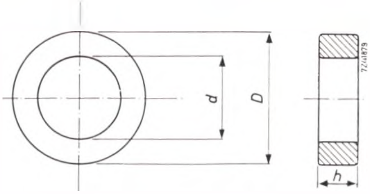
Available types

		H7	*H10*	*H20*
$(\Sigma l/A)$ core	(cm^{-1})	53	30	8.8
$(\Sigma l/A)$ coil	(cm^{-1})	35	26	11.6
A_L	(nH/H^2)	min. 700	min. 1,600	min. 5,500
Number of tags		6	8	8
Tag distance		0.1″	0.1″	0.2″
Area occupied	(mm^2)	max. 10×7.4	max. 12.4×11.2	max. 19.9×19.9
Height	(mm)	4.4	6.2	15.2

description	*type*	*type number*
complete assembly	H7	4322 020 33020
complete assembly	H10	4322 020 33010
complete assembly	H20	4322 020 33000

FERROXCUBE TOROIDS





Advantages of toroids over other shapes are:

a. small magnetic stray field,

b. high μ-values.

They are very attractive for those applications in which small dimensions are required, such as broadband transformers and pulse transformers.

The toroids are barrel-finished and covered with an insulating lacquer.

Table I: Dimensional quantities, tolerances and weights.

D (mm)	d (mm)	h (mm)	l_e (cm)	$\Sigma \frac{l}{A}$ (cm^{-1})	V_e (cm^3)	weight (grams)
4 ± 0.1	2.2 ± 0.1	1.1 ± 0.1	0.946	95.6	0.00937	0.045
6 ± 0.15	4 ± 0.15	2 ± 0.1	1.55	77.5	0.0310	0.15
9 ± 0.2	6 ± 0.2	3 ± 0.1	2.33	51.7	0.105	0.50
14 ± 0.3	9 ± 0.25	5 ± 0.15	3.55	28.5	0.445	2.14
23 ± 0.5	14 ± 0.35	7 ± 0.2	5.70	18.1	1.79	8.6
29 ± 0.5	19 ± 0.4	7.5 ± 0.2	7.50	20.1	2.58	13
26 ± 0.7	23 ± 0.5	10 ± 0.2	9.20	14.2	5.60	29
36 ± 0.7	23 ± 0.5	15 ± 0.2	9.20	9.42	8.50	44

Note: All dimensions apply to the not lacquered version.

Different series are available:

Series A: Ferroxcube grade 3E1
$\mu_{tor} = 2700 \pm 20\%$
green lacquered

dimensions (mm)	type number
36 × 23 × 10	K3 005 00
36 × 23 × 15	K3 005 01
29 × 19 × 7.5	K3 005 02

Series B: Ferroxcube grade 3H1
Sorted into μ groups
Orange lacquered

dimensions (mm)	type number
4 × 2.2 × 1.1	K3 004 95
6 × 4 × 2	K3 004 96
9 × 6 × 3	K3 004 97
14 × 9 × 5	K3 004 98
23 × 14 × 7	K3 004 99

The colour of the circumference of the core indicates the μ group (see table II)

Table II:

group	μ_{tor}	*colour of circum-ference*	*K3 004 95*	*K3 004 96*	*K3 004 97 α-factors*	*K3 004 98*	*K3 004 99*
1	2000–2200	brown	60.2	54.1	44.3	32.9	26.2
2	2140–2360	red	58.3	52.3	42.8	31.8	25.3
3	2300–2540	orange	56.0	50.3	41.2	30.6	24.4
4	2480–2740	yellow	54.0	48.6	39.8	29.5	23.5
5	2680–2960	green	51.8	46.6	38.2	28.3	22.6
6	2900–3210	blue	49.9	44.8	36.7	27.3	21.7
7	3150–3480	violet	48.0	43.2	35.4	26.2	20.9
8	3420–3780	grey	46.2	41.4	34.0	25.2	20.1
9	3720–4110	white	44.2	39.7	32.5	24.1	19.2
10	>4050	black	43.3	38.9	31.8	23.7	18.8

Number of turns for L_{mH}: $N = \alpha \sqrt{L}$

The μ groups are determined with the nominal $\Sigma \frac{l}{A}$ values (see table I)

The α factors of the groups 1–9 are average values, those of group 10 are maximum values.
D.F. at 23 ± 1 °C $\leq 4.3 \times 10^{-6}$

Between +23 and +70 °C the min. μ_{tor} of the product is greater than the min. μ_{tor} of the group.

The sorting into μ groups is done merely for the convenience of the user. The toroids are not available per separate group.

Series C: Ferroxcube grade 3E2
$\mu_{tor} > 5000$
blue lacquered

dimensions (mm)	*type number*
4 × 2.2 × 1.1	2P 653 29
6 × 4 × 2	2P 653 30
9 × 6 × 3	2P 653 31
14 × 9 × 5	2P 653 33
23 × 14 × 7	2P 653 34

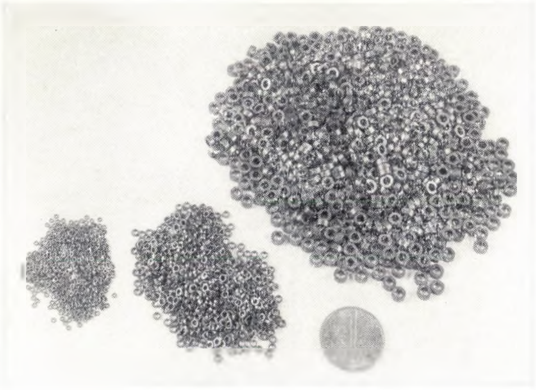
Series D: Ferroxcube grade 4C4
$\mu_{tor} > 100$
red lacquered

dimensions (mm)	*type number*
6 × 4 × 2	2P 653 46
9 × 6 × 3	2P 653 47
14 × 9 × 5	2P 653 48
23 × 14 × 7	2P 653 49
36 × 23 × 15	2P 653 50

Note: It should be noticed that the properties of a toroid will deviate more from the material properties in proportion as its dimensions are smaller.
A straight-forward translation of the material figures is therefore not always possible.

FERROXCUBE 6 (square loop)

MAGNETIC MEMORY CORES



All data-handling systems employ some sort of device for the storage of information. Such a "memory" can accept, store and supply the information at any required moment. For this purpose a magnetic core memory is very often used.

The storage capacity of a magnetic core is the result of its property to assume either of two stable magnetic states. One magnetic state is maintained, until it is made to change into the other.
The main features which can be distinguished are as follows:
1. read/write cycle time of only a few microseconds;
2. random access;
3. the information can be stored for an indefinite period;
4. storage of large quantities of information in a small volume.

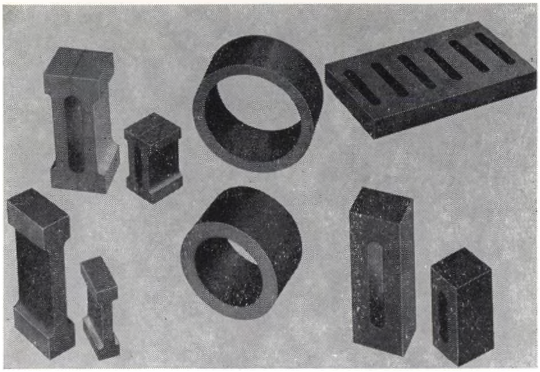
The properties of the cores described below are such that the cores are specially suitable for use in coincident current memories.
We draw your attention to the low temperature coefficient (LTC) cores, the electrical properties of which remain substantially constant over the entire range of operating temperatures.

CORE TYPES

150 mil – 6E1
80 mil – 6B2
50 mil – 6C1, 6C2, 6D5
30 mil – 6F2, 6F3, 6F4

For more information see section B "Electronic building bricks for professional applications".

ULTRASONIC TRANSDUCER – MATERIAL GRADE 7A2



Ultrasonics are more and more applied by all kinds of industries for cleaning and degreasing purposes. Notably watch makers, instrument makers, electron-tube manufacturers, and manufacturers and users of other small components that have intricate shapes or are difficult of access (e.g. hypodermic needles) consider ultrasonic cleaning to be superior to conventional methods. Recent tests showed that, whereas other methods resulted in removal of some 30 to 80% of the adhering dirt, ultrasonic cleaning removed up to 100% of the contamination. Larger machined parts may also be cleaned in this way, e.g. polished lenses and ball bearings, ground ceramic components, etc. In the iron industry ultrasonics can be used for de-rusting steel plates. Other ultra-sound applications are underwater detection (Sonar or Asdic, fishing aids), drilling, welding, destroying of cell membranes or bacteria, etc.

The ultrasonic vibrations are generated by the conversion of H.F. current through electroacoustic transducers. Usually the transducers consist of either piezoelectric or piezomagnetic materials. For piezomagnetic transducers a new grade of ferroxcube has been developed, namely 7A2.

Ferroxcube 7A2 tranducers are best suited for applications in which the temperature is not controlled. This is the case with many modern types of efficient cleaning equipment where the transducers are cemented outside a liquid-filled vessel.

The solid ferroxcube transducers excel by a very high electroacoustic efficiency. If properly mounted they may yield a value of 70 to 85%, whereas the efficiency of laminated metallic piezomagnetic transducers usually does not exceed 35%. This means that for a given acoustic output a smaller, simpler and consequently cheaper electric generator can be used and that the power consumption can be reduced by more than 50%.

The table on page G74 shows the nominal operating frequencies and the physical dimensions of a number of current types of ferroxcube transducers, those on pages G72 and G73 give the main electrical and acoustical properties.

ULTRASONIC TRANSDUCERS – MATERIAL GRADE 7A2

Main properties of the transducers in FXC 7A2

(for drawings see page G 74)	*symbol*	*ring (Fig. 1)*		*window (Fig. 2)*	
low-power data for free transducers					
type number		2P 643 87	2P 644 45	K5 550 05	K5 550 11
ampere-turns required for maximum k on vergin magnetisation curve	$(nI_{pol})_{opt}$	230–350	150–240	150–230	100–150
effective piezomagnetic coupling coefficient at optimum bias	$(k_{eff})_{opt}$	0.20–0.24	0.20–0.24	0.19–0.23	0.19–0.23
open-circuit resonance frequency	f_r	20.8–21.4	29.0–29.8	25.0–25.5	40.0–41.0
short-circuit resonance frequency or frequency of maximum efficiency	$f_{max} \approx f_a$	21.4–21.9	29.8–30.5	25.6–26.0	41.0–41.8
mechanical quality factor of free transducer core	$(Q_{mech})_{free}$	>2000	>2000	>2000	>2000
high-power data for loaded transducers					
effective mechanical quality factor and	Q_{load}	15–30	25–50	20–45	20–45
equivalent electrical parallel resistance	R_{par}4)	n^2.0.012	n^2.0.015	n^2.0.006	n^2.0.015
and parallel reactance of single-loaded-sub-merged3) transducer at frequency f_{max}	$2\pi f_{max} L_{par}$4)	n^2.0.005	n^2.0.012	n^2.0.009	n^2.0.022
permissible rating of electric HF power of single-loaded submerged3)	P	150–180	120–150	40–50	30–35
transducer and corresponding acoustic intensity at the radiating surface	J	1.4–1.7	1.6–2.0	3.0–3.5	3.0–3.5
effective mechanical quality factor and	Q_{load}5)				
equivalent electrical parallel resistance	R_{par}4)5)				
and parallel reactance of transducer cement-coupled to bottom of steel beaker frequency f_{max}6)	$2\pi f_{max} L_{par}$4)				
permissible rating of electric HF power of single-loaded submerged and cement-coupled non-submerged transducers and	P				
corresponding acoustic intensity at the radiating surface 7)	J				

---

[1] The date on the transducers are expressed in terms of the total number of turns n, except those on the multiple-window. They are expressed in terms of the number of turns per individual limb n.

[2] These transducers are supplied marked according to groups with narrow tolerance on f_a.

[3] The inside of a ring is the radiating surface, the outer surface is covered by cell-tight foam rubber. Window and multiple-window transducers are placed in water on a sheet of cell-tight foam rubber, their limbs being covered by pressure-release material.

[4] For conversion of parallel resistance and reactance into series resistance and reactance see Fig. 6.

ULTRASONIC TRANSDUCERS – MATERIAL GRADE 7A2

Main properties of the tansducers in FXC 7A2

multiple window (Fig. 3)	*double dumb-bell with d.c. bias 2× (Fig. 5)*		*glued double dumb-bell with ferroxdure biasing slabs (Fig. 4)*		*units*
low-power data for free transducers					
2P 644 56	2× K5 550 16	2× K5 550 21	K3 040 00	K3 040 05	
70–110	150–230	80–130			Amp. turns[1])
0.18–0.22	0.19–0.23	0.19–0.23	0.17–0.21	0.17–0.21	
22.8–23.3	21.8–22.3	40.9–41.7	21.1–21.8[2]	40.0–40.8[2]	kc/s
23.3–23.7	22.3–22.7	41.8–42.4	21.6–22.3[2]	41.2–42.2	kc/s
>2000	>2000	>2000	>2000	>2000	
high-power data for loaded transducers					
20–35	15–35	15–35	15–35	15–35	
n^2.0.07	n^2.0.008	n^2.0.014	n^2.0.015	n^2.0.023	Ω
n^2.0.11	n^2.0.011	n^2.0.021	n^2.0.008	n^2.0.011	Ω
100–120					W (electric)
2.5–3.0					W/cm² (acoustic)
	20–100	20–100	20–100	20–100	
	n^2.0.006	n^2.0.012	n^2.0.011	n^2.0.021	Ω
	n^2.0.011	n^2.0.021	n^2.0.008	n^2.0.011	Ω
	50–55	30–35	50–55	30–35	W (electric)
	2.4–2.8	2.7–3.2	2.4–2.8	2.7–3.2	W/cm² (acoustic)

---

[5] The mechanical quality factor and the electrical resistance of a cement-coupled non-submerged transducer are highly dependent on the water level and on the geometry and material of the vessel. With only one transducer cement-coupled to a small vessel the resistance range may extend from 1/3 to 5/3 times the listed value. Much smaller tolerances, however, can be obtained when arrays of cement-coupled transducers are used (e.g. large tanks).

[6] The frequency of maximum efficiency of a cement-coupled transducer is slightly lower than that of the free (or submerged) transducer, because the tank wall represents an additional mass loading. A steel wall of 1 mm thickness usually causes a frequency decrease of 0.3 to 1.0 kc/s.

[7] These rating values presuppose a Q_{load} not above 100, otherwise they must be reduced inversely proportional.

ULTRASONIC TRANSDUCERS - MATERIAL GRADE 7A2

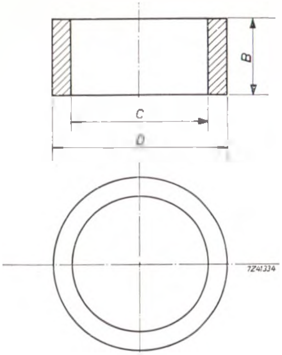


Fig. 1.

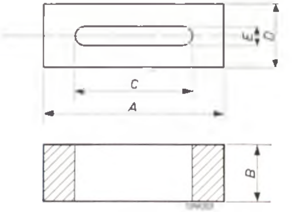


Fig. 2.

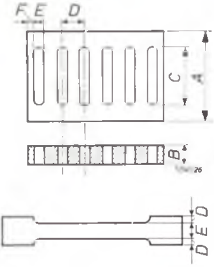


Fig. 3.

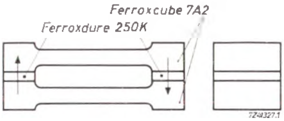


Fig. 4.

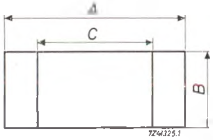


Fig. 5.

Current types of ferroxcube 7A2 transducers and biasing slabs

fig.	weight (g)	f_{max} (kc/s)	dimensions (mm)						type number
			A	B	C	D	E	F	
									transducers
1	490	21.7		40 ± 0.5	73.5 ± 1.5	92 ± 1			2P 643 87
1	380	30.2		40 ± 0.5	49 ± 1.5	69 ± 1.5			2P 644 45
2	490	25.8	96 ± 1	30 ± 1	62 ± 1.5	33.2 ± 0.8	9.4 + 0.8		K5 550 05
2	210	41.4	58 ± 1	30 ± 1	35 ± 1	24.6 ± 0.8	7.8 + 0.8		K5 550 11
3	1100	23.5	98 ± 2	20.0 ± 0.1	62 ± 1.5	24 ± 0.5	10.0 ± 0.2	7+1	2P 644 56
5	320	22.5	96 ± 1	40 ± 1	62 ± 1.5	4.2 + 1.6	9.8 ± 0.2		K5 550 16
5	80	42.1	50.4 ± 0.5	30 ± 1	32.4 ± 0.6	3.3 + 0.4	7.0 ± 0.2		K5 550 21
4	650	22.4	2 × K5 550 16 + 2 × 2P 667 05 glued together with "Araldite"						K3 040 00
4	170	41.7	2 × K5 550 21 + 2 × K6 176 00 glued together with "Araldite"						K3 040 05
									biasing slabs
material: magnetised			40 × 16.6 × 4.0 mm			for use with K5 550 16			2P 667 05
ferroxdure 250 K			30 × 9.0 × 2.0 mm			for use with K5 550 21			6 176 00

Conversion of parallel resistance and reactance into series resistance and reactance

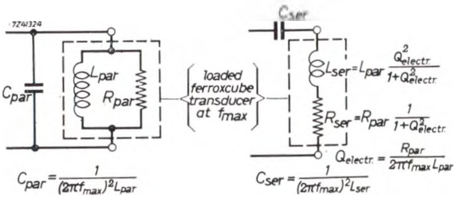


Fig. 6.

Ferroxplana is a hexagonal ferrite suitable for high frequencies. The main properties are given below:

		1Z2	1Z3
Initial permeability μ_i		15	10
$\frac{\tan\delta}{\mu_i}$ at	50 Mc/s	1.0×10^{-3}	—
	100	2×10^{-3}	1.8×10^{-3}
	200	6×10^{-3}	—
	300	—	4×10^{-3}
	500	—	10×10^{-3}
temp. factor $\frac{\Delta\mu}{\mu^2 \Delta T}$		80×10^{-6}	250×10^{-6}
spec. resistance (Ωcm)		10^6	10^6
frequency range (Mc/s)		50—200	200—500

Preferred types in 1Z2:

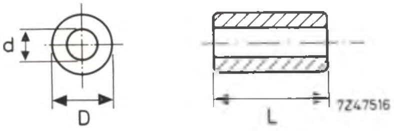


Fig. 1

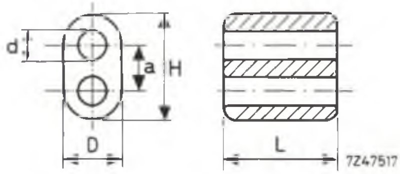


Fig. 2

fig.	*L* (*mm*)	*D* (*mm*)	*d* (*mm*)	*H* (*mm*)	*a* (*mm*)	*type number*
1	15 ± 0.4	8.5 ± 0.3	3.9 ± 0.2	—	—	3122 104 91711
1	10 ± 0.6	4 + 0.6	2 + 0.4	—	—	91761
1	5 ± 0.3	4.6 − 0.6	2 + 0.4	—	—	91781
2	14 ± 0.5	8.25 ± 0.25	3.4 + 0.6	14 ± 0.5	5.85 ± 0.25	4322 020 69751

POWDER IRON

PIECE PARTS FOR SMALL IF-COILS

Main properties of the various grades of powder iron: 1P1, 1P2, 1P3, 2P1.

freq. range	*material*	*measured on a small ring*	μ_i	*particle size*
up to 10 Mc/s	1P1	300 at 10 Mc/s	appr. 10	6–8 μm
up to 40–80 Mc/s	1P2	350 at 30 Mc/s	appr. 8.5	4–6 μm
up to 40–80 Mc/s	1P3[1]	350 at 30 Mc/s	appr. 8.5	4–6 μm
up to 100 Mc/s	2P1		appr. 2.5	

[1] Only for cast parts

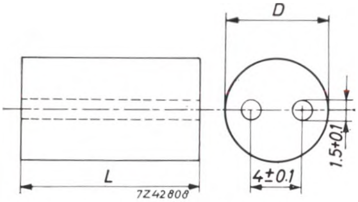


Fig. 1

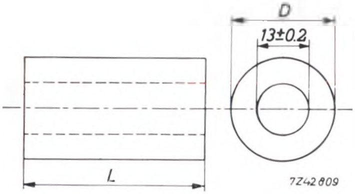


Fig. 2

dimensions (mm)				*fig.*	*material*	*type number*
L	*tol.*	*D*	*tol.*			
8	±0.2	8	−0.1	1	2P1	4322 020 69511
31.7	±0.2	18	±0.2	2	1P1	4322 020 69521

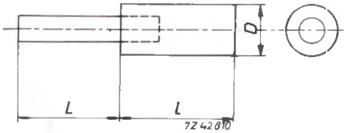


Fig. 3

Cores with tinned copper wire

dimensions (mm)						*fig.*	*type number*
L	*tol.*	*l*	*tol.*	*D*	*tol.*		
30	+4	30	±0.5	4.00	−0.15	3	A3 770 40/1P3
40	+4	22	±0.5	4.95	−0.1	3	A3 770 48/1P3
33	+4	28	±0.5	4.95	−0.1	3	A3 770 63/1P3

PIECE PARTS FOR SMALL IF-COILS

Screw cores

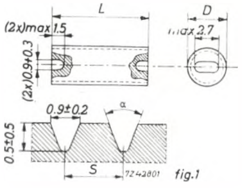


fig.1

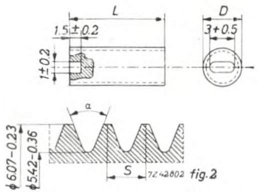


fig.2

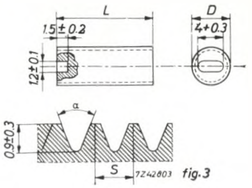


fig.3

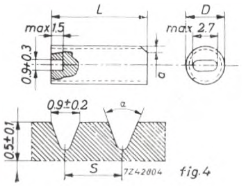


fig.4

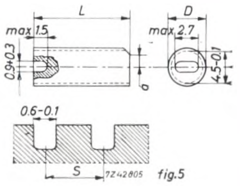


fig.5

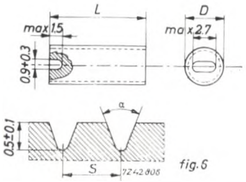


fig.6

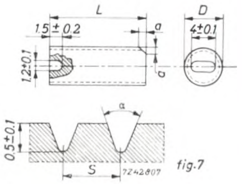


fig.7

dimensions (mm)						pitch (mm)			grade	fig.	type number
L	tol.	D	tol.	a	α	S	total tol.	number of grooves			
5	±0.3	4.95	−0.1		≤85°	1.5	0.1	1	1P1	1	3122 104 91581
6	±0.5	6.07	−0.23		appr. 60°	0.5			1P1	2	4322 020 69501
8	±0.3	4.95	−0.1		≤85°	1.5	0.2	4	1P2	4	3122 104 91611
10	±0.3	7			60°±10°	1	0.1	1	1P2	3	91591
12.25	±0.3	4.95	−0.1	1.3 ± 0.2	≤85°	1.5	0.2	5	1P2	6	91601
12.25	±0.3	4.95	−0.1	1.3 ± 0.2		1.5	0.05	1	1P1	5	93141
12.25	±0.3	4.95	−0.1		≤85°	1.5	0.2	5	1P1	4	90971
13	−1.5				appr. 60°	0.5			1P1	2	90991
15	±0.3	4.95	−0.1		70°+15°	1.5	0.1	5	1P1	1	92971
16.5	±0.3	7	−0.1	1.5 ± 0.3	appr. 60°	1.5	0.05	1	1P2	7	91001
16.5	±0.3	7	−0.1		60°+10°	1	0.1	1	1P2	3	91661
20.25	±0.4	4.95	−0.1		≤85°	1.5	0.2	5	1P1	1	90981

FERROXDURE
"TICONAL"
RECO

Hard magnetic materials

CONTENTS

PERMANENT MAGNETIC CERAMIC MATERIALS AND PERMANENT MAGNETIC CAST ALLOY

PERMANENT MAGNETIC CERAMIC MATERIALS

FERROXDURE – MAGNETIC PROPERTIES AND DESIGN DATA

characteristics	*ferroxdure*				
	isotropic 100[1]	*anisotropic*			
		250K	*300R*	*330K*	*360R*
Magnetic characteristics					
Max. energy . . . . ($\times 10^6$G.Oe) min.	0.9	2.5	3.1	3.1	3.4
product $(BH)_{max}$ avg.	0.95	3.0	3.3	3.3	3.6
Remanence[2] B_r . . . . (kG) min.[3]	2100	3400	3800	3600	3800
avg.	2200	3550	3900	3700	3900
Coercivity[2] . . . . . . H_c(Oe) min.[3]	1600	2200	1600	2800	2000
avg.	1650	2500	1900	3000	2200
Avg. static working condition					
B_d(kG)	1000	1900	2000	1900	2000
H_d (Oe)	950	1600	1650	1700	1800
Permeability . . . . . . μ rev. (G/Oe)	1.112–1.118	1.08–1.15	1.08–1.15	1.08–1.15	1.08–1.15
Field required for saturation H_{sat} (Oe)	12000	10000	8000	12000	10000
Curie temperature. . . . . (°C)	450	450	450	450	450
L/D ratio for open circuits	0.5	0.5	0.5	0.5	0.5
Material characteristics					
Specific electrical resistivity . (Ωm²/m)	$>10^6$	10^8	10^8	10^8	10^8
Coefficient of thermal expansion (0–100 °C) . . . . (in 10^{-6}/°C)	8.5	15.0	10.5	15.0	10.5
Specific gravity . . . . (g/cm³)	4.9	4.8	5.0	4.9	5
Manufacturing process	Processed materials pressed to the required shape in a die and sintered.				
Machinability	Material cannot be machined Surface finishing by grinding				

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[1] In ferroxdure 100, rods are extruded. Discs may be cut from rods which means that values may be a bit lower; [2] Measured at room temperature (20° C). [3] It should be noted that the minimum values of B_r and H_c never occur simultaneously.

Temperature coefficient. With ferroxdure 100 the effect of variations in temperature on the induction is practically reversible. In other words, after temporarily heating or cooling, the starting point on the *BH* curve is regained within 1 or 2 percent without remagnetization being necessary. Only after heating above the Curie point does permanent demagnetization occur. The same applies to anisotropic ferroxdure, but with this material care should be taken that when cooling the magnets below room temperature (which gives an increase of *B* and a decrease of *H*) the working point of the magnets does not pass the knee of the demagnetization curve. Otherwise a lower working point will be obtained after reheating to the original temperature (see leaflet "Ferroxdure Permanent Magnets"). The newer materials ferroxdure 360R and 330K are in this respect less sensitive due to the higher coercivity values, resulting in a favourable shift of the knee.

RECO – MAGNETIC PROPERTIES AND DESIGN DATA

characteristics	*reco (isotropic)*[1]					
	100	*120*	*140*	*160*	*170*	*220*
Magnetic characteristics						
Max. energy product $(BH)_{max}$ ($\times 10^6$G.Oe) min.	1.0	1.1	1.3	1.5	1.5	2.0
avg.	1.2	1.3	1.4	1.65	1.65	2.3
Remanence[3] B_r (kG) min[2].	5800	5300	6200	6000	5200	5600
avg.	6200	5900	6500	6600	5600	6300
Coercivity H_c (Oe) min[2].	460	500	530	600	830	1100
avg.	480	600	565	680	890	1200
Avg. static working condition B_d(kG)	4000	3100	3500	4150	3300	3750
H_d(Oe)	300	400	400	400	500	600
Permeability μ rev. (G/Oe)	4.0–6.5	4.4–5.0	5.0–6.0	4.0–5.0	3.4–4.0	3.2–3.8
Field required for saturation H_{sat} (Oe)	2500	2500	2500	2500	3000	5000
Curie temperature (°C)	730	700	770	810	790	750
L/D ratio for open circuits	3.0	3.0	3.0	3.0	2.2	2.2
Material characteristics						
Specific electrical resistivity Ω/m²/m	0.7	—	0.75	0.65	0.60	—
Coefficient of thermal expansion (0–100 °C) in 10^{-6}/°C	—	12.5	—	11.5	—	—
Specific gravity (g/cm³)	6.9	6.9	7	7	7	7.2
Manufacturing process	casting to the required shapes, hole cored at time of casting.					
Machinability	Material is brittle and cannot be machined Surface finishing by grinding					

[1] Magnetic properties in all directions equal. [2] It should be noted that the minimum values of B_r and H_c never occur simultaneously.

PERMANENT MAGNETIC CAST ALLOY

"TICONAL" – MAGNETIC PROPERTIES AND DESIGN DATA

characteristics	*"Ticonal" (anisotropic)*[1]			
	450	*650*	*750*	*900*[3]
Magnetic characteristics				
Max. energy product $(BH)_{max}$. ($\times 10^6$G.Oe) min.	4.0	6.2	7.0	7.5
avg.	4.25	6.5	7.5	9.0
Remanence[2] B_r . . . . (kG) min.	8000	12800	13200	10000
avg.	8500	13400	14200	10600
Coercivity[2] H_c . . . . (Oe) min.	1200	640	720	1300
avg.	1335	700	760	1400
Avg. static working condition . . . . . . B_d (kG)	5300	11000	10700	8000
H_d (Oe)	800	565	650	1100
Permeability . . . . μ rev. (G/Oe)	2.5–3.0	3–4	3–4	1.7–2.5
Field required for saturation . . . . . . H_{sat} (Oe)	5000	2500	2500	5000
Curie temperature . . . . (°C)	850	850	850	850
L/D ratio for open circuits	2.2	4.5	4.3	2.2
Material characteristics				
Specific electrical resistivity . . . . . . (Ω/m²/m)	0.50	0.45	0.45	0.5
Coefficient of thermal expansion (0–100 °C) . . . . (in 10^{-6}/°C)	10.8	10.8	10.8	10.8
Specific gravity . . . . (g/cm^3)	7.3	7.3	7.3	7.3
Manufacturing process	Casting to the required shapes, holes cored at time of casting.		Casting to the required shape	
Machinability	Surface finishing by grinding			

[1] Magnetic properties in the preferred direction optimal; [2] It should be noted that the minimum values of Br and H_c never occur simultaneously; [3] New material.

"TICONAL" – MAGNETIC PROPERTIES AND DESIGN DATA

characteristics	*"Ticonal" (anisotropic)*[1]				
	190	*360*	*400*	*500*	*600*
Magnetic characteristics					
Max. energy product. $(BH)_{max}$. ($\times 10^6$G.Oe) min.	1.8	3.2	3.8	4.5	5.5
avg.	2.1	3.6	4.0	4.8	5.77
Remanence[2] B_r (kG)min.	7400	10500	11200	12300	13000
avg.	8000	10700	11600	12800	13100
Coercivity[2] H_c (Oe)min.	650	680	610	600	630
avg.	730	710	640	630	645
Avg. static working condition. B_d (kG)	5000	7200	8000	9600	10500
H_d (Oe)	400	500	500	500	550
Permeability μ rev. (G/Oe)	3.8–5.0	4.0–5.0	4.0–5.0	4.0–5.0	3.0–4.0
Field required for saturation H_{sat} (Oe)	2500	2500	2500	2500	2500
Curie temperature (°C)	750	860	860	850	850
L/D ratio for open circuits	3.0	3.5	4.5	4.5	5.0
Material characteristics					
Specific electrical resistivity. (Ω/m²/m)	—	0.50	0.150	0.45	0.45
Coefficient of thermal expansion (0–100 °C) (in 10^{-6}/°C)	11.5	10.8	10.8	10.8	10.8
Specific gravity (g/cm³)	7.0	7.3	7.3	7.3	7.3
Manufacturing process	Casting to the required shapes, holes cored at time of casting.				
Machinability	Surface finishing by grinding				

---

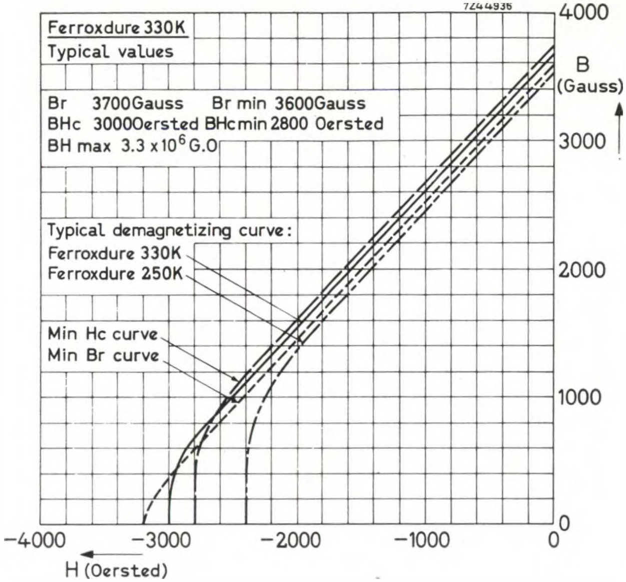
[1] Magnetic properties in the preferred direction optimal. [2] It should be noted that the minimum values of B and H never occur simultaneously.

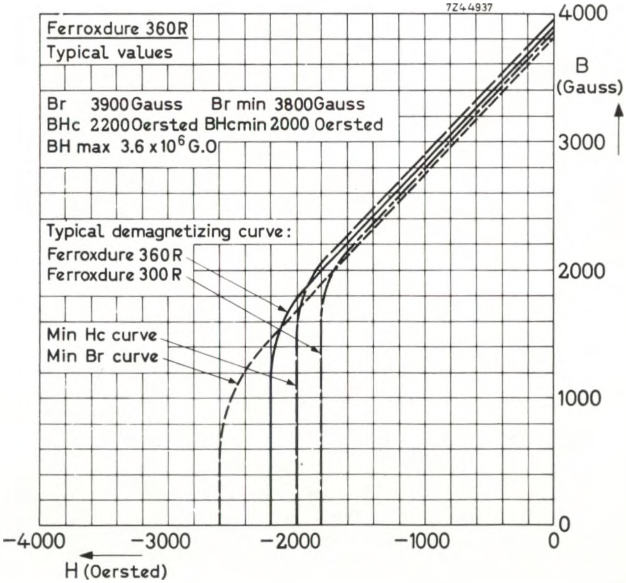
APPLICATION SCHEDULE

material	*applications*							
	L	*D*	*G*	*W*	*Wa*	*S*	*M*	*Mi*
Ferroxdure 100		●				●	●	
Ferroxdure 250K		●					●	
Ferroxdure 300R	●						●	●
Ferroxdure 330K		●			●	●	●	
Ferroxdure 360R	●						●	●
"Ticonal" 190			●	●			●	
"Ticonal" (C) 360		●	●	●		●	●	
"Ticonal" (E) 400		●	●	●		●	●	
"Ticonal" (X) 450	●	●	●	●	●		●	●
"Ticonal" (G) 500	●	●	●	●		●	●	●
"Ticonal" (Gg) 600	●	●	●	●		●	●	●
"Ticonal" 650	●	●	●	●		●	●	●
"Ticonal" 750	●						●	●
"Ticonal" 900			●		●			
Reco (1) 100		●	●	●		●		
Reco 120		●	●	●		●		
Reco (1^{A}) 140		●	●	●		●		
Reco (2) 160		●		●		●	●	
Reco (2^{B}) 170		●		●		●	●	
Reco 220		●	●	●		●		

L = loudspeakers
D = dynamos, generators
G = galvanometers
W = watt. hour meters
Wa = watches
S = sticking devices
M = motors
Mi = microphones

Demagnetising curves

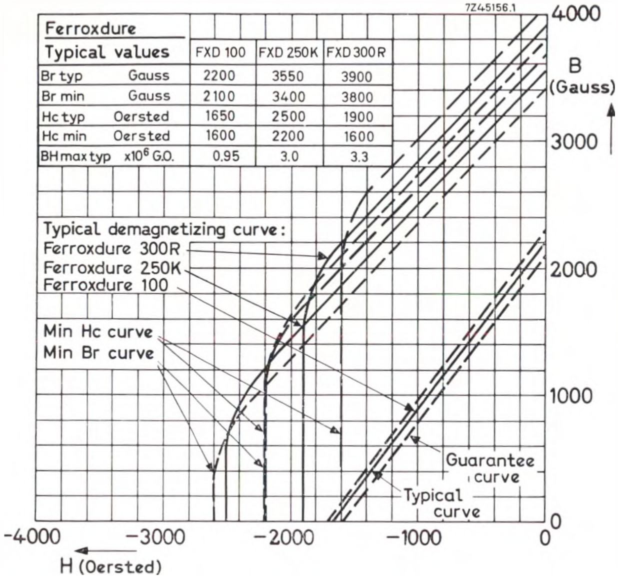




PERMANENT MAGNETIC CERAMIC MATERIALS

FERROXDURE

Demagnetizing curves



Ferroxdure Typical values		FXD 100	FXD 250K	FXD 300R
Br typ	Gauss	2200	3550	3900
Br min	Gauss	2100	3400	3800
Hc typ	Oersted	1650	2500	1900
Hc min	Oersted	1600	2200	1600
BHmax typ	$\times 10^6$ G.O.	0.95	3.0	3.3

N.B. The min. H_c curve for ferroxdure 250K coincides with the min. B_r curve for ferroxdure 300R.

Electrical and mechanical characteristics

The mechanical properties of ferroxdure are similar to those of other ceramic material. Ferroxdure is hard and brittle and can only be machined by grinding with suitable discs of silicon or of diamond. During grinding care must be taken to ensure that cooling is sufficient, to avoid cracks by local overheating.

Being a ceramic material ferroxdure is chemically rather inert. Its chemical resistance is characterised as follows:

Ferroxdure is **not affected** by:
- sodium chloride in a 30% solution;
- a mixture of benzol-trichlorine ethylene in a 50% solution;
- petrol;
- nitric acid;
- nitric acid in a 50% solution;
- acetic acid;
- cresol;
- phenolic solutions;
- sodium sulphate solution;

Ferroxdure is **hardly affected** by:
- delute sulphuric acid;
- hydrochloric acid in a 50% solution;

Ferroxdure is **rather strongly affected** by:
- concentrated hydrochloric acid.

Specific weight	4.8–5 g/cm^3
Mohs' hardness	6–7
Elastic limit	15,000 kg/mm^2
Tensile strength	5 kg/mm^2
Crushing strength	70 kg/mm^2
Linear extension factor (between 20 and 300 °C)	8.5×10^{-6}/°C

FERROXDURE 330K, 360R

Type FXD330K has resemblance to type FXD250K, it has a higher induction and an appreciably higher maximum energy product BH_{max}. The higher coercivity results in greater resistance to demagnetization.
In the majority of cases, it will be possible to insert the magnets magnetized. Furthermore, calculations can be based on the maximum energy product and so, designs having a minimum magnet volume can be obtained.

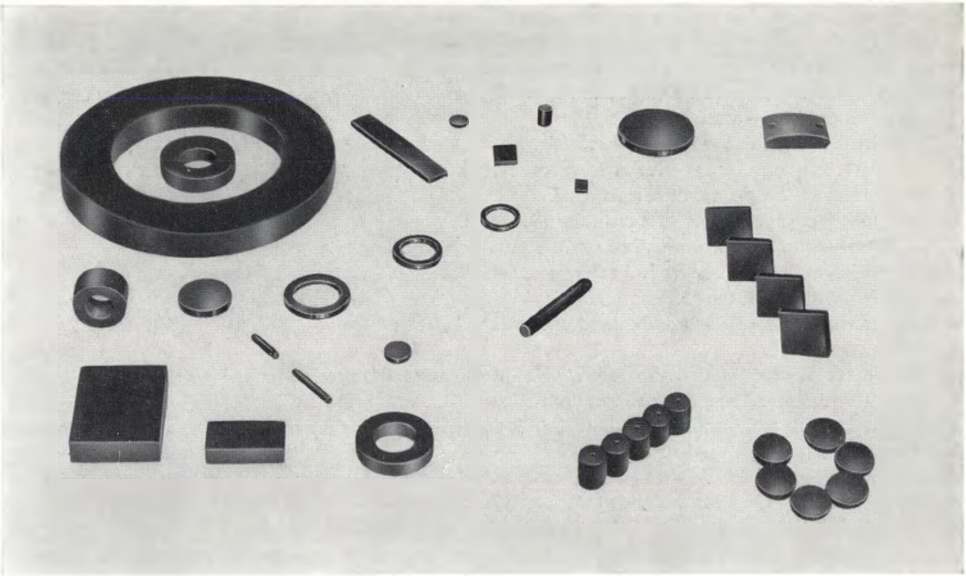
Type FXD360R has resemblance to type FXD300R has the same induction, but higher coercivity and a higher maximum energy product BH_{max}.
The low-temperature stability is improved proportionately and, if no considerable variations in temperature occur, a higher energy product (a wider angle of the load line) can be employed.
The results will be:

- A reduced magnet volume for a given specification.

Application

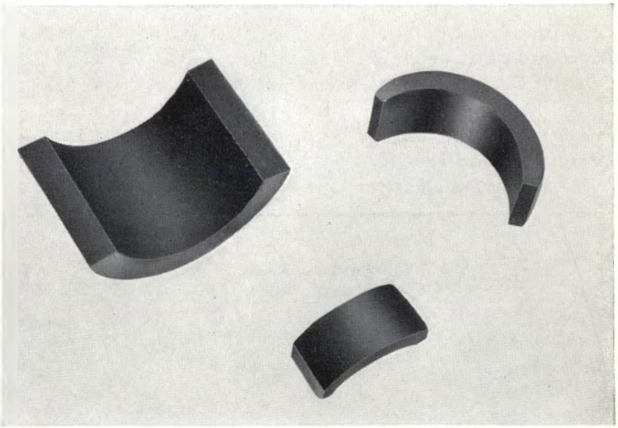
No doubt, the advantages of the crystal-oriented material FXD330K will further stimulate the use of sandwich-type of sticking systems such as magnetic chucks. More in particular, however, it will be of importance for professional applications such as travelling-wave tubes, electronic watches, magnetos, alternators, generators, DC motors, clutches, filters, separators.
As a consequence of the superior reversibility, in many cases it will be possible to obtain – apart from simplified constructions – higher air-gap inductions (up to 30% higher values were observed). This will occur, for instance, when flat magnets – such as e.g. used for biasing magnetostrictive transducers of FXC7A – are mounted magnetized.
If these raised values are not required or cannot be effectuated – on account of e.g. saturated pole shoes – the cross section of the magnet may be reduced proportionately, thus leading to smaller and cheaper systems.
To obtain a homogeneous field in permanent-magnetic D.C. motors use is made of diametrically oriented rings, or diametrically or radially oriented segments. Apart from going a high flux, FXD330K allows the insertion of magnetized magnets as a consequence of the improved reversibility.
If magnets of FXD360R are magnetized in their system and if dismounting requirements are not imposed, a somewhat higher flux can be obtained than in the case of FXD330K.
For static applications in systems having a narrow air gap, FXD360R permits shorter magnets than FXD300R to obtain a given induction in the gap, if the other dimensions remain unchanged. Therefore, for a given specification, the use of FXD360R results in flatter magnet systems; this is of importance in the case a small system height is requested.

The temperature coefficient of induction and coercivity is the same for the new versions as for the older ones, but the load line may make a larger angle with the B-axis without the occurrence of magnetic losses after a transient cooling down.



Preferred type list

The preferred type list comprises the shapes and sizes of permanent magnets for which we already possess the dies or the moulding plates. We shall be glad to offer any other shape or size required within the technical possibilities.



PERMANENT MAGNETIC MATERIALS

PLASTIC-BONDED FERROXDURE

Recent developments in the field of permanent magnetic materials have led not only to improvements in the magnetic properties of existing grades, but also to the manufacturing of plastic-bonded magnets. These are made by mixing ferroxdure powder either with thermoplastic or with thermosetting materials and shaping them by one of the familiar plastic manufacturing techniques, such as extrusion – injection moulding – pressing.

These new permanent magnetic materials, introduced as plastic-bonded ferroxdure, combine the characteristic magnetic properties of isotropic ferroxdure (albeit at a lower level) with the mechanical properties of the plastic materials used.

This opens the possibilities to obtain for example:

- flexible magnets, which can easily be cut, e.g. with a knife or scissors;
- magnets having close geometrical tolerances without need of machining them;
- magnets having intricate shapes;
- magnets which can easily be machined with normal tools;
- inexpensive magnets.

These features, combined with the low price of the materials used, offer the possibility of obtaining inexpensive magnets. They offer the opportunity to use magnets in those cases where this was impracticable in the past, either for technical or for price reasons; they may provide a cheaper solution in magnet applications already existing.

We can now offer the following three plastic-bonded ferroxdure permanent magnetic materials:

Ferroxdure P30 (Norm KPN-K-992) A soft, flexible and resilient material with 85 wt% ferroxdure powder (M) $Fe_{12}O_{19}$ and 15 wt % thermoplastic material, shaped by extrusion or injection moulding.

Ferroxdure P40 (Norm KPN-K-989) A flexible material with 90 wt % ferroxdure powder (M) $Fe_{12}O_{19}$ and 10 wt % thermoplastic material, shaped by extrusion or injection moulding in bars, strips, rods, and suchlike.

Ferroxdure D55 (Norm KPN-V-815) A hard and rigid material with 95 wt % ferroxdure powder (M) $Fe_{12}O_{19}$ and 5 wt % thermosetting material, shaped by pressing. This material is magnetically superior to the flexible materials; moreover, close tolerances can be achieved without machining.

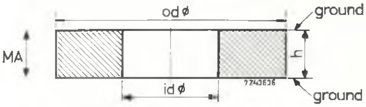
Magnetic Properties (measured in test pieces)

	Fxd P30		*Fxd P40*		*Fxd D55*	
	min.	*typical*	*min.*	*typical*	*min.*	*typical*
Residual induction . . . . B_r (G)	1150	1250	1350	1450	1650	1700
Coercive field strength of the magn. ind. . BH_c (Oe)	1050	1100	1150	1200	1300	1400
Coercive field strength of magnetisation . IH_e (Oe)	2500	2700	2300	2500	2500	2700
External energy product . . $BH_{max} \times 10^6$ (G.Oe)	0.30	0.35	0.40	0.45	0.55	0.60
Saturation induction . . . . B_{sat} (G)	12000	—	12500	—	13500	—
Saturation field strength . . . . H_{sat} (Oe)	10000	—	10000	—	10000	—
Reversible permeability (recoil permeability) μ_{rev}	~1.1	—	~1.15	—	1.15	—

ANISOTROPIC FERROXDURE 300R

Ring magnets for loudspeakers etc.

Preferred types



Direction of magnetisation: axial
Version: unmagnetised

dimensions						type number	
outer diam.		inner diam.		h			
mm	tolerance	mm	tolerance	mm	tolerance	old	new
36	±0.8	18	±0.5	8	±0.1	K6 150 71	4322 020 60071
38.5	±0.6	23	±0.5	9	−0.1	K6 154 81	60381
40	+1.3 −0.7	15	±0.4	7	±0.1	K6 152 61	60081
40	±0.9	22	±0.5	9	±0.1	K6 152 11	60091
45	±1	22	±0.6	8	±0.1	K6 153 01	60101
45	±1	22	±0.6	9	±0.1	K6 152 41	60111
45	±1	22	±0.6	10.5	±0.1	K6 150 51	60121
45	±1	24	±0.6	8.5	±0.1	K6 154 51	60411
45	±1	24	±0.6	9	±0.1	K6 154 21	60131
48	±1	18	±0.5	10.5	±0.1	K6 154 31	60141
51	±1.2	24	±0.6	9	±0.1	K6 151 21	60151
51	±1.2	24	±0.6	10	±0.1		60031
55	±1.2	24	±0.6	8	±0.1	K6 150 81	60161
55	±1.2	24	±0.6	12	±0.1	K6 152 01	60171
60	±1.5	24	±0.6	8	±0.1	K6 153 11	60181
60	±1.5	24	±0.6	12	±0.1	K6 151 91	60191
60	±1.5	24	±0.6	13	±0.1	K6 150 61	60201
60	±1.5	30	±0.7	10	±0.1	K6 152 71	60211
60	±1.5	30	±0.7	13	±0.1	K6 152 91	60221
68	±1.5	32	±0.7	13	±0.1	K6 151 51	60231
72	±1.5	32	±0.7	15	±0.1	K6 151 11	60241
72	±1.5	40	±1	13.7	±0.1	K6 151 31	60251
73	±2.2	31	±0.9	10	±0.1	K6 153 21	60261
84	±1.8	32	±0.9	15	±0.1	K6 152 81	60271
90	±1.8	36	±0.9	17	±0.15	K6 152 51	60281
96	±2.4	40	±1	25	±0.15	K6 153 31	60291
102	±3	51	±1.5	10	±0.15	K6 153 61	60301
102	±3	51	±1.5	14	±0.15	K6 153 71	60311
121	±3.6	57	±1.7	12	±0.2	K6 153 91	60321
134	±4	57	±1.7	14	±0.2	K6 153 51	60331
134	±4	57	±1.7	14	±0.2	K6 154 01 [1]	60341
134	±4	57	±1.7	20	±0.2		60021
155	±4.5	57	±1.7	17.5	±0.15		60011
184	±5.5	73	±2.2	18.5	±0.2	K6 153 41	60351
184	±5.5	81.3	±2	18.5	±0.2		60001

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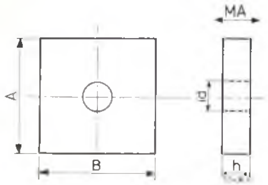
[1] Outer diameter provided with 3 slots

PERMANENT MAGNETIC CERAMIC MATERIALS

ANISOTROPIC FERROXDURE 250K, 300R and 330K

Square magnets for loudspeakers



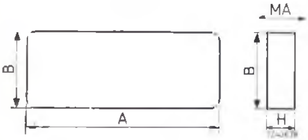
Direction of magnetisation: ⊥ A × B
Version: unmagnetised

dimensions								*type number*	
A		*B*		*h*		*diam. hole*			
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*old*	*new*
30.6	±0.8	30.6	±0.8	5	±0.1	12.4	±0.4	K6 137 51	4322 020 63011
32	±0.8	26	±0.6	8	−0.1	15.5	+0.8	K6 176 51	63091
41	±1	41	±1	8	±0.1	15.5	+0.8	K6 137 61	63041
50	±1	50	±1	10	±0.1	26	±0.6	K6 175 65[1]	63021[1]
50	±1	50	±1	12	±0.1	26	±0.6		63001[1]

[1] Inner diameter provided with 2 slots.

Blocks

Preferred types



Material: see below
Direction of magnetisation: ⊥ A × B
Version: magnetised

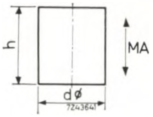
dimensions						*material*	*type number*	
A		*B*		*H*				
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		*old*	*new*
7	±0.2	1.4	±0.1	0.8	±0.1	300R		4322 020 62161[2]
5	±0.2	5	±0.2	4	−0.2	300R	K6 175 90	62021
7	±0.3	7	±0.3	4.2	±0.05	250K		62001
15	±0.3	9	±0.5	5	±0.25	250K	K6 176 10	3122 104 92701
20	±0.5	10	±0.5	5	±0.1	250K	K6 176 30[2]	4322 020 62031
20	±0.5	10	±0.5	5	±0.1	250K	K6 176 40	62041
30	±0.8	30	±0.8	15	±0.1	250K	K6 176 20[2]	62071
40	±1	25	±0.75	10	±0.1	330K		62181
50	±1.3	19	±0.5	4.9	−0.25	250K	K6 175 30[2]	62091
50	±1.3	19	±0.5	4.9	−0.25	250K	K6 175 50	62101
50	±1.3	19	±0.5	6.1	±0.1	250K	K6 175 70[2]	62111
50	±1.3	19	±0.5	6.1	±0.1	250K	K6 175 80	62121
131	±3	51	±1.5	17.5	±0.2	330K		62141[2]

[2] Magnets are not magnetised.

ANISOTROPIC FERROXDURE 250K, 300R AND 330K

Slugs

Preferred types



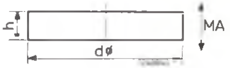
Direction of magnetisation: axial
Version: magnetized

dimensions				material	type number	
d		h				
mm	tolerance	mm	tolerance		old	new
10	±0.5	10	±0.2	250K	K6 038 00	4322 020 61021
10	±0.5	12	±0.2	250K	K6 038 10	61011
10	±0.5	15	±0.2	250K		61001

Discs

Preferred types

Material: see below
Direction of magnetisation: axial
Version: magnetised/unmagnetised
(see below)



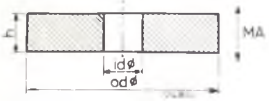
dimensions				material	version	type number	
d		h					
mm	tolerance	mm	tolerance			old	new
5.5	±0.05	1.8	±0.03	330K	unmagnetised	—	4322 020 62591
10	±0.2	2	±0.05	330K	unmagnetised	—	62502
10	±0.5	4.6	±0.1	250K	unmagnetised	—	62581
12	±0.3	6	±0.25	300R	magnetised	K6 112 75	62541
22.8	−0.3	15	−0.5	300R	unmagnetised	K6 112 55	62571
28.8	−0.3	12.5	±0.5	250K	unmagnetised	—	62511
40.6	±1	9	±0.1	250K	unmagnetised	K6 112 65	62551
45	±1.1	9	±0.1	250K	unmagnetised	K6 075 00	62561

PERMANENT MAGNETIC CERAMIC MATERIALS

ANISOTROPIC FERROXDURE 100

Rings (other than for Loudspeakers)

Preferred types

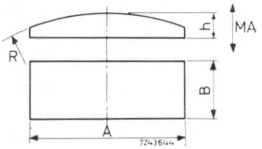


Material: see below
Direction of magnetisation: axial
Version: unmagnetised

dimensions						*material*	*type number*	
outer diam.		*inner diam.*		*h*				
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		*old*	*new*
20	±0.2	5.15	±0.15	4	±0.1	300R	K6 153 81	4322 020 60041
24	+0.08	10.2	±0.3	4.05	±0.1	250K	K6 154 11	60052
30	±0.6	12.7	±0.5	6.35	±0.05	250K	K6 152 20	60061
42	+2.3	10	−0.5	8	+1.6	250K	K6 152 30	60391

Segments

Preferred types



Material: Fxd 300R
Direction of magnetisation: axial
Version: unmagnetised

dimensions							*type number*	
R		A		B		h		
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*mm*	*old*	*new*
49	+10	34	±0.9	23	±0.6	7.1	K6 200 10	4322 020 61541
55	+10	35	±0.9	23	±0.6	10.4	K6 200 05	61531

PERMANENT MAGNETIC CERAMIC MATERIALS

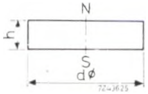
ISOTROPIC FERROXDURE 100

Discs and bars

Preferred types

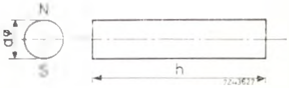
a) axially magnetised

dimensions				*type number*	
diam. d		*h*			
mm	*tolerance*	*mm*	*tolerance*	*old*	*new*
3	±0.2	7.5	±0.25	VK.300.23	4312 020 60131
4	±0.2	3.5	±0.2	VK.310.07	65951
5	±0.3	10	±0.5	VK.300.03	60021
5	±0.2	20	±0.5	VK.300.00	60001
5	±0.3	30	±0.8	VK.300.02	60011
5	±0.2	39	−1	VK.300.25	60101
5	±0.3	50	±1.0	VK.300.22	60151
6	±0.3	33	±0.6	VK.300.17	60071



dimensions				*type number*	
diam. d		*h*			
mm	*tolerance*	*mm*	*tolerance*	*old*	*new*
5.5	±0.3	5	±0.3	VK.310.09	4312 020 65931
8	±0.3	3	±0.3	VK 310 11	65911
8	±0.5	5	±0.5	VK 310 06	65961
10	±0.3	2.5	±0.3	VK 310 05	65971
10	±0.5	5	±0.5	VK 310 08	65941
14	±0.5	4	±0.5	VK 310 12	65901
14	±0.5	5	±0.3	VK 310 13	65891
14	±0.3	10	±0.5	VK 310 17	65831
20	±0.35	5	±0.3	VK 310 17	65881
25	±0.5	5	±0.4	VK 310 18	65871
32	−1	8.7	±0.3	VK 310 34	65811

b) diametrically magnetized

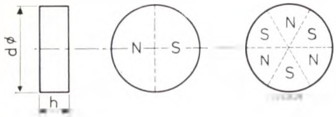


dimensions				*type number*	
diam. d		*h*			
mm	*tolerance*	*mm*	*tolerance*	*old*	*new*
4	±0.1	5	±0.2	VK 300 18	4312 020 60081
4	±0.1	10	±0.2	VK 300 13	60041
4	±0.1	20	±0.2	VK 300 14	60051
4	±0.1	30	±0.2	VK 300 15	60061
5	±0.5	15	±0.5	VK 300 26	60111

PERMANENT MAGNETIC CERAMIC MATERIALS

ISOTROPIC FERROXDURE 100

c) laterally magnetized



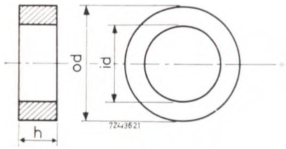
dimensions				type number	
d		h			
mm	tol.	mm	tol.	old	new
14	±0.5	5	±0.3	VK 310 21[1]	4312 020 65771
20	±0.4	3	±0.3	VK 310 36[2]	65791
25	±0.5	5	±0.4	VK 310 23[2]	65851

[1] 2 poles on 1 face.

[2] 6 poles on 1 face.

Rings

Preferred types



a) diametrically magnetised

dimensions						type number	
outer diam.		square hole		h			
mm	tolerance	mm	tolerance	mm	tolerance	old	new
12.25	±0.25	3.2	±0.5	10	±0.5	VK 320 06	4312 020 62111
12	+0.5	3.2	±0.5	12	±0.5	VK 320 07	62121

b) axially magnetised

dimensions						type number	
outer diam.		inner diam.		h			
mm	tolerance	mm	tolerance	mm	tolerance	old	new
11.9	±0.4	5.75	±0.25	6.5	±.05	VK 320 19	4312 020 62211
14	±0.5	1.5	±0.5	5	±0.5	VK 320 16	62181
14	±0.5	4	±0.25	4	±0.25	VK 320 18	62201
15.6	±0.3	6.25	±0.2	3	−0.1	VK 320 03	62101
18	±0.45	5	±0.2	5	±0.2	VK 320 12	62141
29.9	−0.05	10	±0.3	5	−0.1	VK 321 10	62271[1]
36	−0.1	10	±0.2	5	−0.1	VK 321 18	62731[1]
37	±0.8	25	±0.5	3.5	±0.5	VK 321 06	62261

[1] 4p axially magnetised.

Rings

Preferred types (continued)

c) *radially magnetised*

dimensions						*magnetisation*	*type number*	
outer diam.		*inner diam.*		*h*				
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*		*old*	*new*
13	±0.3	5.3	±0.2	8	±0.3	radially N pole on od	VK 320 13	4312 020 62151
13	±0.3	5.3	±0.2	8	±0.3	radially S pole on od	VK 320 14	62161
18	±0.5	12	±0.5	7	±0.5	radially S pole on od	VK 320 47	62251
27	±0.7	20	±0.6	3.5	±0.5	radially S pole on od	VK 321 28	62341

d) *laterally magnetised*

dimensions						*magnetisation*	*type number*	
outer diam.		*inner diam.*		*h*				
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*		*old*	*new*
24	−0.05	10	±0.5	21.25	±0.45	8p lat. on outer ø	VK 375 14	4312 020 62471
24	−0.04	12	±0.3	12	±0.4	16p lat. on outer ø	VK 321 30	62351
29.9	−0.05	10	±0.5	16.1	±0.4	4p lat. on outer ø	VK 375 18	62521
29.9	−0.05	10	±0.5	18.2	±0.4	4p lat. on outer ø	VK 375 23	62481
37	±0.8	25	±0.5	3.5	−0.5	4p lat. on one surface	VK 321 42	62401

e) *rings for couplings*

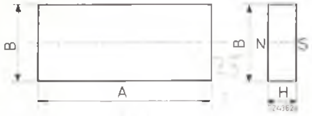
dimensions						*magnetisation*	*type number*	
outer diam.		*inner diam.*		*h*				
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*		*old*	*new*
48	±0.05	30	±0.05	12	±0.1	14p lat. on outer ø	VK 321 24	4312 020 62751
55	±0.05	15	±0.5	13	±0.1	12p lat. on outer ø	VK 322 09	62431
72	±0.05	52	±0.05	12	±0.1	14p lat. on inner ø	VK 322 07	62791
78	±1.5	58	±0.05	13	±0.1	12p lat. on inner ø	VK 322 08	62421
86	+0.2	32	±0.5	23	±0.1	8p lat. on outer ø	VK 322 10	62441
120	±0.5	96	−0.2	23	±0.1	8p lat. on inner ø	VK 323 00	62451

PERMANENT MAGNETIC CERAMIC MATERIALS

ISOTROPIC FERROXDURE 100

Blocks

Preferred types

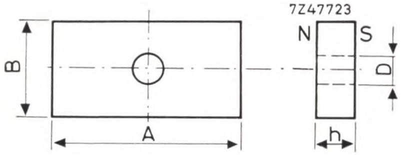


magnetised ⊥ *A* × *B*

dimensions						*type number*	
A		*B*		*h*			
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*old*	*new*
50	±1.25	22	±0.55	5	±0.1	VK 312 02	4312 020 66981
40	±1	25	±0.75	10	±0.1	VK 312 10	66931
40	±1	17	±0.4	4	±0.1	VK 312 04	66971
28	−0.5	13	−0.5	3.5	+0.5	VK 312 13	66751
15	±0.5	15	±0.5	5	±0.3	VK 312 08	66951
8	±0.5	8	±0.5	5	±0.5	VK 312 11	66771
10	±0.5	5	±0.5	3	±0.5	VK 312 12	66761

Blocks with holes

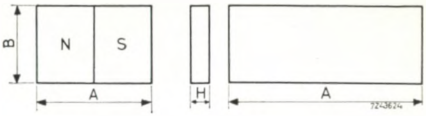
Preferred types



magnetised ⊥ *A* × *B*

dimensions								*type number*	
A		*B*		*h*		*D*			
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*	*old*	*new*
25	±0.4	15	±0.3	5.5	±0.3	4.6	±0.25	VK 312 20	4312 020 66711
25	±0.4	12	±0.3	5	±0.3	4.6	±0.25	VK 312 21	66901

ISOTROPIC FERROXDURE 100



laterally magnetised

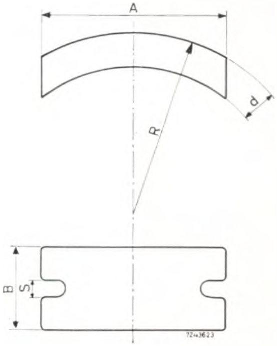
dimensions						*magnetisation*	*type number*	
A		*B*		*H*				
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		*old*	*new*
18	±1	7	±1	6	±1	2p lat. on 18 × 6	VK 303 01	4312 020 66801
20	±0.35	10	±0.25	4	±0.25	2p lat. on 20 × 10	VK 312 14	66741
75	±2	15	±0.4	4	±0.05	8p lat. on 75 × 15	VK 303 02	66861

Segments

Preferred types

not magnetised

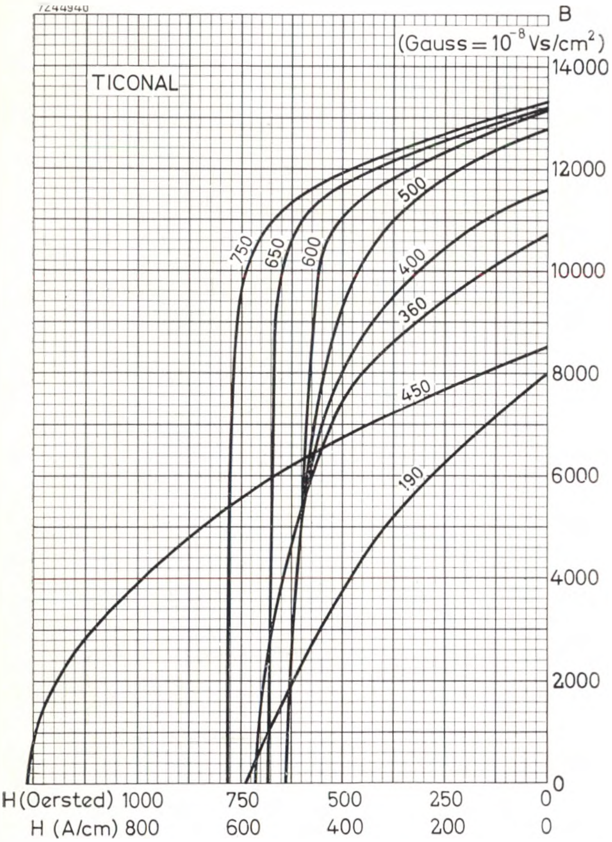
old type number		**VK 360 04**	
new type number		**4312 020 61501**	
		mm	*tolerance*
dimensions	R	54.55	+2.5
	A	54	±0.5
	B	27	±0.3
	s	5.2	+0.5
	d	7.4	±0.2



PERMANENT MAGNETIC CAST ALLOY

ANISOTROPIC „TICONAL"

Demagnetizing curves



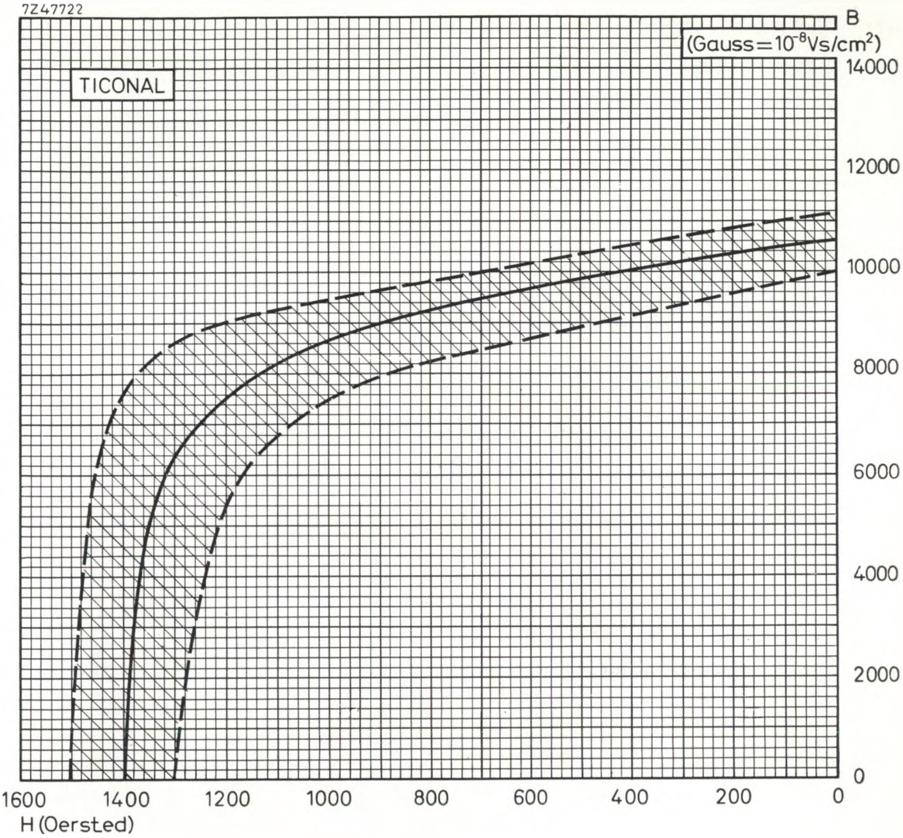
"Ticonal" grades are anisotropic alloys of special composition with high magnetic values in a preferred direction.

The method of production of the grades 360, 400, 500 and 600 is similar. Compared with these types, grade 750 has a high degree of crystal orientation, resulting in a high energy product.

The energy product for type 650 is somewhat lower than for the 750, but it exceeds the values of the older types. Particulars regarding the types 650 and 750 can be found on page H26.

For characteristics see also page H6.

ANISTROPIC „TICONAL"



MAGNETIC MATERIAL TICONAL GRADE 900

This magnetic material has been known for some years under the name of "TICONAL XX". In the meantime the material has been used in practice for some purposes and it is now produced in quantities under the name of "TICONAL 900".

The figure shows the average demagnetizing curve of the material together with upper- and lower-limit curves.

Owing to the great coercive force of "TICONAL 900", the optimum length of the magnet will usually be very small. "TICONAL 900" can often be used with success in those cases where recourse had to be had to platinum-cobalt. It was therefore decided to discontinue the manufacturing of platinum cobalt.

The magnets are cube-shaped. For this reason the magnetic circuit should be designed accordingly.

"TICONAL 900" is economically only attractive for tiny magnets.

Note: In the near future the minimum garanteed values will be equal to the average values given in the graph.

PERMANENT MAGNETIC CAST ALLOY

ANISOTROPIC "TICONAL" – NEW MATERIALS

"Ticonal" 750

The optimum magnetic performance is attended with a circular cross section. Therefore, and to avoid expensive tooling-up, we standardized the following diameters:

10 mm, 12 mm, (1/2"), 14 mm, (5/8"), 18 mm.

The magnet length should be calculated according to the circuit to be used and the performance required.

We have to draw your attention to the fact that, in comparison with the older grades, the high energy product of "Ticonal" 750 is the result of a high degree of crystal orientation. The consequence is a typical demagnetization curve having a sharp knee just at the values B_d and H_d (BH_{max}).

Therefore, the working line of a statically used magnetic circuit - without an external demagnetizing field – should intersect the BH curve in the BH_{max} point, or the results will be disappointing. That means, the use of "Ticonal" 750 would not lead to a higher performance or to a smaller magnet system than obtainable with e.g. "Ticonal" 600 or even "Ticonal" 500.

The material is also suitable for dynamic application incurring external demagnetizing fields.

"Ticonal" 650

"Ticonal" 650 is another interesting new crystal-oriented permanent-magnet material available on commercially attractive delivery terms. It may be used when, for some reason, the magnet for any of the above mentioned applications cannot be made from the outstanding grade "Ticonal" 750.

The energy product guaranteed for "650" is somewhat lower than for "750" but it exceeds the minimum value for the next best grade, "Ticonal" 600, by 12% and that for "Ticonal" 500 by even 36%.

Grade 650 has the essential advantage, that, compared with grade 750, it is not subject to the restriction of a cylindrical shape. Nevertheless, holes should be avoided as well, because holes degrade the magnetic values as a result of disturbing the crystal orientation.

The nature of the material is such that the orientation should be straight and parallel to the axis of magnetization. Apart from cylinders, possible shapes are square bars and prismatic forms, which may have ground pole faces.

To ensure complete crystal orientation and optimum magnetic values, a geometric ratio length/diameter not in excess of 1 is recommended if the diameter does not exceed 15 mm.

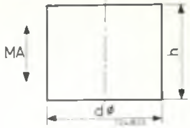
For the rest, our statements on "Ticonal" 750 also apply to "650". The knee in the demagnetization curve is less sharp.
For further data see page H6.

PERMANENT MAGNETIC CAST ALLOY

ANISOTROPIC “TICONAL” – 600 650, AND 750

Slugs (I)

Preferred types

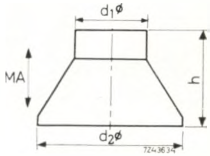


Material: see below
Direction of magnetization: axial
Version: unmagnetized

dimensions				*material*	*type number*	
d		*h*				
mm	*tolerance*	*mm*	*tolerance*		*old*	*new*
9.3	−0.3	5	−0.05	“Ticonal” 750	—	4322 059 75001
9.3	−0.3	10	−0.05	“Ticonal” 750	—	75011
12.9	−0.3	10	−0.05	“Ticonal” 750	—	75061
15.1	−0.03	11.5	±0.05	“Ticonal” 750	—	75041
15.8	−0.1	13.4	±0.1	“Ticonal” 750	—	75031
16.4	±0.3	13.4	−0.1	“Ticonal” 650	3C 010 33	65021
18	−0.4	12	−0.1	“Ticonal” 600	3C 010 18	60001
19.4	±0.3	9.4	±0.1	“Ticonal” 750	—	75081
19.4	±0.3	15.4	−0.1	“Ticonal” 650	3C 010 32	65031
19.4	±0.3	15.4	±0.1	“Ticonal” 750	—	75071
21	±0.5	16	±0.05	“Ticonal” 600	3C 007 45	60011
21	±0.5	22.5	±0.05	“Ticonal” 600	3C 010 30	60041
24.2	−0.4	16	±0.05	“Ticonal” 600	3C 009 96	60021
27.5	±0.5	18.5	±0.05	“Ticonal” 600	3C 007 46	60031

Slugs (II)

Preferred types



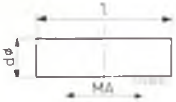
dimensions						*material*	*type number*	
d1		*d2*		*h*				
mm	*tolerance*	*mm*	*tolerance*	*mm*	*tolerance*		*old*	*new*
13.2	−0.5	18	−0.5	13	±0.05	“Ticonal” 600	3C 007 44	4322 059 60051
18	−0.3	26	±0.5	17.5	±0.05	600	3C 010 35	60061

PERMANENT MAGNETIC CAST ALLOY

ANISOTROPIC "TICONAL" – 400, 500 AND 600

Rods

Preferred types



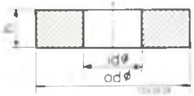
Direction of magnetization: axial
Version: see below

dimensions				*material*	*version*	*type number*	
d		*l*					
mm	*tolerance*	*mm*	*tolerance*			*old*	*new*
4	±0.2	6	±0.2	"Ticonal"500	unmagnetised	3C 009 80	4322 059 50071 1)
5	±0.3	13	±0.1	500	unmagnetised	3C 010 16	50081
5	±0.3	19.5	±1	500	magnetised	3C 009 82	50091
5.5	−1	25	±0.5	500	magnetised	3C 001 24	50101 1)
8.1	−1	65	±0.5	500	magnetised	3C 002 36	50111 1)

1) Bars in these diameters can be supplied in any length between 8 and 100 mm.

Rings

Preferred types



Material: see below
Direction of magnetisation: see below
Version: see below

dimensions						*material*	*d/m*	*version*	*type number*	
outer diam.		*inner diam.*		*h*					*old*	*new*
mm	*tol.*	*mm*	*tol.*	*mm*	*tol.*					
18.1	−0.3	5	+1	10	−0.05	"Ticonal"600	a	unmagnetised	3C 010 36	4322 059 60071
30	±0.5	7	±0.5	25	±0.2	400	a	magnetised	3C 000 60	40001
56	±0.5	48	±0.5	10	±0.5	400	d	unmagnetised	3H 717 83	40011

d/m = direction of magnetisation
d = diametrical
a = axial

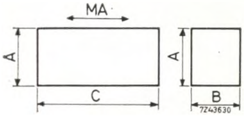
PERMANENT MAGNETIC CAST ALLOY

ANISOTROPIC "TICONAL" – 400, 450, 500 AND 900

Blocks

Preferred types

Direction of magnetization: ⊥ face A × B
Version: see below



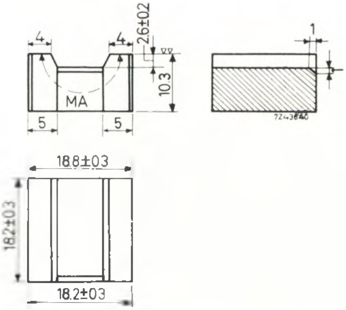
dimensions						material	version	type number	
A		B		C					
mm	tol.	mm	tol.	mm	tol.			old	new
2	±0.05	2.25	−0.03	2.6	±0.05	"Ticonal"900	unmagnetised	—	4322 059 90002
4	±0.05	4	±0.05	5	±0.02	"Ticonal"900	unmagnetised	—	90011
8	−1	5	−0.4	14	−1	"Ticonal"400	magnetised	3H 717 36	40021
27	−1	20	±0.5	17	±0.05	"Ticonal"450	unmagnetised	3C 009 94	45031
21.5	±0.5	14.5	±0.5	22	+0.2	"Ticonal"500	magnetised	3C 000 59	50121
100	±1	12	±0.1	29.1	±0.05	"Ticonal"500	unmagnetised	3C 000 09	50131[1]
22	±0.3	9.1	−0.4	40	±0.1	"Ticonal"500	magnetised	3C 008 40	50141
32	±0.5	20.8	±0.5	40	±0.05	"Ticonal"500	unmagnetised	3C 005 06	50151[2]
10	±0.5	5	±0.5	50	±1	"Ticonal"500	magnetised	3C 002 02	50161
40	±0.05	17	±0.3	10.5	±0.2	"Ticonal"500	unmagnetised	3C 010 46	50171

[1] with two mounting holes. [2] with one mounting hole.

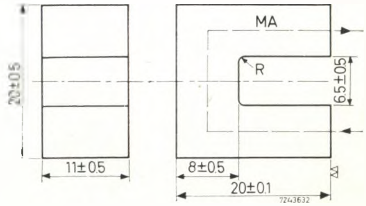
Special types

(Please also consult our original drawings)

Old type number: 3C010.25 (unmagnetised)
New type number: 4322 059 10001
Material: "Reco I"
Version: unmagnetised



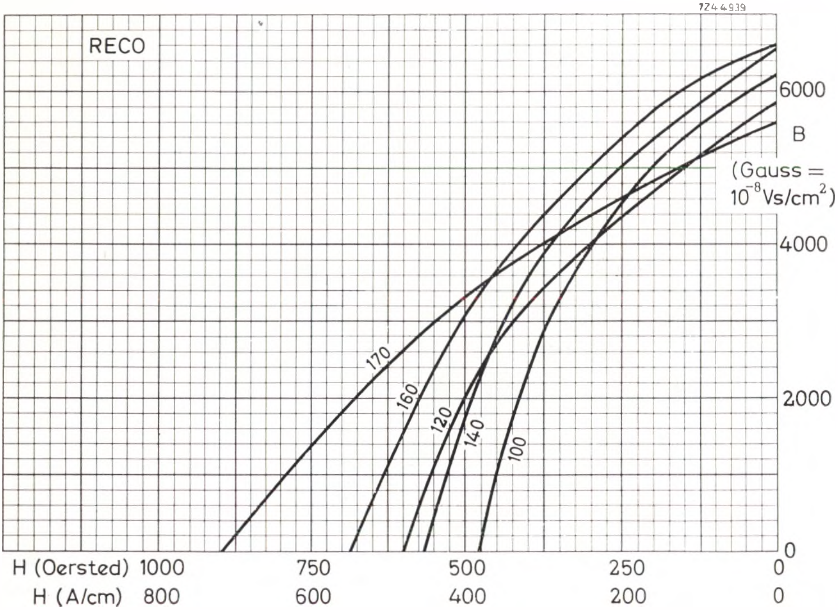
Old type number: 3C009 72.1 (unmagnetised)
New type number: 4322 059 400 31
Material: "Ticonal" 400
Version: unmagnetised



PERMANENT MAGNETIC CAST ALLOY

RECO (ISOTROPIC)

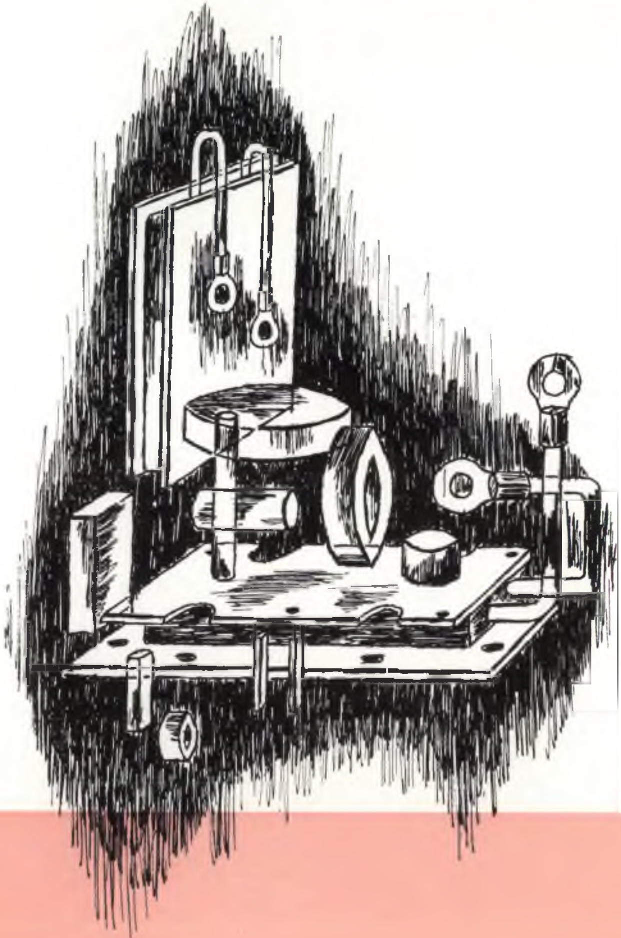
Demagnetizing curves



Reco is a permanent isotropic magnetic cast alloy, the various types are distinguished by the different percentage of cobalt and titanium.
The types 170 and 220 are characterized by their high coercivity.

PELTIER BATTERIES

PIEZOELECTRIC CERAMICS



Other Materials

APPLICATIONS

When considering the application possibilities for Peltier cooling, it should be kept in mind that all these cooling applications in principle can also be solved with compressors (together with additional provisions). Peltier cooling is preferable only in those cases where it offers definite technical or economical advantages. These may be e.g. the following ones:

a. relatively low cooling capacity required, so that a standard compressor device is overdimensioned, and Peltier offers a cheaper solution.
b. necessity for temperature constancy or temperature regulation, which with Peltier is much easier, cheaper and exacter than with compressors.
c. smaller volume
d. noiselessness
e. no supervision required

In the following, a number of such application examples is given.

Measuring apparatus

1. *Melting point determination* (−20 to +80 °C). Here Peltier can act both as cooling and as heating medium. It easily permits melting point determinations down to lower temperatures, and moreover an easy and exact regulation. The melting can be either visually observed or found by a sudden change in a physical property e.g. the permittivity or the electrical resistivity.
2. *Determination of freezing point depression*. This is a customary method for the determination of molecular weight. Here Peltier cooling allows a higher precision, omission of the cooling bath and the possibility to repeat the freezing point determination several times without appreciable time loss.
3. *Solidifying point and cloud point*. This is particularly important for mineral and edible oils. Peltier allows a simpler cooling and a higher precision.
4. *Dew point determination*. By means of alternative Peltier cooling and heating, piloted by condensation of moisture upon a small mirror, a very quick and rapid determination of the dew point is possible, suitable for repeated moisture content measurements of gases, automatic moisture control, etc.
5. *Zero grade standard*. This can be easily and exactly realized by alternative Peltier cooling and heating in a small vessel of water. The Peltier battery can be piloted by using the sudden change in resistivity between water and ice. This zero grade standard can be used as reference temperature for the cold joint of thermocouples.
6. *Flash point*. This important property for mineral oils and fuels can be simply and accurately determined within a large temperature range by means of Peltier cooling, which above room temperature is commuted to Peltier heating. Any desired temperature-time curve can be realized in this way.
7. *Cold resistance of oils*. No bath cooling required; moreover better regulation and exactness.
8. *Viscosity measurements* at low temperature.

Material separation

9. *Ice zone melting*, for purification and separation of organic chemical substances in heterogeneous phase (solid-liquid). By means of Peltier devices, a low temperature (−20 °C) can be reached, and easy regulation of temperature is possible. Moreover, heat and cold can be supplied at the same time, and the zone width adjusted.
10. *Column crystallization*. This is more or less the same procedure as ice zone melting, but on a continuous and industrial scale. For the use of Peltier, the same advantages apply.

APPLICATIONS (continued)

11. *Thermodiffusion.* This is a procedure for purification and separation of organic substances (e.g. proteins) in homogeneous liquid phase. When using Peltier, the required temperature can be adjusted easily, and exactly, the usable temperature range is extended towards the low temperature side, and heat and cold are supplied at the same time.

12. *Gas chromatography*, a separation method via the gas phase. The quantity of adsorbed matter can be increased by cooling the adsorbens. When this absorbens is afterwards heated by inverting the Peltier current, the adsorbed matter can be quickly driven out again. In this way, the sensitivity of the procedure can be increased and the required time shortened.

General laboratory technique

1. *Small thermostat* (—20 +80 °C). By means of Peltier, a smaller and cheaper thermostat can be constructed for the indicated temperature range, which can e.g. serve for circulation cooling with organic chemical reactions or with dialysis processes.

2. *Drying by freezing.* With Peltier cooling, a small and handy device can be constructed for drying small quantities of liquid by freezing out the last moisture remains. This is a well-known technique in biological, biochemical and medical fields.

3. *Cooling of suction filters*, e.g. for recrystallizing. Again, with Peltier a small and easily adjustable device can be constructed, which can either heat or cool a suction filter in a short time.

4. *Test tube cooler*, for chemical or biological work. Peltier enables a small and handy device, easily adjustable and without need for supervision.

Miscellaneous

1. *Keeping baths at constant temperature*, e.g. for etching or staining purposes. Peltier allows a quick and exact adjustment.

2. *Portable cooling box*, for transport of temperature sensitive materials (blood plasma, vaccins, sperma).

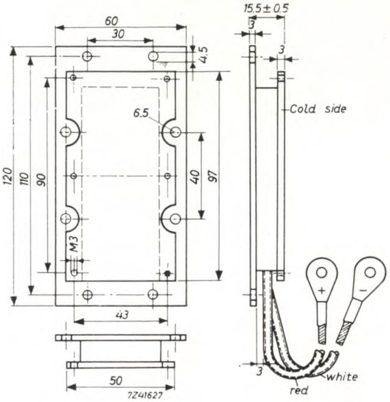
3. *Ultracentrifuge*, where Peltier allows a quick and exact rotor cooling.

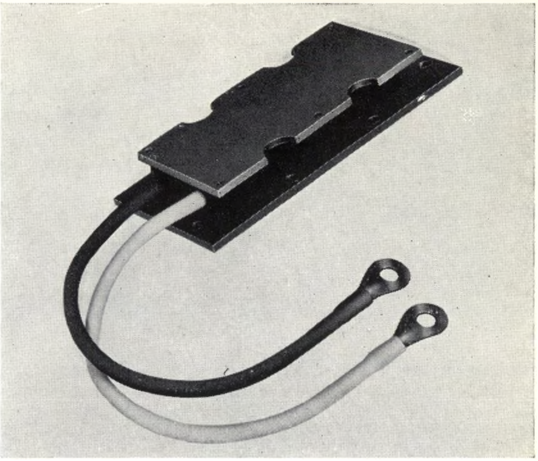
4. *Automatic glass cutting*. When glass is cut off by cracking, local Peltier cooling enables a very good and reproducible location of the crack, suitable for mass production.

Remarks

For all applications mentioned above the standard batteries PT 20/20, or PT 48/6 can be used.
For some of them one battery will be sufficient, for others, e.g. the separation of different substances. the required cooling capacity can only be realized by using more batteries.

HIGH CURRENT TYPE PT 20/20





Dimensional drawing of Peltier battery PT 20/20. The length of the terminals without mounting tags is 240 mm.

characteristic data

Optimum working current: 20 A
(water cooling of hot side required)
Voltage at optimum working current: approx. 2V
Insulation resistance between plate surfaces and connecting cables: > 100 kΩ
The given diagrams of cooling capacity and current versus temperature difference were measured for hot-side temperatures of 20 and 40 °C.

important notes

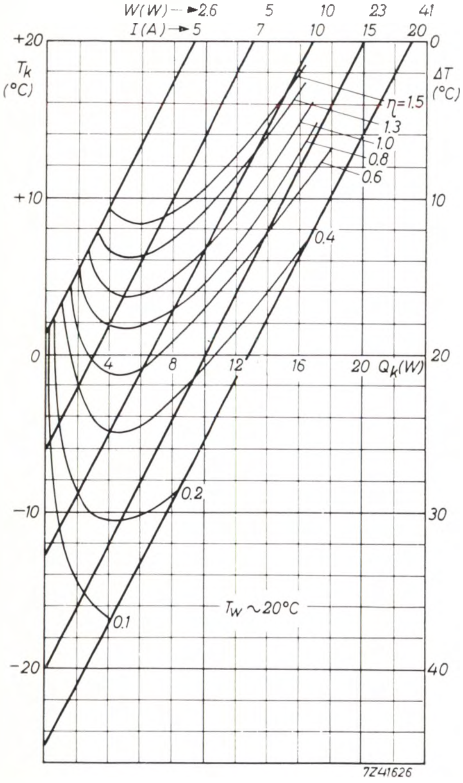
The battery should be fed by d.c. Adequate heat removal on the hot side should be provided; a short period of operation without cooling will cause destruction of the battery. The terminals on which the polarity is indicated, should never be reversed. For protection against oxidation the contact surfaces are provided with a protecting layer, which must be removed before use.

PELTIER BATTERIES

HIGH CURRENT TYPE PT 20/20

The Peltier-battery PT 20/20 is a 2V cooling unit, which consists of a series connection of 20 semiconductor thermoelements made of bismuth telluride.

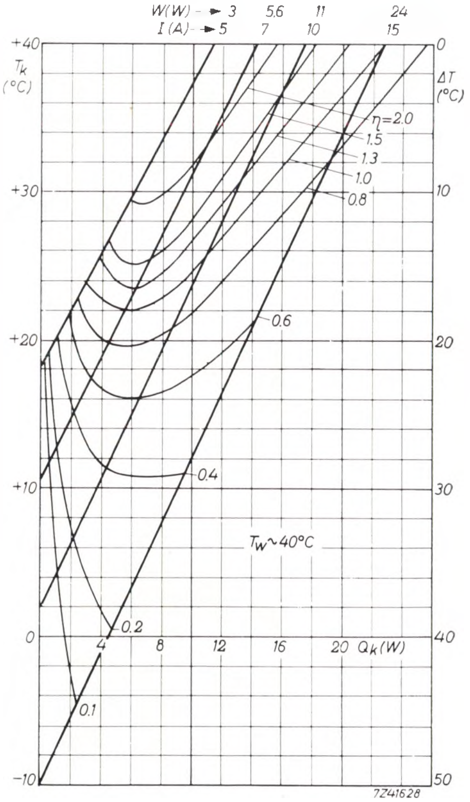
The unit is so designed that adequate insulation is ensured, so that the designer is free from the difficult problem of electric insulation. The easily accessible mounting holes permit easy mounting of heat exchangers or water containers, and facilitate fixing to a wall of a vessel. Mounting of the cooling unit can be done in any position. If a big cooling capacity is required, several units can be combined.



Cooling capacity and current versus temperature, measured for a warm-side **temperature of 20 °C.**

T_k = temperature of the cold plate.

Q_k = cooling capacity in watts.

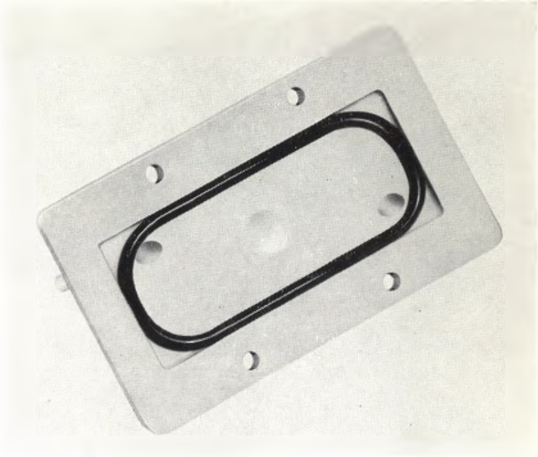


Cooling capacity and current versus temperature, measured for a warm-side **temperature of 40 °C.**

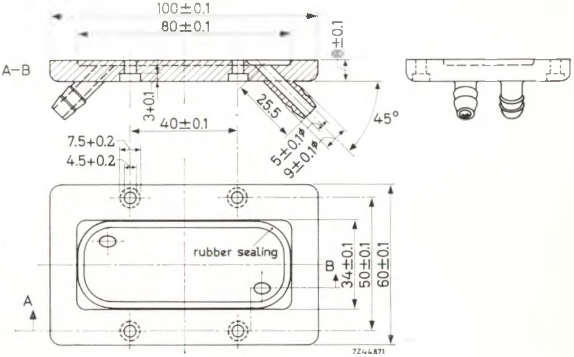
T_k = temperature of the cold plate.

Q_k = cooling capacity in watts.

HIGH CURRENT TYPE PT 20/20

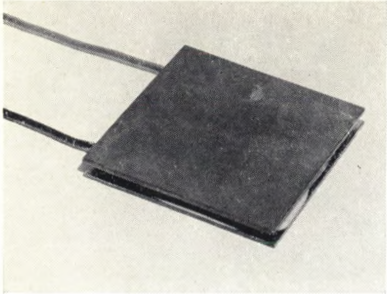


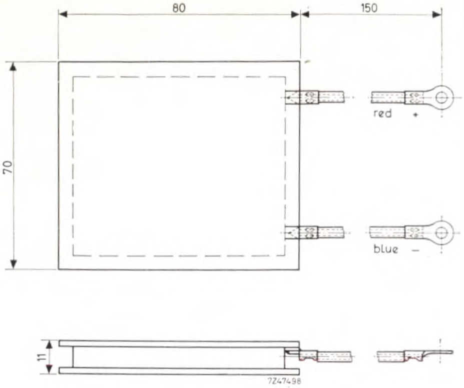
Cooling device to be attached to the warm side of this particular type, type number AM450071.0

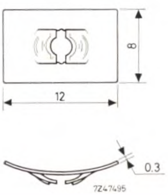


PELTIER BATTERIES

TYPE PT 48/6







Spring nut (fits M3 screw)

The Peltier battery PT 48/6 is a cooling unit which is, because of its low current (max. 6A), very suitable for cooling purposes in which the cooling capacity must be controlled.

weight	310 g
maximum working current	6 A_{dc}
voltage at max. working current	approx. 4.8 V_{dc}
internal resistance	approx. 800 mΩ
maximum $\Delta T(T_w = 20\ °C)$	48 deg. C
maximum cooling capacity ($\Delta T = 0$)	13.5 W
maximum permissible temperature	100 °C

The unit consist of 48 (semiconductor) thermoelements made of bismuth telluride which are connected in series electrically. Adequate electrical insulation is ensured. The battery is very robust and is protected against humidity by means of a caoutchouc layer. It can be mounted in any position by means of the six additional M3 spring nuts.

A larger cooling capacity can be achieved by combining several batteries.

The battery is also available provided with one or two liquid containers, soldered to the warm and/or the cold side, with two terminals for rubber or plastic tubing.

The warm side of the battery is marked with a red stripe.