PHILIPS

Data handbook

Electronic components and materials

Components and materials

Part 4a October 1976

Soft ferrites

COMPONENTS AND MATERIALS

Part 4a **October 1976**

Properties of manganese zinc and nickel zinc ferrites	A
Ferrites for radio, audio and television	B
Beads and chokes	C
Ferroxcube potcores and square cores	D
Ferroxcube transformer cores	E
Index of catalogue numbers	
Contents	

MANY ASSEMBLIES USING FERRITES
ARE DESCRIBED IN PART 3

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, subassemblies and materials; it is made up of three series of handbooks each comprising several parts.

ELECTRON TUBES	**BLUE**
SEMICONDUCTORS AND INTEGRATED CIRCUITS	**RED**
COMPONENTS AND MATERIALS	**GREEN**

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

ELECTRON TUBES (BLUE SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a	**Transmitting tubes for communication and Tubes for r.f. heating Types PE05/25 – TBW15/125**	**December 1975**
Part 1b	**Transmitting tubes for communication** **Tubes for r.f. heating** **Amplifier circuit assemblies**	**January 1976**
Part 2	**Microwave products** Communication magnetrons Magnetrons for microwave heating Klystrons Travelling-wave tubes Diodes Triodes T-R Switches Microwave semiconductor devices Isolators – circulators	**May 1976**
Part 3	**Special Quality tubes;** **Miscellaneous devices**	**January 1975**
Part 4	**Receiving tubes**	**March 1975**
Part 5a	**Cathode-ray tubes**	**August 1975**
Part 5b	**Camera tubes; Image intensifier tubes**	**May 1975**
Part 6	**Products for nuclear technology** Channel electron multipliers Geiger-Mueller tubes Neutron tubes	**July 1975**
Part 7	**Gas-filled tubes** Voltage stabilizing and reference tubes Counter, selector, and indicator tubes Trigger tubes Switching diodes Thyratrons Ignitrons Industrial rectifying tubes High-voltage rectifying tubes	**August 1975**
Part 8	**TV Picture tubes**	**October 1975**
Part 9	**Photomultiplier tubes** **Phototubes (diodes)**	**June 1976**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1a Rectifier diodes, thyristors, triacs — **March 1976**

Rectifier diodes
Voltage regulator diodes (> 1,5 W)
Transient suppressor diodes
Rectifier stacks
Thyristors
Triacs

Part 1b Diodes — **October 1975**

Small signal germanium diodes
Small signal silicon diodes
Special diodes
Voltage regulator diodes (< 1,5 W)
Voltage reference diodes
Tuner diodes

Part 2 Low-frequency transistors — **December 1975**

Part 3 High-frequency and switching transistors — **April 1976**

Part 4a Special semiconductors — **June 1976**

Transmitting transistors
Microwave devices
Field-effect transistors
Dual transistors
Microminiature devices for thick- and thin-film circuits

Part 4b Devices for optoelectronics — **July 1976**

Photosensitive diodes and transistors
Light emitting diodes
Displays
Photocouplers
Infrared sensitive devices
Photoconductive devices

Part 5 Linear integrated circuits — **March 1975**

Part 6 Digital integrated circuits — **May 1976**

LOCMOS HE family
GZ family

COMPONENTS AND MATERIALS (GREEN SERIES)

This series consists of the following parts, issued on the dates indicated.

Part 1 **Functional units, Input/output devices, Peripheral devices** **November 1975**

High noise immunity logic FZ/30-Series
Circuit blocks 40-Series and CSA70
Counter modules 50-Series
NORbits 60-Series, 61-Series
Circuit blocks 90-Series
Input/output devices
Hybrid integrated circuits
Peripheral devices

Part 2a **Resistors** **February 1976**

Fixed resistors
Variable resistors
Voltage dependent resistors (VDR)
Light dependent resistors (LDR)
Negative temperature coefficient thermistors (NTC)
Positive temperature coefficient thermistors (PTC)
Test switches

Part 2b **Capacitors** **April 1976**

Electrolytic and solid capacitors
Paper capacitors and film capacitors
Ceramic capacitors
Variable capacitors

Part 3 **Radio, Audio, Television** **February 1975**

FM tuners
Loudspeakers
Television tuners and aerial input assemblies
Components for black and white television
Components for colour television

Part 4a **Soft ferrites** **October 1976**

Ferrites for radio, audio and television
Beads and chokes
Ferroxcube potcores and square cores
Ferroxcube transformer cores

Part 4b **Piezoelectric ceramics, Permanent magnet materials** **May 1975**

Part 5 **Ferrite core memory products** **July 1975**

Ferroxcube memory cores
Matrix planes and stacks
Core memory systems

Part 6 **Electric motors and accessories** **September 1975**

Small synchronous motors
Stepper motors
Miniature direct current motors

Part 7 **Circuit blocks** **September 1971**

Circuit blocks 100 kHz-Series
Circuit blocks 1-Series
Circuit blocks 10-Series
Circuit blocks for ferrite core memory drive

Part 8 **Variable mains transformers** **July 1975**

Part 9 **Piezoelectric quartz devices** **March 1976**

Part 10 **Connectors** **November 1975**

Properties of manganese-zinc and nickel-zinc ferrites

Introduction	A3
Application	A4
Symbols	A5
Technical data	A11
Characteristic curves	A19

INTRODUCTION

The Ferroxcube *) range of manganese-zinc and nickel-zinc magnetically soft ferrites are intended for use as core material in coils and transformers operating over a wide range of frequencies. Ferroxcube is a ceramic material, manufactured from high-grade raw materials of controlled composition; the composition defines the electrical and mechanical properties.

Ferroxcube products are made by a sequence of ceramic techniques: mixing, pre-firing, milling, drying, shaping by pressing or extrusion, sintering and machining. The finished products have a stable structure and high electrical resistivity. This electrical resistivity allows them to be used at high frequencies without the eddy current losses becoming prohibitively high.
Ferroxcube is made in a wide range of permeabilities.

Ferroxcube cores are available in convenient shapes such as potcores, square cores, E and I-cores, EC-cores, X-cores, U-cores, toroids, aerial rods, yoke rings, screw cores, rods and tubes.
Potcores, square cores, E and I-cores and X-cores enable well-defined air gaps to be used without introducing appreciable stray fields. In this way the permeability of the material may be reduced to an effective value at which core and copper losses are matched. The dependence of the permeability on temperature and time is furthermore reduced to values that guarantee correct operation of the equipment.

This section contains comprehensive data on manganese-zinc ferrites (Ferroxcube 3) and nickel-zinc ferrites (Ferroxcube 4) and their various grades.

*) Our trade name for magnetically soft ferrites.

APPLICATION

The various material grades of Ferroxcube 3 and Ferroxcube 4 and their application as cores are listed in the table below.

grade	available core shapes
3B	potcores, rods, tubes
3B3	frames for i.f. transformers, potcores, rods, screw cores
3B7	potcores and square cores
→ 3B8	potcores, square cores, cross cores (with d.c. polarization)
3C2	yoke rings, L-cores, tooth cores
3C6	E and U-cores, rods, tubes
→ 3C7	E and I-cores, U-cores
3C8	U and I-cores, E-cores, EC-cores for power applications
3D3	potcores, square cores, screw cores
3E1	E and I-cores, toroids, potcores
3E2	H-cores and toroids
3E3	toroids
3E4	potcores and square cores
→ 3E5	square cores
3H1	potcores, square cores, small toroids, cross cores
3H2	tubes, rods, tooth cores
→ 3H3	potcores, square cores
4A4	frames for i.f. transformers
4A10	aerial rods
4B1	frames for i.f. transformers, rods and tubes
4C1	rods and tubes
4C6	potcores, square cores, toroids, frames for i.f. transformers, rods and tubes
4D1, 4D2, 4E1	frames for i.f. transformers, screw cores, tubes and rods
→ 4D3	square cores, cross cores
4H1, 4L1, 4L2, 4MX	These are special-purpose NiZn ferrites developed for one type of application, namely resonant cavities for particle accelerators. In this field, a technical discussion is usually necessary before the correct material can be determined.

Note : For ordering cores please quote the 12-digit catalogue number given in the data of the relevant core.

SYMBOLS AND DEFINITIONS OF TERMS
(in accordance with IEC401 and IEC125)

l_e — effective length of the magnetic path in mm

A_e — cross-section of a homogeneous part of a core in mm^2

$A_{e\,min}$ — minimum cross-section of a homogeneous part of a core in mm^2

C_1 — core constant = the summation of the effective core lengths divided by the effective area, expressed in mm^{-1}

$$C_1 = \Sigma \frac{l_e}{A_e}$$

V_e — effective volume of a core in mm^3 = volume of an ideal toroid in the same material grade and with the same magnetic properties as the core. V_e is calculated from:

$$V_e = \frac{\left(\Sigma \frac{l_e}{A_e}\right)^3}{\left(\Sigma \frac{l_e}{A_e^2}\right)^2} \; mm^3$$

μ_i — relative initial permeability = the ratio of the induction change ΔB to the field strength change ΔH, measured on a magnetic closed circuit without air gap. The magnetization is executed with a very small field change $\Delta H \to 0$. (We recommend $B \le 0,1$ mT.)

$$\mu_i = \frac{1}{\mu_0} \lim_{H \to 0} \frac{B}{H}$$

μ_Δ — relative incremental permeability; dependent on a d.c. polarization on which a very small sinusoidal signal with $B \to 0$ is superimposed. This a.c. signal is so small that the small ellipse becomes a straight line. The slope of the straight line is the relative incremental permeability. (We recommend $B \le 0,2$ mT and f = 4 kHz.)

$$\mu_\Delta = \frac{1}{\mu_0} \frac{\Delta B}{\Delta H}$$

μ_a — relative amplitude permeability = the permeability of a core with a larger a.c. signal than mentioned under μ_Δ, consequently the relative amplitude permeability is dependent on the induction B

$$\mu_a = \frac{1}{\mu_0} \frac{B}{H}$$

→ μ_e — relative effective permeability = permeability of a core with air gap

$$\mu_e = \frac{1}{\mu_0} \frac{\Sigma \frac{l_e}{A_e}}{\Sigma \frac{l_e}{\mu_i A_e}}$$

→ α_F — temperature factor of a core without air gap, defined by

$$\alpha_F = \frac{\mu_\theta - \mu_{ref}}{\mu_{ref}^2 (\theta - \theta_{ref})}, \text{ according to IEC 133,} \quad (1)$$

or

$$\alpha_F = \frac{\mu_\theta - \mu_{ref}}{\mu_\theta \cdot \mu_{ref} (\theta - \theta_{ref})}, \text{ according to IEC 367-1,} \quad (2)$$

α_F can be calculated more accurately with equation (2) than with equation (1), which was in use until 1976. The introduction of equation (2) becomes necessary for new products with small tolerances, or for products which are guaranteed over a wide temperature range. Equation (1) is maintained for products made from long-standing materials. Where data are given in accordance with equation (2), they are marked with an asterisk.

The temperature coefficient (α_μ) of a core with ground air gap, with a relative effective permeability μ_e, is approx.

$$\alpha_\mu = \alpha_F \cdot \mu_e$$

The temperature coefficient of a core with ground air gap, with an inductance factor A_L, is approx.

$$\alpha_\mu = \alpha_F \frac{C_1}{\mu_o} A_L$$

These approximate values of α_μ hold true when the change in μ_e or A_L in the temperature range considered is relatively small.

→ D_F — disaccommodation factor, gives the permeability variation, measured between 10 and 100 min after demagnetization

$$D_F = \frac{\mu_1 - \mu_2}{\mu_1^2 \log \frac{t2}{t1}}$$

Curie point — critical temperature in $^{\circ}C$ above which the ferromagnetic body is paramagnetic.

$\frac{\tan \delta}{\mu_i}$ constant for eddy current and residual losses together at a certain frequency, determined at $\hat{B} \leq 0,1$ mT across the coil. The resulting R/L value for eddy current and residual losses is:

$$\frac{R}{L} = \frac{\tan \delta}{\mu_i} \cdot \mu_e \cdot 2\pi f \Omega/H \text{ (f in Hz)}$$

η_B hysteresis constant, defined by:

$$\eta_B = \frac{\Delta R_h}{\Delta\hat{B} \cdot \mu \cdot 2\pi f \cdot L} \; T^{-1},$$

in which
$\Delta R_h = R_2 - R_1$ in Ω;
$\Delta\hat{B} = \hat{B}_2 - \hat{B}_1$ in T;
f in Hz;
L in H.
The series resistance R_1 is measured at the peak induction $\hat{B}_1$, followed directly by R_2 at $\hat{B}_2$.

The old hysteresis constant $q_{2-24-100}$ (not in accordance with IEC 401) is standardized for an effective volume $V_e = 24$ cm^3 and an effective permeability $\mu_e = 100$

$$q_{2-24-100} = 1,63 . 10^3 . \eta_B \; \frac{\Omega}{H^{3/2} \, mA}$$

$\hat{H}$	peak field strength in A/m
H_c	coercivity = field strength at which the induction in the core becomes zero, after the core has been magnetized to saturation
$\hat{B}$	peak induction in T
B_r	remanence = induction which remains in the core after the core has been magnetized to saturation and the field strength has been reduced to zero
Δ	length of the air gap in mm
L	inductance
α	turns factor = number of turns for 1 mH
A_L	inductance factor in nH/turn^2
AT	amperes x turns
N	number of turns
ρ	specific resistance in Ωm measured with d.c. current
→ μ_θ	permeability at a certain temperature θ
θ	temperature in ^{o}C
P	power loss in kW/m^3
E_1	fundamental voltage
E_3	third harmonic open-circuit voltage
f	frequency

Note

$0,1\ mT = 10^{-4}\ T = 10^{-4}\ Vs/m^2 = 10^{-4}\ Wb/m^2$ (= 1 Gs)

$1\ A/m = \frac{4\pi}{10^3}\ Oe\ (\approx \frac{1}{80}\ Oe)$

$\mu_0 = 4\pi . 10^{-7}\ H/m$ (= 1 Gs/Oe)

Formulae

$$L = \frac{\mu_0 . \mu_e . N^2 . 10^{-3}}{C_1} \text{ H}$$

$$N = \sqrt{\frac{L . 10^9}{A_L}} \text{ turns or } N = \alpha \sqrt{L . 10^3} \text{ turns}$$

$$\hat{B} = \frac{E}{4,44 . f . N . A_e} \text{ T (for a sine wave)}$$

$$Q = \frac{1}{\tan \delta_{tot}}$$

$$\frac{E_3}{E_1} = 0,6 . \tan \delta_h \text{ (third harmonic distortion)}$$

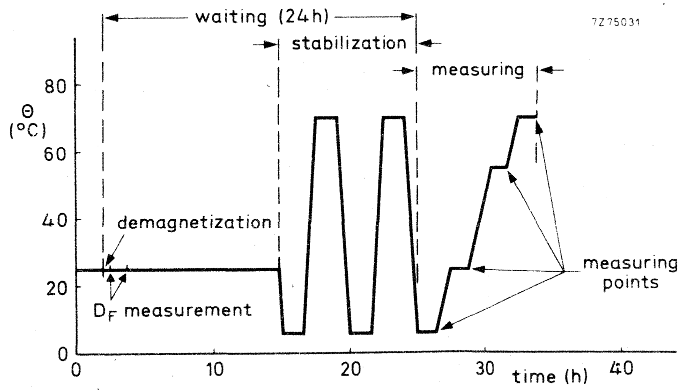
$$\tan \delta_h = \mu . \hat{B} . \eta_B$$

TECHNICAL DATA

Specific heat at 25 °C		
MnZn ferrites (FXC3)	1100 J/kg °C	approx. values
NiZn ferrites (FXC4)	750 J/kg °C	
Thermal conductivity at 25 to 85 °C	3,5 to 4,3 W/m °C	
Coefficient of linear expansion	10^{-5}/°C	
Modulus of elasticity	15 x 10^4 N/mm^2	
Tensile strength	18 N/mm^2	
Crushing strength	73 N/mm^2	

The tables on the following pages are in accordance with IEC 401.
Notes to these tables :

- The figures mentioned are valid for toroids of not too small dimensions and should be considered as a guide. For cores of small dimensions and of different shapes, translation of these figures in a straightforward way is not always possible.
  For guarantees on products the pages on the relevant products should be consulted.
- The temperature factor α_F is determined on circuits without ground air gap, with the exception of 3B7 products for which α_F is measured on toroidally wound core halves. For FXC3 products the measuring sequence is given in the graph below. 3B7 products however, are measured 10 min after demagnetization at each measuring temperature. (D_F measurement is done between 10 and 100 min after demagnetization.)
  The measuring circuits for FXC4 products are thermally demagnetized by heating above the Curie temperature; they are then cooled down slowly to room temperature, again given 24 hours waiting time, etc.



	unit	3B	3B3	
Initial permeability μ_i				
at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C		900 ± 20%	900 ± 20%	
at $\hat{B} = 0,7\text{-}1$ mT, $\theta = 10\text{-}70$ °C				
at $\hat{B} = 0,7\text{-}1$ mT, $\theta = 25\text{-}70$ °C				
Induction B, ballistically measured at				
H = 250 A/m, $\theta = 25$ °C	mT			
$\theta = 100$ °C	mT			
H = 800 A/m, $\theta = 25$ °C	mT	~345		
$\theta = 70$ °C	mT			
$\theta = 100$ °C	mT	~230		
Eddy current and residual loss factor $\frac{\tan\delta}{\mu_i}$ at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C,				
f = 4 kHz	$\times 10^{-6}$		≤ 7	
f = 50 kHz	$\times 10^{-6}$			
f = 100 kHz	$\times 10^{-6}$		≤ 15	
f = 250 kHz	$\times 10^{-6}$		≤ 27	
f = 450 kHz	$\times 10^{-6}$	≤ 50	≤ 50	
f = 500 kHz	$\times 10^{-6}$			
f = 1000 kHz	$\times 10^{-6}$			
Power loss P at 16 kHz, $\hat{B} = 200$ mT				
$\theta = 25$ °C	kW/m³ (= mW/cm³)			
$\theta = 50$ °C	kW/m³ (= mW/cm³)			
$\theta = 100$ °C	kW/m³ (= mW/cm³)			
Hysteresis material constant,				
η_B at $\hat{B} = 0,3\text{-}1,2$ mT, f = 100 kHz, $\theta = 25$ °C	$\times 10^{-3}\ T^{-1}$			
$\hat{B} = 1,5\text{-}3,0$ mT, f = 4 kHz, $\theta = 25$ °C	$\times 10^{-3}\ T^{-1}$		≤ 7,4	
or				
$q_{2\text{-}24\text{-}100}$, at $\hat{B} = 0,3\text{-}1,2$ mT, f = 100 kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA			
$\hat{B} = 1,5\text{-}3,0$ mT, f = 4 kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA		≤ 12	
Resistivity ρ measured with d. c. current	Ω m	≥ 0,2	≥ 1	
Disaccommodation factor D_F, between 10 and 100 min after demagnetization at $\hat{B} \leq 0,1$ mT, $\theta = 25 \pm 1$ °C	$\times 10^{-6}$	≤ 10	≤ 11	
Temperature factor of permeability				
α_F at $\hat{B} \leq 0,1$ mT, θ = +5 to +25 °C	$\times 10^{-6}$/°C			
+25 to +55 °C	$\times 10^{-6}$/°C	0 to +3	0 to +2	
+25 to +70 °C	$\times 10^{-6}$/°C			
Curie point	°C	≥ 150	≥ 150	
Mass density	kg/m³	4700-4900	4700-4900	

3B7	3B8	3C2	3C6	3C7	3C8
2300 ± 20%	2300 ± 20%	900 ± 25%	1700 ± 25%	2400 ± 20%	2000 ± 25%
~430 ~345	~300 ~490 ~420 ~380	~350 ~245	≥ 290	≥ 330	≥ 330
≤ 1 ≤ 5	≤ 1,2 ≤ 5				
			≤ 170 ≤ 160 ≤ 140	≤ 140	≤ 110 ≤ 100
≤ 1,1 ≤ 1,8	≤ 1,0				
≥ 1	≥ 1	≥ 0,1	≥ 1	≥ 1	≥ 1
≤ 4,3	≤ 4,3				
-0,6 to +0,6	1 ± 1 1 ± 1	0 to +4,5		0 to +5	
≥ 170	≥ 200	≥ 150	≥ 190	≥ 190	≥ 200
4700-4900		4700-4900	4700-4900	4700-4900	4700-4900

	unit	3D3	3E1
Initial permeability μ_i			
at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C		750 ± 20%	3800 ± 20%
at $\hat{B} = 0,7\text{-}1$ mT, $\theta = 10\text{-}70$ °C			
at $\hat{B} = 0,7\text{-}1$ mT, $\theta = 25\text{-}70$ °C			
Induction B, ballistically measured at			
H = 250 A/m, $\theta = 100$ °C	mT		
H = 800 A/m, $\theta = 25$ °C	mT	~350	~350
$\theta = 70$ °C	mT		~270
Eddy current and residual loss factor			
$\frac{\tan\delta}{\mu_i}$ at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C			
f = 4 kHz	x 10^{-6}		≤ 2,5
f = 30 kHz	x 10^{-6}		
f = 50 kHz	x 10^{-6}		
f = 100 kHz	x 10^{-6}	≤ 8	≤ 20
f = 500 kHz	x 10^{-6}	≤ 14	≤ 200
f = 1000 kHz	x 10^{-6}	≤ 30	
Power loss P at 16 kHz, $\hat{B} = 200$ mT,			
$\theta = 25$ °C	kW/m³ (= mW/cm³)		
$\theta = 50$ °C	kW/m³ (= mW/cm³)		
$\theta = 100$ °C	kW/m³ (= mW/cm³)		
Hysteresis material constant			
η_B at $\hat{B} = 0,3\text{-}1,2$ mT, f = 100 kHz, $\theta = 25$ °C	x 10^{-3} T^{-1}	≤ 1,8	
$\hat{B} = 1,5\text{-}3,0$ mT, f = 4 kHz, $\theta = 25$ °C	x 10^{-3} T^{-1}		≤ 1,1
or			
$q_{2\text{-}24\text{-}100}$, at $\hat{B} = 0,3\text{-}1,2$ mT, f = 100 kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA	≤ 3	
$\hat{B} = 1,5\text{-}3,0$ mT, f = 4 kHz, $\theta = 25$ °C	$\Omega/H^{3/2}$ mA		≤ 1,8
Resistivity ρ measured with d. c. current	Ωm	≥ 1,5	≥ 0,3
Disaccommodation factor D_F, between 10 and 100 min after demagnetization at $\hat{B} \leq 0,1$ mT, $\theta = 25 \pm 1$ °C	x 10^{-6}	≤ 12	
Temperature factor of permeability			
α_F at $\hat{B} \leq 0,1$ mT, $\theta = +5$ to $+25$ °C	x 10^{-6}/°C		1 ± 1
+25 to +55 °C	x 10^{-6}/°C		1 ± 1
+25 to +70 °C	x 10^{-6}/°C	0 to +2	1 ± 1
Curie point	°C	≥ 150	≥ 125
Mass density	kg/m³	4500-4900	4700-4900

3E2	3E3	3E4	3E5	3H1	3H2	3H3
≥ 5000	≥ 10 000	4700 ± 20%	10 000 ± 20%	2300 ± 20%	2300 ± 20%	2000 ± 20%
~ 355 ~ 260	~ 380 ~ 280			~ 360 ~ 280	400	
≤ 2,5 ≤ 15	≤ 2,5 ≤ 20 ≤ 50	≤ 2,5 ≤ 20 ≤ 200	≤ 5 ≤ 50 ≤ 100	≤ 1 ≤ 5	≤ 1 ≤ 5	1,2 ± 0,4 2 ± 0,5
≤ 1,1 ≤ 1,8	≤ 1,1 ≤ 1,8	≤ 0,85 ≤ 1,4	≤ 1,1	≤ 1,1 ≤ 1,8	≤ 1,1	≤ 0,5 (at 100 kHz : ≤ 0,6)
≥ 0,1	≥ 0,05	≥ 0,3		≥ 1	≥ 1	
≤ 1,9	≤ 1,9	≤ 4,3	≤ 4,3	≤ 4,3	≤ 4,3	≤ 3,0 [1]
		1 ± 1 1 ± 1 1 ± 1	1 ± 1 1 ± 1 1 ± 1	1 ± 0,5 1 ± 0,5 1 ± 0,5	1,2 ± 0,6 1,2 ± 0,6 1,2 ± 0,6	0,7 ± 0,25 0,7 ± 0,25 0,7 ± 0,25
≥ 130	≥ 125	≥ 125	≥ 125	≥ 130	≥ 160	≥ 160
4700-4900	4800-4950	4700-4900		4700-4900	4700-4900	

[1]) At any temperature between 25 and 70 ^{o}C.

	unit	4A4	4B1
Initial permeability μ_i at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C		500 ± 20%	250 ± 20%
Induction B, ballistically measured at			
H = 800 A/m, θ = 25 °C	mT	~270	
θ = 70 °C	mT	~210	
H = 1600 A/m, θ = 25 °C	mT		~325
θ = 100 °C	mT		~260
H = 2000 A/m, θ = 25 °C	mT		
θ = 70 °C	mT		
H = 2400 A/m, θ = 25 °C	mT		
θ = 70 °C	mT		
θ = 100 °C	mT		
H = 3200 A/m, θ = 25 °C	mT		
θ = 100 °C	mT		
H = 4800 A/m, θ = 25 °C	mT		
θ = 100 °C	mT		
Eddy current and residual loss factor $\frac{\tan \delta}{\mu_i}$ at $\hat{B} \leq 0,1$ mT, $\theta = 25$ °C,			
f = 500 kHz	x 10^{-6}	≤ 30	
f = 700 kHz	x 10^{-6}		≤ 70
f = 1 MHz	x 10^{-6}		≤ 90
f = 1,5 MHz	x 10^{-6}	≤ 40	≤ 140
f = 2 MHz	x 10^{-6}	≤ 70	
f = 3 MHz	x 10^{-6}		
f = 5 MHz	x 10^{-6}		
f = 10 MHz	x 10^{-6}		
f = 25 MHz	x 10^{-6}		
f = 40 MHz	x 10^{-6}		
Hysteresis material constant, η_B at $\hat{B}$ = 0,3-1,2 mT, f = 100 kHz, θ = 25 °C	x 10^{-3} T^{-1}	≤ 1,8	
or $q_{2-24-100}$ at $\hat{B}$ = 0,3-1,2 mT, f = 100 kHz, θ = 25 °C	$\Omega/H^{3/2}$ mA	≤ 3	
Resistivity ρ measured with d.c. current	Ωm	≥ 10^3	≥ 10^3
Dielectric constant ϵ at 1 MHz, θ = 25 °C		15-20	
Disaccommodation factor D_F, between 10 and 100 min after demagnetization, $\hat{B} \leq 0,1$ mT, $\theta = 25 \pm 1$ °C	x 10^{-6}	≤ 5	
Temperature factor of permeability α_F at $\hat{B} < 0,1$ mT, θ = +5 to +25 °C	x 10^{-6}/°C		
+25 to +55 °C	x 10^{-6}/°C		0 to +8
+25 to +70 °C	x 10^{-6}/°C	10 ± 5	
Curie point	°C	≥ 135	≥ 250
Mass density	kg/m^3	4700-5100	4400-4800

4C1	4C6	4D1	4D2	4D3	4E1
125 ± 20%	120 ± 20%	50 ± 20%	60 ± 10%	50 ± 30%	15 ± 20%
~275 ~245	~380 ~350	~240 ~220			~175 ~165
≤ 120 ≤ 160 ≤ 300	≤ 40 ≤ 100	≤ 180 ≤ 210 ≤ 300	≤ 100 ≤ 200 ≤ 600	≤ 100 ≤ 200 ≤ 600	≤ 300 ≤ 360
	≤ 6,1 ≤ 10				
≥ 10^3	≥ 10^3	≥ 10^3	≥ 10^3		≥ 10^3
	10-15				
	≤ 10				
0 to+12	1 ± 3 3 ± 3	0 to+15	0 to +15	0 to+15	0 to +15
≥ 350	≥ 350	≥ 400	≥ 350		≥ 500
4200-4600	4000-5000	4000-4400			3500-4000

NiZn ferrites for resonant cavities

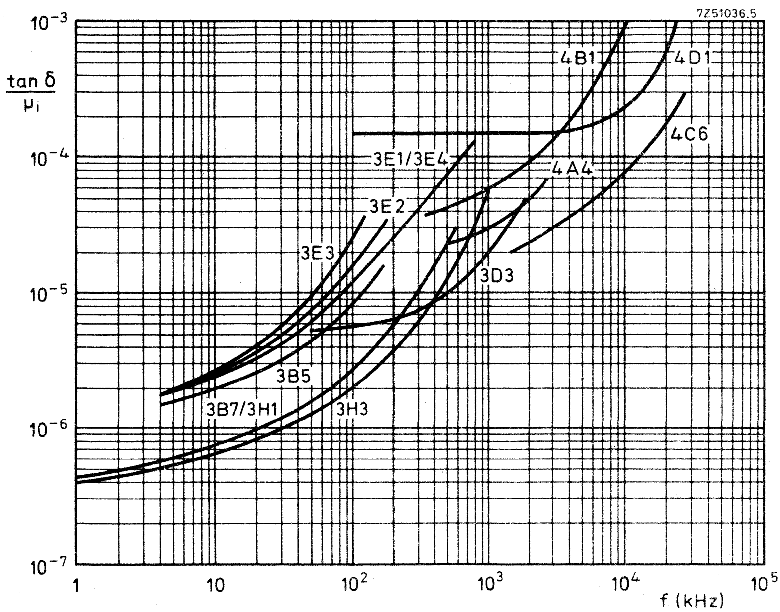
	4H1	4L1	4L2	4MX
Q80/Q~	0,9	0,7	0,7	0,8
μ_{rem}/μ_i	0,6-0,7	0,7-0,8	0,8-0,9	0,8-0,9
μ in remanent state (μ_{rem}) approx.	170	150	190	130
μQ in remanent state at 1,5 MHz, 5 mT	21400	17800	21400	21800
at 1,5 MHz, 10 mT	16000	14000	17000	20500
at 1,5 MHz, 15 mT	12800	11200	14000	18800
at 1,5 MHz, 20 mT	8600	9200	9700	14000
at 2,5 MHz, 5 mT	15000	13000	17000	
at 2,5 MHz, 10 mT	6000	7200	14500	
at 2,5 MHz, 15 mT		5000	11000	
at 2,5 MHz, 20 mT			8200	
at 5 MHz, 5 mT	5000	10600	12000	19200
at 5 MHz, 10 mT		4600	9700	16000
at 5 MHz, 15 mT			6700	12500
at 5 MHz, 20 mT			4500	5600
at 10 MHz, 5 mT		4200		11200
at 10 MHz, 10 mT				8200
at 10 MHz, 15 mT				5600

Q80/Q~ indicates the properties under pulse conditions.
Q80 is the quality factor 80 milliseconds after application of a continuous bias of approx. 4000 A/m.
Q~ is the quality factor in the static state.
μ_{rem}/μ_i indicates the squareness of the hysteresis loop.

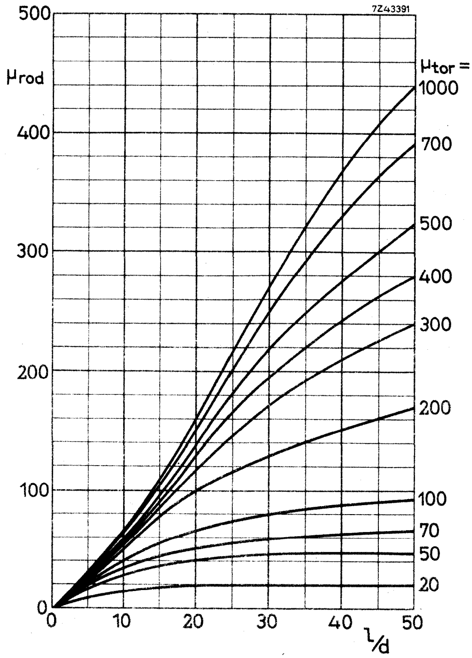
CHARACTERISTIC CURVES

The curves are valid for toroids of not too small dimensions and should be considered as a guide. For guarantees on products, refer to the pages on the relevant products.

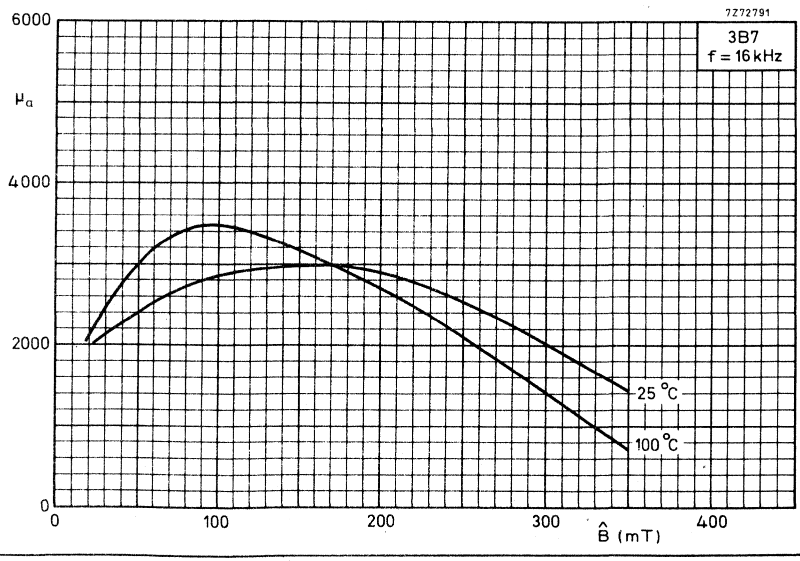
EDDY CURRENT LOSSES AND RESIDUAL LOSSES AS A FUNCTION OF THE FREQUENCY AT LOW INDUCTION LEVEL

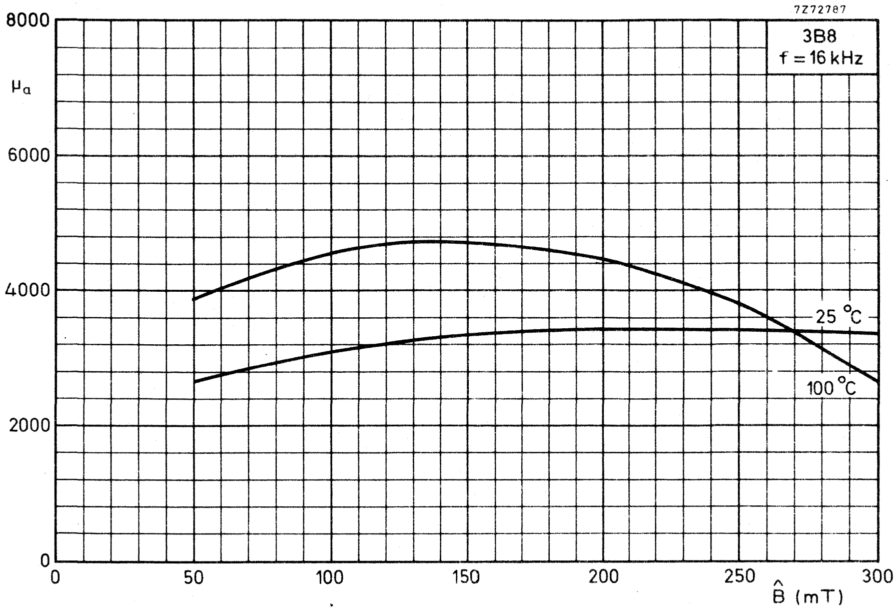


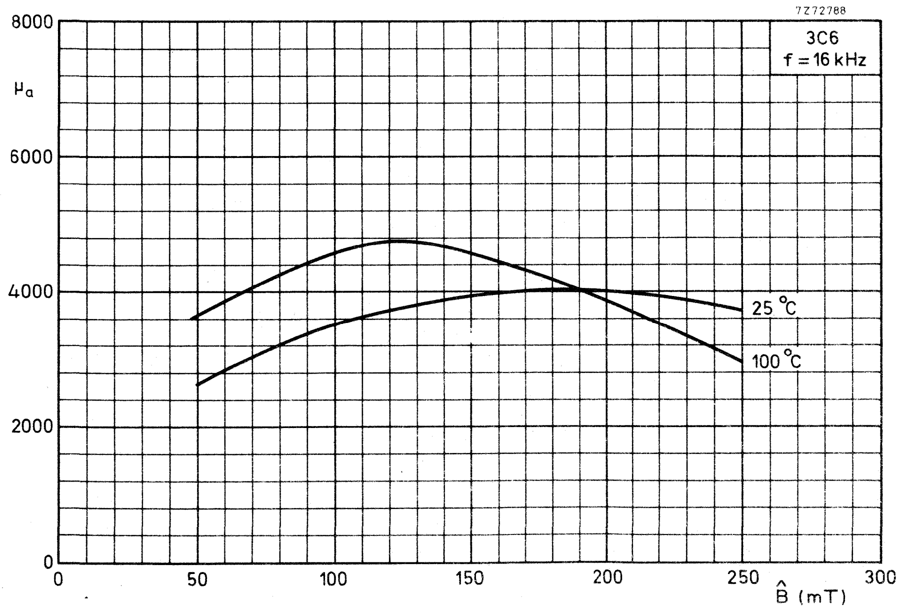
ROD PERMEABILITY AS A FUNCTION OF THE RATIO l/d WITH THE RELATIVE INITIAL PERMEABILITY OF A TOROIDAL CORE AS PARAMETER

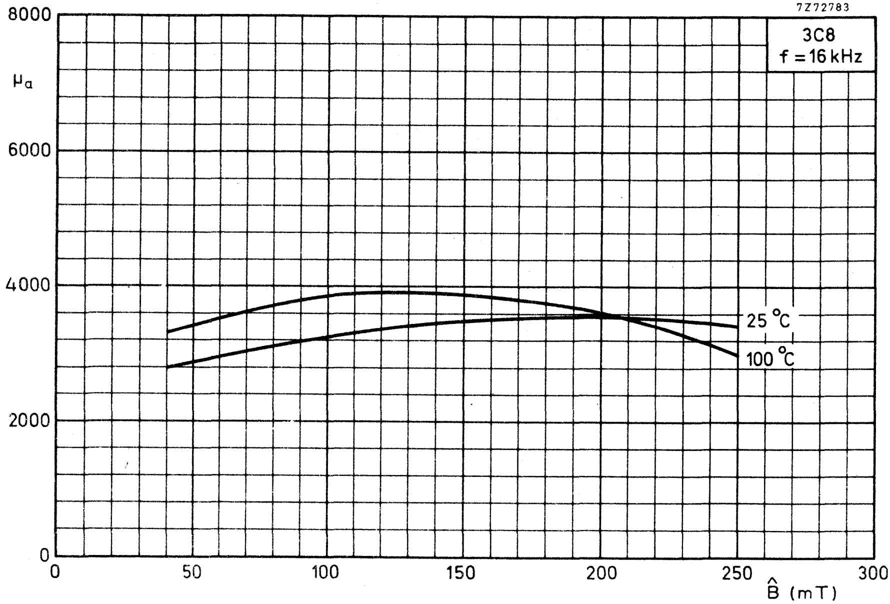


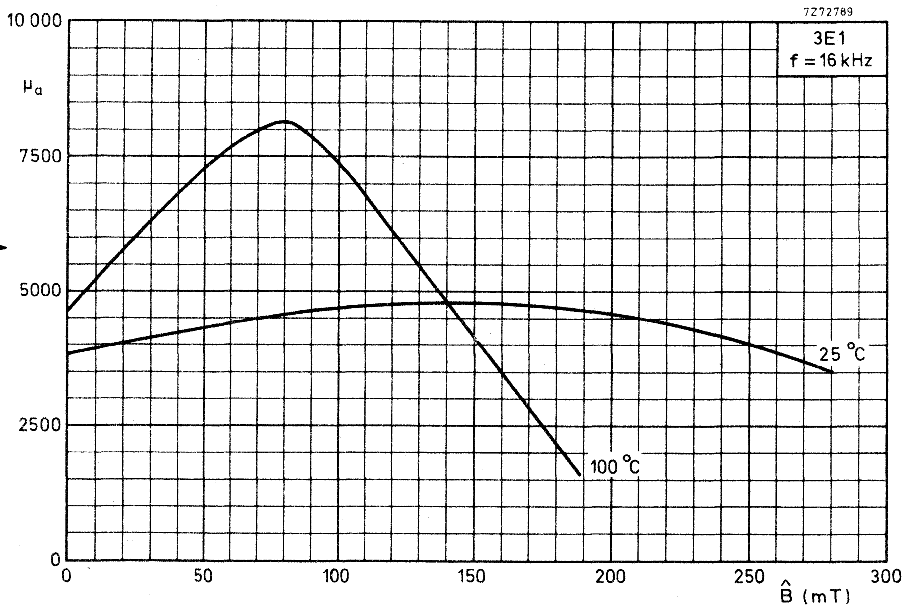
AMPLITUDE PERMEABILITY AS A FUNCTION OF THE INDUCTION

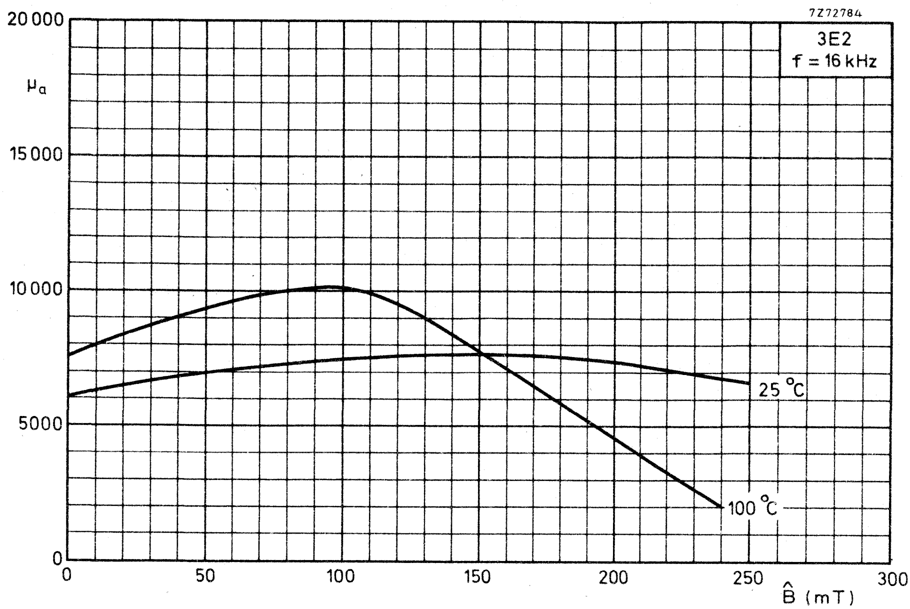


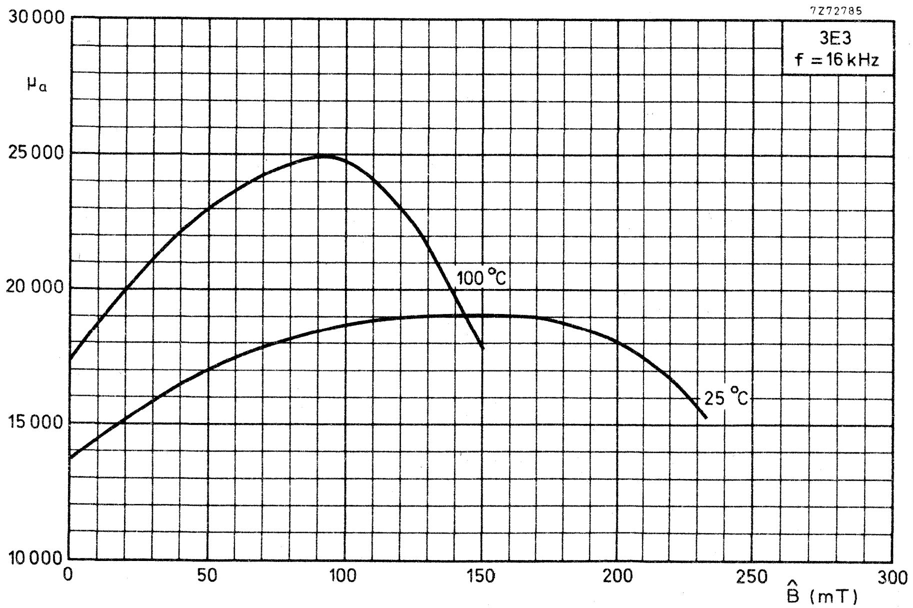

7Z72787
3B8
f = 16 kHz
8000
μ_a
6000
4000
2000
0
0
50
100
150
200
250
300
$\hat{B}$ (mT)
25 °C
100 °C

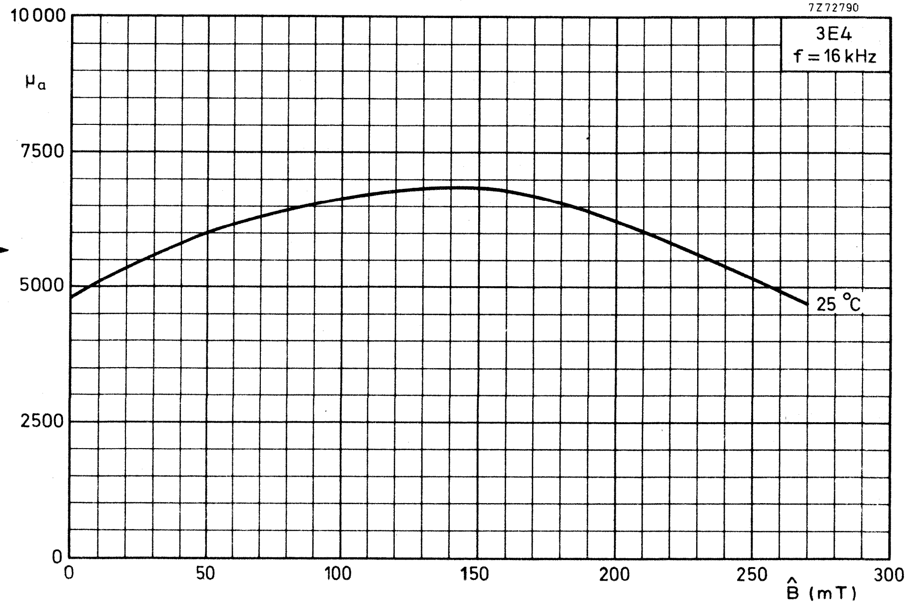

7Z72788
3C6
f = 16 kHz
8000
μ_a
6000
4000
2000
0
0
50
100
150
200
250
300
$\hat{B}$ (mT)
25 °C
100 °C

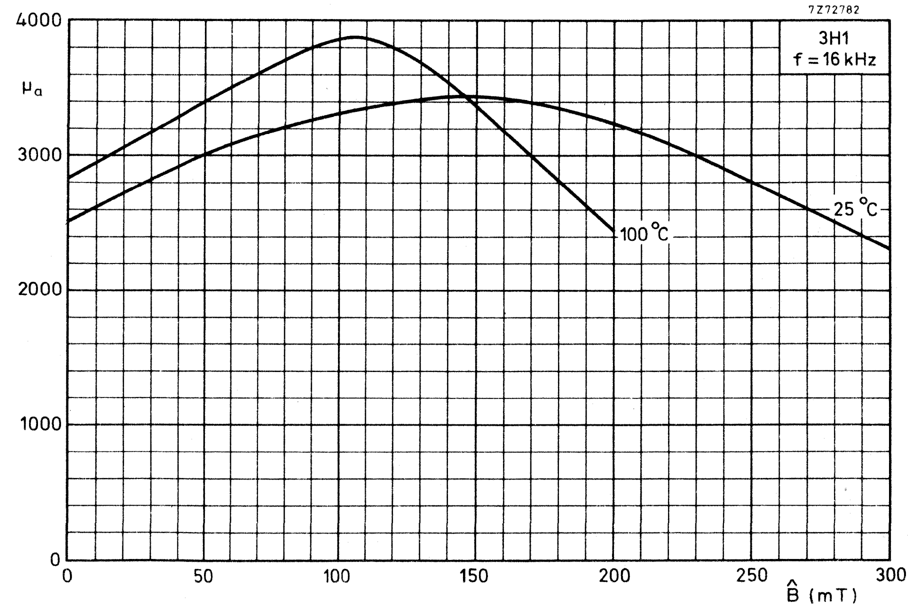

7Z72783
3C8
f = 16 kHz
μa
8000
6000
4000
2000
0
0
50
100
150
200
250
300
B̂ (mT)
25 °C
100 °C

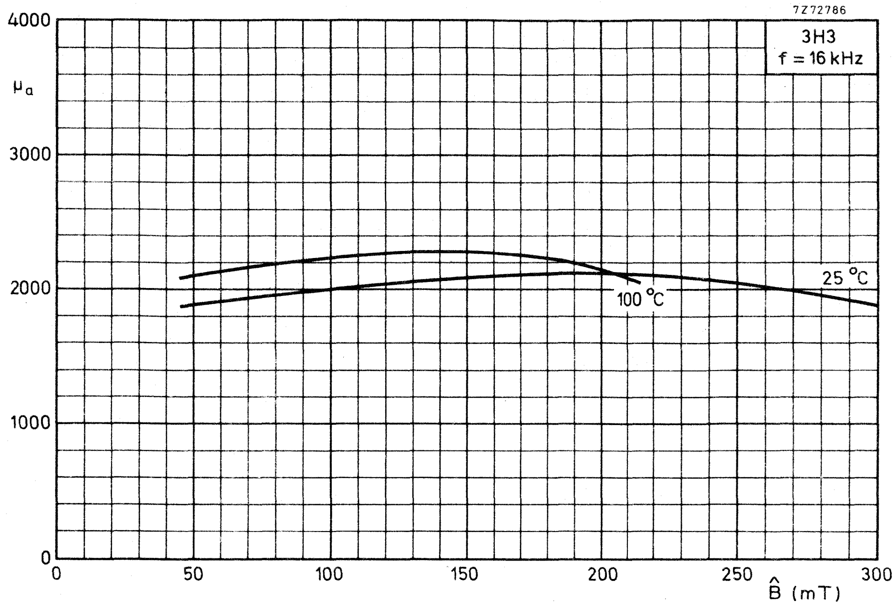

7Z72789
3E1
f = 16 kHz
μa
10 000
7500
5000
2500
0
0
50
100
150
200
250
300
B̂ (mT)
25 °C
100 °C


7Z72784
3E2
f = 16 kHz
μa
20 000
15 000
10 000
5000
0
0
50
100
150
200
250
300
B̂ (mT)
25 °C
100 °C


7Z72785
3E3
f = 16 kHz
μa
30 000
25 000
20 000
15 000
10 000
0
50
100
150
200
250
300
B̂ (mT)
100 °C
25 °C

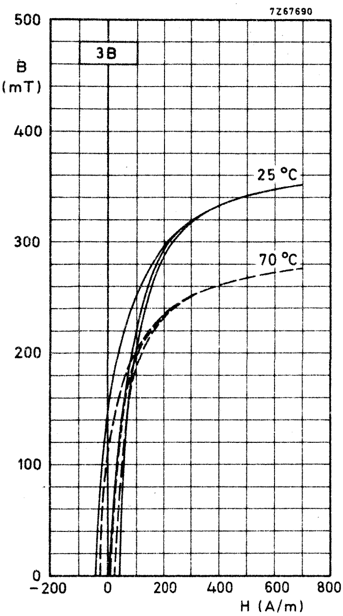

7Z72790
3E4
f = 16 kHz
10 000
μ_a
7500
5000
2500
0
0
50
100
150
200
250
300
25 °C
$\hat{B}$ (mT)

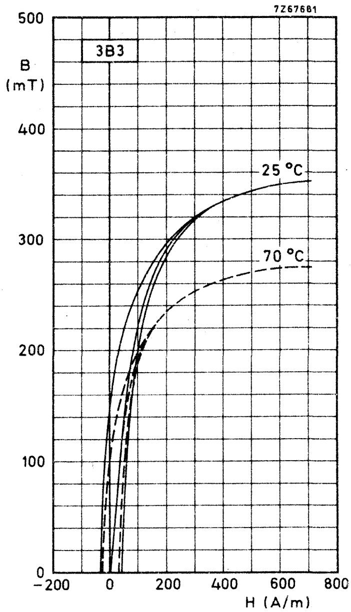

7Z72782
3H1
f = 16 kHz
4000
μ_a
3000
2000
1000
0
0
50
100
150
200
250
300
100 °C
25 °C
$\hat{B}$ (mT)

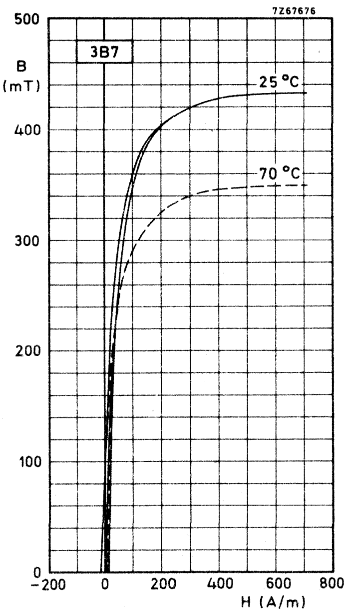

7Z72786
3H3
f = 16 kHz
4000
μ_a
3000
2000
1000
0
0
50
100
150
200
250
300
$\hat{B}$ (mT)
100 °C
25 °C

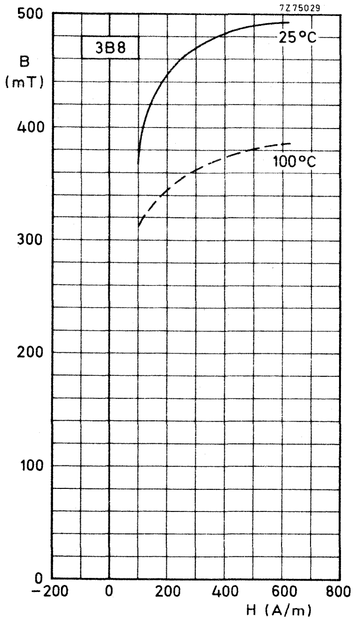

7Z65907
4C6
f=16 kHz
500
μ_a
400
300
200
100
0
0
100
200
300
400
$\hat{B}$ (mT)
70 °C
25 °C

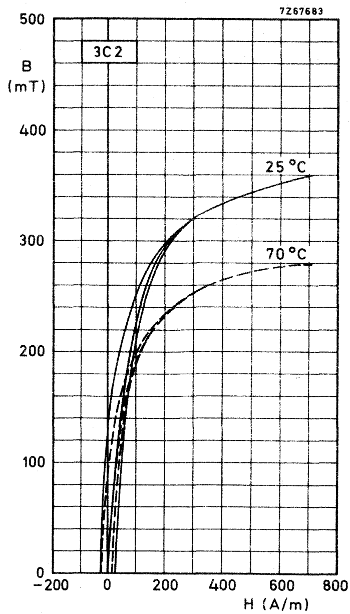
TYPICAL BH-CURVES (measured ballistically)

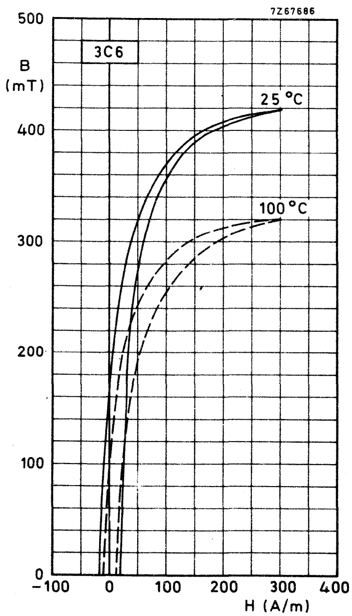


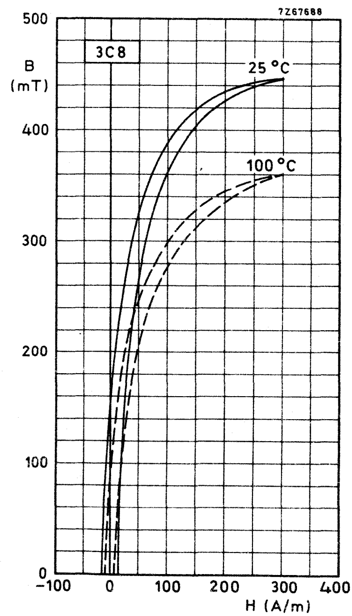


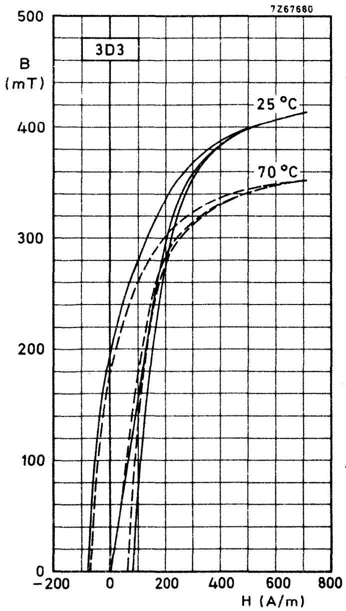


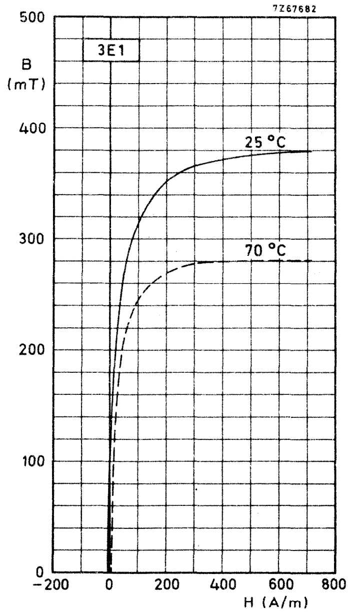

7Z75029
3B8
B (mT)
25 °C
100 °C
500
400
300
200
100
0
−200
0
200
400
600
800
H (A/m)

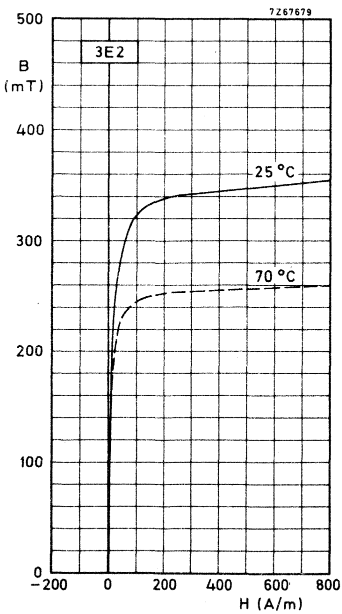

7Z67683
3C2
B (mT)
25 °C
70 °C
500
400
300
200
100
0
−200
0
200
400
600
800
H (A/m)

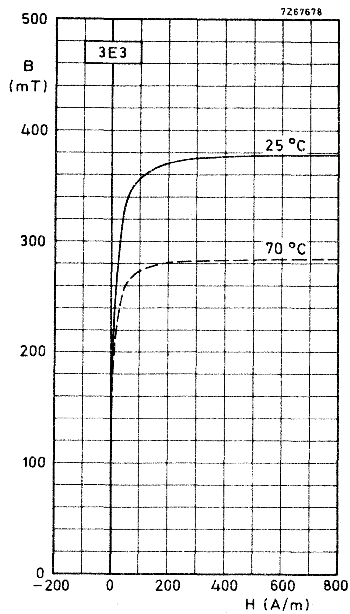

7Z67686
3C6
B (mT)
25 °C
100 °C
500
400
300
200
100
0
−100
0
100
200
300
400
H (A/m)

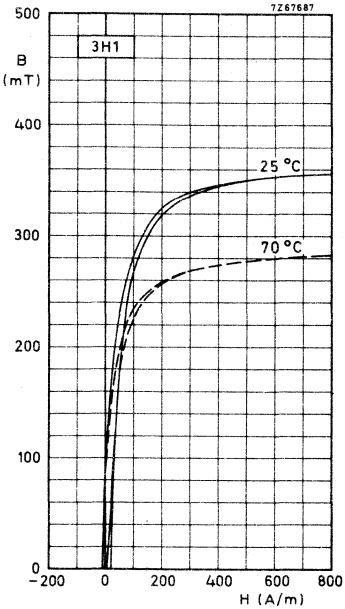

7Z67688
3C8
B (mT)
25 °C
100 °C
500
400
300
200
100
0
−100
0
100
200
300
400
H (A/m)

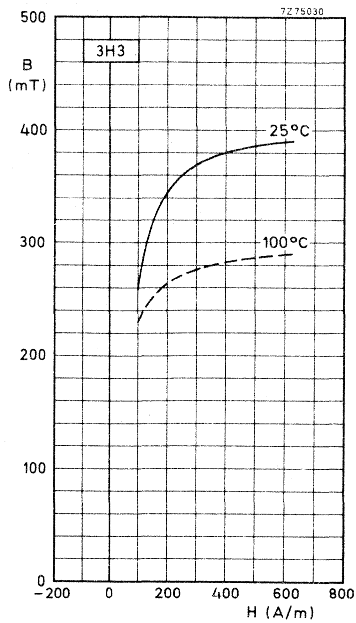

7Z67680
3D3
B (mT)
25 °C
70 °C
H (A/m)

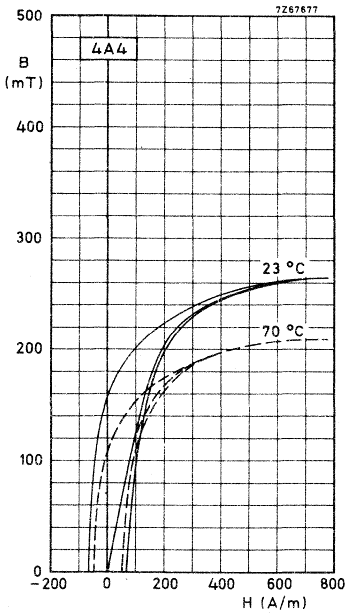

7Z67682
3E1
B (mT)
25 °C
70 °C
H (A/m)

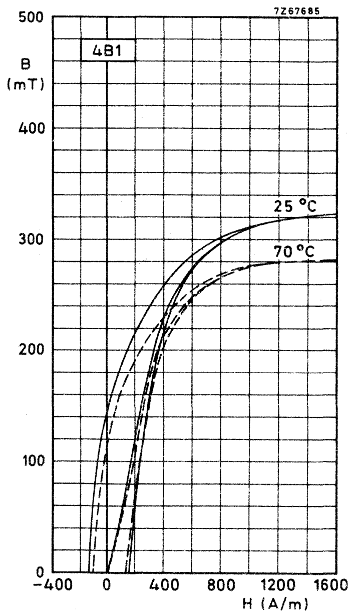

7Z67679
3E2
B (mT)
25 °C
70 °C
H (A/m)

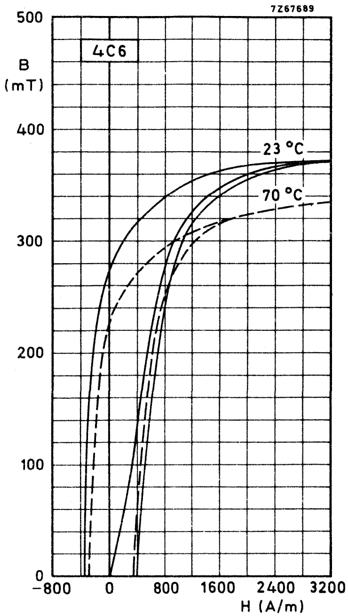

7Z67678
3E3
B (mT)
25 °C
70 °C
H (A/m)

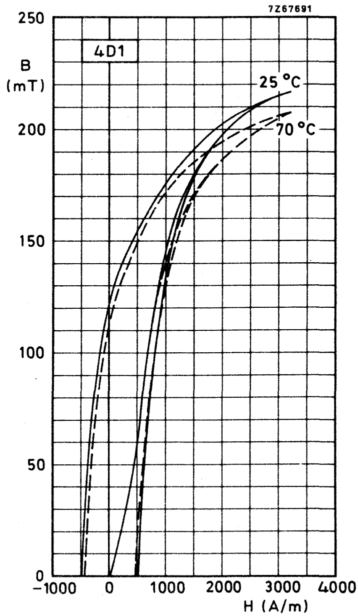

7Z67687
3H1
B (mT)
H (A/m)
25 °C
70 °C

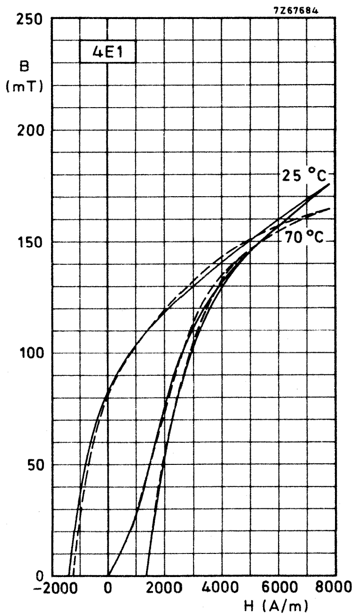

7Z75030
3H3
B (mT)
H (A/m)
25 °C
100 °C


7Z67677
4A4
B (mT)
H (A/m)
23 °C
70 °C

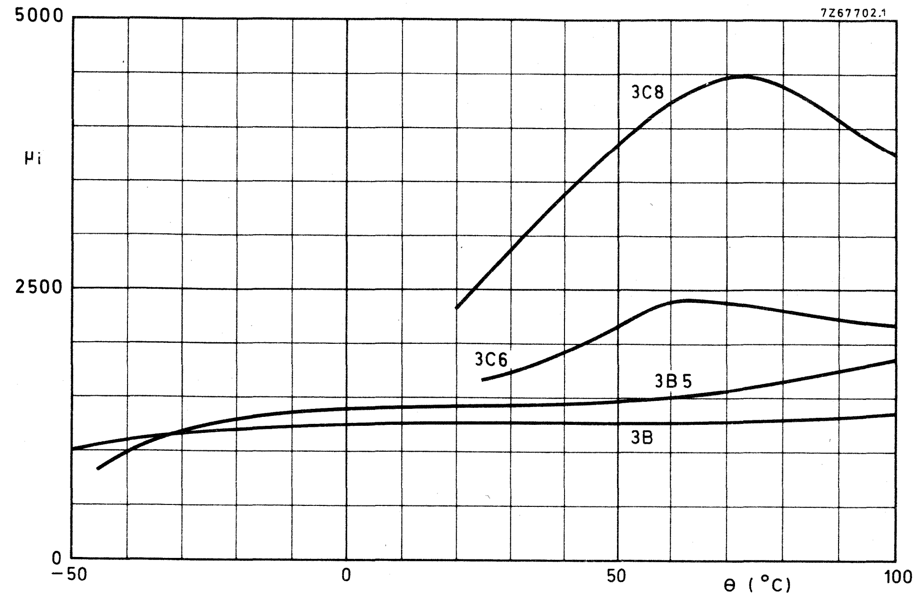

7Z67685
4B1
B (mT)
H (A/m)
25 °C
70 °C

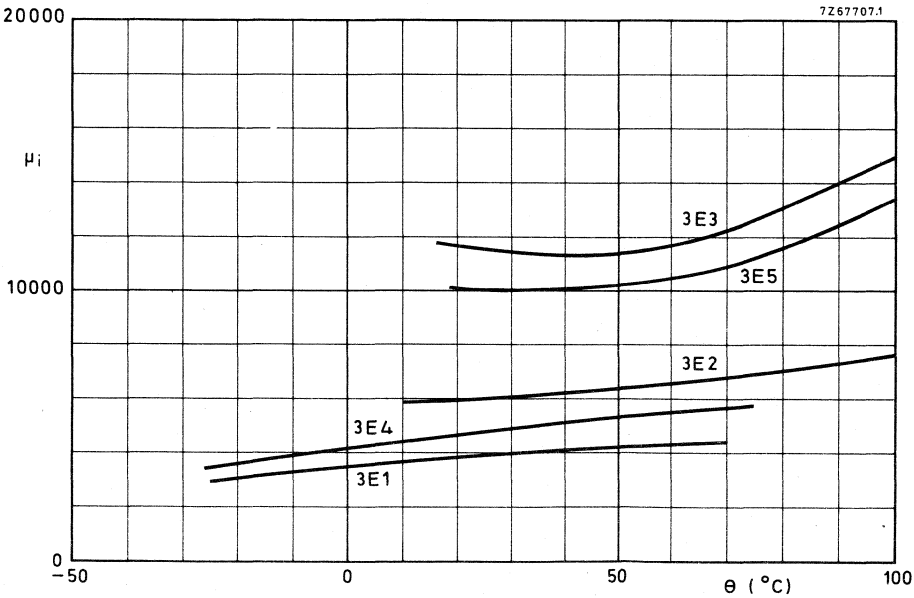

7Z67689
4C6
B
(mT)
500
400
300
200
100
0
23 °C
70 °C
−800
0
800
1600
2400
3200
H (A/m)

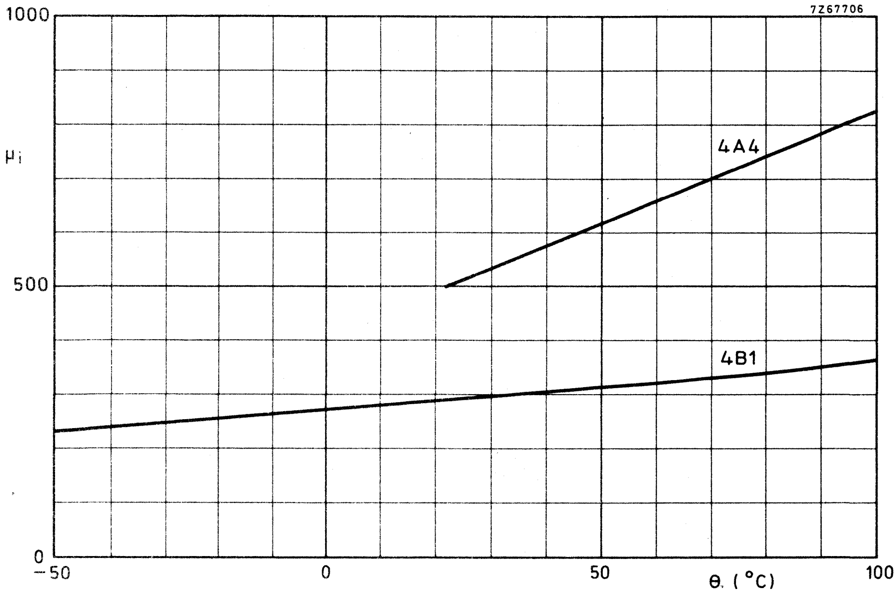

7Z67691
4D1
B
(mT)
250
200
150
100
50
0
25 °C
70 °C
−1000
0
1000
2000
3000
4000
H (A/m)

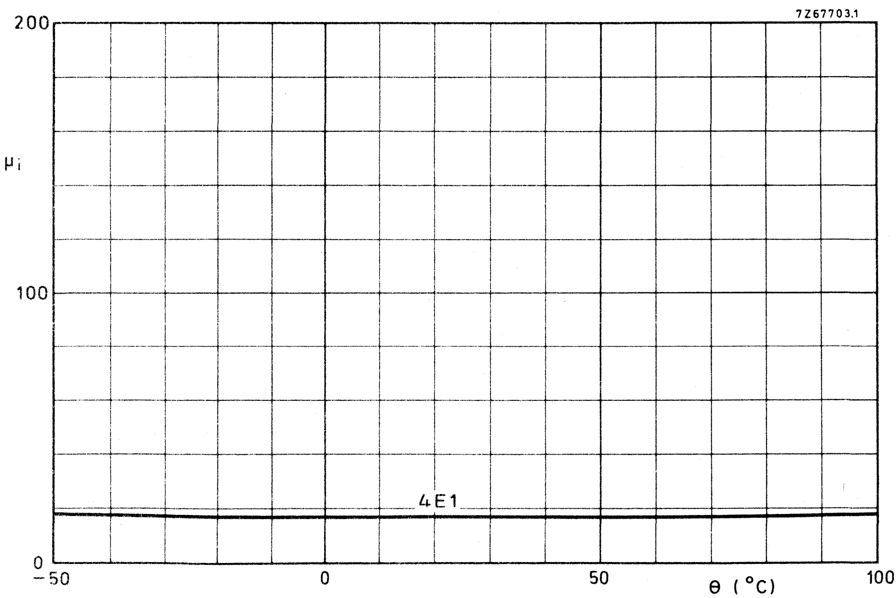

7Z67684
4E1
B
(mT)
250
200
150
100
50
0
25 °C
70 °C
−2000
0
2000
4000
6000
8000
H (A/m)

RELATIVE INITIAL PERMEABILITY AS A FUNCTION OF THE TEMPERATURE

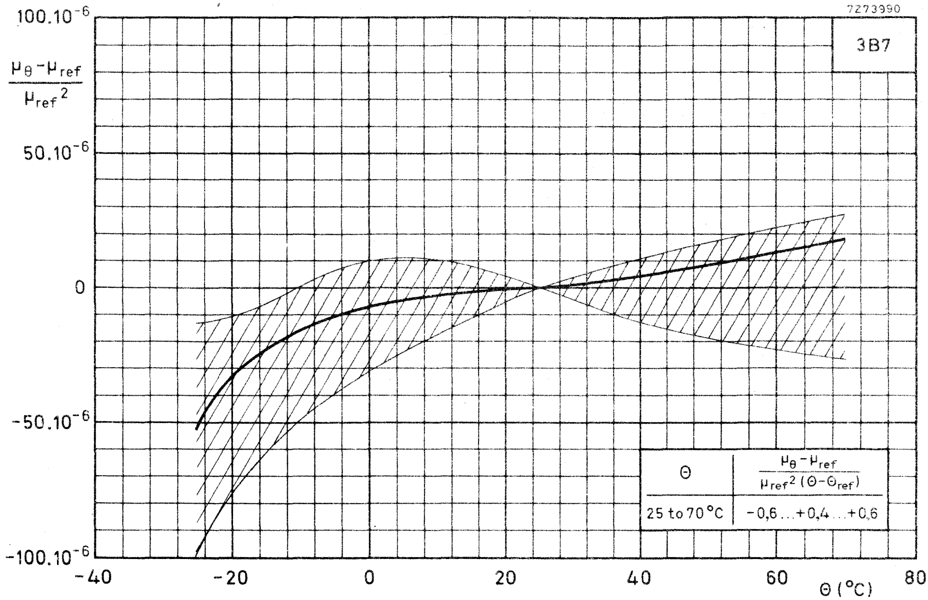


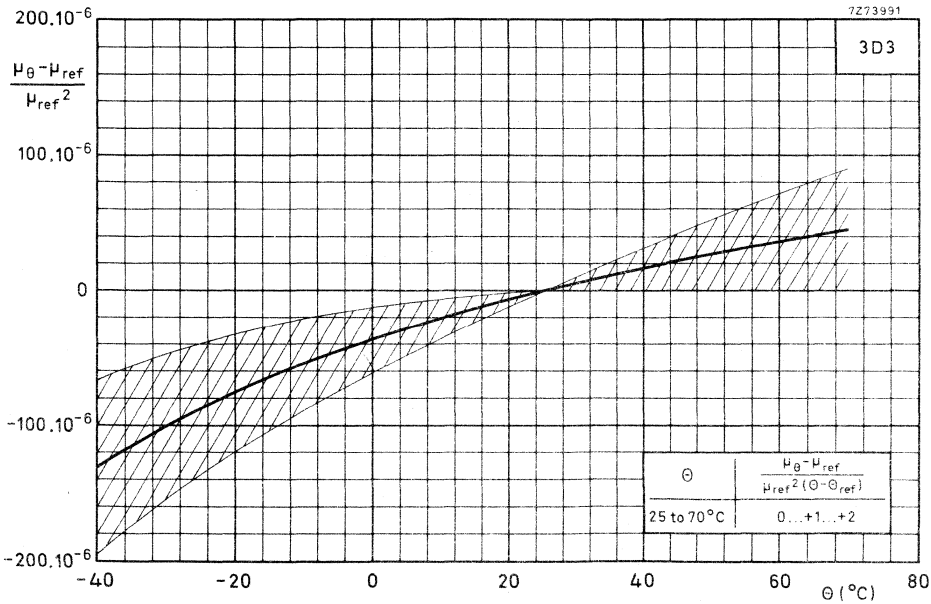


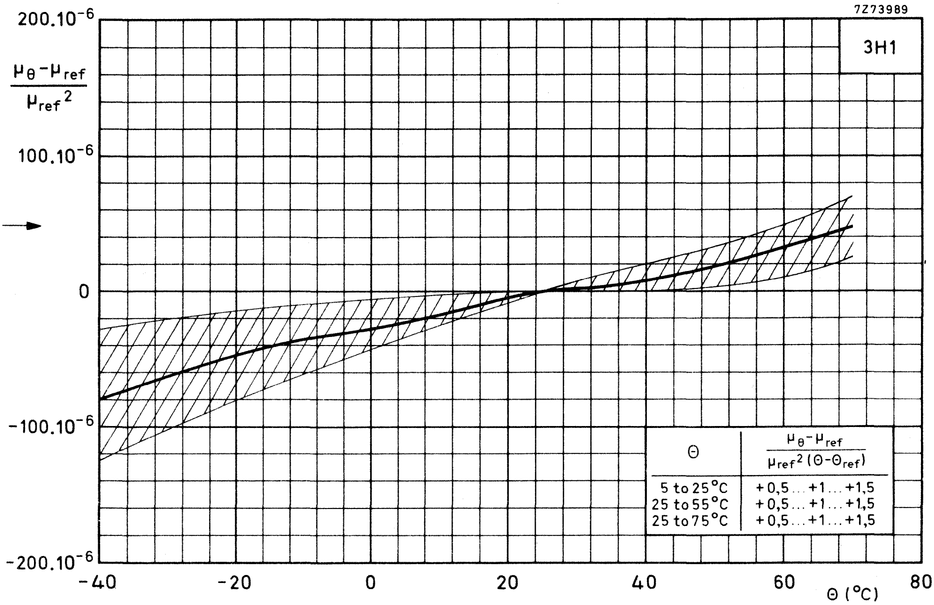

7Z67706
1000
500
0
μi
4A4
4B1
−50
0
50
100
θ (°C)

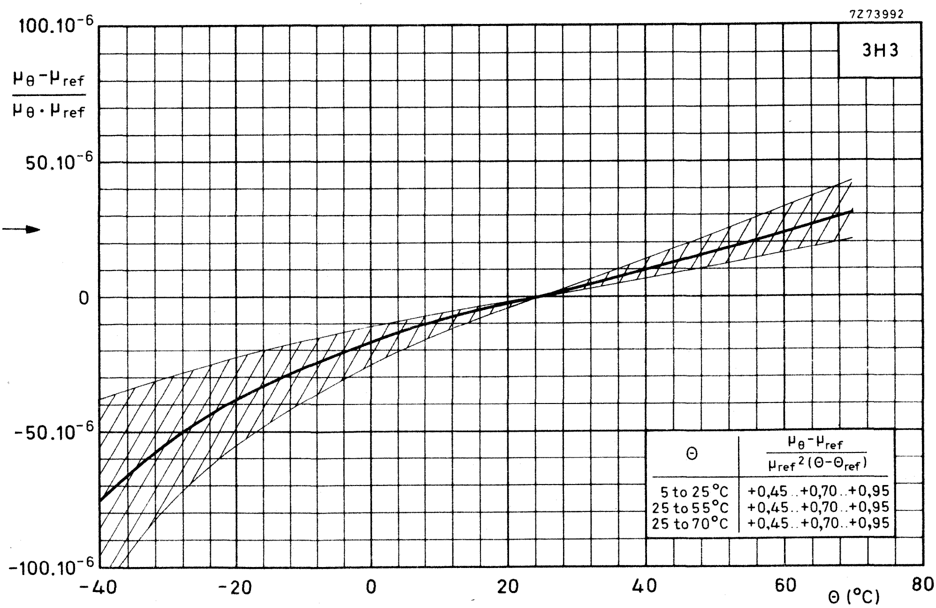

7Z67703.1
200
100
0
μi
4E1
−50
0
50
100
θ (°C)

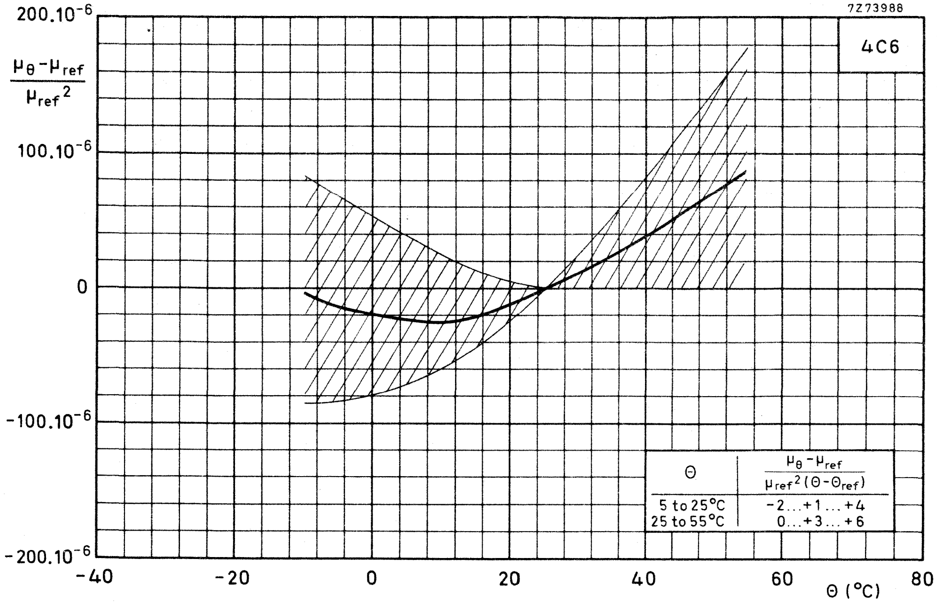
PERMEABILITY FACTOR AS A FUNCTION OF THE TEMPERATURE



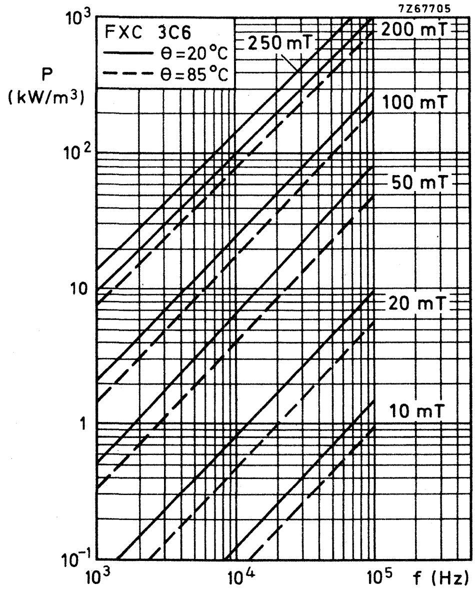


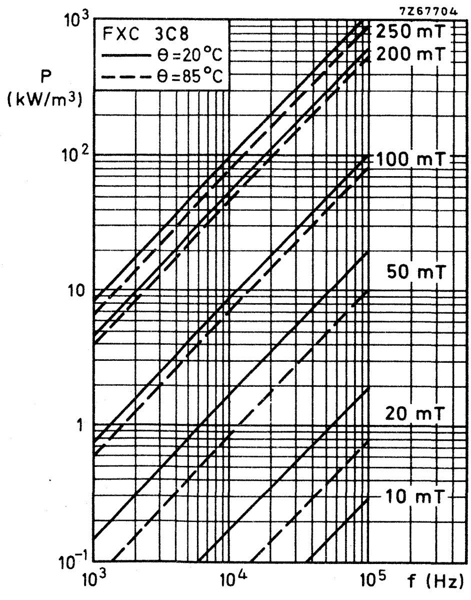

7Z73989
3H1
200.10⁻⁶
$\frac{\mu_\theta - \mu_{ref}}{\mu_{ref}^2}$
100.10⁻⁶
0
-100.10⁻⁶
-200.10⁻⁶
-40
-20
0
20
40
60
80
Θ (°C)
Θ
$\frac{\mu_\theta - \mu_{ref}}{\mu_{ref}^2 (\Theta - \Theta_{ref})}$
5 to 25°C +0,5 ... +1 ... +1,5
25 to 55°C +0,5 ... +1 ... +1,5
25 to 75°C +0,5 ... +1 ... +1,5


7Z73992
3H3
100.10⁻⁶
$\frac{\mu_\theta - \mu_{ref}}{\mu_\theta \cdot \mu_{ref}}$
50.10⁻⁶
0
-50.10⁻⁶
-100.10⁻⁶
-40
-20
0
20
40
60
80
Θ (°C)
Θ
$\frac{\mu_\theta - \mu_{ref}}{\mu_{ref}^2 (\Theta - \Theta_{ref})}$
5 to 25°C +0,45 .. +0,70 .. +0,95
25 to 55°C +0,45 .. +0,70 .. +0,95
25 to 70°C +0,45 .. +0,70 .. +0,95

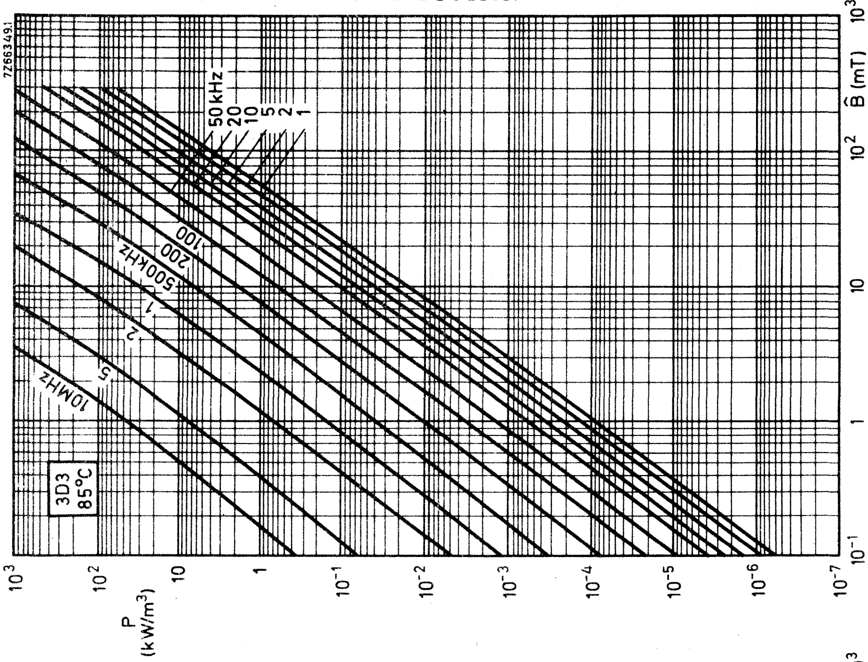


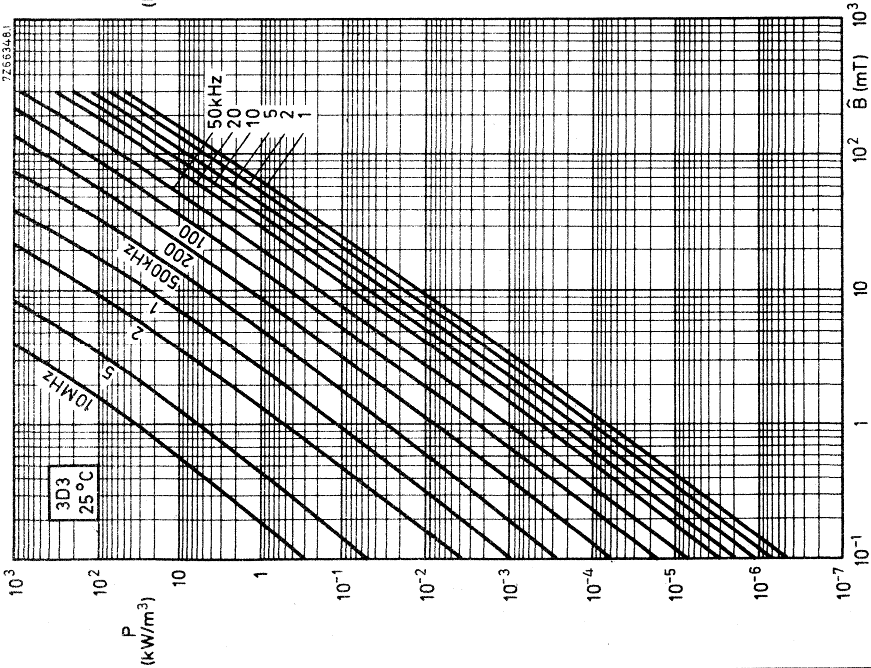
POWER LOSS AS A FUNCTION OF THE FREQUENCY

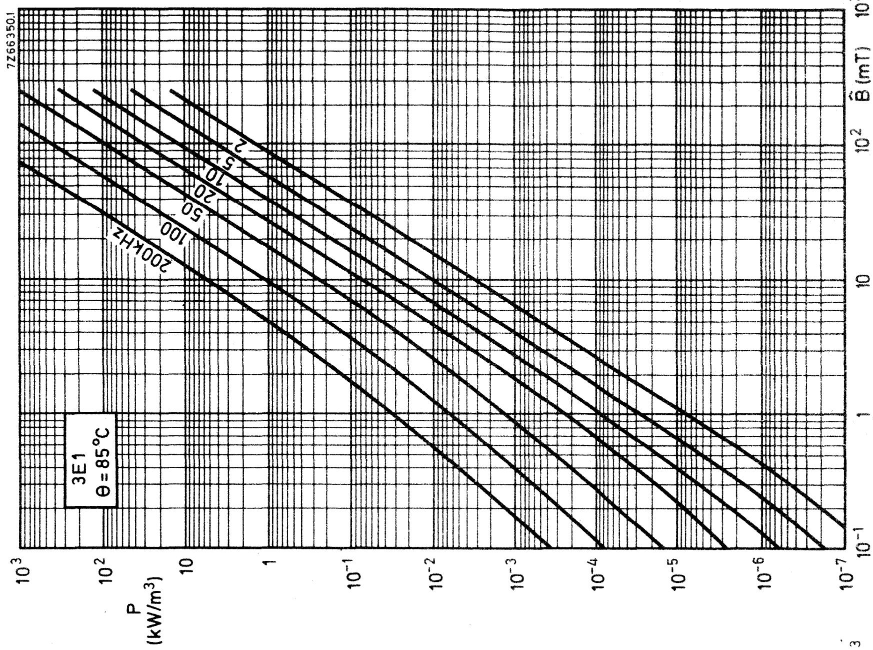


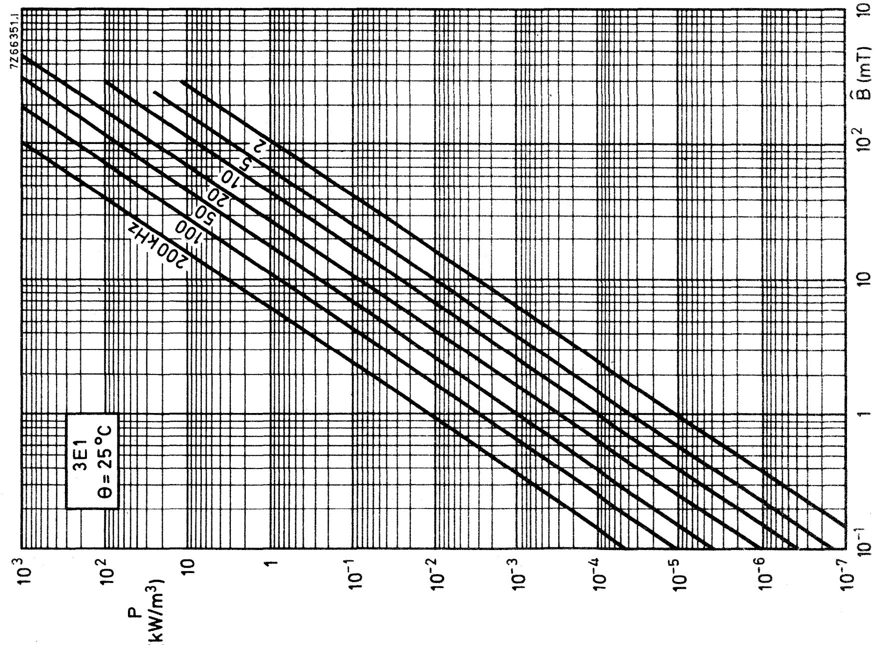


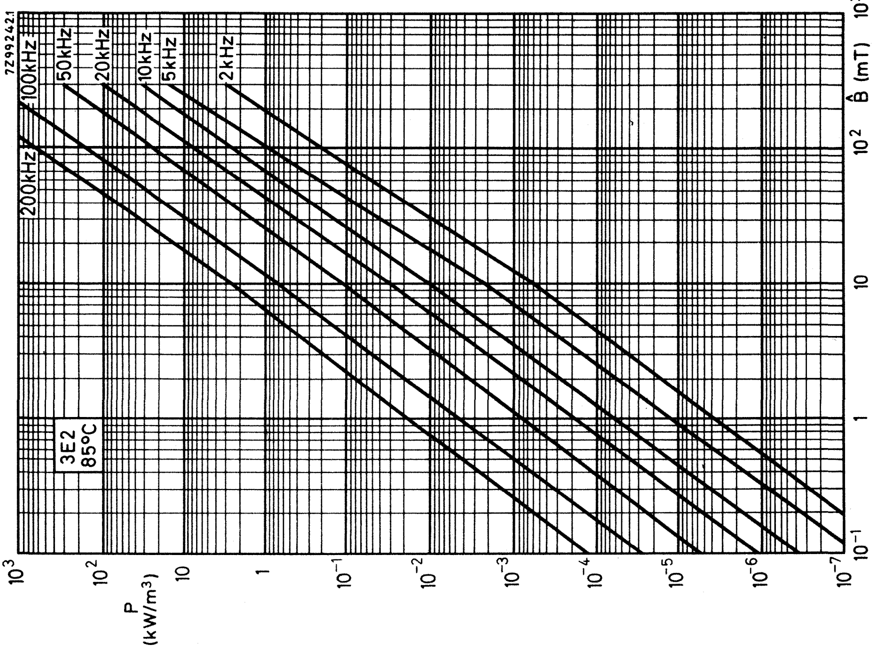
POWER LOSS AS A FUNCTION OF THE INDUCTION

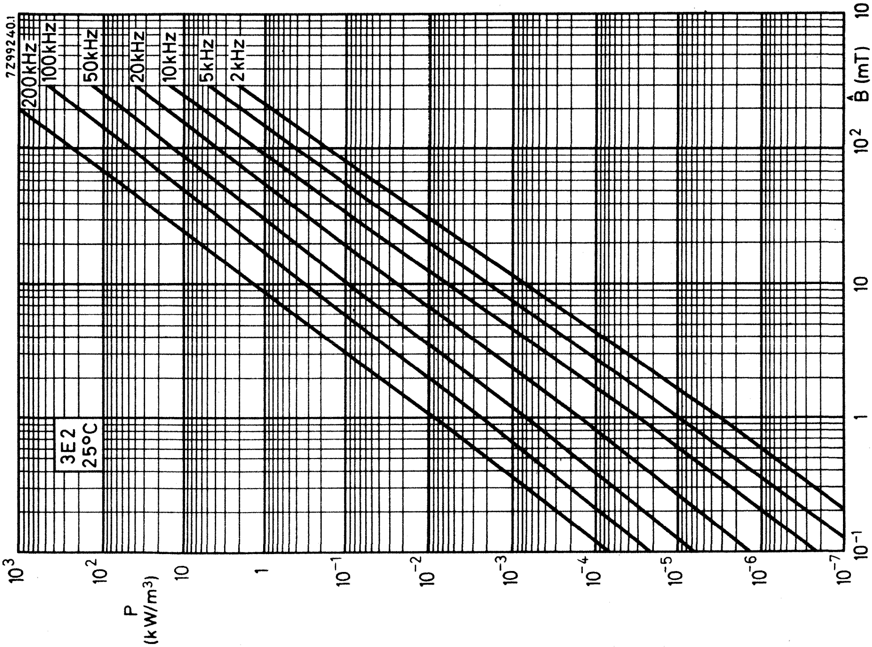


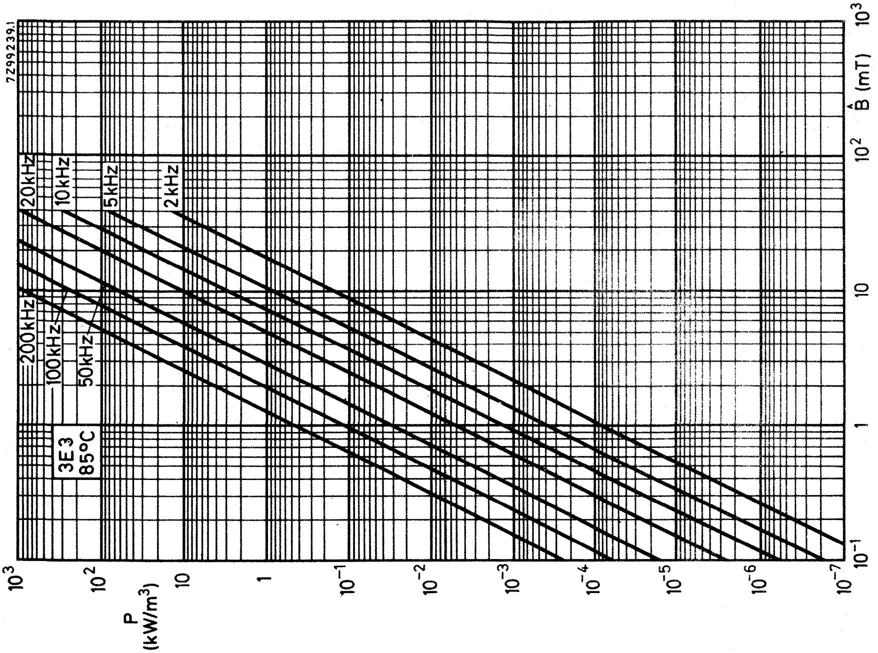


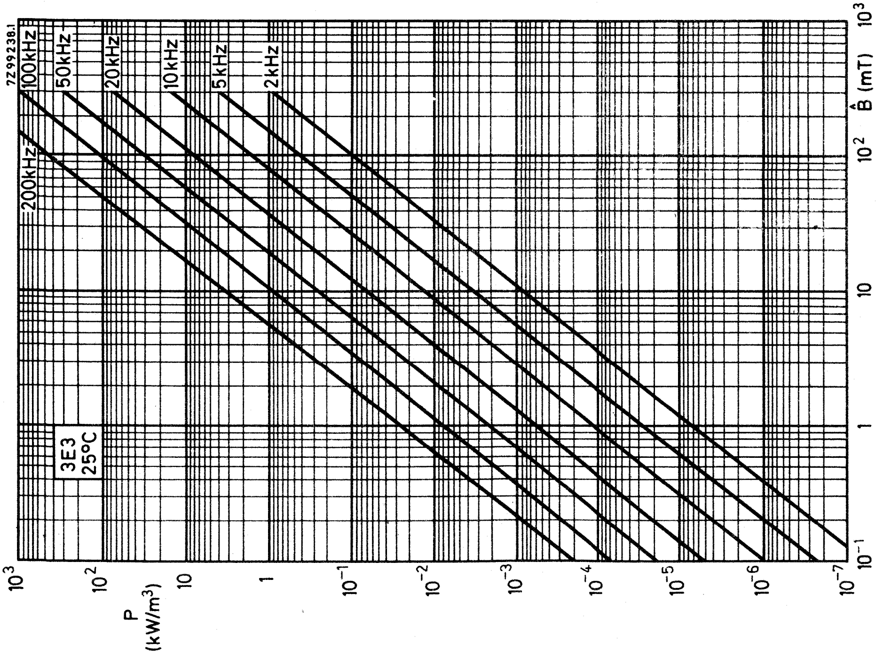

7Z66350.1
3E1
θ = 85°C
200 kHz
100
50
20
10
5
2
B̂ (mT)
P (kW/m³)

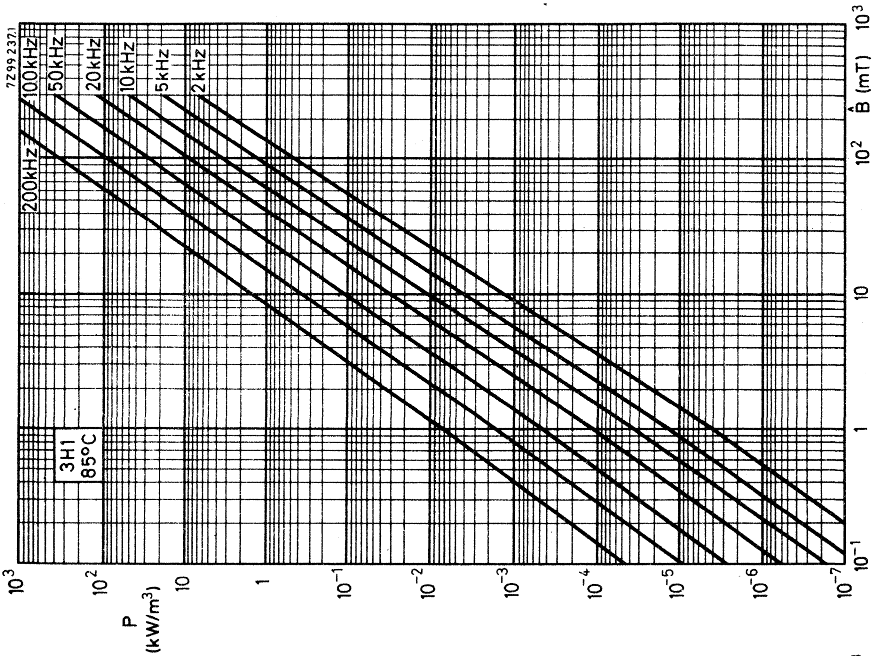

7Z66351.1
3E1
θ = 25°C
200 kHz
100
50
20
10
5
2
B̂ (mT)
P (kW/m³)

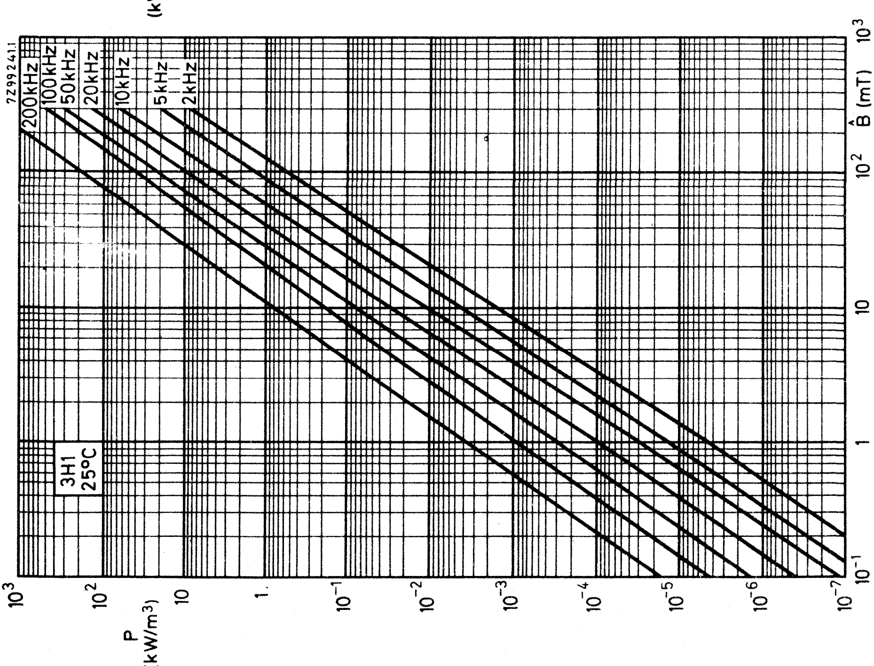

7Z99242.1
3E2
85°C
200kHz
100kHz
50kHz
20kHz
10kHz
5kHz
2kHz
P (kW/m3)
B̂ (mT)

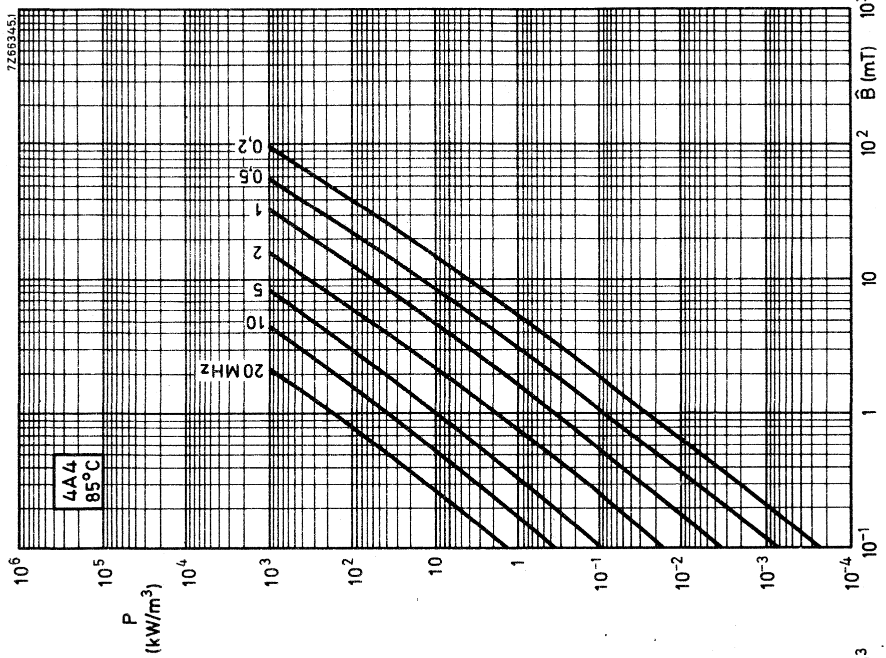

7Z99240.1
3E2
25°C
200kHz
100kHz
50kHz
20kHz
10kHz
5kHz
2kHz
P (kW/m3)
B̂ (mT)

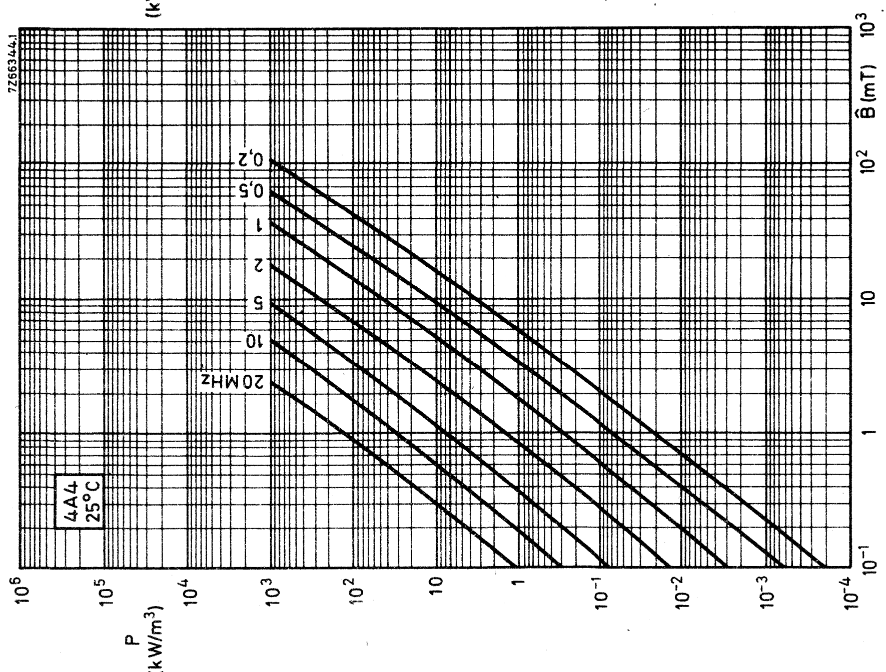

7Z99239.1
3E3
85°C
20kHz
10kHz
5kHz
2kHz
200kHz
100kHz
50kHz
P (kW/m³)
B̂ (mT)

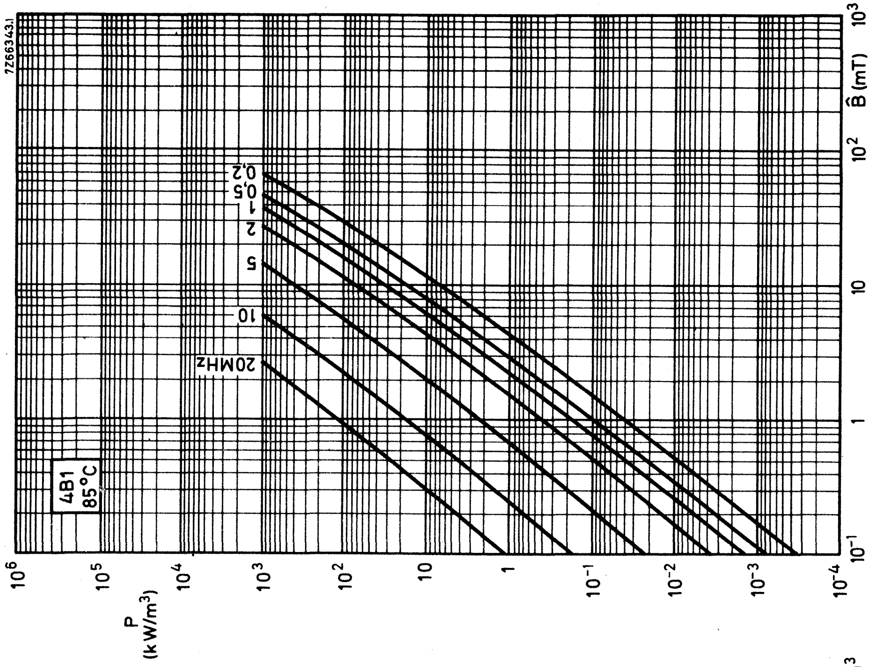

7Z99238.1
3E3
25°C
100kHz
50kHz
20kHz
10kHz
5kHz
2kHz
200kHz
P (kW/m³)
B̂ (mT)

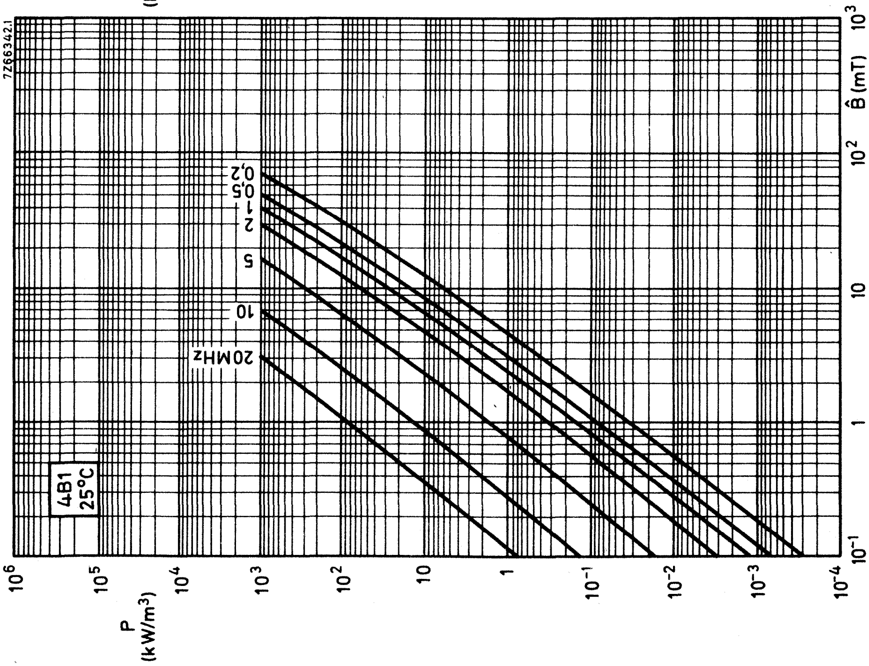

7Z99237.1
3H1
85°C
100kHz
50kHz
20kHz
10kHz
5kHz
2kHz
200kHz
P
(kW/m3)
B̂ (mT)

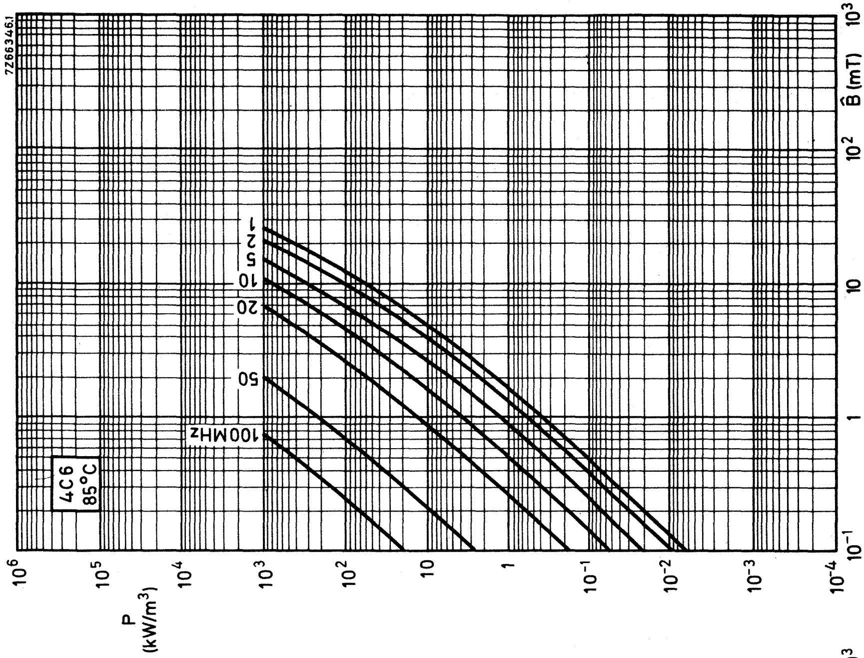

7Z99241.1
3H1
25°C
200kHz
100kHz
50kHz
20kHz
10kHz
5kHz
2kHz
P
(kW/m3)
B̂ (mT)

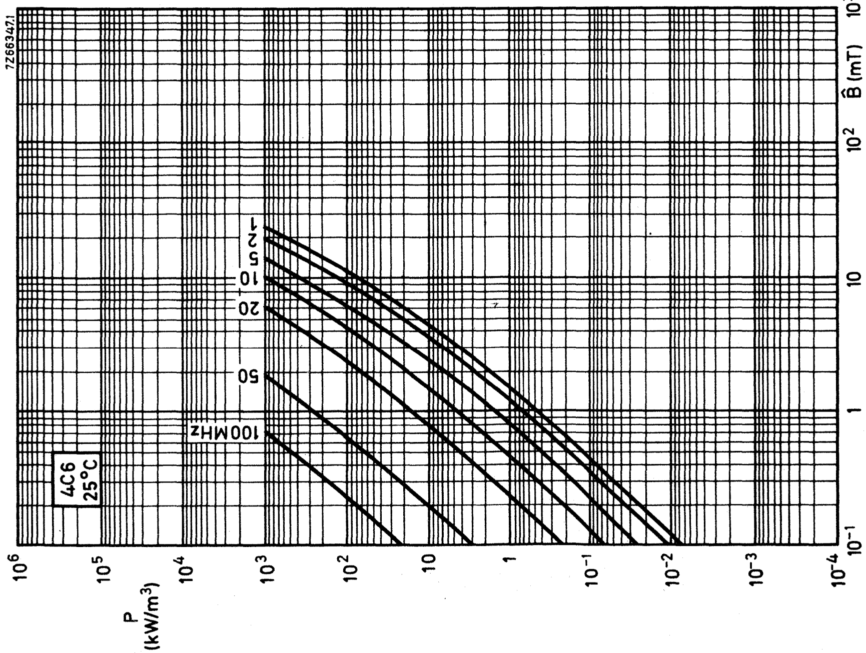

7Z66345.1
4A4
85°C
0,2
0,5
1
2
5
10
20 MHz
P (kW/m³)
B̂ (mT)
10⁶
10⁵
10⁴
10³
10²
10
1
10⁻¹
10⁻²
10⁻³
10⁻⁴
10³
10²
10
1
10⁻¹


7Z66344.1
4A4
25°C
0,2
0,5
1
2
5
10
20 MHz
P (kW/m³)
B̂ (mT)
10⁶
10⁵
10⁴
10³
10²
10
1
10⁻¹
10⁻²
10⁻³
10⁻⁴
10³
10²
10
1
10⁻¹

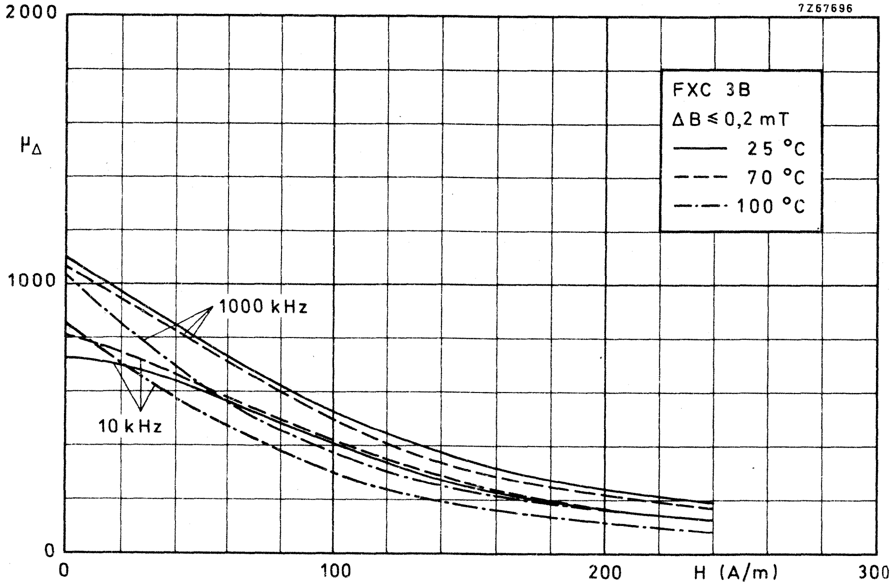

7Z66343.1
4B1
85°C
0,2
0,5
1
2
5
10
20MHz
P
(kW/m3)
B̂ (mT)

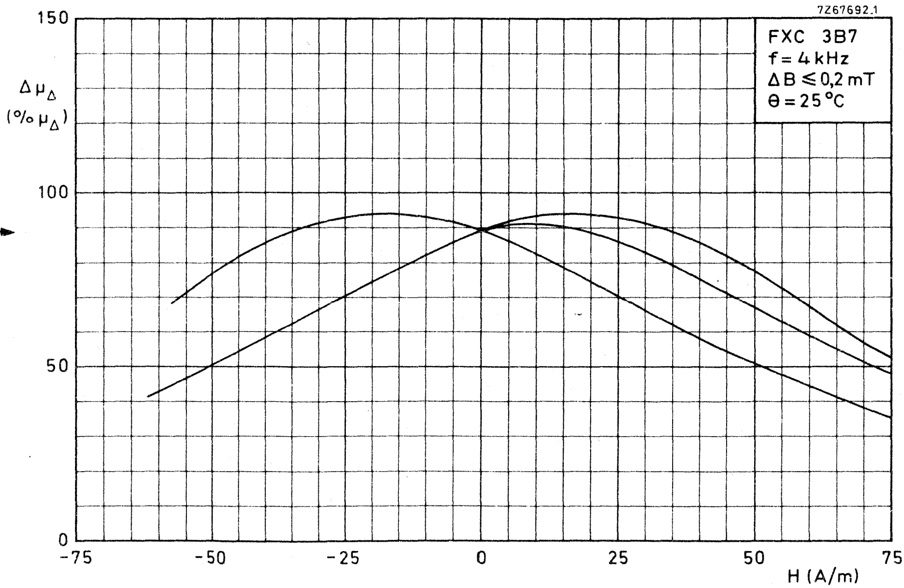

7Z66342.1
4B1
25°C
0,2
0,5
1
2
5
10
20MHz
P
(kW/m3)
B̂ (mT)

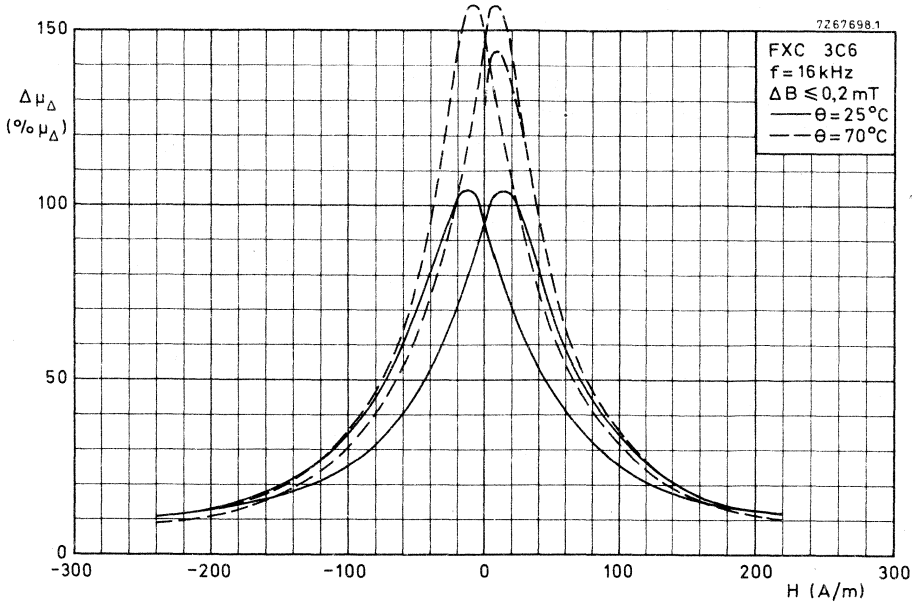

7Z66346.1
4C6
85°C
P
(kW/m³)
B̂ (mT)
1
2
5
10
20
50
100 MHz

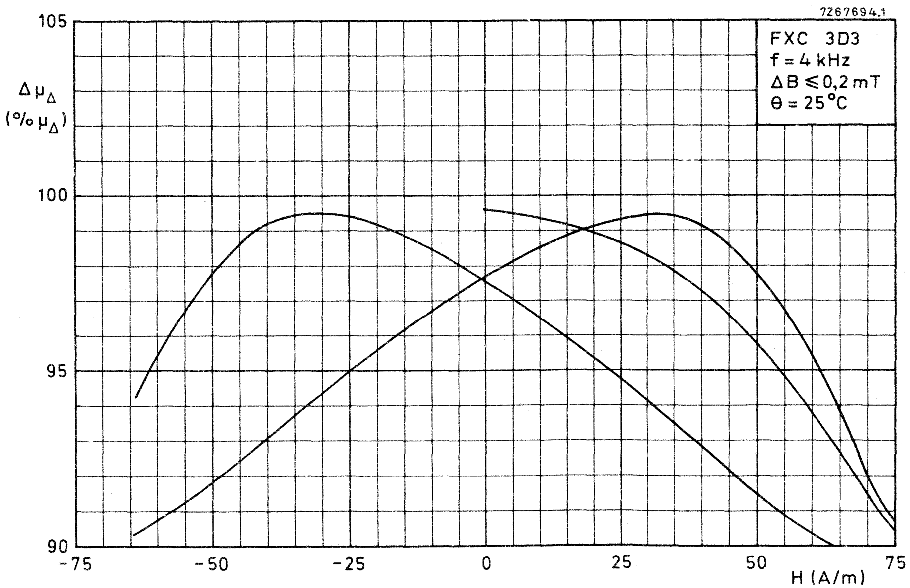

7Z66347.1
4C6
25°C
P
(kW/m³)
B̂ (mT)
1
2
5
10
20
50
100 MHz

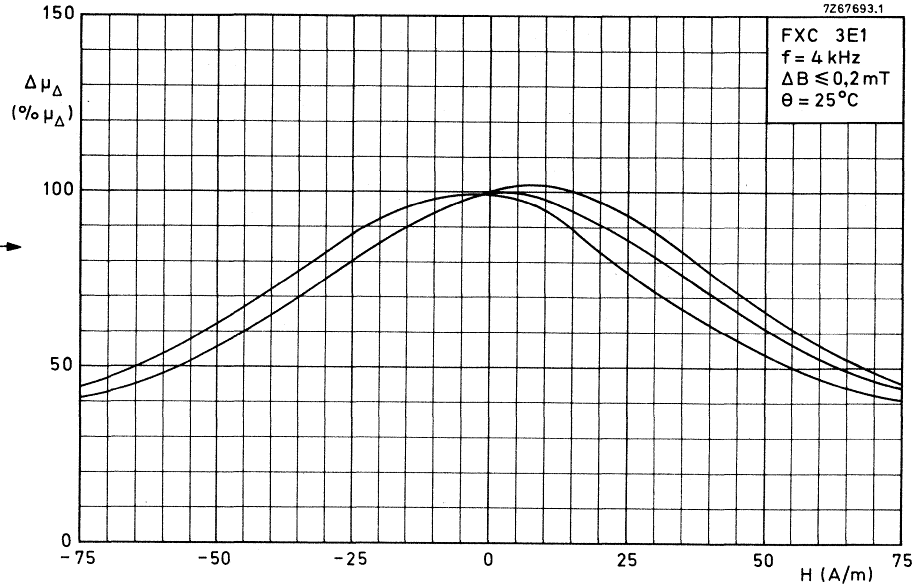
INCREMENTAL PERMEABILITY AS A FUNCTION OF THE FIELD STRENGTH

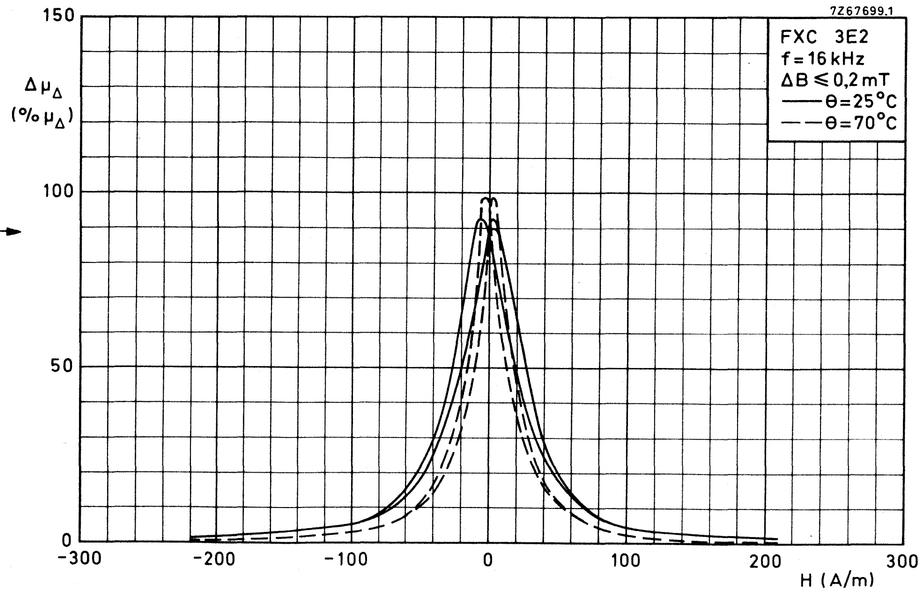


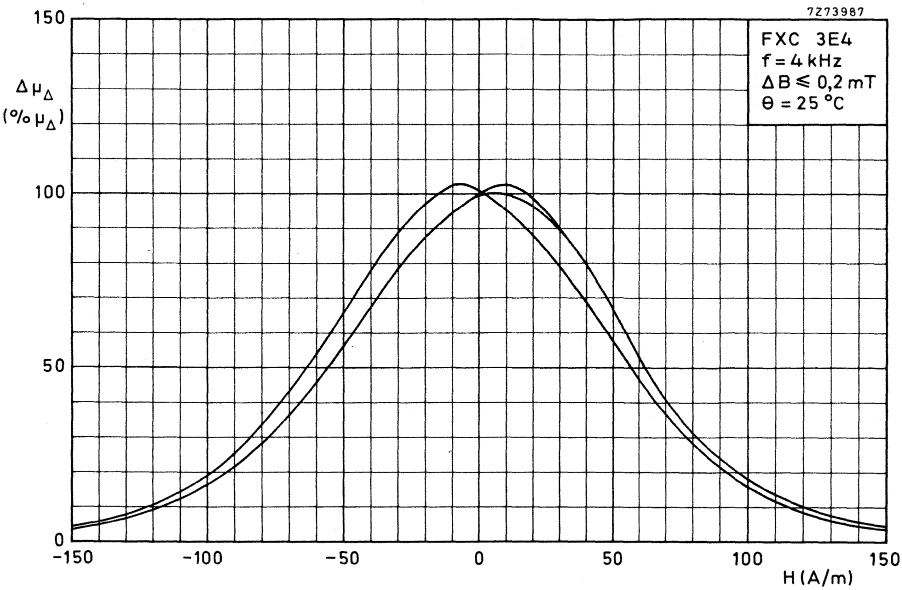


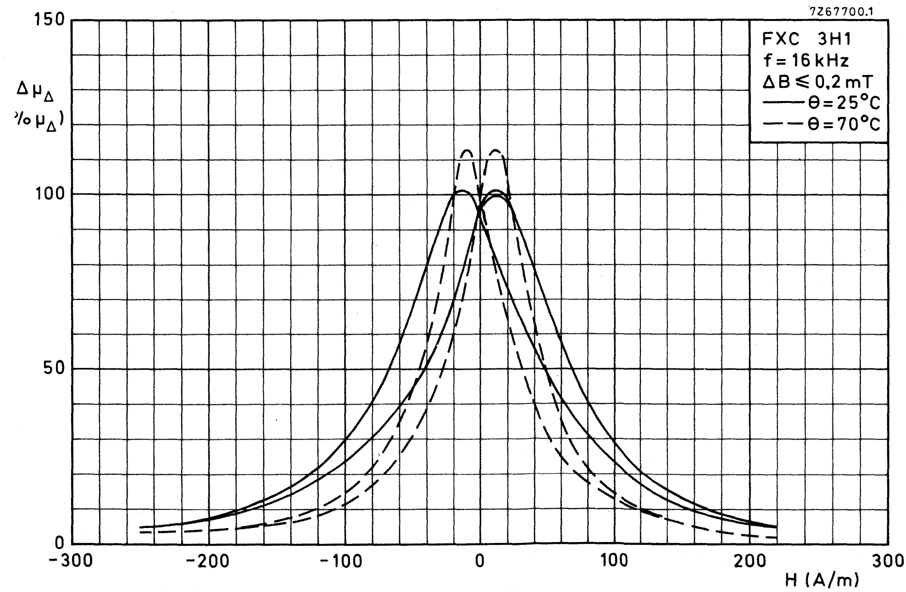

7Z67698.1
FXC 3C6
f = 16 kHz
ΔB ⩽ 0,2 mT
θ = 25°C
θ = 70°C
Δμ_Δ (% μ_Δ)
150
100
50
0
−300
−200
−100
0
100
200
300
H (A/m)

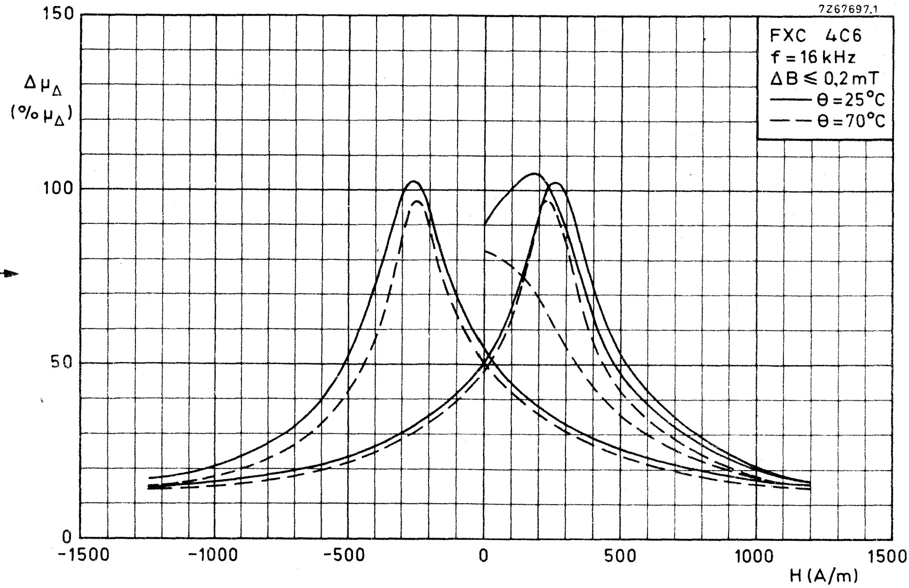

7Z67694.1
FXC 3D3
f = 4 kHz
ΔB ⩽ 0,2 mT
θ = 25°C
Δμ_Δ (% μ_Δ)
105
100
95
90
−75
−50
−25
0
25
50
75
H (A/m)

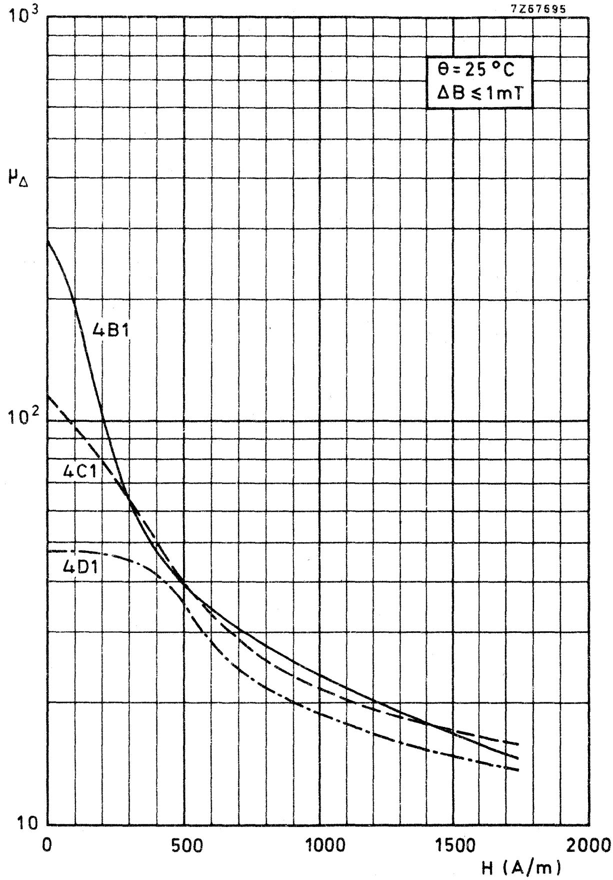

7Z67693.1
FXC 3E1
f = 4 kHz
ΔB ⩽ 0,2 mT
θ = 25 °C
Δμ_Δ (% μ_Δ)
150
100
50
0
−75
−50
−25
0
25
50
75
H (A/m)


7Z67699.1
FXC 3E2
f = 16 kHz
ΔB ⩽ 0,2 mT
——θ = 25 °C
– –θ = 70 °C
Δμ_Δ (% μ_Δ)
150
100
50
0
−300
−200
−100
0
100
200
300
H (A/m)


7Z73987
FXC 3E4
f = 4 kHz
ΔB ≤ 0,2 mT
θ = 25 °C
Δμ_Δ
(% μ_Δ)
150
100
50
0
−150
−100
−50
0
50
100
150
H (A/m)


7Z67700.1
FXC 3H1
f = 16 kHz
ΔB ≤ 0,2 mT
——θ = 25°C
– –θ = 70°C
Δμ_Δ
(% μ_Δ)
150
100
50
0
−300
−200
−100
0
100
200
300
H (A/m)


7Z67697.1
FXC 4C6
f = 16 kHz
ΔB ≤ 0,2 mT
θ = 25°C
θ = 70°C
Δμ_Δ
(% μ_Δ)
150
100
50
0
−1500
−1000
−500
0
500
1000
1500
H (A/m)

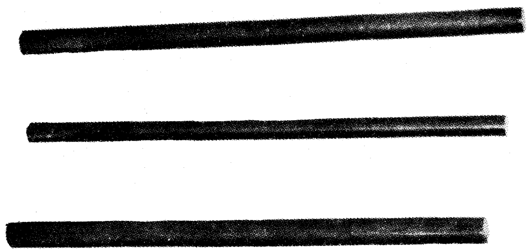

7Z67695
θ = 25 °C
ΔB ≤ 1mT
10^3
μ_Δ
10^2
10
4B1
4C1
4D1
0
500
1000
1500
2000
H (A/m)

Ferrites for radio, audio and television

Antenna rods	B3
Cores for small coils	B5
Frame cores	B13
Yoke rings for use in deflection coils for picture tubes	B15
Cores for transformers	B21
Ferrites for television components	B49
Cores for erasing heads	B53
Ferroxcube for magnetic heads	B55

ANTENNA RODS

RZ 22938-2



GRADE 4A10 (for long wave and medium wave reception)

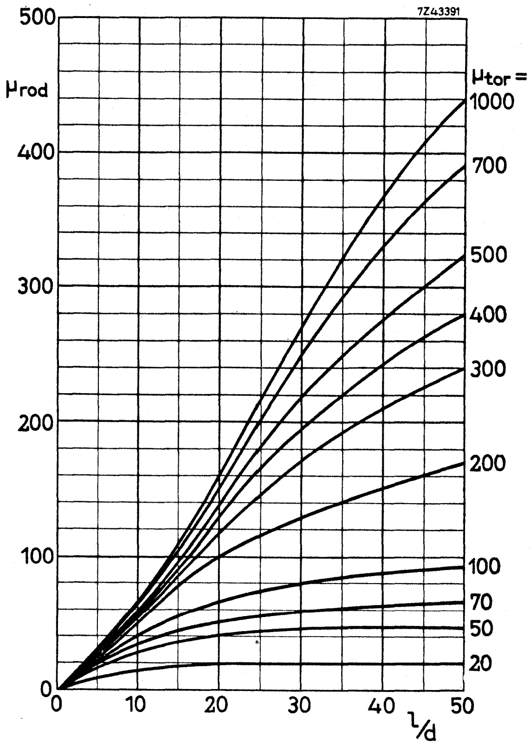
diameter (mm)	length (mm)	L (μH)	Q minimum at 1, 5 MHz	catalogue number
6, 35 ± 0, 2	130 ± 2, 6	500 ± 30	120	4311 020 55420
6, 35 ± 0, 2	140 ± 2, 8	525 ± 30	115	4311 020 55430
10 − 0, 5	100 ± 2	555 ± 30	190	4311 020 55390
10 − 0, 5	140 ± 2, 8	730 ± 41	175	4311 020 55440
10 − 0, 5	160 ± 3, 2	800 ± 47	170	4311 020 55450
10 − 0, 5	170 ± 3, 4	830 ± 50	165	4311 020 55360
10 − 0, 5	180 ± 3, 6	858 ± 53	160	4311 020 55460
10 − 0, 5	200 ± 4	908 ± 61	150	4311 020 55470
10 − 0, 5	210 ± 4, 2	930 ± 65	145	4311 020 55480
10 − 0, 5	240 ± 4, 8	985 ± 76	130	4311 020 55210

- The inductance L is measured with a coil with 97 turns placed on the antenna rod.
- The quality factor Q is measured with a coil with 25 turns placed on the antenna rod.

The winding width of both coils is 68, 3 ± 0, 2 mm.
The measurements are in accordance with DIN 41291 (Blatt 3).

Material properties of 4A10 (valid for toroids of not too small dimensions)

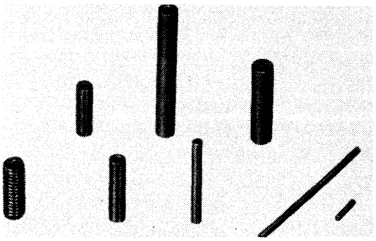
Initial permeability μ_i	350 ± 20%
Loss at low density $\frac{\tan\delta}{\mu_i} \times 10^6$	$\leq 50 \times 10^{-6}$ (1, 5 MHz) $\leq 70 \times 10^{-6}$ (2 MHz)
Curie point θ_C	> 180 °C
Temperature factor of permeability α_F	
+ 5 to +25 °C	$\leq 15 \times 10^{-6}$
+25 to +70 °C	$\leq 10 \times 10^{-6}$
Resistivity ρ	$> 10^4$ Ωm
Density	$4,2 \pm 0,15$ g/cm^3 4050 to 4350 kg/m^3



Rod permeability as a function of the ratio l/d with the relative initial permeability of a toroidal core as parameter.

CORES FOR SMALL COILS

A 52810-1



Ferroxcube rods, tubes and screws to be used as cores in r.f. and h.f. coils with an open magnetic circuit such as in i.f. transformers. Economic operation helps us to serve you better and keeps your costs down. Whilst still offering you our full range we aim at a gradual transition to a standard range. The lists on pages B5 and B6 table the standard range and will help you if the lists on the pages B7 to B10 do not contain your specific requirements.

	ROD CORES				TUBE CORES				
grade	dia. group (mm)	length group (mm)	dia. tol. group (mm)	corresponding length (mm)	outer dia. group (mm)	length group (mm)	outer dia. tol. group (mm)	corresponding length (mm)	inner dia. + tol.
	1, 6	5-30	−0, 2	5-30					
			−0, 05	5-8					see
			−0, 03	5-8					next
	2, 0	5-30	−0, 2	5-30					
			−0, 05	5-10					page
3B			−0, 03	5-10					
3B5	2, 5	5-30	−0, 25	5-30	2, 5	2, 5-30	−0, 3	2, 5-30	
3C2			−0, 05	5-10			−0, 1	2, 5-20	
3C3									
3C6	3, 1	5-30	−0, 25	5-30	3, 1	3 - 30	−0, 3	3 - 30	
3D3			−0, 1	5-25			−0, 1	3 - 25	
3H2			−0, 05	5-16			−0, 05	3 - 25	
4A1	4, 0	8-30	−0, 3	8-30	4, 0	4 - 40	−0, 3	4 - 40	
4B1			−0, 1	8-30			−0, 1	4 - 30	
4C1			−0, 05	8-20			−0, 05	4 - 30	
4C6	5, 0	10-50	−0, 3	10-50	5, 0	5 - 50	−0, 3	5 - 50	
4E1			−0, 1	10-40			−0, 1	5 - 50	
							−0, 05	5 - 30	
	6, 3	10-60	−0, 3	10-60	6, 3	10 - 60	−0, 3	10 - 60	
			−0, 1	10-45			−0, 1	10 - 50	
	10, 0	20-100	−0, 5	20-100	8, 0	20 - 60	−0, 4	20 - 60	

length tolerances (mm)

length	tolerance class	
	coarse	fine
< 6	0 −0,4	0 −0,2
6-8	0 −0,5	0 0,3
8-10	0 −0,6	0 −0,4
10-13	0 −0,7	0 −0,4
13-16	0 −0,8	0 −0,4
16-20	0 −0,9	0 −0,4
> 20	0 −4%	0 −0,4

inner diameter and tolerance (mm)

1,6 + 0,15	
2 + 0,2	for outer dia. ≥ 4
3 + 0,2	for outer dia. ≥ 5
4 + 0,3	for outer dia. ≥ 6,3

The curvature of rods and tubes is characterized by the maximum deviation from the straight line through the end face centres.
This curvature may be checked by means of a tubular gauge with dimensions as given below:

gauge inner diameter $d = d_1 + \frac{\ell_1}{100}$

gauge length $\ell = \geq \ell_1$

where d_1 = maximum outer dia. of the rod or tube
ℓ_1 = maximum length of the rod or tube

Note:

Beads are tubes of which the dimensions of length and outer diameter are approximately the same.

ROD CORES

diameter (mm)	length (mm)	grade	catalogue number
1,4 −0,02	6,75 −0,1	4C5	3122 104 92040
	6,85 −0,2	3D3	3122 104 91920
1,5 −0,1		3D3	4322 020 39390
−0,05	18 ±0,2	3B	3122 104 93320
1,55 +0,2	6 ±0,2	3B	4312 020 30020
	8 ±0,5	4B1	4312 020 30370
	14,2 −0,4	4B1	4312 020 30560
1,6 +0,05	9 ±0,2	3D3	4312 020 30160
		4B1	3122 104 91060
1,6 −0,1	15 ±0,1	3B	3122 104 91270
	3,95 −0,2	4D2	3122 134 91190
+0,15 / −0,05	11,3 ±0,2	4B1	4311 020 50790
±0,05	14 ±0,2	4E1	4313 020 10840
+0,15 / −0,05		3B	4311 020 50110
1,62 ±0,05	17,1 ±0,5	4B1	4313 020 12230
1,65 ±0,05	5,7 −0,3	4E1	4313 020 12330
−0,05	9,2 −0,4	3B	3122 104 91070
	12,2	3B	3122 104 91100
		4B1	3122 104 91110
	14	4B1	4330 020 31770
	19,2	3B	3122 104 91230
	25,2	3B	3122 104 91170
		4B1	3122 104 91180
	28 ±0,2	4B1	4322 020 32090
1,7 −0,15	8,4 −0,4	4D1	3122 104 93160
	8,8	3B	3122 104 90300
	10,2	4D1	4322 020 32040
	14,2	4E1	4322 020 32060
	15,2	4D1	4322 020 32170
	17,8 −1	3B	3122 104 92020
	18,7 −1	3B	3122 104 91900
	28,2 −0,4	4D1	4322 020 32130
		4E1	4322 020 32140
1,75 +0,03	8,8 ±0,15	3D3	4322 020 39480
−0,2	10,2 −0,4	3B	3122 104 91130
	12,2	4B1	3122 104 92070
	18,5 −1	4B1	3122 104 91150
	25 −1	3B	3122 104 91950
1,9 ±0,05	6,5 ±0,2	3B	4313 020 12250
1,9 −0,1	3,8 ±0,2	3D3	4322 020 39490

ROD CORES (continued)

diameter (mm)	length (mm)	grade	catalogue number
2,2 ±0,2	7,5 ±0,5	4E1	4322 020 39400
	11	4E1	4322 020 39410
	16	4B1	4312 020 30460
−0,05	22	3B	4330 020 31000
2,3 −0.05	10.2 −0,4	3D3	4312 020 30030
	12 +0,5	3D3	4312 020 30180
	18 +0,5	3D3	4312 020 30200
2,5 −0.25	20 −1	4B1	4312 020 30510
3 +0,2	11 ±0,5	4B1	4330 020 30560
±0,15	24 ±0,35	4B1	4312 020 30520
3,2 ±0,15	10 ±0,3	4E1	4313 020 12470
3,45 −0,05	17 ±0,3	3C6	4312 020 30420
3,5 −0,05	8 +0,5	3B	4312 020 30150
	23,2 −0,4	3C6	3122 104 92080
4 −0,05	18 ±0,2	3C2	4330 020 30640
−0,05	25 ±0,5	3C6	4312 020 30290
4,5 −0,05	7,2 −0,4	3D3	4322 020 39350
4,9 ±0,05	36 −0,5	3C6	3122 104 90490
	40	3C6	4322 020 39430
	50	3C6	3122 134 90110
5 ±0,3	18 ±0,3	4B1	4312 020 30490
−0,3	20 ±0,5	4B1	4312 020 30570
5 −0,3	23 ±0,5	4B1	4330 030 30000
	24 ±0,4	3D3	4312 020 30190
−0,2	25 ±0,5	3B	4322 020 39450
−0,05	30,2 −0,4	3C6	3122 134 91120
−0,2	40 ±1	3B	4322 020 39470
5,4 −0,05	25 ±0,2	4A1	3122 104 93690
6 −0,1	46,2 −0,4	3C2	3122 104 91310
6,3 ±0,2	31,75 ±1	3B5	4313 020 10210
	50,8 ±1,5	3B5	4313 020 10250
6,35	25,4 ±0,75	3B	4313 020 10300
6,4 +0,2	35 ±0,15	3C6	4322 020 39330
6,65 −0,3	40,4 −0,8	3B	4322 020 32160
10 −0,5	50 ±1	3C6	4330 030 30010

ROD CORES (rectangular cross-section)

5,1 ±0,2 x 6,3 ±0,25	19,8 ±0,3	3C8	3122 134 90720
7,5 ±0,25 x 7,5 ±0,25	25 ±0,5	3C8	3122 134 90620

TUBE CORES

outer diameter (mm)	inner diameter (mm)	length (mm)	grade	catalogue number
2,35 −0,1	0,9 ±0,1	4,6 ±0,2	3H2	4322 020 38420
2,7 −0,4	1,2 +0,2	3,5 −0,5	4E1	3122 104 91690
−0,15	±0,1	±0,2	3H2	4322 020 38360
2,8 −0,05	+0,2	8,2 ±0,2	3B	4322 020 34340
3,1 −0,02	1,3 +0,2	18,8 −0,5	3B	3122 134 90770
3,47 −0,1	1,7 +0,2	14 ±0,2	3B	3122 134 90000
3,5 +0,1 / −0,2	1,3 +0,2	3 +0,5	3B	4312 020 31050 *)
±0,2		5	3B	4312 020 31060 *)
+0,2	1,2 +0,3	6 ±0,5	4B1	4311 020 54160
±0,2	1,3 +0,2	7,5 +0,5	3B	4312 020 31330
−0,5	1,2	10 ±0,2	3B	4330 020 31050
−0,1	1,7	14,2 −0,4	3B	3122 104 92800
±0,2	1,3 +0,2	15 +0,5	3B	4312 020 31320
3,55 ±0,15	2,5 ±0,15	14,3 ±0,4	3B	4313 020 15840
3,6 −0,1	1,4 ±0,1	4 ±0,2	3D3	4322 020 38340
3,7 −0,4	1,2 +0,2	3,5 −0,5	3B	4322 020 34400 *)
			4A1	4322 020 34410
			4B1	4322 020 34420 *)
	1,5		3B	4322 020 34430 *)
3,9 +0,15 / −0,1	±0,15	5,5 ±0,2	4B1	4313 020 15460
±0,05	1,2 +0,2	28	4B1	4330 020 31330
4 ±0,2	2 ±0,2	5 ±0,5	3B5	4313 020 15170
±0,05	1,5 ±0,1	5,5 ±0,25	4E1	4313 020 15630
±0,2	±0,2	6 ±1	3B5	4313 020 18180
±0,15	2 +0,2	36 ±0,6	3C6	4312 020 31450
±0,2	1,5 ±0,2	50 ±1	3B5	4313 020 15010
4,1 ±0,2	±0,3	2,8 ±0,3	4B1	4313 020 17670
+0,2	2 +0,2	3 ±0,2	3B	4330 020 30230
		7	4B1	4311 020 50710
			4A1	4311 020 53460
+0,1			3D3	4312 020 31220
		11 ±0,2	3D3	4312 020 31250
+0,2		11 ±0,5	4B1	4330 020 30830
		12 ±0,2	4D1	4311 020 52100
		30 ±0,15	3B	4312 020 31080
		30 ±0,05	4B1	4311 020 54310
		35 ±0,7	3B	4311 020 50430
		50 ±0,1	3B	4311 020 50060
4,15 −0,05		12,2 −0,4	4A1	3122 104 90820
			4B1	4322 020 34450
			4C1	4322 020 34460

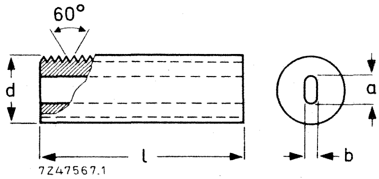
*) Beads

TUBE CORES (continued)

outer diameter (mm)	inner diameter (mm)	length (mm)	grade	catalogue number
4,15 −0,05	2 +0,2	12,2 −0,4	4D1	4322 020 34470
		15,2 −0,4	4B1	4322 020 34380
		21,2 −0,4	4A1	4322 020 34390
4,2 ±0,1	2,1 ±0,1	7 ±0,2	3B	4313 020 15020
	2,3 ±0,1		3B5	4313 020 15120
−0,15	2 +0,3	10 −0,4	4B1	3122 104 91730
4,3 −0,2	+0,2	7,2 −0,4	3B	3122 104 92900
	2,2 −0,2		4D1	3122 104 93890
	2 +0,2	11,5 −0,5	3B	3122 104 94880
4,3 −0,2		12,5 −1	3B	4322 020 34490
		15,4 −0,8	3B	4322 020 36750
		16,5 −0,5	3B	3122 104 94920
		18,5	3B	4322 020 36770
±0,15	+0,3	21,2 −0,4	4B1	4322 020 34480
−0,2	+0,2	25,5 −1	4B1	3122 104 90810
			3B	4322 020 36780
			4C1	3522 200 10950
			4D1	3522 200 10960
			4E1	3522 200 10970
		36,2 −0,4	3B	3522 100 65950
		40,5 −1	3B	3122 104 90800
4,7 ±0,2	±0,2	19 ±0,8	4E1	4313 020 16880
4,9 ±0,05	1,3 +0,2	15 ±0,2	3C6	3122 104 90370
		23	3C6	3122 104 90380
	3 ±0,1	36 −0,5	3C6	3122 104 93760
4,95 ±0,15	2 −0,2	4,3 ±0,5	4D2	3122 104 94990
−0,1	1,3 +0,2	26,5	3B	4330 020 31060
4,9 ±0,5		40 ±0,5	3C6	3122 104 93110
5,3 −0,2	3 +0,2	22,4 −0,8	3B	4322 020 36810
5,4 −0,4	3,6 −0,3	21,2 −0,4	4A1	3104 101 80630
		25,2	4A1	3122 104 93720
6,35 ±0,2	1,4 +0,3	50,8 ±1,5	3B5	4313 020 15280
6,7 −0,4	2,85	33,5 −1	3B	4322 020 34300
7,5 ±0,25	4,5 ±0,15	17 ±0,5	3B5	4313 020 15470
8 +0,5	3,5 +0,3	15 ±0,3	4B1	4312 020 31200
±0,2	4,5 ±0,3	50 ±0,1	3B	4311 020 50030
−0,4	4,2 +0,6	51,4 −2,8	3B	4322 020 34310
			4B1	4322 020 34320
8,4 −0,8	4,3 +0,4	30,2 −0,4	4A1	3122 104 90870
9,5 ±0,3	6,5 ±0,2	17 ±0,05	3B	4313 020 15180
9,5 −0,5	4,5 +0,3	16 −0,8	4B1	4330 030 32020
10,8 −0,5	6,7 +0,4	19,5 −0,4	4A4	3122 134 90780
14 ±0,5	7,8 ±0,5	50 ±0,3	4A1	4311 020 51880

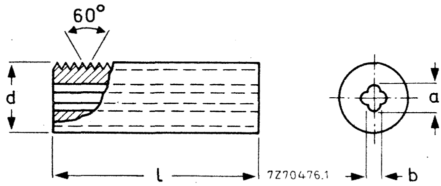
SCREW CORES

Slot trimming hole



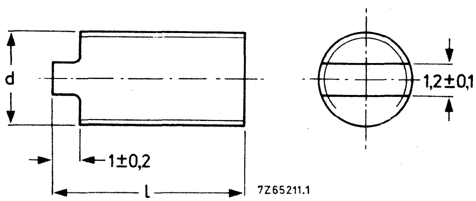
nom. dia. x pitch	l (mm)	d (mm)	a (mm)	b (mm)	grade	catalogue number
3,65 x 0,5	12 ± 0,3	3,65 + 0,05	1,6 ± 0,1	0,7 ± 0,1	3D3	4312 020 32040
5 x 1	15 ± 0,3	5 − 0,1	2,2 ± 0,15	1,1 ± 0,1	3D3	3122 104 93610
5 x 1	20 ± 0,3	5 − 0,1	2,35 − 0,3	1,1 ± 0,1	3D3	4312 020 32130
5,55 x 0,75	13 ± 0,3	5,55 + 0,05	2,65 ± 0,15	1,1 ± 0,1	3D3	4312 020 32060
5,55 x 0,75	25 ± 0,5	5,55 + 0,05	2,65 ± 0,15	1,1 ± 0,1	3D3	4312 020 32070
7,35 x 1,25	16 ± 0,5	7,35 + 0,05	3,65 ± 0,15	1,3 ± 0,1	3D3	4312 020 32110
7,35 x 1,25	25 ± 0,5	7,35 + 0,05	3,65 ± 0,15	1,3 ± 0,1	3D3	4312 020 32120

Cross trimming hole



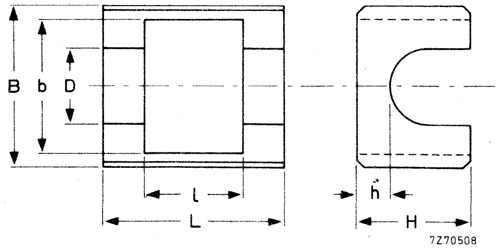
3,5 x 0,7	10 ± 0,25	3,5 ± 0,05	1,4 − 0,1	0,6 − 0,1	3B	3122 104 90750
3,5 x 0,7	10 ± 0,25	3,5 ± 0,05	1,4 − 0,1	0,6 − 0,1	4D2	3122 104 90770
3,5 x 0,7	15 ± 0,25	3,5 ± 0,03	1,4 − 0,1	0,6 − 0,1	3D3	4330 030 36000

Stud trimming



nom. diameter x pitch	l (mm)	d (mm)	grade	catalogue number
3,5 x 0,7	7 ± 0,2	3,5 ± 0,05	4D1	3122 104 90740
3,5 x 0,7	10 ± 0,2	3,5 ± 0,05	3B	3122 104 90550
3,5 x 0,7	10 ± 0,2	3,5 ± 0,05	4D1	3122 104 90590
3,5 x 0,7	15 ± 0,25	3,5 ± 0,03	3B3	4312 020 32150

FRAME CORES



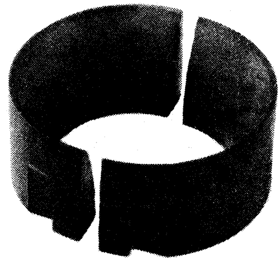
L ± 0,2 (mm)	l ± 0,2 (mm)	B ± 0,2 (mm)	b ± 0,2 (mm)	H ± 0,2 (mm)	h ± 0,2 (mm)	D (mm)	grade	catalogue number
10	6	11,2	8,5	7	2	4,5 +0,2	3B	3122 104 92550
10	6	11,2	8,5	7	2	4,5 +0,2	3B	3122 104 91460 [1])
10	6	11,2	8,5	7	2	4,5 +0,2	3B	4322 020 35250 [2])
10	6	11,2	8,5	7	2	4,5 +0,2	4B1	3122 104 91470 [2])
10	6	11,2	8,5	7	2	4,5 +0,2	4D1	3122 104 91480 [2])
14	10	11,2	8,5	6	4	4,1 ±0,05	4A4	3122 104 94480
14	10	11,2	8,5	6	4	4,25 ±0,05	3D3	4322 020 37030

[1]) partly lacquered
[2]) fully lacquered

YOKE RINGS FOR USE IN DEFLECTION COILS FOR PICTURE TUBES

FOR 110° BLACK AND WHITE PICTURE TUBES

RZ 24668-2



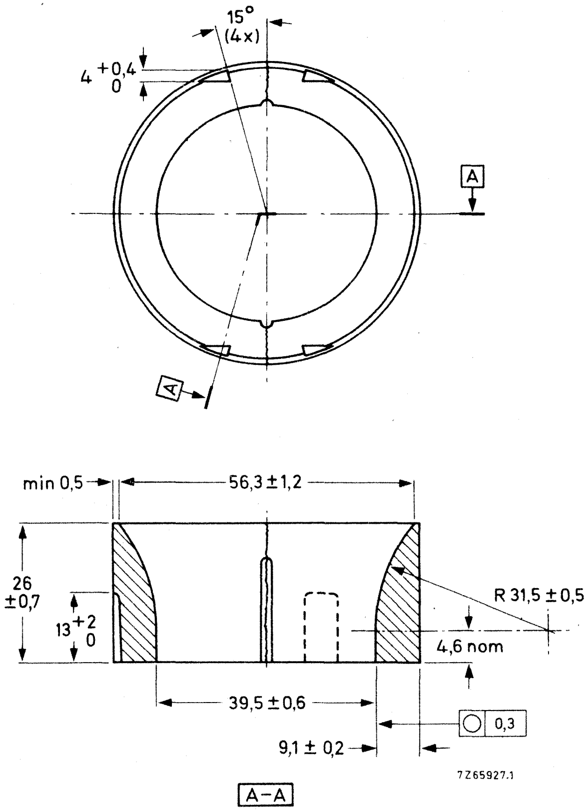
Catalogue number 3122 104 93840

Material Ferroxcube 3C2

Weight 135 g

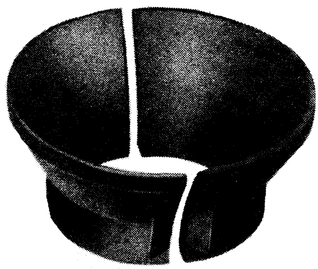
Spring clips for assembling can be supplied, catalogue number 3122 101 06340

Dimensions (mm)



FOR 110° BLACK AND WHITE PICTURE TUBES (12 inch)

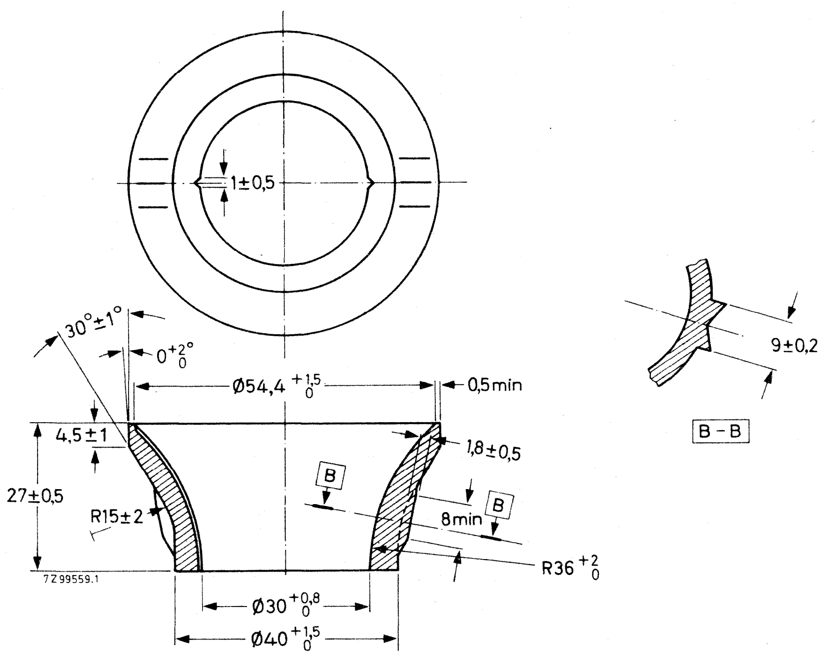
RZ 29121-5



Catalogue number	3122 104 94790
Material	Ferroxcube 3C2
Weight	85 g

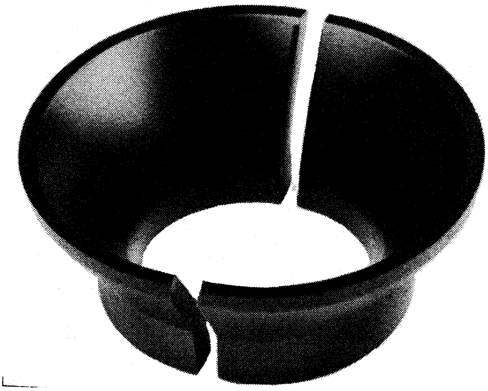
Spring clips for assembling can be supplied.
Catalogue number: 3122 101 91850.

Dimensions (mm)



FOR 90° COLOUR PICTURE TUBES

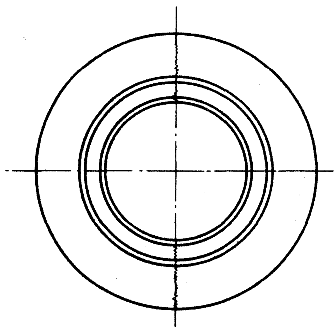
RZ 24668-1

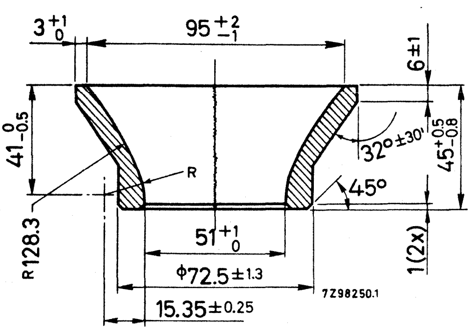


Catalogue number	3122 104 99170
Material	Ferroxcube 3C2
Weight	395 g

The ring has been lacquered.
Thickness of lacquer ≤ 0, 3 mm

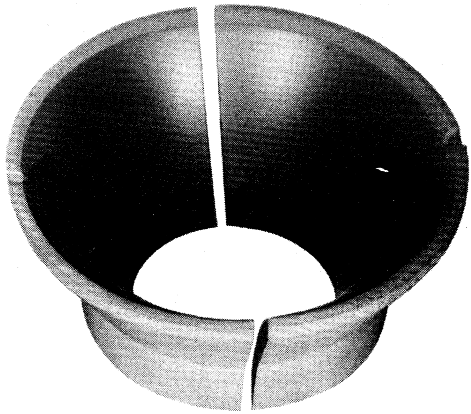
<u>Dimensions (mm)</u> (without lacquer)





FOR 90° COLOUR PICTURE TUBES

RZ 22938-1



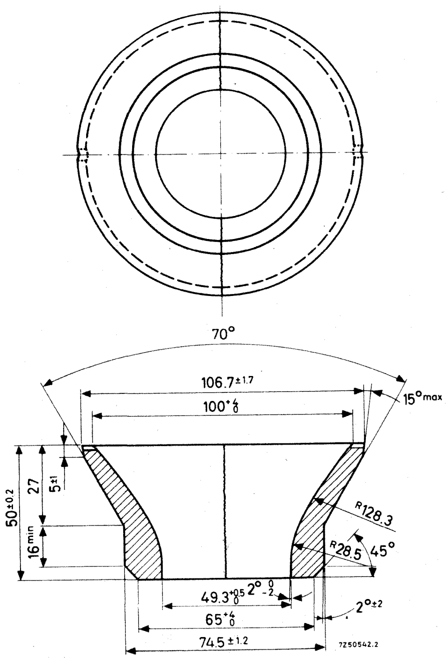
Catalogue number 4313 020 35350

Material Ferroxcube 3C2

Weight 475 g

The inner surface has been lacquered.
Thickness of lacquer ≤ 0, 3 mm

Dimensions (mm) (without lacquer)



FOR 110° COLOUR PICTURE TUBES

Catalogue number 3122 137 52280

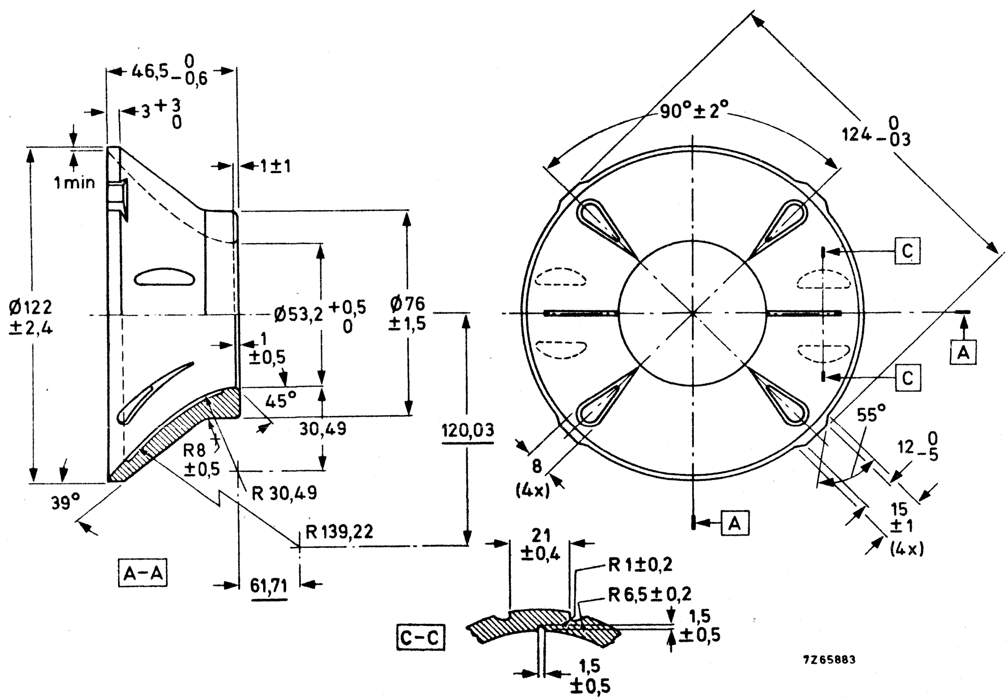
Material Ferroxcube 3C2

Weight 480 g

The inner surface has been lacquered.
Thickness of lacquer ≤ 0,3 mm

Spring clips for assembling can be supplied.
Catalogue number 3122 101 57350

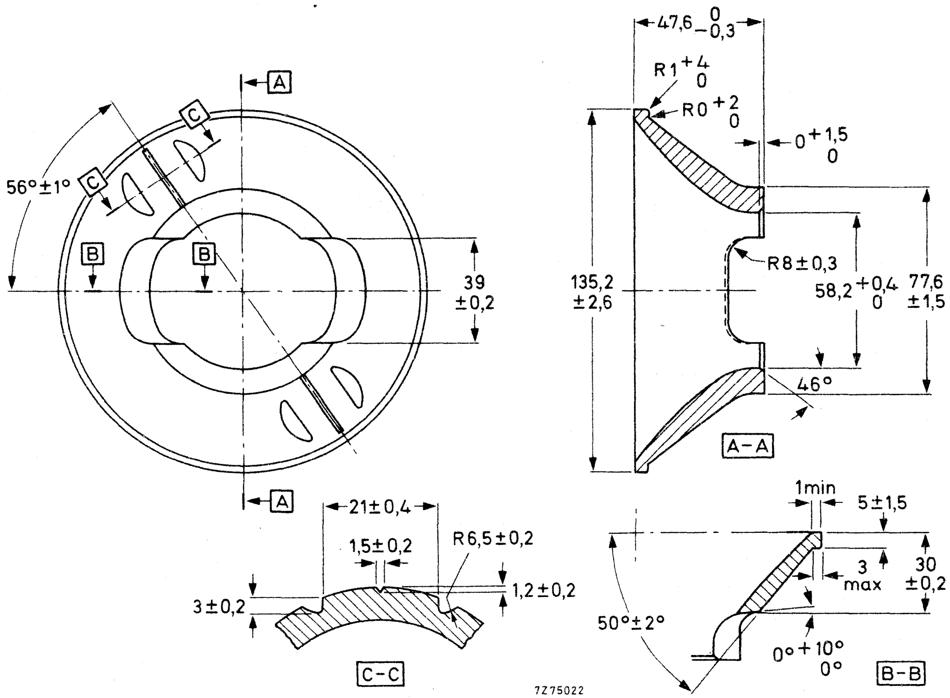
Dimensions (mm) (without lacquer)



FOR 110° COLOUR PICTURE TUBES

Catalogue number	3122 134 90970
Material	3C2
Mass	545 g

Dimensions (mm)



CORES FOR TRANSFORMERS

U-and U I-cores are not only used in line-output transformers for television receivers but also for a number of other applications in the frequency range of 1 kHz to 100 kHz.
On the survey page which follows we have three groups of cores :

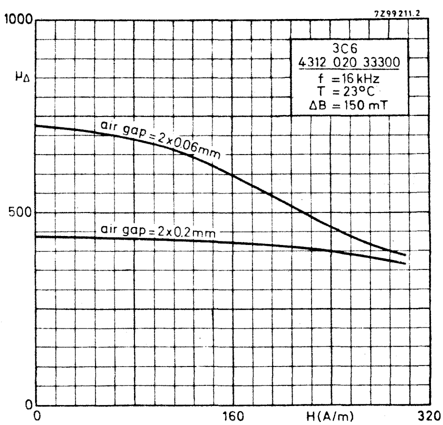
group I : suitable for the construction of driver transformers, small power transformers, chokes and coils.
group II : mainly used for line-output transformers.
group III : for use in power transformers.

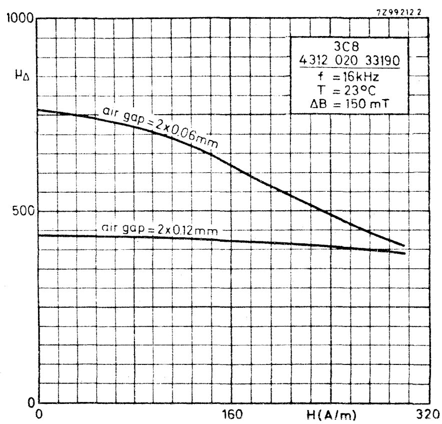
The cores are available in ferroxcube grade 3C6 and 3C8.
See chapter A of this handbook for material properties.

The guaranteed values given under the heading Magnetic Data are found on cores with a roughness of the mating surfaces < 0, 8 μm.
Cores with the usual roughness of 2 μm can yield a lower $\hat{B}$ - value (≈ 3 %).

Test conditions according DIN 42296 (sheet 10).

Two examples are given below of the incremental permeability as a function of the static field strength, viz. an UU-57/57/16 in 3C6 and in 3C8 at two different air gaps.





→ SURVEY

type designation [1]	catalogue number for one core		legs cross-section	group
	grade 3C6	grade 3C8		
U-15/11/6		3122 134 90690	rectangular	I
U-20/16/7		3122 134 90200	square	
U-25/20/13		3122 134 90460	rectangular	
U-30/25/16		3122 134 90760	rectangular	
U-52/27/11		3122 134 90480	round	II
U-57/28/16	4312 020 33300	4312 020 33190	round	
→ U-59/36/17		4312 020 33400	round	
U-64/30/14	4312 020 33320		round	
→ U-64/33/17		3122 134 91350	round	
U-64/40/20		3122 134 90810	round	
U-70/31/17	3122 104 93570		round	
U-70/32/16	4312 020 33330		round	
U-70/33/17		3122 104 93950	round	
U-100/57/25	4312 020 33120		square	
U-46/33/11	3122 104 90480		round	
I-46/10/11	3122 104 90470			
U-58/45/16		3122 104 94760	octagonal	
I-58/13/16		3122 104 94770		
U-82/65/18	3122 104 93120		round	
I-82/15/18	3122 104 93130			
U-93/52/30	4312 020 33100		rectangular	III
I-93/28/30	4312 020 33110			
U-93/76/16	4312 020 33070		rectangular	
I-93/28/16	4312 020 33080			
U-93/76/30	4312 020 33090		rectangular	
I-93/28/30	4312 020 33110			
U-100/57/25	4312 020 33120		square	
I-100/25/25	4312 020 33420			

[1]) The type designation gives the approximate overall dimensions and thickness.

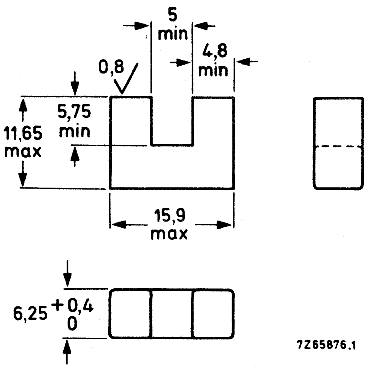
Besides the cores listed on the preceding page a series of E and EC-cores are supplied which suit very well in switched mode power supplies (SMPS), see table below.
For full data see chapter E of this handbook.

type designation	catalogue number of one core		
	grade 3C6	grade 3C8	
		without air gap	with air gap
E20/10/5	4312 020 34070		
E42/21/15		4312 020 34110	
E42/21/20		4312 020 34120 [1]	
E42/33/20		4312 020 34190 [1]	
E55/28/21		4312 020 34100	
E55/28/25		3122 134 90210	3122 134 90210
EC35/17/10		4322 020 52500	8213 140 25270
EC40/19/12		4322 020 52510	8213 140 25280
EC53/24/14		4322 020 52520	8213 140 25290
EC70/34/17		4322 020 52530	8213 140 25300

[1]) Combination of these two cores, catalogue number 4312 020 34170.

MECHANICAL DATA

Dimensions (mm)



Weight 4, 35 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-15/22/6.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 0, 18	3122 134 90690
	25	≥ 140	50	–	
	100	200	–	≤ 0, 16	
	100	≥ 315	250	–	

Magnetic dimensions

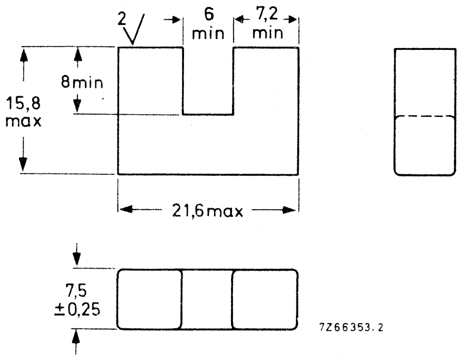
l_e = 48 mm

A_e = 30 mm^2

V_e = 1440 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 9 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-20/32/7.

grade	temperature (^{o}C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 0, 46	3122 134 90200
	100	200	–	≤ 0, 42	
	100	≥ 100	50	–	
	100	≥ 315	250	–	

Magnetic dimensions

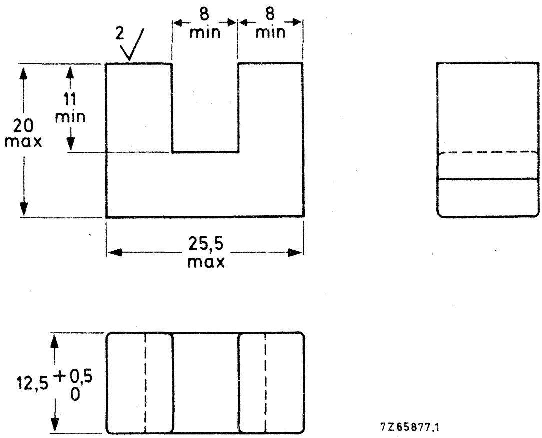
l_e = 68 mm

A_e= 56 mm^2

V_e=3800 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 21 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-25/40/13.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 1,1	3122 134 90460
	100	200	–	≤ 1,0	
	100	≥ 100	50	–	
	100	≥ 315	250	–	

Magnetic dimensions

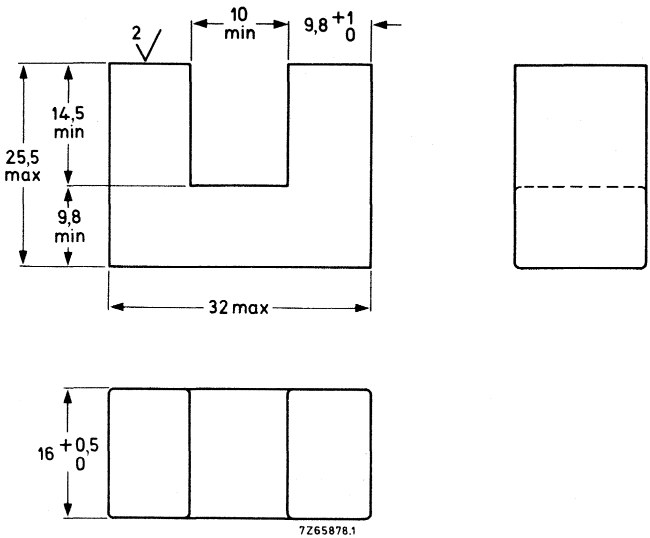
l_e = 86 mm

A_e = 100 mm^2

V_e = 8600 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 48 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-30/50/16.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 2,4	3122 134 90760
	100	200	–	≤ 2,0	
	100	≥ 335	400	–	

Magnetic dimensions

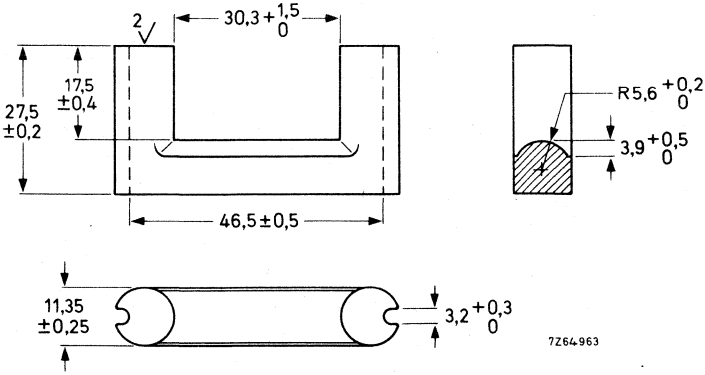
l_e = 111 mm

A_e = 157 mm^2

V_e = 17400 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 40 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-52/56/11

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 1,9	3122 134 90480
	100	200	–	≤ 1,75	
	100	≥ 330	250	–	

Magnetic dimensions

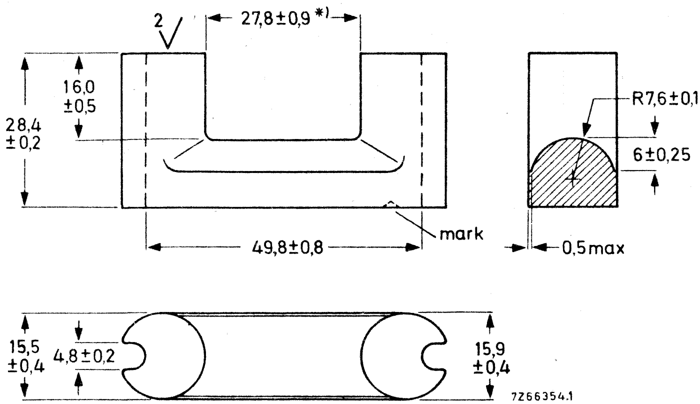
l_e = 165 mm

A_e = 95 mm^2

V_e = 15700 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 70 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-57/57/16

grade	temperature (^{o}C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C6	25 100 100	200 200 ≥ 290	- - 250	≤ 4, 70 ≤ 3, 85 -	4312 020 33300
3C8	25 100 100	200 200 ≥ 330	- - 250	≤ 3, 3 ≤ 3, 05 -	4312 020 33190

Magnetic dimensions

l_e = 163 mm

A_e = 171 mm^2

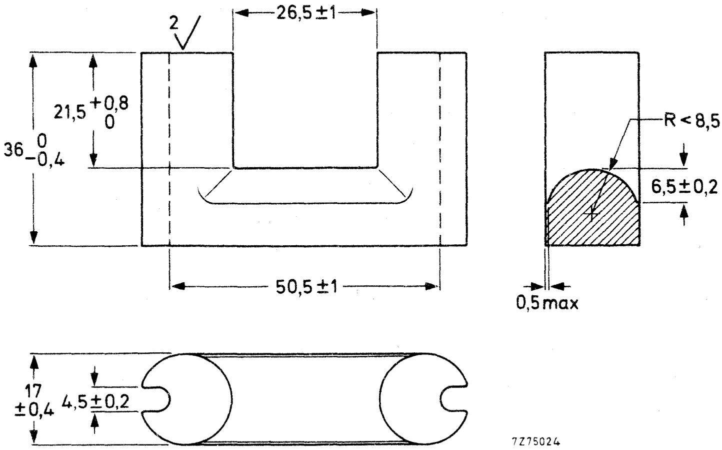
V_e = 27500 mm^3

*) The difference in splay between two U-cores taken at random from one packing will never exceed 0,8 mm.

MECHANICAL DATA

Dimensions in mm

Outlines



Mass 98 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-59/72/17

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 4, 8	4312 020 33400
	100	200	–	≤ 4, 4	
	100	≥ 330	250	–	

Magnetic dimensions

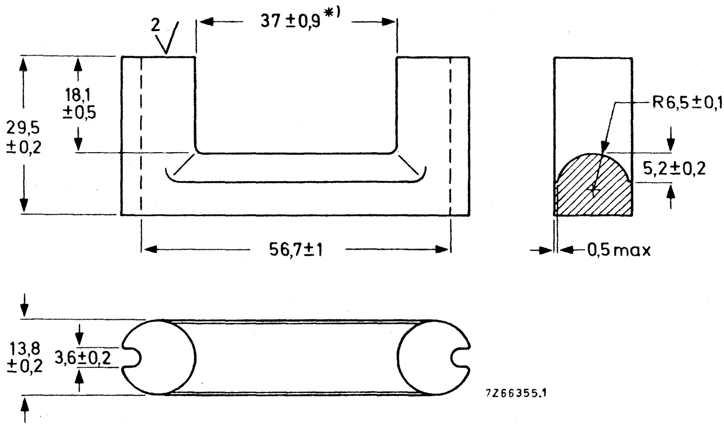
l_e = 189 mm

A_e = 210 mm^2

V_e = 39700 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 65 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-64/59/14

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C6	25	200	-	≤ 4,30	4312 020 33320
	100	200	-	≤ 3,55	
	100	≥ 290	250	-	

Magnetic dimensions

l_e = 185 mm

A_e = 138 mm^2

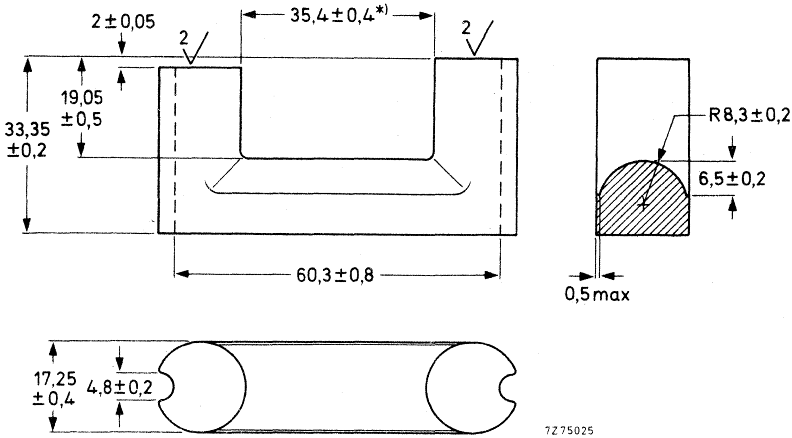
V_e = 25500 mm^3

*) The difference in splay between two U-cores taken at random from one packing will never exceed 1mm.

MECHANICAL DATA

Dimensions in mm

Outlines



MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-64/67/17

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 5,3	3122 134 91350
	100	200	–	≤ 5,0	
	100	≥ 330	250	–	

Magnetic dimensions

l_e = 197 mm

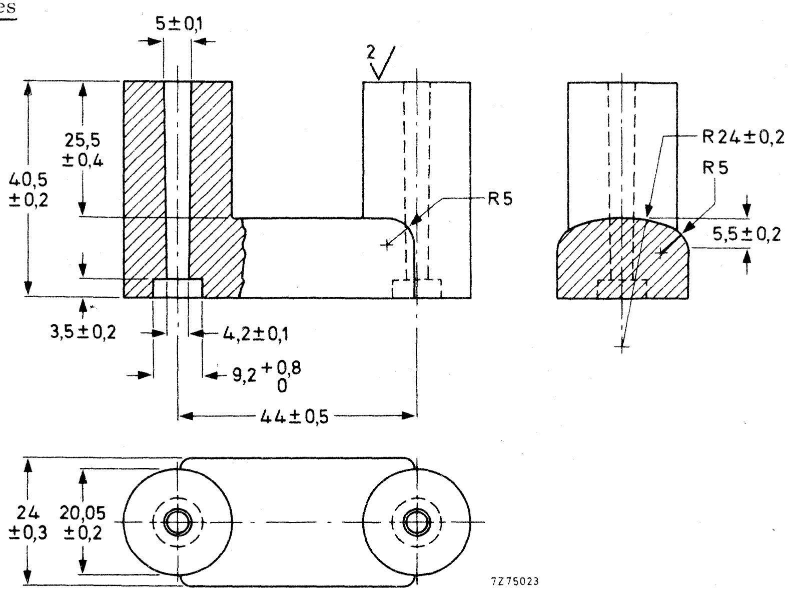
A_e = 214 mm^2

V_e = 43800 mm^3

MECHANICAL DATA

Dimensions in mm

Outlines



Mass 155 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-64/79/20

grade	temperature (^{o}C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 8,5	3122 134 90810
	100	200	–	≤ 7	
	100	≥ 330	250	–	

Magnetic dimensions

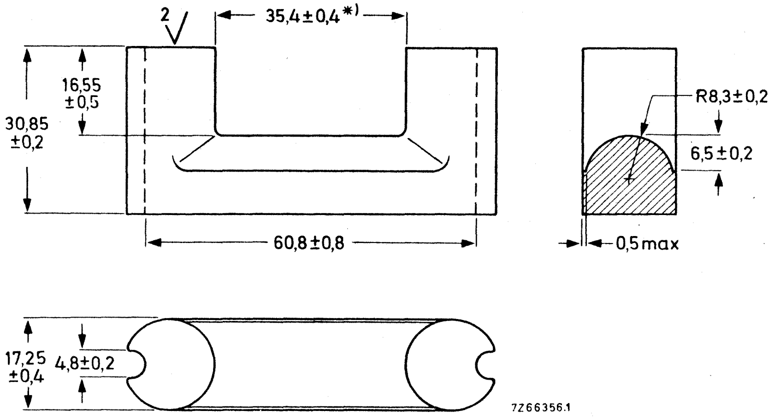
l_e = 210 mm

A_e = 290 mm^2

V_e = 61000 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight 105 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-70/62/17

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C6	25	200	-	≤ 6.8	3122 104 93570
	100	200	-	≤ 5.6	
	100	≥ 290	250	-	

Magnetic dimensions

l_e = 187 mm

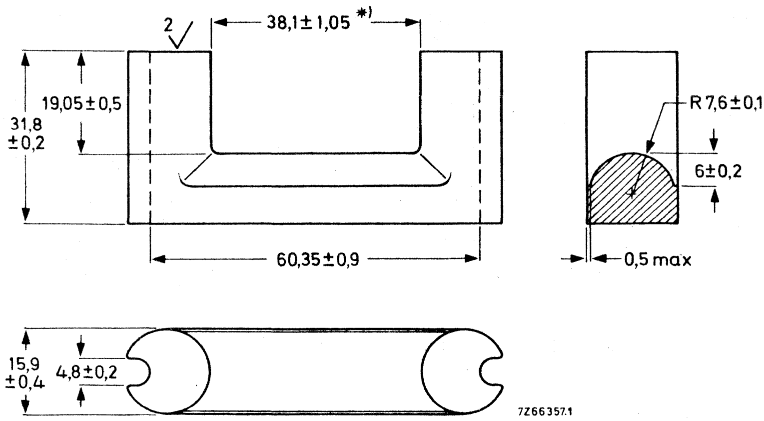
A_e = 214 mm^2

V_e = 40700 mm^3

*) The difference in splay between two U-cores taken at random from one packing will never exceed 1 mm.

MECHANICAL DATA

Dimensions (mm)



Weight 87 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-70/64/16

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C6	25	200	-	≤ 5.86	4312 020 33330
	100	200	-	≤ 4.83	
	100	≥ 290	250	-	

Magnetic dimensions

l_e = 197 mm

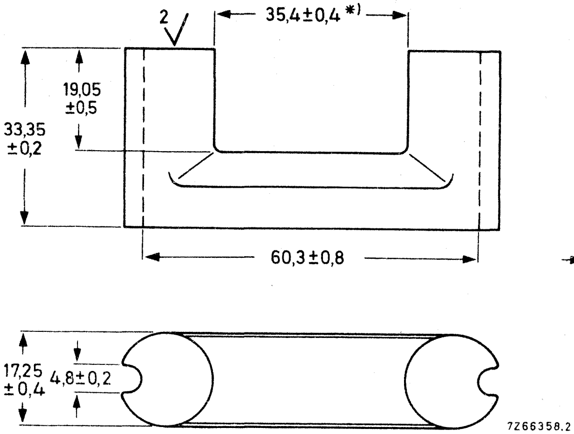
A_e = 177 mm^2

V_e = 34500 mm^3

*) The difference in splay between two U-cores taken at random from one packing will never exceed 1 mm.

MECHANICAL DATA

Dimensions (mm)



Weight 108 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-70/67/17.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C8	25	200	–	≤ 5,3	3122 104 93950
	100	200	–	≤ 5,0	
	100	≥ 330	250	–	

Magnetic dimensions

l_e = 197 mm

A_e = 214 mm^2

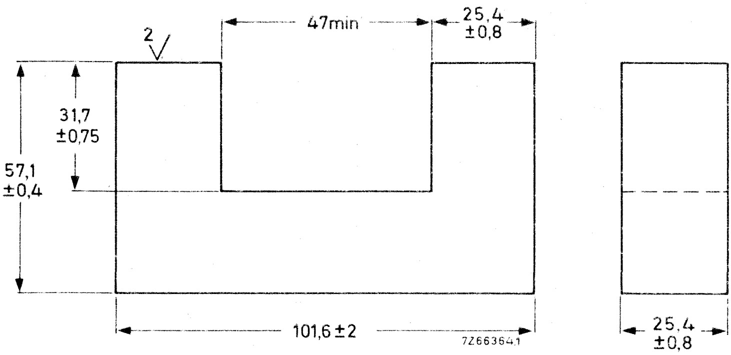
V_e = 43800 mm^3

*) The difference in splay between two U-cores taken at random from one packing will never exceed 1 mm.

MECHANICAL DATA

Dimensions in mm

Outlines



Mass 506 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UU-100/114/25

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	catalogue number of one U-core
3C6	25	200	–	≤ 32,4	4312 020 33120
	100	200	–	≤ 26,7	
	100	≥ 290	250	–	

Magnetic dimensions

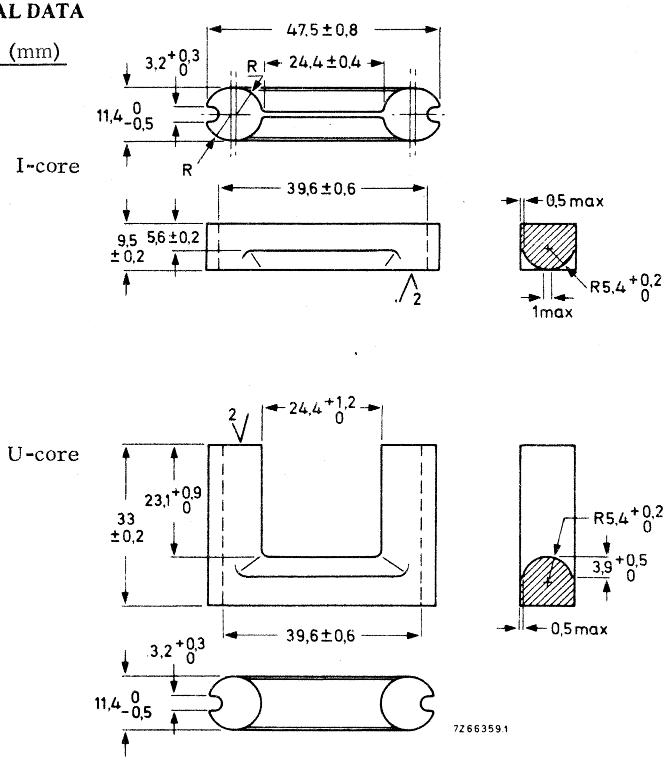
l_e = 310 mm

A_e = 620 mm^2

V_e = 191000 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight U-core 38 g
I-core 20 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-46/43/11

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25	200	-	≤ 1, 97	U	3122 104 90480
	100	200	-	≤ 1, 62	I	3122 104 90470
	100	≥290	250	-		

Magnetic dimensions

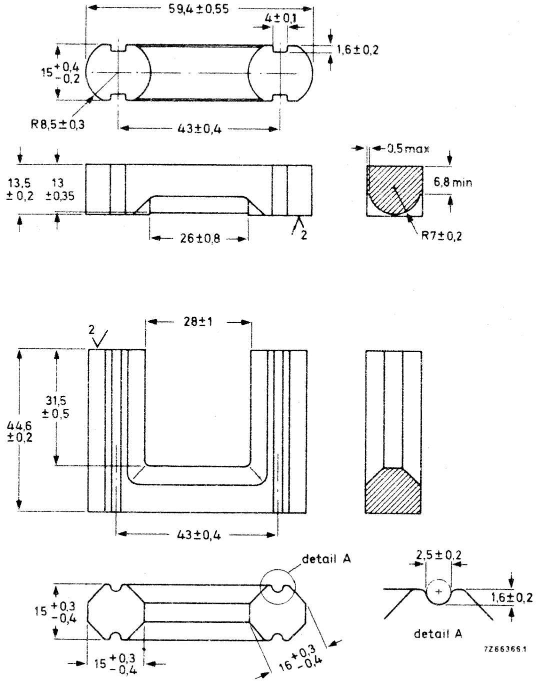
l_e = 129 mm

A_e = 88 mm^2

V_e = 11600 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight U-core 98 g
I-core 50 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-58/58/16.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C8	25	200	–	≤ 3,5	U	3122 104 94760
	100	200	–	≤ 3,2	I	3122 104 94770
	100	≥ 330	250	–		

Magnetic dimensions

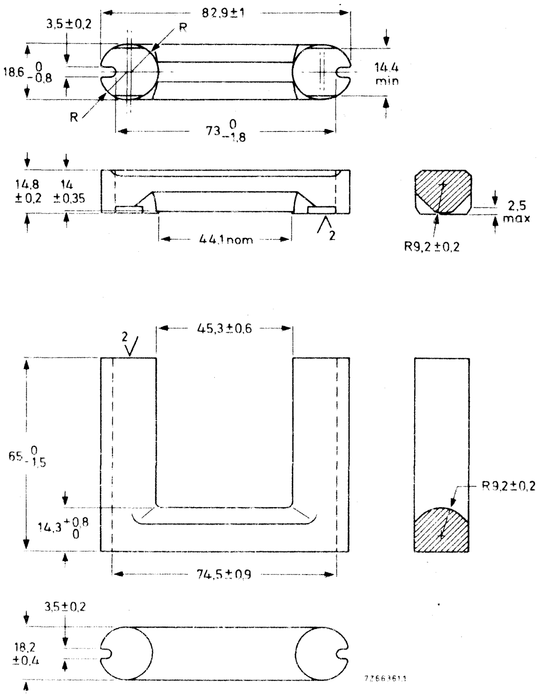
l_e = 164 mm

A_e = 175 mm^2

V_e = 28800 mm^3

MECHANICAL DATA

Dimensions (mm)



Weight U-core 212 g
I-core 93 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-82/80/18

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25	200	–	≤ 10	U	3122 104 93120
	100	200	–	≤ 8,3	I	3122 104 93130
	100	≥ 290	250	–		

Magnetic dimensions

l_e = 243 mm

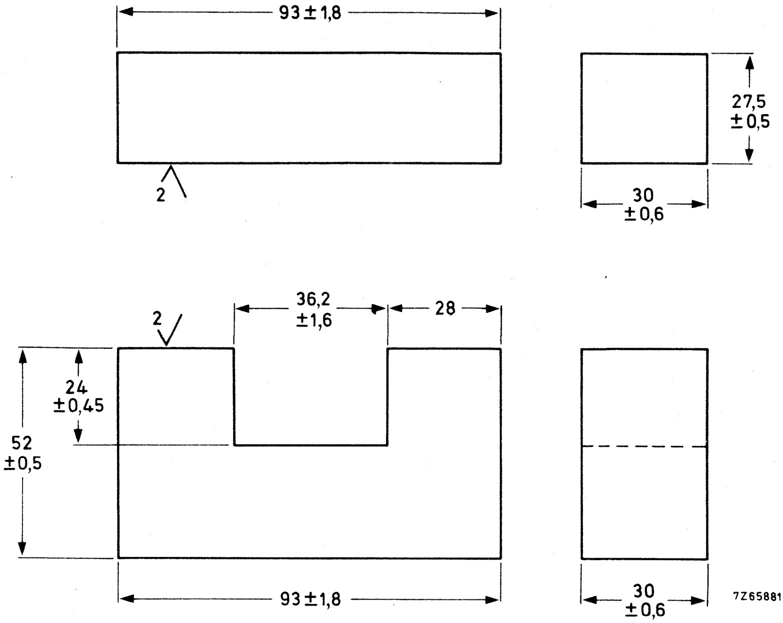
A_e = 234 mm^2

V_e = 58600 mm^3

MECHANICAL DATA

Dimensions in mm

Outlines



Mass

U-core	562 g	
I-core	365 g	

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-93/80/30.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25 100 100	200 200 ≥ 290	– – 250	≤ 26,9 ≤ 22,2 –	U I	4312 020 33100 4312 020 33110

Magnetic dimensions

l_e = 204 mm

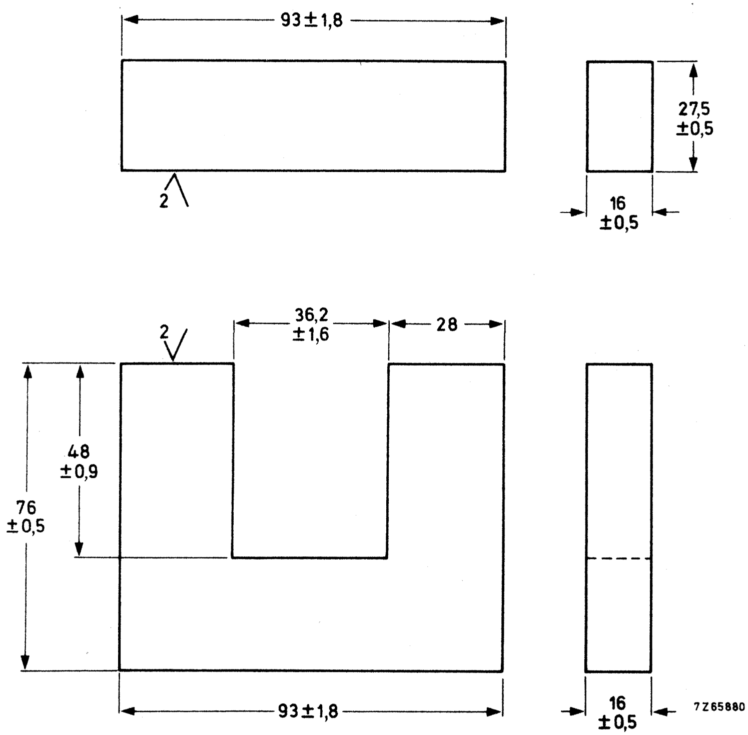
A_e = 780 mm^2

V_e = 158000 mm^3

MECHANICAL DATA

Dimensions in mm

Outlines



Mass	U-core	403 g
	I-core	194 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-93/104/16.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25	200	–	≤ 18,2	U	4312 020 33070
	100	200	–	≤ 15,0	I	4312 020 33080
	100	≥ 290	250	–		

Magnetic dimensions

l_e = 254 mm

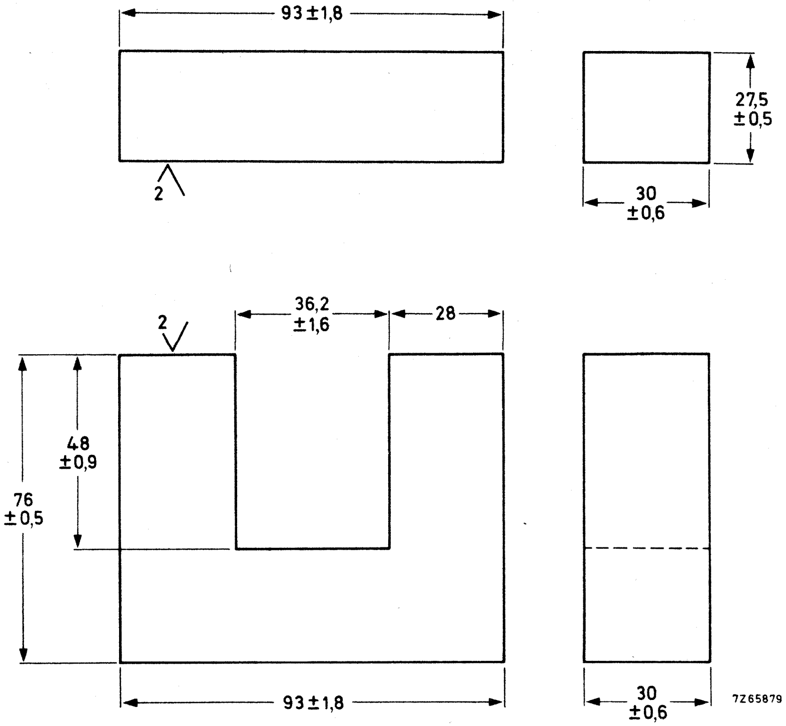
A_e = 420 mm^2

V_e = 107000 mm^3

MECHANICAL DATA

Dimensions in mm

Outlines



Mass	U-core	756 g
	I-core	365 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-93/104/30.

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25	200	–	≤ 34,0	U	4312 020 33090
	100	200	–	≤ 28,0	I	4312 020 33110
	100	≥ 290	250	–		

Magnetic dimensions

l_e = 254 mm

A_e = 780 mm^2

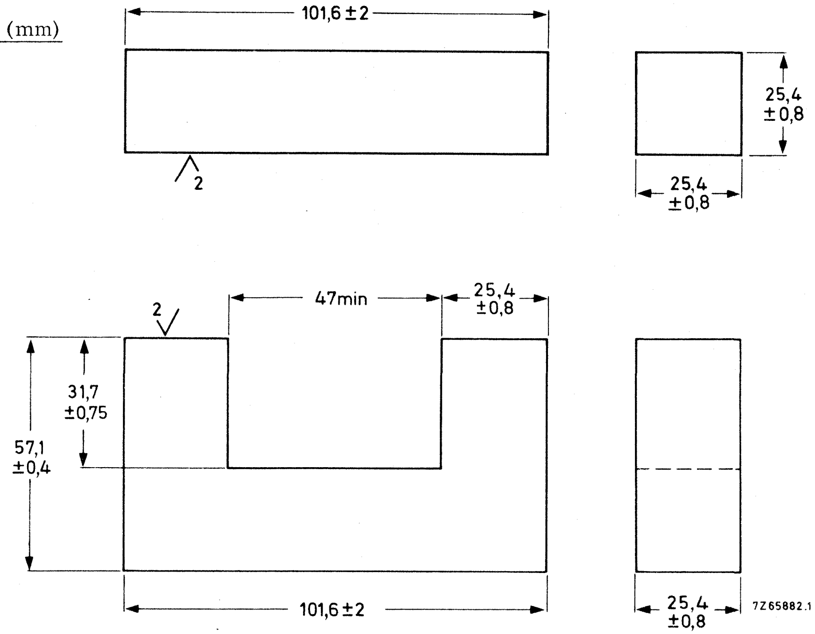
V_e = 200000 mm^3

MECHANICAL DATA

Dimensions (mm)

I-core

U-core



Weight U-core 506 g
I-core 310 g

MAGNETIC DATA

Guaranteed values, measured at 16 kHz, for a core-pair UI-100/82/25

grade	temperature (°C) ± 5	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W)	shape	catalogue number of one core
3C6	25	200	–	≤ 26, 8	U	4312 020 33120
	100	200	–	≤ 22, 1	I	4312 020 33420
	100	≥ 290	250	–		

Magnetic dimensions

l_e = 244 mm

A_e = 645 mm^2

V_e = 157700 mm^3

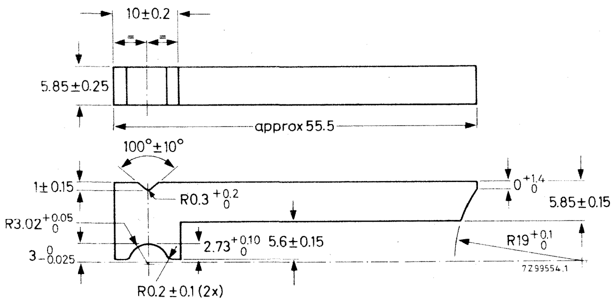
FERRITES FOR TELEVISION COMPONENTS

1. YOKE RINGS See chapter "Yoke rings"

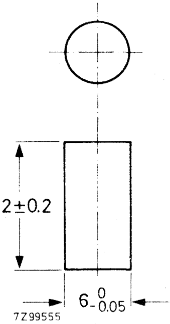
2. U-CORES See chapter "Cores for line-output transformers"

Special ferrite parts are:

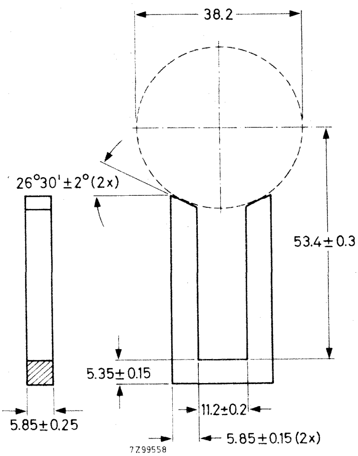
3. FERROXCUBE CORES AND FERROXDURE MAGNET FOR CONVERGENCE UNITS



L-core
Ferroxcube 3C2
Catalogue number 3122 104 94090 } *)
3122 104 94600



Ferroxdure 100 magnet
Catalogue number 3122 104 94330



U-core
Ferroxcube 3C2
Catalogue number 3122 104 93780

*) Equal quantities of both numbers must be ordered. (two cores form one unit)

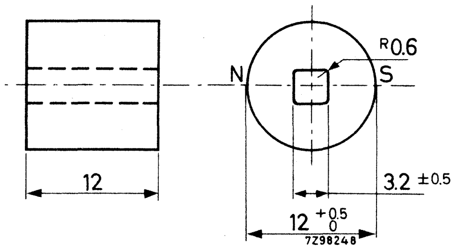
4. FERROXCUBE RODS, TUBES AND FERROXDURE MAGNETS FOR LINEARITY-CONTROL UNITS

Rod cores

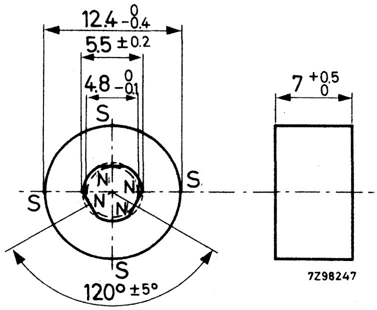
diameter (mm)	length (mm)	grade	catalogue number
4,9 ± 0,05	36 - 0,5	3C6	3122 104 90490
4,9 ± 0,05	50 - 0,5	3C6	3122 134 90110

Tube cores

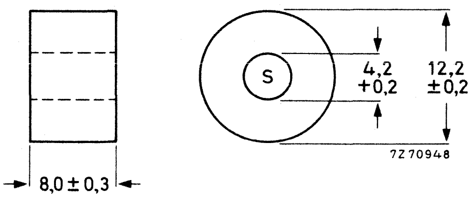
outer diameter (mm)	inner diameter (mm)	length (mm)	grade	catalogue number
4,9 ± 0,05	3 + 0,1	36 - 0,5	3C6	3122 104 93760
4 ± 0,15	2 + 0,2	36 ± 0,6	3C6	4312 020 31450



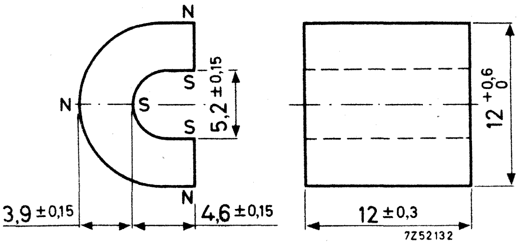
Ring magnet, diametrically magnetized.
Ferroxdure 100.
Catalogue number 3122 104 92690.

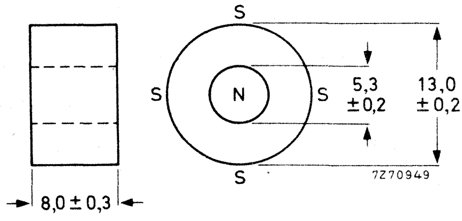


Ring magnet, radially magnetized.
Plastic bonded ferroxdure P40.
Catalogue number 3122 104 93530.



Ring magnet, radially magnetized.
Ferroxdure 100.
Catalogue number 4312 020 63180.





Segment magnet, radially magnetized.
Plastic bonded Ferroxdure P40.
Catalogue number 3122 104 93770

Ring magnet, radially magnetized.
Ferroxdure 100.
Catalogue number 3122 904 92670

5. BLUE LATERAL ROD-CORE

Catalogue number 3122 104 90490 (for dimensions see point 4 of this section)

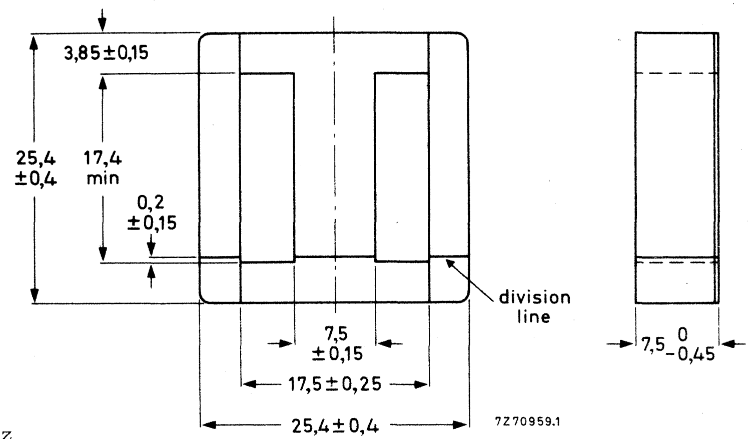
6. TRANSDUCTOR CORES

Ferroxcube E + I core for raster correction in grade 3C7 and 3C8

Magnetic dimensions

Dimensions in mm

l_e = 57,5 mm
A_e = 52,5 mm^2
V_e = 3020 mm^3



Magnetic data

Measured at 16 kHz

grade	temperature (°C)	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W/pair)	catalogue number
3C7	25	200	–	≤ 0,45	4312 020 34340
	25	≥ 400	250	–	
	100	≥ 150	50	–	
3C8	25	200	–	≤ 0,65	3122 134 90960
	25	≥ 380	250	–	
	100	≥ 100	50	–	

grade 3C8: catalogue number 3122 134 90430

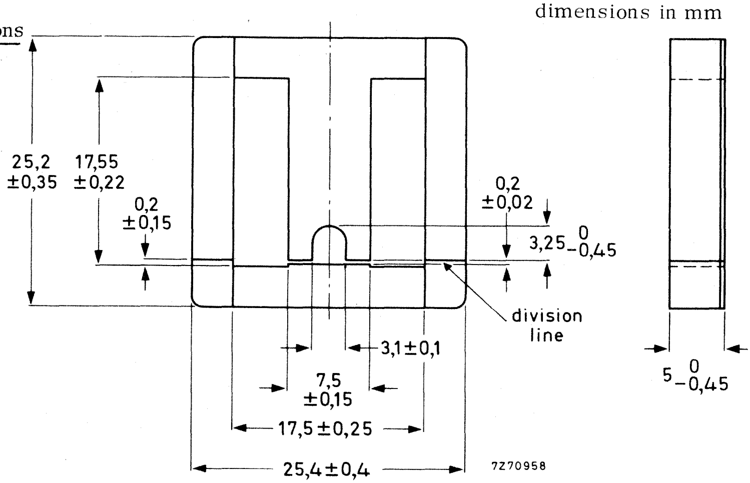
dimensions in mm

magnetic dimensions

l_e = 83 mm

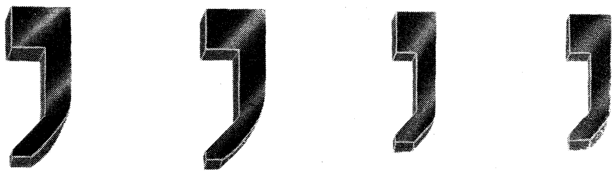
A_e = 19 mm^2

V_e = 1580 mm^3



temperature (°C)	induction $\hat{B}$ (mT)	field strength $\hat{H}$ (A/m)	losses (W/pair)	measuring frequency (kHz)
25	200	–	≤ 0,25	16
25	≥ 380	250	–	16
100	≥ 120	50	–	16

CORES FOR ERASING HEADS


10207

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 to a much higher degree than laminated metal cores, so that they are ideal for this application.
Each core is machined out of solid after sintering to ensure uniform quality of material and excellent shape-symmetry.

MATERIAL PROPERTIES

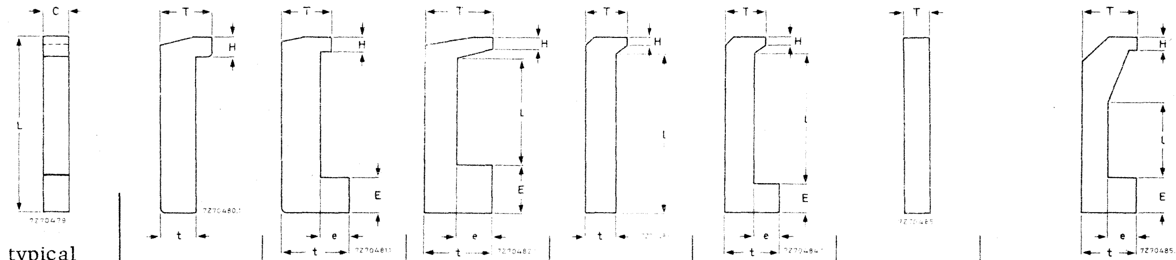
Ferroxcube grade 3H2

Low eddy current losses at frequencies up to 500 kHz

Relative initial permeability is approximately 2300

Saturation flux density at 25 °C is approximately 440 mT

AVAILABLE TYPES



typical side view / catalogue number / size (mm)	3103 209 12030	3103 209 12040	3103 224 90150	3103 224 90090	3103 224 90100	3104 101 80720	3104 101 80400	3104 101 80730
L	10,9 ± 0,1	10,9 ± 0,1	11,2 ± 0,2	9 −0,2	9 −0,2	10,7 ± 0,1	11 ± 0,2	10,7 ± 0,1
l	–	–	5 ± 0,2	8,1 ± 0,1	6,5 + 0,1	–	4,7 ± 0,2	7,4 + 0,1
C	1,7 ± 0,1	1,7 ± 0,1	14,5 −0,2	2,4 ± 0,1	2,4 ± 0,1	1,9 + 0,2	1,9 + 0,2	1,9 + 0,2
T	3,25 ± 0,1	3,05 ± 0,15	4,4 ± 0,1	2,6 ± 0,1	2,6 ± 0,1	1,5 ± 0,1	3,5 ± 0,1	2,6 −0,2
t	2,1 ± 0,1	4,4 ± 0,1	4,4 ± 0,1	1,8 −0,2	3,5 ± 0,1	–	3,5 ± 0,1	2,6 −0,2
H	1,4 + 0,2	1,0 ± 0,1	0,7 ± 0,1	0,5 ± 0,1	0,5 ± 0,1	–	0,9 ± 0,1	0,8 ± 0,1
E	–	2,2 ± 0,3	3,2 −0,4	–	1,7 −0,3	–	2,2 −0,2	1,5 ± 0,1
e	–	1,9 ± 0,1	2,4 + 0,3	–	1,7 ± 0,1	–	2,0 ± 0,1	1,5 ± 0,1

FERROXCUBE FOR MAGNETIC HEADS

INTRODUCTION

The Ferroxcube grades 8C1 (NiZn ferrite) and 8H1 (MnZn ferrite) were developed for application in the production of audio magnetic-video magnetic- and instrumentation magnetic heads.
Their low porosity and high density in respect to the theoretical value of the specific crystal structure gives these materials excellent properties.
The main features are the high resistance to wear and the good magnetic performance incorporated in the well controlled micro-structure. This structure enables high gloss polishing, lapping and glass or metal bonding.
The materials are available in the shape of small blocks (sizes ≈ 17 x 13 x 2 mm) but, on request, specially machined products can be sampled and supplied.

TECHNICAL DATA *)

	unit	8C1 NiZn ferrite	8H1 MnZn ferrite
μ_i at 0,1 MHz		1500	5000
1 MHz		1300	2000
5 MHz		500	600
μ_{max} at 1 kHz		3200	40 000
Curie point	^oC	125	125
Coercivity (H_c)	A/m	160	20
Induction $\hat{B}$ at H = 800 A/m	mT	350	440
Resistivity	Ωm	10^4	0,01
Density	kg/m^3	5310	5100
Porosity	%	< 0,5	< 0,3
Coefficient of linear expansion	$10^{-6}/^oC$	9	10
Hardness (Vickers)	N/mm^2	7500	6500

The wear of recording heads is due to two mechanisms: abrasive action (grinding) and adhesive action (polishing) by cards or tape.
In a practical test, incorporating both mechanisms, the wear resistance of the ferrite magnetic head was compared with a mu-metal one under the same test conditions (volume "take-off" per time unit over the testing period).
For audio magnetic heads the wear resistance under identical conditions (≈ 40% abrasive and ≈ 60% adhesive) can be a factor 80 better than that of the mu-metal one.

*) Valid for toroids ≈ 9 x 5 x 1 mm.

Beads and chokes

Beads C3

Wide-band H.F. chokes C7

BEADS FOR SCREENING, DAMPING AND WIDE-BAND H.F. CHOKES

APPLICATION

The beads are available in the ferroxcube materials 3 and 4. They are used in v.h.f. radio and TV receivers and in electric motors, ignition systems etc. to reduce in- or outgoing interference, and also in v.h.f. circuits to avoid troublesome coupling. The supply leads in radio, TV and other electronic equipment often transfer unwanted r.f. and v.h.f. energy from one circuit or stage to another. Capacitive decoupling of the leads will not always be effective by reason of possible resonances. On the same grounds the addition of a series inductance will not always have the required results. In these cases a number of beads (the total length of which is small compared with the wavelength) simply threaded on the supply leads, or a single wideband choke may be used successfully. For the same volume chokes are more effective than beads.

In "damping circuits" either beads or chokes may be used in conjunction with small capacitors, to provide additional filtering of the self-resonant frequency of that capacitor and its leads.

Ferroxcube beads and ferroxcube-cored chokes have the following advantages over air-cored chokes:

- small volume;
- wide band;
- no sharp fall-off;
- insensitive to stray circuit capacitance;
- no parasitic resonances;
- no additional resistor required for damping;
- low price.

VERSIONS

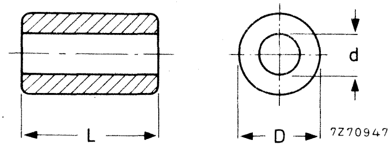


Fig. 1

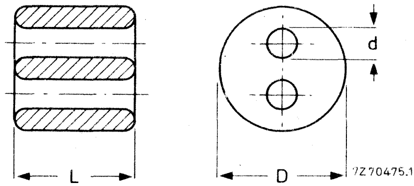


Fig. 2

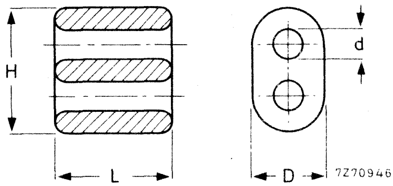


Fig. 3

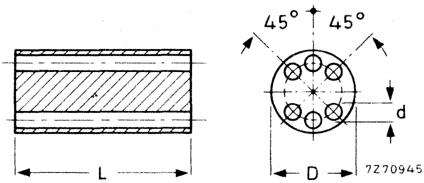


Fig. 4

Fig.	D (mm)	d (mm)	L (mm)	H (mm)	grade	catalogue number
1	3,5 +0,1 −0,2	1,3 +0,2	3 +0,5	–	3B	4312 020 31050
	3,5 ±0,2	1,3 +0,2	5 +0,5	–	3B	4312 020 31060
	3,7 −0,4	1,2 +0,2	3,5 −0,5	–	3B	4322 020 34400
	3,7 −0,4	1,2 +0,2	3,5 −0,5	–	4B1	4322 020 34420
	3,7 −0,4	1,5 +0,2	3,5 −0,5	–	3B	4322 020 34430
2	5,6 ±0,3	0,9 ±0,15	6,35 +0,4	–	4B1	4322 020 38280
	5,6 ±0,25	0,95 +0,15	4,5 −0,5	–	4D1	3122 134 90800
	5,9 −0,6	0,75 +0,3	12,4 −0,8	–	4B1	3122 104 90960
	6,6 −0,6	1,05 +0,3	5 ±0,2	–	4B1	3122 104 94840
	6,6 −0,6	1,05 +0,3	12,4 −0,8	–	4B1	3122 104 90950
	7,2 −0,4	0,7 +0,2	5,1 −0,2	–	4A1	4322 020 36840
3	8,5 −0,5	3,5 +0,5	8 ±0,3	14 +0,5	4B1	4312 020 31570
	8,5 −0,5	3,5 +0,5	14 ±0,4	14 +0,5	4B1	4312 020 31520
4	6 ±0,3	0,7 +0,2	10 ±0,5	–	3B	4312 020 31500
	6 ±0,3	0,7 +0,2	10 ±0,5	–	4B1	4312 020 31550

The beads may be threaded with insulated or bare wire, but if grade 3B is used on bare wire a maximum fall-off in resistance of 8% can be expected, as a result of its lower resistivity.

Fig. 5 shows some performance details of the 3, 5 mm long tube beads in the two material grades. It will be noted that above about 60 MHz the impedance of the 3B type is substantially resistive.

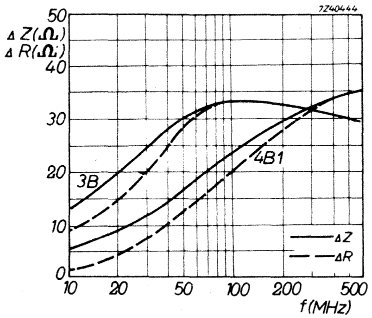


Fig. 5

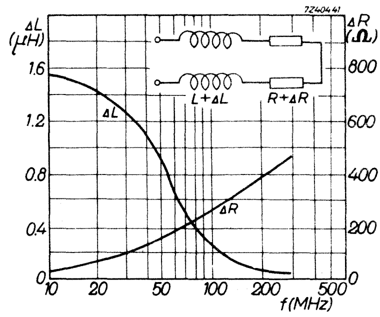


Fig. 6

With twin beads the advantages of mutual inductance can be utilized. Fig. 6 gives the increase of the inductance L and loss resistance R caused by a twin bead 4312 020 31520 on two straight wires.
Grade 4B1 provides ample insulation between the two wires even if bare.

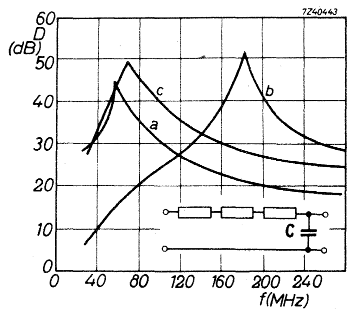


Fig. 7. Damping in an LC circuit consisting of a string of three beads 4322 020 34400 and a ceramic capacitor.

a. C = 1500 pF tubular
b. C = 190 pF tubular
c. C = 1500 pF disc

WIDE-BAND H.F. CHOKES

APPLICATION

See section "Beads for screening and damping and wide-band h.f.chokes"

TECHNICAL DATA

The chokes are supplied with six axial holes through which 1.5, 2.5 or 2 x 1.5 turns of tinned copper wire are threaded.
The table gives the types of choke that are currently available.

Dimensions in mm

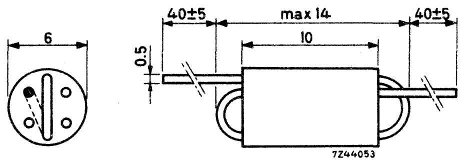


Fig. 1

number of turns	Z_{max} (kΩ)	f at Z_{max} (MHz)	decrease of impedance in the freq. range (MHz)	dB	grade	catalog number
1.5	0.35 ± 20%	120	10-300	≤7	3B	4312 020 36630
1.5	0.45 ± 20%	250	80-300	≤3	4B1	4312 020 36690
2.5	0.75 ± 20%	50	10-220, 30-100	≤7, ≤3	3B	4312 020 36640
2.5	0.85 ± 20%	180	50-300, 80-220	≤6, ≤3	4B1	4312 020 36700
2 x 1.5	0.90 ± 20%	50	10-220, 30-100	≤7, ≤3	3B	4312 020 36650
2 x 1.5	1.00 ± 20%	110	50-300, 80-220	≤7, ≤3	4B1	4312 020 36710

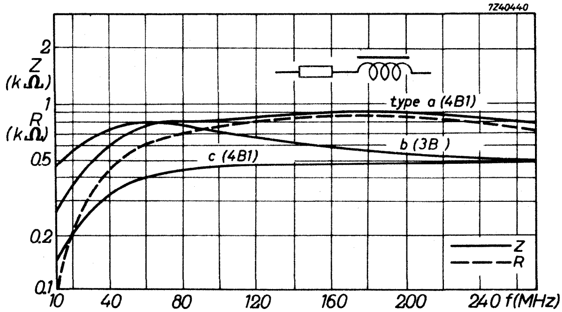


Fig. 2. Performance of three single chokes

Type a = 4312 020 36700
b = 4312 020 36640
c = 4312 020 36690

Fig.2 shows some performance details of three single chokes. It will be noted that above approx. 80 MHz the impedance is substantially resistive and tends to be constant. Double chokes are used for twin leads, in which case the advantages of mutual inductance can be utilized.
Fig. 3 compares the typical obtainable performance.

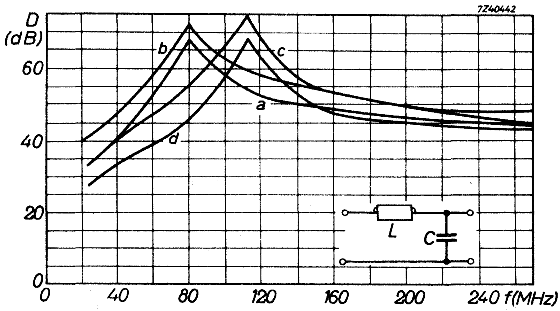


Fig. 3. Damping in an LC circuit consisting of a ferroxcube choke and a ceramic disc capacitor.

a. L = 4312 020 36690, C = 1500 pF
b. L = 4312 020 36700, C = 1500 pF
c. L = 4312 020 36700, C = 550 pF
d. L = 4312 020 36690, C = 550 pF

Ferroxcube potcores and square cores

General D3

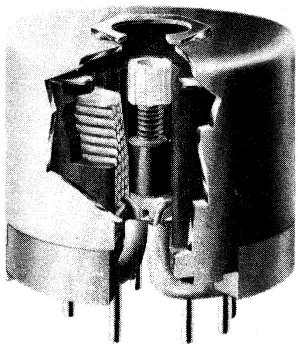
Potcores D35

Square cores D295

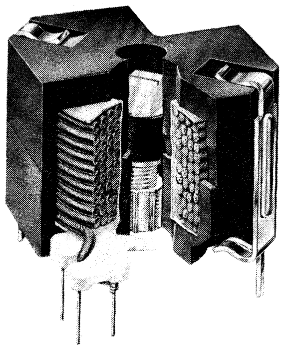
General

Introduction	D5
Survey of symbols	see chapter A
Pre-adjusted cores	D6
Q-curves	D10
Measurement of hysteresis, eddy current and residual losses	D10
Adjustment mechanism	D13
Coil design and calculations	D15
Hysteresis constants	D25
Marking	D26
Mounting data	D29
Coil winding recommendations	D33

INTRODUCTION



RZ 16213 - 3



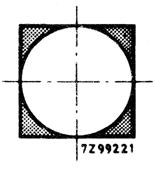
RZ 25252

Ferroxcube potcores and square cores have been developed for stable low loss filters, coils and transformers. Due to their closed shape they combine a low weight with a small volume.

The principal properties of potcores and square cores are the inductance, the quality factor Q, the temperature coefficient α_F , the disaccommodation factor D_F and, if the core is used on higher induction values, the generation of third harmonics.

Our preferred types of potcore are called P-potcores; they are standardized in accordance with the international I.E.C., the British Standards B.S.I., the German D.I.N. and the French F.N.I.E. specifications.

Our preferred types of square core are called RM cores, the I.E.C. and several national standardization committees did already prepare or are preparing standardization.



Square cores have the advantage over conventional (round) potcores that, if mounted on a printed wiring board, the space of the corners (see the adjoining sketch) is used.

PRE-ADJUSTED CORES

In principle potcores and square cores with any μ_e value and A_L-factor can be manufactured. However, in practice the ranges are limited to the μ_e-values and A_L-factors required for the most important fields of application.

Recommended are the pre-adjusted cores which are provided with a nut for an adjustor. However, for those users who prefer to insert the nut themselves, some information is given under Mounting Data in this general part and under Mounting Parts in the data sheets.

For most μ_e-values and A_L-factors of the pre-adjusted cores a continuously variable adjustor mechanism can be delivered. These continuously variable adjustors are specially recommended if the coils are employed as filter coils. The maximum adjustment varies from 8 - 14%, depending on the type.
For the potcores P26/16 and larger a step-by-step adjustor can be delivered, specially recommended if the coils are employed as loading coils. For detailed data see the relevant sections Inductance Adjustors in the data sheets.

When the aforementioned adjustors are used, co..s with a higher μ_e value can be designed in order to obtain a maximum quality factor with a minimum volume, maintaining a small inductance tolerance field.

α AND A_L FACTORS

α is the number of turns for an inductance of 1 mH for a given core shape. For other inductance values the number of turns is $N = \alpha\sqrt{L}$ (L in millihenrys).

A_L is the inductance per turn^2 in nanohenrys (10^{-9} H) for a given core shape. For a given number of turns the total inductance is $L = N^2 A_L$ (L in nanohenrys).

The α and A_L values mentioned under "Pre-adjusted cores" in the data sheets are valid for cores without inductance adjustor. The adjustors give an increase in inductance of the potcores as given under "Inductance adjustors".

Measurement

The α and A_L factors given in the data sheets are guaranteed by means of a tolerance on the inductance, which is valid for a set of cores from one compartment of a primary pack, when the 11 following measuring conditions are met:

1. The core should be magnetically conditioned (demagnetised). The α or A_L value should not be measured less than 24 hours after the conditioning (demagnetisation).

2. The mating surfaces should be carefully cleaned.

3. A standard coil as indicated in the following table should be used.

for series	catalogue number of standard coil	number of turns			number of layers	diam. of copper (mm)
		total	per layer	upper layer		
P 9/5	7622 301 00101	65	11	10	6	0.20
P 11/7	7622 301 00301	71	12	11	6	0.25
P 14/8	7622 301 00501	90	13	12	7	0.30
P 18/11	7622 301 00701	83	12	11	7	0.45
P 22/13	7622 301 00901	71	12	11	6	0.60
P 26/16	7622 301 01101	71	12	11	6	0.70
P 30/19	7622 301 01301	104	15	14	7	0.70
P 36/22	7622 301 01501	135	17	16	8	0.70
P 42/29	7622 301 01701	199	20	19	10	0.80
P 66/56	7622 301 01901	231	29	28	8	1.20
RM 4	7622 300 50101	91	23	22	4	0.224
RM 5	7622 300 50201	107	18	17	6	0.25
RM6-S/ RM6-R	7622 300 50301	113	19	18	6	0.315
RM 8	7622 300 50501	125	21	20	6	0.40

4. The axial lines of the potcore halves should coincide.

5. The silver reference lines (if any) on the circumference of the potcore halves should coincide. If no reference lines are given, the halves may be positioned arbitrarily.

6. A force is applied to the flat sides of the core by means of rings. The inner diameter of these rings should be equal to the average value of the inner diameter of the core.

7. The force mentioned above should be as given in the relevant data sheets.

8. The temperature should be 25 ± 10 °C

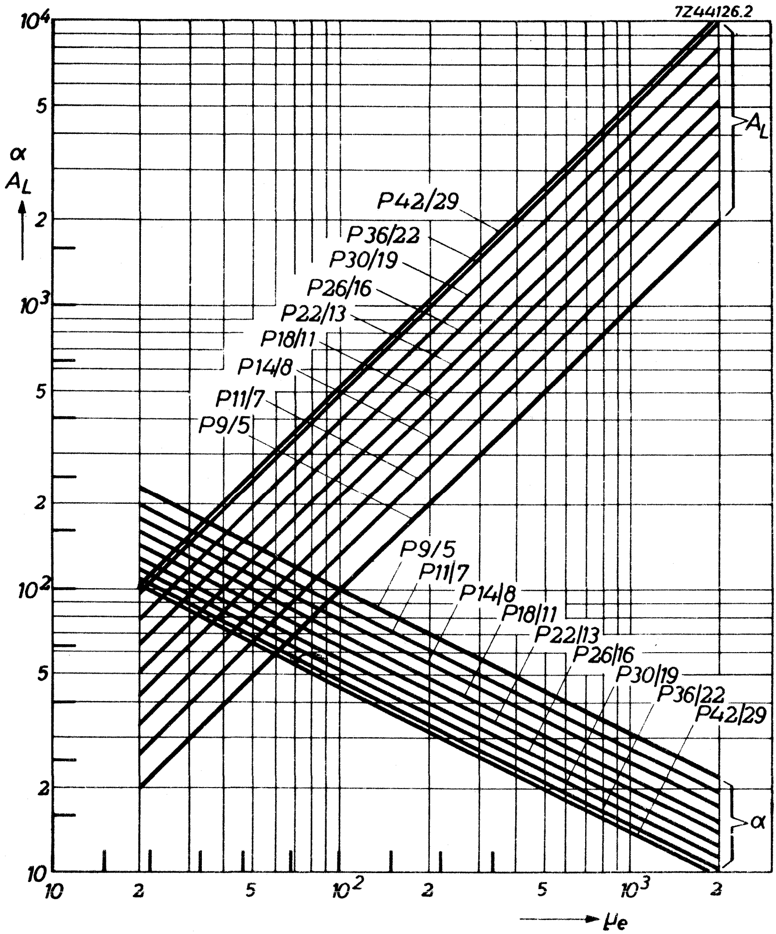
9. The frequency should be 4 kHz.

10. The current through or the voltage over the coil should correspond to a peak flux density ($\hat{B}$) in the core of $\leq 0,1$ mT

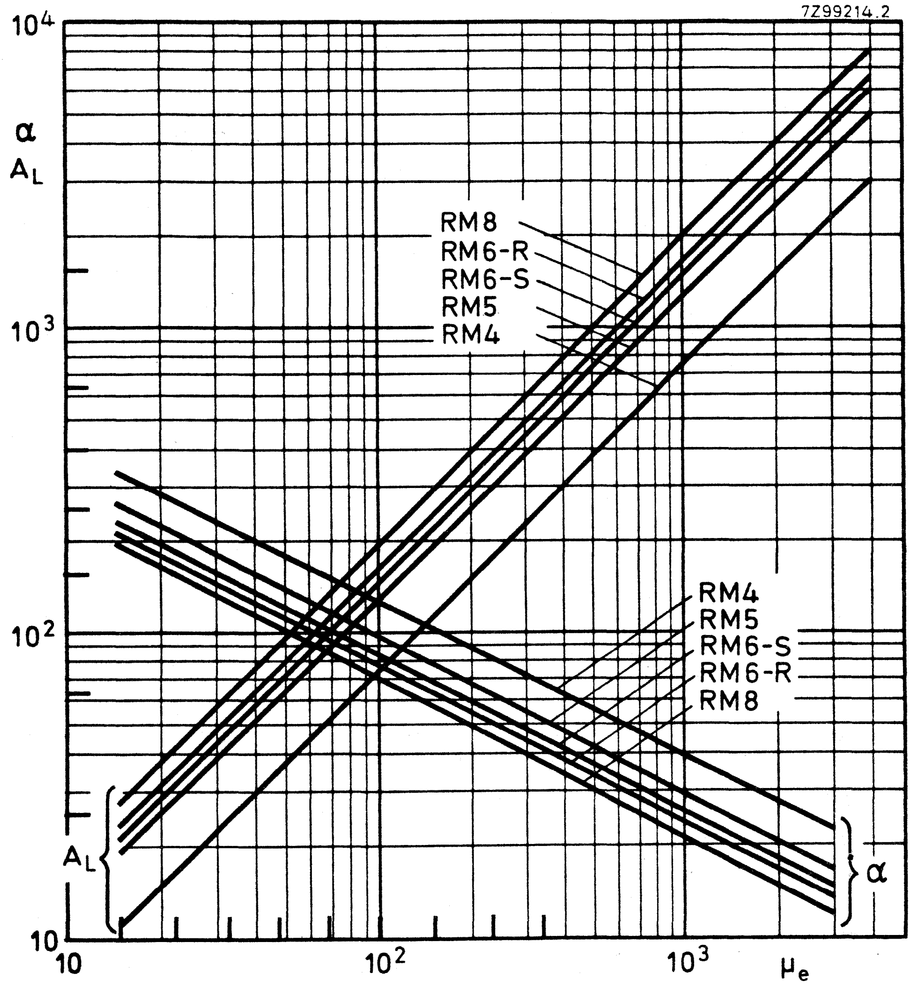
11. The standard coil is held against the bottom of the lower half (half with protruding coil former pins)

Conversion of μ_e-values into α and A_L values

Potcores



Square cores



Q-CURVES

As so many assumptions have to be made in calculating filter cores, an accuracy in Q-factor of better than ± 15% is difficult to obtain. Because of this, the proper value of μ_e or A_L for a given core is best arrived at by comparing Q-curves for various values of μ_e.

Several curves are included for most potcores and square cores. To simplify comparison, the curves for a given core have been made using identical coil windings.

Consequently curves for different μ_e values and the same core size can be compared, as well as curves for the same μ_e value and different core sizes.

The Q-factors for inductances other than given in the curves may be found by interpolation or extrapolation, as necessary.

MEASUREMENT OF HYSTERESIS, EDDY CURRENT AND RESIDUAL LOSSES

The hysteresis constant for calculating the hysteresis losses is $q_{2-24-100}$, see the section Symbols in chapter A. For the relation between the several hysteresis constants see the section Hysteresis Constants. For the guaranteed values, measuring frequencies and induction values see the relevant data sheets.

The eddy current and the residual losses are measured at an induction $\hat{B} \leq 0,1$ mT and are expressed in a $\frac{\tan\delta}{\mu_i}$ value. For guaranteed values and measuring frequencies see the relevant data sheets.

The windings used for the measurement of the above mentioned quantities are indicated in the following table. The winding data refer to a single-section bobbin.

potcore	FXC grade	4 kHz	100 kHz	0,5 - 1 MHz	2 MHz	10 MHz
P 9/5	3B7/3H1	-	35 t/0,2 E	-	-	-
	4C6	-	-	-	17 t/40 x 0,04 E	6 t/0,30 E
P 11/7	3B7/3H1	-	42 turns 0,18 E	-	-	-
	3D3	-	42 turns 0,18 E	22 turns 0,10 E	-	-
	4C6	-	-	-	16 turns 45 x 0,04 E	6 turns 45 x 0,04 E
P 14/8	3B7/3H1	53 turns 0,25 E	37 turns 0,10 E	-	-	-
	3D3	-	37 turns 0,10 E	19 turns 8 x 0,04 E.S.	-	-
	4C6	176 turns 0,14 E	-	-	14 turns 0,40 E	6 turns 0,5 x 1,9 Cu
P 18/11	3B7/3H1	42 turns 0,50 E	35 turns 0,14 E	-	-	-
	3D3	-	35 turns 0,14 E	16 turns 12 x 0,04 E.S.	-	-
	4C6	150 turns 0,25 E	-	-	12 turns 0,60 E	5 turns 0,7 x 2,75 Cu
P 22/13	3B7/3H1	37 turns 0.60 E	29 turns 0,20 E	-	-	-
	3D3	-	29 turns 0,20 E	16 turns 40 x 0,04 E.S.	-	-
	4C6	140 turns 0,25 E	-	-	11 turns 0.70 E	4 turns 1,2 x 3,5 Cu
P 26/16	3B7/3H1	34 turns 0,70 E	28 turns 0.28 E	-	-	-
	3D3	-	28 turns 0,28 E	14 turns 40 x 0,04 E.S.	-	-
	4C6	125 turns 0,40 E	-	-	10 turns 0,90 E	4 turns 2,0 x 4,0 Cu

core	FXC grade	4 kHz	30 kHz	100 kHz	0,5 - 1 MHz	2 MHz	10 MHz
P 30/19	3B7/3H1	30 turns 1,0 E		23 turns 0,40 E	–	–	–
	3D3	–		23 turns 0,40 E	8 turns 2 x (100 x 0,04) E.S.	–	–
P 36/22	3B7/3H1	27 turns 1,2 E		22 turns 0,50 E	–	–	–
	3D3	–		22 turns 0,50 E	7 turns 2 x (100 x 0,04) E.S.	–	–
P 42/29	3B7/3H1	26 turns 1,8 E		20 turns 0,45 E	–	–	–
	3B5	33 turns 1,4 E		32 turns 0,45 E	–	–	–
P 66/56	3H1/3B5	21 turns 1,5 E		18 turns 1,5 E	–	–	–
RM5	3B7/3H1	45 turns 0,30 E	45 turns 0,30 E	17 turns 24 x 0,04	–	–	–
→	3D3	–	–	–	15 turns 0,30 E	–	–
	4C6	–	–	–	–	15 turns 0,30 E	–
RM6-R/ RM6-S	3B7/3H1	66 turns 0,35 E	66 turns 0,35 E	29 turns 12 x 0,04	–	–	–
→	4C6	–	–	–	–	–	4 turns 0,6 E
RM8	3B7/3H1	–	35 turns 0,50 E	31 turns 20 x 0,04	–	–	–
→	3D3	–	–	–	15 turns 24 x 0,07 E	–	–
	4C6	–	–	–	–	14 turns 0,40 E	4 turns 0,6 E

ADJUSTMENT MECHANISM

A major feature of our pot and square cores is their adjustment mechanism. The inductance adjustment is achieved by inserting into the central hole of the core a tube made either of Ferroxcube or carbonyl-iron powder. This tube acts as a partial magnetic shunt across the air gap. It is moulded in a thermoplastic carrier having a threaded end. A polycarbonate nut is cemented in the lower pot or square core half. The adjuster is screwed in this nut.

The main features of our adjustment mechanism are:

- the thread on the adjuster and the nut are very closely dimensioned, well within the recommendations of UN-D12 (ISO recommendations R68, R261, DR782, DR979), resulting in a very low torque.
- The operating torque (2 to 50 mNm, depending on type) is mainly determined by the shape of the head of the adjuster. In this way the plastic carrier of the adjuster cannot be twisted nor can it be much distorted.
- The close tolerances on the adjuster and the nut contribute to a smooth adjustment.
- The fine thread ensures precise control of inductance. In practice, a setting inaccuracy of less than 0,03% is obtainable.
- The adjustment mechanism influences the assembly temperature coefficient by only a very small amount.

The following paste is recommended for locking the adjuster head:

1 part by weight castoroil

3 parts by weight aethylcellulose

Only the head is dipped in the paste and only a very small quantity must be applied. The locking paste also acts as a grease during turning in the adjuster. It does not dry out, so that readjustment after some time is possible.

COIL DESIGN AND CALCULATIONS

LOSSES IN A COIL

The losses can be divided into two groups:

Losses in the winding	Losses in the core
- d.c. copper losses	- hysteresis losses
- eddy current losses	- residual and eddy current losses
- dielectric losses	

The screening losses may be neglected when using ferroxcube potcores and square cores. So we can say:

$$\frac{R_t}{L} = \frac{R_o}{L} + \frac{R_{ec}}{L} + \frac{R_d}{L} + \frac{R_h}{L} + \frac{R_{e+r}}{L} \qquad \Omega/H \qquad \text{Eq. (1)}$$

For filter coils as a rule the maximum Q can be obtained if the sum of the copper losses is made equal to the sum of the core losses.

D.C. copper losses

D.C. losses are given with the formula:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times \text{constant}\ ^{*)} \qquad \Omega/H \qquad (2)$$

In this formula μ_e is the effective permeability of the magnetic circuit. f_{cu} is the space factor, which depends on the diameter and insulation of the wire in question, and the method of winding.

Eddy current losses in the winding

$$\frac{R_{ec}}{L} = \frac{C_{wcu}}{\mu_e} \times V_{cu} \times f^2 \times d^2 \qquad \Omega/H \qquad (3)$$

C_{wcu} is the eddy current copper factor, depending on the dimensions of the coil former and the core.

V_{cu} is the copper volume in mm^3
f is the frequency in Hz
d is the diameter of a single wire in mm

*) For this constant see the coil former data.

Dielectric losses

The capacitances of the coil are not loss-free. These capacitances have a loss angle $\tan \delta_c$ which increases the a.c. resistance of a coil.

$$\frac{R_d}{L} = \left(\frac{2}{Q} + \tan \delta_c\right) \times \omega^3 \times L \times C \qquad \Omega/H \qquad (4)$$

in which Q is the quality factor of the coil.

ω = $2 \times \pi \times f$
f in Hz
L in henry
C in farad

Hysteresis losses

These losses depend on the $q_{2\text{-}24\text{-}100}$ value of the ferroxcube grade concerned, the μ_e value, effective volume of the potcore, inductance and current.

$$\frac{R_h}{L} = q_{2\text{-}V\text{-}\mu} \times \sqrt{L} \times i \times \frac{f}{800} \qquad \Omega/H \qquad (5)$$

For $q_{2\text{-}V\text{-}\mu}$ see Survey of symbols.

Eddy current and residual losses

In the core data $\frac{\tan \delta e}{\mu_1}$ is given as the sum of eddy current and residual losses.

We obtain:

$$\frac{\tan \delta_{e+r}}{\mu_i} = \frac{\tan \delta_e}{\mu_i} + \frac{\tan \delta_r}{\mu_i} = \frac{\tan \delta_r}{\mu_i} + K_1 f \qquad (6)$$

COIL DESIGN

Typical requirements for the design of inductors are:
- inductance value
- minimum Q-factor at the operating frequency
- rms voltage across the inductor
- available space on printed-wiring board or chassis
- maximum and minimum temperature coefficient of inductance
- adjustment range of inductance
- variability

The designer has the choice of:
- core size
- Ferroxcube material grade
- inductance factor (A_L)
- winding wire type (solid or bunched conductors)
- adjuster

The working freqцency is a useful guide to the choice of the core:

(a) At frequencies below 20 kHz, the highest Q-factor will be obtained by using large cores in 3H1 or 3B7 material with high inductance factors. The winding wire should normally be a solid conductor with fine covering. It should be noted that cores with high inductance factors give high temperature coefficients of inductance

(b) At frequencies between 20 kHz and 200 kHz, a high Q-factor will usually be obtainable with cores in 3H1 or 3B7 material. An increase in core size will not necessarily produce a higher Q-factor, particularly at the higher frequencies, the choice of inductance factor is less critical. Bunched conductors should be used to reduce the eddy current copper loss; strands of not greater than 0,07 mm diameter are recommended for use above 50 kHz.

(c) At frequencies between 200 kHz and 2 MHz the core material should be Ferroxcube 3D3. Bunched conductors with a strand diameter of not greater than 0,04 mm are recommended.

(d) At frequencies between 2 MHz and 12 MHz the core material should be Ferroxcube 4C6. Bunched conductors with a strand diameter of maximum 0,04 mm are recommended at frequencies below 5 MHz. A solid conductor is recommended for use between 5 and 12 MHz.

A.C. signal level

In most applications the a.c. signal level is low. Whenever possible, it is good practice to keep the operating flux density below 1mT. At such levels effects of hysteresis are usually negligible. At higher flux levels it may be desirable to make some allowance for the hysteresis loss and the increase in inductance. Curves showing typical variation with a.c. signal level for some cores are shown in the relevant data sheets. For low waveform distortion, RM cores with small hysteresis loss factor should be used. As a guide to the amount of distortion, the formula for the third harmonic voltage (see chapter A) may be used.

D.C. polarisation

The effect of d.c. polarisation on RM core inductors is, in general, to decrease the inductance. As with most other inductor characteristics, the decrease depends on the value of effective permeability, the decrease becoming less as the effective permeability decreases. For most applications, the effect is not serious. The decrease for any particular core may be obtained from the curves given in the coloured data sheets.

Design procedure

(1) Select the core size, material grade, the inductance factor, and the wire type using the information from the coloured data sheets.

(2) Using the adjustment curve, check that the adjustment range is sufficient to cover the A_L or μ_e tolerance, the resonating capacitor tolerance, and say ± 1% for unavoidable circuit strays.

(3) Calculate the number of turns needed, using the derived A_L or α values given in the data sheets of the relevant core.

(4) Select a suitable wire size to fill the coil former.

(5) From the known voltage E_{rms} to be applied across the inductor, calculate $\hat{B}_e$, and check if the level is less than 1mT. If $\hat{B}_e$ is greater than 1mT, care should be taken to ensure that the distortion and hysteresis loss are acceptable. Reference should also be made to the a.c. signal level characteristics in the relevant data sheets.

EXAMPLES OF CALCULATION

Example 1:

A filter coil has to be calculated for 2,75 mH with a maximum permissible temperature coefficient of $+8,5 \times 10^{-3}$ between +5 and +55 °C. The Q factor has to be at least 950 at 100 kHz, the alternating current through the coil is 1 mA.

For a positive temperature coefficient and because of the high frequency take Ferroxcube grade 3H1.
The maximum μ_e value is calculated from the maximum temperature coefficient.

$$t.c. = \left(\frac{\Delta\mu}{\mu_i^2} \times \mu_e + C\right) \times \Delta T$$ (See T.F. in section Symbols of chapter A) [1]

[1] See also Product Information No. 9: Relative Effective Permeability and Inductance Factor of Coils with Ferrxcube Core.

Assume C = +20 x 10^{-6}, then:

$$\mu_e = \frac{\text{t.c.} - C \times \Delta T}{\frac{\Delta\mu}{\mu_i^2} \times \Delta T} = \frac{\text{max. } 8.5 \times 10^{-3} - 1000 \times 10^{-6}}{1 \times 10^{-6} \times 50} = \text{max. } 150$$

A comparison of different Q curves for grade 3H1 and $\mu_e = 150$ indicates that potcore P 18/11 is suitable. The pre-adjusted potcore with nut has cat. No. 4322 022 24270, the inductance adjustor to be used is 4322 021 30730.
To allow for ±5% inductance adjustment by the adjustor, the required inductance should be decreased by 5%, thus down to 0.95 x 2.75 = 2.62 mH without the adjustor.

The number of turns is $N = \alpha\sqrt{L} = 56.3\sqrt{2.62} = 91$.
The wire diameter can be calculated from the window area given on the P 18/11 coil former data sheet: 63 x 0.04 E.S.
The coil formers 4322 021 30270 and 4322 021 30090 can be used.

Calculation of the losses

Eq. (2): $\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 16.4 \times 10^3$ Ω/H (see data P 18/11)

Say f_{cu} = 0.38 for this type of wire

$$\frac{R_o}{L} = \frac{1}{150} \times \frac{1}{0.38} \times 16.4 \times 10^3 = 286\ \Omega/H$$

Eq. (3): $\frac{R_{ec}}{L} = \frac{C_{wcu}}{\mu_e} \times V_{cu} \times f^2 \times d^2$ Ω/H

Assume $C_{wcu} = 100 \times 10^{-9}$

$$\frac{R_{ec}}{L} = \frac{100 \times 10^{-9}}{150} \times 280 \times 10^{10} \times 0.04^2 = 3\ \Omega/H$$

Eq. (4): $\frac{R_d}{L} = \frac{2}{Q} + \tan\delta_c\ \omega^3 \times L \times C$ Ω/H

Assume $\tan\delta_c$ = 0.01 and C = 8 pF

$$\frac{R_d}{L} = \frac{2}{950} + 0.01 \times (2 \times \pi \times 10^5)^3 \times 2.62 \times 10^{-3} \times 8 \times 10^{-12} = 63\ \Omega/H$$

Eq. (5): $\frac{R_h}{L} = q_{2\text{-}V\text{-}\mu} \times \sqrt{L} \times i \times \frac{f}{800}$ Ω/H

$$q_{2\text{-}V\text{-}\mu} = q_{2\text{-}24\text{-}100} \times \left\{\frac{\mu_e}{100}\right\}^{3/2} \times \sqrt{\frac{24\,000}{V_e}}\ \ \Omega/H^{3/2}\ \text{mA}$$

Take $q_{2\text{-}24\text{-}100} = 0.8\ \Omega/H^{3/2}$ mA for grade 3H1 as an average value.

So $q_{2\text{-}V\text{-}\mu} = 0.8 \times \left(\frac{150}{100}\right)^3 \times \sqrt{\frac{24\,000}{1120}} = 6.72\ \ \Omega/H^{3/2}$ mA

Then $\frac{R_h}{L} = 6.72\sqrt{2.62 \times 10^{-3}} \times 1 \times \frac{10^5}{800} = 43\ \Omega/H$

Eq. (7): $\frac{R_{r+e}}{L} = \left\{\frac{\tan \delta_{e+r}}{\mu_i} - K_1 f\right\} \times \mu_e \times 2\pi f\ \Omega/H$

Take $\frac{\tan \delta_{e+r}}{\mu_i}$ at 100 kHz of grade 3H1 = 3.0×10^{-6} as an average value and

$K_1 = 0.3 \times 10^{-11}$

$\frac{R_{r+e}}{L} = (3 \times 10^{-6} - 0.3 \times 10^{-11} \times 10^5) \times 150 \times 6.28 \times 10^5 = 247\ \Omega/H$

Eq. (1): $\frac{R_t}{L} = \frac{R_o}{L} + \frac{R_{ec}}{L} + \frac{R_d}{L} + \frac{R_h}{L} + \frac{R_{r+e}}{L}\quad \Omega/H$

$= 286 + 3 + 63 + 43 + 247 = 642\quad \Omega/H$

Quality factor $Q = \frac{2\pi f}{R_t/L} = \frac{6.28 \times 10^5}{642} = 975$

The measured value was 980, according to the relevant Q curve. An accuracy within ±15% for coil calculations is generally regarded as very good, in view of the great number of variables to be taken into account.

Example 2

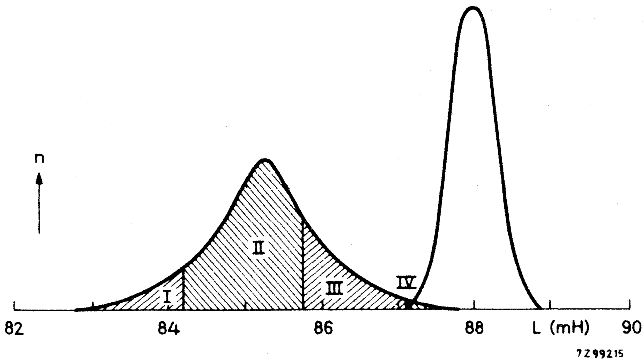
An 88 mH loading coil has to be calculated with optimum results in the smallest possible volume. The requirements are:

Tolerance on inductance	±1 %
D.C. resistance	≤ 4.8 Ω (thus $\frac{R_o}{L} \leq \frac{4.8}{0.088} \leq 53.5\ \Omega/H$)
A.C. resistance at 1800 Hz and 1 mA	≤ 5.8 Ω
Capacitance between the two line windings (C_{a-b})	≤ 200 pF
Inductance unbalance between the two line windings	≤ 0.1%
Resistance unbalance between the two line windings (ΔR_o)	≤ 0.1 Ω

In order to fulfil the requirement for the D.C. resistance we can take for instance potcore P 30/19, made 3H1, with A_L = 630 or P 26/16, grade 3H1, with A_L = 1000 (μ_e = 318). We choose the latter one because it is smaller.
The published inductance tolerance of ±3% (cores without adjustor) can be reduced to ±1% by using step-by-step adjustors; at the same time the number of turns can be made divisible by 4, as follows:
We choose an average inductance for the coils without adjustor lying more than 2% below the required 88 mH (88×10^6 nH).

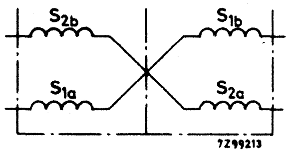
$$N \leq \sqrt{\frac{L}{A_L}} \leq \sqrt{\frac{88 \times 10^6 \times 0.98}{1000}} \leq 294 \text{ turns}$$

We take 292 turns because this number is divisible by 4; the corresponding inductance is 85.25 mH and it will have a tolerance of ±3%, which means values lying between 82.8 and 87.8 mH, see distribution curve.



Distribution curves of coils without (left curve) and with step-by-step adjustor

To shift the inductances to within ±1% distance from 88 mH (i.e. between 87.12 and 88.88 mH), we provide all coils of 82.8 to 84.2 mH (region I) with step-by-step adjustor No.11, which gives a shift of 5.3% (4.4 mH).
For the coils falling in region II we use adjustor No.8, for region III No.4 and no adjustor for the remaining coils (IV).
In order to fulfil the requirements for capacitance and unbalance of inductance and resistance, we divide the 292 turns into four windings of 73 turns, to be wound on a two-section coil former as in the figure below.



Four-winding loading coil on a two-section coil former

The lowest value for R_0/L will be obtained when the available space on the coil former is completely filled with copper wire. Calculations indicate that copper wire with a diameter of 0.28 mm and double polyvinylformal insulation will do very well.

Calculation of the d.c. resistance

Eq. (2): $\frac{R_0}{L} = \frac{1}{318} \times \frac{1}{0.49} \times 7.79 \times 10^3 = 49.9\ \Omega/H$

Calculation of the a.c. resistance

Eq. (3): $$\frac{R_{ec}}{L} = \frac{C_{wcu}}{\mu_e} \times V_{cu} \times f^2 \times d^2 \qquad \Omega/H$$

Assume $C_{wcu} = 100 \times 10^{-9}$

then $$\frac{R_{ec}}{L} = \frac{100 \times 10^{-9}}{318} \times 10^3 \times 3.24 \times 10^6 \times 0.28^2 = 0.8\ \Omega/H$$

Eq. (4): $$\frac{R_d}{L} = (\frac{2}{Q} + \tan\delta_c)\omega^3 \times L \times C_o \qquad \Omega/H$$

Assume Q at 1800 Hz = 200, C_o = 60 pF and $\tan\delta_c = 0.01$, then

$$\frac{R_d}{L} = (\frac{2}{200} + 0.01) \times (2\pi \times 1800)^3 \times 88 \times 10^{-3} \times 60 \times 10^{-12} = \text{negligible.}$$

Eq. (5): $$\frac{R_h}{L} = q_{2\text{-}V\text{-}\mu} \times \sqrt{L} \times i \times \frac{f}{800} \qquad \Omega/H$$

$$q_{2\text{-}V\text{-}\mu} = q_{2\text{-}24\text{-}100} \times \left\{\frac{\mu_e}{100}\right\}^{3/2} \times \sqrt{\frac{24\,000}{V_e}} \quad \Omega/H^{3/2}\ \text{mA}$$

Assume $q_{2\text{-}24\text{-}100} = 0.8$, then

$$q_{2\text{-}V\text{-}\mu} = 0.8 \times \frac{318\sqrt{318}}{1000} \times \sqrt{\frac{24\,000}{3530}} = 11.9 \quad \Omega/H^{3/2}\ \text{mA}$$

$$\frac{R_h}{L} = 11.9 \times \sqrt{0.088} \times 1 \times \frac{1800}{800} = 6.4\ \Omega/H$$

Eq. (7): $$\frac{R_r}{L} = \left\{\frac{\tan\delta_{e+r}}{\mu_i} - K_l f\right\} \times \mu_e \times 2\pi f \qquad \Omega/H$$

Take $\frac{\tan\delta_{e+r}}{\mu_i}$ at 1800 Hz = 0.5×10^{-6} as an average value and

$K_l = 0.2 \times 10^{-11}$

$$\frac{R_{r+e}}{L} = (0.5 \times 10^{-6} - 0.2 \times 10^{-11} \times 1.8 \times 10^3) \times 318 \times 2\pi \times 1.8 \times 10^3 = 1.8\ \Omega/H$$

Eq. (1): $$\frac{R_t}{L} = \frac{R_o}{L} + \frac{R_{ec}}{L} + \frac{R_d}{L} + \frac{R_h}{L} + \frac{R_{r+e}}{L} \qquad \Omega/H$$

$$= 49.9 + 0.8 + 0 + 6.4 + 1.8 = 58.9\ \Omega/H$$

or R_t at 1800 Hz and 1 mA = 5.18 Ω

So we see that the requirement for R_t at 1800 Hz - 1 mA is amply fulfilled and we also notice that the increase of resistance due to the a.c. losses is very low for ferroxcube 3H1.

INDUCTANCE STABILITY

The stability of a correctly assembled pot or square core inductor depends mainly on the extent to which the permeability of the ferrite core varies.

The permeability of a ferrite material may change with temperature, time, mechanical pressure, magnetic polarisation, etc.

The two most important changes affecting the assembly are:

(1) the change of permeability with temperature - temperature coefficient

(2) the change of permeability with time - disaccommodation

Further contributions to inductance variability may arise from:

(a) movement of the adjuster after the final circuit tuning

(b) movement of the wound coil former

(c) relative movement between the two core halves

(d) movement of mechanical piece parts associated with the core assembly

Small movements of the kind indicated above are usually caused by changes of temperature, mechanical vibration, mechanical shock, or a combination of these.

From the formulae given in chapter A it is clear that lowering the value of μ_e will reduce both the temperature coefficient and the effective disaccommodation.

Usually, however, very low values of A_L will prove to be incompatible with the Q requirements and $A_L = 315$ for an RM6 core would be a typical value for a high Q inductor assembly. The corresponding nominal value of temperature coefficient is about + 120 ppm per ^{o}C for material grade 3H1. By suitable choice of tuning capacitors, having negative temperature coefficients, a reasonable measure of compensation may be achieved. A popular resonating capacitor is the polystyrene type which usually has a temperature coefficient of about -120 ppm per ^{o}C.

The achievement of acceptable long-term inductance stability is mainly a matter of careful assembly and suitable stabilizing treatment before final circuit tuning. If the inductor is to be used in a critical circuit, then it should be artificially aged by temperature cycling as described in this general section under Mounting data. The long term inductance change to be expected in such an assembly is not greater than 500 ppm; this figure assumes that the inductor will be operating at an ambient temperature between 25 ^{o}C and 40 ^{o}C, and that the operating temperature will not change by more than ± 15 ^{o}C.

The inductance change of RM core assemblies, using clips with earthing spikes, when subjected to IEC 68-2-6 test Fc vibration conditions, has been shown to be less than 1000 ppm. This is a severe test and such conditions are unlikely to be met in practice.

Bump tests, using RM core assemblies with earthing spikes, in accordance with IEC 68-2-29, tests method E_b have also been carried out. The observed inductance changes, measured on RM6-R, 3H1, $A_L = 160$ core assemblies, were less than 300 ppm.

HYSTERESIS CONSTANTS

The contribution of the hysteresis losses to the core losses is:

$$\frac{R_h}{L} \left(\frac{\text{ohm}}{\text{henry}}\right).$$

These losses can be calculated with the aid of several formulae with different constants:

Table I	R	L	B	H	I	V_e	l_e	f
	units							
$\frac{R_h}{L} = q_{2\text{-}24\text{-}100} \sqrt{\frac{24\,000}{V_e}} \sqrt{\left(\frac{\mu_e}{100}\right)^3} \sqrt{L} \cdot I_{rms} \cdot \frac{f}{800}$	Ω	H			mA	mm^3		Hz
$\frac{R_h}{L} = a.\mu.\hat{B}.f$	Ω	H	T					Hz
$\frac{R_h}{L} = \frac{16}{3} \cdot \frac{\nu}{\mu^3} \cdot \mu^2 \cdot \hat{H}.f$	Ω	H		A/m				Hz
$\frac{R_h}{L} = \frac{h}{\mu^2} \cdot \mu^2 \cdot \frac{N I_{eff}}{l_{eff}} \cdot \frac{f}{800}$	Ω	H			A		mm	Hz
$\frac{R_h}{L} = \frac{h'}{\mu^2} \cdot \mu^2 \cdot H_{eff} \cdot f$	Ω	H		$\frac{A}{m}$				kHz
$\frac{R_h}{L} = \eta_B \cdot \mu \cdot \hat{B} \cdot \omega \ (\omega = 2\pi f)$	Ω	H	T					Hz

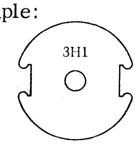
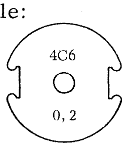
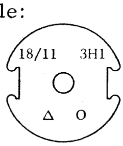
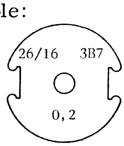
Table II shows the conversion factors for the hysteresis constants given in Table I.

Table II	$q_{2\text{-}24\text{-}100}$ x	a x	$\frac{\nu}{\mu^3}$ x	$\frac{h}{\mu^2}$ x	$\frac{h'}{\mu^2}$ x	η_B x
$q_{2\text{-}24\text{-}100}$ =	1	$2{,}59 \times 10^6$	$6{,}9 \times 10^6$	$1{,}82 \times 10^3$	$1{,}46 \times 10^3$	$1{,}63 \times 10^3$
a =	$0{,}386 \times 10^{-6}$	1	2,67	$0{,}703 \times 10^{-3}$	$0{,}563 \times 10^{-3}$	$0{,}628 \times 10^{-3}$
$\frac{\nu}{\mu^3}$ =	$144{,}8 \times 10^{-9}$	0,376	1	$0{,}264 \times 10^{-3}$	$0{,}212 \times 10^{-3}$	$0{,}236 \times 10^{-3}$
$\frac{h}{\mu^2}$ =	$0{,}549 \times 10^{-3}$	$1{,}42 \times 10^3$	$3{,}79 \times 10^3$	1	0,8	0,893
$\frac{h'}{\mu^2}$ =	$0{,}686 \times 10^{-3}$	$1{,}78 \times 10^3$	$4{,}74 \times 10^3$	1,25	1	1,12
η_B =	$0{,}615 \times 10^{-3}$	$1{,}59 \times 10^3$	$4{,}25 \times 10^3$	1,12	0,896	1

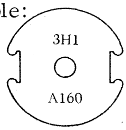
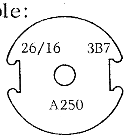
Example: $q_{2\text{-}24\text{-}100} = 1{,}46 \times 10^3 \times \frac{h'}{\mu^2}$.

MARKING

MARKING OF POTCORE HALVES

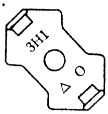
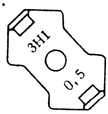
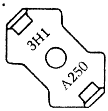
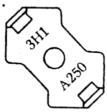
product		marking on product	marking on primary pack	marking on label of storage pack
diameter ≤ 15 mm	without air gap	material	type, material Δ-sign, 0-sign year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: P9/5 3H1 Δ 0 2 A 17 A	example: 4322 020 20982 07552 17 A 2A 3H1 100
	with air gap	material air gap length (mm)	type, material year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: P14/8 4C6 2 A 17 A	example: 4322 020 21350 07552 17 A 2A 4C6 100
diameter ≥ 15 mm	without air gap	dimensions material Δ-sign, 0-sign	type, material Δ-sign, 0-sign year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: P18/11 3H1 Δ 0 2 A 17 A	example: 4322 020 21511 07552 17 A 2 A 3H1 100
	with air gap	dimensions material air gap length (mm)	type, material year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: P26/16 3B7 2 A 17 A	example: 4322 020 22000 07552 17 A 2 A 3B7 100

MARKING OF PRE-ADJUSTED POTCORES

<table>
<tr><th colspan="2">product</th><th>marking on product</th><th>marking on primary pack</th><th>marking on label of storage pack</th></tr>
<tr><td rowspan="2">diameter ≤ 15 mm</td><td rowspan="2">with or without air gap</td><td>material
μ or A sign *)</td><td>type, material
A_L or μ_e sign
A_L or μ_e value
year + manufac. code
series number</td><td>cat. number, lot number
series number
year + manufac. code
material
quantity</td></tr>
<tr><td>example:

</td><td>example:
P14/18 3H1
A_L 160 2 A 17 A</td><td>example:
4322 022 03252
07552 17 A 2 A
3H1 100</td></tr>
<tr><td rowspan="2">diameter ≥ 15 mm</td><td rowspan="2">with or without air gap</td><td>dimensions
material
μ or A sign</td><td>type, material
A_L or μ_e sign
A_L or μ_e value
year + manufac. code
series number</td><td>cat. number, lot number
series number
year + manufac. code
material
quantity</td></tr>
<tr><td>example:

</td><td>example:
P26/16 3B7
A_L 250 2 A 17 A</td><td>example:
4322 021 09061
07552 17 A 2 A
3B7 100</td></tr>
</table>

*) If the μ_e-value or A_L-factor is ≥1000, the μ or A sign will be omitted.

MARKING OF SQUARE CORES

product		marking on product	marking on primary pack	marking on label of storage pack
square core halves	without air gap	material Δ-sign 0-sign	type material year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: RM6-S 3H1 2 A 17 A	example: 4322 020 25025 07552 17 A 2 A 3H1 800
	with air gap	material air gap length (mm)	type material year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: RM6-S 3H1 2 A 17 A	example: 4322 020 25025 07552 17 A 2 A 3H1 800
pre-adjusted cores	types RM5 and smaller	material A-sign A_L-factor, *)	type, material A_L-sign, A_L-factor year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: RM6-S 3H1 A_L 250 2 A 17 A	example: 4322 020 59261 07552 17 A 2 A 3H1 400
	types RM6 and larger	material A-sign A_L-factor	type, material A_L-sign, A_L-factor year + manufac. code series number	cat. number, lot number series number year + manufac. code material, quantity
		example: 	example: RM6-S 3H1 A_L 250 2 A 17 A	example: 4322 020 59261 07552 17 A 2 A 3H1 400

*) If the A_L factor is ≥1000, the A sign will be omitted.

MOUNTING DATA

ASSEMBLING

To obtain a stable inductance it is advisable to glue the coil former to the inside of one core half. Two small spots of a room temperature curing epoxy adhesive may be applied. When the cores are assembled with the accessories, as stated in the relevant data sheets, they fulfil the normal requirements of temperature stability and stability against shock and vibration. However, if the requirements are extremely severe it is advisable to glue also the core halves to each other.

As the difference between the outer diameter of the adjuster of P-potcores and the diameter of the hole in the potcore is very small the potcore halves must be accurately centred. For small quantity production, assembly plugs are useful aids to this end. These assembly plugs are not supplied, however drawings are shown below.

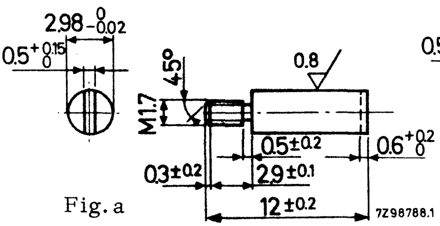


Fig. a

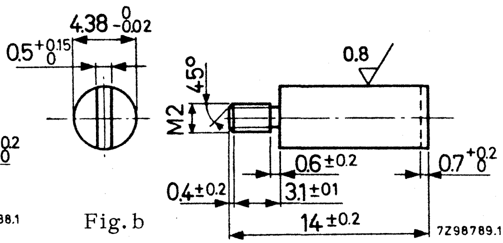


Fig. b

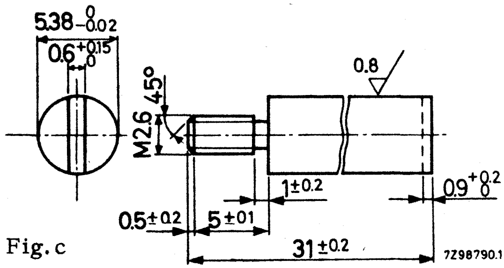


Fig. c

Assembly plugs for centring (a) for P 14/8 and P 18/11, (b) for P 22/13, (c) for P 26/16 to P 42/29. Recommended material is brass.

The centring must be done before any mounting parts are fitted.

The assembly plugs mentioned above can also be used during the impregnation process with wax or other compounds.
After impregnation the plugs must be removed and the inductance adjustors must be inserted; see pages "Inductance adjustment" of the potcore concerned.

For large quantity production special tools have been designed, which first centre the potcore halves and afterwards bend the lips of the containers.
These tools are not supplied, however drawings of the tools are sent on request, see table below.

core type	drawing number of tool
P 11/7	4322 058 00070
P 14/8	4322 058 00000
P 18/11	4322 058 00010
P 22/13	4322 058 00020
P 26/16	4322 058 00030
P 30/19	4322 058 00040
P 36/22	4322 058 00050
P 42/29	4322 058 00060
RM 4	4322 058 00180
RM 5	4322 058 00170
RM 6	4322 058 00150
RM 8	4322 058 00160

See also the section Mounting Parts in the data sheets.

INSERTING THE NUT FOR THE ADJUSTOR

The pre-adjusted cores can be supplied with a nut for the inductance adjustor, cemented into the hole of one of the potcore halves.

For those manufacturers however, who prefer to insert the nut themselves, the following remarks are given.
Push the nut into the centre hole of one of the core halves from the flat side. The recommended distance between the nut and the mating surface of the core is given under "Inductance adjustment".

Cement the nut in the hole of the core half. A suitable adhesive composition is:

1 weight part	Araldit	DY023	curing time 2 hours at 80 °C
5 weight parts	Araldit	CY230	
2.6 weight parts	Versamid	140	

The tools recommended for insertion of the nut are not supplied, but drawings are sent on request.

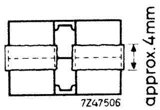
core type	drawing number of insertion tool
P 14/8 and P 18/11	7V48160
P 22/13	7V48161
P 26/16 - P 42/29	7V48198

Also for the dosating devices, recommended for wetting the insides of the centre hole with Araldit, are drawings available:

core type	drawing number of dosating tool
P 14/8 and P 18/11	7V12356
P 22/13	7V12353
P 26/16 - P 42/29	7V12341

CEMENTING THE CORE HALVES TO EACH OTHER

1. Remove all dust from the inside and outside of the core with a dry brush or with a rotating brushing machine.
2. Expose the core to a trichlore vapor bath of at least 10 seconds to remove all grease.
   After cleaning and degreasing, the core must be protected against dust and the joint surfaces must not be touched by hand.
3. Mix Araldit AY18 with hardener HZ18 in a weight ratio of 4:3. If desired, add chalk to the mixture in a maximum ratio of 1:1. The pot life is about two weeks, depending on temperature.
4. Place the coil in the core; if desired, cement the coil former to one of the core halves.
5. Centre the halves and put the core under pressure; the recommended pressure on the contact surface is 0.2 N/mm^2 (0.02 kg/mm^2).
6. Heat the core to about 35 ^oC to drive off any moisture.
7. Brush the adhesive onto the cylindrical surface of the core, to approximately 2 mm on each side of the parting line (see figure below).



   With the core still under pressure (see 5 above) put it in a kiln for 1 hour at 70 ^oC followed by $1\frac{1}{2}$ hour at 100 ^oC to cure the adhesive. Cool the core to room temperature before releasing the applied pressure.
8. With 4C6 material it may be found necessary to apply more than one coat of adhesive, allowing each coat to dry before applying the next. It is only necessary to apply contact pressure to the core halves while curing the adhesive.

IMPREGNATION AND ENCAPSULATION

If additional protection from humidity is required, vacuum impregnation of the wound coil former only is recommended. A good electrical quality wax should be used and the temperature during impregnation should be kept below the maximum operating temperature of the coil former. After impregnation, care should be taken to ensure that any wax scraped off during assembly does not become trapped between the mating faces of the core halves.

Complete impregnation or encapsulation of the assembly is not recommended because it may cause some stressing in the core material. This is almost always accompanied by unacceptable changes in permeability and temperature coefficient.

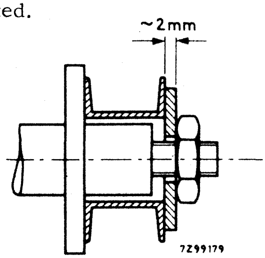
Note

In order to obtain coils which are very stable with temperature variations, it is recommended to subject the complete coil to about five temperature cycles from room temperature to 70 °C. The assembly should then be rested for 24 hours before the final adjustment is made. It has been shown that this procedure is beneficial to all types of assembly.

COIL WINDING RECOMMENDATIONS

PROTECTION OF THE COIL FORMER

Because the flanges of coil formers are thin (down to 0,2 mm), it is necessary to support them during winding, for instance, with a metal flange of 2 mm thickness, see figure. The barrel must also be supported.



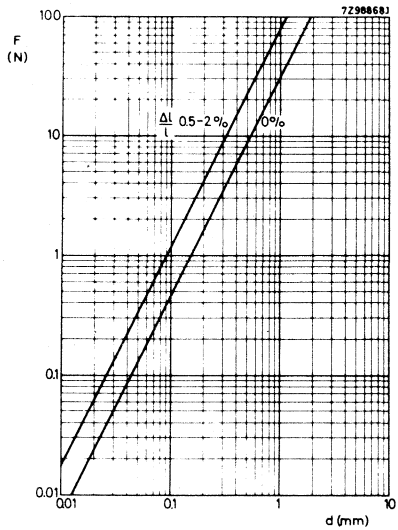
When winding with a wire of an overall diameter of less than approx. 0,4 mm, no attempt should be made to layer-wind the coil, but the random winding should be built up as evenly as possible. For wires of greater overall diameter, a compromise is usual. Approximate layer winding will be found feasible at the start of the winding, and this should be continued as far as possible in order to achieve a satisfactory packing factor.
Each lead-out wire should be terminated by a solder joint at the base of a convenient coil former pin. A dip soldering method in a bath is recommended. The temperature of the bath and the length of the soldering time largely depend on the type of wire. The temperature and the soldering time should be no more than is necessary. A good flux is indispensable, preferably a type which can be removed with warm water. Do not dip the pins too far into the bath; this will avoid contamination of the coil former or tag plate. The capillary action of the solder will ensure that good joints are made when the distance between the bath and coil former or tag plate is between 0,5 and 1 mm.

WIRE TENSION

The following graphs may be used to find the tension necessary in the wire during winding:

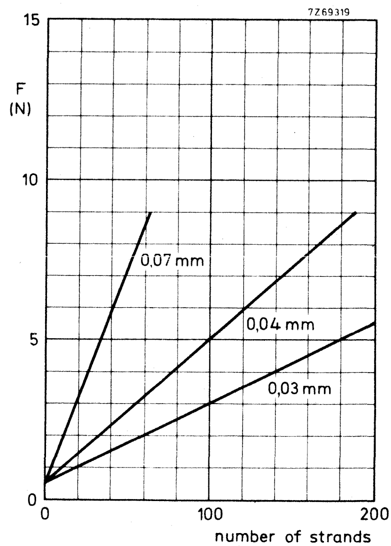
Solid wire

Wire tension (F) as a function of the wire diameter (d) with the occurring stretch ($\frac{\Delta l}{l}$) as parameter



Bunched wire

Wire tension (F) as a function of the number of strands with the strand diameter as parameter



Potcores

POTCORES

INTRODUCTION

Three types of core can be supplied:

- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

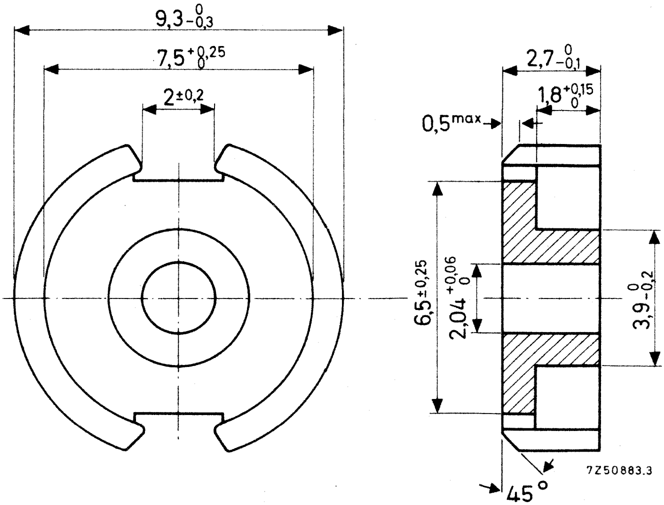
The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41 293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 40 potcore halves or 20 pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores.
Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm

Outlines



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 20970
3H1	4322 020 20980
4C6	4322 020 20940
3D3	4322 020 20900

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I

	temp. (^{o}C)	grade 3B7	3H1	3D3	4C6
$\alpha_F \times 10^6$	+5 to +25	–	+0,5 to +1,5	–	−2 to +4
	+25 to +55	–	+0,5 to +1,5	–	0 to +6
	+25 to +70	−0,6 to +0,6	+0,5 to +1,5 [1])	0 to +2	–
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 6	≤ 6	≤ 20	≤ 10

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 25 Newton, the values in Table II are guaranteed at 25 ± 10 ^{o}C.

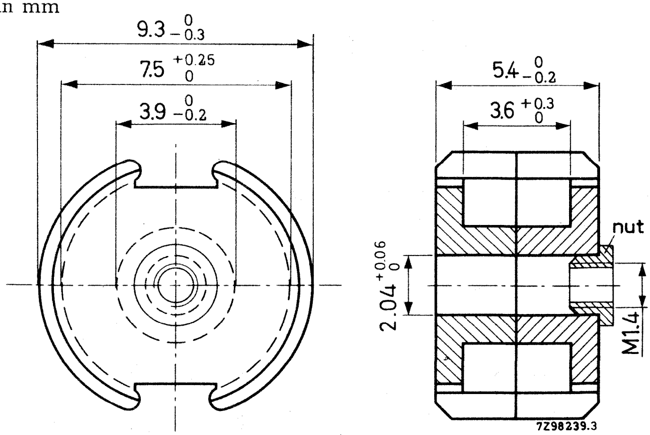
Table II

	$\hat{B}$ (mT)	freq. (MHz)	grade 3B7	3H1	3D3	4C6
→ μ_e ± 25%	≤ 0,1	0,1	1260	1260	636	125
A_L ± 25%	≤ 0,1	0,1	1260	1260	630	125
α	≤ 0,1	0,1	32,7	32,7	≤ 45,5	≤ 103
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,1	≤ 6	≤ 6	≤ 10	–
	≤ 0,1	0,5	–	–	≤ 14	–
	≤ 0,1	1	–	–	≤ 30	–
$q_{2-24-100}$	0,3–1,2	0,1	–	–	≤ 4	–
	1,5–3,0	0,004	≤ 2,0	≤ 1,8	–	–
$\eta_B \times 10^3$	0,3–1,2	0,1	–	–	≤ 2,5	≤ 6,2
	1,5–3,0	0,004	≤ 1,2	≤ 1,1	–	–

[1]) For orientation only.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 6. . . .
Without nut, catalogue number = 4322 022 4. . . .
suffix, see table

Weight per set 1,3 g

Mean length of lines of force l_e = 12,5 mm

$\Sigma \frac{l_e}{A_e} = 1,24\ mm^{-1}$

Effective volume V_e = 126 mm^3

Pre-adjusted potcores with standard A_L factors

The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

A_L	corresponding μ_e-value	tolerance on inductance (%)	Catal. No.: 4322 022 6. . . . with nut; 4322 022 4. . . . without nut		
			3B7	3H1	4C6
16	16	± 1	–	–	1800
25	25	± 1	–	–	1810
40	40	± 1	–	–	1820
63	63	± 1	1030	1230	–
100	100	± 1,5	1040	1240	–
160	160	± 2	1050	1250	–

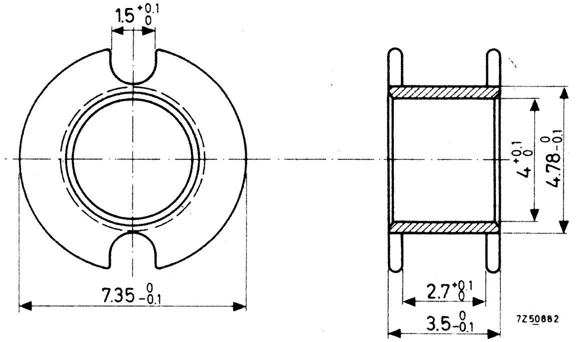
Symmetric air gap for cores with an A_L factor of 16 up-to and including 63
Asymmetric air gap for cores with an A_L factor of 100 and 160

Inductance $L = N^2 A_L$ (in 10^{-9} H)

COIL FORMER

Dimensions (mm)

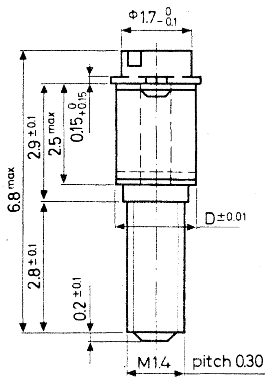
The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS 4061 range 2 (Great Britain).



Catalogue number	4322 021 31700
Material	polycarbonate
Window area	3,4 mm^2
Mean length of turn	19 mm
Maximum temperature	130 °C
D.C. losses	$\frac{R_o}{L} = \frac{1}{\mu e} \times \frac{1}{f_{cu}} \times 69,5 \times 10^3\ \Omega/H$
Weight	0,07 g

INDUCTANCE ADJUSTORS

The tolerances on inductance of the pre-adjusted potcores (without adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03% by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the lips of the adjustor head. 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.



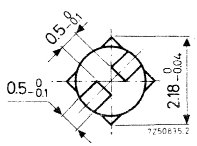


Table I, available types

D	colour	catalog number
1.85	green	4322 021 31250
1.85	yellow	4322 021 31270
1.76	brown	4322 021 31540

Table II, recommended application

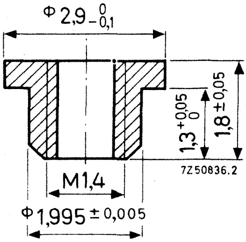
A_L	3B7/3H1/3D3
63	4322 021 31250
100	4322 021 31270
160	4322 021 31540

The adjustors are packed in bags of 100, so please order in multiples of 100.

Dimensions in mm

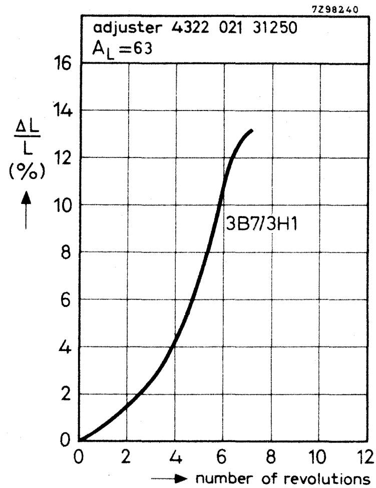
NUT FOR ADJUSTER

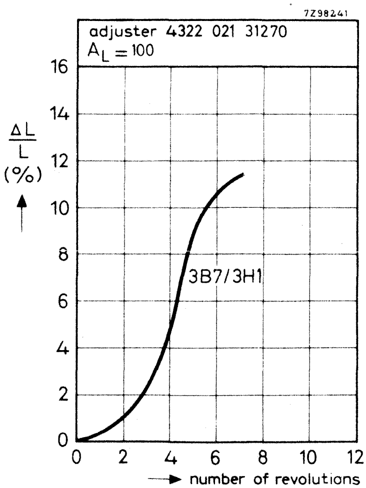
These data are given for those manufacturers who prefer to insert the nut themselves.

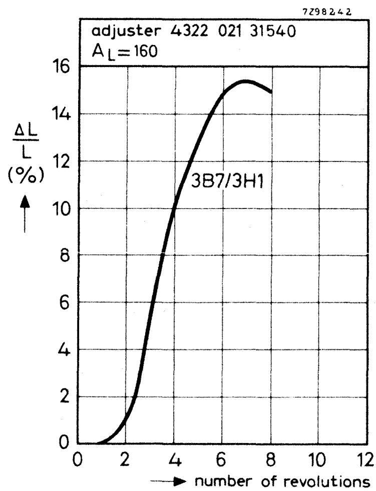


Catalogue number 4322 021 31630
Material brass, nickel plated

ADJUSTMENT CURVES







POTCORES

INTRODUCTION

Three types of core can be supplied:

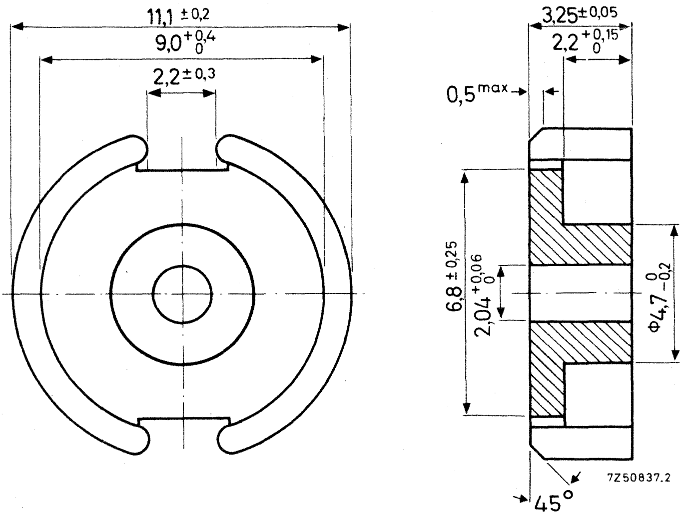
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41 293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 40 potcore halves or 20 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores.
Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 21000
3H1	4322 020 21010
3D3	4322 020 21020
4C6	4322 020 21140

Properties

For toroidally wound core halves the values in Table I are guaranteed.

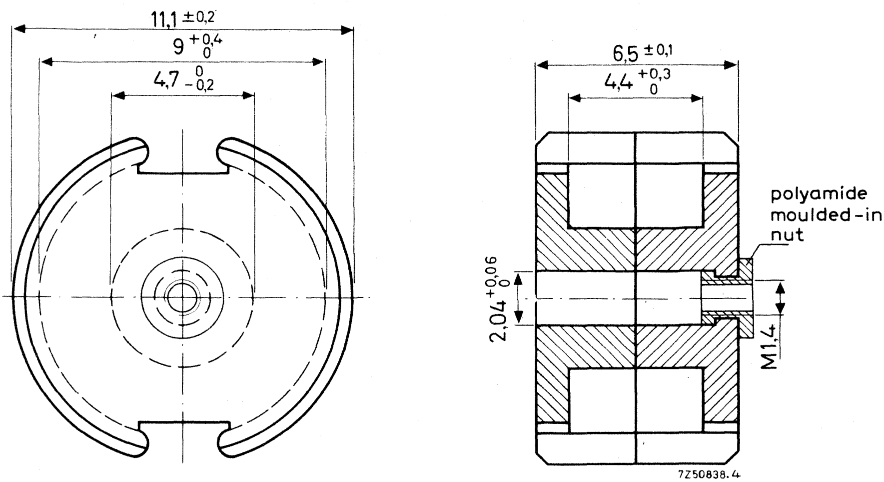
Table I	temp. (^{o}C)	grade 3B7	3H1	3D3	4C6
$\alpha_F \times 10^6$	+5 to +25		+0,5 to +1,5		−2 to +4
	+25 to +55		+0,5 to +1,5		0 to +6
	+25 to +70	−0,6 to +0,6		0 to 2	
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 4,3	≤ 15	≤ 10

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 35 Newton, the values in Table II are guaranteed at 25 ± 10 ^{o}C.

Table II	$\hat{B}$ (mT)	freq. (MHz)	grade 3B7	3H1	3D3	4C6
μ_e ± 25%	≤ 0,1	0,1	1300	1300	660	125
→ A_L ± 25%	≤ 0,1	0,1	1700	1700	870	160
α	≤ 0,1	0,1	≤ 27,9	≤ 27,9	≤ 39,2	≤ 90,5
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,1	≤ 5	≤ 5	≤ 8	
	≤ 0,1	0,5			≤ 14	
	≤ 0,1	1			≤ 30	
		2				≤ 40
		5				
		10				≤ 100
$q_{2-24-100}$	0,3–1,2	0,1			≤ 3,0	≤ 10
	1,5–3,0	0,004	≤ 2,0	≤ 1,8		
$\eta_B \times 10^3$	0,3–1,2	0,1			≤ 1,8	≤ 6,2
	1,5–3,0	0,004	≤ 1,2	≤ 1,1		

PRE-ADJUSTED POTCORES Dimensions in mm

Outlines



With nut, catalogue number = 4322 022 2....
Without nut, catalogue number = 4322 022 0....

Mass per set 1,8 g

Mean length of lines of force l_e = 15,5 mm

$$\Sigma \frac{l_e}{A_e} = 0,956\ mm^{-1}$$

Effective volume $V_e = 251\ mm^3$

Notes to the tables on the next page

1. Examples of catalogue number:
   μ_e = 15, grade 4C6, potcore with nut, catalogue number = 4322 022 20810
   A_L = 100, grade 3B7, potcore without nut, catalogue number = 4322 022 01040
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 660 = A_L of 870, μ_e of 1300 = A_L of 1700.

Pre-adjusted potcores with standard μ_e values [1]

μ_e	α	tolerance on inductance (%)	catal. No.: 4322 022 2.... with nut; 4322 022 0.... without nut			
			3B7	3H1	3D3	4C6
15	225	± 1	–	–	–	0810
22	186	± 1	–	–	–	0820
33	152	± 1	–	–	0430	0830
47	127	± 1	–	–	0440	–
68	105.8	± 1	0050	0250	0450	–
100	87.2	± 1.5	0060	0260	–	–
150	71.2	± 2	0070	0270	–	–
220	58.8	± 5	0080	0280	–	–
660	33.9	± 25	–	–	0400*	–
1300	24.2	± 25	0000*	0200*	–	–

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H)
Symmetric air gap for cores with an μ_e value of 15 up to and including 68
Asymmetric air gap for cores with an μ_e value of 100 up to and including 1300

Pre-adjusted potcores with standard A_L factors [1]

A_L	corresponding μ_e-value	tolerance on inductance (%)	catal. No.: 4322 022 2.... with nut; 4322 022 0.... without nut			
			3B7	3H1	3D3	4C6
16	12.2	± 1	–	–	1400	1800
25	19.0	± 1	–	–	1410	1810
40	30.5	± 1	–	–	1420	1820
63	48	± 1	–	–	1430	–
100	76	± 1	1040	1240	1440	–
160	122	± 1.5	1050	1250	–	–
250	190	± 3	1060	1260	–	–

Inductance $L = N^2 A_L$ (in 10^{-9} H)
Symmetric air gap for cores with an A_L factor of 16 up to and including 63
Asymmetric air gap for cores with an A_L factor of 100 up to and including 250

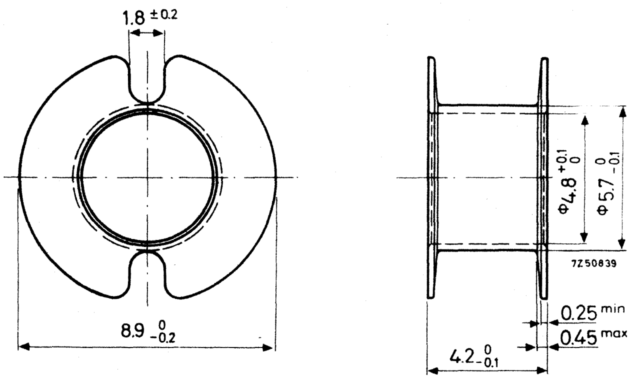
[1]) See Notes on the previous page.

* Only available without nut.

COIL FORMER

Dimensions in mm

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41 294 (Germany) and BS 4061 range 2 (Great Britain).



Catalogue number	4322 021 30240
Material	polycarbonate
Window area	5,5 mm^2
Mean length of turn	23 mm
Max. temperature	130 °C
D.C. losses	$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 58,1 \times 10^3\ \Omega/H$
Weight	0,1 g

INDUCTANCE ADJUSTORS

The tolerances on inductance of the pre-adjusted potcores (without adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy $<0.03\%$ by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the lips of the adjustor head. 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.

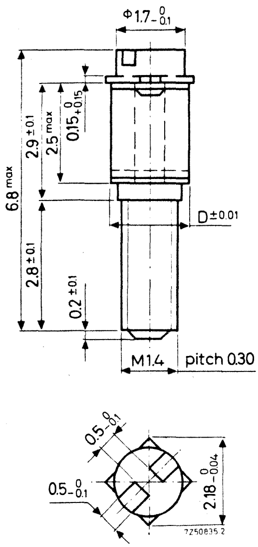


Table I, available types

D	colour	catalog number
1.85	green	4322 021 31250
1.85	red	4322 021 31260
1.85	yellow	4322 021 31270
1.85	grey	4322 021 31280
1.76	brown	4322 021 31540

Table II, recommended application

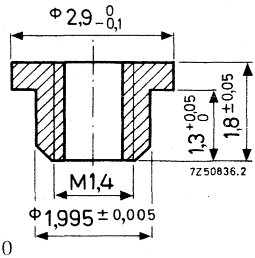
μ_e	A_L	3B7/3H1/3D3
	40	4322 021 31250
33		4322 021 31250
	63	4322 021 31260
47		4322 021 31260
68		4322 021 31270
	100	4322 021 31270
100		4322 021 31540
150	160	4322 021 31540
	250	4322 021 31280
220		4322 021 31280

Dimensions in mm

The adjustors are packed in bags of 100, so please order in multiples of 100.

NUT FOR ADJUSTER

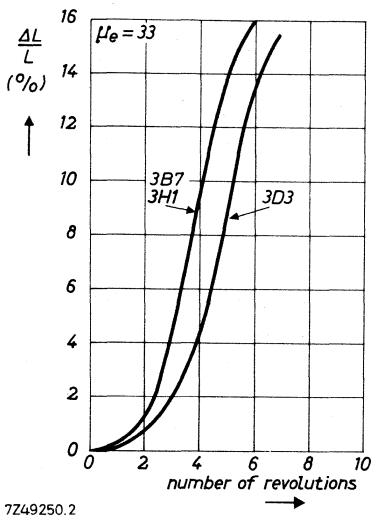
These data are given for those manufacturers who prefer to insert the nut themselves.



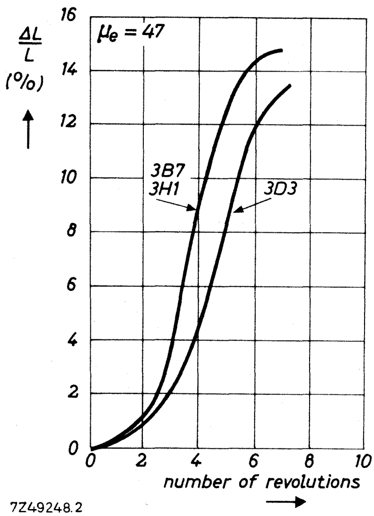
Catalogue number 4322 021 31630

Material brass, nickel plated

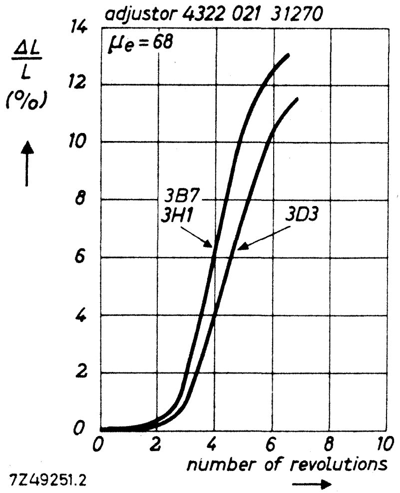
ADJUSTMENT CURVES

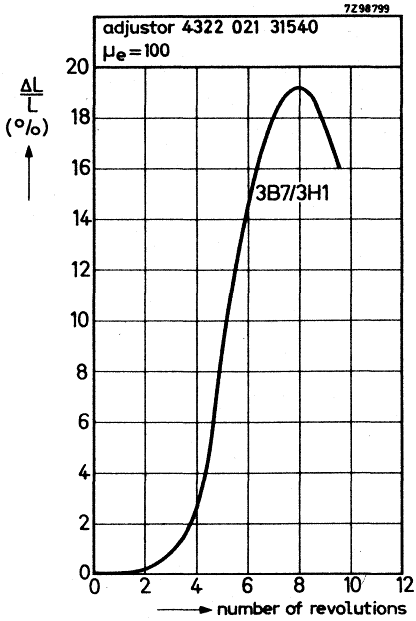


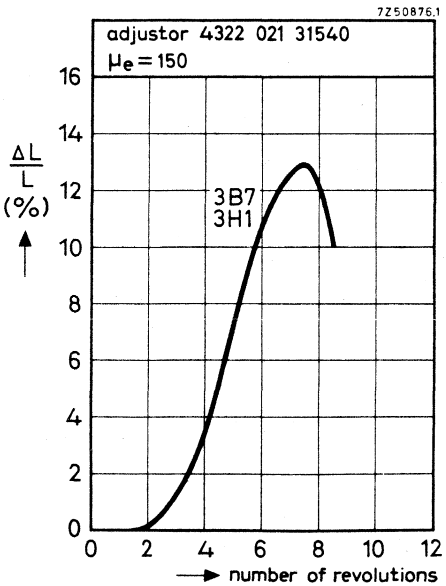
adjuster 4322 021 31250

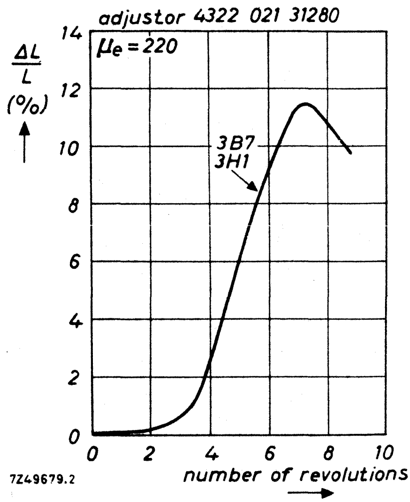


adjuster 4322 021 31260


adjustor 4322 021 31270
$\mu_e = 68$
ΔL/L (%)
3B7
3H1
3D3
number of revolutions
7Z49251.2

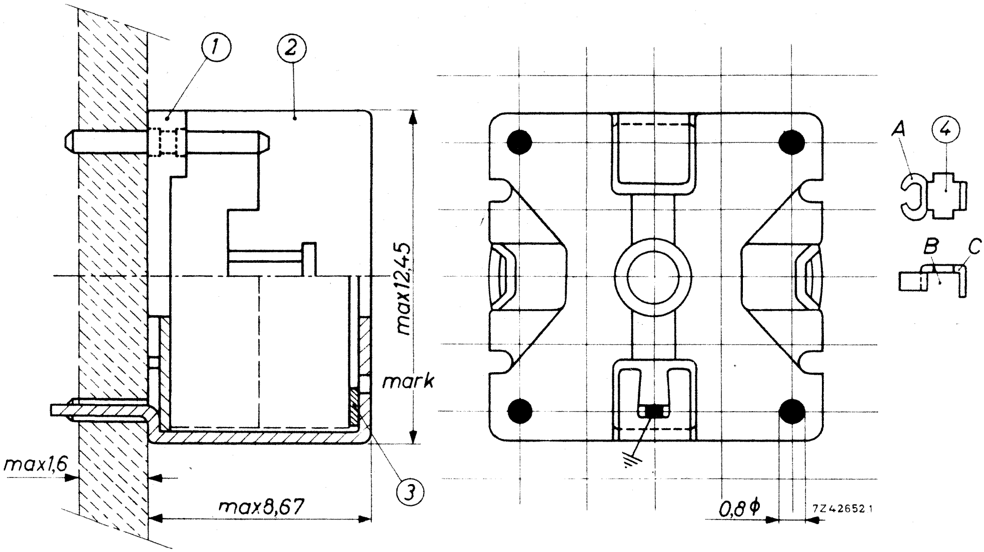

7Z98799
adjustor 4322 021 31540
$\mu_e = 100$
ΔL/L (%)
3B7/3H1
number of revolutions


7Z50876.1
adjustor 4322 021 31540
$\mu_e = 150$
ΔL/L (%)
3B7
3H1
number of revolutions


adjustor 4322 021 31280
$\mu_e = 220$
ΔL/L (%)
3B7
3H1
number of revolutions
7Z49679.2

MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30180
(2) brass container	4322 021 30510
(3) spring	4322 021 30620
(4) soldering spring	4322 021 30700 (4x)

The core is suitable for mounting on printed-wiring boards.

The four soldering pins and the earth tag are arranged so as to fit a grid of 2,54 mm (0,1 inch). The pin length is sufficient for a board thickness of up to 1,6 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.

If stranded wire is applied the use of a soldering spring (4) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over. For solid wire the soldering spring is not strictly necessary.

The container is provided with an earth tag.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

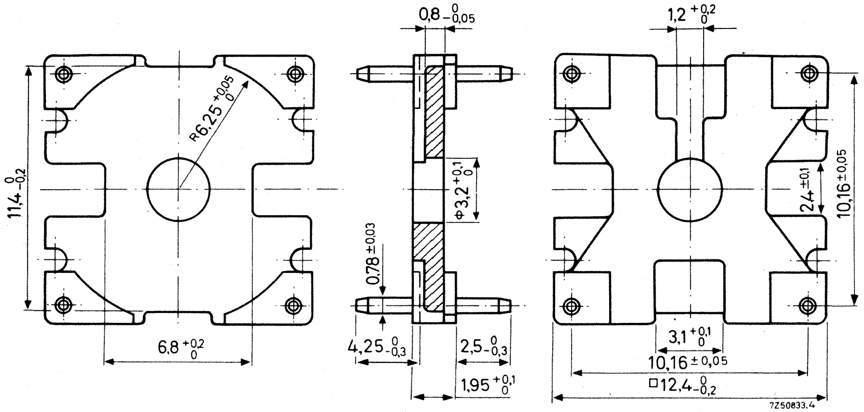
Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 35 Newton. After bending the lips the spring will have the correct tension.

PART DRAWINGS (dimensions in mm)

(1) Tag plate 4322 021 30180

Plate: polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s.

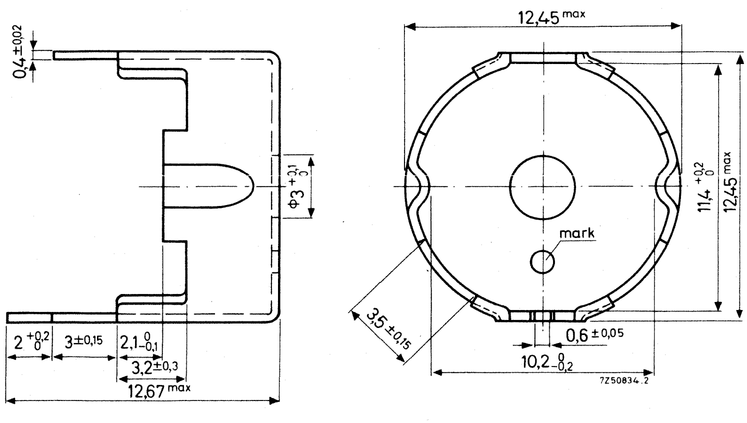
Pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 1000 pieces; please order in multiples of this quantity.

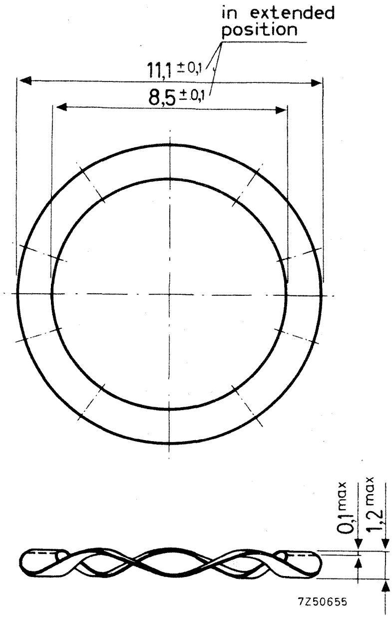
(2) Container 4322 021 30510

Material: brass, nickel plated; tinned soldering pin



(3) Spring 4322 021 30620

Material: chrome-nickel steel

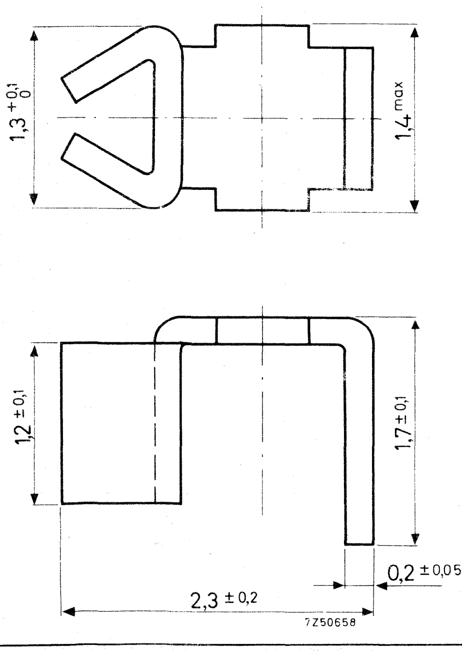


A force of min. 25 N is required to compress the spring to 0,5 mm.
A force of max. 55 N is required to compress the spring to 0,2 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

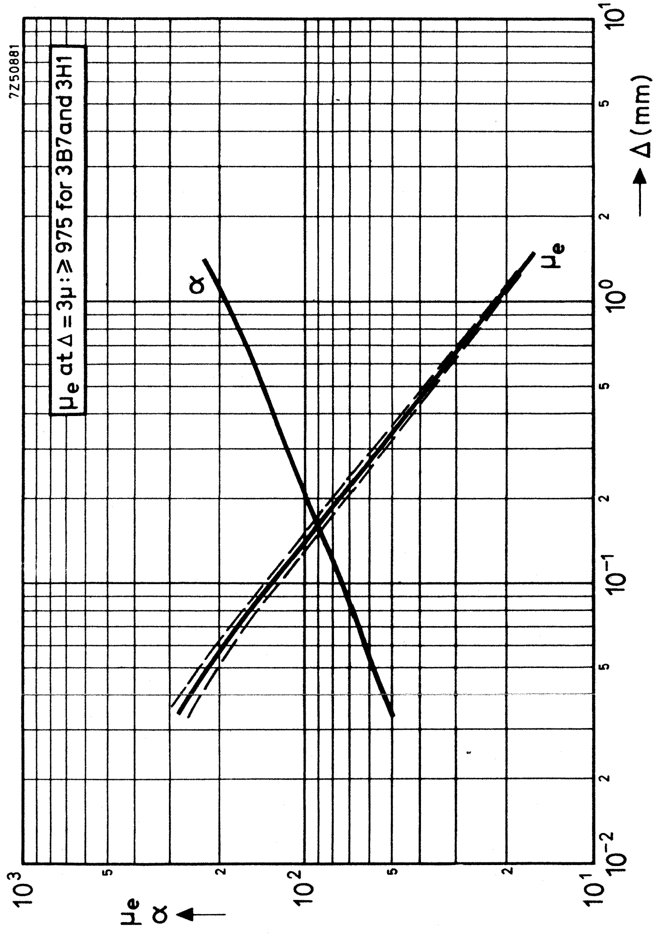
(4) Soldering spring 4322 021 30700

Material: brass, dip-soldered



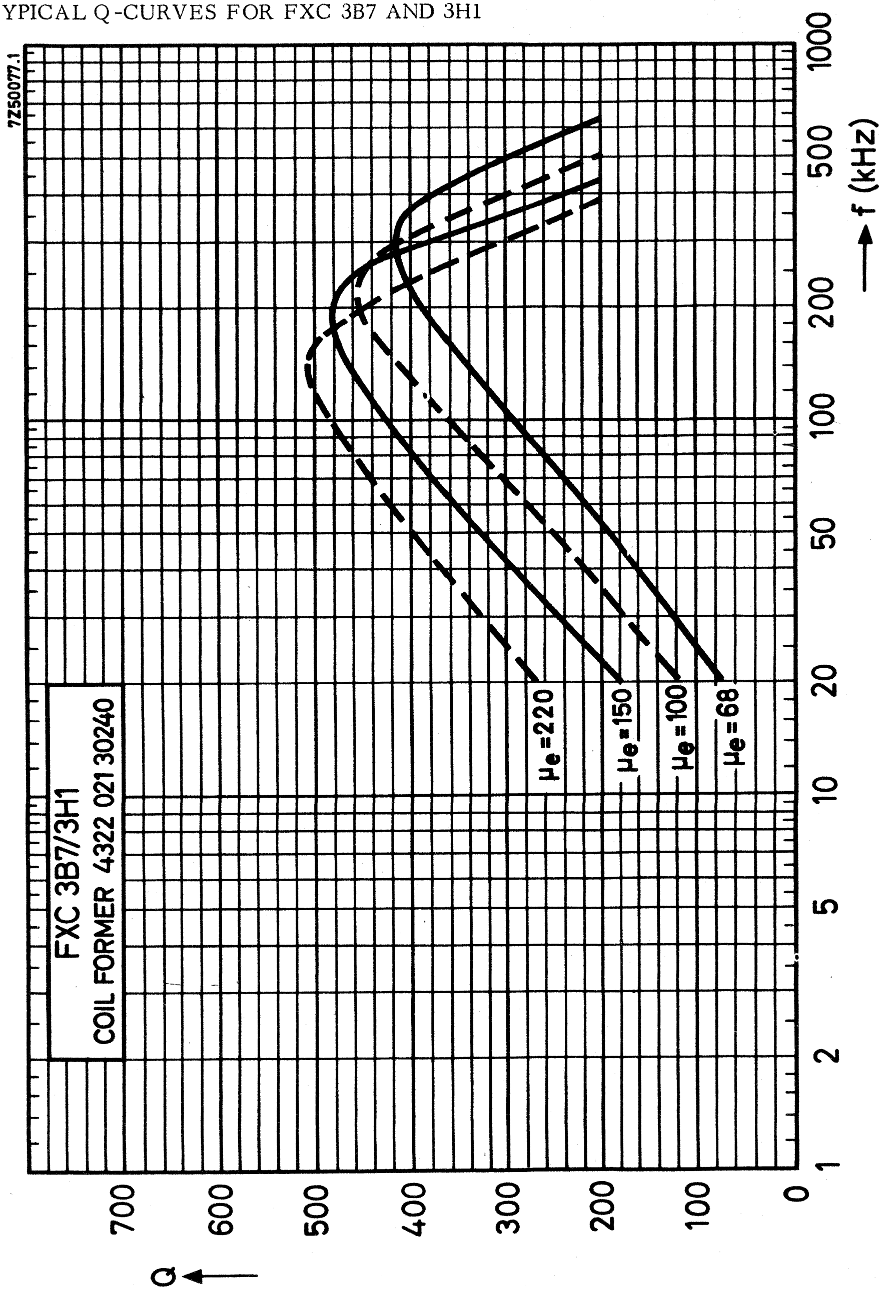
CHARACTERISTIC CURVES

μ_e - α values

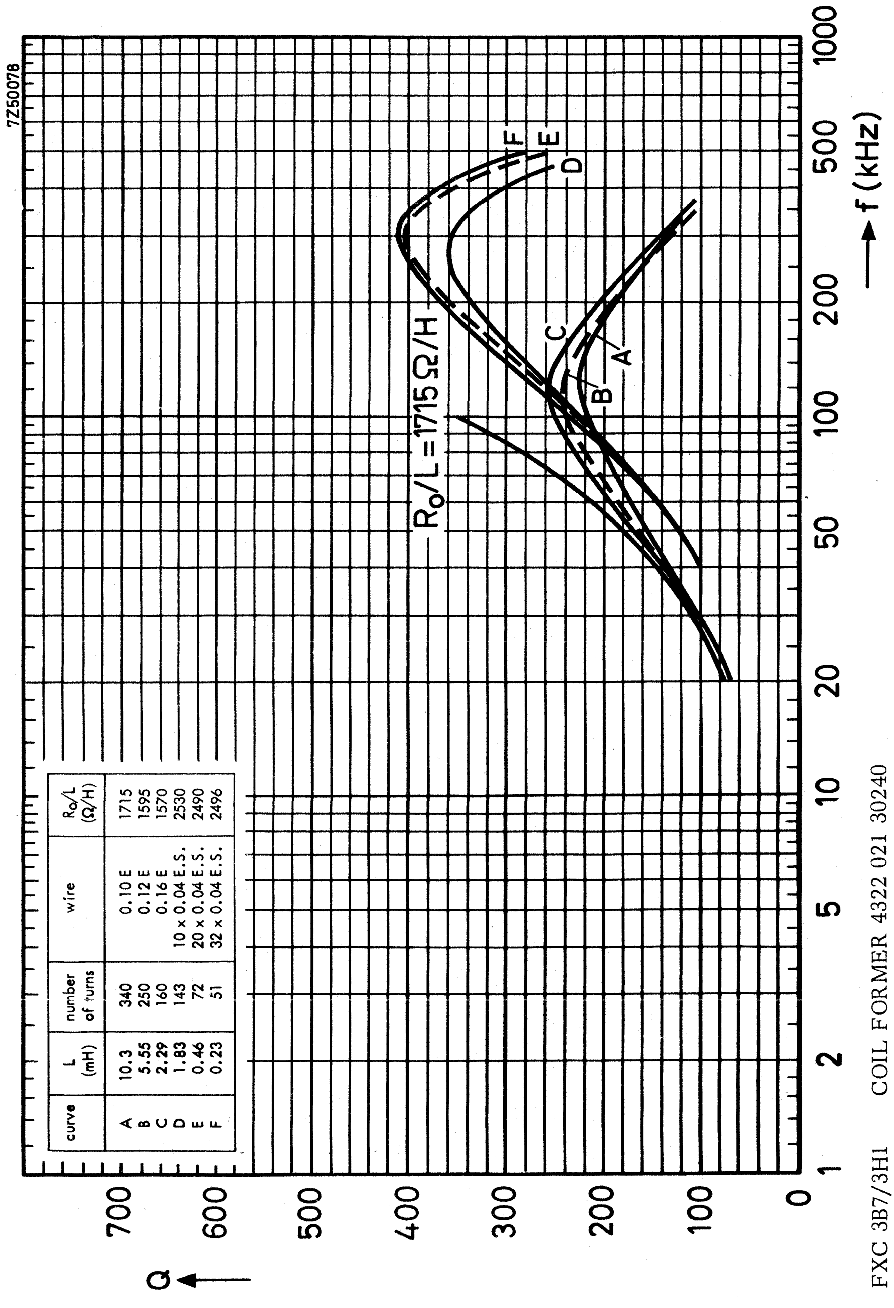


Relative effective permeability and turn factor for 1 mH as a function of the air gap length

TYPICAL Q -CURVES FOR FXC 3B7 AND 3H1



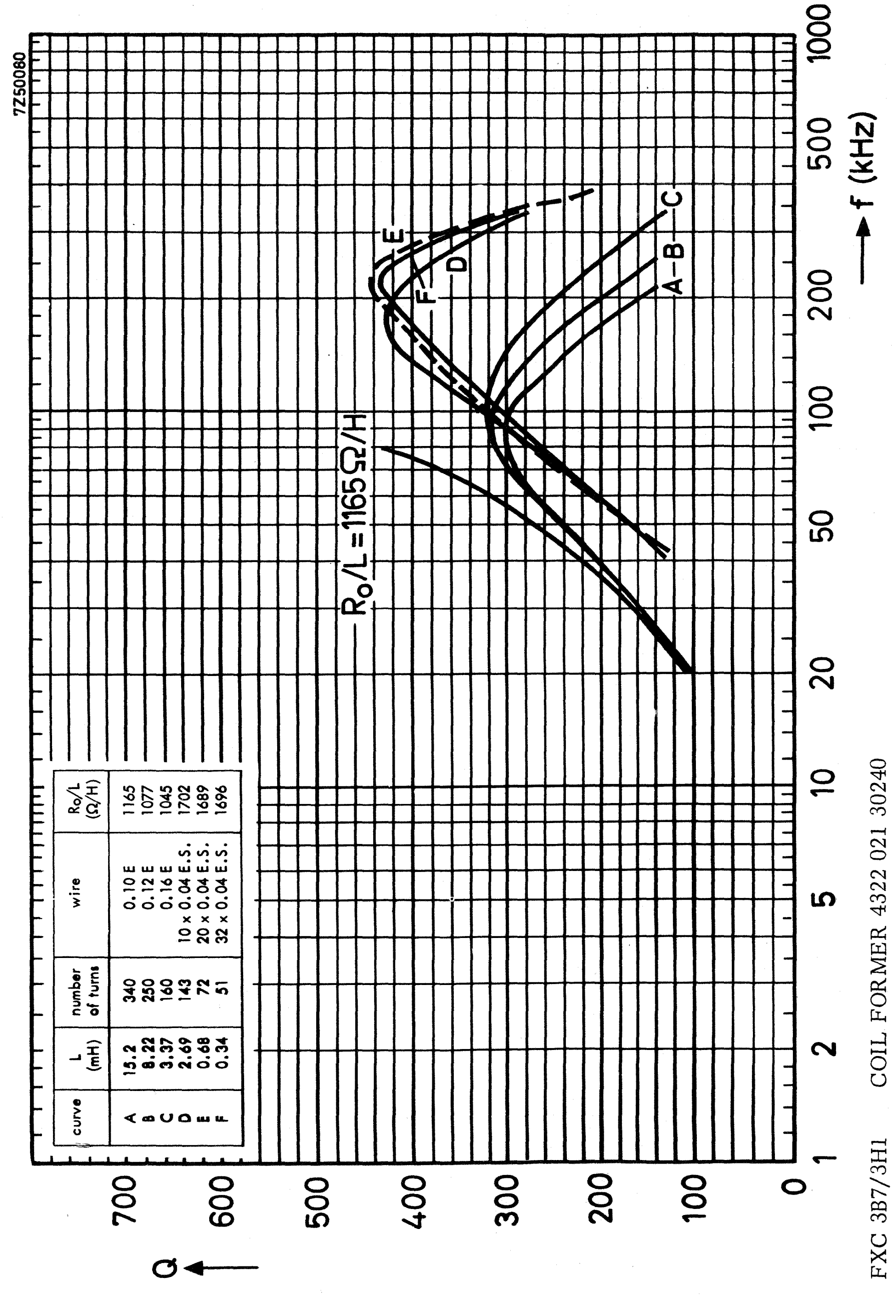
Enveloping curves



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	10.3	340	0.10 E	1715
B	5.55	250	0.12 E	1595
C	2.29	160	0.16 E	1570
D	1.83	143	10 × 0.04 E.S.	2530
E	0.46	72	20 × 0.04 E.S.	2490
F	0.23	51	32 × 0.04 E.S.	2496

FXC 3B7/3H1 COIL FORMER 4322 021 30240

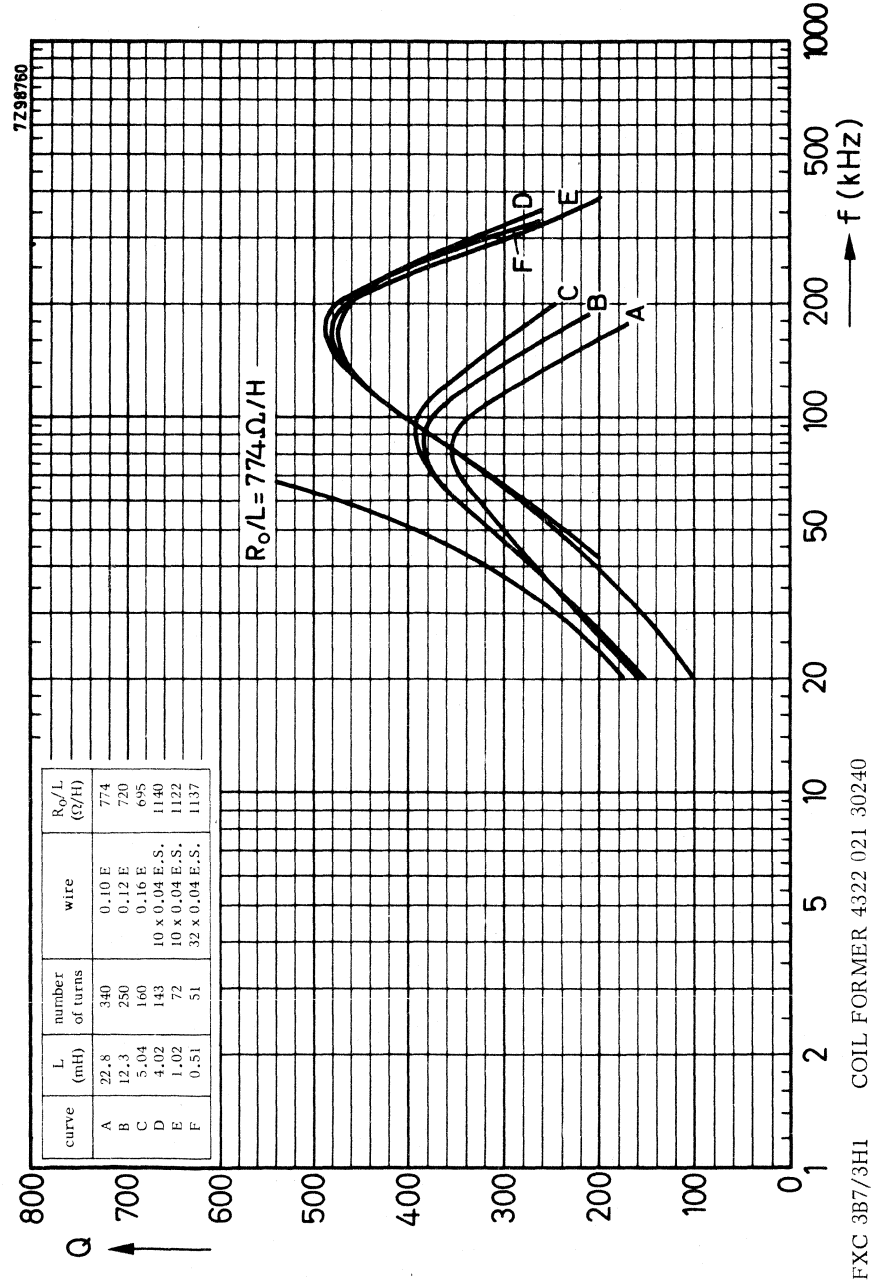
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	15.2	340	0.10 E	1165
B	8.22	250	0.12 E	1077
C	3.37	160	0.16 E	1045
D	2.69	143	10 x 0.04 E.S.	1702
E	0.68	72	20 x 0.04 E.S.	1689
F	0.34	51	32 x 0.04 E.S.	1696

FXC 3B7/3H1 COIL FORMER 4322 021 30240

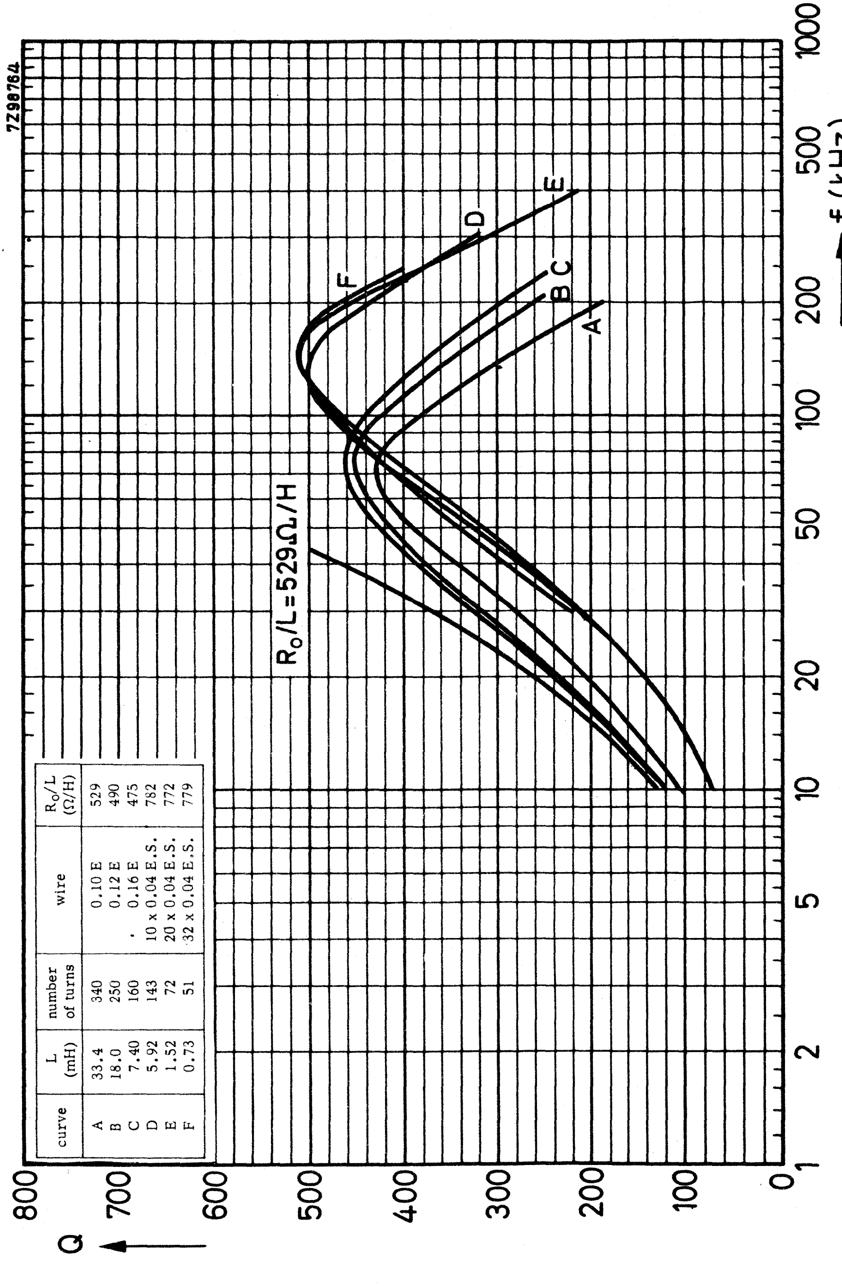
$\mu_e = 100$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	22.8	340	0.10 E	774
B	12.3	250	0.12 E	720
C	5.04	160	0.16 E	695
D	4.02	143	10 x 0.04 E.S.	1140
E	1.02	72	10 x 0.04 E.S.	1122
F	0.51	51	32 x 0.04 E.S.	1137

FXC 3B7/3H1 COIL FORMER 4322 021 30240

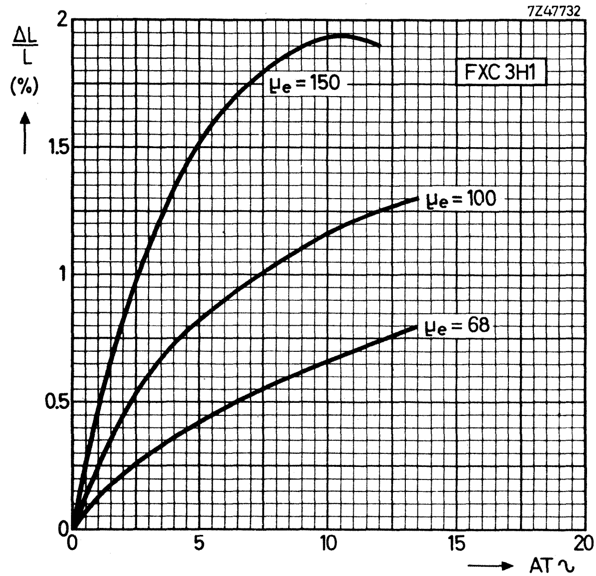
$\mu_e = 150$

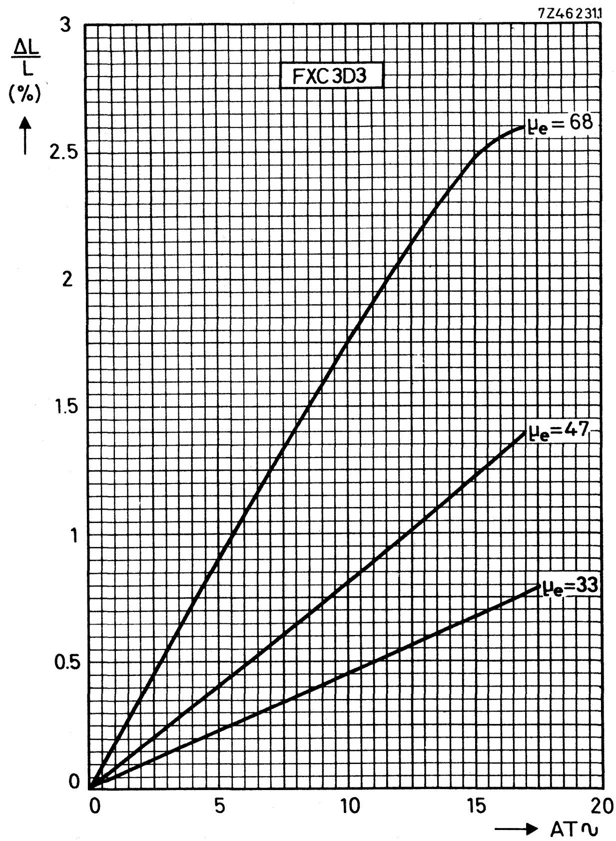


curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	33.4	340	0.10 E	529
B	18.0	250	0.12 E	490
C	7.40	160	0.16 E	475
D	5.92	143	10 x 0.04 E.S.	782
E	1.52	72	20 x 0.04 E.S.	772
F	0.73	51	32 x 0.04 E.S.	779

FXC 3B7/3H1 COIL FORMER 4322 021 30240
$\mu_e = 220$

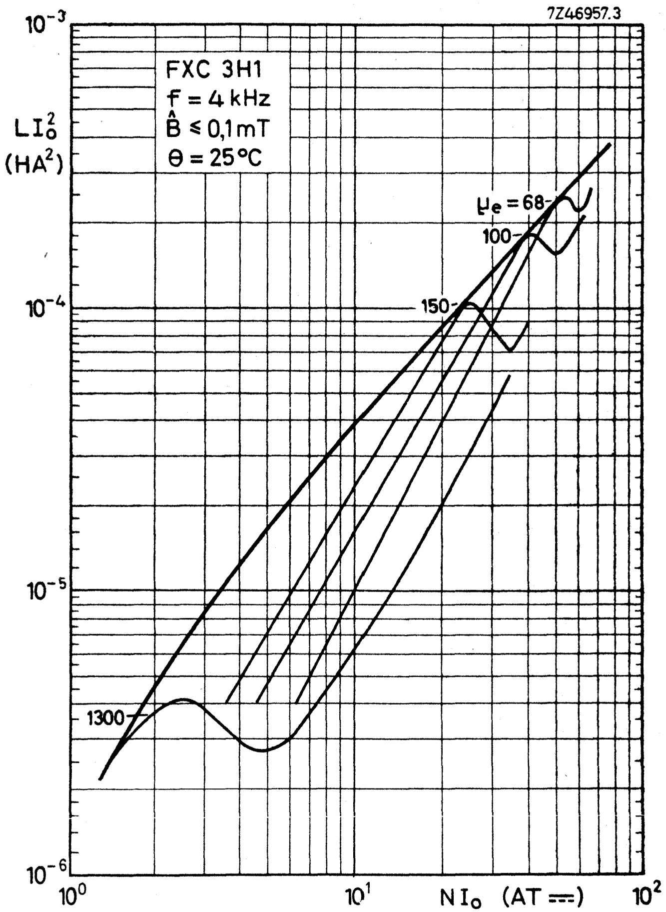
INDUCTANCE VARIATION AS A FUNCTION OF AT ~



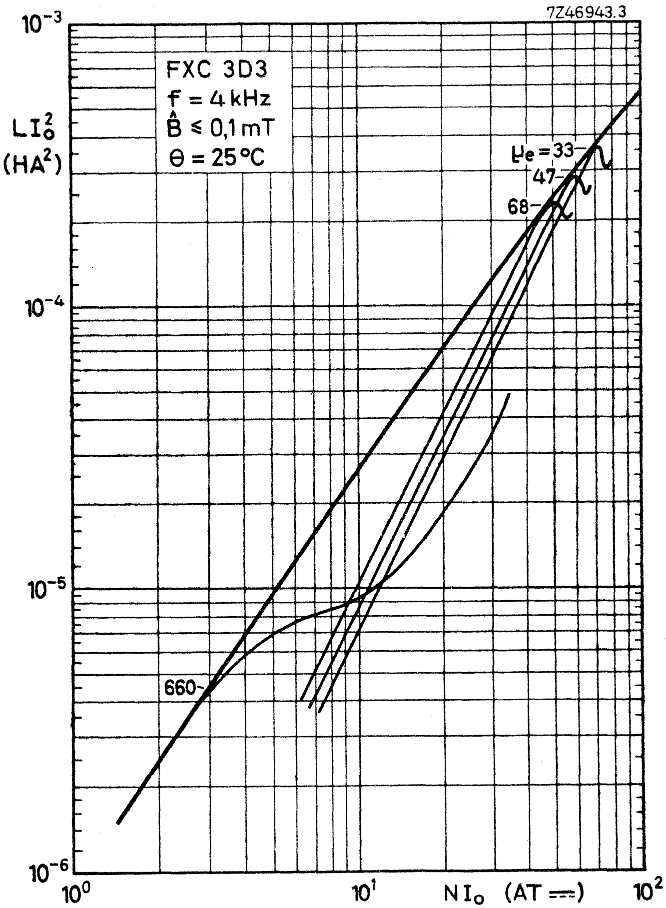

7Z46231.1
FXC 3D3
ΔL/L (%)
3
2.5
2
1.5
1
0.5
0
$\mu_e = 68$
$\mu_e = 47$
$\mu_e = 33$
0
5
10
15
20
AT∿

HANNA CURVES

Indicating the optimum inductance for a certain μ_e-value and direct current.
Typical values.



Typical values



POTCORES

INTRODUCTION

Three types of core can be supplied:

- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

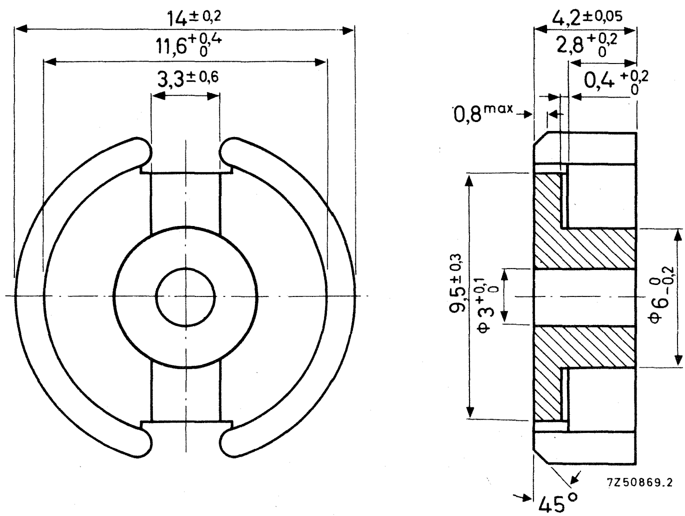
The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41 293 (Germany), BS 4061 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 40 potcore halves or 20 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores. Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm

Outlines



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 21250
3H1	4322 020 21260
3D3	4322 020 21270
3E1	4322 020 21360
4C6	4322 020 21350
3H3	4322 020 21370

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (°C)	grade					
		3B7	3H1	3D3	3E1	4C6	3H3
$\alpha_F \times 10^6$	+5 to +25		+0,5 to +1,5			-2 to +4	+0,7 ± 0,4 1)
	+25 to +55		+0,5 to +1,5			0 to +6	+0,7 ± 0,25
	+25 to +70	-0,6 to +0,6		0 to 2	0 to 2		+0,7 ± 0,25
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 4,3	≤ 12		≤ 10	
	any temp. (±1 °C) between +25 and +70 °C						≤ 3

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 60 Newton, the values in Table II are guaranteed at 25 ± 10 °C.

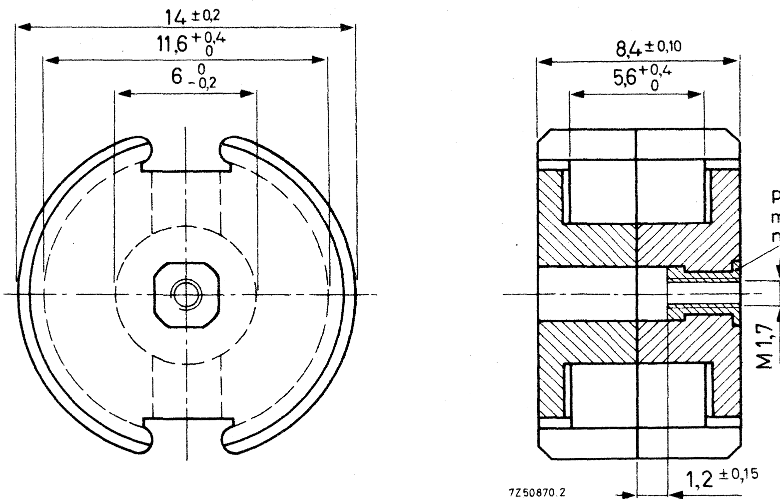
Table II	$\hat{B}$ (mT)	freq. (MHz)	grade					
			3B7	3H1	3D3	3E1	4C6	3H3
μ_e ± 25%	≤ 0,1	0,004				2550		
	≤ 0,1	0,1	1400	1400	680		125	
A_L ± 25%	≤ 0,1	0,004				4050		
	≤ 0,1	0,1	2200	2200	1080		200	
α	≤ 0,1	0,1	≤ 24,4	≤ 24,4	≤ 35,1		≤ 81,8	
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004				≤ 2,5		
	≤ 0,1	0,1	≤ 5	≤ 5	≤ 8	≤ 20		
	≤ 0,1	0,5			≤ 14	≤ 200		
	≤ 0,1	1			≤ 30			
		2					≤ 40	
		10					≤ 100	
$q_{2-24-100}$	0,3-1,2	0,1			≤ 3,0		≤ 10	
	1,5-3,0	0,004	≤ 1,8	≤ 1,4		≤ 3		
$\eta_B \times 10^3$	0,3-1,2	0,1			≤ 1,8		≤ 6,2	
	1,5-3,0	0,004	≤ 1,1	≤ 0,86		≤ 1,8		
	1,5-3,0	0,030						≤ 0,8 2)

1) Target value 0,7 ± 0,25.
2) Target value ≤ 0,65.

PRE-ADJUSTED POTCORES

Dimensions in mm

Outlines



With nut, catalogue number = 4322 022 2. . . .
without nut, catalogue number = 4322 022 0. . . .

Mass per set		3,2 g
Mean length of lines of force	l_e	= 19,8 mm
	$\Sigma \frac{l_e}{A_e}$	= 0,789 mm^{-1}
Effective volume	V_e	= 495 mm^3

Notes to the tables on the next page

1. Examples of catalogue number:
   μ_e = 15, grade 4C6, potcore with nut, catalogue number = 4322 022 22810
   A_L = 100, grade 3B7, potcore without nut, catalogue number = 4322 022 03040
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 680 = A_L of 1080, μ_e of 1400 = A_L of 2200.

Pre-adjusted potcores with standard μ_e values [1]

μ_e	α	tolerance on induc- tance (%)	cat. no.: 4322 022 2.... with nut / 4322 022 0.... without nut				
			3B7	3H1	3D3	4C6	
15	205	± 1	–	–	–	2810	
22	169	± 1	–	–	–	2820	
33	137,9	± 1	2030	2230	2430	2830	
47	115,5	± 1	2040	2240	2440	–	
68	96,1	± 1	2050	2250	2450	–	
100	79,2	± 1,5	2060	2260	–	–	
150	64,6	± 2	2070	2270	–	–	
220	53,3	± 3	2080	2280	–	–	
680	30,3	± 25	–	–	2400*	–	
1400	21,2	± 25	2000*	2200*	–	–	

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H).
Symmetrical air gap for cores with an μ_e value of 15 up to and including 68.
Asymmetrical air gap for cores with an μ_e value of 100 up to and including 1400.

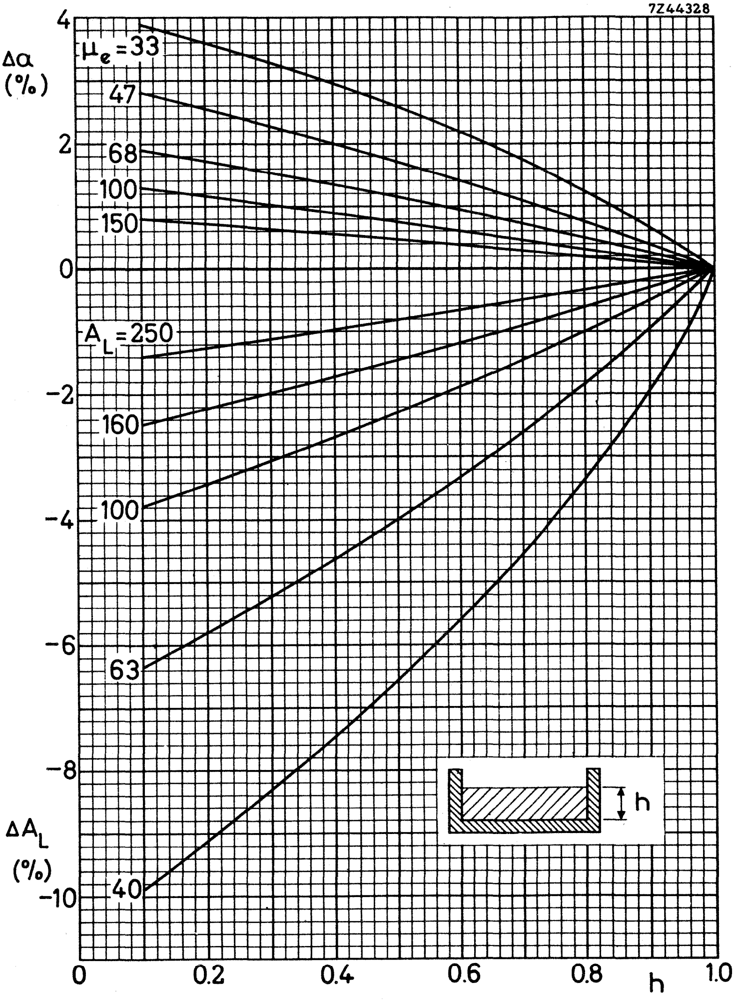
Pre-adjusted potcores with standard A_L factors [1]

A_L (nH)	corre- sponding μ_e-value	tolerance on induc- tance (%)	cat. no.: 4322 022 2.... with nut / 4322 022 0.... without nut				
			3B7	3H1	3D3	4C6	3H3
25	15,7	± 1	–	–	–	3810	–
40	25	± 1	–	–	3420	3820	–
63	39,5	± 1	–	–	3430	3830	–
100	63	± 1	3040	3240	3440	–	–
160	100,5	± 1,5	3050	3250	–	–	3550
250	157	± 2	3060	3260	–	–	3560
315	198	± 2	3070	3270	–	–	3570
400	252	± 2	3080	3280	–	–	3580
630		± 3	–	3300	–	–	–

Inductance $L = N^2 A_L$ (L in 10^{-9} H).
Symmetrical air gap for cores with an A_L factor of 25 up to and including 100.
Asymmetrical air gap for cores with an A_L factor of 160 up to and including 400.

[1]) See notes on the previous page.

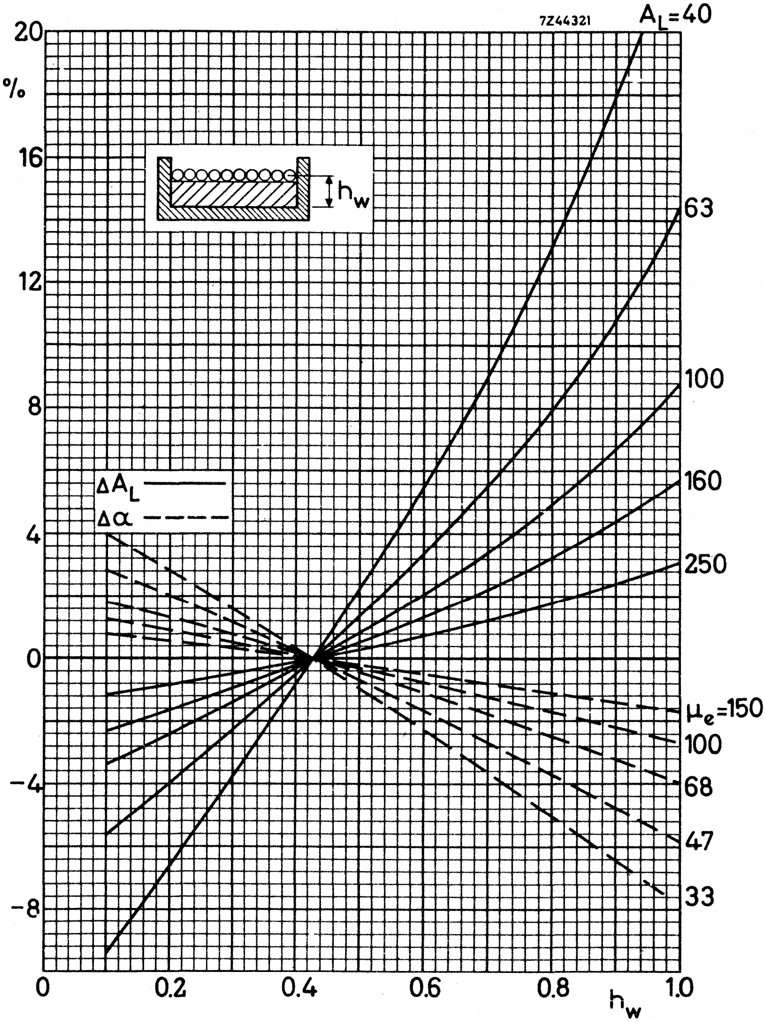
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 68 in that case obtains an α factor of 96.1 + 1.3 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_w on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 96.1 - 1.7 %.

COIL FORMERS

GENERAL

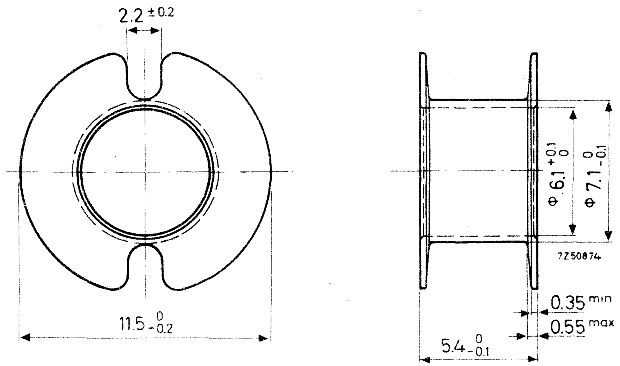
Two types of coil former can be supplied:

- with one section
- with two sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS4061 range 2 (Gr. Britain).

SINGLE-SECTION COIL FORMER

Dimensions (mm)



Catalogue number	4322 021 30250
Material	polycarbonate
Window area	9,7 mm^2
Mean length of turn	29 mm
Max. temperature	130 °C

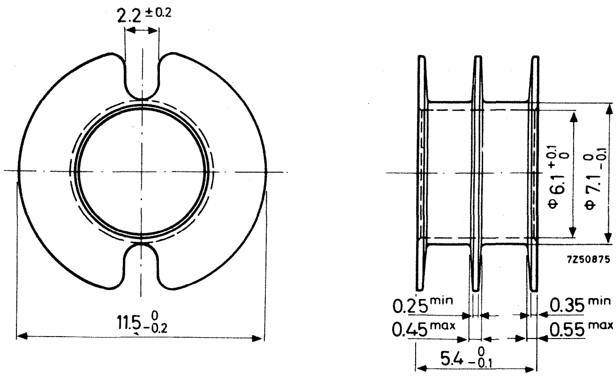
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 32,3 \times 10^3 \ \Omega/H$$

Weight 0,15 g

TWO-SECTION COIL FORMER

Dimensions (mm)



Catalogue number	4322 021 30260
Material	polycarbonate
Window area	2 x 4,5 mm^2
Mean length of turn	29 mm
Max. temperature	130 ^{o}C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 35,1 \times 10^3\ \Omega/H$$

Weight 0,2 g

INDUCTANCE ADJUSTORS

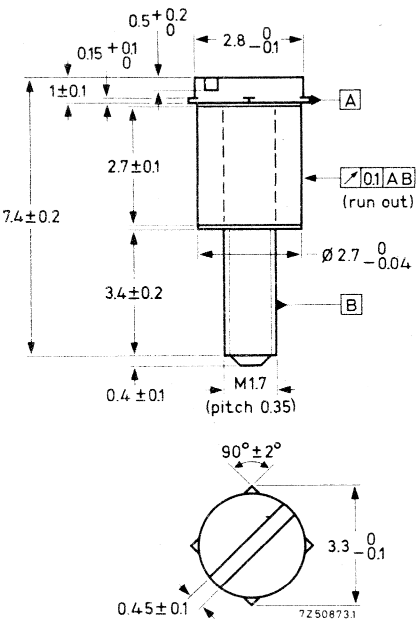


Fig. A

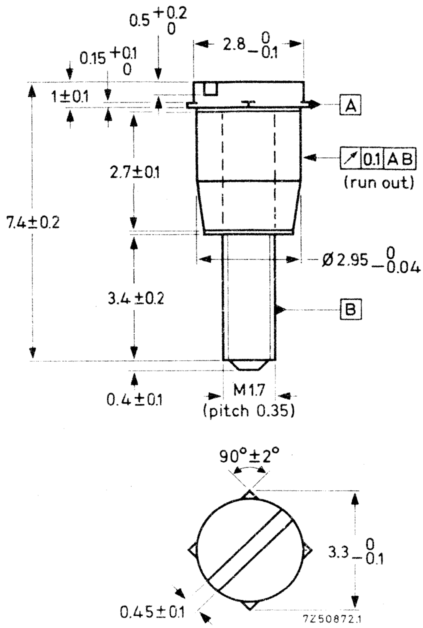


Fig. B

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03% by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.

Table I, available types

Fig.	colour	catalogue number
A	red	4322 021 30740
A	green	4322 021 30750
B	yellow	4322 021 30940
B	white	4322 021 30950
A	brown	4322 021 31070
B	grey	4322 021 31130

The adjusters are packed in bags of 100. Please order in multiples of this quantity.

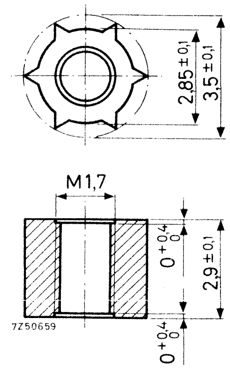
Table II, recommended application

μ_e	A_L	3B7/3H1/3D3	4C6
		cat. number 4322 021	
15		–	30740
	25	–	30740
22		–	30740
	40	30750	30940
33		30750	30950
	63	30740	30940
47		30740	–
	100	30940	–
68		30940	–
100		30950	–
	160	30950	–
150		31070	–
	250	31070	–
220		31130	–
	315	31130	–
	400	31130	–

NUT FOR ADJUSTER

These data are given for those manufacturers who prefer to insert the nut themselves.

Dimensions (mm)

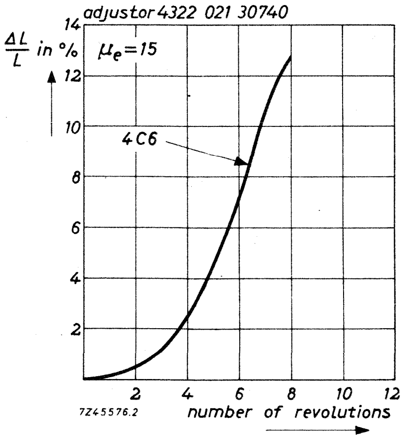


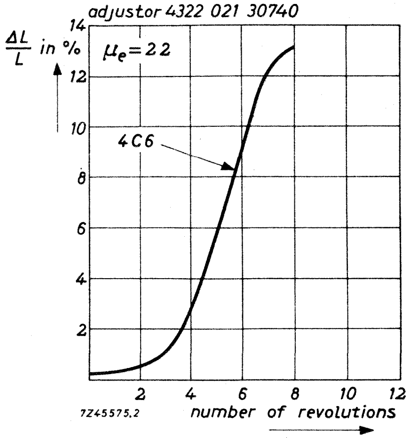
Catalogue number	4322 021 30140
Material	polycarbonate
Max. impregnation temperature during 24 hours	120 °C
→ Recommended distance from mating surface to nut	1,2 ± 0,15 mm

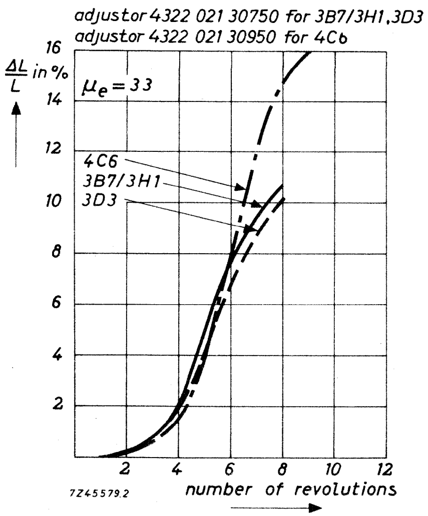
For more information see Potcores General, Mounting data.

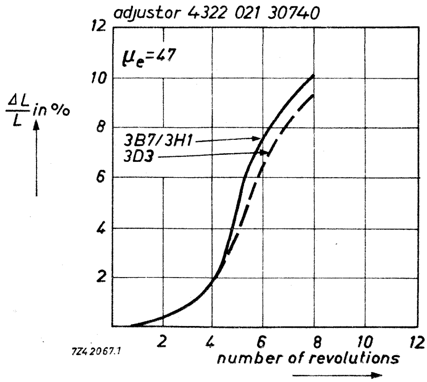
The nuts are packed in bags of 100. Please order in multiples of this quantity.

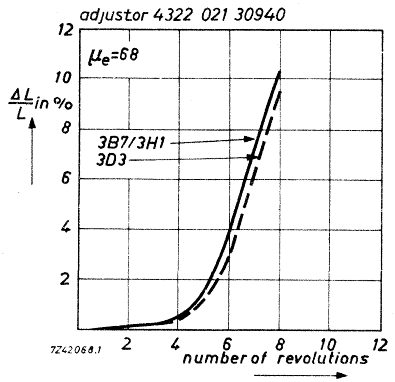
ADJUSTMENT CURVES

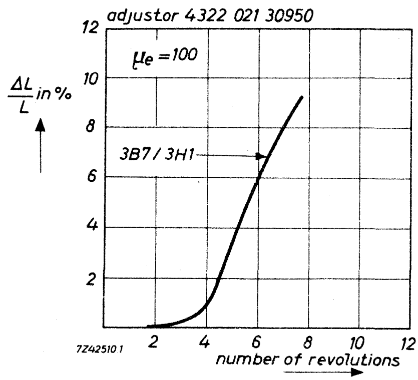


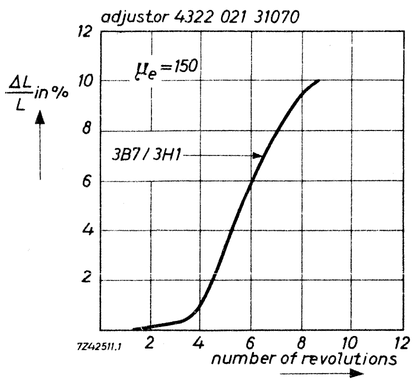


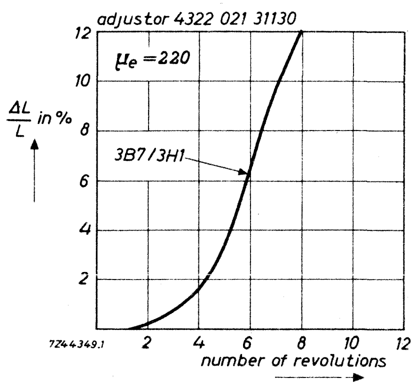





adjustor 4322 021 30940
μ_e=68
$\frac{\Delta L}{L}$ in %
3B7/3H1
3D3
number of revolutions
7Z42068.1

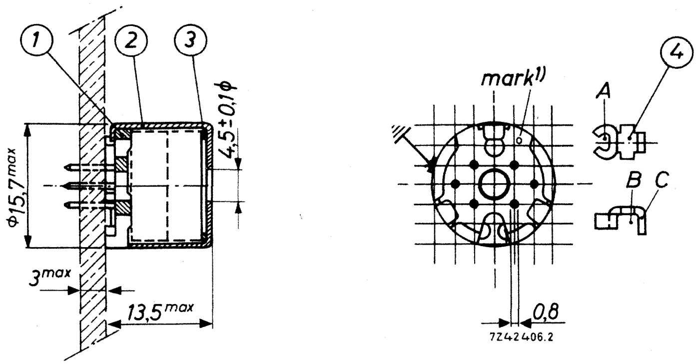

adjustor 4322 021 30950
μ_e =100
$\frac{\Delta L}{L}$ in %
3B7 / 3H1
number of revolutions
7Z42510.1


adjustor 4322 021 31070
μ_e =150
$\frac{\Delta L}{L}$ in %
3B7 / 3H1
number of revolutions
7Z42511.1


adjustor 4322 021 31130
μ_e =220
$\frac{\Delta L}{L}$ in %
3B7/3H1
number of revolutions
7Z44349.1

MOUNTING PARTS

MOUNTING ON PRINTED-WIRING BOARDS



(1) tag plate	4322 021 30440
(2) brass container	4322 021 30520
(3) spring	4322 021 30630
(4) soldering spring	4322 021 30700 (6x)

The container is suitable only for mounting on printed-wiring boards.

If stranded wire is applied the use of a soldering spring (4) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over. For solid wire the soldering spring is not strictly necessary.

The six soldering pins are arranged so as to fit a grid of 2,54 mm (0,1 inch). The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.

The container is provided with an earth tag on its circumference. This tag also serves the purpose of mounting the coil assembly on the printed-wiring board.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 60 Newton. After bending the lips the spring will have the correct tension.

1) There is another mark hole in a similar position on the top of the container.

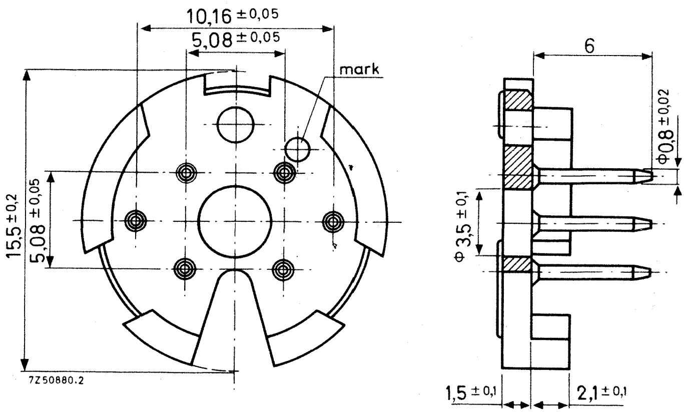
PART DRAWINGS

Dimensions in mm

Tag plate 4322 021 30440

Plate : polyester reinforced with glass fibre resistant against dip-soldering
at 400 °C for 2 s.

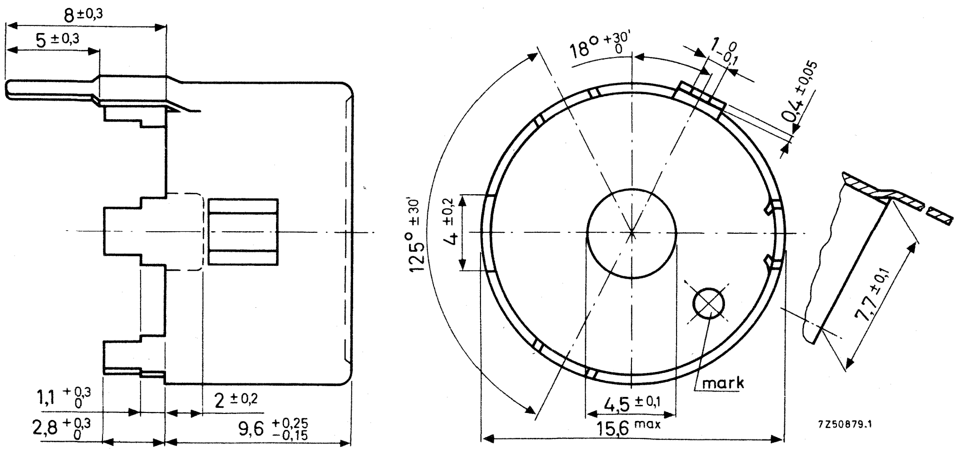
Pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 100 pieces on a polystyrene plate, and with 5 plates to a cardboard box. Please order in multiples of these quantities.

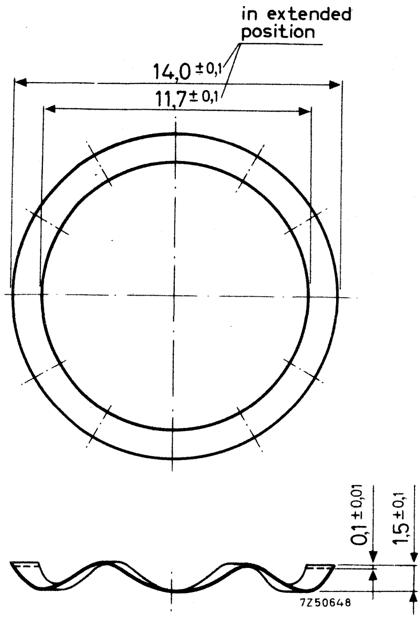
Container for mounting on printed-wiring boards 4322 021 30520

Material : brass, nickel plated; tinned soldering pin



Spring 4322 021 30630

Material: chrome-nickel steel

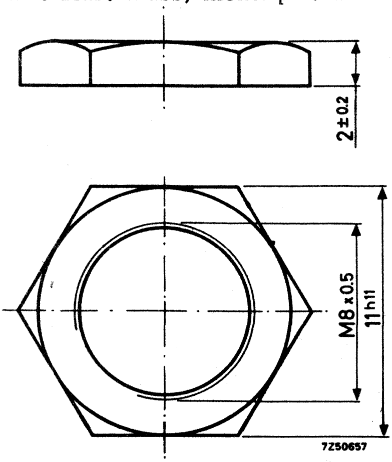


A force of 45 to 75 N is required to compress the spring to 0,35 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

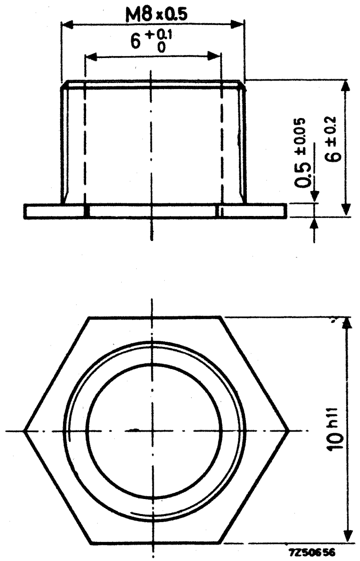
Nut 4322 021 30710

Material: brass, nickel plated



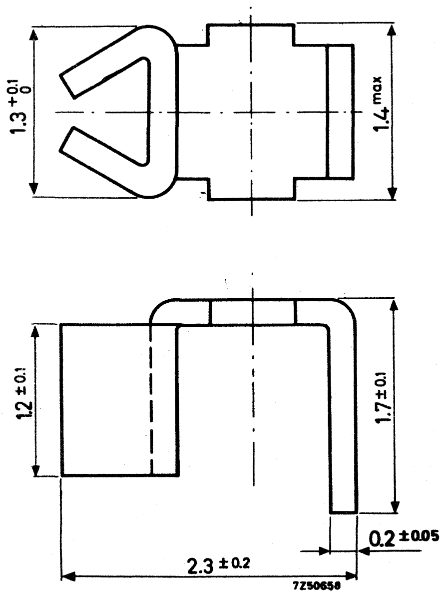
Fixing bush 4322 021 30720

Material: brass, nickel plated



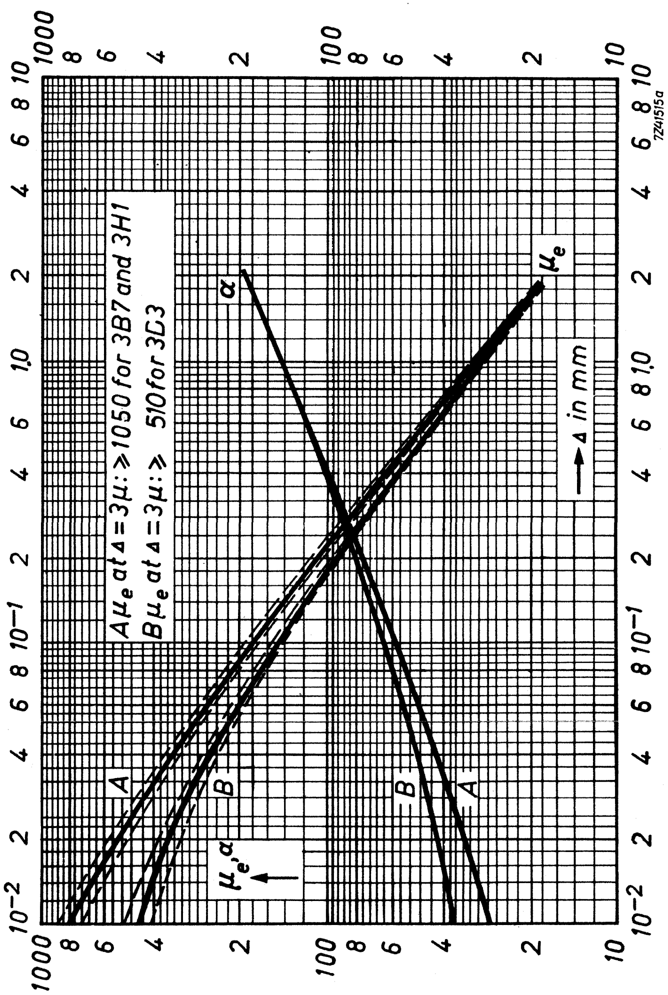
Soldering spring 4322 021 30700

Material: brass, dipsoldered



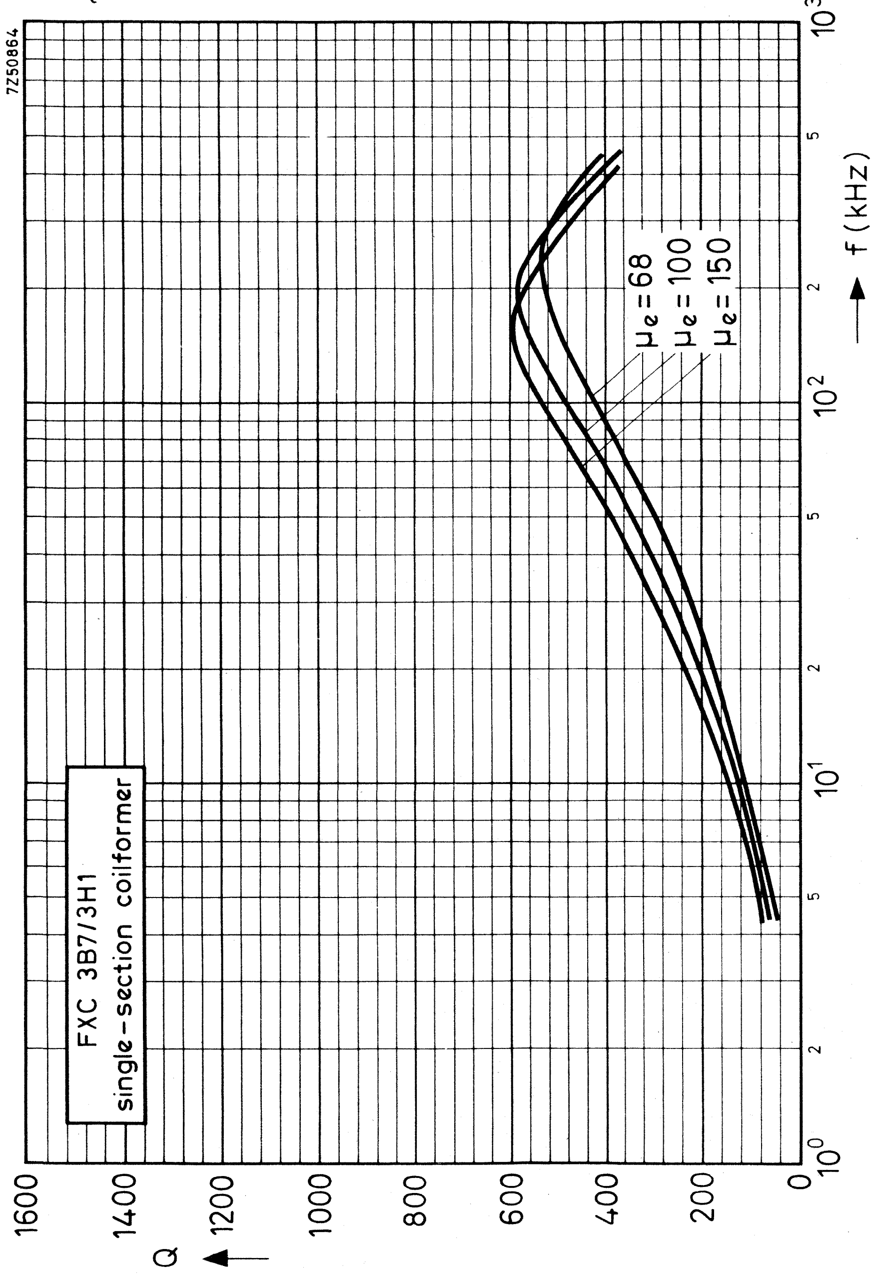
CHARACTERISTIC CURVES

μ_e - α CURVES

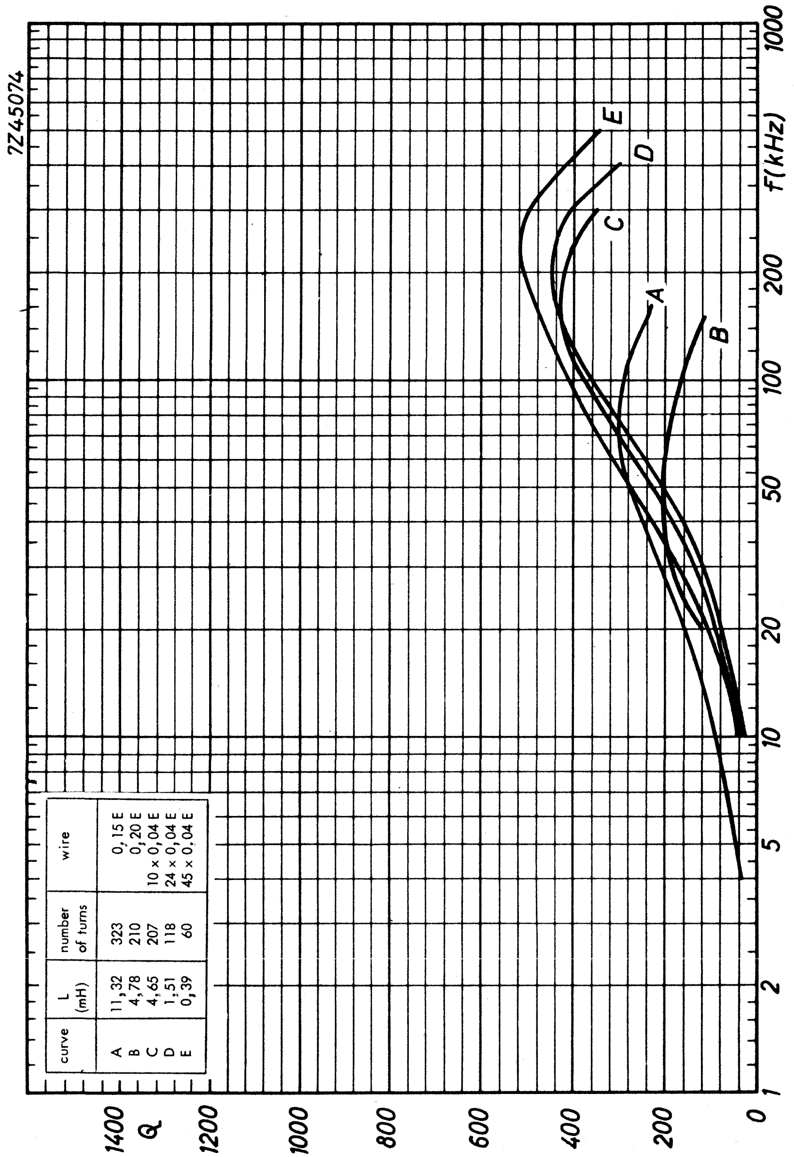


Relative effective permeability and turn factor for 1 mH as a function of the air gap length

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1



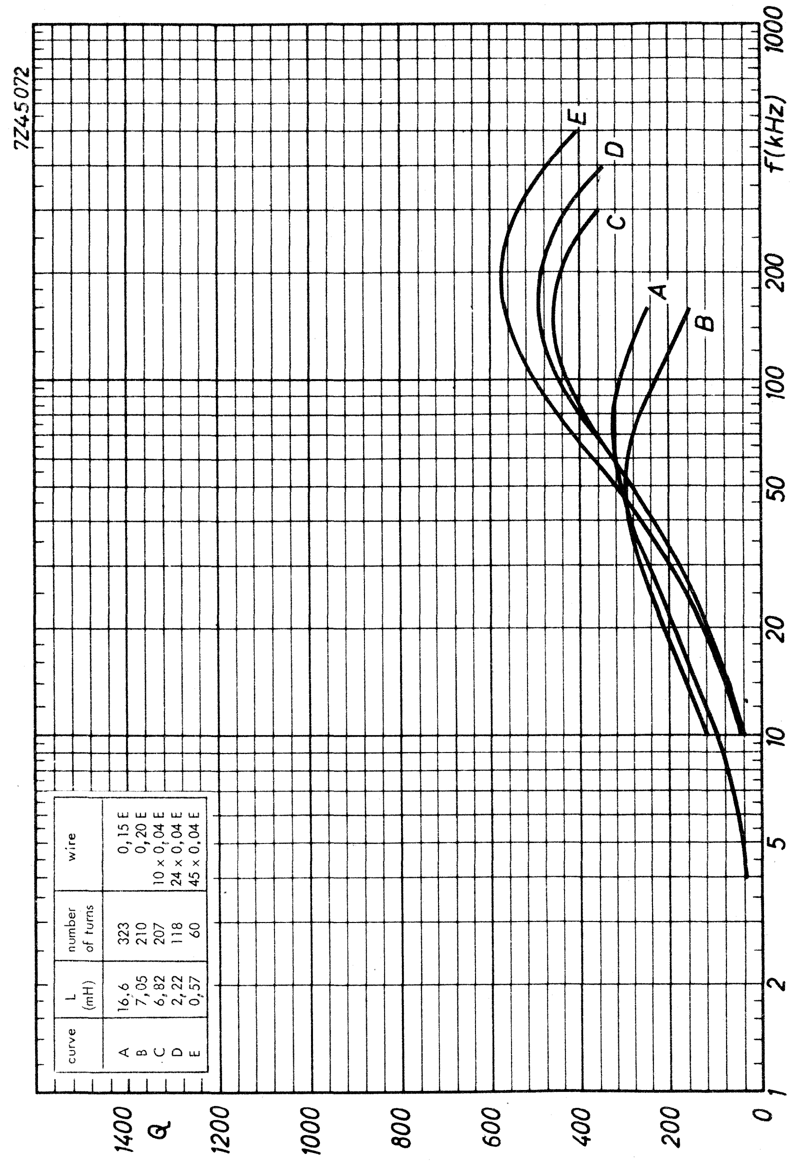
Enveloping curves



curve	L (mH)	number of turns	wire
A	11,32	323	0,15 E
B	4,78	210	0,20 E
C	4,65	207	10 × 0,04 E
D	1,51	118	24 × 0,04 E
E	0,39	60	45 × 0,04 E

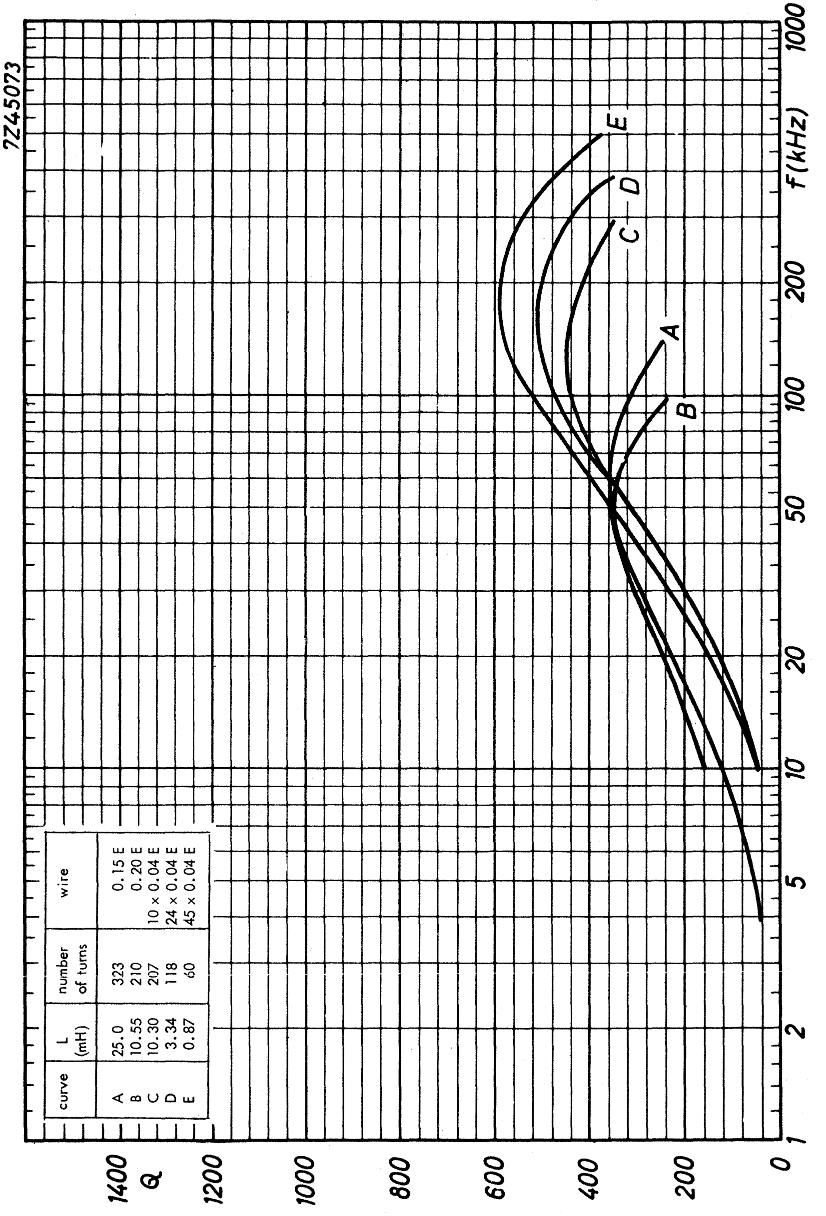
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 68$



FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 100$

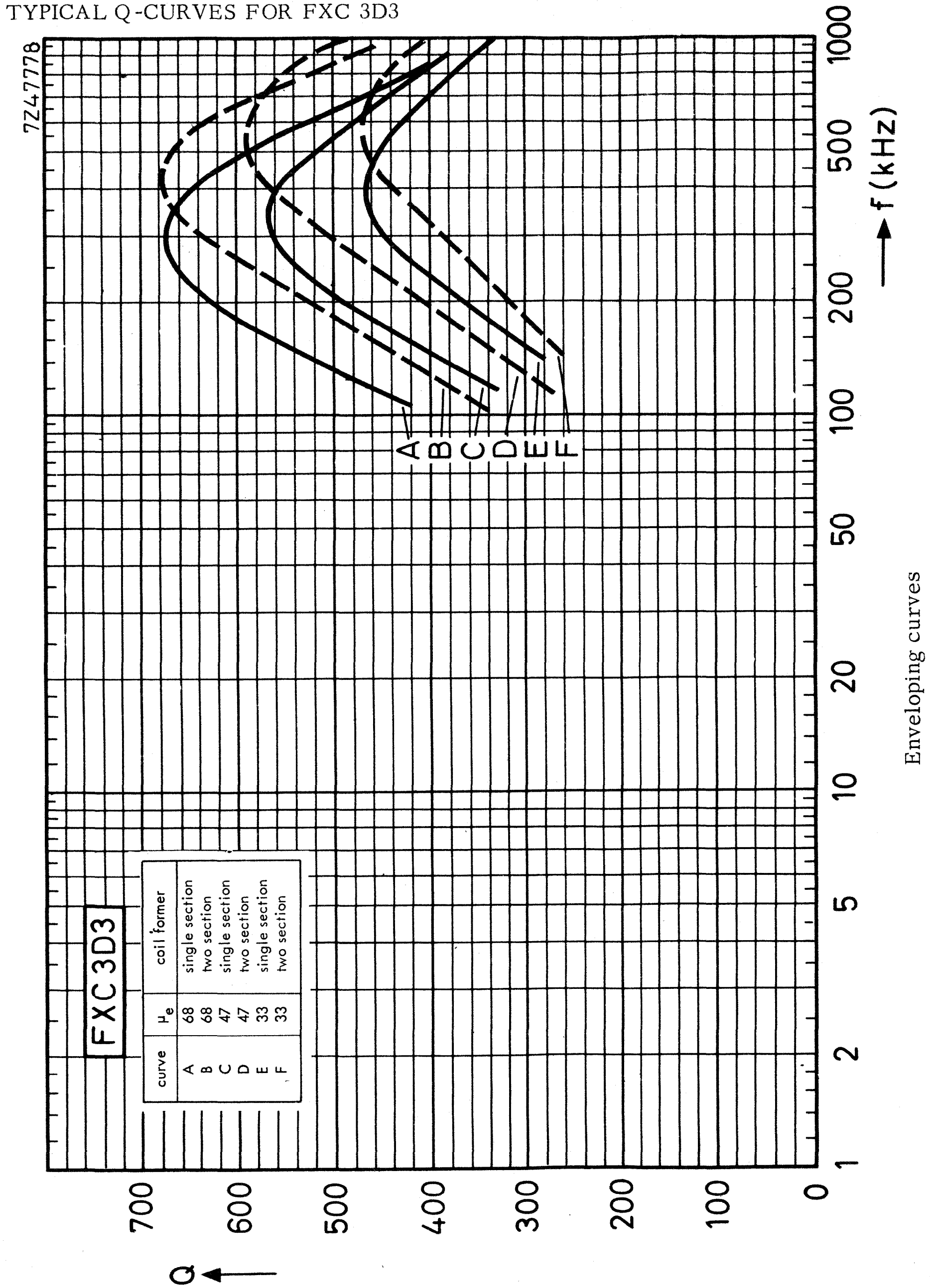


curve	L (mH)	number of turns	wire
A	25.0	323	0.15 E
B	10.55	210	0.20 E
C	10.30	207	10 × 0.04 E
D	3.34	118	24 × 0.04 E
E	0.87	60	45 × 0.04 E

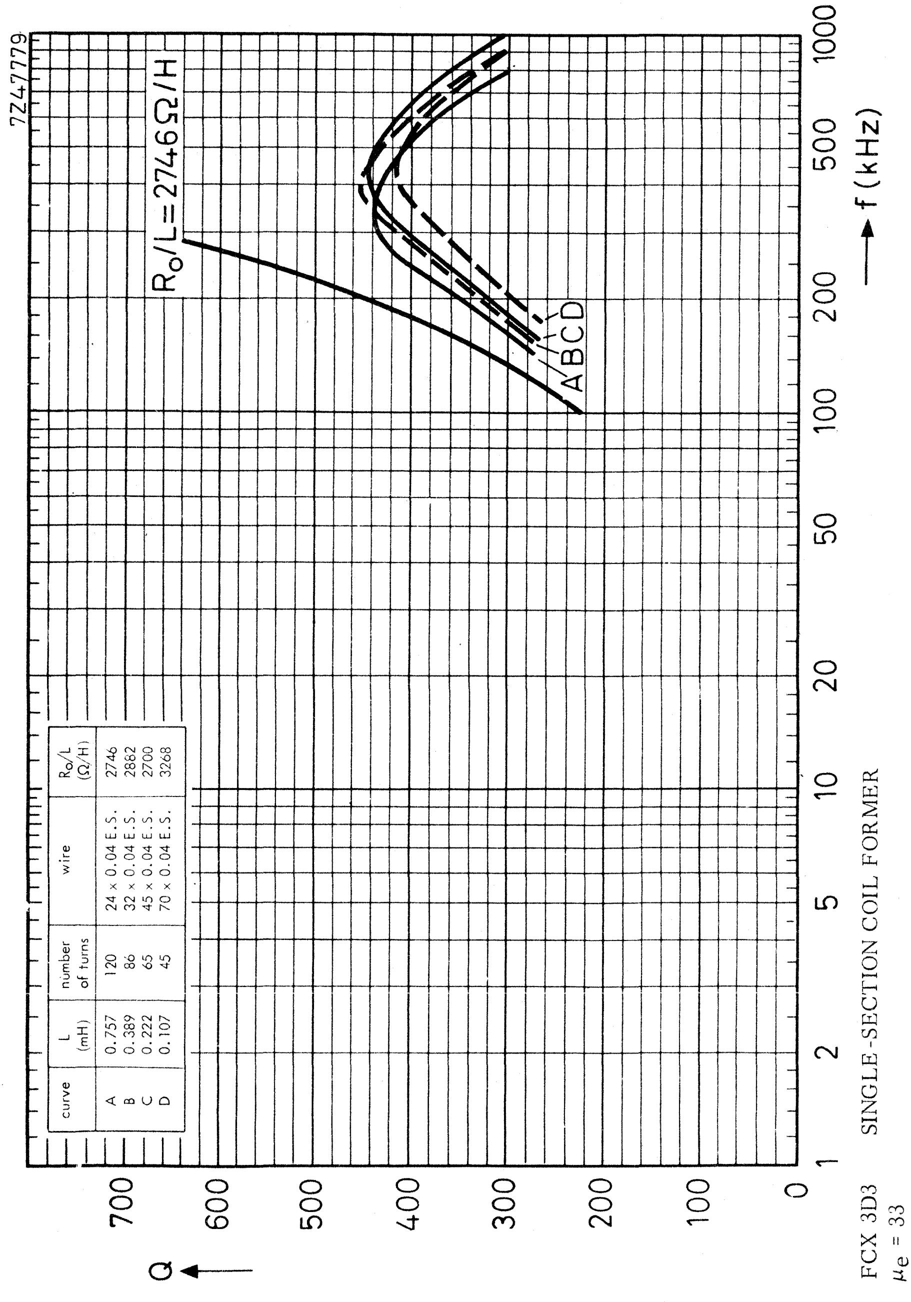
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 150$

TYPICAL Q-CURVES FOR FXC 3D3



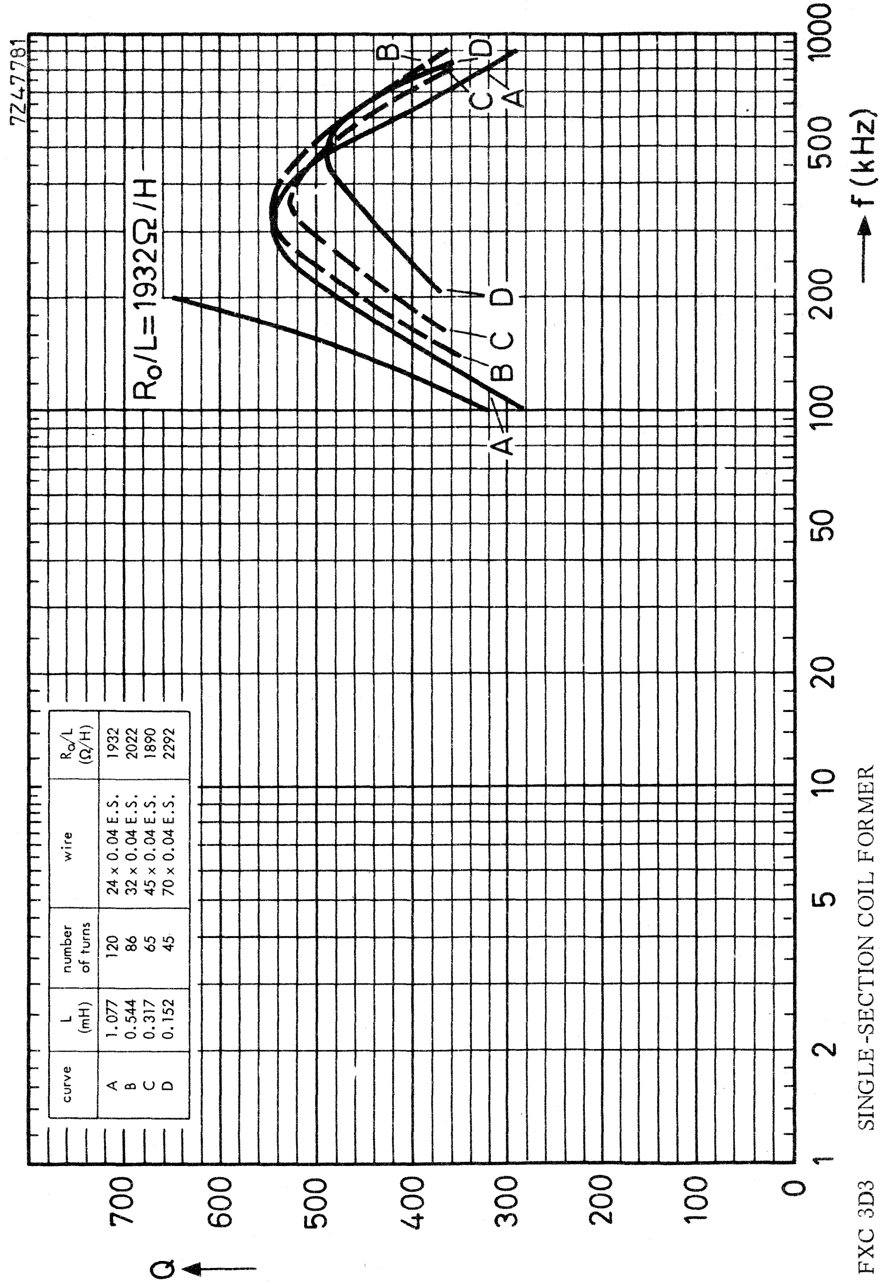
Enveloping curves



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	0.757	120	24 × 0.04 E.S.	2746
B	0.389	86	32 × 0.04 E.S.	2882
C	0.222	65	45 × 0.04 E.S.	2700
D	0.107	45	70 × 0.04 E.S.	3268

SINGLE-SECTION COIL FORMER

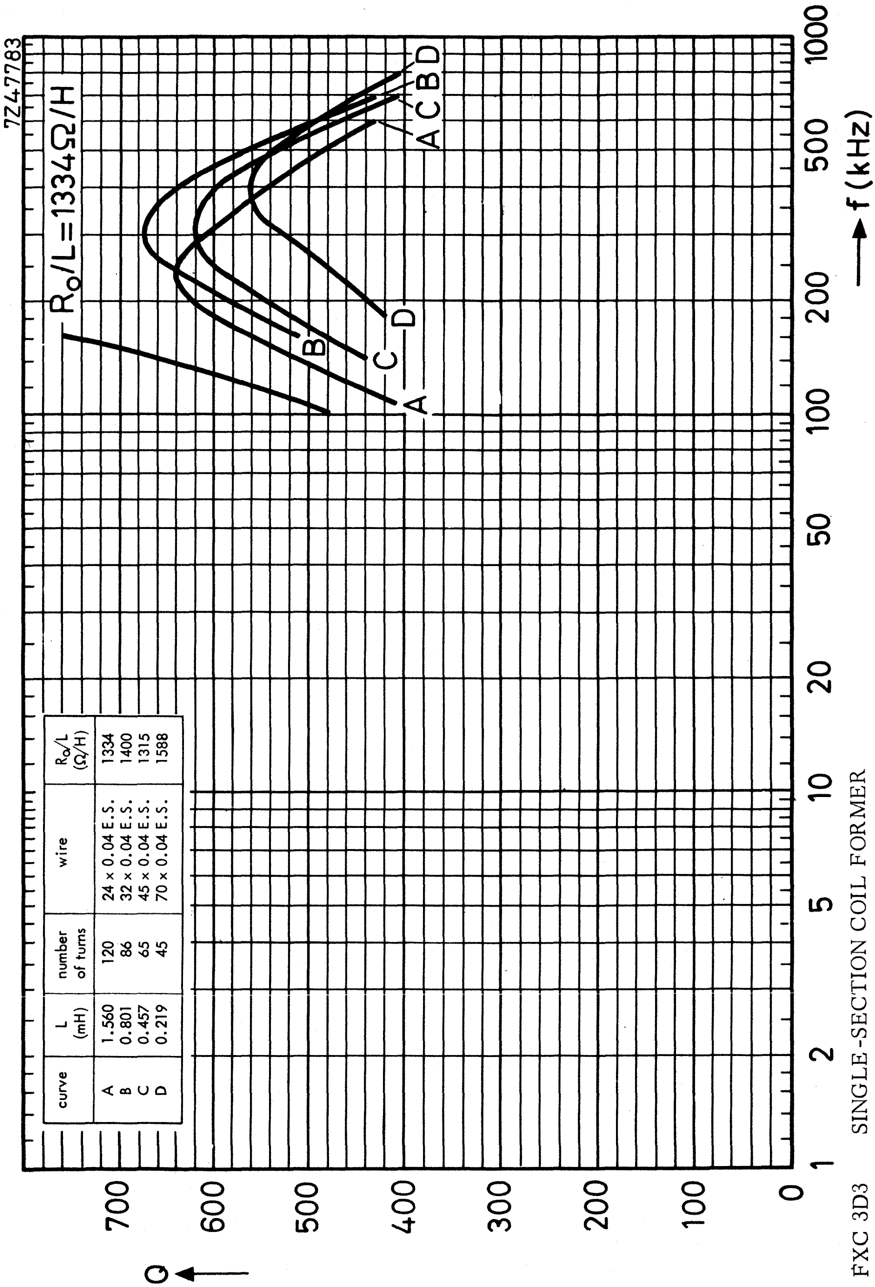
FCX 3D3
$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.077	120	24 × 0.04 E.S.	1932
B	0.544	86	32 × 0.04 E.S.	2022
C	0.317	65	45 × 0.04 E.S.	1890
D	0.152	45	70 × 0.04 E.S.	2292

FXC 3D3 SINGLE-SECTION COIL FORMER

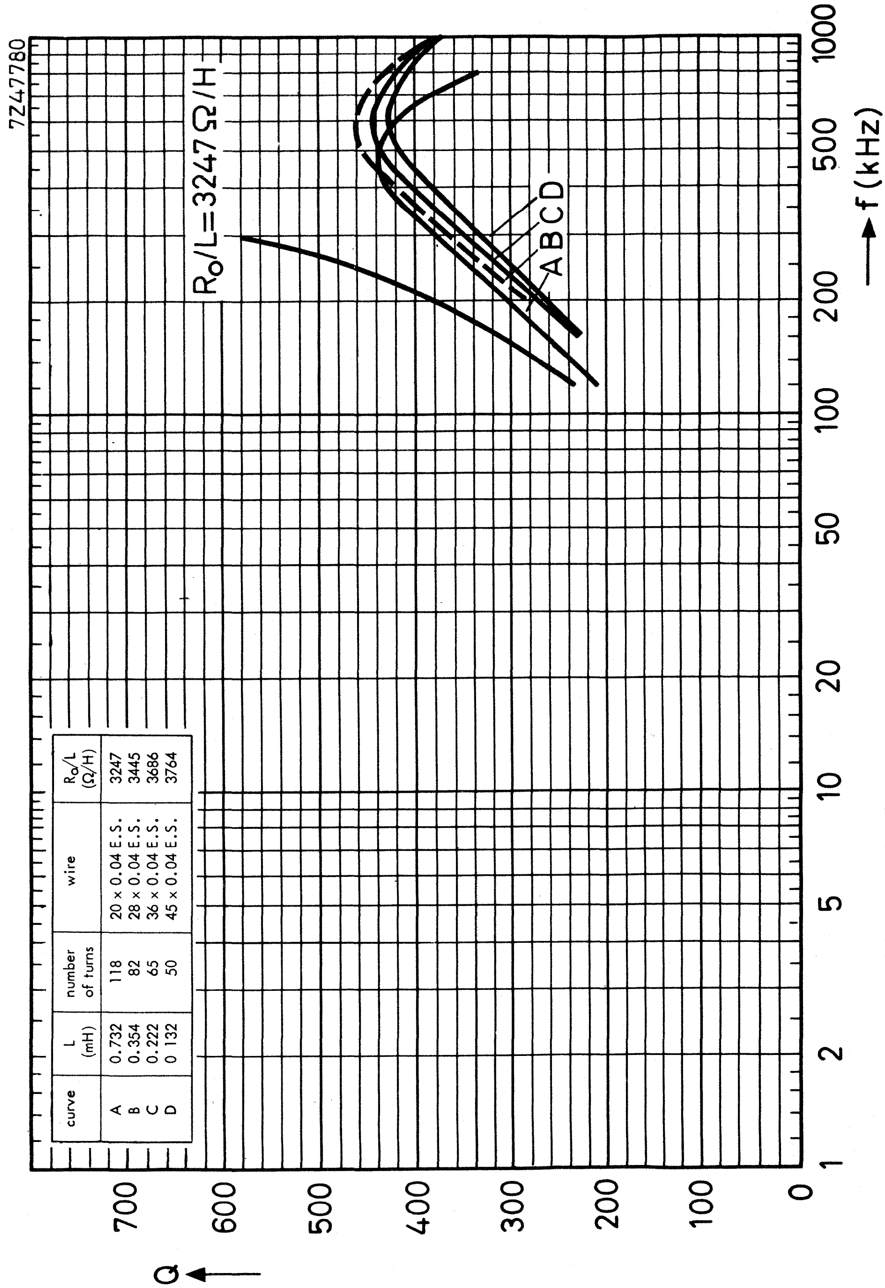
$\mu_e = 47$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.560	120	24 × 0.04 E.S.	1334
B	0.801	86	32 × 0.04 E.S.	1400
C	0.457	65	45 × 0.04 E.S.	1315
D	0.219	45	70 × 0.04 E.S.	1588

SINGLE-SECTION COIL FORMER

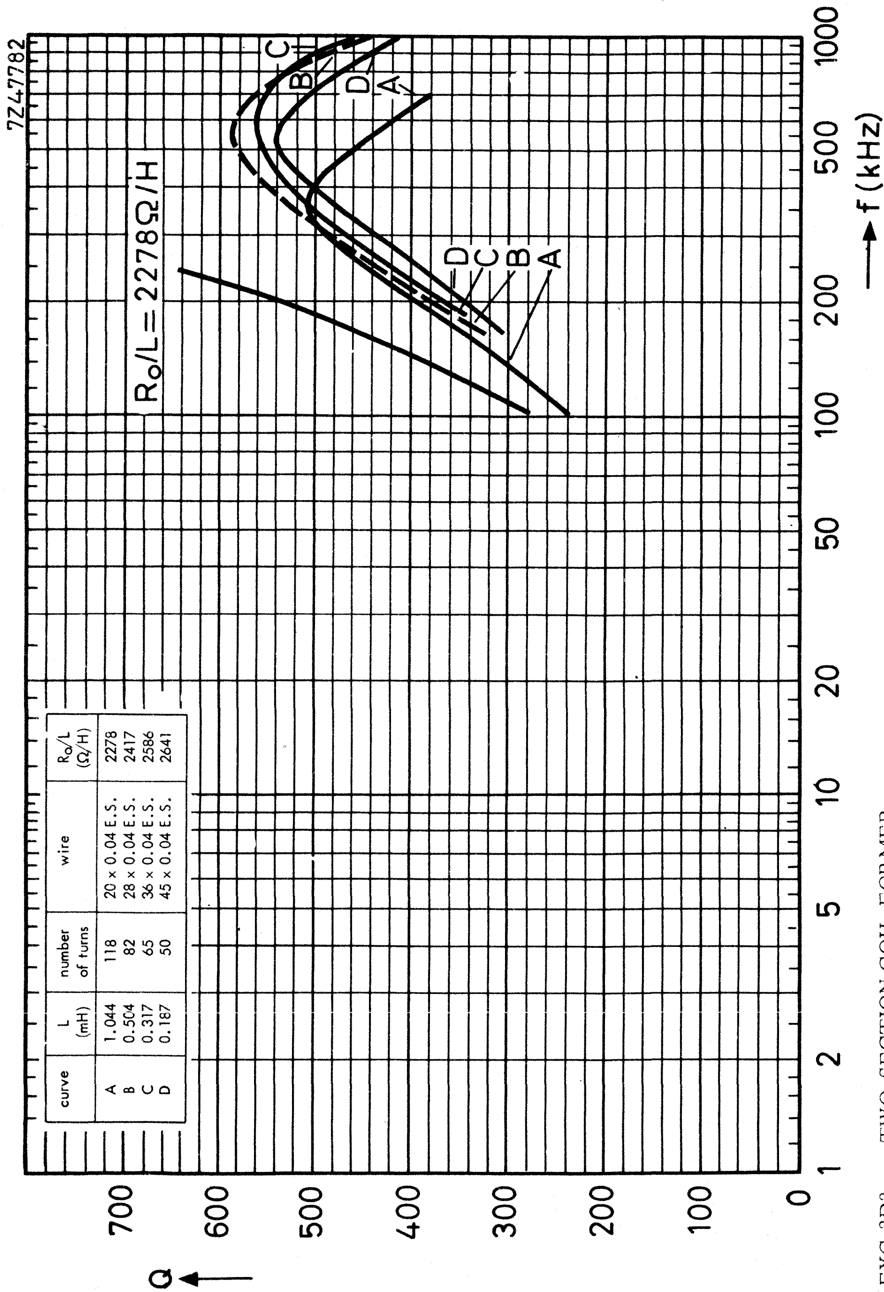
FXC 3D3
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	0.732	118	20 × 0.04 E.S.	3247
B	0.354	82	28 × 0.04 E.S.	3445
C	0.222	65	36 × 0.04 E.S.	3686
D	0 132	50	45 × 0.04 E.S.	3764

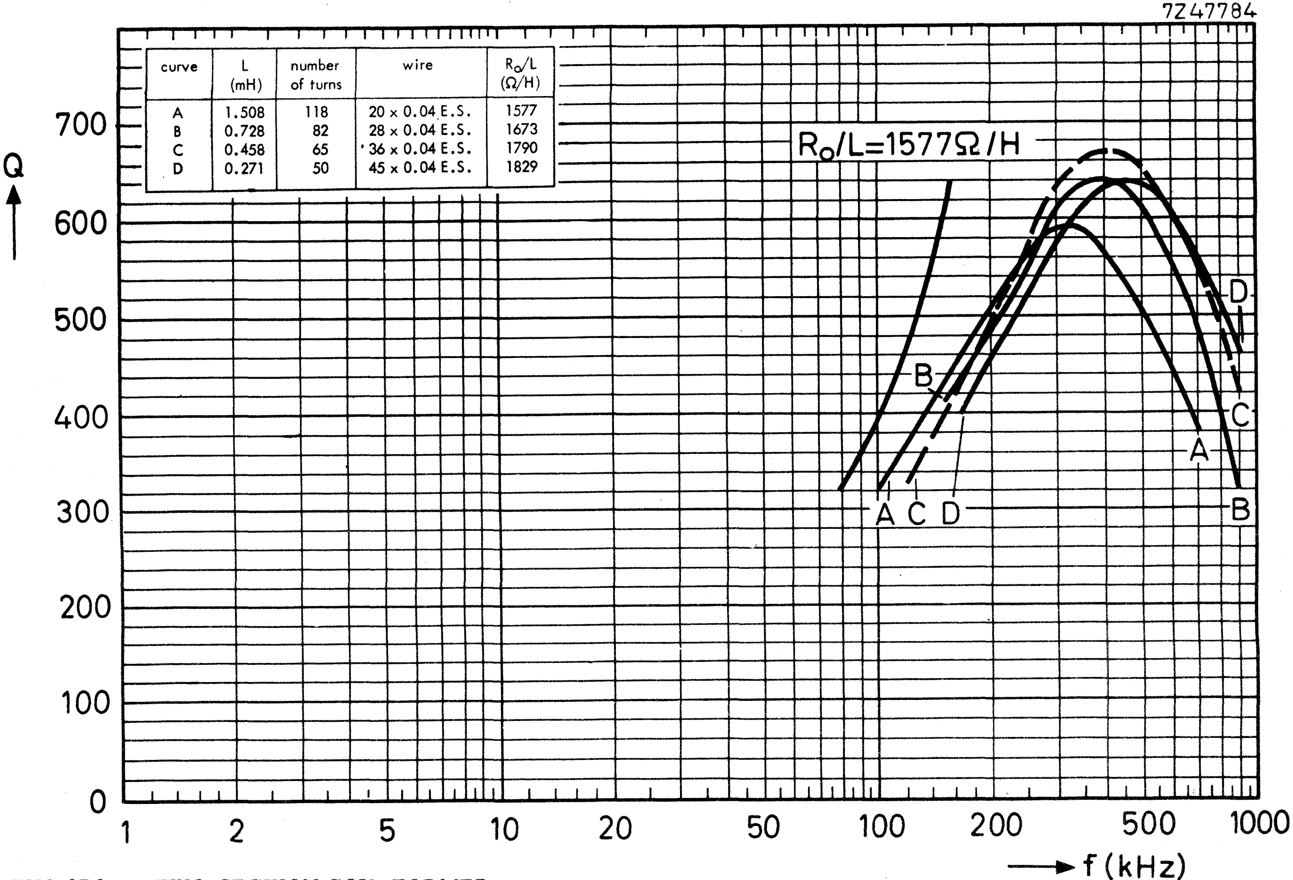
FXC 3D3 TWO-SECTION COIL FORMER

$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.044	118	20 × 0.04 E.S.	2278
B	0.504	82	28 × 0.04 E.S.	2417
C	0.317	65	36 × 0.04 E.S.	2586
D	0.187	50	45 × 0.04 E.S.	2641

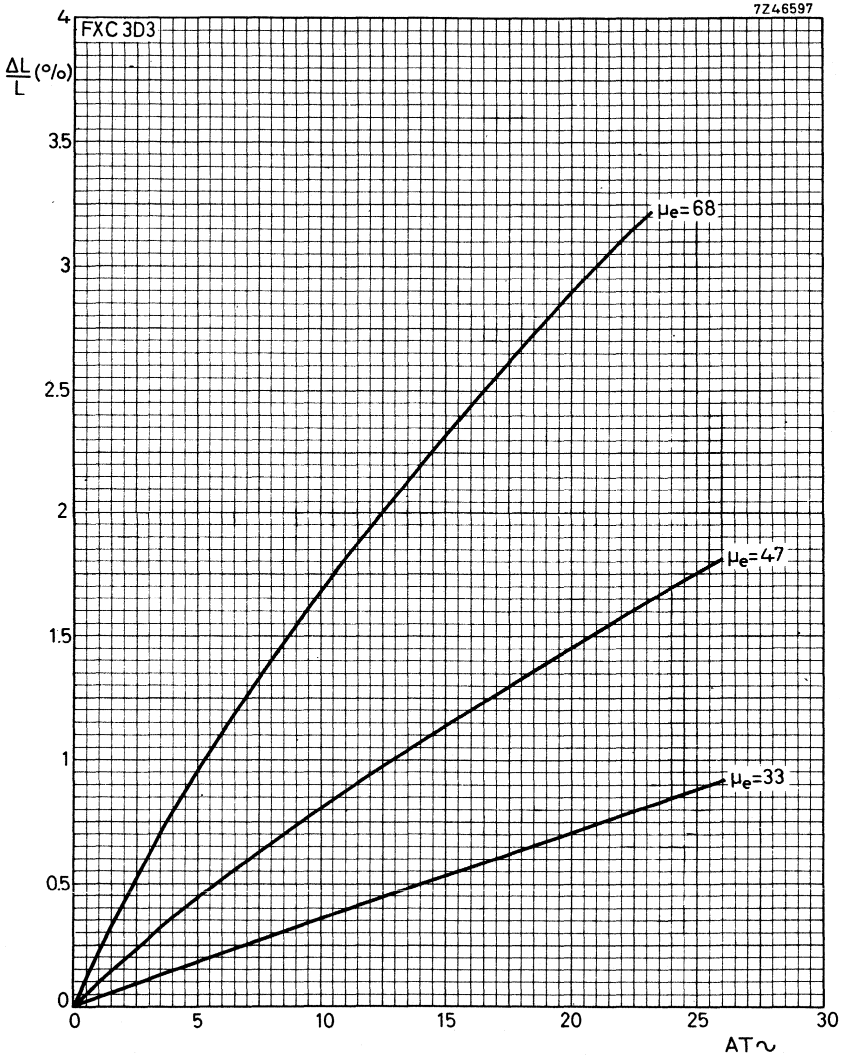
FXC 3D3 TWO-SECTION COIL FORMER
$\mu_e = 47$

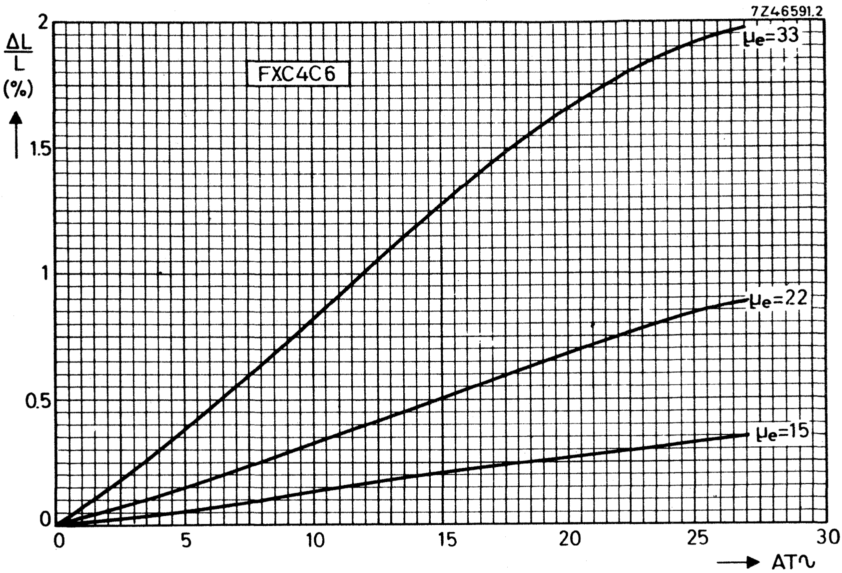


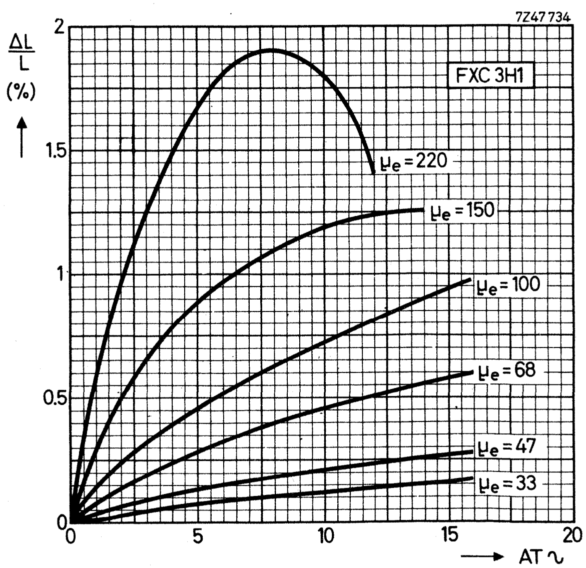
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.508	118	20 x 0.04 E.S.	1577
B	0.728	82	28 x 0.04 E.S.	1673
C	0.458	65	36 x 0.04 E.S.	1790
D	0.271	50	45 x 0.04 E.S.	1829

FXC 3D3 TWO-SECTION COIL FORMER
μ_e = 68

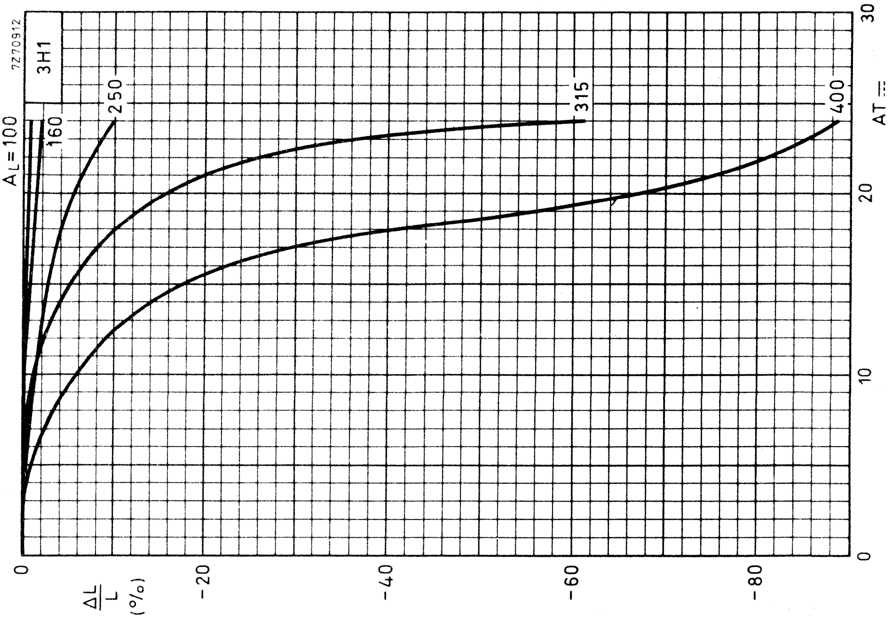
INDUCTANCE VARIATION AS A FUNCTION OF AT~

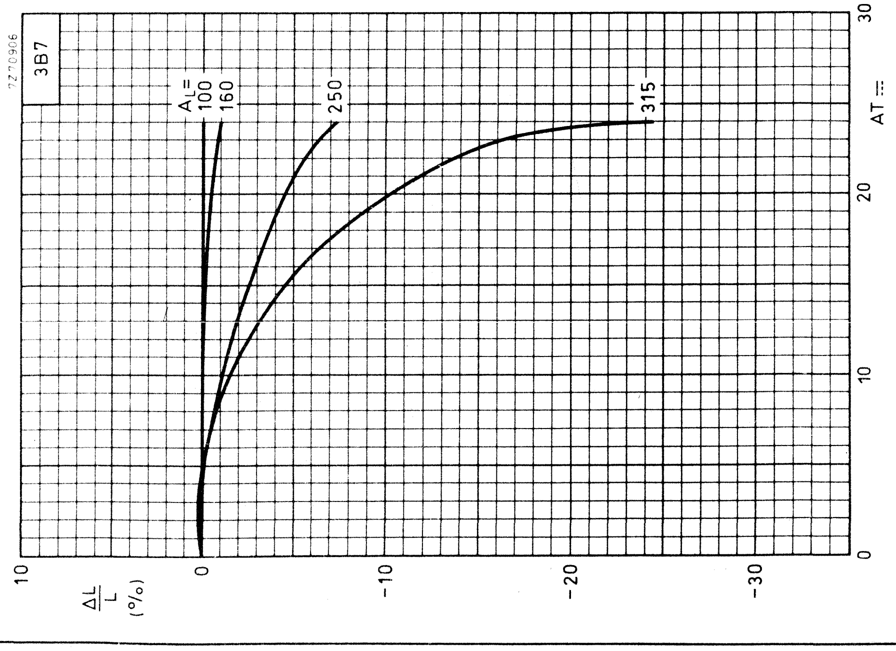


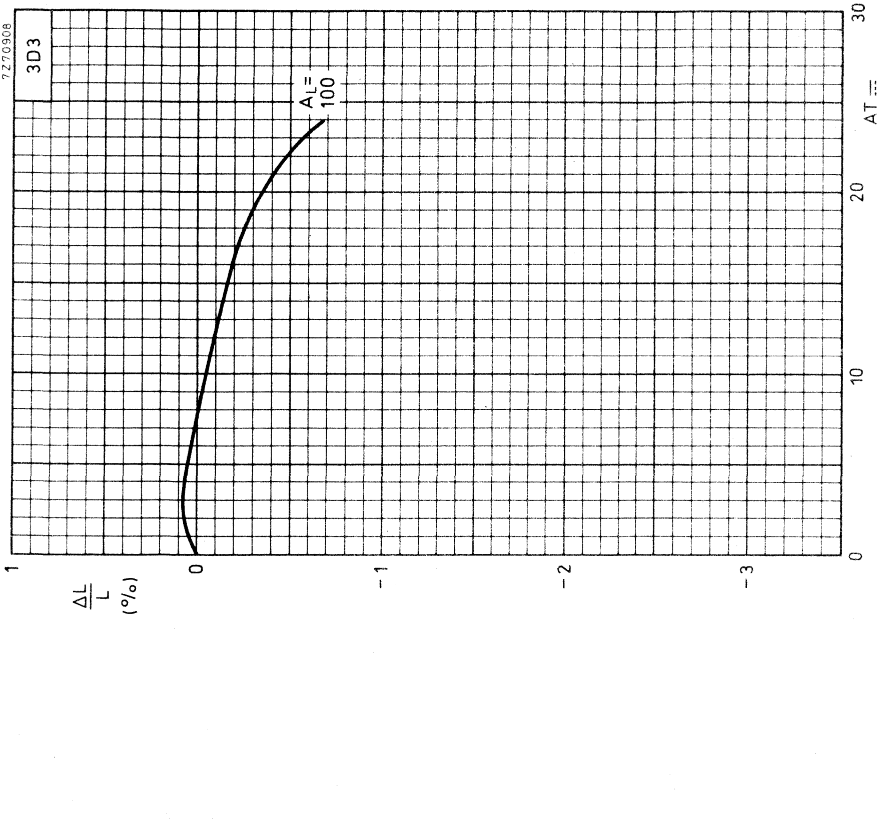

7Z46591.2
FXC4C6
ΔL/L (%)
μe=33
μe=22
μe=15
AT∿
0
0.5
1
1.5
2
5
10
15
20
25
30


7Z47734
FXC 3H1
ΔL/L (%)
μe=220
μe=150
μe=100
μe=68
μe=47
μe=33
AT∿
0
0.5
1
1.5
2
5
10
15
20

INDUCTANCE VARIATION AS A FUNCTION OF AT⎓






7Z70908
3D3
A_L = 100
AT
$\frac{\Delta L}{L}$ (%)
1
0
−1
−2
−3
0
10
20
30

POTCORES

Three types of core can be supplied:

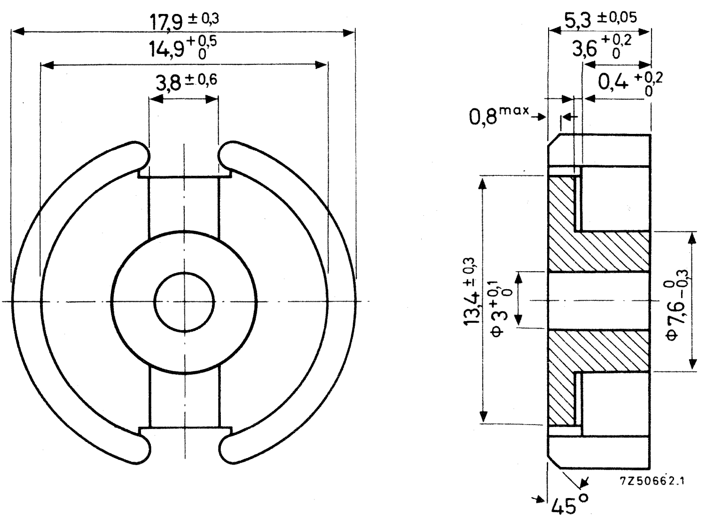
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41 293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number. Quantity: a primary pack contains 40 potcore halves or 20 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores. Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 21500
3D3	4322 020 21520
3E1	4322 020 21640
3H1	4322 020 21510
3H3	4322 020 21650
4C6	4322 020 21610

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (°C)	grade					
		3B7	3D3	3E1	3H1	3H3	4C6
$\alpha_F \times 10^6$	+5 to +25				+0,5 to +1,5	0,7 ± 0,4 [1]	-2 to +4
	+25 to +55				+0,5 to +1,5	0,7 ± 0,25	0 to +6
	+25 to +70	-0,6 to +0,6	0 to 2	0 to 2		0,7 ± 0,25	
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 12		≤ 4,3		≤ 10
	any temp. (±1 °C) between +25 and +70 °C					≤ 3	

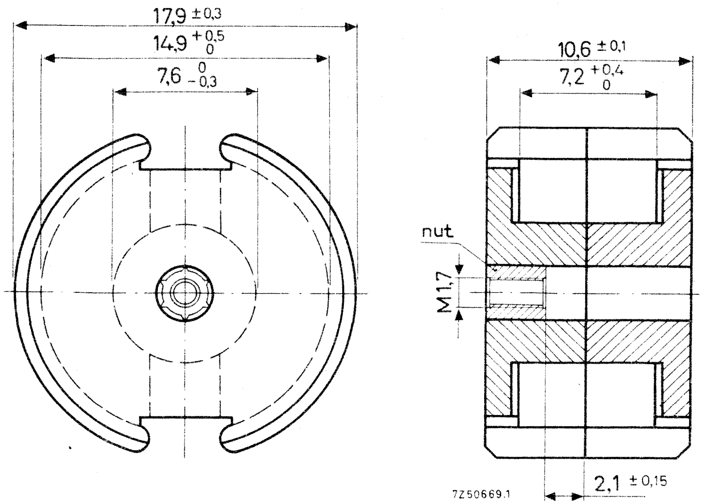
For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 100 Newton, the values in Table II are guaranteed at 25 ± 10 °C.

Table II	$\hat{B}$ (mT)	freq. (MHz)	grade					
			3B7	3D3	3E1	3H1	3H3	4C6
μ_e ± 25%	≤ 0, 1	0, 004			2800			
	≤ 0, 1	0, 1	1750	705		1750		125
A_L ± 25%	≤ 0, 1	0, 004			5900			
	≤ 0, 1	0, 1	3650	1500		3650		260
α	≤ 0, 1	0, 1	≤ 19, 0	≤ 29, 9		≤ 1910		≤ 71, 1
$\frac{\tan \delta}{\mu_i} \times 10^6$	≤ 0, 1	0, 004			≤ 2, 5			
	≤ 0, 1	0, 1	≤ 5	≤ 8	≤ 20	≤ 5		
	≤ 0, 1	0, 5		≤ 14	≤ 200			
	≤ 0, 1	1		≤ 30				
	–	2						≤ 40
	–	10						≤ 100
$q_{2-24-100}$	0, 3-1, 2	0, 1		≤ 3, 0				≤ 10
	1, 5-3, 0	0, 004	≤ 1, 8		≤ 3, 0	≤ 1, 4		
$\eta_B \times 10^3$	0, 3-1, 2	0, 1		≤ 1, 8				≤ 6, 2
	1, 5-3, 0	0, 004	≤ 1, 1		≤ 1, 8	≤ 0, 86		
	1, 5-3, 0	0, 030					≤ 0, 8 [2]	

[1] Target value 0, 7 ± 0, 25.
[2] Target value ≤ 0, 65.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 2. . . .
Without nut, catalogue number = 4322 022 0. . . .

Mass of a set		6, 4 g
Mean length of lines of force	l_e	= 25, 8 mm
	$\Sigma \frac{l_e}{A_e}$	= 0, 597 mm^{-1}
Effective volume	V_e	= 1120 mm^3

Pre-adjusted potcores with standard μ_e values [1])

μ_e	α	tolerance on inductance (%)	catal. No. 4322 022 2.... with nut / 4322 022 0.... without nut			
			3B7	3H1	3D3	4C6
15	178	± 1	-	-	-	4810
22	147	± 1	-	-	-	4820
33	120	± 1	4030	4230	4430	4830
47	100.5	± 1	4040	4240	4440	-
68	83.6	± 1	4050	4250	4450	-
100	68.9	± 1.5	4060	4260	-	-
150	56.3	± 2	4070	4270	-	-
220	46.5	± 3	4080	4280	-	-
705	25.9	± 25	-	-	4400*	-
1750	16.5	± 25	4000*	4200*	-	-

Number of turns $N = \alpha\sqrt{L}$ (L in 10^{-3} H)

Symmetric air gap for cores with an μ_e value of 15 up to and including 68
Asymmetric air gap for cores with an μ_e value of 100 up to and including 1750

1) See Notes on the next page.
*) Only available without nut.

Pre-adjusted potcores with standard A_L factor [1])

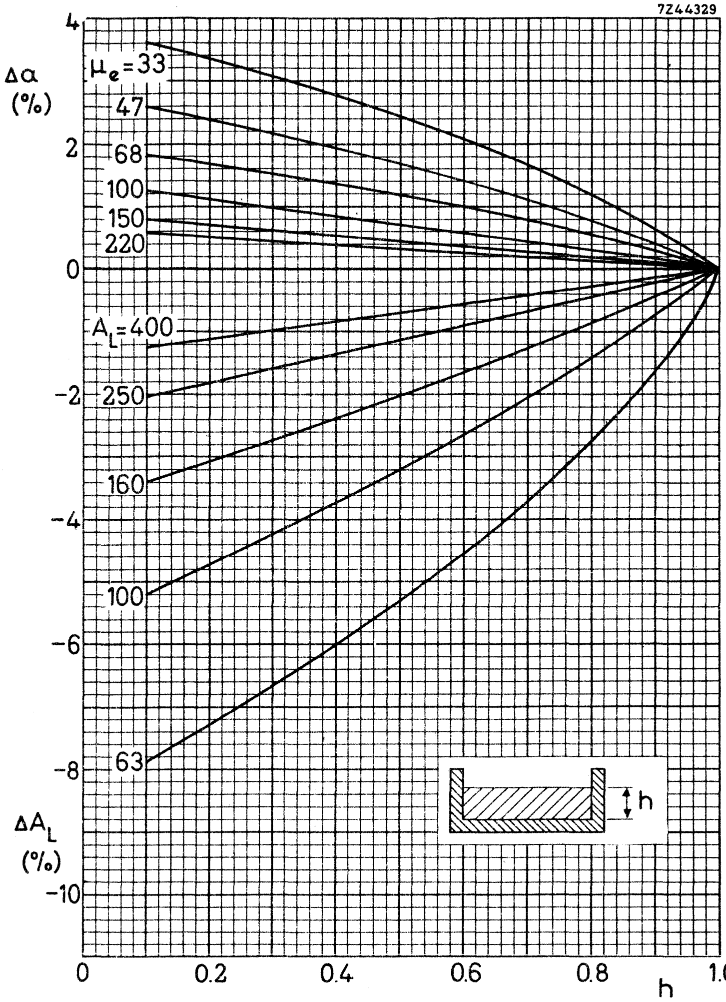
A_L	corre-sponding μ_e - value	tolerance on induc-tance (%)	cat. no. 4322 022 2.... with nut 4322 022 0.... without nut				
			3B7	3D3	3H1	3H3	4C6
25	11,9	±1	–	–	–	–	5810
40	19,0	±1	–	5420	–	–	5820
63	30	±1	5030	5430	5230	–	5830
100	47,5	±1	5040	5440	5240	–	–
160	76	±1	5050	5450	5250	–	–
250	119	±1,5	5060	–	5260	5560	–
315	149	±2	5070	–	5270	5570	–
400	190	±2	5080	–	5280	5580	–
630	298	±3	5100	–	5300	5600	–
1000	475	±5	–	–	5310	–	–

Inductance $L = N^2 A_L$ (L in 10^{-9} H).
Symmetrical air gap for cores with an A_L factor of 25 up to and including 160.
Asymmetrical air gap for cores with an A_L factor of 250 up to and including 630.

Notes to the tables

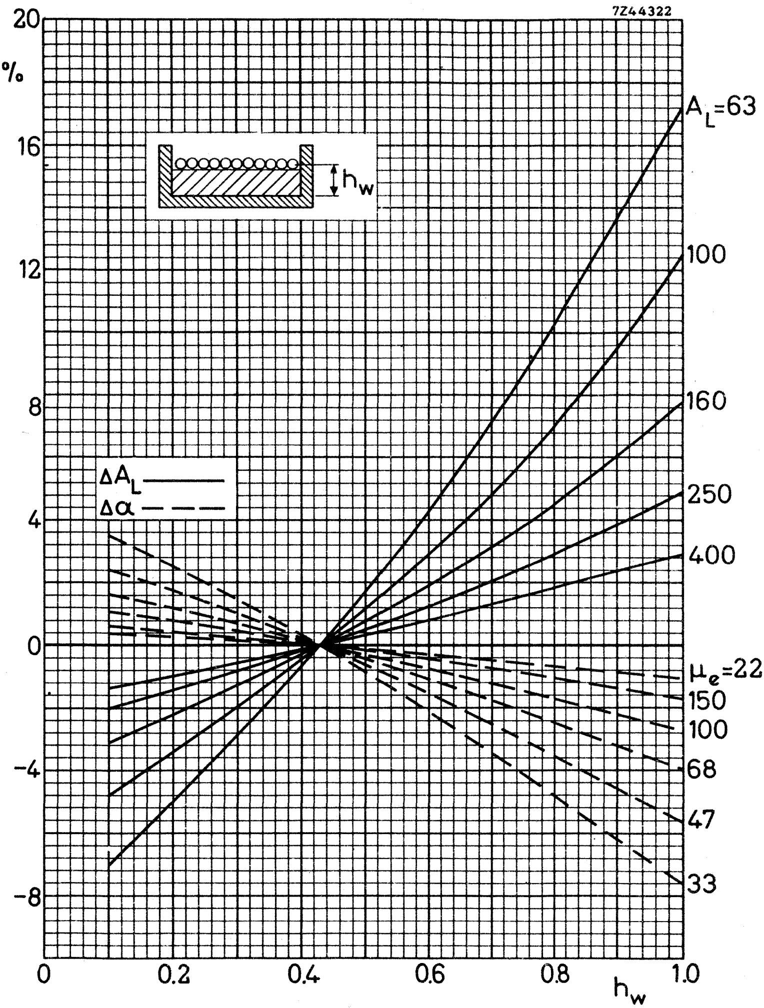
1. Examples of catalogue number:
   μ_e = 15, grade 4C6, potcore with nut, catalogue number = 4322 022 24810
   A_L = 100, grade 3B7, potcore without nut, catalogue number = 4322 022 05040
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 705 = A_L of 1500, μ_e of 1750 = A_L of 3650.

DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.
Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: Of a single-section coil former only 0.4 part of the available neight is used. A potcore with μ_e = 68 in that case obtains an α factor of 83.6 + 1.30 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_w on a single-section coil former.
Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 83.6 - 1.7 %.

COIL FORMERS

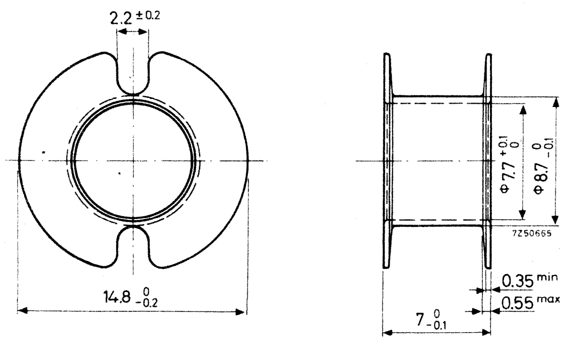
GENERAL

Three types of coil former can be supplied:

- with one section
- with two sections
- with three sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41 294 (Germany) and BS 4061 range 2 (Great Britain). The dimensions in the drawings are in mm.

SINGLE-SECTION COIL FORMER



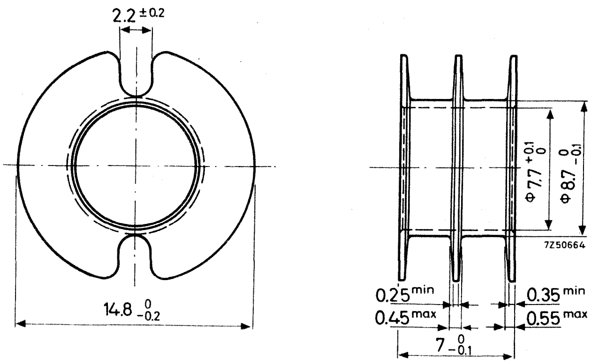
Catalogue number	4322 021 30270
Material	polycarbonate
Window area	18 mm^2
Mean length of turn	37 mm
Max. temperature	130 ^{o}C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 16,4 \times 10^3 \ \Omega/H$$

Weight 0,35 g

TWO-SECTION COIL FORMER



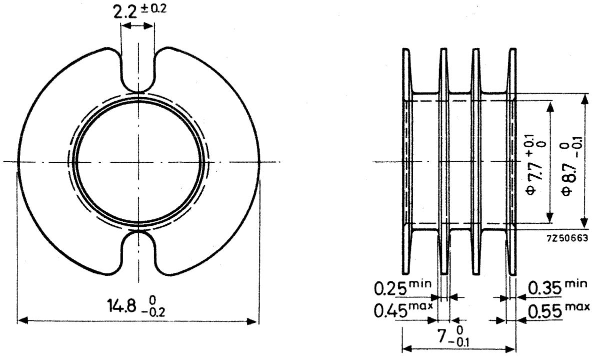
Catalogue number	4322 021 30280
Material	polycarbonate
Window area	2 x 8.7 mm^2
Mean length of turn	37 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 17.2 \times 10^3 \quad \Omega/H$$

Weight 0.35 g

THREE-SECTION COIL FORMER



Catalogue number	4322 021 30290
Material	polycarbonate
Window area	3 x 5.4 mm^2
Mean length of turn	37 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 18.4 \times 10^3 \quad \Omega/H$$

Weight 0.4 g

INDUCTANCE ADJUSTORS

Dimensions in mm

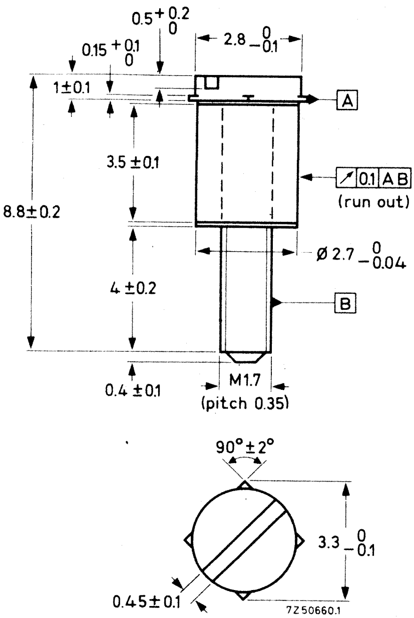


Fig. A

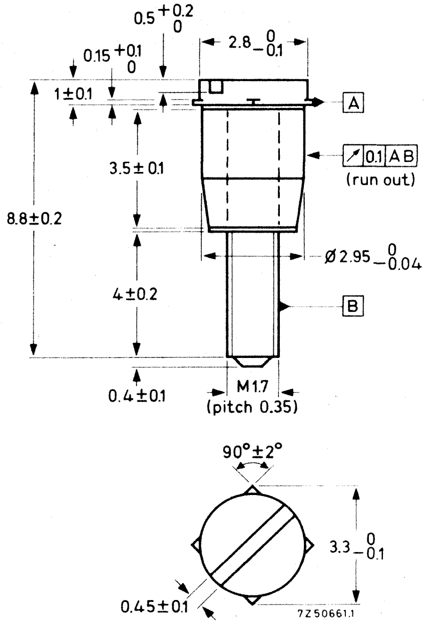


Fig. B

The tolerances on inductance of the pre-adjusted potcores (without adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03 % by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.

Table I, available types:

Fig.	colour	catalogue number
A	brown	4322 021 30730
A	green	4322 021 30760
A	red	4322 021 30770
B	yellow	4322 021 30960
B	white	4322 021 30970
B	grey	4322 021 31080

The adjusters are packed in bags of 100. Please order in multiples of this quantity.

Table II, recommended application:

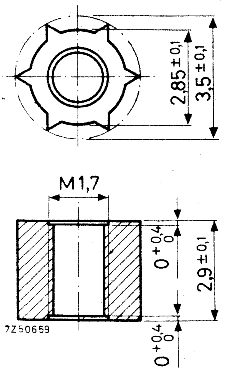
μ_e	A_L	3B7/3H1/3D3	4C6
		cat. number 4322 021	
15			30760
	25		30760
	40		30770
22			30770
	63	30760	
33		30760	30970
	100	30770	
47		30770	
68		30960	
	160	30960	
	250	30970	
100		30970	
	315	30730	
150		30730	
	400	31080	
220		31080	
	630	31080	

NUT FOR ADJUSTER

These data are given for those manufacturers who prefer to insert the nut themselves.

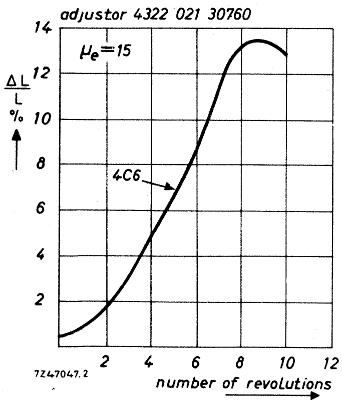
Catalogue number	4322 021 30140
Material	polycarbonate
Max. impregnation temperature during 24 hours	120 °C
Recommended distance from mating surface to nut	2,3 ± 0,15 mm

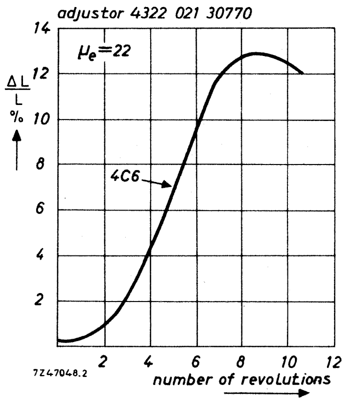
For more information see Potcores General, inductance adjustment.

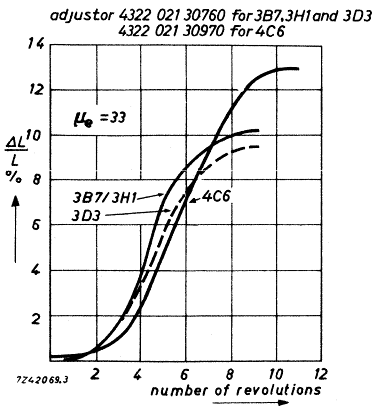


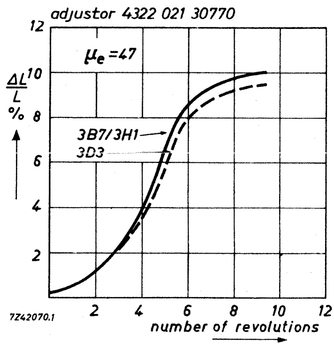
dimensions in mm

ADJUSTMENT CURVES

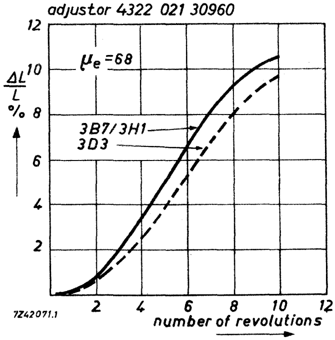




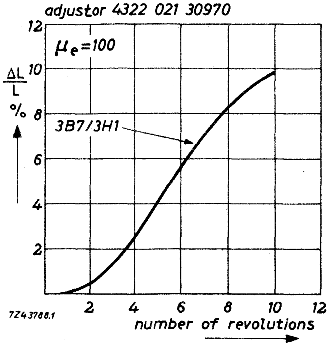




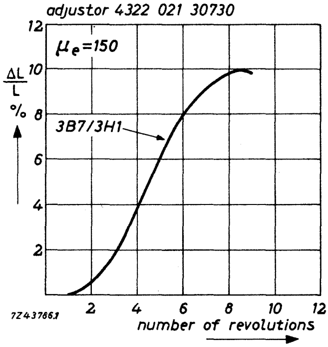
adjustor 4322 021 30960



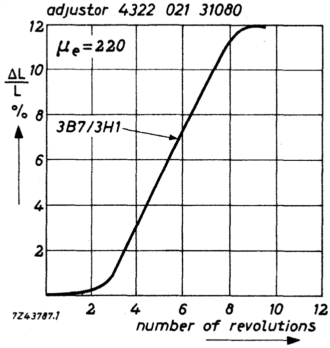
adjustor 4322 021 30970



adjustor 4322 021 30730

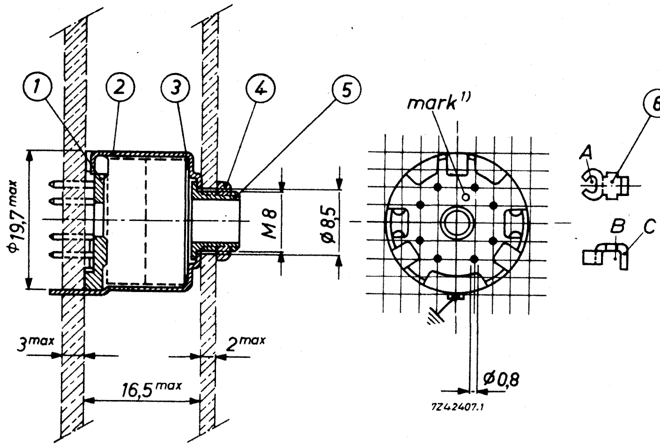


adjustor 4322 021 31080



MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30450	(4) nut	4322 021 30710
(2) brass container	4322 021 30530	(5) fixing bush	4322 021 30720
(3) spring	4322 021 30640	(6) soldering spring	4322 021 30700 (8x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

The eight soldering pins are arranged so as to fit a grid of 2,54 mm (0,1 inch). The pin length is sufficient for a board thickness up to 3 mm. The board should be provided with holes of 1,3 + 0,1 mm diameter.

1) There is another mark hole in a similar position on the top of the container.

If one-hole mounting is preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8, 5 mm diameter.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

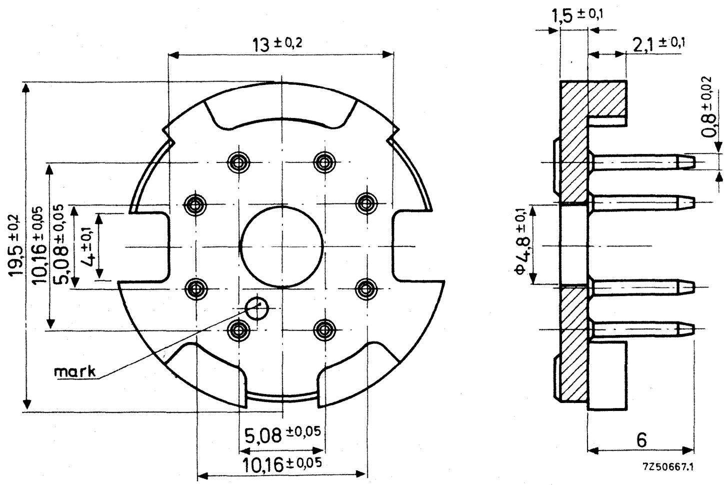
Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 100 Newton. After bending the lips the spring will have the correct tension.

PART DRAWINGS Dimensions in mm

(1) Tag plate 4322 021 30450

Plate : polyester reinforced with glass fibre,
resistant against dip-soldering at 400°C for 2 s.

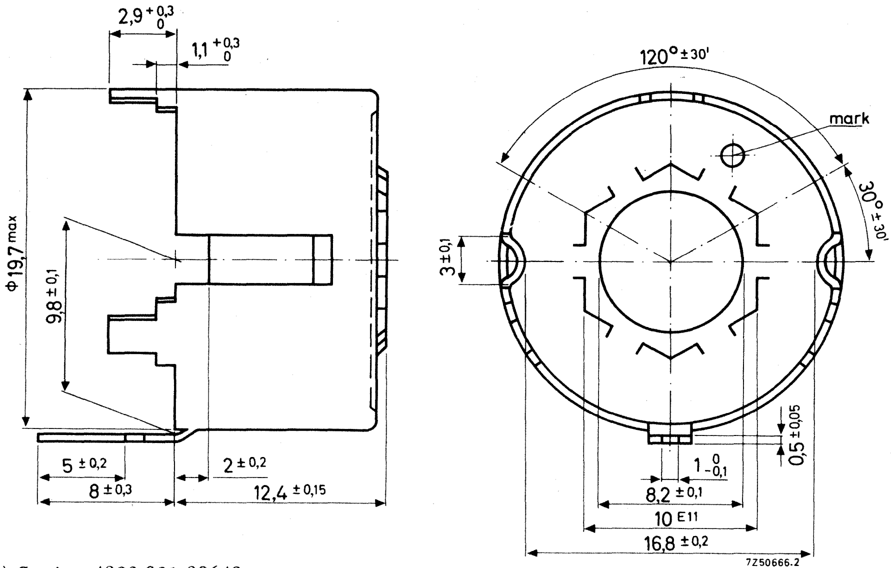
Pins : phosphor-bronze, dip-soldered.



The tag plates are packed in units of 75 pieces on a polystyrene plate, and with 5 plates to a cardboard box. Please order in multiples of these quantities.

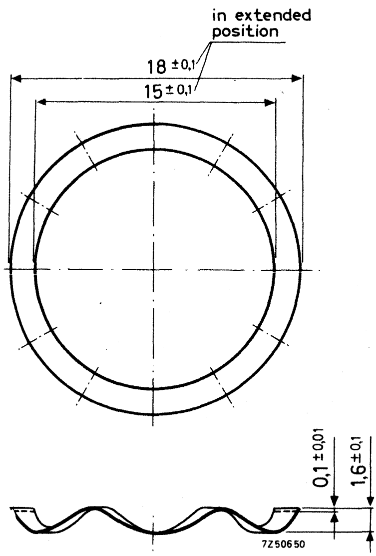
(2) Container 4322 021 30530

Material: brass, nickel plated; tinned soldering pin



(3) Spring 4322 021 30640

Material: chrome-nickel steel

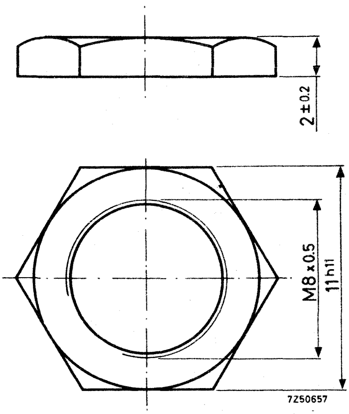


A force of 68 to 113 N is required to compress the spring to 0, 55 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

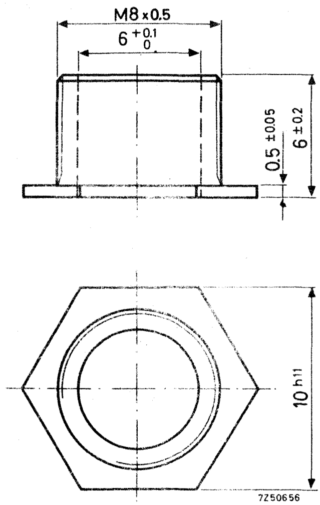
(4) Nut 4322 021 30710

Material : brass, nickel plated



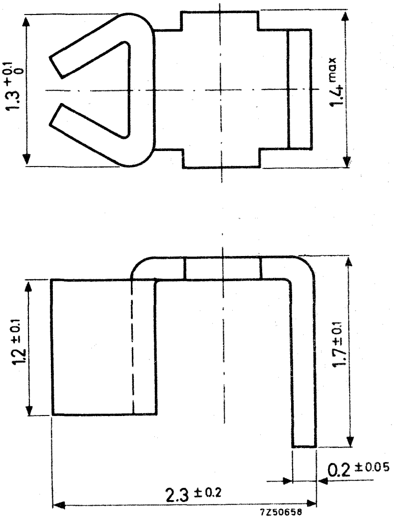
(5) Fixing bush 4322 021 30720

Material : brass, nickel plated



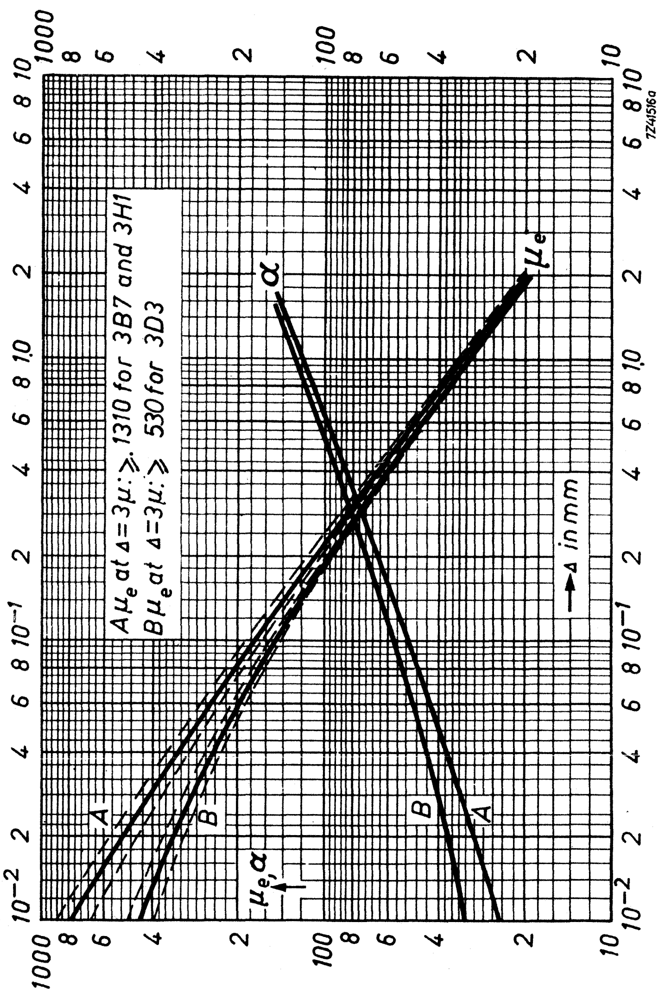
(6) Soldering spring 4322 021 30700

Material : brass, dipsoldered



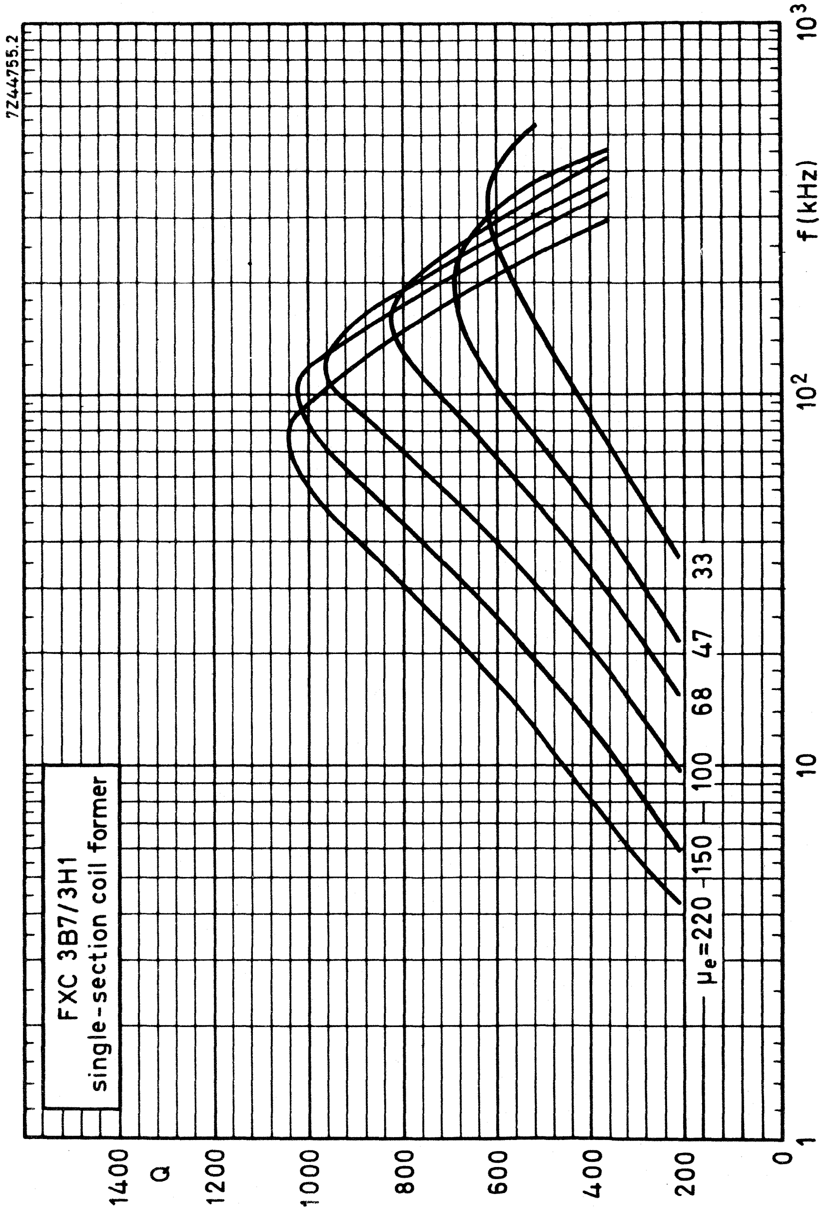
CHARACTERISTIC CURVES

μ_e - α CURVES

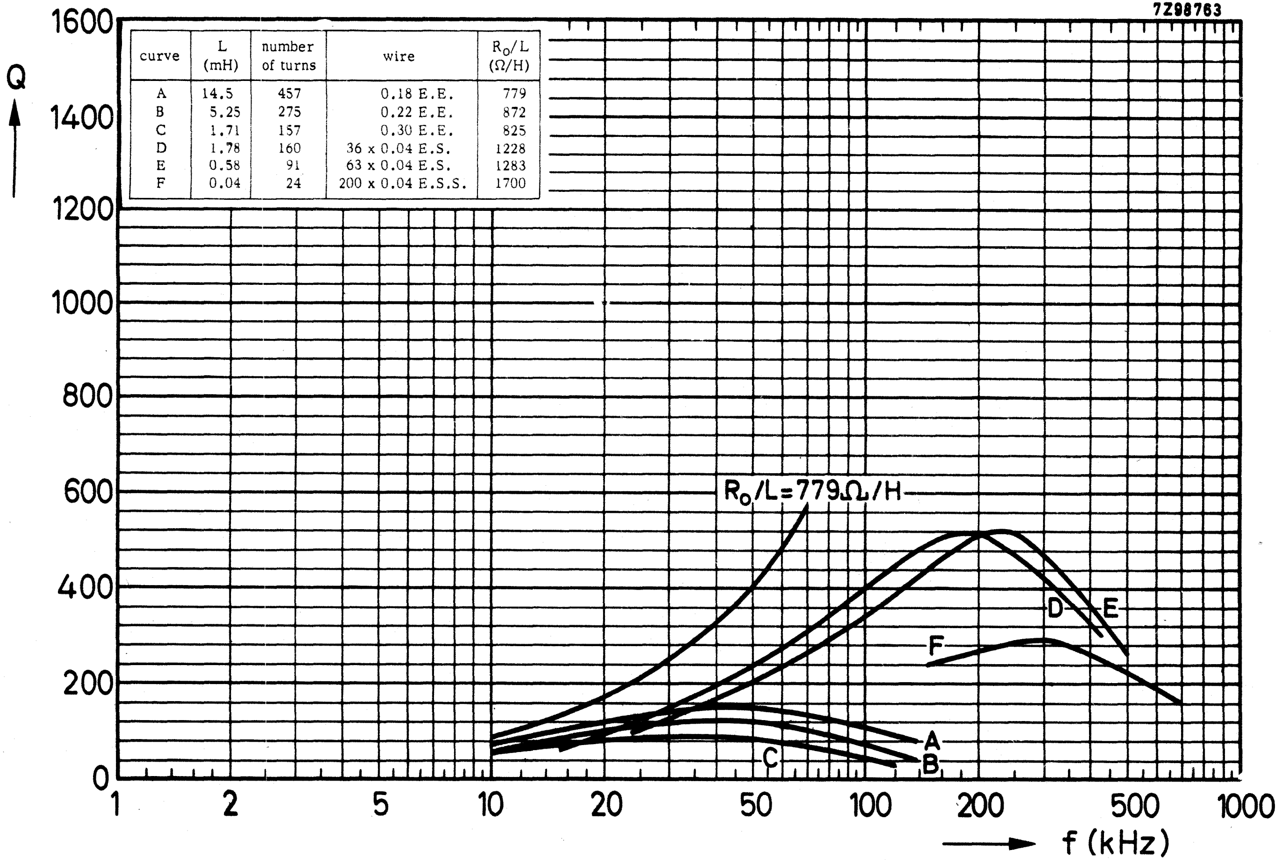


Relative effective permeability and turn factor for 1 mH as a function of the air gap length

TYPICAL Q-CURVES FOR FXC 3B7/3H1



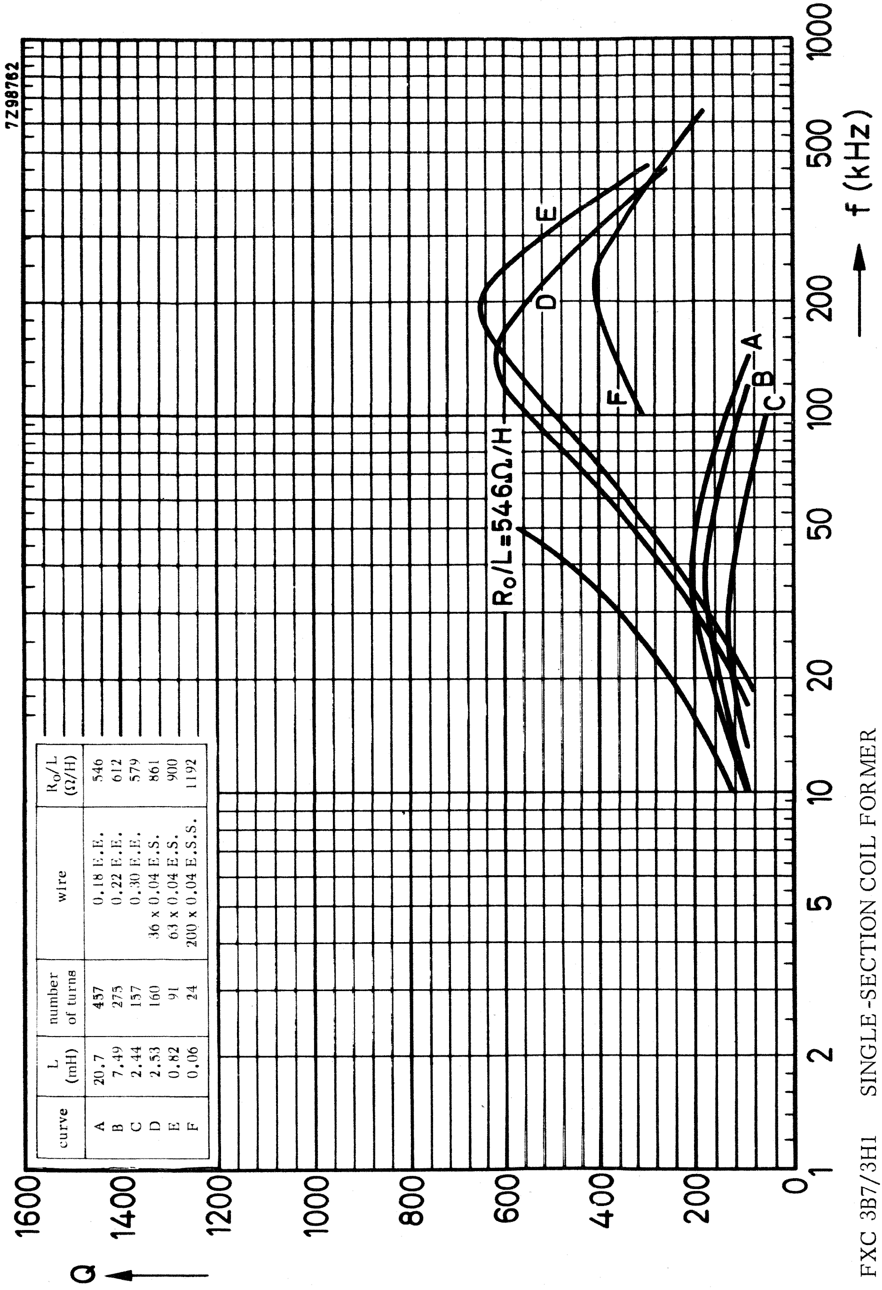
Enveloping curves



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	14.5	457	0.18 E.E.	779
B	5.25	275	0.22 E.E.	872
C	1.71	157	0.30 E.E.	825
D	1.78	160	36 x 0.04 E.S.	1228
E	0.58	91	63 x 0.04 E.S.	1283
F	0.04	24	200 x 0.04 E.S.S.	1700

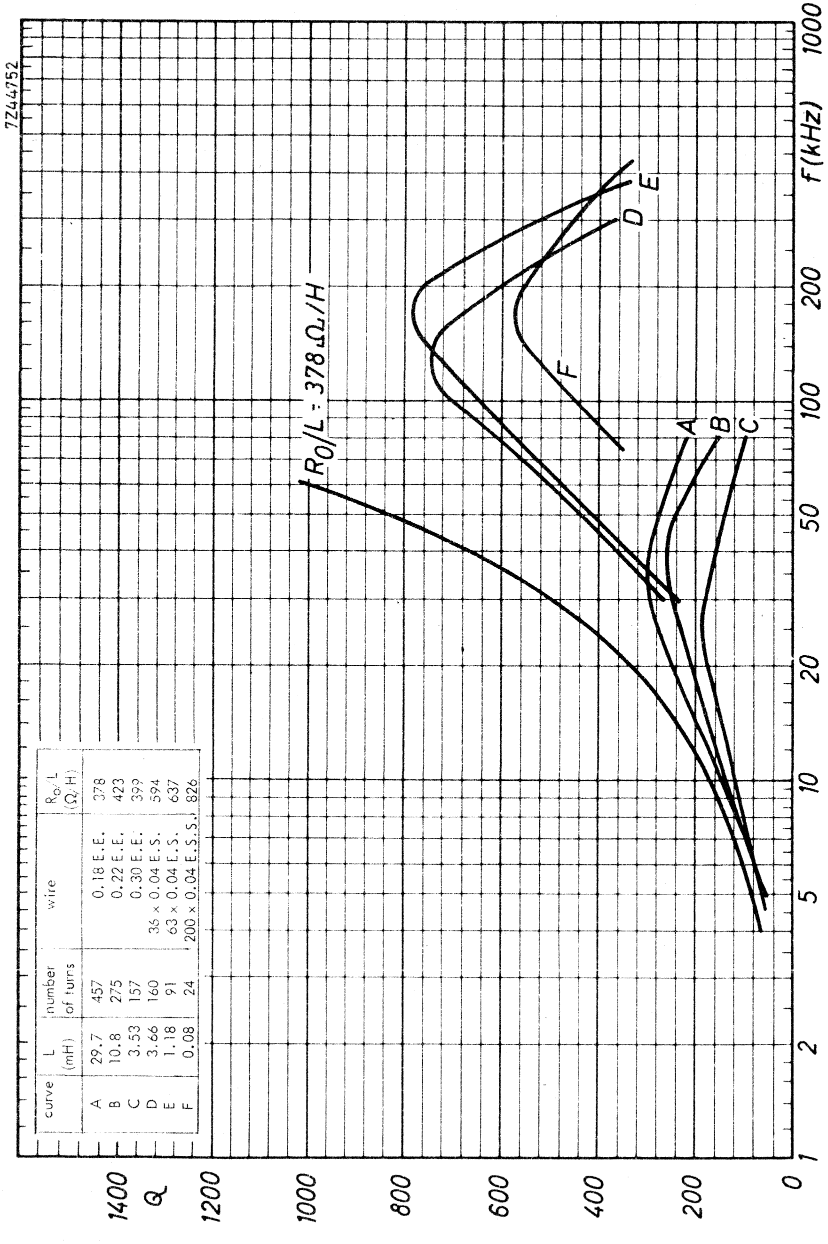
FXC3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	20,7	457	0,18 E.E.	546
B	7,49	275	0,22 E.E.	612
C	2,44	157	0,30 E.E.	579
D	2,53	160	36 x 0,04 E.S.	861
E	0,82	91	63 x 0,04 E.S.	900
F	0,06	24	200 x 0,04 E.S.S.	1192

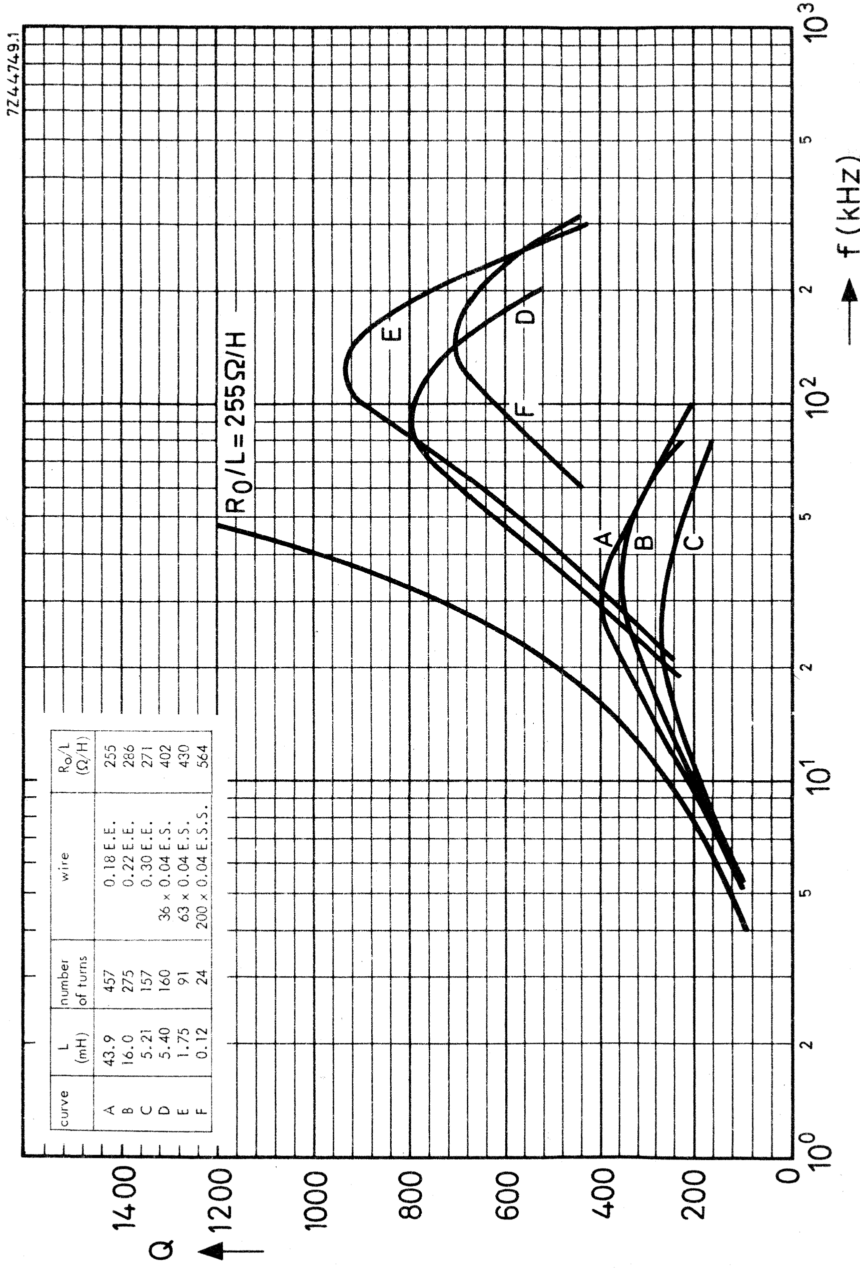
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 47$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	29.7	457	0.18 E.E.	378
B	10.8	275	0.22 E.E.	423
C	3.53	157	0.30 E.E.	399
D	3.66	160	36 × 0.04 E.S.	594
E	1.18	91	63 × 0.04 E.S.	637
F	0.08	24	200 × 0.04 E.S.S.	826

SINGLE-SECTION COIL FORMER

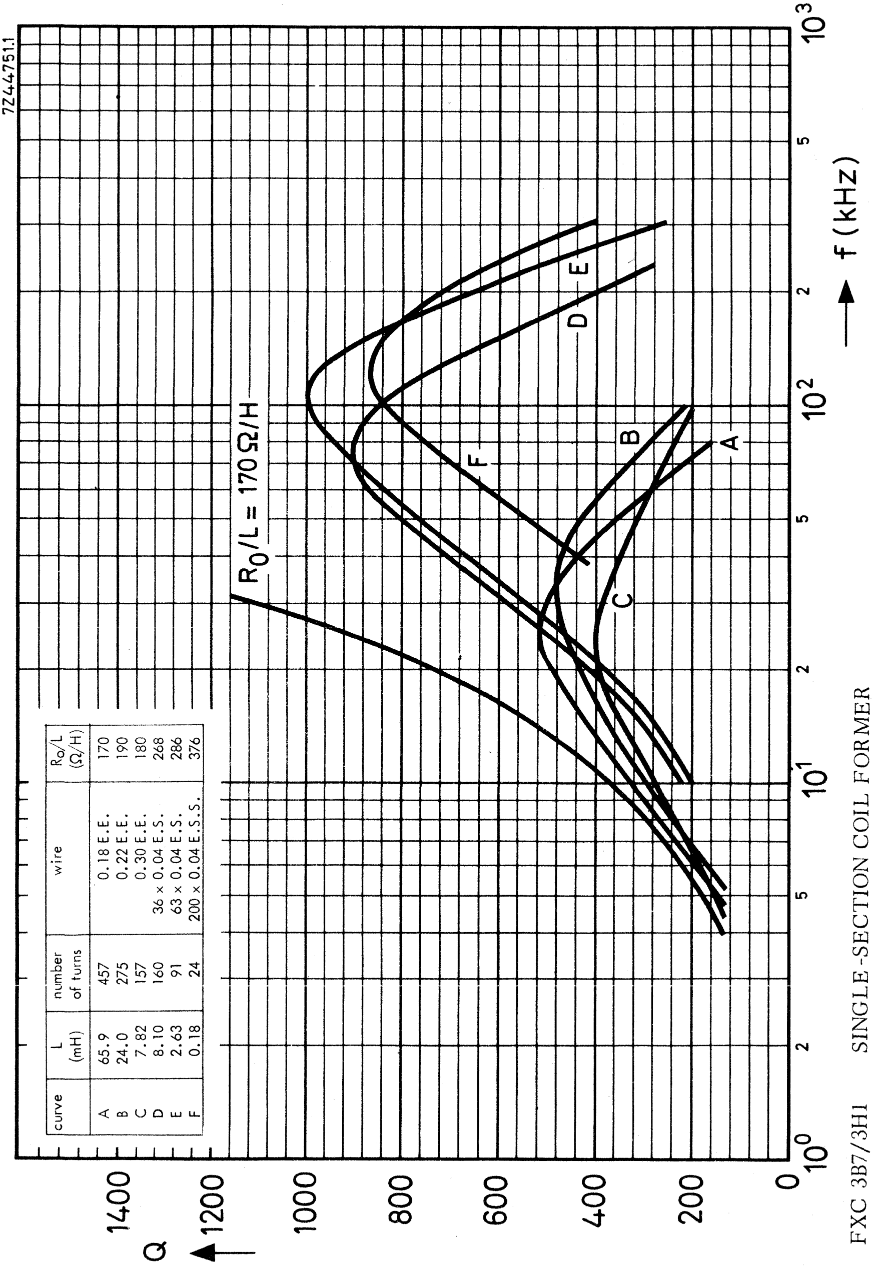
FXC 3B7/3H1
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	43.9	457	0.18 E.E.	255
B	16.0	275	0.22 E.E.	286
C	5.21	157	0.30 E.E.	271
D	5.40	160	36 × 0.04 E.S.	402
E	1.75	91	63 × 0.04 E.S.	430
F	0.12	24	200 × 0.04 E.S.S.	564

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

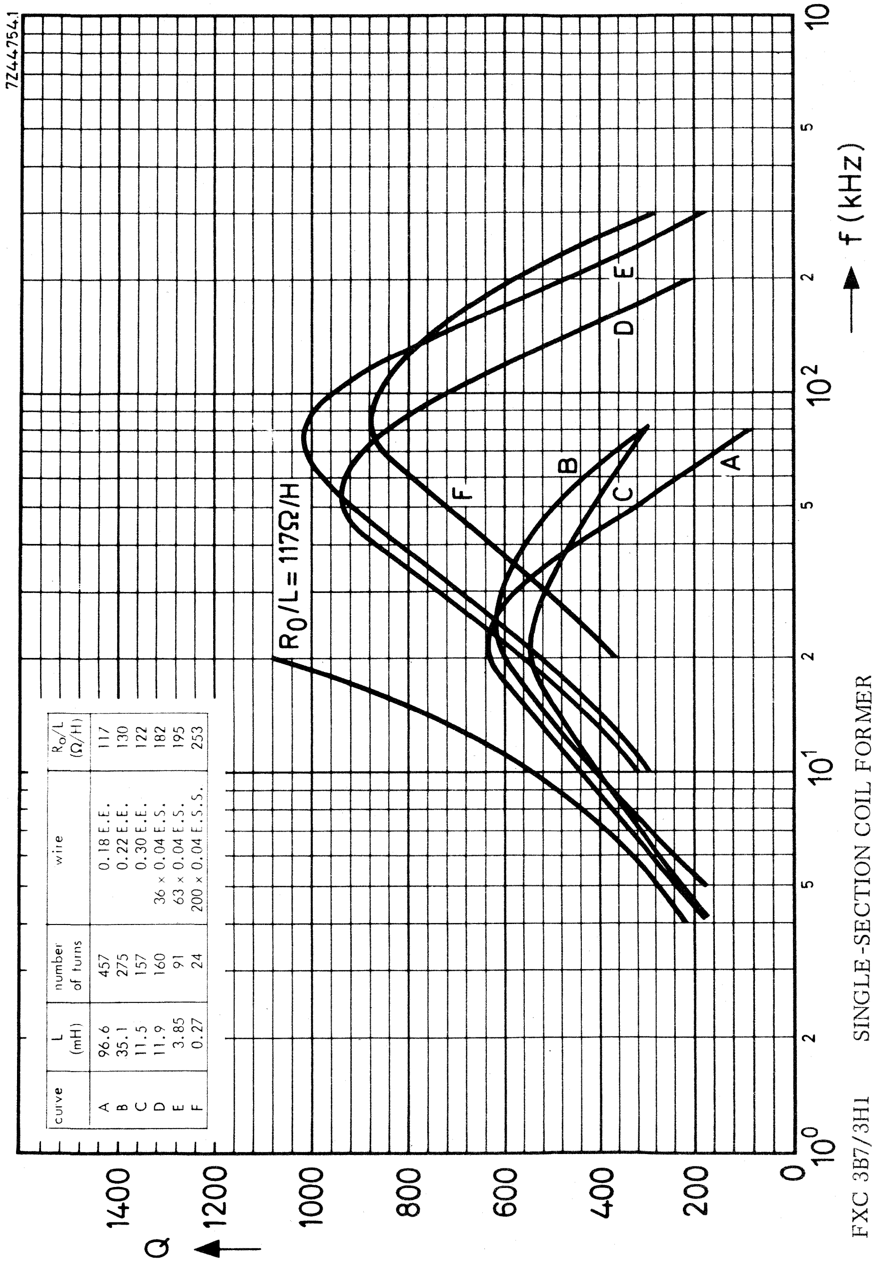
$\mu_e = 100$



curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	65.9	457	0.18 E.E.	170
B	24.0	275	0.22 E.E.	190
C	7.82	157	0.30 E.E.	180
D	8.10	160	36 × 0.04 E.S.	268
E	2.63	91	63 × 0.04 E.S.	286
F	0.18	24	200 × 0.04 E.S.S.	376

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

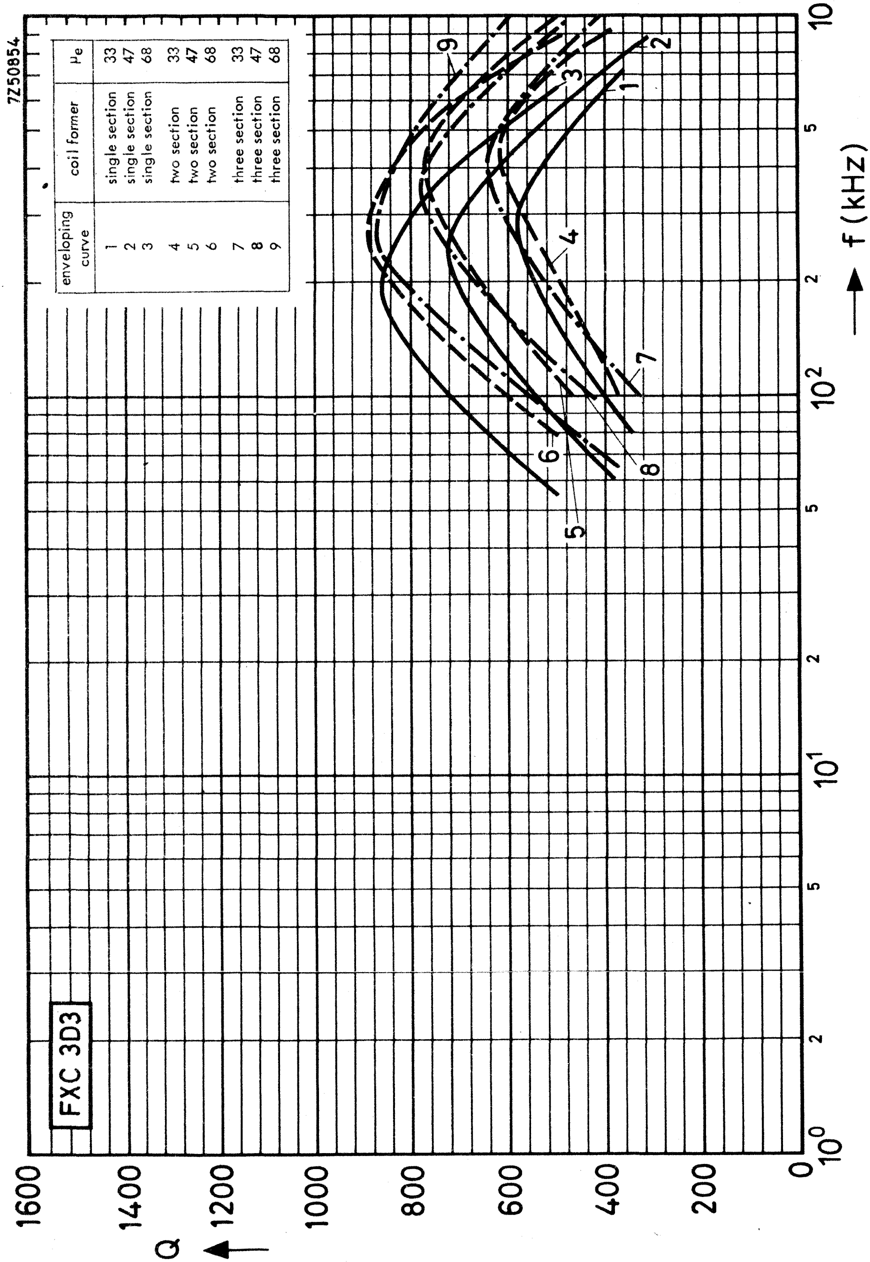
$\mu_e = 150$



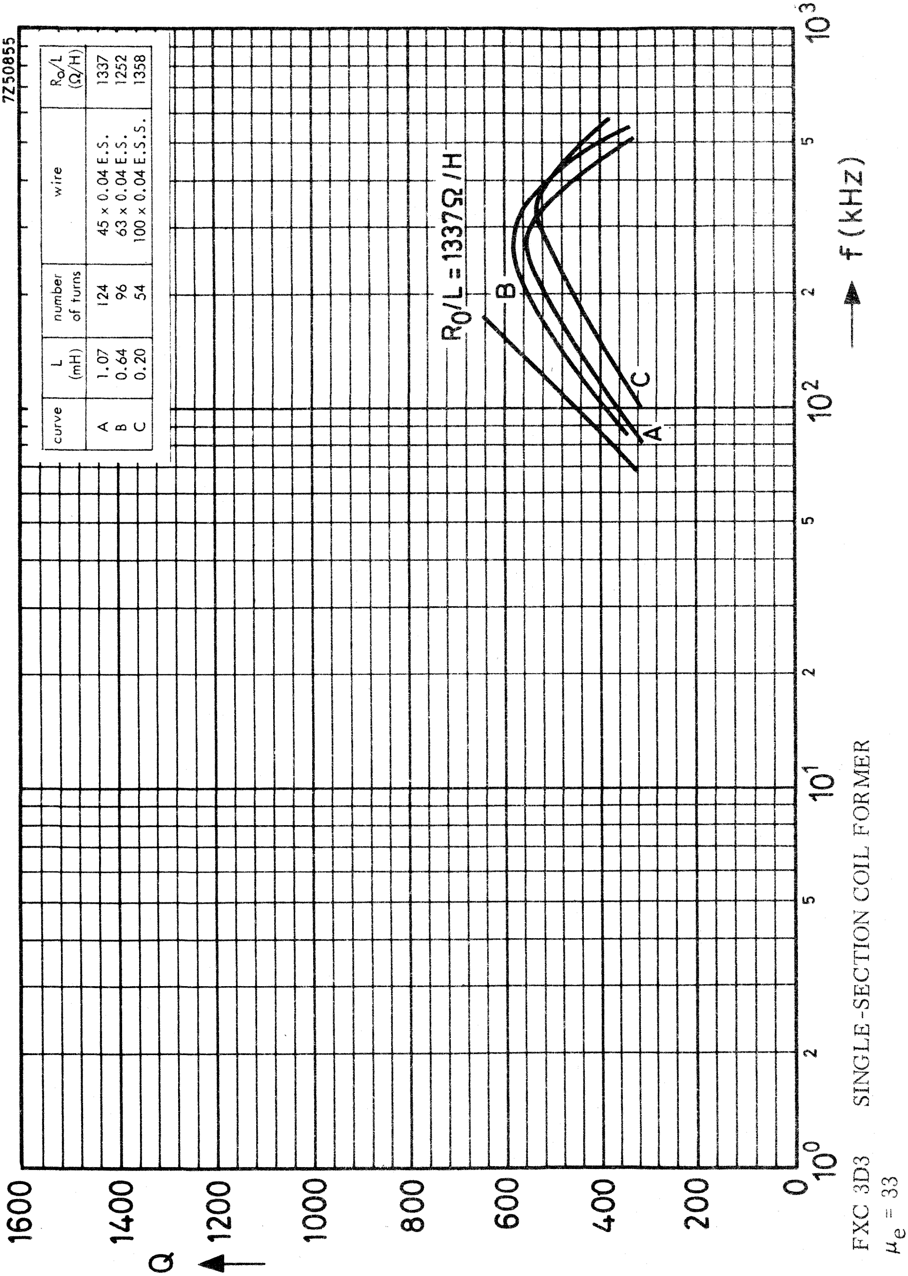
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	96.6	457	0.18 E.E.	117
B	35.1	275	0.22 E.E.	130
C	11.5	157	0.30 E.E.	122
D	11.9	160	36 × 0.04 E.S.	182
E	3.85	91	63 × 0.04 E.S.	195
F	0.27	24	200 × 0.04 E.S.S.	253

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 220$

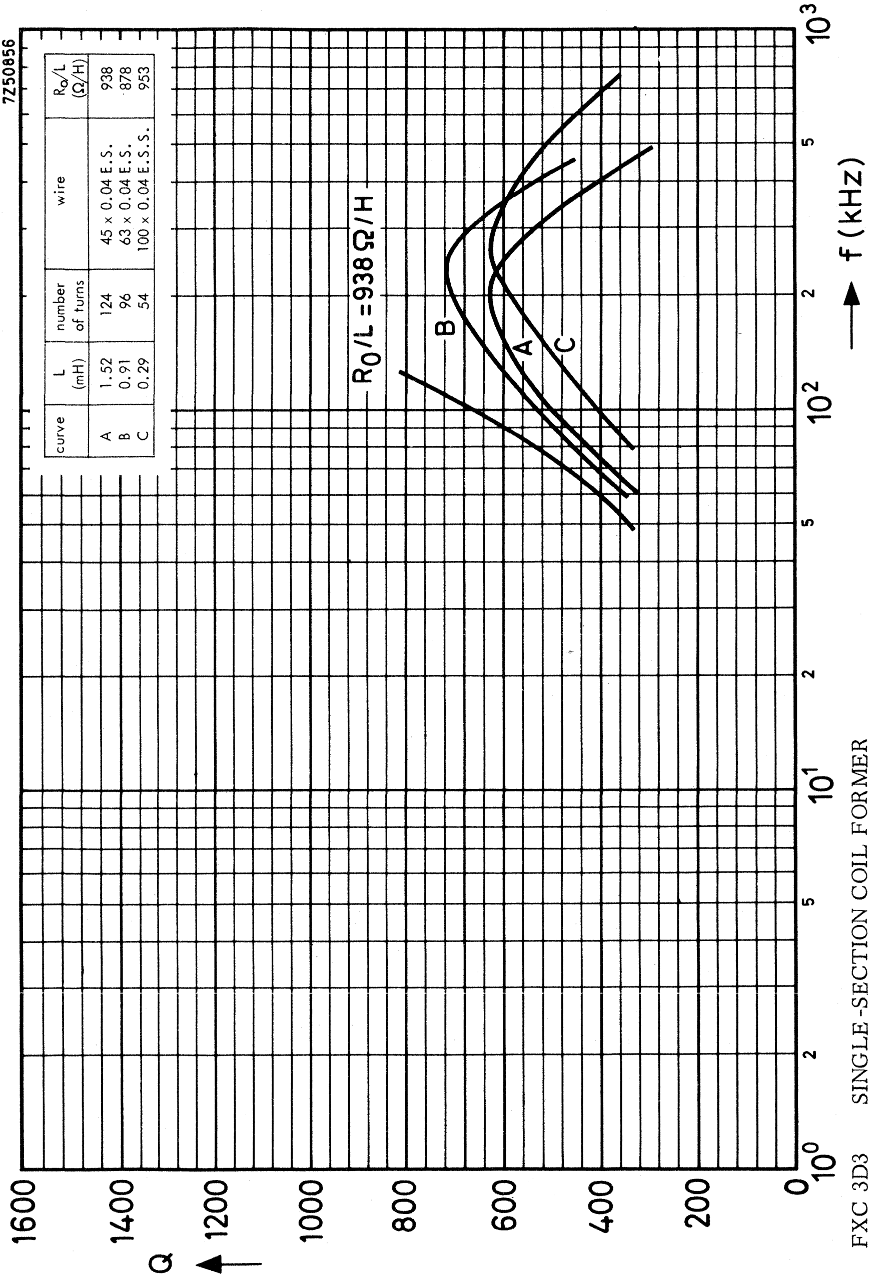
TYPICAL Q-CURVES FOR FXC 3D3



Enveloping curves



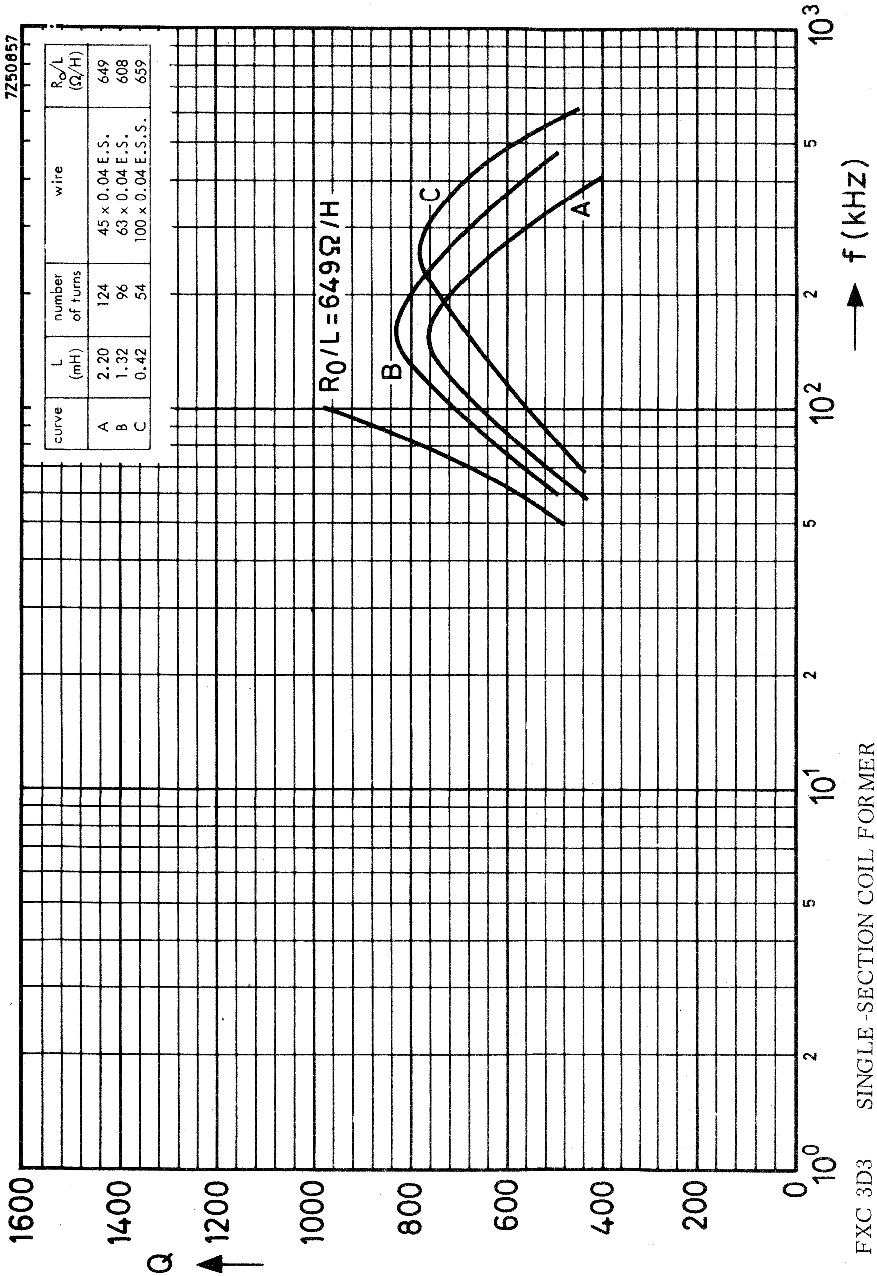
FXC 3D3 SINGLE-SECTION COIL FORMER
$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.52	124	45 x 0.04 E.S.	938
B	0.91	96	63 x 0.04 E.S.	878
C	0.29	54	100 x 0.04 E.S.S.	953

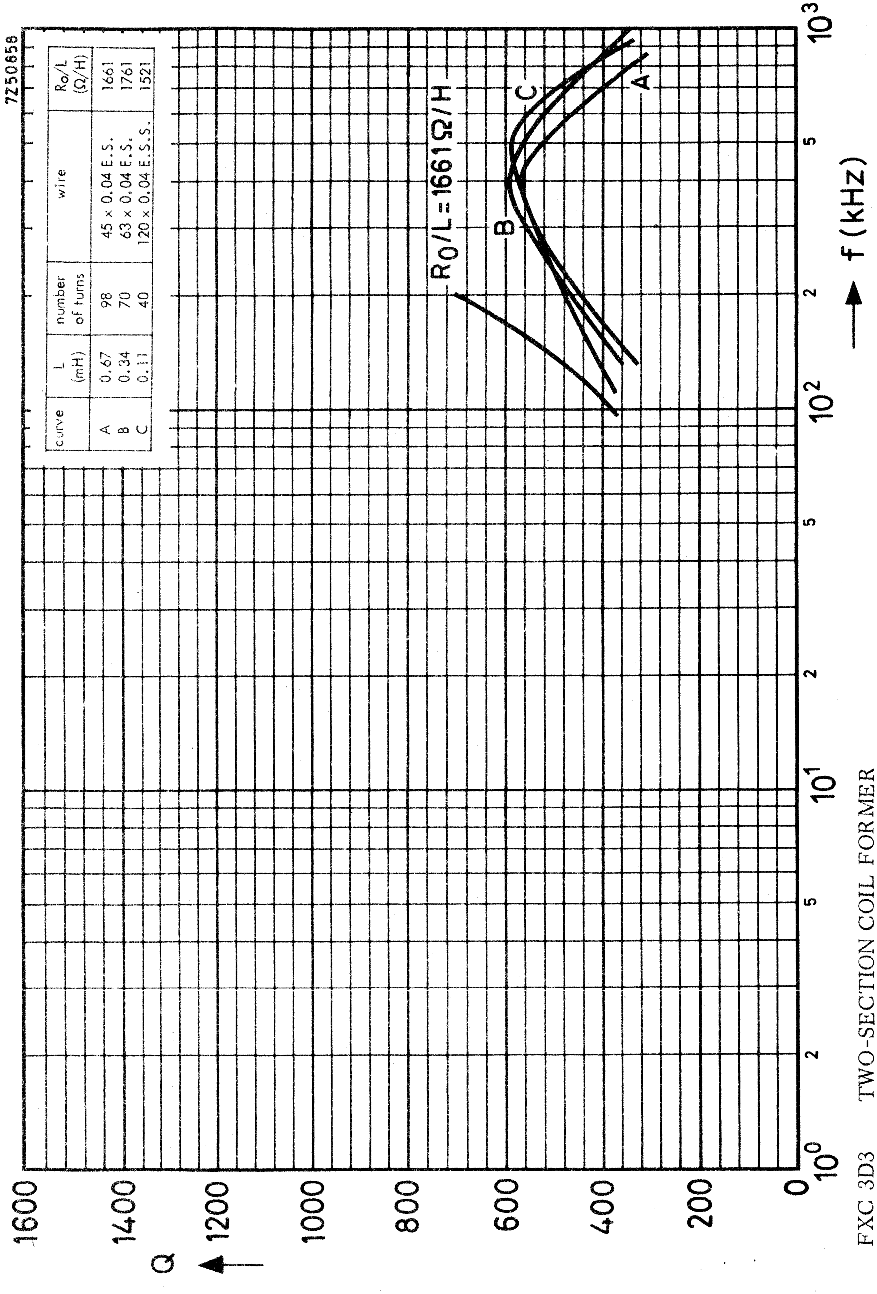
FXC 3D3 SINGLE-SECTION COIL FORMER

$\mu_e = 47$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	2.20	124	45 × 0.04 E.S.	649
B	1.32	96	63 × 0.04 E.S.	608
C	0.42	54	100 × 0.04 E.S.S.	659

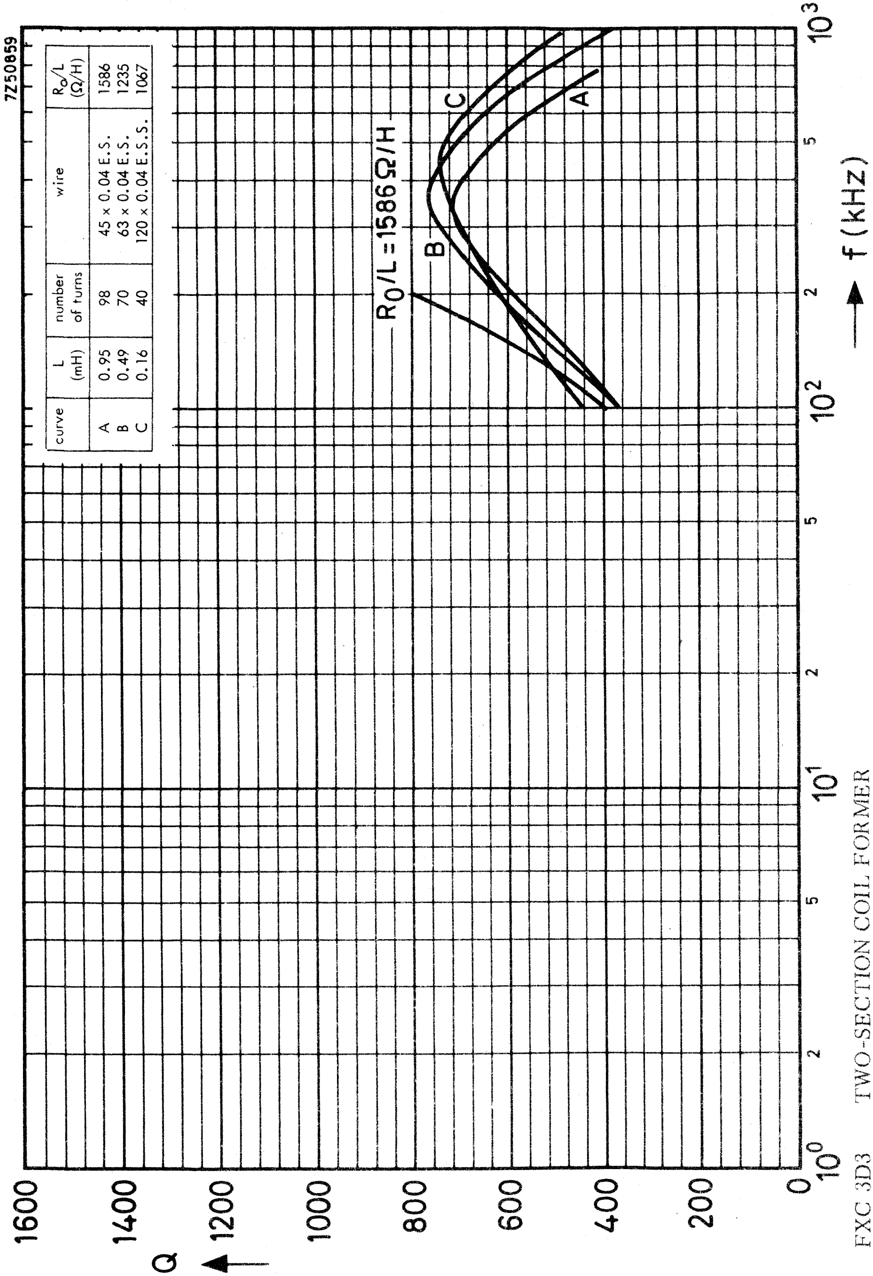
FXC 3D3 SINGLE-SECTION COIL FORMER
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	0.67	98	45 × 0.04 E.S.	1661
B	0.34	70	63 × 0.04 E.S.	1761
C	0.11	40	120 × 0.04 E.S.S.	1521

FXC 3D3 TWO-SECTION COIL FORMER

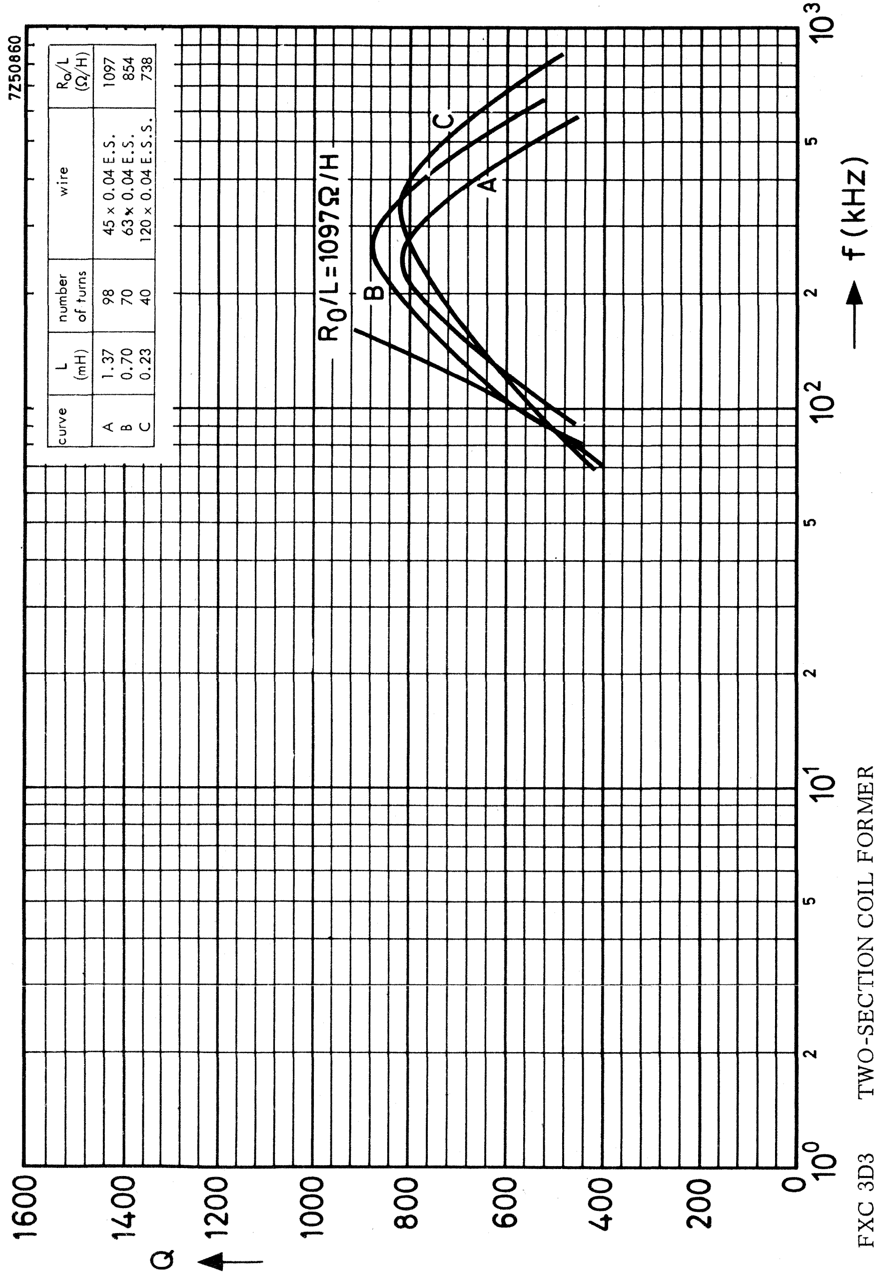
$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	0.95	98	45 × 0.04 E.S.	1586
B	0.49	70	63 × 0.04 E.S.	1235
C	0.16	40	120 × 0.04 E.S.S.	1067

FXC 3D3 TWO-SECTION COIL FORMER

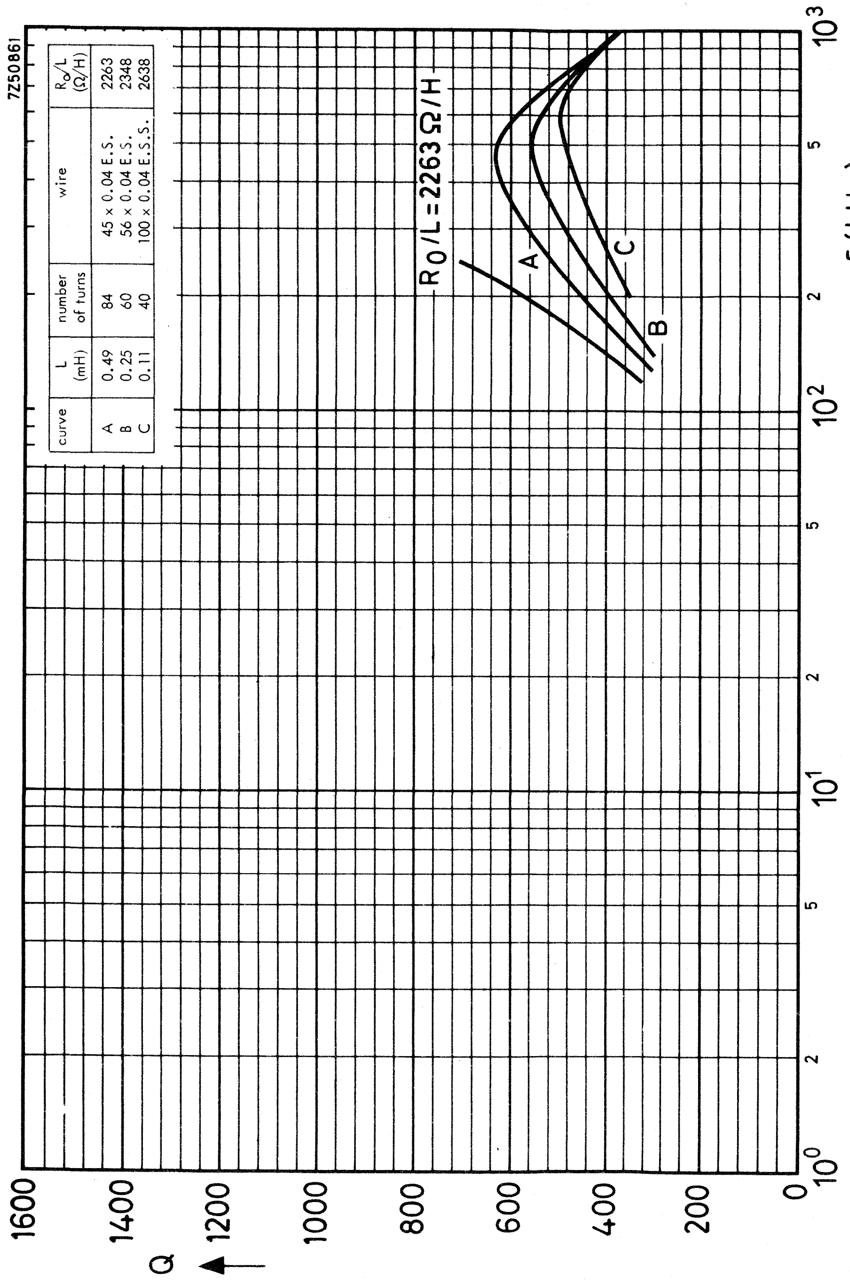
$\mu_e = 47$



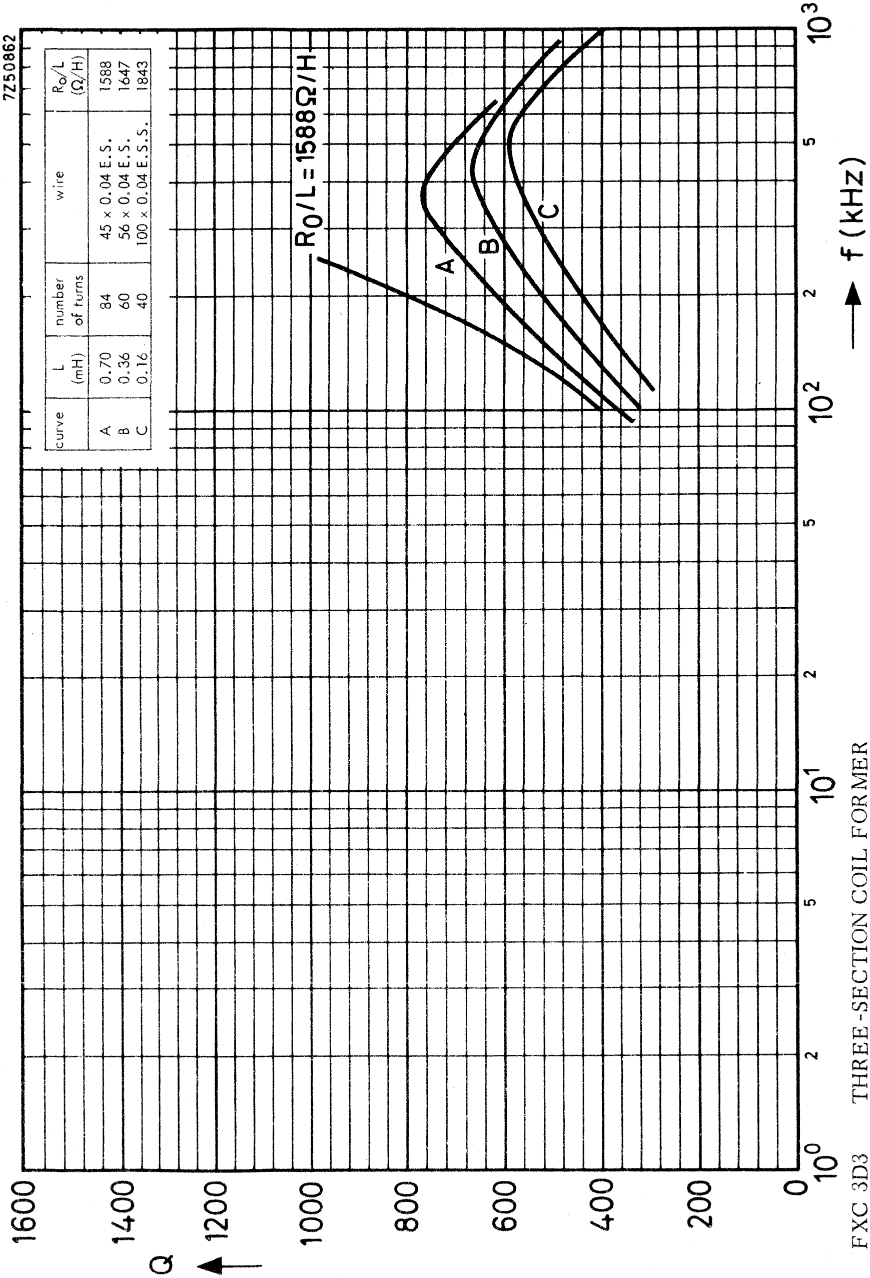
TWO-SECTION COIL FORMER

FXC 3D3

$\mu_e = 68$

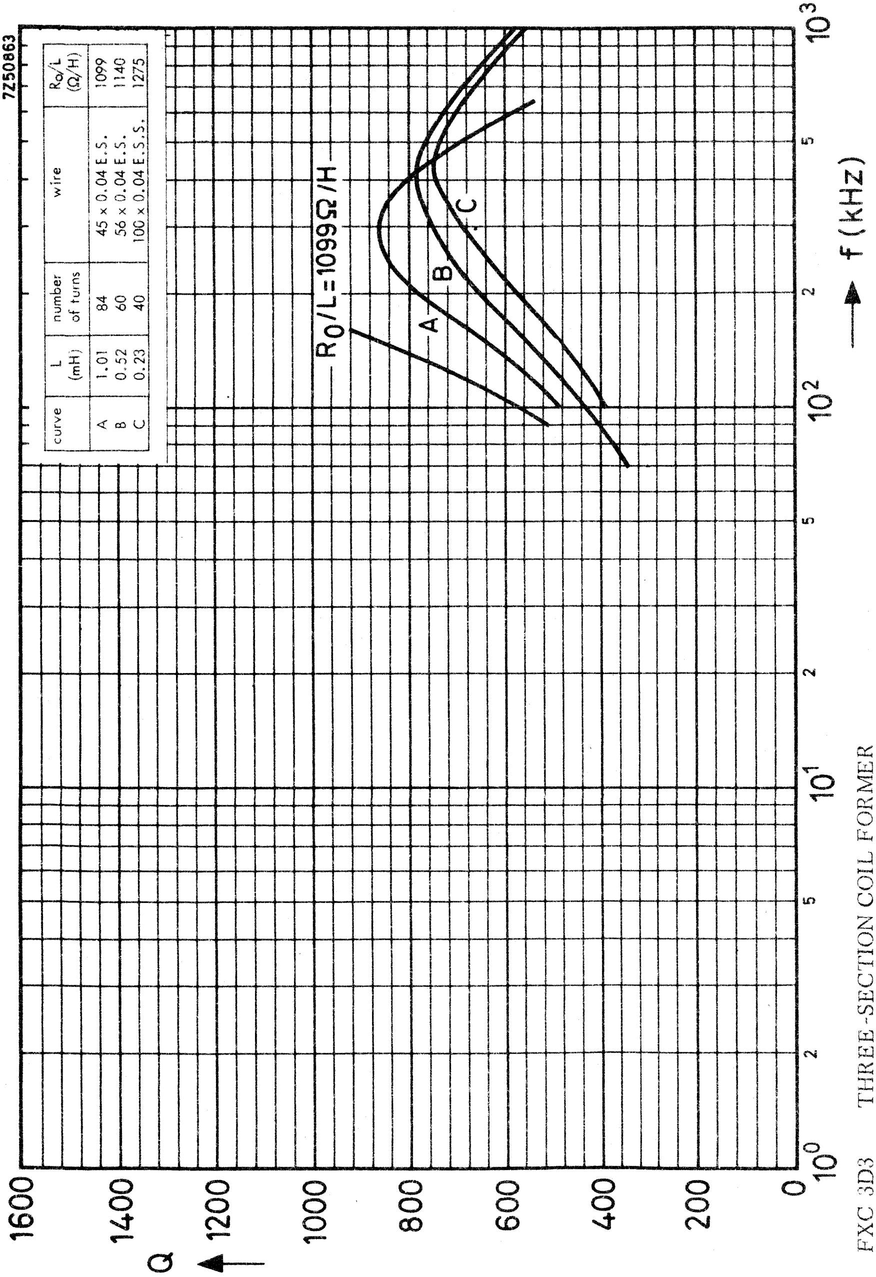


FXC 3D3 THREE-SECTION COIL FORMER
$\mu_e = 33$



THREE-SECTION COIL FORMER

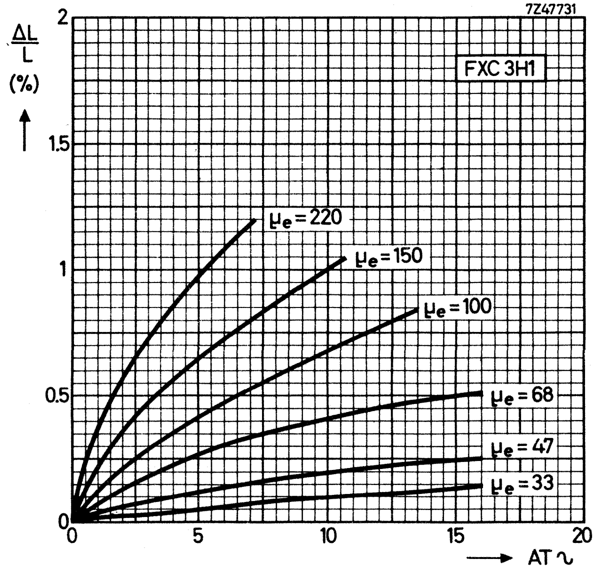
FXC 3D3
$\mu_e = 47$

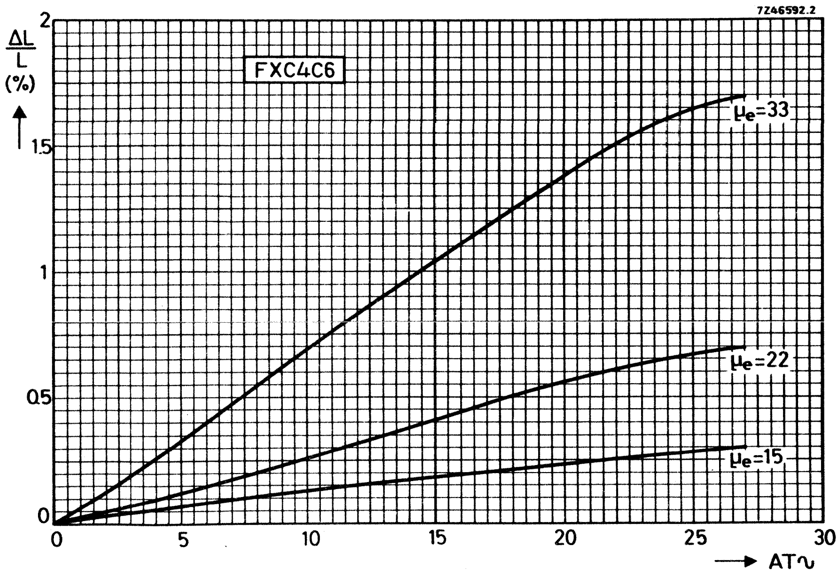


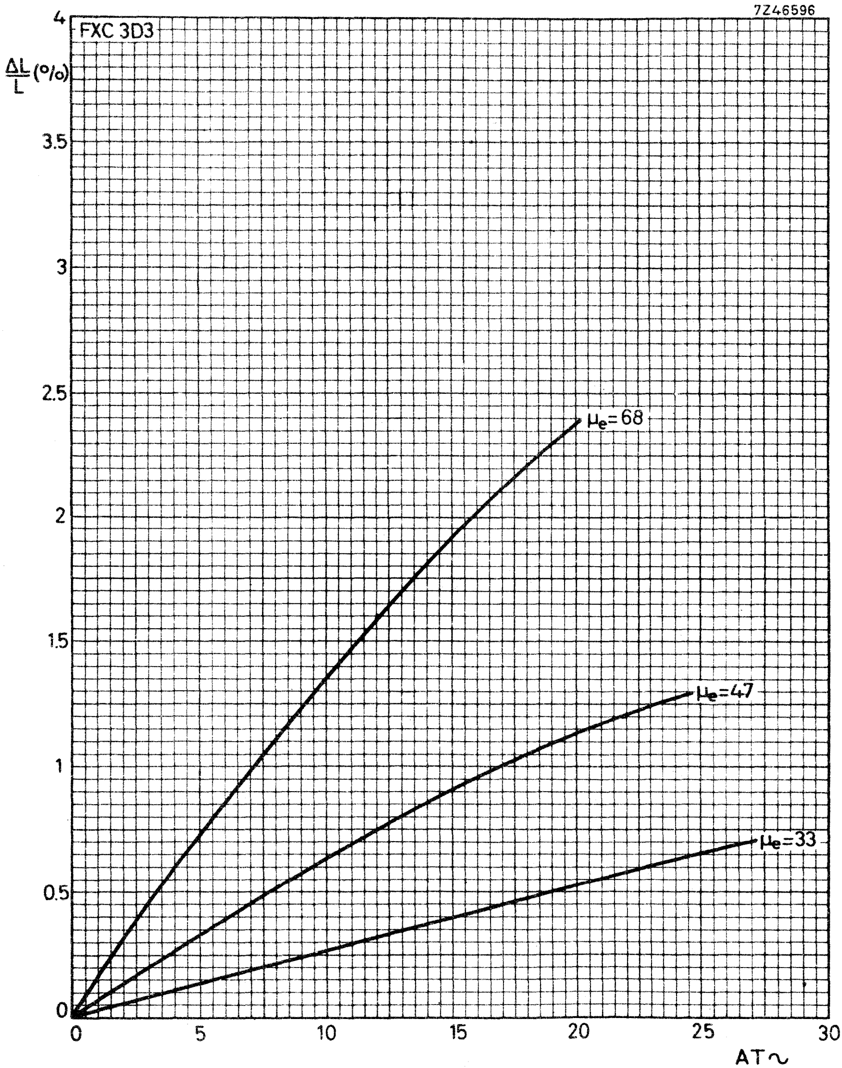
THREE-SECTION COIL FORMER

FXC 3D3
$\mu_e = 68$

INDUCTANCE VARIATION AS A FUNCTION OF AT~

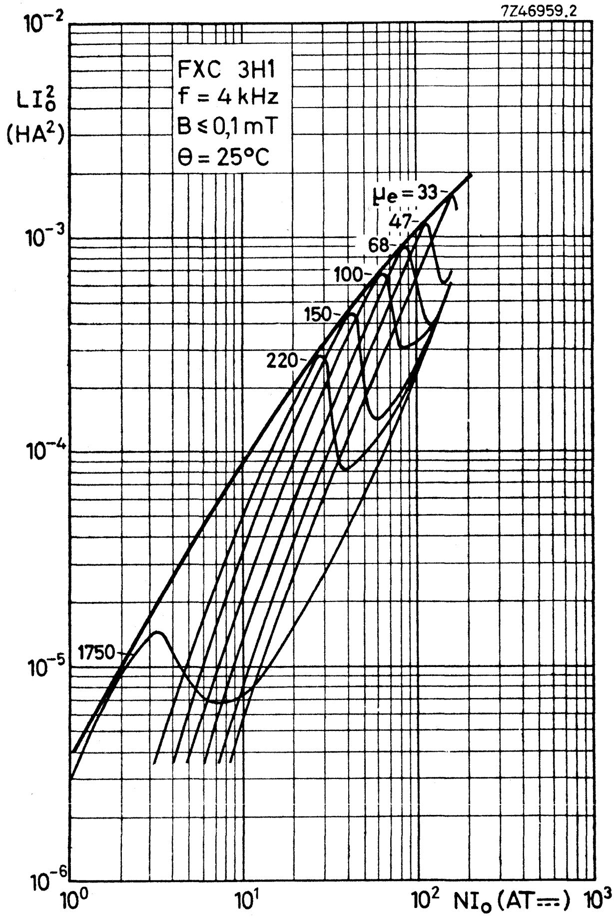


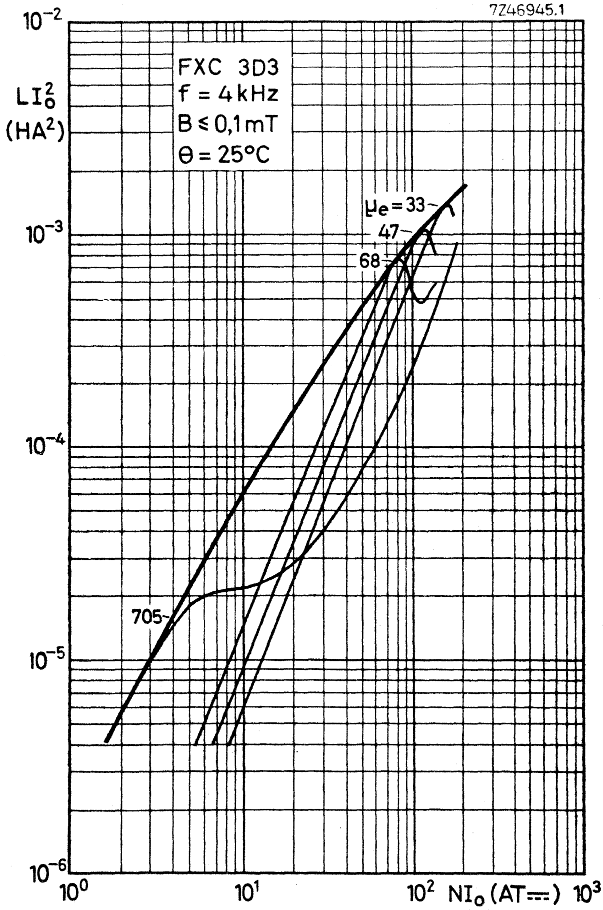



7Z46596
FXC 3D3
ΔL/L (%)
4
3.5
3
2.5
2
1.5
1
0.5
0
μ_e=68
μ_e=47
μ_e=33
0
5
10
15
20
25
30
AT∼

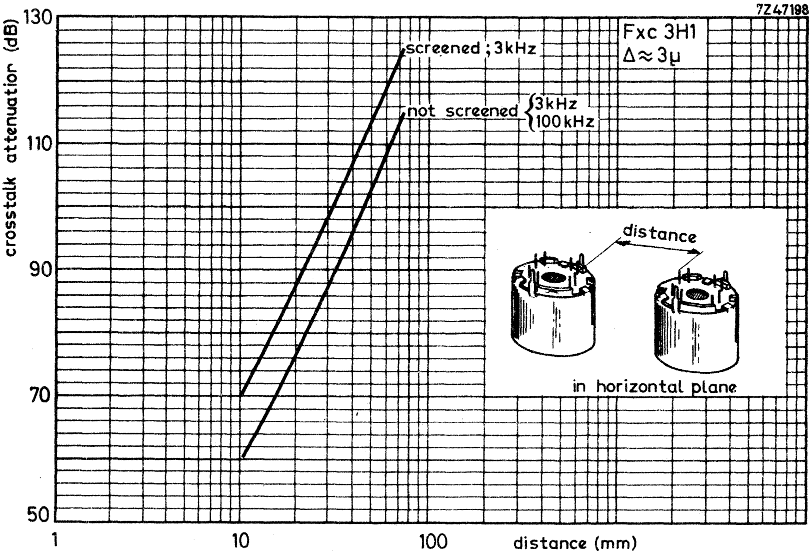
HANNA CURVES (typical values)

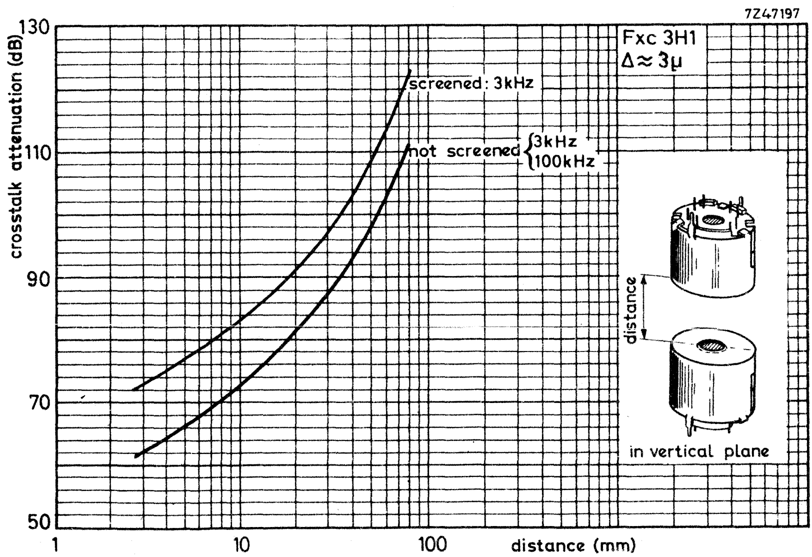
These curves indicate the optimum inductance for a certain μ_e-value and direct current.

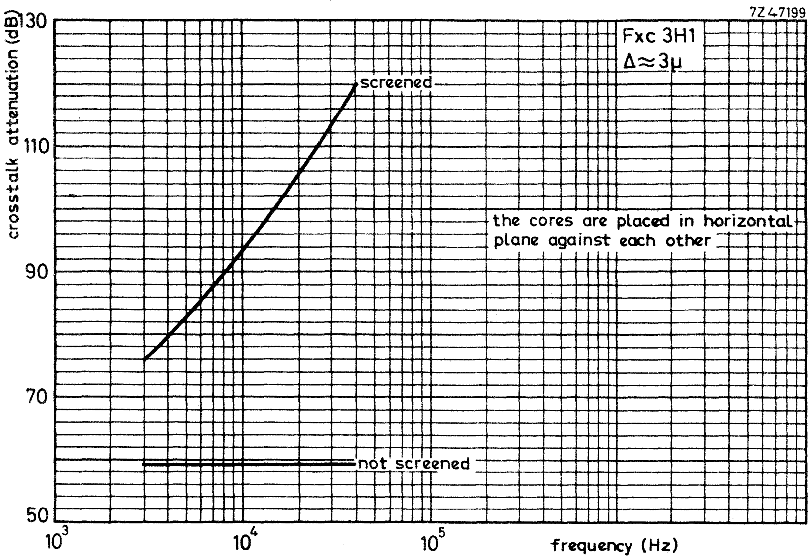



7Z46945.1
FXC 3D3
f = 4 kHz
B ≤ 0,1 mT
Θ = 25°C
LI_o^2 (HA^2)
μ_e = 33
47
68
705
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^0
10^1
10^2
NI_o (AT ⎓)
10^3

CROSSTALK ATTENUATION






7Z47199
Fxc 3H1
Δ≈3μ
screened
not screened
the cores are placed in horizontal plane against each other
crosstalk attenuation (dB)
130
110
90
70
50
10^3
10^4
10^5
frequency (Hz)

POTCORES

Three types of core can be supplied:

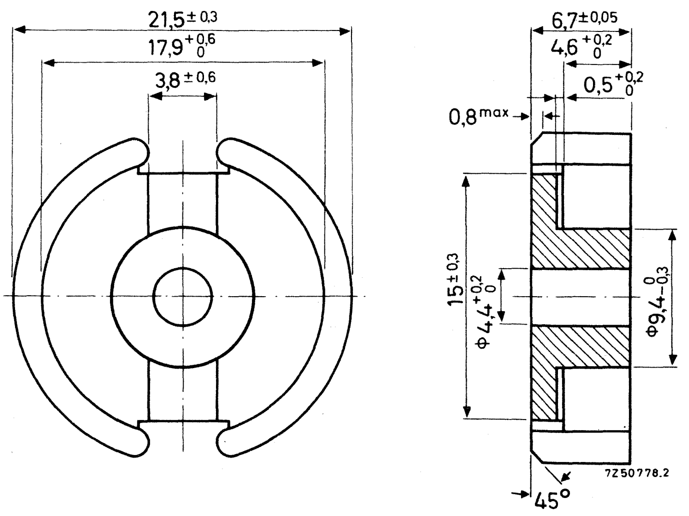
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

The potcores are in accordance with the following specifications:
IEC 133 (international), UTE C93-324 (France), DIN 41 293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number. Quantity: a primary pack contains 40 potcore halves or 20 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores. Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 21750
3D3	4322 020 21770
3E1	4322 020 21850
3H1	4322 020 21760
4C6	4322 020 21830

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I

	temp. (^oC)	grade 3B7	3D3	3E1	3H1	4C6
$\alpha_F \times 10^6$	+5 to +25				+0,5 to +1,5	-2 to +4
	+5 to +55					
	+25 to +55				+0,5 to +1,5	0 to +6
	+25 to +70	-0,6 to +0,6	0 to 2	0 to 2		
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 12		≤ 4,3	≤ 10

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 140 Newton, the values in Table II are guaranteed at 25 ± 10 ^oC.

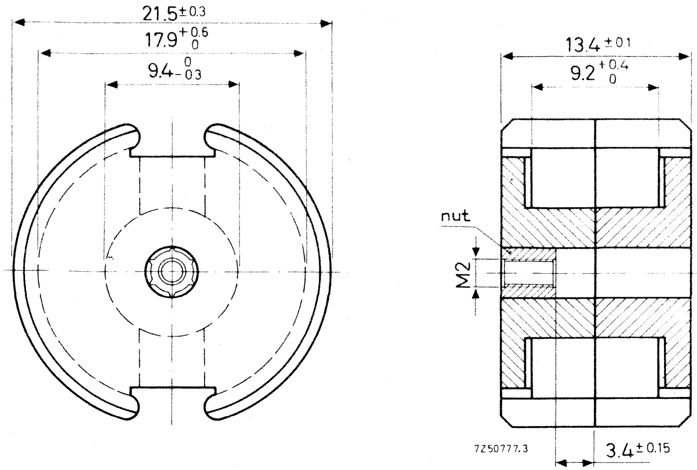
Table II

	$\hat{B}$ (mT)	freq. (MHz)	grade 3B7	3D3	3E1	3H1	4C6
μ_e ± 25%	≤ 0,1	0,004	1840		2950	1840	
→	≤ 0,1	0,1		720			125
A_L ± 25%	≤ 0,1	0,004	4650	1810 *)	7450	4650	320 *)
α	≤ 0,1	0,004	≤ 16,8			≤ 16,8	
	≤ 0,1	0,1		≤ 27,0			≤ 64,7
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	≤ 1,2		≤ 2,5	≤ 1,2	
	≤ 0,1	0,1	≤ 5	≤ 8	≤ 20	≤ 5	
	≤ 0,1	0,5		≤ 14	≤ 200		
	≤ 0,1	1		≤ 30			
		2					≤ 40
		10					≤ 100
$q_{2-24-100}$	1,5-3,0	0,004	≤ 1,8		≤ 3,0	≤ 1,4	
	0,3-1,2	0,1		≤ 3,0			≤ 10
$\eta_B \times 10^3$	1,5-3,0	0,004	≤ 1,1		≤ 1,8	≤ 0,86	
	0,3-1,2	0,1		≤ 1,8			≤ 6,2

*) Measured at 0,1 MHz.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 2....
Without nut, catalogue number = 4322 022 0....

Weight per set			12 g
Mean length of lines of force	l_e	=	31,5 mm
	$\Sigma \frac{l_e}{A_e}$	=	0,497 mm^{-1}
Effective volume	V_e	=	2000 mm^3

Pre-adjusted potcores with standard μ_e values [1])

μ_e	α	tolerance on inductance (%)	catal. No. 4322 022 2.... with nut / 4322 022 0.... without nut			
			3B7	3H1	3D3	4C6
15	162	± 1	–	–	–	6810
22	134	± 1	–	–	–	6820
33	109.4	± 1	–	–	6430	6830
47	91.7	± 1	–	–	6440	–
68	76.2	± 1	6050	6250	6450	–
100	62.8	± 1.5	6060	6260	–	–
150	51.3	± 2	6070	6270	–	–
220	42.4	± 3	6080	6280	–	–
330	34.6	± 3	6090	6290	–	–
720	23.4	± 25	–	–	6400*	–
1840	14.6	± 25	6000*	6200*	–	–

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H)

Symmetric air gap for cores with an μ_e value of 15 up to and including 100
Asymmetric air gap for cores with an μ_e value of 150 up to and including 1840

1) See Notes on the next page.

*) Only available without nut.

Pre-adjusted potcores with standard A_L factors

A_L	corresponding μ_e-value	tolerance on inductance %	cat. no. 4322 022 2.... with nut 4322 022 0.... without nut					
			3B7	3D3	3E4	3H1	3H3	4C6
25	9,9	± 1						7810
40	15,8	± 1		7420				7820
63	25	± 1		7430				7830
100	39,5	± 1	7040	7440		7240		7840
160	63,5	± 1	7050	7450		7250	7550	
250	99	± 1,5	7060	7460		7260	7560	
315	124,5	± 2	7070			7270	7570	
400	158	± 2	7080			7280	7580	
630	249	± 3	7100			7300	7600	
1000	395	± 3	7110			7310		
1250	495	± 3				7390		
2500	990	± 10	7130					
10 000	3955	± 25			7900*			

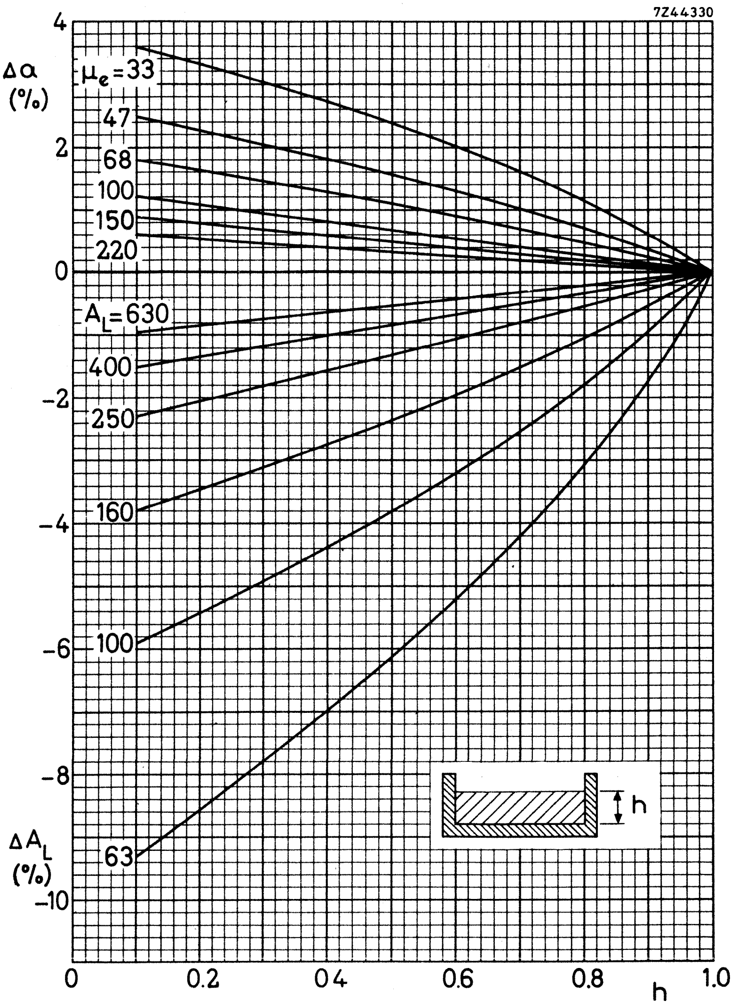
Inductance $L = N^2 A_L$ (L in 10^{-9} H)

Symmetrical air gap for cores with an A_L factor of 25 up to and including 315.
Asymmetrical air gap for cores with an A_L factor of 400 up to and including 1000.

Notes to the tables

1. Examples of catalogue number:
   μ_e = 15, grade 4C6, potcore with nut, catalogue number = 4322 022 26810
   A_L = 100, grade 3B7, potcore without nut, catalogue number = 4322 022 07040
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 720 = A_L of 1810, μ_e of 1840 = A_L of 4650.

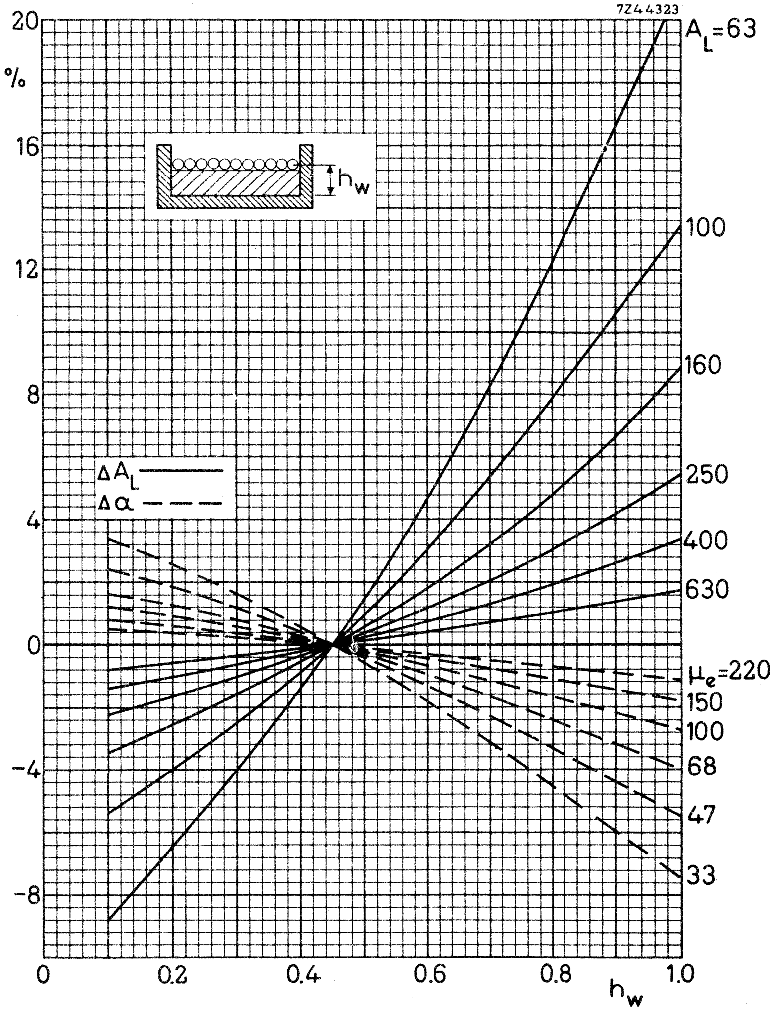
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 68 in that case obtains an α factor of 76.2 + 1.25 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_W on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 76.2 - 1.7 %.

COIL FORMERS

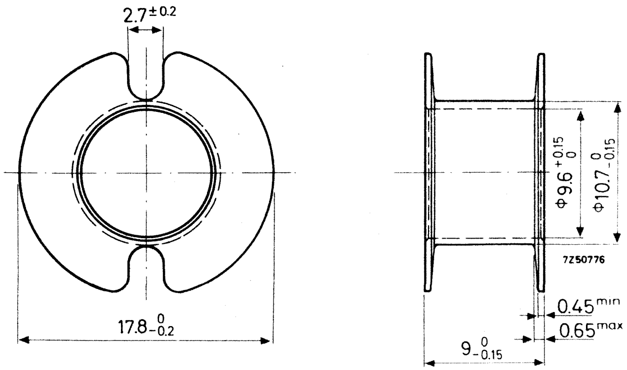
GENERAL

Three types of coil former can be supplied:

- with one section
- with two sections
- with three sections

The dimensions conform with the following specifications : IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS 4061 range 2 (Great Britain). The dimensions in the drawings are in mm.

SINGLE-SECTION COIL FORMER



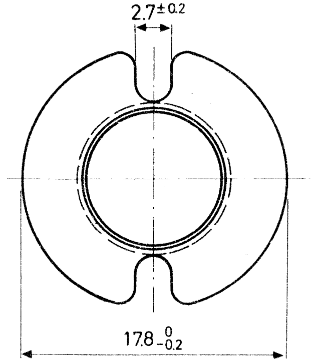
Catalogue number	4322 021 30300
Material	polycarbonate
Window area	28 mm^2
Mean length of turn	44 mm
Max. temperature	130 °C

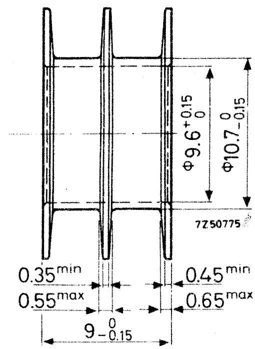
D.C. losses

$$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 11,0 \times 10^3 \ \Omega/H$$

Weight 0, 35 g

TWO-SECTION COIL FORMER





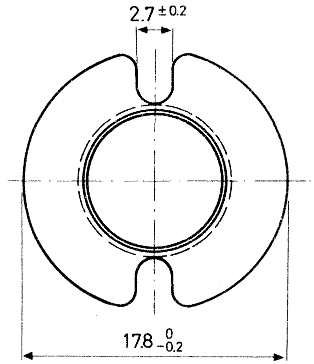
Catalogue number	4322 021 30310
Material	polycarbonate
Window area	2 x 13 mm^2
Mean length of turn	44 mm
Max. temperature	130 ^{o}C

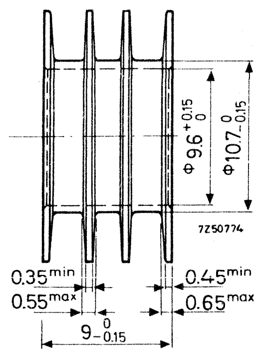
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 11.6 \times 10^3 \ \Omega/H$$

Weight 0.4 g

THREE-SECTION COIL FORMER





Catalogue number	4322 021 30320
Material	polycarbonate
Window area	3 x 8.2 mm^2
Mean length of turn	44 mm
Max. temperature	130 ^{o}C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 12.4 \times 10^3 \ \Omega/H$$

Weight 0.45 g

INDUCTANCE ADJUSTORS

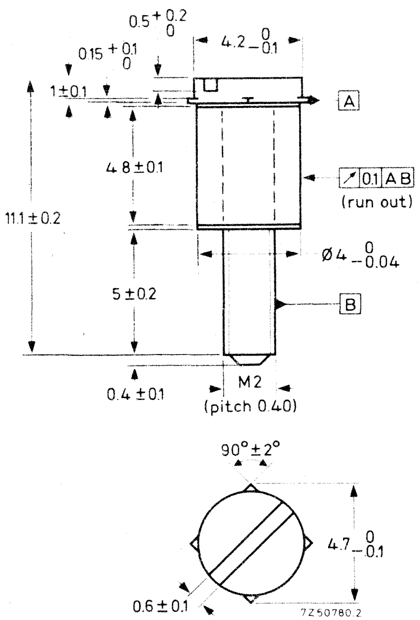


Fig. A

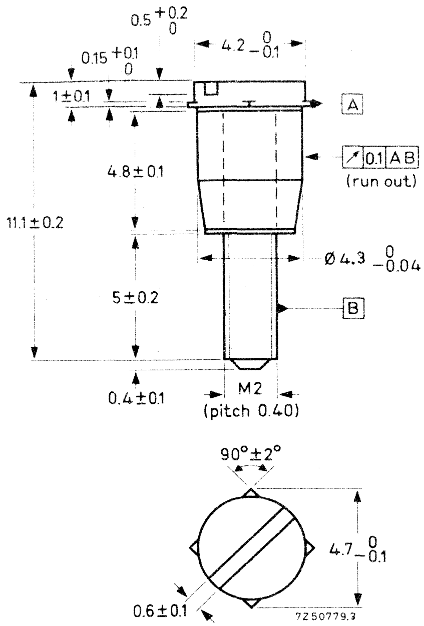


Fig. B

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03 % by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.

Table I, types of adjustor

Fig.	colour	catalogue number
B	yellow	4322 021 31000
B	white	4322 021 31020
B	green	4322 021 31040
B	red	4322 021 31060
A	brown	4322 021 31100
B	black	4322 021 31240

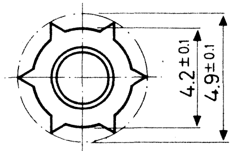
The adjustors are packed in bags of 100, so please order in multiples of 100.

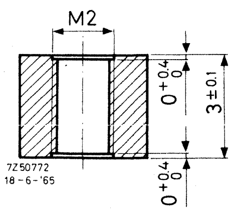
Table II, recommended application

μ_e	A_L	3B7/3H1/3D3	4C6
		catal. No. 4322 021	
	25	–	31060
15		–	31060
	40	–	31060
22		–	31000
	63	31040	31000
33		31040	31020
	100	31060	–
47		31060	–
68		31000	–
	160	31000	–
	250	31020	–
100		31020	–
	315	31020	–
150		31100	–
	400	31100	–
220		31100	–
	630	31100	–
330		31240	–

NUT FOR ADJUSTOR

These data are given for those manufacturers who prefer to insert the nut themselves.



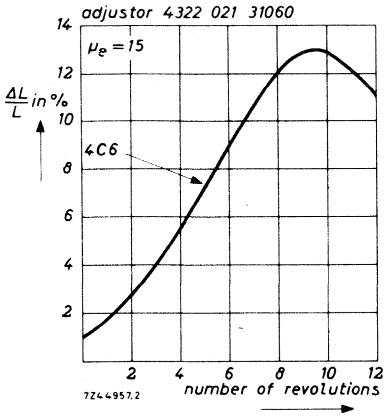


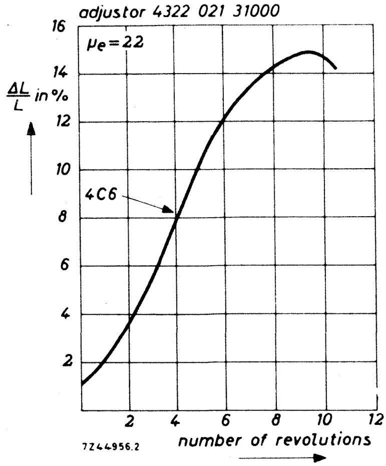
Catalogue number	4322 021 30150
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut	3,4 ± 0,15 mm

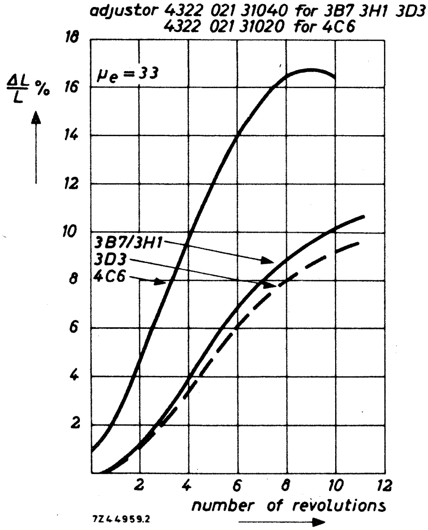
For more information see Potcores General, Inductance adjustment.

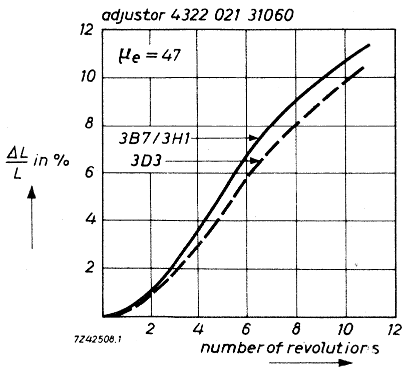
The nuts are packed in bags of 100, so please order in multiples of 100.

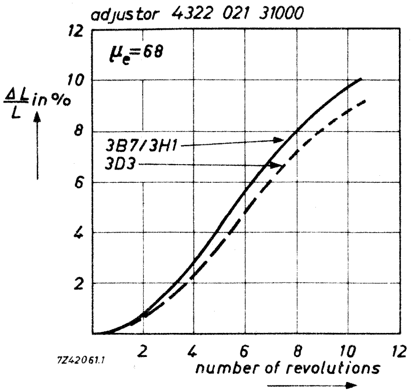
ADJUSTMENT CURVES

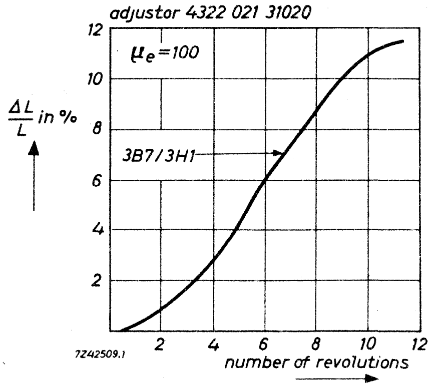


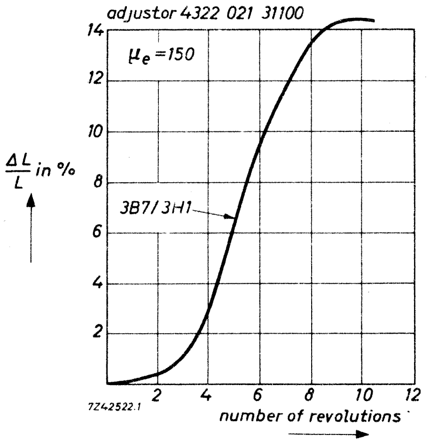


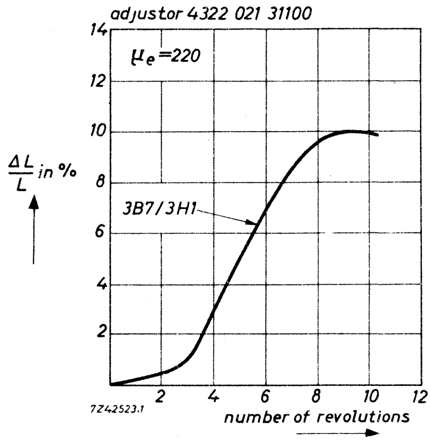


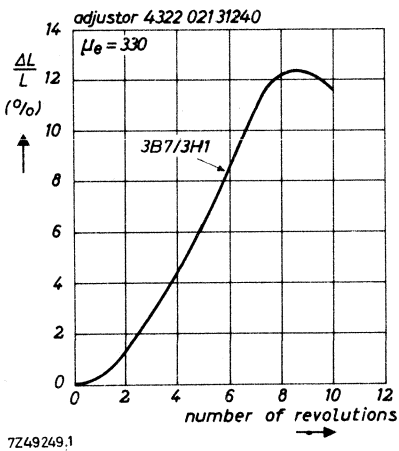



adjustor 4322 021 31000
μe=68
ΔL/L in %
3B7/3H1
3D3
number of revolutions
7Z42061.1


adjustor 4322 021 31020
μe=100
ΔL/L in %
3B7/3H1
number of revolutions
7Z42509.1

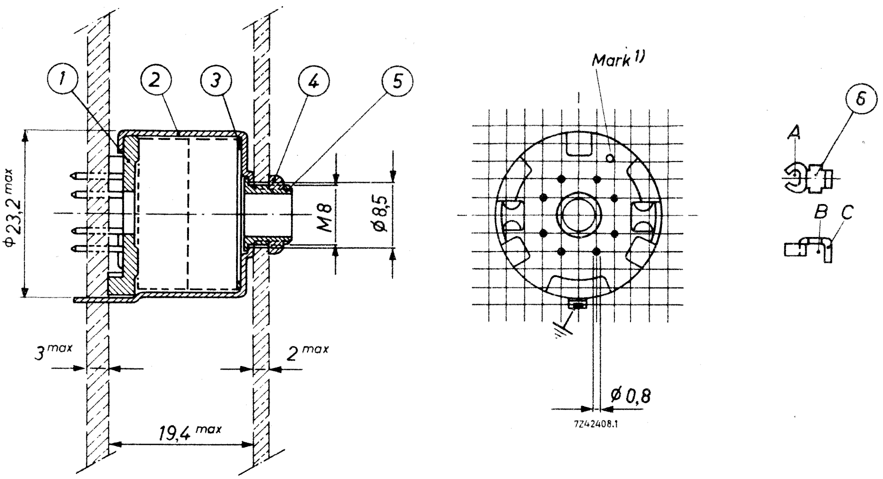

adjustor 4322 021 31100
μe=150
ΔL/L in %
3B7/3H1
number of revolutions
7Z42522.1


adjustor 4322 021 31100
μe=220
ΔL/L in %
3B7/3H1
number of revolutions
7Z42523.1


adjustor 4322 021 31240
μe = 330
ΔL/L (%)
3B7/3H1
number of revolutions
7Z49249.1

MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30460	(4) nut	4322 021 30710
(2) brass container	4322 021 30540	(5) fixing bush	4322 021 30720
(3) spring	4322 021 30650	(6) soldering spring	4322 021 30700 (8x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

The eight soldering pins are arranged to fit printed-wiring boards with a grid of 2,54 mm (0,1 inch).

The pin length is sufficient for a board thickness up to 3 mm. The board should be provided with holes of 1,3 + 0,1 mm diameter.

1) There is another mark hole in a similar position on the top of the container.

If one-hole mounting is preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8,5 mm diameter.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 140 Newton. After bending the lips the spring will have the correct tension.

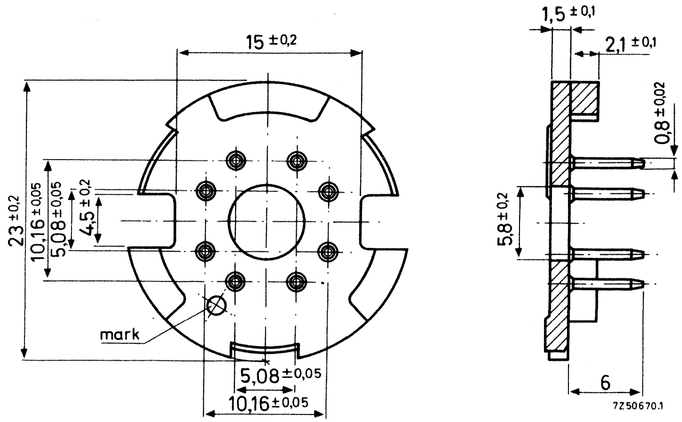
PART DRAWINGS

Dimensions in mm

(1) Tag plate 4322 021 30460

→ Plate: polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s.

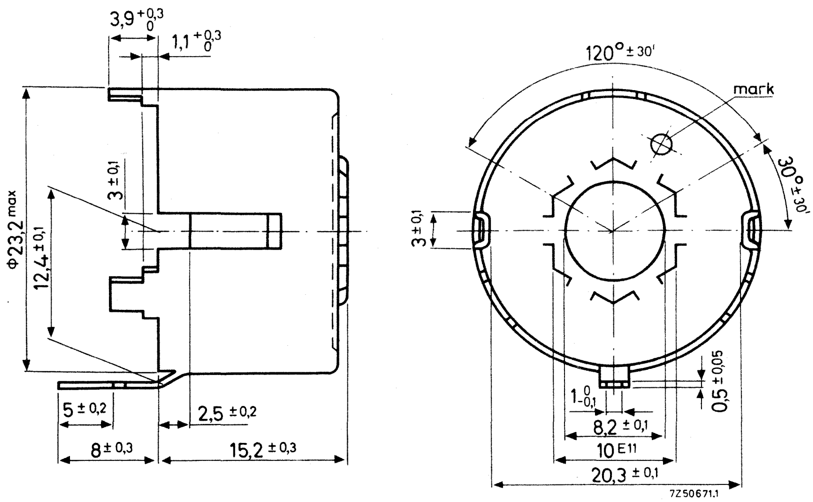
Pins : phosphor bronze, dip-soldered



→ The tag plates are packed in units of 65 pieces on a polystyrene plate. 450 pieces are packed in a cardboard box. Please order in multiples of these quantities.

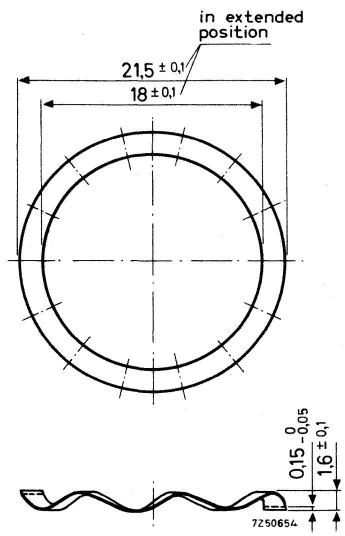
(2) Container 4322 021 30540

Material: brass, nickel plated; tinned soldering pin



(3) Spring 4322 021 30650

Material: chrome-nickel steel

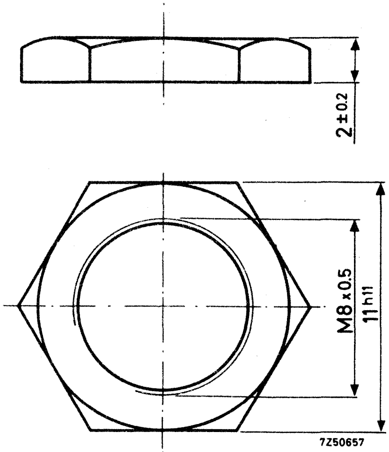


A force of 94 to 156 N is required to compress the spring to 0, 45 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

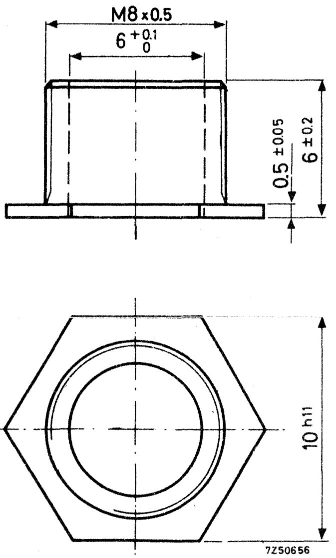
(4) Nut 4322 021 30710

Material: brass, nickel plated



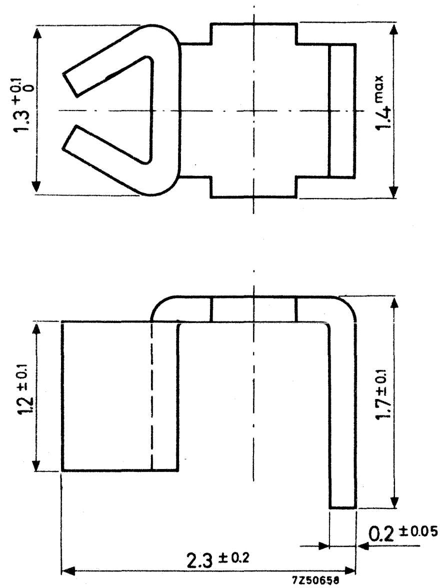
(5) Fixing bush 4322 021 30720

Material: brass, nickel plated



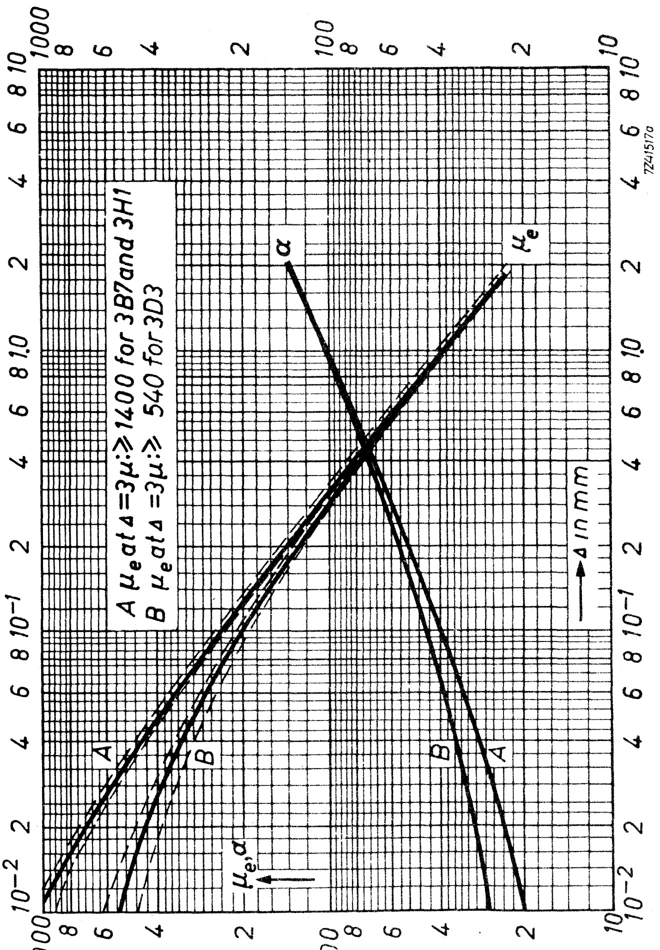
(6) Soldering spring 4322 021 30700

Material: brass, dipsoldered



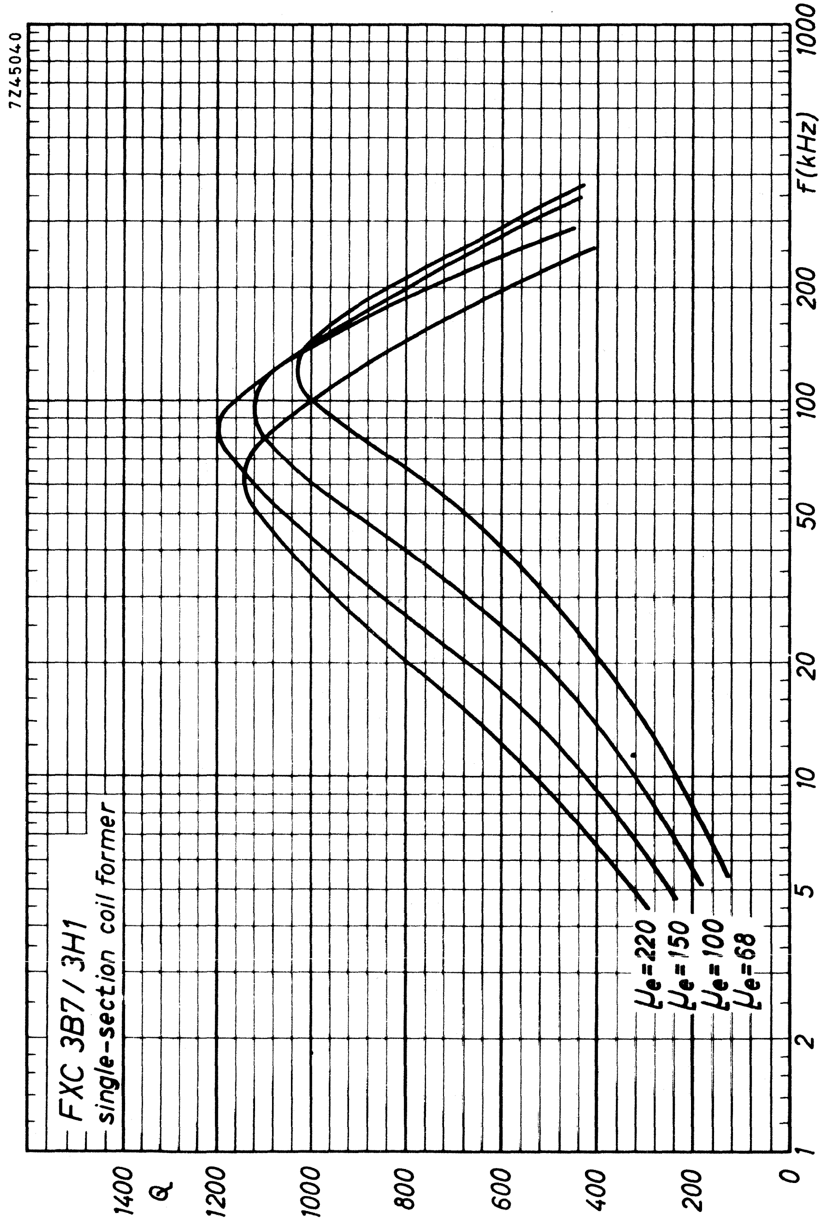
CHARACTERISTIC CURVES

μ_e - α curves

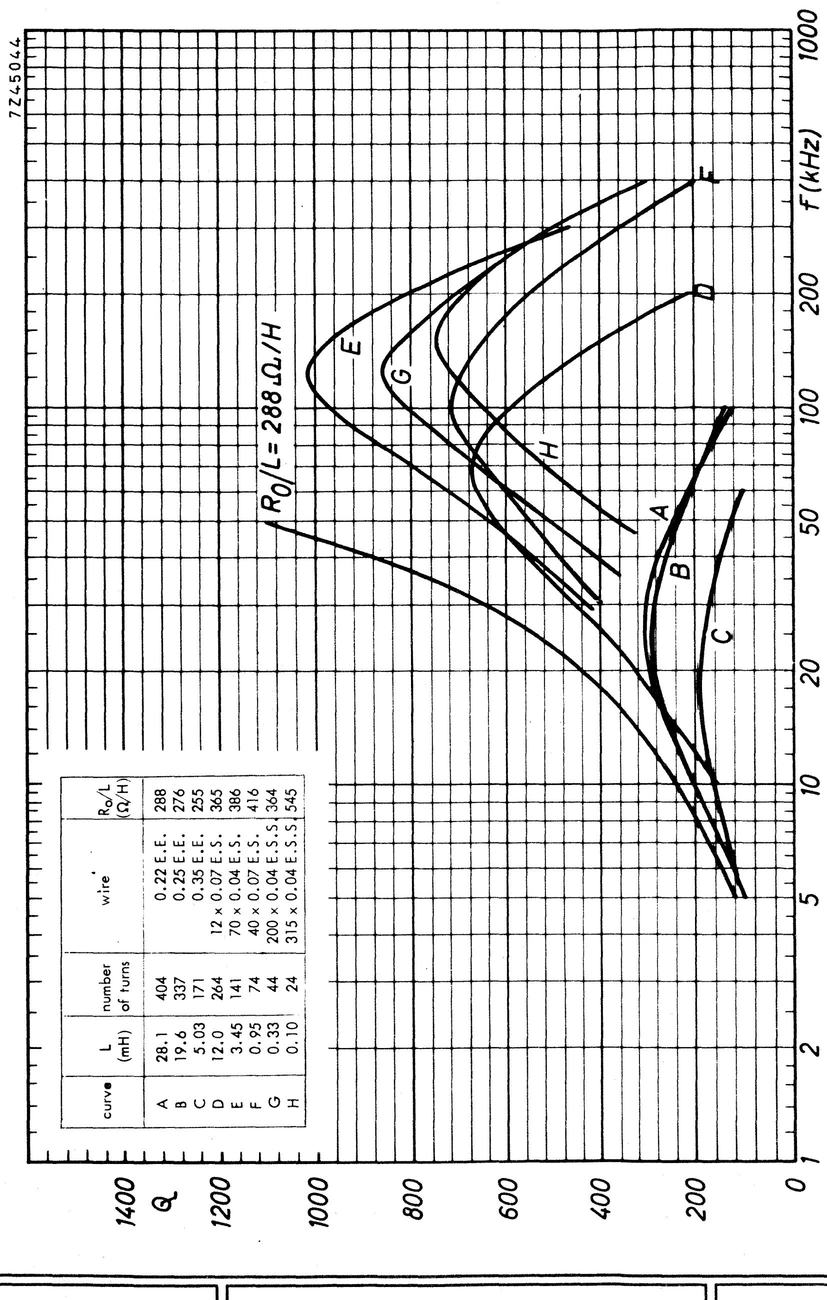


Relative effective permeability and turn factor for 1 mH as a function of the air gap length

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1



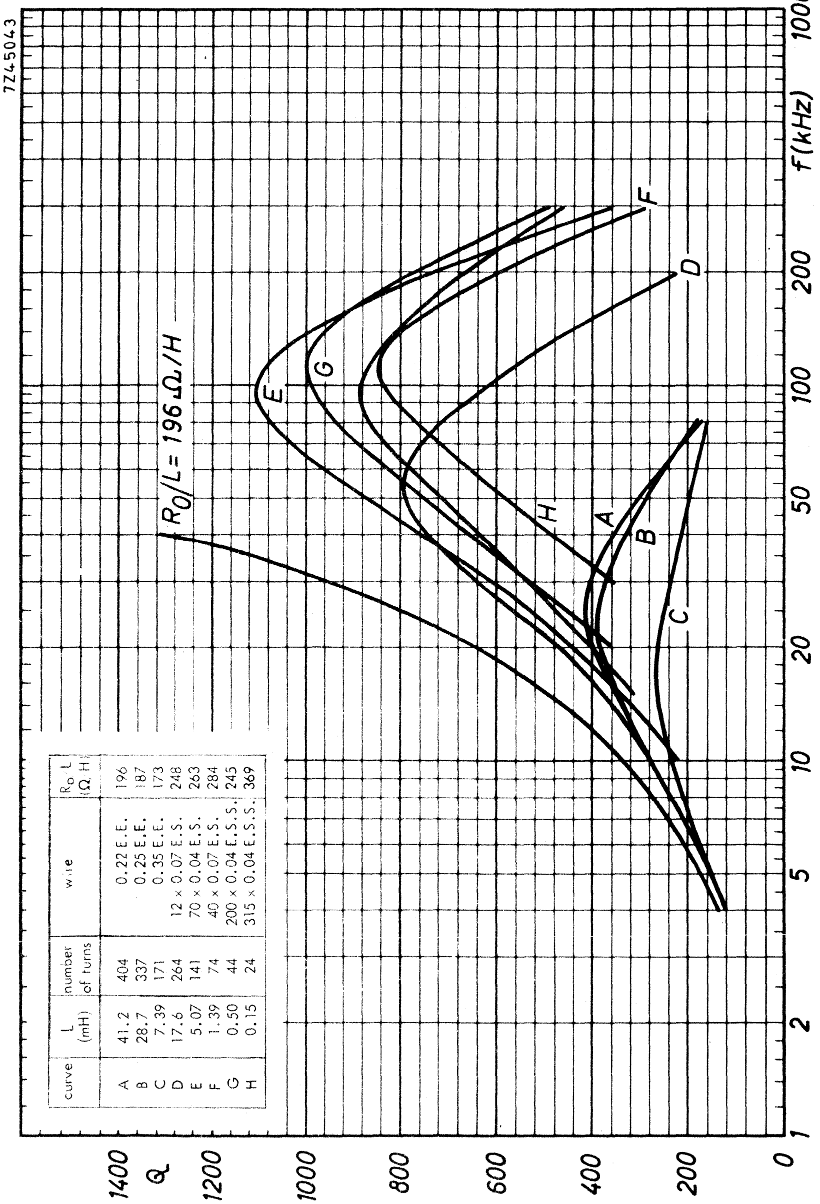
Enveloping curves



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	28.1	404	0.22 E.E.	288
B	19.6	337	0.25 E.E.	276
C	5.03	171	0.35 E.E.	255
D	12.0	264	12 × 0.07 E.S.	365
E	3.45	141	70 × 0.04 E.S.	386
F	0.95	74	40 × 0.07 E.S.	416
G	0.33	44	200 × 0.04 E.S.S.	364
H	0.10	24	315 × 0.04 E.S.S.	545

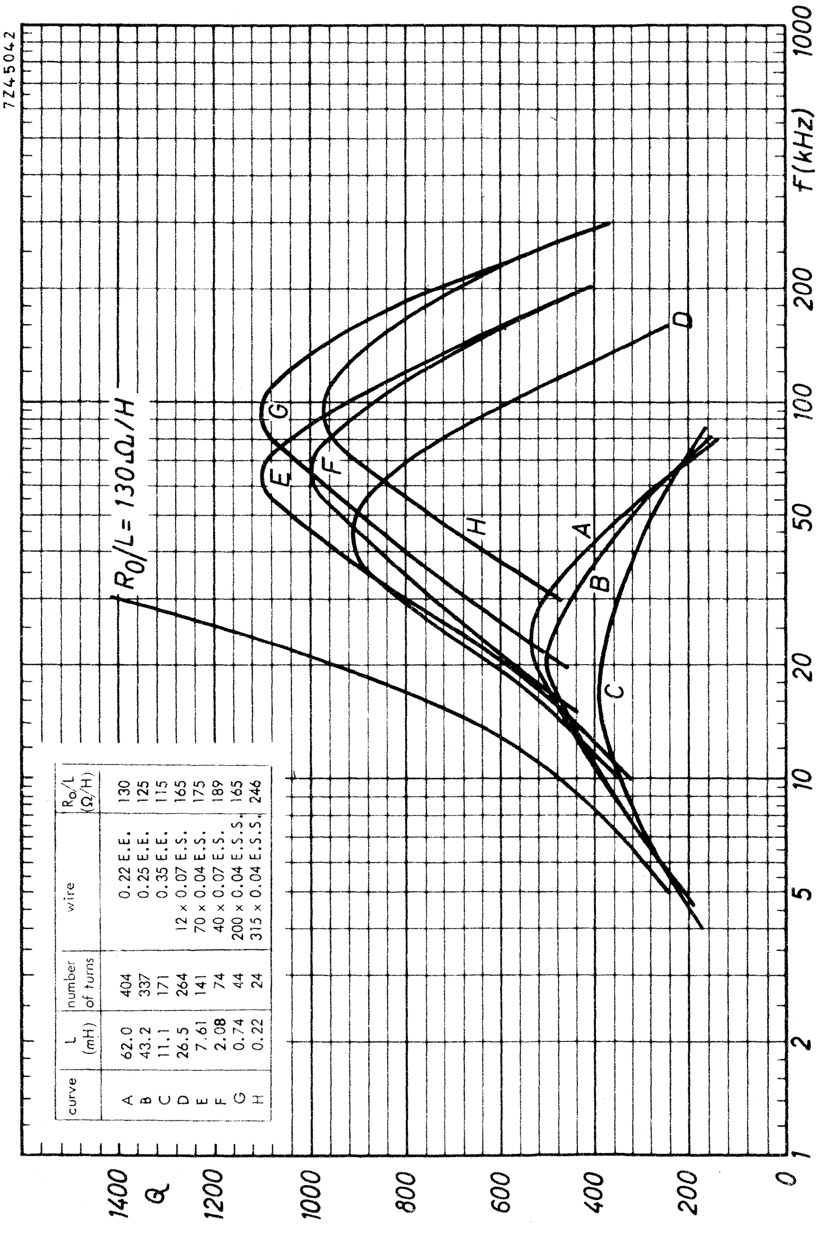
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 68$



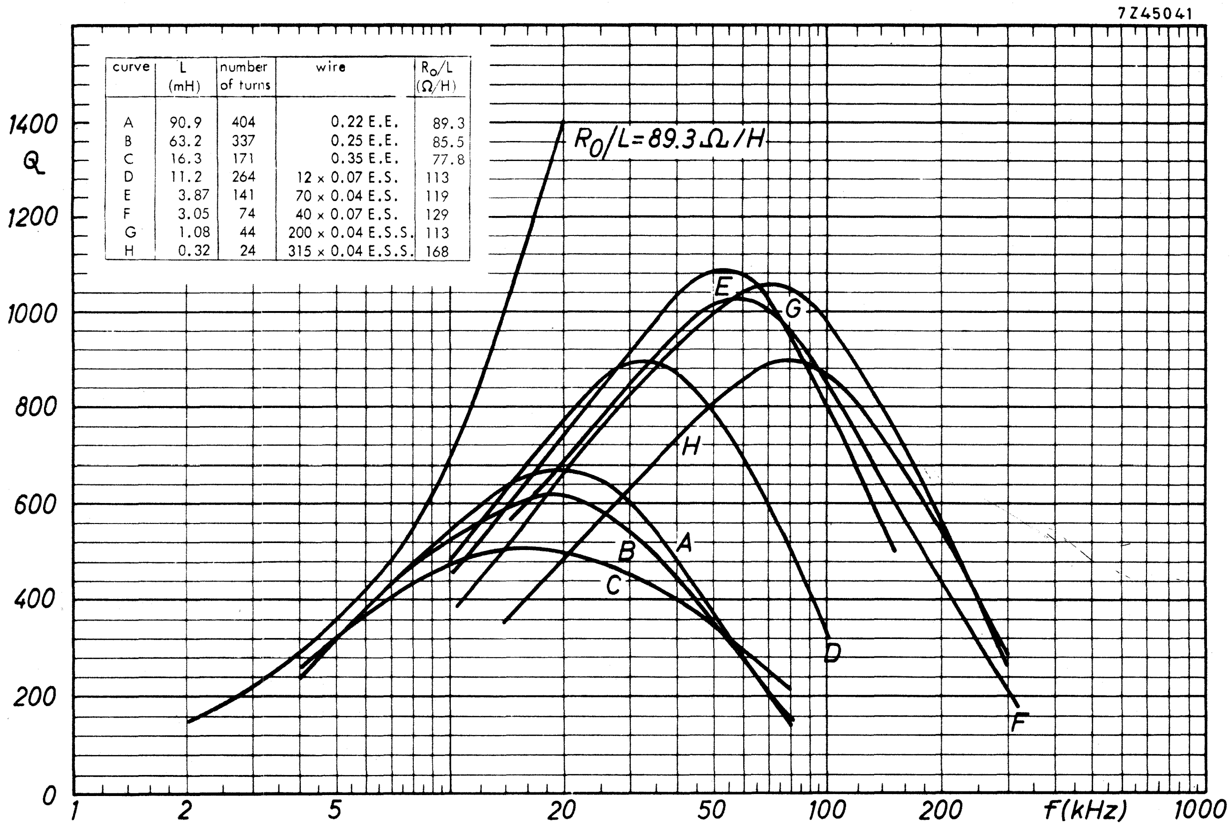
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	41.2	404	0.22 E.E.	196
B	28.7	337	0.25 E.E.	187
C	7.39	171	0.35 E.E.	173
D	17.6	264	12 × 0.07 E.S.	248
E	5.07	141	70 × 0.04 E.S.	263
F	1.39	74	40 × 0.07 E.S.	284
G	0.50	44	200 × 0.04 E.S.S.	245
H	0.15	24	315 × 0.04 E.S.S.	369

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 100$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	62.0	404	0.22 E.E.	130
B	43.2	337	0.25 E.E.	125
C	11.1	171	0.35 E.E.	115
D	26.5	264	12 × 0.07 E.S.	165
E	7.61	141	70 × 0.04 E.S.	175
F	2.08	74	40 × 0.07 E.S.	189
G	0.74	44	200 × 0.04 E.S.S.	165
H	0.22	24	315 × 0.04 E.S.S.	246

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 150$

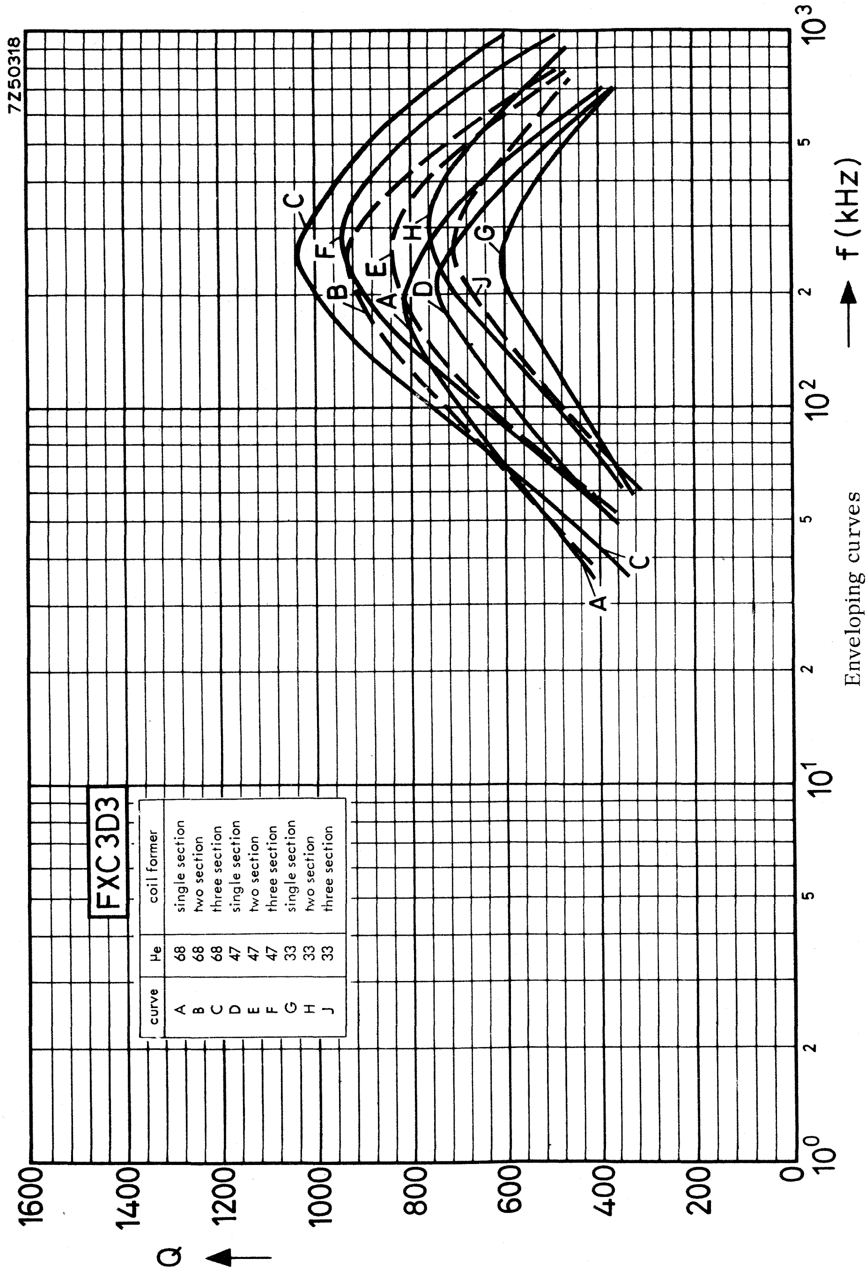


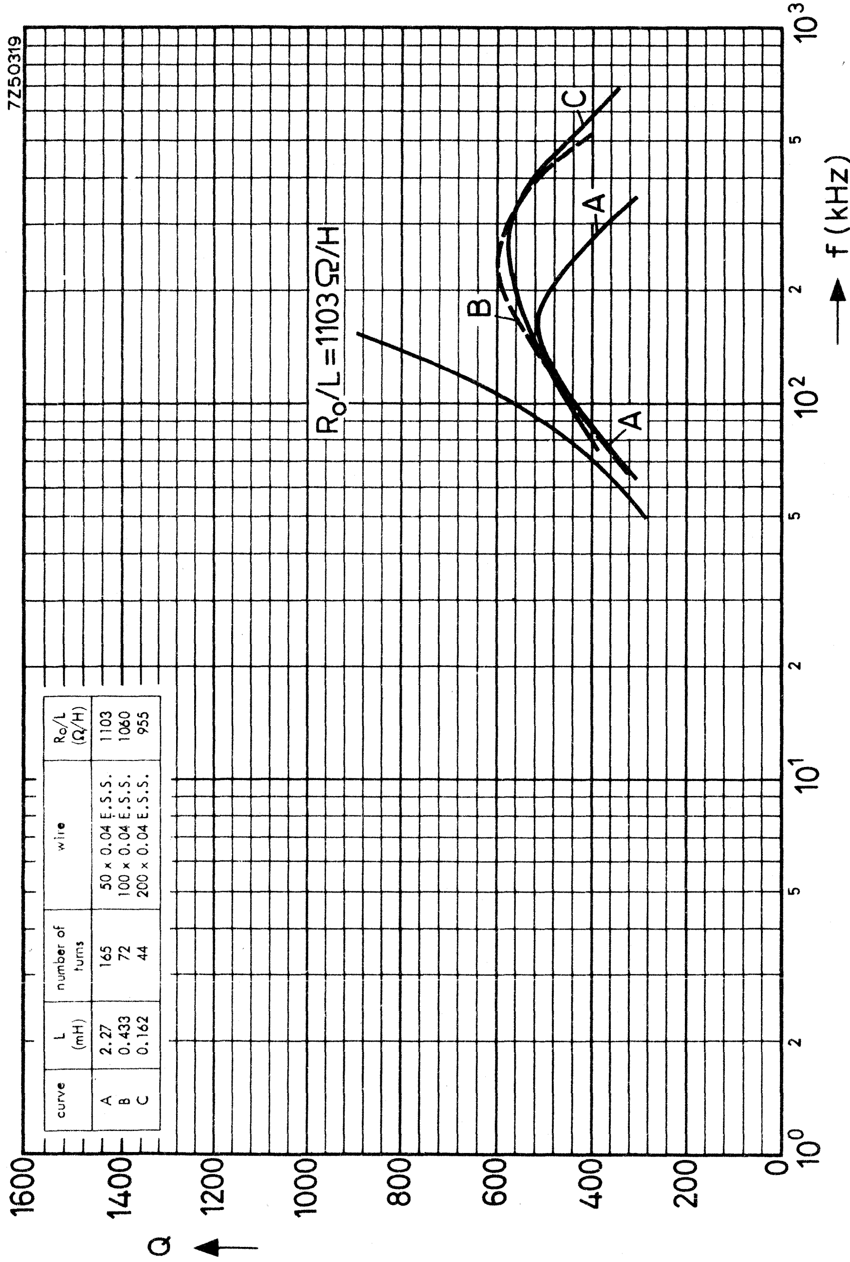
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	90.9	404	0.22 E.E.	89.3
B	63.2	337	0.25 E.E.	85.5
C	16.3	171	0.35 E.E.	77.8
D	11.2	264	12 × 0.07 E.S.	113
E	3.87	141	70 × 0.04 E.S.	119
F	3.05	74	40 × 0.07 E.S.	129
G	1.08	44	200 × 0.04 E.S.S.	113
H	0.32	24	315 × 0.04 E.S.S.	168

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 220$

TYPICAL Q-CURVES FOR FXC 3D3

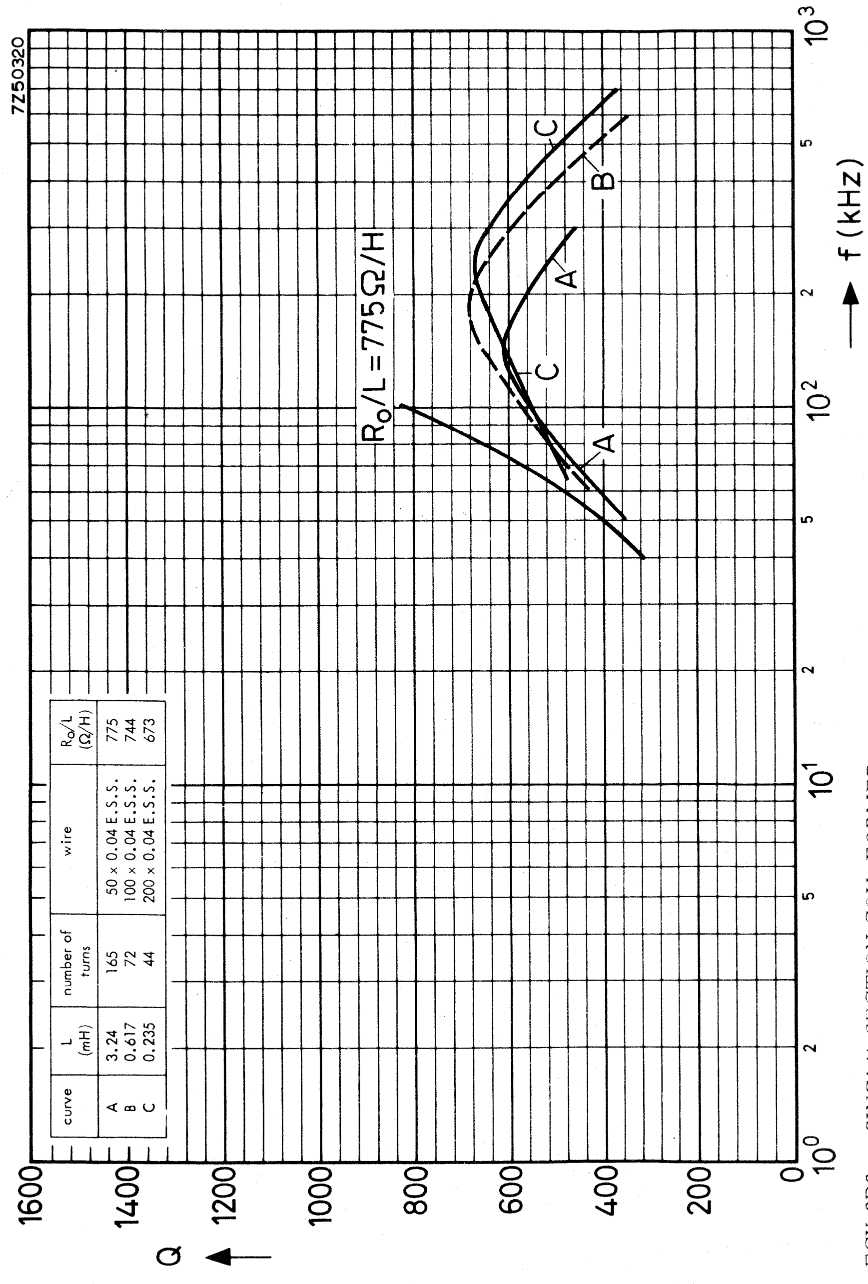




curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	2.27	165	50 × 0.04 E.S.S.	1103
B	0.433	72	100 × 0.04 E.S.S.	1060
C	0.162	44	200 × 0.04 E.S.S.	955

SINGLE-SECTION COIL FORMER

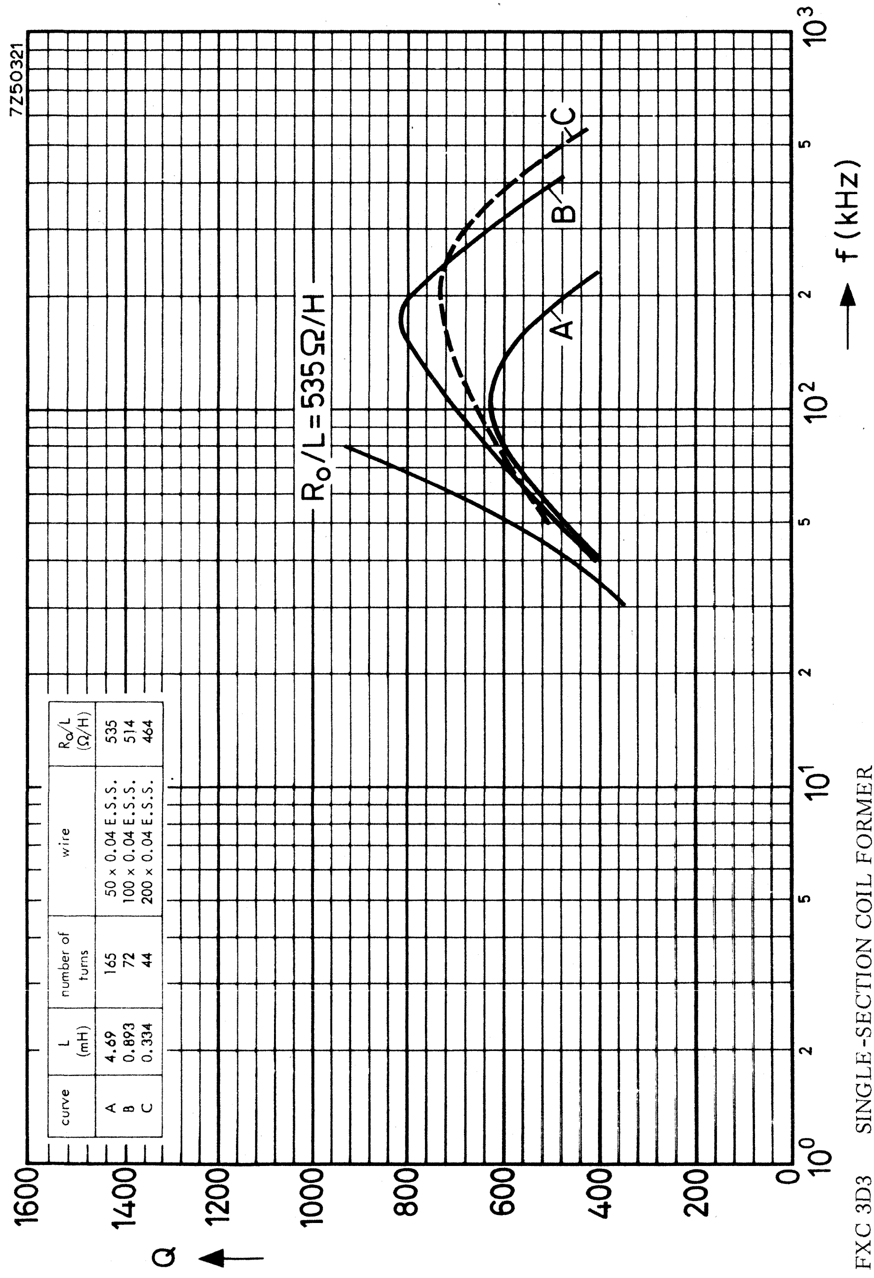
FXC 3D3
$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	3.24	165	50 × 0.04 E.S.S.	775
B	0.617	72	100 × 0.04 E.S.S.	744
C	0.235	44	200 × 0.04 E.S.S.	673

FCX 3D3 SINGLE-SECTION COIL FORMER

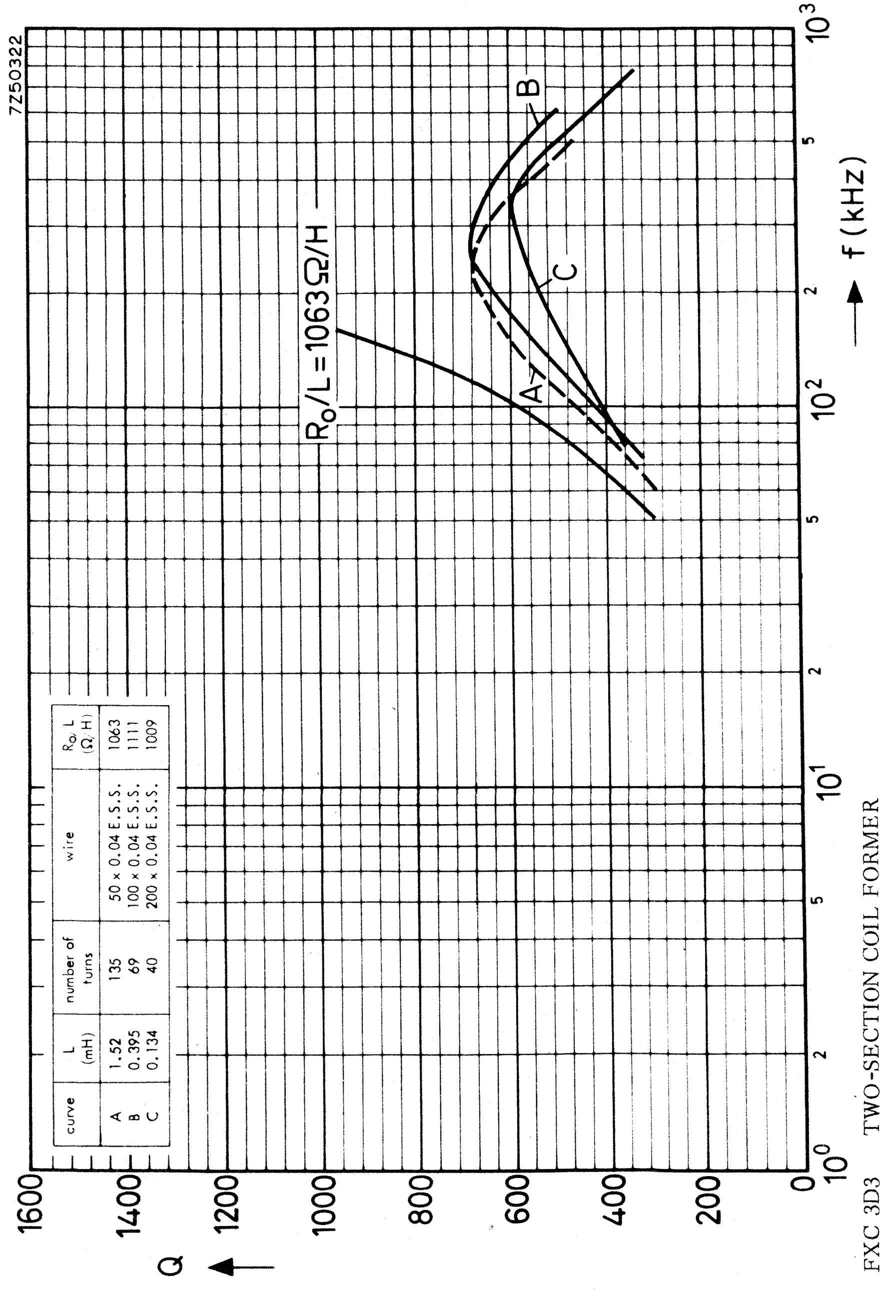
$\mu_e = 47$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	4.69	165	50 × 0.04 E.S.S.	535
B	0.893	72	100 × 0.04 E.S.S.	514
C	0.334	44	200 × 0.04 E.S.S.	464

SINGLE-SECTION COIL FORMER

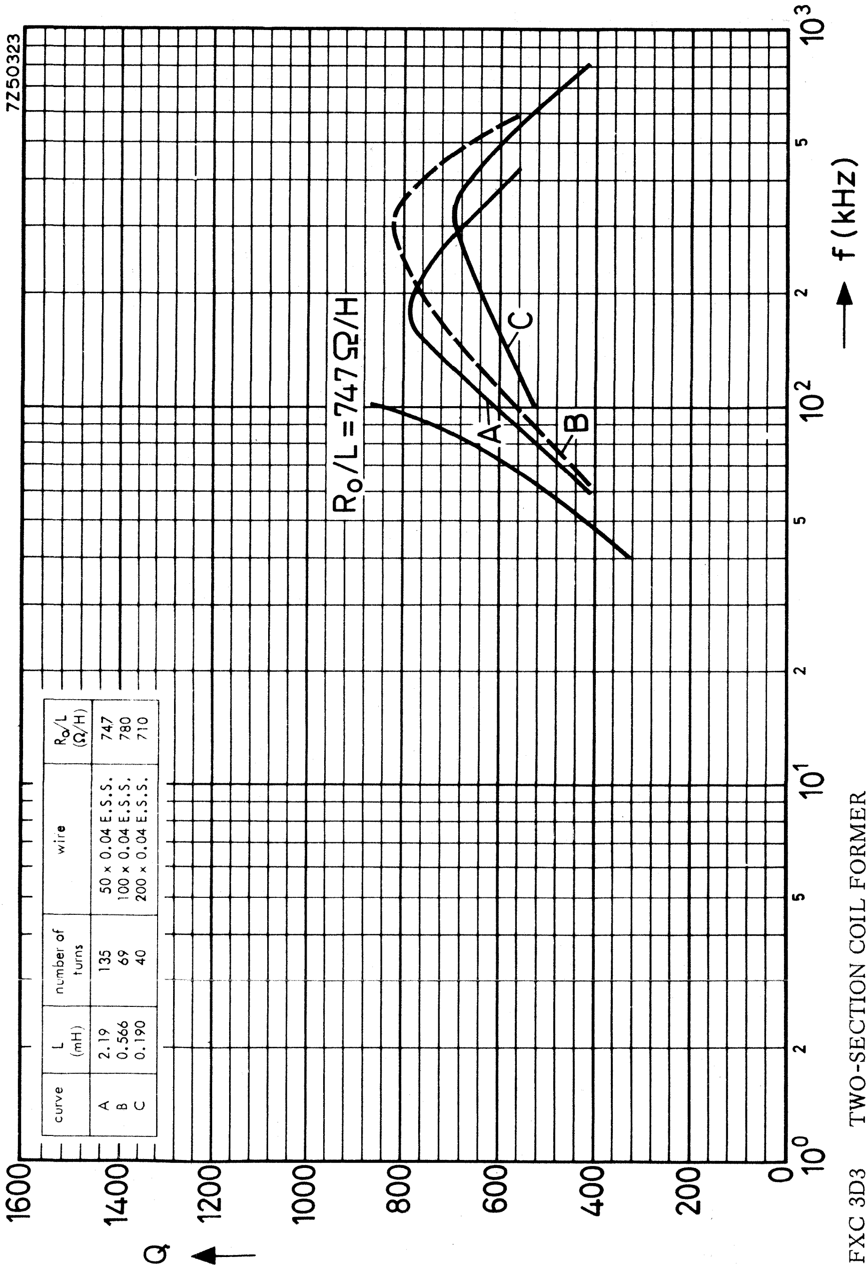
FXC 3D3
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.52	135	50 × 0.04 E.S.S.	1063
B	0.395	69	100 × 0.04 E.S.S.	1111
C	0.134	40	200 × 0.04 E.S.S.	1009

TWO-SECTION COIL FORMER

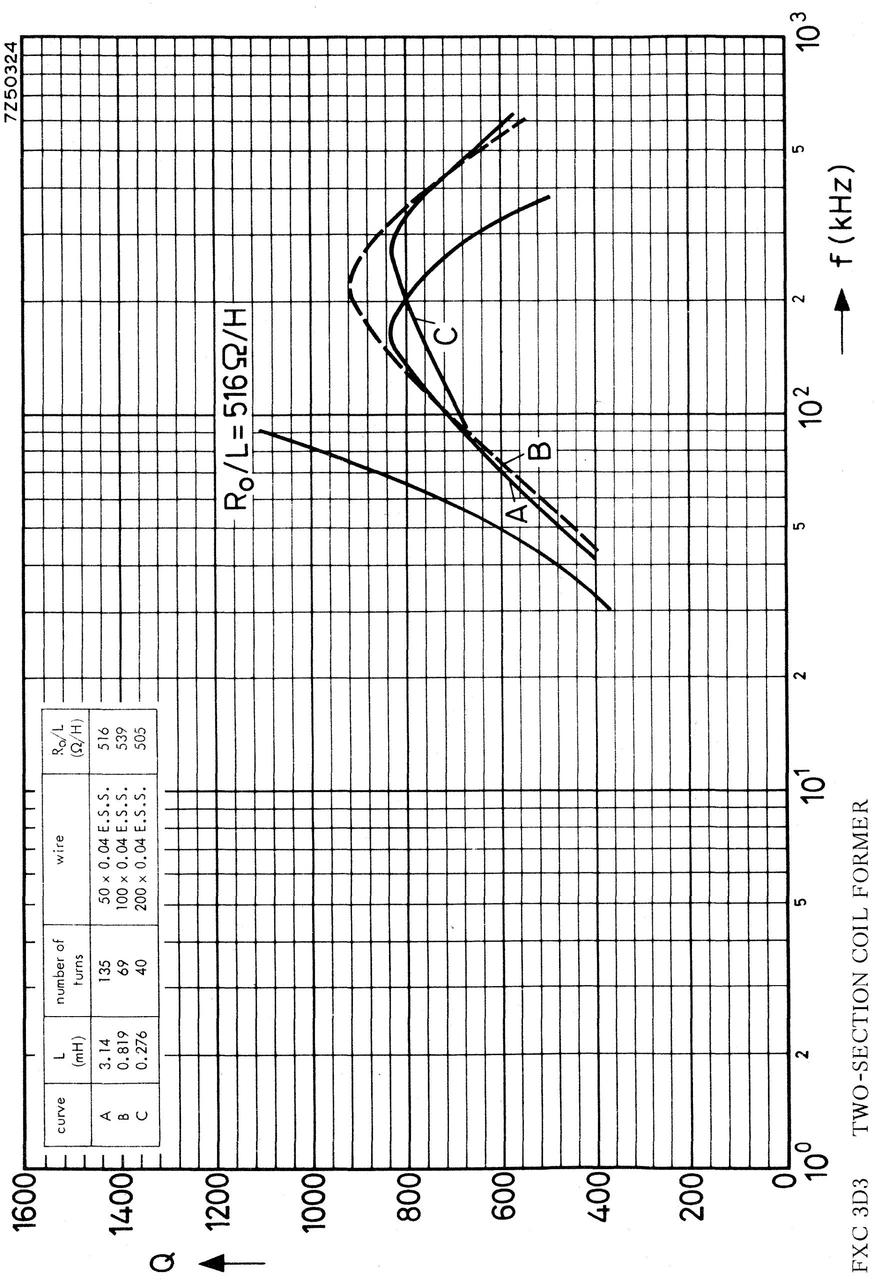
FXC 3D3
$\mu_e = 33$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	2.19	135	50 × 0.04 E.S.S.	747
B	0.566	69	100 × 0.04 E.S.S.	780
C	0.190	40	200 × 0.04 E.S.S.	710

TWO-SECTION COIL FORMER

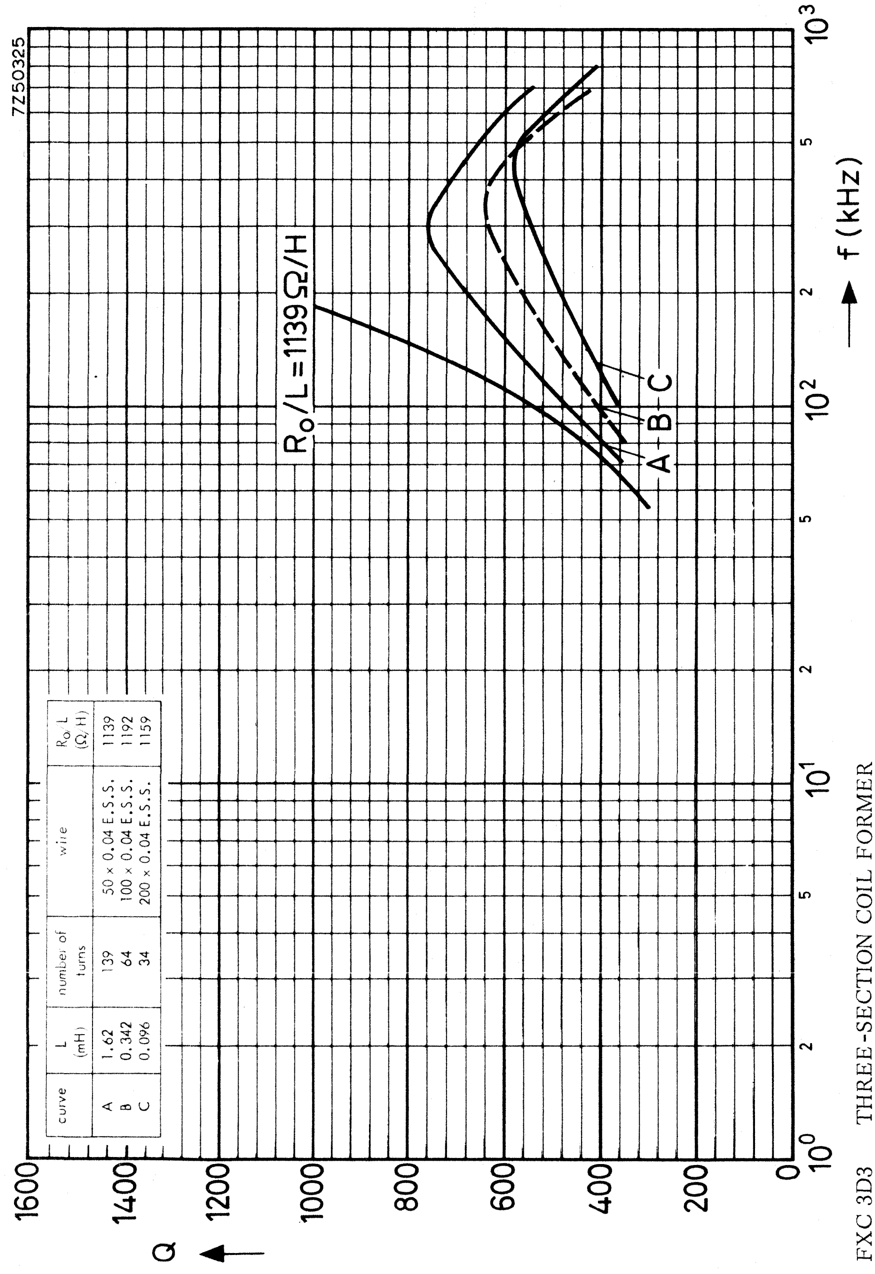
FXC 3D3
$\mu_e = 47$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	3.14	135	50 × 0.04 E.S.S.	516
B	0.819	69	100 × 0.04 E.S.S.	539
C	0.276	40	200 × 0.04 E.S.S.	505

FXC 3D3 TWO-SECTION COIL FORMER

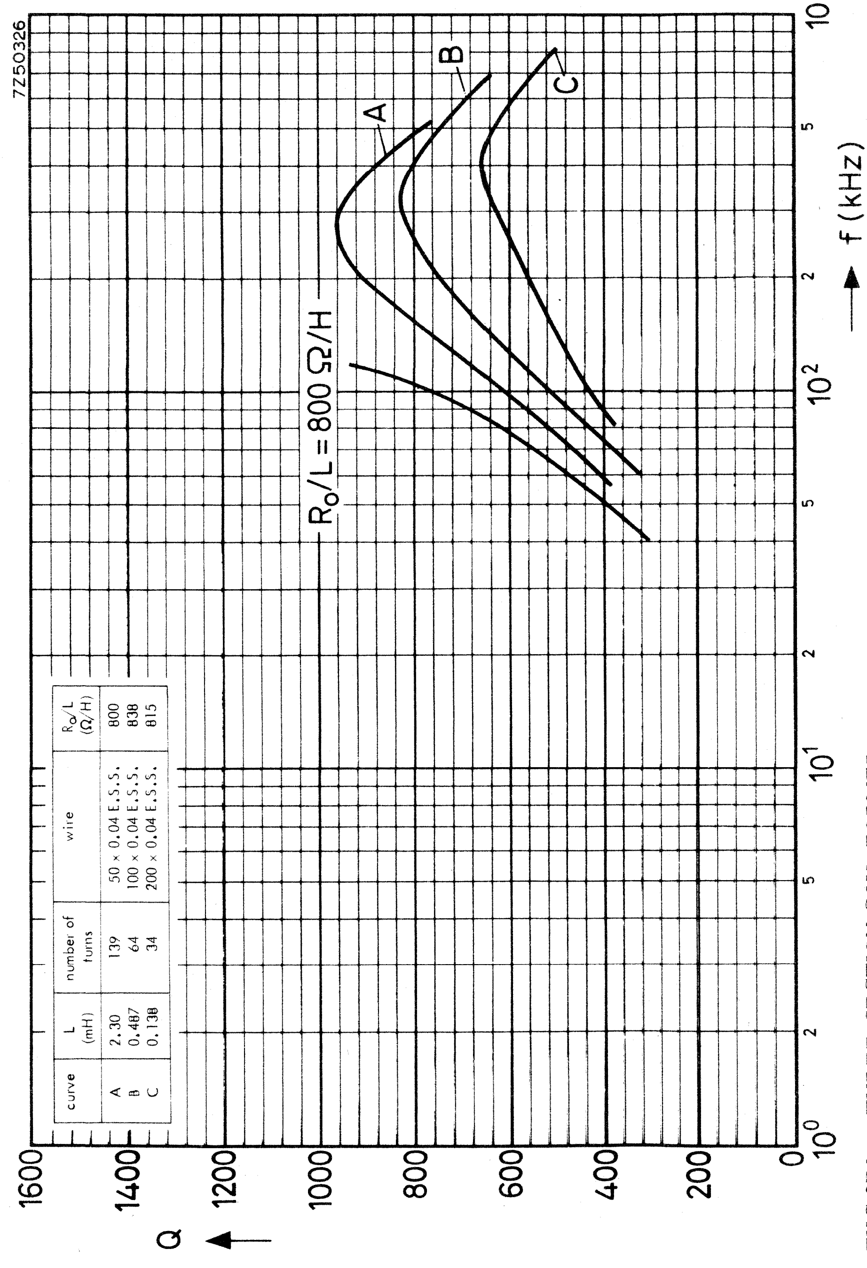
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1.62	139	50 × 0.04 E.S.S.	1139
B	0.342	64	100 × 0.04 E.S.S.	1192
C	0.096	34	200 × 0.04 E.S.S.	1159

THREE-SECTION COIL FORMER

FXC 3D3
$\mu_e = 33$

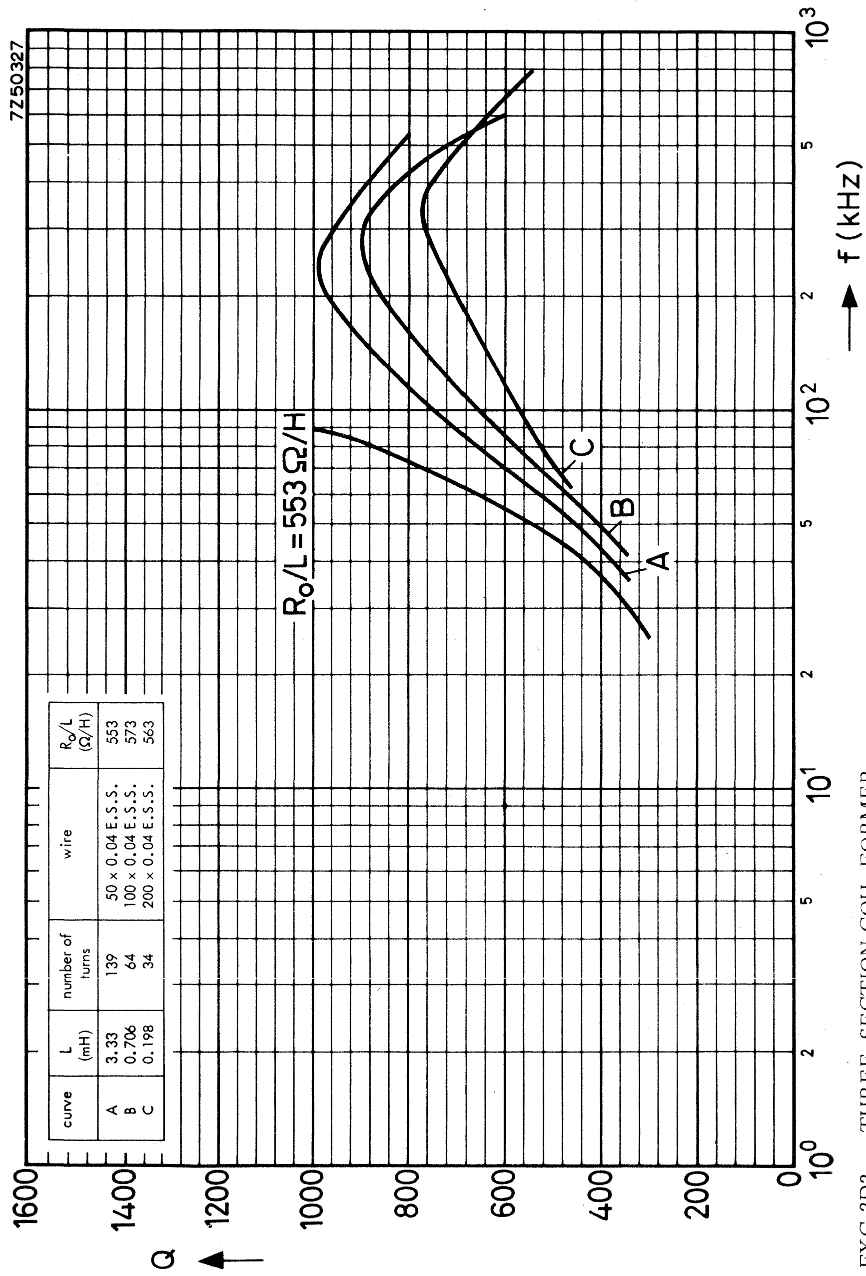


curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	2.30	139	50 × 0.04 E.S.S.	800
B	0.487	64	100 × 0.04 E.S.S.	838
C	0.138	34	200 × 0.04 E.S.S.	815

THREE-SECTION COIL FORMER

FXC 3D3

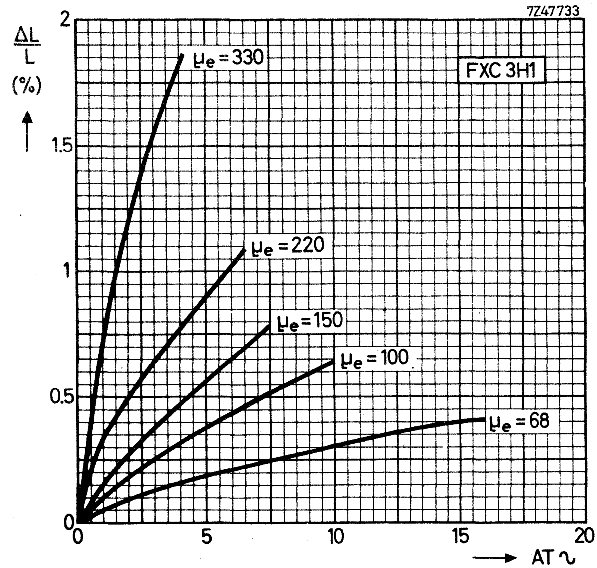
$\mu_e = 47$

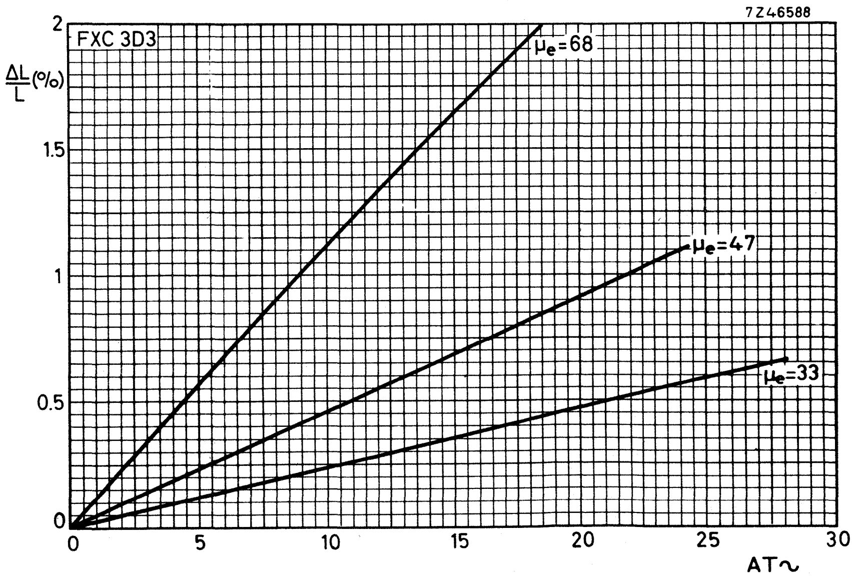


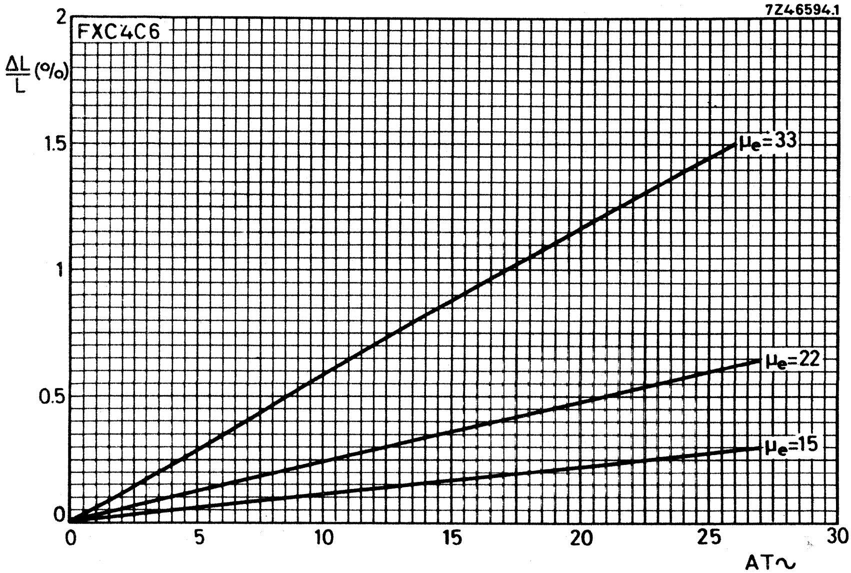
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	3.33	139	50 × 0.04 E.S.S.	553
B	0.706	64	100 × 0.04 E.S.S.	573
C	0.198	34	200 × 0.04 E.S.S.	563

FXC 3D3 THREE-SECTION COIL FORMER
$\mu_e = 68$

INDUCTANCE VARIATION AS A FUNCTION OF AT~

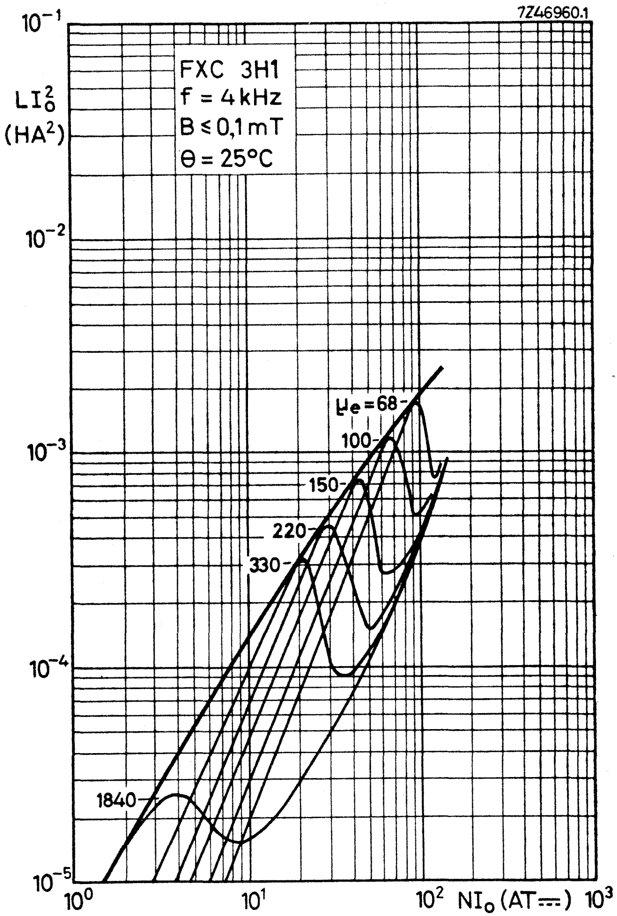




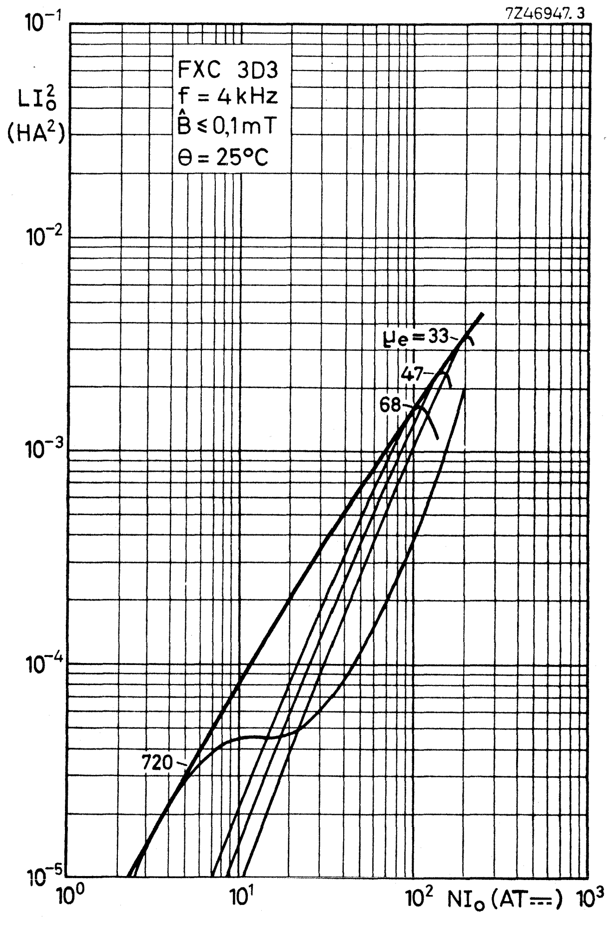

7Z46594.1
FXC4C6
ΔL/L (%)
2
1.5
1
0.5
0
μe=33
μe=22
μe=15
0
5
10
15
20
25
30
AT~

HANNA CURVES

Indicating optimum inductance for a certain μ_e-value and direct current.
Typical values



Typical values



POTCORES

Three types of core can be supplied:

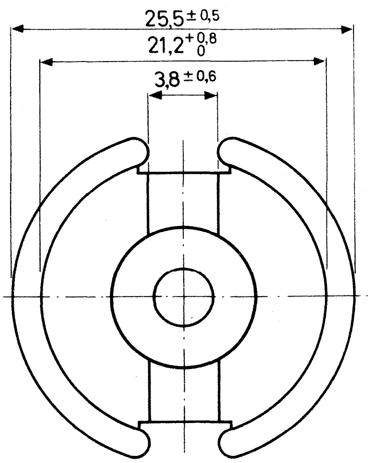
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

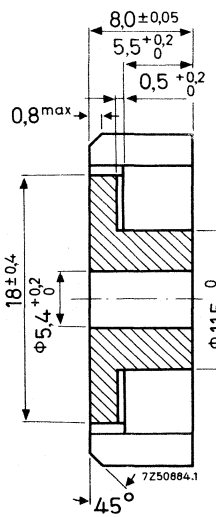
The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN41293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number. Quantity: a primary pack contains 40 potcore halves or 20 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores. Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm





Versions

Ferroxcube grade	catalogue number
3B7	4322 020 22000
3B8	4322 020 22220
3D3	4322 020 22020
3E1	4322 020 22140
3H1	4322 020 22010
4C6	4322 020 22110

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (°C)	grade 3B7	3B8	3D3	3E1	3H1	4C6
$\alpha_F \times 10^6$	+5 to +25		0 to +2 *			+0,5 to +1,5	-2 to +4
	+25 to +55		0 to +2 *			+0,5 to +1,5	0 to +6
	+25 to +70	-0,6 to +0,6		0 to +2	0 to +2		
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 4,3 *	≤ 12		≤ 4,3	≤ 10

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 200 Newton, the values in Table II are guaranteed at 25 ± 10 °C.

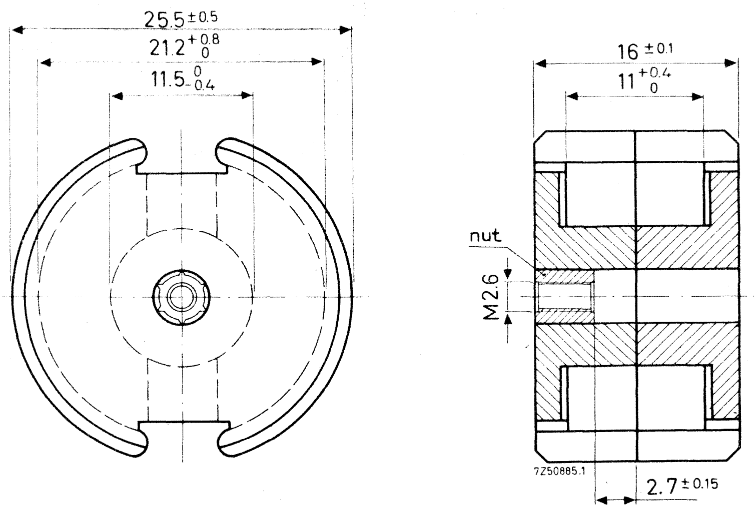
Table II	$\hat{B}$ (mT)	freq. (MHz)	grade 3B7	3B8	3D3	3E1	3H1	4C6
μ_e ± 25%	≤ 0,1	0,004	1910	1790		3075	1910	
	≤ 0,1	0,1			730			125
A_L ± 25%	≤ 0,1	0,004	5900	5615		9650	5900	
	≤ 0,1	0,1			2300			400
α	≤ 0,1	0,004	≤ 14,9	≤ 15			≤ 14,9	
	≤ 0,1	0,1			≤ 24,1			≤ 58,0
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	≤ 1,2	≤ 1,5		≤ 2,5	≤ 1,2	
	≤ 0,1	0,1	≤ 5	≤ 6 *	≤ 8	≤ 20	≤ 5	
	≤ 0,1	0,5			≤ 14	≤ 200		
	≤ 0,1	1			≤ 35			
	≤ 0,1	2						≤ 40
	≤ 0,1	10						≤ 100
$q_{2\text{-}24\text{-}100}$	1,5-3,0	0,004	≤ 1,8			≤ 3,0	≤ 1,4	
	0,3-1,2	0,1			≤ 3,0			≤ 10
$\eta_B \times 10^3$	1,5-3,0	0,004	≤ 1,1	≤ 0,7		≤ 1,8	≤ 0,86	
	0,3-1,2	0,1			≤ 1,8			≤ 6,2

μ_Δ for grade 3B8 at 4,92 AT ≥ 644
at 7,63 AT ≥ 278
at 9,40 AT ≥ 143

*) For guidance only.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 2....
Without nut, catalogue number = 4322 022 0....

Weight per set = 20 g

Effective length l_e = 37,6 mm

$\Sigma \frac{l_e}{A_e}$ = 0.400 mm^{-1}

Effective volume V_e = 3530 mm^3

Pre-adjusted potcores with standard μ_e values [1])

μ_e	α	tolerance on inductance (%)	catal. No.: 4322 022 2.... with nut / 4322 022 0.... without nut			
			3B7	3H1	3D3	4C6
15	146	± 1	–	–	8410	8810
22	120	± 1	–	–	–	8820
33	98.2	± 1	8030	8230	8430	8830
47	82.3	± 1	8040	8240	8440	–
68	68.4	± 1	8050	8250	8450	–
100	56.4	± 1.5	8060	8260	–	–
150	46.1	± 2	8070	8270	–	–
220	38.1	± 3	8080	8280	–	–
330	31.0	± 3	8090	8290	–	–
730	20.8	± 25	–	–	8400 *	–
1910	12.9	± 25	8000 *	8200 *	–	–

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H)

Symmetric air gap for cores with an μ_e value of 15 up to and including 100
Asymmetric air gap for cores with an μ_e value of 150 up to and including 1910

[1]) See Notes on the next page.
*) Only available without nut.

→ Pre-adjusted potcores with standard A_L factors

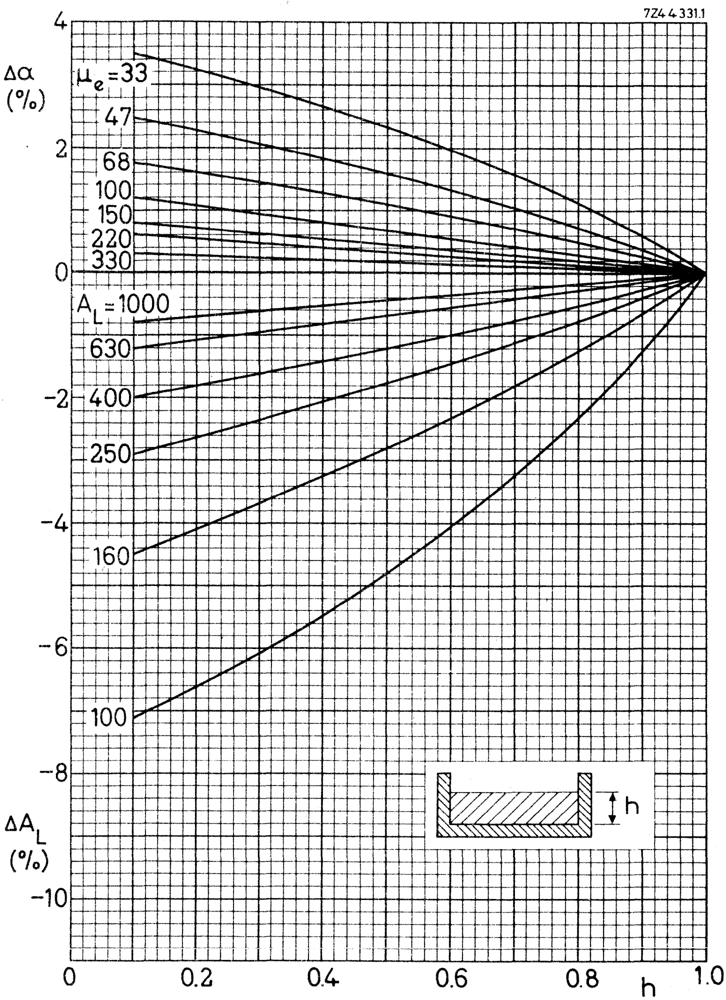
A_L	corre-sponding μ_e-value	tolerance on induc-tance (%)	cat. no.: 4322 022 2.... with nut; 4322 022 0.... without nut				
			3B7	3D3	3H1	3H3	4C6
63	20	± 1	9030	9430	9230		9830
100	31,8	± 1	9040	9440	9240		9840
160	51	± 1	9050	9450	9250		
250	79,5	± 1	9060	9460	9260	9560	
315	100,2	± 1,5	9070		9270	9570	
400	127	± 2	9080	9480	9280	9580	
630	200	± 3	9100		9300	9600	
1000	318	± 3	9110		9310	9610	
1600	510	± 3	9120		9320		

Inductance $L = N^2A_L$ (L in 10^{-9} H)
Symmetrical air gap for cores with an A_L factor of 63 up to and including 400.
Asymmetrical air gap for cores with an A_L factor of 630 up to and including 1600.

Notes to the tables

1. Examples of catalogue number:
   μ_e = 15, grade 4C6, potcore with nut, catalogue number = 4322 022 28810
   A_L = 100, grade 3B7, potcore without nut, catalogue number = 4322 022 09040
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 730 = A_L of 2300, μ_e of 1910 = A_L of 5900.

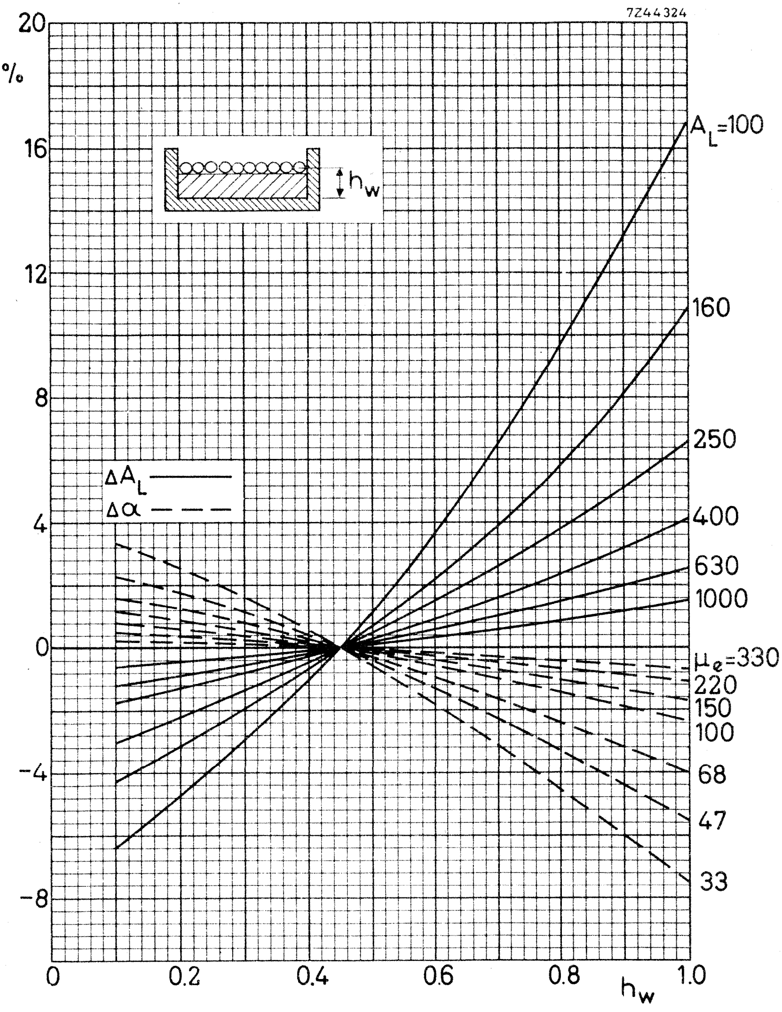
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 68 in that case obtains an α factor of 68.4 + 1.25 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_w on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3 only.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 68.4 - 1.7 %.

COIL FORMERS

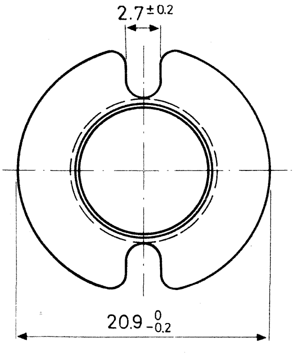
GENERAL

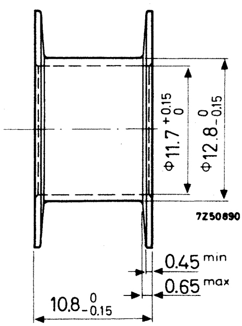
Three types of coil former can be supplied:

- with one section
- with two sections
- with three sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS 4061 range 2 (Great Britain).
The dimensions in the drawings are in mm.

SINGLE-SECTION COIL FORMER





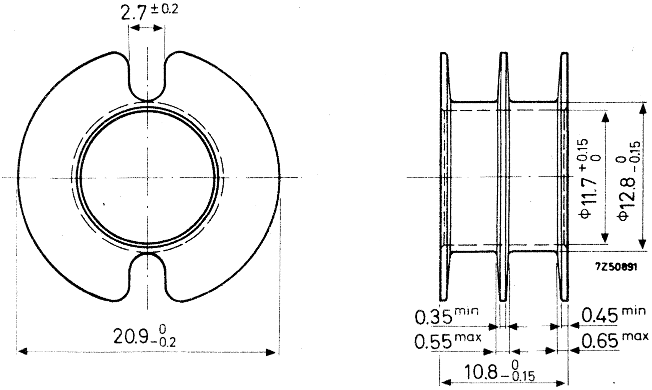
Catalogue number	4322 021 30330
Material	polycarbonate
Window area	39 mm^2
Mean length of turn	53 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 7,42 \times 10^3 \ \Omega/H$$

Weight 0,5 g

TWO-SECTION COIL FORMER



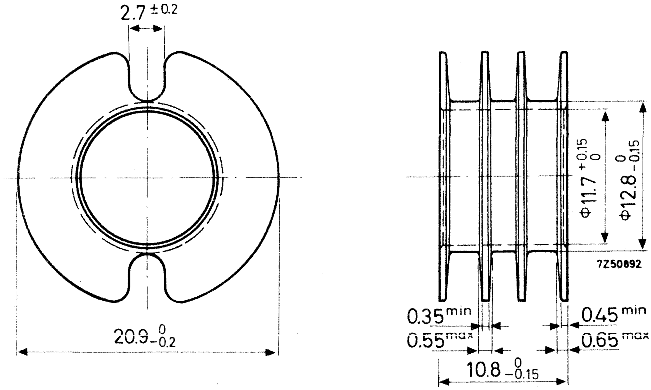
Catalogue number	4322 021 30340
Material	polycarbonate
Window area	2 x 19 mm^2
Mean length of turn	53 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 7.79 \times 10^3 \ \Omega/H$$

Weight 0.6 g

THREE-SECTION COIL FORMER



Catalogue number	4322 021 30350
Material	polycarbonate
Window area	3 x 12 mm^2
Mean length of turn	53 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 8.18 \times 10^3 \ \Omega/H$$

Weight 0.7 g

INDUCTANCE ADJUSTORS

CONTINUOUS ADJUSTORS

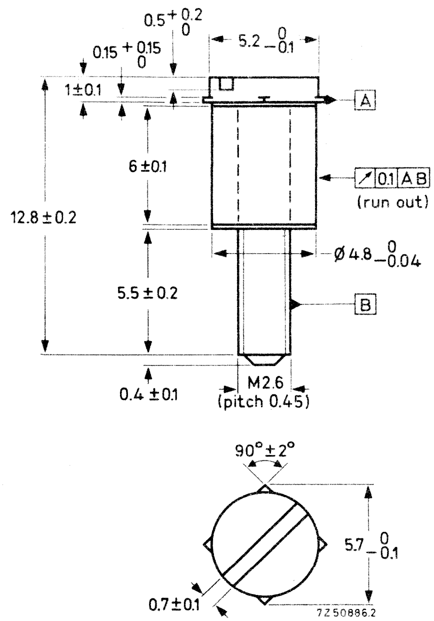


Fig. A

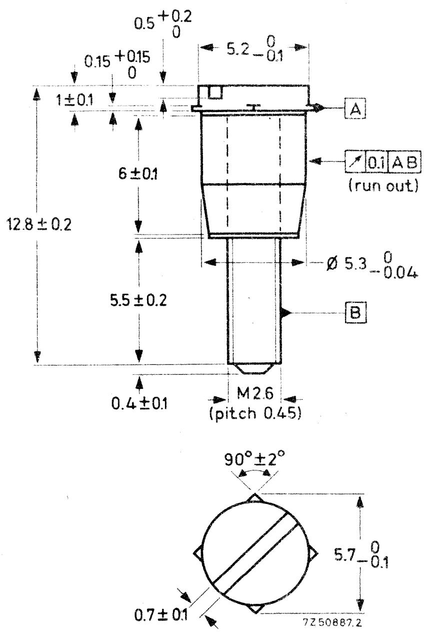


Fig. B

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03 % by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different potcores.

Table I, types of adjustor

Fig.	colour	catalogue number
A	green	4322 021 30780
A	yellow	4322 021 30790
A	red	4322 021 30800
A	brown	4322 021 30810
B	white	4322 021 30980
B	grey	4322 021 31090

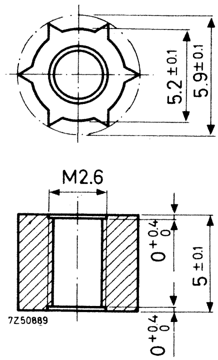
The adjustors are packed in bags of 100, so please order in multiples of 100.

Table II, recommended application

μ_e	A_L	3B7/3H1/3D3	4C6
		catal. No. 4322 021	
15		-	30780
22		-	30780
	63	-	30780
33		30780	30790
	100	30780	30790
47		30800	
	160	30800	
68		30980	
	250	30980	
100	315	30980	
150		30810	
	400	30810	
220		30810	
	630	30810	
330		31090	
	1000	31090	

Nut for adjustor

These data are given for those manufacturers who prefer to insert the nut themselves.

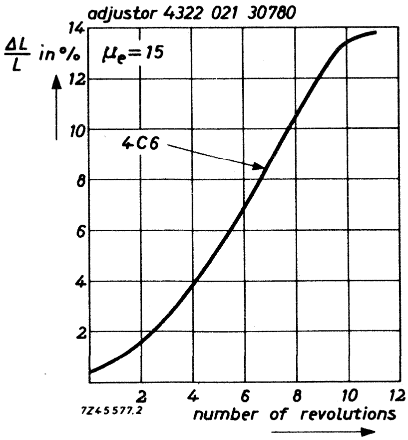


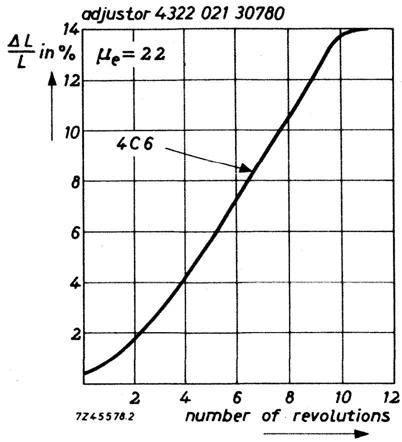
Catalogue number	4322 021 30160
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut	2,7 ± 0,15 mm

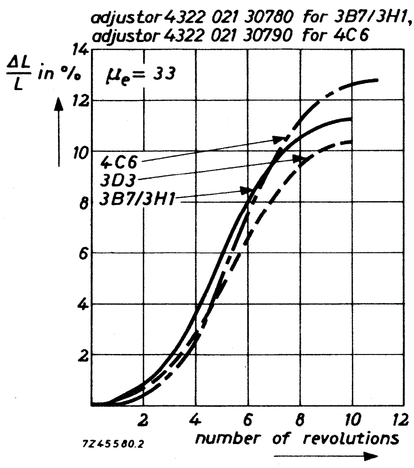
For more information see Potcores General, Mounting data

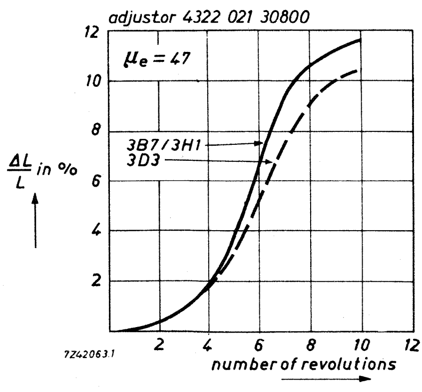
The nuts are packed in bags of 100, so please order in multiples of 100.

Adjustment curves

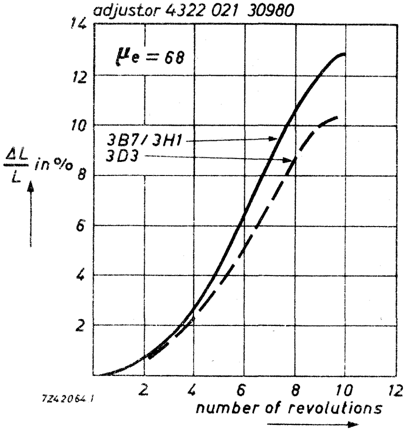




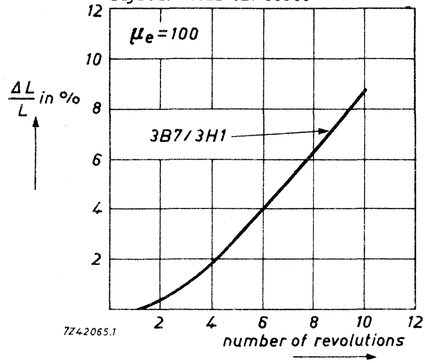




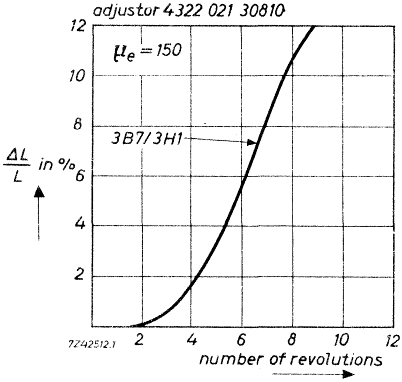
adjustor 4322 021 30980



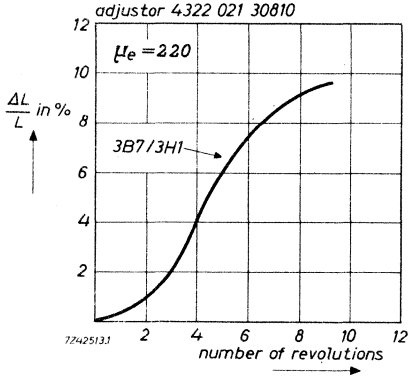
adjustor 4322 021 30980



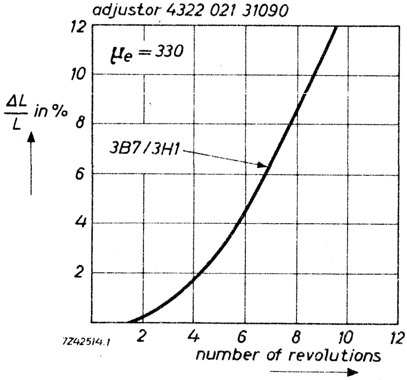
adjustor 4322 021 30810



adjustor 4322 021 30810



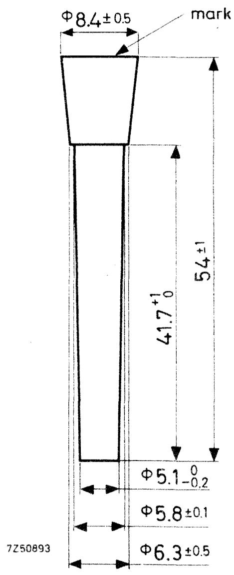
adjustor 4322 021 31090

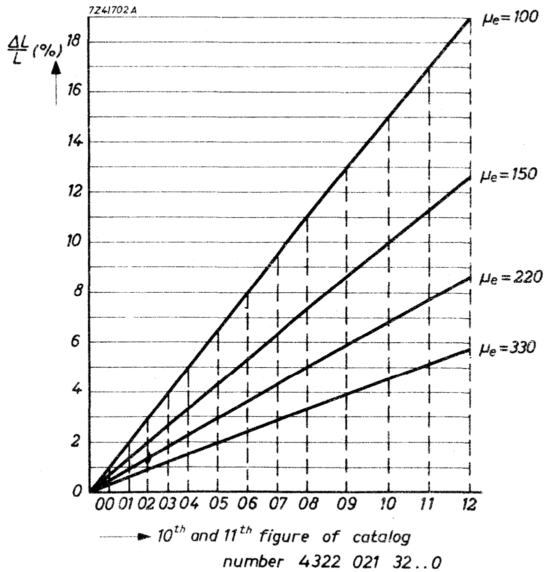


STEP-BY-STEP ADJUSTORS

These adjustors are used when a continuous adjustment of the inductance is not necessary. For instance, they are applied in loading coils to bring the inductance within a certain tolerance field. They are not suitable for adjusting the inductance to an exact value, as is usually necessary in filters. The increment of the losses caused by these adjustors is negligible.
A range of 13 flexible conical adjustors is available under the catalog numbers 4322 021 32000 up to ..32120. Each adjustor causes an increase in the inductance; the higher the catalog number, the greater the effect. The influence of each adjustor on the inductance at different μ_e values of the potcore can be found from the graph.
The 10th and 11th figure of the catalog number are indicated on the head of the adjustor. It should be borne in mind that, when using these adjustors, the inductance of the coil should initially be lower than the wanted value.
When the correct adjustor has been found, it is inserted in the centre hole of the pot. An adhesive (for instance Pliobond of Good Year) is used as sliding and fixing material. After fixing the protruding ends are cut off.

The maximum impregnation temperature is 150 °C.
The maximum working temperature is 90 °C.
Material: rubber with powder iron.

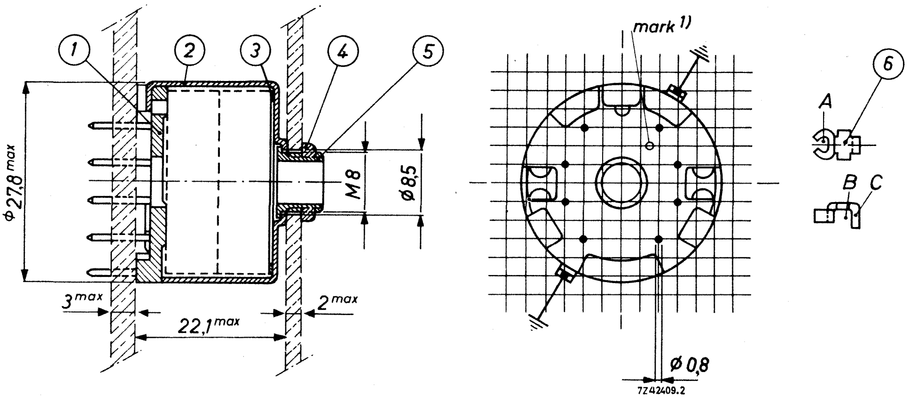




Dimensions in mm

MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30470	(4) nut	4322 021 30710
(2) brass container	4322 021 30550	(5) fixing brush	4322 021 30720
(3) spring	4322 021 30660	(6) soldering spring	4322 021 30700(8x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended.
Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

→ The eight soldering pins are arranged to fit a grid of 2, 54 mm (0, 1 inch).

The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1, 3 + 0, 1 mm diameter.

If one-hole mounting is preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8, 5 mm diameter.

1) There is another mark hole in a similar position on the top of the container.

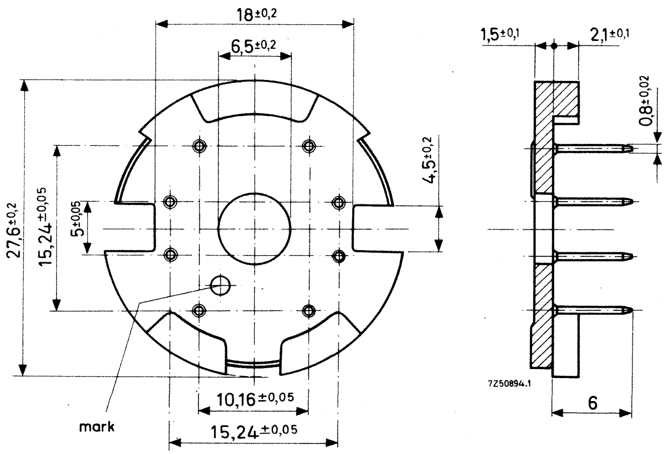
It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.
Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 200 Newton. After bending the lips the spring will have the correct tension.

PART DRAWINGS Dimensions in mm

(1) Tag plate 4322 021 30470

Plate : polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s.

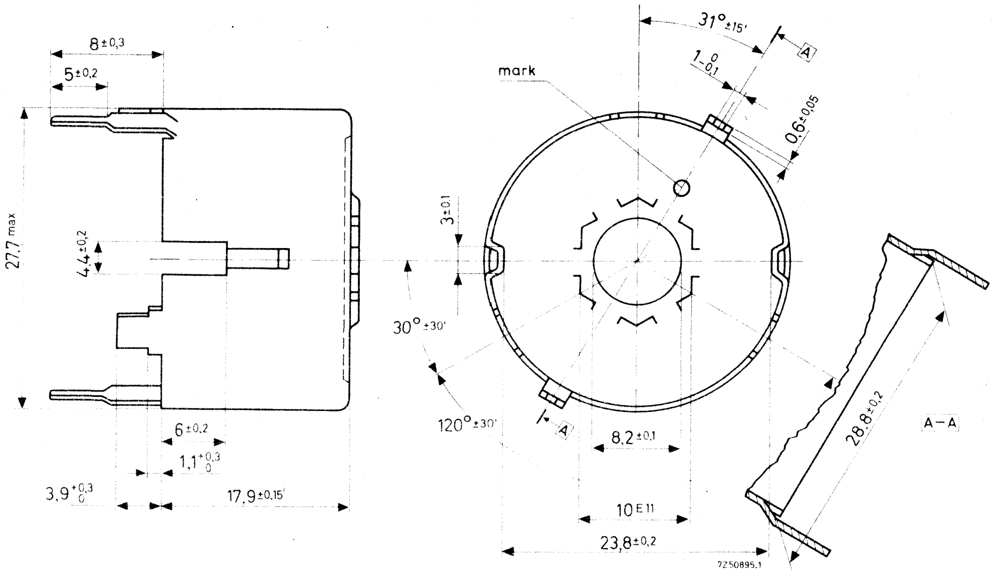
Pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 40 pieces on a polystyrene plate, and with 250 pieces in a cardboard box. Please order in multiples of these quantities.

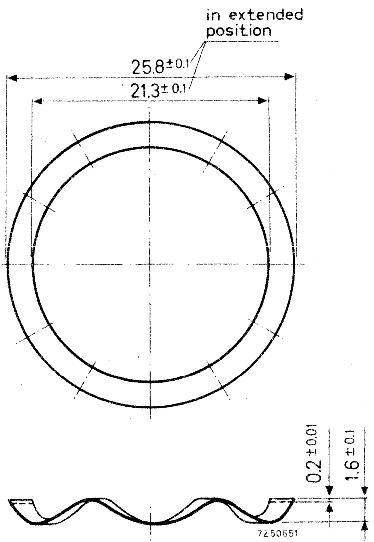
(2) Container 4322 021 30550

Material: brass, nickel plated; tinned soldering pins



→ (3) Spring 4322 021 30660

Material: chrome-nickel steel

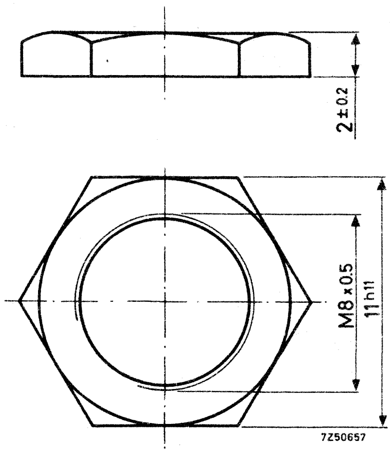


A force of 136 to 225 N is required to compress the spring to 0,55 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

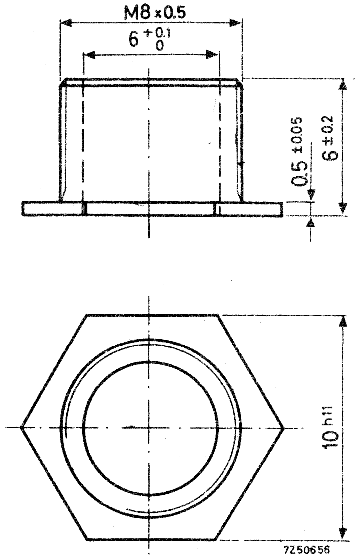
(4) Nut 4322 021 30710

Material: brass, nickel plated



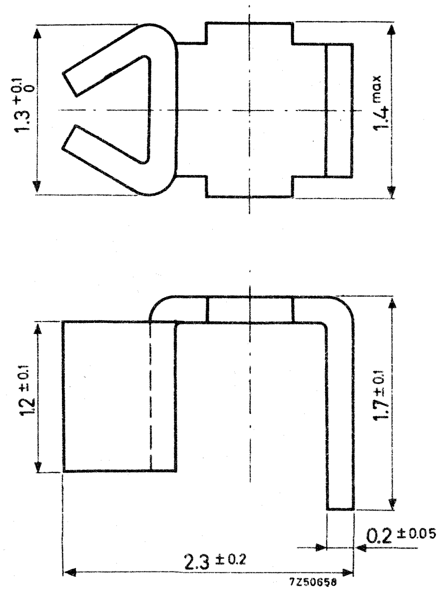
(5) Fixing bush 4322 021 30720

Material: brass, nickel plated



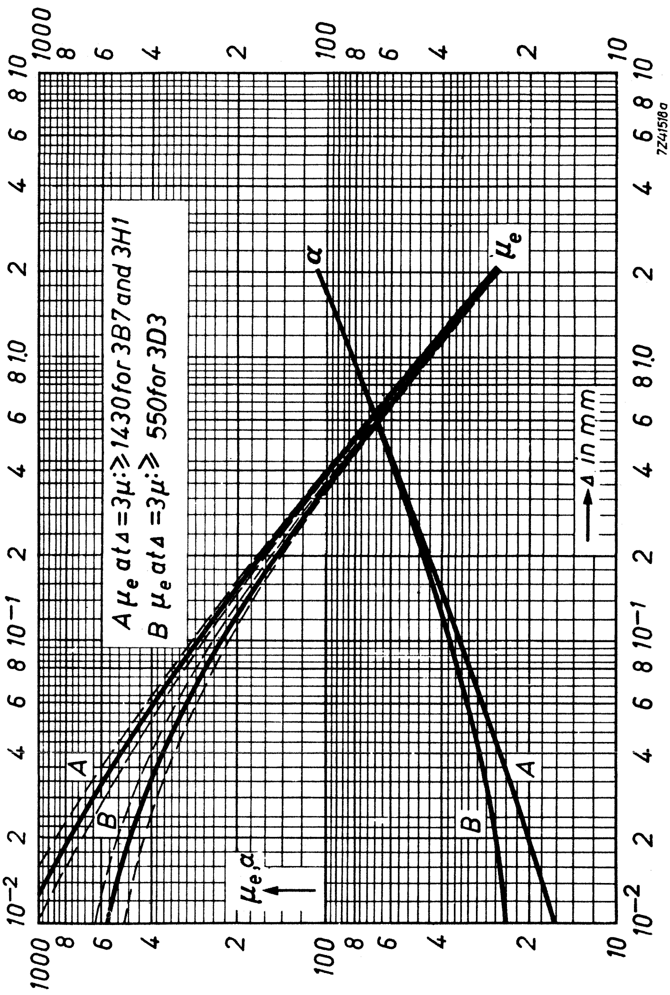
(6) Soldering spring 4322 021 30700

Material : brass, dipsoldered



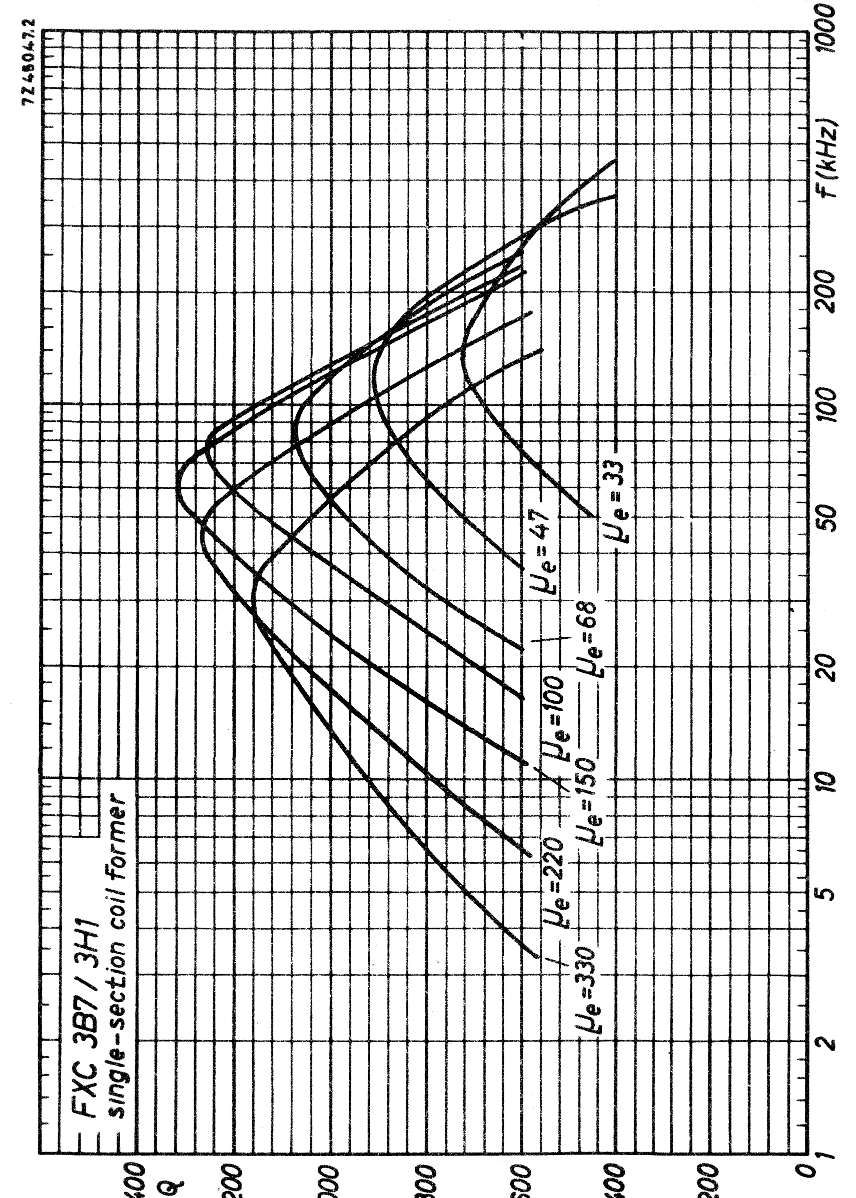
CHARACTERISTIC CURVES

μ_e - α CURVES

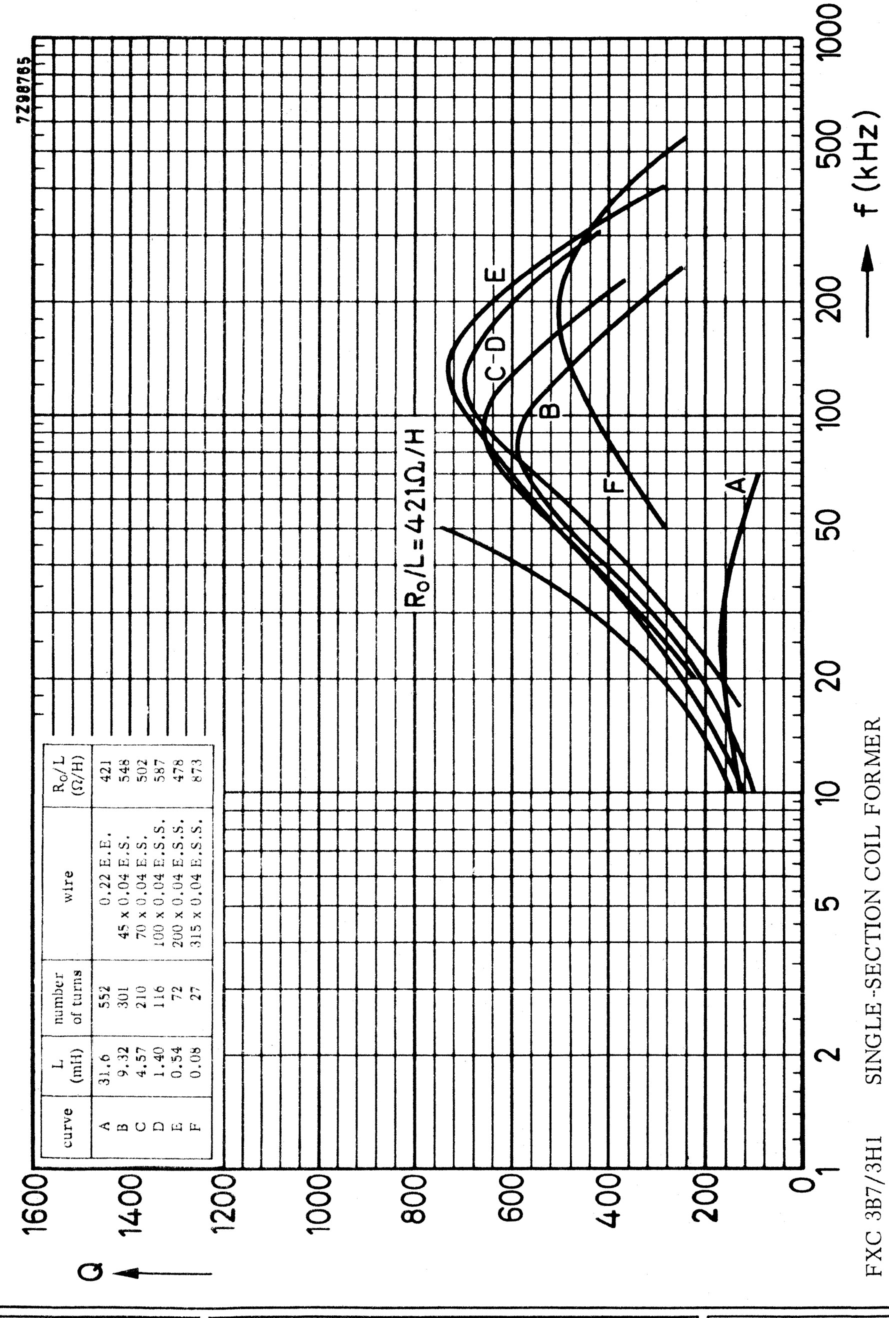


Relative effective permeability and turn factor for 1 mH as a function of the air-gap length.

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1

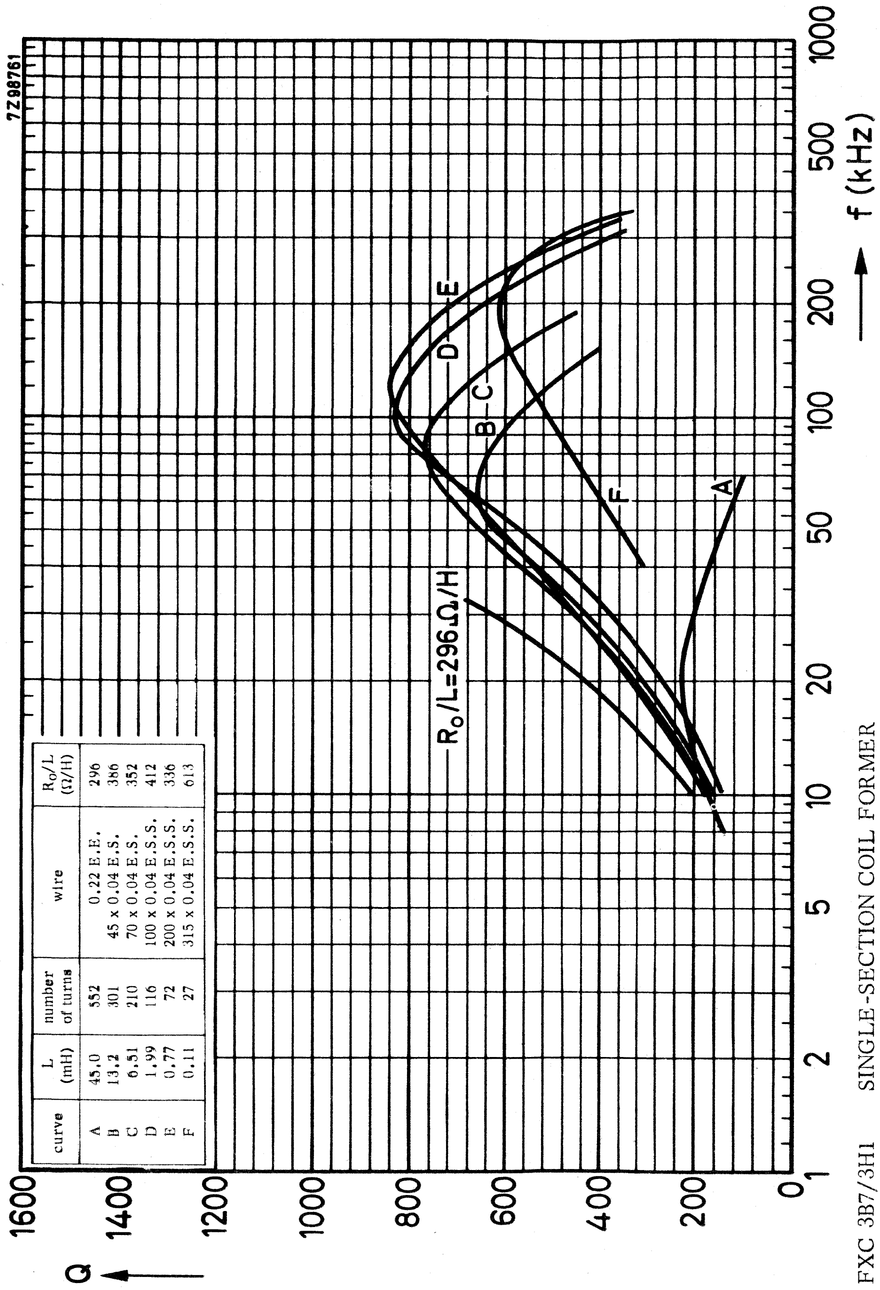


Enveloping curves



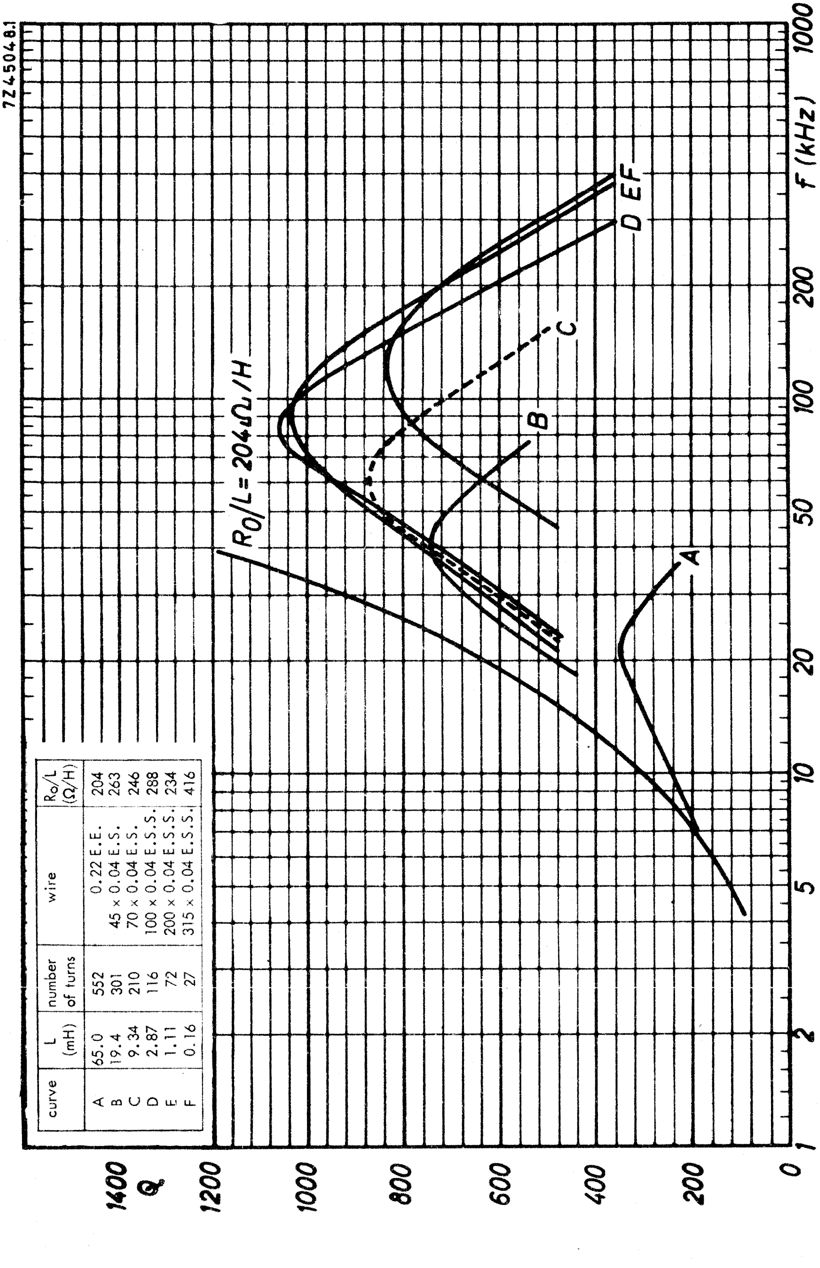
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	31.6	552	0.22 E.E.	421
B	9.32	301	45 x 0.04 E.S.	548
C	4.57	210	70 x 0.04 E.S.	502
D	1.40	116	100 x 0.04 E.S.S.	587
E	0.54	72	200 x 0.04 E.S.S.	478
F	0.08	27	315 x 0.04 E.S.S.	873

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 33$



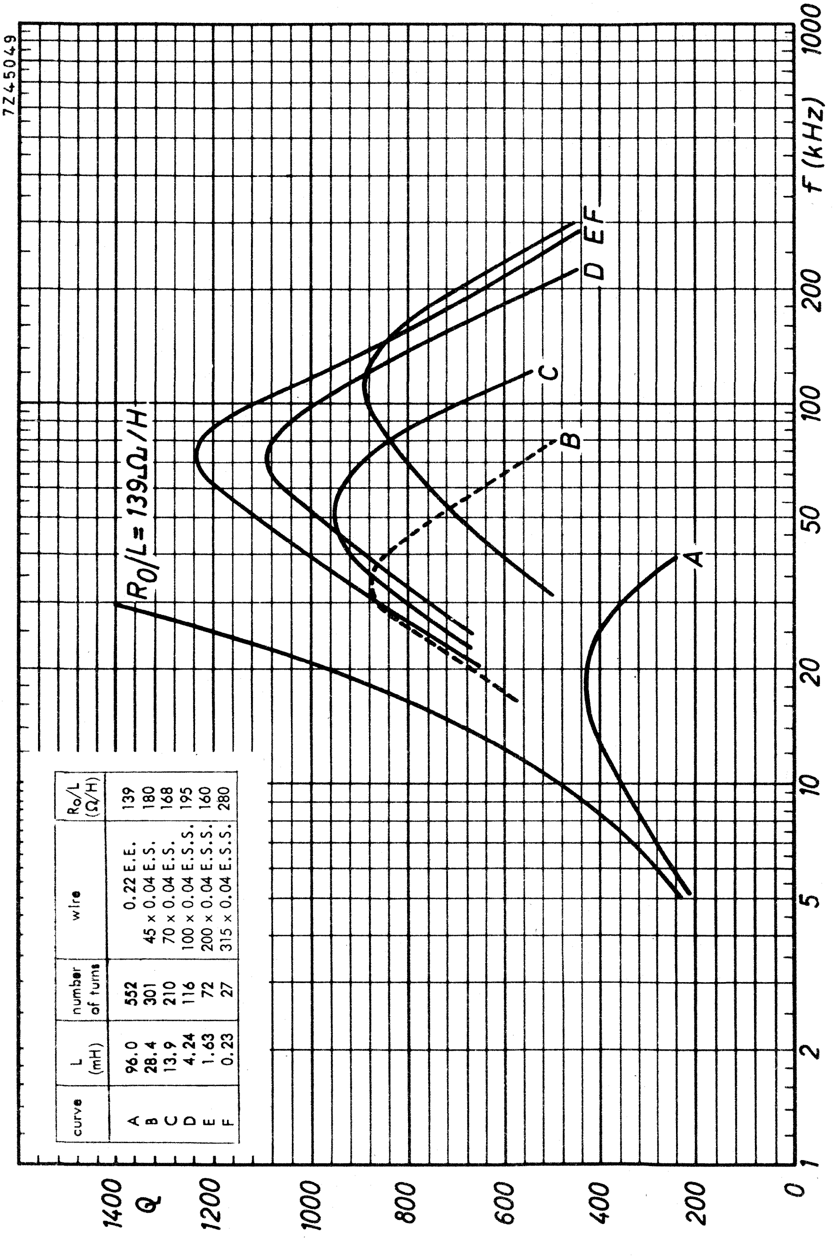
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	45.0	552	0.22 E.E.	296
B	13.2	301	45 x 0.04 E.S.	386
C	6.51	210	70 x 0.04 E.S.	352
D	1.99	116	100 x 0.04 E.S.S.	412
E	0.77	72	200 x 0.04 E.S.S.	336
F	0.11	27	315 x 0.04 E.S.S.	613

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 47$



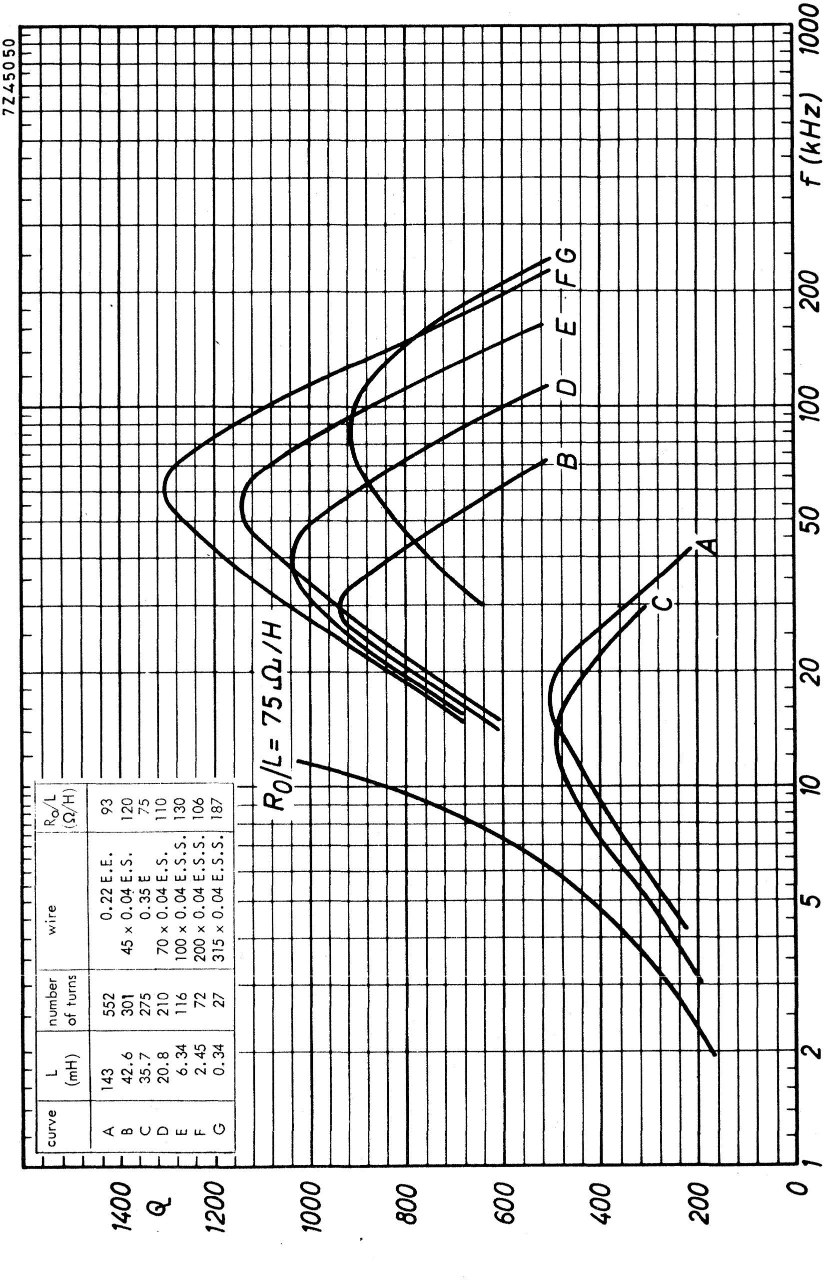
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	65.0	552	0.22 E.E.	204
B	19.4	301	45 × 0.04 E.S.	263
C	9.34	210	70 × 0.04 E.S.	246
D	2.87	116	100 × 0.04 E.S.S.	288
E	1.11	72	200 × 0.04 E.S.S.	234
F	0.16	27	315 × 0.04 E.S.S.	416

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	96.0	552	0.22 E.E.	139
B	28.4	301	45 × 0.04 E.S.	180
C	13.9	210	70 × 0.04 E.S.	168
D	4.24	116	100 × 0.04 E.S.S.	195
E	1.63	72	200 × 0.04 E.S.S.	160
F	0.23	27	315 × 0.04 E.S.S.	280

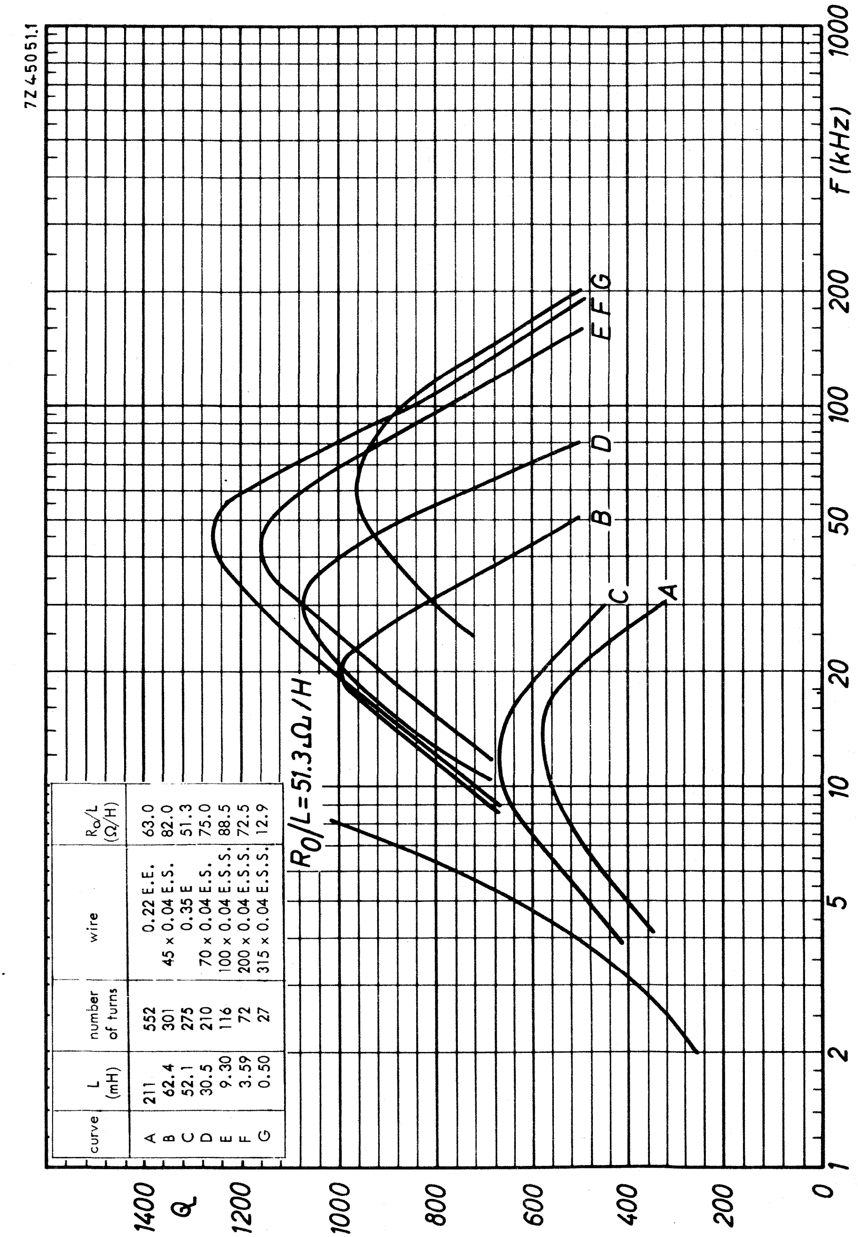
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 100$



curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	143	552	0.22 E.E.	93
B	42.6	301	45 × 0.04 E.S.	120
C	35.7	275	0.35 E	75
D	20.8	210	70 × 0.04 E.S.	110
E	6.34	116	100 × 0.04 E.S.S.	130
F	2.45	72	200 × 0.04 E.S.S.	106
G	0.34	27	315 × 0.04 E.S.S.	187

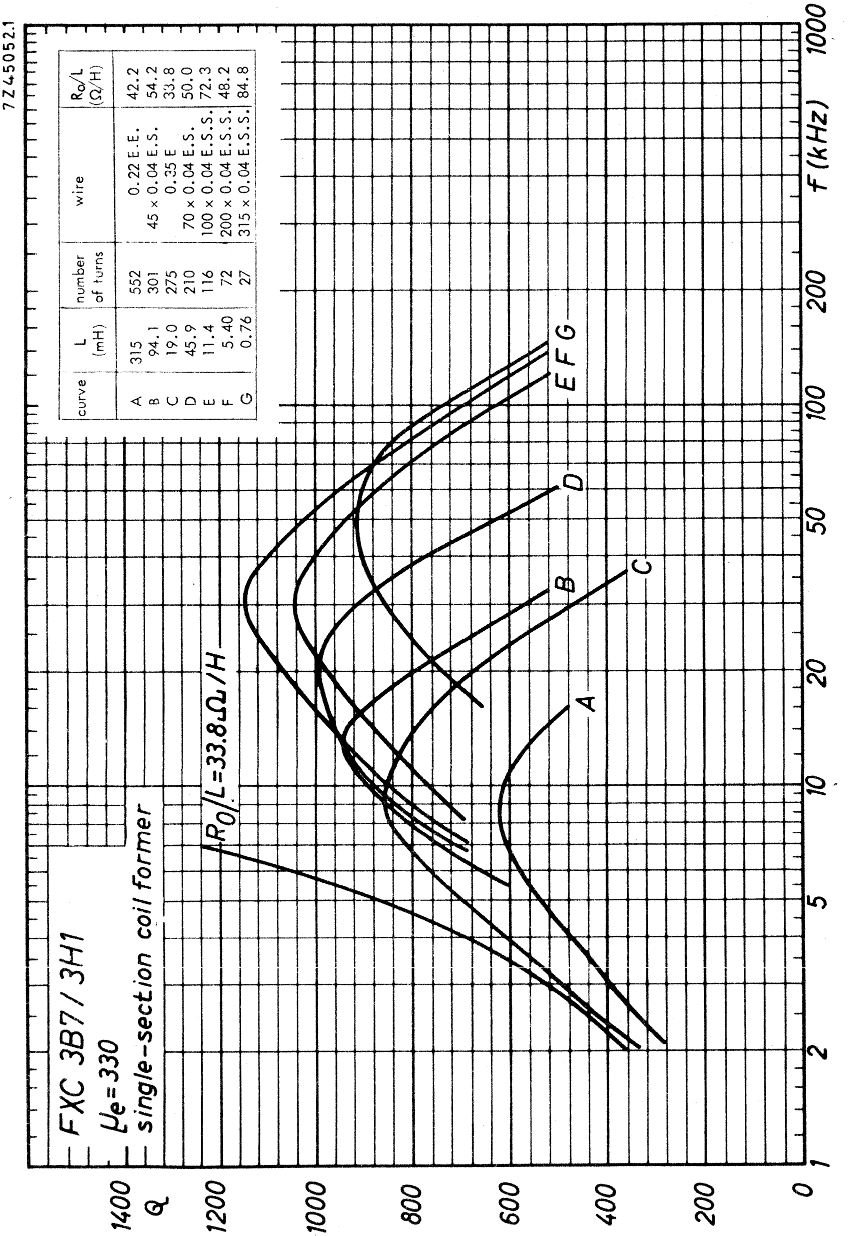
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 150$



curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	211	552	0.22 E.E.	63.0
B	62.4	301	45 × 0.04 E.S.	82.0
C	52.1	275	0.35 E	51.3
D	30.5	210	70 × 0.04 E.S.	75.0
E	9.30	116	100 × 0.04 E.S.S.	88.5
F	3.59	72	200 × 0.04 E.S.S.	72.5
G	0.50	27	315 × 0.04 E.S.S.	12.9

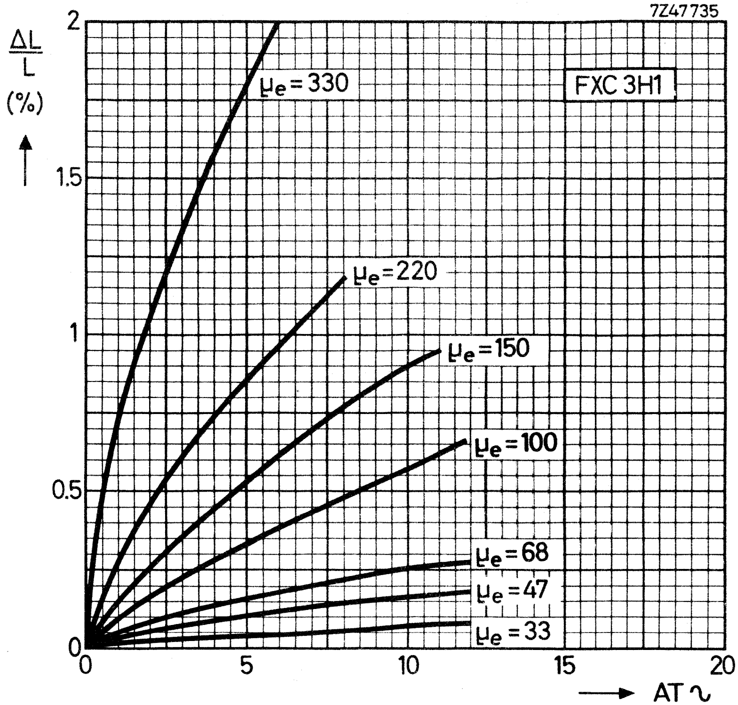
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 220$

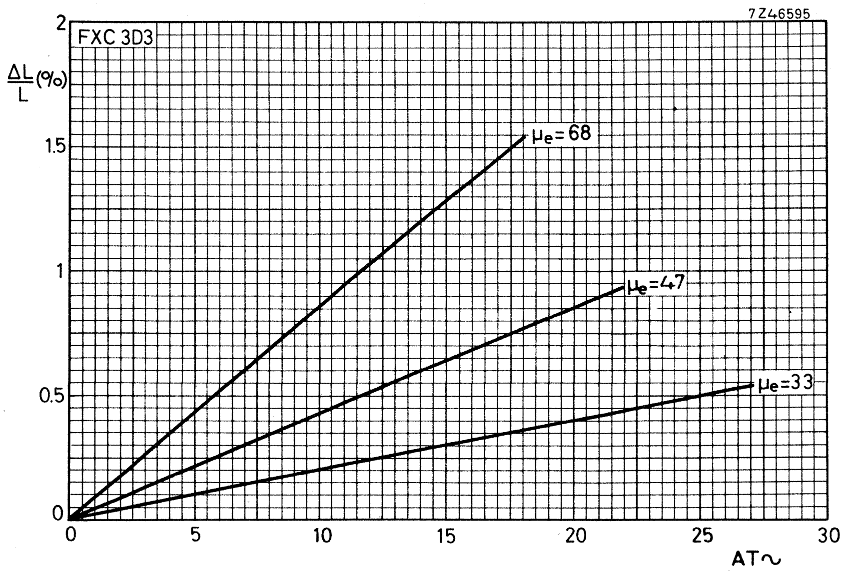


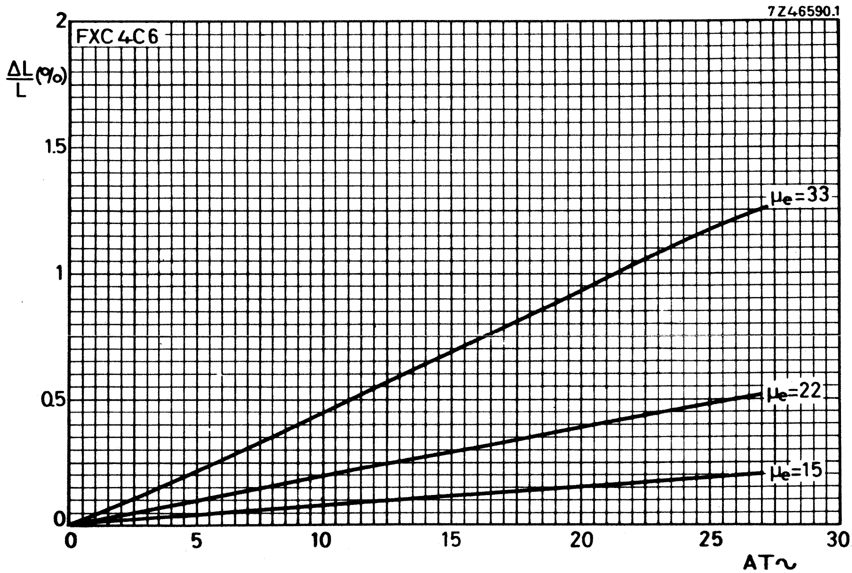
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	315	552	0.22 E.E.	42.2
B	94.1	301	45 × 0.04 E.S.	54.2
C	19.0	275	0.35 E	33.8
D	45.9	210	70 × 0.04 E.S.	50.0
E	11.4	116	100 × 0.04 E.S.S.	72.3
F	5.40	72	200 × 0.04 E.S.S.	48.2
G	0.76	27	315 × 0.04 E.S.S.	84.8

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
μ_e = 330

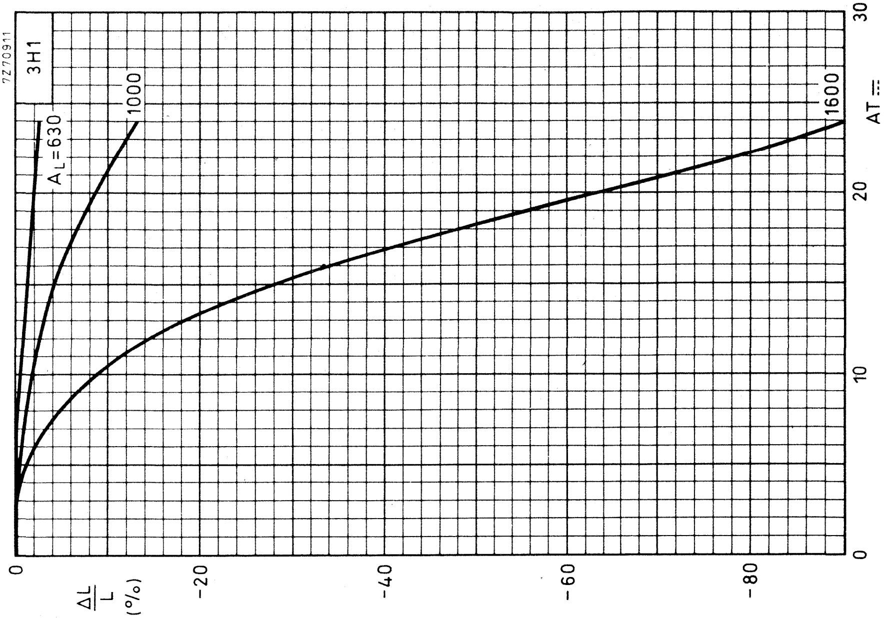
INDUCTANCE VARIATION AS A FUNCTION OF AT ~

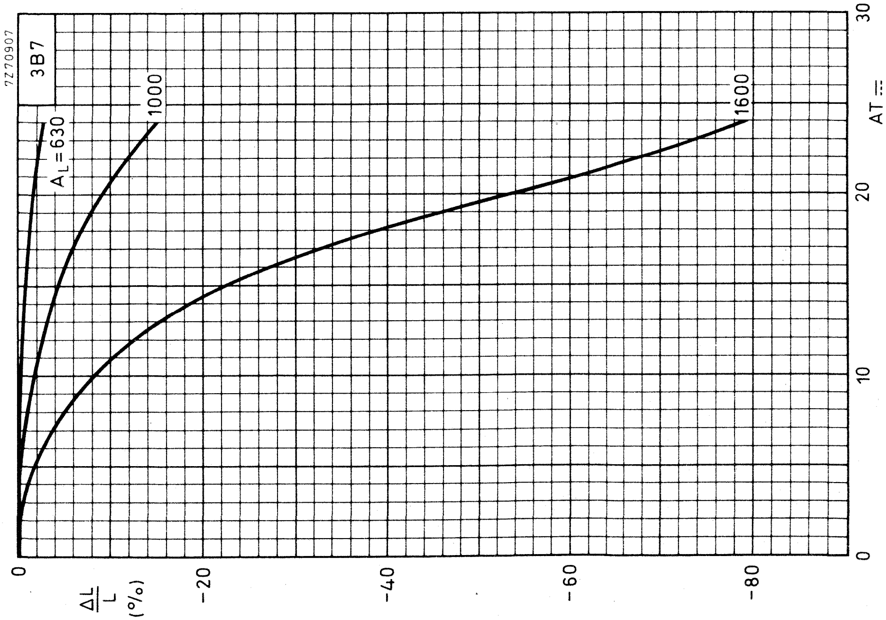


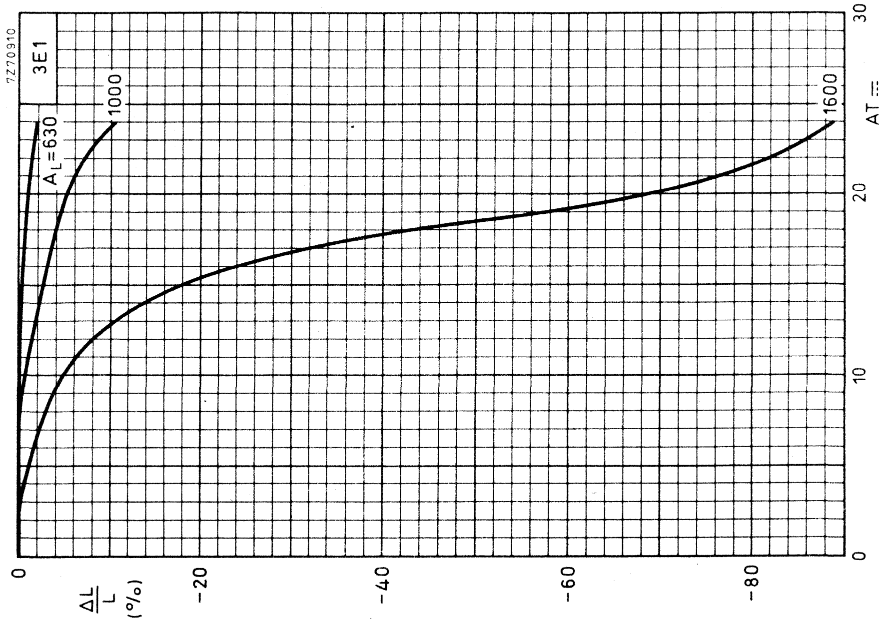

7Z46595
FXC 3D3
ΔL/L (%)
2
1.5
1
0.5
0
μe=68
μe=47
μe=33
0
5
10
15
20
25
30
AT~

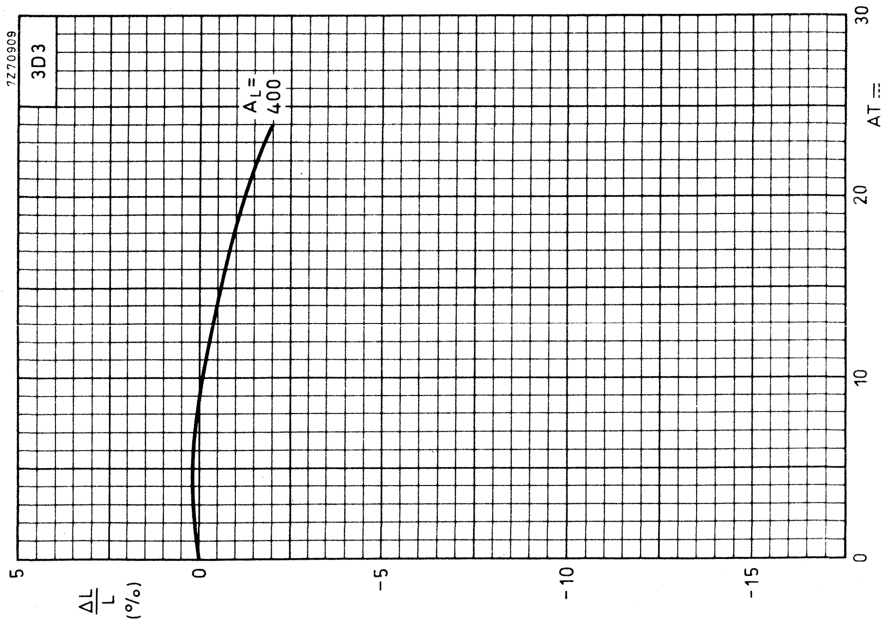

7Z46590.1
FXC 4C6
ΔL/L (%)
2
1.5
1
0.5
0
μe=33
μe=22
μe=15
0
5
10
15
20
25
30
AT~

INDUCTANCE VARIATION AS A FUNCTION OF AT ⎓

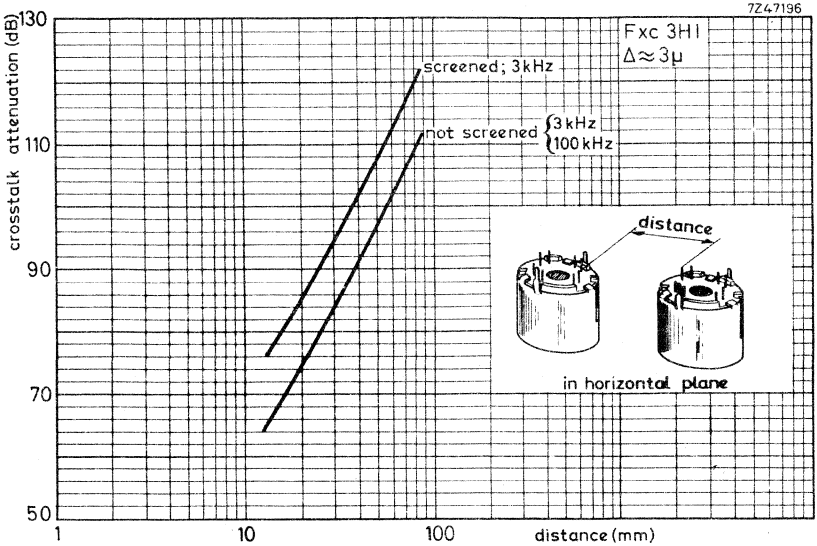


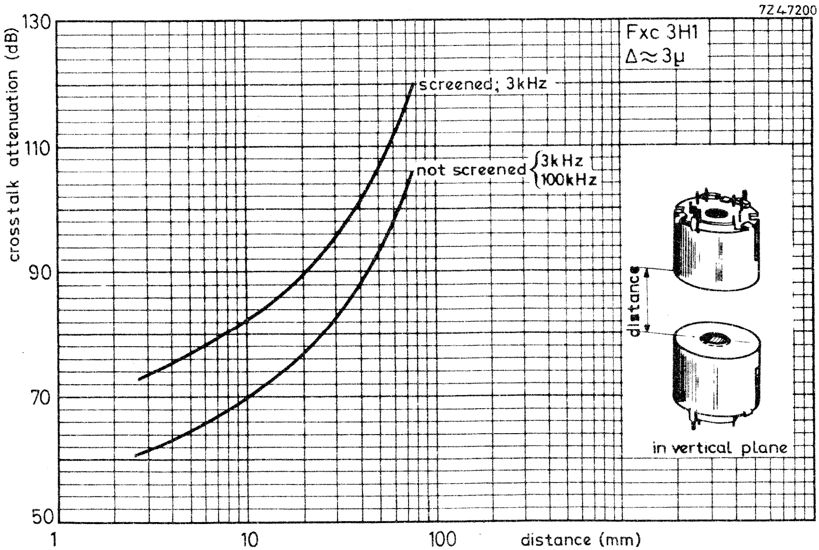


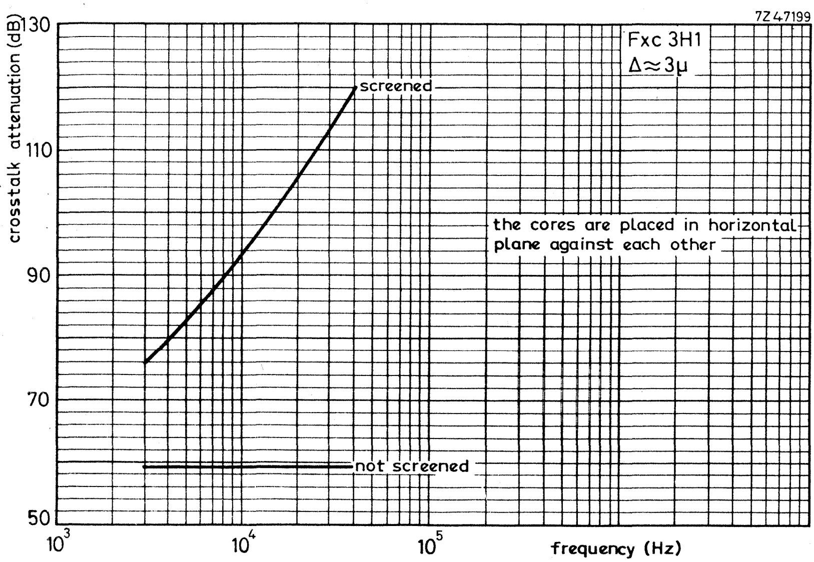

7Z70910
3E1
A_L=630
1000
1600
AT
ΔL/L (%)
0
-20
-40
-60
-80
0
10
20
30


7Z70909
3D3
A_L=
400
AT
ΔL/L (%)
5
0
-5
-10
-15
0
10
20
30

CROSSTALK ATTENUATION






7Z47199
Fxc 3H1
Δ≈3μ
screened
not screened
the cores are placed in horizontal plane against each other
crosstalk attenuation (dB)
130
110
90
70
50
10^3
10^4
10^5
frequency (Hz)

POTCORES

Three types of core can be supplied:

- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

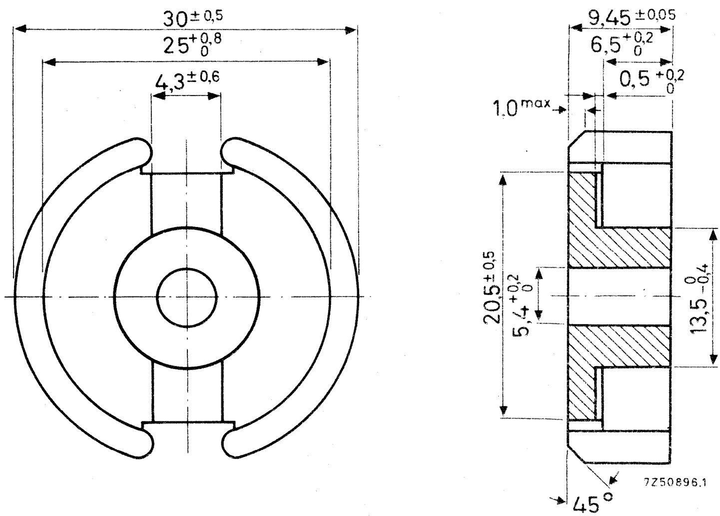
The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.

Quantity: a primary pack contains 10 potcore halves or 5 pieces of pre-adjusted potcores, a storage pack contains 200 halves or 100 pre-adjusted potcores.
Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 22250
3B8	4322 020 22390
3D3	4322 020 22270
3E1	4322 020 22300
3H1	4322 020 22260

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (°C)	grade 3B7	3B8	3D3	3E1	3H1
$\alpha_F \times 10^6$	+5 to +25		0 to +2 *			+0,5 to +1,5
	+25 to +55		0 to +2 *			+0,5 to +1,5
	+25 to +70	-0,6 to +0,6		0 to +2	0 to +2	
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 4,3 *	≤ 12		≤ 4,3

For the combination of two potcores halves randomly chosen from a batch and pressed together with a force of 250 Newton, the values in Table II are guaranteed at 25 ± 10 °C.

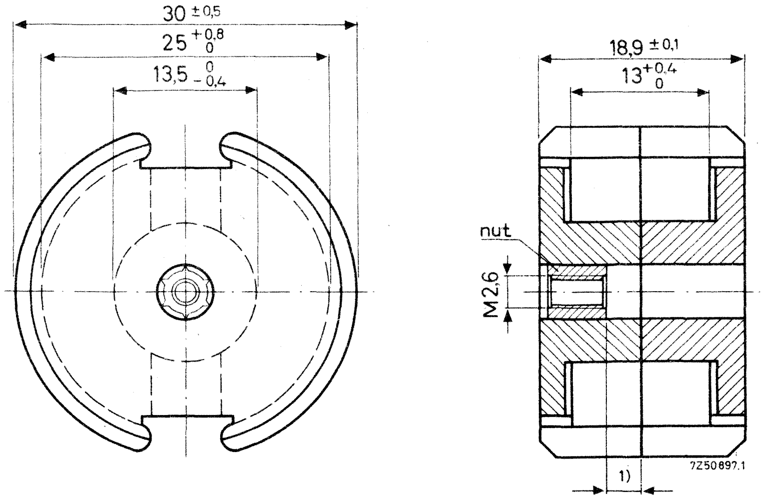
Table II	$\hat{B}$ (mT)	freq. (kHz)	grade 3B7	3B8	3D3	3E1	3H1
μ_e ± 25%	≤ 0,1	4	1990	1840		2920	1990
	≤ 0,1	100			740		
α	≤ 0,1	4	≤ 13,3*	≤ 13,3*			≤ 13,3*
	≤ 0,1	100			≤ 21,7*		
A_L ± 25%	≤ 0,1	4	7500	7085		11100	7500
	≤ 0,1	100			2800		
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	4	≤ 1,2	≤ 1,5		≤ 2,5	≤ 1,2
	≤ 0,1	100	≤ 6	≤ 7	≤ 8	≤ 20	≤ 6
	≤ 0,1	500			≤ 16		
	≤ 0,1	1000			≤ 40		
$q_{2-24-100}$	1,5-3,0	4	≤ 1,8			≤ 3,0	≤ 1
	0,3-1,2	100			≤ 3,0		
$\eta_B \times 10^3$	1,5-3,0	4	≤ 1,1	≤ 0,7		≤ 1,8	≤ 0,62
	0,3-1,2	100			≤ 1,8		

μ_Δ for grade 3B8 at 5,69 AT ≥ 658
at 8,91 AT ≥ 281
at 11,0 AT ≥ 144

*) For guidance only.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 3. . . .
Without nut, catalogue number = 4322 022 1. . . .

Mass per set = 34 g

Effective length l_e = 45,2 mm

$$\Sigma \frac{l_e}{A_e} = 0,33 \text{ mm}^{-1}$$

Effective volume V_e = 6190 mm^3

Notes to the tables on the next page

1. Examples of catalogue number:
   μ_e = 33, grade 3D3, potcore with nut, catalogue number = 4322 022 30430
   A_L = 400, grade 3B7, potcore without nut, catalogue number = 4322 022 11080
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 740 = A_L of 2800, μ_e of 1990 = A_L of 7510.

1) For this distance see adjustment curves under Inductance Adjustment.

Pre-adjusted potcores with standard μ_e values [1]

μ_e	α	tolerance on inductance (%)	cat. no. 4322 022 3.... with nut / 4322 022 1.... without nut		
			3B7	3D3	3H1
33	89,2	± 1	0030	0430	0230
47	74,7	± 1		0440	
68	62,1	± 1	0050	0450	0250
100	51,3	± 1,5	0060		0260
150	41,8	± 2	0070		0270
220	34,6	± 3	0080		0280
330	28,2	± 3	0090		0290
740	18,9	± 25		0400 *	
1990	11,5	± 25	0000 *		0200 *

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H)

Symmetrical air gap for cores with an μ_e value of 33 up to and including 100.
Asymmetrical air gap for cores with an μ_e value of 150 up to and including 1990.

Pre-adjusted potcores with standard A_L factors [1]

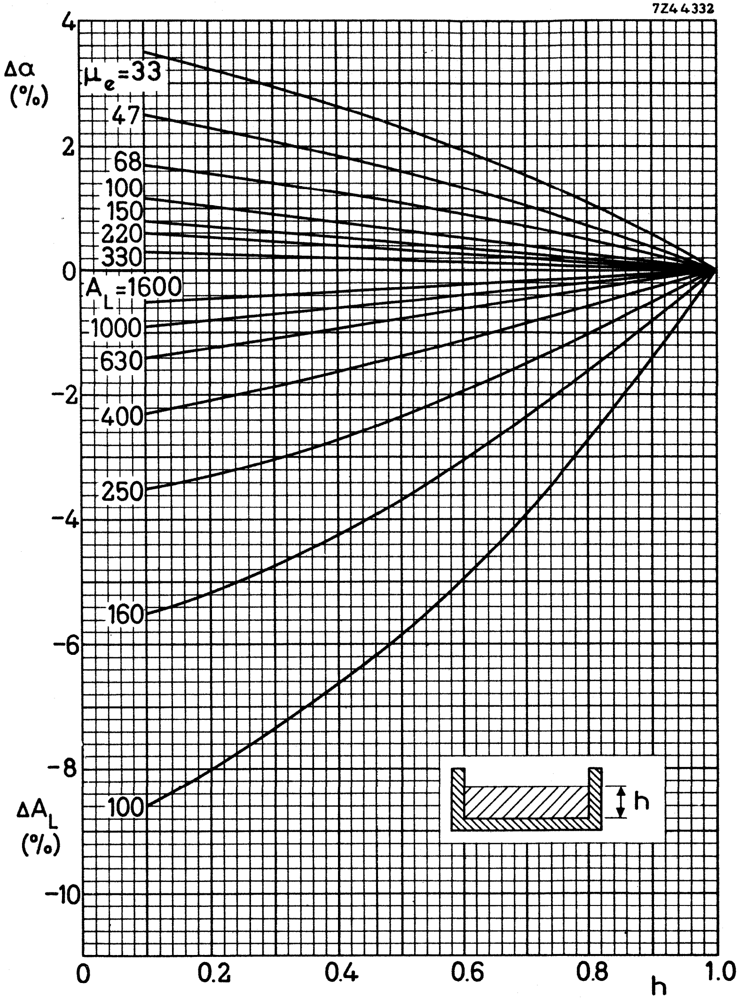
A_L	corresponding μ_e-value	tolerance on inductance (%)	cat. no. 4322 022 3.... with nut / 4322 022 1.... without nut		
			3B7	3D3	3H1
100	26,2	± 1	1040	1440	
160	42	± 1	1050	1450	
250	65,5	± 1	1060	1460	1260
→ 315	83	± 1,5	1070		
400	105	± 1,5	1080		1280
630	165	± 2	1100		1300
1000	263	± 3	1110		1310
1600	420	± 3	1120		1320
2500	655	± 3	1130		1330

Inductance $L = N^2 A_L$ (L in 10^{-9} H)

Symmetrical air gap for cores with an A_L factor of 100 up to and including 400.
Asymmetrical air gap for cores with an A_L factor of 630 up to and including 2500.

[1]) See notes on the previous page.

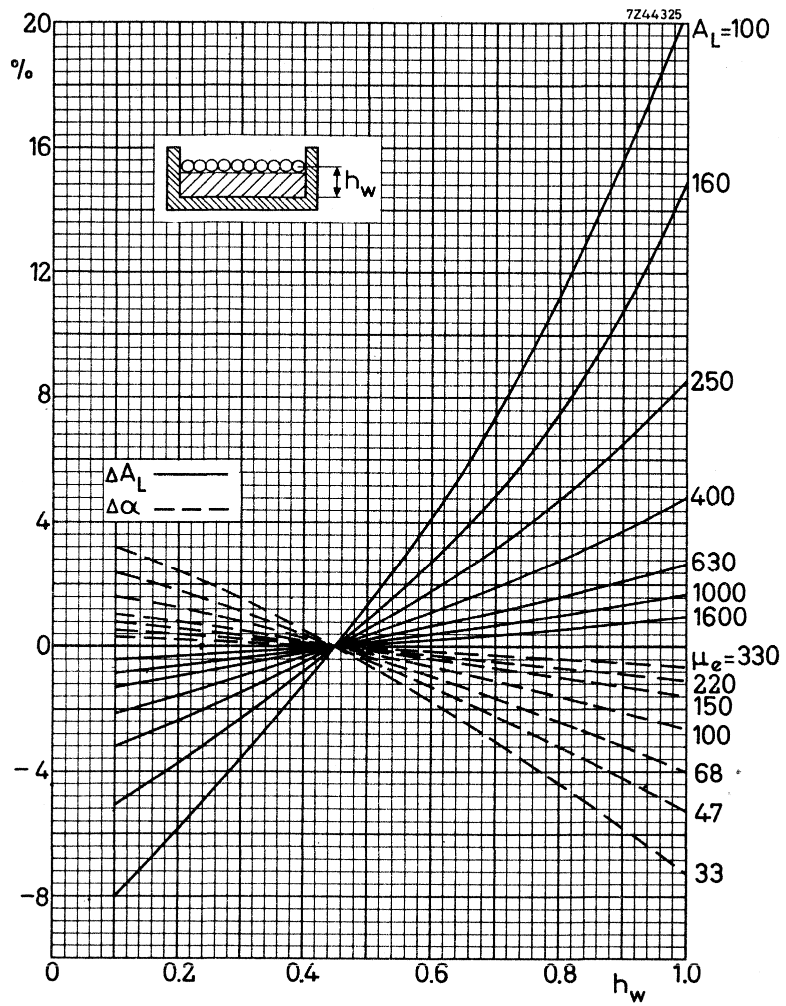
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 68 in that case obtains an α factor of 62.1 + 1.25%.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_W on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 62.1 - 1.6%.

COIL FORMERS

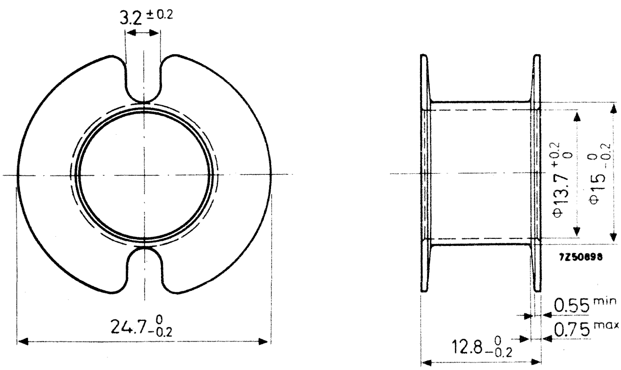
GENERAL

Three types of coil former can be supplied:

- with one section
- with two sections
- with three sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS 4061 range 2 (Great Britain).
The dimensions in the drawings are in mm.

SINGLE-SECTION COIL FORMER



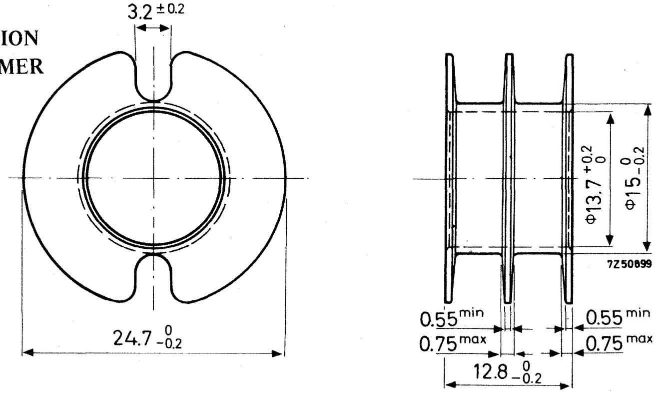
Catalogue number	4322 021 30360
Material	polycarbonate
Window area	55 mm^2
Mean length of turn	62 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 5{,}07 \times 10^3 \ \Omega/H$$

Weight 0,75 g

TWO-SECTION COIL FORMER



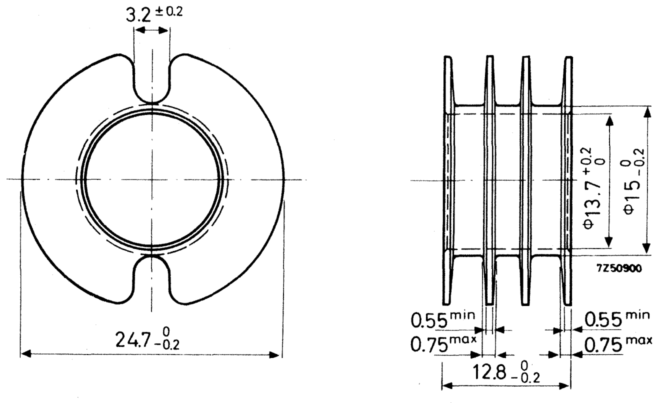
Catalogue number	4322 021 30370
Material	polycarbonate
Window area	2 x 26 mm^2
Mean length of turn	62 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 5.38 \times 10^3 \ \Omega/H$$

Weight 1.0 g

THREE-SECTION COIL FORMER



Catalogue number	4322 021 30380
Material	polycarbonate
Window area	3 x 16 mm^2
Mean length of turn	62 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 5.74 \times 10^3 \ \Omega/H$$

Weight 1.2 g

INDUCTANCE ADJUSTORS

CONTINUOUS ADJUSTORS

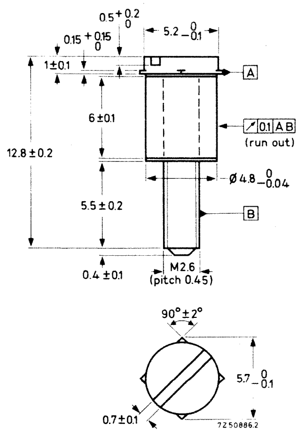


Fig. A

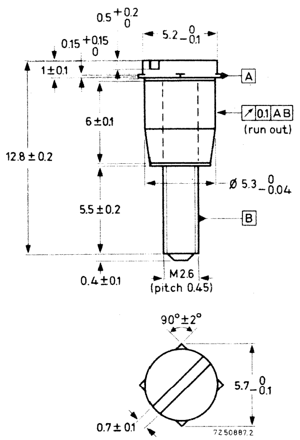


Fig. B

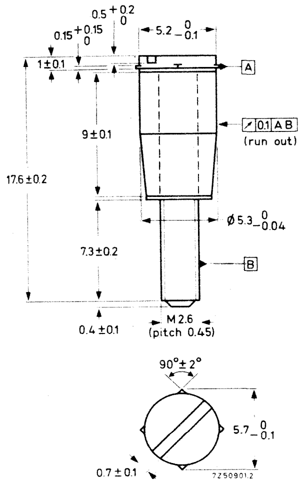


Fig. C

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03 % by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.

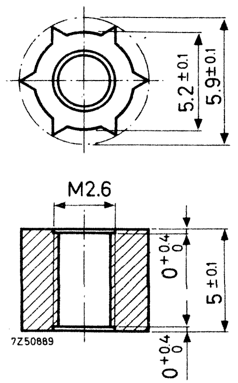
Types of adjustor and recommended applications.

Fig.	colour	catalogue number 4322 021	potcore	
			μ_e	A_L
A	green	30780	33	100
A	red	30800	47	160
B	white	30980	68	250
B	white	30980	100	400
A	brown	30810	150	630
B	grey	31090	220	1000
C	black	31120	330	1600

The adjustors are packed in bags of 100, so please order in multiples of 100.

Nut for adjustor

These data are given for those manufacturers who prefer to insert the nut themselves.

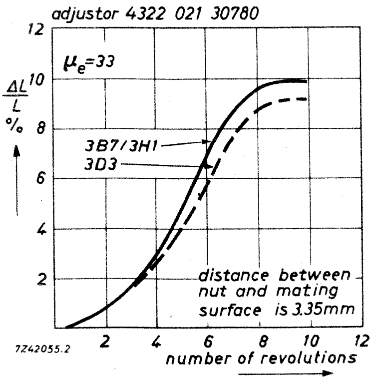


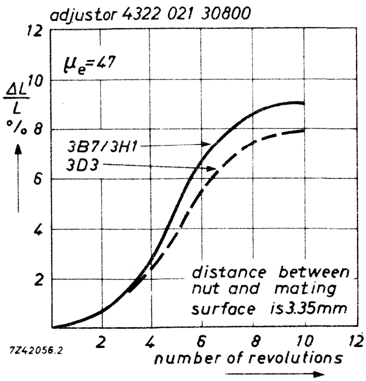
Catalogue number	4322 021 30160
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut (see Adjustment curves)	3.35 ± 0.15 mm or 4.35 ± 0.15 mm

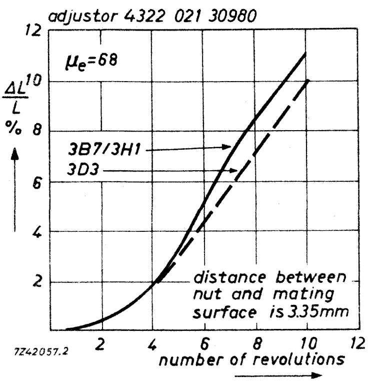
For more information see Potcores General, Mounting data.

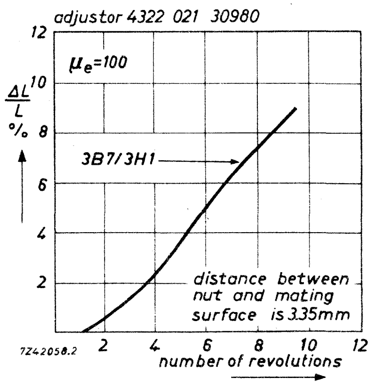
The nuts are packed in bags of 100, so please order in multiples of 100.

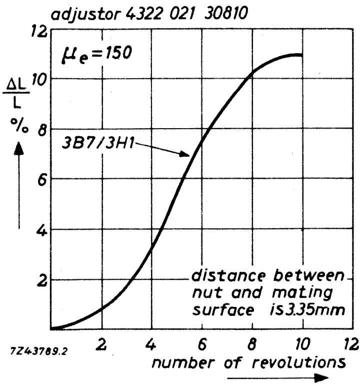
Adjustment curves

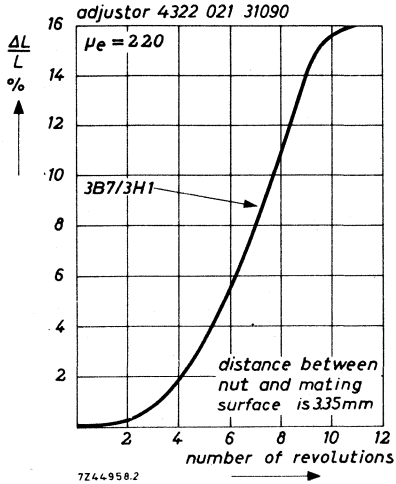


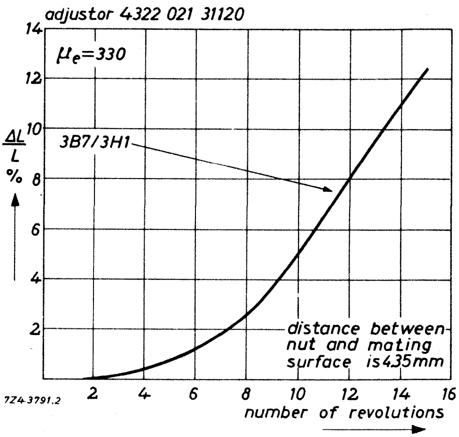







adjustor 4322 021 30810
μ_e=150
ΔL/L %
3B7/3H1
distance between nut and mating surface is 3.35mm
number of revolutions
7Z43789.2

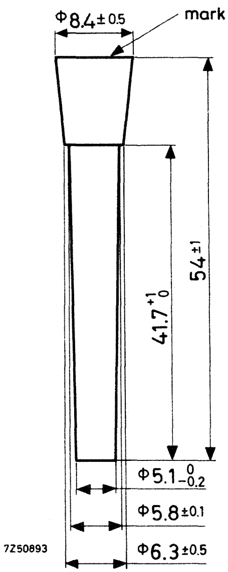

adjustor 4322 021 31090
μ_e=220
ΔL/L %
3B7/3H1
distance between nut and mating surface is 3.35mm
number of revolutions
7Z44958.2

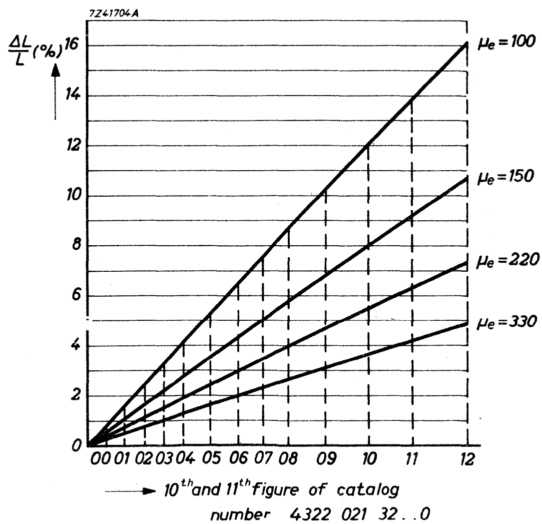

adjustor 4322 021 31120
μ_e=330
ΔL/L %
3B7/3H1
distance between nut and mating surface is 4.35mm
number of revolutions
7Z43791.2

STEP-BY-STEP ADJUSTORS

These adjustors are used when a continuous adjustment of the inductance is not necessary. For instance, they are applied in loading coils to bring the inductance within a certain tolerance field. They are not suitable for adjusting the inductance to an exact value, as is usually necessary in filters. The increment of the losses caused by these adjustors is negligible.
A range of 13 flexible conical adjustors is available under the catalog numbers 4322 021 32000 up to 021 32120. Each adjustor causes an increase in the inductance; the higher the catalog number, the greater the effect. The influence of each adjustor on the inductance at different μ_e values of the potcore can be found from the graph.
The 10th and 11th figure of the catalog number are indicated on the head of the adjustor. It should be borne in mind that, when using these adjustors, the inductance of the coil should initially be lower than the wanted value.
When the correct adjustor has been found, it is inserted in the centre hole of the pot. An adhesive (for instance Pliobond of Good Year) is used as sliding and fixing material. After fixing the protruding ends are cut off.

The maximum impregnation temperature is 150 °C.
The maximum working temperature is 90 °C.
Material: rubber with powder iron.

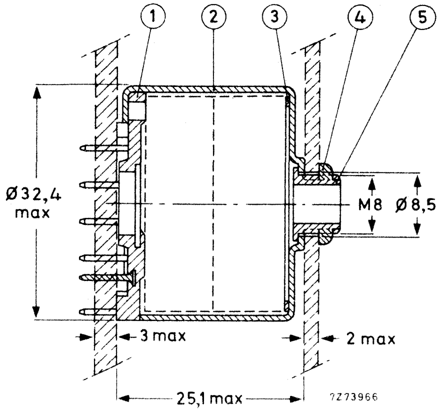


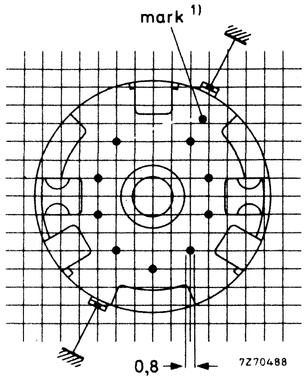


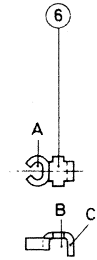
Dimensions in mm

MOUNTING PARTS

MOUNTING







(1) tag plate	4322 021 30480	(4) nut	4322 021 30710
(2) brass container	4322 021 30560	(5) fixing bush	4322 021 30720
(3) spring	4322 021 30670	(6) soldering spring	4322 021 30700 (9x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

→ The nine soldering pins are arranged to fit a grid of 2,54 mm (0,1 inch).
The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.

[1]) There is another mark in a similar position on the top of the container.

If one-hole mounting preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8,5 diameter.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

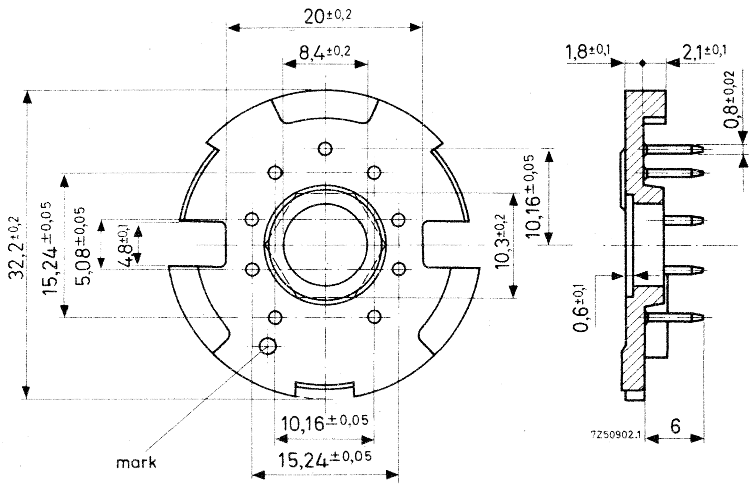
Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 250 Newton. After bending the lips the spring will have the correct tension.

PART DRAWINGS (dimensions in mm)

(1) Tag plate 4322 021 30480

Plate : polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s.

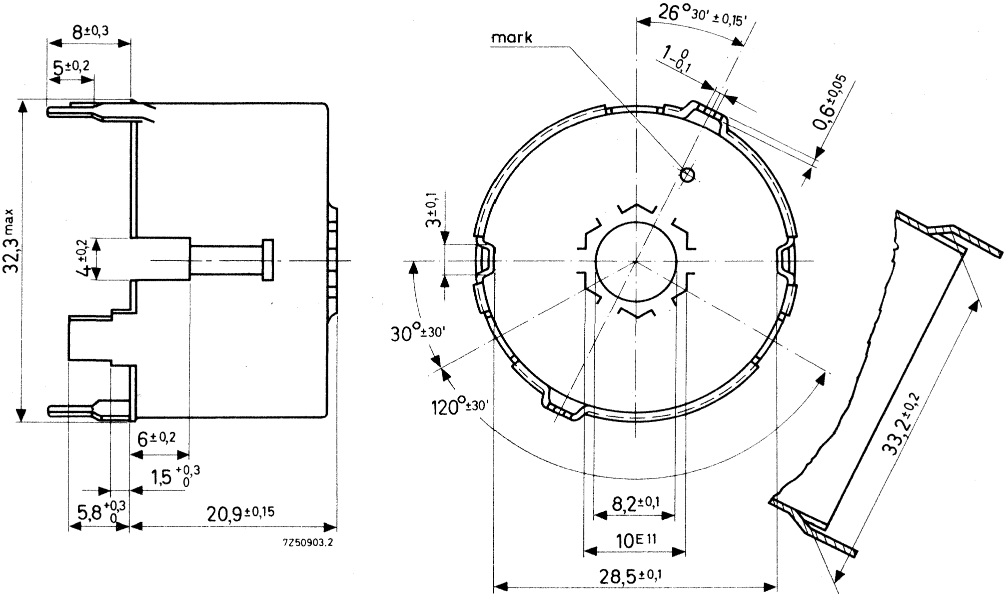
pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 30 pieces on a polystyrene plate, and with 200 pieces in a cardboard box. Please order in multiples of these quantities.

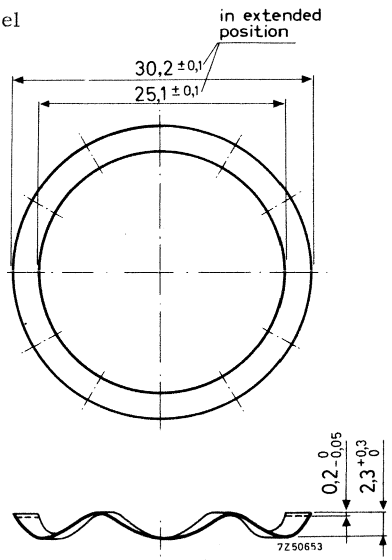
(2) Container 4322 021 30560

→ Material: brass, nickel plated; tinned soldering pins



(3) Spring 4322 021 30670

Material: steel

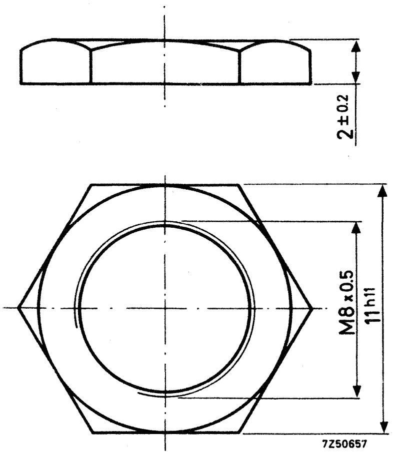


A force of 169 to 281 N is required to compress the spring to 0,45 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

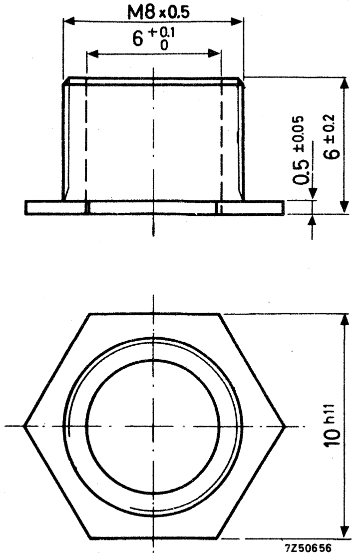
(4) Nut 4322 021 30710

Material: brass, nickel plated



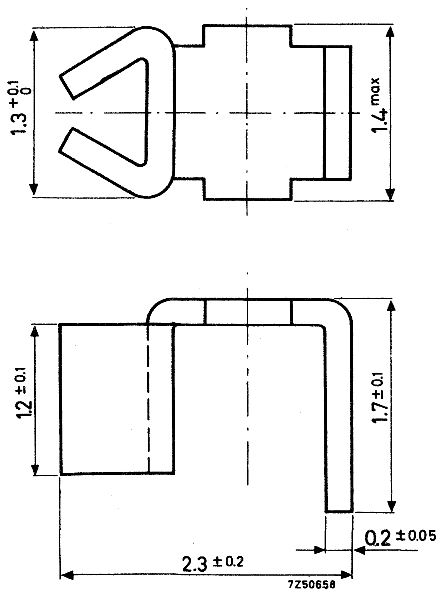
(5) Fixing bush 4322 021 30720

Material: brass, nickel plated



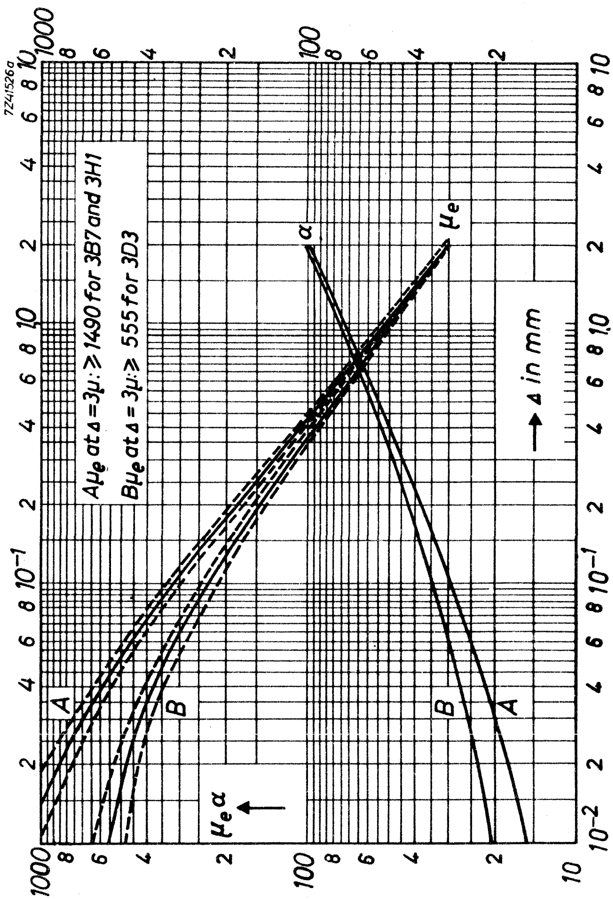
(6) Soldering spring 4322 021 30700

Material: brass, dipsoldered



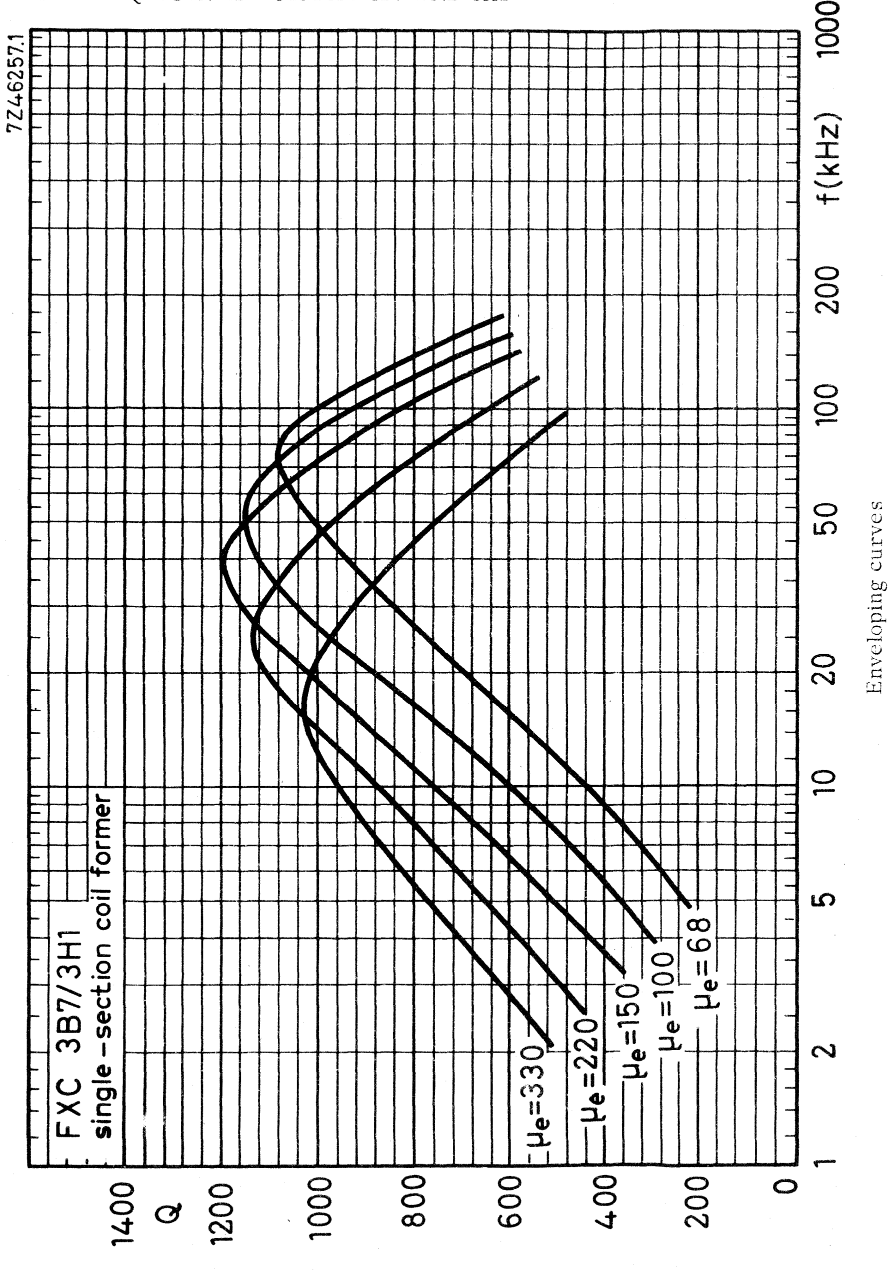
CHARACTERISTIC CURVES

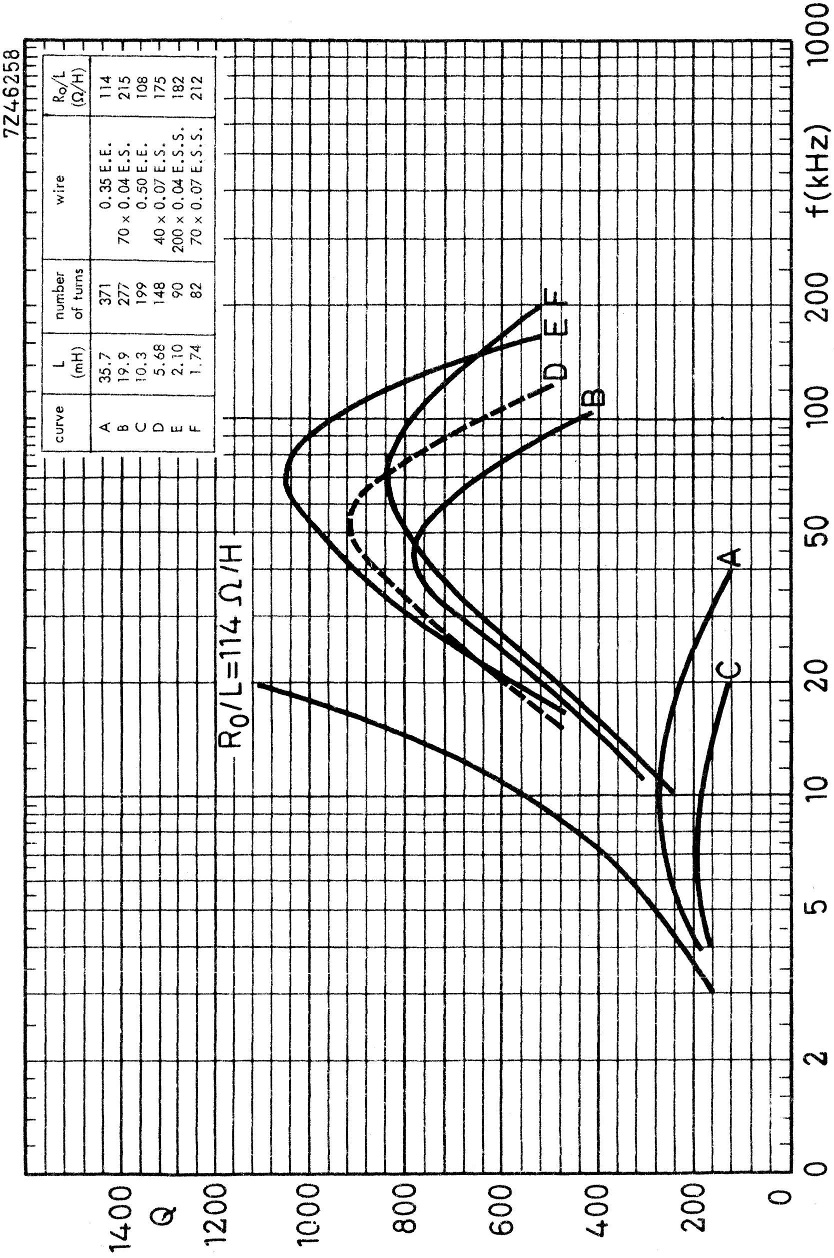
μ_e-α CURVES



Relative effective permeability and turn factor for 1 mH as a function of the air gap length.

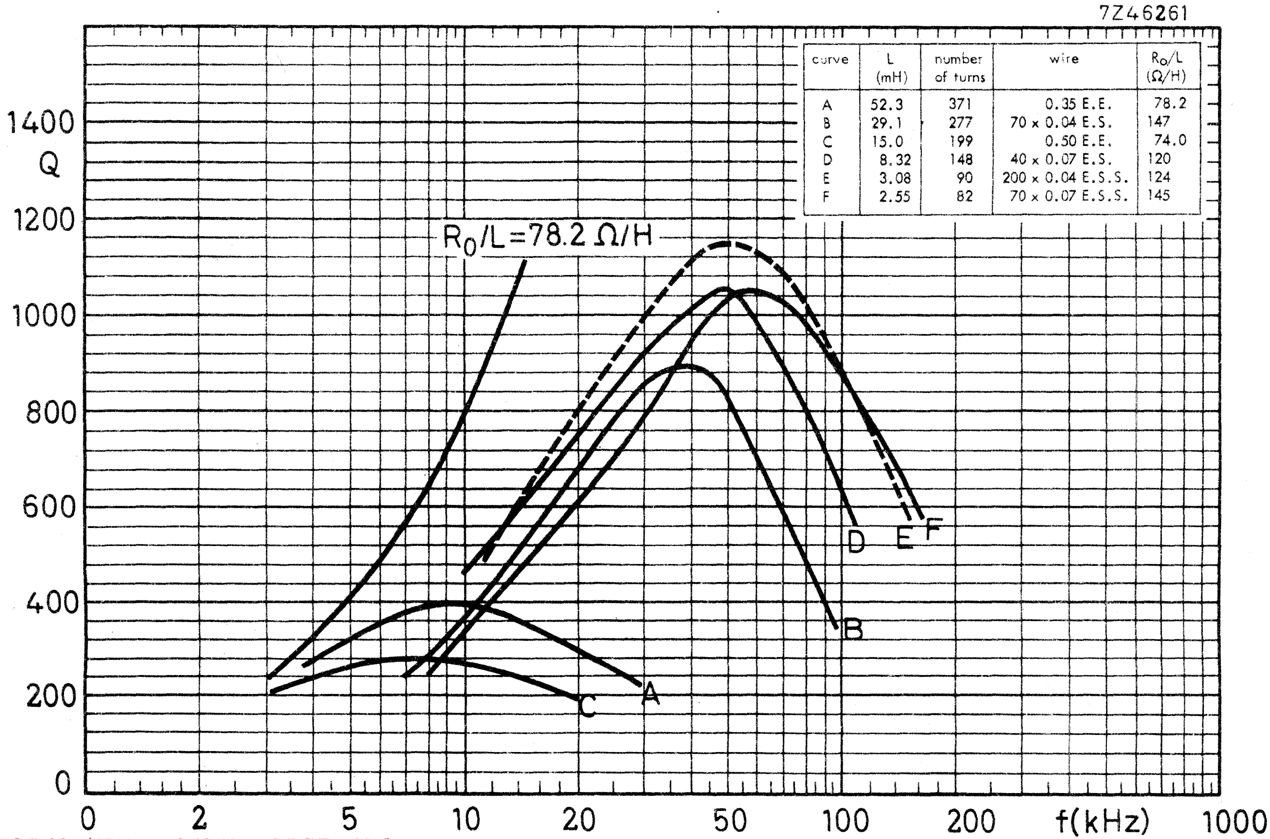
TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1





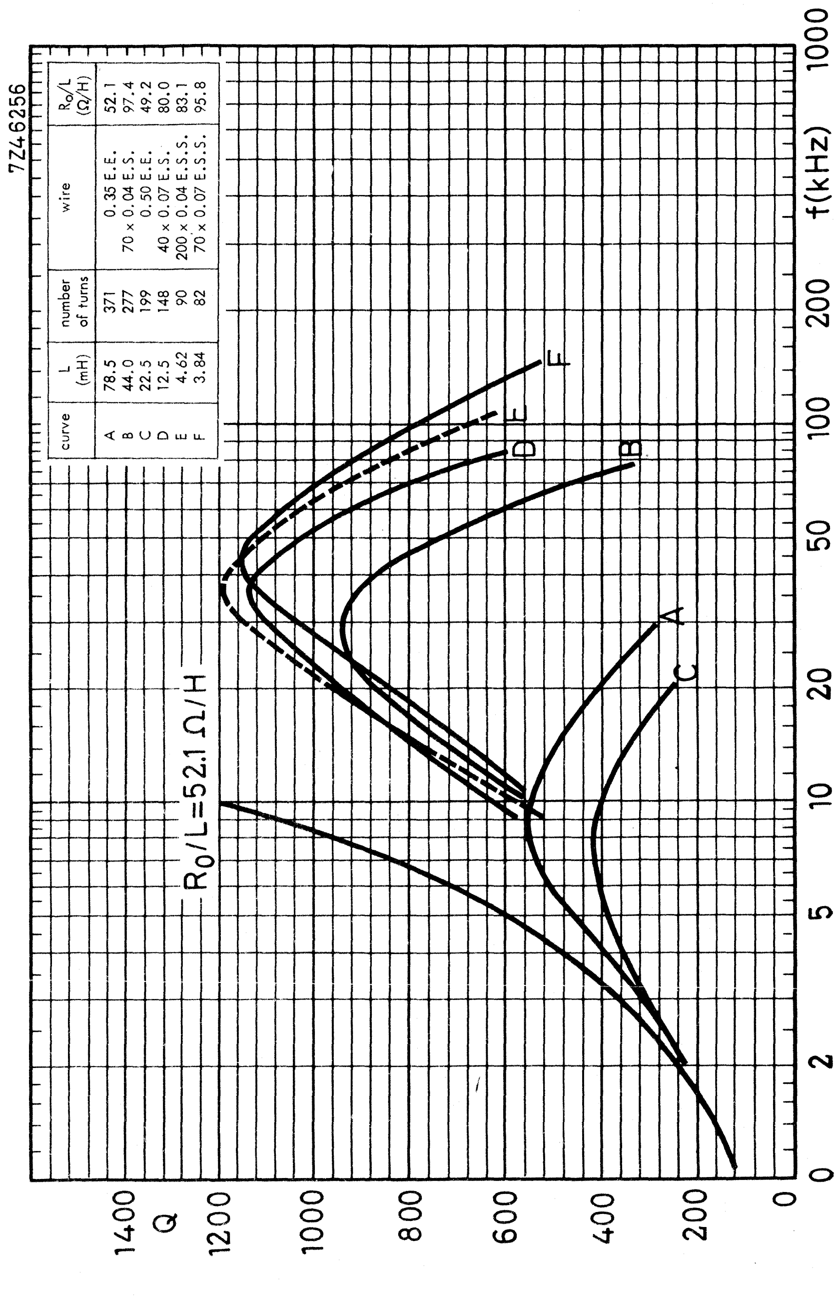
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	35.7	371	0.35 E.E.	114
B	19.9	277	70 × 0.04 E.S.	215
C	10.3	199	0.50 E.E.	108
D	5.68	148	40 × 0.07 E.S.	175
E	2.10	90	200 × 0.04 E.S.S.	182
F	1.74	82	70 × 0.07 E.S.S.	212

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 68$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	52.3	371	0.35 E.E.	78.2
B	29.1	277	70 × 0.04 E.S.	147
C	15.0	199	0.50 E.E.	74.0
D	8.32	148	40 × 0.07 E.S.	120
E	3.08	90	200 × 0.04 E.S.S.	124
F	2.55	82	70 × 0.07 E.S.S.	145

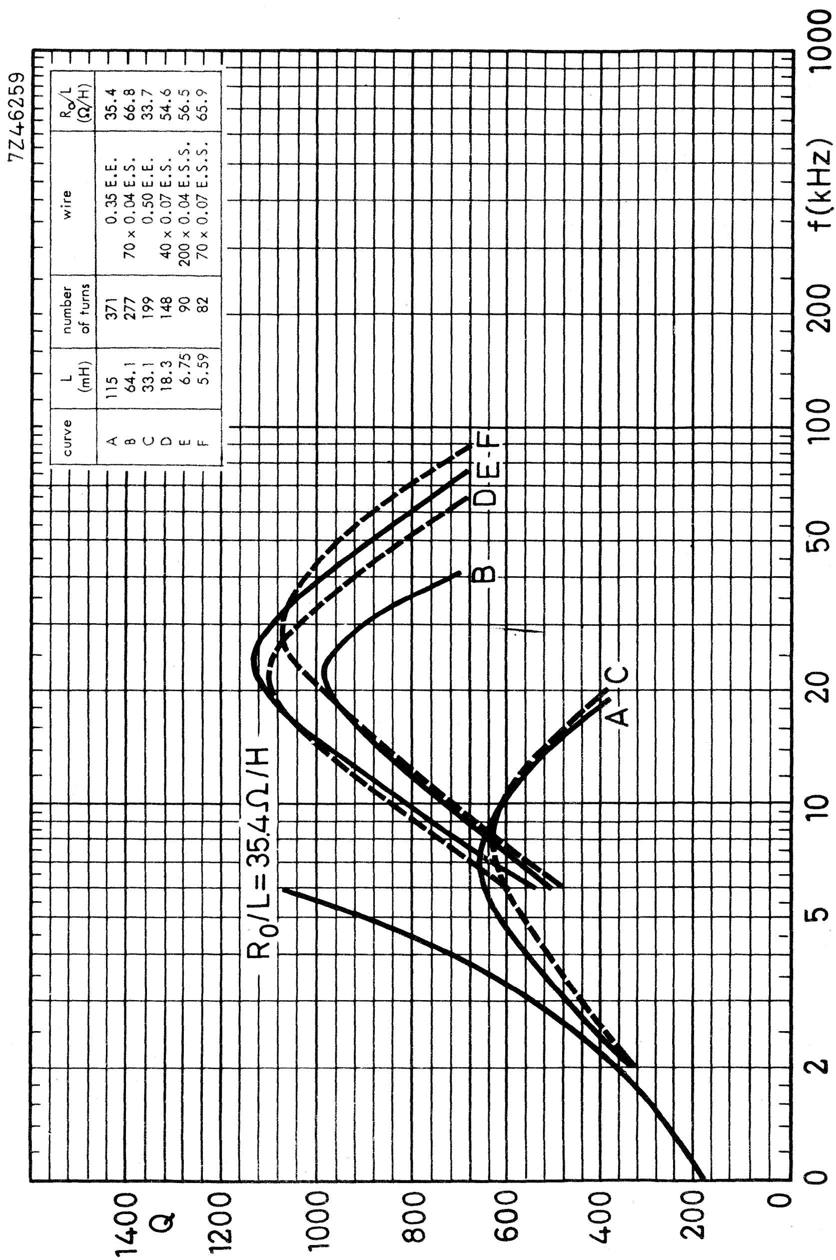
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 100$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	78.5	371	0.35 E.E.	52.1
B	44.0	277	70 × 0.04 E.S.	97.4
C	22.5	199	0.50 E.E.	49.2
D	12.5	148	40 × 0.07 E.S.	80.0
E	4.62	90	200 × 0.04 E.S.S.	83.1
F	3.84	82	70 × 0.07 E.S.S.	95.8

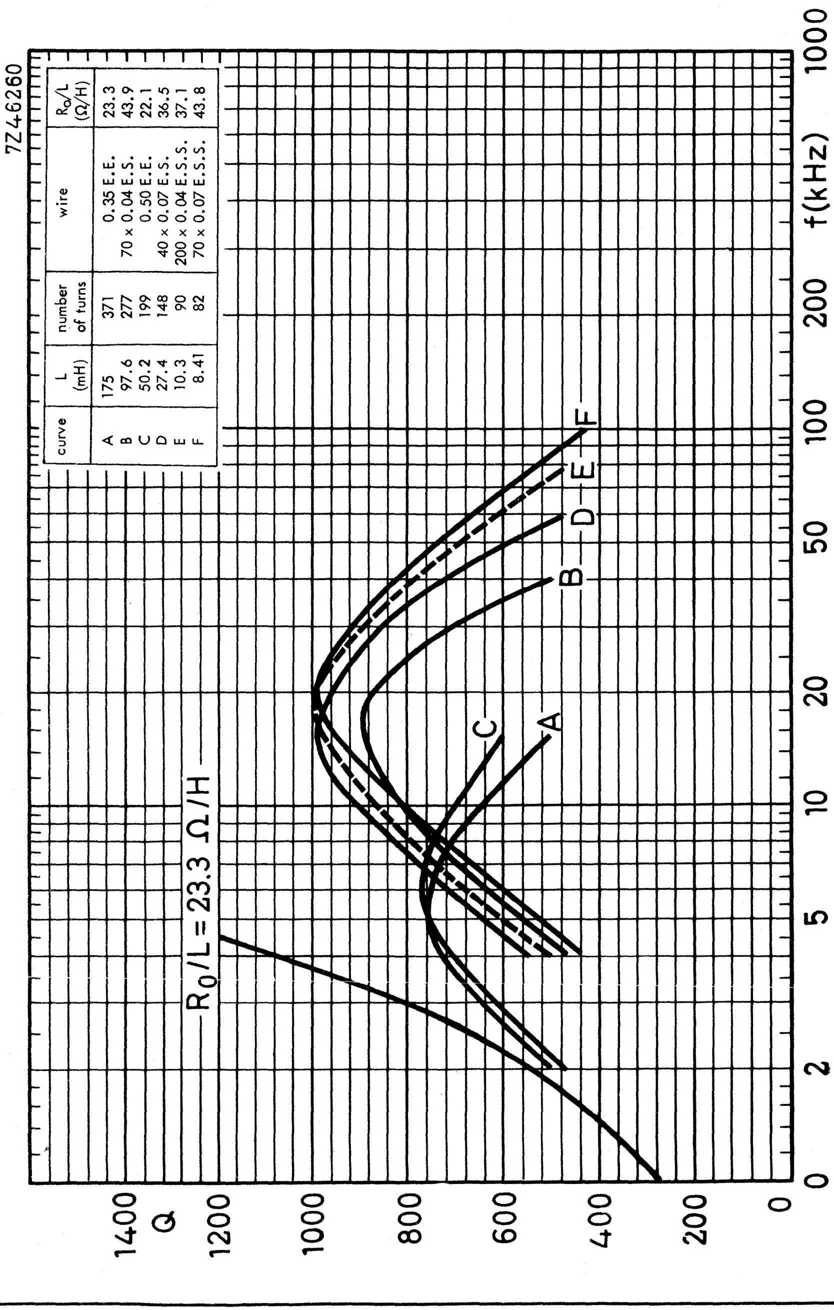
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 150$



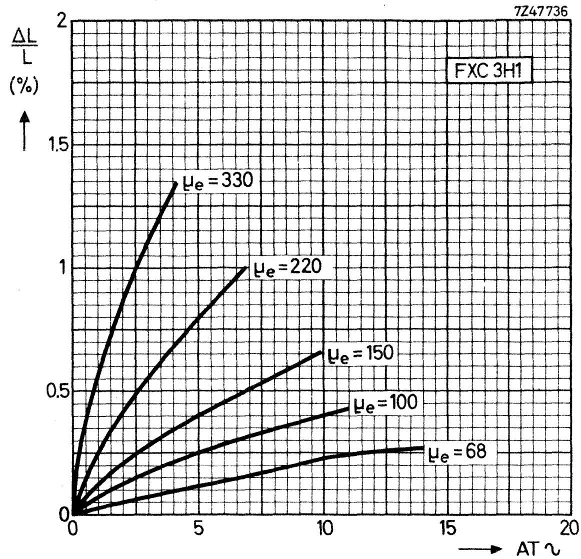
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	115	371	0.35 E.E.	35.4
B	64.1	277	70 × 0.04 E.S.	66.8
C	33.1	199	0.50 E.E.	33.7
D	18.3	148	40 × 0.07 E.S.	54.6
E	6.75	90	200 × 0.04 E.S.S.	56.5
F	5.59	82	70 × 0.07 E.S.S.	65.9

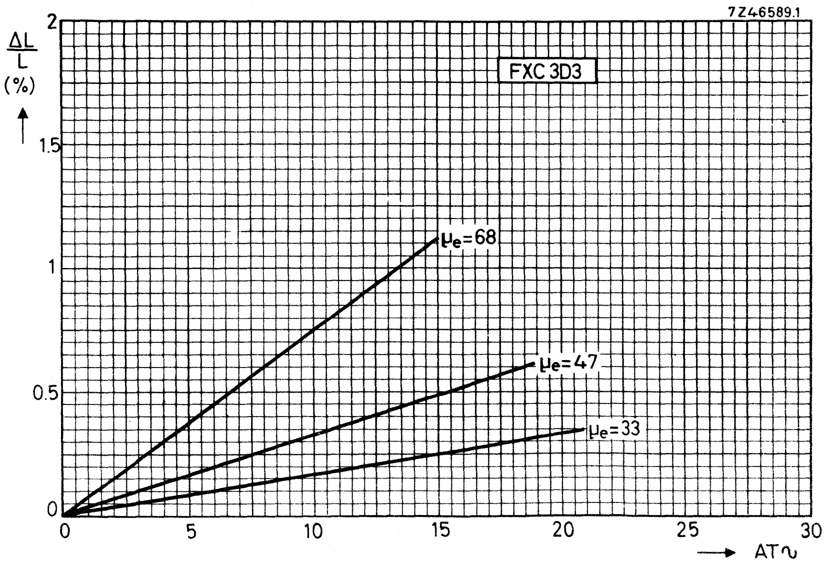
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 220$



FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 330$

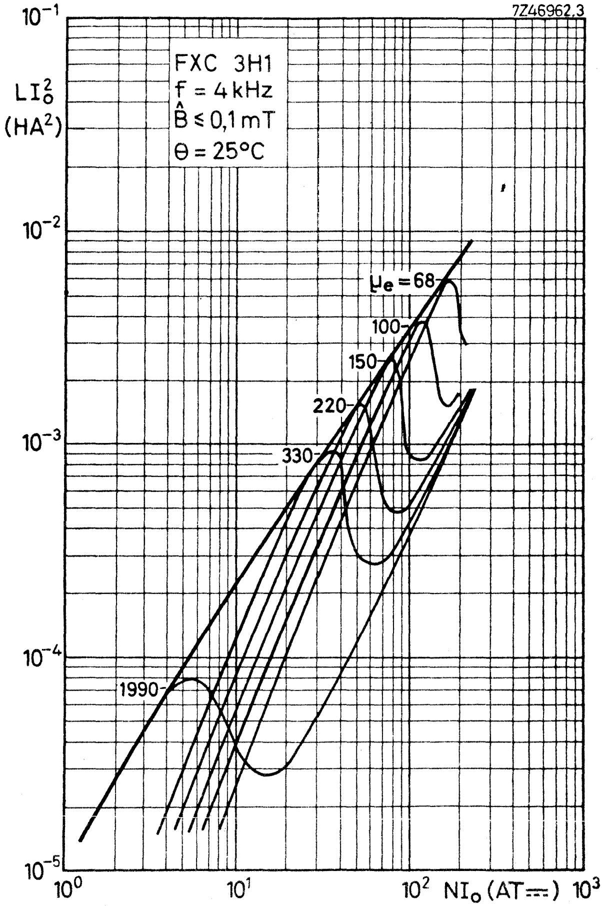
INDUCTANCE VARIATION AS A FUNCTION OF AT~

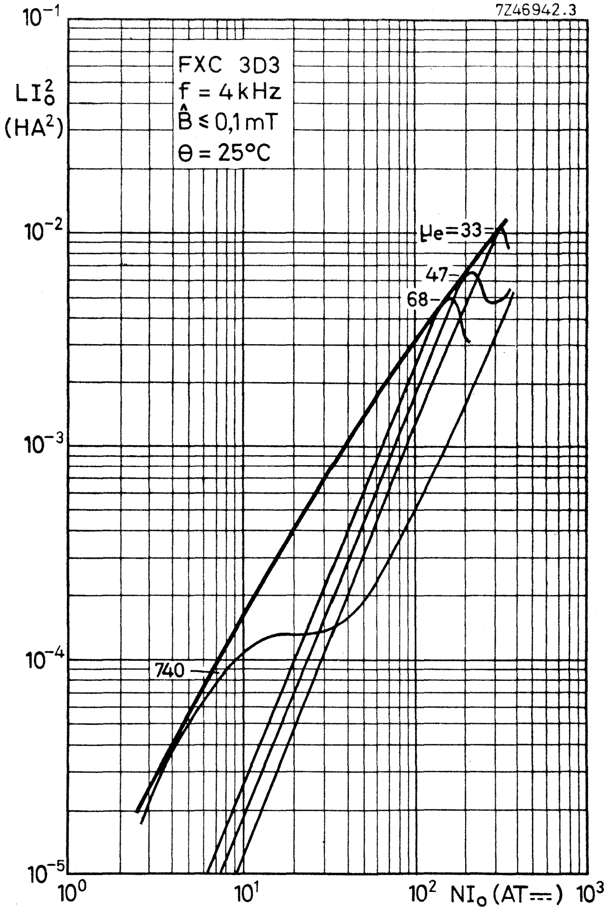




HANNA CURVES

Indicating the optium inductance for a certain μ_e-value and direct current.
Typical values.




7Z46942.3
FXC 3D3
f = 4 kHz
$\hat{B} \leq$ 0,1 mT
Θ = 25°C
LI_o^2
(HA^2)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
μ_e=33
47
68
740
10^0
10^1
10^2
NI_o (AT ⎓)
10^3

POTCORES

Three types of core can be supplied:

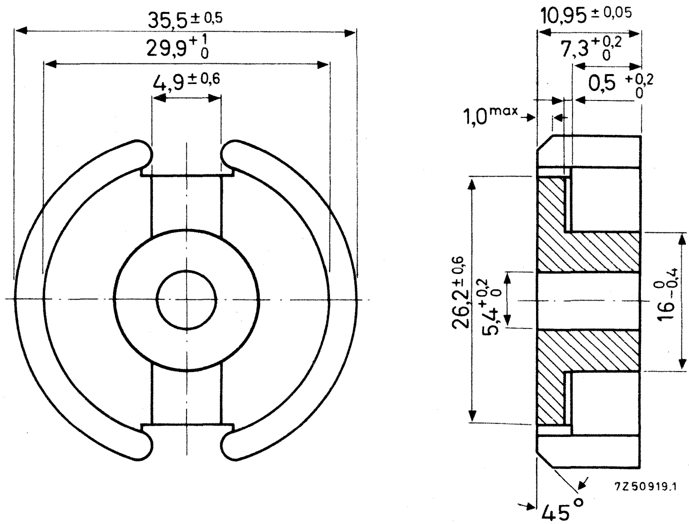
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μ_e) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), DIN 41293 (Germany) and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 10 potcore halves or 5 pieces of pre-adjusted potcores, a storage pack contains 100 halves or 50 pre-adjusted potcores.
Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number
3B7	4322 020 22500
3B8	4322 020 22610
3D3	4322 020 22520
3E1	4322 020 22570
3H1	4322 020 22510

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (^{o}C)	grade				
		3B7	3B8	3D3	3E1	3H1
$\alpha_F \times 10^6$	+5 to +25		0 to +2 *			+0,5 to +1,5
	+25 to +55		0 to +2 *			+0,5 to +1,5
	+25 to +70	-0,6 to +0,6		0 to +2	0 to +2	
$D_F \times 10^6$ (10-100 min)	25 + 1	≤ 4,3	≤ 4,3 *	≤ 12		≤ 4,3

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 350 Newton, the values in Table II are guaranteed at 25 ± 10 ^{o}C.

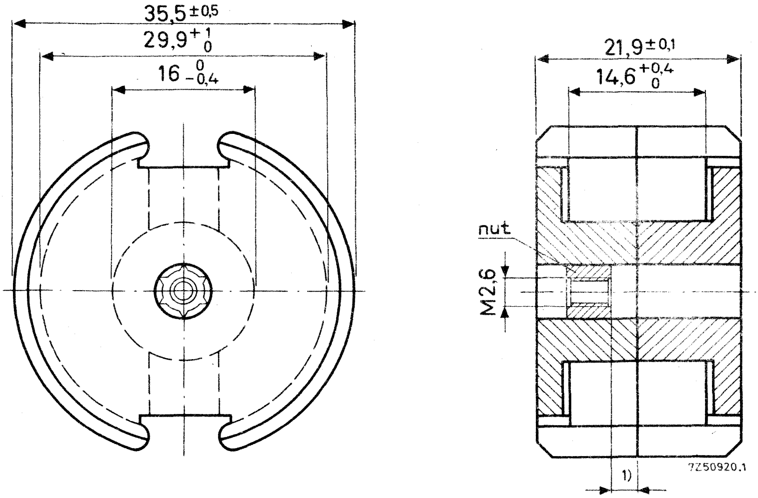
Table II	$\hat{B}$ (mT)	freq. (kHz)	grade				
			3B7	3B8	3D3	3E1	3H1
μ_e ± 25%	≤ 0,1	4	2030	1900		2040	2030
	≤ 0,1	100			750		
α	≤ 0,1	4	≤ 11,7	≤ 11,8			≤ 11,7
	≤ 0,1	100			≤ 19,3		
A_L ± 25%	≤ 0,1	4	9500	9065		14400	9500
→	≤ 0,1	100			3550		
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	4	≤ 1,2	≤ 1,5		≤ 2,5	≤ 1,2
	≤ 0,1	100	≤ 6	≤ 8	≤ 8	≤ 20	≤ 6
	≤ 0,1	500			≤ 18		
	≤ 0,1	1000			≤ 45		
$q_{2-24-100}$	1,5-3,0	4	≤ 1,8			≤ 3,0	≤ 1,0
	0,3-1,2	100			≤ 3,0		
$\eta_B \times 10^3$	1,5-3,0	4	≤ 1,1	≤ 0,7		≤ 1,8	≤ 0,62
	0,3-1,2	100			≤ 1,8		

μ_Δ for grade 3B8 at 6,55 AT ≥ 667
at 10,3 AT ≥ 282
at 12,8 AT ≥ 144.

*) For guidance only.

PRE-ADJUSTED POTCORES

Dimensions in mm



With nut, catalogue number = 4322 022 3. . . .
Without nut, catalogue number = 4322 022 1. . . .

Mass per set	= 54 g
Effective length	l_e = 53,2 mm
	$\Sigma \frac{l_e}{A_e} = 0{,}264\ \text{mm}^{-1}$
Effective volume	V_e = 10700 mm^3

Notes to the tables on the next page

1. Examples of catalogue number:
   μ_e = 33, grade 3D3, potcore with nut, catalogue number = 4322 022 32430
   A_L = 1600, grade 3B7, potcore without nut, catalogue number = 4322 022 13120
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.
3. The versions marked * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.
4. μ_e of 750 = A_L of 3550, μ_e of 2030 = A_L of 9500.

[1]) See Adjustment curves.

Pre-adjusted potcores with standard μ_e values [1])

μ_e	α	tolerance on inductance (%)	cat. no.: 4322 022 3.... with nut / 4322 022 1.... without nut		
			3B7	3D3	3H1
33	79,7	± 1	2030	2430	
47	66,8	± 1		2440	
68	55,6	± 1	2050	2450	2250
100	45,8	± 1,5	2060		2260
150	37,4	± 2	2070		2270
220	30,9	± 3	2080		2280
330	25,2	± 3	2090		2290
750	16,7	± 25		2400 *	
2030	10,2	± 25	2000 *		2200 *

Number of turns $N = \alpha \sqrt{L}$ (L in 10^{-3} H).

Symmetrical air gap for cores with an μ_e value of 33 up to and including 150.
Asymmetrical air gap for cores with an μ_e value of 220 up to and including 2030.

Pre-adjusted potcores with standard A_L factors [1])

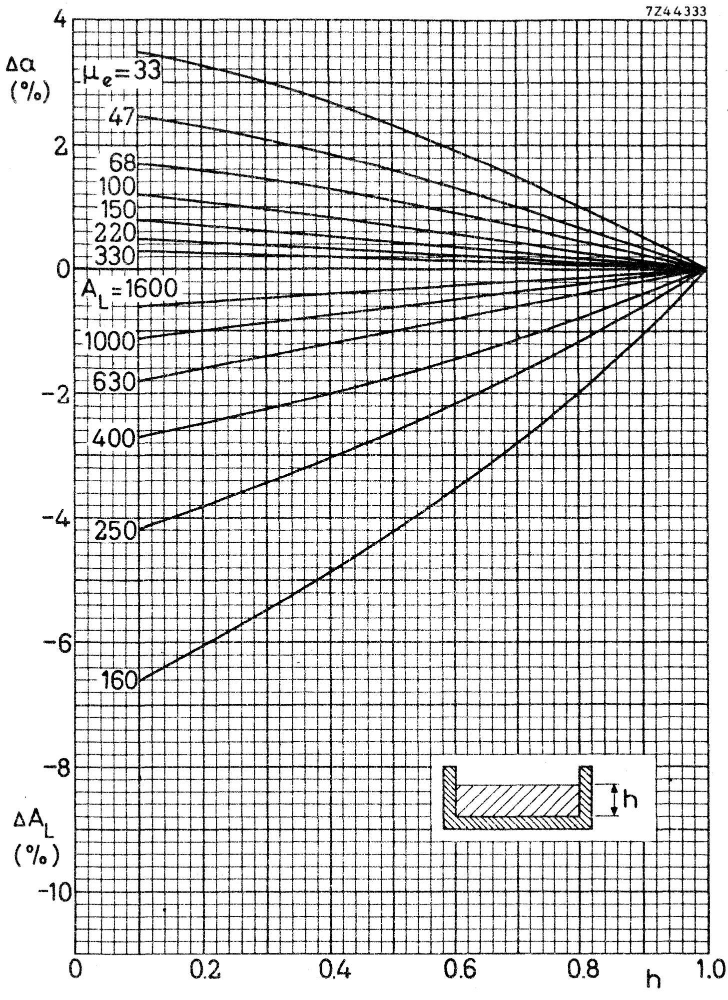
A_L	corresponding μ_e-value	tolerance on inductance (%)	cat. no.: 4322 022 3.... with nut / 4322 022 1.... without nut		
			3B7	3D3	3H1
40	8,39	± 1	3020		3220
100	21	± 1	3040		3240
→ 160	33,6	± 1	3050	3450	3250
250	52,5	± 1	3060	3460	3260
400	84	± 1,5	3080	3480	3280
630	132	± 2	3100		3300
1000	210	± 3	3110		3310
1600	336	± 3	3120		3320
2500	525	± 5			3290

Inductance $L = N^2 A_L$ (L in 10^{-9} H).

Symmetrical air gap for cores with an A_L factor of 40 up to and including 630.
Asymmetrical air gap for cores with an A_L factor of 1000 and 1600.

→ 1) See notes on the previous page.

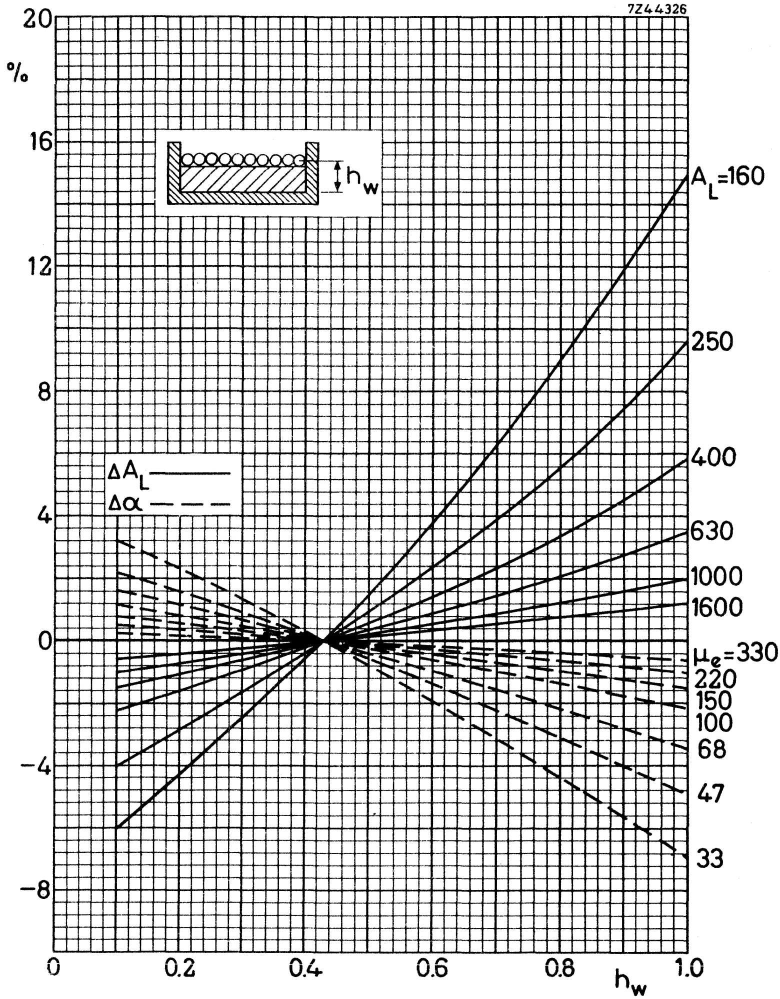
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B7, 3H1 and 3D3.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 68 in that case obtains an α factor of 55.6 + 1.20 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_w on a single-section coil former.
Valid for ferroxcube 3B7, 3H1 and 3D3.
Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 68 obtains for that winding an α factor of 55.6 - 1.6 %.

COIL FORMERS

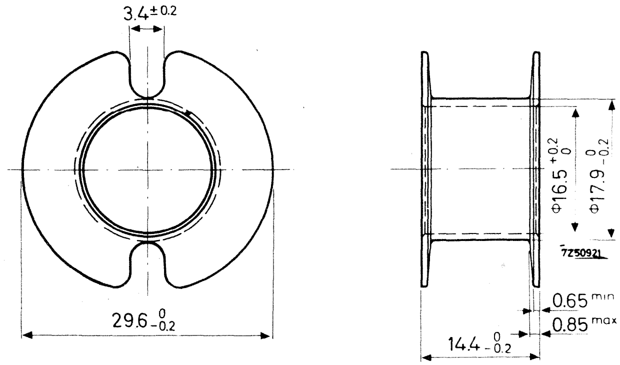
GENERAL

Three types of coil former can be supplied:

- with one section
- with two sections
- with three sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France), DIN 41294 (Germany) and BS 4061 range 2 (Great Britain). The dimensions in the drawings are in mm.

SINGLE-SECTION COIL FORMER



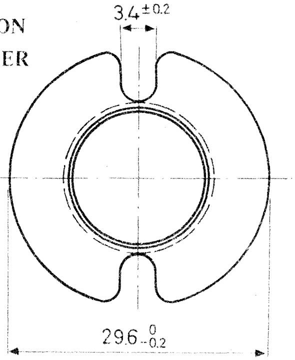
Catalogue number	4322 021 30390
Material	polycarbonate
Window area	75 mm^2
Mean length of turn	74 mm
Max. temperature	130 °C

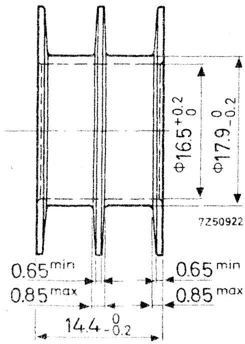
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 3,59 \times 10^3\ \Omega/H$$

Weight 1,2 g

TWO-SECTION COIL FORMER





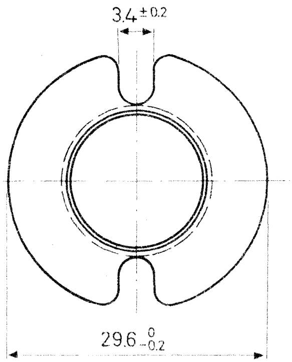
Catalogue number	4322 021 30400
Material	polycarbonate
Window area	2 x 35 mm^2
Mean length of turn	74 mm
Max. temperature	130 °C

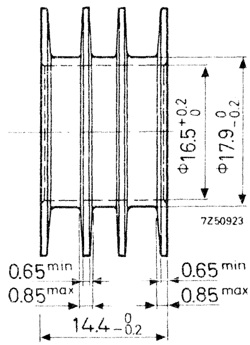
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 3.81 \times 10^3 \quad \Omega/H$$

Weight 1.55 g

THREE-SECTION COIL FORMER





Catalogue number	4322 021 30410
Material	polycarbonate
Window area	3 x 22 mm^2
Mean length of turn	74 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 4.06 \times 10^3 \quad \Omega/H$$

Weight 1.8 g

INDUCTANCE ADJUSTORS

CONTINUOUS ADJUSTORS

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03 % by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.

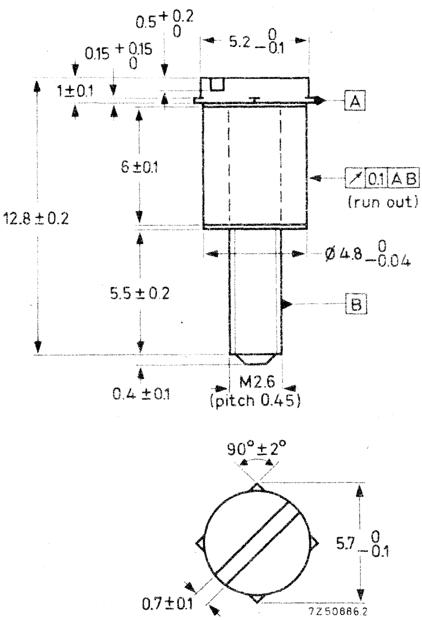


Fig. A

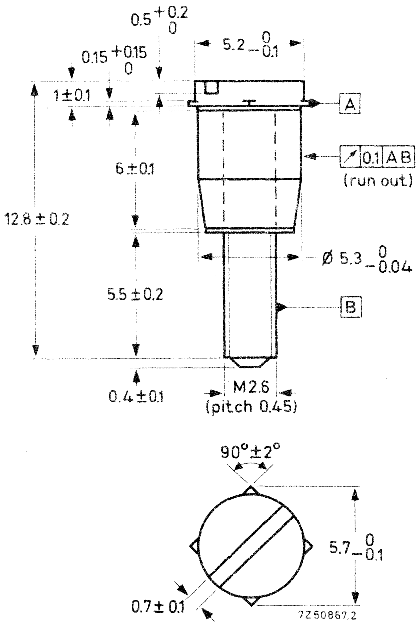


Fig. B

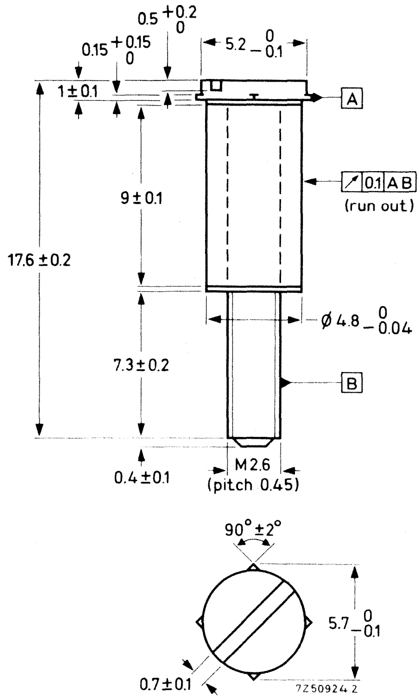


Fig.C

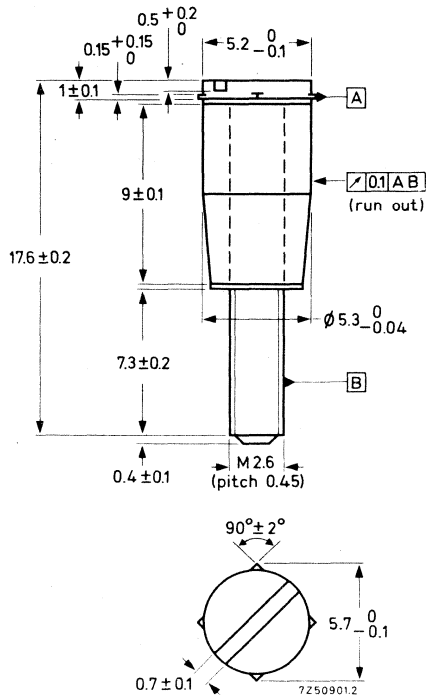


Fig.D

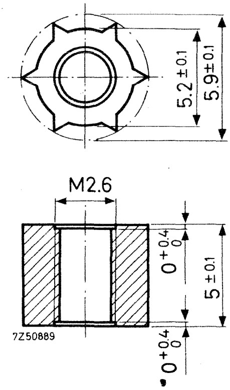
Types of adjustor and recommended applications for potcores with grade 3B7, 3H1 and 3D3:

Fig.	colour	catalog number 4322 021	potcore	
			μ_e	A_L
A	yellow	30790	33	160
B	white	30980	47	250
B	white	30980	68	
A	brown	30810	100	400
A	brown	30810		630
C	grey	31110	150	
B	grey	31090	220	1000
D	black	31120	330	1600

The adjustors are packed in bags of 100, so please order in multiples of 100.

Nut for adjustor

These data are given for those manufacturers who prefer to insert the nut themselves.

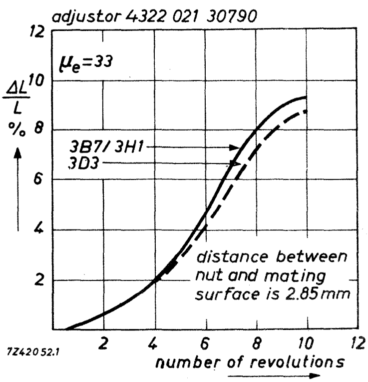


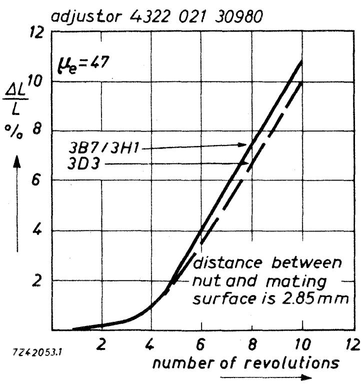
Catalog number	4322 021 30160
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut (See Adjustment curves)	2.85 ± 0.15 mm or 4.95 ± 0.15 mm

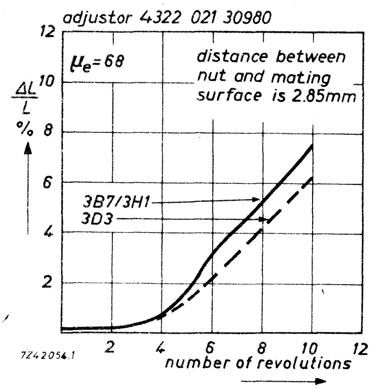
The nuts are packed in bags of 100, so please order in multiples of 100.

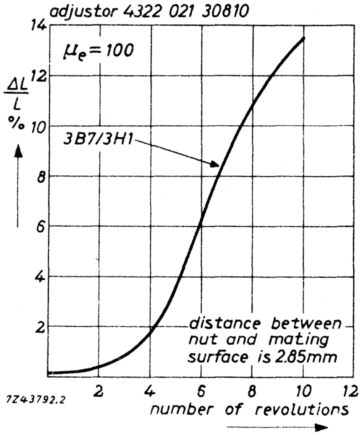
For more information see Potcores General, Mounting data.

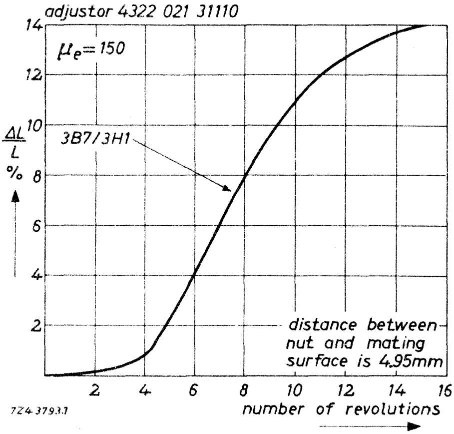
Adjustment curves

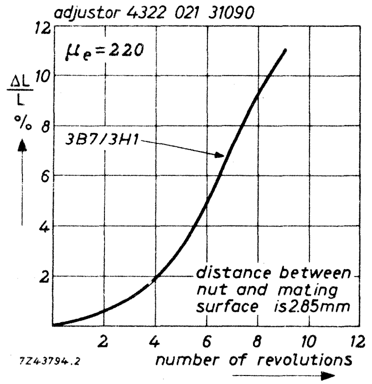


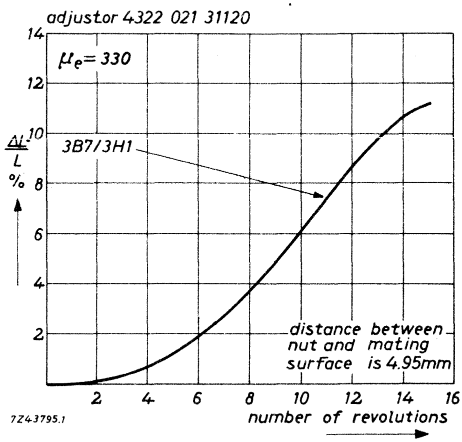



adjustor 4322 021 30980
$\mu_e = 68$
distance between nut and mating surface is 2.85mm
$\frac{\Delta L}{L}$ %
3B7/3H1
3D3
number of revolutions
7Z42054.1


adjustor 4322 021 30810
$\mu_e = 100$
$\frac{\Delta L}{L}$ %
3B7/3H1
distance between nut and mating surface is 2.85mm
number of revolutions
7Z43792.2


adjustor 4322 021 31110
$\mu_e = 150$
$\frac{\Delta L}{L}$ %
3B7/3H1
distance between nut and mating surface is 4.95mm
number of revolutions
7Z43793.1

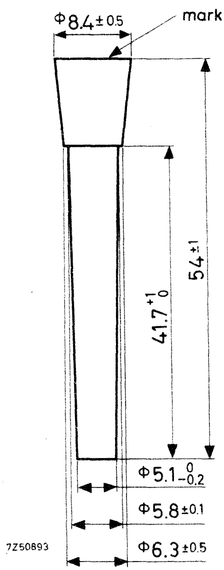

adjustor 4322 021 31090
$\mu_e = 220$
$\frac{\Delta L}{L}$ %
3B7/3H1
distance between nut and mating surface is 2.85mm
number of revolutions
7Z43794.2

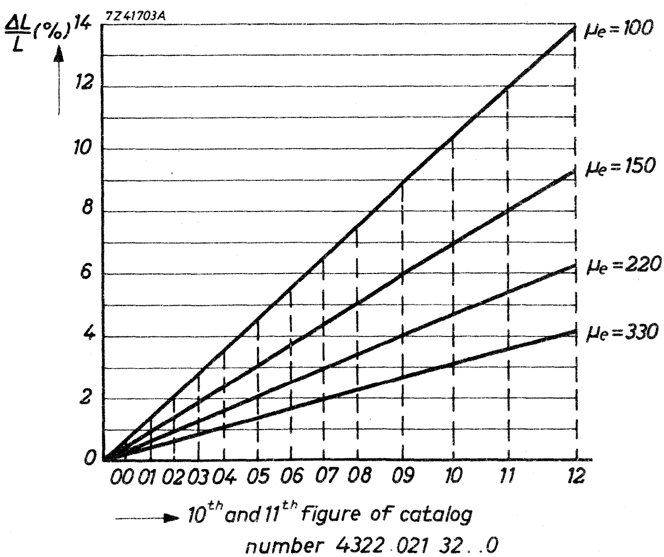

adjustor 4322 021 31120
$\mu_e = 330$
$\frac{\Delta L}{L}$ %
3B7/3H1
distance between nut and mating surface is 4.95mm
number of revolutions
7Z43795.1

STEP-BY-STEP ADJUSTORS

These adjustors are used when a continuous adjustment of the inductance is not necessary. For instance, they are applied in loading coils to bring the inductance within a certain tolerance field. They are not suitable for adjusting the inductance to an exact value, as is usually necessary in filters. The increment of the losses caused by these adjustors is negligible.
A range of 13 flexible conical adjustors is available under the catalog numbers 4322 021 32000 up to 021 32120. Each adjustor causes an increase in the inductance; the higher the catalog number, the greater the effect. The influence of each adjustor on the inductance at different μ_e values of the potcore can be found from the graph.
The 10th and 11th figure of the catalog number are indicated on the head of the adjustor. It should be borne in mind that, when using these adjustors, the inductance of the coil should initially be lower than the wanted value.
When the correct adjustor has been found, it is inserted in the centre hole of the pot. An adhesive (for instance Pliobond of Good Year) is used as sliding and fixing material. After fixing the protruding ends are cut off.

The maximum impregnation temperature is 150 °C.
The maximum working temperature is 90 °C.
Material: rubber with powder iron.

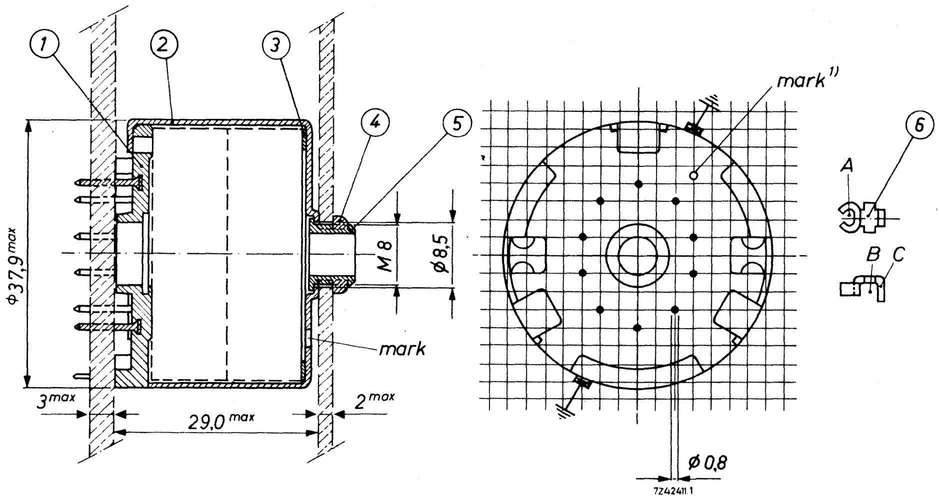




Dimensions in mm

MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30490	(4) nut	4322 021 30710
(2) brass container	4322 021 30570	(5) fixing bush	4322 021 30720
(3) spring	4322 021 30680	(6) soldering spring	4322 021 30700 (10x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

→ The ten soldering pins are arranged to fit a grid of 2,54 mm (0,1 inch).
The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.

1) There is another mark in a similar position on the top of the container.

If one-hole mounting is preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8,5 mm diameter.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 350 Newton. After bending the lips the spring will have the correct tension.

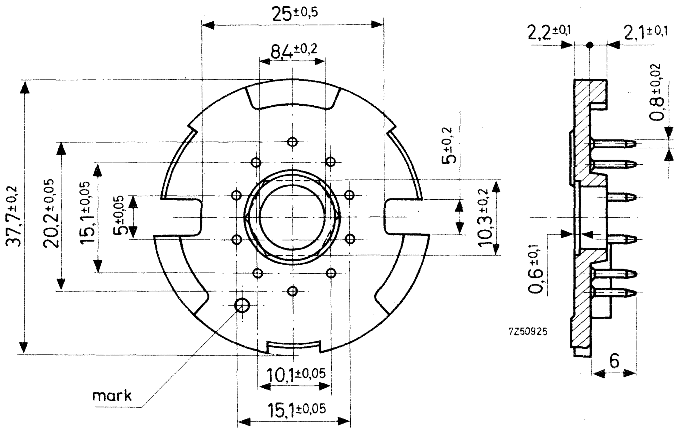
PART DRAWINGS

Dimensions in mm

(1) Tag plate 4322 021 30490

Plate : polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s.

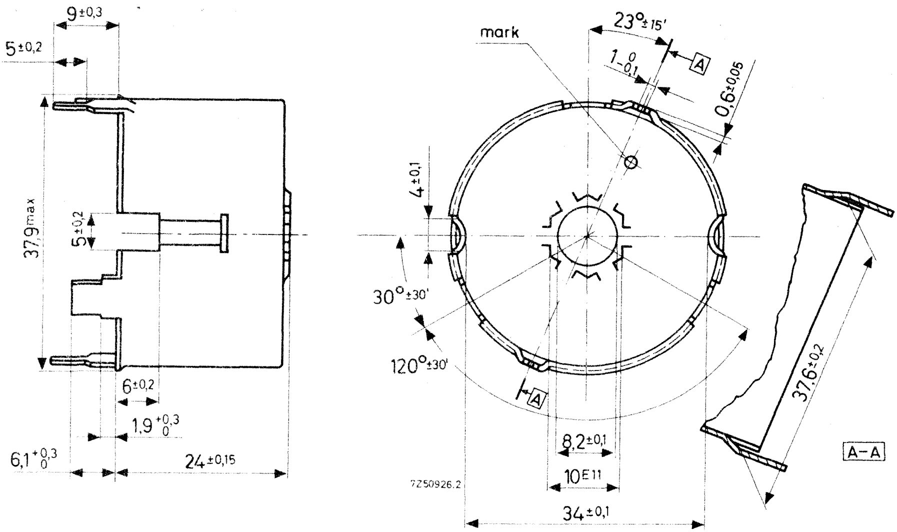
Pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 24 pieces on a polystyrene plate, and with 150 pieces in a cardboard box. Please order in multiples of these quantities.

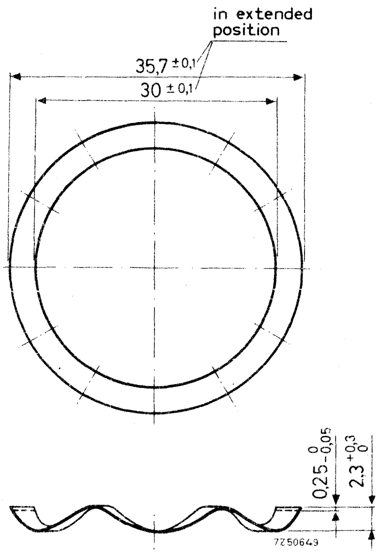
(2) Container 4322 021 30570

Material: brass, nickel plated; tinned soldering pins



(3) Spring 4322 021 30680

Material: steel

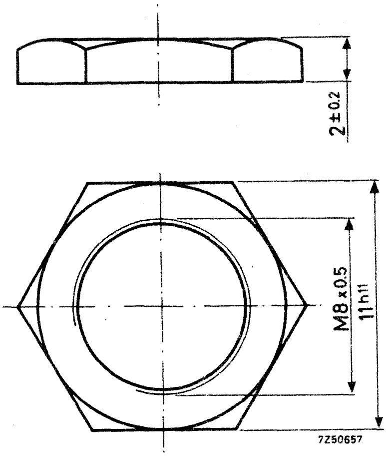


A force of 255 to 425 N is required to compress the spring to 0,55 mm.

The spring are packed in units of 100 pieces. Please order in multiples of this quantity.

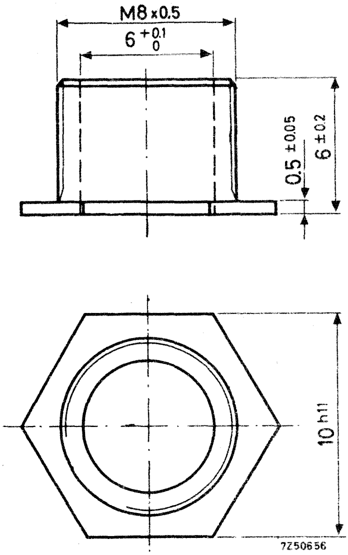
(4) Nut 4322 021 30710

Material : brass, nickel plated



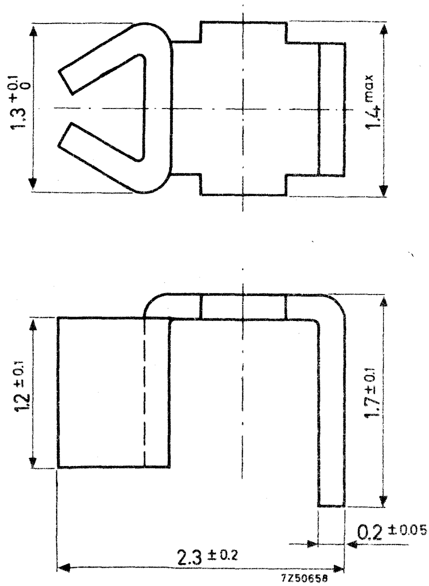
(5) Fixing bush 4322 021 30720

Material : brass, nickel plated



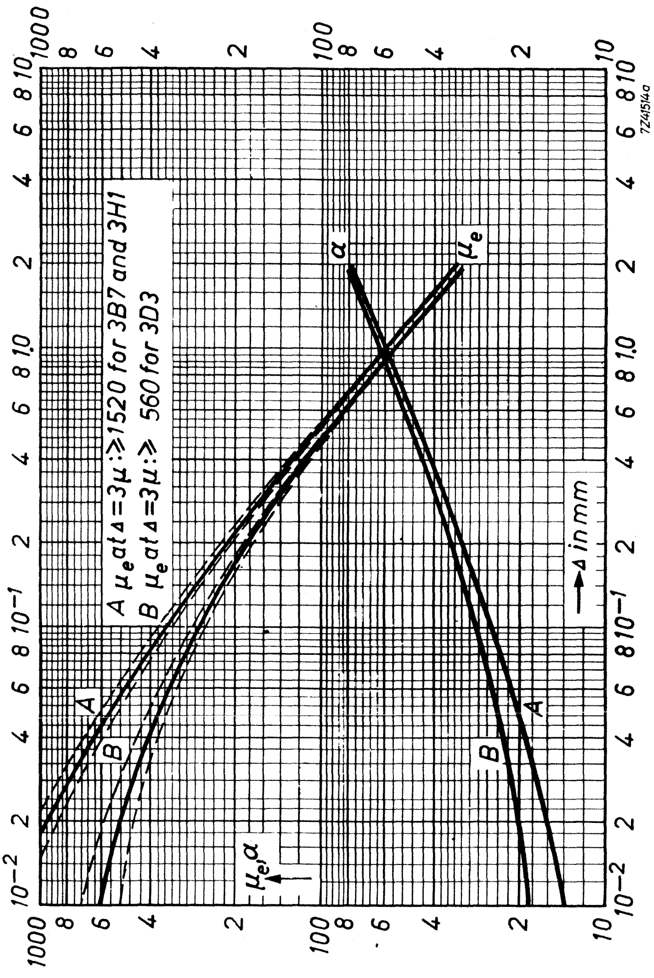
(6) Soldering spring 4322 021 30700

Material : brass, dipsoldered



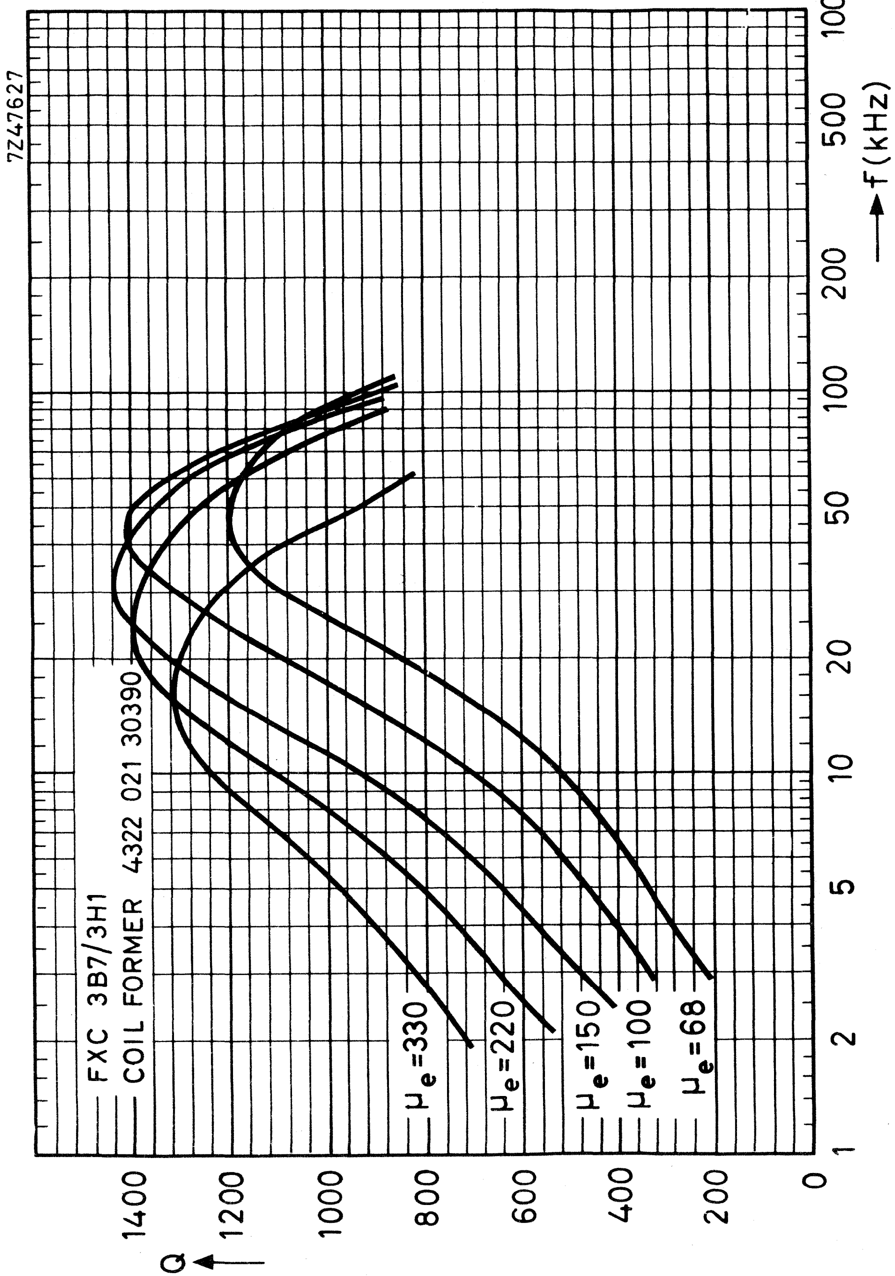
CHARACTERISTIC CURVES

μ_e-α CURVES

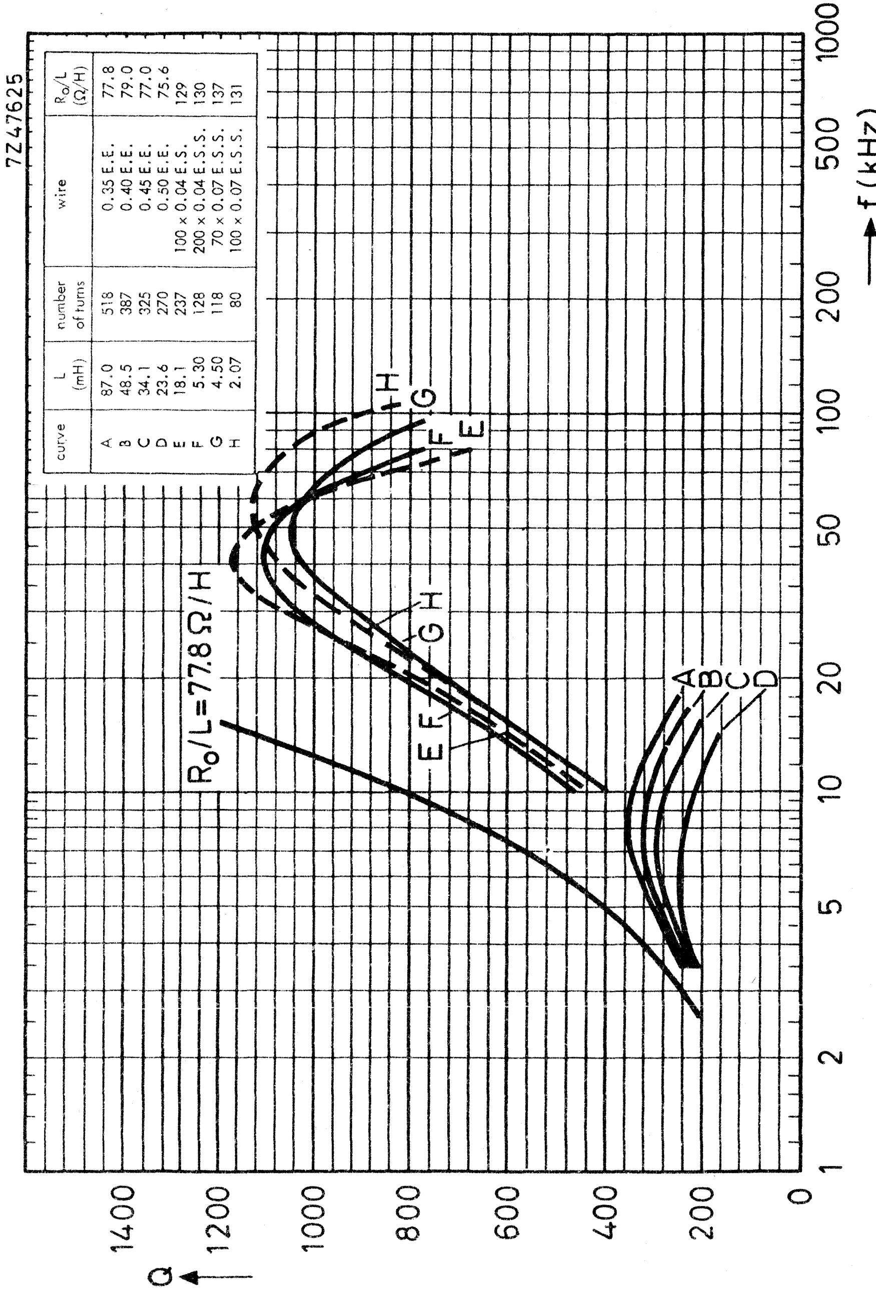


Relative effective permeability and turn factor for 1 mH as a function of the air gap length

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1



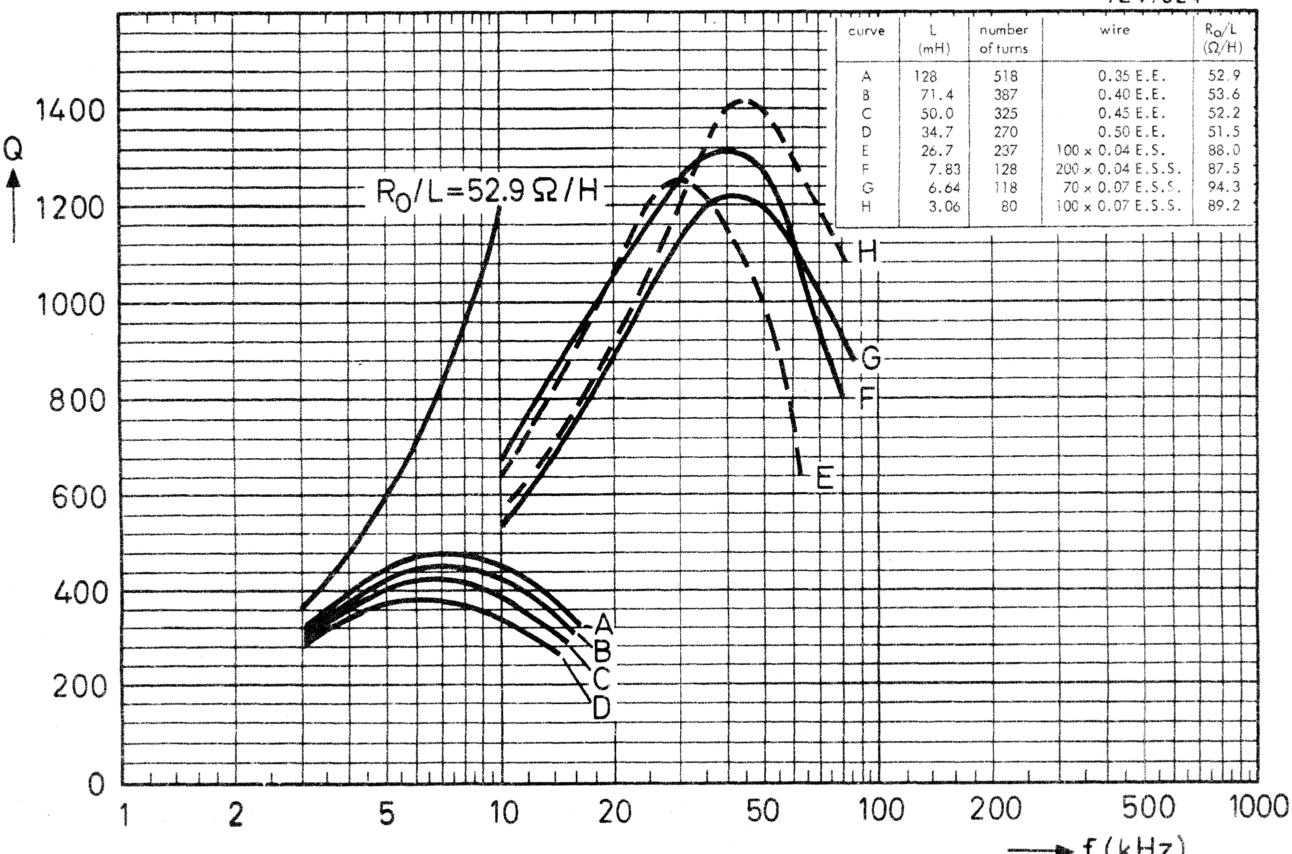
Enveloping curves



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	87.0	518	0.35 E.E.	77.8
B	48.5	387	0.40 E.E.	79.0
C	34.1	325	0.45 E.E.	77.0
D	23.6	270	0.50 E.E.	75.6
E	18.1	237	100 × 0.04 E.S.	129
F	5.30	128	200 × 0.04 E.S.S.	130
G	4.50	118	70 × 0.07 E.S.S.	137
H	2.07	80	100 × 0.07 E.S.S.	131

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 68$

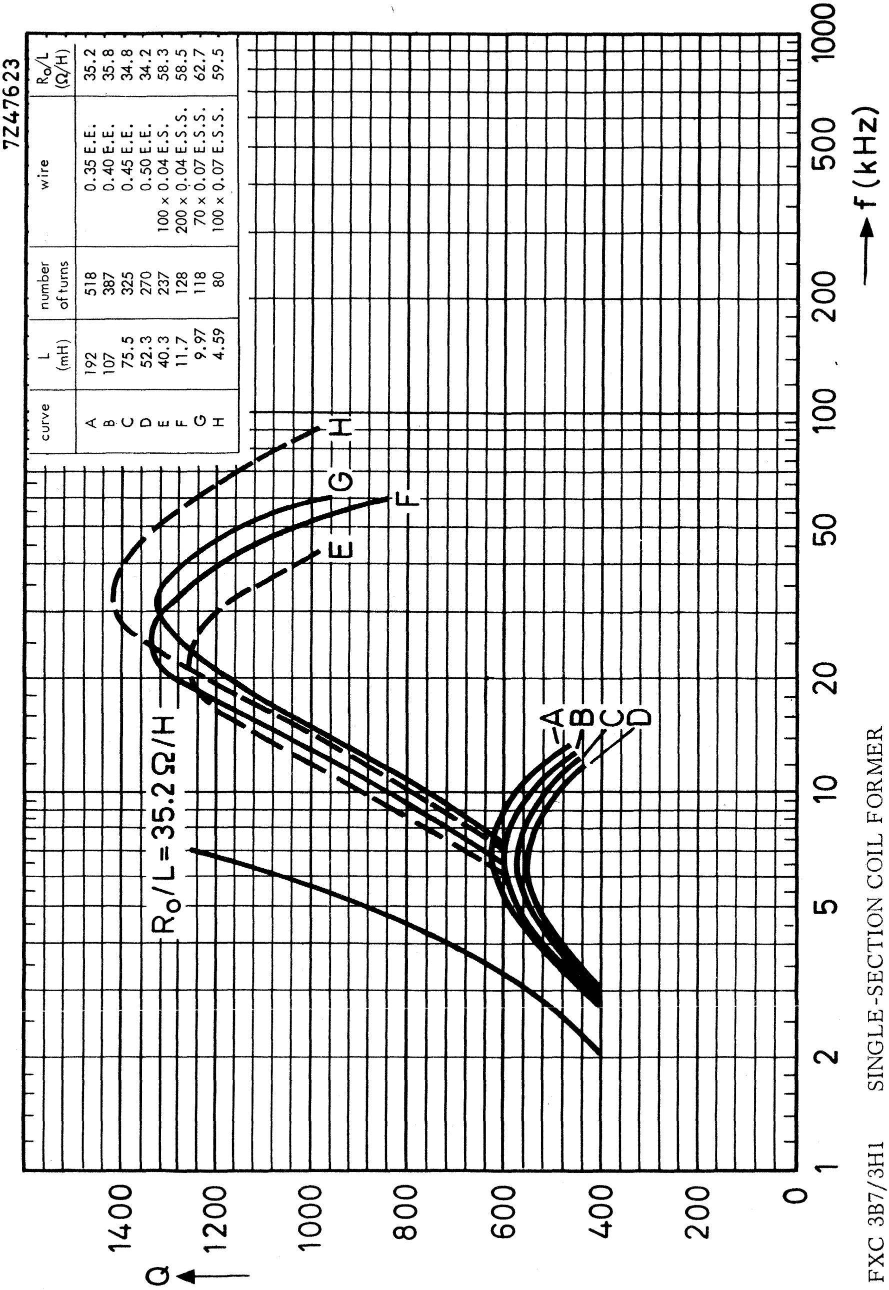
7Z47624



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	128	518	0.35 E.E.	52.9
B	71.4	387	0.40 E.E.	53.6
C	50.0	325	0.45 E.E.	52.2
D	34.7	270	0.50 E.E.	51.5
E	26.7	237	100 × 0.04 E.S.	88.0
F	7.83	128	200 × 0.04 E.S.S.	87.5
G	6.64	118	70 × 0.07 E.S.S.	94.3
H	3.06	80	100 × 0.07 E.S.S.	89.2

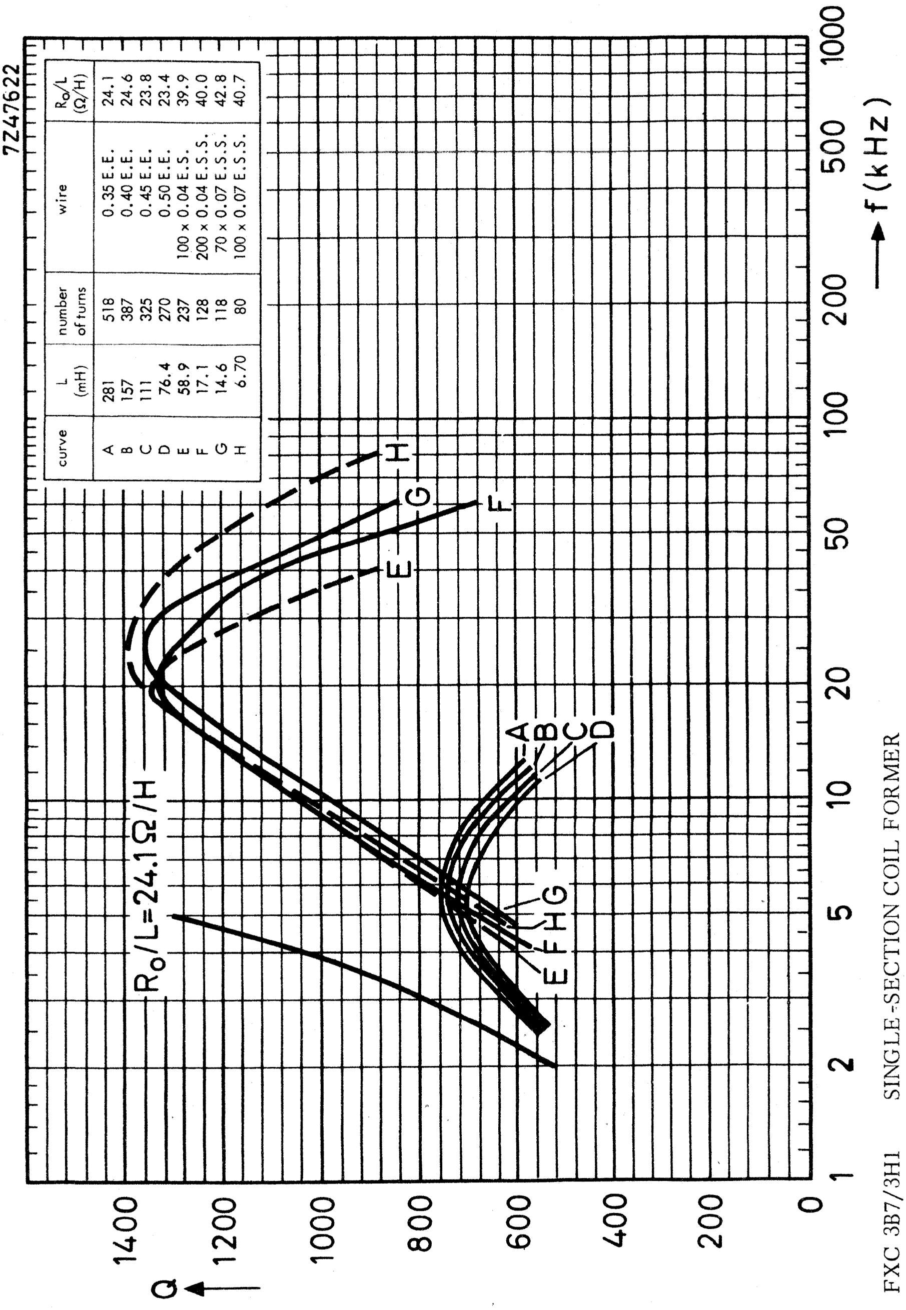
FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 100$



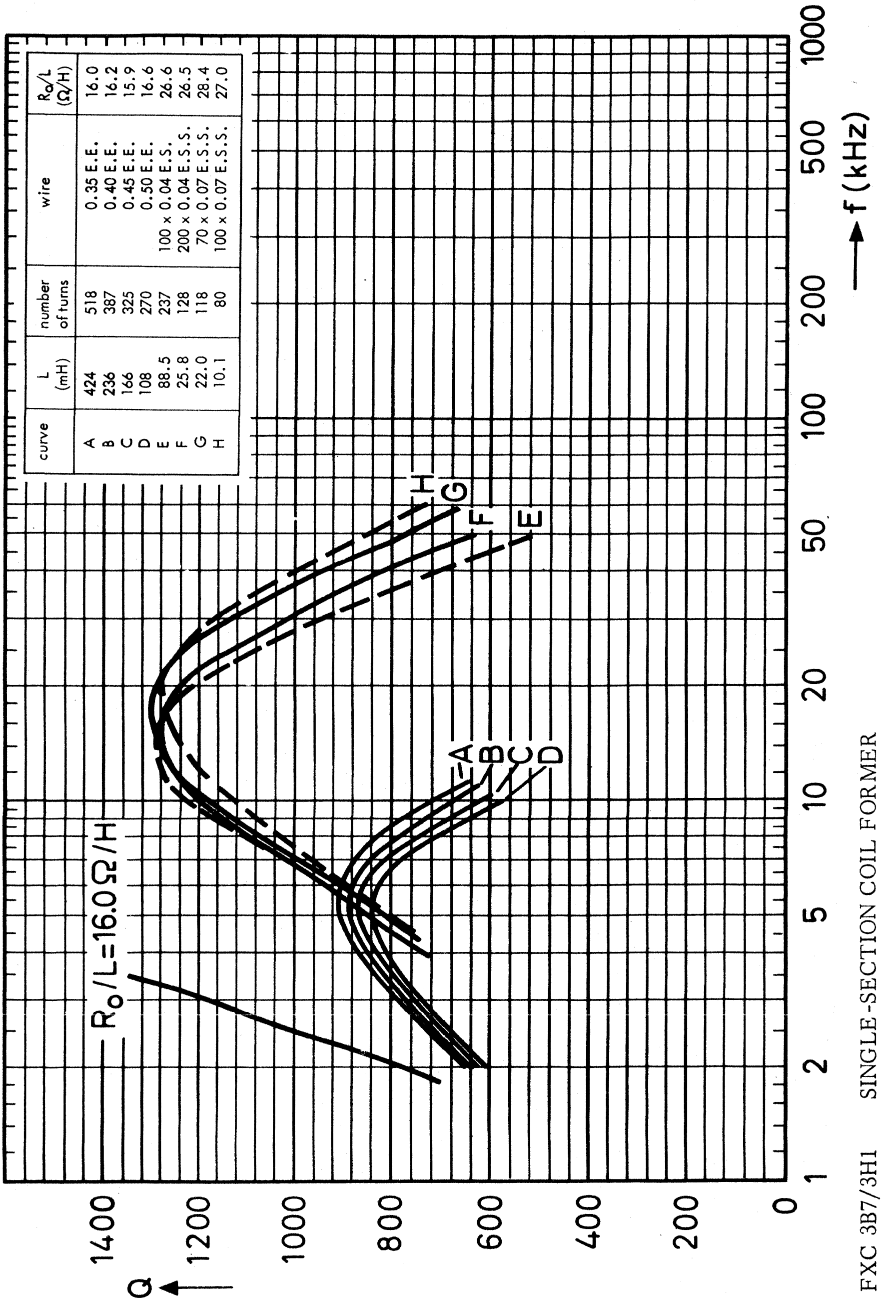
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	192	518	0.35 E.E.	35.2
B	107	387	0.40 E.E.	35.8
C	75.5	325	0.45 E.E.	34.8
D	52.3	270	0.50 E.E.	34.2
E	40.3	237	100 × 0.04 E.S.	58.3
F	11.7	128	200 × 0.04 E.S.S.	58.5
G	9.97	118	70 × 0.07 E.S.S.	62.7
H	4.59	80	100 × 0.07 E.S.S.	59.5

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 150$



curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	281	518	0.35 E.E.	24.1
B	157	387	0.40 E.E.	24.6
C	111	325	0.45 E.E.	23.8
D	76.4	270	0.50 E.E.	23.4
E	58.9	237	100 × 0.04 E.S.	39.9
F	17.1	128	200 × 0.04 E.S.S.	40.0
G	14.6	118	70 × 0.07 E.S.S.	42.8
H	6.70	80	100 × 0.07 E.S.S.	40.7

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER
$\mu_e = 220$

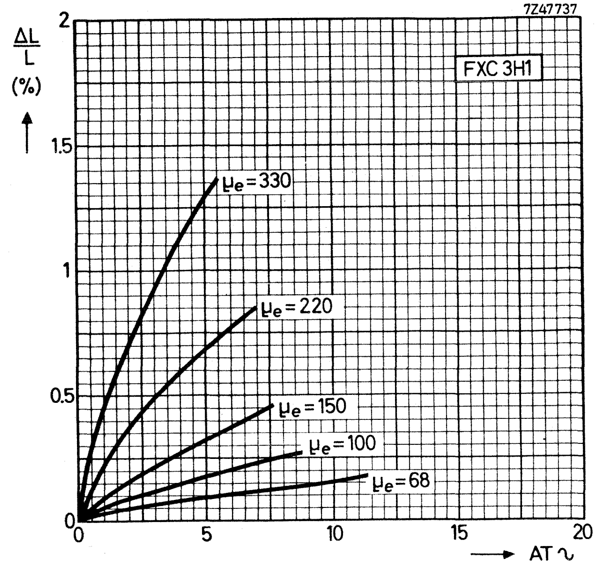


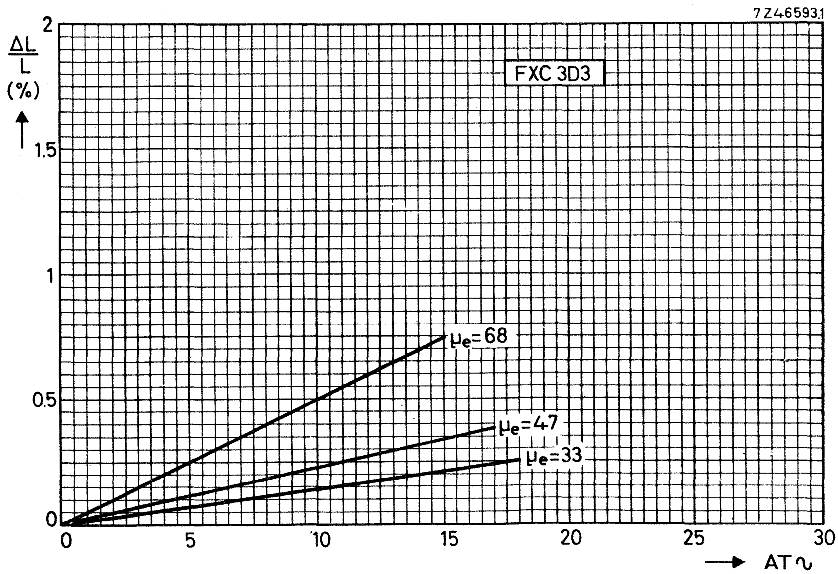
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	424	518	0.35 E.E.	16.0
B	236	387	0.40 E.E.	16.2
C	166	325	0.45 E.E.	15.9
D	108	270	0.50 E.E.	16.6
E	88.5	237	100 × 0.04 E.S.	26.6
F	25.8	128	200 × 0.04 E.S.S.	26.5
G	22.0	118	70 × 0.07 E.S.S.	28.4
H	10.1	80	100 × 0.07 E.S.S.	27.0

FXC 3B7/3H1 SINGLE-SECTION COIL FORMER

$\mu_e = 330$

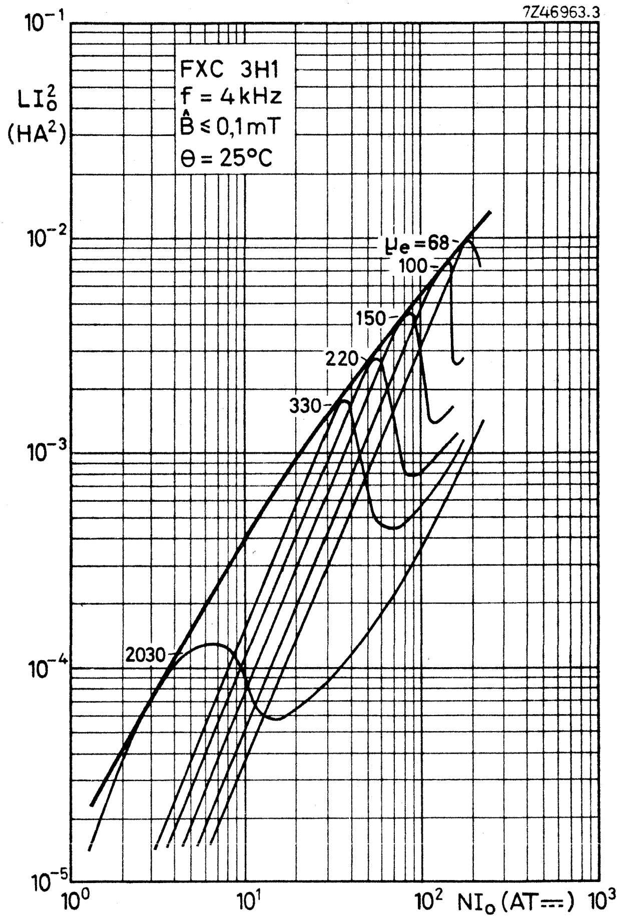
INDUCTANCE VARIATION AS A FUNCTION OF AT ~



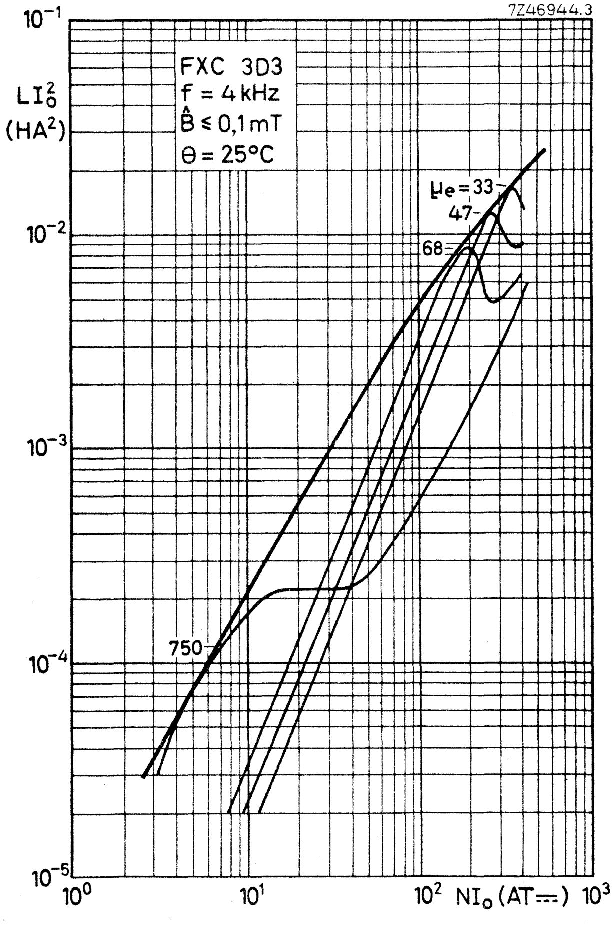


HANNA CURVES

Indicating the optimum inductance for a certain μ_e-value and direct current. Typical values.



Typical values



POTCORES

Three types of core can be supplied:

- Separate core halves, air gap to be ground by the user.
- Pre-adjusted potcores (potcores with an air gap) which are provided with a nut for an adjuster. These have a relative effective permeability (μe) in accordance with the E6 range of values or an inductance factor (A_L) in the R5 range.
- Pre-adjusted potcores without nut.

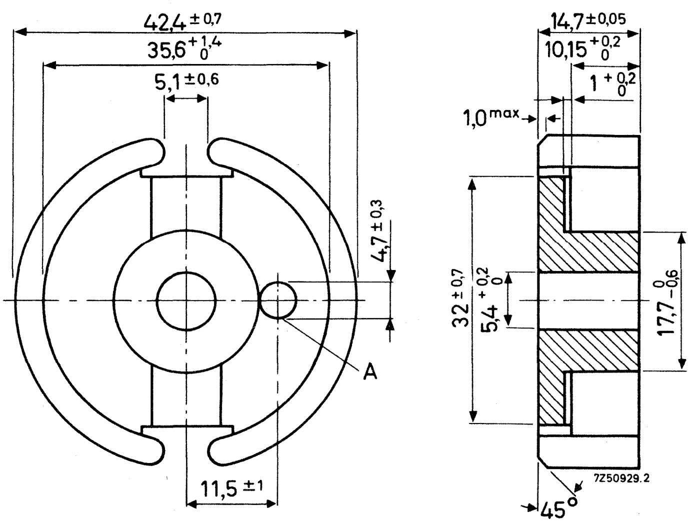
The potcores are in accordance with the following specifications: IEC 133 (international), UTE C93-324 (France), and BS 4061 range 2 (Great Britain).

Potcores and associated parts are ordered by their 12-digit catalogue number.

Quantity: a primary pack contains 10 potcore halves or 5 pre-adjusted potcores.
A storage pack contains 100 halves or 50 pre-adjusted potcores.
Please order in multiples of these quantities.

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

Ferroxcube grade	catalogue number (without hole A)	catalogue number (with hole A)
3B7	4322 020 22750	4322 020 22780
3H1	4322 020 22760	4322 020 22790

The versions without hole A are used for filter coils, the versions with hole A for L-asymmetry adjustment of loading coils.

Properties

For toroidally wound core halves the values in Table I are guaranteed.

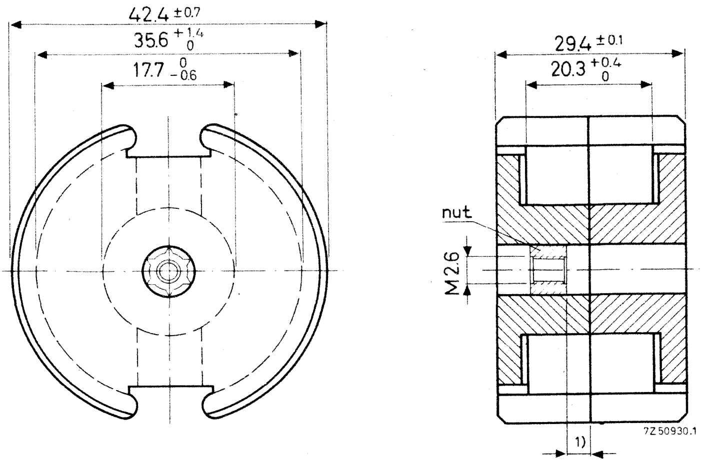
Table I	temp. (^oC)	grade 3B7	grade 3H1	
$\alpha_F \times 10^6$	+5 to +25		+0,5 to +1,5	
	+25 to +55		+0,5 to +1,5	
	+25 to +70	-0,6 to +0,6		
$D_F \times 10^6$ (10-100 min)	25 ± 1	≤ 4,3	≤ 4,3	

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 550 Newton, the values in Table II are guaranteed at 25 ± 10 ^oC.

Table II	$\hat{B}$ (mT)	freq. (kHz)	grade 3B7	grade 3H1
→ μ_e ± 25%	≤ 0,1	4	2120	2120
A_L ± 25%	≤ 0,1	4	10250	10250
α	≤ 0,1	4	≤ 11,4	≤ 11,4
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	4	≤ 1,2	≤ 1,2
	≤ 0,1	100	≤ 8	≤ 8
$q_{2\text{-}24\text{-}100}$	1,5-3,0	4	≤ 1,8	≤ 1,0
$\eta_B \times 10^3$	1,5-3,0	4	≤ 1,1	≤ 0,62

PRE-ADJUSTED POTCORES (without hole A)

Dimensions in mm



With nut, catalogue number = 4322 022 3....
Without nut, catalogue number = 4322 022 1....

Weight per set = 104 g

Effective length l_e = 68,6 mm

$\Sigma \frac{l_e}{A_e}$ = 0,259 mm^{-1}

Effective volume V_e = 18200 mm^3

Notes to the tables on the next page

1. Examples of catalogue number:
   μ_e = 100, grade 3B7, potcore with nut, catalogue number = 4322 022 34060
   A_L = 250, grade 3H1, potcore without nut, catalogue number = 4322 022 15260
2. The inductance will only be within the given tolerance if the winding space of the coil is completely filled.
3. The versions marked with a * are only available without nut because adjustment would not be possible as the air gap of these potcores is practically zero.

[1]) See Adjustment curves.

Pre-adjusted potcores with standard μ_e values [1]

μ_e	α	tolerance on inductance (%)	catal. No. 4322 022 3.... with nut 4322 022 1.... without nut		
			3B7	3H1	
33	78.4	± 1	–	–	
47	65.7	± 1	–	–	
68	55.0	± 1	4050	4250	
100	45.0	± 1.5	4060	4260	
150	36.8	± 2	4070	4270	
220	30.4	± 3	4080	4280	
330	24.8	± 3	4090	4290	
2120	9.85	± 25	4000*	4200*	

Number of turns $N = \alpha\sqrt{L}$ (L in 10^{-3} H)

Symmetric air gap for cores with an μ_e value of 33 up to and including 150
Asymmetric air gap for cores with an μ_e value of 220 up to and including 2120

Pre-adjusted potcores with standard A_L factors [1]

A_L	corresponding μ_e-value	tolerance on inductance (%)	catal. No. 4322 022 3.... with nut 4322 022 1.... without nut		
				3B7	3H1
100	20,5	± 1		5040	5240
250	51	± 1		5060	5260
400	81	± 1		5080	5280
630	130	± 2		5100	5300
1000	205	± 3		5110	5310
1600	325	± 3		5120	5320
2500	510	± 10		5130	–

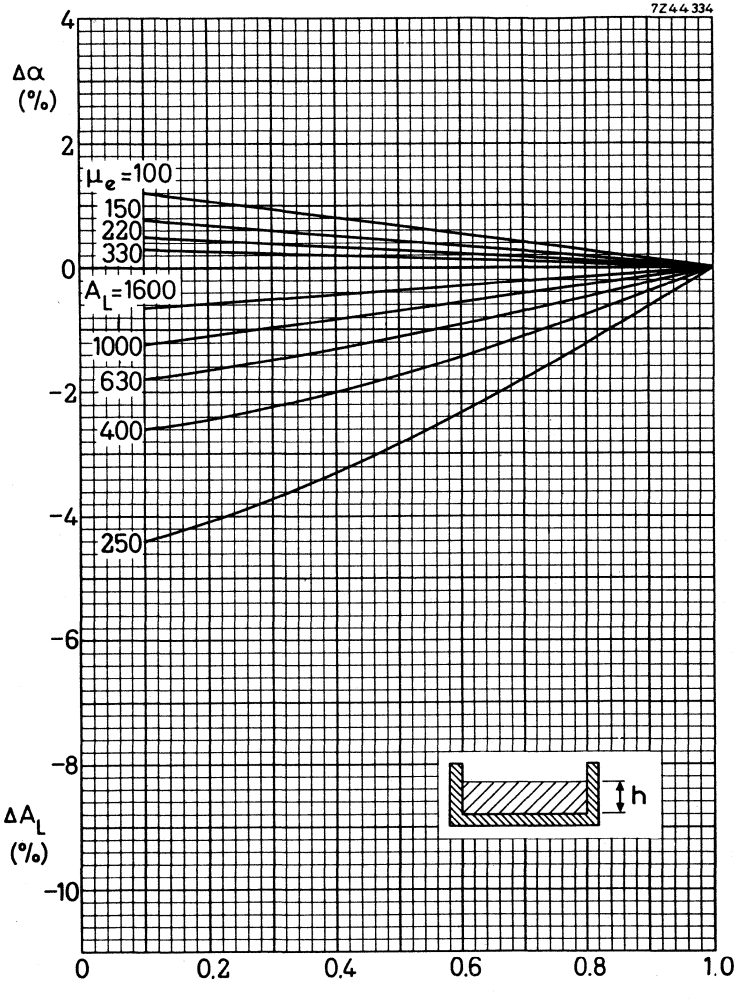
Inductance $L = N^2 A_L$ (in 10^{-9} H)

Symmetric air gap for cores with an A_L factor of 250 up to and including 630
Asymmetric air gap for cores with an A_L factor of 1000 and 1600

[1]) See Notes on the previous page.

*) Only available without nut.

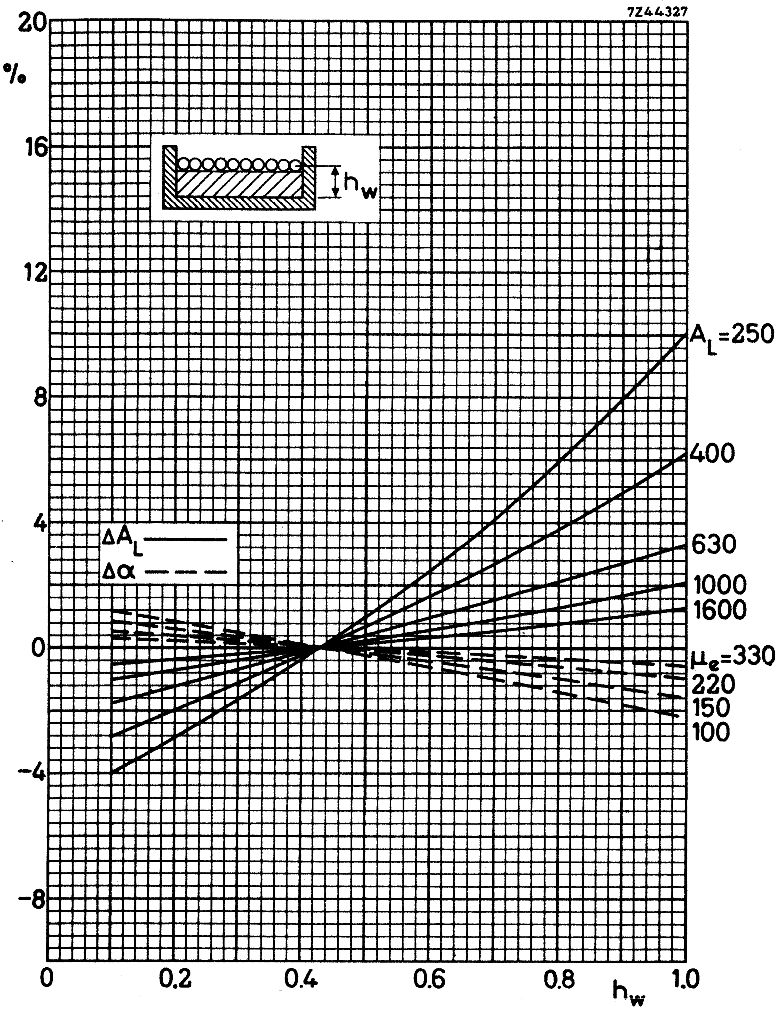
DATA FOR WHEN THE COIL FORMER IS PARTLY FILLED



Increase of the α and decrease of the A_L factor for different μ_e values and A_L factors as a function of the relative winding height on a single-section coil former.

Valid for ferroxcube 3B5, 3B7 and 3H1.

Example: On a single-section coil former only 0.4 part of the available height is used. A potcore with μ_e = 100 in that case obtains an α factor of 45.0 + 0.75 %.



Variation of the α and A_L factors for a coupling winding of one layer as a function of its winding height h_w on a single-section coil former.

Valid for ferroxcube 3B5, 3B7 and 3H1.

Example: On a single-section coil former a coupling winding is laid on 0.7 of the available height. A potcore with μ_e = 100 obtains for that winding an α factor of 45.0 - 1.0 %.

COIL FORMERS

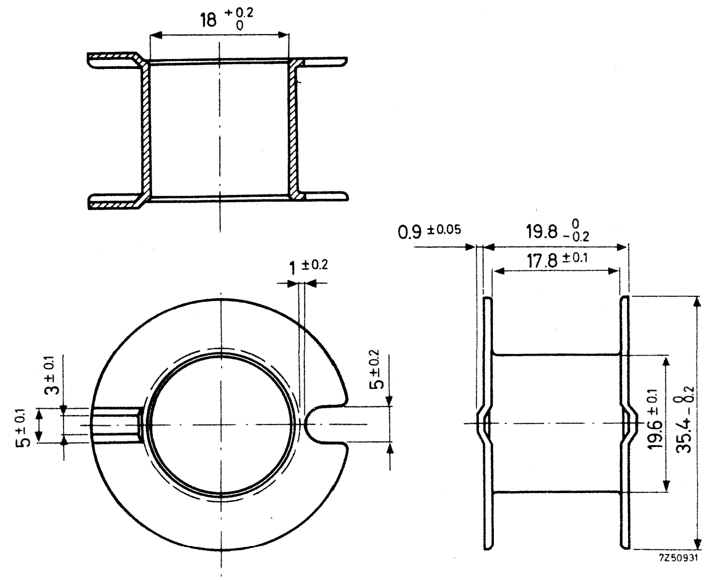
GENERAL

Two types of coil former can be supplied:

- with one section
- with two sections

The dimensions conform with the following specifications: IEC 133 (international), FNIE C93-324 livre 1 (France) and BS 4061 range 2 (Great Britain).

SINGLE-SECTION COIL FORMER



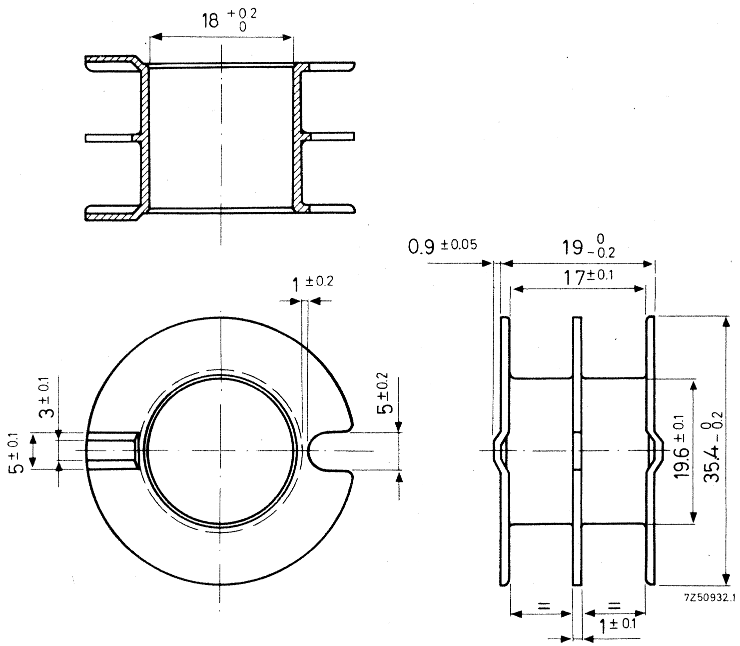
Catalogue number	4322 021 30420
Material	polycarbonate
Window area	140 mm^2
Mean length of turn	86 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 2,16 \times 10^3 \ \Omega/H$$

Weight 2,4 g

TWO-SECTION COIL FORMER



Catalogue number	4322 021 30430
Material	polycarbonate
Window area	2 x 63 mm^2
Mean length of turn	86 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 2.40 \times 10^3 \quad \Omega/H$$

Weight 3.0 g

INDUCTANCE ADJUSTORS

CONTINUOUS ADJUSTORS

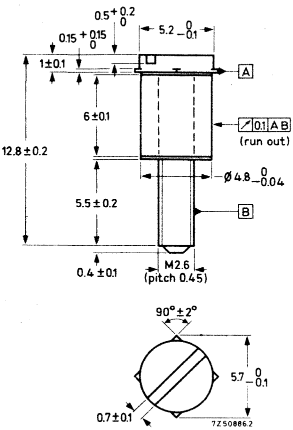


Fig. A

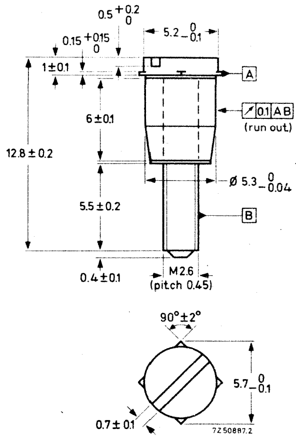


Fig. B

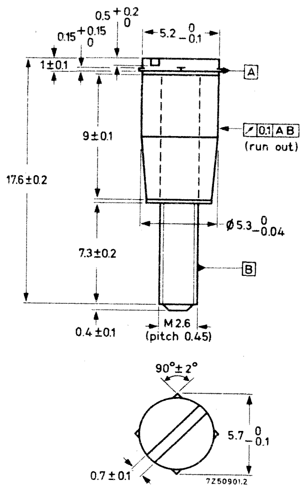


Fig. C

The tolerances on inductance of the pre-adjusted potcores (with adjustor) are given on the pages "Potcores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy <0.03% by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see following pages.
The adjustor is screwed through the potcore into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.

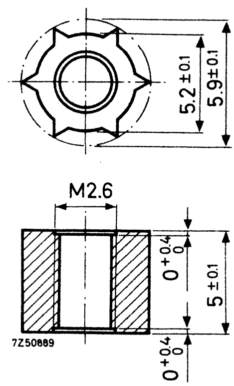
Types of adjustor and recommended applications

Fig.	colour	catalog number 4322 021	potcore	
			μ_e	A_L
B	white	30980	68	250
A	brown	30810	100	400
A	brown	30810		630
B	grey	31090	150	1000
B	grey	31090	220	
C	black	31120	330	1600

The adjustors are packed in bags of 100, so please order in multiples of 100.

Nut for adjustor

These data are given for those manufacturers who prefer to insert the nut themselves.



Catalog number — 4322 021 30160

Material — polycarbonate

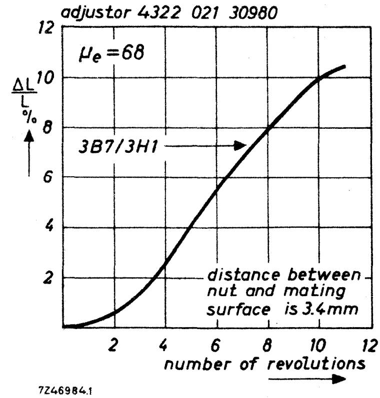
Max. impregnation temperature for 24 hours — 120 °C

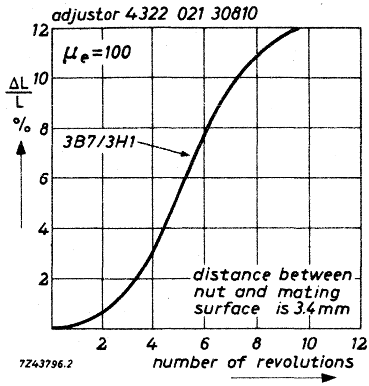
Recommended distance from mating surface to nut (see Adjustment curves) — 3.4 ± 0.15 mm or 5.0 ± 0.15 mm

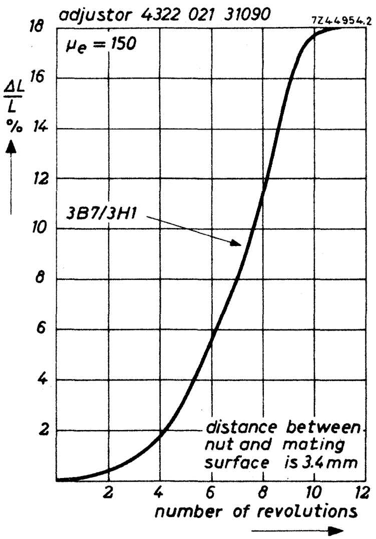
The nuts are packed in bags of 100, so please order in multiples of 100.

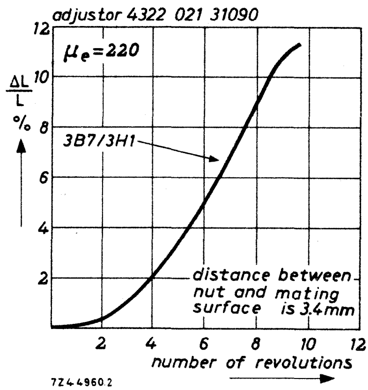
For more information see Potcores General, Mounting Data.

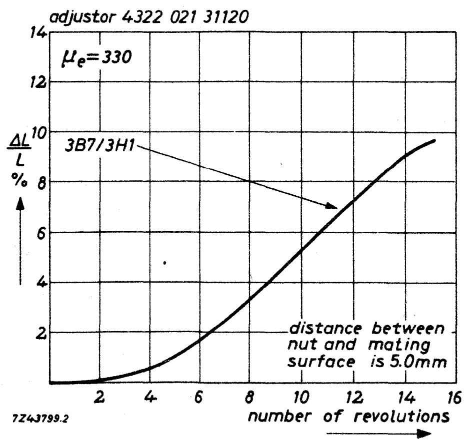
Adjustment curves







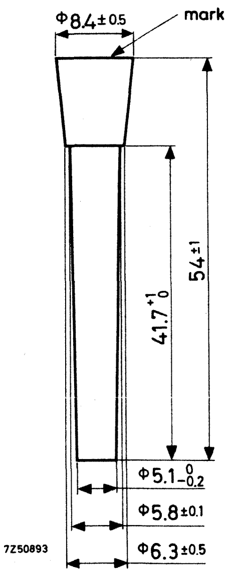


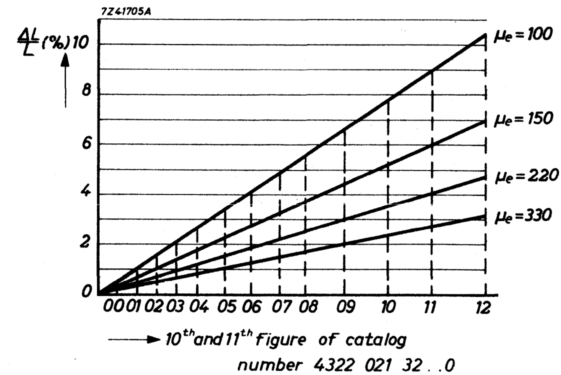


STEP-BY-STEP ADJUSTORS

These adjustors are used when a continuous adjustment of the inductance is not necessary. For instance, they are applied in loading coils to bring the inductance within a certain tolerance field. They are not suitable for adjusting the inductance to an exact value, as is usually necessary in filters. The increment of the losses caused by these adjustors is negligible.
A range of 13 flexible conical adjustors is available under the catalog numbers 4322 021 32000 up to 021 32120. Each adjustor causes an increase in the inductance; the higher the catalog number, the greater the effect. The influence of each adjustor on the inductance at different μ_e values of the potcore can be found from the graph.
The 10th and 11th figure of the catalog number are indicated on the head of the adjustor. It should be borne in mind that, when using these adjustors, the inductance of the coil should initially be lower than the wanted value.
When the correct adjustor has been found, it is inserted in the centre hole of the pot. An adhesive (for instance Pliobond of Good Year) is used as sliding and fixing material. After fixing the protruding ends are cut off.

The maximum impregnation temperature is 150 °C.
The maximum working temperature is 90 °C.
Material: rubber with powder iron.

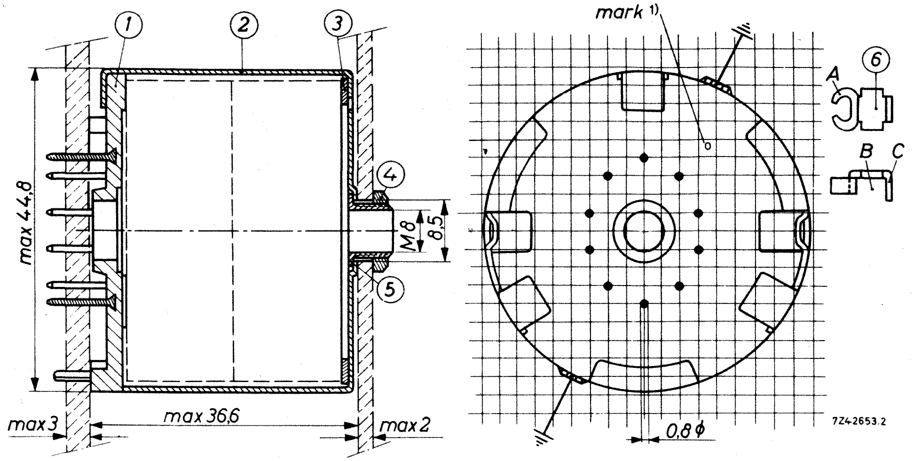




Dimensions in mm

MOUNTING PARTS

MOUNTING



(1) tag plate	4322 021 30500	(4) nut	4322 021 30710
(2) brass container	4322 021 30580	(5) fixing bush	4322 021 30720
(3) spring	4322 021 30690	(6) soldering spring	4322 021 30700 (10x)

The core is suitable for mounting on printed-wiring boards and on conventional panels.

The parts 1, 2, 3 (and 6) are sufficient to construct an assembly for use in combination with printed wiring.

If stranded wire is applied the use of a soldering spring (6) is recommended. Part A of this spring is put over the pin, then the wire is put in B and lip C is bent over.

For solid wire the soldering spring is not strictly necessary.

The ten soldering pins are arranged to fit a grid of 2,54 mm (0,1 inch).
The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.

[1]) There is another mark in a similar position on the top of the container.

If one-hole mounting is preferred, the parts 4 and 5 should be added. The coil assembly may then be mounted on panels having a thickness of up to 2 mm. The panel should be provided with a hole of 8,5 mm diameter.

It is recommended that the spring (3) be placed in the position indicated to obtain the best stability against shock and vibration.

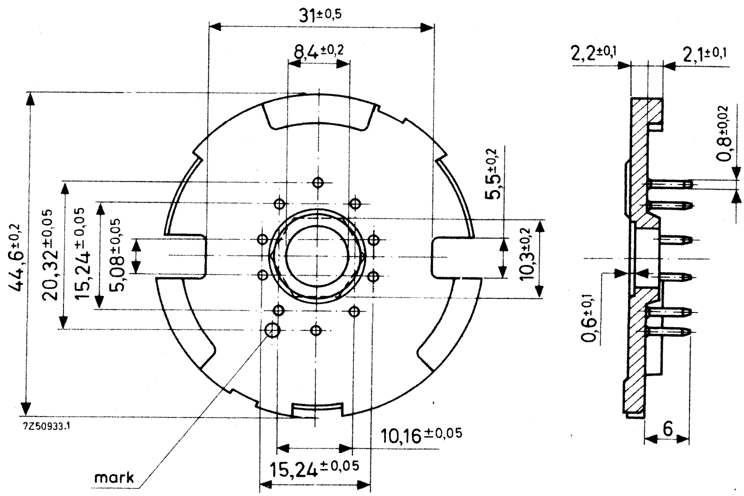
Before bending the lips of the container, pressure should be exerted evenly on the rim of the tag plate until it meets the container. The force which is required is approximately 550 Newton. After bending the lips the spring will have the correct tension.

PART DRAWINGS Dimensions in mm

(1) Tag plate 4322 021 30500

→ Plate : polyester reinforced with glass fibre, resistant against dip-soldering at 400 °C for 2 s

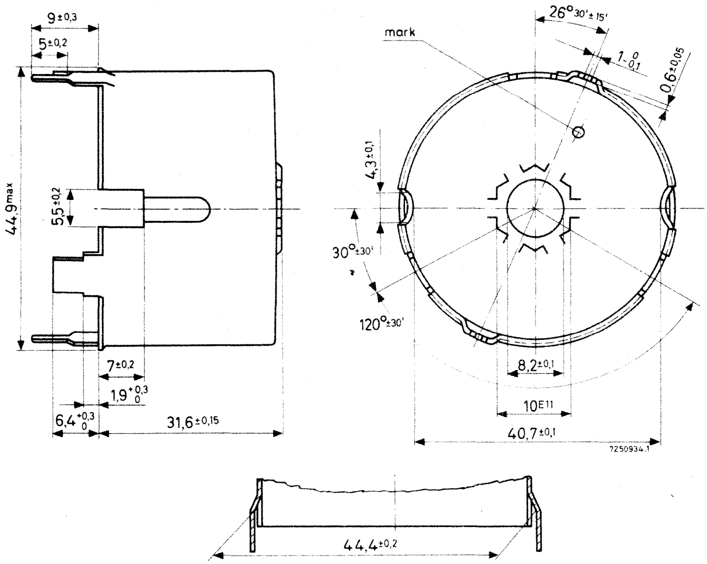
Pins : phosphor bronze, dip-soldered



The tag plates are packed in units of 15 pieces on a polystyrene plate, and with 100 pieces in a cardboard box. Please order in multiples of these quantities.

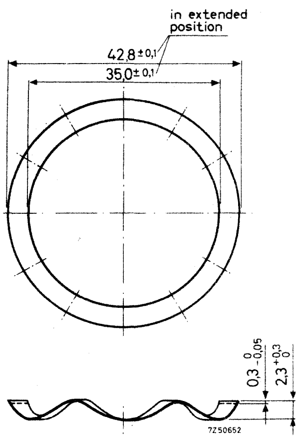
(2) Container 4322 021 30580

Material: brass, nickel plated; tinned soldering pins



(3) Spring 4322 021 30690

Material: chrome-nickel steel

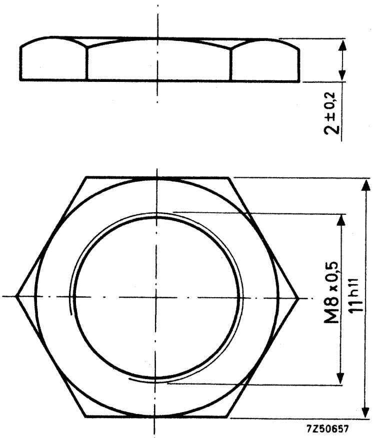


A force of 383 to 638 N is required to compress the spring to 0,67 mm.

The springs are packed in units of 100 pieces. Please order in multiples of this quantity.

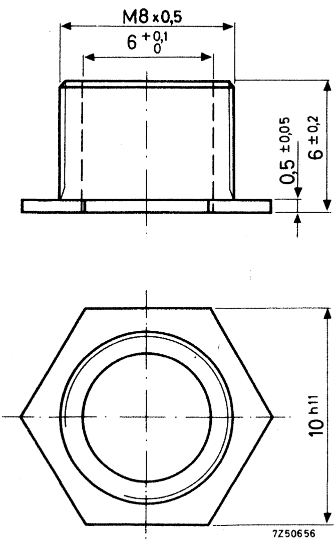
(4) Nut 4322 021 30710

Material: brass, nickel plated



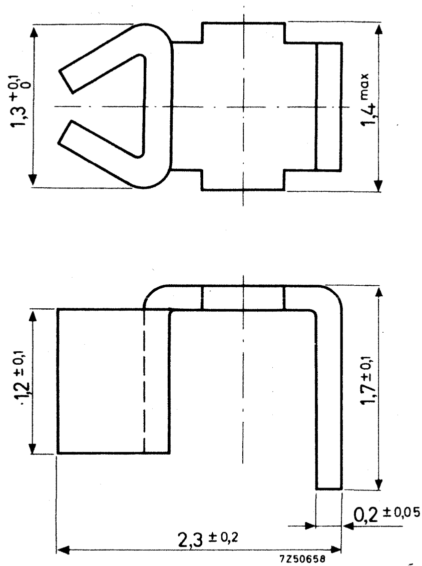
(5) Fixing bush 4322 021 30720

Material: brass, nickel plated



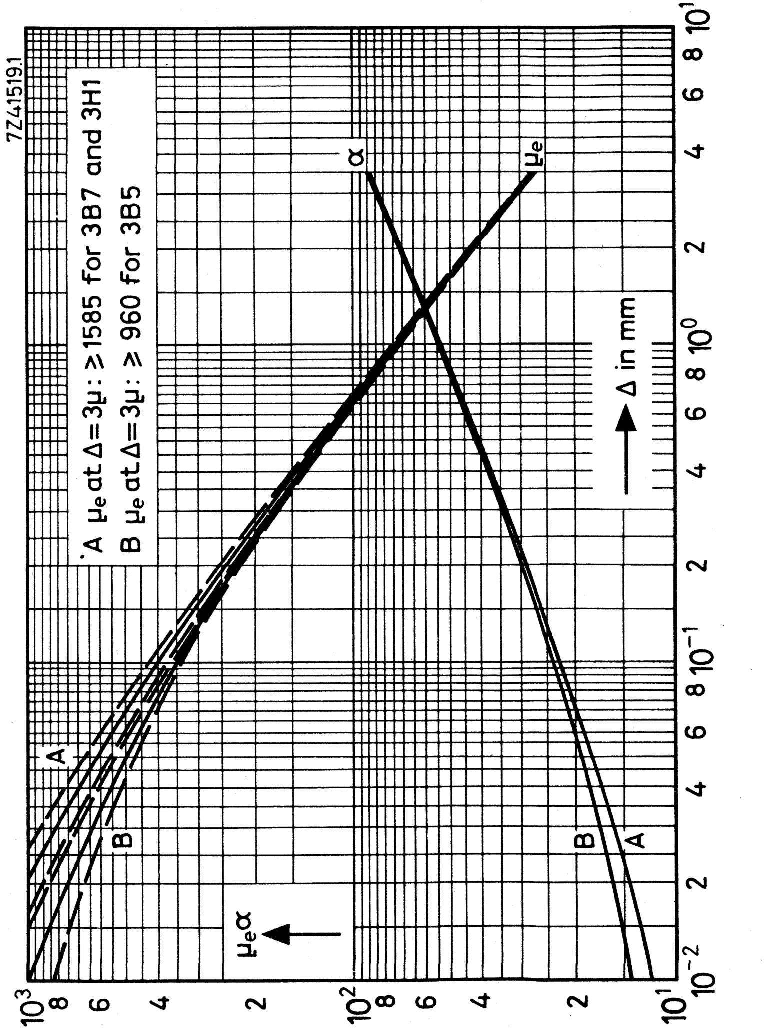
(6) Soldering spring 4322 021 30700

Material: brass, dip-soldered



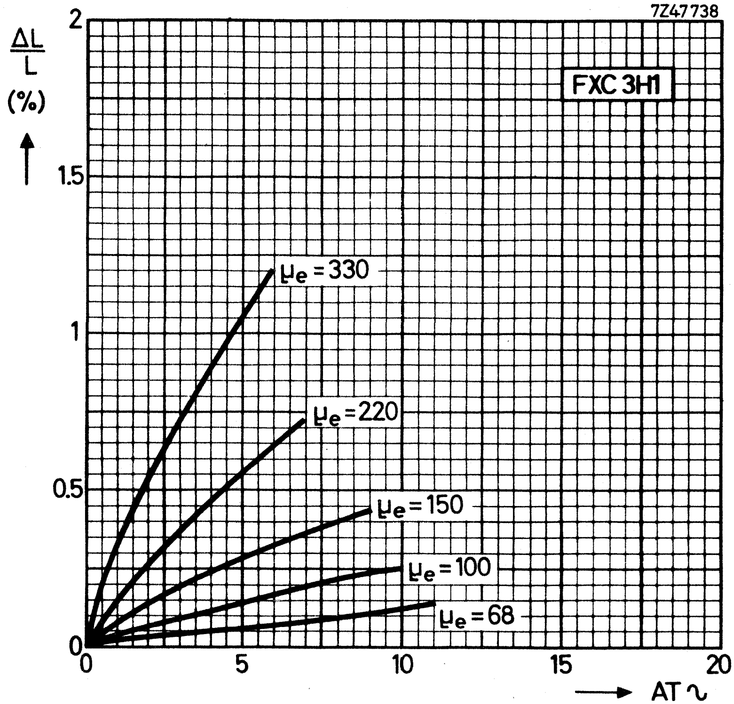
CHARACTERISTIC CURVES

μ_e-α CURVES



Relative effective permeability and turn factor for 1 mH as a function of the air gap length

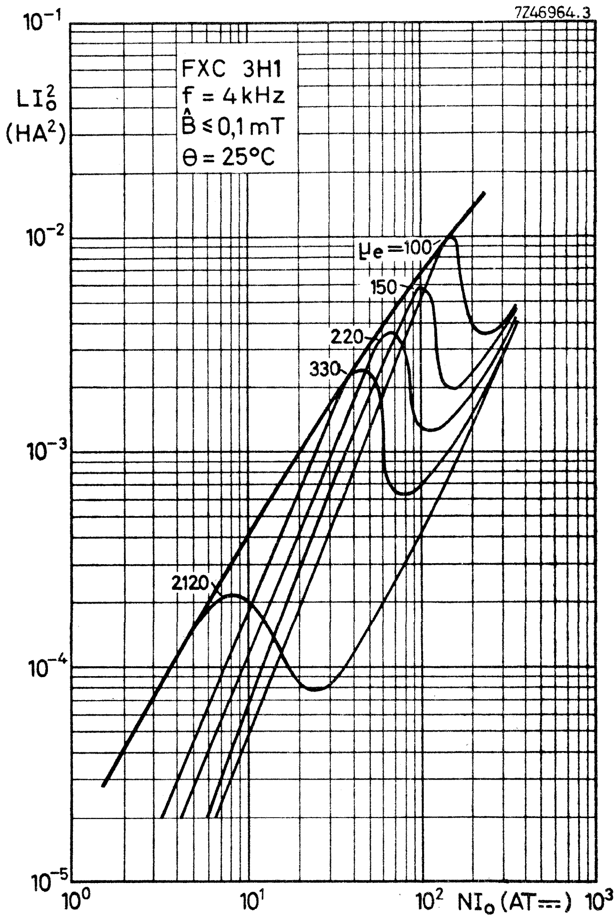
INDUCTANCE VARIATION AS A FUNCTION OF AT ~



HANNA CURVE

Indicating the optimum inductance for a certain μ_e-value and direct current.

Typical values



POTCORES

INTRODUCTION

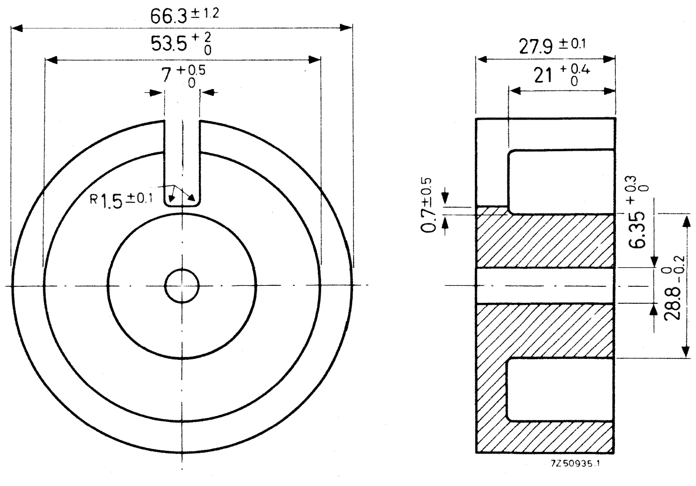
Two types of core can be supplied:

- Separate core halves, air gap to be ground by the user himself.
- Pre-adjusted potcores, available to special order. The μ_e values can be chosen from the E_6 standard series of values, the A_L values from the R_5 series.

Potcores and associated parts are ordered by their 12-digit catalog number.
Quantity: a storage pack contains 12 halves each packed in corrogated fibre cardboard

SEPARATE POTCORE HALVES

Dimensions in mm



Versions

ferroxcube grade	catalogue number
3B5	4322 020 23010
3E1	4322 020 23000

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I	temp. (°C)	grade	
		3B5	3E1
$\alpha_F \times 10^6$	+5 to +23 +23 to +55 +23 to +70	0 to +2	–
$D_F \times 10^6$ (10-100 min)	+23 ± 1	≤ 7,5	–

For the combination of two potcore halves randomly chosen from a batch and pressed together with a force of 1700 Newton, the values in Table II are guaranteed at 25 ± 10 °C.

Table II	$\hat{B}$ (mT)	freq. (kHz)	grade	
			3B5	3E1
μ_e	≤ 0,1	4	≥ 1000	≥ 1970
α	≤ 0,1	4	≤ 11,7	≤ 8,25
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	4	≤ 2,5	–
	≤ 0,1	10	≤ 5	–
	≤ 0,1	100	≤ 25	–
$q_{2-24-100}$	1,5–3,0		≤ 2,5	–
$\eta_B \times 10^3$	1,5–3,0		≤ 1,5	–

Weight (two halves) = 550 g

Core factor and effective dimensions:

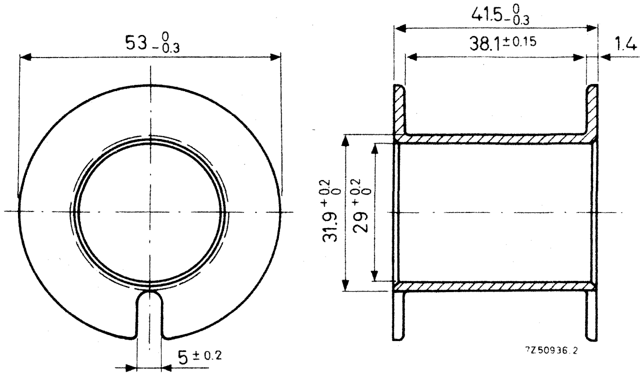
Effective length l_e = 123 mm

$$\Sigma \frac{l_e}{A_e} = 0,172 \text{ mm}^{-1}$$

Effective volume V_e = 88300 mm^3

COIL FORMER

SINGLE-SECTION COIL FORMER



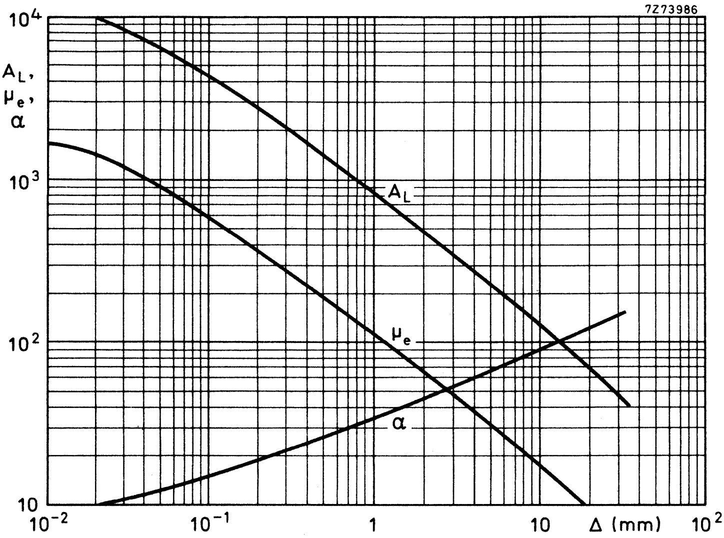
Catalogue number	4322 021 31320
Material	polycarbonate
Window area	400 mm^2
Mean length of turn	130 mm
Max. temperature	130 °C

D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 0,80 \times 10^3\ \Omega/H$$

Weight 11,8 g

CHARACTERISTIC CURVES



Inductance factor, relative effective permeability and turns factor as a function of the air gap length.

Square cores

SQUARE CORES

Three types of core can be supplied:

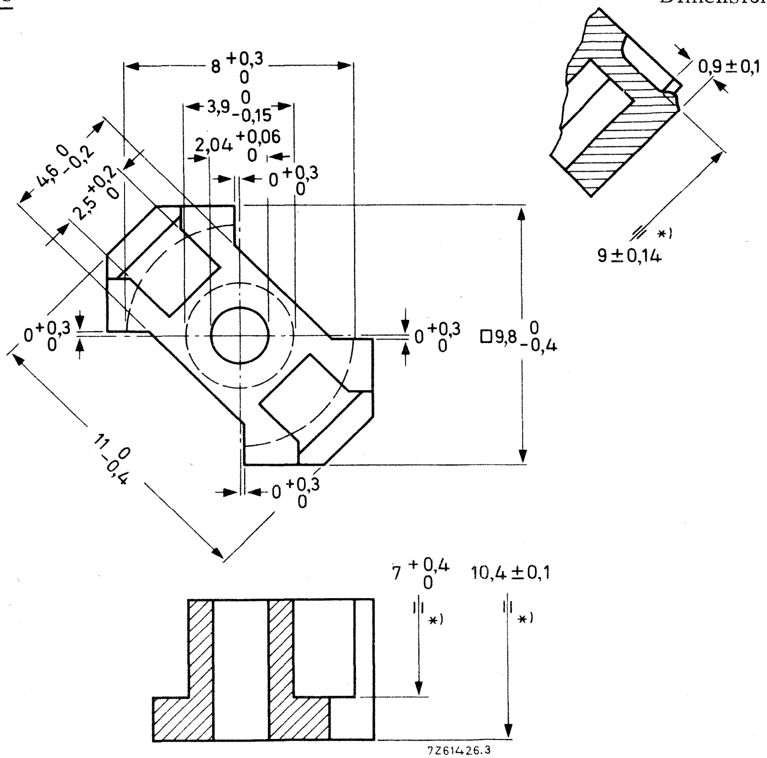
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted cores (2 halves with an air gap) which are provided with a nut for an adjuster. These cores have an inductance factor A_L in accordance with the R5 (R10) range.
- Pre-adjusted cores without nut.

The square cores are in accordance with the following specifications: IEC 431 (international), UTE C93-324 (France), DIN 41980 (Germany).
Square cores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 40 core halves or 20 pre-adjusted cores, a storage pack 200 or 100 respectively. Please order in multiples of these quantities.

SEPARATE CORE HALVES

Outlines

Dimensions in mm



*) Measured on two adjacent core halves.

Versions

Ferroxcube grade	catalogue number
3E4	only pre-adjusted cores are available
3H1	4322 020 26510

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 25 N, the values in the table below are guaranteed.

	$\hat{B}$ (mT)	freq. (MHz)	temperature °C	grade 3E4	grade 3H1
μ_e 1)	≤ 0,1	0,1	25 ± 5		1600
A_L 1)	≤ 0,1	0,1	25 ± 5		1040
α 2)	≤ 0,1	0,1	25 ± 5		31,8
$\alpha_F \times 10^6$			5 to 25	0 to 2	+0,5 to +1,5
			25 to 55	0 to 2	+0,5 to +1,5
			25 to 70	0 to 2	+0,5 to +1,5 3)
$D_F \times 10^6$ (10-100 min)			25 ± 1		≤ 4,3
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	25 ± 10	≤ 2,5	
	≤ 0,1	0,03	25 ± 10		≤ 3
	≤ 0,1	0,1	25 ± 10	≤ 2,0	≤ 6
	≤ 0,1	0,5	25 ± 10	≤ 200	
	≤ 0,1	1	25 ± 10		
	≤ 0,1	2	25 ± 10		
	≤ 0,1	10	25 ± 10		
$q_{2-24-100}$	0,3-1,2	0,1	25 ± 10		
	1,5-3,0	0,004	25 ± 10		≤ 1,8
$\eta_B \times 10^3$	0,3-1,2	0,1	25 ± 10		
	1,5-3,0	0,004	25 ± 10	≤ 1,1	≤ 1,1

1) Tolerance ± 25%.

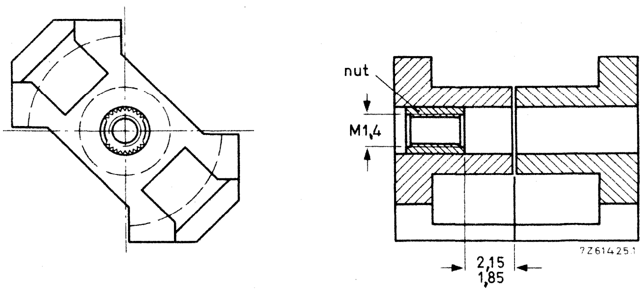
2) Tolerance ± 12,5%.

3) For guidance only.

PRE-ADJUSTED CORES

Outlines

Dimensions in mm



Mass (per set)	2,5 g
Mean length of lines of force	l_e = 21,3 mm
Mean area of lines of force	A_e = 11 mm^2
	$\Sigma \frac{l_e}{A_e} = 1,94\ mm^{-1}$
Effective volume	V_e = 230 mm^3

Pre-adjusted cores with standard A_L values

A_L	corre-sponding μ_e-value	tolerance on induc-tance (%)	cat. no.: 4322 022 7.... with nut / 4322 022 5.... without nut	
			3E4	3H1
40	62	± 1		7220
63	96	± 1,5		7230
100	152	± 2		7240
160	242	± 5		7250
250	380	± 10		7260
→ 2790	3760	± 25	7900 *	

Inductance $L = N^2 A_L$ (in 10^{-9} H)

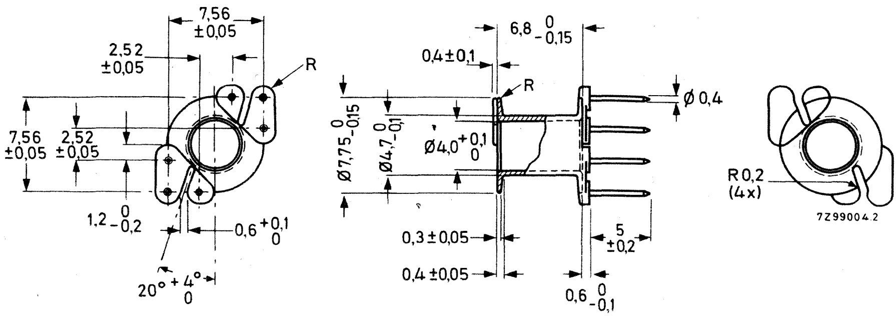
Symmetrical air gap for cores with A_L factor of 40.
Asymmetrical air gap for cores with A_L factor of 63 and higher.
The air gap of the types marked * is practically zero, and consequently inductance adjustment is not possible. Hence these types are not provided with a centre hole, so that maximum performance is achieved.

Notes

1. Example of catalogue number:
   A_L = 63, grade 3H1, core with nut, catalogue number 4322 022 77230
   A_L = 100, grade 3H1, core without nut, catalogue number 4322 022 57240.
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

COIL FORMER

SINGLE-SECTION, 6-PIN COIL FORMER



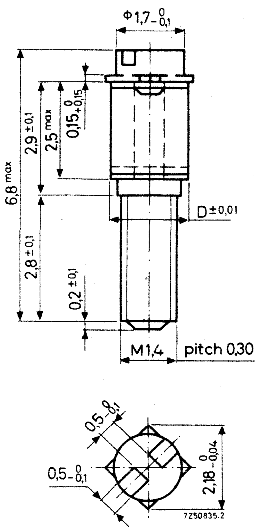
Catalogue number	4322 021 31800
Material	polyester reinforced with glass fibre, dip-soldered pins
Window area	8, 8 mm^2
Mean length of turn	20 mm
Max. temperature	130 °C
Solderability	resistant against dip-soldering at 400 °C for 2 s ←
D.C. losses	$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 55,7 \times 10^3\ \Omega/H$
Mass	0, 16 g

The arrangement of the soldering pins is suitable for both 0, 1 " and 2, 50 mm grid, see chapter on Mounting.
The coil formers are packed in a polystyrene plate of 200 or in a cardboard box of 100. ←
Please order in multiples of these quantities.

INDUCTANCE ADJUSTERS

ADJUSTERS

The tolerances on inductance of the pre-adjusted cores (without adjuster) are given in the table of pre-adjusted cores with standard A_L values. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0,03% by means of a continuous inductance adjuster. Such an adjuster increases the inductance of the coil (see following pages).
The adjuster is screwed through the centre hole of the core into the nut and is held in position by the four protrusions near the top of the adjuster. For special requirements a larger or smaller adjustment range may be obtained by using an adjuster belonging to the next higher or lower A_L value.
The influence of the adjuster on the variability of the inductance is negligible. The maximum permissible temperature is 110 °C.
The table shows the type of adjuster recommended for different square cores.

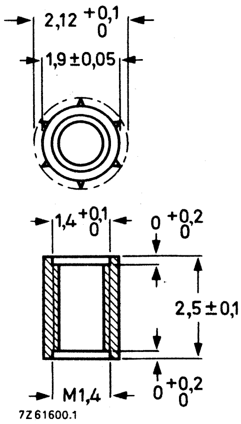


D	A_L of core in 3E4/3H1	recommended adjuster	
		cat. no.	colour
1,85	40	4322 021 31250	green
1,85	63	4322 021 31260	red
1,85	100	4322 021 31270	yellow
1,76	160	4322 021 31540	brown
1,85	250	4322 021 31280	grey

The adjusters are packed in bags of 100.
Please order in multiples of 100.

NUT FOR ADJUSTER

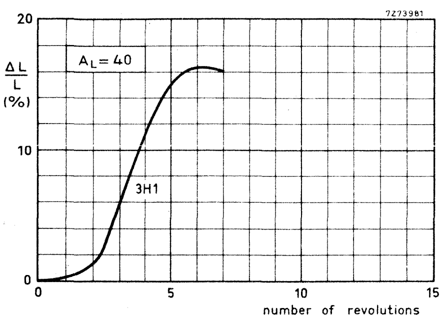
These data are given for those manufacturers who prefer to insert the nut themselves.



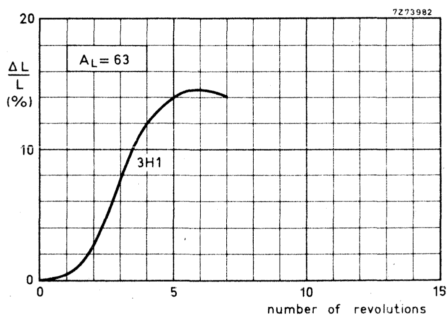
Catalogue number	4322 021 31850
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut	2,0 ± 0,15 mm

The nuts are packed in bags of 100. Please order in multiples of 100.

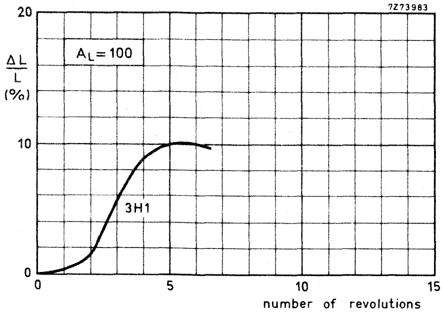
ADJUSTMENT CURVES



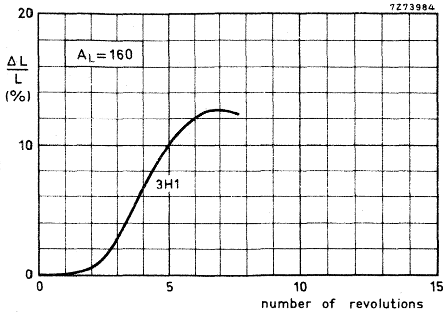
Adjuster 4322 021 31250



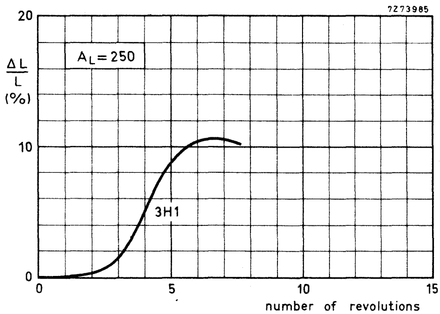
Adjuster 4322 021 31260



Adjuster 4322 021 31270

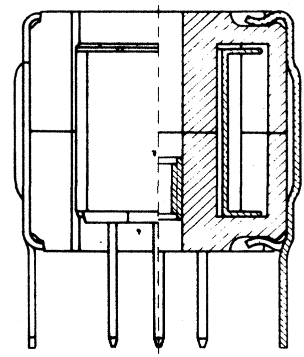


Adjuster 4322 021 31540



Adjuster 4322 021 31280

ASSEMBLING AND MOUNTING



7Z99011.1

ASSEMBLING

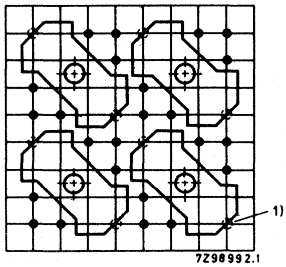
The core halves are clamped together by means of two clips, type 4322 021 31900. As can be seen in the drawing, the hooked ends of each clip fit into recesses made in the core halves.

For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half. We also recommend that a tool be used for assembling. (Drawings of a simple tool are available under number 8222 294 12930.)

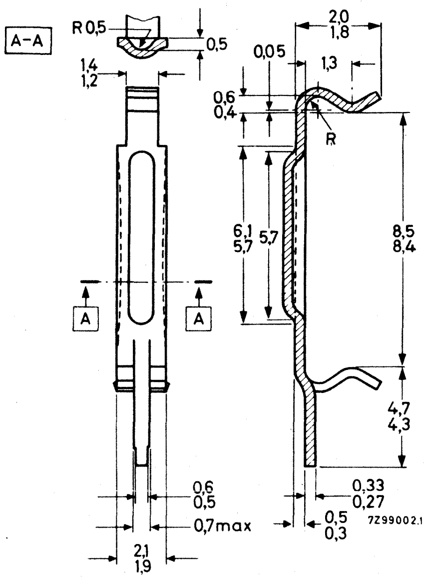
MOUNTING

The two retaining clips are also used for mounting the assembled core on a printed-wiring board: the gold-plated pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing the core.

The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0,1 in grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 2,4 mm. The recommended hole diameter in the board is 1 ± 0,1 mm (according to IEC publication 97).



PART DRAWING (dimensions in mm)

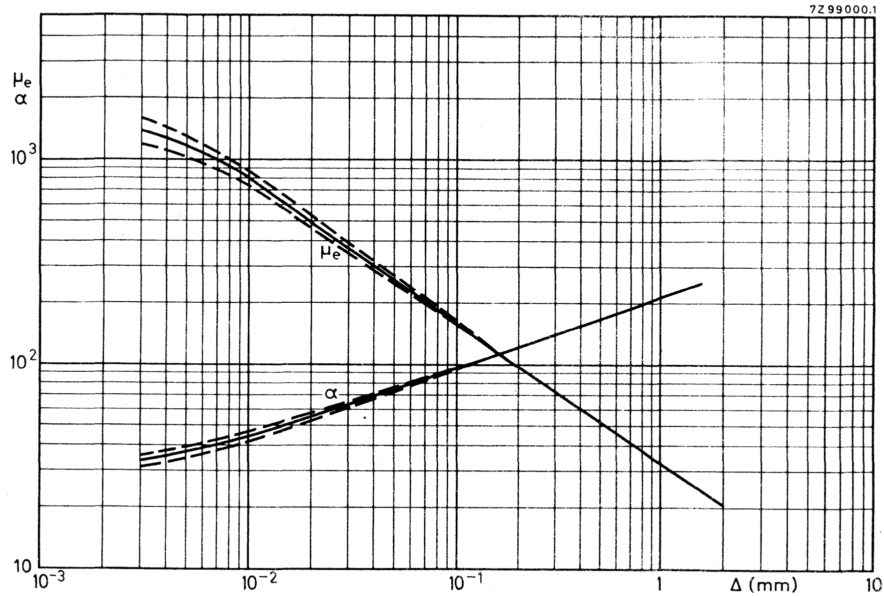


Clip 4322 021 31900
Material: steel, gold plated over nickel.

1) Holes for tag on clip 4322 021 31900 (earth points).

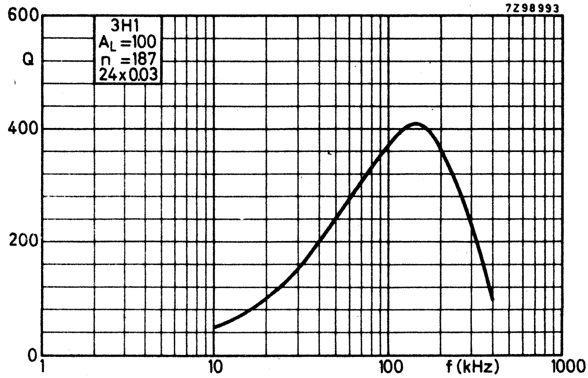
CHARACTERISTIC CURVES

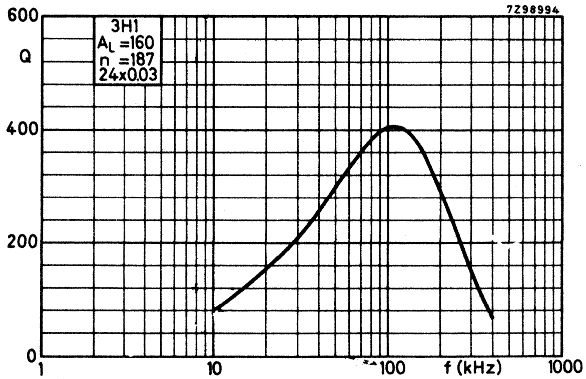
μ_e - α CURVES



Relative effective permeability and turns factor for 1 mH as a function of the air gap length. $\mu_e \geq 1200$ at $\Delta = 3\ \mu m$ for 3H1.

Q-CURVES


7Z98993
3H1
A_L = 100
n = 187
24 x 0.03
600
Q
400
200
0
1
10
100
f (kHz)
1000


7Z98994
3H1
A_L = 160
n = 187
24 x 0.03
600
Q
400
200
0
1
10
100
f (kHz)
1000

SQUARE CORES

Three types of core can be supplied:
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted cores (2 halves with an air gap) which are provided with a nut for an adjuster. These cores have an inductance factor A_L in accordance with the R5(R10) range.
- Pre-adjusted cores without nut.

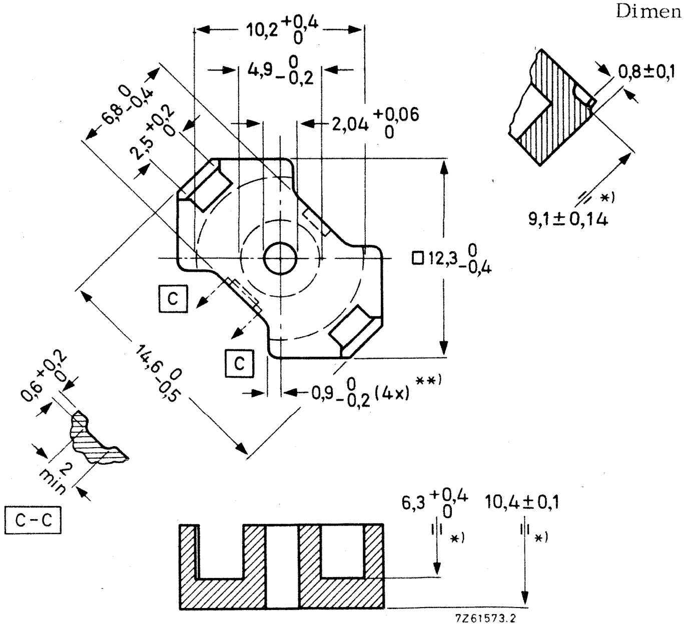
The square cores are in accordance with the following specifications:
IEC 431 (international), UTE C93-324 (France), DIN 41980 (Germany).

Square cores and associated parts are ordered by their 12-digit catalogue number.
Quantity: a primary pack contains 40 core halves or 20 pre-adjusted cores, a storage pack 200 or 100 respectively. Please order in multiples of these quantities.

SEPARATE CORE HALVES

Outlines

Dimensions in mm



*) Measured on two adjacent core halves.

**) Measured on the face with the recesses, 0,8 ± 0,2 mm on the mating face.

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 35 N, the values in the table below are guaranteed.

	$\hat{B}$ (mT)	freq. (MHz)	temp. (°C)	grade 3B7	3D3	3E1	3E4	3H1	3H3	4C6
μ_e 1)	≤ 0,1	0,1	25 ± 5	1590	670			1590		124
A_L 1)	≤ 0,1	0,1	25 ± 5	1960	840			1960		150
α 2)	≤ 0,1	0,1	25 ± 5	23,1	35,3			23,1		82,3
$\alpha_F \times 10^6$			5 to 25	−0,6 to +0,6 3)			0 to +2	+0,5 to 1,5	0,7 ± 0,25 4)	−2 to +4
			25 to 55	−0,6 to +0,6			0 to +2	+0,5 to 1,5	0,7 ± 0,25	0 to +6
			25 to 70	−0,6 to +0,6	0 to +2	0 to +2	0 to +2	+0,5 to 1,5	0,7 ± 0,25	
$D_F \times 10^6$ (10-100 min)			25 ± 1	≤ 4,3	≤ 12		≤ 4,3	≤ 4,3		≤ 10
$D_F \times 10^6$	≤ 0,1	≤ 0,1	5)						≤ 3	
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	25 ± 5			≤ 2,5	≤ 2,5			
	≤ 0,1	0,03		≤ 2,5				≤ 2,5		
	≤ 0,1	0,1		≤ 5	≤ 8	≤ 20	≤ 20	≤ 5		
	≤ 0,1	0,5			≤ 14	≤ 200	≤ 200			
	≤ 0,1	1			≤ 30					
	≤ 0,1	2								≤ 40
	≤ 0,1	10								≤ 100
$q_{2-24-100}$	0,3-1,2	0,1	25 ± 5		≤ 3					≤ 15
	1,5-3,0	0,004		≤ 1,8/≤ 1,4 3)		≤ 3	≤ 1,8	≤ 1,4		
$\eta_B \times 10^3$	0,3-1,2	0,1	25 ± 5		≤ 1,8					≤ 9,2
	1,5-3,0	0,004		≤ 1,1/≤ 0,86 3)		≤ 1,8	≤ 1,1	≤ 0,86		
	1,5-3,0	0,03	25 ± 1						≤ 0,85	

1) Tolerance ± 25%.
2) Tolerance ± 12,5%.
3) For guidance only.
4) α_F of 3H3 has been determined with formula $\alpha_F = \frac{L_\theta - L_{25}}{L_\theta \times L_{25}} \times \frac{1}{\theta - 25}$ /°C.
5) Any temperature between +25 and +70°C.

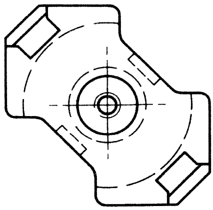
Versions

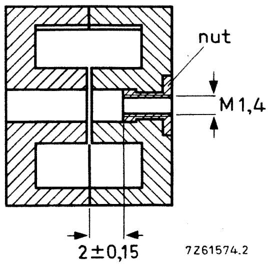
Ferroxcube grade	catalogue number
3B7	4322 020 26750
3D3	4322 020 26770
3E1	only pre-adjusted
3E4	cores are available
3H1	4322 020 26760
3H3	4322 020 26790
4C6	4322 020 26780

PRE–ADJUSTED CORES

Outlines

Dimensions in mm





		with centre hole	without centre hole
Mass		3,0 g	3,2 g
Mean length of lines of force	l_e	21,4 mm	23,2 mm
Mean area of lines of force	A_e	21,2 mm^2	24,8 mm^2
	$\Sigma \frac{l_e}{A_e}$	1,01 mm^{-1}	0,935 mm^{-1}
Effective volume	V_e	450 mm^3	574 mm^3

→ Pre-adjusted cores with standard A_L values

A_L	corre-sponding μ_e-value	tol. on induct-ance(%)	cat. no. 4322 022 7.... with nut / 4322 022 5.... without nut						
			3B7	3D3	3E1	3E4	3H1	3H3	4C6
16	13	± 1							9800
25	20	± 1		9410					9810
40	33	± 1		9420					9820
63	51	± 1	9030	9430			9230		9830
100	82	± 1	9040	9440			9240		
160	130	± 2	9050				9250	9550	
200	160	± 2						9690	
250	200	± 3	9060				9260	9560	
315	250	± 5	9070				9270	9570	
400	330	± 5	9080				9280	9580	
3450	2570	± 25			9900*				
4600	3700	± 25				9930			
4975	3700	± 25				9900*			

Inductance $L = N^2 A_L$ (in 10^{-9} H)

Symmetrical air gap for cores with A_L factor of 16 up to and including 100.
Asymmetrical air gap for cores with A_L factor of 160 and higher.
The air gap of the types marked* is practically zero, and consequently inductance adjustment is not possible. Hence these types are not provided with a centre hole, so that maximum performance is achieved.

Notes

1. Example of catalogue number;
   A_L = 250, grade 3H1, core with nut, catalogue number 4322 022 79260.
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

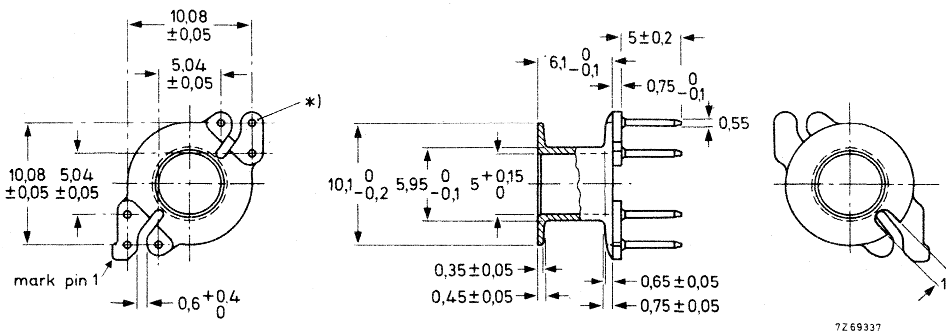
COIL FORMERS

to DIN 41981

SINGLE-SECTION 4-PIN COIL FORMER , catalogue number 4322 021 32830
SINGLE-SECTION 6-PIN COIL FORMER , catalogue number 4322 021 32840

Outlines

Dimensions in mm



Material	phenolformaldehyde reinforced with glass fibre, dip-soldered pins
Minimum window area	9, 5 mm^2
Mean length of turn	25 mm
Maximum temperature	180 °C
Solderability	resistant against dipsoldering at 400 °C for 2 s
D.C. losses	$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 34 \times 10^3 \Omega/H$
Mass	0, 28 g

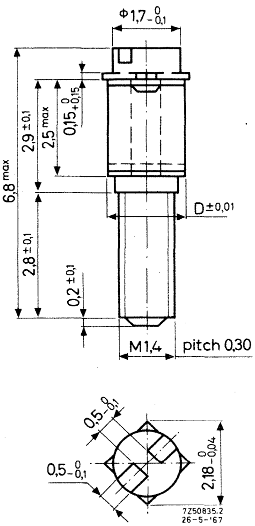
The coil formers are packed on a polystyrene plate of 150 or in a cardboard box of 750. Please order in multiples of these quantities.

*) The 4-pin coil former does not have the two outermost pins.

INDUCTANCE ADJUSTERS

ADJUSTERS

The tolerances on inductance of the pre-adjusted cores (without adjuster) are given in the table of pre-adjusted cores with standard A_L values. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0,03% by means of a continous inductance adjuster. Such an adjuster increases the inductance of the coil (see following pages).
The adjuster is screwed through the centre hole of the core into the nut and is held in position by the four protrusions near the top of the adjuster. For special requirements a larger or smaller adjustment range may be obtained by using an adjuster belonging to the next higher or lower A_L value.
The influence of the adjuster on the variability of the inductance is negligible. The maximum permissible temperature is 110 °C.
The table shows the type of adjuster recommended for different square cores.

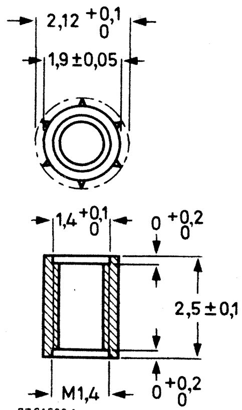


D	A_L of core in 3B7/3H1/3D3	recommended adjuster	
		cat. no.	colour
1,85	40	4322 021 31250	green
1,85	63	4322 021 31260	red
1,85	100	4322 021 31270	yellow
1,76	160	4322 021 31540	brown
1,85	250	4322 021 31280	grey
1,88	315	4322 021 32720	black
1,90	400	4322 021 32710	white

The adjusters are packed in bags of 100.
Please order in multiples of 100.

NUT FOR ADJUSTER

These data are given for those manufacturers who prefer to insert the nut themselves.

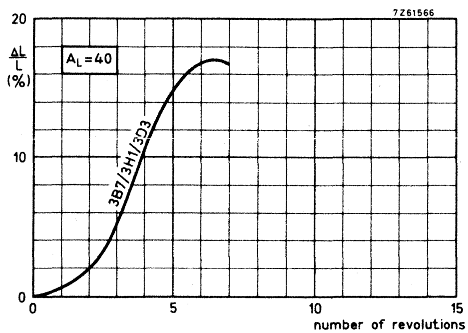


7Z61600.1

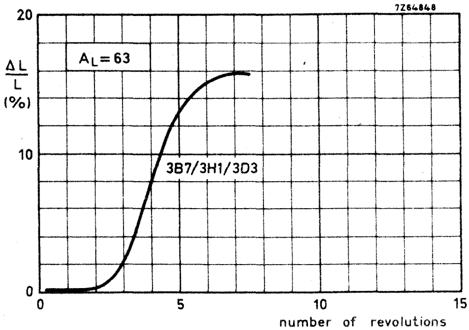
Catalogue number	4322 021 31850
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut	2,0 ± 0,15 mm

The nuts are packed in bags of 100. Please order in multiples of 100.

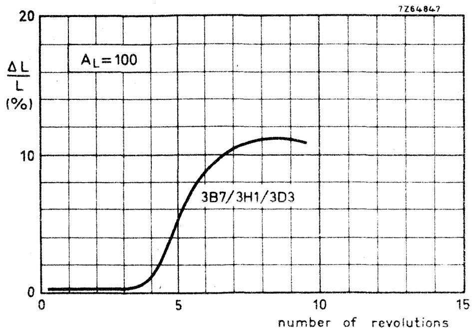
ADJUSTMENT CURVES



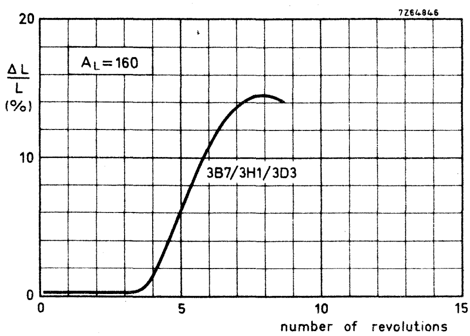
Adjuster 4322 021 31250



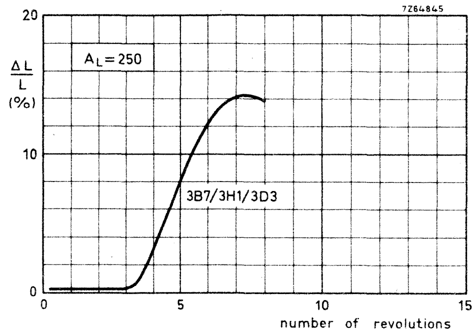
Adjuster 4322 021 31260



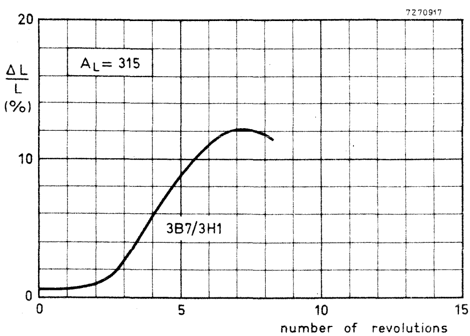
Adjuster 4322 021 31270



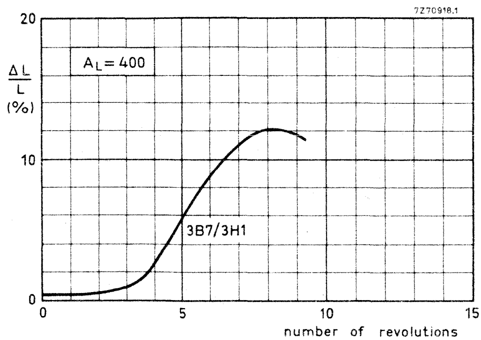
Adjuster 4322 021 31540



Adjuster 4322 021 31280

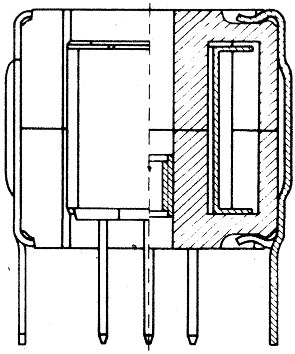


Adjuster 4322 021 32720



Adjuster 4322 021 32710

ASSEMBLING AND MOUNTING



ASSEMBLING

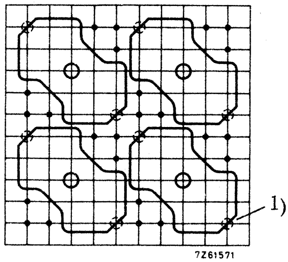
The core halves are clamped together by means of two clips, type 4322 021 31900. As can be seen in the drawing, the hooked ends of each clip fit into recesses made in the core halves.

For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half. We also recommend that a tool be used for assembling. (Drawings of a simple tool are available under number 4322 058 00170.)

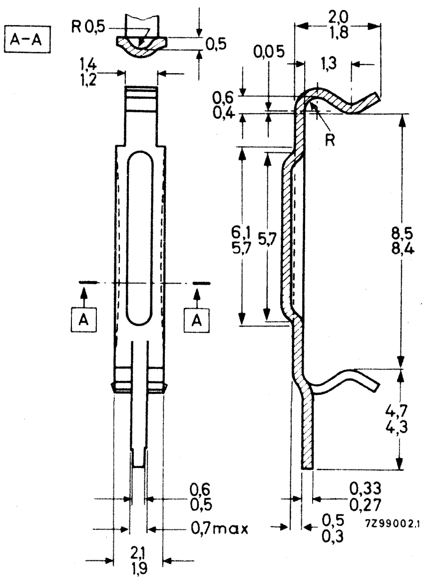
MOUNTING

The two retaining clips are also used for mounting the assembled core on a printed-wiring board: the gold plated pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing the core.

The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0, 1-inch grid as well as those with a 2, 50 mm grid. The pin length is sufficient for a board thickness of up to 2, 4 mm. The recommended hole diameter in the board is 1 ± 0, 1 mm (according to IEC publication 97).



PART DRAWING (dimensions in mm)

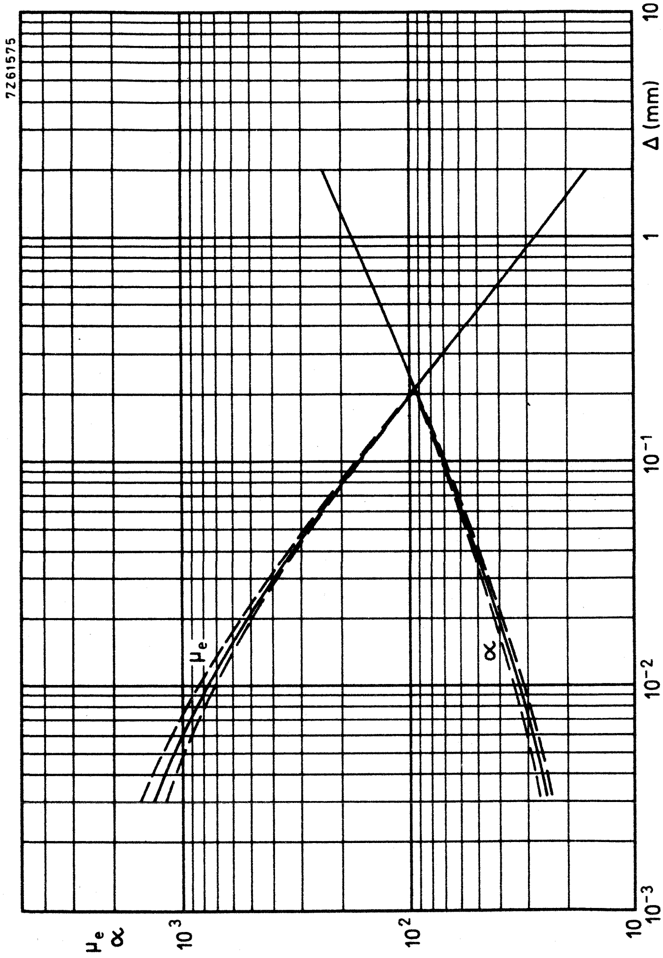


Clip 4322 021 31900
Material: steel, gold plated over nickel

1) Holes for tag on clip 4322 021 31900 (earth points).

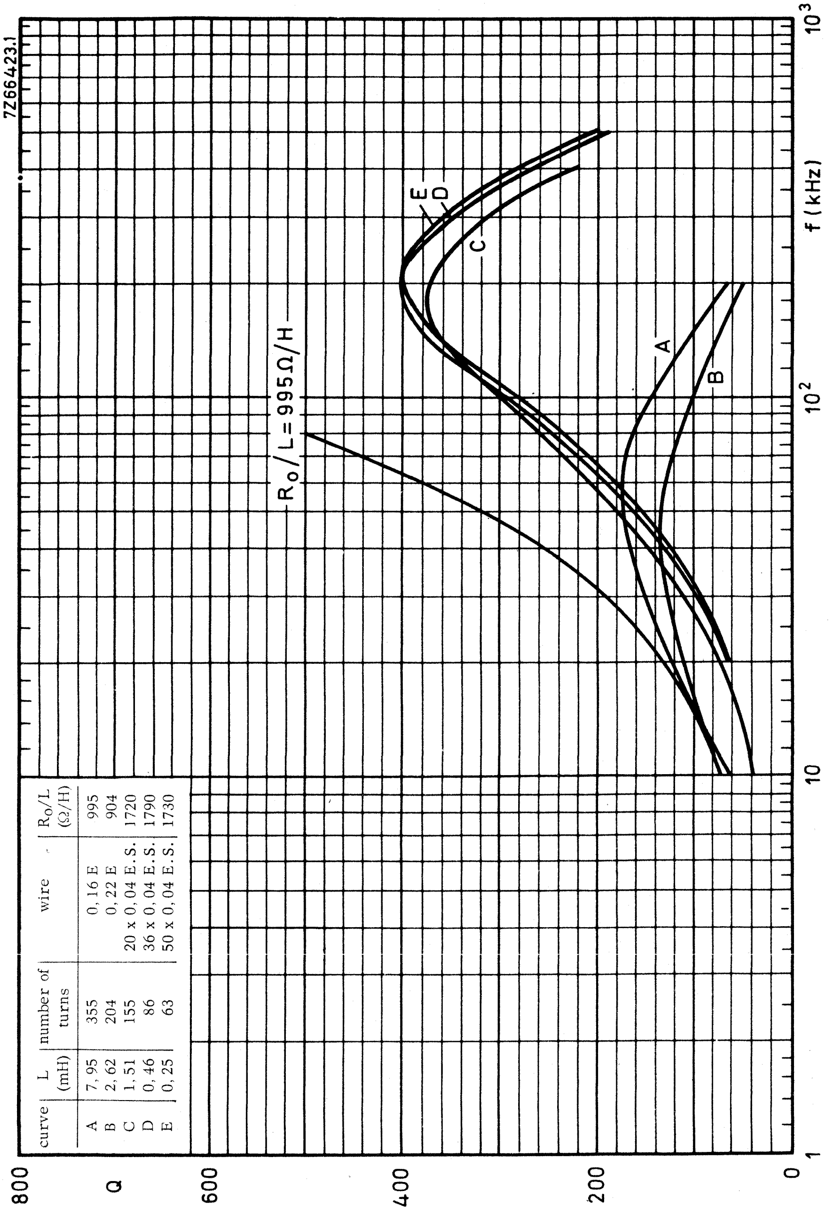
CHARACTERISTIC CURVES

μ_e - α **CURVES**



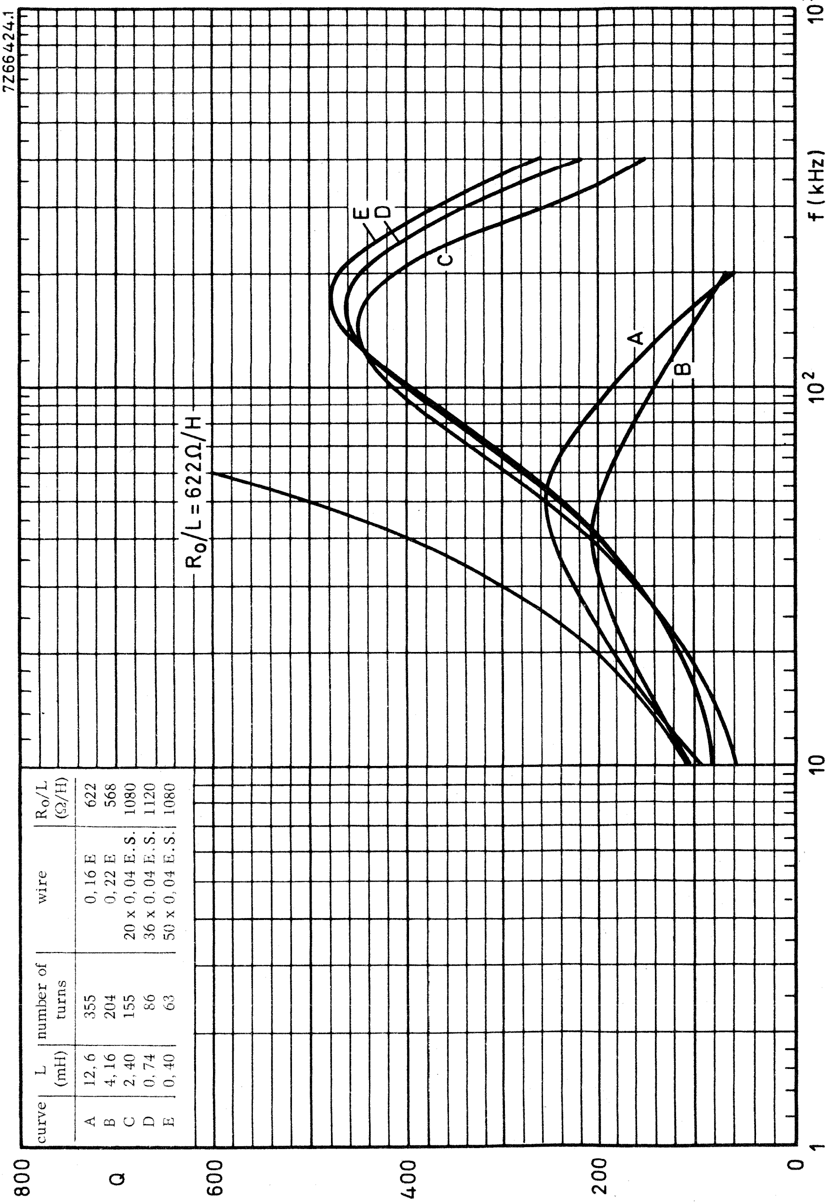
Relative effective permeability and turn factor for 1 mH as a function of the air gap length.
μ_e = 1590 at Δ = 3 μm for 3B7 and 3H1.

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1



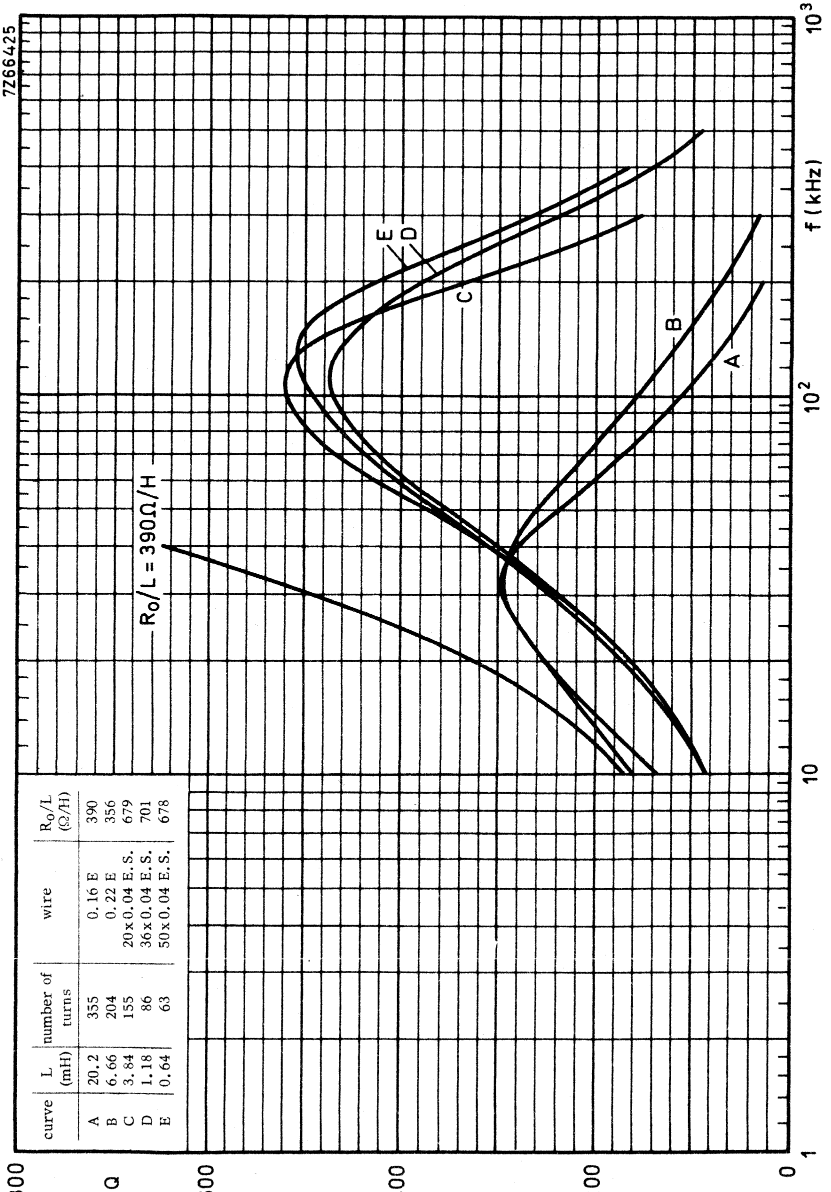
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	7,95	355	0,16 E	995
B	2,62	204	0,22 E	904
C	1,51	155	20 x 0,04 E.S.	1720
D	0,46	86	36 x 0,04 E.S.	1790
E	0,25	63	50 x 0,04 E.S.	1730

FXC 3B7/3H1, single-section coil former, $A_L = 63$



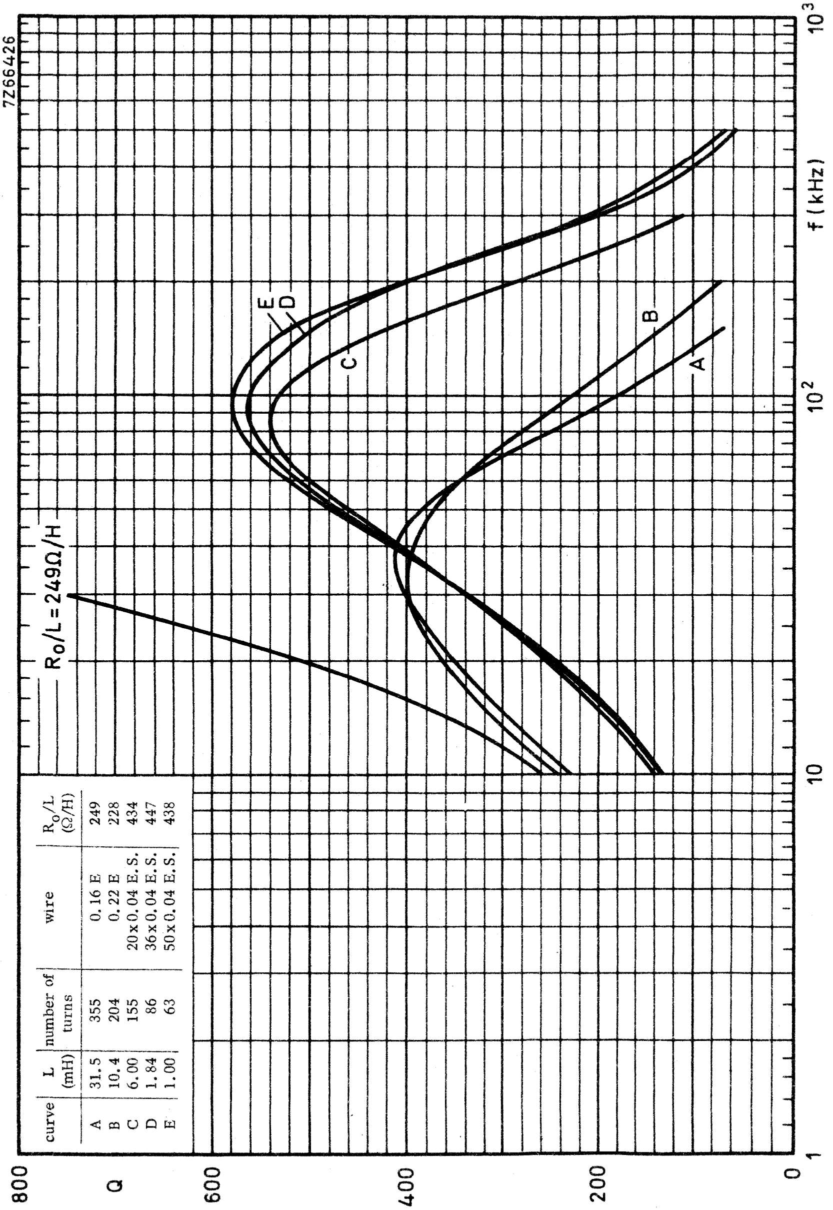
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	12,6	355	0,16 E	622
B	4,16	204	0,22 E	568
C	2,40	155	20 x 0,04 E.S.	1080
D	0,74	86	36 x 0.04 E.S.	1120
E	0,40	63	50 x 0,04 E.S.	1080

FXC 3B7/3H1, single-section coil former, $A_L = 100$



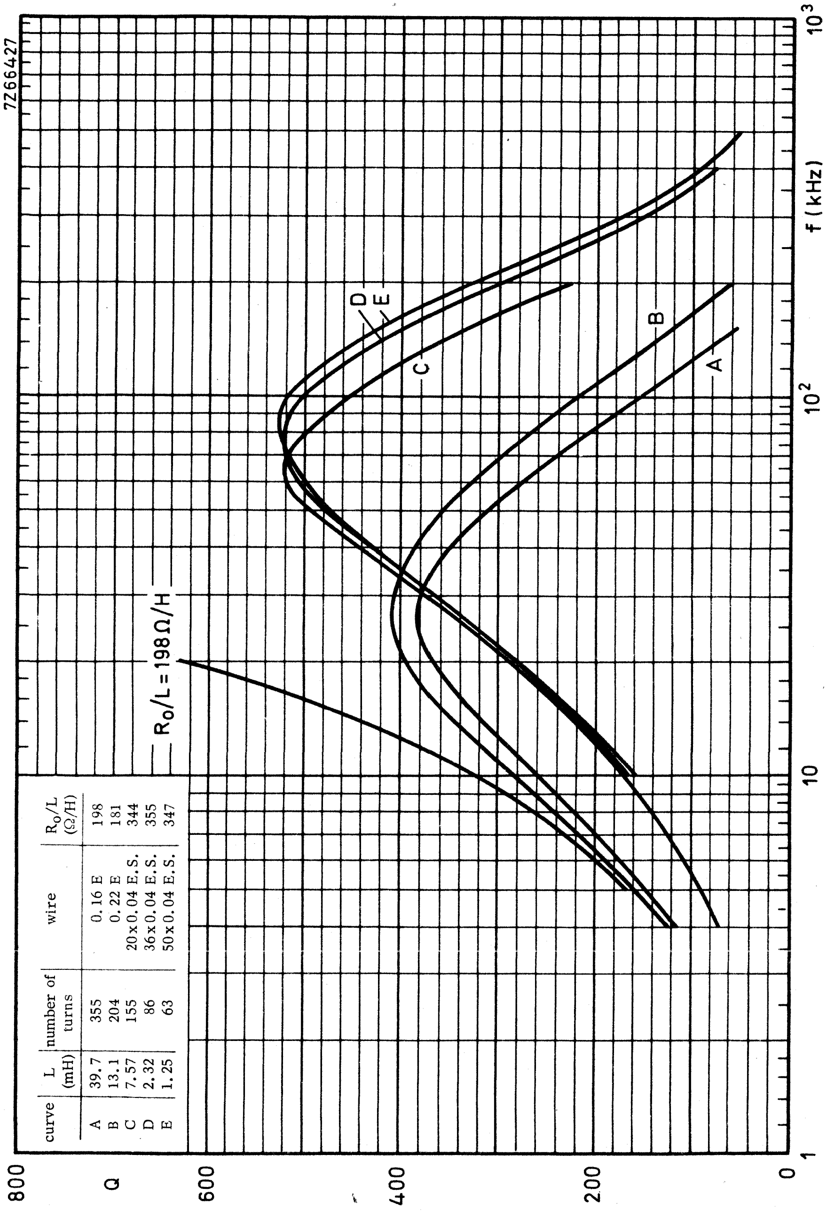
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	20.2	355	0.16 E	390
B	6.66	204	0.22 E	356
C	3.84	155	20 x 0.04 E.S.	679
D	1.18	86	36 x 0.04 E.S.	701
E	0.64	63	50 x 0.04 E.S.	678

FXC 3B7/3H1, single-section coil fromer, $A_L = 160$



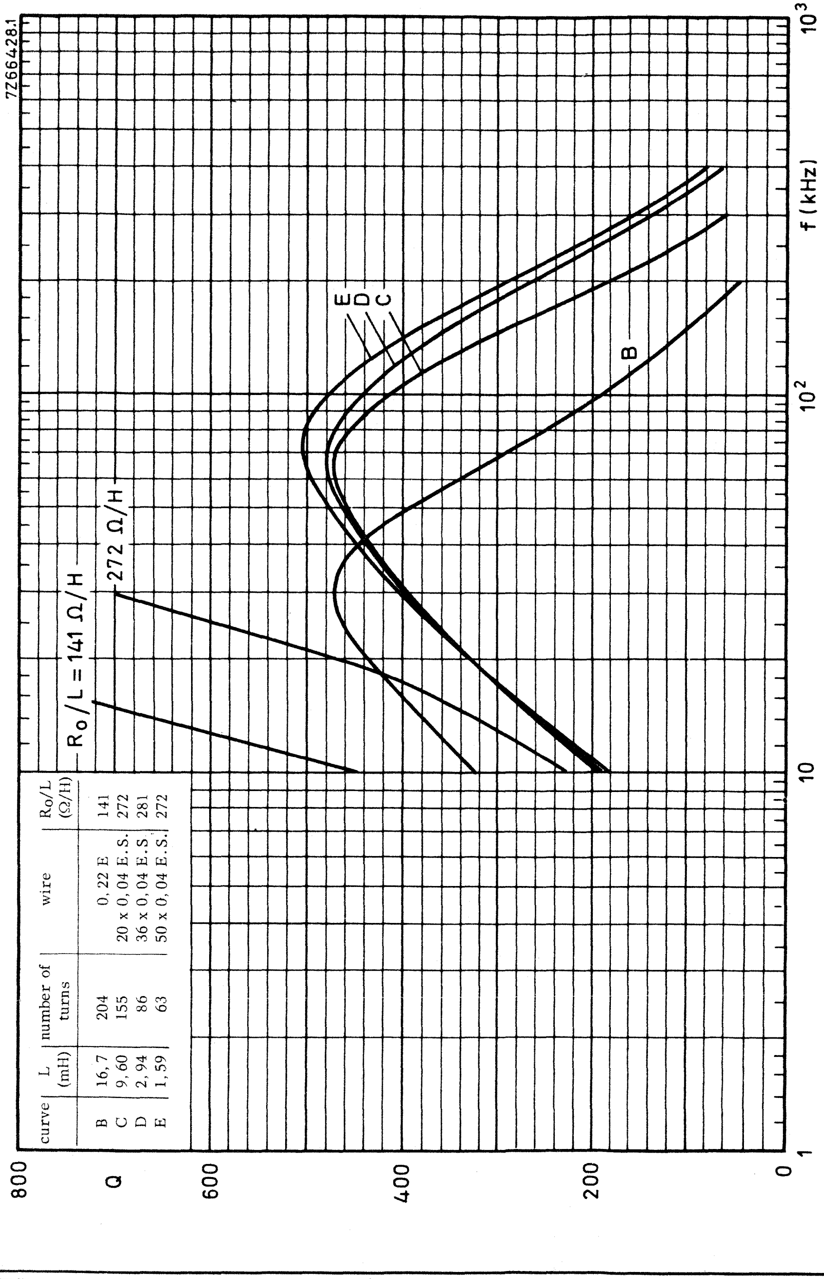
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	31.5	355	0.16 E	249
B	10.4	204	0.22 E	228
C	6.00	155	20 x 0.04 E.S.	434
D	1.84	86	36 x 0.04 E.S.	447
E	1.00	63	50 x 0.04 E.S.	438

FXC 3B7/3H1, single-section coil former, $A_L = 250$



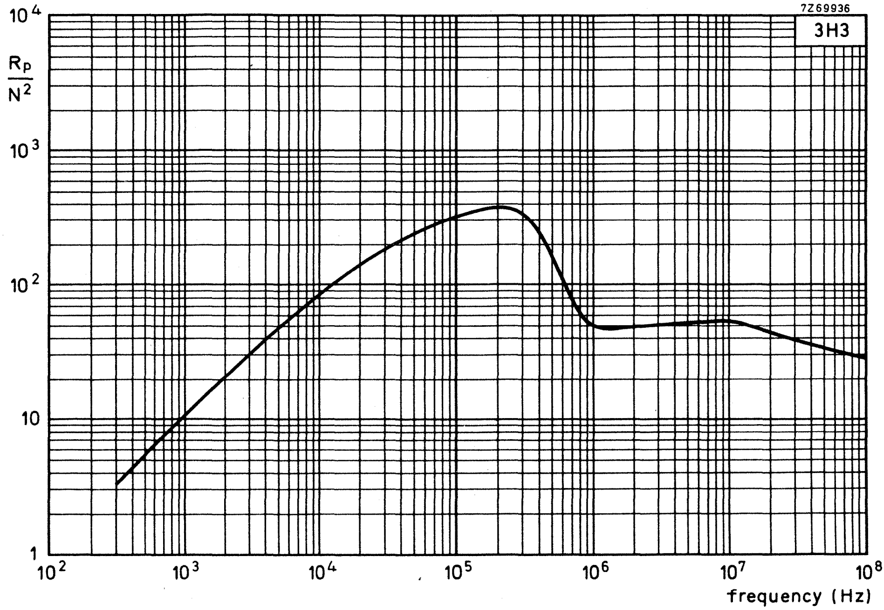
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	39.7	355	0.16 E	198
B	13.1	204	0.22 E	181
C	7.57	155	20x0.04 E.S.	344
D	2.32	86	36x0.04 E.S.	355
E	1.25	63	50x0.04 E.S.	347

FXC 3B7/3H1, single-section coil former, $A_L = 315$

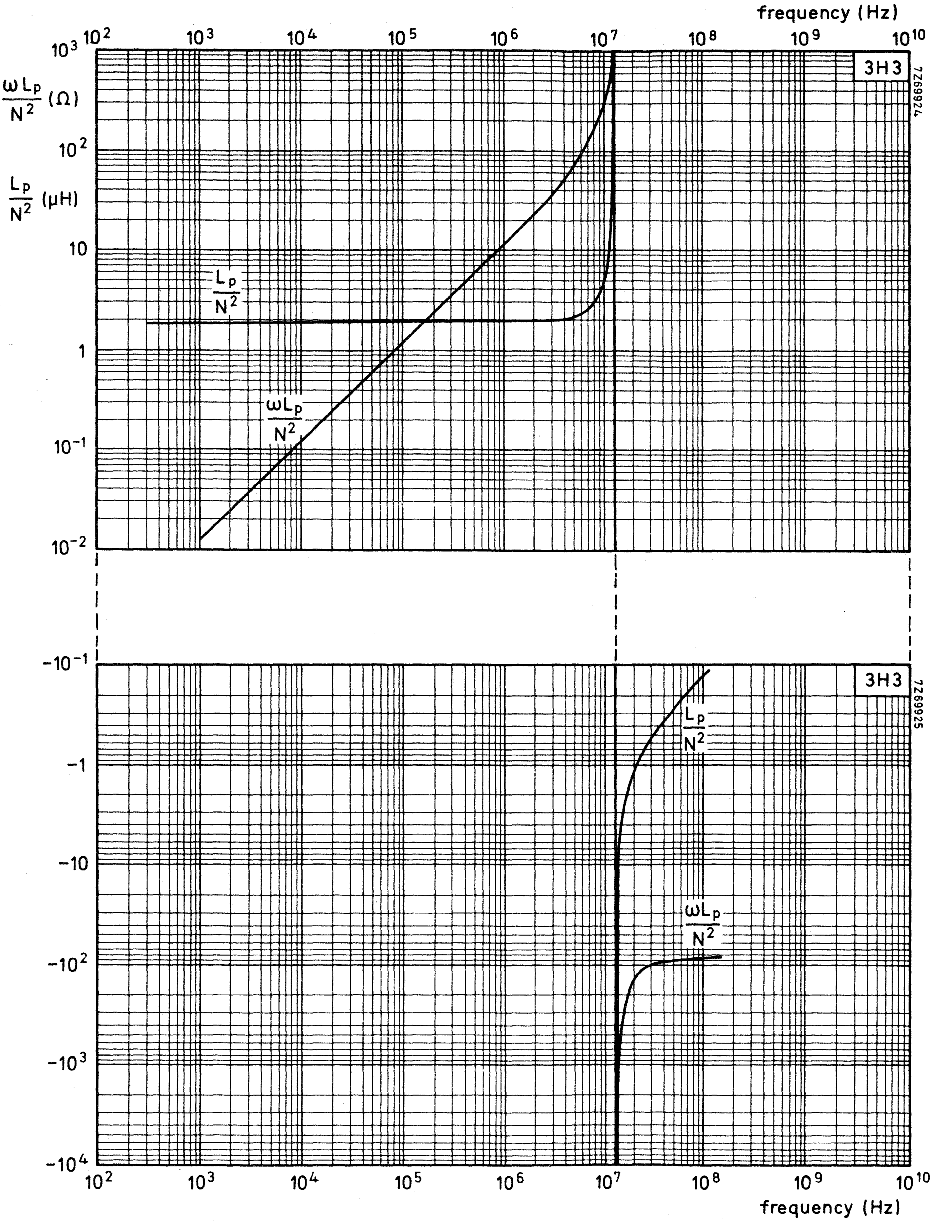


curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
B	16,7	204	0,22 E	141
C	9,60	155	20 x 0,04 E.S.	272
D	2,94	86	36 x 0,04 E.S	281
E	1,59	63	50 x 0,04 E.S.	272

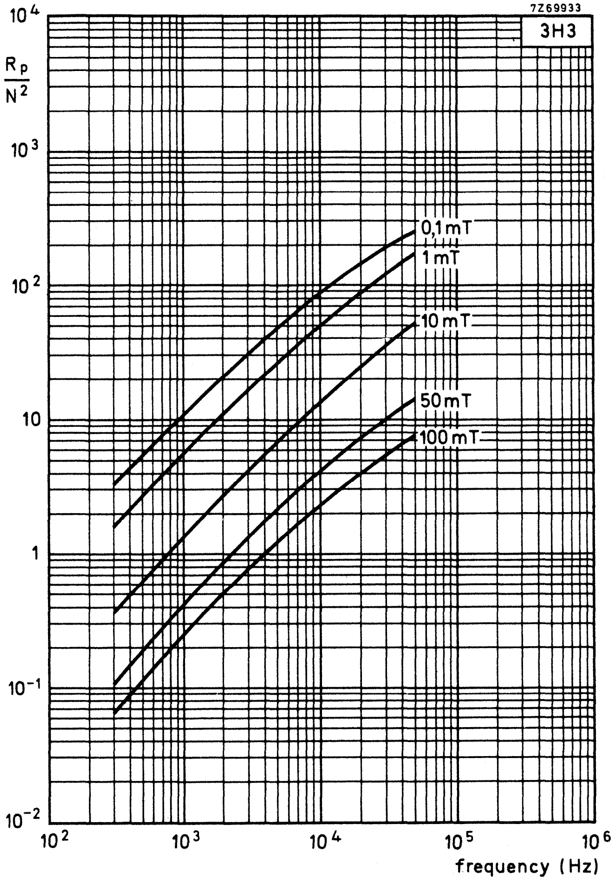
FXC 3B7/3H1, single-section coil former, $A_L = 400$



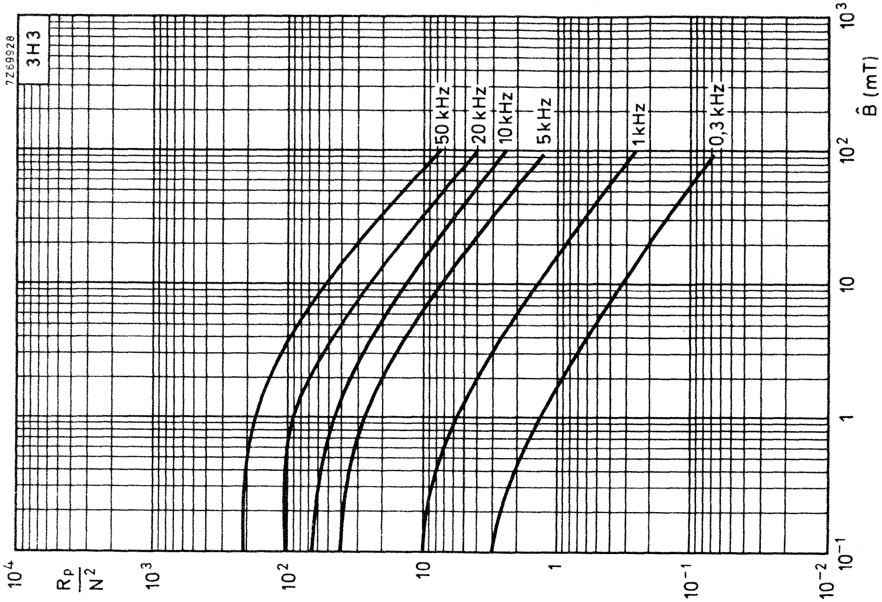
Losses as a function of the frequency at $\hat{B} \approx 0,1$ mT.



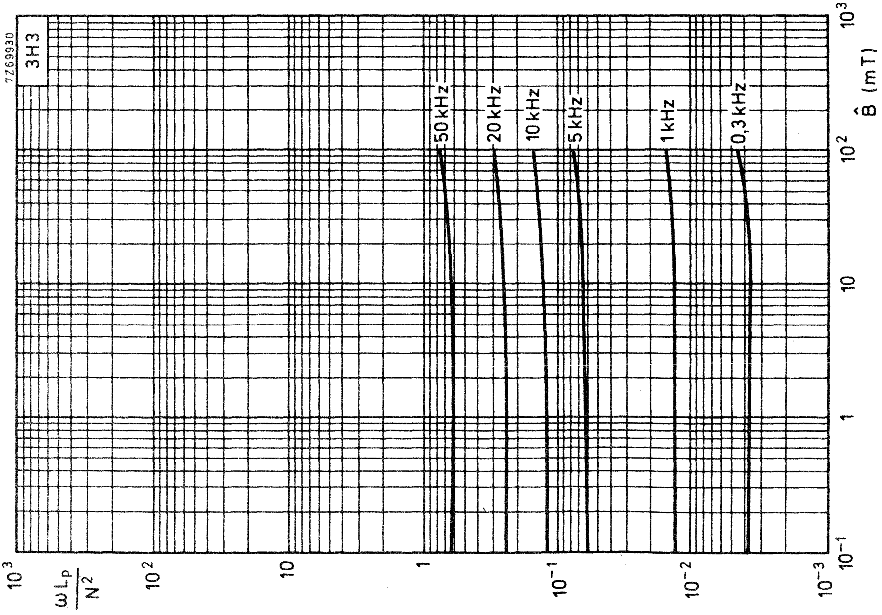
Inductance as a function of the frequency.



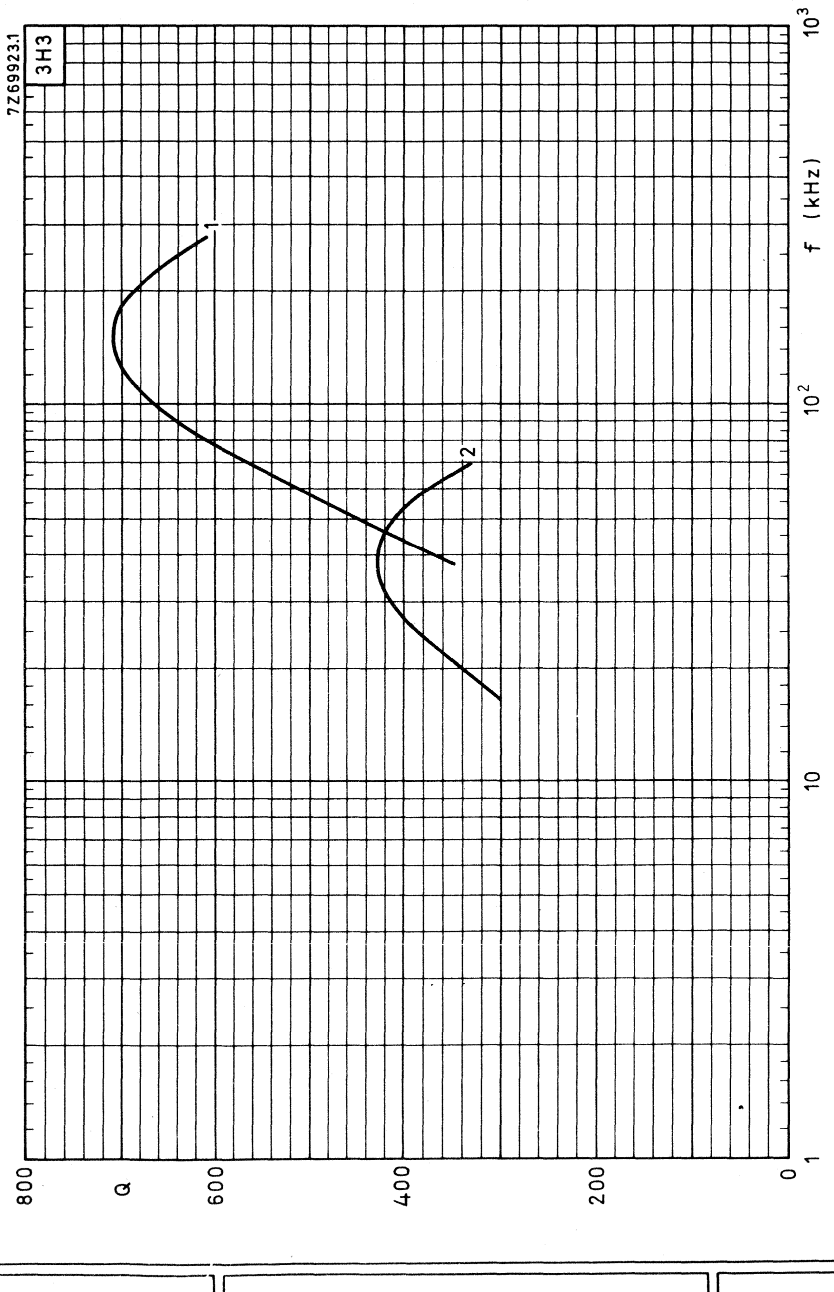
Losses as a function of the frequency.



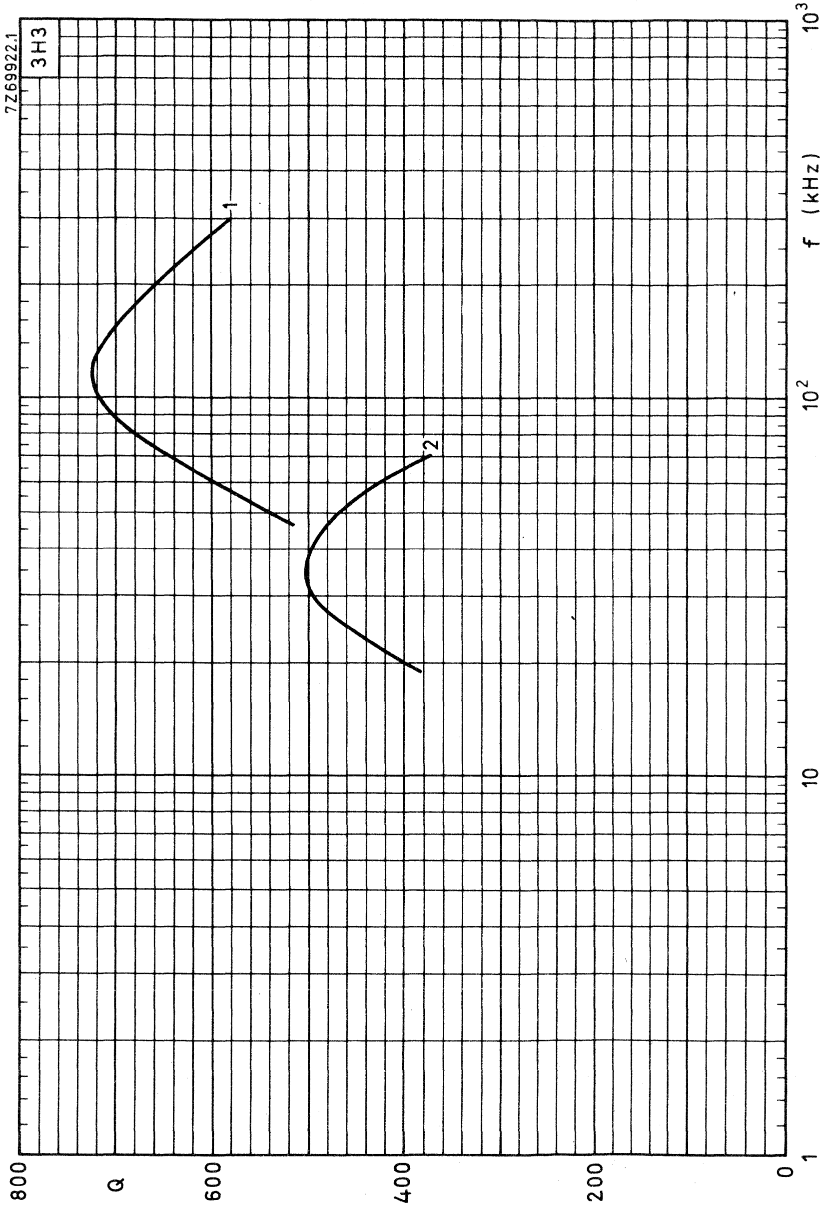
Losses as a function of the peak induction.



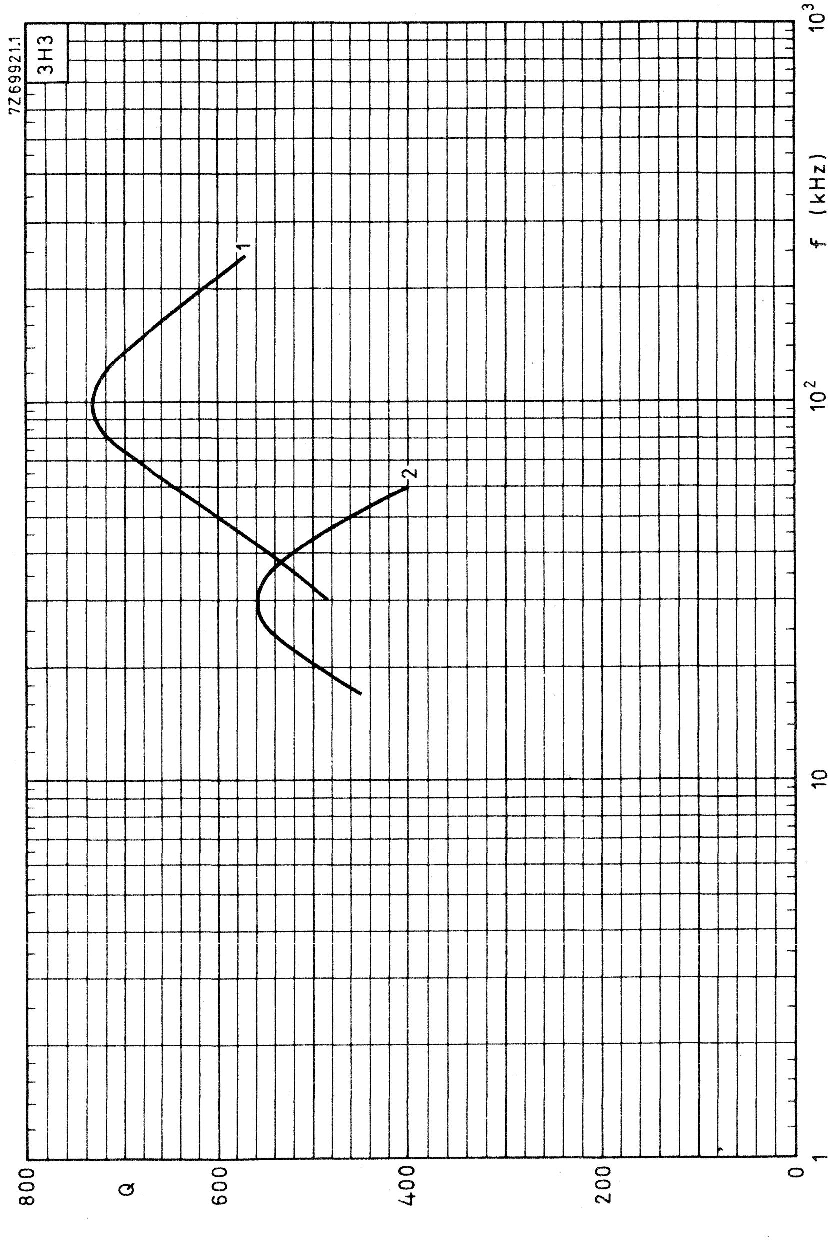
Inductance as a function of the peak induction.



Q-curves. Single-section coil former; curve 1: 63 turns (50 x 0,04 E.S. wire)
curve 2: 355 turns (0,16 E wire).
$A_L = 200$



Q-curves. Single-section coil former; curve 1: 63 turns (50 x 0,04 E.S. wire)
curve 2: 355 turns (0,16 E wire).
$A_L = 250$



Q-curves. Single-section coil former; curve 1: 63 turns (50 x 0,04 E.S. wire)
curve 2: 355 turns (0,16 E wire).
A_L = 315

SQUARE CORES

INTRODUCTION

Three types of core can be supplied:
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted cores (2 halves with an air gap) which are provided with a nut for an adjuster. These cores have an inductance factor A_L in accordance with the R5 (R10) range.
- Pre-adjusted cores without nut.

The square cores are in accordance with the following specifications: IEC 431 (international), UTE C93-324 (France), DIN 41980 (Germany).

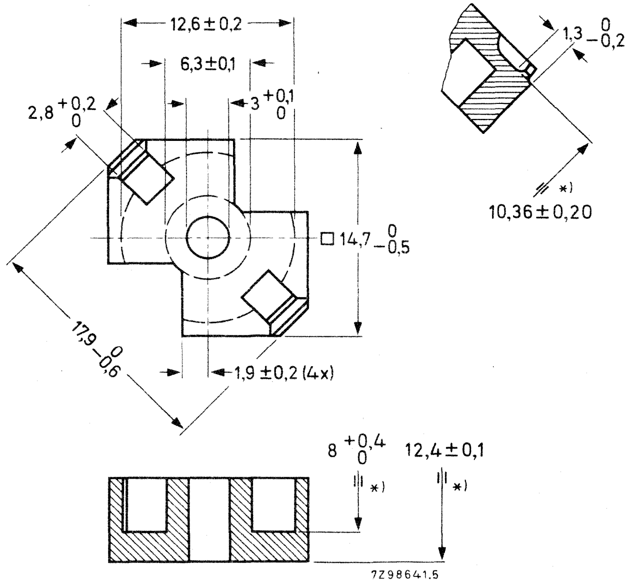
Square cores and associated parts are ordered by their 12-digit catalogue number.

Quantity: a primary pack contains 40 core halves or 20 pre-adjusted cores, a storage pack 200 or 100 respectively, so please order in multiples of these quantities.

SEPARATE CORE HALVES

Dimensions in mm

Outlines



*) Measured on two adjacent core halves.

Versions : see next page.

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 50 N.

	$\hat{B}$ (mT)	freq. (MHz)	temp. (°C)	grade 3B7	3D3	3E1	3E4	3H1	3H3	4C6
μ_e 1)	≤ 0,1	0,1	25 ± 5	1700	700			1700		125
A_L 1)	≤ 0,1	0,1	25 ± 5	2640	1080			2640		194
α 2)	≤ 0,1	0,1	25 ± 5	19,9	31,1			19,9		73,6
$\alpha_F \times 10^6$			+5 to +25	-0,6 to +0,6 3)			0 to +2	+0,5 to +1,5	0,7 ± 0,25	-2 to+4
			+25 to +55	-0,6 to +0,6			0 to +2	+0,5 to +1,5	0,7 ± 0,25	0 to+6
			+25 to +70	-0,6 to +0,6	0 to +2	0 to +2	0 to +2	+0,5 to +1,5	0,7 ± 0,25	
$D_F \times 10^6$ (10-100 min)			25 ± 1	≤ 4,3	≤ 12		≤ 4,3	≤ 4,3		≤ 10
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	≤ 0,1	4)						≤ 3	
	≤ 0,1	0,004	25 ± 5			≤ 2,5	≤ 2,5			
	≤ 0,1	0,03		≤ 2,5				≤ 2,5		
	≤ 0,1	0,1		≤ 5	≤ 8	≤ 20	≤ 20	≤ 5		
	≤ 0,1	0,5			≤ 14	≤ 200	≤ 200			
	≤ 0,1	1,0			≤ 30					
	≤ 0,1	2,0								≤ 40
	≤ 0,1									≤ 100
$q_{2-24-100}$	1,5-3,0	0,004	25 ± 5	≤ 1,8/≤ 1,4 3)		≤ 3	≤ 1,8	≤ 1,4		
	0,3-1,2	0,1			≤ 3					≤ 15
$\eta_B \times 10^3$	1,5-3,0	0,004	25 ± 5	≤ 1,1/≤ 0,86 3)		≤ 1,8	≤ 1,1	≤ 0,86		
	0,3-1,2	0,1			≤ 1,8					≤ 9,2
	1,8-3,0	0,03	25 ± 1						≤ 0,8	

1) Tolerance ± 25%. 2) Tolerance ± 12,5%. 3) For guidance only. 4) Any temperature between +25 and +70 °C.

α_F of 3H3 has been determined with formula : $\alpha_F = \frac{L_\theta - L_{25}}{L_\theta \times L_{25}} \times \frac{1}{\theta - 25}$ /°C

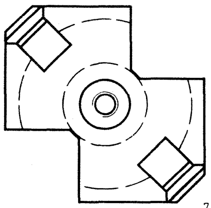
Versions

Ferroxcube grade	catalogue number
3B7	4322 020 25120
3D3	4322 020 25140
3E1	only pre-adjusted cores are available
3E4	only pre-adjusted cores are available
3H1	4322 020 25130
3H3	4322 020 25190
4C6	4322 020 25150

PRE-ADJUSTED CORES

Dimensions in mm

Outlines



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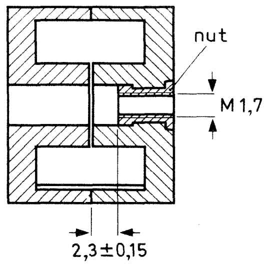


	with centre hole	without centre hole
Mass	5,4 g	5,6 g
Mean length of lines of force	l_e = 25,6 mm	27,5 mm
Mean area of lines of force	A_e = 32 mm^2	38 mm^2
	$\Sigma \frac{l_e}{A_e}$ = 0,810 mm^{-1}	0,732 mm^{-1}
Effective volume	V_e = 810 mm^3	1040 mm^3

Pre-adjusted cores with standard A_L values

A_L	corre-sponding μ_e-value	tol. on induct-ance (%)	catalogue no. 4322 022 7.... with nut 4322 022 5.... without nut						
			3B7	3D3	3E1	3E4	3H1	3H3	4C6
25	15,6	± 1	–	–	–	–	–	–	5810
40	24,9	± 1	5020	5420	–	–	5220	–	5820
63	39,4	± 1	5030	5430	–	–	5230	–	5830
100	62,4	± 2	5040	5440	–	–	5240	–	–
160	100	± 2	5050	5450	–	–	5250	–	–
200	122	± 2	5170	–	–	–	5370	5680	–
250	156	± 2	5060	–	–	–	5260	5560	–
315	197	± 2	5070	–	–	–	5270	5570	–
400	249	± 2	5080	–	–	–	5280	5580	–
630	394	± 3	5100	–	–	–	5300	5600	–
1000	624	± 10	5110	–	–	–	5310	–	–
1250	780	± 10	5190	–	–	–	5390	–	–
4780	2780	± 25	–	–	5800 *	–	–	–	–
6100	3950	± 25	–	–	–	5900 *	–	–	–
6710	3950	± 25	–	–	–	5890	–	–	–

Inductance $L = N^2 A_L$ (in 10^{-9} H)

Symmetrical air gap for cores with A_L factor of 25 up to and including 100.
Asymmetrical air gap for cores with A_L factor of 160 and higher.
The air gap of the types marked * is practically zero, and consequently inductance adjustment is not possible. Hence these types are not provided with a centre hole, so that maximum performance is achieved.

Notes

1. Example of catalogue number:
   A_L = 250, grade 3H1, core with nut, catalogue number 4322 022 75260.
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

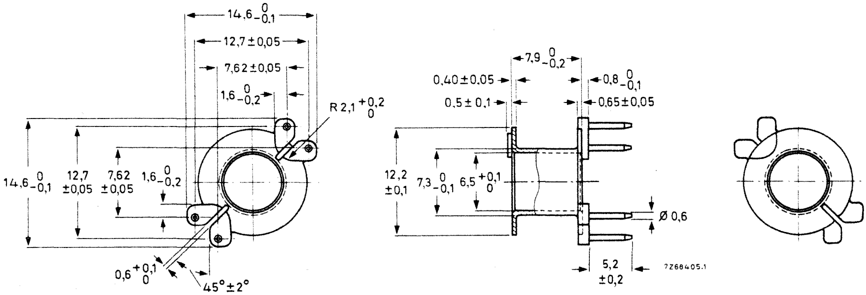
COIL FORMERS

GENERAL

Four types of coil former can be supplied:
- with 1 section and 4 pins
- with 2 sections and 4 pins
- with 1 section and 6 pins
- with 2 sections and 6 pins

The arrangement of the soldering pins is suitable for both 0,1" and 2,50 mm grid, see "Mounting".
The coil formers are packed in a polystyrene plate of 200 or in a cardboard box of 500. Please order in multiples of these quantities.

SINGLE-SECTION, 4-PIN COIL FORMER



Catalogue number 4322 021 32280

Material: phenolformaldehyde reinforced with glass fibre

Window area 17,3 mm^2

Mean length of turn 3,0 cm

Max. temperature 180 °C

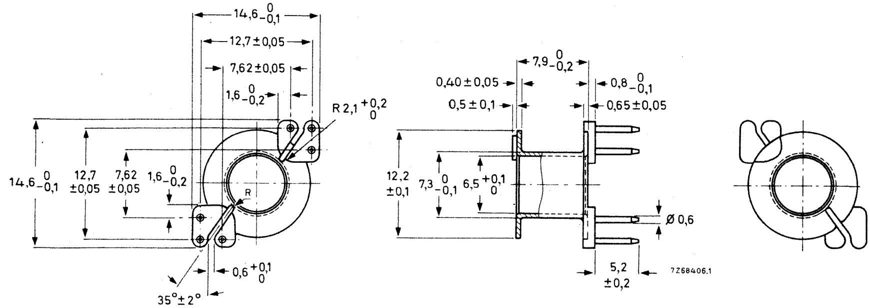
Solderability resistant against dip-soldering at 400 °C for 2 s

D.C. losses:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 18,9 \times 10^3\ \Omega/H$$

Mass 0,4 g

SINGLE-SECTION, 6-PIN COIL FORMER



Catalogue number	4322 021 32290
Material: phenolformaldehyde reinforced with glass fibre	
Window area	17,3 mm^2
Mean length of turn	3,0 cm
Max. temperature	180 °C

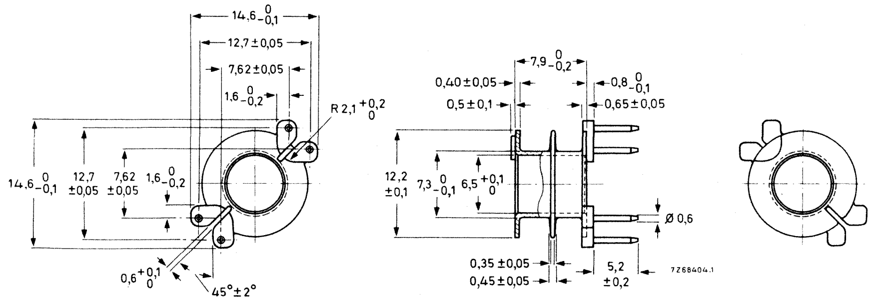
Solderability resistant against dip-soldering at 400 °C for 2 s

D.C. losses:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 18,9 \times 10^3\ \Omega/H$$

Mass 0,4 g

TWO-SECTION, 4-PIN COIL FORMER



Catalogue number	4322 021 32300
Material: phenolformaldehyde reinforced with glass fibre	
Window area	2 x 8,2 mm^2
Mean length of turn	3,0 cm
Max. temperature	180 °C

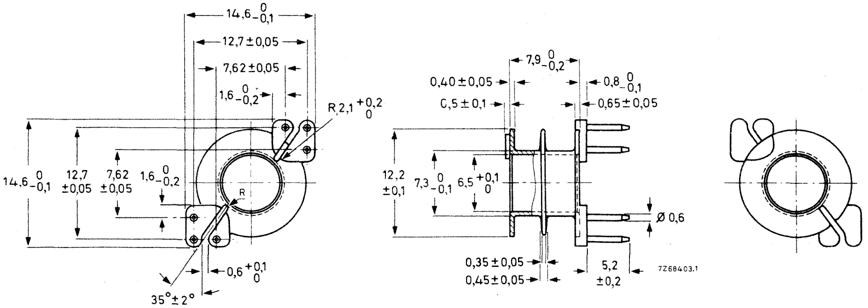
Solderability resistant against dip-soldering at 400 °C for 2 s

D.C. losses:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 19,9 \times 10^3\ \Omega/H$$

Mass 0,4 g

TWO-SECTION, 6-PIN COIL FORMER



Catalogue number	4322 021 32310
Material: phenolformaldehyde reinforced with glass fibre	
Window area	2 x 8,2 mm^2
Mean length of turn	3,0 cm
Max. temperature	180 ^oC

Solderability resistant against dip-soldering at 400 ^oC for 2 s

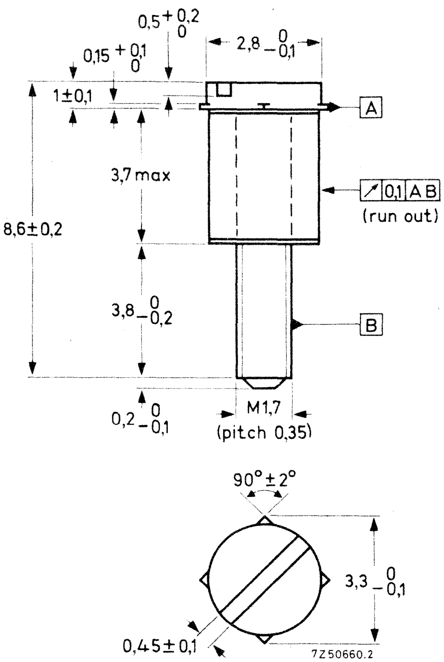
D.C. losses:

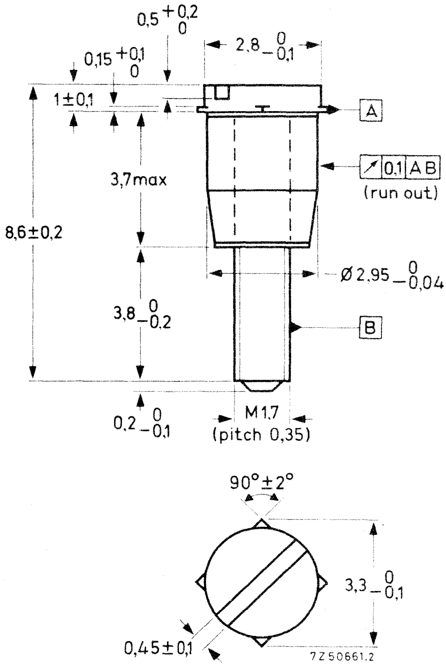
$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 19,9 \times 10^3 \ \Omega/H$$

Mass 0,4 g

INDUCTANCE ADJUSTERS

ADJUSTERS





Version A, tube dia. 2,5 −0,04 mm
Version B, tube dia. 2,7 −0,04 mm
Version C, tube dia. 2,77−0,04 mm

Version D

The tolerances on inductance of the pre-adjusted cores (without adjuster) are given in the table of pre-adjusted cores with standard A_L values. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0,03% by means of a continuous inductance adjuster. Such an adjuster increases the inductance of the coil (see following pages).
The adjuster is screwed through the centre hole of the core into the nut and is held in position by the four protrusions near the top of the adjuster. For special requirements a larger or smaller adjustment range may be obtained by using an adjuster belonging to the next higher or lower A_L value.
The influence of the adjuster on the variability of the inductance is negligible. The maximum permissible temperature is 110 °C.
The table shows the type of adjuster recommended for different square cores.

Table I, available types

version	colour	catalogue number
A	white	4322 021 32130
B	brown	4322 021 32140
C	black	4322 021 32150
B	green	4322 021 32160
B	red	4322 021 32170
D	grey	4322 021 32180

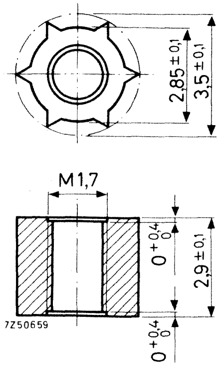
Table II, recommended application

A_L	3B7/3H1/3D3 catalogue number
40	4322 021 32160
63	4322 021 32160
100	4322 021 32170
160	4322 021 32130
200	4322 021 32130
250	4322 021 32130 or 4322 021 32140
315	4322 021 32140
400	4322 021 32150
630	4322 021 32180

The adjusters are packed in bags of 100. Please order in multiples of 100.

NUT FOR ADJUSTER

These data are given for those manufacturers who prefer to insert the nut themselves.

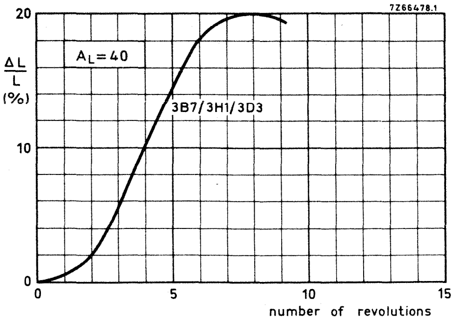


Catalogue number	4322 021 30140
Material	polycarbonate
Max. impregnation temperature during 24 hours	120 °C
Recommended distance from mating surface to nut	2,3 ± 0,15 mm

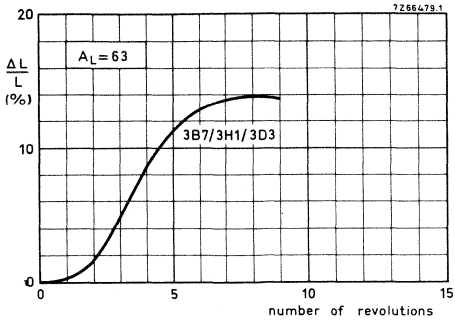
The nuts are packed in bags of 100. Please order in multiples of 100.

ADJUSTMENT CURVES

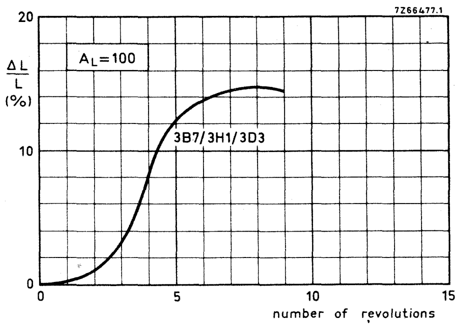
Distance between nut and mating surface = 2,3 mm for all A_L values.



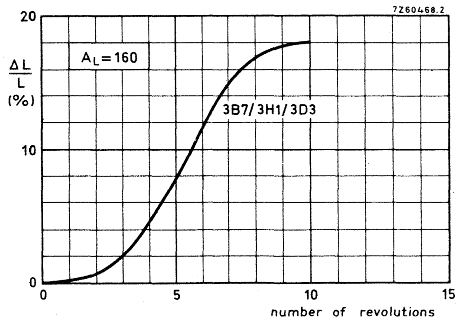
Adjuster 4322 021 32160



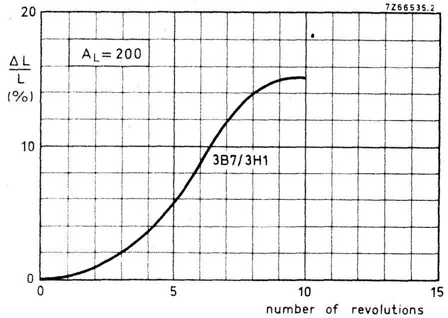
Adjuster 4322 021 32160



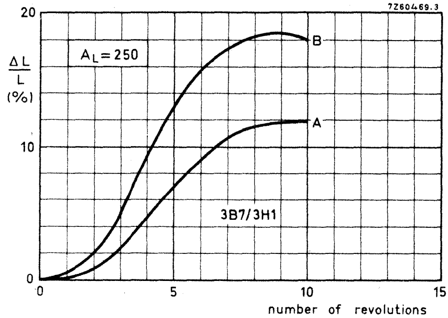
Adjuster 4322 021 32170



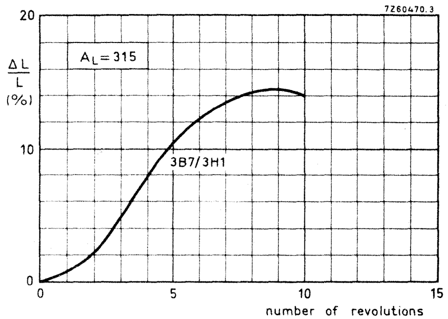
Adjuster 4322 021 32130



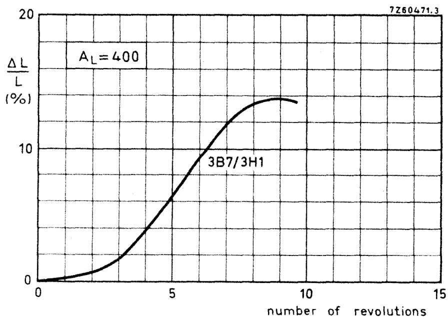
Adjuster 4322 021 32130



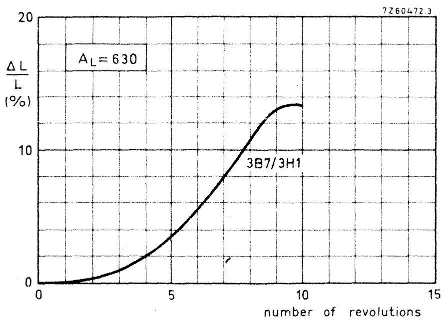
Curve A : adjuster 4322 021 32130
Curve B : adjuster 4322 021 32140



Adjuster 4322 021 32140



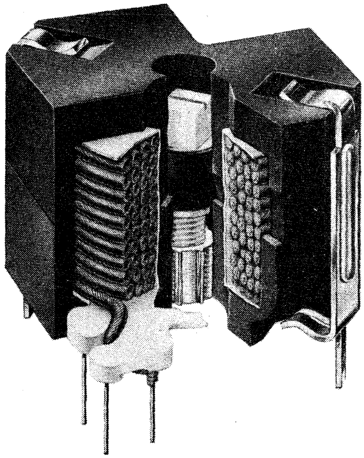
Adjuster 4322 021 32150



Adjuster 4322 021 32180

ASSEMBLING AND MOUNTING

ASSEMBLING



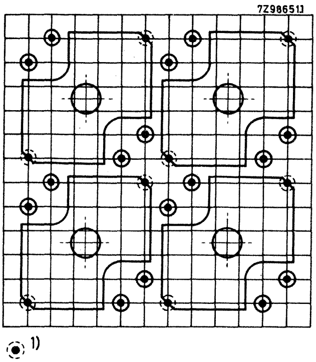
RZ25252

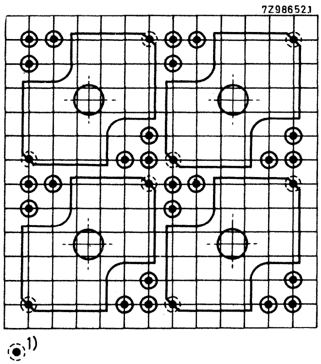
The illustration shows the simplicity of the assembly; the core halves are held together by two clips. The tags of the clips are used for mechanical fastening and/or for earthing. For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half.

The use of a tool for attaching the clips is recommended. (Drawings of a simple tool for this purpose are available under number 4322 058 00150.)

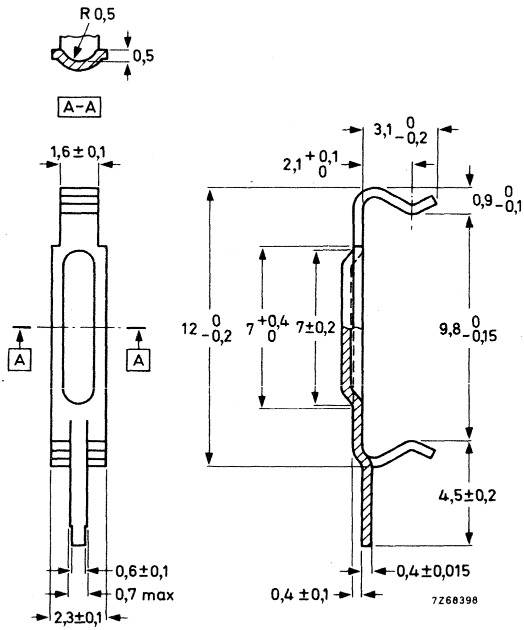
MOUNTING

The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0,1 inch grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness up to 2,4 mm. The recommended hole diameter in the board is 1,0 ± 0,1 or 1,3 ± 0,1 mm (according to IEC publication 97).





PART DRAWING (dimensions in mm)

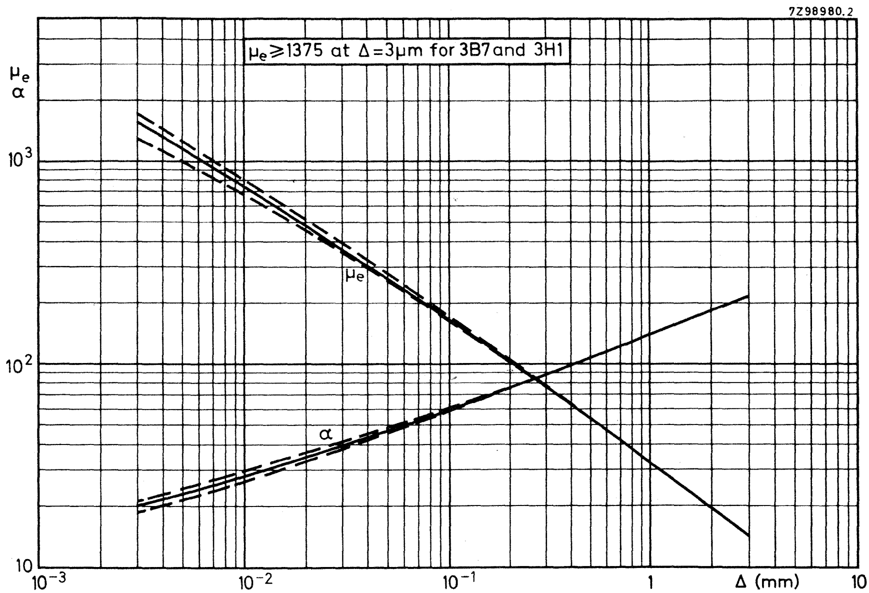


Clip 4322 021 31780
Material: steel; gold plated over nickel

1) Holes for tag on clip 4322 021 31780 (earth points).

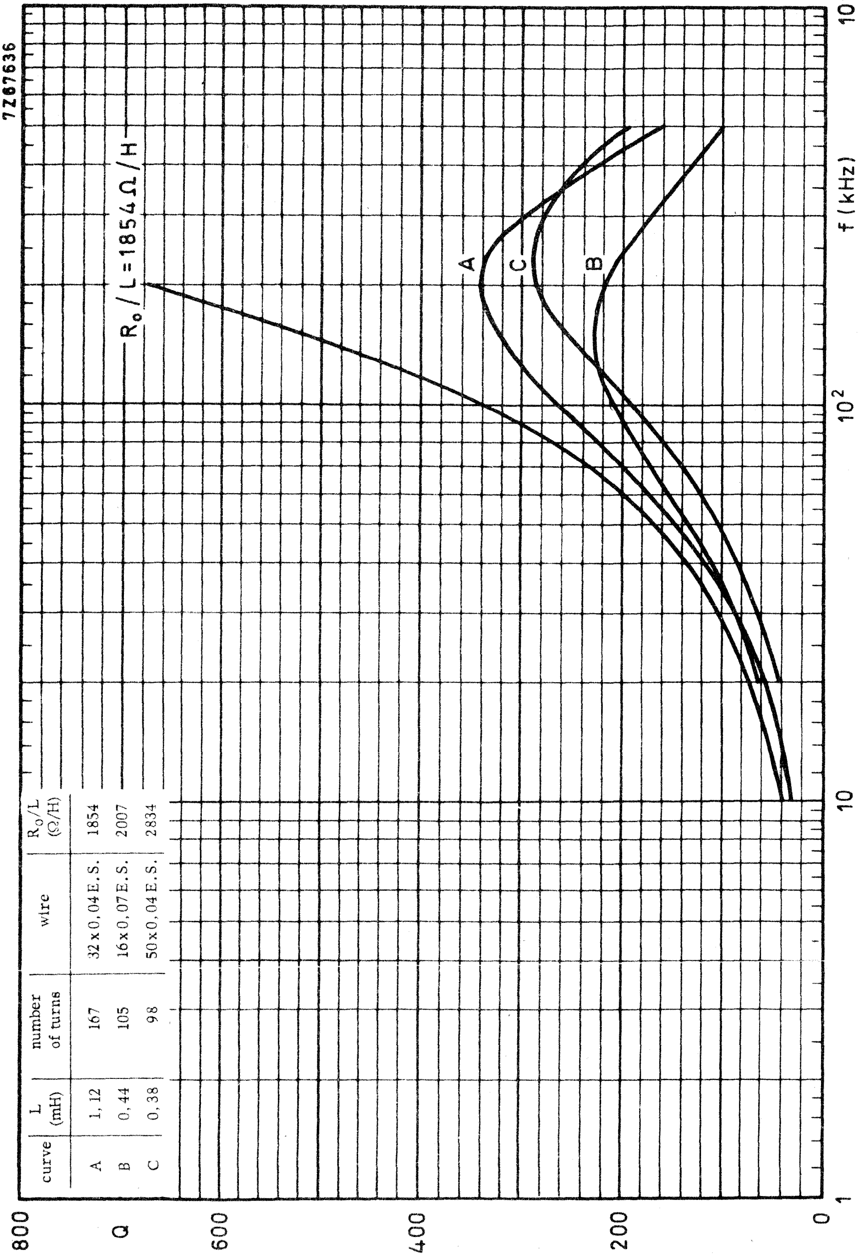
CHARACTERISTIC CURVES

μ_e - α CURVES



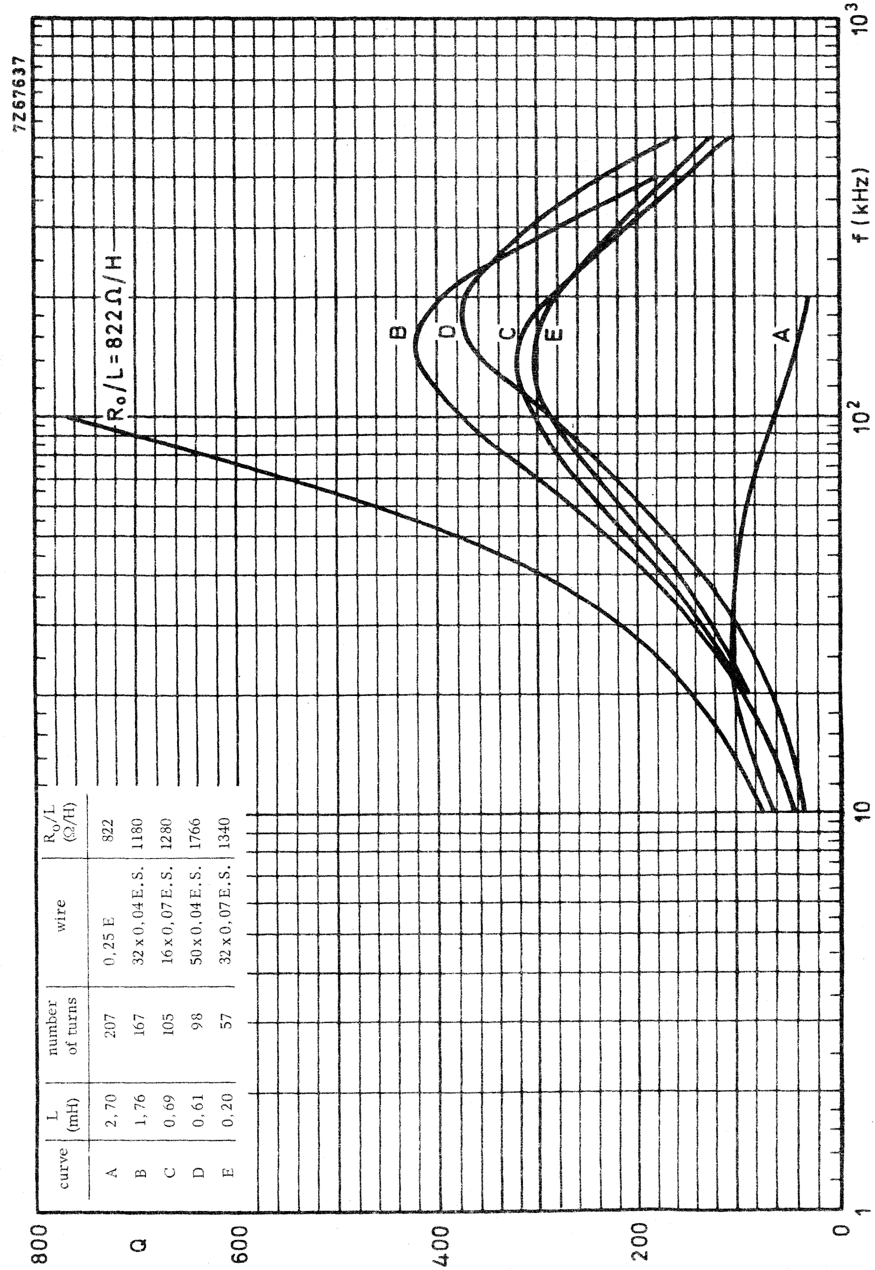
Relative effective permeability and turns factor for 1 mH as a function of the air gap length.

TYPICAL Q-CURVES



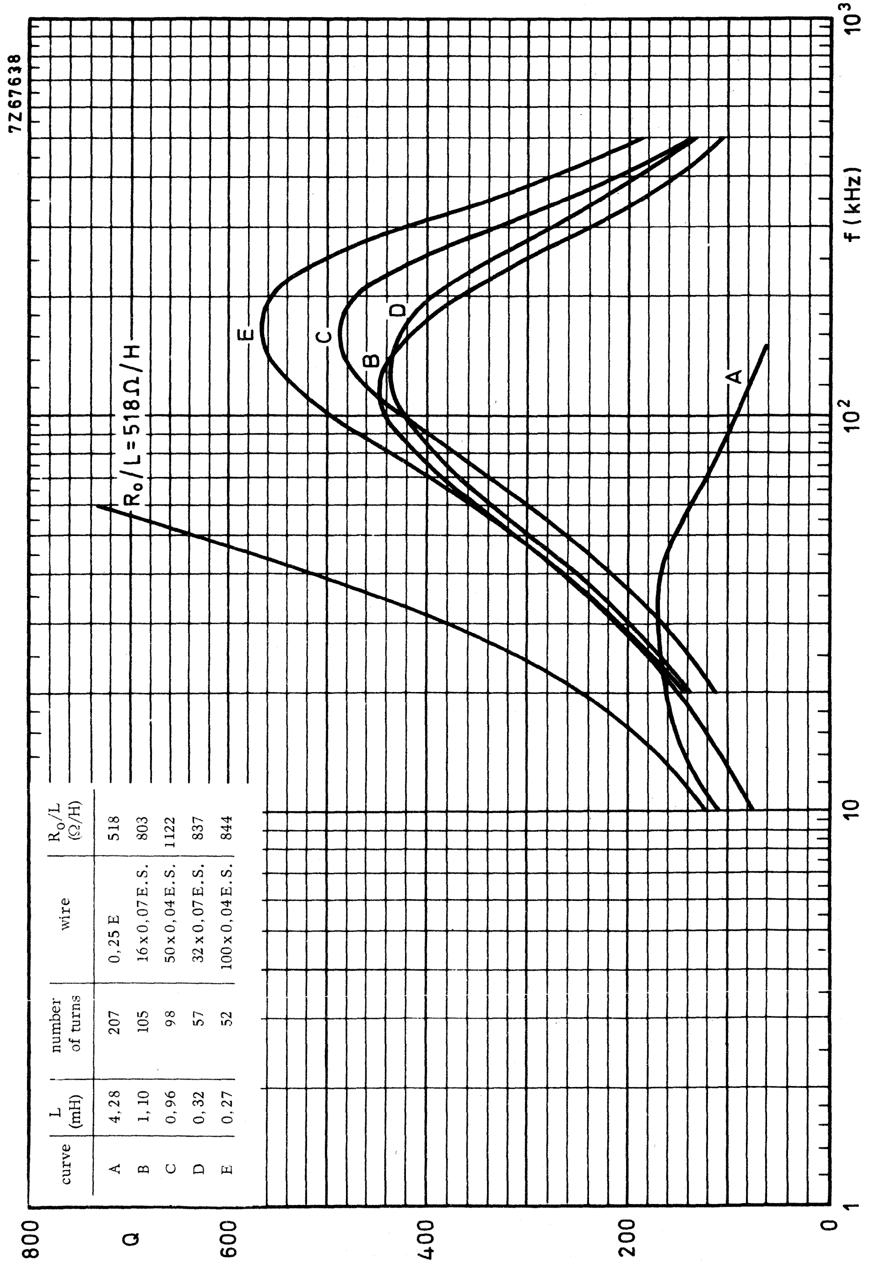
curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	1,12	167	32 x 0,04 E.S.	1854
B	0,44	105	16 x 0,07 E.S.	2007
C	0,38	98	50 x 0,04 E.S.	2834

FXC 3B7/3H1, single-section coil former, $A_L = 40$



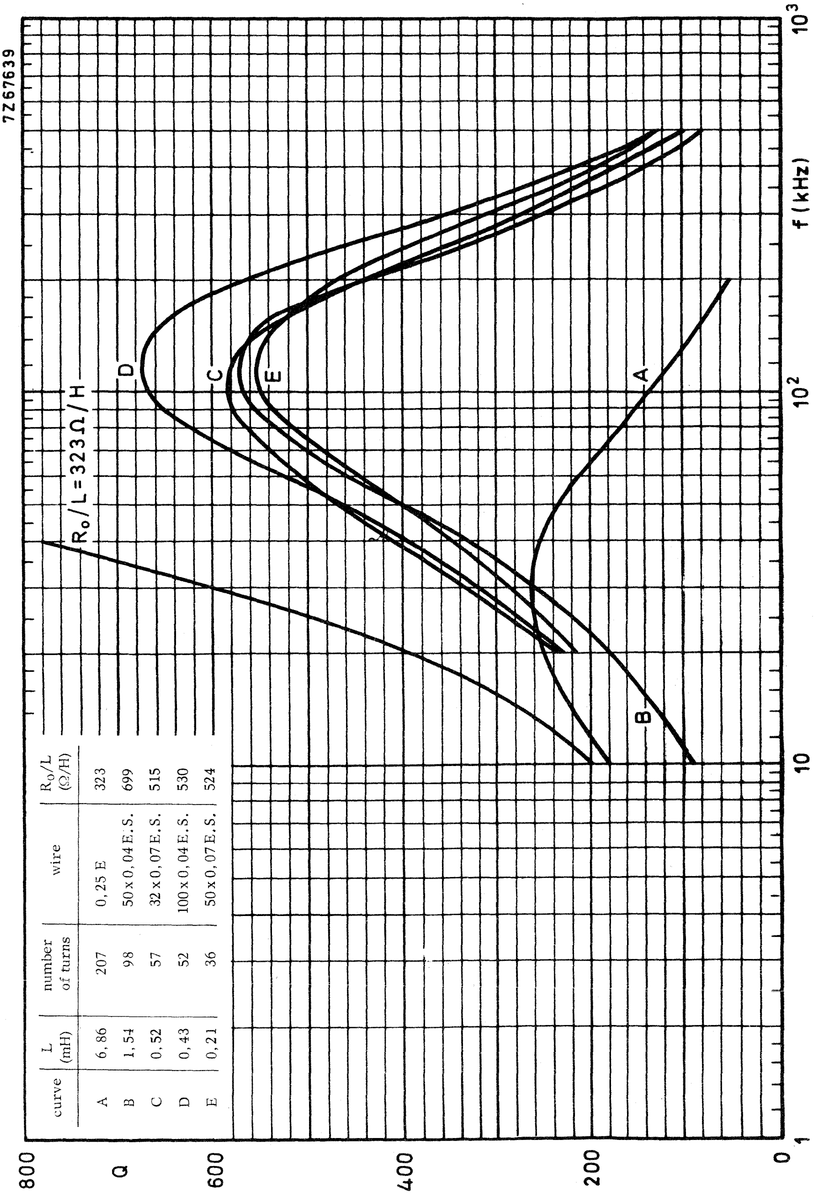
curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	2,70	207	0,25 E	822
B	1,76	167	32 x 0,04 E.S.	1180
C	0,69	105	16 x 0,07 E.S.	1280
D	0,61	98	50 x 0,04 E.S.	1766
E	0,20	57	32 x 0,07 E.S.	1340

FXC 3B7/3H1, single-section coil former, A_L = 63



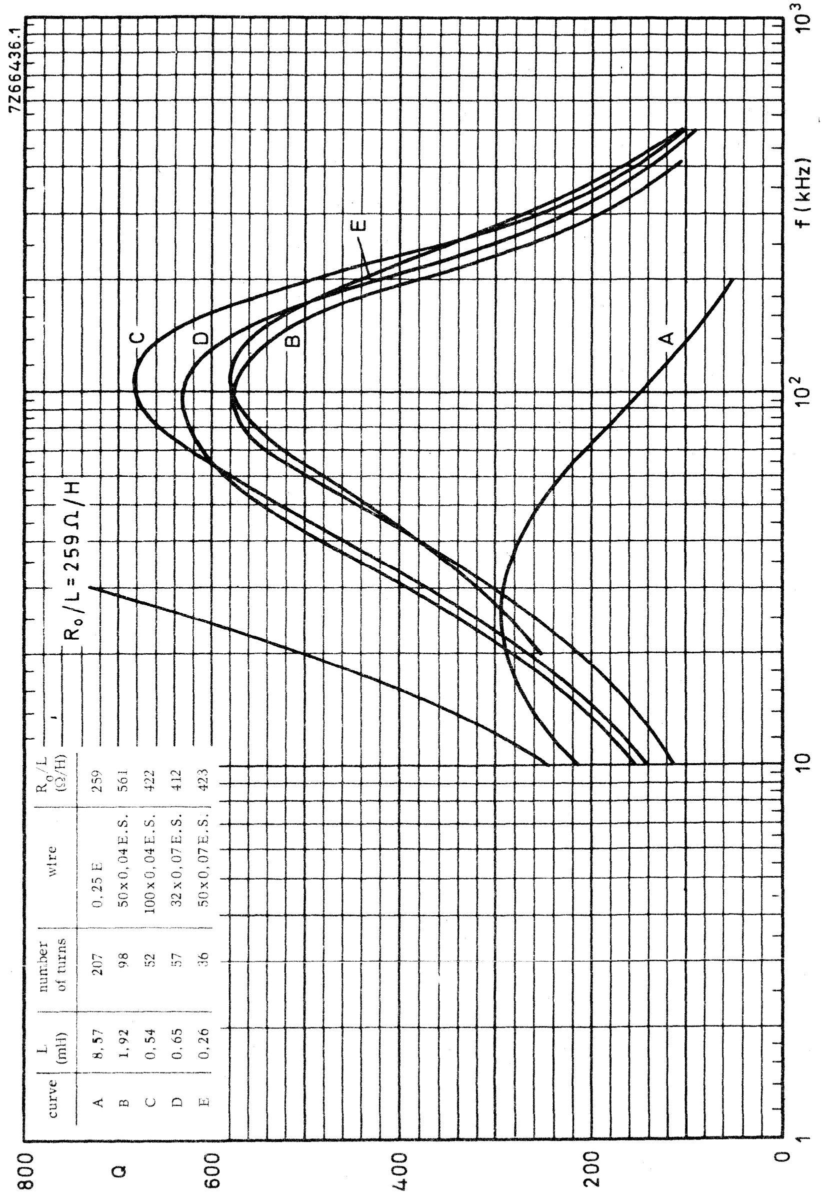
curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	4,28	207	0,25 E	518
B	1,10	105	16 x 0,07 E.S.	803
C	0,96	98	50 x 0,04 E.S.	1122
D	0,32	57	32 x 0,07 E.S.	837
E	0,27	52	100 x 0,04 E.S.	844

FXC 3B7/3H1, single-section coil former, $A_L = 100$



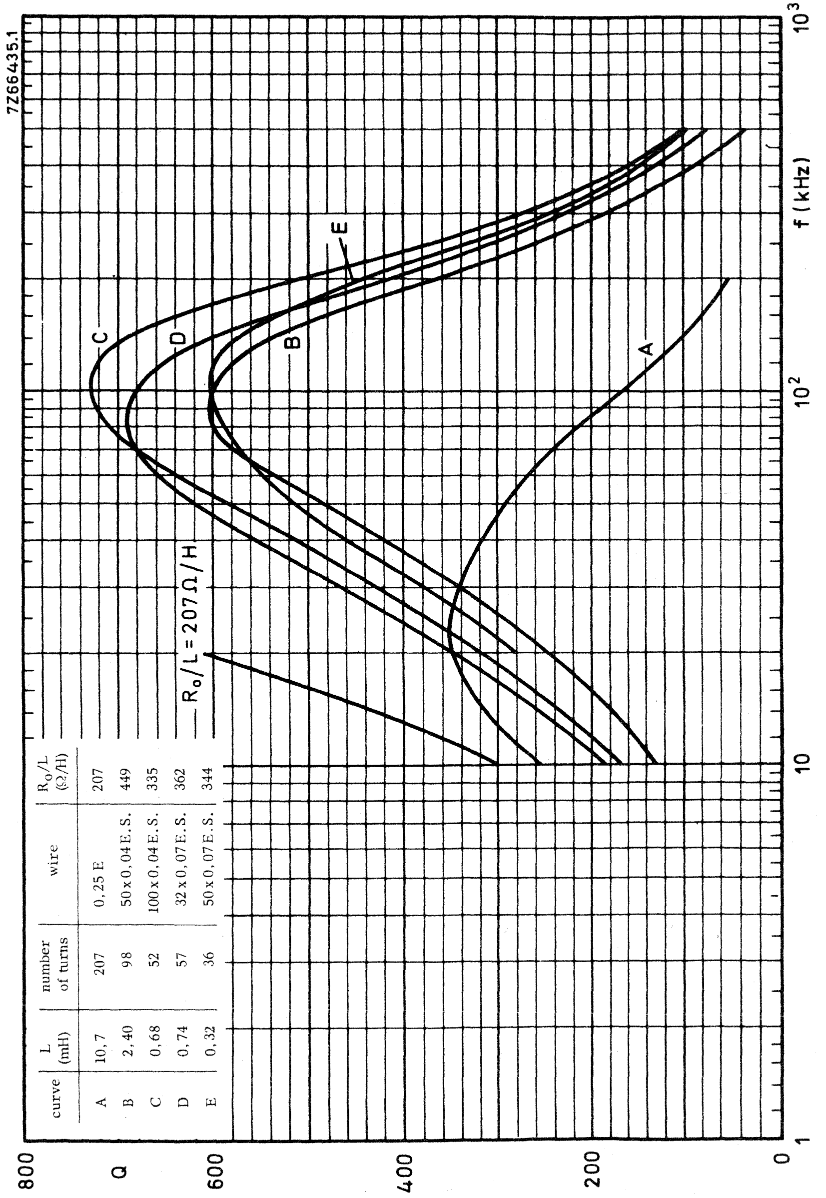
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	6,86	207	0,25 E	323
B	1,54	98	50 x 0,04 E.S.	699
C	0,52	57	32 x 0,07 E.S.	515
D	0,43	52	100 x 0,04 E.S.	530
E	0,21	36	50 x 0,07 E.S.	524

FXC 3B7/3H1, single-section coil former, $A_L = 160$



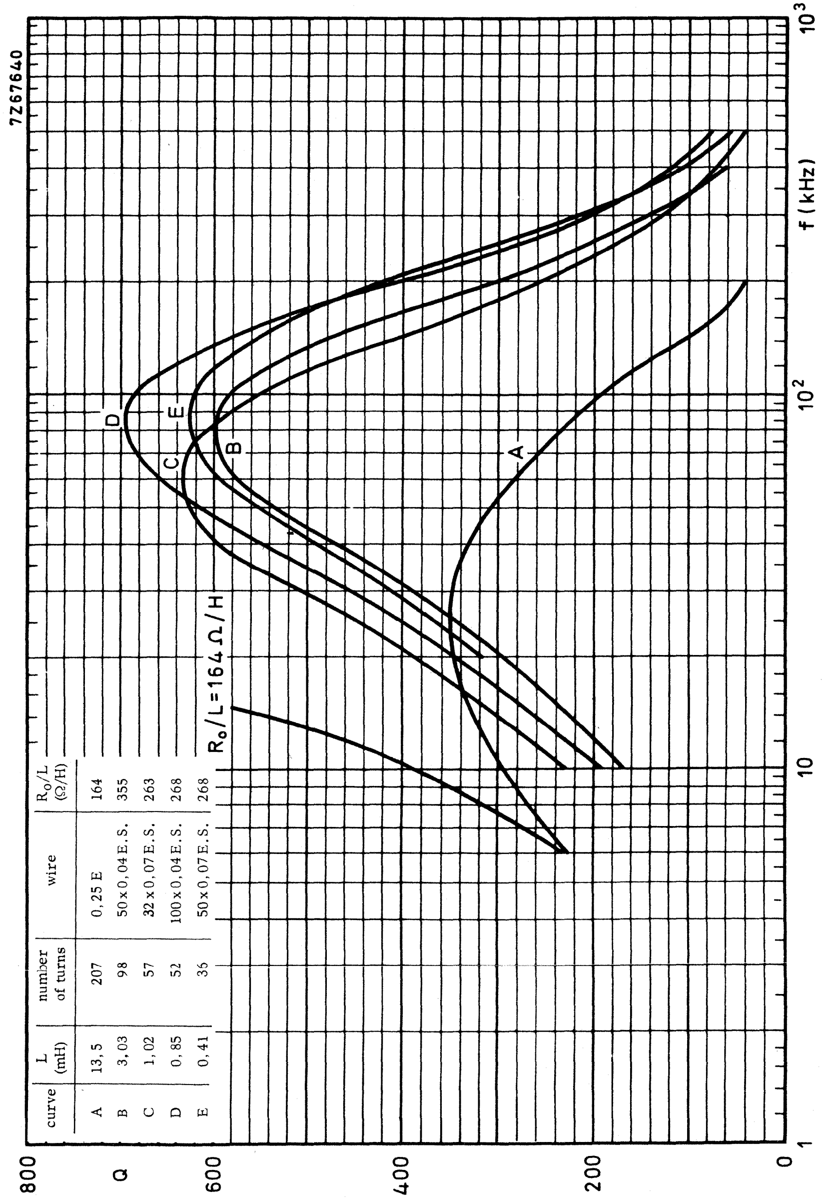
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	8,57	207	0,25 E	259
B	1,92	98	50 x 0,04 E.S.	561
C	0,54	52	100 x 0,04 E.S.	422
D	0,65	57	32 x 0,07 E.S.	412
E	0,26	36	50 x 0,07 E.S.	423

FXC 3B7/3H1, single-section coil former, $A_L = 200$



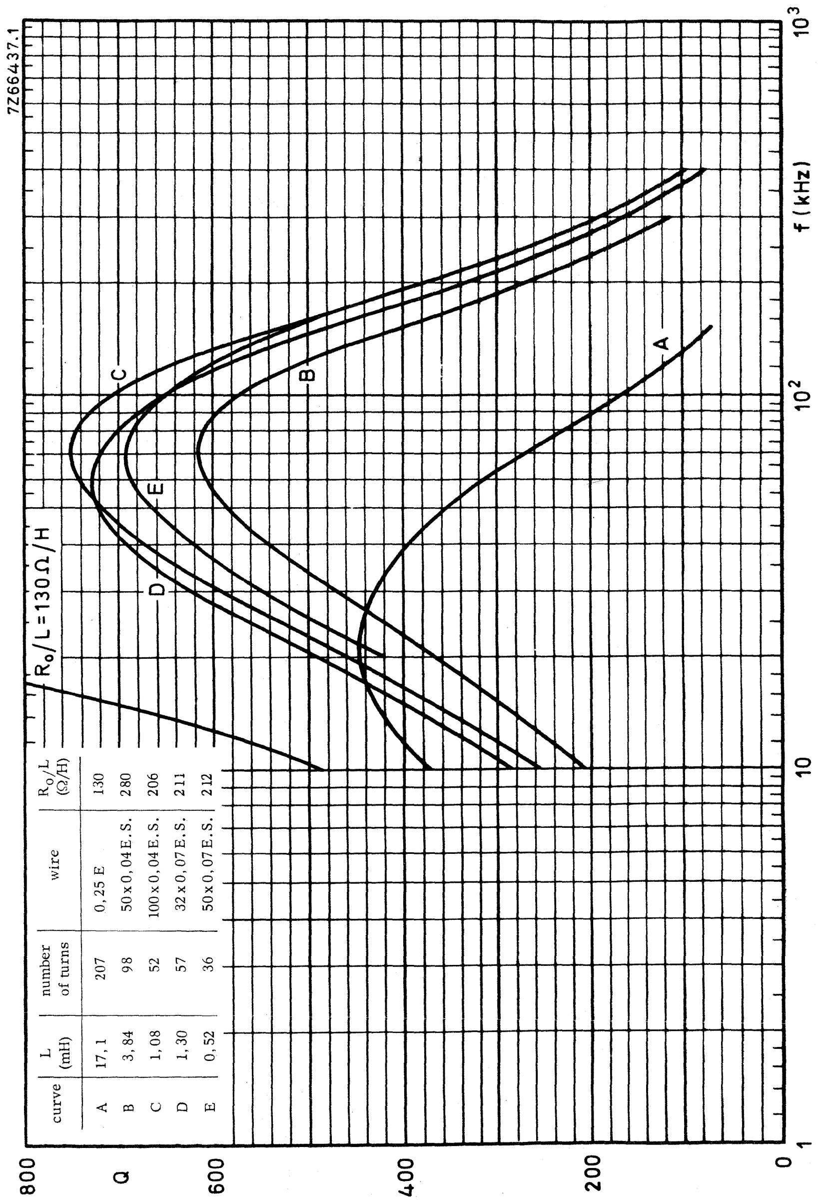
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	10,7	207	0,25 E	207
B	2,40	98	50 x 0,04 E.S.	449
C	0,68	52	100 x 0,04 E.S.	335
D	0,74	57	32 x 0,07 E.S.	362
E	0,32	36	50 x 0,07 E.S.	344

FXC 3B7/3H1, single-section coil former, A_L = 250



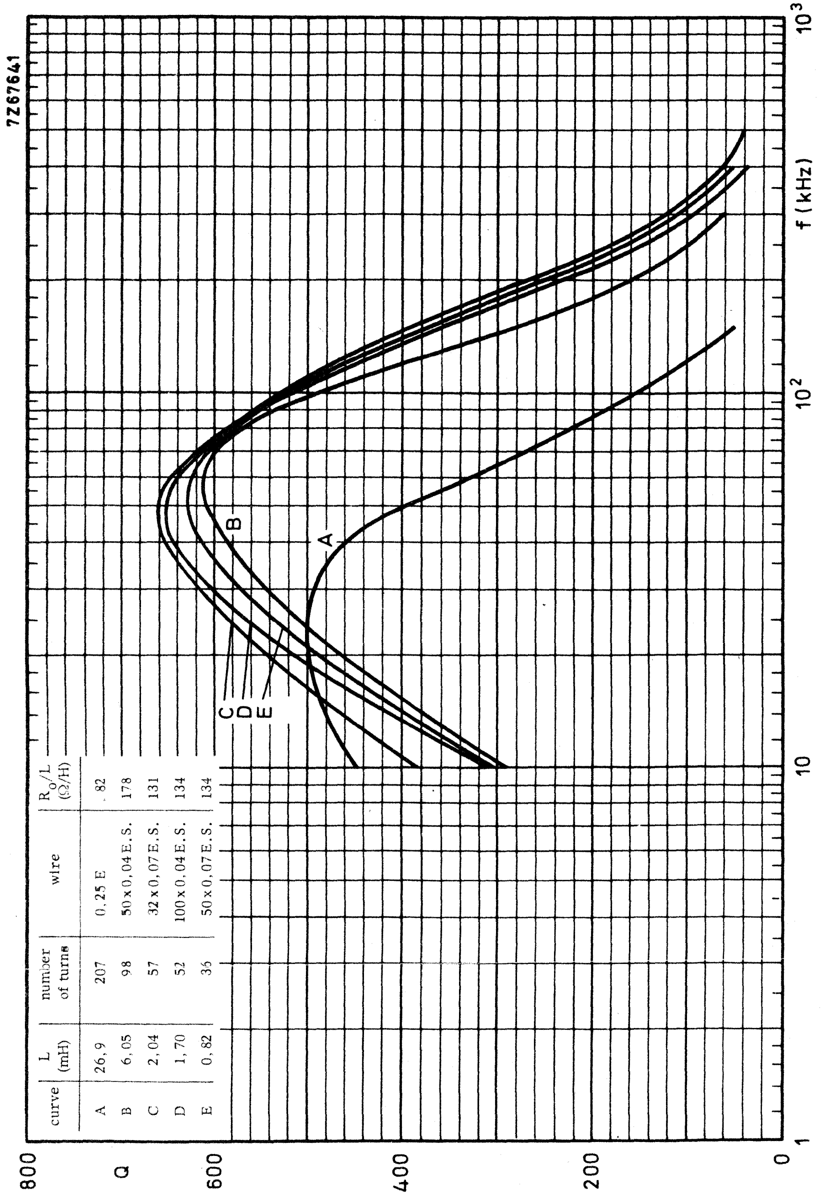
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	13,5	207	0,25 E	164
B	3,03	98	50 x 0,04 E.S.	355
C	1,02	57	32 x 0,07 E.S.	263
D	0,85	52	100 x 0,04 E.S.	268
E	0,41	36	50 x 0,07 E.S.	268

FXC 3B7/3H1, single-section coil former, A_L = 315



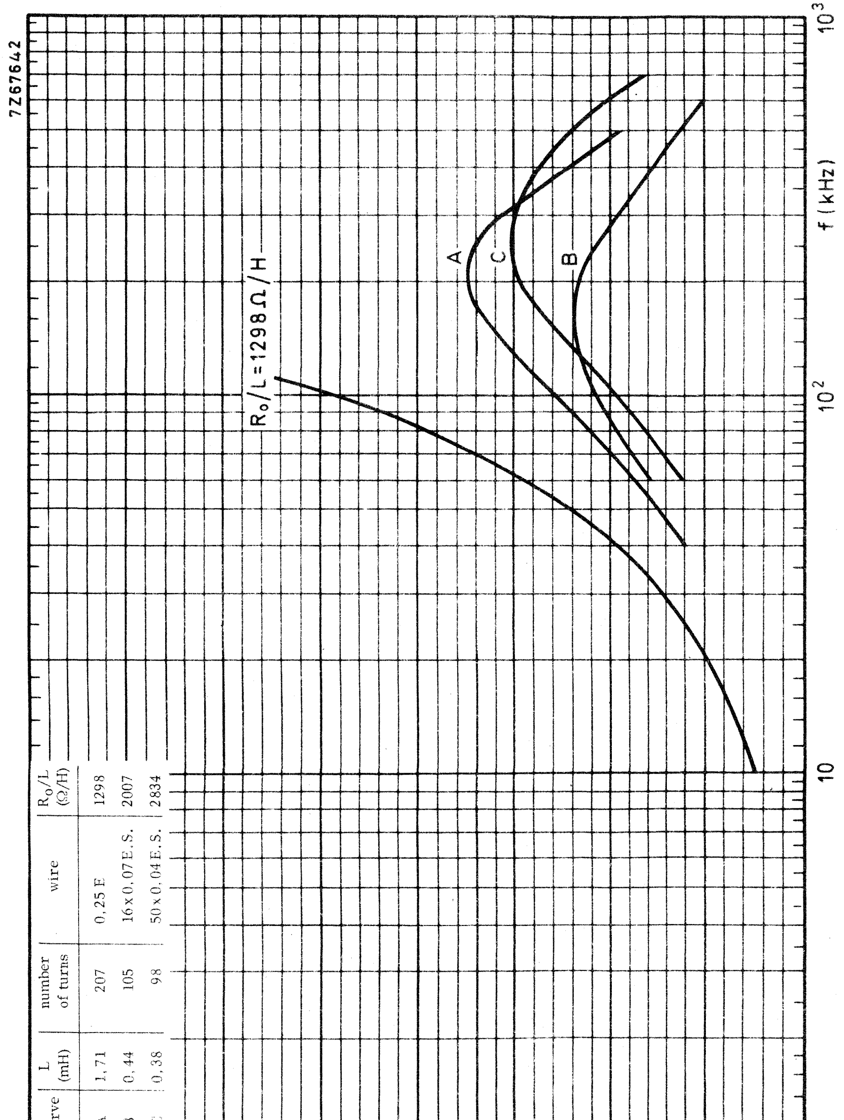
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	17,1	207	0,25 E	130
B	3,84	98	50 x 0,04 E.S.	280
C	1,08	52	100 x 0,04 E.S.	206
D	1,30	57	32 x 0,07 E.S.	211
E	0,52	36	50 x 0,07 E.S.	212

FXC 3B7/3H1, single-section coil former, $A_L = 400$



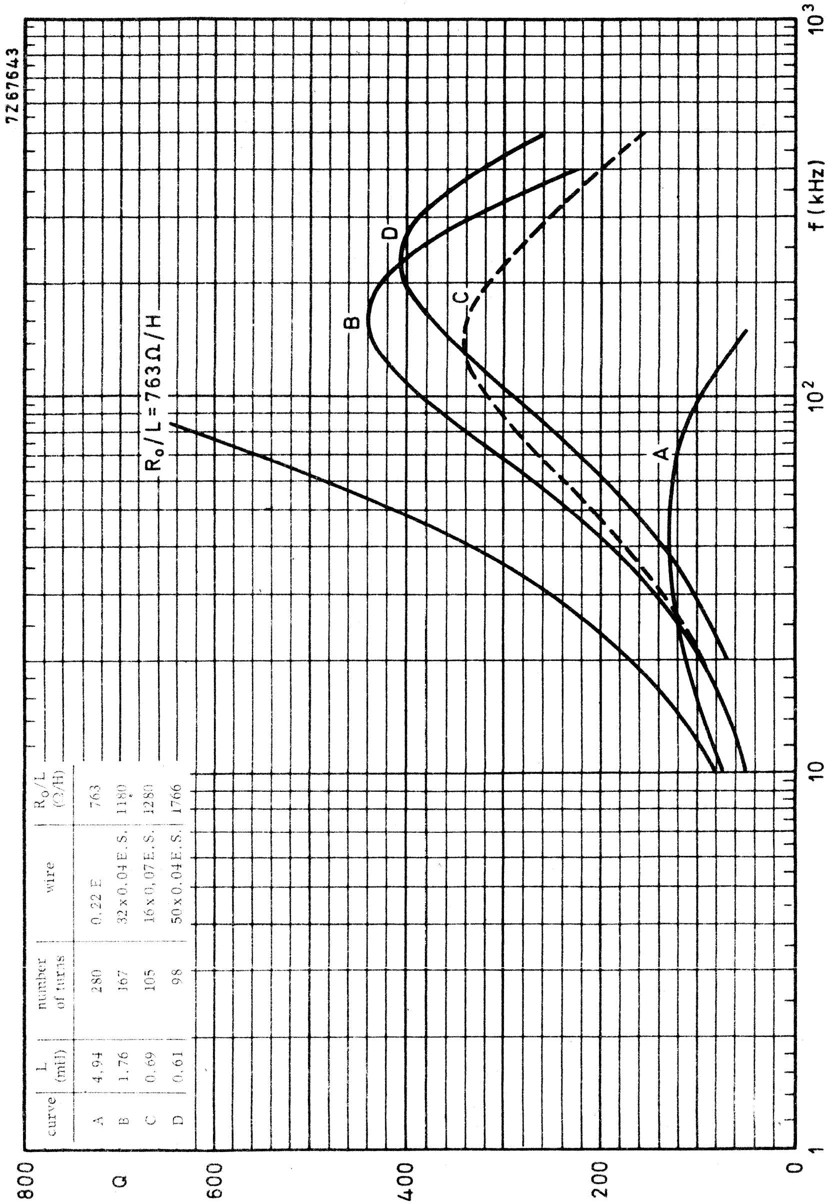
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	26,9	207	0,25 E	82
B	6,05	98	50 x 0,04 E.S.	178
C	2,04	57	32 x 0,07 E.S.	131
D	1,70	52	100 x 0,04 E.S.	134
E	0,82	36	50 x 0,07 E.S.	134

FXC 3B7/3H1, single-section coil former, A_L = 630



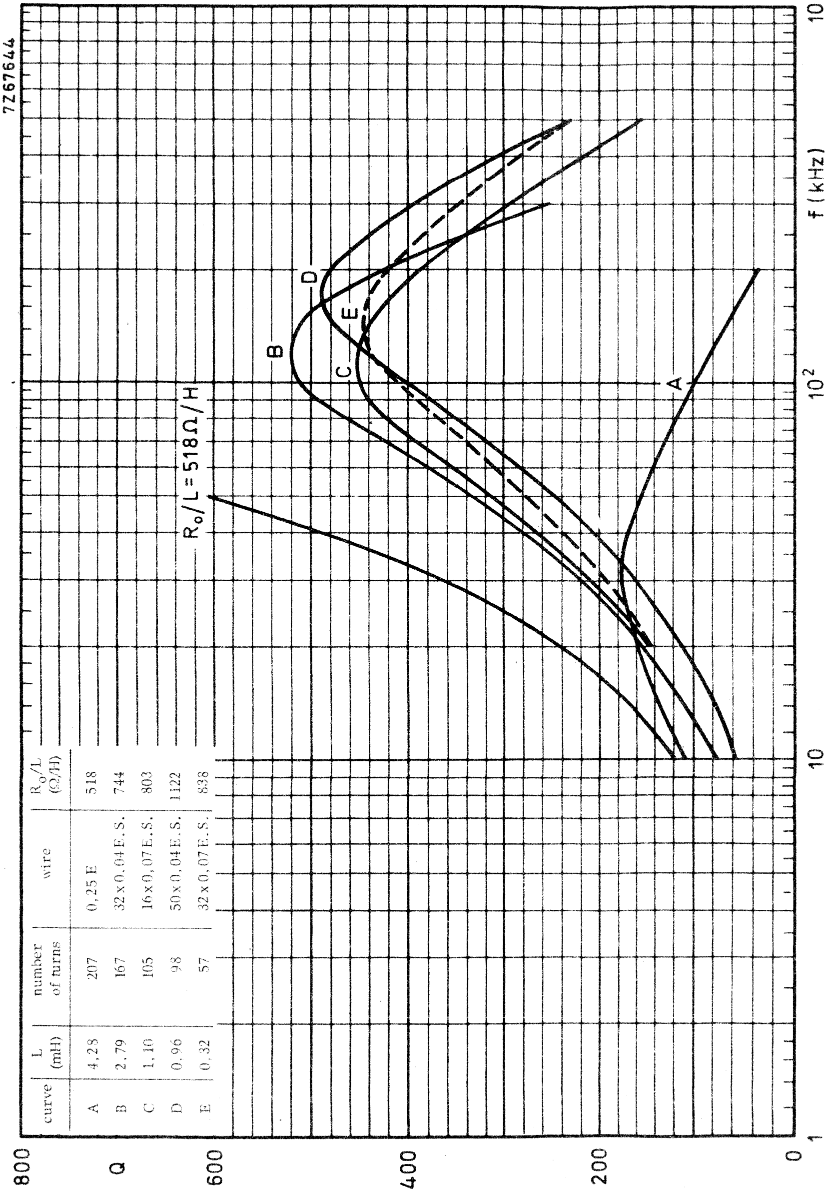
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1,71	207	0,25 E	1298
B	0,44	105	16 x 0,07 E.S.	2007
C	0,38	98	50 x 0,04 E.S.	2834

FXC 3D3, single-section coil former, A_L = 40



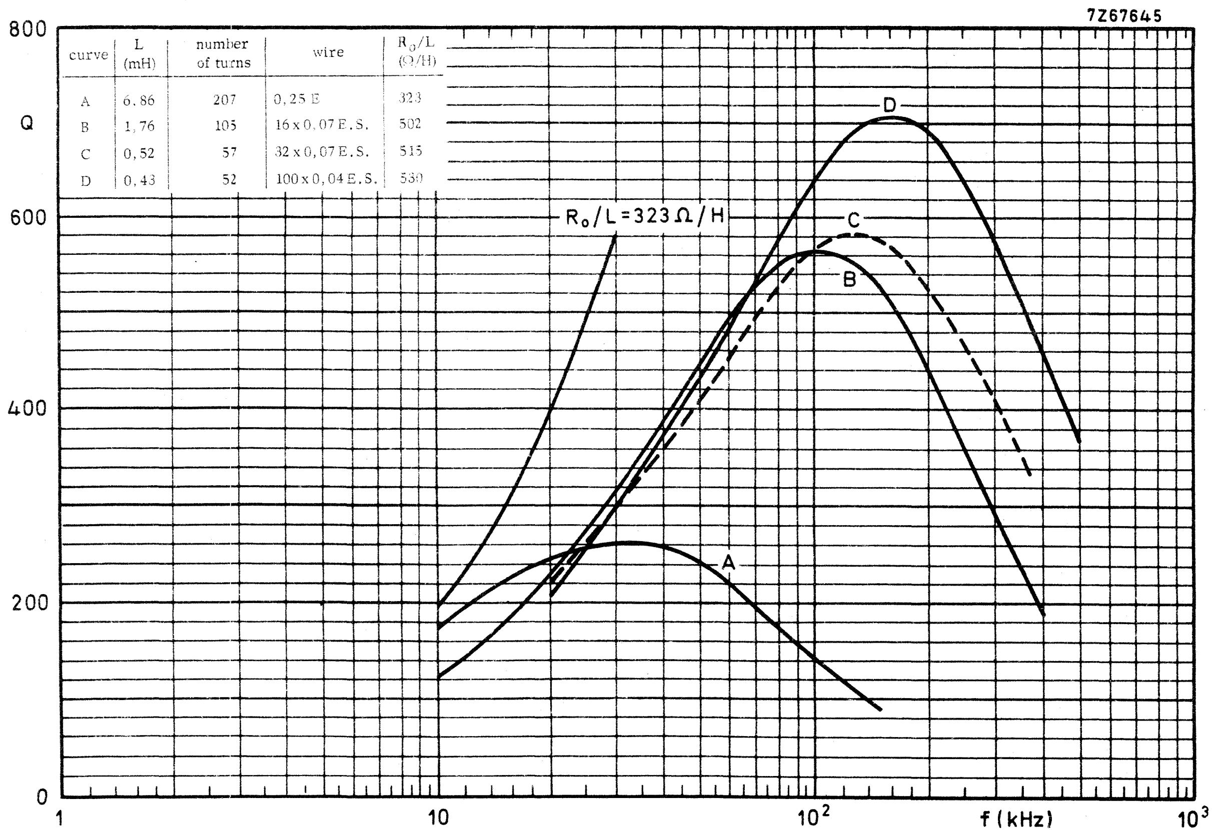
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	4,94	280	0,22 E	763
B	1,76	167	32 x 0,04 E.S.	1180
C	0,69	105	16 x 0,07 E.S.	1280
D	0,61	98	50 x 0,04 E.S.	1766

FXC 3D3, single-section coil former, $A_L = 63$



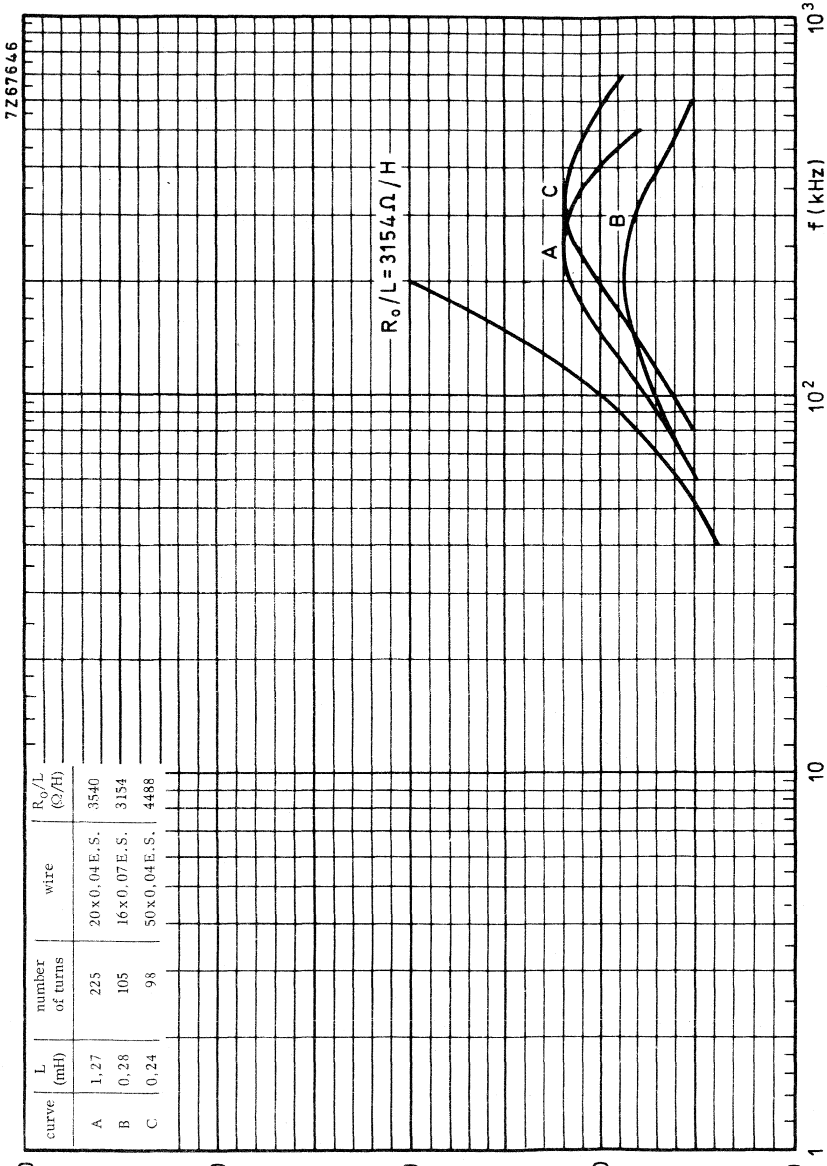
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	4,28	207	0,25 E	518
B	2,79	167	32 x 0,04 E.S.	744
C	1,10	105	16 x 0,07 E.S.	803
D	0,96	98	50 x 0,04 E.S.	1122
E	0,32	57	32 x 0,07 E.S.	838

FXC 3D3, single-section coil former, $A_L = 100$



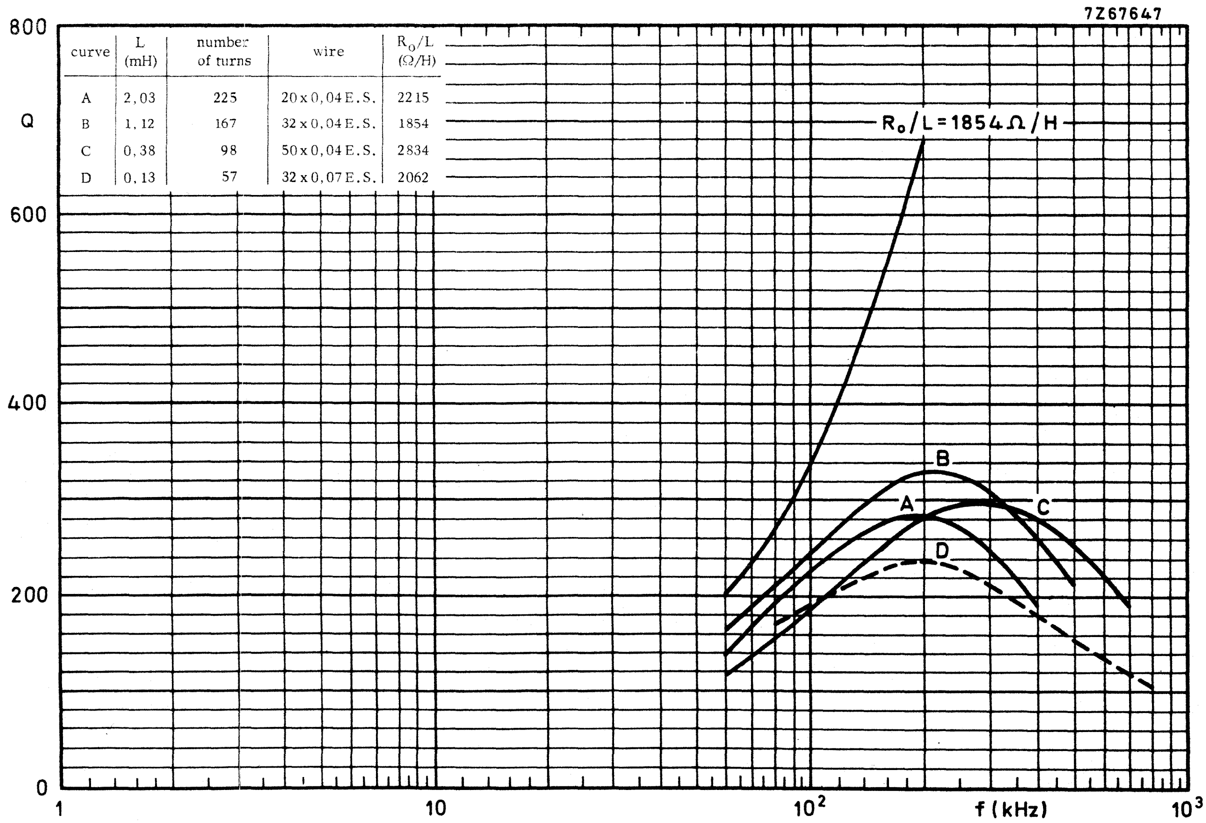
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	6,86	207	0,25 E	323
B	1,76	105	16 x 0,07 E.S.	502
C	0,52	57	32 x 0,07 E.S.	515
D	0,43	52	100 x 0,04 E.S.	530

FXC 3D3, single-section coil former, $A_L = 160$



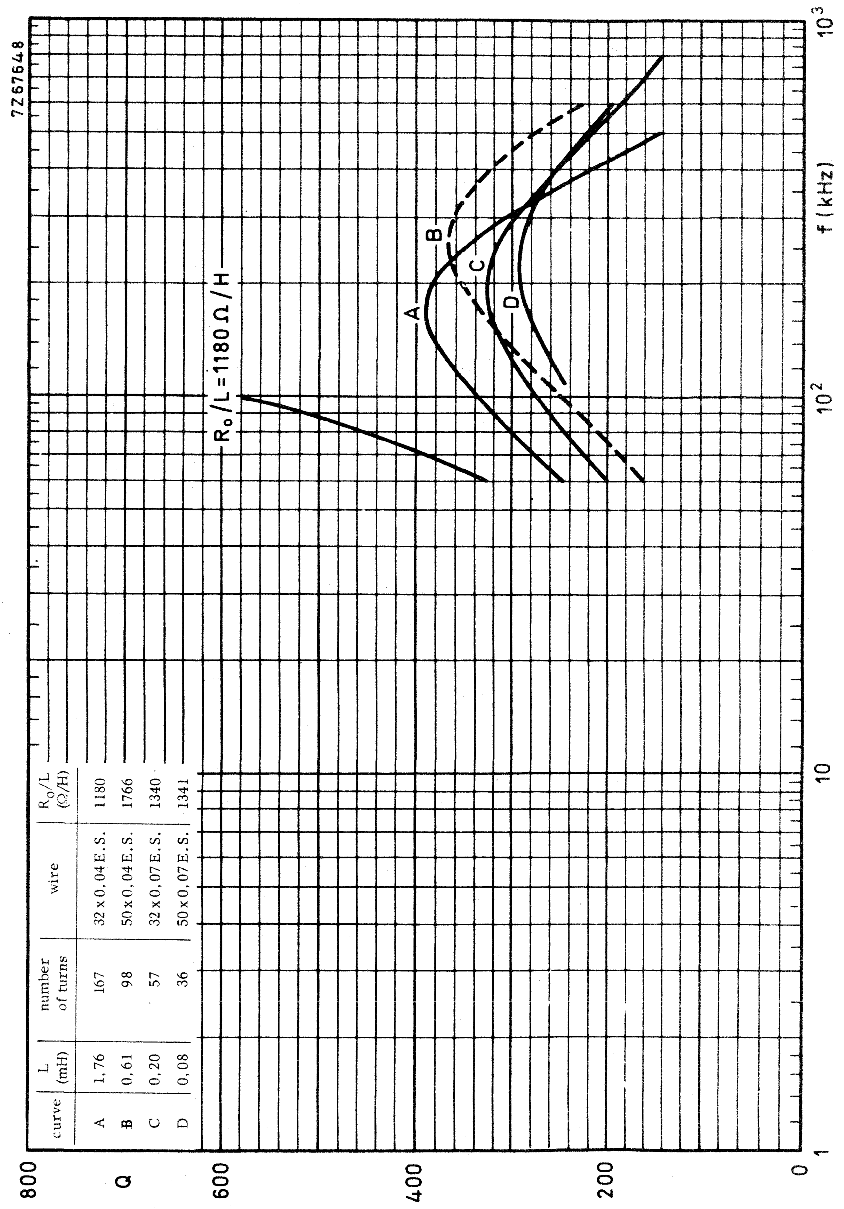
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1,27	225	20 x 0,04 E.S.	3540
B	0,28	105	16 x 0,07 E.S.	3154
C	0,24	98	50 x 0,04 E.S.	4488

FXC 4C6, single-section coil former, $A_L = 25$



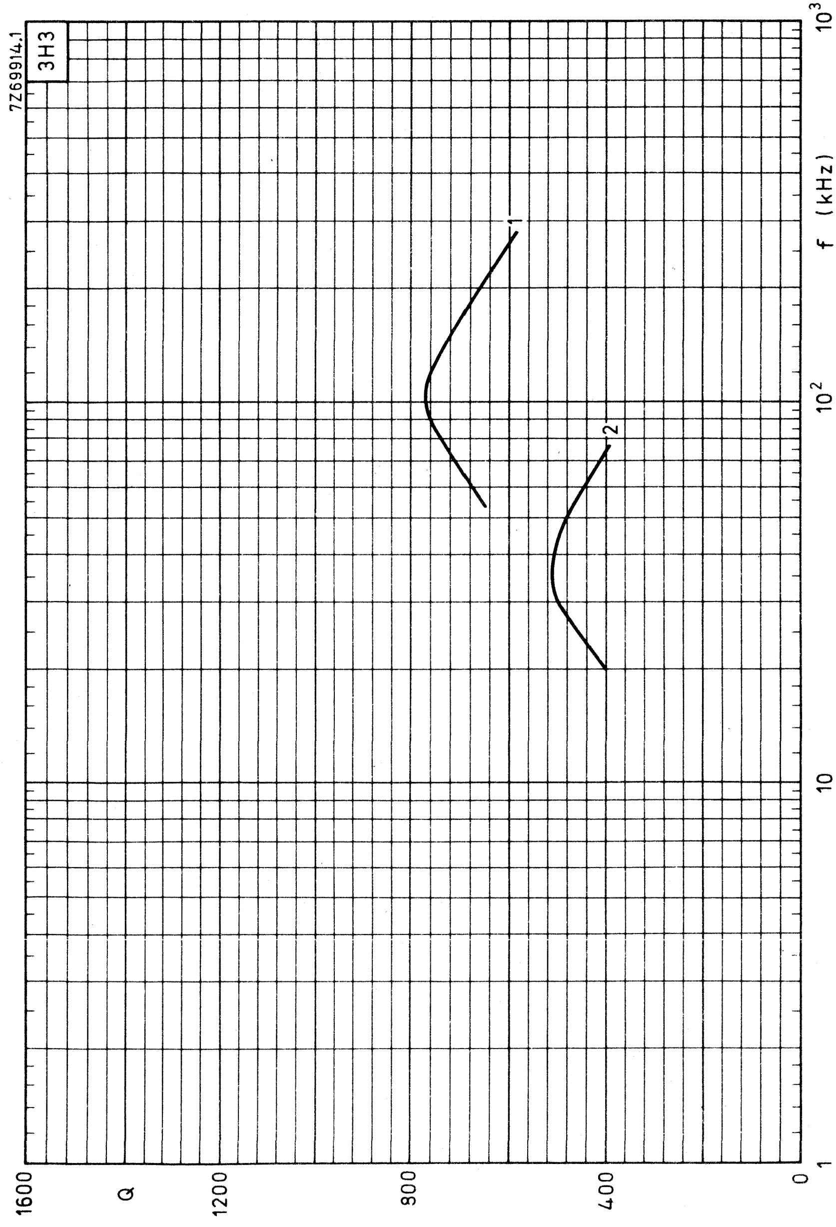
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	2,03	225	20 x 0,04 E.S.	2215
B	1,12	167	32 x 0,04 E.S.	1854
C	0,38	98	50 x 0,04 E.S.	2834
D	0,13	57	32 x 0,07 E.S.	2062

FXC 4C6, single-section coil former, $A_L = 40$

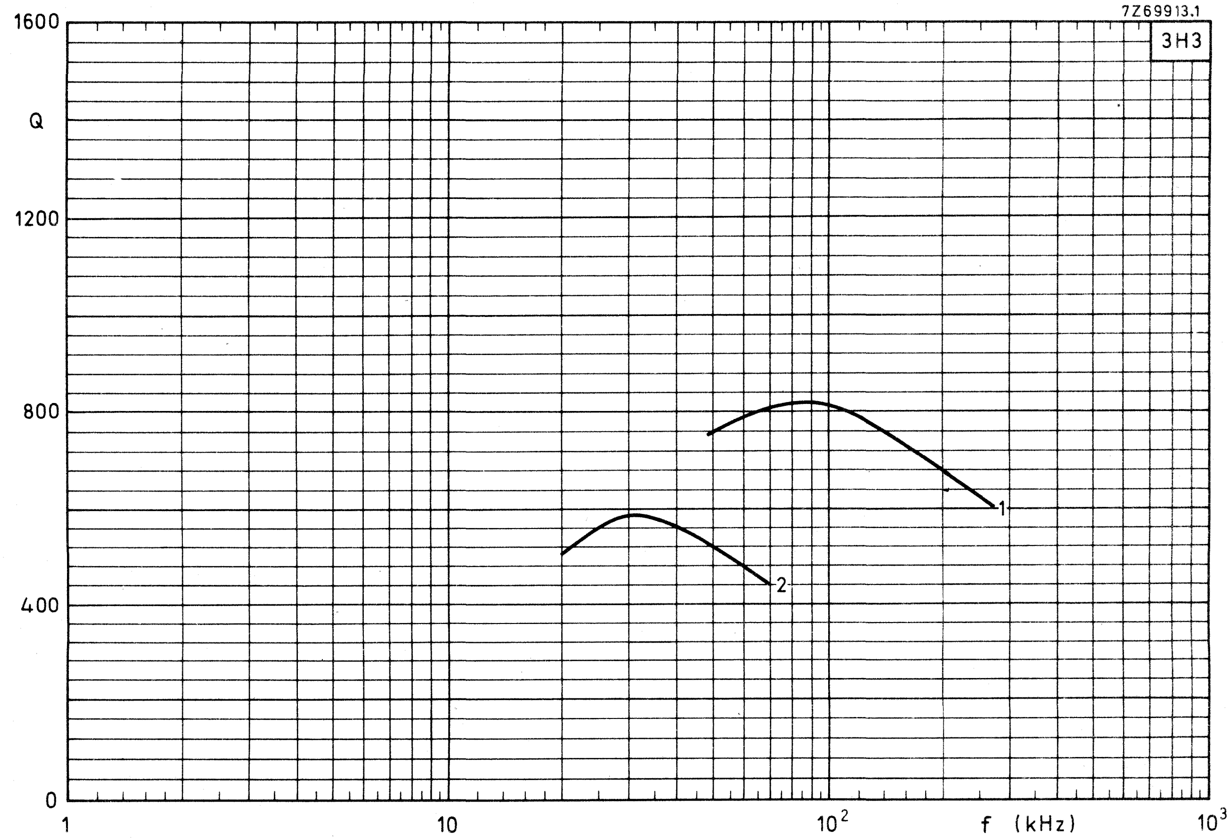


curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	1,76	167	32 x 0,04 E.S.	1180
B	0,61	98	50 x 0,04 E.S.	1766
C	0,20	57	32 x 0,07 E.S.	1340
D	0,08	36	50 x 0,07 E.S.	1341

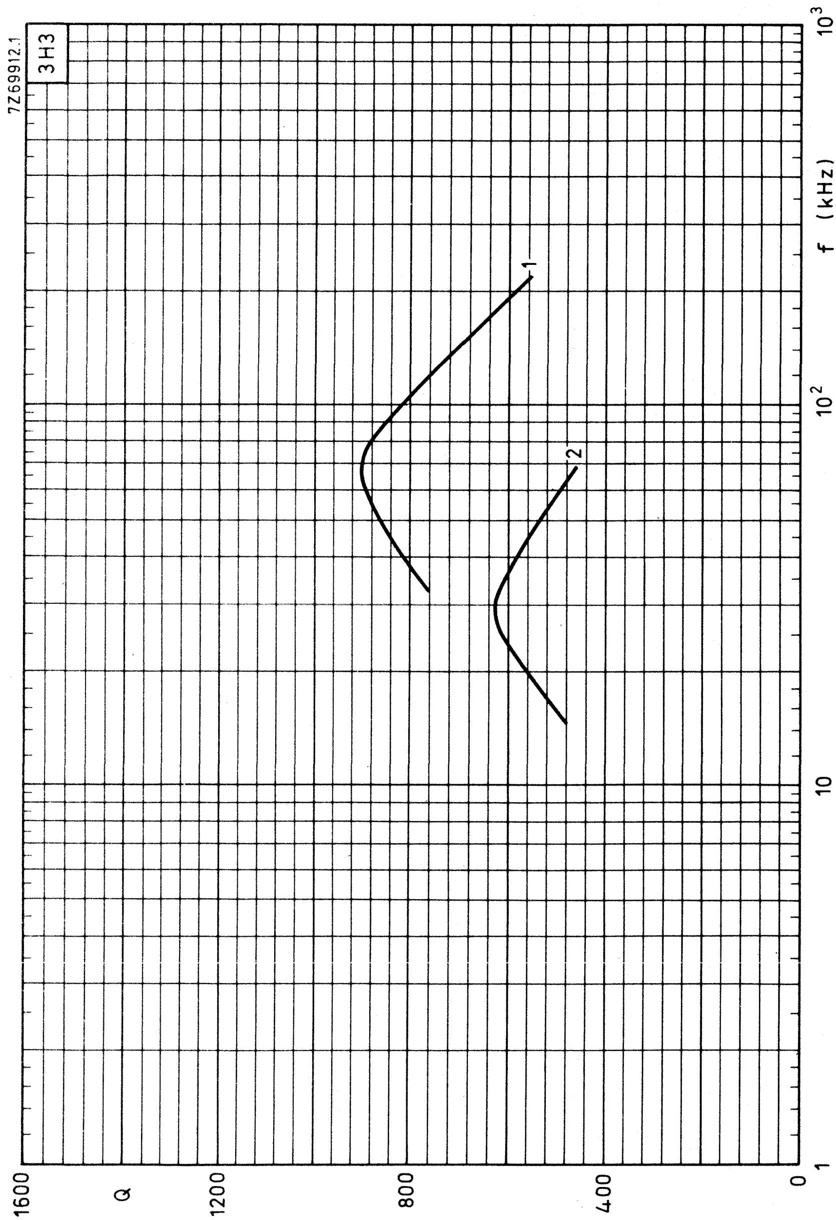
FXC 4C6, single-section coil former, $A_L = 63$



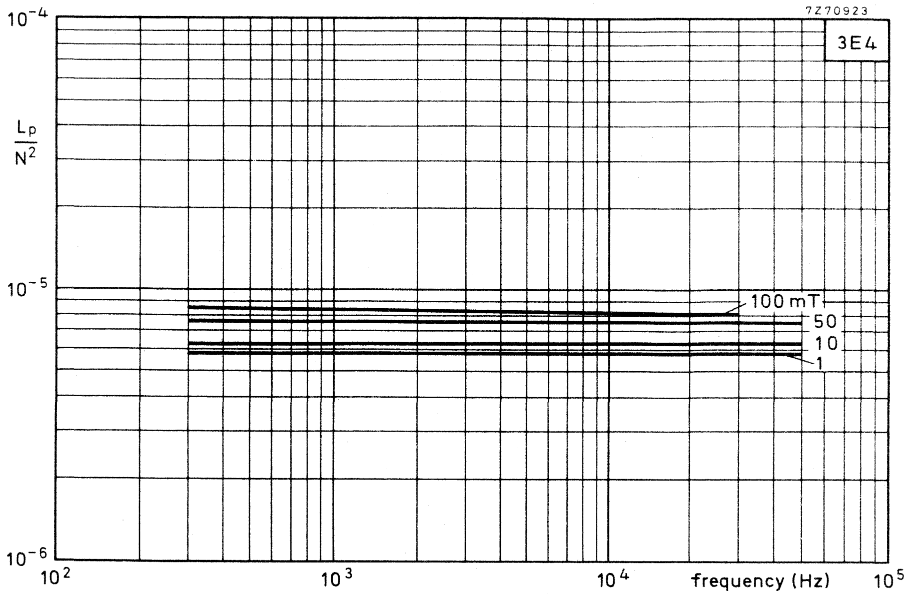
Q-curves. Single-section coil former; curve 1 : 57 turns (32 x 0,07 E.S. wire)
curve 2 : 207 turns (0,25 E wire).
A_L = 250



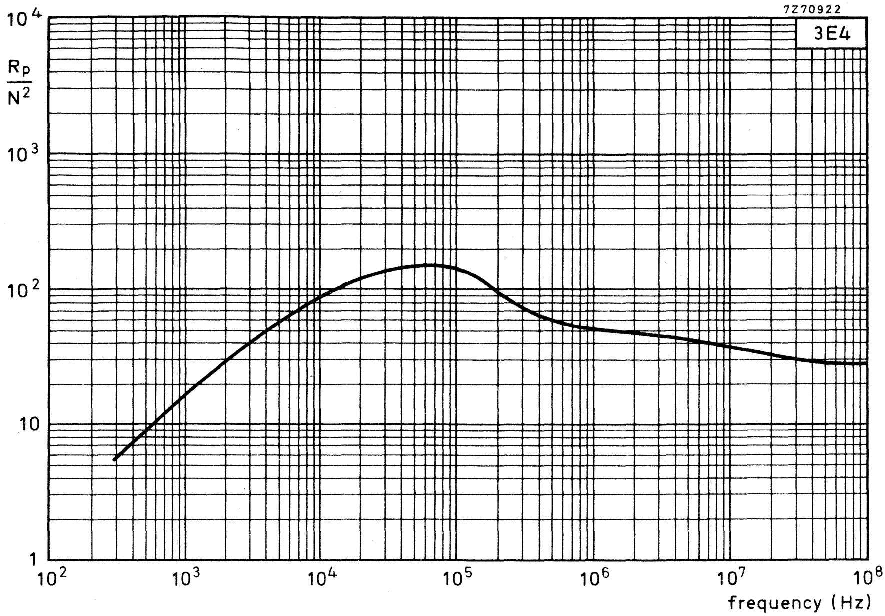
Q-curves. Single-section coil former; curve 1 : 57 turns (32 x 0,07 E.S. wire)
A_L = 315 curve 2 : 207 turns (0,25 E wire).



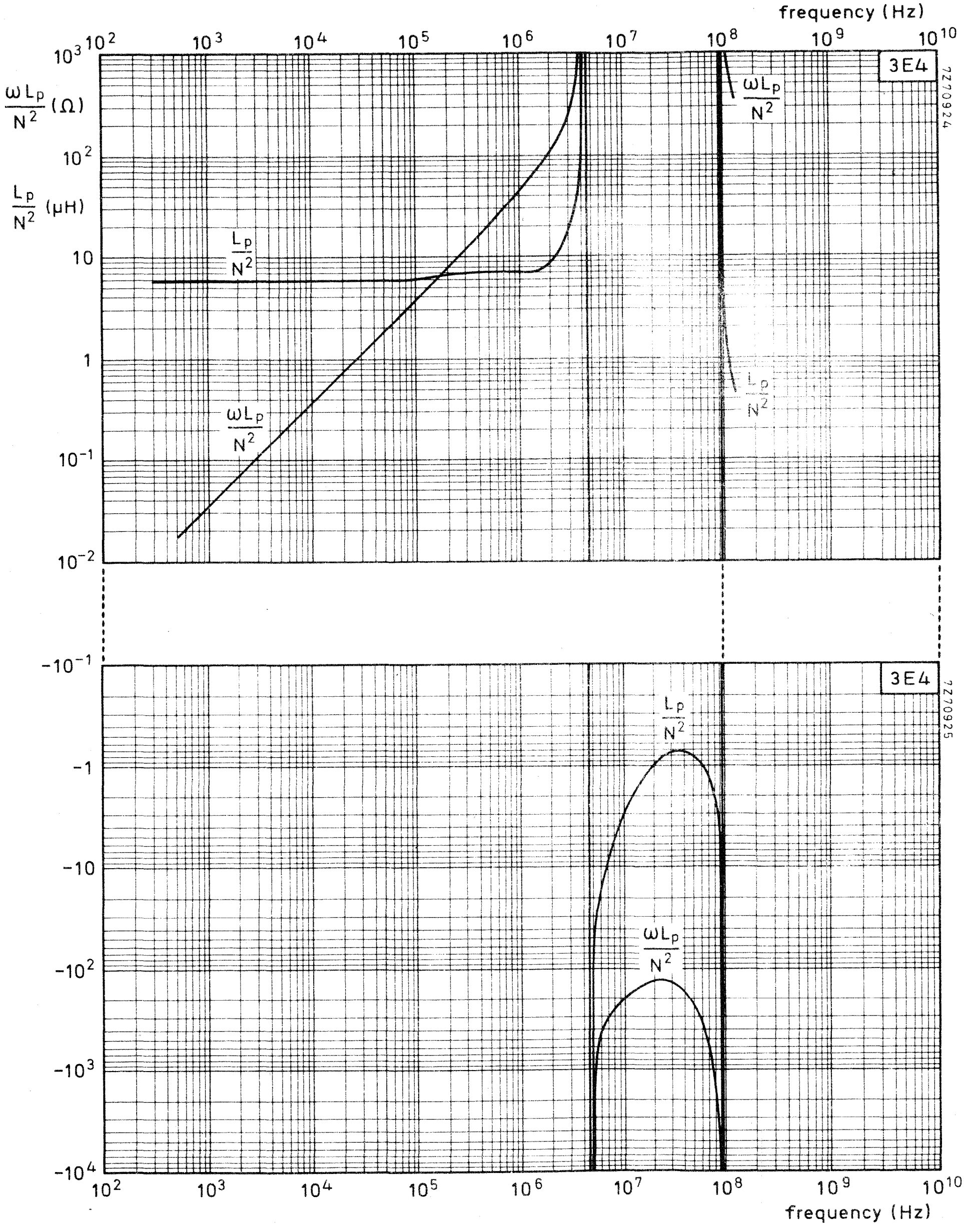
Q-curves. Single-section coil former; curve 1 : 57 turns (32 x 0,07 E.S. wire)
curve 2 : 207 turns (0,25 E wire).
$A_L = 400$



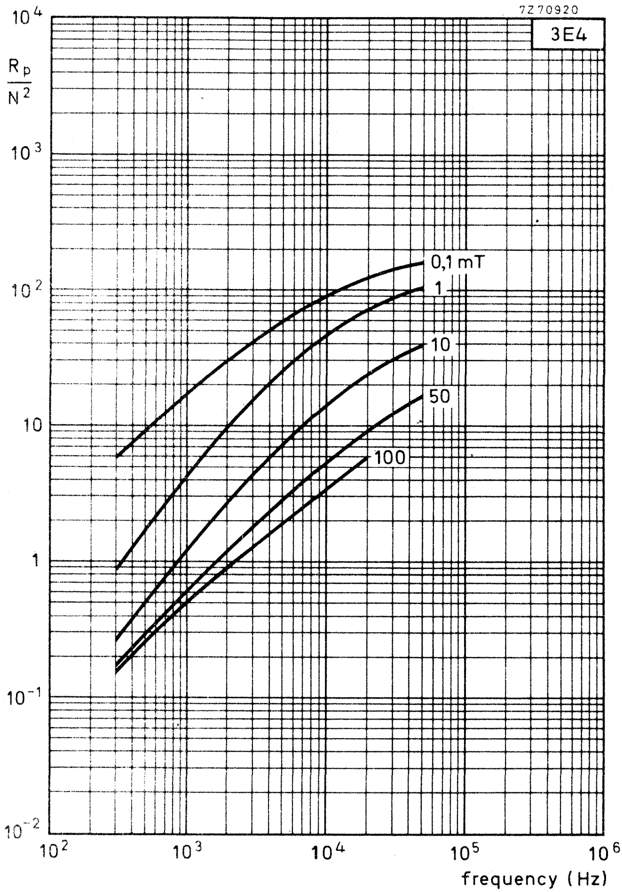
Inductance as a function of the frequency (typical values).



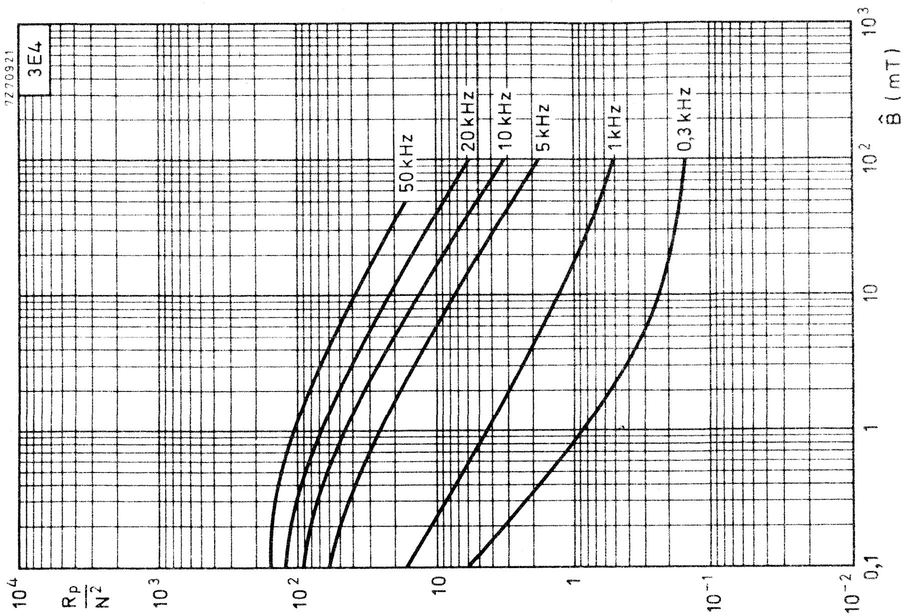
Losses as a function of the frequency at $\hat{B} \approx 0,1$ mT (typical values).



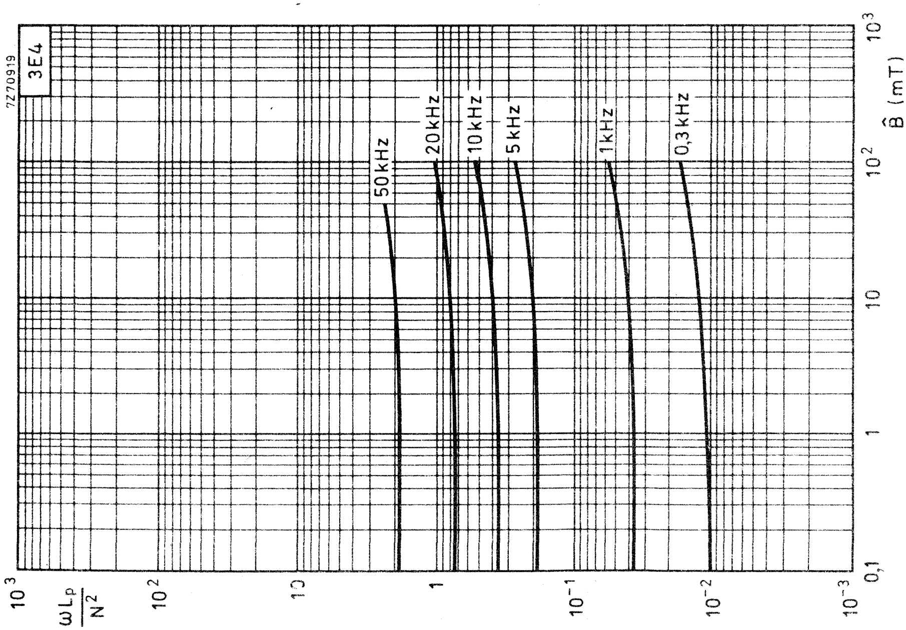
Inductance as a function of the frequency (typical values)



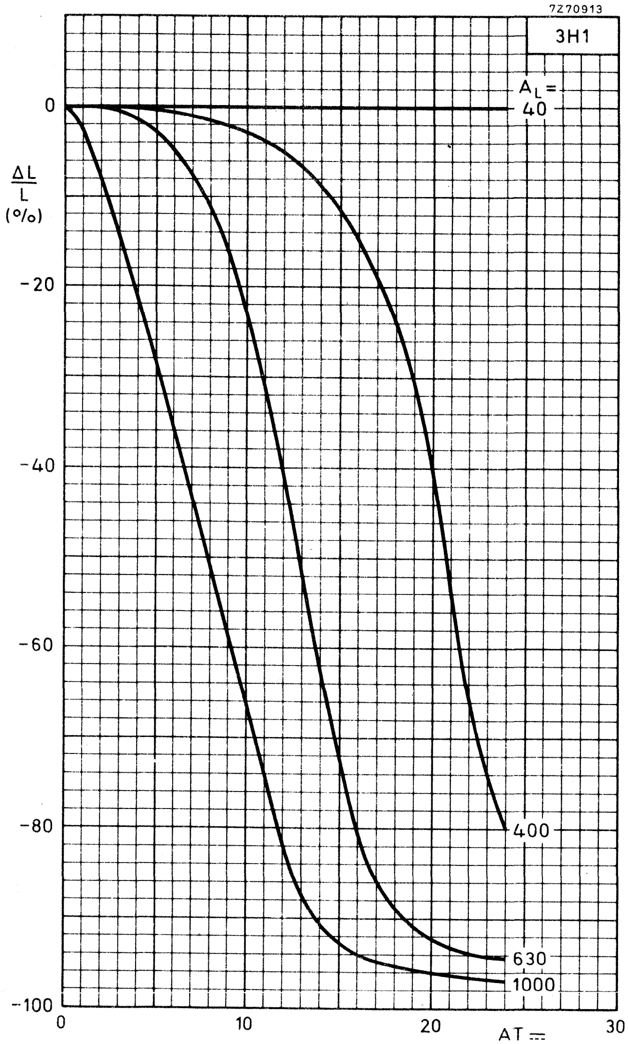
Losses as a function of the frequency (typical values)



Losses as a function of the peak induction

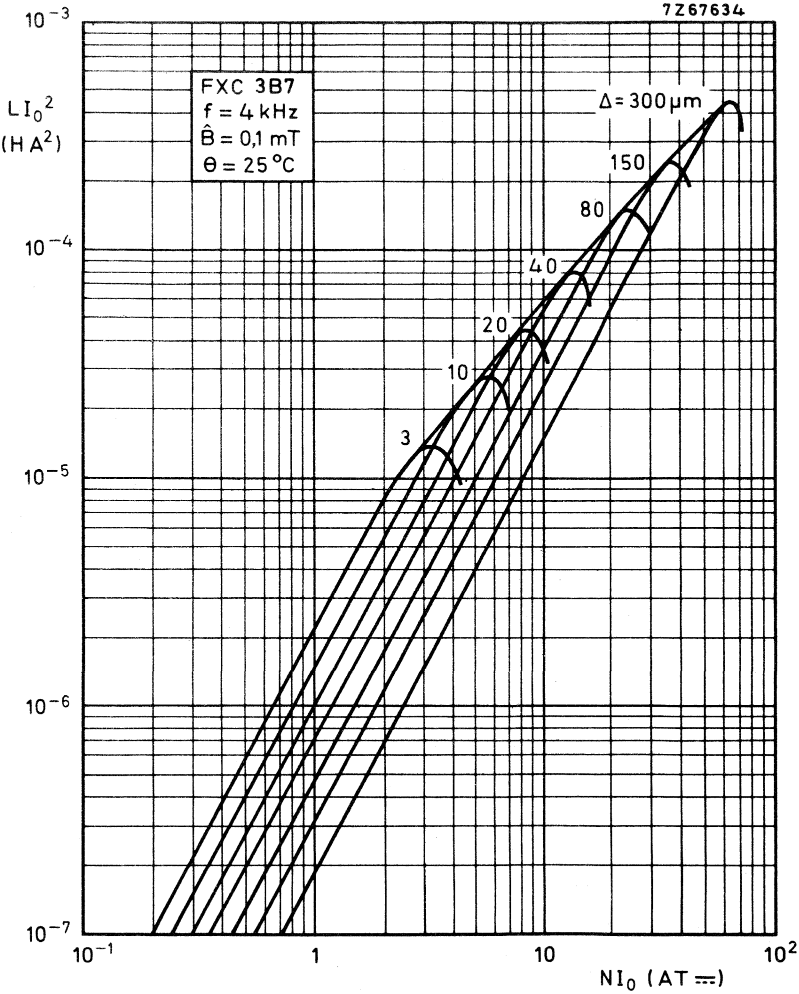


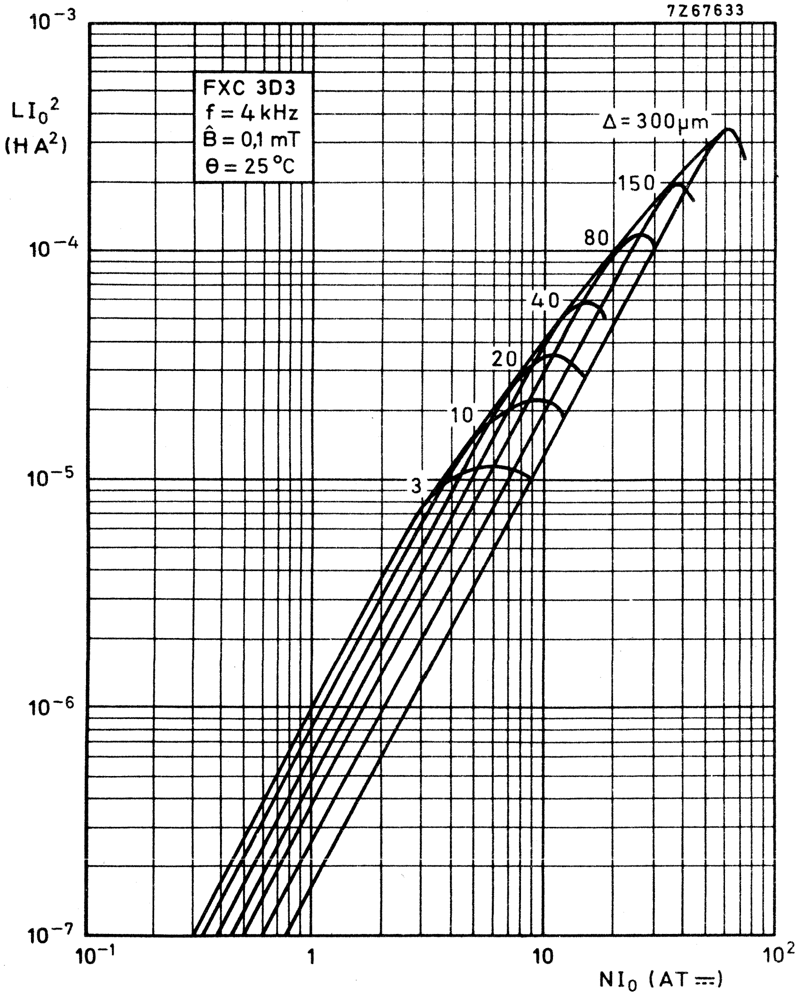
Inductance as a function of the peak induction
(typical values)

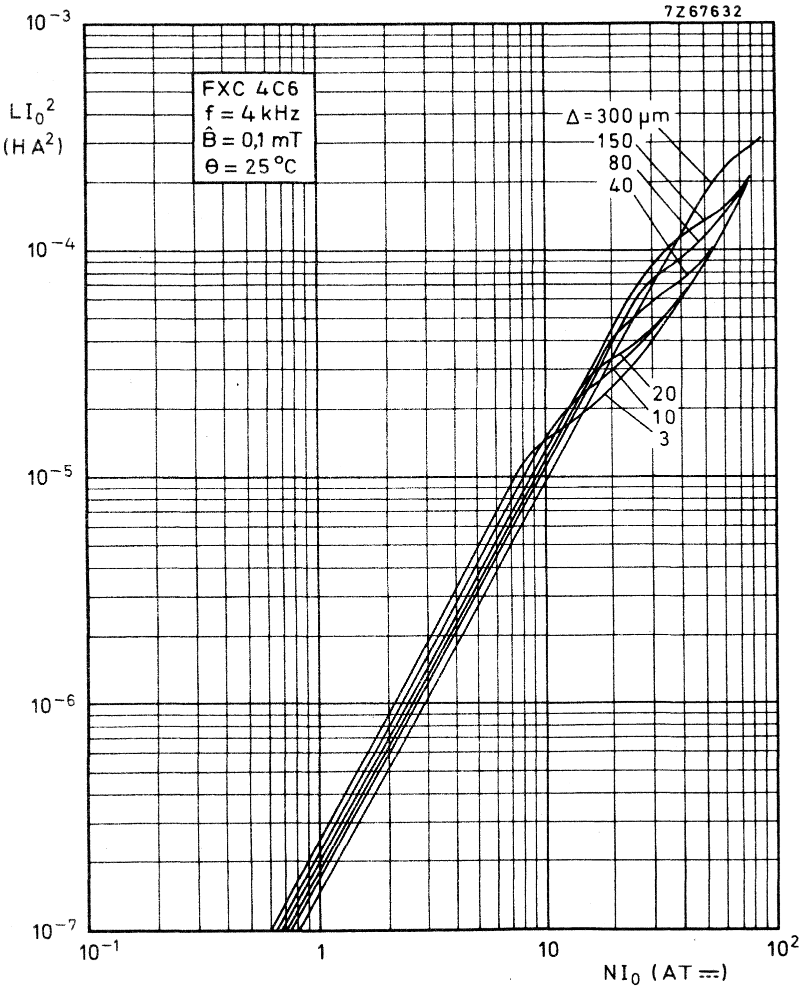

7Z70913
3H1
A_L =
40
400
630
1000
ΔL/L (%)
0
-20
-40
-60
-80
-100
0
10
20
30
AT ⎓

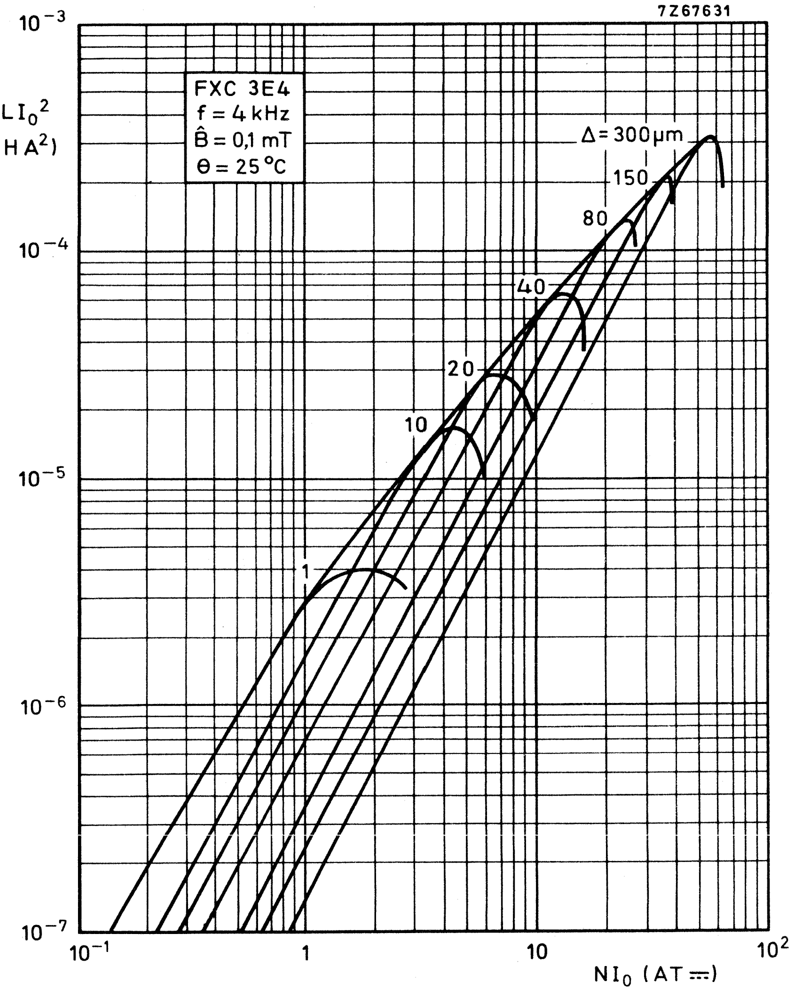
HANNA CURVES (typical values)
for different material grades.

Indicating optimum inductance for a certain airgap and direct current

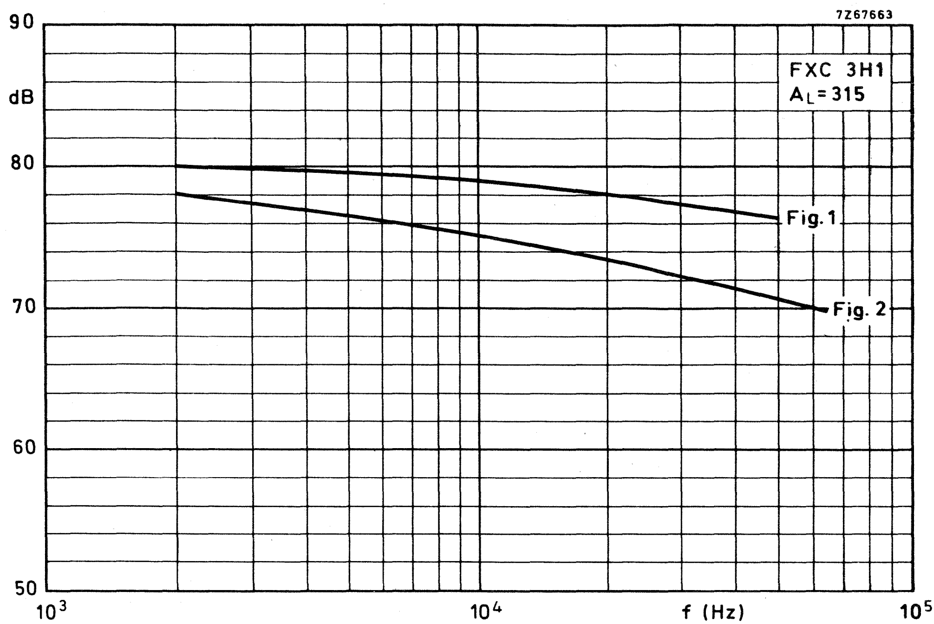



7Z67633
FXC 3D3
f = 4 kHz
B̂ = 0,1 mT
θ = 25 °C
LI0^2
(H A^2)
Δ = 300μm
150
80
40
20
10
3
10^-3
10^-4
10^-5
10^-6
10^-7
10^-1
1
10
10^2
NI0 (AT ⎓)


7Z67632
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
LI_0^2
(HA^2)
FXC 4C6
f = 4 kHz
$\hat{B}$ = 0,1 mT
θ = 25 °C
Δ = 300 μm
150
80
40
20
10
3
10^{-1}
1
10
10^2
NI_0 (AT ⎓)


7Z67631
FXC 3E4
f = 4 kHz
B̂ = 0,1 mT
Θ = 25 °C
LI0^2
(H A^2)
Δ = 300 μm
150
80
40
20
10
1
10^-3
10^-4
10^-5
10^-6
10^-7
10^-1
1
10
10^2
NI0 (AT ⎓)

CROSSTALK ATTENUATION



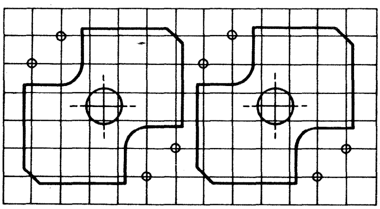


Fig. 1 7Z67659

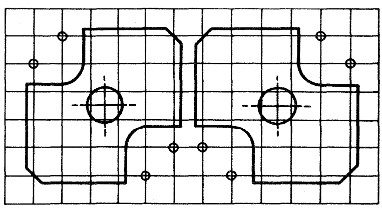


Fig. 2 7Z67660

SQUARE CORES

INTRODUCTION

Three types of core can be supplied:
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted cores (2 halves with an air gap) which are provided with a nut for an adjuster. These cores have an inductance factor A_L in accordance with the R5 (R10) range.
- Pre-adjusted cores without nut.

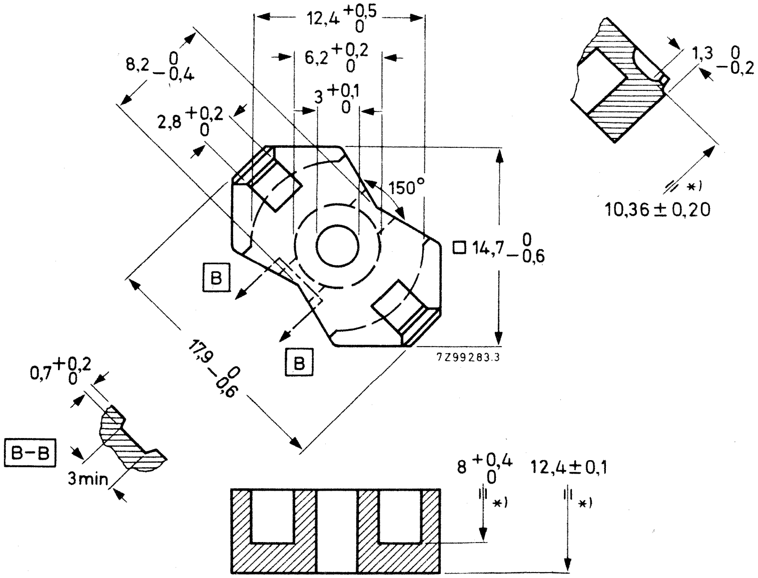
The square cores are in accordance with the following specifications: IEC 431 (international), UTE C93-324 (France), DIN 41980 (Germany).

Square cores and associated parts are ordered by their 12-digit catalogue number. Quantity: a primary pack contains 40 core halves or 20 pre-adjusted cores, a storage pack 200 or 100 respectively. Please order in multiples of these quantities.

SEPARATE CORE HALVES

Dimensions in mm

Outlines



*) Measured on two adjacent core halves.

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 50 N, the following values are guaranteed.

	$\hat{B}$ (mT)	freq. (MHz)	temp. (^oC)	grade 3B7	3B8	3D3	3E1	3E4	3H1	3H3	4C6
μ_e (tol. ±25%)	≤ 0,1	0,1	25 ± 5	1710	1605	700			1710		125
A_L (tol. ±25%)	≤ 0,1	0,1	25 ± 5	2480	2340	1020			2480		182
α (tol. ±12,5%)	≤ 0,1	0,1	25 ± 5	20,6	21,0	32,2			20,6		76
$\alpha_F \times 10^6$			+5 to +25	-0,6 to +0,6 1)	0 to +2 1)			0 to +2	+0,5 to +1,5	0,7 ± 0,25	-2 to +4
			+25 to +55	-0,6 to +0,6	0 to +2 1)			0 to +2	+0,5 to +1,5	0,7 ± 0,25	0 to +6
			+25 to +70	-0,6 to +0,6		0 to +2	0 to +2	0 to +2	+0,5 to +1,5	0,7 ± 0,25	
$D_F \times 10^6$ (10-100 min)			25 ± 1	≤ 4,3	≤ 4,3	≤ 12		≤ 4,3	≤ 4,3		≤ 10
D_F	≤ 0,1	≤ 0,1	2)							≤ 3,0	
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	25 ± 5				≤ 2,5	≤ 2,5			
	≤ 0,1	0,03		≤ 2,5	≤ 3				≤ 2,5		
	≤ 0,1	0,1		≤ 5	≤ 6 1)	≤ 8	≤ 20	≤ 20	≤ 5		
	≤ 0,1	0,5				≤ 14	≤ 200	≤ 200			
	≤ 0,1	1,0				≤ 30					
	≤ 0,1	2,0									≤ 40
	≤ 0,1	10,0									≤ 100
$q_{2-24-100}$	1,5-3	0,004	25 ± 5	≤ 1,8/≤ 1,4 1)			≤ 3,0	≤ 1,8	≤ 1,4		
	0,3-1,2	0,1				≤ 3,0					≤ 15
$\eta_B \times 10^3$	1,5-3	0,004	25 ± 5	≤ 1,1/≤ 0,86 1)			≤ 1,8	≤ 1,1	≤ 0,86		
	0,3-1,2	0,1				≤ 1,8					≤ 9,2
	1,5-3,0	0,03	25 ± 1		≤ 1,0					≤ 0,65	

1) For guidance only.
2) Any temp. between +25 and +70 ^oC.

μ_Δ for grade 3B8 at 3,95 AT ≥ 606
6,01 AT ≥ 271
7,31 AT ≥ 141

α_F of 3H3 has been determined with formula:

$$\alpha_F = \frac{L_\theta - L_{25}}{L_\theta \times L_{25}} \times \frac{1}{\theta - 25} \; / \; ^oC$$

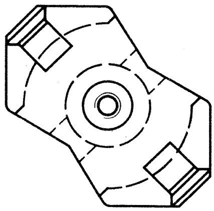
Versions

Ferroxcube grade	catalogue number
3B7	4322 020 25040
3B8	4322 020 27850
3D3	4322 020 25060
3E1	only pre-adjusted cores
3E4	are available
3H1	4322 020 25020
3H3	4322 020 25200
4C6	4322 020 25080

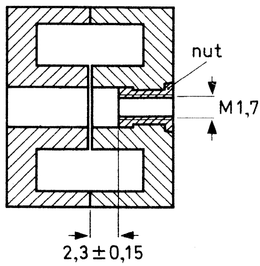
PRE-ADJUSTED CORES

Dimensions in mm

Outlines



7Z98874.4



	with centre hole	without centre hole
Mass (per set)	5,2 g	5,6 g
Mean length of lines of force	l_e = 27,3 mm	29,2 mm
Mean area of lines of force	A_e = 31 mm^2	37 mm^2
	$\Sigma \frac{l_e}{A_e}$ = 0,863 mm^{-1}	0,784 mm^{-1}
Effective volume	V_e = 840 mm^3	1090 mm^3

Pre-adjusted cores with **standard A_L values**

A_L	corre-sponding μ_e-value	tol. on induct-ance (%)	cat. no. 4322 022 6.... with nut; 4322 022 4.... without nut						
			3B7	3D3	3E1	3E4	3H1	3H3	4C6
25	17,1	± 1							7810
40	27,4	± 1		7420					7820
63	43,1	± 1		7430					7830
100	62,0	± 2		7440					
160	110	± 2	7050	7450			7250		
200	137	± 2					7350	7680	
250	171	± 2	7060				7260	7560	
315	216	± 2	7070				7270	7570	
400	274	± 2	7080				7280	7580	
630	431	± 3	7100				7300	7600	
1000	620	± 10	7110				7310		
1250	856	± 10	7190				7390		
4400	3050	± 25			7800				
4840	3050	± 25			7910 *				
5500	3800	± 25				7900			
6050	3800	± 25				7920 *			

Inductance $L = N^2 A_L$ (in 10^{-9} H)

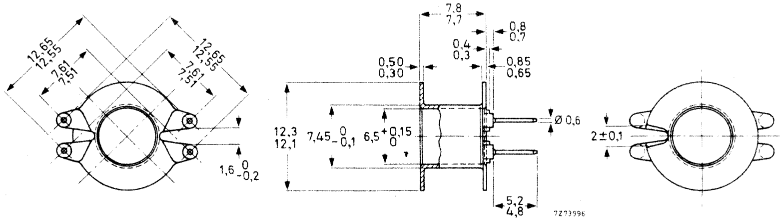
Symmetrical air gap for cores with A_L factor of 25 up to and including 160.
Asymmetrical air gap for cores with A_L factor of 160 and higher.
The air gap of the types marked * is practically zero, and consequently inductance adjustment is not possible. Hence these types are not provided with a centre hole, so that maximum performance is achieved.

Notes

1. Example of catalogue number:
   A_L = 250, grade 3H1, core with nut, catalogue number 4322 022 67260.
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

COIL FORMERS

SINGLE-SECTION, FOUR-PIN COIL FORMER



Catalogue number	4312 021 29240
Material	phenolformaldehyde reinforced with glass fibre
Window area	16,2 mm^2
Mean length of turn	30 mm
Max. temperature	180 °C

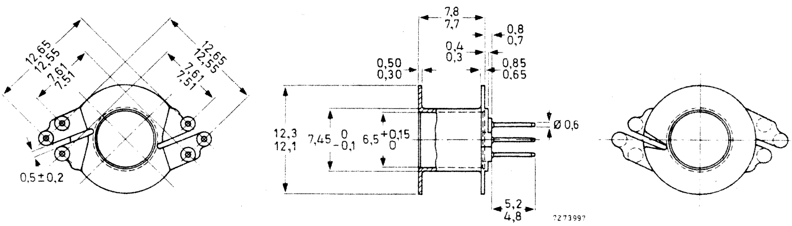
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 22,6 \times 10^3\ \Omega/H$$

Solderability: resistant against dip-soldering at 400 °C for 2 s

Mass 0,4 g

SINGLE-SECTION, SIX-PIN COIL FORMER



Catalogue number	4312 021 29250
Material	phenolformaldehyde reinforced with glass fibre
Window area	16,2 mm^2
Mean length of turn	30 mm
Max. temperature	180 °C

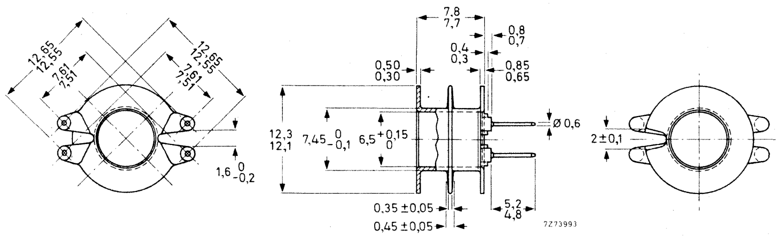
D.C. losses

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 22,6 \times 10^3\ \Omega/H$$

Solderability: resistant against dip-soldering at 400 °C for 2 s

Mass 0,4 g

TWO-SECTION, FOUR-PIN COIL FORMER



Catalogue number	4322 021 30940
Material	phenolformaldehyde reinforced with glass fibre
Window area	2 x 7,7 mm^2
Mean length of turn	30 mm
Max. temperature	180 °C

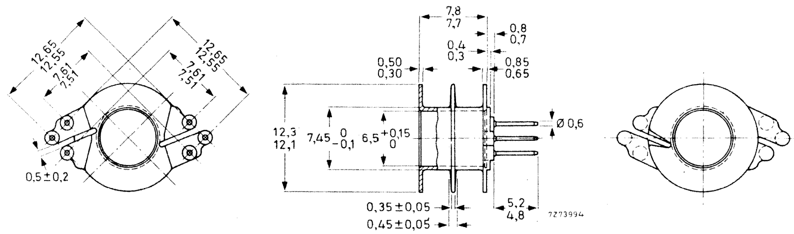
D.C. losses

$$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 23{,}6 \times 10^3\ \Omega/H$$

Solderability: resistant against dip-soldering at 400 °C for 2 s

Mass 0,4 g

TWO-SECTION, SIX-PIN COIL FORMER



Catalogue number	4322 021 30950
Material	phenolformaldehyde reinforced with glass fibre
Window area	2 x 7,7 mm^2
Mean length of turn	30 mm
Max. temperature	180 °C

D.C. losses

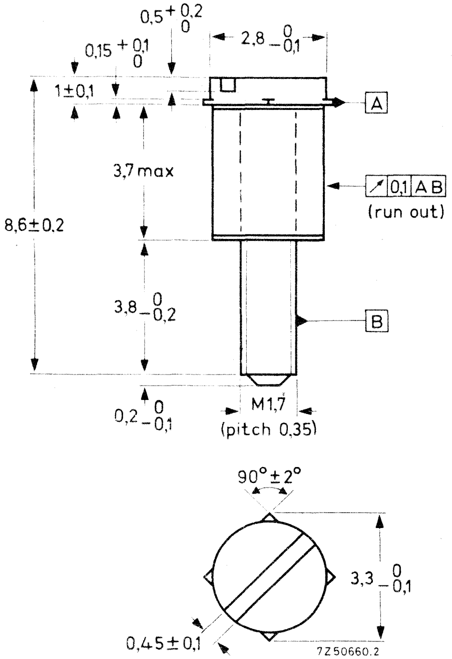
$$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 23{,}6 \times 10^3\ \Omega/H$$

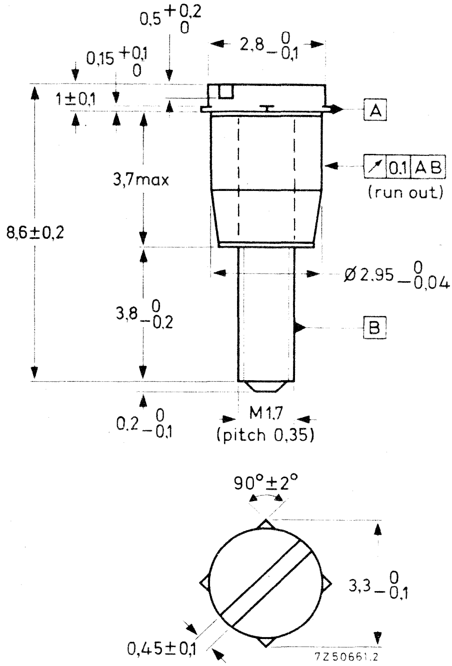
Solderability: resistant against dip-soldering at 400 °C for 2 s

Mass 0,4 g

INDUCTANCE ADJUSTERS

ADJUSTERS





Version A, tube dia. 2,5 −0,04 mm
Version B, tube dia. 2,7 −0,04 mm
Version C, tube dia. 2,77−0,04 mm

Version D

The tolerances on inductance of the pre-adjusted cores (without adjuster) are given in the table of pre-adjusted cores with standard A_L values. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0,03% by means of a continuous inductance adjuster. Such an adjuster increases the inductance of the coil (see following pages).
The adjuster is screwed through the centre hole of the core into the nut and is held in position by the four protrusions near the top of the adjuster. For special requirements a larger or smaller adjustment range may be obtained by using an adjuster belonging to the next higher or lower A_L value.
The influence of the adjuster on the variability of the inductance is negligible. The maximum permissible temperature is 110 °C.
The table shows the type of adjuster recommended for different square cores.

Table I, available types

version	colour	catalogue number
A	white	4322 021 32130
B	brown	4322 021 32140
C	black	4322 021 32150
B	green	4322 021 32160
B	red	4322 021 32170
D	grey	4322 021 32180

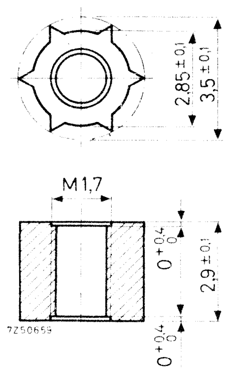
Table II, recommended application

A_L	3B7/3H1/3D3 catalogue number
40	4322 021 32160
63	4322 021 32160
100	4322 021 32170
160	4322 021 32130
200	4322 021 32130
250	4322 021 32130 or
	4322 021 32140
315	4322 021 32140
400	4322 021 32150
630	4322 021 32180

The adjusters are packed in bags of 100. Please order in multiples of 100.

NUT FOR ADJUSTER

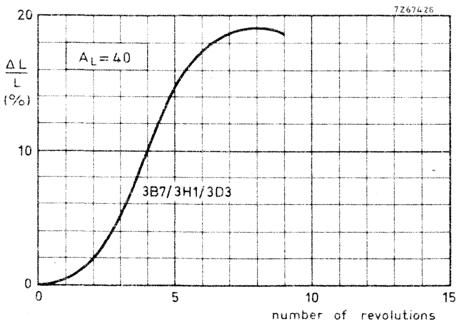
These data are given for those manufacturers who prefer to insert the nut themselves.



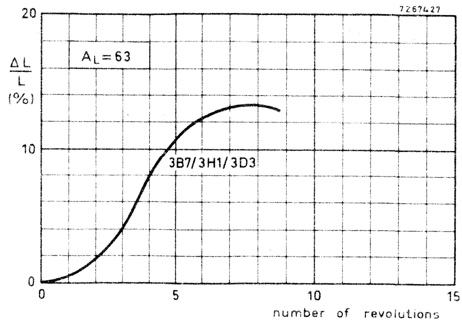
Catalogue number	4322 021 30140
Material	polycarbonate
Max. impregnation temperature during 24 hours	120 °C
Recommended distance from mating surface to nut	2,3 ± 0,15 mm

The nuts are packed in bags of 100. Please order in multiples of 100.

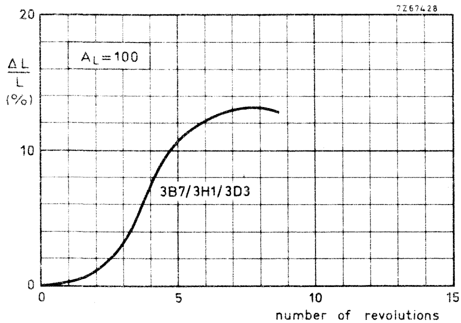
ADJUSTMENT CURVES



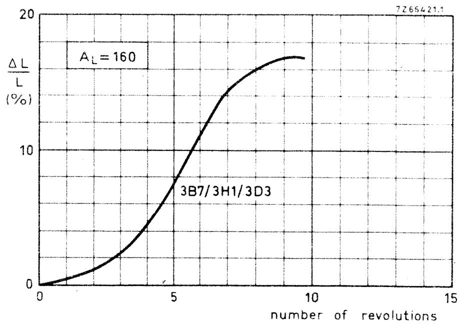
Adjuster 4322 021 32160



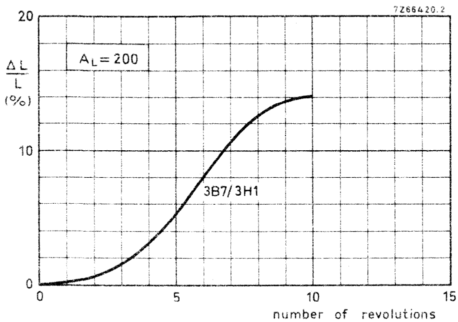
Adjuster 4322 021 32160



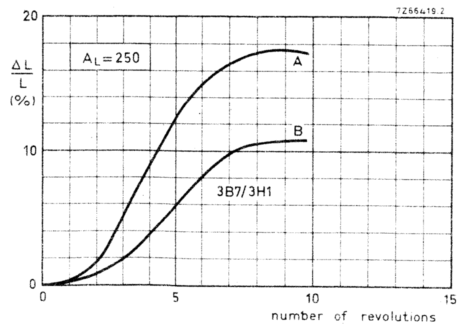
Adjuster 4322 021 32170



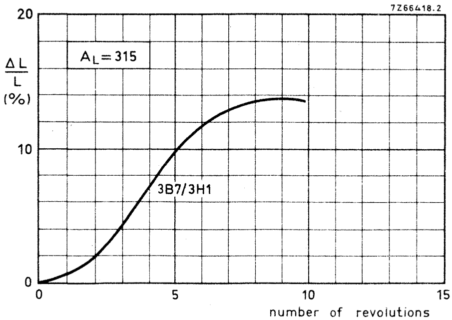
Adjuster 4322 021 32130



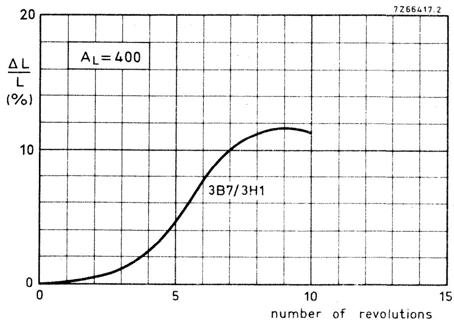
Adjuster 4322 021 32130



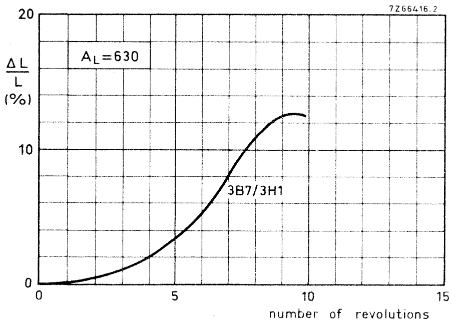
Curve A: adjuster 4322 021 32140
Curve B: adjuster 4322 021 32130



Adjuster 4322 021 32140



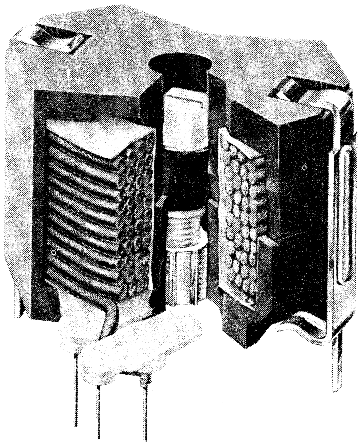
Adjuster 4322 021 32150



Adjuster 4322 021 32180

ASSEMBLING AND MOUNTING

ASSEMBLING



A52776

Cementing

During the cementing procedure care must be taken that the centre holes are kept in line.

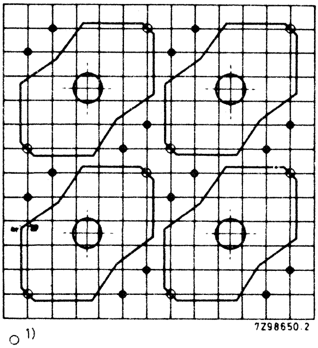
Assembly with clips

The core halves can be clamped together by using two clips. The tags of the clips are used for mechanical fastening and/or for earthing.
For a stable inductance we recommend that an adhesive be applied between the coil former and the lower core half.

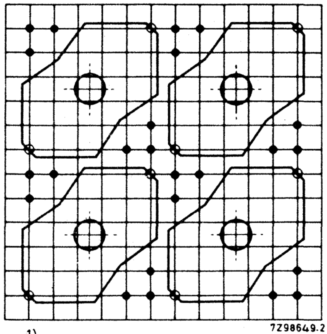
The use of a tool for attaching the clips is recommended. (Drawings of a simple tool for this purpose are available under number 4322 058 00150.)

MOUNTING

The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0,1 inch grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 2,4 mm. The recommended hole diameter in the board is 1,0 ± 0,1 or 1,3 ± 0,1 mm (according to IEC publication 97).

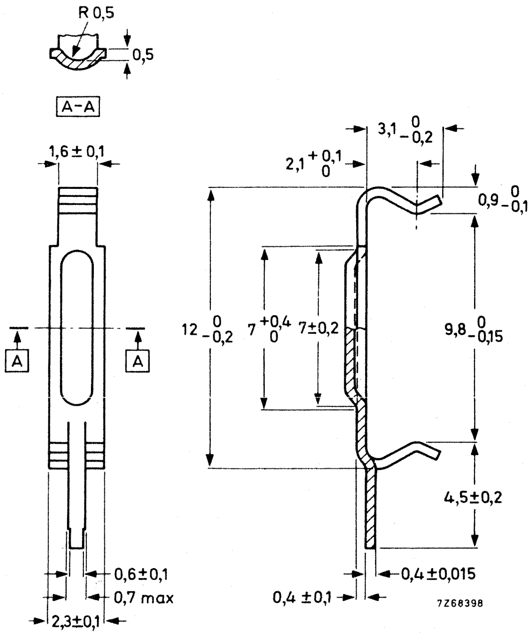


○ 1)



○ 1)

PART DRAWING (dimensions in mm)

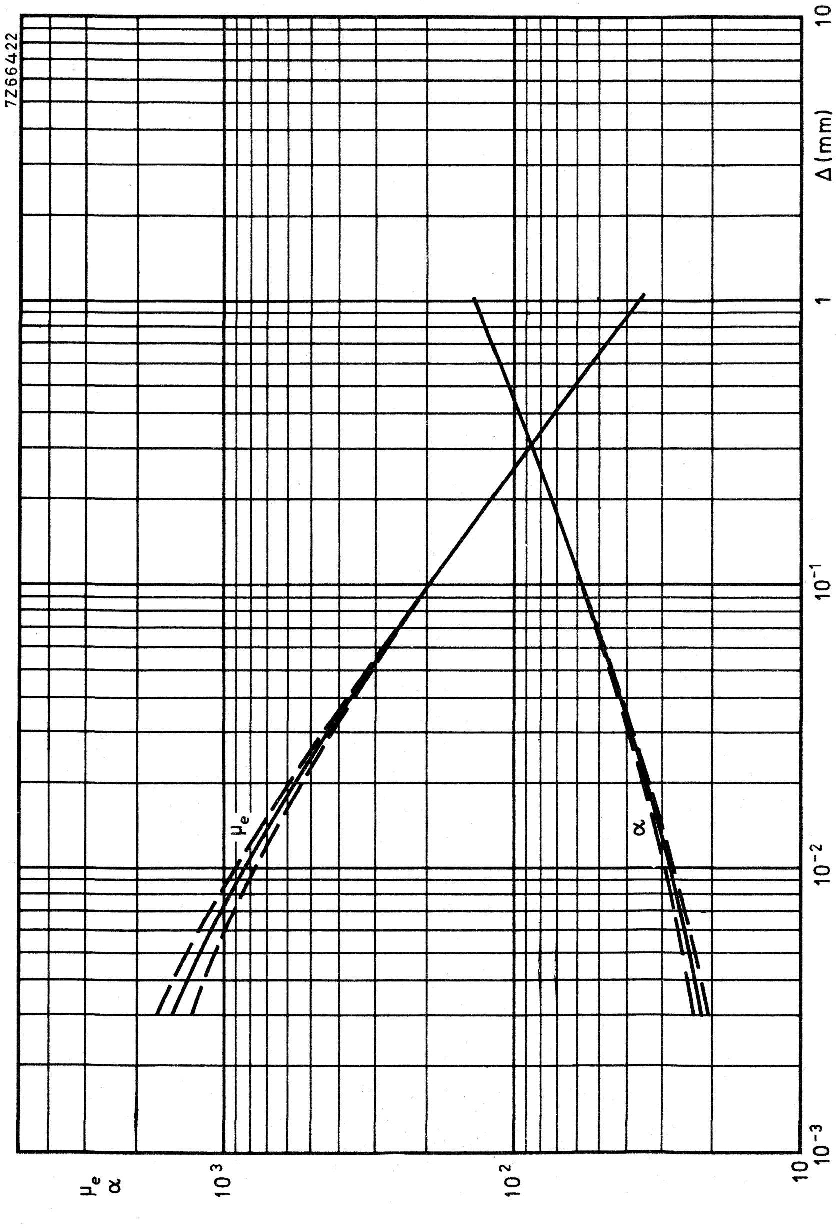


Clip 4322 021 31780
Material: steel, gold plated over nickel

1) Holes for tag on clip 4322 021 31780 (earth points).

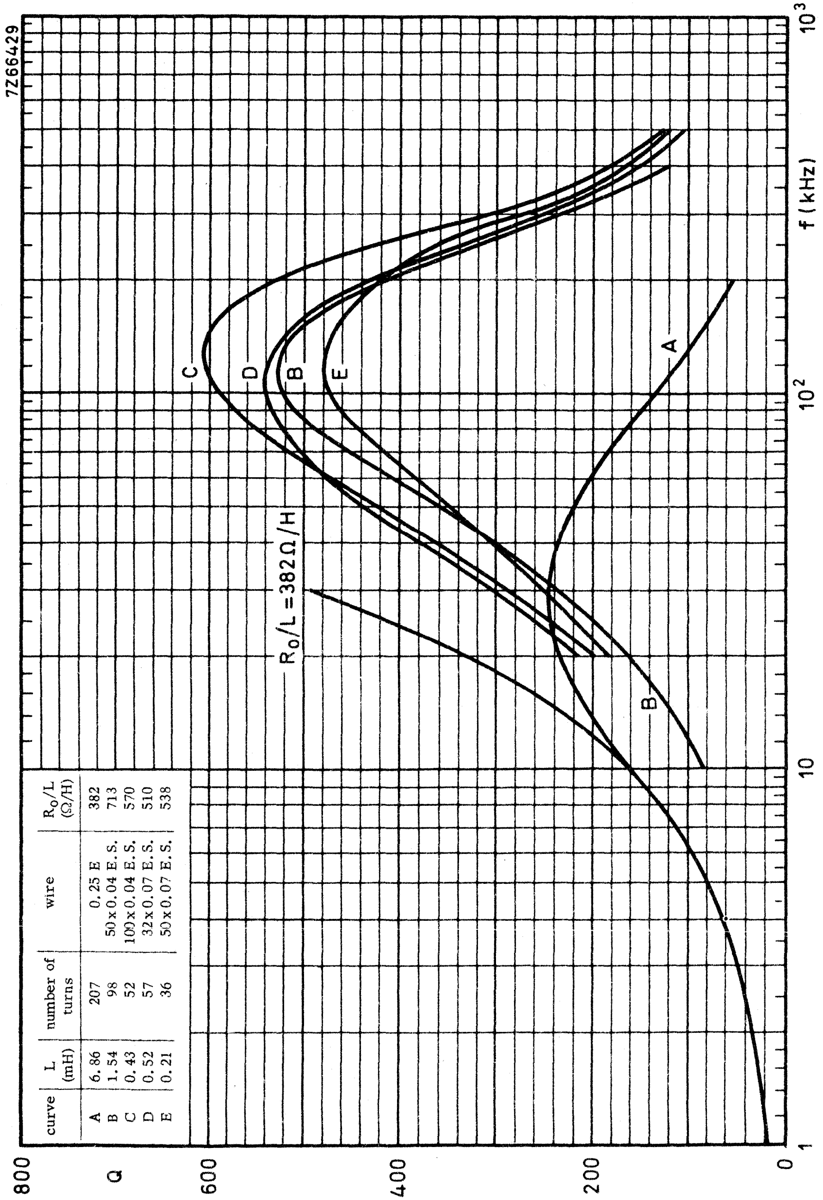
CHARACTERISTIC CURVES

μ_e - α CURVES



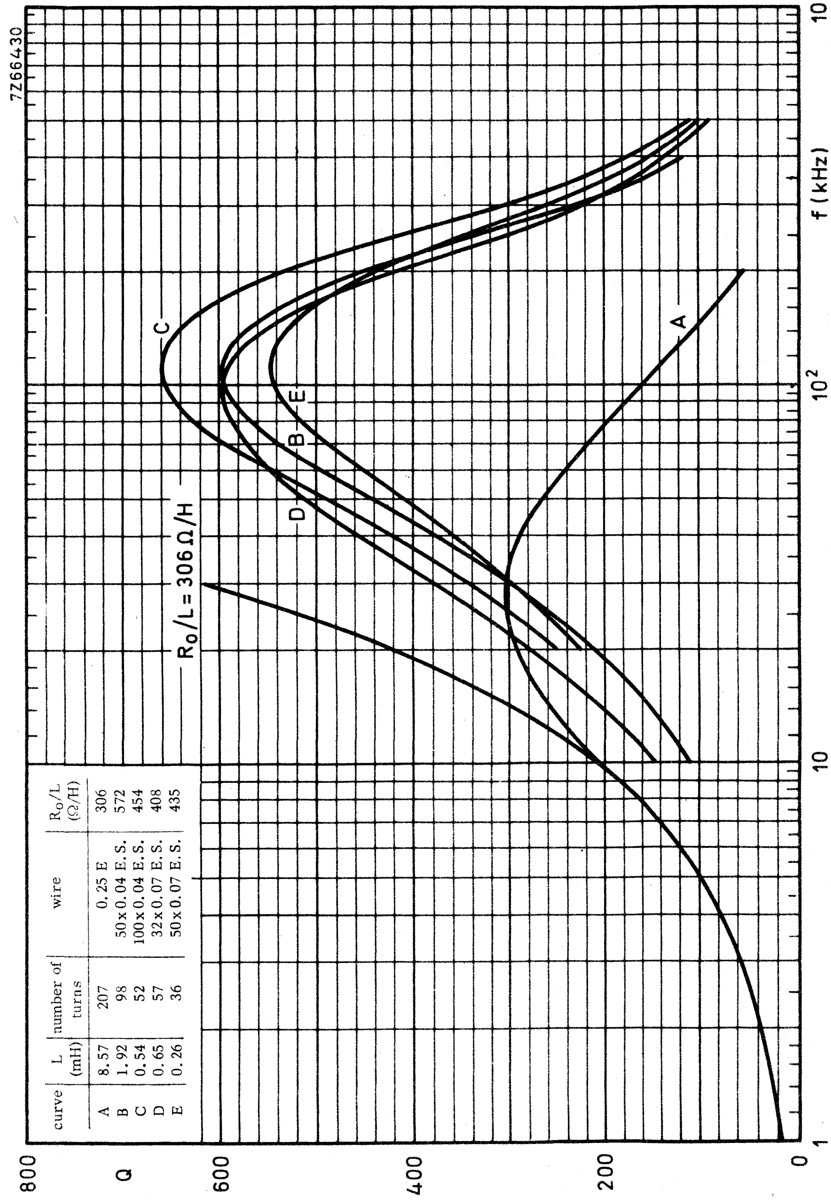
Relative effective permeability and turn factor for 1 mH as a function of the air gap length
$\mu_e \geq 1280$ at $\Delta = 3\ \mu m$ for 3B7 and 3H1

TYPICAL Q-CURVES FOR FXC 3B7 AND 3H1



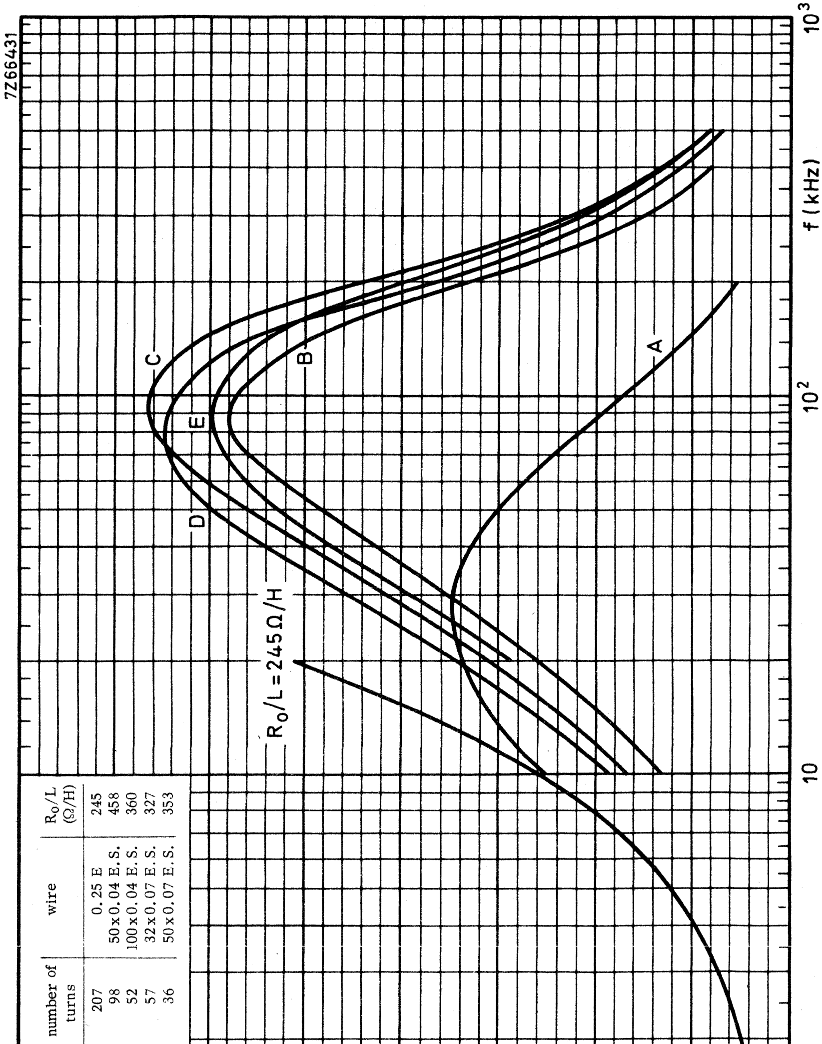
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	6.86	207	0.25 E	382
B	1.54	98	50 x 0.04 E.S.	713
C	0.43	52	109 x 0.04 E.S.	570
D	0.52	57	32 x 0.07 E.S.	510
E	0.21	36	50 x 0.07 E.S.	538

FXC 3B7/3H1, single-section coil former, A_L = 160



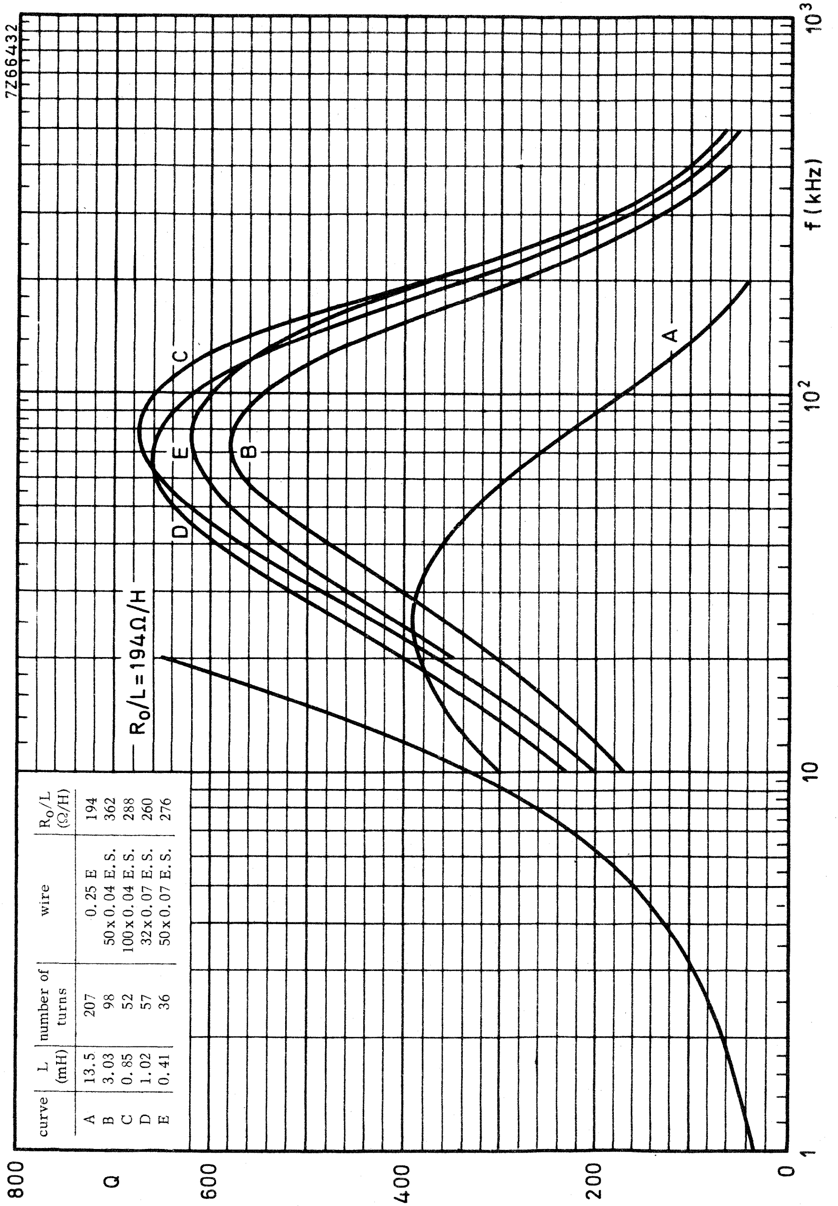
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	8.57	207	0.25 E	306
B	1.92	98	50 x 0.04 E.S.	572
C	0.54	52	100 x 0.04 E.S.	454
D	0.65	57	32 x 0.07 E.S.	408
E	0.26	36	50 x 0.07 E.S.	435

FXC 3B7/3H1, single-section coil former, $A_L = 200$



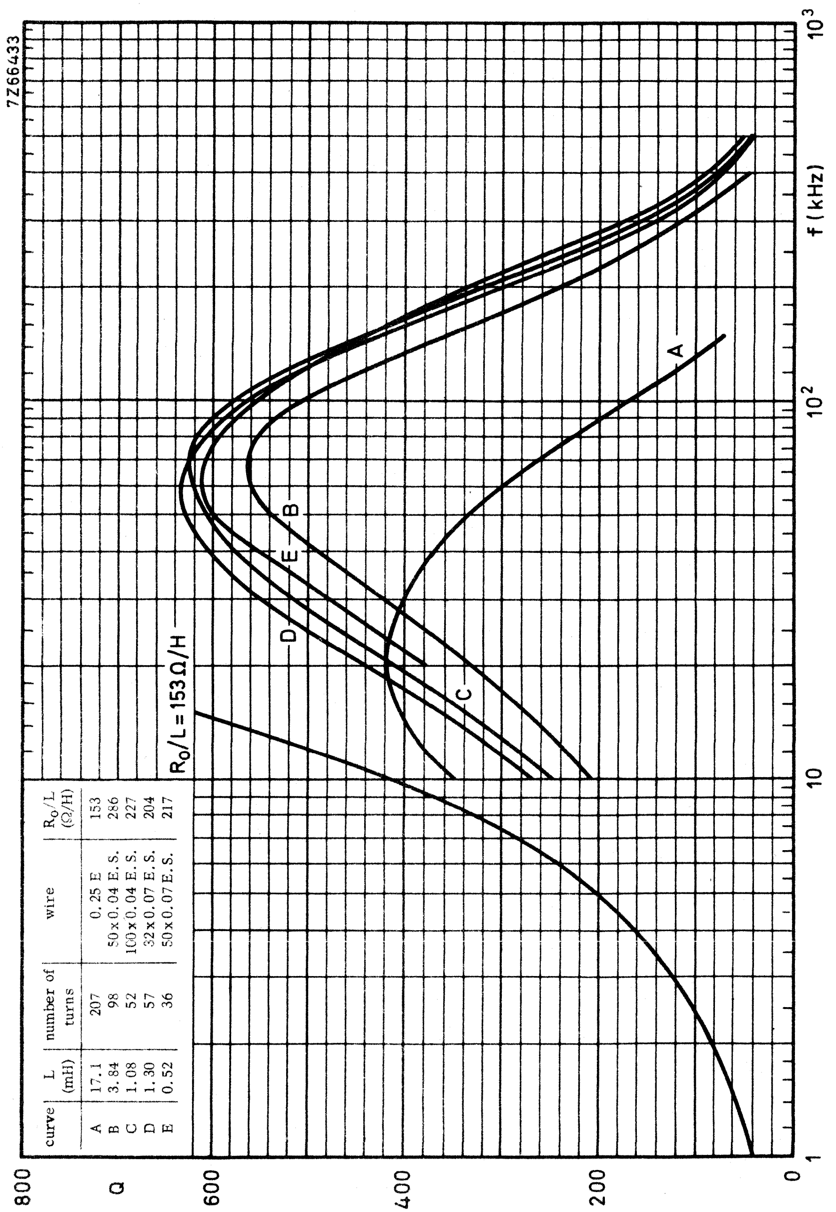
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	10.7	207	0.25 E	245
B	2.40	98	50 x 0.04 E.S.	458
C	0.68	52	100 x 0.04 E.S.	360
D	0.81	57	32 x 0.07 E.S.	327
E	0.32	36	50 x 0.07 E.S.	353

FXC 3B7/3H1, single-section coil former, A_L = 250



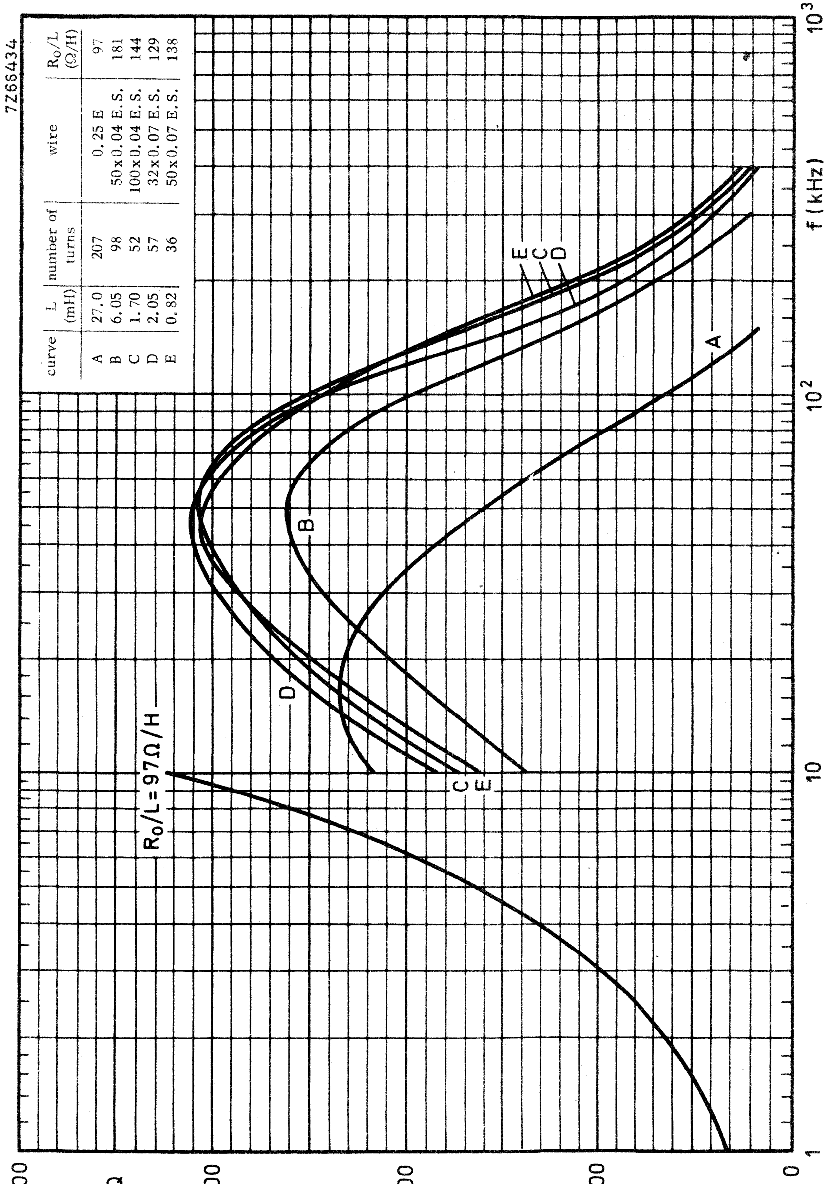
curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	13.5	207	0.25 E	194
B	3.03	98	50 x 0.04 E.S.	362
C	0.85	52	100 x 0.04 E.S.	288
D	1.02	57	32 x 0.07 E.S.	260
E	0.41	36	50 x 0.07 E.S.	276

FXC 3B7/3H1, single-section coil former, $A_L = 315$



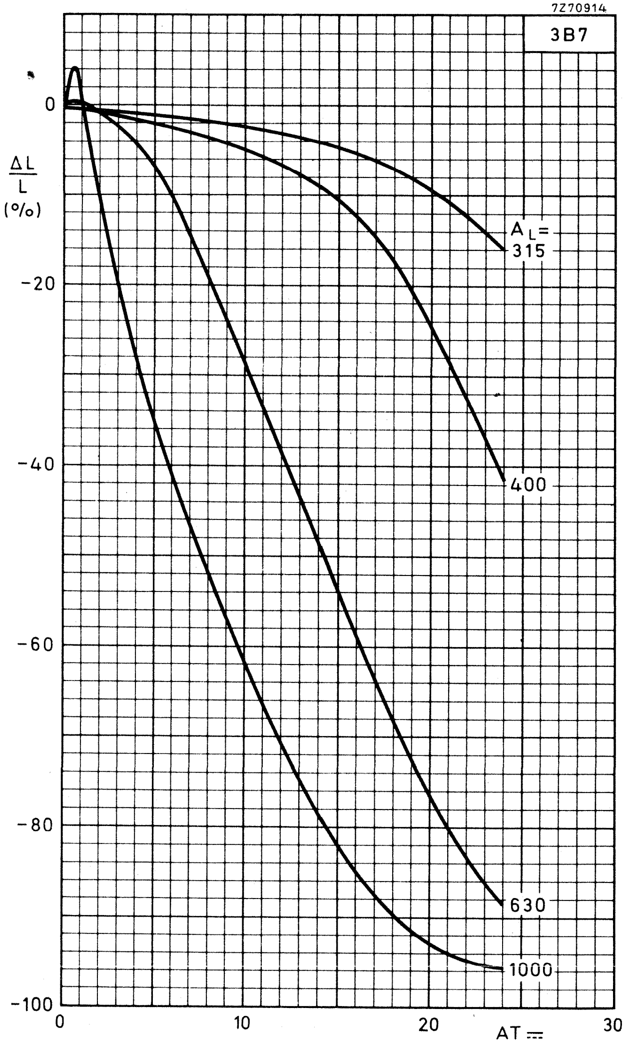
curve	L (mH)	number of turns	wire	R_0/L (Ω/H)
A	17.1	207	0.25 E	153
B	3.84	98	50 x 0.04 E.S.	286
C	1.08	52	100 x 0.04 E.S.	227
D	1.30	57	32 x 0.07 E.S.	204
E	0.52	36	50 x 0.07 E.S.	217

FXC 3B7/3H1, single-section coil former, $A_L = 400$

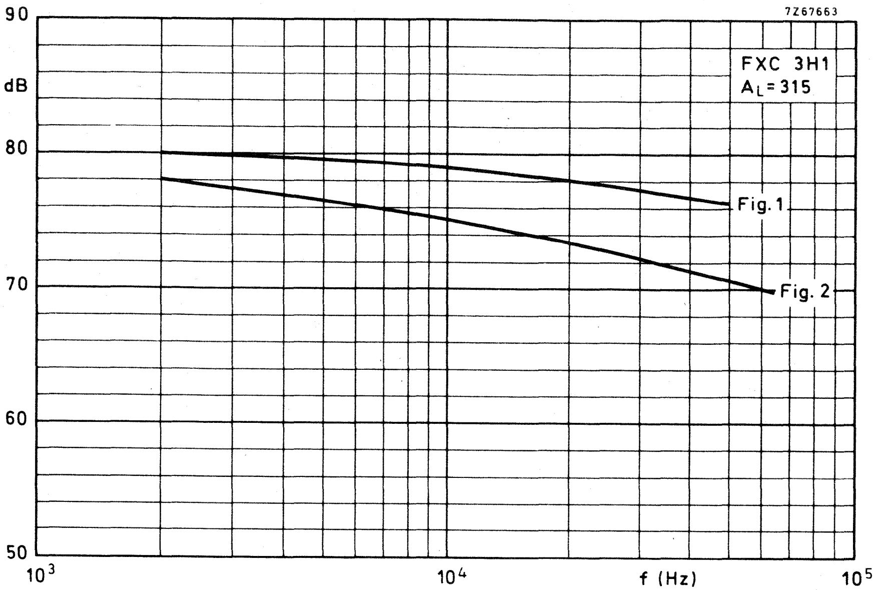


curve	L (mH)	number of turns	wire	R_o/L (Ω/H)
A	27.0	207	0.25 E	97
B	6.05	98	50x0.04 E.S.	181
C	1.70	52	100x0.04 E.S.	144
D	2.05	57	32x0.07 E.S.	129
E	0.82	36	50x0.07 E.S.	138

FXC 3B7/3H1, single-section coil former, A_L = 630


7Z70914
3B7
0
ΔL/L (%)
-20
-40
-60
-80
-100
0
10
20
30
AT ⎓
A_L = 315
400
630
1000

CROSSTALK ATTENUATION



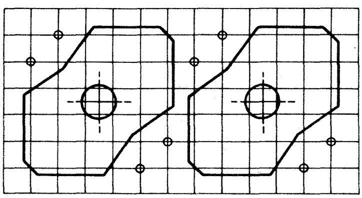


Fig. 1 7Z67662

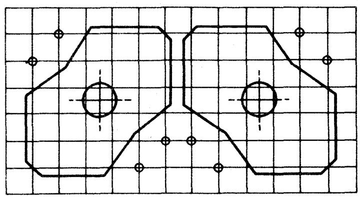
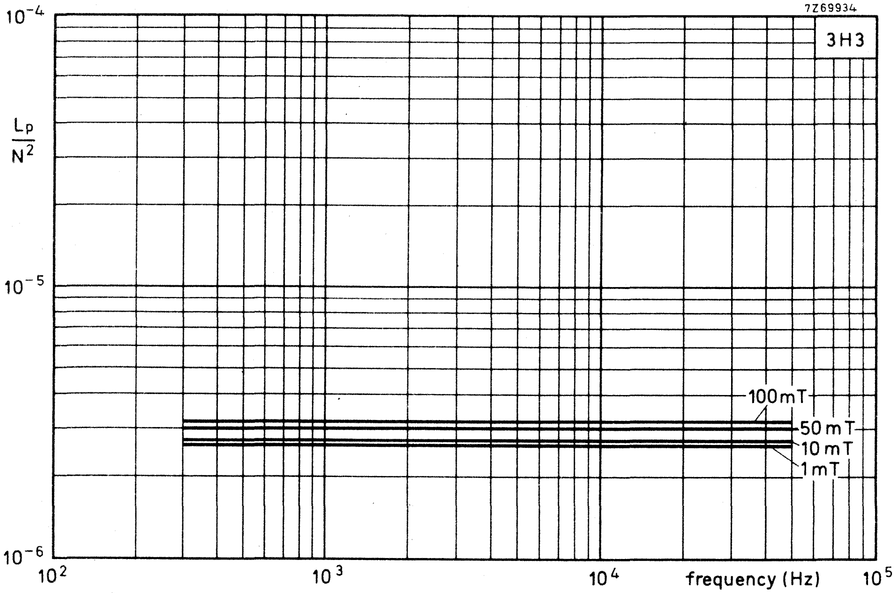
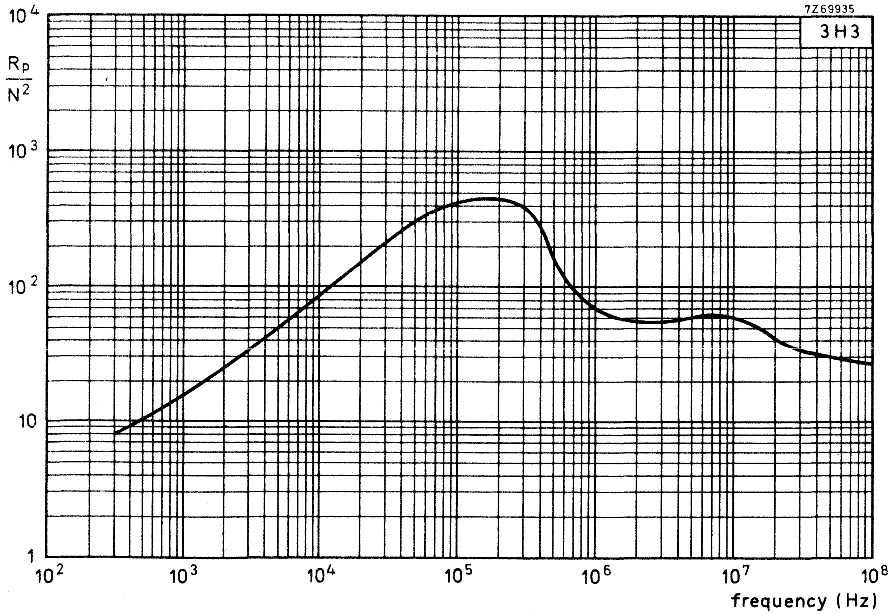


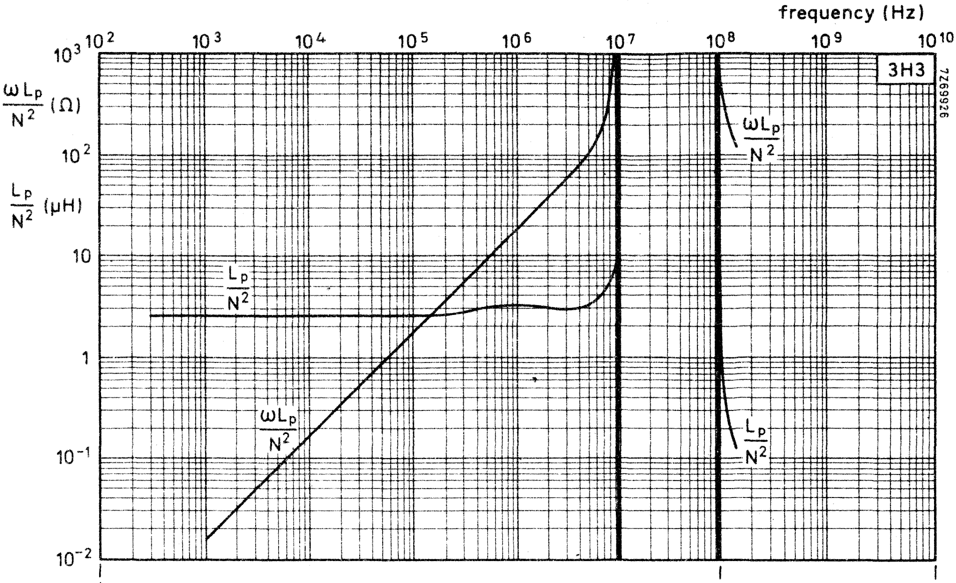
Fig. 2 7Z67661

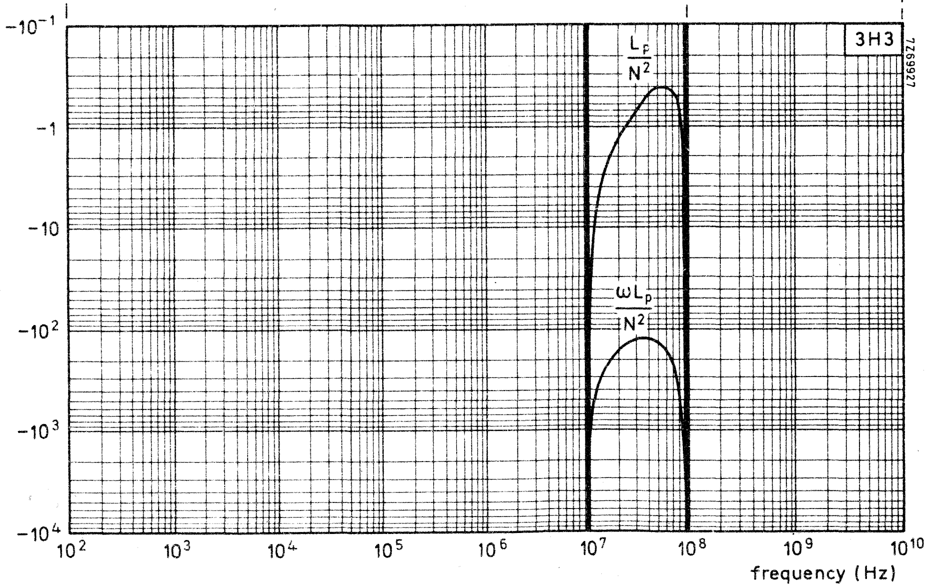


Inductance as a function of the frequency.

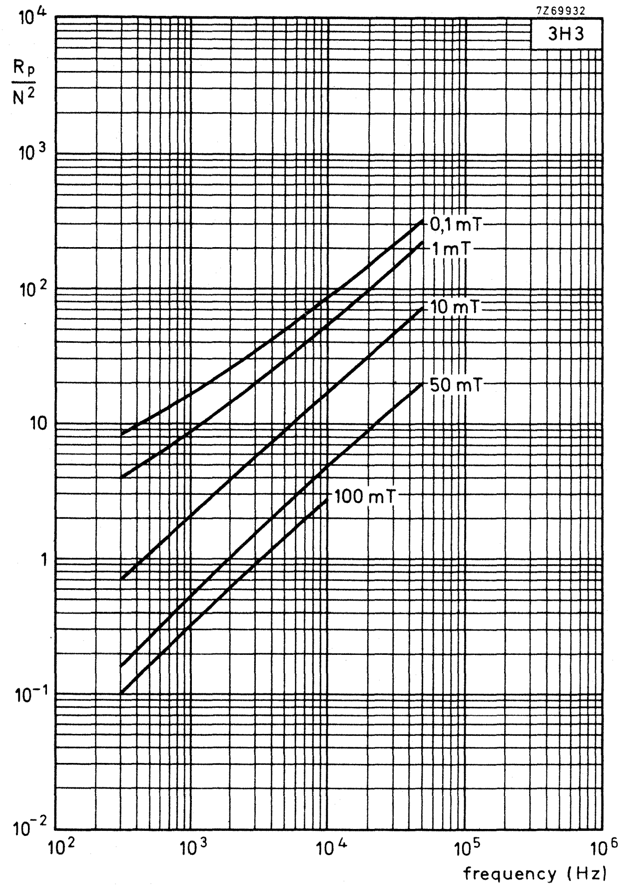


Losses as a function of the frequency at $\hat{B} \approx 0,1$ mT.

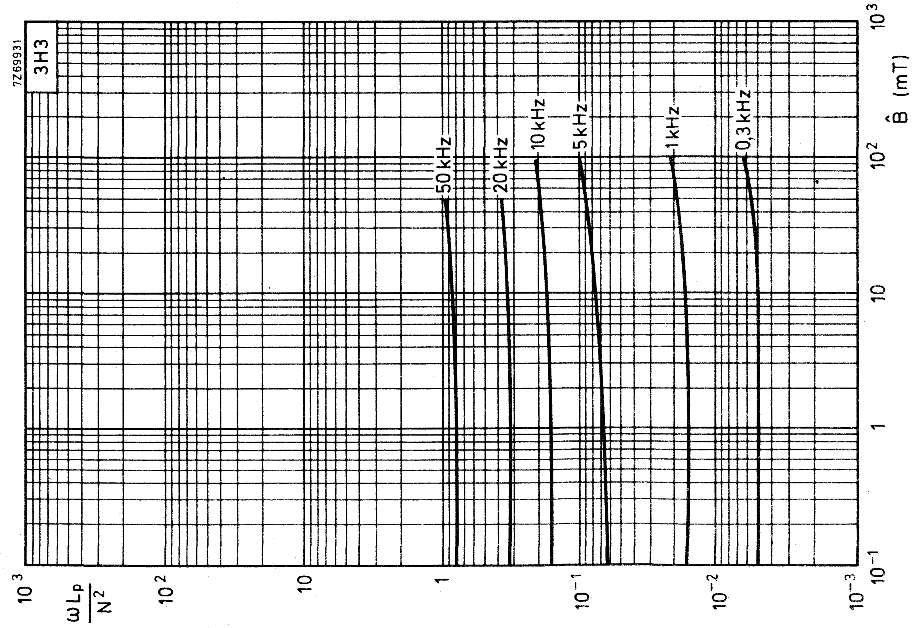




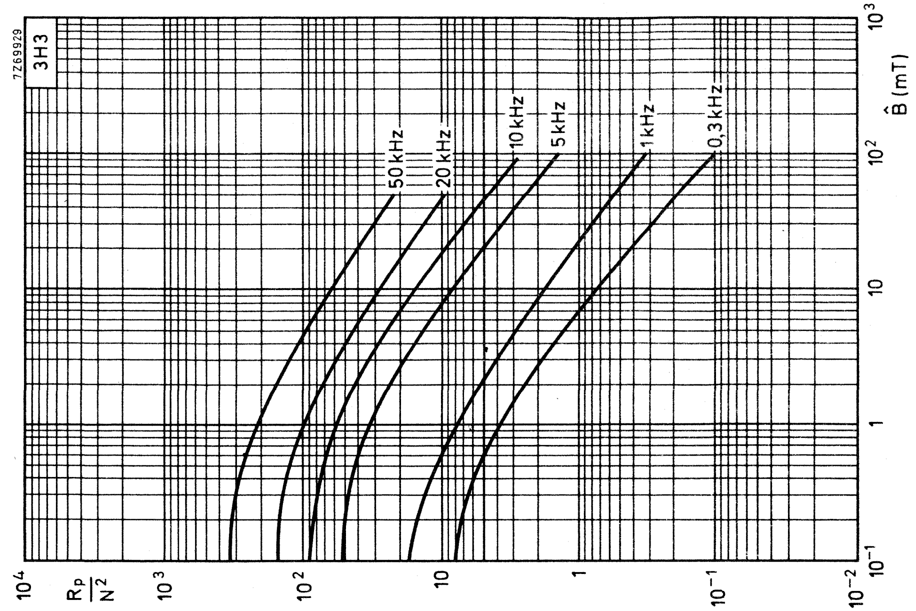
Inductance as a function of the frequency.



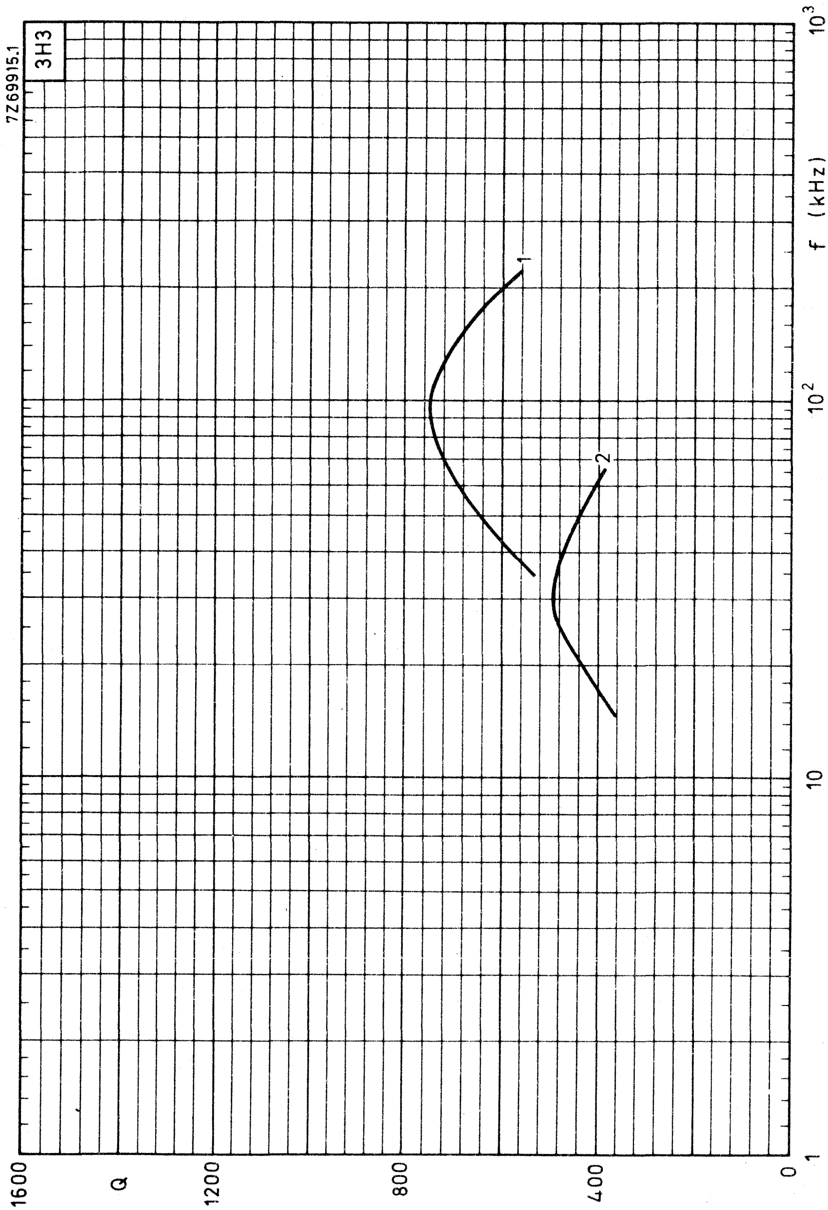
Losses as a function of the frequency.



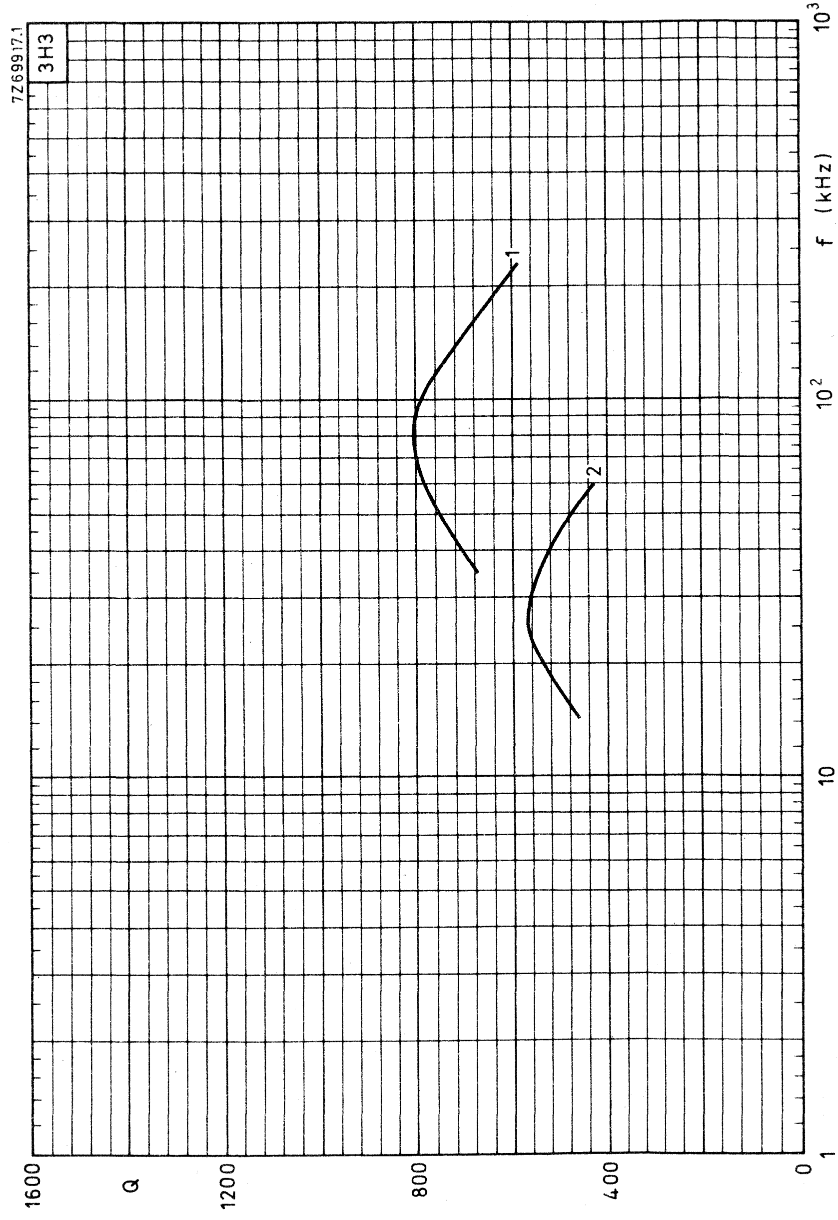
Inductance as a function of the peak induction.



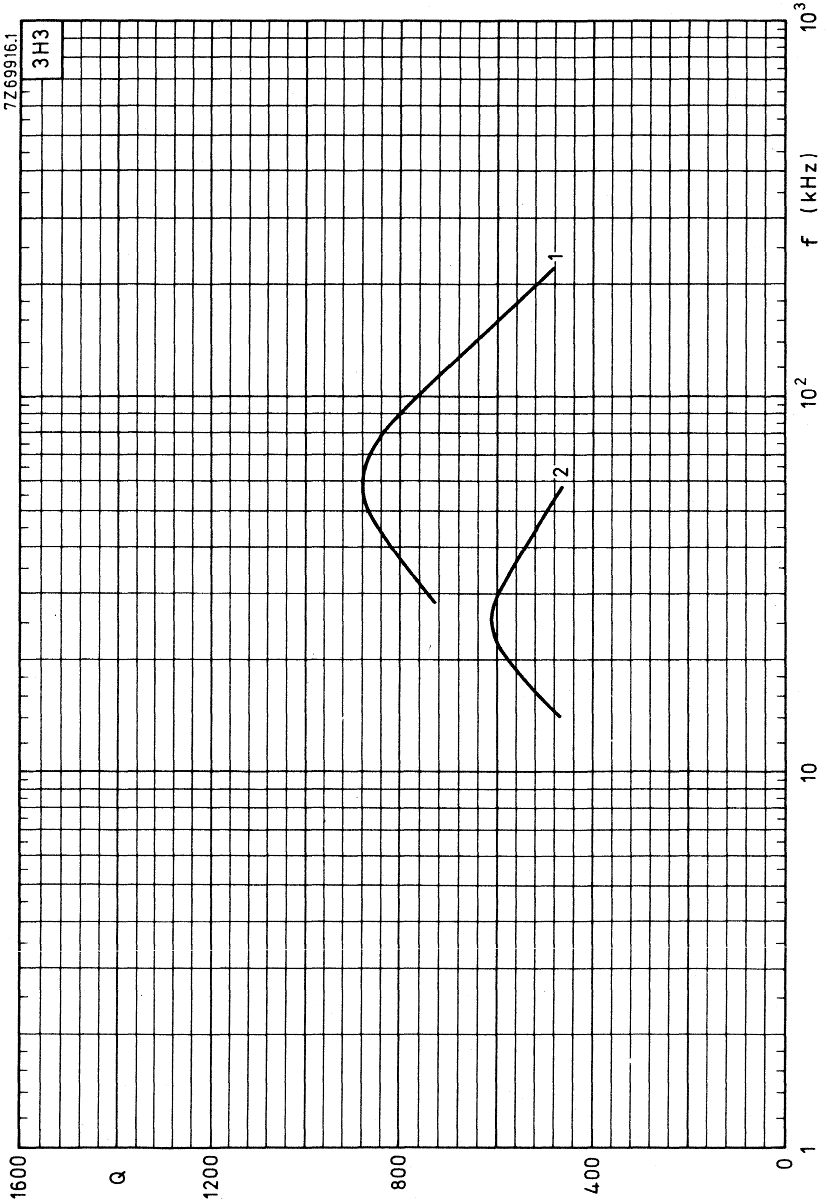
Losses as a function of the peak induction.



Q-curves. Single-section coil former; curve 1 : 57 turns (32 x 0,07 E.S. wire)
curve 2 : 207 turns (0,25 E wire).
A_L = 250



Q-curves. Single-section coil former; curve 1 : 57 turns (32 x 0,07 E.S. wire)
curve 2 : 207 turns (0,25 E wire).
A_L = 315



Q-curves. Single-section coil former; curve 1: 57 turns (32 x 0, 07 E. S. wire)
curve 2: 207 turns (0, 25 E wire).
$A_L = 400$

SQUARE CORES

Three types of core can be supplied:
- Separate core halves, air gap to be ground by the user.
- Pre-adjusted cores (2 halves with an air gap) which are provided with a nut for an adjuster. These cores have an inductance factor A_L in accordance with the R5 (R10) range.
- Pre-adjusted cores without nut.

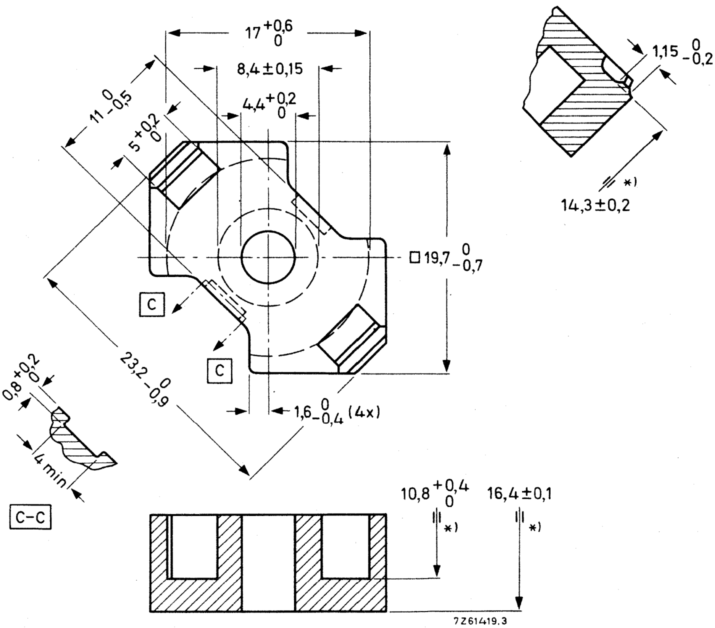
The square cores are in accordance with the following specifications: IEC 431 (international), UTE C93-324 (France), DIN 41980 (Germany).

Square cores and associated parts are ordered by their 12-digit catalogue number. Quantity: a primary pack contains 40 core halves or 20 pre-adjusted cores, a storage pack 200 or 100 respectively. Please order in multiples of these quantities.

SEPARATE CORE HALVES

Dimensions in mm

Outlines



*) Measured on two adjacent core halves.

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 95 N.

	$\hat{B}$ (mT)	freq. (MHz)	temp. (°C)	grade 3B7	3B8	3D3	3E1	3E4	3H1	4C6
μ_e (tol. ±25%)	≤ 0,1	0,1	25 ± 5	1840	1730	720			1840	126
A_L (tol. ±25%)	≤ 0,1	0,1	25 ± 5	3400	3180	1330			3400	230
α (tol±12,5%)	≤ 0,1	0,1	25 ± 5	17,6	17,95	28,1			17,6	67,4
$\alpha_F \times 10^6$			5 to 25	-0,6 to +0,6 [1]	0 to +2 [1]			0 to +2	+0,5 to +1,5	-2 to +4
			25 to 55	-0,6 to +0,6	0 to +2 [1]			0 to +2	+0,5 to +1,5	0 to +6
			25 to 70	-0,6 to +0,6		0 to +1		0 to +2	+0,5 to +1,5	
$D_F \times 10^6$ (10-100 min)			25 ± 1	≤ 4,3	≤ 4,3 [1]	≤ 12		≤ 4,3	≤ 4,3	≤ 10
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	25 ± 10				≤ 2,5	≤ 2,5		
	≤ 0,1	0,03		≤ 2,5					≤ 2,5	
	≤ 0,1	0,1		≤ 5		≤ 8	≤ 20	≤ 20	≤ 5	
	≤ 0,1	0,5				≤ 14	≤ 200			
	≤ 0,1	1,0				≤ 30				
	≤ 0,1	2,0								≤ 40
	≤ 0,1	10,0								≤ 100
$q_{2-24-100}$	1,5-3	0,004	25 ± 10	≤ 1,8/≤ 1,4 [1]			≤ 3	≤ 1,8	≤ 1,4	
	0,3-1,2	0,1				≤ 3				≤ 15
$\eta_B \times 10^3$	1,5-3	0,004	25 ± 10	≤ 1,1/≤ 0,86 [1]			≤ 1,8	≤ 1,1	≤ 0,86	
	0,3-1,2	0,1				≤ 1,8				≤ 9,2
	1,5-3	0,03			≤ 1,0					

[1]) For guidance only.

For grade 3B8 $\mu_\Delta \geq 631$ at 4,8 AT
$\mu_\Delta \geq 276$ at 7,39 AT
$\mu_\Delta \geq 142$ at 9,07 AT

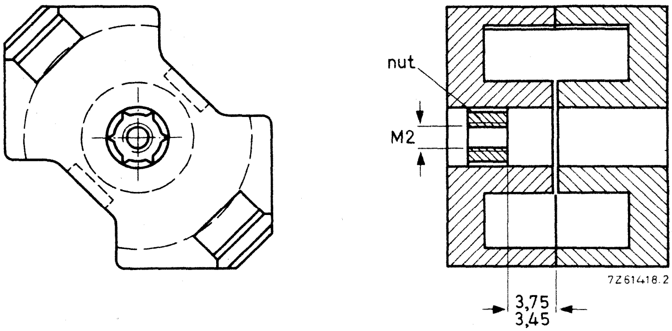
Versions

Ferroxcube grade	catalogue number
3B7	4322 020 27250
3B8	4322 020 27420
3D3	4322 020 27270
3E1	only pre-adjusted cores
3E4	are available
3H1	4322 020 27260
4C6	4322 020 27280

PRE-ADJUSTED CORES

Dimensions in mm

Outlines



		with centre hole	without centre hole
Mass (per set)		17,5 g	18,7 g
Mean length of lines of force	l_e	35,5 mm	38,4 mm
Mean area of lines of force	A_e	52 mm^2	63 mm^2
	$\Sigma \frac{l_e}{A_e}$	0,682 mm^{-1}	0,604 mm^{-1}
Effective volume	V_e	1850 mm^3	2440 mm^3

Pre-adjusted cores with standard A_L values

A_L	corre-sponding μ_e-value	tol. on induct-ance (%)	cat. no. 4322 022 7.... with nut / 4322 022 5.... without nut					
			3B7	3D3	3E1	3E4	3H1	4C6
40	22	± 1		1420				1820
63	34	± 1	1030	1430			1230	1830
100	54	± 1	1040	1440			1240	1840
160	88	± 1,5	1050	1450			1250	1850
250	135	± 2	1060				1260	
315	170	± 2	1070				1270	
400	220	± 3	1080				1280	
630	340	± 3	1100				1300	
1000	540	± 10	1110				1310	
1250	680	± 10	1190				1390	
6300	3050	± 25			1800 *			
→ 7100	3850	± 25				1890 *		
8000	3850	± 25				1900 *		

Inductance $L = N^2 A_L$ (in 10^{-9} H)

Symmetrical air gap for cores with A_L factor of 40 up to and including 250.
Asymmetrical air gap for cores with A_L factor of 315 and higher.
The air gap of the types marked * is practically zero, and consequently inductance adjustment is not possible. Hence these types are not provided with a centre hole, so that maximum performance is achieved.

Notes

1. Example of catalogue number:
   A_L = 250, grade 3H1, core with nut, catalogue number 4322 022 71260.
2. The inductance will only be within the given tolerance if the winding space of the coil former is completely filled.

COIL FORMERS

Four types of coil former can be supplied:

- Single-section, 4-pin coil former, catalogue number 4322 021 32360 (Fig. 1)
- Single-section, 8-pin coil former, catalogue number 4322 021 32380 (Fig. 2)
- Single-section, 12-pin coil former, catalogue number 4322 021 32390 (Fig. 3)
- Two-section, 8-pin coil former, catalogue number 4322 021 32420 (Fig. 4)

The coil formers are packed on a polysterene plate of 100 or in a cardboard box of 500. Please order in multiples of these quantities.

Properties

Material of former	phenolformaldehyde reinforced with glass fibre,
of pins	phosphor bronze; dip-soldered
Window area	
single-section coil former	34,2 mm^2
two-section coil former	34,0 mm^2
Mean length of turn	41 mm
Maximum temperature	180 °C
Solderability	resistant against dip-soldering at 400 °C for 2 s
D.C. losses, $\frac{R_o}{L}$	$\frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 11,4 \times 10^3\ \Omega/H$
Mass	0,55 g

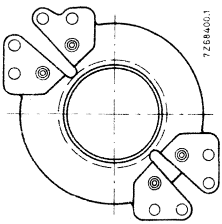


Fig. 1

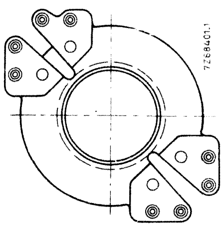


Fig. 2

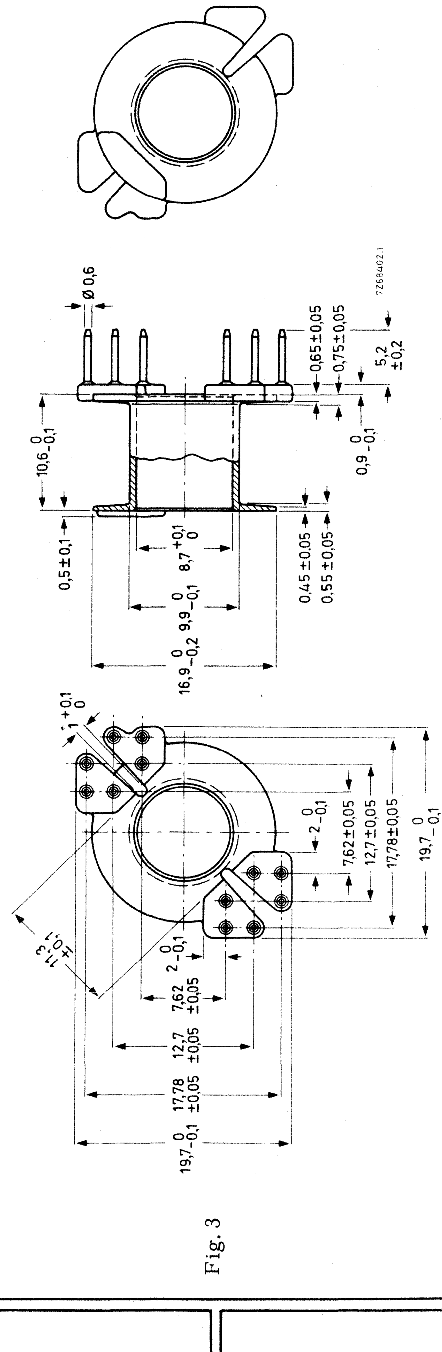


Fig. 3

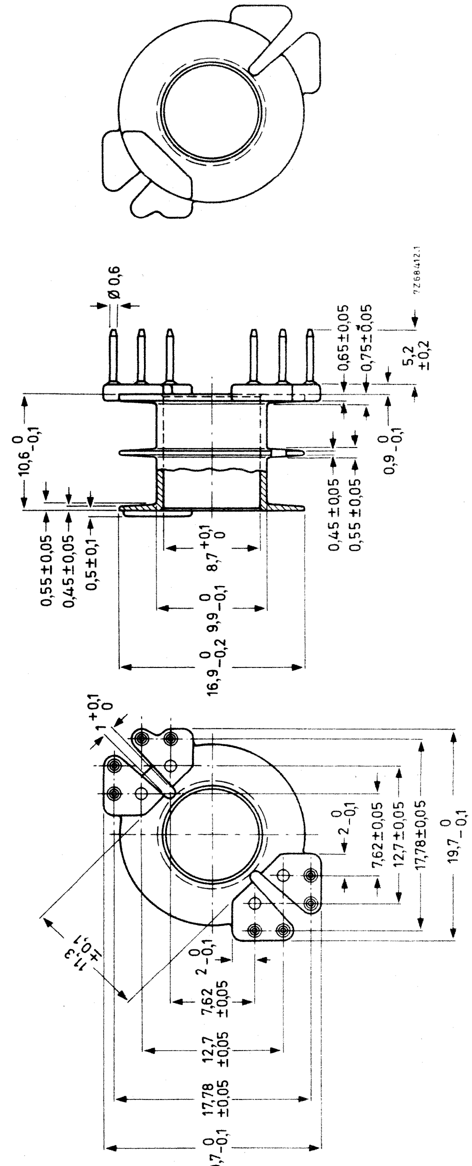
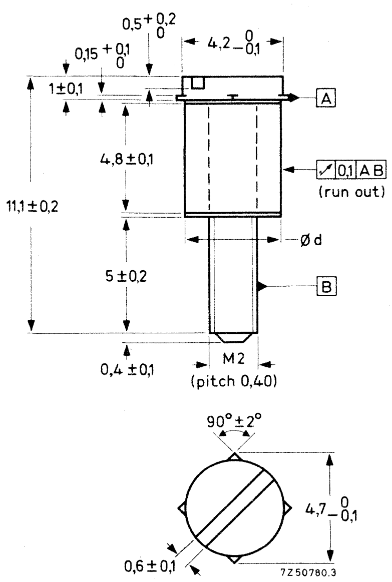

7Z68412.1
Ø 0,6
0,65±0,05
0,75±0,05
5,2 ±0,2
10,6 0 −0,1
0,9 0 −0,1
0,45±0,05
0,55±0,05
0,55±0,05
0,45±0,05
0,5±0,1
8,7 +0,1 0
9,9 0 −0,1
16,9 0 −0,2
1 +0,1 0
2 0 −0,1
7,62±0,05
12,7±0,05
17,78±0,05
19,7 0 −0,1
11,3 +0,1
2 0 −0,1
7,62 ±0,05
12,7 ±0,05
17,78 ±0,05
19,7 0 −0,1

Fig. 4

INDUCTANCE ADJUSTERS

ADJUSTERS



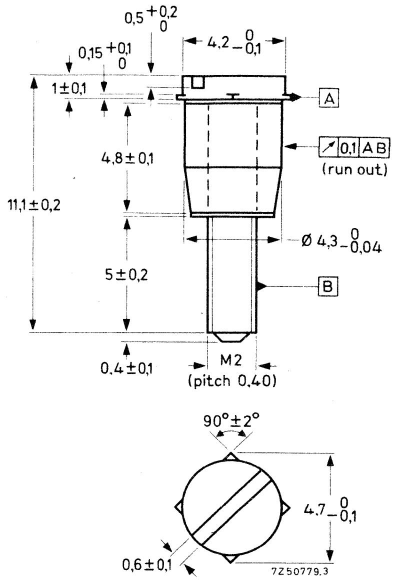


Fig. A. d = 4 mm, tol. -0,04 mm
Fig. C. d = 3,85 mm, tol. -0,04 mm

Fig. B

The tolerances on inductance of the pre-adjusted cores (without adjuster) are given in the table pre-adjusted cores with standard A_L values. After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0,03% by means of a continuous inductance adjuster. Such an adjuster increases the inductance of the coil (see following pages).
The adjuster is screwed through the centre hole of the core into the nut and is held in position by the four protrusions near the top of the adjuster. For special requirements a larger or smaller adjustment range may be obtained by using an adjuster belonging to the next higher or lower A_L value.
The influence of the adjuster on the variability of the inductance is negligible. The maximum permissible temperature is 110 °C.
Table II shows the type of adjuster recommended for different square cores.

Table I, types of adjuster

Fig. 1	colour	catalogue number
B	yellow	4322 021 31000
B	white	4322 021 31020
B	red	4322 021 31060
A	brown	4322 021 31100
B	black	4322 021 31240
C	grey	4322 021 32190

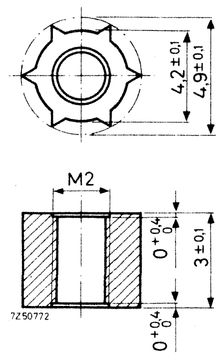
Table II, recommended application

A_L	3B7/3H1/3D3
	cat. no. 4322 021 .....
40	31060
63	31060
100	31000 or 31060
160	31000 or 31020
250	31020
315	32190
400	31100
630	31240

The adjusters are packed in bags of 100. Please order in **multiples of 100.**

NUT FOR ADJUSTER

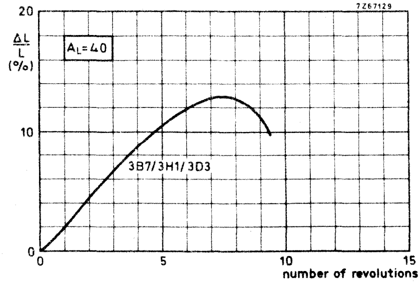
These data are given for those manufacturers who prefer to insert the nut themselves.



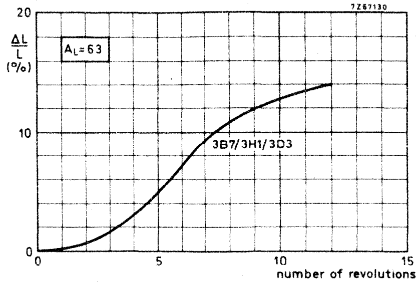
Catalogue number	4322 021 30150
Material	polycarbonate
Max. impregnation temperature for 24 hours	120 °C
Recommended distance from mating surface to nut	3,6 ± 0,15 mm

The nuts are packed in bags of 100. Please order in **multiples of 100.**

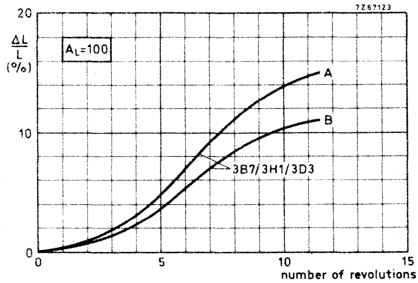
ADJUSTMENT CURVES



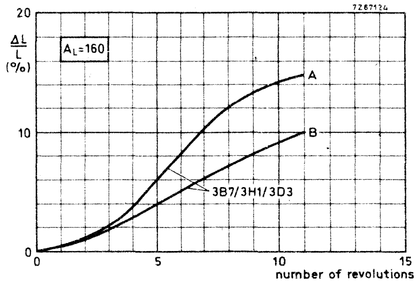
Adjuster 4322 021 31060



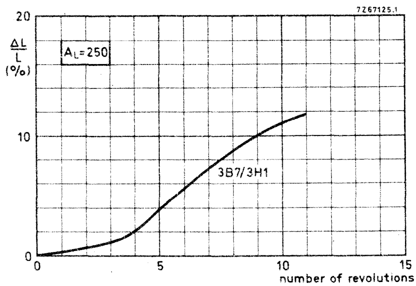
Adjuster 4322 021 31060



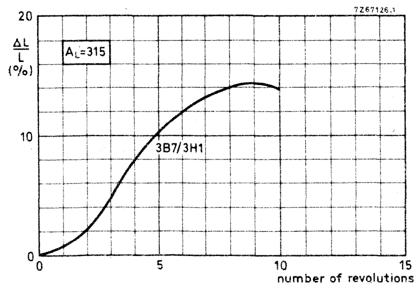
Adjuster 4322 021 31000 (curve A)
Adjuster 4322 021 31060 (curve B)



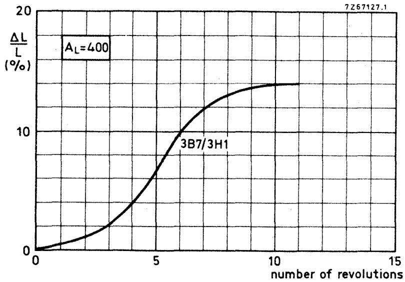
Adjuster 4322 021 31020 (curve A)
Adjuster 4322 021 31000 (curve B)



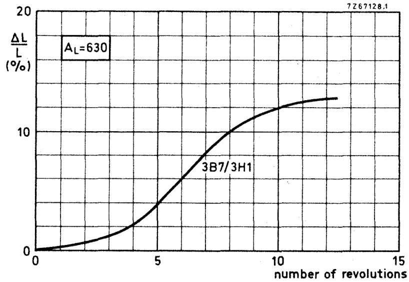
Adjuster 4322 021 31020



Adjuster 4322 021 32190

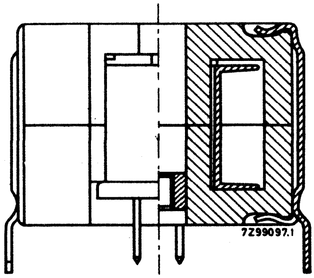


Adjuster 4322 021 31100



Adjuster 4322 021 31240

ASSEMBLING AND MOUNTING



ASSEMBLING

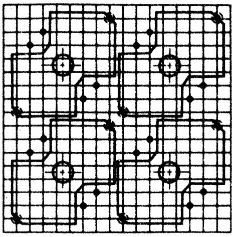
The core halves are clamped together by means of two clips, type 4322 021 31840. As can be seen in the drawing, the hooked ends of each clip fit into recesses made in the core halves.

For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half. We also recommend that a tool be used for assembling. (Drawings of a simple tool are available under number 4322 058 00160.)

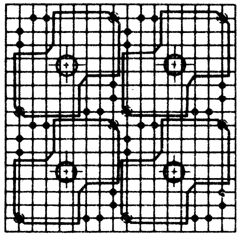
MOUNTING

The two retaining clips are also used for mounting the assembled core on a printed-wiring board: the gold-plated pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing the core.

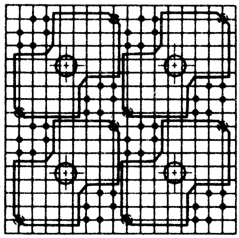
The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0,1 - inch grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 2,4 mm. The recommended hole diameter in the board is 1,0 ± 0,1 or 1,3 ± 0,1 mm (according to IEC publication 97).



◉ 1)

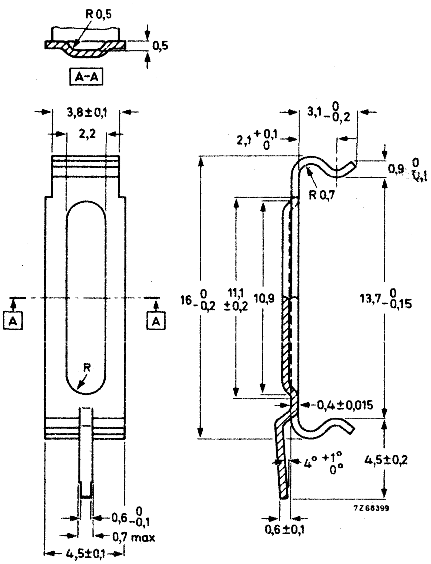


◉ 1)



◉ 1)

7Z68397



PART DRAWING (dimensions in mm)

Clip 4322 021 31840

Material: steel, gold plated over nickel

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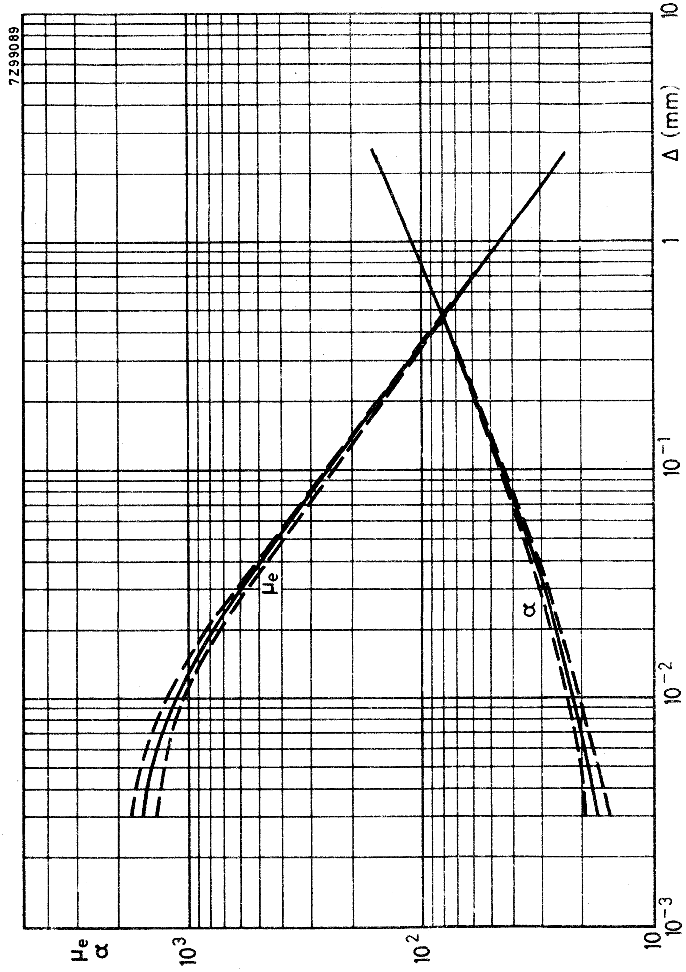
1) Holes for tag on clip 4322 021 31840.

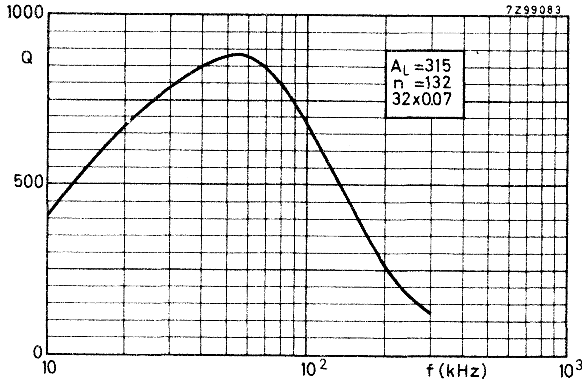
CHARACTERISTIC CURVES

μ_e - α CURVES

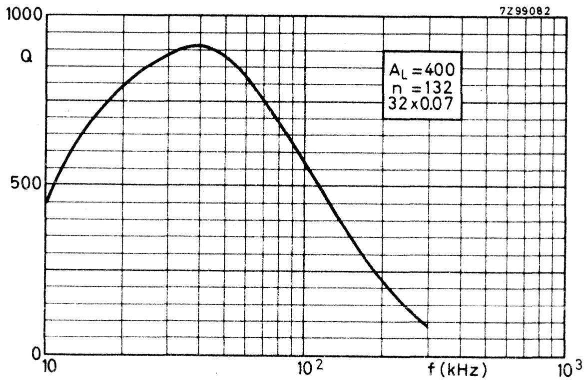


Relative effective permeability and turn factor for 1 mH as a function of the air gap length
$\mu_e = 1840 \pm 25\%$ at $\Delta = 3\ \mu m$ for 3B7 and 3H1

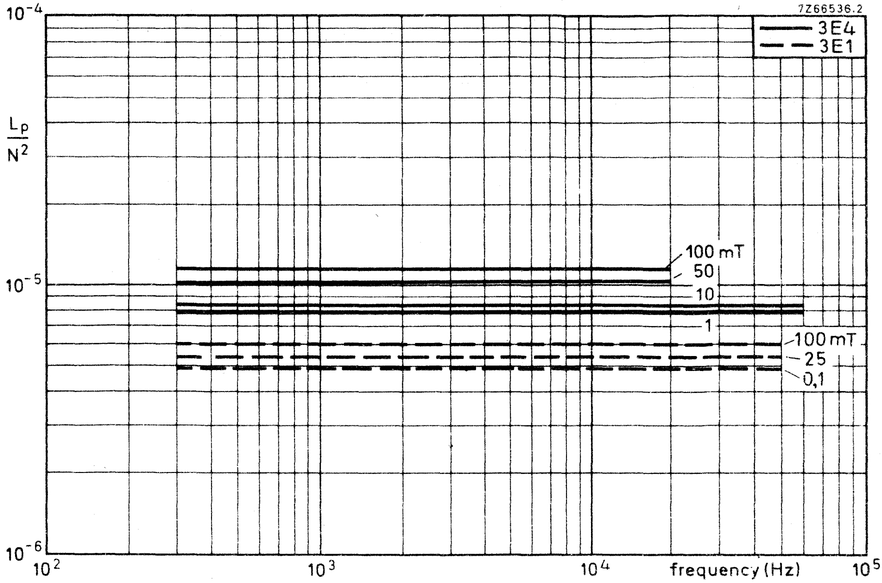
Q-CURVES



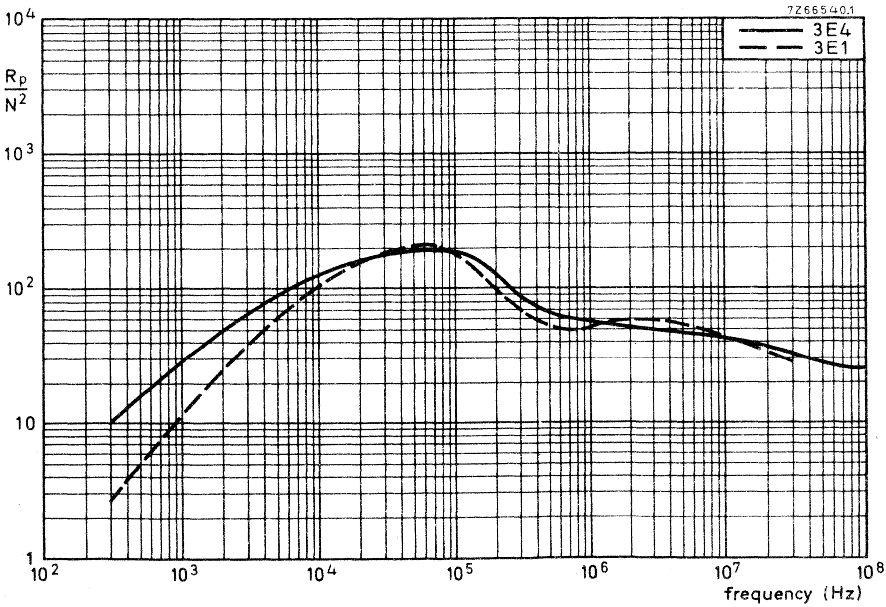
Provisional curve



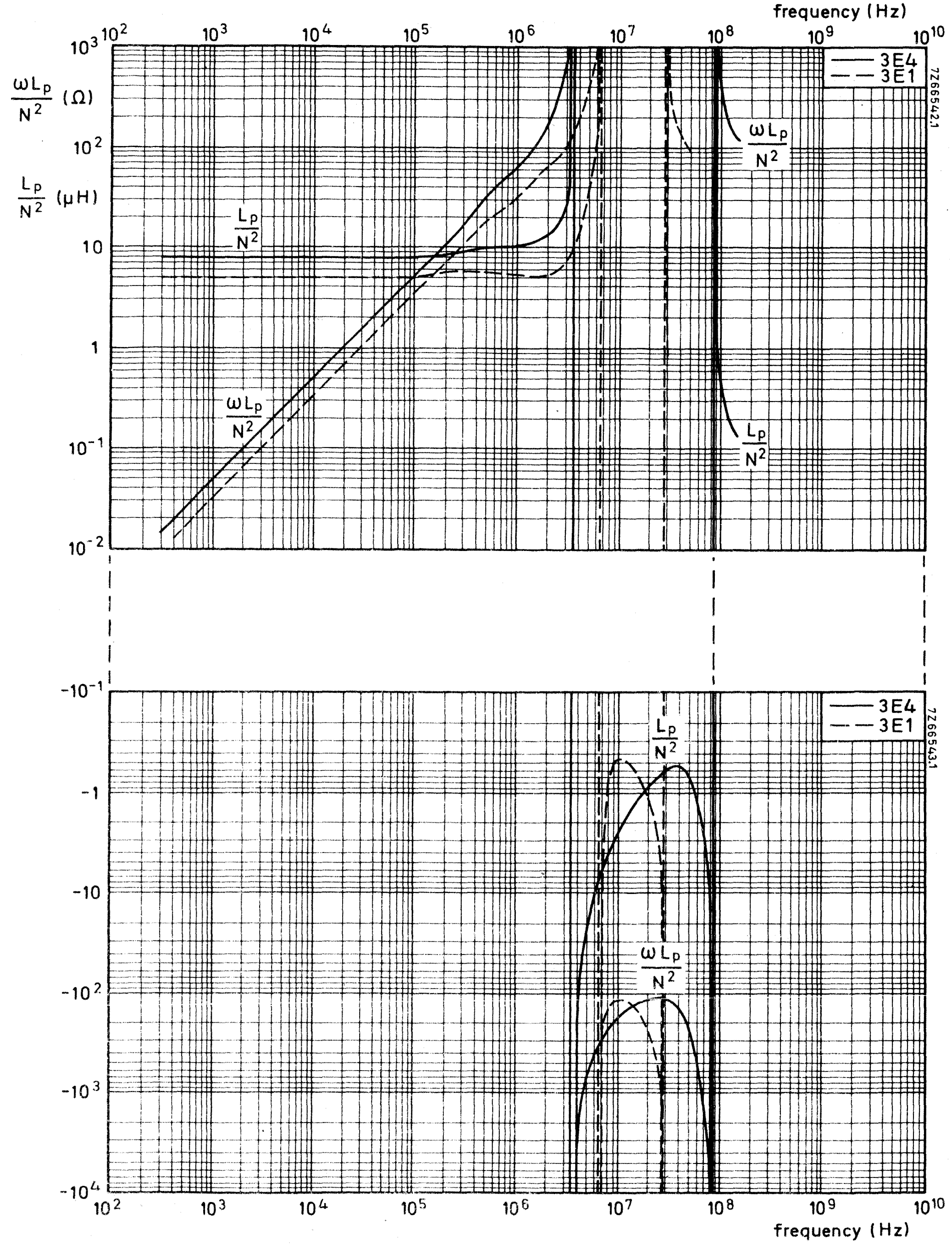
Provisional curve



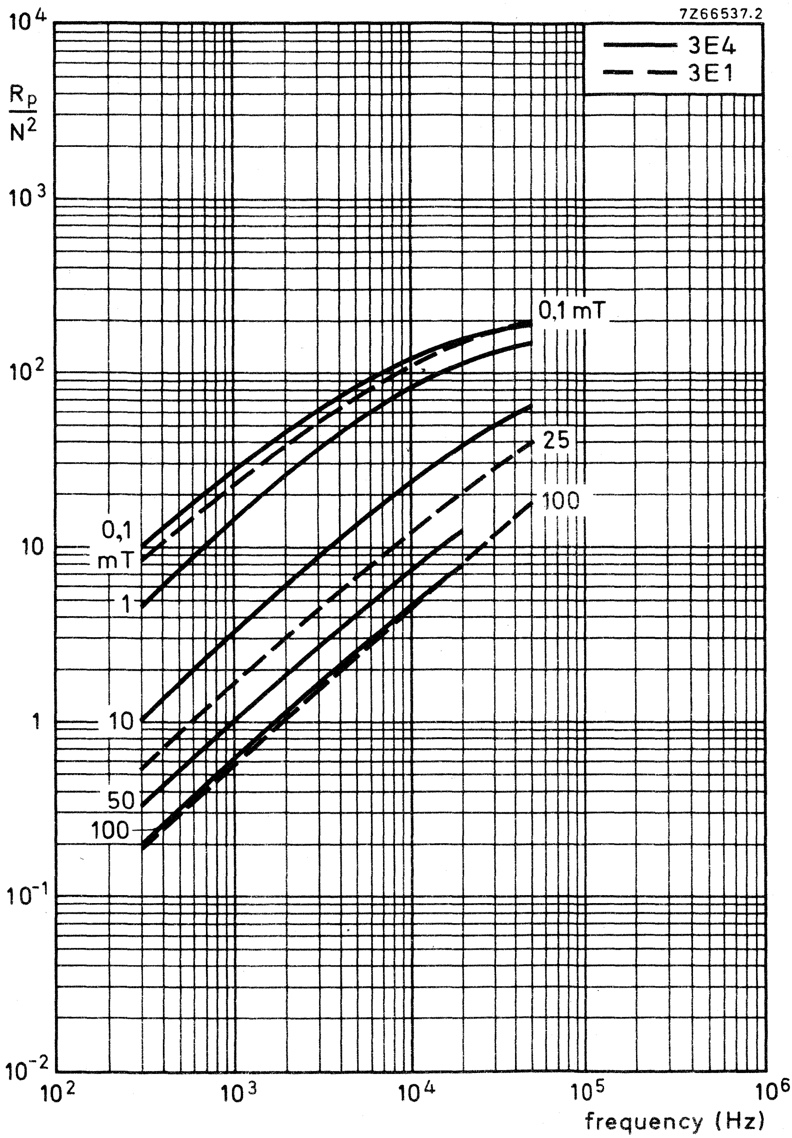
Inductance as a function of the frequency (typical values)



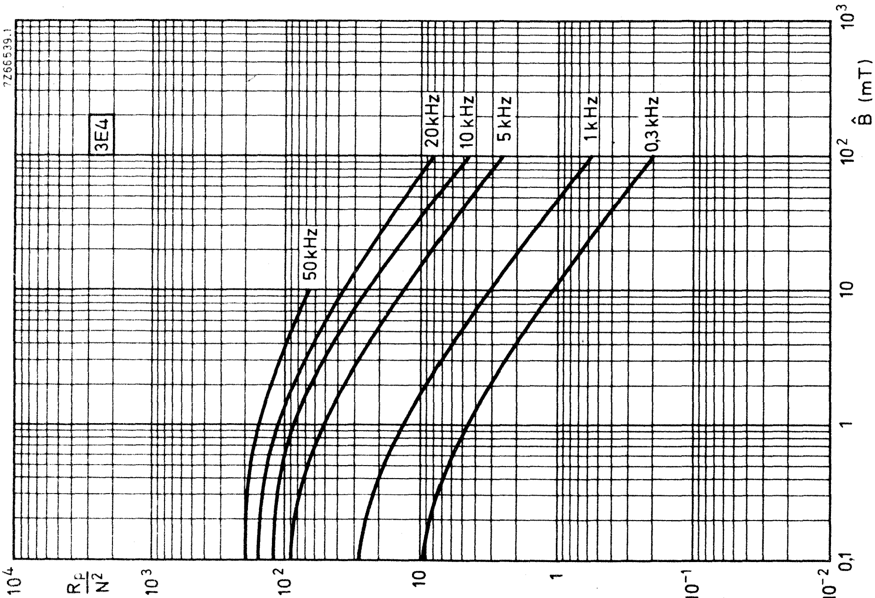
Losses as a function of the frequency at $\hat{B} \approx 0,1$ mT (typical values)



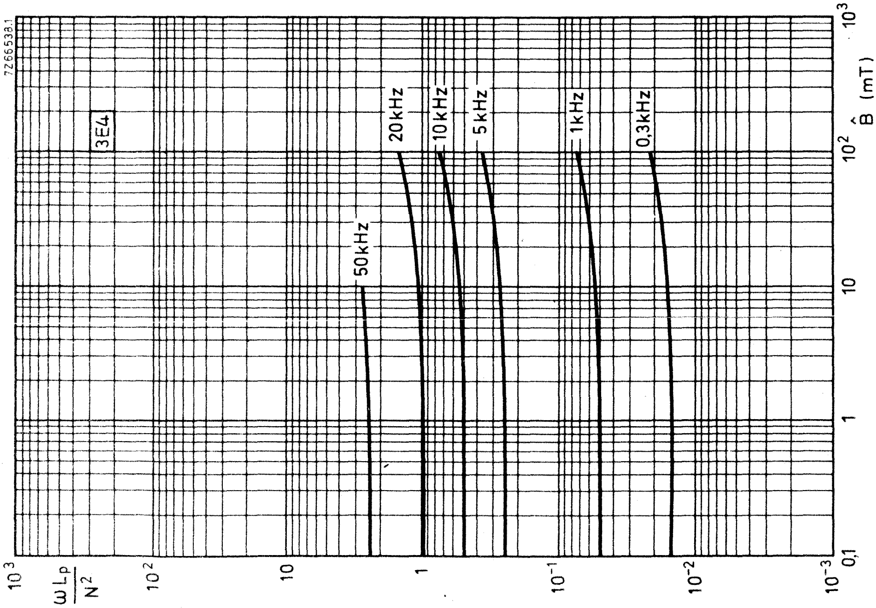
Inductance as a function of the frequency (typical values)



Losses as a function of the frequency (typical values)



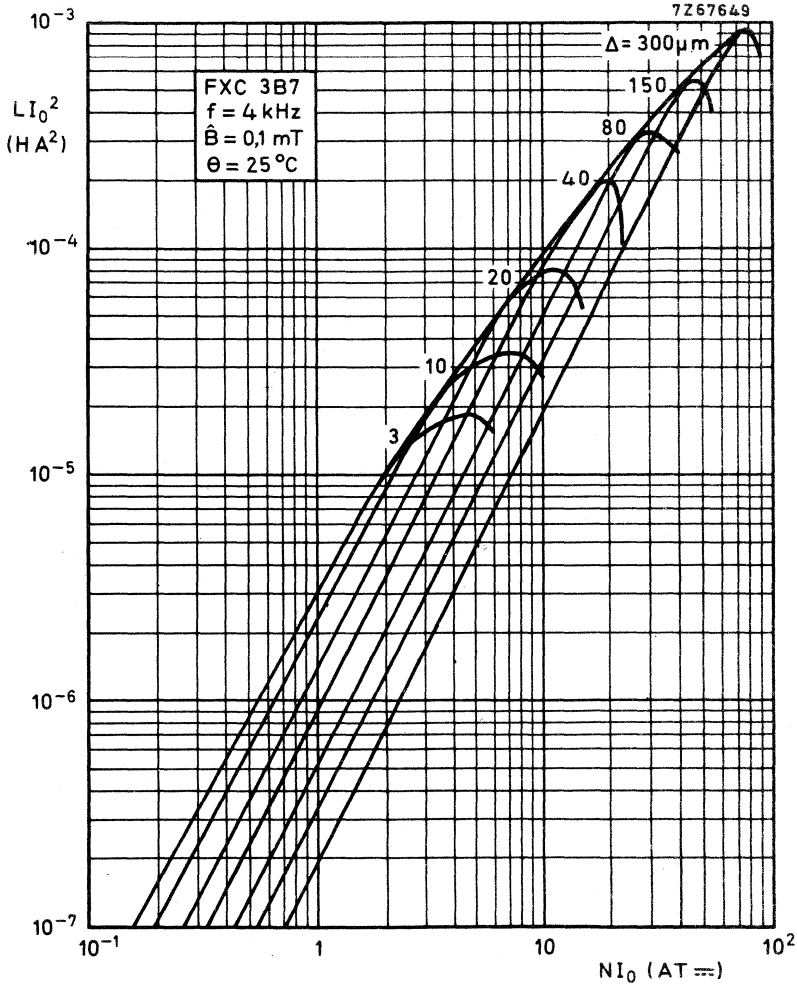
Losses as a function of the peak induction (typical values)

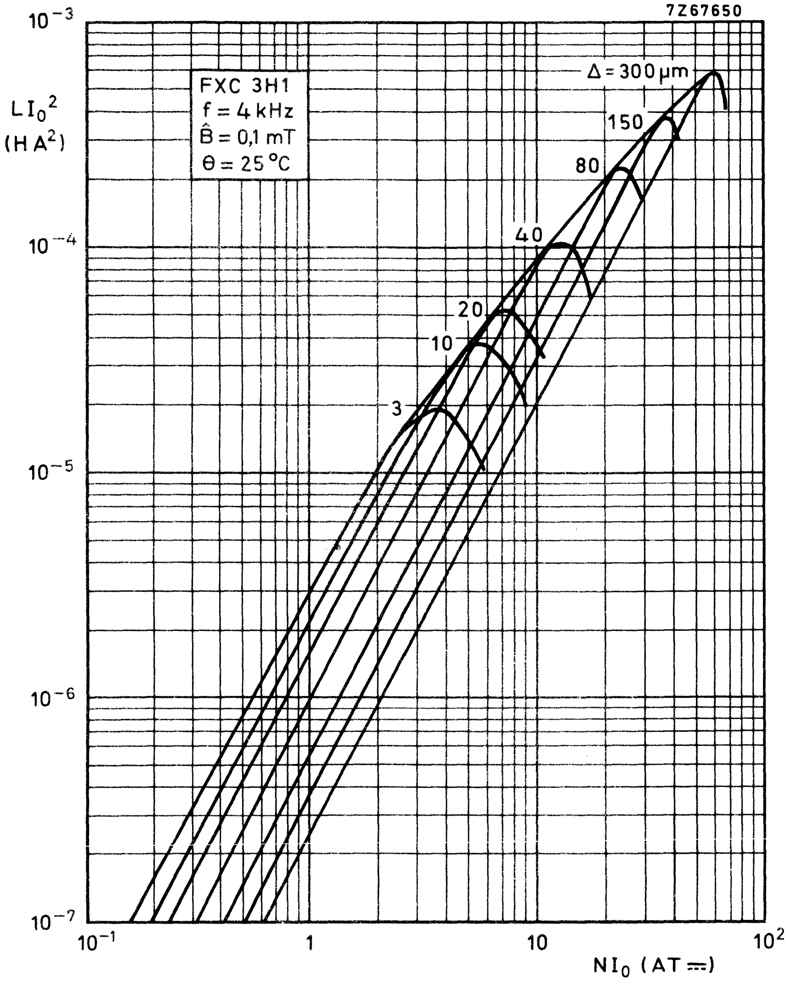


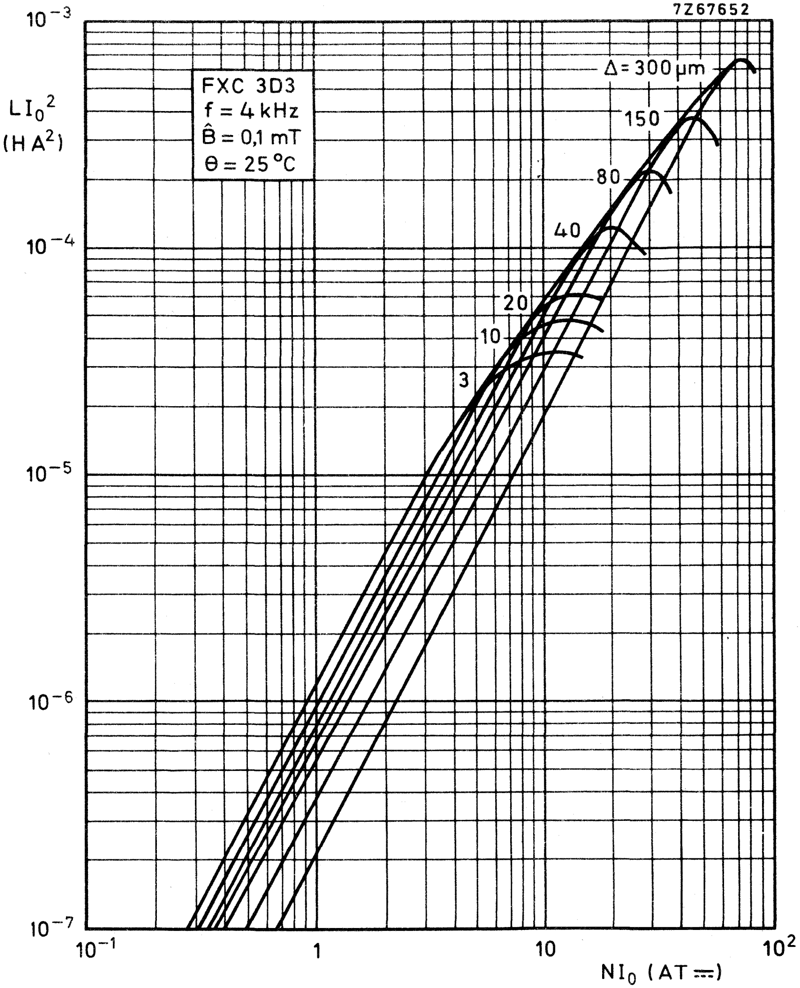
Inductance as a function of the peak induction (typical values)

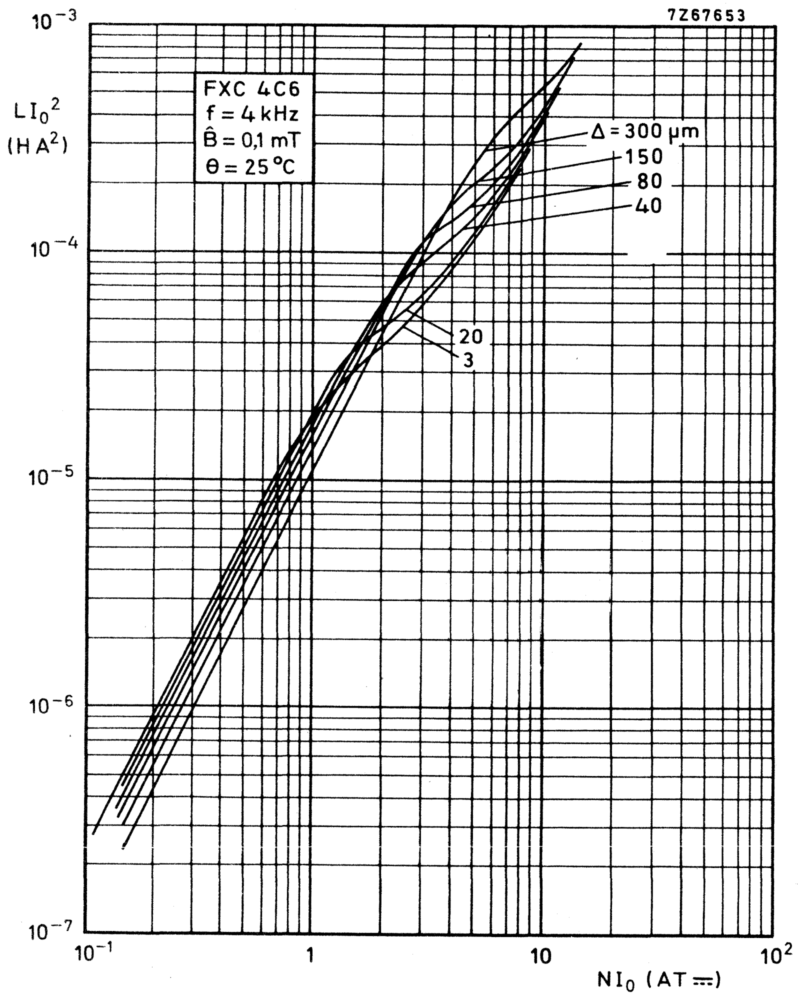
HANNA CURVES (typical values)
for different material grades.

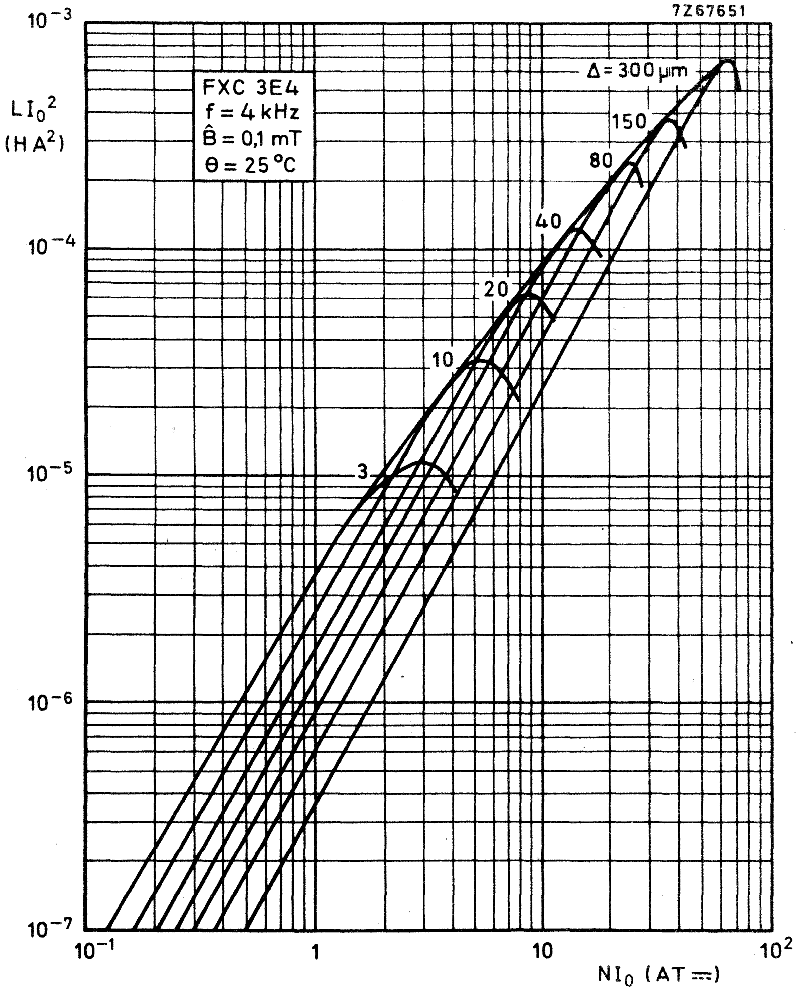
Indicating optimum inductance for a certain air gap and direct current.




7Z67650
FXC 3H1
f = 4 kHz
B̂ = 0,1 mT
θ = 25 °C
LI0² (H A²)
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
10⁻⁷
Δ = 300 µm
150
80
40
20
10
3
10⁻¹
1
10
10²
NI0 (AT ⎓)


7Z67652
FXC 3D3
f = 4 kHz
B̂ = 0,1 mT
θ = 25 °C
LI0^2 (H A^2)
Δ = 300 μm
150
80
40
20
10
3
10^-3
10^-4
10^-5
10^-6
10^-7
10^-1
1
10
10^2
NI0 (AT ⎓)


7Z67653
LI_0^2 (HA^2)
FXC 4C6
f = 4 kHz
$\hat{B}$ = 0,1 mT
θ = 25 °C
Δ = 300 μm
150
80
40
20
3
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-1}
1
10
10^{2}
NI_0 (AT ⎓)


7Z67651
FXC 3E4
f = 4 kHz
B̂ = 0,1 mT
Θ = 25 °C
LI_0^2 (H A²)
Δ = 300 μm
150
80
40
20
10
3
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-1}
1
10
10^{2}
NI_0 (AT ⎓)

SQUARE CORES

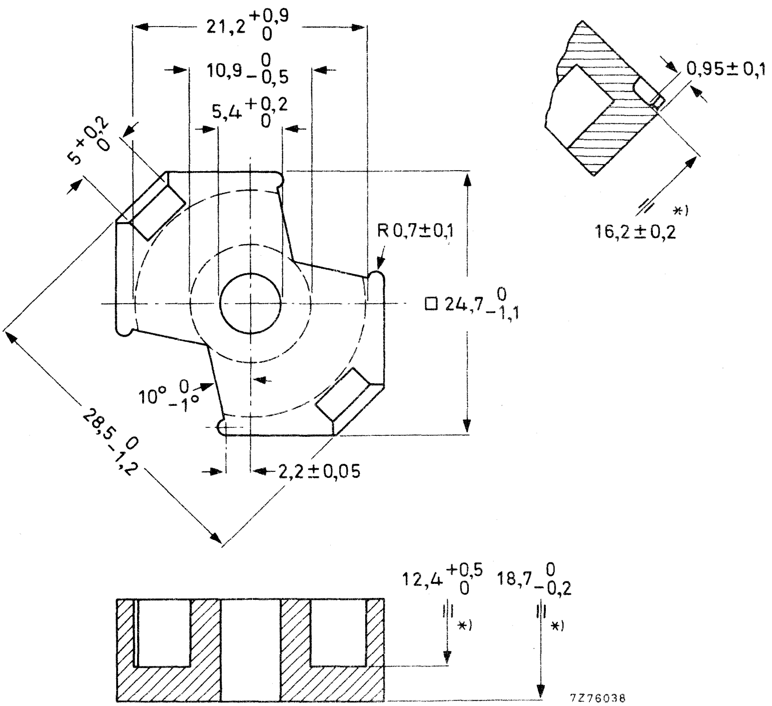
Separate core halves, air gap to be ground by the user, can be supplied.

Square cores and associated parts are ordered by their 12-digit catalogue numbers.

The square cores are in accordance with the following specifications: IEC 431 (international), DIN 41980 (Germany).

SEPARATE CORE HALVES Dimensions in mm

Outlines



*) Measured on two adjacent core halves.

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 130 N, the values in the table below are guaranteed.

	$\hat{B}$ (mT)	freq. (MHz)	temp. (^{o}C)	grade 3C8	grade 3E4	grade 3H1
μ_e ± 25%	≤ 0,1	0,004	25 ± 5	1620	4190	1900
A_L ± 25%	≤ 0,1	0,004	25 ± 5	4130	10700	4860
α ± 12,5%	≤ 0,1	0,004	25 ± 5	16,0	9,93	14,7
$\alpha_F \times 10^6$	≤ 0,1	≤ 0,1	5 to 25		0 to +2	+0,5 to +1,5
			25 to 55		0 to +2	+0,5 to 1,5
			25 to 70		0 to +2	+0,5 to 1,5
$D_F \times 10^6$ (10-100 min)	≤ 0,1	≤ 0,1	25 ± 1		≤ 4,3	≤ 4,3
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	0,004	25 ± 5		≤ 2,5	
	≤ 0,1	0,030	25 ± 5			≤ 2,5
	≤ 0,1	0,100	25 ± 5	≤ 10	≤ 20	≤ 5,0
	≤ 0,1	0,500	25 ± 5		≤ 200	
$\eta_B \times 10^3$	1,5-3,0	0,004	25 ± 5		≤ 1,1	≤ 0,86

Versions

Ferroxcube grade	catalogue number
3C8	4322 020 28350
3E4	4322 020 28290
3H1	4322 020 28270

Mass per set of 2 cores 20 g

Mean length of lines of force l_e = 41,3 mm

Mean area of lines of force A_e = 83,7 mm

$$\Sigma \frac{l_e}{A_e} = 0,493 \text{ mm}^{-1}$$

Effective volume V_e = 3450 mm

COIL FORMERS

Four types of coil formers can be supplied:

- Single-section, 5-pin, catalogue number 4313 021 03620 (Fig. 1)
- Single-section, 8-pin, catalogue number 4313 021 03630 (Fig. 2)
- Two-section, 5-pin , catalogue number 4313 021 03660 (Fig. 3)
- Two-section, 8-pin , catalogue number 4313 021 03670 (Fig. 4)

The arrangement of the soldering pins is suitable for both 0,1 inch and 2,50 mm grid. See "Mounting".

SINGLE-SECTION

Properties

Material	phenolformaldehyde reinforced with glass fibre
Window area	55,4 mm^2
Mean length of turn	50 mm
Max. temperature	180 °C

Solderability: resistant against dip-soldering at 400 °C for 2 s

D.C. losses:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 6,22 \times 10^3\ \Omega/H$$

Mass 1,5 g

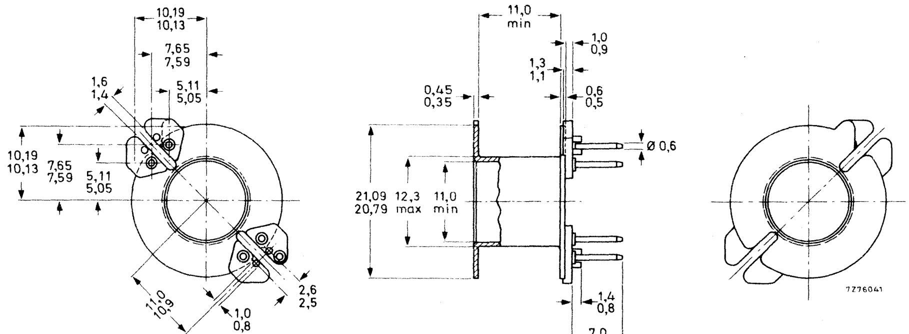


Fig. 1

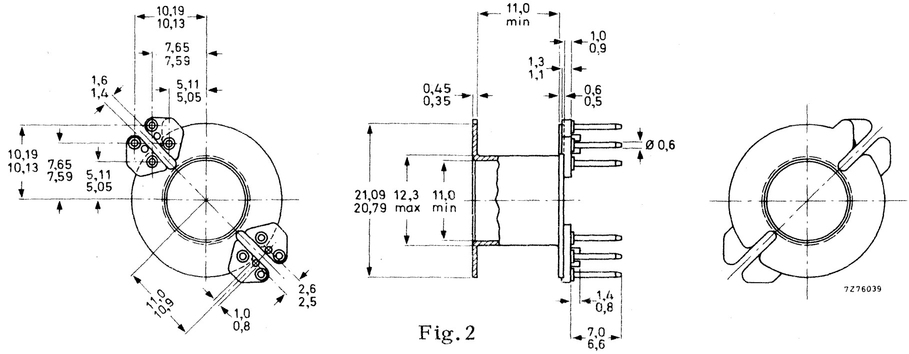


Fig. 2

TWO-SECTION

Properties

Material phenolformaldehyde reinforced with glass fibre

Window area $52,7\ mm^2$

Mean length of turn 50 mm

Max. temperature 180 °C

Solderability: resistant against dip-soldering at 400 °C for 2 s

D.C. losses:

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 5,91 \times 10^3\ \Omega/H$$

Mass 1,7 g

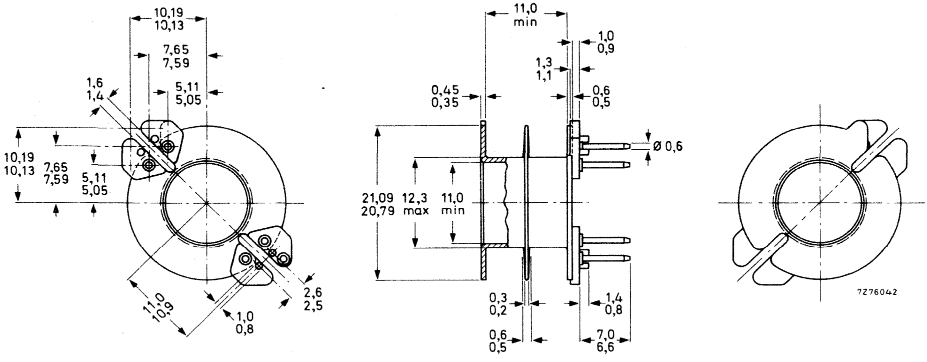


Fig. 3

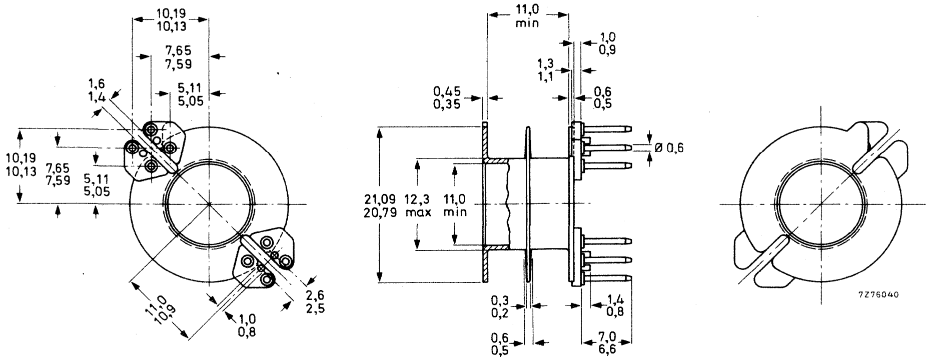
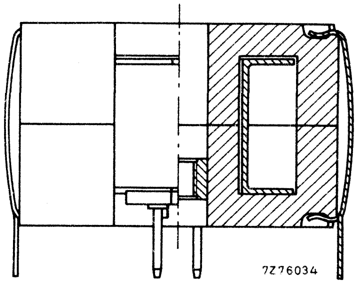


Fig. 4

ASSEMBLING AND MOUNTING



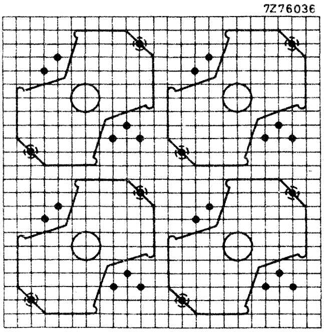
ASSEMBLING

The core halves are clamped together by means of two clips, catalogue number 4313 021 04120. As can be seen in the drawing the hooked ends of both clips fit into the recesses, made in the halves.
For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half. Also the use of a suitable tool for attaching the clips is recommended.

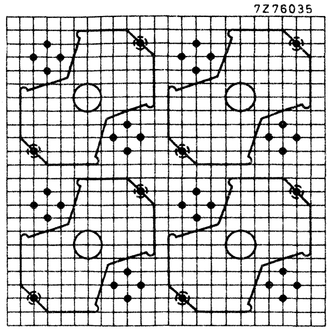
MOUNTING

The two retaining clips are also used for mounting the assembled core on a printed-wiring board. The pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing.

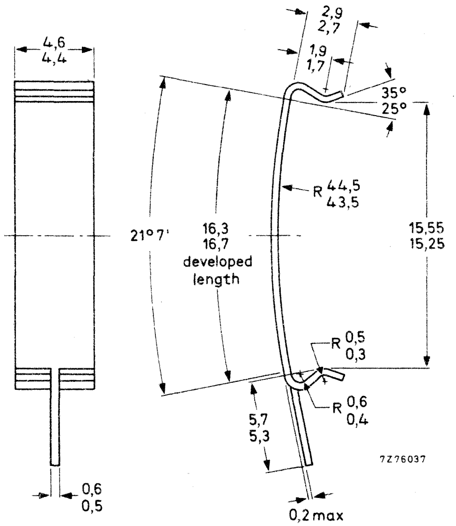
The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0,1 inch grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 2,4 mm.
The recommended hole diameter in the board is 1,0 ± 0,1 or 1,3 ± 0,1 mm (according to IEC publication 97).



Hole pattern for an assembly of 4 cores, each fitted with an 5-pin coil former.



Hole pattern for an assembly of 4 cores, each fitted with an 8-pin coil former.



PART DRAWING
(dimensions in mm)

Clip 4313 021 04120

Material: steel, gold plated over nickel.

1) Holes for tag on clip 4313 021 04120 (earth points).

SQUARE CORES

Separate core halves, air gap to be ground by the user, can be supplied.

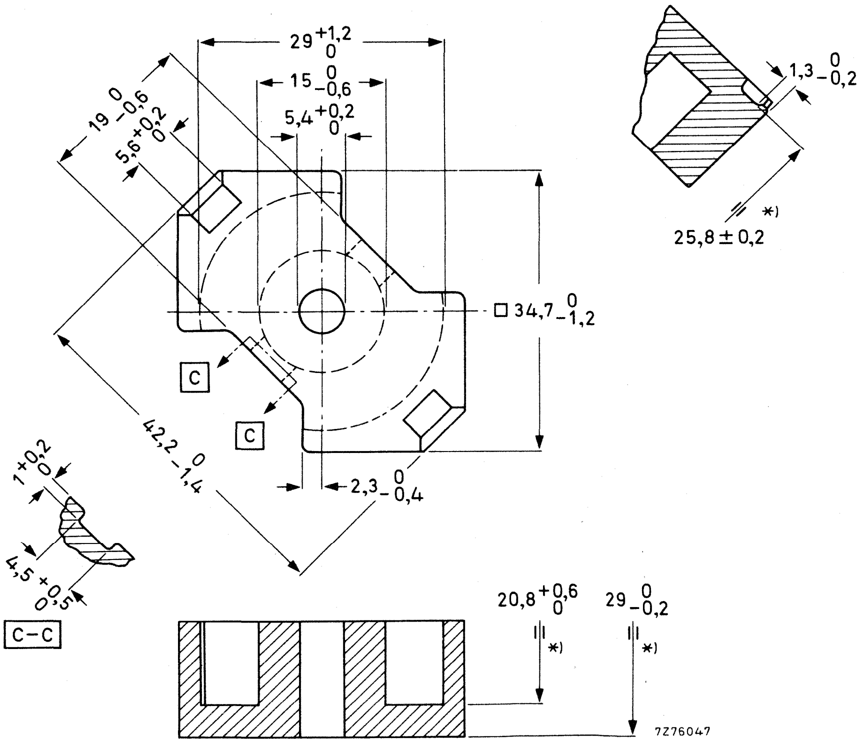
Square cores and associated parts are ordered by their 12-digit catalogue numbers.

The square cores are in accordance with the following specifications:
IEC 431 (international), DIN 41980 (Germany).

SEPARATE CORE HALVES

Outlines

Dimensions in mm



*) Measured on two adjacent core halves.

Versions

Ferroxcube grade	catalogue number
3B8	4322 020 28320

Properties

For the combination of two halves randomly chosen from a batch and pressed together with a force of 80 N, the values in the table below are guaranteed.

	$\hat{B}$ (mT)	freq. (KHz)	temp. (^{o}C)	grade 3B8
μ_e ± 25%	≤ 0, 1	4	25 ± 5	2120
A_L ± 25%	≤ 0, 1	4	25 ± 5	6840
α ± 12, 5%	≤ 0, 1	4	25 ± 5	12, 4
α_F x 10^6	≤ 0, 1	≤ 100	5 to 25	0 to +2 *)
			25 to 55	0 to +2 *)
D_F x 10^6 (10–100 min)	≤ 0, 1	≤ 100	25 ± 1	≤ 4, 3
$\frac{\tan \delta}{\mu_i}$ x 10^6	≤ 0, 1	4	25 ± 5	≤ 1, 5
	≤ 0, 1	30	25 ± 5	≤ 3, 0
	≤ 0, 1	100	25 ± 5	≤ 8, 0 *)
η_B x 10^3	1, 5–3, 0	30	25 ± 5	≤ 1, 0
μ_Δ at 8, 27 AT	≤ 0, 2	4	25 ± 5	≥682
μ_Δ at 13, 1 AT	≤ 0, 2	4	25 ± 5	≥286
μ_Δ at 16, 4 AT	≤ 0, 2	4	25 ± 5	≥145

Mass per set of 2 cores — 65, 5 g

Mean length of lines of force — l_e = 70 mm

Mean area of lines of force — A_e = 178 mm^2

$$\Sigma \frac{l_e}{A_e} = 0,39 \text{ mm}^{-1}$$

Effective volume — V_e = 12400 mm^3

*) For guidance only.

COIL FORMERS

Two types of coil former can be supplied :

- Single section, 10-pin, catalogue number 8222 294 37350 (Fig. 1, see page D448).
- Single section, 12-pin, catalogue number 8222 294 39680 (Fig. 2, see page D448).

The arrangement of the soldering pins is suitable for both 0, 1 inch and 2, 50 mm grid. See "Mounting".

Properties

Material : phenolformaldehyde reinforced with glass fibre

Window area	125 mm^2
Mean length of turn	69 mm
Max. temp.	180 °C

Solderability : resistant against dip-soldering at 400 °C for 2 s.

D.C. losses :

$$\frac{R_0}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 2,98 \times 10^3 \ \Omega/H$$

Mass 3 g

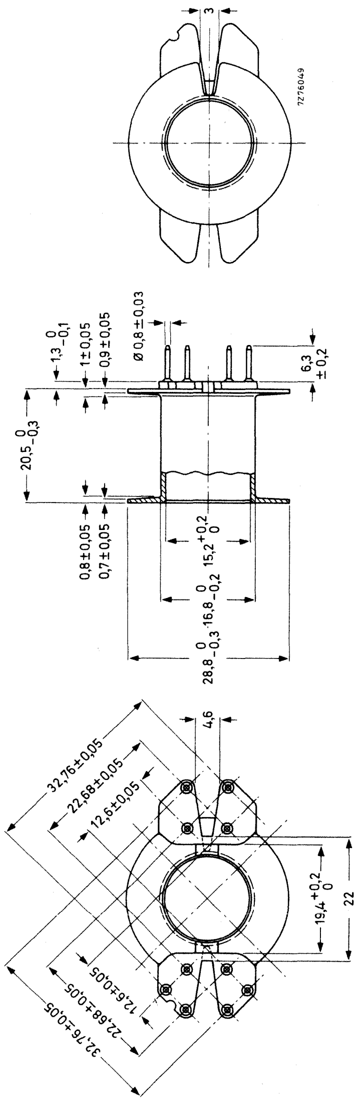

3
7Z76049
Ø 0,8±0,03
1,3 0 −0,1
1±0,05
0,9±0,05
6,3 ±0,2
20,5 0 −0,3
0,8±0,05
0,7±0,05
15,2 +0,2 0
16,8 0 −0,2
28,8 0 −0,3
4,6
32,76±0,05
22,68±0,05
12,6±0,05
19,4 +0,2 0
22

Fig. 1

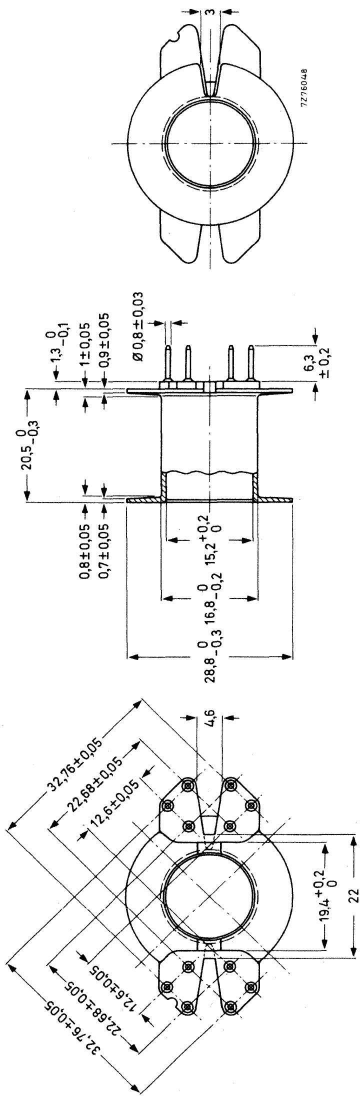
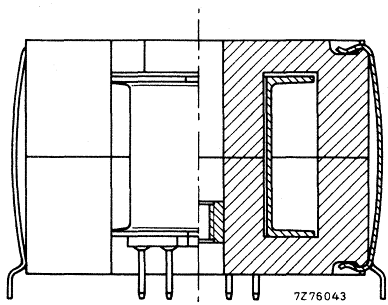

3
7Z76048
Ø 0,8±0,03
1,3 0 −0,1
1±0,05
0,9±0,05
6,3 ±0,2
20,5 0 −0,3
0,8±0,05
0,7±0,05
15,2 +0,2 0
16,8 0 −0,2
28,8 0 −0,3
4,6
32,76±0,05
22,68±0,05
12,6±0,05
19,4 +0,2 0
22

Fig. 2

ASSEMBLING AND MOUNTING



ASSEMBLING

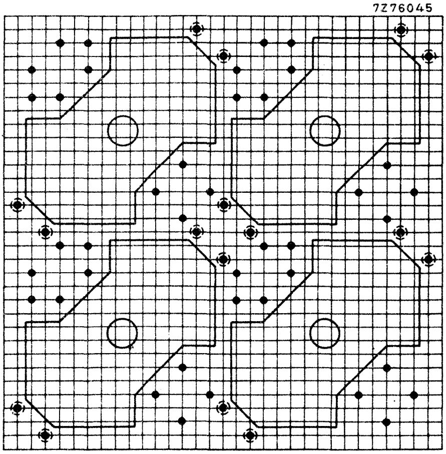
The core halves are clamped together by means of two clips, catalogue number 8222 294 37370. As can be seen in the drawing the hooked ends of both clips fit into the recesses, made in the halves.

For a stable inductance we recommend that an adhesive be applied between the coil former flange and the lower core half and around the two core halves, see page D31.

MOUNTING

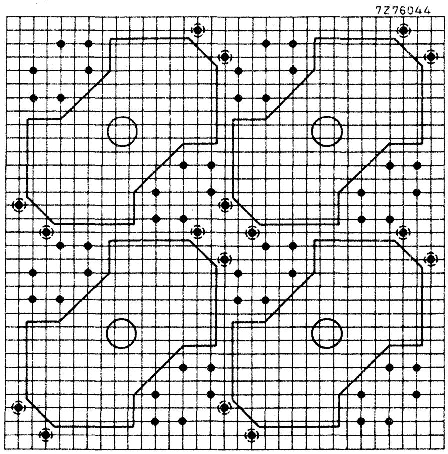
The two retaining clips are also used for mounting the assembled core on a printed-wiring board. The pins are simply soldered into the holes in the board. If so desired, one of the pins can also be used for earthing.

The soldering pins of coil formers and clips are so arranged that they will fit printed-wiring boards with a 0, 1 inch grid as well as those with a 2, 50 mm grid. The pin length is sufficient for a board thickness of up to 2, 4 mm. The recommended hole diameter in the board is 1, 0 ± 0, 1 or 1, 3 ± 0, 1 mm (according to IEC publication 97).



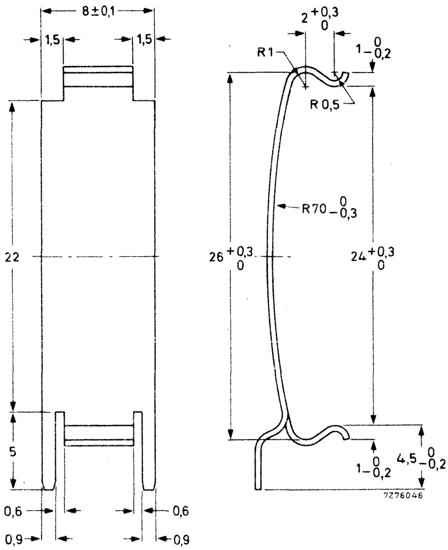
◎ 1)

Hole pattern for an assembly of 4 cores, each fitted with a 10-pin coil former.



◎ 1)

Hole pattern for an assembly of 4 cores, each fitted with a 12-pin coil former.



PART DRAWING
(dimensions in mm)

Clip: 8222 294 37370

Material: steel, tin plated

1) Holes, ϕ 1,3 ± 0,1 mm, for tags on clip 8222 294 37370 (earth points).

Ferroxcube transformer cores

General	E3
E and I-cores	E11
EC-cores	E57
H-cores	E97
Cross cores	E117
Toroids	E173

GENERAL

Introduction	E5
Survey of symbols	see chapter A
Determining the	
A_L- and μ_e-value	E6
Marking	E7
Mounting data	E9

INTRODUCTION

Although potcores can often be used with much success for transformers, there are a number of specific core shapes available, such as E-, EC-, X-, H-cores and toroids, which have especially been designed for this purpose. For a short description of these shapes the relevant sections should be consulted.

At higher frequencies they are superior to dust or laminated cores because of the low eddy current losses and higher permeability of Ferroxcube.

The high permeability of Ferroxcube makes it suitable for low frequencies as well, especially H-cores and toroids in the 3E2 and 3E3 grades, which have a μ_i value of > 5000 and $> 10\,000$ respectively.

At frequencies of 10 kHz or higher EC-cores and E-cores in the 3C8 grade are very suitable for power applications, e.g. in switched-mode power supplies and coupling transformers in power amplifiers. The maximum operation frequency depends on the mode of operation.

DETERMINING THE A_L- AND μ_e- VALUE

The A_L- or α-factor of transformer cores is determined with the following number of turns :

core type	number of turns	wire diam. (mm)	catalog number of measuring coil
E20	60	0,30	3U71065/14
E30	50	0,30	3U71065/15
E42	35	0,50	3U71065/16
E55	25	1,2	3U71065/3
E65	35	1,0	3U71065/10
X22	175	0,40 ortho-	7622 301 04011
X30	175	0,70 cyclic	7622 301 04111
X35	251	0,70 wound	7622 301 04211
H10	20 (one layer)	0,20	–

From the measured value of L, A_L and α can be calculated using the following formulas :

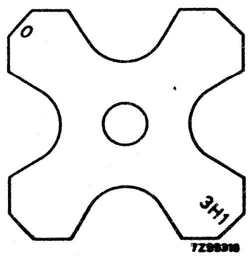
$$L = N^2 A_L \text{ and } \alpha = \frac{10^3}{\sqrt{A_L}} \quad \text{(L in nH)}$$

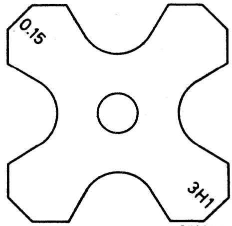
and the value of μ_e from

$$L = \frac{0,4\,\pi\,N^2 .\,\mu_e .\,10^{-5}}{\Sigma \frac{l_e}{A_e}} \quad \text{(L in mH)}$$

$\Sigma \frac{l_e}{A_e}$ can be found in the pages relevant to the transformer cores.

MARKING

type	type designation	example	position of marking
E cores without airgap length > 26 mm	E and dimensions material date manufacturer	E 42/21/15 3E1 B7A	on half of the backface [E42/21/15 3E1 B7A]
length < 26 mm	material	3E1	on half of the backface [3E1]
	E and dimensions date manufacturer	E 20/10/5 B7A	on the primary pack
E cores with airgap length > 26 mm	E and dimensions material airgap	E 42/21/15 3E1 0.9	on half of the backface [E42/21/15 3E1 0.9]
	date manufacturer	B7A	on the primary pack
length < 26 mm	material, airgap	3E1 0.05	on the backface [3E1 | 0.05]
	E and dimensions date manufacturer	E 20/10/5 B7A	on the primary pack
cross cores without airgap	material zero (0)	3H1 0	on the back of two opposite legs 
	catalogue number date manufacturer	4322 020 23752 B7A	on the primary pack

type	type designation	example	position of marking
cross cores with airgap	material airgap	3H1 0, 15	on the back of two opposite legs 
	catalogue number date manufacturer	4322 020 23982 B7A	on the primary pack

Note - EC-cores are not marked.

MOUNTING DATA

Special tools have been designed for bending the lips of the containers of X and H-cores. We do not supply these tools, but we are prepared to provide drawings of them on request.

Catalogue numbers of the tools are:

for X22	4322 058 00080
X30	4322 058 00090
X35	4322 058 00100
H10	4322 058 00120

See also the remarks with regard to the mounting parts in the pages relevant to the transformer cores.

E- and I- cores

INTRODUCTION

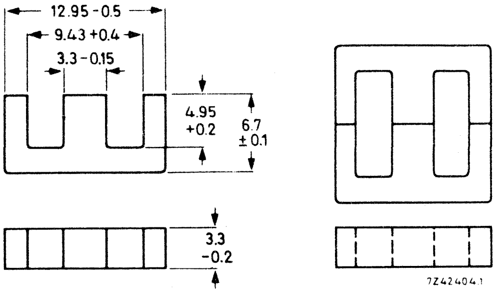
The Ferroxcube E and I-cores are typical transformer cores. They can be used from voice frequencies up to some MHz.
In comparison with conventional laminated iron cores a much higher frequency can be chosen, as a result of the very low eddy current losses of the Ferroxcube. This means that the dimensions can be smaller compared with conventional cores.

The hysteresis losses, and consequently the third harmonic distortion of Ferroxcube cores are lower than that of other materials.
For the low induction applications an additional advantage of Ferroxcube E and I-cores is, that the initial permeability remains constant over a very large frequency range.

Ferroxcube E-cores in the 3C8 grade are also very suitable for power applications at frequencies of 10 kHz to approx. 100 kHz.

E-CORE

Dimensions in mm



Weight	approx. 0, 83 g
Ferroxcube grade	3H1
Catalogue number of E-core	4322 020 34510

SHELL TYPE TRANSFORMER EE13/13/3

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 EE 13/13/3 composed of two cores type E 13/7/3.

Effective parameters for a pair of cores

Effective magnetic path length	l_e = 31, 4 mm
Effective cross-sectional area	A_e = 10, 1 mm^2
Core constant	$C_1 (= \Sigma \frac{l_e}{A_e})$ = 3, 09 mm^{-1}
Effective core volume	V_e = 318 mm^3

Magnetic properties at 25 ± 10 °C

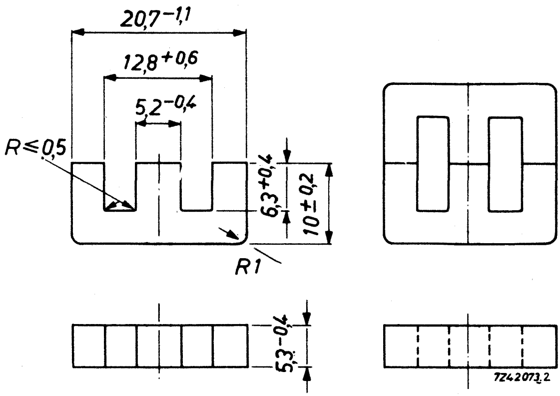
For the combination of two E-cores randomly chosen from a batch and pressed together with a force of 30 N, the values given below are guaranteed.

	μ_e	≥ 1390
	A_L	≥ 566
	α	≤ 42, 1
At f = 4 kHz and $\hat{B}$ between 1, 5 and 3 mT	$\eta_B \times 10^3$	≤ 1, 1 T^{-1}

Note - Number of turns for LmH: $N = \alpha \sqrt{L}$

E-CORES

DIMENSIONS AND WEIGHT



The dimensions are according to D.I.N. 41295.

Weight approx. 4 g

VERSIONS

Ferroxcube grade	3E1	3C6
Catalogue number of E-core	4322 020 34830	4312 020 34070
Catalogue number of E-core with air gap 0,15 ± 0,015 mm	4322 020 34550	

SHELL TYPE TRANSFORMER EE20/20/5

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 EE20/20/5 composed of two cores type E20/10/5.

Effective parameters for a pair of cores

Effective magnetic path length	$l_e = 42,8$ mm
Effective cross-sectional area	$A_e = 31,2$ mm^2
Core constant	$C_1 \left(= \Sigma \frac{l_e}{A_e}\right) = 1,37$ mm^{-1}
Effective core volume	$V_e = 1340$ mm^3

Magnetic properties

For the combination of two E-cores randomly chosen from a batch and pressed together with a force of 55 N, the values given below are guaranteed.

Magnetic properties at 25 ± 10 °C for grade 3E1; Δ = 0

	μ_e	= 2100-3155 *)
	A_L	= 1920-2890
At f = 4 kHz and $\hat{B}$ between 1,5 and 3 mT	$\eta_B \times 10^3$	$\leq 1{,}8\ T^{-1}$
At f = 4 kHz and $\hat{B} \leq 0{,}1$ mT	$\frac{\tan\delta}{\mu_i} \times 10^6$	$\leq 2{,}5$
At f = 100 kHz and $\hat{B} \leq 0{,}1$ mT	$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 20
At f = 500 kHz and $\hat{B} \leq 0{,}1$ mT	$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 200

Magnetic properties for grade 3C6; Δ = 0

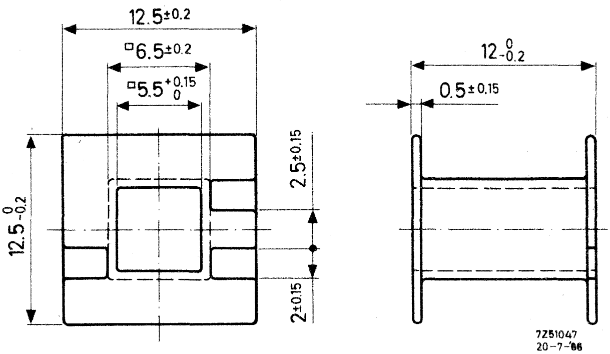
At f = 16 kHz, $\hat{B}$ = 200 mT and	
θ = 25 °C	$P \leq 0{,}3$ W
θ = 100 °C	$P \leq 0{,}25$ W
At f = 16 kHz, $\hat{B} \geq 275$ mT and θ = 100 °C	$\hat{H}$ = 250 A/m

Note - Number of turns for LmH : $N = \alpha\sqrt{L}$

*) In the temperature range +23 to +70 °C $\mu_e \geq 2100$.

COIL FORMERS

for shell type transformer EE20/20/5 (M20)

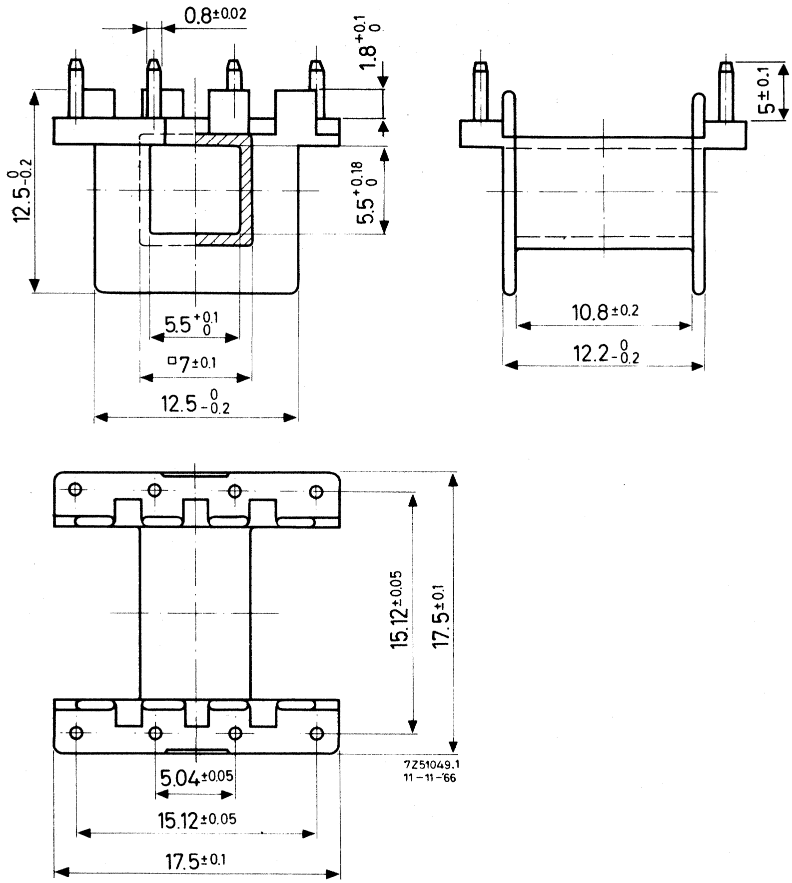


catalogue number	4312 021 28431
material	polycarbonate
minimum window area in mm^2	27
mean length of turn in mm	38
approximate weight in g	0, 5
maximum temperature in ^{o}C	130

The dimensions are practically according to German specification D. I. N. 41305.

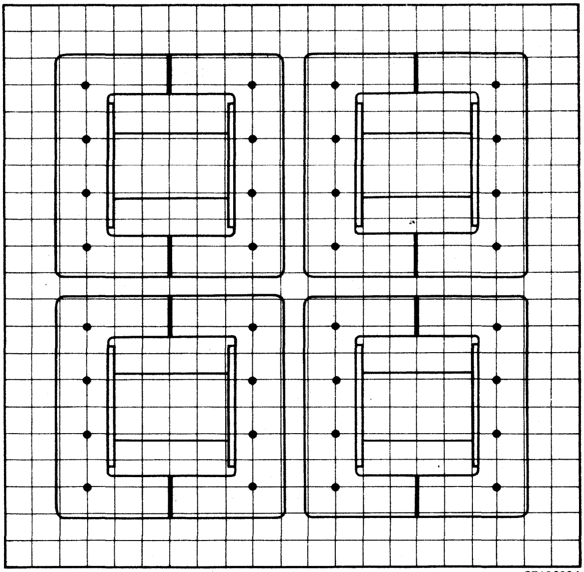
COIL FORMERS
for shell type transformer EE20/20/5(M20)

With soldering pins.



catalogue number	4322 021 20240
material	phenolformaldehyde reinforced with glass fibre ; brass dipsolder pins
minimum window area in mm^2	27
mean length of turn in mm	38
approximate weight in g	
maximum temperature for dipsoldering during 5-6 s in ^oC	280
maximum working temperature in ^oC	130

The coil former fits a shell type transformer EE20/20/5(M20). The soldering pins are so arranged as to fit a grid of 2,52 mm. They will fit printed-wiring boards with 0,1 in grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.



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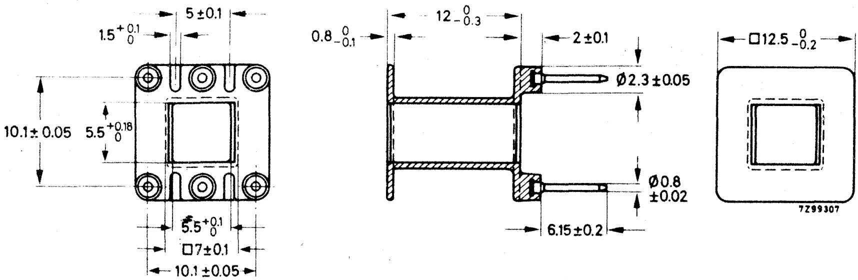
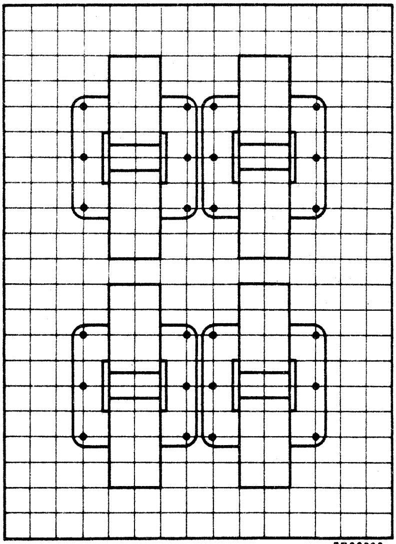
With soldering pins.



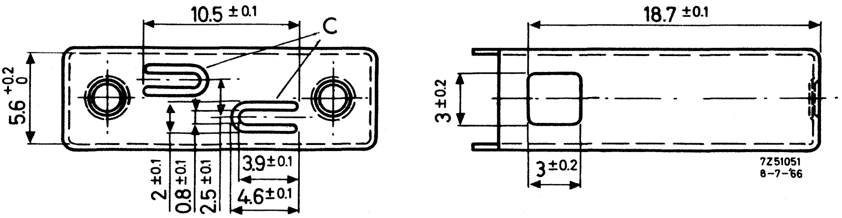
catalogue number	4322 021 20140
material	phenolformaldehyde reinforced with glass fibre ; brass dipsolder pins
minimum window area in mm^2	27
mean length of turn in mm	38
approximate weight in g	
maximum temperature for dipsoldering during 5-6 s in ^{o}C	280
maximum working temperature in ^{o}C	130

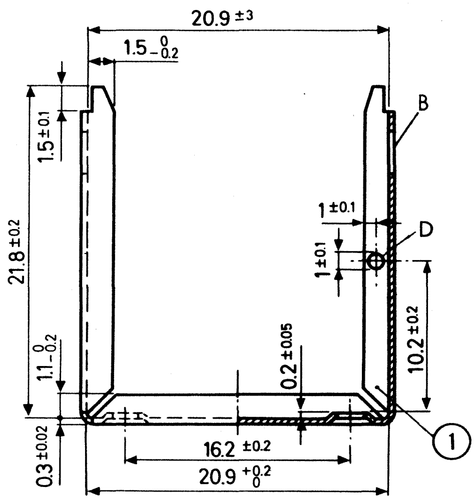
The coil former fits a shell type transformer EE20/20/5(M20). The soldering pins are so arranged as to fit a grid of 2.52 mm. They will fit printed-wiring boards with 0.1 in grid as well as those with a 2.50 mm grid. The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1.3 ± 0.1 mm diameter.



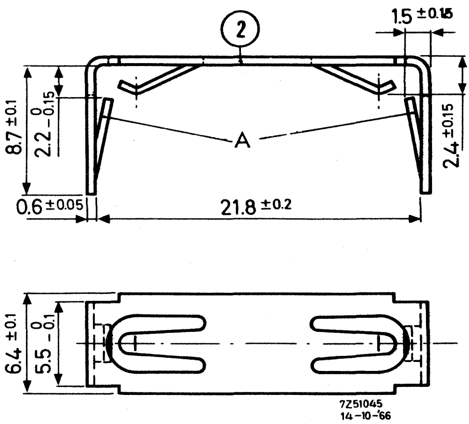
7Z99309

MOUNTING PARTS





(1). Clasp 4322 021 20160
Material: brass, tin-plated



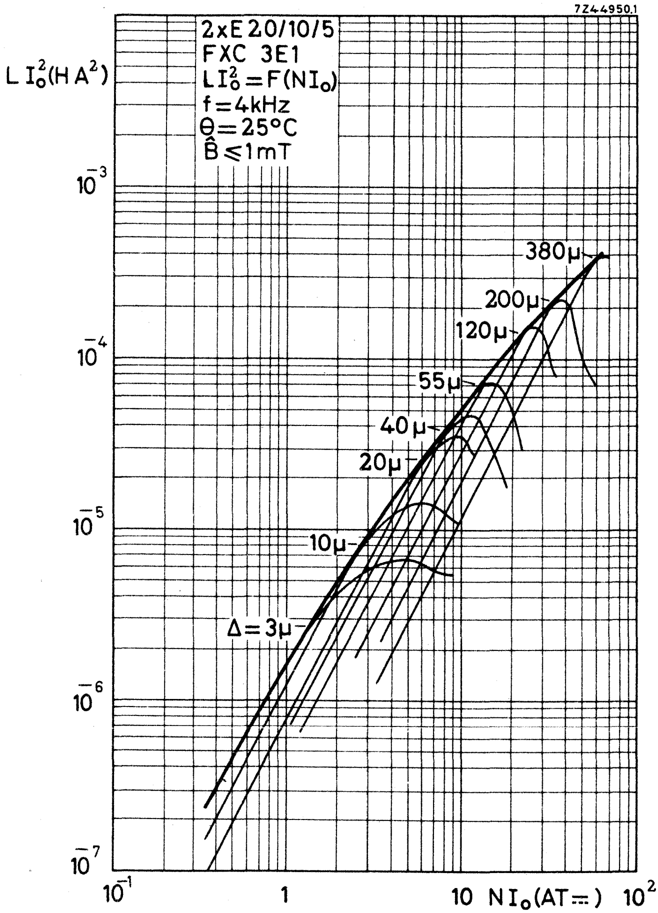
(2). Spring 4322 021 20220
Material: phosphorbronze, tin-plated

The construction is mounted by pushing the spring over the clasp in such a way that the lips A of the spring catch in the square holes B of the clasp. The mechanical pressure, required to keep the two E-cores together is exercised by means of two lips on top of the spring. No special tool is required for mounting the construction.

The construction can be used in horizontal and vertical position.
If the construction is used in vertical position, the lips C of the clasp must be bent. The dimensions and mutual distance of these lips are chosen in such a way that they fit printed-wiring boards with a grid of 0.1" as well as those with a grid of 2.50 mm.
If used in a horizontal position the clasp can be earthed by means of a copper wire soldered in hole D.

CHARACTERISTIC CURVES

HANNA CURVES (typical values)
Indicating optimum inductance for a certain airgap and direct current.



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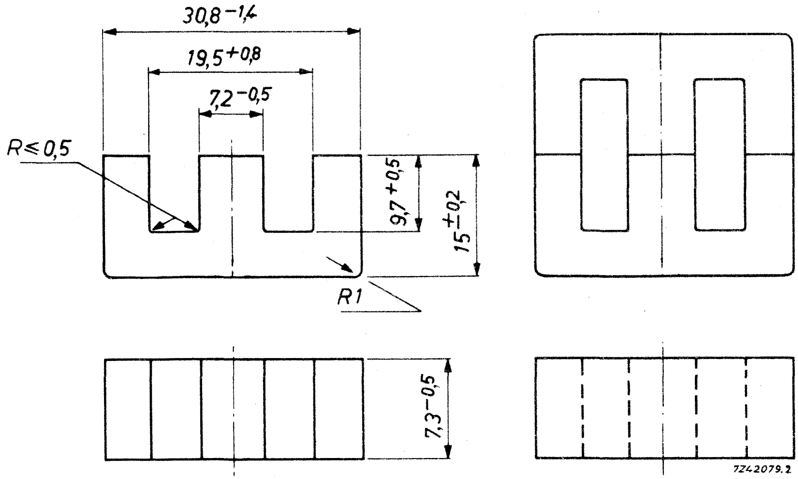
E-CORES

DIMENSIONS AND WEIGHT



The dimensions are according to D.I.N. 41295.

Weight approx. 11 g

VERSIONS

Ferroxcube grade	3E 1
Catalogue number of E-core	4322 020 34840
Catalogue number of E-core	
with air gap 0,15 ± 0,015	4322 020 34650
with air gap 0,30 ± 0,015	4322 020 34660

SHELL TYPE TRANSFORMER EE30/30/7

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 EE30/30/7 composed of two cores type E30/15/7.

Effective parameters for a pair of cores

Effective magnetic path length	$l_e = 66,9$ mm
Effective cross-sectional area	$A_e = 59,7$ mm^2
Core constant	$C_1 \left(= \Sigma \frac{l_e}{A_e}\right) = 1,12$ mm^{-1}
Effective core volume	$V_e = 4000$ mm^3

Magnetic properties at 25 ± 10 °C; Δ = 0

For the combination of two E-cores randomly chosen from a batch and pressed together with a force of 110 N, the values given below are guaranteed.

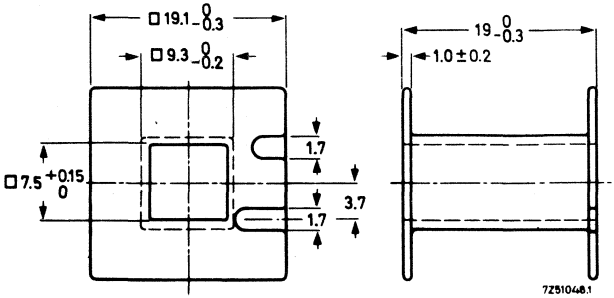
	μ_e	= 2375-3565*)
	A_L	= 2660-4000
At 4 kHz and $\hat{B}$ between 1,5 and 3 mT	$\eta_B \times 10^3$	$\leq$ 1,8 T^{-1}
At 4 kHz and $\hat{B} \leq$ 0,1 mT	$\frac{\tan \delta}{\mu_i} \times 10^6$	$\leq$ 2,5
At 100 kHz and $\hat{B} \leq$ 0,1 mT	$\frac{\tan \delta}{\mu_i} \times 10^6$	$\leq$ 20
At 500 kHz and $\hat{B} \leq$ 0,1 mT	$\frac{\tan \delta}{\mu_i} \times 10^6$	$\leq$ 200

Note - Number of turns for LmH: $N = \alpha \sqrt{L}$

*) In the temperature range + 23 to + 70 °C $\mu_e \geq$ 2375.

COIL FORMERS

for shell type transformer EE30/30/7 (M30)

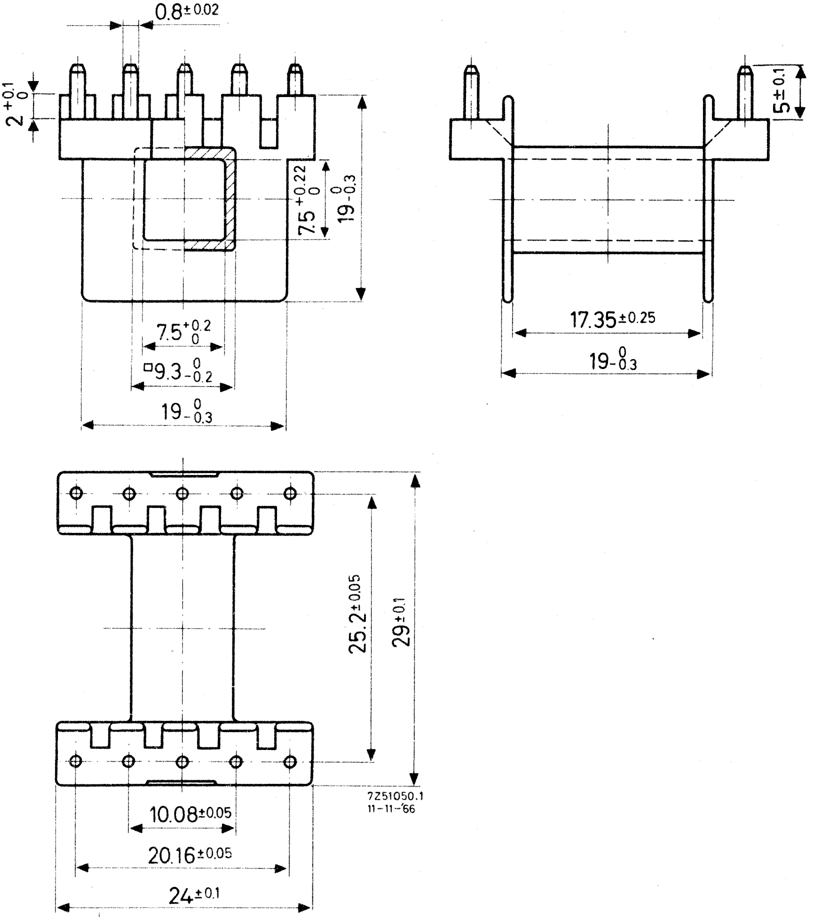


catalogue number	4312 021 28550
material	polycarbonate
minimum window area in mm^2	80
mean length of turn in mm	56
approximate weight in g	1, 3
maximum temperature in ^{o}C	130

The dimensions are practically according to German specification D.I.N. 41305.

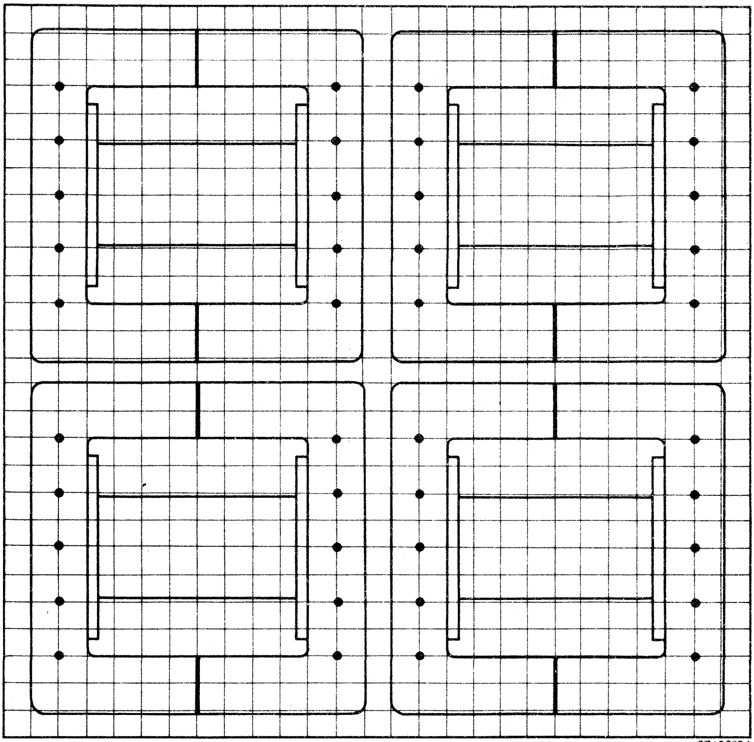
COIL FORMERS
for shell type transformer EE30/30/7(M30)

With soldering pins.



catalogue number	4322 021 20250
material	phenolformaldehyde reinforced with glass fibre ; brass dipsolder pins
minimum window area in mm^2	80
mean length of turn in mm	56
approximate weight in g	
maximum temperature for dipsoldering during 5-6 s in ^oC	280
maximum working temperature in ^oC	130

The coil former fits a shell type transformer EE30/30/7(M30). The soldering pins are so arranged as to fit a grid of 2,52 mm. They will fit printed-wiring boards with 0,1 in grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.



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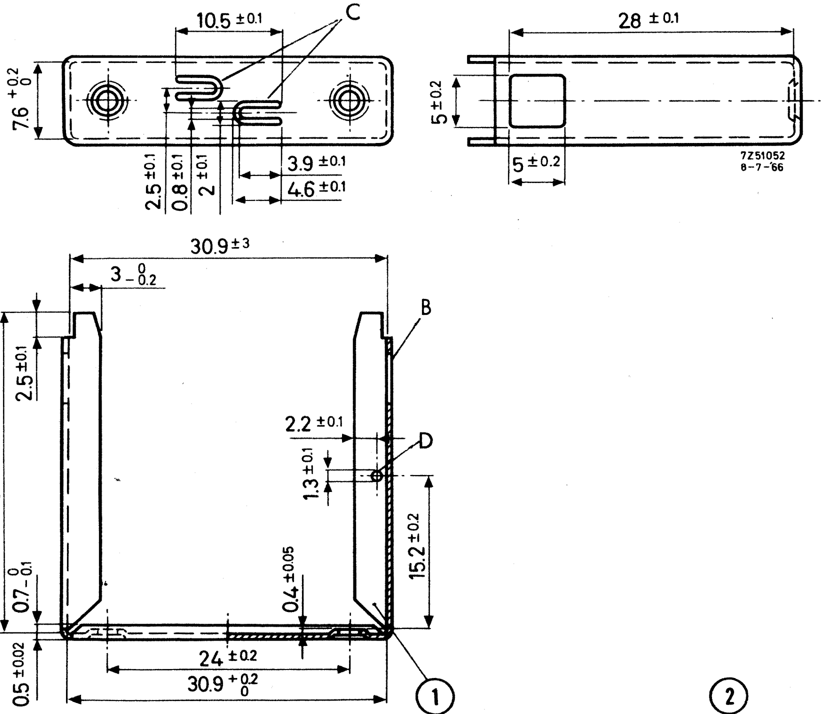
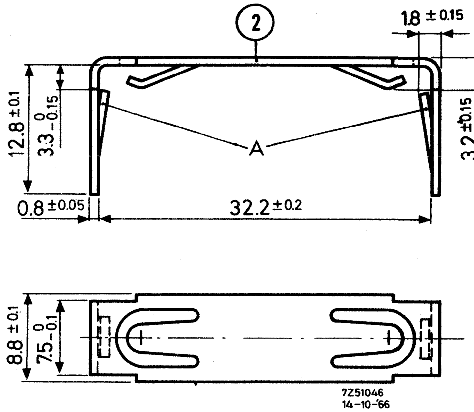
MOUNTING PARTS



(1). Clasp 4322 021 20170
Material: brass, tin-plated



(2). Spring 4322 021 20230
Material: phosphorbronze, tin-plated

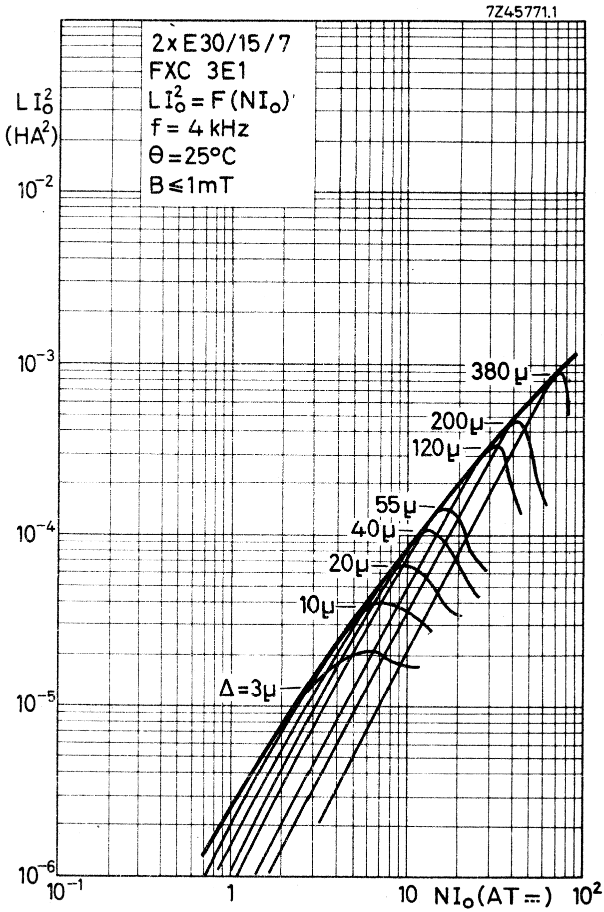
The construction is mounted by pushing the spring over the clasp in such a way that the lips A of the spring catch in the square holes B of the clasp. The mechanical pressure, required to keep the two E-cores together is exercised by means of two lips on top of the spring. No special tool is required for mounting the construction.

The construction can be used in horizontal and vertical position.
If the construction is used in vertical position, the lips C of the clasp must be bent. The dimensions and mutual distance of these lips are chosen in such a way that they fit printed-wiring boards with a grid of 0.1" as well as those with a grid of 2.50 mm.
If used in a horizontal position the clasp can be earthed by means of a copper wire soldered in hole D.

CHARACTERISTIC CURVES

HANNA CURVES (typical values)

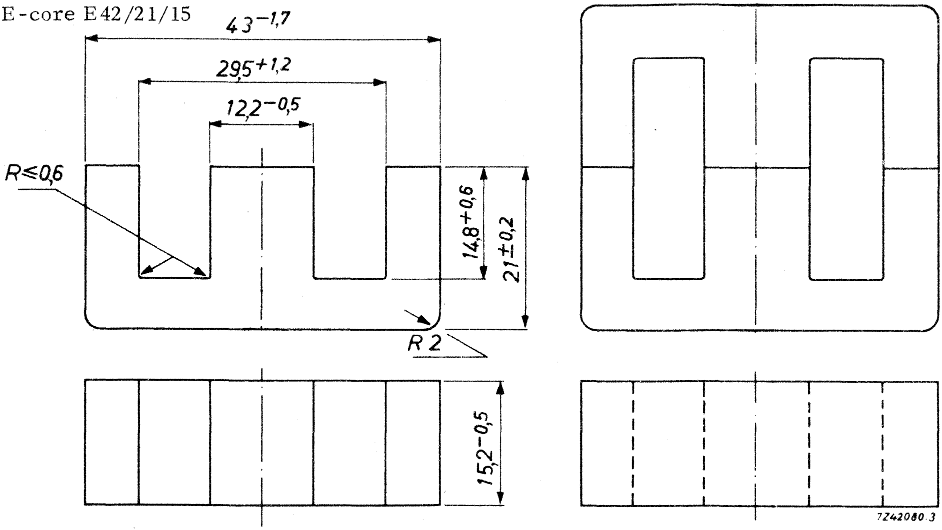
Indicating optimum inductance for a certain airgap and direct current



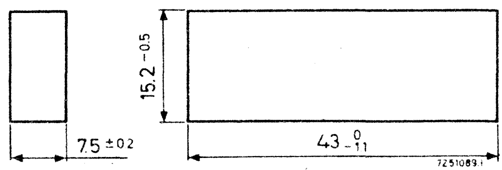
E- AND I-CORES

DIMENSIONS AND WEIGHT

E-core E42/21/15



I-core I42/7,5/15



The dimensions are according to D.I.N. 41295.

Weight	approx. 42 g

VERSIONS

Ferroxcube grade	3E 1	3C8
Catalogue number of E-core	4322 020 34850	4312 020 34110
Catalogue number of E-core		
with air gap 0,25 ± 0,015	4322 020 34740	
with air gap 0,50 ± 0,015	4322 020 34750	
Catalogue number of I-core	4322 020 37320	

SHELL TYPE TRANSFORMERS EE42/42/15 AND EI42/29/15

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 EE42/42/15 composed of two cores type E42/21/15 or the E-I combination EI42/29/15.

Effective parameters for a pair of cores

Shell type transformer		EE42/42/15	EI42/29/15
Effective magnetic path length	l_e =	97,0 mm	67,2 mm
Effective cross-sectional area	A_e =	182 mm^2	183 mm^2
Core constant	C_1 (= $\Sigma \frac{l_e}{A_e}$) =	0,534 mm^{-1}	0,367 mm^{-1}
Effective core volume	V_e =	17600 mm^3	12300 mm^3

Magnetic properties

For the combination of two E-cores or one E- and one I-core randomly chosen from a batch and pressed together with a force of 280 N, the values given below are guaranteed.

Magnetic properties at 25 ± 10 °C for grade 3E1; Δ = 0

	EE42/42/15	EI42/29/15
μ_e =	2570-3855 *)	2400-3600
A_L =	6040-9070	8210-12320

At 4 kHz and $\hat{B}$ between 1,5 and 3 mT: $\eta_B \times 10^3 \leq 1,8\ T^{-1}$

At 4 kHz and $\hat{B} \leq 0,1$ mT: $\frac{\tan\delta}{\mu_i} \times 10^6 \leq 2,5$

At 100 kHz and $\hat{B} \leq 0,1$ mT: $\frac{\tan\delta}{\mu_i} \times 10^6 \leq 20$

Magnetic properties for grade 3C8; Δ = 0

At 16 kHz, $\hat{B}$ = 200 mT and θ = 100 °C: P ≤ 2 W

At 16 kHz, $\hat{B} \geq$ 315 mT and θ = 100 °C: $\hat{H}$ = 250 A/m

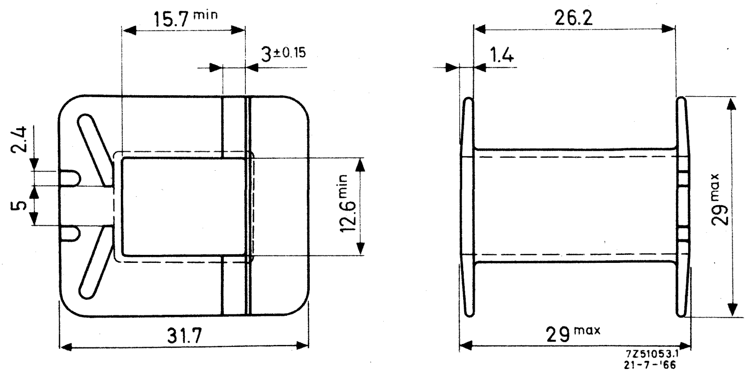
At 16 kHz, $\hat{B} \geq$ 90 mT and θ = 100 °C: $\hat{H}$ = 50 A/m

Note - Number of turns for LmH: $N = \alpha\sqrt{L}$

*) In the temperature range +23 to +70 °C $\mu_e \geq 2575$.

COIL FORMERS

for shell type transformer EE42/42/15 (M42)

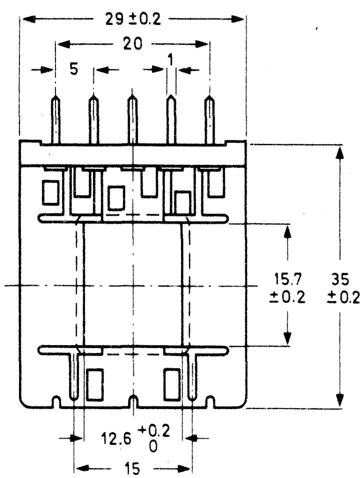


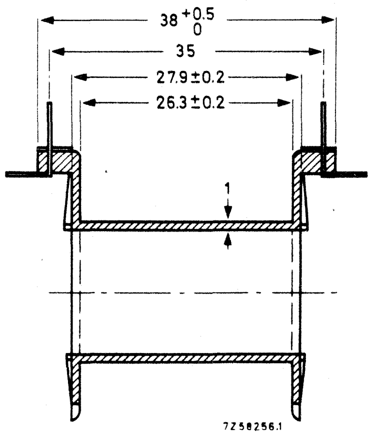
catalogue number	4312 021 28622
material	reinforced polyamide
minimum window area in mm^2	178
mean length of turn in mm	93
approximate weight in g	4
maximum temperature in ^oC	180

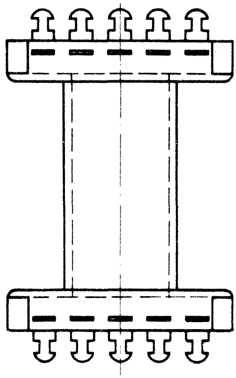
The dimensions are practically according to German specification D.I.N. 41305.

COIL FORMERS
for shell type transformer EE42/42/15(M42)

With soldering pins

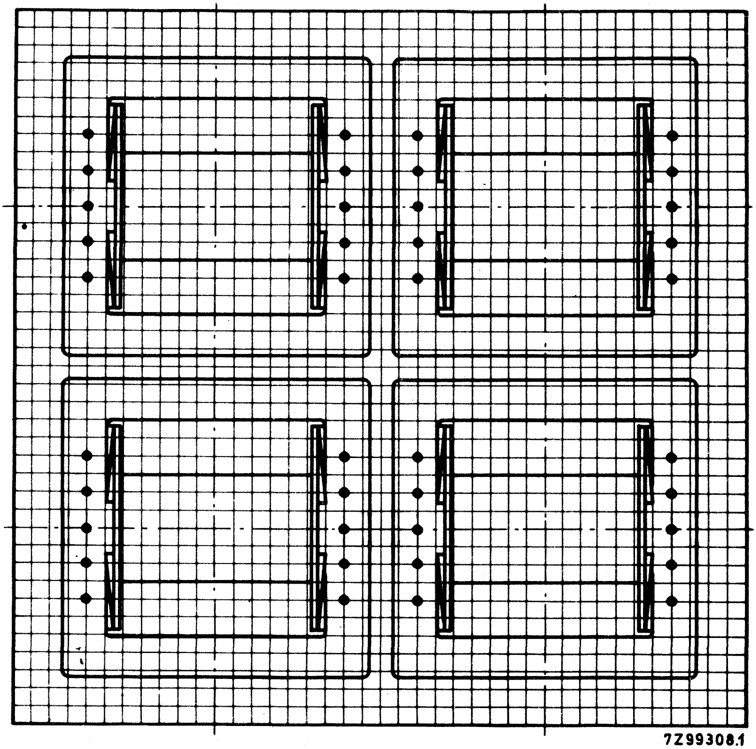






catalogue number	4322 021 31830
material	reinforced polyamide with brass dipsoldered pins
minimum window area in mm^2	178
mean length of turn in mm	93
approximate weight in g	4
maximum temperature in ^{o}C	180

The coil former fits a shell type transformer EE42/42/15(M42). The soldering pins are so arranged as to fit a grid of 2,52 mm. They will fit printed-wiring boards with 0,1 in grid as well as those with a 2,50 mm grid. The pin length is sufficient for a board thickness of up to 3 mm. The board should be provided with holes of 1,3 ± 0,1 mm diameter.



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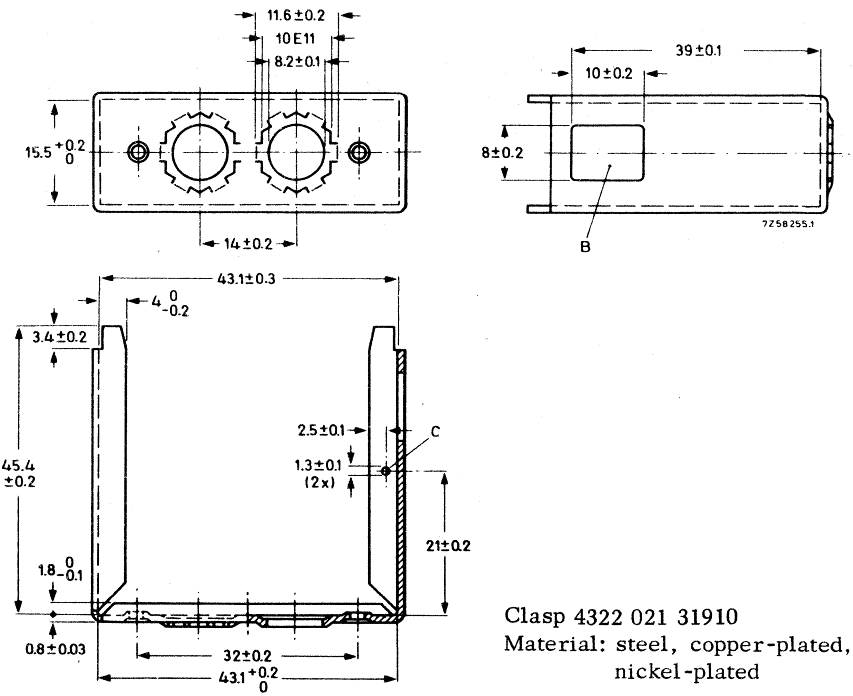
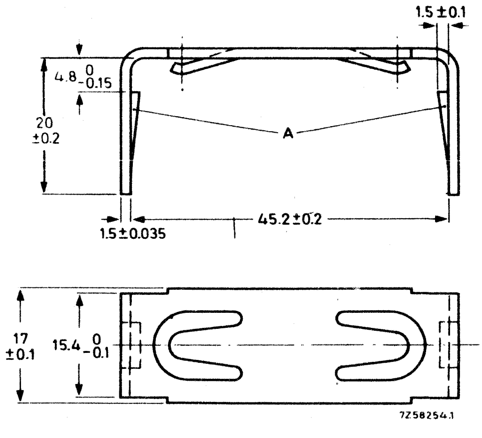
MOUNTING PARTS



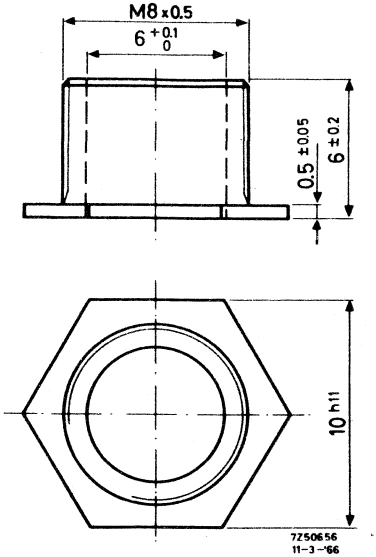
Clasp 4322 021 31910
Material: steel, copper-plated, nickel-plated



Spring 4322 021 31920
Material: phosphorbronze, nickel-plated

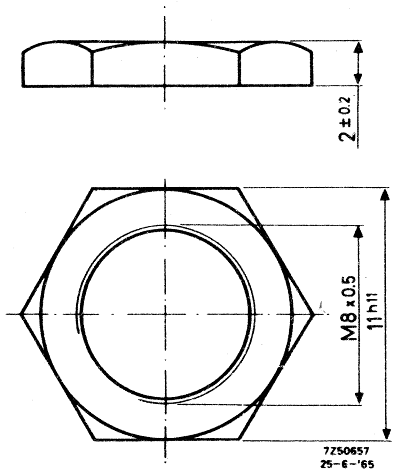
The construction is mounted by pushing the spring over the clasp in such a way that the lips A of the spring catch in the square holes B of the clasp. The mechanical pressure, required to keep the two E-cores together is exercised by means of two lips on top of the spring. No special tool is required for mounting the construction.

The construction can be used in horizontal and vertical position.
If the construction is used in vertical position, two fixing bushes 4322 021 30720 with nuts 4322 021 30710 must be applied in the holes of the clasp.
If used in a horizontal position the clasp can be earthed by means of a copper wire soldered in hole C.



Fixing bush 4322 021 30720

Material: brass, nickel plated



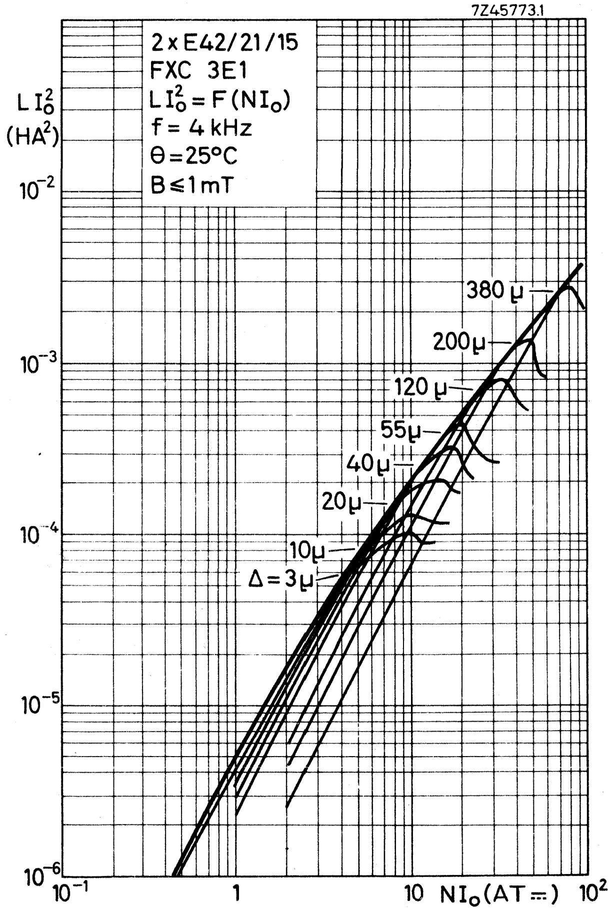
Nut 4322 021 30710

Material: brass, nickel plated

CHARACTERISTIC CURVES

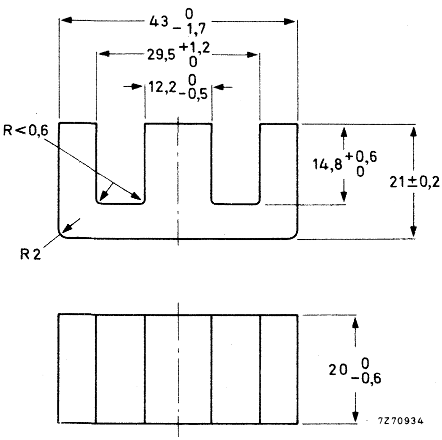
HANNA CURVES (typical values)

Indicating optimum inductance for a certain airgap and direct current

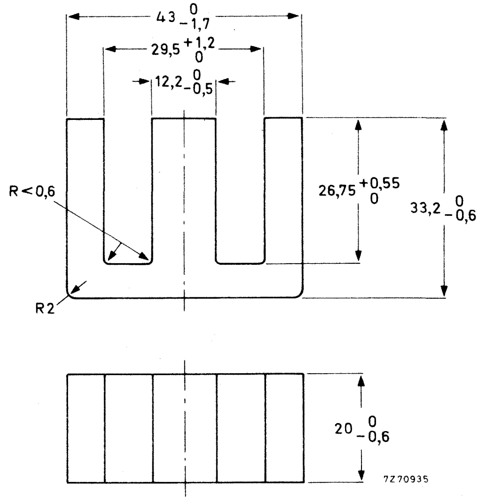


E-CORES

Dimensions in mm



E42/21/20



E42/33/20

Ferroxcube grade	3C8
Catalogue number of core E42/21/20	4312 020 34120
E42/33/20	4312 020 34190
Catalogue number of combination of cores E42/21/20 + E42/33/20	4312 020 34170

SHELL TYPE TRANSFORMERS EE42/42/20 AND EE42/54/20

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 EE42/42/20 composed of two cores E42/21/20 and shell type transformer EE42/54/20 composed of one core E42/21/20 and one core E42/33/20.

Effective parameters for a pair of cores

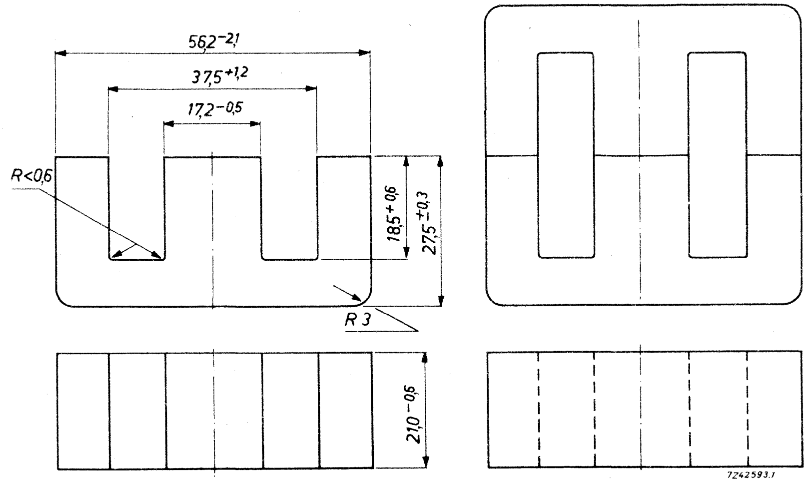
		EE42/42/20	EE42/54/20
Effective magnetic path length	l_e =	98 mm	122 mm
Effective cross-sectional area	A_e =	236 mm^2	236 mm^2
Core constant	$C_1 (= \Sigma \frac{l_e}{A_e})$ =	0,415 mm^{-1}	0,517 mm^{-1}
Effective core volume	V_e =	23100 mm^3	28800 mm^3

Magnetic properties

		EE42/42/20	EE42/54/20
At f = 16 kHz, $\hat{B}$ = 200 mT, θ = 25 °C	P		≤ 3,5 W
θ = 100 °C	P ≤	2,6 W	≤ 3,2 W
At f = 16 kHz, $\hat{B}$ ≥ 90 mT, θ = 100 °C	$\hat{H}$ =	50 A/m	
$\hat{B}$ ≥ 315 mT, θ = 100 °C	$\hat{H}$ =	250 A/m	250 A/m

E-CORES

DIMENSIONS AND WEIGHT



The dimensions are according to D.I.N. 41295.

Weight	approx. 115 g

VERSIONS

Ferroxcube grade	3E1	3C8
Catalogue number of E-core	4322 020 34900	4312 020 34100

SHELL TYPE TRANSFORMER EE55/55/21

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 EE55/55/21 composed of two cores type E55/28/21.

Effective parameters for a pair of cores

Effective magnetic path length	l_e = 123 mm
Effective cross-sectional area	A_e = 354 mm^2
Core constant	$C_1 \left(= \Sigma \frac{l_e}{A_e}\right) = 0,348$ mm^{-1}
Effective core volume	V_e = 43700 mm^3

Magnetic properties

For the combination of two E-cores randomly chosen from a batch and pressed together with a force of 550 N, the values given below are guaranteed.

Magnetic properties at 25 ± 10 °C for grade 3E1; $\Delta = 0$

	μ_e = 2645-3970
	A_L = 9545-14330
At 4 kHz and $\hat{B}$ between 1,5 and 3 mT	$\eta_B \times 10^3 \leq 2,5\ T^{-1}$

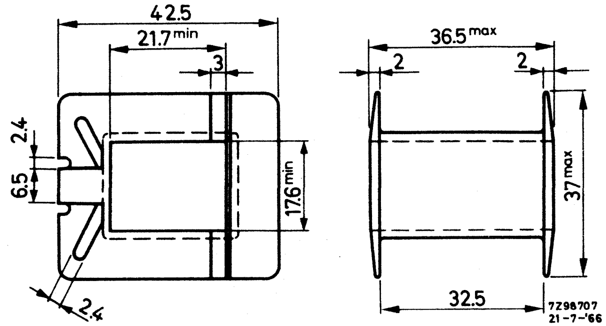
Magnetic properties for grade 3C8; $\Delta = 0$

At 16 kHz, $\hat{B}$ = 200 mT and θ = 25 °C	P ≤ 5,5 W
θ = 100 °C	P ≤ 5,0 W
At 16 kHz, $\hat{B} \geq$ 315 mT and θ = 100 °C	$\hat{H}$ = 250 A/m

Note - Number of turns for LmH: $N = \alpha\sqrt{L}$

COIL FORMER

for shell type transformer EE55/55/21



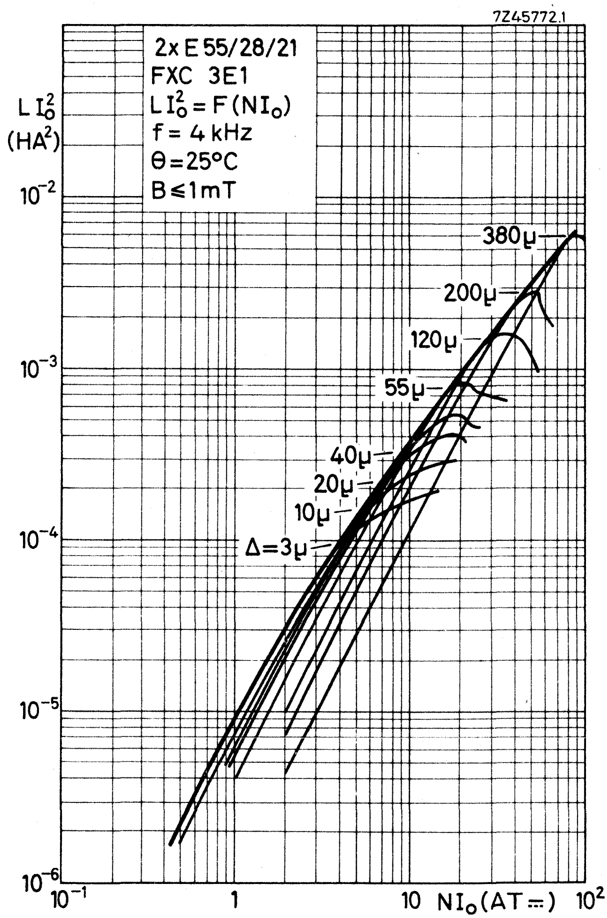
catalogue number	4312 021 28711
material	reinforced polyamide
minimum window area in mm^2	250
mean length of turn in mm	116
approximate weight in g	9
maximum temperature in ^{o}C	180

The dimensions are according to German specification D.I.N. 41305.

CHARACTERISTIC CURVES

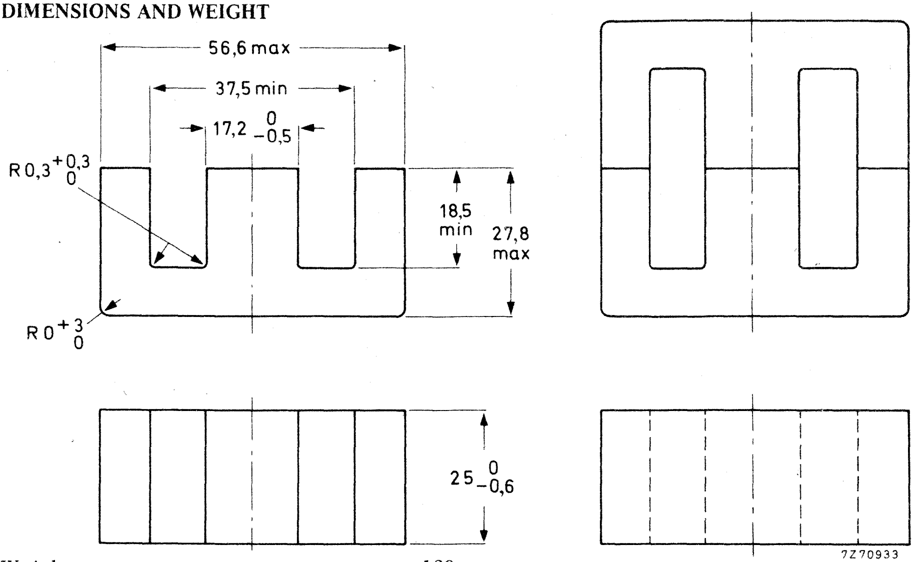
HANNA CURVES (typical values)

Indicating optimum inductance for a certain airgap and direct current



E-CORE

DIMENSIONS AND WEIGHT



Weight approx. 130 g

VERSIONS

Ferroxcube grade	3C8
Catalogue number of E-core	3122 134 90210
Catalogue number of E-core with air gap 1,4 mm	3122 134 90940

SHELL TYPE TRANSFORMER EE55/55/25

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 EE55/55/25 composed of two cores type EE55/28/25.

Effective parameters for a pair of cores

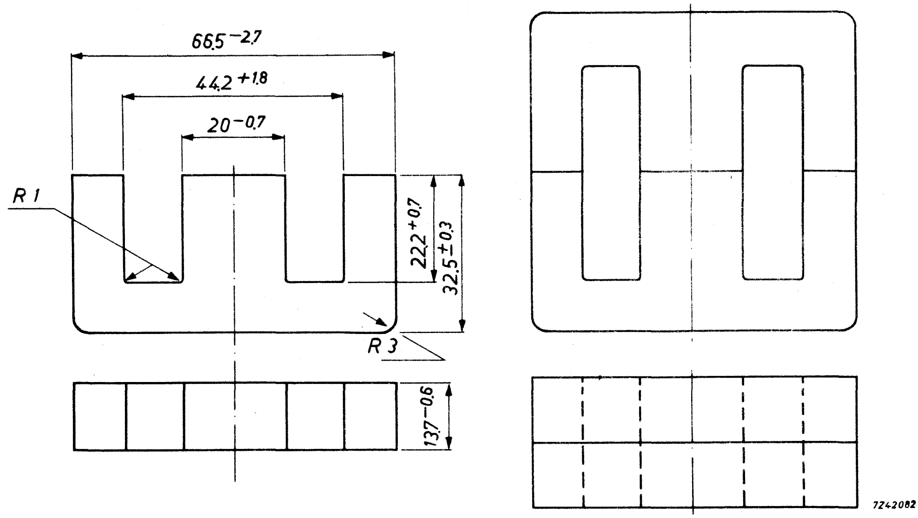
Effective magnetic path length	l_e = 123 mm
Effective cross-sectional area	A_e = 420 mm^2
Core constant	$C_1 (= \Sigma \frac{l_e}{A_e}) = 0,293$ mm^{-1}
Effective core volume	V_e = 52000 mm^3

Magnetic properties; $\Delta = 0$

At f = 16 kHz, $\hat{B}$ = 200 mT, θ = 25 °C	P ≤ 6,2 W
θ = 100 °C	P ≤ 5,7 W
At f = 16 kHz, $\hat{B}$ ≥ 315 mT, θ = 100 °C	$\hat{H}$ = 250 A/m

E-CORE

DIMENSIONS AND WEIGHT



The dimensions are according to D.I.N. 41295.

Weight approx. 76 g

VERSIONS

Ferroxcube grade 3E1

Catalogue number of E-core 4322 020 34910

SHELL TYPE TRANSFORMER 65/65/27

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 65/65/27 composed of four cores type E65/32/13.

Effective parameters for a pair of cores

Effective magnetic path length	l_e = 147 mm
Effective cross-sectional area	A_e = 532 mm^2
Core constant	$C_1 \left(= \Sigma \frac{l_e}{A_e}\right) = 0,275\ mm^{-1}$
Effective core volume	V_e = 78200 mm^3

Magnetic properties at 25 ± 10 °C; Δ = 0

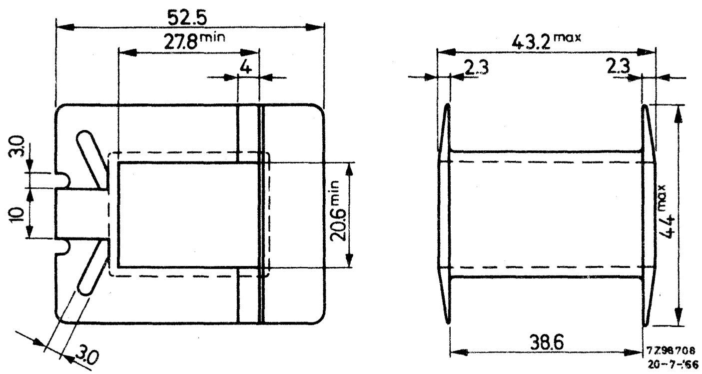
For the combination of four E-cores randomly chosen from a batch and pressed together with a force of 400 N, the values given below are guaranteed.

	μ_e = 2705-4060
	A_L = 12355-18545
At 4 kHz and $\hat{B}$ between 1,5 and 3 mT	$\eta_B \times 10^3 \leq 4,3\ T^{-1}$

Note - Number of turns for LmH: $N = \alpha \sqrt{L}$

COIL FORMER

for shell type transformer 65/65/27 (M65)



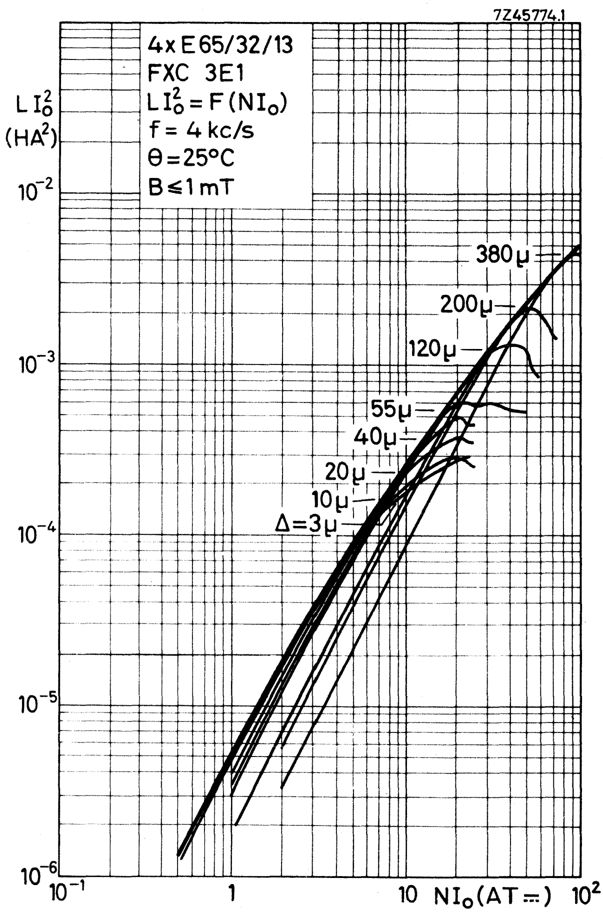
catalogue number	4312 021 28721
material	reinforced polyamide
minimum window area in mm^2	394
mean length of turn in mm	150
approximate weight in g	13
maximum temperature in ^{o}C	180

The dimensions are according to German specification D.I.N. 41305.

CHARACTERISTIC CURVES

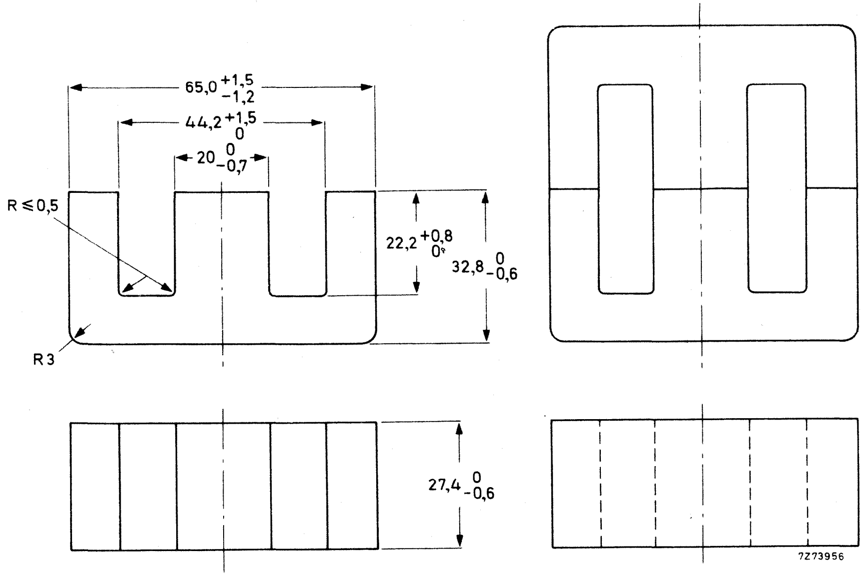
HANNA CURVES (typical values)

Indicating optimum inductance for a certain airgap and direct current



E-CORE

Dimensions in mm



Mass	approx. 203 g
Ferroxcube grade	3C8
Catalogue number of E-core	4312 020 34380

SHELL TYPE TRANSFORMER EE 65/66/27

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 EE65/66/27 composed of two cores type E65/33/27.

Effective parameters for a pair of cores

Effective magnetic path length	l_e = 147 mm
Effective cross-sectional area	A_e = 532 mm^2
Core constant	$C_1 (= \Sigma \frac{l_e}{A_e}) = 0,275$ mm^{-1}
Effective core volume	V_e = 78200 mm^3

Magnetic properties; $\Delta = 0$

At f = 16 kHz, $\hat{B}$ = 200 mT, θ = 25 °C	P ≤ 9,5 W
θ = 100 °C	P ≤ 8,7 W
At f = 16 kHz, $\hat{B}$ ≥ 315 mT, θ = 100 °C	$\hat{H}$ = 250 A/m

EC-cores

INTRODUCTION

Ferroxcube EC-cores are specially designed to meet the stringent demands placed on power supply transformers (e.g. switched-mode power supplies) operating at 10 kHz or higher. At these high frequencies the eddy current losses in the Ferroxcube are very low due to its high resistivity, and the permeability of the Ferroxcube is still the same as at low frequencies. In general, therefore, this means a much smaller transformer can be designed than with laminated iron cores.

EC-cores are supplied in the 3C8 manganese zinc ferrite grade, which meets the main magnetic requirements for power transformer cores, namely:

- high maximum flux density (B) and high relative amplitude permeability (μ_a)
- high resistivity (ρ) to ensure low eddy current losses
- high Curie point, so that magnetic properties are retained at high temperature (up to 200 °C)
- in the operating temperature range (up to 100 °C), losses drop with increasing temperature.

Note: The E-cores E42/21/20, E42/33/20, E55/28/25 and E65/33/27 are also suited for use in power supplies. For data on these cores, see "Ferroxcube transformers cores".

CORE SELECTION

In order to simplify the design of transformers with Ferroxcube EC-cores for switched-mode power supply converters, a set of graphs is given that allows a fairly accurate first design to be made in the minimum of time.
The four graphs are based upon simplified assumptions of normal working conditions. These are:
- the core hot-spot temperature, which occurs in the centre leg, is 40 °C above ambient (ΔT_{cp-a} = 40 °C) and the average winding temperature is 100 °C;
- $F_W/F_R \leq 0,4$ in which
  F_W = ratio of total copper area in the transformer winding to available winding window;
  F_R = ratio of winding a.c. resistance to d.c. resistance;
- the ratio of maximum permissible core peak flux to normal core peak flux ($\phi_{M\,max}/\phi_M$) is constant;
- a 4 mm clearance for creepage distance is allowed at each end of the winding.

Several winding configurations are allowed for in the graphs. In push-pull transformers, all windings contribute to the useful power. They are:
(1 + 1) a single primary and a single secondary;
(1 + 2) a single primary and a split secondary, or
(2 + 1) a split primary and a single secondary;
(2 + 2) a split primary and a split secondary.
For forward converter transformers and flyback converter transformers only the (1 + 1) configuration has been allowed for in the graphs.

It has been assumed that each winding or each half of a split winding, occupies the same space as every other winding. That is, in the (1 + 2) case, each winding occupies 1/3 of the total winding space.

Using the graphs

Select the appropriate graph. Find the intersection of the chosen operating frequency (f) and the required throughput power (P_o). The required core type is that corresponding to the intended winding configuration lying immediately above the intersection.

Notes: If the centre-pole temperature rise is other than the 40 °C assumed, then the value of throughput power used for core selection should be modified. The new value, P_o', is given by

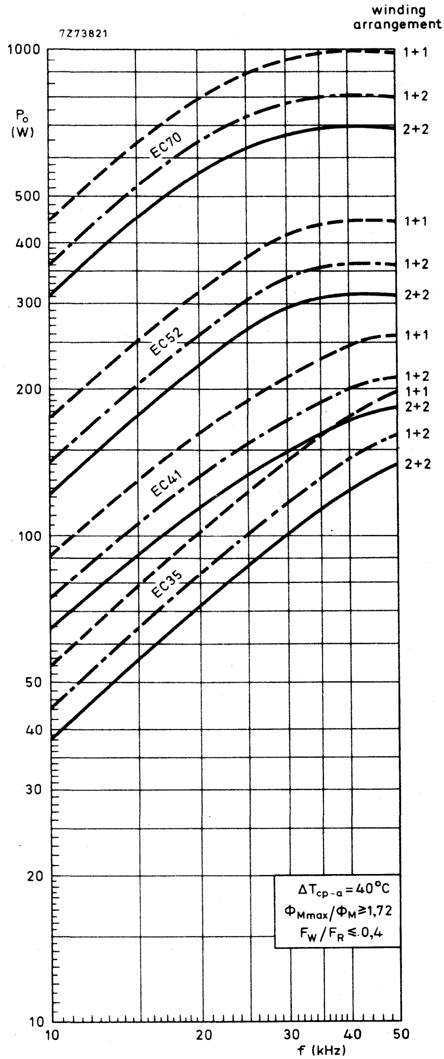
$$P_o' = P_o \sqrt{(\Delta T_{cp-a}/40)} = P_o \sqrt{\left\{(100 - T_a)/40\right\}}$$

in which T_a = ambient temperature in °C.

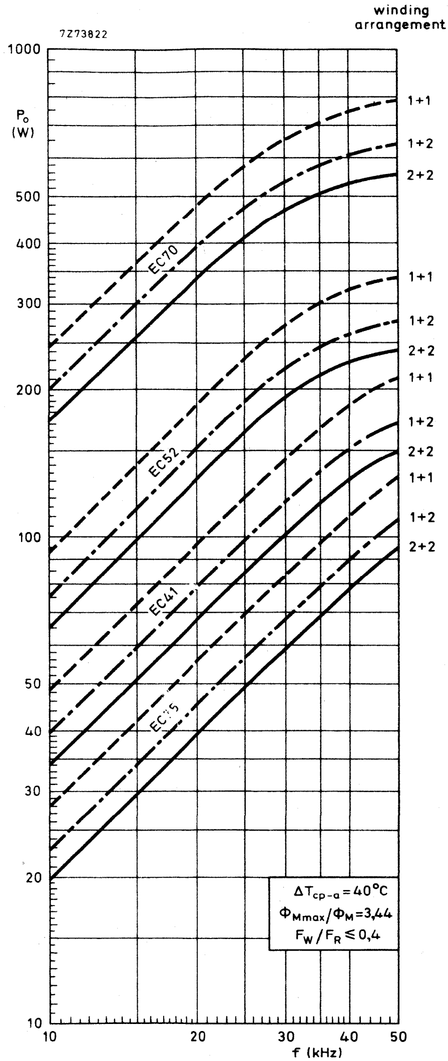
The graph for flyback converter transformers contains the parameter γ, the value of which depends on the converter properties.

Symbol γ indicates the ratio of minimum d.c. output current ($I_{o\ min}$) to maximum d.c. output current ($I_{o\ max}$) [1].
For preliminary core selection an approximate choice of value of γ will suffice.
The value $\gamma = 1$ corresponds to the ringing choke type, in which the transformer core flux falls to zero during each cycle.
The value $\gamma = 0,25$ corresponds to a flyback converter in which the flux does not fall to zero, even under full load conditions ($I_{o\ min} = 25\%\ I_{o\ max}$).

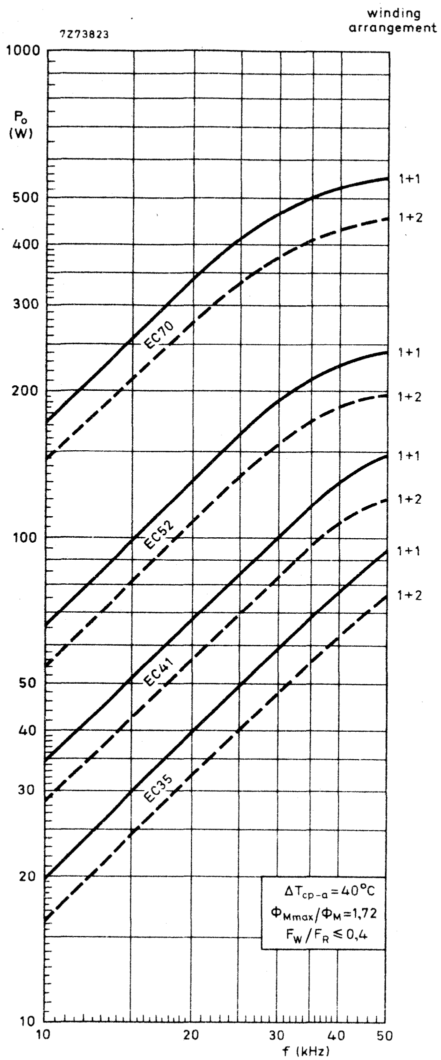
[1]) Various publications on switched-mode power supplies have used the symbol Δ for this ratio. The symbol γ has been introduced here to avoid confusion with the symbol used for the air gap.



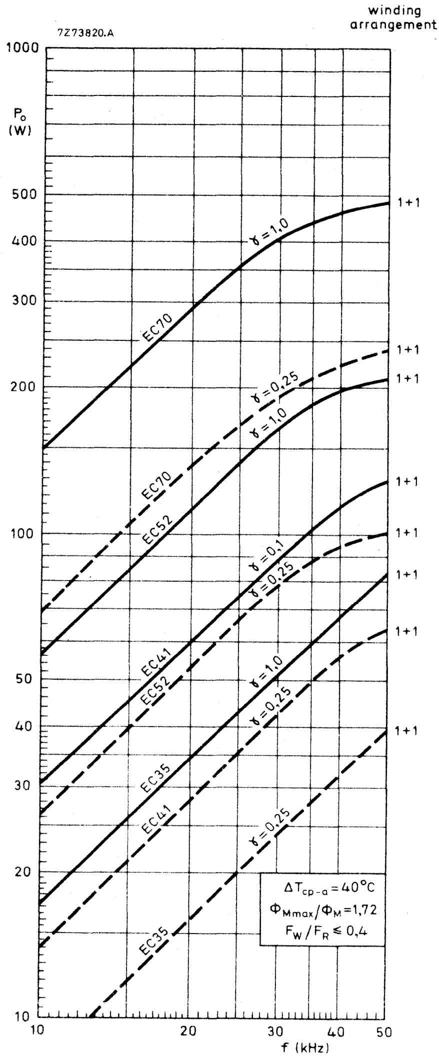
Balanced push-pull converter transformers.



Unbalanced push-pull converter transformers.



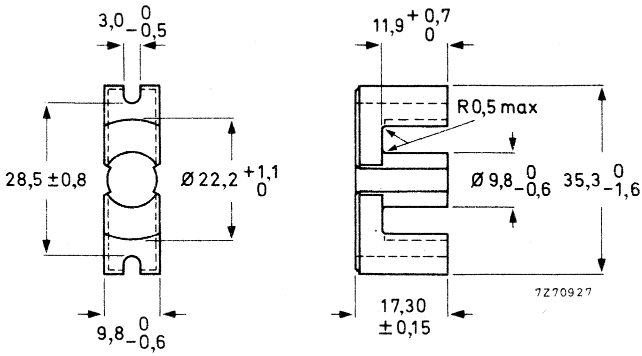
Forward-converter transformers.



Flyback-converter transformers.

EC-CORE

Dimensions in mm



Ferroxcube grade	3C8
Mass	approx. 18 g
Catalogue number of EC-core without air gap	4322 020 52500
Catalogue number of EC-core with air gap 1,4 ± 0,2 mm	8213 140 25270 ←

DIMENSIONAL PARAMETERS FOR A PAIR OF CORES (assuming nominal dimensions, unless otherwise stated)

Core constant *)	C_1	= 0,918 mm^{-1}
Minimum cross-sectional centre pole area	A_{CPmin}	= 66,5 mm^2
Cross-sectional centre pole area	A_{CP}	= 71,0 mm^2
Back and leg cross-sectional area	A_b	= 96,0 mm^2
Centre pole volume	V_{CP}	= 1740 mm^3
Back and leg volume	V_b	= 6040 mm^3
Total core volume	V_f	= 7780 mm^3
Effective magnetic path length *)	l_e	= 77,4 mm
Effective cross-sectional area *)	A_e	= 84,3 mm^2
Effective core volume *)	V_e	= 6530 mm^3

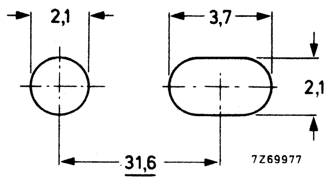
*) According to IEC 205.

MAGNETIC PROPERTIES FOR A PAIR OF CORES WITHOUT AIR GAP

Relative amplitude permeability (μ_a) at θ = 100 °C, B = 320 mT	> 1000
Permissible induction in centre pole ($\hat{B}$) with min. cross-sectional area, at θ = 100 °C	≤ 320 mT
Resistivity (ρ), measured with d.c. current	≥ 1 Ωm
Curie point	≥ 200 °C
Effective total core loss (P) at f = 25 kHz, θ = 100 °C, B = 160 mT	≤ 1, 1 W

MOUNTING

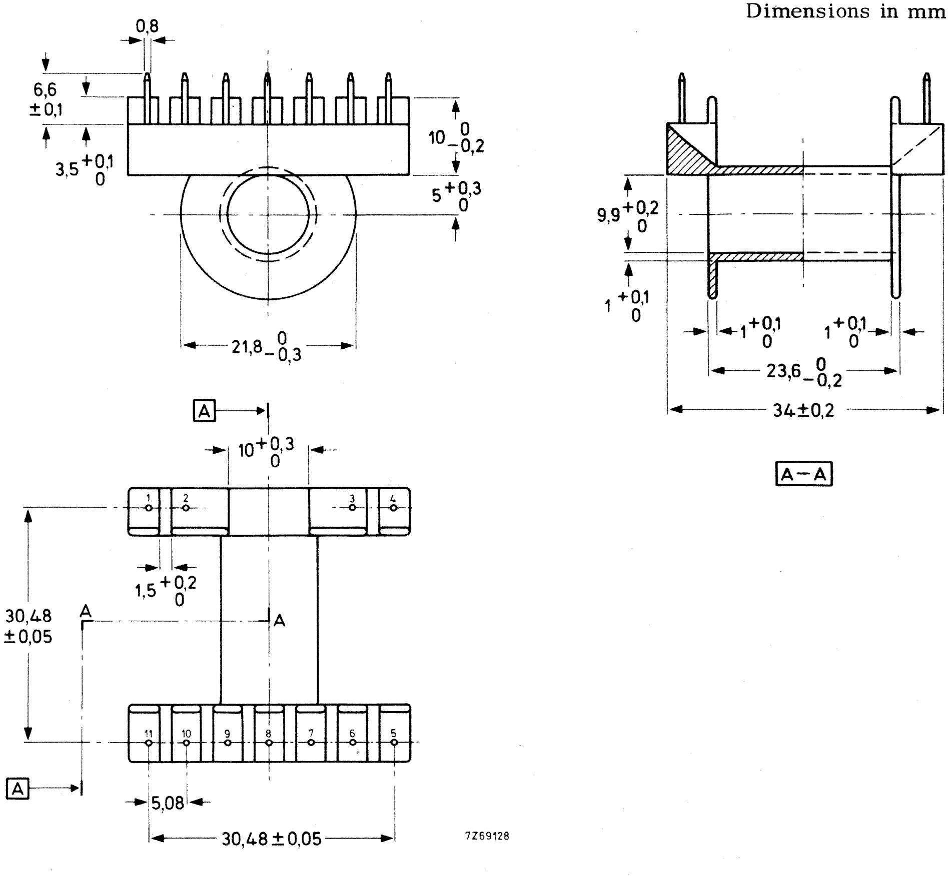
The wound coil former and cores may be assembled by means of non-magnetic M2 screws or studs along the grooves provided. The use of a clamping bar is strongly recommended to ensure that the maximum clamping force of 200 N is uniformly distributed over the cross-section of the outer poles.
The assembly studs can be extended for mounting purposes or to support another sub-assembly.



Recommended piercing diagram.

COIL FORMER

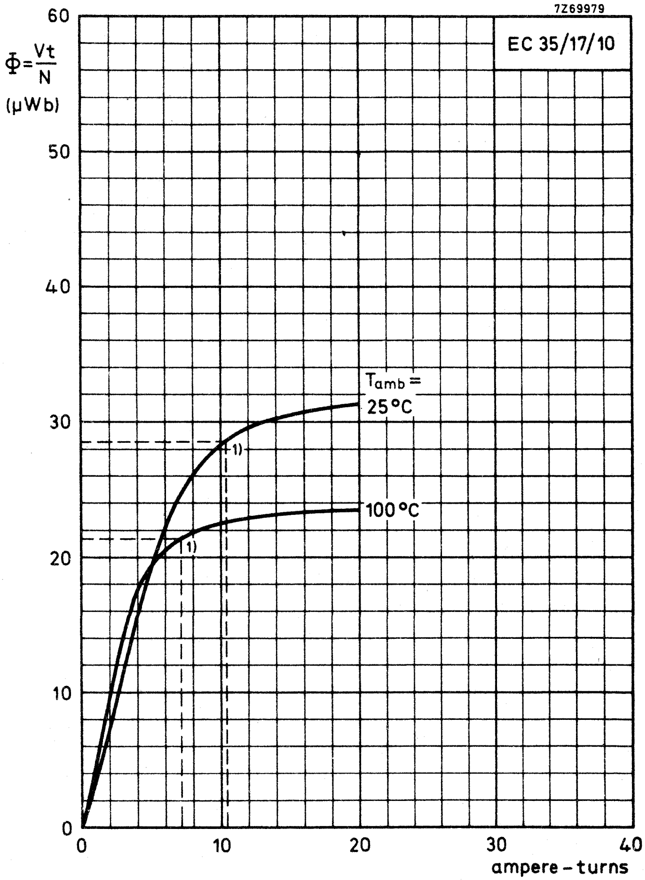
Dimensions in mm



Material	phenolformaldehyde reinforced with glass fibre; brass dip-solder pins
Minimum window area	97,5 mm^2 ←
Mean length of turn	50 mm
Mass	approx. 6 g
Maximum temperature	140 ^{o}C
Catalogue number (coil former with pins)	8222 294 38650 ←

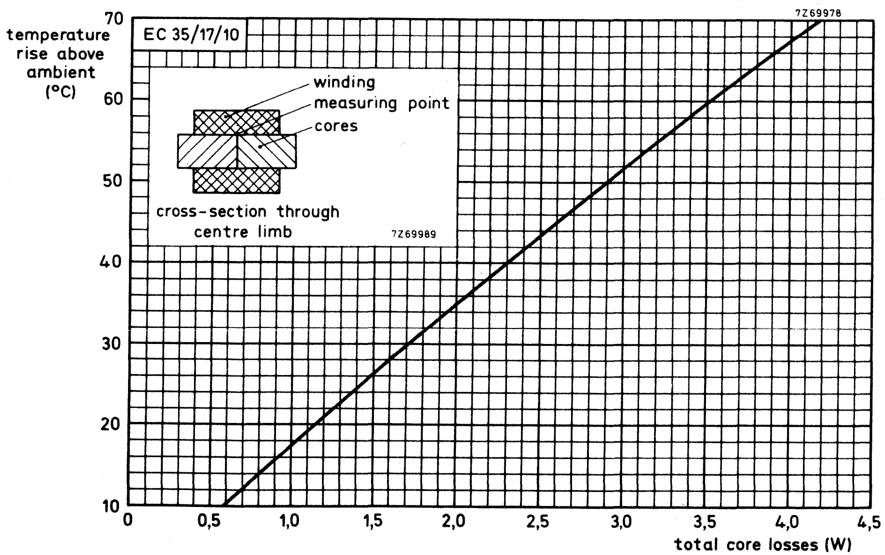
Note : Other coil formers for core EC35/17/10 are available under catalogue numbers 4322 021 33000 and 4313 021 04143; information will be supplied on request.

CHARACTERISTIC CURVES

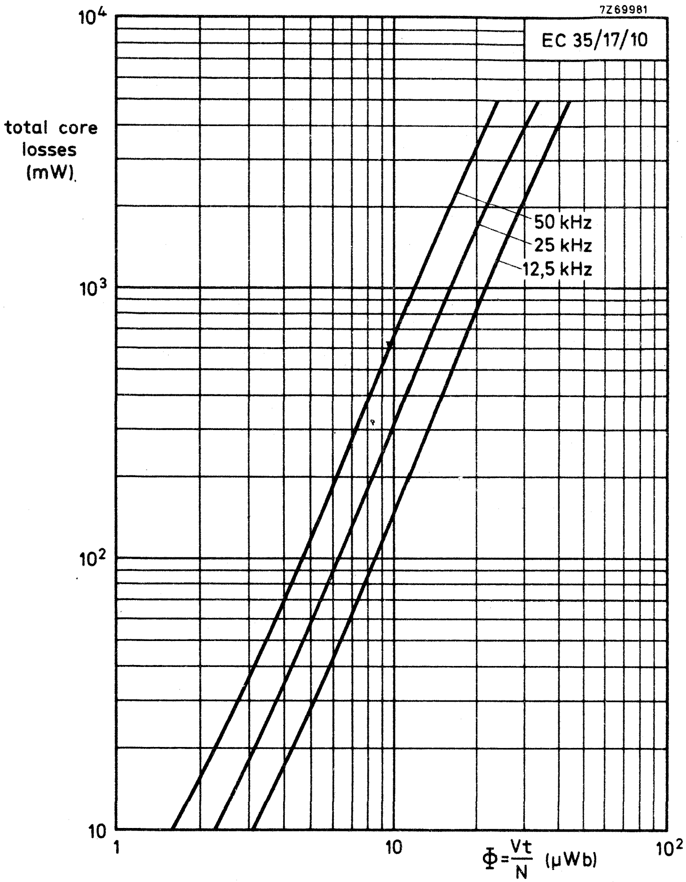


Total flux as a function of ampere-turns.
1) Recommended maximum working flux.

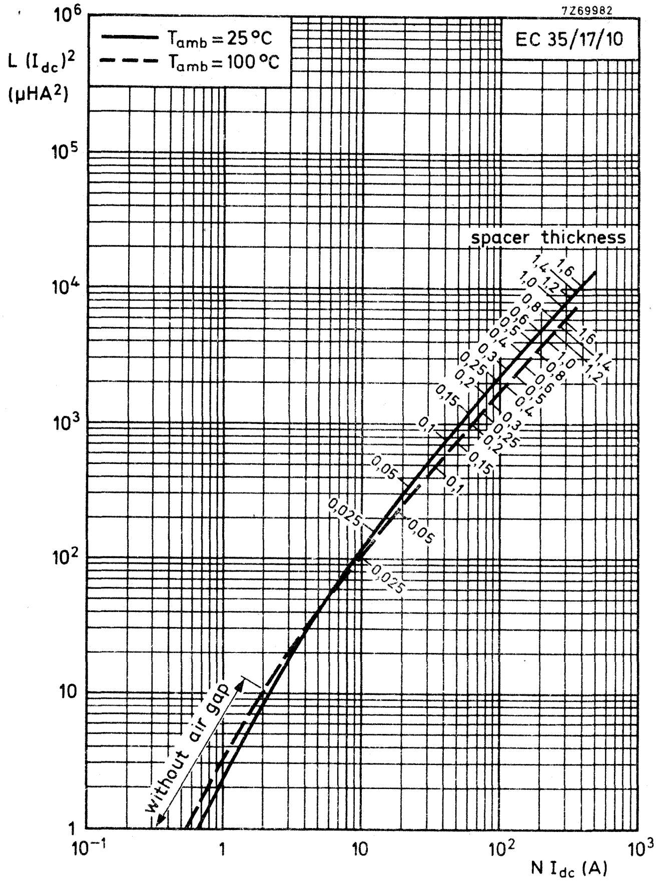
Recommended maximum working flux as a function of core temperature.



Transformer temperature rise as a function of total core losses, in free air conditions, without heatsink.



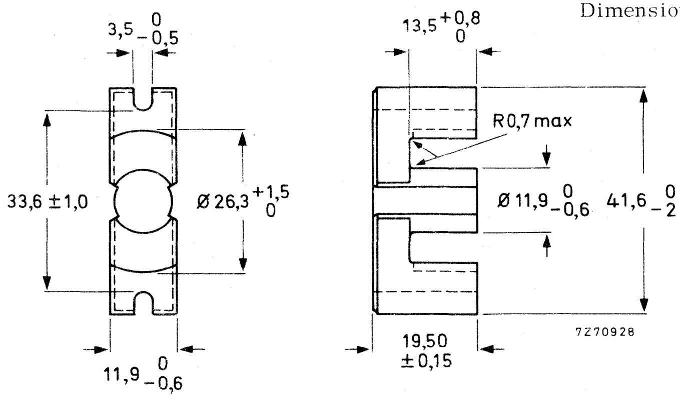
Total core losses as a function of total flux at hot-spot core temperature.



Hanna curves

EC-CORE

Dimensions in mm



Ferroxcube grade	3C8
Mass	approx. 26 g
Catalogue number of EC-core without air gap	4322 020 52510
Catalogue number of EC-core with air gap 1,5 ± 0,2 mm	8213 140 25280 ←

DIMENSIONAL PARAMETERS FOR A PAIR OF CORES (assuming nominal dimensions, unless otherwise stated)

Core constant *)	C_1	= 0,735 mm^{-1}
Minimum cross-sectional centre pole area	A_{CPmin}	= 100,3 mm^2
Cross-sectional centre pole area	A_{CP}	= 106 mm^2
Back and leg cross-sectional area	A_b	= 130 mm^2
Centre pole volume	V_{CP}	= 2950 mm^3
Back and leg volume	V_b	= 9650 mm^3
Total core volume	V_f	= 12600 mm^3
Effective magnetic path length *)	l_e	= 89,3 mm
Effective cross-sectional area *)	A_e	= 121 mm^2
Effective core volume *)	V_e	= 10800 mm^3

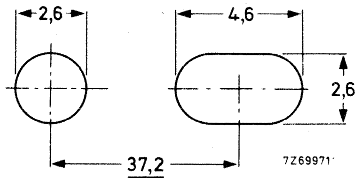
*) According to IEC 205.

→ MAGNETIC PROPERTIES FOR A PAIR OF CORES WITHOUT AIR GAP

Relative amplitude permeability (μ_a) at θ = 100 °C, B = 320 mT	> 1000
Permissible induction in centre pole ($\hat{B}$) with min. cross-sectional area, at θ = 100 °C	≤ 320 mT
Resistivity (ρ), measured with d.c. current	≥ 1 Ωm
Curie point	≥ 200 °C
Effective total core loss (P) at f = 25 kHz, θ = 100 °C, B = 160 mT	≤ 2,2 W

MOUNTING

→ The wound coil former and cores may be assembled by means of non-magnetic M2,5 screws or studs along the grooves provided. The use of a clamping bar is strongly recommended to ensure that the maximum clamping force of 250 N is uniformly distributed over the cross-section of the outer poles.
The assembly studs can be extended for mounting purposes or to support another sub-assembly.

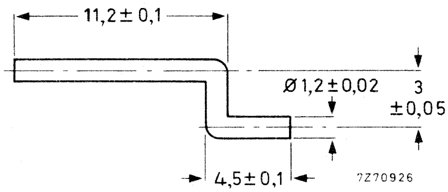


Recommended piercing diagram.

COIL FORMER

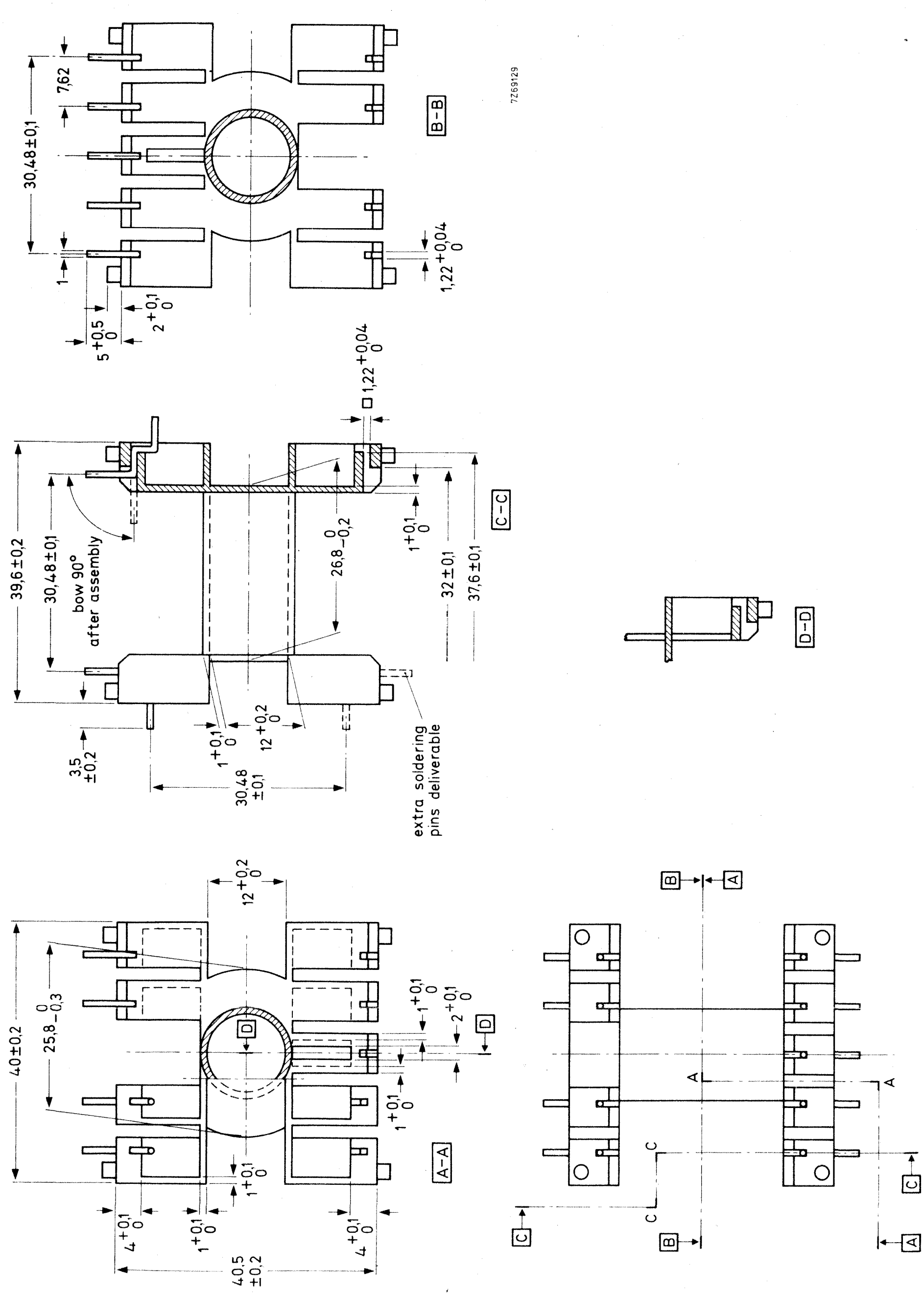
Dimensions in mm	see drawing on the next page
Material	polyamide reinforced with glass fibre
Minimum window area	136 mm^2
Mean length of turn	60 mm
Mass, without pins	approx. 10 g
Maximum temperature	120 °C
Catalogue number	8222 294 38660

Note 1: The coil former is supplied without pins. These must be ordered separately under the catalogue number 8222 294 38770. The minimum order quantity is 5000 pins.

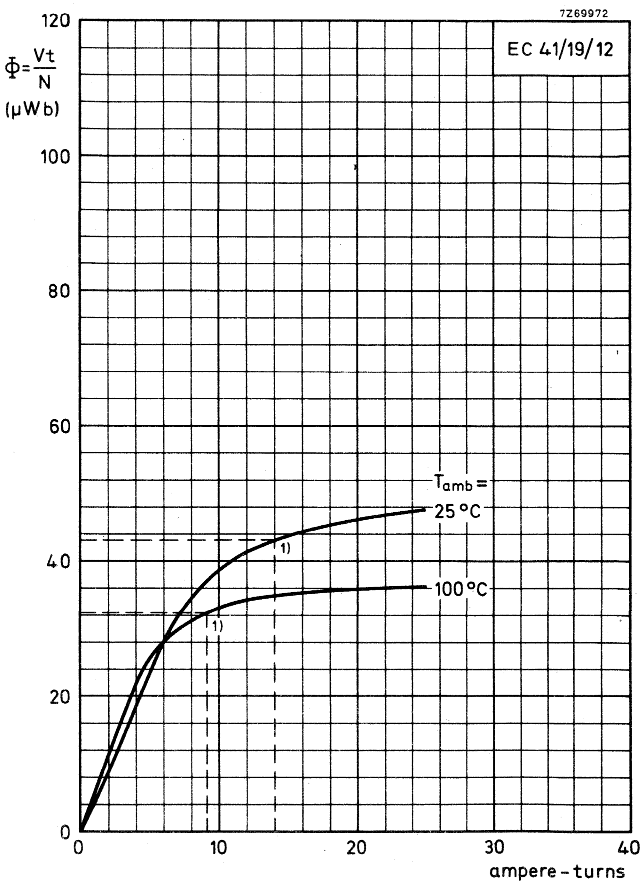


Brass dip-solder pin

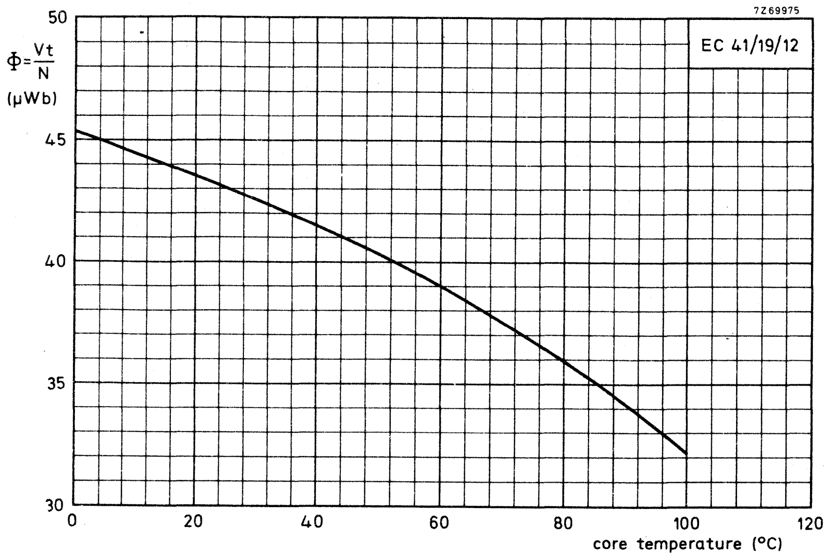
Note 2: Other coil formers for core EC41/19/12 are available under catalogue numbers 4322 021 33010 and 4313 021 04153; information will be supplied on request.


B-B
C-C
D-D
A-A
7Z69129
30,48±0,1
7,62
1,22 +0,04 0
2 +0,1 0
5 +0,5 0
39,6±0,2
30,48±0,1
bow 90° after assembly
26,8 0 −0,2
32±0,1
37,6±0,1
3,5 ±0,2
12 +0,2 0
extra soldering pins deliverable
40±0,2
25,8 0 −0,3
4 +0,1 0
40,5 ±0,2

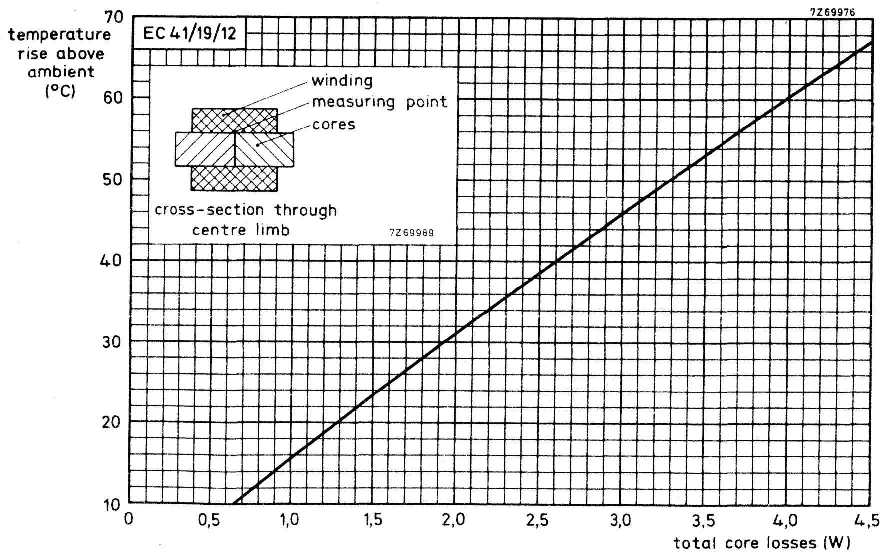
CHARACTERISTIC CURVES



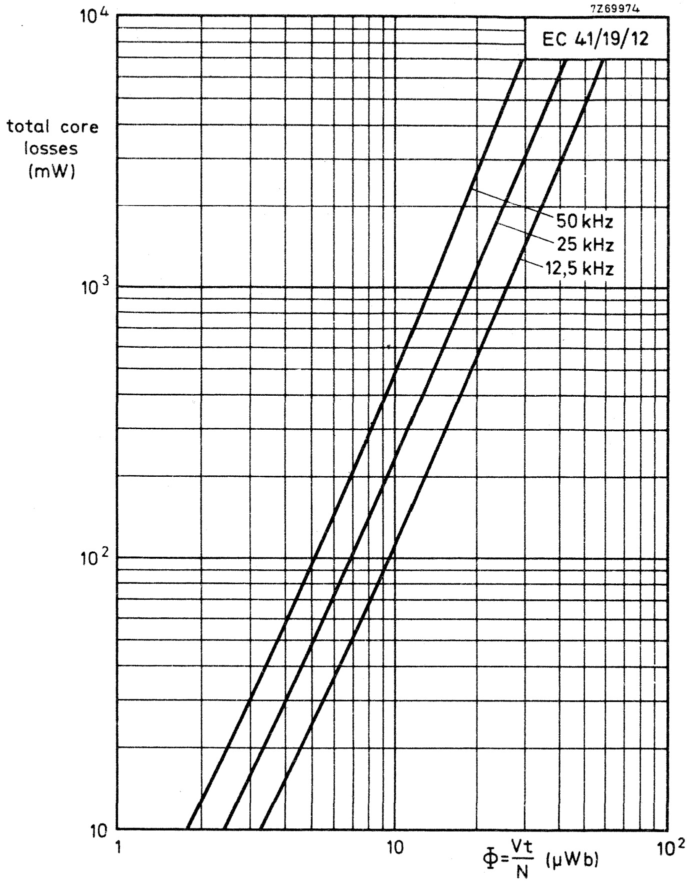
Total flux as a function of ampere-turns.
1) Recommended maximum working flux.



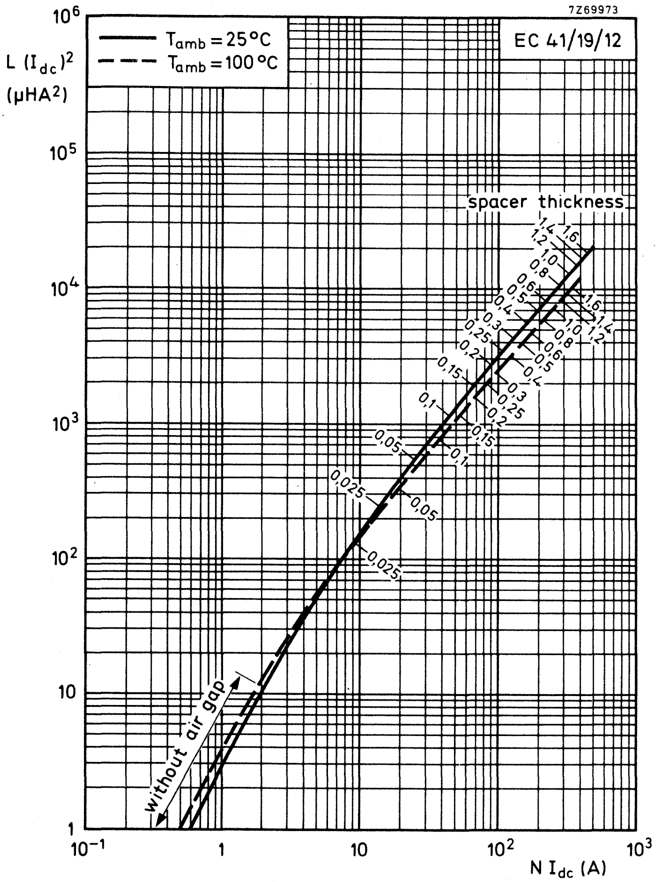
Recommended maximum working flux as a function of core temperature.



Transformer temperature rise as a function of total core losses, in free air conditions, without heatsink.

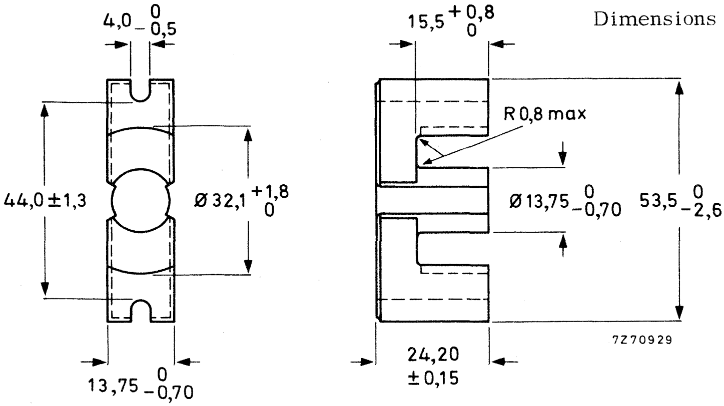


Total core losses as a function of total flux at hot-spot core temperature.



Hanna curves

EC-CORE



Ferroxcube grade	3C8
Mass	approx. 55,5 g
Catalogue number of EC-core without air gap	4322 020 52520
Catalogue number of EC-core with air gap 2,3 ± 0,2 mm	8213 140 25290 ←

DIMENSIONAL PARAMETERS FOR A PAIR OF CORES (assuming nominal dimensions, unless otherwise stated)

Core constant *)	C_l	= 0,581 mm^{-1}
Minimum cross-sectional centre pole area	A_{CPmin}	= 133,8 mm^2
Cross-sectional centre pole area	A_{CP}	= 141,0 mm^2
Back and leg cross-sectional area	A_b	= 222,0 mm^2
Centre pole volume	V_{CP}	= 4480 mm^3
Back and leg volume	V_b	= 19820 mm^3
Total core volume	V_f	= 24300 mm^3
Effective magnetic path length *)	l_e	= 105 mm
Effective cross-sectional area *)	A_e	= 180 mm^2
Effective core volume *)	V_e	= 18800 mm^3

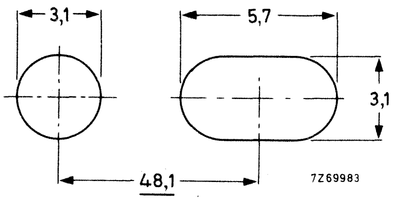
*) According to IEC 205.

→ MAGNETIC PROPERTIES FOR A PAIR OF CORES WITHOUT AIR GAP

Relative amplitude permeability (μ_a) at θ = 100 °C, B = 320 mT	> 1000
Permissible induction in centre pole ($\hat{B}$) with min. cross-sectional area, at θ = 100 °C	≤ 320 mT
Resistivity (ρ), measured with d.c. current	≥ 1 Ωm
Curie point	≥ 200 °C
Effective total core loss (P) at f = 25 kHz, θ = 100 °C, B = 160 mT	≤ 2,7 W

MOUNTING

→ The wound coil former and cores may be assembled by means of non-magnetic M3 screws or studs along the grooves provided. The use of a clamping bar is strongly recommended to ensure that the maximum clamping force of 400 N is uniformly distributed over the cross-section of the outer poles.
The assembly studs can be extended for mounting purposes or to support another sub-assembly.

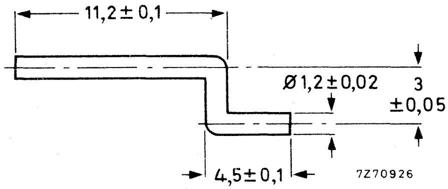


Recommended piercing diagram.

COIL FORMER

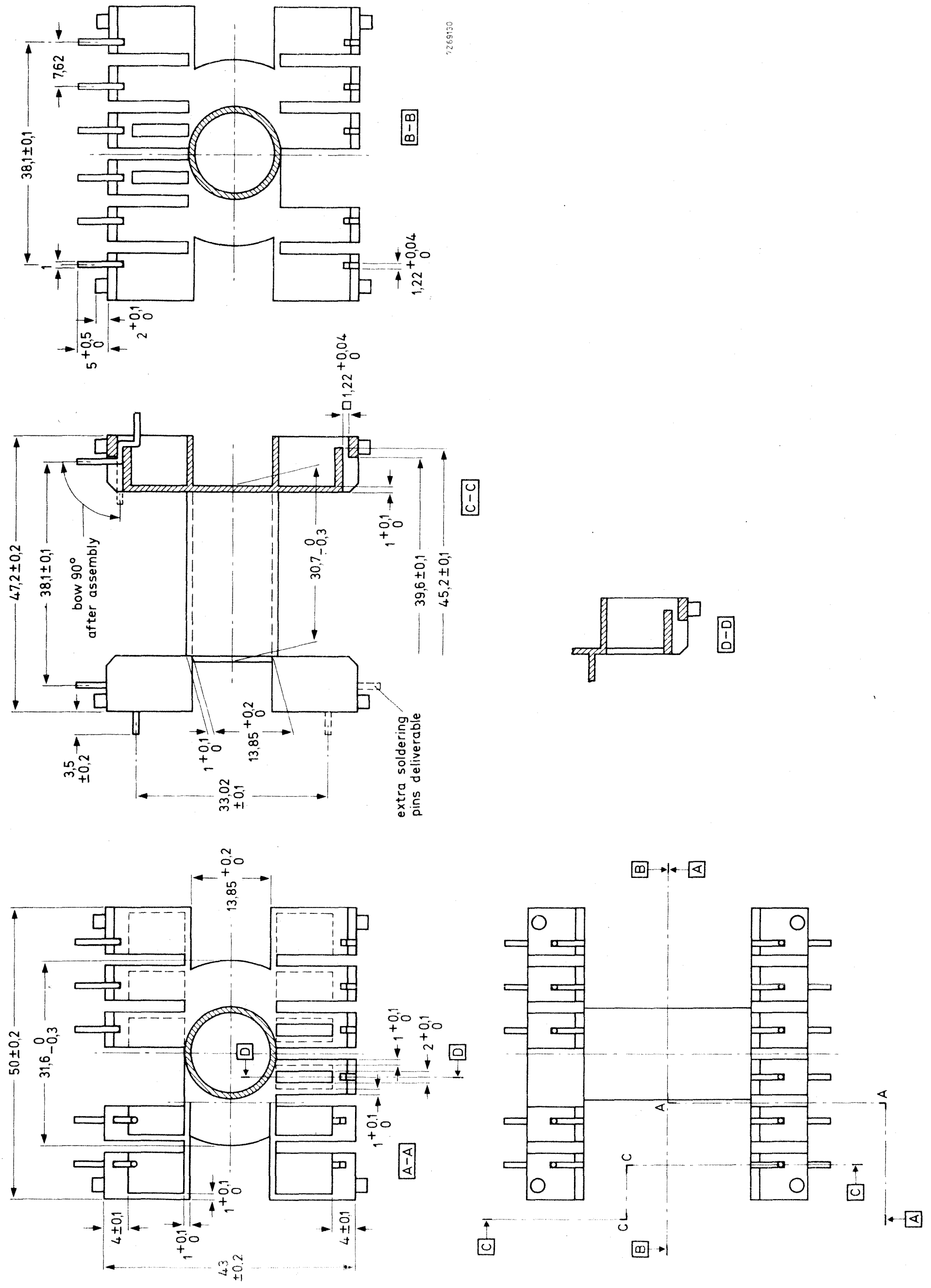
Dimensions in mm	see drawing on the next page
Material	polyamide reinforced with glass fibre
Minimum window area	212 mm^2 ←
Mean length of turn	73 mm
Mass, without pins	approx. 15 g
Maximum temperature	120 °C
Catalogue number	8222 294 38670

Note 1: The coil former is supplied without pins. These must be ordered separately under the catalogue number 8222 294 38770. The minimum order quantity is 5000 pins.

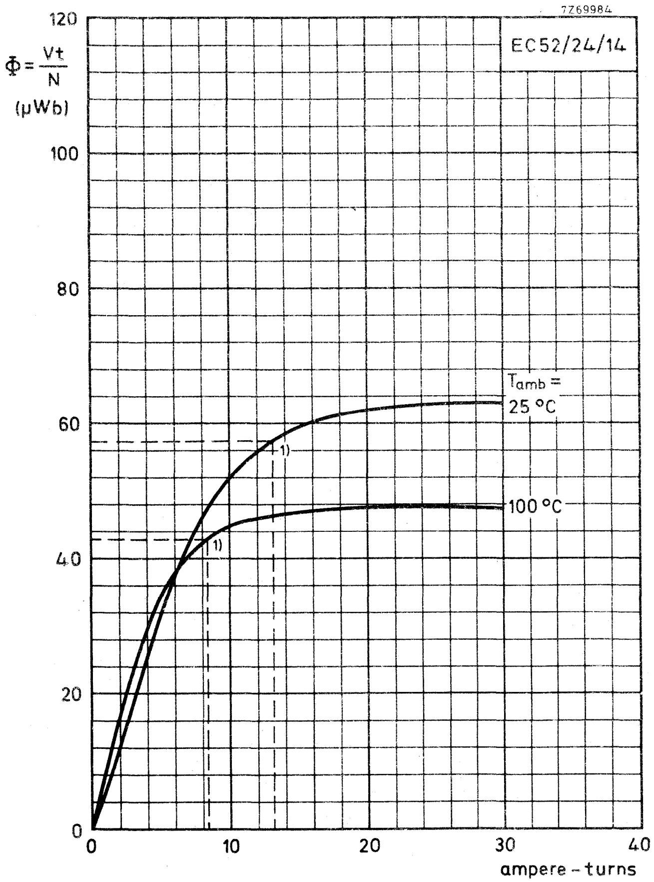


Brass dip-solder pin

Note 2: Other coil formers for core EC52/24/14 are available under catalogue numbers 4322 021 33020 and 4313 021 04163; information will be supplied on request.

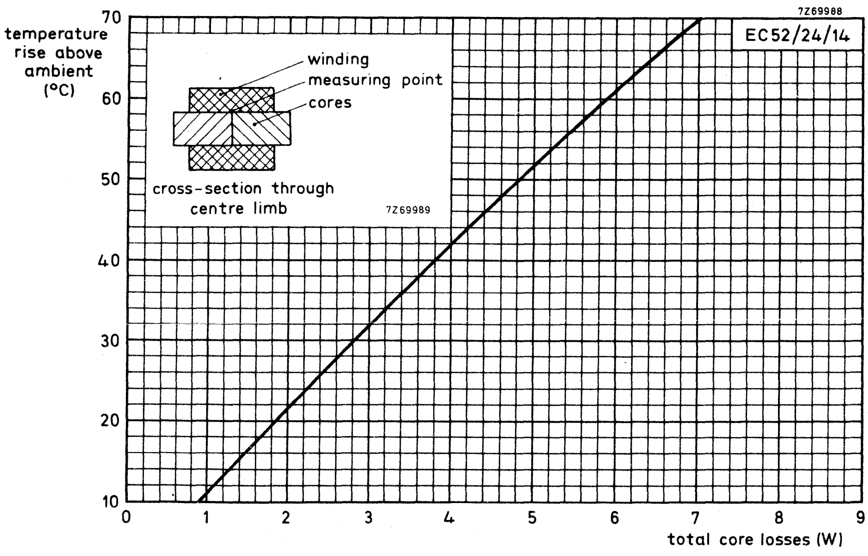

B-B
C-C
D-D
A-A
bow 90° after assembly
extra soldering pins deliverable
7,62
38,1±0,1
47,2±0,2
39,6±0,1
45,2±0,1
33,02 ±0,1
50±0,2
43 ±0,2
7Z69130

CHARACTERISTIC CURVES

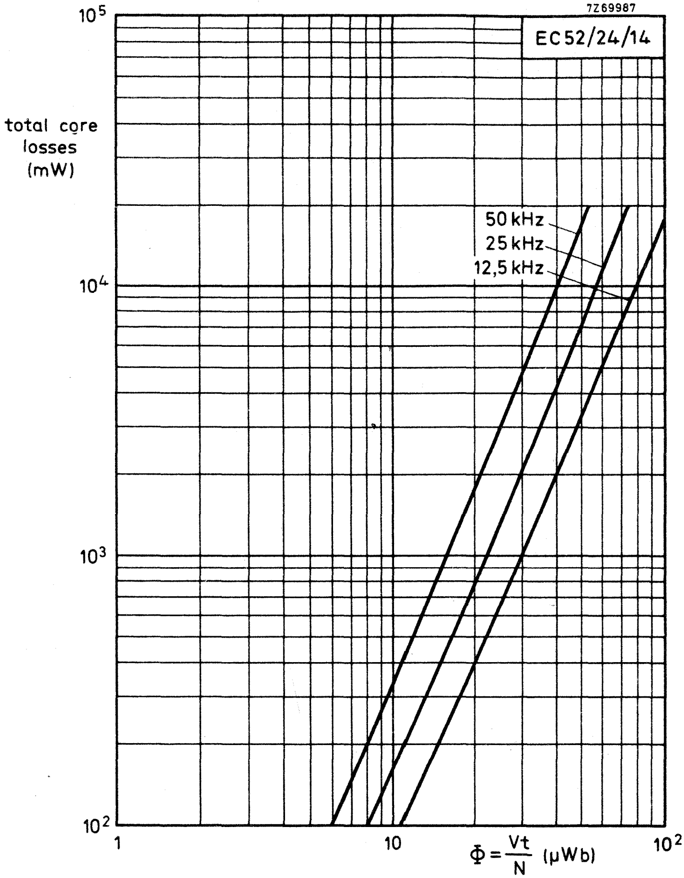


Total flux as a function of ampere-turns.
1) Recommended maximum working flux.

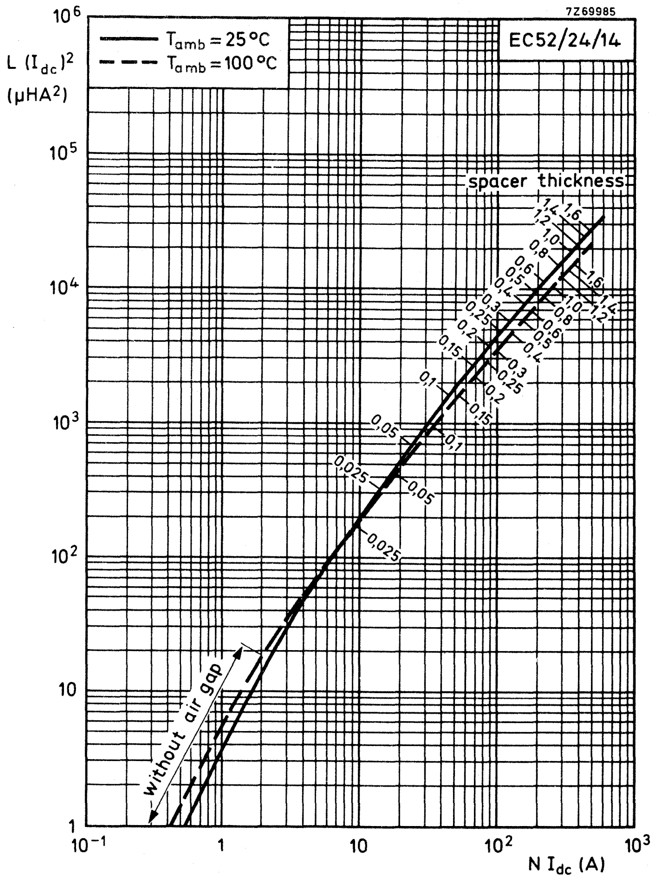
Recommended maximum working flux as a function of core temperature.



Transformer temperature rise as a function of total core losses, in free air conditions, without heatsink.



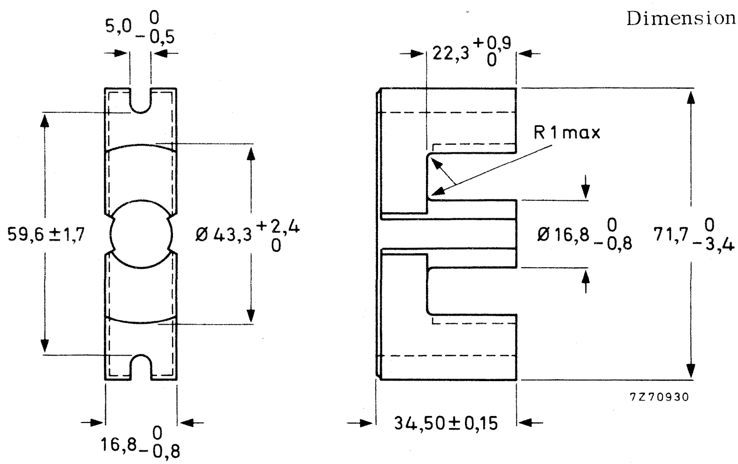
Total core losses as a function of total flux at hot-spot core temperature.



Hanna curves

EC-CORE

Dimensions in mm



Ferroxcube grade	3C8
Mass	approx. 126,5 g
Catalogue number of EC-core without air gap	4322 020 52530
Catalogue number of EC-core with air gap 4,85 ± 0,2 mm	8213 140 25300

DIMENSIONAL PARAMETERS FOR A PAIR OF CORES (assuming nominal dimensions, unless otherwise stated)

Core constant *)	C_1	$= 0,514\ mm^{-1}$
Minimum cross-sectional centre pole area	A_{CPmin}	$= 201,1\ mm^2$
Cross-sectional centre pole area	A_{CP}	$= 211,0\ mm^2$
Back and leg cross-sectional area	A_b	$= 386,0\ mm^2$
Centre pole volume	V_{CP}	$= 9600\ mm^3$
Back and leg volume	V_b	$= 46000\ mm^3$
Total core volume	V_f	$= 55600\ mm^3$
Effective magnetic path length *)	l_e	$= 144\ mm$
Effective cross-sectional area *)	A_e	$= 279\ mm^2$
Effective core volume *)	V_e	$= 40100\ mm^3$

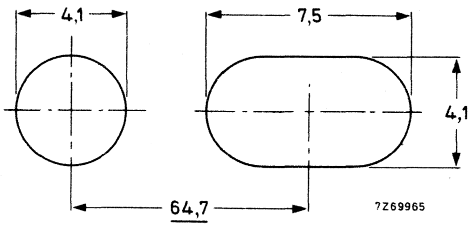
*) According to IEC 205.

→ MAGNETIC PROPERTIES FOR A PAIR OF CORES WITHOUT AIR GAP

Relative amplitude permeability (μ_a) at θ = 100 °C, B = 320 mT	> 1000
Permissible induction in centre pole ($\hat{B}$) with min. cross-sectional area, at θ = 100 °C	≤ 320 mT
Resistivity (ρ), measured with d.c. current	≥ 1 Ωm
Curie point	≥ 200 °C
Effective total core loss (P) at f = 25 kHz, θ = 100 °C, B = 160 mT	≤ 5 W

MOUNTING

→ The wound coil former and cores may be assembled by means of non-magnetic M4 screws or studs along the grooves provided. The use of a clamping bar is strongly recommended to ensure that the maximum clamping force of 600 N is uniformly distributed over the cross-section of the outer poles.
The assembly studs can be extended for mounting purposes or to support another sub-assembly.

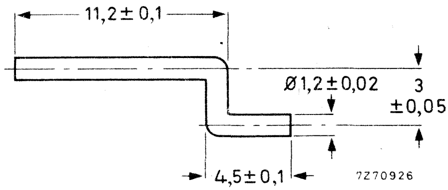


Recommended piercing diagram.

COIL FORMER

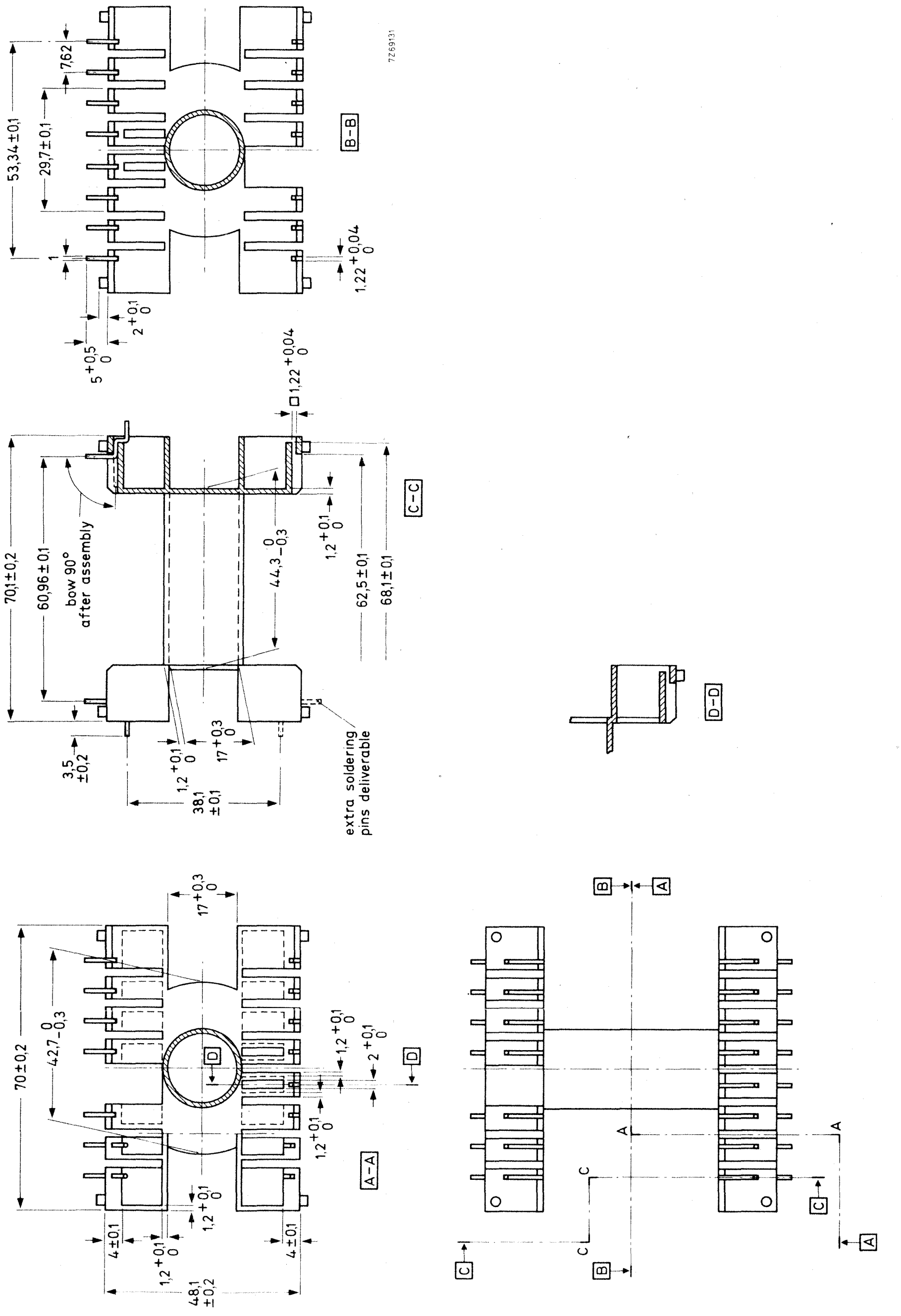
Dimensions in mm	see drawing on the next page
Material	polyamide reinforced with glass fibre
Minimum window area	466 mm^2
Mean length of turn	95 mm
Mass, without pins	approx. 35 g
Maximum temperature	120 °C
Catalogue number	8222 294 38680

Note 1: The coil former is supplied without pins. These must be ordered separately under the catalogue number 8222 294 38770. The minimum order quantity is 5000 pins.

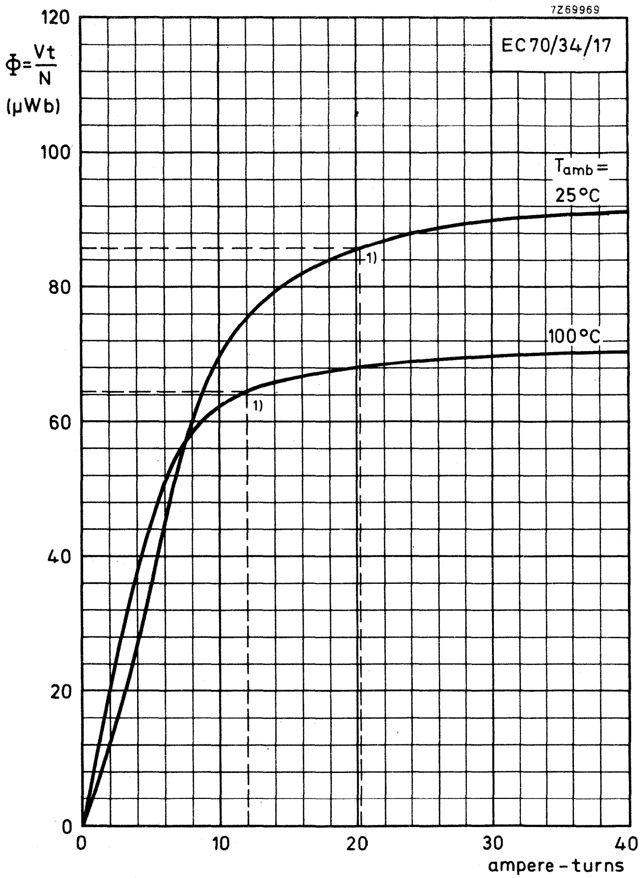


Brass dip-solder pin

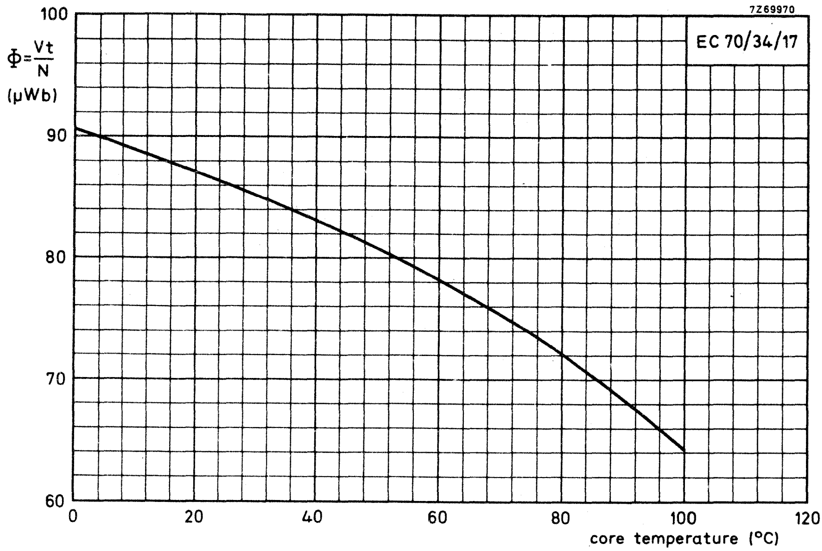
Note 2: Other coil formers for core EC70/34/17 are available under catalogue numbers 4322 021 33030 and 4313 021 04173; information will be supplied on request.


7Z69131
B-B
C-C
bow 90° after assembly
extra soldering pins deliverable
D-D
A-A

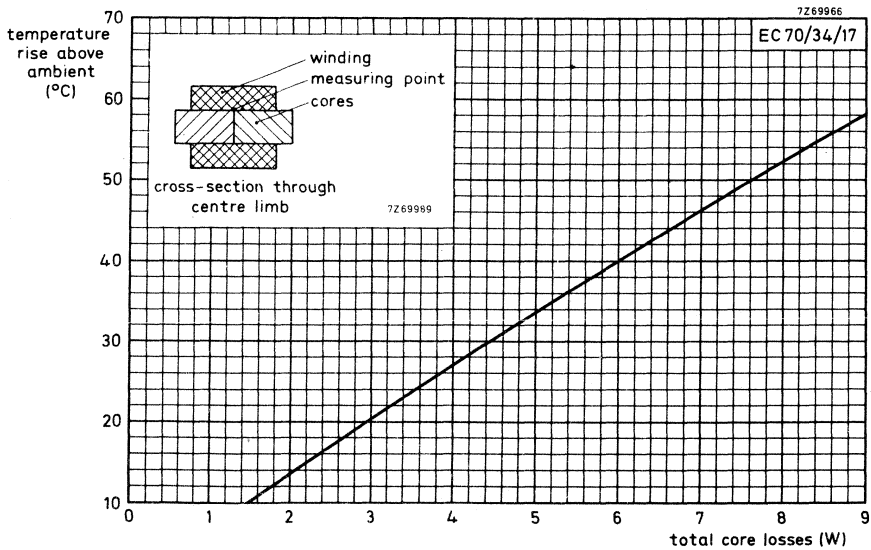
CHARACTERISTIC CURVES



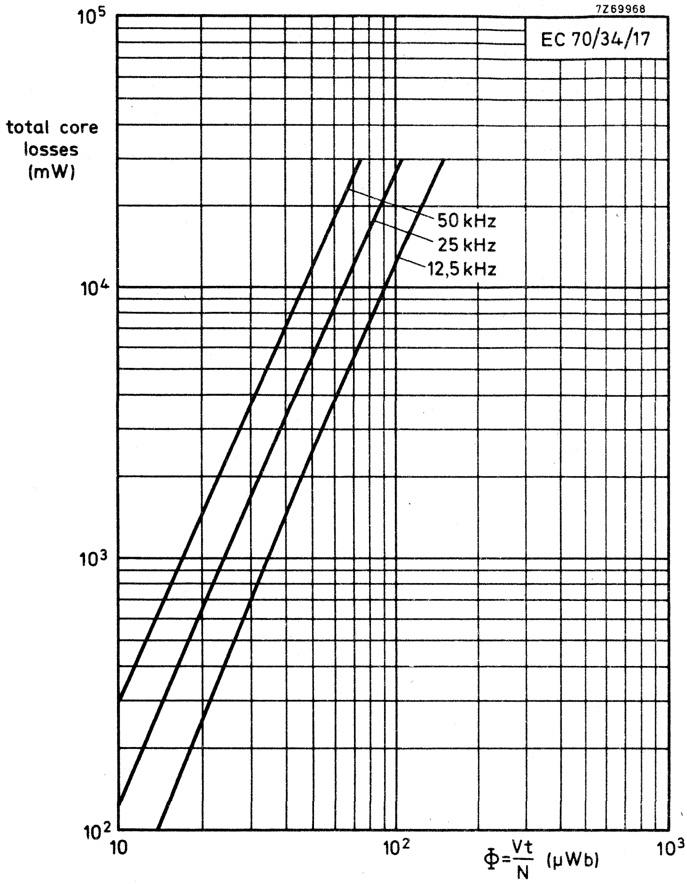
Total flux as a function of ampere-turns.
1) Recommended maximum working flux.



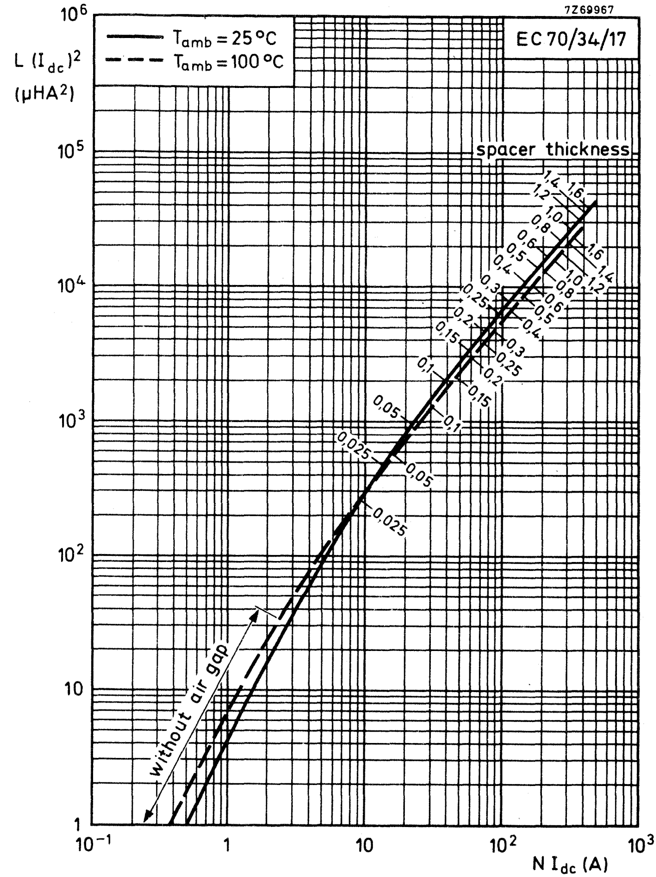
Recommended maximum working flux as a function of core temperature.



Transformer temperature rise as a function of total core losses, in free air conditions, without heatsink.



Total core losses as a function of total flux at hot-spot core temperature.



Hanna curves

H- cores

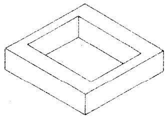
INTRODUCTION

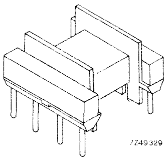
The development of magnetic core materials with high initial permeability for series production opened the way for the construction of transformer cores of very small dimensions without the loss of transformer performance.
One of the problems immediately arising when miniaturizing magnetic cores is that the high initial material permeability practically always is reduced considerably by an unavoidable airgap except when the toroid shape is used. However, for application in transformers the toroid has the disadvantage of being difficult to wind and time consuming in assembly.
The H-core transformer shape overcomes the above mentioned disadvantages with a minimum of component parts and has moreover the advantage that it may be wound on simple conventional winding machines.
The magnetic circuit is closed by a core in the shape of a rectangular window.
The two parts are sufficient to construct a complete transformer suitable for mounting on a printed-wiring board, since the coil former, which forms one piece with the H-core, is provided with soldering pins on grid module distances.

The material grade used is Ferroxcube 3E2.

The high A_L values realised with this small core combined with the proper winding technique lead to small stray capacitances and small stray inductances, in this way permitting the design of wide band transformers in a small volume.

H-CORE





The H10-core consists of a ferroxcube H-shape with coil former, a ferroxcube window, a brass container and a phosphorbronze spring.
All these components are adapted to each other.

The H10-core can only be supplied as a complete assembly.

Catalogue number of the assembly : 4322 020 33040
Approximate weight of the assembly: 2,0 g

The applied ferroxcube material is the high permeable 3E2 grade.

The jointing surfaces are very flat and smoothly lapped.

Dimensional quantities

Mean length of lines of force $l_e = 22,5$ mm
Mean area of lines of force $A_e = 7,5$ mm^2

$$\Sigma \frac{l_e}{A_e} = 3 \quad mm^{-1}$$

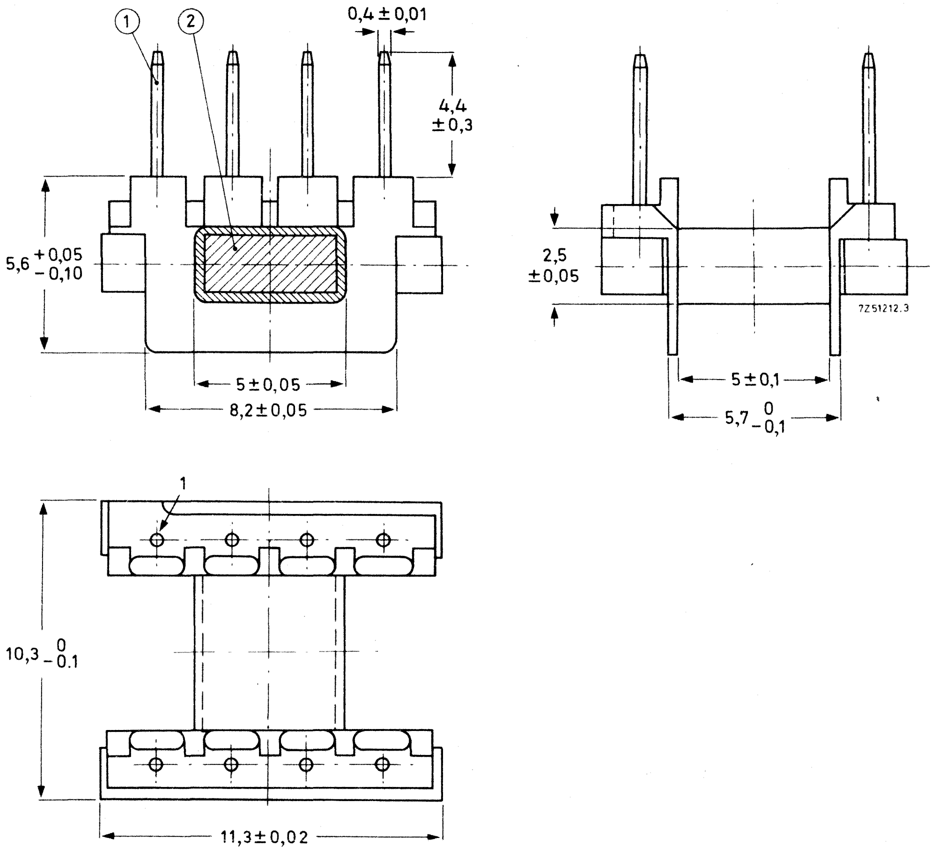
Effective volume $V_e = 170$ mm^3

Electrical requirements, measured with 20 windings of 0,20 mm wire, at $\hat{B} = 0,7-1$ mT, f = 4 kHz and a mechanical force of 1,5 N in the temperature range from +23 till +70 $^{\circ}$C, 24 hours after demagnetisation.

$\mu_e \geq 3820$
$\alpha \leq 25,0$
$A_L \geq 1600$

The eight soldering pins are arranged so as to fit printed-wiring boards with 0,1 in grid as well as those with a 2,50 mm grid. The board should be provided with holes of max. 0,8 + 0,1 mm ϕ.

COIL FORMER



(1) Pins: nickel copper wire, dipsoldered
(2) H-core: ferroxcube

The coil former and the ferroxcube H-shape are combined to one part.

Material of coil former	polyamide with dipsoldered pins of nickel copper wire
Window area in mm^2	7,6
Mean length of turn in mm	21,7
Max. temperature for dipsoldering	
for 5-6 s in ^oC	280
for 1-2 s in ^oC	360-400
Max. working temperature in ^oC	80

For speeding up the soldering operation of the winding wire to the pins, the use of self fluxing wire is advised. In case a terminal of the winding must be connected to the container, it should be soldered to pin 1 (see figure on preceding page).
The side of the coil former where the soldering pins protrude is asymmetrical providing a means for numbering the connections.

In order to avoid damage of the ferroxcube H-shape, care should be taken that during winding the turning couple exercised on this ferroxcube part is not too high.

MOUNTING PARTS

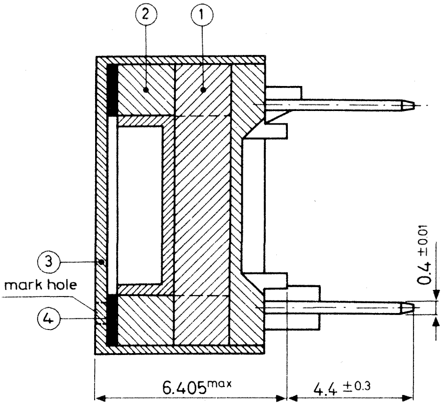


Fig. 1

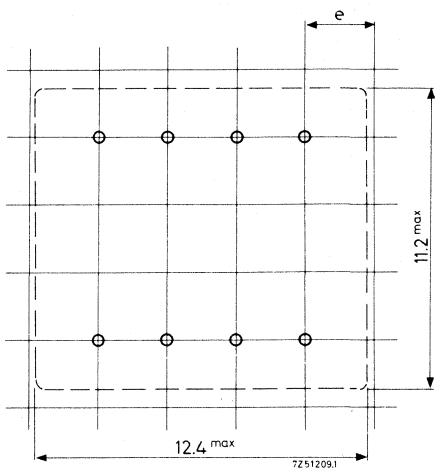


Fig. 2. Hole pattern.
e = 0, 1" or 2,50 mm.

The H10-core is only applied as a complete assembly.
Catalogue number of the assembly: 4322 020 33040

Components according to Fig. 1:
(1) Ferroxcube H-shape with polyamide coil former
(2) Ferroxcube window
(3) Brass container 4322 021 20020
(4) Phosphorbronze spring 4322 021 20390

Take care that the jointing surfaces of the two parts are very clean.

The silver reference lines on one side of the H-shape and on one side of the window should coincide. If no reference lines are given, the parts may be arbitrary positioned.

When glueing is desired, apply a suitable adhesive around the jointing surfaces of the H-shape and the window (see Fig. 3). The spots where the adhesive is to be applied should first be degreased thoroughly. A suitable adhesive is e.g. Araldit type D, with Versamide 140, mixing ratio is 70 : 30: curing time at least 24 hours at room temperature.
There is a marking hole on the top side of the container (see Fig. 1). This hole must be in one line with soldering pin 1. This pin can easely be recognised by the asymmetrical shape of the coil former under side.

If the brass container must be earthed, the longer (tin-plated) lip must be soldered to pin 1 after bending the lips.
For bending the container lips, a simple tool (placed in a press with cranked levers) has been developed.
This tool can not be supplied, however drawings of this tool are supplied on request under cat. number 4322 058 00120.

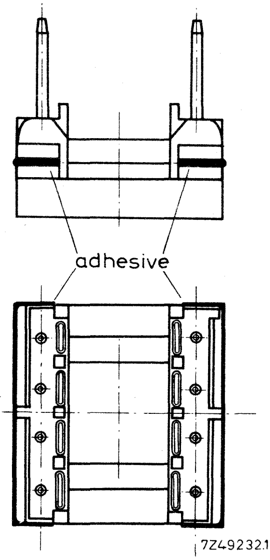
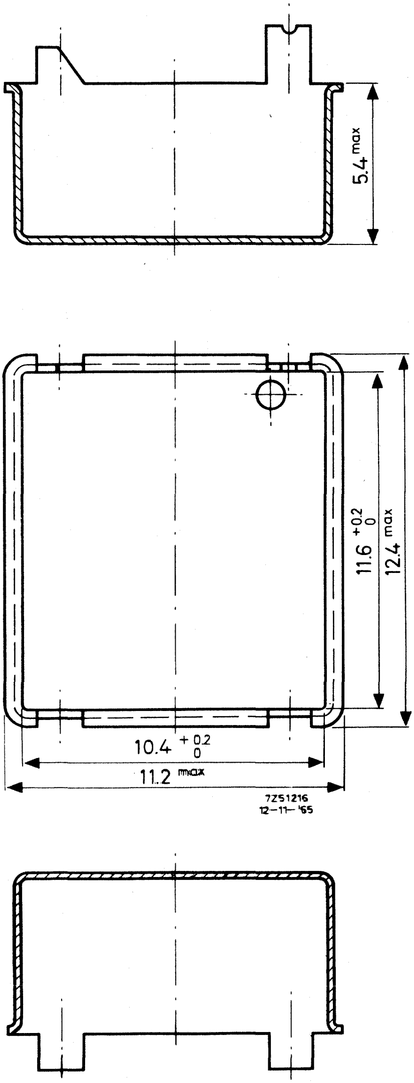
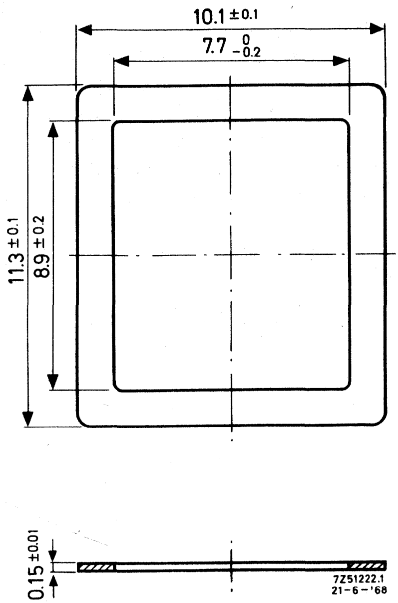


Fig. 3



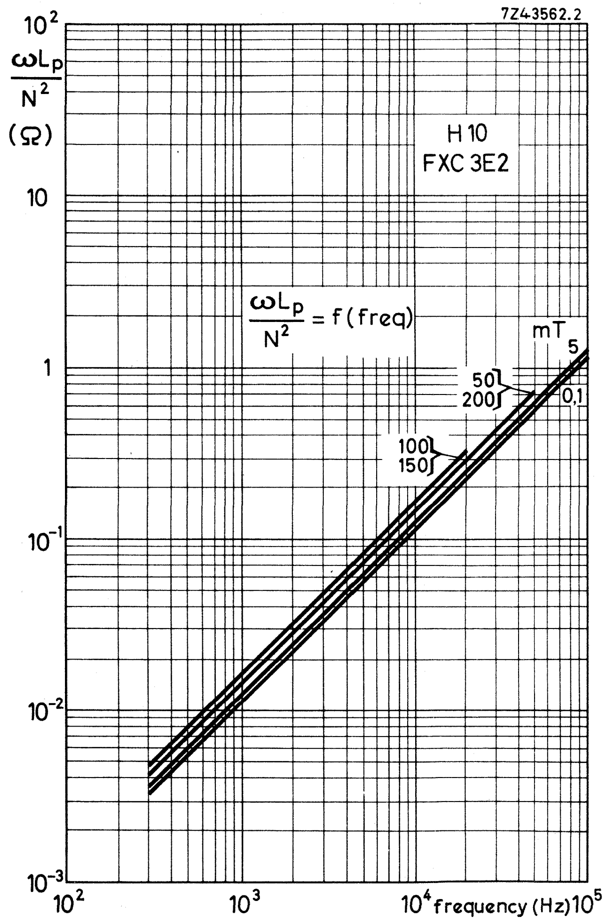
(3) Container 4322 021 20020
Material: brass, nickel-plated

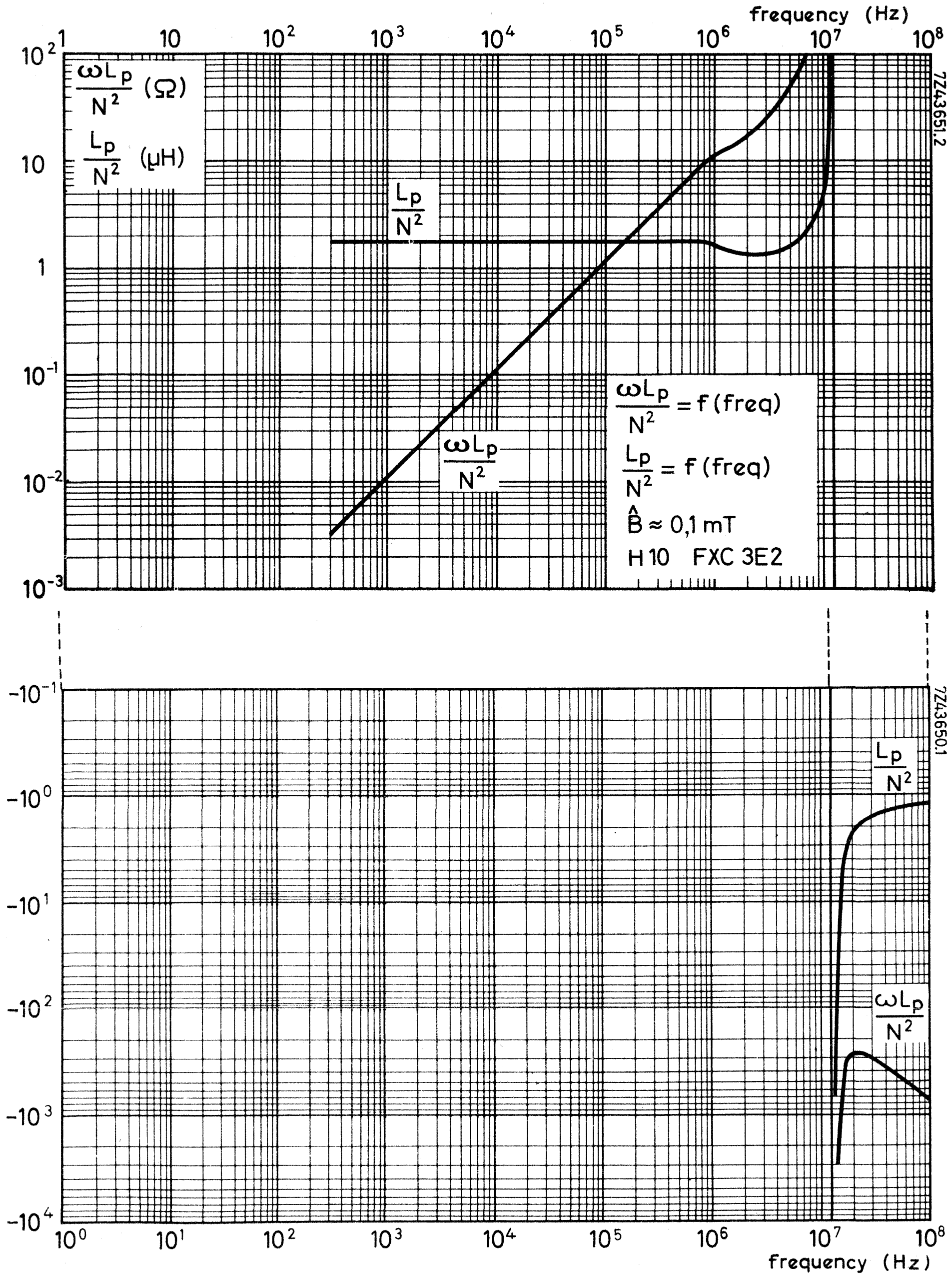


(4) Spring 4322 021 20390
Material: phosphorbronze, nickel-plated

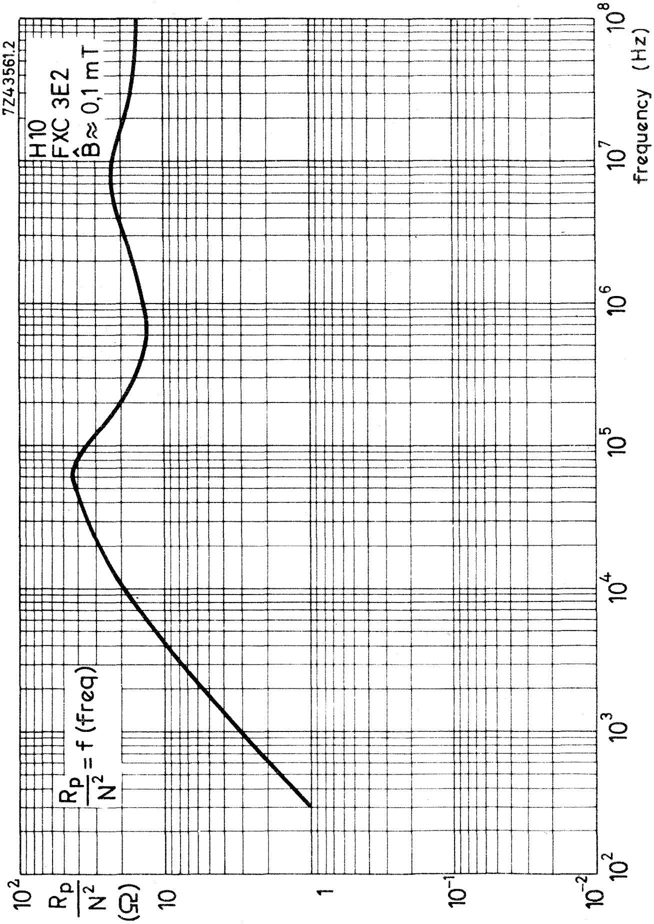
CHARACTERISTIC CURVES

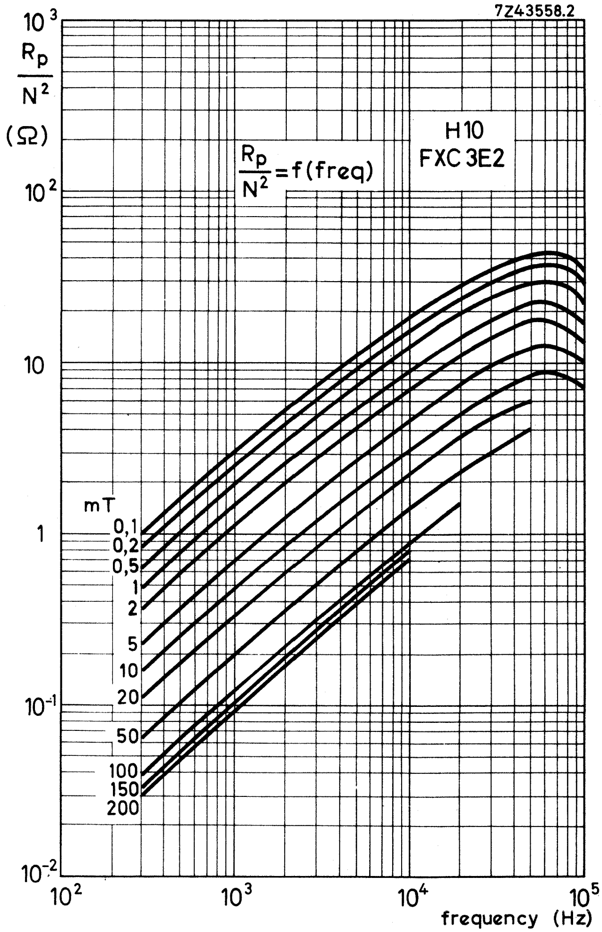
INDUCTANCE AS A FUNCTION OF THE FREQUENCY (typical values)

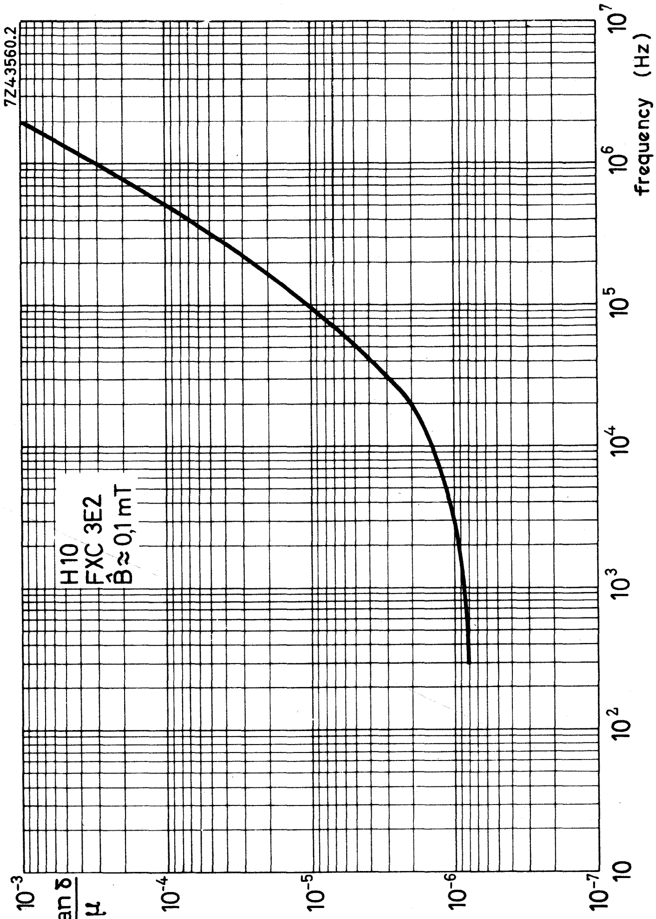



frequency (Hz)
1
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$\frac{\omega L_p}{N^2}$ (Ω)
$\frac{L_p}{N^2}$ (μH)
$\frac{L_p}{N^2}$
$\frac{\omega L_p}{N^2}$
$\frac{\omega L_p}{N^2} = f(freq)$
$\frac{L_p}{N^2} = f(freq)$
$\hat{B} \approx 0{,}1$ mT
H 10 FXC 3E2
7Z43651.2
-10^{-1}
-10^0
-10^1
-10^2
-10^3
-10^4
7Z43650.1
$\frac{L_p}{N^2}$
$\frac{\omega L_p}{N^2}$
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
10^8
frequency (Hz)

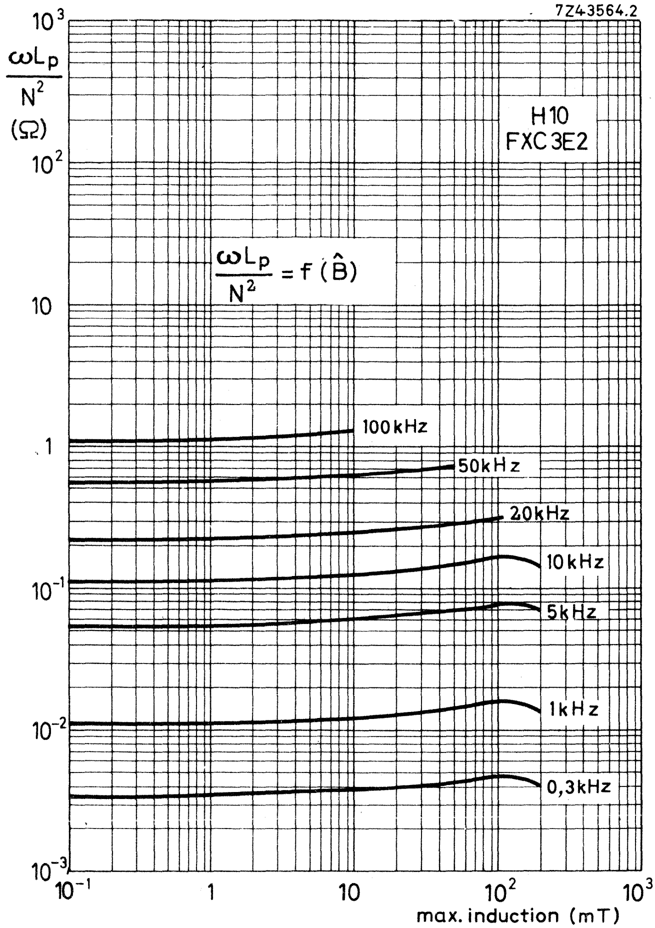
LOSSES AS A FUNCTION OF THE FREQUENCY (typical values)



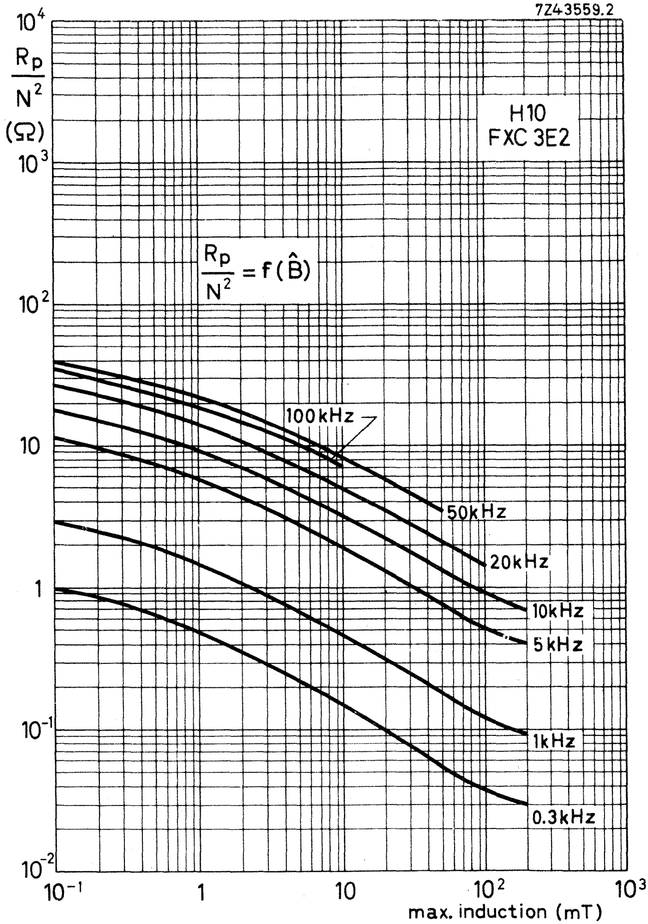

7Z43558.2
$\frac{R_p}{N^2}$ (Ω)
$\frac{R_p}{N^2} = f(freq)$
H10
FXC 3E2
mT
0,1
0,2
0,5
1
2
5
10
20
50
100
150
200
10^3
10^2
10
1
10^{-1}
10^{-2}
10^2
10^3
10^4
10^5
frequency (Hz)


7Z43560.2
H10
FXC 3E2
B̂ ≈ 0,1 mT
tan δ / μ
10⁻³
10⁻⁴
10⁻⁵
10⁻⁶
10⁻⁷
10
10²
10³
10⁴
10⁵
10⁶
10⁷
frequency (Hz)

INDUCTANCE AS A FUNCTION OF THE INDUCTION (typical values)

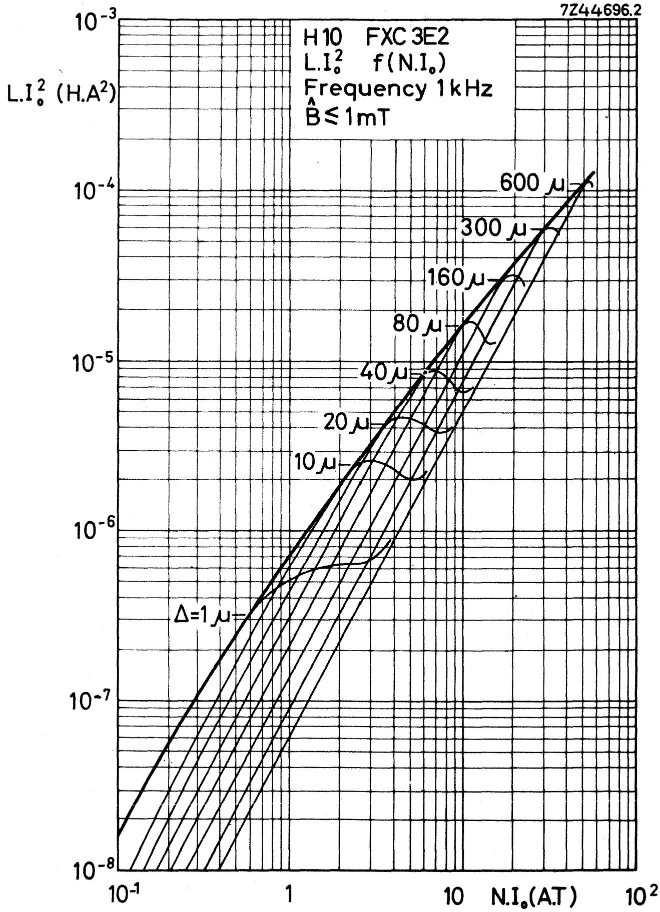


LOSSES AS A FUNCTION OF THE INDUCTION (typical values)

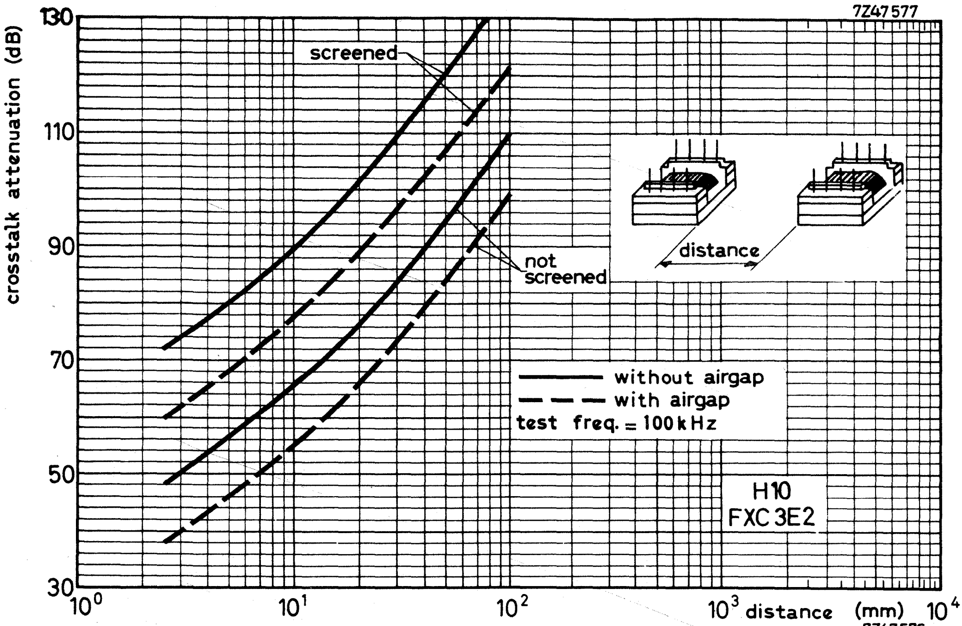


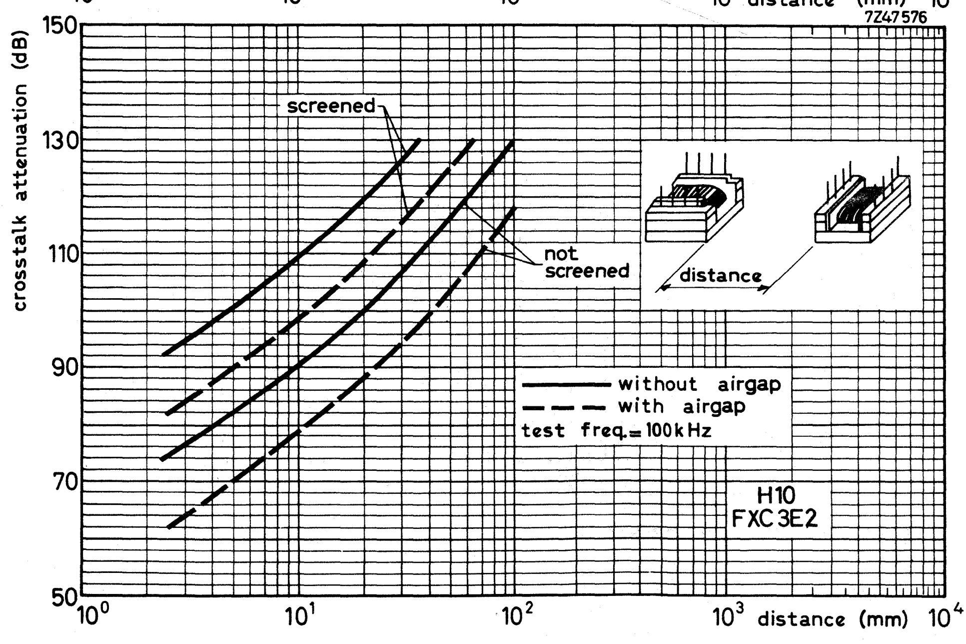
HANNA CURVE (typical values)

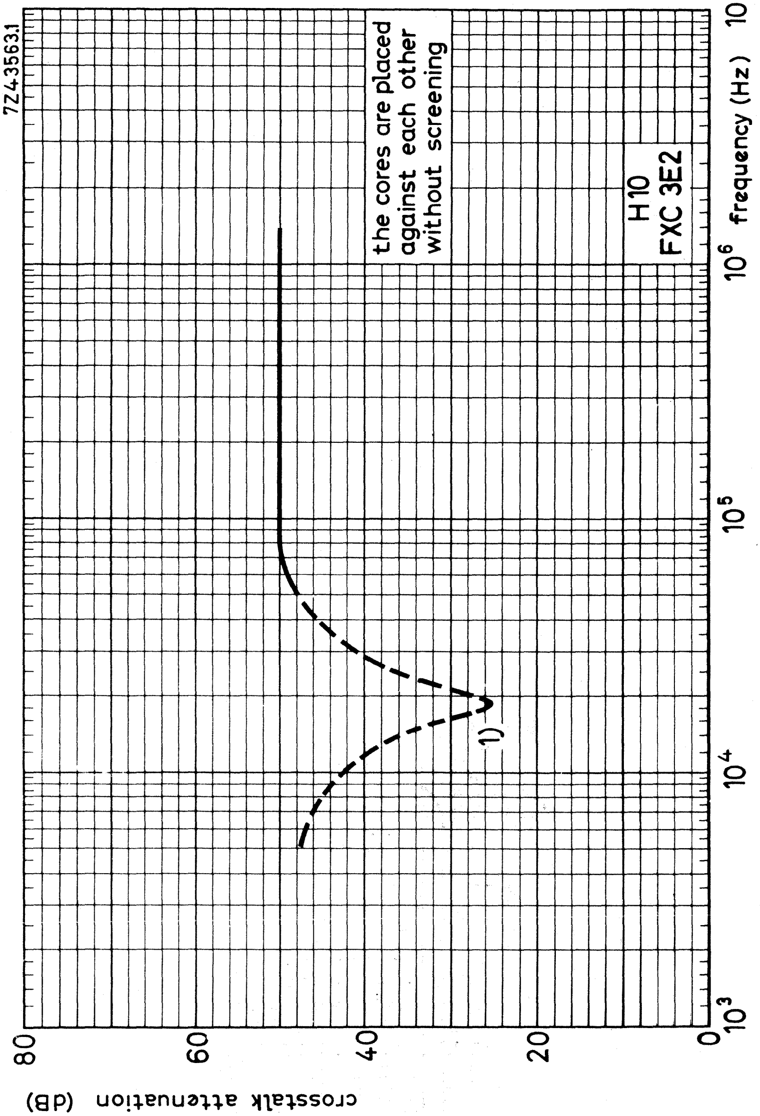
Indicating optimum inductance for a certain airgap and direct current



CROSS TALK ATTENUATION (typical values)







1) This dip does not depend on the magnetic circuit. It is caused by resonances of the inductance and stray capacitance of the two components in the test circuit.

Cross cores

INTRODUCTION

Ferroxcube cross cores have been especially developed for transformers to be used on printed-wiring boards. To this end these cores have coil formers with soldering pins which are positioned according to a grid. The height of the cores is restricted due to the small available distance between two printed-wiring boards.

The optimal height of the cross cores is approximately 0.8x the side of the square bottom surface. (In some cases a somewhat lower height than the optimal one is chosen to adapt the core to currently used heights in equipment design).

The maximum height of the assembled cross core is given under "Mounting parts".

To save space on the mounting board the connection pins of the coil former have been designed to fit within the waste space enclosed by the outer dimensions of the core (see hatched parts in Fig.2). This could be achieved, without loosing much of the dimensional quantities of the magnetic circuit with respect to potcores, by giving the core the X-shape.

The coilformers of the cross cores have the advantage that the fragile lead-out wires can be soldered to the pins directly after winding, resulting in less rejects by wire damage at the production.

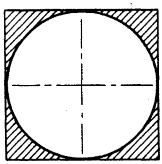


fig.1

7Z43008

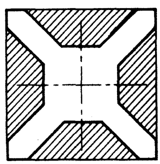


fig.2

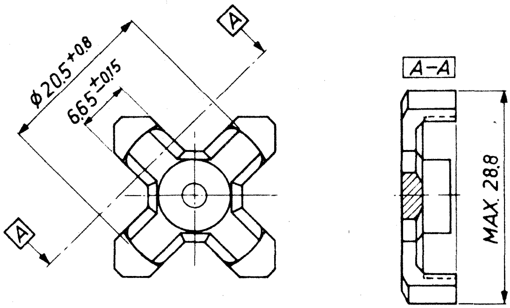
ASSEMBLY

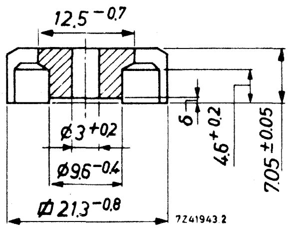
Special tools have been designed which first centre the cross core halves and afterwards bend the lips of the containers.
These tools are not supplied, however drawings of the tools are supplied on request. For cat. numbers of these tools, see table below.

core type	catalog number of recommended tool
X 22	4322 058 00080
X 30	4322 058 00090
X 35	4322 058 00100

See also the remarks with regard to the mounting parts of the cross cores.

CROSS CORES





Dimensions in mm

Two types of core halve can be supplied:
(1) without 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 dimensions of the cross cores meet the following specifications: I.E.C. 226 (international) and C.C.T.U. 06-10 (France).

Cross core halves and associated parts are ordered by their 12-digit catalogue number.

CORE HALVES WITHOUT AIR GAP

Versions

ferroxcube grade	catalogue number
3B7	3522 200 08770
3H1	4322 020 23510
3E1	4322 020 23530
3D3	3522 200 03480
4C6	3522 200 03490

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I

	at temp. (°C)	grade 3B7	3H1	3E1	3D3	4C6
$\alpha_F \times 10^6$	+5 to +23	–	+0.5 to +1.5	–	–	−2 to +4
	+23 to +55	–	+0.5 to +1.5	–	–	0 to +6
	+23 to +70	−0.6 to +0.6	+0.5 to +1.5 [1]	–	0 to +2	–
$D_F \times 10^6$ (10-100 min)	23 ± 1	≤ 4.3	≤ 4.3	–	≤ 12	≤ 10

For the combination of two cross core halves randomly chosen from a batch and pressed together with a force of 120 N, the values in Table II are guaranteed at 25 ± 10 °C.

Table II	at $\hat{B}$ (mT)	at freq. (MHz)	grade 3B7	3H1	3E1	3D3	4C6
μ_e	≤0,1	0,004	≥ 1440	≥ 1440	2000-3325 [2]	–	–
	≤0,1	0,1	–	–	–	≥ 550	≥ 93
α	≤0,1	0,004	≤ 17,8	≤ 17,8	–	–	–
	≤0,1	0,1	–	–	–	≤ 28,8	≤ 70
A_L	≤0,1	0,004	–	–	4350-7250	–	
$\frac{\tan \delta}{\mu_i} \times 10^6$	≤0,1	0,004	≤ 1,6	≤ 1,2	≤ 2,5	–	–
	≤0,1	0,1	≤ 6	≤ 5	≤ 20	≤ 8	–
	≤0,1	0,5	–	–	≤ 200	≤ 14	–
	≤0,1	1	–	–	–	–	–
	≤0,1	2	–	–	–	–	≤ 40
	≤0,1	10	–	–	–	–	≤ 100
q2-24-100	1,5-3	0,004	≤ 1,8	≤ 1,8	3,0	–	–
	0,3-1,2	0,1	–	–	–	≤ 3,0	≤ 10
$\eta_B \times 10^3$	1,5-3	0,004	≤ 1,1	≤ 1,1			
	0,3-1,2	0,1				≤ 1,8	≤ 6,2

Weight per half core 6 g approx.

Mean length of line of force l_e = 38 mm (two halves)

A_e = 66 mm^2 (two halves)

$\Sigma \frac{l_e}{A_e}$ = 0,575 mm^{-1} (two halves)

V_e = 2510 mm^3 (two halves)

1) Orientation value

2) In the temperature range +23 to +70 °C $\mu_e \geq 2000$

CORE HALVES WITH AIR GAP

ferroxcube grade	air gap length in mm	catalog number
3H1	0.02 ± 0.01	4322 020 23710
3H1	0.05 ± 0.015	4322 020 23720
3H1	0.15 ± 0.015	4322 020 23730
3H1	0.25 ± 0.015	4322 020 23740
3E1	0.15 ± 0.015	4322 020 23700

The electrical properties are measured on cores without air gap.

PRE-ADJUSTED CROSS CORES

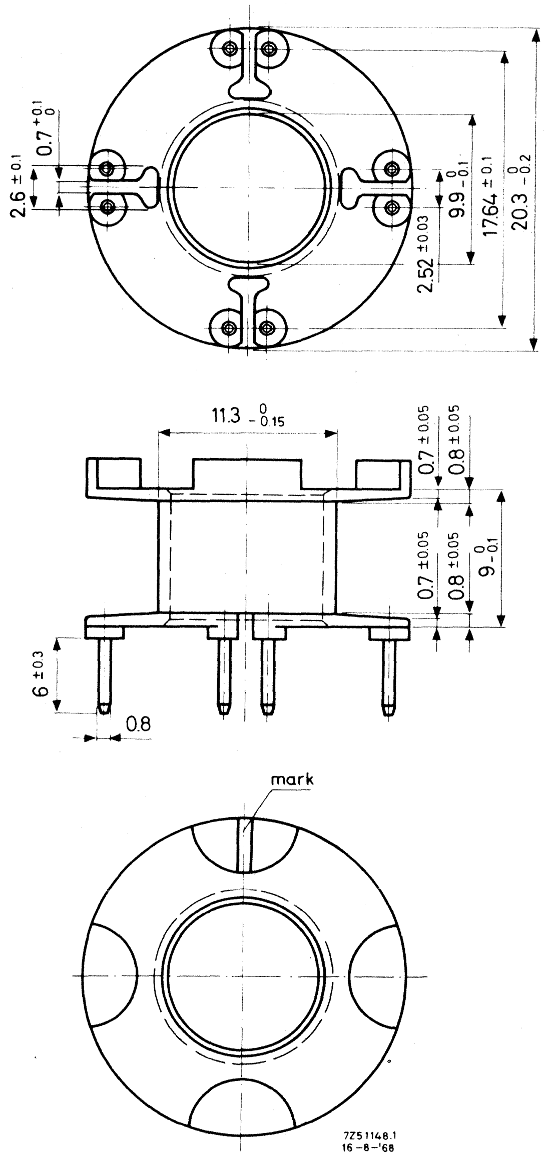
With nut : catalog number 4322 022 6. . . .
Without nut: catalog number 4322 022 4. . . .

Cross cores with standard A_L factors

A_L	corresponding μ_e-value	tolerance on inductance (%)	catalog number 4322 022 6. . . ., with nut 4322 022 4. . . ., without nut
			grade 3H1
160	73	± 1	5250
250	115	± 1.5	5260
400	180	± 2	5280
630	290	± 3	5300

Inductance $L = N^2 A_L$ (in 10^{-9} H)

COIL FORMER


0.7 +0.1 0
2.6 ±0.1
2.52 ±0.03
9.9 0 -0.1
17.64 ±0.1
20.3 0 -0.2
11.3 0 -0.15
0.7 ±0.05
0.8 ±0.05
0.7 ±0.05
0.8 ±0.05
9 0 -0.1
6 ±0.3
0.8
mark
7Z51148.1
16-8-'68

catalogue number	4322 021 31770
Material	reinforced polyester
Window area in mm^2	33,5
Mean length of turn in mm	49
Max. temperature for dipsoldering for 5-6 s in ^oC	280
Max. working temperature in ^oC	130
Force for pulling out pins during 1 min at 25 ^oC in N	≥15
Max. test voltage (50 Hz) between pins during 2 min in V_{rms}	500

$$\frac{R_o}{L} = \frac{1}{\mu_e} \times \frac{1}{f_{cu}} \times 9,9 \times 10^3 \ \Omega/H$$

INDUCTANCE ADJUSTORS

ADJUSTORS

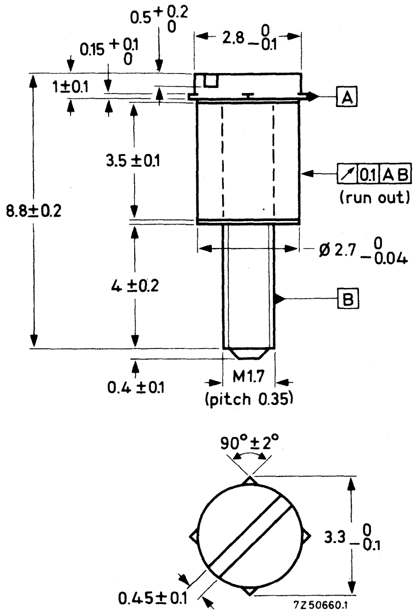


Fig. A

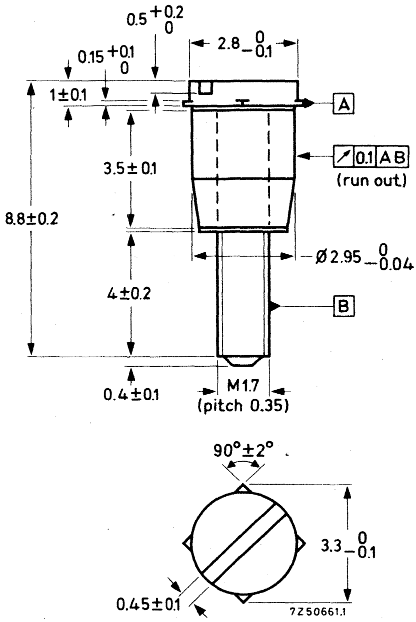


Fig. B

The tolerances on inductance of the pre-adjusted cross cores (without adjustor) are given in section "cross cores", paragraph "Pre-adjusted cross cores". After inserting a coil (impregnated or not) in an electrical circuit, its inductance can be adjusted to the required value with an accuracy < 0.03% by means of a continuous inductance adjustor. Such an adjustor increases the inductance of the coil, see "Adjustment curves". The adjustor is screwed through the cross core into the nut and is held in position by the four protrusions near 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 the adjustors on the variability of the inductance is negligible.
The maximum permissible temperature is 110 °C.
Table II shows the type of adjustor recommended for different cross cores.
The adjustors are packed in bags of 100, so please order in multiples of 100.

Table I, available types:

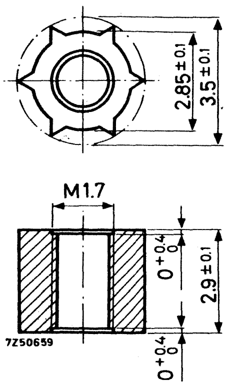
Fig.	colour	catalogue number
A	brown	4322 021 30730
B	white	4322 021 30970
B	grey	4322 021 31080

Table II, recommended application:

A_L	catalogue number grade 3H1
160	4322 021 30970
250	4322 021 30970 or 4322 021 30730
400	4322 021 30730 or 4322 021 31080
630	4322 021 31080
1000	4322 021 31080

NUT FOR ADJUSTOR

These data are given for those manufacturers who prefer to insert the nut themselves.

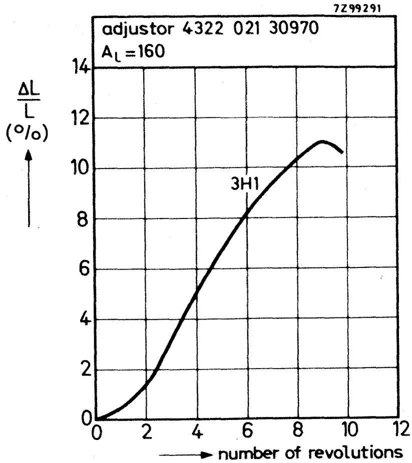


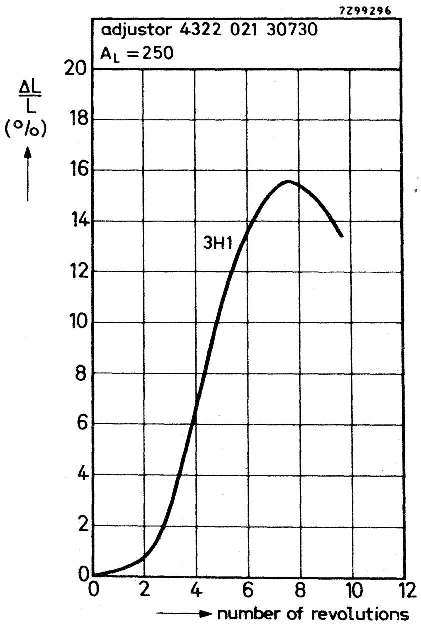
Catalogue number	4322 021 30140
Material	polycarbonate
Maximum impregnation temperature during 24 hours	120 °C
Recommended distance from mating surface to nut	2.3 ± 0.15 mm

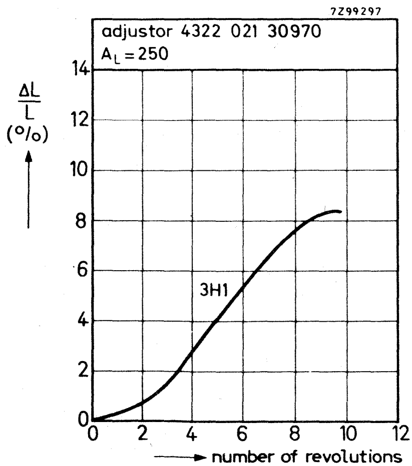
For more information see Potcores General, paragraph "Inserting the nut for the adjustor" (core type P18/11).

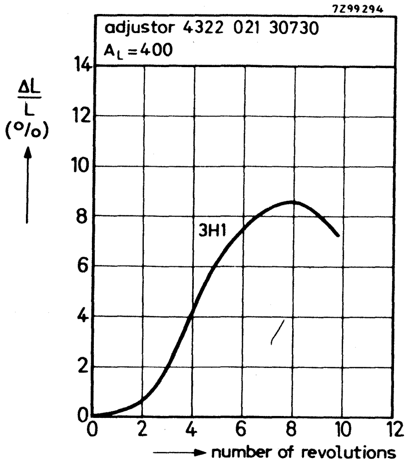
The nuts are packed in bags of 100, so please order in multiples of 100.

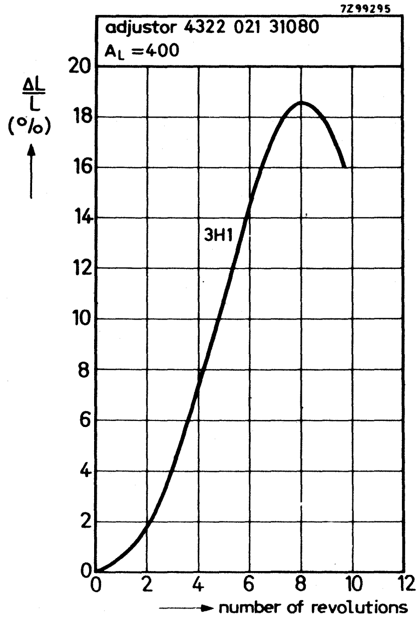
ADJUSTMENT CURVES

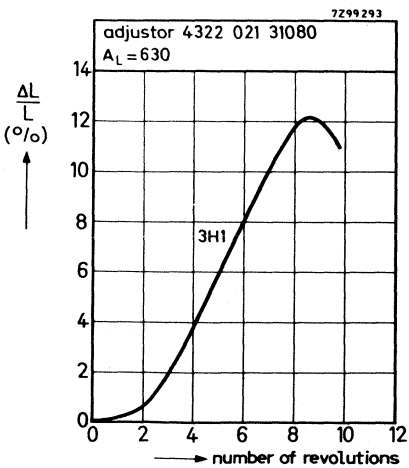


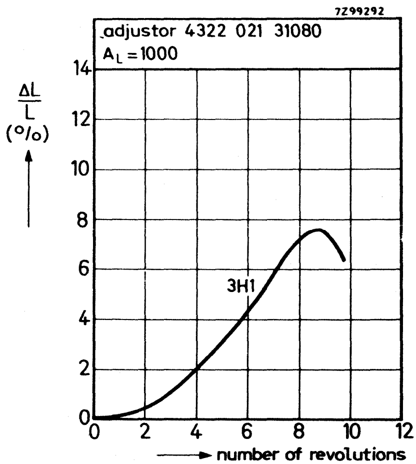




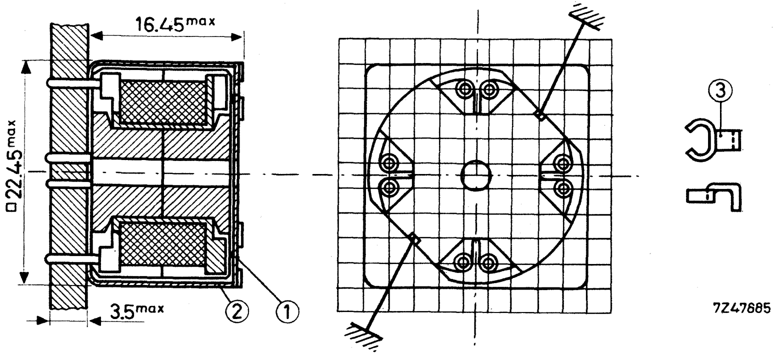

7Z99294
adjustor 4322 021 30730
A_L = 400
ΔL/L (%)
3H1
number of revolutions


7Z99295
adjustor 4322 021 31080
A_L = 400
ΔL/L (%)
3H1
number of revolutions


7Z99293
adjustor 4322 021 31080
A_L = 630
ΔL/L (%)
3H1
number of revolutions


7Z99292
adjustor 4322 021 31080
A_L = 1000
ΔL/L (%)
3H1
number of revolutions

MOUNTING PARTS



(1). Cover 4322 021 30230
(2). Container 4322 021 30040
(3). Soldering spring 4322 021 30700·

The cross core has been developed especially for transformers to be mounted on printed-wiring boards.

An advantage of this construction is that the leading-out wires are soldered to the pins which are directly mounted on the coil former.

The eight soldering pins are positioned according to a grid of 2.52 mm. They will fit printed-wiring boards with a 0.1" grid as well as those with a 2.50 mm grid. The pin length is sufficient for board thicknesses up to 3.5 mm. The printed-wiring board should be provided with holes of 1.3 ± 0.1 mm in diameter.

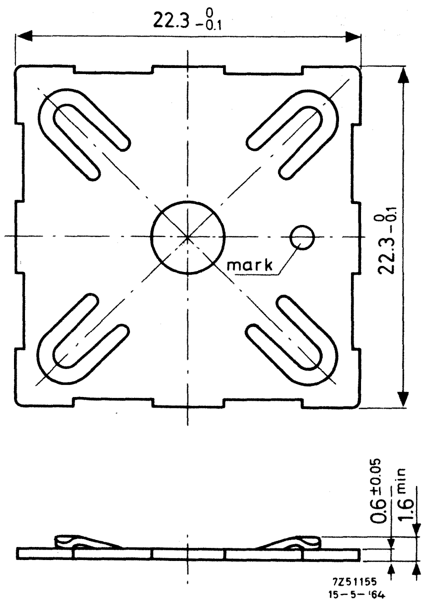
If stranded wire is employed, the use of a soldering spring (pos. 3) is recommended, which facilitates the soldering of the wires to the pins on the coil former. For solid wire the spring is not necessary.

The phosphor-bronze cover has four cut-out lips on the corners, consequently the cover acts as a spring at the same time.

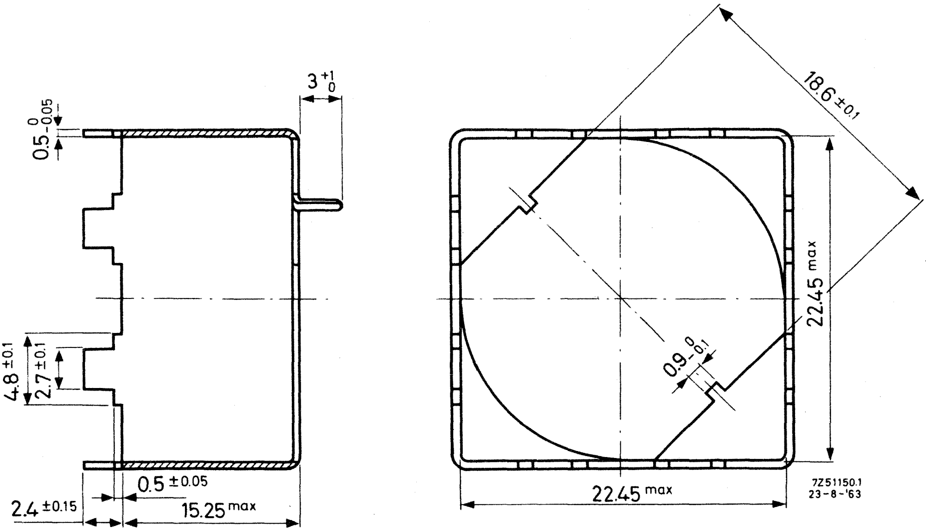
The cover is provided with a marking hole. The mark of the coil former (see the Fig. of coil former) has to be in one line with this hole. These markings facilitate the numbering of the soldering pins and the positioning on the printed-wiring board.

It is recommended to cement the coil former in one of the cross core halves in order to obtain the most possible stable construction.

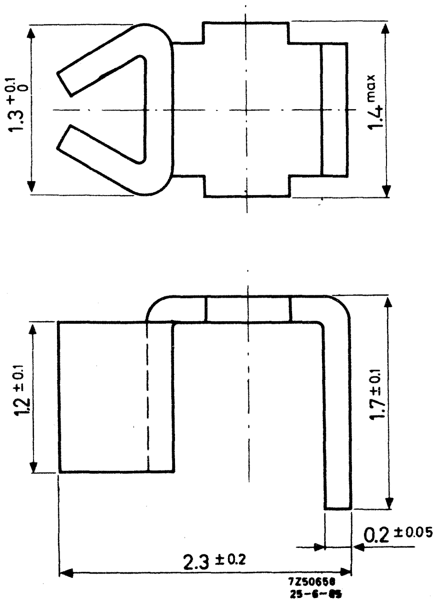
Before bending the lips of the container, pressure should be exercised evenly on the four corners of the cover until the latter meets the container. The required force is approximately 120 Newton. After bending the lips, the core will have the correct tension.



(1) Cover 4322 021 30230
Material: phosphorbronze, nickel plated



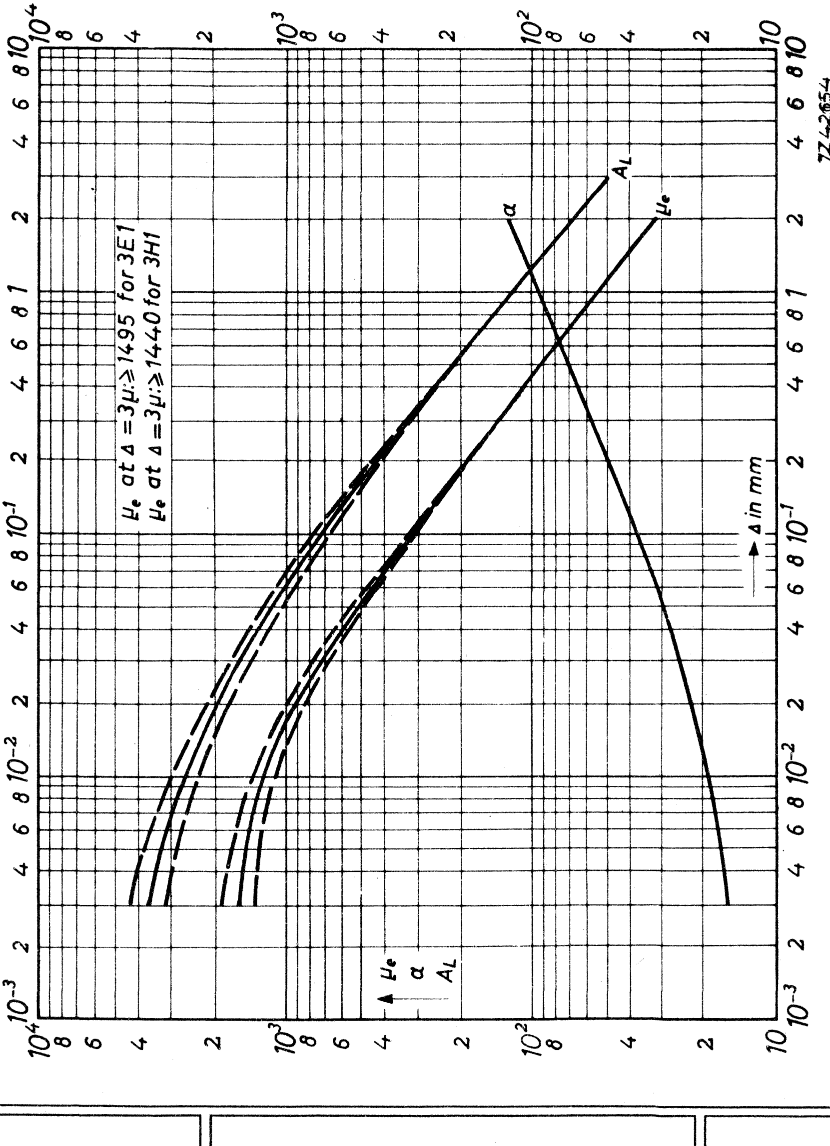
(2) Container 4322 021 30040
Material: brass, nickel plated



(3) Soldering spring 4322 021 30700
Material: brass, dipsoldered

CHARACTERISTIC CURVES

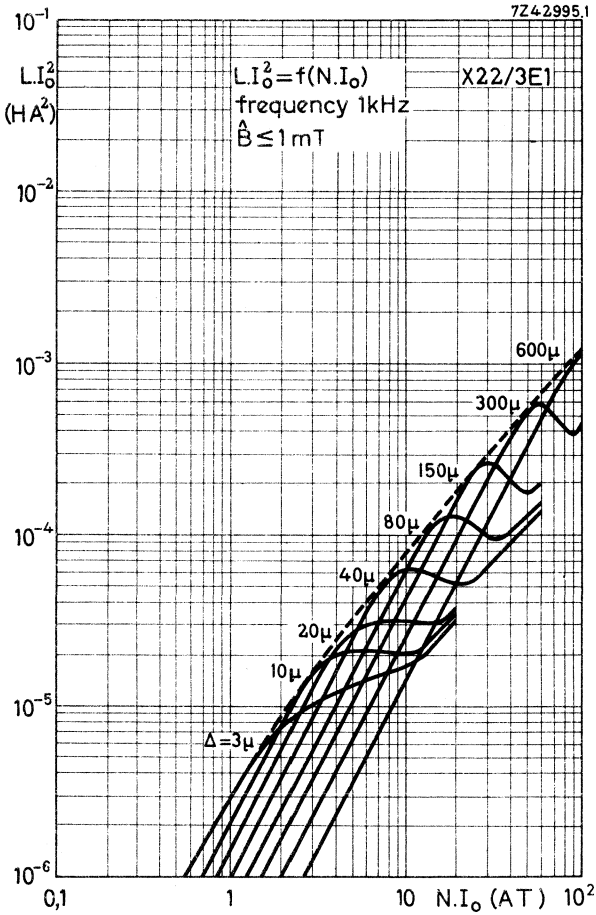
μ_e - α and A_L CURVES.



Effective permeability (μ_e), turn factor for 1 mH (α) and inductance factor in nanohenry (A_L) as a function of the airgap length for grades 3E1 and 3H1.

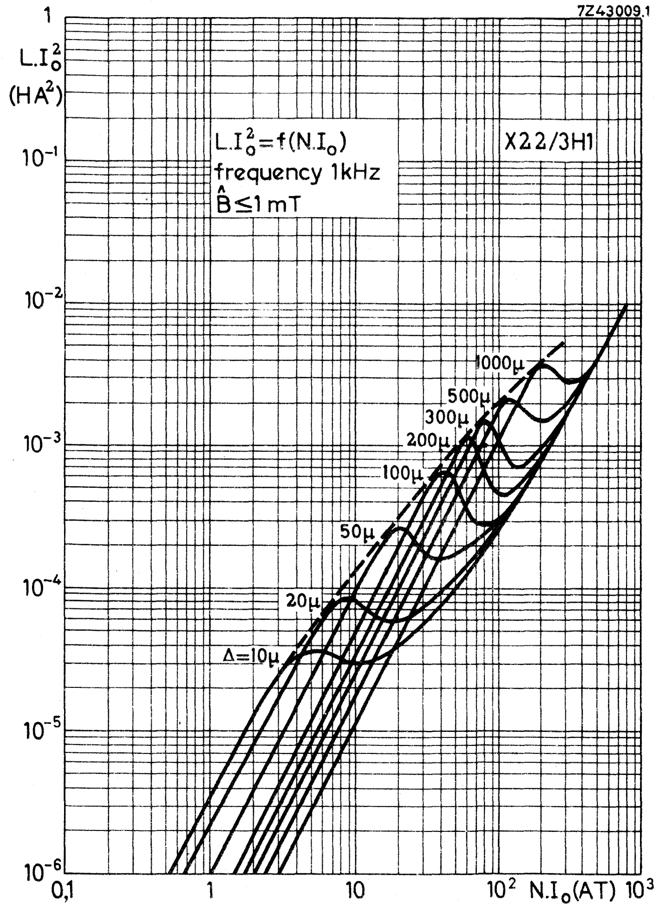
HANNA CURVE (typical values)

Indicating optimum inductance for a certain airgap and direct current.

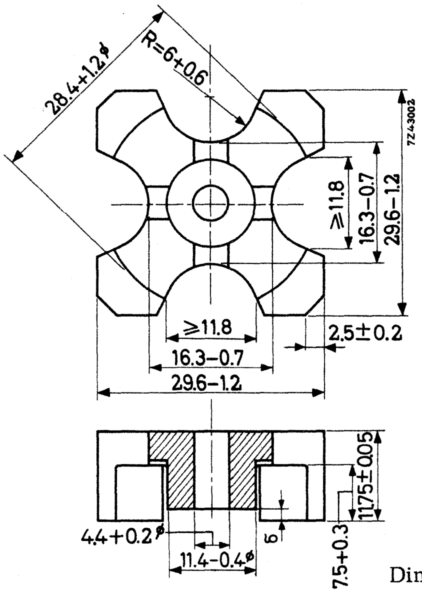


HANNA CURVE (typical values)

Indicating optimum inductance for a certain airgap and direct current.



CROSS CORES



Dimensions in mm

Two types of core halve can be supplied:
1) without airgap
2) with airgap
   Standardised air-gap lengths in each core half are: 0.02, 0.05, 0.15 and 0.25 mm.

The dimensions of the cross cores meet the following specifications: I.E.C. 226 (international) and C.C.T.U.06-10 (France).

Cross core halves and associated parts are ordered by their 12-digit catalogue number.

CORE HALVES WITHOUT AIRGAP

Versions

ferroxcube grade	catalog number
3H1	4322 020 23750
3E1	4322 020 23760

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I

	at temp. (°C)	grade 3H1	grade 3E1
$\alpha_F \times 10^6$	+5 to +23	+0.5 to +1.5	–
	+23 to +55	+0.5 to +1.5	–
	+23 to +70	+0.5 to +1.5 [1]	–
$D_F \times 10^6$	23 ± 1	≤ 4.3	–

For the combination of two cross core halves randomly chosen from a batch and pressed together with a force of 250 N, the values in Table II are guaranteed at 25 ± 10 °C.

Table II

	at $\hat{B}$ (mT)	at freq. (kHz)	grade 3H1	grade 3E1
μ_e	≤ 0,1	4	≥ 1525	2200-3675 [2]
α	≤ 0,1	4	≤ 15.9	–
A_L	≤ 0,1	4	–	5650-9400
$\frac{\tan\delta}{\mu_i} \times 10^6$	≤ 0,1	4	≤ 1.2	≤ 2.5
	≤ 0,1	100	≤ 6	≤ 20
q2-24-100	1,5-3	4	≤ 1.8	≤ 3.0
$\eta_B \times 10^3$	1,5-3	4	≤ 1.1	≤ 1.8

Weight per half core: 19 g approx.

Mean length of lines of force:

l_e = 55,8 mm (two halves)

A_e = 114 mm^2 (two halves)

$\Sigma \frac{l_e}{A_e}$ = 0,49 mm^{-1} (two halves)

V_e = 6360 mm^3 (two halves)

CORE HALVES WITH AIR GAP

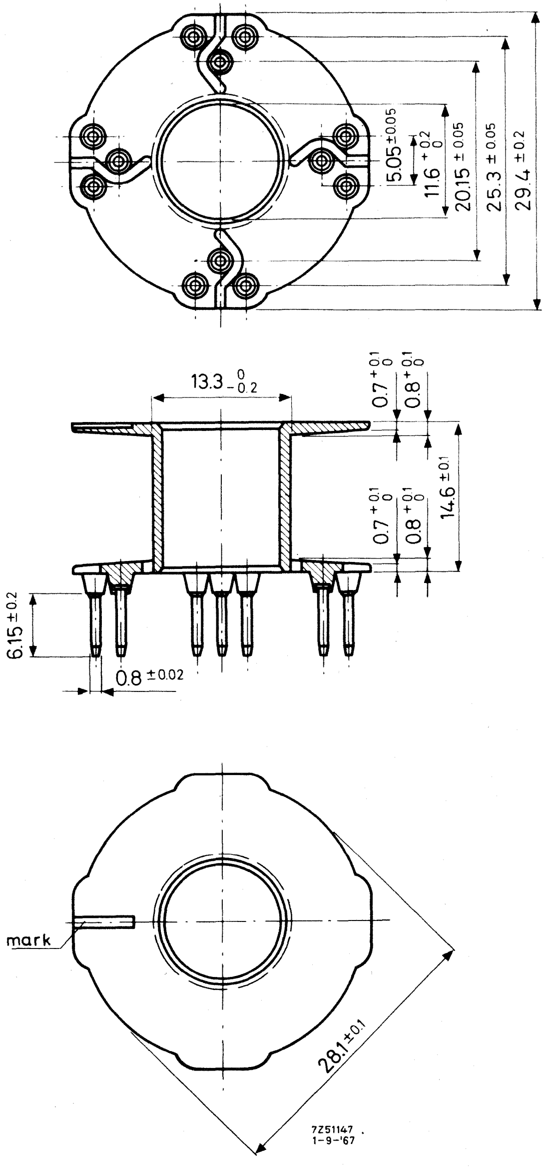
ferroxcube grade	airgap length in mm	catalogue number
3H1	0.02 ± 0.01	4322 020 23960
3H1	0.05 ± 0.015	4322 020 23970
3H1	0.15 ± 0.015	4322 020 23980
3H1	0.25 ± 0.015	4322 020 23990

The electrical properties are measured on cores without air gap.

1) Orientation value

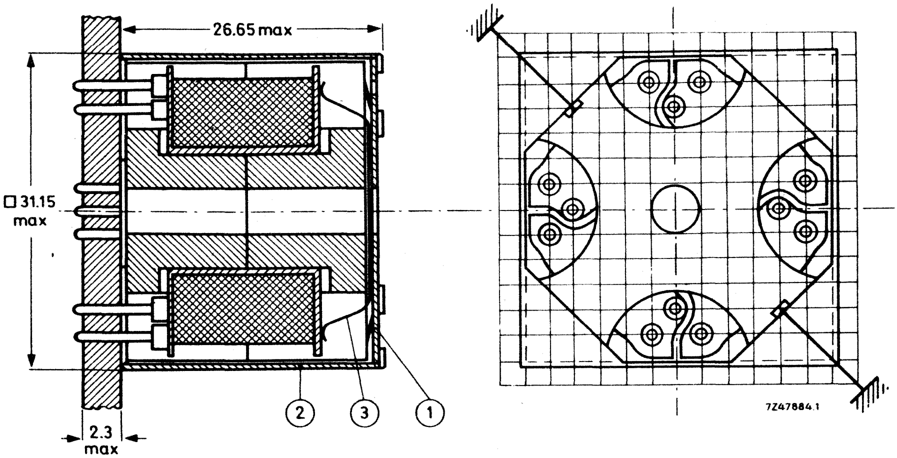
2) In the temperature range +23 to +70 °C $\mu_e \geq 2200$

COIL FORMER


5.05±0.05
11.6 +0.2 0
20.15 ± 0.05
25.3 ± 0.05
29.4 ± 0.2
13.3 0 -0.2
0.7 +0.1 0
0.8 +0.1 0
14.6 ±0.1
0.7 +0.1 0
0.8 +0.1 0
6.15 ±0.2
0.8 ±0.02
mark
28.1 ±0.1
7Z51147
1-9-'67

Catalogue number	4322 021 31190
Material	reinforced polyester
Window area	97 mm^2
Mean length of turn	65 mm
Max. dipsolder temperature (5 to 6 s)	280 °C
Max. working temperature	130 °C
Tensile strength of pins (1 minute at 25 °C)	$\geq$ 20 N
A.C. test voltage between pins (50 Hz, 2 min)	2000 V

MOUNTING PARTS



(1) Cover 4322 021 31150
(2) Container 4322 021 31170
(3) Spring 4322 021 30210
(4) Soldering spring 4322 021 30700 (see below)

The cross core has been developed especially for transformers to be mounted on printed-wiring boards.

An advantage of this construction is that the leading-out wires are soldered to the pins which are directly mounted on the coil former.

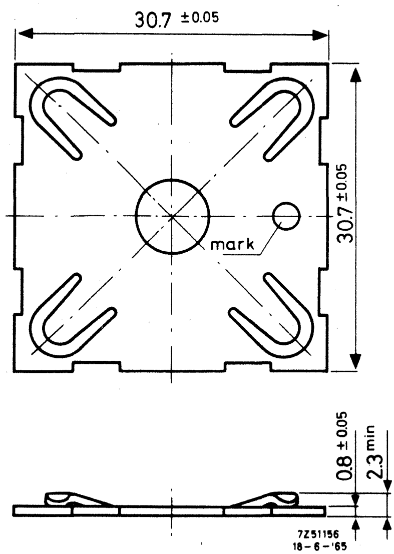
The twelve soldering pins are positioned according to a grid of 2.52 mm. They will fit printed-wiring boards with a 0.1" grid as well as those with a 2.50 mm grid. The pin length is sufficient for board thicknesses up to 2.3 mm. The printed-wiring board should be provided with holes of 1.3 ± 0.1 mm in diameter.

The phosphor-bronze cover has four cut-out lips on the corners, consequently the cover acts as a spring at the same time.

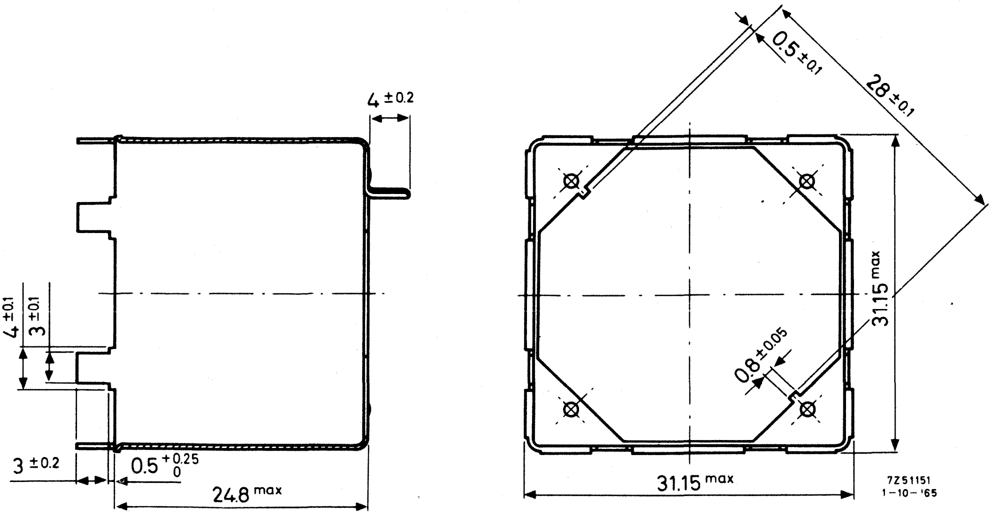
The cover is provided with a marking hole. The mark of the coil former (see the Fig. of coil former) has to be in one line with this hole. These markings facilitate the numbering of the soldering pins and the positioning on the printed-wiring board.

It is recommended to cement the coil former in one of the cross-core halves or to use the spring (pos. 3) in order to obtain the most stable construction.

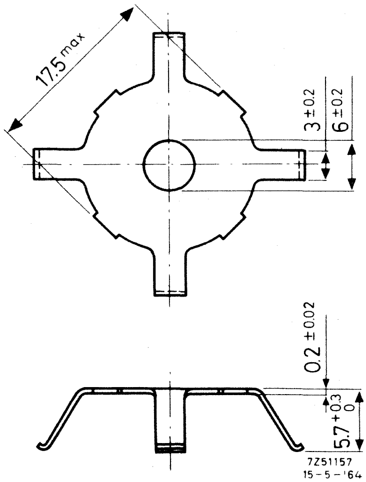
Before bending the lips of the container, pressure should be exercised evenly on the four corners of the cover until the latter meets the container. The required force is approximately 250 Newton. After bending the lips, the core will have the correct tension.



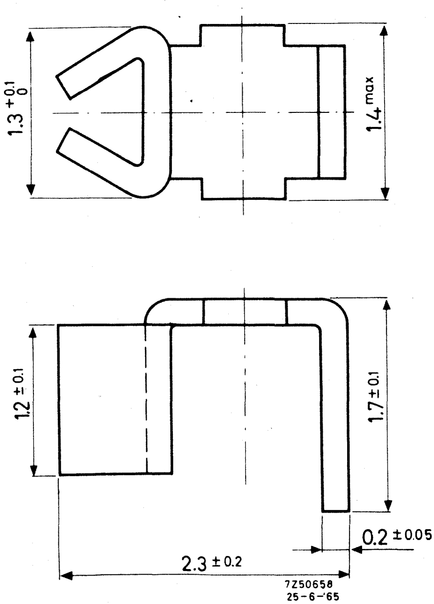
(1) Cover 4322 021 31150
Material: phosphorbronze, nickel plated



(2) Container 4322 021 31170
Material: brass, nickel plated



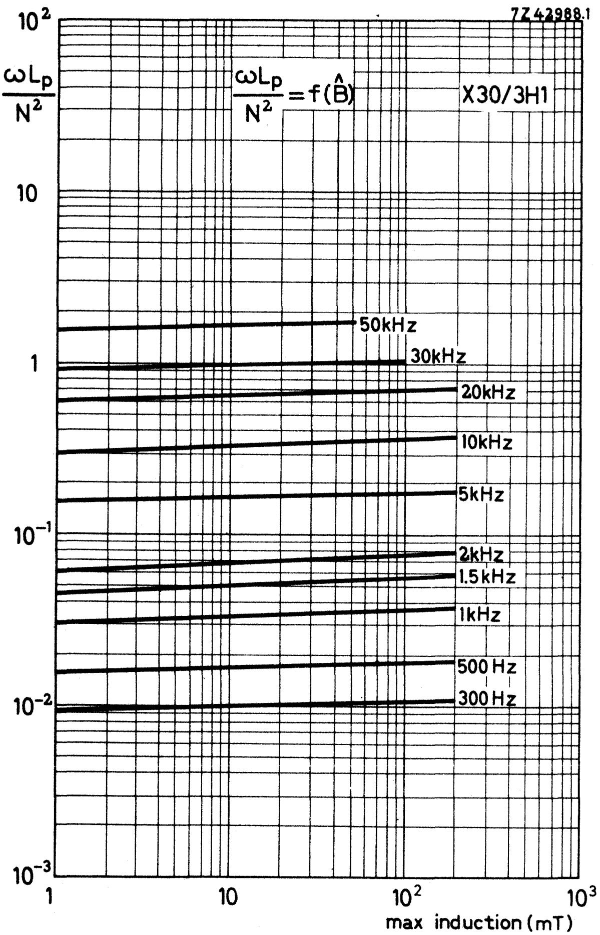
(3) Spring 4322 021 30210
Material: phosphorbronze



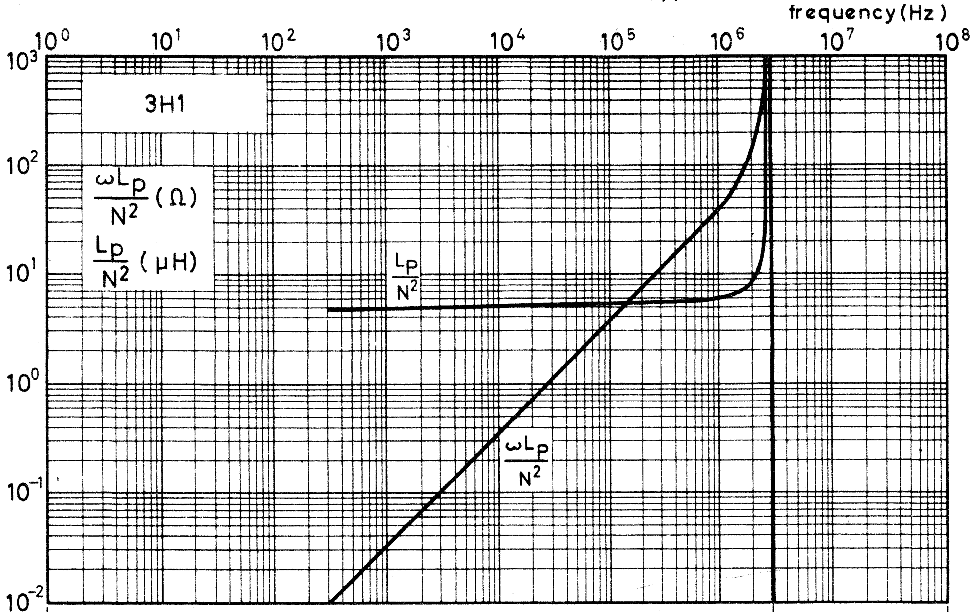
(4) Soldering spring 4322 021 30700
Material: brass, dipsoldered

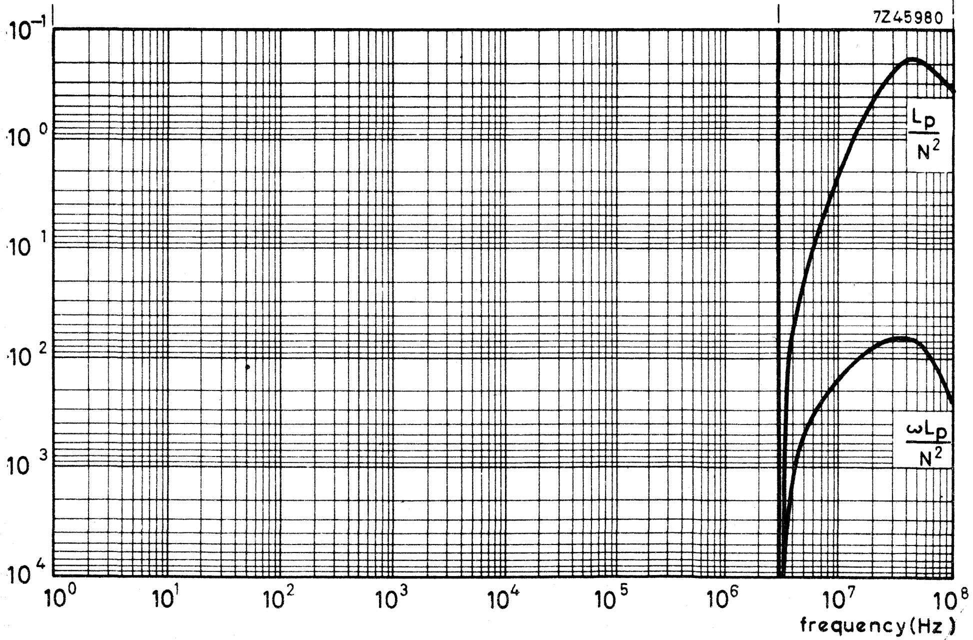
CHARACTERISTIC CURVES

INDUCTANCE AS A FUNCTION OF THE INDUCTION (typical values)

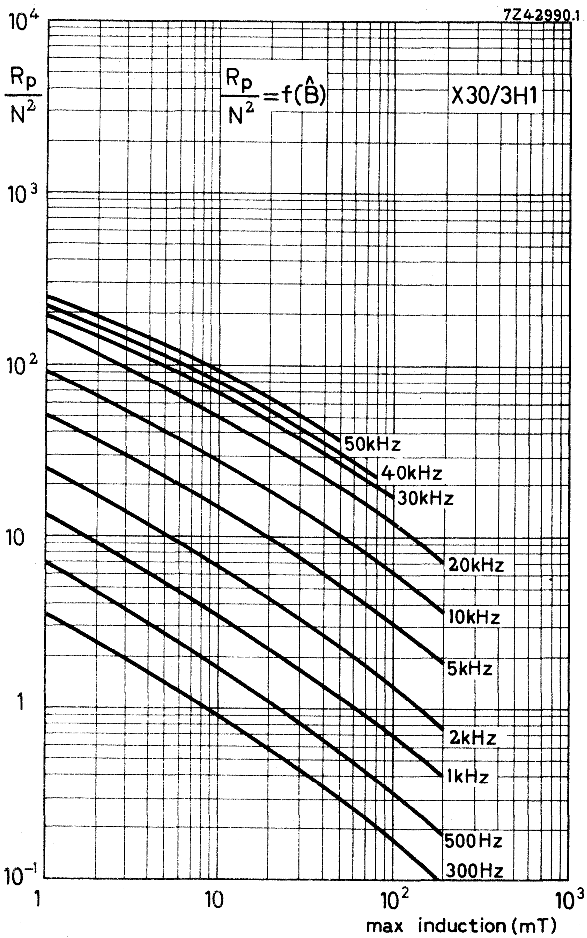


INDUCTANCE AS A FUNCTION OF THE FREQUENCY (typical curves)

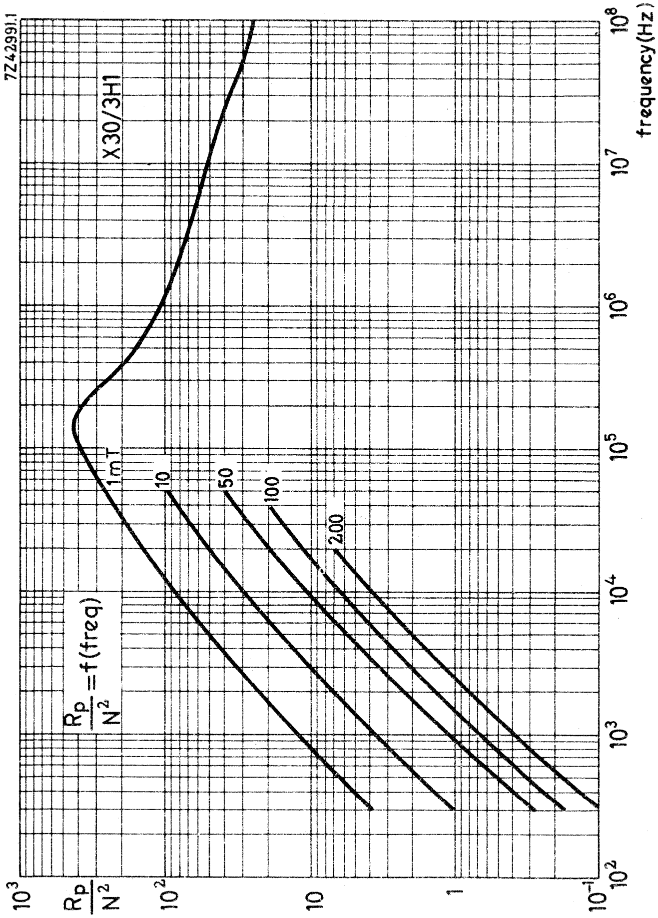




CORE LOSSES AS A FUNCTION OF THE INDUCTION (typical values)

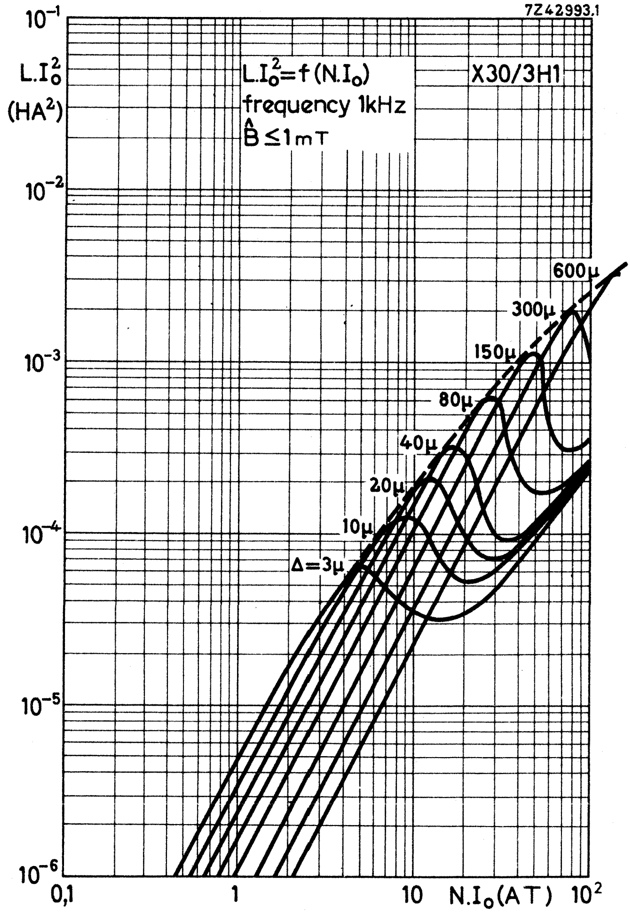


CORE LOSSES AS A FUNCTION OF THE FREQUENCY (typical values)

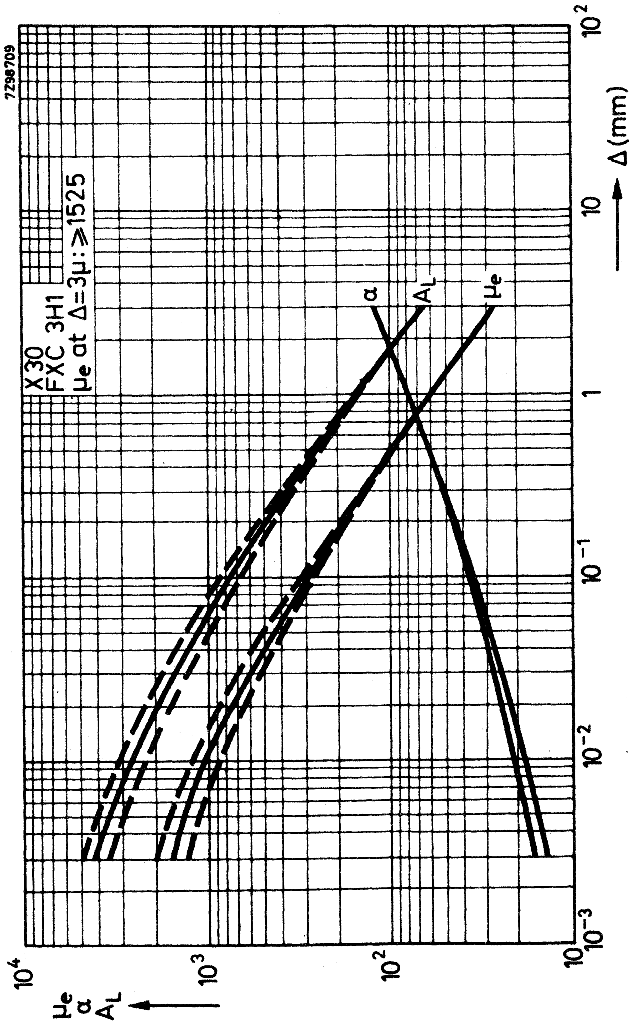


HANNA CURVE (typical values)

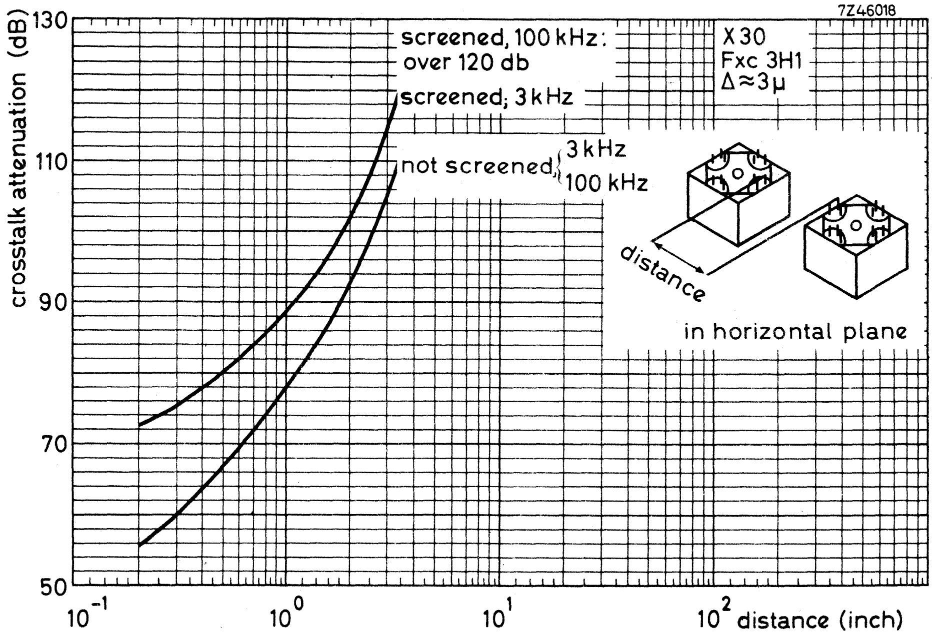
Indicating optimum inductance for a certain airgap and direct current.

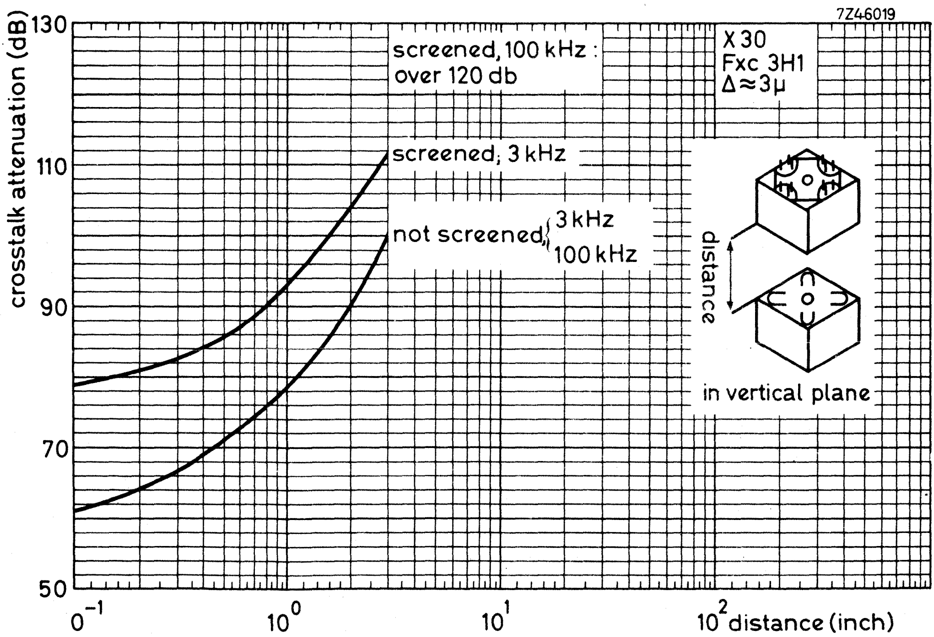


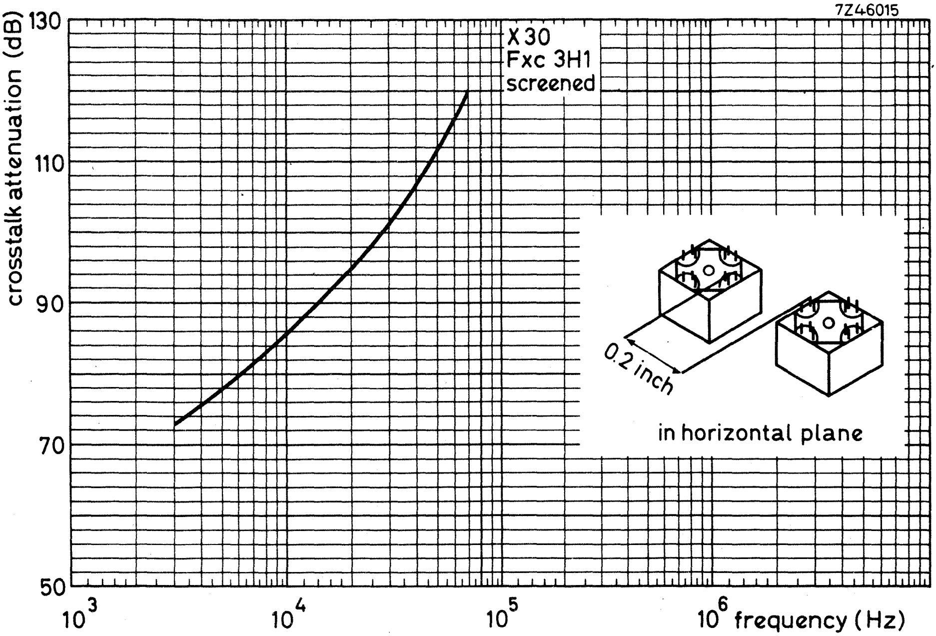
μ_e - α AND A_L CURVES



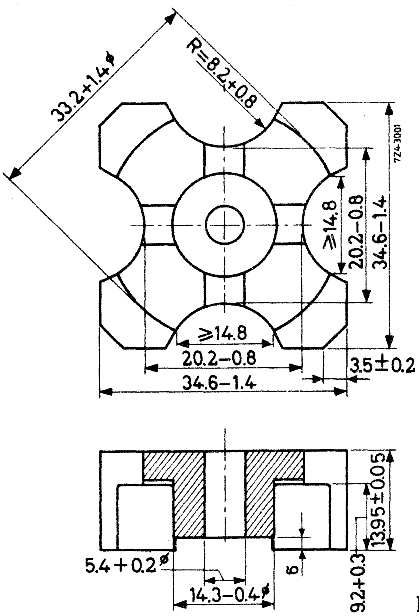
CROSSTALK ATTENUATION






7Z46015
X 30
Fxc 3H1
screened
0.2 inch
in horizontal plane
crosstalk attenuation (dB)
130
110
90
70
50
10^3
10^4
10^5
10^6
frequency (Hz)

CROSS CORES



Dimensions in mm

Two types of core halve can be supplied:

[1]) without airgap

[2]) with airgap. Standardised airgap lengths in each core half are: 0.02, 0.05, 0.15 and 0.25 mm.

The dimensions of the cross cores meet the following specifications: I.E.C. 226 (international) and C.C.T.U. 06-10 (France).

Cross core halves and associated parts are ordered by their 12-digit **catalog** number.

CORE HALVES WITHOUT AIR GAP

Version

ferroxcube grade	catalog number
3H1	4322 020 24000

Properties

For toroidally wound core halves the values in Table I are guaranteed.

Table I

	at temp. (^{o}C)	grade 3H1
$\alpha_F \times 10^6$	+5 to +23 +23 to +55 +23 to +70	+0.5 to +1.5 +0.5 to +1.5 +0.5 to +1.5 *)
$D_F \times 10^6$	23 $\pm$ 1	$\leq$ 4.3

For the combination of two cross core halves randomly chosen from a batch and pressed together with a force of 330 N, the value in Table II are guaranteed at 25 $\pm$ 10 ^{o}C.

Table II

	at $\hat{B}$ (mT)	at freq. (kHz)	grade 3H1
μ_e	$\leq$ 0,1	4	$\geq$ 1580
α	$\leq$ 0,1	4	$\leq$ 14,4
$\frac{\tan\delta}{\mu_i} \times 10^6$	$\leq$ 0,1 $\leq$ 0,1	4 100	$\leq$ 1,2 $\leq$ 7
$q_{2-24-100}$	1,5-3	4	$\leq$ 1,8
$\eta_B \times 10^3$	1,5-3	4	$\leq$ 1,1

Weigth per half core — 29 g approx.

Mean length of lines of force — l_e = 67,3 mm (two halves)

A_e = 164 mm^2 (two halves)

$\Sigma \frac{l_e}{A_e}$ = 0,410 mm^{-1} (two halves)

V_e = 11000 mm^3 (two halves)

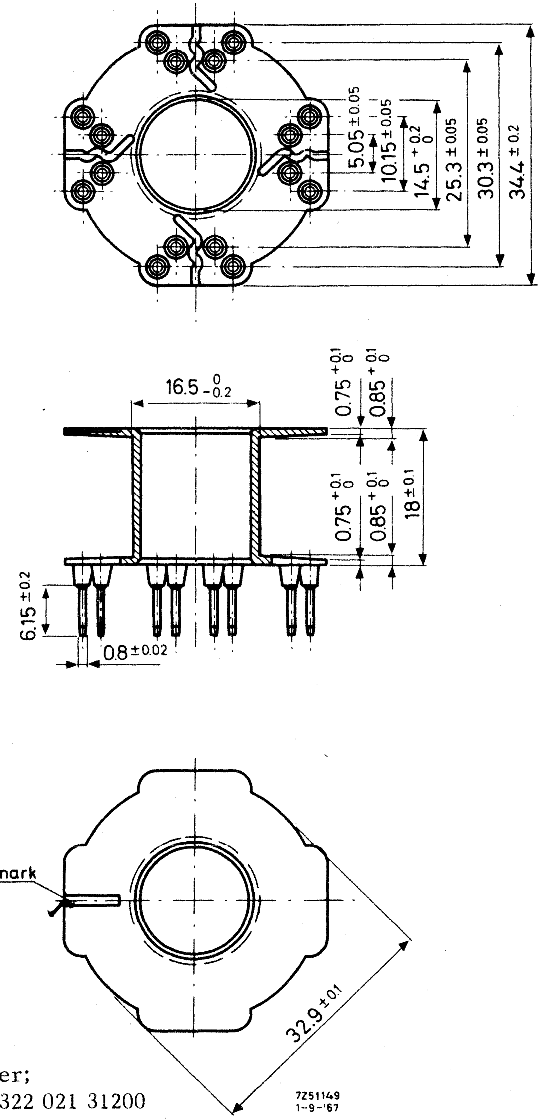
*) Orientation value

CORE HALVES WITH AIR GAP

ferroxcube grade	air gap length in mm	catalog number
3H1	0.02 ± 0.01	4322 020 24210
3H1	0.05 ± 0.015	4322 020 24220
3H1	0.15 ± 0.015	4322 020 24230
3H1	0.25 ± 0.015	4322 020 24240

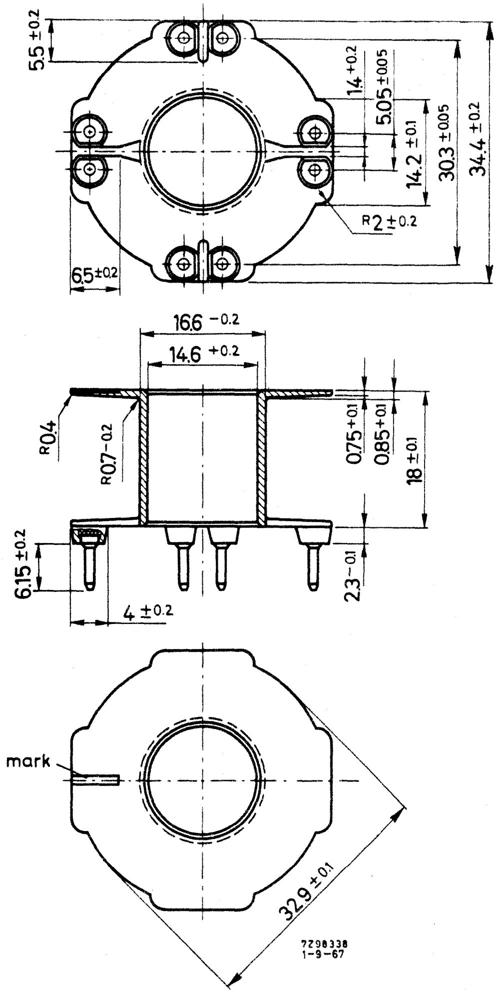
The electrical properties are measured on cores without air gap.

COIL FORMERS



16 pins coil former;
catalog number 4322 021 31200

7Z51149
1-9-'67

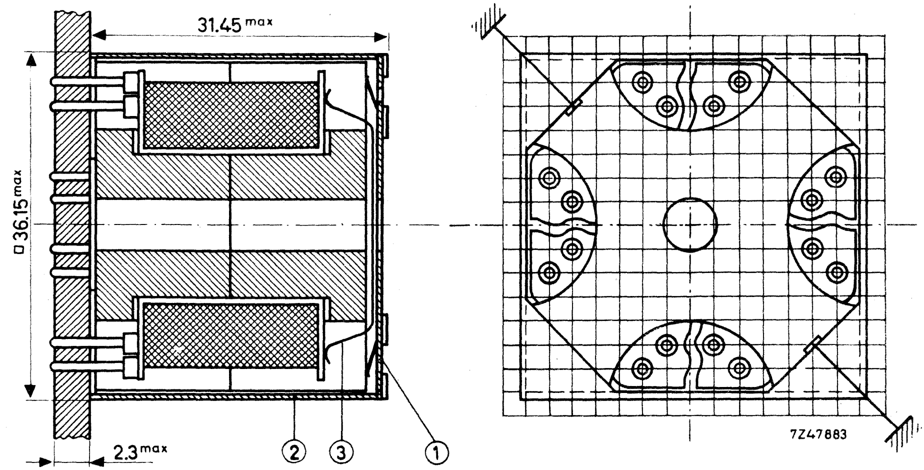


8 pins coil former;
catalog number 4322 021 30190

Properties of the coil formers

Material	reinforced polyester
Window area	134 mm^2
Mean length of turn	77,5 mm
Max. dipsolder temperature (5 to 6 s)	280 °C
Max. working temperature	130 °C
Tensile strength of pins (1 minute at 25 °C)	$\geq$ 20 N
A.C. test voltage between pins (50 Hz, 2 min)	2000 V

MOUNTING PARTS



(1) Cover 4322 021 31160
(2) Container 4322 021 31180
(3) Spring 4322 021 30220
(4) Soldering spring 4322 021 30700 (see below)

The cross core has been developed especially for transformers to be mounted on printed-wiring boards.

An advantage of this construction is that the leading-out wires are soldered to the pins, which are directly mounted on the coil former.

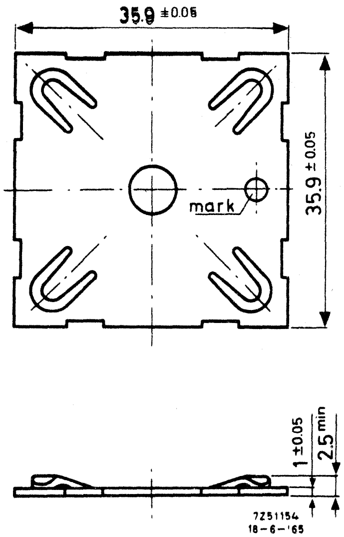
The sixteen soldering pins are positioned according to a grid of 2.52 mm. They will fit printed-wiring boards with a 0.1" grid as well as those with a 2.50 mm grid. The pin length is sufficient for board thicknesses up to 2.3 mm. The printed-wiring board should be provided with holes of 1.3 ± 0.1 mm in diameter.

The phosphor-bronze cover has four cut-out lips on the corners, consequently the cover acts as a spring at the same time.

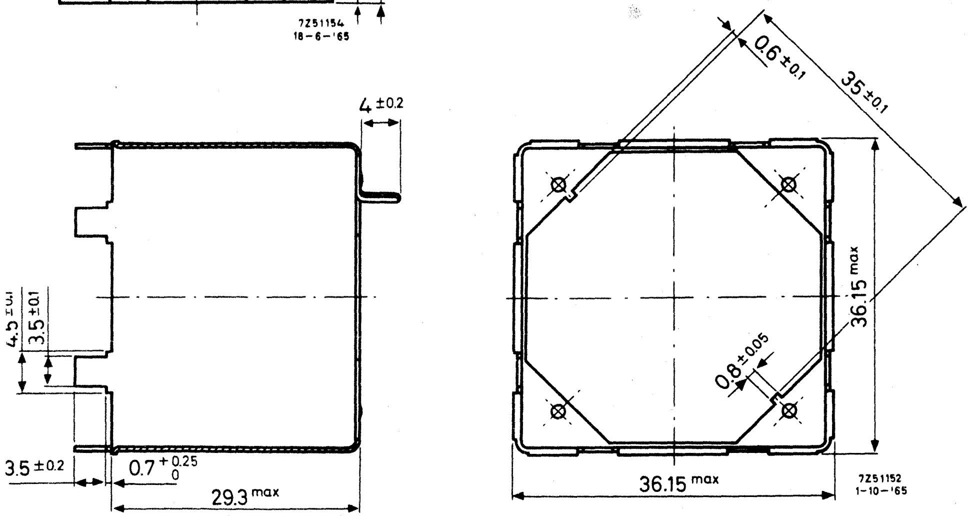
The cover is provided with a marking hole. The mark of the coil former (see the Fig. of coil former) has to be in one line with this hole. These markings facilitate the numbering of the soldering pins and the positioning on the printed-wiring board.

It is recommended to cement the coil former in one of the cross-core halves or to use the spring (pos. 3) in order to obtain the most stable construction.

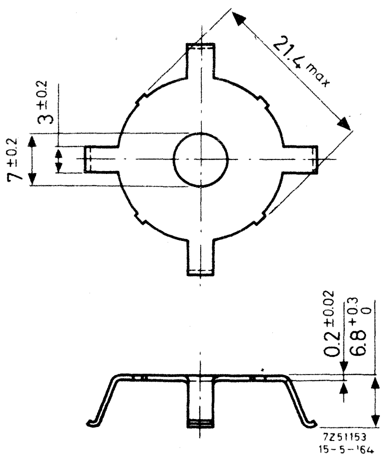
Before bending the lips of the container, pressure should be exercised evenly on the four corners of the cover until the latter meets the container. The required force is approximately 330 Newton. After bending the lips, the core will have the correct tension.



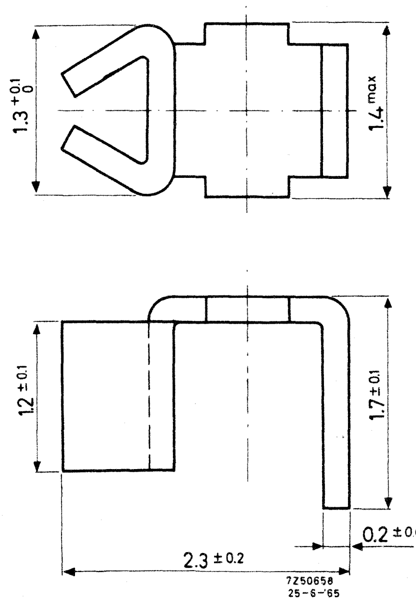
(1) Cover 4322 021 31160
Material: phosphorbronze, nickel plated



(2) Container 4322 021 31180
Material: brass, nickel plated



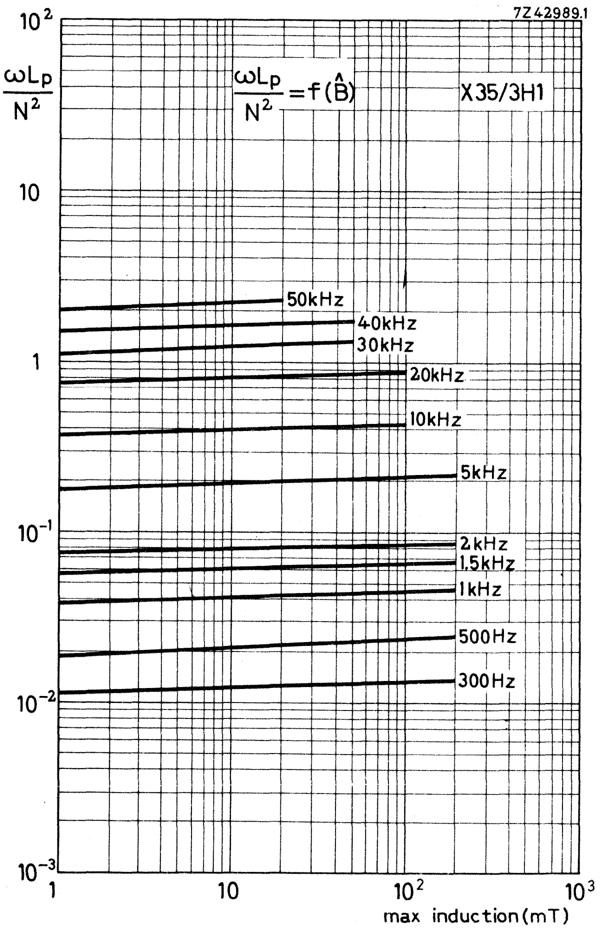
(3) Spring 4322 021 30220
Material: phosphorbronze



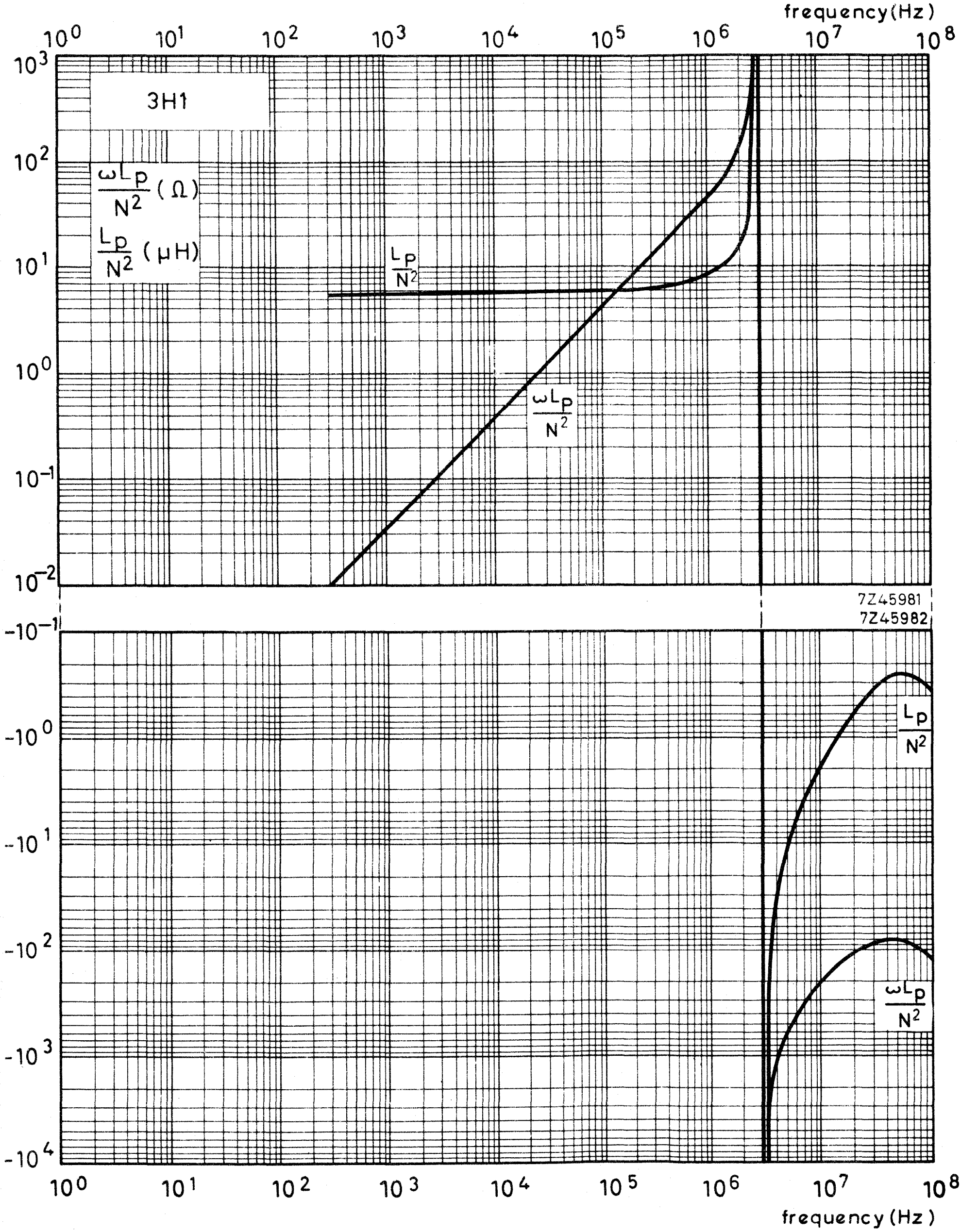
(4) Soldering spring 4322 021 30700
Material: brass, dipsoldered

CHARACTERISTIC CURVES

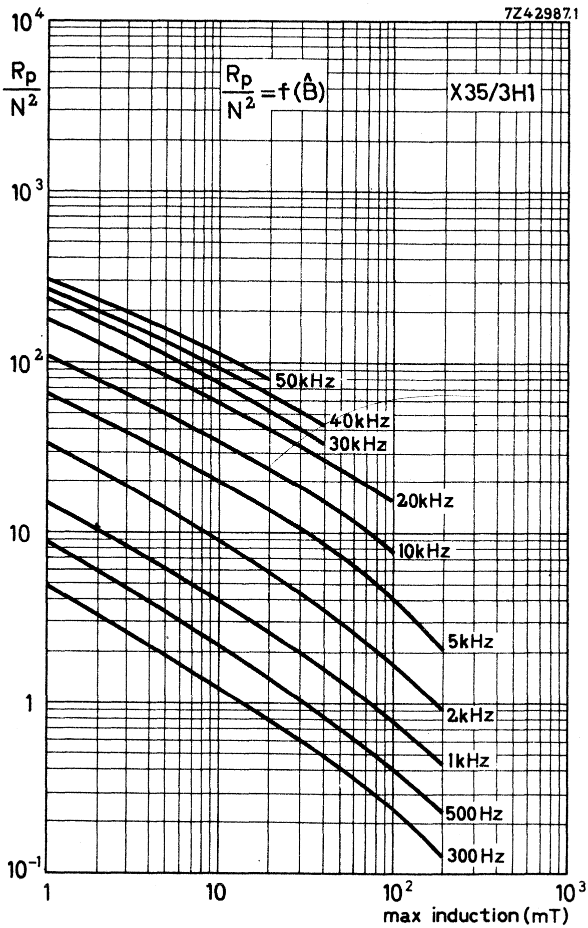
INDUCTANCE AS A FUNCTION OF THE INDUCTION (typical values)



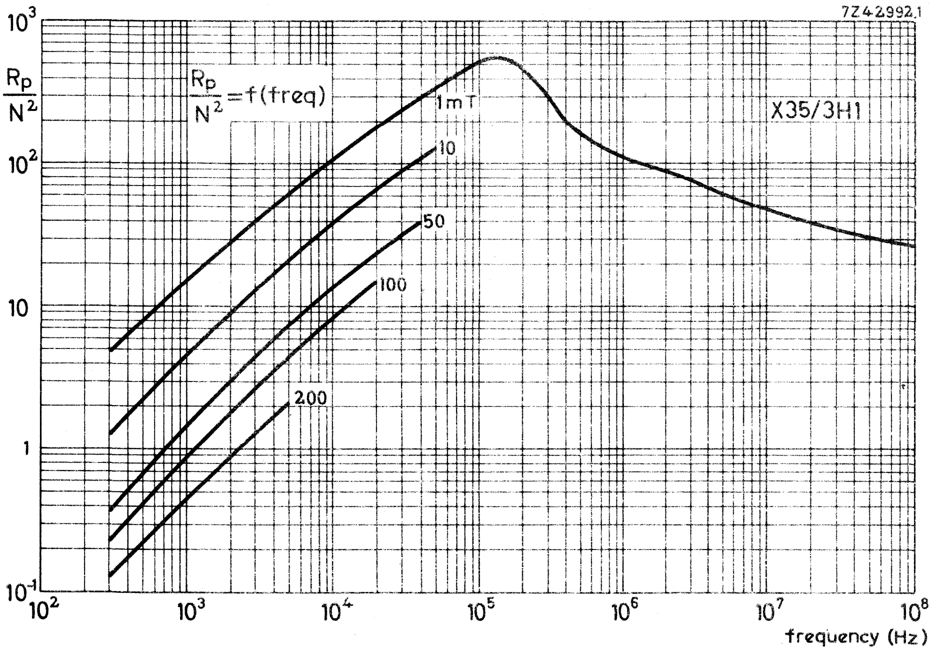
INDUCTANCE AS A FUNCTION OF THE FREQUENCY (typical curves)



CORE LOSSES AS A FUNCTION OF THE INDUCTION (typical values)

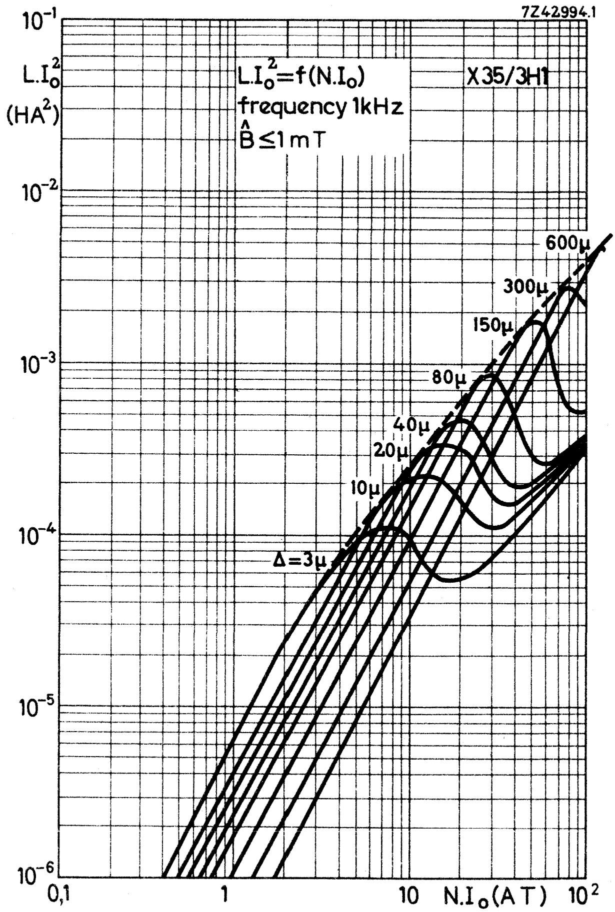


CORE LOSSES AS A FUNCTION OF THE FREQUENCY (typical values)

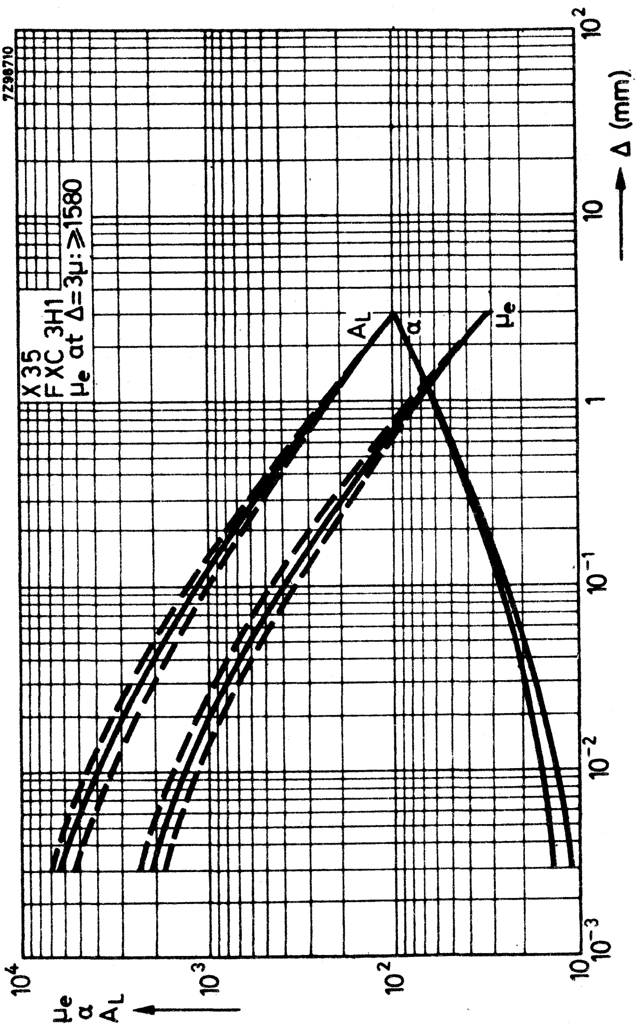


HANNA CURVE (typical values)

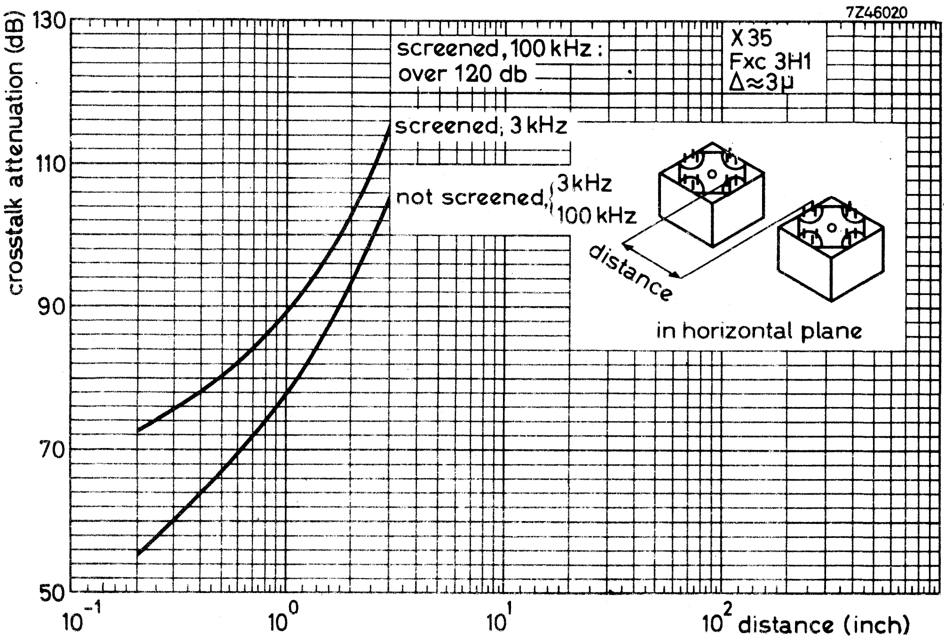
Indicating optimum inductance for a certain airgap and direct current.

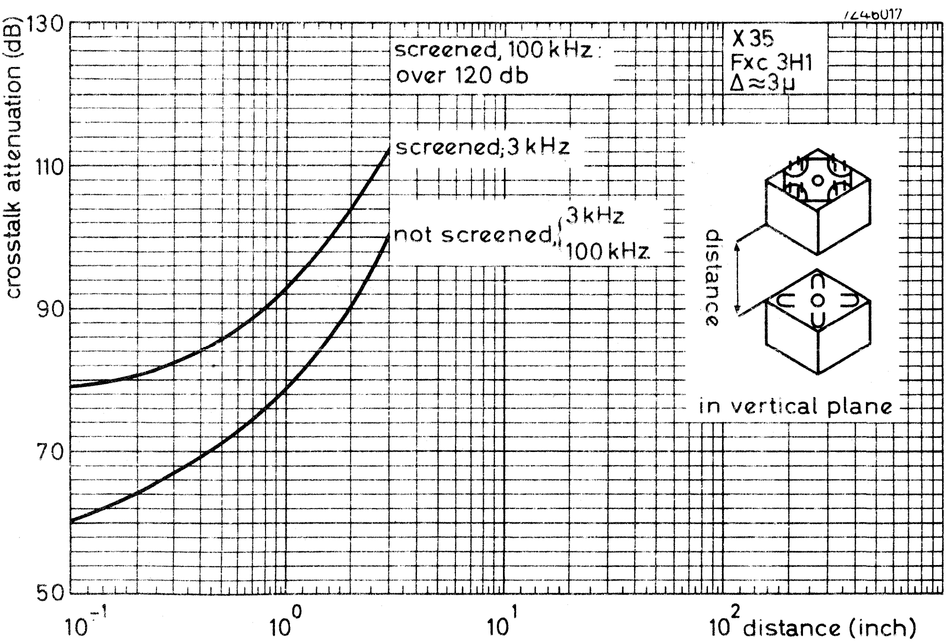


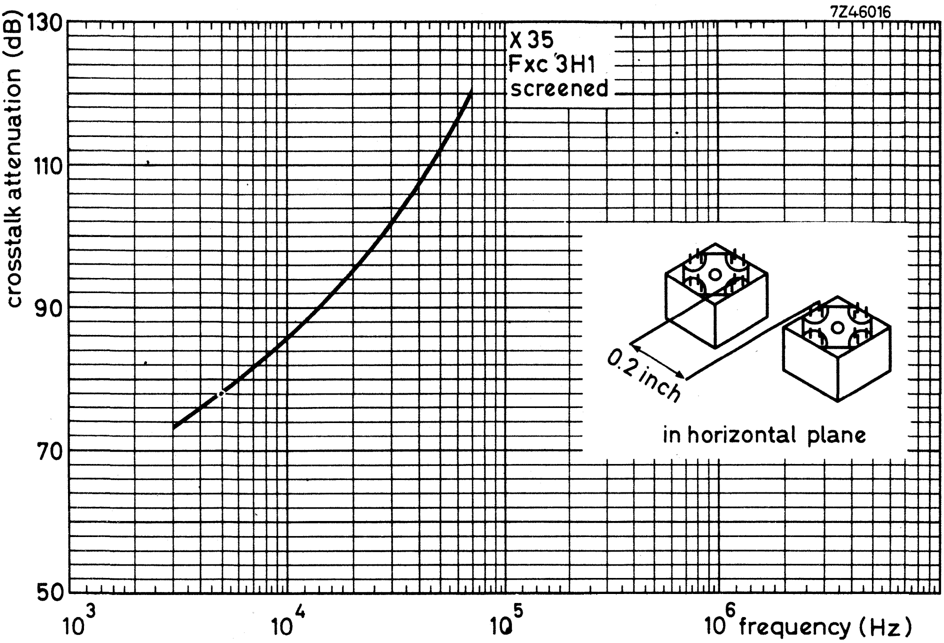
μ_e - α AND A_L CURVES



CROSSTALK ATTENUATION






7Z46016
X 35
Fxc 3H1
screened
0.2 inch
in horizontal plane
crosstalk attenuation (dB)
130
110
90
70
50
10^3
10^4
10^5
10^6
frequency (Hz)

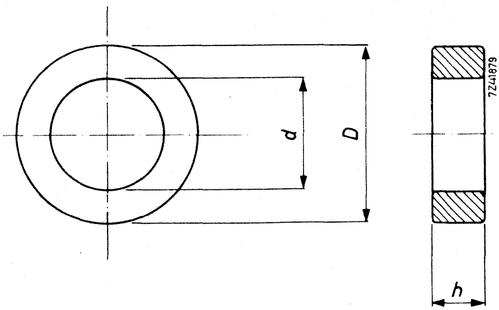
Toroids

INTRODUCTION

Toroids, having no air gap, posses a small magnetic stray field and a high permeability.
In spite of the closed magnetic circuit the losses are low due to the favourable properties of ferroxcube.

Toroids are mainly used in small broadband transformers, pulse transformers and chokes. If, however, the direct current through the transformer is relatively large, transformer cores with an air gap are to be preferred.
Toroids are not recommended for tuned circuits.

TOROIDS



Ferroxcube toroids are used in small broadband transformers, pulse transformers, etc.
Toroids are available in various sizes and ferroxcube grades. They are barrel-finished and coated with an insulating lacquer.

DIMENSIONAL QUANTITIES, TOLERANCES AND WEIGHTS (Table I)

D (mm)	d (mm)	h (mm)	l_e (mm)	$\Sigma\frac{l_e}{A_e}$ (mm^{-1})	V_e (mm^3)	weight (g)
2 ±0.1	1.3 ±0.1	0.7 ±0.1	5,11	20,8	1,25	0.006
3.93 ±0.13	2.23 ±0.09	1.27 ±0.09	–	8,74	–	–
4 ±0.1	2.2 ±0.1	1.1 ±0.1	9,46	9,56	9,37	0.045
4.83 ±0.25	2.28 ±0.25	1.27 ±0.25	–	6,63	–	–
5.84 ±0.13	3.05 ±0.2	1.52 ±0.13	–	6,34	–	–
6 ±0.15	4 ±0.15	2 ±0.1	15,5	7,75	31,0	0.15
9 ±0.2	6 ±0.2	3 ±0.1	23,3	5,17	105	0.50
9.53 ±0.25	4.75 ±0.25	3.18 ±0.25	–	2,84	–	–
14 ±0.3	9 ±0.25	5 ±0.15	35,5	2,85	445	2.14
23 ±0.5	14 ±0.35	7 ±0.2	57,0	1,81	1790	8.6
29 ±0.5	19 ±0.4	7.5 ±0.2	75,0	2,01	2580	13
36 ±0.7	23 ±0.5	10 ±0.2	92,0	1,42	5600	29
36 ±0.7	23 ±0.5	15 ±0.2	92,0	0,942	8500	44

Notes

1. All dimensions apply to non-lacquered toroids.
2. All μ-values in the following are determined with the $\Sigma\frac{l_e}{A_e}$ values of Table I at 25 °C.
   The relevant A_L values can be calculated with the formula $A_L = \frac{0,4\pi\mu}{\Sigma\frac{l_e}{A_e}}$
3. The smaller a toroid, the more its properties deviate from the material properties. Therefore a straight-forward translation of the material figures is not always possible.

GRADES AND SIZES

Toroids of ferroxcube 3E1

μ_{tor} = 2700 ±20% at 23 ± 1 °C
Lacquered green

dimensions (mm)	catalog number
29 x 19 x 7.5	4322 020 36550
36 x 23 x 10	4322 020 36560
36 x 23 x 15	4322 020 36570

Toroids of ferroxcube 3E2

μ_{tor} > 5000 at +23 to +70 °C
Lacquered blue

dimensions (mm)	catalog number
4 x 2.2 x 1.1	4322 020 36650
6 x 4 x 2	4322 020 36660
9 x 6 x 3	4322 020 36670
14 x 9 x 5	4322 020 36680
23 x 14 x 7	4322 020 36690

Toroids of ferroxcube 3E3

μ_{tor} > 10 000 at +10 to +70 °C
Lacquered brown
* Not lacquered

dimensions (mm)	catalog number
*2 x 1.3 x 0.7	4322 020 90950
4 x 2.2 x 1.1	4322 020 36700
6 x 4 x 2	4322 020 36710
9 x 6 x 3	4322 020 36720

Toroids of ferroxcube 3H1

Sorted into μ groups.
Lacquered orange
$D_F \leq 4.3 \times 10^{-6}$ at 23 ± 1 °C

dimensions (mm)	catalog number
4 x 2.2 x 1.1	4322 020 36590
6 x 4 x 2	4322 020 36600
9 x 6 x 3	4322 020 36610
14 x 9 x 5	4322 020 36620
23 x 14 x 7	4322 020 36630

For the convenience of the user the toroids of ferroxcube 3H1 are delivered sorted into groups of approximately equal μ-value. The μ-value is indicated by the code colour of one of the surfaces of the toroid, see Table II. Groups are not separately available.

Table II (for toroids of the 3H1 grade)

group	code colour	μ_{tor} at 23 ± 1 °C	4322 020 36590	36600	36610	36620	36630
					α-factor		
2	red	2140-2360	58,3	52,3	42,8	31,8	25,3
3	orange	2300-2540	56,0	50,3	41,2	30,6	24,4
4	yellow	2480-2740	54,0	48,6	39,8	29,5	23,5
5	green	2680-2960	51,8	46,6	38,2	28,3	22,6
6	blue	2900-3210	49,9	44,8	36,7	27,3	21,7
7	violet	3150-3480	48,0	43,2	35,4	26,2	20,9
8	grey	3420-3780	46,2	41,4	34,0	25,2	20,1
9	white	3720-4110	44,2	39,7	32,5	24,1	19,2

Number of turns for L mH: $N = \alpha\sqrt{L}$

The α factors are mean values, except those of the last group.

Between +23 and +70 °C the min μ_{tor} of the product is higher than the min μ_{tor} of the group.

Toroids of ferroxcube 4C6

$\mu_{tor} > 100$ at +5 to +55 °C
Lacquered violet

dimensions (mm)	catalog number
6 x 4 x 2	4322 020 91000
9 x 6 x 3	4322 020 91010
14 x 9 x 5	4322 020 91020
23 x 14 x 7	4322 020 91070
36 x 23 x 15	4322 020 91090

Toroids of ferroxcube 3B7

Between 0 and +60 °C the deviation in A_L is max. +10/−6% with regard to A_L at the reference temperature +23 °C.
Not lacquered.

dimensions (mm)	A_L ± 20% at 23 ± 1 °C	catalog number
3,93 x 2,23 x 1,27	360	4322 020 90820
4,83 x 2,28 x 1,27	475	4322 020 90830
5,84 x 3,05 x 1,52	495	4322 020 90840
9,53 x 4,75 x 3,18	1100	4322 020 90850

INDEX OF CATALOGUE NUMBERS

The purpose of this index is to provide identification of the component type when only the catalogue number is known. Details of the particular component are given in the relevant section of this book.

3103 209	12030	Core for erasing heads in 3H2
	12040	Core for erasing heads in 3H2
3103 224	90090	Core for erasing heads in 3H2
	90100	Core for erasing heads in 3H2
	90150	Core for erasing heads in 3H2
3104 101	80400	Core for erasing heads in 3H2
	80630	Tube core
	80720	Core for erasing heads in 3H2
	80730	Core for erasing heads in 3H2
3122 104	90300	Rod core
	90370	Tube core
	90380	Tube core
	90470	I-core
	90480	U-core
	90490	Rod core
	90550	Screw core
	90590	Sceerw core
	90740	Screw core
	90750	Screw core
	90770	Screw core
	90800	Tube core
	90810	Tube core
	90820	Tube core
	90870	Tube core
	90950	Bead
	90960	Bead
	91060	Rod core
	91070	Rod core
	91100	Rod core
	91130	Rod core
	91150	Rod core
	91170	Rod core
	91180	Rod core
	91230	Rod core
	91270	Rod core
	91310	Rod core
	91460	Frame core
	91470	Frame core
	91480	Frame core

3122 104 91690	Tube core
91730	Tube core
91900	Rod core
91920	Rod core
91950	Rod core
92020	Rod core
92040	Rod core
92070	Rod core
92080	Rod core
92550	Frame core
92800	Tube core
92900	Tube core
93110	Tube core
93120	U-core
93130	I-core
93160	Rod core
93320	Rod core
93570	U-core
93610	Screw core
93690	Rod core
93720	Tube core
93760	Tube core
93780	U-core
93840	Yoke ring
93890	Tube core
93950	U-core
94090	L-core
94480	Frame core
94600	L-core
94760	U-core
94770	I-core
94790	Yoke ring
94840	Bead
94880	Tube core
94920	Tube core
94990	Tube core
99070	Yoke ring
3122 134 90000	Tube ring
90110	Rod core
90200	U-core
90210	E-core
90430	Transductor core
90460	U-core
90480	U-core
90620	Rod core
90690	U-core
90720	Rod core
90760	U-core
90770	Tube core
90780	Tube core

3122 134 90800	Bead
90810	U-core
90940	E-core
90960	Transductor core
90970	Yoke ring
91190	Rod core
91350	U-core
3122 137 52270	Yoke ring
3522 100 65950	Tube core
3522 200 03480	Cross core X22 in 3D3
03490	Cross core X22 in 4C6
08770	Cross core X22 in 3B7
10950	Tube core
10960	Tube core
10970	Tube core
23510	Cross core X22 in 3H1
23530	Cross core X22 in 3E1
4311 020 50030	Tube core
50060	Tube core
50110	Rod core
50430	Tube core
50710	Tube core
50790	Rod core
51880	Tube core
52100	Tube core
53460	Tube core
54160	Tube core
54310	Tube core
55210	Antenna rod
55360	Antenna rod
55390	Antenna rod
55420	Antenna rod
55430	Antenna rod
55440	Antenna rod
55450	Antenna rod
55460	Antenna rod
55470	Antenna rod
55480	Antenna rod
4312 020 10840	Rod core
30020	Rod core
30030	Rod core for small coils
30150	Rod core for small coils
30160	Rod core
30180	Rod core
30190	Rod core
30200	Rod core
30370	Rod core
30420	Rod core for small coils
30460	Rod core
30490	Rod core

4312 020 30560	Rod core
30570	Rod core
31050	Tube core
31060	Tube core
31080	Tube core
31200	Tube core
31220	Tube core
31250	Tube core
31320	Tube core
31330	Tube core
31450	Tube core
32040	Screw core
32060	Screw core
32070	Screw core
32110	Screw core
32120	Screw core
32130	Screw core
32150	Screw core
33070	U-core
33080	I-core
33090	U-core
33100	U-core
33110	I-core
33120	U-core
33190	U-core
33300	U-core
33320	U-core
33330	U-core
33400	U-core
33420	I-core
34070	E-core E20/10/5 in 3C6
34100	E-core E55/28/21
34110	E-core E42/21/15 in 3C8
34120	E-core E42/21/20 in 3C8
34170	E-core E42/21/20 + E42/33/20
34190	E-core E42/33/20 in 3C8
34340	Transductor core
34380	E-core E65/33/27 in 3C8
34400	Bead
34420	Bead
34430	Bead
36630	Wideband HF choke
36640	Wideband HF choke
36650	Wideband HF choke
36690	Wideband HF choke
36700	Wideband HF choke
36710	Wideband HF choke
4312 021 28430	Coil former E20/10/5
28550	Coil former E30/15/7
28620	Coil former E42/21/15

4312 021 28710	Coil former E55/28/21
28720	Coil former E65/32/13
29240	Coil former RM6-S
29250	Coil former RM6-S
4313 020 10210	Rod core
10250	Rod core
10300	Rod core
12230	Rod core
12250	Rod core
12330	Rod core
12470	Rod core
15010	Tube core
15020	Tube core
15120	Tube core
15170	Tube core
15180	Tube core
15280	Tube core
15460	Tube core
15470	Tube core
15630	Tube core
15840	Tube core
16880	Tube core
17670	Rod core
18180	Rod core
35350	Yoke ring
4313 021 03620	Coil former RM10
03630	Coil former RM10
03660	Coil former RM10
03670	Coil former RM10
04120	Clip for RM10
04143	Coil former EC35/17/10
04153	Coil former EC41/19/12
04163	Coil former EC52/24/14
04173	Coil former EC70/34/17
4322 020 20900	Potcore half P9/5 in 3D3
20940	Potcore half P9/5 in 4C6
20970	Potcore half P9/5 in 3B7
20980	Potcore half P9/5 in 3H1
21000	Potcore half P11/7 in 3B7
21010	Potcore half P11/7 in 3B7
21020	Potcore half P11/7 in 3D3
21040	Potcore half P11/7 in 4C6
21250	Potcore half P11/7 in 3B7
21260	Potcore half P14/8 in 3H1
21270	Potcore half P14/8 in 3D3
21350	Potcore half P14/8 in 4C6
21360	Potcore half P14/8 in 3E1
21500	Potcore half P18/11 in 3B7
21510	Potcore half P18/11 in 3H1
21520	Potcore half P18/11 in 3D3

4322 020 21610	Potcore half P18/11 in 4C6
21640	Potcore half P18/11 in 3E1
21650	Potcore half P18/11 in 3H3
21750	Potcore half P22/13 in 3B7
21760	Potcore half P22/13 in 3H1
21770	Potcore half P22/13 in 3D3
21830	Potcore half P22/13 in 4C6
21850	Potcore half P22/13 in 3E1
22000	Potcore half P26/16 in 3B7
22020	Potcore half P26/16 in 3D3
22110	Potcore half P26/16 in 3E1
22140	Potcore half P26/16 in 3H1
22220	Potcore half P26/16 in 3B8
22250	Potcore half P30/19 in 3B7
22260	Potcore half P30/19 in 3H1
22270	Potcore half P30/19 in 3D3
22300	Potcore half P30/19 in 3E1
22390	Potcore half P30/19 in 3B8
22500	Potcore half P36/22 in 3B7
22510	Potcore half P36/22 in 3H1
22520	Potcore half P36/22 in 3D3
22570	Potcore half P36/22 in 3E1
22610	Potcore half P36/22 in 3B8
22750	Potcore half P42/29 in 3B7
22760	Potcore half P42/29 in 3E1
23000	Potcore half P66/56 in 3B5
23010	Potcore half P66/56 in 3E1
23700	Cross core half X22 with air gap in 3H1
23710	Cross core half X22 with air gap in 3H1
23720	Cross core half X22 with air gap in 3H1
23730	Cross core half X22 with air gap in 3H1
23740	Cross core half X22 with air gap in 3H1
23750	Cross core half X30 in 3H1
23760	Cross core half X30 in 3E1
23960	Cross core half X30 in 3H1
23970	Cross core half X30 in 3H1
23980	Cross core half X30 in 3H1
23990	Cross core half X30 in 3H1
24000	Cross core half X35 in 3H1
24210	Cross core half with air gap X35 in 3H1
24220	Cross core half with air gap X35 in 3H1
24230	Cross core half with air gap X35 in 3H1
24240	Cross core half with air gap X35 in 3H1
25020	Square core RM6-S in 3H1
25040	Square core RM6-S in 3B7
25060	Square core RM6-S in 3D3
25080	Square core RM6-S in 4C6
25120	Square core RM6-R in 3B7
25130	Square core RM6-R in 3H1
25140	Square core RM6-R in 3D3

4322 020 25150	Square core RM6-R in 4C6
25190	Square core RM6-R in 3H3
25200	Square core RM6-S in 3H3
26510	Square core RM4 in 3H1
26750	Square core RM4 in 3B7
26760	Square core RM4 in 3H1
26770	Square core RM4 in 3D3
26780	Square core RM4 in 4C6
26790	Square core RM5 in 3H3
27250	Square core RM8 in 3B7
27260	Square core RM8 in 3H1
27270	Square core RM8 in 3D3
27280	Square core RM8 in 4C6
27420	Square core RM8 in 3B8
27850	Square core RM6-S in 3B8
28270	Square core RM10 in 3H1
28290	Square core RM10 in 3E4
28320	Square core RM10 in 3B8
28350	Square core RM10 in 3C8
31500	Bead
31520	Bead
31550	Bead
31570	Bead
32040	Rod core
32060	Rod core
32090	Rod core
32130	Rod core
32140	Rod core
32160	Rod core
32170	Rod core
33040	H10 - core assembly in 3E2
34300	Tube core
34310	Tube core
34320	Tube core
34340	Tube core
34380	Tube core
34390	Tube core
34400	Tube core
34410	Tube core
34420	Tube core
34430	Tube core
34450	Tube core
34460	Tube core
34470	Tube core
34480	Tube core
34490	Tube core
34510	E-core E13/7/3 in 3H1
34550	E-core E20/10/5 in 3E1
34650	E-core E30/15/7 in 3E1
34660	E-core E30/15/7 in 3E1

4322 020 34740	E-core E42/21/15 in 3E1
34750	E-core E42/21/15 in 3E1
34830	E-core E20/10/5 in 3E1
34840	E-core E30/15/7 in 3E1
34850	E-core E42/21/15 in 3E1
34900	E-core E55/28/21
34910	E-core E65/32/18 in 3E1
36550	Toroid in 3E1
36560	Toroid in 3E1
36570	Toroid in 3E1
36590	Toroid in 3H1
36600	Toroid in 3H1
36610	Toroid in 3E1
36620	Toroid in 3H1
36630	Toroid in 3H1
36650	Toroid in 3E2
36660	Toroid in 3E2
36670	Toroid in 3E2
36680	Toroid in 3E2
36690	Toroid in 3E2
36700	Toroid in 3E3
36710	Toroid in 3E3
36720	Toroid in 3E3
36750	Tube core
36770	Tube core
36780	Tube core
36810	Tube core
36840	Bead
37030	Frame core
37320	I-core 42/7,5/15 in 3E1
38280	Bead
38340	Rod core
38360	Tube core
38420	Tube core
39330	Rod core
39350	Rod core
39390	Rod core
39400	Rod core
39410	Rod core
39430	Rod core
39450	Rod core
39470	Rod core
39480	Rod core
39490	Rod core
52500	EC-core EC55/17/10 in 3C8
52510	EC-core EC41/19/12 in 3C8
52520	EC-core EC52/24/14 in 3C8
52530	EC-core EC70/34/17 in 3C8
90820	Toroid in 3B7
90830	Toroid in 3B7

4322 020 90840	Toroid in 3B7
90850	Toroid in 3B7
90950	Toroid in 3E3
91000	Toroid in 4C6
91010	Toroid in 4C6
91020	Toroid in 4C6
91070	Toroid in 4C6
91090	Toroid in 4C6
4322 021 20020	Brass container H10
20140	Coil former E20/10/5
20160	Clasp E20/10/5
20170	Clasp E30/15/7
20220	Spring E20/10/5
20230	Spring E30/15/7
20240	Coil former E20/10/5
20250	Coil former E30/15/7
20390	Phosphor bronze spring H10
30040	Container for X22
30140	Nut for adjuster P14/8 - P18/11 - RM6-R, RM6-S-X22
30150	Nut for adjuster P22/13, RM8
30160	Nut for adjuster P26/16 - P30/19 - P42/29
30180	Tag plate P11/7
30190	Coil former X35
30210	Spring X30
30220	Spring X35
30230	Cover for X22
30240	Coil former P11/7
30250	Coil former P14/8
30260	Coil former P14/8
30270	Coil former P18/11
30280	Coil former P18/11
30290	Coil former P18/11
30300	Coil former P22/13
30310	Coil former P22/13
30320	Coil former P22/13
30330	Coil former P26/16
30340	Coil former P26/16
30350	Coil former P26/16
30360	Coil former P30/19
30370	Coil former P30/19
30380	Coil former P30/19
30390	Coil former P36/22
30400	Coil former P36/22
30410	Coil former P36/22
30420	Coil former P42/29
30430	Coil former P42/29
30440	Tag plate P14/8
30450	Tag plate P18/11
30460	Tag plate P22/23
30470	Tag plate P26/16

4322 021 30480	Tag plate P30/19
30490	Tag plate P26/22
30500	Tag plate P42/29
30510	Brass container P11/7
30520	Brass container P14/18
30530	Brass container P18/11
30540	Brass container P22/13
30550	Brass container P26/16
30560	Brass container P30/19
30570	Brass container P36/22
30580	Brass container P46/29
30600	Aluminium container P14/8
30620	Spring P11/7
30630	Spring P14/8
30640	Spring P18/11
30650	Spring P22/13
30660	Spring P26/16
30670	Spring P30/19
30680	Spring P36/22
30690	Spring P42/29
30700	Soldering spring P11/7 - P18/11 - P22/13 - P26/16 - X22 - X30 - X33 - X35 - P30/19 - P36/22 - P42/29
30710	Nut P14/8 - P18/11 - P22/13 - P26/16 - P30/19 - P36/22 - P42/29 - E42
30720	Fixing bush P14/8 - P18/11 - P22/13 - P26/16 - P30/19 - P32/22 - P42/29 - E42
30730	Inductance adjuster P18/11 - X22
30740	Inductance adjuster P14/8
30750	Inductance adjuster P14/8
30760	Inductance adjuster P18/11
30770	Inductance adjuster P18/11
30780	Inductance adjuster P26/16 - P30/19
30790	Inductance adjuster P26/16 - P30/19 - P36/22
30800	Inductance adjuster P26/16 - P30/19
30810	Inductance adjuster P26/16 - P30/19 - P36/22 - P42/29
30940	Inductance adjuster P14/8
30950	Inductance adjuster P14/8
30960	Inductance adjuster P18/11
30970	Inductance adjuster P18/11
30980	Inductance adjuster P26/16 - P30/19 - P36/22 - P42/29
31000	Inductance adjuster P22/13 - RM8
31020	Inductance adjuster P22/13 - RM8
31040	Inductance adjuster P22/13
31060	Inductance adjuster P22/13 - RM8
31070	Inductance adjuster P14/8
31080	Inductance adjuster P18/11 - X22
31090	Inductance adjuster P26/16 - P30/19 - P36/22 - P42/29
31100	Inductance adjuster P22/13 - RM8
31110	Inductance adjuster P36/22
31120	Inductance adjuster P30/19 - P36/22 - P42/29

4322 021 31130	Inductance adjuster P14/8
31150	Cover X30
31160	Cover X35
31170	Container X30
31180	Container X35
31190	Coil former X30
31200	Coil former X35
31240	Inductance adjuster P22/13 - RM8
31250	Inductance adjuster P9/5 - P11/7 - RM4 - RM5
31260	Inductance adjuster P11/7 - RM4 - RM5
31270	Inductance adjuster P9/5 - P11/7 - RM4 - RM5
31280	Inductance adjuster P11/7 - RM4 - RM5
31320	Coil former P66/56
31540	Inductance adjuster P9/5 - P11/7 - RM4 - RM5
31630	Nut for adjuster P9/5 - P11/7
31700	Coil former P9/5
31780	Clip for RM6-R, RM6-S
31800	Coil former RM4
31830	Coil former E42/21/15
31840	Nut for adjuster RM8
31850	Nut for adjuster RM4
31900	Clip for RM4 - RM5
31910	Clasp for E42/21/15
31920	Spring E42/21/15
32130	Inductance adjuster for RM6-R - RM6-S
32140	Inductance adjuster for RM6-R - RM6-S
32150	Inductance adjuster for RM6-R - RM6-S
32160	Inductance adjuster for RM6-R - RM6-S
32170	Inductance adjuster for RM6-R - RM6-S
32180	Inductance adjuster for RM6-R - RM6-S
32190	Inductance adjuster for RM8
32280	Coil former for RM6-R
32290	Coil former for RM6-R
32300	Coil former for RM6-R
32310	Coil former for RM6-R
32360	Coil former for RM8
32380	Coil former for RM8
32390	Coil former for RM8
32420	Coil former for RM8
32710	Inductance adjuster RM5
32720	Inductance adjuster for RM5
32830	Coil former for RM5
32840	Coil former for RM5
32850	Nut for adjuster RM5
32940	Coil former for RM6-S
32950	Coil former for RM6-S
33000	Coil former EC35/17/10
33010	Coil former EC41/19/12
33020	Coil former EC52/24/14
33030	Coil former EC70/34/17

4322 022 00...	Pre-adjusted potcore P11/7
01...	Pre-adjusted potcore P11/7
02...	Pre-adjusted potcore P14/8
03...	Pre-adjusted potcore P14/8
04...	Pre-adjusted potcore P18/11
05...	Pre-adjusted potcore P18/11
06...	Pre-adjusted potcore P22/13
07...	Pre-adjusted potcore P22/13
08...	Pre-adjusted potcore P26/16
09...	Pre-adjusted potcore P26/16
10...	Pre-adjusted potcore P30/19
11...	Pre-adjusted potcore P30/19
12...	Pre-adjusted potcore P36/22
13...	Pre-adjusted potcore P36/22
14...	Pre-adjusted potcore P42/29
15...	Pre-adjusted potcore P42/29
20...	Pre-adjusted potcore P11/7
21...	Pre-adjusted potcore P11/7
22...	Pre-adjusted potcore P14/8
23...	Pre-adjusted potcore P14/8
24...	Pre-adjusted potcore P18/11
25...	Pre-adjusted potcore P18/11
26...	Pre-adjusted potcore P22/13
27...	Pre-adjusted potcore P22/13
28...	Pre-adjusted potcore P26/16
29...	Pre-adjusted potcore P26/16
30...	Pre-adjusted potcore P30/19
31...	Pre-adjusted potcore P30/19
32...	Pre-adjusted potcore P36/22
33...	Pre-adjusted potcore P36/22
34...	Pre-adjusted potcore P42/29
35...	Pre-adjusted potcore P42/29
41...	Pre-adjusted potcore P9/5
45...	Pre-adjusted cross core X22
47...	Pre-adjusted square core RM6-S
51...	Pre-adjusted square core RM8
55...	Pre-adjusted square core RM6-R
57...	Pre-adjusted square core RM4
59...	Pre-adjusted square core RM5
61...	Pre-adjusted potcore P9/5
65...	Pre-adjusted cross core X22
67...	Pre-adjusted square core RM6-S
71...	Pre-adjusted square core RM8
75...	Pre-adjusted square core RM6-R
77...	Pre-adjusted square core RM4
79...	Pre-adjusted square core RM5
4322 058 00010	Potcore P18/11
00020	Potcore P22/13
00030	Potcore P26/16
00040	Potcore P30/19

4322 058	00050	Potcore P36/22
	00060	Potcore P42/29
	00070	Potcore P11/7
	00080	Cross core assembly X22
	00090	Cross core assembly X30
	00100	Cross core assembly X35
	00150	Cross core assembly RM6
	00160	Cross core assembly RM8
	00170	Cross core assembly RM5
	00180	Cross core assembly RM4
4330 020	30230	Rod core
	30640	Rod core for small coils 4 x 18 grade 3C2
	30830	Tube core
	31000	Rod core
	31050	Tube core
	31060	Tube core
	31330	Rod core
	31770	Rod core
4330 030	30000	Rod core
	30010	Rod core
	32020	Tube core
	36000	Screw core
7622 300	50101	Standard coil to RM4
	50201	Standard coil to RM5/RM6-S
	50301	Standard coil to RM6-R
	50501	Standard coil to RM8
7622 301	00101	Standard coil to P9/5
	00301	Standard coil to P11/7
	00501	Standard coil to P14/8
	00701	Standard coil to P18/11
	00901	Standard coil to P22/13
	01101	Standard coil to P26/16
	01301	Standard coil to P30/19
	01501	Standard coil to P36/22
	01701	Standard coil to P42/29
	01901	Standard coil to P66/56
8213 140	25270	EC-core EC35/17/10 in 3C8
	25280	EC-core EC41/19/12 in 3C8
	25290	EC-core EC52/24/14 in 3C8
	25300	EC-core EC70/34/17 in 3C8
8222 294	37350	Coil former RM14
	37370	Clip for RM14
	38650	Coil former EC55/17/10
	38660	Coil former EC41/19/12
	38670	Coil former EC52/24/14
	38680	Coil former EC70/34/17
	38770	Pin for coil formers EC41/19/12, EC52/24/14 and EC70/34/17
	39680	Coil former RM14

Contents

	page
DATA HANDBOOK SYSTEM	
PROPERTIES OF MANGANESE-ZINC AND NICKEL-ZINC FERRITES	
Introduction	A3
Application	A4
Symbols and definitions of terms	A5
Technical data	A11
Characteristic curves	A19
FERRITES FOR RADIO, AUDIO AND TELEVISION	
Antenna rods	B3
Cores for small coils	B5
Tooth cores	B13
Yoke rings for use in deflection coils for picture tubes	B15
Cores for transformers	B23
Ferrites for television components	B49
Cores for erasing heads	B53
Ferroxcube for magnetic heads	B55
BEADS AND CHOKES	
Beads for screening, damping and wide-band H.F. chokes	C3
Wide-band H.F. chokes	C7
FERROXCUBE POTCORES AND SQUARE CORES	
General	D3
Introduction	D5
Pre-adjusted cores	D6
Q-curves	D10
Measurement of hysteresis, eddy current and residual losses	D10
Adjustment mechanism	D13
Coil design and calculations	D15
Hysteresis constants	D25
Marking	D26
Mounting data	D29
Coil winding recommendations	D33

Potcores		page
P 9/5,	Potcores	D37
	Coil former	D40
	Inductance adjusters	D41
P 11/7,	Potcores	D43
	Coil former	D47
	Inductance adjusters	D48
	Mounting parts	D51
	Characteristic curves	D54
P 14/8,	Potcores	D65
	Coil formers	D71
	Inductance adjusters	D73
	Mounting parts	D77
	Characteristic curves	D82
P 18/11,	Potcores	D99
	Coil formers	D107
	Inductance adjusters	D110
	Mounting parts	D114
	Characteristic curves	D118
P 22/13,	Potcores	D143
	Coil formers	D151
	Inductance adjusters	D153
	Mounting parts	D157
	Characteristic curves	D161
P 26/16,	Potcores	D181
	Coil formers	D189
	Inductance adjusters	D191
	Mounting parts	D196
	Characteristic curves	D200
P 30/19,	Potcores	D215
	Coil formers	D221
	Inductance adjusters	D223
	Mounting parts	D228
	Characteristic curves	D232
P 36/22,	Potcores	D243
	Coil formers	D249
	Inductance adjusters	D251
	Mounting parts	D256
	Characteristic curves	D260
P 42/29,	Potcores	D271
	Coil formers	D277
	Inductance adjusters	D279
	Mounting parts	D283
	Characteristic curves	D287
P 66/56,	Potcores	D291
	Coil former	D293

		page
Square cores		
RM4,	Square cores	D297
	Coil former	D301
	Inductance adjusters	D303
	Assembling and mounting	D307
	Characteristic curves	D309
RM5,	Square cores	D311
	Coil formers	D315
	Inductance adjusters	D317
	Assembling and mounting	D321
	Characteristic curves	D323
RM6-R,	Square cores	D337
	Coil formers	D341
	Inductance adjusters	D345
	Assembling and mounting	D349
	Characteristic curves	D351
RM6-S,	Square cores	D383
	Coil formers	D387
	Inductance adjusters	D389
	Assembling and mounting	D393
	Characteristic curves	D395
RM8,	Square cores	D411
	Coil formers	D415
	Inductance adjusters	D419
	Assembling and mounting	D423
	Characteristic curves	D425
RM10,	Square cores	D437
	Coil formers	D440
	Assembling and mounting	D442
RM14,	Square cores	D445
	Coil formers	D447
	Assembling and mounting	D449

FERROXCUBE TRANSFORMER CORES

General		
Introduction		E5
Determining the A_L - and μ_e-value		E6
Marking		E7
Mounting data		E9
E and I-cores		
Introduction		E13
E 13/7/3,	E-core	E15
E 20/10/5 (E 20),	E-cores	E17
	Coil formers	E19
	Mounting parts	E24
	Characteristic curves	E26

E 30/15/7 (E 30),	E-cores	E27
	Coil formers	E29
	Mounting parts	E32
	Characteristic curves	E34
E 42/21/15 (E 42),	E and I-cores	E35
	Coil formers	E35
	Mounting parts	E40
	Characteristic curves	E42
E 42/21/20		
E 42/33/20	E-cores	E43
E 55/28/21 (E 55),	E-cores	E45
	Coil former	E47
	Characteristic curves	E48
E 55/28/25,	E-core	E49
E 65/32/13 (E-65),	E-core	E51
	Coil former	E53
	Characteristic curves	E54
E 65/33/27,	E-core	E55

<u>EC-cores</u>

Introduction		E59
Core selection		E61
EC 35/17/10,	EC-core	E65
	Coil former	E67
	Characteristic curves	E69
EC41/19/12,	EC-core	E73
	Coil former	E75
	Characteristic curves	E77
EC52/24/14,	EC-core	E81
	Coil former	E83
	Characteristic curves	E85
EC 70/34/17,	EC-core	E89
	Coil former	E91
	Characteristic curves	E93

<u>H-cores</u>

Introduction		E99
H 10,	H-core	E101
	Coil former	E102
	Mounting parts	E104
	Characteristic curves	E107

<u>Cross cores</u>

Introduction		E119
X 22,	Cross cores	E121
	Coil former	E124
	Inductance adjusters	E127
	Mounting parts	E131

	Characteristic curves	E 135
X 30,	Cross cores	E 139
	Coil former	E 141
	Mounting parts	E 143
	Characteristic curves	E 146
X 35,	Cross cores	E 155
	Coil formers	E 158
	Mounting parts	E 161
	Characteristic curves	E 164

Toroids

Introduction E 174
Toroids E 175

INDEX OF CATALOGUE NUMBERS

A	Properties of manganese zinc and nickel zinc ferrites
B	Ferrites for radio, audio and television
C	Beads and chokes
D	Ferroxcube potcores and square cores
E	Ferroxcube transformer cores
	Index of catalogue numbers
	Contents

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