

# DATA HANDBOOK

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## Variable Capacitors



## **QUALITY ASSURED**

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

## **PRODUCT SAFETY**

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.

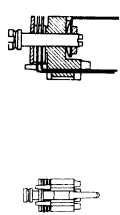


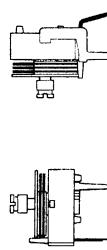
	page
<b>SELECTION GUIDE</b>	4
<b>DEVICE DATA</b>	
2222 808 2.... Ø 5 mm	9
2222 810 00...	19
2222 808 ..... Ø 7.5 mm	23
2222 808 ..... Ø 10 mm	31
2222 809 05...	41
2222 811 00...	49
2222 811 10...	53
2222 809 07...	59
2222 809 080..	65
2222 809 090..	73

**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

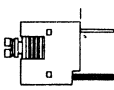

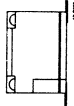
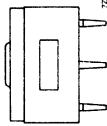
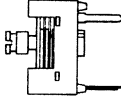
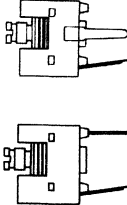
## SELECTION GUIDE

SELECTION GUIDE

catalogue number	housing dimensions mm	capacitance range $C_{min}/C_{max}$ pF	rated voltage V	temp. coeff. $10^{-6}/K$	temperature range °C	page
<b>FILM DIELECTRIC TRIMMERS; general purpose</b>						
2222 808 2 . . . .	$\phi$ 5 	1.5/5 to 4/27	150	-250 $\pm$ 200 to -50 $\pm$ 200	-40 to + 70 -40 to + 85	9
2222 810 00 . . .	7 x 8 x 6 	1.5/10 to 4/37	100	-300 $\pm$ 350 to -200 $\pm$ 250	-40 to + 85	19
2222 808 . . . . .	$\phi$ 7.5 	1.4/5.5 to 3/50	250	-500 $\pm$ 450 to -100 $\pm$ 300	-40 to + 70 -40 to + 85	23
2222 808 . . . . . 2222 808 . . . . .	$\phi$ 10 	2.5/15 to 7/105	250	-500 $\pm$ 150 to -100 $\pm$ 300	-40 to + 70 -40 to + 85	31

**Notes**

Some data on our trimmers, such as the temperature coefficient and the climatic category, are defined on the basis of type approval tests. All specified values are continuously checked by a random test system of which the results are gathered in periodical surveys from which typical values can be derived and made available on request.

catalogue number	housing dimensions mm	housing dimensions professional purpose	capacitance range $C_{min}/C_{max}$ pF	rated voltage V	temp. coeff. $10^{-6}/K$	temperature range $^{\circ}C$	page
<b>FILM DIELECTRIC TRIMMERS; professional purpose</b>							
2222 809 05 . . .	7 x 8 x 9		0.5/2 to 2/18	300	-350 ± 150 and -250 ± 150	-40 to + 125	41
2222 811 00 . . .	7 x 8 x 6		1.5/5 to 3/18	300	-250 ± 200	-40 to + 125	49
2222 811 10 . . .	7 x 8 x 6		1.5/5 to 3/20	300	-200 ± 250	-40 to + 125	53
2222 809 07 . . .	12 x 14 x 10		2/12 to 7/150	200	0 ± 200	-40 to + 125	59
2222 809 080 . .	11 x 11 x 11		4/38 and 5/57	300	-250 ± 150	-40 to + 125	65
2222 809 090 . .	8 x 9 x 10		1.4/5.5 to 2/18	300	-250 ± 150	-40 to + 125	73





**DEVICE DATA**



## FILM DIELECTRIC TRIMMERS

- Housing diameter 5 mm
- For consumer and industrial equipment

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	1.5/5 to 3.5/27 pF
Rated voltage	150 V
Housing diameter	5 mm
Climatic category	40/85/21 for PC versions and 40/70/21 for PP versions
Related specification	IEC 418-1 and 4

### Selection chart

Standard versions

Polypropylene, 5.6 mm and 5.08 mm pitch, round head

Value (pF) $C_{min}/C_{max}$	Top + bottom adjustment	Top adjustment only
	Catalogue number (5.6 mm pitch)	Catalogue number (5.08 mm pitch)
1.5/5	2222 808 23508	2222 808 20508
3/10	2222 808 23109	2222 808 20109
3/15	2222 808 23159	2222 808 20159
4/20	2222 808 23209	2222 808 20209
4/27	2222 808 23279	2222 808 20279

### Economic versions

Polycarbonate, 5.6 mm pitch, round head, top adjustment only

Value (pF) $C_{min}/C_{max}$	Catalogue number
1.5/7	2222 808 20126
1.6/15	2222 808 20127
3/20	2222 808 20123
3.5/27	2222 808 20128

### Hex. head versions

Polycarbonate, 5.6 mm pitch, hex. head, top adjustment only

Value (pF) $C_{min}/C_{max}$	Catalogue number
1.5/7	2222 808 21708
1.6/15	2222 808 21159
3/20	2222 808 21209
3.5/27	2222 808 21279

**DESCRIPTION** – Standard versions

The vanes of the trimmer are stacked on a sturdy plastic base, the colour of which indicates the maximum capacitance (Table 1). The dielectric is a film of polypropylene which supports the vanes in such a way that good stability is ensured and no microphony can occur. Flux absorption between the vanes is prevented. The trimmers are resistant to all standard cleaning solvents except trichloroethylene and trichloroethane, however, cleaning is not advised.

**DESCRIPTION** – Economic versions

The vanes of the trimmer are stacked on a sturdy plastic base, the colour of which indicates the maximum capacitance (Table 2). The dielectric is a film of polycarbonate which supports the vanes in such a way that good stability is ensured and no microphony can occur. Flux absorption between the vanes is prevented. The trimmers are resistant to all standard cleaning solvents except trichloroethylene and trichloroethane, however, cleaning is not advised.

**MECHANICAL DATA**

Outlines	see Fig.1
Effective angle of rotation	180 °C
Operating torque	1 to 15 mNm for 5 to 10 pF and 1 to 25 mNm for 15 to 27 pF
Maximum axial thrust ( $\Delta C \leq 0.3\%$ of $C_{max}$ )	2 N
Mass	approx. 0.45 g

**Mounting**

The trimmer can be mounted on printed-circuit boards with hole diameter min. 1.25 mm. For hole pattern, see Fig.3. Soldering conditions: max. 260 °C, max. 10 s. (See also Tests and Requirements).

**ELECTRICAL DATA**

Rated voltage (DC)	150 V
Test voltage (DC) for 1 min.	300 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Tan δ at $C_{max} \times 10^{-4}$ , 1 MHz	$\leq 55$ for PC versions and $\leq 10$ for PP versions
Category temperature range	-40 to + 70 °C
Climatic category (PP)	40/70/21
Climatic category (PC foil)	40/85/21
Minimum storage temperature	-55 °C

Table 1 — Standard versions

catalogue number	guaranteed max. C <sub>min</sub> min. C <sub>max</sub> at 200 kHz pF	tan δ at C <sub>max</sub> x 10 <sup>-4</sup> 1 100 MHz MHz	temp. coeff. (note 1) 10 <sup>-6</sup> /K	min. f <sub>res</sub> at C <sub>max</sub> MHz	colour of base	smallest packing quantity
2222 808 20508 2222 808 23508	1.5/5	≤ 10 ≤ 25	-200 ± 300	700	grey	1000
2222 808 20109 2222 808 23109	3/10	≤ 10 ≤ 25	-200 ± 300	500	yellow	1000
2222 808 20159 2222 808 23159	3/15	≤ 10 ≤ 25	-50 ± 200	400	blue	1000
2222 808 20209 2222 808 23209	4/20	≤ 10 ≤ 25	-50 ± 200	300	green	1000
2222 808 20279 2222 808 23279	4/27	≤ 10 ≤ 25	-250 ± 200	300	red	1000

Note to Table 1

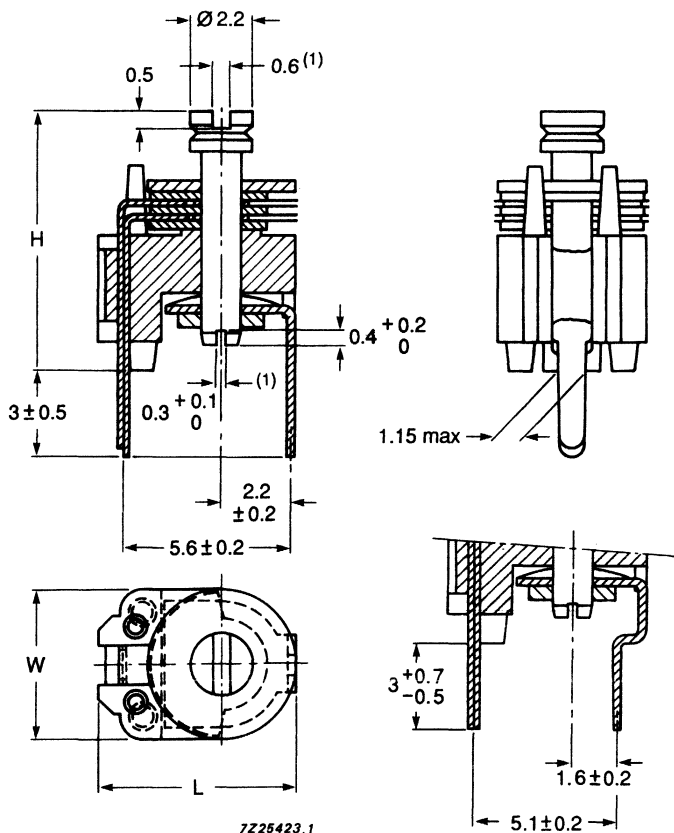
1. C at 60% to 80% of C<sub>max</sub>; T from + 20 °C to + 70 °C.

**Table 2** — Economic versions

reference $C_{\min}/C_{\max}$ pF	catalogue number	shape of head	$\tan \delta$ at $C_{\max} \times 10^{-4}$ 1 MHz	temp. coeff. $10^{-6}/K$	colour of base	smallest packing quantity
1.5/7	2222 808 20126	round	$\leq 55$	$-300 \pm 200$	grey	1000
1.6/15	2222 808 20127	round	$\leq 55$	$-300 \pm 300$	blue	1000
3/20	2222 808 20123	round	$\leq 55$	$-250 \pm 300$	green	1000
3.5/27	2222 808 20128	round	$\leq 55$	$-250 \pm 300$	red	1000

**Table 3** — Hex versions

reference $C_{\min}/C_{\max}$ pF	catalogue number	shape of head	$\tan \delta$ at $C_{\max} \times 10^{-4}$ 1 MHz	temp. coeff. $10^{-6}/K$	colour of base	smallest packing quantity
1.5/7	2222 808 21708	hex	$\leq 55$	$-300 \pm 200$	grey	1000
1.6/15	2222 808 21159	hex	$\leq 55$	$-300 \pm 300$	blue	1000
3/20	2222 808 21209	hex	$\leq 55$	$-250 \pm 300$	green	1000
3.5/27	2222 808 21279	hex	$\leq 55$	$-250 \pm 300$	red	1000



**Note**

The position of the shaft is not relative to the position of the vanes.

Fig.1 Trimmers 2222 808 series — round head.  
 (see Tables 4 and 5 for dimensions H, W and L).

2222 808 2 . . . .  
ø 5 mm

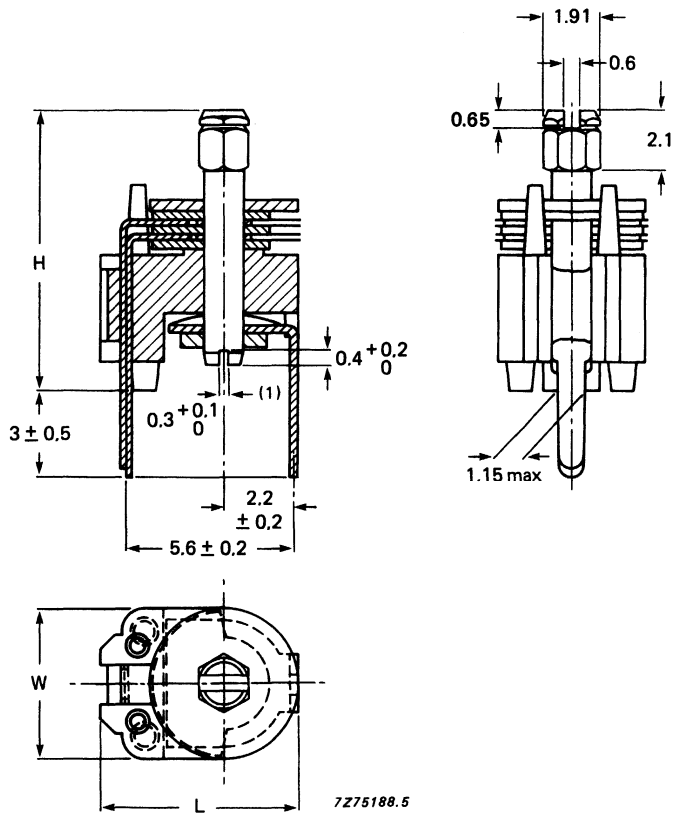


Fig.2 Trimmers 2222 808 series – hex head.  
(see Tables 4 and 5 for dimensions H, W and L).



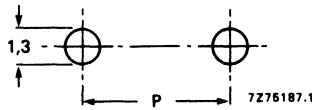


Fig.3 Trimmer pin holes, for P dimensions see selection chart.

Table 4 Standard versions

reference	H <sub>max</sub>	W <sub>max</sub>	L <sub>max</sub>
C <sub>min</sub> /C <sub>max</sub> pF	mm	mm	mm
1.5/5	7	5.5	7.3
3/10	7	5.5	7.3
3/15	8.8	5.5	7.3
4/20	8.8	5.5	7.3
4/27	9.0	6.2	7.8

Table 5 Hex and economic versions

type of head	H <sub>max</sub> mm	W <sub>max</sub> mm	L <sub>max</sub> mm
hex	9.7	5.5	7.3
round	7.7	5.5	7.3

**PACKING**

Bulk packing in cardboard boxes lined with expanded plastic, 1000 pieces per box.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

AQL 0.4% major defects, 1.5% minor defects.

Each capacitor is tested for min. C<sub>max</sub> and is also subjected to the full test voltage. See also note under survey of variable capacitors.

**TESTS AND REQUIREMENTS**

IEC 418-1 clause	IEC 68 test method	test	procedure	requirements	
4.2		method of mounting	method A		
14		capacitance drift	after T.C. measurement	$\Delta C/C$	$\leq 1.75\%$
19		thrust	axial thrust of 2 N	$\Delta C/C$	$\leq 0.4\%$
21		robustness of terminations:			
21.1	Ua	tensile	1 N		
21.2	Ub	bending	1 cycle		no damage
22	Na	rapid change of temperature	1 cycle: ½ h ½ h at upper category temp.	$\Delta C/C$	$\leq 2.5\%$
23	T Ta	soldering solderability	solder bath immersion 3 mm, 235 °C, 2 s		good wetting no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s		no mechanical damage
24	Eb	impact bump	4000 ± 10 bumps, 40 g, 6 ms	$\Delta C/C$	$\leq 1\%$ no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0.75 mm 1.5 h	$\Delta C/C$	$\leq 1\%$ no mechanical damage

## TESTS AND REQUIREMENTS (continued)

IEC 418-1 clause	IEC 68 test method	test	procedure	requirements
26		climatic sequence		$\Delta C/C$ $\leq 4\%$  Tan $\delta$ – PP foil $\leq 15 \times 10^{-4}$ Tan $\delta$ – PC foil $\leq 60 \times 10^{-4}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ $\geq 10\,000\ M\Omega$ Rotor contact R $\leq 10\ m\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof 300 V for 1 min.  visual examination no mechanical damage
26.3	Aa	cold	16 h, –40 °C	operating torque 1 to 20 mNm
26.5		damp heat accelerated, remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	
27	Ca	damp heat steady state	21 days, + 40 °C 90 to 95% R.H.	$\Delta C/C$ $\leq 3\%$  Tan $\delta$ – PP foil $\leq 15 \times 10^{-4}$ Tan $\delta$ – PC foil $\leq 60 \times 10^{-4}$ $R_{ins}$ $\geq 10\,000\ M\Omega$ Rotor contact R $\leq 10\ M\Omega$ voltage proof 300 V for 1 min.  visual examination no mechanical damage operating torque 1 to 20 mNm

**TESTS AND REQUIREMENTS** (continued)

IEC 418-1 clause	IEC 68 test method	test	procedure	requirements
29		endurance	10 cycles	$\Delta C/C$ $\leq 3\%$
29.1		mechanical		$\Delta C/C$ after axial thrust $\pm 0.3\%$ rotor contact R $\leq 10 \text{ m}\Omega$ voltage proof 300 V for 1 min. visual examination no mechanical damage operating torque 0.5 to 22.5 mNm

**Film dielectric trimmers**

**2222 810 00...**

**APPLICATIONS**

- For consumer and industrial equipment.

**DESCRIPTION**

The trimmer consists of an enclosed plastic housing of high temperature resistant material, a brass rotor and a plated brass stator with a PTFE film as the dielectric. In addition there is a plastic actuating cross-slot and a position indicator for top adjustment only. The colour of the plastic actuating cross-slot indicates the nominal C value. The stator vanes with their tag are heat sealed to the housing. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented. Cleaning with solvents is not advised. For outline drawing and dimensions see Fig.1.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

AQL: 0.4% major defects  
1.5% minor defects.

Each capacitor is tested for min.  $C_{max}$  and is also subjected to the full test voltage. See note under survey of variable capacitors.

**QUICK REFERENCE DATA**

$C_{max}$	10 to 37 pF
Rated voltage (DC)	100 V
Related specification	IEC 418-1 and 4
Climatic category (IEC 68)	40/85/21

**SELECTION CHART**

VALUE (pF)	CATALOGUE NUMBERS
10	2222 810 00109
20	2222 810 00209
30	2222 810 00309
37	2222 810 00409

**ELECTRICAL DATA**

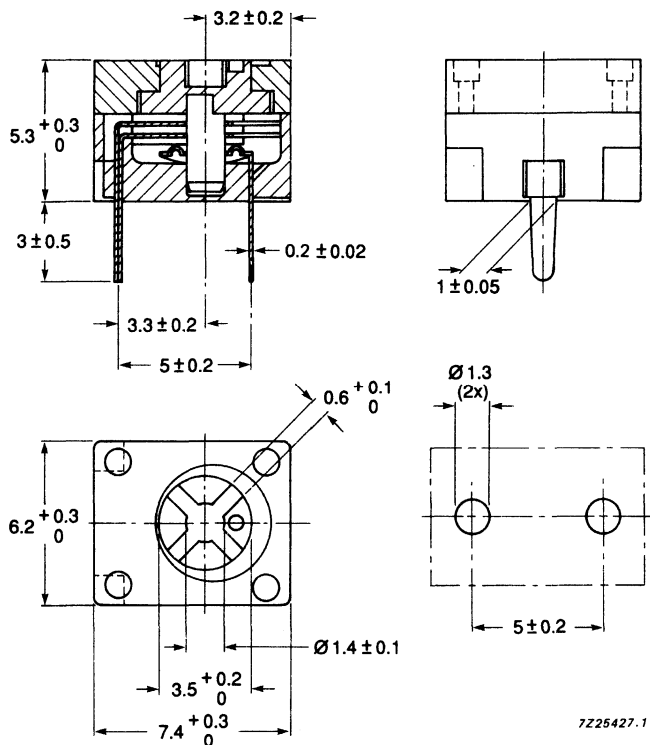
Rated voltage (DC)	100 V
Test voltage (DC) for 1 minute	200 V
Insulation resistance	$\geq 10\ 000\ M\Omega$
Tan $\delta$ at $C_{max}$ , 1 MHz	$\leq 55 \times 10^{-4}$
Category temperature range	-40 to +85 °C
Minimum storage temperature	-55 °C

**MECHANICAL DATA**

Effective angle of rotation	180°
Operating torque	1 to 20 mNm
Maximum axial thrust ( $C \leq 0.3\%$ of $C_{max}$ )	2 N
Mass	0.5 g (approx.)

## Film dielectric trimmers

2222 810 00...



7Z25427.1

Dimensions in mm.

Fig.1 Trimmers 2222 810 00... series.

**MOUNTING REFERENCES**

The trimmer can be mounted on printed-circuit boards with hole diameter min. 1.25 mm.

**Soldering conditions:**

max. 260 °C; max. 10 s.

**PACKING**

Bulk packing in cardboard boxes lined with expanded plastic, 1 000 pieces per box.

## Film dielectric trimmers

2222 810 00...

## ORDERING INFORMATION

REFERENCE $C_{max}$ (pF)	GUARANTEED max. $C_{min}$ min. $C_{max}$ at 200 kHz (pF)	TEMPERATURE COEFFICIENT (ppm/K)	CATALOGUE NUMBERS
10	1.5/10	-300 $\pm$ 350	2222 810 00109
20	2.5/20	-200 $\pm$ 250	2222 810 00209
30	3/30	-250 $\pm$ 250	2222 810 00309
37	4/37	-250 $\pm$ 250	2222 810 00409

COLOUR OF ADJUSTER	COLOUR OF HOUSING	SMALLEST PACKING QUANTITY	CATALOGUE NUMBERS
White	blue	1 000	2222 810 00109
Blue	blue	1 000	2222 810 00209
Green	blue	1 000	2222 810 00309
Black	blue	1 000	2222 810 00409

## TEST AND REQUIREMENTS

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C: \leq 1.75\%$
19		thrust	axial thrust of 2 N	$\Delta C/C: \leq 0.4\%$
21		robustness of terminations		
21.1	Ub	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle; 0.5 hours at lower and 0.5 hours at upper category temperature	$\Delta C/C: \leq 2.5\%$
23	T Ta Tb	soldering solderability resistance to heat	solder bath immersion 3 mm; 235 °C; 2 s solder bath: 260 °C; 10 s	good wetting; no mechanical damage no mechanical damage
24	Eb	impact bump	4 000 $\pm$ 10 bumps; 40 g; 6 ms	$\Delta C/C: \leq 1\%$ ; no mechanical damage
25	Fc	vibration	frequency 10 to 55 Hz; amplitude 0.75 mm; 1.5 hours	$\Delta C/C: \leq 1\%$ ; no mechanical damage

## Film dielectric trimmers

2222 810 00...

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
26		climatic sequence		$\Delta C/C: \leq 4\%$
26.1	B	dry heat	16 hours at upper category temperature	Tan $\delta: \leq 60 \times 10^{-4}$ $R_{ins}: \geq 10\,000\text{ M}\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	voltage proof: 200 V for 1 minute
26.3	Aa	cold	16 hours; -40 °C	visual examination: no mechanical damage
26.5		damp heat accelerated, remaining cycles	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	operating torque: 1 to 20 mNm
27	Ca	damp heat steady state	21 days; +40 °C; 90 to 95% R.H.	$\Delta C/C: \leq 3\%$ Tan $\delta: \leq 60 \times 10^{-4}$ $R_{ins}: \geq 10\,000\text{ M}\Omega$ voltage proof: 200 V for 1 minute visual examination: no mechanical damage operating torque: 1 to 20 mNm
29		endurance mechanical	10 cycles	$\Delta C/C: \leq 3\%$ $\Delta C/C$ after axial thrust: $\leq 0.3\%$ voltage proof: 200 V for 1 minute visual examination: no mechanical damage operating torque: 0.5 to 22.5 mNm



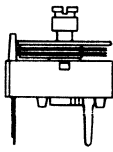
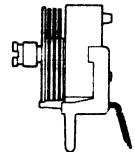
## FILM DIELECTRIC TRIMMERS

- Housing diameter 7,5 mm
- For basic grid of 2,54 mm (0,1 in) or 2,50 mm
- For consumer and industrial equipment

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	1.4/5.5 to 3/50 pF
Rated voltage (d.c.)	250 V
Housing diameter	7.5 mm
Climatic category (IEC 68)	40/070/21 or 40/085/21
Related specification	IEC 418-1 and 4

### Selection chart

reference $C_{min}/C_{max}$	catalogue number 2222 808 followed by			
	vertical spindle		horizontal spindle	
	round head	hexagonal head	round head	
pF	top + bottom adjustment	top adj.	top adjustment	top + bottom adjustment
1.4/5.5	11558	00004		
2/9	00018			
2/10	11109	00005	17109	51109
1.5/15	11159			
2/18	00016			
2/22	11229	00006	17229	51229
2/27	11279			51279
3/33	11339			
3/40	11409		17409	51409
3/50	11509		17509	51509

### DESCRIPTION

The vanes of the trimmers are stacked on a sturdy plastic base, the colour of which indicates the maximum capacitance (Table 1). The dielectric is a film of polypropylene, polyethylene, polycarbonate or PTFE which supports the vanes in such a way that good stability is ensured and no microphony can occur. Flux absorption between the vanes is prevented.

The trimmers are resistant to all cleaning solvents except trichloroethane and trichloroethylene.

A version with vertical spindle (Fig.1) and a version with horizontal spindle (Fig.3) are available. Both versions have top adjustment by means of a screwdriver or trimming key, and bottom adjustment by means of a key according to Fig.5.

### MECHANICAL DATA

Dimensions in mm

Outlines	See Figs 1 and 3
Effective angle of rotation	180°
Operating torque	1 to 15 mNm for 6 to 22 pF and 2 to 25 mNm for 27 to 50 pF
Maximum axial thrust ( $\Delta C \leq 0.3\%$ of $C_{max}$ )	2 N
Mass	approx. 0.8 g

### Mounting

The trimmers can be mounted on printed-wiring boards with a grid of 2,50 mm or 2,54 mm ; hole diameter min. 1,25 mm. See for hole patterns Figs 2 and 4.

Soldering conditions: max. 260 °C, max. 10 s. (See also 'Tests and Requirements'.)

### ELECTRICAL DATA; see also Table 1

Rated voltage (d.c.)	250 V
Test voltage (d.c.) for 1 min.	500 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	
$C_{max} = 10, 15, 22, 33$ pF	- 40 to +70 °C
$C_{max} = 5,5, 9, 18, 27, 40, 50$ pF	- 40 to +85 °C
Climatic category (IEC 68)	
$C_{max} = 10, 15, 22, 33$ pF	40/070/21
$C_{max} = 5,5, 9, 18, 27, 40, 50$ pF	40/085/21
Minimum storage temperature	- 55 °C

### Notes to Table 1 on the next page

1. PC = polycarbonate,  
PE = polyethylene,  
PP = polypropylene,  
PTFE = polytetrafluorethylene.
2. C at 60 to 80% of  $C_{max}$ ;  $\Delta T$  from +20 to upper category temperature.

Table 1 (Notes are on preceding page)

cat. number	spindle	shape of head	fig. adjustment mode	diel. electric film (note 1)	guaranteed max. Cmin min. Cmax at 2000 kHz pF	tan δ at Cmax x 10 <sup>-4</sup> 1 MHz	temp. coeff. (note 2) 10 <sup>-6</sup> /K	min. f <sub>res</sub> at Cmax MHz	colour of base	smallest packaging quant.
2222 808	vertical	round	1 top + bottom	PE	1,4/5,5	≤ 10	≤ 25	850	grey	1400
00004	vertical	round	1 top							1400
00018	vertical	round	1 top + bottom	PTFE	2/9	≤ 10	≤ 15	480	yellow	1400
11109	vertical	round	1 top + bottom							1400
00005	vertical	round	1 top	PP	2/10	≤ 10	≤ 25	480	yellow	1400
17109	vertical	hexagon.	1 top							1400
51109	horizont.	round	3 top + bottom							1200
11159	vertical	round	1 top + bottom	PP	1,5/15	≤ 10	≤ 25	450	blue	1400
00016	vertical	round	1 top + bottom	PTFE	2/18	≤ 10	≤ 15	350	green	1400
11229	vertical	round	1 top + bottom							1400
00006	vertical	round	1 top	PP	2/22	≤ 10	≤ 25	350	green	1400
17229	vertical	hexagon.	1 top							1400
51229	horizont.	round	3 top + bottom							1200
11279	vertical	round	1 top + bottom	PC	2/27	≤ 50		350	red	1400
51279	horizont.	round	3 top + bottom							1200
11339	vertical	round	1 top + bottom	PP	3/33	≤ 10		300	brown	1400
11409	vertical	round	1 top + bottom							1400
17409	vertical	hexagon.	1 top	PC	3/40	≤ 50		300	violet	1400
51409	horizont.	round	3 top + bottom							1200
11509	vertical	round	1 top + bottom							1400
17509	vertical	hexagon.	1 top	PC	3/50	≤ 50		250	black	1400
51509	horizont.	round	3 top + bottom							1200

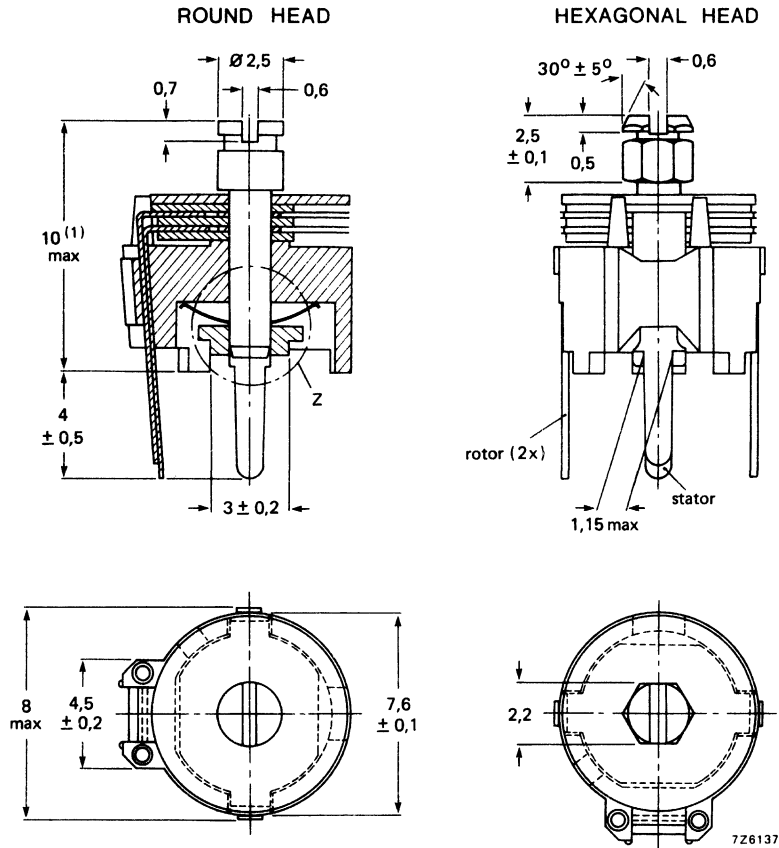


Fig.1 Version with vertical spindle.  
 (1) 11 max. for  $C_{max} = 40 \text{ pF}$  and  $50 \text{ pF}$ .

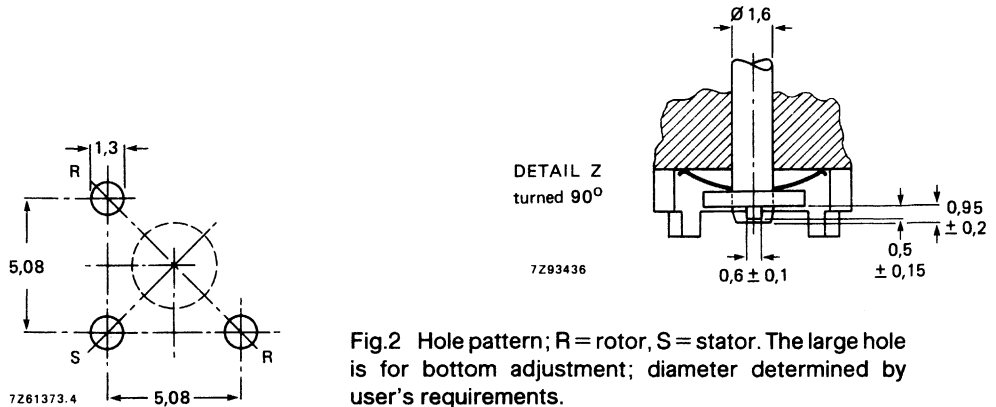


Fig.2 Hole pattern; R = rotor, S = stator. The large hole is for bottom adjustment; diameter determined by user's requirements.

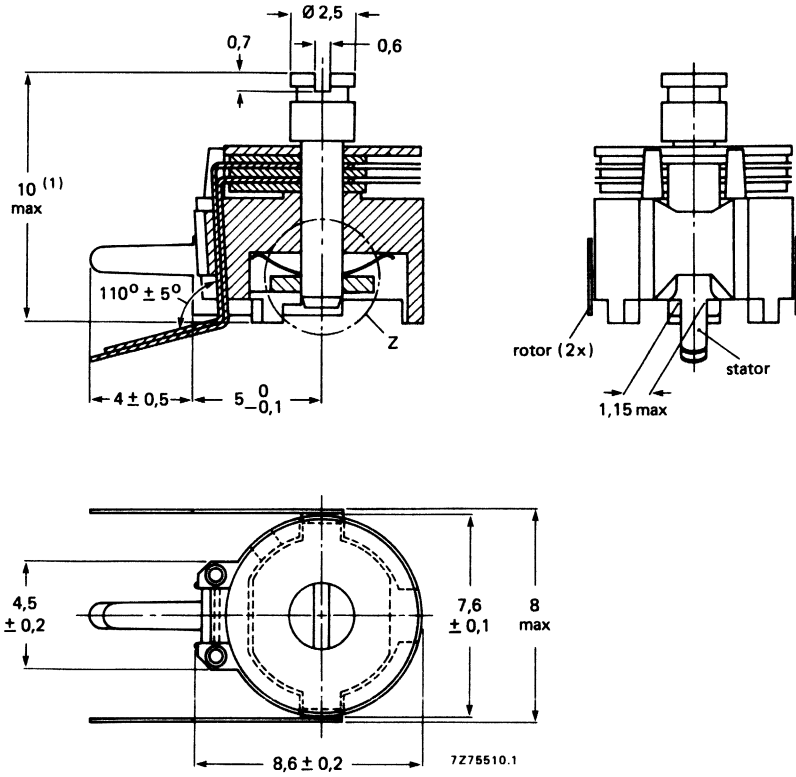


Fig.3 Version with horizontal spindle.  
 (1) 11 max. for  $C_{\text{max}} = 40 \text{ pF}$  and  $50 \text{ pF}$ .

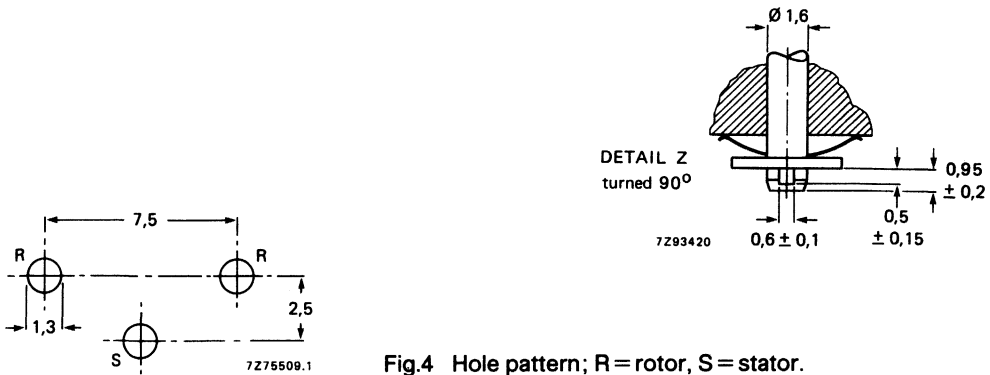


Fig.4 Hole pattern; R=rotor, S=stator.

### ADJUSTMENT

For top adjustment a screwdriver or trimming key can be used; for bottom adjustment a key is required as shown in Fig.5.

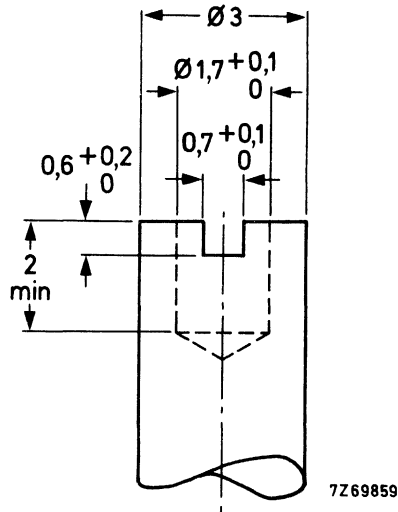


Fig.5.

### PACKING

Bulk packing in cardboard boxes lined with expanded plastic; versions with vertical spindle 1400 per box, versions with horizontal spindle 1200 per box.

### QUALITY LEVEL

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

A.Q.L. 0,4%, major defects

A.Q.L. 1,5%, minor defects

Each capacitor is tested for minimum  $C_{\text{max}}$  and is also subjected to the full test voltage. See also Note under Survey of variable capacitors.

**TESTS AND REQUIREMENTS**

IEC418-1 clause	IEC68 test method	test	procedure	requirements
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$  < 1%; < 2,5% for $C_{max} > 40$ pF
19		thrust	axial thrust of 2 N	$\Delta C/C$  < 0,3%
21		robustness of terminations:		
21.1	Ua	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle: 1/2 h at lower and 1/2 h at upper category temp.	$\Delta C/C$  < 2%
23	T Ta	soldering solderability	solder bath, immersion 3 mm, 235 °C, 2 s	good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s	no mechanical damage
24	Eb	impact bump	4000 ± 10 bumps, 40g, 6 ms	$\Delta C/C$  < 0,6% no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0,35 mm, 1,5 h	$\Delta C/C$  < 0,6% no mechanical damage

**TESTS AND REQUIREMENTS** (continued)

IEC418-1 clause	IEC68 test method	test	procedure	requirements
26		climatic sequence		$\Delta C/C$ < 4%  tan $\delta$ < $10 \times 10^{-4}$ < $70 \times 10^{-4}$ for $C_{max} > 27$ pF
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ > 10 000 M $\Omega$ rotor contact R < 10 m $\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof 500 V for 1 min  visual examination no mechanical damage
26.3	Aa	cold	16 h, - 40 °C	operating torque 1 to 15 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	
27	Ca	damp heat steady state	21 days, + 40 °C, 90 to 95% R.H.	$\Delta C/C$ < 5%  tan $\delta$ < $30 \times 10^{-4}$ < $70 \times 10^{-4}$ for $C_{max} > 27$ pF  $R_{ins}$ > 10 000 M $\Omega$ rotor contact R < 10 m $\Omega$  voltage proof 500 V for 1 min  visual examination no mechanical damage  operating torque 1 to 15 mNm
29 29.1		endurance mechanical	10 cycles	$\Delta C/C$ < 1,5%  $\Delta C/C$ after axial thrust < 0,3% rotor contact R < 10 m $\Omega$  voltage proof 500 V for 1 min  visual examination no mechanical damage  operating torque 1 to 15 mNm



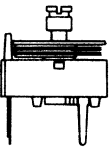
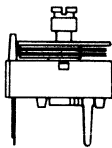
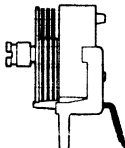
## FILM DIELECTRIC TRIMMERS

- Housing diameter 10 mm
- For consumer and industrial equipment

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	2.5/15 to 7/105 pF
Rated voltage (d.c.)	250 V
Housing diameter	10 mm
Climatic category (IEC 68)	40/070/21 or 40/085/21
Related specification	IEC 418-1 and 4

### Selection chart

reference $C_{min}/C_{max}$	catalogue number 2222 808 followed by					
	vertical spindle 		vertical spindle 		horizontal spindle 	
	hole pattern 5 mm x 10 mm		hole pattern 7,5 mm x 5 mm		hole pattern 5 mm x 10 mm	
	round head	hexagonal head	round head	hexagonal head	round head	hexagonal head
pF	top + bottom adjustment		top + bottom adjustment		top + bottom adjustment	
2.5/15	31159*		32159*		61159*	
3/22.5	31229*		32229*		61229*	
5.5/40	31409		32409*		61409	
5.5/50	01029		01006*			
5.5/65	31659	34659	32659*		61659	64659
6/80	31809	34809	32809*	35809*	61809	64809
7/105	31101		32101*		61101	64101

\* Not for new design.

### DESCRIPTION

The vanes of the trimmers are stacked on a sturdy plastic base, the colour of which indicates the maximum capacitance (Table 1). The dielectric is a film of polypropylene, polycarbonate or PTFE which supports the vanes in such a way that good stability is ensured and no microphony can occur. Flux absorption between the vanes is prevented. The trimmers are resistant to all standard cleaning solvents except trichloroethane and trichloroethylene.

Two versions with vertical spindle (Figs 1 and 3) and a version with horizontal spindle (Fig.5) are available.

**MECHANICAL DATA**

Dimensions in mm

Outlines	See Figs 1, 3 and 5
Effective angle of rotation	180°
Operating torque	2 to 25 mNm
Maximum axial thrust ( $\Delta C < 0,3\%$ of $C_{max}$ )	2 N
Mass	approx. 1,3 g

**Mounting**

The trimmers can be mounted on printed-wiring boards with a grid of 2,50 mm or 2,54 mm; hole diameter min. 1,25 mm. See for hole patterns Figs 2, 4 and 6.

Soldering conditions: max. 260 °C, max. 10 s. (See also 'Tests and Requirements'.)

**ELECTRICAL DATA;**see also Table 1

Rated voltage (d.c.)	250 V
Test voltage (d.c.) for 1 min.	500 V
Contact resistance	max. 10 mΩ
Insulation resistance	min. 10 000 MΩ
Category temperature range	
$C_{max} = 15, 25, 40, 70$ pF	- 40 to + 70 °C
$C_{max} = 50, 90, 105$ pF	- 40 to + 85 °C
Climatic category (IEC68)	
$C_{max} = 15, 25, 40, 70$ pF	40/070/21
$C_{max} = 50, 90, 105$ pF	40/085/21
Minimum storage temperature	- 55 °C

**Notes to Table 1 on the next page**

1. PC = polycarbonate  
PP = polypropylene  
PTFE = polytetrafluorethylene
2. C at 60 to 80% of  $C_{max}$ ;  $\Delta T$  from + 20 °C to upper category temperature.

**Table 1** (Notes are on preceding page)

cat. number followed by	spindle shape of head	hole pattern Fig.	adjustment mode	dielectric film (note 1)	guaranteed max. $C_{min}$ min. $C_{max}$ at 200 kHz pF	$\tan \delta$ at $C_{max} \times 10^{-4}$ 1 MHz	temp. coeff. (note 2) $10^{-6}/K$	min. $f_{res}$ at $C_{max}$ MHz	colour of base	smallest packing quant.
31159*	vertical round	2	top +	PP	2,5/15	< 10	-150 ± 500	420	blue	800
32159*	vertical round	4	bottom							800
61159*	horizontal round	6								700
31229*	vertical round	2	top +	PP	3/22,5	< 10	-150 ± 400	200	green	800
32229*	vertical round	4	bottom							800
61229*	horizontal round	6								700
31409	vertical round	2	top +	PP	5,5/40	< 10	-150 ± 350	200	grey	800
32409*	vertical round	4	bottom							800
61409	horizontal round	6								700
01029	vertical round	2	top +	PTFE	5,5/50	< 10	-500 ± 150	170	yellow	800
01006*	vertical round	4	bottom							800
31659	vertical round	2	top +	PP	5,5/65	< 10	-200 ± 300	170	yellow	800
32659*	vertical hexagonal	4	bottom							800
34659	vertical round	2	top +	PP	6/80	< 50	-100 ± 300	170	red	800
61659	horizontal round	6								700
64659	horizontal hexagonal	6								600
31809	vertical round	2	top +	PC	7/105	< 50	-100 ± 300	170	violet	800
34809	vertical hexagonal	4	bottom							800
32809*	vertical round	4								800
35809*	vertical hexagonal	4								700
61809	horizontal round	6								700
64809	horizontal hexagonal	6								600
31101	vertical round	2	top +	PC	7/105	< 50	-100 ± 300	170	violet	800
32101*	vertical round	4	bottom							800
61101	horizontal round	6								700
64101	horizontal hexagonal	6								600

\* Not for new design.

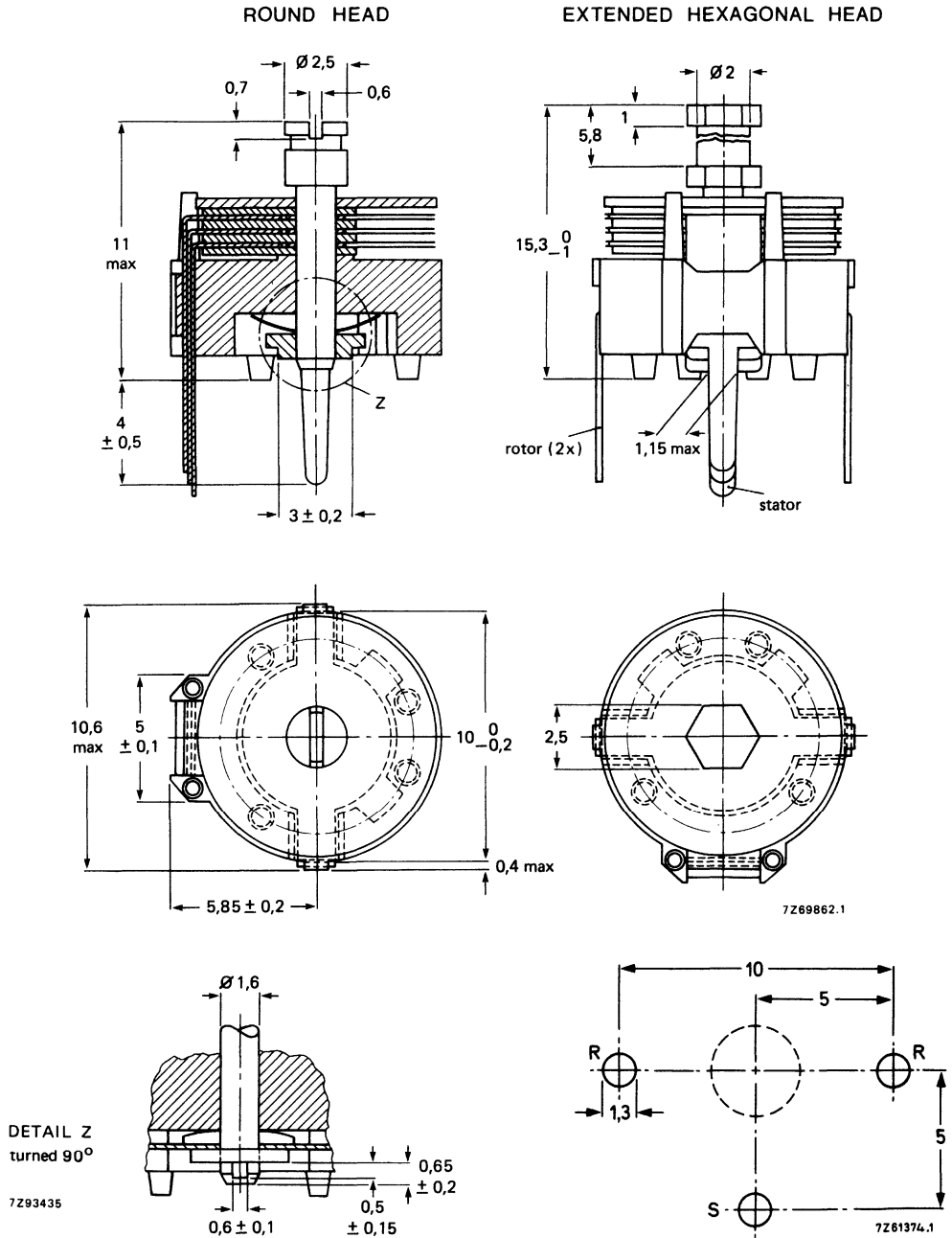


Fig.1 Version with vertical spindle;  
 hole pattern 5 mm x 10 mm.

Fig.2 Hole pattern; R = rotor, S = stator.  
 The large hole is for bottom adjustment;  
 diameter determined by user's requirements.

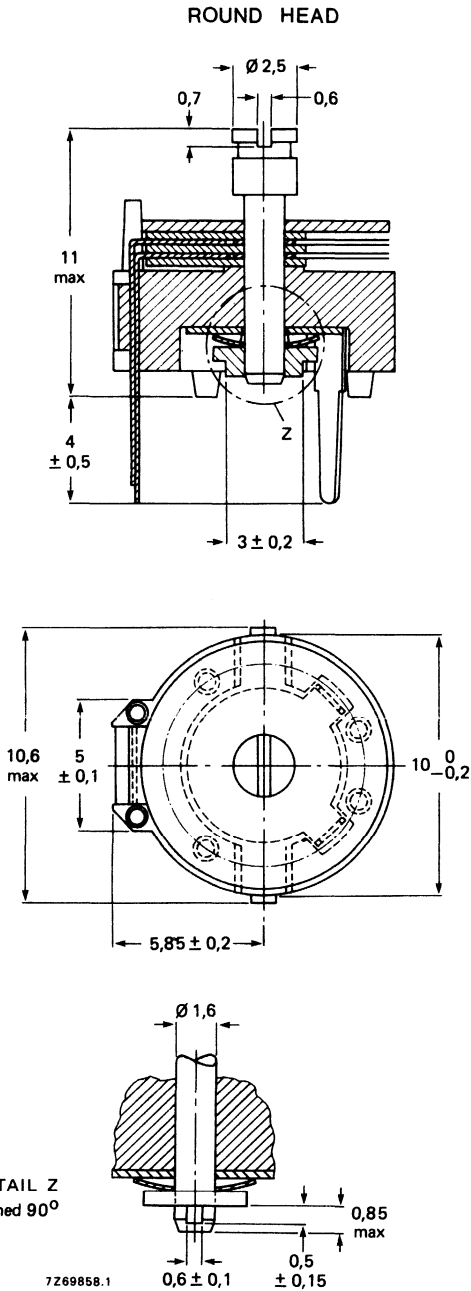


Fig.3 Version with vertical spindle;  
 hole pattern 7,5 mm x 5 mm.

Fig.4 Hole pattern; R = rotor, S = stator.  
 The large hole is for bottom adjustment;  
 diameter determined by user's requirements.

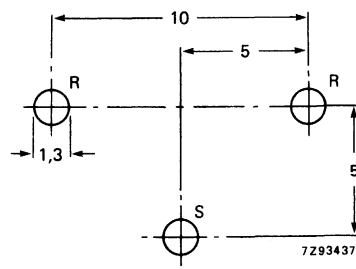
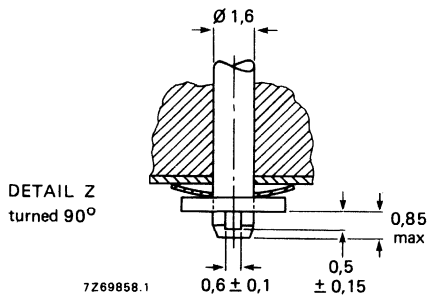
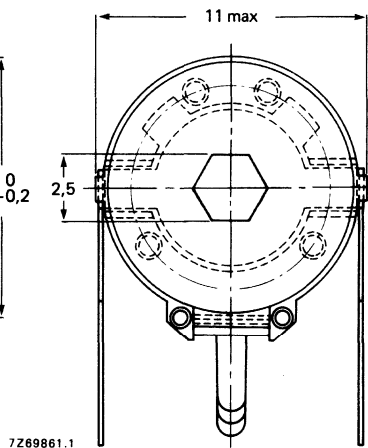
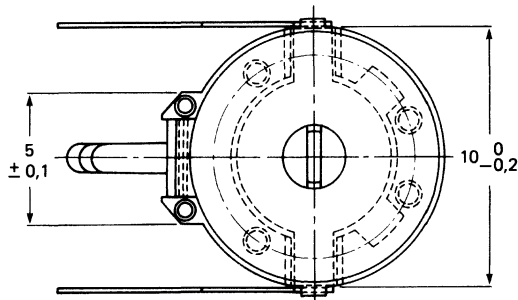
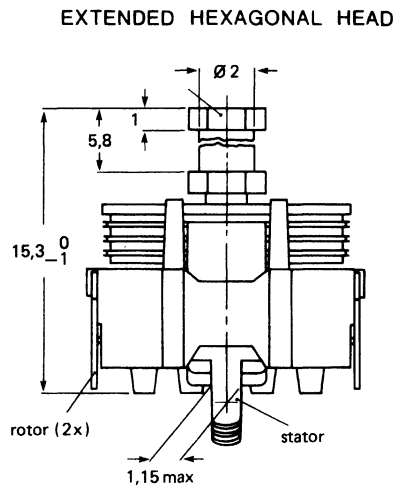
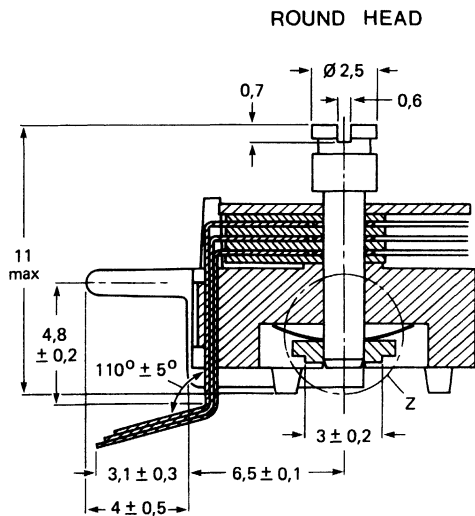


Fig.5 Version with horizontal spindle.

Fig.6 Hole pattern; R = rotor, S = stator

**ADJUSTMENT**

For top adjustment a screwdriver or spanner can be used, for bottom adjustment a key is required as shown in Fig.7.

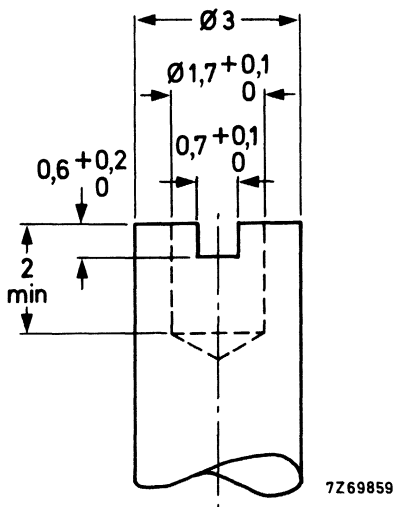


Fig.7.

The hexagonal spindle head is specially designed for the trimming of car radios with a spanner. It enables adjustment of the trimmer from the front by means of a long flexible rod provided with a hexagonal hole. The special shape of the trimmer head prevents a bending load on the trimmer spindle when the adjustment rod and spindle are not in line. It also allows a large axial tolerance.

**PACKING**

Bulk packing in cardboard boxes lined with expanded plastic.

Version with vertical spindle and round head: 800.

Version with vertical spindle and hexagonal head: 700

Version with horizontal spindle and round head: 700

Version with horizontal spindle and hexagonal head: 600.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL -STD -105D and IEC 410.

A.Q.L. 0,4%, major defects

A.Q.L. 1,5%, minor defects

Each capacitor is tested for minimum  $C_{max}$  and is also subjected to the full test voltage. See also Note under Survey of variable capacitors.

**TESTS AND REQUIREMENTS**

IEC418-1 clause	IEC68 test method	test	procedure	requirements
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$ $< 1,5\%$ ; $< 1\%$ for $C_{max} > 50$ pF
19		thrust	axial thrust of 2 N	$\Delta C/C$ $< 0,3\%$
21		robustness of terminations:		
21.1	Ua	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle: 1/2 h at lower and 1/2 h at upper category temp.	$\Delta C/C$ $< 1,5\%$
23	T Ta	soldering solderability	solder bath, immersion 3 mm, 235 °C, 2 s	good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s	no mechanical damage
24	Eb	impact bump	4000 ± 10 bumps, 40g, 6 ms	$\Delta C/C$ $< 0,4\%$ no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0,35 mm, 1,5 h	$\Delta C/C$ $< 0,8\%$ no mechanical damage



**TESTS AND REQUIREMENTS**(continued)

IEC418-1 clause	IEC68 test method	test	procedure	requirements	
26		climatic sequence		$\Delta C/C$  $\tan \delta$	< 3%; < 6% for $C_{max} > 80 \text{ pF}$ < $15 \times 10^{-4}$ ; < $85 \times 10^{-4}$ for $C_{max} > 80 \text{ pF}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ rotor contact R	> 10 000 M $\Omega$ < 10 m $\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof  visual examination	500 V for 1 min  no mechanical damage
26.3	Aa	cold	16 h, - 40 °C	operating torque	2 to 35 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.		
27	Ca	damp heat steady state	21 days, + 40 °C, 90 to 95% R.H.	$\Delta C/C$  $\tan \delta$  $R_{ins}$ rotor contact R  voltage proof  visual examination  operating torque	< 3%; < 3,5% for $C_{max} > 100 \text{ pF}$ < $20 \times 10^{-4}$ ; < $70 \times 10^{-4}$ for $C_{max} > 80 \text{ pF}$ > 10 000 M $\Omega$ < 10 m $\Omega$ 500 V for 1 min no mechanical damage 2 to 35 mNm
29 29.1		endurance mechanical	10 cycles	$\Delta C/C$  $\Delta C/C$ after axial thrust  rotor contact R  voltage proof  visual examination  operating torque	< 1%  < 0,4% < 10 m $\Omega$ 500 V for 1 min no mechanical damage 1,5 to 37 mNm



## FILM DIELECTRIC TRIMMERS

- High temperature type
- Housing dimensions 6 mm x 8 mm x 9 mm
- For basic grid of 2.54 mm
- For professional applications, e.g. fine adjustment of h.f. tuned circuits

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	0.5/2 to 2/18 pF
Rated voltage (DC)	300 V
Housing diameter	6 mm x 8 mm x 9 mm
Climatic category (IEC 68)	40/125/21
Related specification	IEC 418-1 and 4

### Selection chart

Vertical spindle, top and bottom adjustment.

value (pF) $C_{min}/C_{max}$	round head	hex. head
	catalogue number	catalogue number
0.5/2	2222 809 05011	2222 809 05021
1.2/3.5	2222 809 05215	2222 809 05225
1.8/10	2222 809 05216	2222 809 05226
2/18	2222 809 05217	2222 809 05227

### DESCRIPTION

The trimmers consist of a polysulphone housing, brass rotor and plated brass stator with a PTFE film as the dielectric. The stator plates with their tag are heat sealed to the housing. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented. A colour dot indicates the maximum capacitance.

The trimmers have top and bottom adjustment. Top adjustment should be done by means of a screwdriver and bottom adjustment by means of the key as shown in Fig.4.

**MECHANICAL DATA**

Outlines	see Fig.1
Effective angle of rotation	180°
Operating torque	
$C_{\max} = 3.5 \text{ pF}$	1 to 15 mNm
$C_{\max} = 10 \text{ and } 18 \text{ pF}$	2.5 to 20 mNm
Maximum axial thrust ( $\Delta C \leq 0.3\%$ of $C_{\max}$ )	2 N
Mass	approx. 0.45 g

**Mounting**

The trimmers can be mounted on printed-circuit boards with hole diameter min. 2.54 mm. For hole pattern, see Fig.3.

Soldering conditions: max. 260 °C, max. 10 s. (See Tests and Requirements).

**ELECTRICAL DATA**

Rated voltage (DC)	300 V
Test voltage (DC) for 1 min.	600 V
Contact resistance	max. 5 mΩ
Insulation resistance between stator and rotor	min. 10 000 MΩ
Category temperature range	-40 to + 125 °C
Climatic category (IEC 68)	40/125/21
Minimum storage temperature	-55 °C

Table 1

guaranteed max. $C_{min}$ min. $C_{max}$ at 200 kHz pF	catalogue number	shape of head	tan $\delta$ at		temp. coeff. (note 1) $10^{-6}/K$	min. $f_{res}$ at $C_{max}$ MHz	colour of base	smallest packing quantity
			1 MHz	100 MHz				
0.5/2	2222 809 05011 2222 809 05021	round hex	$\leq 10$	$\leq 20$	$-250 \pm 200$	1200	no	140
1.2/3.5	2222 809 05215 2222 809 05225	round hex	$\leq 10$	$\leq 20$	$-250 \pm 150$	850	orange	140
1.8/10	2222 809 05216 2222 809 05226	round hex	$\leq 10$	$\leq 20$	$-350 \pm 150$	580	white	140
2/18	2222 809 05217 2222 809 05227	round hex	$\leq 10$	$\leq 25$	$-350 \pm 150$	360	red	140

Note

1. C at 60% to 80% of  $C_{max}$ ; T from + 20 °C to + 125 °C.

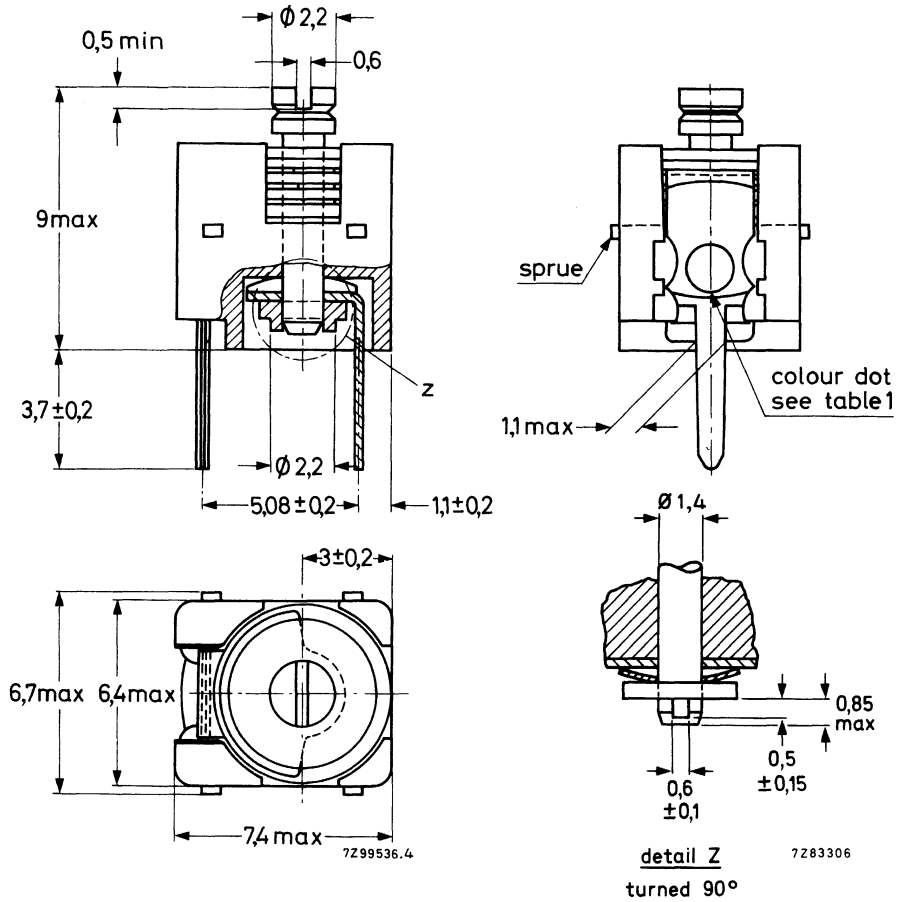
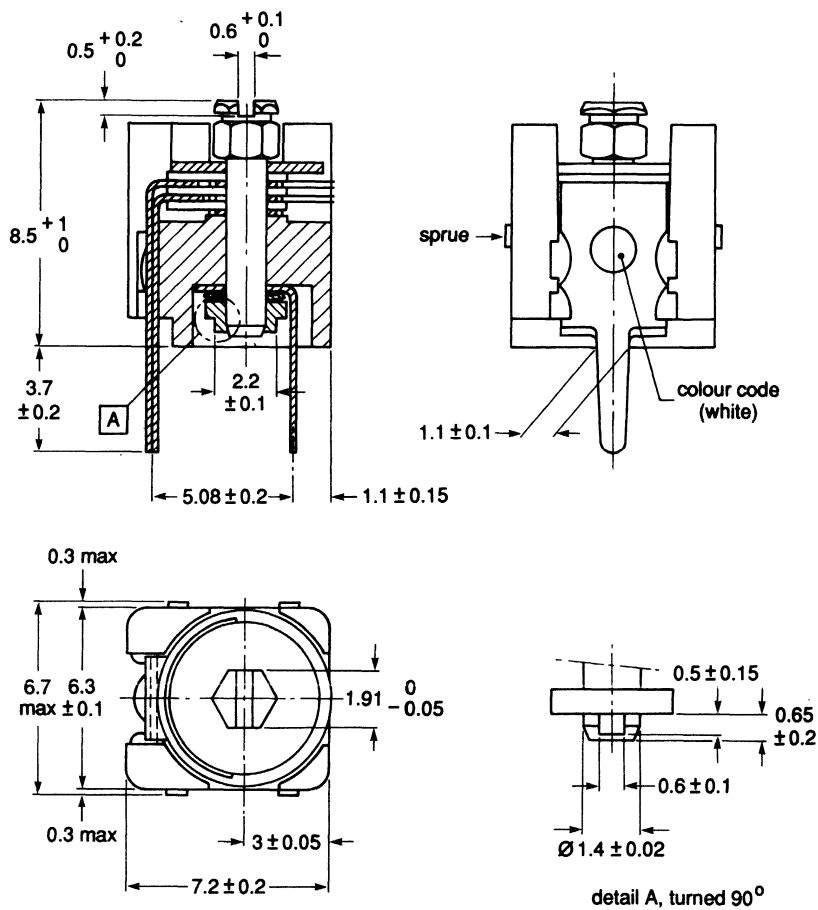
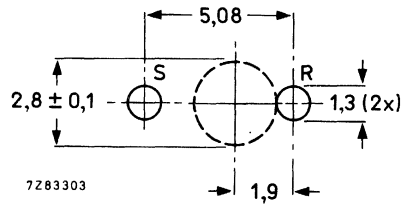


Fig.1 Trimmers 2222 809 05 ... series, round head.



7225428

Fig.2 Trimmers 2222 809 05 ... series, hex. head.



**Note:** The large hole is required only where bottom adjustment is used. R = rotor, S = stator.

Fig.3 Trimmer pin holes.

**ADJUSTMENT**

For top adjustment a screwdriver or trimming key can be used; for bottom adjustment a key is required as shown in Fig.4.

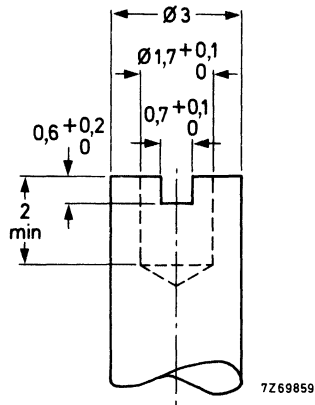


Fig.4 Bottom adjustment key.

**PACKING**

Blister packs of 140 pieces each.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

AQL 0.4% major defects, 1.5% minor defects.

Each capacitor is tested for min.  $C_{max}$  and is also subjected to the full test voltage. See also note under survey of variable capacitors.



## TESTS AND REQUIREMENTS

IEC 418-1 clause	IEC 68 test method	test	procedure	requirements	
4.2		method of mounting	method A		
14		capacitance drift	after T.C. measurement	$\Delta C/C$	$\leq 1\%$
19		thrust	axial thrust of 2 N	$\Delta C/C$	$\leq 0.3\%$
21		robustness of terminations:			
21.1	Ua	tensile	1 N		
21.2	Ub	bending	1 cycle		no damage
22	Na	rapid change of temperature	1 cycle: $\frac{1}{2}$ h at lower and $\frac{1}{2}$ h at upper category temp.	$\Delta C/C$	$\leq 2\%$
23	T Ta	soldering solderability	solder bath, immersion 3 mm, 235 °C, 2 s		good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s		no mechanical damage
24	Eb	impact bump	4000 $\pm$ 10 bumps, 40g, 6 ms	$\Delta C/C$	$\leq 0.6\%$ no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0.35 mm 1.5 h	$\Delta C/C$	$\leq 0.2\%$ no mechanical damage

## TESTS AND REQUIREMENTS (continued)

IEC 418-1 clause	IEC 68 test method	test	procedure	requirements
26		climatic sequence		$\Delta C/C$ $\leq 2.5\%$  $\tan \delta (< 18 \text{ pF})$ $\leq 10 \times 10^{-4}$ $(\geq 18 \text{ pF})$ $\leq 40 \times 10^{-4}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ $\geq 10\,000 \text{ M}\Omega$ rotor contact R $\leq 5 \text{ m}\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof 600 V for 1 min  visual examination no mechanical damage
26.3	Aa	cold	16 h, -40 °C	operating torque 1 to 20 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	
27	Ca	damp heat steady state	21 days, + 40 °C 90 to 95% R.H.	$\Delta C/C$ $\leq 2.5\%$  $\tan \delta (< 18 \text{ pF})$ $\leq 10 \times 10^{-4}$ $(\geq 18 \text{ pF})$ $\leq 25 \times 10^{-4}$ $R_{ins}$ $\geq 10\,000 \text{ M}\Omega$ rotor contact R $\leq 5 \text{ m}\Omega$ voltage proof 600 V for 1 min visual examination no mechanical damage operating torque 1 to 20 mNm
29 29.1		endurance mechanical	25 cycles	$\Delta C/C$ $\leq 0.3\%$  $\Delta C/C$ after axial thrust $\leq 0.3\%$ rotor contact R $\leq 5 \text{ m}\Omega$ voltage proof 600 V for 1 min visual examination no mechanical damage operating torque 1 to 20 mNm

## Film dielectric leaded trimmers

2222 811 00...

### FEATURES

- High temperature resistance type.

### APPLICATIONS

- For consumer and industrial equipment.

### DESCRIPTION

The trimmer consists of an enclosed plastic housing of high temperature resistant material, a brass rotor and a plated brass stator with a PTFE film as the dielectric. In addition there is a plastic actuating cross-slot and a position indicator for top adjustment only. The colour of the plastic actuating cross-slot indicates the nominal C value. The stator vanes with their tag are heat sealed to the housing. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented.

Cleaning with solvents is not advised.

For outline drawing and dimensions see Fig.1.

### QUALITY LEVEL

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

AQL: 0.4% major defects  
1.5% minor defects.

Each capacitor is tested for min.  $C_{max}$  and is also subjected to the full test voltage.

### QUICK REFERENCE DATA

$C_{max}$	5 to 18 pF
Rated voltage (DC)	300 V
Related specification	IEC 418-1 and 4
Climatic category (IEC 68)	40/125/21

### SELECTION CHART

VALUE (pF)	CATALOGUE NUMBERS
5	2222 811 00508
10	2222 811 00109
15	2222 811 00159
18	2222 811 00209

### ELECTRICAL DATA

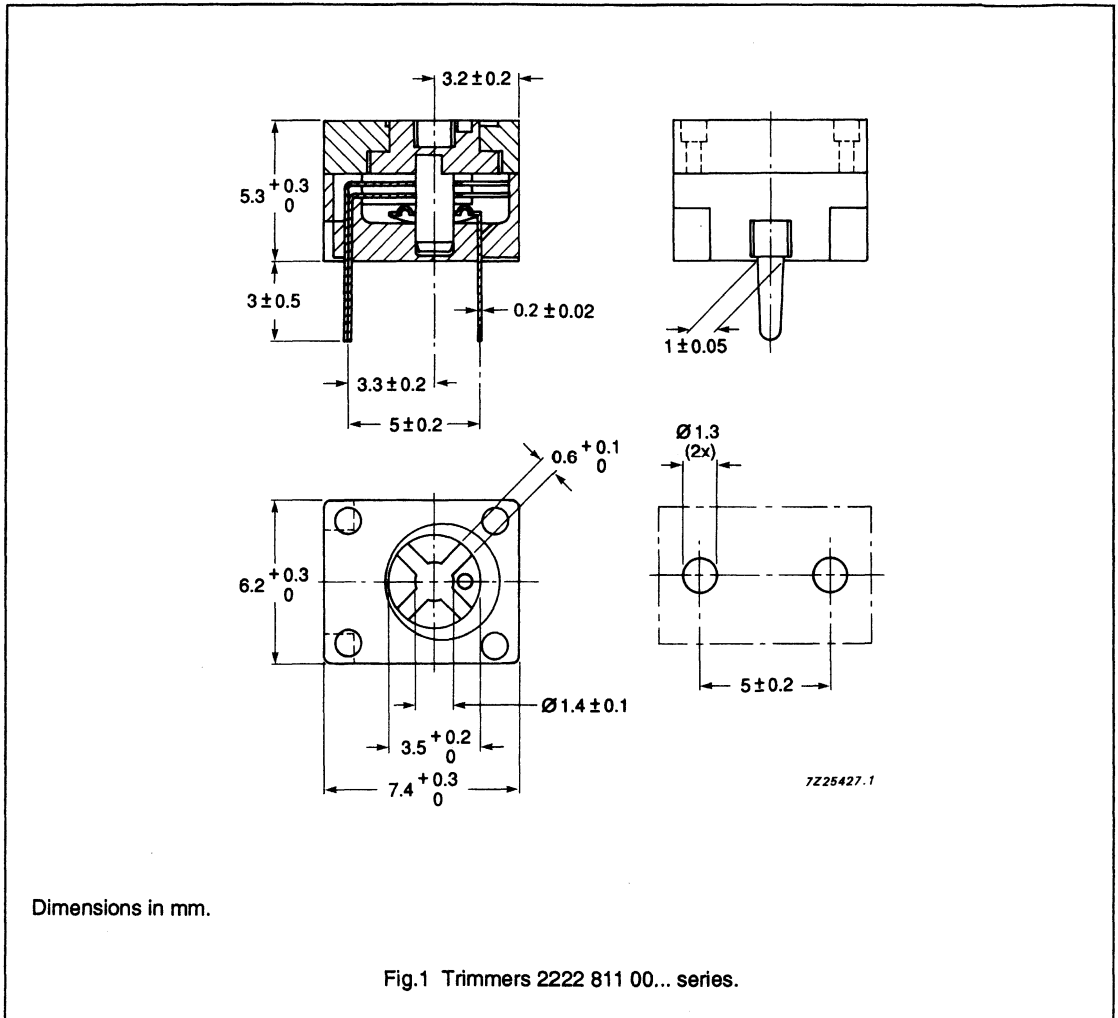
Rated voltage (DC)	300 V
Test voltage (DC) for 1 minute	600 V
Insulation resistance	$\geq 10\,000\ \Omega$
Tan $\delta$ at $C_{max}$ , 1 MHz	$\leq 10 \times 10^{-4}$
Temperature coefficient	$-250 \pm 200 \times 10^{-6}$
Category temperature range	-40 to +125 °C
Minimum storage temperature	-55 °C

### MECHANICAL DATA

Effective angle of rotation	180°
Operating torque	1 to 20 mNm
Maximum axial thrust ( $C \leq 0.3\%$ of $C_{max}$ )	2 N
Mass	0.5 g (approx.)

Film dielectric leaded trimmers

2222 811 00...



**MOUNTING REFERENCES**

The trimmer can be mounted on printed-circuit boards with hole diameter min. 1.25 mm.

**PACKING**

Blister packs of 140 pieces each.

**Soldering conditions:**

max. 260 °C; max. 10 s.

## Film dielectric leaded trimmers

2222 811 00...

## ORDERING INFORMATION

REFERENCE $C_{max}$ (pF)	GUARANTEED max. $C_{min}$ min. $C_{max}$ at 200 kHz (pF)	Tan $\delta$ at $C_{max} \times 10^{-4}$		TEMPERATURE COEFFICIENT (ppm/K)	min. $f_{res}$ at $C_{max}$ (MHz)	CATALOGUE NUMBERS
		1 (MHz)	100 (MHz)			
5	1.5/5	$\leq 10$	$\leq 20$	-250 $\pm$ 200	1 000	2222 811 00508
10	2/10	$\leq 10$	$\leq 20$	-250 $\pm$ 200	650	2222 811 00109
15	2.5/15	$\leq 10$	$\leq 20$	-250 $\pm$ 200	500	2222 811 00159
18	3/18	$\leq 10$	$\leq 20$	-250 $\pm$ 200	400	2222 811 00209

COLOUR OF ADJUSTER	COLOUR OF HOUSING	SMALLEST PACKING QUANTITY	CATALOGUE NUMBERS
White	black	140	2222 811 00508
Blue	black	140	2222 811 00109
Green	black	140	2222 811 00159
Black	black	140	2222 811 00209

## TEST AND REQUIREMENTS

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C: \leq 1\%$
19		thrust	axial thrust of 2 N	$\Delta C/C: \leq 0.3\%$
21		robustness of terminations		
21.1	Ua	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle; 0.5 hours at lower and 0.5 hours at upper category temperature	$\Delta C/C: \leq 2\%$
23	T Ta Tb	soldering solderability resistance to heat	solder bath immersion 3 mm; 235 °C; 2 s solder bath: 260 °C; 10 s	good wetting; no mechanical damage no mechanical damage
24	Eb	impact bump	4 000 $\pm$ 10 bumps; 40 g; 6 ms	$\Delta C/C: \leq 0.6\%$ ; no mechanical damage
25	Fc	vibration	frequency 10 to 55 Hz; amplitude 0.75 mm; 1.5 hours	$\Delta C/C: \leq 0.2\%$ ; no mechanical damage

## Film dielectric leaded trimmers

2222 811 00...

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
26		climatic sequence		$\Delta C/C: \leq 2.5\%$
26.1	B	dry heat	16 hours at upper category temperature	$\tan \delta: \leq 60 \times 10^{-4}$ $R_{ins}: \geq 10\,000\,M\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	voltage proof: 600 V for 1 minute
26.3	Aa	cold	16 hours; -40 °C	visual examination: no mechanical damage
26.5		damp heat accelerated, remaining cycles	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	operating torque: 1 to 20 mNm
27	Ca	damp heat steady state	21 days; +40 °C; 90 to 95% R.H.	$\Delta C/C: \leq 2.5\%$ $\tan \delta: \leq 10 \times 10^{-4}$ $R_{ins}: \geq 10\,000\,M\Omega$ voltage proof: 600 V for 1 minute visual examination: no mechanical damage operating torque: 1 to 20 mNm
29		endurance mechanical	10 cycles	$\Delta C/C: \leq 3\%$ $\Delta C/C$ after axial thrust: $\leq 0.3\%$ voltage proof: 600 V for 1 minute visual examination: no mechanical damage operating torque: 1 to 20 mNm

## Film dielectric surface mounted trimmers

2222 811 10...

### FEATURES

- High temperature resistance type
- High Q-value.

### APPLICATIONS

- For consumer and industrial equipment.

### DESCRIPTION

The trimmer consists of an enclosed plastic housing of high temperature resistant material, a brass rotor and a plated brass stator with a PTFE film as the dielectric. In addition there is a plastic actuating cross-slot and a position indicator for top adjustment only. The colour of the plastic actuating cross-slot indicates the nominal C value. The stator vanes with their tag are heat sealed to the housing. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented.

Cleaning with solvents is not advised.

The SMD type is only suitable for infra-red reflow soldering applications.

For outline drawings and dimensions see Fig.1.

### QUALITY LEVEL

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

AQL: 0.4% major defects  
1.5% minor defects.

Each capacitor is tested for min.  $C_{max}$  and is also subjected to the full test voltage.

### QUICK REFERENCE DATA

$C_{max}$	5 to 20 pF
Rated voltage (DC)	300 V
Related specification	IEC 418-1 and 4
Climatic category (IEC 68)	40/125/21

### SELECTION CHART

VALUE (pF)	CATALOGUE NUMBERS
5	2222 811 10508
10	2222 811 10109
15	2222 811 10159
20	2222 811 10209

### ELECTRICAL DATA

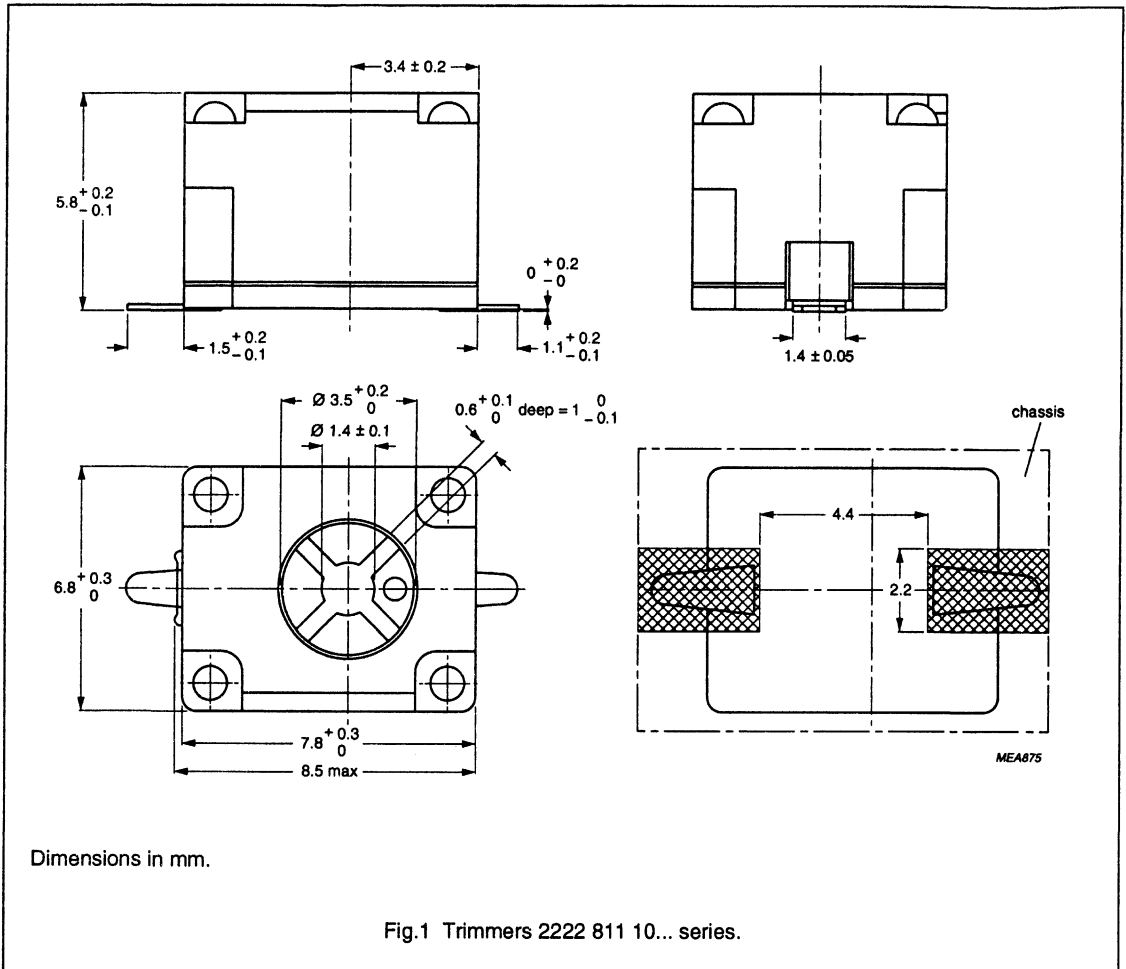
Rated voltage (DC)	300 V
Test voltage (DC) for 1 minute	600 V
Insulation resistance	$\geq 10\ 000\ \text{M}\Omega$
$\tan \delta$ at $C_{max}$ , 1 MHz	$\leq 10 \times 10^{-4}$
Temperature coefficient	$-200 \pm 250 \times 10^{-6}$
Category temperature range	-40 to +125 °C
Minimum storage temperature	-55 °C

### MECHANICAL DATA

Effective angle of rotation	180°
Operating torque	1 to 25 mNm
Maximum axial thrust ( $C \leq 0.3\%$ of $C_{max}$ )	2 N
Mass	0.65 g (approx.)

Film dielectric surface mounted trimmers

2222 811 10...



**MOUNTING REFERENCES**

The trimmer is suitable for surface mounting. The trimmer operation can be done during automatic placement, as well as by hand.

**Soldering conditions:**

Soldering can be done by hand or by reflow.

manual: max. 260 °C; max. 10 s.

reflow: max. 240 °C; max. 30 s.

Refer also to Figs 2 and 3.

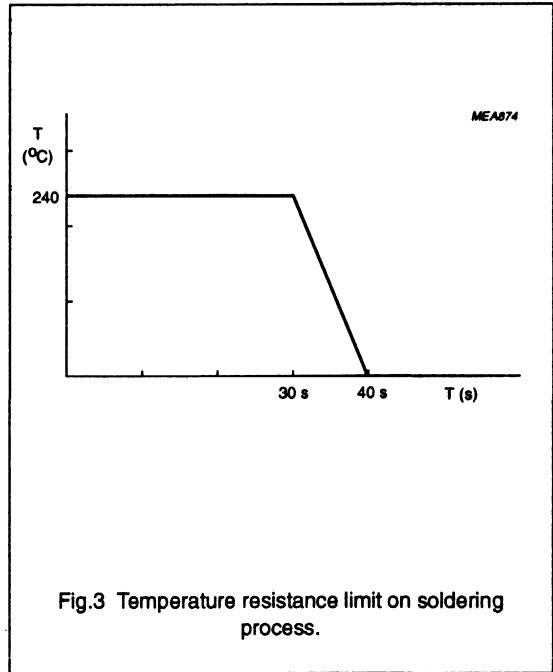
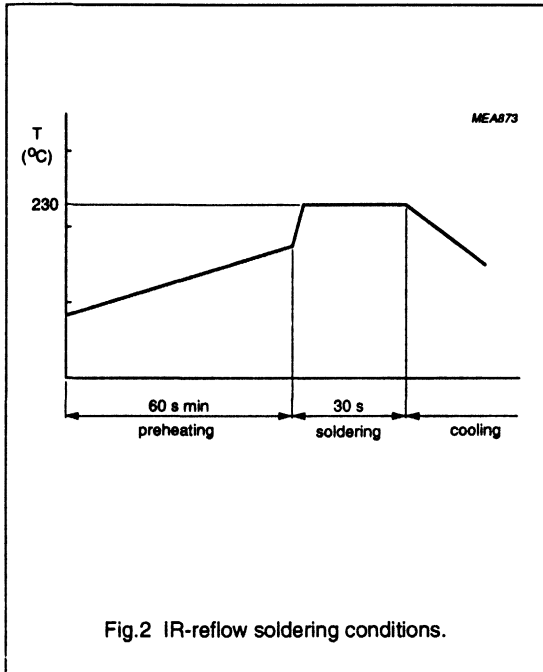
**PACKING**

Bulk packing in cardboard boxes lined with expanded plastic, 700 pieces per box.



Film dielectric surface mounted trimmers

2222 811 10...



## Film dielectric surface mounted trimmers

2222 811 10...

## ORDERING INFORMATION

REFERENCE $C_{max}$ (pF)	GUARANTEED max. $C_{min}$ min. $C_{max}$ at 200 kHz (pF)	Tan $\delta$ at $C_{max} \times 10^{-4}$		TEMPERATURE COEFFICIENT (ppm/K)	min. $f_{res}$ at $C_{max}$ (MHz)	CATALOGUE NUMBERS
		1 (MHz)	100 (MHz)			
5	1.5/5	$\leq 10$	$\leq 20$	$-200 \pm 250$	1 000	2222 811 10508
10	2/10	$\leq 10$	$\leq 20$	$-200 \pm 250$	650	2222 811 10109
15	2.5/15	$\leq 10$	$\leq 20$	$-200 \pm 250$	500	2222 811 10159
20	3/20	$\leq 10$	$\leq 20$	$-200 \pm 250$	400	2222 811 10209

COLOUR OF ADJUSTER	COLOUR OF HOUSING	SMALLEST PACKING QUANTITY	CATALOGUE NUMBERS
White	black	140	2222 811 10508
Blue	black	140	2222 811 10109
Green	black	140	2222 811 10159
Black	black	140	2222 811 10209

## TEST AND REQUIREMENTS

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$ : $\leq 1\%$ for $\geq 10$ pF; $\leq 2\%$ for 5 pF
19		thrust	axial thrust of 2 N	$\Delta C/C$ : $\leq 0.3\%$
21		robustness of terminations		
21.1	Ua	tensile	1 N	
22	Na	rapid change of temperature	1 cycle; 0.5 hours at lower and 0.5 hours at upper category temperature	$\Delta C/C$ : $\leq 2\%$
23	T Ta	soldering solderability	reflow soldering; body temperature: 80 °C; processing temperature: 260 °C during 10 s recovery: 24 $\pm$ 2 hours	good wetting; no mechanical damage
	Tb	resistance to heat	solder bath: 235 °C; 30 s	no mechanical damage
24	Eb	impact bump	4 000 $\pm$ 10 bumps; 40 g; 6 ms	$\Delta C/C$ : $\leq 0.6\%$ ; no mechanical damage

## Film dielectric surface mounted trimmers

2222 811 10...

IEC 418-1 CLAUSE	IEC 68 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
25	Fc	vibration	frequency 10 to 55 Hz; amplitude 0.35 mm; 1.5 hours	$\Delta C/C$ : $\leq 0.2\%$ ; no mechanical damage
26		climatic sequence		$\Delta C/C$ : $\leq 2.5\%$
26.1	B	dry heat	16 hours at upper category temperature	$\tan \delta$ : $\leq 60 \times 10^{-4}$ $R_{ins}$ : $\geq 10\ 000\ M\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	voltage proof: 600 V for 1 minute
26.3	Aa	cold	16 hours; -40 °C	visual examination: no mechanical damage
26.5		damp heat accelerated, remaining cycles	1 cycle; 24 hours; +40 °C; 95 to 100% R.H.	operating torque: 1 to 25 mNm
27	Ca	damp heat steady state	21 days; +40 °C; 90 to 95% R.H.	$\Delta C/C$ : $\leq 2.5\%$ $\tan \delta$ : $\leq 10 \times 10^{-4}$ $R_{ins}$ : $\geq 10\ 000\ M\Omega$ voltage proof: 600 V for 1 minute visual examination: no mechanical damage operating torque: 1 to 25 mNm
29		endurance mechanical	25 cycles	$\Delta C/C$ : $\leq 3\%$ $\Delta C/C$ after axial thrust: $\leq 0.3\%$ voltage proof: 600 V for 1 minute visual examination: no mechanical damage operating torque: 1 to 25 mNm



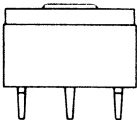
## FILM DIELECTRIC TRIMMERS

- High temperature type
- Housing dimensions 11 mm x 14 mm x 9 mm
- For basic grid of 2,54 mm
- For professional applications, e.g. fine adjustment of h.f. tuned circuits, capacitive volume or voltage control

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	
single stator type	2,5/20 to 7/100
differential type	2/12 to 7/150
Rated voltage (d.c.)	200 V
Housing dimensions	11 mm x 14 mm x 9 mm
Climatic category (IEC 68)	40/125/21
Related specification	IEC 418-1 and 4

### Selection chart

$C_{min}/C_{max}$	catalogue number	
	vertical spindle	
		
pF	single stator type	differential type
2/12		2222 809 07018
2,5/20	2222 809 07004	2222 809 07006
4/40	2222 809 07008	2222 809 07009
5/60	2222 809 07011	2222 809 07012
6/80	2222 809 07013	2222 809 07014
7/100	2222 809 07015	2222 809 07016
7/150		2222 809 07107

### DESCRIPTION

The trimmers consist of a glass reinforced polysulphone frame with a polysulphone dust cover, brass rotor and stator with PTFE or polycarbonate film as the dielectric. The stator plates are stacked on pins and separated by rings, so that it is possible to produce a single-stator or a differential type. The rotor contact surfaces are plated to ensure a long life and a stable contact even under severe climatic conditions.

The trimmers have top adjustment by means of a screwdriver; capacitance increase is obtained with clockwise rotation. (Trimmers with counter-clockwise rotation and trimmers with insulated rotor are available on request.)

### MECHANICAL DATA

Dimensions in mm

Outlines	See Fig.1
Effective angle of rotation	180°
Operating torque	1,5 to 25 mNm
Maximum axial thrust ( $\Delta C < 0,3\%$ of $C_{max}$ )	2 N
Mass	
single-stator type	approx. 2,3 g
differential type	approx. 2,9 g

### Mounting

The trimmers can be mounted on printed-wiring boards with a grid of 2,54 mm; hole diameter min. 1,25 mm. See for hole pattern Fig.2.

Soldering conditions: max. 260 °C, max. 10 s. (See also 'Tests and Requirements'.)

### ELECTRICAL DATA; see also Table 1

Rated voltage (d.c.)	200 V
Test voltage (d.c.) for 1 min.	400 V
Contact resistance	max. 5 mΩ
Insulation resistance between stator and rotor	min. 10 000 MΩ
Category temperature range	- 40 to + 125 °C
Climatic category (IEC 68)	40/125/21
Minimum storage temperature	- 55 °C

**Table 1**

guaranteed max. $C_{min}$ min. $C_{max}$ at 200 kHz pF	type	cat. number 2222 809 followed by	spindle	adjustment mode	dielectric film (note 1)	$\tan \delta$ at $C_{max}$ $\times 10^{-4}$ 1 MHz 100 MHz (note 2) $10^{-6}/K$	temp. coeff.  $10^{-6}/K$	smallest packing quantity	
2/12	differential	07018	vertical	top	PTFE	$< 10$	$< 17$	$0 \pm 200$	70
2.5/20	single-stator differential	07004 07006	vertical	top	PTFE	$< 10$	$< 17$	$0 \pm 200$	70
4/40	single-stator differential	07008 07009	vertical	top	PTFE	$< 10$	$< 17$	$0 \pm 200$	70
5/60	single-stator differential	07011 07012	vertical	top	PTFE	$< 10$	$< 25$	$0 \pm 200$	70
6/80	single-stator differential	07013 07014	vertical	top	PTFE	$< 10$	$< 25$	$0 \pm 200$	70
7/100	single-stator differential	07015 07016	vertical	top	PTFE	$< 10$	$< 25$	$0 \pm 200$	70
7/150	differential	07107	vertical	top	PC	$< 50$		$0 \pm 200$	70

**Notes to Table 1**

1. PTFE = polytetrafluoroethylene;  
PC = polycarbonate.
2. C at 60 to 80% of  $C_{max}$ ;  $\Delta T$  from  $+20$  to  $+125$  °C.

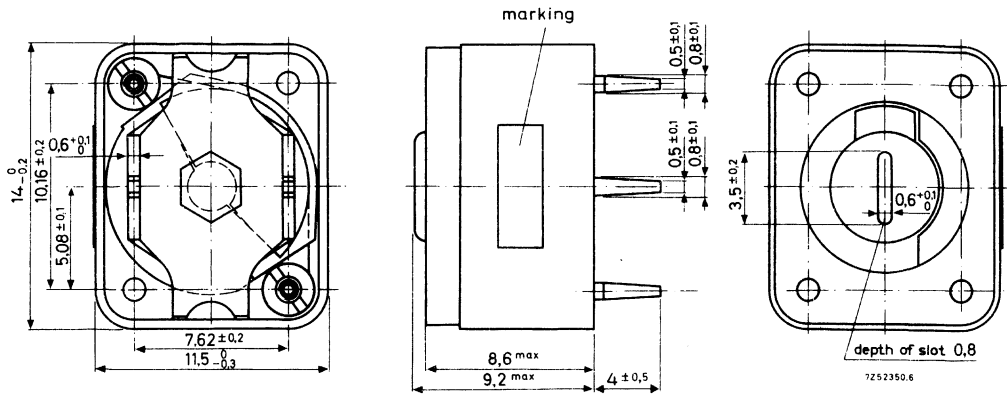


Fig. 1.

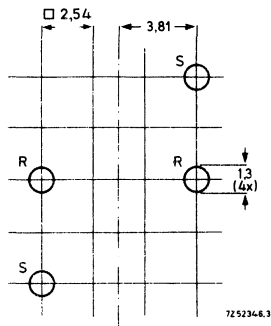


Fig. 2 Hole pattern; R = rotor, S = stator.

**MARKING**

The trimmers are marked with the capacitance value in pF, followed by the letter E (single-stator type) or the letter D (differential type).

**ADJUSTMENT**

The trimmers can be adjusted with a screwdriver or trimming key (top adjustment).

**PACKING**

Blister packs of 70 pieces each.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

A.Q.L. 0,4%, major defects

A.Q.L. 1,5%, minor defects

Each capacitor is tested for minimum  $C_{max}$  and is also subjected to the full test voltage. See also Note under Survey of variable capacitors.



**TESTS AND REQUIREMENTS**

IEC418-1 clause	IEC68 test method	test	procedure	requirements
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$ < 1%
19		thrust	axial thrust of 2 N	$\Delta C/C$ < 0,3%
21		robustness of terminations:		
21.1	Ua	tensile	1 N	no damage
21.2	Ub	bending		bending not allowed
22	Na	rapid change of temperature	1 cycle: 1/2 h at lower and 1/2 h at upper category temp.	$\Delta C/C$ < 1%
23	T	soldering		
	Ta	solderability	solder bath, immersion 3 mm, 235 °C, 2 s	good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s	no mechanical damage
24	Eb	impact bump	4000 ± 10 bumps, 40g, 6 ms	$\Delta C/C$ < 0,2% no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0,35 mm, 1,5 h	$\Delta C/C$ < 0,25% no mechanical damage

**TESTS AND REQUIREMENTS** (continued)

IEC418-1 clause	IEC68 test method	test	procedure	requirements	
26		climatic sequence		$\Delta C/C$	< 3%
				$\tan \delta$	< $10 \times 10^{-4}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ rotor contact R	$\geq 10\,000\,M\Omega$ < $10\,m\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof	400 V for 1 min
				visual examination	no mechanical damage
26.3	Aa	cold	16 h, - 40 °C	operating torque	1,5 to 35 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.		
27	Ca	damp heat steady state	21 days, + 40 °C, 90 to 95% R.H.	$\Delta C/C$	< 3%
				$\tan \delta$	< $10 \times 10^{-4}$
				$R_{ins}$ rotor contact R	$\geq 10\,000\,M\Omega$ < $10\,m\Omega$
				voltage proof	400 V for 1 min
				visual examination	no mechanical damage
				operating torque	1,5 to 35 mNm
29 29.1		endurance mechanical	25 cycles	$\Delta C/C$	< 0,3%
				$\Delta C/C$ after axial thrust	< 0,3%
				rotor contact R	< $10\,m\Omega$
				voltage proof	400 V for 1 min
				visual examination	no mechanical damage
				operating torque	1 to 50 mNm

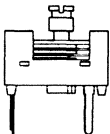
## FILM DIELECTRIC TRIMMERS

- High temperature type
- Housing dimensions 10 mm x 11 mm x 11 mm
- For basic grid of 2,54 mm
- For professional applications, e.g. fine adjustment of h.f. tuned circuits

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	4/38 pF and 5/57 pF
Rated voltage (d.c.)	300 V
Housing dimensions	10 mm x 11 mm x 11 mm
Climatic category (IEC 68)	40/125/21
Related specification	IEC 418-1 and 4

### Selection chart

	catalogue number
$C_{min}/C_{max}$	vertical spindle 
pF	round head; top + bottom adjustment
4/38	2222 809 08002
5/57	2222 809 08003

### DESCRIPTION

The trimmers consist of a polysulphone housing, brass rotor and plated brass stator with a PTFE film as the dielectric. The stator plates with their tag are heat-sealed to the housing. The rotor contact surface is plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented. A colour dot indicates the maximum capacitance. The trimmers have top and bottom adjustment; top adjustment should be done by means of a screwdriver, bottom adjustment by means of the key according to Fig.3.

**MECHANICAL DATA**

Dimensions in mm

Outlines	See Fig.1
Effective angle of rotation	180°
Operating torque	2 to 25 mNm
Maximum axial thrust ( $\Delta C < 0,3\%$ of $C_{max}$ )	2 N
Mass	approx. 1,6 g

**Mounting**

The trimmers can be mounted on printed-wiring boards with a grid of 2,54 mm; hole diameter min. 1,25 mm. See for hole pattern Fig.2.

Soldering conditions: max. 260 °C, max. 10 s. (See also 'Tests and Requirements'.)

**ELECTRICAL DATA; see also Table 1**

Rated voltage (d.c.)	300 V
Test voltage (d.c.) for 1 min.	600 V
Contact resistance	max. 5 m $\Omega$
Insulation resistance	min. 10 000 M $\Omega$
Category temperature range	-40 to +125 °C
Climatic category (IEC 68)	40/125/21
Minimum storage temperature	-55 °C

**Table 1**

guaranteed max. $C_{min}$ min. $C_{max}$ at 200 kHz pF	cat. number 2222 809 followed by	spindle	shape of head	adjustment mode	dielectric film (note 1)	$\tan \delta$ at $C_{max} \times 10^{-4}$ MHz	temp. coeff. (note 2) $10^{-6}/K$	min. $f_{res}$ at $C_{max}$ MHz	colour of dot	smallest packing quantity
4/38	08002	vertical	round	top + bottom	PTFE	$< 10$	$-250 \pm 150$	170	yellow	70
5/57	08003	vertical	round	top + bottom	PTFE	$< 10$	$-250 \pm 150$	150	blue	70

**Notes to Table 1**

1. PTFE = polytetrafluorethylene.
2. C at 60 to 80% of  $C_{mac}$ ;  $\Delta T$  from +20 to +125 °C.

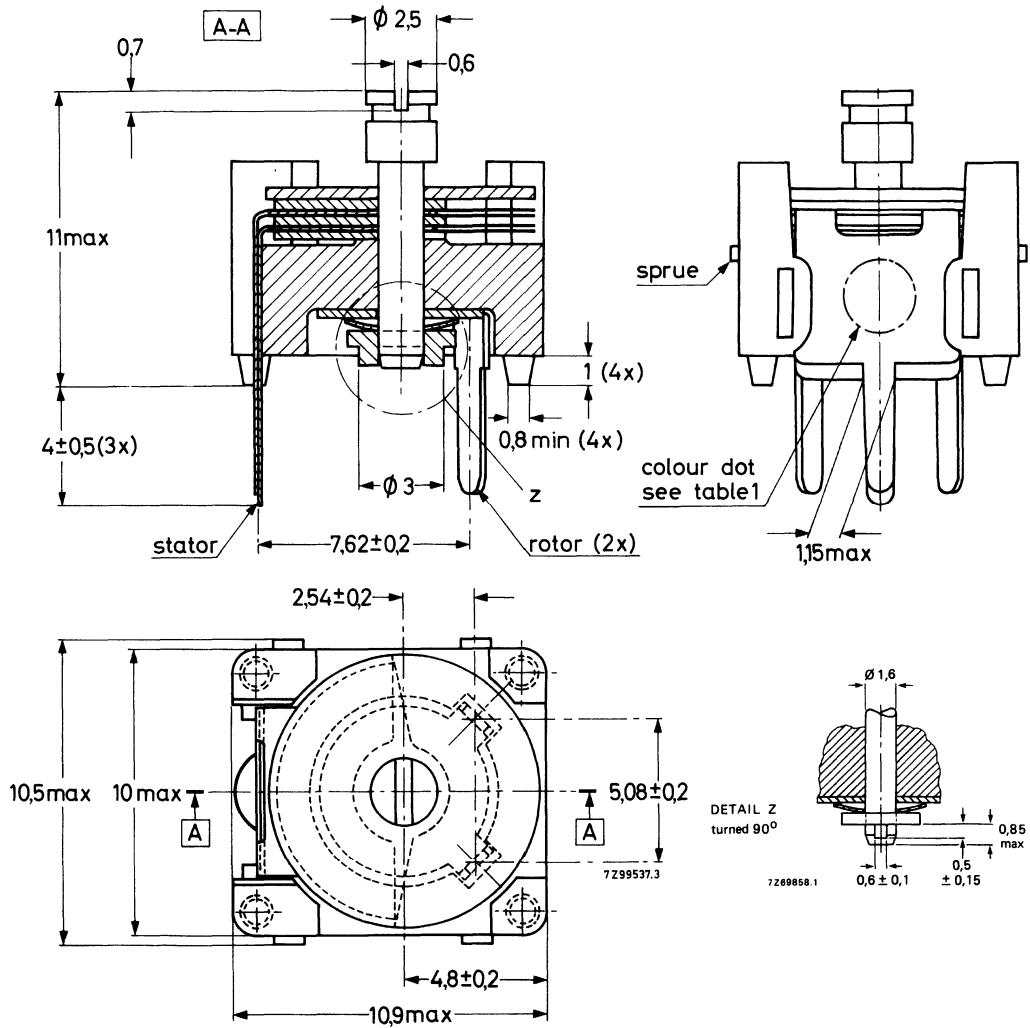


Fig.1.

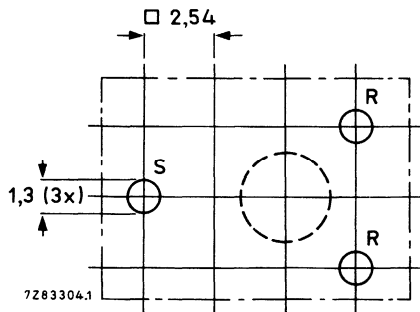


Fig.2 Hole pattern; the large hole is necessary only if bottom adjustment is to be used. R = rotor, S = stator.

**ADJUSTMENT**

For top adjustment a screwdriver or trimming key can be used; for bottom adjustment a key is required as shown in Fig.3.

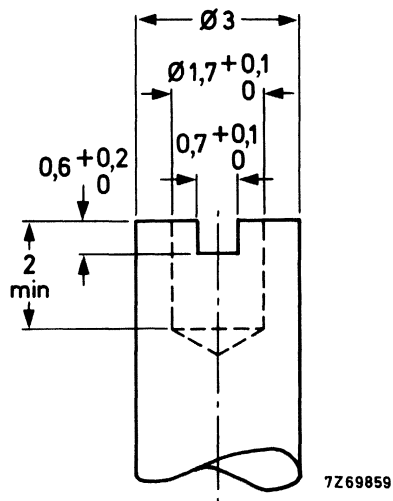


Fig.3.

**PACKING**

Blister packs of 70 pieces each.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

A.Q.L. 0,4%, major defects

A.Q.L. 1,5%, minor defects

Each capacitor is tested for minimum  $C_{\max}$  and is also subjected to the full test voltage. See also Note under Survey of variable capacitors.

**TESTS AND REQUIREMENTS**

IEC418-1 clause	IEC68 test method	test	procedure	requirements
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$ < 1,5%
19		thrust	axial thrust of 2 N	$\Delta C/C$ < 0,2%
21		robustness of terminations:		
21.1	Ua	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle: 1/2 h at lower and 1/2 h at upper category temp.	$\Delta C/C$ < 2,5%
23	T Ta	soldering solderability	solder bath, immersion 3 mm, 235 °C, 2 s	good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s	no mechanical damage
24	Eb	impact bump	4000 $\pm$ 10 bumps, 40g, 6 ms	$\Delta C/C$ < 0,5% no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0,35 mm, 1,5 h	$\Delta C/C$ < 0,2% no mechanical damage



**TESTS AND REQUIREMENTS** (continued)

IEC418-1 clause	IEC68 test method	test	procedure	requirements
26		climatic sequence		$\Delta C/C$ < 2,5%  $\tan \delta$ < $10 \times 10^{-4}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ > 10 000 M $\Omega$ rotor contact R < 5 m $\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	voltage proof 600 V for 1 min  visual examination no mechanical damage
26.3	Aa	cold	16 h, - 40 °C	operating torque 1 to 20 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, + 40 °C, 95 to 100% R.H.	
27	Ca	damp heat steady state	21 days, + 40 °C, 90 to 95% R.H.	$\Delta C/C$ < 2,5%  $\tan \delta$ < $10 \times 10^{-4}$  $R_{ins}$ > 10 000 M $\Omega$ rotor contact R < 5 m $\Omega$  voltage proof 600 V for 1 min  visual examination no mechanical damage  operating torque 1 to 20 mNm
29 29.1		endurance mechanical	25 cycles	$\Delta C/C$ < 0,3%  $\Delta C/C$ after axial thrust < 0,3%  rotor contact R < 5 m $\Omega$  voltage proof 600 V for 1 min  visual examination no mechanical damage  operating torque 1 to 20 mNm



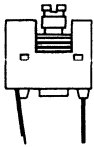
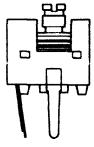
## FILM DIELECTRIC TRIMMERS

- High temperature type
- Housing dimensions 8 mm x 9 mm x 10 mm
- For basic grid of 2,54 mm
- For professional applications, e.g. fine adjustment of h.f. tuned circuits

### QUICK REFERENCE DATA

$C_{min}/C_{max}$	1,4/5,5 to 2/18 pF
Rated voltage (d.c.)	300 V
Housing dimensions	8 mm x 9 mm x 10 mm
Climatic category (IEC 68)	40/125/21
Related specification	IEC 418-1 and 4

### Selection chart

	catalogue number	
$C_{min}/C_{max}$	vertical spindle 	vertical spindle 
	round head; top + bottom adjustment	round head; top + bottom adjustment
pF	version with 1 rotor tag	version with 2 rotor tags
1,4/5,5	2222 809 09004	2222 809 09001
2/9	2222 809 09005	2222 809 09002
2/18	2222 809 09006	2222 809 09003

### DESCRIPTION

The trimmers consist of a polysulphone housing, brass rotor and plated brass stator with a PTFE film as the dielectric. The stator plates with their tag are heat-sealed to the housing. The rotor contact surface is plated to ensure a long life and a stable contact even under severe climatic conditions. Flux absorption between the vanes is prevented. A colour dot indicates the maximum capacitance.

Versions with one rotor tag and with two rotor tags are available. The trimmers have top and bottom adjustment; top adjustment should be done by means of a screwdriver, bottom adjustment by means of the key according to Fig.5.

**MECHANICAL DATA**

Dimensions in mm

Outlines	See Figs 1 and 3
Effective angle of rotation	180°
Operating torque	
$C_{\max} = 5,5 \text{ pF}$	1 to 15 mNm
$C_{\max} = 9 \text{ and } 18 \text{ pF}$	2,5 to 20 mNm
Maximum axial thrust ( $\Delta C < 0,3\%$ of $C_{\max}$ )	2 N
Mass	approx. 0,8 g

**Mounting**

The trimmers can be mounted on printed-wiring boards; hole diameter min. 1,25 mm. See for hole patterns Figs 2 and 4.

Soldering conditions: max. 260 °C, max. 10 s. (See also 'Tests and Requirements'.)

**ELECTRICAL DATA**; see also Table 1

Rated voltage (d.c.)	300 V
Test voltage (d.c.) for 1 min.	500 V
Contact resistance	max. 5 m $\Omega$
Insulation resistance between stator and rotor	min. 10 000 M $\Omega$
Category temperature range	- 40 to + 125 °C
Climatic category (IEC 68)	40/125/21
Minimum storage temperature	- 55 °C

**Table 1**

guaranteed max. $C_{min}$ min. $C_{max}$ at 200 KHz pF	cat. number 2222 809 followed by	spindle	shape of head	adjustment mode	dielectric film (note 1)	$\tan \delta$ at $C_{max} \times 10^{-4}$ MHz	temp. coef. (note 2) $10^{-6}/K$	min. $f_{res}$ at $C_{max}$ MHz	colour of dot	smallest packing quantity
1,4/5,5	09004* 09001**	vertical	round	top + bottom	PTFE	< 10	-250 ± 150	850	green	105
2/9	09005* 09002**	vertical	round	top + bottom	PTFE	< 10	-250 ± 150	580	white	105
2/18	09006* 09003**	vertical	round	top + bottom	PTFE	< 10	-250 ± 150	360	red	105

\* With one rotor contact  
 \*\* With two rotor contacts

**Notes to Table 1**

1. PTFE = polytetrafluorethylene.
2. C at 60 to 80% of  $C_{max}$ ;  $\Delta T$  from + 20 to + 125 °C.

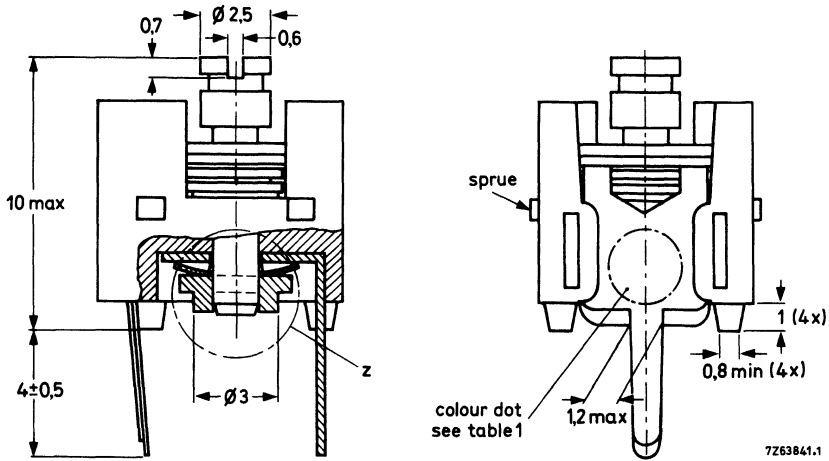


Fig.1 Version with one rotor contact.

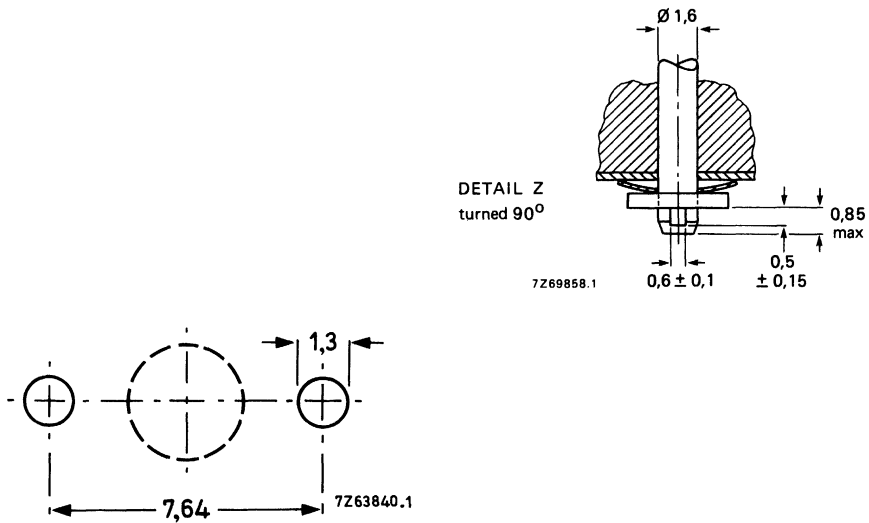


Fig.2 Hole pattern. The large hole is for bottom adjustment; the diameter is determined by user's requirements.

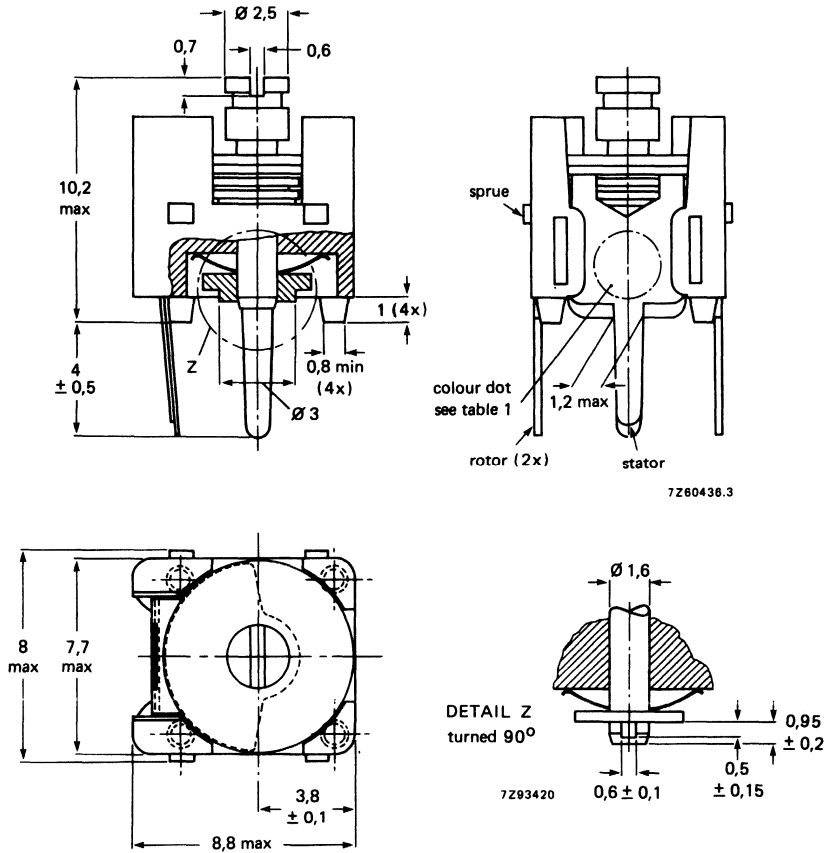


Fig.3 Version with two rotor contacts.

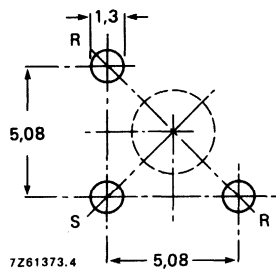


Fig.4 Hole pattern; R=rotor, S=stator. The large hole is for bottom adjustment; the diameter is determined by user's requirements.

**ADJUSTMENT**

For top adjustment a screwdriver or trimming key can be used; for bottom adjustment a key is required as shown in Fig.5.

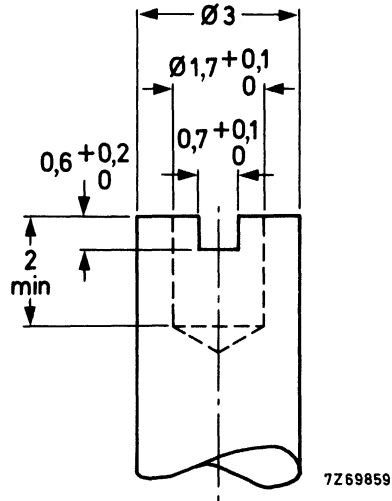


Fig.5.

**PACKING**

Blister packs of 105 pieces each.

**QUALITY LEVEL**

Sampling and data evaluation for quality level in accordance with MIL-STD-105D and IEC 410.

A.Q.L. 0,4%, major defects

A.Q.L. 1,5%, minor defects

Each capacitor is tested for minimum  $C_{\text{max}}$  and is also subjected to the full test voltage. See also Note under Survey of variable capacitors.



**TESTS AND REQUIREMENTS**

IEC418-1 clause	IEC68 test method	test	procedure	requirements
4.2		method of mounting	method A	
14		capacitance drift	after T.C. measurement	$\Delta C/C$ < 1,5%
19		thrust	axial thrust of 2 N	$\Delta C/C$ < 0,3%
21		robustness of terminations:		
21.1	Ua	tensile	1 N	
21.2	Ub	bending	1 cycle	no damage
22	Na	rapid change of temperature	1 cycle: 1/2 h at lower and 1/2 h at upper category temp.	$\Delta C/C$ < 1%
23	T Ta	soldering solderability	solder bath, immersion 3 mm, 235 °C, 2 s	good wetting, no mechanical damage
	Tb	resistance to heat	solder bath 260 °C, 10 s	no mechanical damage
24	Eb	impact bump	4000 ± 10 bumps, 40g, 6 ms	$\Delta C/C$ < 0,5% no mechanical damage
25	Fc	vibration	freq. 10 to 55 Hz, ampl. 0,35 mm, 1,5 h	$\Delta C/C$ < 0,3% no mechanical damage

**TESTS AND REQUIREMENTS** (continued)

IEC418-1 clause	IEC68 test method	test	procedure	requirements	
26		climatic sequence		$\Delta C/C$	$< 2,5\%$
				$\tan \delta$	$\leq 10 \times 10^{-4}$
26.1	B	dry heat	16 h at upper category temp.	$R_{ins}$ rotor contact R	$\geq 10\,000\ M\Omega$ $< 5\ m\Omega$
26.2	D	damp heat accelerated, first cycle	1 cycle, 24 h, $+40\ ^\circ C$ , 95 to 100% R.H.	voltage proof	500 V for 1 min
				visual examination	no mechanical damage
26.3	Aa	cold	16 h, $-40\ ^\circ C$	operating torque	1 to 20 mNm
26.5		damp heat accelerated remaining cycles	1 cycle, 24 h, $+40\ ^\circ C$ , 95 to 100% R.H.		
27	Ca	damp heat steady state	21 days, $+40\ ^\circ C$ , 90 to 95% R.H.	$\Delta C/C$	$< 3\%$
				$\tan \delta$	$\leq 10 \times 10^{-4}$
				$R_{ins}$ rotor contact R	$\geq 10\,000\ M\Omega$ $< 5\ m\Omega$
				voltage proof	500 V for 1 min
				visual examination	no mechanical damage
				operating torque	1 to 20 mNm
29 29.1		endurance mechanical	25 cycles	$\Delta C/C$	$< 3\%$
				$\Delta C/C$ after axial thrust	$< 0,3\%$
				rotor contact R	$< 5\ m\Omega$
				voltage proof	500 V for 1 min
				visual examination	no mechanical damage
				operating torque	1 to 20 mNm

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## PHILIPS COMPONENTS

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Book	Title
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SC02	Power Diodes
SC03	Thyristors and Triacs
SC04	Small-signal Transistors
SC05	Low-frequency Power Transistors and Hybrid IC Power Modules
SC06	High-voltage and Switching NPN Power Transistors
SC07	Small-signal Field-effect Transistors
SC08a	RF Power Bipolar Transistors
SC08b	RF Power MOS Transistors
SC09	RF Power Modules
SC10	Surface Mounted Semiconductors
SC13	PowerMOS Transistors
SC14	RF Wideband Transistors, Video Transistors and Modules
SC15	Microwave Transistors
SC16	Wideband Hybrid IC Modules
SC17	Semiconductor Sensors

### Integrated circuits

IC01	Semiconductors for Radio and Audio Systems
IC02	Semiconductors for Television and Video Systems
IC03	Semiconductors for Telecom Systems
IC04	CMOS HE4000B Logic Family
IC05	Advanced Low-power Schottky (ALS) Logic Series
IC06	High-speed CMOS Logic Family
IC08	100K ECL Logic Family
IC10	Memories
IC11	General-purpose/Linear ICs
IC12	Display Drivers and Microcontroller Peripherals (planned)
IC13	Programmable Logic Devices (PLD)
IC14	8048-based 8-bit Microcontrollers
IC15	FAST TTL Logic Series
IC16	ICs for Clocks and Watches
IC18	Semiconductors for In-Car Electronics and General Industrial Applications (planned)
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