

# DATA SHEET

## **SFR16S/25/25H** **Standard metal film resistors**

Product specification  
Supersedes data of 17th April 2002  
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## Standard metal film resistors

## SFR16S/25/25H

## FEATURES

- Low cost
- Low noise
- Small size (SFR16S).

## APPLICATIONS

- General purpose resistors.

## DESCRIPTION

A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps.

The resistors are coated with a coloured lacquer (light-blue for

type SFR16S; light-green for type SFR25 and red-brown for type SFR25H) which provides electrical, mechanical and climatic protection. The encapsulation is resistant to all cleaning solvents, in accordance with "MIL-STD-202E, method 215", and "IEC 60068-2045".

## QUICK REFERENCE DATA

DESCRIPTION	VALUE		
	SFR16S	SFR25	SFR25H
Resistance range	±5%; 1 Ω to 3 MΩ ±1%; 4.99 Ω to 3 MΩ	±5%; 0.22 Ω to 10 MΩ ±1%; 1 Ω to 10 MΩ jumper (0 Ω)	
Resistance tolerance	±1%, E24/E96 series; ±5%, E24 series		
Temperature coefficient: R < 4.7 Ω 4.7 Ω ≤ R ≤ 100 kΩ 100 kΩ < R ≤ 1 MΩ R > 1 MΩ	≤±250 × 10 <sup>-6</sup> /K ≤±100 × 10 <sup>-6</sup> /K ≤±250 × 10 <sup>-6</sup> /K ≤±250 × 10 <sup>-6</sup> /K	≤±100 × 10 <sup>-6</sup> /K ≤±100 × 10 <sup>-6</sup> /K ≤±100 × 10 <sup>-6</sup> /K ≤±250 × 10 <sup>-6</sup> /K	≤±100 × 10 <sup>-6</sup> /K ≤±100 × 10 <sup>-6</sup> /K ≤±100 × 10 <sup>-6</sup> /K ≤±250 × 10 <sup>-6</sup> /K
Absolute maximum dissipation at T <sub>amb</sub> = 70 °C	0.5 W	0.4 W	0.5 W
Thermal resistance, R <sub>th</sub>	170 K/W	200 K/W	150 K/W
Maximum permissible voltage	200 V	250 V	350 V
Noise: R < 68 kΩ 68 kΩ ≤ R ≤ 100 kΩ 100 kΩ ≤ R ≤ 1 MΩ R > 1 MΩ	max. 0.1 μV/V max. 0.5 μV/V max. 1.5 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V
Basic specifications	IEC 60115-1 and 60115-2		
Climatic category (IEC 60068)	55/15/56		
Stability, ΔR/R max., after: load: R ≤ 1 MΩ R > 1 MΩ climatic tests: R ≤ 1 MΩ R > 1 MΩ soldering short time overload	±1% + 0.05 Ω ±1% + 0.05 Ω ±1% + 0.05 Ω ±1% + 0.05 Ω ±0.25% + 0.05 Ω ±0.25% + 0.05 Ω	±1% + 0.05 Ω ±1% + 0.05 Ω ±1% + 0.05 Ω ±1% + 0.05 Ω ±0.25% + 0.05 Ω ±0.25% + 0.05 Ω	±1% + 0.05 Ω ±2% + 0.1 Ω ±1% + 0.05 Ω ±2% + 0.1 Ω ±0.25% + 0.05 Ω ±1% + 0.05 Ω

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### ORDERING INFORMATION

**Table 1** 12NC ordering code indicating resistor type and packaging

TYPE	TOL.	ORDERING CODE 23.. ... ..			
		BANDOLIER IN AMMOPACK			BANDOLIER ON REEL
		RADIAL TAPED	STRAIGHT LEADS		STRAIGHT LEADS
		4 000 units	1 000 units	5 000 units	5 000 units
SFR16S	±5%	–	..22 187 73...	..22 187 53...	..06 187 23...
	±1%	–	–	..06 187 3...	..06 187 1....
	jumper <sup>(1)</sup>	–	–	–	..06 187 90013
SFR25	±5%	..06 184 03...	..22 181 53...	..22 181 43...	..22 181 63...
	±1%	–	–	..22 188 2...	..06 181 8....
	jumper <sup>(1)</sup>	–	–	..22 181 90019	..06 181 90011
SFR25H	±5%	–	..22 186 16...	..22 186 76...	..06 186 63...
	±1%	–	–	..22 186 3....	..06 186 8....

#### Note

- The jumper has a maximum resistance  $R_{\max} = 10 \text{ m}\Omega$  at 5 A.

#### Composition of the 12NC

- The resistors have a 12-digit ordering code starting with 23
- The subsequent 7 digits indicate the resistor type and packaging; see Table 1.
- The remaining digits indicate the resistance value:
  - The first 2 or 3 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with Tables 2 or 3.

**Table 2** Last digit for ±5% tolerance

RESISTANCE DECADE	LAST DIGIT
0.10 to 0.91 $\Omega$	7
1 to 9.1 $\Omega$	8
10 to 91 $\Omega$	9
100 to 910 $\Omega$	1
1 to 9.1 k $\Omega$	2
10 to 91 k $\Omega$	3
100 to 910 k $\Omega$	4
1 to 9.1 M $\Omega$	5
≥10 M $\Omega$	6

**Table 3** Last digit for ±1% tolerance

RESISTANCE DECADE	LAST DIGIT
1 to 9.76 $\Omega$	8
10 to 97.6 $\Omega$	9
100 to 976 $\Omega$	1
1 to 9.76 k $\Omega$	2
10 to 97.6 k $\Omega$	3
100 to 976 k $\Omega$	4
1 to 9.76 M $\Omega$	5
≥10 M $\Omega$	6

#### ORDERING EXAMPLE: 12NC

The ordering code of a SFR25 resistor, value 5 600  $\Omega$  ±5%, taped on a bandolier of 5000 units in ammopack is: 2322 181 43562.

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### FUNCTIONAL DESCRIPTION

#### Product characterization

Standard values of nominal resistance are taken from the E24 series for resistors with a tolerance of  $\pm 5\%$ . The values of the E24 series are in accordance with "IEC publication 60063".

#### Limiting values

TYPE	LIMITING VOLTAGE <sup>(1)</sup> (V)	LIMITING POWER (W)
SFR16S	200	0.5
SFR25	250	0.4
SFR25H	350	0.5

#### Note

- The maximum voltage that may be continuously applied to the resistor element, see "IEC publication 60115-1".

The maximum permissible hot-spot temperature is 155 °C.

#### DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.1.

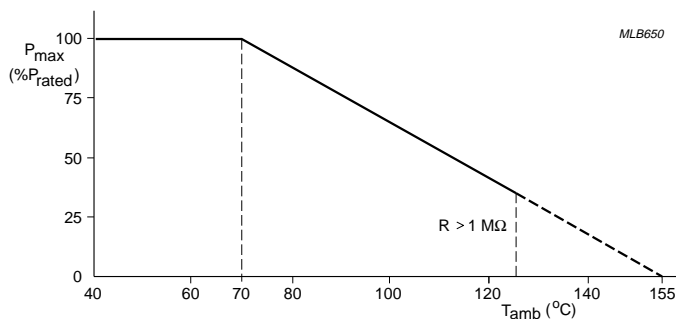
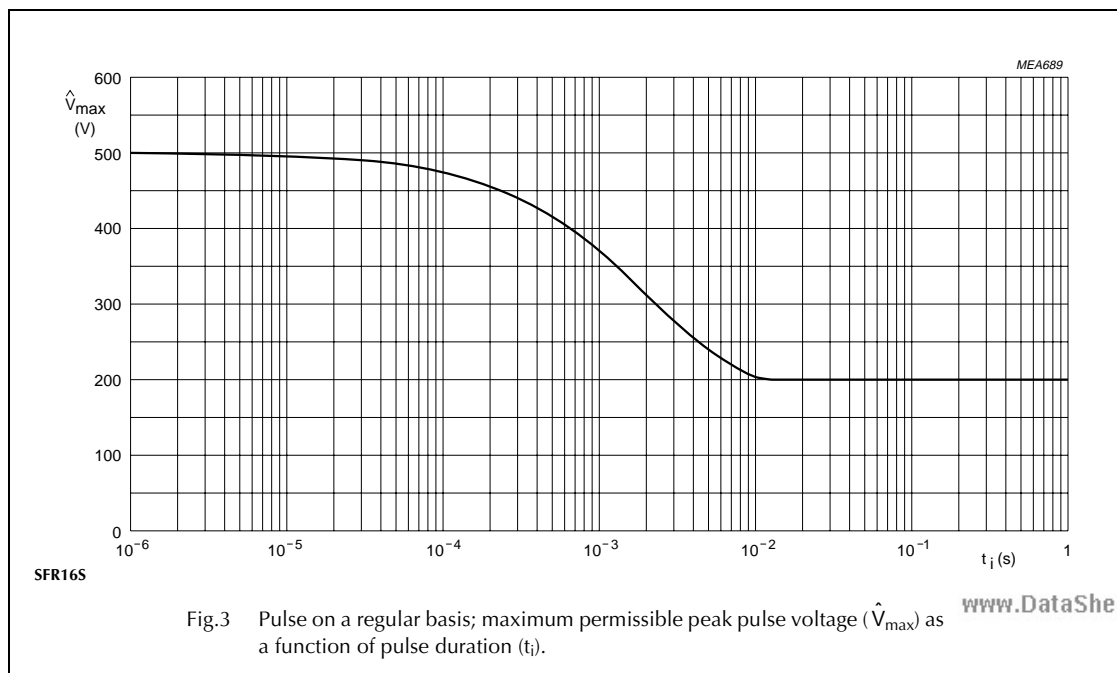
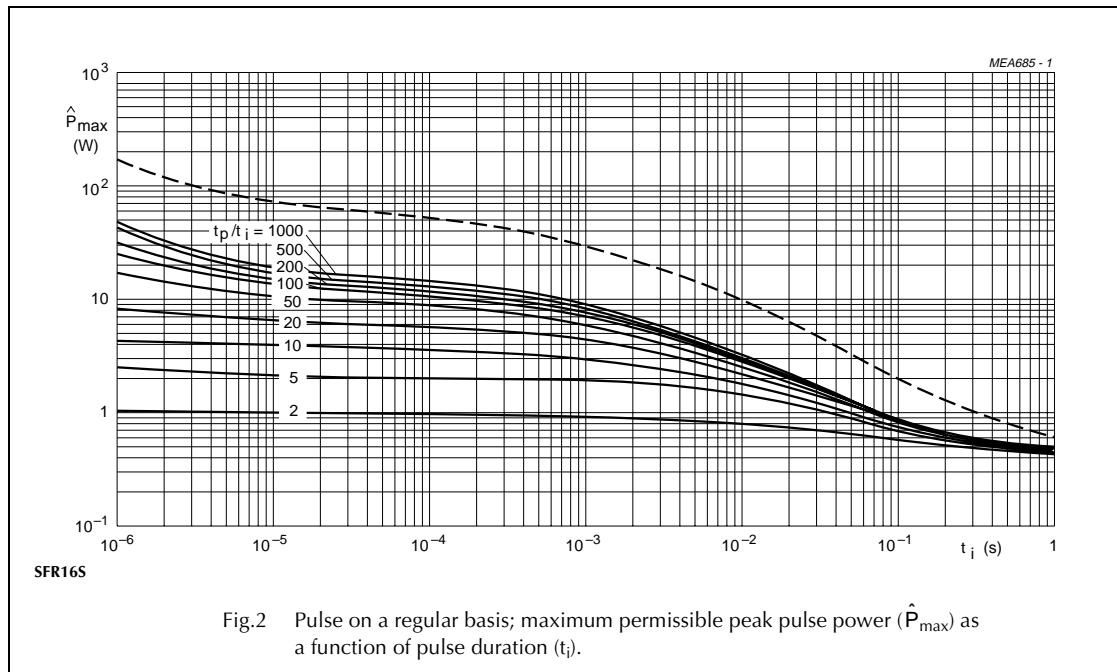


Fig.1 Maximum dissipation ( $P_{max}$ ) in percentage of rated power as a function of the ambient temperature ( $T_{amb}$ ).

## Standard metal film resistors

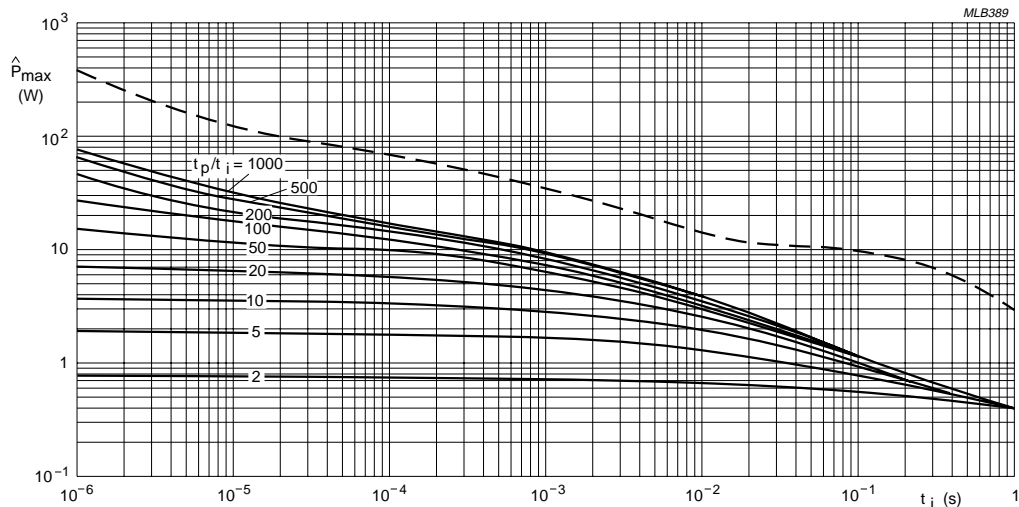
## SFR16S/25/25H

## PULSE LOADING CAPABILITIES



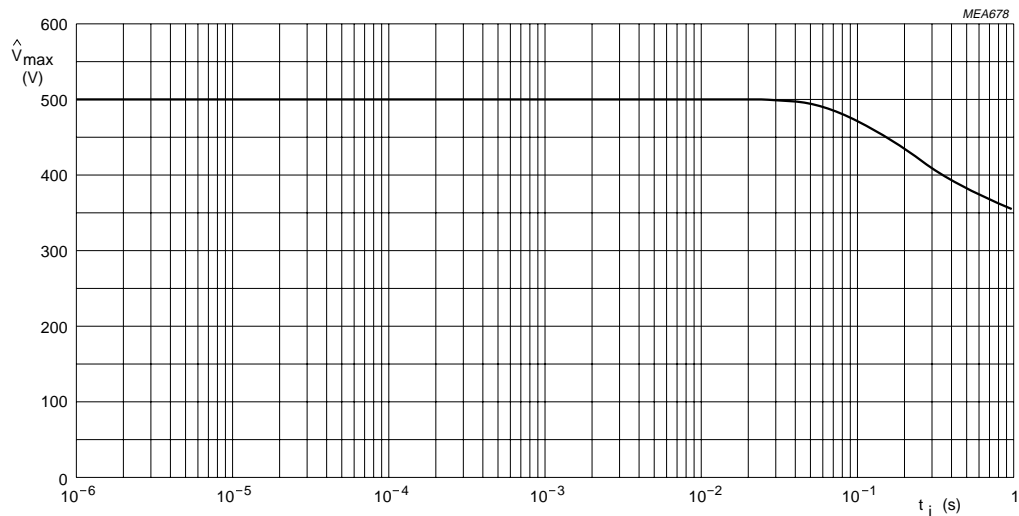
## Standard metal film resistors

## SFR16S/25/25H



SFR25

Fig.4 Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ ).



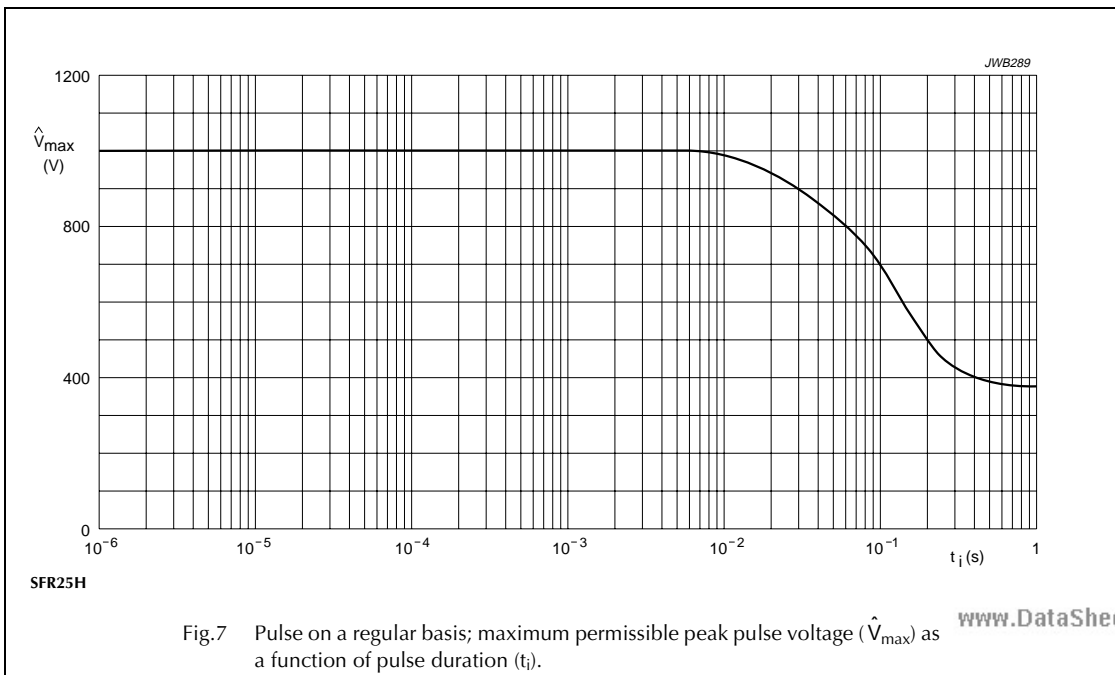
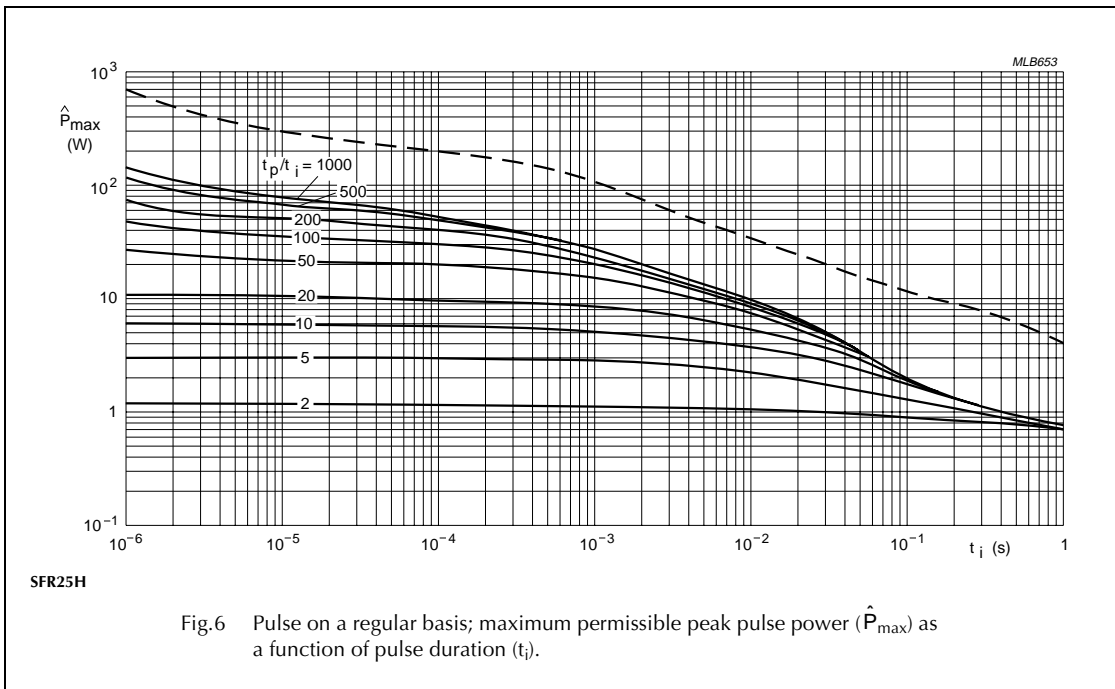
SFR25

Fig.5 Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{V}_{max}$ ) as a function of pulse duration ( $t_i$ ).

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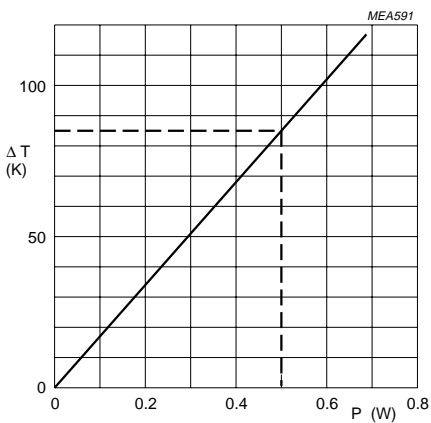
SFR16S/25/25H



## Standard metal film resistors

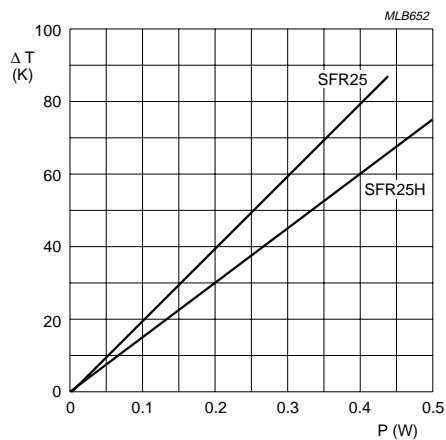
## SFR16S/25/25H

## Application information



SFR16S

Fig.8 Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power.



SFR25/SFR25H

Fig.9 Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power.



## Standard metal film resistors

## SFR16S/25/25H

## MECHANICAL DATA

## Mass per 100 units

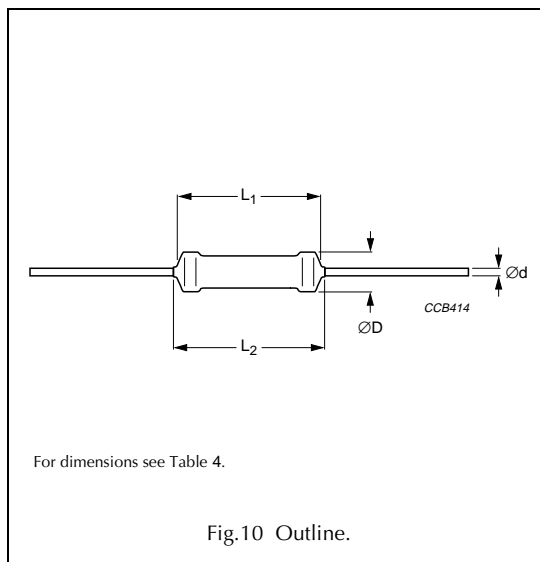
TYPE	MASS (g)
SFR16S	11.5
SFR25	21.0
SFR25H	22.0

## Marking

The nominal resistance and tolerance are marked on the resistor using four or five coloured bands in accordance with IEC publication 60062 "Colour codes for fixed resistors".

## Outlines

The length of the body ( $L_1$ ) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation ("IEC publication 60294").



**Table 4** Resistor type and relevant physical dimensions; see Fig.10

TYPE	ØD MAX. (mm)	L <sub>1</sub> MAX. (mm)	L <sub>2</sub> MAX. (mm)	Ød (mm)
SFR16S	1.9	–	3.4	0.45 ±0.05
SFR25	2.5	6.5	7.0	0.58 ±0.05
SFR25H	2.5	6.5	7.0	0.58 ±0.05

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## SFR16S/25/25H

In Table 5 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2"; a short description of the test procedure is also given. In some instances deviations from the IEC recommendations were necessary for our method of specifying.

## TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category 55/155/56 (rated temperature range  $-55\text{ }^{\circ}\text{C}$  to  $+155\text{ }^{\circ}\text{C}$ ; damp heat, long term, 56 days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1", subclause 5.3.

**Table 5** Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.16	21 (U)	robustness of terminations:			number of failures $<10 \times 10^{-6}$  number of failures $<10 \times 10^{-6}$  no damage $\Delta R/R$ max.: $\pm 0.25\% + 0.05\ \Omega$		
4.16.2	21 (Ua1)	tensile all samples	$\varnothing 0.45$ mm, load 5 N; 10 s $\varnothing 0.58$ mm, load 10 N; 10 s				
4.16.3	21 (Ub)	bending half number of samples	$\varnothing 0.45$ mm, load 2.5 N; $4 \times 90^{\circ}$ $\varnothing 0.58$ mm, load 5 N; $4 \times 90^{\circ}$				
4.16.4	21 (Uc)	torsion other half of samples	$3 \times 360^{\circ}$ in opposite directions				
4.17	20 (Ta)	solderability	2 s; $235\text{ }^{\circ}\text{C}$ ; flux 600		good tinning; no damage		
4.18	20 (Tb)	resistance to soldering heat	3.5 s; $350\text{ }^{\circ}\text{C}$ ; solder bath method		$\Delta R/R$ max.: $\pm 0.25\% + 0.05\ \Omega$		
4.19	14 (Na)	rapid change of temperature	30 minutes at $-55\text{ }^{\circ}\text{C}$ and 30 minutes at $+155\text{ }^{\circ}\text{C}$ ; 5 cycles		$\Delta R/R$ max.: $\pm 0.25\% + 0.05\ \Omega$		
4.20	29 (Eb)	bump	$3 \times 1500$ bumps in 3 directions; 40 g		no damage $\Delta R/R$ max.: $\pm 0.25\% + 0.05\ \Omega$		
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 hours ( $3 \times 2$ hours)		no damage $\Delta R/R$ max.: $\pm 0.25\% + 0.05\ \Omega$		

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IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.23 4.23.2 4.23.3 4.23.4 4.23.5 4.23.6	2 (Ba) 30 (Db) 1 (Aa) 13 (M) 30 (Db)	climatic sequence: dry heat damp heat (accelerated) 1 <sup>st</sup> cycle cold low air pressure damp heat (accelerated) remaining cycles	16 hours; 155 °C 24 hours; 55 °C; 90 to 100% RH 2 hours; -55 °C 2 hours; 8.5 kPa; 15 to 35 °C 5 days; 55 °C; 95 to 100% RH	R ≤ 1 MΩ R > 1 MΩ	R <sub>ins</sub> min.: 1 000 MΩ  ΔR/R max.: ±1% + 0.05 Ω ΔR/R max.: ±1% + 0.05 Ω      ΔR/R max.: ±2% + 0.1 Ω		
4.24.2	3 (Ca)	damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation 0.01 P <sub>n</sub>		R <sub>ins</sub> min.: 1 000 MΩ ΔR/R max.: ±1% + 0.05 Ω		
4.25.1		endurance	1 000 hours at 70 °C; P <sub>n</sub> or V <sub>max</sub>	R ≤ 1 MΩ R > 1 MΩ	ΔR/R max.: ±1% + 0.05 Ω ΔR/R max.: ±1% + 0.05 Ω      ΔR/R max.: ±2% + 0.1 Ω		
4.8.4		temperature coefficient	between -55 °C and +155 °C (TC × 10 <sup>-6</sup> /K)	R < 4.7 Ω R ≤ 100 kΩ R ≤ 1 MΩ R > 1 MΩ	≤±250 ≤±100 ≤±250 ≤±250	≤±100 ≤±100 ≤±100 ≤±250	≤±100 ≤±100 ≤±100 ≤±250
4.7		voltage proof on insulation	400 V (RMS) ( <b>SFR16S</b> ) or 600 V (RMS) ( <b>SFR25</b> and <b>SFR25H</b> ); during 1 minute; V-block method		no breakdown		
4.12		noise	"IEC publication 60195"	R < 68 kΩ R ≤ 100 kΩ R ≤ 1 MΩ R > 1 MΩ	max. 0.1 μV/V max. 0.5 μV/V max. 1.5 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V	max. 0.1 μV/V max. 0.1 μV/V max. 0.1 μV/V max. 1.5 μV/V
4.6.1		insulation resistance	500 V (DC) during 1 minute; V-block method		R <sub>ins</sub> min.: 1 000 MΩ		

**Standard metal film resistors****SFR16S/25/25H**

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.13		short time overload	room temperature; $P = 6.25 \times P_n$ (SFR25) or $6.25 \times 0.25 W$ (SFR16S); 5 s on, 45 s off ( $V \leq 2 \times V_{max}$ ); 10 cycles		$\Delta R/R$ max.: $\pm 0.25\% + 0.05 \Omega$		$\Delta R/R$ max.: $\pm 1\% + 0.05 \Omega$
		intermittent overload in accordance with "JIS-C5202 5.8"	$16 \times 0.16 W$ ; 1 s on and 25 s off; 10000 $\pm 200$ cycles; $V_{max} = 600 V$		$\Delta R/R$ max.: $\pm 0.75\% + 0.05 \Omega$	–	–
see 2 <sup>nd</sup> amendment to "IEC 60115-1", Jan. '87		pulse load			see Figs 2, 3, 4, 5, 6 and 7		