

DATA SHEET

SFR16S/25/25H
5033E/5043E/5053H
Standard metal film resistors

Product specification
Supersedes data of 31st July 2000
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Standard metal film resistors

SFR16S/25/25H
5033E/5043E/5053H

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 (5033E)	SFR25 (5043E)	SFR25H (5053H)
Resistance range	1 Ω to 3 MΩ	1 Ω to 10 MΩ and jumper (0 Ω)	
Resistance tolerance	±1%; ±5%; E24/E96 series		
Temperature coefficient: R < 4.7 Ω 4.7 Ω ≤ R ≤ 100 kΩ 100 kΩ < R ≤ 1 MΩ R > 1 MΩ	≤±250 × 10 ⁻⁶ /K ≤±100 × 10 ⁻⁶ /K ≤±250 × 10 ⁻⁶ /K ≤±250 × 10 ⁻⁶ /K	≤±100 × 10 ⁻⁶ /K ≤±100 × 10 ⁻⁶ /K ≤±100 × 10 ⁻⁶ /K ≤±250 × 10 ⁻⁶ /K	≤±100 × 10 ⁻⁶ /K ≤±100 × 10 ⁻⁶ /K ≤±100 × 10 ⁻⁶ /K ≤±250 × 10 ⁻⁶ /K
Absolute maximum dissipation at T _{amb} = 70 °C	0.5 W	0.4 W	0.5 W
Thermal resistance, R _{th}	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)	55/155/56		
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 Ordering code indicating resistor type and packaging

TYPE	TOL. (%)	12NC	NAFTA PART NUMBER	TAPING (mm)	SPQ (units)
SFR25 ⁽¹⁾ (SFR55)	±1	2306 181 8....	5043EDxxxxxF12AF5	52	5000; tape & reel
SFR25	±5	2306 181 63...	5043EMxxxxxJ12AFX	52	5000; tape & reel
SFR25 ⁽¹⁾ (SFR55)	±1	2322 188 2....	5043EDxxxxxF5AAF5	52	5000; ammopack
SFR25	±5	2322 181 43...	2322 181 43xxx	52	5000; ammopack
SFR25 jumper ⁽²⁾	–	2306 181 90011	5043EM0R000J12AFX	52	5000; tape & reel
SFR25 jumper ⁽²⁾	–	2322 181 90019	5043EM0R000J18AFX	52	5000; ammopack
SFR25H	±1	2306 186 8....	5053HDxxxxxF12AF5	52	5000; tape & reel
SFR25H	±5	2306 186 63...	5053HMxxxxxJ12AFX	52	5000; tape & reel
SFR25H	±5	2322 186 76...	2322 186 76xxx	52	5000; ammopack
SFR16S	±1	2306 187 1....	5033EDxxxxxF12AF5	52	5000; tape & reel
SFR16S	±5	2306 187 23...	5033EMxxxxxJ12AFX	52.5	5000; tape & reel
SFR16S	±1	2306 187 3....	2306 187 3....	52.5	5000; ammopack
SFR16S	±5	2322 187 53...	2322 187 53...	52.5	5000; ammopack
SFR16S jumper ⁽²⁾	–	2306 187 90013	2306 187 90013	52.5	5000; tape & reel

Notes

1. In North America, the SFR25 1% is also known as SFR55.
2. The jumper has a maximum resistance $R_{\max} = 10 \text{ m}\Omega$ at 5 A.

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Composition of the clear text code (NAFTA P/N)

- The resistors have an ordering code starting with 50
- The subsequent digits indicate the resistor type, temperature coefficient, ohmic value, tolerance and packaging; see Table 1
- The ohmic value is represented by 5 digits; see Table 2
- For temperature coefficient and tolerance, see Table 3.

Table 2 Examples of the ohmic value

OHMIC VALUE	5 DIGIT VALUE
1 Ω	1R000
10 Ω	10R00
100 Ω	100R0
1 k Ω	1K000
10 k Ω	10K00
100 k Ω	100K0
1 M Ω	1M000

Table 3 Letter coding for temperature coefficient and tolerance

TC ($\times 10^{-6}/K$)	LETTER CODE	TOL. (%)	LETTER CODE
200	M	± 5	J
100	D	± 1	F

ORDERING EXAMPLE: CLEAR TEXT CODE

The ordering code of a SFR25 resistor, value 5600 $\Omega \pm 1\%$, taped on a bandolier of 5000 units in tape on reel is: 5043ED5K600F12AF5.

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 4 or 5.

Table 4 Last digit for $\pm 5\%$ tolerance

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

Table 5 Last digit for $\pm 1\%$ tolerance

RESISTANCE DECADE	LAST DIGIT
0.10 to 0.976 Ω	7
1 to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	1
1 to 9.76 k Ω	2
10 to 97.6 k Ω	3
100 to 976 k Ω	4
1 to 9.76 M Ω	5
≥ 10 M Ω	6

ORDERING EXAMPLE: 12NC

The ordering code of a SFR25 resistor, value 5600 $\Omega \pm 5\%$, taped on a bandolier of 5000 units in ammpack is: 2322 181 43562.

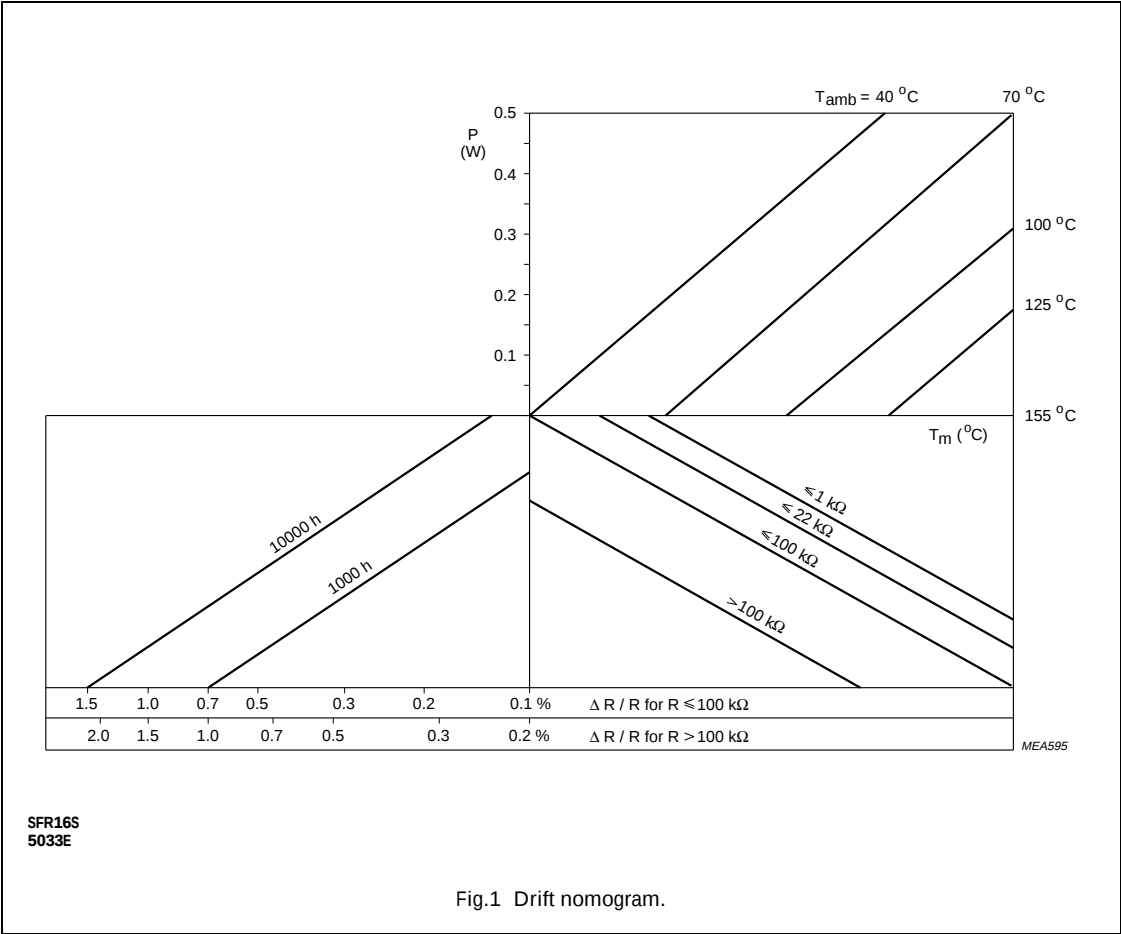
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FUNCTIONAL DESCRIPTION

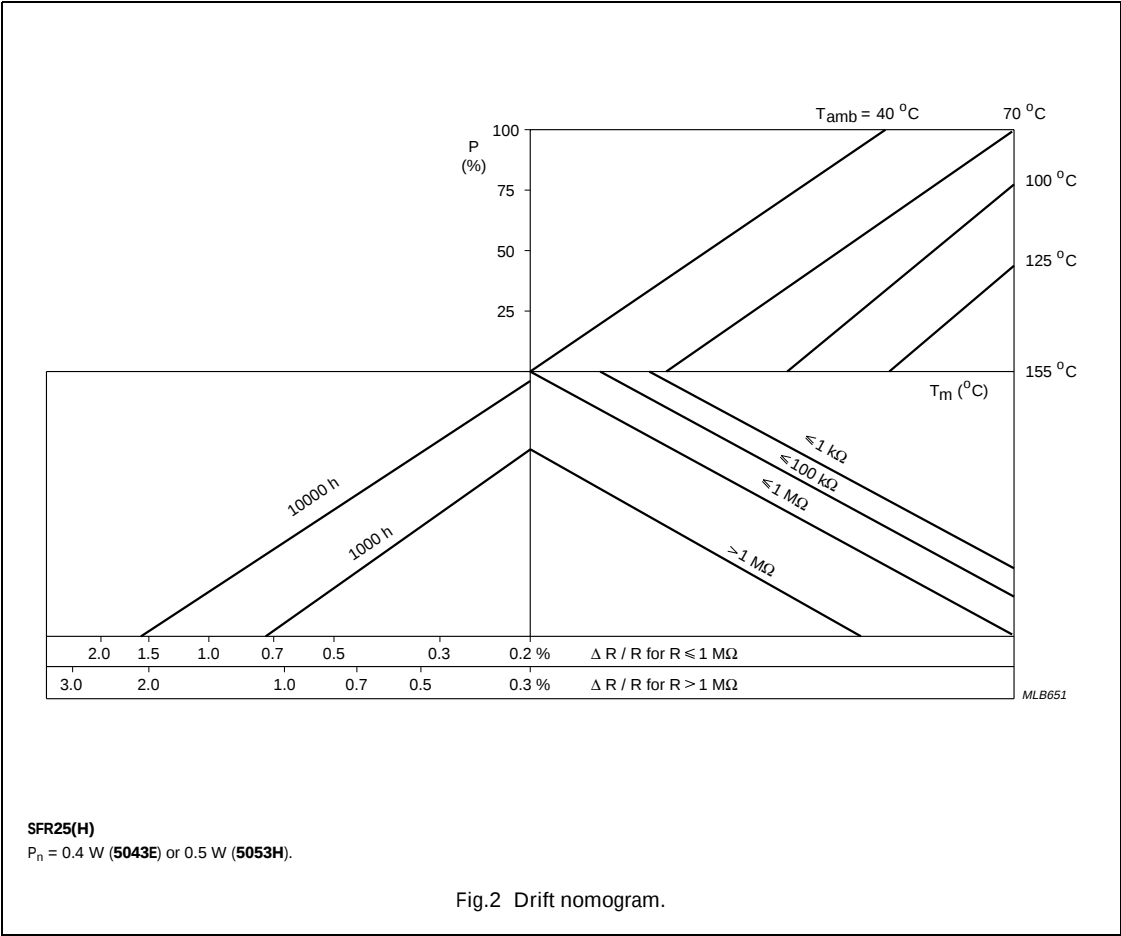
Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of $\pm 5\%$; $\pm 1\%$.
The values of the E24/E96 series are in accordance with “IEC publication 60063”.



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Limiting values

TYPE	LIMITING VOLTAGE ⁽¹⁾ (V)	LIMITING POWER (W)
SFR16S/5033E	200	0.5
SFR25/5043E	250	0.4
SFR25H/5053H	350	0.5

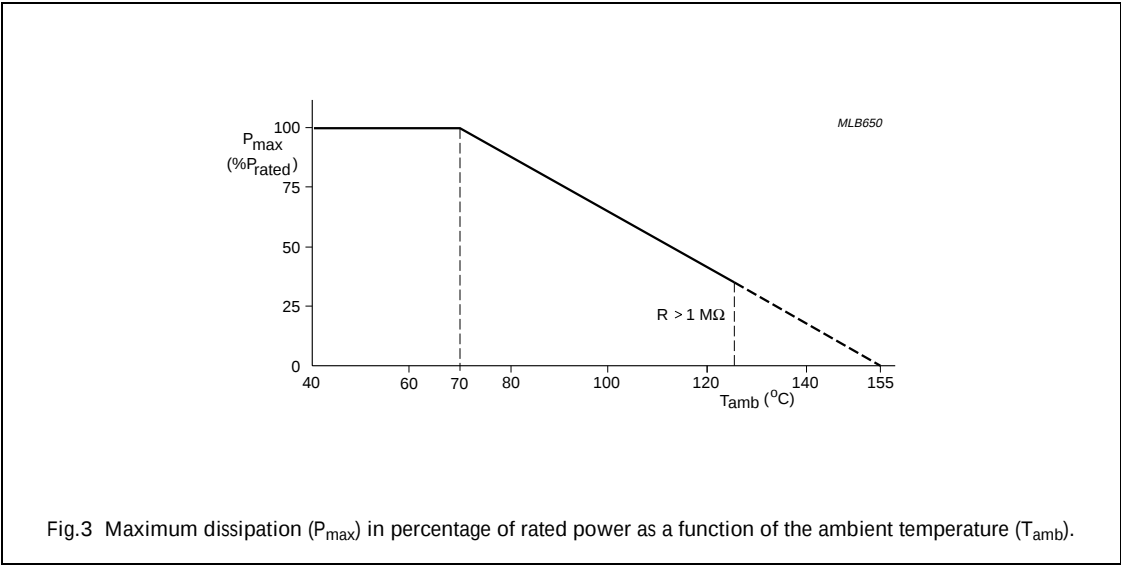
Note

1. 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

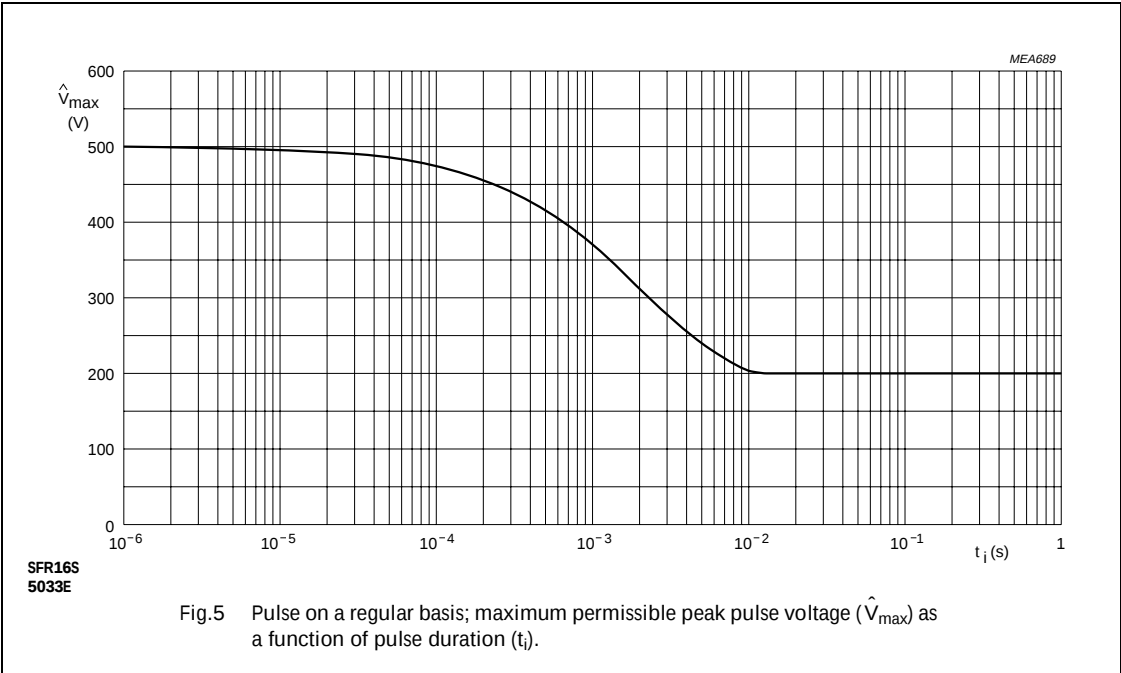
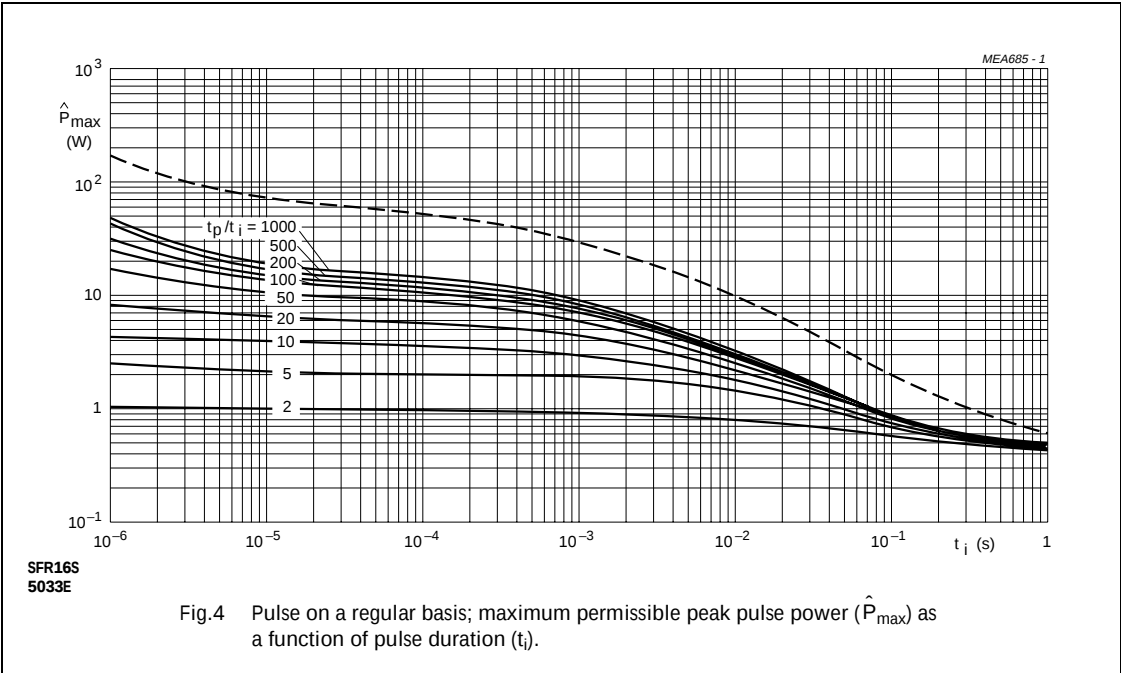
The power that the resistor can dissipate depends on the operating temperature; see Fig.3.



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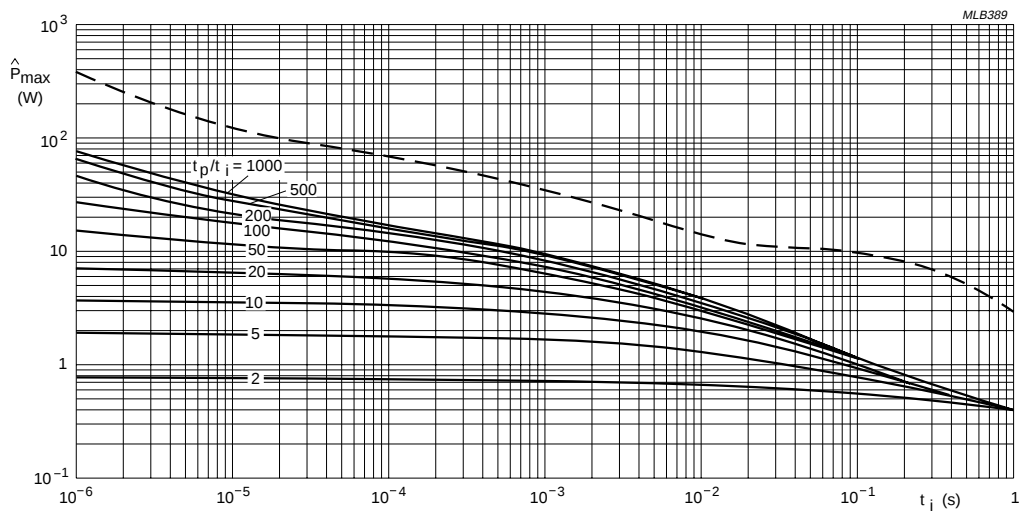
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PULSE LOADING CAPABILITIES



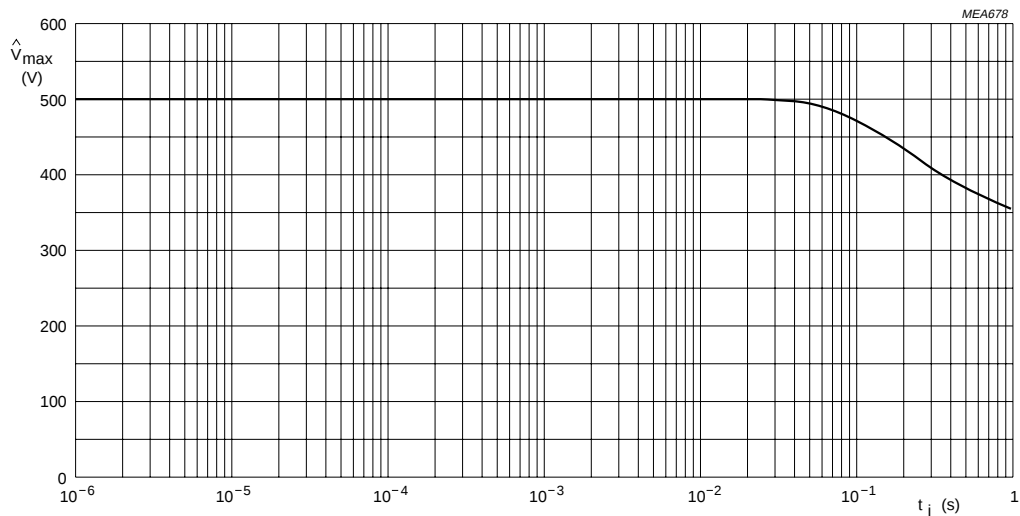
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SFR25
5043E

Fig.6 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).

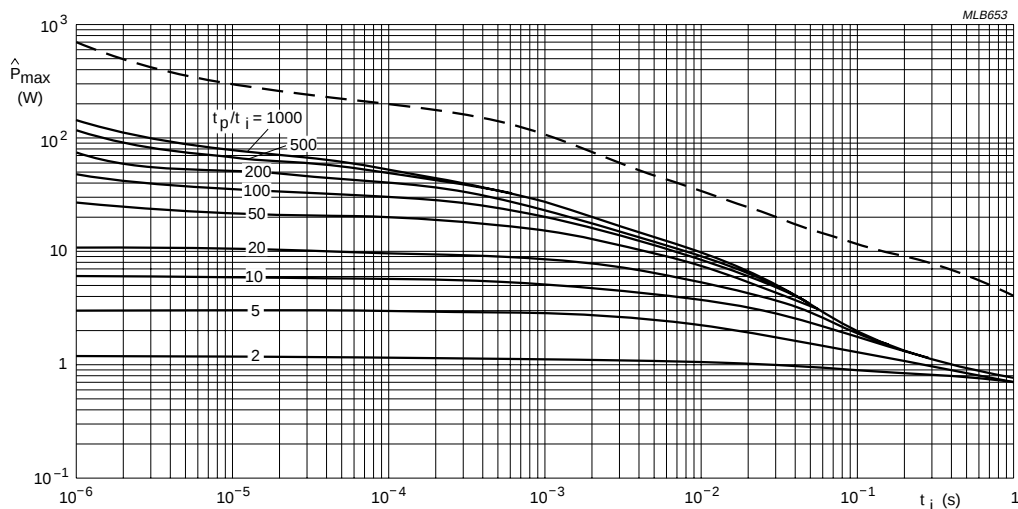


SFR25
5043E

Fig.7 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

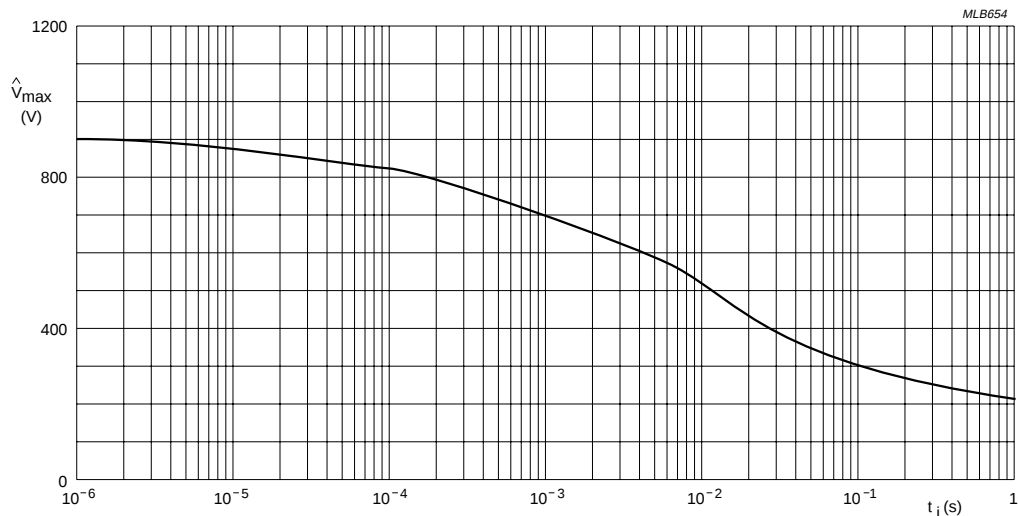
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SFR25H
5053H

Fig.8 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



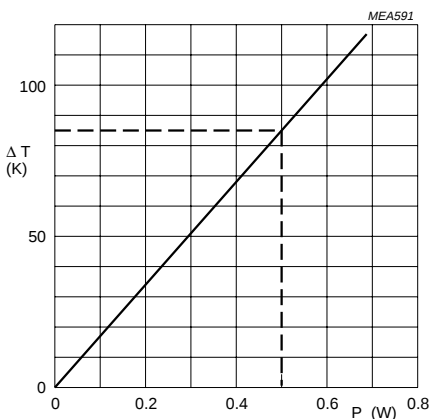
SFR25H
5053H

Fig.9 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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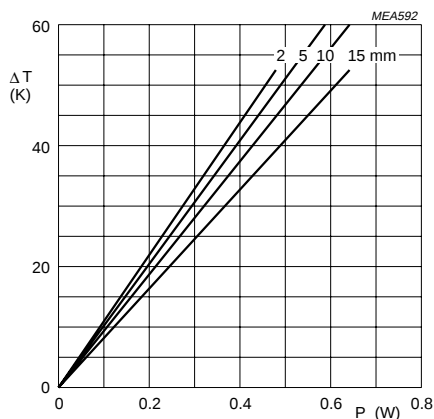
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Application information



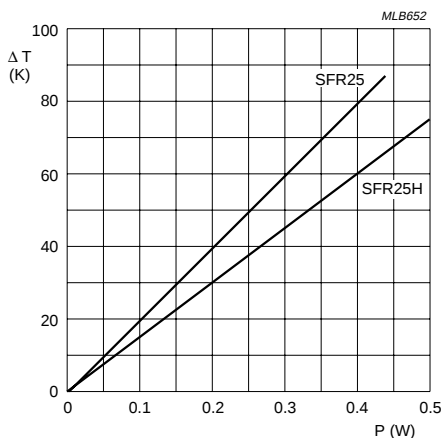
SFR16S
5033E

Fig.10 Hot-spot temperature rise (ΔT) as a function of dissipated power.



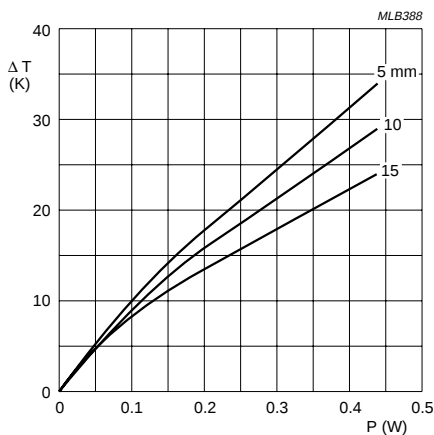
SFR16S
5033E

Fig.11 Temperature rise (ΔT) at the end of the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.



SFR25/SFR25H
5043E/5053H

Fig.12 Hot-spot temperature rise (ΔT) as a function of dissipated power.

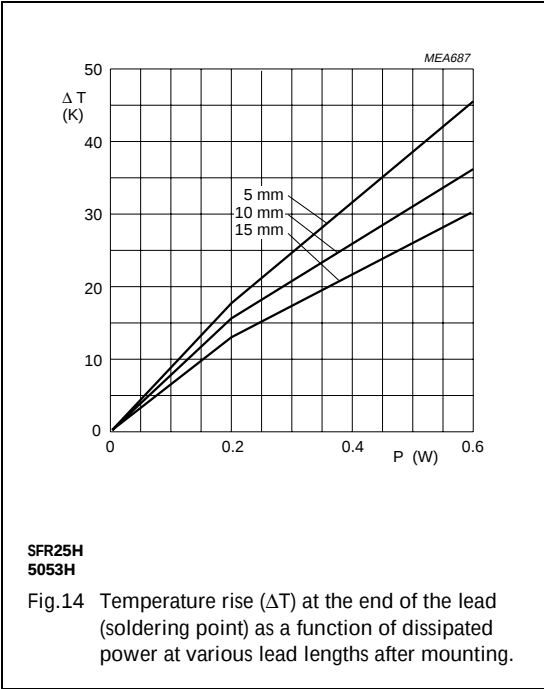


SFR25
5043E

Fig.13 Temperature rise (ΔT) at the end of the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.

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MECHANICAL DATA

Mass per 100 units

TYPE	MASS (g)
SFR16S/5033E	12.5
SFR25/5043E	25

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").

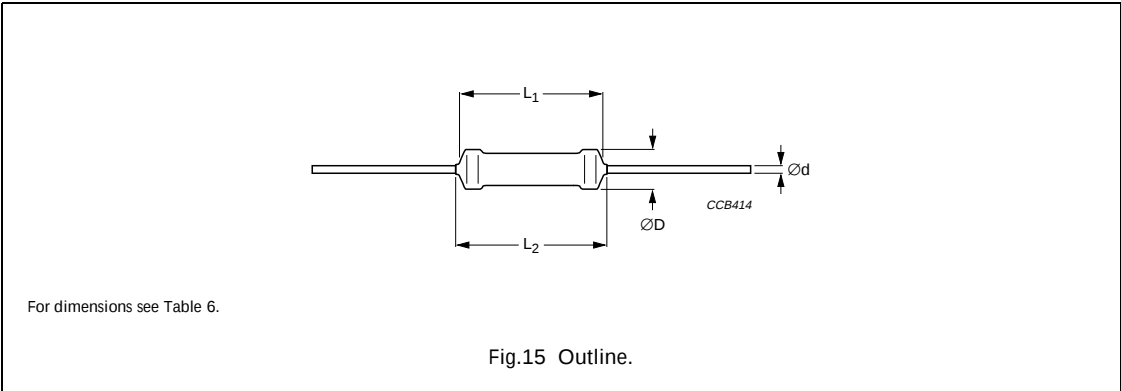


Table 6 Resistor type and relevant physical dimensions; see Fig.15

TYPE	$\varnothing D$ MAX. (mm)	L_1 MAX. (mm)	L_2 MAX. (mm)	$\varnothing d$ (mm)
SFR16S/5033E	1.9	3.2	3.4	0.45 ± 0.05
SFR25/5043E	2.5	6.5	7.0	0.58 ± 0.05
SFR25H/5053H	2.5	6.5	7.0	0.58 ± 0.05

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In Table 7 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 °C to +155 °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 7 Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S (5033E)	SFR25 (5043E)	SFR25H (5053H)
4.16	21 (U)	robustness of terminations:			number of failures $<10 \times 10^{-6}$ number of failures $<10 \times 10^{-6}$ no damage $\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		
4.16.2	21 (Ua1)	tensile all samples	$\varnothing 0.45 \text{ mm}$, load 5 N; 10 s $\varnothing 0.58 \text{ mm}$, load 10 N; 10 s				
4.16.3	21 (Ub)	bending half number of samples	$\varnothing 0.45 \text{ mm}$, load 2.5 N; $4 \times 90^\circ$ $\varnothing 0.58 \text{ mm}$, 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 °C; flux 600		good tinning; no damage		
4.18	20 (Tb)	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body		$\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		
4.19	14 (Na)	rapid change of temperature	30 minutes at –55 °C and 30 minutes at +155 °C; 5 cycles		$\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		
4.20	29 (Eb)	bump	3×1500 bumps in 3 directions; 40 g		no damage $\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		
4.22	6 (Fc)	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 hours (3×2 hours)		no damage $\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		

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IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S (5033E)	SFR25 (5043E)	SFR25H (5053H)
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 st 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 _{ins} min.: 1000 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 _n		R _{ins} min.: 1000 MΩ ΔR/R max.: ±1% + 0.05 Ω		
4.25.1		endurance	1000 hours at 70 °C; P _n or V _{max}	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 ^{–6} /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) (SFR16S) or 600 V (RMS) (SFR25 and SFR25H); 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
4.6.1.1		insulation resistance	500 V (DC) during 1 minute; V-block method		R _{ins} min.: 1000 MΩ		

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IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S (5033E)	SFR25 (5043E)	SFR25H (5053H)
4.13		short time overload	room temperature; $P = 6.25 \times P_n$ (SFR25) or $6.25 \times 0.25 \text{ W}$ (SFR16S); 5 s on, 45 s off ($V \leq 2 \times V_{\max}$); 10 cycles		$\Delta R/R \text{ max.: } \pm 0.25\% + 0.05 \Omega$		$\Delta R/R \text{ max.: } \pm 1\% + 0.05 \Omega$
		intermittent overload in accordance with “JIS-C5202 5.8”	$16 \times 0.16 \text{ W}$; 1 s on and 25 s off; 10000 $\pm$ 200 cycles; $V_{\max} = 600 \text{ V}$		$\Delta R/R \text{ max.: } \pm 0.75\% + 0.05 \Omega$	–	–
see 2 nd amendment to “IEC 60115-1”, Jan. '87		pulse load			see Figs 4, 5, 6, 7, 8 and 9		