

DATA SHEET

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

Product specification
Supersedes data of 31st July 2000
File under BCcomponents, BC08

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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 M Ω | 1 Ω to 10 M Ω and jumper (0 Ω) | |
| Resistance tolerance | $\pm 1\%$; $\pm 5\%$; E24/E96 series | | |
| Temperature coefficient: R < 4.7 Ω 4.7 Ω \leq R \leq 100 k Ω 100 k Ω < R \leq 1 M Ω R > 1 M Ω | $\leq \pm 250 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 250 \times 10^{-6}/K$ $\leq \pm 250 \times 10^{-6}/K$ | $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 250 \times 10^{-6}/K$ | $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 100 \times 10^{-6}/K$ $\leq \pm 250 \times 10^{-6}/K$ |
| 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 k Ω 68 k Ω \leq R \leq 100 k Ω 100 k Ω \leq R \leq 1 M Ω R > 1 M Ω | max. 0.1 $\mu V/V$ max. 0.5 $\mu V/V$ max. 1.5 $\mu V/V$ max. 1.5 $\mu V/V$ | max. 0.1 $\mu V/V$ max. 0.1 $\mu V/V$ max. 0.1 $\mu V/V$ max. 1.5 $\mu V/V$ | max. 0.1 $\mu V/V$ max. 0.1 $\mu V/V$ max. 0.1 $\mu V/V$ max. 1.5 $\mu V/V$ |
| Basic specifications | IEC 60115-1 and 60115-2 | | |
| Climatic category (IEC 60068) | 55/155/56 | | |
| Stability, $\Delta R/R$ max., after: load: R \leq 1 M Ω R > 1 M Ω climatic tests: R \leq 1 M Ω R > 1 M Ω soldering short time overload | $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 0.25\% + 0.05 \Omega$ $\pm 0.25\% + 0.05 \Omega$ | $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 0.25\% + 0.05 \Omega$ $\pm 0.25\% + 0.05 \Omega$ | $\pm 1\% + 0.05 \Omega$ $\pm 2\% + 0.1 \Omega$ $\pm 1\% + 0.05 \Omega$ $\pm 2\% + 0.1 \Omega$ $\pm 0.25\% + 0.05 \Omega$ $\pm 1\% + 0.05 \Omega$ |

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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 | 5 000; tape & reel |
| SFR25 | ±5 | 2306 181 63... | 5043EMxxxxxJ12AFX | 52 | 5 000; tape & reel |
| SFR25 ⁽¹⁾ (SFR55) | ±1 | 2322 188 2.... | 5043EDxxxxxF5AAF5 | 52 | 5 000; ammopack |
| SFR25 | ±5 | 2322 181 43... | 2322 181 43xxx | 52 | 5 000; ammopack |
| SFR25 jumper ⁽²⁾ | – | 2306 181 90011 | 5043EM0R000J12AFX | 52 | 5 000; tape & reel |
| SFR25 jumper ⁽²⁾ | – | 2322 181 90019 | 5043EM0R000J18AFX | 52 | 5 000; ammopack |
| SFR25H | ±1 | 2306 186 8.... | 5053HDxxxxxF12AF5 | 52 | 5 000; tape & reel |
| SFR25H | ±5 | 2306 186 63... | 5053HMxxxxxJ12AFX | 52 | 5 000; tape & reel |
| SFR25H | ±5 | 2322 186 76... | 2322 186 76xxx | 52 | 5 000; ammopack |
| SFR16S | ±1 | 2306 187 1.... | 5033EDxxxxxF12AF5 | 52 | 5 000; tape & reel |
| SFR16S | ±5 | 2306 187 23... | 5033EMxxxxxJ12AFX | 52.5 | 5 000; tape & reel |
| SFR16S | ±1 | 2306 187 3.... | 2306 187 3.... | 52.5 | 5 000; ammopack |
| SFR16S | ±5 | 2322 187 53... | 2322 187 53... | 52.5 | 5 000; ammopack |
| SFR16S jumper ⁽²⁾ | – | 2306 187 90013 | 2306 187 90013 | 52.5 | 5 000; 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 Ω $\pm 1\%$, 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 Ω $\pm 5\%$, 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".

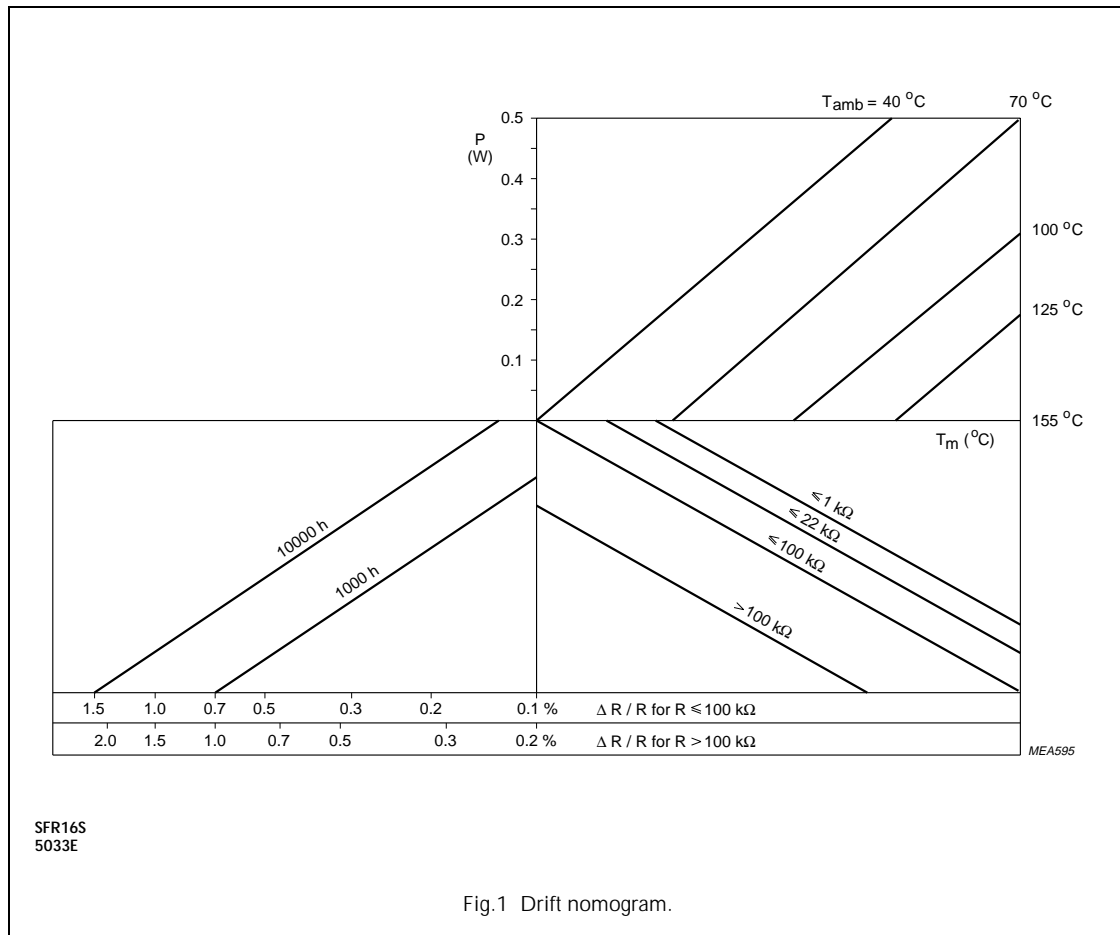
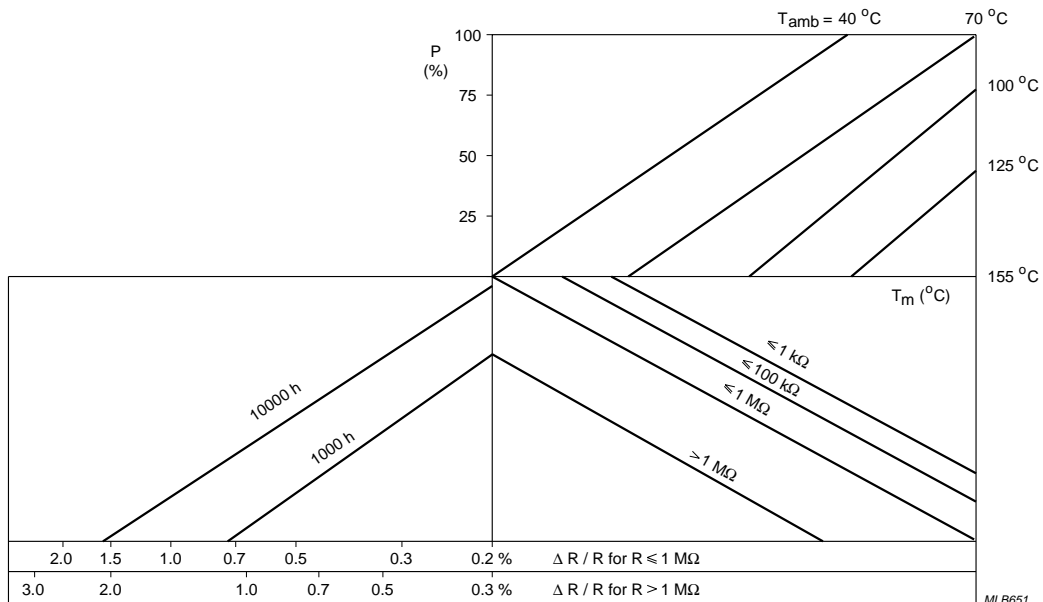


Fig.1 Drift nomogram.

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MLB651

SFR25(H)

P_n = 0.4 W (5043E) or 0.5 W (5053H).

Fig.2 Drift nomogram.

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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

- 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.

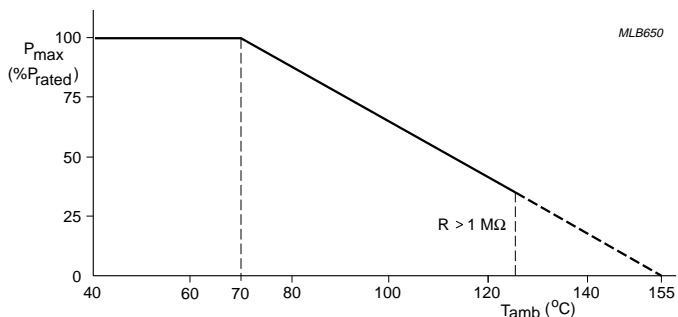
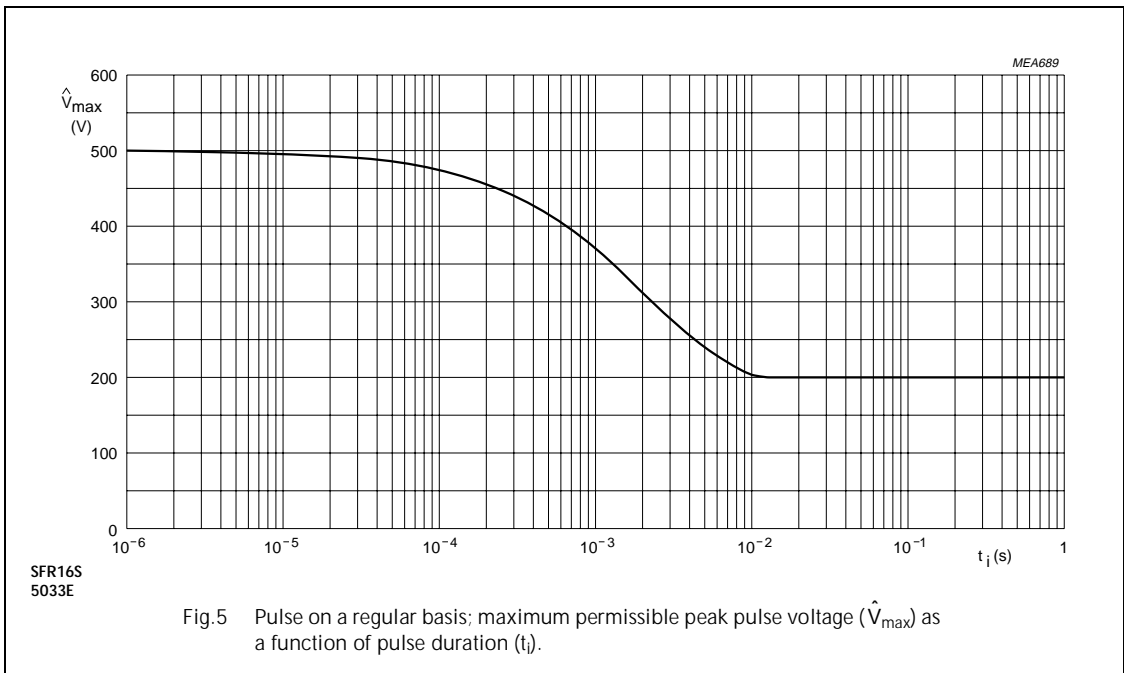
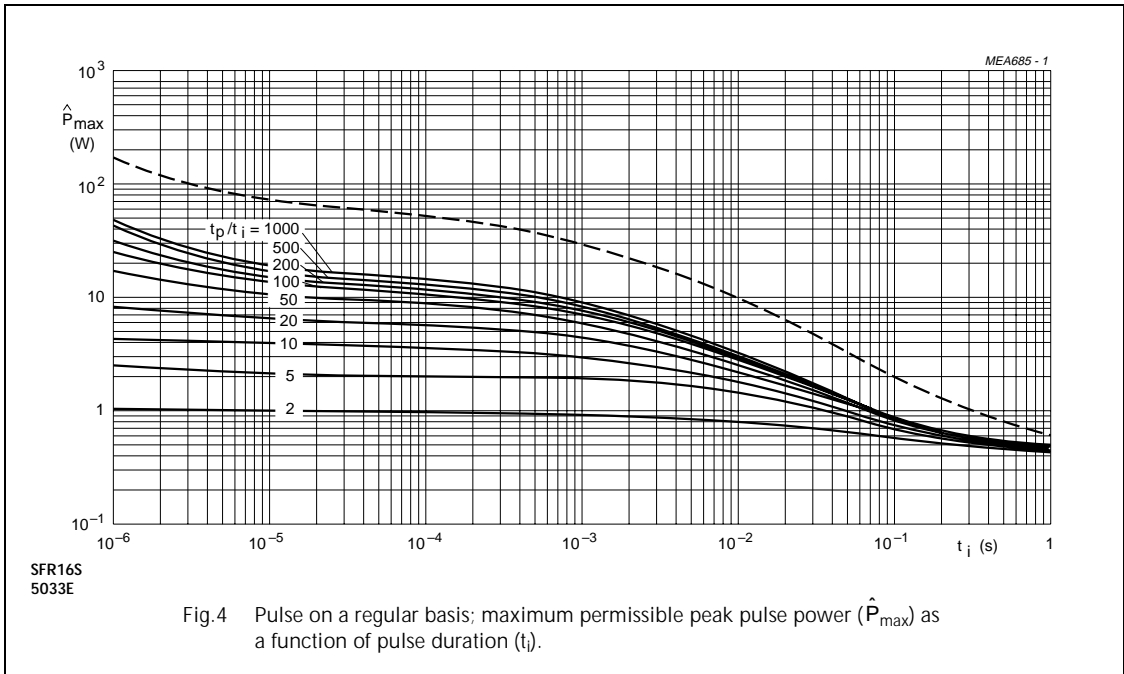


Fig.3 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

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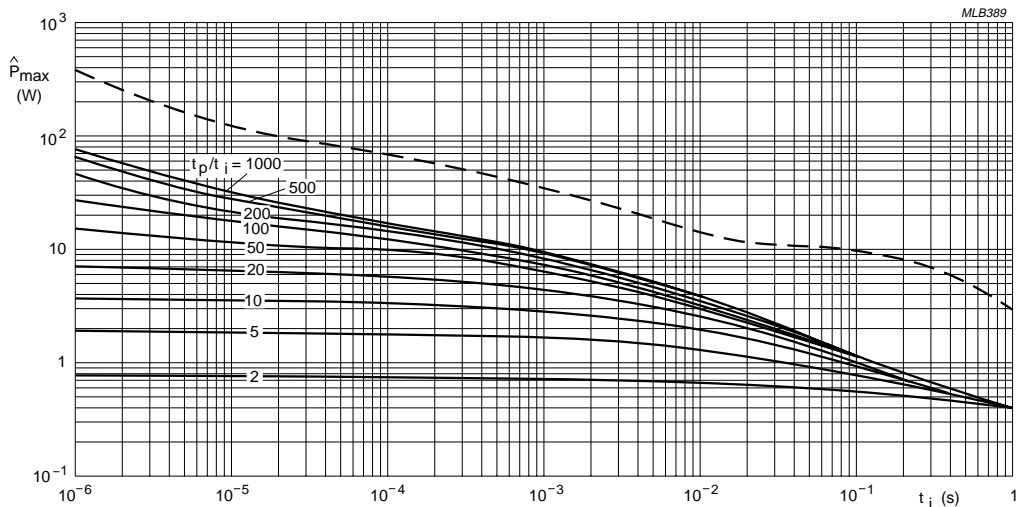
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PULSE LOADING CAPABILITIES



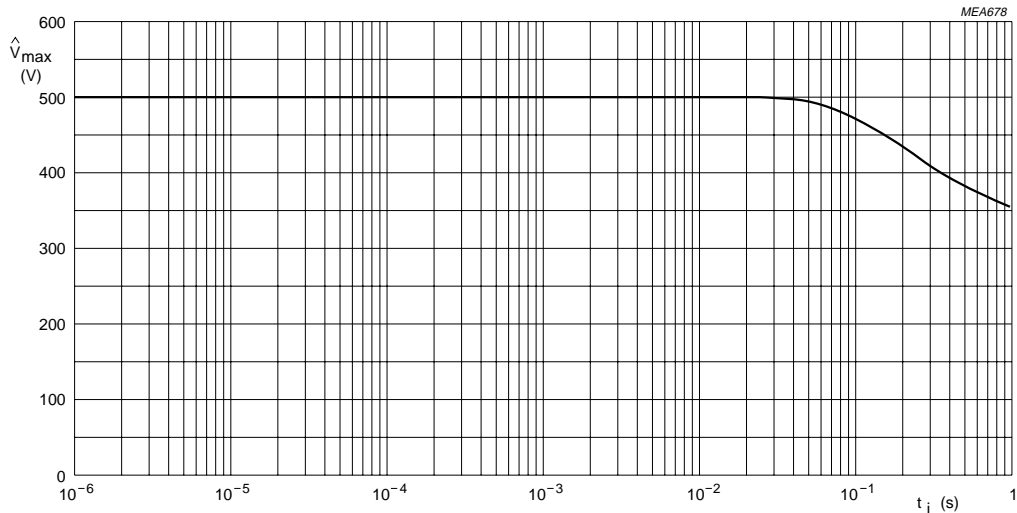
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SFR25
5043E

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

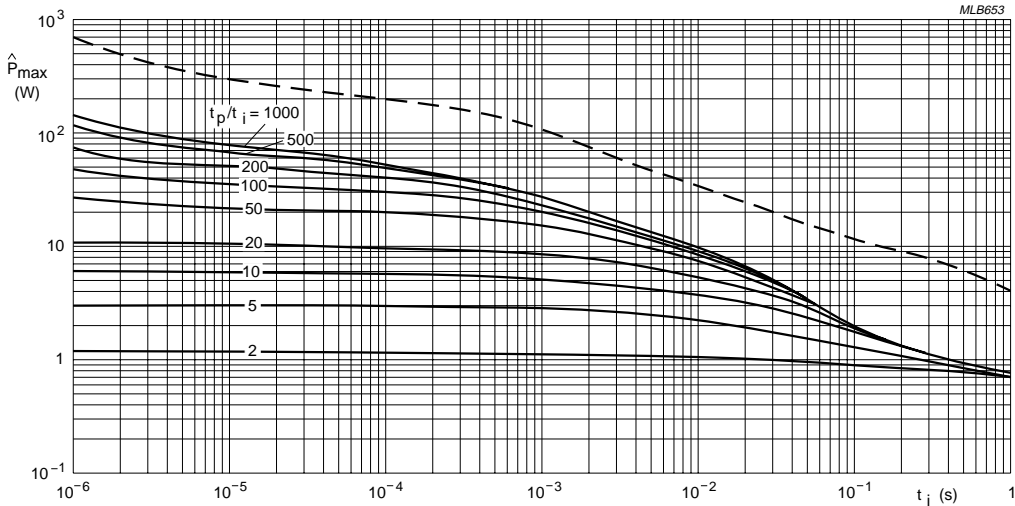


SFR25
5043E

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

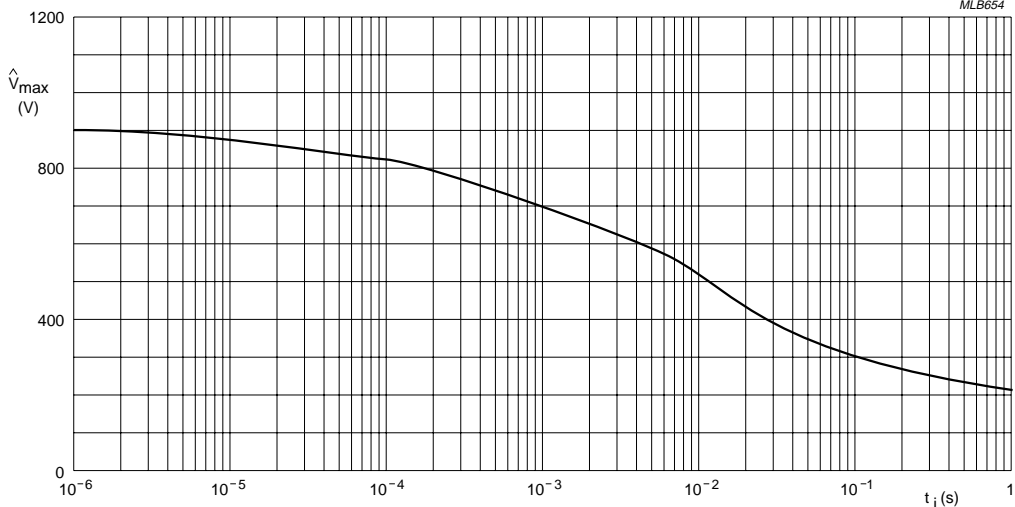
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SFR25H
5053H

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



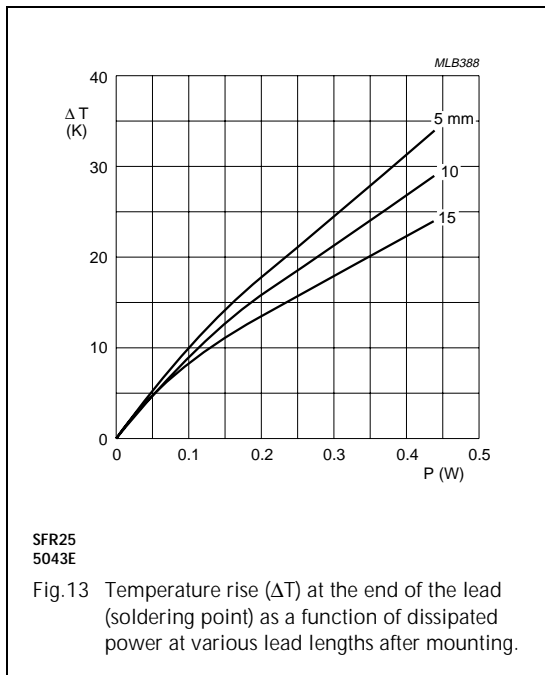
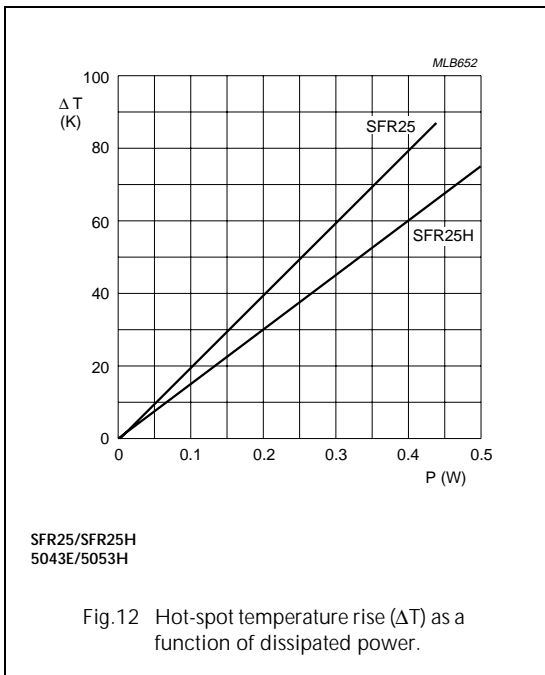
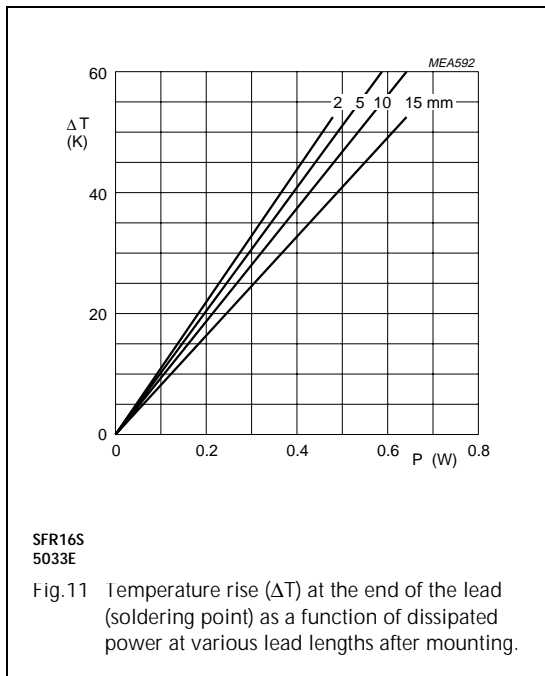
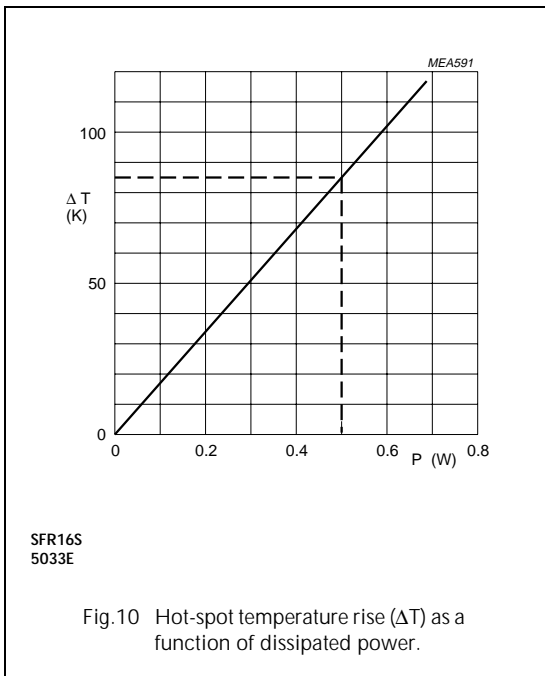
SFR25H
5053H

Fig.9 Pulse on a regular basis; maximum permissible peak pulse voltage (\hat{V}_{max}) as a function of pulse duration (t_i).

Standard metal film resistors

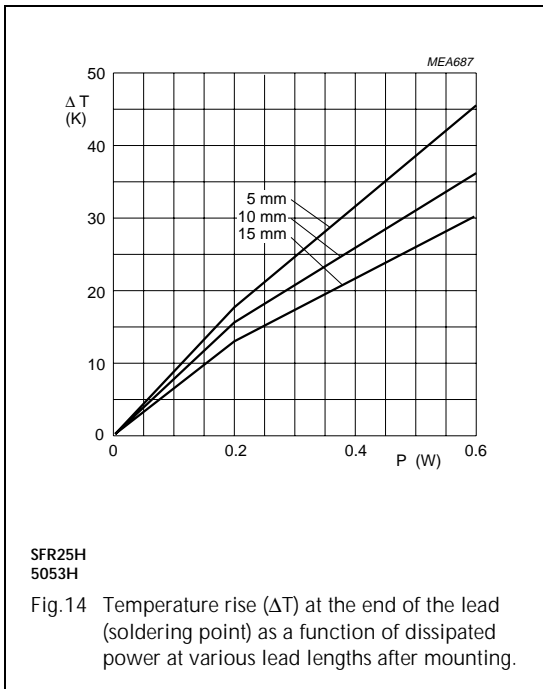
SFR16S/25/25H 5033E/5043E/5053H

Application information



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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").

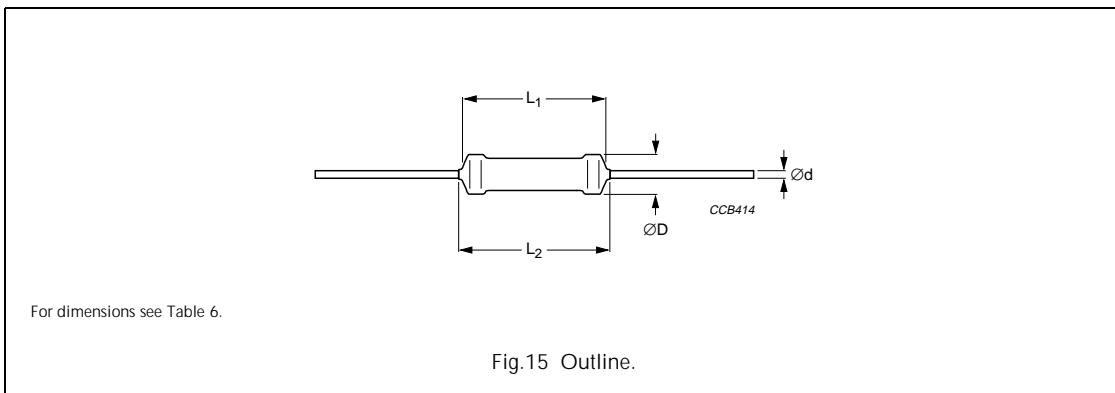


Table 6 Resistor type and relevant physical dimensions; see Fig.15

| 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 $\Delta R/R$ 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 °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 | | $\Delta R/R$ 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 | | $\Delta R/R$ max.: $\pm 0.25\% + 0.05 \Omega$ | | |
| 4.20 | 29 (Eb) | bump | 3×1500 bumps in 3 directions; 40 g | | no damage $\Delta R/R$ 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 $\Delta R/R$ 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 $6.25 \times 0.25 W$ (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" | $16 \times 0.16 W$; 1 s on and 25 s off; 10000 ± 200 cycles; $V_{max} = 600 V$ | | $\Delta R/R \text{ max.: } \pm 0.75\% + 0.05 \Omega$ | – | – |
| see 2 nd amendment to "IEC 60115-1", Jan. '87 | | pulse load | | | see Figs 4, 5, 6, 7, 8 and 9 | | |