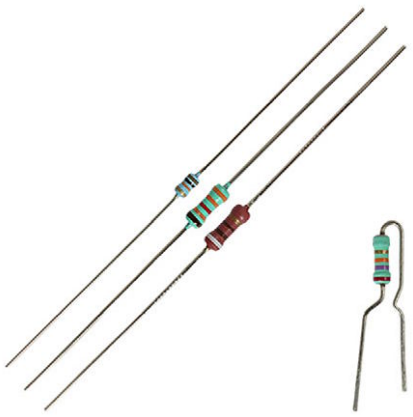
# Standard Metal Film Leaded Resistors



## FEATURES

- Small size (SFR16S: 0204, SFR25 / SFR25H: 0207)
- Low noise (max. 1.5 µV/V for $R > 1$ MΩ)
- Compatible to both lead (Pb)-free and lead containing soldering processes
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE

## APPLICATIONS

- General purpose resistors

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 colored 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 IEC 60068-2-45.

## TECHNICAL SPECIFICATIONS

| DESCRIPTION | SFR16S | SFR25 | SFR25H |
|---|---|---|---|
| DIN size | 0204 | 0207 | 0207 |
| Resistance range | 1 Ω to 3 MΩ; jumper (0 Ω) | 0.22 Ω to 10 MΩ; jumper (0 Ω) | 0.22 Ω to 10 MΩ |
| Resistance tolerance | ± 5 %; ± 1 % | | |
| Temperature coefficient | ± 250 ppm/K; ± 100 ppm/K | | |
| Rated dissipation, $P_{70}$ | 0.5 W | 0.4 W | 0.5 W |
| Thermal resistance | 170 K/W | 200 K/W | 150 K/W |
| Operating voltage, $U_{max.}$ AC/DC | 200 V | 250 V | 350 V |
| Operating temperature range | -55 °C to 155 °C | | |
| Permissible film temperature | 155 °C | | |
| Max. resistance change at rated dissipation $\lvert\Delta R/R$ max.$\rvert$, after 1000 h | ± (2 % $R$ + 0.05 Ω) | | |

**Note**

- $R$ value is measured with probe distance of 24 mm ± 1 mm using 4-terminal method.



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## TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

| TYPE | TOLERANCE | TCR | RESISTANCE | E-SERIES |
|---|---|---|---|---|
| SFR16S | ± 5 % | ± 250 ppm/K | 1 Ω to ≤ 4.7 Ω | E24 |
| | | ± 100 ppm/K | 4.7 Ω to 100 kΩ | |
| | | ± 250 ppm/K | > 100 kΩ to 3 MΩ | |
| | ± 1 % | ± 100 ppm/K | 5.6 Ω to 100 kΩ | E24; E96 |
| | | ± 250 ppm/K | > 100 kΩ to 976 kΩ | |
| | Jumper (0 Ω) | - | ≤ 30 mΩ; $I_{max.}$ = 3 A | - |
| SFR25, SFR25H | ± 5 % | ± 250 ppm/K | 0.22 Ω to 4.7 Ω | E24 |
| | | ± 100 ppm/K | > 4.7 Ω to 1 MΩ | |
| | | ± 250 ppm/K | > 1 MΩ to 10 MΩ | |
| | ± 1 % | ± 250 ppm/K | 1 Ω to 4.7 Ω | E24; E96 |
| | | ± 100 ppm/K | > 4.7 Ω to 1 MΩ | |
| | | ± 250 ppm/K | > 1 MΩ to 10 MΩ | |
| | Jumper (0 Ω) (1) | - | ≤ 30 mΩ; $I_{max.}$ = 5 A | - |

**Note**

(1) Jumper is only available for SFR25.

## PART NUMBER AND PRODUCT DESCRIPTION

**PART NUMBER: SFR2500001001FA500**

| S | F | R | 2 | 5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | F | A | 5 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| TYPE | VARIANT | TCR/MATERIAL | RESISTANCE | TOLERANCE | PACKAGING | SPECIAL |
|---|---|---|---|---|---|---|
| **SFR16S0**<br>**SFR2500**<br>**SFR25H0** | **0** = neutral<br>**Z** = value overflow (special) | **0** = standard<br>**Z** = jumper | **3 digit value**<br>**1 digit multiplier**<br>MULTIPLIER<br>**7** = $*10^{-3}$ **2** = $*10^{2}$<br>**8** = $*10^{-2}$ **3** = $*10^{3}$<br>**9** = $*10^{-1}$ **4** = $*10^{4}$<br>**0** = $*10^{0}$ **5** = $*10^{5}$<br>**1** = $*10^{1}$ **Z** = 0000 | **F** = ± 1 %<br>**J** = ± 5 %<br>**Z** = jumper | **N4**<br>**A5**<br>**A1**<br>**R5** | The 2 digits are used for all special parts.<br>**00** = standard |

**PRODUCT DESCRIPTION: SFR25 1 % A5 1K0**

| SFR25 | 1 % | A5 | 1K0 |
|---|---|---|---|
| TYPE | TOLERANCE | PACKAGING (1) | RESISTANCE VALUE |
| **SFR16S**<br>**SFR25**<br>**SFR25H** | **± 1 %**<br>**± 5 %** | **N4**<br>**A5**<br>**A1**<br>**R5** | **47K** = 47 kΩ<br>**51R1** = 51.1 Ω |

**Notes**

- The products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER.

(1) N4 packaging indicates SFR25 and SFR25H radial version.



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| PACKAGING | | | | | | |
|---|---|---|---|---|---|---|
| TYPE | CODE | QUANTITY | PACKAGING STYLE | WIDTH | PITCH | DIMENSIONS |
| SFR16S | A5 | 5000 | Taped acc. to IEC 60286-1 fan-folded in a box | 52 mm | 5 mm | 75 mm x 73 mm x 270 mm |
| | R5 | 5000 | Taped acc. to IEC 60286-1 on a reel | | | 92 mm x 278 mm x 278 mm |
| | A1 (1) | 1000 | Taped acc. to IEC 60286-1 fan-folded in a box | | | 75 mm x 28 mm x 262 mm |
| SFR25, SFR25H | A5 | 5000 | Taped acc. to IEC 60286-1 fan-folded in a box | 52 mm | 5 mm | 75 mm x 98 mm x 270 mm |
| | R5 | 5000 | Taped acc. to IEC 60286-1 on a reel | | | 93 mm x 300 mm x 298 mm |
| | A1 (1) | 1000 | Taped acc. to IEC 60286-1 fan-folded in a box | | | 75 mm x 28 mm x 262 mm |
| | N4 (2) | 4000 | Taped acc. to IEC 60286-2 fan-folded in a box | - | 12.7 mm | 45 mm x 262 mm x 330 mm |

**Notes**

(1) A1 packaging only available for resistors with ± 5 % tolerance.

(2) N4 packaging only available for SFR25 and SFR25H radial version.

## MARKING

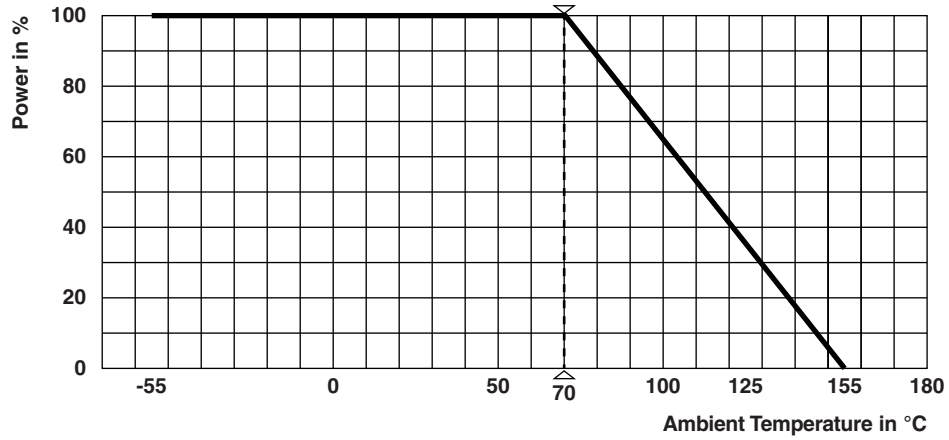
The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC 60062, marking codes for resistors and capacitors.



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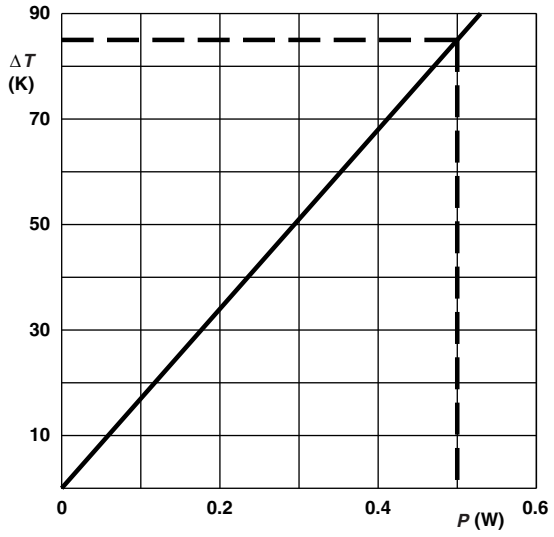
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## FUNCTIONAL PERFORMANCE

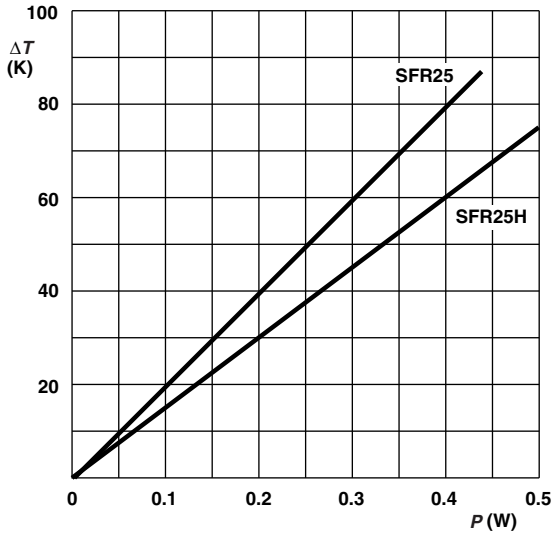



### Derating

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




SFR16S Hot-spot temperature rise ($\Delta T$) as a function of dissipated power

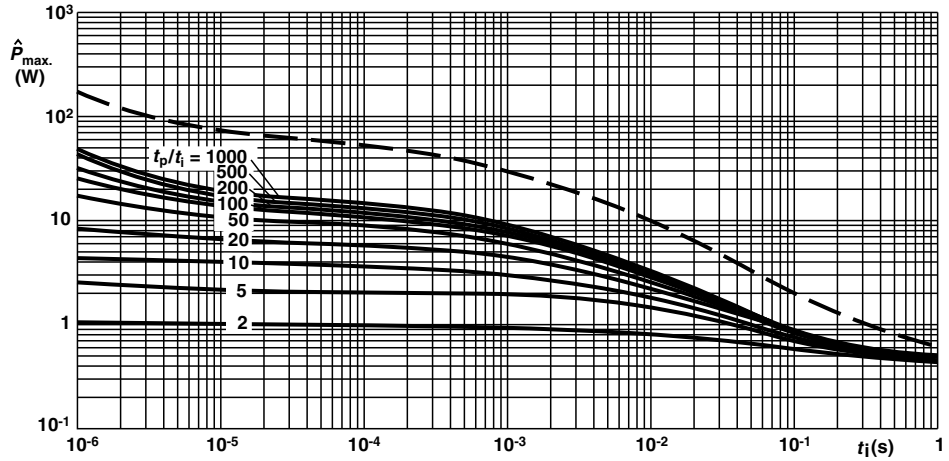



SFR25/SFR25H Hot-spot temperature rise ($\Delta T$) as a function of dissipated power

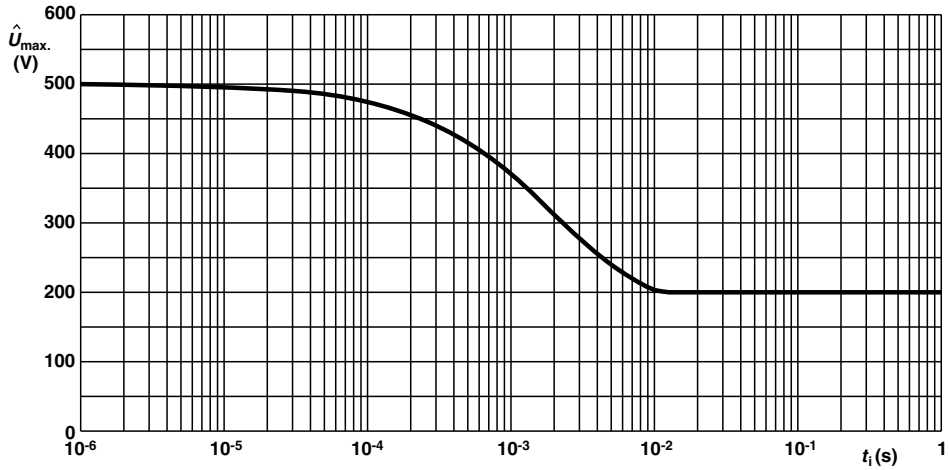
**Note**

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

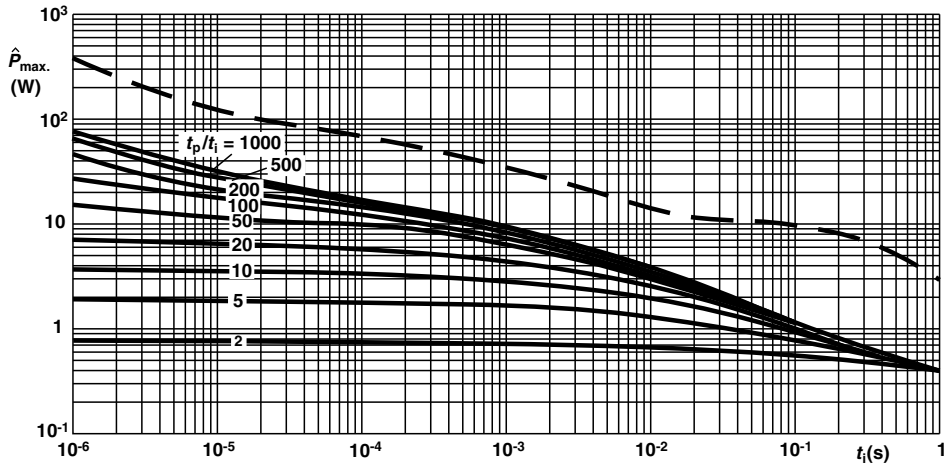

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SFR16S Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration ($t_i$)

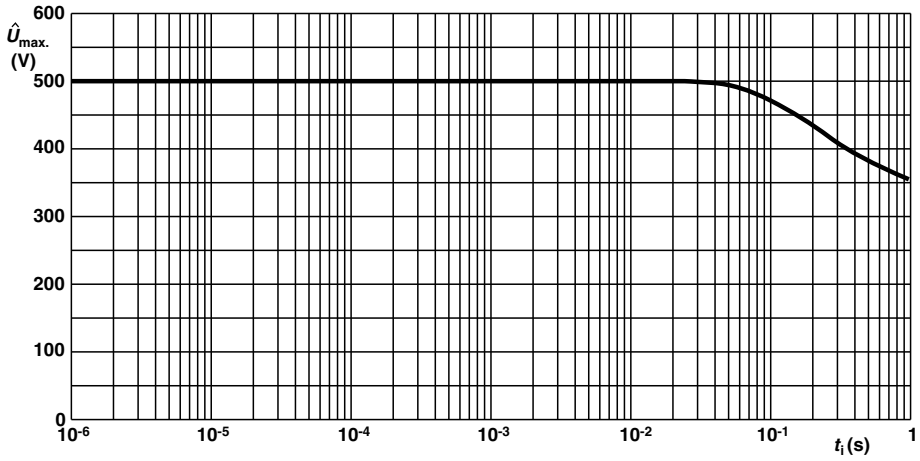



SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration ($t_i$)

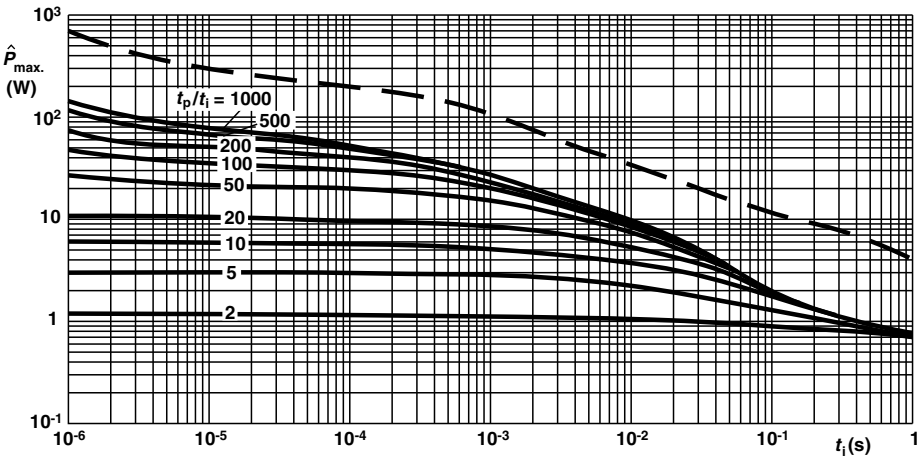



SFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration ($t_i$)

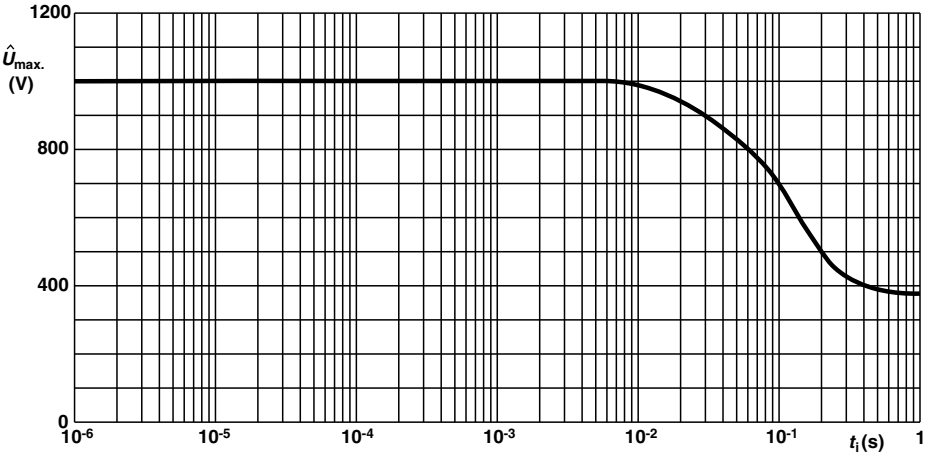

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SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration ($t_i$)




SFR25H Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration ($t_i$)




SFR25H Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration ($t_i$)


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## TESTS PROCEDURES AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

- EN 60115-1, generic specification (includes tests)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents listed above.

The tests are carried out in accordance with IEC 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3.

Unless otherwise specified the following values apply:

- Temperature: 15 °C to 35 °C
- Relative humidity: 45 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 4.31. In test procedures and requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. A short description of the test procedure is also given.

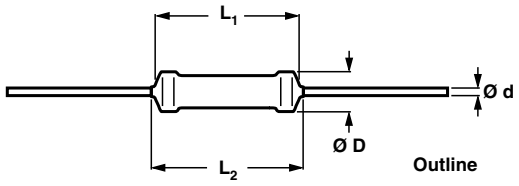
**TEST PROCEDURES AND REQUIREMENTS**

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$) | | | | |
|---|---|---|---|---|---|---|---|---|
| 4.5 | - | Resistance | - | ± 5 %; ± 1 % | | | | |
| 4.8 | - | Temperature coefficient | At (20 / -55 / 20) °C and (20 / 155 / 20) °C | ± 250 ppm/K; ± 100 ppm/K | | | | |
| 4.12 | - | Noise | IEC 60195 | | < 68 kΩ | 68 kΩ to 100 kΩ | > 100 kΩ to 1 MΩ | > 1 MΩ |
| | | | | **SFR16S** | ≤ 0.1 µV/V | ≤ 0.5 µV/V | ≤ 1.5 µV/V | ≤ 1.5 µV/V |
| | | | | **SFR25, SFR25H** | ≤ 0.1 µV/V | ≤ 0.1 µV/V | ≤ 0.1 µV/V | ≤ 1.5 µV/V |
| 4.13 | - | Short time overload | Room temperature; $P = 6.25 \times P_n$; (voltage not more than 2 x limiting voltage); 5 s | ± (0.25 % $R$ + 0.05 Ω) | | | | |
| 4.16 | 21 (Ua1)<br>21 (Ub)<br>21 (Uc) | Robustness of terminations | Tensile, bending, and torsion | ± (0.25 % $R$ + 0.05 Ω) | | | | |
| 4.17 | 20 (Ta) | Solderability | at +235 °C; 2 s; solder bath method; SnPb40<br>at +245 °C; 3 s; solder bath method; SnAg3Cu0.5 | Good tinning (≥ 95 % covered); no damage | | | | |
| 4.18 | 20 (Tb) | Resistance to soldering heat | Unmounted components (260 ± 5) °C; (10 ± 1) s | ± (0.25 % $R$ + 0.05 Ω) | | | | |
| 4.19 | 14 (Na) | Rapid change of temperature | 30 min at -55 °C and 30 min at +155 °C; 5 cycles | ± (0.25 % $R$ + 0.05 Ω) | | | | |
| 4.20 | 29 (Eb) | Bump | 3 x 1500 bumps in 3 directions; 40 g | ± (0.25 % $R$ + 0.05 Ω); no damage | | | | |
| 4.22 | 6 (Fc) | Vibration | 10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s$^2$ | ± (0.25 % $R$ + 0.05 Ω); no damage | | | | |
| 4.23 | | Climatic sequence: | | | | | | |
| 4.23.2 | 2 (Ba) | Dry heat | 155 °C; 16 h | | | | | |
| 4.23.3 | 30 (Db) | Damp heat, cyclic | 55 °C; 24 h; 90 % to 100 % RH; 1 cycle | | | | | |
| 4.23.4 | 1 (Aa) | Cold | -55 °C; 2 h | | | | | |
| 4.23.5 | 13 (M) | Low air pressure | 8.5 kPa; 2 h; 15 °C to 35 °C | | | | | |
| 4.23.6 | 30 (Db) | Damp heat, cyclic | 55 °C; 5 days; 95 % to 100 % RH; 5 cycles | **SFR16S, SFR25, SFR25H** | ± (1 % $R$ + 0.05 Ω); no visible damage<br>± (1 % $R$ + 0.05 Ω); no visible damage | | | |
| 4.23.7 | | DC load | apply rated power for 1 min | | ± 2 % R; no visible damage | | | |


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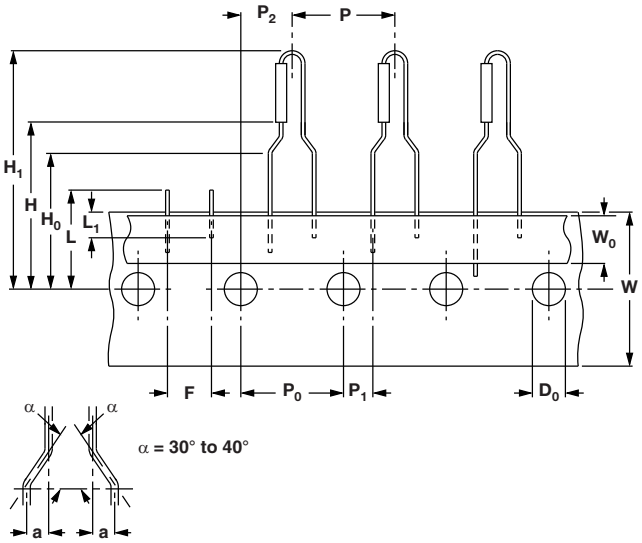
| TEST PROCEDURES AND REQUIREMENTS | | | | |
|---|---|---|---|---|
| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$) |
| 4.24 | 78 (Cab) | Damp heat (steady state) | (40 ± 2) °C; 56 days; (93 ± 3) % RH | ± (2 % $R$ + 0.05 Ω) |
| 4.25.1 | | Endurance (at 70 °C) | $U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; 1.5 h on; 0.5 h off 70 °C; 1000 h | ± (2 % $R$ + 0.05 Ω) |

## DIMENSIONS




| DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions | | | | | |
|---|---|---|---|---|---|
| TYPE | Ø $D_{max.}$ (mm) | $L_{1\ max.}$ (mm) | $L_{2\ max.}$ (mm) | Ø d (mm) | MASS (mg) |
| SFR16S | 1.9 | 3.5 | 4.1 | 0.45 ± 0.05 | 102 |
| SFR25 | 2.5 | 6.5 | 7.5 | 0.58 ± 0.05 | 205 |
| SFR25H | 2.5 | 6.5 | 7.5 | 0.58 ± 0.05 | 205 |

## SFR25, SFR25H WITH RADIAL TAPING




| DIMENSIONS in millimeters | | |
|---|---|---|
| Pitch of components | P | 12.7 ± 1.0 |
| Feed-hole pitch | $P_0$ | 12.7 ± 0.2 |
| Feed-hole center to lead at topside at the tape | $P_1$ | 3.85 ± 0.5 |
| Feed-hole center to body center | $P_2$ | 6.35 ± 1.0 |
| Lead-to-lead distance | F | 4.8 + 0.7 / - 0 |
| Tape width | W | 18.0 ± 0.5 |
| Minimum hold down tape width | $W_0$ | 5.5 |
| Maximum component height | H1 | 29 |
| Lead wire clinch height | $H_0$ | 16.5 ± 0.5 |
| Height of component from tape center | H | 19.5 ± 1 |
| Feed-hole diameter | $D_0$ | 4.0 ± 0.2 |
| Maximum length of snipped lead | L | 11.0 |
| Minimum lead wire (tape portion) shortest lead | $L_1$ | 2.5 |

**Note**

- Please refer to document “Packaging” for more detail (www.vishay.com/doc?28721).


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## HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 23.
- The subsequent 6 digits for 1 % or 7 digits for 5 % indicated the resistor type and packaging.
- The remaining digits indicated the resistance value:
  - The first 3 digits for 1 % or 2 digits for 5 % indicated the resistance value.
  - The last digit indicated the resistance decade.

### Resistance Decade for ± 5 % Tolerance

| RESISTANCE DECADE | LAST DIGIT |
|---|---|
| 0.10 Ω to 0.91 Ω | 7 |
| 1 Ω to 9.1 Ω | 8 |
| 10 Ω o 91 Ω | 9 |
| 100 Ω to 910 Ω | 1 |
| 1 kΩ to 9.1 kΩ | 2 |
| 10 kΩ to 91 kΩ | 3 |
| 100 kΩ to 910 kΩ | 4 |
| 1 MΩ to 9.1 MΩ | 5 |
| = 10 MΩ | 6 |

### Resistance Decade for ± 1 % Tolerance

| RESISTANCE DECADE | LAST DIGIT |
|---|---|
| 1 Ω to 9.76 Ω | 8 |
| 10 Ω to 97.6 Ω | 9 |
| 100 Ω to 976 Ω | 1 |
| 1 kΩ to 9.76 kΩ | 2 |
| 10 kΩ to 97.6 kΩ | 3 |
| 100 kΩ to 976 kΩ | 4 |
| 1 MΩ to 9.76 MΩ | 5 |
| = 10 MΩ | 6 |

### 12NC Example

The 12NC of a SFR25 resistor, value 5600 Ω ± 5 %, taped on a bandolier of 5000 units in ammopack was:
2322 181 43562.

**HISTORICAL 12NC** - Resistor type and packaging

| TYPE | TOL. | 23.. ... ..... | | | |
|---|---|---|---|---|---|
| | | BANDOLIER IN AMMOPACK | | | BANDOLIER ON REEL |
| | | RADIAL TAPED | STRAIGHT LEADS | | STRAIGHT LEADS |
| | | 4000 UNITS | 1000 UNITS | 5000 UNITS | 5000 UNITS |
| SFR16S | ± 5 % | - | ..22 187 73... | ..22 187 53... | ..06 187 23... |
| | ± 1 % | - | - | ..06 187 3... | ..06 187 1.... |
| | Jumper | - | - | ..06 187 90013 | ..22 187 90346 |
| SFR25 | ± 5 % | ..06 184 03... | ..22 181 53... | ..22 181 43... | ..22 181 63... |
| | ± 1 % | - | - | ..22 188 2... | ..06 181 8.... |
| | Jumper | - | ..22 181 90018 | ..22 181 90019 | ..06 181 90011 |
| SFR25H | ± 5 % | ..06 186 03... | ..22 186 16... | ..22 186 76... | ..06 186 63... |
| | ± 1 % | - | - | ..22 186 3.... | ..06 186 8.... |


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