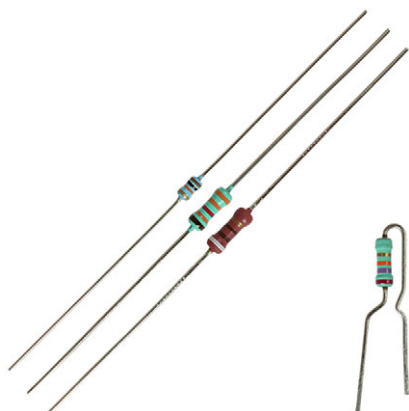


## Standard Metal Film Leaded Resistors



### FEATURES

- Small size (SFR16S: 0204, SFR25 / SFR25H: 0207)
- Low noise (max. 1.5  $\mu\text{V/V}$  for  $R > 1 \text{ M}\Omega$ )
- Compatible to both lead (Pb)-free and lead containing soldering processes
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**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                                                               | 10 $\Omega$ to 3 M $\Omega$                                       | 1.0 $\Omega$ to 10 M $\Omega$ | 1.0 $\Omega$ to 10 M $\Omega$ |
| Resistance tolerance                                                           | $\pm 5 \%$ ; $\pm 1 \%$                                           |                               |                               |
| Temperature coefficient                                                        | $\pm 250 \text{ ppm/K}$ ; $\pm 100 \text{ ppm/K}$                 |                               |                               |
| 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, $U_{\text{max}}$ AC/DC                                      | 200 V                                                             | 250 V                         | 350 V                         |
| Operating temperature range                                                    | $-55 \text{ }^{\circ}\text{C}$ to $+155 \text{ }^{\circ}\text{C}$ |                               |                               |
| Permissible film temperature                                                   | 155 $^{\circ}\text{C}$                                            |                               |                               |
| Max. resistance change at rated dissipation [ $\Delta R/R$ max.], after 1000 h | $\pm (2 \% R + 0.05 \Omega)$                                      |                               |                               |

### Note

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

**TEMPERATURE COEFFICIENT AND RESISTANCE RANGE**

| TYPE          | TOLERANCE | TCR             | RESISTANCE                         | E-SERIES |
|---------------|-----------|-----------------|------------------------------------|----------|
| SFR16S        | $\pm 5\%$ | $\pm 100$ ppm/K | 10 $\Omega$ to 100 k $\Omega$      | E24      |
|               |           | $\pm 250$ ppm/K | > 100 k $\Omega$ to 3 M $\Omega$   |          |
|               | $\pm 1\%$ | $\pm 100$ ppm/K | 100 $\Omega$ to 100 k $\Omega$     | E24; E96 |
|               |           | $\pm 250$ ppm/K | > 100 k $\Omega$ to 976 k $\Omega$ |          |
| SFR25, SFR25H | $\pm 5\%$ | $\pm 250$ ppm/K | 1.0 $\Omega$ to 4.7 $\Omega$       | E24      |
|               |           | $\pm 100$ ppm/K | > 4.7 $\Omega$ to 1 M $\Omega$     |          |
|               |           | $\pm 250$ ppm/K | > 1 M $\Omega$ to 10 M $\Omega$    |          |
|               | $\pm 1\%$ | $\pm 100$ ppm/K | 10 $\Omega$ to 1 M $\Omega$        | E24; E96 |

**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                | 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 114 mm x 260 mm |
|               | R5                | 5000     | Taped acc. to IEC 60286-1 on a reel           |       |         | 93 mm x 300 mm x 298 mm |
|               | A1                | 1000     | Taped acc. to IEC 60286-1 fan-folded in a box |       |         | 78 mm x 31 mm x 260 mm  |
|               | N4 <sup>(1)</sup> | 4000     | Taped acc. to IEC 60286-2 fan-folded in a box | -     | 12.7 mm | 45 mm x 262 mm x 330 mm |

**Note**

<sup>(1)</sup> N4 packaging only available for SFR25 and SFR25H radial version



## 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<br>(special) | 0 = standard   | 3 digit value<br>1 digit multiplier<br>MULTIPLIER<br>7 = *10 <sup>-3</sup> 2 = *10 <sup>2</sup><br>8 = *10 <sup>-2</sup> 3 = *10 <sup>3</sup><br>9 = *10 <sup>-1</sup> 4 = *10 <sup>4</sup><br>0 = *10 <sup>0</sup> 5 = *10 <sup>5</sup><br>1 = *10 <sup>1</sup> | F = ± 1 %<br>J = ± 5 % | N4<br>A5<br>A1<br>R5 | The 2 digits<br>are used for<br>all special<br>parts.<br>00 = standard |

PRODUCT DESCRIPTION: SFR25 1 % A5 1K0

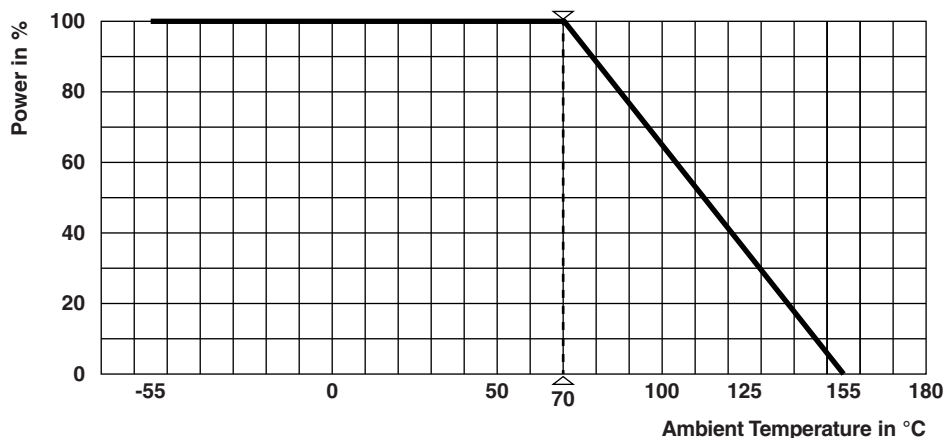
| SFR25                     | 1 %            | A5                       | 1K0                          |
|---------------------------|----------------|--------------------------|------------------------------|
| TYPE                      | TOLERANCE      | PACKAGING <sup>(1)</sup> | RESISTANCE VALUE             |
| 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
- <sup>(1)</sup> N4 packaging indicates SFR25 and SFR25H radial version

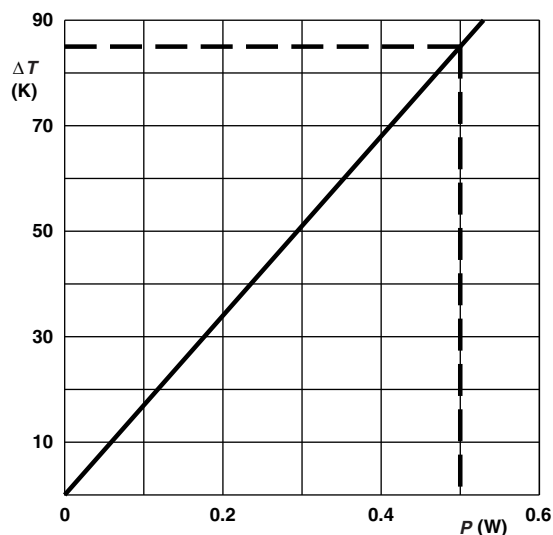


## FUNCTIONAL PERFORMANCE

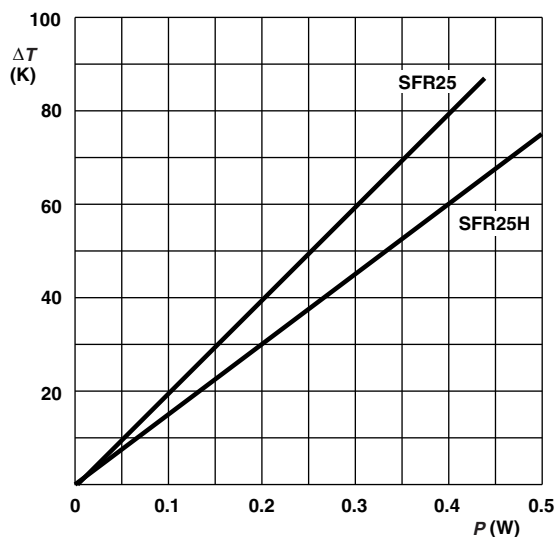


### Derating

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



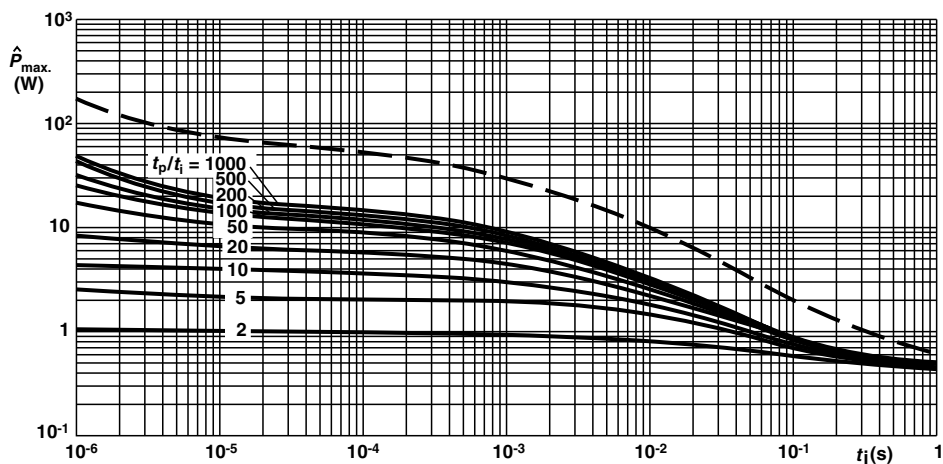
SFR16S Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power



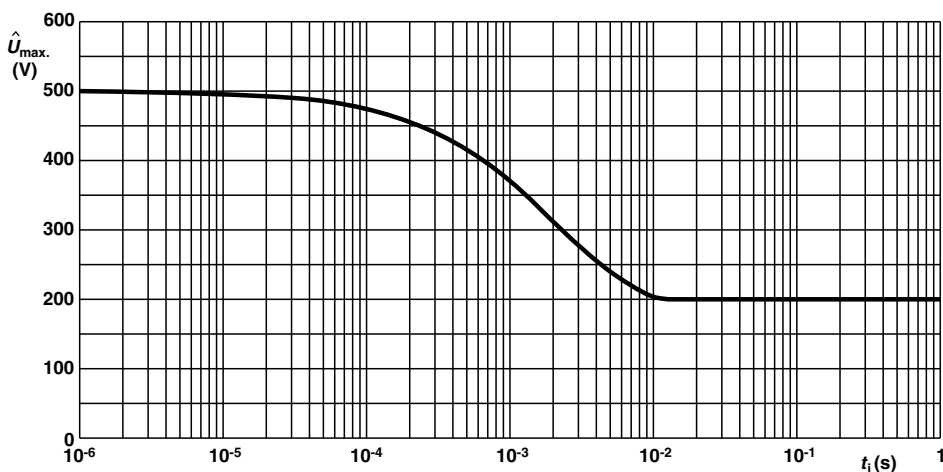
SFR25/SFR25H Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power

### Note

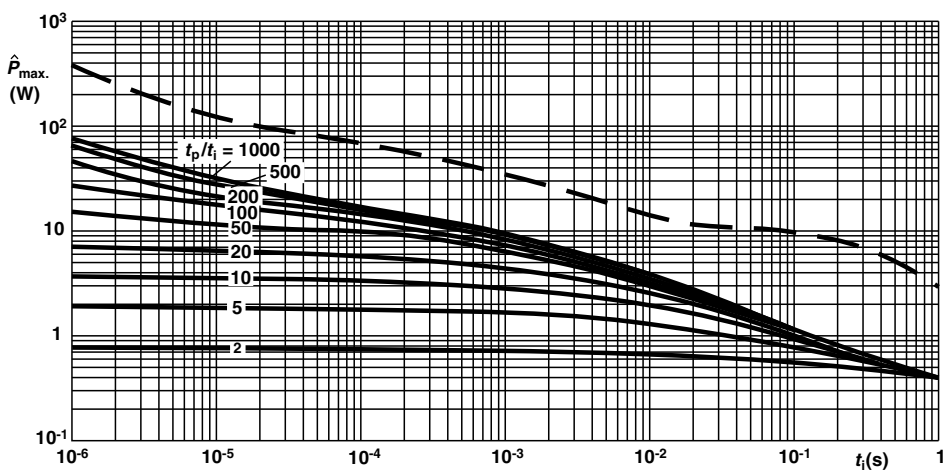
- The maximum permissible hot-spot temperature is 155 °C



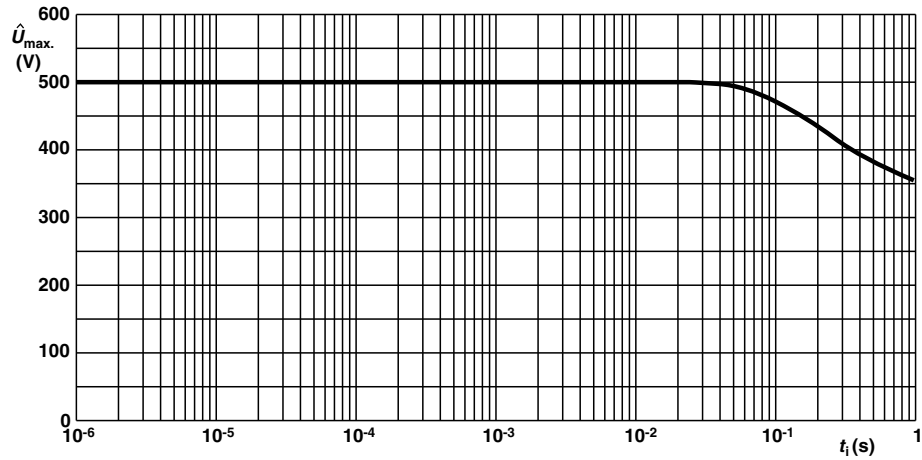
SFR16S Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max.}$ ) as a function of pulse duration ( $t_i$ )



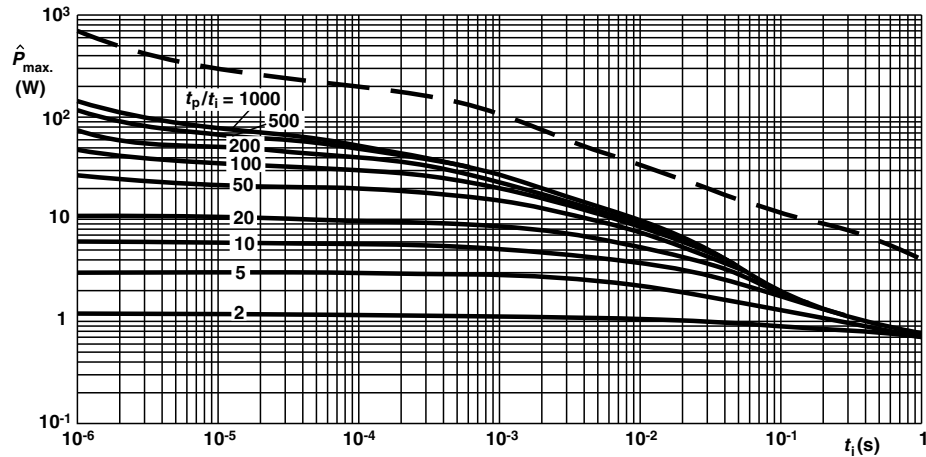
SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max.}$ ) as a function of pulse duration ( $t_i$ )



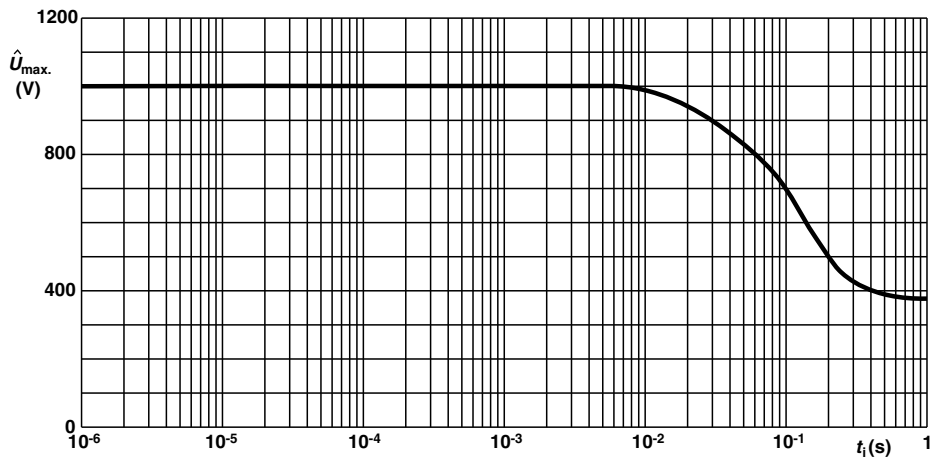
SFR25 Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max.}$ ) as a function of pulse duration ( $t_i$ )



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 ( $t_i$ )

**TESTS PROCEDURES AND REQUIREMENTS**

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

- EN 60115-1, generic specification
- IEC 60068-2-xx, test methods

The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included. The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

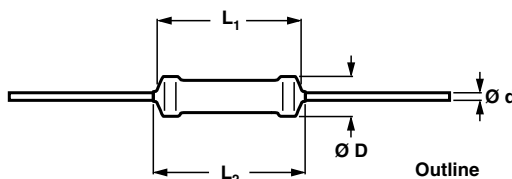
Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar)

A climatic category LCT/ UCT / 56 is applied, defined by the lower category temperature (LCT = -55 °C), the upper category temperature (UCT = 155 °C), and the duration of exposure in the damp heat, steady state test (56 days). The components are mounted for testing on printed circuit boards in accordance with IEC 60115-1, 5.5 unless otherwise specified.

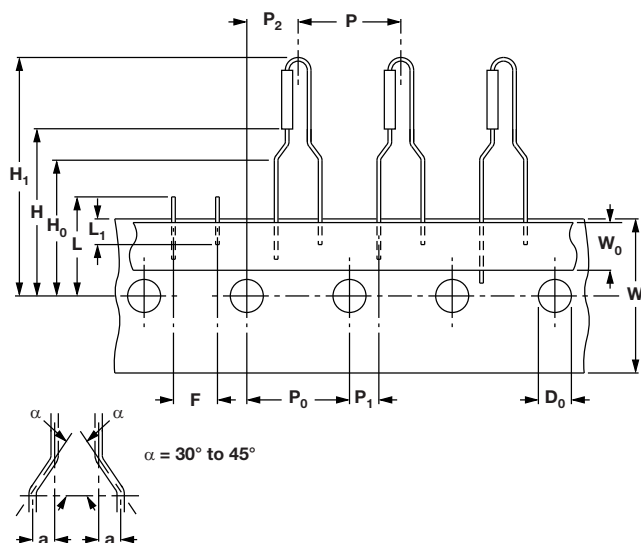
| TEST PROCEDURES AND REQUIREMENTS |                                |                                       |                                                                                                   |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
|----------------------------------|--------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| IEC 60115-1<br>CLAUSE            | IEC 60068-2<br>TEST<br>METHOD  | TEST                                  | PROCEDURE                                                                                         | REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R_{\text{max.}}$ )                                                                                                              |                                  |                                  |                                  |                                  |
| 5.6                              | -                              | Resistance                            | -                                                                                                 | $\pm 5 \%$ ; $\pm 1 \%$                                                                                                                                                   |                                  |                                  |                                  |                                  |
| 6.2                              | -                              | Temperature coefficient of resistance | At (20 / -55 / 20) °C and (20 / 155 / 20) °C                                                      | $\pm 250 \text{ ppm/K}$ ; $\pm 100 \text{ ppm/K}$                                                                                                                         |                                  |                                  |                                  |                                  |
| 6.6                              | -                              | Current noise                         | IEC 60195                                                                                         |                                                                                                                                                                           | < 68 k $\Omega$                  | 68 k $\Omega$ to 100 k $\Omega$  | > 100 k $\Omega$ to 1 M $\Omega$ | > 1 M $\Omega$                   |
|                                  |                                |                                       |                                                                                                   | SFR16S                                                                                                                                                                    | $\leq 0.1 \text{ }\mu\text{V/V}$ | $\leq 0.5 \text{ }\mu\text{V/V}$ | $\leq 1.5 \text{ }\mu\text{V/V}$ | $\leq 1.5 \text{ }\mu\text{V/V}$ |
|                                  |                                |                                       |                                                                                                   | SFR25, SFR25H                                                                                                                                                             | $\leq 0.1 \text{ }\mu\text{V/V}$ | $\leq 0.1 \text{ }\mu\text{V/V}$ | $\leq 0.1 \text{ }\mu\text{V/V}$ | $\leq 1.5 \text{ }\mu\text{V/V}$ |
| 8.1                              | -                              | Short term overload                   | Room temperature;<br>$P = 6.25 \times P_n$ ;<br>(voltage not more than 2 x limiting voltage); 5 s | $\pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                           |                                  |                                  |                                  |                                  |
| 9.5                              | 21 (Ua1)<br>21 (Ub)<br>21 (Uc) | Robustness of terminations            | Tensile, bending, and torsion                                                                     | $\pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                           |                                  |                                  |                                  |                                  |
| 11.1                             | 20 (Ta)                        | Solderability                         | at +235 °C; 2 s;<br>solder bath method;<br>SnPb40                                                 | Good tinning ( $\geq 95 \%$ covered); no damage                                                                                                                           |                                  |                                  |                                  |                                  |
|                                  |                                |                                       | at +245 °C; 3 s;<br>solder bath method;<br>SnAg3Cu0.5                                             |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 11.2                             | 20 (Tb)                        | Resistance to soldering heat          | Unmounted components<br>(260 $\pm$ 5) °C; (10 $\pm$ 1) s                                          | $\pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.1                             | 14 (Na)                        | Rapid change of temperature           | 30 min at -55 °C and<br>30 min at +155 °C;<br>5 cycles                                            | $\pm (0.25 \% R + 0.05 \Omega)$                                                                                                                                           |                                  |                                  |                                  |                                  |
| 9.9                              | 27 (Ea)                        | Bump                                  | 3 x 1500 bumps in 3 directions;<br>40 g                                                           | $\pm (0.25 \% R + 0.05 \Omega)$ ; no damage                                                                                                                               |                                  |                                  |                                  |                                  |
| 9.11                             | 6 (Fc)                         | Vibration                             | 10 sweep cycles per direction;<br>10 Hz to 2000 Hz<br>1.5 mm or 200 m/s <sup>2</sup>              | $\pm (0.25 \% R + 0.05 \Omega)$ ; no damage                                                                                                                               |                                  |                                  |                                  |                                  |
| 10.3                             |                                | Climatic sequence:                    |                                                                                                   | <div>SFR16S, SFR25, SFR25H</div> $\pm (1 \% R + 0.05 \Omega)$ ; no visible damage<br>$\pm (1 \% R + 0.05 \Omega)$ ; no visible damage<br>$\pm 2 \% R$ ; no visible damage |                                  |                                  |                                  |                                  |
| 10.3.4.2                         | 2 (Bb)                         | Dry heat                              | 155 °C; 16 h                                                                                      |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.3.4.3                         | 30 (Db)                        | Damp heat, cyclic                     | 55 °C; 24 h;<br>90 % to 100 % RH; 1 cycle                                                         |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.3.4.4                         | 1 (Ab)                         | Cold                                  | -55 °C; 2 h                                                                                       |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.3.4.5                         | 13 (M)                         | Low air pressure                      | 1 h; (1 $\pm$ 0.1) kPa;<br>15 °C to 35 °C                                                         |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.3.4.6                         | 30 (Db)                        | Damp heat, cyclic                     | 55 °C; 5 days;<br>95 % to 100 % RH; 5 cycles                                                      |                                                                                                                                                                           |                                  |                                  |                                  |                                  |
| 10.3.4.7                         |                                | DC load                               | apply rated power for 1 min                                                                       |                                                                                                                                                                           |                                  |                                  |                                  |                                  |

**TEST PROCEDURES AND REQUIREMENTS**

| IEC 60115-1<br>CLAUSE | IEC 60068-2<br>TEST<br>METHOD | TEST                                                         | PROCEDURE                                                                                               | REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R_{\max}$ ) |
|-----------------------|-------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 10.4                  | 78 (Cab)                      | Damp heat<br>(steady state)                                  | $(40 \pm 2) ^\circ\text{C}$ ; 56 days;<br>$(93 \pm 3) \% \text{RH}$                                     | $\pm (2 \% R + 0.05 \Omega)$                          |
| 7.1                   |                               | Endurance at<br>the rated<br>temperature $70 ^\circ\text{C}$ | $U = \sqrt{P_{70} \times R}$ or $U = U_{\max}$ ;<br>1.5 h on; 0.5 h off<br>$70 ^\circ\text{C}$ ; 1000 h | $\pm (2 \% R + 0.05 \Omega)$                          |

**DIMENSIONS**

**DIMENSIONS** - Leaded resistor types, mass and relevant physical dimensions

| TYPE   | $\varnothing D_{\max}$<br>(mm) | $L_1$ max.<br>(mm) | $L_2$ max.<br>(mm) | $\varnothing d$<br>(mm) | MASS<br>(mg) |
|--------|--------------------------------|--------------------|--------------------|-------------------------|--------------|
| SFR16S | 1.9                            | 3.5                | 4.1                | $0.45 \pm 0.05$         | 102          |
| SFR25  | 2.5                            | 6.5                | 7.5                | $0.58 \pm 0.05$         | 205          |
| SFR25H | 2.5                            | 6.5                | 7.5                | $0.58 \pm 0.05$         | 205          |

**SFR25, SFR25H WITH RADIAL TAPING**

**DIMENSIONS** in millimeters

|                                                 |       |                   |
|-------------------------------------------------|-------|-------------------|
| Pitch of components                             | P     | $12.7 \pm 1.0$    |
| Feed-hole pitch                                 | $P_0$ | $12.7 \pm 0.2$    |
| Feed-hole center to lead at topside at the tape | $P_1$ | $3.85 \pm 0.5$    |
| Feed-hole center to body center                 | $P_2$ | $6.35 \pm 1.0$    |
| Lead-to-lead distance                           | F     | $4.8 + 0.7 / - 0$ |
| Tape width                                      | W     | $18.0 \pm 0.5$    |
| Minimum hold down tape width                    | $W_0$ | 5.5               |
| Maximum component height                        | H1    | 29                |
| Lead wire clinch height                         | $H_0$ | $16.5 \pm 0.5$    |
| Height of component from tape center            | H     | $19.5 \pm 1$      |
| Feed-hole diameter                              | $D_0$ | $4.0 \pm 0.2$     |
| Maximum length of snapped 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](http://www.vishay.com/doc?28721))

**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.

**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  $\pm 5$  % Tolerance**

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

**Resistance Decade for  $\pm 1$  % Tolerance**

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

**12NC Example**

The 12NC of a SFR25 resistor, value 5600  $\Omega \pm 5$  %, taped on a bandolier of 5000 units in ammpack 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 | $\pm 5$ % | -                     | ..22 187 73... | ..22 187 53... | ..06 187 23...    |
|        | $\pm 1$ % | -                     | -              | ..06 187 3...  | ..06 187 1....    |
|        | Jumper    | -                     | -              | ..06 187 90013 | ..22 187 90346    |
| SFR25  | $\pm 5$ % | ..06 184 03...        | ..22 181 53... | ..22 181 43... | ..22 181 63...    |
|        | $\pm 1$ % | -                     | -              | ..22 188 2...  | ..06 181 8....    |
|        | Jumper    | -                     | ..22 181 90018 | ..22 181 90019 | ..06 181 90011    |
| SFR25H | $\pm 5$ % | ..06 186 03...        | ..22 186 16... | ..22 186 76... | ..06 186 63...    |
|        | $\pm 1$ % | -                     | -              | ..22 186 3.... | ..06 186 8....    |



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