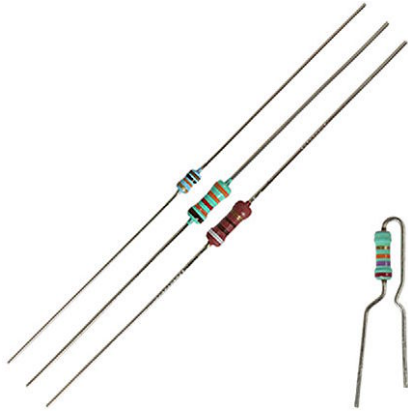


Standard Metal Film Leaded Resistors



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



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 M Ω ; jumper (0 Ω) | 0.22 Ω to 10 M Ω ; jumper (0 Ω) | 0.22 Ω to 10 M Ω |
| 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_{max} AC/DC | 200 V | 250 V | 350 V |
| Operating temperature range | -55 $^{\circ}\text{C}$ to +155 $^{\circ}\text{C}$ | | |
| 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 | ± 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

| 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 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 ⁽¹⁾ | 1000 | Taped acc. to IEC 60286-1 fan-folded in a box | | | 78 mm x 31 mm x 260 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 |

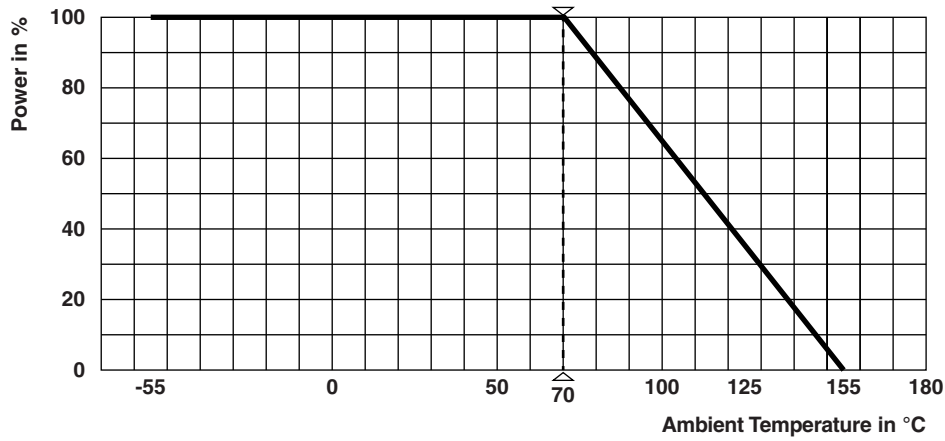
Notes

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

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

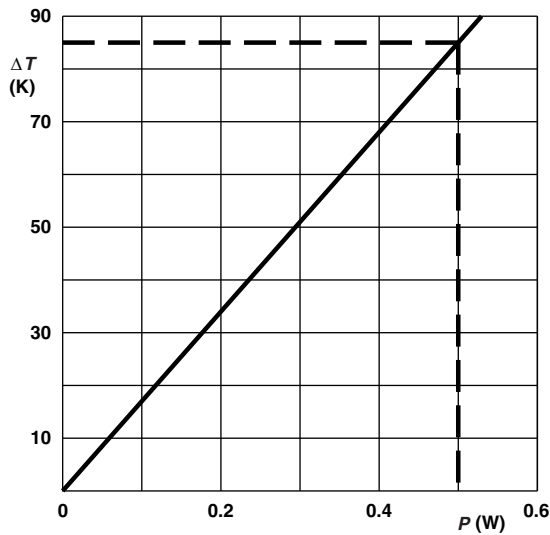


FUNCTIONAL PERFORMANCE

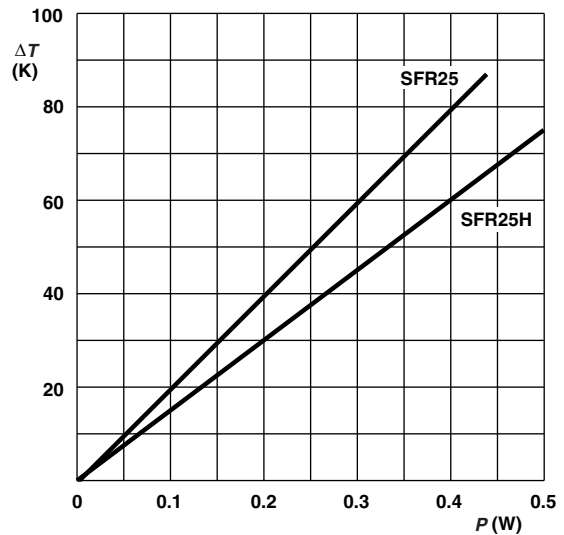


Derating

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



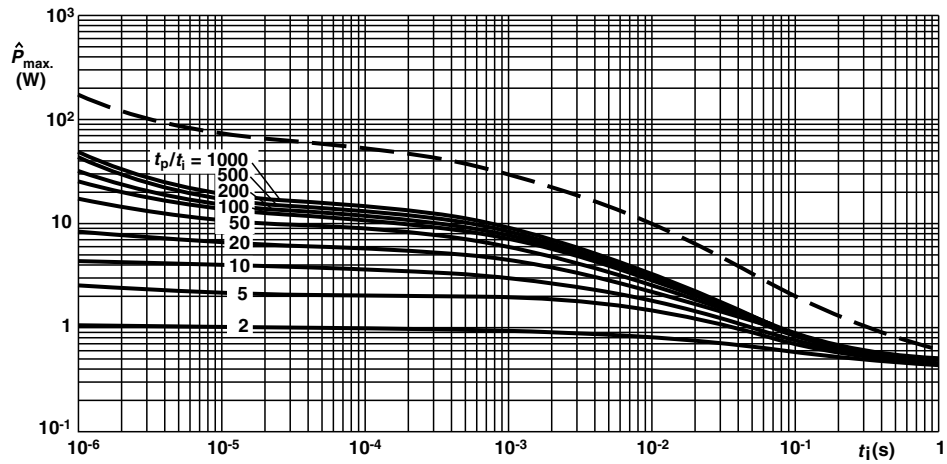
SFR16S Hot-spot temperature rise (ΔT) as a function of dissipated power



SFR25/SFR25H Hot-spot temperature rise (ΔT) as a function of dissipated power

Note

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



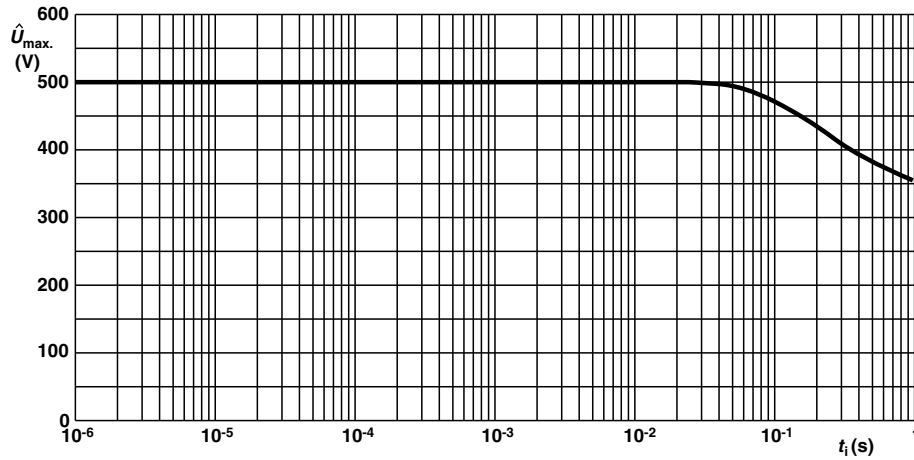
SFR16S Pulse on a regular basis; maximum permissible peak pulse power (\hat{P}_{max}) as a function of pulse duration (t_i)



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

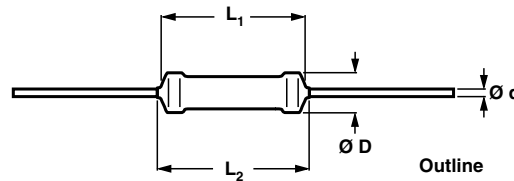
Relative humidity: 25 % to 75 %

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

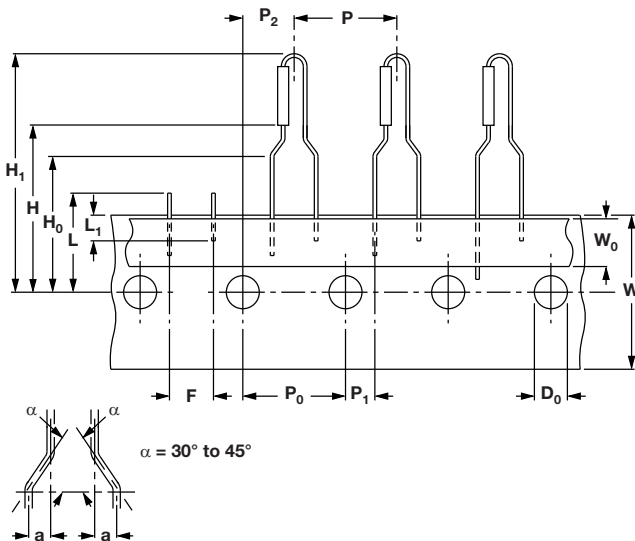
A climatic category LCT/ UCT / 56 is applied, defined by the lower category temperature (LCT = -55 °C), the upper category temperature (UCT = 155 °C), and the duration of exposure in the damp heat, steady state test (56 days). The components are mounted for testing on printed circuit boards in accordance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

| TEST PROCEDURES AND REQUIREMENTS | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--|--|---|--|------------------------------|--|----------------------------------|--|----------------|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TEST | PROCEDURE | REQUIREMENTS PERMISSIBLE CHANGE (ΔR_{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 | <table border="1"> <tr> <td></td> <td>< 68 kΩ</td> <td>68 kΩ to 100 kΩ</td> <td>> 100 kΩ to 1 MΩ</td> <td>> 1 MΩ</td> </tr> <tr> <td>SFR16S</td> <td>$\leq 0.1 \mu\text{V/V}$</td> <td>$\leq 0.5 \mu\text{V/V}$</td> <td>$\leq 1.5 \mu\text{V/V}$</td> <td>$\leq 1.5 \mu\text{V/V}$</td> </tr> <tr> <td>SFR25, SFR25H</td> <td>$\leq 0.1 \mu\text{V/V}$</td> <td>$\leq 0.1 \mu\text{V/V}$</td> <td>$\leq 0.1 \mu\text{V/V}$</td> <td>$\leq 1.5 \mu\text{V/V}$</td> </tr> </table> | | < 68 k Ω | 68 k Ω to 100 k Ω | > 100 k Ω to 1 M Ω | > 1 M Ω | SFR16S | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.5 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ | SFR25, SFR25H | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.1 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ |
| | | | | | < 68 k Ω | 68 k Ω to 100 k Ω | > 100 k Ω to 1 M Ω | > 1 M Ω | | | | | | | | | | | |
| SFR16S | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.5 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ | | | | | | | | | | | | | | | |
| SFR25, SFR25H | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.1 \mu\text{V/V}$ | $\leq 0.1 \mu\text{V/V}$ | $\leq 1.5 \mu\text{V/V}$ | | | | | | | | | | | | | | | |
| 8.1 | - | Short term overload | Room temperature; $P = 6.25 \times P_n$; (voltage not more than 2 x limiting voltage); 5 s | $\pm (0.25 \% R + 0.05 \Omega)$ | | | | | | | | | | | | | | | |
| 9.5 | 21 (Ua1) 21 (Ub) 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; solder bath method; SnPb40 at +245 °C; 3 s; solder bath method; SnAg3Cu0.5 | Good tinning ($\geq 95 \%$ covered); no damage | | | | | | | | | | | | | | | |
| 11.2 | 20 (Tb) | Resistance to soldering heat | Unmounted components (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 30 min at +155 °C; 5 cycles | $\pm (0.25 \% R + 0.05 \Omega)$ | | | | | | | | | | | | | | | |
| 9.9 | 27 (Ea) | Bump | 3 x 1500 bumps in 3 directions; 40 g | $\pm (0.25 \% R + 0.05 \Omega)$; no damage | | | | | | | | | | | | | | | |
| 9.11 | 6 (Fc) | Vibration | 10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s ² | $\pm (0.25 \% R + 0.05 \Omega)$; no damage | | | | | | | | | | | | | | | |
| 10.3 | 2 (Bb) 30 (Db) 1 (Ab) 13 (M) 30 (Db) | Climatic sequence: | 155 °C; 16 h 55 °C; 24 h; 90 % to 100 % RH; 1 cycle -55 °C; 2 h 8.5 kPa; 2 h; 15 °C to 35 °C 55 °C; 5 days; 95 % to 100 % RH; 5 cycles apply rated power for 1 min | <table border="1"> <tr> <td>SFR16S, SFR25, SFR25H</td> <td>$\pm (1 \% R + 0.05 \Omega)$; no visible damage</td> </tr> <tr> <td></td> <td>$\pm (1 \% R + 0.05 \Omega)$; no visible damage</td> </tr> <tr> <td></td> <td>$\pm 2 \% R$; no visible damage</td> </tr> </table> | SFR16S, SFR25, SFR25H | $\pm (1 \% R + 0.05 \Omega)$; no visible damage | | $\pm (1 \% R + 0.05 \Omega)$; no visible damage | | $\pm 2 \% R$; no visible damage | | | | | | | | | |
| SFR16S, SFR25, SFR25H | | $\pm (1 \% R + 0.05 \Omega)$; no visible damage | | | | | | | | | | | | | | | | | |
| | | $\pm (1 \% R + 0.05 \Omega)$; no visible damage | | | | | | | | | | | | | | | | | |
| | | $\pm 2 \% R$; no visible damage | | | | | | | | | | | | | | | | | |
| 10.3.4.2 | | Dry heat | | | | | | | | | | | | | | | | | |
| 10.3.4.3 | | Damp heat, cyclic | | | | | | | | | | | | | | | | | |
| 10.3.4.4 | | Cold | | | | | | | | | | | | | | | | | |
| 10.3.4.5 | Low air pressure | | | | | | | | | | | | | | | | | | |
| 10.3.4.6 | Damp heat, cyclic | | | | | | | | | | | | | | | | | | |
| 10.3.4.7 | DC load | | | | | | | | | | | | | | | | | | |

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

DIMENSIONS


| DIMENSIONS - Leded resistor types, mass and relevant physical dimensions | | | | | |
|--|-----------------------------|-----------------|-----------------|----------------------|-----------|
| TYPE | $\varnothing D_{max.}$ (mm) | L_1 max. (mm) | L_2 max. (mm) | $\varnothing d$ (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 | H_1 | 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 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)

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 ± 5 % Tolerance

| RESISTANCE DECADE | LAST DIGIT |
|-------------------|------------|
| 0.10 Ω to 0.91 Ω | 7 |
| 1 Ω to 9.1 Ω | 8 |
| 10 Ω to 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 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 | ± 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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