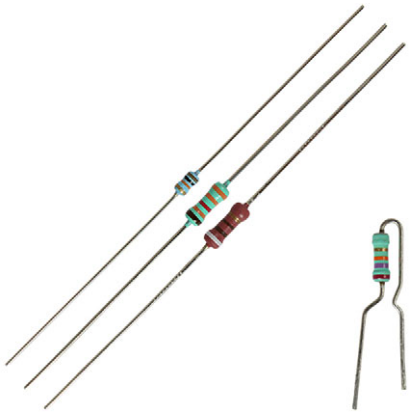
Standard Metal Film Leaded Resistors



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	10 Ω to 3 MΩ	1.0 Ω to 10 MΩ	1.0 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

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE	**TOLERANCE**	**TCR**	**RESISTANCE**	**E-SERIES**
SFR16S	± 5 %	± 100 ppm/K	10 Ω to 100 kΩ	E24
		± 250 ppm/K	> 100 kΩ to 3 MΩ	
	± 1 %	± 100 ppm/K	100 Ω to 100 kΩ	E24; E96
		± 250 ppm/K	> 100 kΩ to 976 kΩ	
SFR25, SFR25H	± 5 %	± 250 ppm/K	1.0 Ω to 4.7 Ω	E24
		± 100 ppm/K	> 4.7 Ω to 1 MΩ	
		± 250 ppm/K	> 1 MΩ to 10 MΩ	
	± 1 %	± 100 ppm/K	10 Ω to 1 MΩ	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 (1)	4000	Taped acc. to IEC 60286-2 fan-folded in a box	-	12.7 mm	45 mm x 262 mm x 330 mm

Note

(1) 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 **SFR2500** **SFR25H0**	**0** = neutral **Z** = value overflow (special)	**0** = standard	**3 digit value** **1 digit multiplier** MULTIPLIER **7** = $*10^{-3}$ **8** = $*10^{-2}$ **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$ **5** = $*10^{5}$	**F** = ± 1 % **J** = ± 5 %	**N4** **A5** **A1** **R5**	The 2 digits are used for all special parts. **00** = standard

PRODUCT DESCRIPTION: SFR25 1 % A5 1K0

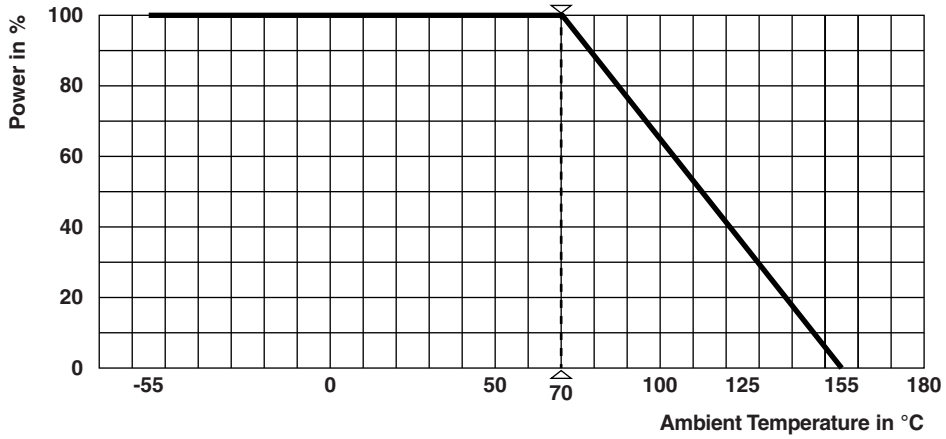
SFR25	1 %	A5	1K0
TYPE	TOLERANCE	PACKAGING (1)	RESISTANCE VALUE
SFR16S **SFR25** **SFR25H**	**± 1 %** **± 5 %**	**N4** **A5** **A1** **R5**	**47K** = 47 kΩ **51R1** = 51.1 Ω

Notes

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

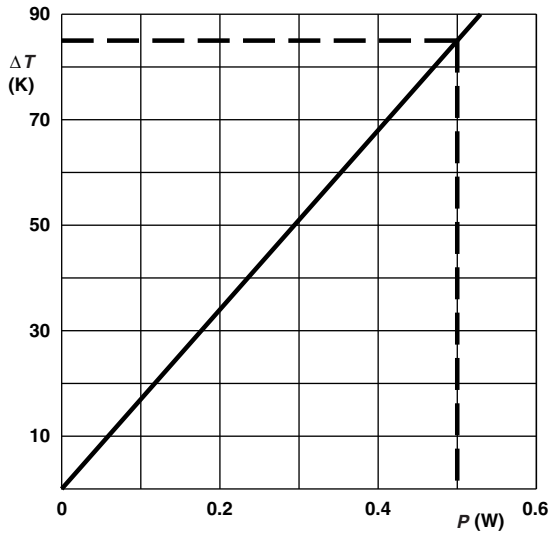
(1) N4 packaging indicates SFR25 and SFR25H radial version

FUNCTIONAL PERFORMANCE

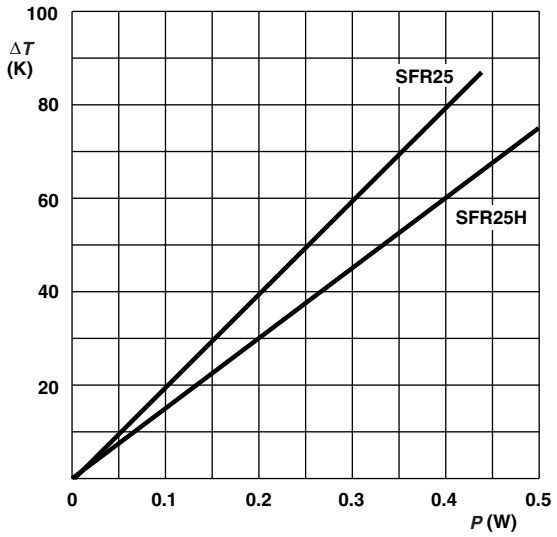


Derating

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



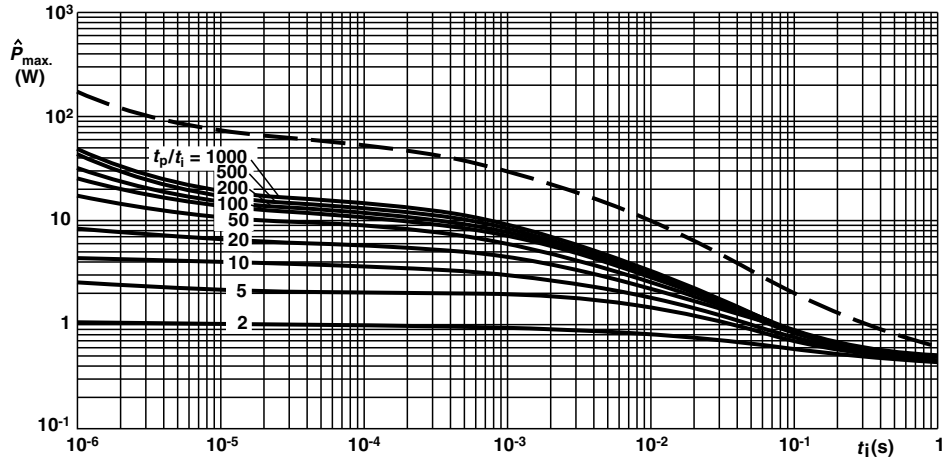
SFR16S Hot-spot temperature rise (ΔT) as a function of dissipated power



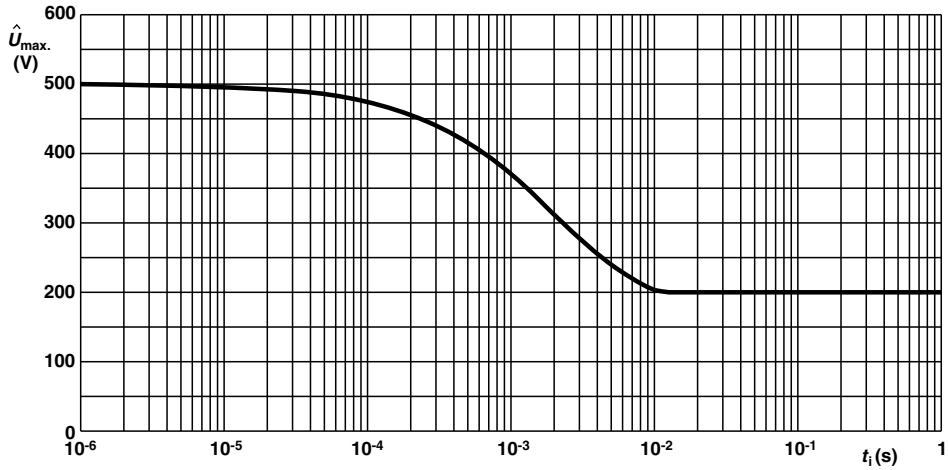
SFR25/SFR25H Hot-spot temperature rise (ΔT) as a function of dissipated power

Note

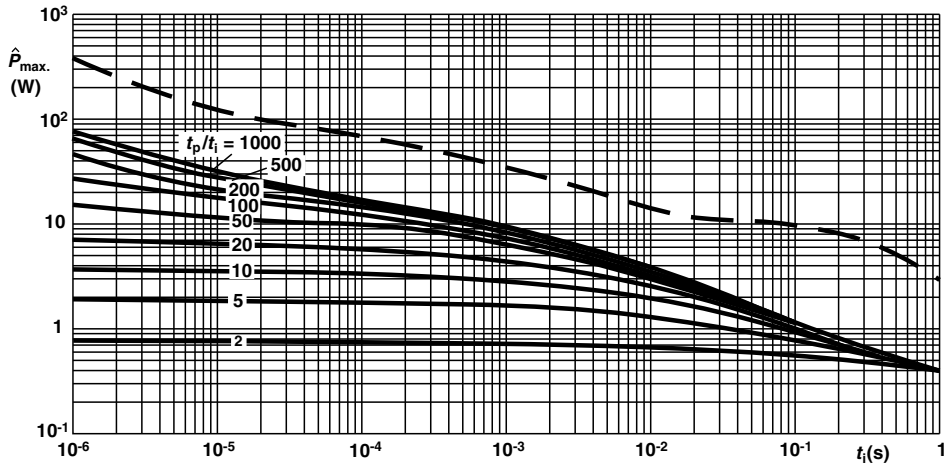
- The maximum permissible hot-spot temperature is 155 °C



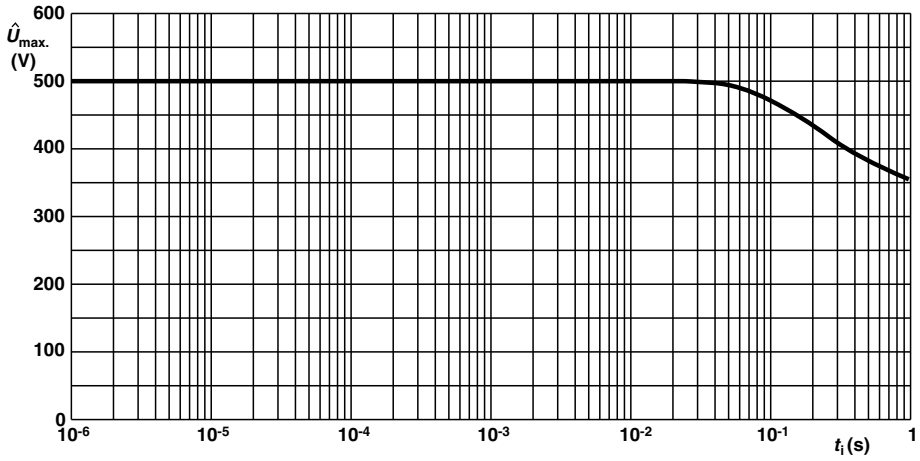
SFR16S Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



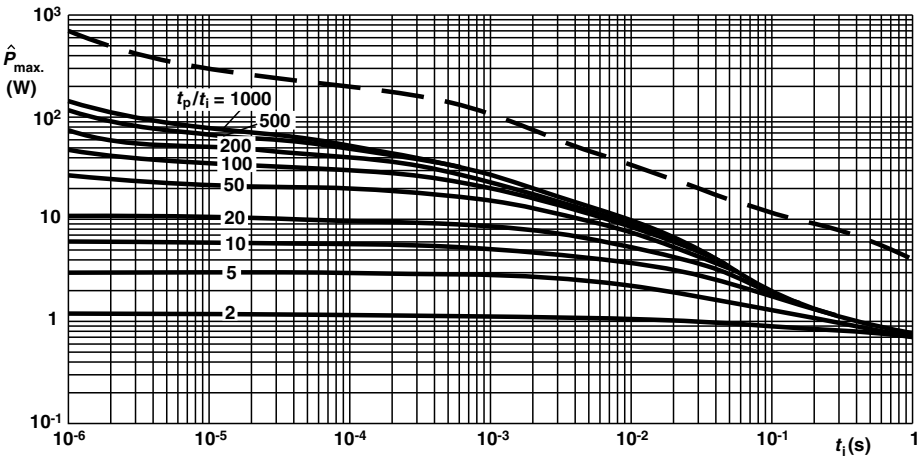
SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration (t_i)



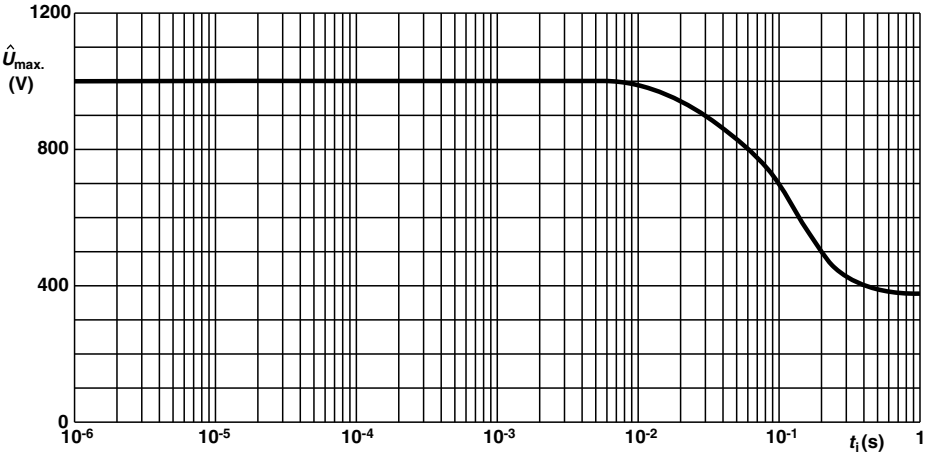
SFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



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)

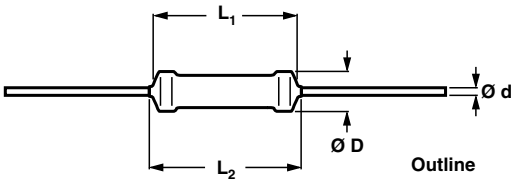
A climatic category LCT/ UCT / 56 is applied, defined by the lower category temperature (LCT = -55 °C), the upper category temperature (UCT = 155 °C), and the duration of exposure in the damp heat, steady state test (56 days). The components are mounted for testing on printed circuit boards in accordance 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 ($\Delta R_{max.}$)				
5.6	-	Resistance	-	± 5 %; ± 1 %				
6.2	-	Temperature coefficient of resistance	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	± 250 ppm/K; ± 100 ppm/K				
6.6	-	Current 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
8.1	-	Short term 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)				
9.5	21 (Ua1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	± (0.25 % R + 0.05 Ω)				
11.1	20 (Ta)	Solderability	at +235 °C; 2 s; solder bath method; SnPb40	Good tinning (≥ 95 % covered); no damage				
			at +245 °C; 3 s; solder bath method; SnAg3Cu0.5					
11.2	20 (Tb)	Resistance to soldering heat	Unmounted components (260 ± 5) °C; (10 ± 1) s	± (0.25 % R + 0.05 Ω)				
10.1	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)				
9.9	27 (Ea)	Bump	3 x 1500 bumps in 3 directions; 40 g	± (0.25 % R + 0.05 Ω); no damage				
9.11	6 (Fc)	Vibration	10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s²	± (0.25 % R + 0.05 Ω); no damage				
10.3		Climatic sequence:						
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; 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 ± 0.1) kPa; 15 °C to 35 °C					
10.3.4.6	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 ± (1 % R + 0.05 Ω); no visible damage ± 2 % R; no visible damage			
10.3.4.7		DC load	apply rated power for 1 min					

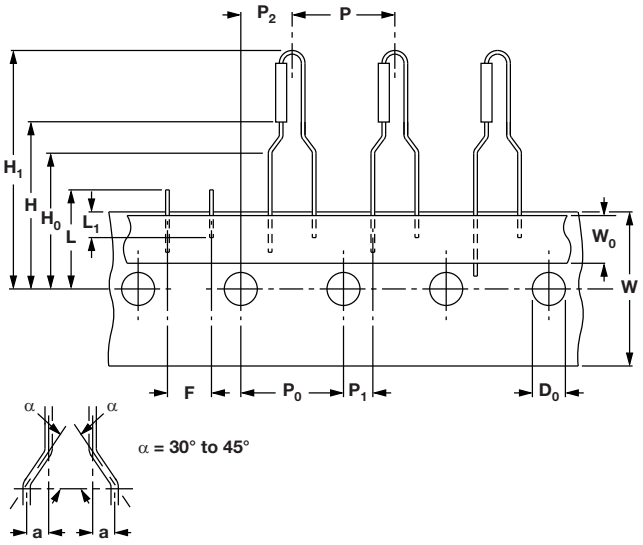
TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$)
10.4	78 (Cab)	Damp heat (steady state)	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (2 % R + 0.05 Ω)
7.1		Endurance at the rated temperature 70 °C	$U = \sqrt{P_{70} \times R}$ 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)

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 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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