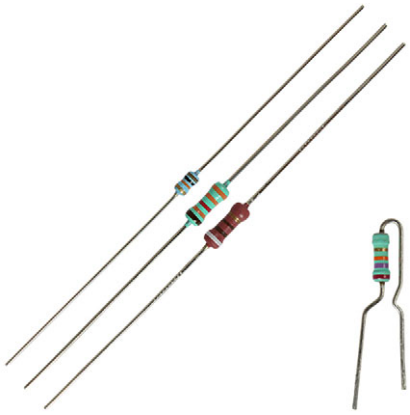
Standard Metal Film Leaded Resistors



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	5.1 Ω to 3 MΩ	0.22 Ω to 10 MΩ	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 %	± 100 ppm/K	5.1 Ω to 100 kΩ	E24
		± 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	
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	

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

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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** = $*10^{-3}$ **2** = $*10^{2}$ **8** = $*10^{-2}$ **3** = $*10^{3}$ **9** = $*10^{-1}$ **4** = $*10^{4}$ **0** = $*10^{0}$ **5** = $*10^{5}$ **1** = $*10^{1}$	**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

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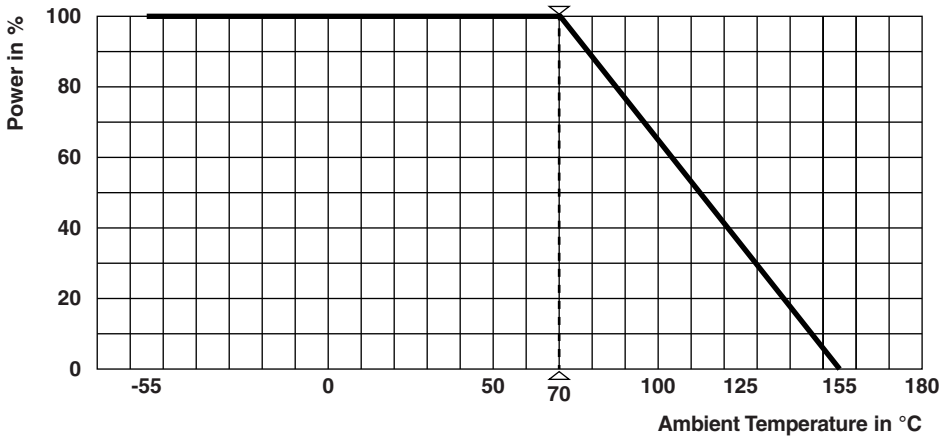
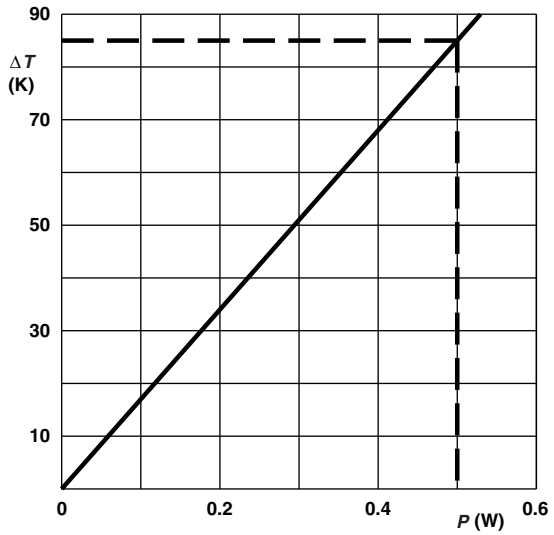
FUNCTIONAL PERFORMANCE

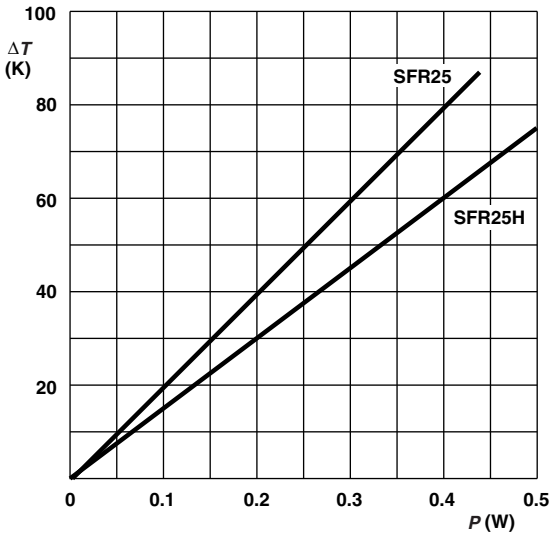


Derating

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



SFR16S Hot-spot temperature rise (Δ*T*) as a function of dissipated power



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

Note

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

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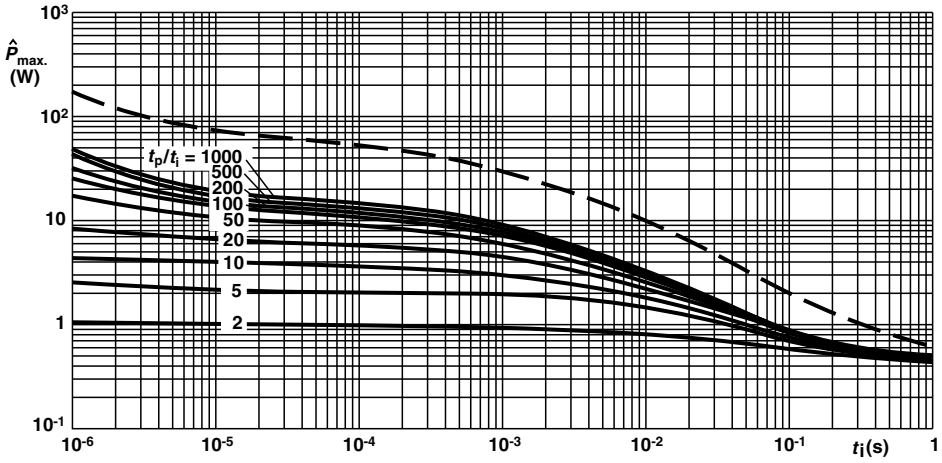
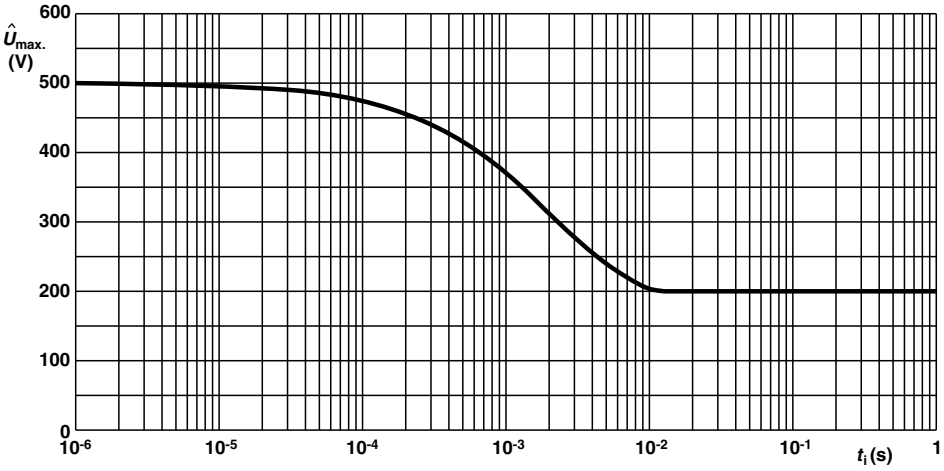
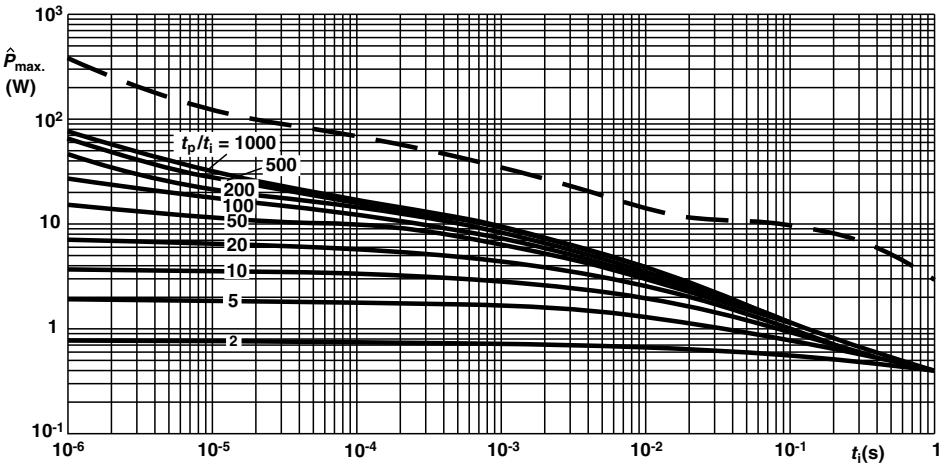


SFR16S Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



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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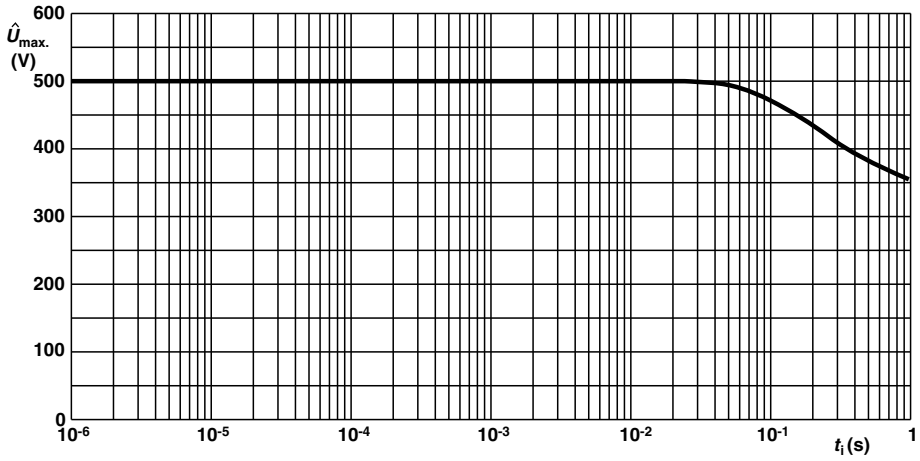
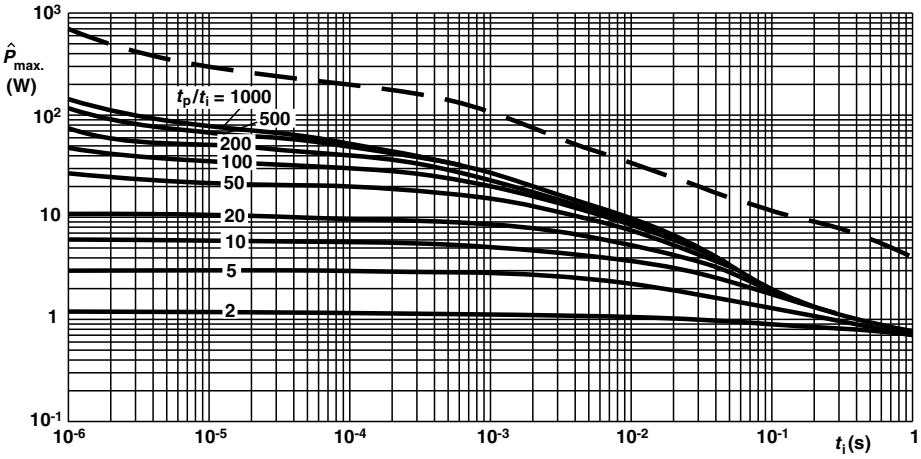
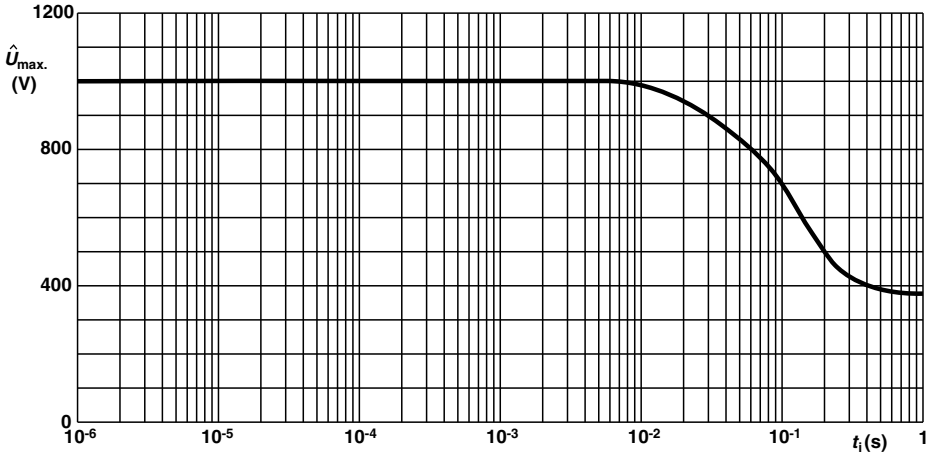


SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration (t_i)



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
- 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/s^2	± (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	8.5 kPa; 2 h; 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			
10.3.4.7		DC load	apply rated power for 1 min		± 2 % R; no visible damage			

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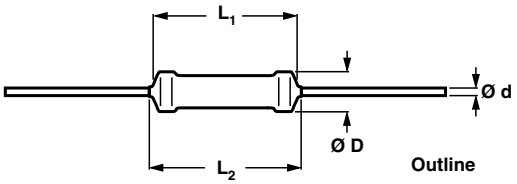
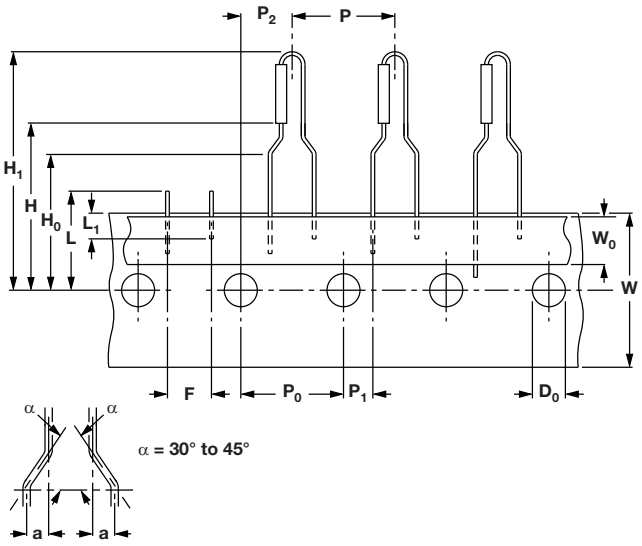
TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$)
10.4	78 (Cab)	Damp heat (steady state)	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (2 % R + 0.05 Ω)
7.1		Endurance at the rated temperature 70 °C	$U = \sqrt{P_{70}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

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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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