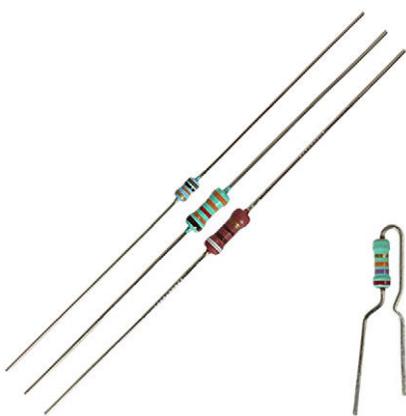


Standard Metal Film Leaded Resistors



FEATURES

- Small size (SFR16S: 0204, SFR25 / SFR25H: 0207)
- Low noise (max. 1.5 μ 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 $\text{M}\Omega$; jumper (0 Ω)	0.22 Ω to 10 $\text{M}\Omega$; jumper (0 Ω)	0.22 Ω to 10 $\text{M}\Omega$
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 $^{\circ}\text{C}$ 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	$\pm 5\%$	$\pm 250 \text{ ppm/K}$	$1 \Omega \text{ to } \leq 4.7 \Omega$	E24
		$\pm 100 \text{ ppm/K}$	$4.7 \Omega \text{ to } 100 \text{ k}\Omega$	
		$\pm 250 \text{ ppm/K}$	$> 100 \text{ k}\Omega \text{ to } 3 \text{ M}\Omega$	
	$\pm 1\%$	$\pm 100 \text{ ppm/K}$	$5.6 \Omega \text{ to } 100 \text{ k}\Omega$	E24; E96
		$\pm 250 \text{ ppm/K}$	$> 100 \text{ k}\Omega \text{ to } 976 \text{ k}\Omega$	
	Jumper (0Ω)	-	$\leq 30 \text{ m}\Omega; I_{\max.} = 3 \text{ A}$	-
SFR25, SFR25H	$\pm 5\%$	$\pm 250 \text{ ppm/K}$	$0.22 \Omega \text{ to } 4.7 \Omega$	E24
		$\pm 100 \text{ ppm/K}$	$> 4.7 \Omega \text{ to } 1 \text{ M}\Omega$	
		$\pm 250 \text{ ppm/K}$	$> 1 \text{ M}\Omega \text{ to } 10 \text{ M}\Omega$	
	$\pm 1\%$	$\pm 250 \text{ ppm/K}$	$1 \Omega \text{ to } 4.7 \Omega$	E24; E96
		$\pm 100 \text{ ppm/K}$	$> 4.7 \Omega \text{ to } 1 \text{ M}\Omega$	
		$\pm 250 \text{ ppm/K}$	$> 1 \text{ M}\Omega \text{ to } 10 \text{ M}\Omega$	
	Jumper (0Ω) ⁽¹⁾	-	$\leq 30 \text{ m}\Omega; I_{\max.} = 5 \text{ A}$	-

Note

⁽¹⁾ Jumper is only available for SFR25.

PART NUMBER AND PRODUCT DESCRIPTION							
PART NUMBER: SFR2500001001FA500							
S	F	R	2	5	0	0	0
TYPE	VARIANT	TCR/MATERIAL	RESISTANCE	TOLERANCE	PACKAGING	SPECIAL	
SFR16S0 SFR2500 SFR25H0	0 = neutral Z = value overflow (special)	0 = standard Z = jumper	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 = $*10^5$ Z = 0000	F = $\pm 1\%$ J = $\pm 5\%$ Z = jumper	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	$\pm 1\%$ $\pm 5\%$	N4 A5 A1 R5	47K = 47 k Ω 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.

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

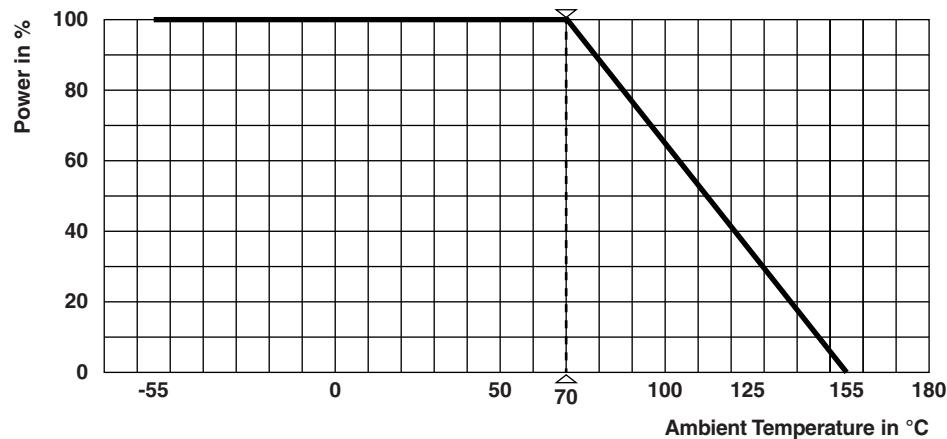
Notes

⁽¹⁾ A1 packaging only available for resistors with $\pm 5\%$ tolerance.

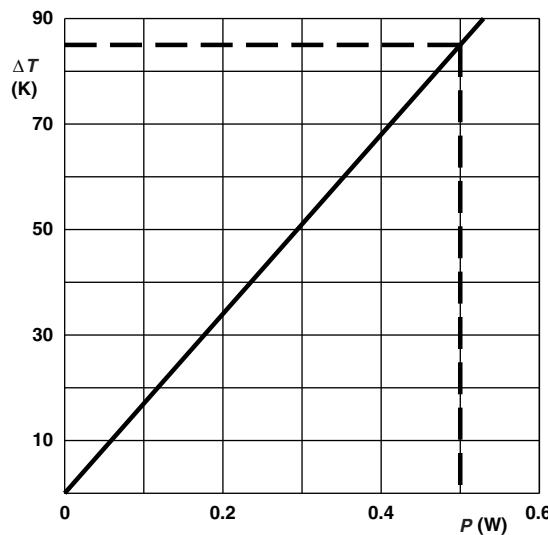
⁽²⁾ N4 packaging only available for SFR25 and SFR25H radial version.

MARKING

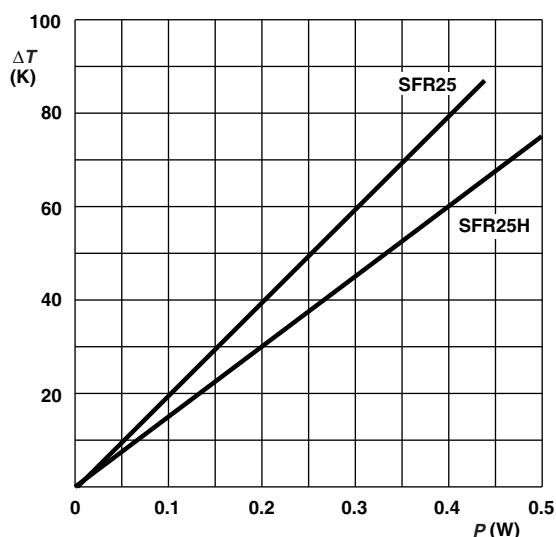
The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC 60062, marking codes for resistors and capacitors.

FUNCTIONAL PERFORMANCE

Derating

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



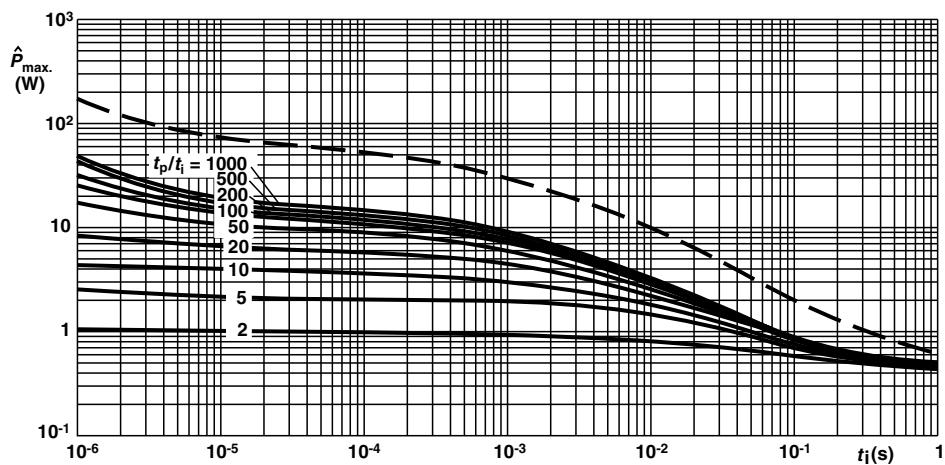
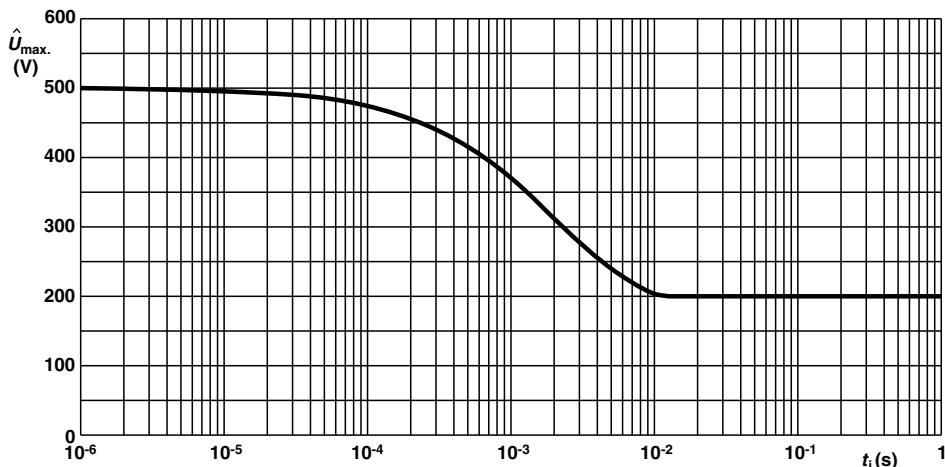
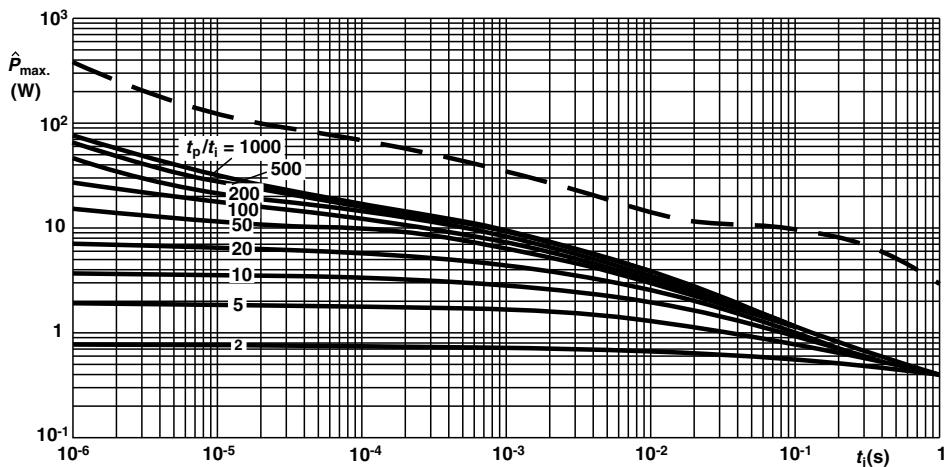
SFR16S Hot-spot temperature rise (ΔT) as a function of dissipated power

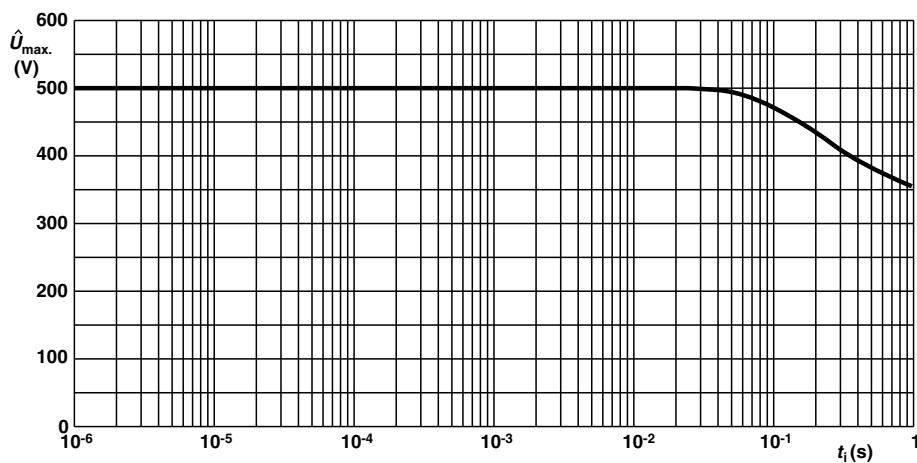


SFR25/SFR25H Hot-spot temperature rise (ΔT) as a function of dissipated power

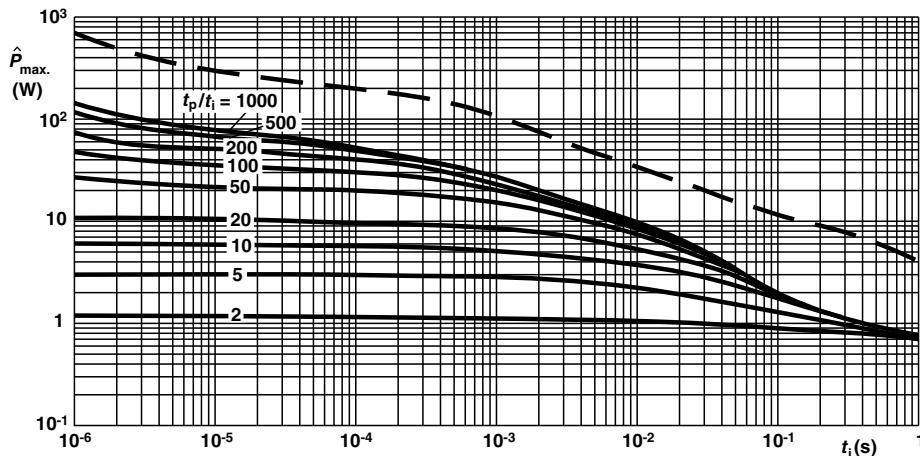
Note

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

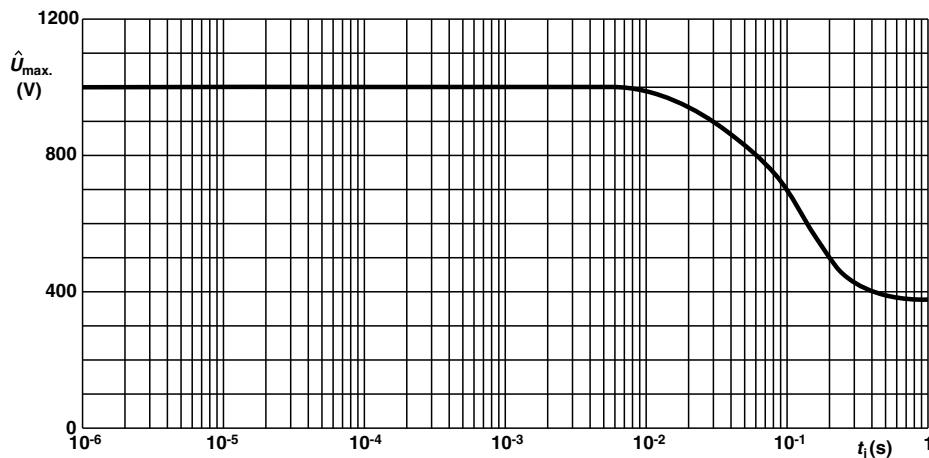

SFR16S Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{\max.}$) as a function of pulse duration (t_i)

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 (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:

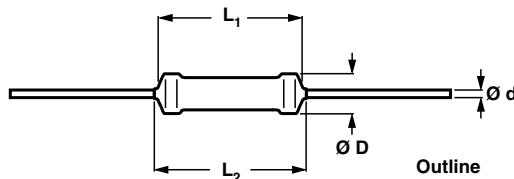
- Temperature: 15 °C to 35 °C
- Relative humidity: 45 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

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	-	$\pm 5\% ; \pm 1\%$				
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	$\pm 250 \text{ ppm/K} ; \pm 100 \text{ ppm/K}$				
4.12	-	Noise	IEC 60195		$< 68 \text{ k}\Omega$	68 kΩ to 100 kΩ	$> 100 \text{ k}\Omega$ to 1 MΩ	$> 1 \text{ M}\Omega$
				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	$\leq 0.1 \mu\text{V/V}$	$\leq 0.1 \mu\text{V/V}$	$\leq 0.1 \mu\text{V/V}$	$\leq 1.5 \mu\text{V/V}$
4.13	-	Short time overload	Room temperature; $P = 6.25 \times P_n$; (voltage not more than 2 x limiting voltage); 5 s	$\pm (0.25\% R + 0.05 \Omega)$				
4.16	21 (Ja1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	$\pm (0.25\% R + 0.05 \Omega)$				
4.17	20 (Ta)	Solderability	at +235 °C; 2 s; solder bath method; SnPb40	Good tinning ($\geq 95\%$ covered); no damage				
			at +245 °C; 3 s; solder bath method; SnAg3Cu0.5					
4.18	20 (Tb)	Resistance to soldering heat	Unmounted components (260 ± 5) °C; (10 ± 1) s	$\pm (0.25\% R + 0.05 \Omega)$				
4.19	14 (Na)	Rapid change of temperature	30 min at -55 °C and 30 min at +155 °C; 5 cycles	$\pm (0.25\% R + 0.05 \Omega)$				
4.20	29 (Eb)	Bump	3 x 1500 bumps in 3 directions; 40 g	$\pm (0.25\% R + 0.05 \Omega)$; 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	$\pm (0.25\% R + 0.05 \Omega)$; no damage				
4.23		Climatic sequence: Dry heat						
4.23.2	2 (Ba)	Damp heat, cyclic	155 °C; 16 h 55 °C; 24 h;	SFR16S, SFR25, SFR25H				
4.23.3	30 (Db)	Cold	90 % to 100 % RH; 1 cycle					
4.23.4	1 (Aa)	Low air pressure	-55 °C; 2 h					
4.23.5	13 (M)	Damp heat, cyclic	8.5 kPa; 2 h; 15 °C to 35 °C					
4.23.6	30 (Db)	DC load	55 °C; 5 days; 95 % to 100 % RH; 5 cycles					
4.23.7			apply rated power for 1 min				$\pm (1\% R + 0.05 \Omega)$; no visible damage $\pm (1\% R + 0.05 \Omega)$; no visible damage $\pm 2\% R$; no visible damage	

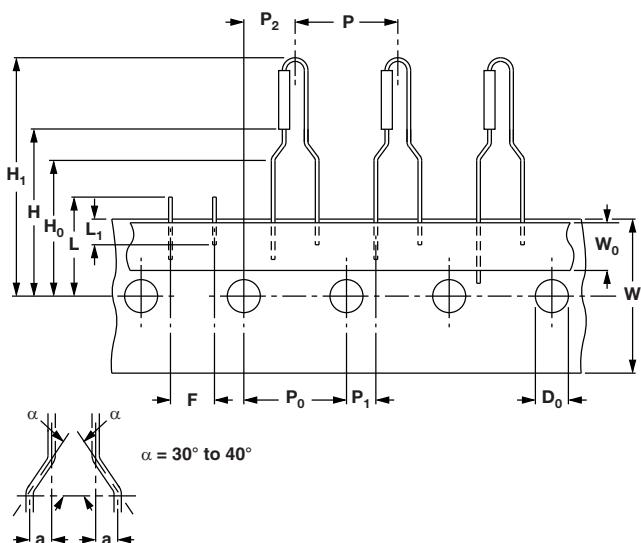
TEST PROCEDURES AND REQUIREMENTS				
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$)
4.24	78 (Cab)	Damp heat (steady state)	(40 \pm 2) °C; 56 days; (93 \pm 3) % RH	\pm (2 % R + 0.05 Ω)
4.25.1		Endurance (at 70 °C)	$U = \sqrt{P_{70} \times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

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 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 k Ω to 9.1 k Ω	2
10 k Ω to 91 k Ω	3
100 k Ω to 910 k Ω	4
1 M Ω to 9.1 M Ω	5
= 10 M Ω	6

Resistance Decade for $\pm 1\%$ 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 k Ω to 9.76 k Ω	2
10 k Ω to 97.6 k Ω	3
100 k Ω to 976 k Ω	4
1 M Ω to 9.76 M Ω	5
= 10 M Ω	6

12NC Example

The 12NC of a SFR25 resistor, value 5600 $\Omega \pm 5\%$, 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	$\pm 5\%$	-	..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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