

## **Standard Metal Film Leaded 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

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.

copper are welded to the end-caps.

#### **FEATURES**

- Small size (SFR16S: 0204, SFR25 / SFR25H: 0207)
- Low noise (max. 1.5  $\mu$ V/V for R > 1 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



HALOGEN FREE

### **APPLICATIONS**

General purpose resistors

TECHNICAL SPECIFICATIONS					
DESCRIPTION	SFR16S	SFR25	SFR25H		
DIN size	0204	0207	0207		
Resistance range	1 $\Omega$ to 3 M $\Omega$ ; jumper (0 $\Omega$ )	1 $\Omega$ to 3 M $\Omega$ ; jumper (0 $\Omega$ ) 0.22 $\Omega$ to 10 M $\Omega$ ; jumper (0 $\Omega$ ) 0.22 $\Omega$ to			
Resistance tolerance	± 5 %; ± 1 %				
Temperature coefficient	± 250 ppm/K; ± 100 ppm/K				
Rated dissipation, P <sub>70</sub>	0.5 W	0.4 W	0.5 W		
Thermal resistance	170 K/W	200 K/W	150 K/W		
Operating voltage, U <sub>max.</sub> 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  ΔR/R max. , after 1000 h	± (2 % R + 0.05 Ω)				

## Note

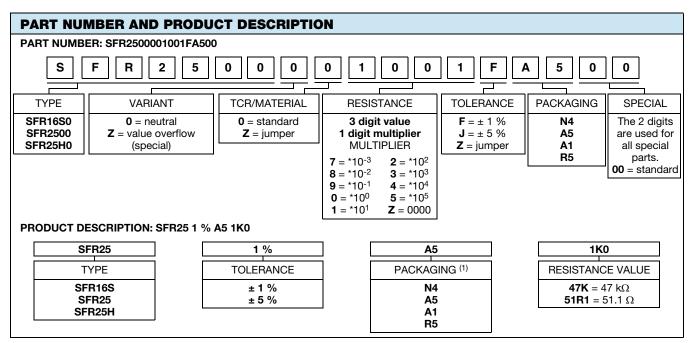
• R value is measured with probe distance of 24 mm  $\pm$  1 mm using 4-terminal method.



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE						
TYPE	TOLERANCE	TCR	RESISTANCE	E-SERIES		
		± 250 ppm/K	1 $\Omega$ to $\leq$ 4.7 $\Omega$			
	± 5 %	± 100 ppm/K	4.7 Ω to 100 kΩ	E24		
SFR16S		± 250 ppm/K	> 100 kΩ to 3 MΩ			
SFR165	± 1 %	± 100 ppm/K	5.6 Ω to 100 kΩ	E24; E96		
	± 1 70	± 250 ppm/K	> 100 kΩ to 976 kΩ	E24, E90		
	Jumper (0 Ω)	-	$≤$ 30 mΩ; $I_{max.}$ = 3 A	-		
SFR25, SFR25H		± 250 ppm/K	0.22 Ω to 4.7 Ω			
	± 5 %	± 100 ppm/K	$>$ 4.7 $\Omega$ to 1 M $\Omega$	E24		
		± 250 ppm/K	> 1 M $\Omega$ to 10 M $\Omega$			
		± 250 ppm/K	1 Ω to 4.7 Ω			
	± 1 %	± 100 ppm/K	$>$ 4.7 $\Omega$ to 1 M $\Omega$	E24; E96		
		± 250 ppm/K	> 1 M $\Omega$ to 10 M $\Omega$			
	Jumper (0 Ω) <sup>(1)</sup>	-	≤ 30 mΩ; I <sub>max.</sub> = 5 A	-		

#### Note

<sup>(1)</sup> Jumper is only available for SFR25.



#### Notes

- The products can be ordered using either the PRODUCT DESCRIPTION or the PART NUMBER.
- (1) N4 packaging indicates SFR25 and SFR25H radial version.

# SFR16S, SFR25, SFR25H

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PACKAGING						
TYPE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	DIMENSIONS
	A5	5000	Taped acc. to IEC 60286-1 fan-folded in a box		5 mm	75 mm x 73 mm x 270 mm
SFR16S	R5	5000	Taped acc. to IEC 60286-1 on a reel	52 mm		92 mm x 278 mm x 278 mm
	A1 <sup>(1)</sup>	1000	Taped acc. to IEC 60286-1 fan-folded in a box			75 mm x 28 mm x 262 mm
	A5	5000	Taped acc. to IEC 60286-1 fan-folded in a box			75 mm x 98 mm x 270 mm
SFR25, SFR25H	R5	5000	Taped acc. to IEC 60286-1 on a reel	52 mm 5 mm	93 mm x 300 mm x 298 mm	
	A1 <sup>(1)</sup>	1000	Taped acc. to IEC 60286-1 fan-folded in a box			75 mm x 28 mm x 262 mm
	N4 <sup>(2)</sup>	4000	Taped acc. to IEC 60286-2 fan-folded in a box	-	12.7 mm	45 mm x 262 mm x 330 mm

#### **Notes**

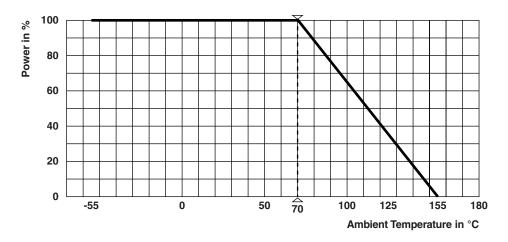
## **MARKING**

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.

 $<sup>^{(1)}\,</sup>$  A1 packaging only available for resistors with  $\pm~5~\%$  tolerance.

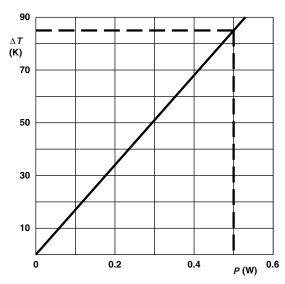
<sup>(2)</sup> N4 packaging only available for SFR25 and SFR25H radial version.

## **FUNCTIONAL PERFORMANCE**

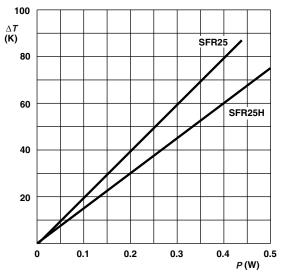


## **Derating**

Maximum dissipation (P<sub>max.</sub>) in percentage of rated power as a function of the ambient temperature (T<sub>amb</sub>)



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

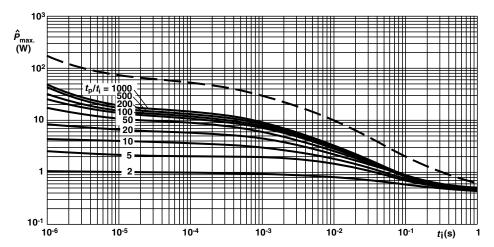


SFR25/SFR25H Hot-spot temperature rise ( $\Delta T$ ) as a function of dissipated power

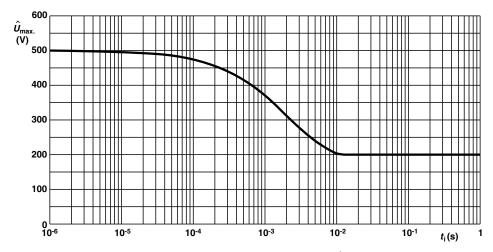
#### Note

 $\bullet~$  The maximum permissible hot-spot temperature is 155  $^{\circ}\text{C}.$ 

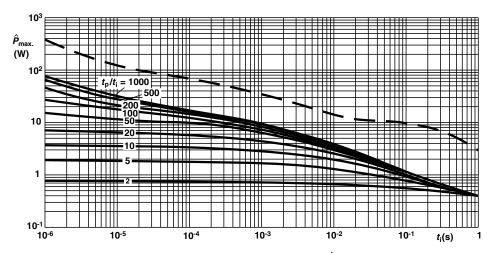




SFR16S Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )

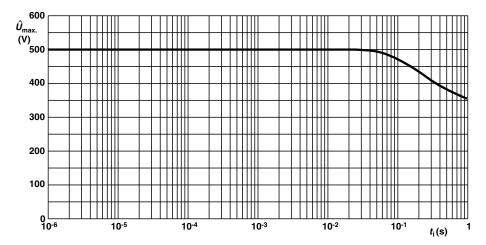


SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )

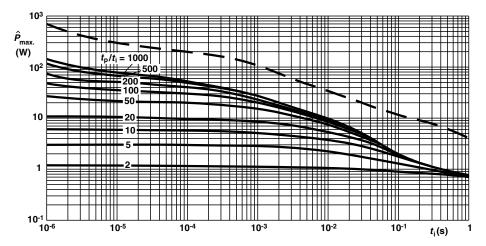


SFR25 Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )

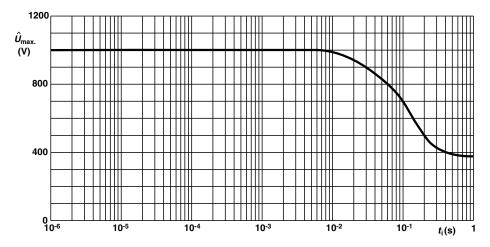




SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



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.

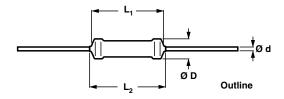
TEST F	ROCEDU	JRES AND RE	QUIREMENTS					
IEC 60115-1 CLAUSE	60115-1 60068-2 TEST PROCEDURE			REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R_{ m max}$ .)				
4.5	-	Resistance	-	± 5 %; ± 1 %				
4.8	-	Temperature coefficient	At (20 / -55 / 20) °C and (20 / 155 / 20) °C	± 250 ppm/K; ± 100 ppm/K				
					< 68 kΩ	68 kΩ to 100 kΩ	$>$ 100 k $\Omega$ to 1 M $\Omega$	> 1 MΩ
4.12	-	Noise	IEC 60195	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
4.13	-	Short time 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)				
4.16	21 (Ua1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	± (0.25 % R + 0.05 Ω)				
4.17	20 (Ta)	Solderability	at +235 °C; 2 s; solder bath method; SnPb40 at +245 °C; 3 s; solder bath method;	Good tinning (≥ 95 % covered); no damage			ge	
4.18	20 (Tb)	Resistance to soldering heat	SnAg3Cu0.5 Unmounted components (260 ± 5) °C; (10 ± 1) s	± (0.25 % R + 0.05 Ω)				
4.19	14 (Na)	Rapid change of temperature	30 min at -55 °C and 30 min at +155 °C; 5 cycles		± (	0.25 % <i>R</i> + 0.	05 Ω)	
4.20	29 (Eb)	Bump	3 x 1500 bumps in 3 directions; 40 g		± (0.25 %	6 R + 0.05 Ω);	no damage	
4.22	6 (Fc)	Vibration	10 sweep cycles per direction; 10 Hz to 2000 Hz 1.5 mm or 200 m/s <sup>2</sup>	$\pm$ (0.25 % $R$ + 0.05 Ω); no damage				
4.23		Climatic sequence:						
4.23.2	2 (Ba)	Dry heat	155 °C; 16 h					
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; 90 % to 100 % RH; 1 cycle					
4.23.4	1 (Aa)	Cold	-55 °C; 2 h					
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; 15 °C to 35 °C					
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 5 days; 95 % to 100 % RH; 5 cycles	SFR16S, SFR25, SFR25H $\pm$ (1 % $R$ + 0.05 $\Omega$ ); no visible dar $\pm$ (1 % $R$ + 0.05 $\Omega$ ); no visible dar age		mage		
4.23.7		DC load	apply rated power for 1 min			± 2 % R; no \	; no visible damage	

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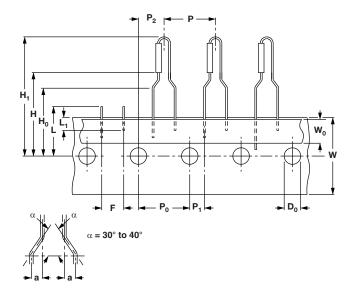
TEST P	TEST PROCEDURES AND REQUIREMENTS						
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R_{ m max.}$ )			
4.24	78 (Cab)	Damp heat (steady state)	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (2 % R + 0.05 Ω)			
4.25.1		Endurance (at 70 °C)	$U = \sqrt{P_{70}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

## **DIMENSIONS**



<b>DIMENSIONS</b> - Leaded resistor types, mass and relevant physical dimensions						
TYPE Ø D <sub>max.</sub> L <sub>1 max.</sub> L <sub>2 max.</sub> Ø d MASS (mm) (mm) (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



<b>DIMENSIONS</b> in millimeters						
Pitch of components	Р	12.7 ± 1.0				
Feed-hole pitch	P <sub>0</sub>	12.7 ± 0.2				
Feed-hole center to lead at topside at the tape	P <sub>1</sub>	3.85 ± 0.5				
Feed-hole center to body center	P <sub>2</sub>	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 <sub>0</sub>	16.5 ± 0.5				
Height of component from tape center	Н	19.5 ± 1				
Feed-hole diameter	D <sub>0</sub>	4.0 ± 0.2				
Maximum length of snipped lead	L	11.0				
Minimum lead wire (tape portion) shortest lead	L <sub>1</sub>	2.5				

### Note

 Please refer to document "Packaging" for more detail (www.vishay.com/doc?28721).



# SFR16S, SFR25, SFR25H

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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 ο 91 Ω	9
100 $\Omega$ to 910 $\Omega$	1
1 kΩ to 9.1 kΩ	2
10 kΩ to 91 kΩ	3
100 kΩ to 910 kΩ	4
1 M $\Omega$ to 9.1 M $\Omega$	5
= 10 MΩ	6

### Resistance Decade for ± 1 % Tolerance

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

### 12NC Example

The 12NC of a SFR25 resistor, value 5600  $\Omega$  ± 5 %, taped on a bandolier of 5000 units in ammopack was: 2322 181 43562.

HISTORICAL 12NC - Resistor type and packaging							
			23				
TYPE	TOL.	В	SANDOLIER IN AMMOPAC	CK	BANDOLIER ON REEL		
ITPE	TOL.	RADIAL TAPED	STRAIGH	IT LEADS	STRAIGHT LEADS		
		4000 UNITS	1000 UNITS	5000 UNITS	5000 UNITS		
	± 5 %	-	22 187 73	22 187 53	06 187 23		
SFR16S	± 1 %	-	-	06 187 3	06 187 1		
	Jumper	1	-	06 187 90013	22 187 90346		
	± 5 %	06 184 03	22 181 53	22 181 43	22 181 63		
SFR25	± 1 %	-	-	22 188 2	06 181 8		
	Jumper	1	22 181 90018	22 181 90019	06 181 90011		
SFR25H	± 5 %	06 186 03	22 186 16	22 186 76	06 186 63		
SFR25H	± 1 %	-	-	22 186 3	06 186 8		



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# Vishay:

5043EM470R0J 5043EM100R0J 5043ED1K070F 5033EM 0R 5%TR SFR25 27K 5%TR SFR25 3.9 5%TR SFR25H 120 1%TR SFR25H 2.2 1%TR SFR25H 274K 1%TR SFR25H 324 1%TR SFR25H 8.2 5%TR SFR25H 90.9 1%TR SFR55 620 1%TR 5043DM2M200J 5043EM100K0J 5043CX33K00J12BFX SFR25H9.09K1%TR 5043EM4R700J SFR16S0004701JA5 SFR2500001001FA500