

## 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 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.

### FEATURES

- Low cost
- Low noise (max. 1.5  $\mu\text{V/V}$  for  $R > 1 \text{ M}\Omega$ )
- Small size (SFR16S: 0204, SFR25/25H: 0207)
- Lead (Pb)-free solder contacts
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

### APPLICATIONS

- General purpose resistors

TECHNICAL SPECIFICATIONS				
DESCRIPTION	UNIT	SFR16S	SFR25	SFR25H
Resistance Range	$\Omega$	$\pm 5 \%$ ; 1 to 3M $\pm 1 \%$ ; 4.99 to 3M Jumper (0 $\Omega$ )	$\pm 5 \%$ ; 0.22 to 10M $\pm 1 \%$ ; 1 to 10M Jumper (0 $\Omega$ )	
Resistance Tolerance	%	$\pm 1$ , E24/E96 series; $\pm 5$ , E24 series		
Temperature Coefficient: $R \leq 4.7 \Omega$ $4.7 \Omega < R \leq 100 \text{ k}\Omega$ $100 \text{ k}\Omega < R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	ppm/K	$\leq \pm 250$ $\leq \pm 100$ $\leq \pm 250$ $\leq \pm 250$	$\leq \pm 100$ $\leq \pm 100$ $\leq \pm 100$ $\leq \pm 250$	$\leq \pm 100$ $\leq \pm 100$ $\leq \pm 100$ $\leq \pm 250$
Rated Dissipation, $P_{70}$	W	0.5	0.4	0.5
Thermal Resistance, $R_{th}$	K/W	170	200	150
Maximum Permissible Voltage, ( $U_{max}$ . AC/DC)	V	200	250	350
Noise: $R < 68 \text{ k}\Omega$ $68 \text{ k}\Omega \leq R \leq 100 \text{ k}\Omega$ $100 \text{ k}\Omega \leq R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\mu\text{V/V}$	max. 0.1 max. 0.5 max. 1.5 max. 1.5	max. 0.1 max. 0.1 max. 0.1 max. 1.5	max. 0.1 max. 0.1 max. 0.1 max. 1.5
Basic Specifications		IEC 60115-1		
Climatic Category (IEC 60068-1)		55/155/56		
Stability, $\Delta R$ max., after: Load (1000 h, $P_{70}$ ): $R$ Range Long Term Damp Heat Test (56 Days): $R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$		$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$	$\pm (2 \% R + 0.05 \Omega)$ $\pm (1 \% R + 0.05 \Omega)$ $\pm (2 \% R + 0.1 \Omega)$
Soldering (10 s, 260 °C)		$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$
Short Time Overload		$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (0.25 \% R + 0.05 \Omega)$	$\pm (1 \% R + 0.05 \Omega)$

#### Note

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

PART NUMBER AND PRODUCT DESCRIPTION						
PART NUMBER: SFR2500001001FA500						
S	F	R	2	5	0	0
0	0	0	0	1	0	0
1	0	0	1	F	A	5
0	0					0
MODEL/SIZE	VARIANT	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING <sup>(1)</sup>	SPECIAL
SFR16S0 SFR2500 SFR25H0	0 = Neutral Z = Value overflow (special)	0 = Standard Z = Jumper	3 digit value 1 digit multiplier MULTIPLIER  7 = *10 <sup>-3</sup> 2 = *10 <sup>2</sup> 8 = *10 <sup>-2</sup> 3 = *10 <sup>3</sup> 9 = *10 <sup>-1</sup> 4 = *10 <sup>4</sup> 0 = *10 <sup>0</sup> 5 = *10 <sup>5</sup> 1 = *10 <sup>1</sup> Z = 0000	F = ± 1 % J = ± 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			
MODEL/SIZE	TOLERANCE	PACKAGING <sup>(1)</sup>	RESISTANCE VALUE			
SFR16S SFR25 SFR25H	± 1 % ± 5 %	N4 A5 A1 R5	47K = 47 kΩ 51R1 = 51.1 Ω			

**Notes**

<sup>(1)</sup> Please refer to table PACKAGING

- The jumper has a maximum resistance  $R_{max.} = 30 \text{ m}\Omega$  at 3 A (SFR16S)
- The jumper has a maximum resistance  $R_{max.} = 30 \text{ m}\Omega$  at 5 A (SFR25)
- The PART NUMBER is shown to facilitate the introduction of a unified part numbering system for ordering products

PACKAGING						
MODEL	TOLERANCE	TAPING	AMMO PACK		REEL	
			PIECES	CODE	PIECES	CODE
SFR16S	1 %	Axial, 52 mm	5000	A5	5000	R5
SFR16S	5 %	Axial, 52 mm	5000	A5	5000	R5
			1000	A1		
SFR25, SFR25H	1 %	Axial, 52 mm	5000	A5	5000	R5
SFR25, SFR25H	5 %	Axial, 52 mm	5000	A5	5000	R5
			1000	A1		
SFR25, SFR25H	1 %	Radial	4000	N4	-	-
SFR25, SFR25H	5 %	Radial	4000	N4	-	-

**DIMENSIONS**


DIMENSIONS - Resistor types and relevant physical dimensions in millimeters				
TYPE	Ø D <sub>max.</sub>	L <sub>1 max.</sub>	L <sub>2 max.</sub>	Ø d
SFR16S	1.9	3.5	4.1	0.45 ± 0.05
SFR25	2.5	6.5	7.5	0.58 ± 0.05
SFR25H	2.5	6.5	7.5	0.58 ± 0.05

MASS PER UNIT	
TYPE	MASS (mg)
SFR16S	102
SFR25	205
SFR25H	205

**OUTLINES**

The length of the body ( $L_1$ ) is measured by inserting the leads into holes of two identical gauge plates and moving these plates parallel to each other until the resistor body is clamped without deformation (IEC 60294).

**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.

**PRODUCTS WITH RADIAL LEADS (SFR25, SFR25H)**


DIMENSIONS - Radial taping				
SYMBOL	PARAMETER	VALUE	TOLERANCE	UNIT
P	Pitch of components	12.7	$\pm 1.0$	mm
$P_0$	Feed-hole pitch	12.7	$\pm 0.2$	mm
$P_1$	Feed-hole centre to lead at topside at the tape	3.85	$\pm 0.5$	mm
$P_2$	Feed-hole center to body center	6.35	$\pm 1.0$	mm
F	Lead-to-lead distance	4.8	+ 0.7/- 0	mm
W	Tape width	18.0	$\pm 0.5$	mm
$W_0$	Minimum hold down tape width	5.5	-	mm
H1	Component height	29	Max.	mm
$H_0$	Lead wire clinch height	16.5	$\pm 0.5$	mm
$H_0$	Height of component from tape center	19.5	$\pm 1$	mm
$D_0$	Feed-hole diameter	4.0	$\pm 0.2$	mm
L	Maximum length of snapped lead	11.0	-	mm
$L_1$	Minimum lead wire (tape portion) shortest lead	2.5	-	mm

**Note**

- Please refer to document "Packaging" for more detail ([www.vishay.com/doc?28721](http://www.vishay.com/doc?28721)).



**FUNCTIONAL PERFORMANCE  
PRODUCT CHARACTERIZATION**

Standard values of nominal resistance are taken from the E96/E24 series for resistors with a tolerance of ± 1 % or ± 5 %. The values of the E96/E24 series are in accordance with IEC 60063.

The power that the resistor can dissipate depends on the operating temperature



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



SFR16S Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max.}$ ) as a function of pulse duration (t<sub>i</sub>)



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 ( $t_i$ )



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**

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

**Application Information**







TEST PROCEDURES AND REQUIREMENTS							
IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					SFR16S	SFR25	SFR25H
4.24	78 (Cab)	Damp heat (steady state)	56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 $P_{70}$ (steps: 0 V to 100 V)		$R_{ins}$ min.: 1000 M $\Omega$ $\Delta R$ max.: $\pm (2 \% R + 0.05 \Omega)$		
4.25.1		Endurance (at 70 °C)	1000 h; loaded with $P_{70}$ or $U_{max}$ ; 1.5 h ON and 0.5 h OFF		$\Delta R$ max.: $\pm (2 \% R + 0.05 \Omega)$		
4.8		Temperature coefficient	Between - 55 °C and + 155 °C	$R < 4.7 \Omega$ $R \leq 100 \text{ k}\Omega$ $R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\leq \pm 250 \text{ ppm/K}$ $\leq \pm 100 \text{ ppm/K}$ $\leq \pm 250 \text{ ppm/K}$ $\leq \pm 250 \text{ ppm/K}$	$\leq \pm 100 \text{ ppm/K}$ $\leq \pm 100 \text{ ppm/K}$ $\leq \pm 100 \text{ ppm/K}$ $\leq \pm 250 \text{ ppm/K}$	$\leq \pm 100 \text{ ppm/K}$ $\leq \pm 100 \text{ ppm/K}$ $\leq \pm 100 \text{ ppm/K}$ $\leq \pm 250 \text{ ppm/K}$
4.7		Voltage proof on insulation	$U_{RMS} = 400 \text{ V}$ (SFR16S) or $U_{RMS} = 600 \text{ V}$ (SFR25 and SFR25H); during 1 min; V-block method		No breakdown		
4.12		Noise	IEC 60195	$R < 68 \text{ k}\Omega$ $R \leq 100 \text{ k}\Omega$ $R \leq 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	max. 0.1 $\mu\text{V/V}$ max. 0.5 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$	max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$	max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 0.1 $\mu\text{V/V}$ max. 1.5 $\mu\text{V/V}$
4.6.1.1		Insulation resistance	$U_{max}$ , DC = 500 V during 1 min; V-block method		$R_{ins}$ min.: 1000 M $\Omega$		
4.13		Short time overload	Room temperature; $P = 6.25 \times P_n$ (SFR25, SFR25H) or 6.25 x 0.25 W (SFR16S); (voltage not more than 2 x limiting voltage); 10 cycles; 5 s ON and 45 s OFF		$\Delta R$ max.: $\pm (0.25 \% R + 0.05 \Omega)$		$\Delta R$ max.: $\pm 1 \% R + 0.05 \Omega$

**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 $\Omega$ to 0.91 $\Omega$	7
1 $\Omega$ to 9.1 $\Omega$	8
10 $\Omega$ to 91 $\Omega$	9
100 $\Omega$ to 910 $\Omega$	1
1 k $\Omega$ to 9.1 k $\Omega$	2
10 k $\Omega$ to 91 k $\Omega$	3
100 k $\Omega$ to 910 k $\Omega$	4
1 M $\Omega$ to 9.1 M $\Omega$	5
= 10 M $\Omega$	6

**Resistance Decade for  $\pm 1 \%$  Tolerance**

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

**12NC Example**

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



<b>HISTORICAL 12NC - Resistor type and packaging</b>					
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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