

### **Standard Metal Film Leaded Resistors**



#### **FEATURES**

- Low cost
- Low noise (max. 1.5  $\mu$ V/V for R > 1 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 <a href="https://www.vishav.com/doc?99912">www.vishav.com/doc?99912</a>

### **APPLICATIONS**

• General purpose resistors

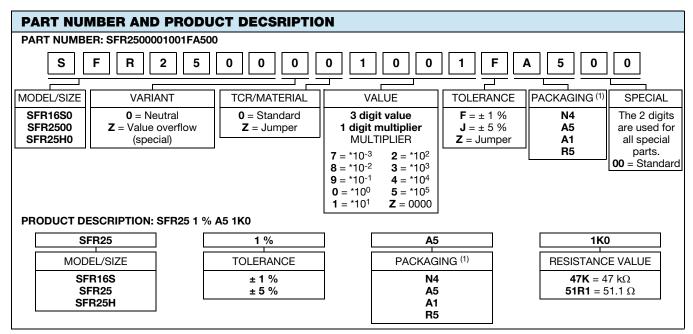
A homogeneous film of metal alloy is deposited on a high grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps.

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	UNIT	SFR16S	SFR25	SFR25H			
		± 5 %; 1 to 3M	± 5 %; 0.	22 to 10M			
Resistance Range	Ω	± 1 %; 4.99 to 3M	± 1 %;	1 to 10M			
		Jumper (0 $\Omega$ )	Jumper (0 Ω)				
Resistance Tolerance	%	± 1,	E24/E96 series; $\pm$ 5, E24 se	eries			
Temperature Coefficient:							
$R \leq 4.7 \Omega$		≤ ± 250	≤ ± 100	≤ ± 100			
$4.7 \Omega < R \le 100 \text{ k}\Omega$	ppm/K	≤± 100	≤ ± 100	≤ ± 100			
100 k $\Omega$ < $R$ ≤ 1 M $\Omega$		≤± 250	≤ ± 100	≤ ± 100			
$R > 1 \text{ M}\Omega$		≤ ± 250	≤ ± 250	≤ ± 250			
Rated Dissipation, P <sub>70</sub>	W	0.5	0.4	0.5			
Thermal Resistance, R <sub>th</sub>	K/W	170	200	150			
Maximum Permissible Voltage, (U <sub>max.</sub> AC/DC)	V	200	250	350			
Noise:							
$R < 68 \text{ k}\Omega$		max. 0.1	max. 0.1	max. 0.1			
$68 \text{ k}\Omega \le R \le 100 \text{ k}\Omega$	μV/V	max. 0.5	max. 0.1	max. 0.1			
100 kΩ $\leq R \leq$ 1 MΩ		max. 1.5	max. 0.1	max. 0.1			
$R > 1 \text{ M}\Omega$		max. 1.5	max. 1.5	max. 1.5			
Basic Specifications			IEC 60115-1				
Climatic Category (IEC 60068-1)			55/155/56				
Stability, ∆R max., after:							
Load (1000 h, P <sub>70</sub> ):							
R Range		$\pm$ (2 % R + 0.05 $\Omega$ )	$\pm$ (2 % $R$ + 0.05 $\Omega$ )	$\pm$ (2 % $R$ + 0.05 $\Omega$ )			
Long Term Damp Heat Test (56 Days):							
$R \le 1 \text{ M}\Omega$		$\pm$ (1 % $R$ + 0.05 $\Omega$ )	$\pm$ (1 % $R$ + 0.05 $\Omega$ )	$\pm$ (1 % $R$ + 0.05 $\Omega$ )			
$R > 1 \text{ M}\Omega$		$\pm$ (1 % $R$ + 0.05 $\Omega$ )	$\pm$ (1 % $R$ + 0.05 $\Omega$ )	± (2 % R + 0.1 Ω)			
Soldering (10 s, 260 °C)		$\pm$ (0.25 % $R$ + 0.05 $\Omega$ )	± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)			
Short Time Overload		± (0.25 % R + 0.05 Ω)	$\pm$ (0.25 % $R$ + 0.05 $\Omega$ )	± (1 % R + 0.05 Ω)			

#### Note

• R value is measured with probe distance of 24 mm ± 1 mm using 4-terminal method



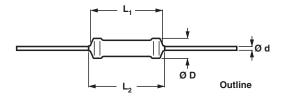
#### **Notes**

(1) Please refer to table PACKAGING

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

PACKAGING								
MODEL	TOLEDANOE		AMMO	AMMO PACK		REEL		
MODEL	TOLERANCE	TAPING	PIECES	CODE	PIECES	CODE		
SFR16S	1 %	Axial, 52 mm	5000	A5	5000	R5		
CED160	5 %	Avial E0 mm	5000	A5	5000	R5		
SFR16S	5 %	Axial, 52 mm	1000	A1				
SFR25, SFR25H	1 %	Axial, 52 mm	5000	A5	5000	R5		
CEDOE CEDOEII	5 %	Avial E0 mm	5000	A5	5000	R5		
SFR25, SFR25H	5 %	Axial, 52 mm	1000	A1	5000			
SFR25, SFR25H	1 %	Radial	4000	N4	-	-		
SFR25, SFR25H	5 %	Radial	4000	N4	-	-		

### **DIMENSIONS**



<b>DIMENSIONS</b> - 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	$0.45 \pm 0.05$			
SFR25	2.5	6.5	7.5	$0.58 \pm 0.05$			
SFR25H	2.5	6.5	7.5	$0.58 \pm 0.05$			



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

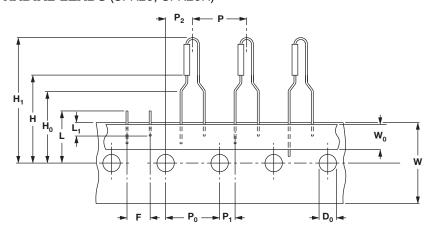
### **OUTLINES**

The length of the body (L<sub>1</sub>) 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		
Р	Pitch of components	12.7	± 1.0	mm		
P <sub>0</sub>	Feed-hole pitch	12.7	± 0.2	mm		
P <sub>1</sub>	Feed-hole centre to lead at topside at the tape	3.85	± 0.5	mm		
P <sub>2</sub>	Feed-hole center to body center	6.35	± 1.0	mm		
F	Lead-to-lead distance	4.8	+ 0.7/- 0	mm		
W	Tape width	18.0	± 0.5-	mm		
$W_0$	Minimum hold down tape width	5.5	-	mm		
H1	Component height	29	Max.	mm		
H <sub>0</sub>	Lead wire clinch height	16.5	± 0.5	mm		
H <sub>0</sub>	Height of component from tape center	19.5	± 1	mm		
D <sub>0</sub>	Feed-hole diameter	4.0	± 0.2	mm		
L	Maximum length of snipped lead	11.0	-	mm		
L <sub>1</sub>	Minimum lead wire (tape portion) shortest lead	2.5	-	mm		

### Note

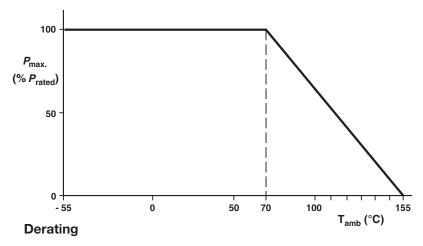
• Please refer to document "Packaging" for more detail (www.vishay.com/doc?28721).



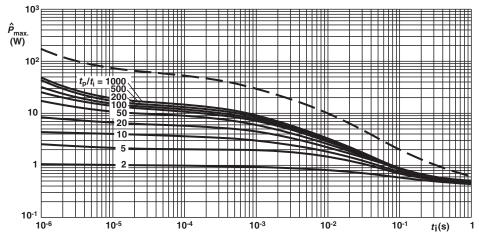
# FUNCTIONAL PERFORMANCE PRODUCT CHARACTERIZATION

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

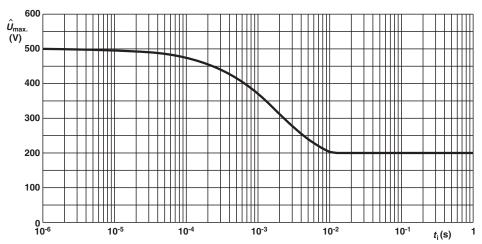
The power that the resistor can dissipate depends on the operating temperature



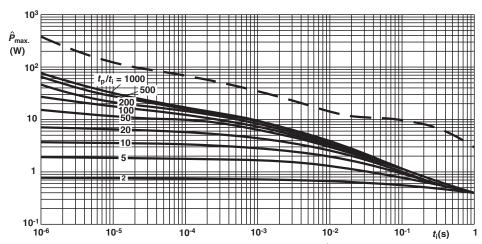
Maximum dissipation (P<sub>max</sub>) in percentage of rated power as a function of the ambient temperature (T<sub>amb</sub>)



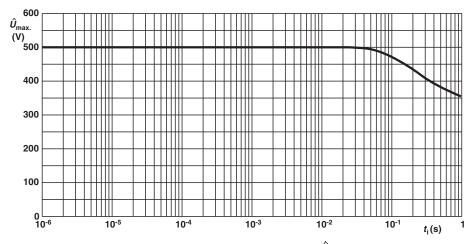
SFR16S Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



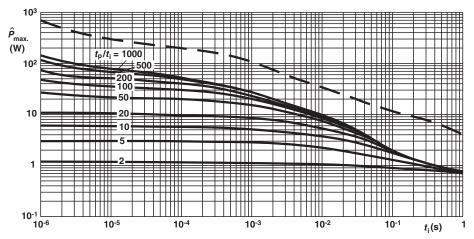
SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max.}$ ) as a function of pulse duration ( $t_i$ )



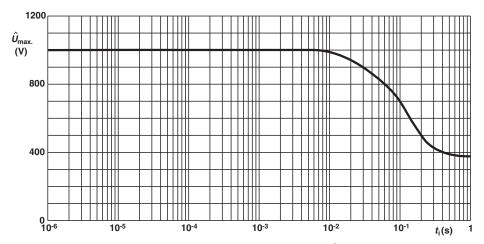
SFR25 Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



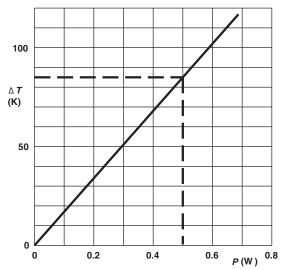
SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



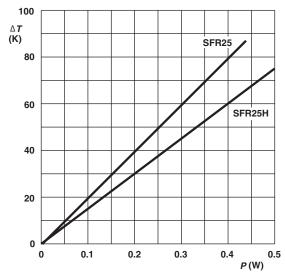
SFR25H Pulse on a regular basis; maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ )



SFR25H Pulse on a regular basis; maximum permissible peak pulse voltage ( $\hat{U}_{max}$ ) as a function of pulse duration ( $t_i$ )



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**

ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000



### **TESTS AND REQUIREMENTS**

Essentially all tests are carried out in accordance with IEC 60115-1 specification, category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category temperature; damp heat, steady state, test duration: 56 days).

The tests are carried out in accordance with IEC 60068-2-xx test method under standard atmospheric conditions according to IEC 60068-1, 5.3.

In the Test Procedures and Requirements table, 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. In some instances deviations from the IEC recommendations were necessary for our method of specifying. All soldering tests are performed with mildly activated flux.

TEST PROCEDURES AND REQUIREMENTS							
IEC 60115-1	IEC 60068-2	TEST	PROCEDURE	RESISTANCE	ı	REQUIREMENTS	3
CLAUSE	TEST METHOD			RANGE	SFR16S	SFR25	SFR25H
4.16		Robustness of terminations:					
4.16.2	21 (Ua1)	Tensile all samples	Ø 0.45 mm, load 5 N; 10 s Ø 0.58 mm, load 10 N; 10 s		Number of failures < 10 x 10 <sup>-6</sup>		
4.16.3	21 (Ub)	Bending half number of samples	Ø 0.45 mm, load 2.5 N; 4 x 90° Ø 0.58 mm, load 5 N; 4 x 90°		Number of failures < 10 x 10 <sup>-6</sup>		
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite directions		∆R max	No damage x.: ± (0.25 % R +	0.05 Ω)
4.17	20 (Ta)	Solderability	2 s; 235 °C: Solder bath method; SnPb40 3 s; 245 °C: Solder bath method; SnAg3Cu0.5		Good tinning (≥ 95 % covered); no damage		
		Solderability (after aging)	8 h steam or 16 h 155 °C; leads immersed 6 mm; for 2 s at 235 °C: Solder bath (SnPb40) for 3 s at 245 °C: Solder bath (SnAgCu0.5) method		Good tinning (≥ 95 % covered) no damage		overed);
4.18	20 (Tb)	Resistance to soldering heat	Thermal shock: 10 s; 260 °C; 3 mm from body		$\Delta R \text{ max.: } \pm (0.25 \% R + 0.05 \Omega)$		0.05 Ω)
4.19	14 (Na)	Rapid change of temperature	30 min at - 55 °C and 30 min at + 155 °C; 5 cycles		∆R ma:	x.: ± (0.25 % <i>R</i> +	0.05 Ω)
4.20	29 (Eb)	Bump	3 x 1500 bumps in 3 directions; 40 g		∆R max	No damage x.: ± (0.25 % <i>R</i> +	0.05 Ω)
4.22	6 (Fc)	Vibration	Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)		No damage $\Delta R$ max.: $\pm$ (0.25 % $R$ + 0.05 $\Omega$ )		0.05 Ω)
4.23		Climatic sequence:	, ,		F	R <sub>ins</sub> min.: 1000 Ms	Ω
4.23.2	2 (Ba)	Dry heat	16 h; 155 °C				
4.23.3	30 (Db)	Damp heat (accelerated) 1 <sup>st</sup> cycle	24 h; 55 °C; 90 % to 100 % RH				
4.23.4	1 (Aa)	Cold	2 h; - 55 °C				
4.23.5	13 (M)	Low air pressure	2 h; 8.5 kPa; 15 °C to 35 °C				
4.23.6	30 (Db)	Damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 % to 100 % RH	$R \le 1 \text{ M}\Omega$ $R > 1 \text{ M}\Omega$	$\Omega$ ΔR max.: ± (1 % R + 0.05 $\Omega$ ) ± (		$\Delta R \text{ max.:}$ ± (2 % R + 0.1 Ω)



TEST P	ROCEDU	JRES AND REC	QUIREMENTS					
IEC 60115-1	IEC 60068-2	TEST	PROCEDURE RESISTANCE RANGE	RESISTANCE	REQUIREMENTS			
CLAUSE	TEST METHOD	1231		RANGE	SFR16S	SFR25	SFR25H	
4.24	78 (Cab)	Damp heat (steady state)	56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 P <sub>70</sub> (steps: 0 V to 100 V)		$R_{\rm ins}$ min.: 1000 MΩ ΔR max.: ± (2 % R + 0.05 Ω)			
4.25.1		Endurance (at 70 °C)	1000 h; loaded with $P_{70}$ or $U_{\rm max.}$ ; 1.5 h ON and 0.5 h OFF		$\Delta R$ max.: ± (2 % $R$ + 0.05 $\Omega$ )			
				$R < 4.7 \Omega$	≤ ± 250 ppm/K			
4.8		Temperature	Between	<i>R</i> ≤ 100 kΩ	≤ ± 100 ppm/K	≤ ± 100 ppm/K		
1.0		coefficient	- 55 °C and + 155 °C	$R \le 1 \text{ M}\Omega$	≤ ± 250 ppm/K	≤ ± 100 ppm/K	≤ ± 100 ppm/K	
				$R > 1 \text{ M}\Omega$	≤ ± 250 ppm/K	≤ ± 250 ppm/K	≤ ± 250 ppm/K	
4.7		Voltage proof on insulation	$U_{\rm RMS} = 400$ V (SFR16S) or $U_{\rm RMS} = 600$ V (SFR25 and SFR25H); during 1 min; V-block method		No breakdown			
				$R < 68 \text{ k}\Omega$	max. 0.1 μV/V	max. 0.1 μV/V	max. 0.1 μV/V	
4.12		Noise	IEC 60195	<i>R</i> ≤ 100 kΩ	max. 0.5 μV/V	max. 0.1 μV/V	max. 0.1 μV/V	
4.12		Noise	IEC 60193	<i>R</i> ≤ 1 MΩ	max. 1.5 μV/V	max. 0.1 μV/V	max. 0.1 μV/V	
				$R > 1 \text{ M}\Omega$	max. 1.5 μV/V	max. 1.5 μV/V	max. 1.5 μV/V	
4.6.1.1		Insulation resistance	U <sub>max.</sub> 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 $6.25 \times 0.25 \text{ W (SFR16S)};$ (voltage not more than $2 \times \text{limiting voltage};$ 10  cycles; 5  s ON and  45  s OFF		$\Delta R \text{ max.:} $ $\pm (0.25\% R \pm 0.05\%)$ $\pm 1$		ΔR max.: ± 1 % R + 0.05 Ω)	

### **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 $\Omega$ to 0.91 $\Omega$	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 k $\Omega$ to 910 k $\Omega$	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 Ω to 97.6 Ω	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							
	TOL.	23					
TYPE		BANDOLIER IN AMMOPACK			BANDOLIER ON REEL		
		RADIAL TAPED STRAIGHT 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	-	-	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	-	22 181 90018	22 181 90019	06 181 90011		
SFR25H	± 5 %	06 186 03	22 186 16	22 186 76	06 186 63		
SERZSE	± 1 %	-	-	22 186 3	06 186 8		



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Revision: 02-Oct-12 Document Number: 91000

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CW0106K000JE73 672D826H075EK5C CWR06JC105KC CWR06NC475JC MAL219699001E3 MCRL007035R00JHB00 GBU4K-E3/51
GBU8M-E3/51 PTF56100K00QYEK PTN0805H1502BBTR1K RCWL1210R130JNEA RH005220R0FE02 RH005330R0FC02
RH010R0500FC02 132B20103 RH1007R000FJ01 RH2503R500FE01 RH254R220FS03 RH-50-40R2-1%-C02 134D336X9075C6
132B00301 135D277X0025F6 DG202BDY-T1-E3 DG9426EDQ-T1-GE3