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 μV/V for R > 1 MΩ)
- 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

Pb-free
RoHS
COMPLIANT

APPLICATIONS

- General purpose resistors

TECHNICAL SPECIFICATIONS

DESCRIPTION	UNIT	SFR16S	SFR25	SFR25H
Resistance Range	Ω	± 5 %; 1 to 3M	± 5 %; 0.22 to 10M	
		± 1 %; 4.99 to 3M	± 1 %; 1 to 10M	
		Jumper (0 Ω)	Jumper (0 Ω)	
Resistance Tolerance	%	± 1, E24/E96 series; ± 5, E24 series		
Temperature Coefficient:	ppm/K			
$R \leq 4.7\ \Omega$		≤ ± 250	≤ ± 100	≤ ± 100
$4.7\ \Omega < R \leq 100$ kΩ		≤ ± 100	≤ ± 100	≤ ± 100
100 kΩ $< R \leq$ 1 MΩ		≤ ± 250	≤ ± 100	≤ ± 100
$R >$ 1 MΩ		≤ ± 250	≤ ± 250	≤ ± 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:	μV/V			
$R <$ 68 kΩ		max. 0.1	max. 0.1	max. 0.1
68 kΩ $\leq R \leq$ 100 kΩ		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 MΩ		max. 1.5	max. 1.5	max. 1.5
Basic Specifications		IEC 60115-1		
Climatic Category (IEC 60068-1)		55/155/56		
Stability, ΔR max., after:				
Load (1000 h, P_{70}):				
R Range		± (2 % R + 0.05 Ω)	± (2 % R + 0.05 Ω)	± (2 % R + 0.05 Ω)
Long Term Damp Heat Test (56 Days):				
$R \leq$ 1 MΩ		± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)
$R >$ 1 MΩ		± (1 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)	± (2 % R + 0.1 Ω)
Soldering (10 s, 260 °C)		± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)
Short Time Overload		± (0.25 % R + 0.05 Ω)	± (0.25 % R + 0.05 Ω)	± (1 % R + 0.05 Ω)

Note

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

PART NUMBER AND PRODUCT DECSRIPTION

PART NUMBER: SFR2500001001FA500

S	F	R	2	5	0	0	0	1	0	0	1	F	A	5	0	0

MODEL/SIZE	VARIANT	TCR/MATERIAL	VALUE	TOLERANCE	PACKAGING (1)	SPECIAL
SFR16S0 **SFR2500** **SFR25H0**	**0** = Neutral **Z** = Value overflow (special)	**0** = Standard **Z** = Jumper	**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} **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 (1)	RESISTANCE VALUE
SFR16S **SFR25** **SFR25H**	**± 1 %** **± 5 %**	**N4** **A5** **A1** **R5**	**47K** = 47 kΩ **51R1** = 51.1 Ω

Notes

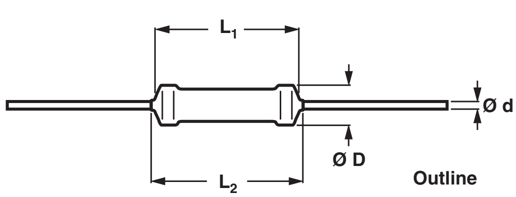
(1) Please refer to table PACKAGING

- The jumper has a maximum resistance $R_{max.}$ = 30 mΩ at 3 A (SFR16S)
- The jumper has a maximum resistance $R_{max.}$ = 30 mΩ 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



Outline

DIMENSIONS - Resistor types and relevant physical dimensions in millimeters

TYPE	Ø $D_{max.}$	$L_{1\ max.}$	$L_{2\ max.}$	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

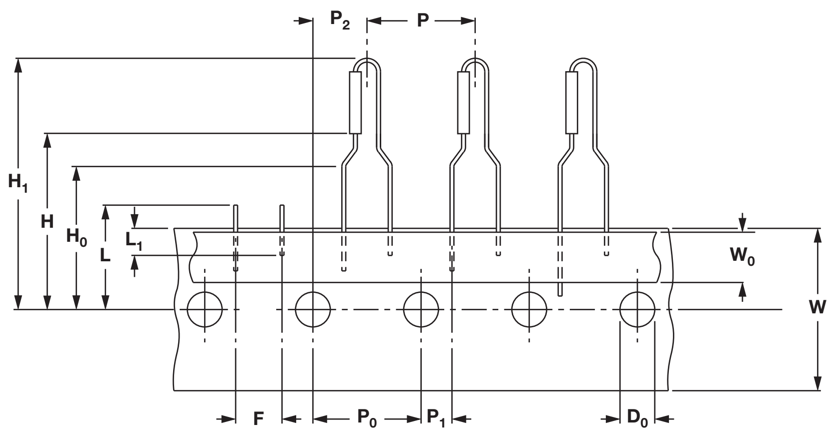
OUTLINES

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	± 1.0	mm
P_0	Feed-hole pitch	12.7	± 0.2	mm
P_1	Feed-hole centre to lead at topside at the tape	3.85	± 0.5	mm
P_2	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_0	Lead wire clinch height	16.5	± 0.5	mm
H_0	Height of component from tape center	19.5	± 1	mm
D_0	Feed-hole diameter	4.0	± 0.2	mm
L	Maximum length of snipped lead	11.0	-	mm
L_1	Minimum lead wire (tape portion) shortest lead	2.5	-	mm

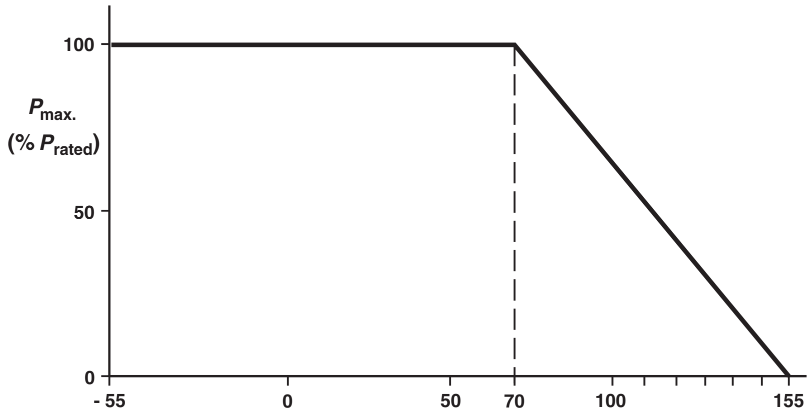
Note

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

FUNCTIONAL PERFORMANCE
PRODUCT CHARACTERIZATION

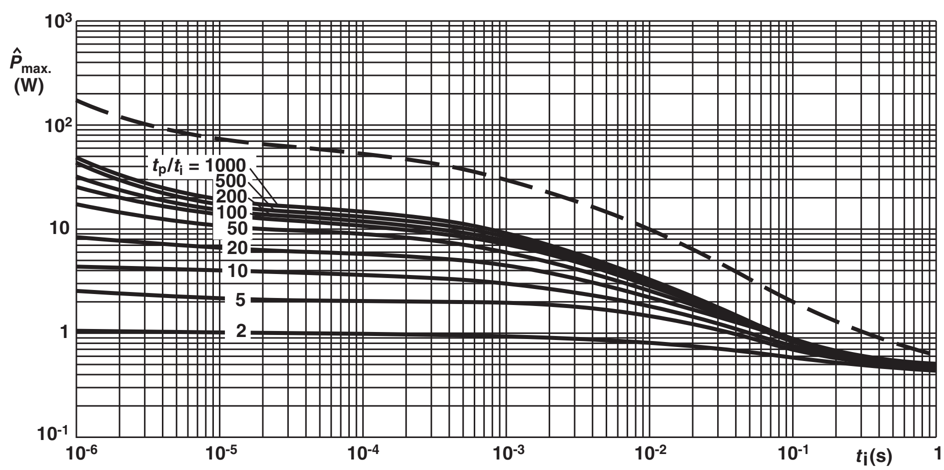
Standard values of nominal resistance are taken from the E96/E24 series for resistors with a tolerance of ± 1 % or ± 5 %. The values of the E96/E24 series are in accordance with IEC 60063.

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

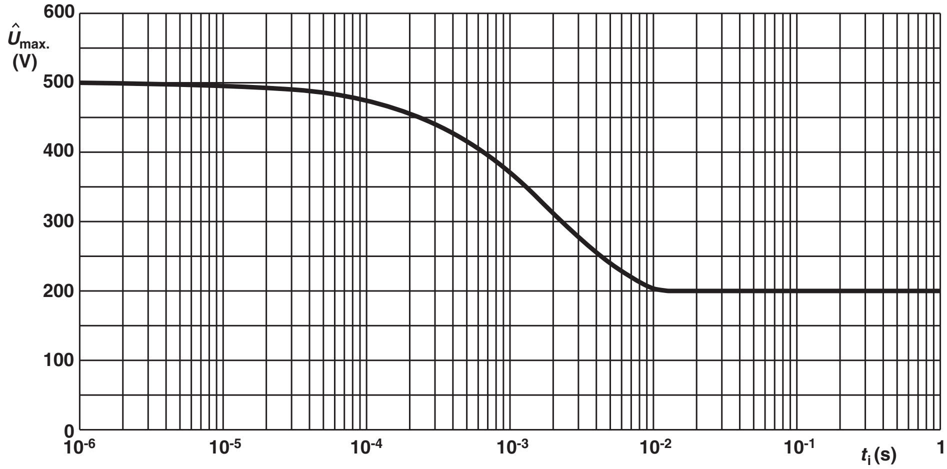


Derating

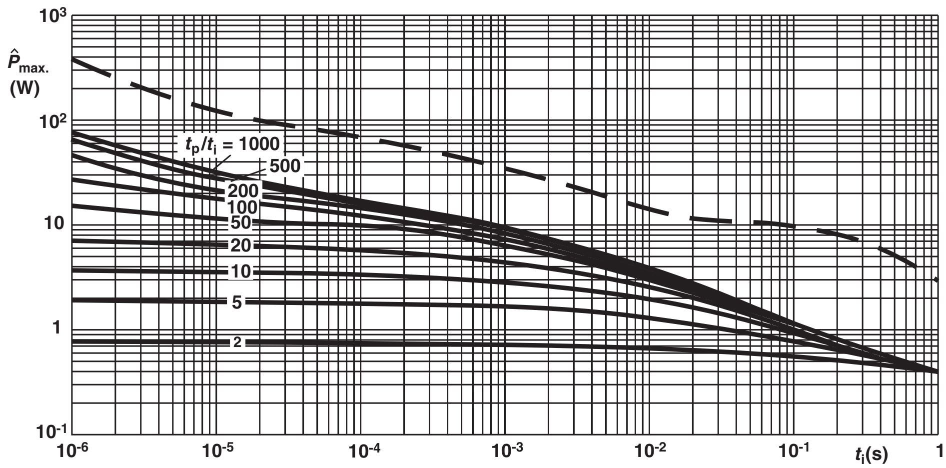
Maximum dissipation ($P_{max.}$) in percentage of rated power as a function of the ambient temperature (T_{amb})



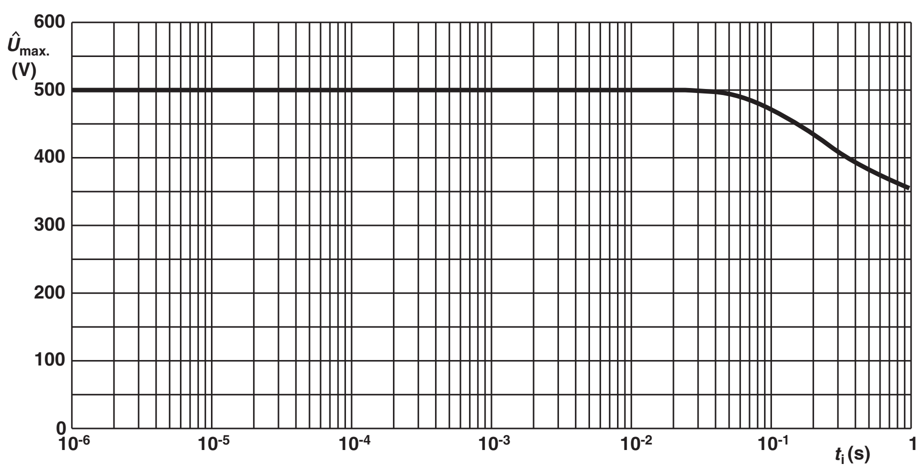
SFR16S Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



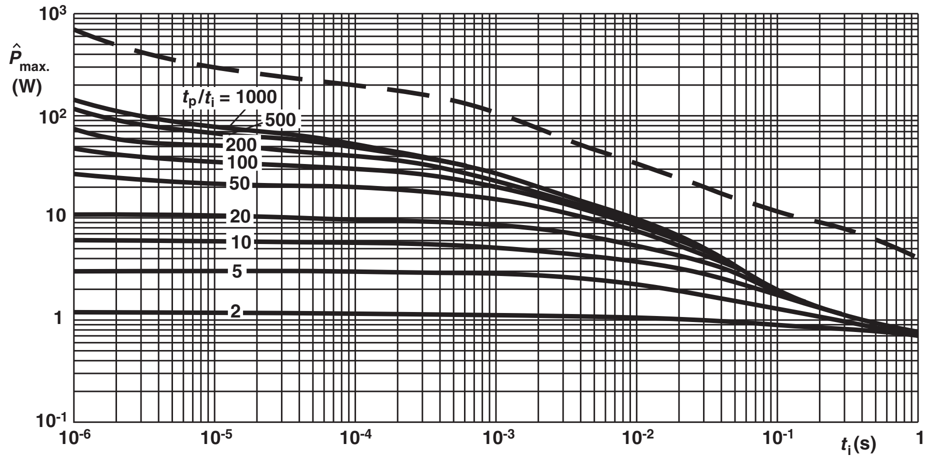
SFR16S Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration (t_i)



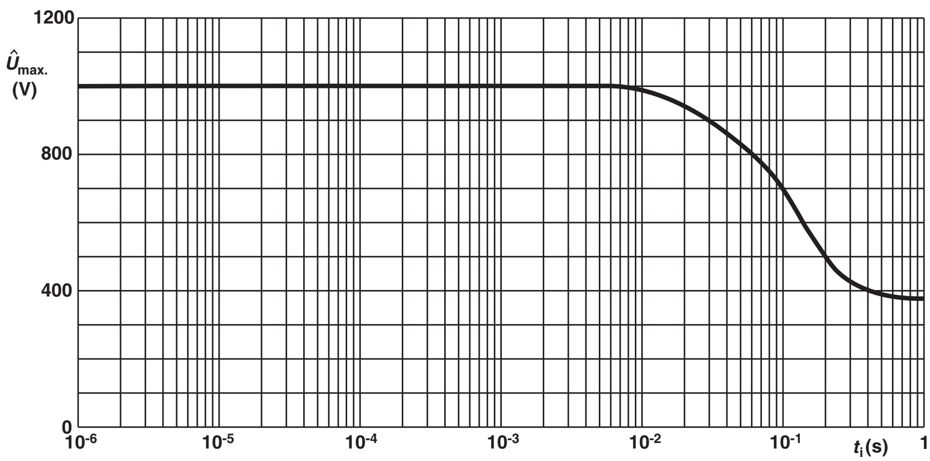
SFR25 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



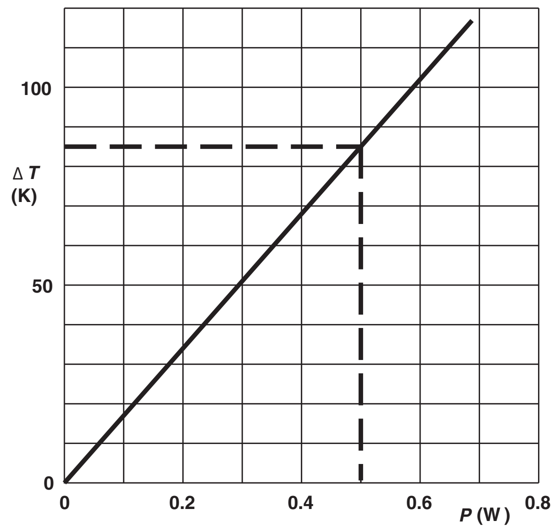
SFR25 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{U}_{max.}$) as a function of pulse duration (t_i)



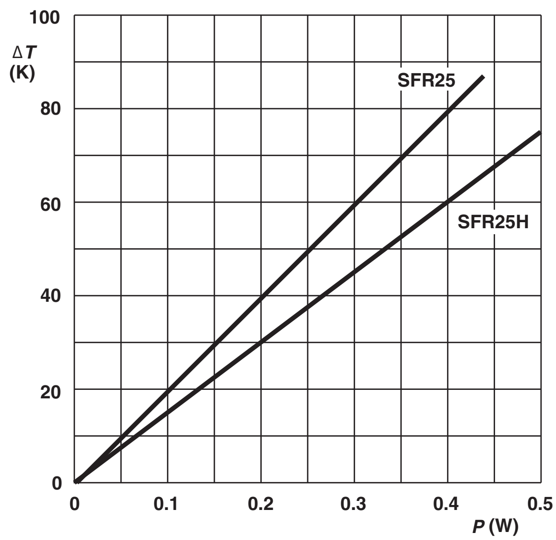
SFR25H Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max.}$) as a function of pulse duration (t_i)



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 (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.

Application Information

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 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS		
					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^{-6}		
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^{-6}		
4.16.4	21 (Uc)	Torsion other half of samples	3 x 360° in opposite directions		No damage Δ*R* max.: ± (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		
4.18	20 (Tb)	Resistance to soldering heat	Thermal shock: 10 s; 260 °C; 3 mm from body		Δ*R* max.: ± (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		Δ*R* max.: ± (0.25 % *R* + 0.05 Ω)		
4.20	29 (Eb)	Bump	3 x 1500 bumps in 3 directions; 40 g		No damage Δ*R* max.: ± (0.25 % *R* + 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 Δ*R* max.: ± (0.25 % *R* + 0.05 Ω)		
4.23		Climatic sequence:			R_{ins} min.: 1000 MΩ		
4.23.2	2 (Ba)	Dry heat	16 h; 155 °C				
4.23.3	30 (Db)	Damp heat (accelerated) 1st 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* ≤ 1 MΩ	Δ*R* max.: ± (1 % *R* + 0.05 Ω)		
				R > 1 MΩ	Δ*R* max.: ± (1 % *R* + 0.05 Ω)		Δ*R* max.: ± (2 % *R* + 0.1 Ω)

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 MΩ ΔR max.: ± (2 % R + 0.05 Ω)		
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		ΔR max.: ± (2 % R + 0.05 Ω)		
4.8		Temperature coefficient	Between - 55 °C and + 155 °C	R < 4.7 Ω $R \leq$ 100 kΩ $R \leq$ 1 MΩ R > 1 MΩ	≤ ± 250 ppm/K ≤ ± 100 ppm/K ≤ ± 250 ppm/K ≤ ± 250 ppm/K	≤ ± 100 ppm/K ≤ ± 100 ppm/K ≤ ± 100 ppm/K ≤ ± 250 ppm/K	≤ ± 100 ppm/K ≤ ± 100 ppm/K ≤ ± 100 ppm/K ≤ ± 250 ppm/K
4.7		Voltage proof on insulation	U_{RMS} = 400 V (**SFR16S**) or U_{RMS} = 600 V (**SFR25** and **SFR25H**); during 1 min; V-block method		No breakdown		
4.12		Noise	IEC 60195	R < 68 kΩ $R \leq$ 100 kΩ $R \leq$ 1 MΩ R > 1 MΩ	max. 0.1 µV/V max. 0.5 µV/V max. 1.5 µV/V max. 1.5 µV/V	max. 0.1 µV/V max. 0.1 µV/V max. 0.1 µV/V max. 1.5 µV/V	max. 0.1 µV/V max. 0.1 µV/V max. 0.1 µV/V max. 1.5 µV/V
4.6.1.1		Insulation resistance	$U_{max.}$ DC = 500 V during 1 min; V-block method		R_{ins} min.: 1000 MΩ		
4.13		Short time overload	Room temperature; P = 6.25 x 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		ΔR max.: ± (0.25 % R + 0.05 Ω)		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 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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«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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