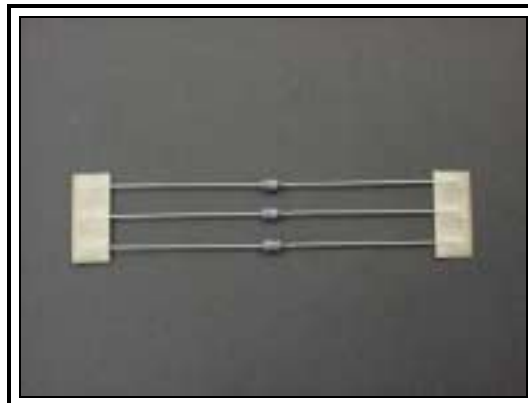


## STANDARD FILM RESISTOR – SFR16S

### FEATURES

- Metal film technology;
- Non-flammable;
- General purpose resistors;
- Small size
- High stability;
- Low cost;
- Low noise;
- Jumper available ( $0\Omega$ );
- Different forming style available;
- Different packaging and configurations.



### MARKET SEGMENTS AND APPLICATIONS

Industry sector	Application segment	End-user equipment
Industrial	Power	Power supplies Motor speed controls
Telecom	Data Communication	Line protection resistor Power supplies
Consumer	Sound & Vision	Amplifiers, Television, Video cassette recorder
	Kitchen Appliances	Blender
	Lighting	Ballast equipment
Automotive	Electronic Systems	Dashboard electronics Lighting equipment Window/mirror steering ABS system, Alarm system Airbag, Electronic fuel injection

### TECHNOLOGY

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 wires of electrolytic copper are welded to the end-caps. The resistors are coated with non-flammable light blue lacquer, which provides electrical, mechanical and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with "MIL-STD-202E, method 215" and "IEC 60068-2-45".

#### SFR16S

**QUICK REFERENCE DATA**

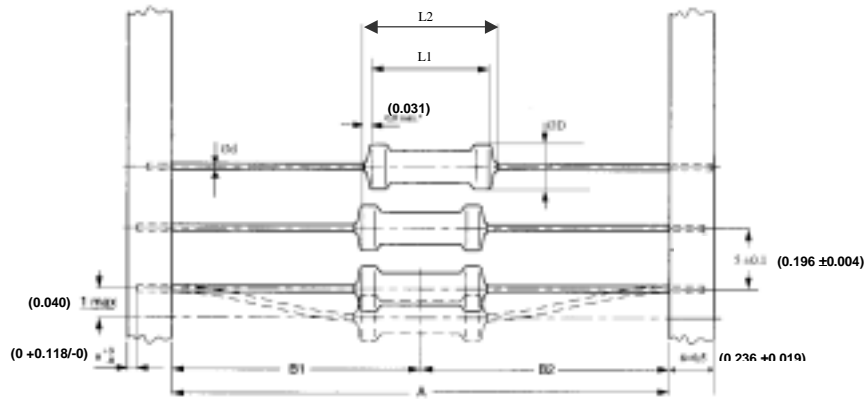
DESCRIPTION	SFR16S ±5% (E24 serie)	SFR16S ±1% (E24/E96 series)
	<b>Cu-lead</b>	
Resistance range	1Ω to 3MΩ	4.99Ω to 2.4MΩ
Temperature coefficient R < 4.7Ω 4.7 ≤ R ≤ 200kΩ R > 200KΩ	≤ ±250ppm/°C ≤ ±100ppm/°C ≤ ±250ppm/°C	≤ ±100ppm/°C ≤ ±250ppm/°C
Absolute maximum dissipation at Tamb = 70°C	0.5W	
Thermal resistance. Rth	170KW	
Limiting voltage (DC or RMS)	200V	
Rated Voltage <sup>(1)</sup>	$\sqrt{P_n \times R}$	
Basic specification	IEC 60115-1 and 60115-2	
Climatic category (IEC 60068)	55 / 155 / 56	
Stability, ΔR/Rmax., after: Load R ≤ 200KΩ R > 200KΩ Climatic tests: R ≤ 200KΩ R > 200KΩ Resistance to soldering heat Short time overload	± 1% +0.05Ω  ± 1% +0.05Ω  ± 0.25% +0.05Ω ± 0.25% +0.05Ω	±0,5% +0.05Ω ±1% +0.05Ω  ±0,5% +0.05Ω ±1% +0.05Ω ±0.25% +0.05Ω ± 0.25% +0.05Ω

Note:

1- Maximum rated voltage is the "Limiting voltage".

**MECHANICAL DATA**

**Axial style**



\* Max. displacement between any two resistors.  
Dimensions in mm.

Table 1.

Type	A	$\phi D$ max.	L1 max	L2 max	$\phi d$	B1-B2	Mass per 100 units
SFR16S	$52.5 \pm 1.5$ ( $2.067 \pm 0.059$ )	1.9 (0.075)	3.2 (0.126)	3.4 (0.134)	$0.45 \pm 0.05$ ( $0.018 \pm 0.002$ )	$\pm 1.2$ (0.047)	11.5g
	$26 \pm 1.5$ ( $1.024 \pm 0.059$ )						8.0g

Dimensions in mm / (inches)

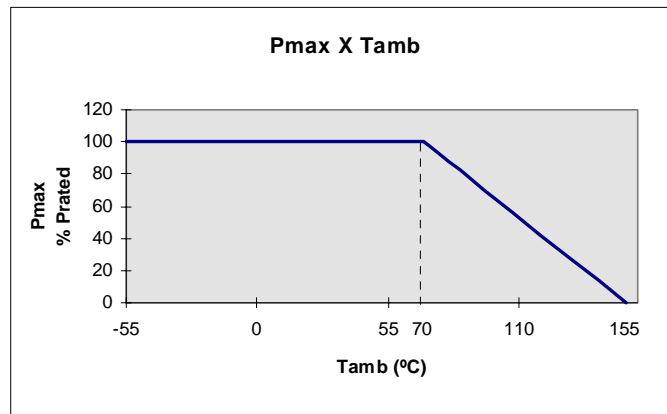
**MOUNTING**

The resistors are suitable for processing on automatic insertion equipment, cutting and bending machines.

**ELECTRICAL CHARACTERISTICS**

**DERATING**

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



Maximum dissipation (Pmax) in percentage of rated power as a function of the ambient temperature (Tamb).

**APPLICATION INFORMATION**

Hot-spot

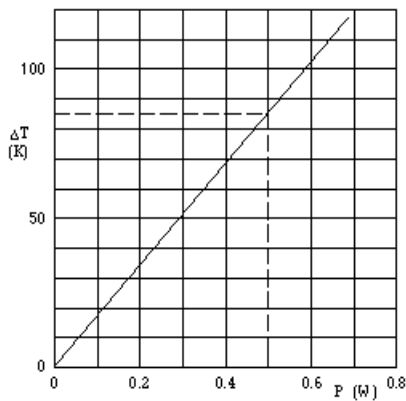


Fig. 1 - Hot spot temperature rise ( $\Delta T$ ) as a function of dissipated power.

Solder-spot

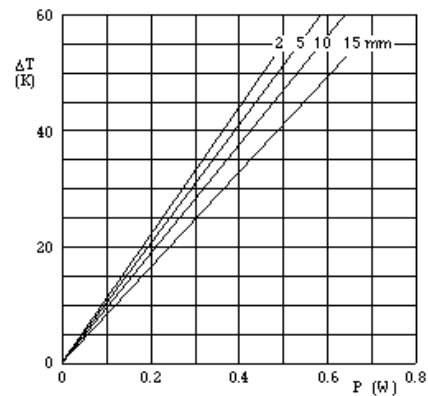


Fig. 2 - Temperature rise ( $\Delta T$ ) at the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.

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

**PULSE LOADING CAPABILITIES**

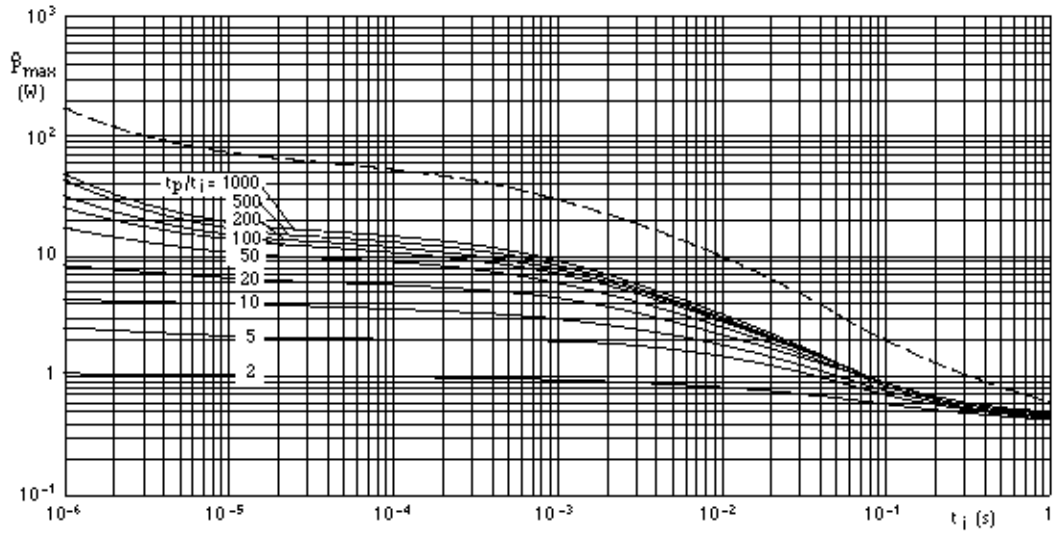


Fig. 3 – Pulse on a regular basis, maximum permissible peak pulse power ( $\hat{P}_{max}$ ) as a function of pulse duration ( $t_i$ ).

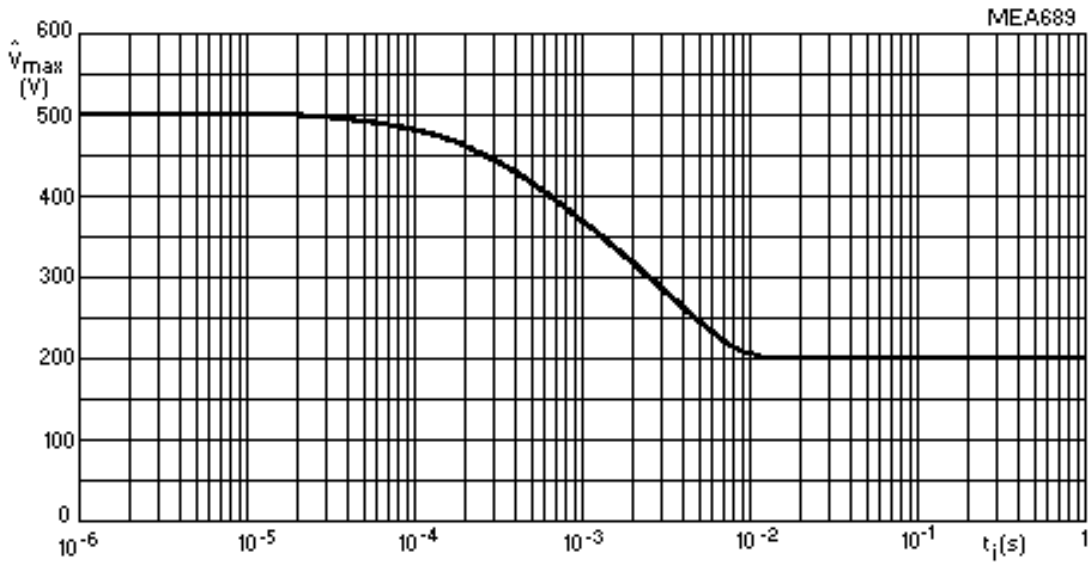


Fig. 4 - Pulse on a regular basis, maximum permissible peak pulse voltage ( $\hat{V}_{max}$ ) as a function of pulse duration ( $t_i$ ).

## MARKING

The nominal resistance and tolerance are marked on the resistor using four or five colored bands in accordance with IEC publication 60062 "color code for fixed resistors".

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

## ORDERING INFORMATION

Table 2. Ordering code indicating resistor type and packaging

TYPE	LEAD $\varnothing$ mm	TOL %	ORDERING CODE 23xx xxx xxxxx			
			BANDOLIER IN AMMOPACK		BANDOLIER ON REEL	
			STRAIGHT LEADS			
			52.5 (2.067)	52.5 (2.067)	26 (1.024)	52.5 (2.067)
			5000 units	1000 units	5000 units	5000 units
SFR16S	Cu 0.45 (Cu 0.018)	1	2306 187 3xxxx	2322 187 73xxx	2306 187 7xxxx	2306 187 1xxxx
		5	2322 187 53xxx	-	2322 187 43xxx	2306 187 23xxx
			-	-	-	2322 187 83xxx

Dimensions in mm / (Inches)

**Note: For formed types see "Formed Types Specification"**

## ORDERING CODE

- The resistors have a 12 digit ordering code starting with 23
- The subsequent 6 or 7 digits indicate the resistor type and packaging see table 2.
- For 5% tolerance the remaining 3 digits indicate the resistance value;
  - The first 2 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with table 3.
- For 1% tolerance the remaining 4 digits indicate the resistance value;
  - The first 3 digits indicate the resistance value.
  - The last digit indicates the resistance decade in accordance with table 3.

Table 3. Last digit 12NC

Resistance Decade for 5%	Resistance Decade for 1%	LAST DIGIT
1 to 9.1 $\Omega$	4.99 to 9.76 $\Omega$	8
10 to 91 $\Omega$	10 to 97.6 $\Omega$	9
100 to 910 $\Omega$	100 to 976 $\Omega$	1
1 to 9.1k $\Omega$	1 to 9.76k $\Omega$	2
10 to 91k $\Omega$	10 to 97.6k $\Omega$	3
100 to 910k $\Omega$	100 to 976k $\Omega$	4
1M $\Omega$ to 3 M $\Omega$	1M $\Omega$ to 2.4M $\Omega$	5

Example:

The ordering code for resistor type SFR16S resistor, value of 680 $\Omega$   $\pm 5\%$ , taped on a bandolier of 5000 units in ammpack, is: 2322 187 53681.

### SFR16S

## NAFTA ORDERING INFORMATION – CROSS REFERENCE

### NAFTA ORDERING CODES

Table 4. Ordering code indicating resistor type and packaging

Type	Tol. %	Resistance range	12NC	NAFTA Part Number	Taping	SPQ units
SFR16S	± 1	4.99Ω to 2.4MΩ	2306 187 1xxxx	5033EDxxxxxF12AF5	52.5 (2.067)	5000; reel
			2306 187 7xxxx	5033EDxxxxxF26M	26 (1.024)	5000; ammopack
			2306 187 3xxxx	5033EDxxxxxF18AF5	25.5 (2.067)	5000; ammopack
	± 5	1Ω to 3MΩ	2306 187 23xxx	5033EMxxxxxJ12AFX	52.5 (2.067)	5000; reel
			2322 187 43xxx	5033EMxxxxxJ26M	26 (1.024)	5000; ammopack
			2322 187 53xxx	5033EMxxxxxJ18AFX	52.5 (2.067)	5000; ammopack
			2322 187 73xxx	5033EMxxxxxJ08AFX	52.5 (2.067)	1000; ammopack

Dimensions in mm / (inches)

### COMPOSITION OF OHMIC VALUE

The ohmic value is represented by 5 digits; see table 5.

Table 5. Examples of the ohmic value

Value	5 Digits (All Other)
1 Ω	1R000
10 Ω	10R00
100 Ω	100R0
1 KΩ	1K000
10 KΩ	10K00
100 KΩ	100K0
1 MΩ	1M000

### SFR16S

**PACKAGING**

**Bandolier in ammopack**

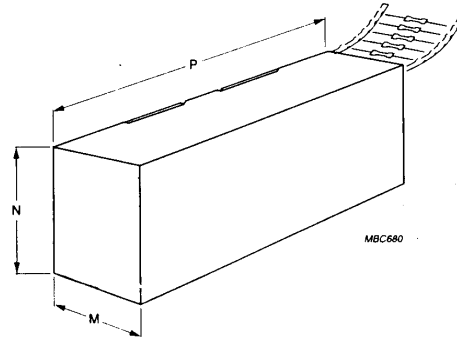


Table 6.

Type	Quantity	M	N	P	Bandolier Width
SFR16S	5000	79 (3.110)	73 (2.874)	260 (10.236)	52.5 ±1.5 (2.067 ± 0.059)
	5000	51 (2.008)	79 (3.110)	255 (10.039)	26 ±1.5 (1.024 ±0.059)
	1000	71 (2.795)	31 (1.220)	140 (5.512)	52.5 ±1.5 (2.067 ±0.059)

Dimensions in mm / (Inches)

**Bandolier on Reel**

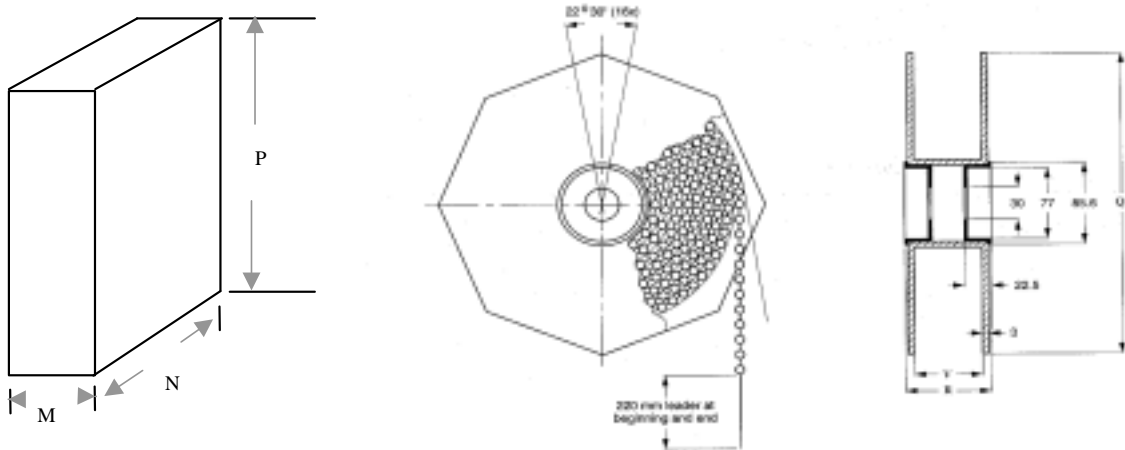


Table 7.

Type	Quantity	M	N	P	Q	V	R	Bandolier Width
SFR16S	5000	92 (3.622)	273 (10.748)	273 (10.748)	267 (10.512)	75 (2.953)	86 (3.386)	52.5 ±1.5 (2.067 ±0.059)

Dimensions in mm / (Inches)

**SFR16S**



## TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", category 55/155/56 (rated temperature range -55 °C to +155°C ; damp heat, long term, 56 days).

The tests are carried out in accordance with IEC publication 60068-2, "Recommended basic climatic and mechanical robustness testing procedure for electronic components" and under standard atmospheric conditions according to "IEC 60068-1" subclause 5.3.

In Table 8 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-1" 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.

Table 8. Test procedures and requirements

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTANCE RANGE	REQUIREMENTS	
					SFR16S 5%	SFR16S 1%
4.6.11		Insulation resistance	500V (DC) during 1 minute; V-block method		R <sub>ins</sub> min.: 10 <sup>4</sup> MΩ	
4.7		Voltage proof on insulation	400V (RMS); during 1 minute; V-block method		no breakdown	
4.8.4		Temperature coefficient	Between -55 °C and + 155 °C (Tc ppm/°C)	R < 4.7Ω R ≤ 200KΩ R > 200KΩ	≤ ± 250 ≤ ± 100 ≤ ± 250	≤ ±100 ≤ ±250
4.12		Noise	IEC publication 60195	R < 68Ω R ≤ 100Ω R > 1MΩ	max. 0.1 μV/V max. 0.5 μV/V max. 1.5 μV/V	
4.13		Short time overload	Room temperature; P = 6.25 x 0.25W; 5s on 45s off (V ≤ 2 x V <sub>máx</sub> ); 10 cycles;		ΔR/R max.: ± 0.25% + 0.05Ω	
4.16	U	Robustness of terminations:				
4.16.2	Ua	- Tensile all samples	Load 5N; 10s		Number of failures < 10x10 <sup>-6</sup>	
4.16.3	Ub	- Bending half number of samples	Load 2.5N; 4 x 90°		Number of failures < 10x10 <sup>-6</sup>	
4.16.4	Uc	- Torsion other half of samples	3 x 360° in opposite directions		no damage	
					ΔR/R max.: ± 0.25%+0.05Ω	ΔR/R max.: ± 0.1%+0.05Ω
4.17	Ta	Solderability	2s; 235°C; flux 600		Good tinning; no damage	
4.18	Tb	Resistance to soldering heat	Thermal shock: 3s; 350 °C ;6 mm from body		ΔR/R max.: ± 0.25% + 0.05Ω	
4.19	Na	Rapid change of temperature	30 minutes at -55 °C and 30 minutes at +155 °C; 5 cycles	R ≤ 100K  R > 100K	ΔR/R max.: ± 0.25% + 0.05Ω	ΔR/R max.: ± 0.1% + 0.05Ω ΔR/R max.: ± 0.25% + 0.05Ω

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	RESISTENCE RANGE	REQUIREMENTS	
					SFR16S 5%	SFR16S 1%
4.22	Fc	Vibration	Frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10g; 3 directions; total 6 hours (3x2 hours)		no damage	
					$\Delta R/R$ max.: $\pm 0.25\% + 0.05\Omega$	$\Delta R/R$ max.: $\pm 0.1\% + 0.05\Omega$
4.23 4.23.2 4.23.3	Ba Db	Climatic sequence: Dry heat	16 hours; 155 °C		$R_{ins}$ min.: $10^3 M\Omega$	
4.23.4 4.23.5	Aa M	Damp heat (accelerated) 1 <sup>st</sup> cycle Cold Low air pressure	24 hours; 55 °C; 90 to 100% RH 2 hours; - 55 °C 2 hours; 8.5 kPa; 15 to 35 °C			
4.23.6	Db	Damp heat (accelerated) remaining cycles	5 days; 55 °C; 95 to 100% RH	$R \leq 200K\Omega$ $R > 200K\Omega$	$\Delta R/R$ max.: $\pm 1\% + 0.05\Omega$	$\Delta R/R$ max.: $\pm 0.5\% + 0.05\Omega$ $\Delta R/R$ max.: $\pm 1\% + 0.05\Omega$
4.24.2	Ca	Damp heat (steady state)	56 days; 40 °C; 90 to 95% RH; dissipation 0.01 Pn	$R \leq 200K\Omega$ $R > 200K\Omega$	$R_{ins}$ min.: $10^3 M\Omega$	
					$\Delta R/R$ max.: $\pm$ 1% + 0.05 $\Omega$	$\Delta R/R$ max.: $\pm 0.5\% + 0.05 \Omega$ $\Delta R/R$ max.: $\pm 1\% + 0.05\Omega$
4.25.1		Endurance	1000 hours at 70 °C; Pn or Vmax	$R \leq 200K\Omega$ $R > 200K\Omega$	$\Delta R/R$ max.: $\pm 1\% + 0.05\Omega$	$\Delta R/R$ max.: $\pm 0.5\% + 0.05\Omega$ $\Delta R/R$ max.: $\pm 1\% + 0.05\Omega$
See 2 <sup>nd</sup> amendment to "IEC 60115-1",		Pulse load			See Figs. 3 and 4	

## SFR16S