STANDARD FILM RESISTOR - SFR16S

FEATURES

- Metal film technology
- Non-flammable
- General purpose resistors
- Small size
- High stability
- Low cost
- Low noise
- Jumper available (0 Ω)
- Various forming styles available
- Various packaging and taping 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 a 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-202, method 215 and IEC 60068-2-45.

QUICK REFERENCE DATA

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

(1) Maximum rated voltage is the limiting voltage

MECHANICAL DATA

AXIAL STYLE

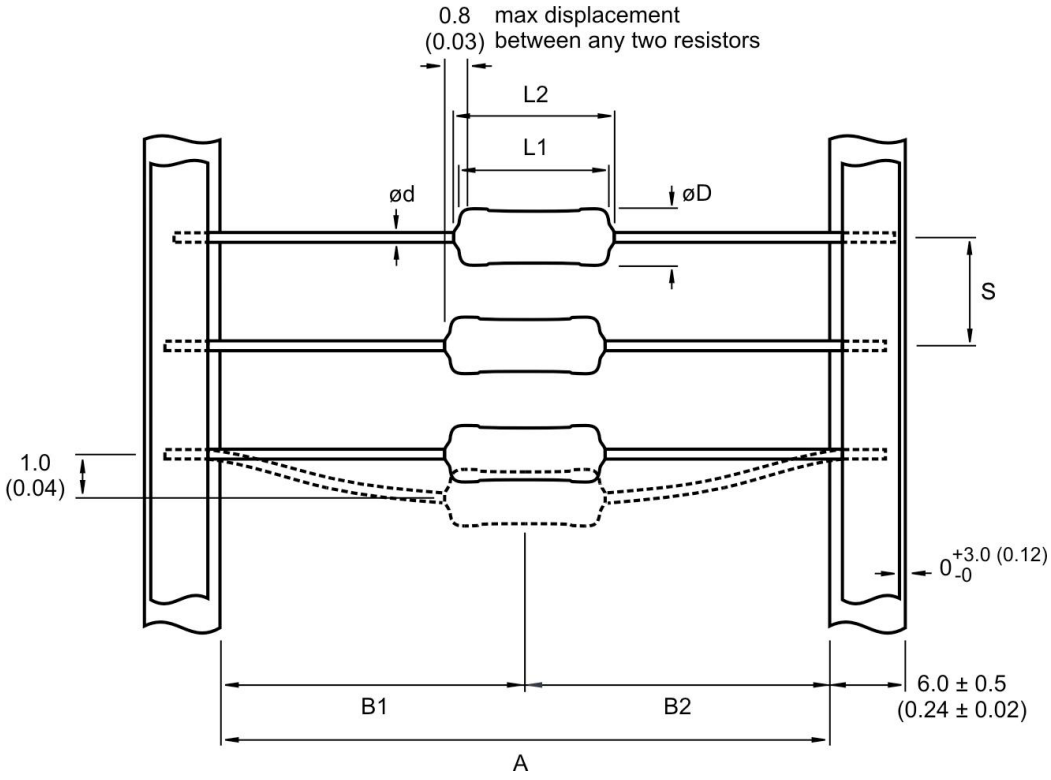

Fig. 1

Table 1. Mechanical Data.

PRODUCT	A	L1 max	L2 max	ϕD max	B1 - B2	ϕd	S	WEIGHT gr/100 pcs
SFR16S	52.5 ±1.5 (2.07 ±0.06)	3.2 (0.13)	3.4 (0.14)	1.9 (0.08)	±1.2 (±0.05)	0.45 ±0.05 (0.018 ±0.002)	5.0 ±0.1 (0.20 ±0.01)	11.5
	26.0 ±1.5 (1.03 ±0.06)							8.0

Dimensions unless specified in mm (inches)

MOUNTING

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

ELECTRICAL CHARACTERISTICS

DERATING

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

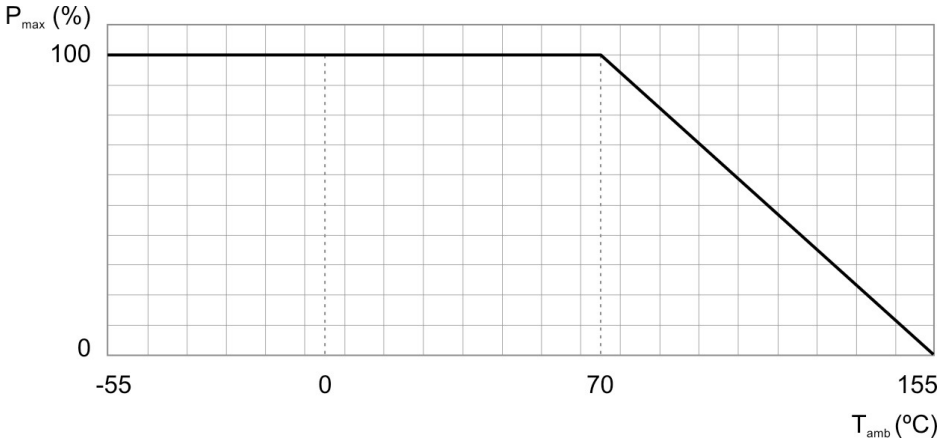

Fig. 2. Maximum dissipation (P_{max}) in percentage of rated power as a function of ambient temperature (T_{amb})

APPLICATION INFORMATION

Hot spot

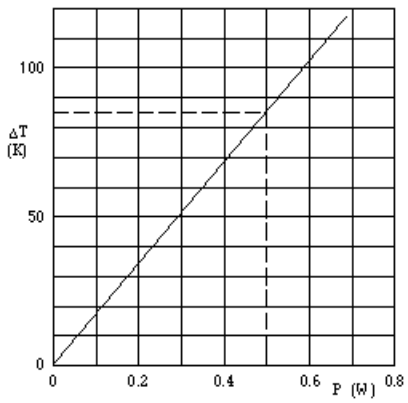

Fig. 3. Hot spot temperature rise (ΔT) as a function of dissipated power

Solder spot

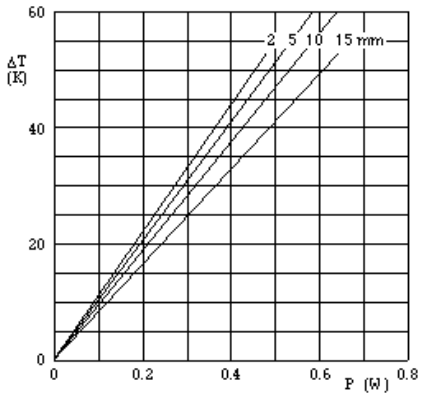

Fig. 4. Temperature rise (ΔT) at the lead (solder spot) as a function of dissipated power at various lead lengths after mounting

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

PULSE LOADING CAPABILITIES

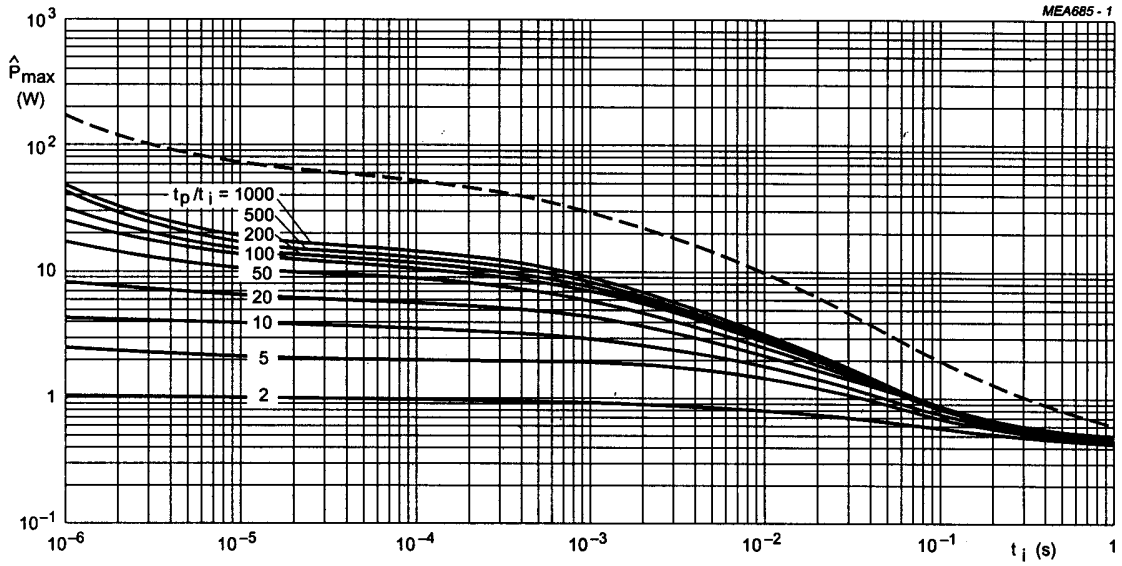

Fig. 5. Pulse on a regular basis, maximum permissible peak pulse power (^P_{max}) as a function of pulse duration (ti)

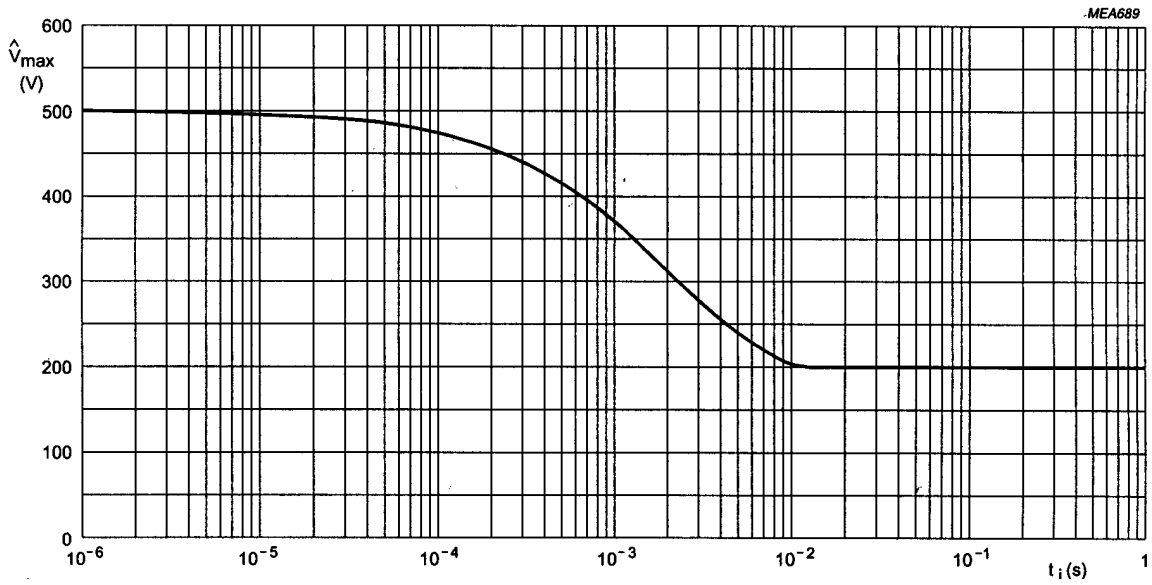

Fig.6. Pulse on a regular basis, maximum permissible peak pulse voltage (^V_{max}) as a function of pulse duration (ti)

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 ±5% or ±1%. The values of the E24/E96 series are in accordance with IEC publication 60063.

ORDERING INFORMATION

Table 2. Ordering code.

LEAD ∅	TOL	TAPING	QTY pcs	PACKAGING	ORDERING CODE
0.45 Cu (0.018)	±5%	52.5 (2.07)	1000	AMMOPACK	**2322 187 73xxx**
			5000	REEL	**2306 187 23xxx**
				AMMOPACK	**2322 187 53xxx**
		26.0 (1.03)		AMMOPACK	**2322 187 43xxx**
	±1%			AMMOPACK	**2306 187 7xxxx**
		52.5 (2.07)		AMMOPACK	**2306 187 3xxxx**
				REEL	**2306 187 1xxxx**

Dimensions unless specified in mm (inches)

The resistors have a 12 digit ordering code starting with 2306 or 2322.
The next 5 digits indicate the resistor type and packaging see table 2.
For 5% tolerance last 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 last 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 of ordering code.

RESISTANCE DECADE (5%)	RESISTANCE DECADE (1%)	LAST DIGIT
1 - 9.1 Ω	4.99 - 9.76 Ω	8
10 - 91 Ω	10 - 97.6 Ω	9
100 - 910 Ω	100 - 976 Ω	1
1 - 9.1 kΩ	1 - 9.76 kΩ	2
10 - 91 kΩ	10 - 97.6 kΩ	3
100 - 910 kΩ	100 - 976 kΩ	4
1 MΩ - 3 MΩ	1 MΩ - 2.4 MΩ	5

Example:
SFR16S, 680 Ω, ±5%, taping distance 52.5 mm, ammopack 5000 pcs is **2322 187 53681**.

NAFTA ORDERING INFORMATION

Table 4. NAFTA ordering code.

LEAD ∅	TOL	TAPING	QTY pcs	PACKAGING	NAFTA ORDERING CODE
0.45 Cu (0.018)	±1%	52.5 (2.07)	5000	REEL	**5033EDxxxxxF12AF5**
		26.0 (1.03)		AMMOPACK	**5033EDxxxxxF26M**
		52.5 (2.07)		AMMOPACK	**5033EDxxxxxF18AF5**
	±5%			REEL	**5033EMxxxxxJ12AFX**
		26.0 (1.03)		AMMOPACK	**5033EMxxxxxJ26M**
		52.5 (2.07)		AMMOPACK	**5033EMxxxxxJ18AFX**
			1000	AMMOPACK	**5033EMxxxxxJ08AFX**

Dimensions unless specified in mm (inches)

The ohmic value in the NAFTA ordering code (see table 4) is represented by the “xxxxx” in the middle of the above ordering code. Table 5 gives some examples how to use these 5 digits.

Table 5. Examples of the ohmic value.

VALUE	5 DIGITS
1 Ω	1R000
10 Ω	10R00
100 Ω	100R0
1 kΩ	1K000
10 kΩ	10K00
100 kΩ	100K0
1 MΩ	1M000

PACKAGING

TAPE IN AMMOPACK

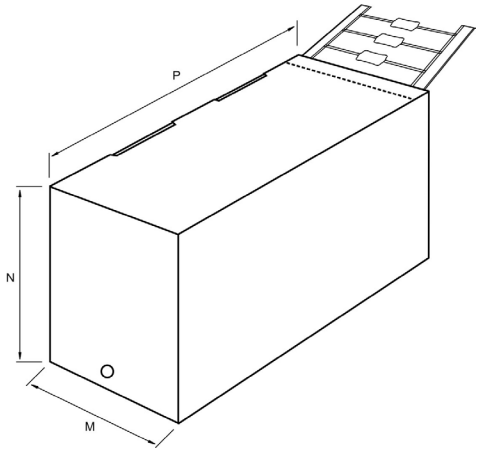

Table 6. Ammopack.

PRODUCT	TAPING	M	N	P	QTY
SFR16S	52.5 ±1.5 (2.07 ±0.06)	79 (3.2)	73 (2.9)	260 (10.3)	5000
	26.0 ±1.5 (1.03 ±0.06)	51 (2.1)	79 (3.2)	255 (10.1)	5000
	52.5 ±1.5 (2.07 ±0.06)	71 (2.8)	31 (1.3)	140 (5.6)	1000

Dimensions unless specified in mm (inches)

TAPE ON REEL

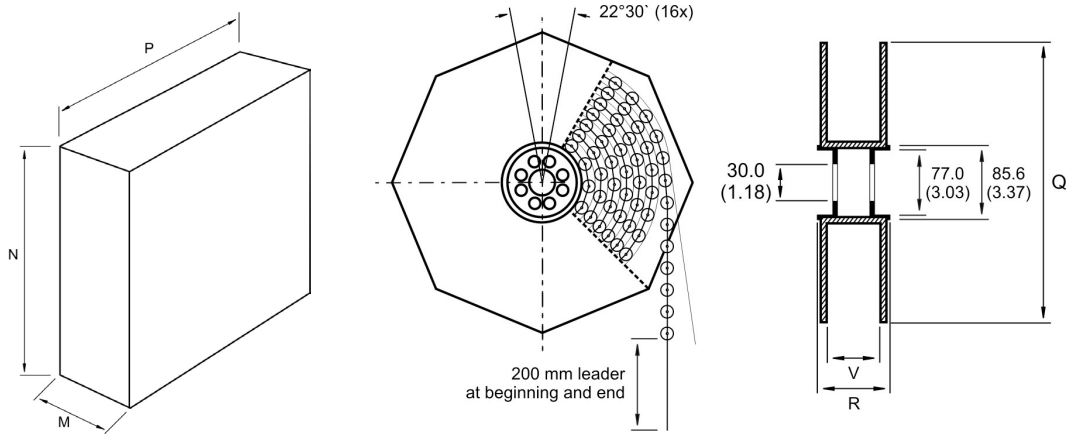

Table 7. Reel.

PRODUCT	TAPING	M	N	P	Q	V	R	QTY
SFR16S	52.5 ±1.5 (2.07 ±0.06)	92 (3.7)	273 (10.8)	273 (10.8)	267 (10.6)	75 (3.0)	86 (3.4)	5000

Dimensions unless specified in mm (inches)

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance to the schedule of IEC publications 60115 – 1, category 55/155/56 (rated temperature range - 55 to +155 °C; damp heat, long term, 56 days and along the lines of IEC publications 60068-2); “Recommended basic climatic and mechanical robustness testing procedure for electronic components” and under standard atmosphere conditions according to IEC 60068-1 subclause 5.3, unless otherwise specified.
In some instances deviations from IEC applications were necessary for our method specified.

Table 8. Test and requirements.

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				SFR16S 5%	SFR16S 1%
4.6.1.1	-	Insulation resistance	500V (DC) during 1 minute; V-block method	$R_{ins\ min}$ 10^4 MΩ	

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				SFR16S 5%	SFR16S 1%
4.7	-	Voltage proof on insulation	400V (RMS); during 1 minute; V-block method	No breakdown or flashover	
4.8	-	Temperature coefficient	Between - 55 °C and + 155 °C R < 4.7 Ω R < 200 KΩ R > 200 KΩ	≤ ±250 ppm/°C ≤ ±100 ppm/°C < +250 ppm/°C	≤ ±100 ppm/°C ≤ ±250 ppm/°C
4.12	-	Noise	IEC publication 60195 R < 68 Ω R < 100 Ω R > 1 MΩ	≤ 0.1 µV/V ≤ 0.5 µV/V ≤ 1.5 µV/V	
4.13	-	Short time overload	Room temperature; P = 6.25 x Pn; 5 s ON and 45 s OFF (V ≤ 2 x V_{max}); 10 cycles	$\Delta R/R_{max}$ ±0.25% + 0.05 Ω	
4.16	21(U)	Robustness of terminations:		No damage	
4.16.2	21(Ua1)	Tensile all samples	Load 5 N; 10 s		
4.16.3	21(Ub)	Bending half number of samples	Load 2.5 N; 4 x 90°		
4.16.4	21(Uc)	Torsion other half of samples	3 x 360° in opposite directions	$\Delta R/R_{max}$ ±0.25%+ 0.05Ω	$\Delta R/R_{max}$ ±0.1%+ 0.05 Ω
4.17	20(Ta)	Solderability (after ageing)	16 h 155 °C; leads immersed in flux 600, leads immersed 2 mm for 2 ±0.5 s in a solder bath at 235 ±5 °C	Good tinning (≥ 95% covered); No damage	
4.18	20(Tb)	Resistance to soldering heat	Thermal shock: 3 seconds; 350 °C; 6 mm from body	$\Delta R/R_{max}$ ±0.25% + 0.05 Ω	
4.19	14(Na)	Rapid change of temperature	30 minutes at – 55 °C and 30 minutes at + 155 °C; 5 cycles R ≤ 100 K R > 100 K	No visual damage $\Delta R/R_{max}$ ±0.25%+ 0.05 Ω	$\Delta R/R_{max}$ ±0.1% +0.05 Ω $\Delta R/R_{max}$ +0.25%+ 0.05Ω

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				SFR16S 5%	SFR16S 1%
4.22	6(Fc)	Vibration	Frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10g; three directions; total 6 h (3x2 h)	No damage	
				$\Delta R/R_{max}$ $\pm 0.25\% + 0.05\ \Omega$	$\Delta R/R_{max}$ $\pm 0.1\% + 0.05\ \Omega$
4.23		Climatic sequence:		$R_{ins\ min}$ 10^3 MΩ	
4.23.2	2(Ba)	Dry heat	16 h; 155 °C		
4.23.3	30(Db)	Damp heat (accelerated) 1st cycle	24 h; 25 °C to 55 °C; 90 to 100% RH		
4.23.4	1(Aa)	Cold	2 h; - 55 °C		
4.23.6	30(Db)	Damp heat (accelerated) remaining cycles	5 days; 25 °C to 55 °C; 90 to 100% R.H.		
			R ≤ 200 KΩ	$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$	$\Delta R/R_{max}$ $\pm 0.5\% + 0.05\ \Omega$
			R > 200 KΩ		$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$
4.24	3(Ca)	Damp heat (steady state)	56 days; 40 °C; 90 to 95% R.H.; loaded with 0.01 Pn	$R_{ins\ min}$ 10^3 MΩ	
			R ≤ 200 KΩ	$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$	$\Delta R/R_{max}$ $\pm 0.5\% + 0.05\ \Omega$
			R > 200 KΩ		$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$
4.25.1	-	Endurance (at 70 °C)	1000 h; loaded with Pn or V_{max}; 1.5 h ON and 0.5 h OFF		
			R ≤ 200 KΩ	$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$	$\Delta R/R_{max}$ $\pm 0.5\% + 0.05\ \Omega$
			R > 200 KΩ		$\Delta R/R_{max}$ $\pm 1\% + 0.05\ \Omega$
4.29	45(Xa)	Component solvent resistance	Isopropyl alcohol followed by brushing in accordance with MIL STD 202	No visual damage	
See 2nd amendment to ÏEC 60115-1		Pulse load		See Figs. 5 and 6	