Metal film resistors

MRS16/25

FEATURES

- Precision resistors in small outlines
- Low noise.

APPLICATIONS

- All general purpose applications.

DESCRIPTION

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 iron are welded to the end-caps.

The resistors are coated with a green 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 68-2-45"*.

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
	MRS16T	MRS25
Resistance range	4.99 Ω to 1 MΩ	1 Ω to 10 MΩ
Resistance tolerance and series	±1%; E24/E96 series	
Maximum dissipation at T_{amb} = 70 °C	0.4 W	0.6 W
Thermal resistance (R_{th})	170 K/W	150 K/W
Temperature coefficient	$\leq \pm 50 \times 10^{-6}$/K	
Maximum permissible voltage (DC or RMS)	200 V	350 V
Basic specifications	IEC 115-1 and 115-2	
Climatic category (IEC 68)	55/155/56	
Stability after:		
load:		
R ≤ 100 kΩ	ΔR/R max.: ±0.5% +0.05 Ω	ΔR/R max.: ±0.5% +0.05 Ω
R > 100 kΩ	ΔR/R max.: ±1% +0.05 Ω	ΔR/R max.: ±0.5% +0.05 Ω
climatic tests:		
R ≤ 100 kΩ	ΔR/R max.: ±0.5% +0.05 Ω	ΔR/R max.: ±0.5% +0.05 Ω
R > 100 kΩ	ΔR/R max.: ±1% +0.05 Ω	ΔR/R max.: ±0.5% +0.05 Ω
soldering:		
R ≤ 100 kΩ	ΔR/R max.: ±0.1% +0.05 Ω	ΔR/R max.: ±0.1% +0.05 Ω
R > 100 kΩ	ΔR/R max.: ±0.25% +0.05 Ω	ΔR/R max.: ±0.1% +0.05 Ω
short time overload	ΔR/R max.: ±0.25% +0.05 Ω	ΔR/R max.: ±0.25% +0.05 Ω

ORDERING INFORMATION

Table 1 Ordering code indicating resistor type and packaging

TYPE	ORDERING CODE 2322		
	BANDOLIER IN AMMOPACK		BANDOLIER ON REEL
	1000 units	5000 units	5000 units
MRS16T	157 1....	157 2....	157 3....
MRS25	156 1....	156 2....	156 3....

Ordering code (12NC)

- The resistors have a 12-digit ordering code.
- The first 8 digits indicate the resistor type and packaging; see Table 1.
- 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 2.

Table 2 Last digit of 12NC

RESISTANCE DECADE	LAST DIGIT
1 to 9.76 Ω	8
10 to 97.6 Ω	9
100 to 976 Ω	1
1 to 9.76 kΩ	2
10 to 97.6 kΩ	3
100 to 976 kΩ	4
1 to 9.76 MΩ	5
10 MΩ	6

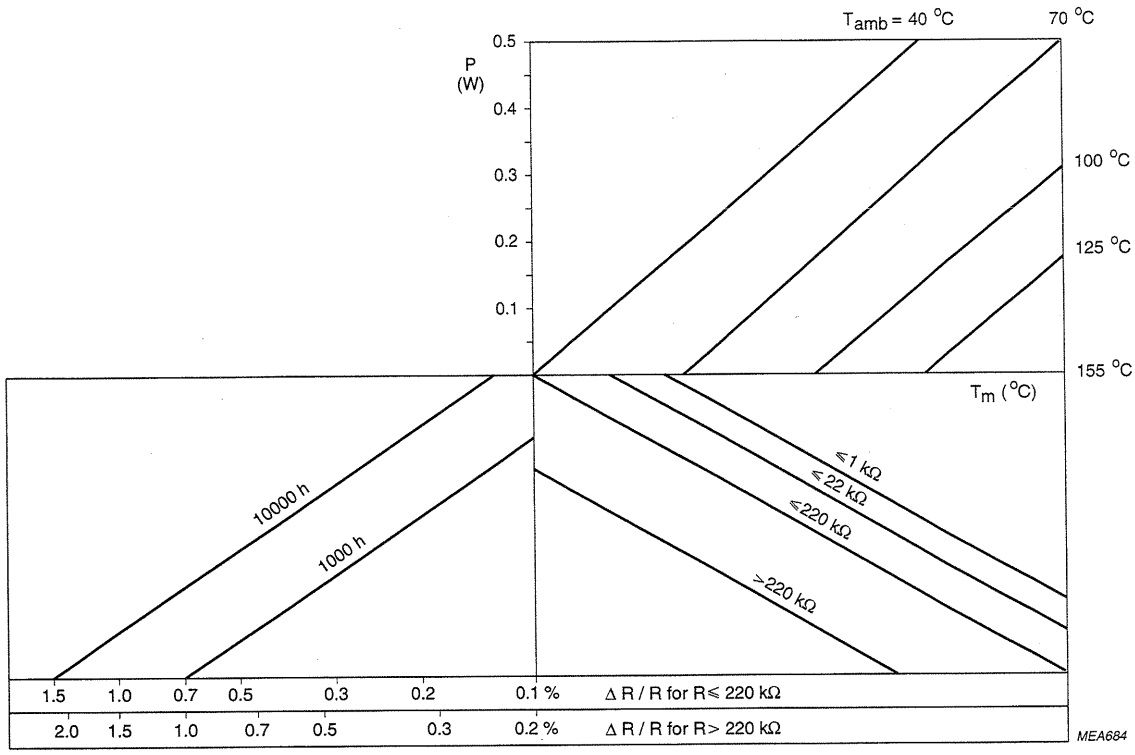
ORDERING EXAMPLE

The ordering code of a MRS16 resistor, value 750 Ω, on a bandolier of 1000 units in ammopack is: 2322 157 17501.

FUNCTIONAL DESCRIPTION

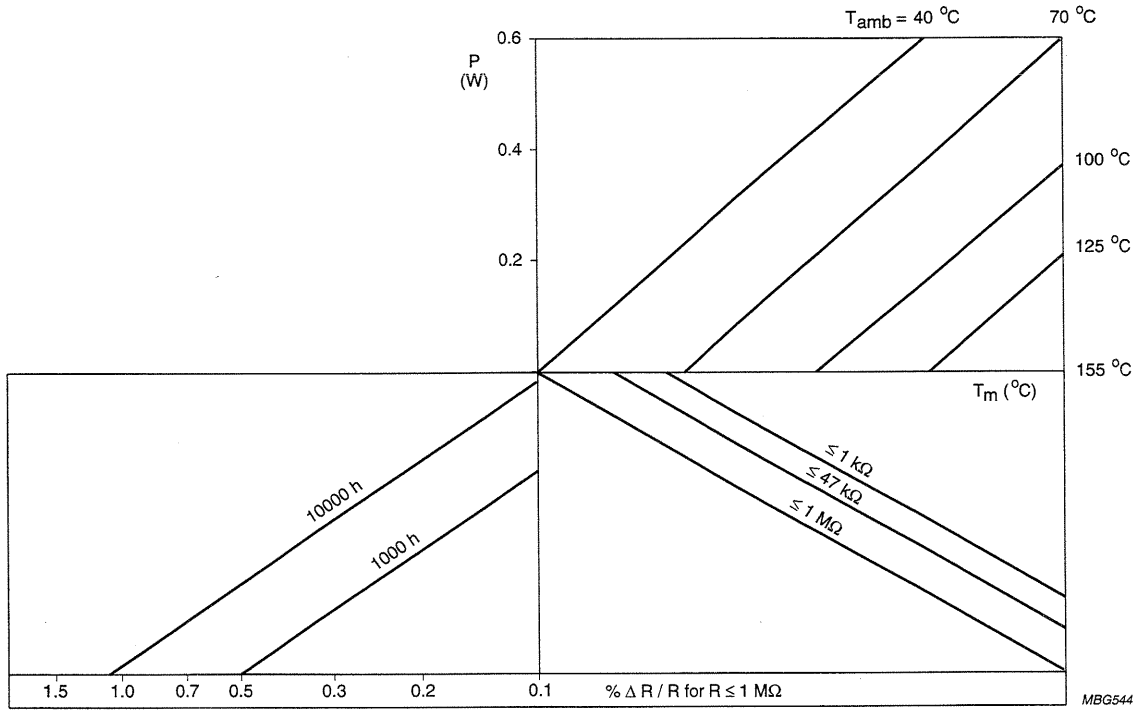
Product characterization

Standard values of nominal resistance are taken from the E24/E96 series for resistors with a tolerance of ±1%. The values of the E24/E96 series are in accordance with *"IEC publication 63"*.



MRS16T

Fig.1 Drift nomogram.



MRS25

Fig.2 Drift nomogram.

Limiting values

TYPE	LIMITING VOLTAGE(1) (V)	LIMITING POWER (W)
MRS16T	200	0.4
MRS25	350	0.6

Note

1. The maximum voltage that may be continuously applied to the resistor element, see *"IEC publication 115-1"*.

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

DERATING

The power that the resistor can dissipate depends on the operating temperature; see Fig.3.

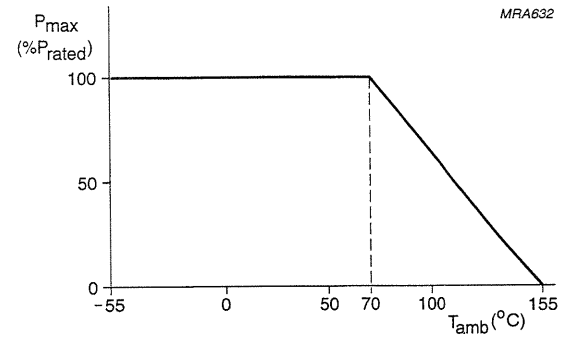
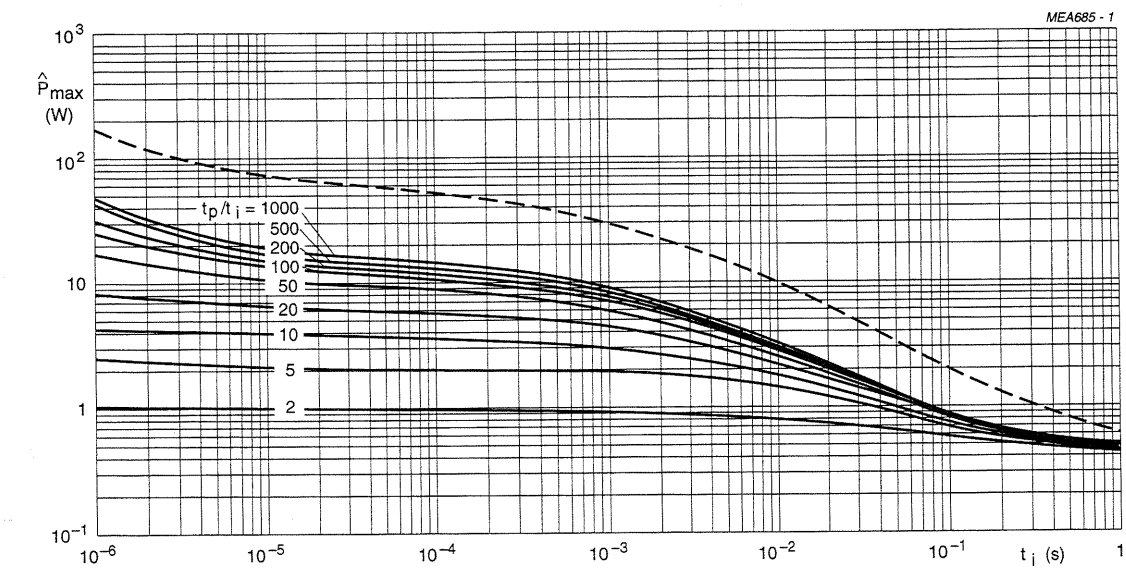


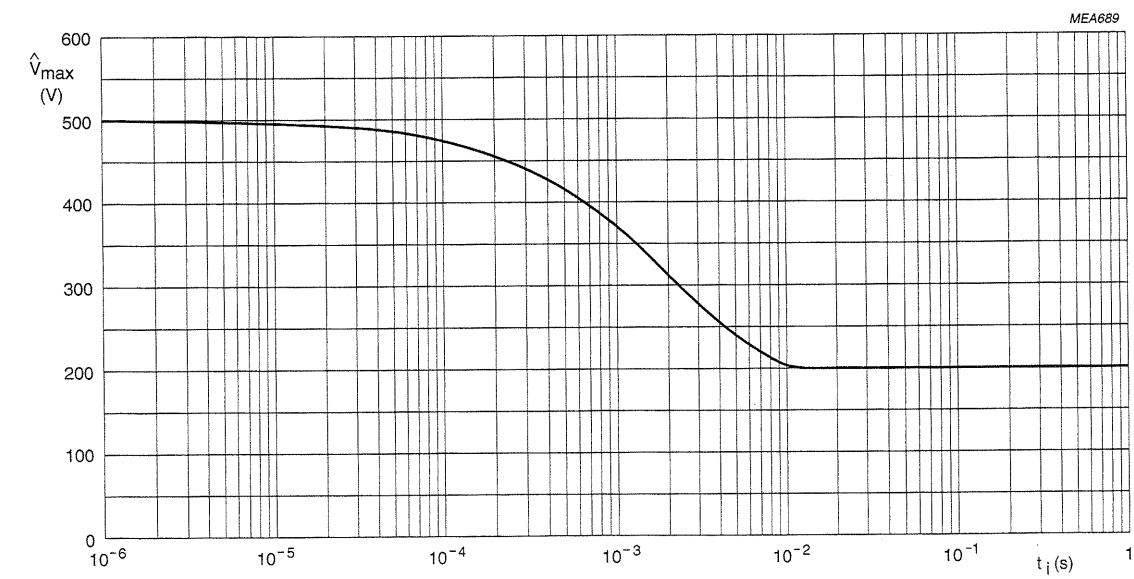
Fig.3 Maximum dissipation (P_{max}) in percentage of rated power as a function of the ambient temperature (T_{amb}).

PULSE LOADING CAPABILITIES



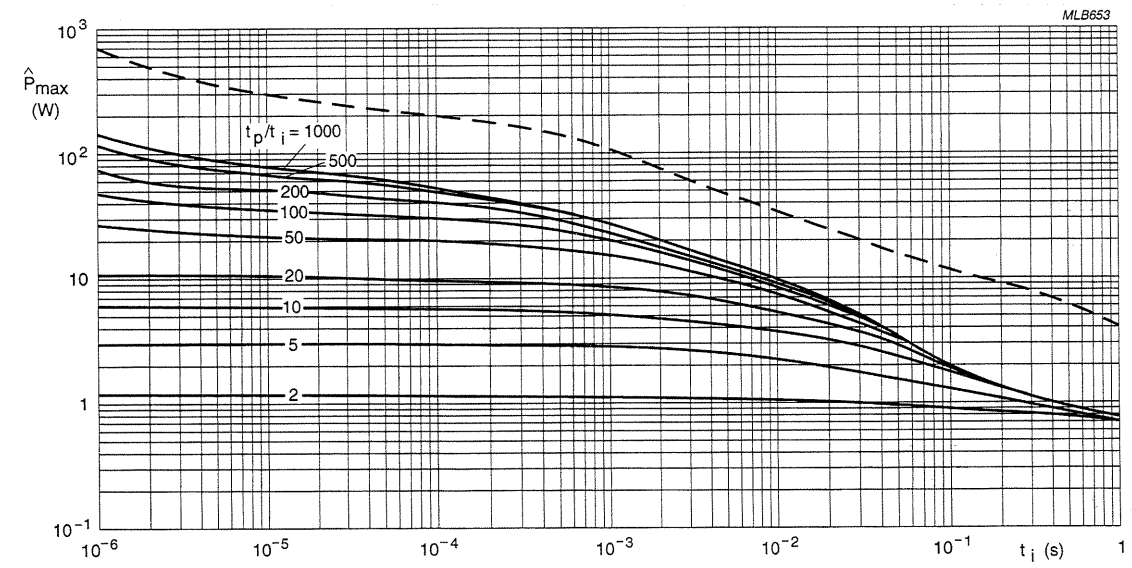
MRS16T

Fig.4 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



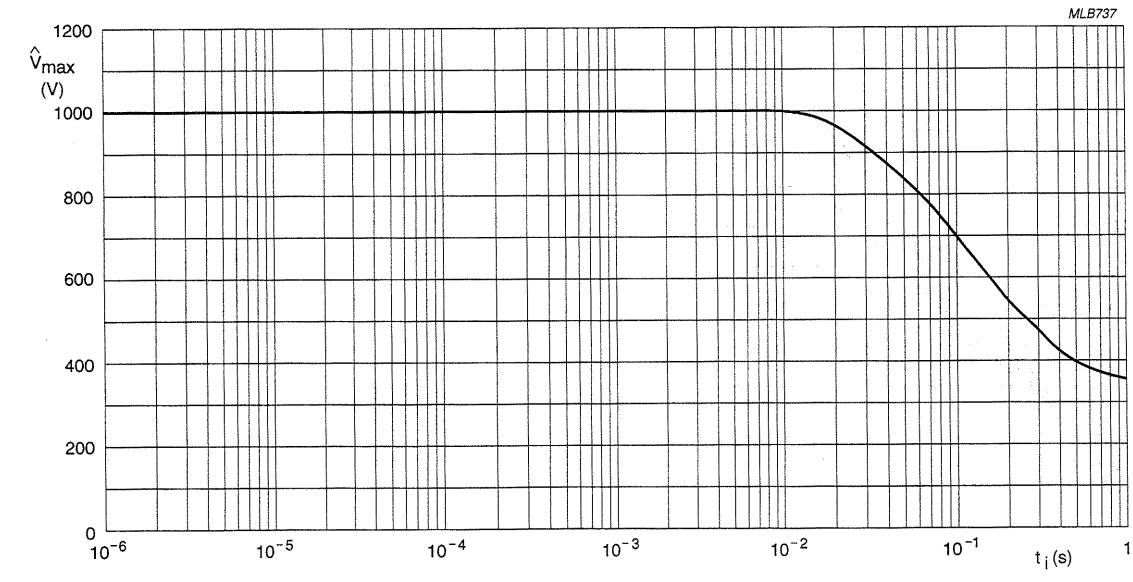
MRS16T

Fig.5 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).



MRS25

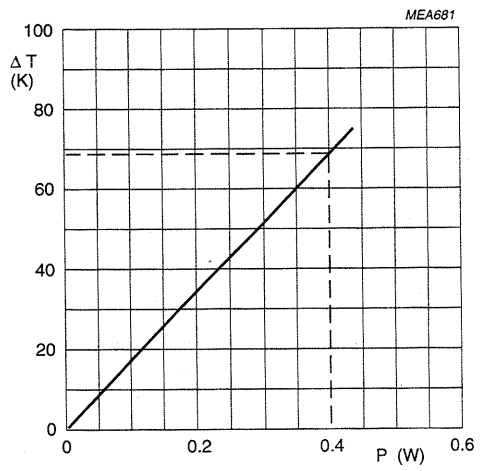
Fig.6 Pulse on a regular basis; maximum permissible peak pulse power ($\hat{P}_{max}$) as a function of pulse duration (t_i).



MRS25

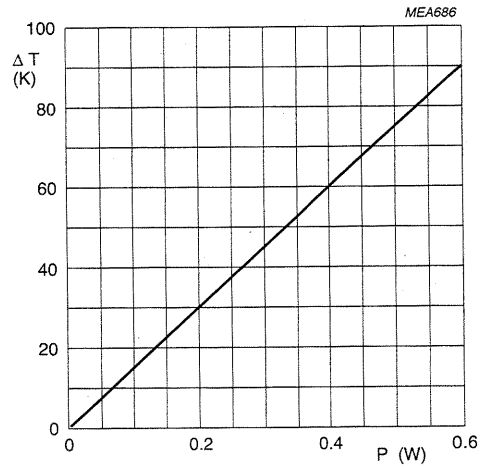
Fig.7 Pulse on a regular basis; maximum permissible peak pulse voltage ($\hat{V}_{max}$) as a function of pulse duration (t_i).

Application information



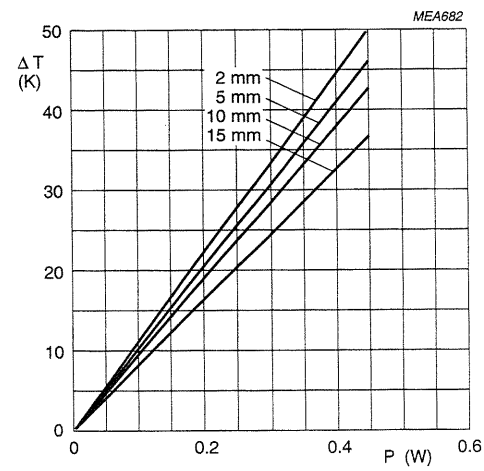
MRS16T

Fig.8 Hot-spot temperature rise (ΔT) as a function of dissipated power.



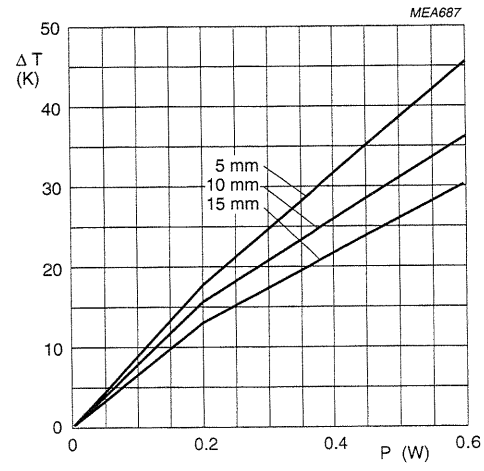
MRS25

Fig.9 Hot-spot temperature rise (ΔT) as a function of dissipated power.



MRS16T

Fig.10 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.



MRS25

Fig.11 Temperature rise (ΔT) at the lead end (soldering point) as a function of dissipated power at various lead lengths after mounting.

MECHANICAL DATA

Mass per 100 units

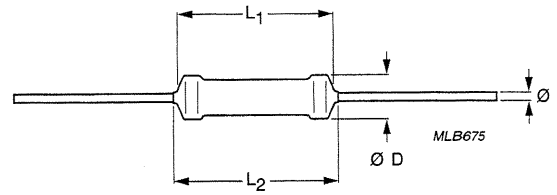
TYPE	MASS (g)
MRS16T	12.5
MRS25	25

Marking

The nominal resistance and tolerance are marked on the resistor using five coloured bands in accordance with IEC publication 62 *"Colour codes for fixed resistors"*.

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 publication 294")*.



For dimensions see Table 3.

Fig.12 Outline.

Table 3 Resistor type and relevant physical dimensions; see Fig.12

TYPE	∅D MAX. (mm)	L_1 TYP. (mm)	L_2 MAX. (mm)	∅d (mm)
MRS16T	1.9	3.2	3.7	0.5
MRS25	2.5	6.5	7.0	0.6

TESTS AND REQUIREMENTS

Essentially all tests are carried out in accordance with the schedule of *"IEC publication 115-1"*, category **LCT/UCT/56** (rated temperature range: **L**ower **C**ategory **T**emperature, **U**pper **C**ategory **T**emperature; damp heat, long term, **56** days). The testing also covers the requirements specified by EIA and EIAJ.

The tests are carried out in accordance with IEC publication 68, *"Recommended basic climatic and mechanical robustness testing procedure for electronic components"* and under standard atmospheric conditions according to *"IEC 68-1"*, subclause 5.3.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45% to 75%

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

In Table 4 the tests and requirements are listed with reference to the relevant clauses of *"IEC publications 115-1 and 68"*; 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.

Table 4 Test procedures and requirements

IEC 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				MRS16T	MRS25
Tests in accordance with the schedule of IEC publication 115-8					
4.4.1		visual examination		no holes; clean surface; no damage	
4.4.2		dimensions (outline)	gauge (mm)	see Table 3	
4.5		resistance	applied voltage (+0/–10%): R < 10 Ω: 0.1 V 10 Ω ≤ R < 100 Ω: 0.3 V 100 Ω ≤ R < 1 kΩ: 1 V 1 kΩ ≤ R < 10 kΩ: 3 V 10 kΩ ≤ R < 100 kΩ: 10 V 100 kΩ ≤ R < 1 MΩ: 25 V 1 MΩ ≤ R: 50 V	$R - R_{nom}$: max. ±1%	
4.18	Tb	resistance to soldering heat	thermal shock: 3 s; 350 °C; 6 mm from body: R ≤ 100 kΩ R > 100 kΩ	ΔR/R max.: ±0.1% +0.05 Ω ΔR/R max.: ±0.25% +0.05 Ω	ΔR/R max.: ±0.1% +0.05 Ω
4.29	45 (Xa)	component solvent resistance	isopropyl alcohol or H_2O followed by brushing in accordance with *"MIL 202 F"*	no visual damage	
4.17	Ta	solderability	2 s; 235 °C	good tinning; no damage	
4.7		voltage proof on insulation	voltage (RMS) during 1 minute, metal block method: 400 V for **MRS16T**, 700 V for **MRS25**	no breakdown or flashover	

IEC 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				MRS16T	MRS25
4.13		short time overload	room temperature; $P = 6.25 \times P_n$ (**MRS25**) or 6.25×0.25 W (**MRS16T**); ($V \leq 2 \times V_{max}$); 5 s on 45 s off, 10 cycles	$\Delta R/R$ max.: ±0.25% +0.05 Ω	
4.16	U	robustness of terminations:			
4.16.2	Ua	tensile all samples	load 10 N; 10 s	number of failures $<10 \times 10^{-6}$	
4.16.3	Ub	bending half number of samples	load 5 N; 4 × 90°	number of failures $<10 \times 10^{-6}$	
4.16.4	Uc	torsion other half of samples	3 × 360° in opposite directions	no damage $\Delta R/R$ max.: ±0.1% +0.05 Ω	
4.20	Eb	bump	3 × 1500 bumps in 3 directions; 40 g	no damage $\Delta R/R$ max.: ±0.1% +0.05 Ω	
4.22	Fc	vibration	frequency 10 to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 hours (3 × 2 hours)	no damage $\Delta R/R$ max.: ±0.1% +0.05 Ω	
4.19	14 (Na)	rapid change of temperature	30 minutes at LCT and 30 minutes at UCT; 5 cycles:	no visual damage	
			R ≤ 100 kΩ	$\Delta R/R$ max.: ±0.1% +0.05 Ω	
			R > 100 kΩ	$\Delta R/R$ max.: ±0.25% +0.05 Ω	$\Delta R/R$ max.: ±0.1% +0.05 Ω
4.23		climatic sequence:			
4.23.3	30 (D)	damp heat (accelerated) 1st cycle			
4.23.6	30 (D)	damp heat (accelerated) remaining cycles	6 days; 55 °C; 95 to 98% RH:	R_{ins} min.: 10^3 MΩ	
			R ≤ 100 kΩ	$\Delta R/R$ max.: ±0.5% +0.05 Ω	
			R > 100 kΩ	$\Delta R/R$ max.: ±1% +0.05 Ω	$\Delta R/R$ max.: ±0.5% +0.05 Ω
4.24.2	3 (Ca)	damp heat (steady state) (IEC)	56 days; 40 °C; 90 to 95% RH; loaded with 0.01 P_n (IEC steps: 4 to 100 V):		
			R ≤ 100 kΩ	$\Delta R/R$ max.: ±0.5% +0.05 Ω	
			R > 100 kΩ	$\Delta R/R$ max.: ±1% +0.05 Ω	$\Delta R/R$ max.: ±0.5% +0.05 Ω
4.25.1		endurance (at 70 °C)	1000 hours; loaded with P_n or V_{max}; 1.5 hours on and 0.5 hours off:		
			R ≤ 100 kΩ	$\Delta R/R$ max.: ±0.5% +0.05 Ω	
			R > 100 kΩ	$\Delta R/R$ max.: ±1% +0.05 Ω	$\Delta R/R$ max.: ±0.5% +0.05 Ω

IEC 115-8 CLAUSE	IEC 68-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS	
				MRS16T	MRS25
4.23.2	27 (Ba)	endurance at upper category temperature	1 000 hours; no load:		
			$R \leq 100\ k\Omega$	$\Delta R/R$ max.: $\pm 0.5\% + 0.05\ \Omega$	
			$R > 100\ k\Omega$	$\Delta R/R$ max.: $\pm 1\% + 0.05\ \Omega$	$\Delta R/R$ max.: $\pm 0.5\% + 0.05\ \Omega$
4.8.4.2		temperature coefficient	at 20/LCT/20 °C and 20/UCT/20 °C ($TC \times 10^{-6}/K$)	$\leq \pm 50 \times 10^{-6}/K$	
Other tests in accordance with IEC 115 clauses and IEC 68 test method					
4.17	20 (Tb)	solderability (after ageing)	8 hours steam or 16 hours 155 °C; leads immersed 6 mm for 2 ±0.5 s in a solder bath at 235 ±5 °C	good tinning (≥95% covered); no damage	
4.6.1.1		insulation resistance	voltage (DC) after 1 minute, metal block method: 100 V for **MRS16T**, 500 V for **MRS25**	R_{ins} min.: $10^4\ M\Omega$	
4.12		noise	IEC publication 195 (measured with Quantech - equipment):		
			$R \leq 68\ k\Omega$	max. 0.1 µV/V	max. 0.1 µV/V
			$R \leq 100\ k\Omega$	max. 0.5 µV/V	max. 0.1 µV/V
			$R \leq 1\ M\Omega$	max. 1.5 µV/V	max. 0.1 µV/V
			$R > 1\ M\Omega$	max. 1.5 µV/V	max. 1.5 µV/V
see 2nd amendment to *"IEC 115-1"*, Jan.'87		pulse load		see Figs 4 and 5	see Figs 6 and 7