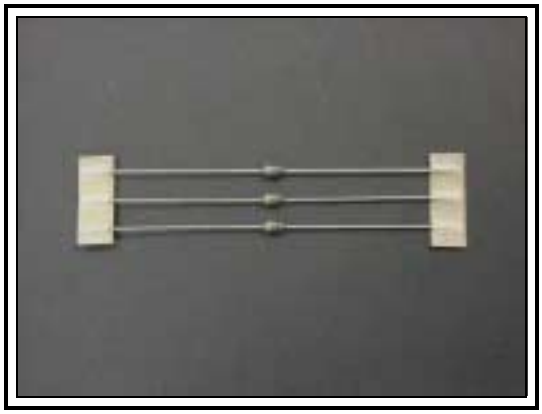
# PRECISION FILM RESISTOR – MRS16S

## FEATURES

- Precision resistors in small outlines
- Low noise.



## MARKET SEGMENTS AND APPLICATIONS

| Industry sector | Application segment | End-user equipment |
|---|---|---|
| Industrial | Controls | Electrical testers<br>Power system control<br>Instruments (measuring)<br>Surface scanners |
| | Security | Electric fence energizer |
| | Control/medical | Blood analyzers |
| Automotive | Engine Management | Electronic Fuel Injection System |
| Consumer | Sound & Vision | Amplifiers, TV<br>Professional audio equipment |

## TECHNOLOGY

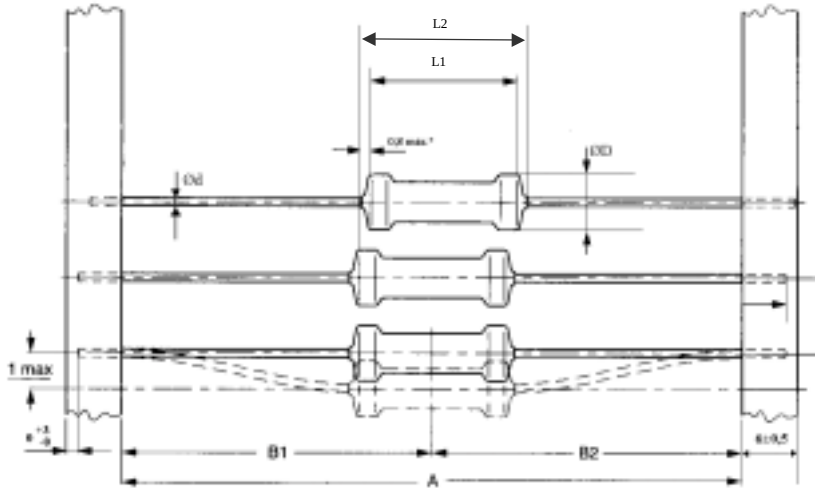
A homogeneous film of metal alloy is deposited on a high-grade ceramic body. After a helical groove has been cut in the resistive layer, tinned connecting wires to the end-caps.
The resistors are coated with a green lacquer that provides electrical, mechanical, and climatic protection. The encapsulation is resistant to all cleaning solvents in accordance with *"MIL-STD 202E, method 215"* e *"IEC 68-2-45"*.

## QUICK REFERENCE DATA

| DESCRIPTION | MRS16S (E-24 / E-96 series) |
|---|---|
| | **Cu-lead** |
| Resistance range | 4.99Ω to 1MΩ |
| Resistance tolerance | ± 1% |
| Maximum dissipation Tamb = 70ºC | 0.40W |
| Basic specifications | IEC 60115-1 and 60115-2 |
| Climatic category (IEC 60068) | 55/ 155/ 56 |
| Thermal resistance (Rth) | 170 K/W |
| Limiting voltage (DC or RMS) | 200V |
| Rated voltage (1) | $\sqrt{Pn \times R}$ |
| Temperature Coefficient: | ≤ ± 50 ppm/ °C |
| Stability after: | |
| Load: | |
| R≤100KΩ | ΔR/R max.: ±0,5% +0.05Ω |
| R>100KΩ | ΔR/R max.: ±1% + 0.05Ω |
| Climatic tests: | |
| R≤100KΩ | ΔR/R max.: ±0.5% + 0.05Ω |
| R>100KΩ | ΔR/R max.: ±1% + 0.05Ω |
| Resistance to Soldering heat: | |
| R≤100KΩ | ΔR/R max.: ±0.1% + 0.05Ω |
| R>100KΩ | ΔR/R max.: ±0.25% + 0.05Ω |
| Short time overload | ΔR/R max.: ±0.25% + 0.05Ω |

Note:
1- Maximum rated voltage is the “Limiting voltage”.

## MECHANICAL DATA




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

Table 1.

| Type | A | L1max | L2max | ϕd | Dmax | \|B1-B2\| | Mass per 100 units (g) |
|---|---|---|---|---|---|---|---|
| MRS16S | 52 .5 ± 1.5 | 3.2 | 3.4 | 0.45 ± 0.05 | 1.9 | ± 1.2 | 11.5 |
| | 26 ± 1.5 | | | | | | 8.0 |

Dimensions in mm

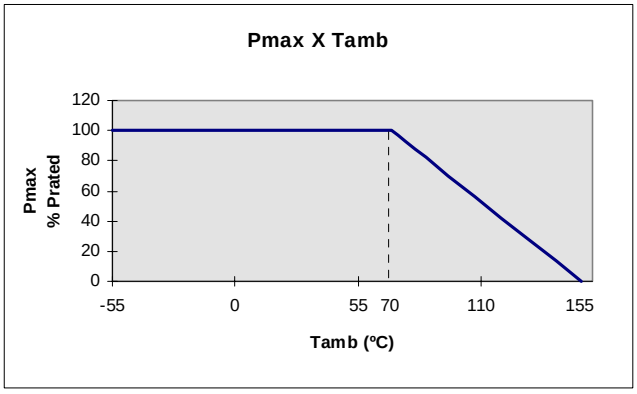
## MOUNTING

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

## ELECTRICAL CHARACTERÍSTICS

### DERATING

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




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

### APPLICATION INFORMATION FOR HOT-SPOT AND SOLDER-SPOT

Hot-spot

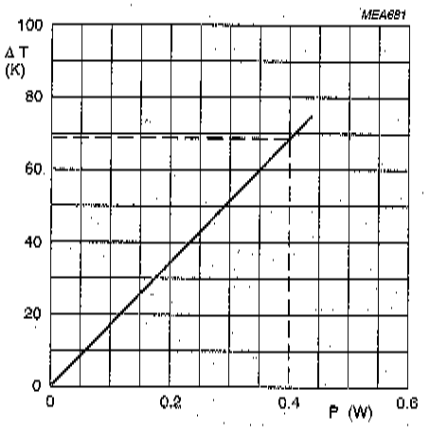



Fig. 1 - Hot spot temperature rise (ΔT) as a function of dissipated power.

Solder-spot

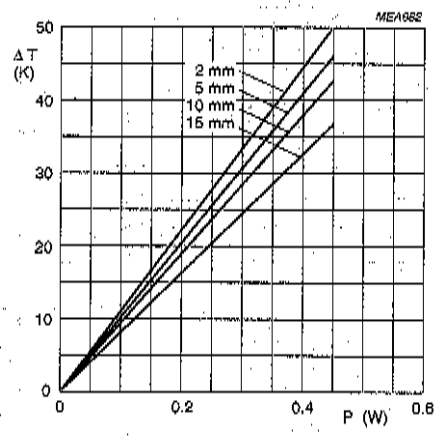



Fig. 2 - Temperature rise (ΔT) at the lead (soldering point) as a function of dissipated power at various lead lengths after mounting.

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

**PULSE LOADING CAPABILITIES**

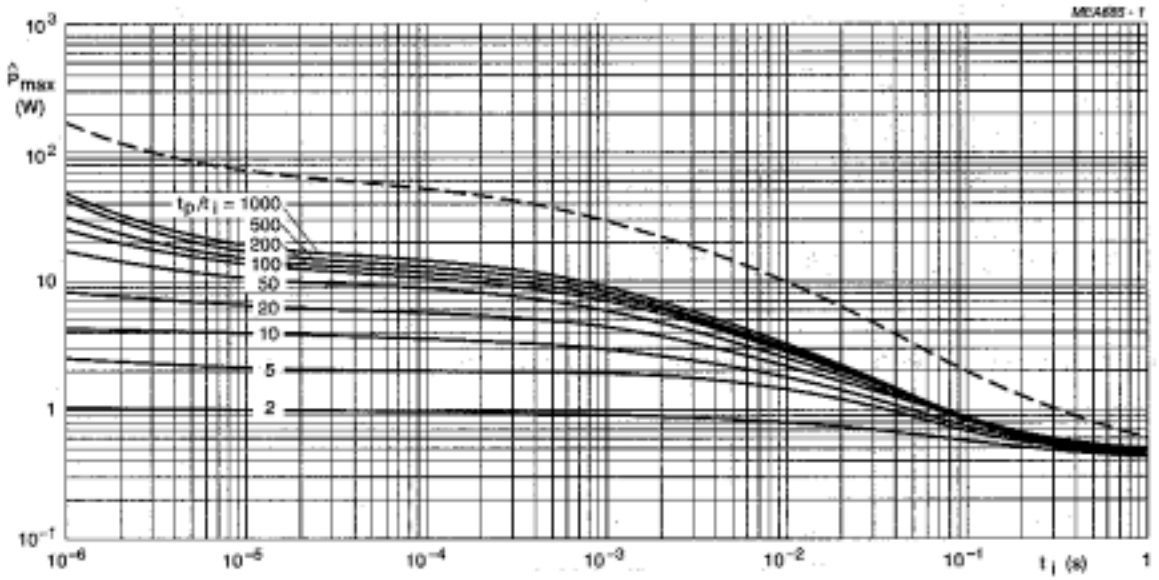



Fig. 3 - Pulse on a regular basis, maximum permissible peak pulse power (^Pmax) as a function of pulse duration (ti).

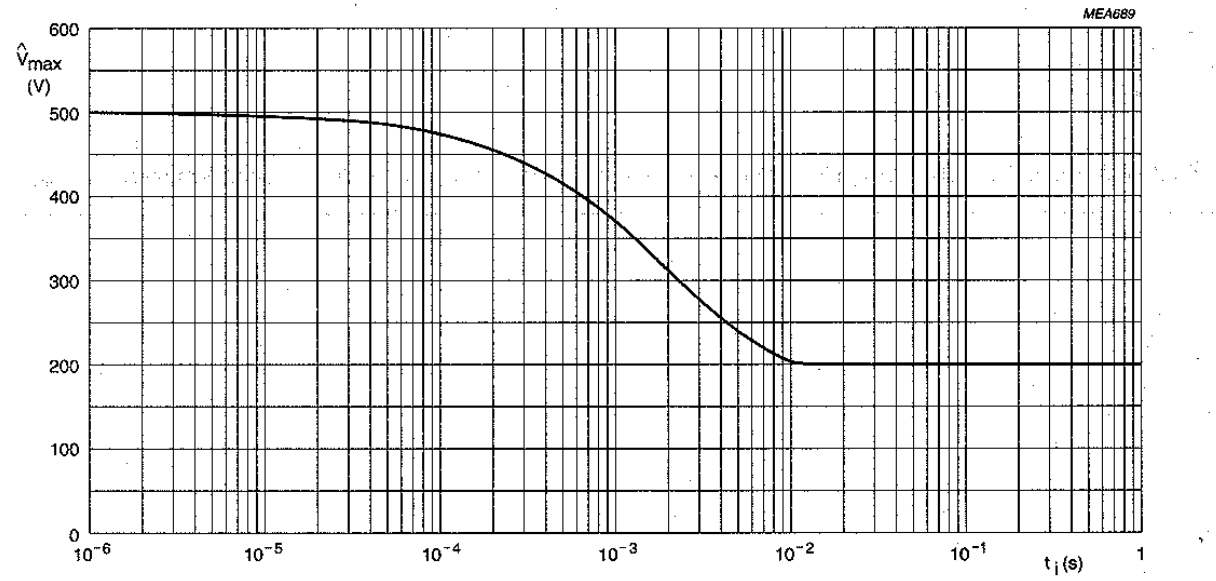



Fig. 4 - Pulse on a regular basis, maximum permissible peak pulse voltage (^Vmax) as a function of pulse duration (ti).

## MARKING

The nominal resistance and tolerance are marked on the resistor using 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 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 ∅ (mm) | TOL (%) | ORDERING CODE 23xx xxx xxxxx | | | |
|---|---|---|---|---|---|---|
| | | | BANDOLIER IN AMMOPACK | | | BANDOLIER ON REEL |
| | | | STRAIGHT LEADS | | | |
| | | | 52.5 mm | 52.5 mm | 26 mm | 52.5 mm |
| | | | 5000 units | 1000 units | 5000 units | 5000 units |
| MRS16S | Cu 0.45 | 1 | 22 157 2xxxx | 22 157 1xxxx | 22 157 4xxxx | 22 157 3xxxx |

***Note: For formed types see “Formed Types Specification”***

## ORDERING CODE

- The resistors have a 12 digit ordering code starting with 23.
- The first 6 digits indicate the resistor type and packaging see table 2.
- 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 of 12NC

| RESISTANCE DECADE | LAST DIGIT |
|---|---|
| 4.99 to 9.76Ω | 8 |
| 10 to 97.6Ω | 9 |
| 100 to 976Ω | 1 |
| 1 to 9.76kΩ | 2 |
| 10 to 97.6kΩ | 3 |
| 100 to 976kΩ | 4 |
| 1 to 1MΩ | 5 |

Example:
The ordering code for resistor type MRS16S with Cu leads and a value of 750Ω 1%, supplied on a bandolier of 1000 units in ammopack, is 2322 157 17501.

## PACKAGING

**Bandolier in ammopack.**

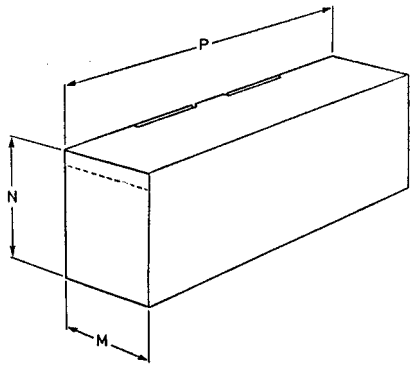
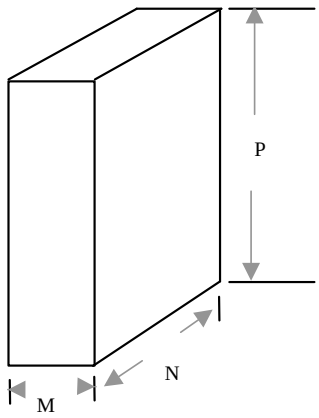


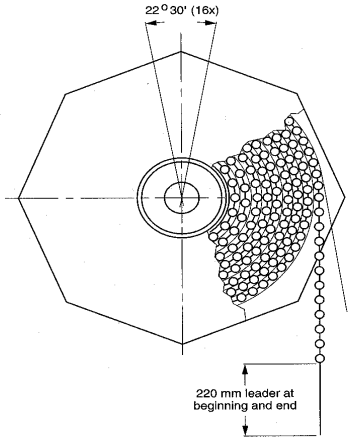

Table 4.

| Type | Quantity | M | N | P | Bandolier Width |
|---|---|---|---|---|---|
| MRS16S | 5000 | 78 | 98 | 260 | 52.5 ±1.5 |
| | 1000 | 71 | 31 | 140 | |

Dimensions in mm

**Bandolier on Reel**



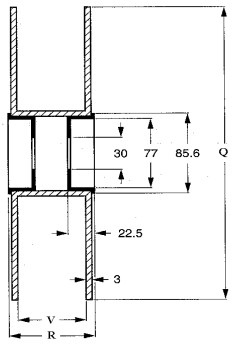




Table 5.

| Type | Quantity | M | N | P | Q | V | R | Bandolier Width |
|---|---|---|---|---|---|---|---|---|
| MRS16S | 5000 | 92 | 273 | 273 | 267 | 75 | 86 | 52 .5 ±1.5 |

Dimensions in mm

## TESTS AND REQUERIMENTS

Essentially all tests are carried out in accordance with the schedule of "IEC publication 60115-1", 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 IEA and IEAJ.

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

In table 6 the tests and requirements are listed with reference to the relevant clauses of "IEC publications 60115-1 and 60068-2, a short description of the tests 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 middle activated.

Table 6. Test procedures and requirements.

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TESTS | PROCEDURE | REQUEREMENTS |
|---|---|---|---|---|
| 4.4.1 | | Visual examination | | No holes; clean surface; no damage |
| 4.4.2 | | Dimensions (outline) | Gauge (mm) | See Table 1 |
| 4.5 | | Resistance | applied voltage (+0/-10%):<br>R<10Ω: 0.1V<br>10Ω ≤ R < 100Ω: 0.3V<br>100Ω ≤ R <1 kΩ : 1V<br>1kΩ ≤ R < 10 kΩ:3V<br>10 kΩ ≤ R < 100 kΩ: 10V<br>100 kΩ ≤ R < 1MΩ: 25V<br>R = 1MΩ: 50V | R - Rnom: max.: ± 1% |
| 4.6.1.1 | | Insulation resistance | $100V_{DC}$ after 1 min, metal block method. | $R_{ins}$ min.: $10^4$ MΩ |
| 4.7 | | Voltage proof on insulation | $400V_{RMS}$ during 1min, metal block method. | No breakdown or flashover |
| 4.8.4.2 | | Temperature coefficient | At 20/LCT/20°C and 20/UCT/20ºC (TC x ppm/C) | ≤ ±50 ppm / °C |
| 4.12 | | Noise | R≤68KΩ<br>R≤100KΩ<br>R>100KΩ | Max. 0.1µV/V<br>Max. 0.5µV/V<br>Max. 1.5µV/V |
| 4.13 | | Short time overload | Room temperature; P= 6.25x.0.25W; 5s on 45s off, 10 cycles (V≤2xVmax.) | ΔR/R max. ± 0.25% + 0.05Ω |
| 4.16 | U | Robustness of terminations: | | |
| 4.16.2 | Ua | Tensile other half of samples | ϕ0.45mm, load 5N; 10s | Number of failures <10x10$^{-6}$ |
| 4.16.3 | Ub | Bending half number of samples | ϕ0.45mm, load 2.5N; 4 x 90$^o$ | Number of failures < 10x10$^{-6}$ |
| 4.16.4 | Uc | Torsion other half of samples | 3 x 360° in opposite directions | no damage<br>ΔR/R max. ± 0.1% + 0.05Ω |
| 4.17 | 20(Ta) | Solderability ( after aging ) | 8 hours steam or 16 hours155°C; leads immersed 6mm for 2±0.5s in a solder bath at 235±5$^o$ C | Good tinning ( ≥ 95% covered) ; no damage |

| IEC 60115-1 CLAUSE | IEC 60068-2 TEST METHOD | TESTS | PROCEDURE | REQUEREMENTS |
|---|---|---|---|---|
| 4.18 | Tb | Resistance to soldering heat | Thermal shock 3s; 350°C; 6mm from body: | R≤100KΩ:<br>ΔR/R max. ± 0.1% + 0.05Ω<br>R>100KΩ:<br>ΔR/R max. ± 0.25% + 0.05Ω |
| 4.19 | (14)Na | Rapid change of temperature | 30 minutes at LCT and 30 minutes at UCT; 5 cycles:<br>R≤100KΩ<br>R>100KΩ | No visual damage<br><br>ΔR/R máx. ± 0.1% + 0.05Ω<br>ΔR/R máx. ± 0.25% + 0.05Ω |
| 4.22 | Fc | Vibration | Frequency 10 to 500Hz; displacement 1.5 mm or acceleration 10g; 3directions; total 6 hours (3 x 2 hours) | no damage<br>ΔR/R max. ± 0.1% + 0.05Ω |
| 4.23<br><br>4.23.3<br><br>4.23.6 | <br><br>30(Db)<br><br>30(Db) | Climatic sequence:<br><br>Damp heat (accelerated) 1st cycle<br><br>Damp heat (accelerated) remaining cycles | <br><br><br><br>6 days; 55ºC; 95 a 98% R.H:<br>R≤ 100KΩ<br>R> 100KΩ | $R_{isol}$ min. $10^3$ MΩ<br><br><br><br><br>ΔR/R max. ± 0.5% + 0.05Ω<br>ΔR/R max. ± 1% + 0.05Ω |
| 4.24.2 | 3(Ca) | Damp heat (stead y state) (IEC) | 56 days; 40°C; 90 to 95% RH : loaded with 0.01 Pn (IEC steps: 4 to 100V) :<br>R≤ 100KΩ<br>R> 100KΩ | $R_{isol}$ min. $10^3$ MΩ<br><br>ΔR/R max. ± 0.5%+ 0.05Ω<br>ΔR/R max. : ± 1%+0.05Ω. |
| 4.25.1 | | Endurance (at 70°C) | 1000hours; loaded with Pn or Vmax; 1.5 hours on and 0.5 hours off:<br>R≤ 100KΩ<br>R> 100KΩ | <br><br>ΔR/R max. ± 0.5%+ 0.05Ω<br>ΔR/R max. : ± 1%+0.05Ω. |
| 4.29 | 45(Xa) | Component solvent resistance | Isopropyl alcohol or $H_2O$ followed by brushing in accordance with "MIL 202 F" | No visual damage |
| See 2nd amendment to "ÏEC 60115-1", | | Pulse load | | See Figs. 3 and 4 |