

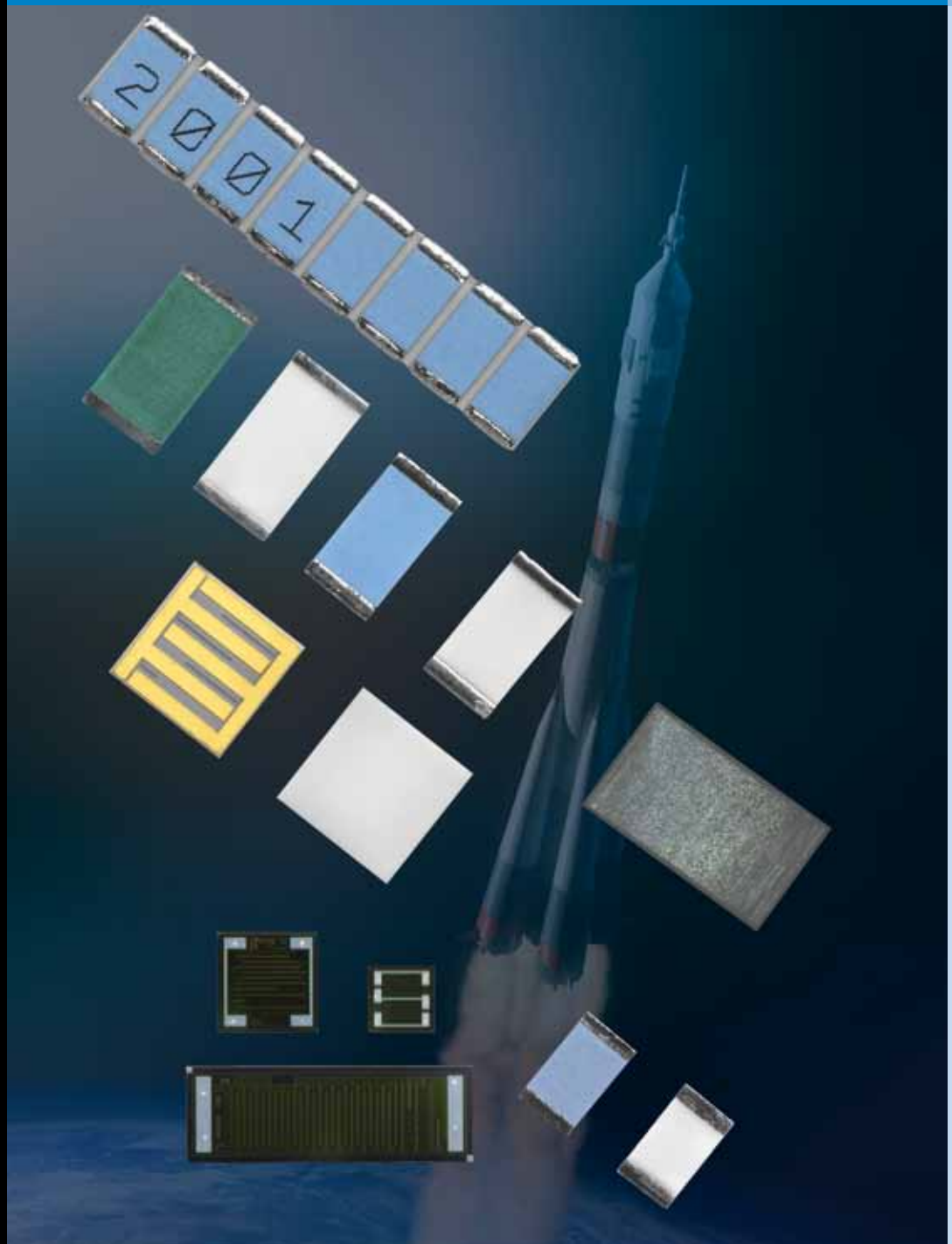


# RESISTIVE PRODUCTS SPACE APPLICATIONS

RESISTIVE PRODUCTS

Vishay Sfernice

CAPABILITIES





Components used in aerospace equipment are designed to function reliably when subjected to extremely hot and cold temperatures, intense vibration, and other environmental stresses. Vishay Sfernice has been involved in this market since the early 1980s, beginning with space-level qualifications for its metal film, wirewound, and SIL products. With the growing demand for miniaturization, Vishay Sfernice SMD products have been qualified for space applications since 2002.

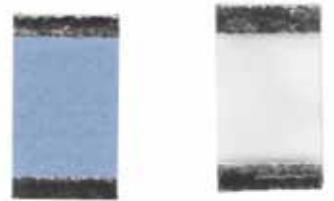
In 2009, Vishay Sfernice became the first manufacturer of passive components to hold the ESCC/QML qualification (ESCC Technology Flow Qualified Manufacturer) granted by the European Space Agency (ESA). At Vishay Sfernice, our goal is to offer the widest range of qualified or SCD (customer source control drawing) products and thus to serve as a one-stop-shop for our space customers.

## QUALIFIED PRODUCTS

### PHR

#### Key Features and Benefits:

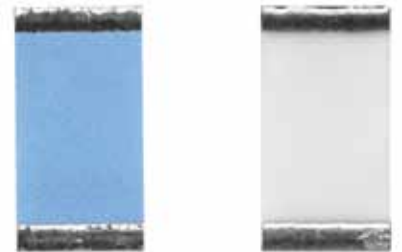
- Space level ESA qualified: ESCC4001/023
- Thin film technology
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: 0603 to 2010 (0402 qualification ongoing)
- Wide ohmic range: 10 Ω to 3 MΩ (depending on size)
- Tight tolerance: down to 0.01 %
- Tight temperature coefficient: down to 5 ppm/°C (- 55 °C; + 155 °C)
- Load life stability: 0.15 % after 2000 h at 70 °C at nominal power (0.02 % typical)



### PFRR

#### Key Features and Benefits:

- Established reliability: R failure rate (0.01 %/1000 h)
- Thin film technology
- Operating temperature range – 55 °C; + 155 °C
- ESA qualified: ESCC4001/023
- Various sizes: 0603 to 2010 (0402 qualification ongoing)
- Wide ohmic range: 100 Ω to 3.01 MΩ (depending on size)
- Tight tolerance: down to 0.05 %
- Tight temperature coefficient: down to 10 ppm/°C (- 55 °C; + 155 °C)
- Load life stability: 0.25 % after 8000 h at 70 °C at nominal power (0.05 % typical)
- The industry's only SMD product with an official space qualification and performance as tight as 0.05 % / 10 ppm



### PRAHR / CNWHR

#### Key Features and Benefits:

- Space level ESA qualified: ESCC4001/025
- Thin film technology
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: PRAHR100, PARHR135, PRAHR182 (PRAHR070 ongoing)
- Wide ohmic range 100 Ω to 1 MΩ (depending on size)
- Tight tolerances: 0.1 % absolute, 0.05 % ratio (tighter on request)
- Tight temperature coefficient: 10 ppm/°C (- 55 °C; + 155 °C) absolute, 3 ppm/°C ratio
- Same ohmic value (any value) or different ohmic values in same network: CNWHR
- Load life stability: 0.1 % after 1000 h at 70 °C at nominal power, 0.02 % on the ratio



## CHPHR

### Key Features and Benefits:

- Space level ESA qualified: ESCC4001/026
- Thick film technology
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: 0603 to 2512
- Wide ohmic range: 1 Ω to 10 MΩ
- Load life stability: 1 % after 1000 h at 70 °C at nominal power
- Tin/lead or gold terminations



## PRODUCTS WITH ONGOING QUALIFICATION

### LHR

### Key Features and Benefits:

- Space level ESA qualification ongoing
- Thin film technology
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: 0603 to 2010 (2512 under development)
- Ohmic range 0.1 Ω to 9.99 Ω
- Load life stability: 0.5 % after 2000 h at 70 °C at nominal power
- Temperature coefficient: 50 ppm/°C to 300 ppm/°C (depending on ohmic value)



### PZHR

### Key Features and Benefits:

- Space level ESA qualification ongoing
- Strap: 0 Ω
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: 0603 to 2512
- Conform to MIL-PRF-32159

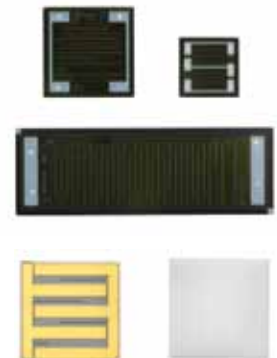


## PRODUCTS AVAILABLE UNDER CUSTOMER SPECIFICATION

### DIE CHIPS, CURRENT SENSORS and NETWORKS

### Key Features and Benefits:

- Thin film technology
- Nickel chromium, tantalum nitride or chromium silicium depending on performance needed
- Custom networks available
- Operating temperature range – 55 °C; + 155 °C
- Various sizes: 20 mil x 20 mil to 67 mil x 134 mil
- Wide ohmic range 0.05 Ω to 5 MΩ (depending on size)
- Tight tolerance: down to 0.01 %
- Tight temperature coefficient: down to 5 ppm/°C (-55 °C; +155 °C)
- Load life stability: 0.05 % after 2000 h at 70 °C typical



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## SEMICONDUCTORS:

Rectifiers • High-Power Diodes and Thyristors • Small-Signal Diodes • Zener and Suppressor Diodes  
• FETs • Optoelectronics • ICs • Modules

## PASSIVE COMPONENTS:

Resistive Products • Magnetics • Capacitors



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VMN-PL0433-1007

### Hi-Rel Thin Film Chip Resistors



#### KEY BENEFITS

- High-reliability product
- ESA approved to ESCC 4001/029
- Advanced thin film technology
- SnPb termination plating, minimum 6 % Pb

#### APPLICATIONS

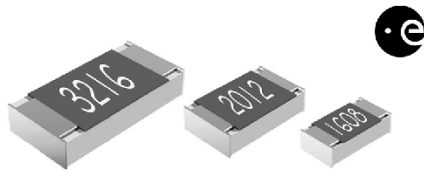
- Aerospace
- Avionics
- Military

#### RESOURCES

- Datasheet: TNPS....ESCC: <http://www.vishay.com/doc?28789>
- For technical questions contact [specialresistors@vishay.com](mailto:specialresistors@vishay.com)



## Hi-Rel Thin Film Chip Resistors



TNPS .... ESCC high-reliability thin film chip resistors are the premium choice for design and manufacture of equipment where a mature technology and proven reliability are of utmost importance. They are regularly used in communication and research satellites and fit equally well into aircraft and military electronic systems.

Approval of the TNPS .... ESCC products is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005.

### FEATURES

- High-reliability product
- ESA approved to ESCC 4001/029
- Advanced thin film technology
- SnPb termination plating, minimum 6 % Pb

### APPLICATIONS

- Aerospace
- Avionics
- Military

### METRIC SIZE

IMPERIAL	0603	0805	1206
METRIC	RR1608M	RR2012M	RR3216M

### TECHNICAL SPECIFICATIONS

DESCRIPTION	TNPS0603 .... ESCC	TNPS0805 .... ESCC	TNPS1206 .... ESCC
Metric size	RR1608M	RR2012M	RR3216M
Resistance range	10.0 Ω to 221 kΩ	10.0 Ω to 422 kΩ	10.0 Ω to 1.00 MΩ
Resistance tolerance	± 1 %; ± 0.5 %; ± 0.1 %		
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K; ± 15 ppm/K		
Rated dissipation $P_{70}$	0.1 W	0.125 W	0.25 W
Operating voltage, $U_{max}$ , AC <sub>RMS</sub> or DC	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{F max}$ .	125 °C		
Operating temperature range	- 55 °C to 125 °C		
Max. resistance change at $P_{70}$ , $ \Delta R $ max., after:			
1000 h	≤ (0.05 % $R$ + 10 mΩ)		
2000 h	≤ (0.1 % $R$ + 20 mΩ)		
Permissible voltage against ambient (insulation)	100 V	200 V	300 V
Storage temperature range	-55 °C to +125 °C		

#### Note

- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

### TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

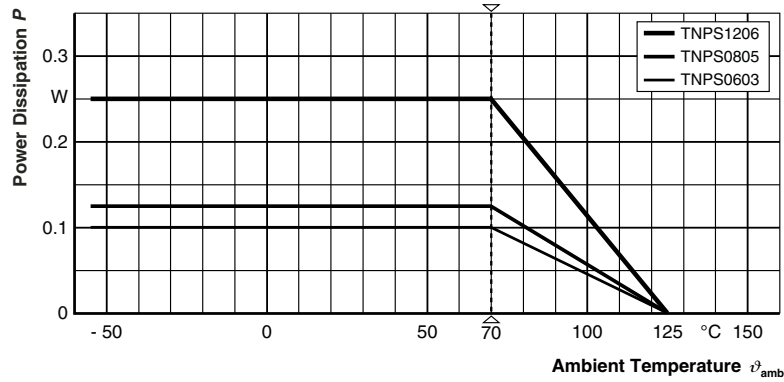
DESCRIPTION		RESISTANCE RANGE		
TCR	TOLERANCE	TNPS0603 .... ESCC	TNPS0805 .... ESCC	TNPS1206 .... ESCC
± 50 ppm/K	± 1 %	10.0 Ω to 221 kΩ	10.0 Ω to 422 kΩ	10.0 Ω to 1.00 MΩ
	± 0.5 %	10.0 Ω to 221 kΩ	10.0 Ω to 422 kΩ	10.0 Ω to 1.00 MΩ
± 25 ppm/K	± 0.1 %	10.0 Ω to 221 kΩ	10.0 Ω to 422 kΩ	10.0 Ω to 1.00 MΩ
	± 0.1 %	10.0 Ω to 221 kΩ	10.0 Ω to 422 kΩ	10.0 Ω to 1.00 MΩ

#### Notes

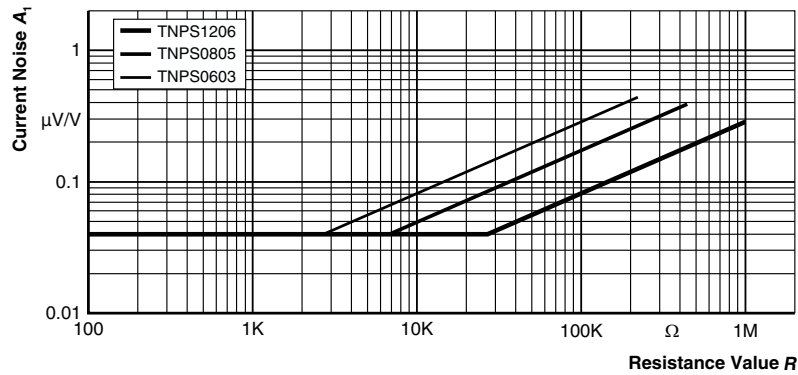
- The indicated combinations of TCR, tolerance and resistance range are a subset of those combinations approved to ESCC 4001/029
- According to ESCC 4001/029, resistance values are to be selected from the E96 series only

### Hi-Rel Thin Film Chip Resistors

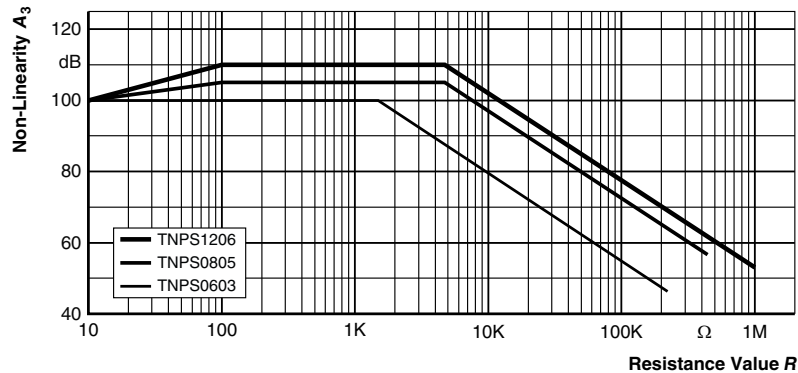
#### FUNCTIONAL PERFORMANCE



#### Derating



Current Noise  $A_1$  in accordance with IEC 60195



Non-Linearity  $A_3$  in accordance with IEC/TR 60440

Resistors - Avionics, Military, and Space



## Hi-Rel Thin Film Chip Resistors

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic substrate ( $Al_2O_3$ ) and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly fine trimming resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilize the trimming result. The resistor elements are covered by a protective coating designed for electrical, mechanical, and climatic protection. The terminations receive a final SnPb plating, controlled for a minimum lead content of 6 %. The resistance value is stamped on the coating with a four-character code system according to **IEC 60062** <sup>(1)</sup>. The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual chip resistors. Only accepted products are placed into a special matrix case packaging or into antistatic blister tape in accordance with **IEC 60286-3** <sup>(1)</sup>.

### ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow, or vapor phase as shown in **IEC 61760-1** <sup>(1)</sup>. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters, and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. Solderability is specified for 2 years after production. The permitted storage time is 20 years.

### APPROVALS

The resistors are approved to **ESCC 4001/029**. Conformity is indicated by the **ESCC Qualified Components** logo on the package label. Approval is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005.

The detail specification **ESCC 4001/029** has been established after successful completion of an **Evaluation Test Programme** according to **ESCC 2264000**.

These products are subjected to a screening test according to the ruling of the generic specification **ESCC 4001** and the detail specification **ESCC 4001/029**.

The production is succeeded by production test sequences for resistance, plating properties, solderability, and dimensions. This sequence is followed by screening tests for overload, non-linearity, temperature coefficient, resistance at room temperature, and a visual inspection. A Certificate of Conformity provides summary information by reporting the numbers of rejects for each test or inspection.

### LOT VALIDATION TESTS

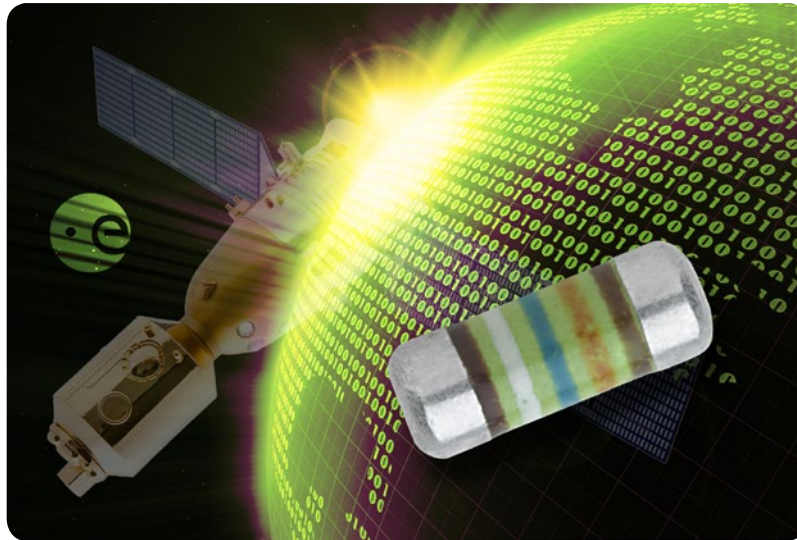
Execution of Lot Validation Tests according to the ruling of **ESCC 4001** is available as a separate order item. This is to be combined with the dedicated order line for the required amount of samples, using packaging code "LX".

The applicable scope of the Lot Validation Tests, graduated to Group 1, Group 2, and Group 3, is illustrated in the datasheet with the number of samples required for each level.

Deliverable item to the Lot Validation Tests is the test report together with the used samples, shipped in waffle tray package.



### Hi-Rel Thin Film MINI-MELF Resistors



#### KEY BENEFITS

- High-reliability product
- ESA approved to ESCC 4001/022
- Advanced thin film technology
- SnPb termination plating, minimum 6 % Pb

#### APPLICATIONS

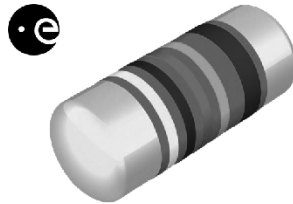
- Aerospace
- Avionics
- Military

#### RESOURCES

- Datasheet: MS1....ESCC: <http://www.vishay.com/doc?28790>
- For technical questions contact [specialresistors@vishay.com](mailto:specialresistors@vishay.com)



## Hi-Rel Thin Film MINI-MELF Resistors



MS1 .... ESCC high-reliability thin film MINI-MELF resistors are the premium choice for the design and manufacture of equipment where matured technology and proven reliability are of the utmost importance. They are regularly used in communication and research satellites and fit equally well into aircraft and military electronic systems.

Approval of the MS1 .... ESCC is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005.

### FEATURES

- High-reliability product
- ESA approved to ESCC 4001/022
- Advanced thin film technology
- SnPb termination plating, minimum 6 % Pb

### APPLICATIONS

- Aerospace
- Avionics
- Military

### METRIC SIZE

<b>DIN</b>	0204
<b>CECC</b>	RC3715M

TECHNICAL SPECIFICATIONS	
DESCRIPTION	MS1 .... ESCC
CECC size	RC3715M
Resistance range	2.21 $\Omega$ to 5.11 M $\Omega$
Resistance tolerance	$\pm 1 \%$ ; $\pm 0.5 \%$ ; $\pm 0.1 \%$
Temperature coefficient	$\pm 50$ ppm/K; $\pm 25$ ppm/K; $\pm 15$ ppm/K
Rated dissipation $P_{70}$	0.25 W
Operating voltage, $U_{max}$ . AC <sub>RMS</sub> or DC	200 V
Permissible film temperature, $\vartheta_{F max}$ .	125 °C
Operating temperature range	- 55 °C to 125 °C
Max. resistance change at $P_{70}$ , $ \Delta R $ max., after:	
1000 h	$\leq (0.35 \% R + 50 \text{ m}\Omega)$
2000 h	$\leq (0.5 \% R + 50 \text{ m}\Omega)$
Permissible voltage against ambient (insulation):	
1 min; $U_{ins RMS}$	500 V
Storage temperature range	-65 °C to +155 °C

### Note

- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

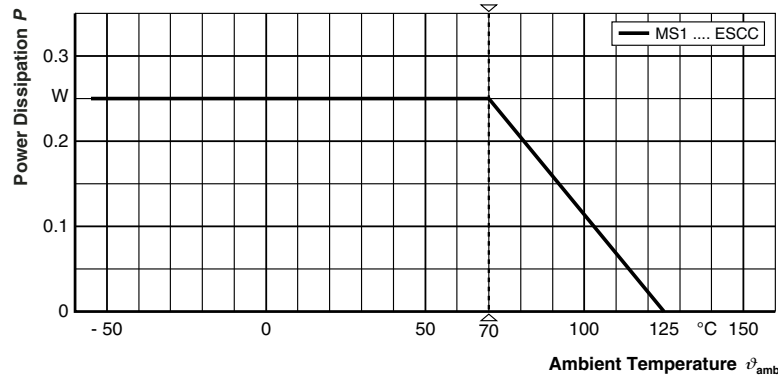
TEMPERATURE COEFFICIENT AND RESISTANCE RANGE			
DESCRIPTION		RESISTANCE RANGE	
TCR	TOLERANCE	MS1 .... ESCC	
$\pm 50$ ppm/K	$\pm 1 \%$	2.21 $\Omega$ to 5.11 M $\Omega$	
	$\pm 0.5 \%$	10.0 $\Omega$ to 1.00 M $\Omega$	
	$\pm 0.1 \%$	43.2 $\Omega$ to 1.00 M $\Omega$	
$\pm 15$ ppm/K	$\pm 0.1 \%$	43.2 $\Omega$ to 221 k $\Omega$	

### Notes

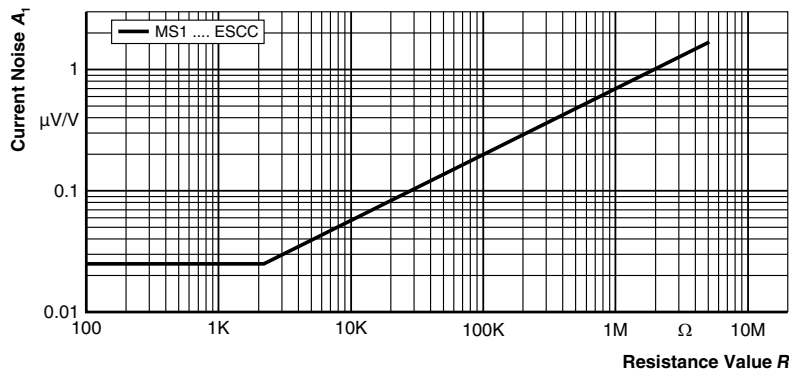
- The indicated combinations of TCR, tolerance and resistance range are a subset of those combinations approved to ESCC 4001/022
- According to ESCC 4001/022, resistance values are to be selected from the E96 series only

### Hi-Rel Thin Film MINI-MELF Resistors

#### FUNCTIONAL PERFORMANCE

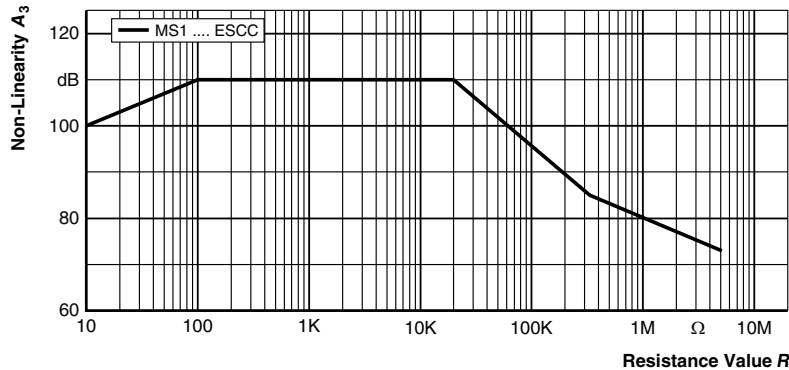


#### Derating



In accordance with IEC 60195

#### Current Noise - $A_1$



In accordance with IEC/TR 60440, superior requirements adopted from EN 140401-803

#### Non-linearity - $A_3$



## Hi-Rel Thin Film MINI-MELF Resistors

### DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade ceramic body ( $Al_2O_3$ ) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallized rod. A special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. The resistor elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final SnPb plating, controlled for a minimum lead content of 6 %. Five color code rings designate the resistance value and tolerance in accordance with **IEC 60062** <sup>(1)</sup>.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are placed into a special matrix case packaging or into antistatic blister tape in accordance with **IEC 60286-3** <sup>(1)</sup>.

### ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow, or vapor phase as shown in **IEC 61760-1** <sup>(1)</sup>. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters, and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. Solderability is specified for 2 years after production. The permitted storage time is 20 years.

### APPROVALS

The resistors are approved to **ESCC 4001/022**. Conformity is indicated by the **ESCC Qualified Components** logo on the package label. Approval is granted by the European Space Components Coordination and registered in the ESCC Qualified Parts List, REP005.

Revision 16-Sep-13

### SCREENING TESTS

These products are subjected to a screening test according to the ruling of the generic specification **ESCC 4001** and the detail specification **ESCC 4001/022**.

The production is succeeded by production test sequences for resistance, plating properties, solderability, and dimensions. This sequence is followed by screening tests for overload, non-linearity, temperature coefficient, resistance at room temperature, and a visual inspection. A certificate of conformity provides summary information by reporting the numbers of rejects for each test or inspection.

The requirements for burn-in with measurement of resistance drift, for a test of bend strength of the end face plating, and for a vibration test are waived by the detail specification **ESCC 4001/022**. The seal test is not applicable since MS1 is not a hermetically sealed product.

### LOT VALIDATION TESTS

Execution of Lot Validation Tests according to the ruling of **ESCC 4001** is available as a separate order item. This is to be combined with the dedicated order line for the required amount of samples, using packaging code "LX".

The applicable scope of the Lot Validation Tests, graduated to Group 1, Group 2, and Group 3, is illustrated in the datasheet with the number of samples required for each level.

Deliverable item to the Lot Validation Tests is the test report together with the used samples.