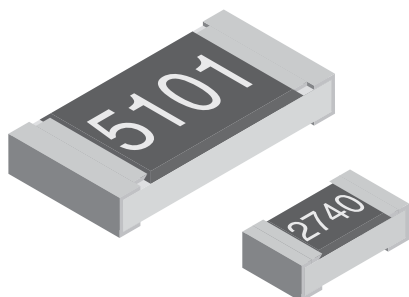




## Thin Film Rectangular Chip Resistors



### FEATURES

- Metal film layer on high quality ceramic
- Protective top coat
- Pure tin on nickel barrier layer
- Low temperature coefficient and tight tolerances
- 56 days at 40 °C and 93 % relative humidity down to  $\leq \pm 0.2 \%$
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### TECHNICAL SPECIFICATIONS

DESCRIPTION	M10	M11	M12	M25
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 20 kΩ	10 Ω to 56 kΩ	10 Ω to 100 kΩ	10 Ω to 220 kΩ
Resistance tolerance	± 1 %; ± 0.5 %	± 1 %; ± 0.5 %; ± 0.25 %; ± 0.1 %		
Temperature coefficient	± 50 ppm/K; ± 25 ppm/K			
Rated dissipation, $P_{70}$	0.063 W	0.100 W	0.125 W	0.250 W
Operating voltage, $U_{\text{max}}$ , AC <sub>RMS</sub> /DC	25 V	75 V	150 V	200 V
Permissible film temperature, $\vartheta_{\text{F max}}$	125 °C (155 °C)			
Operating temperature range	-55 °C to 125 °C (155 °C)			
Insulation voltage: 1 min; $U_{\text{ins}}$	> 50 V	> 100 V	> 200 V	> 300 V
Failure rate: FIT <sub>observed</sub>	0.3 x 10 <sup>-9</sup> /h			

### Notes

- Power rating depends on the max. temperature at the solder point, the component placement density and the substrate material
- Marking: 4 digits, M10 - no marking

### MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION

OPERATION MODE		STANDARD
Rated dissipation, $P_{70}$	M10	0.063 W
	M11	0.100 W
	M12	0.125 W
	M25	0.250 W
Operating temperature range		-55 °C to 125 °C (155 °C)
Permissible film temperature, $\vartheta_{F max}$		125 °C (155 °C)
Max. resistance change at $P_{70}$ for resistance range, $ \Delta R/R $ , after:	M10	10 $\Omega$ to 20 k $\Omega$
	M11	10 $\Omega$ to 56 k $\Omega$
	M12	10 $\Omega$ to 100 k $\Omega$
	M25	10 $\Omega$ to 220 k $\Omega$
	1000 h	$\leq 0.2 \%$

### Note

- A suitable low thermal resistance of the circuit board assembly must be safeguarded in order to maintain the film temperature of the resistors within the specified limits. Please consider the application note "Thermal Management in Surface-Mounted Resistor Applications" ([www.vishay.com/doc?28844](http://www.vishay.com/doc?28844)) for information on the general nature of thermal resistance.



TEMPERATURE COEFFICIENT AND RESISTANCE RANGE				
TYPE	TCR	TOLERANCE	RESISTANCE	E-SERIES
M10	± 25 ppm/K	± 0.5 %	10 Ω to 20 kΩ	E24; E96
M11	± 50 ppm/K	± 0.5 %	47 Ω to 56 kΩ	
		± 0.1 %	100 Ω to 56 kΩ	
	± 25 ppm/K	± 1 %	51 Ω to 56 kΩ	
		± 0.5 %	47 Ω to 56 kΩ	
		± 0.1 %	10 Ω to 56 kΩ	
M12	± 50 ppm/K	± 0.1 %	47 Ω to 100 kΩ	
	± 25 ppm/K	± 0.5 %		
		± 0.25 %		
		± 0.1 %	10 Ω to 100 kΩ	
M25	± 50 ppm/K	± 0.1 %	47 Ω to 220 kΩ	
	± 25 ppm/K	± 1 %	10 Ω to 220 kΩ	
		± 0.5 %		
		± 0.1 %		

PACKAGING						
TYPE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS
M10	P0	10 000	Paper tape according to IEC 60286-3, Type 1a	8 mm	2 mm	Ø 180 mm/7"
M11 M12 M25	P1	1000 <sup>(1)</sup>			4 mm	Ø 180 mm/7"
	P5	5000				Ø 180 mm/7"
	PN	20 000				Ø 330 mm/13"

**Note**

<sup>(1)</sup> For TCR ≤ 25 ppm/K and tolerance ≤ 0.1 % only



**PART NUMBER AND PRODUCT DESCRIPTION**

**PART NUMBER: M1004020D5620DP000**

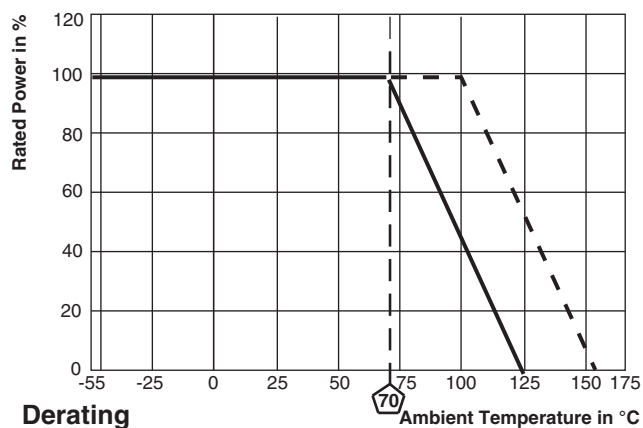
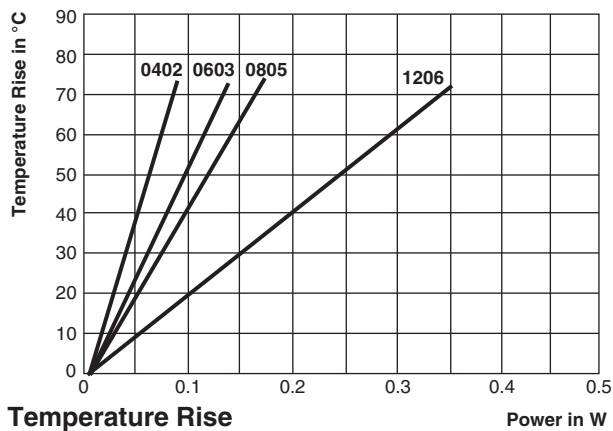
M	1	0	0	4	0	2	0	D	5	6	2	0	D	P	0	0	0
TYPE / SIZE				VERSION		TCR			RESISTANCE				TOLERANCE		PACKAGING		
M100402 M110603 M120805 M251206				0 = neutral		D = ± 25 ppm/K C = ± 50 ppm/K			3 digit value 1 digit multiplier  Multiplier 8 = x 10 <sup>-2</sup> 9 = x 10 <sup>-1</sup> 0 = x 10 <sup>0</sup> 1 = x 10 <sup>1</sup> 2 = x 10 <sup>2</sup> 3 = x 10 <sup>3</sup>				B = ± 0.1 % C = ± 0.25 % D = ± 0.5 % F = ± 1 %		P0 P1 P5 PN		

**PRODUCT DESCRIPTION: M10 25 562R 0.5 % P0**

<b>M10</b>	<b>25</b>	<b>562R</b>	<b>0.5 %</b>	<b>P0</b>
<b>TYPE</b>	<b>TCR</b>	<b>RESISTANCE</b>	<b>TOLERANCE</b>	<b>PACKAGING</b>
M10 M11 M12 M25	± 25 ppm/K ± 50 ppm/K	49K9 = 49.9 kΩ 5R1 = 5.1 Ω	± 0.1 % ± 0.25 % ± 0.5 % ± 1 %	P0 P1 P5 PN

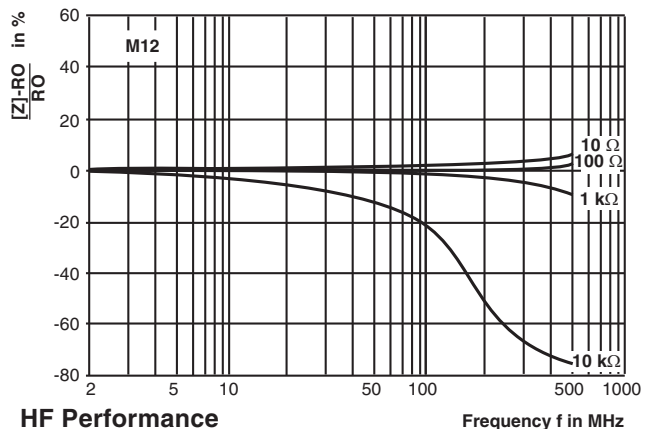
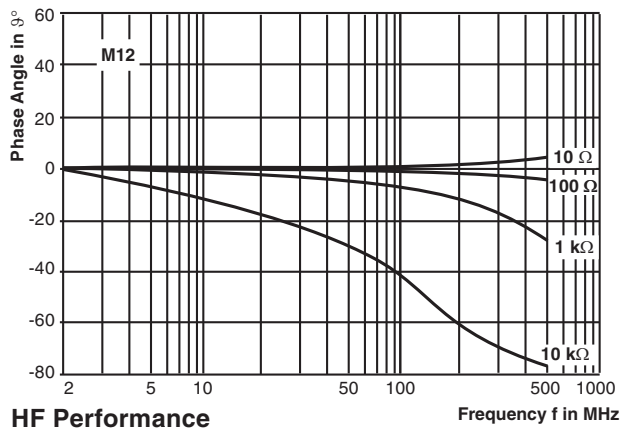
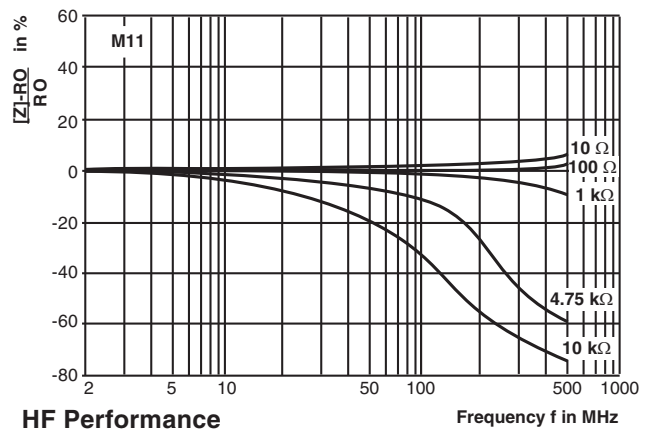
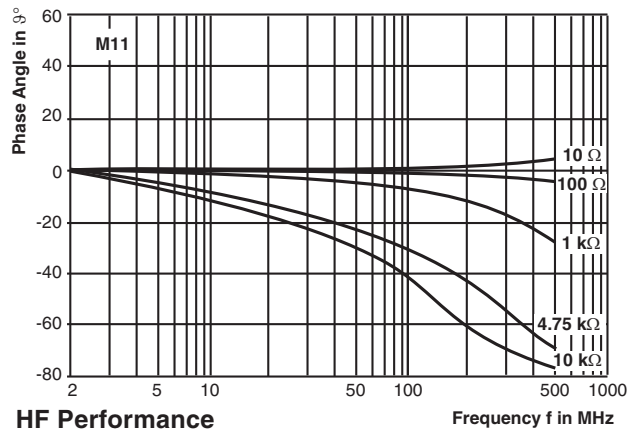
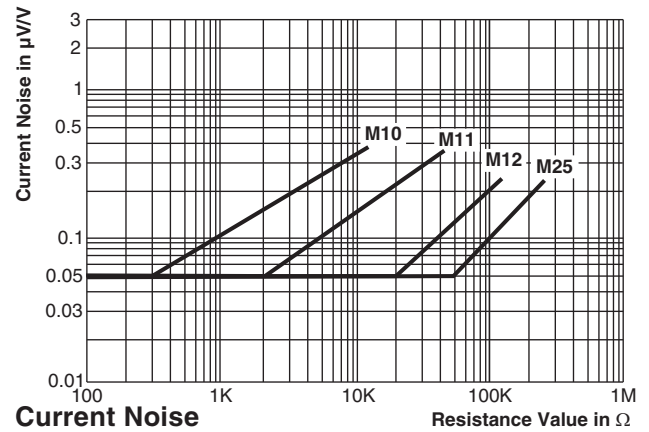
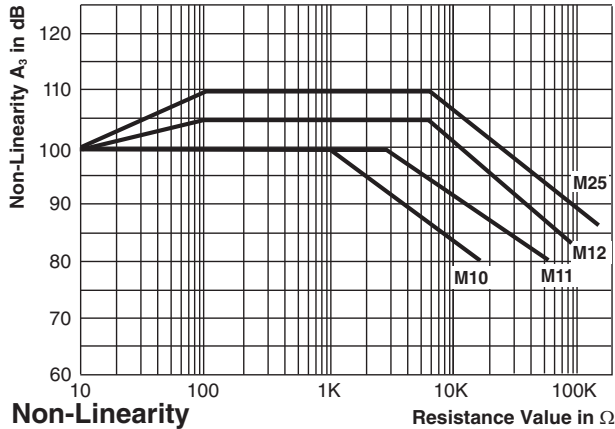
**Note**

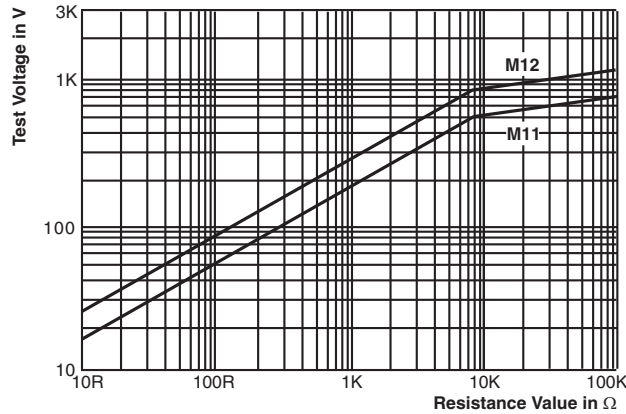
- Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION



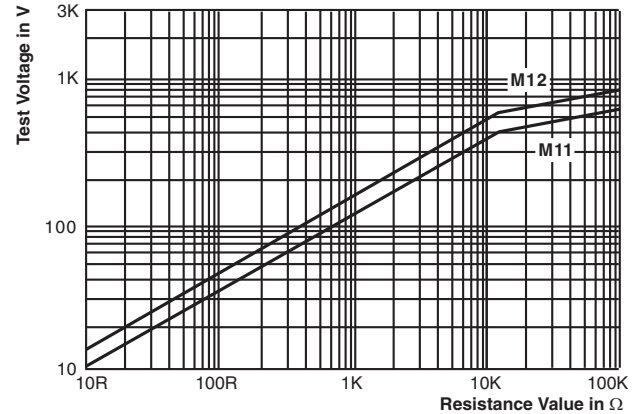
**Note**

- The solid line is based on IEC / EN reference test conditions which is considered as standard mode. However, above that the maximum permissible film temperature is 155 °C (dashed line).

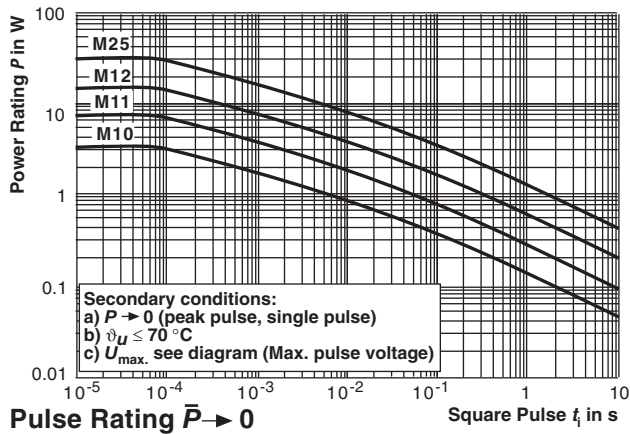




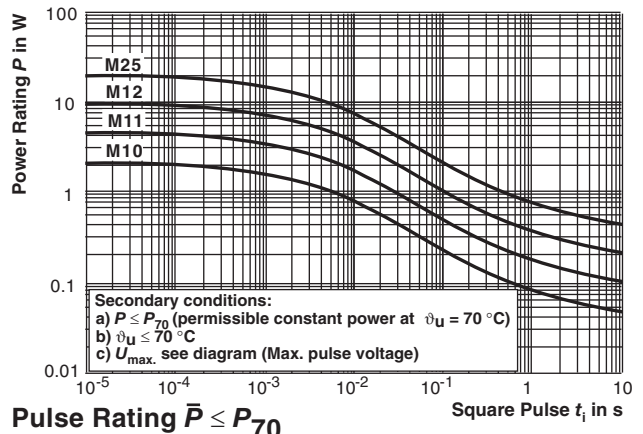
**Single-Pulse High Voltage Overload Test**  
1.2/50  $\mu$ s EN140000 4.27



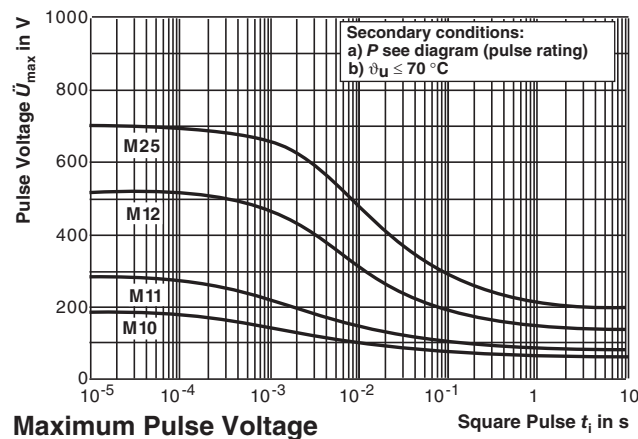
**Single-Pulse High Voltage Overload Test**  
10/700  $\mu$ s EN140000 4.27



**Pulse Rating  $\bar{P} \rightarrow 0$**



**Pulse Rating  $\bar{P} \leq P_{70}$**



**Maximum Pulse Voltage**

**DESCRIPTION**

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of special metal alloy is deposited on a high grade ceramic substrate ( $\text{Al}_2\text{O}_3$ ) 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 the 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 pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual chip resistors. This includes full screening for the elimination of products with a potential risk of early life failures according to EN 140401-801, 2.1.2.2. Only accepted products are laid directly into the tape in accordance with **IEC 60286-3, Type 1a** <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, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are RoHS-compliant, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth has been proven under extensive testing.

**MATERIALS**

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein <sup>(2)</sup>
- The Global Automotive Declarable Substance List (GADSL) <sup>(3)</sup>
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) <sup>(4)</sup> for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see [www.vishay.com/how/leadfree](http://www.vishay.com/how/leadfree).

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at [www.vishay.com/doc?49037](http://www.vishay.com/doc?49037).

**RELATED PRODUCTS**

The M10, M11, M12, M25 series are not recommended for new designs. A suitable replacement for new designs is the TNPW e3 series which has advanced performance and extended range availability. Please refer to the latest edition of the TNPW e3 data sheet: [www.vishay.com/doc?28758](http://www.vishay.com/doc?28758).

**Notes**

<sup>(1)</sup> The quoted IEC standards are also released as EN standards with the same number and identical contents.

<sup>(2)</sup> The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at <http://std.iec.ch/iec62474>.

<sup>(3)</sup> The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at [www.gadsl.org](http://www.gadsl.org).

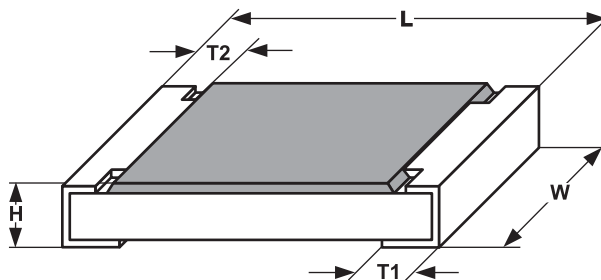
<sup>(4)</sup> The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <http://echa.europa.eu/candidate-list-table>.



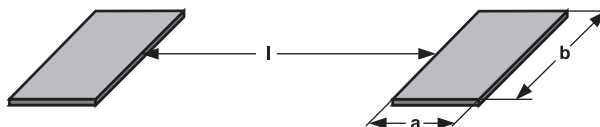
<b>TEST PROCEDURES AND REQUIREMENTS</b>				
EN 60115-1 CLAUSE	IEC 60068-2 <sup>(1)</sup> TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ( $\Delta R$ )
			Stability for product types:	
			<b>M10</b>	10 $\Omega$ to 20 k $\Omega$
			<b>M11</b>	10 $\Omega$ to 56 k $\Omega$
			<b>M12</b>	10 $\Omega$ to 100 k $\Omega$
			<b>M25</b>	10 $\Omega$ to 220 k $\Omega$
4.5	-	Resistance	-	$\pm 1.0 \% R$ ; $\pm 0.5 \% R$ ; $\pm 0.25 \% R$ ; $\pm 0.1 \% R$
4.8	-	Temperature coefficient	At (20/-55/20) °C and (20/125/20) °C	$\pm 50$ ppm/K; $\pm 25$ ppm/K
4.25.1	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R} \leq U_{max.}$ ; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h	$\pm 0.2 \% R$
4.25.3	-	Endurance at upper category temperature	125 °C; 1000 h	$\pm 0.2 \% R$
4.24	78 (Cab)	Damp heat, steady state	(40 $\pm$ 2) °C; 56 days; (93 $\pm$ 3) % RH	$\pm 0.2 \% R$
4.19	14 (Na)	Rapid change of temperature	30 min at LCT; 30 min at UCT; LCT = -55 °C; UCT = 125 °C	$\pm 0.05 \% R$
4.13	-	Short time overload	$U = 2.5 \times \sqrt{P_{70} \times R} \leq 2 \times U_{max.}$ ; 2 s	$\pm 0.05 \% R$
4.18	58 (Td)	Resistance to soldering heat	Solder bath method; (260 $\pm$ 5) °C; (10 $\pm$ 1) s	$\pm 0.05 \% R$

**Note**

<sup>(1)</sup> The quoted IEC standards are also released as EN standards with the same number and identical contents.

**DIMENSIONS**

<b>DIMENSIONS AND MASS</b>						
TYPE	H (mm)	L (mm)	W (mm)	T1 (mm)	T2 (mm)	MASS (mg)
<b>M10</b>	$0.35 \pm 0.05$	$1.00 \pm 0.05$	$0.50 \pm 0.05$	$0.25 \pm 0.1$	$0.20 \pm 0.1$	0.65
<b>M11</b>	$0.45 \pm 0.05$	$1.55 + 0.1 / - 0.05$	$0.85 \pm 0.1$	$0.30 \pm 0.2$	$0.30 \pm 0.2$	2
<b>M12</b>	$0.45 \pm 0.05$	$2.00 + 0.2 / - 0.1$	$1.25 \pm 0.15$	$0.30 + 0.2 / - 0.1$	$0.30 \pm 0.2$	5.5
<b>M25</b>	$0.55 \pm 0.05$	$3.20 + 0.1 / - 0.2$	$1.60 \pm 0.15$	$0.45 \pm 0.2$	$0.40 \pm 0.2$	10

**SOLDER PAD DIMENSIONS**

<b>RECOMMENDED SOLDER PAD DIMENSIONS</b>						
TYPE	WAVE SOLDERING			REFLOW SOLDERING		
	a (mm)	b (mm)	l (mm)	a (mm)	b (mm)	l (mm)
<b>M10</b>	-	-	-	0.40	0.60	0.50
<b>M11</b>	0.90	0.90	1.00	0.50	0.90	1.00
<b>M12</b>	0.90	1.30	1.30	0.70	1.40	1.20
<b>M25</b>	1.10	1.70	2.30	0.90	1.70	2.00

**Notes**

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x <sup>(1)</sup>, or in publication IPC-7351. They do not guarantee any supposed thermal properties, particularly as these are also strongly influenced by many other parameters.  
Still, the given solder pad dimensions will be found adequate for most general applications.

<sup>(1)</sup> The quoted IEC standards are also released as EN standards with the same number and identical contents



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