

MMU 0102, MMA 0204, MMB 0207 - Precision

Vishay Beyschlag

Precision Thin Film MELF Resistors



LINKS TO ADDITIONAL RESOURCES



MMU 0102, MMA 0204 and MMB 0207 precision thin film MELF resistors are the perfect choice for most fields of modern professional electronics where reliability and stability is of major concern. The typical applications in the fields of automotive, telecommunication, and medical equipment reflect the outstanding level of proven reliability.

FEATURES

- IECQ-CECC approved according to EN 140401-803
- AEC-Q200 qualified
- Advanced metal film technology
- Superior stability: class 0.05
- Intrinsic sulfur resistance
- Material categorization: for definitions of compliance please see <u>www.vishay.com/doc?99912</u>

APPLICATIONS

- Automotive
- Telecommunication
- Industrial
- Medical equipment

TECHNICAL SPECIFICATIONS								
DESCRIPTION	MMU 0102	MMA 0204	MMB 0207					
DIN size	0102	0204	0207					
Metric size code	RC2211M	RC3715M	RC6123M					
Resistance range	22 Ω to 332 k Ω	10 Ω to 5.11 M Ω	15 Ω to 10 $M\Omega$					
Resistance tolerance	± 0.5 %; ± 0.2	25 %; ± 0.1 %	± 0.25 %; ± 0.1 %					
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K							
Rated dissipation, P ₇₀ ⁽¹⁾	0.2 W	0.25 W	0.4 W					
Operating voltage, Umax. ACRMS/DC	150 V 200 V		350 V					
Permissible film temperature, $\vartheta_{\rm Fmax.}^{(1)}$		125 °C						
Operating temperature range ⁽¹⁾	-55 °C to 125 °C							
Permissible voltage against ambient (insulation):								
1 min, U _{ins}	200 V	300 V	500 V					
Failure rate: FIT _{observed}		≤ 0.05 x 10 ⁻⁹ /h						

Note

⁽¹⁾ Please refer to APPLICATION INFORMATION below

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature is not exceeded.

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.

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RoHS

FREE

GREEN (5-2008)



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MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION						
OPERATION MODE		PRECISION	STANDARD			
	MMU 0102	0.06 W	0.2 W			
Rated dissipation, P70	MMA 0204	0.07 W	0.25 W			
	MMB 0207	0.11 W	0.4 W			
Operating temperature range		-10 °C to 85 °C	-55 °C to 125 °C			
Permissible film temperature, ϑ_{F} max.		85 °C	125 °C			
	MMU 0102	22 Ω to 332 k Ω	22 Ω to 332 k Ω			
	MMA 0204	10 Ω to 1 M Ω	10 Ω to 5.11 M Ω			
Max. resistance change at P_{70} for	MMB 0207	15 Ω to 1 M Ω	15 Ω to 10 $M\Omega$			
resistance range, $ \Delta R/R $ after:	1000 h	≤ 0.05 %	≤ 0.1 %			
	8000 h	≤ 0.1 %	≤ 0.2 %			
	225 000 h	≤ 0.3 %	≤0.6 %			

Note

The presented operation modes do not refer to different types of resistors, but actually show examples of different loads, that lead to different film temperatures and different achievable load-life stability (drift) of the resistance value. 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) for information on the general nature of thermal resistance

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE ⁽¹⁾							
TYPE/SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES			
	· 25.ppm/k	± 0.25 %	47 Ω to 332 k Ω				
	± 25 ppm/K	± 0.1 %	100 Ω to 221 k Ω				
MMU 0102		± 0.5 %	22 Ω to 100 k Ω	E24; E192			
	± 15 ppm/K	± 0.25 %	47 Ω to 100 k Ω				
		± 0.1 %	100 Ω to 100 k Ω				
	· 25 ppm/k	± 0.25 %	10 O to 5 11 MO				
	± 25 ppm/K	± 0.1 %	10 22 10 5.11 1022	E24; E192			
MMA 0204		± 0.5 %	10 Ω to 1 M Ω				
	± 15 ppm/K	± 0.25 %	20 O to 1 MO				
		± 0.1 %	20 22 10 1 10122				
MMB 0207	- 25 ppm/k	± 0.25 %	15 Ω to 10 $M\Omega$				
	± 25 ppm/K	± 0.1 %	20 Ω to 10 $M\Omega$	E24; E192			
	± 15 ppm/K	± 0.1 %	20 Ω to 1 $M\Omega$				

Notes

⁽¹⁾ For the approved IECQ-CECC resistance range, please refer to <u>www.vishay.com/doc?28945</u>



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PACKAGING								
TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	PACKAGING DIMENSIONS		
MMU 0102	B3 = BL	3000	Antistatic blister tape acc. IEC 60286-3, Type 2a	8 mm	4 mm	Ø 180 mm / 7"		
	B0	10 000				Ø 330 mm / 13"		
MMA 0204	B3 = BL	3000		8 mm	4 mm	Ø 180 mm / 7"		
	B0	10 000				Ø 330 mm / 13"		
MMB 0207	B2	2000		12 mm	4 mana	Ø 180 mm / 7"		
	B7	7000			4 11111	Ø 330 mm / 13"		



Note

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





DESCRIPTION

Production is strictly controlled and follows an extensive set instructions established for reproducibility. A of homogeneous film of metal alloy is deposited on a high grade ceramic body (Al₂O₃) and conditioned to achieve the desired temperature coefficient. Nickel plated steel termination caps are firmly pressed on the metallised rods. 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 pure matte tin on nickel plating. Four (E24 series) or five (E192 series) color code rings designate the resistance value and tolerance in accordance with IEC 60062⁽¹⁾.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. This includes full screening for the elimination of products with a potential risk of early life failures according to EN 140401-803, 2.1.2.2. Only accepted products are laid directly into the blister tape in accordance with **IEC 60286-3**, **Type 2a** ⁽¹⁾.

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** ⁽¹⁾. 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 completely lead (Pb)-free, the pure matte tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes. Solderability is specified for 2 years after production or requalification, however, excellent solderability is proven after extended storage in excess of 10 years. The permitted storage time is 20 years. 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 ⁽²⁾
- The Global Automotive Declarable Substance List (GADSL) ⁽³⁾
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) ⁽⁴⁾ 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.

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.

APPROVALS

Where applicable, the resistors are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140401-803** which refers to **EN 60115-1**, **EN 60115-8** and the variety of environmental test procedures of the IEC 60068 ⁽¹⁾ series.

Conformity is attested by the use of the **CECC** logo () as the mark of conformity on the package label.

Vishay Beyschlag has achieved **"Approval of Manufacturer**" in accordance with **IECQ 03-1**. The release certificate for **"Technology Approval Schedule**" in accordance with **CECC 240001** based on **IECQ 03-3-1** is granted for the Vishay Beyschlag manufacturing process. The resistors are qualified according to AEC-Q200.

RELATED PRODUCTS

For thin film products with a wider resistance, see the datasheet:

 "Professional MELF Resistors" (www.vishay.com/doc?28713)

For products with tighter precision specification, see the datasheet

 "Ultra Precision MELF Resistors" (www.vishay.com/doc?28715)

Resistors are available with established reliability in accordance with **EN 140401-803 Version E**. Please refer to datasheet

 "MELF Resistors with Established Reliability" (www.vishay.com/doc?28707)

Notes

- ⁽¹⁾ The quoted IEC standards are also released as EN standards with the same number and identical contents
- (2) The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at http://std.iec.ch/iec62474
- (3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at www.gadsl.org
- ⁽⁴⁾ The SVHC list is maintained by the European Chemical Agency (ECHA) and available at http://echa.europa.eu/candidate-list-table

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FUNCTIONAL PERFORMANCE



Derating - Precision Operation Mode



Derating - Standard Operation Mode





Single Pulse

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Continuous Pulse

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Maximum pulse voltage, single and continuous pulses; applicable if $\hat{P} \leq \hat{P}_{max}$; for permissible resistance change ± (0.5 % R + 0.01 Ω)

Pulse Voltage



Pulse load rating in accordance with IEC 60115-1 clause 4.27; 1.2 μ s/50 μ s; 5 pulses at 12 s intervals; for permissible resistance change ± (0.5 % *R* + 0.05 Ω)

1.2/50 Pulse

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10/700 Pulse

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Current Noise Voltage Ratio

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TESTS AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification

EN 60115-8, sectional specification

EN 140401-803, detail specification

IEC 60068-2-xx, test methods

The components are approved under the IECQ-CECC quality assessment system for electronic components.

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-803. The table presents only the most important tests, for the full test schedule refer to the documents listed above. However, some additional tests and a number of improvements against those minimum requirements have been included. The testing also covers most of the requirements specified by EIA/ECA-703 and JIS-C-5201-1.

The tests are carried out under standard atmospheric conditions in accordance with IEC 60068-1, 4.3, whereupon the following values are applied:

Temperature: 15 °C to 35 °C

Relative humidity: 25 % to 75 %

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

A climatic category LCT / UCT / 56 is applied, defined by the lower category temperature (LCT), the upper category temperature (UCT), and the duration of exposure in the damp heat, steady state test (56 days).

The components are mounted for testing on printed circuit boards in accordance with EN 60115-8, 2.4.2, unless otherwise specified.

TEST PROCEDURES AND REQUIREMENTS									
EN 60115-1 CLAUSE	IEC 60068-2 ⁽¹⁾ TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (∆ <i>R</i>)					
			Stability for product types:	STABILITY CLASS 0.05 OR BETTER	STABILITY CLASS 0.1 OR BETTER	STABILITY CLASS 0.25 OR BETTER	STABILITY CLASS 2.0 OR BETTER		
			MMU 0102	100 Ω to 100 k Ω	43 Ω to 147 k Ω	22 Ω to 332 k Ω	-		
			MMA 0204	100 Ω to 100 k Ω	43 Ω to 221 k Ω	10 Ω to 1 M Ω	1.01 $M\Omega$ to 5.11 $M\Omega$		
			MMB 0207	100 Ω to 270 k Ω	43 Ω to 510 k Ω	15 Ω to 1 M Ω	1.01 M Ω to 10 M Ω		
4.5	-	Resistance	-	± 0.5 % /	± 0.5 % <i>R</i> ; ± 0.25 % <i>R</i> ; ± 0.1 % <i>R</i>				
4.8	-	Temperature coefficient	At (20/-55/20) °C and (20/125/20) °C	± 25	± 25 ppm/K				
4.05.1		Endurance at 70 °C: precision operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h	±'	(0.05 % <i>R</i> + 5 mΩ (0.1 % <i>R</i> + 5 mΩ))	± (0.08 % <i>R</i> + 5 mΩ) ± (0.16 % <i>R</i>		
4.23.1	-	Endurance at 70 °C: standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h 70 °C; 8000 h		± (0.1 % ± (0.2 %	9 <i>R</i> + 5 mΩ) 9 <i>R</i> + 5 mΩ)	+ 5 mΩ2)		
4 25 3		Endurance at	85 °C; 1000 h	± (0.02 % <i>R</i> + 5 mΩ)	± (0.05 % <i>R</i> + 5 mΩ)	± (0.1 % <i>R</i> + 5 mΩ)	± (0.15 % <i>R</i> + 5 mΩ)		
7.20.0	_	temperature	125 °C; 1000 h	± (0.05 % R + 5 mΩ)	± (0.1 % <i>R</i> + 5 mΩ)	± (0.15 % R + 5 mΩ)	± (0.25 % <i>R</i> + 5 mΩ)		
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	\pm (0.05 % R + 5 mΩ) \pm (0.1 % R + 5 mΩ) \pm (0.25 % R + 5 mΩ)					



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TEST	PROCED	OURES AND F	REQUIREMENTS					
EN 60115-1 CLAUSE	IEC 60068-2 ⁽¹⁾ TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (∆ <i>R</i>)				
			Stability for product types:	STABILITY CLASS 0.05 OR BETTER	STABILITY CLASS 0.1 OR BETTER	STABILITY CLASS 0.25 OR BETTER	STABILITY CLASS 2.0 OR BETTER	
			MMU 0102	100 Ω to 100 k Ω	43 Ω to 147 k Ω	22 Ω to 332 k Ω	-	
			MMA 0204	100 Ω to 100 k Ω	43 Ω to 221 k Ω	10 Ω to 1 M Ω	1.01 M Ω to 5.11 M Ω	
			MMB 0207	100 Ω to 270 k Ω	43 Ω to 510 k Ω	15 Ω to 1 M Ω	1.01 M Ω to 10 M Ω	
4.37	67 (Cy)	Damp heat, steady state, accelerated	$\begin{array}{c} (85 \pm 2) \ ^{\circ}\text{C}; \\ (85 \pm 5) \ ^{\circ}\text{C}; \\ U = 0.3 \ x \ \sqrt{P_{70}} \ x \ R \\ \leq 100 \ \text{V} \ \text{and} \\ U = 0.3 \ x \ U_{\text{max.}}; \\ (\text{the smaller} \\ \text{value is valid}) \\ 1000 \ \text{h} \end{array}$	± (0.15 % <i>R</i> + 5 mΩ)	± (0.25 %	R + 5 m Ω)	± (2.0 % <i>R</i> + 5 mΩ)	
-	1 (Ab)	Cold	-55 °C; 2 h		± (0.02 %	6 <i>R</i> + 5 mΩ)		
		Rapid change	30 min at LCT; 30 min at UCT; LCT = -10 °C; UCT = 85 °C					
4.19 14 (Na)	14 (Na)	of temperature	1000 cycles	± (0.1 % F	r + 5 mΩ) -		-	
			LCT = -55 °C; UCT = 125 °C	_	_	+ (0.2.9	(A R + 5 mO)	
		Short time	Tood cycles	_	_	± (0.2)	0 /1 + 3 111 <u>2</u> 2)	
		overload: precision operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max}$:	± (0.01 % <i>R</i> + 5 mΩ)	± (0.02 % <i>R</i> + 5 mΩ)	± (0.03 % <i>R</i> + 5 mΩ)	± (0.08 % <i>R</i> + 5 mΩ)	
4.13	4.13 - Short time overload: standard operation mode		whichever is the less severe; 5 s	± (0.05 % <i>R</i> + 5 mΩ)			± (0.10 % <i>R</i> + 5 mΩ)	
4.27	-	Single pulse high voltage overload: standard operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs/700 µs	± (0.25 % <i>R</i> + 5 mΩ)				
4.39	-	Periodic electric overload: standard operation mode	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (0.5 % R + 5 mΩ)				
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude \leq 1.5 mm or \leq 200 m/s ² ; 7.5 h	± (0.01 % <i>R</i> + 5 mΩ)	± (0.02 % <i>R</i> + 5 mΩ)	± (0.03	% <i>R</i> + 5 mΩ)	
4.38	-	Electrostatic discharge (human body model)	IEC 61340-3-1 ⁽¹⁾ ; 3 pos. + 3 neg. discharges MMU 0102: 1.5 kV MMA 0204: 2 kV MMB 0207: 4 kV	± (0.5 % <i>R</i> + 50 mΩ)				

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TEST PROCEDURES AND REQUIREMENTS								
EN 60115-1 CLAUSE	IEC 60068-2 ⁽¹⁾ TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (∆ <i>R</i>)				
			Stability for product types:	STABILITY CLASS 0.05 OR BETTER	STABILITY CLASS 0.1 OR BETTER	STABILITY CLASS 0.25 OR BETTER	STABILITY CLASS 2.0 OR BETTER	
			MMU 0102	100 Ω to 100 k Ω	43 Ω to 147 k Ω	22 Ω to 332 k Ω	-	
			MMA 0204	100 Ω to 100 k Ω	43 Ω to 221 k Ω	10 Ω to 1 M Ω	1.01 $M\Omega$ to 5.11 $M\Omega$	
			MMB 0207	100 Ω to 270 k Ω	43 Ω to 510 k Ω	15 Ω to 1 M Ω	1.01 M Ω to 10 M Ω	
			Solder bath method; SnPb40; non-activated flux; (215 ± 3) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage				
4.17 58 (Td) Solderability		Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage					
	4.18 58 (Td) Resistance to soldering heat		Solder bath method; (260 ± 5) °C; (10 ± 1) s	\pm (0.05 % R + 10 mΩ) \pm (0.20 % R + 10 mΩ)			± (0.20 % <i>R</i> + 10 mΩ)	
4.18			Reflow method 2 (IR/forced gas convection); (260 ± 5) °C; (10 ± 1) s	± (0.01 % <i>R</i> + 5 mΩ)	± (0.025 %	<i>R</i> + 5 mΩ)	± (0.1 % <i>R</i> + 5 mΩ)	
4.29	45 (XA)	Component solvent resistance	lsopropyl alcohol; 50 °C; method 2	No visible damage				
4.30	45 (XA)	Solvent resistance of marking	lsopropyl alcohol; 50 °C; method 1, toothbrush	Marking legible; no visible damage				
4.32	21 (Ue ₃)	Shear (adhesion)	45 N		No visib	le damage		
4.33	21 (Ue ₁)	Substrate bending	Depth 2 mm, 3 times	No vis ± (0.02 <mark>% R</mark>	sible damage, no c + 10 mΩ) ⁽²⁾	ppen circuit in ben ± (0.05 %	t position $R + 10 \text{ m}\Omega$) ⁽²⁾	
4.7	-	Voltage proof	$U_{\rm RMS} = U_{\rm ins}; 60 \ {\rm s}$		No flashove	r or breakdown		
4.35	-	Flammability	IEC 60695-11-5 ⁽¹⁾ , needle flame test; 10 s	No burning after 30 s				

Notes

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

⁽²⁾ Special requirements apply to MICRO-MELF, MMU 0102:

• $R < 100 \Omega$: ± (0.25 % R + 10 m Ω)

• 100 $\Omega \le R \le 221 \text{ k}\Omega$: ± 0.1 % R

• 221 kΩ < *R*: ± 0.25 % *R*



DIMENSIONS



DIMENSIONS AND MASS							
TYPE / SIZE	L (mm)	D (mm)	L _{1 min.} (mm)	D ₁ (mm)	K (mm)	MASS (mg)	
MMU 0102	2.2 + 0 / - 0.1	1.1 + 0 / - 0.1	1.2	D + 0 / - 0.1	0.4 + 0.1 / - 0.05	8	
MMA 0204	3.6 + 0 / - 0.2	1.4 + 0 / - 0.1	1.8	D + 0 / - 0.15	0.75 ± 0.1	22	
MMB 0207	5.8 + 0 / - 0.15	2.2 + 0 / - 0.2	3.2	D + 0 / - 0.2	1.15 ± 0.1	80	

Note

Color code marking is applied according to IEC 60062 ⁽¹⁾ in four bands (E24 series) or in five bands (E192 series). Each color band appears as a single solid line, voids are permissible if at least ²/₃ of the band is visible from each radial angle of view. The last color band for tolerance is approximately 50 % wider than the other bands. An interrupted band between the 4th and 5th full band indicates the temperature coefficient (yellow = TC25, orange = TC15)

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

SOLDERING RECOMMENDATIONS

For recommended solder pad dimensions please refer to <u>www.vishay.com/doc?28950</u>. For recommended soldering profiles please refer to <u>www.vishay.com/doc?31090</u>.



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