EMERSON

Therm-O-Disc™

MICROTEMP® Thermal Cutoffs/Fuses/Links

Issue Date: _____ Revision Date: _____

TCO TECHNICAL SPECIFICATION

ALL STATEMENTS, TECHNICAL INFORMATION, AND RECOMMENDATIONS CONTAINED HEREIN ARE BASED ON LABORATORY TESTS AND ARE BELIEVED TO BE REPRESENTATIVE OF THE DESCRIBED PRODUCTS. THE DESCRIPTION IS SUBJECT TO CHANGE WITHOUT NOTICE, EXCEPT THAT CHANGES TO THE PART NUMBER, ELECTRICAL / TEMPRATURE RATINGS, DIMENSIONS, CONSTRUCTION OR MANUFACTURING LOCATIONS ARE TO BE SUPPLIED. TESTING IN THE INDIVIDUAL APPLICATION MUST BE DONE.

T-O-D CAN NOT ACCEPT ANY RESPONSIBILITY IN THIS PRODUCT SPECIFICATON AND THE SALES, UNTIL THE CUSTOMER HAS SIGNED AND RETURNED THE ABOVE TO EMERSON OFFICE DESCRIBED ABOVE.

MICROTEMP® Thermal Cutoffs/Fuses/Links

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1. Limitation of effect

MICROTEMP® Thermal Cutoffs are designed for thermal protection as electrical cut off. If used for other purposes, or the instructions and cautions are not followed, this product specification is not in effect. These specifications are not in effect for other part numbers or another customer that is not described in page 1-2. For more details see page 1.

2. Definitions and types of **MICROTEMP® Thermal Cutoffs**

2.1. Rated Voltage (per CB Report): Available voltage in the circuit. See Table 1.

2.2. Rated Current (per CB Report): Available current in the circuit. See Table 1.

Table 1

Para	2.1	2.2
Type	Voltage AC (V)	Rated Current AC (A)
E, G4AXXTTTC	250	10
E, G5XXXTTTC	277	20
E, G, Z6AXXTTTC	250	16
E, G7FXXTTTC	250	5
E, G8AXXTTTC	277	20
	250	25

2.3. Opening Temperature Tolerance: T_F +0°C/-5°C specified by 6.4

2.4. Temperature Rating (T_F): Rated opening temperature specified by 6.4. See Table 2

2.5. Holding temperature (T_H): Maximum temperature of the MICROTEMP® TCO measured at the case end of the thermal cutoff at which the thermal cutoff can be maintained for a period for 168 hours without opening. NOTE: it is advised that TCOs are not exposed to continuous operating temperatures in excess of T_F -25°C or 200 °C whichever is lower. See Table 2.

2.6. Maximum temperature (Tmax): The maximum temperature at which a thermal cutoff can be maintained for 10 minutes as an open circuit and can then be maintained at twice rated voltage for a period of 2 minutes during which its mechanical and electrical properties will not be impaired. See Table 2. In Table 2, if the cell is crossed out, there is no TCO of this type and temperature available.

Table 2

T function ºC	G4A		G5A		G6A		G7F		G8A		Z6A	
	T hold ºC	Tmax ºC	T hold ºC	Tmax ºC	T hold ºC	Tmax ºC	T hold ºC	Tmax ºC	T hold ºC	Tmax ºC	T hold ºC	Tmax ºC
72	57	100	57	410	47	100	-	-	47	410	-	-
73	58	100	58	410	48	100	-	-	48	410	-	-
77	62	300	62	410	62	300	62	125	62	410	-	-
84	69	220	69	220	69	220	69	125	69	220	-	-
91	76	300	76	430	76	300	-	-	-	-	-	-

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93	78	300	78	410	-	-	78	140	78	410	-	-
98	83	300	83	410	83	300	83	140	83	410	83	280
104	89	200	89	225	89	200	-	-	89	225	89	260
110	95	240	95	225	-	-	95	140	95	225	-	-
117	102	240	102	410	102	240	102	150	102	410	102	275
121	106	300	106	410	106	300	106	150	106	410	106	380
125	110	185	110	235			110	150				
128	113	205	113	235	113	205	113	150	113	235	-	-
134	119	205	119	410	-	-	119	175	-	-	-	-
141	126	205	126	350	-	-	126	175	-	-	-	-
144	129	300	129	410	129	300	129	175	119	410	134	380
152	137	205	137	410	127	205	137	175	-	-	142	380
158	143	240	143	410	-	-	143	200	-	-	-	-
167	152	210	152	410	-	-	152	200	152	410	157	380
172	157	310	157	410	-	-	157	200	-	-	-	-
184	169	240	169	410	169	210	169	200	169	410	174	380
190	175	350	175	410	-	-	175	270	-	-	-	-
192	177	210	177	350	167	210	177	210	177	350	-	-
205	190	310	190	410	-	-	-	-	-	-	-	-
216	200	450	200	410	-	-	-	-	-	-	-	-
229	200	450	200	410	200	375	-	-	200	410	200	380
240	200	450	200	410	200	450	-	-	200	410	200	380
257	220	470	-	-	-	-	-	-	-	-	-	-

2.7. Note: Rated current, rated voltage and Tmax are considered as each maximum capability to cut off.

3. Dimensions (mm): See Figure1 and Table 3.

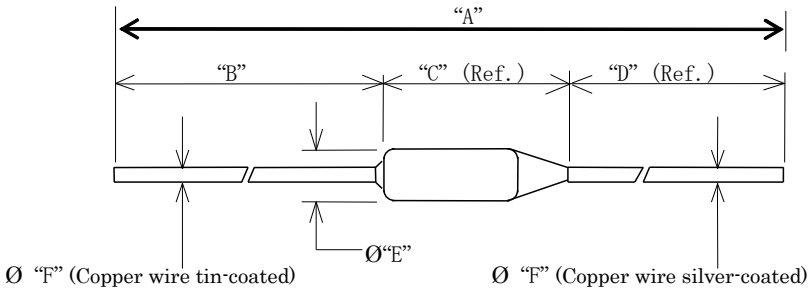


Figure 1
E,G4X / E, G5X / E,G, Z6X /E,G7F /E,G8X

Table 3

Type	"A" ±3.0	"B" ±1.5	"C" Ref	"D" Ref	"E" ±0.2	"F" (Gage/Dia)
E, G4A00TTTC	63.8	34.9	14.7	14.2	4.0	#18 AWG/1.00
E, G4A01TTTC	82.9	34.9	14.7	33.2	4.0	#18 AWG/1.00
E, G5A00TTTC	63.8	34.9	14.7	14.2	4.0	#18 AWG/1.00
E, G5A01TTTC	82.9	34.9	14.7	33.2	4.0	#18 AWG/1.00
E, G, Z6A00TTTC	63.8	34.9	14.7	14.2	4.0	#18 AWG/1.00
E, G, Z6A01TTTC	82.9	34.9	14.7	33.2	4.0	#18 AWG/1.00
E, G7F01TTTC	82.6	34.9	9.9	37.8	3.0	#23 AWG/0.58
E, G8A00TTTC	63.8	34.9	14.7	14.2	4.0	#18 AWG/1.00
E, G8A01TTTC	82.9	34.9	14.7	33.2	4.0	#18 AWG/1.00
Type	"A" ±3.0	"B" ±2.0	"C" Ref	"D" Ref	"E" ±0.2	"F" (Gage/Dia)
G4A20TTTC	148.0	70.0	14.7	14.2	4.0	#18 AWG/1.00
G5A10TTTC	148.0	70.0	14.7	33.2	4.0	#18 AWG/1.00

4. Construction:

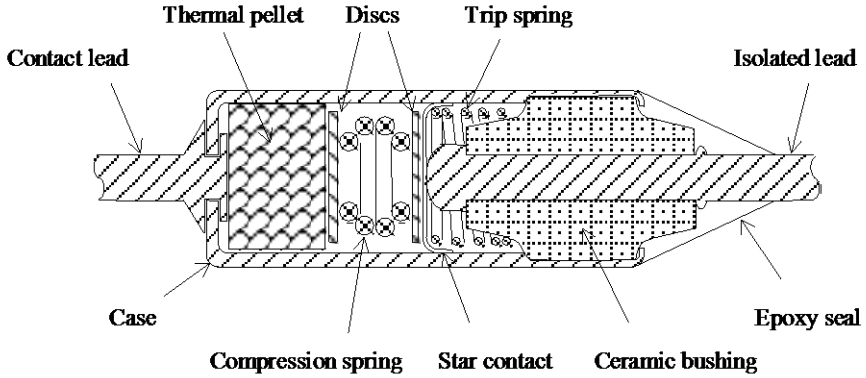


Figure 2 - E4, G4, E6, G6, Z6, E7, G7

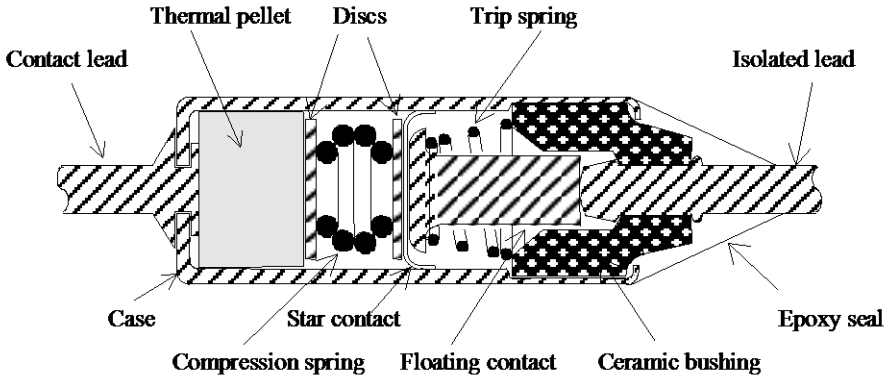


Figure 2 - E5, G5, E8, G8

Material Name	Description	Material Name	Description
Thermal pellet	Non-conduction Organic chemical	Star contact	Silver compound
Discs	Copper compound	Floating contact	Silver compound
Trip spring	Stainless steal	Isolated lead	Copper wire silver-coated
Compression Spring	Stainless steal	Contact lead	Copper wire tin-coated
Epoxy seal	Epoxy resin	Case	Copper compound, Silver coated
Ceramic bushing	Ceramic	Insulation bushing	Fluorine resin

Note: Hole or bubble in epoxy seal is not reason of rejection until 1.2mm diameter. Discoloration in silver coat is not reason of rejection, if markings in case are still clear.

5. Marking: The **MICROTEMP®** TCO is marked with the following information:

5.1 Name of product: **MICROTEMP®**

5.2 Agency approval **(XXX0X TTTC)**

Note: One agency mark doesn't mean only one agency approval. See details in Paragraph 7.

5.3 Part number (Ex.) G4A00

5.3.1 GXX0X and EXX0X series TCOs meet the environmental requirements of paragraph 10.

5.3.2 GXX0X series star contact used to contain cadmium but not anymore. Since Oct 1st 2010, GXX0X and EXX0X series constructions are identical.

5.3.3 TOD no longer supports EXX0X series query for customer's new project but will keep supporting the existing E series business.

5.4 Rated temperature: (Ex.) Tf110C

5.5 Mfg. location & lot code: (Ex.) ZCHABA

* 5.5.1 Manufacturing location:

S: Shenzhen, China Z: Zhuhai, China A: Delicias, Mexico

*5.5.2 Manufacture year: (Note: I, O, Q, and U are not applicable)

A:	2013	F:	2018	L:	2023	S:	2028	Y:	2033
B:	2014	G:	2019	M:	2024	T:	2029	Z:	2034
C:	2015	H:	2020	N:	2025	V:	2030		
D:	2016	J:	2021	P:	2026	W:	2031		
E:	2017	K:	2022	R:	2027	X:	2032		

5.5.3 Manufacture month: (Note: I, O, Q and U are not applicable)

A:	January	G:	July
B:	February	H:	August
C:	March	J:	September
D:	April	K:	October
E:	May	L:	November
F:	June	M:	December

5.5.4 Lot code:

AAA	1st
AAZ	24th
ABA	25th

*Example: Z D G ABA (Zhuhai, 25th lot of July 2016)
5.5.1 5.5.2 5.5.3 5.5.4

6 Test methods and criteria:

6.1 Tensile strength of TCO: (Ref.: IEC 60691 4th 9.2)

The TCO body shall be fixed, then either lead is slowly loaded in the axial direction until the load becomes as noted below, and for 10 min. IEC 60691 requirement is 1min. The lead wires or TCO body shall not be ruptured. Effect on performance is not considered.

Lead Wire	LbF	KgF	N
#18	3.7	1.7	16.5
#23	1.2	0.5	5.2

6.2 Bending strength of lead wire (applies only to case lead wire): (Ref.: IEC 60691 4th 9.2.4)

The **MICROTEMP®** TCO body shall be held upright and 1Kg static load is applied to the axial direction of the lead wire under this load. The **MICROTEMP®** TCO shall be bent 90° in vertical direction, then returned to the original position and bent 90° in the reverse direction, and back to original position. The lead wire shall not be broken or disconnected.

6.3 Solderability:

As received parts (lead wires) are to be dipped into an RMA (mildly activated rosin flux such as 25% rosin by weight, 75% isopropyl alcohol) to completely wet the surface. Dip the fluxed parts into a 60% SN / 40% Pb solder pot maintained at a temperature of 230 ±5°C for 3±0.5 seconds up to the point 3mm apart from the body of the **MICROTEMP®** TCO. The pot must be thoroughly stirred and the surface dross removed by skimming prior to immersion. The acceptable part shall have a bright, uniformly adhering coating of solder over 95% of the immersed surface when viewed at 10X magnification. Pinholes are allowed provided they are not concentrated in one localized area. (Reference T-O-D® EPR 16811)

6.4 Opening Temperature (A): (Ref.: IEC 60691 4th 11.3)

Place the **MICROTEMP®** TCO in mineral oil and raise the temperature of the oil at any speed until it reaches 10°C below the rated functioning temperature. Then raise the temperature by 0.5°C per minute. The **MICROTEMP®** TCO shall open at the rated functioning temperature, +0/-5°C. (Note: Applied current shall be 10mA or less)

6.5 Internal Resistance:

Internal resistance is measured at a 25 mm span across the **MICROTEMP®** TCO body. The internal resistance shall be no more than 1.5 milliohms for a E4A, G4A, E6A, G6A, Z6A, 2.5 milliohms for a E5A, G5A, E8A, G8A and 3.0 milliohms for a E7F, G7F.

6.6 Withstanding Voltage: (Ref IEC 60691 4th 10.1)

After the **MICROTEMP®** TCO is fully opened, $2V_R$ AC shall be applied for one minute between both lead wires. The **MICROTEMP®** TCO shall not indicate voltage breakdown.

6.7 Temperature/Humidity Cycling: (Ref.: IEC 60691 4th Edition, Para 10.2.2, 11.2)

The MICROTEMP® shall be subjected to 3 complete cycles of:

- 24 hours at T_F-15 °C (not less than 60 °C) followed immediately by
- 96 hours at 35 ±2 °C and 90 ±5% relative humidity followed by
- 8 hours at 0.0 ±2 °C. The parts are then to be returned to room temperature.
- The third humidity cycle will be 168 hours
- Following this conditioning, the samples are tested per 6.4 and the opening temperature must be within T_F +1/-7 °C. Following the opening test, the insulation resistance must be more than 0.2 megohm at 500 V_{DC}.

6.8 Aging Test: (Ref.: IEC 60691 4th Edition, Para 11.5)

The **MICROTEMP®** TCO shall be exposed to the temperature steps indicated in Table 5. After the exposure of a **MICROTEMP®** TCO to the 0 step (or step 1 if step 0 is not used) for one week, the TCOs are to remain closed. After the exposure of a **MICROTEMP®** TCO to the 0 step, at least 50% of the samples must be closed. After the 1st step, at least 50% of the samples shall be closed, unless the samples were exposed to the 0 step in which case they may all be open. After the 5th step, all samples shall be open. (At each step of the 2nd to 4th steps, the sample may open.). Step 0 is used whenever T_F-15°C > 200°C.

Table 5

Step	Exposure Temperature	Exposure time
0	200°C	3 Weeks
1	(T_F – 15)°C	3 Weeks
2	(T_F – 10)°C	2 Weeks
3	(T_F – 5)°C	1 Week
4	(T_F – 3)°C	1 Week
5	(T_F + 3)°C	1 Day

7. Approved Safety Standards:

7.1 U.L. File No. E40667 (N): Zhuhai, China; Delicias, Mexico
Note: Number is applied to GXXXX, EXXXX and ZXXXX.

7.2 CSA Class No. 4823 54 and File No. 026323_0_000: Zhuhai, China; Delicias, Mexico
Note: Number is applied to GXXXX, EXXXX and ZXXXX.

7.3 VDE License No. X4/6A 40017228; X5/8A 40017249; X7F 40017242; Z6A 40032859; Zhuhai, China; Delicias, Mexico

7.5 CCC certification number, Zhuhai, China

CCC Certificate	Expiry	Content
2002010205019896	05/02/2021	G4A,G4A00,G4A01,G4A50,G4A51,G4A62,G4A63, G6A,G6A00,G6A01,G6A50,G6A51
2004010205118874	05/02/2021	E4A,E4A00,E4A01,E4A50,E4A51, E6A,E6A00,E6A01,E6A50,E6A51
2002010205025399	05/02/2021	G5A,G5A00,G5A01,G5A50,G5A51,G5A62,G5A63, G8A,G8A00,G8A01,G8A50,G8A51
2004010205118871	05/02/2021	E5A,E5A00,E5A01,E5A5 0,E5A51, E8A,E8A00,E8A01,E8A50,E8A51
2003010205063140	01/27/2020	G7F,G7F01,G7F51
2004010205118877	01/27/2020	E7F,E7F01,E7F51
2011010205485018	05/11/2020	Z6A, Z6A00, Z6A01, Z6A50, Z6A51
2012010205579212	2020/8/24	G5AP02
2012010205586007	2020/8/24	G4AP02
2012010205586009	2020/8/24	G5AP12

7.6 The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the TCO selected will operate as intended in the user's application.

8 Instructions

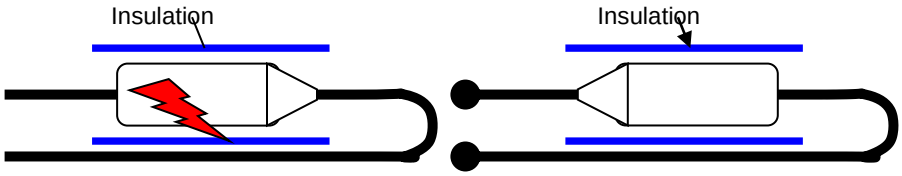
8.1 Installation:

8.1.1 Direction at Mounting:

The **MICROTEMP®** TCOs do not have electrical polarity, and can be used at any orientation. However, the following precautions should be taken during mounting of **MICROTEMP®** TCOs:

(1) To avoid nuisance opening due to thermal gradients, attach the epoxy side lead closer to the heat source rather than the case lead so that the epoxy end is at consistently higher temperature than the case lead.

(2) When a lead wire is connected as shown below (Figure 4), a break of insulation may cause short-circuiting between the epoxy end lead and the metal case. Bend the lead wires as shown in Figure 5 below. Otherwise, assure the reliability of the insulation material.



If there is a breakdown in the insulation (short) from the lead to the case the circuit will not open when pellet melts

Figure 4

If there is a breakdown in the insulation (short), from the lead to the case the circuit is open when pellet melts

Figure 5

8.1.2 When bending the epoxy lead, special care must be taken in supporting the lead near the body so that the epoxy and bushing will not be damaged. Bending the lead too close to the epoxy may break the bushing and seal, which may shorten the life of the **MICROTEMP®** TCO or compromise the performance for moisture resistance. Bending the lead too close to the case may weaken the case lead joint. Maintain at least the minimum distances as indicated in Figure 6 for any lead bends.

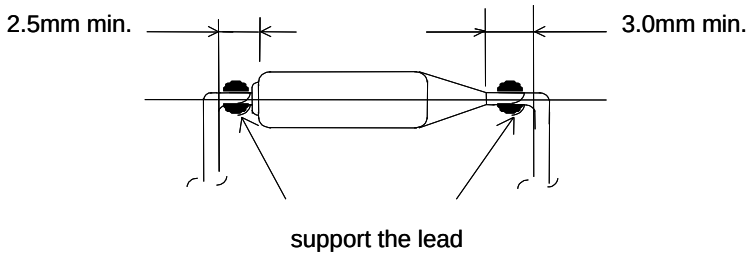


Figure 6

8.1.3 In mounting, connecting and lead forming process, take care not to apply tensile / pushing force of over 1 KgF (0.7 KgF for X7F51) between both leads and body even in axial direction. Also, avoid twisting lead to mount or form lead. These are precautions to prevent excessive stress or invisible damage in epoxy and leads.

8.2 Connection:

8.2.1 Soldering leads – **MICROTEMP®** TCO leads should be heat sunk during the soldering operation. If excessive heat is conducted into the **MICROTEMP®** TCO, it can shorten the life. Since the heat conduction can be different in each application, test samples for the actual operation should be utilized. Test samples should be x-rayed before and after the soldering, and the size of the thermal pellet should be measured. The condition should be verified so that no shrinkage will occur. In some cases of pellet shrinkage, a **MICROTEMP®** TCO may open after soldering in a short period of time, even at room temperature. The shrinkage may be caused by a partial melt of thermal pellet surface with a moment of excessive heat.

8.2.2 Splicing – The **MICROTEMP®** TCO's can be connected to additional lead wires or terminals by splicing. If the splice process is insecure, it may produce high resistance junction which can cause self-heating and may cause a nuisance opening. It will be generally better to use copper splice for a high current operation**.** The temperature capabilities of a splice and or termination must be considered. For example, solder backup should be considered for splices or terminations in applications where the joint is cycled to temperatures in excess of 150 °C.

8.2.3 Connection with screws – The **MICROTEMP®** TCO lead can be attached to the terminal by lead curling. If excessive tension is added during the mounting operation, it may loosen the junction of case-lead assembly, which can cause a nuisance opening. Do not apply instantaneous axial tensile load of over 1.8 KgF.

8.2.4 Connection with wires - The **MICROTEMP®** TCO lead can connect a solid wire using an open barrel splice. The solder backup would be needed at any temperature.

8.2.5 Welding – The **MICROTEMP®** TCO leads may need to be heat sunk during a welding operation to prevent shrinkage of the thermal pellet. Care must be taken not to pass welding current through the TCO as that could cause the TCO not to function.

8.2.6 General –The connection method and installation methods need to be considered to avoid excess heating due to current flow through the connection. Check temperature of MICROTEMP® TCO body in actual use condition.

8.2.7 Molding or shrinkable tube - When resin molding or shrinkable tube is applied, the temperature of the MICROTEMP® TCO's body should be controlled. Tests should be performed to assure the pellet height is not reduced due to any processing operation. Refer to instruction for soldering leads in connection. In resin molding, solvents should be avoided.

8.3 Location of **installation (also refer to the MICROTEMP Thermal Cutoff** Technical Data section of the Therm-O-Disc Product Catalog, especially for use of Thermocoupled TCO dummies):
During normal operation in an application, a suitable temperature margin against the opening temperature must be considered. Ensure that the **MICROTEMP®** TCO can sense the overheating of fault condition to satisfy the purpose of upper limit temperature protection in the specific application. Generally, installation configuration and total heat mass may cause a delay of temperature rise.

8.4 Temperature Range:

8.4.1 Temperature range for continuous use is –30°C to 200°C.

8.4.1.1 To avoid nuisance opening, the maximum temperature of the **MICROTEMP®** TCO body (Ta) when mounted in the actual product with current applied should be ≤Tf - 25°C and no higher than 200°C.

8.4.1.2 When ambient temperature Ta = Tf - 15°C (Max.220°C) = Th, the TCO will have the quickest response to temperature rise, but will have the shortest term of continuity (shortest life). Refer to Paragraph 2.5.

8.4.2 The overshoot temperature after the opening in the application should not exceed the maximum temperature (T_{MAX}). Excessive overshoot temperatures may cause dielectric breakdown of the MICROTEMP® TCO and allow re-conduction to occur. The MICROTEMP® TCO is only tested at T_{MAX} for 10 minutes. Functional MICROTEMP® TCOs should be tested to verify proper operation in the application.

8.5 Storing condition before building in your products: Keep box of **MICROTEMP®** TCO closed in a dry and 40 °C or under temperature condition. Build in your products within 6 months after receiving, to

avoid unexpected contamination entering into box and to avoid unclear marking by discoloration of silver coating.

(For more information on the **MICROTEMP®** TCO application and installation, refer to the **MICROTEMP®** Thermal Cutoffs section of the Therm-O-Disc Product Catalog)

9 Cautions:

9.1 Mechanical Deformation and Stress:

9.1.1 Do not cause any mechanical deformation of the **MICROTEMP®** TCO body because it can cause a locking of the contacts.

9.1.2 Do not apply a pushing force in an application, which may move the contact lead inside the body, which can keep the contacts from opening, or can cause re-conduction.

9.1.3 Do not break the epoxy seal. It may loosen the contact lead inside the body. This can also keep the contacts from opening or can cause re-conduction.

9.3 Environmental Conditions:

Do not expose this product in the following environments or under the following conditions:

9.3.1 Submersed in water or solvent, in a high humidity environment, or in the environment of corrosive, but not limited to, gasses such as sulfite gas or nitric oxide gas.

9.3.2 Continuous use at over Th

9.4 Important notice:

The user must determine the suitability of the **MICROTEMP®** TCO for the application and assumes all risk and liability associated therewith.

10 **MICROTEMP® Thermal Cutoffs** are considered to meet the requirements for hazardous substances in product design and manufacturing that are controlled per the below directives.

10.1 Substances are controlled per below regulation

(1) DIRECTIVE 2000/53/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 September 2000 on end-of life vehicles

(2) DIRECTIVE 2011/65/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

11 Export control regulations

We consider MICROTEMP® Thermal Cutoffs to meet the below regulations.

11.1 The items covered in this specification may be subject to the export laws of the United States of America, including without limitation the Export Administration Regulations and the Office of Foreign Asset Control Regulations. The export, re-export or diversion of these items in contravention of these or other applicable regulations is strictly prohibited.