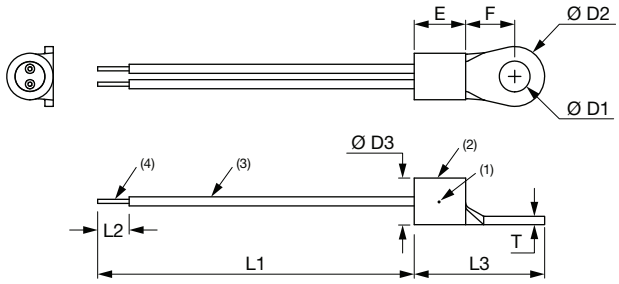
Important Information on the Use of NTCALUG Ring Tongue Thermistors

MOUNTING INSTRUCTIONS

1. NTCALUG MECHANICAL OUTLINE:



Drawing 1

Notes

(1) NTC thermistor
(2) Ring tongue, tin plated copper
(3) Insulated cables or naked conductors
(4) Cable insulation stripping or optional connector

Connectors, shrinkable tubes, or non-shrinkable tubes can be added to the standard NTCALUG thermistors.

2. MECHANICAL INTERFACES

2.1 Contact Surfaces

The ring tongue terminal is made of a base copper material with a tin plating metallization. The most often used surface materials in contact with the ring tongue are stainless steel, copper, copper alloys, brass, bronze, and aluminum. Other surface contacts are possible; for example, with plastics or alumina. The contact surface must have a sufficient smooth roughness to avoid damage to the ring tongue.

The routing of the cables, shrinkable tubes non-shrinkable tubes, cable harness tapes, or other mechanical items must be made against smooth surfaces without sharp edges. Burrs or sharp edges could damage plastic materials and degrade the electrical insulation properties of each material, or lead to a mechanical failure or failure due to external environmental causes.

2.2 Vishay's NTCALUG NTC ring tongue thermistors are mounted using **screws or bolts**.

Screw Material

- Any kind of **metal screw** material could potentially be used, provided there is no potential electrochemical corrosion created by the choice of dissimilar materials and environmental conditions
- NTCALUG NTC ring tongue thermistor sensors are made to sense the surface temperature or ambient air temperature. In the case of a surface temperature measurement, the choice of the screw base material could be of importance for the thermistor parameters, like the speed of response to a temperature change (response time) or the differences between the measured temperature and the surface temperature (thermal gradient). The screw material parameters to consider would be the thermal conductivity, the material density, the specific heat, and the mechanical strength. Tests should be completed to validate the choice made at the design stage
- **Plastic screws** could potentially be used, provided that the application is compatible with the use of such screws (for example: vibration, upper temperature category, brittleness at cold temperature, thermal expansion compatibility, relaxation of plastics, plastic yield, long term degradation of plastics, de-condensation of thermoplastics, low thermal conductivity of plastics, etc.)

Screw Shape

- Due to its special shape, it is not possible to use **plow bolts** or similar screw types for securing the ring tongue

Plow Bolt

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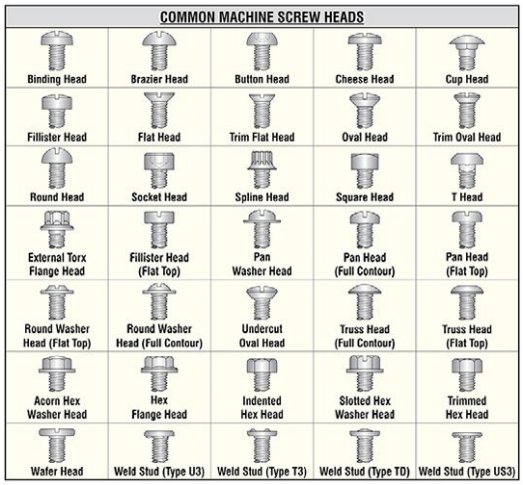
- The screw used to secure the ring tongue should have a **flat contact surface** with the ring tongue. Beveled screws are not recommended ("flat head", "oval head", or similar (see the chart below))



Screw Head Styles [1]

Note

[1] Extract from the Engineers Black Book 3rd Edition, © by Pat Rapp Enterprises, reprinted with permission of Hi Impact Supplies, LA, CA, USA

Tightening Torque Guideline

- The screws are secured with the ring tongue with a **tightening torque** per the guidelines given in Table 1:

TABLE 1: SCREW TIGHTENING TORQUE [1]

NOMINAL DIAMETER OF SCREW THREAD (mm) [1]	NOMINAL DIAMETER OF SCREW THREAD (INCHES) OR #STUD SIZE	TIGHTENING TORQUE GUIDELINE (N·m) [1]
3.00	0.118, #3, #4	0.5 to 0.6
3.50	0.138, #5, #6	0.7 to 0.9
4.00	0.157, #8	1.0 to 1.3
5.00	0.197, #10	2.0 to 2.5
6.00	0.236, #1/4	4.0 to 4.9
8.00	0.315, #5/16	8.9 to 10.8
10.00	0.394, #3/8	18.0 to 23.0

(For other metric fasteners, refer to ISO and DIN norms. For imperial fasteners inch·Lb or Ft·Lb tightening torques, refer to [2] and SAE and ASME norms).

Notes

[1] After JIS C 2805 - §7.1 Table 3

[2] UL 486 "Wire Connector and Soldering Lugs"

Engaging an excessive tightening torque will deform the ring tongue and could have serious consequences to the thermistor's integrity, such as cracking the potting material, degrading the adhesion of the potting material, breaking the thermistor chip, etc.

- **Lock washer** usage, in addition to screws, must be validated for suitability in the design

Lock Washers

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Screw Size for NTCALUG Types

It is not recommended to use other screw sizes than the size written in the datasheet or on the product specification, as this could lead to a detachment of the NTCALUG in the customer appliance. Table 2 is given as a guideline:

TABLE 2: MOUNTING SCREW FOR NTCALUG SERIES

NOMINAL DIAMETER OF SCREW THREAD (mm)	VISHAY NTCALUG TYPES	
2.00	NTCALUG03	
3.00	NTCALUG39	NTCALUG87
	NTCALUG79	NTCALUG01
3.50	NTCALUG02	NTCALUG01
4.00	NTCALUG80	NTCALUG91
	NTCALUG29	
5.00	NTCALUG54	
6.00	NTCALUG85	NTCALUG33
8.00	Customized types	
10.00	Customized types	

2.3 Vishay NTCALUG NTC ring tongues can be mounted using **rivets**.

- **Blind rivets** and **knurled rivets** have been used to secure the ring tongues. It is the responsibility of the customer to correctly design and validate such a fixation method for their appliance, especially to avoid an excessive deformation of the ring tongue

Blind Rivets

Knurled Rivets

- **Plastic push-in rivets** could be used, provided that the longevity and secureness of the connection can be assured at all temperatures

2.4 Vishay NTCALUG NTC ring tongues can be mounted by **plastic pin melting (fusion bonding)**.

During the melting operation, the temperature reached in the vicinity of the ring tongue sensor, and by the heat dissipated in the ring tongue, must not exceed the NTCALUG operating temperature. Noxious gases have to be avoided as well.

2.5 It is not recommended to use double-sided adhesive to secure the assembly between the ring tongue and the surface to be sensed, as the adhesive will create a thermal insulation barrier that will badly influence the response time and the thermal gradient.

2.6 Brazing or soldering the ring tongue sensor to a metal surface is not allowed, as the processing temperatures will be higher than the specified maximum operating temperature.

2.7 Electrical welding or **ultrasonic welding** of the ring tongue is not recommended.

2.8 Adhesive bonding of the ring tongue is permitted, provided that the primer and adhesives are chemically inert to the epoxy potting resin of the NTCALUG, and that the temperature reached during the heat curing of the adhesive and the exothermal reaction of the adhesive cross-linking process does not exceed the NTCALUG operating temperature.

2.9 Securing the ring tongue by placing an **adhesive tape** on top of it is possible, assuming that the hand or machine mechanical pressure applied during the placement of the tape does not deform the ring tongue or the ring tongue barrel in a way that could lead to issues like delamination or permanent electrical drift.

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2.10 Securing the **cable wires** to the same surface and temperature as the ring tongue by placing an **adhesive tape** is possible. It can **reduce the thermal** gradient and increase the accuracy of the real surface temperature to be sensed. Care should be taken that the cable and tape can operate up to the maximum surface temperature to be sensed. Also check 2.13 on cable looseness.

2.11 Securing the ring tongue **fixation by external pressure**, with a cover lid, for example, is possible, provided the constant mechanical pressure applied during the lifetime of the sensor and appliance does not deform the ring tongue or the ring tongue barrel, which could lead to issues like delamination or permanent electrical drift. The securing of the ring tongue should be validated in the whole operating temperature range and take into account the differences of dilatation of dissimilar materials and mechanical tolerances between fitting items. Buffer layers could be used to absorb mechanical stresses.

2.12 Bending the ring tongue barrel before or after mounting is not allowed, as this could lead to delamination and electrical drift. Consult Vishay if a bended ring tongue is needed.

2.13 Sufficient cable looseness has to be present in a mechanical mounting of NTCALUG sensors to avoid a constant or intermittent force being applied on the cables, on the connectors, or on the ring tongue barrel potting material. **Sufficient cable looseness** must also be present when connecting or disconnecting a disconnectable connector. Do not apply continuous mechanical load to a connector.

3. ELECTRICAL CONNECTIONS

3.1 Stripping the Cable Insulation

Conventional stripping tools can be used to **strip the insulation** of the cables of NTCALUG series thermistors. Hand tools or built-in applicator stripping tools can be used.

For **soft cable insulation material** like PTFE, the insulation stripping might need the use of special stripping blades to avoid the deformation of insulation material.

For **harder cable insulation material** like PEEK, special stripping tools or stripping blade die sets might be needed.

Laser insulation stripping can be used if this does not damage the conductor plating or strands.

Cable insulation burning could be used, provided the cable insulation does not get charred and keeps its solderability or crimpability without deterioration of the electrical contact. This is the least preferred method of cable stripping.

3.2 Wire Tinning

Some series might need a pre-tinning if, for example, the cables are shortened and stripped. Pre-tinning is advisable when soldering the end conductor wires to a circuit board, connector, solder post, or soldered splice. The process will bring sufficient molten solder material to the bare metal conductors to ease the soldering operation later. Precautions have to be taken in this operation.

The stranded wire must be uniformly coated with a thin coat of solder, and the untinned length of strands from end of insulation to the solder is not greater than 1 wire diameter (D). Products are considered as defective when the solder does not wet the tinned portion of the wire, when there is solder build-up that can affect the next assembly step. The cable insulation must not be damaged by the heat brought during the process.

Further recommendations can be found in IPC-A-610D (Acceptability of Electronic Assemblies - §6.3) and IPC-A-620C (Requirements and Acceptance for Cable and Wire Harness Assemblies - §4.4).

If pre-tinning of wires is applied, the use of resin-type or non-activated **flux material** is recommended. After pre-tinning, the flux residues should be minimized or cleaned. The medium to clean the flux residues should be tested and validated on the NTCALUG product prior to release for a mass production. Most NTCALUG series have stripped pre-tinned wire conductors (without connectors) that are solderable following the solderability tests described in IEC 60068-2-20.

4. SOLDERING

It is not permitted to apply solder or soldering heat to the ring tongue thermistor eyelet or barrel.

The leadwires of the ring tongue thermistors (without connectors) comply with the solderability requirements as outlined in IEC 60068-2-20. Care must be taken when soldering ring tongue NTC thermistors; they cannot be damaged by excessive heat conducted through the leadwire connections or directly to the thermistor body.

The soldering time and temperature have to be controlled to avoid burning or damaging the cable insulation. Before, during, and after the soldering process, care has to be taken to avoid contact of the solder, soldering tip, soldering cup, or any other hot device to the cable insulation. Such contact could melt or burn the insulation or adhere conductive solder to the cable insulation or within the cable insulation.

During bending or separating of the leads, no mechanical stress at the outlet of the potting resin is allowed. In any case the leads may not be bent closer than 4 mm from the outlet of the potting resin body.

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The maximum process temperatures, the maximum time of exposure, and the minimum distances to respect also depend on the material of the leadwires used.

For dip, wave, and iron soldering of RoHS-compliant NTC thermistors, the following combined solder conditions should not be surpassed:

TABLE 3: SOLDERING CONDITIONS FOR LEADED NTC THERMISTORS NTCALUG SERIES

	WITH Cu WIRES Ø < 0.65 mm	WITH Ni OR STEEL WIRES Ø < 0.55 mm
Wave or Dip Soldering		
Maximum bath or wave temperature	260 °C	260 °C
Maximum soldering time	3 s	5 s
Minimum distance from thermistor body	6 mm	3 mm
Solder Iron (Manual or Robot)		
Maximum solder tip temperature	340 °C	340 °C
Maximum soldering iron wattage	30 W	30 W
Maximum soldering time	2 s	3 s
Minimum distance from thermistor body	6 mm	3 mm
PiP / PiH Reflow Soldering	**Not recommended**	**Not recommended**
Maximum thermistor body temperature T_p	Toper. Maximum +15 °C	Toper. Maximum +25 °C
Maximum exposure time to T_p max.	30 s	30 s

The use of resin-type flux or non-activated flux is recommended. Failure to follow the above soldering conditions may result in thermal-electrical damage like material and permanent resistance changes.

NTCALUG thermistors are **not designed for reflow soldering processes**.

Solderable board-in terminals mounted on Vishay NTCALUG thermistor sensors are solderable in the PCB according to the soldering norms. Refer to the connector manufacturer's recommendations for the design and validation of this mechanical and electrical connection.

Bad storage conditions or exceeding the shelf life can affect the solderability of the solderable board-in terminals and lead to electrical connection defects. Refer to the Storage section.

In the event a **heat-shrink tube** is applied to the NTCALUG thermistors, the heating temperature of the shrink tube must not exceed 125 °C in most cases. In any case, the limits as defined in Table 3 under the PIP / PIH reflow soldering section should not be surpassed. Excessive heating can cause the internal solder junction to melt.

A **heat-shrink tube** serrating the cables is not to be placed directly against the potting resin of the ring tongue barrel, as any bending in the cables would create a pressure and traction force on the cables, which could lead to electrical or mechanical failures.

Extension cables can be soldered to the conductors of the NTCALUG thermistor sensors.

The soldering time and temperature have to be controlled to avoid burning or damaging the cable insulation. Before, during, and after the soldering process, care has to be taken to avoid contact of the solder, soldering tip, soldering cup, or any other hot device to the cable insulation. Such contact could melt or burn the insulation or adhere conductive solder to the cable insulation or within the cable insulation.

In case a **heat-shrink tube** is applied to the NTCALUG thermistors cables, the heating temperature of the shrink tube must not exceed 125 °C in most cases. In any case, the limits as defined in Table 3 under the PIP / PIH reflow soldering section should not be surpassed. Excessive heating can cause the internal solder junction to melt.

It is not permitted to solder the ring tongue thermistor eyelet or barrel.

5. COLD JOINING

Cold joining techniques such as crimp splicing can be applied to NTCALUG types to make cable wire extensions or connector applications. Care should be taken that no intermittent contacts can be caused by the crimp splice. During bending or separating of the leads, no mechanical stress at the outlet of the potting resin is allowed. In any case the leads may not be bent closer than 4 mm from the outlet of the potting resin body. No mechanical stress like tensile, torsion, or vibration forces should remain on the part during normal operation in the application.

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6. CONNECTORS

Sufficient cable looseness must be present when mechanically mounting NTCALUG sensors to avoid a constant or intermittent force being applied on the cables, connectors, or ring tongue barrel potting material.

Sufficient cable looseness must also be present when connecting or disconnecting a disconnectable connector. Do not apply continuous mechanical load to a connector.

If some **traction force** has to be applied to the connector, ensure that this force does not exceed the maximum pulling force of the cable, the connector manufacturer minimum terminal retention force in the connector housing, the connector manufacturer minimum terminal-cable traction force, or any figures provided in a datasheet or in the product specifications.

Mount the connectors straightly in the counter-connectors.

Do not mount **connectors that do not match each other**. The use of the same manufacturer's connector and counter connector is preferred. The use of non-branded connectors that do not 100 % match other connectors, and forcing them to fit, can severely damage the inner terminals of the connector assembly or lead to intermittent open circuits or corrosion.

Connections to **customized connectors**, like overmolded types, must be validated for suitability before use.

PCB conductive tracks and surfaces have to be clean for the **PCB edge direct connections**. Specific circuit board design applies for each connector manufacturer, type, and reference. Only use a PCB edge connector with the PCB that was designed for it. Do not mix the designs, which could lead to non-mountable connectors, detached connectors, or intermittent contacts.

Choose the **connector terminal to match the cable** of the NTCALUG. Failing to do so could result in failures. Match the relative sizes between the connector size and pitch with the cable section and dimensions. Do not use large connectors with small cables or tiny connectors with large cables.

Mounting a crimped connector to the cables must be done according to the guidelines of the connector manufacturer industry standards such as IPC-A-620 (Requirements and Acceptance for Cable and Wire Harness Assemblies), or other suitable norms. The mounting includes the non-destructive and destructive controls at the end of the process.

Suitable **stripping and crimping tools** must be used to crimp the connector terminals. Non-suitable tools can lead to failures on the connector contacts and connections.

It is preferable to not use pliers or clamps serrated on the cable insulation to insert the terminals in the connector housing or to insert the connector housing into the counter-connector, as this could damage the cable insulation, leading to a reduced cable insulation withstanding voltage. Do not bend the connector terminal, as this could lead to a lower terminal retention force by the connector housing or a complete detachment of the terminal from the connector housing.

If Vishay is supplying NTCALUG sensors **with terminals only**, take precautions when transporting, storing, moving, and holding the terminals before their insertion in the connector housing. A **terminal latch** could be deformed, displaced, or damaged, which will result in bad terminal retention in the connector housing and a failing connection afterwards. A bended terminal will cause the same effects.

Inserting the NTCALUG thermistor sensor into a **cable harness** is possible. Care must be taken to avoid pulling on the cables or exerting a constant force. A **cable tie** serrating the cables must be placed sufficiently away from the NTCALUG thermistor epoxy potting and barrel to avoid a deformation or cracking of the epoxy, or a pulling on the cables, leading to a mechanical or insulation failure.

When an NTCALUG thermistor sensor is mounted in the appliance, ensure that the cable harness connected to it does not **pull by its hanging weight** on the connection during the mounting. The same applies during the functioning of the appliance.

If the connector has to be removed and reinserted, do it only a few times. Consult the connector manufacturer's product specifications for the **insertion / withdrawal** figure. Typically, the standard connectors are made for a maximum of five insertion / removal operations.

A **heat-shrink tube** serrating the cables is not to be placed directly against the connector housing, as it would create a permanent shear force to the terminals that could lead to a mechanical or electrical connector failure. Refer to the connector manufacturer's recommendations for the details.

Wire Wrap (Solderless Wrap)

AWG#30 and AWG#28 **monostranded or solid core conductors** of some of the NTCALUG series devices can be connected to PCB square posts using the **wire wrapping technique**.

Note

- An example of a wire wrap tool is OK Jonard Industries' WSU-30M for modified AWG#30 wire wrap

Note that some cable insulations, like PEEK material, can be more difficult to strip and need the use of special or non-conventional stripper tools or blades. Do not pull excessively on the cables when stripping the cable insulation. Acceptability of the wire wrap connection can be found in IPC-A-610.

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7. STORAGE

NTCALUG thermistors should be stored in their original packing containers before use. The storage location and package containers should be maintained within the following limits:

Storage temperature: 10 °C to 40 °C

Relative humidity (without condensation): 10 % RH to 70 % RH

Thermistors must not be stored in corrosive or deoxidizing atmospheres (Cl_2, H_2S, NH_3, NO_x, SO_x, etc.). Avoid storage in heat or direct (UV) sunlight. The presence of ozone or ionizing radiation must be avoided all times. Humidity, temperature, and container materials are critical factors that can influence the solderability of the parts. Touching the exposed metal conductors may change their soldering properties.

When an original packing container is intermediately opened to store the goods temporarily prior to assembly or production, it is advisable to store the goods in closed containers for a limited time.

Shelf Life: properly packaged and stored NTCALUG thermistors have a minimum shelf life of 24 months after manufacturing date (DC). Thermo-electrical functionality will not be influenced after longer storage time in the described conditions. Solderability of exposed conductor leads should be checked before using parts exceeding 24 months storage in the specified conditions after manufacturing date.

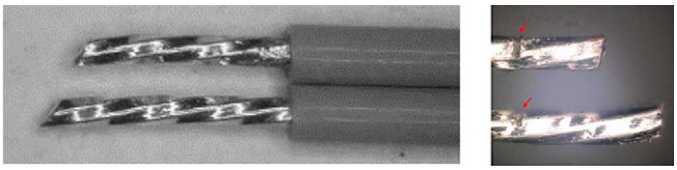
8. HANDLING

NTCALUG thermistors must not be dropped. Do not touch components with bare hands; gloves are recommended. Avoid contamination of the thermistor surface during handling.

Unpacking Goods

Plastic bags containing NTCALUG products should be opened with care.

If **scissors** or **cutters** are used, do not touch any component or leads, which could result in notches on the conductor, shortened conductors, and damaged cable insulation or potting material.



Opening the bag with scissors or cutters can damage components

Do not place **heavy weight** on top of the plastic bags or on top of NTCALUGs placed on a mounting table. A deformation of the lug into a U-shape and other damages might occur, which will result in non-mountable items.

9. SEALING AND POTTING

NTCALUG thermistors may only be sealed, potted, or over-molded in suitable resins if it is clearly mentioned and allowed in the respective datasheets. Sealing or potting can affect the reliability of the component. The potting material must be compatible with the use of electronic components, be electrically non-conductive, and chemically stable in the whole operating temperature range. Potting or over-molding in Polyamide-based resins is not recommended. When sealing, potting, or over-molding is permitted per the datasheet, care must be taken that there is no mechanical stress exerted on the component caused by thermal expansion or compression during the production process (curing / over-molding) or in the final application. No residual forces or stress may exist during normal operation. The upper category operating temperature of the thermistor must not be exceeded. Ensure that the materials used are chemically neutral and stable at the maximum operating temperature. If using a ceramic adhesive / potting or filling material, avoid phosphate-based binders. As thermistors are temperature-sensitive components, it should be considered that molding or sealing will affect the thermal surrounding and will influence the response time, power dissipation, and thermal gradient. Extensive testing is encouraged in order to determine whether over-molding or potting influences the functionality and / or reliability of the component.

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10. CLEANING

Cleaning processes can affect the reliability of the component. If cleaning is necessary, mild cleaning agents are recommended. Cleaning agents based on water are not allowed. Washing processes may damage the product due to the possible static or cyclic mechanical loads (e.g. ultrasonic cleaning). They may cause cracks, which might lead to reduced reliability and / or lifetime. Intensive spraying may lead to coating and potting damage or reduced insulation voltage.

11. INSPECTION MEASURING

Resistance Versus Temperature

NTC thermistors can exhibit a large resistance change depending on the changing surrounding temperature. The change of resistance can be as high as -8 % per degree Celsius. When measuring or inspecting resistance values of NTC thermistors with precision, it is advisable to immerse the thermistor body and its connecting leads in a good thermal conductive homogeneous medium. Such a medium is preferably silicone oil or PFPEs non-reactive perfluorinated liquid polymers. Water is not recommended because of its electrical conductivity. The liquid medium should be measured with a calibrated thermometer and referenced close to the NTC thermistor body. Measuring NTC thermistors in air can and will be influenced by many parameters, like radiated heat or cold / heat flows from surrounding bodies. Measuring currents that can be applied to the NTC thermistor should be low enough to prevent any self-heating or be limited in time. Preferably, electrical power induced by the measuring current should be lower than 10 % of the specified dissipation factor (D in mW/°C) or generate a temperature increase of less than 0.1 °C. For many NTCALUG thermistors, a measuring current of 10 µA to 100 µA will not induce any self-heating. Some ohm-meters or DMMs measure resistance values with measuring currents of 1 mA or higher. These currents can heat up some NTCALUG thermistors by more than 5 °C.

Dimensional

NTCALUG thermistors are bulk packed and have no fixed pitch between the wires or at the cable epoxy outlet.

Visual

The color of the insulated cables or other mechanical items (shrink tubes, connectors, etc.) can differ slightly from lot to lot and does not affect the product performance.

12. OPERATION

Use thermistors only within the specified operating temperature range. Never use NTC thermistors in constant voltage mode or outside the specified maximum or derated power. Overpowering a NTC thermistor can cause internal solder reflow, thermal runaway and fire ignition, short circuit or open circuit failures, loosening of withstanding insulation voltage, or insulation breakdown. Instant power applied should be limited to 10 % of the maximum specified power to prevent high voltage (> 30 V_{DC}) build up and thermal shock. Environmental conditions must not harm the thermistors. Avoid operation of NTCALUG thermistors in corrosive or deoxidizing atmospheres (Cl_2, H_2S, NH_3, NO_x, SO_x, etc.) unless specified. Only use the thermistors under normal atmospheric conditions or within the specified conditions. NTCALUG thermistors may not be used in a vacuum or at very low or high air pressure. Avoid any contact with water or electrically conductive liquids, unless specified in the respective datasheets. It must be ensured that no water enters the NTCALUG thermistors (e.g. along or through cable insulation or at the cable epoxy outlet). For measurement purposes, see the Inspection paragraph. Avoid dew formation and condensation unless the thermistor is specified for these conditions. During operation, any bending, twisting, or movement of the cables or wires should be prevented.

Standard NTCALUG thermistors are specified with a minimum insulation dielectric withstanding voltage. For non-insulated thermistors, any contact with a metallic or conductive surface could result in a leakage current, disruption, short circuit, or a malfunctioning of the component.

Insulated NTCALUG thermistors should not be used above their specified minimum dielectric withstanding voltages.

13. FAILURE MODE

For safety critical applications, be sure to provide an appropriate fail-safe or redundancy function in the circuit to prevent secondary (product) damage caused by a malfunctioning or failure of an NTC thermistor. For every use of Vishay thermistors, it is the customer's responsibility to consult and respect the Vishay disclaimer notice, which is part of every Vishay product datasheet. If you have any doubt as to the possible failure modes in your application, consult Vishay.

This list of guidelines and information does not claim to be complete, but represents the experiences of Vishay and may be supplemented, adapted, or enhanced at any time.

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