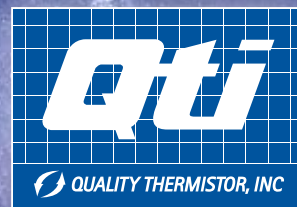


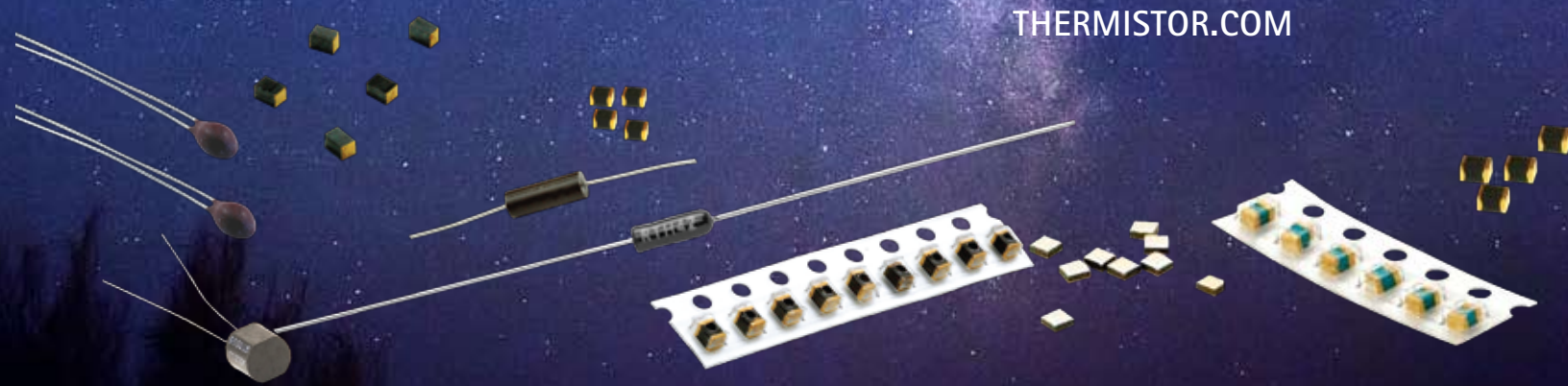


AEROSPACE AND MILITARY

TEMPERATURE SENSORS
PASSIVE COMPONENT TESTING



THERMISTOR.COM



ABOUT US



Quality Thermistor, Inc. (QTI) was founded in 1977 to meet the increasing demand for high quality thermistor components for the aerospace industry. Since then, QTI, a small business, has exceeded the requirements of some of the most stringent high cost of failure thermal applications, changing the landscape of the supply chain for the entire industry.

WHY QTI BRAND?

The QTI brand products found in this catalog are manufactured with the most reliable, sensitive and cost effective temperature sensor technologies available for temperature measurement and control.

EXPERTS IN THERMISTOR MANUFACTURING:

Quality Thermistor manufactures the ceramic sensor element for the NTC based products detailed in this catalog. We assure our customers are receiving the most stable, accurate and reliable sensors available.

100% FINAL TESTING:

All of the temperature sensor products manufactured by Quality Thermistor are 100% inspected for accuracy in temperature controlled baths to ensure proper electrical and curve-fit tolerances. "Set-point" tolerances can be specified at any temperature between -55°C and 300°C. Calibration data is available as an option on all the sensor products we manufacture.

ATTENTION TO DETAIL:

The proprietary manufacturing processes and materials used in manufacturing our temperature sensors are chosen to optimize thermal time response and maximize performance and reliability within your application.

VALUE ADDED ASSEMBLY SERVICES:

QTI also manufactures, tests and delivers complete temperature sensor assemblies for customers who prefer to have a fully assembled, tested and lot qualified sensor assembly. The thermistor and RTD elements detailed in this catalog can all be incorporated into higher level temperature sensor assemblies. Contact QTI's Applications Engineering Department to assist you in creating a Source Control Drawing for your next temperature sensing application.

DESIGN ASSISTANCE:

QTI is AS9100 and ISO 9001 registered.

While we trust that the information provided within this design guide will assist you in the selection of the appropriate materials, there is no substitute for candid one-to-one dialog. We encourage you to contact the Quality Thermistor factory or field sales representative in your area to discuss specific design, sales or customer support needs. "Live" design assistance is also available Monday through Friday (8 am - 5 pm MST) at www.thermistor.com



FACTS

DUNS Number	08284-1925
Tax ID	82-0332004
SIC Code	3823
NAICS Code	334513, 334415
FSC	5905, 6685, 5961
Cage Code	56866
Registrations	
Small Business	
CCR Registered	
ORCA Registered	

CONTACT US

2108 Century Way
Boise, ID 83709
208-377-3373
208-376-4754 FAX
www.thermistor.com
qtisales@thermistor.com

PRODUCTS

- MIL-PRF-23648 Defense Supply Center Columbus
- MIL-PRF-32192 Defense Supply Center Columbus
- S-311-P-827 NASA Goddard Space Flight Center
- Precision USB Temperature & Humidity Acquisition Systems
- RTD and Thermocouple temperature probes, up screened for MIL & S-Level
- RoHS and Non-RoHS products

TEST LAB

Quality Thermistor is ISO9001:2000 and AS9100 certified and can perform testing and screening to the following specifications:

- MIL-PRF 23648/1, /9, /19, and /20
- MIL-PRF-32192/1,/2,/3,/4, and /5
- MIL-STD-202
- MIL-STD-883
- NASA GSFC S311-P827
- Customer source control drawings
- Passive component screening
- Class K & H Element Evaluation
- MIL-PRF-19500 Testing/Screening

SERVICES

- Sensor Integration for Temperature Compensation, Control and Monitoring
- Qualified test lab
- Custom Electronic Solutions
- Design for Manufacturer and Assembly
- Rapid Prototyping and Developing
- Mirrored manufacturing facilities
- Live engineering support and online engineering chat



QTI maintains one of the largest Qualified Products Listing (QPL) thermistor product lines of any component supplier, and maintains a strong in-house test lab competence to test and screen components to all Group A, B and Group C screening in order to deliver lot qualified components for the most demanding thermal applications.

In addition to QPL parts, QTI also builds and delivers lot qualified parts to customer Specification Control, or Source Control Draw-

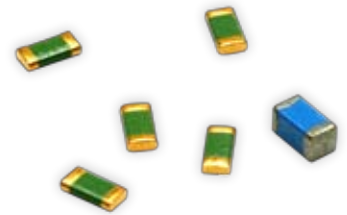
ings (SCD). Contact QTI for assistance in creating an SCD to specify the electrical performance characteristics and physical configuration of your temperature sensor element, or temperature sensor assembly.

QTI's Quality Conformance Inspection (QCI) lab has the capability to test and screen thermistor components and temperature sensor assemblies to any of the following:

LOT QUALIFICATION TESTING:

MIL-PRF-23648 and MIL-PRF-32192 Groups A and B

- Visual and mechanical inspection
- Solderability
- Insulation Resistance
- High Temperature Storage
- Zero Power Resistance
- Resistance to Solvents
- Dielectric Withstanding Voltage
- Resistance Ratio characteristics
- Short Time Overload
- Low Temperature Storage



MIL-PRF-23648 and MIL-PRF-32192 Group C

- Dissipation Constant
- R/T Characteristic
- Moisture Resistance
- Vibration, High Frequency
- Thermal Time Constant
- Thermal Shock
- Loaded Life
- Shock, Specified Pulse
- Terminal Strength
- Resistance to Soldering Heat
- High Temperature Exposure
- Immersion

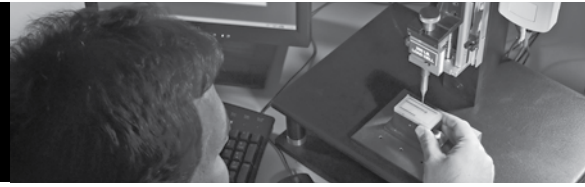
SPACE LEVEL LOT QUALIFICATION TESTING:

NASA Goddard Space Flight Center S311-P827

- Visual Inspection
- Lot serialization
- High Temperature storage
- Immersion
- Low Temperature Storage
- Solder mounting integrity
- Load Life
- Shock, Specified Pulse
- Mechanical Inspection
- Zero-Power resistance
- Resistance/Temp. characteristics
- Solderability
- Dissipation Constant
- Resistance to soldering heat
- High Temperature Exposure
- Thermal Outgassing
- Preconditioning
- Thermal Shock
- PDA
- Short Time Overload
- Thermal Time Constant
- Moisture resistance
- Vibration, High Frequency

QTI is a Small Business, and maintains current registration in the Central Contractor Registry (CCR). QTI's CAGE Code is 56866 and DUNS number is 08284-1925

QUALITY THERMISTOR, INC. QCI LABORATORY SERVICES



QTI maintains a Quality Conformance Inspection (QCI) Laboratory for the MIL or Space Level lot qualification of passive components. Thermistors, resistors, capacitors and Inductors can all be lot qualified through the appropriate level of testing and screening to meet the stringent quality requirements of the Defense and Aerospace electronics markets.

In 1977, QTI started testing the thermistors it manufactured for the MIL-PRF-23648 Defense Supply Center Performance Specification. Since 1977,

QTI has kept up with the market by manufacturing and testing surface mount thermistor components to MIL-PRF-32192 as well as a recently released NASA Goddard Space Flight Center S-311-P-827 specification.

For other passive component types, QTI can also lot qualify, test and screen components for highreliability applications. MIL-PRF-38534 Element Evaluation to Class K or H can be performed or any or all of the applicable lot qualification testing detailed below:

QUALIFICATION TESTING - RESISTORS:

- Visual and Mechanical Inspection
- Materials, dimensions marking and workmanship
- Dielectric Withstanding Voltage
- DC Resistance
- Low temperature and high temperature exposure
- Low Temperature storage and operation
- Thermal Shock
- Load Life
- Moisture Resistance
- Resistance to Soldering Heat
- Insulation Resistance
- Shock and Vibration
- Power rating
- Terminal Strength
- Solderability
- Resistance to Solvents

Fixed and variable resistors, wire wound and film resistors, resistor networks can all be subjected to any and all qualification testing detailed. high stability, high voltage and precision resistors in chip, SMD and leaded package styles can all be accommodated.

QUALIFICATION TESTING - CAPACITORS:

- Thermal Shock and voltage conditioning
- Partial Discharge (Corona)
- Radiographic Inspection
- Visual, Mechanical for materials, interface requirements and workmanship
- Physical dimensions, marking legibility and resistance to solvents
- Capacitance
- Dissipation Factor
- Dielectric Withstanding Voltage
- Insulation Resistance
- High and Low Temperature Storage
- Solderability
- Voltage/Temperature limits
- Shock and Vibration
- Immersion
- Terminal Strength
- Resistance to Soldering Heat
- Moisture Resistance
- Life (at elevated ambient)
- Partial Discharge - extended life, as well as elevated ambient temperature

Fixed and variable capacitors; with paper, plastic, glass mica and ceramic dielectrics can be lot qualified with any or all of the above qualification testing conditions. Electrolytic capacitors with aluminum or tantalum plates can also be screened and lot qualified to meet the applications quality level. For any specialized capacitors, such as supercapacitors, contact QTI directly to design the appropriate conformance inspection routine.

QUALIFICATION TESTING - INDUCTORS:

- Visual and Mechanical Inspection
- Solderability
- Resistance to solvents
- Resistance to soldering heat
- Terminal Strength
- Dielectric Withstanding Voltage
- Induced Voltage
- Insulation Resistance
- Electrical Characteristics
- Temperature Rise
- Corona Discharge
- Shock and Vibration
- Thermal Shock
- Immersion and Moisture Resistance
- Overload and Life
- Burn-In
- Radiographic Inspection
- Rated Load
- Other applicable electrical characteristics (contact QTI for details)

Types of inductors which could be tested would be air Core, radio frequency and ferromagnetic core inductors in laminated core, or ferrite core construction as well as variable inductors all can be lot qualified with the necessary level of conformance inspection. Contact QTI to design the right lot qualification inspection routine for your passive component application.

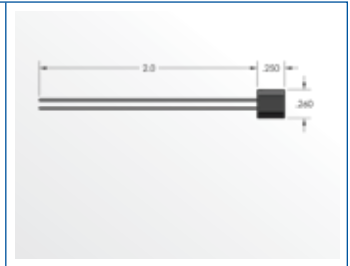


NTC MILITARY AND SPACE LEVEL THERMISTOR ELEMENTS

RTH06 MIL-PRF-23648/1



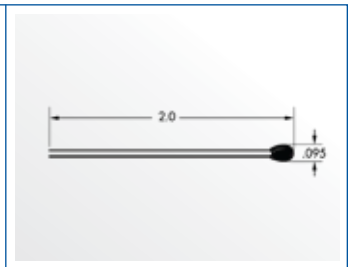
- Resistance values from 68 ohms to 75k ohms
- Typical dissipation Constant = 5mW/°C in still air
- Thermal time constant in still air or = 80 seconds max
- Temp Range: -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Power rating: 0.5 watts @25°C max
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



RTH44 MIL-PRF-23648/20



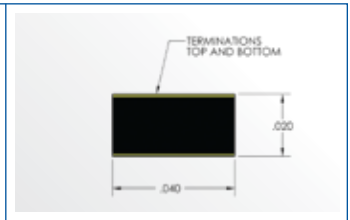
- Resistance values from 300 ohms to 500k ohms
- Operating temp range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Typical dissipation Constant = 2mW/°C in still air
- Tolerance: 1, 2, 5, 10%
- Power rating: 0.2 watts @25°C max
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



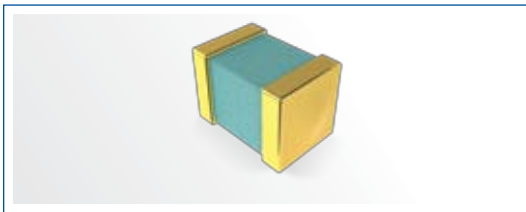
M32192/3 NTC THERMISTOR DIE



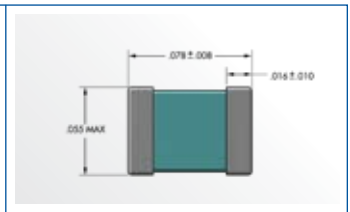
- Resistance values from 15 ohms to 20 Mohms
- Typical dissipation Constant = .625mW/°C in still air
- Thermal time constant in still air = 10 seconds max
- Power rating: 0.0625W, derate to 0 at 125
- Available with a variety of termination finishes
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



M32192/4 NTC EIA 0805 PACKAGE



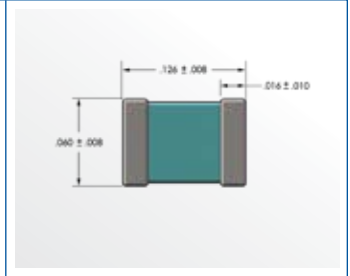
- Typical dissipation Constant = 2mW/°C in still air
- Thermal time constant in still air = 8 seconds max
- Power rating: 0.125 watts @25°C max
- Available with a variety of termination finishes
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



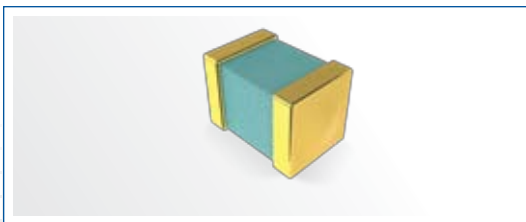
M32192/5 NTC EIA 1206 PACKAGE



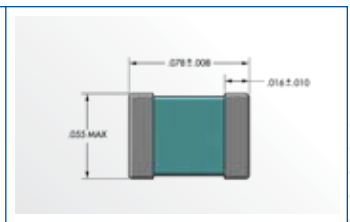
- M32192/5 NTC EIA 1206 PACKAGE
- Thermal Time Constant: 8 seconds max in still air
- *Dissipation Constant: 2 mW/°C min in still air
- *Power Rating: 0.25 W at 25°C, derate to 0 W at 125°C
- Resistance @25°C: 470 ohm to 10 Mohm
- Operating temperature range: -55°C to 125°C
- Storage temperature range: -65°C to 150°C
- *Thermal Time Constant and Dissipation Constant may vary depending on mounting



SPACE LEVEL NASA GSFC S-311-P-827/01, 02, 03 & 04



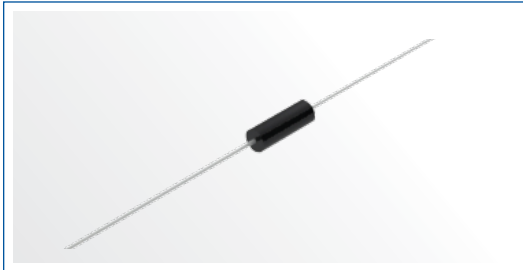
- Available in 50k and 100k ohms
- Interchangeable tolerances to +/- 0.5°C (0-70°C)
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Available with Sn/Pb or Gold termination
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



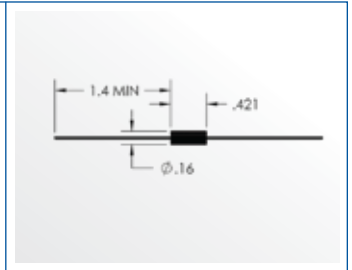
PTC MILITARY THERMISTOR ELEMENTS



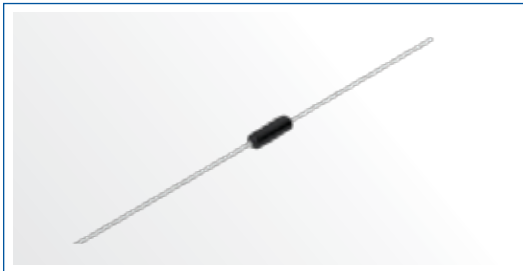
RTH22 MIL-PRF-23648/9



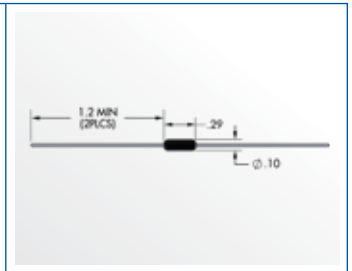
- Positive Temperature Coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Operating temp range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Tolerance: 5, 10%
- Power rating: 0.5 watts @25°C
- Thermal time constant in still air = 60 seconds max
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



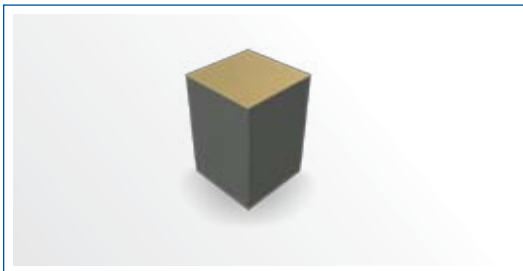
RTH42 MIL-PRF-23648/19



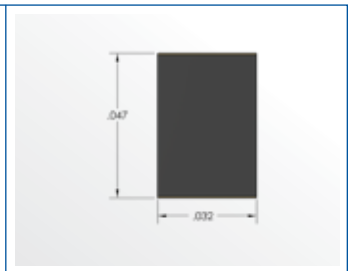
- Positive Temperature Coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Operating temp range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Tolerance: 5, 10%
- Power rating: 0.250 watts @25°C
- Thermal time constant in still air = 60 seconds max
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



M32192/1 PTC THERMISTOR DIE



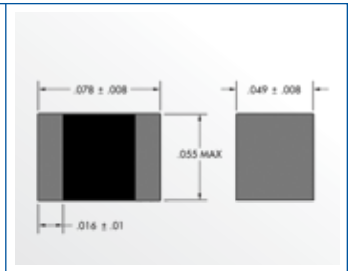
- Positive Temperature Coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Typical dissipation Constant = 1.25mW/°C in still air
- Thermal time constant in still air = 30 seconds max
- Power rating: 0.125W, derate to 0 at 125
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



M32192/2 PTC EIA 0805 PACKAGE



- Positive Temperature Coefficient: 0.7%/°C
- Typical dissipation Constant = 2.5mW/°C in still air
- Thermal time constant in still air = 30 seconds max
- Power rating: 0.250 watts @25°C max
- Available with a variety of termination finishes
- Complete specifications can be obtained by contacting DSCC (Defense Supply Center, Columbus)



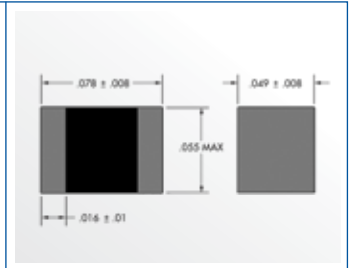


PTC SPACE LEVEL THERMISTOR ELEMENTS

SPACE LEVEL NASA GSFC S-311-P-827/31, 32



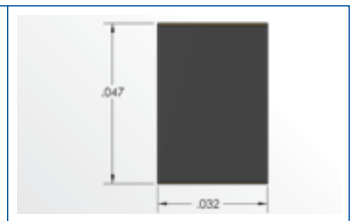
- Resistance values from 150 ohms to 2k ohms
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Available with Sn/Pb or Gold termination
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



SPACE LEVEL NASA GSFC S-311-P-827/33,34



- Resistance values from 75 ohms to 1.5k ohms
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



DESIGN ENGINEERS for high-reliability military and aerospace markets are faced with challenges when given the assignment of redesigning legacy applications which have a high count of radial and axial leaded passive components, or generating a new design which needs to incorporate a high percentage of surface mount passive components. Quality Thermistor's high reliability surface mount thermistors are manufactured to meet or exceed the MIL-PRF-32192 military specification, as well as the newly introduced NASA-GSFC S-311-P-827 specifications.

The Defense Supply Center Columbus (DSCC) introduced a new surface mount thermistor specification in November of 2006. MIL-PRF-32192 now gives the design Engineer fully qualified DSCC options for two PTC and three NTC surface mount package styles.

MIL-PRF-32192/1

Bare PTC thermistor die available in resistance values from 10 ohms to 10,000 ohms. This specification should be considered in new designs and for legacy designs which used either MIL-PRF-23648/9 or MIL-PRF-23648/19.

MIL-PRF-32192/2

Basic EIA 0805 PTC surface mount package available in resistance values from 22 ohms to 5,600 ohms. This specification should be considered for new designs as well as an alternative to MIL-PRF-23648/9 and MIL-PRF-23648/19.

MIL-PRF-32192/3

Bare NTC thermistor die available in resistance values from 15 ohms to 20 Mohms. This is ideal for new board designs which contain other bare die, wire bondable components could easily integrate this part style. This specification should be considered for legacy replacements which use either MIL-PRF-23648/1 or MIL-PRF-23648/20.

MIL-PRF-32192/4

Basic EIA 0805 NTC surface mount package. Any new high reliability application PCB design can take advantage of this part style. This specification should be considered for new designs as well as an alternative to MIL-PRF-23648/1 and MIL-PRF-23648/20.

MIL-PRF-32192/5

Basic EIA 1206 NTC surface mount package. Any new high reliability application PCB design can take advantage of this part style. This specification should be considered for new designs as well as an alternative to MIL-PRF-23648/1 and MIL-PRF-23648/20.

GSFC approved thermistor specification

S-311-P-827 gives the Aerospace engineers a cost-effective option and more.

As the Aerospace market continues to thrive and grow, the push for smaller, lighter, more accurate and reliable parts intensifies. While the new DSCC MIL-PRF-32192 Specification is sufficient for Defense/Military requirements, the Aerospace community requires additional screening to qualify parts for flight.

Many customers have chosen to create their own SCD's that incorporate all or part of the M32192 specification but also added additional 100% screening requirements. This escalates customer costs internally and increases the unit cost due to a lack of standardization.

To meet the demands of our Aerospace customers and help "standardize" the aerospace test regimen, Quality Thermistor engineers worked jointly with engineers at NASA/GSFC to create a GSFC approved SMD thermistor specification. This new specification, S-311-P-827, incorporates PTC thermistors (both EIA 0805 and hybrid 0303 die) and NTC thermistors (EIA 0805). All devices procured to this specification will meet the requirements for Level I classification per EEE-INST-002.

There are two NTC thermistors currently listed in the specification. These parts are available in "interchangeable" tolerances of either $\pm 0.5C$ or $\pm 1.0C$ over the range of 0C to 70C. The PTC thermistors are all available in 1% or 2% tolerances at the reference temperature of 25°C.

For more information, contact the engineering staff at Quality Thermistor, or see the link below for the complete specification on the NASA NEPP website: nepp.nasa.gov.

QTI HIGH TEMPERATURE PLATINUM SENSORS



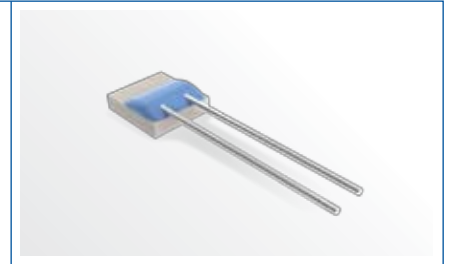
RTDHT – Radial Leaded Platinum Sensors for HIGH TEMPERATURES

- SPECIFICATIONS: Resistance = 100Ω
- TEMP. RANGE: -70 to 500°C continuous
- ACCURACY: IEC 60751 Class B
- STANDARD LOT QUALIFICATION TESTING: Group A and B
- MIL-PRF-23648 and MIL-PRF-32192 Group C
- SPACE LEVEL LOT QUALIFICATION TESTING: NASA Goddard Space Flight Center S311-P827



QTRTD– Radial Leaded Platinum Sensors for CRYO TEMPERATURES

- SPECIFICATIONS: Resistance = 100Ω at 0° C | Resistance = $1,000\Omega$ at 0° C
- TEMP. RANGE: -196 to 150°C
- ACCURACY: IEC 60751 Class B
- STANDARD LOT QUALIFICATION TESTING: MIL-PRF-23648 Group A and B
- FULL LOT QUALIFICATION TESTING: (In addition to standard Lot Qualification) MIL-PRF-23648 Group A and B
- SPACE LEVEL LOT QUALIFICATION TESTING: NASA Goddard Space Flight Center S311-P827



QTRTD– Series 0603 Surface Mount Platinum RTD

- SPECIFICATIONS: Resistance = $1,000\Omega$ at 0° C
- TEMP. RANGE: -50 to 130°C Continuous
- ACCURACY: IEC 60751 Class B
- STANDARD LOT QUALIFICATION TESTING: MIL-PRF-23648 Group A and B
- FULL LOT QUALIFICATION TESTING: (In addition to standard Lot Qualification) MIL-PRF-23648 Group A and B
- SPACE LEVEL LOT QUALIFICATION TESTING: NASA Goddard Space Flight Center S311-P827



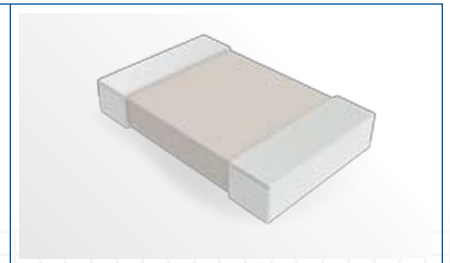
QTRTD– Series 0805 Surface Mount Platinum RTD

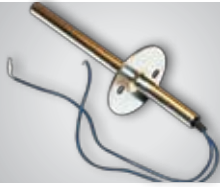
- SPECIFICATIONS: Resistance = 100Ω at 0° C | Resistance = $1,000\Omega$ at 0° C
- TEMP. RANGE: -50 to 130°C Continuous
- ACCURACY: IEC 60751 Class B
- STANDARD LOT QUALIFICATION TESTING: MIL-PRF-23648 Group A and B
- FULL LOT QUALIFICATION TESTING: (In addition to standard Lot Qualification) MIL-PRF-23648 Group A and B
- SPACE LEVEL LOT QUALIFICATION TESTING: NASA Goddard Space Flight Center S311-P827



QTRTD– Series 1206 Surface Mount Platinum RTD

- SPECIFICATIONS: Resistance = 100Ω at 0° C | Resistance = $1,000\Omega$ at 0° C
- TEMP. RANGE: -50 to 130°C Continuous
- ACCURACY: IEC 60751 Class B
- STANDARD LOT QUALIFICATION TESTING: MIL-PRF-23648 Group A and B
- FULL LOT QUALIFICATION TESTING: (In addition to standard Lot Qualification) MIL-PRF-23648 Group A and B
- SPACE LEVEL LOT QUALIFICATION TESTING: NASA Goddard Space Flight Center S311-P827





MTBF CALCULATIONS FOR QTI NTC THERMISTORS

GOAL

Evaluate QTI thermistor reliability and accurately determine a mean time between failures (MTBF) for use in commercial and/or industrial equipment life calculations.

BACKGROUND

Thermistors are extremely accurate and robust temperature sensing elements that are ideal for temperature measurement over the range of -55C to +150C. They are very repeatable, customizable, and when properly designed can provide excellent resolution. Thermistors are composed of a sintered metal-oxide semiconductor with two leads attached; typically by soldering. Thermistors are often then coated with an epoxy or similar protective coating for added protection and dielectric strength.

The one potential problem with thermistors is the lack of stability and resulting long-term reliability. As thermistors are exposed to higher temperatures, they become less stable and the resistance values tend to drift from the calibrated value. Since there is no published "standard" performance specification like there are with RTD's (IEC 60751), stability and reliability have been left up to each individual manufacturer to specify.

Many customers require reliability data (MTBF) to accurately calculate the overall life of their end-product. The MTBF number is established as a result of the calculated failures in time (FIT). A FIT is defined as the number of devices that will fail in a given time (hours). For Thermistors, a failure in time is defined as failures over 1 million



hours. Using equations from MIL-HDBK-217, one can determine a FIT value that will show that most components will outlast human life.

APPROACH

Using MIL-HDBK-217F as a general reference for FIT / MTBF, the various factors that make up the overall FIT number will be addressed. By entering the performance factors specific to a given application we can determine the applicable MTBF.

DATA

From MIL-HDBK-217F:

Where the number of failures in time = $\lambda_p = \lambda_b \pi_T \pi_P \pi_S \pi_Q \pi_E$

- $\lambda_b = 0.0019$ (fixed value from MIL-SPEC MIL-HDBK-217F 9.1)
- π_T = Temperature Factor (80 °C = 3.4, 125 °C = 7.1) = 1 Section 9.1
- π_P = Power Factor ([power dissipation] 0.39 0.25 W: 0.58; 0.1 W: 0.44)
- π_S = Power Stress Factor (0.71e1.1(S) where S = Actual Power Dissipation / Rated Power; 100%: 1, 90%: .9) = 1 Section 9.1
- π_Q = Quality Factor (Consumer part = 10, Military = 1, Unknown = 3)
- π_E = Environmental Factor (Mounted environment)

HANDLING & SOLDERING METHODS FOR QTI SMD THERMISTORS



APPLICATION NOTE:

HANDLING

The electronic ceramics and dielectrics utilized in QTI SMD's make them inherently fragile. SMD thermistors should be handled with appropriate tools, especially designed for this purpose. When removing devices from waffle pack packaging, use non metallic tweezers and due care to avoid damage. Ensure automated equipment does not place stresses on the component. While robust, the termination finish consists of a soft solderable or gold outer layer. This may become marred or damaged by excessive force or handling.

GENERAL

NTC (Negative Temperature Coefficient) thermistors, which are typically composed of metal oxides, are manufactured to take on the form of disks, rods, chips and other shapes. A more common shape, the SMD (surface mount device), is widely used in standard reflow soldering processes. The different values and tolerances offered by the industry allow many renditions of package sizes within the dimensional constraints of an EIA standard. Although the SMD EIA standard specifies a maximum component height, in most cases a minimum is not, allowing the manufacturer greater flexibility in offering different values within an NTC. PTC (Positive Temperature Coefficient) devices, typically consisting of an encapsulated silicon sensing element, have specialized construction methods and materials which requires consideration during circuit design and assembly stage. This bulletin will focus on the methods and materials recommended for component attachment either through hand soldering for prototype construction or reflow/wave soldering operations for normal production.

REFLOW SOLDERING

QTI SMD thermistors perform well in reflow soldering operations using standard low temp eutectic solders such as SN63 (see note). The gradual increase of temperature allows the component body temp to rise gradually resulting in proper solder junctions and reducing any stresses that may occur. Thermistors which contain a tin/lead plate on the terminations outperform those that do not in solderability requirements, however care must be taken to ensure proper solder paste dispensing, especially if a "low profile" component is used, to reduce any tensile stresses on the component.

HAND SOLDERING

Due to the nature of their materials and construction, NTC thermistors can be very brittle, requiring delicate handling, especially during hand soldering operations. Their composition makes them very prone to tensile stress anomalies while remaining relatively strong in compression. During a reflow soldering operation, the component body temp is allowed to rise gradually prior to solder reflow, however in a hand solder operation, there is typically no preheat and the component is subjected to a thermal shock which may result in a fractured component. If hand soldering is necessary, a greater than 150C temperature difference between the thermistor and the soldering iron is not recommended prior to solder iron contact. A pre-heat of the component should diminish any possibility of thermal shock occurring. Although typically more mechanically robust, the internal construction methods utilized in PTC devices makes them unsuitable for hand soldering. If hand soldering for prototype purposes is required, ensure proper component preheat and low temp solder (max 230 C) is used.

DESIGN/PROTOTYPE CONSIDERATIONS

- QTI SMD's are not suitable for mounting on flexible substrates or in configurations that may place loads on the body. Improper CTE matches or board flexing will result in failure of the device.
- Exposure to soldering heat induces an irreversible shift in the device base resistance, therefore rework is not recommended. This magnitude of this shift is dependent on the device, contact QTI sales for more information.
- QTI PTC surface mount devices are not suitable for high temp (>230 C) soldering

CONCLUSIONS

QTI SMD thermistors are designed to accommodate most standard reflow soldering operations using standard low temp eutectic solders such as SN63. Care should be taken in selecting a thermistor that is right for the application. High temp solders are generally not recommended, especially for hand soldering operations. If the application requires the use of a high temp solder, a pre-heat of the component should be instituted to reduce any effects of thermal shock.

NOTE: Eutectic solder Sn63 has a melting point of approx. 183C and typical reflow profiles will peak at 220C-240C for 40-75 seconds depending on the application.

Jay Kochaver, Director of Technology

R/T CHARACTERISTICS FOR MIL-PRF-23648, MIL-PRF-32192 AND S-311-P-827 NTC THERMISTORS

Reference R/T Characteristics for MIL-PRF-23648, MIL-PRF-32192 and S-311-P-827 NTC Thermistors

To determine the resistance at particular temperature, multiply the 25°C base resistance value by the multiplier in the table below. For example; a 10,000 ohm at 25°C, MIL Ratio B part would measure 36,430 ohm at 0°C (10,000 x 3.643 = 36,430):

Temp °C	Ratio A	Ratio B	Ratio C	Ratio D	Ratio H	Ratio L	Ratio M	Ratio N	Ratio R	Ratio X
25/125 Ratio	19.8	29.4	48.7	7.1	13.0	16.1	23.3	38.5	62.5	142.9
-55	54.78000	96.40000	130.6000	11.5100	31.900	36.60000	60.78000	117.50000	159.0000	479.0000
-50	40.0600	67.06000	90.0600	9.5500	24.300	27.50000	44.13000	81.32000	110.1000	307.0000
-45	29.53146	47.08421	62.4862	7.9702	18.608	20.90389	32.31143	56.69045	77.3916	196.7041
-40	22.05000	33.66000	44.0300	6.6900	14.400	16.10000	23.98000	40.16000	55.5000	128.0000
-35	16.59240	24.28525	31.2370	5.6370	11.275	12.46138	17.93125	28.66344	39.7669	83.1606
-30	12.58000	17.70000	22.3500	4.7700	8.930	9.70000	13.52000	20.64000	28.4000	54.0000
-25	9.61546	13.03128	16.1407	4.0569	7.115	7.61934	10.27869	14.99955	20.3471	35.2012
-20	7.42200	9.71200	1.8000	3.4700	5.690	6.05000	7.89100	11.03000	14.6500	23.3800
-15	5.77700	7.29800	8.6910	2.9800	4.560	0.84000	6.10200	8.17500	10.5100	15.8400
-10	4.52700	5.53400	6.4530	2.5600	3.680	3.89000	4.75400	6.11900	7.6090	10.8500
-5	3.58000	4.23400	4.8300	2.2200	2.990	3.15000	3.73100	4.61500	5.5580	7.5080
0	2.84800	3.26600	3.6430	1.9300	2.450	2.57000	2.94900	3.51000	4.0940	5.2460
5	0.28200	2.54000	2.7740	1.6780	2.020	2.10000	2.34600	2.69000	3.0410	3.7000
10	1.83800	1.99000	2.1280	1.4700	1.680	1.73000	1.87900	2.07800	2.2770	2.6330
15	1.49200	1.57100	1.6440	1.2900	1.420	1.43000	1.51300	1.61700	1.7180	1.8910
20	1.21800	1.24900	1.2780	1.1300	1.180	1.19000	1.22600	1.26700	1.3060	1.3690
25	1.00000	1.00000	1.0000	1.0000	1.000	1.00000	1.00000	1.00000	1.0000	1.0000
30	0.82610	0.80580	0.7870	0.8845	0.854	0.84100	0.81940	0.79420	0.7709	0.7358
35	0.68620	0.65320	0.6234	0.7847	0.732	0.71100	0.67520	0.63480	0.5983	0.5455
40	0.57270	0.53260	0.4968	0.6983	0.628	0.60400	0.55920	0.51050	0.4674	0.4073
45	0.48040	0.43680	0.3983	0.6232	0.537	0.51500	0.46550	0.41290	0.3647	0.3065
50	0.40450	0.36020	0.3210	0.5578	0.464	0.44200	0.38930	0.33590	0.2905	0.2317
55	0.34270	0.29860	0.2602	0.5000	0.403	0.38000	0.32700	0.27480	0.2311	0.1764
60	0.29140	0.24880	0.2120	0.4505	0.350	0.32800	0.27600	0.22950	0.1848	0.1358
65	0.24900	0.20820	0.1734	0.4064	0.305	0.28500	0.23390	0.18670	0.1487	0.1049
70	0.21370	0.17510	0.1426	0.3675	0.267	0.24800	0.19900	0.15500	0.1202	0.0813
75	0.18410	0.14800	0.1179	0.3332	0.236	0.21600	0.17000	0.12930	0.0977	0.0635
80	0.15920	0.12560	0.0978	0.3027	0.208	0.18900	0.14580	0.10840	0.0798	0.0498
85	0.13820	0.10710	0.0814	0.2757	0.183	0.16700	0.12550	0.09120	0.0655	0.0393
90	0.12040	0.09164	0.0681	0.2516	0.163	0.14700	0.10840	0.07710	0.0540	0.0313
95	0.10530	0.07874	0.0572	0.2301	0.145	0.13000	0.09393	0.06540	0.0447	0.0250
100	0.09230	0.06792	0.0482	0.2109	0.130	0.11500	0.08168	0.05570	0.0372	0.0200
105	0.08130	0.05880	0.0408		0.117	0.10173	0.07126	0.04760	0.0312	0.0161
110	0.07180	0.05108	0.0347		0.105	0.08996	0.06235	0.04080	0.0262	0.0130
115	0.06360	0.04452	0.0296		0.094	0.07949	0.05473	0.03510	0.0220	0.0106
120	0.05650	0.03894	0.0253		0.085	0.07076	0.04818	0.03030	0.0186	0.0087
125	0.05040	0.03416	0.0217		0.077	0.06183	0.04253	0.02630	0.0158	0.0071

Reference R/T Characteristics for MIL-PRF-23648, MIL-PRF-32192 and S-311-P-827 PTC Thermistors

Temp °C	10 to 75 ohms	82 to 160 ohms	180 to 510 ohms	560 to 1,800 ohms	1,800 to 6,200 ohms	6,800 to 10,000 ohms
25/125 Ratio	.53 - .55	.53 - .55	.53 - .55	.53 - .55	.53 - .55	.53 - .55
-55	.615	.582	.56	.55	.515	.51
-15	.79	.77	.755	.74	.73	.73
0	.863	.847	.838	.835	.825	.825
25	1	1	1	1	1	1
50	1.16	1.17	1.18	1.2	1.23	1.19
75	1.35	1.37	1.4	1.42	1.45	1.4
100	1.545	1.584	1.623	1.656	1.67	1.61
125	1.75	1.8	1.86	1.92	1.96	1.83

- Numbers above are for reference only. Consult the specific performance specification for actual r/t multipliers by part style; MIL-PRF-23648/9 and /19, MIL-PRF-32192/1 and /2, and S-311-P-827-31, -32, -33 and -34.



QUALITY THERMISTOR, INC.
2108 CENTURY WAY
BOISE, ID 83709

WWW.THERMISTOR.COM

800-554-4784 U.S.
208-377-3373 WORLDWIDE
208-376-4754 FAX
qtisales@thermistor.com