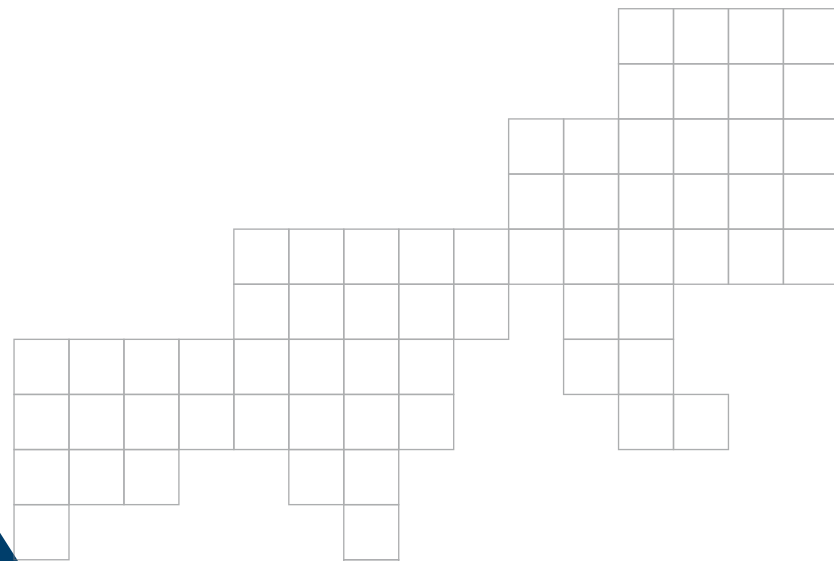




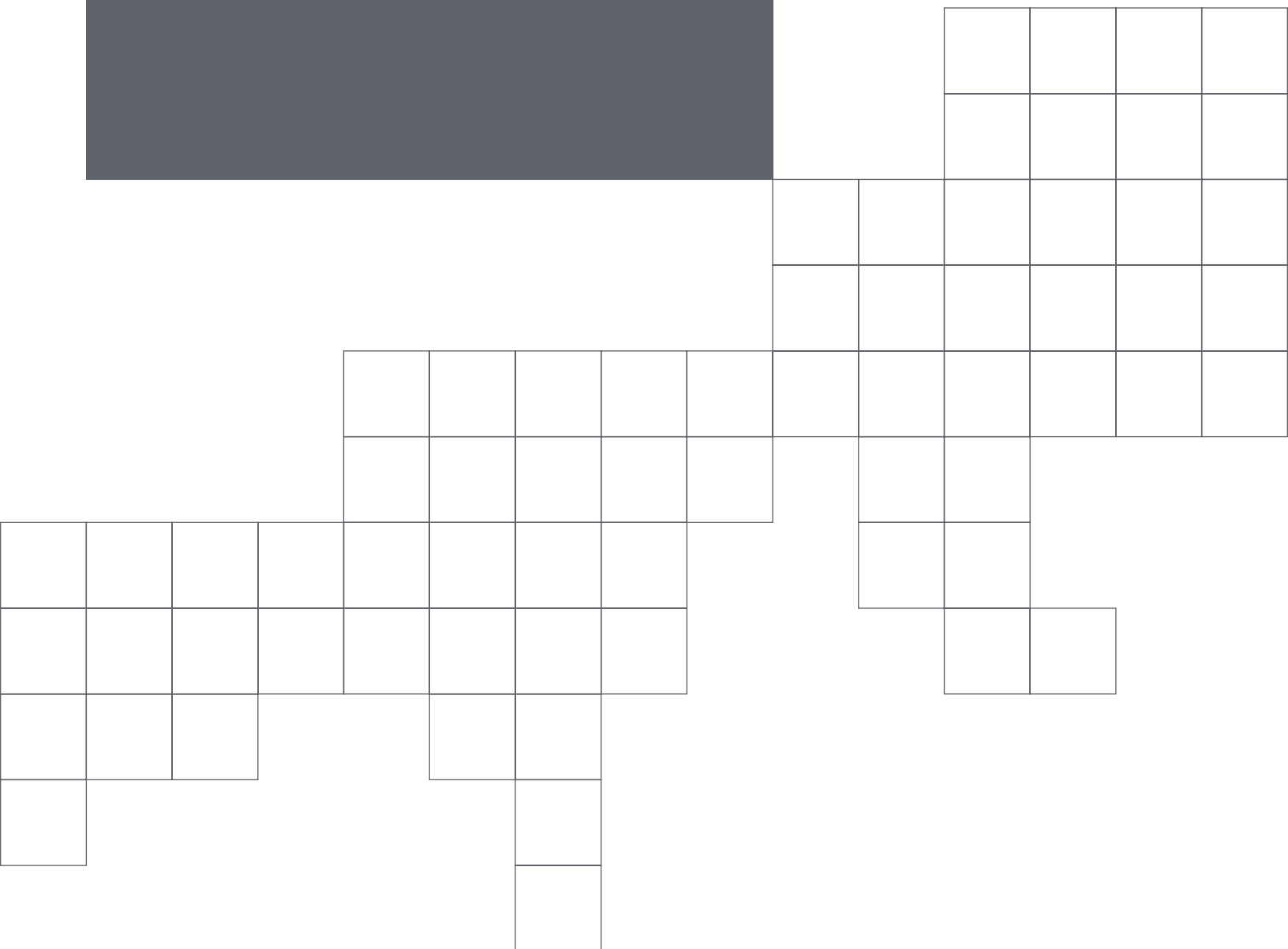
Aerospace and Defense Guide

Temperature Sensing Product Line



Contents

- 3. | About CTS Temperature Solutions
- 4. | High Temp Platinum Sensors
- 5. | High-REL NTC Thermistors
- 6. | High-TREL PTC Thermistors
- 7. | Value Added Capabilities
- 8. | Resistance/Temperature Chart
- 9. | Contact Information





About CTS Temperature Solutions

Our three locations allow us increased manufacturing capacity and greater control over the quality of our parts, from thermistor fabrication through finished probe assembly. We also maintain a full thermistor test lab capable of performing a variety of stress and accelerated life testing for thermistors used in defense and aerospace applications.

Why CTS Temperature Solutions?

CTS designs and manufactures the thermistors used in our probes, so we are assured that customers receive the most stable, accurate and reliable sensors available.

Test for 100% accuracy

All of the temperature probes manufactured by CTS are 100% inspected for accuracy in temperature-controlled baths to ensure proper electrical and curve-fit tolerances. Calibration data is available as an option on all of the probes we manufacture.

About the details

Our proprietary manufacturing processes and the materials used in manufacturing ensure proper sensor placement to optimize thermal time response and minimize thermal load on the sensing element.

CTS Test Lab

CTS maintains an extensive test laboratory, designed with defense and aerospace customers in mind. This test lab is ISO 9001:2008 and AS9100 Revision B certified. We are qualified to perform all tests dictated by the Department of Defense, Defense Logistics Agency MIL-PRF-23648, and MIL-PRF-32192 specifications. In addition we have the facilities to perform many of the tests specified in MIL-STD-202, MIL-STD-883, NASA Goddard S-311-P-18 and S-311-P-827, EEE-INST-002, TOR-2006, ESA 4006, and MIL-PRF-38534 Class K and H Element Evaluation tests.

Testing services provided upon customer request:

- Power burn-in
- Temperature cycling
- Moisture testing
- Shock and vibration testing
- Temperature characterization
- Space-level screening
- QCI military testing
- Cryo-chamber conditioning
- Wafer evaluation
- Die shear
- Wire bonding/evaluation
- Bake out

Provide design assistance

While we trust that the information provided within this catalog will assist you, there is no substitute for candid one-to-one dialog. We encourage you to contact CTS to discuss specific design, sales or customer support needs.

Facts

DUNS Number: 08284-1925

Tax ID Number: 82-0332004

SIC Code: 3823

NAICS Code: 334513, 334416, 541380 FSC: 5905, 6685, 5961

Cage Code: 56866

Registrations

Small business

CCR Registered

SAM Registered

ITAR Registered

Certifications

ISO9001:2008 AS9100

UL

NSF

Testing Capabilities:

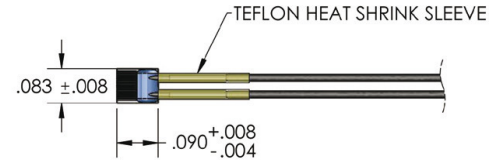
- Environmental: 150m Torr to 150 PSI
- -196°C to 1400°C
- Up to 100% relative humidity
- DC power: 0 to 6000 volts
- 0 to 100 amps
- Inspection: 0x to 100x optical
- Digital image capture
- Shock/vibration: 30g to 1500g, 75Hz to 2000Hz
- Wire bond pull: 0 to 1000 grams
- Die shear: 0g to 10 Kg
- Solderability: per all military specs
- Density: 0.001 to 61 g/cm³

High Temp Platinum Sensors

Radial Leaded Platinum Sensor For High Temperatures



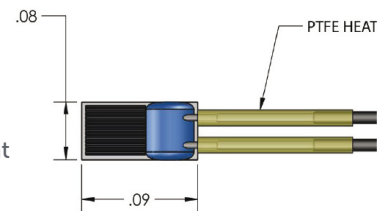
- Typical resistance values: 100, 500, 1000, 2000 ohms
- Operating temperature range: -70°C to 500°C
- Accuracy: IEC 60751 Class A, B
- Standard lot qualification testing: Groups A, B and C MIL-PRF-23648
- Additional qualification testing available: S-311-P-18, ESA 4006, TOR-2006, MIL PRF-38534 Class K and Class H Element Evaluation, EEE-INST-002



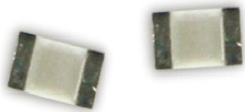
Radial Leaded Platinum Sensor For Cryo Temperatures



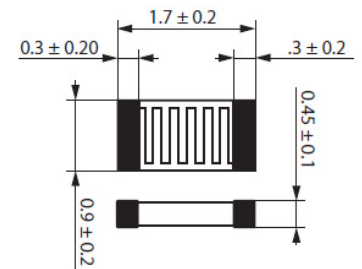
- Typical resistance values: 100 ohms and 1000 ohms at 0°C
- Operating temperature range: -196°C to 200°C
- Accuracy: IEC 60751 Class B
- Additional qualification testing available: S-311-P-18, ESA 4006, TOR-2006, MIL-PRF-38534 Class K and Class H Element Evaluation, EEE-INST-002



0603 Series Surface Mount Platinum RTD



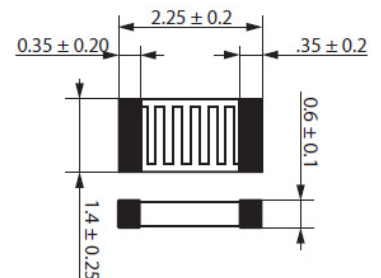
- Typical resistance value: 1000 ohms at 0°C
- Operating temperature range: -50°C to 130°C continuous
- Accuracy: IEC 60751 Class B
- Standard lot qualification testing: MIL-PRF-23648 Group A and B
- Space level lot qualification testing: NASA GSFC S-311-P-827
- Additional qualification testing available: S-311-P-18, ESA 4006, TOR-2006, MIL-PRF-38534 Class K and Class H Element Evaluation, EEE-INST-002



0805 Series Surface Mount Platinum RTD



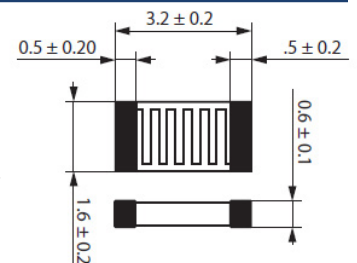
- Typical resistance values: 100 ohms and 1000 ohms at 0°C
- Operating temperature range: -50°C to 130°C
- Accuracy: IEC 60751 Class B
- Space level lot qualification testing: NASA GSFC S-311-P-827
- Additional qualification testing available: S-311-P-18, ESA 4006, TOR-2006, MIL-PRF-38534 Class K and Class H Element Evaluation, EEE-INST-002



1206 Series Surface Mount Platinum RTD



- Typical resistance values: 100 ohms and 1000 ohms at 0°C
- Operating temperature range: -50°C to 130°C
- Accuracy: IEC 60751 Class B
- Space level lot qualification testing: NASA GSFC S-311-P-827
- Additional qualification testing available: S-311-P-18, ESA 4006, TOR-2006, MIL-PRF-38534 Class K and Class H Element Evaluation, EEE-INST-002



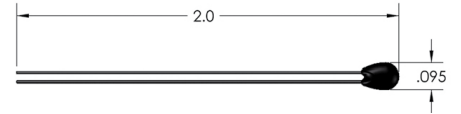


High-REL NTC Thermistors

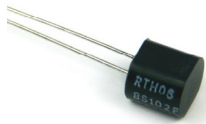
RTH44 MIL-PRF-23648/20



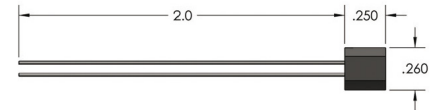
- Resistance values from 300 ohms to 500k ohms
- Operating temp range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Typical Dissipation Constant = 2mW/°C in still air
- Tolerance: 1%, 2%, 5%, 10%
- Power rating: 0.2 Watts at 25°C max



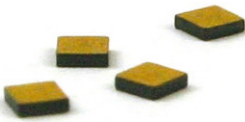
RTH06 MIL-PRF-23648/1



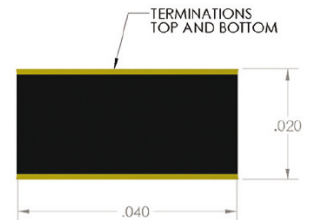
- Resistance values from 68 ohms to 75k ohms
- Typical Dissipation Constant = 5mW/°C in still air
- Thermal Time Constant in still air = 80 seconds max
- Temp Range: -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Power rating: 0.5 Watts at 25°C max



M32192/3 NTC Thermistor Die



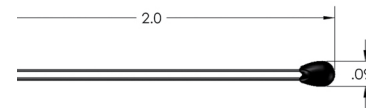
- Resistance values from 15 ohms to 20 M ohms
- Typical Dissipation Constant = 0.625mW/°C in still air
- Thermal Time Constant in still air = 10 seconds max
- Power rating: 0.0625W, derate to 0 at 125 °C
- Available with a variety of termination finishes



Space Level NASA GSFC S-311-P-18



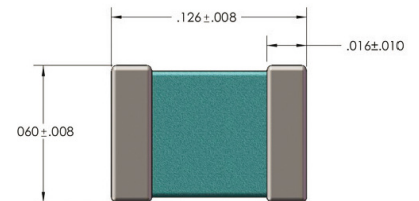
- Available in 50k or 100k ohms
- Interchangeable tolerances to +/- 0.5°C (0°C to 70°C)
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Available with Sn/Pb or gold termination
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



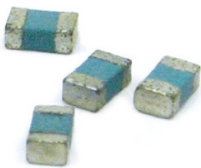
M32192/5 NTC EIA 1206 Package



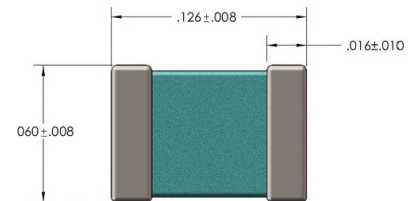
- Thermal Time Constant: 8 seconds max in still air
- Dissipation Constant: 2 mW/°C min in still air
- Power rating: 0.25 W at 25°C, derate to 0 W at 125°C
- Resistance at 25°C: 470 ohms to 10 M ohms
- Operating temperature range: -55°C to 125°C
- Storage temperature range: -65°C to 150°C



Space Level NASA GSFC S-311-P-827/01, 02, 03, 04



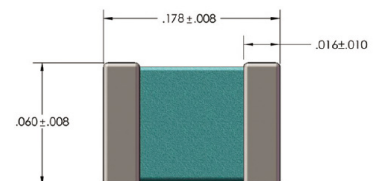
- Available in 50k or 100k ohms
- Interchangeable tolerances to +/- 0.5°C (0°C to 70°C)
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Available with Sn/Pb or gold termination
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



M32192/3 NTC Thermistor Die



- Typical Dissipation Constant = 2mW/°C in still air
- Thermal Time Constant in still air = 8 seconds max
- Power rating: 0.125 Watts at 25°C max
- Available with a variety of termination finishes

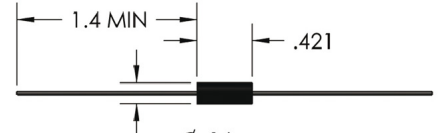


High-TREL PTC Thermistors

RTH44 MIL-PRF-23648/20



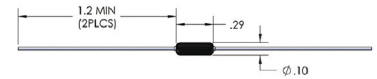
- Positive temperature coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Operating temperature range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Tolerance: 5%, 10%
- Power rating: 0.5 Watts at 25°C
- Thermal Time Constant in still air = 60 seconds max



RTH42 MIL-PRF-23648/19



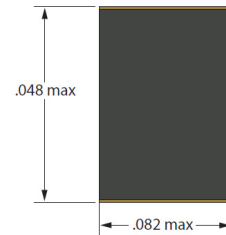
- Positive temperature coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Operating temp range -55°C to 125°C
- Meets or exceeds MIL-PRF 23648
- Tolerance: 5%, 10%
- Power rating: 0.250 Watts at 25°C
- Thermal Time Constant in still air = 60 seconds max



M32192/1 PTC THERMISTOR DIE



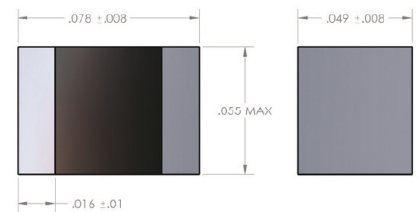
- Positive temperature coefficient: 0.7%/°C
- Resistance values from 10 ohms to 10k ohms
- Typical Dissipation Constant = 1.25mW/°C in still air
- Thermal Time Constant in still air = 30 seconds max
- Power rating: 0.125W, derate to 0 at 125°C



M32192/2 PTC EIA 0805 Package



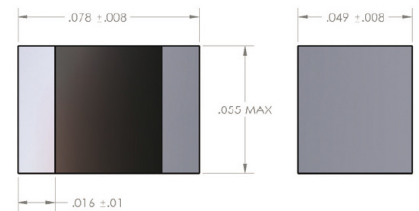
- Positive temperature coefficient: 0.7%/°C
- Typical Dissipation Constant = 2.5mW/°C in still air
- Thermal Time Constant in still air = 30 seconds max
- Power rating: 0.250 Watts at 25°C max
- Available with a variety of termination finishes



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



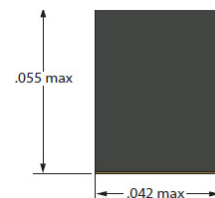
- Resistance values from 150 ohms to 2k ohms
- Acceptable for use in NASA space programs specifying quality level (Grade) 1 parts
- Available with Sn/Pb or gold termination
- Meets Level 1 classification per EEE-INST-002
- Single lot traceability



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

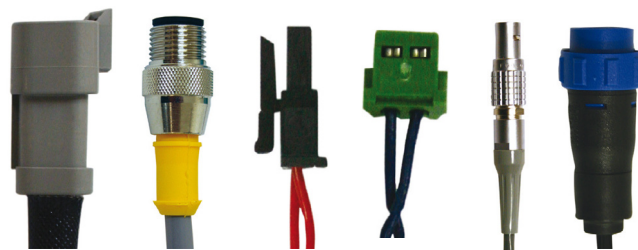




Value-Added Capabilities

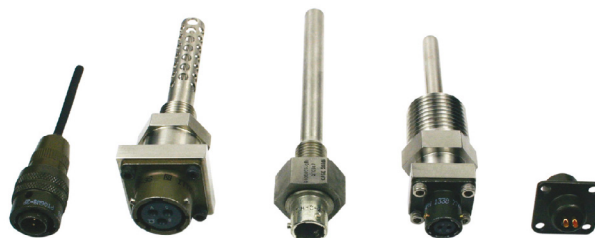
Customer Source Control Drawings

CTS Temperature Solutions will work with your Design Engineering staff to define the appropriate sensor element or sensor assembly for your high-reliability application. From Land Systems to Defense Electronics applications to satellite communications sensor assemblies, CTS has the experience to recommend and use the right materials, inspection methods, and lot qualification testing to provide a fully flight-qualified sensor element or assembly.



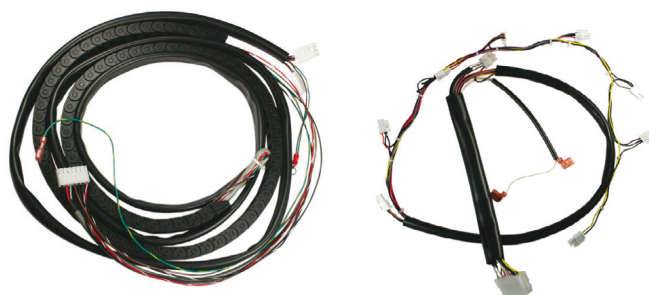
Passive Component Testing

CTS Temperature Solutions maintains a qualified test lab to perform passive component lot qualification testing. Let CTS run your next lot of resistors, thermistors, RTDs, capacitors, inductors, or other passive components through the appropriate MIL or NASA Goddard level lot qualification testing.



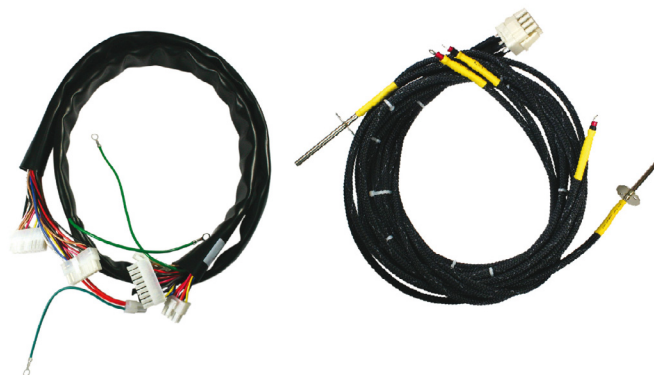
Complex Sensor Assemblies

Let CTS add any cable, connector, or wire harness needed to connect to your sensor element or assembly at the system level. Both commercial grade and MIL-DTL-38999 connectors can be designed and manufactured to be delivered to the end user as complete, tested assemblies. Save your program both time and money by sourcing your sensor and harness from a single approved source.



Cable And Wire Harness Assemblies

Have CTS build your next cable or wire harness assembly. With two assembly facilities totaling more than 30,000 square feet dedicated to harness and assembly work, CTS can design, build, test, and deliver high quality cable and wire harnesses to your specification. CTS has experience supplying cable and wire harness assemblies to medical and automotive markets, as well as to Defense Electronics customers.



Resistance/Temperature Chart

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 (OC)	Ratio A	Ratio B	Ratio C	Ratio D	Ratio H	Ratio L	Ratio M	Ratio N	Ratio R	Ratio X
Ratio 25/125	19.8	29.4	48.7	7.1	13	16.1	23.3	38.5	62.5	142.9
-55	54.78000	96.40000	130.60000	11.51000	31.90000	36.60000	60.78000	117.50000	159.00000	479.00000
-50	40.06000	67.06000	90.06000	9.55000	24.30000	27.50000	44.13000	81.32000	110.10000	307.00000
-45	29.53146	47.08421	62.48620	7.97020	18.60800	20.90389	32.31143	56.69045	77.39160	196.70410
-40	22.05000	33.66000	44.03000	6.69000	14.40000	16.10000	23.98000	40.16000	55.50000	128.00000
-35	16.59240	24.28525	31.23700	5.63700	11.27500	12.46138	17.93125	28.66344	39.76690	83.16060
-30	12.58000	17.70000	22.35000	4.77000	8.93000	9.70000	13.52000	20.64000	28.40000	54.00000
-25	9.61546	13.03128	16.14070	4.05690	7.11500	7.61934	10.27869	14.99955	20.34710	35.20120
-20	7.42200	9.71200	1.80000	3.47000	5.69000	6.05000	7.89100	11.03000	14.65000	23.38000
-15	5.77700	7.29800	8.69100	2.98000	4.56000	0.84000	6.10200	8.17500	10.51000	15.84000
-10	4.52700	5.53400	6.45300	2.56000	3.68000	3.89000	4.75400	6.11900	7.60900	10.85000
-5	3.58000	4.23400	4.83000	2.22000	2.99000	3.15000	3.73100	4.61500	5.55800	7.50800
0	2.84800	3.26600	3.64300	1.93000	2.45000	2.57000	2.94900	3.51000	4.09400	5.24600
5	0.28200	2.54000	2.77400	1.67800	2.02000	2.10000	2.34600	2.69000	3.04100	3.70000
10	1.83800	1.99000	2.12800	1.47000	1.68000	1.73000	1.87900	2.07800	2.27700	2.63300
15	1.49200	1.57100	1.64400	1.29000	1.42000	1.43000	1.51300	1.61700	1.71800	1.89100
20	1.21800	1.24900	1.27800	1.13000	1.18000	1.19000	1.22600	1.26700	1.30600	1.36900
25	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
30	0.82610	0.80580	0.78700	0.88450	0.85400	0.84100	0.81940	0.79420	0.77090	0.73580
35	0.68620	0.65320	0.62340	0.78470	0.73200	0.71100	0.67520	0.63480	0.59830	0.54550
40	0.57270	0.53260	0.49680	0.69830	0.62800	0.60400	0.55920	0.51050	0.46740	0.40730
45	0.48040	0.43680	0.39830	0.62320	0.53700	0.51500	0.46550	0.41290	0.36470	0.30650
50	0.40450	0.36020	0.32100	0.55780	0.46400	0.44200	0.38930	0.33590	0.29050	0.23170
55	0.34270	0.29860	0.26020	0.50000	0.40300	0.38000	0.32700	0.27480	0.23110	0.17640
60	0.29140	0.24880	0.21200	0.45050	0.35000	0.32800	0.27600	0.22950	0.18480	0.13580
65	0.24900	0.20820	0.17340	0.40640	0.30500	0.28500	0.23390	0.18670	0.14870	0.10490
70	0.21370	0.17510	0.14260	0.36750	0.26700	0.24800	0.19900	0.15500	0.12020	0.08130
75	0.18410	0.14800	0.11790	0.33320	0.23600	0.21600	0.17000	0.12930	0.09770	0.06350
80	0.15920	0.12560	0.09780	0.30270	0.20800	0.18900	0.14580	0.10840	0.07980	0.04980
85	0.13820	0.10710	0.08140	0.27570	0.18300	0.16700	0.12550	0.09120	0.06550	0.03930
90	0.12040	0.09164	0.06810	0.25160	0.16300	0.14700	0.10840	0.07710	0.05400	0.03130
95	0.10530	0.07874	0.05720	0.23010	0.14500	0.13000	0.09393	0.06540	0.04470	0.02500
100	0.09230	0.06792	0.04820	0.21090	0.13000	0.11500	0.08168	0.05570	0.03720	0.02000
105	0.08130	0.05880	0.04080		0.11700	0.10173	0.07126	0.04760	0.03120	0.01610
110	0.07180	0.05108	0.03470		0.10500	0.08996	0.06235	0.04080	0.02620	0.01300
115	0.06360	0.04452	0.02960		0.09400	0.07949	0.05473	0.03510	0.02200	0.01060
120	0.05650	0.03894	0.02530		0.08500	0.07076	0.04818	0.03030	0.01860	0.00870
125	0.05040	0.03416	0.02170		0.07700	0.06183	0.04253	0.02630	0.01580	0.00710

R/T Characteristics For MIL-PRF-23648, MIL-PRF-32192 And S-311-P-827 PTC Thermistors

Temp°C	10-75 ohms	82 -160 ohms	180-510 ohms	560-1,800 ohms	1,800-6,200 ohms	6,800-10,000 ohms
	0.53 - 0.55	0.53-0.55	0.53-0.55	0.53-.055	0.53-0.55	0.53-0.55
-55	0.615	0.582	0.56	0.55	0.515	0.51
-15	0.079	0.77	0.74	0.74	0.73	0.73
0	0.863	0.847	0.835	0.835	0.825	0.825
25	1	1	1	1	1	1
50	1.16	1.17	1.2	1.2	1.23	1.19
75	1.35	1.37	1.42	1.42	1.45	1.4
100	1.545	1.584	1.656	1.656	1.67	1.61
125	1.75	1.8	1.92	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, MIL-PRF-32192/1 and /2, and S-311-P-827-31, -32, -33, and -34.



About CTS Corporation

CTS Corporation - Your Partner in Smart Solutions

Founded in 1896, CTS Corporation (NYSE: CTS) is a leading designer and manufacturer of products that Sense, Connect, and Move. The company manufactures sensors, actuators, and electronic components in North America, Europe, and Asia. CTS provides solutions to OEMs in the aerospace, communications, defense, industrial, information technology, medical, and transportation markets. CTS focuses on providing advanced technology, exceptional customer service and superior value to industry partners throughout the globe.

CTS aims to be at the forefront of technology, delivering innovative sensing, connectivity and motion solutions for the creation and advancement of products and services around the world.

Contact Information

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4925 Indiana Avenue
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