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# NASA GSFC NTC THERMISTORS

44900 Series

## FEATURES

- Interchangeability
- Proven stability and reliability
- Temperature range -40°C to +125°C
- Rapid time response
- Thermally conductive epoxy coating
- Insulated or uninsulated leads

## APPLICATIONS

- Satellite and spacecraft thermal-control systems
- Avionics and onboard electronics monitoring
- Battery and power-distribution temperature monitoring
- Payload electronics and scientific instrumentation
- Optical payloads, detectors, and focal plane assemblies
- Propulsion system temperature monitoring
- Launch vehicle instrumentation
- Spacecraft applications requiring low-outgassing materials and documented flight heritage

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## GENERAL DESCRIPTION

The 44900 Series consists of epoxy-encapsulated, precision interchangeable NTC thermistors designed for temperature measurement, compensation, and control in extended space-flight applications. The product family supports NASA GSFC S-311-P-18 part-number construction, allowing selection of resistance value, lead material, lead style, and lead length to meet application-specific requirements. NASA GSFC S-311-P-18 establishes procurement requirements for NTC thermistors intended for high-reliability space environments.

Designed for demanding aerospace and satellite applications, the 44900 Series combines stable temperature measurement performance, tight interchangeability, low-outgassing materials, and documented qualification activity. Available resistance values range from 2.252kΩ to 30kΩ at 25°C, with interchangeability to ±0.1°C and a thermally conductive epoxy encapsulation suitable for spacecraft thermal monitoring applications.

## SPECIFICATION

- NASA GSFC S-311-P-18 configurable construction
- Selectable resistance, lead style, and lead length options
- Flight tested and characterized Annual requalification testing
- Resistance values from 2.252kΩ to 30kΩ @ 25°C
- Interchangeability to ±0.1°C Thermally conductive epoxy coating
- Low-outgassing materials
- High sensitivity and fast thermal response
- Available in custom tolerances
- 32 AWG or 28 AWG leads available
- RoHS Compliant



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## WHY NASA GSFC S-311-P-18 MATTERS

NASA GSFC S-311-P-18 was developed specifically for NTC thermistors used in space-flight temperature measurement, compensation, and control applications. Rather than leaving critical design characteristics to individual manufacturers, the specification establishes standardized requirements for resistance values, interchangeability, operating temperature ranges, lead constructions, lead-length coding, identification, performance verification, and quality requirements. This provides spacecraft designers with a consistent framework for selecting and procuring thermistors for high-reliability applications.

For spacecraft programs, sensor selection often extends beyond electrical performance. Mechanical integration, wire construction, contamination control, traceability, and long-term reliability are equally important considerations. NASA GSFC S-311-P-18 addresses these needs by defining configurable lead-wire materials, insulation systems, lead lengths, and resistance classes within a controlled part-number structure. As a result, sensor configurations can be specified, documented, and procured using a common format that reduces ambiguity between engineering, procurement, manufacturing, and quality organizations.

The specification also establishes performance expectations for thermistors intended for extended operation in the space environment. Qualified devices are selected and tested to verify resistance accuracy, interchangeability, environmental durability, and mechanical integrity. This provides confidence that the temperature sensor can maintain predictable performance throughout manufacturing, integration, launch, and mission operations.

## HOW TO BUILD A NASA GSFC S-311-P-18 PART

NASA S-311-P-18 identifies compliant parts using a Goddard part number format that includes the specification prefix, dash number, lead code, and lead length




### GSFC Prefix

Defines the thermistor as being ordered to the NASA GSFC S-311-P-18 thermistor procurement specification.

### Dash Number

Defines the resistance range of the thermistor at 25°C, the tolerance class of the element, and the operating and storage temperature limits. Options include:

| Dash Number | Zero Power Resistance [Ω] | Operating & Storage Temperature Limits [°C] | Color Code [Body/End] | Accuracy from 0°C to 70°C |
|---|---|---|---|---|
| **01** | 2252 | -55°C to +90°C | Black / Yellow | ±0.2°C |
| **02** | 2252 | -55°C to +70°C | Orange / Orange | ±0.1°C |
| **03** | 3000 | -55°C to +90°C | Black / Green | ±0.2°C |
| **04** | 3000 | -55°C to +70°C | Orange / Black | ±0.1°C |
| **05** | 5000 | -55°C to +90°C | Black / Violet | ±0.2°C |
| **06** | 5000 | -55°C to +70°C | Orange / Yellow | ±0.1°C |
| **07** | 10000 | -55°C to +90°C | Black / Blue | ±0.2°C |
| **08** | 10000 | -55°C to +70°C | Orange / Brown | ±0.1°C |
| **09** | 30000 | -55°C to +90°C | Black / Grey | ±0.2°C |
| **10** | 30000 | -55°C to +70°C | Orange / Red | ±0.1°C |



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## Lead Code

Defines the lead material and insulation style. Options include:

| Lead Code | Description |
|---|---|
| **S** | 32 AWG, Tinned, Solid Copper Wire, LW(0.20)C-51-N per MIL-STD-1276 |
| **A** | 28 AWG Silver Coated Stranded Wire, ETFE per M22759/33-28-9 |
| **T** | 28 AWG Silver Coated Stranded Wire, PTFE per M16878/6BCB9 |

## Lead Length

Defines the lead length in centimeters using three characters. The R in in the code indicated a decimal point. Example configurations are expressed as:

7R6 indicates 7.6 centimeters

76R indicates 76 centimeters

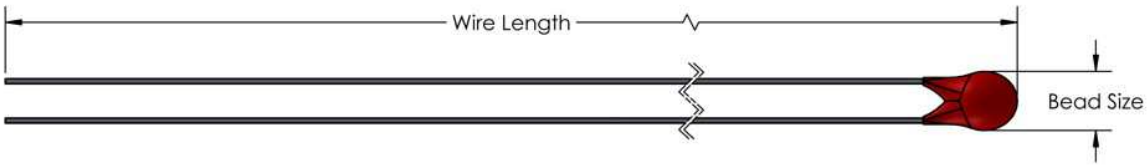
101 indicates 100 centimeters

Lead lengths are allowed to be:

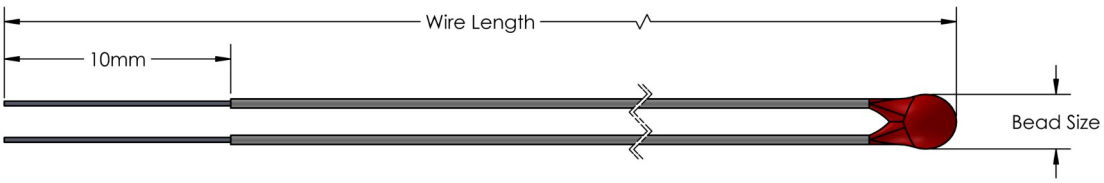
7.6 centimeters **minimum** -0.0cm / +1.5cm

100 centimeters **maximum** -0.0cm / +1.5cm

## Bare Lead NTC Thermistor




## Insulated Lead NTC Thermistor






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| Qualification Activity | NASA GSFC S-311-P-18 / MIL-PRF-23648G |
|---|---|
| Visual & Mechanical Inspection | Verify design, construction, dimensions, marking, and workmanship. |
| Zero-Power Resistance Measurement | Measured at 25°C and 125°C. Measurement temperature accuracy ±0.01°C for bead styles and ±0.05°C for other styles. |
| Resistance vs Temperature Characterization | Resistance verified at -55, -15, 0, 25, 50, 75, 100, 125°C and up to 200°C. |
| Insulation Resistance | Minimum 500 MΩ per MIL-STD-202 Method 302. |
| Dielectric Withstanding Voltage | 500 VAC for 2 minutes at atmospheric pressure; 200 VAC for 2 minutes at reduced pressure. |
| Short-Time Overload | Thermistor operated at maximum power rating for 10 cycles consisting of 5 minutes ON / 10 minutes OFF. |
| Low-Temperature Storage | -62°C ±3°C for minimum 3 hours, followed by resistance verification. |
| High-Temperature Storage | Maximum operating temperature for 100 hours, unpowered. |
| Thermal Shock | MIL-STD-202 Method 107. Bead thermistors cycled between 100°C water and 0°C water. 5 cycles, transfer time under 3 seconds. |
| Resistance to Soldering Heat | 300°C ±10°C solder, immersion 2 ±0.5 seconds, measurement after 24 ±4 hours recovery. |
| Moisture Resistance | MIL-STD-202 Method 106. Post-test insulation resistance ≥ 100 MΩ plus resistance verification. |
| Dissipation Constant | Measured at 25°C and 75°C in still air chamber. |
| Thermal Time Constant | Determined using 75°C-to-25°C thermal transition method. |
| Terminal Strength | Per MIL-STD-202 Method 211. Pull test applied to each lead. |
| Load Life | Maximum power applied 1.5 hours ON / 0.5 hours OFF for 1000 hours. Measurements at 250, 500, 750, and 1000 hours. |
| High-Temperature Exposure | Maximum operating temperature for 1000 hours. Measurements after 100 hours and 1000 hours. |
| High-Frequency Vibration | MIL-STD-202 Method 204, Condition D. Device monitored for discontinuities ≥ 0.1 ms. Thermistors intended to survive 20 G vibration environments. |
| Shock (Specified Pulse) | MIL-STD-202 Method 213, Condition A. 10 shocks in each of two perpendicular planes. Devices intended to survive 100 G shock environments. |
| Immersion | MIL-STD-202 Method 104, Condition B. Post-test insulation resistance ≥ 100 MΩ. |
| Resistance Drift Requirement | Drift limits defined by applicable style specification sheet. |
| Qualification Sample Size | Qualification testing performed on 62+ samples divided across Groups I-VII. |
| Traceability & Documentation | QPL qualification, Group A/B/C inspections, qualification retention every 12 months. |



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## Ordering Information

**Configuration Model Number**
**S311P18 –___ ___ ___**

**Dash Number**

| | |
|---|---|
| **01** | 2252Ω, -55/+90, ±0.2°C |
| **02** | 2252Ω, -55/+70, ±0.1°C |
| **03** | 3000Ω, -55/+90, ±0.2°C |
| **04** | 3000Ω, -55/+70, ±0.1°C |
| **05** | 5000 Ω, -55/+90, ±0.2°C |
| **06** | 5000 Ω, -55/+70, ±0.1°C |
| **07** | 10000 Ω, -55/+90, ±0.2°C |
| **08** | 10000 Ω, -55/+70, ±0.1°C |
| **09** | 30000 Ω, -55/+90, ±0.2°C |
| **10** | 30000 Ω, -55/+70, ±0.1°C |

**Lead Length**

| | |
|---|---|
| **NNN** | Lead length with R as decimal indicator |

**Lead Code**

| | |
|---|---|
| **S** | 32AWG, Tinned Solid Copper |
| **A** | 28AWG, Silver Coated Stranded ETFE |
| **T** | 28AWG, Silver Coated Stranded PTFE |

1. Each Thermistor design is color coded in accordance with the 311P18 Specification
.
2. Please see Cross-reference table 6 & 7 for ordering part number of existing configurations



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## Existing Configurations Cross Reference Table

| Accuracy | GSFC S311-P18 Number | Ordering Part Number | Zero Power Resistance ohm at 25°C | Beta 0-50°C (K) | Operating & Storage Temperature | Lead Wire | Lead Wire Length [cm] | Color Code per 311P18 specification |
|---|---|---|---|---|---|---|---|---|
| ±0.2°C | 01S7R6 | 11026886-00 | 2252 | 3891 | -55-+90°C | 32AWG, Tinned Solid Copper | 7.6 | Black/Yellow |
| | 01T101 | SP44901X-1 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 100 | Black/Yellow |
| | 01A76R | SP44901X-15 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 76 | Black/Yellow |
| | 01A101 | SP44901X-18 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 100 | Black/Yellow |
| | 01A64R | 10201644-00 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 64 | Black/Yellow |
| | 01T76R | SP44901X-3 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 76 | Black/Yellow |
| | 01A7R6 | SP44901X-6 | 2252 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Black/Yellow |
| | 03S7R6 | 11028351-00 | 3000 | 3891 | -55-+90°C | 32AWG, Tinned Solid Copper | 7.6 | Black/Green |
| | 03A76R | SP44903X-12 | 3000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 76 | Black/Green |
| | 03A7R6 | SP44903X-13 | 3000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Black/Green |
| | 03T7R6 | SP44903X-2 | 3000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 7.6 | Black/Green |
| | 05S7R6 | 11026149-00 | 5000 | 3891 | -55-+90°C | 32AWG, Tinned Solid Copper | 7.6 | Black/Violet |
| | 05T101 | SP44905X-13 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 100 | Black/Violet |
| | 05A76R | SP44905X-15 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 76 | Black/Violet |
| | 05A7R6 | SP44905X-16 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Black/Violet |
| | 05A101 | SP44905X-17 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 100 | Black/Violet |
| | 05A20R | SP44905X-19 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 20 | Black/Violet |
| | 05A45R | SP44905X-21 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 45 | Black/Violet |
| | 05S76R | SP44905X-23 | 5000 | 3891 | -55-+90°C | 32AWG, Tinned Solid Copper | 76 | Black/Violet |
| | 05S101 | SP44905X-24 | 5000 | 3891 | -55-+90°C | 32AWG, Tinned Solid Copper | 100 | Black/Violet |
| | 05T7R6 | SP44905X-5 | 5000 | 3891 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 7.6 | Black/Violet |
| | 07S7R6 | 11026889-00 | 10K | 3574 | -55-+90°C | 32AWG, Tinned Solid Copper | 7.6 | Black/Blue |
| | 07T101 | SP44907X-10 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 100 | Black/Blue |
| | 07T76R | SP44907X-14 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 76 | Black/Blue |
| | 07S101 | SP44907X-22 | 10K | 3574 | -55-+90°C | 32AWG, Tinned Solid Copper | 100 | Black/Blue |
| | 07A7R6 | SP44907X-23 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Black/Blue |
| | 07A45R | SP44907X-27 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 45 | Black/Blue |
| | 07A30R | SP44907X-29 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 30 | Black/Blue |
| | 07T30R | SP44907X-3 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 30 | Black/Blue |
| | 07A101 | SP44907X-30 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 100 | Black/Blue |
| | 07A31R | SP44907X-31 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 31 | Black/Blue |
| | 07S40R | SP44907X-32 | 10K | 3574 | -55-+90°C | 32AWG, Tinned Solid Copper | 40 | Black/Blue |
| | 07A76R | SP44907X-33 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 76 | Black/Blue |
| | 07A20R | SP44907X-34 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 20 | Black/Blue |
| | 07T16R | SP44907X-36 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 16 | Black/Blue |
| | 07A61R | SP44907X-40 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 61 | Black/Blue |
| | 07A41R | SP44907X-43 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 41 | Black/Blue |
| | 07A80R | SP44907X-45 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 80 | Black/Blue |



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| Accuracy | GSFC S311-P18 Number | Ordering Part Number | Zero Power Resistance ohm at 25°C | Beta 0-50°C (K) | Operating & Storage Temperature | Lead Wire | Lead Wire Length [cm] | Color Code per 311P18 specification |
|---|---|---|---|---|---|---|---|---|
| | 07A56R | 10214287-00 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 56 | Black/Blue |
| | 07T7R6 | SP44907X-8 | 10K | 3574 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 7.6 | Black/Blue |
| | 09S7R6 | 11029759-00 | 30K | 3810 | -55-+90°C | 32AWG, Tinned Solid Copper | 7.6 | Black/Gray |
| | 09T76R | SP44909X-12 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 76 | Black/Gray |
| | 09A7R6 | SP44909X-16 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Black/Gray |
| | 09A101 | SP44909X-18 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 100 | Black/Gray |
| | 09A15R | SP44909X-22 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded ETFE | 15 | Black/Gray |
| | 09T101 | SP44909X-7 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 100 | Black/Gray |
| | 09T7R6 | SP44909X-8 | 30K | 3810 | -55-+90°C | 28AWG, Silver Coated Stranded PTFE | 7.6 | Black/Gray |
| ±0.1°C | 02S7R6 | 11026887-00 | 2252 | 3891 | -55-+70°C | 32AWG, Tinned Solid Copper | 7.6 | Orange/Orange |
| | 02A7R6 | SP44902X-10 | 2252 | 3891 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Orange/Orange |
| | 02A101 | SP44902X-16 | 2252 | 3891 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 100 | Orange/Orange |
| | 04A16R | SP44904X-10 | 3000 | 3891 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 16 | Orange/Orange |
| | 04A101 | SP44904X-8 | 3000 | 3891 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 100 | Orange/Orange |
| | 04A60R | SP44904X-9 | 3000 | 3891 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 60 | Orange/Orange |
| | 06S7R6 | 11029046-00 | 5000 | 3891 | -55-+70°C | 32AWG, Tinned Solid Copper | 7.6 | Orange/Yellow |
| | 08S7R6 | 11028352-00 | 10K | 3574 | -55-+70°C | 32AWG, Tinned Solid Copper | 7.6 | Orange/Brown |
| | 08T15R | SP44908X-11 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded PTFE | 15 | Orange/Brown |
| | 08T7R6 | SP44908X-12 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded PTFE | 7.6 | Orange/Brown |
| | 08T101 | SP44908X-15 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded PTFE | 100 | Orange/Brown |
| | 08A7R6 | SP44908X-19 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 7.6 | Orange/Brown |
| | 08T30R | SP44908X-2 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded PTFE | 30 | Orange/Brown |
| | 08T50R | SP44908X-20 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded PTFE | 50 | Orange/Brown |
| | 08A76R | SP44908X-23 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 76 | Orange/Brown |
| | 08A30R | SP44908X-24 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 30 | Orange/Brown |
| | 08A101 | SP44908X-26 | 10K | 3574 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 100 | Orange/Red |
| | 10A101 | SP44910X-14 | 30K | 3943 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 100 | Orange/Red |
| | 10T101 | SP44910X-8 | 30K | 3943 | -55-+70°C | 28AWG, Silver Coated Stranded ETFE | 100 | Orange/Red |

**NORTH AMERICA**
Tel +1 800 522 6752

**EUROPE**
Tel +31 73 624 6999

**ASIA**
Tel +86 0400 820 6015

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