



Model N7030 RTD and N7040 Thermocouple Analog Transmitter

Product Datasheet



Key Features

- True Analog Transmitter
- Qualified per IEEE 323 Class 1E Mild Environment
- Qualified per IEEE 344 Class 1E Seismic
- Loop Powered 14 to 48 VDC
- Analog ANSI-ISA, NAMUR 43
- EMC, NRC RG 1.180, CE



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Overview

The N7030 and N7040 Analog Temperature Transmitter Series are two-wire 4-20 mA DC current loop powered temperature transmitters. They are analog signal conditioning devices designed to accept standard RTD or Thermocouple inputs and convert the input to a linearized 4-20 mA DC output signal that is proportional to the input. The transmitter is nominally powered from a 24 VDC supply but will accept any regulated DC supply such that the voltage measured at the transmitter's terminals is between 14 and 48 VDC under all conditions.

Weed Instrument, Co. was acquired by Ultra Energy.

Nuclear Power Plant Applications

DELIVERING CRITICAL MEASUREMENTS – The Model N7030 RTD and N7040 Thermocouple Analog Temperature Transmitter is the perfect transmitter for critical measurements & safety instrumentation such as:

- Reactor Coolant System (RCS) Temperature
- Pressurizer Temperature
- RCS Hot Leg Wide Range
- Pressurizer Return Line Temperature
- Pressurizer Level Reference Leg Temperature
- RCS Cold Leg Narrow Range
- RCS Hot Leg Narrow Range
- Pressurizer Heater Return Line Temperature
- External Pipe and Pressure Vessel Temperature
- Reed Switch Level Transmitter
- Millivolt Transmitter
- Potentiometer Transmitter
- Containment Temperature
- Fuel Pool
- Spent Fuel
- Radioactive Waste Treatment Thermocouple

Replacement for Obsolete Transmitters and Signal Conditioners Including These Discontinued Models

- Rosemount™ Model 444 Alphaline® Temperature Transmitter
- FOXBORO™ 893 Temperature Transmitter
- FOXBORO™ 694A Resistance-to-Current Converter
- FOXBORO™ 693A Millivolt-to-Current Converter
- Weed Instrument N7000 Series including Models N7013, N7014

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The Analog Temperature Transmitter provides high accuracy transmission of temperature measurements specifically designed for nuclear power plant applications. Each transmitter has an enclosure which is moisture and impact resistant and provides a high degree of EMI/RFI protection. For on-machine applications and potentially harsh plant environments, a NEMA 4X IP66 housing is available. The transmitter is insensitive to age related drift and ambient temperature changes to ensure stability and accuracy over its mission life.

Qualifications at a Glance (see page 7 for further detail):

- Nuclear qualified per IEEE 323/344 Class 1E Mild Environment
- Qualified life of 40 years at 25°C (77°F)
- Vibration and seismic qualified
- Analog Signals meet ANSI-ISA, NAMUR 43, and ANSI-ISA-50.00.01-1975 requirements
- EMC qualification per US NRC Regulatory Guide 1.180 Rev. 1 Oct. 2003
- CE Mark Certification

Transmitter will be used with the ITS-90 temperature scale. Sensor type and temperature range must be specified when ordering.

Specifications

FUNCTIONAL SPECIFICATIONS	DESCRIPTION
Transmitter Types	Analog Transmitter (Ω , RTD, mV, Thermocouple) inputs
Model N7030 Input - RTD	Single element Platinum 100 Ω or 200 Ω 3 or 4 wire per model configuration table Factory set, non-field configurable Temperature coefficients (alphas α available by request): <ul style="list-style-type: none">• Curve A: 0.003902 $\Omega/\Omega/^\circ\text{C}$ (US Standard)• Curve B: 0.00385055 $\Omega/\Omega/^\circ\text{C}$ (ASTM-1137, IEC-60751, DIN 43760, ITS-90)
Model N7040 Input - Thermocouple	Types: B, E, J, K, N, R, S, and T thermocouples -10 mV to +100 mV per model configuration table Factory set, non-field configurable

FUNCTIONAL SPECIFICATIONS CONT.	DESCRIPTION
Input Range and Spans	Ω Range: 18.52 Ω (Pt100@-200°C) to 788.72 Ω (Pt200@+850°C) Ω minimum span: 3 Ω Ω maximum span: 754 Ω RTD Pt Range: -200°C to 850°C (-328°F to +1562°F) per ITS-90 RTD Pt 100 minimum span: 10°C (18°F) RTD maximum span: 1050°C (1890°F) mV Range: -10 mV to +100 mV mV minimum span: 5 mV mV maximum span: 110 mV Thermocouple temperature ranges per ITS-90
Output	Single isolated loop powered 4-20 mA Measurement valid from 3.8 mA to 20.5 mA Sensor Fault indicated by ≤ 3.6 mA or ≥ 21.0 mA Linear to temperature for RTD inputs Linear to mV for thermocouple inputs
Response Time (for a 1-time constant response (63.2%) to a step change input)	N7030 RTD Input Transmitter: 134 ms, transmitter only N7040 Thermocouple Input Transmitter: 232 ms, transmitter only
Isolation between any of the following: <ul style="list-style-type: none"> 4-20 mA current loop Sensor input Transmitter case 	≥ 1 M Ω (50 VDC for 60 s, <50 μ A leakage)
Zero & Span Adjustability	Zero: $\pm 13.8^\circ\text{C}$ ($\pm 25^\circ\text{F}$) Span: $\pm 20\%$ of calibrated span Non-interactive
Zero & Span Setability	$\pm 0.05\%$ span
Turn on Time	1 minute to achieve rated accuracy

FUNCTIONAL SPECIFICATIONS CONT.	DESCRIPTION
Power Supply	Single 4-20 mA loop: 14 to 48 VDC terminal Voltage Power budget: 23mA x 48 VDC = 1104 mW maximum
In-rush Current	Less than 100 mA for less than 15 ms excluding the output current
Power Supply Input Protection	+48V Maximum input voltage -48V Reverse voltage protection
Sensor Wiring Protection	No damage due to sensor miswiring or short circuits between sensor leads Warning: Connecting power to the sensor inputs will damage the transmitter
Output Maximum Load Limits	Single Loop: Determined from the following equation (Power Supply Voltage – 14V) / 0.022A Maximum loop resistance vs. some typical supply voltages: <ul style="list-style-type: none"> • 0Ω at 14 VDC • 455Ω at 24 VDC • 1,545Ω at 48 VDC Conforms to: ANSI/ISA-50.00.01 Class 2L transmitter
Sensor Fault Signaling	Sensor breakdown information per NAMUR NE 43 RTD sensor: Any sensor lead wire open, RTD sensor shorted Thermocouple sensor: Sensor lead open ≤ 3.6 mA or ≥ 21.0 mA (specified when ordering)
Humidity Range	5% to 95% non-condensing
Humidity Effect	Less than ±0.25% of span for 15%-95% change in relative humidity (non-condensing)
Temperature Limits: Operating / Storage	0°C to 70°C (32°F to 158°F) / -40°C to 100°C (-40°F to 212°F)

PERFORMANCE SPECIFICATIONS	DESCRIPTION
Accuracy (Includes linearity and repeatability)	±0.1% of span or ±0.05°C (±0.09°F); whichever is larger, excluding sensor error for RTD ±0.15% of span in mV or ±20 µV; whichever is larger, excluding sensor and cold junction compensation errors for mV and Thermocouples

PERFORMANCE SPECIFICATIONS CONT.	DESCRIPTION
Stability (drift)	±0.2% of span per year maximum
Cold Junction Compensation Error	±0.5°C (±0.9°F) (Thermocouple input only)
Ambient Temperature Effect	RTD: ±[0.15°C (0.27°F) + 0.05% span] for a 5.5°C (10°F) change Thermocouple: ±[1°C (1.8°F) + 0.1% span in mV] for a 5.5°C (10°F) change
Power Supply Effect	±0.02% of span/Volt
EMI/RFI Effect	±0.1% of span
Mounting Position Effect	None
Reference Conditions	24 VDC Terminal Voltage 25°C (77°F) ambient conditions 385 Pt 100 Ω - IEC 60751 at 0°C (32°F), Type K Thermocouple at 0°C (32°F)
Reliability	Mean-Time-Between-Failure predication in accordance with MIL-HDBK-271F, FN2: MTBF at 25°C (77°F) of 1.8 million hours or greater

PHYSICAL SPECIFICATIONS	DESCRIPTION
Housing, Mounting	DIN rail mount Panel mount IP67 head mount options Other enclosures as a special
Connection	Terminal strip Ring lugs not required 16 to 24 AWG wire
Weight	Transmitter 0.6 lbs (0.27 kg): <ul style="list-style-type: none"> With panel mount 0.7 lbs (0.32 kg) With DIN rail 0.9 lbs (0.41 kg) In ADALET XIHMKFCX Connection Head 3.9 lbs (1.77 kg) In Hoffman/Pentair Junction Box A606CHNF 5.3 lbs (2.40 kg)

Nuclear Qualifications

Quality Assurance and Certification of Origin

This product is designed, manufactured, and qualified by Ultra under its 10CFR50 App. B QA program. This product is designed and manufactured in U.S.A.

Nuclear Power / Environmental Qualifications

IEEE 323/344 Class 1E Mild Environment.

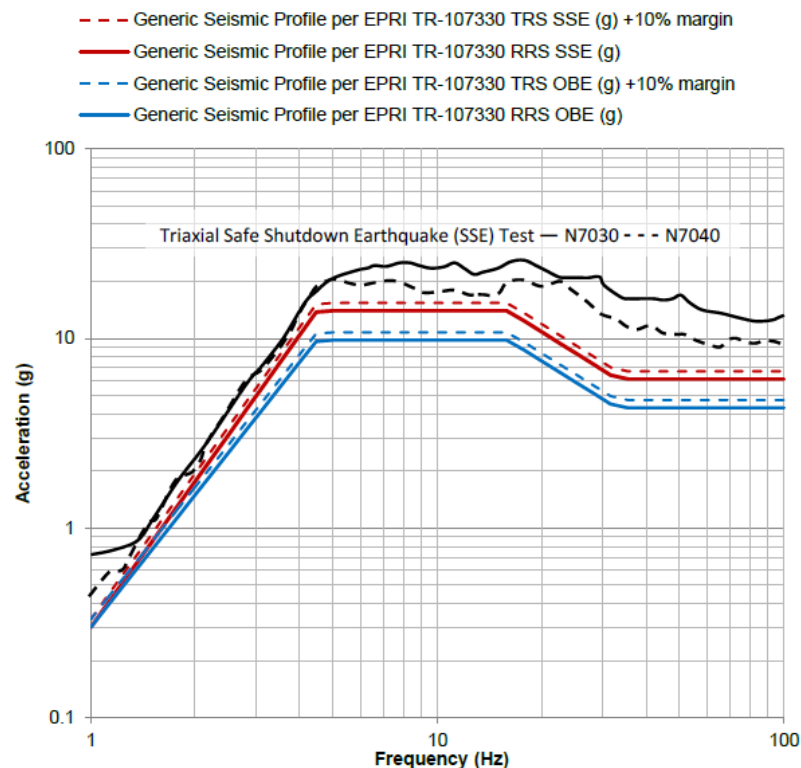
Qualified Life

40 years at 25°C (77°F).

Vibration, Seismic Profile

Generic Seismic Profile per EPRI TR-107330. Figure 4-5 Required Response Spectra for all mounting options (DIN rail, panel, and Ex d connection head), see US NRC Regulatory Guide 1.209. Spectra below, TRS has 10% margin added to the RRS.

Seismic Test Profile - N7030/N7040 5% Damping Ratio - Horizontal and Vertical



Seismic Profile N7030 and N7040

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Generic Seismic Profile per EPRI TR-107330. (Figure 4-5 Required Response Spectra). TR-107330 provides seismic test levels taken from SQRTS-01 (assumes floor motion typical of lower level plant location and applies cabinet amplification factors.)

Freq. (Hz)	Generic Seismic Profile per EPRI TR-107330 RRS SSE (g)	Generic Seismic Profile per EPRI TR-107330 TRS SSE (g) +10% margin	N7030 Safe Shutdown Earthquake (SSE) Tests Actual (g)
1	0.3	0.33	0.9
5	14.0	15.4	20
16	14.0	15.4	20
36	6.1	6.71	15
100	6.1	6.71	12

Radiation

$\leq 10^3$ rads (10 Gy). The commonly used radiation threshold for concern for electronics that contain metal oxide semiconductors (MOS) is 10^3 rads (10 Gy) (US NRC Regulatory Guide 1.209).

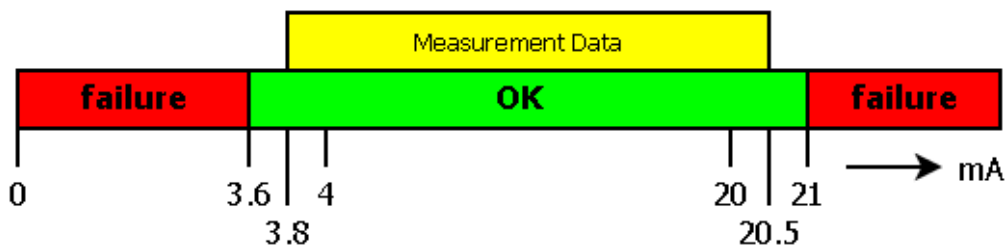
Radiation aging for electronic equipment not required to perform a safety-related function in a high-energy line break environment and subject to lifetime doses of less than 10^3 rads (10 Gy) is not required for mild qualification.

Compliance

Summary: CE, RoHS, EMC per US NRC Reg. Guide 1.180, UL94 V-0 flame retardancy, and general electrical safety.

Compatibility of Analog Signals: ANSI-ISA, NAMUR 43

ANSI-ISA-50.00.01-1975 R2012 Compatibility of Analog Signals for Electronic Industrial Process Instruments Approved 17 July 2012. NAMUR NE 43 analog output over range and under range annunciations.



EMC, NRC RG 1.180, CE

EMC per US NRC Reg. Guide 1.180. European EMC Directive 2014/30/EU by conforming to applicable EN and IEC Standards: Compliance testing to the EN 61000 Series standards, CE mark declaration.

Class 1E Mild Environment according to IEEE 323- 1974/1983/2003 & IEEE 344-1975/1987/2004

IEEE 323-1974/1983/2003

Both Regulatory Guide 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants,” issued November 1974, and Revision 1 of Regulatory Guide 1.89, issued June 1984, endorse IEEE Std. 323-1974.

Regulatory Guide 1.89 focuses on the environmental qualification of equipment intended for use in harsh environments that are subject to design-basis accidents. Regulatory Guide 1.89 limits its scope to equipment intended for application in harsh environments; additional guidance is warranted to address qualification for mild environmental conditions as needed for computer-based technologies.

IEEE revised the industry guidance for qualification, IEEE Std. 323, in 2003. A particular distinction between IEEE Std. 323-2003 and IEEE Std. 323-1974 is that the 2003 version does not require age conditioning to an end-of-installed-life condition for equipment in mild environments where significant aging mechanisms are not present. The NRC regulatory guide 1.209 endorses IEEE Std. 323-2003. The practices in IEEE Std. 323-2003 are sufficiently comprehensive to address qualification for the less severe environmental conditions of typical plant locations where safety-related, computer-based I&C systems are generally located. These plant areas are unaffected by design-basis accidents and the most severe conditions to which the equipment is subjected, which arise from the environmental extremes resulting from normal and abnormal operational occurrences.

IEEE 344-1975/1987/2004

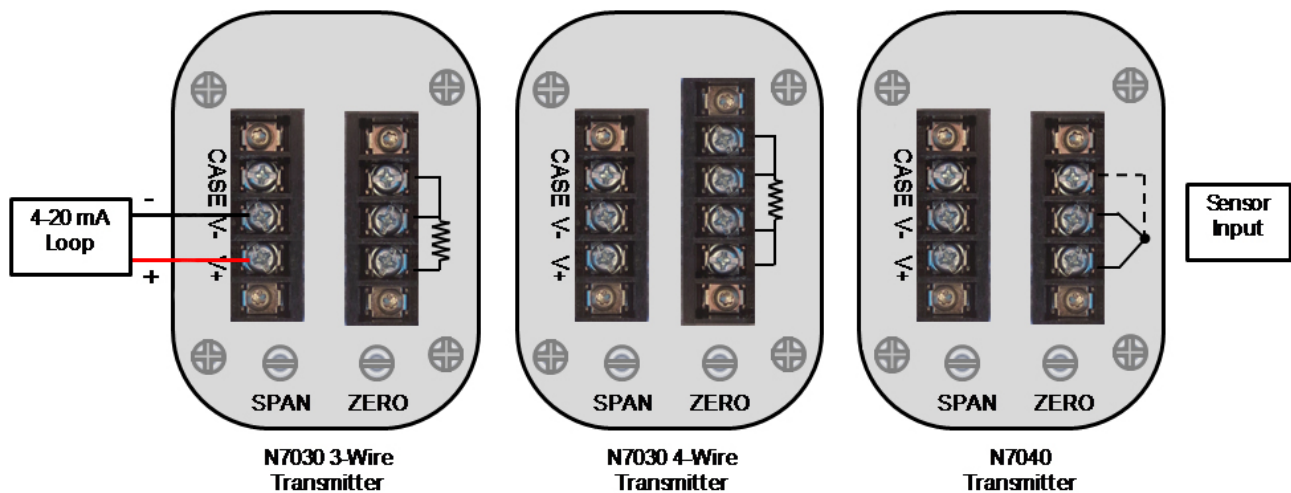
The NRC issued Revision 2 of Regulatory Guide 1.100, “Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants”, in June 1988. With a few exceptions and clarifications, it endorsed the IEEE 344-1987, issued January 1987. NRC Regulatory Guide 1.100 Revision 3 issued September 2009 endorses, with exceptions and clarifications, IEEE Std. 344-2004.

The major change from IEEE Std. 344-1987 to IEEE Std. 344-2004 is the update and expansion of Clause 10, “Experience,” which describes the use of experience data as a method for seismic qualification of Class 1E electrical equipment (including I&C components). The qualification of Ultra Energy’s Analog Temperature Transmitter does not rely in any way on experience data; therefore, the qualification also meets the requirements of IEEE 344-2004 and complies with USNRC Regulatory Guide 1.100 Revision 3.

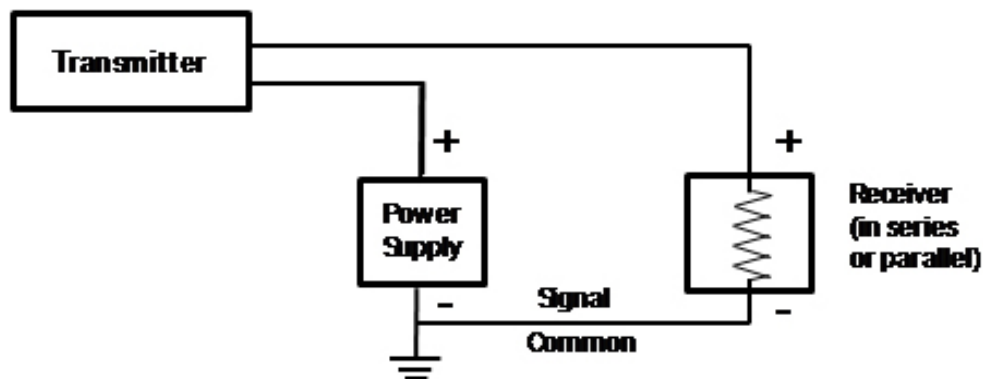
References:

1. IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, IEEE Std. 323-1974/1983/2003, Institute of Electrical and Electronics Engineers, Piscataway, NJ
2. US NRC Regulatory Guide 1.89
3. Recommended Practice for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations, IEEE Std. 344-1975/1987/2004, Institute of Electrical and Electronics Engineers, Piscataway, NJ
4. USNRC Regulatory Guide 1.100

Electrical Connections

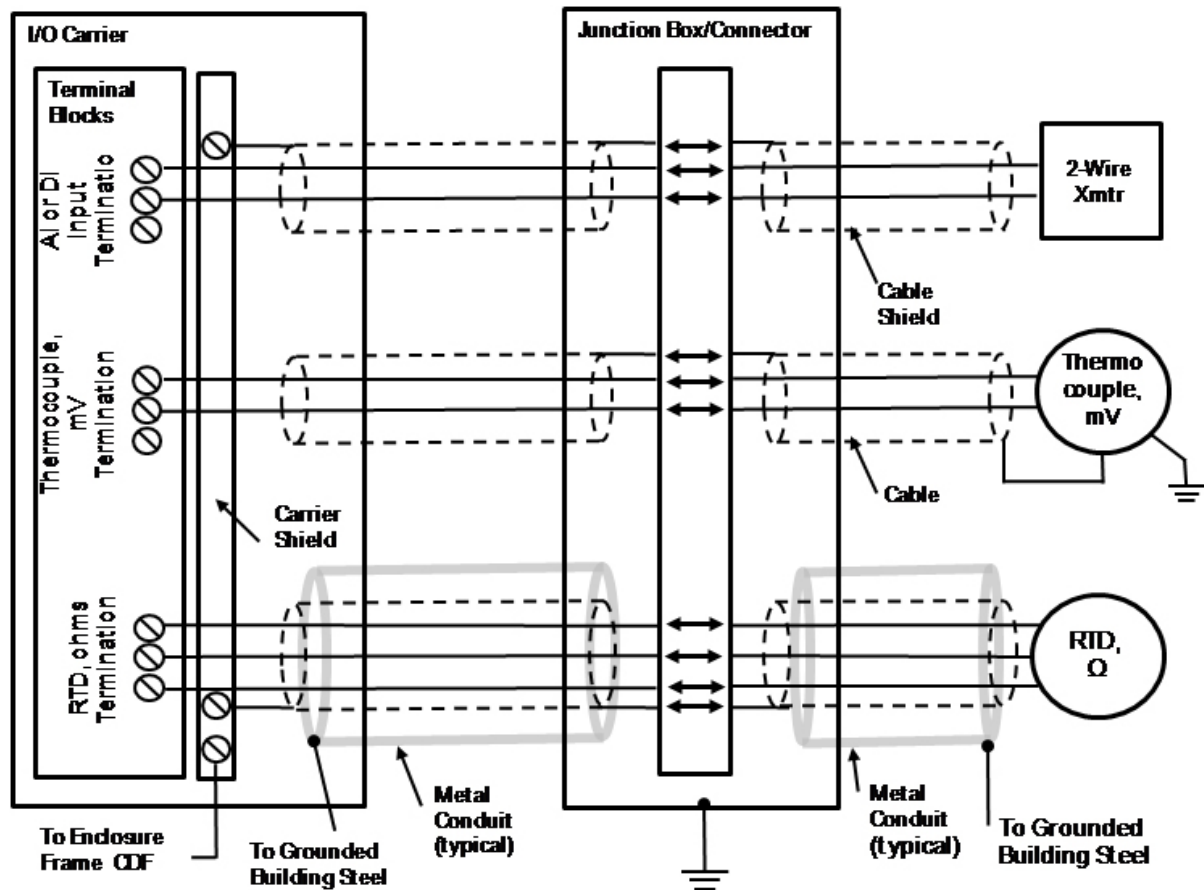


Typical Current Loop and Sensor Electrical Connections



Typical 2 Wire Current Loop Circuit [1]

Electrical Wiring and Grounding



Typical Wiring and Grounding Connections for Cable Runs [2]

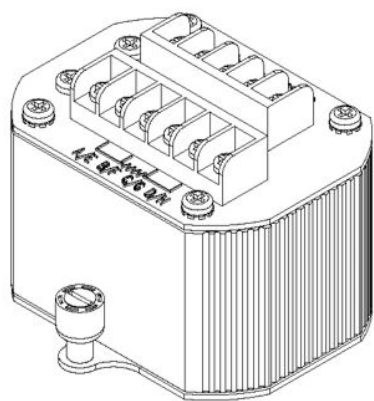
Properly grounded, dual shielded cabling (one internal and one external shield with drain wire) should be used for the input signal to ensure proper EMI/RFI performance. The transmitter's output connection provides DC power to the transmitter and transmits 4-20 mA output signals to the receiver instruments. Current loop wiring should be properly shielded and grounded to reduce effects of electrical interference.

Consult these references for additional guidance:

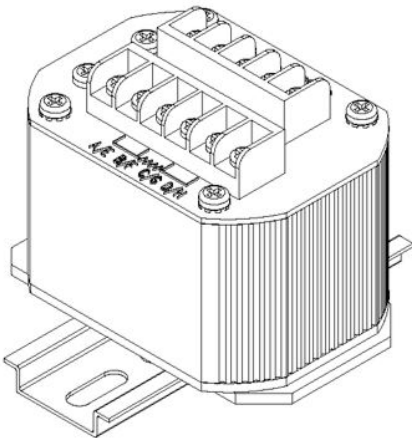
1. ANSI-ISA-50.00.01-1975 (R2012) Compatibility of Analog Signals for Electronic Industrial Process Instruments, Approved 17 July 2012.
2. Control System Power and Grounding Better Practice, David Brown, David Harrold, and Roger Hope, Control Engineering, Elsevier/Newnes, and Reed Business Information, 2004.
3. IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations, IEEE Std 1050-1996, 1996.

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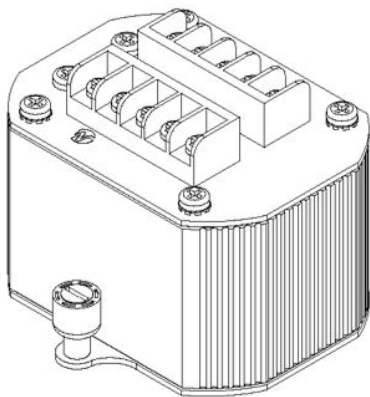
Mounting Options



N7030 4-Wire RTD Temperature Transmitter
2-Hole Head / Panel Mount

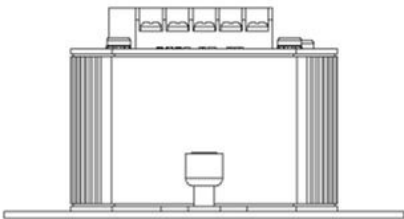
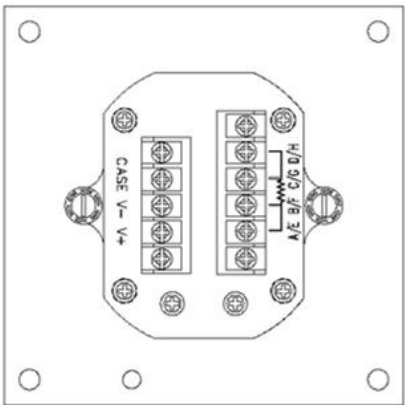
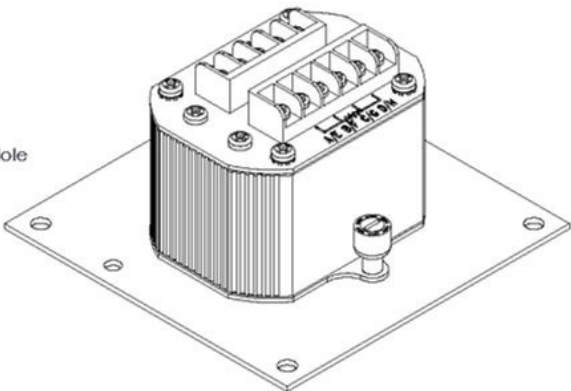
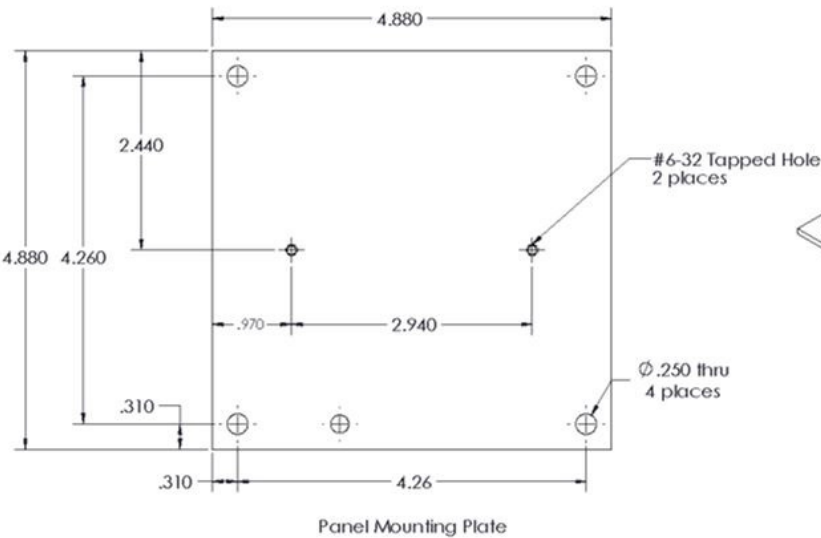


N7030 4-Wire RTD Temperature Transmitter
DIN Rail Mount



N7040 T/C Temperature Transmitter
2-Hole Head / Panel Mount

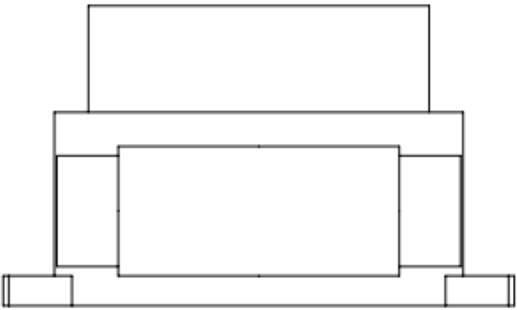
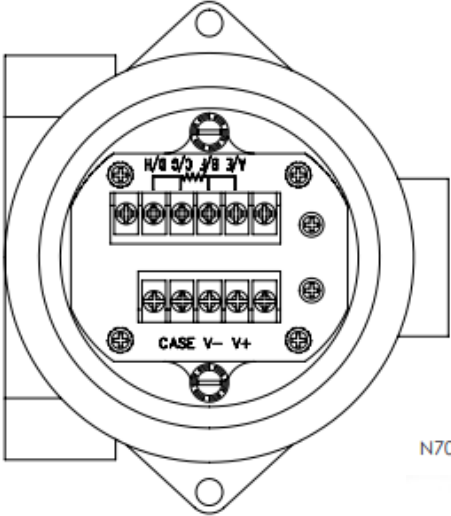
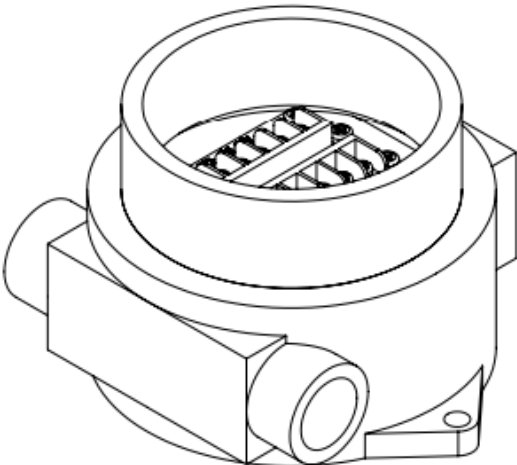
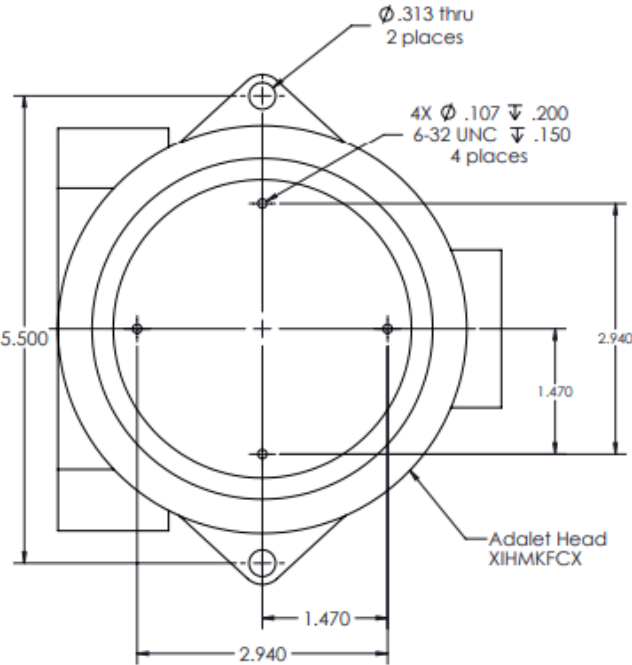
Panel Mount



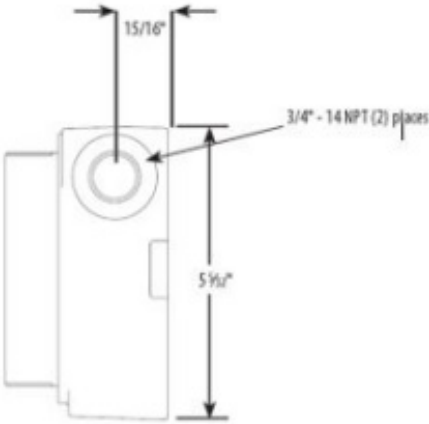
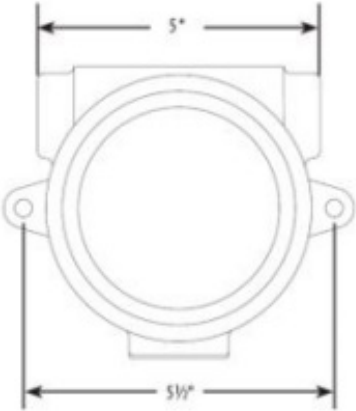
N7030 4-Wire transmitter shown

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Connection Head Mount



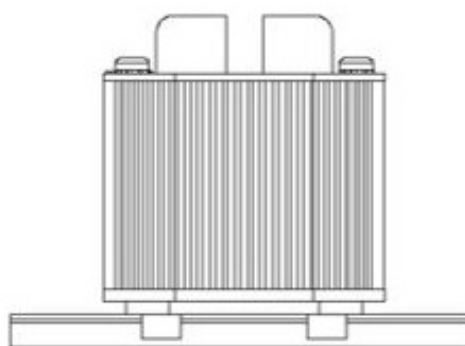
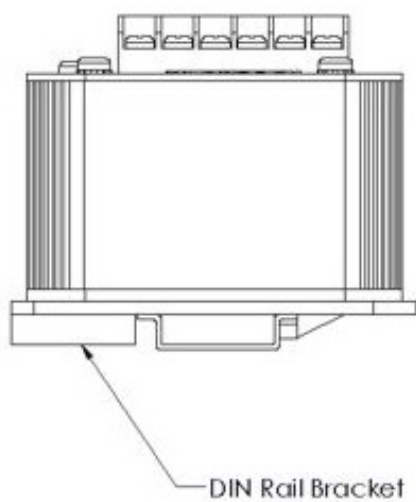
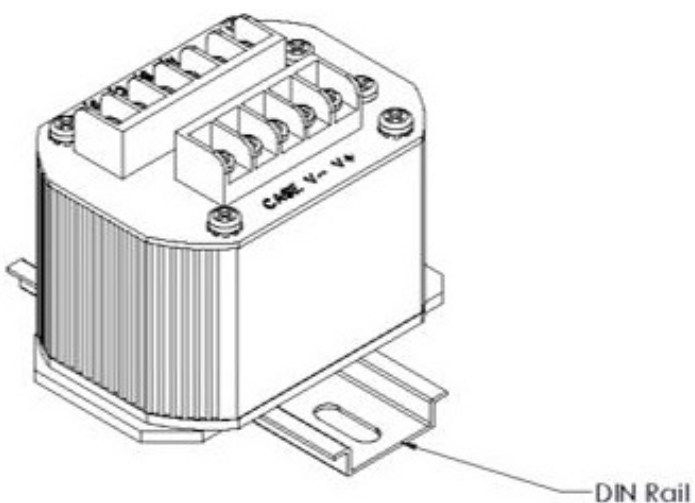
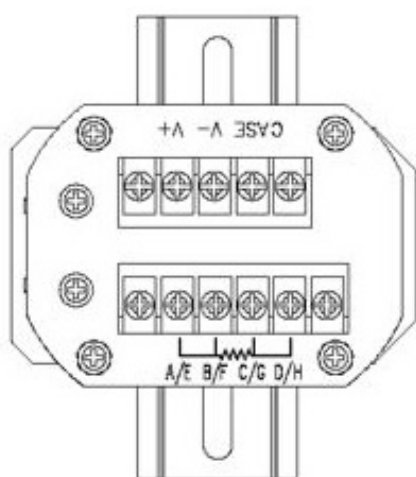
N7030 4-Wire Transmitter Shown



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DIN Rail Mount



N7000 4-Wire Transmitter Shown

Junction Box & Special Enclosures

Weather proof housings and engineered to order special configurations are available, contact the factory with your unique requirements.



Weather proof housing, PN 0403-100-0004 (Hoffman A606CHNF)

INDUSTRY STANDARDS

UL 50, 50E Listed; Type 4, 12, 13; File No. E27567

cUL Listed per CSA C22.2 No. 94; Type 4, 12, 13; File No. E27567

UL 508A Listed; Type 4, 12, 13; File No. E61997

cUL Listed per CSA C22.2 No. 94; Type 4, 12, 13; File No. E61997

NEMA/EEMAC Type 4, 12, 13

CSA, File No. 42184: Type 4 and 12

IEC 60529, IP66

Non-Proprietary Qualification Summary Reports are available upon request.

Contact Ultra Energy to request a copy of the following documents:

1. Nuclear Qualified Model N7030 and N7040 Analog Temperature Transmitter Model Configuration
2. Non-Prop. Qualification Summary, N7030 RTD Temperature Transmitter Document Number: 3077-RD5086-005
3. Qualification Test Report, N7030 RTD Temperature Transmitter Document Number: 3077-RD5086-006
4. Non-Prop. Qualification Test Report, N7040 Thermocouple Temperature Transmitter 3077-RD5086-009
5. Qualification Test Report, N7040 Thermocouple Temperature Transmitter Document Number: 3077-RD5086-007

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Ultra reserves the right to vary these specifications without notice.

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Ultra Energy Ltd 2022.