N9004 fast time response RTD assembly

Key applications

- Reactor coolant loops (RCS) hot and cold legs
- Reactor coolant pumps
- RCS wide range
- Feedwater systems
- RHR/SIS systems

Overview

The model N9004 fast time response RTD is designed to be installed in a compatibly designed thermowell for rapid detection of temperature changes in the Hot and Cold legs of the reactor coolant loops (RCS) of PWRs (pressurized water reactors). The N9004 RTD is currently installed in many operating PWR nuclear plants, with some of the original installations occurring in the early 1980's. There is little drift of either calibration or time response associated with normal operating conditions. Thus, the RTD assembly has low maintenance costs. Also, due to unique design features, ALARA amounts are reduced during installation and removal, especially when a Quick Disconnect Connector (QDC) is used.

Technical specification

Feature	Description
Maximum operating temperature	0°F to 750°F (-18°C to 400°C)
Element type	Platinum (wire-wound)
Accuracy/interchangeability	IEC 60751 Class B is standard. IEC 60751 Class A is available upon request. Other special accuracies are also available. RTD accuracy shall be within ±0.3°F (±0.17°C) of the values provided in the specific resistance versus temperature interpolation table, including the effects of repeatability, but excluding hysteresis.
Hysteresis	Hysteresis is the difference in the element resistance when the measurement temperature is decreasing compared to when it is increasing. Hysteresis shall no exceed 0.8°F (0.44°C) for a temperature span of 32°F to 625°F (0°C to 330°C).
Calibration points	Standard calibration points are 32°, 212° and 554°F (0°, 100° and 290°C)
Drift/stability	Sensor drift is less than ±0.2°F (±0.11°C) shift per year up to a maximum of 0.5°F (0.28°C) for the qualified life. These values were determined based on pre and post qualification test data.
Insulation resistance	At room temperature and dry external surfaces, the insulation resistance between any wire and the sensor case will be at least 100 MΩ with 100 VDC applied for a minimum of 30 seconds prior to measurement.
Response time (installed in an Ultra Energy thermowell)	The response time for each sensor is normally 5 seconds or less in Ultra Electronics Energy thermowell as verified by a plunge test in accordance with ASTM E644 for a 63.2% of a step change from room temperature air to water flowing transverse to the assembly at 3 ft/s (~1m/s) at 180°F. Actual response time provided will vary depending on final design of the associated thermowell.

Technical specification

Feature	Description
Operating current	Standard operating current is 1 to 4 mA continuous. A continuous current of 20 mA (RMS) or less will not damage the sensor. A short duration or pulsed current of 40 mA maximum will not damage the sensor.
Self-heating error	In 154°F (68°C) water flowing transverse to the sensor sheath at 3 ft/s (~1 m/s), with a sheath diameter of 0.25 inches (6.35 mm), the RTD is capable of dissipating 10 mW/°C without causing the indicated temperature to rise more than 0.36°F (0.2°C).
Qualification	RTD assemblies are qualified to Class 1E requirements of IEEE 323-1974/1983 and IEEE 344-1975/1987. Original qualification reports are 548-8854-001 and 06-8680-003.
Quality standards	RTD assemblies are supplied in accordance with Ultra Energy QA/QC Quality Assurance & Control Manual 100-1 which meets the requirements of 10 CFR 50 Appendix B, 10 CFR Part 21, ISO 9001, ASME NQA-1 and ANSI N45.2.
Sheath material	Stainless steel
External leadwire material	Stranded Constantan with polyolefin
Sheath insulation material	MgO
Internal leadwire material	Solid Constantan
Mounting connections	RTDs normally have a 150 lb S.S. union and schedule 80 minimum S.S. extension nipple with 1/2" NPT male threads for interface to the thermowell or protection tube. The terminal head conduit port has 3/4" NPT female threads as standard. The QDC will normally have 1/2" NPT male threads. Custom mounting connections are available upon request.
Storage requirements	RTDs to be stored in accordance with ANSI N45.2 Level B or better.

Technical specification

Feature	Description
Shipping weight	Approx. 5 lbs. Actual weight depends on configuration supplied.
Identification tags	S.S. identification tag attached to terminal head using SS braided cable. Custom configured tagging is available upon request.
Storage requirements	RTDs to be stored in accordance with ANSI N45.2 Level B or better.
Accessories	
Silicone sealant	Item No. 0102-004-0012T
P1 thread sealant	Item No. 0109-001-0113T
PST 580 thread sealant	Item No. 0109-001-0114T
Viton gasket for terminal head	Item No. 0322-001-0023T
6-Wire terminal block	Item No. 0308-004-0006T
8-Wire terminal block	Item No. 0308-004-0009T
Terminal head - GP single port	Item No. 0342-002-0016T
Terminal head - GP dual Port	Item No. 0342-002-0017T
RTD removal tool	Item No. 0125-003-0004
RTD insertion tool	Item No. 0125-003-0005
Thermowell cleaning kit	Item No. 0125-004-0001
QDC O-ring	Item No. 0322-001-0070T

Technical specification

Model number configurator

N9004	Model N9004 Fast Time Response RTD Assembly

Code	Element Style
S	Single Platinum Element, 4 Wire Configuration
D	Dual Platinum Element, 6 Wire Configuration
E	Dual Platinum Element, 8 Wire Configuration
X	Other

Code	Resistance at 32°F (0°C)
1	100 Ohms
2	200 Ohms

Code	Temperature Coefficient (Ohms/Ohm/°C)
A	0.003902
B	0.00385055

Following Codes Applicable to AP1000 Only	
Code	Application + Extension Length
AP"Y"	AP1000, Y = Ext Length in Inches

Code	QDC Cable Length
XXX	Cable Length in Inches

Code	Heat Shield Required
HS	Heat Shield

Head/Ext. Code	/	N9004	E	-	1	B	-	AP1.6	-	300	-	HS

Note: See the Terminal Head and Extension Code Configurator to determine the appropriate Head/Ext. Code.

Technical specification

Head/extension code configurator

8	Stainless Steel (Specify Single or Dual Port Head in Item Description)
X	Other - Consult Factory

Code	Extension Style & Material
D	Nipple/Union/Nipple Extension Assembly
X	Other - Consult factory

Code	Extension Length ("B" Dimension)
30	3.0 Inches [76.2 mm] (Minimum Length Possible)
35	3.5 Inches [88.9 mm]
40	4.0 Inches [101.6 mm]
45	4.5 Inches [114.3 mm]
50	5.0 Inches [127 mm]
55	5.5 Inches [139.7 mm]
60	6.0 Inches [152.4 mm] (Maximum Length Allowed for Qualified Assemblies)
XX	Other - Consult Factory

Code	Head Connection (Instrument x Conduit)
A	1/2" Female NPT x 1/2" Female NPT
D	1/2" Female NPT x 3/4" Female NPT
X	Other - Consult Factory

8	D	40	D

Technical specification

QDC model number configurator

880701	Generation 1 QDC

Code	Pin/Socket Configuration
4	4 Pins/Sockets
8	8 Pins/Sockets
X	Other - Consult Factory

Code	Conductor Wire Gauge
16	16 AWG Conductor Size
18	18 AWG Conductor Size
20	20 AWG Conductor Size (Standard size for most applications)
X	Other - Consult Factory

Code	Connector Style
B	Bayonet
X	Other - Consult Factory

Code	Insulator Material
P	PES (Polyethersulfone) or PEI (Polyetherimide)
X	Other - Consult Factory

Code	O-Ring Material
E	Nordel EPDM
X	Other - Consult Factory

Code	Pin Side Potting
3	EGS Type 3
W	Ultra Electronics, Energy Potting
X	Pin Side Not Supplied

Code	Pin Side Lead Wire or Cable
F	Rockbestos Firewall III, XLPE (Standard)
W	Ultra Electronics, Energy Supplied XLPE
X	Pin Side Not Supplied

Code	Socket Side Potting
3	EGS Type 3
W	Ultra Electronics, Energy Potting
X	Socket Side Not Supplied

Code	Socket Side Lead Wire or Cable
F	Rockbestos Firewall III, XLPE (Standard)
W	Ultra Electronics, Energy Supplied XLPE
X	Pin Side Not Supplied

Code	SS Flexible Armor on Pin Side + Length
000	No Armor
XXX	Length to the nearest inch

Code	Cable or Wire Length on Pin Side
000	Pin Side Not Supplied
XXX	Length to the nearest inch

Code	SS Flexible Armor on Socket Side + Length
000	No Armor
XXX	Length to the nearest inch

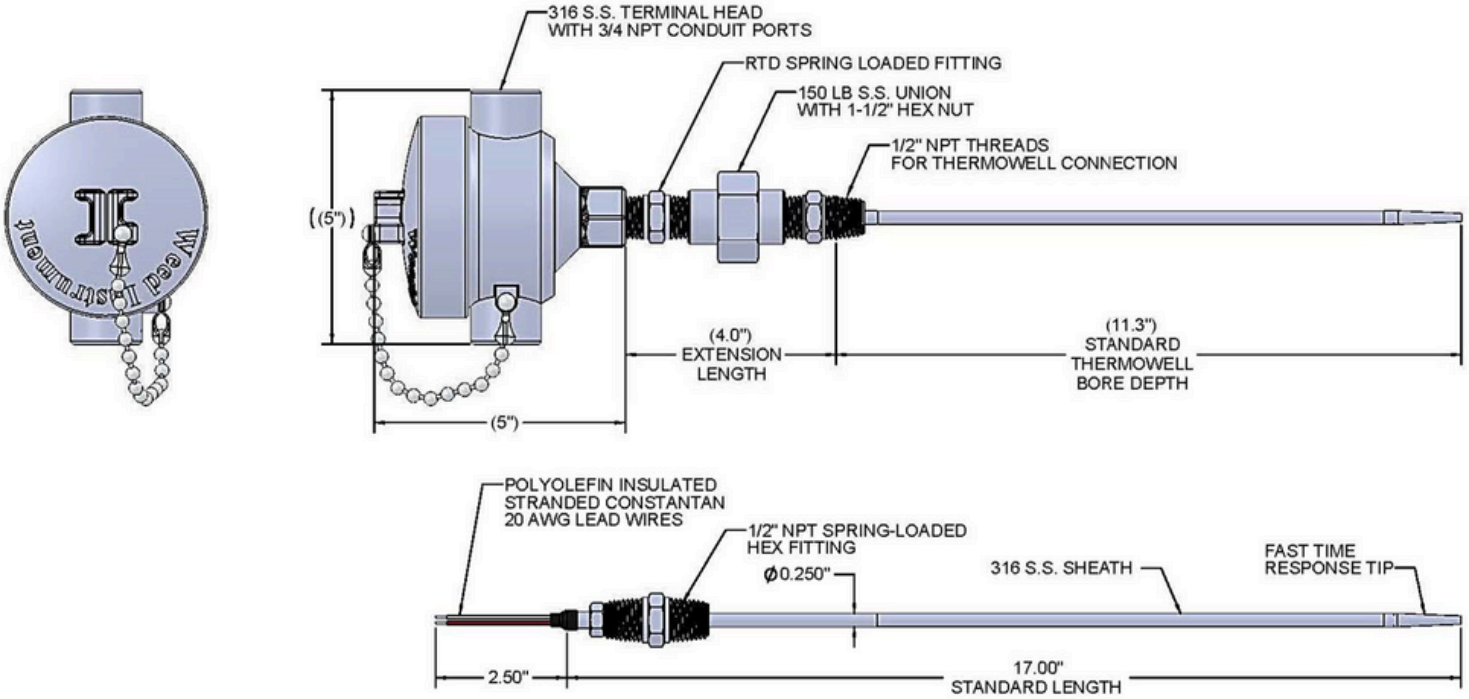
Code	Cable or Wire Length on Socket Side
000	Socket Side Not Supplied
XXX	Length to the nearest inch

880701	-	8	-	20	-	B	P	E	3	F	3	F	-	60	-	72	-	240	-	252

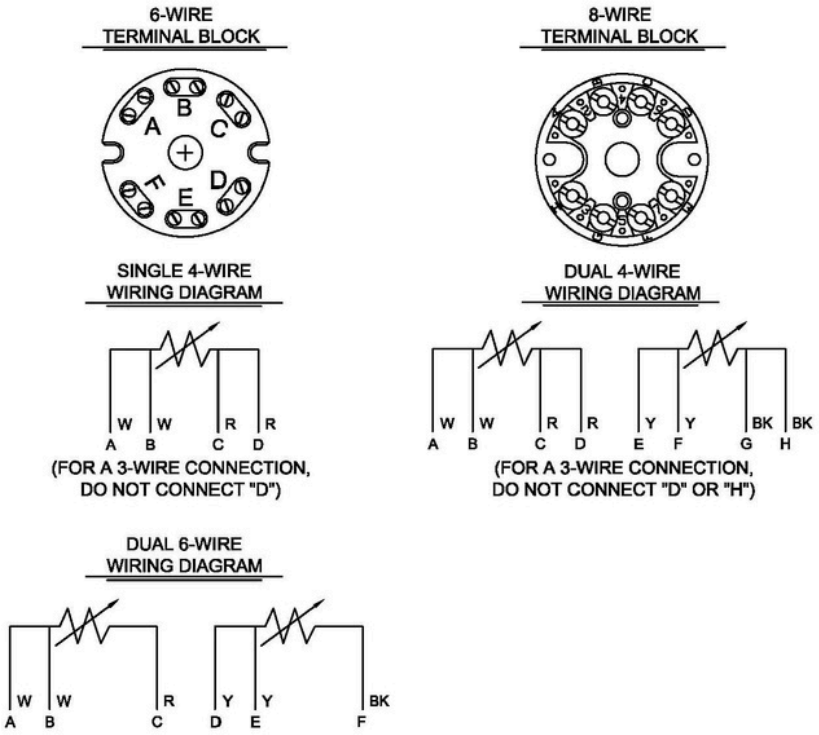
Note: There is no Gen 3 QDC model number configuration. Contact the factory to obtain the specific Gen 3 model number.

Technical specification

Typical assembly configuration

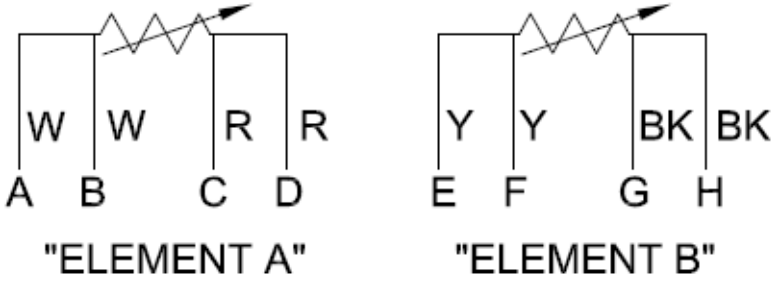


Typical wiring diagram



Technical specification

QDC wiring diagram

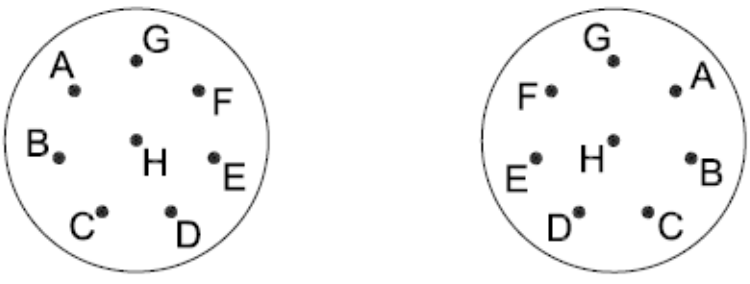


WIRING COLOR CODE
W = WHITE
R = RED
Y = YELLOW
BK = BLACK

NOTE:

- ELEMENT "A" - ELEMENT CLOSEST TO THE TIP WILL BE COLOR CODED AS RED & WHITE AND CONNECTED TO QDC PINS A, B, C & D.
- ELEMENT "B" - ELEMENT ABOVE ELEMENT "A" WILL BE COLOR CODED AS BLACK & YELLOW AND CONNECTED TO QDC PINS E, F, G & H.

CONNECTOR WIRING DIAGRAM



FAQs

Can I order the N9004 with a QDC?
Yes. Please contact Nuclear Sales to determine exact model number and configuration.

Can I specify my own required calibration points?
Yes. Calibration at ice point (32°F/0°C) and boiling point (212°F/100°C) are required to determine the appropriate Alpha temperature coefficient. Up to 4 additional calibration points at higher temperatures can be specified. Data from only 3 of the actual calibration points (32°F/0°C, 212°F/100°C and a select third point) will be used to generate a custom temperature versus resistance table using the Callendar-Van Dusen equation.

Can the N9004 RTD be ordered to meet special accuracy needs?
Yes. Please contact Nuclear Sales with the specific requirements so we may determine if we can meet your needs.

Can I use my own thermowell with the N9004 RTD?
Yes, but response time will be adversely affected. The RTD to thermowell interface must be designed and manufactured correctly for the N9004 to achieve a fast response.

Can Cross Calibration and LCSR (Loop Current Step Response) be performed on the N9004?
Yes. Cross calibration and LCSR testing is normally performed during either startup or shutdown sequence of the power plant. The maximum current allowed for LCSR testing is 40 mA.

Is there a specification for insulation resistance at operating temperature?
The standard for high temperature insulation resistance for N9004 RTDs is the insulation resistance between any wire and the external case will be at least 20 MΩ with 100 VDC applied with the RTD sensing portion at a test temperature of 625°F (~330°C). The test voltage is normally applied for a minimum of 30 seconds prior to recording any measurement.

About Ultra Energy

Organizations working with nuclear and industrial technologies must deliver reliable production at the same time as safeguarding people, the environment and infrastructure. We develop and manufacture measurement and control solutions that give our customers complete, long-term control over systems operating in harsh environments, helping them operate safely and increasing the value derived from their investments over their total lifespan.

Part of Curtis-Wright, Ultra Energy has worked with nuclear and industrial customers for over 60 years. We support customers across the world from facilities located in the US and UK. Our solutions are embedded in strategic national infrastructure and our people are active partners in customer programs that are focused on delivering advanced future nuclear and industrial capabilities.

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