

**RTT20**  
**I/A Series<sup>®</sup> Temperature Transmitter**

**Installation, Configuration, Operation,  
Calibration, and Maintenance**

**Style A**



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# 1. Introduction

## General Description

The RTT20 I/A Series Temperature Transmitter is a microprocessor-based, two-wire device for converting various mV and ohm type sensors into a linear 4 to 20 mA or digital output. A standard two-wire system provides a nominal 24 V dc power to the transmitter and also carries the output signal to a receiver tied into the loop wiring. There are three different output types with communications capabilities as follows:

Output Code -I: 4 to 20 mA without remote communications

Output Code -T: 4 to 20 mA output with HART communication

Output Code -D: 4 to 20 mA or FoxCom™ digital communication

The microprocessor-based transmitter was designed for easy installation in a wide variety of applications. The major differences between the three output types is in communications. The optional 1-Line and 3-Line Indicator/Configurators are designed to enable the user to locally reconfigure any transmitter database. A single indicator can be easily moved from one transmitter to another. No tools are required to install or remove it. Simply plug it in and make the desired adjustments to the transmitter. Then remove it and move on to the next transmitter. The 4 to 20 mA transmitter (Output Code -I) can only be adjusted using these Indicator/Configurators because there is no remote communications capability. Whenever the local Indicator/Configurators are used for reconfigurations, the loop must be put in manual. As a safety feature, the output will be held at the last value until the transmitter is returned to the operational mode.

The HART and FoxCom protocol transmitters have an internal modem to enable the database to be remotely reranged or reconfigured as follows:

HART protocol – with a HART Communicator or a Foxboro PC-based configurator.

FoxCom protocol – with a PC-Based Configurator and/or from an I/A Series system.

All of the remote configurators can communicate with the transmitter from any wiring termination point in the loop. This allows the transmitter to be installed in hazardous locations or areas which are not at grade level. The configurator can only be used in an area for which it is rated. Communication between the remote configurator and the transmitter is based upon the Frequency Shift Keying (FSK) technique. Since the FSK tones do not add any current to the two-wire system, reading transmitter data does not interfere with the output signal. When new configuration data is being downloaded into the transmitter, however, the output is interrupted and the loop must therefore be put in manual. The transmitter with FoxCom protocol can also be digitally integrated into an I/A Series System and reconfigured with any of the system workstations, eliminating the need for the separate configurator.

The microprocessor-based transmitter has been designed to accept a wide variety of mV and resistive sensors:

- ◆ Thermocouples
- ◆ RTDs (2, 3 or 4 wire)
- ◆ Millivolt dc sources
- ◆ Resistive Sensors (Ohms measurement)
- ◆ Dewpoint Sensors (Foxboro Model 2781)

The input and output characteristics are determined by the configuration information loaded into the transmitter at the factory. This configuration can be easily changed using the Indicator/Configurators or any of the various remote configurators.

## Transmitter Identification

See Figure 1 for typical transmitter data plate contents. For a complete explanation of the Model Number code, see PL 008-659.

**— NOTE**

Figure 1 shows a typical data plate. For a recapitulation of the specific information that applies to each agency certification, see “Electrical Certification Rating” on page 15.

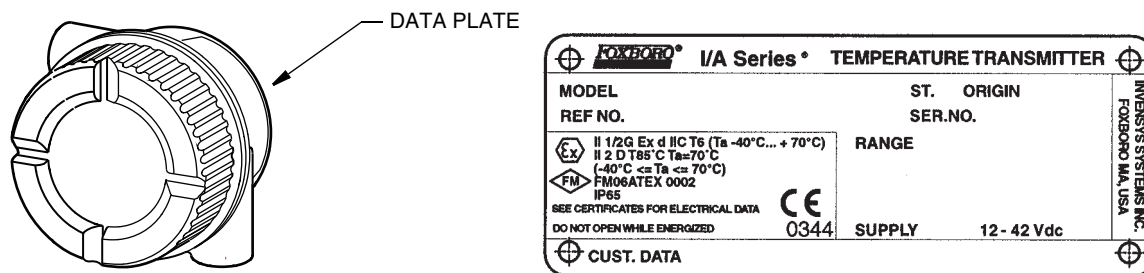


Figure 1. Transmitter Identification

## Reference Documents

This document contains information on installation, configuration, operation, calibration, and maintenance of the RTT20 Transmitter. Additional information about the transmitter and the remote configurators are contained in the documents listed in Table 1.

Table 1. Reference Documents

Document	Description
MI 020-460	Operation, Calibration, and Configuration Using a HART Communicator
MI 020-484	HART Model 275 Communicator Messages
MI 020-495	PC20 Intelligent Transmitter Configurator
MI 020-501	PC50 Intelligent Field Device Tool (Installation and Parts List)
MI 020-504	PC50 Intelligent Field Device Tool (Operation Using HART Protocol)
MI 020-505	PC50 Intelligent Field Device Tool (Operation Using FoxCom Protocol)
PL 008-659	Parts List - RTT20 I/A Series Temperature Transmitter
DP 020-460	Dimensional Print - I/A Series Temperature Transmitter

# Standard Specifications

## Operating Conditions

*Table 2. Operating Conditions*

Influence	Reference Operating Conditions	Normal Operating Conditions
Ambient Conditions Without Integral Display With Integral Display	24 ±2°C (75 ±3°F) 24 ±2°C (75 ±3°F)	-40 to +85°C (-40 to +185°F) -29 to +70°C (-20 to +158°F)
Relative Humidity	50 ±10%	0 to 100% (noncondensing)
Supply Voltage	30 ±0.5 V dc	12 to 42 V dc
Vibration	0 m/s <sup>2</sup> (0 g)	30 m/s <sup>2</sup> (3 g) maximum(a)

(a) Limited to 10 m/s<sup>2</sup>(1 g) maximum with 316 ss housing.

## Functional Specifications

<b>Input Types and Range Limits</b>	See Table 4.
<b>Span Limits</b>	Minimum: 5°C (10°F). Maximum: See Table 4.
<b>Output Types</b>	4 to 20 mA. 4 to 20 mA with HART communication. 4 to 20 mA or FoxCom digital communication.
<b>Two-Wire Transmitter</b>	The same two wires are used for input power, output signal, and remote communication.
<b>Input Response Time</b>	With minimum damping, the 90% response time for an 80% input step is 1.2 seconds.
<b>Electronic Damping</b>	<u>4 to 20 mA Version</u> : 1.2 seconds . <u>HART Version</u> : Damping is set as a floating decimal point value between 0 and 32 seconds.  <u>FoxCom Version</u> : Damping is configurable to settings of 0.00, 0.25, 0.50, 1, 2, 4, 8, 16, and 32 seconds.
<b>Turn On Time</b>	Two-wire Sensor: 3.5 seconds. Three- and Four-wire Sensors: 7 seconds.
<b>Minimum Power Supply Current</b>	35 mA
<b>Output</b>	Ranging: Zero and span adjustment are non-interacting. Underrange Current: 3.8 mA. Overrange Current: 20.75 mA. Failsafe (User-Configurable for Output Code -D and -T): 4 to 20 mA Version: Upscale/Downscale ON/OFF HART and FoxCom Versions: Downscale: 3.6 to 3.8 mA. Upscale: 20.75 to 23.0 mA. Action: Direct or Reverse.
<b>Output Update Rate</b>	4 to 20 mA: 6 times per second (all output versions). HART Digital: 2 times per second. FoxCom Digital: 10 times per second.
<b>Electromagnetic Compatibility (EMC)</b>	The RTT20 complies with the requirements of the European EMC Directive 89/336/EEC.
<b>Isolation</b>	500 V ac, rms.

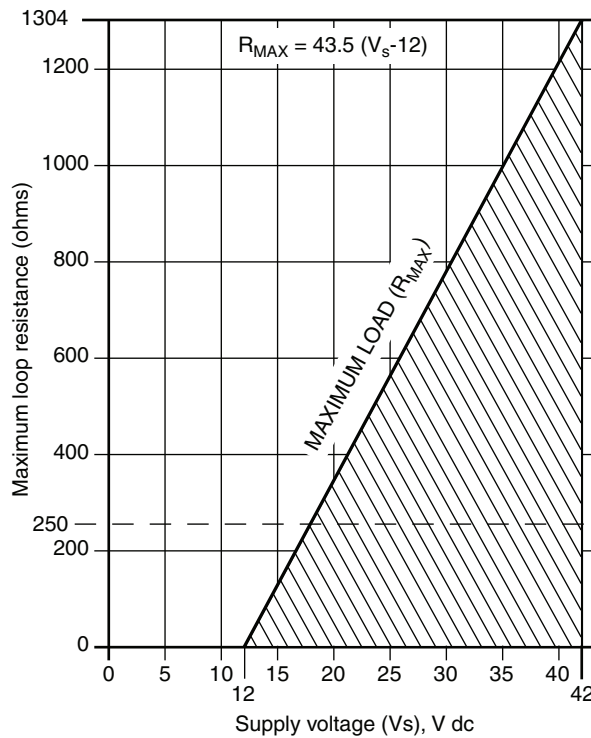
**Input Impedance  
(mV Input Mode)  
RFI Protection**

>10 MΩ.

**Susceptibility radiated**

- In metal housing:
  - 30 V/m peak; 26-1000 mHz
  - 50% AM @ 11 kHz
  - 30 V/m peak; 900 MHz;
  - 50% duty cycle; 200 Hz rep.rate
- Basic Transmission:
  - 20 V/m peak; 26-1000 mHz
  - 50% AM @ 11 kHz
  - 20 V/m peak; 900 MHz;
  - 50% duty cycle; 200 Hz rep.rate

**Supply Voltage  
Requirements and External Loop  
Load Limitations**



**NOTES:**

1. MINIMUM LOAD WITH HART COMMUNICATOR OR PC-BASED CONFIGURATOR CONNECTED IS 250 Ω.
2. CONNECTING A PC-BASED CONFIGURATOR OR HART COMMUNICATOR WHILE OPERATING BELOW THE MINIMUM SPECIFIED LOAD MAY CAUSE COMMUNICATION PROBLEMS.

*Table 3. Input Types***Single Sensor**

Sensor Type	Conventional Output Code -I	FoxCom Output Code -D	HART Output Code -T
T/C Type B, C, E, J, K, L, N, R, S, T, U	Yes	Yes	Yes
RTD (2-, 3-, or 4-wire) 100 ohm DIN or SAMA	Yes	Yes	Yes
RTD 2-, 3-, or 4-wire) 100, 120, or 200 ohm Nickel	No	Yes	Yes
RTD (2-, 3-, or 4-wire) 10 ohm copper	No	Yes	Yes
Millivolt	Yes	Yes	Yes
Ohms (2-, 3-, or 4-wire)	Yes	Yes	Yes
Dewpoint	No	Yes	Yes
2 to 22 Point Custom Curve	No	Yes	Yes

**Dual Sensors**

Sensor Type RTD (2-wire only) DIN or SAMA	Conventional Output Code -I	FoxCom Output Code -D	HART Output Code -T
Redundant	No	No	No
Difference	No	Yes	Yes
Average	No	Yes	Yes
Independent (with digital output only)	No	Yes	Yes

Table 4. Range Limits, Maximum Span, and Accuracy (a)

Input Type	Model Code Letter	See Note	Range Limits		Maximum Span		± Digital Accuracy (b)(p)	
			°C	°F	°C	°F	°C	°F
RTD (2, 3, or 4 wire)								
Pt100 DIN/IEC	Q	c	-200 and +850	-328 and +1562	1050	1890	0.05	0.09
Pt100 DIN/IEC	A	d	-200 and +850	-328 and +1562	1050	1890	0.05	0.09
Pt100 SAMA	P	e	-200 and +650	-328 and +1202	850	1530	0.05	0.09
Ni 200	D	f,n	-130 and +315	-202 and +599	445	801	0.44	0.79
Ni 120, Minco	G	n	-80 and +320	-112 and +608	400	720	0.03	0.05
Ni 100	I	g,n	-60 and +250	-76 and +482	310	558	0.04	0.07
Cu 10	F	h,n	-70 and +150	-94 and +302	220	396	0.51	0.92
Thermocouple								
Type B	B	k,r	0 and +1820	+32 and +3308	1820	3276	0.51	0.92
Type C	C	k,p	0 and +2320	+32 and +4208	2320	4176	0.38	0.68
Type E	E	k	-270 and +1000	-454 and +1832	1270	2286	0.08	0.14
Type J	J	k	-210 and +1200	-346 and +2129	1410	2538	0.11	0.20
Type K	K	k	-270 and +1372	-454 and -2502	1642	2956	0.14	0.25
Type L	L	m	-200 and +900	-328 and +1652	1100	1980	0.13	0.23
Type N	N	k	-270 and +1300	-454 and +2372	1570	2862	0.15	0.27
Type R	R	k	-50 and +1768	-58 and +3214	1818	3272	0.42	0.76
Type S	S	k	-50 and +1768	-58 and +3214	1818	3272	0.49	0.88
Type T	T	k	-270 and +400	-454 and +752	670	1206	0.10	0.18
Type U	U	m	-200 and +600	-328 and -1112	800	1440	0.09	0.16
Other								
Millivolt	M		-15 and +115 mV dc		130 mV dc		6 μV	
Resistance	O		1 and 500 Ω		500 Ω		20 mΩ	
Dew Point	W	n	-45 and +96°C (-50 and +205°F)		142°C (255°F)		0.05°C (0.09°F)	
Custom	Z	n	2 to 22-point user-configurable curve					

(a) For 4 to 20 mA output accuracy, add ±0.05% to digital accuracy.

(b) Digital accuracy is either the listed value or ±0.01% of span, whichever is greater. For thermocouples only, add the applicable cold junction error to digital accuracy:

Integral: ±0.2°C (±0.5°F).

Remote: Depends on accuracy of remote sensor.

(c) IEC/DIN 751; alpha = 0.00385 (1984) ASTM-B Standard Accuracy.

(d) IEC/DIN 751; alpha = 0.00385 (1984) ASTM-A High Accuracy.

(e) SAMA Standard RC 21-4; alpha = 0.003923.

(f) NR 226/227. Refer to TI 005-24a.

(g) DIN 43760.

(h) CR 228/229. Refer to TI 005-24a.

(k) NIST Monogram 125, DIN IEC 584.

(m) DIN 43710 (1985).

(n) Not accessible with optional LCD Indicator/Configurator.

(p) Tungsten 5% Rhenium-Tungsten 26%.

(q) Does not include sensor accuracy.

(r) May exhibit a decrease in performance at temperatures below 43°C (109°F).

## Physical Specifications

Basic Transmitter	Polycarbonate with molded ryton terminal block. Screw terminals of nickel over copper-plated steel.			
Mounting Options	Option	Code	Bracket	Hardware
	Mounting Set	-M1	Epoxy-Coated Steel	Plated Steel
	Stainless Steel Mounting Set	-M2	Stainless Steel	Stainless Steel
	DIN Rail Hardware	-D1	Aluminum and Plastic	Plated Steel
Enclosure Construction	Housing: Epoxy-coated, low-copper aluminum or 316 ss. Union coupling (thermowell only): zinc plated steel or 316 ss.			
Environmental Protection	Housing: NEMA 4X, IP66.			
Approximate Mass	Basic Transmitter Package: 0.13 kg (0.28 lb). Aluminum Pipe or Surface Mount Housing: 1.47 kg (3.25 lb). 316 ss Pipe or Surface Mount Housing: 3.25 kg (7.25 lb). 3-Line Indicator: Add 0.06 kg (0.13 lb).			
Housing Connections (2)	1/2 NPT (see note below)			

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### — NOTE

Housings with optional PG 13.5 connections are available except in transmitters that are certified for explosionproof/flameproof installations.

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## Electrical Certification Rating

The electrical certification is printed on the agency label which is located on the basic module and on the transmitter housing (if applicable). The Electrical Safety Design Code is also included as part of the model code on the data plate which is located on the basic module or on the transmitter housing (if applicable). See Figure 1 for an example of a typical data plate. For a complete explanation of the model code, see PL 008-659.

### DANGER

To prevent possible explosions and to maintain explosionproof, dust-ignitionproof protection, observe applicable wiring practices. Plug any unused conduit opening with a metal pipe plug, which engages a minimum of five full threads.

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### WARNING

To maintain IEC IP66 and NEMA Type 4X protection, any unused conduit opening must be plugged with a metal plug. In addition, the threaded housing cover must be installed. Hand tighten cover as much as possible so that the O-ring is fully captured.

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## Electrical Safety Specifications

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### — NOTE

These transmitters have been designed to meet the electrical safety description listed in Table 5. For detailed information or status of agency approvals/certifications, contact Global Customer Support.

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Table 5. Electrical Safety Specifications

Agency Certification, Type of Protection, and Area Classification	With Package Config. Codes	Application Conditions	Electrical Safety Design Code
<b>CENELEC</b> (KEMA) intrinsically safe EEx ia, IIC, Zone 0.	All	KEMA No. Ex-95.D4252X Temperature Class T4 - T6.	EA
<b>CENELEC</b> (KEMA) Nonsparking/nonincendive, Ex N IIC	All	KEMA No. Ex-95.Y.4253X Temperature Class T4 - T6.	KN
<b>ATEX (FM)</b> flameproof, II 1/2 G, Ex d, IIC.	S, T, L, M	FM06ATEX0002 Temperature Class T6. Ta = -40 to +70°C	ED
<b>ATEX (FM)</b> flameproof, II 2 G, Ex d, IIC.	W, Y	FM06ATEX0002 Temperature Class T6. Ta = -40 to +70°C	
<b>ATEX (FM)</b> flameproof, II 2 D.	S, T, L, M, W, Y	FM06ATEX0002 T85°C, Ta = 70°C max. ambient	
<b>CSA</b> intrinsically safe, Class I, Division 1, Groups A, B, C, and D.	B	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient. Connect per MI 020-454.	CA
<b>CSA</b> intrinsically safe, Class I, Division 1, Groups A, B, C, and D; dust-ignitionproof, Class II, Division 1, Groups E, F, and G; Class III, Division 1.	S, T, L, M, W, Y	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient. Connect per MI 020-454.	
<b>CSA</b> Class I, Division 2, Groups A, B, C, and D.		Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	
<b>CSA</b> Explosionproof, Class I, Division 1, Groups B, C, and D; dust-ignitionproof, Class II, Division 1, Groups E, F, and G; and Class III, Division 1.	S, T, L, M, W, Y	Connect to source not exceeding 42 V. Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	CD <sup>(a)</sup>
<b>CSA</b> Class I, Division 2, Groups A, B, C, and D.		Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	
<b>CSA</b> Class I, Division 2, Groups A, B, C, and D.	All	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	CN
<b>FM</b> intrinsically safe, Class I, Division 1, Groups A, B, C, and D.	B	Temperature Class T6; T4 at 85°C maximum ambient. Connect per MI 020-454.	FA
<b>FM</b> intrinsically safe, Class I, Division 1, Groups A, B, C, and D; dust-ignitionproof, Class II, Division 1, Groups E, F, and G; Class III, Division 1.	S, T, L, M, W, Y	Temperature Class T6; T4 at 85°C maximum ambient. Connect per MI 020-454.	
<b>FM</b> nonincendive, Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.		Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	
<b>FM</b> Explosionproof, Class I, Division 1, Groups B, C, and D; dust-ignitionproof, Class II, Division 1, Groups E, F, and G; and Class III, Division 1.	S, T, L, M, W, Y	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	FD <sup>(a)</sup>
<b>FM</b> nonincendive, Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.		Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	
<b>FM</b> nonincendive, Class I, Division 2, Groups A, B, C, and D.	B	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	FN
<b>FM</b> nonincendive, Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.	L, M, S, T, W, Y	Temperature Class T4 at 85°C and T6 at 40°C maximum ambient.	
<b>IECEx</b> flameproof, Ex d IIC	L, M, S, T, W, Y	IECEx FMG07.0001X Temperature Class T6. Ta = 70°C	VV

(a) FM approval and CSA certification of the Model RTT20 for the explosionproof rating listed above included pressure piling tests with various lengths of conduit to ensure that conduit seals per NEC 501-5(a)1 within 457 mm (18 inches) of the housing are **not** required.