Rosemount™ 327T Temperature Transmitter

ROSEMOUNT™

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Contents

1   Introduction

The Rosemount 327T Temperature Transmitter detects media temperature and converts it into an analog output signal (4 - 20 mA). The temperature transmitter includes an IO-Link interface for configuring parameter settings or viewing process and diagnostic data.

1.1   Getting started

Follow these steps to configure the temperature transmitter for normal operation.

Procedure

1. Connect the temperature transmitter to a PC to set parameters using IO-Link.

2. Set the standard unit of measurement in °F or °C (**Uni**). (See Adjustable parameters)

3. Set the analog signal. (See Analog function)
    - **OU2**: **I** = 4-20 mA or **Ineg** = 20-4 mA

    - **ASP** and **AEP**: scaling of the measuring range.

4. Configure Drift Monitoring. (See Setting range for drW and drA)
    - **drW**: drift threshold at which the temperature transmitter signals "warning".

    - **drA**: drift threshold at which the temperature transmitter signals "alarm".

    - **ddr**: Drift Monitoring Diagnostic delay.

5. Set which diagnostic cases the temperature transmitter signals using **drEd**. (See Diagnostic cases)
    - **ON**: only failure diagnostic cases

    - **ONdr**: alarm and failure diagnostic cases

    - **OFF**: warning, alarm, and failure diagnostic cases

6. Configure analog signal for diagnostic cases (**FOU2**). (See Adjustable parameters)
    - **ON**: 21.5 mA

    - **OFF**: 3.5 mA

7. Configure switching signal for diagnostic cases in three-wire operation (**dOU1**). (See Diagnostic function (three-wire))
    - **dOU1**: Output opens, closes, or pulsates; according to configuration.

8. Configure output logic for diagnostic output in three-wire operation (**P-n**). (See Adjustable parameters)
    - **pnp**

    - **npn**

9. Complete all other necessary parameter settings.

Postrequisites

Perform these tasks to complete setting up the transmitter:

- Mounting the transmitter

- Wire the Transmitter

- Operation

1.2 Functions and features

The temperature transmitter detects process temperature and converts it into an analog output signal.

The temperature transmitter includes an IO-Link interface for configuring parameter settings or viewing process and diagnostic data.

The transmitter operates in two-wire or three-wire operation modes. The modes produce these output signals:

Operating mode	Output signals
Two-wire	Analog signal for temperature measurement and diagnostics
Three-wire	• OUT1: switching signal for diagnostics and IO-Link communication • OUT2: analog signal for temperature measurement and diagnostics

1.2.1 Analog function

The temperature transmitter converts the measured temperature value into an analog signal proportional to the temperature.

The temperature transmitter also uses the analog output to send diagnostic messages (see Diagnostic function). Diagnostic messages interrupt the transfer of the measured temperature value depending on the operating mode and drEd. The transmitter modifies the analog output to the following values according to NE43: 3.5 mA (FOU2 = On) or 21.5 mA (FOU2 = OFF).

Depending on the OU2 setting, the analog signal is between these measuring ranges in normal operation:

- I: 4-20 mA

- Ineg: 20-4 mA

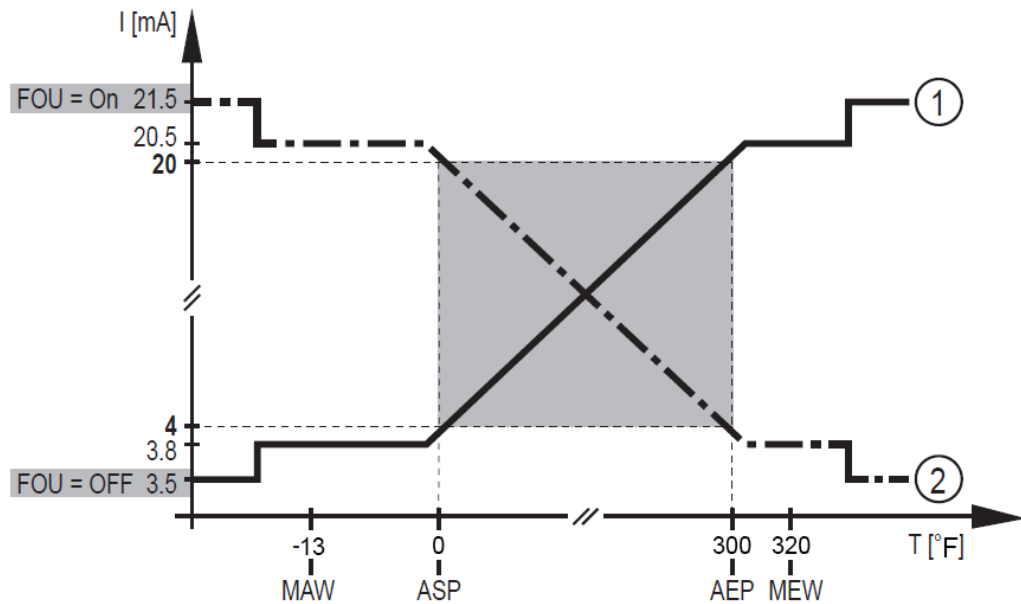The measuring range is scalable using these parameters:

- ASP: the analog start point and the measured temperature when the analog signal is 4 mA (OU2 = I) or 20 mA (OU2 = Ineg)

- AEP: the analog end point and the measured temperature when the analog signal is 20 mA (OU2 = I) or 4 mA (OU2 = Ineg).

Note
The minimum difference between ASP and AEP is 9°F (5°C).

If the measured temperature value is outside the scaled measuring range, the analog signal is 20-20.5 mA or 3.8-4 mA (see Figure 1-1). When the measured temperature value continues to increase or decrease, diagnostic case 5 occurs. For more information, see Diagnostic cases.

Figure 1-1: Analog output with factory settings

- 1: Setting OU2 = I
- 2: Setting OU2 = Ineg
- MAW: initial value of the measuring range
- MEW: final value of the measuring range
- ASP: analog start point
- AEP: analog end point

1.2.2   Diagnostic function

The temperature transmitter uses two different, thermally coupled sensor elements (NTC, PT 1000) to automatically detect drifts and errors during temperature measurement.

The temperature transmitter forms an average value using the individual NTC and Pt 1000 measured values. That value determines the measured temperature value and is the basis for Drift Monitoring Diagnostic (see Drift Monitoring).

The temperature transmitter can detect other errors. Use the parameter drEd to set which diagnostic cases the temperature transmitter signals. For more information, see Diagnostic cases.
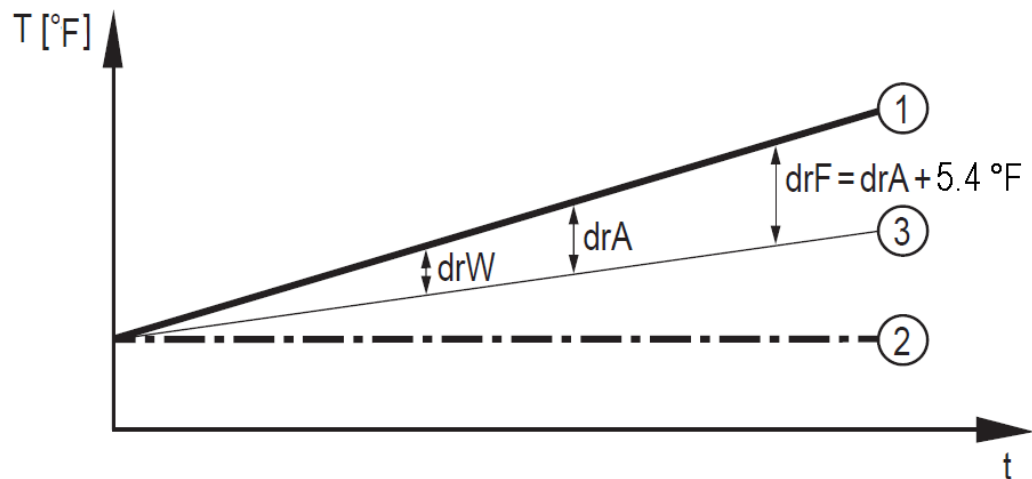
The analog signal provides diagnostic case messages in two-wire operations. In three-wire operations, the switching signal provides diagnostic case messages in addition to the analog signal.

Drift Monitoring

For Drift Monitoring Diagnostic, the temperature transmitter compares the temperature deviation of sensor element 1 (NTC) and sensor element 2 (Pt 1000) to the average temperature value. The parameters drW (warning threshold) and drA (alarm threshold) define the permissible temperature deviation.

When values exceed these thresholds, the temperature transmitter triggers drift monitoring and identifies a fault (see Diagnostic cases).

Figure 1-2: Drift monitoring example

Example: NTC sensor element (1) measures 149 °F and Pt 1000 sensor element (2) measures 140 °F. The average value (3) is 144.5 °F, i.e. both elements deviate by 4.5 °F. With setting drW = 4 °F and drA = 9 °F, the temperature transmitter provides a warning message if drEd = OFF. In this case, the temperature transmitter would not send an alarm message.

For more information about configuring drW and drA, see Setting range for drW and drA.

Note
Temperature difference of at most 0.18 °F (0.1 °C) can occur with sensor elements because of standard manufacturing tolerances. This does not affect the drift monitoring diagnostic.

Note
Large temperature changes in the medium might cause short-term differences between the measured temperature values of both sensor elements. To avoid short-term drift warnings, increase the drift warning delay time (ddr).

Sensor backup

If one of the two sensors in the transmitter fails, the temperature transmitter can use the remaining sensor for temperature measurement.

For more information on operating the temperature transmitter in backup mode, see Troubleshooting.

Note
Drift monitoring is not possible if a sensor fails and sensor backup is active.

Diagnostic cases

The temperature transmitter identifies error scenarios with these diagnostic cases.

For more information on parameters relating to diagnostic cases, see Adjustable parameters or Drift Monitoring.

Table 1-1: Warnings

Diagnostic number	Description
1	The temperature deviation exceeded the drift warning threshold (drW).
2	The temperature of the internal electronics exceeded the limit of 257 °F (125 °C).

Table 1-2: Alarms

Case number	Description
3	The temperature deviation exceeded the drift alarm threshold (drA).
4	One of the two sensor elements failed.
5	The measured temperature value is outside the allowable measuring range.
6	The supply voltage is outside the operating range.[1]

(1) For 2-wire operation, no diagnostic message is provided in case of low voltage (see Diagnostic function (two-wire)).

Table 1-3: Failures

Case number	Description
7	The temperature deviation exceeded the drift failure threshold (**drF**).
8	An error occurred while setting parameters using IO-Link.
9	Both sensor elements failed or general electronics problems.

Diagnostic function (two-wire)

In two-wire operation, the temperature transmitter uses the analog output for temperature measurement and diagnostics.

drEd configures the diagnostic cases that the temperature transmitter signals using the analog output:

- ON: Limits the diagnostic messages to only failure messages. The temperature transmitter will signal only diagnostic cases 7-9.

- ONdr: Limits the diagnostic messages to alarm and failure messages. The temperature transmitter will signal only diagnostic cases 3-9.

- OFF: Allows all diagnostic messages. The temperature transmitter will signal all diagnostic cases.

For more information, see Diagnostic cases.

To signal a diagnostic case, the temperature transmitter interrupts the transfer of temperature measurements and provides these analog outputs using FOU2:

- ON: 21.5 mA

- OFF: 3.5 mA

Note

In a two-wire operation, the temperature transmitter does not provide diagnostic messages in the event of low voltage.

Diagnostic function (three-wire)

In three-wire operation, the temperature transmitter uses an analog output for temperature measurement and a switching output for diagnostics and IO-Link communication.

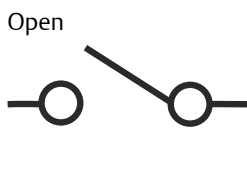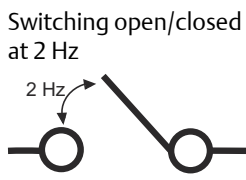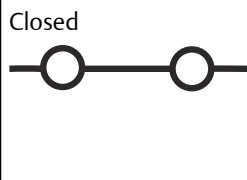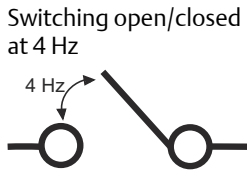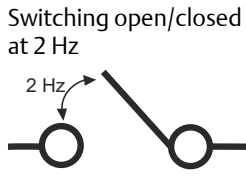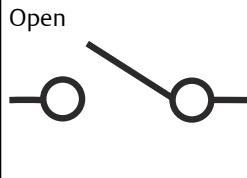drEd configures which diagnostic messages the temperature transmitter uses to indicate failures.

- ON: Signals only failure diagnostic messages for the analog and switching outputs (cases 7-9).

- ONdr: Signals only failure diagnostic messages (cases 7-9) for the analog output and alarm and failure diagnostic messages (cases 3-9) for the switching output.

- OFF: Signals only failure diagnostic messages (cases 7-9) for the analog output and all diagnostic messages (cases 1-9) for the switching output.

Note

Using the switching output in three-wire operation for diagnostics results in the analog output being disrupted only if a failure is seen. This ensures maximum use of the analog output.

dOU1 is used to define how the diagnostic output reacts to diagnostic messages:

dOU1	Normal	Warning	Alarm and failure
Normally closed (nc)	Closed	Closed	Open
Normally closed, extended (nc+)	Closed	Switching open/closed at 2 Hz 2 Hz	Open

dOU1	Normal	Warning	Alarm and failure
Normally open, extended (no+)	Open	Switching open/closed at 2 Hz	Closed
Heartbeat (Hb)	Switching open/closed at 4 Hz	Switching open/closed at 2 Hz	Open

1.2.3   IO-Link

The IO-Link communication interface enables direct access to process and diagnostic data. IO-Link can change parameter values without disrupting normal operation. Operating the temperature transmitter using IO-Link interface requires an IO-Link capable device (IO-Link master).

Using a PC, suitable IO-link software, and an IO-Link adapter cable enables communication with the temperature transmitter when not in operation.

The IODDs necessary for configuring the unit, detailed information about process data structure, diagnostic information, parameter addresses and the necessary information about the required IO-Link hardware and software are available at Emerson.com.

2   Installation

This section provides instructions for mounting and connecting the temperature transmitter.

2.1   Mounting the transmitter

This section provides instructions for mounting the temperature transmitter.

> **⚠ CAUTION**
>
> - Before installing or removing the temperature transmitter, ensure no pressure is applied to the system and there is no medium present.
>
> - Take measures to avoid dangers related to extreme machine and medium temperatures.

2.1.1   Installing with G1 process connection

These process connection adapters are available.

- Adapter with sealing ring

- G1 flange

  Note
  The sealing ring on the transmitter acts as the process seal. The upper sealing area on the process connection must be flush with the tapped hole and have a surface characteristic of at least 21 Ra (0.81 Ra).

Note
Tighten the temperature transmitter to a torque of 25.81 ft/lb (35 Nm).

Follow these guidelines for adapters with a leakage port:

- Mount the temperature transmitter horizontally or slightly diagonally. Do not mount the transmitter to the lowest point of the tank or pipe.

- Align the leakage port so that it is located at the lowest possible point.

Note
For more information about available adapters, see the *Rosemount™ 327T Product Data Sheet* or visit Emerson.com.

- Follow the instructions included with the adapter.

- Use a suitable and approved lubricating paste for the application.

2.1.2   Mounting in 3-A® environments

Follow these guidelines when installing the temperature transmitter in a 3-A compliant environment.

- Use only adapters certified for use in 3-A environments.

- Do not mount the temperature transmitter at the lowest point of the tank or pipe. Mounting the transmitter to a higher point allows the medium to run off the transmitter.

2.2   Wire the Transmitter

Follow these steps to wire the transmitter for two-wire or three-wire operations.
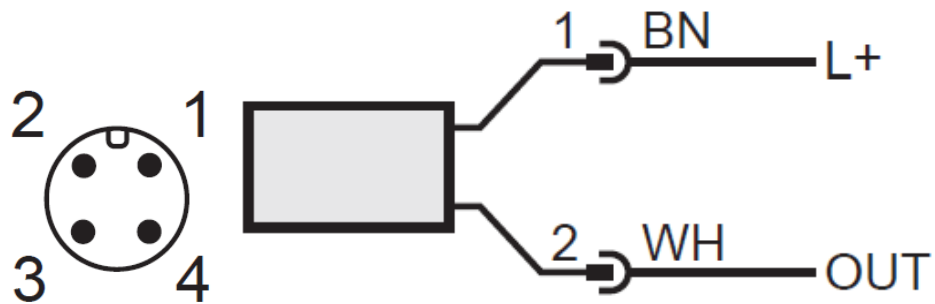
⚠ CAUTION

- A certified electrician must wire the temperature transmitter.

- Adhere national and international regulations when wiring the temperature transmitter.

Voltage supply to EN 50178, SELV, PELV / "supply class 2" to cULus.
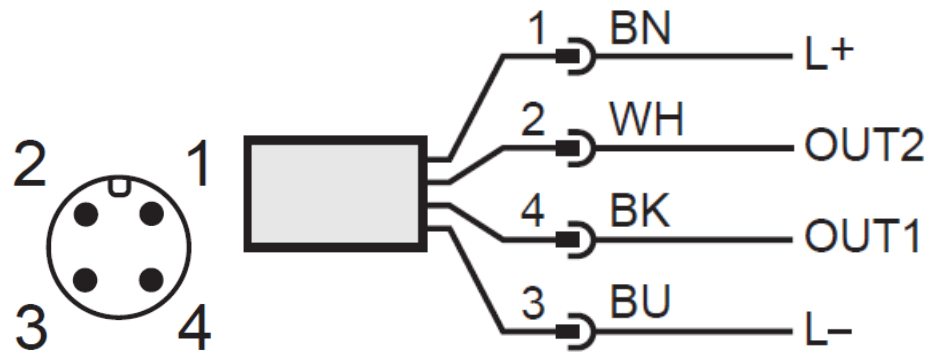
Procedure

1. Disconnect power from the temperature transmitter.
2. Wire the temperature transmitter according to the diagrams below.

Figure 2-1: For two-wire operation:

- BN: Brown   • Pin 1: L+
- WH: White   • Pin 2: OUT (analog signal for temperature and diagnostics)

Figure 2-2: For three-wire operation:

- BK: Black
- BN: Brown
- WH: White
- BU: Blue

- Pin 1: L+
- Pin 2: OUT2 (analog signal for temperature and diagnostics)
- Pin 3: L-
- Pin 4: OUT1 (switching signal for diagnostics and IO-Link communication)

3   Operation

This section provides information for using the temperature transmitter.

3.1   Setting Parameters

These options are available when setting parameter values using IO-Link.

- Reading current process values.

- Reading, changing and saving current parameter settings and transmitting them to other units of the same type.

- Read saved diagnostic information (see Troubleshooting).

Note
To configure the temperature transmitter, connect the temperature transmitter to a PC using the IO-Link interface. For more information, go to Emerson.com.

3.1.1   Adjustable parameters

This table describes parameters that can be modified.

Parameter	Description
Uni	Sets the standard unit of measurement: °F or °C .
OU2	Configuration of the analog signal: I = 4-20 mA or Ineg = 20-4 mA
ASP	Analog start point for measured temperature value
AEP	Analog end point for measured temperature value
drW	Drift warning threshold. If the temperature measurement exceeds the deviation value, the temperature transmitter sends a warning diagnostic message when drEd is set to OFF. • °F/°C: Maximum permitted temperature deviation of both sensor elements from the average value. • OFF: Drift warning deactivated.
drA	Drift alarm threshold. If the temperature measurement exceeds the deviation value, the temperature transmitter sends an alarm diagnostic message when drEd is set to ONdr or OFF. • °F/°C: Maximum permitted temperature deviation of both sensor elements from the average value. • OFF: Drift alarm deactivated.

Parameter	Description
drF	Drift failure threshold drF = drA + 5.4 °F (3 °C) . If the temperature measurement exceeds the deviation value, the temperature transmitter sends a failure diagnostic message.
	Note
	• The drF value is a result of the drA setting. drF cannot be set.
	• Setting drA to OFF automatically results in: drF = 14.4 °F (8 °C)
ddr	Delay of the drift detection. The time which the drift value must be above the warning threshold drW or alarm threshold drA before the temperature transmitter sends a diagnostic signal (0.5 - 300 minutes).
drEd	Sets which diagnostic cases the temperature transmitter communicates.
	• ON: Limits the diagnostic cases to "failure" cases.
	• ONdr: Limits the diagnostic cases to "alarm" and "failure" cases.
	• OFF: Limits the diagnostic cases to "warning", "alarm" and "failure" cases.
FOU2	Response of the analog signal when a diagnostic case occurs. Instead of the measured temperature value, the temperature transmitter provides a defined current value according to Namur NE43 (On: 21.5 mA; OFF: 3.5 mA).
dOU1	Response of the diagnostic switching output after a diagnostic case occurs. The output opens, closes, or pulsates depending on the configuration.
P-n	The switching logic for the diagnostic output: pnp or npn.
HI	Displays the highest recorded temperature measurement.
LO	Displays the lowest recorded temperature measurement.
Fnr	Shows the fault number. For more information, see Troubleshooting.
rES	Restores factory default settings.
	Note Record the current parameter settings before restoring the factory default settings.

3.2 Operating mode

Eight seconds after applying power, the temperature transmitter is in run mode and is operating within specifications. In run mode, the transmitter measures and evaluates temperature and provides output signals according to parameter settings.
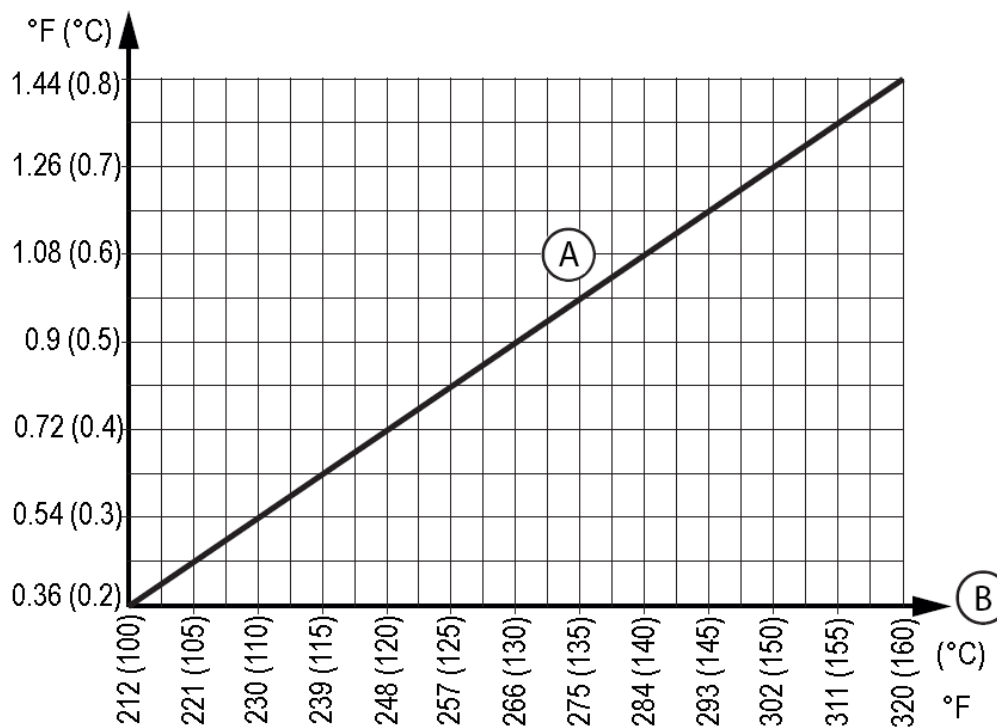
4   Setting range for drW and drA

This table shows the allowable setting ranges for drW and drA depending on process temperature.

Process temperature range		Setting range
14 to 212 °F	-10 to 100 °C	0.36 to 9 °F (0.2 to 5 °C)
-13 to 32 °F	-25 to 0 °C	0.54 to 9 °F (0.3 to 5 °C)
> 212 °F	> 100 °C	[A] to 9 °F (5 °C)[1]

(1) See Figure 4-1 for the minimum value for [A].

Figure 4-1: Minimum setting ranges for drW and drA

A. Minimum value for drW and drA
B. Medium temperature

Note

- If the value for drW or drA is lower than the value [A], it changes automatically to the value [A].

- In case of operation in gaseous media, the value should be greater than 0.6 °F (0.35 °C).

5 Troubleshooting

This table includes the steps needed to correct errors with the temperature transmitter.

1. Connect the temperature transmitter to a PC.

2. Read the value for the parameter **Fnr**.

3. Take corrective measures as instructed by this table:

Fnr	Type of fault	Corrective measures
0	No fault, no anomaly occurred.	None
20	Internal malfunction in the transmitter electronics.	Replace the temperature transmitter.
21	Sensor backup is active, possibly because a sensor element failed.	1. Replace the temperature transmitter. 2. Continue measurement with only one sensor element while waiting for replacement transmitter: • In two-wire operation, set **drEd** to ON so the remaining temperature sensor element can communicate the measured temperature value using the analog signal. In this case, the analog output provides diagnostics in case of a failure. • In three-wire operation, the temperature transmitter can signal all diagnostic cases using the switching output except those used for drift monitoring (diagnostic cases 1, 3, 7).
30	Wiring fault	Check the wiring.
42	The temperature is outside the allowable temperature range. The analog signal is 21.5 mA (FOU2 = On) or 3.5 mA (FOU2 = OFF)	1. Check measuring range. 2. Adjust **ASP** and **AEP** values to accommodate the operating conditions or correct the process temperature.
71	Detected sensor drift exceeds warning level **drW**	At the first detected drift. 1. Check if the parameter **drW** is programmed correctly. 2. Prepare replacement of the unit.
72	Drift exceeds alarm threshold **drA**. The temperature measurement might be less accurate.	1. Check that the parameter **drA** is programmed correctly. 2. Replace the temperature transmitter.

Fnr	Type of fault	Corrective measures
91	Supply voltage is outside the operating voltage range.	Check the supply voltage and ensure the voltage supply is correct.
92	Operating temperature of the electronics is outside the recommended range.	1. Check the temperature of the transmitter housing considering ambient and process temperature conditions. 2. Make necessary adjustments to adhere to the recommended operating temperature range.
100	Error while setting parameters using IO-Link.	Modify the parameter setting using IO-Link again or reset all parameters to factory default settings.

6 Product certifications

6.1 European directive information

The most recent revision of the EC Declaration of Conformity can be found at Emerson.com/Rosemount.

6.2 Ordinary location information

As standard, this product has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

Voltage supply to EN 50178, SELV, PELV / "supply class 2" to cULus.

6.3 3-A® certification

This product is authorized to display the 3-A symbol. Ensure gaskets and process connection accessories selected for installation meet both the application and 3-A requirements. A certificate of compliance is available at Emerson.com/Rosemount.

6.4 Other industry certifications

All Rosemount 327T transmitter surfaces and materials which come into contact with process medium comply with the following regulations:

7 Factory settings

Use this worksheet to reference factory default settings and record user-modified settings.

Parameter	Factory-default setting	User-defined setting
OU2	I	
ASP	0 °F	
AEP	300 °F	
drW	0.36 °F	
drA	0.9 °F	
ddr	30 min	
drEd	Ondr	
dOU1	nc+	
FOU2	On	
p-n	PnP	
Uni	°F	

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