Model DT335-0700, 2/3/4-Wire RTD Input Transmitter

USB Programmable, DIN Rail Mount, DC-Powered Dual/Single Transmitter or Signal Splitter w/ 2/3/4-Wire RTD or Resistance Inputs and Sourcing Current or Voltage Outputs

USER'S MANUAL

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IMPORTANT SAFETY CONSIDERATIONS

You must consider the possible negative effects of power, wiring, component, sensor, or software failure in the design of any type of control or monitoring system. This is very important where property loss or human life is involved. It is important that you perform satisfactory overall system design and it is agreed between you and Acromag, that this is your responsibility.

This manual is for DT335 dual 4-wire RTD transmitters (4-wire refers to this unit having separate isolated DC power input) that convert RTD/resistance input signals to isolated voltage or current output signals. If your application requires dual 2-wire RTD (loop-powered) transmitters instead, please refer to similar DT235 series models. For current/voltage signals, refer to our other DT33x models (4-wire) and DT23x (2-wire loop powered) models. For thermocouple input signals, please refer to our DT333 (4-wire) and DT233 (2-wire loop-powered) models.

GETTING STARTED
DESCRIPTION

Symbols on equipment:

Means "Refer to User's Manual (this manual) for additional information".

DT335-0700 channels are modeled after ANSI/ISA Type IV transmitters. Input channels interface with RTD sensors or resistance inputs and drive isolated DC outputs of voltage or current. This dual channel device is unique in that it may operate as a dual channel transmitter, a single channel transmitter, or channel 1 signal splitter. Units are setup, calibrated, and scaled using configuration software and a USB connection to Windows-based PC's (Windows 7 and later versions only), or using a USB-OTG cable to Android smartphones or tablets using the Agility mobile app. Units provide adjustable/scalable input/output ranges, plus dual signal output drive capability for voltage or current, input/output/power isolation for each channel, and variable input filtering.

Key Features

- **Digitally configured and calibrated w/ Windows software via USB, or a wired USB-OTG connection to Android smartphones or tablets.**
- **Dual Channels in a thin 17.5mm wide enclosure for high-density mounting.**
- **Operates as a dual transmitter, a single transmitter, or a CH1 signal splitter.**
- **High measurement accuracy and linearity with 16-bit I/O conversion.**
- **RTD input transmitter is linearized with respect to temperature (°C or °F).**
- **Resistance input transmitter is linearized with respect to resistance (Ω).**
- **Pt100, Pt200, Pt500, Pt1000, Copper, and Nickel type RTDs supported.**
- **25Ω, 450Ω, 2250Ω, and 4500Ω resistive ranges also supported.**
- **Connects to two-wire, three-wire, or four-wire RTD sensors.**
- **Four-wire sensor wiring eliminates error associated with lead-wire resistance, while three-wire sensor wiring compensates for lead-wire resistance.**
- **Supports Celsius, Fahrenheit, and Kelvin temperature units.**
- **Separate short-circuit protected voltage and current output terminals at each output supports ±10V, ±5V, 0-10V, 0-5V, or 0-20mA, 4-20mA output.**
- **Output channels can transmit Normal or Reverse Acting output signals.**
- **Up or down-scale lead-break/burnout detection.**
- **Both inputs and outputs are independently adjustable/scalable.**
- **Variable input filter adjustment (none, low, medium, high).**
- **Reverse-polarity protected 6-32VDC power is bus/redundant power ready.**
- **Wide ambient temperature operation from -40°C to +70°C.**
- **Thoroughly tested and hardened for harsh environments.**
- **CE Approved.**
- **FCC Conformity Class A**
- **cULus Listed - Class I/Division 2 - Haz. Loc., ATEX, & IECEx.**

Application

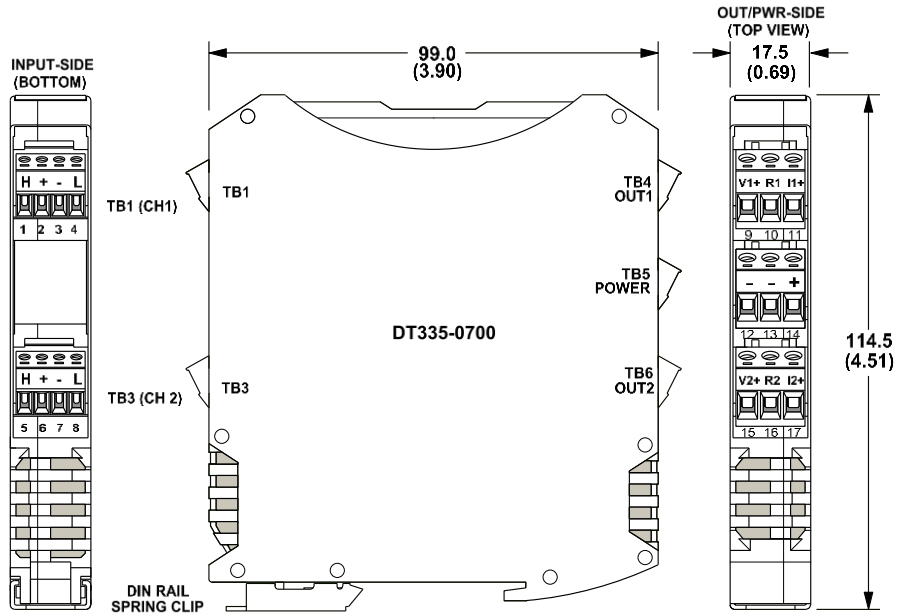
For additional information on these devices and related topics, please visit our web site at www.acromag.com. Also see whitepaper 8500-917: The Basics of Temperature Measurement Using RTD's.

DT300 dual transmitters are designed for high-density mounting on T-type DIN rails and can be mounted side-by-side on 0.7-inch (17.5mm) centers and support 6-32V DC power via terminals on the unit, or optionally via power wired to a DIN-rail bus connector. This model interfaces with RTD or resistance elements, isolates the input and allows it to mate with grounded or non-grounded signals, and provides an output signal linearized to the RTD sensor temperature, or resistance. Unit drives isolated outputs that source current or voltage from 0-20mA, 4-20mA, ±10V, ±5V, 0-10V, and 0-5V.

Mechanical Dimensions

Units may be mounted to 35mm "T" type DIN rail (35mm, type EN50022), providing two isolated I/O channels on 0.7-inch centers.

WARNING: *IEC Safety Standards may require that this device be mounted within an approved metal enclosure or sub-system, particularly for applications with exposure to voltages greater than or equal to 75VDC or 50VAC.*



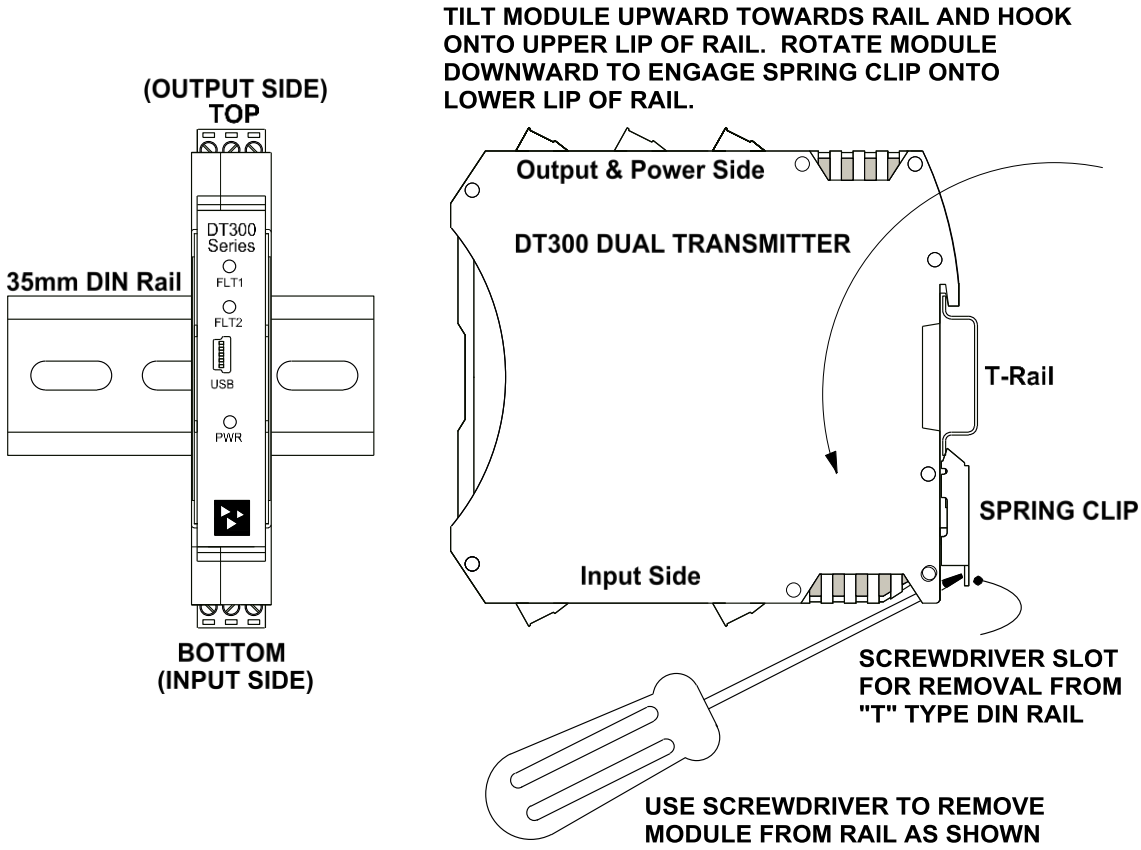
DIMENSIONS ARE IN MILLIMETERS (INCHES)

DIN Rail Mounting & Removal

NOTE: It is recommended that this unit be mounted upright on a DIN rail allowing free air flow intake from the bottom vent to flow through the unit and out the top vent. This will allow the unit to run cooler, perform better, and help to extend the life of the electronics.

Refer to the following figure for attaching and removing a unit from the DIN rail. A spring-loaded DIN clip is located on the input side bottom. The opposite rounded edge at the bottom of the output side allows you to tilt the unit upward to lift it from the rail while prying the spring clip back with a screwdriver. To attach the module to T-type DIN rail, angle the top of the unit towards the rail and place the top groove of the module over the upper lip of the DIN rail. Firmly push the unit downward towards the rail until it snaps into place. To remove it from the DIN rail, first separate the input terminal blocks from the bottom side of the module to create a clearance to the DIN mounting area. You can use a screwdriver to pry the pluggable terminals out of their sockets. Next, while holding the module in place from above, insert a screwdriver into the lower path of the bottom of the module to the DIN rail clip and use it as a lever to force the DIN rail spring clip down while pulling the bottom of the module outward until it disengages from the rail. Then simply lift it from the rail.

DT300 DUAL TRANSMITTER DIN RAIL MOUNTING AND REMOVAL



ELECTRICAL CONNECTIONS

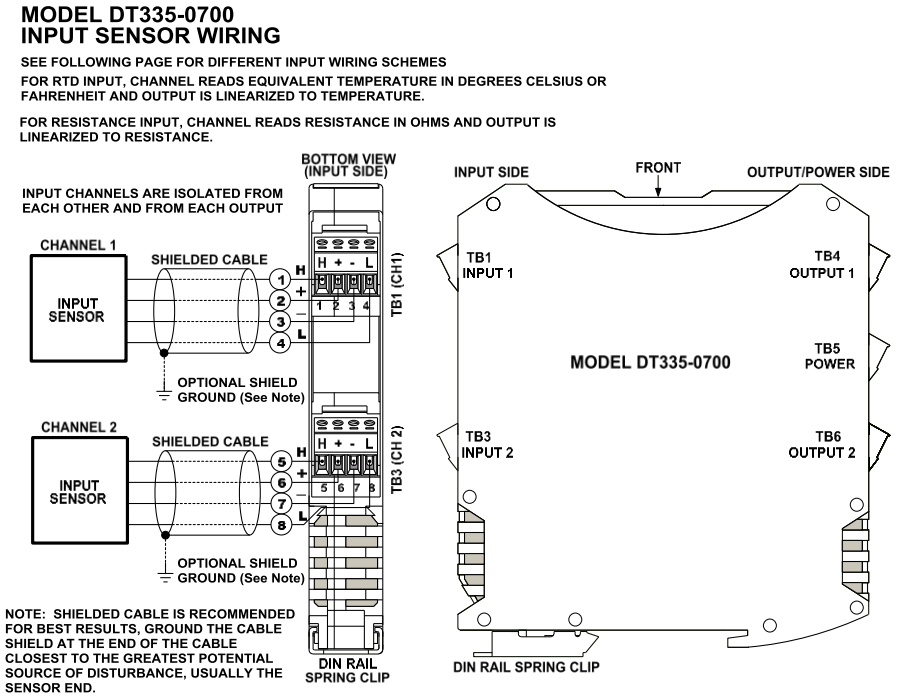
WARNING – EXPLOSION HAZARD – Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.
WARNING – EXPLOSION HAZARD – Substitution of any components may impair suitability for Class I, Division 2.
WARNING – EXPLOSION HAZARD – The area must be known to be non-hazardous before servicing/replacing the unit and before installing.

Wire terminals can accommodate 14–28 AWG (2.08–0.081mm^2) solid or stranded wire with a minimum temperature rating of 90^{o}C. Channel input wiring may be shielded or unshielded type (14-30 AWG). Ideally, output wires should be twisted pair, or shielded twisted pair. Use insulated wire to keep channels isolated. Terminals are pluggable and can be removed from their sockets by prying outward from the top with a flat-head screwdriver blade. The DT335 models allows RTD sensors to be wired to TB1 or TB3. Strip back wire insulation 0.25-inch on each lead and insert the wire ends into the cage clamp connector of the terminal block. Use a screwdriver to tighten the screw by turning it in a clockwise direction to secure the wire (0.5-0.6Nm torque). Use adequate wire insulation and follow proper wiring practices, as common mode voltages can exist on signal wiring. As a rule, output wires are normally separated from each other and from input wiring for safety and low noise pickup.

Sensor Input Connections

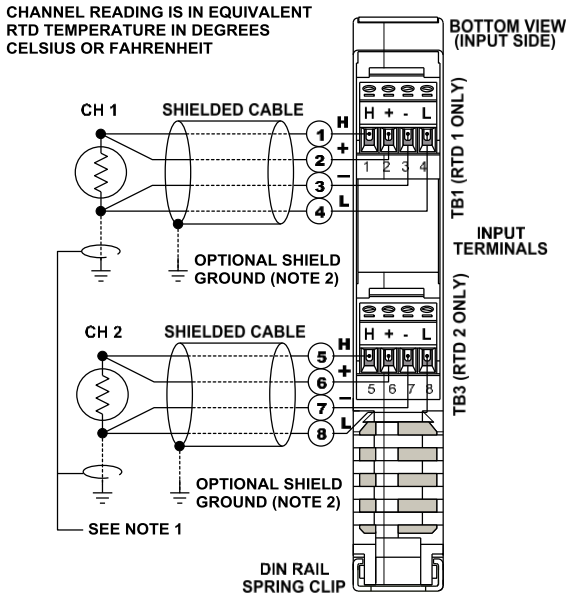
This module supports 2, 3, and 4-wire input connections from RTD and resistance sensors. Sensor wires are wired directly to transmitter input terminals at TB1 (channel 1) and TB3 (channel 2) at the bottom of the module (the spring-loaded DIN clip side), as shown in the connection drawing below. Observe proper polarity when making input connections.

- **Channel inputs are isolated from each other and from each output**.
- **Unit has three operating modes**: You may operate this unit as a dual transmitter, a single transmitter, or a CH1 signal splitter.
- **Three-wire input connections require <u>one wired jumper</u> to be placed between input (H) and input (+)**. This jumper routes excitation current from the input (H) terminal to the input (+) lead of the sensor. Excitation current passes through the sensor and produces a sensor voltage drop that is measured differentially between the input ± leads.
- **Two-wire input connections require <u>two wired jumpers</u> to be placed between input (+) and input (H) and between input (-) and input (L)**. The second jumper routes the excitation return current from input (-) to the A/D reference resistance at the input (L) terminal to accomplish ratio-metric conversion of the sensor signal. Ratio-metric refers to measuring sensor resistance as a ratio of the reference resistance used to drive the A/D reference, rather than measuring it using an absolute reference voltage. By using the same excitation current to excite both the sensor and the A/D reference resistor at the same time, any changes in excitation current will be immediately reflected in the ADC reference, resulting in a more accurate and stable measurement.
- **Four-wire input connections use no wired jumpers and eliminate errors associated with sensor lead-wire resistance.** In a 4-wire connection, the sensor voltage is measured using a different pair of leads (input ±) than the ones that carry the sensor excitation current (input H & L), effectively removing lead-wire IR drop from the sensor measurement by the A/D. A 3-wire input connection accomplishes the same thing, but only if the third-wire matches the input ± wires in diameter, length, and material (and therefore resistance).



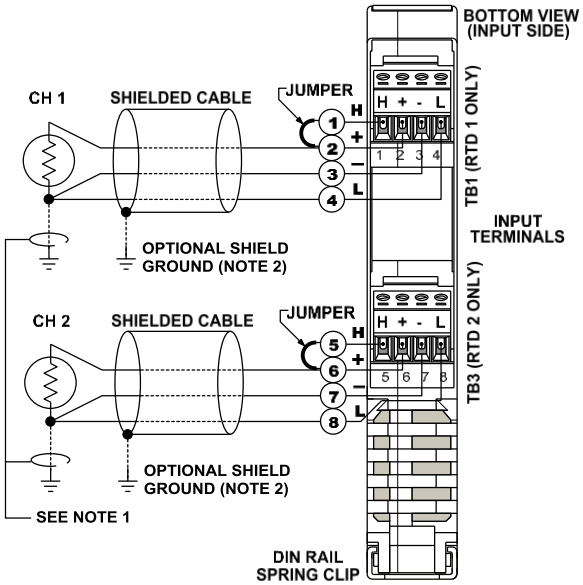
4-WIRE RTD INPUT SENSOR WIRING

NOTE: LEAD-WIRE RESISTANCE
LEAD-WIRE RESISTANCE HAS A NEGLIGIBLE EFFECT ON THE RTD MEASUREMENT WHEN USING A 4-WIRE CONFIGURATION.



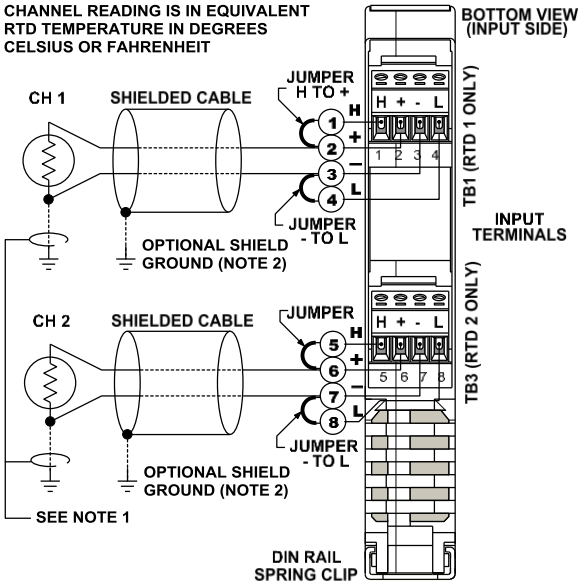
3-WIRE RTD INPUT SENSOR WIRING

NOTE: LEAD-WIRE RESISTANCE
LEAD-WIRE RESISTANCE HAS NEGLIGIBLE EFFECT ON THE RTD MEASUREMENT WHEN THE + AND L LEADS ARE MATCHED (OF EQUAL LENGTH & GAGE)



2-WIRE RTD INPUT SENSOR WIRING

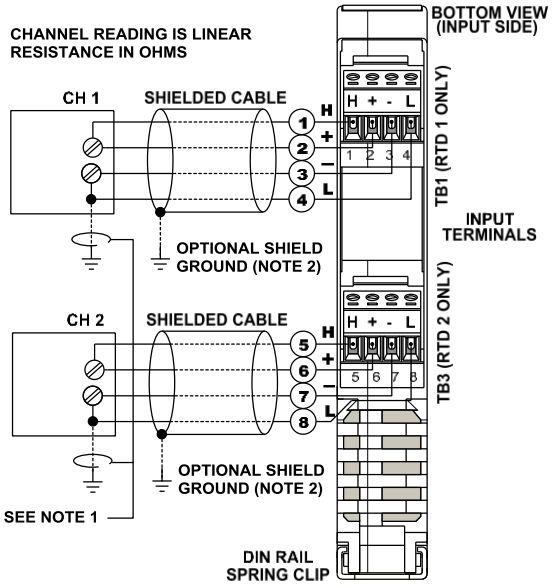
NOTE: LEAD-WIRE RESISTANCE
LEAD-WIRE RESISTANCE OF THE + & - LEADS CAUSES A POSITIVE SHIFT IN RTD MEASUREMENT PROPORTIONAL TO THE EQUIVALENT TEMPERATURE OF THE SUM TOTAL OF THE INPUT (+) & INPUT (-) LEAD RESISTANCES.



4-WIRE RESISTANCE DECADE BOX WIRING

CONNECT SAME AS FOR 4-WIRE RTD CONNECTION

NOTE: LEAD-WIRE RESISTANCE
LEAD-WIRE RESISTANCE HAS A NEGLIGIBLE EFFECT ON THE RTD MEASUREMENT WHEN USING A 4-WIRE CONFIGURATION.



NOTE 1: SENSOR GROUND

THIS GROUND CONNECTION IS RECOMMENDED FOR BEST RESULTS. IF SENSORS ARE INHERENTLY CONNECTED TO GROUND, USE CAUTION AND AVOID MAKING ADDITIONAL GROUND CONNECTIONS WHICH COULD GENERATE GROUND LOOPS AND MEASUREMENT ERRORS. DO NOT GROUND THE INPUT SENSOR IF UNIT IS CONNECTED TO A GROUNDED PC WITHOUT AN USB ISOLATOR.

NOTE 2: OPTIONAL CABLE SHIELD GROUND

SHIELDED CABLE IS RECOMMENDED. FOR BEST RESULTS, GROUND THE CABLE SHIELD AT THE END OF THE CABLE CLOSEST TO THE GREATEST POTENTIAL SOURCE OF DISTURBANCE, USUALLY THE SENSOR END.

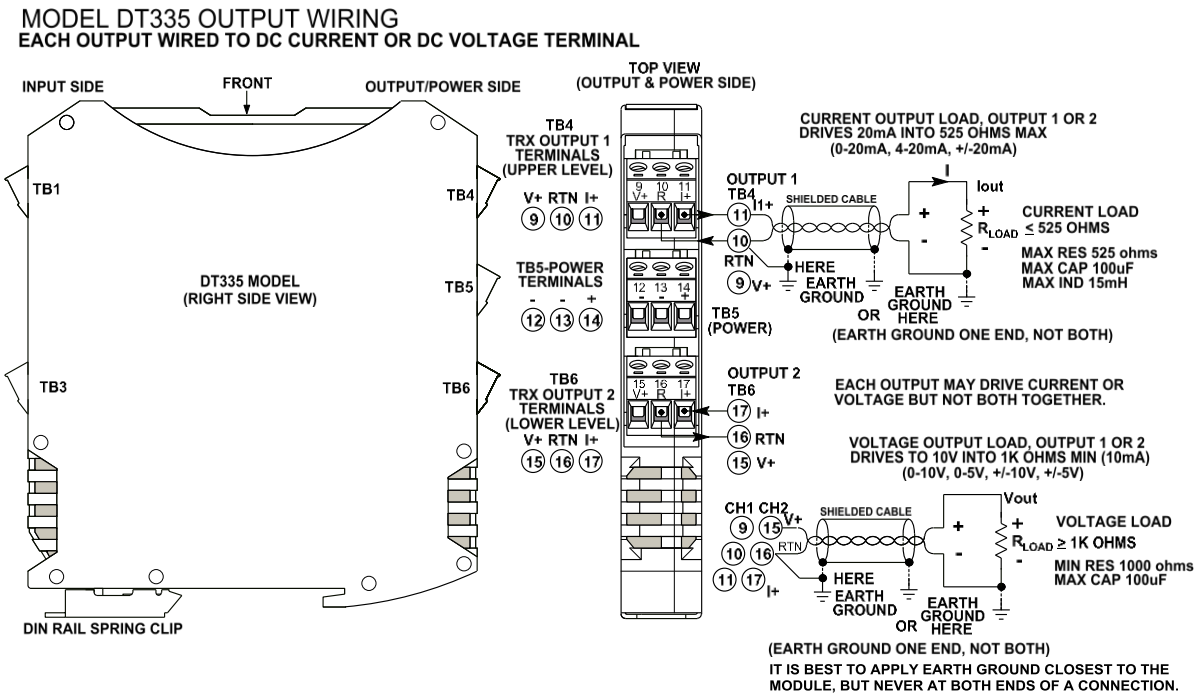
Output Connections

(To DC Current or Voltage Terminals)

Outputs are short-circuit protected from damage.

Each transmitter channel is modeled after AN ANSI/ISA Type 4 transmitter with unit power separate from the input and output.

- **Output connections are polarized.** Tandem current and voltage output terminals at each isolated channel share a common return (RTN). Current is sourced from I Out+ and returned to RTN. Voltage is sourced positive at V Out+ with respect to RTN. Only one channel output terminal (voltage or current) may be loaded at one time.
- **Variations in load resistance have negligible effect on output accuracy** when load limits are respected with respect to output type (see below).



Observe proper polarity. Note that twisted-pair wiring is often used to connect the longest distance between each field output and its remote load as shown above (shielded twisted pair wiring is recommended for best results). An output connection to earth ground at each return will help protect the isolated output circuit from damage in noisy environments.

WARNING: For compliance to applicable safety and performance standards, the use of twisted pair output wiring is recommended. Failure to adhere to sound wiring and grounding practices as instructed may compromise safety, performance, and possibly damage the unit.

TIP - Ripple & Noise: Place additional capacitance at the load to help reduce the 60Hz/120Hz ripple sometimes present in industrial applications. For large 60Hz ripple, connect an external 1uF or larger capacitor directly across the load to reduce excess ripple. For sensitive applications with high-speed acquisition at the load, high frequency noise may be reduced significantly by placing a 0.1uF capacitor directly across the load, and as close to the load as possible.

Power Connections

The power terminals are reverse polarity protected.

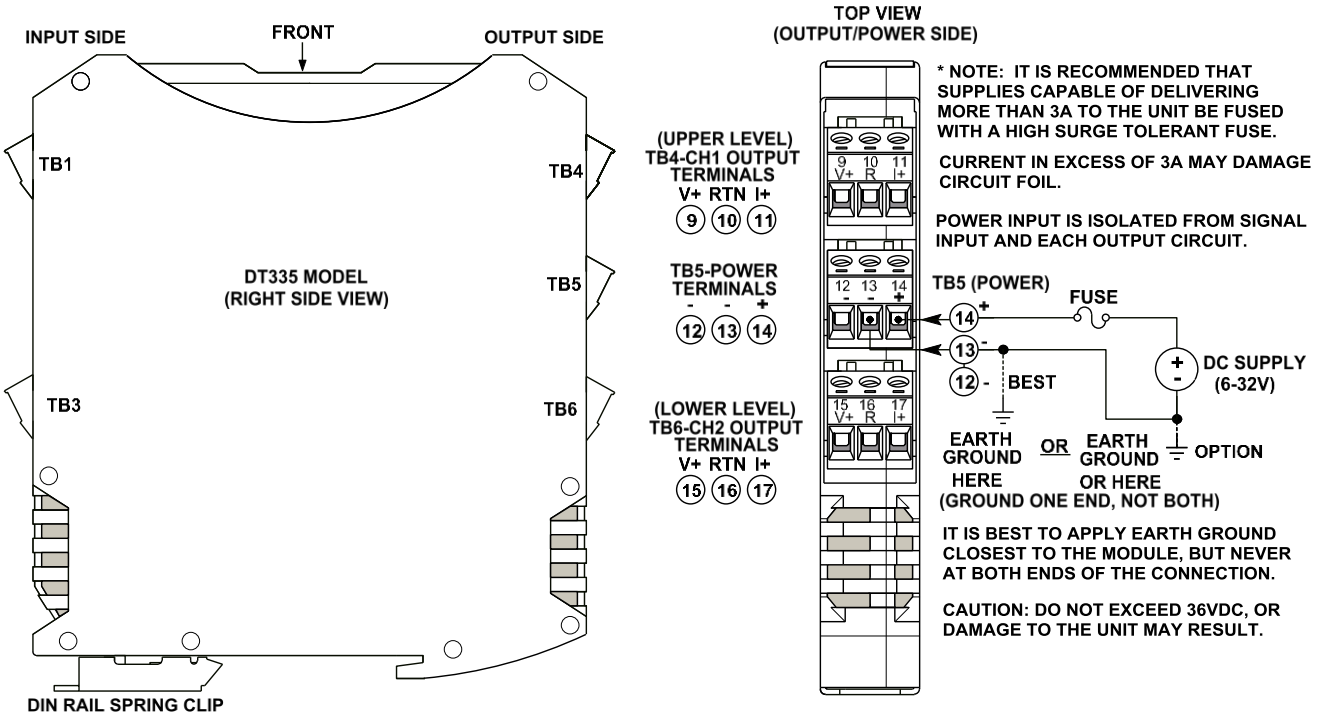
IMPORTANT – External Fuse: If this unit is powered from a supply capable of delivering more than 3A to the unit, it is recommended that potential fault current be limited via a high surge tolerant fuse rated for a maximum current less than 3A (for example, see Bel Fuse MJS or RJS fuse types).

The unit is powered from 6-32V DC (36V DC peak) by connecting power as shown below. This transmitter can be optionally powered (or redundantly powered) via the DIN rail bus when coupled to an optional DIN rail bus connector (Acromag Model 1005-063) with a bus terminal block (Acromag 1005-220 or 1005-221). This optional power connection method can allow several dual channel modules to share a single power supply connection without wiring power to each unit's power terminals.

- Power connections are isolated from each input and each output. The supply voltage should be from 6-32V DC. This voltage must never exceed 36V DC peak, or damage to the unit may result.
- Variations in power supply voltage between the minimum required and 32V maximum, has negligible effect on transmitter accuracy.
- Note the placement of earth ground at power. The power cable shield and DC- should ideally be grounded closest to the module. The input and output circuit commons are capacitively coupled to earth ground at DC- through high-voltage isolation capacitors, offering some protection if their circuits happen to float relative to power (not recommended).

CAUTION: Risk of Electric Shock – More than one disconnect switch may be required to de-energize this equipment before servicing.

DT335 MODEL POWER WIRING
UNIT IS DC-POWERED ONLY AT 6 TO 32VDC.



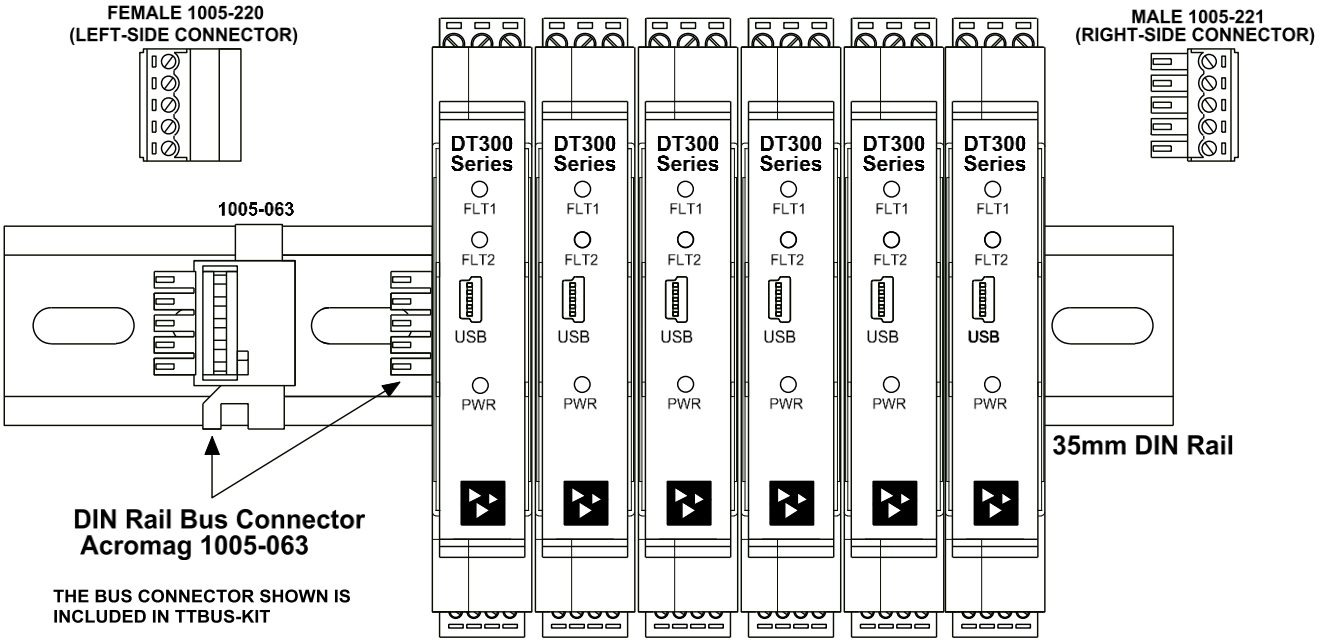
Optional Bus Power Connections

TIP: How many units may share a bussed connection to power? This device consumes up to 1.6W. For a bussed power connection, it is recommended that you fuse-limit the maximum supply current to 3A or less including inrush. The turn-ON inrush current may peak up to twice its DC value. To calculate the safe maximum number of units that can share this supply connection, multiply 1.5A and your supply voltage and divide the result by 1.6W. For this model, this is roughly equivalent to the number of supply volts. That is, a 24V supply fused with 3A may drive 24 units safely.

Power is normally wired to the TB5 terminals of the unit as shown on the previous page. However, this dual channel device is equipped to be optionally or redundantly powered via a DIN rail bus connector (Acromag 1005-063) mated to an optional plug-in terminal block (Acromag 1005-220 or 1005-221, depending on left side or right-side wire entry). Any power input via the bus connector is diode-coupled to the same point in the circuit as unit power connected at its power terminal TB5. You could power multiple units by snapping them together along the DIN rail bus using connector 1005-063, then connecting a mating terminal block (select a left side or right-side connector, see figure below). While the intent of the bus power connector is to allow several units to conveniently share a single supply, you could also use the bus power connector to redundantly power units (with local power also applied at TB5), allowing a backup supply to maintain power to the units should the main supply at TB5 fail.

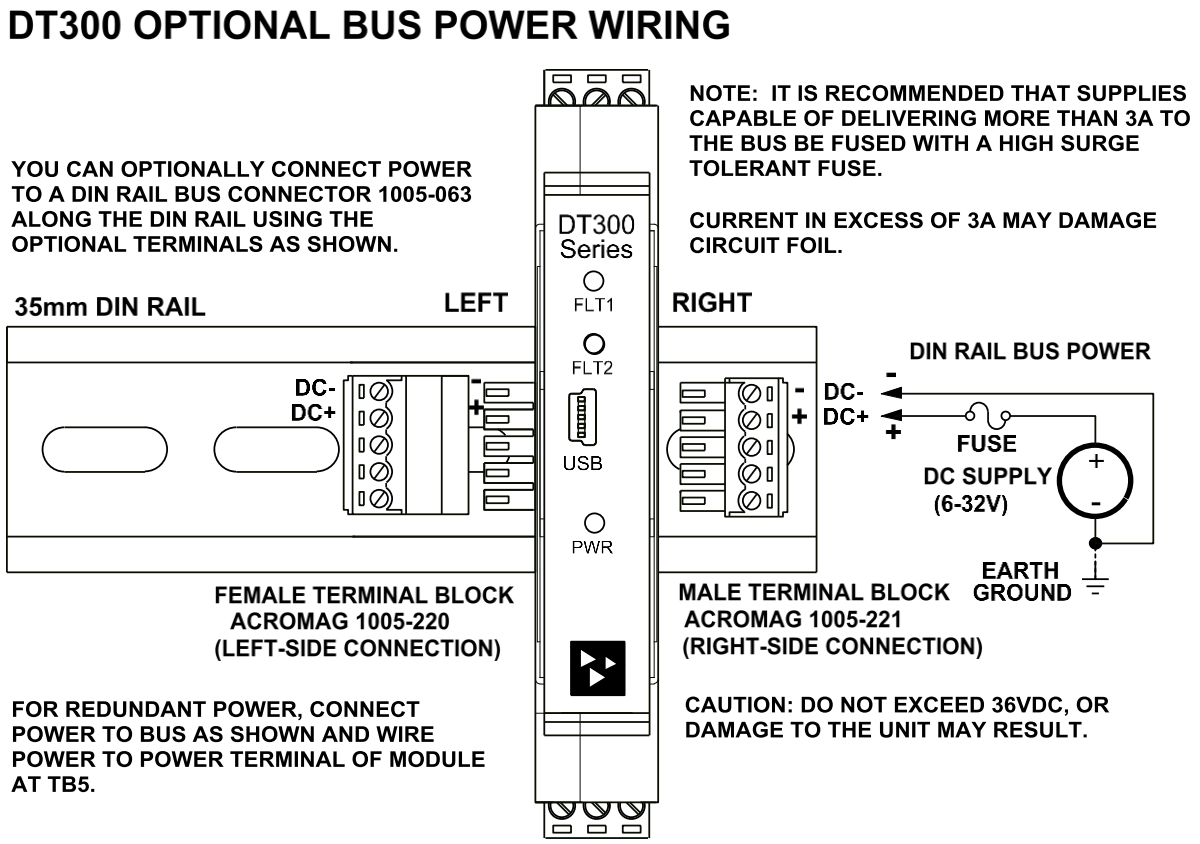
Acromag TTBUS-KIT connector kit contains bus connector 1005-063, plus left-side terminal 1005-220, and right-side terminal 1005-221, allowing units to snap together, side-by-side, along the DIN rail and share the power connection.

Important – End Stops: If this module uses optional power (or redundant power) via its DIN rail bus for hazardous location installations (Class I, Division 2 or ATEX/IECEx Zone 2) it should use two end stops (like Acromag 1027-222) to secure the terminal block and module (not shown).



Optional Bus Power Connections…

The figure below shows how to wire power to the optional bus terminal block when mated to the bus connector. Note that power is wired to the rightmost bus terminals on the right, or the left-most terminals on the left. Observe proper polarity.



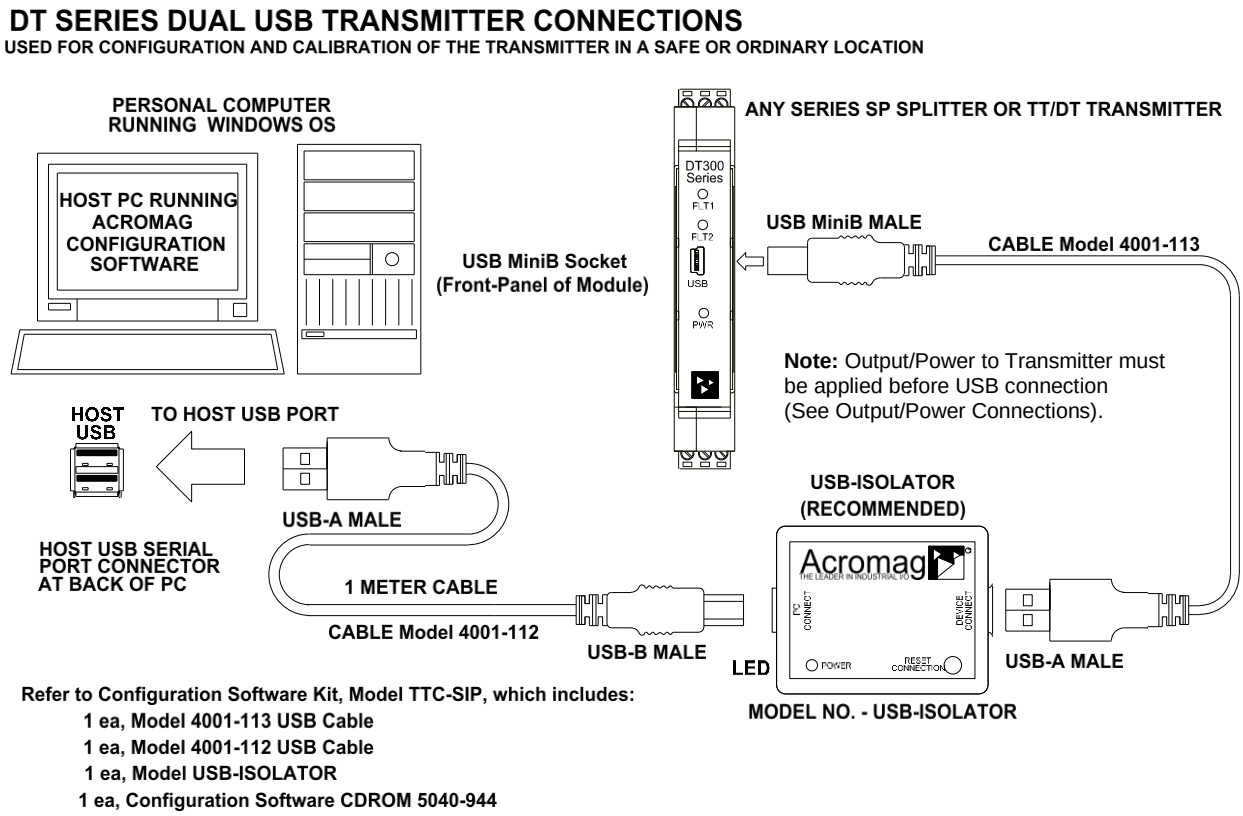
Earth Ground Connections

The unit housing is plastic and does not require an earth ground connection. This dual transmitter's inputs, outputs, and power circuit are electrically isolated from each other, allowing each of these circuits to be individually earth grounded as indicated. If the transmitter is mounted in a metal housing, a ground wire connection is typically required for the enclosure housing and you should connect that metal enclosure's ground terminal (green screw) to earth ground using suitable wire per applicable codes. See the Electrical Connections Drawings for Input, Output, and Power, and note the position of earth ground for each isolated entity. Ground connections shown are recommended for best results and help protect the unit and its isolated circuitry by giving it a low impedance path to ground for shunting destructive transient energy away from sensitive module circuitry.

- Avoid inadvertent connections to earth ground at other points than those indicated, as this could drive ground loops and negatively affect operation.
- A USB isolator is recommended when configuring or calibrating a unit to avoid the ground loop that occurs if your input is also earth grounded (A PC commonly earth grounds its USB port contacting both the USB signal and shield ground which are held in common to the input circuit ground of this transmitter).

USB Connections

This transmitter is configured and calibrated via configuration software that runs on a Windows-based PC connected to the unit via USB (Windows 7 or later required), or via a USB-OTG connection to an Android smartphone or tablet using the Acromag Agility mobile app. Refer to the drawing below to connect your PC or laptop to the transmitter to reconfigure or calibrate it using this software.



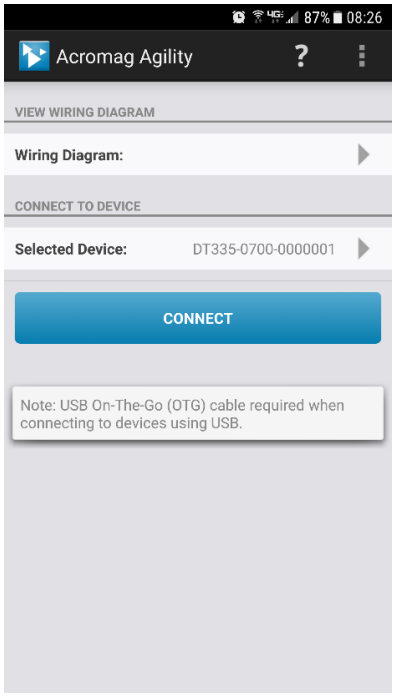
WARNING: The intent of mating USB with this transmitter is so that it can be conveniently set up and calibrated in a safe area, then installed in the field which may be in a hazardous area. Do not attempt to connect a PC or laptop to this unit while installed in a hazardous area, as USB energy levels could ignite explosive gases or particles in the air.

- USB Signal Isolation is recommended and required when connected to a grounded input – Input 1 and USB connections are isolated from each output and power of this model. USB Isolation is recommended for safety and noise suppression and is required when the input 1 sensor signal happens to be earth grounded. You may use Acromag model USB-ISOLATOR to isolate your USB port, or you can optionally use another USB signal isolator that supports USB Full Speed operation (12Mbps).

IMPORTANT: USB logic signals to the transmitter are referenced to the potential of the transmitter's input 1 circuit ground. Input 1 ground is held in common with USB ground and USB cable shield ground. Thus, an isolator is required when the input 1 signal is earth grounded and the unit is connected to the USB port of an earth-grounded PC. You could avoid the use of an isolator if a battery powered laptop was instead used to connect to the transmitter, and the laptop had no other earth ground connection, either directly or indirectly via a connected peripheral.

CONFIGURATION SOFTWARE

Quick Overview – Android

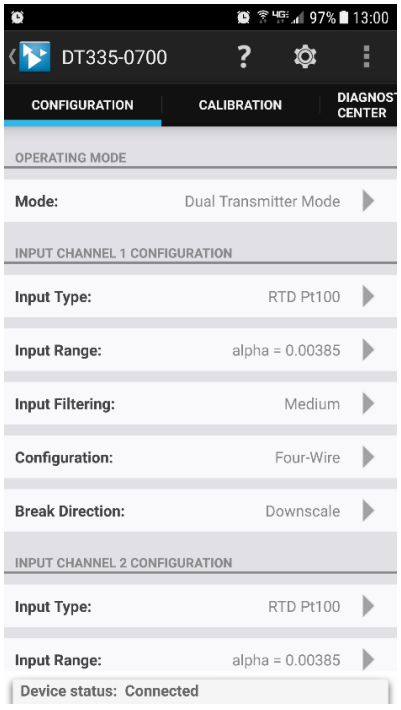


This transmitter can be setup & calibrated via the Acromag Agility™ Config Tool. This software APP can be downloaded free of charge from play.google.com. To connect to this transmitter, a USB OTG (On-The-Go) cable (5028-565) and USB A to Mini-B cable (4001-113) are required. This app is compatible with Android devices using Ice Cream Sandwich (4.0) or later.

The initial connection screen of the app is shown at left. Once a device is connected, the main portion of the app will launch. The screen is divided into three tabs for this model. A short description of each tab follows.

Connection Screen Set up – DEVICE SELECT (First Connect to Unit Here)

- Select from connected transmitters by tapping the **[Select Device]** button. This will bring up a list of attached devices. Select the desired device and tap the Connect button to open the device.
- To view wiring diagrams of a transmitter, tap the **[Wiring Diagram]** button and select the desired model. Swipe left or right to view more diagrams. No connection is required to view the diagrams.
- Android requires user permission to access external hardware. If the Device List displays "No Device Permission", select this device and when prompted to give permission to access the USB device, tap **[OK]**.



Configuration Tab – CONFIGURE I/O

- Once connected, the app will automatically read your transmitter and display its current configuration.
- Changing any option on this page will send the changes to the transmitter instantly. The device status at the bottom of the page will report if the changes were sent successfully.

Calibration Tab – (Calibrate the Input and/or Output if Needed)

- On screen instruction guides the set up to properly calibrate the transmitter. After completing instructions, tap the **[Calibrate]** button.
- The device status at the bottom of the page will report if the calibration was sent successfully.

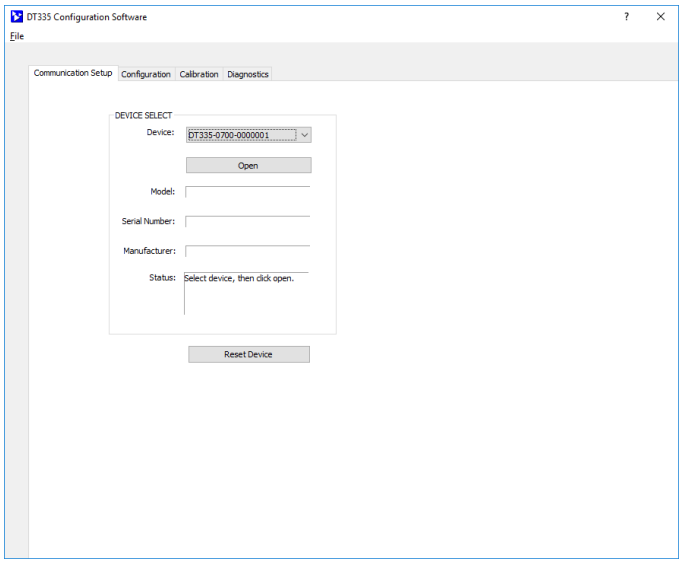
Diagnostic Center Tab – (Verify Input operation)

- Select the polling indicator by tapping the **[Indicator]** button.
- Start polling by tapping the **[Start Polling]** button.

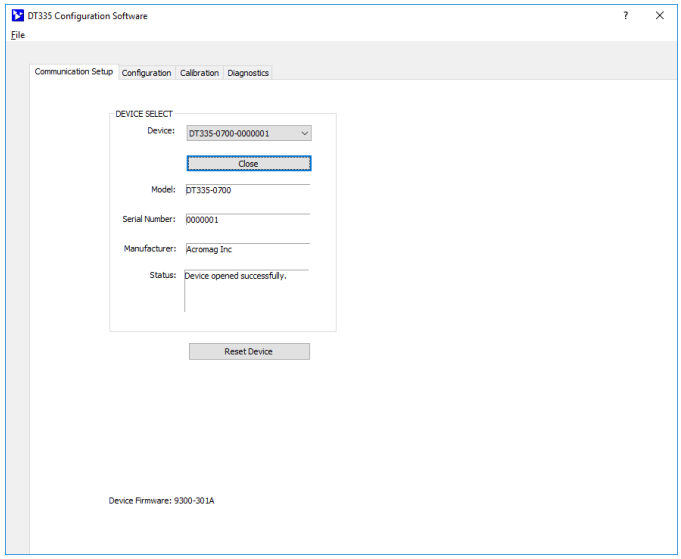
Utility Page – (Reboot or Restore Settings)

- Tap the **[Gear]** in the Action bar to access the Utility Page.
- You can tap the **[Restore/Reset Factory]** utility buttons to get out of trouble if you ever misconfigure or improperly calibrate a transmitter.

Quick Overview – Windows



*Click **"Open"** to connect to the DT335 and your screen will look like:*



HELP – You can press F1 for Help on a selected or highlighted field or control. You can also click the [?] button in the upper-right hand corner of the screen and then click again to point to a field or control to get a Help message pertaining to the item you pointed to.

For detailed configuration and calibration procedures, see the Operation Step-By-Step section of the Technical Reference on page 18 of this manual.

This dual transmitter can be setup and calibrated with a USB connection and Configuration Software running on your Windows PC/laptop. The USB software can be downloaded free of charge from our web site at https://www.acromag.com/, and is included on a CDROM bundled in the TTC-SIP Configuration Kit (see Accessories). For this model, look for the program DT335Config.exe (compatible with v7 or later versions of the Windows OS).

The initial USB config software screen for this model is shown at left. Configuration info is divided across four separately tabbed pages as follows: Communication Set up, Configuration, Calibration, and Diagnostics. A short description of each of these configuration pages follows:

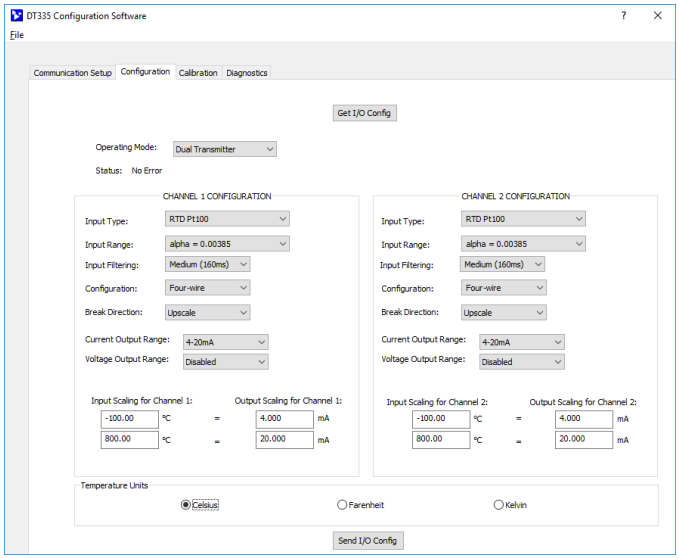
Communication Set up (First Connect to Unit Here)

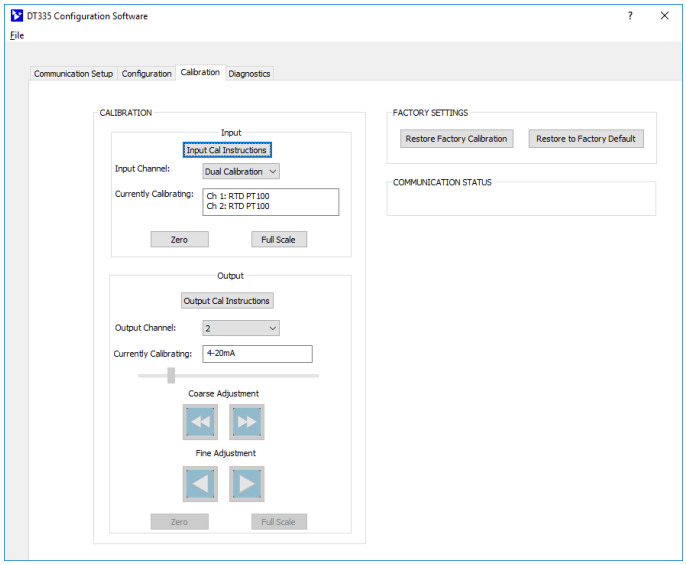
- Select from connected transmitters and Open/Close communication with them.
- Display Model, Serial, and Manufacturer of the connected transmitter and report the status of communication with it.

Configuration (Configure the Unit Here)

- Click **[Get I/O Config]** to retrieve the I/O configuration of the current connected unit.
- Select the Operating Mode: Dual Transmitter, Single transmitter, or Signal Splitter.
- View the config message status in the Status field.
- Select the Input Type for each channel: Platinum, Copper, Nickel, or Resistance for each channel at TB1 (CH1) and TB3 (CH2).
- Select the Input Range: RTD alpha or resistance.
- Set the level of digital filtering to High, Medium, Low, or None (No digital filter). I/O response times vary with filter and indicated next to selection.
- Select the Configuration: 4-Wire, 3-Wire, or 2-Wire.
- Set the Lead Break detent: Under or Over-Range.
- Set the current or voltage Output Range to ±10V, ±5V, 0-5V, 0-10V, ±20mA, 0-20mA, or 4-20mA.
- Use I/O Scaling fields to specify the input range endpoints to map to the output range zero and full-scale endpoints (some over/under-range included).
- Set the Temperature Units: °C, °F, or °K.
- After making changes, send your settings to the unit by clicking **[Send I/O Config]** and follow the on-screen prompts.

Quick Overview – Windows...





HELP – You can press F1 for Help on a selected or highlighted field or control. You can also click the [?] button in the upper-right hand corner of the screen and then click again to point to a field or control to get a Help message pertaining to the item you pointed to.

Calibration (Input, or Output if Needed)

- Calibrate an input or output channel, as needed.

This unit has already been factory calibrated. If you encounter excessive error, you can choose to click the Calibration tab to display the Calibration control page shown in the second screen at left. Note that only nominal I/O ranges are used for calibration, not scaled sub-ranges ranges.
To calibrate an Input or Output channel of this model, simply select the channel click the respective "Cal Instructions" button and follow the on-screen prompts.

Input…
Before attempting input calibration, first set the Input Range and its filter from the Configuration page as required before calibrating the input and be sure to click the **[Send I/O Config]** button.

Click **[Input Cal Instructions]** to begin input calibration. Next when you click input **[Zero]** or **[Full Scale]**, you will be prompted to apply a specific input level at TB1 (CH1), or TB3 (CH2), depending on your selected input range. Once you have applied this signal to the correct input, click **[OK]** of the prompt and follow the on-screen instructions to complete input calibration.

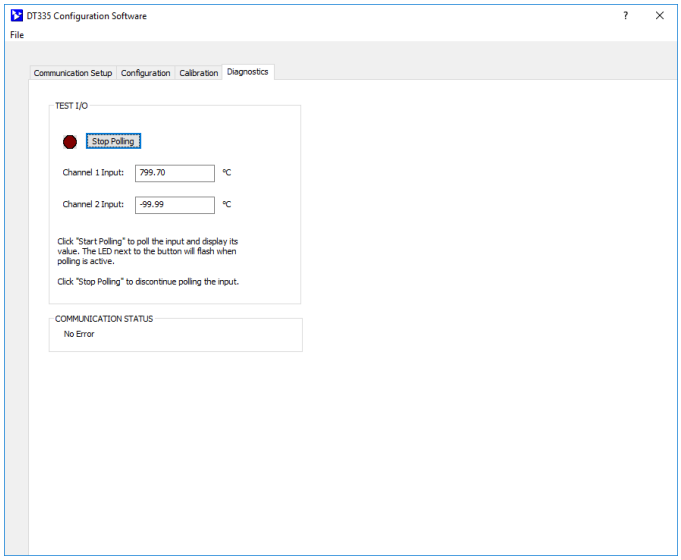
Output…
Click **[Output Cal Instructions]** to begin output calibration. You will be prompted to adjust the input signal as required to drive the corresponding output to its precise output range zero or full-scale level. Once the output is set to zero or full-scale, you simply click the corresponding **[Zero]** or **[Full-Scale]** button of the CALIBRATION - Output to set the output range zero or full-scale endpoint.

Factory Settings
(Use in Case of Trouble or for Sanitation Purposes)

- Restore a transmitter to its original factory calibration.
- Restore a transmitter to its initial factory configuration.

You can click the "Restore Factory" buttons if you ever misconfigure or improperly calibrate a transmitter such that its operation appears erratic, or for sanitation purposes when decommissioning a module.

Quick Overview – Windows...



HELP – You can press F1 for Help on a selected or highlighted field or control. You can also click the [?] button in the upper-right hand corner of the screen and then click again to point to a field or control to get a Help message pertaining to the item you pointed to.

Diagnostics (Optional, to Verify Unit Operation)

- Use this screen to verify communication with the unit or problems with your input wiring.
- Click **[Start Polling]** to periodically read your input channels and validate operation. Click **[Stop Polling]** to stop polling the input channels. The simulated red lamp to the left of the button flashes slowly when the software polls the input channels. Stop polling before selecting another page or sending a new reconfiguration.

After making Configuration changes, you may use the Diagnostics - TEST I/O controls to start/stop polling the input channel(s) to check your input readings (see screen at left).

The communication status of the polling messages is also indicated and can be helpful to troubleshoot connection problems.

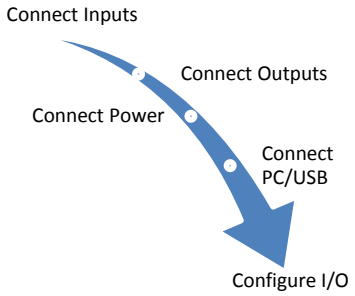
Calibration Status (Bottom of Screen)

- Displays communication status messages for the calibration process.

The CALIBRATION STATUS message bar at the bottom of the screen will display status messages relative to calibration, potentially helpful in discerning issues.

TECHNICAL REFERENCE
OPERATION STEP-BY-STEP
Connections

This section will walk you through the Connection-Configuration-Calibration process step-by-step. But before you attempt to reconfigure or recalibrate this transmitter, please make the following electrical connections



Note: Your input source, output meters, and load resistors (current outputs) must be accurate beyond the unit specifications, or better than ±0.1%. A good rule of thumb is that your equipment accuracy should be four times better than the rated accuracy you are trying to achieve with this transmitter.

Calibration Connections (at each Transmitter Input):

1. **Connect Each Input:** Connect a precision resistance decade box or RTD simulator to the input at TB1 and/or TB3 according to the channel/RTD configuration you are using (Refer to Sensor Input Connections). The resistance source must be adjustable over the range desired for zero and full-scale. All input types share the same wiring and procedure for calibration.

2. **Connect to One, Voltage or Current terminal of Each Output Channel:** Wire output loads to the transmitter output appropriate for either current or voltage, as required by your application. You will need to measure output current or voltage accurately to calibrate the output. You could connect a current meter in series with a load to read the output current directly, or a digital volt meter in parallel with a load to measure output voltage. Alternatively, you could simply connect a voltmeter across a precision load resistor to accurately read output current as a function of the IR voltage drop produced in the load resistor (recommended for current outputs).

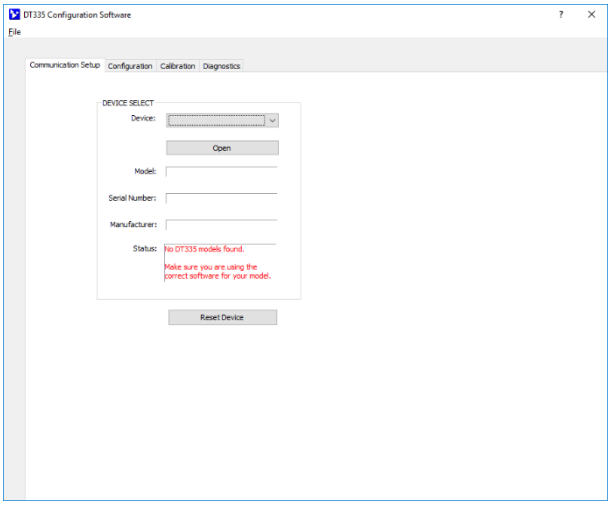
3. **Connect Power:** Wire 6-32VDC power to the unit at TB5 as shown in the Electrical Connections section. Optionally, you may wire power to the bus terminal as shown in the optional power connections drawing. But in either case, never exceed 36VDC peak, or damage to the unit may result.

   Apply power to the transmitter before connecting to USB. You will not be able to configure or calibrate the unit without power applied, as this device does not draw power from its USB connection.

4. **Connect to PC via USB:** Connect the transmitter to the PC using the USB isolator and cables provided in Configuration Kit TTC-SIP (refer to Accessories). You may only omit the isolator if you are using a battery powered laptop to connect to the unit, or your input 1 signal source is not already earth grounded (USB ground and input 1 return share common).

   Now that you have made your connections and applied power, you can execute the DT335Config.exe software to begin configuration (software is compatible with v7 or later versions of the Windows operating system).

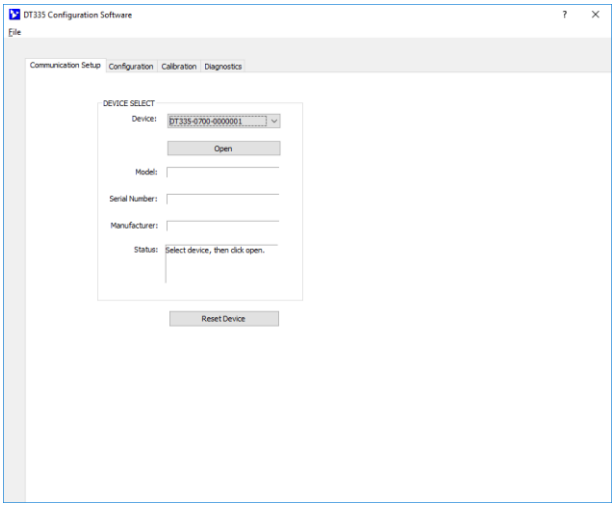
Configuration



Note that you should have power connected to the transmitter at this point or you will not be able to configure, calibrate, or test the unit (DT300 models do not draw power from USB).

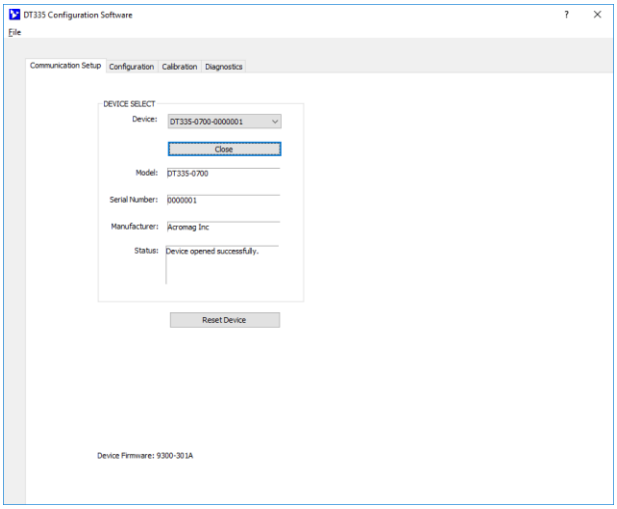
After executing the Acromag Configuration software for the DT335, the screen shown at left will appear, if you have not already connected to your transmitter via USB (note the red status message and that fields are blank under these conditions).

Connect your PC to the unit via USB, and the unit's model-serial information will appear in the Device field as shown in the second screen at left.



If you happen to be connected to more than one unit via a USB hub, you can use the Device scroll field to the right of the Device field to select another unit of the same model using the serial suffix of the Device model to discern one unit from another.

Once you have selected a device, click the **[Open]** button to open communication with the unit.

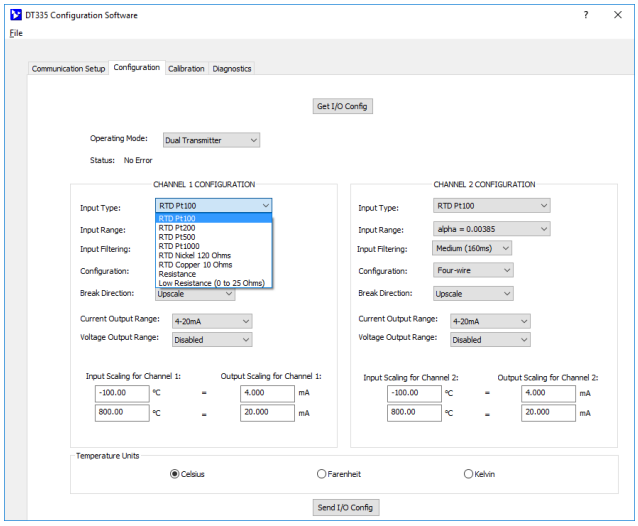


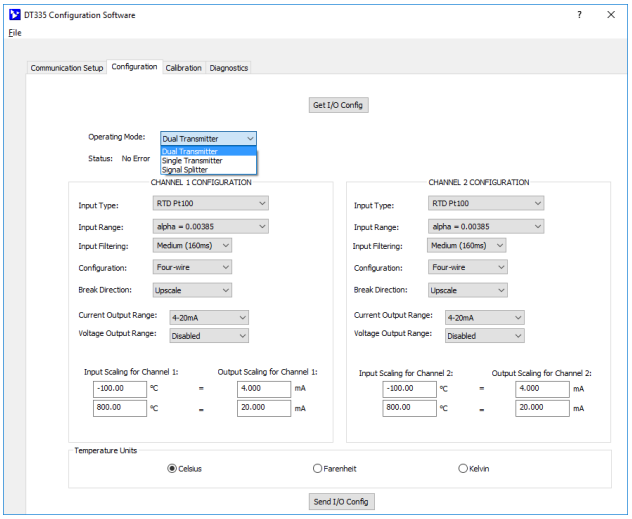
After clicking [Open] of the Connection screen with USB connected, the selected unit's Model, Serial Number, and Manufacturer will be displayed as shown in the third screen at left. Additionally, the communication Status field indicates "Device opened successfully".

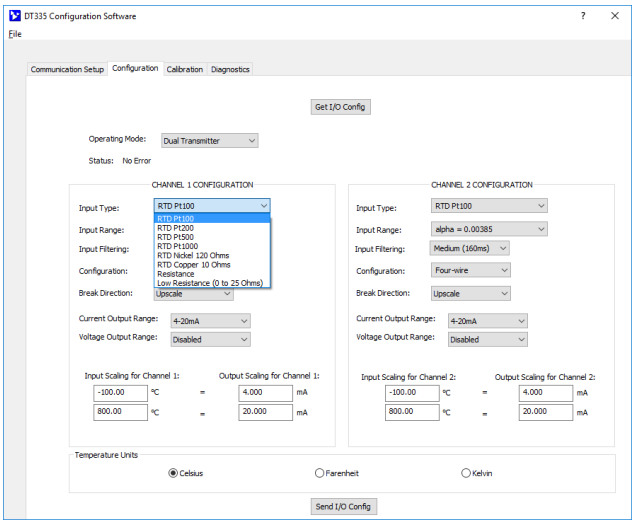
TIP: Always Close a connection with one device before selecting another device and make sure that you have the correct model software for the device you are connected to.

At this point, you can click the **"Configuration"** tab to begin configuring the unit, **"Calibration"** to calibrate an input or output, or **"Diagnostics"** to optionally test module operation.

Configuration…







The Configuration screen for Dual Transmitter is the first screen at left. When you click the "Configuration" tab, the software retrieves the unit's current configuration.

The initial screen represents the connected module's current configuration and operating mode before making changes. Otherwise, you can load the configuration from a saved file, or you may change fields as required. You can always click **[Get I/O Config]** to retrieve the connected module's current configuration at any time.

If you make any changes to the indicated configuration, the only way to preserve the changes is to write them to the device by clicking **[Send I/O Config]**, or to save them to a file by clicking **"File"** in the upper left-hand corner of the screen.

Select the Operating Mode…

The second screen at left shows the Operating Mode selection. DT models have three modes of operation: [1]Dual Transmitter, [2]Single CH1 Transmitter, and [3]CH1 Signal Splitter. The Configuration Screen varies slightly with the Operating Mode selected. To configure the unit as a single CH2 transmitter (instead of CH1), select Dual transmitter mode and ignore CH1.

Select the Input Type…

The third screen at left shows the Input Type selection.

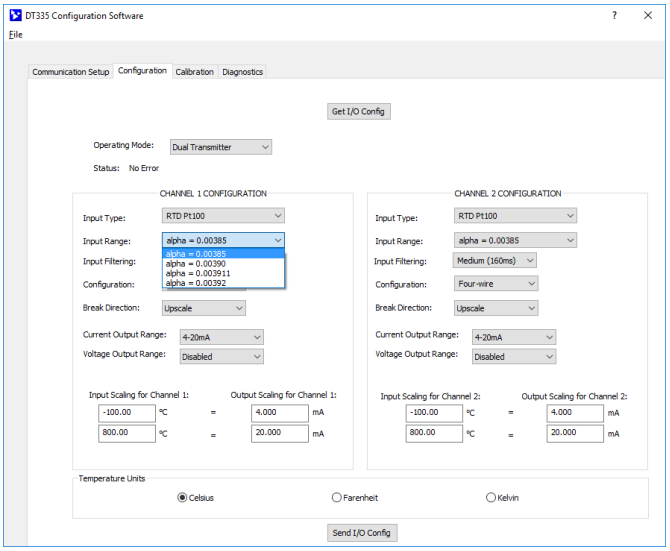
- If you select a RTD type, the output will be linear with respect to the sensor temperature.
- If you select Resistance**,** the output will be linear with respect to the input resistance, not temperature, and no special linearization will be performed.

Select the Input Range…

- If RTD Input Type is selected, then the Input Range menu will display RTD alpha values. Refer to "RTD Resistance versus Temperature" section for an explanation of alpha value.
- If you select Resistance Input Type, the Input Range menu will display resistance ranges. Select the lowest resistance range that can support the input resistance full-scale.

The ranges indicated are nominal and may be rescaled to the output, such that you may use a portion of the input range to drive the transmitter current or voltage output. Because rescaling smaller will proportionally decrease resolution, you should be careful to avoid going smaller than 12-bits to achieve rated performance. Each halving of the nominal range will reduce resolution by 1 bit. Decreasing range resolution can magnify error, especially noticeable for very small input ranges which degrade the input signal-to-noise ratio and the resolution of the analog-to-digital input conversion.

Configuration...



HELP – You can press **[F1]** for Help on a selected or highlighted field or control. You can also click the **[?]** button in the upper-right hand corner of the screen and click to point to a field or control to get a Help message pertaining to the item you pointed to.

If the scaled input/output zero and full-scale points are chosen too close together, performance will be degraded.

Once you have made your configuration selections, click the **[Send I/O Config]** button to write them to the module. You can read the Status of your sent message to the unit in the "Status" field. Alternately, you could click **"File"** in the upper left corner to save the settings to a file on your PC, for later reference.

Select the Temperature Units...
Select the temperature units to use in the Configuration Software. You may select Celsius, Fahrenheit, or Kelvin.

Select the Input Filtering…
- Set Low, Medium, High, or None (No digital filtering). Higher filter levels result in lower average noise but achieve slower I/O response times as indicated in parenthesis next to the selection. Always set the input filter as desired prior to calibrating an input.

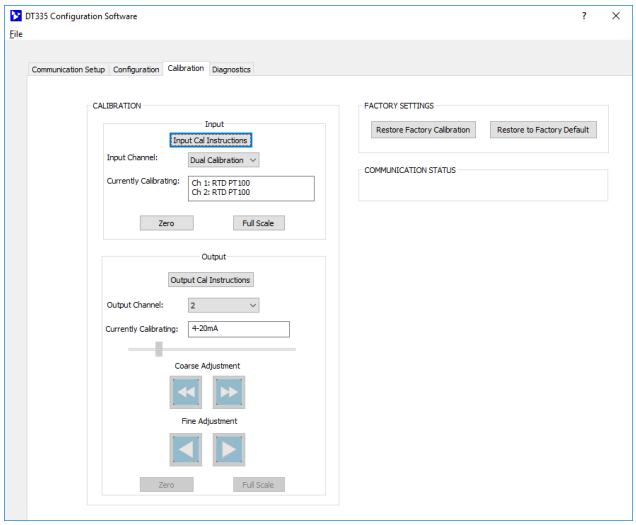
Select the Configuration...
- Select **"Four-wire"** and sensor lead-wire resistance will not affect the sensor measurement.
- Select **"Three-wire"** and sensor lead-wire resistance will be compensated for (the [+] and [L] leads must be the same length, diameter, and material).
- Select **"Two-wire"** and sensor lead-wire resistance will not be compensated for (the ± lead-wires will contribute a positive shift in the sensor resistance).

Select the Break Direction...
- Select **"Downscale"** to drive the transmitter output to its under-range limit, or **"Upscale"** to drive the output to its over-range limit if an input lead breaks (RTD input readings always go down-scale). Outputs may optionally be made reverse-acting, which does not change the break detent. Under/over-range limits are ~5% outside the selected nominal range.

Select the Current or Voltage Output Range…
- Unit has both DC voltage & DC current output terminals at each channel. Current outputs drive 0-20mA, 4-20mA, or Disabled, into loads up to 525Ω. Voltage Outputs drive ±10V, ±5V, 0-10V, 0-5V, or Disabled, and the voltage output may drive 1KΩ or higher loads. Only one output, current or voltage may be loaded at one time.

Select the I/O Scaling…
- Scale nominal input/output ranges down as desired, being careful not to reduce an I/O range too much, as resolution decreases and noise/error is magnified (each range halving reduces its resolution 1 bit).
- Use these fields to set the input signal min/zero value inside to correspond to the output range zero value. Set the input signal max/full-scale value to correspond to the output range full-scale value. Rescale the output similarly and you can even swap input levels to configure a reverse-acting output if desired. Some under/over-range is built into every nominal range and these limits vary by range.

Calibration (Optional)



IMPORTANT: The unit has already had its input and output channels factory calibrated with a high level of precision. If you attempt to recalibrate an I/O channel, you could degrade its performance if not done properly, or done using low grade equipment. Consider your decision to recalibrate carefully.

CAUTION-Input Calibration: Driving inputs outside of its nominal input range will not be acceptable for calibration of zero or full-scale. Since your input signal levels cannot be validated during calibration, incorrect signal levels will produce an undesired output response.

Once you have configured the unit channel(s), you can install the unit in the field because it has already been factory calibrated with high precision. But if at some point you encounter excessive I/O error, or to satisfy company maintenance requirements, you can optionally click the **Calibration** tab to display the Calibration control page as shown at left.

You can use Input Channel to calibrate one channel, or both in sequence. But before you calibrate input(s), sets the input range and filter as required by your application. Calibration of the input and output stages is a simple two-part process initiated by simply clicking the Input Cal or Output Cal **"...Instructions"** button to begin the process and then follow the on-screen prompts to continue.

CALIBRATION – Each Input Separately or In Sequence

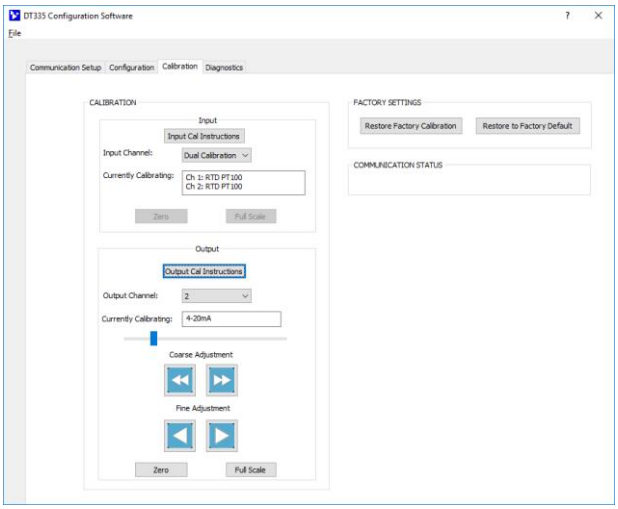
Before attempting input calibration, set the nominal Input Range and input filter on the "Configuration" page and make sure you write your selection to the unit by clicking ***[Send I/O Config].*** *For the DT335, wire an input RTD or resistance source (high-precision decade box) to TB1 (CH1) or TB3 (CH2) as shown in Connections for your sensor wiring configuration.*

After setting the input type/range/filter, select Channel 1, Channel 2, or Dual Calibration as required. Then click the **[Input Cal Instructions]** button to begin input calibration and enable the Input [Zero] and [Full-Scale] buttons.

Click Input **[Zero]** and you will be prompted to input the minimum value of your selected input range at the selected input channel. This will be the range minimum at the input terminal and varies with the nominal Input Range selected (calibration does not use the scaled range zero, but the zero of the nominal input range selected). Once you input zero precisely, click **[OK]** and follow the on-screen prompt to calibrate zero.

Click the Input **[Full-Scale]** and you will be prompted to input the full-scale value of your selected input range at the selected input channel. This will be the range maximum at the input terminal and varies with the Input Range selected (calibration does not use the scaled range maximum, but the full-scale of the nominal input range selected). Once you input full-scale precisely, click the **[OK]** button and follow the on-screen prompt to calibrate full-scale.

Calibration (Optional)…



If your output acts erratic or appears imprecise, you may need to repeat the channel input or output calibration, being very careful to connect and select the correct channel, take accurate measurements, and adjust to correct signal levels. For current outputs, if you are measuring a voltage across an output load resistor, make sure that you use the exact load resistance when calculating the load current being measured. Also, for rescaled input ranges, make sure that you still have adequate input resolution (12-bit or better), as an input span set too-tight will have diminished resolution and magnified error.

CALIBRATION – Each Output Separately

Wire your output monitor to the correct terminal, voltage or current, for the output channel you wish to calibrate. Set your nominal output range to calibrate on the "Configuration" page and make sure you write your selection to the unit by clicking ***[Send I/O Config].***

On the calibration page, select the Output Channel to calibrate, 1 or 2. Then click **[Output Cal Instructions]** to begin output calibration by enabling the Output adjustment controls and [Zero] and [Full-Scale] buttons.

Use the Output Course and Fine Adjustment controls to drive the output to its precise nominal output zero (i.e. 0mA, 4.000mA, -10V, -5V, or 0V, depending on the nominal output range setting) as indicated by your output meter. Measure this output level very accurately, or output performance will be degraded. At the precise output range zero, click Output **[Zero]** of Calibration - Output to calibrate the output zero.

Use the Output Course and Fine Adjustment controls to drive the output to its precise nominal output full-scale (i.e. 20.000mA, 5V, or 10V, depending on the nominal output range setting). Measure this output level very accurately, or output performance will be degraded. At the precise output range full-scale, click Output **[Full-Scale]** of Calibration - Output to calibrate the output full-scale level.

CALIBRATION – FACTORY SETTINGS

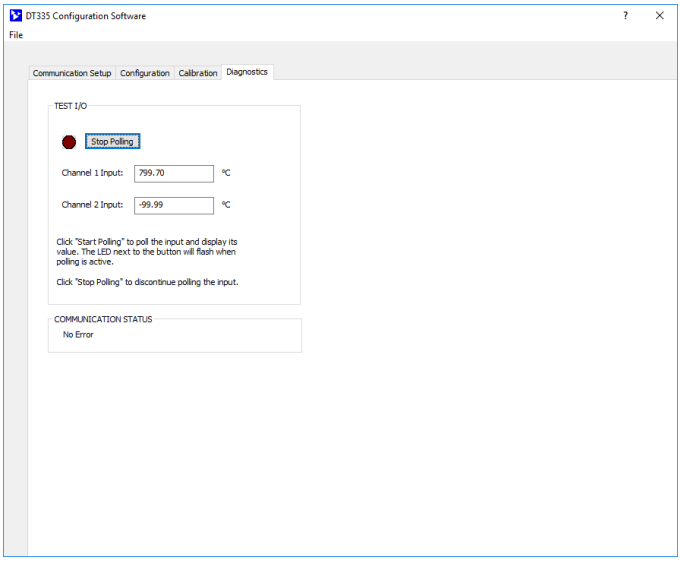
You can use the **[Restore Factory Calibration]** button to restore the transmitter's original factory calibration if you think you made an error during recalibration, have degraded its performance, or the I/O channel appears erratic.

You can use the **[Restore to Factory Default]** button to return the unit to its original factory configuration settings. This option does not restore calibration, only configuration. Alternately, this button can be used as a sanitation tool to restore the unit to its initial configuration when decommissioning a module.

CALIBRATION – COMMUNICATION STATUS

This field displays calibration status messages like "No Error", "Transfer Error", and "Timeout Error" during calibration. If you encounter a Transfer or Timeout Error, your calibration did not take effect and you may have to repeat the calibration process.

Diagnostics



At this point, following Configuration or Calibration, you could choose the Diagnostics tab to display the Diagnostics page shown at left. From this page, you can test transmitter operation by polling the input channels and checking their values. Click **[Start Polling]** to trigger the software to periodically read the input channels and display their values in the fields below the polling button. Note the simulated lamp next to the polling button flashes slowly each time it samples the inputs. Click **[Stop Polling]** to stop polling the inputs before moving onto another tab/page.

In the screen at left, note the input values are indicated in range units and “No error” is displayed in the Communication status field.

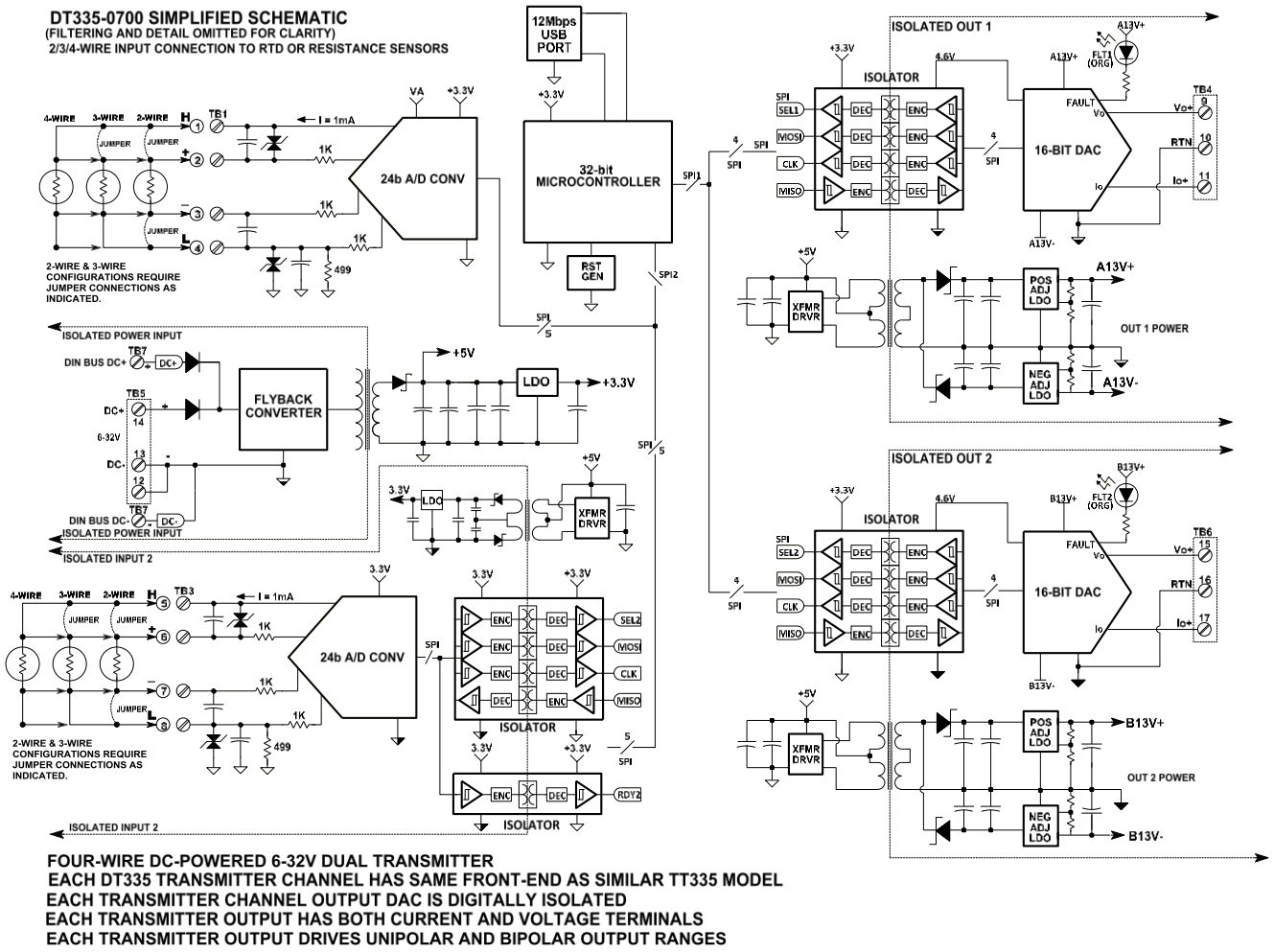
RTD Resistance versus Temperature

TEMP °C	Temperature in Ohms					
	100Ω Platinum RTD				120Ω Nickel RTD (α = 0.006872)	10Ω Copper RTD (α = 0. 004274)
	α = 0.00385	α = 0.00390	α = 0.003911	α = 0.00392		
– 200	18.520	17.396	17.260	17.079		1.058
– 150	39.723	38.903	38.789	38.648		3.113
– 100	60.256	59.721	59.638	59.543		5.128
– 50	80.306	80.044	80.000	79.952	86.17	7.104
– 40	84.271	84.061	84.026	83.988	92.76	7.490
– 30	88.222	88.065	88.038	88.010	99.41	7.876
– 20	92.160	92.056	92.038	92.019	106.15	8.262
– 10	96.086	96.034	96.025	96.015	113.00	8.649
0	100.000	100.000	100.000	100.000	120.00	9.035
+ 10	103.903	103.954	103.963	103.973	127.17	9.421
+ 20	107.794	107.896	107.915	107.934	134.52	9.807
+ 30	111.673	111.827	111.855	111.883	142.06	10.194
+ 40	115.541	115.745	115.783	115.821	149.79	10.580
+ 50	119.397	119.652	119.700	119.747	157.74	10.966
+ 60	123.242	123.547	123.605	123.661	165.90	11.352
+ 70	127.075	127.429	127.498	127.563	174.25	11.738
+ 80	130.897	131.300	131.379	131.454	182.84	12.125
+ 90	134.707	135.160	135.249	135.333	191.64	12.511
+ 100	138.506	139.007	139.107	139.200	200.64	12.897
+ 150	157.325	158.066	158.222	158.360	248.95	14.828
+ 200	175.856	176.828	177.044	177.226	303.46	16.776
+ 250	194.098	195.294	195.574	195.799	366.53	18.725
+ 300	212.052	213.463	213.811	214.079	439.44	
+ 350	229.716	231.336	231.756	232.065		
+ 400	247.092	248.912	249.409	249.758		
+ 450	264.179	266.192	266.769	267.157		
+ 500	280.978	283.175	283.836	284.263		
+ 550	297.487	299.862	300.611	301.075		
+ 600	313.708	316.252	317.094	317.594		
+ 650	329.640	332.346	333.284	333.820		
+ 700	345.284	348.143	349.181	349.752		
+ 750	360.638	363.644	364.787	365.391		
+ 800	375.704	378.848	380.099	380.736		
+ 850	390.481	393.756	395.119	395.788		

NOTE: 200Ω, 500Ω, and 1000Ω Platinum RTD resistances can be calculated based on the table above. For 200Ω Platinum, multiply the Pt100 resistances in the table by 2. For 500Ω Platinum, multiply the resistances in the table by 5. For 1000Ω Platinum, multiply the resistances in the table by 10.

NOTE: Alpha (α) is used to identify the RTD curve and its value is derived by dividing the sensor resistance at 100°C (boiling point of water) minus the sensor resistance at 0°C (freezing point of water), by the sensor resistance at 0°C, then by 100°C (α = [R100°C -R0°C] / R0°C/ 100°C). For Pt100Ω α=0.00385, this is 38.5Ω/100.0Ω/100°C, or 0.00385Ω/Ω/°C.

BLOCK DIAGRAM



How It Works

Key Points of Operation

- Unit is DC powered with each input, output, and power Isolated.
- Supports 2, 3, or 4 wire sensor connection.
- Each Isolated Output has both current and voltage output terminals.
- Input 1 circuit ground is common to USB ground.

This dual transmitter uses a 32-bit microcontroller and two 24-bit A/D converters to digitize each input channel and communicate to each isolated output DAC along digitally isolated SPI busses. Each 16-bit output DAC drives separate voltage and current terminals with a shared output return. Output ranges are user-configured/scaled. Power for the input and output circuits is provided via an isolated fly-back converter operating on voltage wired to the power terminals at TB5 or wired to optional bus power terminals along the DIN rail. Setup involves selecting the input types/ranges/wiring/break detection/units, selecting the output ranges (current or voltage), selecting input filter levels, and scaling input range endpoints to output range zero/full-scale endpoints. I/O scaling may be done in reverse to produce a reverse acting output. Refer to the block diagram above to gain a better understanding of transmitter operation.

How it Works...

Input 1/USB, Input 2, each output, and the power circuit are all isolated from each other. The unit does not draw power from USB, but the USB port ground is common to the input 1 circuit ground. The USB port ground of most PC's is also common to the USB cable shield and earth ground. Input 1 sensors could be grounded or ungrounded. For this reason, it is recommended that USB signals be isolated when connected to a PC to prevent a ground loop from occurring between the PC earth ground and a grounded input 1 sensor, which would have the negative effect of pulling the input 1 ADC reference supply to ground and clipping its input range.

TROUBLESHOOTING

Diagnostics Table

Before attempting repair or replacement, be sure that all installation and configuration procedures have been followed and that the unit is wired properly. Verify that power is applied to the unit and that your supply voltage is at least 7V. Verify that your load is appropriate to your output type, current or voltage

If your problem still exists after checking your wiring and reviewing this information, or if other evidence points to another problem with the unit, an effective and convenient fault diagnosis method is to exchange the questionable unit with a known good unit.

Acromag's Application Engineers can provide further technical assistance if required. Repair services are also available from Acromag.

POSSIBLE CAUSE	POSSIBLE FIX
Cannot Communicate with Unit via USB…	
Output shifts off-range when you connect USB…	
Output Erratic, Not operational, or at Wrong Value…	
Unit fails to operate or exhibits an output shift…	
A missing USB Isolator could cause a ground loop between a grounded input 1 sensor and earth ground at the connected Personal Computer's USB port because USB and input 1 share a common ground connection.	Without USB isolation, a ground loop is possible between a grounded input and earth ground of the PC USB port. The input ADC of the channel is normally ratiometrically biased off input ground to process the input signal. A grounded signal source could inadvertently short this reference to earth ground and prevent operation with a non-isolated USB connection. For this reason and for increased safety and noise immunity, it is best to connect to USB via a USB isolator. Use an isolator like the Acromag USB-ISOLATOR. Otherwise, use a battery powered laptop to configure the transmitter, which does not normally earth ground its USB port.
Software Fails to Detect Transmitter…	
Bad USB Connection	Recheck USB Cable Connection.
(Agility) Your smart device needs permission to connect to the Acromag transmitter the first time.	When you first connect to your smart device, it will prompt for permission. Be sure to give your permission or Agility will not discern your device connection. You may have to unplug/replug the USB connection to your tablet/phone to get this prompt.
USB has not enumerated the device.	Use the reset button on the Acromag USB isolator to trigger renumeration of the unit, or simply unplug and re-plug the USB cable to the transmitter.

Diagnostics Table…

POSSIBLE CAUSE	POSSIBLE FIX
Software Fails to Detect Transmitter…	
Communication or power was interrupted while USB was connected and configuration software running.	Close the current connection with the software, then select & re-open the unit for communication (or simply exit the Configuration software and reboot it).
For an input step, the output appears to make 2 steps to reach its final value…	
For a step change in the input, the A/D needs 2 input samples to ramp up to its final level.	For an input step, it takes two samples for the A/D to transition to its final output level, evident when using a scope to examine the output in response to a step change of the input which will appear to make two steps in its transition to its final level.
Output goes right to Over-Range (105%) or Under-Range Limit…	
This indicates that either the input signal is out of range, scaling is incorrect, or a sensor lead has broken. It can also occur due to contention between earth ground at the PC USB port and the input sensor.	Check and adjust the input signal as required to drive output within its linear operating range. A fully up/down-scale output can be driven by a sensor fault, such as an open/broken lead. Check input 1 sensor wiring and if not isolating USB, check for a ground loop between the sensor & USB port earth ground.
Cannot Calibrate Input Channel…	
Is input wired properly?	Check that the input is wired to ± input terminals using the correct polarity. Have you added the input jumper(s) required for 3-wire or 2-wire input configuration.
Changing Input Filter Setting Affects Input Calibration…	
You may note a small shift in the input reading when changing the input filter setting.	An input should be calibrated at the desired filter setting. For best results, set the input filter as desired before calibrating the input.
Cannot Measure Input Temperature or Resistance…	
Have you wired the input to the correct terminals for the input type/range and configuration?	Refer to Sensor Input Connections and verify the sensor or resistance decade box is wired to the transmitter correctly.
Output Noise Seems Excessive…	
Scaled input or output range is too small.	Scaling I/O to very small spans will diminish resolution and signal to noise ratio, potentially magnifying error. Every halving of the nominal range reduces resolution by 1-bit. Increase your range span.
An orange output fault LED is ON...	
Corresponding current output load is too large to drive it accurately, or you have an open-circuit, or the output driver has over-heated.	Indicates the current load is open-circuit or too large to maintain its output accurately (≥525Ω), or the IC die temperature has exceeded 142°C (resets upon cooling below 124°C). It may also occur if the loop supply voltage is too low to support the load.

For Service & Repair: This unit contains solid-state components and requires no maintenance, except for periodic cleaning and transmitter calibration (zero and full-scale) and verification. Its enclosure is not meant to be opened for access and can be damaged easily if snapped apart. It is highly recommended that a non-functioning transmitter be returned to Acromag for repair or replacement. Acromag has automated test equipment that thoroughly checks and calibrates the performance of each transmitter and can restore firmware. Please refer to Acromag's Service Policy and Warranty Bulletins or contact Acromag for complete details on how to obtain repair or replacement.

Service & Repair Assistance

This unit contains solid-state components and requires no maintenance, except for periodic cleaning and transmitter calibration (zero and full-scale) and verification. Its enclosure is not meant to be opened for access and can be damaged easily if snapped apart. It is highly recommended that a non-functioning transmitter be returned to Acromag for repair or replacement. Acromag has automated test equipment that thoroughly checks and calibrates the performance of each transmitter and can restore firmware. Please refer to Acromag's Service Policy and Warranty Bulletins or contact Acromag for complete details on how to obtain repair or replacement.

ACCESSORIES

Software Interface Package

Software Interface Package/Configuration Kit – Order TTC-SIP

- USB Signal Isolator
- USB A-B Cable 4001-112
- USB A-mini B Cable 4001-113
- Configuration Software CDROM 5040-TBD

This kit contains all the essential elements for configuring DT family Transmitters. Isolation is recommended for USB port connections to these transmitters and will block a potential ground loop between your PC and a grounded input. A software CDROM is included that contains the Windows software used to program TT/DT/SP transmitters.

USB Isolator

USB Isolator – Order USB-ISOLATOR

- USB Signal Isolator
- USB A-B Cable 4001-112
- Instructions 8500-900

This kit contains a USB isolator and a 1M USB A-B cable for connection to a PC. This isolator and cable are also included in TTC-SIP (see above).

USB A-B Cable

USB A-B Cable – Order 4001-112

USB A-B Cable 4001-112

This is a 1 meter, USB A-B replacement cable for connection between your PC and the USB isolator. It is normally included with the TTC-SIP Software Interface Package and with the isolator model USB-ISOLATOR.

USB A-mini B Cable

USB A-mini B Cable – Order 4001-113

- USB A-mini B Cable 4001-113

This is a 1-meter, USB A-miniB replacement cable for connection between the USB isolator and the DT33x transmitter. It is normally included in TTC-SIP.

Note that software for all DT/TT/SP Series models is available free of charge, online at www.acromag.com.

USB OTG Cable

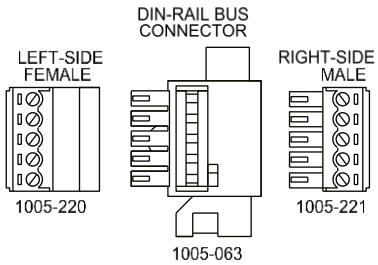
USB OTG Cable – Order 5028-565

- USB OTG Cable 5028-565

This is a 6 inch, USB On-The-Go cable for connection between the USB A-mini B Cable and a mobile phone or tablet. It is required to use the Acromag Agility™ Config Tool App.

Note that the Acromag Agility ™ Config Tool is available free of charge, online at the Google Play store.

DIN Bus Connector Kit



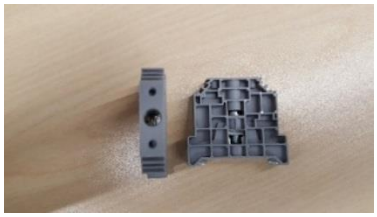
Bus Connector Kit for DIN Rail Connection to Power – Order TTBUS-KIT

This kit contains one each of the following terminals

- DIN Rail Bus Connector 1005-063 for 17.5mm TT/SP/DT Modules.
- Left Side terminal block, female connector 1005-220.
- Right Side terminal block, male connector 1005-221.
- Two End Stops for 35 mm DIN Rails 1027-222 (not shown).

Series SP Splitters and DT transmitters are shipped with their bus port plugged. Remove this plug and insert DIN Rail Bus Connector 1005-063 shown at left, which allows multiple units to snap together along a DIN rail bus. Then add a left-side or right-side terminal block at an end to connect the bus to power. These terminals can be used to optionally (or redundantly) drive power to Series TT/DT/SP modules via the DIN rail bus connector and allowing modules to neatly and conveniently share a connection to Power. Two end stops 1027-222 are used to secure the terminal block and module for hazardous location installations and are not shown

End Stops



Two End Stops – Order 4001-252

- Two 1027-222 End Stops for 35 mm DIN Rail mounting

For hazardous location installations (Class I, Division 2 or ATEX/IECEx Zone 2), you can use two end stops (Acromag 1027-222) to help secure modules to 35mm DIN rail (not shown).

SPECIFICATIONS

Model Number

Model DT335-0700

Signal Transmitter
Isolated RTD or resistance Input
Four-Wire DC Powered
CE Approved
Includes cULus Class I, Div 2, ATEX/IECEx approvals

Custom calibration to your specifications can be added as a separate line item at time of purchase.

The DT335 model prefix denotes Dual Transmitter. The 3rd digit 3 denotes a 4-wire, separately-powered member of our DIN-Mounted DT300 transmitter family. The trailing "35" denotes an RTD or resistance input type. The trailing "-0700" model suffix denotes 4-wire DC power with CE and cULus Class I, Division 2, ATEX/IECEx Zone 2 Approvals.

Factory calibration to your own specification may be ordered as a separate line item at the time of purchase on a per unit basis. This will require the specification of each input range/type/wiring/break detection/units, filter level, each output range, scaled range zeros and full-scale values. You can also specify normal or reverse acting outputs. A standard model without adding custom factory calibration is calibrated by default to reference test conditions with both transmitter outputs mapped to normally acting 4 to 20mA, and medium input filters selected.

Models can be mounted on standard 35mm "T" Type DIN rail. Recalibration of any model will require use of the TTC-SIP configuration kit, ordered separately (see Accessories section).

Inputs (Each)

This model has dual isolated inputs at TB1 and TB3 intended for RTD or resistance sensor connections.

This unit has three different operating modes: dual transmitter, single transmitter, and CH1 signal splitter.

Input Reference Test Conditions (each): 100Ω Pt RTD, α = 0.00385; -200°C to 850°C input; configuration = three or four wire; filtering = medium; break detect=upscale; Output = 4 to 20mA, ascending; R-Load = 250Ω. Break detection = Over-range; Ambient = 25°C; Power supply = 24VDC; Unit mounted upright on a DIN rail to allow free air flow from the bottom vent to pass through the unit and out the top vent.
Input Range & Accuracy: Models have separate input channels at TB1 & TB3. The input is processed differentially and ratiometrically by the A/D converter and may be scaled separately from its output with a smaller portion of the range driving the output.

Table 1 - Input Sensor Ranges and Accuracy at Reference Test Conditions

Input Type	°C or Ω Spans in Range	Typical Accuracy
Pt 100Ω	-200°C to +850°C	±0.25°C
Pt 200Ω	-200°C to +850°C	±0.30°C
Pt 500Ω	-200°C to +850°C	±0.50°C
Pt 1000Ω	-200°C to +850°C	±1.00°C
Ni 120Ω (Minco 7-120)	-80°C to +320°C	±0.08°C
Cu 10Ω (Minco 16-9)	-200°C to +270°C	±1.00°C
Resistance (Linear)	0 to 25Ω	±0.05Ω
	0 to 450Ω	±0.10Ω
	0 to 900Ω	±0.90Ω
	0 to 2250Ω	±2.25Ω
	0 to 4500Ω	±4.50Ω

Input Configuration: Four-wire (this has negligible lead-wire effect), three-wire with lead-wire compensation, and two-wire without lead-wire compensation.
Input Linearization: Preset for input RTD and linearized to temperature or ohms (resistor).

Inputs...continued

Input Linearization: Preset for input RTD and linearized to temperature or ohms (resistor).
Input Excitation Current: Set to 0.1mA, 0.2mA, 0.5mA, 1mA typical, for Inputs 1000Ω, 500Ω, 200Ω, 100Ω & Nickel & Copper respectively.
Input Lead-Wire Compensation (3-Wire Sensor): Requires balanced input [+] and [L] sensor leads (same size, length, & type) and only used with three-wire configuration.
Input Lead-Wire Resistance Effect: Four-wire configuration: Less than 0.001°C per Ω of unbalance, typical. Three-wire and two-wire configurations: 3.5°C per Ω of unbalance, typical (Pt100), 1.4°C per Ω of unbalance, typical (Ni), 25.5°C per Ω of unbalance, typical (Cu). Maximum resistance of 25Ω per lead.
Input Lead-Wire Break/Burnout Detection: Can be set for Over-range or Under-range open sensor or lead break detection. This only applies to the output signal, not the input reading, which always goes down-scale for an RTD lead break. Detent limits are output range dependent. Over-range output limits are approximately 24mA, 11V, or 5.5V depending on the output range selected. Under-range limit is approximately 0mA, -5.5V, or -11.0V depending on the output range selected. Note that this refers to the output behavior not the input reading (the input reading always goes down-scale for an RTD lead break).
Input Analog to Digital Converter (A/D): Each channel uses a 24-bit, Σ-Δ A/D converter with only the first 16-bits used. Its signal is normalized to a bipolar range count of ±25000 to simplify I/O scaling (see Resolution below).
Sampling Rate (A/D): Inputs sampled at a variable rate with filter as follows:

A/D SAMPLING RATE (SAMPLES/SECOND) PER INPUT FILTER				
MODEL	**None**	**Low**	**Med**	**High**
DT335	107.325sps	26.83125sps	6.71sps	0.83875sps

Input Impedance: 15.4MΩ, typical.
Input Overvoltage Protection: Inputs include Bipolar Transient Voltage Suppressors (TVS) and diode-clamping with series resistance and capacitive filtering.
Input Filtering: RC filtering plus digital filtering, optimized and fixed per input range and filter selection within the Σ-Δ ADC. See Normal Mode Noise Rejection and Output Response Time.
Input Noise Rejection (Common Mode): 106dB, typical with 100Ω input unbalance.
Input Noise Rejection (Normal Mode): Varies with input filter level as follows:

Typical 60Hz Rejection per Input Filter Setting				
MODEL	**None (dB)**	**Low (dB)**	**Med[1] (dB)**	**High[1] (dB)**
DT335	1dB	23dB	*> 80dB[1]*	*> 80dB[1]*

[1]**Note:** At medium and high filter settings, the heavily attenuated 60Hz signal cannot be measured due to 4th order filtering by the input ADC which adds 80dB minimum of rejection at frequencies between 47Hz and 61Hz.
Input Bandwidth: The frequency at which the DT335 output is attenuated 3dB is 16Hz with no input filter. See also Normal Mode Noise Rejection and Output Response Time.

Inputs...continued

Input Resolution: The ADC's of this model will divide the input signal range into the number of parts that can be calculated using the expression for ADC counts as $32768*R_{IN}*Gain/499$, with Gain=1 for all input types except Copper RTD uses Gain=16 (resistance of input sensor is R_{IN}). The number of parts between the nominal input range low and high endpoints shown in the following table.

Table 2 - Input Resolution per Input Type

Input Type	α Alpha[1]	ADC Input Resolution
Pt 100Ω, 200Ω, 500Ω, 1000Ω	0.00385	1 part in 24425
	0.00390	1 part in 24714
	0.003911	1 part in 24812
	0.00392	1 part in 24868
Ni 120Ω (Minco 7-120)	0.006872	1 part in 26569
Cu 10Ω (Minco 16-9)	0.004274	1 part in 19384
Resistance (0 to 25 Ohms)	N/A	1 part in 26172
Resistance (450, 900, 2250, 4500 Ohms)	N/A	1 part in 29491

Notes (Table 2): [1]Alpha (α) is used to identify the RTD curve. Refer to "RTD Resistance versus Temperature" section for an explanation of alpha value. This transmitter allows a portion of the nominal input range to be rescaled to the output range selected. However, the effective input resolution will be proportionally diminished as the span is reduced. The effective I/O resolution of this transmitter will be the lowest resolution of the ADC itself, its normalization to ±25000, or the output DAC (output DAC is 1 part in 46984 for 4-20mA).

Input Zero and Full-Scale Adjustment: Nominal input ranges are selectable and range endpoints are adjustable over the full range of input temperature/resistance. Input Zero and Full-Scale selections must be within the nominal range and will be mapped to zero/0% and full-scale/100% at the output. Keep in mind that the input resolution diminishes below nominal as a programmed range is reduced. Likewise, error is magnified as input span is reduced.

Outputs (Each)

Unit outputs are short-circuit protected from damage.

Output Range: Each channel has separate voltage and current output terminals that share a common return. Only one output signal of a channel, voltage or current, may be loaded at one time. See Table 3 for supported output ranges with over-range.

Output Accuracy: Better than ±0.05% of span, typical, and ±0.1% maximum, with nominal input and output ranges. This includes the effects of repeatability, terminal point conformity, and linearization, but does not include sensor error.

Output Noise/Ripple: Less than ±0.1% of output span, typical.

Note (High Speed Acquisition w/current output): Additional filtering is recommended at the load for sensitive applications with high-speed acquisition rates. For excessive 60Hz supply ripple and current output, a 1uF or larger bulk capacitor is recommended at the load. High frequency noise is often reduced or eliminated by placing a 0.1uF or 0.01uF capacitor directly across the load (this can also raise RF immunity).

Output Ambient Temperature Effect: Better than ±80ppm/°C (±0.0080%/°C) over the ambient temperature range. This includes the combined effect of zero and span drift for reference test conditions (see Input Specifications).

Output Resolution: Each output is driven by a 16-bit voltage/current DAC from Texas Instruments (DAC8760IPWPR) and its nominal range resolution is indicated in Table 3 below. The effective I/O resolution of a channel will be the lowest resolution of the input A/D or output D/A relative to the selected and scaled I/O range.

Outputs...continued

IMPORTANT: Input and output ranges may be rescaled to ranges smaller than nominal, which can increase potential error as resolution and signal-to-noise ratio are diminished for small I/O spans. Each halving of the range will drop resolution by 1 bit. In general, rated accuracy can be achieved for effective I/O resolution equal or greater than 12-bit (1/4096).

16-bit DAC COUNT	Table 3: Output Ranges and Resolution w/Over-Range					
	Voltage Output				Current Output	
	0-5V	0-10V	±5V	±10V	0-20mA	4-20mA
0	**0V**	**0V**	-5.5V	-11V	**0mA**	0mA
2979			**-5.0V**	**-10V**		
10923					4mA	**4mA**
54612					**20mA**	**20mA**
59577	**5.0V**	**10.0V**				
62556			**+5.0V**	**+10V**		
65535	5.5V	11.0V	+5.5V	+11V	24mA	24mA
RES	**1/59577**	**1/59577**	**1/59577**	**1/59577**	**1/54612**	**1/43689**
1 lsb	83.925uV	167.8uV	167.8uV	335.7uV	0.34132uA	0.34132uA
%Span	0.001678%				0.001707%	0.002133%

Output Response Time: The maximum time measured for the output signal to reach 98% of its transition for a step change in the input driving current output to a 500Ω load with the input set to No filter, Low filter, Medium filter, and High filter.

INPUT FILTER	TYPICAL OUT RESPONSE TIME TO 98% OF TRANSITION
NONE	25ms
LOW	44ms
MEDIUM	146ms
HIGH	1068ms

Output Load: The voltage outputs can drive loads down to 1KΩ minimum. The current outputs can drive 21mA DC into 0-525Ω.

USB Interface

The USB interface includes a USB MINI-B socket for temporary connection to a PC or laptop for setup, reconfiguration, and calibration purposes. USB isolation is required when input is connected to a grounded input sensor at channel 1 (see "IMPORTANT" below). During reconfiguration & recalibration, the transmitter receives its power from its separate DC power connection (via DIN rail bus or power terminal TB5), not USB. As such, you must connect power to the unit when you connect USB.
CAUTION: Do not attempt to connect USB in a hazardous environment. Transmitter should be set up and configured in a safe environment only.
Data Rate: USB v1.1 full-speed only, at 12Mbps. Up to 32K commands per second. USB 2.0 compatible.
Transient Protection: Adds transient voltage protection on USB power & data lines.
Cable Length/Connection Distance: 5.0meters maximum.
Driver: No special drivers required. Uses the built-in USB Human Interface Device (HID) drivers of the Windows Operating System (Windows XP or later versions only).

USB Interface...

USB Connector: 5-pin, Mini USB B-type socket, Hirose UX60SC-MB-5S8(80).

USB PIN	DEFINITION
1	+5V Power (Transient Protected, but not used by the module)
2	Differential Data (+)
3	Differential Data (-)
4	NC – Not Connected
5[1]	Power Ground (Connects directly to Signal Ground)
SHLD[1]	Signal Ground (Connects directly to Signal Ground)

[1]**Note:** Most Host Personal Computers (except battery powered laptops) will connect earth ground to the USB shield and signal ground.

IMPORTANT – USB Isolation is Required: Each input is isolated from each output and may be connected to grounded or un-grounded sensors, but the input 1 circuit ground connects in common to the USB power/signal/shield ground which will in-turn make a connection to earth ground at a PC when connected to its USB port if you do not use an isolator (Input 2 is isolated from USB0. Failure to connect USB without isolation would short the input 1 ratio-metric reference to ground if sensor signal 1 is also earth grounded, interfering with operation of channel 1. For this reason, USB isolation is strongly recommended when connecting to a PC. In the absence of USB isolation when also connected to a grounded input sensor at CH1, a battery powered laptop could be used to connect to the unit instead, as the laptop does not normally connect to earth ground.

Power

Unit power connections are reverse-polarity protected.

CAUTION: *Do not exceed 36VDCpk to avoid damaging the unit. Terminal voltage at or above 6V minimum must be maintained across the unit during operation*

Power Supply (Connect at TB5 or via DIN Rail Bus Terminal): 6-32V DC SELV (Safety Extra Low Voltage), 1.6W maximum. Observe proper polarity (reverse voltage protection is included). Current draw varies with voltage level (currents indicated assume dual transmitter mode with both current outputs driving 20mA into 500Ω).

SUPPLY	DT335 CURRENT CONSUMPTION
6V	242mA Typical / 265mA Max
9V	155mA Typical/171mA Max
12V	115mA Typical / 125mA Max
15V	91mA Typical / 99mA Max
24V	57mA Typical / 63mA Max
32V	44mA Typical / 48mA Max

Power Supply Effect: Less than ±0.001% of output span effect per volt DC change.

Enclosure & Physical

General purpose plastic enclosure for mounting on 35mm "T-type" DIN rail.
Case Material: Self-extinguishing polyamide, UL94 V-0 rated, color light gray. General purpose NEMA Type 1 enclosure.
Circuit Board: Military grade fire-retardant epoxy glass per IPC-4101/98.
Unit Weight: 0.35 pounds (0.16 Kg).
Dimensions: Width = 17.5mm (0.69 inches), Length = 114.5mm (4.51 inches), Depth = 99.0mm (3.90 inches). Refer to Mechanical Dimensions drawing.
I/O Connectors: Removable plug-in type terminal blocks rated for 12A/250V; AWG #26-12, stranded or solid copper wire.
Program Connector: 5-pin, Mini USB B-type socket, Hirose UX60SC-MB-5S8(80).
DIN-Rail Mounting: Unit is normally mounted to 35x15mm, T-type DIN rails. Refer to the DIN Rail Mounting & Removal section for more details.

Enclosure/Physical...

LED Indicators (Front-Panel)

Power PWR (Green) – Channel Green ON indicates power is applied to unit (this LED is sourced from isolated internal 3.3V rail).
Fault FLT - Channel Output (Orange, Each Output, FLT1 & FLT2) - Orange FLT LED per current output channel. ON indicates channel current output is open circuit, or the corresponding current output load resistance is too high to drive accurate current to it (load resistance is greater than 525Ω). ON may also indicate over-temperature if the output driver die temperature has exceeded 142°C.

Environmental

These limits represent the minimum requirements of the applicable standard, but this product has typically been tested to comply with higher standards in some cases.

Operating Temperature: -40°C to +70°C (-40°F to +158°F). It is recommended this unit be mounted upright on a DIN rail, allowing free air to flow into the bottom vent, pass through the unit and out the top vent.
Storage Temperature: -40°C to +85°C (-40°F to +185°F).
Relative Humidity: 5 to 95%, non-condensing.
Isolation: Input 1/USB, input 2, output 1, output 2, and DC power circuits are isolated from each other for common-mode voltages up to 250VAC, or 354V DC off DC power ground, on a continuous basis (will withstand 1500VAC dielectric strength test for one minute without breakdown). Complies with test requirements of UL 61010C-1 First Edition, August 9, 2002 "UL Standard for Safety for Process Control Equipment" for the voltage rating specified.
Operating Shock & Vibration Immunity: Designed to comply with IEC 60068-2-6: 10-500Hz, 4G, 2 hours/axis, for random vibration, and IEC 60068-2-27: 25G, 11ms half-sine, 18 shocks at 6 orientations, for mechanical shock.
Installation Category: Suitable for installation in a Pollution Degree 2 environment with an Installation Category (Over-voltage Category) II rating per IEC 1010-1 (1990).
2014/30/EU Electromagnetic Compatibility (EMC)
Minimum Immunity per BS EN 61000-6-2:
1) Electrostatic Discharge Immunity (ESD), per IEC 61000-4-2.
2) Radiated Field Immunity (RFI), per IEC 61000-4-3.
3) Electrical Fast Transient Immunity (EFT), per IEC 61000-4-4.
4) Surge Immunity, per IEC 61000-4-5.
5) Conducted RF Immunity (CRFI), per IEC 61000-4-6.

This is a Class A Product with Emissions per BS EN 61000-6-4:
1) Enclosure Port, per CISPR 16.
2) Low Voltage AC Mains Port, per CISPR 14, 16.

Agency Approvals

Electromagnetic Compatibility (EMC): CE marked, per EMC Directive 2014/30/EU.
FCC Conformity: This device complies with Part 15, Class A of the FCC rules.
Safety Approvals: cULus Listed Class I, Division 2, Groups A, B, C, D Hazardous Location or Nonhazardous Locations only. These devices are open-type devices that are to be installed in an enclosure suitable for the environment. Consult Factory.
ATEX/IECEx Certified: ATEX/IECEx Certified for Explosive Atmospheres per ATEX Directive 2014/34/EU which complies with standards EN IEC 60079-0:2018, EN IEC 60079-7:2015 +A1:2018, IEC60079-0 Edition 7, and IEC 60079-7 Edition 5.1.

Ex II 3 G Ex ec IIC T5 Gc -40°C ≤ Ta ≤ +70°C
UL 20 ATEX 2416**X** IECEx UL 20.0088**X**
X = Special Conditions

1) The equipment shall only be used in an area of not more than pollution degree 2, as defined in EN/IEC 60664-1.

2) The equipment shall be installed in an enclosure that provides a degree of protection not less that IP 54 and only accessible with the use of a tool in accordance with EN/IEC 60079-0.
3) Transient protection should be provided and set to a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.

Reliability Prediction

Reliability Prediction
MTBF (Mean Time Between Failure): MTBF in hours using MIL-HDBK-217F, FN2. *Per MIL-HDBK-217, Ground Benign, Controlled,* $G_B G_C$

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT[1])
25°C	776,253 hrs	88.6 years	1,288.2
40°C	531,612 hrs	60.7 years	1,881.1

[1]**Note:** FIT refers to Failures in 10^9 hours.

Configuration Controls

Software Configuration Only via USB or USB-OTG
This dual transmitter drives two channels of current or voltage proportional to input signals taken from differential voltage measurements across resistance input sensors (RTD or resistances wired to TB1/CH1 or TB3/CH2). No switches or potentiometers are used to adjust this transmitter. Its behavior as a dual isolated signal amplifier/transducer is determined via programmed variables set using a temporary USB connection to a host computer or laptop running a Windows-compatible configuration software program specific to the transmitter model. This software provides the framework for digital control of all configuration and calibration parameters, and this information is stored in non-volatile memory.

Refer to Operation Step-By-Step in the Technical Reference section of this manual for detailed information on available software control of this model.

REVISION HISTORY

The following table shows the revision history for this document:

Release Date	Version	EGR/DOC	Description of Revision
17-JUN-2019	A	BC/ARP	Initial Release.
27-JAN-2020	B	BC/ARP	Added MTBF Figures.
15-SEP-2020	C	CAP/ARP	Added cULus, ATEX, IECEx, and FCC approvals.