USB Programmable, DIN Rail Mount, DC-Powered Dual/Single Transmitter or Signal Splitter w/ DC Current/Voltage Inputs & Current or Voltage Outputs

Model DT336-0700, DC Current & Low DC Voltage Inputs
Model DT337-0700, DC ±1V/±10V Medium Voltage Inputs
Model DT338-0700, DC ±15V/±150V High Voltage Battery Sources Inputs

USER'S MANUAL

ACROMAG INCORPORATED
30765 South Wixom Road
Wixom, MI 48393-2417 U.S.A.

Tel: (248) 295-0880
Fax: (248) 624-9234
email: sales@acromag.com

8501129C

Table of Contents

GETTING STARTED

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 DT33x dual 4-wire transmitters that convert DC voltage and/or current input signals to isolated voltage or current output signals (4-wire transmitters refer to having separate isolated DC power). If your application requires dual 2-wire (loop-powered) transmitters instead, please refer to similar DT23x series 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”.

The DT33x-0700 models provide two isolated ANSI/ISA Type IV transmitters with isolated current or voltage outputs. Units may operate as dual transmitters, a single channel transmitter, or a channel 1 signal splitter, and will interface with DC Current or DC voltage input signals according to their model. They isolate each input, and separately modulate two isolated DC outputs that may drive current or voltage. Units are setup, calibrated, and rescaled using configuration software and a USB connection to Windows-based PC’s (Windows 7 and later), or an Android -based tablet or smartphone running our Agility mobile app and connected via a USB-OTG cable. Units provide adjustable and scalable input and output ranges, plus dual output signal drive capability for voltage or current, input/output/power isolation for each channel, and variable input filtering.

Key Features

- **Unit is digitally configured and calibrated w/ Windows software via USB, or our Agility Android APP installed in a smartphone or tablet and connected via a USB-OTG cable.**
- **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.**
- **Independently adjustable and scalable input and output ranges.**
- **The DT336 input has a DC Current path for 0,4-20mA/0-11.17mA/ ±1mA and a DC Voltage path for ±0.5V/0-500mV. DT337 channels have separate DC Voltage input paths for up to ±1V, and up to ±10V. DT338 channels have separate DC Voltage input paths for high-level ranges to ±15V, and ±150V Battery Sources.**
- **Variable input filter adjustment (none, low, medium, or high).**
- **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.**
- **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 B**
- **cULus Listed - Class I/Division 2 - Haz. Loc., ATEX, & IECEx.**

Application

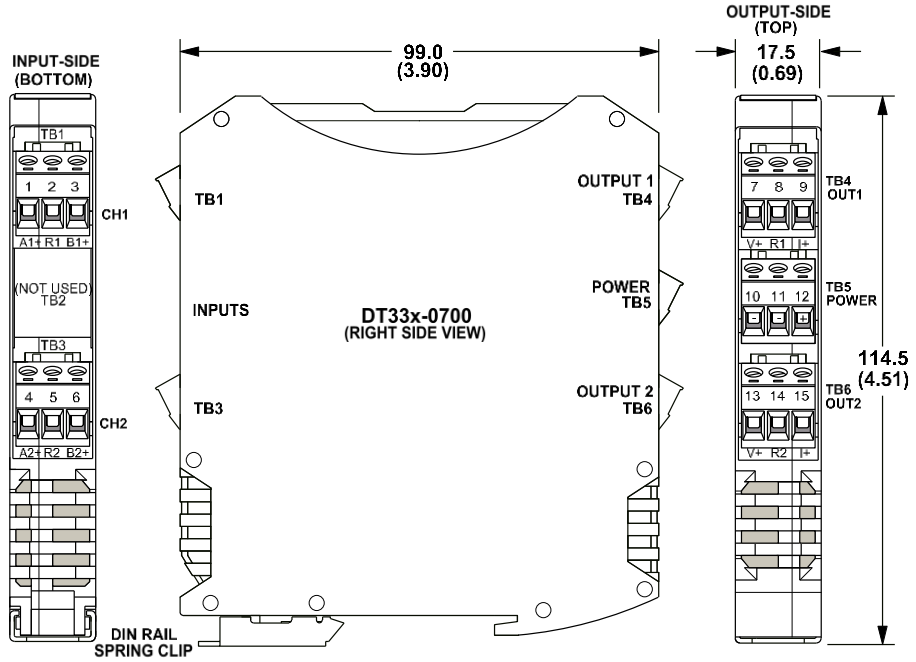
For additional information on these devices and related topics, please visit our web site at www.acromag.com.

DT300 Dual Transmitters are designed for high-density mounting on T-type DIN rails. Units may 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. Each channel isolates a wide range of current or voltage input signals depending on model and can mate with grounded or non-grounded sensors. Units drive isolated outputs that source current or voltage at each output channel with support for 0-20mA, 4-20mA, or ±10V, ±5V, 0-10V, and 0-5V output ranges.

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.*



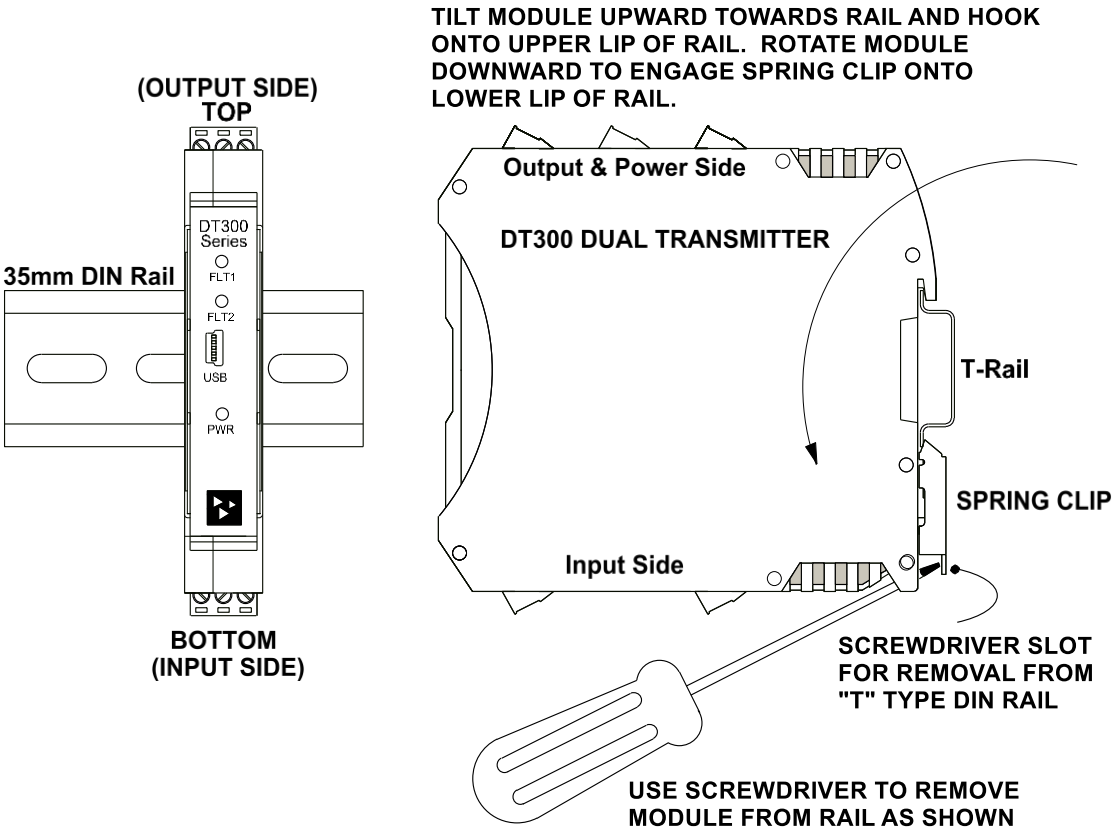
DIMENSIONS ARE IN MILLIMETERS (INCHES)

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.

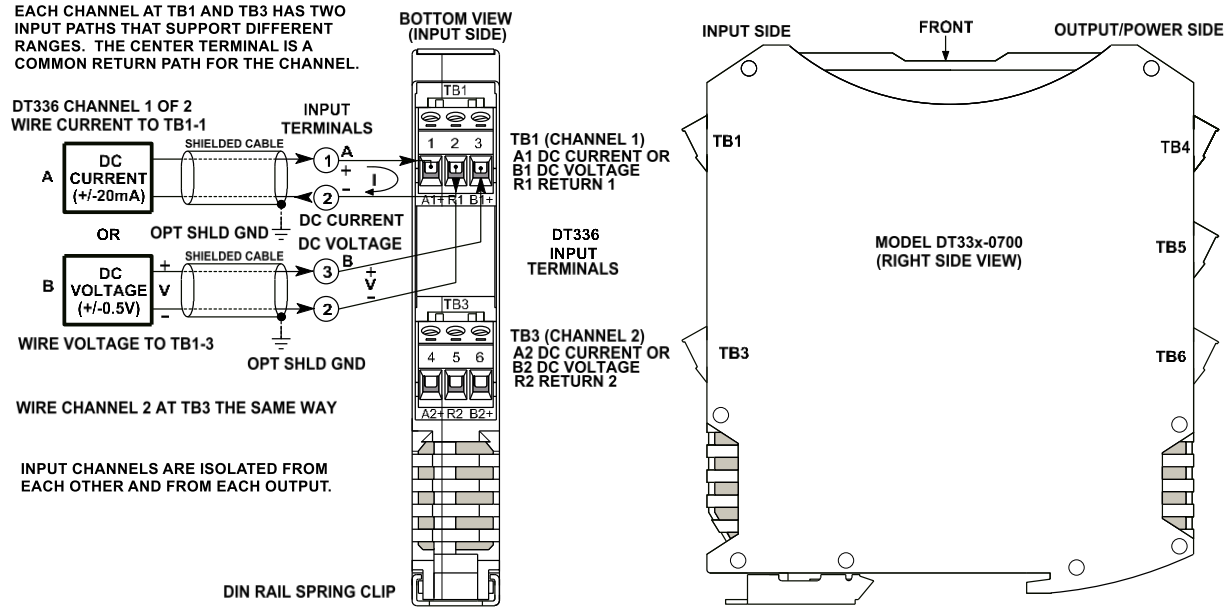
Wire terminals may accommodate 14–28 AWG (2.08–0.081mm^2) solid or stranded wire with a minimum temperature rating of 90°C. Input wiring may be shielded or unshielded type. Ideally, output wires should be twisted pair, or shielded twisted pair. Use insulated wire to keep channels isolated. Terminals are pluggable and can be removed from their sockets by prying outward from the top with a flat-head screwdriver blade. Input channels each have two input paths that support different nominal ranges (for example, DT336 allows current input to be wired to TB1-1/TB3-1, and voltage input wired to TB1-3/TB3-3). 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 (0.5-0.6 Nm torque). Use adequate wire insulation and follow proper wiring practice, as common mode voltages can exist on signal wiring. Generally, output wires are separated from input wires for safety, but this is equally important for low noise pickup.

Input Connections

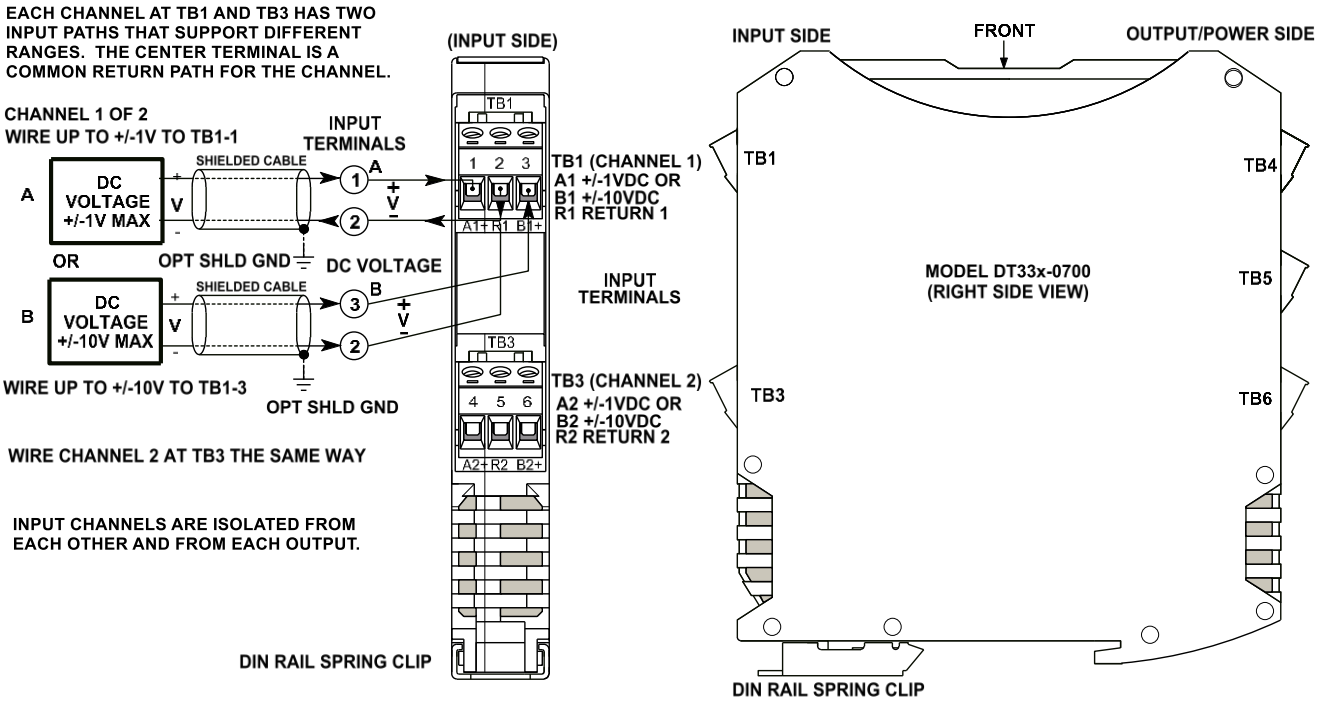
Each channel has two input paths, A and B, that support different nominal input signal ranges. Sensor wires connect directly to transmitter input terminals at TB1 (channel 1) and TB3 (channel 2) at the bottom of the module (the spring-loaded DIN clip side, as shown in the connection drawing below). Observe proper polarity when making input connections and make sure that you connect your signal to the correct input terminal (input return is the middle terminal).

- **Unit has three operating modes**: You may operate this unit as a dual transmitter, a single transmitter, or a CH1 signal splitter.
- **Dual Transmitter inputs at TB1 (channel 1) and TB3 (channel 2) are isolated from each other and from their respective outputs at TB4 (channel 1) and TB6 (channel 2), and from power at TB5**. Each output has separate terminals for driving current or voltage which share an output return.
- **Inputs are polarized ±, observe proper polarity.** The outside terminals of TB1 and TB3 are positive inputs A & B and labeled "+". The common return for input paths A & B is the middle terminal of the terminal block. See connection figure below per input model.
- **DT336 ±20mA DC Current is wired to the leftmost terminal of TB1/TB3 and ±0.5VDC is wired to the rightmost terminal of TB1/TB3. The return for these signal paths is the middle terminal of TB1/TB3.**
- **DT337 ±1V DC maximum is wired to the leftmost terminal of TB1/TB3 and ±10V DC maximum is wired to the rightmost terminal of TB1/TB3. The return for these signal paths is the middle terminal of TB1/TB3.**
- **DT338 ±15V DC maximum is wired to leftmost terminal of TB1/TB3 and ±150V Battery Sources DC maximum is wired to the rightmost terminal of TB1/TB3. The return for these signal paths is the middle terminal of TB1/TB3.**

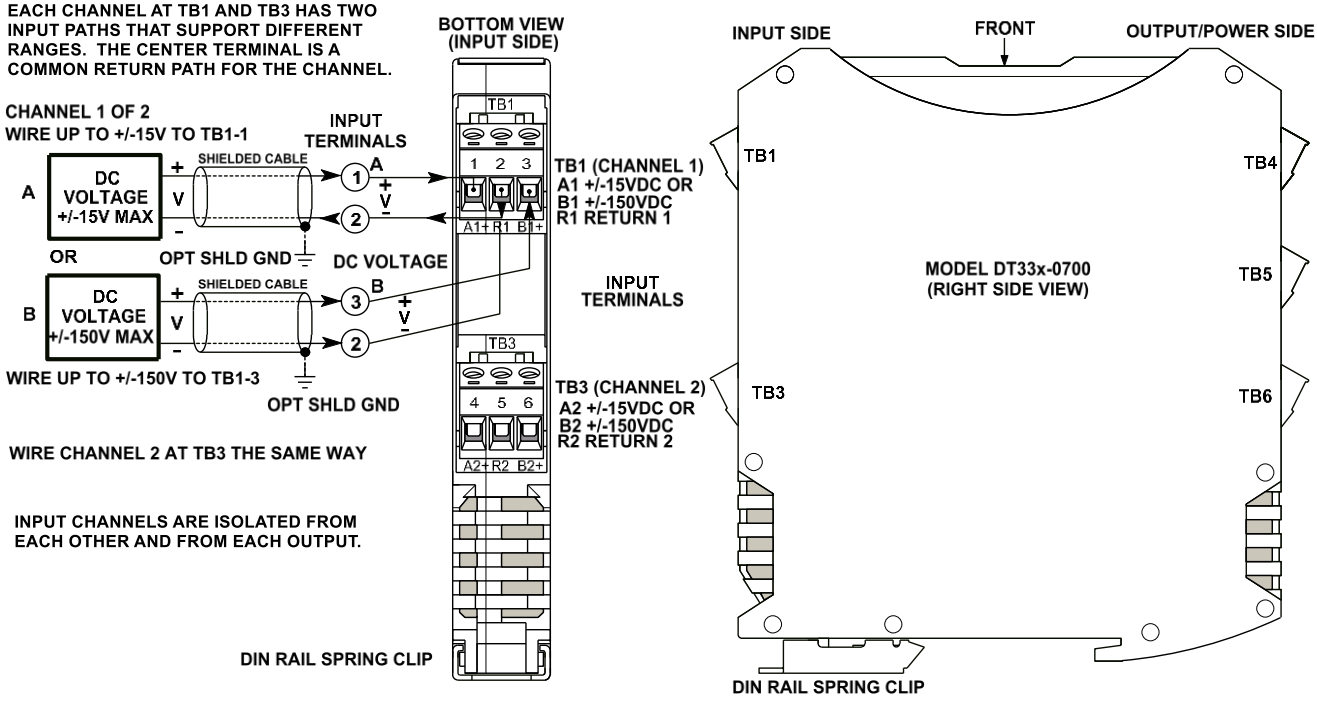
MODEL DT336-0700 INPUT SENSOR WIRING
DC CURRENT AND DC MILLIVOLTAGE INPUT



MODEL DT337-0700 INPUT SENSOR WIRING
MEDIUM DC VOLTAGE INPUT



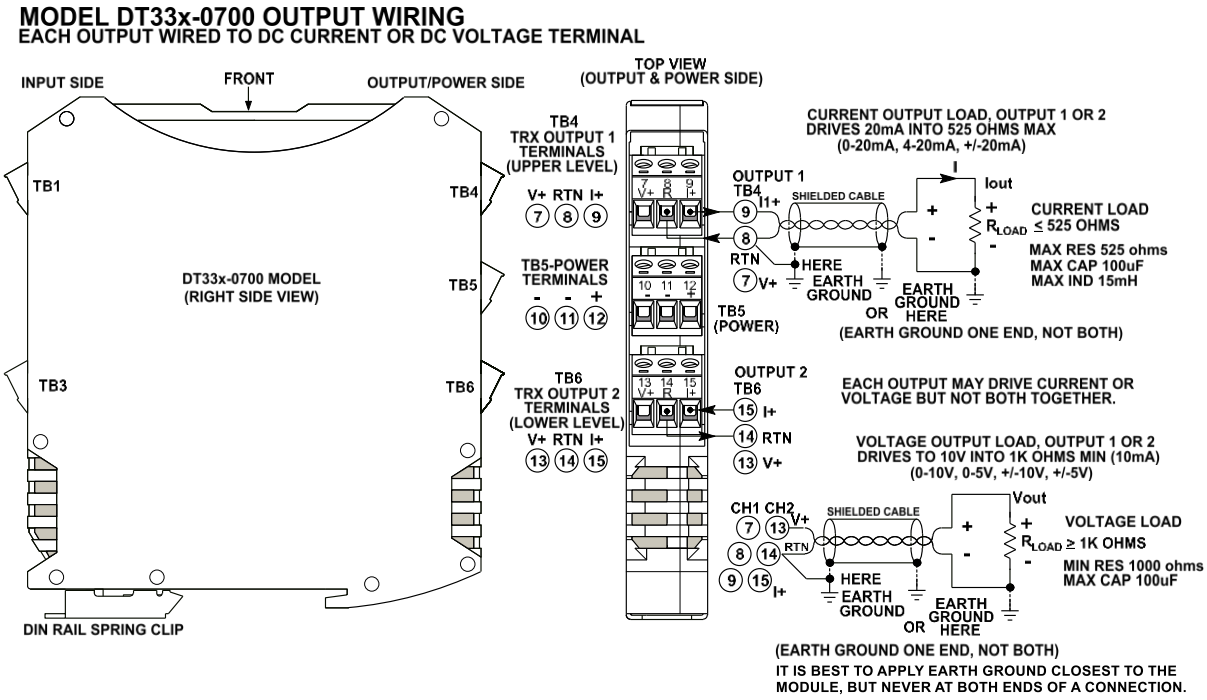
MODEL DT338-0700 INPUT SENSOR WIRING
HIGH-LEVEL DC VOLTAGE INPUT



Output Connections (To DC Current or Voltage Terminals)

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

- **Output connections are polarized.** The current and voltage output terminals of each output share a common return (RTN). Current output is sourced from I+ and returned to R. The Voltage output is sourced positive at V+ with respect to return R. Only one channel output terminal (voltage or current) may be loaded at a time, current or voltage, but each channel may be different.
- **Variations in load resistance has 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. Additionally, shielded twisted pair wiring is recommended for best results. An output connection to earth ground at each output 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, as close to the load as possible.

Power Connections

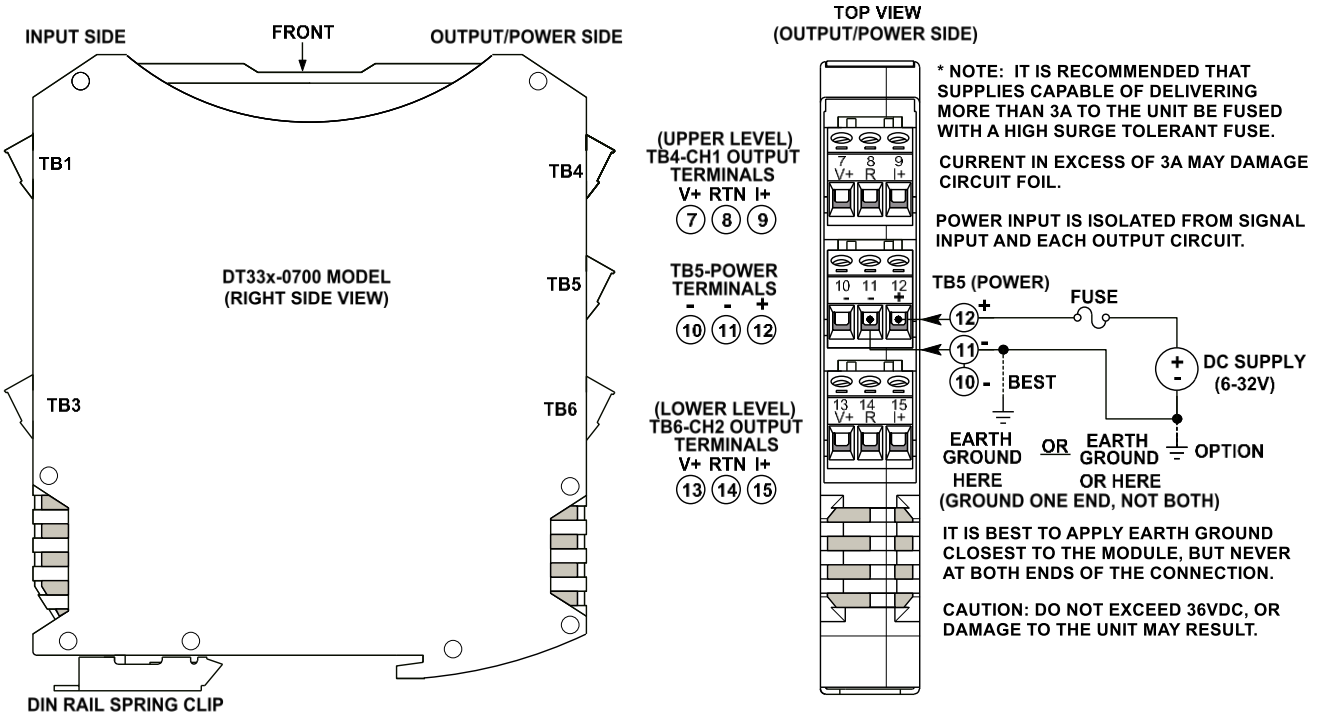
The power terminals are reverse polarity protected.

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 without wiring power to each power terminal block individually.

- 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.

DT33x-0700 MODEL POWER WIRING
UNIT IS DC-POWERED ONLY AT 6 TO 32VDC.



Power Connections…

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

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

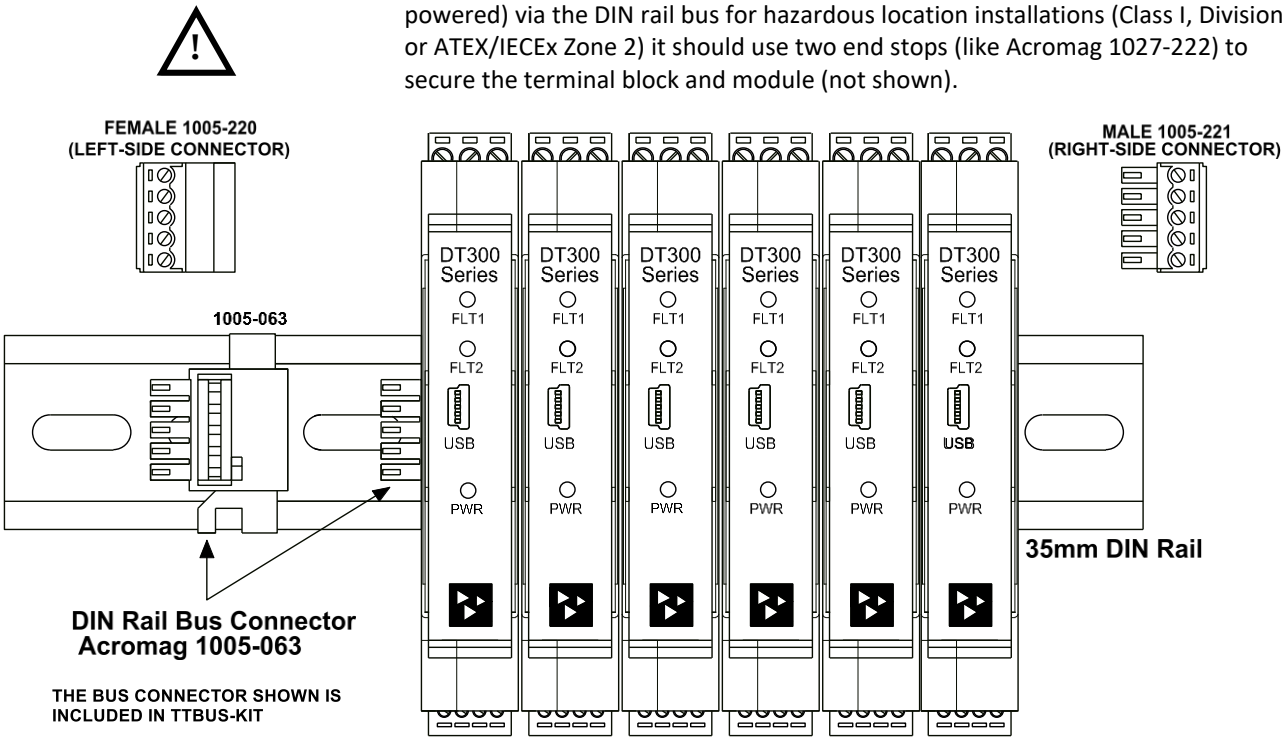
Optional Bus Power Connections

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.

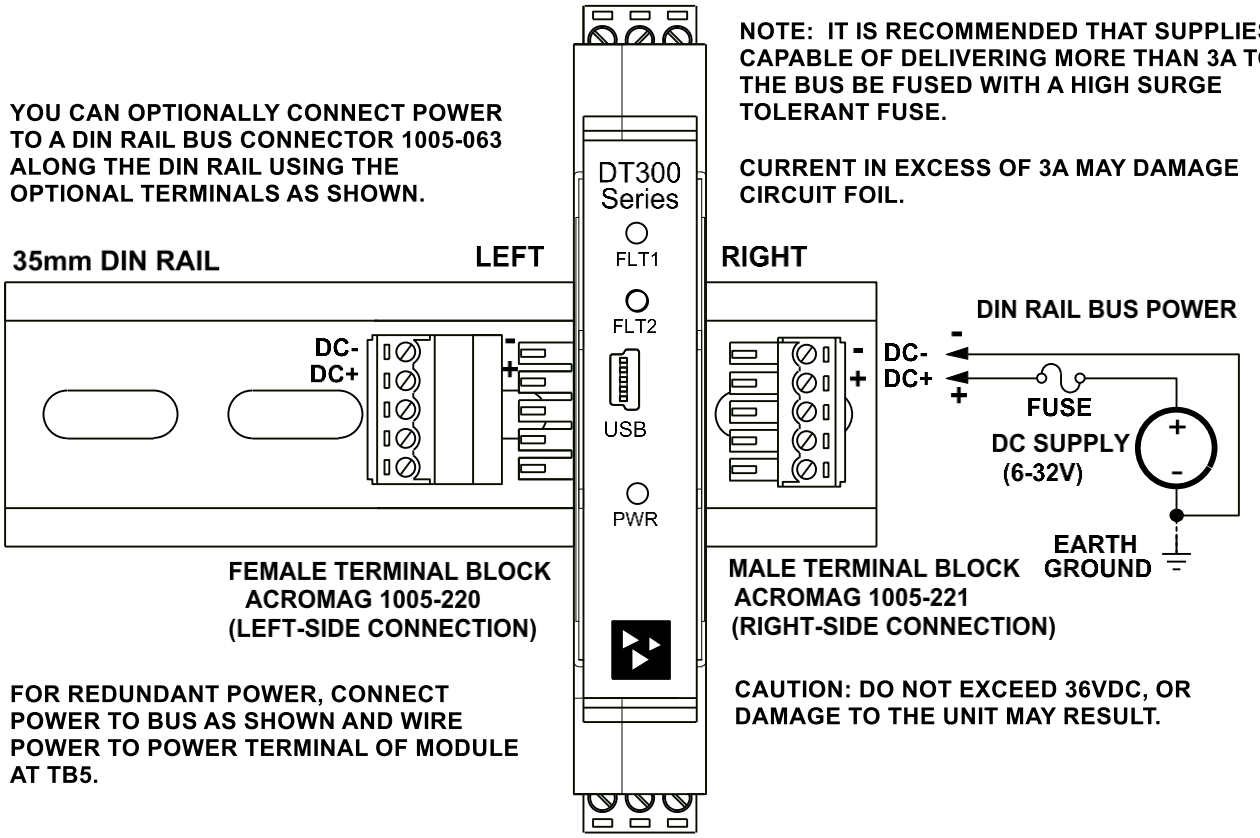
Important – End Stops: If this module uses the optionally powered (or redundantly powered) via the DIN rail bus for hazardous location installations (Class I, Division 2 or ATEX/IECEx Zone 2) it should use two end stops (like Acromag 1027-222) to secure the terminal block and module (not shown).



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.

DT300 OPTIONAL BUS POWER WIRING



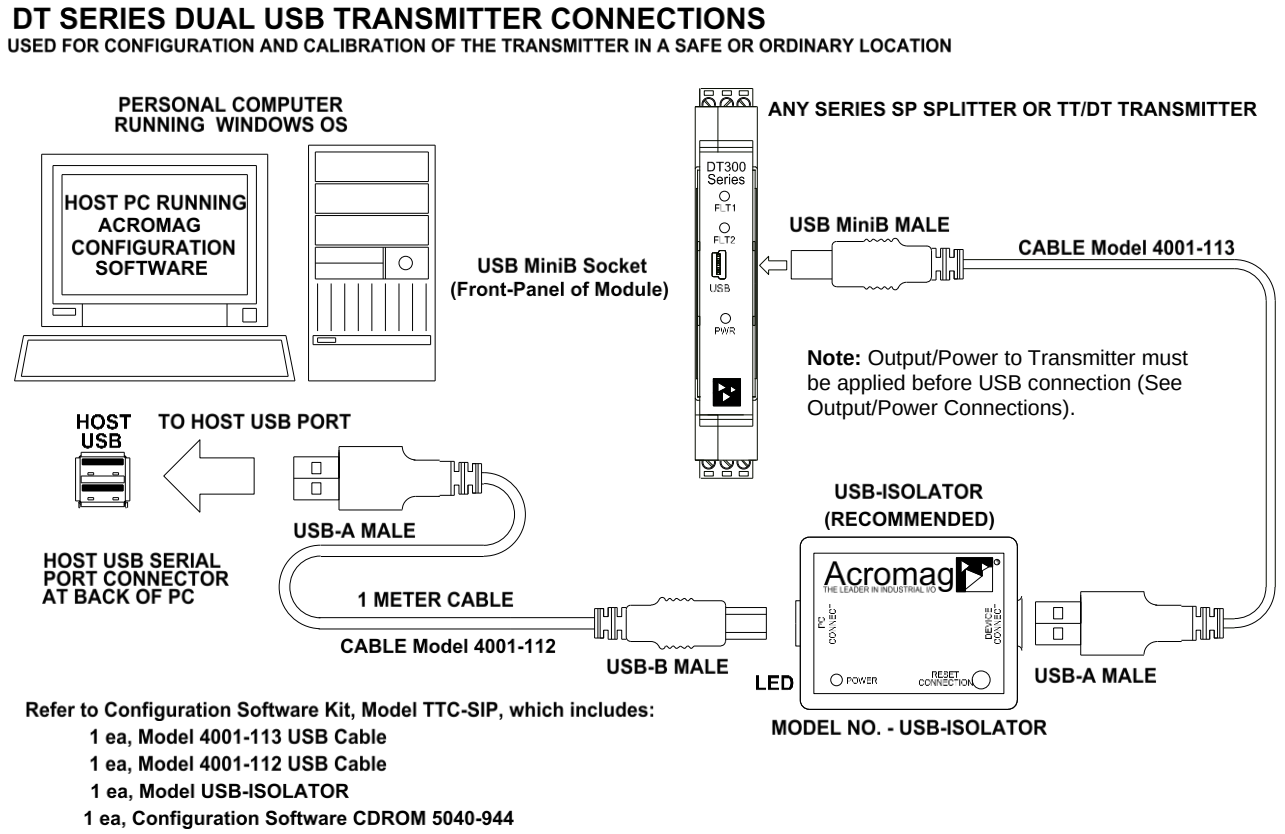
Earth Ground Connections

The unit housing is plastic and does not require an earth ground connection. Internally, the inputs, outputs, and power circuits 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 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 Inputs, 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.



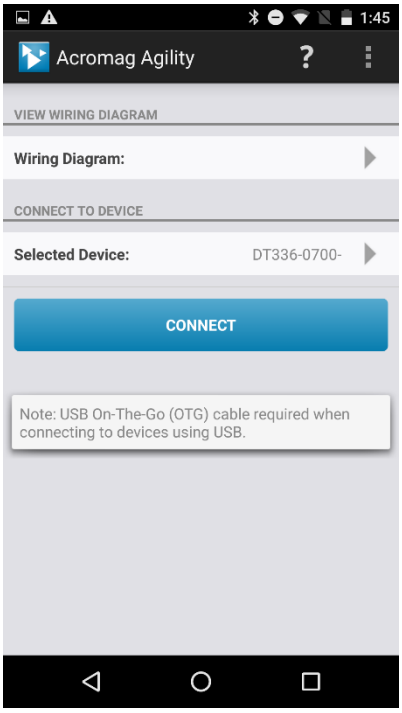
WARNING: The intent of mating USB with this transmitter is so that it can be conveniently set up and calibrated in a safe area, then installed in the field which may be in a hazardous area. Do not attempt to connect a PC or laptop to this unit while installed in a hazardous area, as USB energy levels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

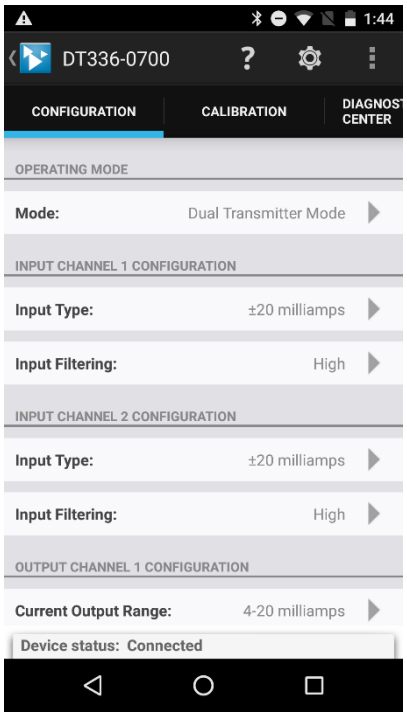
- USB Signal Isolation is recommended and required when connected to a grounded input – Input 1 and USB connections are isolated from each output and power of this model. USB Isolation is recommended for safety and noise suppression but required when the input signal happens to be grounded. You may use 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. This 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. Briefly, the APP screen is divided into four tabs for this model. A short description of each tab follows.

Initial 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 just 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, its mode, and display its current configuration.
- Changing any option on this page will send the changes to the transmitter instantly. The device status field 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 input or output. After completing instructions, tap the **[Calibrate]** button.
- The device status at the bottom of the page will report if the calibration was sent successfully.

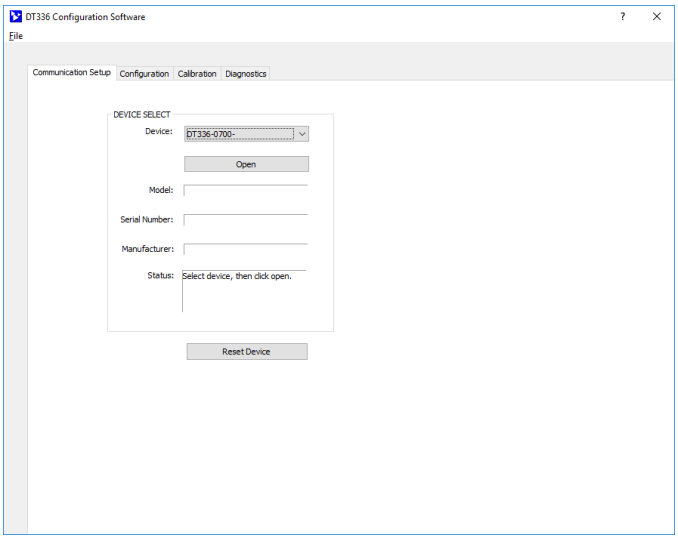
Diagnostic Center Tab – (Verify Input operation)

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

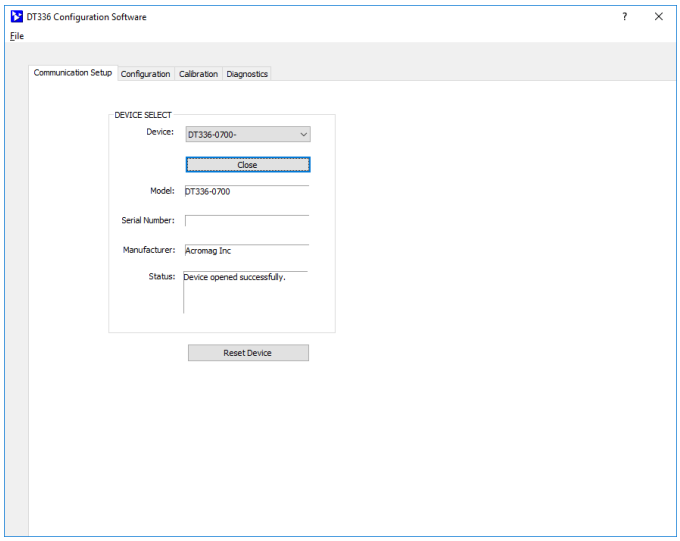
Utility Page – (Reboot or Restore Settings)

- 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 DT336-0700 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 configured and calibrated via its USB Configuration Software and a USB connection to your Windows PC or laptop. The USB software can be downloaded free of charge from our web site at www.acromag.com, and is included on a CDROM bundled with the Configuration Kit TTC-SIP (see Accessories section). For this model, look for the program DT33XConfig.exe. This software is compatible with v7 or later versions of the Windows OS.

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

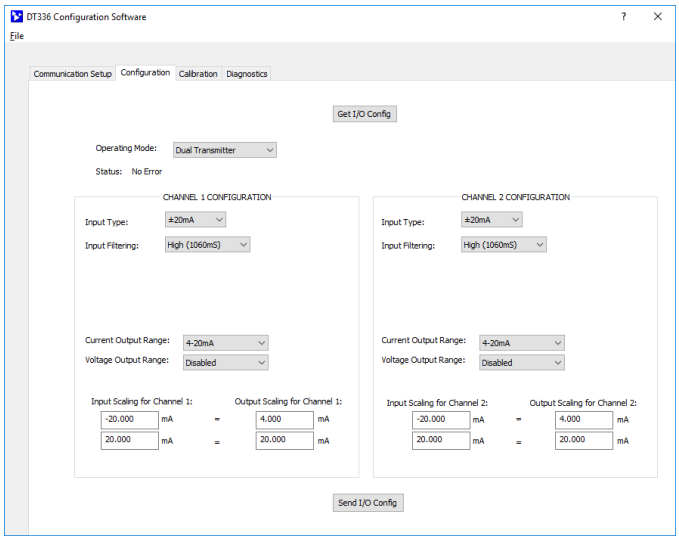
Communication Set up (First Connect to Unit Here)

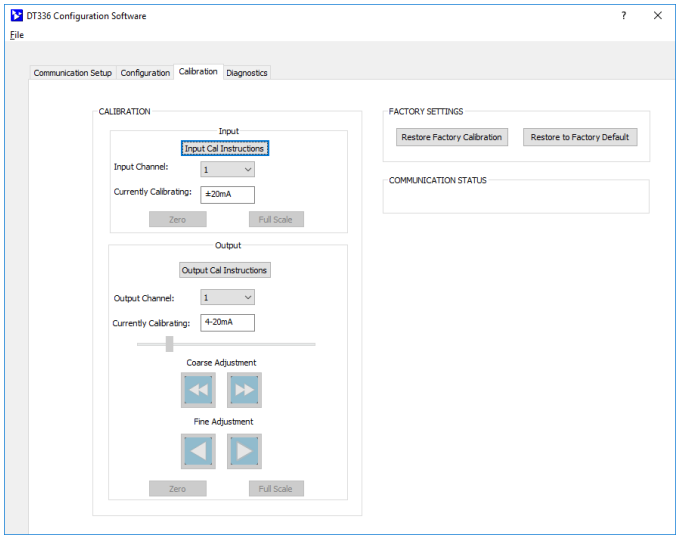
- Select from connected transmitters and Open/Close communication with them.
- Display the Model, Serial Number, and Manufacturer of the connected transmitter and report the status of communication with it.

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.
- Select the Input Range for each channel at TB1 and TB3. You can select current ranges ±20mA, 0-20mA, 4-20mA, 0-11.17mA, or ±1mA or voltage ranges ±0.5V and 0-500mV for the DT336-0700 model.
- Set the level of digital filtering to High, Medium, Low, or None (No digital filter). I/O response times vary with filter and are indicated next to your selection (see Specifications for details).
- Set the current or voltage Output Range to ±10V, ±5V, 0-5V, 0-10V, ±20mA, 0-20mA, or 4-20mA.
- View the config message status in the Status field.
- Use the I/O Scaling fields to specify the input range endpoints to correspond to the nominal output range zero and full-scale endpoints (some over/under-range is included).
- 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 current or voltage 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.

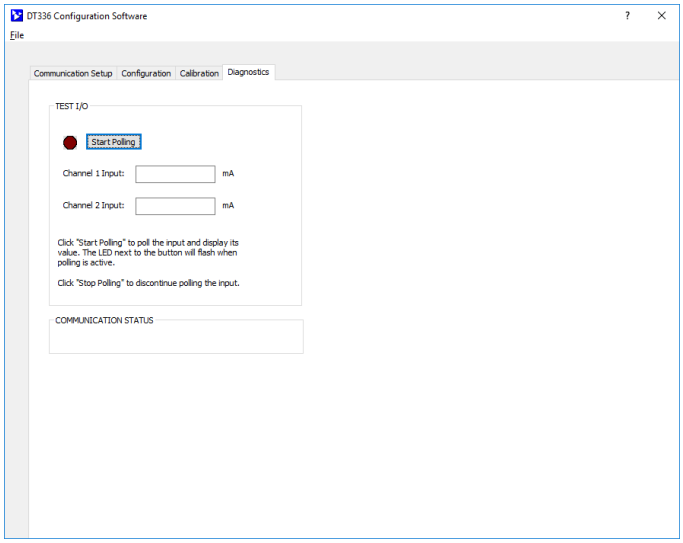
Output…
Click **[Output Cal Instructions]** to begin output calibration. You will be prompted to adjust the input signal as required to drive the corresponding output to its precise output range zero or full-scale level. Once the output is set to zero or full-scale, you simply click the corresponding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

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).

- 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.

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

Communication Status (Bottom of Screen)

- Displays communication status messages for the calibration process.

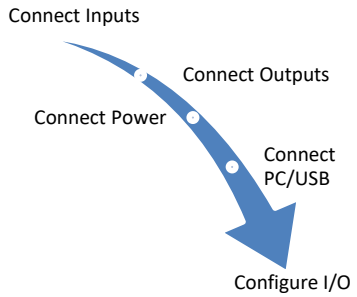
The COMMUNICATION STATUS message bar at the bottom of the screen will display status messages relative to calibration.

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: For best results, your input signal sources, output meters, and load resistors (for current outputs) must be accurate beyond the unit specifications, or better than ±0.1%. A good rule of thumb is to ensure that your equipment accuracy be four times better than the rated accuracy you are trying to achieve with this transmitter (i.e. ±0.025% accurate to achieve ±0.1% accuracy).

Calibration Connections (at each Transmitter Input):

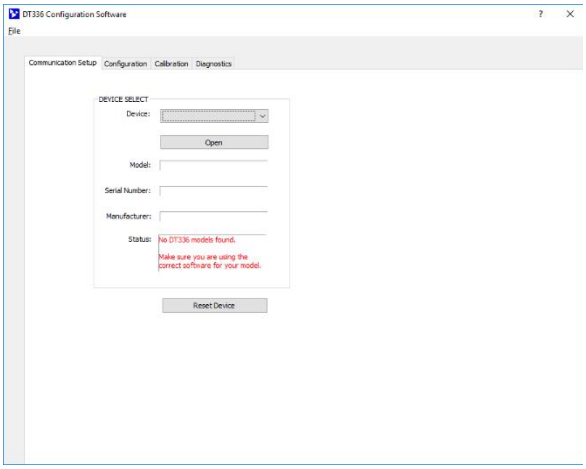
1. **Connect Transmitter Inputs:** For the DT336, connect a precision current source to input A terminal TB1-1 (CH1 current in), or TB3-1 (CH2 current in), or voltage to TB1-3 (CH1 positive voltage) or TB3-3 (CH2 positive voltage). For DT337 and DT338, connect a precision voltage source to voltage A or B inputs at TB1 (CH1) and TB3 (CH2) according to your selected model/input range (the outside terminals #1 & #3 provide two different paths to the input channel according to the input range magnitude). For all three models, the center terminals TB1-2 and TB3-2 are the signal return terminals for both input paths. The channel ADC will sample the correct signal path according to the input range you have selected. Your signal source must be adjustable to the nominal input range zero and full-scale levels. Observe proper polarity. For voltage input, use a voltage source with an output impedance no more than 100Ω and set the input filter level as desired before calibrating an input.
2. **Connect to Voltage or Current terminal of Each Output Channel, not both:** Wire your output load to the transmitter output appropriate for current or voltage, as required by your application. You will need to measure the output current or voltage very accurately to calibrate the output. You could connect a current meter in series with a load to read 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. For either case, never exceed 36VDC peak voltage, 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 omit the isolator only if you are using a battery powered laptop to connect to the unit, or if your input 1 source is not already grounded.

   Now that you have made your connections and applied power, you can execute the DT33XConfig.exe software for your model to begin configuration of the unit (software is compatible with v7 or later versions of the Windows operating system).

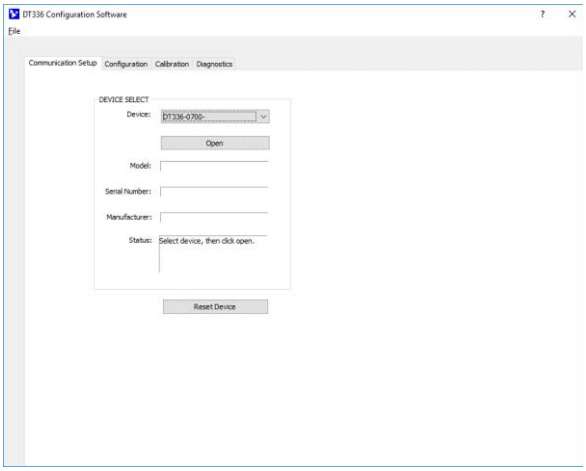
Configuration



Note that you should already have power connected to the transmitter at this point, as this model does not draw power from USB and you will not be able to configure, calibrate, or test the unit without power applied.

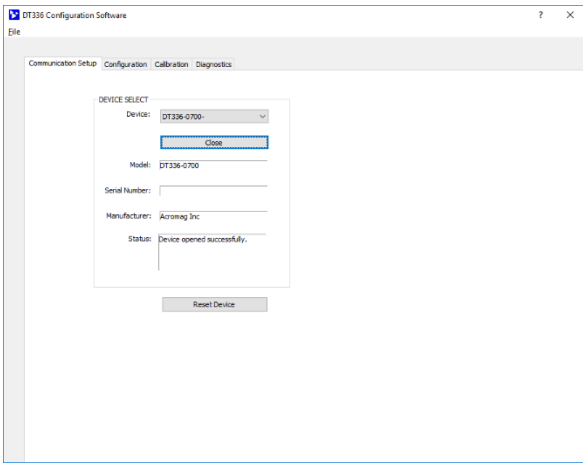
After executing the Acromag Configuration software for this model, the screen shown at left will appear, if you have not already connected to your transmitter via USB (note red status message and fields are blank under these conditions).

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 (same model) using the serial information suffix of the Device model data to discern one unit from another.

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

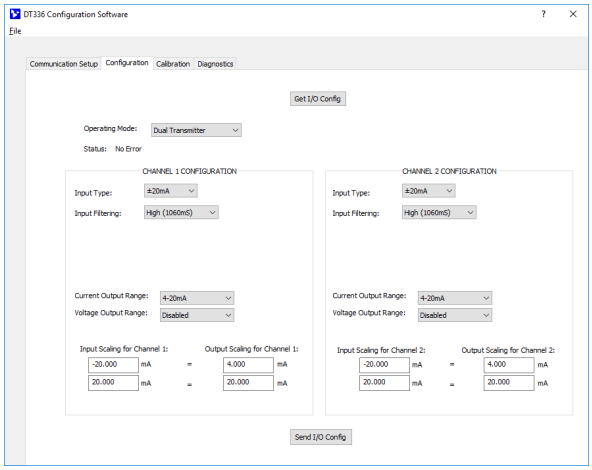


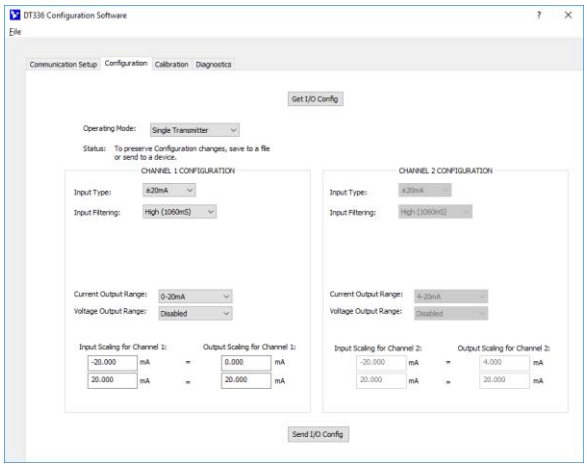
With USB connected, after clicking [Open] of the Connection screen, the selected unit's Model, Serial Number, Manufacturer will be displayed as shown in the screen at left. Additionally, the communication Status field indicates "Device opened successfully" as shown.

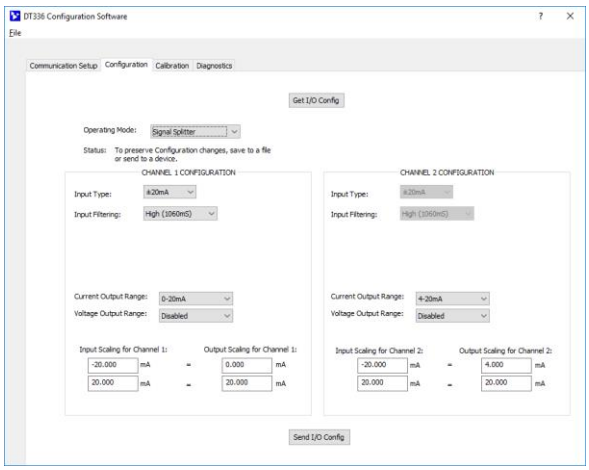
TIP: Always close a connection with one device before selecting another device and make sure that you have the correct model software for the device(s) you are connected to.

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 its operation.

Configuration…







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

IMPORTANT: DT models have three modes of operation: [1]Dual Transmitter, [2]Single Transmitter, and [3]Signal Splitter. The Configuration Screen varies with the Operating Mode selected. The second screen at left is for Single Transmitter mode, the third screen at left is for Signal Splitter mode.

The initial Configuration screen returned represents the connected module's current configuration and operating mode before making changes. Otherwise, you could have loaded the configuration from a saved file, or you may have changed a field. You can always click **[Get I/O Config]** to retrieve the connected module's current configuration at any time.

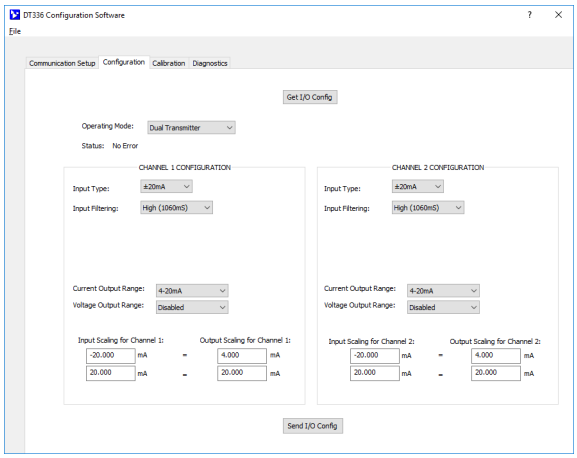
Note that if you make any changes to the configuration indicated, the only way to preserve the changes is to write them to the device by clicking **[Send I/O Config]**, or to save them to a file by clicking **"File"** in the upper left-hand corner of the screen.

NOTE: Note that each channel of these dual transmitter models has two input paths different by the range supported. For the DT336, the first input path is at TB1-1/TB3-1 (leftmost terminal of TB1/TB3) and intended for DC current only. The second input path is at TB1-3/TB3-3 (the rightmost terminal of TB1/TB3) and intended for DC voltage only. For both the DT337 & DT338 models, each input path supports a different range of DC voltage input for the channel. Your input range selection will determine which terminal you must wire your input to. Note that the center terminal is always the channel signal return for both input paths.

Select the Operating Mode...
The three screens at left show three DT Operating Modes: [1]Dual Transmitter, [2]Single 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/Range…
Input Type refers to the nominal input range. Different Input ranges may use different signal paths (see NOTE above). The first terminal of a DT336 channel supports DC current (TB1/TB3-1) of ±20mA, 0-20mA, 4-20mA, 0-11.17mA, and ±1mA. Its third terminal (TB1/TB3-3) supports DC voltage ranges of ±0.5V, 0-500mV. The first and third terminal of the DT337 & DT338 models support different DC voltage ranges (TB1/TB3-1 and TB1-3/TB3-3). Signal return is wired to the middle terminal between them (TB1/TB3-2).

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.

The ranges indicated are nominal and may be rescaled to the output, such that you may use only a portion of the input range to drive the transmitter current or voltage output. Because rescaling it smaller will proportionally decrease its 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.

Select the Input Filtering…
You may select the level of digital filtering to apply to the input channel as Low, Medium, High, or None (No digital filtering). The respective I/O response times are indicated in parenthesis next to your filter selection. Note that higher filter levels result in lower average noise, but with slower I/O response times. Always set the input filter as desired before calibrating an input.

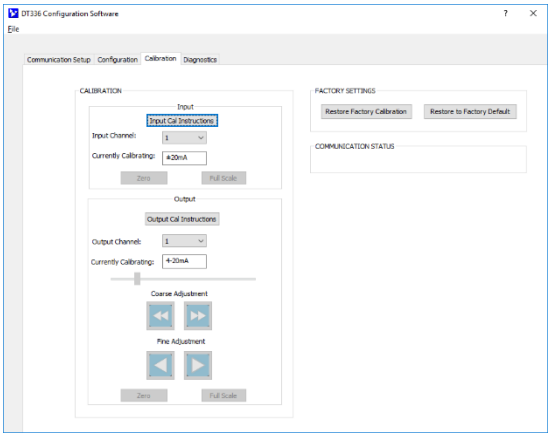
Select the nominal Output Signal Range, Current or Voltage...
Transmitter channels may each drive current or voltage (on separate channel output terminals), but not both signals simultaneously. Select the nominal output signal type and range (the opposite signal type is disabled). Only one channel output terminal, current or voltage may be loaded at one time (current may drive up to 525Ω, voltage may drive 1KΩ or higher loads).

Set the Scaled I/O Sub-Range Zero & Full-Scale Endpoints…
You may rescale a selected input or output range differently for each channel and use a smaller portion of the nominal ranges to drive an input to the output. Be careful as you scale ranges not to reduce the nominal range too much, as resolution will be proportionally diminished and I/O channel noise/error will be magnified (each halving of a range reduces its respective resolution by 1 bit).

In the Input Scaling fields for input and output, set the input signal minimum/zero value inside full range to correspond to the output range minimum/zero value. Set the input signal maximum/full-scale value inside its full range to correspond to the output range maximum/full-scale value. You can optionally swap input levels to configure a reverse acting output response if desired. Note that some under and over-range is built into every I/O range selection and these limits vary by range.

Once you have made your configuration selections, click **[Send I/O Config]** to write them to the module. Read the Status of your configuration transmission in the "Status" field. Alternately, you may click **"File"** in the upper left corner to save your configuration settings to a file on your PC, for later reference.

Calibration (Optional)



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 it in the field, as the unit has already been factory calibrated. But if at some point, you encounter excessive I/O error, you can optionally click the **Calibration** tab to display the Calibration control page as shown at left.

IMPORTANT: The unit has already had its inputs and outputs factory calibrated with a high level of precision. If you attempt to recalibrate an I/O channel, you could degrade its performance if you don't do it properly, or you do it using low grade equipment. Consider your decision to recalibrate carefully.

Before you calibrate an input, set its input filter as desired in your application before calibrating. Calibration of any stage of this model 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

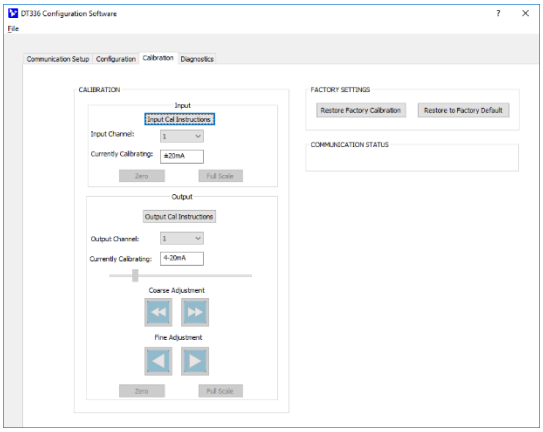
Before attempting input calibration, set the nominal Input Range and input filter on the "Configuration" page and make sure you write your selection to the unit by clicking ***[Send I/O Config].*** *For the DT336, wire an input current source to the left-most input terminal of TB1-1 (CH1) or TB3-1 (CH2), or a voltage source to the right-most terminal of TB1 (CH1) or TB3 (CH2). The center terminal TB1-2 or TB3-2 is the signal return for either input path of the channel. For DT337/338 models, the left and right outer-most terminals are for different nominal ranges of voltage input.*

After setting the input range you wish to calibrate, select Channel 1 or 2 as required. Then click its **[Input Cal Instructions]** button to begin input calibration and enable the Input [Zero] and [Full-Scale] buttons.

Click the Input **[Zero]** and you will be prompted to input the minimum value of your selected input range at the appropriate input channel. For DC current or voltage, this will be the range minimum at the input terminal and varies with the Input Range selected (calibration does not use the scaled range zero, but the zero of the nominal input range selected). Once you input the zero precisely, click the **[OK]** button 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 appropriate input channel. For DC current or voltage, this will be the range minimum at the input terminal and varies with the Input Range selected (calibration does not use the scaled range zero, but the zero 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 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 span (12-bit or better), as an input span set too-tight will have diminished resolution and magnified error.

Note: Input calibration from the factory has all sub-ranges of a nominal input range along an input terminal path calibrated automatically by extrapolating from the calibration of the major range for that path to save time (see Specifications Table 1 and note the ranges that share the same divider and gain setting). One exception is ±1mA of the DT236 where its gain doubles requiring it be calibrated separately from ±20mA. However, you still have the option of calibrating a specific sub-range independent of its major range to increase precision if required, but make sure you always calibrate the smaller input range after its major range to prevent the subsequent re-calibration of a range from stepping on the calibration of a smaller sub-range.

CALIBRATION – Each Output Separately

Wire your output monitor to the correct terminal, voltage or current, for the channel output 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

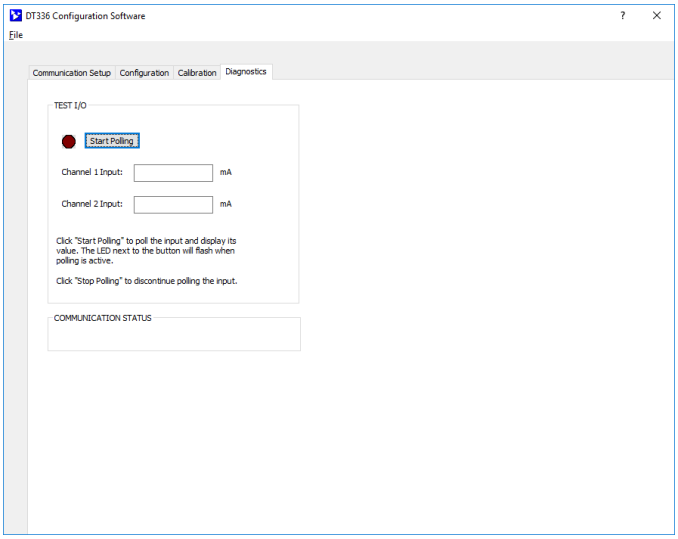
You can use the **[Restore Factory Calibration]** button to restore the transmitter's original factory calibration if you think you made an error during recalibration, have degraded its performance, or the I/O channel appears erratic.

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.

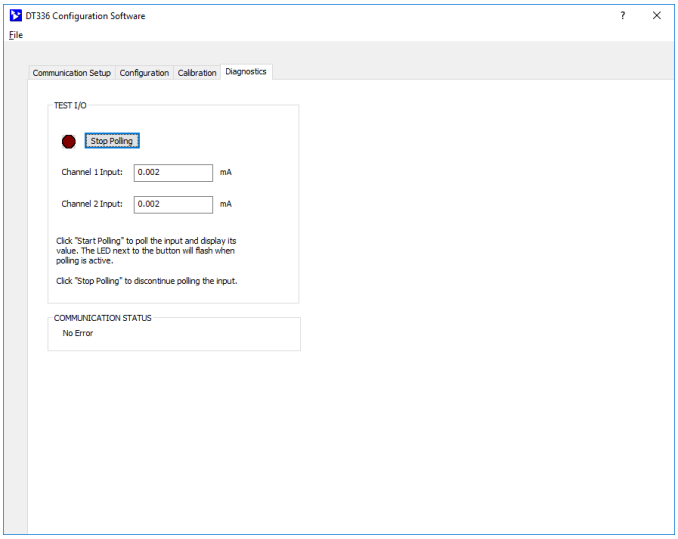
CALIBRATION – COMMUNICATION STATUS

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

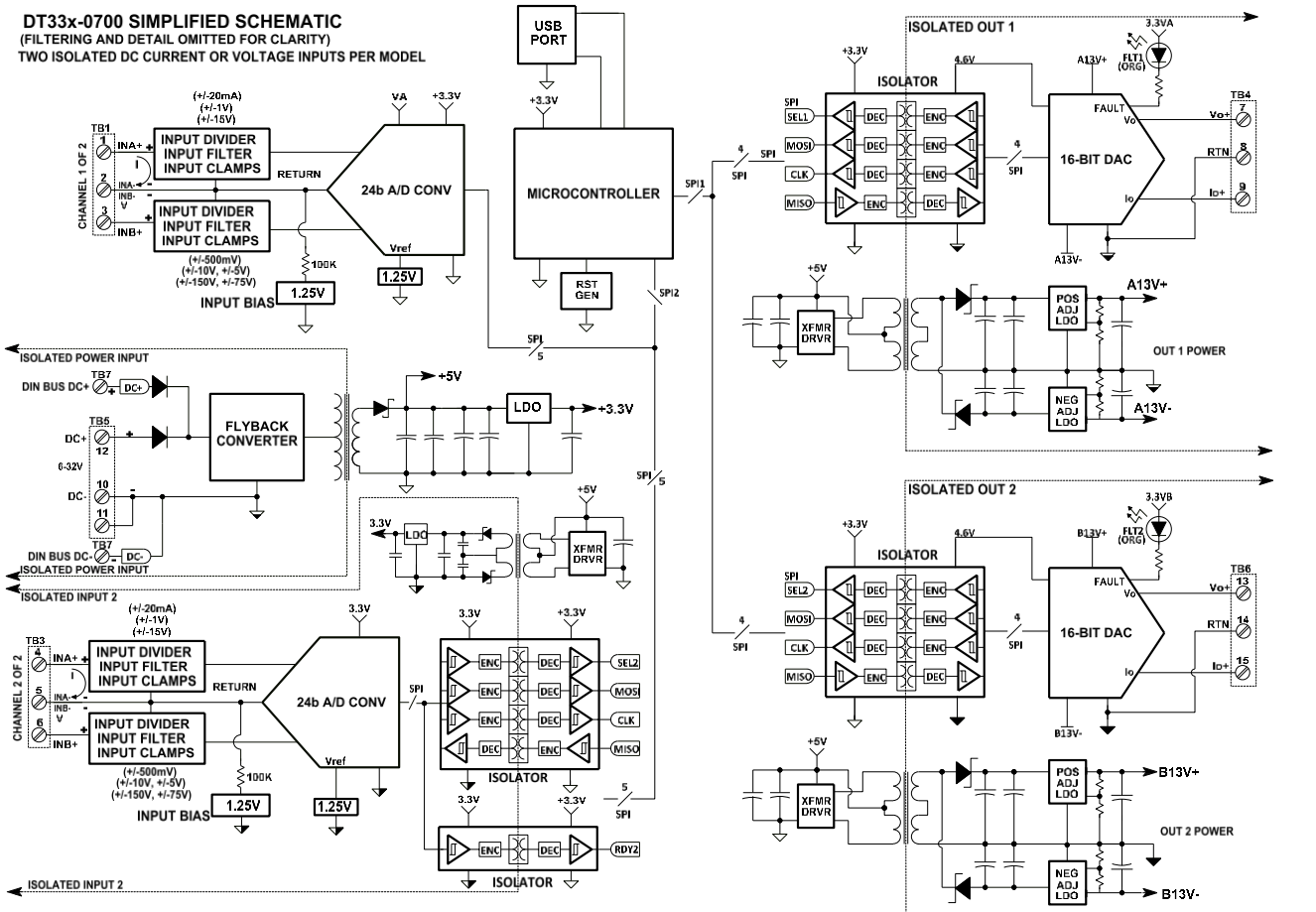


At this point, following Configuration or Calibration, you could choose the Diagnostics tab to display the Diagnostics page shown at left. From this page, you can test transmitter operation by polling the input channel(s). Click **[Start Polling]** to trigger the software to periodically read the input channel(s) 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 second screen at left, note the input values are indicated in range units and “No error” is displayed in the Communication status field.

BLOCK DIAGRAM



FOUR-WIRE DC-POWERED 6-32V DUAL TRANSMITTER
EACH TRANSMITTER CHANNEL HAS SAME FRONT-END AS SIMILAR TT MODELS
EACH TRANSMITTER CHANNEL OUTPUT DAC IS DIGITALLY ISOLATED
EACH TRANSMITTER OUTPUT HAS BOTH CURRENT AND VOLTAGE TERMINALS
EACH TRANSMITTER OUTPUT DRIVES UNIPOLAR AND BIPOLAR OUTPUT RANGES

How It Works

Key Points of Operation

- Unit is DC powered and Isolated.
- Each input is Differential
- 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 using a digitally isolated SPI bus. Each 16-bit output DAC drives separate voltage and current terminals with a shared output return. Output ranges are user-configured/scaled. Power to drive the input and output circuits is provided via an isolated fly-back converter operating on input voltage wired to the power terminals at TB5, or alternatively wired to optional bus power terminals along the DIN rail. Setup involves selecting the input ranges, 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 and USB, Input 2, each output, and the power circuits are all isolated from each other. This 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 bias supply to ground and clipping any negative range.

TROUBLESHOOTING

Diagnostics Table

Before attempting repair or replacement, be sure that all installation and configuration procedures have been followed and that the unit channels are wired properly. Verify that power is applied to the unit and that your supply voltage is at least 6V. Verify that your loads are appropriate to your output type and wired to the correct terminal, current or voltage. Check both channels.

If your problem still exists after checking your I/O channel 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 to this model is normally biased up 1.25V off input ground to process negative-going signals. A grounded signal source could inadvertently short this bias to earth ground and clip the negative input range 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 and re-open the transmitter 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.	To step the input, it takes two samples for the A/D to ramp up to its final output level, evident when using a scope to examine the output transition in response to an input step change, which appears 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 upscale or down-scale output can be driven by a sensor fault, such as an open/broken sensor lead. Check input 1 sensor wiring. If not isolating USB, check for a ground loop between sensor & earth ground of USB port.
Cannot Calibrate Input Channel…	
Is input wired properly?	Check that input is wired to ± input terminals using correct polarity.
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 Voltage or Current…	
Have you wired the input to the correct terminals for the range selection?	Each channel has two potential signal paths at TB1 and TB3—have you wired your signal to the proper input per your signal type.
Output Noise Seems Excessive…	
Scaled input or output range is too small.	Scaling the 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 I/O span.
An orange output fault LED is ON...	
The corresponding current output load is too large to drive it accurately or is 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 Bulletin 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 5040-944

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

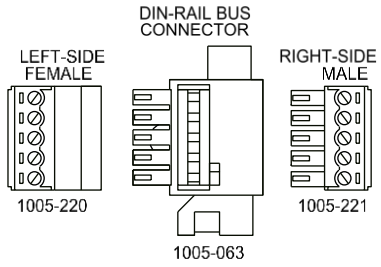
USB OTG Cable – Order 5028-565

- 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. Then add a left-side or right-side terminal block 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 DT33X-0700

Signal Transmitter
Isolated DC I/V Input
Four-Wire 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 DT model prefix denotes a Dual Transmitter. The 3rd digit "3" denotes a 4-wire, separately-powered member of the DIN-Mounted DT300 transmitter family. The trailing 3x digits denote its input type with 36 denoting DC current/millivoltage, 37 denoting medium DC voltage, and 38 denoting high DC voltage. The trailing "-0700" model suffix denotes a 4-wire transmitter 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, 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 for 4-20mA DC at TB1/TB3-1 (DT336), ±1V DC at TB1/TB3-1 (DT337), or ±15V DC at TB1/TB3-1 (DT338), and both transmitter outputs mapped to 4 to 20mA outputs normally acting, and with medium input filter selection. The center input terminal TB1/TB3-2 is the common signal return for the voltage/current input signals.

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).

Input (Each)

Models have two channels with two input paths each for current and/or voltage that varies by model.

Two signal paths at channel 1 (TB1) and channel 2 (TB3) support different ranges. On DT236, DC current is input at TB1/TB3-1, and DC voltage at TB1/TB3-3. On DT237, ±1V DC is input at TB1/TB3-1, and ±10V at TB1/TB3-3. On the DT238, ±15V DC is input at TB1/TB3-1, and ±150V is input at TB1/TB3-3. Signal return for the channel is TB1/TB3-2.

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

Input Reference Test Conditions: DT336 TB1/TB3 input A is 4 to 20mA or input B is ±0.5V, DT337 TB1/TB3 input A is ±1V or input B is ±5V, DT338 TB1/TB3 input A is ±15V or input B is ±150V; medium filter; 4-20mA output into a 250Ω load; 25°C Ambient; and 24V DC Supply.

Input Range: Models have separate input channels at TB1 & TB3 which include two signal paths A & B that support different ranges. The input is processed differentially by the A/D converter and may be scaled separately from its output channel with a smaller portion of the range driving the output (note that resolution will decrease and error increase as nominal input ranges are rescaled smaller).

MODEL	Input Path A at TB1/TB3-1	Input Path B at TB1/TB3-3
DT336	±20mA, 0 to 20mA, 4-20mA, 0 to 11.17mA, & ±1mA DC into a precision 24.9Ω current shunt resistor to convert to Vin.[1]	-0.5V to +0.5V, or 0 to 500mV, direct to an ADC without a resistive divider and having an input impedance of 15MΩ min.
DT337	±1V or 0-1V to an ADC without a resistive divider (input impedance 15MΩ min).	±10V/0-10V & ±5V/0-5V DC to an ADC after passing through a 86.6K/1084.6K resistive divider.
DT338	±15V or 0-15V DC w/28K/527K divider.	±150V/±75V or 0-150V/0-75V DC w/5.36K/1003.36K divider. [2]

[1]**Note:** An optional external sensor is required to monitor AC current signals for input to TB1/TB3-1 of a DT336 (see Acromag Model 5020-350). This toroidal sensor generates 0 to 11.17mA DC to drive a DC current input to this module with AC input current through its own primary (see Table 1 of next page for scaling the AC current by number of primary turns).

[2]**Note:** Per cULus Shock & Fire Safety: +/- 150 VDC Maximum Battery Sources or +/- 60 VDC Maximum SELV MAINS Sources.

Input...continued

Analog to Digital Converter (A/D): Each input 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): ADC Inputs are sampled at a variable rate with filter as follows:

A/D SAMPLING RATE (SAMPLES/SECOND) PER INPUT FILTER			
NONE	**LOW**	**MED**	**HIGH**
214.65sps	53.6625sps	13.42sps	1.6775sps

Input Impedance: Each channel has two input circuit paths A & B that support different ranges. Input impedance will vary with the input path divider as follows:

	INPUT IMPEDANCE PER MODEL INPUT PATH DIVIDER	
MODEL	**INPUT PATH A**	**INPUT PATH B**
DT336-0700	24.9Ω Current Shunt	No Divider[1], 15MΩ
DT337-0700	No Divider[1], 15MΩ	86.6K/(998K+86.6K), 1MΩ
DT338-0700	28K/(499K+28K), 500KΩ	5.36K/(998K+5.36K), 1MΩ

[1] **Note:** Direct connection to A/D channel without a resistive divider.
Input Overvoltage Protection: Inputs include Bipolar Transient Voltage Suppressers and diode clamping along with series resistance and capacitive filtering.
Input Filter: RC filtering plus digital filtering, optimized and fixed per input range and filter selection within the Σ-Δ ADC. See also Normal Mode Noise Rejection and Output Response Time.
Input Noise Rejection (Common Mode): Varies with filter selection between no filtering and high filtering as follows (data is measured with a 100Ω input unbalance):

Typical Common Mode Noise Rejection		
MODEL	**NO FILTER**	**HIGH FILTER**
DT33x	100dB	120dB

Input Noise Rejection (Normal Mode): Varies with input filter level and input path divider. The minimum measured rejection of the DT336 model is given which does not divide its inputs. The higher rejection of the DT337 & DT338 is estimated by adding 20*log[input_divider] (see Input Resolution for applicable dividers per input path).

Typical 60Hz Rejection for Input Path A & B per Input Filter Setting				
MODEL	**None (dB)**	**Low (dB)**	**Med[1] (dB)**	**High[1] (dB)**
DT336	A, B: 7	A, B: 25	*> 80dB[1]*	*> 80dB[1]*
DT337 est	A: 7, B: 29	A: 25, B: 47	*> 80dB[1]*	*> 80dB[1]*
DT338 est	A: 32, B: 52	A: 50, B: 70	*> 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.
Bandwidth: The frequency where the DT336 is attenuated 3dB for each input filter level setting is shown below (DT337 & DT338 similar). See also Normal Mode Noise Rejection and Output Response Time.

Bandwidth (-3dB) per Input Filter Setting				
MODEL	**None (dB)**	**Low (dB)**	**Med (dB)**	**High (dB)**
DT336	34Hz	18Hz	12Hz	1.4Hz

Input...continued

Input Resolution: Input analog to digital conversion divides the input signal range into parts calculated by subtracting endpoint A/D counts computed via the expression (Vin*Gain/1.25) * 32768+32768. Vin is the voltage after the input divider and gain is applied to the signal (see Table 1). The input divider is different for input paths A & B. Ranges that share the same gain are calibrated by linearly extrapolating from their nominal input range calibration. For simplification, raw A/D counts indicated in Table 1 are normalized to ±25000/15.5 bits for ±100% (bipolar ranges), or 0-25000/14.5 bits for 0-100% (unipolar ranges), and the effective input resolution of a range will be the lesser of the raw resolution indicated in Table 1 or its normalized resolution. The effective resolution of an I/O conversion will be the lowest resolution of the A/D, its normalized value, or the output DAC (see Output). For example, the output DAC resolution is 1 part in 54612 for 0-20mA output, or 1 part in 59577 for ±10V output.

Nominal input ranges may be rescaled to smaller sub-ranges to drive the output. The effective input resolution is proportionally diminished as you rescale input spans below nominal losing 1-bit every time you halve the range. So be careful not to diminish resolution below 12-bits minimum (1 part in 4096) for rated performance

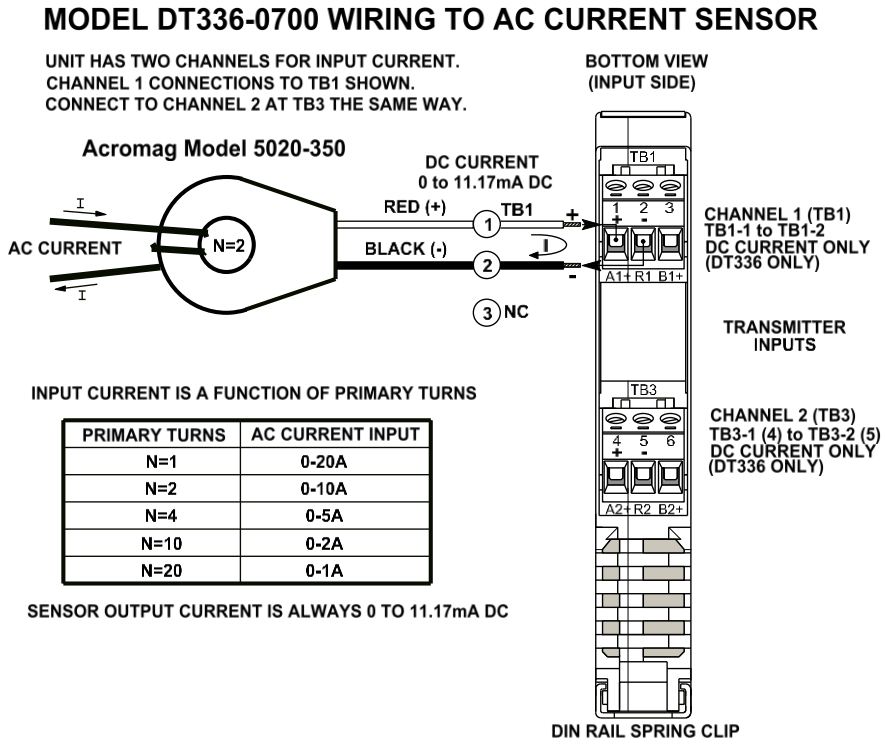
Table 1: DT INPUT RESOLUTION PER INPUT PATH/RANGE PER MODEL

DTx36 INPUT RANGE	xDIVIDER	xGAIN	A/D INPUT RESOLUTION[1]
A (TB1/TB3-1): ±20mA	24.9Ω Shunt	2	6658 - 58878 (1/52220)
A (TB1/TB3-1): 0-20mA	24.9Ω Shunt	2	32768 - 58878 (1/26110)
A (TB1/TB3-1): 4-20mA	24.9Ω Shunt	2	37990 - 58878 (1/20888)
A (TB1/TB3-1): 0-11.17mA	24.9Ω Shunt	2	32768 - 47350 (1/14582)
A (TB1/TB3-1): ±1mA	24.9Ω Shunt	32	11880 - 53656 (1/41776)
B (TB1/TB3-3): ±0.5VDC	NONE	2	6554 - 58982 (1/52428)
B (TB1/TB3-3): 0-0.5V DC	NONE	2	32768 - 58982 (1/26214)
DTx37 INPUT RANGE	**xDIVIDER**	**xGAIN**	**A/D INPUT RESOLUTION[1]**
A (TB1/TB3-1): ±1V DC	NONE	1	6554 - 58982 (1/52428)
A (TB1/TB3-1): 0-1V DC	NONE	1	32768 - 58982 (1/26214)
B (TB1/TB3-3): ±10V DC	86.6K/1084.6K	1	11837 - 53699 (1/41862)
B (TB1/TB3-3): ±5V DC	86.6K/1084.6K	1	22303 - 43233 (1/20931)
B (TB1/TB3-3): 0-10V DC	86.6K/1084.6K	1	32768 - 53699 (1/20931)
B (TB1/TB3-3): 0-5V DC	86.6K/1084.6K	1	32768 - 43233 (1/10465)
DTx38 INPUT RANGE	**xDIVIDER**	**xGAIN**	**A/D INPUT RESOLUTION[1]**
A (TB1/TB3-1): ±15V DC	28K/527K	1	11876 - 53660 (1/41784)
A (TB1/TB3-1): 0-15V DC	28K/527K	1	32768 - 53660 (1/20892)
B (TB1/TB3-3): ±150V DC	5.36K/1003.36	1	11762 - 53774 (1/42012)
B (TB1/TB3-3): ±75V DC	5.36K/1003.36	1	22265 - 43271 (1/21006)
B (TB1/TB3-3): 0-150V DC	5.36K/1003.36	1	32768 - 53774 (1/21006)
B (TB1/TB3-3): 0-75V DC	5.36K/1003.36	1	32768 - 43271 (1/10503)

[1]**Note:** AD_count = (Vin*Gain/1.25) * 32768+32768.

Optional AC Current Sensor (Model 5020-350, for AC Current IN to DT336 at TB1): Optional sensor can be connected to TB1 of the DT336 model for AC current sensing and is a toroidal instrument transformer that converts the sinusoidal 50-60Hz AC current signal into low level 0 to 11.17mA DC. The input AC current range is a function of the number of turns placed through the toroid as shown in Table 2 below. This sensor is isolated and requires no calibration or adjustment. When used with a DT336 module, it also facilitates AC current input isolation from the ADC voltage input, as well as redundant input isolation with respect to each output of this transmitter.

Input...continued



The output wires of this sensor are polarized with red as plus (+) and black as minus (-). Normally these output wires are attached to one end of a user supplied cable, while the other end connects to the process current input terminals at TB1 of this module, as shown above (current input to input+ and returned via input-).

Table 2: Optional AC Current Sensor Turns & Range (for DT336 Model Only)		
AC Current Input Range	**Primary Turns**	**Sensor Output (Red/Black)**
0 to 20A AC	1	0 to 11.17mA DC
0 to 10A AC	2	"
0 to 5A AC	4	"
0 to 2A AC	10	"
0 to 1A AC	20	"

AC Input Burden: A function of the wire gauge resistance used for primary turns (the current carrying wire being monitored).
AC Current Sensor to Transmitter Wiring Distance: 400 feet maximum for 18 gage wiring. Other wire gauges can be used if the resistance of both wires is less than 5Ω.
AC Input Overload: The AC current sensor will withstand overload conditions as follows:

- 20 times full scale for 0.01 seconds.
- 10 times full scale for 0.1 seconds.
- 5 times full scale for 1.0 second.

Output (Each)

Unit outputs are short-circuit protected from damage.

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).

Output Range: Each output has a separate voltage and current output terminal that share a return terminal. Only one output signal, voltage or current, may be loaded at each channel at one time. Supported output ranges with over-range are shown in Table 3 below.

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

Note (High Speed Acquisition): Additional filtering at the load is recommended for sensitive applications with high-speed acquisition rates. For excessive 60Hz supply ripple with 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 (< ±20ppm/°C typical). 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.

16-bit DAC COUNT	Table 3: Nominal 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 per input filter setting measured for the output to reach 98% of its transition with a step change in the input signal while driving output current to a 500Ω load, or voltage to a 10KΩ load with a 24V supply and the input set to No filter, Low filter, Medium filter, and High filter.

Typical Output Response Time to 98% of Transition Per Input Filter			
None	**Low**	**Medium**	**High**
25ms	41ms	140ms	1140ms

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

USB Interface

USB MINI-B socket for temporary connection to a PC or laptop for configuration and calibration purposes. USB isolation is required when input is connected to a grounded input sensor (see "IMPORTANT" below). During reconfiguration & recalibration, the transmitter receives its power from its 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 Connector: 5-pin, Mini USB B-type socket, Hirose UX60-MB-5S8.

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 of this unit is isolated from each output and may be connected to grounded or un-grounded input sensors, but the input 1 circuit ground connects in common to the USB power/signal/shield ground. This will in-turn make a connection to earth ground at the PC when directly connected to the USB port of a Personal Computer if you do not use an isolator. Failure to connect USB without isolation would short the 1.25V input return bias supply of input 1 to ground if the sensor is also earth grounded, interfering with operation of channel 1, truncating its negative input range, and possibly shifting its output. For this reason, USB isolation is strongly recommended when connecting to a PC. In the absence of USB isolation when 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.

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 included. Current draw varies with voltage as follows (currents indicated assume dual transmitter mode with both current outputs driving 20mA into 500Ω).

SUPPLY	DT333-0700 CURRENT DRAW
6V	239mA Typical / 263mA Max
9V	155mA Typical/171mA Max
12V	115mA Typical / 127mA Max
15V	90mA Typical / 99mA Max
24V	57mA Typical / 63mA Max
32V	44mA Typical / 48mA Max

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

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: 1019-127, 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.

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 550Ω). 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.
Altitude: Up to 2000 meters.
Isolation: Input 1/USB, input 2, output 1, output 2, and power circuits are all 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.

Environmental...

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).
Electromagnetic Compatibility (EMC)
Minimum Immunity per BS EN 61000-6-1:
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 B Product with Emissions per BS EN 61000-6-3:
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 B 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.

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_BG_C*

Temperature	MTBF (Hours)	MTBF (Years)	Failure Rate (FIT)
25°C	TBD hrs	TBD years	TBD
40°C	TBD hrs	TBD years	TBD

Configuration Controls

Software Configuration Only via USB or USB-OTG

This dual transmitter drives two isolated channels of current or voltage proportional to input signals taken from differential voltage measurements across the sensors (voltages sourced at TB1 or TB3), or across a 24.9Ω current shunt resistor (for current input at TB1-1 of DT336 models). 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
11-DEC-18	A	BC/ARP	Initial Release
15 SEP 2020	B	CAP/ARP	Added cULus, ATEX, IECEx, and FCC approvals
28 JAN 2022	C	CAP/AMM	Added Altitude: Up to 2000 meters (Environmental Section)