USB Programmable, DIN Rail Mount, Passive I/O Signal Splitter

Model SP233-0600, Isolated Thermocouple & mV Input w/ Dual Isolated 2-Wire 4-20mA Transmitter 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 our 2-wire (loop-powered) SP233 splitter/transmitter that converts a thermocouple or DC millivoltage input signal to dual isolated 4-20mA current loops. If your application requires a dual output 4-wire transmitter (separate isolated DC power) that drives voltage/current outputs, please refer to the similar SP333 model. For DC current/voltage input versions, please refer to our other SP300 (4-wire) and SP200 (2-wire loop-powered) models.

GETTING STARTED

DESCRIPTION

Symbols on equipment:

Means “Refer to User’s Manual (this manual) for additional information”

Model SP233-0600 signal splitter/repeaters are ANSI/ISA Type II transmitters with dual isolated outputs. These units are designed to interface with a thermocouple sensor (Type J, K, T, R. S, B, E, N), or millivoltage (±100mV) input signal, isolate the input, and separately modulate two isolated 2-wire current loops proportional to the input.

This unit provides an adjustable input range, degrees °F or °C selection, TC linearization, input isolation, upscale/downscale break detection, variable input filtering, and cold-junction compensation. All units are set up and calibrated using a wired USB connection to a Windows-based PC running configuration software (Windows 7 and later versions only), or an Android-based tablet or smartphone running our Agility mobile APP.

Key Features

- **Digitally set up and calibrated via a wired USB connection to a Windows-based personal computer, or a wired USB-OTG connection to an Android tablet or smartphone.**
- **Slim 17.5mm wide enclosure for high-density DIN-rail mounting.**
- **Very low 7V two-wire loop burden.**
- **Supports TC Type J, K, T, R, S, B, E, N, or ±100mV input.**
- **Adjustable input and output ranges. Input & outputs can be scaled independently and the input may be scaled differently for each output.**
- **TC input is linearized with respect to temperature and includes accurate Cold Junction Compensation.**
- **Supports both Celsius and Fahrenheit temperature configuration.**
- **High measurement accuracy & linearity w/24-bit input & 16-bit output conversion.**
- **Extra output connection supports optional sourced output wire termination.**
- **Supports up-scale or down-scale lead-break/burnout detection.**
- **Variable input filter adjustment (none, low, medium, high).**
- **Normal or reverse acting output(s).**
- **Convenient non-polarized two-wire loop power/output connections allow the unit to be powered from one or both output loops to function as a simple isolated transmitter (one 2-wire transmitter) or a signal splitter.**
- **Programmable output clamp limits or select Namur compliant range/limits.**
- **Wide ambient temperature operation.**
- **Thoroughly tested and hardened for harsh environments.**
- **CE Approved & includes UL/cUL Class 1, Division 2 Approvals.**
- **FCC Conformity Class B.**
- **ATEX / IECEx Certified for Explosive Atmospheres.**
  Ⓔx II 3 G Ex nA IIC T4 Gc - 40°C ≤ Ta ≤ +80°C
  DEMKO 18 ATEX 2086X and IECEx UL 18.0092X

Application

For additional information on these devices and related topics, please visit our web site at www.acromag.com and download our whitepaper 8500-904, Introduction to Two-Wire Transmitters.

These transmitters are designed for high-density mounting on T-type DIN rails. Units may be mounted side-by-side on 17.5mm centers.

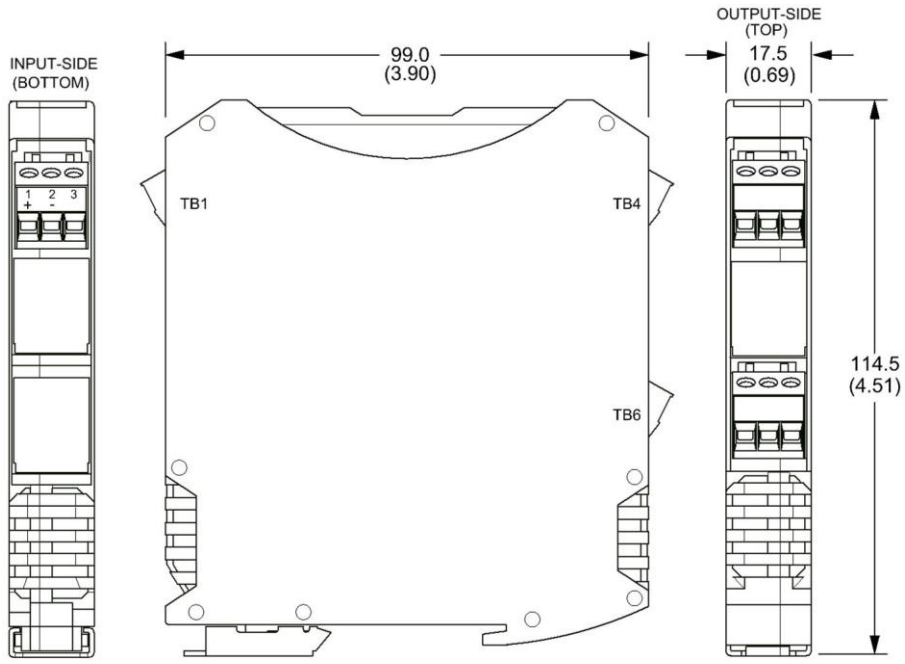
Models isolate thermocouple or millivoltage input signals and can mate with grounded or non-grounded sensors. They provide dual isolated 4-20mA output current loops linear with sensor temperature. A unique feature of these splitters is that the input and outputs can each be scaled independently, and you may even scale the input differently for each output.

The output signal is transmitted via dual isolated two-wire, 4-20mA current loops. Two-wire current signals can be transmitted over long distances with high noise immunity and two-wire loops have inherent live-zero 4mA offset current for convenient output fault detection if an output wire breaks, also supported by a Fault LED that signals a broken loop or low loop supply voltage. An extra connection screw at each output allow it to be optionally wired for a “sourced” 4-20mA output configuration (see Optional Output Wiring).

Mechanical Dimensions

Units may be mounted to 35mm “T” type DIN rail (35mm, type EN50022), and side-by-side on 0.69-inch centers.

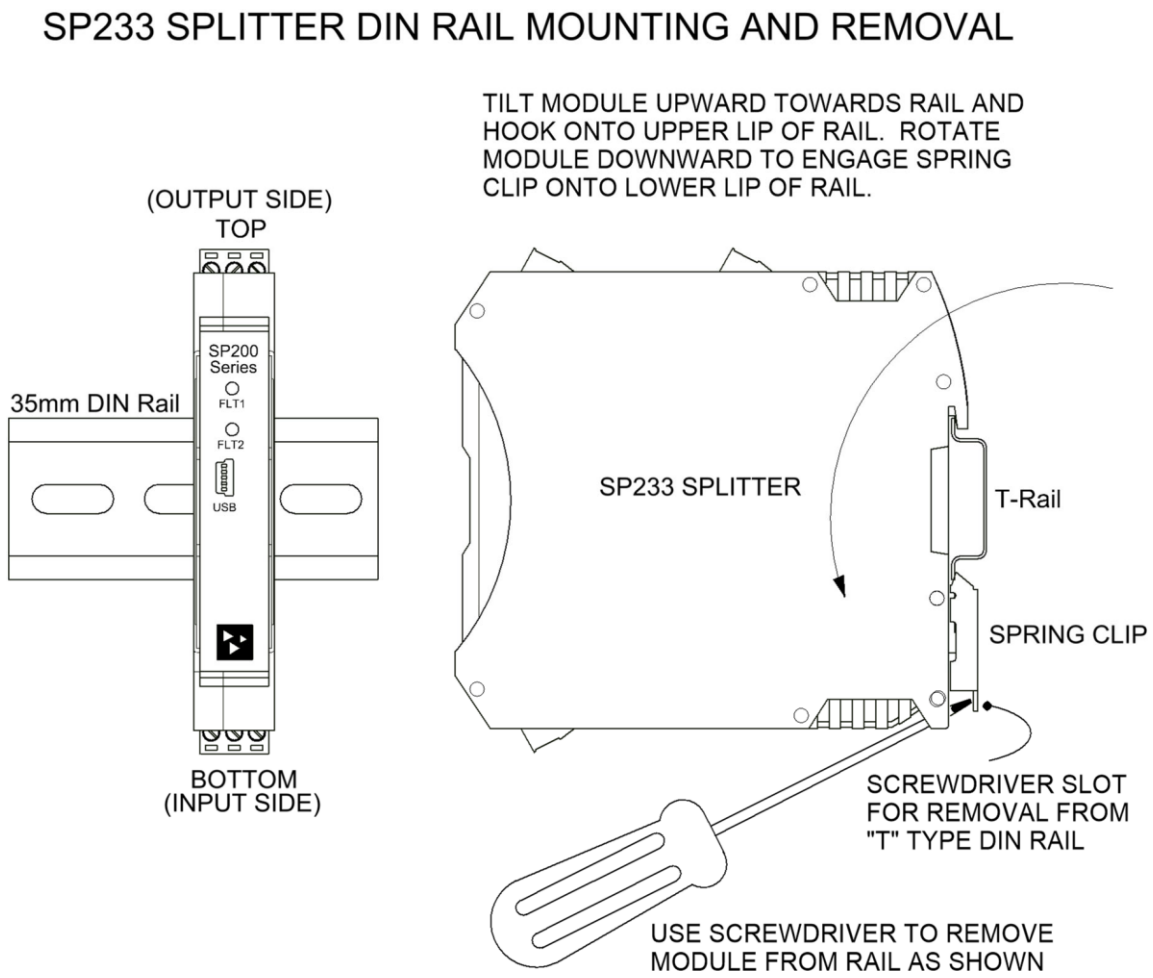
WARNING: *IEC Safety Standards may require that this device be mounted within an approved metal enclosure or sub-system, particularly for applications with exposure to voltages greater than or equal to 75VDC or 50VAC.*



DIMENSIONS ARE IN MILLIMETERS (INCHES)

DIN Rail Mounting & Removal

Refer to the figure below 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 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.



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.

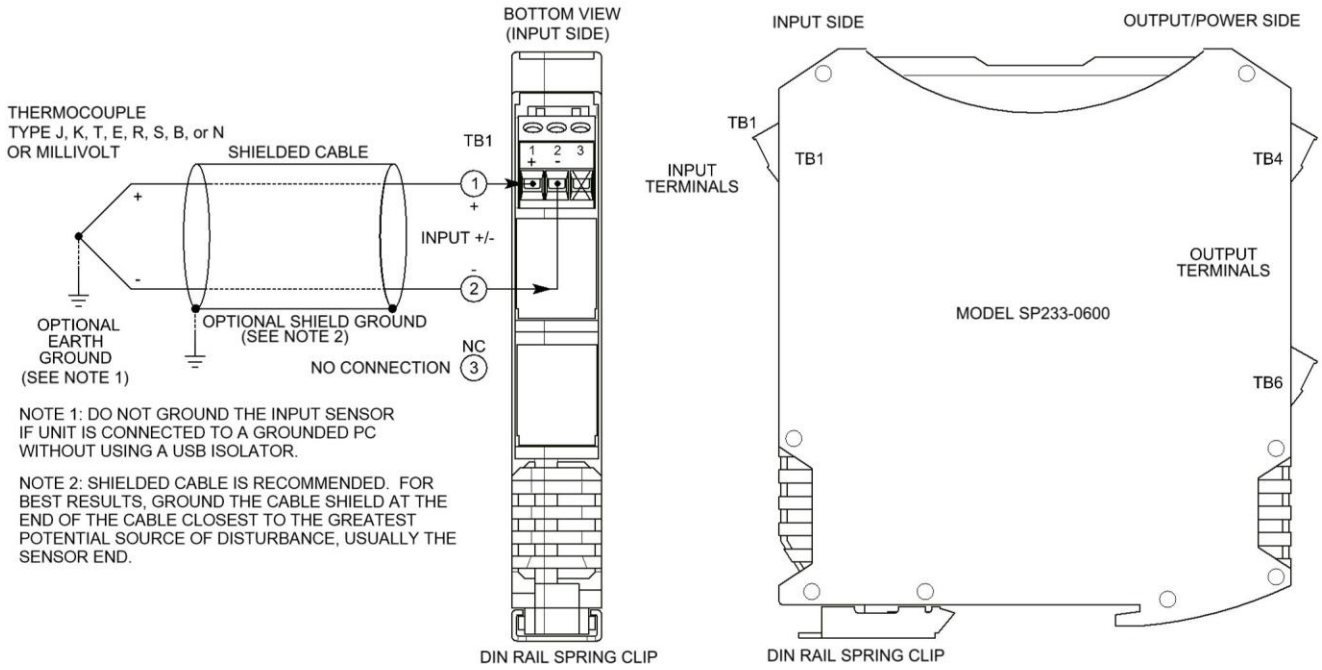
Wire terminals can accommodate 14–26 AWG (2.08–0.13mm^2) solid or stranded wire with a minimum temperature rating of 85°C. Input wiring may be shielded or unshielded type. Ideally, output wires should be twisted pair, or shielded twisted pair. Terminals are pluggable and can be removed from their sockets by prying outward from the top with a flat-head screwdriver blade. This model wires ±100mV or TC input signals to TB1. 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). Since common mode voltages can exist on signal wiring, adequate wire insulation should be used and proper wiring practices followed. As a rule, output wires are normally separated from input wiring for safety, as well as for low noise pickup.
Important – End Stops: For hazardous location installations (Class I, Division 2 or ATEX / IECEx Zone 2), it should utilize two end stops (like Acromag 1027-222) to help secure modules to the DIN rail (not shown).

Input Connections

Sensor wires are wired directly to first two transmitter input terminals of TB1 on the bottom of the module (the spring-loaded DIN clip side), as shown in the connection drawing that follows. Observe proper polarity when making input connections.

- **SP233 TC or DC millivoltage is wired to terminal block TB1**.
- **The input is isolated from each output**. One or both output loops may power the input, allowing it to operate as a standard single-channel transmitter or signal splitter.
- **The single input may be scaled differently for each output.**
- **Differential input is polarized ±** with the positive input on the left labeled "+", and the negative input to its right. Do not connect to the 3rd rightmost terminal. Observe proper polarity. See Input Sensor Wiring below.

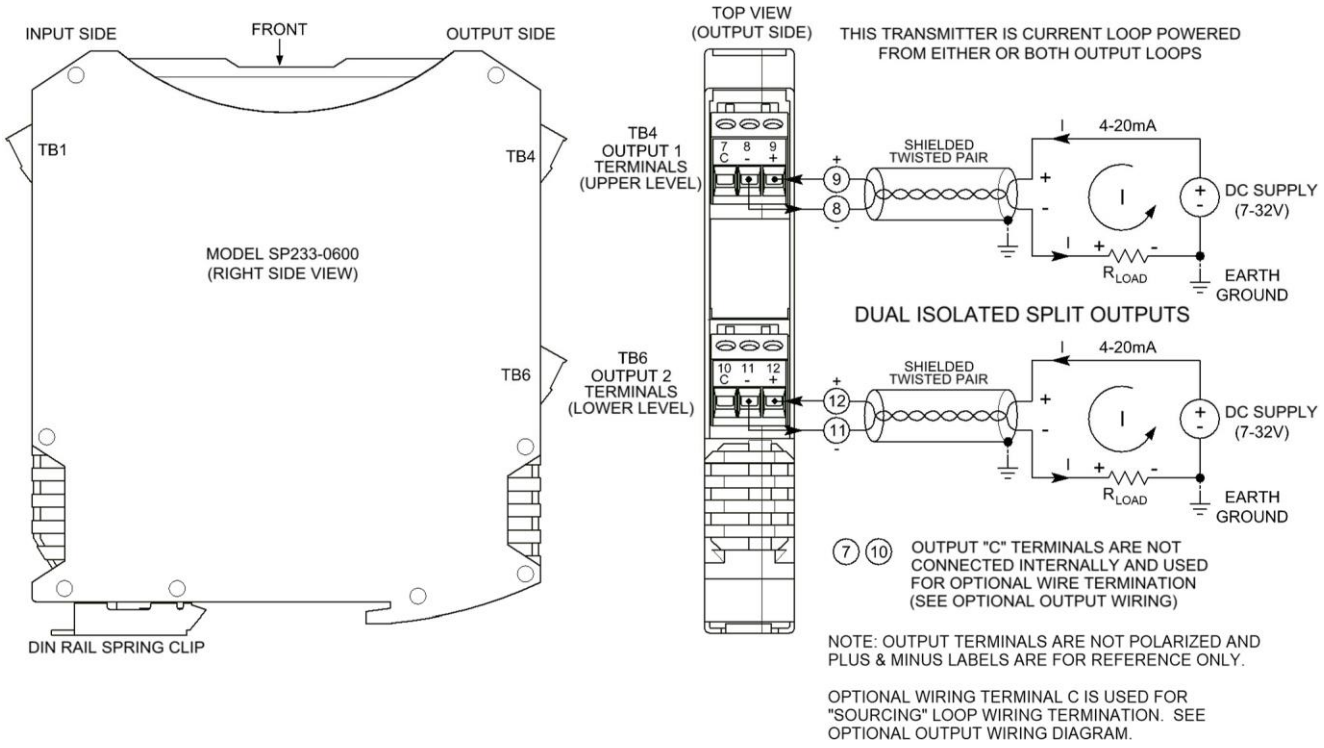
MODEL SP233-0600 INPUT SENSOR WIRING



Output/Power Connections

This transmitter has dual ANSI/ISA Type 2 outputs in which the unit's power and output signal share the same two leads, with each splitter output having a "floating" connection with respect to earth ground. Connect a DC power supply and load in series in each of the two-wire output loops as shown in the drawings that follow.

- Output connections are not polarized. The output + and – designations are for reference only with current normally input to Output+ and returned via Output- (current sinking). Either or both output loops may power the input.
- Loop supply voltages should be from 7-32V DC with the minimum voltage level adjusted to supply over-range current to the loop load, plus 7V MIN across the transmitter, plus any transmission line drop.
- Variation in power supply voltage between the 7V minimum required and 32V maximum allowed, has negligible effect on transmitter accuracy.
- Variation in load resistance has negligible effect on output accuracy if the loop supply voltage level is set correctly for the loop load resistance.
- Note the traditional placement of earth ground in a 2-wire current loop. Output Earth ground is normally applied at the loop power supply minus terminal. Each 2-wire transmitter output varies off this ground by the voltage drop in the load resistance and lead-wire of the output loop.



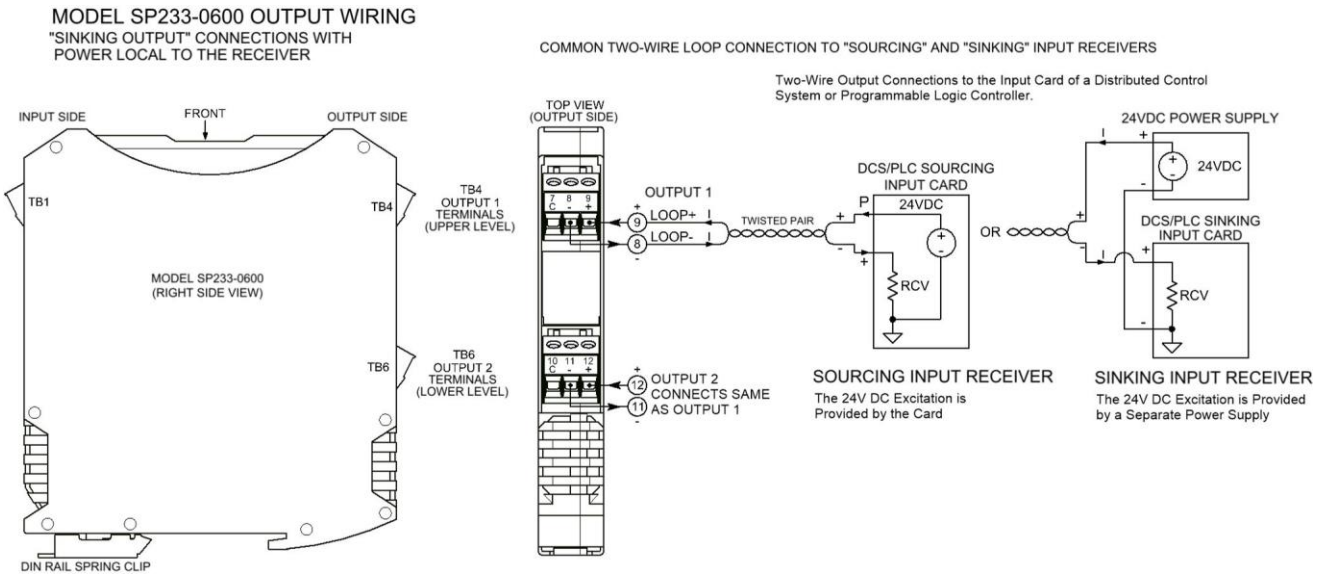
Output/Power Connections…

The traditional loop-powered 2-wire “sinking” output connections are shown above. Outputs are passive and loop current is modulated by the transmitter. Shielded twisted-pair wiring is often used at the outputs to connect the longest distance between the field transmitter and the remote receivers as shown. Each output of this transmitter is isolated and fluctuates relative to earth ground by the voltage drop in the output load and connection wire. This makes it flexible in the way it connects to various “Receiver” devices.

In most installations, the output loop power supply will be local to either the transmitter, or local to the remote receiver of the loop. Common receiver devices include the input channel of a Programmable Logic Controller (PLC), a Distributed Control System (DCS), or a panel meter. Some receiver devices already provide excitation for the transmitter loop and these are referred to as active “sourcing inputs”. Other receivers that do not provide loop excitation are referred to as “sinking inputs”, and these will require that a separate power supply connect within the loop. These types of receivers are depicted in the figures on the next two pages:

Output/Power Connections…

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.

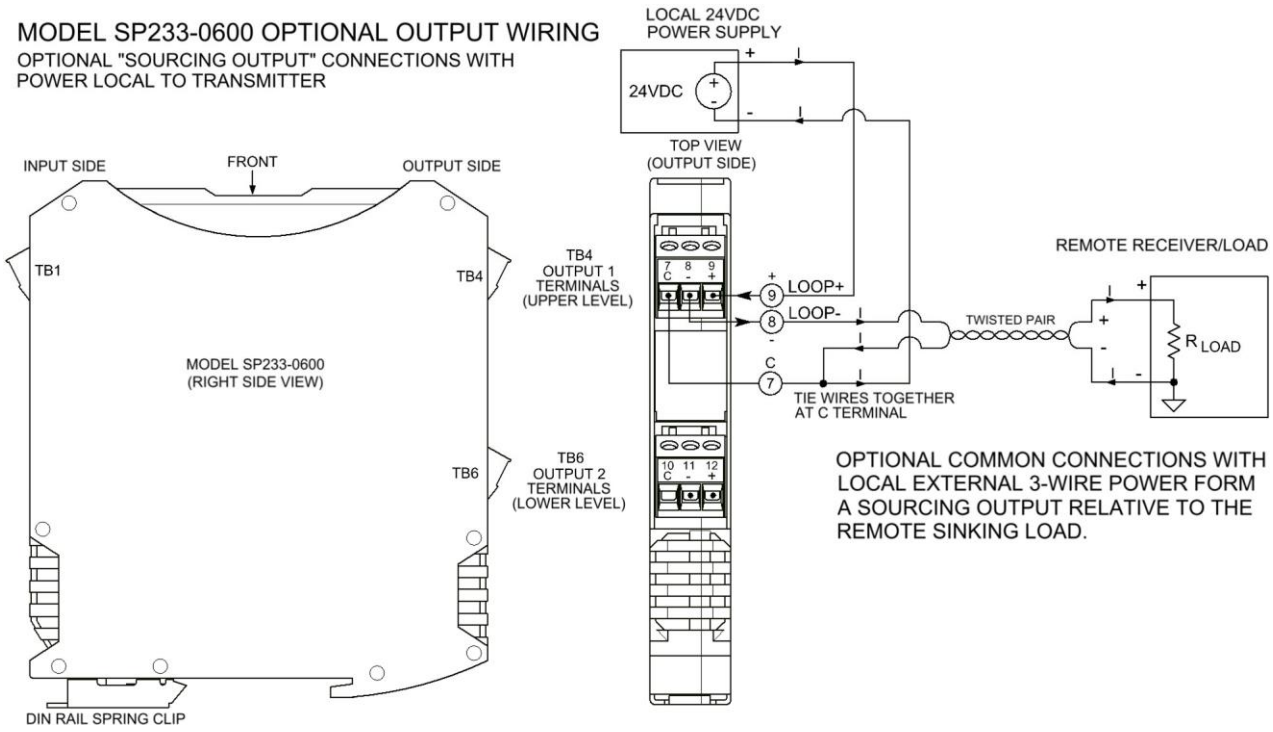


TIP - Ripple & Noise: Place additional capacitance at the load to help reduce the 60Hz/120Hz ripple sometimes present in industrial applications. For large 60Hz ripple, connect an external 1uF or larger capacitor directly across the load to reduce excess ripple. For sensitive applications with high-speed 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.

TIP - Inductive Loads: If either two-wire current loop includes a highly inductive load (such as an I/P current-to-pressure transducer), this may reduce output stability. In this case, place a 0.1uF capacitor directly across the inductive load(s) and this will typically cure the problem.

Output/Power Connections…

This model includes an extra termination screw at each output marked “C” which is intended to provide a convenient tie point for a “sourcing” wiring variation as shown below. The C terminals do not connect to the internal circuit. Use of the C terminal in your wiring scheme allows you to connect external power local to the transmitter and form a “sourcing” entity from this “sinking” output as shown below.



Earth Ground Connections

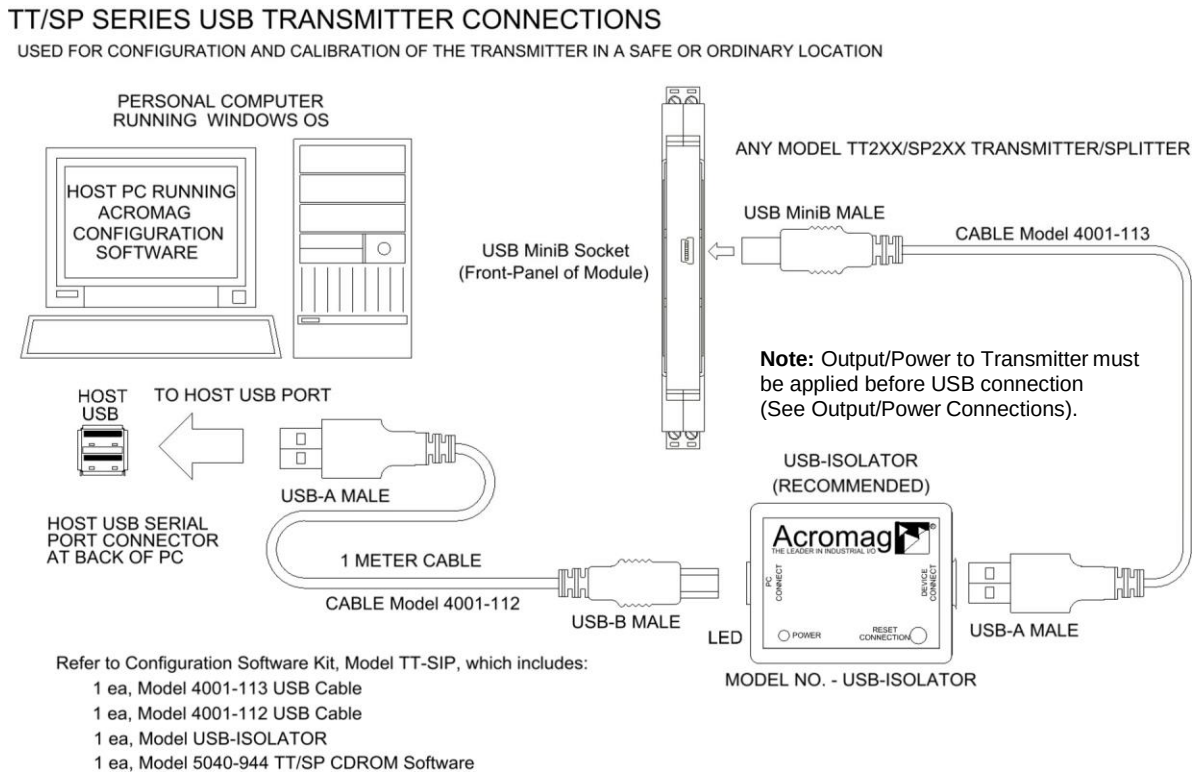
IMPORTANT: A USB isolator is recommended when configuring or calibrating the unit to avoid the ground loop that occurs if your input signal is also earth grounded (A PC commonly ties earth ground to its USB port signal and shield ground, which is held in common to the input circuit ground of this transmitter).

The unit housing is plastic and does not require an earth ground connection to itself. If the module is mounted in a metal housing, an earth ground wire connection to that metal housing’s ground terminal (green screw) is usually required using suitable wire per applicable codes. As a rule of good practice, isolated circuits are normally earth grounded at one point. See the Electrical Connections Drawing for Output/Power connections and note the traditional position of earth ground for a two-wire output current loop. That is, earth ground is normally applied at the output loop power minus terminal and in common with the loop load or loop receiver minus. The Type II transmitter output terminals will have a “floating” connection relative to earth ground and their potential varies with the voltage drop in the load and connection wire. Circuits wired to isolated analog inputs should be earth grounded as reflected in their input connection diagram. Ground connections noted 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.

Respect the traditional position of earth ground in a two-wire current loop and avoid inadvertent connections to earth ground at other points in the same loop, which would drive ground loops and negatively affect operation.

USB Connections

Splitter is set up, configured, & calibrated via configuration software that runs on a Windows-based PC connected via USB (Windows 7 or later required), or a USB connection to a compatible Android-based tablet or smartphone with our Agility mobile APP installed. Refer to the drawing below to connect your PC or laptop to the splitter for reconfiguration and calibration using this software (the optional connection to an Android smartphone or tablet would typically not require the use of an isolator, because those devices are battery powered).



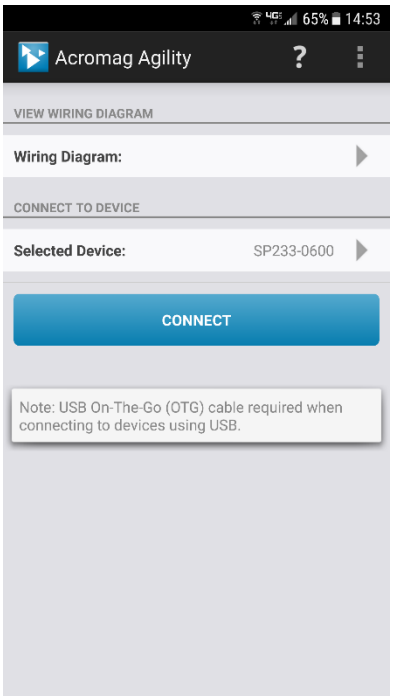
WARNING: The intent of mating USB with this transmitter is so that it can be conveniently set up and calibrated in a safe area, then installed in the field which may be in a hazardous area. Do not attempt to connect a PC or laptop to this unit while installed in a hazardous area, as USB energy levels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

- **USB Signal Isolation is Required (See Below) -** You may use our model USB-ISOLATOR to isolate your USB port, or you can optionally use another USB signal isolator that supports USB Full Speed operation (12Mbps).
- **Configuration Requires USB and Loop Power** - This transmitter draws power from both the current loop and from USB during set up.

IMPORTANT: USB logic signals to the unit are referenced to the potential of its internal signal ground. This ground is held in common with the USB ground and shield ground. The potential of a transmitter's current output pin (output minus) relative to earth ground varies with the load current and resistance (net IR drop). Without isolation, IR drop would drive a potential difference between the normally grounded current loop and grounded USB connection at the PC, causing a ground loop that would inhibit set up & calibration, or may even damage the transmitter. It is recommended you use an isolated USB connection. Alternatively, you could avoid using an isolator if a battery powered laptop was used to connect to the transmitter, and the laptop has no earth ground connection, either directly or via a connected peripheral.

CONFIGURATION SOFTWARE

Quick Overview – Android Reconfiguration

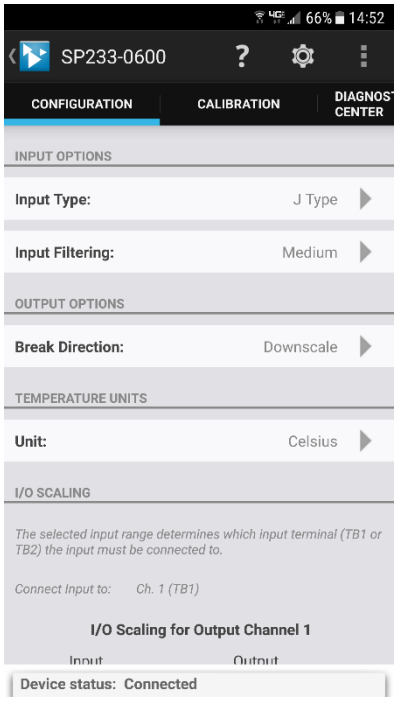


This splitter can be configured & calibrated via the Acromag Agility™ Config Tool App. This app can be downloaded free of charge from the Google Play store at play.google.com and is compatible with Android devices that use Ice Cream Sandwich (4.0) or later OS.

To connect to this splitter, a USB OTG (On-The-Go) cable (Acromag 5028-565) and USB A to Mini-B cable (Acromag 4001-113) are also required. When you start the app, the initial Agility Connection screen at left will be presented and if you have also connected a module using a USB OTG cable, your module will be listed in the "Selected Device:" field of the Connection screen as shown.

The ability to select other devices only applies to Bluetooth devices which also utilize this app. Tap the **[CONNECT]** button to open communication with the device indicated to the right of "Selected Device" and move to the main portion of the app shown in the second screen at left. Note Android requires user permission to access external hardware--If the Device List displays "No Device Permission", select the device and when prompted to give permission to access the USB device, and tap **[OK].**

If you wish to view a wiring diagram for your splitter model, tap the arrow next to "Wiring Diagram:". You may swipe left or right to scroll and view more diagrams.



The main app screen also has four icons across the top: an Acromag logo w/connected model indicated, a question mark, a gear icon, and three vertical dots. These icons access additional features of this software as follows:

This icon located in the top left-hand corner of most app screens and serves as a Home button--when tapped it will return you to the Connection page of the app from subsequent pages.

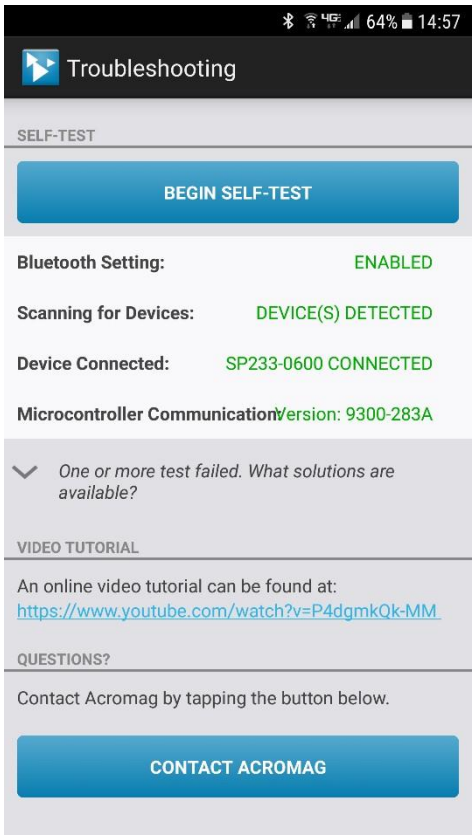
Tapping the question mark will access a Self-Test utility useful for testing your device connection.

Tapping the Gear/Settings icon will access a Utility Page that allows you Reboot the device, Reset to Factory Calibration, or Restore its Factory Settings.

Tapping this icon will return "About" & "Contact Acromag" reference Information.

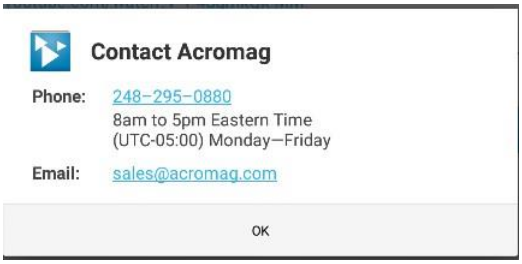
A short description of what each icon does follows:

Quick Overview – Android Reconfiguration...continued



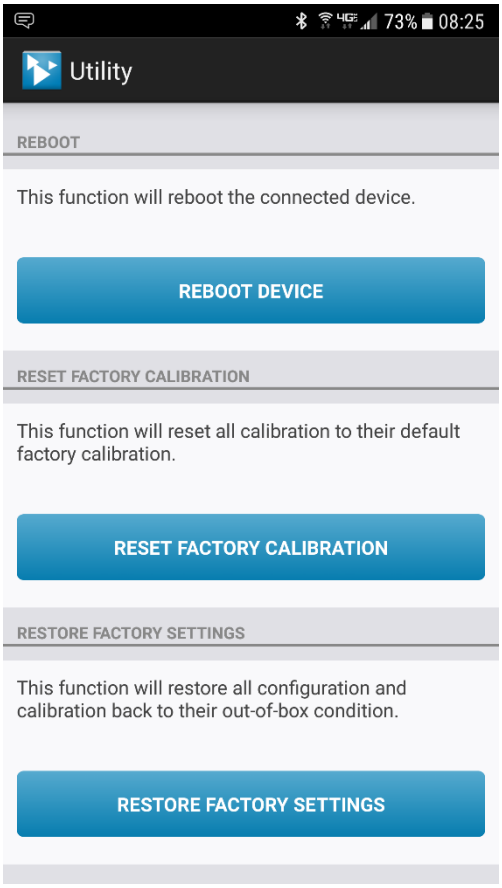
The HELP area of this application invokes a Self-Test feature that can be used to determine if your smart phone or tablet has its Bluetooth wireless technology enabled (for uB applications which support Bluetooth), whether any modules can be detected by rescanning, whether a device is connected, and whether the microcontroller of the connected module is operational. You simply tap **[BEGIN SELF-TEST]** to perform the diagnostic exchange and review the results returned. If one or more tests indicate Failed, you may tap the down arrow message below the self-test report to access additional information regarding failed tests. Optionally, you can review an online video tutorial on working with the unit by tapping the Video Tutorial URL line.

If you wish to contact Acromag for assistance, tap the **[CONTACT ACROMAG]** bar to obtain the phone and email information window shown below for communicating with Acromag directly (the same information is also obtained via the menu dotted action bar icon and "Contact Acromag" selection).



For additional help with Troubleshooting, you may also refer to the Troubleshooting Table in this manual which lists common issues related to working with these splitters and some recommended remedies and checks.

Quick Overview – Android Reconfiguration...continued

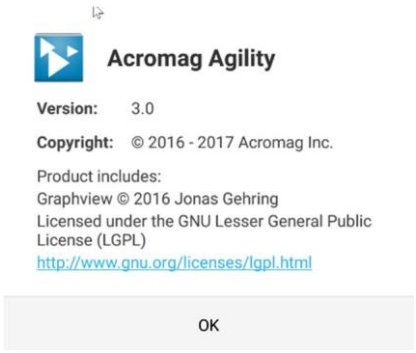


Tap the **[Gear]** icon in the Action bar to access the Utility Page shown at left. Utilize these features if you if you encounter erratic behavior with your splitter and need to get out of trouble, perhaps if you ever inadvertently misconfigure or improperly calibrate a splitter.

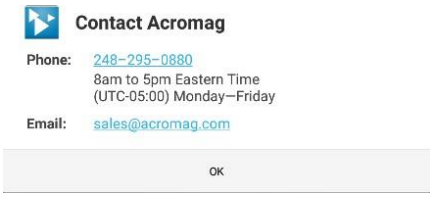
You can tap **[REBOOT DEVICE]** on this page to reset/restart the connected splitter, perhaps if it ever appears to freeze, or exhibits erratic operation. This is akin to a power-on reset of the splitter.

You can tap **[RESET FACTORY CALIBRATION]** to get out of trouble if you ever miscalibrate a splitter (this only affects splitter calibration).

You can tap **[RESTORE FACTORY SETTINGS]** to get out of trouble if you ever misconfigure or miscalibrate a transmitter (this affects both splitter calibration and configuration). You can also use this feature to de-commission a splitter.

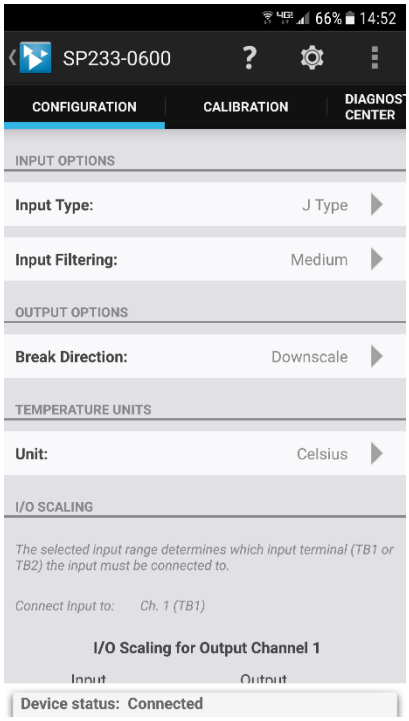


If you tap the right-most dotted Menu icon of the action bar at the top right of your screen, you will get a selection menu for “About” information on this software application, and “Contact Acromag” for contact information, both shown at left



Below the icons of the top line are file three tabs: Configuration, Calibration, and Diagnostic Center, each of which are described in the following pages.

Quick Overview – Android Reconfiguration...continued



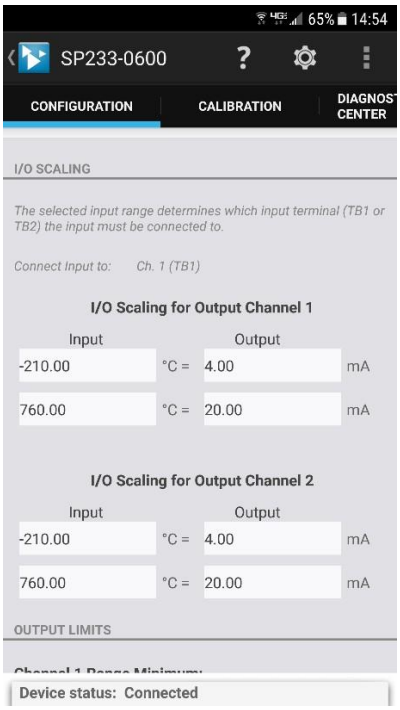
Input/Output Configuration

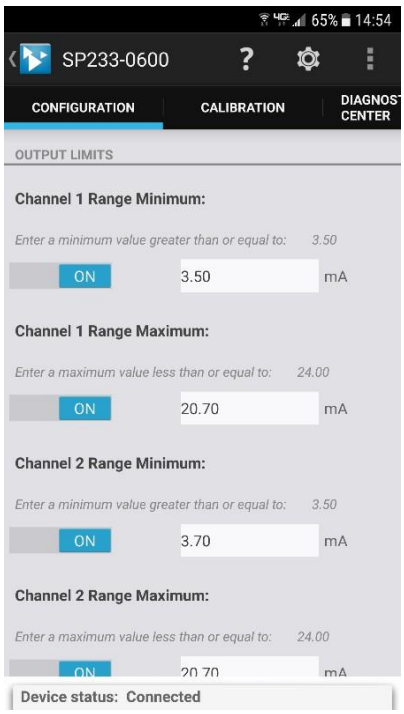
The I/O Configuration screen is shown at left and below (scroll down to see everything in this screen). If your splitter is connected when you select this tab, the app automatically reads and displays your current I/O and scaling information.

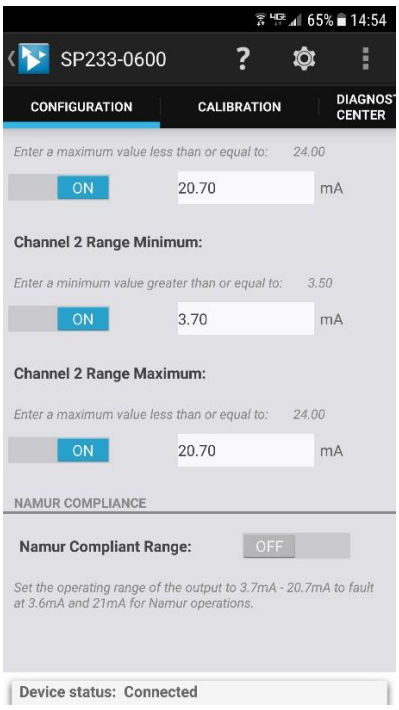
From this screen, you can set your input type/range, input filtering level, TC break direction, TC temperature units, output scaling for each output, and even the input scaling for each output. You can also set your own range clamp limits, or you may select a Namur compliant output range with linear operation from 3.7mA to 20.7mA and downscale/upscale fault limits set outside this range at 3.6mA and 21mA respectively by turning the Namur Compliant Range switch on the bottom of this screen to ON.

Likewise, changing any option on this page will send the change to the splitter immediately.

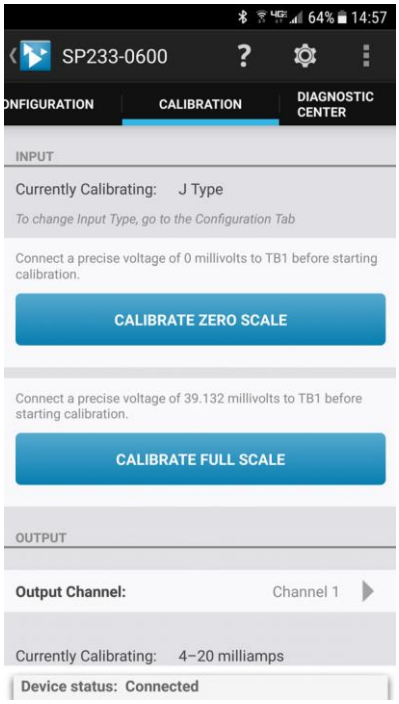
Note that the Device Status is indicated in the footer of all pages and will report if a device is connected and if changes were sent successfully.

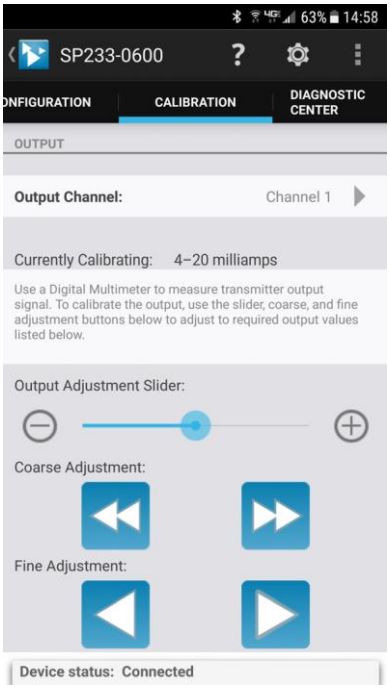






Quick Overview – Android Reconfiguration...continued





Input Calibration

If you have setup your unit and encounter excessive error, you may click the Calibration tab to display the Calibration control screen shown at left, which presents Input calibration controls first, followed by Output calibration controls as you scroll down the page.

IMPORTANT: The splitter has already had its input & output channels factory calibrated with high precision. If you attempt to recalibrate the input or outputs, you could degrade its performance if done improperly, or if you used lower grade equipment. Consider recalibration carefully.

The selected input range is indicated at the top and this is the range that will be calibrated when you invoke this tab. Note that the software does not use your *scaled* range zero to calibrate, but the zero of the nominal input type/range setting. Some sub-ranges will have their calibration extrapolated from the calibration of a larger native range. In these instances, as a rule, it's best to calibrate the largest native range first to keep its recalibration from over-writing any sub-range calibration. For the SP233, your input signal is connected to the first two terminals of TB1.

For input zero calibration, connect a precise input signal level for the zero of your range indicated, then tap the **[CALIBRATE INPUT ZERO]** button one time to internally set the input ADC level to its input range zero (0%) point.

For input full-scale calibration, connect a precise input signal level for the full-scale value of your range indicated, then tap **[CALIBRATE INPUT FULL-SCALE]** one time to set the input ADC level to its input range full-scale point (100%).

The device status at the bottom of the page will report if the calibration was sent successfully.

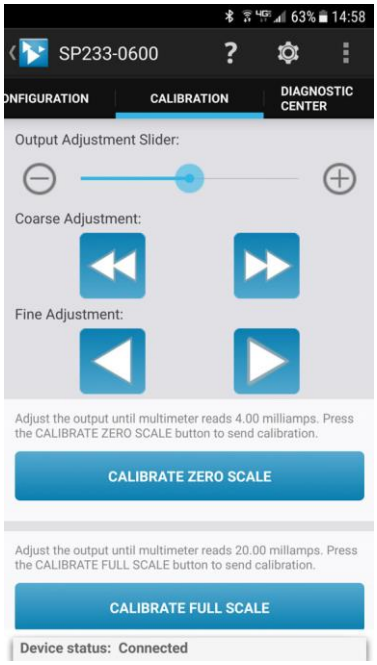
Output Calibration (Each of Two Output Channels)

Scroll down the Calibration page to access the Output Calibration controls: output channel selector, and adjustment controls shown at left, and the **[CALIBRATE OUTPUT ZERO]** and **[CALIBRATE OUTPUT FULL-SCALE]** buttons as shown on the next page.

First select the Output channel to calibrate, Channel 1 or Channel 2, and its output range will be displayed along with some instructions on how to proceed.

For Output Zero calibration, use the output adjustment slider and the coarse and fine adjustment controls to precisely set your output zero level while monitoring your output signal. For best results, be sure to use a meter with an accuracy at least 4x greater than the signal you are measuring for best results. Note that the output adjustment controls temporarily remove control of the output level from the input to accomplish calibration (control of the output level returns to the input signal after 30 seconds).

Quick Overview – Android Reconfiguration...continued



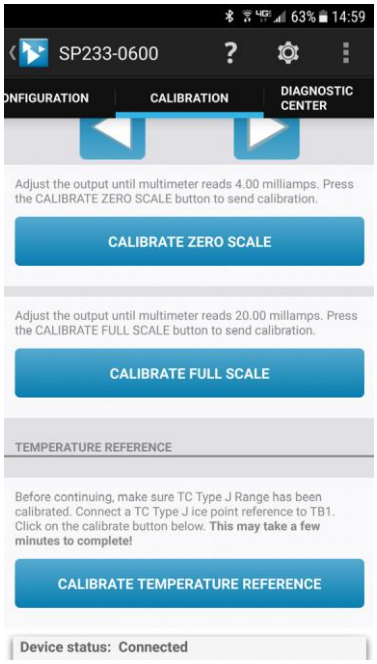
Output Calibration (Each of Two Outputs)

Once your output level is precisely set to its zero point (4.000mA for this splitter), tap the **[CALIBRATE OUTPUT ZERO]** button one time to set the output DAC level (internally its corresponding digital count) to correspond to the zero (0%) of the output range.

For Full-Scale calibration, use the output adjustment slider and the coarse and fine adjustment controls to precisely set your output full-scale level while precisely monitoring your output signal. For best results, be sure to use a meter with an accuracy at least 4x greater than the signal you are measuring. Note that the output adjustment controls temporarily remove control of the output from the input level to accomplish calibration (control of the output level returns to the input signal after 30 seconds).

Once your output level is precisely set to its full-scale level (20.000mA for this splitter), tap the **[CALIBRATE OUTPUT FULL-SCALE]** button one time to set the output DAC level (its corresponding digital count) to correspond to the full-scale (100%) level of the output range.

Repeat the Output Calibration of zero and full-scale for the second output as required by selecting the opposite channel.

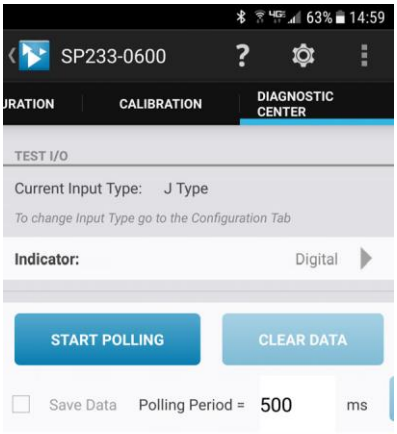


If following calibration, your output acts erratic or appears imprecise, you may need to repeat input or output calibration, being very careful to take accurate measurements and input correct signal levels. If you are measuring voltage across an output load resistance to measure the current level (recommended), make sure that you use exact resistance when calculating the measured loop current. When rescaling I/O, make sure that you have adequate I/O span, as “too-tight” input or output spans will have diminished resolution and magnify error.

CJC Temperature Reference Calibration (TC Inputs Only)

To discern the remote temperature of a thermocouple input, the unit includes Cold-junction-Compensation which effectively subtracts the digital count corresponding to the temperature of the local junction at the input terminals from the TC input reading (the thermoelectric millivoltage at the TC input corresponds to the difference in temperature between the remote junction and the cold junction at the input terminals). For J, K, or T types, J is used to establish the Cold Junction reading. For T, R, or S types, T is used to set the Cold Junction reading. The B type TC has its cold junction calibrated separately. For a unit that is properly mounted and warmed up (been operating for 10 minutes or more), simply drive an ice point reference to the input for the TC type of interest (a J, T, or B reference signal), and tap the **[Calibrate Temperature Reference]** button to record the corresponding ADC digital reading that will correspond to that TC input type connected to the input terminals with the remote junction at 0°C (e.g. the digital count of the thermoelectric equivalent millivoltage signal of the local junction).

Quick Overview – Android Reconfiguration...continued



Performing Diagnostics (Polling & Trending the Input)

The **Diagnostic Center** screen tab is shown at left and used to verify input (ADC) operation of your splitter. This page can be used to poll the input data and display its value, or graphically trend its value over time. The input type currently set is shown at the top of the screen (the actual input value, not the *rescaled* input value is polled).

Select the **Indicator** pointer to set your desired indication to "Digital" (discrete value) or "Graph" (graphical trend).

You can also set a polling period to control the interval between polled readings by simply over-typing the value in the Polling Period field.

Start polling the input by tapping the **[START POLLING]** button.

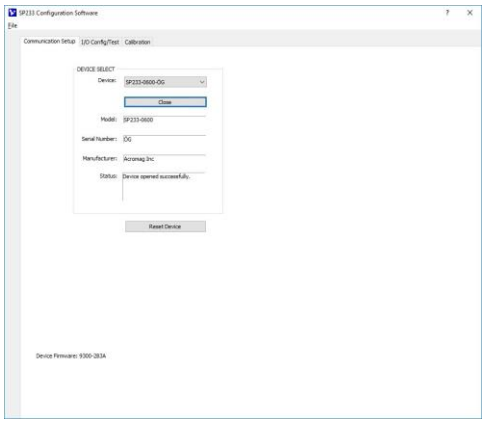
Clear the polling data by tapping **[CLEAR DATA].**

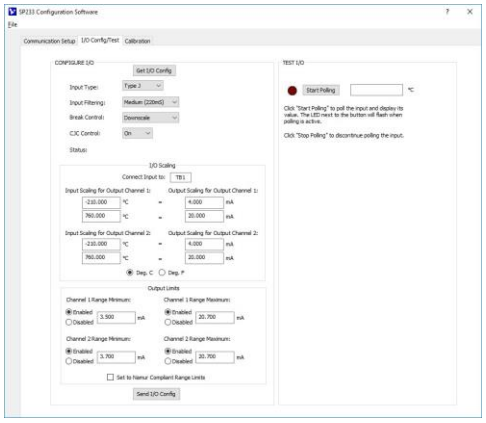
Check the "Save Data" box if you wish to log the polled values to a CSV (Comma Separated Value) data file for reference.

Note the Communication Status of the device is indicated at the bottom of the screen and can be helpful to discern proper communications.

Quick Overview – Windows

*Click **"Open"** to connect to the SP233-0600 and your screen should look like:*





In addition to the Android Agility mobile app, this splitter can optionally be configured and calibrated via its USB Configuration Software and a USB connection to your PC or laptop. USB or Android configuration software can be downloaded free of charge from our web site at www.acromag.com. The USB software is also included on a CDROM bundled with the Configuration Kit TT-SIP (see Accessories section). For this model, look for program SP233Config.exe (USB software is compatible with Windows 7 or later versions of the Windows operating system).

The initial configuration software screen for this model is shown at left. Configuration is divided into three pages as follows: Communication Setup, I/O Configuration, and Calibration. A short description of each of these pages follows.

Communication Set up – DEVICE SELECT (First Connect to the Unit Here)

- Select from connected transmitters using the Device scroll field and Open/Close communications with them.
- Display the Model, Serial Number, Manufacturer of the connected transmitter, and report the Status of connection communication.

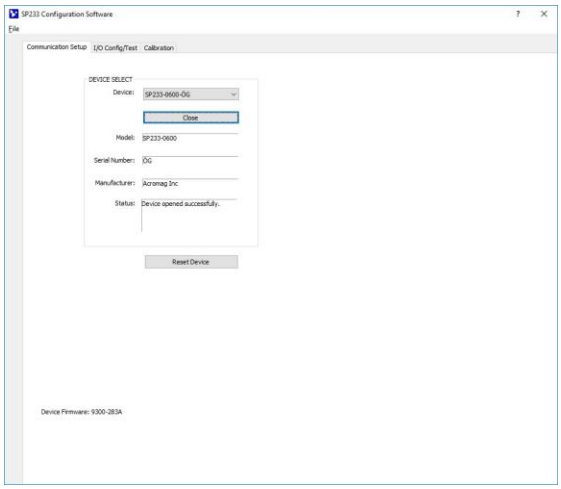
This section is used to select a connected transmitter, read its model/serial information, and open/close communications with it. Device connection Status is also indicated here, along with the connected transmitter's ID info (Model, Serial Number, & Manufacturer).

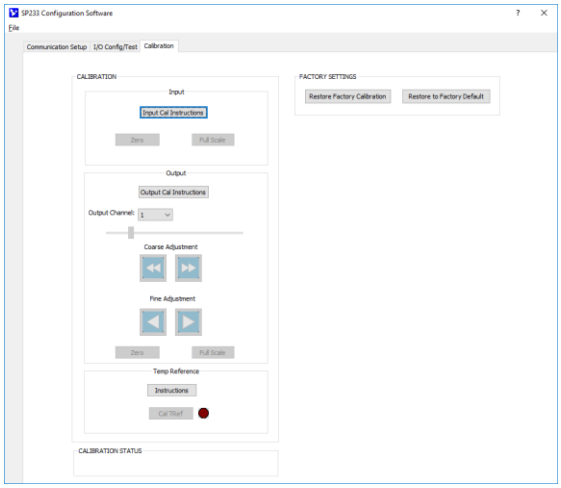
I/O Config/Test – CONFIGURE I/O (Reconfigure and/or Test the Unit Here)

- You can click the **[Get I/O Config]** button to retrieve the I/O configuration of the currently connected transmitter.
- Select an Input Range for your model. For the SP233, you can select a ±100mV, or TC type J, K, T, R, S, N, or E for input at TB1.
- Set the level of digital filtering to none, High, Medium, Low, or None. Note that the corresponding I/O response time varies with filter selection (see Specifications).
- View the unit's configuration communication status in the Status field.
- Use the I/O Scaling fields to specify input range endpoints that are to map to the 4mA and 20mA output endpoints of each output. Note that you can specify different input range endpoints for each output.
- Last, after making I/O changes, send your settings to the unit by clicking the **[Send I/O Config]** button and follow the on-screen prompts.

For detailed configuration and calibration procedures, see the Operation Step-By-Step section of the Technical Reference on page 24 of this manual.

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 to point to a field or control to get a Help message pertaining to the item you pointed to.

I/O Config/Test - TEST I/O (Optional, Verify Unit Operation Here)

After making I/O configuration changes, you can use the TEST I/O controls to Start/Stop Polling the input channel, as required to check your input readings.

- Click **[Start Polling]** to periodically read your input channel and validate its operation. Click **[Stop Polling]** to stop polling the input channel. Note the simulated red lamp left of the button flashes slowly when the software is polling the input channel.

CALIBRATION (Calibrate the Input and/or Output if Needed)

This unit has already been factory calibrated. If you encounter excessive error, you can click the Calibration tab to display the Calibration control page shown in the second screen at left.

To calibrate the Input or Output stage of this model, simply click the respective Input or Output "Instructions" button to get started and follow the on-screen prompts.

Input…
First set the Input Range to calibrate from the I/O Config/Test page and be sure to click the **[Send I/O Config]** button before attempting calibration. On the Calibration page, click the **[Input Cal Instructions]** button to begin input calibration.

When you click the **[Zero]** or **[Full Scale]** buttons of the Input Calibration section, you will be prompted to apply a specific millivoltage (at TB1). Once you have applied this signal to the input terminals, click the **[OK]** button of the prompt to calibrate and follow the on-screen instructions.

Output…
Click the **[Output Cal Instructions]** button to begin output calibration. You will be prompted to adjust the input signal as required to drive the output to precisely 4.000mA (Zero), or 20.000mA (Full-Scale). Then once the output is set to zero or full-scale, you simply click the corresponding **[Zero]** or **[Full-Scale]** button of the CALIBRATION - Output section to set the output range zero or full-scale endpoint.

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

- Restores a transmitter to its original factory calibration.
- Restores 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.

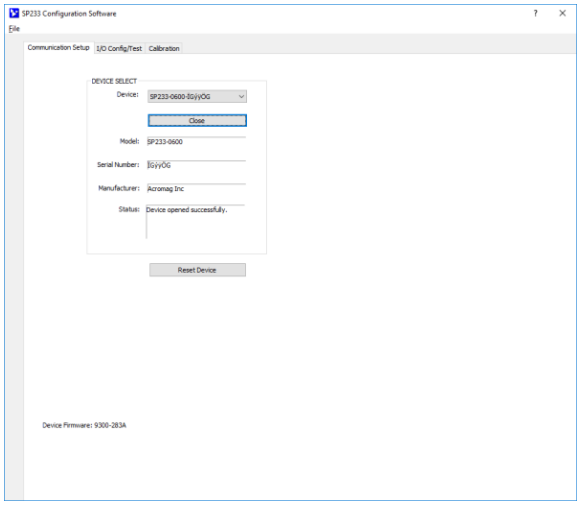
Calibration Status (Bottom of Screen)

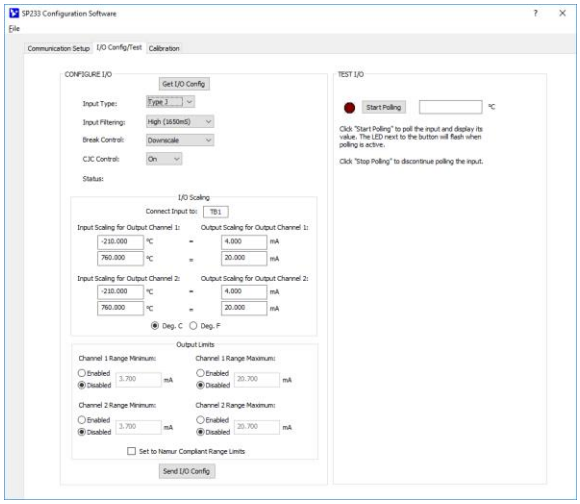
- Displays communication status messages for the calibration process.

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

Quick Overview – Windows...

*Click **"Open"** to connect to the SP233-0600 and your screen will look like:*





For a detailed configuration and calibration procedure, see the Operation Step-By-Step section of the Technical Reference on page 24.

In addition to the Android Agility mobile app and a wired USB-OTG connection to a smart phone or tablet, this splitter can be configured and calibrated via USB Configuration Software and a USB connection to a Windows PC or laptop. The configuration software can be downloaded free of charge from our web site at www.acromag.com. This software is also included on a CDROM bundled with the Configuration Kit TT-SIP (see Accessories). For this model, look for program SP233Config.exe. This software is compatible with Windows 7 or later versions of the Windows operating system.

The initial configuration software screen for this model is shown at left. Configuration information is divided across three pages (tabs) as follows: Communication Setup, I/O Config/Test, and Calibration. A short description of each of these configuration pages follows.

Communication Setup (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 on communication status.

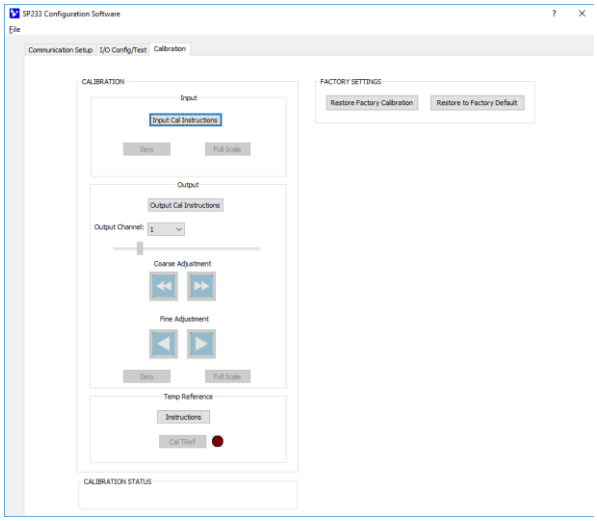
I/O Configure (Configure the Unit Here)

- Click **[Get I/O Config]** button to retrieve the current I/O configuration of the connected transmitter.
- View the Status of reconfiguration communications.
- Select **Input Type** (TC type or select ±100mV).
- Set the digital **Input Filtering** level to High, Medium, Low, or None. Corresponding I/O response time varies with filtering and is indicated in parenthesis next to your selection.
- Set the TC **Break Control** to Up or Downscale detection.
- Use **CJC Control** to set Cold Junction Compensation ON/OFF.
- View reconfiguration status in the **Status** field after sending.
- Use **I/O Scaling** fields to specify input range endpoints to map to each 4-20mA output endpoints. Note that you can specify different input range endpoints for each output.
- Set the temperature units to Degrees Celsius or Fahrenheit.
- After making Configure I/O and I/O Scaling changes, send your settings to the unit by clicking **[Send I/O Config]** and following the on-screen prompts.

I/O Test (Optional, Verify Unit Operation Here)

- Click the **[Start Polling]** button to periodically read your input channel and validate operation. Click **[Stop Polling]** to stop polling the input channel. Note the simulated red lamp to the left of the button flashes slowly when the software is polling the input channel. Stop polling before sending a configuration or selecting another page.

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 to point to a field or control to get a Help message pertaining to the item you pointed to.

Factory Settings (In Case of Trouble or for Sanitation)

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

You can click the **[Restore...]** buttons if you ever misconfigure or calibrate a transmitter in such a way that its operation appears erratic, or simply for sanitation purposes when decommissioning a module.

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.

CALIBRATION (Of Input, Output, or Temperature Reference)

The unit has already been factory calibrated, but if you encounter excess error, you can click the Calibration tab to display the Cal page shown at left.
Here you may separately calibrate the input, each output, or the CJC Temperature Reference of the unit, as needed to improve accuracy. You simply click the respective **[...Instructions]** button and follow the on-screen prompts. Detailed instructions on how to calibrate the unit is found in the Operation Step-By-Step section of Technical Reference in this manual.

Input…

Before attempting calibration, first select the Input Range to calibrate from the I/O Config page and be sure to click the **[Send I/O Config]** button of that page. On the Calibration page, click the **[Input Cal Instructions]** button to begin input calibration and follow the on-screen prompts.

When you click the **[Zero]** or **[Full Scale]** buttons of the Calibration Input section, you will be prompted to apply a specific signal level at TB1, according to your selected input type. Once you have applied this signal to the input terminals, click the **[OK]** button of the prompt and follow the on-screen instructions to complete input calibration.

Output…

Select the Output Channel to calibrate. Then click the **[Output Cal Instructions]** button to begin calibrating the selected output. You can use the Course and Fine adjustment controls to precisely set the output temporarily to its output range zero (4mA) or full-scale (20mA) level. Note that after 30 seconds, control of the output will return to the input signal level. Once the output is set to its range zero or full-scale, you simply click the corresponding **[Zero]** or **[Full-Scale]** button of the Calibration - Output section to set the output range zero or full-scale DAC endpoint.

Temp Reference (TC Input only)...

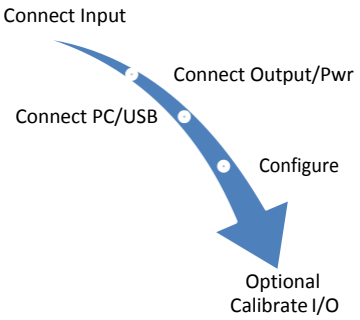
This section calibrates the cold-junction temperature reference used to Cold Junction Compensate T/C input measurements. Click the **[Instructions]** button to begin reference calibration. You will be prompted to connect a TC Type J, T, or B ice-point reference to the input, depending on your TC input type selected (J type is used for J, K, or T, T type for T, R, or S types, and the B type has its cold junction calibrated separately).

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

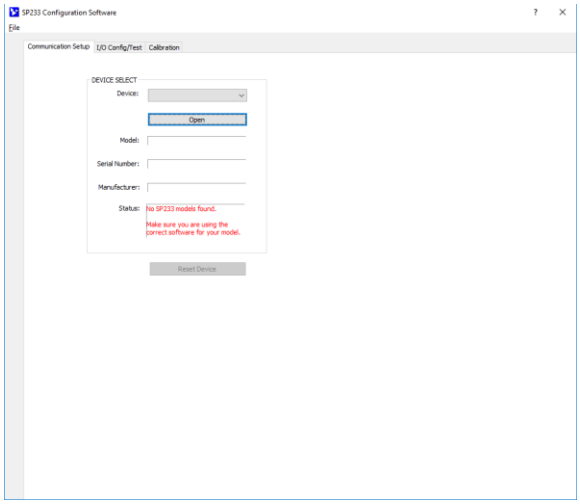


Note: The input signal source and the output meter must be accurate beyond the unit specifications, or better than ±0.1%. A good rule of thumb is to ensure your equipment accuracy is four times better than the rated accuracy you are trying to achieve with this splitter.

1. **Connect Input:** Refer to Input Connections on page 7-8. For SP233 models, connect a precision signal source to TB1. Your signal source must be adjustable to nominal range zero and full-scale levels for the input type of interest.
2. **Connect Output/Power (each Output):** Refer to Output/Power Connections of pages 8-11 and wire an output current loop to the transmitter outputs as illustrated. You will need to measure output loop current accurately at each output to calibrate the unit. You could connect a current meter in series in each output loop to read the loop current directly (not recommended). Alternatively, you could simply connect a voltmeter across a series connected precision load resistor in each loop, and accurately read the output current as a function of the IR voltage drop produced in the precision resistor (recommended). In any case, be sure to power each loop with a voltage that is minimally greater than the 7V required by the transmitter, plus the IR drop of the wiring and terminals, plus the IR drop in the load. To compute the IR drop, be sure to use a current level that considers over-scale current levels (up to 24mA).
   Loop Power Supply Voltage: Make sure your voltage level is minimally 7V plus 0.021*load_resistance. Ideally, it should be great enough to drive fault current levels into your load (i.e. up to 7V+ 0.024*Rload, assuming negligible line drop and maximum possible over-range). Always apply power to at least one output loop, even when connected to USB.
3. **Connect to PC via isolated USB:** Refer to USB Connection on page 12 and connect the splitter to the PC using a USB isolator and cables like those provided in the Configuration Kit TT-SIP. Optionally, you could instead connect the unit to an Android smartphone or tablet running the Agility mobile app with a USB-OTG cable.

   Now that you have made your input, output/power, and USB connections, and have applied power to your output loop(s), you can execute the SP233Config.exe software to begin configuration of your unit (this software is compatible with Windows 7 or later versions of the Windows operating system), or you may start the Agility mobile app (Android only) after making a USB-OTG connection to your smart phone or tablet.

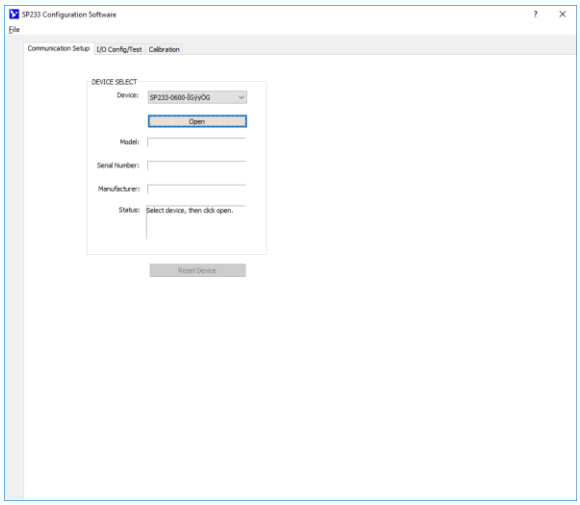
Configuration



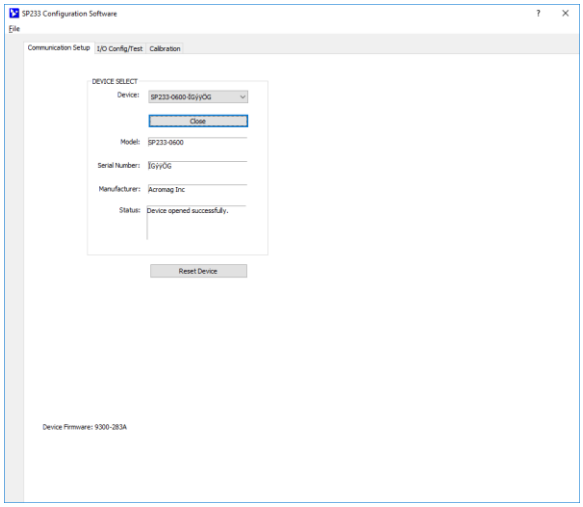
If you have not already connected to your transmitter via USB, then executing the Acromag Configuration software for the SP233 will display a screen like the one at left (note fields are blank under these conditions and a red status message is displayed).

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

If you are connected to more than one unit via a USB hub, you can use the Device scroll field to select another unit using the serial information 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 that unit.

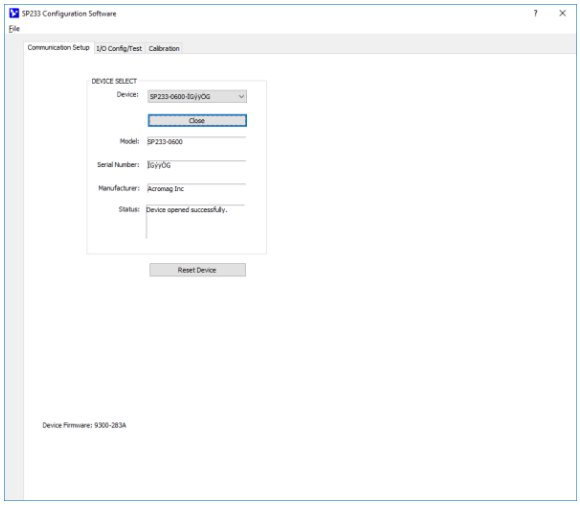


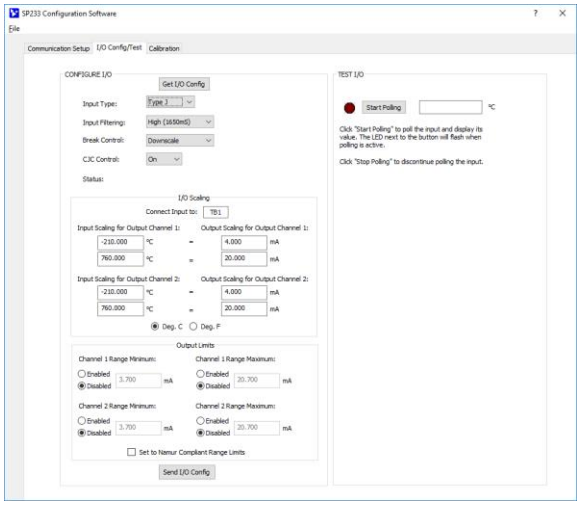
After clicking **[Open]**, the selected unit's Model, Serial Number, Manufacturer, and connection Status will be displayed as shown in the screen at left.

Note that the [Open] button function changes to [Close] if you wish to close your connection to the SP233 module.

Optionally, you could click [Reset Device] to reset the connected module from this page.

Configuration…





Note that if you make any changes to this screen which represents the current configuration of the connected module, the only way to preserve your changes is to either write it to the device after completing your changes by clicking ***[Send I/O Config]****, or by saving the changes to a file by clicking* ***"File"*** *in the upper left-hand corner of the screen.*

After connecting via USB and clicking [Open] to open communication with a unit, the Status field indicates "Device opened successfully" as shown at left. Once opened successfully, you can click on the "**I/O Config/Test**" tab to begin configuring the unit, or optionally test its operation.

> You should have loop power connected in each output loop of this dual output transmitter. You will not be able to calibrate or test a unit without loop power applied to at least one output.

If you click the "**I/O Config/Test**" tab, the software retrieves the unit's current configuration and displays it in the I/O Config/Test page shown in the second screen at left. If you make any changes to the I/O Config/Test Screen options, but do not write them to the unit, you can always retrieve the module's current configuration by clicking **[Get I/O Config]** at the top of this screen.

CONFIGURE I/O...

Select the Input Range/Type *– For SP233-0600, y*ou can select ±100mV DC, or type J, K, T, R, S, B, E, or N T/C input and this signal source must be wired to TB1.

A nominal selected input range can be rescaled to the output in the I/O Scaling section and you could use a portion of the input range to drive the 4-20mA output current loop, if desired. You can even rescale the input differently for each output. However, resolution will decrease proportionally as you rescale an input smaller than nominal. If you reduce the input range too far, this will reduce signal resolution by 1 bit each time you halve the range, potentially magnifying error and degrading the signal-to-noise ratio of the input.

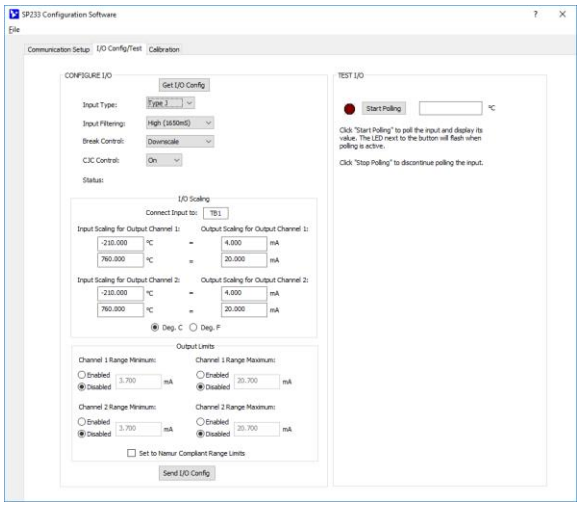
Select the Input Filtering - You may select the level of digital filtering to apply to the input channel as None, Low, Medium, or High. Higher filter levels result in lower average noise, but with slower I/O response time (see Specifications).

Select Upscale or Downscale Break Detection – Choose to send the output upscale or downscale if a TC lead breaks.

Turn CJC (Cold Junction Compensation) ON or OFF – the TC signal represents the difference in temperature between two TC ends. The CJC control tells the unit whether to correct the differential TC reading for the cold junction temperature (TB1 terminal temperature), or not (no effect on the ±100mV input range).

The communication status of writing configuration changes to the module is indicated in the Status message field.

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.*

I/O Scaling…

This transmitter allows you to rescale its input and output ranges, and you can even rescale the input differently for each 4-20mA output. You must be careful not to reduce a nominal range too much, as resolution will be reduced by 1 bit each time you halve the range, potentially magnifying noise and error.

In the corresponding I/O Scaling section, set the input signal minimum/zero value to correspond to 4mA of output current, and the input signal maximum/full-scale value to correspond to 20mA of output current. For TC inputs, you can choose °C or °F units for the input range. Each range selection has some under and over-range built-in. You could also swap I/O levels to configure a reverse acting output response if desired.

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

Once you have made your configuration selections, click **[Send I/O Config]** to write changes to the module. You can read the status of your communication with the module in the Configure I/O Status field. Alternately, you could click **"File"** in the upper left-hand corner to save the settings to a file on your PC, for reference later, or for duplicating your configuration on other modules.

At this point, you can test the module's operation by clicking the **[Start Polling]** button to trigger the software to periodically read the input and display its value in the field to the right. Note the simulated lamp next to the button flashes slowly each time it samples the input. Click the **[Stop Polling]** button to stop polling the input channel before moving onto the next page.

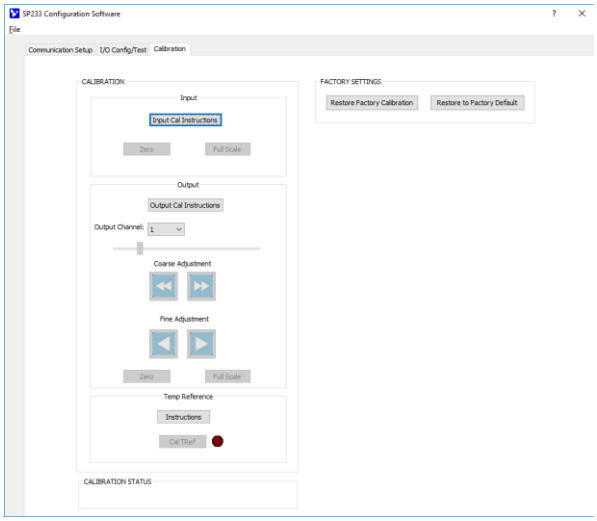
Setting Output Limits...

In the Output Limits section, you can set your own output range clamp limits from 3.5mA to 24mA. These are range minimum and maximum values the output can drive, effectively to its upscale and downscale detents. Under-range and a downscale lead break would send the output to its range minimum, and over-range and an upscale lead break send the output to the range maximum. Optionally, you could instead check the box at the bottom next to "Set to Namur Compliant Range Limits", and you would get a linear operating range from 3.7mA to 20.7mA, with fault levels of 3.6mA (downscale) and 21.0mA (upscale). Setting fault limits outside the operating range has the added benefit of discerning a fault from an input under/over-range condition, such as that driven by a lead break.

TEST I/O...

Click **[Start Polling]** to periodically poll the connected unit and display its input reading. Click **[Stop Polling]** to stop polling the input.

Calibration (Optional)



CAUTION – CALIBRATION Input: You must input values within your nominal input type range. Driving input levels outside of the selected input range will not be acceptable for calibration of zero and full-scale. Since input levels cannot be validated during field calibration, incorrect signal levels will produce an undesired output response.

This unit has already been factory calibrated to a high degree of accuracy. But if you have configured your unit properly and still encounter excessive error, you can click the Calibration tab to display the Calibration control page shown at left.

IMPORTANT: Consider your decision to recalibrate carefully, as this unit has already had its input and output channels factory calibrated with a high level of precision. If you attempt to recalibrate the input or an output channel, you can degrade its performance if you do it improperly, or you use lower grade equipment.

Calibration of I/O for this model is a simple two-part process initiated by simply clicking the respective Input or Output **[...Instructions]** button to get started and following the on-screen prompts.

CALIBRATION - Input

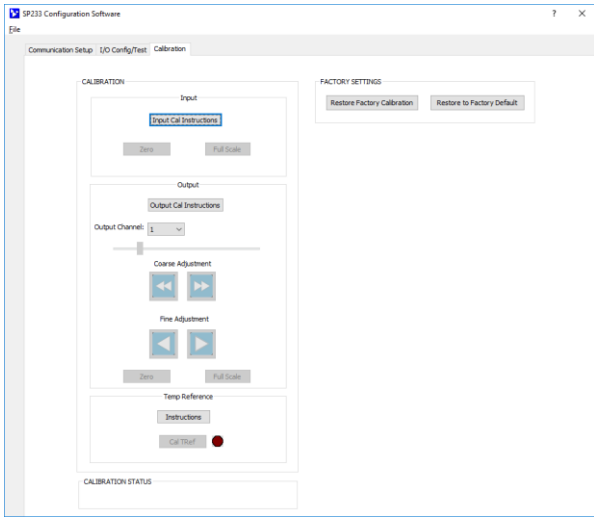
*Before attempting to recalibrate the input, select the input type/range to calibrate in the "I/O Config/Test" page, and make sure you write your selections to the unit by clicking the **[Send I/O Config]** button of that page.*

Click the **[Input Cal Instructions]** button to begin input calibration and enable the Input [Zero] and [Full-Scale] buttons.

For the SP233 example, click the Input **[Zero]** button and you will be prompted to input the minimum signal value of your selected input range at TB1 (note that it uses nominal range endpoints, not your scaled range endpoints). Once you input the zero signal precisely, click the **[OK]** button of the prompt to calibrate the range zero and follow the on-screen prompts.

For the SP233 example, click the Input **[Full-Scale]** button and you will be prompted to input the maximum value of your selected input range at TB1. The software does not use your scaled full-scale range endpoint, but the nominal full-scale of the selected input type/range. Once you input full-scale precisely, click the **[OK]** button of the prompt to calibrate the range full-scale and follow the on-screen prompts.

Calibration…



CALIBRATION – Each Output

Click the **[Output Cal Instructions]** button to begin output calibration and enable the Output [Zero] and [Full-Scale] buttons.

First adjust the input signal as necessary to drive the output current to precisely 4.000mA. Be sure to measure this level accurately or performance will be degraded. After driving the output to 4.000mA, click the Output **[Zero]** button of the Calibration Output section to calibrate the output zero level.

Next adjust the input signal as necessary to drive the output current to precisely 20.000mA. Be sure to measure this level accurately or performance will be degraded. After driving the output to 20.000mA, click the Output **[Full-Scale]** button of the Calibration Output section to calibrate the output full-scale level.

Repeat this process for the second output channel.

If following calibration, your output acts erratic or appears imprecise, you may need to repeat input or output calibration, being very careful to take accurate measurements and input correct signal levels. If you are measuring voltage across an output load resistance to measure the current level in an output (recommended), make sure that you use exact resistance when calculating the measured loop current. When rescaling, make sure that you have adequate input span, as “too-tight” input spans have diminished resolution and will magnify error.

Factory Settings

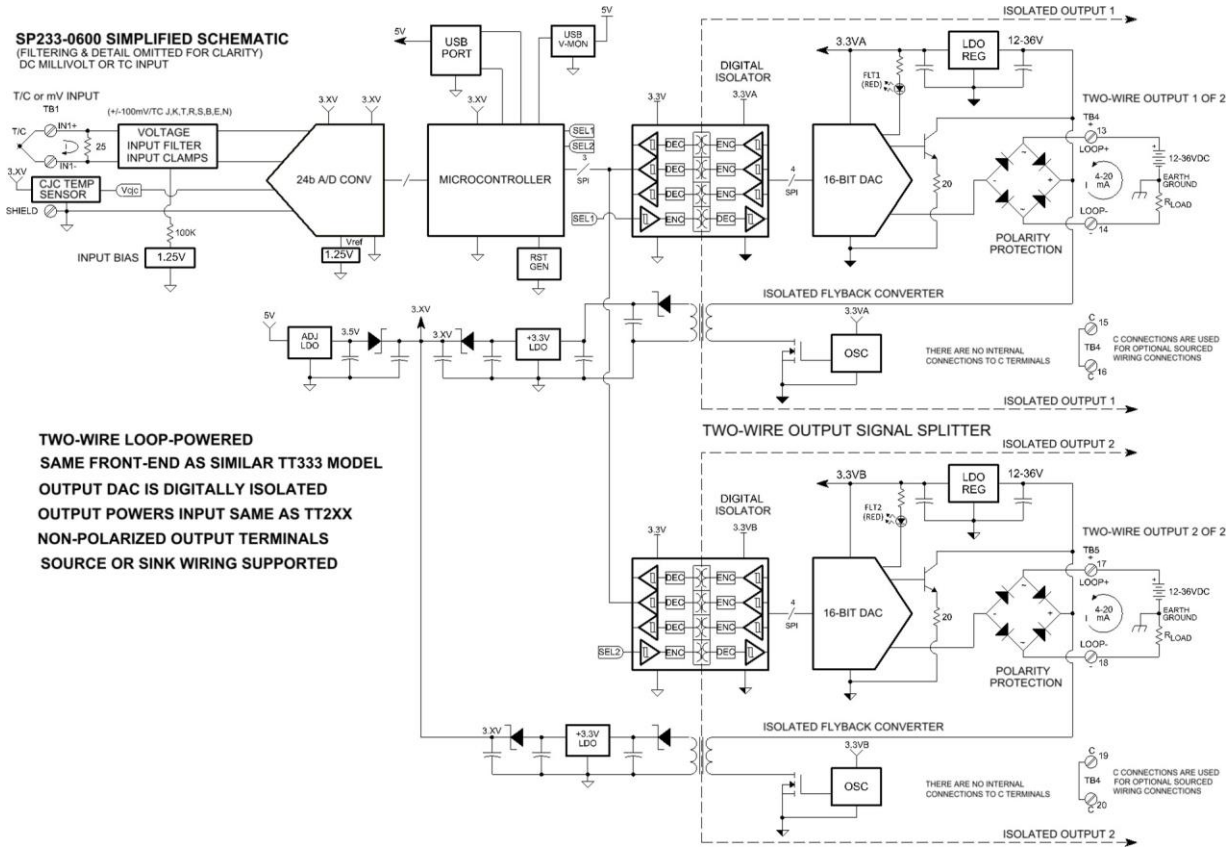
You can use the **[Restore Factory Calibration]** button to restore the transmitter’s original factory calibration if you think you made an error during recalibration, have somehow degraded its performance, or if the I/O channel appears erratic.

You can use the **[Restore to Factory Default]** button to return the unit to its original factory state (see Specifications Reference Test Conditions) and configuration settings. This does not restore calibration, only the configuration. Alternately, this button can be used as a sanitation tool to restore the unit to its initial configuration.

Calibration 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, you should repeat the calibration process.

BLOCK DIAGRAM



How It Works

Key Points of Operation

- Unit is Loop Powered
- Input is isolated from Outputs
- Outputs isolated from each other
- Input is Differential & Bipolar
- Output/Power Terminals are Not Polarized.
- Input circuit ground is common to USB ground.
- USB powers a portion of the input circuit when connected, but not the output.

This signal splitter uses a 32-bit microcontroller and 24-bit ADC to convert the input to a serial digital signal that is isolated with a digital isolator and transmitted to a 16-bit current DAC in each output. Power for the common isolated input is provided via an isolated flyback converter operating in parallel with each output loop and one or both output loops may power the input. A cold junction compensation temperature sensor is located near the input terminals. Setup involves selecting the input type (T/C or mV), upscale or downscale break detection, turning CJC on or off as desired, selecting a filter level, and scaling the input range endpoints to the output range endpoints. The input may be scaled differently for each output. Output scaling can be reversed to optionally produce a reverse acting output. The output range may clamp to user-specified levels from 3.5mA to 24mA. Refer to the block diagram above to gain a better understanding of how this splitter works. The input/USB and each output/power circuit are isolated from each other. The USB port ground is common to the input circuit ground. The USB port ground of most PC's is also common to the USB cable shield and earth ground and input sensors could be grounded or ungrounded. For this reason, it is recommended that USB signals be isolated when connecting to a PC to prevent a ground loop from occurring between the PC earth ground and a grounded input sensor, which would have the negative effect of pulling the input bias supply to ground, clipping the negative portion of the bipolar 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 loop and that your loop power supply voltages are sufficient to supply over-scale current into the loads (MIN 0.020*Rload), plus 7V MIN at the unit terminals, plus any line drop.*

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
Software Does Not Detect Unit or Communication Set up Screen is Blank…	
USB is not connected between unit and host PC.	Verify a USB cable from the USB isolator is plugged into the unit and into the isolator. Verify that the USB cable from the PC is also plugged into the PC USB port and into the isolator.
USB has not enumerated the device.	Use the reset button on the Acromag USB isolator to trigger renumeration of the splitter, or simply unplug and re-plug the USB cable to the splitter.
Communication or power was interrupted with USB connected and config software running.	Close the current connection with the software, then select and re-open the splitter for communication (or simply exit the Configuration software and reboot it).
Cannot Communicate with Splitter via USB…	
Unit fails to operate or exhibits an output shift…	
Output shifts off-range when you connect USB…	
A missing USB Isolator could cause a ground loop between a grounded input signal/sensor and earth ground at the connected Personal Computer's USB port.	Isolated splitters and transmitters can be used with grounded or ungrounded inputs, but you can only connect grounded sensors if the USB signals are also isolated. Without USB isolation, a ground loop is created between a grounded input and earth ground of the PC USB port. This module's input is biased 1.25V off input ground to allow it to process negative-going signals. Earth ground applied via the non-isolated USB connection with an earth grounded sensor would clip the input bias and truncate the negative signal range. It's best to connect to USB via a USB isolator for this reason and for increased safety and noise immunity. 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.
Output is Erratic, Not operational, or at Wrong Value…	
Is your output loop power supply at the correct level for your load? Is Output Fault LED blinking?	Verify loop voltage and level in each output. Ideally, your supplies must be adequate to provide 7V MIN to the transmitter, plus the IR drop in the load, plus the IR drop in the lead wires, and all at the maximum loop current (>20mA).

Diagnostics Table…

POSSIBLE CAUSE	POSSIBLE FIX
Cannot Calibrate Input Channel…	
Is input wired properly?	Check that input is wired to correct ± input terminals with correct polarity.
Cannot Calibrate an Output or Cannot Test the Unit…	
Loop power ON to the unit?	The unit receives power from both USB (when connected), and the output loop power supplies. While you can configure a unit over USB without loop power applied, a loop power connection is required to test operation or calibrate the unit.
Unit drives a low current, but fails to drive higher output current...	
Loop supply voltage is too low to support current into the loop load or the loop load resistance is too large for the current level. Does the output fault LED blink at the higher current?	Check power voltage level. Make sure it is at least 7V plus 0.02x*Rload. If transmit distance is especially long, then it must have added voltage to support the IR drop in the wire. Ideally, the voltage should also have ample overhead to drive the load at the maximum upscale output current > 20mA.
Cannot Measure Input Signal…	
Your input may be wired to the wrong screw terminal.	On the SP233, DC mV or TC signal is input to first two terminals of TB1 (the third terminal is not used).
For input step, output appears to make 2 steps to reach its final value…	
For a step change in the input, the A/D typically needs two input samples to charge to its final level.	When you step the input signal, it takes two samples for the A/D to charge up to its final value, and this is evident when using a scope to examine the output transition in response to a step change at the input, which appears to make two steps to arrive at its final level.
Output goes above Over-Range (21mA) or below Under-Range Limit (3.6mA)...	
This indicates a fault condition and either the input signal is out of range, 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. A fully upscale signal can also indicate failed communication with the output DAC (firmware problem).	Check the input signal with respect to its range and reduce or increase it as required to drive the output current within its linear operating range. A fully upscale or down-scale signal can be driven by a sensor fault, such as an open or broken sensor lead. Check the wiring of your input sensor. If you are not isolating USB, check for a ground loop between a grounded sensor and earth ground of the PC USB port.

Diagnostics Table…

POSSIBLE CAUSE	POSSIBLE FIX
Output holds last value when I connect USB…	
Unit is awaiting initialization via its configuration software used to set it up, configure it, and calibrate it.	Boot the configuration software to regain operation. The USB port is intended for set up and configuration of the module and it should not be left connected to USB without also booting the USB software.
Output Fault (FLT) LED blinks rapidly...	
The corresponding output loop voltage is too low to support the loop load current, or the load resistance is too high for the loop supply voltage level. Note this LED will blink one time if loop power is turned off.	Check the corresponding output loop voltage level and wiring. Verify your output load resistance is less than R=(Vs-7)/0.02x. Note that an isolated 2-wire output is earth grounded at the Vs supply minus lead (load minus), not the transmitter output.

Service & Repair Assistance

This unit contains solid-state components and requires no maintenance, except for periodic cleaning and transmitter configuration parameter (zero and full-scale) verification. The enclosure is not meant to be opened for access and can be damaged easily if snapped apart. Thus, 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 the Acromag 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 TT-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 TT/SP family Transmitters/Splitters. Isolation is recommended for USB port connections to these transmitters and will block a potential ground loop between your PC and a grounded current loop. A software CDROM is included that contains the Windows software used to program the transmitter.

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 TT-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 TT-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 TT/SP transmitter/splitter. It is normally included in TT-SIP.

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

ACCESSORIES

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 an Android mobile phone or tablet that support USB. It is required to use the Acromag Agility™ Config Tool App for Android OS reconfiguration of this splitter.

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

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 Numbers

Model SP233-0600 Signal Transmitter w/ Isolated TC/mV Input and dual Two-Wire Loop-Powered Outputs, CE Approved, With UL/cUL Class 1, Division 2 approvals

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

The SP233 model prefix denotes an isolated thermocouple input model of the DIN-Rail Mounted Series SP23x Splitter family. The trailing "-0600" model suffix denotes two-wire loop powered outputs with CE and UL/cUL Class 1, Division 2 Approvals. Models can be mounted on standard 35mm "T" Type DIN rail.

Optional factory calibration to your own specifications is ordered as a separate line item at time of purchase, on a per unit basis. Factory calibration requires the specification of input type (J, K, T, E, R, S, B, N, or ±100mV), scaled input range Zero and Full-Scale (mV or °C) for each output, input filter level (none, low, medium, or high), sensor fault direction (go upscale or downscale), plus output zero/full-scale range endpoints for each output. You can also specify a normal or reverse acting output and whether CJC is ON or OFF at the input.

A standard model without an added custom factory configuration/calibration is calibrated by default to reference test conditions for T/C Type J, with 0°C to 200°C input mapped to both splitter outputs with 4.000mA zero and 20.000mA full-scale endpoints, upscale fault detection, and CJC ON. Recalibration of any model will require use of the TTC-SIP configuration kit, ordered separately (see Accessories).

Input

On the SP233, a single thermocouple or DC millivoltage signal is input at TB1.

Reference Test Conditions: TC Type J with a 10mV min span (e.g. Type J, 0 to 200°C), or ±100mV range with a 10mV minimum calibrated span; Output 4-20mA into 250Ω; Ambient = 25°C; Power Supply = 24VDC.
Input & Accuracy: Configurable for native input types/ranges shown in Table 1 below. Unit provides TC linearization, TC Cold-Junction Compensation (CJC), and lead break detection.

Table 1: Range/Accuracy		ISA/ANSI Color	°C Temp Range	Typical[1] Accuracy
T/C	T/C Material			
J	+Iron, -Constantan	White/Red	-210 to +760°C	±0.5°C
K	+Chromel, -Alumel	Yellow/Black	-200 to +1372°C	±0.5°C
T	+Copper, -Constantan	Blue/Red	-260 to +400°C	±0.5°C
R	+Pt/13%Rh, -Constantan	Black/Red	− 50 to +1768°C	±1.0°C
S	+Pt/10%Rh, -Constantan	Black/Red	− 50 to +1768°C	±1.0°C
E	+Chromel, -Constantan	Purple/Red	-200 to +1000°C	±0.5°C
B	+Pt/10%Rh, -Pt/6%Rh	Gray/Red	+260 to 1820°C	±1.0°C
N	+Nicrosil, -NISIL	Orange/Red	-230 to -170°C; -170 to +1300°C	±1.0°C ±0.5°C
mV	NA	NA	±100mV	±0.05% ±0.1% Max

[1]**Note (Table 1):** Accuracy is generally ±0.1% of the full-scale span, typical, or per the table 1 specification, whichever is greater.
[2]**Note (Table 1): Accuracy in Table 1 is given with CJC switched OFF.** CJC uncertainty should be combined with the uncertainty numbers of Table 1 to determine a potential overall inaccuracy. Relative inaccuracy with CJC enabled may increase by as much as ±0.5°C during the post power-on warm-up period, but will converge to ±0.2°C typical after reaching thermal equilibrium in about five minutes.

Input…

Analog to Digital Converter (A/D or ADC): 24-bit, Σ-Δ A/D converter, but only ~15.5-bits are used as the 24-bit signal is subsequently normalized to a bipolar range count of ±25000 to simplify I/O scaling (see Input Resolution below). Input ranges may be rescaled to smaller ranges to drive each 4-20mA output and the effective input resolution is proportionally diminished as you reduce input span below its nominal range by rescaling (you lose 1-bit every time you halve the range). Be careful not to diminish resolution below 12-bits minimum (1 part in 4096) for rated performance.
Input Resolution: The A/D in this splitter divides its input signal into parts calculated by subtracting endpoint A/D counts computed via (Vin*Gain/1.25)* 32768+32768, with Gain=8, 16, 32, or 64, depending on the input Type (see Table 1). This count is then converted to TC temperature via a linearizer function for the TC type (the output is made linear with respect to TC temperature, not voltage). The linearizer to temperature conversion resolves to 0.05C, which can limit the input resolution for small spans (for example, a span of 200°C yields a linearizer resolution of 200/0.05=4000 parts). The linearized temperature is interpolated to the output based on a straight-line calculation formed by mapping input range endpoints you specify to the output range endpoints of the output range. Input ranges that share the same gain are calibrated by extrapolating from another input range calibration. The effective I/O resolution for a given range will be the lowest resolution of the A/D (see below), or its linearized value (using 0.05C intervals), as the D/A resolution is always greater. Internally for simplification, the raw A/D counts indicated in Table 2 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 2 or this 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). Output DAC resolution is 1 part in 43690 for 4-20mA output.

Table 2: INPUT RANGE	xDIVIDER	xGAIN	RAW A/D INPUT RESOLUTION
V (-1.000V to +1.000V)	NONE	1	6554 to 58982 or 1/52428
mV (-100mV to +100mV)	NONE	8	11796 to 53740 or 1/41943
T/C J (-210 to +760°C) (-8.095mV to 42.919mV)	NONE	16	29373 to 50770 or 1/21397
T/C K (-200 to +1372°C) (-5.891mV to 54.886mV)	NONE	16	30297 to 55789 or 1/25492
T/C T (-260 to +400°C) (-6.232mV to 20.872mV)	NONE	32	27540 to 50277 or 1/22736
T/C R (-50°C to+1768°C) (-0.226mV to 21.101mV)	NONE	32	32578 to 50469 or 1/17890
T/C S (-50°C to+1768°C) (-0.236mV to 18.693mV)	NONE	32	32570 to 48449 or 1/15879
T/C E (-200 to +1000°C) (-8.825mV to 76.373mV)	NONE	8	30917 to 48785 or 1/17867
T/C B (+260 to 1820°C) (0.317mV to 13.820mV)	NONE	64	33300 to 55954 or 1/22654
T/C N (-230 to +1300°C) (-4.226mV to 47.513mV)	NONE	16	30995 to 52696 or 1/21701
CJC (-50°C to 150°C) (0V to 1V)	NONE	1	32768 to 58983 or 1/26214

Input…

For simplification, the raw A/D counts indicated in Table 2 are internally normalized to ±25000/15.5 bits (bipolar ranges), or 0-25000/14.5 bits (unipolar ranges), and the effective input resolution of a range will be the lesser of the raw resolution indicated or this normalized resolution. The effective I/O resolution of your transmitter will be the lowest of either the input A/D, or the linearization conversion to temperature (which resolves to 0.05°C on TC inputs). The output resolution of this unit is 1/43690 for 4-20mA and this is greater than the input resolution and will not be a limiting factor, except for the ±1V range. In most cases or for small input spans, input resolution will be dominated by the 0.05°C temperature resolution of the thermocouple linearizer.

Input Sampling Rate (A/D): Input is sampled at a variable rate according to the input filter selection as follows (see Output Response Time):

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

Input Linearization (TC Inputs): Within ±0.25°C of the NIST tables (internal breakpoint tables resolve to ±0.05°C).

Input Thermocouple CJC Reference (TC Inputs Only): Table 2 below shows the accuracy of the CJC sensor used in this circuit. CJC has been factory calibrated at 25°C to ±0.1°C. The accuracy of CJC over the full operating range will be about ±1.0°C.

Table 2: Thermocouple CJC[1] Sensor Absolute Accuracy

CJC Range	Typical	Maximum
25°C	±0.1°C	±0.3°C
10 to 80°C	±0.3°C	±0.6°C
-40 to 80°C	±0.5°C	±1.2°C

[1]**Note:** Cold Junction Compensation may be switched OFF to permit direct connection of the input to DC millivolts via copper wires to simplify calibration. Otherwise a hand-held calibrator may be used. For best results, allow the module to reach thermal equilibrium and warm up for 5-10 minutes prior to calibrating CJC. During calibration, physically position the module the same as its field application (recommended upright on a DIN rail). Note that the input is normally calibrated with CJC OFF, and CJC calibration is done separately.

Input Zero and Full-Scale Adjustment: Input range endpoints are selectable over the full range indicated in Table 1 for each input type. Input Zero and Full-Scale must be within range and will be mapped to 4mA and 20mA at the output. Your input resolution is reduced and potential error is magnified as your programmed input range is reduced. Nominal rated ±0.1% error assumes a minimum input span of 10mV.

Input Lead Break Detection: Can be set Upscale or Downscale for open sensor/lead break fault detection. Output limits are scaled I/O range dependent and can be from 3.5mA up to 24mA. Unit allows you to set your own output limits, or select Namur Compliant fault limits with a linear operating range from 3.7mA to 20.7mA and break detect set to levels outside of these limits.

IMPORTANT: Calibration should be done with break detection already set as required by the application, as changing it may affect calibration somewhat.

Input Bias Current: ±125nA typical (TC break current).

Input Linearization (T/C Inputs): Within ±0.25°C of the NIST tables.

Input…

Input Overvoltage Protection: Bipolar Transient Voltage Suppressers (TVS) at TB1, 5.6V working level, 14V clamp level. Differential input also includes input diode over-voltage clamping on each lead, capacitive filtering, and series resistance.
Input Filter Bandwidth: Normal mode and digital filtering optimized and fixed per filter selection within the Σ-Δ ADC. Bandwidth (-3dB) varies with digital filter selection as follows: 4Hz w/No Filter, 1.2Hz Low Filter, 0.98Hz Medium Filter, and 0.33Hz High Filter. See Normal Mode Noise Rejection and Output Response Time.
Input Noise Rejection (Common Mode): Varies with input filter selection between 102dB (no filter) and 152dB (high filter), typical at 60Hz, with 100Ω input unbalance.
Noise Rejection (Normal Mode): Varies with input filter selection. Table below indicates the typical rejection at 60Hz for each input filter selection. Note that at the medium and high input filter settings, the A/D converter adds 80dB minimum of rejection for frequencies between 49Hz and 61Hz.

	TYPICAL 60Hz REJECTION PER INPUT FILTER			
INPUT	**NONE**	**LOW**	**MED**	**HIGH**
TB1 TC/mV	0.5dB	20dB	> 80dB	> 80dB

Output Range (Each at TB4 and TB6): Nominal 4-20mA DC w/ linear operating range from 3.7mA-20.7mA (w/ range set to Namur NE 43 limits). Namur limits allow you to discern downscale/upscale fault levels at ~3.5mA/21mA from linear operation.
Output Accuracy: Typically better than ±0.05% of span (±0.1% Max) for nominal input ranges. Relative accuracy varies with calibrated input/output span and scaling, and this includes the combined effects of repeatability, terminal point conformity, and linearization, but does not include sensor error.
Output Ripple/Noise: Less than ±0.1% of output span.
Note – High Speed Acquisition: Additional filtering at the load is recommended for sensitive applications with high-speed acquisition rates. For excessive 60Hz supply ripple, a 1uF or larger capacitor is recommended at the load. High frequency noise may be 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: The combined effect of zero and span drift over temperature is better than ±0.008% of span per °C (±80ppm/°C) over the full ambient temperature range for reference test conditions (see Input Specifications).
Output DAC Resolution: A 16-bit current DAC with current approximated via 24mA*COUNT/65536 (see table below). For a 4-20mA output range, we have an output resolution of 54613-10923, or 1 part in 43690. The range limits are normally truncated to Namur limits near ~3.7mA (low) and ~20.7mA (upper), which allows you to discern an upscale or downscale lead break condition apart from the linear operating range. The effective I/O resolution of this transmitter will be the lowest resolution of either the input, or the output.

I-LOOP = 24mA*COUNT/65536	COUNT = 65536*I-LOOP/24mA
3.7mA	10103
4.0mA	**10923**
12mA	32768
20mA	**54613**
20.7mA	56525
23.9996mA	65535

Output

Output Response Time: For an input step while driving 4 to 20mA to a 250Ω load and 24V supply, response time varies by digital filter level as follows:

INPUT DIGITAL FILTER LEVEL	RESPONSE TIME TO 98% OF TRANSITION (TYPICAL)
	SP233
NONE	21ms
LOW	48ms
MEDIUM	149ms
HIGH	1138ms

CAUTION: *Do not exceed 36VDC peak to avoid damage to the unit. Terminal voltage above 7V minimum must be maintained across the unit during operation.*

Output Power Supply: Loop powered from 7-32V DC SELV (Safety Extra Low Voltage), 24mA maximum. The voltage across the output must never exceed 36V, even with a shorted load. Set this level to provide a minimum of 21mA over-range current to the load (0.021*R typical), plus 7V across the output terminals, plus any interim line drop. Reverse polarity protection is inherent as output terminals are not polarized (± output labels of enclosure are for reference only).

Output Power Supply Effect: Less than ±0.001% of output span effect per volt DC of supply change within rated limits for load.

Output Compliance and Load Resistance Equation: 7V minimum is required for transmitter. Unit will drive up to 17V to a load with a 24V loop supply and 20mA of loop current (800Ω), assuming negligible line drop. Compute R_{load} (Max) = (V_{supply} - 7V)/0.021A for 21mA output current. Refer to the following table:

V_{supply} Volts	Max R_{load} w/21mA & No Line Drop
10V	143Ω
12V	238Ω
18V	524Ω
24V	810Ω
32V	1190Ω

Ideally, you should be able to drive at least 21mA to your load and this would yield a maximum load resistance of 800Ω for 21mA of loop current and a 24V loop supply.

Output Load Resistance Effect: Less than ±0.001% of output span effect for a ±100Ω change in load resistance.

USB Interface

Unit includes a USB socket for temporary connection to a PC or laptop for set up and reconfiguration (or optionally to a USB-OTG cable connected to an Android smartphone or tablet). USB isolation is required when connected to a grounded input sensor or driver (see note below). During reconfiguration and calibration, the transmitter receives power from both the USB port and the output loop. Both power sources must be present to calibrate the unit.

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.

Inrush Current Limiting: Includes series inrush current limiting at USB power.

Cable Length/Connection Distance: 5.0meters maximum.

USB Interface…

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, Molex 67503-1020.

PIN	DEFINITION
1	+5V Power (Includes Inrush Current Limiting)
2	Differential Data (+)
3	Differential Data (-)
4	NC – Not Connected
5[1]	Power Ground (Connects to Signal Ground via ferrite bead)
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 recommended: The input of this transmitter is isolated from both outputs and can be connected to grounded or un-grounded input signals. However, the transmitter's input circuit ground is connected 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 without using an isolator. Failure to connect USB without isolation would connect the 1.25V input bias supply to input ground if the sensor is also earth grounded. This will interfere with operation and cause the output to shift. For this reason, USB isolation is strongly recommended when connecting to a PC. Otherwise, in the absence of USB isolation, and when connected to a grounded input sensor, a battery powered laptop could be used to connect to the unit, as the laptop does not normally connect to earth ground.

Enclosure & Physical

General purpose plastic enclosure for mounting on 35mm "T-type" DIN rail.
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 3-position terminal blocks rated for 12A/250V; AWG #26-12, stranded or solid copper wire.
Program Connector: USB Mini B-type, 5-pin. See USB Interface.
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.
DIN-Rail Mounting: Unit is normally mounted to 35x15mm, T-type DIN rails. Refer to the DIN Rail Mounting & Removal section for more details.
Shipping Weight: 0.5 pounds (0.22 Kg) packed.

LED Indicators

Output Fault LED Indicators (Red, Each Output, FLT1 & FLT2) – One Red FLT LED per output loop. Blinking red continuously indicates the corresponding output load resistance is too high to modulate its loop current accurately, or the loop voltage level is too low to drive the loop resistance at the desired current level. OFF is normal, blinks for fault, or blinks once if the loop power is lost or the loop is opened.

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 +80°C (-40°F to +176°F).
Storage Temperature: -40°C to +85°C (-40°F to +185°F).
Relative Humidity: 5 to 95%, non-condensing.

Environmental…

Isolation: Input/USB and the output/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). This complies with test requirements of ANSI/ISA-82.01-1988 for voltage rating specified.
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).
Shock & Vibration Immunity: Conforms to: IEC 60068-2-6: 10-500 Hz, 4G, 2 Hours/axis, for sinusoidal vibration; IEC 60068-2-64: 10-500 Hz, 4G-rms, 2 Hours/axis, for random vibration, and IEC 60068-2-27: 25G, 11ms Half-sine, 18 shocks at 6 orientations, for mechanical shock.

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.
3) DC Power Port, per CISPR 16.
4) Telecom / Network Port, per CISPR 22.

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: UL Listed (USA & Canada). Hazardous Locations – 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.

ATEX / IECEX Certified: The SP233-0600 model is ATEX / IECEx Certified for Explosive Atmospheres per ATEX Directive 2014/34/EU which complies with standards IEC 60079-0 Edition 6, IEC 60079-15 Edition 4, EN 60079-0:2012+A11:2013, and EN 60079-15:2010.

Ex II 3 G Ex nA IIC T4 Gc -40°C ≤ Ta ≤ +80°C
DEMKO 18 ATEX 2086**X**
IECEx UL 18.0092**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 60079-15
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

Soft Configuration Only via USB/Windows Software or USB-OTG/Android Agility App
This transmitter drives analog output current in dual 2-wire loops proportional to a sensor input based on the differential voltage measurement across the sensor for differential sensor voltage input at TB1. No switches or potentiometers are used to make adjustment to this transmitter. Its behavior as an 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, or a wired USB-OTG connection to an Android smartphone or tablet running Agility. The USB software or Agility app provides the framework for digital control of all configuration and calibration parameters, which are stored in non-volatile memory of the unit.

LED Indicators, Red FLT1 & FLT2
Red FLT LED per output loop (LED is powered by the loop). Blinking red continuously indicates the corresponding output load resistance is too high to drive its current accurately, or the loop voltage level is too low to drive the loop resistance at the desired current level. OFF is normal and LED will blink once as loop power is lost or the loop is opened.

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
19 FEB 2018	A	BC/MJO	Initial Release Version
27 NOV 2018	B	CAP/ARP	Added UL / ATEX / IECEx / FCC statements.