

How to Select a 4-20mA Isolator

And Why You Need Electrical Isolation





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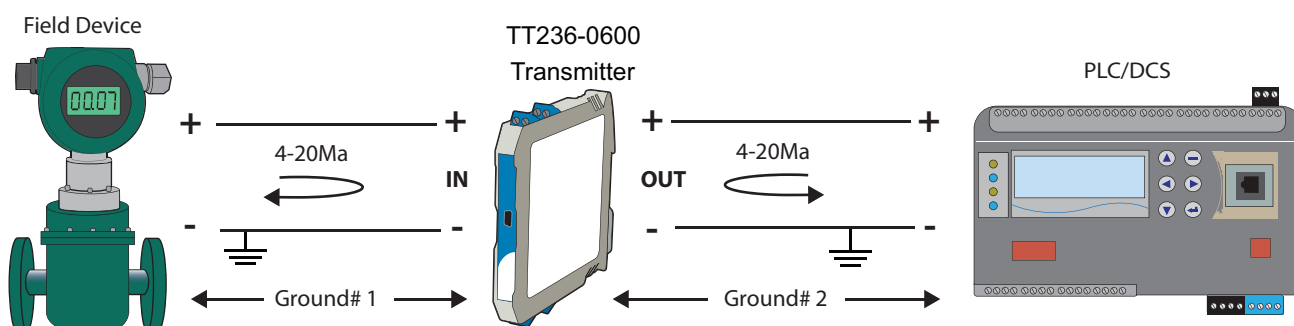


Introduction

Acromag manufactures a variety of isolators to provide a cost effective solution for many applications. The main reasons for using an isolator are to: eliminate bucking power supplies; protect expensive control room equipment from transient spikes; and break ground loops that may exist between two instruments.

Bucking Power Supplies

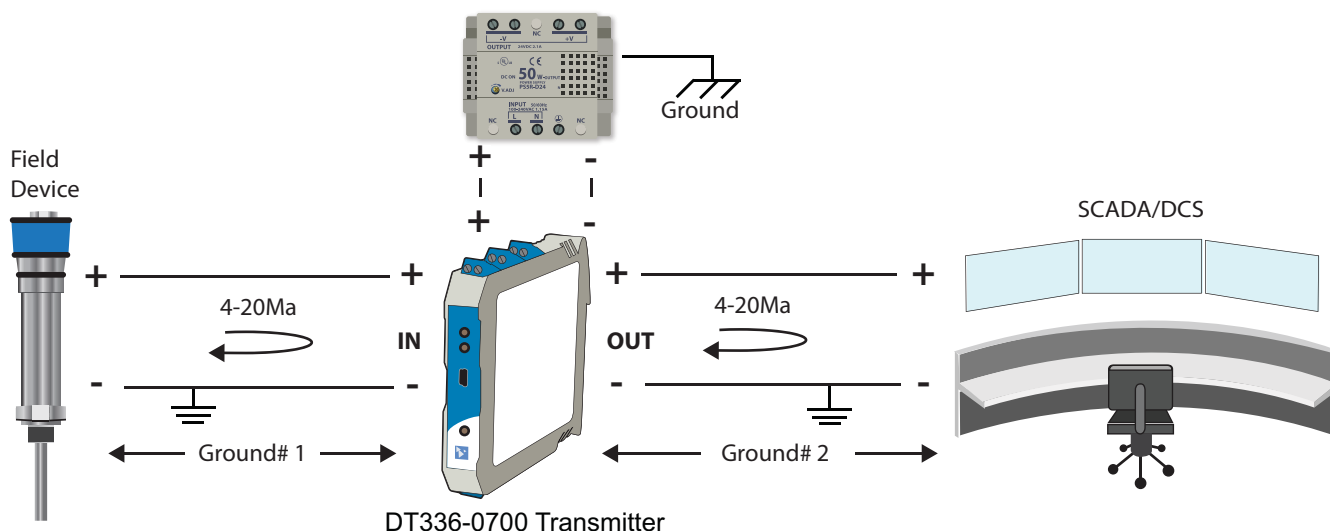
Bucking Power Supplies is when two or more devices want to supply the power to the 4 to 20 mA loop. If you insert an isolator that is passive on the input and output, you can satisfy both. You'll also pass through the signal without having to run wires for power to the isolator. Acromag's [TT236-0600](#), [DT236-0600](#) or [651T-0600](#) all have this capability.



Protecting Equipment from Electrical Surges

Often, remote equipment can be installed in an environment with a lot of electrical noise or potential surges. These can be caused by variable speed drives, pump motors, equipment startups/shutdowns and lightning strikes. This can damage or destroy sensitive control room equipment such as computers, DCS, PLCs, etc. The cost to repair or replace this equipment can easily be thousands of dollars. These Acromag isolators will filter most noise: [TT336-0700](#), [DT336-0700](#), [631T-0100](#) (AC powered) or [631T-0500](#) (DC powered).

Surge suppression is also isolated for common mode voltages, up to 250V AC or 354V DC off-ground, on a continuous basis. It will withstand a 1500V AC dielectric strength test for one minute without breakdown. In the event of something catastrophic, such as a lightning strike, the isolator will be destroyed, but will still protect the control room equipment.

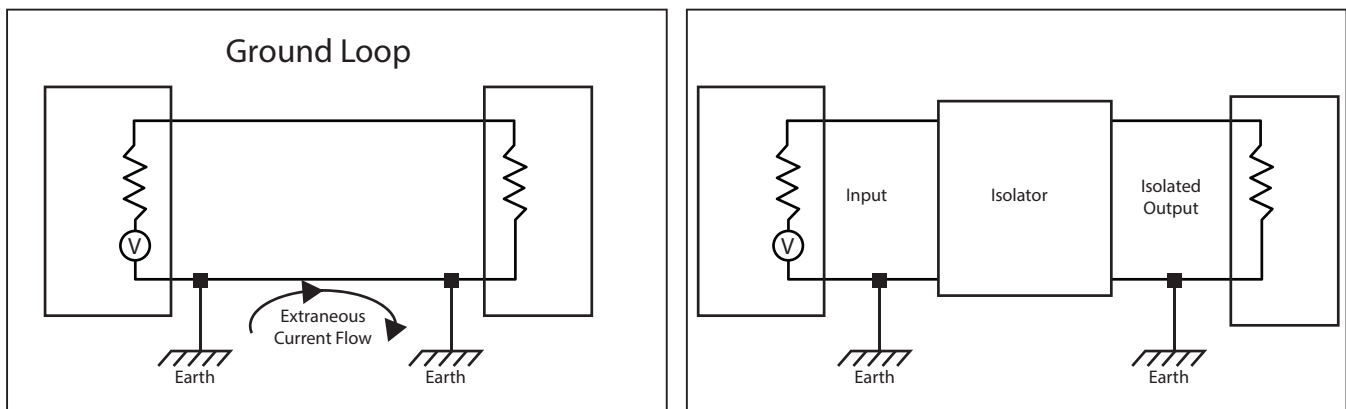




Ground Loops

Ground loops are unintended induced currents in a signal loop. A single ground poses no problem. However, multiple grounds lead to the possibility of creating ground loops; even more so as the distance increases between the grounds. The thought that earth ground is a giant current sink with the same voltage potential (voltage) everywhere is incorrect. Earth ground at different locations is often at a different absolute potential from each other. So, if you ground a control loop in more than one place, you are placing a conductor between those two potentials. This will, of course, induce a current.

Ground loops are especially troublesome because they are exhibited in several different ways. If a DC current is created, it will create an offset in the signal. If it is an AC current, it will add noise to the signal. A combination of the two can lead to some very misleading results. If you add a time variable, such as someone turning on or off a piece of equipment, you can see how a ground loop can be difficult to troubleshoot and should be avoided whenever possible. Sometimes you must ground both pieces of equipment to properly wire other signals, etc. This is where an isolator comes in. It physically breaks the conductor running between the two locations, but still retransmits the signal. Any of the isolators mentioned so far, as well as many others offered by Acromag, will isolate the two locations by creating separate loops.



Selecting an Isolator

The first thing to consider is where the power is going to come from. You want to be sure that it will work in your application. There are three major categories of isolators:

1. Output Loop-powered
2. Input Loop-powered
3. Externally Powered

Output Loop-powered Isolators

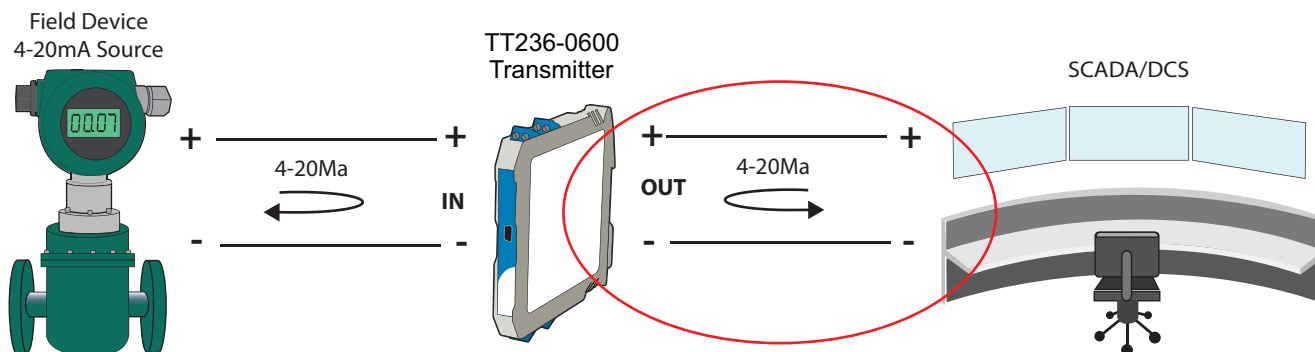
As the name implies, output loop-powered takes the power for its internal circuitry from the output loop, not a separate PSU. It is well-suited for Bucking Power Supply applications because it has a sinking input and a sinking output.

In the drawing on the next page, the PLC sees it as a two-wire field device, not the actual four-wire device. Since there isn't extra power circuitry this is usually the lowest cost alternative.

Examples of this type of Isolator are the [TT236-0600](#) and [651T-0600](#) or dual-channelled [DT236-0600](#) and [652T-0600](#).



Diagram Showing Output Loop Power



Application

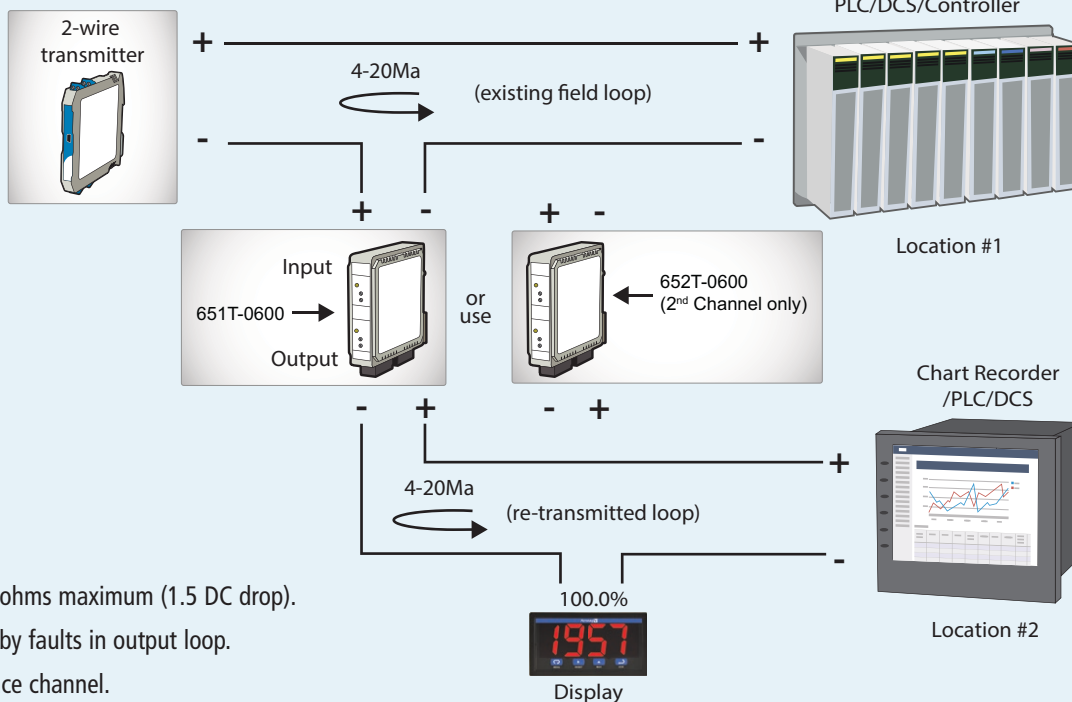
Retransmit a signal from a 2-wire loop to a second location.

Solution

Use either a model [651T-0600](#) (single channel) or [652T-0600](#) (dual channel) transmitter.

Process Measurement

- Pressure
- Flow → ±
- Level
- Temperature
- Speed



Notes:

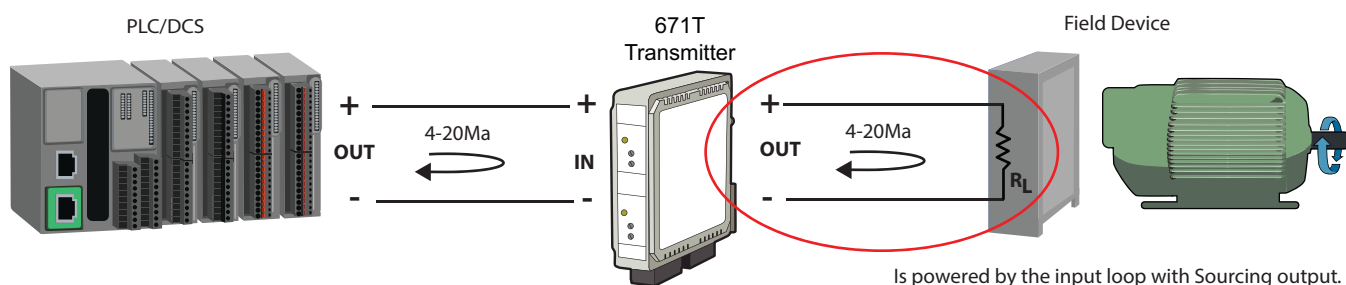
1. Isolator input load = 75 ohms maximum (1.5 DC drop).
2. Input loop is unaffected by faults in output loop.
3. [Series 652T](#) provides space channel.



Input Loop-powered Isolators

Input loop-powered isolators are mostly used when you need a sourcing output, and you don't have AC or DC power available in the panel where it needs to be mounted. Be careful when specifying this type of isolator because not only does it require the input signal source be able to power the isolator, but also the load of the output field device. The compliance or required voltage is calculated by the formula $V_c = 4.9V\text{ DC} + (0.0212A \times R_{load})$. So, if the input signal source is 24V DC, then it can drive the isolator up to a little over 900Ω field load.

Note: this calculation does not account for any other devices on the input loop. Their burden will need to be added to the compliance voltage. In the event of an output open circuit, the input voltage drop is limited to below 20V, nominal. This will limit voltage available to any other device on the input loop, causing them to read artificially low. Examples of this type of isolator are the [671T-0600](#) and multi-channel [672T-0600](#) / [674T-0600](#).



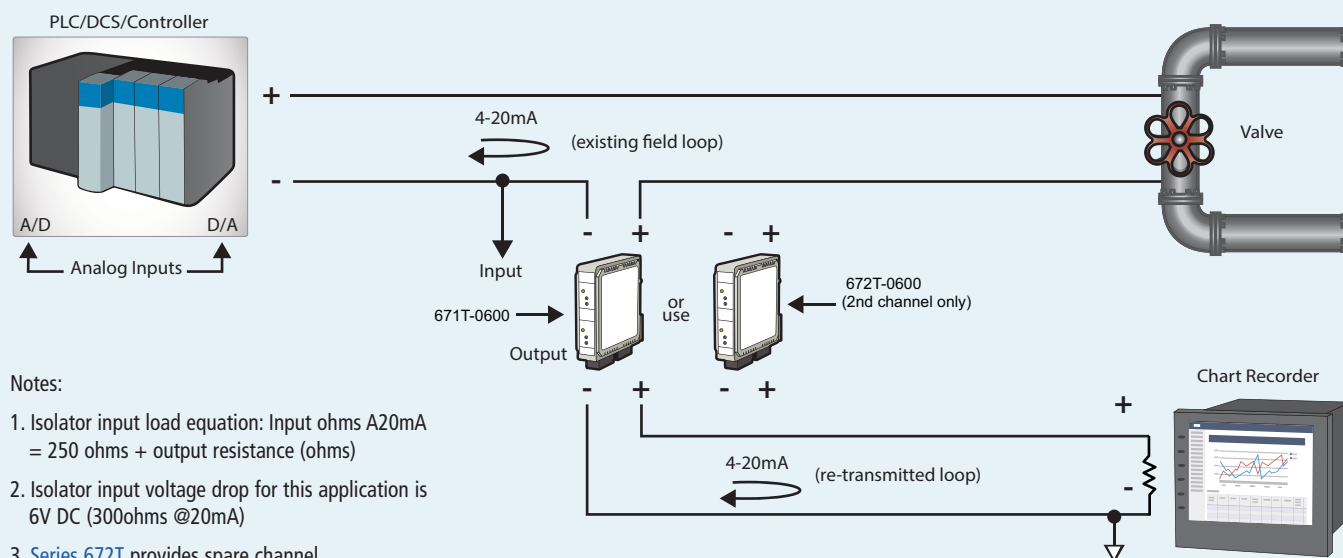
Application

Retransmitting a signal output from a controller or a D/A card.

Solution

Use either a model [671T-0600](#) (single channel) or [672T-0600](#) (dual channel) transmitter.

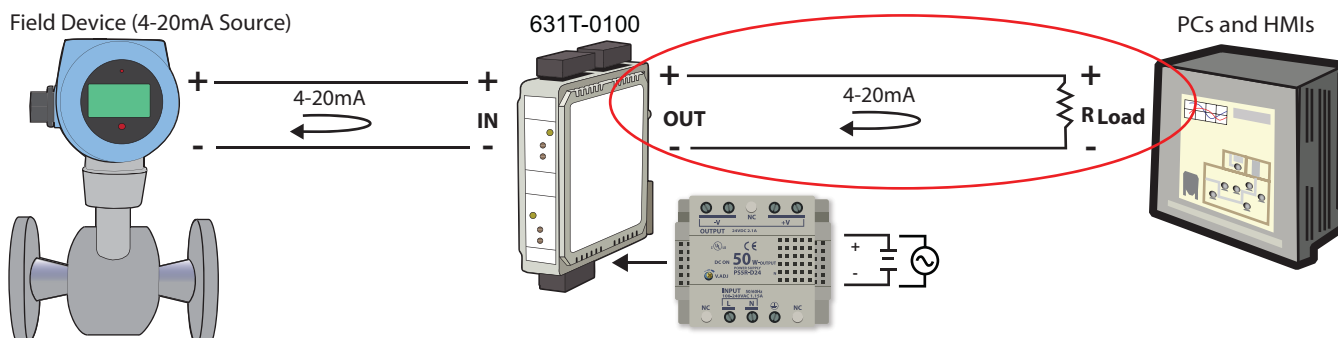
Important: The [671T transmitter](#) is an input loop powered current isolator. Its input voltage burden is normally a function of its output voltage drop and is communicated as $4.9 + I_{out} \times R_{out}$. If the output load resistance R_{out} is excessive relative to the input loop voltage, or R_{out} is open-circuited, the input voltage burden may increase up to the limit of available input loop voltage. Consequently, if there are any loop-powered transmitters connected in series in the 671T input loop, this output loop fault can pinch-off excess input loop voltage, reducing the available voltage to power any series-connected transmitters in the loop, potentially causing them to lose regulation of the input loop current. You could select a different current isolator than 671T, or a different series transmitter that is separately powered to avoid this fault condition.





Externally Powered Isolators

Acromag also offers externally powered isolators. They are powered not by the current signal, but by a local source, so their burden on the loop is minimal. Acromag has both AC and DC powered models. All have sourcing outputs and sinking inputs. Some offer an excitation power source to provide power for a two-wire field device. All of Acromag's externally powered isolators are three-way isolated for ultimate protection. The input, output and power source are isolated from each other. Examples of externally powered isolators are [TT336-0700](#), [631T-0100](#) (AC), [631T-0500](#)(DC) and dual channel models [DT336-0700](#), [632T-0100](#) (AC) and [632T-0500](#) (DC).

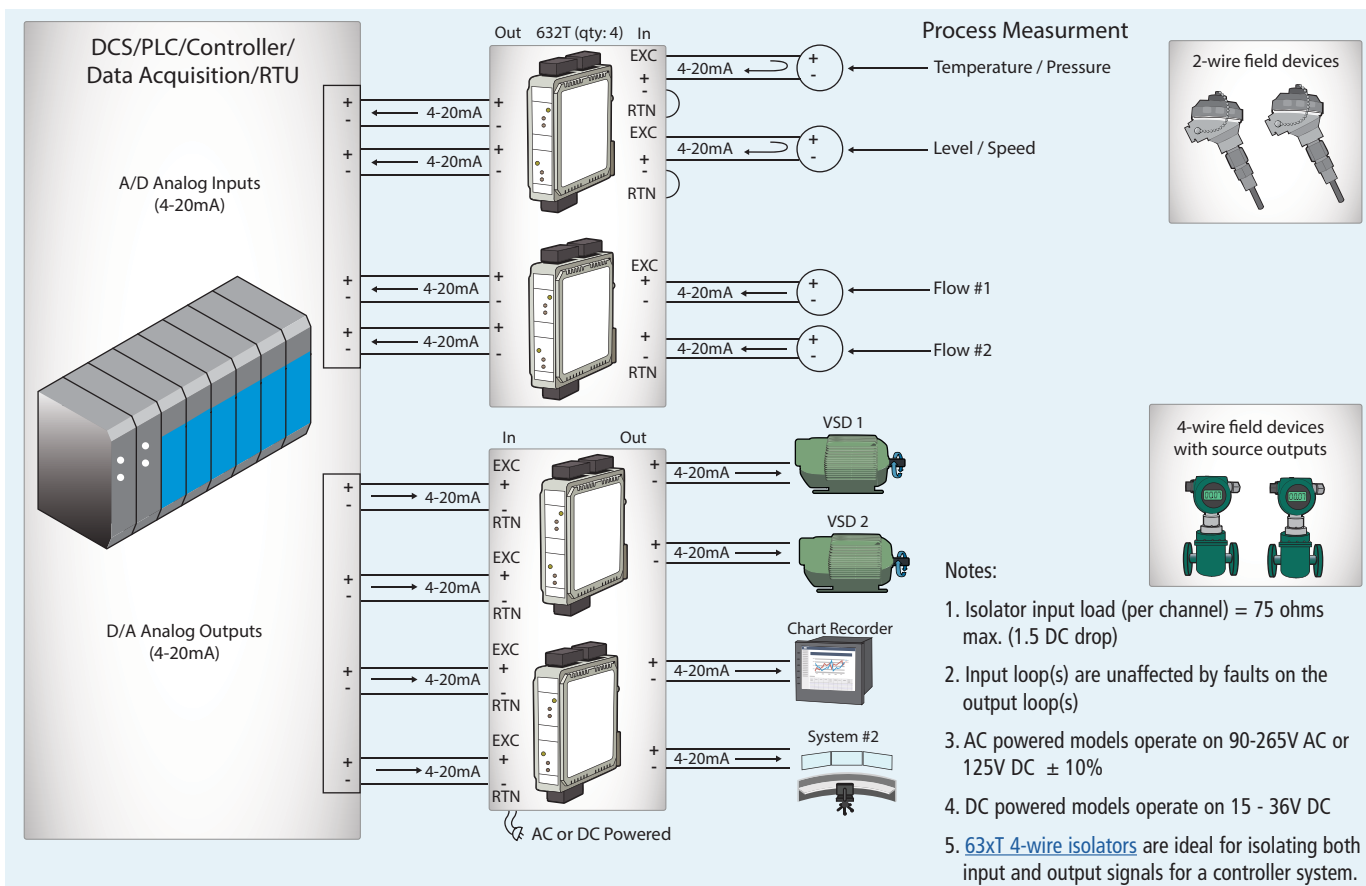


Application

Require 4-wire isolators for input and output signals for controller.
Built-in excitation supply needed for some field 2-wire devices.

Solution

Model [632T-0100](#) (dual channel, AC powered) or
Model [632T-0500](#) (dual channel, DC powered).
Model [631T](#) for single channel 4-wire isolators.





More Considerations

Once you have the sourcing/sinking, input, output and power matched, there is still more to consider. Often, two or more devices are wired in series on the loop because they need to monitor the same signal. This could be a PLC and display or DCS. If they are on the same loop, they are not isolated from each other. If one experiences a surge or noise, it can be passed to the other. Furthermore, if one device is down for maintenance, the loop can be broken and neither device receives the signal.

In this case, an isolated splitter can solve the problem. They have a single input and two identical outputs. Acromag offers output loop-powered models [SP236-0600](#) and [653T-0600](#). We also offer externally powered models [633T-0100](#) (AC) and DC powered models [SP336-0700](#) and [633T-0500](#).

Application

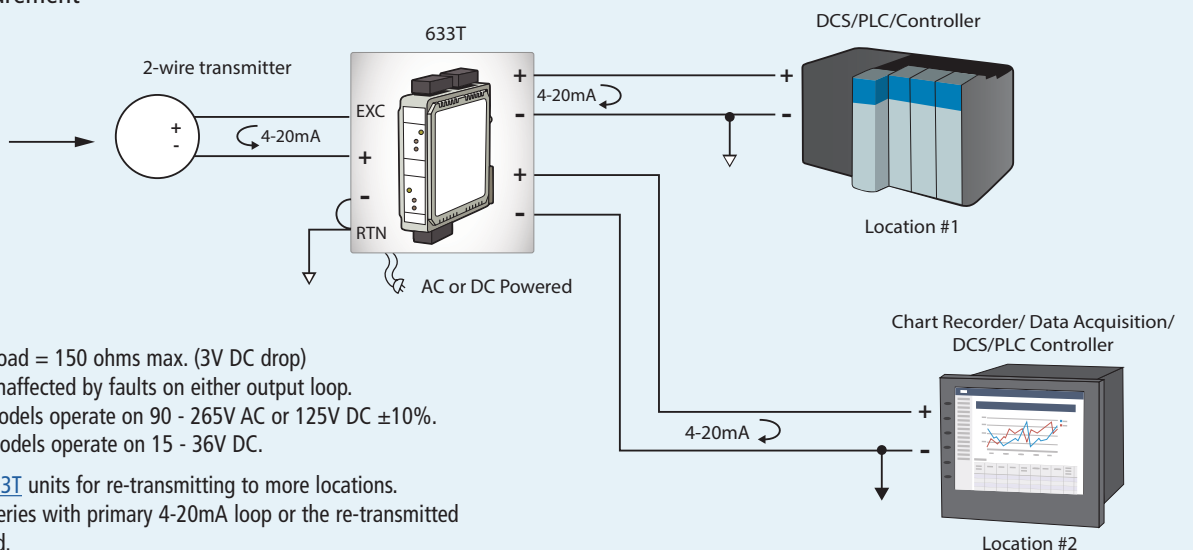
Require a 4-wire isolator “splitter” to excite a field device and re-transmit 4-20mA to two locations.

Solution

Model [633T-0100](#) (dual channel, AC powered) or Model [633T-0500](#) (dual channel, DC powered).

Process Measurement

- Pressure
- Flow
- Level
- Temperature
- Speed



Flexibility and Configuration

The final point of consideration is flexibility and preferred configuration. Do you want a unit that has no configuration options? This way you know how it is configured, and if need be, a replacement will drop right in.

Or do you prefer a unit that has configuration options? Examples of this would be the ability to increase the filtering in a noisier environment, correct for sensor error by scaling the output, or even changing the output to a voltage signal.

Acromag has options for either preference. Our [600T Series](#) can be adjusted slightly through the Zero and Span potentiometers. Our [TT](#), [DT](#) and [SP Series](#) have different options for filtering and scaling that can easily be set using our [Windows®-based software](#) or our [Agility™ app](#) for Android®.

Whatever your needs for electrical isolation are, you'll likely find a solution at Acromag.

Maybe you'd also like: [Why Do I Need Electrical Isolation? Examining the important aspects of electrical isolation; what it does, why we need it, and how to test for it.](#)



About Acromag

Acromag is a multi-million-dollar international corporation that combines more than 60 years of process monitoring and control experience with a solid background in high-tech computer design.

We are focused on developing industrial I/O solutions that provide the best long-term value in the industry. A complete line of industrial I/O products including process instruments, signal conditioning equipment, data acquisition boards, distributed I/O modules, and network communication devices are available. Industries served include manufacturing, water services, power generation, mining, defense, and transportation.

Acromag I/O is ideal for a broad range of monitoring and control operations where controllers communicate with instrumentation on the plant floor or in the field.

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