Pulse Characteristics/Troubleshooting

Description

This bulletin contains pulse characteristics and pulse troubleshooting actions for FuelMaster fixed and mobile FMU-2500 Classic and Plus, FMU-3000, and FMU-3500 series FMUs. The pulser connectors J4, J5, J6, and J7 on the Pedestal I/O Board have 7 positions:

- Two +12V positions for sending +12 VDC to a pulser.
- Two P_ positions for receiving pulse inputs: P1 for position 1, P2 for position 2, etc.
- Two OK_ positions for DC pump handle detection: OK1 for position 1, OK2 for position 2, etc.
- One 0V position for pulsers requiring connection to a common/DC ground.

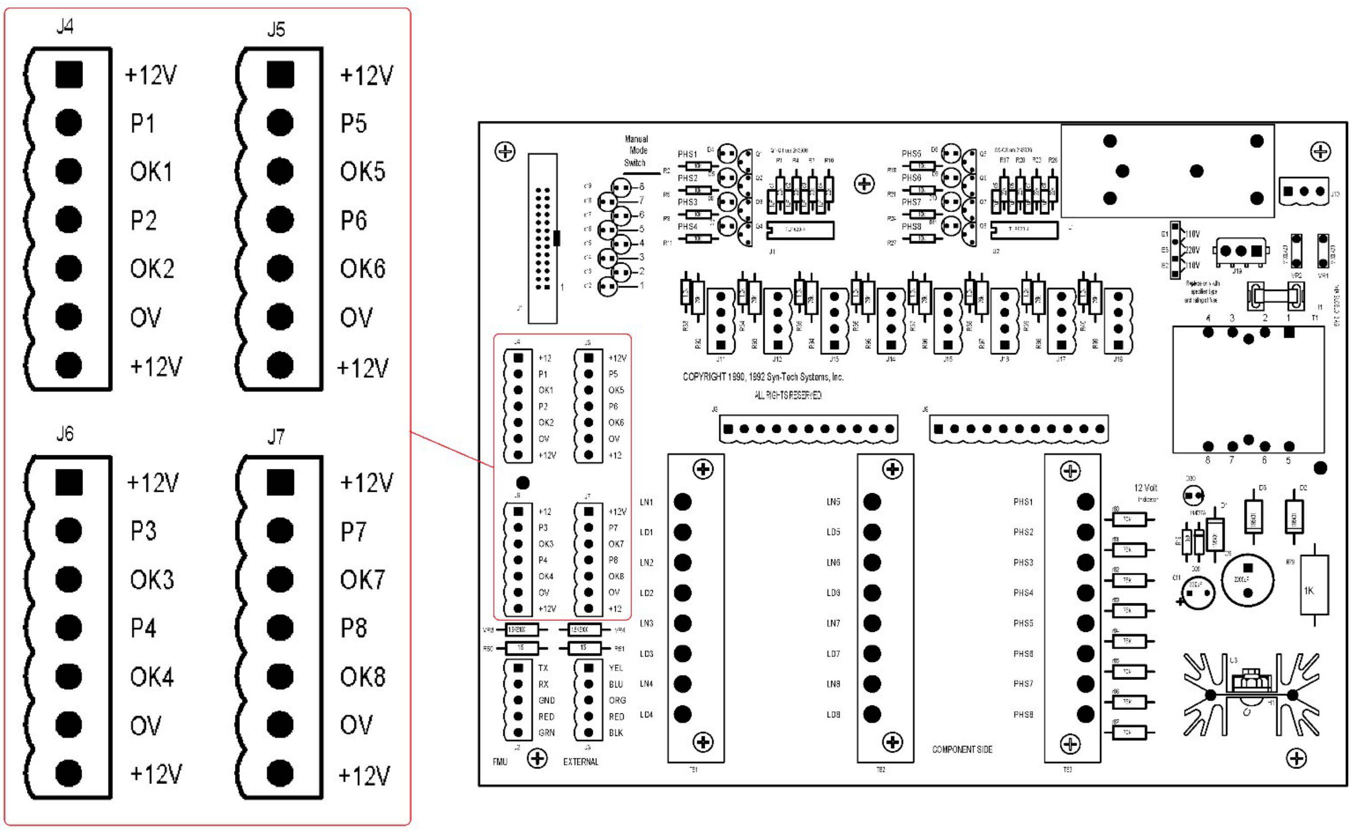

Figure 1. Location of Pulser Connectors on Pedestal I/O Board

Each pulser connector can receive inputs from two pulsers: J4 for positions 1 and 2, J6 for positions 3 and 4, J5 for positions 5 and 6, and J7 for positions 7 and 8.

The +12V positions are powered whenever the FMU power switch is turned on. Any +12V position may be used to apply 12 VDC to a pulser and should not be used for other 12 VDC purposes. The maximum safe working current available to these positions is 1 amp.

If working with an existing system with limited available wires, the +12V and 0V positions can be shared with multiple P_ positions. Do not share P_ or OK_ positions.

Voltage/Current Limits

The input voltage necessary to detect a pulse: 6 VDC minimum, 14 VDC maximum

The minimum current necessary to detect a pulse: 6mA (current must drop below 6mA between pulses)

Counts During Reset

All +12V positions have a constant +12 VDC whenever the FMU power switch is turned on. This can lead to a problem with some contact closure pulsers such as the Veeder Root 1871 10:1 pulser. If the contacts make or break when the dispenser is resetting, pulses may be generated before fuel is pumped causing the transaction to be skewed by one or more extra pulses. The problem can be solved by either replacing the pulser with one having a 110 VAC internal switch, or by controlling the +12V as shown in Figure 2 with a relay. LD1 is the authorization line. Authorization does not occur until the dispenser has completed reset. When LD1 applies power to the relay, 12VDC is applied to the pulser.

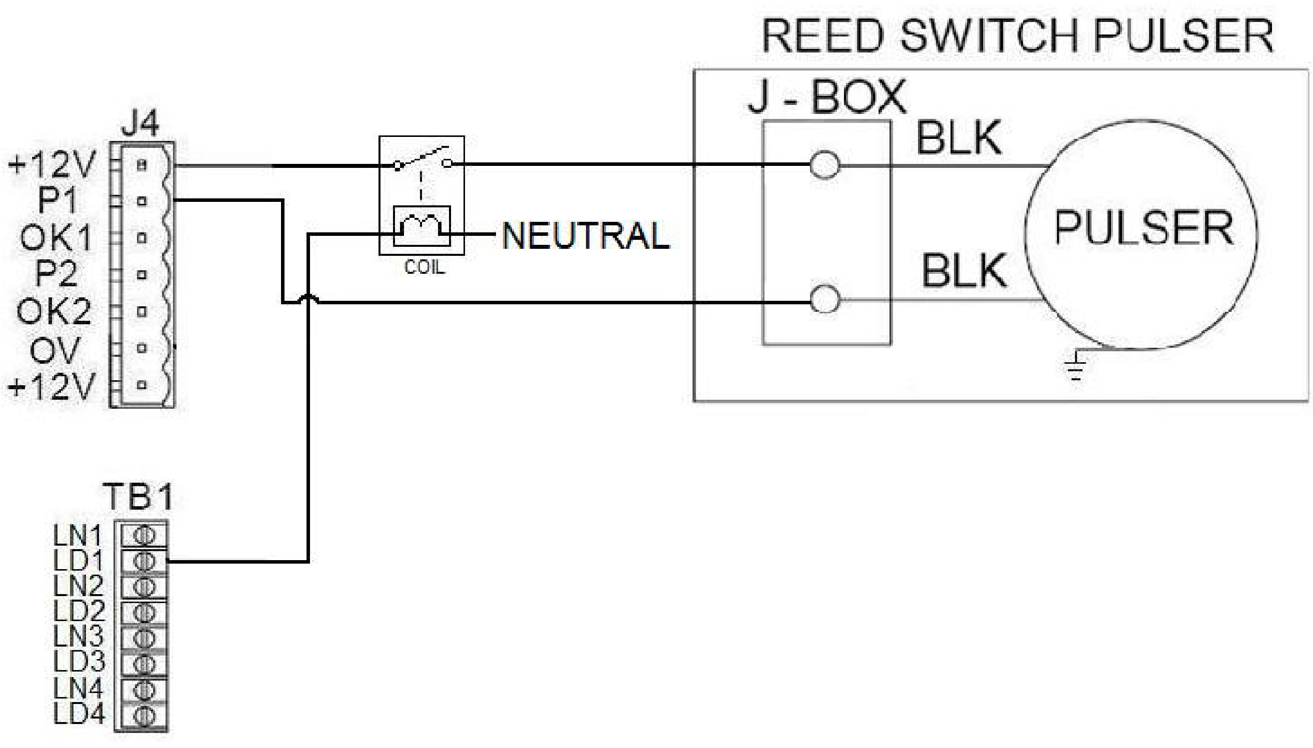

Figure 2. Controlling 12 VDC Output to Pulsers without a 110VAC Pulser

If it is suspected that these "counts during reset" are occurring when they shouldn't, there is a check that may be made. Set up a count test with the FMU. Go to the dispenser hose with the suspected problem, take down the hose and turn on the pump handle, but don't pump any fuel. Turn off the pump handle, hang up the hose, and check the count test display. If any counts are shown, the problem exists and must be corrected.

Counts during reset are affected by pump handle detection. If pump handle detection is set to START ONLY, or START AND END in newer systems, or YES in older systems, pulses that occur before fuel starts pumping will show in a count test, but not in a downloaded transaction. The pump handle detection resets the pulse counter to 0 (zero) before the transaction starts. Without pump handle detection at the beginning of the transaction, extra pulses may be counted. END ONLY, NONE, or NO pump handle detect settings do not reset the pulse counter, and the count test does not reflect the reset.

Divide Rate

The Divide Rate reflects the number of pulses necessary to register one unit (example: 1:1 is 1 pulse/gallon, 10:1 is 10 pulses/gallon). Divide Rate selections in FMU and FuelMaster software configurations must be divisible by 1, and all numbers must be whole numbers.

Pulse Filtering

The purpose of PULSE FILTERING is to bleed off false pulses that may be generated by AC wires in close proximity to unshielded pulser wires. PULSE FILTERING is not necessary when shielded pulser cables are used, or when pulser wires are not pulled through the same conduit as wires carrying AC power.

PULSE FILTERING has limitations. The maximum pulses the FMU can read with PULSE FILTERING turned on is 9000 per minute. With PULSE FILTERING turned off, the FMU can acknowledge 120,000 or more per minute. To determine if PULSE FILTERING may be used, multiply the flow rate of any dispensing hose times the divide rate (15 gal/minute X 1000 pulses/gal = 15,000 pulses/minute = TOO MUCH). Besides the pulse limitation, there are applications that require PULSE FILTERING be turned off such as Tekinno single line displays, and pulse delay circuits.

PULSE FILTERING is switched on or off by a bank of 8 dipswitches in the lower right corner of the Satellite I/O Control Board (see Figure 3). As of November 2013, numbers silkscreened on the dipswitches have been blocked out. Older systems were not blocked out. When two sets of numbers are shown, the numbers silkscreened on the circuit board take precedence.

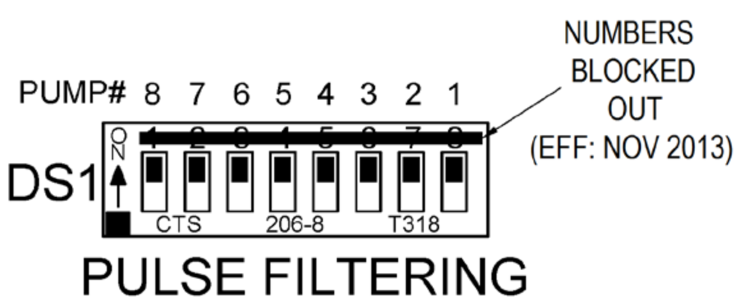

Figure 3. Pulse Filtering

FMU power need not be reset when changing PULSE FILTERING settings.

The presence of false pulses can be tested by setting up a Count Test with PULSE FILTERING turned off, pumping fuel from the hose being tested, then observing the display on the FMU. If pulses continue to be displayed after pumping stops, there is likely false pulses being generated. Turn on PULSE FILTERING for the hose being tested, and repeat the test. If the false pulses are no longer displayed, pulse filtering is necessary for the hose being tested.

Pulse Width

Pulse Width is the duration in time of a pulse, generally measured in milliseconds (ms). With PULSE FILTERING turned on, the minimum pulse width is 4 ms. With PULSE FILTERING turned off, the minimum pulse width is 0.5 ms.

The higher the divide ratio (example: 100:1), the shorter the pulse width should be; otherwise, pulses can be received quicker than they may be processed. Fortunately, FuelMaster FMUs will continue to receive pulses after the transaction is finished. Unfortunately, if there is a quantity limit the pulses with a long pulse width may lag the flow of fuel, and the FMU won't know soon enough the quantity limit has been reached until it has been exceeded.

The Bennett 3K fuel dispenser has a chart in its installation manual that tells how many pulses per minute the dispenser will deliver at various pulse widths. A 64ms pulse width, for example, will permit the delivery of 467 pulses per minute. If you have a 100:1 divide ratio, and a flow rate of 15 gals/minute, you will need to process 1500 pulses/minute. In this example, it will take more than 2 minutes after pumping has finished to process the pulses for a 15 gallon transaction. A 16ms pulse width can deliver 1875 pulses/minute. This pulse width would process all the pulses as fast they can be delivered for a 100:1 divide ratio and 15 gals/minute flow rate.

The FMU will count pulses at the minimum pulse width (4ms with PULSE FILTERING, 0.5ms without PULSE FILTERING). When the pulse width from the pulser/dispenser is adjustable, try to get as close to the FuelMaster FMU minimums as possible.

Open Collector Pulsers/Pullup Resistors

FuelMaster can work with open collector pulse transmitters. The open collector pulse transmitters in the dispenser are opto-isolators; switching devices that use light from an LED to activate the switch rather than a hardwire connection (using light to activate a switch assures a degree of surge protection and removes ground loops).

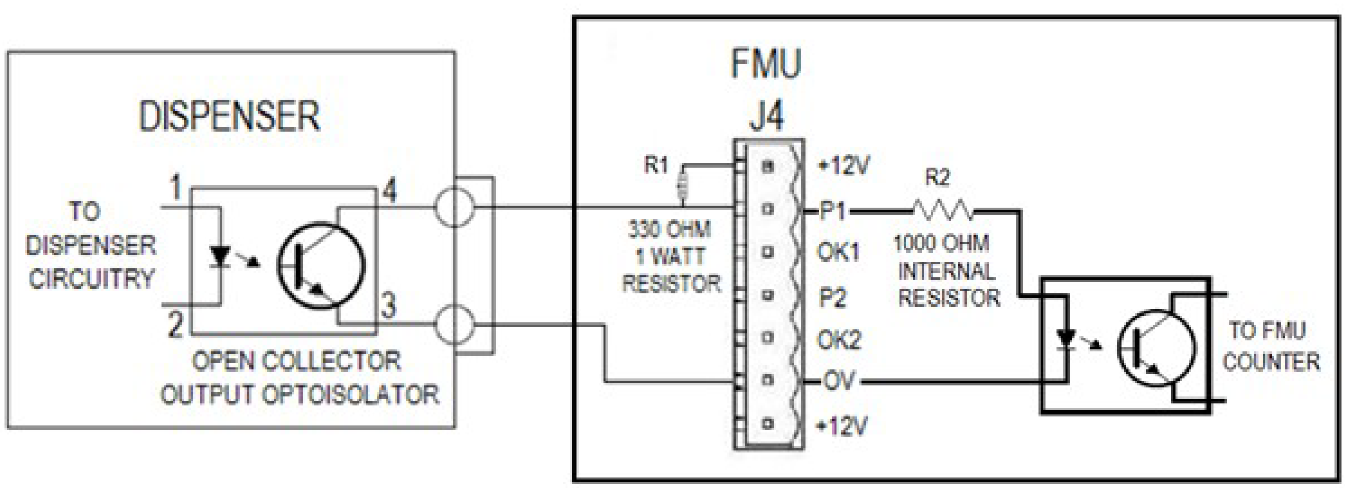

Figure 4. Open Collector Pulse Input

In the dispenser circuitry, the pulse is traveling from position 1 to position 2 (Figure 4). As it travels from 1 to 2 it flashes an LED against a photo sensitive base located between positions

3 and 4. As the photo sensitive base is flashed, it functions as a switch completing the circuit from position 3 to position 4.

In the FMU, power is supplied to the P# line through a pullup resistor (R1) connected between +12V and P#. Because the pulse output from the dispenser has more current than the current applied to the P# line in the FMU, a pulse is returned to P# even though P# already has power on it.

CAUTION	Some opto-isolators have maximum input values that cannot be exceeded without damage. The older Gasboy C06425 Pump I/F Board would accept the 9.5 VDC supplied through the pullup resistor, but would be damaged if the full +12V input was applied to it.

Pullup resistor size: the FMU has 1000-ohm **internal resistance (R2), and a 12VDC power source (which could drop to a lesser voltage). The pullup resistor must permit at least 6mA of current to detect a pulse. A** 330-ohm 1-watt **resistor has been accepted as a common application to ensure enough current and voltage is present to detect a pulse, while having sufficient protection under most circumstances. Wattage is a safety factor to protect the resistor.**

Experience has shown that a 330-ohm 1-watt resistor is a good choice for most every application. In some cases, other sizes of pullup resistors may be directed by the equipment manufacturer. The most common besides 330 ohm are 220 and 470 ohm. All are 1 watt.

To determine if a substitute resistor will work, plug the value into the following formula in place of the 330-ohm resistor. The end result must equal 6mA, or more:

12VDC/ (330 + 1000) = .009A = 9mA

Monitor Mode: Solution for Pulses Too Slow to be Counted by the FMU

There are situations such as slow-fill CNG where the pulses may be sent to the FMU so slow a regular transaction will timeout from a NO PULSE TIMEOUT before the pulse is counted. There is a no cost FMU firmware option which may be enabled to account for these situations: Monitor Mode. Monitor Mode can be enabled for any or all hose positions. Monitor Mode activates any selectable hose position to continuously activate and record pulses. Transactions are generated after 10,000 units, or at the end of the day. See product Bulletin 172 for a complete description and how to enable Monitor Mode.

How Many Pulses Will the FMU Receive, and For How Long Per Transaction?

The maximum size of any transaction is 65,000 units (some older systems had a maximum size of 10,000 units; Classic systems had a maximum size of 65,000 pulses). A 1:1 divide ratio transaction will contain 1 pulse X 65,000 gallons or 65,000 pulses. A 100:1 divide ratio transaction will contain 100 pulses X 65,000 gallons or 6,500,000 pulses.

Normally an FMU will continue to receive pulses if those started during the transaction continue after the transaction ends. If there is a quantity limit, the FMU will attempt to terminate the transaction at the quantity limit. As noted under Pulse Width, the fuel may pump faster than the sending device (pulser or dispenser) can send pulses. The FMU cannot know the quantity limit has been reached if it is waiting on pulses used to register quantity.

Similarly, if fuel is flowing very fast (normally greater than 15 gallons/minute), the flow can't be stopped without a tremendous hydraulic shock to the fuel delivery equipment. A slow let down to prevent hydraulic shock will result in the quantity limit being exceeded. In these cases, two stage (fast flow and slow flow) valves come into play. The transaction is started with the fast and slow valves both open for maximum flow. A setpoint (configurable with different values for every hose) is configured in the FMU to determine when the fast valve closes, and the slow valve finishes the transaction. Flow through the slow valve is slow enough to terminate the transaction when the quantity limit (or preset) is reached.

The Pump Finish Timer starts after the last pulse is received.

4-20mA Current Loop

This is a method normally used for transmitting pulses over a long distance (1000 feet, or more). Pulse voltage at the pulse generation end is converted to a proportional current with 4mA normally representing the minimum output, and 20mA representing the maximum output. A receiver converts the current back to a voltage which can be read as a pulse. Some meters and pulse transmitters use the 4-20mA current loop to wire to a pulse receiver such as FuelMaster. There should be a wiring diagram, and possibly a choice of other wiring methods. actor. A pulse dividing factor for meters which will likely vary for every meter. Many pulse output flow meters will have their own K-factor for a specific rate of flow such as 200 pulses/gallon, or 150 pulses/liter. The installation manual for the flow meter will have K-factors in a table of values based on different factors such as pulses/gallon or pulses/liter.

Opto-Isolators

With the first major military contract awarded to Syntech, there were several electronic dispensers in use operating in standalone mode; dispensers such as the Gilbarco Advantage and Legacy electronic, Tokheim 262, and some foreign made dispensers on military installations in foreign countries. At the time, there was no electronic dispenser interface kit available to assist with the interface to FuelMaster. Other means were necessary to attain a pulse. For the first application of these interfaces, a Syntech engineer was sent to the location with test equipment, and probed the wiring of the electronic dispenser until he found a pulse. When the pulse was discovered, it was tested for its properties: voltage or current, and fixed or adjustable divide rate.

To make these pulses available to FuelMaster, opto-isolators (also known as oinks) and installation diagrams were developed. When wired between the dispenser and FuelMaster, these opto-isolators provided a pulse input. In some cases, the divide rate was so high the number of pulses coming into FuelMaster exceeded the limitation created by PULSE FILTERING, and it was deemed necessary to keep PULSE FILTERING available. In the creation of the opto-isolators, provision was made to allow for adjustable "divide by" settings. By moving a resistor's solder point in the opto-isolator the 1:1 pulse input could be changed to 1:2, 1:4, or 1:8. Most opto-isolators are inventoried in both 1:1 and 1:4 configurations.

Because these opto-isolators were only needed in fleet applications, the accuracy was not sufficient for retail operations governed by Weights & Measures. Additionally, as the electronic dispenser interface became available, the need for opto-isolators didn't exist for more recent electronic dispensers.

Pulse Delay Circuits

As Syntech entered the retail sales arena, several new problems were discovered. Check valves are installed in fueling hoses or nozzles to prevent the draining of the fuel hose. Check valves hold a minimum pressure so the fueling hose doesn't stretch from the pressures generated while fueling. The excess pressure is let down either at the nozzle end by the fueling customer attempting to drain the hose, or more often at the tank end by releasing the excess pressure back to the tank.

When the fuel pump is turned on for a new retail transaction, hose pressure is built up and the long fueling hose takes on more fuel. This additional fuel is counted by the fueling equipment, but is not immediately delivered to the paying fuel customer. If the transaction is cancelled, the retail customer is charged for the fuel used to pressurize the hose without getting any fuel out of the hose. To remedy this problem, Syntech developed a Pulse Delay Circuit to prevent the counting of fuel during hose pressurization. An adjustable delay may be set by the system owner to delay counting pulses until the fueling hose is fully pressurized. Then the customer is billed only for the fuel that actually leaves the fuel nozzle.

Product bulletin PB-132 describes the installation of Pulse Delay Circuits, and how to set a delay to prevent the counting of pulses until the fuel hose finishes pressurizing.

Troubleshooting

Counts Test

There are several issues that may be detected and corrected by performing a Count Test. A Count Test is a built-in test in the FMU firmware for detecting the presence of pulses. Count Tests are covered in detail in Product Bulletin PB-039 for DoD FMUs, and in PB-040 for commercial FMUs. The Counts Test can detect:

- Serviceability of FMU to count pulses. Disconnect pulser connector from J4, J5, J6, or J7. Start Counts Test and use jumper to touch between +12V and and P position. Every time the two positions are jumped, a count should show in the Counts Test.
- Serviceability of a pulser. Same as above, but with pulser connector connected, hose switch moved to Manual, and fuel pumped from dispenser hose. Counts should register in Counts Test at hose position corresponding to hose which was pumped from.
- Proper wiring configuration. Counts should be reflected in the correct hose position.
- Counts during reset. Start Counts Test. Move hose switch to Manual for hose being tested. Go to dispenser, take down hose, and turn on pump handle, but don't pump fuel. Go back to FMU and check for presence of counts for hose under test. If any counts are shown, pulser is counting during reset.
- Counts occurring as a result of bleed over from AC wires. Turn off PULSE FILTERING on Satellite I/O Control Board. Start Counts Test. Move desired hose switch to Manual. Go to dispenser, pump some fuel, then stop pumping. Go back to FMU and observe counts in Counts Test. If counts are occurring after dispensing stopped, counts are occurring from bleed over. Turn PULSE FILTERING back on and repeat test. Extra counts should stop. Note limitations when PULSE FILTERING is turned on.

- The number of pulses per gallon of fuel pumped. Start Counts Test. Move hose switch to Manual for hose under test. Pump one gallon of fuel, exactly. Go back to FMU and observe counts. The number of counts shown are the number to be used in configuring the FMU divide rate: number of pulsers/gallon of fuel.
- Shorts/opens in pulser wires. Verify serviceability of FMU to count pulses. Reconnect pulser connector to J4, J5, J6, J7, as necessary. Go to first junction in pulser wires, and disconnect. On pulser wires leading from FMU, touch together wire from +12V and P_, and check Counts Test display. If a count is generated, wires are good. Reconnect wires and go to next junction and disconnect. Repeat test. If a count is not generated, problem is with wires leading from first junction to second junction.

Two FMUs, One Pulser

(see Figure 5). It is possible to connect one pulser into two or more FMUs when it is desired to have redundancy (example: long lube bay with one hose reel pulser tied into an FMU at each end of the lube bay). If this is done, do not apply +12V from more than one FMU. The applied voltage will not be exactly equal from each FMU, and can result in damage or a shortened life expectancy. The DC grounds (commons) of all FMUs tied into the pulser must be connected for the +12V to be recognized by each FMU.

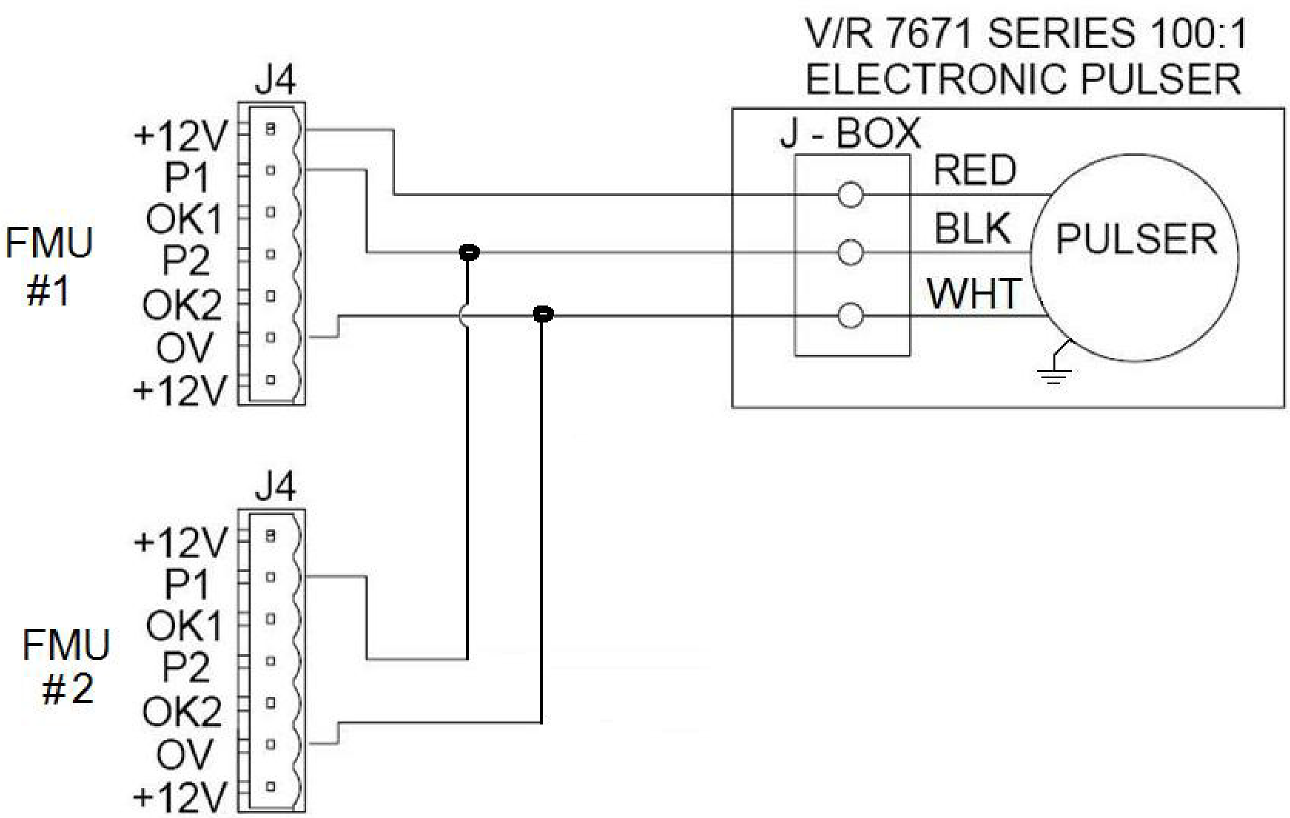

Figure 5. Two FMUs, One Pulser

TIP	If any questions arise, contact Syntech Systems, Inc.'s Customer Satisfaction Center (CSC) at 1-800-888-9136, ext. 2, or email support@myfuelmaster.com.

Change Log

Date	Description
3/7/2017	Original
11/11/2020	Rebranded/Reformatted