Integrated Control Systems

PULSE ANALYZER II
INSTRUCTION MANUAL

I. Overview

The PA2 pulse analyzer was designed to assist the service technician in troubleshooting pulser problems with consoles or card systems. The PA2 performs 3 basic functions:

1. Reads and displays pulse count directly from a contact closure type pulser, electronic open-collector pulser, or active pulser.

2. Reads and displays pulse count in-circuit from a pulser connected to a console or card system.

3. Emulates the operation of a pulser by generating a contact closure pulse output.

II. Background

A pulser is a device which usually mounts to the register of a fuel pump or dispenser, and generates an output signal which is proportional to either the money or quantity of fuel being dispensed in real time. These signals are input to a console or card system where they are interpreted, allowing the console or card system to record the fuel flow.

Pulsers fall into two general categories; Active and Passive.

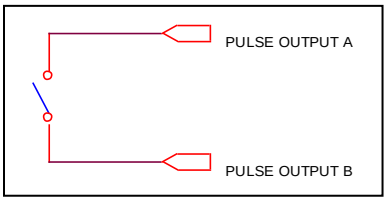
Active pulsers are powered by an input voltage, usually 12 volts DC. They will generate a specific output voltage pulse which is then input to a console or card system. Active pulsers are usually manufacturer specific, which means they only work with the same manufacturer's equipment.

Passive pulsers may require an input voltage to supply their internal circuitry, just as active pulsers do. A passive pulser however, does not generate a voltage at the output, but simply switches two contacts together to generate the output pulse. This is known as a contact closure output. It behaves like a simple switch contact. This technique is more compatible with different manufacturer's equipment, because it will work with many different voltages.

Some common examples of contact closure output pulsers are: Veeder Root 1871, 7671, (Western Electronics / Emco Electronics / OPW) models 500, 800f, Integrated Control Systems models SP1, MR1, GB1, and VR1 and others.

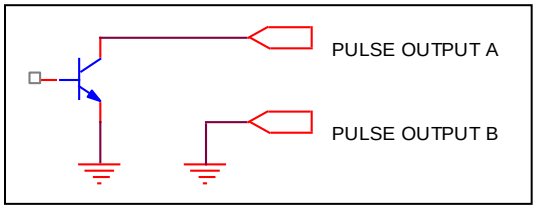
It should be noted that the Veeder Root 1871 pulser uses a mechanical reed switch, while the others listed above utilize an electronic solid state relay for the pulse output. The solid state relay is much more accurate than a mechanical switch, as a mechanical switch will bounce when closing, producing unwanted extra pulses which must be filtered out.

Below is a schematic representation of a contact closure output:



Another type of passive pulser is the open collector output. Some electronic dispensers such as the Gasboy 9800 series and the Gasboy Astra, have an internal circuit for generating a pulse output. This output uses a transistor to switch the pulse signal to DC ground only. This type of pulse output requires the console or card system to generate a voltage, which is then grounded to indicate a pulse. The V/R 7671 solid state pulse transmitter also has an open collector type output.

Below is a schematic representation of an open collector pulser:



Some consoles and card systems are not compatible with the open collector pulse output, while nearly all are compatible with contact closure pulsers. Consult the wiring diagrams for your particular console or card system model. The PA2 pulse analyzer with operate with either type.

III. PA2 Operation

The above diagram illustrates the connection points and switches on the PA1 pulse analyzer.

IV. Powering On and Off

To turn on the pulse analyzer, simply press the knob to the right of the display. The display will display “I.C.S. Pulse Analyzer II”. It will then display the firmware version number and the current battery voltage. If the battery voltage is below 7 volts, replace the battery.

After the power up sequence, the PA2 will display a menu depending on the position of the MODE switch. Each mode has different menu options. Rotate the selector knob to the right of the display to change menu options. Press the selector knob to execute the option.

The PA2 has an automatic power-off feature to conserve batteries. It will power down if not used for more than 2 minutes.

V. Operation

The PA2 has 3 modes of operation which are selected with the MODE switch to the left of the display. These modes are:

Contact Count
Powered Count
Pulse Output

Note: *To avoid damaging the PA2 circuitry, make sure that the leads are disconnected before changing the MODE switch position.*

The modes and menu options are:

MODE	Menu Option
Contact Count	Set Pulser Type
	Begin Counting
	Self Test
	Power Off
Powered Count	Set Pulser Type
	Begin Counting
	Read Pulse Volt
	Power Off
Pulse Output	Set Pulse Speed
	Set # of Pulses
	Begin Pulsing
	Power Off

Rotate the selector knob to select the desired menu option and press the knob to execute it.

Contact Count Mode

Set Pulser Type - This option displays another menu with 3 selections: Electronic, Mechanical, and Unlimited. These selections set the timing of the digital filter that the PA2 uses when counting pulses.

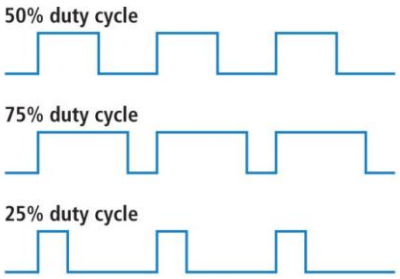
Pulser Type	Filter Duration	Maximum Pulse Speed
Electronic	1 millisecond	1000 pulses/second
Mechanical	10 millisecond	100 pulses/second
Unlimited	0.1 millisecond	10000 pulses/second

As previously mentioned, mechanical pulsers will generate contact bounce which must be filtered out for correct counts. The Mechanical option sets the timing of the PA2 input filter to compensate for contact bounce. Likewise, the Electronic option sets the filter to very high speed for cleaner electronic pulsers. The Unlimited option should only be used for specific tests and will probably display overcounts if used on mechanical pulsers.

Begin Counting – This option will put the PA2 into pulse count mode. The screen will display the exact count received from the pulser, as well as the pulse duty cycle and frequency.

Count indicates the number of pulses received by the PA2. If the PA2 leads are connected to the pulser before entering the count mode, the PA2 will trigger a count on the second transition (open or close) from the starting state. For example: if the pulser output is open when count mode begins, the PA2 will count “1” when the pulser output closes. On the other hand, if the pulser output is closed when count mode begins, the PA2 will count “1” when the pulser output opens. In this way, the PA2 never triggers the first count when the leads are connected. The count is displayed on the PA2 as Count>00000000.

Duty cycle refers to the ratio of a pulse’s on time to it’s off time. Ideally, each pulse from a pulser should be a 50% duty cycle, where the on time is equal to the off time. Below is a graphical representation of duty cycle:



The duty cycle value is only valid when the pulses are being sent continuously. Duty cycles with values below 25%, or greater than 75% may indicate a problem for some consoles or card systems where the frequency of the pulses approaches the maximum input speed. The duty cycle is displayed on the PA2 as DC>00, where the value can range from 00 to 99.

The frequency of pulses is also displayed in the PA2 count mode. The frequency is displayed here as the number of pulses per minute. By knowing the number of pulses per minute being read and the number of pulses per unit volume, one can determine the flow rate of the dispenser. For example; a frequency of 1000 pulses per minute from a 100 pulse per gallon pulser such as the SP1, gives 1000/100 = 10 gallons per minute flow rate. The frequency is also useful in selecting the correct filter speed on some card systems or consoles. The frequency is displayed on the PA2 as FQ>0000, where the value can be from 0 to 9999.

Self Test – This option will perform a self test on the PA2’s pulse input and output circuitry. It will send a number of pulses using the output circuit while using the input circuit to read them back. If you suspect that the PA2 is not counting or pulsing properly, use this function to test it. Make sure the leads are disconnected before beginning this test.

Power Off – You guessed it, this option powers off the PA2. Note that all settings are saved to internal EEPROM during power off and will be re-loaded at the next power on.

Powered Count Mode

Set Pulser Type – This option in powered count mode is identical to the one in contact count mode. See the Set Pulser Type option above for the description.

Begin Counting – This option in powered count mode is identical to the one in contact count mode. See the Begin Counting option above for the description. When counting pulses in the powered count mode, the PA2 will detect a change in the pulse input when the voltage between the red and black leads exceeds or falls below 1.5 volts.

Read Pulse Volt – This option will read the actual voltage of the pulses at the point where the leads are connected. If the leads are connected at the input of a card system or console, this option can determine if the pulse voltage is too low for reliable operation. This option is also used to read the voltage of pulse output from an active type pulser. The maximum voltage that can be read accurately with this option is 12 volts DC. Note that most voltmeters will not yield an accurate voltage measurement for a pulse stream.

Power Off – You guessed it, this option powers off the PA2. Note that all settings are saved to internal EEPROM during power off and will be re-loaded at the next power on.

Pulse Output Mode

Set Pulse Speed – This option will use the selector knob to set the speed of pulses that are output. The speed is set in pulses per minute. To use the pulse output function to test a console or card system, set the pulse speed to the maximum possible speed for the pump/dispenser and pulser type.

Gallons example: If the dispenser can flow a maximum of 10 gallons per minute, and it contains a 100 pulse per gallon pulser, then the maximum pulse speed is: 10 x 100 = 1000 pulses per minute.

Money example: If the dispenser can flow a maximum of 10 gallons per minute, the pulser is sending 100 pulses per dollar, and the price is set to 3 dollars per gallon, then the maximum pulse speed is: 10 x 100 x 3 = 3000 pulses per minute.

Turning the selector knob slowly will increase or decrease the pulse speed by 10. Turning the knob quickly will increase or decrease the pulse speed by 100. Once the desired speed is displayed, press the selector knob. This setting will automatically be saved when the PA2 powers off.

Set # of Pulses – This option will use the selector knob to set the total number of pulses that are output. Turning the selector knob slowly will increase or decrease the number by 10. Turning the knob quickly will increase or decrease it by 100. Once the desired number is displayed, press the selector knob. This setting will automatically be saved when the PA2 powers off.

Begin Pulsing – This option will begin sending contact closure pulses. Make sure the PA2 leads connected are properly to the console or card system and press the selector knob. The pulses will be sent with the number of pulses and speed of pulses selected above. When all pulses have been sent, the display will read “Output Complete”. Press the selector knob again to return to the menu.

Power Off - You guessed it, this option powers off the PA2. Note that all settings are saved to internal EEPROM during power off and will be re-loaded at the next power on.

VI. Testing a Pulser – Stand Alone

To test a contact closure pulser stand alone, first make sure that the pulser is not attached to the console or card system. There should be no voltage on the pulser's output wires.

Move the PA2 mode switch to the contact count mode. Use the selector knob to display the "Set Pulser Type" option and press the selector knob. Now move the selector knob again to select "Electronic" for an electronic pulser (such as any ICS pulser) or "Mechanical" for a mechanical pulser such as the Veeder Root 1871. Press the selector knob to set the selection and return to the previous menu.

Connect the leads to the output wires of the pulser. For ICS pulsers, these will be either the red or blue pair of wires. If the pulser is an open collector type as mentioned above, connect the red lead to the positive side, and the black lead to the negative. If the pulse is not an open collector type, polarity is not important.

Use the selector knob to select "Begin Counting" and press the selector knob. The count display will appear.

If the pulser requires power to operate, turn this power on. Now operate the pump and dispense fuel. If the pulser is working properly, the output count should be displayed on the PA2 display. Note that the display does not show a decimal point. It displays a pulse count only.

Compare the number of pulses counted by the PA2 to the money or gallons indicated on the dispenser.

When finished, press the selector knob again to return to the menu.

Note: *When the PA2 is in the contact count mode, the pulse analyzer sends 9 volts DC out on the red lead, and looks for the pulsed 9 volts DC on the black lead. A pulse is triggered if the voltage on the input wire rises above or falls below 1.5 volts DC.*

VII. Testing a pulser In-Circuit

If the pulser being tested has voltage on its output leads, then it must be tested using the In-Circuit mode. This mode can be used to test contact closure pulsers that are still connected to the console or card system, or it can be used to test active pulsers which generate a voltage for their pulse output. Keep in mind that the pulse analyzer 2 can only handle voltages of up to 25 Volts DC. Connecting the pulse analyzer to any voltage higher than this can damage it.

To test a pulser In-Circuit, determine which wire or terminals on the pulser, or on the console / card system is more positive than the other for the pulse circuit. Many card systems and consoles will indicate which are the positive and negative pulse terminals. An appendix of known connections is provided at the end of this manual.

Move the PA2 mode switch to the powered count mode. Use the selector knob to display the "Set Pulser Type" option and press the selector knob. Now move the selector knob again to select "Electronic" for an electronic pulser (such as any ICS pulser) or "Mechanical" for a mechanical pulser such as the Veeder Root 1871. Press the selector knob to set the selection and return to the previous menu.

Connect the PA2 red lead to the positive and the black lead to the negative terminal, or to the system's DC ground.

Use the selector knob to select "Begin Counting" and press the selector knob. The count display will appear.

If the pulser requires power to operate, turn this power on. Now operate the pump and dispense fuel. If the pulser is working properly, the output count should be displayed on the PA2 display. Note that the display does not show a decimal point. It displays a pulse count only.

Now compare the number of pulses counted by the PA2 to the money or gallons indicated on the dispenser.

When finished, press the selector knob to return to the menu.

Note: *The pulse analyzer will trigger a count when the voltage difference between the positive and negative leads is greater than 1.5 volts DC.*

VIII. Generating an output pulse

In order to test that a console or card system is correctly reading pulses, the PA2 can generate a contact closure pulse. To use this feature, first make sure that the pulser wires are disconnected from the pulse circuit as the pulser can interfere with the PA2 output.

> Troubleshooting tip: *To troubleshoot pulse count problems, this test should be performed first directly at the console / card system input terminals with the pulse field wiring disconnected. Once that test is successful, reconnect the pulse wires and perform the same test again at the dispenser end of the pulser wiring to determine if field wiring is causing a problem.*

Set the PA2 mode switch to the Pulse Output position.

Connect the PA2 leads to the pulse input terminals of the console or card system. Make sure that any existing pulser wires are removed.

Use the selector knob to select the "Set pulse speed" option and press the selector knob.

Set the speed of pulses to output. The speed is set in pulses per minute. In order to test not only the accuracy of the count, but also the maximum speed of the console / card system pulse input, set the speed to the maximum that the pump and pulser can produce.

Gallons example: If the dispenser can flow a maximum of 10 gallons per minute, and it contains a 100 pulse per gallon pulser, then the maximum pulse speed is: 10 x 100 = 1000 pulses per minute.

Money example: If the dispenser can flow a maximum of 10 gallons per minute, the pulser is sending 100 pulses per dollar, and the price is set to 3 dollars per gallon, then the maximum pulse speed is: 10 x 100 x 3.00 = 3000 pulses per minute.

Turning the selector knob slowly will increase or decrease the pulse speed by 10. Turning the knob quickly will increase or decrease the pulse speed by 100. Once the desired speed is displayed, press the selector knob. This setting will automatically be saved when the PA2 powers off.

Use the selector knob to select “Set # of pulses” and press the selector knob. Now rotate the selector knob again to set the total number of pulses that are output. Turning the selector knob slowly will increase or decrease the number by 10. Turning the knob quickly will increase or decrease it by 100. Once the desired number is displayed, press the selector knob. This setting will automatically be saved when the PA2 powers off.

Use the selector knob to select “Begin pulsing” and press the selector knob. The PA2 will display the pulse output screen with the current count and the total count to be sent. The pulses will be sent with the number of pulses and the pulse speed selected. When all pulses have been sent, the display will change to “Output Complete”.

Compare the pulses sent by the PA2 with the number of pulses read by the console or card system.

When finished, press the selector knob to return to the menu.

> Troubleshooting tip: *If a console or card system is not counting pulses reliably, it could be caused by the pulser speed exceeding the input speed of the console. This was a common problem with early TMS consoles. To test for this problem, perform a test first with the pulse speed set to a slow setting. If this test is successful, perform the test again at the maximum pulse speed for the dispenser. If a count problem exists at high speed, but not at low speed, the pulse speed may be too fast for the console / card system.*

IX. Replacing the Battery

When the pulse analyzer powers on, the display will indicate the battery voltage. If the battery voltage falls below 6.0 volts, the PA2 will display “REPLACE BATTERY” and switch back off. If this happens, the battery must be replaced before operation. The pulse analyzer II uses a standard 9 Volt transistor battery. Alkaline or Lithium batteries work best. To replace the battery, make sure the unit is off. With the cover open, turn the pulse analyzer over and remove the 4 screws on the back. Now gently tap on the back of the unit until the front panel of the pulse analyzer comes out of the enclosure. The battery holder will be visible on the rear of the panel. Replace the battery and reassemble the unit.

X. Technical Support

If you have a problem with the pulse analyzer II, or need help connecting it to your equipment, please call ICS technical support at: 972-291-6064.

Pulse Analyzer II Operation Quick Reference

Test	Action
Contact Closure Pulser (Stand Alone test)	1. Set PA2 mode to Contact Count 2. Select “Pulser Type” and set “Electronic” or “Mechanical” 3. Select “Begin Counting” 4. Disconnect pulser output from any other circuit 5. Connect PA2 leads to pulser 6. Apply power to pulser 7. Dispense fuel 8. Compare PA2 count with dispenser
Contact Closure Pulser (Powered Count test) **Or** **Active Pulser test**	1. Set PA2 mode to Powered Count 2. Select “Pulser Type” and set “Electronic” or “Mechanical” 3. Select “Begin Counting” 4. Connect PA2 leads to pulser or pulser circuit 5. Apply power to pulser 6. Dispense fuel 7. Compare PA2 count with dispenser
Pulse Output	1. Set PA2 mode to Pulse Output 2. Select “Set pulse speed” and set desired speed 3. Select “Set # of pulses” and set desired count 4. Connect PA2 leads to console or card system 5. Select “Begin pulsing” 6. Compare PA2 count with console / card system count

Pulse Analyzer Connection Chart

The following chart show the correct connection of the pulse analyzer to commonly used pulsers.

Contact Closure Pulser Testing

Pulser output wires should be disconnected from any console or card system.
Pulse Analyzer II mode switch should be set to Contact Count

Pulser Manufacturer	Pulser Model	Red Lead To:	Black Lead To:
Integrated Control Systems	SP1	Red	Red
Integrated Control Systems	MR1	Red	Red
Integrated Control Systems	GB1	Red	Red
Integrated Control Systems	VR1	Red	Red
Integrated Control Systems	GPI1	Red	Red
Western Electronics / Emco Electronics / OPW	Model 400b	Red	Red
Western Electronics / Emco Electronics / OPW	Model 500	Red	Red
Western Electronics / Emco Electronics / OPW	Model 800f	Red	Red
Western Electronics / Emco Electronics / OPW	Model 50	Red	Red
Western Electronics / Emco Electronics / OPW	Model 788	Red	Red
Veeder Root	1871	Black	Black
Veeder Root	7671	Black	White

In-Circuit Pulser Testing

Below are the correct connection points for In-Circuit testing on various manufacturers consoles and card systems

Card Systems

System Manufacturer	System Model	Red Lead To:	Black Lead To:
Western Electronics / Emco Electronics / OPW	Phoenix 8000	PUL-n	DC Ground
Western Electronics / Emco Electronics / OPW	Phoenix AFC	P-IN	DC Ground
Western Electronics / Emco Electronics / OPW	FL6		
OPW	K800		
OPW	System2 / C/OPT / CFN		
OPW	K2500		
OPW	Keegard		
Gasboy	Series 1000 / Fleetkey		
Gasboy	Top Kat		
Gasboy	Islander / Islander II		
Gasboy	Keytrol		
Cardlock Vending	Cardmaster		
NBCS / E-Fueling	Fuel Guard		
NBCS / E-Fueling	Fuel Manager		
EJ Ward	RT FCT	PULSE	DC Common
EJ Ward	XT FCT	PULSE	DC Common

Fuel Consoles

System Manufacturer	System Model	Red Lead To:	Black Lead To:
Western Electronics / Emco Electronics	Alpha I / Alpha II	PUL-IN	GROUND
Western Electronics / Emco Electronics	Sprint	PUL-IN	GROUND
Triangle Microsystems (TMS)	800f		
Triangle Microsystems (TMS)	800f+		
Triangle Microsystems (TMS)	MPC		
Triangle Microsystems (TMS)	Petrosmart EZ		