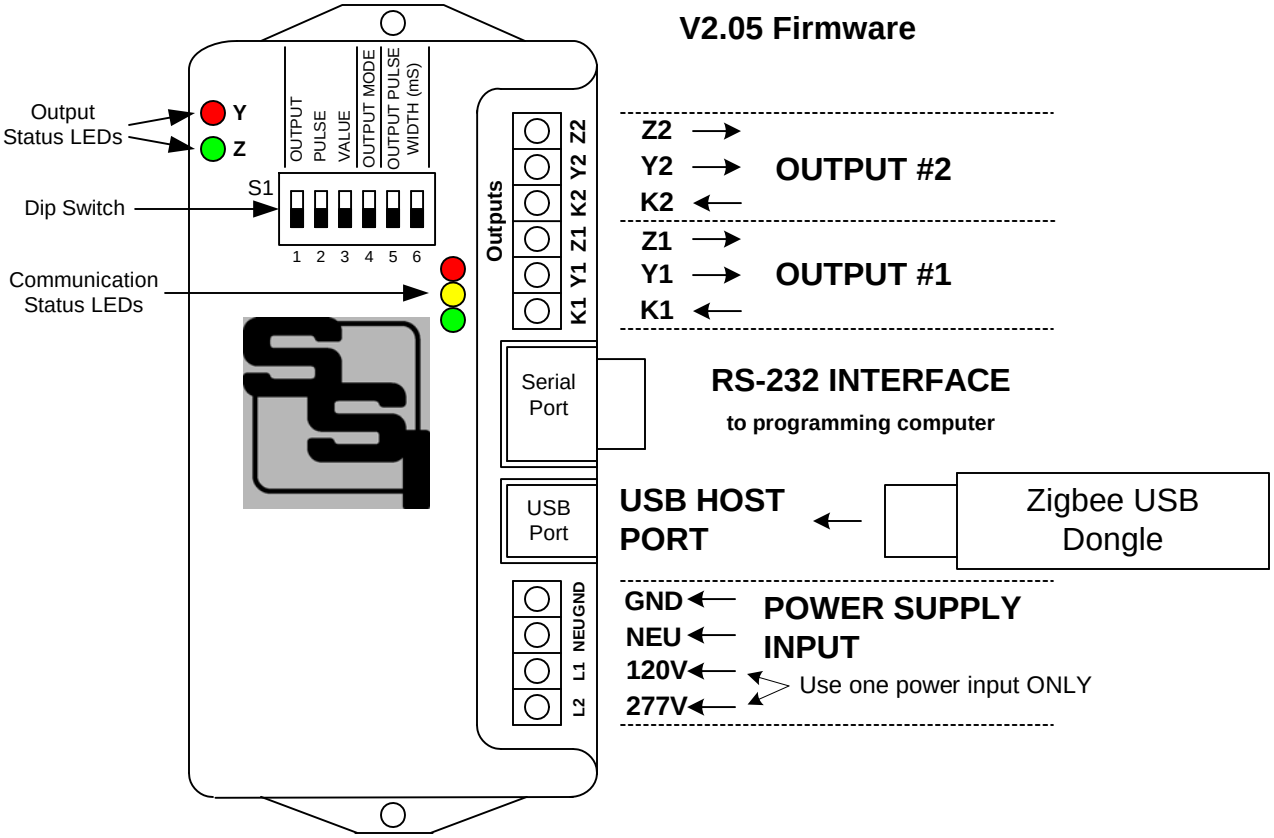
INSTALLATION INSTRUCTION SHEET
MPG-1 Metering Pulse Generator

V2.05 Firmware



MOUNTING POSITION - The MPG-1 can be mounted in any position. Two mounting holes are provided. The MPG-1 must be mounted in a non-metalic enclosure or somewhere where it can receive the streaming wireless information from the meter without interference. The MPG-1 must be mounted within about 75 feet from your meter. Distances vary with building construction and proximity to the meter. For best results, mount as close to the meter as possible. The pulse output lines from the MPG-1 may be run longer distances, but the MPG-1 should have uninterrupted access for best results. Choose a mounting location that will not have any metalic parts -- moving or stationary -- that can affect the RF field.

POWER INPUT - The MPG-1 is powered by an AC voltage of between 90 and 300 volts. For 120VAC, connect the AC supply's "hot" wire to the **L1** terminal. For 208 to 277VAC, connect the AC supply's "hot" wire to the **L2** terminal. Connect the **NEU** terminal to the AC supply's "neutral" wire. Connect **GND** to electrical system Ground.

METER INPUT - The MPG-1 receives data from a Zigbee-equipped AMI electric meter that has been paired wiith a RAVEn Zigbee USB receiver. The RAVEn USB receiver must be paired with the meter before it can be used. Once paired & inserted into the USB port, the MPG-1 starts receiving demand information from the meter. (See Page 3.)

OUTPUTS - Two 3-wire isolated outputs are provided on the MPG-1, with output terminals K1, Y1 & Z1 and K2, Y2, & Z2. Transient suppression for the contacts of the solid-state relays is provided internally. The output loads should be limited to 100 mA at 120 VAC/VDC. Maximum power dissipation of each output is 800mW. The outputs are protected by fuses F1& F2. One-tenth (1/10) Amp fuses (the maximum size) are supplied standard.

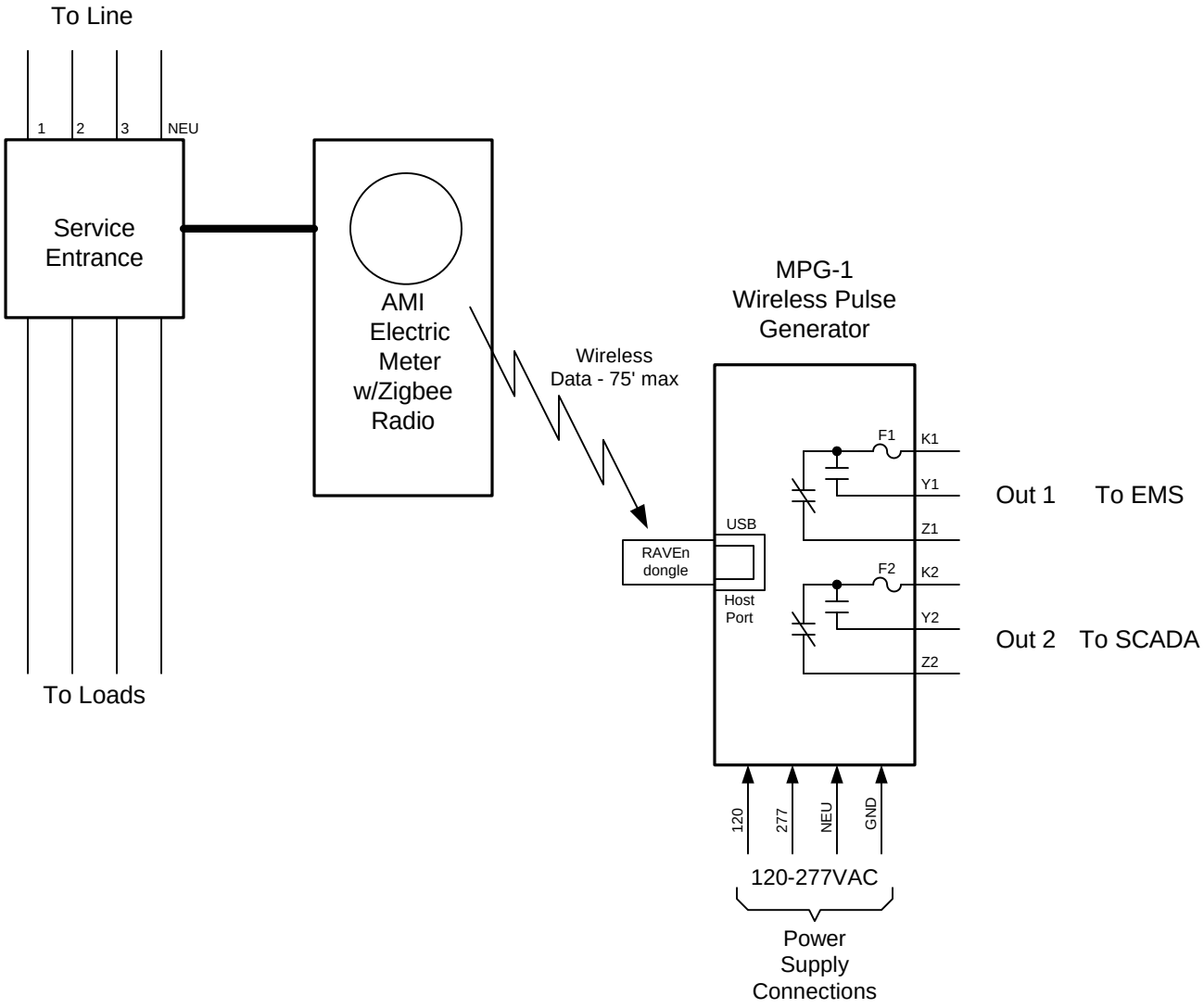
OPERATION - See the following pages for a full explanation of the operation of the MPG-1.

SOLID STATE INSTRUMENTS

a division of Brayden Automation Corp.
6230 Aviation Circle, Loveland, Colorado 80538
Phone: (970)461-9600 Fax: (970)461-9605
E-mail: support@solidstateinstruments.com

Revision: 9/8/2016 P/N: 05908-96007B

MPG-1 Wiring Diagram



MPG-1WiringDiagram.vsd

MPG-1 Wireless Pulse Generator Wiring Diagram		REVISIONS	
		NO. / DATE / DESCRIPTION	
DATE ORIGINAL: 3/27/16	SCALE: N/A		
LATEST REVISION	JOB NO.	CHECKED	DRAWN: WHB

Brayden Automation Corp./ Solid State Instruments div.
6230 Aviation Circle
Loveland, CO 80538
(970)461-9600
(970)461-9205 fax
www.solidstateinstruments.com

MPG-1 Wireless Meter Pulse Generator

Pairing the RAVEn Zigbee Radio Receiver

The RAVEn is a USB Zigbee Receiver device that must be paired with a Zigbee-equipped AMI electric meter. This may be accomplished either with the assistance of the utility or on their website if they have the process automated. The process for getting this done varies from utility to utility and not all utilities provide Zigbee radio availability. Contact your electric utility to find out how their pairing process is accomplished. This process is also known as "provisioning". The RAVEn must be powered to be paired with the meter and must be within range of the meter, usually within 75 feet.

The Meter must be programmed with the RAVEn's MAC address and installation ID code. By being "paired", the meter knows that it can only send data to that particular RAVEn and the RAVEn only accepts data from that particular electric meter. See the RAVEn instructions for more information on pairing the RAVEn with an electric meter.

Testing the RAVEn Receiver

Once you have paired your electric meter with the RAVEn, you will need to test it. An easy way to test it is to use Rainforest Automation's Personal Meter Reader (PMR) software. Go to the following link, download and install the Personal Meter Reader ("PMR") software at http://rainforestautomation.com/personal-meter-reader/

Using the Personal Meter Reader (PMR) Software

Insert the RAVEn in your computer's USB Port and then launch the PMR software. Your computer will need to be within 75 feet of the meter that the RAVEn is paired with. The PMR software will recognize the RAVEn and you will see the speedometer measure your current kW demand. The green bar graph icon in the upper right-hand corner indicates that your RAVEn is receiving data from the meter. Once you see this, your RAVEn is paired properly and ready to be installed in the MPG-1. Turn off power to the RAVEn and remove it from the computer. Install in the MPG-1's USB host port.

Before Powering the MPG-1, install the RAVEn in the MPG-1's USB port and set all system settings.

Set the MPG-1's Settings

Set the MPG-1's output pulse value, the pulse mode and the pulse timing by using DIP Switch S1 on the MPG-1 board just above the microcontroller.

Output Pulse Value

The pulse value (PV) is the number of watt-hours that each pulse is worth. The MPG-1 can be set from 10 Wh to 2000 Wh per pulse. See Table 1 to select and configure the desired pulse value for your application. Select a pulse output value that you think will be appropriate for your application. A good starting point is 100 wh/pulse. You can adjust it up or down depending on your needs. Larger facilities will require a larger pulse value to keep from overranging the MPG-1's registers.

Table 1
Pulse Value (PV)

Pulse Value (Wh)	S1.1	S1.2	S1.3
10	DN	DN	DN
25	DN	DN	UP
50	DN	UP	DN
100	DN	UP	UP
250	UP	DN	DN
500	UP	DN	UP
1000	UP	UP	DN
2000	UP	UP	UP

Set the Output Pulse Mode

The MPG-1 has two output modes, the 3-Wire (Form C) **Toggle** mode or the 2-Wire (Form A) **Fixed** mode. Set S1.4 in the **DOWN** position for Toggle or in the **UP** position for the Fixed mode. The toggle mode is the classic pulse output mode that emulates the standard KYZ 3-Wire electric meter output. It toggles back and forth, to the opposite state, each time a *"pulse"* is generated by the MPG-1. Even though there are three wires, it is common to use K and Y, or K and Z, for many two-wire systems that require or desire a generally symetrical 50/50 duty cycle pulse. The toggle mode is used for systems that are doing demand control and need regularly spaced pulses. The 3-Wire pulse value must be doubled if your device uses only two wires and is only counting the closure as a pulse(not the opening also). Red and Green Output LEDs show the output status. See additional information on Page 5.

Table 2
Output Pulse Mode

Output Mode	S1.4
TOGGLE	DN
FIXED	UP

In the Fixed mode, only the K-Y output is used. This is the standard 2-Wire system where the output contact is normally-open until such time as a pulse is generated. When a pulse is generated, the contact is closed for a selected fixed time interval in milliseconds. Form A mode is generally associated with Energy measuring systems.

Set the Fixed Mode Output Pulse Width Time

If you are using the MPG-1 in the Fixed Mode, set the output closure time or pulse width, selectable at 50mS, 100mS, 500mS and 1000mS (1 second) as shown in Table 3. Upon a pulse being generated, the K-Y terminals of each contact will close for the selected number of milliseconds and light the RED LED only. This setting applies only to the Form A output mode, and does not affect the toggle output mode.

Table 3
Fixed Output Pulse Width (mS)

Pulse Width (mS)	S1.5	S1.6
50	DN	DN
100	DN	UP
500	UP	DN
1000	UP	UP

MPG-1 Wireless Meter Pulse Generator (con't)

Power up the MPG-1

Once the settings have been made on the DIP switch and the RAVEn has been inserted into the USB port, power up the MPG-1 board. The RED LED on the RAVEn dongle will flash for up to 60 seconds while it is establishing communications with the meter. Once it has completed establishing communications, the RAVEn's RED LED will stay on continuously. If this LED is not on continuously, the MPG-1 will not receive information from the RAVEn. If no valid communication is received from the RAVEn, it will reset itself every 120 seconds (default reset time) trying to establish a connection. The RED LED on the RAVEn **MUST** be lit continuously before moving on. If it is not, then it is not provisioned correctly with the utility's meter. Do not proceed until this step is successfully completed.

Communication LEDs

Upon power-up, the YELLOW comm LED should light indicating that the RAVEn dongle is correctly initialized and communicating with the MPG-1's processor. Within about approximately 45 - 60 seconds, the GREEN comm LED will blink each time a valid transmission is received from the meter. As long as valid transmissions are received by the RAVEn dongle and successfully relayed to the MPG-1's processor, the Green comm LED will blink about once every 8-9 seconds. If the Green comm LED does not blink, that is an indication that the data transmissions from the meter are not being received, may be corrupted, or in some manner are not valid transmissions. If the Green comm LED has been blinking reliably for some time, then stops for a while and then restarts again, this indicates that transmissions are intermittent and sporatic, or generally means there is a problem in the RAVEn's ability to receive data reliably from the meter. To correct this, change the proximity of the MPG-1 to the meter, move it closer to the meter if possible and eliminate any metalic obstructions between the meter and the MPG-1. Also check to make sure that any walls or barriers between the MPG-1 and the meter have as little metal in them as possible. In some applications you may need line-of-sight.

Pulse Outputs

Outputs can be configured to be in the **Toggle** (Form C) mode or the **Fixed** (Form A) mode. Generally speaking, the Form C mode can be used with either 2-Wire or 3-Wire Pulse receiving devices, while the Form A mode uses only a 2-Wire interface to the downstream (receiving) pulse device. The choice would depend on the desired pulse format that the receiving device prefers to see.

If the RAVEn is reliably receiving data from the meter and passing it on to the MPG-1's processor, then you should see the Red and Green output LED's toggle each time the selected pulse value is reached, and the processor generates a pulse. If the pulse output value is too high and pulses are too slow, then select a lower pulse value with Dip Switches S1.1-1.3. (See Table 1 on Page 3).

If pulses are being generated too rapidly, select a higher pulse output value with Dip Switches S1.1-S1.3. The maximum number of pulses per second is approximately 10, which means that the output's open and closed times are about 50mS each. If the calculation by the MPG-1's processor is for pulse output timing that exceeds 15 pulses per second, the MPG-1 will light the RED comm LED, indicating an overflow error, and that the pulse value is too small. It is "latched" so that the next time you look at it this RED LED will be lit. In this way, you can quickly determine if a pulse output value is too small. In the optimum application, pulses would not exceed more than one pulse per 8 seconds. This allows a very even and "normal" pulse rate that as closely as possible resembles an actual KYZ pulse output from the meter.

The MPG-1 will "spread out" the pulses over the next 6-7 second period if a high enough watthour value is received in a transmission to require that more than one pulse is generated. For example, suppose you have the Output Pulse Value of 10 wh selected. The next 8 second transmission yields 24 wh have been used. Since 24 watt hours exceeds the 10 watthour setting, two pulses must be generated. The first 10wh pulse will be generated immediately. About three seconds later the second 10wh pulse will be generated. The remainder of four watt-hours stays in the register accumulated energy register (AER) awaiting the next transmission and the energy value of that transmission to be added to the contents of the AER. Another example: Assume 25 wh/p Output Pulse Value. Let's say the next transmission is for 130 watt hours. 130 is greater than 25, so 5 pulses will be outtputted over the next 7 seconds, one each 1.4 seconds (7 seconds / 5 = 1.4 seconds). The remainder of 5 wh will stay in the AER awaiting the next transmission. Some trial and error may have to be done for any particular building since pulse rates will change depending on maximum load.

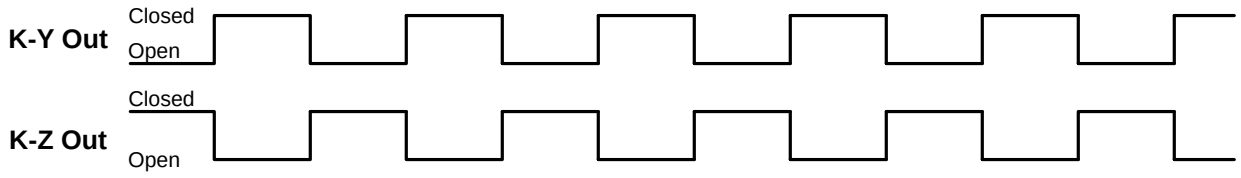
Overranging the Output

As mentioned above, if there are too many pulses calculated to be outputted in a 6-7 second interval than the MPG-1 can generate given the timing constraints, the MPG-1 will light the RED COM LED. In this situation, simply increase the pulse output value with Switches S1.1 thru S1.3, and cycle power to the MPG-1. This is intended to notify the user that a higher pulse value is needed. As load is added to a building over time, there is some likelihood that this will occur so be sure to consider this if/when you add load to the building. If an error condition occurs, set the Pulse Value for the next highest pulse value. Remember to change the pulse constant of your receiving device as well, since pulses will now be worth a higher watt-hour value. Cycle power to the MPG-1 to reset the RED Com LED after increasing the pulse value.

WORKING WITH THE MPG-1 RELAY

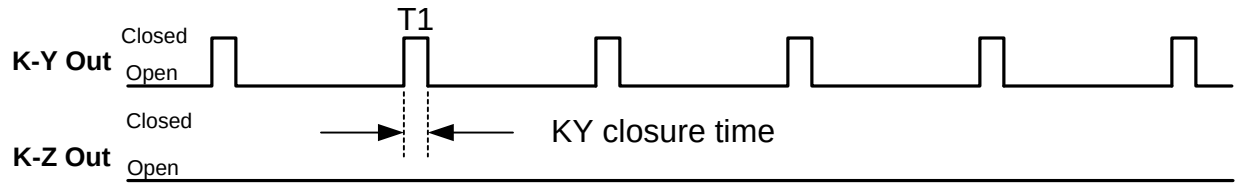
OPERATING MODES: The MPG-1 Meter Pulse Generator allows the outputs to be configured in either the "Toggle" or "Fixed" pulse output mode. In the *Toggle* mode, the outputs alternate or toggle back and forth each time a pulse is generated. This is synonomous with the classical 3-Wire Pulse metering and emulates the SPST switch model. Figure 1 below shows the timing diagram for the "Toggle" output mode. KY and KZ closures or continuity are always opposite of each other. In other words, when the KY terminals are closed (on), the KZ terminals are open(off). This mode is best for timing pulses to derive demand whether 2 or 3 wires are being used.

Figure 1: 2-Wire or 3-Wire TOGGLE Output Operation



In the Fixed output mode, shown in Figure 2 below, an output pulse (K-Y closure only) is a fixed width (T1) each time the output is triggered. The pulse width (closure time) is determined by the setting of Dip Switches 5 and 6. (See Table 3 on Page 3.) This mode is best for energy counting systems but not generally best for systems doing demand control where pulses are timed to derive instantaneous kW demand. The K-Z output is not used in the fixed mode. However, it is used in the Signed mode. See Page 6.

Figure 2: 2-Wire Only FIXED Output Operation



In Signed mode, with a Form A output mode selected, the K-Z output pulse represents negative (or kWh received) energy. (See Page 6.)

Contact the factory for technical support at (970)461-9600.

MPG-1 Advanced Settings

Meter Multiplier

If the building on which you are using the MPG-1 has an "Instrument-Rated" electric meter, AND the local utility has not included this multiplier in the programming of the meter, you will have to add the Meter Multipler to the MPG-1's program. To check out whether or not this is needed, either install the RAVEn on a computer in the building and look at the serial output using a terminal program, or hook up the MPG-1's serial port to a computer and view with a terminal program.

Determine the Multiplier of the facility's electric meter. If the meter is a self-contained meter and the multiplier is one (1) you can skip this step. The meter multiplier is normally the Current Transformer ("CT") ratio but can also include the Potential Transformer Ratio on larger applications. A 800 Amp to 5 Amp current transformer, for example, has a ratio of 160. Therefore, the meter multipler on a building with 800:5A CT's would be 160. The Multiplier is normally printed on the monthly utility bill. If you cannot find it any other place, call your utility and ask what the meter or billing multiplier is.

If the utility's Zigbee transmission to the RAVEn includes the correct multiplier value you can skip this step also. This is very rare on instrument-rated metering implementations however, since most utilities do not want to program the multiplier into the meter. This will be in hexideciminal format. What you're looking for is whether this is 1 or something else besides one. If, for instance, the multipler is a decimal 160, it will be transmitted by the meter to the RAVEn as a hexideciminal "A0". If the multiplier *is* one(1), you know that either this is a self-contained meter and a mutiplier of 1 is correct, *OR* that this is an instrument-rated meter and the utility most likely does NOT send the correct multiplier as part of the Zigbee transmission. If the latter is true, you will have to program the multiplier into the MPG-1.

Setting up the Serial Port

Connect the Male-to-Female DB9 serial cable to the computer's serial port. Connect the other end to the MPG-1. With TeraTerm, Puddy or some similar terminal program, select the correct serial port to be used, set the baud rate at 115200 and the terminal mode Receive as CR+LF. Also make sure that the local echo is enabled or "ON".

Turn on the MPG-1 and after the initialization process, the RED LED on the RAVEn should be lit continuously. Assuming that the RAVEn is paired with the meter, is on, and is within 75' of the meter, then every 8 to 10 seconds, you will see the following serial information received from the MPG-1:

MPG V2.05
Time Stamp: 1ef03316
Demand: 000d6b
Multiplier: 00000001
Divisor: 000003e8

If the multiplier coming from the meter is 1 AND *you know* that the meter's multipler is something other than one, you will have to program the correct multiplier into the MPG-1 so that the true energy value is correct.

Programming the Multipler

To change the multiplier in the MPG-1, use the M command. Enter M160 and press <Enter> to change the mulitplier to 160, as outlined in the application above. The serial link to the MPG-1 will return "OK". You will not see the "M10" that you typed in on the screen unless the local echo is enabled. To read back what the value of the multiplier currently in the MPG-1 is, press R and <Enter>. The serial link will return the current multiplier stored in the MPG-1. For example, "Multiplier = 40" will be returned if the current multipler is 40. Case does not matter. The maximum multiplier is 99999 and must be an integer (whole) number.

The serial port is used for programming and monitoring the MPG-1. Therefore you have to enter your data between outputs from the MPG-1.

MPG-1 Advanced Settings (con't)

Bi-Directional Energy Flow (Signed Mode)

If you have energy flowing in both directions in the case of DER (solar wind, etc) applications, the MPG-1 can provide both positive and negative pulses. This is known as the ***Signed*** mode, meaning that "kWh Delivered" (from the utility *to* the customer) is positive or forward flow, and "kWh Received" (from the customer *to* the utility) is negative or reverse flow.

The Pulse Value Setting (set by dip switches S1.1-S1.3) is the same for both positive and negative values.

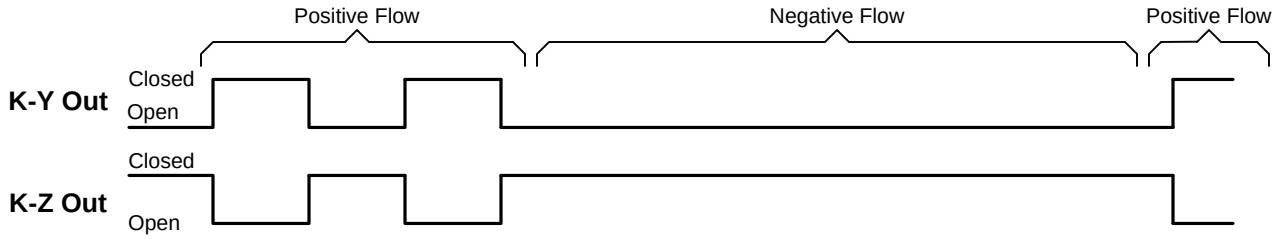
To enter the functional or operational mode into the MPG-1, use the S and N commands. Press N <Enter> to set the MPG-1 in the Normal mode. Press S <Enter> to set the MPG-1 in the Signed mode. The serial link to the MPG-1 will return "OK". To read what mode the MPG-1 is currently in, press R <Enter>. The serial link will return the mode stored in the MPG-1. For example, "Mode = Normal" will be returned. Case does not matter.

Form C Signed mode - A positive energy value received from the meter is added to the positive Accumulated Energy Register(+AER). Negative energy values received are ignored. Only Form C toggle pulses are generated on the KYZ output for Positive energy flow. See Figure 3 below.

Form A Signed mode - A positive energy value received is added to the positive Accumulated Energy Register(+AER). A negative energy value received is added to the negative Accumulated Energy Register(-AER). When either register equals or exceeds the Pulse Value setting, a pulse of the corresponding sign is outputted on the correct line. Pulses in this mode are Form A (2-wire) "Fixed" only. K-Y pulses are Positive pulses and K-Z pulses are negative pulses. They share a common K terminal on the output. Set the pulse value with dip switches S1.1 thru S1.3. Set the pulse width using dip switches S1.5 and S1.6. See Figure 4 below.

Figure 3: 3-Wire (FORM C) TOGGLE Output Operation

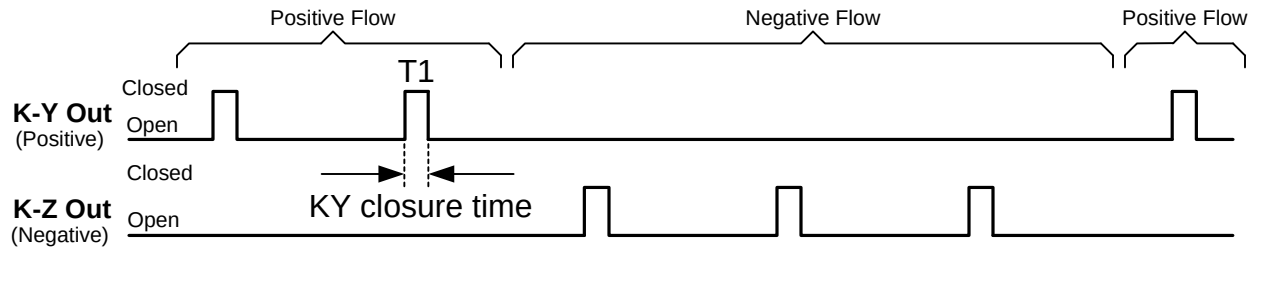
Positive Energy Pulse Outputs Only



In Signed mode, with a Form C output mode selected, the K-Y and K-Z output pulses represent positive (or kWh delivered) energy; Negative (or kWh received) energy is ignored.

Figure 4: 2-Wire (FORM A) FIXED Output Operation

Positive and Negative Energy Pulse Outputs



In Signed mode, with a Form A output mode selected, the K-Y output pulse represents positive (or kWh delivered) energy; K-Z output pulse represents negative (or kWh received) energy.