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Application Note AN1802

Using WattsOn-Mark II with W2-PLC in an Export Limit Application

Associated Product: WattsOn-Mark II & W2-PLC

Summary

The WattsOn-Mark II energy meter is capable of monitoring import and export power and energy. Recently, many utilities are starting to limit the amount of power that may be exported to the grid. This whitepaper discusses an application using an additional output module (controller) which features logic and management to ensure that any export limits are maintained.

The controller features five (5) output relays which may be used to enable multiple inverters or contactors. A sixth relay is used to indicate an error. It communicates with the meter using the Modbus/RTU protocol, using the meter's built-in RS-485 channel.

The logic is based on a failsafe design, whereby the controller will only enable its output relays (and therefore inverters and contactors), if there is proper communication with the meter, the meter is working correctly, and is configured properly.

Multiple configuration parameters are available through the meter to manage the controller's behavior.

Background

This whitepaper does not discuss detailed wiring and configuration of the WattsOn-Mark II meter. It is assumed that the meter is correctly installed, and that a direction of power flow is established. In most cases, the meter is installed between the utility and the facility. The facility may include loads which consume (import) energy, as well as production devices (solar inverters, wind, generators), which produce (export) energy. The method of CT installation will determine how the meter considers the flow of power namely; import (+) or export (-). In either case, the controller may be configured to act upon either import or export direction of power to actuate its logic and relay outputs.

When the WattsOn-Mark II and CTs are installed as per the User Manual, the utility is considered the "source" and the facility is considered the "load". In this case, power flowing from the utility to the facility is considered "+" (import) and power flowing from the facility to the utility (ie: excess generation) is considered "-" (export). In some cases, the installation considers the inverter as the source, in which case power flowing out of the inverter will be considered positive. It is important to note the sign of the power which is to be acted upon, as this will influence the controller configuration.

Wiring

WattsOn-Mark II power supply, voltage input and CT wiring should be performed as per the user manual. Additionally, any CT & PT configuration must be done to ensure proper measurement of parameters. Prior to This manual assumes the use of the –DL (integrated display) model of the WattsOn-Mark II, as it can be used to change the controller settings. Prior to installing the W2-PLC, ensure that the meter is performing correctly, and that the measurements are accurate. Also ensure that the CTs have been correctly installed regarding the sign of the power and that they are properly phased with the voltages (ensure power factors are correct, etc). These checks may be done with the on-board LCD display. The remainder of the manual assumes that the meter is correctly installed and configured for measurements, and that the sign of the power (positive or negative) to consider as export to the grid has been established.

Once proper WattsOn-Mark II wiring and configuration has been confirmed, add the controller to the system. The controller must be wired with a 24VDC power supply (may be shared with the WattsOn-Mark II), RS-485 communications to the WattsOn-Mark II meter RS-485 terminal, and output relays to the relevant inverters or contactors to control. The controller may interface with up to 5 separate inverters on contactors, based on the output connections and software configuration. Note that the controller relays are rated as per the table below. Care must be taken not to exceed the ratings specified, especially the relay output voltage and current. If larger voltages or currents are to be controlled, the use of an interfacing relay will be required. Additionally, if inductive loads such as large relays or contactors are being controlled, consideration to transient protection must be given to ensure that high voltage and current surges during switching do not damage the controller relays.

Output Voltage Range	**5-264VAC (47-63 Hz)** **5-30 VDC**
Output Type	Relay, form A (SPST)
Maximum Current	1A per point
Minimum Load Current	5mA @ 5VDC
Maximum Inrush Current	3A for 10 ms
OFF to ON Response	< 15 ms
ON to OFF Response	< 15 ms
Status Indicators	Logic Side (red LED)

Software Configuration

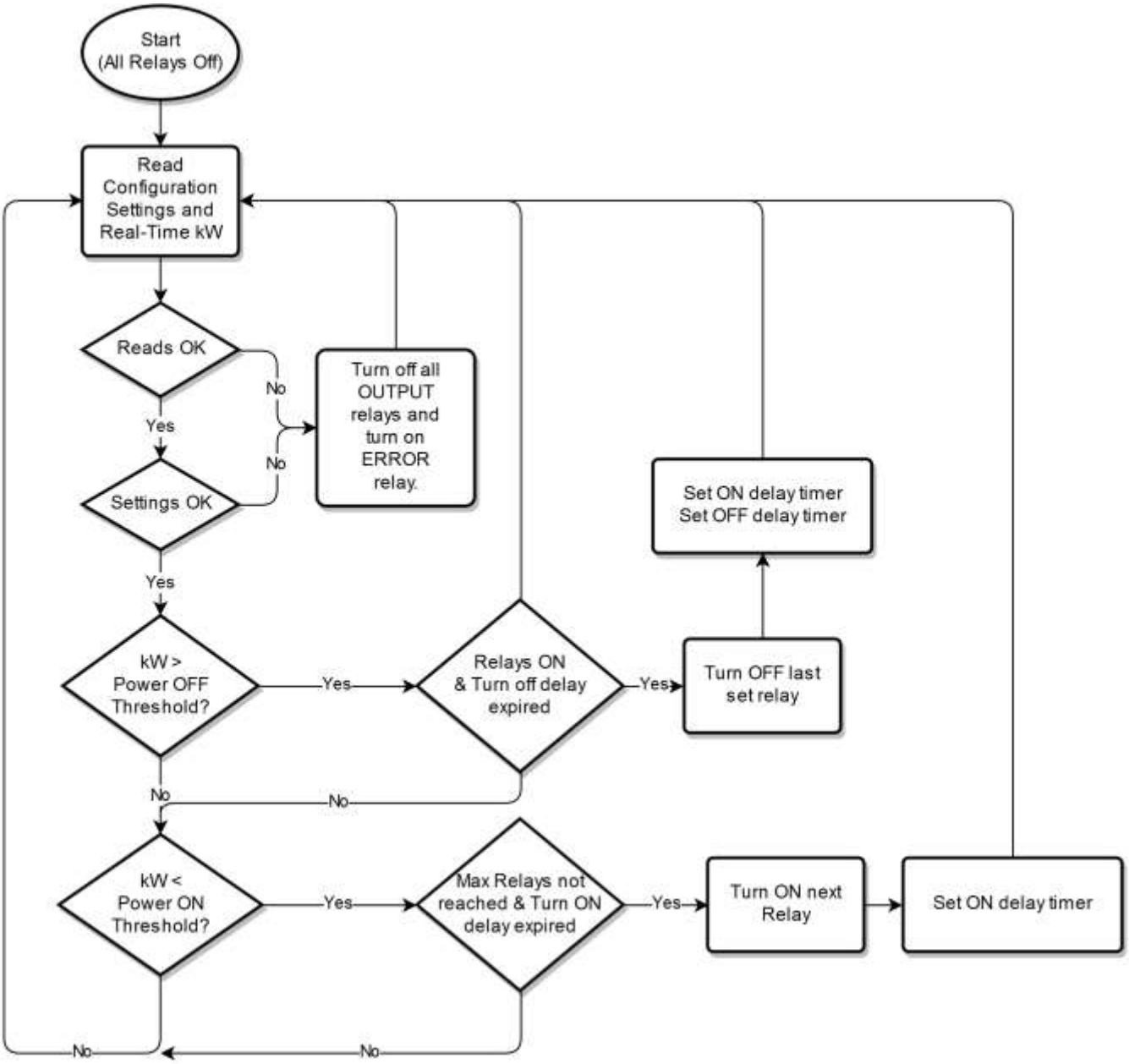
The controller configuration is stored on the WattsOn-Mark II scratchpad area. The controller continuously reads both the instantaneous power reading from the meter, as well as its configuration parameters. The configuration parameters are as follows:

All of the registers are defined as 16-bit signed integers.

NOTE: It is recommended that if any of the settings are changed that the controller be either power cycled, or restarted by cycling the on-board switch to STOP and then RUN.

Parameter	Offset	Address	Min. Value	Max. Value	Description
Power ON Threshold	0x540	41345	-30000 (-3,000kW)	30000 (3,000kW)	The kW value under which outputs will be switched ON. Outputs will continue to be switched on while the kW reading is below this value. NOTE: This value is stored as: kW * 10. Example: 15kW is 150, 12.5kW is 125
Power OFF Threshold	0x541	41346	-30000 (-3,000kW)	30000 (3,000kW)	The kW value over which outputs will be switched OFF. Outputs will continue to be switched off while the kW reading is above this value. NOTE: This value is stored as: kW * 10. (as above)
Controlled Outputs	0x542	41347	1	5	Number of outputs (ie: inverters) to control. This is the maximum number of relays that will sequentially engage on below the Power ON Threshold.
ON Timeout (seconds)	0x543	41348	0	3600	The time (in seconds) to delay after a relay has been turned ON before making further decisions to turn on additional relays. Note: when a relay is turned ON, there is no timeout before it can be turned OFF. In the case where the power immediately rises above the OFF threshold, the relay will immediately turn off.
OFF Timeout (seconds)	0x544	41349	0	3600	The time (in seconds) to delay after a relay has been turned off before making further decisions to turn off additional relays. Note: when a relay is turned OFF, the ON timeout is also restored, so that a relay will not turn on immediately after being turned off, even if the power drops below the ON threshold.
Filter Strength	0x545	41350	10	100	Input power readings are averaged over a short duration to avoid triggering on momentary spikes. The lower the number, the more averaging takes place. A value of 75 is recommended. A value of 100 is NO filtering.
Export is Negative	0x546	41351	0	1	True (1) /False (0). This setting determines whether the relay logic acts on negative or positive power.

Controller Logic



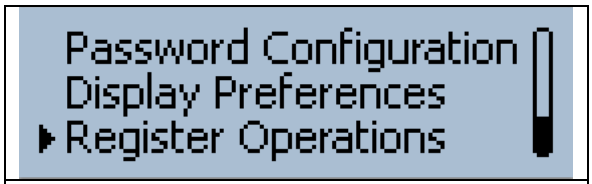
Configuring Settings using the on-board display

The on-board meter LCD display may be used to configure all of the settings which the controller needs (defined on page 3 above). Although the display does not have a native menu for the controller parameters, there is a "Registers Operation" page which allows direct access to all of the required registers and allows viewing/changing them.

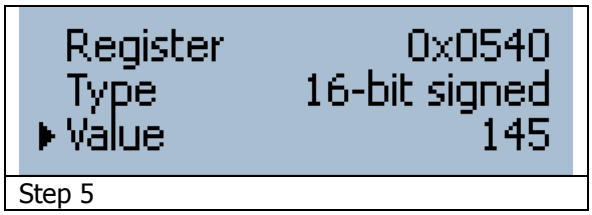
To view/change any of the settings:

1. Press the BACK button on the display.
2. Select "Configuration"
3. Press "Up" to cycle to the very bottom of the menu
4. Select "Register Operations"
5. The Register Operations screen shows the register offset, the type and the current value.
6. Use the UP/DOWN arrows to select a field.
7. Use Enter to enter the field
8. Use LERFT/RIGHT to navigate the digit and UP/DOWN to change the value.
9. The necessary register value must first be selected in the register field to show the corresponding value. Subsequently, the value may be changed.
10. When finished entering a value, use RIGHT (Enter) to scroll to the end of the field, and acknowledge the changes.
11. Use "BACK" to exit the menu system.

Step 2



Step 4



Step 5

Troubleshooting

The following cases will prevent the controller from working, and will trigger relay Y6 to trigger (a RED LED will turn on beside the Y6 terminal output.

If the Y6 relay output is engaged, ensure that the following conditions are met:

1	Controlled Inverters	Must be 1 to 5
2	On Timeout	Must be 0 to 3600
3	Off Timeout	Must be 0 to 3600
4	Filter Strength	Must be 10 to 100
5	Power Direction	Must be 0 or 1
6	Power On Threshold	Must be -30000 to +30000
7	Power Off Threshold	Must be -30000 to +30000
8	Power On Threshold	Must be LESS than Power Off Threshold
9	Communications	Must succeed within 1 second timeout