PROFIRE Modbus Register Map

PROFIRE
1.855.776.3473
solutions@profireenergy.com

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1. Introduction

The Modbus Card is designed for use with PF3100 Burner Management Systems. It implements a Modbus Slave Device which allows settings and measurements in the BMS to be read remotely by a PLC or other remote Master Device. The protocol used is Modbus RTU and the physical implementation is half-duplex RS-485.

This document outlines key configuration information needed to utilize the Modbus Card. This information applies to hardware version 1.3.x and firmware bundle numbers NA-00019 and higher.

General Information

The Modbus Card currently can only be used to control and read status information from PROFIRE BMS Controller cards. The Modbus card does not understand "appliances" at present, but can be used to access all BMSs individually within an appliance. If all BMSs are functioning correctly in an appliance, the first configured BMS in the appliance is the one for which overall appliance status should be read from. To determine which is the first configured BMS, look at the list of BMS Controllers on the Appliance Status Screen of the PF3100 User Interface. The first BMS in the list on the right side of this screen is the first configured BMS. If this BMS is not available for some reason (e.g. – it is damaged, power is lost, Modbus communications are down), then the second BMS in the list should be used. This failover scheme continues for all BMSs in the list.

Communications

The Modbus card implements Modbus RTU protocol over RS-485. The Modbus address used to communicate with each BMS Controller card in a PF3100 system is the last 2 digits of the MAC Address of the BMS, not the MAC address of the Modbus card itself. For example: a BMS with MAC address A): MAC address A0:00:00:00:00:2B has a Modbus address of 2B hex (43 decimal). **Programmer Note: when replacing the BMS card, ensure that you note the new MAC address as it will change from the original upon replacement.**

The Baud rate of the Modbus communications is set to 19200bps and 9600 bps partially automatically. To change the Baud rate, send several messages to the Modbus card using the desired baud rate. Once a response is received from the Modbus card, the baud rate will be set. It cannot be changed again unless the unit is power cycled.

A termination resistor is present on the board next to the Modbus wiring connector and can be enabled or disabled using the switch.

Most units for the various registers described in this document are currently hard-coded and cannot be changed. There is a Modbus register (30160/40160) that can be used to change the temperature unit to Celsius or Fahrenheit. The default value is Fahrenheit. If different units are required, they will need to be converted by an external PLC.

The Start and Status contacts on the Modbus card are not currently supported.

Configuration of the Modbus Module is not currently supported via the PF3100 User Interface. A future firmware release will add this functionality and allow many settings to be adjusted through the UI including: appliance settings, MAC addresses, baud rate, parity bits, data bits, stop bits, register units, and Start/Status contact behavior.

LED Indicators

The Modbus card has two (2) LEDs mounted on the board to help trouble shoot communications. Both LEDs blink three times when the card is powered up.

If a valid message that is addressed to a BMS connected to the Modbus card is received, the RX LED will blink twice. If an error or an invalid message is received, the RX LED will blink once.

When the card transmits a Modbus message it will blink the TX LED once.

Please Note: When troubleshooting the communications, perform the testing when the Modbus card is the only slave device on the bus to minimize other communications not intended for the card.

2. Modbus Register Map

The following are the registers that are currently supported by the Modbus Card firmware.

Note: If a given input (such as temperature) becomes invalid for any reason (such as a hardware or wiring error on the temperature module) the register will report a value of 0. Similarly, if the Modbus card loses communications with a BMS Controller card for 1 second or more, all registers associated with that BMS will report a value of 0.

Read-Only Discrete Inputs

These are single bit values that are read only. Reading one input will result in a single byte being returned with the least significant bit holding the value. Reading multiple inputs per command will result in a bit packed vector being returned.

Use the “Read Input Status” command (0x02) to read the Discrete Inputs.

Example 1: Read Single – Reading 1 register starting from Register Offset 3 will result in one data byte being returned with the least significant bit containing the value from Register Offset 2. All other unused bits will be set to zero.

Example 2: Read Multiple – Reading 12 registers starting from Register Offset 3 will result in two data byes being returned. The value of the registers will be populated in the bits of each byte, beginning with the least significant bit of each byte. All other unused bits will be set to zero.

Register Address (Offset)	Names & Values	Description	Minimum Version Supported
10001 (0)	Run 0 = Not running 1 = Running	The Run bit is set when the PF3100 BMS is actively firing, is attempting to relight, or is waiting for a wait condition to clear before relighting.	NA-00019
10002 (1)	Pilot 0 = Deenergized 1 = Energized	The Pilot bit is set whenever the controller is attempting to drive the High Fire Solenoid to an open position. This is not a proof of position.	NA-00023
10004 (3)	High Fire 0 = Deenergized 1 = Energized	The High Fire bit is set whenever the controller is attempting to drive the High Fire Solenoid to an open position. This is not a proof of position.	NA-00023
10005 (4)	SSV1 0 = Deenergized 1 = Energized	The SSV1 bit is set whenever the controller is attempting to drive the SSV1 Solenoid to an open position. This is not a proof of position.	NA-00023
10006 (5)	SSV2 0 = Deenergized 1 = Energized	The SSV2 bit is set whenever the controller is attempting to drive the SSV2 Solenoid to an open position. This is not a proof of position.	NA-00023
10015 (14)	Aux Input 0 = Open 1 = Closed	The Aux Input bit shows the state of the Aux In input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open. Depending on the Aux In Contact Mode setting in the user interface, this register may represent Proof of Low Fire, Proof of Closure 2, Proof of Pilot, Low Fuel Pressure, or Chamber Pressure.	NA-00023
10016 (15)	Pressure Input 0 = Open 1 = Closed	The Pressure Input bit shows the state of the Pressure input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open.	NA-00023
10017 (16)	Level Input 0 = Open 1 = Closed	The Level Input bit shows the state of the Level input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open.	NA-00023
10021 (20)	POC Input 0 = Open 1 = Closed	The POC Input bit shows the state of the Proof of Closure input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open.	NA-00023
10022 (21)	ESD Input 0 = Open 1 = Closed	The ESD Input bit shows the state of the Emergency Shutdown input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open.	NA-00023
10023 (22)	Start Input 0 = Open 1 = Closed	The Start Input bit shows the state of the Start input on the BMS. The bit is set to 1 if the input is closed. This bit will be set to zero if the input is open.	NA-00023

Register Address (Offset)	Names & Values	Description	Minimum Version Supported
10024 (23)	BMS Communication Status 0 = No Communication 1 = Communicating	The BMS communication bit indicates if the Modbus card has PFRN communication with the BMS controller.	NA-00040

Read-Only Input/Holding Registers

The Input Registers (300xx) are 2 byte read-only values. They are mirrored in corresponding Holding Registers (400xx) for convenience and to maintain compatibility with some PLCs.

Use the "Read Input Register" command (0x04) to read the Input Registers (300xx).

Use the "Read Holding Registers" command (0x03) to read the Holding Registers (400xx).

Example 1: Read Single – Reading 1 register starting from Register Offset 3 will result in two data bytes being returned. The first byte will be the most significant byte of Register Offset 3, and the second byte will be the least significant byte.

Example 2: Read Multiple – Reading 2 registers starting from Register Offset 3 will result in four data bytes being returned. The first byte will be the most significant byte of Register Offset 3, the second byte will be the least significant byte of Register Offset 3, the third byte will be the most significant byte of Register Offset 4, and the fourth byte will be the least significant byte of Register Offset 4.

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30001/40001 (3)	Run 0 = Not Running 1 = Running	The Run bit is set when the PF3100 BMS is actively firing, is attempting to relight, or is waiting for a wait condition to clear before relighting.	NA-00023
30004/40004 (3)	Process Thermocouple Reading -50°C (-58°F) to 1350°C (2462°F)	This is the current reading of the Process Thermocouple, encoded as a 16 bit signed integer in °C or °F.	NA-00019
30006/40006 (5)	Pilot Flame Quality 0 to 100%	This number represents the quality of the pilot flame. The higher the number, the better the flame. In a multi-pilot system, if any one pilot module is reporting pilot flame quality of 100%, this register will contain 100%.	NA-00019
30008/40008 (7)	Process Temp Setpoint 0°C (32°F) to 1350°C (2462°F)	This is the current value of the Process Temperature Setpoint, encoded as a 16 bit signed integer in °C or °F.	NA-00019
30009/40009 (8)	Low Fire Setpoint 0°C (32°F) to 1350°C (2462°F)	This is the current value of the Low Fire Temperature Setpoint, encoded as a 16 bit signed integer in °C or °F.	NA-00029

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30010/40010 (9)	Pilot Off Setpoint 0°C (32°F) to 1350°C (2462°F)	This is the current value of the Pilot Off Temperature Setpoint, encoded as a 16 bit signed integer in °C or °F.	NA-00029
30011/40011 (10)	Level Input Dry Contact 0 = Open 1 - Closed 4-20mA input 0 - 100%	This number represents the state of the Level Input. This value will depend on the input configuration. If the input is configured as a 4-20mA input, the value reported will represent the mA reading. If the input is configured as a dry contact, it will represent the state of the switch.	NA-00019
30012/40012 (11)	Pressure Input Dry Contact 0 = Open 1 = Closed 4-20mA Input 0 - 100%	This number represents the state of the Pressure Input. This value will depend on the input configuration. If the input is configured as a 4-20mA input, the value reported will represent the mA reading. If the input is configured as a dry contact, it will represent the state of the switch.	NA-00019
30017/40017 (16)	Low Temp Setpoint 0°C (32°F) to 1350°C (2462°F)	This is the current value of the Low Temperature Setpoint, encoded as a 16 bit signed integer in °C or °F.	NA-00029
30018/40018 (17)	High Temp Setpoint 0°C (32°F) to 1350°C (2462°F)	This is the current value of the High Temperature Setpoint, encoded as a 16 bit signed integer in °C or °F.	NA-00029
30020-30039/40020-40039 (19-38)	Temperature Inputs -50°C (-58°F) to 1350°C (2462°F)	These registers report the current readings of the logical temperature inputs encoded as a 16 bit signed integer in °C or °F. These are reported in the same order they appear in the temperature wizard on the PF3100 UI. The top one on the configuration screen corresponds to x0020, the next one down will be x0021, and so on.	NA-00020
30040/40040 (39)	Main Flame Quality 0 - 100%	This number represents the quality of the main flame. The higher the number, the better the flame. In a multi-pilot system, if any one pilot module is reporting main flame quality of 100%, this register will contain 100%.	NA-00023
30041/40041 (4)	Valve Output Status Bits 0 = Deenergized 1 = Energized Bit 0: Pilot Bit 1: Reserved Bit 2: SSV1 Bit 3: Reserved Bit 4: SSV2 Bit 5: Reserved Bit 6: High Fire Bit 7: Reserved	This register contains a bitmap reporting the status of each valve output on the BMS card. The Ion Pilot Card valve output is not currently reported. See registers 10002, 10004, 10005, 10006 for more details.	NA-00023
30042/40042 (41)	Aux Output Percentage 0 to 100%	This number represents the Aux Output Percentage. If the output is being driven with 4mA it will report 0%, and if the output is being driven with 20mA, it will report 100%. Depending on the 4-20 Aux Out Mode setting in the user interface, this register may represent Process Temperature, Fuel Pressure, Tank Level, LEL Input Reading, or Proportional Valve Position.	NA-00023

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30043/40043 (42)	Shutdown Codes	This is a 16 bit code that represents the reason that the last BMS last shut down. If the shutdown code has been acknowledged, or if the controller is running, this value will be zero.	NA-00023
30044/40044 (43)	Dry Input State Bits 0 = Open 1 = Closed Bit 0: Start Bit 1: ESD Bit 2: POC Bit 3: AUX_IN Bit 4: LEVEL Bit 5: PRESSURE	This register contains a bitmap reporting the status of each dry contact switch input on the BMS card. See registers 10015, 10016, 10017, 10021, 10022 and 10023 for more details.	NA-00023
30050/40050 (49)	Modbus Receive Counter	This number is a rolling counter that is incremented every time a Modbus message is received that is properly addressed to any PF3100 BMS on the system. This number has a range of 0 to 65535, and will roll over to 0 if a message is received when the counter is at the maximum value.	NA-00029
30051/40051 (50)	Ethernet Message Receive Counter	This number is a rolling counter that is incremented every time a Modbus message is received that is properly addressed to any PF3100 BMS on the system. This number has a range of 0 to 65535, and will roll over to 0 if a message is received when the count	NA-00029
30060/40060 (59)	Temperature Unit 0 = Celsius 1 = Fahrenheit	This number represents the temperature unit used for all of the temperature data reported from the Modbus card.	NA-00029
30061/40061 (60)	IO Expansion Module Mac Address Slot 1	Returns the last 2 bytes of the IO Expansion module Mac address currently connected to this slot. The low byte is the last byte of the Mac address. The high byte is the second last byte of the Mac address.	NA-00040
30062/40062 (61)	IO Expansion Module Mac Address Slot 2		NA-00040
30063/40063 (62)	IO Expansion Module Mac Address Slot 3		NA-00040
30064/40064 (63)	IO Expansion Module Mac Address Slot 4		NA-00040
30065/40065 (64)	IO Expansion Module Mac Address Slot 5		NA-00040

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30070/40070 (69)	IO Expansion Module Slot 1 Input 1	IO expansion inputs for the IO Expansion module in Slot 1. If the input is in 420 mode, this register will return the mA value x 10. If the input is in digital mode this register will return a 0 for open and a 1 for closed.	NA-00040
30071/40071 (70)	IO Expansion Module Slot 1 Input 2		NA-00040
30072/40072 (71)	IO Expansion Module Slot 1 Input 3		NA-00040
30073/40073 (72)	IO Expansion Module Slot 1 Input 4		NA-00040
30074/40074 (73)	IO Expansion Module Slot 2 Input 1	IO expansion inputs for the IO expansion module in Slot 2. If the input is in 420 mode, this register will return the mA value x 10. If the input is in digital mode this register will return a 0 for open and a 1 for closed.	NA-00040
30075/40075 (74)	IO Expansion Module Slot 2 Input 2		NA-00040
30076/40076 (75)	IO Expansion Module Slot 2 Input 3		NA-00040
30077/40077 (76)	IO Expansion Module Slot 2 Input 4		NA-00040
30078/40078 (77)	IO Expansion Module Slot 3 Input 1	IO expansion inputs for the IO expansion module in Slot 3. If the input is in 420 mode, this register will return the mA value x 10. If the input is in digital mode this register will return a 0 for open and a 1 for closed.	NA-00040
30079/40079 (78)	IO Expansion Module Slot 3 Input 2		NA-00040
30080/40080 (79)	IO Expansion Module Slot 3 Input 3		NA-00040
30081/40081 (80)	IO Expansion Module Slot 3 Input 4		NA-00040

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30082/40082 (81)	IO Expansion Module Slot 4 Input 1	IO expansion inputs for the IO expansion module in Slot 4. If the input is in 420 mode, this register will return the mA value x 10. If the input is in digital mode this register will return a 0 for open and a 1 for closed.	NA-00040
30083/40083 (82)	IO Expansion Module Slot 4 Input 2		NA-00040
30084/40084 (83)	IO Expansion Module Slot 4 Input 3		NA-00040
30085/40085 (84)	IO Expansion Module Slot 4 Input 4		NA-00040
30086/40086 (85)	IO Expansion Module Slot 5 Input 1	IO expansion inputs for the IO expansion module in Slot 5. If the input is in 420 mode, this register will return the mA value x 10. If the input is in digital mode this register will return a 0 for open and a 1 for closed.	NA-00040
30087/40087 (86)	IO Expansion Module Slot 5 Input 2		NA-00040
30088/40088 (87)	IO Expansion Module Slot 5 Input 3		NA-00040
30089/40089 (88)	IO Expansion Module Slot 5 Input 4		NA-00040
30110/40110 (109)	Modbus Error Counter for Incoming Check Sum Failures	Increments on a CRC failure on an incoming packet from the Modbus Master.	NA-00040
30111/40111 (110)	Modbus Error Counter for Incoming Invalid Device Addressing	Increments on an invalid device address request from the Modbus Master.	NA-00040
30112/40112 (111)	Modbus Error Counter for Incoming Receive Failures Due to Receive Timeout	Increments on incoming packet timeout failures from the Modbus Master. For example, an incorrect packet.	NA-00040
30113/40113 (112)	Modbus Error Counter for Incoming Invalid Modbus Function Code	Increments on an invalid function code request from the Modbus Master.	NA-00040
30114/40114 (113)	Modbus Error Counter for Incoming Requests for Unsupported Registers	Increments on a request to read or write an invalid or unsupported register.	NA-00040

Register Address (Offset)	Names & Values	Descriptions	Version Supported
30115/40115 (114)	Modbus Error Counters for Incoming Packet Faults	Increments on common or incoming packet faults including: ILLEGAL_FUNCTION ILLEGAL_DATA_ADDRESS ILLEGAL_DATA_VALUE SLAVE_DEVICE_FAILURE	NA-00040

Read/Write Holding Registers

These are 2 byte read/write values.

Use the "Pre-set Single Register" command (0x06) or the "Pre-set Multiple Registers" command (0x10) to write these registers.

Use the "Read Holding Registers" command (0x03) to read these registers.

Example 1: Write Single – Writing 1 register starting from Register Offset 100 will require two data bytes to be sent. The first byte will be the most significant byte of Register Offset 100 and the second byte will be the least significant byte.

Example 2: Write Multiple – Writing 2 registers starting from Register Offset 100 will require four data bytes to be sent. The first byte will be the most significant byte of Register Offset 100, the second byte will be the least significant byte of Register Offset 100, the third byte will be the most significant byte of Register Offset 101, and the fourth byte will be the least significant byte of Register Offset 101.

Register Address (Offset)	Names & Values	Description	Version Supported
40100 (99)	Start/Stop Register Set register to decimal 1234 to start BMS Set register to decimal 4321 to stop BMS	This register is used to remotely stop or start a single BMS, and will clear when the command is accepted. To start an entire appliance, send the same start command to every BMS in the appliance within a 10 second window.	NA-00019
40101 (100)	Process Temp Setpoint Change Request -50°C (-58°F) to 1350°C (2462°F)	This register is used to request the BMS to change the Process Temperature Setpoint to the specified value. Read register 30008/40008 to verify that the change was accepted.	NA-00029
40102 (101)	Low Fire Setpoint Change Request -50°C (-58°F) to 1350°C (2462°F)	This register is used to request the BMS to change the Low Fire Setpoint to the specified value. Read register 30009/40009 to verify that the change was accepted.	NA-00029
40103 (102)	Pilot Off Setpoint Change Request -50°C (-58°F) to 1350°C (2462°F)	This register is used to request the BMS to change the Pilot Off Setpoint to the specified value. Read register 300010/400010 to verify that the change was accepted.	NA-00029

Register Address (Offset)	Names & Values	Description	Version Supported
40104 (103)	Low Temperature Setpoint Change Request -50°C (-58°F) to 1350°C (2462°F)	This register is used to request the BMS to change the Low Temperature Setpoint to the specified value. Read register 300017/400017 to verify that the change was accepted.	NA-00029
40143(142)	Clear Shutdown Code - Set register value to 1 to acknowledge shutdown.	This register is used to acknowledge a shutdown and return system to ready state.	NA-00039.5
40160 (159)	Temperature Unit Change Request Set register value to 0 to set to °Celsius. Set register value to 1 to set the °Fahrenheit.	The register is used to request the Modbus card to change the temperature unit for reported values. Read register 300060/400060 to verify that the change was accepted.	NA-00029

3. PROFIRE Contact Information

If you have any concerns or questions about this product, please contact PROFIRE as follows:

US

1.801.796.5127
321 South, 1250 West Suite 1
Lindon, UT
84042, USA

solutions@profireenergy.com

CANADA

1.780.960.5278
Box 3313, Bay 12, 55 Alberta Ave
Spruce Grove, AB
T7X 3A6, Canada

solutions@profireenergy.com

www.profireenergy.com

4. Document Revision History

Revision	Date	Name	Description of Changes
v1.0	12-Apr-16	C. Shaw	Initial release.
v1.1	25-Apr-16	C. Shaw	Added registers for valve status, as well as 4-20 Aux Output percentage and Shutdown code.
v1.2	25-Apr-16	C. Shaw	Added registers for dry contact switch inputs.
v1.3	25-Apr-16	C. Shaw	Added auto-baud, temperature unit configurability, TX and RX LED indicators, and made a few minor updates in the information/communications sections. Added registers to both the read-only and read-write register sections for release NA-00029.
v1.4	29-Jul-16	C. Shaw	Minor formatting changes.
v1.5	26-Sep-17	E. Hunter	Major formatting changes. General update.
v1.6	28-Feb-18	E. Hunter	Minor update to table.
v1.7	28-Mar-18	E. Hunter	Major updates to tables.
V1.8	28-Mar-18	R. Baron	Formatting update