APC

APPLICATION NOTE #70

InfraStruXure® Manager v.4x
Building Management System Integration

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Abstract

Building Management Systems (BMS) are implemented in a building's infrastructure to collect data of assorted managed devices that comprise this infrastructure. Some examples of the devices that the BMS would monitor could include generators, computer room air conditioners (CRAC), uninterruptible power supply (UPS), power distribution units (PDU), fire sensors, or building switchgear. The BMS itself is typically a stand-alone computer that contains a Modbus software program and a hardware interface used to connect it to the monitored devices. This program is designed specifically for each application, as each building infrastructure is unique and the monitoring points may be different for each device. A master-slave type system exists between the BMS and the connected devices. There is one node (the master node or BMS) that requests data from one of the "slave" nodes (connected devices) and then translates the responses into readable data. Slave nodes will not typically transmit data without a request from the master node, and do not communicate with other slaves. The Modbus protocol is a standard in the industry and is supported by almost all of the BMS vendors. APC integrates Modbus RTU over a RS-485 serial connection for InfraStruXure Manager's communication with a BMS (e.g. Johnson Controls' Metasys™, Siemens' APOGEE™, ALC's WebCTRL™, etc.). This paper explains the integration of APC InfraStruXure Manager Server Appliance v4.x with a Building Management System.

Modbus Protocol

Modbus is an application layer messaging protocol, which provides client/server communication between devices connected on different types of buses or networks within a building's infrastructure. There are few different types of the Modbus protocol, which include Modbus TCP (TCP/IP binary), Modbus (serial ASCII), and Modbus RTU (serial binary). For the discussion in this application note, InfraStruXure Manager uses the Modbus RTU (Remote Terminal Unit) protocol. Modbus RTU communication is most commonly used in the industry, because the transmission of binary data is smaller in packet size compared to the transmission of data in the ASCII format and Modbus TCP has not yet been widely implemented by BMS vendors.

Communication Interface

The InfraStruXure Manager uses a RS-485 serial interface. The RS-485 serial interface allows for longer cable lengths and can be networked. This is an advantage over a RS-232 serial interface, which would allow for a shorter communication distance between devices and the BMS and RS-232 only supports point-to-point connections. InfraStruXure Manager's RS-485 port also supports half-duplex communication, which requires a 2-wire cable.

The following table identifies the active pins for a 9-pin, female (InfraStruXure Manager DB9-F) connector, for connection to the RS-485 port and the BMS.

InfraStruXure Manager DB9 F-Pin	RS-485 Signal
1	Not Used
2	Not Used
3	RxD/TxD+
4	Ground
5	Not Used
6	Ground
7	Not Used
8	RxD/TxD-
9	Not Used
Shell	Chassis Ground

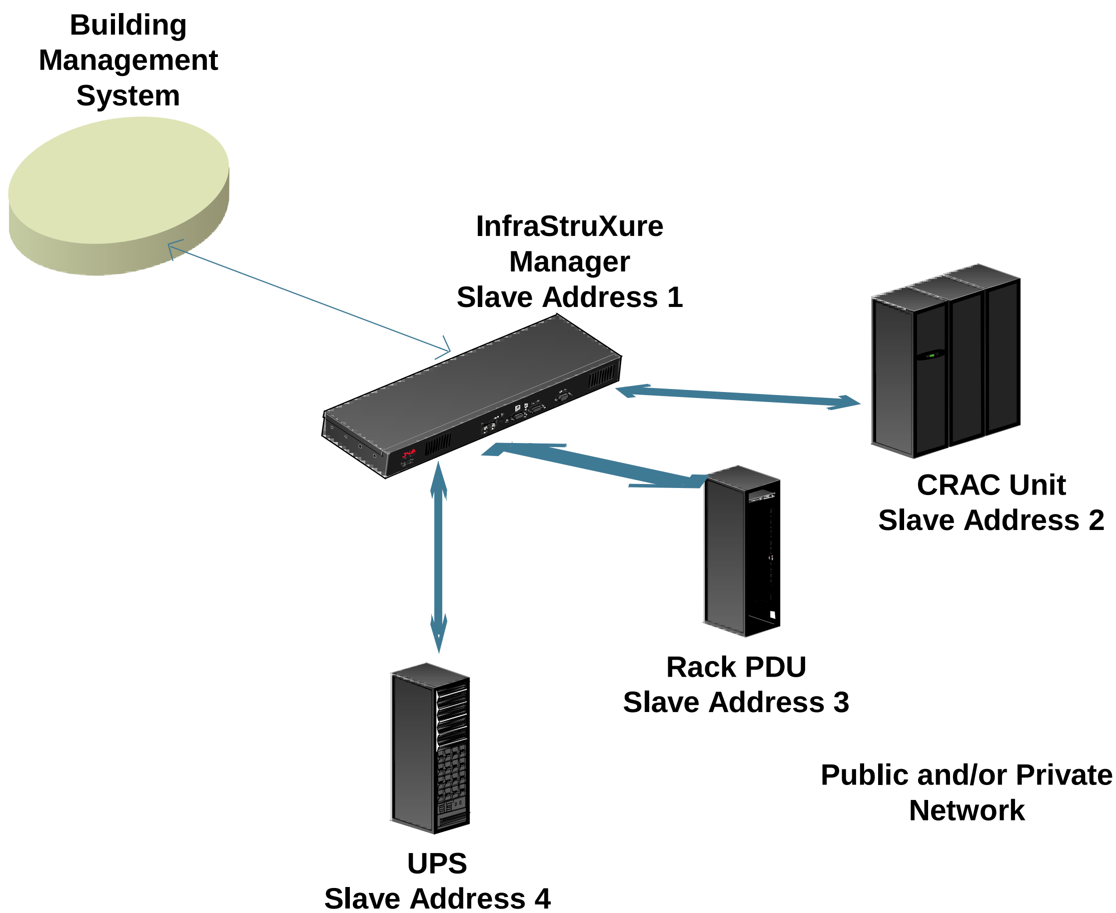
The Modbus RTU protocol has certain specifications, which enable the BMS to communicate with InfraStruXure Manager. BMS systems generally transmit data at either a 19200 or a 9600 baud rate of which InfraStruXure Manager can be configured with either. This configuration depends on the data transmission speed of the BMS. To ensure proper communication and data transmission between InfraStruXure Manager and the BMS, the following settings also need to be configured on the BMS:

8 data bits
1 stop bit
Even Parity

Note: Any data transmission errors could be a result of incorrect communication settings.

Communication between InfraStruXure Manager and the BMS

As stated previously, InfraStruXure Manager is connected to the BMS through a RS-485 port located on the server appliance. InfraStruXure Manager monitors the connected APC devices on the Public LAN or on the on the APC LAN, which is a private Ethernet connection. This allows for only one connection between the BMS and InfraStruXure Manager, instead of multiple connections to each monitored device. InfraStruXure Manager then becomes the gateway for all information the BMS would request. When BMS support is enabled in the InfraStruXure Manager (this service is disabled by default), each device on the public and private network is added to a list of devices available for Modbus monitoring. As the devices are added to InfraStruXure Manager, the user has the ability to add devices, to be monitored up to a maximum of 247. The devices are assigned a slave address (1-247), which serves as a unique identifier for the individual data points of each device. The BMS is then configured to request data from each of these devices as if it were connected directly to them.



In the current integration of InfraStruXure Manager and BMS systems, there is support for Modbus Function Code 04 (Read Input Registers) and Modbus Function Code 16 (Mask Write Registers). The communication between a BMS and connected devices, involves Read Input Registers, Queries, and Responses. These are explained below:

Below is a passage from the Modbus Technical Spec Chapter 2, Data and Control Functions, detailing each function.

Read Input Registers

Reads the binary contents of input registers (3X references) in the slave. Broadcast is not supported. The maximum parameters supported by various controller models are listed below.

Query

The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero- registers 1 ... 16 are addressed as 0 ... 15.

Here is an example of a request to read register 30009 from slave device 17:

Field Name	Example (Hex)
Slave Address	11
Function	04
Starting Address Hi	00
Starting Address Lo	08
Number of Points Hi	00
Number of Points Lo	01
Error Check (LRC or CRC)	--

Response

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high-order bits and the second contains the low-order bits. Data is scanned in the slave at the rate of 125 registers per scan for 984-X8X controllers (984-685, etc), and at the rate of 32 registers per scan for all other controllers. The response is returned when the data is completely assembled.

Here is an example of a response to the query above:

Field Name	Example (Hex)
Slave Address	11
Function	04
Byte Count	02
Data Hi (Register 30009)	00
Data Lo (Register 30009)	0A
Error Check (LRC or CRC)	--

The contents of register 30009 are shown as the two byte values of 00 0A hex, or 10 decimal.

Mask Write Registers

Modifies the contents of a specified 4*x* register using a combination of an AND mask, an OR mask, and the register's current contents. The function can be used to set or clear individual bits in the register. Broadcast is not supported.

Query

The query specifies the 4*x* reference to be written, the data to be used as the AND mask, and the data to be used as the OR mask.

Here is an example of a Mask Write to register 5 from slave device 17:

Field Name	Example (Hex)
Slave Address	11
Function	16
Reference Address Hi	00
Reference Address Lo	04
And_Mask Hi And_Mask Low	00 F2
Or_Mask Hi	00
Or_Mask Lo Error Check (LRC or CRC)	25 --

Response

The normal response is an echo of the query. The response is returned after the register has been written.

Here is an example of a response to the query above:

Field Name	Example (Hex)
Slave Address	11
Function	16
Reference Address Hi	00
Reference Address Lo	04
And_Mask Hi And_Mask Low	00 F2
Or_Mask Hi	00
Or_Mask Lo	25
Error Check (LRC or CRC)	--

Floating point numbers

Modbus registers contain 16 bits of data. Because Modbus registers do not handle floating point numbers the float is converted to an int by multiplying it by 10, 100 or 1000 (depending on the number of decimal places) to preserve the precision.

Thus, in some of the valid responses there will be a note indicating that the response must be divided by 10, 100 or 1000 to yield the correct results.

Registers common to all device types

The following registers are found in each device type's data points:

The register address 30001 (0x00) is always the Device Type, which will allow the BMS to determine the layout of the rest of the register table and send the appropriate requests.

Queries of InfraStruXure Manager Data Points Notations

- Queries of Modbus registers should not be done in blocks, which include double byte and single byte responses. Blocks of register requests should be done in blocks that only include double byte or single byte responses. Register requests that are done in blocks which do include double and single byte responses, will result in an exception response for the entire block of registers.

- If an exception is generated for a register block request, a scan of all the registers will need to be performed on an individual basis. When it is determined which register is causing the exception, it will then need to be excluded from that register block request.

- The Building Management system should be set at a maximum to poll InfraStruXure Manager at a speed no faster than once per second. A polling rate high higher than this may results in failed data transmission or exceptions generated for the register responses.

- The Building Management System should not use a Modbus splitter as the BMS system only supports a single master device. Use of this splitter may result in unexpected register values or timeouts.

InfraStruXure Manager Data Points for non Modbus supported devices.

The following tables describe the data points available for each of the devices that do not directly support Modbus communication but support Modbus communication within InfraStruXure Manager.

How the tables are laid out

Each table contains the following columns:

- Register Address – this is the address of the Input Register at which the data resides. Included in parenthesis is the hex representation of that address which would appear in a Modbus packet (notice the hex representation is zero-based, as per the Modbus spec – see passage above).
- Description – a brief description of what the data at this address represents
- Units – the units, if any, of the data at this address

- Valid Responses – values which may be returned and their meanings

InfraStruXure Manager Device Data—APC Part #AP9420(U), AP9421(U), AP9422, AP9423(U), AP92200

The InfraStruXure Manager data points allow for a quick high level view of the system as a whole. The overall status of each device monitored by the InfraStruXure Manager can be obtained, as well as the status of InfraStruXure Manager itself. The InfraStruXure Manager status is equal to the most severe status of all its monitored devices. This allows for a tiered form of querying from the BMS. If the InfraStruXure Manager status is Informational, this means all its monitored devices are also in an Informational state, and no further querying needs to be done (unless desired). If the InfraStruXure Manager status is *Warning* or *Critical*, the offending device(s) can be found by scanning InfraStruXure Manager data points. That device can then be queried directly to find the source of the problem (note that different device types offer different levels of information available via Modbus at this time).

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	01 = InfraStruXure Manager
30002 thru 30248 (0x01 thru 0xF7)	Device Status of each device monitored by the InfraStruXure Manager (including the InfraStruXure Manager itself) 0x01 = Device status of device at slave address 01 0x02 = Device status of device at slave address 02 0x03 = Device status of device at slave address 03 etc.	NA	If the register relates to the InfraStruXure Manager: 00 = No Device Present 01 = Unknown Status 02 = Informational 03 = Warning 04 = Critical If the register relates to another device: 00 = Unknown / No Device Present 02 = Informational 04 = Warning 08 = Critical

Environmental Monitor Unit Device Data—APC Part # AP9312(T)(TH)

The Environmental Monitor Unit data points allow monitoring of the temperature and humidity of each of its two probes, as well as the overall device status.

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	09 = Environmental Monitor Unit

30002 (0x01)	Device Status	NA	00 = Unknown 02 = Informational 04 = Warning 08 = Critical
30003 (0x02)	Probe 1 Temperature	Degrees Celsius	0 – 6000 response must be divided by 100 to yield 0.00 – 60.00
30004 (0x03)	Probe 2 Temperature	Degrees Celsius	0 – 6000 response must be divided by 100 to yield 0.00 – 60.00
30005 (0x04)	Probe 1 Humidity	Percent	0 – 9500 response must be divided by 100 to yield 0.00 – 95.00
30006 (0x05)	Probe 2 Humidity	Percent	0 – 9500 response must be divided by 100 to yield 0.00 – 95.00

Automatic Transfer Switch (ATS) Device Data—APC Part # AP7701

The Automatic Transfer Switch's data points allow monitoring overall device status.

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	06 = Automatic Transfer Switch (Redundant Switch)
30002 (0x01)	Device Status	NA	00 = Unknown 02 = Informational 04 = Warning 08 = Critical

Metered and Switched Rack Power Distribution Unit (Rack PDU) Device Data

The Rack Power Distribution Unit data points allow monitoring overall device status.

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	0C or 0E = Rack Mount –Power Distribution Unit

30002 (0x01)	Device Status	NA	00 = Unknown 02 = Informational 04 = Warning 08 = Critical

InfraStruXure Power Distribution Unit (InfraStruXure PDU) Device Data

The Power Distribution Unit data points allow monitoring of many aspects of this device, from high level (Device Status) to mid level (Circuit Panel Input OverVoltage L1) to low level (Circuit Panel Input Voltage L1L2). The data points were set up to allow for a tiered form of querying from the BMS, with the state data points grouped together (30003 – 30029), followed by more detailed data points. If the PDU Device Status is Informational this means all its values are within user defined thresholds or normal range, and no further querying needs to be done (unless desired). If the PDU Device Status is *Warning* or *Critical* the state data points can all be gathered in one request to determine the cause of the problem. Data pertaining to portions of the device which may vary from model to model (i.e. Breakers) is kept at the end of the data points table, as these data points are dynamically allocated register addresses. This keeps the addressing scheme of the remainder of the table intact.

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	0D = Power Distribution Unit
30002 (0x01)	Device Status	NA	00 = Unknown 02 = Informational 04 = Warning 08 = Critical
30003 (0x02)	Communication State If communications are not established with the device the responses of the remainder of the data points are deemed stale and should not be considered accurate until communications are established again.	NA	00 = No Comm Established 01 = Agent Comm. Established 02 = Device Comm. Established
30004 (0x03)	Transformer Input: Undervoltage L1 transformer input's low voltage threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30005 (0x04)	Transformer Input: Overvoltage L1 transformer input's high voltage threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30006	Transformer Input: Undervoltage L2	NA	00 = Unknown State

(0x05)	transformer input's low voltage threshold exceeded on phase 2		01 = True State 02 = False State
30007 (0x06)	Transformer Input: Overvoltage L2 transformer input's high voltage threshold exceeded on phase 2	NA	00 = Unknown State 01 = True State 02 = False State
30008 (0x07)	Transformer Input: Undervoltage L3 transformer input's low voltage threshold exceeded on phase 3	NA	00 = Unknown State 01 = True State 02 = False State
30009 (0x08)	Transformer Input: Overvoltage L3 Transformer input's high voltage threshold exceeded on phase 3	NA	00 = Unknown State 01 = True State 02 = False State
30010 (0x09)	Transformer Input: Over Temp transformer input's high temperature threshold exceeded state	NA	00 = Unknown State 01 = True State 02 = False State
30011 (0x0A)	Ground Monitoring Point: Ground OverCurrent	NA	00 = Unknown State 01 = True State 02 = False State
30012 (0x0B)	Circuit Panel Input: UnderVoltage L1 Circuit panel input's low voltage threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30013 (0x0C)	Circuit Panel Input: OverVoltage L1 Circuit panel input's high voltage threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30014 (0x0D)	Circuit Panel Input: UnderVoltage L2 Circuit panel input's low voltage threshold exceeded on phase 2	NA	00 = Unknown State 01 = True State 02 = False State
30015 (0x0E)	Circuit Panel Input: OverVoltage L2 Circuit panel input's high voltage threshold exceeded on phase 2	NA	00 = Unknown State 01 = True State 02 = False State
30016 (0x0F)	Circuit Panel Input: UnderVoltage L3 Circuit panel input's low voltage threshold exceeded on phase 3	NA	00 = Unknown State 01 = True State 02 = False State
30017	Circuit Panel Input: OverVoltage L3	NA	00 = Unknown State

(0x10)	Circuit panel input's high voltage threshold exceeded on phase 3		01 = True State 02 = False State
30018 (0x11)	Circuit Panel Input: OverCurrent L1 Circuit panel input's high current threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30019 (0x12)	Circuit Panel Input: OverCurrent L2 Circuit panel input's high current threshold exceeded on phase 2	NA	00 = Unknown State 01 = True State 02 = False State
30020 (0x13)	Circuit Panel Input: OverCurrent L3 Circuit panel input's high current threshold exceeded on phase 3	NA	00 = Unknown State 01 = True State 02 = False State
30021 (0x14)	Circuit Panel Input: UnderCurrent L1 Circuit panel input's low current threshold exceeded on phase 1	NA	00 = Unknown State 01 = True State 02 = False State
30022 (0x15)	Circuit Panel Input: UnderCurrent L2 Circuit panel input's low current threshold exceeded on phase 2	NA	00 = Unknown State 01 = True State 02 = False State
30023 (0x16)	Circuit Panel Input: UnderCurrent L3 Circuit panel input's low current threshold exceeded on phase 3	NA	00 = Unknown State 01 = True State 02 = False State
30024 (0x17)	Circuit Panel Input: Frequency Out Of Range Circuit panel input's frequency is outside normal range	NA	00 = Unknown State 01 = True State 02 = False State
30025 (0x18)	Circuit Panel Input: Neutral Overcurrent	NA	00 = Unknown State 01 = True State 02 = False State
30026	UPS Input: Voltage Lost L1	NA	00 = Unknown State

(0x19)	(UPS Input Fuse Problem) The UPS input voltage on phase 1 has dropped to 0		01 = True State 02 = False State
30027 (0x1A)	UPS Input: Voltage Lost L2 (UPS Input Fuse Problem) The UPS input voltage on phase 2 has dropped to 0	NA	00 = Unknown State 01 = True State 02 = False State
30028 (0x1B)	UPS Input: Voltage Lost L3 (UPS Input Fuse Problem) The UPS input voltage on phase 3 has dropped to 0	NA	00 = Unknown State 01 = True State 02 = False State
30029 (0x1C)	PowerFlow Bypass: Status	NA	00 = Unknown 01 = UPS Operation Mode 02 = System Off Mode 03 = On Battery Mode 04 = Maintenance Bypass Mode 05 = Atypical Bypass Mode 06 = No Panel Feed Mode 07 = Forced Bypass Mode
30030 (0x1D)	Service Type	NA	00 = Delta 01 = WYE
30031 (0x1E)	Utility Input: Voltage Voltage coming in from the power utility	Volts	120 – 600
30032 (0x1F)	Load Tie Present	NA	00 = Not Present 01 = Present
30033 (0x20)	Load Test Present	NA	00 = Not Present 01 = Present
30034 (0x21)	Main Input: Position	NA	00 = Closed 01 = Open
30035 (0x22)	Main Input: Rating	Amps	0 – 32767
30036 (0x23)	Bypass: Position Q1	NA	00 = Closed 01 = Open
30037 (0x24)	Bypass: Position Q2	NA	00 = Closed 01 = Open
30038	Bypass: Position Q3	NA	00 = Closed

(0x25)			01 = Open
30039 (0x26)	Bypass: Rating Q2	Amps	80 – 400
30040 (0x27)	Bypass: Rating Q3	Amps	80 – 400
30041 (0x28)	Cross Tie Breaker	NA	00 = Closed 01 = Open
30042 (0x29)	Power Flow: Panel Rating	Amps	0 – 32767 response must be divided by 10
30043 (0x2A)	Power Flow: EPO Mode	NA	00 = Disarmed 01 = Armed
30044 (0x2B)	Transformer Input: Voltage L1L2 Transformer input's voltage between phases 1 and 2	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30045 (0x2C)	Transformer Input: Voltage L2L3 Transformer input's voltage between phases 2 and 3	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30046 (0x2D)	Transformer Input: Voltage L3L1 Transformer input's voltage between phases 3 and 1	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30047 (0x2E)	Transformer Input: Voltage L1N Transformer input's voltage between phases 1 and Neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30048 (0x2F)	Transformer Input: Voltage L2N Transformer input's voltage between phases 2 and Neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30049 (0x30)	Transformer Input: Voltage L3N Transformer input's voltage between phases 3 and Neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30050 (0x31)	Transformer Input: Frequency	Hz	0 – 999 response must be divided by 10 to yield 0.0 – 99.9
30051 (0x32)	Transformer Input: Under Voltage Threshold	Percent	0 – 30
30052 (0x33)	Transformer Input: Over Voltage Threshold	Percent	0 – 30
30053	Circuit Panel Input: Current L1	Amps	0 – 9999

(0x34)	Circuit panel input's phase 1 current		response must be divided by 10 to yield 0.0 – 999.9
30054 (0x35)	Circuit Panel Input: Current L2 Circuit panel input's phase 2 current	Amps	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30055 (0x36)	Circuit Panel Input: Current L3 Circuit panel input's phase 3 current	Amps	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30056 (0x37)	Circuit Panel Input: Current Neutral Circuit panel input's neutral current	Amps	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30057 (0x38)	Circuit Panel Input: Power L1 Circuit panel input's phase 1 power	kW	0 – 32767 response must be divided by 10
30058 (0x39)	Circuit Panel Input: Power L2 Circuit panel input's phase 2 power	kW	0 – 32767 response must be divided by 10
30059 (0x3A)	Circuit Panel Input: Power L3 Circuit panel input's phase 3 power	kW	0 – 32767 response must be divided by 10
30060 (0x3B)	Circuit Panel Input: Total Power Circuit panel input's total power	kW	0 – 32767 response must be divided by 10
30061 (0x3C)	Circuit Panel Input: Volt Amps L1 Circuit panel input's phase 1 volt amps	kVA	0 – 32767 response must be divided by 10
30062 (0x3D)	Circuit Panel Input: Volt Amps L2 Circuit panel input's phase 2 volt amps	kVA	0 – 32767 response must be divided by 10
30063 (0x3E)	Circuit Panel Input: Volt Amps L3 Circuit panel input's phase 3 volt amps	kVA	0 – 32767 response must be divided by 10
30064 (0x3F)	Circuit Panel Input: Total Volt Amps Circuit panel input's total volt amps	kVA	0 – 32767 response must be divided by 10
30065	Circuit Panel Input: Power Factor L1	NA	0 – 100

(0x40)	Circuit panel input's phase 1 power factor		response must be divided by 100 to yield 0 or 1
30066 (0x41)	Circuit Panel Input: Power Factor L2 Circuit panel input's phase 2 power factor	NA	0 – 100 response must be divided by 100 to yield 0 or 1
30067 (0x42)	Circuit Panel Input: Power Factor L3 Circuit panel input's phase 3 power factor	NA	0 – 100 response must be divided by 100 to yield 0 or 1
30068 (0x43)	Circuit Panel Input: Total Power Factor Circuit panel input's total power factor	NA	0 – 100 response must be divided by 100 to yield 0 or 1
30069 (0x44)	Circuit Panel Input: Voltage L1L2 Circuit panel input's voltage between phases 1 and 2	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30070 (0x45)	Circuit Panel Input: Voltage L2L3 Circuit panel input's voltage between phases 2 and 3	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30071 (0x46)	Circuit Panel Input: Voltage L3L1 Circuit panel input's voltage between phases 3 and 1	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30072 (0x47)	Circuit Panel Input: Voltage L1N Circuit panel input's voltage between phases 1 and neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30073 (0x48)	Circuit Panel Input: Voltage L2N Circuit panel input's voltage between phases 2 and neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30074 (0x49)	Circuit Panel Input: Voltage L3N Circuit panel input's voltage between phases 3 and neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30075 (0x4A)	Circuit Panel Input: Frequency	Hz	0 – 999 response must be divided by 10 to yield 0.0 – 99.9
30076 (0x4B)	Circuit Panel Input: Under Voltage Threshold	Percent	0 – 30
30077	Circuit Panel Input: Over Voltage Threshold	Percent	0 – 30

(0x4C)			
30078 (0x4D)	Circuit Panel Input: Under Current Threshold Phase	Percent	0 – 100
30079 (0x4E)	Circuit Panel Input: Over Current Threshold Phase	Percent	0 – 100
30080 (0x4F)	Circuit Panel Input: Over Current Threshold Neutral	Percent	0 – 100
30081 (0x50)	Circuit Panel Input: Frequency Threshold	Hz	00 - Off 01 - 0.2 Hz 02 - 0.5 Hz 03 - 1.0 Hz 04 - 1.5 Hz 05 - 2.0 Hz 06 - 3.0 Hz 07 - 4.0 Hz 08 - 5.0 Hz 09 - 9.0 Hz
30082 (0x51)	Ground Monitoring Point: Ground Current	Amps	0 – 50 response must be divided by 10 to yield 0.0 – 5.0
30083 (0x52)	Ground Monitoring Point: Ground Current Threshold	Amps	1 – 50 response must be divided by 10 to yield 1.0 – 5.0
30084 (0x53)	Cross Tie Point: Voltage L1L2 Cross Tie Point's voltage between phases 1 and 2	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30085 (0x54)	Cross Tie Point: Voltage L2L3 Cross Tie Point's voltage between phases 2 and 3	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30086 (0x55)	Cross Tie Point: Voltage L3L1 Cross Tie Point's voltage between phases 3 and 1	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30087 (0x56)	Cross Tie Point: Voltage L1N Cross Tie Point's voltage between phases 1 and neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30088	Cross Tie Point: Voltage L2N	Volts	0 – 9999

(0x57)	Cross Tie Point's voltage between phases 2 and neutral		response must be divided by 10 to yield 0.0 – 999.9
30089 (0x58)	Cross Tie Point: Voltage L3N Cross Tie Point's voltage between phases 3 and neutral	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30090 (0x59)	Contact Count	NA	0 - 4
30091 (0x5A)	Breaker Count	NA	0 - 84
30092 (0x5B)	Bypass Input Open	NA	00 = Unknown State 01 = True State 02 = False State

The following fields are generated dynamically based on the number of Contacts, thus they do not have hard coded addresses, but rather relative addresses. Contacts are 0 indexed for purposes of register addressing (i.e. 1st contact number is 0, 2nd contact number is 1, etc.). Thus if there are 0 contacts the following 3 data points would be skipped entirely and the next data point would be the Breaker Alarm State. If there are 2 contacts the data points would be:

30122 = Contact 1 State
30123 = Contact 1 Alarm State
30124 = Contact 1 Configuration
30125 = Contact 2 State
30126 = Contact 2 Alarm State
30127 = Contact 2 Configuration

The total number of contacts can be found above (Contact Count)

30122 (0x79) + (contact number X 3)	Contact: State Indicates if the contact is in an Active or Inactive state. Depending on the Contact Configuration (below) Active may be open or closed.	NA	00 = Active 01 = Inactive
30123 (0x7A) + (contact number X 3)	Contact: Alarm State	NA	00 = No Alarm 64 = Contact Abnormal
30124	Contact: Configuration	NA	00 = Active State is Closed

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<table>
<tr><td>(0x7B)
+
(contact number X 3)</td><td>This allows the user to determine if the contact's active state is open or closed.</td><td></td><td>01 = Active State is Open</td></tr>
<tr><td colspan="4">The following fields are generated dynamically based on the number of Breakers, thus they do not have hard coded addresses, but rather relative addresses. Breakers are 0 indexed for purposes of register addressing (i.e. 1st breaker number is 0, 2nd breaker number is 1, etc.). The Breaker addresses follow the Contact addresses, thus if there are 0 contacts Breaker Alarm State would be 30122. If there are 2 contacts Breaker Alarm State would be 30128. The Breaker addressing scheme works the same as the Contact addressing scheme. If there are 0 breakers, the next 6 data points would be skipped entirely. If there are 2 breakers the data points would be:

Breaker 1 Alarm State
Breaker 1 Rating
Breaker 1Tie Indicator
Breaker 1 Under Current Threshold
Breaker 1 Over Current Threshold
Breaker 1 Current
Breaker 2 Alarm State
Breaker 2 Rating
Breaker 2Tie Indicator
Breaker 2 Under Current Threshold
Breaker 2 Over Current Threshold
Breaker 2 Current

The total number of breakers can be found above (Breaker Count)</td></tr>
<tr><td>30122
(0x79)
+
(Contact Count X 3)
+
(breaker number X 6)</td><td>Breaker: Alarm State</td><td>NA</td><td>00 = No Alarms
01 = Undercurrent
02 = Overcurrent
03 = Alarm Conflict</td></tr>
</table>

30123 (0x7A) + (Contact Count X 3) + (breaker number X 6)	Breaker: Rating	Amps	0 – 60
30124 (0x7B) + (Contact Count X 3) + (breaker number X 6)	Breaker: Tie Indicator	NA	00 = No Tie Present 01 = Tie Present
30125 (0x7C) + (Contact Count X 3) + (breaker number X 6)	Breaker: Under Current Threshold	Amps	0 – 256
30126 (0x7D) + (Contact Count X 3) + (breaker number X 6)	Breaker: Over Current Threshold	Amps	0 – 256

30127 (0x7E) + (Contact Count X 3) + (breaker number X 6)	Breaker: Current	Amps	0 – 32767 40/60/80/150 kVA Unit: response must be divided by 100 to yield 0.00 – 32.767

Symmetra UPS Device Data

The Symmetra® data points allow monitoring of many aspects of this device, from high level (Device Status) to mid level (Output Voltage Threshold Exceeded) to low level (Output Voltage). The data points were set up to allow for a tiered form of querying from the BMS, with the state data points grouped together (30003 – 30069), followed by more detailed data points. If the Symmetra Device Status is Informational this means all its values are within user defined thresholds or normal range, and no further querying needs to be done (unless desired). If the Symmetra Device Status is *Warning* or *Critical* the state data points can all be gathered in one request to determine the cause of the problem. Data pertaining to portions of the device which may vary from model to model (i.e. Output Phases) is kept at the end of the data points table, as these data points are dynamically allocated register addresses. This keeps the addressing scheme of the remainder of the table intact.

Register Address	Description	Units	Valid Responses
30001 (0x00)	Device Type	NA	08 = Symmetra
30002 (0x01)	Device Status	NA	00 = Unknown 02 = Informational 04 = Warning 08 = Critical
30003 (0x02)	Communication State If communications are not established with the device the responses of the remainder of the data points are deemed stale and should not be considered accurate until communications are established again.	NA	00 = Comm Lost 01 = Comm Lost on Battery 02 = Comm. Established
30004 (0x03)	Power Failure (On Battery State)	NA	00 = Unknown State 01 = True State 02 = False State

APC Legendary Reliability®

30005 (0x04)	Runtime Violation	NA	00 = Unknown State 01 = True State 02 = False State
30006 (0x05)	Discharged Battery	NA	00 = Unknown State 01 = True State 02 = False State
30007 (0x06)	Low Battery	NA	00 = Unknown State 01 = True State 02 = False State
30008 (0x07)	Battery Voltage High	NA	00 = Unknown State 01 = True State 02 = False State
30009 (0x08)	Battery Failure	NA	00 = Unknown State 01 = True State 02 = False State
30010 (0x09)	Battery Charger Failure	NA	00 = Unknown State 01 = True State 02 = False State
30011 (0x0A)	No Batteries Found	NA	00 = Unknown State 01 = True State 02 = False State
30012 (0x0B)	Battery Temperature High	NA	00 = Unknown State 01 = True State 02 = False State
30013 (0x0C)	Output Voltage Out Of Range	NA	00 = Unknown State 01 = True State 02 = False State
30014 (0x0D)	Load (kVA) Alarm	NA	00 = Unknown State 01 = True State 02 = False State
30015 (0x0E)	Overloaded	NA	00 = Unknown State 01 = True State 02 = False State

30016 (0x0F)	Timed Sleep Mode	NA	00 = Unknown State 01 = True State 02 = False State
30017 (0x10)	UPS Off	NA	00 = Unknown State 01 = True State 02 = False State
30018 (0x11)	Self Test Result	NA	00 = Unknown 01 = Passed 02 = Failed
30019 (0x12)	Base Module Fan Failure	NA	00 = Unknown State 01 = True State 02 = False State
30020 (0x13)	System Level Fan Failure	NA	00 = Unknown State 01 = True State 02 = False State
30021 (0x14)	Power Module Failure	NA	00 = Unknown State 01 = True State 02 = False State
30022 (0x15)	No Working Power Modules	NA	00 = Unknown State 01 = True State 02 = False State
30023 (0x16)	In Forced Bypass	NA	00 = Unknown State 01 = True State 02 = False State
30024 (0x17)	Software Bypass	NA	00 = Unknown State 01 = True State 02 = False State
30025 (0x18)	Hardware Failure Bypass	NA	00 = Unknown State 01 = True State 02 = False State
30026 (0x19)	Overloaded Bypass	NA	00 = Unknown State 01 = True State 02 = False State

30027 (0x1A)	UPS Switch Bypass	NA	00 = Unknown State 01 = True State 02 = False State
30028 (0x1B)	Shutdown from Bypass	NA	00 = Unknown State 01 = True State 02 = False State
30029 (0x1C)	Base Module Bypass Power Supply Failure	NA	00 = Unknown State 01 = True State 02 = False State
30030 (0x1D)	Bypass Not In Range	NA	00 = Unknown State 01 = True State 02 = False State
30031 (0x1E)	Stuck In Bypass Mode	NA	00 = Unknown State 01 = True State 02 = False State
30032 (0x1F)	Stuck in On-Line Mode	NA	00 = Unknown State 01 = True State 02 = False State
30033 (0x20)	Maintenance Bypass Failure	NA	00 = Unknown State 01 = True State 02 = False State
30034 (0x21)	Backfeed Relay Open	NA	00 = Unknown State 01 = True State 02 = False State
30035 (0x22)	System Start Up Configuration Failure	NA	00 = Unknown State 01 = True State 02 = False State
30036 (0x23)	External DC Disconnect Switch Open	NA	00 = Unknown State 01 = True State 02 = False State
30037 (0x24)	DC Disconnect Switch Open	NA	00 = Unknown State 01 = True State 02 = False State

30038 (0x25)	Not Synchronized Fault	NA	00 = Unknown State 01 = True State 02 = False State
30039 (0x26)	Site Wiring Fault	NA	00 = Unknown State 01 = True State 02 = False State
30040 (0x27)	Internal Communications Failure	NA	00 = Unknown State 01 = True State 02 = False State
30041 (0x28)	Redundant Intelligence Module In Control	NA	00 = Unknown State 01 = True State 02 = False State
30042 (0x29)	Redundant Intelligence Module Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30043 (0x2A)	Redundant Intelligence Module Failed	NA	00 = Unknown State 01 = True State 02 = False State
30044 (0x2B)	Main Intelligence Module Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30045 (0x2C)	Main Intelligence Module Failed	NA	00 = Unknown State 01 = True State 02 = False State
30046 (0x2D)	Extended Run Frame Fault	NA	00 = Unknown State 01 = True State 02 = False State
30047 (0x2E)	Redundancy Lost	NA	00 = Unknown State 01 = True State 02 = False State
30048 (0x2F)	Redundancy Alarm (Below Threshold)	NA	00 = Unknown State 01 = True State 02 = False State
30049 (0x30)	InputDisconnectQ001 Status	NA	00 = Unknown 01 = Open 02 = Closed

30050 (0x31)	OutputDisconnectQ002 Status	NA	00 = Unknown 01 = Open 02 = Closed
30051 (0x32)	BypassQ003 Status	NA	00 = Unknown 01 = Open 02 = Closed
30052 (0x33)	External Switch Gear Communication Card Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30053 (0x34)	External Switch Gear Communication Card Failure	NA	00 = Unknown State 01 = True State 02 = False State
30054 (0x35)	Isolation Transformer Temperature High	NA	00 = Unknown State 01 = True State 02 = False State
30055 (0x36)	Internal DC Disconnect Switch Open	NA	00 = Unknown State 01 = True State 02 = False State
30056 (0x37)	Static Bypass Switch Module Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30057 (0x38)	Static Bypass Switch Module Failure	NA	00 = Unknown State 01 = True State 02 = False State
30058 (0x39)	System ID Card Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30059 (0x3A)	System ID Card Failure	NA	00 = Unknown State 01 = True State 02 = False State
30060 (0x3B)	System Power Supply Card Failure	NA	00 = Unknown State 01 = True State 02 = False State
30061 (0x3C)	Battery Monitor Card Failure	NA	00 = Unknown State 01 = True State 02 = False State

30062 (0x3D)	Battery Monitor Card Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30063 (0x3E)	XR Communication Card Presence	NA	00 = Unknown 01 = Inserted 02 = Removed
30064 (0x3F)	XR Communication Card Failure	NA	00 = Unknown State 01 = True State 02 = False State
30066 (0x41)	OutputPercentLoadState	NA	N/A
30067 (0x42)	ShuttingDown	NA	00 = False (Shutdown Not In Progress) 01 = True (Shutdown Is In Progress)
30068 (0x43)	Runtime Calibrating	NA	00 = Unknown State 01 = Runtime Calibration in Progress 02 = Runtime Calibration Complete
30069 (0x44)	Diagnostic State	NA	00 = Unknown State 01 = Self Test in Progress 02 = Self Test Complete 03 = Self Test Passed 04 = Self Test Failed
30070 (0x45)	Number Of Batteries	NA	1 - 144
30071 (0x46)	Number Of Bad Batteries	NA	1 – 144
30072 (0x47)	Low Runtime Threshold	Minutes	0 – 999
30073 (0x48)	Runtime Remaining	Minutes	0 – 9999

30074 (0x49)	Battery Capacity	Percent	0 – 1000 response must be divided by 10 to yield 0.0 – 100.0
30075 (0x4A)	Internal Battery Temp	Degrees Celsius	0 – 1000 response must be divided by 10 to yield 0.0 – 100.0
30076 (0x4B)	Nominal Battery Voltage	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30077 (0x4C)	Actual Battery Bus Voltage	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
30078 (0x4D)	Battery Current	Amps	-32768 to 32768 response must be divided by 10 to yield -3276.8 to 3276.8
30079 (0x4E)	Minimum Return Capacity	Percent	00 10 25 90
30080 (0x4F)	Low Battery Runtime	Minutes	02 05 07 10
30082 (0x51)	Input Line Fail Cause	NA	00 = No Transfers Have Occurred 01 = Detection of low utility voltage 02 = Detection of high utility voltage 03 = Unacceptable utility voltage rate of change 04 = Detection of a line voltage notch or spike 05 = Due to software command or UPS's test control

30083 (0x52)	Number Input Phases	NA	1-3
30084 (0x53)	Number Of Inputs	NA	1-2
30085 (0x54)	Input Frequency	Hz	0 – 9999 response must be divided by 100 to yield 0.00 – 99.99
30086 (0x55)	Number Of Outputs	NA	1
30087 (0x56)	Number Output Phases	NA	1-3
30089 (0x58)	Output Frequency	Hz	0 – 9999 response must be divided by 100 to yield 0.00 – 99.99
30090 (0x59)	Power Module Count	NA	**NOT SUPPORTED**
30091 (0x5A)	Current Redundancy (Fault Tolerance Level)	NA	0 - 8
30092 (0x5B)	Current Load Capability	kVA	0 – 999 response must be divided by 10 to yield 0.0 – 99.9
30093 (0x5C)	System Power Supply Count	NA	0 - 2

The following fields are generated dynamically based on the number of Inputs, thus they do not have hard coded addresses, but rather relative addresses. Inputs are 0 indexed for purposes of register addressing (i.e. 1st input number is 0, 2nd input number is 1, etc.).

For each input there is an Input Type. There is also an Input Voltage and Input Current per each phase of each input. The number of phases and the number of inputs are dynamic.

Input 1	Input Type	
	Phase 1	Input Voltage
		Input Current
	Phase 2	Input Voltage
		Input Current
	Phase 3	Input Voltage
		Input Current

Thus if there is 1 input with 3 phases the data points would be:

30095 = Input 1 Type

30096 = RESERVED

30097 = Input 1 Phase 1 Voltage

30098 = Input 1 Phase 1 Current

30099 = Input 1 Phase 2 Voltage

30100 = Input 1 Phase 2 Current

30101 = Input 1 Phase 3 Voltage

30102 = Input 1 Phase 3 Current

Thus if there are 2 inputs with 3 phases the data points would continue at:

30103 = Input 1 Type

30104 = RESERVED

30105 = Input 1 Phase 1 Voltage

30106 = Input 1 Phase 1 Current

30107 = Input 1 Phase 2 Voltage

30108 = Input 1 Phase 2 Current

30109 = Input 1 Phase 3 Voltage

30110 = Input 1 Phase 3 Current

Note:

- The Output data points would start at 30103 for a single input 3 phase UPS.
- The Output data points would start at 30099 for a single phase UPS.
- The Output data points would start at 30111 for a dual input 3 phase UPS

	Input Type	NA	01 = Unknown 02 = Main 03 = Bypass
	Input Voltage	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
	Input Current	Amps	0 – 9999 response must be divided by 100 to yield 0.00 – 99.99

The following fields are generated dynamically based on the number of Outputs, thus they do not have hard coded addresses, but rather relative addresses. Outputs are 0 indexed for purposes of register addressing (i.e. 1st output number is 0, 2nd output number is 1, etc.)

For each output phase there is an Output Voltage, Output Current, Output Max Current, Output Load, Output Percent Load and Output Percent Power. The number of phases and the number of outputs are dynamic.

Output 1	Phase 1	Output Voltage
		Output Current
		Output Max Current
		Output Load
		Output Percent Load
		Output Percent Power
	Phase 2	Output Voltage
		Output Current
		Output Max Current
		Output Load
		Output Percent Load
		Output Percent Power
	Phase 3	Output Voltage
		Output Current
		Output Max Current
		Output Load
		Output Percent Load
		Output Percent Power

	Output Voltage	Volts	0 – 9999 response must be divided by 10 to yield 0.0 – 999.9
	Output Current	Amps	0 – 999 response must be divided by 10 to yield 0.0 – 99.9

	Output Max Current	Amps	0 – 999 response must be divided by 10 to yield 0.0 – 99.9
	Output Load	VoltAmps	0 - 9999 response must be divided by 10 to yield 0.0 – 999.9
	Output Percent Load	Percent	0 – 100
	Output Percent Power	Percent	0 – 100

InfraStruXure Manager Data Points for Modbus supported devices.

The following tables describe the data points available for each of the devices supporting Modbus communication within InfraStruXure Manager. These devices support Modbus communication directly, which means InfraStruXure Manager uses the register maps provided for each device.

In Row RC Device Data

The In Row RC data points allow monitoring of many aspects of this device, from high level (Device Status) to mid level (High Fluid Temperature) to low level (Supply Air Set point). This device does support Mask Write Registers.

Absolute Starting Register Number, (Hexadecimal)	Absolute Starting Register Number, (Decimal)	Data Point	R/W	Units	Valid Response
0000	0	OVERALL_STATUS	R	ENUM	0 = No Alarm 2 = Informational 4 = Warning 8 = Critical
0001	1	GROUP_COOL_OUTPUT	R	LONG	(Tenths) kW
0003	3	GROUP_COOL_DEMAND	R	LONG	(Tenths) kW
0005	5	COOL_SETPOINT	R/W	LONG	(Tenths Deg) F
0007	7	SUPPLY_AIR_SETPOINT	R/W	LONG	(Tenths Deg) F
0009	9	GROUP_AIR_FLOW	R	LONG	CFM
000B	11	GROUP_MAX_RACK_TEMP	R	LONG	(Tenths Deg) F
000D	13	GROUP_MIN_RACK_TEMP	R	LONG	(Tenths Deg) F
000F	15	FAN_SPEED_PREFERENCE	R/W	ENUM	0 = Low 1 = Med-Low 2 = Med

					3 = Med-High 4 = High
0010	16	NUM_OF_UNITS	R/W	LONG	N/A
0012	18	CONFIGURATION_TYPE	R/W	ENUM	0 = RACS 1 = HACS 2 = InRow
0013	19	COOL_PID_P	R/W	LONG	(Hundredths) Unitless
0015	21	COOL_PID_I	R/W	LONG	(Hundredths) Unitless
0017	23	COOL_PID_D	R/W	LONG	(Hundredths) Unitless
0019	25	PERCENT_GLYCOL	R/W	LONG	%
InRow RC Unit					
0080	128	UNIT_NAME	R/W	ASCII	N/A
0095	149	UNIT_LOCATION	R/W	ASCII	N/A
00AA	170	UNIT_ID	R/W	LONG	N/A
00AC	172	MODEL_NUM	R	ASCII	N/A
00B6	182	SERIAL_NUM	R	ASCII	N/A
00C0	192	FIRMWARE_REV	R	ASCII	N/A
00C4	196	HARDWARE_REV	R	ASCII	N/A
00C8	200	DATE_OF_MANUFACTURE	R	ASCII	mm/dd/yyyy
00CE	206	OPERATE_MODE	R	ENUM	0 = Standby 1 = On 2 = Idle
00CF	207	UNIT_COOL_OUTPUT	R	LONG	(Tenths) kW
00D1	209	UNIT_COOL_DEMAND	R	LONG	(Tenths) kW
00D3	211	RACK_INLET_TEMP	R	LONG	(Tenths Deg) F
00D5	213	SUPPLY_TEMP	R	LONG	(Tenths Deg) F
00D7	215	RETURN_TEMP	R	LONG	(Tenths Deg) F
00D9	217	UNIT_AIR_FLOW	R	LONG	CFM
00DB	219	FAN_SPEED	R	LONG	(Tenths) %
00DD	221	ACTIVE_POWER_SOURCE	R	ENUM	0 = A 1 = B
00DE	222	FILTER_DP	R	LONG	(Hundredths) in W.C.
00E0	224	CONTAINMENT_DP	R	LONG	(Hundredths) in W.C.
00E2	226	FLUID_VALVE_POS	R	LONG	% Open
00E4	228	FLUID_FLOW	R	LONG	(Tenths) GPM
00E6	230	FLUID_TEMP_IN	R	LONG	(Tenths Deg) F

00E8	232	FLUID_TEMP_OUT	R	LONG	(Tenths Deg) F
00EA	234	AIR_FILTER_RUNHOUR	R	LONG	Hours
00EC	236	FAN_1_RUNHOUR	R	LONG	Hours
00EE	238	FAN_2_RUNHOUR	R	LONG	Hours
00F0	240	FAN_3_RUNHOUR	R	LONG	Hours
00F2	242	FAN_4_RUNHOUR	R	LONG	Hours
00F4	244	FAN_5_RUNHOUR	R	LONG	Hours
00F6	246	FAN_6_RUNHOUR	R	LONG	Hours
00F8	248	FAN_7_RUNHOUR	R	LONG	Hours
00FA	250	FAN_8_RUNHOUR	R	LONG	Hours
00FC	252	FAN_LEFT_PWRSP_RUNHOUR	R	LONG	Hours
00FE	254	FAN_RIGHT_PWRSP_RUNHOUR	R	LONG	Hours
0100	256	CONDS_PUMP_RUNHOUR	R	LONG	Hours
0102	258	AIR_FILTER_SERVICE_INTERVAL	R/W	LONG	Weeks
0104	260	AIR_FILTER_SERVICE_INTERVAL_ ALARM	R/W	ENUM	0 = Enable 1 = Disable
0105	261	RACK_TEMP_HIGH_THRESH	R/W	LONG	(Tenths Deg) F
0107	263	SPLY_AIR_TEMP_HIGH_THRESH	R/W	LONG	(Tenths Deg) F
0109	265	RTN_AIR_TEMP_HIGH_THRESH	R/W	LONG	(Tenths Deg) F
010B	267	IN_FLUID_TEMP_HIGH_THRESH	R/W	LONG	(Tenths Deg) F
010D	269	STARTUP_DELAY	R/W	LONG	Seconds
010F	271	COOL_CAPACITY	R/W	ENUM	0 = Automatic 1 = Maximum
0110	272	IDLE_ON_LEAK	R/W	ENUM	0 = Yes 1 = No
0111	273	INPUT_NORMAL	R/W	ENUM	0 = Open 1 = Closed
0112	274	INPUT_STATE	R	ENUM	0 = Open 1 = Closed
0113	275	OUTPUT_NORMAL	R/W	ENUM	0 = Open 1 = Closed
0114	276	OUTPUT_STATE	R	ENUM	0 = Open 1 = Closed
0115	277	OUTPUT_SOURCE	R/W	ENUM	0 = Any Alarm 1 = Critical Alarms

0116	278	POWER_SOURCE	R/W	ENUM	0 = A only 1 = B only 2 = A & B
InRow RC Faults					
0180	384	INTERNAL_COMM_FAULT	R	ENUM	0 = Clear 1 = Alarm
0181	385	ALINK_ISOLATION_RELAY_FAULT	R	ENUM	0 = Clear 1 = Alarm
0182	386	COOL_FAIL	R	ENUM	0 = Clear 1 = Alarm
0183	387	HIGH_RACK_TEMP	R	ENUM	0 = Clear 1 = Alarm
0184	388	AIR_FILTER_CLOGGED	R	ENUM	0 = Clear 1 = Alarm
0185	389	LWR_RTN_AIR_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
0186	390	UPR_RTN_AIR_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
0187	391	LWR_SPLY_AIR_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
0188	392	UPR_SPLY_AIR_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
0189	393	RACK_TEMP_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
018A	394	FLUID_VALVE_ACT_FAULT	R	ENUM	0 = Clear 1 = Alarm
018B	395	FAN_1_FAULT	R	ENUM	0 = Clear 1 = Alarm
018C	396	FAN_2_FAULT	R	ENUM	0 = Clear 1 = Alarm
018D	397	FAN_3_FAULT	R	ENUM	0 = Clear 1 = Alarm
018E	398	FAN_4_FAULT	R	ENUM	0 = Clear 1 = Alarm

018F	399	FAN_5_FAULT	R	ENUM	0 = Clear 1 = Alarm
0190	400	FAN_6_FAULT	R	ENUM	0 = Clear 1 = Alarm
0191	401	FAN_7_FAULT	R	ENUM	0 = Clear 1 = Alarm
0192	402	FAN_8_FAULT	R	ENUM	0 = Clear 1 = Alarm
0193	403	WATER_DETECTED	R	ENUM	0 = Clear 1 = Alarm
0194	404	CONDS_PUMP_FAULT	R	ENUM	0 = Clear 1 = Alarm
0195	405	FLUID_FLOW_FAULT	R	ENUM	0 = Clear 1 = Alarm
0196	406	HIGH_FLUID_TEMP_IN	R	ENUM	0 = Clear 1 = Alarm
0197	407	IN_FLUID_TEMP_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
0198	408	OUT_FLUID_TEMP_SENSOR_FAUL T	R	ENUM	0 = Clear 1 = Alarm
0199	409	CONDENSATE_PAN_FULL	R	ENUM	0 = Clear 1 = Alarm
019A	410	POWER_SOURCE_A_FAIL	R	ENUM	0 = Clear 1 = Alarm
019B	411	POWER_SOURCE_B_FAIL	R	ENUM	0 = Clear 1 = Alarm
019C	412	FAN_PWRSP_LEFT_FAULT	R	ENUM	0 = Clear 1 = Alarm
019D	413	FAN_PWRSP_RIGHT_FAULT	R	ENUM	0 = Clear 1 = Alarm
019E	414	AIR_FILTER_RUNHOUR_VIOLATIO N	R	ENUM	0 = Clear 1 = Alarm
019F	415	DP_RACS_HIGH_FAULT	R	ENUM	0 = Clear 1 = Alarm

01A0	416	INPUT_CONTACT_FAULT	R	ENUM	0 = Clear 1 = Alarm
01A1	417	GROUP_COMM_FAULT	R	ENUM	0 = Clear 1 = Alarm
01A2	418	SUPPLY_HIGH_TEMP_FAULT	R	ENUM	0 = Clear 1 = Alarm
01A3	419	RETURN_HIGH_TEMP_FAULT	R	ENUM	0 = Clear 1 = Alarm
01A4	420	DP_FILTER_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
01A5	421	DP_CONTAINMENT_SENSOR_FAULT	R	ENUM	0 = Clear 1 = Alarm
Logging Registers					
FFEE	65518	APC RX CRC ERRORS	R	LONG	RX CRC ERRORS
FFF0	65520	APC RX PACKET COUNTER	R	LONG	RX PACKET COUNTER
FFF2	65522	APC TX PACKET COUNTER	R	LONG	TX PACKET COUNTER
FFF4	65524	APC SER FRAME ERRORS	R	LONG	SER FRAME ERRORS
FFF6	65526	APC SER OVERRUN ERRORS	R	LONG	SER OVERRUN ERRORS
FFF8	65528	APC SER PARITY ERRORS	R	LONG	SER PARITY ERRORS
FFFA	65530	APC SER RX15 ERRORS	R	LONG	SER RX15 ERRORS
FFFC	65532	APC SER RX35 ERRORS	R	LONG	SER RX35 ERRORS
FFFE	65534	APC SER BAUD RATE	R	INTEGER	SER BAUD RATE
Note 1: ASCII strings include Null terminator.					
Note 2: To prevent Building Management Service and automated script difficulties, accesses to data points on unsupported units will return a value of 0 instead of an error.					
Note 3: Accesses to items before data is available will result in an invalid address error.					

Conclusion

InfraStruXure Manager is designed to communicate with a BMS system using the Modbus RTU protocol. The Modbus protocol is a standard in the industry and is supported by almost all BMS vendors. All APC devices monitored are connected to the InfraStruXure Manager through the Public LAN or the APC LAN, which is a private Ethernet connection. InfraStruXure Manager then becomes the gateway for all information the BMS would request.

InfraStruXure Manager Appliance

InfraStruXure Manager appliance provide centralized management for all of APC Network Critical Physical Infrastructure (NCPI) devices, and can forward this information via the included Modbus port to RSView (note: this Modbus support primarily provides monitoring capability only, not control (control is only possible currently for APC cooling units). APC highly recommends anyone considering Modbus integration should consider using InfraStruXure Manager since its Modbus support spans the entire APC product range and also provides many features that are complementary to RSView. If control is required for UPSs, etc., then see the following links for information on how to integrate directly with each individual device:

APC UPS Building Management System Integration Card

This card can be used with all APC UPSs except Symmetra Megawatt which includes its own built-in Modbus support.

Product information including manuals:: http://www.apcc.com/products/family/index.cfm?id=34&tab=features#anchor1

APC Battery Management System Modbus Register Map

Manuals and Modbus register map:: http://www.apcc.com/resource/include/techspec_index.cfm?base_sku=AP9921X&tab=documentation

APC InfraStruXure InRow RC Modbus Register Map

Manuals and Modbus register map: http://www.apcc.com/prod_docs/results.cfm?class=user&product=339

APC Symmetra Megawatt Modbus Register Map

Manuals: http://www.apcc.com/prod_docs/results.cfm?class=user&product=185

References

- www.modbus.org
- Honeywell (2003), Modbus Serial Communications User Manual
- Richard George (2001), Modbus RTU vs. Modbus ASCII, www.control.com/993480352/index_html

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