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APPLICATION NOTE #156

StruxureWare Data Center Expert v7.2.0
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 software program used to collect data and a hardware interface used to connect it to the monitored devices. This software 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.

Modbus Protocol

The Modbus protocol is a standard in the buildings industry and is supported by many BMS vendors. Modbus is an application layer messaging protocol, which provides client/server communication between devices connected on different types of buses or networks, typically within a building's infrastructure. There are a few different types of the Modbus protocols, which include Modbus TCP (TCP/IP binary), Modbus (serial ASCII), and Modbus RTU (serial binary). For the discussion in this application note, StruxureWare Data Center Expert uses the Modbus TCP protocol. Modbus TCP communication is becoming more common in the industry, because Modbus TCP/IP simply takes the Modbus instruction set and wraps TCP/IP around it. Implementation costs are exceptionally low and minimum hardware is required, which is why the industry is more and more adopting Modbus TCP as a standard.

Schneider Electric integrates Modbus TCP over an Ethernet connection for StruxureWare Data Center Expert's communication with a BMS (e.g. TAC Andover Continuum™ and TAC Vista™, Johnson Controls' Metasys™, Siemens' APOGEE™, ALC's WebCTRL™, etc.). This paper explains the integration of the Schneider Electric StruxureWare Data Center Expert v7.2.0 server appliance with a Building Management System.

> Note: APC and TAC are subsidiaries of Schneider Electric and have tested and integrated StruxureWare Data Center Expert's Modbus TCP with T.A.C. Andover Continuum™ and Vista™. The integration of these management systems provides the ability to correlate the physical infrastructure of the data center "white space" with the supporting building infrastructure.
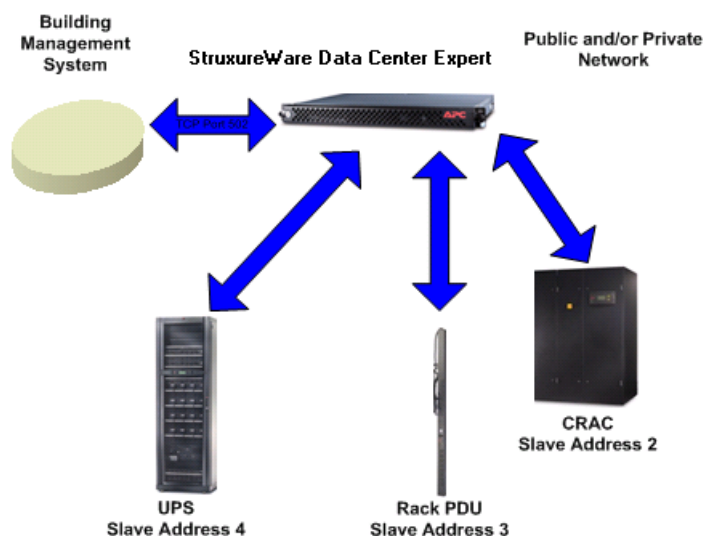
Communication Interface

StruxureWare Data Center Expert uses a RJ-45 Ethernet interface. The RJ-45 Ethernet interface allows for longer cable lengths and faster transmission of data compared to traditional RS-232 or RS-485 data transmission. RS-232 and RS-485 can be as slow as a baud rate of 2400, have limited communication distance between devices and the BMS, and only support point-to-point connections. By converting the communication to RJ-45, data transmission increases greatly, with the potential of transferring at 1GB port speeds if your network permits.

Modbus TCP communication between the BMS and StruxureWare Data Center Expert occurs on TCP port 502 as an industry standard.

Note: Any data transmission or discovery errors could be a result of incorrect communication settings on the BMS or port 502 not being an open port for data transmission.

Communication between StruxureWare Data Center Expert and the BMS

As stated previously, StruxureWare Data Center Expert is connected to the BMS through a RJ-45 port (GB1) located on the server appliance. StruxureWare Data Center Expert monitors the connected devices on the Public LAN or on the APC LAN, which is a private Ethernet connection. This allows for only one connection between the BMS and StruxureWare Data Center Expert, instead of multiple connections to each monitored device. StruxureWare Data Center Expert then becomes the gateway for all information the BMS would request. When the BMS add-on module is enabled in StruxureWare Data Center Expert (this is done with an additional purchased license key), each device on the public and private network is added to a list of devices available for Modbus monitoring. As devices are added to StruxureWare Data Center Expert, 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 would then be configured to add an Ethernet gateway (this terminology may vary per BMS vendor) connecting through TCP port 502 in order to discover StruxureWare Data Center Expert. After the configured device register maps in StruxureWare Data Center Expert have been imported into the BMS, the BMS can then request data from each of these devices as if it were connected directly to them.

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

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 31000 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. 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 31009 are shown as the two byte values of 00 0A hex, or 10 decimal.

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 integer 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.

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StruxureWare Data Center Expert Data Registers

StruxureWare Data Center Expert allows the user the flexibility to configure the data registers for each device. The register range spans from 31000 – 39999 and the amount of Modbus registers vary per device. First you will select the device you would like to read data from, chose the Slave address and then generate the register map (Figure 1). Once the register map is created it can then be exported and imported into the BMS (Figure2).

Figure 1
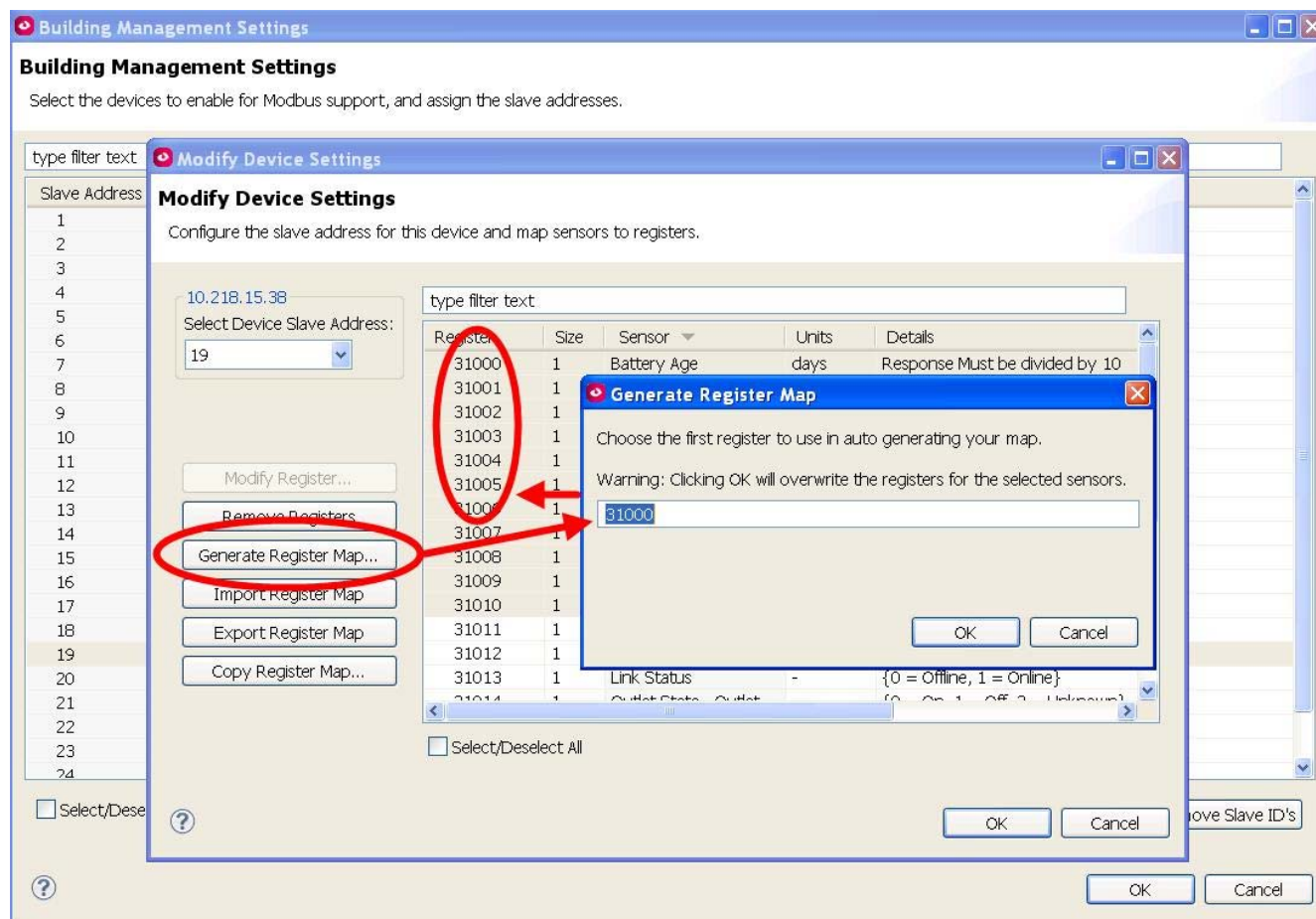
Figure 2
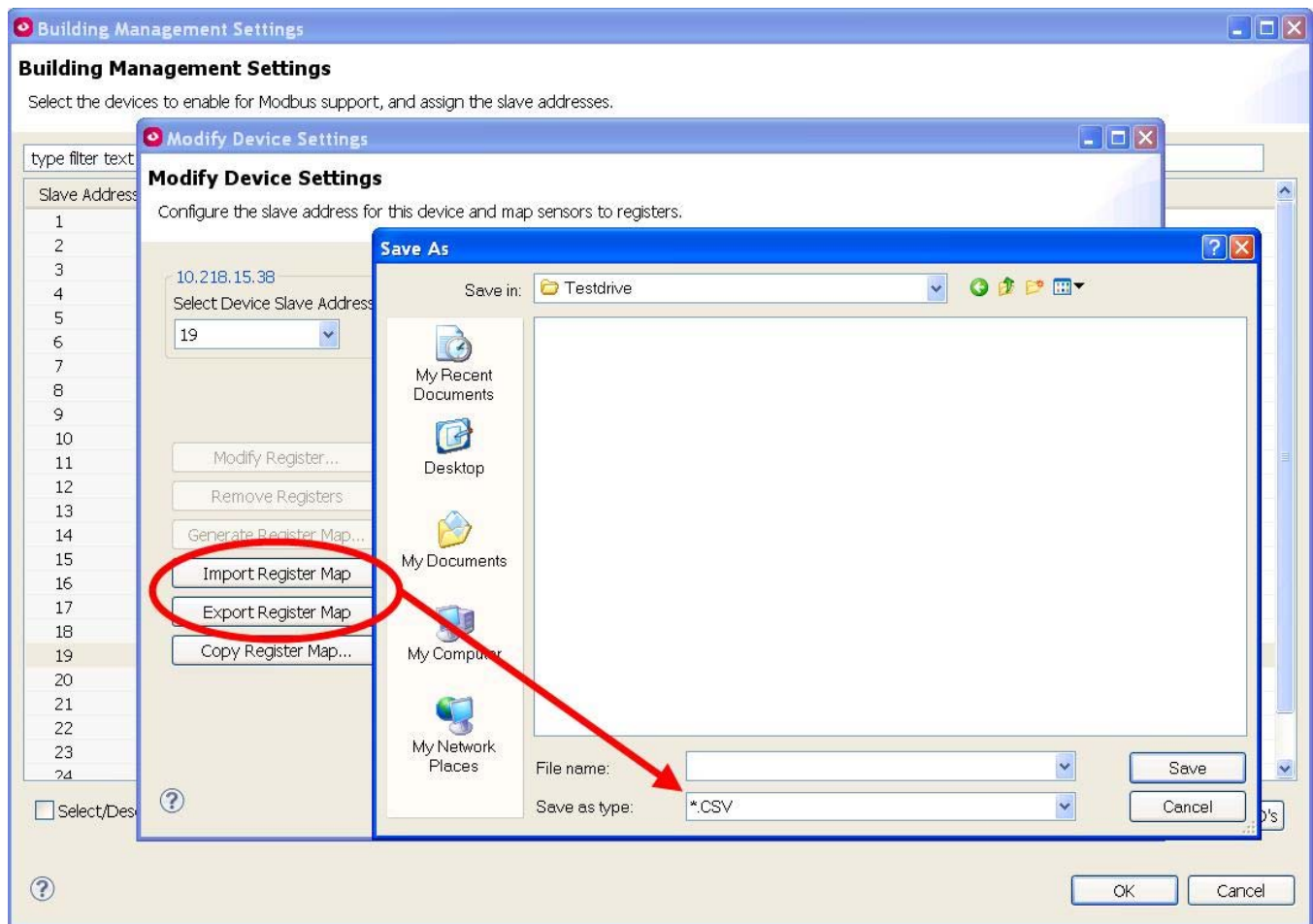
StruxureWare Data Center Expert Device Alarm Count Register

The device alarm count register will always remain 30999 and will display the maximum number of device alarms per device that are active within StruxureWare Data Center Expert. Devices that have unmapped register values will return 0xDEAD as seen below.

Register Description	Modbus Register	Register Value(s)	Register Value Description
Active Alarm Count	0x30999	0-Max	Active Alarm Count
Magic Values		0xDEAD	Value refers to an empty or unmapped register

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StruxureWare Data Center Expert Device Status Register

The device status register is common to all discovered devices. The Modbus register for the device status will always remain at 30998 with the register value changing. Below are the following register values for device status:

Register Description	Modbus Register	Register Value(s)	Register Value Description
Device Status Register	0x30998	0xFFFD	Device discovery phase is in progress
		0xFFFE	No Status is available for device
		0xFFFF	Ok state
		0x0000	Informational state
		0x0001	Device is in warning state
		0x0002	Device is in error state
		0x0003	Device is in critical state
		0x0004	Device is in failure state
		0x0005	Device is in maintenance mode

StruxureWare Data Center Expert Device Alarm Codes

In the following table are the Alarm codes common to all devices. Each alarm will have two registers per alarm with the registers starting prior to 30998 and based on the number of alarms, you would need to poll two registers for each alarm. For example: If there are 10 devices sensors in an alarm state each with one alarm, you would need to poll 20 registers prior 30998, in order to display the alarm code and the sensor code for the device it corresponds to.

Register Description	Modbus Register	Register Value(s)	Register Value Description
Each alarm spans two registers with the first register representing the alarm code and the second representing the corresponding sensor.	0x30998 – (max alarms reported) *2	0xFFFE	Device alarm
		0xFFFF	Exclude (test) alarm
		0x0001	Device info alarm
		0x0002	Communication lost
		0x0003	Threshold violation: too low
		0x0004	Threshold violation: too low too long
		0x0005	Threshold violation: too high
Alarms are read as a negative offset from the Device Status Register (0x30998) up to Max alarms reported. Alarms are provided in order of severity. A single alarm occupies two registers		0x0006	Threshold violation: too high too long
		0x0007	Threshold violation: increase too fast
		0x0008	Threshold violation: decrease too fast
		0x0009	Threshold violation: state change
		0x000A	DDF Download Failure
		0x000B	Capture drive failure
		0x000C	Remote link failed
		0x000D	Log on error
		0x000E	General Device Alarm
		0x????	Specific device alarms (see each device alarm table for the Modbus register value and register value description)

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StruxureWare Data Center Expert Corresponding Device Sensor Codes

In the following table are the corresponding sensor codes paired with the alarm codes above.

Register Value(s)	Register Value Description
0xFFFF	Sensor association unknown.
0xFFFE	Sensor association known but sensor not mapped to a register.
Sensor register #	Address of the register mapped to the alarming sensor

Environmental Management System Device Alarm Codes (EMS)

The following table contains Modbus alarm codes specific to the EMS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x031A	Lost communication with the management interface	0x1A21	Discrete input abnormal state with 'informational' severity
0x1902	Sensor disconnected	0x1A23	Maximum analog input threshold violation
0x1903	Maximum temperature threshold violation	0x1A25	High analog input threshold violation
0x1905	High temperature threshold violation	0x1A27	Low analog input threshold violation
0x1907	Low temperature threshold violation	0x1A29	Minimum analog input threshold violation
0x1909	Minimum temperature threshold violation	0x1A2C	Beacon disconnected
0x190B	Maximum humidity threshold violation	0x1A2D	Beacon on
0x190D	High humidity threshold violation	0x1A31	Relay output abnormal state
0x190F	Low humidity threshold violation	0x1A33	Switched outlet abnormal state
0x1911	Minimum humidity threshold violation	0x1A35	Current limit exceeded
0x1913	Short-term increasing temperature rate of change violation	0x1B02	Lost communication
0x1915	Short-term decreasing temperature rate of change violation	0x1B04	Sensor disconnected
0x1917	Long-term increasing temperature rate of change violation	0x1B05	Maximum temperature threshold violation
0x1919	Long-term decreasing temperature rate of change violation	0x1B07	High temperature threshold violation
0x1A02	Lost communication	0x1B09	Low temperature threshold violation
0x1A04	Sensor disconnected	0x1B0B	Minimum temperature threshold violation

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1A05	Maximum temperature threshold violation	0x1B0D	Maximum humidity threshold violation
0x1A07	High temperature threshold violation	0x1B0F	High humidity threshold violation
0x1A09	Low temperature threshold violation	0x1B11	Low humidity threshold violation
0x1A0B	Minimum temperature threshold violation	0x1B13	Minimum humidity threshold violation
0x1A0D	Maximum humidity threshold violation	0x1B15	Short-term increasing temperature rate of change violation
0x1A0F	High humidity threshold violation	0x1B17	Short-term decreasing temperature rate of change violation
0x1A11	Low humidity threshold violation	0x1B19	Long-term increasing temperature rate of change violation
0x1A13	Minimum humidity threshold violation	0x1B1B	Long-term decreasing temperature rate of change violation
0x1A15	Short-term increasing temperature rate of change violation	0x1B1D	Discrete input abnormal state with 'critical' severity
0x1A17	Short-term decreasing temperature rate of change violation	0x1B1F	Discrete input abnormal state with 'warning' severity
0x1A19	Long-term increasing temperature rate of change violation	0x1B21	Discrete input abnormal state with 'informational' severity
0x1A1B	Long-term decreasing temperature rate of change violation	0x1B24	Beacon disconnected
0x1A1D	Discrete input abnormal state with 'critical' severity	0x1B25	Beacon on
0x1A1F	Discrete input abnormal state with 'warning' severity		

Environmental Monitoring Unit Device Alarm Codes (EMU)

The following table contains Modbus alarm codes specific to the EMU.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x031A	Lost Communication	0x0329	A minimum temperature threshold violation exists for integrated Environmental Monitor Sensor
0x031B	Critical fault on integrated Environmental Monitor input contact	0x031D	A low temperature threshold violation exists for integrated Environmental Monitor Sensor
0x0343	Warning fault on integrated Environmental Monitor input contact	0x031F	A high temperature threshold violation exists for integrated Environmental Monitor Sensor
0x0349	Lost communication to the integrated Environmental Monitor input contact	0x0327	A maximum temperature threshold violation exists for integrated Environmental Monitor Sensor
0x0323	A high humidity threshold violation exists for integrated Environmental Monitor Sensor	0x032D	A minimum humidity threshold violation exists for integrated Environmental Monitor Sensor
0x032B	A maximum humidity threshold violation exists for integrated Environmental Monitor Sensor	0x0321	A low humidity threshold violation exists for integrated Environmental Monitor Sensor
0x0347	Lost Communication		

Network Air FM Device Alarm Codes

The following table contains Modbus alarm codes specific to the Network Air FM.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1303	Module power on	0x13B9	VFD 1 fault tolerance exceeded
0x1305	Water detected	0x13BB	VFD 2 fault tolerance exceeded
0x1307	Fire detected	0x13BD	Cooling coil: No fluid flow
0x1309	Smoke detected	0x13BF	Condenser: No fluid flow
0x130D	Head pressure high	0x13C1	Lost communication with expansion module 1
0x130F	Condensate pump failed	0x13C3	Lost communication with expansion module 2
0x1311	Air block interlock open	0x13C5	Lost communication with expansion module 3

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1319	Environmental temperature high	0x13C7	VFD 1 maintenance required
0x131B	Environmental temperature low	0x13C9	VFD 2 maintenance required
0x131D	Environmental humidity high	0x13CB	Coil fluid inlet temperature high
0x131F	Environmental humidity low	0x13CD	Coil fluid inlet temperature low
0x1325	Suction pressure high	0x13CF	Hot water inlet temperature high
0x1327	Suction pressure low	0x13D1	Hot water inlet temperature low
0x132D	Supply temperature high	0x13D3	Economizer isolator valve active
0x132F	Supply temperature low	0x13D5	Coil fluid inlet temperature sensor failed
0x1335	Humidifier water conductivity high	0x13D7	Return sensor failed
0x1337	Humidifier excessive foam	0x13D9	Supply sensor failed
0x1339	Humidifier current high	0x13DB	Module enabled
0x133B	Humidifier without power	0x13DD	Input #1 asserted
0x133D	Humidifier internal memory error	0x13DF	Input #2 asserted
0x133F	Humidifier water level low	0x13E1	Input #3 asserted
0x1341	Humidifier water level reduction excessive	0x13E3	Input #4 asserted
0x1343	Humidifier drain malfunction	0x13E5	Input #5 asserted
0x1345	Humidifier cylinder full when unit off	0x13E7	Input #6 asserted
0x1347	Humidifier replace cylinder	0x13E9	Input #7 asserted
0x1349	Air flow low	0x13EB	Input #8 asserted
0x134B	Coil fluid valve actuator failed	0x13ED	Input #9 asserted
0x134D	Condenser valve actuator failed	0x13EF	Input #10 asserted
0x134F	Hot water valve actuator failed	0x13F1	Input #11 asserted
0x1351	VFD 1 acceleration overcurrent	0x13F3	Input #12 asserted
0x1353	VFD 2 acceleration overcurrent	0x13F5	Input #13 asserted
0x1355	VFD 1 deceleration overcurrent	0x13F7	Input #14 asserted
0x1357	VFD 2 deceleration overcurrent	0x13F9	Input #15 asserted

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1359	VFD 1 steady operation overcurrent	0x13FB	Input #16 asserted
0x135B	VFD 2 steady operation overcurrent	0x13FD	Remote sensor at address 3 removed
0x135D	VFD 1 steady operation overvoltage	0x13FF	Remote sensor at address 4 removed
0x135F	VFD 2 steady operation overvoltage	0x1403	Remote sensor at address 5 removed
0x1361	VFD 1 DC undervoltage	0x1405	Remote sensor at address 6 removed
0x1363	VFD 2 DC undervoltage	0x1407	Remote sensor at address 7 removed
0x1365	VFD 1 power supply open phase	0x1409	Remote sensor at address 8 removed
0x1367	VFD 2 power supply open phase	0x140B	Remote sensor at address 9 removed
0x1369	VFD 1 output wiring error	0x140D	Remote sensor at address 10 removed
0x136B	VFD 2 output wiring error	0x140F	Remote sensor added
0x136D	VFD 1 heat sink temperature high	0x1411	Primary sensors failed
0x136F	VFD 2 heat sink temperature high	0x1413	Secondary Sensors failed
0x1371	VFD 1 motor 1 overload	0x1415	Secondary sensors active
0x1373	VFD 2 motor 1 overload	0x1417	System is offline
0x1375	VFD 1 overload	0x1419	System failure
0x1377	VFD 2 overload	0x141B	Backup system online
0x1379	VFD 1 acceleration overvoltage	0x141D	System power off
0x137B	VFD 2 acceleration overvoltage	0x141F	System is load sharing
0x137D	VFD 1 deceleration overvoltage	0x1421	Backup system unavailable
0x137F	VFD 2 deceleration overvoltage	0x1423	System smoke detected
0x1381	VFD 1 external thermal sensor temperature high	0x1425	System fire detected
0x1383	VFD 2 external thermal sensor temperature high	0x1427	Group fatal smoke alarm
0x1385	VFD 1 braking resistor overheated	0x1429	Group fatal fire alarm
0x1387	VFD 2 braking resistor temperature high	0x142B	System communication lost

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1389	VFD 1 motor 2 overload	0x142D	Group configuration invalid
0x138B	VFD 2 motor 2 overload	0x142F	Group configuration conflict
0x138D	VFD 1 memory error	0x1431	Module firmware mismatch
0x138F	VFD 2 memory error	0x1433	System firmware mismatch
0x1391	VFD 1 keypad transmission error	0x1435	Module download failure
0x1393	VFD 2 keypad transmission error	0x1437	VFD 1 mains failure
0x1395	VFD 1 CPU error	0x1439	VFD 2 mains failure
0x1397	VFD 2 CPU error	0x143B	VFD 1 overvoltage
0x1399	VFD 1 option communication error	0x143D	VFD 2 overvoltage
0x139B	VFD 2 option communication error	0x143F	VFD 1 inverter overload
0x139D	VFD 1 option error	0x1441	VFD 2 inverter overload
0x139F	VFD 2 option error	0x1443	VFD 1 motor failure
0x13A1	VFD 1 drive startup error	0x1445	VFD 2 motor failure
0x13A3	VFD 2 drive startup error	0x1447	VFD 1 power card fail
0x13A5	VFD 1 RS485 communication error	0x1449	VFD 2 power card fail
0x13A7	VFD 2 RS485 communication error	0x14AF	Mains A failure
0x13A9	Air filter clogged	0x14B1	Mains B failure
0x13AB	Compressor 1 maintenance required	0x14B3	Humidifier RS-485 failure
0x13AD	Compressor 2 maintenance required	0x14B5	Persistent low suction pressure
0x13AF	Heater maintenance required	0x14FB	The NMC firmware is older than the corresponding device firmware
0x13B1	Humidifier maintenance required	0x14FD	The NMC firmware is newer than the corresponding device firmware
0x13B3	Blower 1 maintenance required	0x14FF	The StruxureWare Data Center Expert server is still able to communicate with the NMC, but the NMC cannot communicate with the device
0x13B5	Blower 2 maintenance required	0x13B7	Humidifier fault tolerance exceeded

In Row SC Device Alarm Codes

The following table contains Modbus alarm codes specific to the In Row SC.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x2302	An internal communication fault exists	0x2330	A fan power supply left fault exists
0x2304	An a-link isolation relay fault exists	0x2332	A fan power supply right fault exists
0x2308	An external communication fault exists	0x2334	An air filter run hours violation exists
0x2310	A cooling failure exists	0x2336	A condenser fan 1 fault exists
0x2312	A rack inlet high temperature violation exists	0x2338	A condenser fan 2 fault exists
0x2314	An air filter clogged fault exists	0x233A	A condenser fan 3 fault exists
0x2316	A return air sensor fault exists	0x233C	A supply air high temperature violation exists
0x2318	A condenser inlet air sensor fault exists	0x233E	A return air high temperature violation exists
0x231A	A supply air sensor fault exists	0x2340	A filter sensor fault exists
0x231C	A condenser outlet air sensor fault exists	0x2344	A suction temperature sensor fault exists
0x231E	A rack inlet temperature sensor fault exists	0x2346	A suction pressure sensor fault exists
0x2320	A high discharge pressure alarm exists	0x2348	A discharge pressure sensor fault exists
0x2322	A low suction pressure alarm exists.	0x234C	On standby an input contact fault exists.
0x2324	An evaporator fan 1 fault exists.	0x234E	A persistent high discharge pressure alarm exists.
0x2326	An evaporator fan 2 fault exists.	0x2350	A persistent low suction pressure alarm exists.
0x2328	An evaporator fan 3 fault exists.	0x2352	A startup low suction pressure alarm exists.
0x232A	A water detection fault exists.	0x2354	A startup line pressure imbalance alarm exists.
0x232C	A condensate pump fault exists.	0x2356	Lost group communication.
0x232E	A condensate pan full fault exists.		

In Row RP Device Alarm Codes

The following table contains Modbus alarm codes specific to the In Row RP.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x2C02	An internal communication fault exists.	0x2C4A	A suction temperature sensor fault exists.
0x2C04	An A-link isolation relay fault exists.	0x2C4C	A suction pressure sensor fault exists.
0x2C08	An external communication fault exists.	0x2C4E	A discharge pressure sensor fault exists.
0x2C10	A cooling failure exists.	0x2C50	On standby an input contact fault exists.
0x2C12	A rack inlet high temperature violation exists.	0x2C52	A persistent high discharge pressure alarm exists.
0x2C14	An air filter clogged fault exists.	0x2C54	A persistent low suction pressure alarm exists.
0x2C16	An upper return air sensor fault exists.	0x2C5C	An outside heat exchanger fault exists.
0x2C1A	A lower return air sensor fault exists.	0x2C60	A factory configuration not completed alarm exists.
0x2C1C	An upper supply air sensor fault exists.	0x2C62	A liquid refrigerant sensor fault exists.
0x2C1E	A middle supply air sensor fault exists.	0x2C64	An excessive compressor cycling alarm exists.
0x2C20	A lower supply air sensor fault exists.	0x2C66	A no backup units available alarm exists.
0x2C22	A rack inlet temperature sensor fault exists.	0x2C38	A condensate pump fault exists.
0x2C24	A condensor fluid actuator fault exists.	0x2C3A	A condensate pan full fault exists.
0x2C26	A high discharge pressure alarm exists.	0x2C3C	An upper fan power supply fault exists.
0x2C28	A low suction pressure alarm exists.	0x2C3E	A lower fan power supply fault exists.
0x2C2A	An evaporator fan 1 fault exists.	0x2C40	An air filter run hours violation exists.
0x2C2C	An evaporator fan 2 fault exists.	0x2C42	Lost group communication.
0x2C2E	An evaporator fan 3 fault exists.	0x2C44	A supply air high temperature violation exists.
0x2C30	An evaporator fan 4 fault exists.	0x2C46	A return air high temperature violation exists.
0x2C32	An evaporator fan 5 fault exists.	0x2C48	A filter sensor fault exists.
0x2C34	An evaporator fan 6 fault	0x2C36	A water detection fault exists.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
	exists.		
0x1F02	Internal communication fault exists.	0x1F56	Humidifier communication fault exists.
0x1F04	An A-link isolation relay fault exists.	0x1F58	Compressor run hours violation exists.
0x1F08	External communication fault exists.	0x1F5A	Heater 1 run hours violation exists.
0x1F10	Cooling failure exists.	0x1F5C	Heater 2 run hours violation exists.
0x1F12	Rack inlet 1 high temperature violation exists.	0x1F5E	Heater 3 run hours violation exists.
0x1F14	Rack inlet 2 high temperature violation exists.	0x1F60	Humidifier run hours violation exists.
0x1F16	Rack inlet 3 high temperature violation exists.	0x1F62	Fan 1 run hours violation exists.
0x1F18	High humidity violation exists.	0x1F64	Fan 2 run hours violation exists.
0x1F1A	Low humidity violation exists.	0x1F66	Fan 3 run hours violation exists.
0x1F1C	Air filter clogged fault exists.	0x1F68	Air filter run hours violation exists.
0x1F1E	Return air sensor fault exists.	0x1F6A	Condensate pump run hours violation exists.
0x1F20	Supply air upper sensor fault exists.	0x1F6C	Lost group communication.
0x1F22	Rack inlet temperature sensor 1 fault exists.	0x1F6E	Compressor drive communication fault exists.
0x1F24	Rack inlet temperature sensor 2 fault exists.	0x1F70	Supply air high temperature violation exists.
0x1F26	Rack inlet temperature sensor 3 fault exists.	0x1F72	Return air high temperature violation exists.
0x1F28	Coil fluid valve actuator fault exists.	0x1F74	Filter sensor fault exists.
0x1F2A	High discharge pressure alarm exists.	0x1F78	Suction pressure sensor fault exists.
0x1F2C	Low suction pressure fault alarm exists.	0x1F7A	Discharge pressure sensor fault exists.
0x1F2E	High suction pressure fault alarm exists.	0x1F7E	On standby an input contact fault exists.
0x1F30	Frequent Humidifier faults.	0x1F80	Humidity supply sensor fault exists.
0x1F32	Fan 1 fault exists.	0x1F82	Humidity return sensor fault exists.
0x1F34	Fan 2 fault exists.	0x1F84	Heater 1 fault exists.
0x1F36	Fan 3 fault exists.	0x1F86	Heater 2 fault exists.
0x1F38	Water detection fault exists.	0x1F88	Heater 3 fault exists.
0x1F3A	Condensate pump fault exists.	0x1F8A	Compressor high pressure alarm exists.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1F3C	Fluid flowmeter fault exists.	0x1F8C	Fan speed decreased to avoid water emission.
0x1F3E	Humidifier water conductivity too high.	0x1F8E	Fan speed decreased to avoid compressor high pressure.
0x1F40	Humidifier low water level alarm exists.	0x1F90	Compressor speed decreased to avoid abnormal pressure.
0x1F42	Humidifier excessive output reduction alarm exists.	0x1F92	Heater Interlock Shutdown exists.
0x1F44	Humidifier drain fault exists.	0x1F94	Invalid Supply Air Setpoint condition exists.
0x1F46	Humidifier cylinder full when unit off alarm exists.	0x1F96	Fluid calibration activated by user.
0x1F48	Replace humidifier cylinder alarm exists.	0x1F98	Cooling unit idle.
0x1F4A	Compressor drive fault exists.	0x1F9A	Oil return pump active.
0x1F4C	Compressor drive warning exists.	0x1F9C	Supply air lower sensor fault exists.
0x1F4E	Entering fluid high temperature violation exists.	0x1F9E	Air flow decreased while compressor off.
0x1F50	Entering fluid temperature sensor fault exists.	0x1FA0	Excessive compressor cycling.
0x1F52	Leaving fluid temperature sensor fault exists.	0x1FA2	Persistent high head pressure.
0x1F54	Power supply feed A fault exists.		

In Row RC Device Alarm Codes

The following table contains Modbus alarm codes specific to the In Row RC.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1D02	Internal communication fault exists	0x1D2A	Condensate pump fault exists
0x1D04	A-link isolation relay fault exists	0x1D2C	Fluid flowmeter fault exists
0x1D06	Cooling failure exists	0x1D2E	Entering fluid high temperature violation exists
0x1D08	Rack inlet high temperature violation exists	0x1D30	Entering fluid temperature sensor fault exists
0x1D0A	Air filter clogged fault exists	0x1D32	Leaving fluid temperature sensor fault exists
0x1D0C	Lower return air sensor fault exists	0x1D34	Condensate pan full fault exists

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1D0E	Upper return air sensor fault exists	0x1D36	Power source A failure exists
0x1D10	Lower supply air sensor fault exists	0x1D38	Power source B failure exists
0x1D12	Upper supply air sensor fault exists	0x1D3A	Fan power supply left fault exists
0x1D14	Rack inlet temperature sensor fault exists	0x1D3C	Fan power supply right fault exists
0x1D16	Coil fluid valve actuator fault exists	0x1D3E	Air filter run hours violation exists
0x1D18	Fan 1 fault exists	0x1D42	On standby input contact fault exists
0x1D1A	Fan 2 fault exists	0x1D44	Supply air high temperature violation exists
0x1D1C	Fan 3 fault exists	0x1D46	Return air high temperature violation exists
0x1D1E	Fan 4 fault exists	0x1D48	Group communication lost
0x1D20	Fan 5 fault exists	0x1D4A	Filter sensor fault exists
0x1D22	Fan 6 fault exists	0x1D4E	Fluid calibration activated by user.
0x1D24	Fan 7 fault exists	0x1D52	External communication fault exists
0x1D26	Fan 8 fault exists	0x1D28	Water detection fault exists

Air Removal Unit (ARU) Device Alarm Codes

The following table contains Modbus alarm codes specific to the ARU.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1201	Internal communication fault exists.	0x1206	The overall operation of the fan has exceeded the runhour threshold
0x1202	Exhaust temperature cannot be maintained (critical).	0x1207	No redundant AC input present.
0x1203	Exhaust temperature violates the override setpoint.	0x1208	Controller firmware update timed out.
0x1204	Fan failure exists.	0x1209	Firmware upgrade of ARU controller has ended in a failure.
0x1205	Fan speed (rpm) fault detected.	0x120A	The data version of the ARU controller is incompatible with the data version of the Network Management Interface.

Stultz Chiller Device Alarm Codes

The following table contains Modbus alarm codes specific to Stultz Chillers.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x3002	Lost Communication	0x3076	Sensor 14 is returning invalid values.
0x3004	No description available.	0x3078	Sensor 15 is returning invalid values.
0x3006	No description available.	0x307A	Sensor 16 is returning invalid values.
0x3008	No description available.	0x307C	Sensor 17 is returning invalid values.
0x300A	A common alarm exists.	0x307E	Sensor 18 is returning invalid values.
0x300C	Unit requires maintenance.	0x3080	Sensor 19 is returning invalid values.
0x300E	A/C Fan 1 has stopped spinning.	0x3082	Sensor 20 is returning invalid values.
0x3010	A/C Fan 2 has stopped spinning.	0x3084	Sensor 21 is returning invalid values.
0x3012	A/C Fan 3 has stopped spinning.	0x3086	Compressor 1 overload protection is active.
0x3014	A high pressure alarm exists in circuit 1.	0x3088	Compressor 2 overload protection is active.
0x3016	A high pressure alarm exists in circuit 2.	0x308A	A low pressure alarm exists in circuit 1.
0x3018	Water has been detected.	0x308C	A low pressure alarm exists in circuit 2.
0x301A	A phase failure has occurred.	0x308E	Electrical re-heat stage 1 is overheated.
0x301C	Fire/Smoke has been detected.	0x3090	Electrical re-heat stage 2 is overheated.
0x301E	A return air high temperature violation exists.	0x3092	Electrical re-heat stage 3 is overheated.
0x3020	A return air high humidity violation exists.	0x3094	Electrical re-heat stage 4 is overheated.
0x3022	A supply air high temperature violation exists.	0x3096	An alarm condition exists in Dry Cooler 1.
0x3024	A supply air high humidity violation exists.	0x3098	An alarm condition exists in Dry Cooler 2.
0x3026	A water high temperature violation exists.	0x309A	An alarm condition exists in Dry Cooler 3.
0x3028	A return air low temperature violation exists.	0x309C	An alarm condition exists in Dry Cooler 4.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x302A	A return air low humidity violation exists.	0x309E	An alarm condition exists in Pump 1.
0x302C	A supply air low temperature violation exists.	0x30A0	An alarm condition exists in Pump 2.
0x302E	A supply air low humidity violation exists.	0x30A2	An alarm condition exists in Pump 3.
0x3030	A water low temperature violation exists.	0x30A4	An alarm condition exists in Pump 4.
0x3032	Sensor 1 value deviates beyond acceptable limit.	0x30A6	An alarm condition exists in Humidifier 1.
0x3034	Sensor 2 value deviates beyond acceptable limit.	0x30A8	An alarm condition exists in Humidifier 2.
0x3036	Sensor 3 value deviates beyond acceptable limit.	0x30AA	An alarm condition exists in Humidifier 3.
0x3038	Sensor 4 value deviates beyond acceptable limit.	0x30AC	A 5uS alarm exists in Humidifier 1.
0x303A	Sensor 5 value deviates beyond acceptable limit.	0x30AE	A 5uS alarm exists in Humidifier 2.
0x303C	Sensor 6 value deviates beyond acceptable limit.	0x30B0	A 5uS alarm exists in Humidifier 3.
0x303E	Sensor 7 value deviates beyond acceptable limit.	0x30B2	A 20uS alarm exists in Humidifier 1.
0x3040	Sensor 8 value deviates beyond acceptable limit.	0x30B4	A 20uS alarm exists in Humidifier 2.
0x3042	Sensor 9 value deviates beyond acceptable limit.	0x30B6	A 20uS alarm exists in Humidifier 3.
0x3044	Sensor 10 value deviates beyond acceptable limit.	0x30B8	An alarm exists in Fan 1.
0x3046	Sensor 11 value deviates beyond acceptable limit.	0x30BA	An alarm exists in Fan 2.
0x3048	Sensor 12 value deviates beyond acceptable limit.	0x30BC	An alarm exists in Fan 3.
0x304A	Sensor 13 value deviates beyond acceptable limit.	0x30BE	Fan 1 filter is clogged.
0x304C	Sensor 14 value deviates beyond acceptable limit.	0x30C0	Fan 2 filter is clogged.
0x304E	Sensor 15 value deviates beyond acceptable limit.	0x30C2	Fan 3 filter is clogged.
0x3050	Sensor 16 value deviates beyond acceptable limit.	0x30C4	External Alarm 1 is active.
0x3052	Sensor 17 value deviates beyond acceptable limit.	0x30C6	External Alarm 2 is active.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x3054	Sensor 18 value deviates beyond acceptable limit.	0x30C8	External Alarm 3 is active.
0x3056	Sensor 19 value deviates beyond acceptable limit.	0x30CA	External Alarm 4 is active.
0x3058	Sensor 20 value deviates beyond acceptable limit.	0x30CC	External Alarm 5 is active.
0x305A	Sensor 21 value deviates beyond acceptable limit.	0x30CE	External Alarm 6 is active.
0x305C	Sensor 1 is returning invalid values.	0x30D0	External Alarm 7 is active.
0x305E	Sensor 2 is returning invalid values.	0x30D2	External Alarm 8 is active.
0x3060	Sensor 3 is returning invalid values.	0x30D4	External Alarm 9 is active.
0x3062	Sensor 4 is returning invalid values.	0x30D6	External Alarm 10 is active.
0x3064	Sensor 5 is returning invalid values.	0x30D8	A Hot Gas Re-Heat alarm exists.
0x3066	Sensor 6 is returning invalid values.	0x30DA	A circuit 1 electronic expansion valve pressure sensor error condition exists.
0x3068	Sensor 7 is returning invalid values.	0x30DC	A circuit 1 electronic expansion valve temperature sensor error condition exists.
0x306A	Sensor 8 is returning invalid values.	0x30DE	A circuit 1 electronic expansion valve stepper motor error condition exists.
0x306C	Sensor 9 is returning invalid values.	0x30E0	A circuit 2 electronic expansion valve pressure sensor error condition exists.
0x306E	Sensor 10 is returning invalid values.	0x30E2	A circuit 2 electronic expansion valve temperature sensor error condition exists.
0x3070	Sensor 11 is returning invalid values.	0x30E4	A circuit 2 electronic expansion valve stepper motor error condition exists.
0x3072	Sensor 12 is returning invalid values.	0x30E6	A freeze alarm is active.
0x3074	Sensor 13 is returning invalid values.	0x30E8	A dehumidifier alarm is active.

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Power Generation Automatic Transfer Switch (ATS) Device Alarm Codes

The following table contains Modbus alarm codes specific to the ATS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1714	The output voltage on phase has fallen below the low voltage threshold.	0x17D3	The generator failed to stop. After de-assertion of the Engine Start signal the quality of Source 2 continued to be seen as good.
0x1716	The output voltage on phase has risen above the high voltage threshold.	0x17C7	InfraStruxure ATS is not in automatic mode.
0x1724	The output current on phase has fallen below the low current threshold.	0x17C2	The device's Emergency Power Off (EPO) circuit is tripped.
0x1726	The output current on phase has risen above the high current threshold.	0x17C1	The device's Emergency Power Off (EPO) circuit has been switched back to the test position.
0x1760	The ATS output frequency is outside the range.	0x174E	The initiated test has failed.
0x17C4	There is an internal communication error in the device.	0x1780	User input contact on the device is in an abnormal state.
0x17C6	A data incompatibility exists within the device. This is typically the result of mismatches between firmware revisions of the transfer switch controller and the Network Management interface.	0x1781	User input contact on the device is in an abnormal state.
0x17D1	The ATS cannot communicate with the generator.	0x1782	User input contact on the device is in an abnormal state.
0x17D7	The ATS could not read these registers from the generator	0x1783	User input contact on the device is in an abnormal state.
0x1704	The ATS has transferred to neutral position. In this position neither Source 1 nor Source 2 is selected and the ATS will have no output voltage. The ATS is now running in mode.	0x17D4	The state of the generator's Remote Start input and the ATS's Engine Start output do not match. This indicates something wrong in the Engine Start wiring which must be corrected. This condition may prevent the generator from being started when needed.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x17CC	An internal ATS fault has been detected. The ATS may have forced itself to not-in-auto mode (abnormal condition).	0x17C5	The ATS exterior panel door is open.
0x17D2	The generator failed to start. After assertion of the Engine Start signal the quality of Source 2 was poor	0x17CB	The ATS' DC backup has been lost. The ATS will lose power on Source 1 failure causing the Engine Start signal to be asserted. The ATS will then restart from Source 2.

Rack Automatic Transfer Switch (ATS) Device Alarm Codes

The following table contains Modbus alarm codes specific to the ATS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0C02	The ability to switch between input sources was lost	0x0C12	Source is unavailable or a status problem exists
0x0C06	Lost Communication	0x0C14	The RMS Voltage is above the allowed limit at Source (x)
0x0C07	An Overload threshold violation exists	0x0C16	The RMS Voltage is below the allowed limit at Source (x)
0x0C09	A fault exists at the power supply	0x0C18	The frequency is above the allowed limit at Source (x)
0x0C0B	A Low Load threshold violation exists	0x0C1A	The frequency is below the allowed limit at Source (x)
0x0C0D	A near overload threshold violation exists	0x0C20	A fault exists at the hardware
0x0C0F	An overload threshold violation exists		

Metered and Switched Rack Power Distribution Unit (RPDU) Device Alarm Codes

The following table contains Modbus alarm codes specific to the RPDU

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0F01	A low load threshold violation exists at Bank (x)	0x0F14	An overload threshold violation exists at Phase (x)
0x0F03	A near overload threshold violation exists at Bank (x)	0x0F16	A power supply 1 fault exists
0x0F05	An overload threshold violation exists at Bank (x)	0x0F18	A power supply 2 fault exists
0x0F08	Lost communication	0x0F1F	A low load threshold violation exists at Outlet bank (x)
0x0F10	A low load threshold violation exists at Phase (x)	0x0F21	A near overload threshold violation exists at Outlet bank (x)
0x0F12	A near overload threshold violation exists at Phase (x)	0x0F23	An overload threshold violation exists at Outlet bank (x)

InfraStruxure Remote Power Distribution Unit Device Alarm Codes

The following table contains Modbus alarm codes specific to the Remote InfraStruxure PDU.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x2A80	User Contact 1 is not in the normal state (critical).	0x2A84	User Contact 1 is not in the normal state (warning).
0x2A81	User Contact 2 is not in the normal state (critical)..	0x2A85	User Contact 2 is not in the normal state (warning).
0x2A82	User Contact 3 is not in the normal state (critical)..	0x2A86	User Contact 3 is not in the normal state (warning).
0x2A83	User Contact 4 is not in the normal state (critical)..	0x2A87	User Contact 4 is not in the normal state (warning).

InfraStruxure Power Distribution Unit Device Alarm Codes

The following table contains Modbus alarm codes specific to the InfraStruxure PDU.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1610	The input voltage on phase (x) has fallen below the input voltage low threshold	0x2406	Communication lost with the metering board for modules .
0x1612	The input voltage on phase (x) has risen above the input voltage high threshold	0x2410	Distribution module breaker current is below the minimum threshold
0x1614	The output voltage on phase (x) has fallen below the output voltage low threshold	0x2412	Distribution module breaker current is below the low threshold
0x1616	The output voltage on phase (x) has risen above the output voltage high threshold	0x2414	Distribution module breaker current is above the high threshold
0x1618	The bypass voltage on phase (x) has fallen below the bypass voltage low threshold	0x2416	Distribution module breaker current is above the maximum threshold
0x161A	The bypass voltage on phase (x) has risen above the bypass voltage high threshold	0x2418	Distribution module breaker is open.
0x1624	The output current in phase (x) has fallen below the output current low threshold	0x2420	Distribution subfeed phase (x)current is below the minimum threshold
0x1626	The output current in phase (x) has risen above the output current high threshold	0x2422	Distribution subfeed phase (x) current is below the low threshold
0x1662	The neutral current has risen above the neutral current high threshold	0x2424	Distribution subfeed phase (x) current is above the high threshold
0x1640	The main input breaker has been opened.	0x2426	Distribution subfeed phase (x) current is above the maximum threshold
0x1644	The output breaker (Q2) has been opened.	0x2428	Distribution subfeed breaker is open.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1648	The bypass feed breaker has been opened.	0x1630	The current in branch has fallen below the branch current low threshold
0x164C	The cross tie breaker has been opened.	0x1632	The current in branch has risen above the branch current high threshold
0x1650	The UPS input fuse on phase (x) has failed.	0x1634	The current in branch has fallen below the branch current minimum threshold
0x1660	The PDU output frequency is outside the range	0x1636	The current in branch has risen above the branch current maximum threshold
0x1680	User Contact 1 is not in the normal state.	0x2948	The bypass feed switch has been opened.
0x1681	User Contact 2 is not in the normal state.	0x2A80	A critical fault exists for integrated environmental input contact 1
0x1682	User Contact 3 is not in the normal state.	0x2A81	A critical fault exists for integrated environmental input contact 2
0x1683	User Contact 4 is not in the normal state.	0x2A82	A critical fault exists for integrated environmental input contact 3
0x1690	Output Relay 1 is not in the normal state.	0x2A83	A critical fault exists for integrated environmental input contact 4
0x1691	Output Relay 2 is not in the normal state.	0x2A84	A warning fault exists for integrated environmental input contact 1 .
0x1692	Output Relay 3 is not in the normal state.	0x2A85	A warning fault exists for integrated environmental input contact 2 .
0x1693	Output Relay 4 is not in the normal state.	0x2A86	A warning fault exists for integrated environmental input contact 3 .
0x16C1	The PDU is in maintenance bypass.	0x2A87	A warning fault exists for integrated environmental input contact 4 .
0x16C3	PDU Emergency Power Off Mode Set to Test	0x29C1	The system is in maintenance bypass.
0x16D1	PDU Emergency Power Off Mode tripped	0x29C6	Input Isolation Transformer Over Temperature

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x16C4	PDU Internal Communication Failure	0x29C8	Transformer Cooling Fan Failure
0x16CC	The data version of the PDU controller is incompatible with the data version of the Network Management Interface.	0x29CA	System Mode Alarm
0x16C6	PDU Input Isolation Transformer Over Temperature	0x16CA	PDU System Mode Alarm
0x16C8	PDU Cooling Fan Failure		

Silcon UPS Device Alarm Codes

The following table contains Modbus alarm codes specific to the Silcon UPS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0102	Lost communication.	0x3A1F	A weak battery exists.
0x0103	The load exceeds 100% of rated capacity.	0x3A23	The system is locked in operational mode.
0x0107	The battery power is too low to support the load; if power fails the UPS will be shut down immediately.	0x3A25	A RAM1 memory write fault exists.
0x0109	On battery power in response to an input power problem.	0x3A27	A memory write fault exists.
0x010F	The battery power is too low to continue to support the load; the UPS will shut down if input power does not return to normal soon.	0x3A29	Lost communication with the VQ bypass.
0x0114	The output power is turned off.	0x3A2B	Lost communication with the VQ output.
0x011B	In bypass in response to an internal hardware fault.	0x3A2D	Lost communication with the DMU.
0x011D	In bypass in response to the bypass switch at the UPS typically for maintenance.	0x3A2F	Lost communication with the controller.
0x0125	A graceful shutdown process is being used to shut down the load equipment before the UPS turns off.	0x3A31	Lost communication with the parallel interface (IF).

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x012C	The internal battery temperature exceeds the critical threshold.	0x3A33	An external shutdown was accepted.
0x0148	Lost communication while the UPS was on battery.	0x3A35	A direct current (DC) capacitor charge fault exists.
0x0207	A battery fault exists.	0x3A37	Lost communication with the VQ Mains.
0x020F	An input voltage or frequency problem prevents switching to bypass mode.	0x3A39	A bypass synchronization fault exists.
0x0217	In bypass in response to an overload.	0x3A3B	A charge fault exists.
0x022B	The output voltage is outside its defined limits.	0x3A3D	The SII auxiliary input is activated.
0x022D	A phase synchronization fault exists.	0x3A41	A blown inverter fuse exists.
0x022F	The battery is not installed properly.	0x3A43	A blown rectifier fuse exists.
0x0231	The battery voltage exceeds the nominal battery voltage rating.	0x3A45	An auxiliary 1 fault exists.
0x3A01	The peak current limiter is active.	0x3A5B	A high temperature charger magnetic fault exists.
0x3A03	A bypass power supply fault exists.	0x3A5F	A battery monitor warning exists.
0x3A05	The delta current limiter is active.	0x3A61	A battery monitor alarm exists.
0x3A07	A fan fault exists.	0x3A69	A TSM 1/2/3 temperature shutdown exists.
0x3A09	A high direct current (DC) warning exists.	0x3A6B	A charger 0/30 temperature warning exists.
0x3A0B	An inverter voltage fault exists.	0x3A6D	A charger 0/30 temperature shutdown exists.
0x3A0D	A parallel synchronization fault exists.	0x3A6F	A high output voltage exists.
0x3A0F	A second power supply fault exists.	0x3A71	An SSW temperature over 90 fault exists.
0x3A11	An internal power supply fault exists.	0x3A75	A low current fault exists for the AC capacitors.
0x3A1B	A static bypass switch high temperature exists.	0x3A79	The advanced battery management is not installed.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x3A1D	The battery temperature exceeds the critical threshold.		

Symmetra Three Phase UPS Device Alarm Codes

The following table contains Modbus alarm codes specific to the Symmetra Three Phase UPS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0102	Lost Communication.	0x0223	No power modules detected as installed.
0x0103	The load exceeds 100% of rated capacity.	0x0225	An input voltage or frequency problem occurred while on bypass turning off the UPS.
0x0106	The UPS failed its diagnostic self-test due to either an overload or poor battery health.	0x0227	A runtime alarm threshold violation exists.
0x0107	The battery power is too low to support the load; if power fails the UPS will be shut down immediately.	0x0229	An extended run frame fault exists.
0x0109	On battery power in response to an input power problem.	0x022B	The output voltage is not within its defined limits.
0x010F	The battery power is too low to continue to support the load; the UPS will shut down if input power does not return to normal soon.	0x022D	A phase synchronization fault exists.
0x0114	The output power is turned off.	0x022F	No batteries detected as installed.
0x0115	Turned off for a defined period of time in response to a software command or off while waiting for input power to return to normal.	0x0231	The battery voltage exceeds the Nominal Battery Voltage rating.
0x0119	At least one faulty battery exists.	0x0235	A site wiring fault exists.
0x011C	In bypass in response to the UPS front-panel or a user-initiated software command typically for maintenance.	0x0237	The backfeed relay is open.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0125	A graceful shutdown process is being used to shut down the load equipment before the UPS turns off.	0x2601	A maintenance bypass fault exists.
0x012A	A battery charger fault exists.	0x2603	A high isolation transformer temperature exists.
0x012C	The internal battery temperature exceeds the critical threshold.	0x2605	The external DC disconnect switch is open.
0x0148	Lost communication while the UPS was on battery.	0x2607	A system power supply card fault exists.
0x0201	A power module fault exists.	0x2609	A battery monitor card fault exists.
0x0203	A main intelligence module fault exists.	0x260B	The battery monitor card was removed.
0x0205	A redundant intelligence module fault exists.	0x260D	An XR communication card fault exists.
0x0207	A battery fault exists.	0x260F	The external run frame (XR) communication card was removed.
0x0209	A load (kVA) alarm threshold violation exists.	0x2611	An external switch gear communication card fault exists.
0x020B	Lost power module redundancy.	0x2613	The external switch gear communication card was removed.
0x020D	A redundancy alarm threshold violation exists.	0x2615	The internal DC disconnect switch is open.
0x020F	An input voltage or frequency problem prevents switching to bypass mode.	0x2617	A static bypass switch module fault exists.
0x0211	The bypass relay is stuck in its bypass position.	0x2619	The system ID card was removed.
0x0213	The bypass relay is stuck in its online position.	0x261B	A system identification card fault exists.
0x0215	In bypass in response to an internal hardware fault.	0x261D	In bypass in response to switchgear or UPS static switch.
0x0217	In bypass in response to an overload.	0x261F	The static bypass switch module was removed.
0x0219	In bypass for maintenance.	0x2621	A system start-up configuration fault exists.
0x021B	The input circuit breaker is open.	0x2623	The battery charger is shutdown externally.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x021D	A system level fan fault exists.	0x0221	An internal bus communication fault exists.
0x021F	The redundant intelligence module is in control.		

Symmetra Single Phase UPS Device Alarm Codes

The following table contains Modbus alarm codes to the Symmetra Single Phase UPS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0102	Lost Communication.	0x0211	The bypass relay is stuck in its bypass position.
0x0103	The load exceeds 100% of rated capacity.	0x0213	The bypass relay is stuck in its online position.
0x0107	The battery power is too low to support the load; if power fails the UPS will be shut down immediately.	0x0215	In bypass in response to an internal hardware fault.
0x0109	On battery power in response to an input power problem.	0x0217	In bypass in response to an overload.
0x010F	The battery power is too low to continue to support the load; the UPS will shut down if input power does not return to normal soon.	0x0219	In bypass for maintenance.
0x0114	The output power is turned off.	0x021B	The input circuit breaker is open.
0x0115	Turned off for a defined period of time in response to a software command or off while waiting for input power to return to normal.	0x021D	A system level fan fault exists.
0x0119	At least one faulty battery exists.	0x021F	The redundant intelligence module is in control.
0x011C	In bypass in response to the UPS front-panel or a user-initiated software command typically for maintenance.	0x0221	An IIC bus communication fault exists.
0x0125	A graceful shutdown process is being used to shut down the load equipment before the UPS turns off.	0x0223	No power modules detected as installed.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x012A	A battery charger fault exists.	0x0225	An input voltage or frequency problem occurred while on bypass turning off the UPS.
0x012C	The internal battery temperature exceeds the critical threshold.	0x0227	A runtime alarm threshold violation exists.
0x0148	Lost communication while the UPS was on battery.	0x0229	An extended run frame fault exists.
0x0201	A power module fault exists.	0x0235	A site wiring fault exists.
0x0203	A main intelligence module fault exists.	0x2501	A system fault exists.
0x0205	A redundant intelligence module fault exists.	0x2503	A bypass relay failure exists.
0x0207	A battery fault exists.	0x2505	A power module turn off failure exists.
0x0209	A load (kVA) alarm threshold violation exists.	0x2507	A frame identification failure exists.
0x020B	Lost power module redundancy.	0x020F	An input voltage or frequency problem prevents switching to bypass mode.
0x020D	A redundancy alarm threshold violation exists.		

Smart-UPS Device Alarm Codes

The following table contains Modbus alarm codes specific to Smart-UPS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0102	Lost Communication.	0x0165	An inverter fault exists.
0x0103	The load exceeds 100% of rated capacity.	0x0167	An analog-to-digital (A/D) converter fault exists.
0x0107	The battery power is too low to support the load; if power fails the UPS will be shut down immediately.	0x0169	A logic power supply fault exists.
0x0109	On battery power in response to an input power problem.	0x016B	A backfeed relay fault exists.
0x010B	Compensating for a low input voltage.	0x0201	A power module fault exists.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x010D	Compensating for a high input voltage.	0x0207	A battery fault exists.
0x010F	The battery power is too low to continue to support the load; the UPS will shut down if input power does not return to normal soon.	0x0209	A load (kVA) alarm threshold violation exists.
0x0114	The output power is turned off.	0x020F	An input voltage or frequency problem prevents switching to bypass mode.
0x0115	Turned off for a defined period of time in response to a software command or off while waiting for input power to return to normal.	0x0215	In bypass in response to an internal hardware fault.
0x0119	At least one faulty battery exists.	0x0217	In bypass in response to an overload.
0x011B	In bypass in response to an internal hardware fault.	0x0219	In bypass for maintenance.
0x011C	In bypass in response to the UPS front-panel or a user-initiated software command typically for maintenance.	0x021D	A system level fan fault exists.
0x011D	In bypass in response to the bypass switch at the UPS typically for maintenance.	0x0227	A runtime alarm threshold violation exists.
0x011F	A bypass power supply fault exists.	0x0229	An extended run frame fault exists.
0x0120	A base module fan fault exists.	0x022B	The output voltage is outside its defined limits.
0x0122	Lost communication with the battery packs.	0x022D	A phase synchronization fault exists.
0x0125	A graceful shutdown process is being used to shut down the load equipment before the UPS turns off.	0x022F	The battery is not installed properly.
0x0126	An automatic voltage regulator (AVR) relay fault exists.	0x0231	The battery voltage exceeds the nominal battery voltage rating.
0x0128	An abnormal output voltage exists.	0x0235	A site wiring fault exists.
0x012A	A battery charger fault exists.	0x0A01	An emergency power off (EPO) switch is activated.
0x012C	The internal battery temperature exceeds the	0x0A03	A static bypass switch module fault exists.

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Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
	critical threshold.		
0x012F	The battery is not installed properly.	0x0A05	A system start up configuration fault exists.
0x0138	An inverter DC imbalance exists.	0x0A07	A power supply unit (PSU) fault exists.
0x013B	An electronics unit fan fault exists.	0x0A09	A weak battery exists.
0x013E	A main relay fault exists.	0x0A0B	A high battery temperature exists.
0x0140	A bypass relay fault exists.	0x0A0D	An internal mechanical bypass exists.
0x0148	Lost communication while the UPS was on battery.	0x0A0F	Lost parallel redundancy.
0x0150	A power factor correction input relay fault exists.	0x0A11	A parallel bus communication fault exists on cable 1.
0x0152	The internal UPS temperature exceeds the critical threshold.	0x0A13	A parallel bus communication fault exists on cable 2.
0x0154	The battery voltage exceeds the nominal battery voltage rating.	0x0A15	An auxiliary bus communication fault exists.
0x0156	An EEPROM fault exists.	0x0A17	A parallel bus termination fault exists on cable 1.
0x0159	A fault exists at the battery temperature sensor.	0x0A19	A parallel bus termination fault exists on cable 2.
0x015B	A battery bus soft start fault exists.	0x0A1B	An auxiliary bus termination fault exists.
0x015D	The output has a short-circuit.	0x0A1D	A no master present fault exists in the parallel system.
0x015F	An output relay fault exists.	0x0A1F	An overload exists on a parallel unit.
0x0161	A power factor correction fault exists.	0x0A21	A parallel configuration fault exists.
0x0163	A DC bus overvoltage exists.		

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Battery Management System (BMS) Device Alarm Codes

The following table contains Modbus alarm codes specific to the BMS.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x0802	A communication fault exists at unit	0x082C	The charger current probe is disconnected at string .
0x080E	A low voltage exists at string .	0x082E	The pilot temperature probe is disconnected.
0x0810	A high voltage exists at string .	0x0830	The ambient temperature probe is disconnected.
0x0812	A high ripple current exists at string .	0x0834	A stuck monitor relay exists at unit .
0x0814	The batteries are discharging at string .	0x0836	An abnormal condition exists at discrete input 1.
0x0816	A shorted battery cell exists at string battery .	0x0838	An abnormal condition exists at discrete input 2.
0x0818	An open fuse or bad connection exists at string battery .	0x083A	The voltage has gone above the maximum user defined limit at string battery .
0x081A	The battery capacity is low at string battery .	0x083C	The voltage has gone below the minimum user defined limit at string battery .
0x081E	A potential thermal runaway exists at string battery .	0x083E	The voltage has gone above the maximum chemistry limit at string battery .
0x0820	A battery dryout/sulfation condition exists at string battery .	0x0840	The voltage has gone below the minimum chemistry limit at string battery .
0x0822	A high pilot temperature exists.	0x0842	The system has suspended battery monitoring.
0x0824	A high ambient temperature exists.	0x0844	An open cell or inter-connection exists at string battery .
0x0826	A low ambient temperature exists.		

Rack Access PX Device Alarm Codes

The following table contains Modbus alarm codes specific to the Rack Access PX.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x031A	Lost Communication	0x1C0E	Name: ; Location: ; Action: door key override unlocked
0x1C02	Name: ; Location: ; Action: door lost communication	0x1C10	Name: ; Location: ; Action: door forced entry

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1C06	Name: ; Location: ; Action: door unlocked	0x1C13	Name: ; Location: ; Action: Beacon disconnected
0x1C08	Name: ; Location: ; Action: door handle opened	0x1C14	Name: ; Location: ; Action: Beacon turned on
0x1C0A	Name: ; Location: ; Action: door opened	0x1C16	Name: ; Location: ; Hardware failure
0x1C0C	Name: ; Location: ; Action: door relock timeout	0x1C18	Name: ; Location: ; Action: Door sense disconnected

NetBotz® Rack Monitor 200 Device Alarm Codes

The following table contains Modbus alarm codes specific to the NetBotz Rack Monitor 200.

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x031A	Lost Communication	0x2E1F	Discrete input abnormal state with 'critical' severity
0x1902	Sensor disconnected	0x2E21	Discrete input abnormal state with 'warning' severity
0x1903	Maximum temperature threshold violation	0x2E23	Discrete input abnormal state with 'informational' severity
0x1905	High temperature threshold violation	0x2E26	Beacon disconnected
0x1907	Low temperature threshold violation	0x2E27	Beacon on
0x1909	Minimum temperature threshold violation	0x2E2B	Relay output abnormal state
0x190B	Maximum humidity threshold violation	0x2E2D	Switched outlet abnormal state
0x190D	High humidity threshold violation	0x2E2F	Current limit exceeded
0x190F	Low humidity threshold violation	0x2F02	Lost communication
0x1911	Minimum humidity threshold violation	0x2F04	Temperature or Temperature/Humidity Sensor disconnected
0x1913	Short-term increasing temperature rate of change violation	0x2F05	Maximum temperature threshold violation
0x1915	Short-term decreasing temperature rate of change violation	0x2F07	High temperature threshold violation

Register Value(s)	Register Value Description	Register Value(s)	Register Value Description
0x1917	Long-term increasing temperature rate of change violation	0x2F09	Low temperature threshold violation
0x1919	Long-term decreasing temperature rate of change violation	0x2F0B	Minimum temperature threshold violation
0x2E02	Lost communication	0x2F0D	Maximum humidity threshold violation
0x2E04	Temperature or Temperature/Humidity Sensor disconnected	0x2F0F	High humidity threshold violation
0x2E05	Maximum temperature threshold violation	0x2F11	Low humidity threshold violation
0x2E07	High temperature threshold violation	0x2F13	Minimum humidity threshold violation
0x2E09	Low temperature threshold violation	0x2F15	Short-term increasing temperature rate of change violation
0x2E0B	Minimum temperature threshold violation	0x2F17	Short-term decreasing temperature rate of change violation
0x2E0D	Maximum humidity threshold violation	0x2F19	Long-term increasing temperature rate of change violation
0x2E0F	High humidity threshold violation	0x2F1B	Long-term decreasing temperature rate of change violation
0x2E11	Low humidity threshold violation	0x2F1E	Dry Contact Sensor disconnected
0x2E13	Minimum humidity threshold violation	0x2F1F	Discrete input abnormal state with 'critical' severity
0x2E15	Short-term increasing temperature rate of change violation	0x2F21	Discrete input abnormal state with 'warning' severity
0x2E17	Short-term decreasing temperature rate of change violation	0x2F23	Discrete input abnormal state with 'informational' severity
0x2E19	Long-term increasing temperature rate of change violation	0x2E1E	Dry Contact Sensor disconnected
0x2E1B	Long-term decreasing temperature rate of change violation		

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Conclusion

StruxureWare Data Center Expert is designed to communicate with a Building Management System through the Modbus TCP protocol, using port 502. The Modbus TCP protocol is a standard in the industry and is supported by almost all BMS vendors. All monitored devices are connected to the StruxureWare Data Center Expert server through the Public LAN or the APC LAN, which is a private Ethernet connection. StruxureWare Data Center Expert then becomes the gateway for all information the BMS would request.

StruxureWare Data Center Expert Server Appliance

The StruxureWare Data Center Expert server appliance provides centralized management for all APC and non APC SNMP Physical Infrastructure devices, and can forward this information via the included Modbus port to a BMS such as T.A.C. Continuum™ and Vista™.

Note: StruxureWare Data Center Expert Modbus support primarily provides monitoring capability only, not control.

Schneider Electric highly recommends anyone considering Modbus integration to consider using StruxureWare Data Center Expert since its Modbus support spans the majority of the APC product range as well as non-APC SNMP discovered devices, and provides many features that are complementary to T.A.C. Continuum™ and Vista™. If control is required for UPS's, etc., 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 UPS's except Symmetra Megawatt which includes its own built-in Modbus support.
Product information including manuals: http://www.apc.com/products/resource/include/techspec_index.cfm?base_sku=AP9622

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?DocType=User%20Manual&Query_Type=3&Value=339

APC Symmetra Megawatt Modbus Register Map

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

References

- www.modbus.org