SATEC
Powerful Solutions

# Branch Feeder Monitor™

# BFM II

# DNP3 Communications Protocol

## Reference Guide

BG0590 Rev. A3

Every effort has been made to ensure that the material herein is complete and accurate. However, the manufacturer is not responsible for any mistakes in printing or faulty instructions contained in this book. Notification of any errors or misprints will be received with appreciation.

For further information regarding a particular installation, operation or maintenance of equipment, contact the manufacturer or your local representative or distributor.

REVISION HISTORY

| | | |
|---|---|---|
| A1 | Nov 2015 | Initial release. |
| A3 | Feb 2016 | Class 0 and Level 1 implementation only |

# Table of Contents

# 1 General

This document specifies a subset of the DNP3 communications protocol used to transfer data between a master computer station and the BFM II. The document provides the complete information necessary to develop third-party communications software capable of communication with the BFM II. Additional information concerning communications operation, configuring the communications parameters, and communications connections is found in the BFM II Installation and Operation Manual.

# 2 DNP 3.0 Protocol Implementation

DNP3 (Distributed Network Protocol) is an open standard designed by Harris Control Division. DNP defines a command-response method of communicating digital information between a master and slave device. Detailed information regarding DNP3 is available in the "Basic 4 Document Set" which can be obtained from the DNP User Group.

## 2.1 Deviations from Standard

The BFM II implements Level 1 of the DNP3 communication protocol. The device does not support unsolicited requests or hardware collision avoidance.

The data link layer differs from the Basic 4 specifications because of the master-slave relationship between devices. When the device receives a request, no further requests can be sent until after the device makes the appropriate response.

## 2.2 DNP Implementation

The BFM II, like most devices, allows retrieving regular analog and binary data from the device by executing directed (non-broadcast) Read requests.

Binary-Output-Status objects and Analog-Output-Status objects are sent with flags that always indicate ONLINE.

A Binary-Output-Status object that indicates the current state of a control digital point (relay) uses remote forced data as well as local forced data bits. The value of a state bit indicates the current state of the digital output point.

The BFM II executes the parameter clear function and demands resets using the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to specified points of the Control-Relay-Output-Block object.

Issuing the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to appropriative points of the Analog-Output-Block object can change the setup parameters. The device also supports the DNP functions Write, Cold-Restart and Delay Measurement.

Refer to Appendix A for specific requests and responses. Appendix B contains the standard DNP Device Profile Document.

The device attempts to respond with the same object variation and qualifier as those in the request. Exceptions to this rule include changing variation 0 to a specific variation and changing qualifier code 6 to 1.

If the device receives an invalid request, it sets the internal indication to the error code. The following internal indication bits are supported:

| Octet Position | Bit Position | Description |
|---|---|---|
| 0 | 0 | Set when a request received with a broadcast destination address. Cleared after next response. |
| 0 | 7 | Device restart - set when the device powers up or after executing Cold Restart, cleared by writing zero to object 80. |
| 0 | 4 | Time-synchronization required from the master. Cleared when master sets the time. |
| 0 | 5 | Set when the device is in the Local state. Cleared when the device is in the Remote state. |
| 1 | 5 | Set when the current configuration in the device is corrupted. May also be set as a result of the legal changes in the setup configuration whenever another setup is affected by the changes made. Cleared by resetting the device diagnostics. |

### 2.2.1 Class 0 Response

The BFM II DNP implementation supports a wide variety of messages. The most common method of getting static object information from the device via DNP is to issue a read Class 0 request.

The BFM II allows you to configure the Class 0 response by assigning ranges of points to be polled via Class 0 requests (see Section 3.9, DNP Protocol setup).

The Class 0 point list may contain up to 32 ranges of points. The total number of points that can be reported in the Class 0 response is limited by the one application fragment size, or 2048 bytes.
Refer to "Configuring DNP" in the BFM II installation and Operation Manual for information on how to configure Class 0 responses via PAS.

### 2.2.2 Device Address

Each device on a DNP link must have a unique address. The BFM II allows up to 60 device addresses in the range of 0 to 65532 to be selected, 54 addresses for submeters and additional 4 addresses for virtual meters. The DNP master can use addresses 65533 to 65535 for broadcast requests. A broadcast request never generates a DNP response.

### 2.2.3 Transaction Timing

The BFM II response time to master requests via serial ports is indicated in Table 2-1. It includes the receive termination delay - 4 character times plus a default 4-ms character timeout (user-programmable from 1 to 1000 ms), and a default 5-ms response delay (user-programmable from 0 to 1000 ms).

**Table 2-1 Response Time**

| Baud Rate, bps | Response Time, ms (including a 5-ms response delay) | | |
|---|---|---|---|
| | Min | Max | Typical |
| 9600 | 13 | 15 | 13 |
| 19200 | 11 | 12 | 11 |
| 57600 | 9 | 10 | 9 |
| 115200 | 9 | 10 | 9 |

The Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge requests for reset/clear registers and setpoint changing are immediately confirmed.

### 2.2.4 Scaling 16-bit Analog Inputs

Any of the variations 1 through 4 can be used with the Analog Input objects. Variations specified in Sections 3.1 and 3.5 show those that can be used to read a full-range value without a possible over-range error when no scaling is used to accommodate the value to the requested object size.

When over-range occurs, a positive value is reported as 32767 and a negative value as -32768, with the over-range bit in the flag octet being set to 1 if a variation 2 is requested. To avoid over-range errors when a variation 2 or 4 is required, a liner scaling may be used to scale 32-bit analog readings to 16-bit Analog Input objects (see Section 3.9, DNP Options setup). Scaling is enabled in the device by default.

When scaling is enabled, either analog input requested with variation 2 or 4 will be scaled to the range of -32768 to 32767 for bi-directional parameters (such as power and power factor), and to the range of 0 to 32767 for single-ended positive parameters (voltage, current, frequency, etc.). To get a true reading, the reverse conversion should be done using the following formula:

$$Y = ((X - DNP\_LO) \times (HI - LO)) / (DNP\_HI - DNP\_LO) + LO$$

where:

- Y - True reading in engineering units
- X - Raw input data in the range of DNP_LO – DNP_HI
- LO, HI - Data low and high scales in engineering units (for device data scales, see Section 4)
- DNP_LO - DNP low conversion scale: DNP_LO = -32768 for a point with a negative LO scale
  DNP_LO = 0 for a point with a zero or positive LO scale

DNP_HI - DNP high conversion scale: DNP_HI = 32767

**EXAMPLE**

If you have read a value of 201 for point AI:3 that shows the I1 current (see Section 3.1) and the CT primary current is 200A (the high current scale is 2×200 = 400A), then the current reading in engineering units is as follows:

(201 - 0) × (400 - 0)/(32767 - 0) + 0 = 2.45A

### 2.2.5 Scaling 16-bit Binary Counters

Binary counters are stored in the device in 32-bit integer format. Using 16-bit Binary Counter objects can cause over-range errors if the counter value exceeds 32767.

Scaling binary counters (see DNP Options setup in Section 3.9) allows changing a binary counter unit from 1 to 1000 in powers of 10 to accommodate a 32-bit counter value to 16-bit object format. If the scaling unit is greater than 1, the counter value is reported being divided by the scaling unit. To get the actual value, multiply the counter reading by the selected scaling unit.

## 2.3 Password Protection

The BFM II has a password protection option allowing you to protect your setups, cumulative registers and logs from being changed or cleared through communications. You can disable or enable password protection through communications or via the front display. For details, refer to your instrument Installation and Operation Manual.

When password protection is enabled, the user password you set in your instrument should be written into the device authorization register (point AO:192) before another write request is issued. If the correct password is not supplied while password protection is enabled, the instrument will respond to all write requests with the exception response "Control operation not supported for this point". It is recommended to clear the password register after you have completed your changes in order to activate password protection.

# 3 DNP Point Map

## 3.1 Analog Inputs - Basic Set

| Object : Var. | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:0 | V1/V12 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:1 | V2/V23 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:2 | V3/V31 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:3 | I1 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:4 | I2 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:5 | I3 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:6 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:7 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:8 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:9 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:10 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:11 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:12 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:13 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:14 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:15 | Power factor L1 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:16 | Power factor L2 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:17 | Power factor L3 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:18 | Total PF | -1000-1000 | ×0.001 | INT16 | R | |
| 30:3 | AI:19 | Total kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:20 | Total kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:21 | Total kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:22 | In (neutral) current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:23 | Frequency | 0-10000 | ×0.01Hz | UINT16 | R | |
| 30:3 | AI:24 | Maximum kW import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:25 | kW import accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:26 | Maximum kVA sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:27 | kVA accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:28 | I1 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:29 | I2 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:30 | I3 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:31 | Present kW import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:32 | Present kVA sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:33 | PF (import) at Max. kVA sliding window demand | 0-1000 | ×0.001 | UINT16 | R | |
| 30:3 | AI:43 | Reserved | 0 | | UINT16 | R | |

**NOTES:**

[1] When the 4LN3, 3LN3, or 3BLN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

[2] All analog input points except of harmonics are 1-second average values. For volts, amps and power scales and units, refer to Section 4 "Data Scales and Units". For analog input scaling formulas and examples, see Section 2.2.5, " Scaling Analog Input Objects".

[3] On a 3-s interval.

## 3.2 Binary Inputs - Basic Set

| Object : Var. | Object : Point | Description | Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **Relays** | | | | | |
| 01:1 | BI:0 | Relay #1 status | 0-1 | | | R | |
| 01:1 | BI:1 | Relay #2 status | 0-1 | | | R | |
| … | … | … | 0-1 | | | R | |
| 01:1 | BI:7 | Relay #8 status | 0-1 | | | R | |
| | | **Digital Inputs** | | | | | |
| 01:1 | BI:64 | Digital input #1 | 0-1 | | | R | |
| 01:1 | BI:65 | Digital input #2 | 0-1 | | | R | |
| … | … | … | | | | | |
| 01:1 | BI:135 | Digital input #72 | 0-1 | | | R | |

## 3.3 Binary Counters - Basic Set

| Object : Var. | Object : Point | Description | Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 20:5 | BC:0 | kWh import | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:1 | kWh export | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:2 | kvarh net | -999,999,999-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:3 | kVAh | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:4 | kvarh import | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:5 | kvarh export | 0-999,999,999 | U5 | UINT32 | R | |

## 3.4 Frozen Binary Counters

| Object : Var. [1] | Object : Point | Description | Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **Total Energies – Basic Set** | | | | | |
| 21:var | FBC:0 | kWh import | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:1 | kWh export | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:2 | kvarh net | -999,999,999-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:3 | kVAh | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:4 | kvarh import | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:5 | kvarh export | 0-999,999,999 | U5 | UINT32 | R | |
| | | **Counters – Extended Set** | | | | | |
| 21:var | FBC:35328 | Counter #1 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35329 | Counter #2 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35330 | Counter #3 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35331 | Counter #4 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35332 | Counter #5 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35333 | Counter #6 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35334 | Counter #7 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35335 | Counter #8 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35336 | Counter #9 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35337 | Counter #10 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35338 | Counter #11 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35339 | Counter #12 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35340 | Counter #13 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35341 | Counter #14 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35342 | Counter #15 | 0-999,999,999 | | UINT32 | R | |
| 21:var | FBC:35343 | Counter #16 | 0-999,999,999 | | UINT32 | R | |
| | | **Total Energies - Extended Set** | | | | | |
| 21:var | FBC:38656 | kWh import | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38657 | kWh export | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38658 | KWh net | -999,999,999-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38659 | KWh total | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38660 | kvarh import | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38661 | kvarh export | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38662 | kvarh net | -999,999,999-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38663 | kvarh total | 0-999,999,999 | U5 | UINT32 | R | |
| 21:var | FBC:38664 | kVAh total | 0-999,999,999 | U5 | UINT32 | R | |

**NOTE**

[1] For object variation, see DNP Options setup (see Section 3.9).

[2] Issuing a freeze and clear request (or freeze and clear - No acknowledgement) to object 20 variation 0 using function code 0x09 (or 0x10) and the data qualifier 0x06 causes all counters to be reset to zero.

## 3.5 Analog Inputs, Binary Inputs and Counters – Extended Set

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:4 | AI:32768 | **None** | 0 | | UINT16 | R | |
| | | **Special Inputs** | | | | R | |
| 30:4 | BI:33024 | Voltage disturbance | 0-100 | % Un | | R | |
| 30:4 | BI:33025 | Phase rotation order | 0=ERR, 1=POS, 2=NEG | | | R | |
| | | **Digital Inputs** | | | | R | |
| 01:1 | BI:34304 | DI1 | 0-1 | | | R | |
| 01:1 | BI:34305 | DI2 | 0-1 | | | R | |
| | | … | | | | R | |
| 01:1 | BI:34375 | DI72 | 0-1 | | | R | |
| | | **Relay Outputs** | | | | R | |
| 01:1 | BI:34816 | Relay #1 | 0-1 | | | R | |
| 01:1 | BI:34817 | Relay #2 | 0-1 | | | R | |
| | | … | | | | R | |
| 01:1 | BI:34823 | Relay #8 | 0-1 | | | R | |
| | | **Static Event Flags** | | | | R | |
| 01:1 | BI:35072 | Phase order error | 0-1 | | | R | |
| 01:1 | BI:35073 | Positive phase order | 0-1 | | | R | |
| 01:1 | BI:35074 | Negative phase order | 0-1 | | | R | |
| 01:1 | BI:35079 | Device fault (non-critical error) | 0-1 | | | R | |
| 01:1 | BI:35080 | No voltage | 0-1 | | | R | |
| 01:1 | BI:35081 | Remote control | 0-1 | | | R | |
| | | **Counters** | | | | | |
| 20:5 | BC:35328 | Counter #1 | 0-999,999,999 | | UINT32 | R | |
| 20:5 | BC:35329 | Counter #2 | 0-999,999,999 | | UINT32 | R | |
| | | … | | | | R | |
| 20:5 | BC:35331 | Counter #4 | 0-999,999,999 | | UINT32 | R | |
| | | **Total Energies** | | | | | |
| 20:5 | BC:38656 | kWh import | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38657 | kWh export | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38658 | kWh net | -999,999,999-999,999,999 | U5 | INT32 | R | |
| 20:5 | BC:38659 | kWh total | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38660 | kvarh import | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38661 | kvarh export | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38662 | kvarh net | -999,999,999-999,999,999 | U5 | INT32 | R | |
| 20:5 | BC:38663 | kvarh total | 0-999,999,999 | U5 | UINT32 | R | |
| 20:5 | BC:38664 | kVAh total | 0-999,999,999 | U5 | UINT32 | R | |
| | | **1-Cycle Phase Values** | | | | | |
| 30:3 | AI:35840 | V1/V12 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:35841 | V2/V23 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:35842 | V3/V31 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:35843 | I1 current | 0-Imax | U2 | UINT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:35844 | I2 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:35845 | I3 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:35846 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35847 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35848 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35849 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35850 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35851 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:35852 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:35853 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:35854 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:35855 | Power factor L1 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:35856 | Power factor L2 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:35857 | Power factor L3 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:3 | AI:35870 | V12 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:35871 | V23 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:35872 | V31 voltage | 0-Vmax | U1 | UINT32 | R | |
| | | **1-Cycle Low Phase Values** | | | | | |
| 30:3 | AI:36096 | Low L-N voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:36097 | Low current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:36098 | Low kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36099 | Low kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36100 | Low kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:36101 | Low PF Lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:36102 | Low PF Lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **1-Cycle High Phase Values** | | | | | |
| 30:3 | AI:36352 | High L-N voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:36353 | High current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:36354 | High kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36355 | High kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36356 | High kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:36357 | High PF Lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:36358 | High PF Lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **1-Cycle Total Values** | | | | | |
| 30:3 | AI:36608 | Total kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36609 | Total kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:36610 | Total kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:36611 | Total PF | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:36612 | Total PF lag | 0-1000 | ×0.001 | UINT16 | R | |
| 30:4 | AI:36613 | Total PF lead | 0-1000 | ×0.001 | UINT16 | R | |
| 30:3 | AI:36614 | Total kW import | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:36615 | Total kW export | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:36616 | Total kvar import | 0-Pmax | U3 | UINT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:36617 | Total kvar export | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:36618 | 3-phase average L-N/L-L voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:36619 | 3-phase average L-L voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:36620 | 3-phase average current | 0-Imax | U2 | UINT32 | R | |
| | | **1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:36865 | In (neutral) current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:36866 | Frequency | 0-10000 | ×0.01Hz | UINT16 | R | |
| 30:4 | AI:36867 | Voltage unbalance | 0-3000 | ×0.1% | UINT16 | R | |
| 30:4 | AI:36868 | Current unbalance | 0-3000 | ×0.1% | UINT16 | R | |
| | | **1-Second Phase Values** | | | | | |
| 30:3 | AI:37120 | V1/V12 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:37121 | V2/V23 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:37122 | V3/V31 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:37123 | I1 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:37124 | I2 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:37125 | I3 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:37126 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37127 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37128 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37129 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37130 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37131 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37132 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37133 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37134 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:37135 | Power factor L1 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:37136 | Power factor L2 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:37137 | Power factor L3 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:3 | AI:37150 | V12 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:37151 | V23 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:37152 | V31 voltage | 0-Vmax | U1 | UINT32 | R | |
| | | **1-Second Low Phase Values** | | | | | |
| 30:3 | AI:37376 | Low L-N voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:37377 | Low current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:37378 | Low kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37379 | Low kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37380 | Low kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:37381 | Low PF Lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:37382 | Low PF Lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **1-Second High Phase Values** | | | | | |
| 30:3 | AI:37632 | High L-N voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:37633 | High current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:37634 | High kW | -Pmax-Pmax | U3 | INT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:37635 | High kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37636 | High kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:37637 | High PF Lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:37638 | High PF Lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **1-Second Total Values** | | | | | |
| 30:3 | AI:37888 | Total kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37889 | Total kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:37890 | Total kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:37891 | Total PF | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:37892 | Total PF lag | 0-1000 | ×0.001 | UINT16 | R | |
| 30:4 | AI:37893 | Total PF lead | 0-1000 | ×0.001 | UINT16 | R | |
| 30:3 | AI:37894 | Total kW import | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37895 | Total kW export | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37896 | Total kvar import | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37897 | Total kvar export | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:37898 | 3-phase average L-N/L-L voltage | 0-Vmax | U1 | UINT32 | R | 1 |
| 30:3 | AI:37899 | 3-phase average L-L voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:37900 | 3-phase average current | 0-Imax | U2 | UINT32 | R | |
| | | **1-Second Auxiliary Values** | | | | | |
| 30:3 | AI:38144 | I4 Current | 0-I4max | U2 | UINT32 | R | |
| 30:3 | AI:38145 | In (neutral) current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:38146 | Frequency | 0-10000 | ×0.01Hz | UINT16 | R | |
| 30:4 | AI:38147 | Voltage unbalance | 0-3000 | ×0.1% | UINT16 | R | |
| 30:4 | AI:38148 | Current unbalance | 0-3000 | ×0.1% | UINT16 | R | |
| | | **Present Volt, Ampere and Power Demands** | | | | | |
| 30:3 | AI:38400 | V1/V12 Volt demand | 0-Vmax | U1 | UINT32 | R | 2 |
| 30:3 | AI:38401 | V2/V23 Volt demand | 0-Vmax | U1 | UINT32 | R | 2 |
| 30:3 | AI:38402 | V3/V31 Volt demand | 0-Vmax | U1 | UINT32 | R | 2 |
| 30:3 | AI:38403 | I1 Ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:38404 | I2 Ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:38405 | I3 Ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:38406 | kW import block demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38407 | kvar import block demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38408 | kVA block demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38409 | kW import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38410 | kvar import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38411 | kVA sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38412 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:38413 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:38414 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:38415 | kW import accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38416 | kvar import accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38417 | kVA accumulated demand | 0-Pmax | U3 | UINT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:38418 | kW import predicted sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38419 | kvar import predicted sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38420 | kVA predicted sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:38421 | PF (import) at Max. kVA sliding window demand | 0-1000 | ×0.001 | UINT16 | R | |
| 30:3 | AI:38422 | kW export block demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38423 | kvar export block demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38424 | kW export sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38425 | kvar export sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38426 | kW export accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38427 | kvar export accumulated demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38428 | kW export predicted sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:38429 | kvar export predicted sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| | | **Minimum 1-Cycle Phase Values** | | | | | |
| 30:3 | AI:44032 | V1 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:44033 | V2 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:44034 | V3 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:44035 | I1 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:44036 | I2 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:44037 | I3 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:44038 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44039 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44040 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44041 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44042 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44043 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44044 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:44045 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:44046 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:44047 | Power factor L1 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:44048 | Power factor L2 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:44049 | Power factor L3 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| | | **Minimum 1-Cycle Total Values** | | | | | |
| 30:3 | AI:44288 | Total kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44289 | Total kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:44290 | Total kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:44291 | Total PF | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:44292 | Total PF lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:44293 | Total PF lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **Minimum 1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:44545 | In current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:44546 | Frequency | 0-10000 | ×0.01Hz | UINT32 | R | |
| 30:4 | AI:44547 | Voltage unbalance | 0-3000 | ×0.1% | UINT32 | R | |
| 30:4 | AI:44548 | Current unbalance | 0-3000 | ×0.1% | UINT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **Maximum 1-Cycle Phase Values** | | | | | |
| 30:3 | AI:46080 | V1 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46081 | V2 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46082 | V3 voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46083 | I1 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:46084 | I2 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:46085 | I3 current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:46086 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46087 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46088 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46089 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46090 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46091 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46092 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46093 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46094 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:46095 | Power factor L1 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:46096 | Power factor L2 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:46097 | Power factor L3 | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:3 | AI:46110 | V12 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:46111 | V23 voltage | 0-Vmax | U1 | UINT32 | R | |
| 30:3 | AI:46112 | V31 voltage | 0-Vmax | U1 | UINT32 | R | |
| | | **Maximum 1-Cycle Total Values** | | | | | |
| 30:3 | AI:46336 | Total kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46337 | Total kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:46338 | Total kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:46339 | Total PF | 0-1000 | ×0.001 | UINT32 | R | Absolute value |
| 30:4 | AI:46340 | Total PF lag | 0-1000 | ×0.001 | UINT32 | R | |
| 30:4 | AI:46341 | Total PF lead | 0-1000 | ×0.001 | UINT32 | R | |
| | | **Maximum 1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:46593 | In Current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:46594 | Frequency | 0-10000 | ×0.01Hz | UINT32 | R | |
| 30:4 | AI:46595 | Voltage unbalance | 0-3000 | ×0.1% | UINT32 | R | |
| 30:4 | AI:46596 | Current unbalance | 0-3000 | ×0.1% | UINT32 | R | |
| 30:3 | AI:46597 | Reserved | 0 | | UINT32 | R | |
| | | **Maximum Demands** | | | | | |
| 30:3 | AI:46848 | V1 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [2] |
| 30:3 | AI:46849 | V2 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [2] |
| 30:3 | AI:46850 | V3 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [2] |
| 30:3 | AI:46851 | I1 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:46852 | I2 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:46853 | I3 Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:46854 | Not used | 0 | | UINT32 | R | |

| Object : Var. | Object : Point | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:4 | AI:46855 | Not used | 0 | | UINT32 | R | |
| 30:4 | AI:46856 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:46857 | Maximum kW import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46858 | Maximum kvar import sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46859 | Maximum kVA sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:46860 | Not used | 0 | | UINT32 | R | |
| 30:4 | AI:46861 | Not used | 0 | | UINT32 | R | |
| 30:4 | AI:46862 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:46863 | Maximum kW export sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46864 | Maximum kvar export sliding window demand | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:46865 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:46866 | Not used | 0 | | UINT32 | R | |
| 30:3 | AI:46869 | In Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |
| | | **Analog Inputs** | | | | | 3 |
| 30:3 | AI:47872 | Analog input AI1 | AI1min-AI1max | | UINT32 | R | |
| 30:3 | AI:47873 | Analog input AI2 | AI2min-AI2max | | UINT32 | R | |
| | | | | | | R | |
| 30:3 | AI:47879 | Analog input AI8 | AI8min-AI8max | | UINT32 | R | |

**NOTES:**

[1] When the 4LN3, 4LL3, 3LN3, 3LL3, 3BLN3 or 3BLL3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line.

[2] When the 4LN3, 3LN3 or 3BLN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

[3] For volts, amps, power and frequency scales and units: refer to Section 4 ”Data Scales and Units”. For analog input scaling formulas and examples, see Section 2.2.5, “ Scaling Analog Input Objects”.

[4] On a 0.2-s interval.

[5] On a 3-s interval.

## 3.6 Factory Device Settings and Identification

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| **Device Identification** | | | | | | | |
| 30:3 | AI:256 | Device serial number | 0-999999 | | UINT32 | R | |
| 30:3 | AI:257 | Device model ID | 15400 | | UINT32 | R | |
| 30:3 | AI:258-AI:261 | Device model name | "BFM II" | | UINT32 | R | Null-terminated string. Each four characters are packed into a 32-bit word. |
| 30:3 | AI:262-AI:265 | Reserved | | | UINT32 | R | |
| 30:4 | AI:266 | Device firmware version number | 3701-3799 | | UINT16 | R | Two higher decimal digits = major version number, two lower decimal digits = minor version number |
| 30:4 | AI:267 | Device firmware build number | 1-99 | | UINT16 | R | |
| 30:4 | AI:268 | Reserved | | | UINT16 | R | |
| 30:4 | AI:269 | Reserved | | | UINT16 | R | |
| 30:4 | AI:270 | Boot loader version number | | | UINT16 | R | Two higher decimal digits = major version number, two lower decimal digits = minor version number |
| 30:4 | AI:271 | Boot loader build number | 1-99 | | UINT16 | R | |
| 30:3 | AI:272-AI:274 | Reserved | | | UINT32 | R | |
| **Factory Device Settings** | | | | | | | |
| 30:4 | AI:275 | V1-V3 input range | 120, 277 | V | UINT16 | R | |
| 30:4 | AI:276 | V1-V3 input overload | 120 | % | UINT16 | R | |
| 30:4 | AI:277 | Reserved | | | UINT16 | R | |
| 30:4 | AI:278 | Reserved | | | UINT16 | R | |
| 30:4 | AI:279 | I1-I3 input range | 1, 5, 50 | A | UINT16 | R | |
| 30:4 | AI:280 | I1-I3 input overload | 200 | % | UINT16 | R | |
| 30:4 | AI:281 | Reserved | | | UINT16 | R | |
| 30:4 | AI:282 | Reserved | | | UINT16 | R | |
| 30:4 | AI:283 | Reserved | | | UINT16 | R | |
| 30:4 | AI:284 | Reserved | | | UINT16 | R | |
| 30:4 | AI:285 | Reserved | | | UINT16 | R | |
| 30:4 | AI:286 | Reserved | | | UINT16 | R | |
| **Port Identification** | | | | | | | |
| 30:4 | AI:320 | Active port number | 0-2 = serial port COM1-COM3, 4 = Modem port, 5 = USB/Modbus port, 6-10 = Ethernet/TCP port 1-99 | | UINT16 | R | |

## 3.7 Device Control

| Object : Var. | Object : Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| **Device Authorization Register** | | | | | | | |
| 40:1(read) | AO:192 | When write: 8-digit password. When read: | 0/-1 (Read) | | | R/W | |

| Object : Var. | Object : Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 41:1(write) | | 0 = access permitted, -1 = authorization required. | 0-99999999(Write) | | | | |
| **Remote Relay Control** | | | | | | | |
| 10:2(read)<br>12:1(write) | BO:0<br>CROB:0 | Relay #1 Force operate/Force release/Normal | 0/1 = state OFF/ON | | | R/W | [4] |
| 10:2(read)<br>12:1(write) | BO:1<br>CROB:1 | Relay #2 Force operate/Force release/Normal | 0/1 = state OFF/ON | | | R/W | [4] |
| | | … | | | | | |
| 10:2(read)<br>12:1(write) | BO:7<br>CROB:7 | Relay #8 Force operate/Force release/Normal | 0/1 = state OFF/ON | | | R/W | [4] |
| **Device Reset/Clear** | | | | | | | |
| 10:2(read)<br>12:1(write) | BO:64<br>CROB:64 | Clear total energy registers | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:65<br>CROB:65 | Clear total maximum demand registers (all demands) | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:66<br>CROB:66 | Clear power demands | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:67<br>CROB:67 | Clear volt/ampere/harmonic demands | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:68-75<br>CROB:68-75 | Reserved | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:76<br>CROB:76 | Clear pulse counters (all counters) | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:77-84<br>CROB:77-84 | Clear pulse counter#1-#8 | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:85<br>CROB:85 | Clear Min/Max log | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:86-93<br>CROB:86-93 | Reserved | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:94-101<br>CROB:94-101 | Clear pulse counter#9-#16 | 0/1 = state OFF/ON | | | R/W | Returns zero<br>PULSE ON [1] |
| **Device Diagnostics** | | | | | | | |
| 10:2(read)<br>12:1(write) | BO:128<br>CROB:128 | Critical error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:129<br>CROB:129 | Permanent fault (critical error) | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:130<br>CROB:130 | RAM/Data error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:131<br>CROB:131 | CPU watchdog reset | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:132<br>CROB:132 | DSP/Sampling fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:133<br>CROB:133 | CPU exception | 0/1 = state OFF/ON | | | R/W | [2] |

| Object : Var. | Object : Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 10:2(read)<br>12:1(write) | BO:134<br>CROB:134 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:135<br>CROB:135 | Software watchdog reset | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:136<br>CROB:136 | Power down | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:137<br>CROB:137 | Device reset [3] | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:138<br>CROB:138 | Configuration reset [3] | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:139<br>CROB:139 | RTC fault (critical error) | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:140<br>CROB:140 | Configuration fault (critical error) | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:141<br>CROB:141 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:142<br>CROB:142 | Expanded memory fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:143<br>CROB:143 | CPU EEPROM fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:144<br>CROB:144 | AC board EEPROM fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:145<br>CROB:145 | I/O board EEPROM fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:146<br>CROB:146 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:147<br>CROB:147 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:148<br>CROB:148 | C Library error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:149<br>CROB:149 | RTOS Kernel error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:150<br>CROB:150 | Task error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:151<br>CROB:151 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:152<br>CROB:152 | IRIG-B signal lost | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | BO:153<br>CROB:153 | IRIG-B time unlocked | 0/1 = state OFF/ON | | | R/W | [2] |

**NOTES:**

[1] The following restriction should be noted when using object 12 to control the listed points.

- The Count byte is ignored.
- The Control Code byte is checked:
  - Pulse On (1) is valid for all points; other codes are invalid and will be rejected.
- The On Time and Off Time fields are ignored.
- The status byte in the response will reflect the success or failure of the control operation:
  - Request Accepted (0) will be returned if the command was accepted;
  - Request not Accepted due to Formatting Errors (3) is returned if the Control Code byte was incorrectly formatted or if an invalid code was present in the command;
  - Control Operation not Supported for this Point (4) is returned if the Control Point was out of control.

[2] The device diagnostics points indicate possible problems with the device hardware or setup configuration. The hardware problems are indicated by the appropriate points, which are set whenever the instrument fails self-test diagnostics, or in the event of loss of power. The dedicated binary point indicates the setup configuration problems, which is set when either configuration register is corrupted. In this event, the instrument will use the default configuration. The configuration corrupt bit may also be set as a result of the legal changes in the setup configuration since the instrument might implicitly change or clear other setups if they are affected by the changes made.

Issuing the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command using the Control-Relay-Output-Block object (with the code operation Latch-Off) to points 128-153 resets device diagnostics points.

The following restrictions should be noted when using Object 12 to control these points:

- The Count byte is ignored.
- The Control Code byte is checked:
  - Latch Off is valid for all points; other codes are invalid and will be rejected.
- The On Time and Off Time fields are ignored.
- The status byte in the response will reflect the success or failure of the control operation:
  - Request Accepted (0) is returned if the command was accepted;
  - Request not Accepted due to Formatting Errors (3) is returned if the Control Code byte was incorrectly formatted or if an invalid Code was present in the command.

[3] These self-check alarms are doubled with the corresponding internal indication bits.

[4] To manually operate relays, use the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to points 0-31 of the Control-Relay-Output-Block object with the Control Code value Latch On. To manually release relays, use the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to point 0-31 of the Control-Relay-Output-Block object with the Control Code value Latch Off. To revert relays to normal operation, use the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to the corresponding points of the Control-Relay-Output-Block object with the Control Code value Null Operation and the Clear sub-field set to 1.

To operate a relay in pulse mode with the Pulse On or Pulse Off control code, put the relay in pulse mode and select a required pulse polarity via the Relay Outputs setup (use the supplemental PAS software to change the relay properties). The actual pulse width will be taken from the On Time/Off Time fields of the Control-Relay-Output-Block object.

The following restrictions should be noted when using object 12 to control these points:

- The Count byte is ignored.
- The Control Code byte is checked:
  - Pulse On, Pulse Off, Latch On (Pulse On/Close) and Latch Off (Pulse On/Trip) are valid for all points; other codes are invalid and will be rejected;

- Clear sub-field is valid; other sub-fields are ignored.

- The On Time specifies in ms the amount of time the digital point is to be turned on. The minimal value of the On Time is 500 ms and the actual value may differ from the specified value by up to 10 ms.

- The Off Time specifies in ms the amount of time the digital point is to be turned off. The minimal value of the Off Time is 500 ms and the actual value may differ from the specified value by up to 10 ms.

- The Status byte in the response reflects the success or failure of the control operation:
  - Request Accepted (0) will be return if the command was accepted;
  - Request not Accepted due to Formatting Errors (3) will be returned if the Control Code byte was incorrectly formatted or an invalid Code was present in the command;
  - Control Operation not Supported for this Point (4) will be returned if the Control Point was out of control.

## 3.8 Device Setup

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| **Basic Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:0 | Wiring mode | F26 | | UINT16 | R/W | |
| 40:1 (read)<br>41:1 (write) | AO:1 | PT ratio (primary to secondary ratio) | 10-65000 | ×0.1 | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:2 | PT secondary (Line-to-Line) | 50-480 | V | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:3 | Reserved | | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:4 | Reserved | | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:5 | CT primary current | 1-10000 | A | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:6 | CT secondary current | 1, 5, 50 | A | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:7 | Reserved | | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:8 | Reserved | | | UINT16 | R/W | |
| 40:1 (read) | AO:9-16 | Reserved | | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:17 | Nominal line frequency | 50, 60 | Hz | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:18 | Phase order | 0 = ABC, 1 = CBA | | UINT16 | R/W | |
| 40:2 (read) | AO:19-23 | Reserved | | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:24 | I maximum demand load current | 0-10000 | A | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:25 | Reserved | | | UINT16 | R/W | |
| 40:2 (read) | AO:26-31 | Reserved | | | UINT16 | R/W | Read as 65535 |
| **Demand Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:32 | Power demand period (block interval) | 1, 2, 3, 5, 10, 15, 30, 60 | min | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:33 | Number of demand periods in a sliding window | 1-15 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:34 | Reserved | | | UINT16 | R/W | A DI input is considered a pulse or KYZ input. The pulse edge restarts the power demand accumulation interval. |
| 40:2 (read) | AO:35-39 | Reserved | | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:40 | Volt demand period | 0-9000 | sec | UINT16 | R/W | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 40:2 (read)<br>41:2 (write) | AO:41 | Ampere demand period | 0-9000 | sec | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:42 | Harmonic demand period | 0-9000 | sec | UINT16 | R/W | |
| 40:2 (read) | AO:43-47 | Reserved | | | UINT16 | R/W | Read as 65535 |
| **Device Options Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:48 | Power calculation mode | 0 = using reactive power: S = f(P,Q),<br>1 = using non-active power:<br>Q = f(S,P) | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:49 | Energy roll value | 0 = $1\times10^4$, 1 = $1\times10^5$, 2 = $1\times10^6$,<br>3 = $1\times10^7$, 4 = $1\times10^8$, 5 = $1\times10^9$ | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:50 | Reserved | | | UINT16 | R/W | |
| 40:2 (read | AO:51 | Reserved | | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:52 | Tariff control | 0 = via a calendar scheduler, 0x4000 = via communications, 0x0100-0x010F = via tariff inputs DI1-DI8 (bits 0:3 denote the first digital input index used) | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:53 | Number of tariffs | 1-8 (does not have effect with a calendar tariff control option) | | UINT16 | R/W | When read with a calendar tariff control option, indicates the actual number of tariffs selected in TOU profiles |
| 40:2 (read | AO:54 | Reserved | | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:55 | Energy LED test mode | 0=disabled, 1=Wh test, 2=varh test | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:56 | Test energy LED pulse rate, Wh/varh per pulse (in secondary units) | 1-10000 | ×0.01 | UINT16 | R/W | |
| **Channels Assignment Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | +0 | Channel CT primary current | 1-10000 A | A | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +1 | Submeter's phase L1 current input channel | 0=not assigned, 1-54 = I1-I54 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +2 | Submeter's phase L2 current input channel | 0=not assigned, 1-54 = I1-I54 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +3 | Submeter's phase L3 current input channel | 0=not assigned, 1-54 = I1-I54 | | UINT16 | R/W | |
| | AO:280-283 | **Submeter #1 channels** | | | | | |
| | AO:284-287 | **Submeter #2 channels** | | | | | |
| | | **…** | | | | | |
| | AO:492-495 | **Submeter #54 channels** | | | | | |
| **Transformer Correction Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | +0 | Ratio correction factor | 700-1300 | ×0.001 | UINT16 | R/W | 40:2 (read)<br>41:2 (write) |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 40:2 (read)<br>41:2 (write) | +1 | Phase angle error | -600 to 600 | min | INT16 | R/W | 40:2 (read)<br>41:2 (write) |
| 40:2 (read)<br>41:2 (write) | +2,3 | Reserved | | | INT16 | R/W | 40:2 (read)<br>41:2 (write) |
| | AO:512-515 | **V1 transformer correction** | | | | | |
| | AO:516-519 | **V2 transformer correction** | | | | | |
| | AO:520-523 | **V3 transformer correction** | | | | | |
| | AO:524-527 | **Reserved** | | | | | |
| | AO:528-531 | **I1 transformer correction** | | | | | |
| | AO:532-535 | **I2 transformer correction** | | | | | |
| | AO:536-539 | **I3 transformer correction** | | | | | |
| | ….. | **…..** | | | | | |
| | AO:740-743 | **I54 transformer correction** | | | | | |
| **Communication Ports Setup** | | | | | | | |
| | | **COM1 Setup** | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:112 | Communication protocol | 0 = Modbus RTU, 1 = Modbus ASCII, 2 = DNP3.0 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:113 | Interface | 0 = RS-232, 1 = RS-422, 2 = RS-485, 4 = Modem | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:114 | Device address | Modbus: 1-247<br>DNP3.0: 0–65532 | | UINT16 | R/W | Every submeter/virtual meter has its own device address, this address represents the 1st Sm address |
| 40:2 (read)<br>41:2 (write) | AO:115 | Baud rate | 1 = 300 bps, 2 = 600 bps, 3 = 1200 bps, 4 = 2400 bps, 5 = 4800 bps,<br>6 = 9600 bps, 7 = 19200 bps,<br>8 = 38400 bps, 9 = 57600 bps, 10 = 115200 bps | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:116 | Data format | 0 = 7 bits/even parity,<br>1 = 8 bits/no parity,<br>2 = 8 bits/even parity | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:117 | CTS mode | 0 = not used, 1 = wait for CTS before sending data | | UINT16 | R/W | N/A for COM2-COM4 (read as 65535) |
| 40:2 (read)<br>41:2 (write) | AO:118 | RTS mode | 0 = not used,<br>1 = RTS is asserted during the transmission | | UINT16 | R/W | N/A for COM2-COM4 (read as 65535) |
| 40:2 (read)<br>41:2 (write) | AO:119 | Minimum delay before sending data | 0-1000 (default = 5) | ms | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:120 | Inter-character timeout | 1-1000 (default = 4) | ms | UINT16 | R/W | Added to standard 4-character time |
| 40:2 (read)<br>41:2 (write) | AO:121-127 | Reserved | | | | | Read as 65535 |
| | | **COM2 Setup** | | | | | |
| | AO:128-143 | Point descriptions and ranges as for port COM1 | | | | R/W | |
| | | **COM3 Setup** | | | | | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | AO:144-159 | Point descriptions and ranges as for port COM1 | | | | R/W | |
| | | **COM4 Setup** | | | | | |
| | AO:160-175 | Point descriptions and ranges as for port COM1 | | | | R/W | |

## 3.9 DNP Protocol Setup

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| **DNP Options Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:64 | Default Binary Input Static object variation | F3 (default=0) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:65 | Default Binary Input Change object variation | F3 (default=1) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:66 | Default Binary Counter static object variation | F3 (default=3) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:67 | Default Frozen Binary Counter object variation | F3 (default=4) | | UINT16 | R/W | 1 |
| 40:2 (read) | AO:68 | Reserved | Read as 65535 | | UINT32 | R | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:69 | Default Binary Counter Change Event object variation | F3 (default=2) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:70 | Default Analog Input object variation | F3 (default=3) | | UINT16 | R/W | 1 |
| 40:2 (read) | AO:71 | Reserved | Read as 65535 | | UINT32 | R/W | Read as 65535 |
| 40:2 (read) | AO:72 | Reserved | Read as 65535 | | UINT32 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:73 | Default Analog Input Change Event object variation | F3 (default=2) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:74 | Re-mapping static point indices for event objects | 0=disabled (default), 1=enabled | | UINT16 | R/W | |
| 40:1 (read)<br>41:2 (write) | AO:75 | 16-bit BC scaling | 0=×1 (default), 1=×10, 2=×100, 3=×1000 | | UINT16 | R/W | 6 |
| 40:1 (read)<br>41:2 (write) | AO:76 | 16-bit AI scaling | 0=disabled, 1=enabled (default) | | UINT16 | R/W | 3 |
| 40:2 (read)<br>41:2 (write) | AO:77 | Number of Analog Input change event points | 0 to 64 (default=43) | | UINT16 | R/W | 2 |
| 40:2 (read)<br>41:2 (write) | AO:78 | Number of Binary Input change event points | 0 to 64 (default=21) | | UINT16 | R/W | 2 |
| 40:2 (read)<br>41:2 (write) | AO:79 | Number of Binary Counter change event points | 0 to 64 (default=0) | | UINT16 | R/W | 2 |
| 40:2 (read)<br>41:2 (write) | AO:80 | Select/Operate Timeout | 2 to 30 (default=10 sec) | sec | UINT16 | R/W | 4 |
| 40:2 (read)<br>41:2 (write) | AO:81 | Multi Fragment Interval | 50 to 500 (default=50 ms) | ms | UINT16 | R/W | |
| 40:1 (read) | AO:82-AO:84 | Reserved | Read as 65535 | | UINT32 | R | Read as 65535 |
| 40:1 (read)<br>41:1 (write) | AO:85 | Time Sync Period | 1 to 86400 (default=86400 sec)<br>0 = disable time requests | sec | UINT32 | R/W | 5 |
| 40:2 (read)<br>41:2 (write) | AO:86 | Voltage scale, secondary volts | 60 to 535V (default=144V) | V | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:87 | Current scale, secondary amps | 10 to 1000 (default CT secondary × CT overload) | ×0.1A | UINT16 | R/W | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 40:1 (read)<br>41:1 (write) | AO:256-AO:263 | Device location | | | UINT32 | R/W | Null-terminated string. Each four characters are packed into a 32-bit word. |
| 40:2 (read)<br>41:2 (write) | AO:264 | Maximum file directory entries | 10-200 | | UINT16 | R/W | Default = 20 |
| **DNP Events Setup** | | | | | | | |
| 40:1(read)<br>41:1(write) | +0 | Threshold/Deadband | | | UINT32 | R/W | A hysteresis for the point return threshold is 0.05Hz for frequency and 2% of the operating threshold for other points |
| 40:1(read)<br>41:1(write) | +1 | DNP point number | DNP point number available for the selected object | | UINT32 | R/W | |
| 40:2(read)<br>41:2(write) | +2 | Event scan control field (bitmap) | Bits 0-1 - DNP Object:<br>0=none, 1=AI, 2=BI, 3=BC<br>Bit 2 – Object change event scan:<br>0= disabled, 1=enabled<br>Bits 5-6 - DNP event poll class:<br>0=Class 1, 1=Class 2, 2=Class 3<br>Bit 7 – unused<br>Bits 8-9 – Threshold/Deadband relation:<br>0=Delta, 1=more than (over threshold) [7], 2=less than (under threshold) [7] | | UINT16 | R/W | If Event log is enabled, the source of a DNP event will be recorded to the device Event log file as a general Setpoint #17. |
| | AO:896-AO:898 | **DNP Event #1** | | | | | |
| | AO:899-AO:901 | **DNP Event #2** | | | | | |
| | | **…** | | | | | |
| | AO:1085-AO:1087 | **DNP Event #64** | | | | | |
| **DNP Class 0 Point Assignments** | | | | | | | |
| 40:1(read)<br>41:1(write) | +0 | DNP object and variation | F4 | | UINT32 | R/W | |
| 40:1(read)<br>41:1(write) | +1 | Start point number | Start point number for the selected object | | UINT32 | R/W | |
| 40:2(read)<br>41:2(write) | +2 | Number of points in a range | 0-128 | | UINT16 | R/W | |
| | AO:1152-AO:1154 | **DNP Class 0 Points Range 1** | | | | | |
| | AO:1155-AO:1157 | **DNP Class 0 Points Range 2** | | | | | |
| | | **…** | | | | | |
| | AO:1245-AO:1247 | **DNP Class 0 Points Range 32** | | | | | |

**NOTES:**

[1] The default object variation indicates the variation that is used for requests with qualifier code 06 (variation 0) when no specific variation is requested by a master station.

[2] The sum of all points allocated for change event objects should not exceed 64. If no points are allocated for change events, the report-by-exception mode is not supported.

[3] Scaling 16-bit AI objects (see Section 2.2.5) lets accommodate 32-bit analog input readings to 16-bit object format. Scaling is enabled by default. It is not applied to 32-bit AI objects (object 30, variations 1 and 3).

[4] The Select Before Operate command causes the device to start a timer. The following Operate command must be sent before the value specified by the Select/Operate Timeout expires.

[5] The device requests time synchronization by bit 4 in the first octet of the internal indication word being set when the time specified by the Time Sync Period elapses. The master should synchronize the time in the device by writing the Time and Date object. The device does not request time synchronization if the Time Sync Period is set to 0.

[6] Scaling 16-bit Binary Counters (see Section 2.2.6) allows changing a counter unit in powers of 10 to accommodate a 32-bit counter value to 16-bit BC object format.

## 3.10 Generic Data

| Address | Point ID | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **Generic Data** | | | | | Point references |
| | 0x7400 | V1 voltage | 0-Vmax | U1 | UINT32 | | [1] |
| | 0x7401 | V2 voltage | 0-Vmax | U1 | UINT32 | | [1] |
| | 0x7402 | V3 voltage | 0-Vmax | U1 | UINT32 | | [1] |
| | 0x7403 | V4 voltage | 0-V4max | U4 | UINT32 | | |
| | 0x7404 | V12 voltage | 0-Vmax | U1 | UINT32 | | |
| | 0x7405 | V23 voltage | 0-Vmax | U1 | UINT32 | | |
| | 0x7406 | V31 voltage | 0-Vmax | U1 | UINT32 | | |
| | 0x7407 | I1 current | 0-Imax | U2 | UINT32 | | |
| | 0x7408 | I2 current | 0-Imax | U2 | UINT32 | | |
| | 0x7409 | I3 current | 0-Imax | U2 | UINT32 | | |
| | 0x740A | Reserved | | | UINT32 | | |
| | 0x740B | In current | 0-Imax | U2 | UINT32 | | |
| | 0x740C | Reserved | | | UINT32 | | |
| | 0x740D | Reserved | | | UINT32 | | |
| | 0x740E | Reserved | | | UINT32 | | |
| | 0x740F | Reserved | | | UINT32 | | |
| | 0x7410 | Reserved | | | UINT32 | | |
| | 0x7411 | Zero-sequence voltage | 0-Vmax | U1 | UINT32 | | |
| | 0x7412 | Zero-sequence current | 0-Imax | U2 | UINT32 | | |
| | 0x7413 | Reserved | | | UINT32 | | |
| | 0x7414 | Voltage unbalance | 0-3000 | ×0.1% | UINT32 | | |
| | 0x7415 | Current unbalance | 0-3000 | ×0.1% | UINT32 | | |
| | 0x7416 | Reserved | | | UINT32 | | |
| | 0x7417 | Not used | | | UINT32 | | |
| | 0x7418 | Frequency | 0-10000 | ×0.01Hz | UINT32 | | |
| | 0x741C | Reserved | | | UINT32 | | |
| | 0x7424 | Reserved | | | UINT32 | | |
| | 0x7428 | Reserved | | | UINT32 | | |
| | 0x742C | Reserved | | | UINT32 | | |
| | 0x7430 | Reserved | | | UINT32 | | |
| | 0x7434 | Reserved | | | UINT32 | | |
| | 0x7438 | Reserved | | | UINT32 | | |
| | 0x750A | Positive-sequence voltage | 0-Vmax | U1 | UINT32 | | [2] |
| | 0x750B | Negative-sequence voltage | 0-Vmax | U1 | UINT32 | | [2] |
| | 0x750C | Zero-sequence voltage | 0-Vmax | U1 | UINT32 | | [2] |
| | 0x750D | Negative-sequence voltage unbalance | 0-3000 | ×0.1% | UINT32 | | [2] |
| | 0x750E | Zero-sequence voltage unbalance | 0-3000 | ×0.1% | UINT32 | | [2] |
| | 0x2980 | Reserved | | | UINT32 | | [2] |
| | 0x2981 | Reserved | | | UINT32 | | [2] |
| | 0x2982 | Reserved | | | UINT32 | | [2] |

| Address | Point ID | Description | Options/Range[3] | Units[3] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | 0x2983 | Reserved | | | UINT32 | | 2 |
| | 0x2984 | Reserved | | | UINT32 | | 2 |
| | 0x2985 | Reserved | | | UINT32 | | 2 |
| | 0x6005 | Reserved | | | UINT32 | | 2 |
| | 0x6006 | Reserved | | | UINT32 | | 2 |
| | 0x6007 | Reserved | | | UINT32 | | 2 |
| | 0x6008 | Reserved | | | UINT32 | | 2 |
| | 0x600A | Reserved | | | UINT32 | | 2 |
| | 0x600B | Reserved | | | UINT32 | | 2 |
| | 0x600C | Reserved | | | UINT32 | | 2 |
| | 0x600D | Reserved | | | UINT32 | | 2 |
| | 0x600F | Reserved | | | UINT32 | | 2 |
| | 0x6010 | Reserved | | | UINT32 | | 2 |
| | 0x6011 | Reserved | | | UINT32 | | 2 |
| | 0x6012 | Reserved | | | UINT32 | | 2 |
| | 0xC481 | Reserved | | | UINT32 | | |
| | 0xC486 | Reserved | | | UINT32 | | |
| | 0xC48B | Reserved | | | UINT32 | | |

**NOTES:**

[1] When the 4LN3, 4LL3, 3LN3, 3LL3, 3BLN3 or 3BLL3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line.

[2] When the 4LN3, 3LN3 or 3BLN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

[3] For volts, amps, power and frequency scales and units, refer to Section 4 "Data Scales and Units".

# 4 Data Scales and Units

| Code | Condition | Value/Range | Notes |
|---|---|---|---|
| **Data Scales** | | | |
| Vmax | | Voltage Scale × PT Ratio, V | 2 |
| Imax | | Current Scale × CT Ratio [1], A, | 3 |
| Pmax | PT Ratio = 1 | Vmax × Imax × 2, W | 4 |
| | PT Ratio > 1 | (Vmax × Imax × 2)/1000, kW | |
| AImin<br>AImax | +/-1mA | AImin = -AI full scale × 2<br>AImax = AI full scale × 2 | |
| | 0-20mA | AImin = AI zero scale<br>AImax = AI full scale | |
| | 4-20mA | AImin = AI zero scale<br>AImax = AI full scale | |
| | 0-1mA | AImin = AI zero scale<br>AImax = AI full scale | |
| **Data Units** | | | |
| U1 | PT Ratio = 1 | 0.1V | |
| | PT Ratio > 1 | 1V | |
| U2 | | 0.01A | |
| U3 | PT Ratio = 1 | 0.001 kW/kvar/kVA | |
| | PT Ratio > 1 | 1 kW/kvar/kVA | |
| U4 | | $10^{-d}$ x register measurement unit (see F15 in Section 5). d = 0-4 – number of decimal places for energy registers (see Device Options Setup) | |
| U5 | | 0.001, 0.01, 0.1, 1 kWh/kVAh/kvarh (programmable) | 5 |

1 CT Ratio = CT primary current/CT secondary current

2 The default Voltage scale is 144V (120V +20%). You can change it via the DNP Options setup (see Section 3.9) or via the Device Options setup in PAS.

3 The default Current Scale is 4 × CT secondary current for devices with a 400% overload (ANSI) or 2 × CT secondary current for devices with a 200% overload (IEC). You can change it via the DNP Options setup (see Section 3.9) or via the Device Options setup in PAS.

4 Pmax is rounded to whole kilowatts. If Pmax is greater than 9,999,000 W, it is truncated to 9,999,000 W.

5 See Energy Decimal Places in the Device Options setup.

# 5 Data Formats

| Format Code | Value | Description | Notes |
|---|---|---|---|
| **Wiring Mode** | | | |
| F1 | 0 | 3OP2 - 3-wire open delta using 2 CTs (2 element) | |
| | 1 | 4LN3 - 4-wire WYE using 3 PTs (3 element), line-to-neutral voltage readings | |
| | 2 | 3DIR2 - 3-wire direct connection using 2 CTs (2 element) | |
| | 3 | 4LL3 - 4-wire WYE using 3 PTs (3 element), line-to-line voltage readings | |
| | 4 | 3OP3 - 3-wire open delta using 3 CTs (2 1/2 element) | |
| | 5 | 3LN3 - 4-wire WYE using 2 PTs (2 1/2 element), line-to-neutral voltage readings | |
| | 6 | 3LL3 - 4-wire WYE using 2 PTs (2 1/2 element), line-to-line voltage readings | |
| | 8 | 3BLN3 - 3-wire broken delta using 2 PTs (2 1/2 element), line-to-neutral voltage readings | |
| | 9 | 3BLL3 - 3-wire broken delta using 2 PTs (2 1/2 element), line-to-line voltage readings | |
| **DNP Object Variations** | | | |
| F3 | | **Static Binary Input Objects** | |
| | 0 | Single-Bit Binary Input | |
| | 1 | Binary Input With Status | |
| | | **Binary Input Change Event Objects** | |
| | 0 | Binary Input Change Without Time | |
| | 1 | Binary Input Change With Time | |
| | | **Static Binary Counters** | |
| | 0 | 32-bit Binary Counter | |
| | 1 | 32-bit Binary Counter Without Flag | |
| | 2 | 16-bit Binary Counter | |
| | 3 | 16-bit Binary Counter Without Flag | |
| | | **Binary Counter Change Events** | |
| | 0 | 32-bit Counter Change Event Without Time | |
| | 1 | 32-bit Counter Change Event With Time | |
| | 2 | 16-bit Counter Change Event Without Time | |
| | 3 | 16-bit Counter Change Event With Time | |
| | | **Frozen Binary Counters** | |
| | 0 | 32-bit Frozen Counter | |
| | 1 | 32-bit Frozen Counter Without Flag | |
| | 2 | 32-bit Frozen Counter With Time of Freeze | |
| | 3 | 16-bit Frozen Counter | |
| | 4 | 16-bit Frozen Counter Without Flag | |
| | 5 | 16-bit Frozen Counter With Time of Freeze | |
| | | **Static Analog Input Objects** | |
| | 0 | 32-bit Analog Input | |
| | 1 | 32-bit Analog Input Without Flag | |
| | 2 | 16-bit Analog Input | |
| | 3 | 16-bit Analog Input Without Flag | |
| | | **Analog Input Change Events** | |
| | 0 | 32-bit Analog Change Event Without Time | |
| | 1 | 32-bit Analog Change Event With Time | |
| | 2 | 16-bit Analog Change Event Without Time | |
| | 3 | 16-bit Analog Change Event With Time | |
| **DNP Class 0 Objects** | | | |
| F4 | 0x1E01 | Analog Input 30:01 | |
| | 0x1E02 | Analog Input 30:02 | |
| | 0x1E03 | Analog Input 30:03 | |
| | 0x1E04 | Analog Input 30:04 | |
| | 0x2801 | Analog Output 40:01 | |
| | 0x2802 | Analog Output 40:02 | |
| | 0x0101 | Binary Input 01:01 | |
| | 0x0102 | Binary Input 01:02 | |
| | 0x1401 | Binary Counter 20:01 | |
| | 0x0A01 | Binary Output 10:01 | |
| | 0x0A01 | Binary Output Status 10:02 | |
| | 0x1402 | Binary Counter 20:02 | |

| Format Code | Value | Description | Notes |
|---|---|---|---|
| | 0x1405 | Binary Counter 20:05 | |
| | 0x1406 | Binary Counter 20:06 | |
| | 0x1501 | Frozen Counter 21:01 | |
| | 0x1502 | Frozen Counter 21:02 | |
| | 0x1505 | Frozen Counter 21:05 | |
| | 0x1506 | Frozen Counter 21:06 | |
| | 0x1509 | Frozen Counter 21:09 | |
| | 0x150A | Frozen Counter 21:10 | |
| **Timestamp** | | | |
| F5 | | Local time in a UNIX-style format. Represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000. | |
| **Event Source/Point ID** | | | |
| F19 | | **Setpoint Operation Events** | |
| | 0x0000-0x59FF | Trigger parameter ID (see BFM II Modbus Guide, Section 3) | |
| | 0x6400-0xFFFF | Trigger parameter ID (see BFM II Modbus Guide, Section 3) | |
| | | **Setpoint Action Events** | |
| | 0x5A00-0x5A3F | Setpoint #1-#64 | |
| | | **Communications Events** | |
| | 0x5B00-0x5BFF | Data/Function point ID (low byte, see F21) | |
| | | **Self-Check Diagnostics Events** | |
| | 0x5D00-0x5DFF | Data/Function point ID (low byte, see F21) | |
| | | **Self-Update Events** | |
| | 0x5E08 | RTC DST/Standard time update | 1 |
| | | **Run-time Error** | |
| | 0x6014 | Library error | |
| | 0x6015 | RTOS Kernel error | |
| | 0x6016 | Task error | |
| | | **Control Events** | |
| | 0x6100 | XSWIn_OpOpn = operation "Open" (n=see F20 Control Events) | |
| | 0x6101 | XSWIn_OpCls = operation "Close" (n=see F20 Control Events) | |
| | 0x6102 | XSWIn_Pos = switch position change (n=see F20 Control Events, Value = position) | |
| | 0x6103 | Remote control (Value: 0=OFF, 1=ON) | |
| | | **Hardware Diagnostics Events** | |
| | 0x6201 | Permanent fault | |
| | 0x6202 | RAM/Data error | |
| | 0x6203 | CPU watchdog reset | |
| | 0x6204 | DSP/Sampling fault | |
| | 0x6205 | CPU exception | |
| | 0x6206 | Reserved | |
| | 0x6207 | Software watchdog reset | |
| | 0x620E | Expanded memory fault (Event effect = File ID + 1) | |
| | 0x620F | CPU EEPROM fault | |
| | 0x6210 | AC board EEPROM fault | |
| | 0x6211 | I/O board EEPROM fault | |
| | | **External Events** | |
| | 0x6300 | Power down | |
| | 0x6308 | Power up | |
| | 0x6309 | External reset | |
| | 0x6318 | IRIG-B signal lost | |
| | 0x6319 | IRIG-B time unlocked | |
| | 0x631A | IRIG-B time locked | |
| | 0x6320 | SNTP server failed | 2 |
| | 0x6321 | SNTP server reconnected | 2 |
| **Event Effect ID** | | | |
| F20 | | **Communications/Self-check/Self-update Events** | |
| | 0x0000 | None | |
| | 0x6000 | Total energy registers cleared | |
| | 0x6100 | All total maximum demands cleared | |
| | 0x6101 | Power maximum demands cleared | |
| | 0x6102 | Volt/Ampere maximum demands cleared | |
| | 0x6103 | Volt maximum demands cleared | |
| | 0x6104 | Ampere maximum demands cleared | |

| Format Code | Value | Description | Notes |
|---|---|---|---|
| | 0x6105 | Harmonic maximum demands cleared | |
| | 0x6200 | Billing/TOU registers cleared | |
| | 0x6300 | Billing/TOU maximum demand registers cleared | |
| | 0x6400 | All counters cleared | |
| | 0x6401-0x641F | Counter cleared (low byte = counter ID) | |
| | 0x6500 | Min/Max log cleared | |
| | 0x6A00-0x6A1B | Log file cleared (low byte = File ID) | |
| | 0x6B00 | EN50160 statistics cleared | |
| | 0x6B06 | Communication counters cleared | |
| | 0x6B07 | Switch operation counters cleared | |
| | 0xF100-0xF11F | Setpoint cleared (low byte = setpoint ID) | |
| | 0xF200 | Setup/Data cleared | |
| | 0xF300 | Setup reset (set by default) | |
| | 0xF400 | Setup changed | |
| | 0xF500 | RTC set | 1 |
| | 0xF600 | Device function/option enabled | |
| | 0xF700 | Device function/option disabled | |
| | 0xF800 | Device function restarted | |
| | 0xF900 | Device function stopped | |
| | | **Control Events** | |
| | 0xA0XX | Position change (bits 0:7=switch number) | |
| | 0xA1XX | Operation activated (bits 0:7=switch number) | |
| | 0xA2XX | Operation terminated (bits 0:7=switch number) | |
| | 0xA3XX | Operation terminated by timeout (bits 0:7=switch number) | |
| | | **Setpoint Operation Events** | |
| | 0xE100-0xE13F | Setpoint operated (low byte = setpoint ID) | |
| | 0xE200-0xE23F | Setpoint released (low byte = setpoint ID) | |
| | | **Setpoint Action Events** | |
| | See F14 | Setpoint action ID | |
| **Data/Function Point ID** | | | |
| F21 | | **Data Location** | |
| | 0x03 | Data memory | |
| | 0x04 | Factory setup | |
| | 0x05 | Access/Password setup | |
| | 0x06 | Basic setup | |
| | 0x07 | Communications setup | |
| | 0x08 | Real-time clock | |
| | 0x09 | Digital inputs setup | |
| | 0x0A | Pulse counters setup | |
| | 0x0B | AO setup | |
| | 0x0E | Timers setup | |
| | 0x10 | Event/alarm setpoints | |
| | 0x11 | Pulsing setup | |
| | 0x12 | User assignable register map | |
| | 0x13 | Reserved | |
| | 0x14 | Data log setup | |
| | 0x15 | File/Memory setup | |
| | 0x16 | Billing/TOU registers setup | |
| | 0x18 | TOU daily profiles | |
| | 0x19 | TOU calendar | |
| | 0x1D | RO Setup | |
| | 0x1C | User selectable options | |
| | 0x1F | DNP 3.0 class 0 map | |
| | 0x20 | DNP 3.0 options setup | |
| | 0x21 | DNP 3.0 events setup | |
| | 0x22 | DNP 3.0 event setpoints | |
| | 0x23 | Calibration registers | |
| | 0x24 | Date/Time Setup | |
| | 0x25 | Net setup | |
| | 0x26 | AI setup | |
| | 0x27 | Waveform log setup | |
| | 0x28 | PQ log setup | |
| | 0x29 | Fault log setup | |
| | 0x2A | Device mode control | |
| | 0x2B-0x3F | Reserved | |
| | | **Device Mode/Option** | |

| Format Code | Value | Description | Notes |
|---|---|---|---|
| | 0x40 | General device operations | |
| | 0x41 | Energy test mode | |
| | 0x42 | Setpoints mode | |
| | 0x43 | PQ recorder | |
| | 0x44 | Fault recorder | |
| | | **Device Diagnostics** | |
| | 0x80 | Device diagnostics | |
| | 0x81 | Critical error | |
| **Event Type ID** | | | |
| F22 | | **Setpoint Events** | |
| | 0x0000 | SP: Generic setpoint event | |
| | 0x0001-0x0010 | SP1-SP16: Setpoint #1-#16 event | |
| | | **Fault Events** | |
| | 0x0200 | FE: Generic fault event | |
| | 0x0201 | FE1: Zero-sequence current | |
| | 0x0202 | FE2: Zero-sequence voltage | |
| | 0x0203 | FE3: Current unbalance | |
| | 0x0204 | FE4: Voltage unbalance | |
| | 0x0205 | FE5: Overcurrent and undervoltage | |
| | 0x0206 | FE6: Undervoltage | |
| | 0x0207 | FE7: Neutral current (I4) | |
| | | **DI Events** | |
| | 0x0300 | DI: Generic DI event | |
| | 0x0301-0x0348 | DI1-DI72: DI1-DI72 event | |
| | | **RO Events** | |
| | 0x0400 | RO: Generic RO event | |
| | 0x0401-0x0408 | RO1-RO8: RO1-RO8 event | |

NOTES:

1 The event value field shows the present device time in the F5 format.

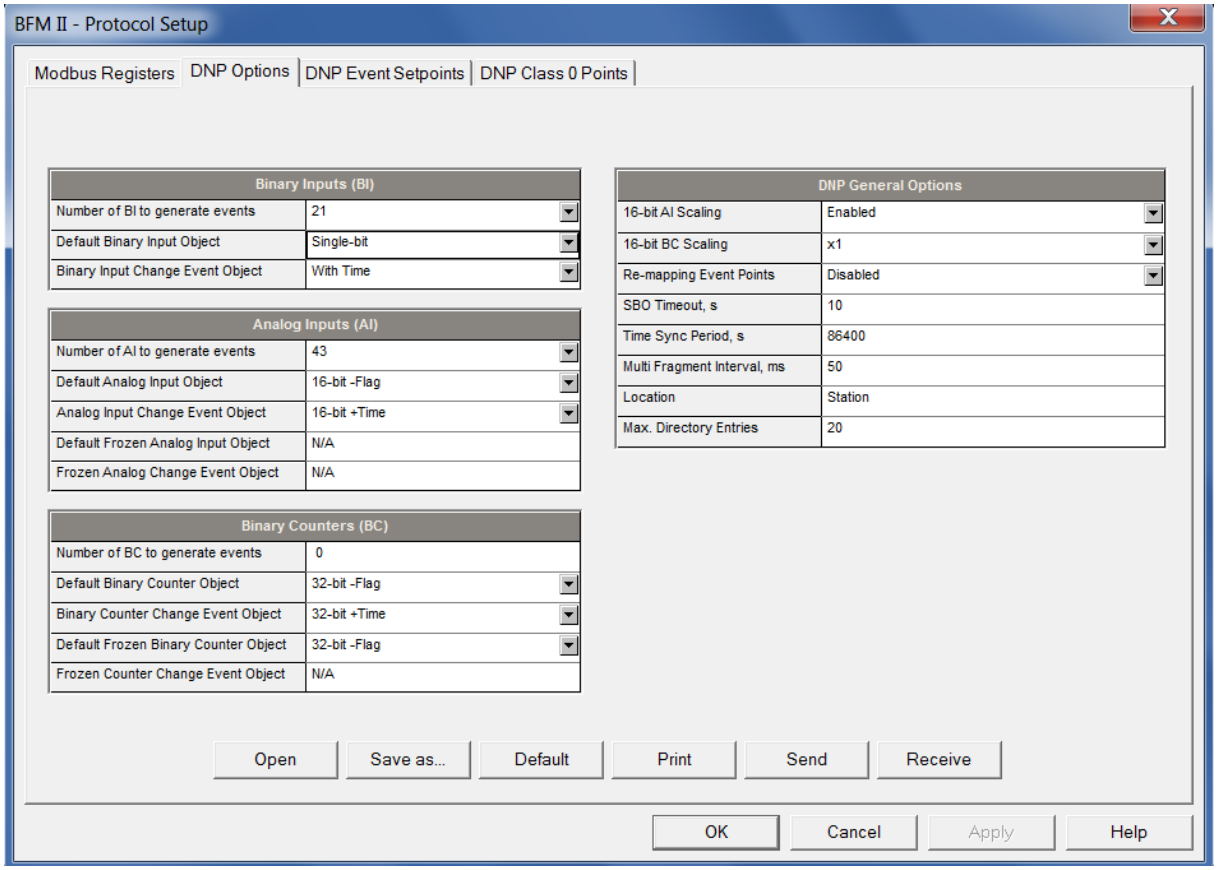
2 The event value field shows the server IP address in a network byte order.

# 6 Configuring DNP3

The PAS software supplied with the BFM II provides a configuration tool for customizing your device for use with DNP3 client applications. See the BFM II Operation Manual for more information on installation and operating PAS on your computer.

## 6.1 DNP Options

From the Meter Setup menu select Protocol Setup and click on the DNP Options tab.




Available DNP options are described in the following table. Refer to the DNP3 Data Object Library document available from the DNP User's Group on the DNP3 object types.

| Parameter | Options | Default | Description |
|---|---|---|---|
| **Binary Inputs (BI)** | | | |
| Number of BI to Generate events | 0-64 [3] | 21 | The total number of BI change event points for monitoring |
| Binary Input Object | Single-bit<br>With Status | Single-bit | The default BI object variation for requests with qualifier code 06 when no specific variation is requested |
| Binary Input Change Event Object | Without Time<br>With Time | With Time | The default BI change event object variation for requests with qualifier code 06 when no specific variation is requested |
| **Analog Inputs (AI)** | | | |
| Number of AI to Generate events | 0-64 [3] | 43 | The total number of AI change event points for monitoring |
| Analog Input Object | 32-bit<br>32-bit –Flag<br>16-bit<br>16-bit –Flag | 16-bit -Flag | The default AI object variation for requests with qualifier code 06 when no specific variation is requested |

| Parameter | Options | Default | Description |
|---|---|---|---|
| Analog Input Change Event Object | 32-bit -Time<br>32-bit +Time<br>16-bit -Time<br>16-bit +Time | 16-bit +Time | The default AI change event object variation for requests with qualifier code 06 when no specific variation is requested |
| **Binary Counters (BC)** | | | |
| Number of BC to Generate events | 0-64 [3] | 0 | The total number of BC change event points for monitoring |
| Binary Counter Object | 32-bit +Flag<br>32-bit –Flag<br>16-bit +Flag<br>16-bit –Flag | 32-bit -Flag | The default BC object variation for requests with qualifier code 06 when no specific variation is requested |
| Binary Counter Change Event Object | 32-bit -Time<br>32-bit +Time<br>16-bit -Time<br>16-bit +Time | 32-bit +Time | The default BC change event object variation for requests with qualifier code 06 when no specific variation is requested |
| Frozen Binary Counter Object | 32-bit +Flag<br>32-bit –Flag<br>32-bit +Time<br>16-bit +Flag<br>16-bit –Flag<br>16-bit +Time | 32-bit -Flag | The default frozen BC object variation for requests with qualifier code 06 when no specific variation is requested |
| **DNP General Options** | | | |
| 16-bit AI Scaling | Disabled<br>Enabled | Enabled | Allows scaling 16-bit analog input objects (see description below) |
| 16-bit BC Scaling | x1, x10, x100, x1000 | x1 | Allows scaling 16-bit binary counter objects (see description below) |
| Re-mapping Event Points | Disabled<br>Enabled | Disabled | Allows re-mapping event points starting with point 0. |
| SBO Timeout [1] | 2-30 sec | 10 | Defines the Select Before Operate (SBO) timeout when using the Control-Relay-Output-Block object |
| Time Sync Period [2] | 0-86400 sec | 86400 | Defines the time interval between periodic time synchronization requests |
| Multi Fragment Interval | 50-500 ms | 50 | Defines the time interval between fragments of the response message when it is fragmented |
| Location | 1-31 characters | | Defines the device location string that is reported in the COMTRADE .cfg files. |
| Max. Directory Entries | 10-100 | 20 | Defines the maximum number of file entries the device may include in a directory response (the most recent events are always reported). The maximum number of entries in a disturbance waveform directory is twice the number specified. |

[1] The Select Before Operate command causes the device to start a timer. The following Operate command must be sent before the specified timeout value expires.

[2] The device requests time synchronization by bit 4 in the first octet of the internal indication word being set to 1 when the time interval specified by the Time Sync Period elapses. The master should synchronize the time in the device by sending the Time and Date object to clear this bit. The device does not send time synchronization requests if the Time Sync Period is set to 0.

[3] The total number of AI, BI and BC change event points may not exceed 64. When you change the number of the change event points in the device, all event setpoints are set to defaults (see Configuring DNP Event Classes below).

### Scaling 16-bit AI objects

Scaling 16-bit AI objects allows accommodating native 32-bit analog input readings to 16-bit object format; otherwise it may cause an over-range error if the full-range value exceeds a 16-bit point limit.

Scaling is enabled by default. It is not applied to points that are read using 32-bit AI objects.

Refer to Sections 3 and 4 for information on the data point scales and on a reverse conversion that should be applied to the received scaled values.

### Scaling 16-bit Binary Counters

Scaling 16-bit Binary Counters allows changing a counter unit in powers of 10 to accommodate a 32-bit counter value to 16-bit BC object format.

If the scaling unit is greater than 1, the counter value is reported being divided by the selected scaling unit from 10 to 1000. To get the actual value, multiply the counter reading by the scaling unit.

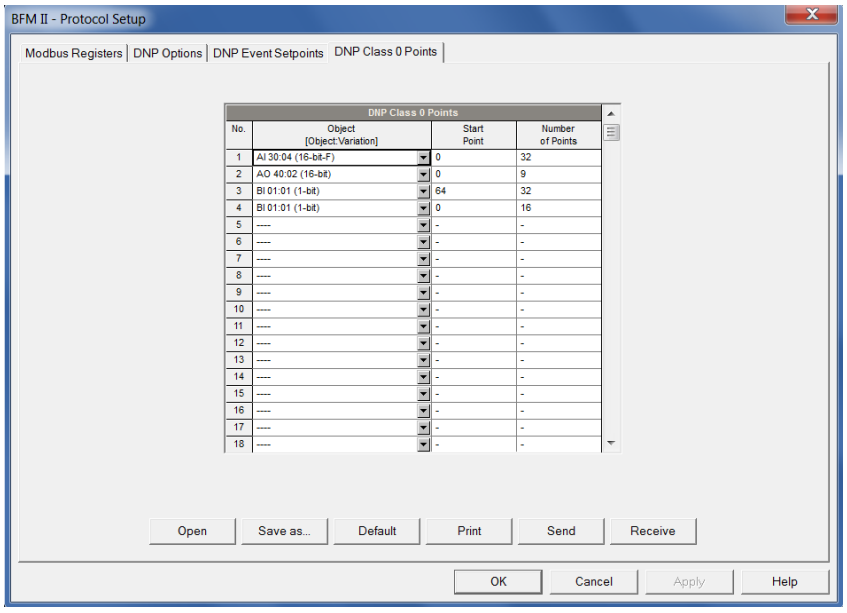
## 6.2 Configuring DNP Class 0 Response

The most common method of getting static object information from the device via DNP is to issue a read Class 0 request. The device allows you to configure the Class 0 response by assigning ranges of points to be polled via Class 0 requests.

To view the factory-set DNP Class 0 assignments or build your own Class 0 response message:

1. From the Meter Setup menu select Protocol Setup and click on the DNP Class 0 Points tab
    1. Select the object and variation type for a point range.
    2. Specify the start point index and the number of points in the range. Refer to Section 3 for available data points.
    3. Repeat these steps for all point ranges you want to be included into the Class 0 response.
    4. Click Send to download your setup to the device.

The factory-set Class 0 point ranges are shown in the picture below.



# APPENDIX A DNP Application Messages

The device is a DNP IED responding to external DNP Master requests. Table A-1 describes the BFM II application level responses to external requests, including object variations, functions, codes and qualifiers supported by the device. The object and formats are detailed in the DNP Basic 4 Documentation Set.

**Table A-1 Application Responses**

| Object | | | Request | | Response | |
|---|---|---|---|---|---|---|
| **Object** | **Variation** | **Description** | **Function Code** | **Qualifier Code** | **Function Code** | **Qualifier Code** |
| 01 | 0 | Single Bit Binary Input | 1 | B | 129 | 01 |
| 01 | 1 | Single Bit Binary Input | 1 | A | 129 | C |
| 01 | 2 | Binary Input with Status | 1 | A | 129 | C |
| 02 | 0 | Binary Input Change | 1 | 06 | 129 | 17,28 |
| 02 | 1 | Binary Input Change without Time | 1 | 07,08 | 129 | 17,28 |
| 02 | 2 | Binary Input Change with Time | 1 | 07,08 | 129 | 17,28 |
| 10 | 0 | Binary Output | 1 | B | 129 | 01 |
| 10 | 1 | Binary Output | 1 | A | 129 | C |
| 10 | 2 | Binary Output Status | 1 | A | 129 | C |
| 12 | 1 | Control Relay Output Block | 3,4,5 | A | 129 | C |
| 12 | 1 | Control Relay Output Block | 6 | A | None | N/A |
| 20 | 0 | Binary Counter | 1,<br>7,9,<br>8,10 | B<br>B<br>B | 129<br>129<br>129 | 01<br>N/R<br>N/A |
| 20 | 1 | 32-bit Binary Counter | 1 | A | 129 | C |
| 20 | 2 | 16-bit Binary Counter | 1 | A | 129 | C |
| 20 | 5 | 32-bit Binary Counter without flag | 1 | A | 129 | C |
| 20 | 6 | 16-bit Binary Counter without flag | 1 | A | 129 | C |
| 21 | 0 | Frozen Counter | 1 | B | 129 | 01 |
| 21 | 1 | 32-bit Frozen Counter | | | | |
| 21 | 2 | 16-bit Frozen Counter | | | | |
| 21 | 5 | 32-bit Frozen Counter with time of freeze | | | | |
| 21 | 6 | 16-bit Frozen Counter with time of freeze | | | | |
| 21 | 9 | 32-bit Frozen Counter without flag | | | | |
| 21 | 10 | 16-bit Frozen Counter without flag | | | | |
| 22 | 0 | Counter Change Event | 1 | 06 | 129 | 17 |
| 22 | 1 | 32-bit Counter Change Event without Time | 1 | 07,08 | 129 | 17 |
| 22 | 2 | 16-bit Counter Change Event without Time | 1 | 07,08 | 129 | 17 |
| 22 | 5 | 32-bit Counter Change Event with Time | 1 | 07,08 | 129 | 17 |
| 22 | 6 | 16-bit Counter Change Event with Time | 1 | 07,08 | 129 | 17 |
| 30 | 0 | Analog Input (respond like 30:3) | 1 | B | 129 | 01 |
| 30 | 1 | 32-bit Analog Input | 1 | A | 129 | C |
| 30 | 2 | 16-bit Analog Input | 1 | A | 129 | C |
| 30 | 3 | 32-bit Analog Input without flag | 1 | A | 129 | C |
| 30 | 4 | 16-bit Analog Input without flag | 1 | A | 129 | C |
| 32 | 0 | Analog Change Event | 1 | 06 | 129 | 17 |
| 32 | 1 | 32-bit Analog Change Event without Time | 1 | 07,08 | 129 | 17 |
| 32 | 2 | 16-bit Analog Change Event without Time | 1 | 07,08 | 129 | 17 |
| 32 | 3 | 32-bit Analog Change Event with Time | 1 | 07,08 | 129 | 17 |
| 32 | 4 | 16-bit Analog Change Event with Time | 1 | 07,08 | 129 | 17 |
| 40 | 0 | Analog Output Status (respond like 40:1) | 1 | B | 129 | 01 |
| 40 | 1 | 32-bit Analog Output Status | 1 | A | 129 | C |
| 40 | 2 | 16-bit Analog Output Status | 1 | A | 129 | C |
| 41 | 1 | 32-bit Analog Output Block | 3,4,5 | A | 129 | C |
| 41 | 2 | 16-bit Analog Output Block | 3,4,5 | A | 129 | C |
| 41 | 1 | 32-bit Analog Output Block | 6 | A | None | N/A |
| 41 | 2 | 16-bit Analog Output Block | 6 | A | None | N/A |
| 50 | 1 | Time and Date [1] | 1,2 | A | 129 | C |
| 60 | 1 | Class 0 | 1 | B | 129 | 01 |
| 60 | 2 | Class 1 | 1 | 06,07,08 | 129 | 17 |
| 60 | 3 | Class 2 | 1 | 06,07,08 | 129 | 17 |
| 60 | 4 | Class 3 | 1 | 06,07,08 | 129 | 17 |
| 70 | 3 | File-Control/File command | 25 | 5B | 129 | 5B |

| Object | | | Request | | Response | |
|---|---|---|---|---|---|---|
| **Object** | **Variation** | **Description** | **Function Code** | **Qualifier Code** | **Function Code** | **Qualifier Code** |
| 70 | 4 | File-Control/File command status | 26 | 5B | 129 | 5B |
| 70 | 5 | File-Control/File transport | 1 | 5B | 129 | 5B |
| 70 | 6 | File-Control/File transport status | 1 | | 129 | 5B |
| 70 | 7 | File-Control/File descriptor | 1 | | 129 | 5B |
| 80 | 1 | Internal indication [2] | 2 | D | 129 | |
| N/A | N/A | Cold Restart [3] (respond Obj. 52:2) | 13 | N/A | 129 | 07 |
| N/A | N/A | Delay Measurement (respond Obj. 52:2) | 23 | N/A | 129 | 07 |

[1] For this object, the quantity specified in the request must be exactly 1 or an index of 0, as there is only one instance of this object defined in the device.

[2] For this object, the qualifier code must specify an index 7 only.

[3] Respond with time object 50 variation 2 indicating time until device availability.

Qualifier Hex Codes for each category:
A - 00,01,03,04,07,17,27,08,18,28
B - 06 only
C - Qualifier echo
D - 00,01,03,04,17,27,18,28

N/A - Not Available

N/R - Null Response

# Appendix B DNP Device Profile

**DNP3**

**DEVICE PROFILE DOCUMENT**

This document must be accompanied by a table having the following headings:

Object Group | Request Function Codes | Response Function Codes

Object Variation | Request Qualifiers | Response Qualifiers

Object Name (optional)

Vendor Name: SATEC Ltd.

Device Name: BFM II Branch Feeder Monitor™

| Highest DNP Level Supported: | Device Function: |
|---|---|
| For Requests L1 | ☐ Master■ Slave |
| For Responses L1 | |

Device supports READ of each object using either all points (Qualifier = 6) or specific points using qualifier defined in Basic 4 Documentation Set: 00, 01, 03, 04, 07, 17, 27, 08, 18, 28. Control Relay Block requires specific parameters described in this manual. Treats range field of qualifier 07 and 08 to mean point range [0..N-1].

| Maximum Data Link Frame Size (octets): | Maximum Application Fragment Size (octets): |
|---|---|
| Transmitted 292 | Transmitted 2048 |
| Received 292 | Received 249 |

| Maximum Data Link Re-tries: | Maximum Application Layer Re-tries: |
|---|---|
| ■ None | ■ None |
| ☐ Fixed at_____ | ☐ Configurable, range _____ to _____ |
| ☐ Configurable, range ___ to_____ | (Fixed is not permitted) |

Requires Data Link Layer Confirmation:

■ Never

☐ Always

☐ Sometimes If 'Sometimes', when?

_____

☐ Configurable If 'Configurable', how? _____

Requires Application Layer Confirmation:

☐ Never

☐ Always (not recommended)

■ When reporting Event Data (Slave devices only)

☐ When sending multi-fragment responses (Slave devices only)

☐ Sometimes If 'Sometimes', when?

_____

☐ Configurable If 'Configurable', how? _____

Device Profile Document (continued)

Timeouts while waiting for:

Data Link Confirm ■ None ☐ Fixed at _____ ☐ Variable ☐ Configurable

Complete Appl. Fragment ■ None ☐ Fixed at _____ ☐ Variable ☐ Configurable

Application Confirm ☐ None ■ Fixed at _5 sec__ ☐ Variable ☐ Configurable

Complete Appl. Response ■ None ☐ Fixed at _____ ☐ Variable ☐ Configurable

Others

Timeouts between fragments of the multi-fragment responses. Configurable: 50-500 ms (50 ms by default).

_____

Attach explanation if 'Variable' or 'Configurable' was checked for any timeout

Sends/Executes Control Operations:

WRITE Binary Outputs ■ Never ☐ Always ☐ Sometimes ☐ Configurable

SELECT/OPERATE ☐ Never ■ Always ☐ Sometimes ☐ Configurable

DIRECT OPERATE☐ Never ■ Always ☐ Sometimes ☐ Configurable

DIRECT OPERATE - NO ACK ☐ Never ■ Always ☐ Sometimes ☐ Configurable

Count > 1 ■ Never ☐ Always ☐ Sometimes ☐ Configurable

Pulse On ☐ Never ☐ Always ■ Sometimes [1] ☐ Configurable

Pulse Off ■ Never ☐ Always ☐ Sometimes [4] ☐ Configurable

Latch On ☐ Never ☐ Always ■ Sometimes [2] ☐ Configurable

Latch Off ☐ Never ☐ Always ■ Sometimes [3] ☐ Configurable

Queue ■ Never ☐ Always ☐ Sometimes ☐ Configurable

Clear Queue ☐ Never ☐ Always ■ Sometimes ☐ Configurable

1. **Select timeout period is configurable : 2s to 30s**

[1] used to activate the Reset function associated with points 64 to 101

[1] [2] [3] [4] used to control Relays associated with points 0 to 31

| Reports Binary Input Change Events when no specific variation requested: | Reports time-tagged Binary Input Change Events when no specific variation requested: |
|---|---|
| ■ Never | ■ Never |
| ☐ Only time-tagged | ☐ Binary Input Change With Time |
| ☐ Only non-time-tagged | ☐ Binary Input Change With Relative Time |
| ☐ Configurable to send both, one or the other (attach explanation) | ☐ Configurable (attach explanation) |

Device Profile Document (continued)

<table>
<tr>
<td>Sends Unsolicited Responses:<br><br>■ Never<br>☐ Configurable (attach explanation)<br>☐ Only certain objects<br>☐ Sometimes (attach explanation)<br><br>☐ ENABLE/DISABLE UNSOLICITED<br>Function codes supported</td>
<td>Sends Static Data in Unsolicited Responses:<br>■ Never<br>☐ When Device Restarts<br>☐ When Status Flags Change<br><br>No other options are permitted.</td>
</tr>
<tr>
<td>Default Counter Object/Variation:<br><br>☐ No Counters Reported<br>☐ Configurable (attach explanation)<br>■ Default Object 20<br>Default Variation 5<br>☐ Point-by-point list attached</td>
<td>Counters Roll Over at:<br><br>☐ No Counters Reported<br>☐ Configurable (attach explanation)<br>☐ 16 Bits<br>☐ 32 Bits<br>■ Other Value Counters<br>-999999999 to 99999999 (point 2)<br>0 to 9999999 (points 0,1,3)<br>☐ Point-by-point list attached</td>
</tr>
<tr>
<td colspan="2">Sends Multi-Fragment Responses: ■ Yes ☐ No</td>
</tr>
</table>