# EM133 Multifunction Meter

## DNP3 Communications Protocol

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## Reference Guide

BG0494 Rev. A2

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 | Aug 2011 | Release |
| A2 | Feb 2015 | Added transformer correction setup |

# Table of Contents

# 1 General

This document specifies a subset of the DNP3 communications protocol used to transfer data between a master station and the EM133. Refer to the EM133 Installation and Operation Manual for information on configuring communication parameters and electrical connections.

**IMPORTANT**

In 3-wire connection schemes, the unbalanced current and phase readings for power factor, active power, and reactive power will be zeros, because they have no meaning. Only the total three-phase power values will be shown.

Most of the advanced features are configured using multiple setup parameters that can be accessed in a number of contiguous registers. When writing the setup registers, it is recommended to write all the registers at once using a single request, or to clear (zero) the setup before writing into separate registers.

# 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 EM133 implements Level 1 of the DNP3 communication protocol. The device does not support unsolicited responses 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 EM133, 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 EM133 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 information on 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 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 writing zero to points 64-75 using object 12. |

### 2.2.1 Device Address

Each device on a DNP link must have a unique address. The EM133 allows a device address in the range of 0 to 65532 to be selected. The DNP master can use addresses 65533 to 65535 for broadcast requests. A broadcast request never generates a DNP response.

### 2.2.2 Transaction Timing

The EM133 response time to master requests is indicated in Table 2-1.

**Table 2-1 Response Time**

| Baud Rate, bps | Response Time, ms | | |
|---|---|---|---|
| | 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.

### 2.2.3 Class 0 Response

The EM133 DNP implementation supports a wide variety of messages. The most common method of getting static object information from the meter via DNP is to issue a read Class 0 request.

The EM133 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 EM133 installation and Operation Manual for information on how to configure Class 0 responses via PAS.

### 2.2.4 Frozen Counters

The EM133 supports function codes 7 “Immediate Freeze”, 8 “Immediate Freeze – No Acknowledgment ”, 9 “Freeze with Clear” and 10 “Freeze with Clear – No Acknowledgment” for Binary Counter object 20.

The freeze command copies the Binary Counter points listed in Section 3.4 to a freeze buffer with the time of freeze. All Binary Counter points are frozen together. Since the freeze command may request clearing counters, the device uses a single freeze buffer that is shared among all communication ports and TCP/IP connection sockets so that issuing a freeze command via a number of connections may cause unpredictable results.

The objects that were frozen can be requested by asking for 16-bit or 32-bit Frozen Counter objects with any variation listed in the device profile (see Appendix D), with the time of freeze or without time. 16-bit Frozen Counter objects may be scaled to avoid over-range errors if this option is enabled in the device (see Section 2.2.7, Scaling 16-bit Binary Counters).

The response contains the last frozen values of the corresponding Binary Counter points. Frozen Counters requested with variation 0 are responded with the default variation specified for the Frozen Counter object in the DNP Options Setup (see Section 3.9, DNP Protocol setup).

### 2.2.5 Frozen Analog Inputs

The EM133 supports function codes 7 “Immediate Freeze” and 8 “Immediate Freeze – No Acknowledgment ” for Analog Input object 30.

Any of the Analog Input points listed in Sections 3.1 and 3.5 can be frozen. The points that are to be frozen must be listed in the Class 0 point list (see Section 2.2.3) using any Frozen Analog Input object type. The total number of points that can be frozen is limited to 50. If Class 0 doesn’t specify Frozen Analog Input points, the device responds to function 7 “Immediate Freeze” with the IIN2.1 bit set - “Outstation does not support requested operation for objects in the request”.

The freeze command copies the corresponding Analog Input points to a freeze buffer with the time of freeze. The device provides a local freeze buffer for every communication port and every TCP/IP connection socket, so the Frozen Analog Input points must be requested via the same connection through which a freeze command was sent; otherwise the device may not guarantee that the frozen values are correlated with the corresponding freeze command.

The objects that were frozen can be requested by asking for 16-bit or 32-bit Frozen Analog Input objects with variations 0 through 6, with the time of freeze or without time. 16-bit Frozen Analog Input objects may be scaled to avoid over-range errors if this option is enabled in the device (see Section 2.2.6, Scaling 16-bit Analog Inputs).

The response contains the last frozen values of the corresponding Analog Input points if the freeze command was executed before, or immediate values of the corresponding Analog Input points in the event the freeze command has never been executed. Requesting Frozen Analog Input points with time of freeze without the freeze command can be used to get immediate values of the Analog Input points with timestamps. Frozen Analog Inputs requested with variation 0 are responded with the variation specified for the requested points in the Class 0 point list.

### 2.2.6 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 3.4 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 DNP Options setup in Section 3.9). 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<br>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:

$(201 - 0) \times (400 - 0)/(32767 - 0) + 0 = 2.45A$

### 2.2.7 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

System and configuration parameters in the EM133 are password protected from unauthorized changes via communications. Refer to the meter Installation and Operation Manual for details.

A user password must be written into the device authorization register (point AO:192) before another write request is issued. If the correct password is not supplied, the meter responds 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. [3] | 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-Fmax | ×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 | |
| 30:4 | AI:34 | V1/V12 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |
| 30:4 | AI:35 | V2/V23 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |
| 30:4 | AI:36 | V3/V31 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:4 | AI:37 | I1 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:38 | I2 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:39 | I3 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:40 | I1 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:41 | I2 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:42 | I3 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |

**NOTES:**

1 Voltage and voltage harmonics readings: 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 2.2.6, “ Scaling Analog Input Objects”.

3 Any of the analog input points listed in the table can be frozen using functions 7 or 8 with object 30 and variation 0. See Section 2.2.5 for details.

## 3.2 Binary Inputs - Basic Set

| Object : Var. | Object : Point | Description | Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 01:1 | BI:0 | Relay #1 status | 0-1 | | | R | |
| 01:1 | BI:1 | Relay #2 status | 0-1 | | | R | |
| 01:1 | BI:2 | Relay #3 status | 0-1 | | | R | |
| 01:1 | BI:16 | Status input #1 | 0-1 | | | R | |
| 01:1 | BI:17 | Status input #2 | 0-1 | | | R | |
| 01:1 | BI:18 | Status input #3 | 0-1 | | | R | |
| 01:1 | BI:19 | Status input #4 | 0-1 | | | R | |
| 01:1 | BI:20 | Status input #5 | 0-1 | | | R | |
| 01:1 | BI:21 | Status input #6 | 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 | kWh | UINT32 | R | |
| 20:5 | BC:1 | kWh export | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:2 | kvarh net | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:3 | kVAh | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:4 | kvarh import | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:5 | kvarh export | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:6 | kVAh import | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:7 | kVAh export | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:8 | kvarh Q1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:9 | kvarh Q2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:10 | kvarh Q3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:11 | kvarh Q4 | 0-999,999,999 | kvarh | UINT32 | R | |

## 3.4 Frozen 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 | kWh | UINT32 | R | |
| 21:var | FBC:1 | kWh export | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:2 | kvarh net | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:3 | kVAh | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:4 | kvarh import | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:5 | kvarh export | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:6 | kVAh import | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:7 | kVAh export | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:8 | kvarh Q1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:9 | kvarh Q2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:10 | kvarh Q3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:11 | kvarh Q4 | 0-999,999,999 | kvarh | 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 | |
| | | **Total Energies - Extended Set** | | | | | |
| 21:var | FBC:38656 | kWh import | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:38657 | kWh export | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:38658 | Not used | | | UINT32 | R | |

| Object : Var.[1] | Object : Point | Description | Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 21:var | FBC:38659 | Not used | | | UINT32 | R | |
| 21:var | FBC:38660 | kvarh import | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38661 | kvarh export | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38662 | Not used | | | UINT32 | R | |
| 21:var | FBC:38663 | Not used | | | UINT32 | R | |
| 21:var | FBC:38664 | kVAh total | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:38665 | Not used | | | UINT32 | R | |
| 21:var | FBC:38666 | Not used | | | UINT32 | R | |
| 21:var | FBC:38667 | kVAh import | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:38668 | kVAh export | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:38669 | Not used | | | UINT32 | R | |
| 21:var | FBC:38670 | Not used | | | UINT32 | R | |
| 21:var | FBC:38671 | Not used | | | UINT32 | R | |
| 21:var | FBC:38672 | Not used | | | UINT32 | R | |
| 21:var | FBC:38673 | Not used | | | UINT32 | R | |
| 21:var | FBC:38674 | kvarh Q1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38675 | kvarh Q2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38676 | kvarh Q3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38677 | kvarh Q4 | 0-999,999,999 | kvarh | UINT32 | R | |
| | | **Phase Energies - Extended Set** | | | | | |
| 21:var | FBC:38912 | kWh import L1 | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:38913 | kWh import L2 | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:38914 | kWh import L3 | 0-999,999,999 | kWh | UINT32 | R | |
| 21:var | FBC:38915 | kvarh import L1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38916 | kvarh import L2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38917 | kvarh import L3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 21:var | FBC:38918 | kVAh total L1 | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:38919 | kVAh total L2 | 0-999,999,999 | kVAh | UINT32 | R | |
| 21:var | FBC:38920 | kVAh total L3 | 0-999,999,999 | kVAh | UINT32 | R | |

**NOTE**

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

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

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:4 | AI:32768 | **None** | 0 | | UINT16 | R | |
| | | **Digital Inputs DI1-DI6** | | | | R | |
| 01:1 | BI:34304 | DI1 | 0-1 | | | R | |
| 01:1 | BI:34305 | DI2 | 0-1 | | | R | |
| 01:1 | BI:34306 | DI3 | 0-1 | | | R | |
| 01:1 | BI:34307 | DI4 | 0-1 | | | R | |
| 01:1 | BI:34308 | DI5 | 0-1 | | | R | |
| 01:1 | BI:34309 | DI6 | 0-1 | | | R | |
| | | **Relay Outputs RO1-RO3** | | | | R | |
| 01:1 | BI:34816 | Relay #1 | 0-1 | | | R | |
| 01:1 | BI:34817 | Relay #2 | 0-1 | | | R | |
| 01:1 | BI:34818 | Relay #3 | 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 | |
| 20:5 | BC:35330 | Counter #3 | 0-999,999,999 | | UINT32 | R | |
| 20:5 | BC:35331 | Counter #4 | 0-999,999,999 | | 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 | |
| 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 | |
| 30:4 | AI:35858 | V1/V12 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 2-cycle value |
| 30:4 | AI:35859 | V2/V23 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 2-cycle value |
| 30:4 | AI:35860 | V3/V31 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 2-cycle value |
| 30:4 | AI:35861 | I1 Current THD | 0-9999 | ×0.1% | UINT16 | R | 2-cycle value |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:4 | AI:35862 | I2 Current THD | 0-9999 | ×0.1% | UINT16 | R | 2-cycle value |
| 30:4 | AI:35863 | I3 Current THD | 0-9999 | ×0.1% | UINT16 | R | 2-cycle value |
| 30:4 | AI:35864 | I1 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 2-cycle value |
| 30:4 | AI:35865 | I2 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 2-cycle value |
| 30:4 | AI:35866 | I3 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 2-cycle value |
| 30:4 | AI:35867 | I1 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 2-cycle value |
| 30:4 | AI:35868 | I2 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 2-cycle value |
| 30:4 | AI:35869 | I3 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 2-cycle value |
| 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 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 | 3 |
| 30:4 | AI:36613 | Total PF lead | 0-1000 | ×0.001 | UINT16 | R | 3 |
| 30:3 | AI:36614 | Total kW import | 0-Pmax | U3 | UINT32 | R | 3 |
| 30:3 | AI:36615 | Total kW export | 0-Pmax | U3 | UINT32 | R | 3 |
| 30:3 | AI:36616 | Total kvar import | 0-Pmax | U3 | UINT32 | R | 3 |
| 30:3 | AI:36617 | Total kvar export | 0-Pmax | U3 | UINT32 | R | 3 |
| 30:3 | AI:36618 | 3-phase average L-N/L-L voltage | 0-Vmax | U1 | UINT32 | R | 1, 3 |
| 30:3 | AI:36619 | 3-phase average L-L voltage | 0-Vmax | U1 | UINT32 | R | 3 |
| 30:3 | AI:36620 | 3-phase average current | 0-Imax | U2 | UINT32 | R | 3 |
| | | **1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:36864 | Not used | | | UINT32 | R | |
| 30:3 | AI:36865 | In (neutral) Current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:36866 | Frequency | 0-Fmax | ×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 | |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 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 | |
| 30:4 | AI:37138 | V1/V12 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |
| 30:4 | AI:37139 | V2/V23 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |
| 30:4 | AI:37140 | V3/V31 Voltage THD | 0-9999 | ×0.1% | UINT16 | R | [1] 3-sec value |
| 30:4 | AI:37141 | I1 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:37142 | I2 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:37143 | I3 Current THD | 0-9999 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:37144 | I1 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 3-sec value |
| 30:4 | AI:37145 | I2 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 3-sec value |
| 30:4 | AI:37146 | I3 K-Factor | 10-9999 | ×0.1 | UINT16 | R | 3-sec value |
| 30:4 | AI:37147 | I1 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:37148 | I2 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |
| 30:4 | AI:37149 | I3 Current TDD | 0-1000 | ×0.1% | UINT16 | R | 3-sec value |
| 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 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 | [3] |
| 30:4 | AI:37893 | Total PF lead | 0-1000 | ×0.001 | UINT16 | R | [3] |
| 30:3 | AI:37894 | Total kW import | 0-Pmax | U3 | UINT32 | R | [3] |
| 30:3 | AI:37895 | Total kW export | 0-Pmax | U3 | UINT32 | R | [3] |
| 30:3 | AI:37896 | Total kvar import | 0-Pmax | U3 | UINT32 | R | [3] |
| 30:3 | AI:37897 | Total kvar export | 0-Pmax | U3 | UINT32 | R | [3] |
| 30:3 | AI:37898 | 3-phase average L-N/L-L voltage | 0-Vmax | U1 | UINT32 | R | [1, 3] |
| 30:3 | AI:37899 | 3-phase average L-L voltage | 0-Vmax | U1 | UINT32 | R | [3] |
| 30:3 | AI:37900 | 3-phase average current | 0-Imax | U2 | UINT32 | R | [3] |
| | | **1-Second Auxiliary Values** | | | | | |
| 30:3 | AI:38144 | Not used | | | UINT32 | R | |
| 30:3 | AI:38145 | In (neutral) Current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:38146 | Frequency | 0-Fmax | ×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 | |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **Present Demands** | | | | | |
| 30:3 | AI:38400 | V1/V12 Volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:38401 | V2/V23 Volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:38402 | V3/V31 Volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 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 | | | UINT32 | R | |
| 30:3 | AI:38413 | Not used | | | UINT32 | R | |
| 30:3 | AI:38414 | Not used | | | 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 | |
| 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 | |
| 30:3 | AI:38430 | Not used | | | UINT32 | R | |
| 30:3 | AI:38431 | Not used | | | UINT32 | R | |
| 30:3 | AI:38432 | Not used | | | UINT32 | R | |
| 30:3 | AI:38433 | Not used | | | UINT32 | R | |
| 30:3 | AI:38434 | In Ampere demand | 0-Imax | U2 | UINT32 | R | |
| | | **Total Energies** | | | | | |
| 20:5 | BC:38656 | kWh import | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:38657 | kWh export | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:38658 | Not used | | | UINT32 | R | |
| 20:5 | BC:38659 | Not used | | | UINT32 | R | |
| 20:5 | BC:38660 | kvarh import | 0-999,999,999 | kvarh | UINT32 | R | |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 20:5 | BC:38661 | kvarh export | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38662 | Not used | | | UINT32 | R | |
| 20:5 | BC:38663 | Not used | | | UINT32 | R | |
| 20:5 | BC:38664 | kVAh total | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:38665 | Not used | | | UINT32 | R | |
| 20:5 | BC:38666 | Not used | | | UINT32 | R | |
| 20:5 | BC:38667 | kVAh import | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:38668 | kVAh export | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:38669 | Not used | | | UINT32 | R | |
| 20:5 | BC:38670 | Not used | | | UINT32 | R | |
| 20:5 | BC:38671 | Not used | | | UINT32 | R | |
| 20:5 | BC:38672 | Not used | | | UINT32 | R | |
| 20:5 | BC:38673 | Not used | | | UINT32 | R | |
| 20:5 | BC:38674 | kvarh Q1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38675 | kvarh Q2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38676 | kvarh Q3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38677 | kvarh Q4 | 0-999,999,999 | kvarh | UINT32 | R | |
| | | **Phase Energies** | | | | | |
| 20:5 | BC:38912 | kWh import L1 | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:38913 | kWh import L2 | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:38914 | kWh import L3 | 0-999,999,999 | kWh | UINT32 | R | |
| 20:5 | BC:38915 | kvarh import L1 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38916 | kvarh import L2 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38917 | kvarh import L3 | 0-999,999,999 | kvarh | UINT32 | R | |
| 20:5 | BC:38918 | kVAh total L1 | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:38919 | kVAh total L2 | 0-999,999,999 | kVAh | UINT32 | R | |
| 20:5 | BC:38920 | kVAh total L3 | 0-999,999,999 | kVAh | UINT32 | R | |
| | | **V1/V12 Harmonics** | | | | | 1 |
| 30:4 | AI:39168 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:39169 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:39107 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| | | **V2/V23 Harmonics** | | | | | 1 |
| 30:4 | AI:39424 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:39425 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:39463 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| | | **V3/V31 Harmonics** | | | | | 1 |
| 30:4 | AI:39680 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:39681 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:39719 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **I1 Harmonics** | | | | | |
| 30:4 | AI:39936 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:39937 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:39975 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| | | **I2 Harmonics** | | | | | |
| 30:4 | AI:40192 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:40193 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:40231 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| | | **I3 Harmonics** | | | | | |
| 30:4 | AI:40448 | H01 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | AI:40449 | H02 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| 30:4 | | ... | | | | | |
| 30:4 | AI:40487 | H40 Harmonic magnitude | 0-100.00 | 0.01% | UINT16 | R | |
| | | **Fundamental (H01) Phase Values** | | | | | 2-cycle values |
| 30:3 | AI:43264 | V1/V12 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:43265 | V2/V23 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:43266 | V3/V31 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:43267 | I1 Current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:43268 | I2 Current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:43269 | I3 Current | 0-Imax | U2 | UINT32 | R | |
| 30:3 | AI:43270 | kW L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43271 | kW L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43272 | kW L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43273 | kvar L1 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43274 | kvar L2 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43275 | kvar L3 | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43276 | kVA L1 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:43277 | kVA L2 | 0-Pmax | U3 | UINT32 | R | |
| 30:3 | AI:43278 | kVA L3 | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:43279 | Power factor L1 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:43280 | Power factor L2 | -1000-1000 | ×0.001 | INT16 | R | |
| 30:4 | AI:43281 | Power factor L3 | -1000-1000 | ×0.001 | INT16 | R | |
| | | **Fundamental (H01) Total Values** | | | | | 2-cycle values |
| 30:3 | AI:43520 | Total fundamental kW | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43521 | Total fundamental kvar | -Pmax-Pmax | U3 | INT32 | R | |
| 30:3 | AI:43522 | Total fundamental kVA | 0-Pmax | U3 | UINT32 | R | |
| 30:4 | AI:43523 | Total fundamental PF | -1000-1000 | ×0.001 | INT16 | R | |
| | | **Minimum 1-Cycle Phase Values** | | | | | |
| 30:3 | AI:44032 | V1/V12 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:44033 | V2/V23 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:44034 | V3/V31 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 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 | |
| | | **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 | UINT16 | R | Absolute value |
| | | **Minimum 1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:44544 | Not used | | | UINT32 | R | |
| 30:3 | AI:44545 | In Current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:44546 | Frequency | 0-Fmax | ×0.01Hz | UINT16 | R | |
| | | **Maximum 1-Cycle Phase Values** | | | | | |
| 30:3 | AI:46080 | V1/V12 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46081 | V2/V23 Voltage | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46082 | V3/V31 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 | |
| | | **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 | UINT16 | R | Absolute value |
| | | **Maximum 1-Cycle Auxiliary Values** | | | | | |
| 30:3 | AI:46592 | Not used | | | UINT32 | R | |
| 30:3 | AI:46593 | In Current | 0-Imax | U2 | UINT32 | R | |
| 30:4 | AI:46594 | Frequency | 0-Fmax | ×0.01Hz | UINT16 | R | |
| | | **Maximum Demands** | | | | | |
| 30:3 | AI:46848 | V1/V12 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46849 | V2/V23 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 30:3 | AI:46850 | V3/V31 Maximum volt demand | 0-Vmax | U1 | UINT32 | R | [1] |
| 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 | |
| 30:3 | AI:46854 | Not used | | | UINT32 | R | |
| 30:3 | AI:46855 | Not used | | | UINT32 | R | |
| 30:3 | AI:46856 | Not used | | | 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 | |
| 30:3 | AI:46860 | Not used | | | UINT32 | R | |
| 30:3 | AI:46861 | Not used | | | UINT32 | R | |

| Object : Var. [3] | Object : Point | Description | Options/Range[2] | Units[2] | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 30:3 | AI:46862 | Not used | | | 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 | | | UINT32 | R | |
| 30:3 | AI:46866 | Not used | | | UINT32 | R | |
| 30:3 | AI:46867 | Not used | | | UINT32 | R | |
| 30:3 | AI:46868 | Not used | | | UINT32 | R | |
| 30:3 | AI:46869 | In Maximum ampere demand | 0-Imax | U2 | UINT32 | R | |

**NOTES:**

1 Voltage and voltage harmonics readings: 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 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 2.2.6, " Scaling Analog Input Objects".

3 Any of the analog input points listed in the table can be frozen using functions 7 or 8 with object 30 and variation 0. See Section 2.2.5 for details.

## 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 | 0-99999999 | | UINT32 | R | |
| 30:4 | AI:257 | Device model ID | 13330 | | UINT16 | R | |
| 30:3 | AI:258-AI:261 | Device model name | "EM133EH" | | 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 | 1200-1299 | | 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 | |
| 30:3 | AI:268-AI:269 | Reserved | | | UINT32 | 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 | 690 | V | UINT16 | R | |
| 30:4 | AI:276 | V1-V3 input overload | 120 | % | UINT16 | R | |
| 30:3 | AI:277-AI:278 | Reserved | | | UINT32 | R | |
| 30:4 | AI:279 | I1-I3 input range | 1, 5 | A | UINT16 | R | |
| 30:4 | AI:280 | I1-I3 input overload | 200 | % | UINT16 | R | |
| 30:4 | AI:281-AI:288 | Reserved | | | UINT16 | R | |
| **Device Identification (alias)** | | | | | | | |
| 30:4 | AI:1023 | Firmware build number | 1-99 | | UINT16 | R | |
| 30:4 | AI:1024 | Firmware version number | 1200-1299 | | UINT16 | R | Two higher decimal digits = major version number, two lower decimal digits = minor version number |
| 30:3<br>30:3 | AI:1025<br>AI:1026 | Device options | F2 | | UINT32 | R | |
| **Port Identification** | | | | | | | |
| 30:4 | AI:1027 | Current serial port number | 0=COM1, 1=COM2, 2=COM3 | | UINT16 | R | |

## 3.7 Device Control

| Object : Var. | Object : Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| **Device Authorization Register** | | | | | | | |
| 40:1(read)<br>41:1(write) | AO:192 | When write: 8-digit password. When read: 0 = access permitted, -1 = authorization required. | 0/-1 (Read)<br>0-99999999(Write) | | | R/W | |
| **Device Reset/Clear** | | | | | | | |
| 10:2(read)<br>12:1(write) | BO:0<br>CROB:0 | Clear total energy registers | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:1<br>CROB:1 | Clear total maximum demand registers (all demands) | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:2<br>CROB:2 | Clear power demands | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:3<br>CROB:3 | Clear volt/ampere demands | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:4-11<br>CROB:4-11 | Reserved | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:12<br>CROB:12 | Clear pulse counters (all counters) | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:13<br>CROB:13 | Clear pulse counter#1 | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:14<br>CROB:14 | Clear pulse counter#2 | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:15<br>CROB:15 | Clear pulse counter#3 | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:16<br>CROB:16 | Clear pulse counter#4 | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:17-20<br>CROB:17-20 | Reserved | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| 10:2(read)<br>12:1(write) | BO:21<br>CROB:21 | Clear Min/Max log | 0/1 = state OFF/ON | | | R<br>W | Returns zero<br>PULSE ON [1] |
| **Alarm Notification** | | | | | | | |
| 10:2(read)<br>12:1(write) | B0:64<br>CROB:64 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | B0:65<br>CROB:65 | Reserved | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | B0:66<br>CROB:66 | RAM/Data error | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | B0:67<br>CROB:67 | CPU watchdog reset | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read)<br>12:1(write) | B0:68<br>CROB:68 | Sampling fault | 0/1 = state OFF/ON | | | R/W | [2] |
| 10:2(read) | B0 :69 | CPU exception | 0/1 = state OFF/ON | | | R/W | [2] |

| Object : Var. | Object : Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| 12:1(write) | CROB:69 | | | | | | |
| 10:2(read)<br>12:1(write) | BI :70<br>CROB:70 | Reserved | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0 :71<br>CROB:71 | Software watchdog reset | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:72<br>CROB:72 | Loss of power (power down) | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:73<br>CROB:73 | Device reset (cold restart) 3 | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:74<br>CROB:74 | Configuration reset 3 | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:75<br>CROB:75 | RTC fault (time synchronization required) 3 | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:76<br>CROB:76 | Reserved | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:77<br>CROB:77 | Reserved | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:78<br>CROB:78 | Reserved | 0/1 = state OFF/ON | | | R/W | 2 |
| 10:2(read)<br>12:1(write) | B0:79<br>CROB:79 | EEPROM fault | 0/1 = state OFF/ON | | | R/W | 2 |
| **Remote Relay Control** | | | | | | | |
| 10:2(read)<br>12:1(write) | BO:80<br>CROB:80 | Relay #1 Force operate/Force release/Normal | 0/1 = state OFF/ON | | | R/W | 4 |
| 10:2(read)<br>12:1(write) | BO:81<br>CROB:81 | Relay #2 Force operate/Force release /Normal | 0/1 = state OFF/ON | | | R/W | 4 |
| 10:2(read)<br>12:1(write) | BO:82<br>CROB:82 | Relay #3 Force operate/Force release /Normal | 0/1 = state OFF/ON | | | R/W | 4 |

**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 alarm indication 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 meter 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 meter 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 meter 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 64-75 can reset hardware fault points. The configuration corrupt status point is also reset automatically when you change setup either via the front panel or through communications.

The following restrictions should be noted when using Object 12 to control the listed 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 a relay, use the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to point 80 or 81 of the Control-Relay-Output-Block object with the Control Code value Latch On. To manually release Relay #1, use the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to point 80 or 81 of the Control-Relay-Output-Block object with the Control Code value Latch Off.

The following restrictions 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, 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 50 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 50 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 | F1 | | UINT16 | R/W | |
| 40:1 (read)<br>41:1 (write) | AO:1 | PT ratio | 10 to 65000 | ×0.1 | UINT32 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:2 | CT primary current | 1 to 50,000 | A | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:3 | Power block demand period | 1,2,3,5,10,15,20,30,60 min,<br>255 = external synchronization | min | UINT16 | R/W | If the external synchronization is selected, the DI1 input is considered a pulse or KYZ input. The pulse edge restarts the power demand block accumulation interval. |
| 40:2 (read)<br>41:2 (write) | AO:4 | Volt/ampere demand period | 0 to 1800 | sec | UINT16 | R/W | |
| 40:1 (read) | AO:5 | Reserved | | | UINT32 | R/W | Read as 65535 |
| 40:1 (read) | AO:6 | Reserved | | | UINT32 | R/W | Read as 65535 |
| 40:1 (read) | AO:7 | Reserved | | | UINT32 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:8 | Number of blocks in a sliding window | 1 to 15 | | UINT16 | R/W | |
| 40:1 (read) | AO:9-AO:10 | Reserved | | | UINT32 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:11 | Nominal line frequency | 25, 50, 60, 400 | Hz | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:12 | Maximum demand load current | 0 to 50,000 (0 = CT primary current) | A | UINT16 | R/W | |
| 40:1 (read) | AO:13-AO:19 | Reserved | | | UINT32 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:20 | PT ratio multiplication factor | ×1, ×10 | | UINT16 | R/W | |
| **Communication Ports Setup** | | | | | | | |
| | AO:64-71 | **COM1 Setup** | | | | | |
| | AO:80-87 | **COM2 Setup** | | | | | |
| 40:2 (read)<br>41:2 (write) | +0 | Communication protocol | COM1: 0=SATEC ASCII, 1=Modbus RTU, 2=DNP3.0<br>COM2: 0=SATEC ASCII, 1=Modbus RTU, 2=DNP3.0, 5=Profibus DP | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +1 | Interface | COM1: 2=RS-485<br>COM2: 0=RS-232, 1=RS-422, 2=RS-485, 5=RF, 6=Ethernet, 7=Profibus, 8=GSM/GPRS | | UINT16 | R/W | |
| 40:1 (read)<br>41:1 (write) | +2 | Device address | SATEC ASCII: 0-99<br>Modbus RTU: 1-247<br>DNP3.0: 0–65532 | | UINT32 | R/W | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | | Profibus DP: 0-126 | | | | |
| 40:2 (read)<br>41:2 (write) | +3 | Baud rate | 1=300 bps, 2=600 bps, 3=1200 bps, 4=2400 bps, 5=4800 bps, 6=9600 bps, 7=19200 bps, 8=38400 bps, 9=57600 bps, 10=115200 bps | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +4 | Data format | 0=7 bits/even parity,<br>1=8 bits/no parity,<br>2=8 bits/even parity | | UINT16 | R/W | Format 0 is not allowed in DNP3.0 |
| 40:2 (read)<br>41:2 (write) | +5 | Flow control | N/A | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | +6 | RTS mode | N/A | | UINT16 | R/W | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | +7 | Response delay | 2-1000 ms | | UINT16 | R/W | |
| **Device Options Setup** | | | | | | | |
| 40:2 (read)<br>41:2 (write) | AO:92 | 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:93 | Energy roll value | $0=1\times10^4$, $1=1\times10^5$, $2=1\times10^6$, $3=1\times10^7$, $4=1\times10^8$, $5=1\times10^9$ | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:94 | Phase energy calculation mode | 0=disabled, 1=enabled | | UINT16 | R/W | |
| 40:2 (read) | AO:95-AO:101 | Reserved | | | UINT16 | R | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:102 | Energy LED test mode | 0=disabled, 1=Wh test, 2=varh test | | UINT16 | R/W | LED pulse rate is 10,000 pulses/kWh |
| 40:2 (read)<br>41:2 (write) | AO:103 | Starting voltage, percent of FS voltage | 15-50 | ×0.1% | UINT16 | R/W | Default 1.5% |
| 40:2 (read) | AO:104-<br>AO:105 | Reserved | | | UINT16 | R | Read as 65535 |
| 40:2 (read)<br>41:2 (write) | AO:106 | Device resolution (see Section 4 for details) | 0 = Low resolution, 1 = High resolution | | UINT16 | R/W | Default 0 |
| **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) | +1 | Phase angle error | -600 to 600 | min | INT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | +2,3 | Reserved | | | INT16 | R/W | |
| | AO:512-515 | **V1 transformer correction** | | | | | |
| | AO:516-519 | **V2 transformer correction** | | | | | |
| | AO:520-523 | **V3 transformer correction** | | | | | |
| | AO:524-527 | **Reserved** | | | | | Read as 65535 |
| | AO:528-531 | **I1 transformer correction** | | | | | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | AO:532-535 | **I2 transformer correction** | | | | | |
| | AO:536-539 | **I3 transformer correction** | | | | | |

## 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:32 | Default Binary Input Static object variation | F3 (default=0) | | UINT16 | R/W | 1 |
| 40:2 (read) | AO:33 | Reserved | Read as 65535 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:34 | Default Binary Counter object variation | F3 (default=3) | | UINT16 | R/W | 1 |
| 40:2 (read)<br>41:2 (write) | AO:35 | Default Frozen Binary Counter object variation | F3 (default=4) | | UINT16 | R/W | 1 |
| 40:2 (read) | AO:36:37 | Reserved | Read as 65535 | | UINT32 | R | |
| 40:2 (read)<br>41:2 (write) | AO:38 | Default Analog Input object variation | F3 (default=3) | | UINT16 | R/W | 1 |
| 40:2 (read) | AO:39-AO:42 | Reserved | Read as 65535 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:43 | 16-bit BC scaling | 0=×1 (default), 1=×10, 2=×100, 3=×1000 | | UINT16 | R/W | 5 |
| 40:2 (read)<br>41:2 (write) | AO:44 | 16-bit AI scaling | 0=disabled, 1=enabled (default) | | UINT16 | R/W | 2 |
| 40:2 (read) | AO:45-AO:47 | Reserved | Read as 65535 | | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:48 | Select/Operate Timeout | 2 to 30 (default=10 sec) | sec | UINT16 | R/W | 3 |
| 40:2 (read)<br>41:2 (write) | AO:49 | Multi Fragment Interval | 5 to 500 (default=10 ms) | ms | UINT16 | R/W | |
| 40:2 (read) | AO:50-AO:52 | Reserved | Read as 65535 | | UINT16 | R | |
| 40:1 (read)<br>41:1 (write) | AO:53 | Time Sync Period | 0 to 86400 (default=86400 sec) | sec | UINT32 | R/W | 4 |
| 40:2 (read)<br>41:2 (write) | AO:54 | Voltage scale, secondary volts | 60 to 828V (default=144V) | V | UINT16 | R/W | |
| 40:2 (read)<br>41:2 (write) | AO:55 | Current scale, secondary amps | 10 to 100 (default 2×CT secondary) | ×0.1A | UINT16 | R/W | |
| **DNP Class 0 Point Assignments** | | | | | | | |
| 40:1(read)<br>41:1(write) | | DNP object and variation | F4 | | UINT32 | R/W | |
| 40:1(read)<br>41:1(write) | | Start point number | Start point number for the selected object | | UINT32 | R/W | |
| 40:2(read)<br>41:2(write) | | Number of points in a range | 0-128 | | UINT16 | R/W | |
| | AO:1152-AO:1154 | **DNP Class 0 Point Range 1** | | | | | |
| | AO:1155-AO:1157 | **DNP Class 0 Point Range 2** | | | | | |

| Object:Var. | Object:Point | Description | Options/Range | Units | Type | R/W | Notes |
|---|---|---|---|---|---|---|---|
| | | **...** | | | | | |
| | AO:1245-AO:1247 | **DNP Class 0 Point Range 32** | | | | | |

**NOTES:**

1 The default 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 Scaling 16-bit AI objects (see Section 2.2.6) 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).

3 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.

4 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 meter does not request time synchronization if the Time Sync Period is set to 0.

5 Scaling 16-bit Binary Counters (see Section 2.2.7) allows changing a counter unit in powers of 10 to accommodate a 32-bit counter value to 16-bit BC object format.

# 4 Data Scales and Units

| Code | Condition | Value/Range | Notes |
|---|---|---|---|
| **Data Scales** | | | |
| Vmax | | Voltage scale × PT Ratio, V | 2 |
| Imax | | Current scale × CT Ratio, A | 1, 3 |
| Pmax | Wiring 4LN3, 3LN3, 3BLN3 | Vmax × Imax × 3, W | 4 |
| | Wiring 4LL3, 3LL3, 3BLL3, 3OP2, 3OP3, 3DIR2 | Vmax × Imax × 2, W | |
| Fmax | Nominal frequency 25, 50 or 60 Hz | 100 Hz | |
| | Nominal frequency 400Hz | 500 Hz | |
| **Data Units – Low Resolution Option** | | | |
| U1 | | 1V | |
| U2 | | 1A | |
| U3 | | 1kW/kvar/kVA | |
| **Data Units – High Resolution Option** | | | |
| U1 | PT Ratio = 1 | 0.1V | |
| | PT Ratio > 1 | 1V | |
| U2 | | 0.01A | |
| U3 | PT Ratio = 1 | 1W/Var/VA | |
| | PT Ratio > 1 | 1kW/kvar/kVA | |

See Device Options Setup for information on selecting the device resolution option.

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 2 × CT secondary current (2.0A with 1A secondaries, 10.A with 5A secondaries). 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. With PT=1.0, if Pmax is greater than 9,999,000 W, it is truncated to 9,999,000 W.

# 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 | |
| **Device Options** | | | |
| | Bit 1=1 | 690V Option | |
| | Bits 2-5 | Reserved | |
| | Bit 6=1 | Analog output 0/4 or 4/20mA | |
| | Bit 7=1 | Analog output 0-1mA | |
| | Bit 8=1 | Analog output ±1mA | |
| | Bit 9=1 | RO option | |
| | Bit 10=1 | DI option | |
| | Bit 11=1 | Reserved | |
| | Bit 12=1 | Setup is secured by a password (authorization required) | |
| | Bits 13-15 | Reserved | |
| | Bits 16-18 | Number of RO - 1 | |
| | Bits 19-22 | Number of DI – 1 | |
| | Bits 23-24 | Number of AO - 1 | |
| | Bits 25-31 | Reserved | |
| **DNP Object Variations** | | | |
| F3 | | **Static Binary Input Objects** | |
| | 0 | Single-Bit Binary Input | |
| | 1 | Binary Input With Status | |
| | | **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 | |
| | | **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 | |
| **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 | |
| | 0x1F01 | Frozen Analog Input 31:01 | |
| | 0x1F02 | Frozen Analog Input 31:02 | |
| | 0x1F03 | Frozen Analog Input 31:03 | |
| | 0x1F04 | Frozen Analog Input 31:04 | |
| | 0x1F05 | Frozen Analog Input 31:05 | |
| | 0x1F06 | Frozen Analog Input 31:06 | |

| Format Code | Value | Description | Notes |
|---|---|---|---|
| | 0x2801 | Analog Output 40:01 | |
| | 0x2802 | Analog Output 40:02 | |
| | 0x0101 | Binary Input 01:01 | |
| | 0x0102 | Binary Input 01:02 | |
| | 0x0A01 | Binary Output 10:01 | |
| | 0x0A02 | Binary Output Status 10:02 | |
| | 0x1401 | Binary Counter 20:01 | |
| | 0x1402 | Binary Counter 20:02 | |
| | 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 | |
| | 0x3201 | Time and Date 50:01 | |

# APPENDIX A DNP Application Messages

The device is a DNP IED responding to external DNP Master requests. Table A-1 describes the EM133 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 | Binary Input (responds with the default variation [4]) | 1 | B | 129 | 01 |
| 01 | 1 | Single Bit Binary Input | 1 | A | 129 | C |
| 01 | 2 | Binary Input with Status | 1 | A | 129 | C |
| 10 | 0 | Binary Output (responds with variation 1) | 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 (responds with the default variation [4]) | 1,<br>7,9,<br>8,10 | B<br>B<br>B | 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 (responds with the default variation 4) | 1 | B | 129 | 01 |
| 21 | 1 | 32-bit Frozen Counter | 1 | A | 129 | C |
| 21 | 2 | 16-bit Frozen Counter | 1 | A | 129 | C |
| 21 | 5 | 32-bit Frozen Counter with time of freeze | 1 | A | 129 | C |
| 21 | 6 | 16-bit Frozen Counter with time of freeze | 1 | A | 129 | C |
| 21 | 9 | 32-bit Frozen Counter without flag | 1 | A | 129 | C |
| 21 | 10 | 16-bit Frozen Counter without flag | 1 | A | 129 | C |
| 30 | 0 | Analog Input (responds with the default variation [4]) | 1,<br>7 [5]<br>8 [5] | B<br>B<br>B | 129<br>129 | 01<br>N/R<br>N/A |
| 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 |
| 31 | 0 | Frozen Analog Input (responds with the variation listed for Class 0) | 1 [6] | B | 129 | 01 |
| 31 | 1 | 32-bit Frozen Analog Input | 1 [6] | A | 129 | C |
| 31 | 2 | 16-bit Frozen Analog Input | 1 [6] | A | 129 | C |
| 31 | 3 | 32-bit Frozen Analog Input with Time | 1 [6] | A | 129 | C |
| 31 | 4 | 16-bit Frozen Analog Input with Time | 1 [6] | A | 129 | C |
| 31 | 5 | 32-bit Frozen Analog Input without flag | 1 [6] | A | 129 | C |
| 31 | 6 | 32-bit Frozen Analog Input without flag | 1 [6] | A | 129 | C |
| 40 | 0 | Analog Output Status (responds with variation 2) | 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 |
| 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 only point index 0 is allowed.

[2] For this object only point index 7 is allowed.

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

[4] The default object variation used in device responses to master requests with no specific variation specified can be selected via the DNP Options Setup (see Section 3.9, DNP Protocol setup).

[5] Functions Immediate Freeze (7) and Immediate Freeze-No Acknowledgement (8) copy the Analog Input points listed in the Class 0 point list as Frozen Analog Input objects (see Section 3.9, DNP Protocol setup) to a freeze buffer. In the event Class 0 doesn't contain Frozen Analog Input points, the device responds to function Immediate Freeze (7) with the IIN2.1 bit set - "Outstation does not support requested operation for objects in the request".

[6] The response contains the last frozen values of the corresponding Analog Input points if the freeze command was executed before, or immediate values of the corresponding Analog Input points in the event the freeze command has never been executed. Frozen Analog Inputs requested with variation 0 are responded with the variation specified for the requested points in the Class 0 point list. Any Frozen Analog Input point can be requested except points AI:256-AI:288 and AI:1024-AI:1027. See Section 2.2.5 for more information on Frozen Analog Inputs.

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: Powermeter Series EM133

| 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 Retries: | Maximum Application Layer Retries: |
|---|---|
| ■ 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? _____

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[1,4] | ☐ 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[4] | ☐ Configurable |

♦ **Select timeout period is configurable: 2s to 30s**

[1] used to activate the *Reset* function associated with points 0 to 21

[2, 3, 4] used to control Relays associated with points 80 to 81

[3] used to reset the self-check alarm registers associated with points 64 to 75

Reports Binary Input Change Events when no specific variation requested:

■ Never

☐ Only time-tagged

☐ Only non-time-tagged

☐ Configurable to send both, one or the other (attach explanation)

Reports time-tagged Binary Input Change Events when no specific variation requested:

■ Never

☐ Binary Input Change With Time

☐ Binary Input Change With Relative Time

☐ Configurable (attach explanation)

Device Profile Document (continued)

| | |
|---|---|
| Sends Unsolicited Responses:<br>■ Never<br>☐ Configurable (attach explanation)<br>☐ Only certain objects<br>☐ Sometimes (attach explanation)<br>☐ ENABLE/DISABLE UNSOLICITED Function codes supported | Sends Static Data in Unsolicited Responses:<br>■ Never<br>☐ When Device Restarts<br>☐ When Status Flags Change<br>No other options are permitted. |
| Default Counter Object/Variation:<br>☐ No Counters Reported<br>■ Configurable (attach explanation)<br>Counters requested with variation 0 are responded with the default variation specified for the Counter object in the DNP Options Setup.<br>☐ Default Object<br>☐ Default Variation<br>☐ Point-by-point list attached | Counters Roll Over at:<br>☐ No Counters Reported<br>☐ Configurable (attach explanation)<br>☐ 16 Bits<br>☐ 32 Bits<br>☐ Other Value Counters<br>■ Point-by-point list attached<br>See Sections 3.3-3.5. |
| Sends Multi-Fragment Responses: ☐ Yes ■ No | |