



# EM133 Multifunction Meter

## DNP3 Communications Protocol

---

### Reference Guide

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	August 2011	Release
----	-------------	---------

# Table of Contents

<b>1 GENERAL .....</b>	<b>5</b>
<b>2 DNP 3.0 PROTOCOL IMPLEMENTATION .....</b>	<b>6</b>
2.1 DEVIATIONS FROM STANDARD .....	6
2.2 DNP IMPLEMENTATION .....	6
2.2.1 DEVICE ADDRESS .....	6
2.2.2 TRANSACTION TIMING .....	7
2.2.3 CLASS 0 RESPONSE .....	7
2.2.4 FROZEN COUNTERS .....	7
2.2.5 FROZEN ANALOG INPUTS .....	7
2.2.6 SCALING 16-BIT ANALOG INPUTS .....	8
2.2.7 SCALING 16-BIT BINARY COUNTERS .....	8
2.3 PASSWORD PROTECTION .....	9
<b>3 DNP POINT MAP .....</b>	<b>10</b>
3.1 ANALOG INPUTS - BASIC SET .....	10
3.2 BINARY INPUTS - BASIC SET .....	12
3.3 BINARY COUNTERS - BASIC SET .....	13
3.4 FROZEN COUNTERS .....	13
Total Energies – Basic Set .....	13
Counters – Extended Set .....	13
Total Energies - Extended Set .....	13
Phase Energies - Extended Set .....	14
3.5 ANALOG INPUTS, BINARY INPUTS AND COUNTERS – EXTENDED SET .....	15
Digital Inputs DI1-DI6 .....	15
Relay Outputs RO1-RO3 .....	15
Counters .....	15
1-Cycle Phase Values .....	15
1-Cycle Total Values .....	16
1-Cycle Auxiliary Values .....	16
1-Second Phase Values .....	16
1-Second Total Values .....	17
1-Second Auxiliary Values .....	17
Present Demands .....	18
Total Energies .....	18
Phase Energies .....	19
V1/V12 Harmonics .....	19
V2/V23 Harmonics .....	19
V3/V31 Harmonics .....	19
I1 Harmonics .....	20
I2 Harmonics .....	20
I3 Harmonics .....	20
Fundamental (H01) Phase Values .....	20
Fundamental (H01) Total Values .....	20
Minimum 1-Cycle Phase Values .....	20
Minimum 1-Cycle Total Values .....	21
Minimum 1-Cycle Auxiliary Values .....	21
Maximum 1-Cycle Phase Values .....	21
Maximum 1-Cycle Total Values .....	21
Maximum 1-Cycle Auxiliary Values .....	21
Maximum Demands .....	21
3.6 FACTORY DEVICE SETTINGS AND IDENTIFICATION .....	23
Device Identification .....	23
Factory Device Settings .....	23
Device Identification (alias) .....	23
Port Identification .....	23

3.7	DEVICE CONTROL .....	24
	Device Authorization Register .....	24
	Device Reset/Clear .....	24
	Alarm Notification .....	24
	Remote Relay Control .....	25
3.8	DEVICE SETUP .....	27
	Basic Setup .....	27
	Communication Ports Setup .....	27
	Device Options Setup .....	28
3.9	DNP PROTOCOL SETUP .....	29
	DNP Options Setup .....	29
	DNP Class 0 Point Assignments .....	29
<b>4</b>	<b>DATA SCALES AND UNITS .....</b>	<b>31</b>
	Data Scales .....	31
	Data Units – Low Resolution Option .....	31
	Data Units – High Resolution Option .....	31
<b>5</b>	<b>DATA FORMATS .....</b>	<b>32</b>
	Wiring Mode .....	32
	Device Options .....	32
	DNP Object Variations .....	32
	DNP Class 0 Objects .....	32
	<b>APPENDIX A DNP APPLICATION MESSAGES .....</b>	<b>34</b>
	<b>APPENDIX B DNP DEVICE PROFILE .....</b>	<b>36</b>

# 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 appropriate 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 linear 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:

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

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  $2 \times 200 = 400\text{A}$ ), then the current reading in engineering units is as follows:

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

## 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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	Type	R/W	Notes
30:3	AI:0	V1/V12 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:1	V2/V23 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:2	V3/V31 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
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	<sup>1</sup> 3-sec value
30:4	AI:35	V2/V23 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 3-sec value
30:4	AI:36	V3/V31 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 3-sec value

Object : Var. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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:**

- <sup>1</sup> 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.
- <sup>2</sup> 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".
- <sup>3</sup> 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. <sup>1</sup>	Object : Point	Description	Range	Units	Type	R/W	Notes
		<b>Total Energies – Basic Set</b>					
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	
		<b>Counters – Extended Set</b>					
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	
		<b>Total Energies - Extended Set</b>					
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. <sup>1</sup>	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	
		<b>Phase Energies - Extended Set</b>					
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**

<sup>1</sup> For object variation, see DNP Options setup (see Section 3.9).

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

Object : Var. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	Type	R/W	Notes
30:4	AI:32768	None	0		UINT16	R	
		<b>Digital Inputs DI1-DI6</b>				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	
		<b>Relay Outputs RO1-RO3</b>				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	
		<b>Counters</b>					
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	
		<b>1-Cycle Phase Values</b>					
30:3	AI:35840	V1/V12 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:35841	V2/V23 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:35842	V3/V31 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
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	<sup>1</sup> 2-cycle value
30:4	AI:35859	V2/V23 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 2-cycle value
30:4	AI:35860	V3/V31 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 2-cycle value
30:4	AI:35861	I1 Current THD	0-9999	×0.1%	UINT16	R	2-cycle value

Object : Var. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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	
		<b>1-Cycle Total Values</b>					
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	<sup>3</sup>
30:4	AI:36613	Total PF lead	0-1000	×0.001	UINT16	R	<sup>3</sup>
30:3	AI:36614	Total kW import	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:36615	Total kW export	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:36616	Total kvar import	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:36617	Total kvar export	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:36618	3-phase average L-N/L-L voltage	0-Vmax	U1	UINT32	R	1, <sup>3</sup>
30:3	AI:36619	3-phase average L-L voltage	0-Vmax	U1	UINT32	R	<sup>3</sup>
30:3	AI:36620	3-phase average current	0-Imax	U2	UINT32	R	<sup>3</sup>
		<b>1-Cycle Auxiliary Values</b>					
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	
		<b>1-Second Phase Values</b>					
30:3	AI:37120	V1/V12 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:37121	V2/V23 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:37122	V3/V31 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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	<sup>1</sup> 3-sec value
30:4	AI:37139	V2/V23 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 3-sec value
30:4	AI:37140	V3/V31 Voltage THD	0-9999	×0.1%	UINT16	R	<sup>1</sup> 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	
		<b>1-Second Total Values</b>					
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	<sup>3</sup>
30:4	AI:37893	Total PF lead	0-1000	×0.001	UINT16	R	<sup>3</sup>
30:3	AI:37894	Total kW import	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:37895	Total kW export	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:37896	Total kvar import	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:37897	Total kvar export	0-Pmax	U3	UINT32	R	<sup>3</sup>
30:3	AI:37898	3-phase average L-N/L-L voltage	0-Vmax	U1	UINT32	R	<sup>1, 3</sup>
30:3	AI:37899	3-phase average L-L voltage	0-Vmax	U1	UINT32	R	<sup>3</sup>
30:3	AI:37900	3-phase average current	0-Imax	U2	UINT32	R	<sup>3</sup>
		<b>1-Second Auxiliary Values</b>					
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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	Type	R/W	Notes
		<b>Present Demands</b>					
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	
		<b>Total Energies</b>					
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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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	
		<b>Phase Energies</b>					
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	
		<b>V1/V12 Harmonics</b>					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	
		<b>V2/V23 Harmonics</b>					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	
		<b>V3/V31 Harmonics</b>					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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	Type	R/W	Notes
		<b>I1 Harmonics</b>					
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	
		<b>I2 Harmonics</b>					
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	
		<b>I3 Harmonics</b>					
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	
		<b>Fundamental (H01) Phase Values</b>					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	
		<b>Fundamental (H01) Total Values</b>					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	
		<b>Minimum 1-Cycle Phase Values</b>					
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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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	
		<b>Minimum 1-Cycle Total Values</b>					
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
		<b>Minimum 1-Cycle Auxiliary Values</b>					
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	
		<b>Maximum 1-Cycle Phase Values</b>					
30:3	AI:46080	V1/V12 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:46081	V2/V23 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:46082	V3/V31 Voltage	0-Vmax	U1	UINT32	R	<sup>1</sup>
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	
		<b>Maximum 1-Cycle Total Values</b>					
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
		<b>Maximum 1-Cycle Auxiliary Values</b>					
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	
		<b>Maximum Demands</b>					
30:3	AI:46848	V1/V12 Maximum volt demand	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:46849	V2/V23 Maximum volt demand	0-Vmax	U1	UINT32	R	<sup>1</sup>
30:3	AI:46850	V3/V31 Maximum volt demand	0-Vmax	U1	UINT32	R	<sup>1</sup>
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. <sup>3</sup>	Object : Point	Description	Options/Range <sup>2</sup>	Units <sup>2</sup>	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:**

- <sup>1</sup> 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.
- <sup>2</sup> 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".
- <sup>3</sup> 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
<b>Device Identification</b>							
30:3	AI:256	Device serial number	0-99999999		UINT32	R	
30:4	AI:257	Device model ID	13330		UINT16	R	
30:4	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	
<b>Factory Device Settings</b>							
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	
<b>Device Identification (alias)</b>							
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 30:3	AI:1025 AI:1026	Device options	F2		UINT32	R	
<b>Port Identification</b>							
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
<b>Device Authorization Register</b>							
40:1(read) 41:1(write)	AO:192	When write: 8-digit password. When read: 0 = access permitted, -1 = authorization required.	0/-1 (Read) 0-99999999(Write)			R/W	
<b>Device Reset/Clear</b>							
10:2(read) 12:1(write)	BO:0 CROB:0	Clear total energy registers	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:1 CROB:1	Clear total maximum demand registers (all demands)	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:2 CROB:2	Clear power demands	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:3 CROB:3	Clear volt/ampere demands	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:4-11 CROB:4-11	Reserved	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:12 CROB:12	Clear pulse counters (all counters)	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:13 CROB:13	Clear pulse counter#1	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:14 CROB:14	Clear pulse counter#2	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:15 CROB:15	Clear pulse counter#3	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:16 CROB:16	Clear pulse counter#4	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:17-20 CROB:17-20	Reserved	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
10:2(read) 12:1(write)	BO:21 CROB:21	Clear Min/Max log	0/1 = state OFF/ON			R W	Returns zero PULSE ON <sup>1</sup>
<b>Alarm Notification</b>							
10:2(read) 12:1(write)	BO:64 CROB:64	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	BO:65 CROB:65	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	BO:66 CROB:66	RAM/Data error	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	BO:67 CROB:67	CPU watchdog reset	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	BO:68 CROB:68	Sampling fault	0/1 = state OFF/ON			R/W	2
10:2(read)	BO :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) 12:1(write)	BI :70 CROB:70	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0 :71 CROB:71	Software watchdog reset	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:72 CROB:72	Loss of power (power down)	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:73 CROB:73	Device reset (cold restart) <sup>3</sup>	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:74 CROB:74	Configuration reset <sup>3</sup>	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:75 CROB:75	RTC fault (time synchronization required) <sup>3</sup>	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:76 CROB:76	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:77 CROB:77	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:78 CROB:78	Reserved	0/1 = state OFF/ON			R/W	2
10:2(read) 12:1(write)	B0:79 CROB:79	EEPROM fault	0/1 = state OFF/ON			R/W	2
<b>Remote Relay Control</b>							
10:2(read) 12:1(write)	BO:80 CROB:80	Relay #1 Force operate/Force release/Normal	0/1 = state OFF/ON			R/W	4
10:2(read) 12:1(write)	BO:81 CROB:81	Relay #2 Force operate/Force release /Normal	0/1 = state OFF/ON			R/W	4
10:2(read) 12:1(write)	BO:82 CROB:82	Relay #3 Force operate/Force release /Normal	0/1 = state OFF/ON			R/W	4

**NOTES:**

<sup>1</sup> 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.

- <sup>2</sup> 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.

- <sup>3</sup> These self-check alarms are doubled with the corresponding internal indication bits.

- <sup>4</sup> 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
<b>Basic Setup</b>							
40:2 (read) 41:2 (write)	AO:0	Wiring mode	F1		UINT16	R/W	
40:1 (read) 41:1 (write)	AO:1	PT ratio	10 to 65000	×0.1	UINT32	R/W	
40:2 (read) 41:2 (write)	AO:2	CT primary current	1 to 50,000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:3	Power block demand period	1,2,3,5,10,15,20,30,60 min, 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) 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) 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) 41:2 (write)	AO:11	Nominal line frequency	25, 50, 60, 400	Hz	UINT16	R/W	
40:2 (read) 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) 41:2 (write)	AO:20	PT ratio multiplication factor	×1, ×10		UINT16	R/W	
<b>Communication Ports Setup</b>							
	AO:64-71	<b>COM1 Setup</b>					
	AO:80-87	<b>COM2 Setup</b>					
40:2 (read) 41:2 (write)	+0	Communication protocol	COM1: 0=SATEC ASCII, 1=Modbus RTU, 2=DNP3.0, 7= IEC 60870-5 COM2: 0=SATEC ASCII, 1=Modbus RTU, 2=DNP3.0, 5=Profibus DP, 7= IEC 60870-5		UINT16	R/W	
40:2 (read) 41:2 (write)	+1	Interface	COM1: 2=RS-485 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) 41:1 (write)	+2	Device address	SATEC ASCII: 0-99 Modbus RTU: 1-247		UINT32	R/W	

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
			DNP3.0: 0-65532 Profibus DP: 0-126				
40:2 (read) 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) 41:2 (write)	+4	Data format	0=7 bits/even parity, 1=8 bits/no parity, 2=8 bits/even parity		UINT16	R/W	Format 0 is not allowed in DNP3.0
40:2 (read) 41:2 (write)	+5	Flow control	N/A		UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	+6	RTS mode	N/A		UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	+7	Send delay	2-1000 ms		UINT16	R/W	
<b>Device Options Setup</b>							
40:2 (read) 41:2 (write)	AO:92	Power calculation mode	0=using reactive power: $S=f(P,Q)$ , 1=using non-active power: $Q=f(S,P)$		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:93	Energy roll value	0= $1 \times 10^4$ , 1= $1 \times 10^5$ , 2= $1 \times 10^6$ , 3= $1 \times 10^7$ , 4= $1 \times 10^8$ , 5= $1 \times 10^9$		UINT16	R/W	
40:2 (read) 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) 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) 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- AO:105	Reserved			UINT16	R	Read as 65535
40:2 (read) 41:2 (write)	AO:106	Device resolution (see Section 4 for details)	0 = Low resolution, 1 = High resolution		UINT16	R/W	Default 0

### 3.9 DNP Protocol Setup

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
<b>DNP Options Setup</b>							
40:2 (read) 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		UINT32	R/W	
40:2 (read) 41:2 (write)	AO:34	Default Binary Counter object variation	F3 (default=3)		UINT16	R/W	1
40:2 (read) 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) 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		UINT32	R/W	
40:1 (read) 41:2 (write)	AO:43	16-bit BC scaling	0= $\times 1$ (default), 1= $\times 10$ , 2= $\times 100$ , 3= $\times 1000$		UINT16	R/W	5
40:1 (read) 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) 41:2 (write)	AO:48	Select/Operate Timeout	2 to 30 (default=10 sec)	sec	UINT16	R/W	3
40:2 (read) 41:2 (write)	AO:49	Multi Fragment Interval	5 to 500 (default=10 ms)	ms	UINT16	R/W	
40:1 (read)	AO:50-AO:52	Reserved	Read as 65535		UINT32	R	
40:2 (read) 41:2 (write)	AO:53	Time Sync Period	0 to 86400 (default=86400 sec)	sec	UINT32	R/W	4
40:2 (read) 41:2 (write)	AO:54	Voltage scale, secondary volts	60 to 828V (default=144V)	V	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:55	Current scale, secondary amps	10 to 100 (default 2 $\times$ CT secondary)	$\times 0.1A$	UINT16	R/W	
<b>DNP Class 0 Point Assignments</b>							
40:1(read) 41:1(write)		DNP object and variation	F4		UINT32	R/W	
40:1(read) 41:1(write)		Start point number	Start point number for the selected object		UINT32	R/W	
40:2(read) 41:2(write)		Number of points in a range	0-128		UINT16	R/W	
	AO:1152-AO:1154	<b>DNP Class 0 Point Range 1</b>					
	AO:1155-AO:1157	<b>DNP Class 0 Point Range 2</b>					

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

**NOTES:**

- <sup>1</sup> 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.
- <sup>2</sup> 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).
- <sup>3</sup> 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.
- <sup>4</sup> 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.
- <sup>5</sup> 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
<b>Data Scales</b>			
Vmax		Voltage scale $\times$ PT Ratio, V	2
Imax		Current scale $\times$ CT Ratio, A	1, 3
Pmax	Wiring 4LN3, 3LN3, 3BLN3	$V_{max} \times I_{max} \times 3$ , W	4
	Wiring 4LL3, 3LL3, 3BLL3, 3OP2, 3OP3, 3DIR2	$V_{max} \times I_{max} \times 2$ , W	
Fmax	Nominal frequency 25, 50 or 60 Hz	100 Hz	
	Nominal frequency 400Hz	500 Hz	
<b>Data Units – Low Resolution Option</b>			
U1		1V	
U2		1A	
U3		1kW/kvar/kVA	
<b>Data Units – High Resolution Option</b>			
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.

<sup>1</sup> CT Ratio = CT primary current/CT secondary current

<sup>2</sup> 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.

<sup>3</sup> The default Current scale is  $2 \times$  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.

<sup>4</sup> 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
<b>Wiring Mode</b>			
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	
<b>Device Options</b>			
	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	
<b>DNP Object Variations</b>			
F3	<b>Static Binary Input Objects</b>		
	0	Single-Bit Binary Input	
	1	Binary Input With Status	
	<b>Static Binary Counters</b>		
	0	32-bit Binary Counter	
	1	32-bit Binary Counter Without Flag	
	2	16-bit Binary Counter	
	3	16-bit Binary Counter Without Flag	
	<b>Frozen Binary Counters</b>		
	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	
	<b>Static Analog Input Objects</b>		
	0	32-bit Analog Input	
	1	32-bit Analog Input Without Flag	
	2	16-bit Analog Input	
	3	16-bit Analog Input Without Flag	
	<b>DNP Class 0 Objects</b>		
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	



<b>Format Code</b>	<b>Value</b>	<b>Description</b>	<b>Notes</b>
	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	Variation	Object Description	Request		Response	
			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, 7,9, 8,10	B B B	129 129	01 N/R 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, 7 <sup>5</sup> , 8 <sup>5</sup>	B B B	129 129	01 N/R 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 <sup>6</sup>	B	129	01
31	1	32-bit Frozen Analog Input	1 <sup>6</sup>	A	129	C
31	2	16-bit Frozen Analog Input	1 <sup>6</sup>	A	129	C
31	3	32-bit Frozen Analog Input with Time	1 <sup>6</sup>	A	129	C
31	4	16-bit Frozen Analog Input with Time	1 <sup>6</sup>	A	129	C
31	5	32-bit Frozen Analog Input without flag	1 <sup>6</sup>	A	129	C
31	6	32-bit Frozen Analog Input without flag	1 <sup>6</sup>	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 <sup>1</sup>	1,2	A	129	C
60	1	Class 0	1	B	129	01
80	1	Internal indication <sup>2</sup>	2	D	129	
N/A	N/A	Cold Restart <sup>3</sup> (respond Obj. 52:2)	13	N/A	129	07
N/A	N/A	Delay Measurement (respond Obj. 52:2)	23	N/A	129	07

<sup>1</sup> 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

<b>DNP3</b> <b>DEVICE PROFILE DOCUMENT</b> 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: For Requests    L1 For Responses    L1	Device Function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
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): Transmitted    292 Received        292	Maximum Application Fragment Size (octets): Transmitted    2048 Received        249
Maximum Data Link Retries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Configurable, range ____ to _____	Maximum Application Layer Retries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Configurable, range ____ to _____ (Fixed is not permitted)
Requires Data Link Layer Confirmation: <input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes    If 'Sometimes', when? _____ <input type="checkbox"/> Configurable    If 'Configurable', how? _____	
Requires Application Layer Confirmation: <input checked="" type="checkbox"/> Never <input type="checkbox"/> Always (not recommended) <input type="checkbox"/> When reporting Event Data (Slave devices only) <input type="checkbox"/> When sending multi-fragment responses (Slave devices only) <input type="checkbox"/> Sometimes    If 'Sometimes', when? _____ <input type="checkbox"/> Configurable    If 'Configurable', how? _____	

Device Profile Document (continued)

<p>Timeouts while waiting for:</p> <p>Data Link Confirm    <input checked="" type="checkbox"/> None   <input type="checkbox"/> Fixed at _____   <input type="checkbox"/> Variable   <input type="checkbox"/> Configurable</p> <p>Complete Appl. Fragment    <input checked="" type="checkbox"/> None   <input type="checkbox"/> Fixed at _____   <input type="checkbox"/> Variable   <input type="checkbox"/> Configurable</p> <p>Application Confirm Complete Appl.    <input type="checkbox"/> None   <input checked="" type="checkbox"/> Fixed at <u>5 sec</u>   <input type="checkbox"/> Variable   <input type="checkbox"/> Configurable</p> <p>Response    <input checked="" type="checkbox"/> None   <input type="checkbox"/> Fixed at _____   <input type="checkbox"/> Variable   <input type="checkbox"/> Configurable</p> <p>Others</p> <p>Timeouts between fragments of the multi-fragment responses. Configurable: 50-500 ms (50 ms by default).</p> <hr/> <p>Attach explanation if 'Variable' or 'Configurable' was checked for any timeout</p>	
<p>Sends/Executes Control Operations:</p> <p>WRITE Binary Outputs   <input checked="" type="checkbox"/> Never   <input type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>SELECT/OPERATE    <input type="checkbox"/> Never   <input checked="" type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>DIRECT OPERATE    <input type="checkbox"/> Never   <input checked="" type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>DIRECT OPERATE -</p> <p>NO ACK                    <input type="checkbox"/> Never   <input checked="" type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>Count &gt; 1                <input checked="" type="checkbox"/> Never   <input type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>Pulse On                    <input type="checkbox"/> Never   <input type="checkbox"/> Always   <input checked="" type="checkbox"/> Sometimes<sup>1,4</sup>   <input type="checkbox"/> Configurable</p> <p>Pulse Off                    <input type="checkbox"/> Never   <input type="checkbox"/> Always   <input checked="" type="checkbox"/> Sometimes<sup>4</sup>   <input type="checkbox"/> Configurable</p> <p>Latch On                    <input type="checkbox"/> Never   <input type="checkbox"/> Always   <input checked="" type="checkbox"/> Sometimes<sup>2</sup>   <input type="checkbox"/> Configurable</p> <p>Latch Off                    <input type="checkbox"/> Never   <input type="checkbox"/> Always   <input checked="" type="checkbox"/> Sometimes<sup>3</sup>   <input type="checkbox"/> Configurable</p> <p>Queue                        <input checked="" type="checkbox"/> Never   <input type="checkbox"/> Always   <input type="checkbox"/> Sometimes   <input type="checkbox"/> Configurable</p> <p>Clear Queue                <input type="checkbox"/> Never   <input type="checkbox"/> Always   <input checked="" type="checkbox"/> Sometimes<sup>4</sup>   <input type="checkbox"/> Configurable</p> <p>◆ <b>Select timeout period is configurable: 2s to 30s</b></p> <p>1    used to activate the <i>Reset</i> function associated with points 0 to 21</p> <p>2, 3, 4 used to control Relays associated with points 80 to 81</p> <p>3    used to reset the self-check alarm registers associated with points 64 to 75</p>	
<p>Reports Binary Input Change Events when no specific variation requested:</p> <p><input checked="" type="checkbox"/> Never</p> <p><input type="checkbox"/> Only time-tagged</p> <p><input type="checkbox"/> Only non-time-tagged</p> <p><input type="checkbox"/> Configurable to send both, one or the other (attach explanation)</p>	<p>Reports time-tagged Binary Input Change Events when no specific variation requested:</p> <p><input checked="" type="checkbox"/> Never</p> <p><input type="checkbox"/> Binary Input Change With Time</p> <p><input type="checkbox"/> Binary Input Change With Relative Time</p> <p><input type="checkbox"/> Configurable (attach explanation)</p>

Device Profile Document (continued)

<p>Sends Unsolicited Responses:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Never</li> <li><input type="checkbox"/> Configurable (attach explanation)</li> <li><input type="checkbox"/> Only certain objects</li> <li><input type="checkbox"/> Sometimes (attach explanation)</li> <li><input type="checkbox"/> ENABLE/DISABLE UNSOLICITED Function codes supported</li> </ul>	<p>Sends Static Data in Unsolicited Responses:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Never</li> <li><input type="checkbox"/> When Device Restarts</li> <li><input type="checkbox"/> When Status Flags Change</li> </ul> <p>No other options are permitted.</p>
<p>Default Counter Object/Variation:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> No Counters Reported</li> <li><input checked="" type="checkbox"/> Configurable (attach explanation)</li> </ul> <p>Counters requested with variation 0 are responded with the default variation specified for the Counter object in the DNP Options Setup.</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Default Object</li> <li><input type="checkbox"/> Default Variation</li> <li><input type="checkbox"/> Point-by-point list attached</li> </ul>	<p>Counters Roll Over at:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> No Counters Reported</li> <li><input type="checkbox"/> Configurable (attach explanation)</li> <li><input type="checkbox"/> 16 Bits</li> <li><input type="checkbox"/> 32 Bits</li> <li><input type="checkbox"/> Other Value Counters</li> <li><input checked="" type="checkbox"/> Point-by-point list attached</li> </ul> <p>See Sections 3.3-3.5.</p>
<p>Sends Multi-Fragment Responses: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>	