ezPAC™

Substation Automation Unit
SA310 / SA320 / SA330

DNP3 Communications Protocol

Reference Guide

BG0340 Rev. A7

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

REVISION HISTORY

A5	Aug 2005	F/W Version 10.3.12 or later. Added BO Object 10, Variation Added point AI:43 for DC Voltage. Added points BC:4 and BC:5 for kvarh import/export energy counters. Event setpoints are configurable for high and low thresholds and delta triggers.
A6	Mar 2007	F/W Version 10.3.20 or later. Added BC scaling option. Added expansion analog inputs' points. Added device diagnostics points.
A7	July 2009	F/W versions 10.XX.11 or later. Added support for 96 DI and 64 RO.

Table of Contents

1 General

This document specifies a subset of the DNP3 communications protocol used to transfer data between a master computer station and the SA300. The document provides the complete information necessary to develop third-party communications software capable of communication with the SA300. Additional information concerning communications operation, configuring the communications parameters, and communications connections is found in the SA300 Installation and Operation Manual.

2 DNP 3.0 Protocol Implementation

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

2.1 Deviations from Standard

The SA300 implements Level 2 of the DNP3 communication protocol. The device does not support unsolicited requests or hardware collision avoidance.

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

2.2 DNP Implementation

The SA300, 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 SA300 executes the parameter clear function and demands resets using the Direct-Operate, SBO/Operate or Direct-Operate-No-Acknowledge command to specified points of the Control-Relay-Output-Block object.

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

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

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

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

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

2.2.1 Class 0 Response

The SA300 DNP implementation supports a wide variety of messages. The most common method of getting static object information from the device via DNP is to issue a read Class 0 request.

The PM130 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).

2.2.2 Event Objects

The SA300 allows you to assign any static object point to a predefined object change event point for Class 1, Class 2 or Class 3 event polling. A total of 64 change event points are available. You can assign any of the Analog Input, Binary Input or Binary Counter static points to the corresponding change event point through the DNP Event setup (see Section 3.9). You can also link any point to Class 1, Class 2 or Class 3 object polling.

By default, a change event point index is the same as for the corresponding static object point. The SA300 gives you an option to re-map a static point index for the corresponding event point starting with index 0, separately for each object type - Analog Input, Binary Input or Binary Counter change events. For example, if the re-mapping option is active and you first assign static point AI:23 (1-sec frequency) to an event Class 1 point, the corresponding Analog Input change event point will be identified as point 0 in the Class 1 poll response.

Each point assigned to an event class can be separately enabled or disabled for scanning.

The conditions for Analog Input change events can be specified by either an operating threshold, or a deadband, using one of the following three relations:

Delta – a new event is generated when the absolute value of the difference between the last reported value of the point and its current value exceeds the specified deadband value;

More than (Over) - a new event is generated when the point value rises over the specified threshold, and then when the point value returns below the threshold taking into consideration a predefined hysteresis;

Less than (Under) - a new event is generated when the point value drops below the specified threshold, and then when the point value returns above the threshold taking into consideration a predefined hysteresis.

For Binary Counter and Binary Input change events, a Delta relation is only applicable.

The number of event points for each object type (Analog Input, Binary Input or Binary Counter) is limited through the DNP Options setup (see Section 3.9). Every time you change the number of points for any of the objects, the device clears all event buffers and links the default set of static points to each event object type.

The scan time rates for polling events of different types are as follows:

- 1 cycle for Binary Input points
- 200 ms for Binary Counter and Analog Input points

The memory consumption for keeping events depends on the event objects variation, or DNP object size. For each event object type and event class, the device uses a separate buffer. The maximum buffer size (MBS) per DNP event object/event class is 512 bytes. The maximum number of events per class that the device can hold can be calculated as follows:

Maximum number of events = MBS/(DNP Event Object Size + 1)

For example, the device can hold up to 512/12=40 measures of the 32-bit Analog change event with Time objects, or up to 512/8=64 measures of the 8-bit Binary change event with Time objects.

To disable change event objects, explicitly set all registers that specify the number of the Analog Input, Binary Input and Binary Counter objects to generate events to 0. In this case, the device will support only static objects.

2.2.3 Device Address

Each device on a DNP link must have a unique address. The SA300 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.

2.2.4 Transaction Timing

The SA300 response time to master requests at 19200 bps is indicated in Table 2-1.

Table 2-1 Response Time

Baud Rate, bps	Response Time, ms	
	Typical	Max
1	2	17
5	9	17
10	12	18
43 (Object 30:3)	27	40

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

2.2.5 Scaling 16-bit Analog Inputs

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

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

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

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

where:

- Y - True reading in engineering units
- X - Raw input data in the range of DNP_LO – DNP_HI
- LO, HI - Data low and high scales in engineering units (for device data scales, see Section 4)
- DNP_LO - DNP low conversion scale: DNP_LO = -32768 for a point with a negative LO scale
  DNP_LO = 0 for a point with a zero or positive LO scale
- DNP_HI - DNP high conversion scale: DNP_HI = 32767

EXAMPLE

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

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

2.2.6 Scaling 16-bit Binary Counters

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

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

2.3 Password Protection

The SA300 has a password protection option allowing you to protect your setups, cumulative registers and logs from being changed or cleared through communications. You can disable or enable password protection through communications or via the front display. For details, refer to your instrument Installation and Operation Manual.

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

3 DNP Point Map

3.1 Analog Inputs - Basic Set

Object : Var.	Object : Point	Description	Options/Range[2]	Units[2]	Type	R/W	Notes
30:3	AI:0	V1/V12 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:1	V2/V23 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:2	V3/V31 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:3	I1 current	0-Imax	U2	UINT32	R	
30:3	AI:4	I2 current	0-Imax	U2	UINT32	R	
30:3	AI:5	I3 current	0-Imax	U2	UINT32	R	
30:3	AI:6	kW L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:7	kW L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:8	kW L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:9	kvar L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:10	kvar L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:11	kvar L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:12	kVA L1	0-Pmax	U3	UINT32	R	
30:3	AI:13	kVA L2	0-Pmax	U3	UINT32	R	
30:3	AI:14	kVA L3	0-Pmax	U3	UINT32	R	
30:4	AI:15	Power factor L1	-1000-1000	×0.001	INT16	R	
30:4	AI:16	Power factor L2	-1000-1000	×0.001	INT16	R	
30:4	AI:17	Power factor L3	-1000-1000	×0.001	INT16	R	
30:4	AI:18	Total PF	-1000-1000	×0.001	INT16	R	
30:3	AI:19	Total kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:20	Total kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:21	Total kVA	0-Pmax	U3	UINT32	R	
30:3	AI:22	In (neutral) current	0-Imax	U2	UINT32	R	
30:4	AI:23	Frequency	0-10000	×0.01Hz	UINT16	R	
30:3	AI:24	Maximum kW import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:25	kW import accumulated demand	0-Pmax	U3	UINT32	R	
30:3	AI:26	Maximum kVA sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:27	kVA accumulated demand	0-Pmax	U3	UINT32	R	
30:3	AI:28	I1 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:29	I2 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:30	I3 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:31	Present kW import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:32	Present kVA sliding window demand	0-Pmax	U3	UINT32	R	
30:4	AI:33	PF (import) at Max. kVA sliding window demand	0-1000	×0.001	UINT16	R	
30:4	AI:34	V1/V12 voltage THD	0-9999	×0.1%	UINT16	R	1, 3
30:4	AI:35	V2/V23 voltage THD	0-9999	×0.1%	UINT16	R	1, 3
30:4	AI:36	V3/V31 voltage THD	0-9999	×0.1%	UINT16	R	1, 3

Object : Var.	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]
30:4	AI:38	I2 current THD	0-9999	×0.1%	UINT16	R	[3]
30:4	AI:39	I3 current THD	0-9999	×0.1%	UINT16	R	[3]
30:4	AI:40	I1 current TDD	0-1000	×0.1%	UINT16	R	[3]
30:4	AI:41	I2 current TDD	0-1000	×0.1%	UINT16	R	[3]
30:4	AI:42	I3 current TDD	0-1000	×0.1%	UINT16	R	[3]
30:3	AI:43	DC voltage	0-999900	0.01V	UINT16	R	

NOTES:

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

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

[3] On a 3-s interval.

3.2 Binary Inputs - Basic Set

Object : Var.	Object : Point	Description	Range	Units	Type	R/W	Notes
		Relays					
01:1	BI:0	Relay #1 status	0-1			R	
01:1	BI:1	Relay #2 status	0-1			R	
.	...	...	0-1			R	
01:1	BI:63	Relay #64 status	0-1			R	
		Digital Inputs					
01:1	BI:64	Digital input #1	0-1			R	
01:1	BI:65	Digital input #2	0-1			R	
.	...	...					
01:1	BI:159	Digital input #96	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	-999,999,999-999,999,999	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	

3.4 Frozen Binary Counters

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

NOTE

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

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

3.5 Analog Inputs, Binary Inputs and Counters – Extended Set

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:4	AI:32768	**None**	0		UINT16	R	
		Special Inputs				R	
30:4	BI:33024	Voltage disturbance	0-100	% Un		R	
30:4	BI:33025	Phase rotation order	0=ERR, 1=POS, 2=NEG			R	
		Digital Inputs DI1-DI48				R	
01:1	BI:34304	DI1	0-1			R	
01:1	BI:34305	DI2	0-1			R	
		...				R	
01:1	BI:34399	DI96	0-1			R	
		Relay Outputs RO1-RO32				R	
01:1	BI:34816	Relay #1	0-1			R	
01:1	BI:34817	Relay #2	0-1			R	
		...				R	
01:1	BI:34879	Relay #64	0-1			R	
		Counters					
20:5	BC:35328	Counter #1	0-999,999,999		UINT32	R	
20:5	BC:35329	Counter #2	0-999,999,999		UINT32	R	
		...				R	
20:5	BC:35343	Counter #16	0-999,999,999		UINT32	R	
		Total Energies					
20:5	BC:38656	kWh import	0-999,999,999	1 kWh	UINT32	R	
20:5	BC:38657	kWh export	0-999,999,999	1 kWh	UINT32	R	
20:5	BC:38658	kWh net	-999,999,999-999,999,999	1 kWh	INT32	R	
20:5	BC:38659	kWh total	0-999,999,999	1 kWh	UINT32	R	
20:5	BC:38660	kvarh import	0-999,999,999	1 kvarh	UINT32	R	
20:5	BC:38661	kvarh export	0-999,999,999	1 kvarh	UINT32	R	
20:5	BC:38662	kvarh net	-999,999,999-999,999,999	1 kvarh	INT32	R	
20:5	BC:38663	kvarh total	0-999,999,999	1 kvarh	UINT32	R	
20:5	BC:38664	kVAh total	0-999,999,999	1 kVAh	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	

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
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	2, 4
30:4	AI:35859	V2/V23 voltage THD	0-9999	×0.1%	UINT16	R	2, 4
30:4	AI:35860	V3/V31 voltage THD	0-9999	×0.1%	UINT16	R	2, 4
30:4	AI:35861	I1 current THD	0-9999	×0.1%	UINT16	R	4
30:4	AI:35862	I2 current THD	0-9999	×0.1%	UINT16	R	4
30:4	AI:35863	I3 current THD	0-9999	×0.1%	UINT16	R	4
30:4	AI:35864	I1 K-Factor	10-9999	×0.1	UINT16	R	4
30:4	AI:35865	I2 K-Factor	10-9999	×0.1	UINT16	R	4
30:4	AI:35866	I3 K-Factor	10-9999	×0.1	UINT16	R	4
30:4	AI:35867	I1 current TDD	0-1000	×0.1%	UINT16	R	4
30:4	AI:35868	I2 current TDD	0-1000	×0.1%	UINT16	R	4
30:4	AI:35869	I3 current TDD	0-1000	×0.1%	UINT16	R	4
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	
30:3	AI:35873	I1x current	0-Ixmax	U2	UINT32	R	
30:3	AI:35874	I2x current	0-Ixmax	U2	UINT32	R	
30:3	AI:35875	I3x current	0-Ixmax	U2	UINT32	R	
		1-Cycle Low Phase Values					
30:3	AI:36096	Low L-N voltage	0-Vmax	U1	UINT32	R	
30:3	AI:36097	Low current	0-Imax	U2	UINT32	R	
30:3	AI:36098	Low kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36099	Low kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36100	Low kVA	0-Pmax	U3	UINT32	R	
30:4	AI:36101	Low PF Lag	0-1000	×0.001	UINT32	R	
30:4	AI:36102	Low PF Lead	0-1000	×0.001	UINT32	R	
30:4	AI:36103	Low voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:36104	Low current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:36105	Low K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:36106	Low current TDD	0-1000	×0.1%	UINT32	R	4
30:3	AI:36107	Low L-L voltage	0-Vmax	U1	UINT32	R	
30:4	AI:36108	Low voltage interharmonics THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:36109	Low current interharmonics THD	0-9999	×0.1%	UINT32	R	4
		1-Cycle High Phase Values					
30:3	AI:36352	High L-N voltage	0-Vmax	U1	UINT32	R	
30:3	AI:36353	High current	0-Imax	U2	UINT32	R	

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:3	AI:36354	High kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36355	High kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36356	High kVA	0-Pmax	U3	UINT32	R	
30:4	AI:36357	High PF Lag	0-1000	×0.001	UINT32	R	
30:4	AI:36358	High PF Lead	0-1000	×0.001	UINT32	R	
30:4	AI:36359	High voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:36360	High current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:36361	High K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:36362	High current TDD	0-1000	×0.1%	UINT32	R	4
30:3	AI:36363	High L-L voltage	0-Vmax	U1	UINT32	R	
30:4	AI:36364	High voltage interharmonics THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:36365	High current interharmonics THD	0-9999	×0.1%	UINT32	R	4
		1-Cycle Total Values					
30:3	AI:36608	Total kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36609	Total kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:36610	Total kVA	0-Pmax	U3	UINT32	R	
30:4	AI:36611	Total PF	-1000-1000	×0.001	INT16	R	
30:4	AI:36612	Total PF lag	0-1000	×0.001	UINT16	R	
30:4	AI:36613	Total PF lead	0-1000	×0.001	UINT16	R	
30:3	AI:36614	Total kW import	0-Pmax	U3	UINT32	R	
30:3	AI:36615	Total kW export	0-Pmax	U3	UINT32	R	
30:3	AI:36616	Total kvar import	0-Pmax	U3	UINT32	R	
30:3	AI:36617	Total kvar export	0-Pmax	U3	UINT32	R	
30:3	AI:36618	3-phase average L-N/L-L voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:36619	3-phase average L-L voltage	0-Vmax	U1	UINT32	R	
30:3	AI:36620	3-phase average current	0-Imax	U2	UINT32	R	
		1-Cycle Auxiliary Values					
30:3	AI:36864	I4 Current	0-I4max	U2	UINT32	R	
30:3	AI:36865	In (neutral) current	0-Imax	U2	UINT32	R	
30:4	AI:36866	Frequency	0-10000	×0.01Hz	UINT16	R	
30:4	AI:36867	Voltage unbalance	0-3000	×0.1%	UINT16	R	
30:4	AI:36868	Current unbalance	0-3000	×0.1%	UINT16	R	
30:3	AI:36869	DC voltage	0-999900	×0.01V	UINT32	R	
30:3	AI:36870	V4 voltage	0-V4max	U4	UINT32	R	
30:3	AI:36871	I4x current	0-I4xmax	U2	UINT32	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	

Object : Var.	Object : Point	Description	Options / Range[3]	Units[3]	Type	R / W	Notes
30:3	AI:37127	kW L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37128	kW L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37129	kvar L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37130	kvar L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37131	kvar L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37132	kVA L1	0-Pmax	U3	UINT32	R	
30:3	AI:37133	kVA L2	0-Pmax	U3	UINT32	R	
30:3	AI:37134	kVA L3	0-Pmax	U3	UINT32	R	
30:4	AI:37135	Power factor L1	-1000-1000	×0.001	INT16	R	
30:4	AI:37136	Power factor L2	-1000-1000	×0.001	INT16	R	
30:4	AI:37137	Power factor L3	-1000-1000	×0.001	INT16	R	
30:4	AI:37138	V1/V12 voltage THD	0-9999	×0.1%	UINT16	R	2, 5
30:4	AI:37139	V2/V23 voltage THD	0-9999	×0.1%	UINT16	R	2, 5
30:4	AI:37140	V3/V31 voltage THD	0-9999	×0.1%	UINT16	R	2, 5
30:4	AI:37141	I1 current THD	0-9999	×0.1%	UINT16	R	5
30:4	AI:37142	I2 current THD	0-9999	×0.1%	UINT16	R	5
30:4	AI:37143	I3 current THD	0-9999	×0.1%	UINT16	R	5
30:4	AI:37144	I1 K-Factor	10-9999	×0.1	UINT16	R	5
30:4	AI:37145	I2 K-Factor	10-9999	×0.1	UINT16	R	5
30:4	AI:37146	I3 K-Factor	10-9999	×0.1	UINT16	R	5
30:4	AI:37147	I1 current TDD	0-1000	×0.1%	UINT16	R	5
30:4	AI:37148	I2 current TDD	0-1000	×0.1%	UINT16	R	5
30:4	AI:37149	I3 current TDD	0-1000	×0.1%	UINT16	R	5
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	
30:3	AI:37153	I1x current	0-Ixmax	U2	UINT32	R	
30:3	AI:37154	I2x current	0-Ixmax	U2	UINT32	R	
30:3	AI:37155	I3x current	0-Ixmax	U2	UINT32	R	
		1-Second Low Phase Values					
30:3	AI:37376	Low L-N voltage	0-Vmax	U1	UINT32	R	
30:3	AI:37377	Low current	0-Imax	U2	UINT32	R	
30:3	AI:37378	Low kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37379	Low kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37380	Low kVA	0-Pmax	U3	UINT32	R	
30:4	AI:37381	Low PF Lag	0-1000	×0.001	UINT32	R	
30:4	AI:37382	Low PF Lead	0-1000	×0.001	UINT32	R	
30:4	AI:37383	Low voltage THD	0-9999	×0.1%	UINT32	R	2, 5
30:4	AI:37384	Low current THD	0-9999	×0.1%	UINT32	R	5
30:4	AI:37385	Low K-Factor	10-9999	×0.1	UINT32	R	5
30:4	AI:37386	Low current TDD	0-1000	×0.1%	UINT32	R	5
30:3	AI:37387	Low L-L voltage	0-Vmax	U1	UINT32	R	
30:4	AI:37388	Low voltage interharmonics THD	0-9999	×0.1%	UINT32	R	2, 5

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:4	AI:37389	Low current interharmonics THD	0-9999	×0.1%	UINT32	R	5
		1-Second High Phase Values					
30:3	AI:37632	High L-N voltage	0-Vmax	U1	UINT32	R	
30:3	AI:37633	High current	0-Imax	U2	UINT32	R	
30:3	AI:37634	High kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37635	High kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37636	High kVA	0-Pmax	U3	UINT32	R	
30:4	AI:37637	High PF Lag	0-1000	×0.001	UINT32	R	
30:4	AI:37638	High PF Lead	0-1000	×0.001	UINT32	R	
30:4	AI:37639	High voltage THD	0-9999	×0.1%	UINT32	R	2, 5
30:4	AI:37640	High current THD	0-9999	×0.1%	UINT32	R	5
30:4	AI:37641	High K-Factor	10-9999	×0.1	UINT32	R	5
30:4	AI:37642	High current TDD	0-1000	×0.1%	UINT32	R	5
30:3	AI:37643	High L-L voltage	0-Vmax	U1	UINT32	R	
30:4	AI:37644	High voltage interharmonics THD	0-9999	×0.1%	UINT32	R	2, 5
30:4	AI:37645	High current interharmonics THD	0-9999	×0.1%	UINT32	R	5
		1-Second Total Values					
30:3	AI:37888	Total kW	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37889	Total kvar	-Pmax-Pmax	U3	INT32	R	
30:3	AI:37890	Total kVA	0-Pmax	U3	UINT32	R	
30:4	AI:37891	Total PF	-1000-1000	×0.001	INT16	R	
30:4	AI:37892	Total PF lag	0-1000	×0.001	UINT16	R	
30:4	AI:37893	Total PF lead	0-1000	×0.001	UINT16	R	
30:3	AI:37894	Total kW import	0-Pmax	U3	UINT32	R	
30:3	AI:37895	Total kW export	0-Pmax	U3	UINT32	R	
30:3	AI:37896	Total kvar import	0-Pmax	U3	UINT32	R	
30:3	AI:37897	Total kvar export	0-Pmax	U3	UINT32	R	
30:3	AI:37898	3-phase average L-N/L-L voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:37899	3-phase average L-L voltage	0-Vmax	U1	UINT32	R	
30:3	AI:37900	3-phase average current	0-Imax	U2	UINT32	R	
		1-Second Auxiliary Values					
30:3	AI:38144	I4 Current	0-I4max	U2	UINT32	R	
30:3	AI:38145	In (neutral) current	0-Imax	U2	UINT32	R	
30:4	AI:38146	Frequency	0-10000	×0.01Hz	UINT16	R	
30:4	AI:38147	Voltage unbalance	0-3000	×0.1%	UINT16	R	
30:4	AI:38148	Current unbalance	0-3000	×0.1%	UINT16	R	
30:3	AI:38149	DC voltage	0-999900	×0.01V	UINT32	R	
30:3	AI:38150	V4 voltage	0-V4max	U4	UINT32	R	
30:3	AI:38151	I4x current	0-I4xmax	U2	UINT32	R	
		Present Volt, Ampere and Power Demands					
30:3	AI:38400	V1/V12 Volt demand	0-Vmax	U1	UINT32	R	2
30:3	AI:38401	V2/V23 Volt demand	0-Vmax	U1	UINT32	R	2
30:3	AI:38402	V3/V31 Volt demand	0-Vmax	U1	UINT32	R	2

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:3	AI:38403	I1 Ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:38404	I2 Ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:38405	I3 Ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:38406	kW import block demand	0-Pmax	U3	UINT32	R	
30:3	AI:38407	kvar import block demand	0-Pmax	U3	UINT32	R	
30:3	AI:38408	kVA block demand	0-Pmax	U3	UINT32	R	
30:3	AI:38409	kW import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:38410	kvar import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:38411	kVA sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:38412	Not used	0		UINT32	R	
30:3	AI:38413	Not used	0		UINT32	R	
30:3	AI:38414	Not used	0		UINT32	R	
30:3	AI:38415	kW import accumulated demand	0-Pmax	U3	UINT32	R	
30:3	AI:38416	kvar import accumulated demand	0-Pmax	U3	UINT32	R	
30:3	AI:38417	kVA accumulated demand	0-Pmax	U3	UINT32	R	
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	0		UINT32	R	
30:3	AI:38431	Not used	0		UINT32	R	
30:3	AI:38432	V4 volt demand	0-Vmax	U4	UINT32	R	
30:3	AI:38433	I4 ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:38434	In ampere demand	0-Imax	U2	UINT32	R	
		Minimum 1-Cycle Phase Values					
30:3	AI:44032	V1 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:44033	V2 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:44034	V3 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:44035	I1 current	0-Imax	U2	UINT32	R	
30:3	AI:44036	I2 current	0-Imax	U2	UINT32	R	
30:3	AI:44037	I3 current	0-Imax	U2	UINT32	R	
30:3	AI:44038	kW L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:44039	kW L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:44040	kW L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:44041	kvar L1	-Pmax-Pmax	U3	INT32	R	

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:3	AI:44042	kvar L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:44043	kvar L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:44044	kVA L1	0-Pmax	U3	UINT32	R	
30:3	AI:44045	kVA L2	0-Pmax	U3	UINT32	R	
30:3	AI:44046	kVA L3	0-Pmax	U3	UINT32	R	
30:4	AI:44047	Power factor L1	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:44048	Power factor L2	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:44049	Power factor L3	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:44050	V1 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:44051	V2 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:44052	V3 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:44053	I1 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:44054	I2 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:44055	I3 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:44056	I1 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:44057	I2 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:44058	I3 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:44059	I1 current TDD	0-1000	×0.1%	UINT32	R	4
30:4	AI:44060	I2 current TDD	0-1000	×0.1%	UINT32	R	4
30:4	AI:44061	I3 current TDD	0-1000	×0.1%	UINT32	R	4
30:3	AI:44062	V12 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:44063	V23 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:44064	V31 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:44065	I1x current	0-Ixmax	U2	UINT32	R	
30:3	AI:44066	I2x current	0-Ixmax	U2	UINT32	R	
30:3	AI:44067	I3x current	0-Ixmax	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	UINT32	R	Absolute value
30:4	AI:44292	Total PF lag	0-1000	×0.001	UINT32	R	
30:4	AI:44293	Total PF lead	0-1000	×0.001	UINT32	R	
		Minimum 1-Cycle Auxiliary Values					
30:3	AI:44544	I4 current	0-Imax	U2	UINT32	R	
30:3	AI:44545	In current	0-Imax	U2	UINT32	R	
30:4	AI:44546	Frequency	0-10000	×0.01Hz	UINT32	R	
30:4	AI:44547	Voltage unbalance	0-3000	×0.1%	UINT32	R	
30:4	AI:44548	Current unbalance	0-3000	×0.1%	UINT32	R	
30:3	AI:44549	DC voltage	0-999900	×0.01V	UINT32	R	
30:3	AI:44550	V4 voltage	0-V4max	U4	UINT32	R	
30:3	AI:44551	I4x current	0-Ixmax	U2	UINT32	R	
30:4	AI:44552	V4 THD	0-9999	×0.1%	UINT32	R	4

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:4	AI:44553	I4x THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:44554	I4x TDD	0-1000	×0.1%	UINT32	R	4
		Maximum 1-Cycle Phase Values					
30:3	AI:46080	V1 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:46081	V2 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:46082	V3 voltage	0-Vmax	U1	UINT32	R	1
30:3	AI:46083	I1 current	0-Imax	U2	UINT32	R	
30:3	AI:46084	I2 current	0-Imax	U2	UINT32	R	
30:3	AI:46085	I3 current	0-Imax	U2	UINT32	R	
30:3	AI:46086	kW L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46087	kW L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46088	kW L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46089	kvar L1	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46090	kvar L2	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46091	kvar L3	-Pmax-Pmax	U3	INT32	R	
30:3	AI:46092	kVA L1	0-Pmax	U3	UINT32	R	
30:3	AI:46093	kVA L2	0-Pmax	U3	UINT32	R	
30:3	AI:46094	kVA L3	0-Pmax	U3	UINT32	R	
30:4	AI:46095	Power factor L1	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:46096	Power factor L2	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:46097	Power factor L3	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:46098	V1 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:46099	V2 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:46100	V3 voltage THD	0-9999	×0.1%	UINT32	R	2, 4
30:4	AI:46101	I1 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:46102	I2 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:46103	I3 current THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:46104	I1 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:46105	I2 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:46106	I3 K-Factor	10-9999	×0.1	UINT32	R	4
30:4	AI:46107	I1 current TDD	0-1000	×0.1%	UINT32	R	4
30:4	AI:46108	I2 current TDD	0-1000	×0.1%	UINT32	R	4
30:4	AI:46109	I3 current TDD	0-1000	×0.1%	UINT32	R	4
30:3	AI:46110	V12 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:46111	V23 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:46112	V31 voltage	0-Vmax	U1	UINT32	R	
30:3	AI:46113	I1x current	0-Ixmax	U2	UINT32	R	
30:3	AI:46114	I2x current	0-Ixmax	U2	UINT32	R	
30:3	AI:46115	I3x current	0-Ixmax	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	

Object : Var.	Object : Point	Description	Options/Range[3]	Units[3]	Type	R/W	Notes
30:4	AI:46339	Total PF	0-1000	×0.001	UINT32	R	Absolute value
30:4	AI:46340	Total PF lag	0-1000	×0.001	UINT32	R	
30:4	AI:46341	Total PF lead	0-1000	×0.001	UINT32	R	
		Maximum 1-Cycle Auxiliary Values					
30:3	AI:46592	I4 Current	0-Imax	U2	UINT32	R	
30:3	AI:46593	In Current	0-Imax	U2	UINT32	R	
30:4	AI:46594	Frequency	0-10000	×0.01Hz	UINT32	R	
30:4	AI:46595	Voltage unbalance	0-3000	×0.1%	UINT32	R	
30:4	AI:46596	Current unbalance	0-3000	×0.1%	UINT32	R	
30:3	AI:46597	DC voltage	0-999900	×0.01V	UINT32	R	
30:3	AI:46598	V4 Voltage	0-V4max	U4	UINT32	R	
30:3	AI:46599	I4x Current	0-Ixmax	U2	UINT32	R	
30:4	AI:46600	V4 THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:46601	I4x THD	0-9999	×0.1%	UINT32	R	4
30:4	AI:46602	I4x TDD	0-1000	×0.1%	UINT32	R	4
		Maximum Demands					
30:3	AI:46848	V1 Maximum volt demand	0-Vmax	U1	UINT32	R	2
30:3	AI:46849	V2 Maximum volt demand	0-Vmax	U1	UINT32	R	2
30:3	AI:46850	V3 Maximum volt demand	0-Vmax	U1	UINT32	R	2
30:3	AI:46851	I1 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:46852	I2 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:3	AI:46853	I3 Maximum ampere demand	0-Imax	U2	UINT32	R	
30:4	AI:46854	Not used	0		UINT32	R	
30:4	AI:46855	Not used	0		UINT32	R	
30:4	AI:46856	Not used	0		UINT32	R	
30:3	AI:46857	Maximum kW import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:46858	Maximum kvar import sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:46859	Maximum kVA sliding window demand	0-Pmax	U3	UINT32	R	
30:4	AI:46860	Not used	0		UINT32	R	
30:4	AI:46861	Not used	0		UINT32	R	
30:4	AI:46862	Not used	0		UINT32	R	
30:3	AI:46863	Maximum kW export sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:46864	Maximum kvar export sliding window demand	0-Pmax	U3	UINT32	R	
30:3	AI:46865	Not used	0		UINT32	R	
30:3	AI:46866	Not used	0		UINT32	R	
30:3	AI:46867	V4 Maximum volt demand	0-Vmax	U4	UINT32	R	
30:3	AI:46868	I4 Maximum ampere demand	0-I4max	U2	UINT32	R	
30:3	AI:46869	In Maximum ampere demand	0-Imax	U2	UINT32	R	
		Analog Inputs					3
30:3	AI:47872	Analog input AI1	AI1min-AI1max		UINT32	R	
30:3	AI:47873	Analog input AI2	AI2min-AI2max		UINT32	R	
						R	
30:3	AI:47887	Analog input AI16	AI16min-AI16max		UINT32	R	

NOTES:

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

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

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

[4] On a 0.2-s interval.

[5] On a 3-s interval.

3.6 Factory Device Settings and Identification

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
Device Identification							
30:3	AI:256	Device serial number	0-999999		UINT32	R	
30:4	AI:257	Device model ID	310, 320, 330		UINT16	R	
30:4	AI:258-AI:261	Device model name	“SA310”, “SA320”, “SA330”		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	1001-1099		UINT16	R	Two higher decimal digits = major version number, two lower decimal digits = minor version number
30:4	AI:267	Device firmware build number	1-99		UINT16	R	
30:4	AI:268	DSP firmware version number	101-199		UINT16	R	Two higher decimal digits = major version number, two lower decimal digits = minor version number
30:4	AI:269	DSP firmware build number	1-99		UINT16	R	
30:4	AI:270	Boot loader version number			UINT16	R	Two higher decimal digits = major version number, two lower decimal digits = minor version number
30:4	AI:271	Boot loader build number	1-99		UINT16	R	
30:3	AI:272-AI:274	Reserved			UINT32	R	
Factory Device Settings							
30:4	AI:275	V1-V3 input range	690	V	UINT16	R	
30:4	AI:276	V1-V3 input overload	120	%	UINT16	R	
30:4	AI:277	V4 input range	690	V	UINT16	R	
30:4	AI:278	V4 input overload	120	%	UINT16	R	
30:4	AI:279	I1-I3 input range	1, 5	A	UINT16	R	
30:4	AI:280	I1-I3 input overload	400	%	UINT16	R	
30:4	AI:281	I4 input range	1, 5	A	UINT16	R	
30:4	AI:282	I4 input overload	400	%	UINT16	R	
30:4	AI:283	I1x-I3x input range	1, 5	A	UINT16	R	
30:4	AI:284	I1s-I3x input overload	3000	%	UINT16	R	
30:4	AI:285	I4x input range	1, 5	A	UINT16	R	
30:4	AI:286	I4x input overload	3000	%	UINT16	R	
30:4	AI:287	VDC input range	300	V	UINT16	R	
30:4	AI:288	VDC input overload	100	%	UINT16	R	
Port Identification							
30:4	AI:320	Active port number	0-2 = serial port COM1-COM3, 3 = IR Port, 4 = Modem port, 5 = USB/Modbus port, 6-10 = Ethernet/TCP port 1-99		UINT16	R	

3.7 Device Control

Object : Var.	Object : Point	Description	Options/Range	Units	Type	R/W	Notes
Device Authorization Register							
40:1(read) 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	
Remote Relay Control							
10:2(read) 12:1(write)	BO:0 CROB:0	Relay #1 Force operate/Force release/Normal	0/1 = state OFF/ON			R/W	4
10:2(read) 12:1(write)	BO:1 CROB:1	Relay #2 Force operate/Force release/Normal	0/1 = state OFF/ON			R/W	4
		...					
10:2(read) 12:1(write)	BO:63 CROB:63	Relay #64 Force operate/Force release/Normal	0/1 = state OFF/ON			R/W	4
Device Reset/Clear							
10:2(read) 12:1(write)	BO:64 CROB:64	Clear total energy registers	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:65 CROB:65	Clear total maximum demand registers (all demands)	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:66 CROB:66	Clear power demands	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:67 CROB:67	Clear volt/ampere/harmonic demands	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:68-75 CROB:68-75	Reserved	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:76 CROB:76	Clear pulse counters (all counters)	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:77-84 CROB:77-84	Clear pulse counter#1-#8	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:85 CROB:85	Clear Min/Max log	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:86-93 CROB:86-93	Reserved	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
10:2(read) 12:1(write)	BO:94-101 CROB:94-101	Clear pulse counter#9-#16	0/1 = state OFF/ON			R W	Returns zero PULSE ON 1
Device Diagnostics							
10:2(read) 12:1(write)	BO:128 CROB:128	Critical error - device operations stop	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:129 CROB:129	Permanent fault (critical error)	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:130 CROB:130	RAM/Data error	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:131 CROB:131	CPU watchdog reset	0/1 = state OFF/ON			R/W	2, 5

Object : Var.	Object : Point	Description	Options/Range	Units	Type	R/W	Notes
10:2(read) 12:1(write)	BO:132 CROB:132	DSP/Sampling fault	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:133 CROB:133	CPU exception	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:134 CROB:134	Reserved	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:135 CROB:135	Software watchdog reset	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:136 CROB:136	Power down	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:137 CROB:137	Device reset [3]	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:138 CROB:138	Configuration reset [3]	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:139 CROB:139	RTC fault (critical error)	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:140 CROB:140	Configuration fault (critical error)	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:141 CROB:141	Reserved	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:142 CROB:142	Expanded memory fault	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:143 CROB:143	CPU EEPROM fault	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:144 CROB:144	AC board EEPROM fault	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:145 CROB:145	I/O board EEPROM fault	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:146 CROB:146	Reserved	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:147 CROB:147	Reserved	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:148 CROB:148	C Library error	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:149 CROB:149	RTOS Kernel error	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:150 CROB:150	Task error	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:151 CROB:151	Reserved	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:152 CROB:152	IRIG-B signal lost	0/1 = state OFF/ON			R/W	2, 5
10:2(read) 12:1(write)	BO:153 CROB:153	IRIG-B time unlocked	0/1 = state OFF/ON			R/W	2, 5

NOTES:

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

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

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

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

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

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

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

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

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

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

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

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

- The On Time specifies in ms the amount of time the digital point is to be turned on. The minimal value of the On Time is 500 ms and the actual value may differ from the specified value by up to 10 ms.
- The Off Time specifies in ms the amount of time the digital point is to be turned off. The minimal value of the Off Time is 500 ms and the actual value may differ from the specified value by up to 10 ms.
- The Status byte in the response reflects the success or failure of the control operation:
  - Request Accepted (0) will be return if the command was accepted;
  - Request not Accepted due to Formatting Errors (3) will be returned if the Control Code byte was incorrectly formatted or an invalid Code was present in the command;
  - Control Operation not Supported for this Point (4) will be returned if the Control Point was out of control.

[5] Available with Version 10.3.20 or later.

3.8 Device Setup

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
Basic Setup							
40:2 (read) 41:2 (write)	AO:0	Wiring mode	F26		UINT16	R/W	
40:1 (read) 41:1 (write)	AO:1	PT ratio (primary to secondary ratio)	10-65000	×0.1	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:2	PT secondary (Line-to-Line)	10-690	V	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:3	V4 PT ratio (primary to secondary ratio)	10-65000	×0.1	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:4	V4 PT secondary voltage	10-690	V	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:5	CT primary current	1-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:6	CT secondary current	1, 5	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:7	I4 CT primary current	1-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:8	I4 CT secondary current	1, 5	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:9	Ix CT primary current	1-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:10	Ix CT secondary current	1, 5	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:11	I4x CT primary current	1-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:12	I4x CT secondary current	1-10000	A	UINT16	R/W	
40:1 (read)	AO:13-15	Reserved			UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	AO:16	VDC nominal voltage	10-300	V	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:17	Nominal line frequency	50, 60	Hz	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:18	Phase order	0 = ABC, 1 = CBA		UINT16	R/W	
40:2 (read)	AO:19-23	Reserved			UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	AO:24	I maximum demand load current	0-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:25	I4 maximum demand load current	0-10000	A	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:26	Ix maximum demand load current	0-10000	A	UINT16	R/W	

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
40:2 (read) 41:2 (write)	AO:27	I4x maximum demand load current	0-10000	A	UINT16	R/W	
40:2 (read)	AO:28-31	Reserved			UINT16	R/W	Read as 65535
Demand Setup							
40:2 (read) 41:2 (write)	AO:32	Power demand period (block interval)	1, 2, 5, 10, 15, 30, 60	min	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:33	Number of demand periods in a sliding window	1-15		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:34	Demand synchronization source input	0 = device clock, 1-48 = DI1-DI48		UINT16	R/W	A DI input is considered a pulse or KYZ input. The pulse edge restarts the power demand accumulation interval.
40:2 (read)	AO:35-39	Reserved			UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	AO:40	Volt demand period	0-9000	sec	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:41	Ampere demand period	0-9000	sec	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:42	Harmonic demand period	0-9000	sec	UINT16	R/W	
40:2 (read)	AO:43-47	Reserved			UINT16	R/W	Read as 65535
Device Options Setup							
40:2 (read) 41:2 (write)	AO:48	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:49	Energy roll value	0 = 1×10^4, 1 = 1×10^5, 2 = 1×10^6, 3 = 1×10^7, 4 = 1×10^8, 5 = 1×10^9		UINT16	R/W	
40:2 (read	AO:50-55	Reserved			UINT16	R/W	Read as 65535
40:2 (read) 41:2 (write)	AO:56	"kWh"/"kvarh" LED pulse rate, Wh/varh per pulse (in secondary units)	1 - 10000	×0.01Wh	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:57	"VDC MEASURE LOW" LED alarm threshold, %	10 - 1000	×0.1%	UINT16	R/W	
Communication Ports Setup							
		COM1 Setup					
40:2 (read) 41:2 (write)	AO:112	Communication protocol	0 = Modbus RTU, 1 = Modbus ASCII, 2 = DNP3.0		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:113	Interface	0 = RS-232, 1 = RS-422, 2 = RS-485, 3 = Infrared, 4 = Modem		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:114	Device address	1-247		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:115	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,		UINT16	R/W	

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
			10 = 115200 bps				
40:2 (read) 41:2 (write)	AO:116	Data format	0 = 7 bits/even parity, 1 = 8 bits/no parity, 2 = 8 bits/even parity		UINT16	R/W	
40:2 (read) 41:2 (write)	AO:117	CTS mode	0 = not used, 1 = wait for CTS before sending data		UINT16	R/W	N/A for COM2-COM5 (read as 65535)
40:2 (read) 41:2 (write)	AO:118	RTS mode	0 = not used, 1 = RTS is asserted during the transmission		UINT16	R/W	N/A for COM2-COM5 (read as 65535)
40:2 (read) 41:2 (write)	AO:119	Minimum delay before sending data	0-1000 (default = 5)	ms	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:120	Inter-character time-out	0-1000 (default = 4-character time)	ms	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:121-127	Reserved					Read as 65535
		COM2 Setup					
	AO:128-143	Point descriptions and ranges as for port COM1				R/W	
		COM3 Setup					
	AO:144-159	Point descriptions and ranges as for port COM1				R/W	
		COM4 Setup					
	AO:160-175	Point descriptions and ranges as for port COM1				R/W	
		COM5 Setup					
	AO:176-191	Point descriptions and ranges as for port COM1				R/W	

3.9 DNP Protocol Setup

Object:Var.	Object:Point	Description	Options/Range	Units	Type	R/W	Notes
DNP Options Setup							
40:2 (read) 41:2 (write)	AO:64	Default Binary Input Static object variation	F3 (default=0)		UINT16	R/W	1
40:2 (read) 41:2 (write)	AO:65	Default Binary Input Change object variation	F3 (default=1)		UINT16	R/W	1
40:2 (read) 41:2 (write)	AO:66	Default Binary Counter static object variation	F3 (default=3)		UINT16	R/W	1
40:2 (read) 41:2 (write)	AO:67	Default Frozen Binary Counter object variation	F3 (default=4)		UINT16	R/W	1
40:2 (read)	AO:68	Reserved	Read as 65535		UINT32	R	Read as 65535
40:2 (read) 41:2 (write)	AO:69	Default Binary Counter Change Event object variation	F3 (default=2)		UINT16	R/W	1
40:2 (read) 41:2 (write)	AO:70	Default Analog Input object variation	F3 (default=3)		UINT16	R/W	1
40:2 (read)	AO:71	Reserved	Read as 65535		UINT32	R/W	Read as 65535
40:2 (read)	AO:72	Reserved	Read as 65535		UINT32	R/W	Read as 65535
40:2 (read) 41:2 (write)	AO:73	Default Analog Input Change Event object variation	F3 (default=2)		UINT16	R/W	1
40:2 (read) 41:2 (write)	AO:74	Re-mapping static point indices for event objects	0=disabled (default), 1=enabled		UINT16	R/W	
40:1 (read) 41:2 (write)	AO:75	16-bit BC scaling	0=×1 (default), 1=×10, 2=×100, 3=×1000		UINT16	R/W	6
40:1 (read) 41:2 (write)	AO:76	16-bit AI scaling	0=disabled, 1=enabled (default)		UINT16	R/W	3
40:2 (read) 41:2 (write)	AO:77	Number of Analog Input change event points	0 to 64 (default=43)		UINT16	R/W	2
40:2 (read) 41:2 (write)	AO:78	Number of Binary Input change event points	0 to 64 (default=21)		UINT16	R/W	2
40:2 (read) 41:2 (write)	AO:79	Number of Binary Counter change event points	0 to 64 (default=0)		UINT16	R/W	2
40:2 (read) 41:2 (write)	AO:80	Select/Operate Timeout	2 to 30 (default=10 sec)	sec	UINT16	R/W	4
40:2 (read) 41:2 (write)	AO:81	Multi Fragment Interval	50 to 500 (default=50 ms)	ms	UINT16	R/W	
40:1 (read)	AO:82-AO:84	Reserved	Read as 65535		UINT32	R	Read as 65535
40:2 (read) 41:2 (write)	AO:85	Time Sync Period	1 to 86400 (default=86400 sec) 0 = disable time requests	sec	UINT32	R/W	5
40:2 (read) 41:2 (write)	AO:86	Voltage scale, secondary volts	60 to 828V (default=144V)	V	UINT16	R/W	
40:2 (read) 41:2 (write)	AO:87	Current scale, secondary amps	10 to 200 (default CT secondary × CT overload)	×0.1A	UINT16	R/W	

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

NOTES:

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

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

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

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

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

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

[7] Available with Version 10.3.12 or later.

4 Data Scales and Units

Code	Condition	Value/Range	Notes
Data Scales			
Vmax		Voltage Scale × PT Ratio, V	2
V4max		Voltage Scale × V4 PT Ratio, V	2
Imax		Current Scale × CT Ratio [1], A,	3
I4max		Current Scale × I4 CT Ratio [1], A,	3
Ixmax	1A secondary	30 × CTx Ratio [1], A	
	5A secondary	150 × CTx Ratio [1], A	
I4xmax	1A secondary	30 × I4x CTx Ratio [1], A	
	5A secondary	150 × I4x CTx Ratio [1], A	
Pmax	PT Ratio = 1	Vmax × Imax × 2, W	4
	PT Ratio > 1	(Vmax × Imax × 2)/1000, kW	
AImin AImax	+/-1mA	AImin = -AI full scale × 2 AImax = AI full scale × 2	
	0-20mA	AImin = AI zero scale AImax = AI full scale	
	4-20mA	AImin = AI zero scale AImax = AI full scale	
	0-1mA	AImin = AI zero scale AImax = AI full scale	
	0-50mA	AImin = AI zero scale AImax = AI full scale	
	+/-10V	AImin = -AI full scale AImax = AI full scale	
Data Units			
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	
U4	V4 PT Ratio = 1	0.1V	
	V4 PT Ratio > 1	1V	

[1] CT Ratio = CT primary current/CT secondary current

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

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

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

5 Data Formats

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

Format Code	Value	Description	Notes
	0x1405	Binary Counter 20:05	
	0x1406	Binary Counter 20:06	
	0x1501	Frozen Counter 21:01	
	0x1502	Frozen Counter 21:02	
	0x1505	Frozen Counter 21:05	
	0x1506	Frozen Counter 21:06	
	0x1509	Frozen Counter 21:09	
	0x150A	Frozen Counter 21:10	

APPENDIX A DNP Application Messages

The device is a DNP IED responding to external DNP Master requests. Table A-1 describes the SA300 application level responses to external requests, including object variations, functions, codes and qualifiers supported by the device. The object and formats are detailed in the DNP Basic 4 Documentation Set.

Table A-1 Application Responses

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

Object			Request		Response	
Object	**Variation**	**Description**	**Function Code**	**Qualifier Code**	**Function Code**	**Qualifier Code**
80	1	Internal indication [2]	2	D	129	
N/A	N/A	Cold Restart [3] (respond Obj. 52:2)	13	N/A	129	07
N/A	N/A	Delay Measurement (respond Obj. 52:2)	23	N/A	129	07

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

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

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

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

N/A - Not Available

N/R - Null Response

Appendix B DNP Device Profile

DNP3

DEVICE PROFILE DOCUMENT

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

Object Group | Request Function Codes | Response Function Codes

Object Variation | Request Qualifiers | Response Qualifiers

Object Name (optional)

Vendor Name: SATEC Ltd.

Device Name: SA300 Substation Automation Unit

Highest DNP Level Supported:	Device Function:
For Requests L2	☐ Master ■ Slave
For Responses L2	

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

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

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

Requires Data Link Layer Confirmation:

■ Never

☐ Always

☐ Sometimes If 'Sometimes', when?

_____

☐ Configurable If 'Configurable', how? _____

Requires Application Layer Confirmation:

☐ Never

☐ Always (not recommended)

■ When reporting Event Data (Slave devices only)

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

☐ Sometimes If 'Sometimes', when?

_____

☐ Configurable If 'Configurable', how? _____

Timeouts while waiting for:

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

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

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

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

Others

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

_____

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

Sends/Executes Control Operations:

WRITE Binary Outputs ■ Never ☐ Always ☐ Sometimes ☐ Configurable

SELECT/OPERATE ☐ Never ■ Always ☐ Sometimes ☐ Configurable

DIRECT OPERATE☐ Never ■ Always ☐ Sometimes ☐ Configurable

DIRECT OPERATE -

NO ACK ☐ Never ■ Always ☐ Sometimes ☐ Configurable

Count > 1 ■ Never ☐ Always ☐ Sometimes ☐ Configurable

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

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

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

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

Queue ■ Never ☐ Always ☐ Sometimes ☐ Configurable

Clear Queue ☐ Never ☐ Always ■ Sometimes ☐ Configurable

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

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

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

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

Device Profile Document (continued)

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