PM296/RPM096 POWER QUALITY ANALYZERS

COMMUNICATIONS

DNP3-2003 Communications Protocol

REFERENCE GUIDE

REVISION HISTORY

Rev.A6 (F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later):

Added point AI:43 for DC Voltage (see Table 3-1).
Added BO Object 10 Variation 1 (see Tables 3-32, A-1).
Added points BC:4 and BC:5 for kvarh imp/exp energy counters (see Tables 3-1, 3-11).

Rev.A5 (F/W Versions 2.26.2/2.36.2 and 2.27.2/2.37.2 or later):

For revision changes, see Sections “DNP Options Setup” and “DNP Event Setpoints Setup”.

Rev.A4 (F/W Versions 2.26/2.36 and 2.27/2.37 or later):

The revision complies with the requirements of the DNP3-2003 Intelligent Electronic Device (IED) Certification Procedure.

BG0293 Rev. A6

Table of Contents

1 GENERAL

This document specifies a subset of the DNP3-2000 serial communications protocol used to transfer data between a master computer station and the PM296/RPM096 Power Quality Analyzers. The document provides all necessary information for developing third-party communications software capable of communicating with the PM296/RPM096.

Additional information concerning communications operation, configuration of communications parameters, and communications connections is found in the PM296/RPM096 Installation and Operation Manual.

IMPORTANT

1. The voltage parameters throughout the protocol can represent line-to-neutral or line-to-line voltages depending on the wiring mode selected in the instrument. When the 4LN3 or 3LN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages. In 4LN3, 4LL3, 3LN3 and 3LL3 wiring modes, harmonic voltages will represent line-to-neutral voltages. In a 3-wire direct connection, harmonic voltages will represent line-to-neutral voltages as they appear on the instrument's input transformers. In a 3-wire open delta connection, harmonic voltages will comprise L12 and L23 line-to-line voltages.
2. In 3-wire connection schemes, the unbalanced current and phase readings for power factor, active power, and reactive power will be zero, because they have no meaning. Only the total three-phase power values can be used.

2 DNP PROTOCOL

Introduction

DNP3-2000 (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 DNP3-2000 is available in the “Basic 4 Document Set” which can obtain from the DNP USER GROUP. This document describes a LEVEL 2 DNP3-2000 communication protocol implemented between a master station and a slave PM296/RPM096 instrument.

PM296/RPM096 Deviation from Standard

The PM296/RPM096 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 Powermeter receives a request, no further requests can be sent until the Powermeter makes the appropriate response.

DNP Implementation

Overview

The PM296/RPM096, like most devices, retrieves regular analog and binary data from the instrument by executing a directed (non-broadcast) Read request.

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 PM296/RPM096 executes the parameter clear function and demands resets using the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to specified points of the Control-Relay-Output-Block object.

Issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to appropriative points of the Analog-Output-Block object can change the setup parameters. The DNP functions Write, Cold-Restart and Delay Measurement are also supported by the PM296/RPM096. Refer to *Appendix A* for specific requests and responses. *Appendix B* contains the standard DNP Device Profile Document.

The Powermeter 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 Powermeter 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 instrument 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 instrument is in the Local state (is being programmed via the front panel). Cleared when the instrument is in the Remote state.
1	5	Set when the current configuration in the instrument 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 when either setup is reloaded.

Class 0 Response

The PM296/RPM096 DNP implementation supports a wide variety of messages. The most common method to extract DNP static object information is to issue a Read Class-0 request.

There is an option for assigning objects to be polled via Class 0 requests. When this option is used, the Class 0 response includes all static object points specified by the Class 0 Point Assignment Setup Registers (see Table 3-30). By default, the following points are specified by the Class 0 Point Assignment setup: 32 first Analog Input points from Table 3-1, 12 Analog Output points from Table 3-2, 2 Binary Input points represented Status Inputs and 2 Binary Input points represented Relay Status (see Table 3-13).

Object Point Mapping and Event Objects

The PM296/RPM096 has a special mapping mechanism allowing you to map either static object point onto predefined point range. A total of 64 points are available for mapping. DNP static objects can be accessed directly by using the dedicated object point number. DNP event objects can be generated and accessed only through a mapping mechanism.

You can map any of the 64 mapping points to either Analog Input, Binary Input or Binary Counter object point. By default those are factory mapped to the first 64 points of the Analog Input object: 43 points from the Basic Data Registers (see Table 3-1) and last 21 mapping points are filled with the repeated AI:0 from the same table. To re-map these, you must define the required number of points for each allowable DNP object in the DNP Options Setup (see Table 3-8), and then configure each point individually to be polled as an event source, via the DNP Event Setpoints Setup (see Table 3-9). For any mapped static object point, you can enable a corresponding event object point. Note that any changes made to the DNP Options Setup cause a reset of the DNP Event Options Setup points to their defaults.

All event options are disabled by default. Since a mapped static point is configured to create DNP Event objects, events are generated for this point as its value or state changes. Two different scan time rates are used for polling events:

- 200 ms for Binary Counter and Analog Input points;
- 50 ms for Binary Input points.

The memory consumption for keeping events depends on the event objects variation (DNP object size). The maximum buffer size (MBS) per DNP Event Object/ Event Class is 612 byte. The maximum number of events that the instrument can hold can be calculated as follows:

Maximum Events Number = MBS / (DNP Event Object Size + 1)

For example, the instrument can hold up to 51 measures of the 32-bit Analog Change Event With Time Object: (612 / 12) or up to 76 measures of the 8-bit Binary Change Event With Time Object: (612 / 8).

To suppress mapping, explicitly set all registers that specify the number of the Analog Input, Binary Input and/or Binary Counter objects to 0. In this case PM296/RPM096 supports Static Operation Polling only.

DNP Address

The instrument on a DNP link must have a unique address. The *PM296/RPM096* allows one of 256 addresses to be selected. The selectable addresses have a range of 0-255. DNP uses the address 65535 for broadcast function. Note that a broadcast request never generates a DNP response.

Transaction Timing

To allow the master to switch the communication link, the Powermeter minimum response time must be at least 3.5-character time (depending on the baud rate) and at least 5 ms. Table 2-1 shows the actual response time measured at 9600 bps.

Table 2-1 Response Time

Number of Parameters	Typical response time, ms	Maximum response time, ms
1	10	12
5	15	16
10	21	22
43 (Object 30:3)	45	62

Note that Direct-Operate (Direct-Operate-No-Acknowledge) requests for reset/clear registers and setpoint changing are immediately confirmed.

Scaling Analog Input and Analog Input Change Event Objects

With the Analog-Input and Analog-Input-Change-Event objects, any of variations 1 through 4 can be used. Variations specified in the tables in Section 3 show those that should 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 being set to 1 in the flag octet if variation 2 is requested. To avoid over-range errors when variation 2 or 4 is required, a liner scaling may be used (see Section *DNP Options Setup*) to scale 32-bit analog readings to 16-bit Analog Input objects. By default, scaling is disabled.

When scaling is enabled, <u>either analog input requested with variation 2 or 4</u> 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	-	the true reading in engineering units
X	-	the raw input data in the range of DNP_LO – DNP_HI
LO, HI	-	the data low and high scales in engineering units (specified for each Analog-Input point, see Section 3)
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

Suppose you have read a value of 201 for point 3 that contains a current reading (see *Table 3-1*). If your instrument has CT primary current set to 5000 A, then the current high scale is HI = 2×5000 = 10000, and in accordance with the above formula, the current reading in engineering units will be as follows:

$$(201 - 0) \times (10000 - 0)/(32767 - 0) + 0 = 61A$$

3 PM296/RPM096 Registers

Basic Data Registers

These registers are used to retrieve a predefined set of the data measured by the Powermeter. All electrical parameters are averaged values over the specified number of real-time measurements.

Table 3-1 Basic Data Parameters

Object/Var. [5]	Parameter	Object/Point	Unit [2]	Value range [1]
30:3	Voltage L1/L12 [4]	AI:0	V	0 to Vmax
30:3	Voltage L2/L23 [4]	AI:1	V	0 to Vmax
30:3	Voltage L3/L31 [4]	AI:2	V	0 to Vmax
30:3	Current L1	AI:3	A	0 to Imax
30:3	Current L2	AI:4	A	0 to Imax
30:3	Current L3	AI:5	A	0 to Imax
30:3	kW L1	AI:6	kW	-Pmax to Pmax
30:3	kW L2	AI:7	kW	-Pmax to Pmax
30:3	kW L3	AI:8	kW	-Pmax to Pmax
30:3	kvar L1	AI:9	kvar	-Pmax to Pmax
30:3	kvar L2	AI:10	kvar	-Pmax to Pmax
30:3	kvar L3	AI:11	kvar	-Pmax to Pmax
30:3	kVA L1	AI:12	kVA	0 to Pmax
30:3	kVA L2	AI:13	kVA	0 to Pmax
30:3	kVA L3	AI:14	kVA	0 to Pmax
30:4	Power factor L1	AI:15	0.001	-999 to 1000
30:4	Power factor L2	AI:16	0.001	-999 to 1000
30:4	Power factor L3	AI:17	0.001	-999 to 1000
30:4	Total Power factor	AI:18	0.001	-999 to 1000
30:3	Total kW	AI:19	kW	-Pmax to Pmax
30:3	Total kvar	AI:20	kvar	-Pmax to Pmax
30:3	Total kVA	AI:21	kVA	0 to Pmax
30:3	Neutral (unbalanced) current	AI:22	A	0 to Imax
30:4	Frequency	AI:23	0.01Hz	0 to 10000
30:3	Maximum sliding window kW demand [3]	AI:24	kW	0 to Pmax
30:3	Accumulated kW demand	AI:25	kW	0 to Pmax
30:3	Maximum sliding window kVA demand [3]	AI:26	kVA	0 to Pmax
30:3	Accumulated kVA demand	AI:27	kVA	0 to Pmax
30:3	Maximum ampere demand L1	AI:28	A	0 to Imax
30:3	Maximum ampere demand L2	AI:29	A	0 to Imax
30:3	Maximum ampere demand L3	AI:30	A	0 to Imax
30:3	Present sliding window kW demand [3]	AI:31	kW	0 to Pmax
30:3	Present sliding window kVA demand [3]	AI:32	kVA	0 to Pmax
30:4	PF (import) at maximum kVA demand	AI:33		0 to 1000
30:4	Voltage THD L1/L12	AI:34	%	0 to 9999
30:4	Voltage THD L2/L23	AI:35	%	0 to 9999
30:4	Voltage THD L3	AI:36	%	0 to 9999
30:4	Current THD L1	AI:37	%	0 to 9999
30:4	Current THD L2	AI:38	%	0 to 9999
30:4	Current THD L3	AI:39	%	0 to 9999
30:4	Current TDD L1	AI:40	%	0 to 1000
30:4	Current TDD L2	AI:41	%	0 to 1000
30:4	Current TDD L3	AI:42	%	0 to 1000
30:4	DC Voltage [6]	AI:43	0.01V	0 to 999900
20:5	kWh import	BC:0	kWh	0 to 999,999,999
20:5	kWh export	BC:1	kWh	0 to 999,999,999
20:5	kvarh net	BC:2	kvarh	-999,999,999 to 999,999,999
20:5	kVAh	BC:3	kVAh	0 to 999,999,999
20:5	kvarh import	BC:4	kvarh	0 to 999,999,999
20:5	kvarh export	BC:5	kvarh	0 to 999,999,999
20:5	Reserved	BC:6-15		0

AI indicates Analog-Input point, BC - Binary Counter point.

[1] The parameter limits are as follows:

Imax (100% over-range) = 2 × CT primary current [A]
Imax aux (100% over-range) = 2 × Auxiliary CT primary current [A/mA]

Direct wiring (PT Ratio = 1):

Vmax (690 V input option) = 828.0 V
Vmax (120 V input option) = 144.0 V
Pmax = (Imax × Vmax × 3) [kW x 0.001] if wiring mode is 4LN3 or 3LN3
Pmax = (Imax × Vmax × 2) [kW x 0.001] if wiring mode is 4LL3, 3OP2, 3DIR2, 3OP3 or 3LL3

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

Wiring via PTs (PT Ratio > 1):

Vmax (690 V input option) = 144 × PT Ratio [V]
Vmax (120 V input option) = 144 × PT Ratio [V]
Pmax = (Imax × Vmax × 3)/1000 [MW x 0.001] if wiring mode is 4LN3 or 3LN3
Pmax = (Imax × Vmax × 2)/1000 [MW x 0.001] if wiring mode is 4LL3, 3OP2, 3DIR2, 3OP3 or 3LL3

2 When using direct wiring (PT Ratio = 1), voltages are transmitted in 0.1 V units, currents in 0.01 A units, and powers in 0.001 kW/kvar/kVA units. For wiring via PT (PT Ratio > 1), voltages are transmitted in 1V units, currents in 0.01 A units, and powers in 1 kW/kvar/kVA units.

3 To get block interval demand readings, set the number of demand periods equal to 1 (see Table 3-2).

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

5 Variations specified in the table show those that should 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 (see Section 2).

6 Available starting with F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later.

Basic Setup Registers

These registers are used to access the basic setup parameters. In the event that the modulus field is not equal to 1, the value received from the Powermeter must be multiplied by the modulus. When written, such a number should be divided by the modulus. The basic setup registers (Object 40, Variation 2) are assigned to Class 0 by default.

Table 3-2 Basic Setup Registers

Object/ Variation	Parameter	Object/ Point	Range
40:2 (read) 41:2 (write)	Wiring mode [1]	AO:0	0 = 3OP2, 1 = 4LN3, 2 = 3DIR2, 3 = 4LL3, 4 = 3OP3, 5 = 3LN3, 6 = 3LL3
40:1 (read) 41:1 (write)	PT ratio	AO:1	10 to 65000 x 0.1
40:2 (read) 41:2 (write)	CT primary current	AO:2	1 to 10000 A
40:2 (read) 41:2 (write)	Power demand period	AO:3	1,2,5,10,15,20,30,60 min 255 = external synchronization
40:2 (read) 41:2 (write)	Volt/ampere demand period	AO:4	0 to 1800 sec
40:2 (read) 41:2 (write)	Averaging buffer size	AO:5	8, 16, 32
40:2 (read) 41:2 (write)	Reset enable/disable	AO:6	0 = disable, 1 = enable
40:2 (read) 41:2 (write)	Auxiliary CT primary current	AO:7	1 to 10000 A
40:2 (read) 41:2 (write)	The number of demand periods	AO:8	1 to 15
40:2 (read) 41:2 (write)	Thermal demand time constant	AO:9	10 to 36000 x 0.1sec
40:2 (read) 41:2 (write)	The number of pre-event waveform cycles	AO:10	1 to 8
40:2 (read) 41:2 (write)	Nominal frequency	AO:11	50, 60 Hz
40:2 (read) 41:2 (write)	Maximum demand load current	AO:12	0 to 10000 A (0 = CT primary current)
40:1 (read)	Reserved	AO:13	Read as 65535
40:2 (read) 41:2 (write)	DC voltage offset [2]	AO:14	0 to 9999 (default 0)
40:2 (read) 41:2 (write)	DC voltage full scale [2]	AO:15	0 to 9999 (default 20,100 or 300)

Object/ Variation	Parameter	Object/ Point	Range
40:2 (read) 41:2 (write)	The number of waveform cycles to log	AO:16	0 to 2560, 0 = auto-select

AO indicates Analog-Output-Status (Read) and Analog-Output-Block (Write) points.

1 The wiring mode options are as follows:
3OP2 - 3-wire open delta using 2 CTs (2 element)
4LN3 - 4-wire WYE using 3 PTs (3 element), line to neutral voltage readings
3DIR2 - 3-wire direct connection using 2 CTs (2 element)
4LL3 - 4-wire WYE using 3 PTs (3 element), line to line voltage readings
3OP3 - 3-wire open delta using 3 CTs (2 1/2 element)
3LN3 - 4-wire WYE using 2 PTs (2 1/2 element), line to neutral voltage readings
3LL3 - 4-wire WYE using 2 PTs (2 1/2 element), line to line voltage readings

2 To get true DC voltage readings, set the offset to zero and the full scale to 20, 100 or 300 V according to your order.

User Selectable Options Setup

Table 3-3 User Selectable Options Registers

Object/ Variation	Parameter	Object/ Point	Range
40:2 (read) 41:2 (write)	Power calculation mode	AO:92	0 = using reactive power, 1 = using non-active power
40:2 (read) 41:2 (write)	Energy roll value	AO:93	0 = 1×10^4 1 = 1×10^5 2 = 1×10^6 3 = 1×10^7 4 = 1×10^8 5 = 1×10^9
40:2 (read) 41:2 (write)	Phase energy calculation mode	AO:94	0 = disabled, 1 = enabled
40:2 (read) 41:2 (write)	Analog output option	AO:95	0 = none 3 = 0-1 mA 1 = 0-20 mA 4 = ±1 mA 2 = 4-20 mA
40:2 (read) 41:2 (write)	Analog expander output [1]	AO:96	0 = none 3 = 0-1 mA 1 = 0-20 mA 4 = ±1 mA 2 = 4-20 mA
40:2 (read)	Battery option	AO:97	0-battery OFF, 1-battery ON
40:2 (read)	Reserved	AO:98	
40:2 (read)	Thermal demand option	AO:99	0-disabled, 1-enabled

1 Do not enable the analog expander output if the analog expander is not connected to the instrument, otherwise the computer communications will become garbled.

The registers shown in Table 3-4 are used to retrieve the firmware version number and instrument options.

Table 3-4 Firmware and Instrument Option Registers

Object/ Variation	Parameter	Object/ Point	Read/ Write	Range
30:4	Firmware build number [1]	AI:1023	Read	0-65535
30:4	Firmware version number	AI:1024	Read	0-65535
30:3	Instrument option 1	AI:1025	Read	See Table 3-5
30:3	Instrument option 2	AI:1026	Read	See Table 3-5
30:4	Active serial port number	AI:1027	Read	0 = Port 1, 1 = Port 2

AI indicates Analog-Input points. Scaling mechanism is not supported for these registers.

1 Available starting with F/W Versions 2.26.2/2.36.2 and 2.27.1/2.37.1 or later.

Table 3-5 Instrument Options

Options point	Bit number	Description
Options 1 (AI:1025)	0	120V option
	1	690V option
	2-3	Reserved
	4	100% current over-range
	5	Reserved
	6	Analog output 0/4-20 mA
	7	Analog output 0-1 mA
	8	Analog output ±1 mA
	9	Relays option
	10	Digital inputs option
	11	Auxiliary current option
	12-13	Reserved
	14	Analog expander output ±1 mA
	15	Reserved
Options 2 (AI:1026)	0-2	Number of relays - 1
	3-6	Number of digital inputs - 1
	7-8	Number of analog outputs -1
	9-10	Reserved
	11-12	DC voltage input option: 01=20V, 10=100V, 11=300V
	13-15	Reserved

Communications Setup

These registers are used to access the communications setup parameters.

NOTE

When changing the instrument address, baud rate or data format, the new communications parameters will take effect 100 ms after the instrument responds to the master's request.

Table 3-6 Communications Setup Registers

Comm. Port	Object/ Variation	Parameter	Object/ Point	Range	
Port #1	40:2 (read) 41:2 (write)	Protocol	AO:64	0 = ASCII 1 = Modbus RTU 2 = DNP3.0	
	40:2 (read) 41:2 (write)	Interface	AO:65	0 = RS-232, 1 = RS-422, 2 = RS-485	
	40:2 (read) 41:2 (write)	Address	AO:66	0 to 255	
	40:2 (read) 41:2 (write)	Baud rate	AO:67	0 = 110 bps 1 = 300 bps 2 = 600 bps 3 = 1200 bps	4 = 2400 bps 5 = 4800 bps 6 = 9600 bps 7 = 19200 bps
	40:2 (read) 41:2 (write)	Data format	AO:68	1 = 8 bits/no parity 2 = 8 bits/even parity	
	40:2 (read) 41:2 (write)	Incoming flow control (handshaking)	AO:69	0 = no handshaking 1 = software handshaking (XON/XOFF protocol) 2 = hardware handshaking (CTS protocol)	
	40:2 (read) 41:2 (write)	Outgoing flow control (RTS/DTR)	AO:70	0 = RTS signal not used 1 = RTS permanently asserted (DTR mode) 2 = RTS asserted during the transmission	
Port #2	40:2 (read) 41:2 (write)	Protocol	AO:80	0 = ASCII 1 = Modbus RTU 2 = DNP3.0	
	40:2 (read) 41:2 (write)	Interface	AO:81	1 = RS-422, 2 = RS-485	
	40:2 (read) 41:2 (write)	Address	AO:82	0 to 255	
	40:2 (read) 41:2 (write)	Baud rate	AO:83	0 = 110 bps 1 = 300 bps 2 = 600 bps 3 = 1200 bps	4 = 2400 bps 5 = 4800 bps 6 = 9600 bps 7 = 19200 bps
	40:2 (read) 41:2 (write)	Data format	AO:84	1 = 8 bits/no parity 2 = 8 bits/even parity	
	40:1 (read)	Reserved	AO:85	Read as 65535	

AO indicates Analog-Output points.

DNP Options Setup

This section describes the general DNP setup registers related to DNP timing and events processing.

The following static objects generate the corresponding DNP change events:

Table 3-7 DNP Static, Frozen and Event objects

Static Object		Change Object	
Name	**Obj. var.**	**Name**	**Obj. var.**
Single-Bit Binary Input Binary Input With Status	01:1 01:2	Binary Input Change Without Time Binary Input Change With Time	02:1 02:2
32-bit: Binary Counter Binary Counter Without Flag 16-bit: Binary Counter Binary Counter Without Flag	 20:1 20:5 20:2 20:6	32-bit: Counter Change Event Without Time Counter Change Event With Time 16-bit Counter Change Event Without Time Counter Change Event With Time	 22:1 22:5 22:2 22:6
32-bit: Frozen Counter Frozen Counter Without Flag Frozen Counter With Time of Freeze 16-bit: Frozen Counter Frozen Counter Without Flag Frozen Counter With Time of Freeze	 21:1 21:9 21:5 21:2 21:10 21:6		
32-bit: Analog Input Analog Input Without Flag 16-bit: Analog Input Analog Input Without Flag	 30:1 30:3 30:2 30:4	32-bit: Analog Change Event Without Time Analog Change Event With Time 16-bit: Analog Change Event Without Time Analog Change Event With Time	 32:1 32:3 32:2 32:4

The following registers are used to access the DNP Options Setup parameters. The value range of points 32 to 41 reflects the elements number of the corresponding DNP object/variation list described above. For instance, the default value for the frozen Binary Counter is the Frozen Counter Without Flag obj21var10.

Table 3-8 DNP Options Setup Registers

Object/ Variation	Parameter	Object/ Point	Range
40:2 (read) 41:2 (write)	Binary Input Static	AO:32	0 to 1, 0 by default
40:2 (read) 41:2 (write)	Binary Input Change	AO:33	0 to 1, 1 by default
40:2 (read) 41:2 (write)	Binary Counter	AO:34	0 to 3, 3 by default
40:2 (read) 41:2 (write)	Frozen Binary Counter	AO:35	0 to 5, 4 by default
40:2 (read) 41:2 (write)	Reserved	AO:36	
40:2 (read) 41:2 (write)	Binary Counter Change Event	AO:37	0 to 3, 2 by default
40:2 (read) 41:2 (write)	Analog Input	AO:38	0 to 3, 3 by default
40:2 (read) 41:2 (write)	Reserved	AO:39	
40:2 (read) 41:2 (write)	Reserved	AO:40	
40:2 (read) 41:2 (write)	Analog Input Change Event	AO:41	0 to 3, 2 by default
40:1 (read)	Reserved	AO:42-43	Read as 65535
40:2 (read) 41:2 (write)	DNP Scaling	AO:44	0 = scaling is OFF, 1 = scaling is ON
40:2 (read) 41:2 (write)	Number mapped points for the Analog Input objects [1]	AO:45	0 to 64 (default 64/40/32) [2]
40:2 (read) 41:2 (write)	Number mapped points for the Binary Input objects [1]	AO:46	0 to 64 (default 0) [2]
40:2 (read) 41:2 (write)	Number mapped points for the Binary Counter objects [1]	AO:47	0 to 64 (default 0) [2]

Object/ Variation	Parameter	Object/ Point	Range
40:2 (read) 41:2 (write)	Select/Operate Timeout	AO:48	2 to 30 seconds (the default 10 seconds)
40:2 (read) 41:2 (write)	Multi Fragment Interval	AO:49	50 to 500 ms (the default 50 ms)
40:2 (read)	Reserved	AO:50-52	Read as 65535
40:2 (read) 41:2 (write)	Time Sync Period	AO:53	1 to 86400 seconds (the default 86400 sec)

AO indicates Analog-Output points.

1 The sum of the mapped points cannot exceed the total number of the DNP map space. If the total number of the mapped points equals 0, the report-by-exception mode is not supported.

2 The total number of the event setpoints is limited to:
64 with F/W 2.26.2/2.36.2 or later,
40 with F/W 2.27.2/2.37.2 or later,
32 with older F/W revisions.

The Analog Input variation defines the default variation of the Analog Input object that is selected when no specific variation is requested for the Analog Input object by a master station, with the Analog Input object requests using Qualifier code 06 (variation 0). By default it is set to the 16-bit Analog Input object without flag (object 30, variation 4).

The DNP Scaling is used to control the scaling mechanism. The scaling is turned ON if this parameter is set to 1. By default this parameter is set to 0 and scaling is OFF. Choosing 32-bit Analog Input objects (object 30, variation 1, 3) disables this parameter.

The DNP map space contains 64 event definition register groups (see Table 3-9), which may describe up to 64 points of the static objects: Analog Input, Binary Input and Binary Counter. The points 0 to 42 of the Analog Input object (see Table 3-1) are mapped by the default. The default map does not contain the Binary Input and Binary Counter objects. To re-map the current setting, the user must write new values into points 45-47 of the Analog Output object. If the new values of these parameters are accepted by PM296/RPM096, the new content of the event definition register groups is created automatically. All registers of this group are described below (see Table 3-9). Note here that for every mapped point the object type and sequence number from the range 0 to (number of points - 1) are defined automatically. The type of object cannot be changed manually and is defined from the DNP Options Setup Registers only.

The Select Before Operate command causes the PM296/RPM096 to start a timer. The Operate command must be received correctly before the value specified by the Select/Operate Timeout parameter expires.

The PM296/RPM096 requests time syncs when the time specified by the Time Sync Period parameter has elapsed. The bit 4 of the first octet of the internal indication word is set. The master synchronizes the time by writing the DNP Time and Date object to the meter.

DNP Event Setpoints Setup

These registers are used to define the DNP Event Setpoints for generating events.

Table 3-9 DNP Event Setpoints Registers

Event No.	Object/Var	Register contents	Object/Point	Range/scale
#0	40:2(read) 41:2(write)	DNP point number	AO:896	Any actual DNP point number of the selected object [1]
	40:1(read) 41:1(write)	Dead band	AO:897	0 to 4.3×10^9
	40:2(read) 41:2(write)	Control field	AO:898	See Table 3-10
	…	…	…	…
#63 [2]	40:2(read) 41:2(write)	DNP point number	AO:1085	Any actual DNP point number of the selected object [1]
	40:2(read) 41:2(write)	Threshold/Deadband	AO:1086	-2147483848 to 2147483647 (not used for BI change events)
	40:2(read) 41:2(write)	Control field	AO:1087	See Table 3-10

1 Analog Input (AI), Binary Input (BI) or Binary Counter (BC).

2 The total number of the event setpoints is limited to:
64 with F/W 2.26.2/2.36.2 or later,
40 with F/W 2.27.2/2.37.2 or later,
32 with older F/W revisions.

Table 3-10 DNP Event Control Field

Bits	Name	Range
0-1	DNP object	0 = none, 1 = AI change event, 2= BI change event, 3= BC change event
2	Object change event scan	0 = disabled, 1 = enabled
3-4	Not used	
5-6	DNP event poll class	0 = Class 1, 1 = Class 2, 2 = Class 3
7	Event log on an event [1,2]	0 = disabled, 1 = enabled
8-9	Threshold/Deadband relation	0 = Delta, 1 = More than (over threshold) [1], 3 = Less than (under threshold) [1]
10-15	Not used	

1 Available with F/W Versions 2.26.2/2.36.2 and 2.27.2/2.37.2 or later.

2 The source of the DNP events recorded to the device Event log is identified as the general Setpoint #17.

Either an operating threshold, or deadband should be specified to generate events for numeric (AI and BC) objects, using one of the three allowable relations:

1. 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.
2. 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.
3. 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.

A hysteresis for the point return threshold is 0.05 Hz for frequency and 2% of the operating threshold for all other points.

The scan time for binary input change events is 50 ms with a timestamp precision at +/-10 ms. The scan time for analog input and binary counter change events is 200 ms.

Freeze Requests on Binary Counter Objects

Acceptable object variation and qualifier combinations included in the device response are specified in Table 3-7. The Immediate Freeze, Immediate Freeze-No Acknowledgement, Freeze and Clear, Freeze and Clear-No Acknowledgement DNP commands can be applied to all Binary Counters objects supported by the PM296/RPM096. These registers are used to access the Frozen Binary Counters.

Table 3-11 Frozen Binary Counters

Object/Variation (See Table 3-7)	Parameter	Object/Point	Unit	Value range
Total energies				
21:10	kWh import	FBC:0	kWh	0 to 999,999,999
21:10	kWh export	FBC:1	kWh	0 to 999,999,999
21:10	kvarh net	FBC:2	kvarh	-999,999,999 to 999,999,999
21:10	kVAh total	FBC:3	kVAh	0 to 999,999,999
21:10	kvarh import [1]	FBC:4	kvarh	0 to 999,999,999
21:10	kvarh export [1]	FBC:5	kvarh	0 to 999,999,999
21:10	Reserved	FBC:6-15		0
Pulse counters				
21:10	Pulse counter #1	FBC:35328	n/a	0 to 10^9-1
21:10	Pulse counter #2	FBC:35329	n/a	0 to 10^9-1
21:10	Pulse counter #3	FBC:35330	n/a	0 to 10^9-1
21:10	Pulse counter #4	FBC:35331	n/a	0 to 10^9-1
21:10	Pulse counter #5	FBC:35332	n/a	0 to 10^9-1
21:10	Pulse counter #6	FBC:35333	n/a	0 to 10^9-1
21:10	Pulse counter #7	FBC:35334	n/a	0 to 10^9-1
21:10	Pulse counter #8	FBC:35335	n/a	0 to 10^9-1
21:10	Pulse counter #9	FBC:35336	n/a	0 to 10^9-1
21:10	Pulse counter #10	FBC:35337	n/a	0 to 10^9-1
21:10	Pulse counter #11	FBC:35338	n/a	0 to 10^9-1

Object/Variation (See Table 3-7)	Parameter	Object/Point	Unit	Value range
21:10	Pulse counter #12	FBC:35339	n/a	0 to 10^9-1
21:10	Pulse counter #13	FBC:35340	n/a	0 to 10^9-1
21:10	Pulse counter #14	FBC:35341	n/a	0 to 10^9-1
21:10	Pulse counter #15	FBC:35342	n/a	0 to 10^9-1
21:10	Pulse counter #16	FBC:35343	n/a	0 to 10^9-1
Total energies				
21:10	kWh import	FBC:38656	kWh	0 to 999,999,999
21:10	kWh export	FBC:38657	kWh	0 to 999,999,999
21:10	kWh net	FBC:38658	kWh	-10^9+1 to10^9-1
21:10	kWh total	FBC:38659	kWh	0 to 999,999,999
21:10	kvarh import	FBC:38660	kvarh	0 to 999,999,999
21:10	kvarh export	FBC:38661	kvarh	0 to 999,999,999
21:10	kvarh net	FBC:38662	kWh	-10^9+1 to 10^9-1
21:10	kvarh total	FBC:38663	kvarh	0 to 999,999,999
21:10	kVAh total	FBC:38664	kVAh	0 to 999,999,999

[1] Available starting with F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later.

FBC - indicates Frozen-Binary-Counter points.

Warning

Any attempt to issue a freeze and clear (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 specified in this manual to be reset to zero.

Resetting Energy, Demands, Counters and Min/Max Log

The energy value can be reset to zero by issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command using the Control-Relay-Output-Block object to point 0. The request must use the operation Pulse-On. Issuing the same parameters and Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to points 1-3 can reset the maximum demands.

Table 3-12 Reset/Clear Registers

Object/ Var.	Register function	Object/ Point	Read/ Write	Description
10:2	Clear total energy registers	BO:0	Read	Return zero
12:1		CROB:0	Write	PULSE ON
10:2	Clear total maximum demand registers (all demands)	BO:1	Read	Return zero
12:1		CROB:1	Write	PULSE ON
10:2	Clear power demands	BO:2	Read	Return zero
12:1		CROB:2	Write	PULSE ON
10:2	Clear volt/ampere demands	BO:3	Read	Return zero
12:1		CROB:3	Write	PULSE ON
10:2	Reserved	BO:4-11	Read	Return zero
12:1		CROB:4-11	Write	
10:2	Clear pulse counters (all counters)	BO:12	Read	Return zero
12:1		CROB:12	Write	PULSE ON
10:2	Clear pulse counters 1-8	BO:13-20	Read	Return zero
12:1		CROB:13-20	Write	PULSE ON
10:2	Clear Min/Max log	BO:21	Read	Return zero
12:1		CROB:21	Write	PULSE ON
10:2	Reserved	BO:22-29	Read	Return zero
12:1		CROB:22-29	Write	PULSE ON
10:2	Clear pulse counters 9-16	BO:30-37	Read	Return zero
12:1		CROB:30-37	Write	PULSE ON

BO indicates Binary Output Status. CROB indicates Control-Relay-Output-Block point.

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 for the following:
  - 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) will be 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) will be returned if the Control Point was out of control (for instance, reset is disabled via Basic Setup).

Issuing the same parameters and Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to point 12-16 can clear the Pulse Counters.

Issuing the same parameters and Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to point 21 can reset the Min/Max log.

Status Registers

These registers are used to retrieve the status of digital input/output points (hardware or software) from the instrument.

Table 3-13 Status Registers (Read)

Object/Var.	Description	Object/Point	Bit meaning
01:1	Relay #1 status	BI:0	0 = released, 1 = operated
01:1	Relay #2 status	BI:1	0 = released, 1 = operated
01:1	Relay #3 status	BI:2	0 = released, 1 = operated
01:1	Relay #4 status	BI:3	0 = released, 1 = operated
01:1	Relay #5 status	BI:4	0 = released, 1 = operated
01:1	Relay #6 status	BI:5	0 = released, 1 = operated
01:1	Reserved	BI:6-15	Not used (permanently set to 0)
01:1	Status input #1	BI:16	0 = open, 1 = closed
01:1	Status input #2	BI:17	0 = open, 1 = closed
01:1	Status input #3	BI:18	0 = open, 1 = closed
01:1	Status input #4	BI:19	0 = open, 1 = closed
01:1	Status input #5	BI:20	0 = open, 1 = closed
01:1	Status input #6	BI:21	0 = open, 1 = closed
01:1	Status input #7	BI:22	0 = open, 1 = closed
01:1	Status input #8	BI:23	0 = open, 1 = closed
01:1	Status input #9	BI:24	0 = open, 1 = closed
01:1	Status input #10	BI:25	0 = open, 1 = closed
01:1	Status input #11	BI:26	0 = open, 1 = closed
01:1	Status input #12	BI:27	0 = open, 1 = closed
01:1	Reserved	BI:28-31	Not used (permanently set to 0)
01:1	Reserved	BI:32-47	Not used (permanently set to 0)
01:1	Battery status	BI:48	0 = low, 1 = normal
	Reserved	BI:49-63	Not used (permanently set to 0)

BI indicates Single-Bit Binary-Input points (Read).

Alarm Status Registers

These registers are used to retrieve the status alarm parameters from the instrument.

NOTE

The PM296/RPM096 provides a self-check alarm register.

The self-check alarm points indicate possible problems with the instrument 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 (or SBO/Operate or Direct-Operate-No-Acknowledge) command using the Control-Relay-Output-Block object (with the code operation Latch-Off) to points from range 64 to 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.

Table 3-14 Alarm Status Registers

Object/Var.	Description	Object/Point	Bit meaning
	Self-check Alarm Register		1 = alarm has been asserted 0 = alarm hasn't been asserted
10:2(read) 12:1(write)	Reserved	B0:64 CROB:64	Reading returns 0

Object/Var.	Description	Object/Point	Bit meaning
10:2(read) 12:1(write)	ROM error	B0:65 CROB:65	
10:2(read) 12:1(write)	RAM error	B0:66 CROB:66	
10:2(read) 12:1(write)	Watchdog timer reset	B0:67 CROB:67	
10:2(read) 12:1(write)	Sampling failure	B0:68 CROB:68	
10:2(read) 12:1(write)	Out of control trap	B0 :69 CROB:69	
10:2(read) 12:1(write)	Reserved	BI :70 CROB:70	Reading returns 0
10:2(read) 12:1(write)	Timing failure	B0 :71 CROB:71	
10:2(read) 12:1(write)	Loss of power (power up)	B0:72 CROB:72	
10:2(read) 12:1(write)	External reset (Cold Restart) [1]	B0:73 CROB:73	
10:2(read) 12:1(write)	Configuration corrupted [1]	B0:74 CROB:74	
10:2(read) 12:1(write)	Time synchronization required [1]	B0:75 CROB:75	
10:2(read) 12:1(write)	Low battery [2]	B0:76 CROB:76	
10:2(read) 12:1(write)	Reserved	77-79 77-79	Reading returns 0

BO indicates Binary-Output-Status (Read) or Control-Relay-Output Block (Write) points.

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

2 Available starting with F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later.

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) 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 if an invalid Code was present in the command.

Extended Data Registers

These registers are used to retrieve any data measured by the instrument. A list of the extended data parameters, their points and value ranges are shown in Table 3-15.

Table 3-15 Extended Data Registers

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:4	None	AI:32768	n/a	0	
Special inputs					
30:4	Voltage disturbance [6]	BI:33024	%	0 to 100	
30:4	Phase rotation	BI:33025		0=ERR, 1=POS, 2=NEG	
Status inputs					
01:1	Status input #1	BI:34304	n/a	0/1	
01:1	Status input #2	BI:34305	n/a	0/1	
01:1	Status input #3	BI:34306	n/a	0/1	
01:1	Status input #4	BI:34307	n/a	0/1	
01:1	Status input #5	BI:34308	n/a	0/1	
01:1	Status input #6	BI:34309	n/a	0/1	
01:1	Status input #7	BI:34310	n/a	0/1	
01:1	Status input #8	BI:34311	n/a	0/1	
01:1	Status input #9	BI:34312	n/a	0/1	
01:1	Status input #10	BI:34313	n/a	0/1	
01:1	Status input #11	BI:34314	n/a	0/1	
01:1	Status input #12	BI:34315	n/a	0/1	

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
01:1	Reserved	BI:34316-34319	n/a	0/0	
Relay status					
01:1	Relay #1 status	BI:34816	n/a	0/1	
01:1	Relay #2 status	BI:34817	n/a	0/1	
01:1	Relay #3 status	BI:34818	n/a	0/1	
01:1	Relay #4 status	BI:34819	n/a	0/1	
01:1	Relay #5 status	BI:34820	n/a	0/1	
01:1	Relay #6 status	BI:34821	n/a	0/1	
01:1	Reserved	BI:34822-34831	n/a	0/0	
Pulse counters					
20:5	Pulse counter #1	BC:35328	n/a	0 to 10^9-1	
20:5	Pulse counter #2	BC:35329	n/a	0 to 10^9-1	
20:5	Pulse counter #3	BC:35330	n/a	0 to 10^9-1	
20:5	Pulse counter #4	BC:35331	n/a	0 to 10^9-1	
20:5	Pulse counter #5	BC:35332	n/a	0 to 10^9-1	
20:5	Pulse counter #6	BC:35333	n/a	0 to 10^9-1	
20:5	Pulse counter #7	BC:35334	n/a	0 to 10^9-1	
20:5	Pulse counter #8	BC:35335	n/a	0 to 10^9-1	
20:5	Pulse counter #9	BC:35336	n/a	0 to 10^9-1	
20:5	Pulse counter #10	BC:35337	n/a	0 to 10^9-1	
20:5	Pulse counter #11	BC:35338	n/a	0 to 10^9-1	
20:5	Pulse counter #12	BC:35339	n/a	0 to 10^9-1	
20:5	Pulse counter #13	BC:35340	n/a	0 to 10^9-1	
20:5	Pulse counter #14	BC:35341	n/a	0 to 10^9-1	
20:5	Pulse counter #15	BC:35342	n/a	0 to 10^9-1	
20:5	Pulse counter #16	BC:35343	n/a	0 to 10^9-1	
Real-time values per phase					
30:3	Voltage L1/L12 [5]	AI:35840	0.1V/1V	0 to Vmax	
30:3	Voltage L2/L23 [5]	AI:35841	0.1V/1V	0 to Vmax	
30:3	Voltage L3/L31 [5]	AI:35842	0.1V/1V	0 to Vmax	
30:3	Current L1	AI:35843	0.01A/1A	0 to Imax	
30:3	Current L2	AI:35844	0.01A/1A	0 to Imax	
30:3	Current L3	AI:35845	0.01A/1A	0 to Imax	
30:3	kW L1	AI:35846	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L2	AI:35847	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L3	AI:35848	0.001kW/1kW	-Pmax to Pmax	
30:3	kvar L1	AI:35849	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L2	AI:35850	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L3	AI:35851	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kVA L1	AI:35852	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L2	AI:35853	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L3	AI:35854	0.001kVA/1kVA	0 to Pmax	
30:4	Power factor L1	AI:35855	0.001	-999 to 1000	×0.001
30:4	Power factor L2	AI:35856	0.001	-999 to 1000	×0.001
30:4	Power factor L3	AI:35857	0.001	-999 to 1000	×0.001
30:4	Voltage THD L1/L12	AI:35858	0.1%	0 to 9999	×0.1
30:4	Voltage THD L2/L23	AI:35859	0.1%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:35860	0.1%	0 to 9999	×0.1
30:4	Current THD L1	AI:35861	0.1%	0 to 9999	×0.1
30:4	Current THD L2	AI:35862	0.1%	0 to 9999	×0.1
30:4	Current THD L3	AI:35863	0.1%	0 to 9999	×0.1
30:4	K-Factor L1	AI:35864	0.1	10 to 9999	×0.1
30:4	K-Factor L2	AI:35865	0.1	10 to 9999	×0.1
30:4	K-Factor L3	AI:35866	0.1	10 to 9999	×0.1
30:4	Current TDD L1	AI:35867	0.1%	0 to 1000	×0.1
30:4	Current TDD L2	AI:35868	0.1%	0 to 1000	×0.1
30:4	Current TDD L3	AI:35869	0.1%	0 to 1000	×0.1
30:3	Voltage L12	AI:35870	0.1V/1V	0 to Vmax	
30:3	Voltage L23	AI:35871	0.1V/1V	0 to Vmax	
30:3	Voltage L31	AI:35872	0.1V/1V	0 to Vmax	
Real-time low values on any phase					
30:3	Low voltage [5]	AI:36096	0.1V/1V	0 to Vmax	
30:3	Low current	AI:36097	0.01A/1A	0 to Imax	
30:3	Low kW	AI:36098	0.001kW/1kW	-Pmax to Pmax	
30:3	Low kvar	AI:36099	0.001kvar/1kvar	-Pmax to Pmax	

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:3	Low kVA	AI:36100	0.001kvar/1kvar	-Pmax to Pmax	
30:4	Low PF Lag	AI:36101	0.001	0 to 1000	×0.001
30:4	Low PF Lead	AI:36102	0.001	0 to 1000	×0.001
30:4	Low voltage THD	AI:36103	0.1%	0 to 9999	×0.1
30:4	Low current THD	AI:36104	0.1%	0 to 9999	×0.1
30:4	Low K-Factor	AI:36105	0.1	10 to 9999	×0.1
30:4	Low current TDD	AI:36106	0.1%	0 to 1000	×0.1
30:4	Low L-L voltage	AI:36107	0.1V/1V	0 to Vmax	
Real-time high values on any phase					
30:3	High voltage [5]	AI:36352	0.1V/1V	0 to Vmax	
30:3	High current	AI:36353	0.01A/1A	0 to Imax	
30:3	High kW	AI:36354	0.001kW/1kW	-Pmax to Pmax	
30:3	High kvar	AI:36355	0.001kvar/1kvar	-Pmax to Pmax	
30:3	High kVA	AI:36356	0.001kvar/1kvar	-Pmax to Pmax	
30:4	High PF Lag	AI:36357	0.001	0 to 1000	×0.001
30:4	High PF Lead	AI:36358	0.001	0 to 1000	×0.001
30:4	High voltage THD	AI:36359	0.1%	0 to 9999	×0.1
30:4	High current THD	AI:36360	0.1%	0 to 9999	×0.1
30:4	High K-Factor	AI:36361	0.1	10 to 9999	×0.1
30:4	High current TDD	AI:36362	0.1%	0 to 1000	×0.1
30:4	High L-L voltage	AI:36363	0.1V/1V	0 to Vmax	
Real-time total values					
30:3	Total kW	AI:36608	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar	AI:36609	0.001kvar/1kvar	-Pmax to Pmax	
30:3	Total kVA	AI:36610	0.001kVA/1kVA	0 to Pmax	
30:4	Total PF	AI:36611	0.001	-999 to 1000	×0.001
30:4	Total PF Lag	AI:36612	0.001	0 to 1000	×0.001
30:4	Total PF Lead	AI:36613	0.001	0 to 1000	×0.001
30:3	Total kW import	AI:36614	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kW export	AI:36615	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar import	AI:36616	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar export	AI:36617	0.001kW/1kW	-Pmax to Pmax	
30:3	3-phase average voltage [5]	AI:36618	0.1V/1V	0 to Vmax	
30:3	3-phase average L-L voltage	AI:36619	0.1V/1V	0 to Vmax	
30:3	3-phase average current	AI:36620	0.01A/1A	0 to Imax	
Real-time auxiliary values					
30:3	Auxiliary current	AI:36864	0.01A/mA	0 to Imax aux	
30:3	Neutral current	AI:36865	0.01A	0 to Imax	
30:4	Frequency [3]	AI:36866	0.01Hz	0 to 10000	×0.01
30:4	Voltage unbalance	AI:36867	1%	0 to 300	
30:4	Current unbalance	AI:36868	1%	0 to 300	×0.01
30:3	DC voltage	AI:36869	0.01V	0 to999900	×0.01
Average values per phase					
30:3	Voltage L1/L12 [5]	AI:37120	0.1V/1V	0 to Vmax	
30:3	Voltage L2/L23 [5]	AI:37121	0.1V/1V	0 to Vmax	
30:3	Voltage L3/L31 [5]	AI:37122	0.1V/1V	0 to Vmax	
30:3	Current L1	AI:37123	0.01A/1A	0 to Imax	
30:3	Current L2	AI:37124	0.01A/1A	0 to Imax	
30:3	Current L3	AI:37125	0.01A/1A	0 to Imax	
30:3	kW L1	AI:37126	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L2	AI:37127	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L3	AI:37128	0.001kW/1kW	-Pmax to Pmax	
30:3	kvar L1	AI:37129	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L2	AI:37130	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L3	AI:37131	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kVA L1	AI:37132	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L2	AI:37133	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L3	AI:37134	0.001kVA/1kVA	0 to Pmax	
30:4	Power factor L1	AI:37135	0.001	-999 to 1000	×0.001
30:4	Power factor L2	AI:37136	0.001	-999 to 1000	×0.001
30:4	Power factor L3	AI:37137	0.001	-999 to 1000	×0.001
30:4	Voltage THD L1/L12	AI:37138	0.1%	0 to 9999	×0.1
30:4	Voltage THD L2/L23	AI:37139	0.1%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:37140	0.1%	0 to 9999	×0.1
30:4	Current THD L1	AI:37141	0.1%	0 to 9999	×0.1
30:4	Current THD L2	AI:37142	0.1%	0 to 9999	×0.1

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:4	Current THD L3	AI:37143	0.1%	0 to 9999	×0.1
30:4	K-Factor L1	AI:37144	0.1	10 to 9999	×0.1
30:4	K-Factor L2	AI:37145	0.1	10 to 9999	×0.1
30:4	K-Factor L3	AI:37146	0.1	10 to 9999	×0.1
30:4	Current TDD L1	AI:37147	0.1%	0 to 1000	×0.1
30:4	Current TDD L2	AI:37148	0.1%	0 to 1000	×0.1
30:4	Current TDD L3	AI:37149	0.1%	0 to 1000	×0.1
30:3	Voltage L12	AI:37150	0.1V/1V	0 to Vmax	
30:3	Voltage L23	AI:37151	0.1V/1V	0 to Vmax	
30:3	Voltage L31	AI:37152	0.1V/1V	0 to Vmax	
Average low values on any phase					
30:3	Low voltage [5]	AI:37376	0.1V/1V	0 to Vmax	
30:3	Low current	AI:37377	0.01A/1A	0 to Imax	
30:3	Low kW	AI:37378	0.001kW/1kW	-Pmax to Pmax	
30:3	Low kvar	AI:37379	0.001kvar/1kvar	-Pmax to Pmax	
30:3	Low kVA	AI:37380	0.001kvar/1kvar	-Pmax to Pmax	
30:4	Low PF Lag	AI:37381	0.001	0 to 1000	×0.001
30:4	Low PF Lead	AI:37382	0.001	0 to 1000	×0.001
30:4	Low voltage THD	AI:37383	0.1%	0 to 9999	×0.1
30:4	Low current THD	AI:37384	0.1%	0 to 9999	×0.1
30:4	Low K-Factor	AI:37385	0.1	10 to 9999	×0.1
30:4	Low current TDD	AI:37386	0.1%	0 to 1000	×0.1
30:4	Low L-L voltage	AI:37387	0.1V/1V	0 to Vmax	
Average high values on any phase					
30:3	High voltage [5]	AI:37632	0.1V/1V	0 to Vmax	
30:3	High current	AI:37633	0.01A/1A	0 to Imax	
30:3	High kW	AI:37634	0.001kW/1kW	-Pmax to Pmax	
30:3	High kvar	AI:37635	0.001kvar/1kvar	-Pmax to Pmax	
30:3	High kVA	AI:37636	0.001kvar/1kvar	-Pmax to Pmax	
30:4	High PF Lag	AI:37637	0.001	0 to 1000	×0.001
30:4	High PF Lead	AI:37638	0.001	0 to 1000	×0.001
30:4	High voltage THD	AI:37639	0.1%	0 to 9999	×0.1
30:4	High current THD	AI:37640	0.1%	0 to 9999	×0.1
30:4	High K-Factor	AI:37641	0.1	10 to 9999	×0.1
30:4	High current TDD	AI:37642	0.1%	0 to 1000	×0.1
30:4	High L-L voltage	AI:37643	0.1V/1V	0 to Vmax	
Average total values					
30:3	Total kW	AI:37888	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar	AI:37889	0.001kvar/1kvar	-Pmax to Pmax	
30:3	Total kVA	AI:37890	0.001kVA/1kVA	0 to Pmax	
30:4	Total PF	AI:37891	0.001	-999 to 1000	×0.001
30:4	Total PF Lag	AI:37892	0.001	0 to 1000	×0.001
30:4	Total PF Lead	AI:37893	0.001	0 to 1000	×0.001
30:3	Total kW import	AI:37894	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kW export	AI:37895	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar import	AI:37896	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar export	AI:37897	0.001kW/1kW	-Pmax to Pmax	
30:3	3-phase average voltage [5]	AI:37898	0.1V/1V	0 to Vmax	
30:3	3-phase average L-L voltage	AI:37899	0.1V/1V	0 to Vmax	
30:3	3-phase average current	AI:37900	0.01A/1A	0 to Imax	
Average auxiliary values					
30:3	Auxiliary current	AI:38144	0.01A/mA	0 to Imax aux	
30:3	Neutral current	AI:38145	0.01A	0 to Imax	
30:4	Frequency [3]	AI:38146	0.01Hz	0 to 10000	×0.01
30:4	Voltage unbalance	AI:38147	1%	0 to 300	
30:4	Current unbalance	AI:38148	1%	0 to 300	×0.01
30:3	DC voltage	AI:38149	0.01V	0 to 999900	×0.01
Present demands					
30:3	Volt demand L1/L12 [5]	AI:38400	0.1V/1V	0 to Vmax	
30:3	Volt demand L2/L23 [5]	AI:38401	0.1V/1V	0 to Vmax	
30:3	Volt demand L3/L31 [5]	AI:38402	0.1V/1V	0 to Vmax	
30:3	Ampere Demand L1	AI:38403	0.01A	0 to Imax	
30:3	Ampere Demand L2	AI:38404	0.01A	0 to Imax	
30:3	Ampere Demand L3	AI:38405	0.01A	0 to Imax	
30:3	kW import block demand	AI:38406	0.001kW/1kW	0 to Pmax	
30:3	kvar import block demand	AI:38407	0.001kvar/1kvar	0 to Pmax	

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:3	kVA block demand	AI:38408	0.001kVA/1kVA	0 to Pmax	
30:3	kW import demand sliding window	AI:38409	0.001kW/1kW	0 to Pmax	
30:3	kvar import demand sliding window	AI:38410	0.001kvar/1kar	0 to Pmax	
30:3	kVA demand sliding window	AI:38411	0.001kVA/1kVA	0 to Pmax	
30:4	kW import thermal demand	AI:38412	0.001kW/1kW	0 to Pmax	
30:4	kvar import thermal demand	AI:38413	0.001kvar/1kar	0 to Pmax	
30:4	kVA thermal demand	AI:38414	0.001kVA/1kVA	0 to Pmax	
30:3	kW import accumulated demand	AI:38415	0.001kW/1kW	0 to Pmax	
30:3	kvar import accumulated demand	AI:38416	0.001kvar/1kvar	0 to Pmax	
30:3	kVA accumulated demand	AI:38417	0.001kVA/1kVA	0 to Pmax	
30:3	kW import predicted sliding window demand	AI:38418	0.001kW/1kW	0 to Pmax	
30:3	kvar import predicted sliding window demand	AI:38419	0.001kvar/1kvar	0 to Pmax	
30:3	kVA predicted sliding window demand	AI:38420	0.001kVA/1kVA	0 to Pmax	
30:4	PF (import) at maximum sliding window kVA demand	AI:38421	0.001	0 to 1000	×0.001
30:3	kW export block demand	AI:38422	0.001kW/1kW	0 to Pmax	
30:3	kvar export block demand	AI:38423	0.001kvar/1kvar	0 to Pmax	
30:3	kW export sliding window demand	AI:38424	0.001kW/1kW	0 to Pmax	
30:3	kvar export sliding window demand	AI:38425	0.001kvar/1kvar	0 to Pmax	
30:3	kW export accumulated demand	AI:38426	0.001kW/1kW	0 to Pmax	
30:3	kvar export accumulated demand	AI:38427	0.001kvar/1kvar	0 to Pmax	
30:3	kW export predicted sliding window demand	AI:38428	0.001kW/1kW	0 to Pmax	
30:3	kvar export predicted sliding window demand	AI:38429	0.001kvar/1kvar	0 to Pmax	
30:3	kW export thermal demand	AI:38428	0.001kW/1kW	0 to Pmax	
30:3	kvar export thermal demand	AI:38429	0.001kvar/1kvar	0 to Pmax	
Total energies					
20:5	kWh import	BC:38656	kWh	0 to 999,999,999	
20:5	kWh export	BC:38657	kWh	0 to 999,999,999	
20:5	kWh net	BC:38658	kWh	-10^9+1to10^9-1	
20:5	kWh total	BC:38659	kWh	0 to 999,999,999	
20:5	kvarh import	BC:38660	kvarh	0 to 999,999,999	
20:5	kvarh export	BC:38661	kvarh	0 to 999,999,999	
20:5	kvarh net	BC:38662	kWh	$-10^9+1$to 10^9-1	
20:5	kvarh total	BC:38663	kvarh	0 to 999,999,999	
20:5	kVAh total	BC:38664	kVAh	0 to 999,999,999	
Minimum real-time values per phase (M)					
30:3	Voltage L1/L12 [5]	AI:44032	0.1V/1V	0 to Vmax	
30:3	Voltage L2/L23 [5]	AI:44033	0.1V/1V	0 to Vmax	
30:3	Voltage L3/L31 [5]	AI:44034	0.1V/1V	0 to Vmax	
30:3	Current L1	AI:44035	0.01A/1A	0 to Imax	
30:3	Current L2	AI:44036	0.01A/1A	0 to Imax	
30:3	Current L3	AI:44037	0.01A/1A	0 to Imax	
30:3	kW L1	AI:44038	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L2	AI:44039	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L3	AI:44040	0.001kW/1kW	-Pmax to Pmax	
30:3	kvar L1	AI:44041	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L2	AI:44042	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L3	AI:44043	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kVA L1	AI:44044	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L2	AI:44045	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L3	AI:44046	0.001kVA/1kVA	0 to Pmax	
30:4	Power factor L1	AI:44047	0.001	-999 to 1000	×0.001
30:4	Power factor L2	AI:44048	0.001	-999 to 1000	×0.001
30:4	Power factor L3	AI:44049	0.001	-999 to 1000	×0.001
30:4	Voltage THD L1/L12	AI:44050	0.1%	0 to 9999	×0.1
30:4	Voltage THD L2/L23	AI:44051	0.1%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:44052	0.1%	0 to 9999	×0.1
30:4	Current THD L1	AI:44053	0.1%	0 to 9999	×0.1
30:4	Current THD L2	AI:44054	0.1%	0 to 9999	×0.1
30:4	Current THD L3	AI:44055	0.1%	0 to 9999	×0.1
30:4	K-Factor L1	AI:44056	0.1	10 to 9999	×0.1
30:4	K-Factor L2	AI:44057	0.1	10 to 9999	×0.1
30:4	K-Factor L3	AI:44058	0.1	10 to 9999	×0.1

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:4	Current TDD L1	AI:44059	0.1%	0 to 1000	×0.1
30:4	Current TDD L2	AI:44060	0.1%	0 to 1000	×0.1
30:4	Current TDD L3	AI:44061	0.1%	0 to 1000	×0.1
30:3	Voltage L12	AI:44062	0.1V/1V	0 to Vmax	
30:3	Voltage L23	AI:44063	0.1V/1V	0 to Vmax	
30:3	Voltage L31	AI:44064	0.1V/1V	0 to Vmax	
Minimum real-time total values (M)					
30:3	Total kW	AI:44288	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar	AI:44289	0.001kvar/1kvar	-Pmax to Pmax	
30:3	Total kVA	AI:44290	0.001kVA/1kVA	0 to Pmax	
30:4	Total PF [4]	AI:44291	0.001	0 to 1000	×0.001
30:4	Total PF lag	AI:44292	0.001	0 to 1000	×0.001
30:4	Total PF lead	AI:44293	0.001	0 to 1000	×0.001
Minimum real-time auxiliary values (M)					
30:3	Auxiliary current	AI:44544	0.01A/mA	0 to Imax aux	
30:3	Neutral current	AI:44545	0.01A	0 to Imax	
30:4	Frequency [3]	AI:44546	0.01Hz	0 to 10000	×0.01
30:4	Voltage unbalance	AI:44547	1%	0 to 300	
30:4	Current unbalance	AI:44548	1%	0 to 300	×0.01
30:3	DC voltage	AI:44549	0.01V	0 to999900	×0.01
Minimum demands (M)					
30:4	Reserved	AI:44800- AI:44816		0	
Maximum real-time values per phase (M)					
30:3	Voltage L1/L12 [5]	AI:46080	0.1V/1V	0 to Vmax	
30:3	Voltage L2/L23 [5]	AI:46081	0.1V/1V	0 to Vmax	
30:3	Voltage L3/L31 [5]	AI:46082	0.1V/1V	0 to Vmax	
30:3	Current L1	AI:46083	0.01A	0 to Imax	
30:3	Current L2	AI:46084	0.01A	0 to Imax	
30:3	Current L3	AI:46085	0.01A	0 to Imax	
30:3	kW L1	AI:46086	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L2	AI:46087	0.001kW/1kW	-Pmax to Pmax	
30:3	kW L3	AI:46088	0.001kW/1kW	-Pmax to Pmax	
30:3	kvar L1	AI:46089	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L2	AI:46090	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kvar L3	AI:46091	0.001kvar/1kvar	-Pmax to Pmax	
30:3	kVA L1	AI:46092	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L2	AI:46093	0.001kVA/1kVA	0 to Pmax	
30:3	kVA L3	AI:46094	0.001kVA/1kVA	0 to Pmax	
30:4	Power factor L1	AI:46095	0.001	-999 to 1000	×0.001
30:4	Power factor L2	AI:46096	0.001	-999 to 1000	×0.001
30:4	Power factor L3	AI:46097	0.001	-999 to 1000	×0.001
30:4	Voltage THD L1/L12	AI:46098	0.1%	0 to 9999	×0.1
30:4	Voltage THD L2/L23	AI:46099	0.1%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:46100	0.1%	0 to 9999	×0.1
30:4	Current THD L1	AI:46101	0.1%	0 to 9999	×0.1
30:4	Current THD L2	AI:46102	0.1%	0 to 9999	×0.1
30:4	Current THD L3	AI:46103	0.1%	0 to 9999	×0.1
30:4	K-Factor L1	AI:46104	0.1	10 to 9999	×0.1
30:4	K-Factor L2	AI:46105	0.1	10 to 9999	×0.1
30:4	K-Factor L3	AI:46106	0.1	10 to 9999	×0.1
30:4	Current TDD L1	AI:46107	0.1%	0 to 1000	×0.1
30:4	Current TDD L2	AI:46108	0.1%	0 to 1000	×0.1
30:4	Current TDD L3	AI:46109	0.1%	0 to 1000	×0.1
30:3	Voltage L12	AI:46110	0.1V/1V	0 to Vmax	
30:3	Voltage L23	AI:46111	0.1V/1V	0 to Vmax	
30:3	Voltage L31	AI:46112	0.1V/1V	0 to Vmax	
Maximum real-time total values (M)					
30:3	Total kW	AI:46336	0.001kW/1kW	-Pmax to Pmax	
30:3	Total kvar	AI:46337	0.001kvar/1kvar	-Pmax to Pmax	
30:3	Total kVA	AI:46338	0.001kVA/1kVA	0 to Pmax	
30:4	Total PF [4]	AI:46339	0.001	0 to 1000	×0.001
30:4	Total PF lag	AI:46340	0.001	0 to 1000	×0.001
30:4	Total PF lead	AI:46341	0.001	0 to 1000	×0.001
Maximum real-time auxiliary values (M)					
30:3	Auxiliary current	AI:46592		0	

Obj/Var [7]	Parameter	Object/Point	Unit[2]	Value, range [1]	Comment
30:3	Neutral current	AI:46593	0.01A	0 to Imax	
30:4	Frequency [3]	AI:46594	0.01Hz	0 to 10000	×0.01
30:4	Voltage unbalance	AI:46595	1%	0 to 300	
30:4	Current unbalance	AI:46596	1%	0 to 300	×0.01
30:3	DC voltage	AI:46597	0.01V	0 to999900	×0.01
Maximum demands (M)					
30:3	Max. volt demand L1/L12 [5]	AI:46848	0.1V/1V	0 to Vmax	
30:3	Max. volt demand L2/L23 [5]	AI:46849	0.1V/1V	0 to Vmax	
30:3	Max. volt demand L3/L31 [5]	AI:46850	0.1V/1V	0 to Vmax	
30:3	Max. ampere demand L1	AI:46851	0.01A	0 to Imax	
30:3	Max. ampere demand L2	AI:46852	0.01A	0 to Imax	
30:3	Max. ampere demand L3	AI:46853	0.01A	0 to Imax	
30:4	Reserved	AI:46854		0	
30:4	Reserved	AI:46855		0	
30:4	Reserved	AI:46856		0	
30:3	Max. kW import sliding window demand	AI:46857	0.001kW/1kW	0 to Pmax	
30:3	Max. kvar import sliding window demand	AI:46858	0.001kvar/1kvar	0 to Pmax	
30:3	Max. kVA sliding window demand	AI:46859	0.001kVA/1kVA	0 to Pmax	
30:4	Max. kW import thermal demand	AI:46860	0.001kW/1kW	0 to Pmax	
30:4	Max. kvar import thermal demand	AI:46861	0.001kvar/1kvar	0 to Pmax	
30:4	Max. kVA thermal demand	AI:46862	0.001kVA/1kVA	0 to Pmax	
30:3	Max. kW export sliding window demand	AI:46863	0.001kW/1kW	0 to Pmax	
30:3	Max. kvar export sliding window demand	AI:46864	0.001kvar/1kvar	0 to Pmax	
30:3	Max. kW export thermal demand	AI:46865	0.001kW/1kW	0 to Pmax	
30:3	Max. kvar export thermal demand	AI:46866	0.001kvar/1kvar	0 to Pmax	

1 For the parameter limits, see Note[1] to Table 3-1.

2 When using direct wiring (PT Ratio = 1), voltages are transmitted in 0.1V units, currents in 0.01A units, and powers in 0.001 kW/kvar/kVA units. For wiring via PT (PT Ratio > 1), voltages are transmitted in 1V units, currents in 0.01A units, and powers in 1 kW/kvar/kVA units.

3 The actual frequency range is 45.00 - 65.00 Hz.

4 New absolute min/max value (lag or lead).

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

6 Operate limit for the voltage disturbance trigger specifies the voltage deviation allowed in percentage of nominal (full scale) voltage, which refers to line-to-line voltage in 3OP2 and 3OP3 wiring modes, and line-to-neutral voltage in other modes. The nominal voltage is 120 × PT Ratio VRMS for instruments with the 120 V input option, 380 × PT Ratio VRMS for instruments with the 690 V input option.

7 Variations specified in the table show those that should 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 (see Section 2).

(M) These parameters are logged to the Min/Max log.

Analog Output Setup

These registers are used to obtain or change the allocation of the internal multiplexed analog output channels. For the output parameters that can be selected see Table 3-18.

Table 3-16 Analog Output Allocation Registers

Channel	Points
Channel #1	192-194
Channel #2	195-197

Table 3-17 Analog Channel Allocation Registers

Channel	Object/Var	Register contents	Object/ Point	Range/scale
#1	40:2(read) 41:2(write)	Output parameter ID	AO:192	see Table 3-18
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:193	

Channel	Object/Var	Register contents	Object/ Point	Range/scale
#2	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:194	
	40:2(read) 41:2(write)	Output parameter ID	AO:195	see Table 3-18
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:196	
	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:197	

NOTES

1. Except for the signed power factor (see Note 3 to Table 3-18), the output scale is linear within the value range. The scale range will be inverted if the full scale specified is less than the zero scale.
2. For bi-directional analog output (±1 mA), the zero scale corresponds to the center of the scale range (0 mA) and the direction of current matches the sign of the output parameter. For signed (bi-directional) values, such as powers and signed power factor, the scale is always symmetrical with regard to 0 mA, and the full scale corresponds to +1 mA output for positive readings and to -1 mA output for negative readings. For these, the zero scale (0 mA output) is permanently set in the instrument to zero for all parameters except of signed power factor for which it is set to 1.000. In the write request, the zero scale is ignored. No error will occur when you attempt to change it. Unsigned parameters are output within the current range 0 to +1 mA and can be scaled using both zero and full scales as in the event of single-ended analog output.

Table 3-18 Analog Output Parameters

Parameter	ID	Unit [2]	Scale range [1]	Modulus
None	0	n/a	0	
Real-time values per phase				
Voltage L1/L12 [5]	3072	0.1V/1V	0 to Vmax	
Voltage L2/L23 [5]	3073	0.1V/1V	0 to Vmax	
Voltage L3/L31 [5]	3074	0.1V/1V	0 to Vmax	
Current L1	3075	0.01A	0 to Imax	
Current L2	3076	0.01A	0 to Imax	
Current L3	3077	0.01A	0 to Imax	
Voltage THD L1/L12	3090	0.1%	0 to 9999	×0.1
Voltage THD L2/L23	3091	0.1%	0 to 9999	×0.1
Voltage THD L3	3092	0.1%	0 to 9999	×0.1
Current THD L1	3093	0.1%	0 to 9999	×0.1
Current THD L2	3094	0.1%	0 to 9999	×0.1
Current THD L3	3095	0.1%	0 to 9999	×0.1
K-Factor L1	3096	0.1	10 to 9999	×0.1
K-Factor L2	3097	0.1	10 to 9999	×0.1
K-Factor L3	3098	0.1	10 to 9999	×0.1
Current TDD L1	3099	0.1%	0 to 1000	×0.1
Current TDD L2	3100	0.1%	0 to 1000	×0.1
Current TDD L3	3101	0.1%	0 to 1000	×0.1
Voltage L12	3102	0.1V/1V	0 to Vmax	
Voltage L23	3103	0.1V/1V	0 to Vmax	
Voltage L31	3104	0.1V/1V	0 to Vmax	
Real-time total values				
Total kW	3840	0.001kW/1kW	-Pmax to Pmax	
Total kvar	3841	0.001kvar/1kvar	-Pmax to Pmax	
Total kVA	3842	0.001kVA/1kVA	0 to Pmax	
Total PF [4]	3843	0.001	-999 to 1000	×0.001
Total PF lag	3844	0.001	-999 to 1000	×0.001
Total PF lead	3845	0.001	-999 to 1000	×0.001
Real-time auxiliary values				
Auxiliary current	4096	0.01A/mA	0 to Imax aux	
Neutral current	4097	0.01A	0 to Imax	
Frequency [3]	4098	0.01Hz	0 to 10000	×0.01
DC voltage	4899	0.01V	0 to 999900	×0.01
Average values per phase				
Voltage L1/L12 [5]	4352	0.1V/1V	0 to Vmax	
Voltage L2/L23 [5]	4353	0.1V/1V	0 to Vmax	
Voltage L3/L31 [5]	4354	0.1V/1V	0 to Vmax	
Current L1	4355	0.01A	0 to Imax	
Current L2	4356	0.01A	0 to Imax	
Current L3	4357	0.01A	0 to Imax	

Parameter	ID	Unit [2]	Scale range [1]	Modulus
Voltage L12	4358	0.1V/1V	0 to Vmax	
Voltage L23	4359	0.1V/1V	0 to Vmax	
Voltage L31	4360	0.1V/1V	0 to Vmax	
Average total values				
Total kW	5120	0.001kW/1kW	-Pmax to Pmax	
Total kvar	5121	0.001kvar/1kvar	-Pmax to Pmax	
Total kVA	5122	0.001kVA/1kVA	0 to Pmax	
Total PF [4]	5123	0.001	-999 to 1000	×0.001
Total PF lag	5124	0.001	-999 to 1000	×0.001
Total PF lead	5125	0.001	-999 to 1000	×0.001
3-phase average voltage [5]	5126	0.1V/1V	0 to Vmax	
3-phase average L-L voltage	5127	0.1V/1V	0 to Vmax	
3-phase average current	5128	0.01A	0 to Imax	
Average auxiliary values				
Auxiliary current	5376	0.01A/mA	0 to Imax aux	
Neutral current	5377	0.01A	0 to Imax	
Frequency [3]	5378	0.01Hz	0 to 10000	×0.01
Present demands				
Accumulated kW import demand	5647	0.001kW/1kW	0 to Pmax	
Accumulated kvar import demand	5648	0.001kvar/1kvar	0 to Pmax	
Accumulated kVA demand	5649	0.001kVA/1kVA	0 to Pmax	
Accumulated kW export demand	5658	0.001kW/1kW	0 to Pmax	
Accumulated kvar export demand	5659	0.001kvar/1kvar	0 to Pmax	

1 For the parameter limits, see Note [1] to Table 3.1.

2 When using direct wiring (PT Ratio = 1), voltages are transmitted in 0.1V units, currents in 0.01A units, and powers in 0.001 kW/kvar/kVA units. For wiring via PTs (PT Ratio > 1), voltages are transmitted in 1V units, currents in 0.01A units, and powers in 1 kW/kvar/kVA units.

3 The actual frequency range is 45.00 to 65.00 Hz

4 The output scale for signed (bi-directional) power factor is symmetrical with regard to ±1.000 and is linear from -0 to -1.000, and from 1.000 to +0 (note that -1.000 ≡ +1.000). Negative power factor is output as [-1.000 minus measured value], and non-negative power factor is output as [+1.000 minus measured value]. To define the entire range for power factor from -0 to +0, the scales would be specified as -0/0. Because a negative zero may not be transmitted, the value of -0.001 is used to specify the scale of -0, and both +0.001 and 0.000 are used to specify the scale of +0. To define the range of -0 to 0, you must send -1/1 or -1/0 (considering the modulus of ×0.001).

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

Analog Expander Channels Allocation Registers

These registers are used to obtain or change the allocation of the analog expander channels. For the output parameters that can be selected see Table 3-18.

Table 3-19 Analog Expander Allocation Registers

Channel	Points	Channel	Points
Channel #1	256-258	Channel #9	280-282
Channel #2	259-261	Channel #10	283-285
Channel #3	262-264	Channel #11	286-288
Channel #4	265-267	Channel #12	289-291
Channel #5	268-270	Channel #13	292-294
Channel #6	271-273	Channel #14	295-297
Channel #7	274-276	Channel #15	298-300
Channel #8	277-279	Channel #16	301-303

Table 3-20 Analog Expander Channel Allocation Registers

Channel	Object/ Var.	Register contents	Object/ Point	Range/scale
#1	40:2(read) 41:2(write)	Output parameter ID	AO:256	See Table 3-18
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:257	
	40:1(read) 41:1(write)	Full scale (20 mA)	AO:258	
	. . .			

Channel	Object/ Var.	Register contents	Object/ Point	Range/scale
#16	40:2(read) 41:2(write)	Output parameter ID	AO:301	see Table 3-18
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:302	
	40:1(read) 41:1(write)	Full scale (20 mA)	AO:303	

NOTE

Settings you made for analog expander outputs will not be in effect until the analog expander output is globally enabled. To activate the analog expander output, set the analog expander option to the enabled state in the user selectable options setup (see Table 3-3).

Digital Inputs Allocation Registers

These registers are used to obtain or change the digital inputs allocation available in your instrument.

Table 3-21 Digital Inputs Allocation Registers

Object/ Var.	Register contents	Object/ Point	Range
40:2(read) 41:2(write)	Status inputs allocation mask [1]	AO:130	See Table 3-22
40:2(read) 41:2(write)	Pulse inputs allocation mask	AO:131	See Table 3-22
40:2(read) 41:2(write)	Not used [1]	AO:132	Read as 0
40:2(read) 41:2(write)	External demand synchronization input mask	AO:133	See Table 3-22
40:2(read) 41:2(write)	Time synchronization input mask	AO:134	See Table 3-22

[1] Writing to these locations is ignored. No error will occur.

NOTES

1. All digital inputs that are not allocated as pulse inputs will be automatically configured as status inputs.
2. A digital input allocated for the external demand synchronization pulse or time synchronization pulse will be automatically configured as a pulse input.

Table 3-22 Digital Inputs Allocation Mask

Bit number	Description
0	Digital input # 1 allocation status
1	Digital input # 2 allocation status
2	Digital input # 3 allocation status
3	Digital input # 4 allocation status
4	Digital input # 5 allocation status
5	Digital input # 6 allocation status
6	Digital input # 7 allocation status
7	Digital input # 8 allocation status
8	Digital input # 9 allocation status
9	Digital input # 10 allocation status
10	Digital input # 11 allocation status
11	Digital input # 12 allocation status
12-15	N/A (read as 0)

Bit meaning: 0 = input not allocated, 1 = input allocated to the group

Pulsing Setpoints Registers

These registers are used to obtain or change the setup of the pulsing output for any of two relays.

NOTE

Allocating a relay as a pulsing relay will unconditionally disable all setpoints associated with this relay. If a relay was manually operated or released, it will automatically revert to normal operation.

Table 3-23 Pulsing Setpoints

Relay	Registers
Relay #1	768-769
Relay #2	770-771
Relay #3	772-773
Relay #4	774-775
Relay #5	776-777
Relay #6	778-779

Table 3-24 Pulsing Setpoint Registers

Object/ Var.	Register contents	Object/ Point	Range
40:2(read) 41:2(write)	Output parameter ID	AO:768	See Table 3-25
40:2(read) 41:2(write)	Number of unit-hours per pulse	AO:769	0-9999 for energy pulsing, otherwise write 0.
…	…	…	…
40:2(read) 41:2(write)	Output parameter ID	AO:778	See Table 3-25
40:2(read) 41:2(write)	Number of unit-hours per pulse	AO:779	0-9999 for energy pulsing, otherwise write 0.

Table 3-25 Pulsing Output Parameters

Pulsing parameter	Identifier
None	0
KWh import	1
KWh export	2
KWh total (absolute)	3
Kvarh import (inductive)	4
Kvarh export (capacitive)	5
Kvarh total (absolute)	6
KVAh	7
Start power demand interval	8

Relay Operation Control

These points allow the user to manually override relay operation normally operated via alarm setpoints.

NOTE

A relay allocated as a pulsing relay may not be manually operated or released. When a relay is allocated for pulsing, it automatically reverts to normal operation.

Table 3-26 Relay Operation Control Registers

Object/ Var.	Register contents	Object/ Point	State Range
10:2(read) 12:1(write)	Relay #1 Force operate/Force release/Normal	BO:80 CROB:80	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay #2 Force operate/Force release/Normal	BO:81 CROB:81	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay #3 Force operate/Force release/Normal	BO:82 CROB:82	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay #4 Force operate/Force release/Normal	BO:83 CROB:83	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay #5 Force operate/Force release/Normal	BO:84 CROB:84	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay #6 Force operate/Force release /Normal	BO:85 CROB:85	0/1 = state OFF/ON

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, Latch Off are valid for all points; others Codes are invalid and will be rejected;

- Clear sub-field is valid; others 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 will reflect 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 (for instance, a relay is allocated for pulsing via Basic Setup).

To manually operate relays 1-6, use the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to points 80-85 of the Control-Relay-Output-Block object with the Control Code value Latch On. To manually release relays 1-6, use the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to point 80-85 of the Control-Relay-Output-Block object with the Control Code value Latch Off. To revert relays 1-6 to normal operation, use the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to the correspondent point of the Control-Relay-Output-Block object with the Control Code value Null Operation and Clear sub-field set to 1.

Pulse Counter Setup

Table 3-27 Pulse Counter Registers

Counter	Setup registers (see Table 3-28)
Counter #1	832-833
Counter #2	834-835
Counter #3	836-837
Counter #4	838-839
Counter #5	840-841
Counter #6	842-843
Counter #7	844-845
Counter #8	846-847
Counter #9	848-849
Counter #10	850-851
Counter #11	852-853
Counter #12	854-855
Counter #13	856-857
Counter #14	858-859
Counter #15	860-861
Counter #16	862-863

Table 3-28 Pulse Counter Setup Registers

Object/ Var.	Register contents	Object/ Point	Range
40:2(read) 41:2(write)	Associated digital input ID	AO:832	See Table 3-29
40:2(read) 41:2(write)	Scale factor (number of units per input pulse)	AO:833	1-9999
…	…	…	…
40:2(read) 41:2(write)	Associated digital input ID	AO:862	See Table 3-29
40:2(read) 41:2(write)	Scale factor (number of units per input pulse)	AO:863	1-9999

Table 3-29 Pulsing Output Parameters

Discrete input	Input ID
Not allocated	0
Digital input #1	1
Digital input #2	2
Digital input #3	3
Digital input #4	4
Digital input #5	5
Digital input #6	6
Digital input #7	7

Discrete input	Input ID
Digital input #8	8
Digital input #9	9
Digital input #10	10
Digital input #11	11
Digital input #12	12

Class 0 Point Assignment

These registers are used to obtain or change the assignment of the DNP Read objects to the Class 0 polling response.

Table 3-30 Class 0 Assignment Register Groups

Groups	Points
Group #1	1152-1154
Group #2	1155-1157
…	…
Group #32	1245-1247

Table 3-31 Class 0 Point Assignment Setup Registers

Group	Object/ Var.	Register Contents	Object/ Point	Range/scale
#1	40:1(read) 41:1(write)	DNP Object and Variation	AO:1152	See Table 3-32
	40:1(read) 41:1(write)	DNP Point number	AO:1153	0 - 65535
	40:1(read) 41:1(write)	Number of the DNP points	AO:1154	≥1 if Point number is correct
#2	40:1(read) 41:1(write)	DNP Object and Variation	AO:1155	See Table 3-32
	40:1(read) 41:1(write)	DNP Point number	AO:1156	0 - 65535
	40:1(read) 41:1(write)	Number of the DNP points	AO:1157	≥1 if Point number is correct
…		…	…	…
#32	40:1(read) 41:1(write)	DNP Object and Variation	AO:1245	See Table 3-32
	40:1(read) 41:1(write)	DNP Point number	AO:1246	0 - 65535
	40:1(read) 41:1(write)	Number of the DNP points	AO:1247	≥1 if Point number is correct

Table 3-32 DNP Read Objects for Class 0

No.	Object & Variation	Code	
		Hexadecimal	Decimal[1]
1	Analog Input 30:01	0x1E01	7681
2	Analog Input 30:02	0x1E02	7682
3	Analog Input 30:03	0x1E03	7683
4	Analog Input 30:04	0x1E04	7684
5	Analog Output 40:01	0x2801	10241
6	Analog Output 40:02	0x2802	10242
7	Binary Input 01:01	0x0101	257
8	Binary Input 01:02	0x0101	258
9	Binary Output 10:01 [2]	0x0A01	2561
10	Binary Output Status 10:02	0x0A02	2562
11	Binary Counter 20:01	0x1401	5121
12	Binary Counter 20:02	0x1402	5122
13	Binary Counter 20:05	0x1405	5125
14	Binary Counter 20:06	0x1406	5126
15	Frozen Counter 21:01	0x1501	5377
16	Frozen Counter 21:02	0x1502	5378
17	Frozen Counter 21:05	0x1505	5381
18	Frozen Counter 21:06	0x1506	5382
19	Frozen Counter 21:09	0x1509	5385
20	Frozen Counter 21:10	0x150A	5386

1 The decimal value is calculated as follow: Object * 256 + Variation. For instance, Analog Input object 30, variation 03: 30 * 256 + 3 = 7683.

2 Available with F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later.

Appendix A DNP Application Messages

The Powermeter is a DNP IED responding to external DNP Master requests. Table A-1 describes the PM296/RPM096 application level responses to external requests, including object variations, functions, codes and qualifiers supported by the instrument. The object and formats are detailed in the DNP Basic 4 Documentation Set.

Table A-1 Application Responses

OBJECT			REQUEST		RESPONSE	
Obj	**Var**	**Description**	**Func. Code**	**Qual. Code**	**Func. Code**	**Qual. 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 [4]	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 (responds 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 (responds 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

OBJECT			REQUEST		RESPONSE	
Obj	Var	Description	Func. Code	Qual. Code	Func. Code	Qual. Code
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
80	1	Internal indication [2]	2	D	129	
N/A	N/A	Cold Restart [3] (responds by Object 52:2)	13	N/A	129	07
N/A	N/A	Delay Measurement (responds by Object 52:2)	23	N/A	129	07

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

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

3 Responds with time object 50 variation 2 indicating time until instrument availability.

4 Available with F/W Versions 2.26.3/2.36.3 and 2.27.2/2.37.2 or later.

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

DNP3-2000 **DEVICE PROFILE DOCUMENT** This document must be accompanied by a table having the following headings: Object Group — Request Function Codes — Response Function Codes Object Variation — Request Qualifiers — Response Qualifiers Object Name (optional)	
Vendor Name: SATEC Ltd.	
Device Name: Powermeter PM296/RPM096	
Highest DNP Level Supported: For Requests L2 For Responses L2	Device Function: ☐ Master ■ Slave
Instrument 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 Re-tries: ■ None ☐ Fixed at____________________ ☐ Configurable, range ___ to_____	Maximum Application Layer Re-tries: ■ None ☐ 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	■ Sometimes①④	☐ Configurable
Pulse Off	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☐ Always	■ Sometimes②	☐ Configurable
Latch Off	☐ Never	☐ Always	■ Sometimes③	☐ Configurable
Queue	■ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☐ Never	☐ Always	■ Sometimes④	☐ Configurable

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

① used to activate the *Reset* function associated with points 0 to 37

② ③ ④ used to control Relays associated with points 80 to 85

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

Maximum number of CROB (object 12, variation 1) objects supported in a single message ___1_____.

Maximum number of analog output (object 41, any variation) objects supported in a single message ___3_____.

☐ Pattern Control Block and Pattern Mask (object 12, variations 2 and 3, respectively) supported. If so, describe any restrictions.

☐ CROB (object 12) and analog output (object 41) permitted together in a single message.

Reports Binary Input Change Events when no specific variation requested:

☐ Never

☐ Only time-tagged

☐ Only non-time-tagged

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

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

☐ Never

■ Binary Input Change With Time

☐ Binary Input Change With Relative Time

☐ Configurable (attach explanation)

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	