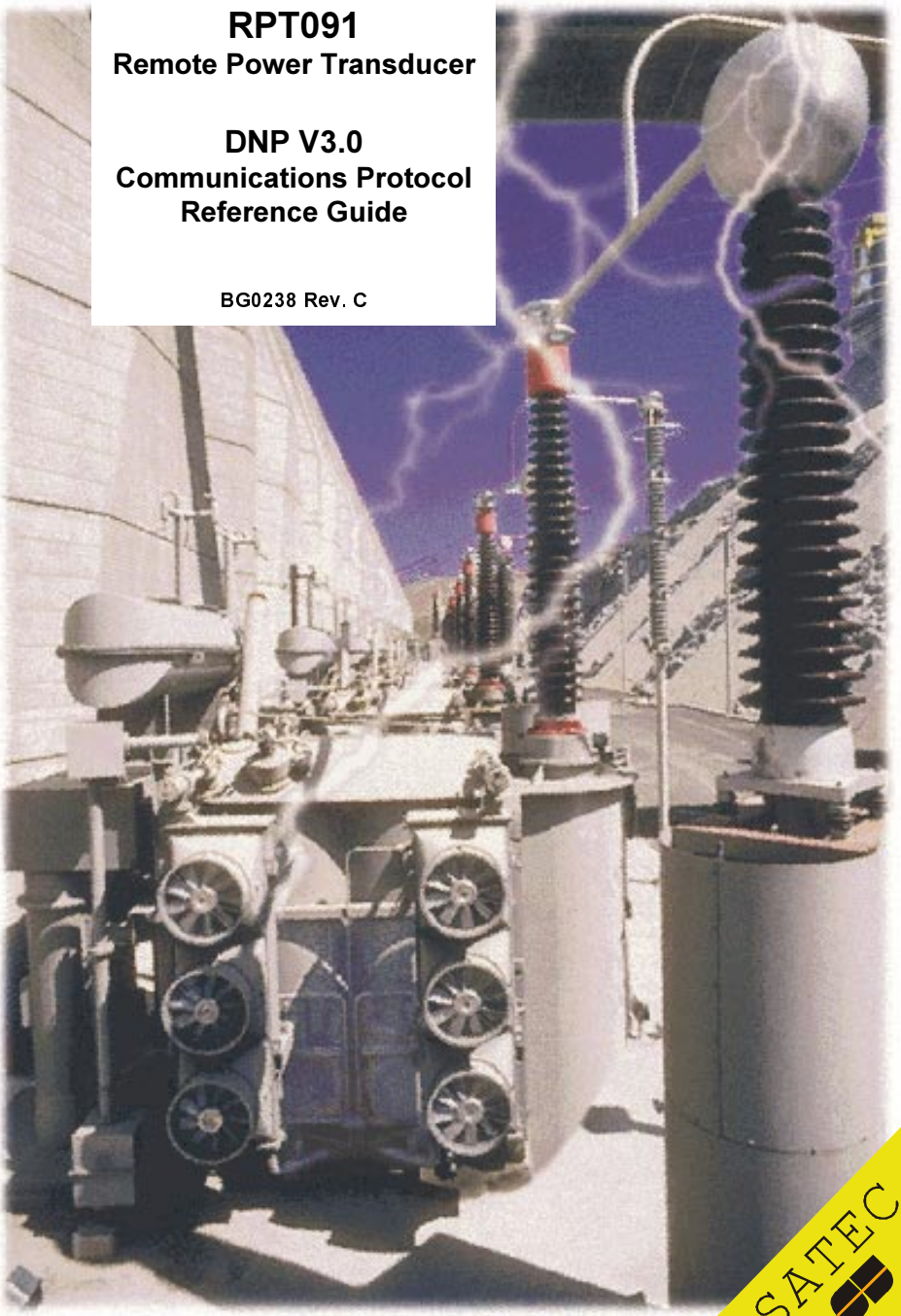
RPT091
Remote Power Transducer

DNP V3.0
Communications Protocol
Reference Guide

BG0238 Rev. C



SATEC

RPT091
REMOTE POWER TRANSDUCER

DNP V3.0 Communications Protocol

Reference Guide

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

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Table of Contents

1 Introduction

This document specifies a subset of the DNP V3.0 serial communications protocol used to transfer data between a master computer station and the *RPT091* Remote Power Transducer. The document provides all necessary information for developing a third-party communications software capable of communication with the *RPT091*.

Additional information concerning communications operation, configuring the communications parameters and communications connections is found in the RPT091 *Installation and Operation Manual*.

NOTE

Most of the instrument's advanced features are configured using multiple setup parameters that can be accessed in some contiguous registers. When writing the setup registers, it is recommended to write all the registers at once using a single request, or to clear (zero) the setup before writing into separate registers. Each value being written is checked for compatibility with the other setup parameters, so if the new value does not conform to them, the request will be rejected.

2 DNP Protocol

DNP V3.00 (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 DNP V3.00 is available in the “Basic 4 Document Set” which can obtained from the DNP User Group.

2.1 RPT091 Deviation from Standard

The *RPT091* 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 after the Powermeter makes the appropriate response.

2.2 DNP Request/Response Overview

The *RPT091* DNP implementation supports a wide variety of messages. The most common method to extract information from the Powermeter is to issue a Read Class-0 request. The instrument responds with the value of Analog-Inputs (see Table 4-1, *Input Data Parameters*) and Analog-Output-Status (see Table 4-2, *Basic Setup Registers*) by default.

The *RPT091*, like most devices, retrieves regular analog and binary data from the instrument by executing a directed (non-broadcast) Read of the configured CLASS-0 objects (object 60, variation 1, qualifier 6). Analog-Inputs and Counters are sent without flags. 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 Class-0 response may be configured with specially defined software binary points (see Table 4-19, *Class 0 Object Assignment*). These points can be read via Binary-Output-Status and can be changed by issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to points 96 through 119 of the Control-Relay-Output-Block object.

The *RPT091* 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 points 0 through 13 of the Analog-Output-Block object can change the setup parameters. The DNP functions Write, Select-Before- Operate, Operate, Cold-Restart and Delay Measurement are also supported by the *RPT091*. 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, i.e., 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.

3 DNP Interface

3.1 General

This section describes a LEVEL 1 DNP V3.00 communication protocol implemented between a master station and a slave Powermeter. A DNP device (RTU, Computer, etc.) has an address in the range of 0 to 65535, and it is this address that allows a master to selectively request data from any other device. DNP uses the address 65535 for broadcast function. A broadcast request never generates a DNP response.

The DNP implementation in the *RPT091* conforms to all Harris IED implementation guidelines. All data items that are available from the Powermeter can be obtained via the DNP Read Class 0 command. Individual items can also be read using the Read Analog-Input, Read Counter, Read Analog Output Status or Read Binary Input commands.

The Energy and Demands values can be reset to zero by issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to the specified point of the Control-Relay-Output-Block object. The reset request to reset the Energy and Demands values must use a code operation Pulse On. Note that a Latch-On / Latch-Off operation codes are used to control the digital software/hardware points.

The setpoint parameters can be changed by issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command using the Analog-Output-Block object.

3.2 DNP Address

The instrument on a DNP link must have a unique address. The *RPT091* allows one of 256 addresses to be selected. The selectable addresses have a range of 0-255.

3.3 Transaction Timing

To allow the master to switch the communication link, it is guaranteed that the Powermeter minimum response time be at least 3.5 character time (depending on the baud rate) and at least 5 ms. Table 3-1 shows the actual response time measured at 9600 bps.

Table 3-1 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 (or SBO/Operate or Direct-Operate-No-Acknowledge) requests for reset energy/demand and setpoint changing are immediately confirmed.

3.4 Object Format

The *RPT091* uses two objects, which correspond to instrument measurements. These are Counter (object 20, variations 5 and 6) and Analog-Input (object 30, variations 3 and 4).

The Single-Bit Binary-Input (object 1, variation 1) and Binary-Output-Status (object 10, variation 2) are used to represent the state of digital input/output points (software or hardware). The Control-Relay-Output-Block (object 12, variation 1) is used to control digital points.
The *RPT091* supports a response when a value is requested as a variation 0 and will respond as if the requested variation was for a 32 bit Counter or 32 bit Analog-Input or 16 bit Analog-Output-Status. By the default Class 0 reads are treated as a request for Analog-Input (see Table 4-1, *Input Data Parameters*) and Analog-Output-Status points (see Table 4-2, *Basic Setup Registers*). To configure the Class 0 assignment use the Binary points 96-119. Table 4-26 lists the assignment meaning of these points.

4 RPT091 Registers

4.1 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 the real-time measurements.

Table 4-1 Input Data Parameters

Object/ Var.	*Parameter*	*Object/ Point*	*Unit*	*Value range* ⓘ	*Note*
30:3	Voltage L1/L12	AI:0	V	0 to Vmax	
30:3	Voltage L2/L23	AI:1	V	0 to Vmax	
30:3	Voltage L3/L31	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		-999 to 1000	× 0.001
30:4	Power factor L2	AI:16		-999 to 1000	× 0.001
30:4	Power factor L3	AI:17		-999 to 1000	× 0.001
30:4	Power factor total	AI:18		-999 to 1000	× 0.001
30:3	kW total	AI:19	kW	-Pmax to Pmax	
30:3	kvar total	AI:20	kvar	-Pmax to Pmax	
30:3	kVA total	AI:21	kVA	0 to Pmax	
30:3	Unbalanced current	AI:22	A	0 to Imax	
30:4	Frequency	AI:23	Hz	4500 to 6500	× 0.01
30:3	Sliding window maximum kW demand	AI:24	kW	0 to Pmax	
30:3	Accumulated kW demand	AI:25	kW	0 to Pmax	
30:3	Sliding window maximum kVA demand	AI:26	kVA	0 to Pmax	
30:3	Accumulated kVA demand	AI:27	kVA	0 to Pmax	

Object/ Var.	*Parameter*	*Object/ Point*	*Unit*	*Value range* ①	*Note*
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	Sliding window kW demand	AI:31	kW	0 to Pmax	
30:3	Sliding window kVA demand	AI:32	kVA	0 to Pmax	
30:4	Reserved	AI:33		0	
30:4	Voltage THD L1/L12	AI:34	%	0 to 9999	× 0.1
30:4	Voltage THD L2/L23	AI:35	%	0 to 9999	× 0.1
30:4	Voltage THD L3	AI:36	%	0 to 9999	× 0.1
30:4	Current THD L1	AI:37	%	0 to 9999	× 0.1
30:4	Current THD L2	AI:38	%	0 to 9999	× 0.1
30:4	Current THD L3	AI:39	%	0 to 9999	× 0.1
30:4	Current TDD L1	AI:40	%	0 to 1000	× 0.1
30:4	Current TDD L2	AI:41	%	0 to 1000	× 0.1
30:4	Current TDD L3	AI:42	%	0 to 1000	× 0.1
20:5	kWh import	CT:0	kWh	0 to 999,999,999	
20:5	kWh export	CT:1	kWh	0 to -999,999,999	
20:5	kvarh net	CT:2	kvarh	-999,999,999 to 999,999,999	
20:5	kVAh	CT:3	kVAh	0 to 999,999,999	

AI indicates Analog-Input point, CT - Counter point. All these points assigned to Class 0 by default.

① The parameter limits are as follows:
Vmax = 828 * PT Ratio [V] @ PT Ratio = 1, and **Vmax** = 144 * PT Ratio [V] @ PT Ratio > 1, for the instruments with 690 V input option
Vmax =144 * PT Ratio [V], for the instruments with 120 V input option
Imax = 1.2 * CT primary current [A] for the instruments with 20% over-range
Imax = 1.5 * CT primary current [A] for the instruments with 50% over-range
Pmax = (Imax * Vmax * 3)/1000 [kW] if wiring mode is 4LN3 or 3LN3
Pmax = (Imax * Vmax * 2)/1000 [kW] if wiring mode is 4LL3, 3OP2, 3DIR2, 3OP3 or 3LL3

NOTES

- The voltage parameters can represent line-to-neutral or line-to-line voltages depending on the wiring mode selected in the instrument. When a 4LN3 or 3LN3 wiring mode is selected, they will be line-to-neutral voltages, and when another configuration is selected, 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 that 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.

- In 3-wire connection schemes, the individual phase values for power factor, active power, apparent power and reactive power will be zeros, because they have no meaning. Only total three-phase power values can be used.

4.2 Basic Setup Registers

These registers are used to access the Basic Setup parameters. The values are read and written without conversion. 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.

Table 4-2 Basic Setup Registers

Object/ Variation	*Parameter*	*Object/ Point*	*Range*	*Note*
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	× 0.1
40:1 (read) 41:1 (write)	CT primary current	AO:2	1 to 50000 A	
40:2 (read) 41:2 (write)	Demand period	AO:3	1,2,5,10,15,20,30,60 min 255 = external synchronization	
40:2 (read) 41:2 (write)	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	
40:1 (read)	Reserved	AO:7	Read as 65535	
40:2 (read) 41:2 (write)	The number of demand periods	AO:8	1 - 15	
40:1 (read)	Reserved	AO:9	Read as 65535	
40:1 (read)	Reserved	AO:10	Read as 65535	
40:2 (read) 41:2 (write)	Nominal frequency	AO:11	50, 60	
40:2 (read) 41:2 (write)	Maximum demand load current	AO:12	1 to 50000	
40:2 (read) 41:2 (write)	Phase energy calculation enable	AO:13	0 = disable, 1 = enable	

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

The basic setup registers assigned to Class 0 by default.

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

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

Table 4-3 Firmware & Instrument Option Registers

Object/ Variation	*Parameter*	*Object/ Point*	*Read/ Write*	*Range*
30:4	Firmware version number	AI:1024	Read	0-65535
30:4	Instrument option 1	AI:1025	Read	see Table 4-4
30:4	Instrument option 2	AI:1026	Read	see Table 4-4

AI indicates Analog-Input points.

Table 4-4 Instrument Options

Options Register	*Bit Number*	*Description*
Options 1 (AI:1025)	0	120V option
	1	690V option
	2-4	Reserved
	5	50% current over-range option
	6	Analog output 0/4-20 mA option
	7	Analog output 0-1 mA option
	8	Analog output -1-+1 mA option
	9	Relays option
	10	Digital inputs option
	11-15	Reserved
Options 2 (AI:1026)	0-2	Number of relays - 1
	3-6	Number of digital inputs - 1
	7-15	Reserved

4.3 Communications Setup

These registers are used to access the Communications Setup parameters.

NOTE

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

Table 4-5 Communications Setup Registers

Object/ Variation	*Parameter*	*Object/ Point*	*Range*
40:1 (read)	Reserved	AO:64	Read as 65535
40:2 (read) 41:2 (write)	Interface	AO:65	1 = RS-422, 2 = RS-485
40:2 (read) 41:2 (write)	Address	AO:66	0 to 255
40:2 (read) 41:2 (write)	Baudrate	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

AO indicates Analog-Output points.

4.3 DNP Options Setup

These registers are used to access the DNP Options Setup parameters.

Table 4-6 DNP Options Setup Registers

Object/ Variation	*Parameter*	*Object/ Point*	*Range*
40:1 (read)	Reserved	AO:32-47	Read as 65535
40:2 (read) 41:2 (write)	Select/Operate Timeout	AO:48	2 to 30 seconds
40:2 (read)	Reserved	AO:49-52	Read as 65535
40:2 (read) 41:2 (write)	Time Synch Period	AO:53	1 to 84600 seconds

AO indicates Analog-Output points.

The Select Before Operate command causes the *RPT091* to start a timer. The Operate command must be received correctly before the value specified by the Select / Operate Timeout parameter expires.
The *RPT091* requests for time synchs when the time specified by the TimeSyhchPeriod parameter elapsed. The bit 4 of the first octet of the internal indication word is set. The master synchronizes the time by writing the Time and Date object to Powermeter.

4.4 Resetting Energy and Demands

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 parameter Pulse-On.

Issuing the same Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to point 1 can reset the maximum demands.

Table 4-7 Reset Energy/Demands Registers

Object/ Var.	*Parameter*	*Object/ Point*	*Read/ Write*	*Description*
10:2 12:1	Energy	BO:0 CROB:0	Read Write	Return zero PULSE ON
10:2 12:1	Maximum demands	BO:0 CROB:1	Read Write	Return zero PULSE ON

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

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

- The *Count* byte is ignored. The *Control Code* byte is checked for the following:

  a code of *Pulse On* (1) is valid for all points;

  all 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:

  a status of *Request Accepted* (0) will be returned if the command was accepted;

  a status of *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;

  a status of *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).

4.5 Status Registers

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

Table 4-8 Status Registers (*Read*)

Object/ Var.	*Description*	*Object/ Point*	*Bit meaning*
01:1	Relay #1 status	BI:0	Relay status:
01:1	Relay #2 status	BI:1	0 = released, 1 = operated
01:1	Reserved	BI:2-15	Permanently set to 0
01:1	Status input #1	BI:16	Contact: 0 = open, 1 = closed
01:1	Status input #2	BI:17	
01:1	Status input #3	BI:18	
01:1	Status input #4	BI:19	
01:1	Reserved	BI:20-31	Permanently set to 0
01:1	Setpoint #1-#16	BI:32-47	Setpoint status: 0-is released;1-is operated

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

4.6 Status Alarm Registers

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

NOTE

The RPT091 provides two alarm registers: the first is the setpoint alarm register, and the second is the self-check alarm register.

The setpoint alarm register stores the status of the operated alarm setpoints by setting the appropriate bits to 1. The alarm status points can be reset by issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command using the Control-Relay-Output-Block (object 12, variation 1) to points 48 to 63. It is possible to reset each alarm status point separately by writing 0 to a corresponding alarm point.

The self-check alarm register gives indication of 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 RPT091 will use the default configuration. Issuing the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command using the Binary Output object 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 4-9 Status Alarm Registers

Object/ Var.	*Description*	*Object/ Point*	*Bit meaning*
	Setpoint Alarm Registers		*1 = setpoint has been operated* *0 = setpoint hasn't been operated*
10:2(read) 12:1(write)	Alarm **##**1:16	BO:48-63 CROB:48-63	0-1
	Self-check Alarm Registers		*1 = alarm has been asserted* *0 = alarm hasn't been asserted*
10:2(read)	Reserved	BO:64	Reading returns 0
10:2(read) 12:1(write)	ROM error	BO:65 CROB:65	0-1
10:2(read) 12:1(write)	RAM error	BO:66 CROB:66	0-1
10:2(read) 12:1(write)	Watchdog timer reset	BO:67 CROB:67	0-1
10:2(read) 12:1(write)	Sampling failure	BO:68 CROB:68	0-1
10:2(read) 12:1(write)	Out of control trap	BO:69 CROB:69	0-1
10:2(read)	Reserved	BO:70	Reading returns 0
10:2(read) 12:1(write)	Timing failure	BO:71 CROB:71	0-1
10:2(read) 12:1(write)	Loss of power (power up)	BO:72 CROB:72	0-1
10:2(read) 12:1(write)	External reset (Cold Restart) ①	BO:73 CROB:73	0-1
10:2(read) 12:1(write)	Configuration corrupted①	BO:74 CROB:74	0-1
10:2(read) 12:1(write)	Time synch required①	BO:75 CROB:75	0-1
10:2(read) 12:1(write)	Reserved	BO:76-79 CROB:76-79	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 correspondent internal indication bits.

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:

  a code of *Latch Off* is valid for all points;

  all 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:

  a status of *Request Accepted* (0) will be return if the command was accepted;

  a status of *Request not Accepted due to Formatting Errors* (3) would be returned if the *Control Code* byte was incorrectly formatted or if an invalid Code was present in the command.

4.7 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 4-10.

Table 4-10 Extended Data Registers

Object/ Var.	*Parameter*	*Object/ Point*	*Unit*	*Value, range* ⓘ	*Note*
30:4	None	AI:32768	n/a	0	
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	Reserved	BI:34308-34319	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	Reserved	BI:34818-34831	n/a	0/0	
Real-time values per phase					
30:3	Voltage L1/L12	AI:35840	V	0 to Vmax	
30:3	Voltage L2/L23	AI:35841	V	0 to Vmax	
30:3	Voltage L3/L31	AI:35842	V	0 to Vmax	
30:3	Current L1	AI:35843	A	0 to Imax	
30:3	Current L2	AI:35844	A	0 to Imax	
30:3	Current L3	AI:35845	A	0 to Imax	
30:3	kW L1	AI:35846	kW	-Pmax to Pmax	
30:3	kW L2	AI:35847	kW	-Pmax to Pmax	
30:3	kW L3	AI:35848	kW	-Pmax to Pmax	
30:3	kvar L1	AI:35849	kvar	-Pmax to Pmax	
30:3	kvar L2	AI:35850	kvar	-Pmax to Pmax	
30:3	kvar L3	AI:35851	kvar	-Pmax to Pmax	
30:3	kVA L1	AI:35852	kVA	0 to Pmax	
30:3	kVA L2	AI:35853	kVA	0 to Pmax	
30:3	kVA L3	AI:35854	kVA	0 to Pmax	
30:4	Power factor L1	AI:35855	n/a	-999 to 1000	× 0.001
30:4	Power factor L2	AI:35856	n/a	-999 to 1000	× 0.001

Object/ Var.	Parameter	Object/ Point	Unit	Value, range ①	Note
30:4	Power factor L3	AI:35857	n/a	-999 to 1000	× 0.001
30:4	Voltage THD L1/L12	AI:35858	%	0 to 9999	×0.1
30:4	Voltage THD L2/L23	AI:35859	%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:35860	%	0 to 9999	×0.1
30:4	Current THD L1	AI:35861	%	0 to 9999	×0.1
30:4	Current THD L2	AI:35862	%	0 to 9999	×0.1
30:4	Current THD L3	AI:35863	%	0 to 9999	×0.1
30:4	K-Factor L1	AI:35864	%	10 to 9999	×0.1
30:4	K-Factor L2	AI:35865	%	10 to 9999	×0.1
30:4	K-Factor L3	AI:35866	%	10 to 9999	×0.1
30:4	Current TDD L1	AI:35867	%	0 to 1000	×0.1
30:4	Current TDD L2	AI:35868	%	0 to 1000	×0.1
30:4	Current TDD L3	AI:35869	%	0 to 1000	×0.1
Real-time total values					
30:3	Total kW	AI:36608	kW	-Pmax to Pmax	
30:3	Total kvar	AI:36609	kvar	-Pmax to Pmax	
30:3	Total kVA	AI:36610	kVA	0 to Pmax	
30:4	Total PF	AI:36611	n/a	-999 to 1000	×0.001
30:4	Reserved	AI:36612	n/a	0	
30:4	Reserved	AI:36613	n/a	0	
Real-time auxiliary values					
30:4	Reserved	AI:36864		0	
30:3	Neutral current	AI:36865	A	0 to Imax	
30:4	Frequency ②	AI:36866	Hz	0 to 6500	×0.01
Average values per phase					
30:3	Voltage L1/L12	AI:37120	V	0 to Vmax	
30:3	Voltage L2/L23	AI:37121	V	0 to Vmax	
30:3	Voltage L3/L31	AI:37122	V	0 to Vmax	
30:3	Current L1	AI:37123	A	0 to Imax	
30:3	Current L2	AI:37124	A	0 to Imax	
30:3	Current L3	AI:37125	A	0 to Imax	
30:3	kW L1	AI:37126	kW	-Pmax to Pmax	
30:3	kW L2	AI:37127	kW	-Pmax to Pmax	
30:3	kW L3	AI:37128	kW	-Pmax to Pmax	
30:3	kvar L1	AI:37129	kvar	-Pmax to Pmax	
30:3	kvar L2	AI:37130	kvar	-Pmax to Pmax	
30:3	kvar L3	AI:37131	kvar	-Pmax to Pmax	
30:3	kVA L1	AI:37132	kVA	0 to Pmax	
30:3	kVA L2	AI:37133	kVA	0 to Pmax	
30:3	kVA L3	AI:37134	kVA	0 to Pmax	
30:4	Power factor L1	AI:37135	n/a	-999 to 1000	×0.001
30:4	Power factor L2	AI:37136	n/a	-999 to 1000	×0.001
30:4	Power factor L3	AI:37137	n/a	-999 to 1000	×0.001
30:4	Voltage THD L1/L12	AI:37138	%	0 to 9999	×0.1

Object/ Var.	Parameter	Object/ Point	Unit	Value, range ①	Note
30:4	Voltage THD L2/L23	AI:37139	%	0 to 9999	×0.1
30:4	Voltage THD L3	AI:37140	%	0 to 9999	×0.1
30:4	Current THD L1	AI:37141	%	0 to 9999	×0.1
30:4	Current THD L2	AI:37142	%	0 to 9999	×0.1
30:4	Current THD L3	AI:37143	%	0 to 9999	×0.1
30:4	K-Factor L1	AI:37144	n/a	10 to 9999	×0.1
30:4	K-Factor L2	AI:37145	n/a	10 to 9999	×0.1
30:4	K-Factor L3	AI:37146	n/a	10 to 9999	×0.1
30:4	Current TDD L1	AI:37147	%	0 to 1000	×0.1
30:4	Current TDD L2	AI:37148	%	0 to 1000	×0.1
30:4	Current TDD L3	AI:37149	%	0 to 1000	×0.1
Average total values					
30:3	Total kW	AI:37888	kW	-Pmax to Pmax	
30:3	Total kvar	AI:37889	kvar	-Pmax to Pmax	
30:3	Total kVA	AI:37890	kVA	0 to Pmax	
30:4	Total PF	AI:37891	n/a	-999 to 1000	×0.001
30:4	Reserved	AI:37892		0	
30:4	Reserved	AI:37893		0	
Average auxiliary values					
30:4	Reserved	AI:38144		0	
30:3	Neutral current	AI:38145	A	0 to Imax	
30:4	Frequency ②	AI:38146	Hz	0 to 6500	×0.01
Present demands					
30:4	Reserved	AI:38400		0	
30:4	Reserved	AI:38401		0	
30:4	Reserved	AI:38402		0	
30:3	Amp. Demand L1	AI:38403	A	0 to Imax	
30:3	Amp. Demand L2	AI:38404	A	0 to Imax	
30:3	Amp. Demand L3	AI:38405	A	0 to Imax	
30:3	Block kW demand	AI:38406	kW	0 to Pmax	
30:4	Reserved	AI:38407		0	
30:3	Block kVA demand	AI:38408	kVA	0 to Pmax	
30:3	Sliding window kW demand	AI:38409	kW	0 to Pmax	
30:4	Reserved	AI:38410		0	
30:3	Sliding window kVA demand	AI:38411	kVA	0 to Pmax	
30:4	Reserved	AI:38412		0	
30:4	Reserved	AI:38413		0	
30:4	Reserved	AI:38414		0	
30:3	Accumulated kW demand (import)	AI:38415	kW	0 to Pmax	
30:4	Reserved	AI:38416		0	
30:3	Accumulated kVA demand	AI:38417	kVA	0 to Pmax	

Object/ Var.	Parameter	Object/ Point	Unit	Value, range ①	Note
Total energies					
20:5	kWh import	CT:38656	kWh	0 to 999,999,999	
20:5	kWh export	CT:38657	kWh	-999,999,999, to 0	
20:5	Reserved	CT:38658		0	
20:5	Reserved	CT:38659		0	
20:5	kvarh import (inductive)	CT:38660	kvarh	0 to 999,999,999	
20:5	kvarh export (capacitive)	CT:38661	kvarh	-999,999,999 to 0	
20:5	Reserved	CT:38662		0	
20:5	Reserved	CT:38663		0	
20:5	kVAh total	CT:38664	kVAh	0 to 999,999,999	
Phase energies					
20:5	kWh import L1	CT:38912	kWh	0 to 999,999,999	
20:5	kWh import L2	CT:38913	kWh	0 to 999,999,999	
20:5	kWh import L3	CT:38914	kWh	0 to 999,999,999	
20:5	kvarh import L1 (inductive)	CT:38915	kvarh	0 to 999,999,999	
20:5	kvarh import L2 (inductive)	CT:38916	kvarh	0 to 999,999,999	
20:5	kvarh import L3 inductive)	CT:38917	kvarh	0 to 999,999,999	
20:5	kVAh L1	CT:38918	kVAh	0 to 999,999,999	
20:5	kVAh L2	CT:38919	kVAh	0 to 999,999,999	
20:5	kVAh L3	CT:38920	kVAh	0 to 999,999,999	
Maximum demands					
30:4	Reserved	AI:46848		0	
30:4	Reserved	AI:46849		0	
30:4	Reserved	AI:46850		0	
30:3	Max. ampere demand L1	AI:46851	A	0 to Imax	
30:3	Max. ampere demand L2	AI:46852	A	0 to Imax	
30:3	Max. ampere demand L3	AI:46853	A	0 to Imax	
30:4	Reserved	AI:46854		0	
30:4	Reserved	AI:46855		0	
30:4	Reserved	AI:46856		0	
30:3	Max. sliding window kW demand	AI:46857	kW	0 to Pmax	
30:4	Reserved	AI:46858		0	
30:3	Max. sliding window kVA demand	AI:46859	kVA	0 to Pmax	

① For parameter limits, see note ① to Table 4-1.
② The actual frequency range is 45.00 - 65.00 Hz

4.8 Multiplexed Analog Output Allocation Registers

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 4-13.

Table 4-11 Analog Output Allocation Registers

Channel	*Points*	*Channel*	*Points*
Channel #1	192-194	Channel #9	216-218
Channel #2	195-197	Channel #10	219-221
Channel #3	198-200	Channel #11	222-224
Channel #4	201-203	Channel #12	225-227
Channel #5	204-206	Channel #13	228-230
Channel #6	207-209	Channel #14	231-233
Channel #7	210-212	Channel #15	234-236
Channel #8	213-215	Channel #16	237-239

Table 4-12 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 4-13
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:193	
	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:194	
⋮	⋮	⋮	⋮	⋮
#16	40:2(read) 41:2(write)	Output parameter ID	AO:237	see Table 4-13
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:238	
	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:239	

NOTES

1. Except for the signed power factor(see note ③ for Table 4-13), 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, which is symmetrical with regard to 0 mA. In the instrument, the zero scale (0 mA output) is permanently set to 0 for all parameters except signed power factor for which it is set to 1.0. In a write request, the zero scale is ignored. No error will occur when you are trying to change it.

Table 4-13 Analog Output Parameters

Parameter	*ID*	*Unit*	*Scale range ①*	*Modulus*
None	0	n/a	0	
Real-time values per phase				
Voltage L1/L12	3072	V	0 to Vmax	
Voltage L2/L23	3073	V	0 to Vmax	
Voltage L3/L31	3074	V	0 to Vmax	
Current L1	3075	A	0 to Imax	
Current L2	3076	A	0 to Imax	
Current L3	3077	A	0 to Imax	
Real-time total values				
Total kW	3840	kW	-Pmax to Pmax	
Total kvar	3841	kvar	-Pmax to Pmax	
Total kVA	3842	kVA	0 to Pmax	
Total PF	3843	n/a	-1000 to 1000 ③	×0.001
Total PF lag	3844	n/a	0 to 1000	×0.001
Total PF lead	3845	n/a	0 to 1000	×0.001
Real-time auxiliary values				
Frequency ②	4098	Hz	0 to 10000	×0.01
Average values per phase				
Voltage L1/L12	4352	V	0 to Vmax	
Voltage L2/L23	4353	V	0 to Vmax	
Voltage L3/L31	4354	V	0 to Vmax	
Current L1	4355	A	0 to Imax	
Current L2	4356	A	0 to Imax	
Current L3	4357	A	0 to Imax	
Average total values				
Total kW	5120	kW	-Pmax to Pmax	
Total kvar	5121	kvar	-Pmax to Pmax	
Total kVA	5122	kVA	0 to Pmax	
Total PF	5123	n/a	-1000 to 1000 ③	×0.001
Total PF lag	5124	n/a	0 to 1000	×0.001
Total PF lead	5125	n/a	0 to 1000	×0.001
Average auxiliary values				
Neutral current	5377	A	0 to Imax	
Frequency ②	5378	Hz	0 to 10000	×0.01
Present demands				
Accumulated kW demand	5647	kW	0 to Pmax	
Accumulated kVA demand	5649	kVA	0 to Pmax	

① For parameter limits, see Note ① to Table 4.1.
② The actual frequency range is 45.00 to 65.00 Hz
③ 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 of the fact that 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).

4.9 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 4-13.

Table 4-14 Analog Expander Allocation Registers

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

Table 4-15 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 4-13
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:257	
	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:258	
⋮	⋮	⋮	⋮	⋮
#14	40:2(read) 41:2(write)	Output parameter ID	AO:295	see Table 4-13
	40:1(read) 41:1(write)	Zero scale (0/4 mA)	AO:296	
	40:1(read) 41:1(write)	Full scale (20/1 mA)	AO:297	

4.10 Digital Inputs Allocation Registers

These registers are used to obtain or change the allocation of the instrument digital inputs.

Table 4-16 Digital Inputs Allocation Registers

Object/ Var.	*Register contents*	*Object/ Point*	*Range*
40:2(read) 41:2(write)	Status inputs allocation ①	AO:130	see Table 4-17
40:2(read) 41:2(write)	Pulse inputs allocation ①	AO:131	see Table 4-17
40:2(read) 41:2(write)	Analog output multiplexer allocation	AO:132	see Table 4-17
40:2(read) 41:2(write)	External synchronization pulse allocation	AO:133	see Table 4-17

① These registers are configured automatically when the analog multiplexer or external synchronization inputs are allocated. An attempt to write to them will be ignored. No error will occur.

Table 4-17 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
4-15	N/A (read/written as 0)

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

4.11 Alarm Setpoints Registers

These registers allow viewing or changing the setup of the sixteen alarm setpoints.

Table 4-18 Alarm Setpoints

Setpoint #	*Points*	*Setpoint #*	*Points*
Setpoint #1	512-517	Setpoint #9	560-565
Setpoint #2	518-523	Setpoint #10	566-571
Setpoint #3	524-529	Setpoint #11	572-577
Setpoint #4	530-535	Setpoint #12	578-583
Setpoint #5	536-541	Setpoint #13	584-589
Setpoint #6	542-547	Setpoint #14	590-595
Setpoint #7	548-553	Setpoint #15	596-601
Setpoint #8	554-559	Setpoint #16	602-607

Table 4-19 Alarm Setpoint Registers

Setpoint	*Object/ Var.*	*Register contents*	*Object/ Point*	*Range/scale*
#1	40:2(read) 41:2(write)	Trigger parameter ID	AO:512	see Table 4-20
	40:1(read) 41:1(write)	Action	AO:513	see Table 4-21
	40:2(read) 41:2(write)	Operate delay	AO:514	0-9999 (× 0.1 sec)
	40:2(read) 41:2(write)	Release delay	AO:515	0-9999 (× 0.1 sec)
	40:2(read) 41:2(write)	Operate limit	AO:516	see Table 4-20
	40:2(read) 41:2(write)	Release limit	AO:517	see Table 4-20
⋮	⋮	⋮	⋮	⋮
#16	40:2(read) 41:2(write)	Trigger parameter ID	AO:602	see Table 4-20
	40:2(read) 41:2(write)	Action	AO:603	see Table 4-21
	40:2(read) 41:2(write)	Operate delay	AO:604	0-9999 (× 0.1 sec)
	40:2(read) 41:2(write)	Release delay	AO:605	0-9999 (× 0.1 sec)
	40:2(read) 41:2(write)	Operate limit	AO:606	see Table 4-20
	40:1(read) 41:1(write)	Release limit	AO:607	see Table 4-20

NOTES

1. The setpoint is disabled when its trigger parameter is set to NONE. To disable the setpoint, write zero into this register.
2. When writing the setpoint registers (except in the event when the setpoint is to be disabled), it is recommended to write all the setpoint registers using a single request, or disable the setpoint before writing into separate registers. Each value being written is checked for compatibility with the other setpoint parameters, so if the new value does not conform to those, the request will be rejected.
3. Operate and release limits for the trigger parameters and their conversion scales are indicated in Table 4-20. Each limit value occupies two contiguous registers, the first of which (low word) contains the limit value, and the second (high word) is reserved for long parameters. This register is always read as zero. When written, its value is ignored.

4. Limits indicated in Table 4-20 by an n/a mark are read as zeros and are not checked when written. Write them as zeros.
5. When a setpoint action is directed to a relay allocated to output energy pulses, an attempt to re-allocate it to a setpoint will result in a negative response.

Table 4-20 Alarm Setpoint Trigger Parameters

Trigger parameter	*Trigger ID*		*Operate/Release Limits*		
	Hex	*Dec*	*Unit*	*Range ①*	*Modulus*
None	0000	0		0	
Status inputs					
Status input #1 ON	0600	1536		n/a	
Status input #2 ON	0601	1537		n/a	
Status input #3 ON	0602	1538		n/a	
Status input #4 ON	0603	1539		n/a	
Status input #1 OFF	8600	34304		n/a	
Status input #2 OFF	8601	34305		n/a	
Status input #3 OFF	8602	34306		n/a	
Status input #4 OFF	8603	34307		n/a	
Phase reversal					
Positive phase rotation reversal ②	8901	35073		n/a	
Negative phase rotation reversal ②	8902	35074		n/a	
High/low real-time values per phase					
High current L1	0C03	3075	A	0 to Imax	
High current L2	0C04	3076	A	0 to Imax	
High current L3	0C05	3077	A	0 to Imax	
Low current L1	8C03	35843	A	0 to Imax	
Low current L2	8C04	35844	A	0 to Imax	
Low current L3	8C05	35845	A	0 to Imax	
High/low real-time values on any phase					
High voltage	0E00	3584	V	0 to Vmax	
Low voltage	8D00	36096	V	0 to Vmax	
High voltage THD	0E07	3591	%	0 to 9999	×0.1
High current THD	0E08	3592	%	0 to 9999	×0.1
High current TDD	0E0A	3594	%	0 to 9999	×0.1
High/low real-time auxiliary values					
High frequency ③	1002	4098	Hz	0 to 10000	×0.01
Low frequency ③	9002	36866	Hz	0 to 10000	×0.01
High/low average values per phase					
High current L1	1103	4355	A	0 to Imax	
High current L2	1104	4356	A	0 to Imax	
High current L3	1105	4357	A	0 to Imax	
Low current L1	9103	37123	A	0 to Imax	
Low current L2	9104	37124	A	0 to Imax	
Low current L3	9105	37125	A	0 to Imax	

Trigger parameter	Trigger ID		Operate/Release Limits		
	Hex	Dec	Unit	Range ①	Modulus
High/low average values on any phase					
High voltage	1300	4864	V	0 to Vmax	
Low voltage	9200	37376	V	0 to Vmax	
High/low average total values					
High total kW import	1406	5126	kW	0 to Pmax	
High total kW export	1407	5127	kW	0 to Pmax	
High total kvar import	1408	5128	kvar	0 to Pmax	
High total kvar export	1409	5129	kvar	0 to Pmax	
High total kVA	1402	5122	kVA	0 to Pmax	
Low total PF lag	9404	37892		0 to 1000	×0.001
Low total PF lead	9405	37893		0 to 1000	×0.001
High average auxiliary values					
High neutral current	1501	5377	A	0 to Imax	
High present demands					
High ampere demand L1	1603	5635	A	0 to Imax	
High ampere demand L2	1604	5636	A	0 to Imax	
High ampere demand L3	1605	5637	A	0 to Imax	
High block kW demand	1606	5638	kW	0 to Pmax	
High block kVA demand	1608	5640	kVA	0 to Pmax	
High sliding window kW demand	1609	5641	kW	0 to Pmax	
High sliding window kVA demand	160B	5643	kVA	0 to Pmax	
High accumulated kW demand	160F	5647	kW	0 to Pmax	
High accumulated kVA demand	1611	5649	kVA	0 to Pmax	

① For the parameter limits, see note ① to Table 4-1.

② The setpoint is operated when the actual phase sequence does not match the indicated phase rotation.

③ The actual frequency range is 45.00 - 65.00 Hz.

Table 4-21 Setpoint Actions

Description	Action ID	
	Hex	Dec
No action	0000	0
Operate relay #1	3000	12288
Operate relay #2	3001	12289

4.12 Pulsing Setpoints Registers

These registers are used for viewing or changing the setup of the pulsing output for either of the 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 4-22 Pulsing Setpoints

Relay	Registers
Relay #1	768-769
Relay #2	770-771

Table 4-23 Pulsing Setpoint Registers

Object/ Var.	Register Contents	Object/ Point	Range
40:2(read) 41:2(write)	Output parameter ID	AO:768	see Table 4-24
40:2(read) 41:2(write)	Number of unit-hours per pulse	AO:769	1-9999 for energy pulsing, otherwise write 0.
40:2(read) 41:2(write)	Output parameter ID	AO:770	see Table 4-24
40:2(read) 41:2(write)	Number of unit-hours per pulse	AO:771	1-9999 for energy pulsing, otherwise write 0.

Table 4-24 Pulsing Output Parameters

Pulsing Parameter	Identifier
None	0
kWh import	1
kWh export	2
kvarh import (inductive)	4
kvarh export (capacitive)	5
kvarh total	6
kVAh	7

4.13 Relay Operation Control Registers

These registers 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 4-25 Relay Operation Control Registers

Object/ Var.	Register contents	Object/ Point	Range
10:2(read) 12:1(write)	Relay Force operate/Force release/Normal	BO:80 CROB:80	0/1 = state OFF/ON
10:2(read) 12:1(write)	Relay Force operate/Force release/Normal	BO:81 CROB:81	0/1 = state OFF/ON

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

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:
  codes of Latch On, Latch Off are valid for all points;
  all others *Codes* are invalid and will be rejected;
  the *Clear* sub-field is valid;
  the others sub-fields are ignored.
- 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:
  a status of *Request Accepted* (0) will be return if the command was accepted;
  a status of *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;
  a status of *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, use the Direct-Operate (or SBO/Operate or Direct-Operate-No-Acknowledge) command to the appropriate point of the Control-Relay-Output-Block object with the *Control Code* value *Latch On*. To manually release relay, use the Direct-Operate (or Direct-Operate-No-Acknowledge) command to the appropriate point of the Control-Relay-Output-Block object with the *Control Code* value *Latch Off*. To revert relay to normal operation, use the Direct-Operate (or Direct-Operate-No-Acknowledge) command to the appropriate point of the Control-Relay-Output-Block object with the *Control Code* value *Nul Operation* and *Clear* sub-field being set to 1.

4.14 Class 0 Object Assignment

The *RPT091* provides Read / Direct-Operate(or SBO/Operate or Direct-Operate-No-Acknowledge) Configuration Points ## 96-119 that allow the user to configure Class 0 object assignment. These Configuration points are currently defined as shown in Table 4-26.

Table 4-26 Class 0 Object Assignment

Object/ Var.	***Parameter Group***	***Object/ Point***
10:2(read) 12:1(write)	Basic Data Parameters	BO:96 CROB:96
10:2(read) 12:1(write)	Basic Energy Parameters	BO:97 CROB:97
10:2(read) 12:1(write)	Basic Setup Parameters	BO:98 CROB:98
10:2(read) 12:1(write)	Firmware & Instrument Options	BO:99 CROB:99

Object/ Var.	*Parameter Group*	*Object/ Point*
10:2(read) 12:1(write)	Communication Setup Parameters	BO:100 CROB:100
10:2(read) 12:1(write)	Real- time values per phase	BO:101 CROB:101
10:2(read) 12:1(write)	Real- time total values	BO:102 CROB:102
10:2(read) 12:1(write)	Real- time auxiliary values	BO:103 CROB:103
10:2(read) 12:1(write)	Average values per phase	BO:104 CROB:104
10:2(read) 12:1(write)	Average values total	BO:105 CROB:105
10:2(read) 12:1(write)	Average values auxiliary	BO:106 CROB:106
10:2(read) 12:1(write)	Present demands	BO:107 CROB:107
10:2(read) 12:1(write)	Total energies	BO:108 CROB:108
10:2(read) 12:1(write)	Phase energies	BO:109 CROB:109
10:2(read)	Reserved	110-118
10:2(read) 12:1(write)	Maximum demands	BO:119 CROB:119
10:2(read)	Reserved	120-127

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

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:
  codes of Latch On, Latch Off are valid for all points;
  all others codes are invalid and will be rejected;
  all sub-fields are ignored.
- 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:
  a status of *Request Accepted* (0) will be return if the command was accepted;
  a status of *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.

The Basic Data Parameters (point 96) & Basic Setup Parameters (point 98) are assigned to Class 0 by default. Setting a value of the particular point to 1 causes the indicated objects to be sent. Attempting to set all points from the range 96 -127 to 0 causes default setting when the Class 0 object is requested.

Appendix A DNP Application Messages

The Powermeter is a DNP IED responding to external DNP Master requests. *Table A-1* describes the *RPT091* 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
10	0	Binary Output	1	A	129	01
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	Counter (responds like 20:5)	1	B	129	01
20	5	32-bit Binary Counter without flag	1	A	129	C
20	6	16-bit Binary Counter without flag	1	A	129	C
30	0	Analog Input (respond like 30:3)	1	B	129	01
30	3	32-bit Analog Input without flag	1	A	129	C
30	4	16-bit Analog Input without flag	1	A	129	C
40	0	Analog Output Status (responds like 40:2)	1	B	129	01
40	1	32-bit Analog Output Status	1	A	129	C
40	2	16-bit Analog Output Status	1	A	129	C
41	1	32-bit Analog Output Block	3,4,5	A	129	C
41	2	16-bit Analog Output Block	3,4,5	A	129	C
41	1	32-bit Analog Output Block	6	A	None	N/A
41	2	16-bit Analog Output Block	6	A	None	N/A
50	1	Time and Date ①	1,2	A	129	C
60	1	Class 0	1	B	129	01
60	2	Class 1	1	06,07,08	129	N/R
60	3	Class 2	1	06,07,08	129	N/R

OBJECT			REQUEST		RESPONSE	
Obj	**Var**	**Description**	**Func. Code**	**Qual. Code**	**Func. Code**	**Qual. Code**
60	4	Class 3	1	06,07,08	129	N/R
80	1	Internal indication ②	2	D	129	N/A
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 1or an index of 0 only as there is only one instance of this object defined in the Powermeter.
② - For this object, the qualifier code must specify an index 7 only.
③ - Respond with a time object 50 variation 2 indicating time till Powermeter 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

The Powermeter is a DNP IED responding to external DNP Master requests. *Table A-1* describes the *RPT091* 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.

Appendix B DNP Device Profile

<table>
<tr><td colspan="2">DNP V3.00
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)</td></tr>
<tr><td colspan="2">Vendor Name: SATEC Ltd.</td></tr>
<tr><td colspan="2">Device Name: Powermeter Series RPT091</td></tr>
<tr><td>Highest DNP Level Supported:
For Requests L1
For Responses L1</td><td>Device Function:
☐ Master ■ Slave</td></tr>
<tr><td colspan="2">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 (Energy and Demand Reset Command) requires specific parameters described in this manual. Treats range field of qualifier 07 and 08 to mean point range [0..N-1].</td></tr>
<tr><td>Maximum Data Link Frame Size (octets):
Transmitted 292
Received 292</td><td>Maximum Application Fragment Size (octets):
Transmitted 2048
Received 249</td></tr>
<tr><td>Maximum Data Link Re-tries:
■ None
☐ Fixed at_____
☐ Configurable, range ___ to_____</td><td>Maximum Application Layer Re-tries:
■ None
☐ Configurable, range ____ to _____
(Fixed is not permitted)</td></tr>
</table>

Device Profile Document (continued)

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

Others

_____

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	■ Sometimes①	☐ 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 21

② ③ used to configure Class 0 object assignment (points 96 to 119)

② ③ ④ used to control Relays associated with point 80

③ used to reset the setpoint alarm and self-check alarm registers associated with points 48 to 74

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 #2 0 to 9999999 #0,3 0 to -9999999 #1 ☐ Point-by-point list attached
Sends Multi-Fragment Responses: ■Yes ☐ No	