SERIES PM130EH POWERMETERS

COMMUNICATIONS

ASCII Communications Protocol

REFERENCE GUIDE

Every effort has been made to ensure that the material herein is complete and accurate. However, the manufacturer is not responsible for any mistakes in printing or faulty instructions contained in this book. Notification of any errors or misprints will be received with appreciation.

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

BG0372 Rev.A2

Table of Contents

1 GENERAL

This document specifies the ASCII serial communications protocol used to transfer data between a master computer station and the PM130EH. The document provides the complete information necessary to develop third-party communications software capable of communication with the Series PM130EH instruments.

All messages within the ASCII communications protocol are designed to consist only of printable characters.

Additional information concerning communications operation, configuring the communications parameters and communications connections is found in "Series PM130EH Powermeters, Installation and Operation Manual".

IMPORTANT

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

2 ASCII FRAMING

2.1 ASCII Message Frame

The following specifies the ASCII message frame:

Field No.	1	2	3	4	5	6	7
Contents	SYNC (!)	Message length	Slave address	Message type	Message body	Check sum	Trailer (CRLF)
Length, char	1	3	2	1	0 to 246	1	2

SYNC

Synchronization character: one character '!' (ASCII 33), used for starting synchronization.

Message length

The length of the message including only number of bytes in fields #2, #3, #4 and #5. Contains three characters between '006' and '252'.

Slave address

Two characters between '00' and '99'. The instrument with address '00' responds to requests with any incoming address. For RS-422/RS-485 communications (multi-drop mode), this field must NEVER be zero.

Message type

One character representing the type of a host request. A list of the message types is shown in Tables 2-1 and 2-2. Note that they are case-sensitive.

Message body

Contains the message parameters in ASCII representation. All parameter fields have a fixed format. The data fields vary in length depending on the data type. Unless otherwise indicated, the parameters should be right justified and left-padded with zeros. Most parameters are represented in ASCII hexadecimal notation, and in some cases (to provide compatibility with old instruments) a decimal representation is preserved. For data formats, see Section 3.2.

Check sum

Arithmetic sum, calculated in a 2-byte word over fields #2, #3, #4 and #5 to produce a one-byte check sum in the range of 22h to 7Eh (hexadecimal) as follows: $[\sum(\text{each byte} - 22H)] \bmod 5CH + 22H$

Trailer

Two ASCII characters CR (ASCII 13) and LF (ASCII 10).

NOTE

Fields #3 and #4 of the instrument response are always the same as those in the host request.

Table 2-1 Specific ASCII Requests

Message type		Description
Char	**ASCII Hex**	
0	0x30	Read basic data registers
1	0x31	Read basic setup
2	0x32	Write basic setup
3	0x33	Read instrument status
4	0x34	Reset/clear functions
8	0x38	Reset the instrument
9	0x39	Read version number
?	0x3F	Read extended status

Message type		Description
Char	ASCII Hex	
G	0x47	Read pulsing setpoint
g	0x67	Write pulsing setpoint
O	0x4F	Read Min/Max log

Table 2-2 Direct Read/Write ASCII Requests

Message type		Description
Char	ASCII Hex	
A	0x41	Long-size direct read
a	0x61	Long-size direct write
X	0x58	Variable-size direct read
x	0x78	Variable-size direct write

2.2 ASCII Specific and Direct Requests

The ASCII protocol implements two different types of messages to transfer data between a master application and the instrument: specific requests and direct read/write requests.

Specific ASCII requests use different formats for accessing different data locations. The message body differs depending on the request type. Each data field has a fixed position in the ASCII string. Chapter 4 describes specific ASCII requests and their message body formats.

Direct read/write requests use a universal message body format, specified in Section 5.1. These requests allow a master application to access different data locations (registers) in the instrument by specifying a direct register index. A number of consequent registers can be read or written by a single request by specifying an arbitrary start register and the number of registers to be accessed. Chapter 5 describes registers accessed via direct read/write requests and their contents.

All measurement data in your instrument can be accessed using direct read requests, and some data can be read via specific ASCII requests. In all cases, a direct register read offers you more precise data with extended resolution. Setup data can be partially accessed using both specific and direct requests, and partially via either specific or direct requests.

2.3 Data Formats

Specific ASCII requests use both decimal and hexadecimal notation. Direct requests transfer ASCII data only in a hexadecimal notation.

Using a decimal notation, data is transmitted in a decimal representation as is, i.e., no conversion is needed. Negative numbers are transmitted with a sign at the left. Fractional numbers are represented with a decimal point. When the value exceeds the field range, it is truncated to the right.

In a hexadecimal notation, each data byte is transferred by two hexadecimal characters in ASCII representation (i.e., ASCII printable characters 0-9, A-F are used to represent hexadecimal digits 0h-9h, 0ah-0fh). All data is transferred as 2-character (8-bit unsigned byte), 4-character (16-bit unsigned or signed integer) or 8-character (32-bit unsigned or signed long integer) whole numbers. Negative numbers are transmitted in 2-complement code. Each data byte is transmitted high order digit first. Each integer or long integer register is transmitted high order bytes first.

Fractional numbers are transmitted being scaled by 10 in power N, where N is the number of digits in the fractional part. For example, the frequency reading of 50.01 Hz is transmitted as 5001 being pre-multiplied by 100. Whenever a data register contains a fractional number, the register measurement unit is given with a multiplier ×0.1, ×0.01 or ×0.001, showing an actual register resolution (the weight of the least significant decimal digit). To get an actual fractional number with specified precision, scale the register value with the given multiplier. To write a fractional number into the register, divide the number by the given multiplier.

3 EXCEPTION RESPONSES

The instrument will send the following error codes in the message body in response to incorrect host requests:

XK - the instrument is in programming mode
XM - invalid request type or illegal operation
XP - invalid data address or data value, or data is not available

NOTE

When a check or framing error is detected, the instrument will not act on or respond to the master's request.

4 SPECIFIC ASCII REQUESTS

4.1 Basic Data

Table 4-1 Read Request

Message type (ASCII)					
0					
Message body (decimal)					
Request - no body					
Response					
Field	**Offset**	**Length**	**Parameter**	**Unit** [2]	**Range** [1]
1	0	4	Voltage L1/L12 [6]	V/kV	0 to Vmax
2	4	4	Voltage L2/L21 [6]	V/kV	0 to Vmax
3	8	4	Voltage L3/L31 [6]	V/kV	0 to Vmax
4	12	5	Current L1	A	0 to Imax
5	17	5	Current L2	A	0 to Imax
6	22	5	Current L3	A	0 to Imax
7	27	6	kW L1	kW/MW	-Pmax to Pmax
8	33	6	kW L2	kW/MW	-Pmax to Pmax
9	39	6	kW L3	kW/MW	-Pmax to Pmax
10	45	4	Power factor L1		-.99 to 1.00 [4]
11	49	4	Power factor L2		-.99 to 1.00 [4]
12	53	4	Power factor L3		-.99 to 1.00 [4]
13	57	6	kW total	kW/MW	-Pmax to Pmax
14	63	4	Power factor total		-.99 to 1.00 [4]
15	67	6	kWh import	MWh [3]	0 to 99999.
16	73	5	Neutral (unbalanced) current	A	0 to Imax
17	78	4	Frequency	Hz	45.0 to 65.0
18	82	6	kvar L1	kvar/Mvar	-Pmax to Pmax
19	88	6	kvar L2	kvar/Mvar	-Pmax to Pmax
20	94	6	kvar L3	kvar/Mvar	-Pmax to Pmax
21	100	6	kVA L1	kVA/MVA	0 to Pmax
22	106	6	kVA L2	kVA/MVA	0 to Pmax
23	112	6	kVA L3	kVA/MVA	0 to Pmax
24	118	6	kvarh net	Mvarh [3]	-9999. to 99999.
25	124	6	kvar total	kvar/Mvar	-Pmax to Pmax
26	130	6	kVA total	kVA/MVA	0 to Pmax
27	136	6	Maximum sliding window kW import demand [5]	kW/MW	0 to Pmax
28	142	6	Accumulated kW import demand	kW/MW	0 to Pmax
29	148	5	Max. ampere demand L1	A	0 to Imax
30	153	5	Max. ampere demand L2	A	0 to Imax
31	158	5	Max. ampere demand L3	A	0 to Imax
32	163	2	Reserved		0
33	165	6	kWh export	MWh [3]	0 to 99999.
34	171	6	Maximum sliding window kVA demand [5]	kVA/MVA	0 to Pmax
35	177	4	Voltage THD L1/L12 [7]	%	0.0 to 999.
36	181	4	Voltage THD L2/L23 [7]	%	0.0 to 999.
37	185	4	Voltage THD L3 [7]	%	0.0 to 999.
38	189	4	Current THD L1	%	0.0 to 999.
39	193	4	Current THD L2	%	0.0 to 999.
40	197	4	Current THD L3	%	0.0 to 999.
41	201	8	kVAh	MVAh [3]	0 to 99999.99
42	209	6	Present sliding window kW import demand [5]	kW/MW	0 to Pmax
43	215	6	Present sliding window kVA demand [5]	kVA/MVA	0 to Pmax
44	221	4	PF (import) at maximum KVA demand		0 to 1.00
45	225	4	Current TDD L1	%	0.0 to 99.9
46	229	4	Current TDD L2	%	0.0 to 99.9
47	233	4	Current TDD L3	%	0.0 to 99.9

1 The parameter limits are as follows:

Vmax (690 V input option) = 828V @ PT Ratio = 1

Vmax (690 V input option) = 144 × PT Ratio [V] @ PT Ratio > 1
Vmax (120 V input option) =144 × PT Ratio [V]
Imax (x150% over-range) = 1.5 × CT primary current [A]
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

2 The value is transmitted as a whole number until the field is filled up, and then it is converted to higher units and transmitted with a decimal point (when the value is greater than the field width, the right most digits of the fractional part will be truncated). Voltages are transmitted in volts as whole numbers or in kilovolts with a decimal point, currents in amperes as whole numbers, and powers in kilowatts as whole numbers or in megawatts with a decimal point.

3 Energy readings are transmitted in MWh, Mvarh and MVAh units with a decimal point. If the energy value exceeds the field resolution, the right-most digits are truncated. The energy roll value is user selectable (see Section 5.4).

4 For negative power factor, the minus sign is transmitted before a decimal point as shown in the table.

5 To get block interval demand readings, set the number of demand periods equal to 1 (see Table 4-4).

6 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.

7 In the 4LN3, 4LL3, 3LN3, 3LL3 and 3DIR2 wiring modes, the harmonic voltages will represent line-to-neutral voltages; in the 3OP2 and 3OP3 wiring modes, they will comprise L12 and L23 line-to-line voltages.

4.2 Basic Setup

Table 4-2 Read Request

Message type (ASCII)				
1				
Message body (decimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	3	Parameter identifier	See Table 4-4
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	3	Parameter identifier	See Table 4-4
2	3	4	Not used	Permanently set to 00.0
3	7	6	Parameter value	See Table 4-4

Table 4-3 Write Request

Message type (ASCII)				
2				
Message body (decimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	3	Parameter identifier	See Table 4-4
2	3	4	Not used	Set to 00.0
3	7	6	Parameter value	See Table 4-4

Table 4-4 Basic Setup Parameters

Parameter	Identifier	Range
Wiring mode 1	W40	0 = 3OP2, 1 = 4LN3, 2 = 3DIR2, 3 = 4LL3, 4 = 3OP3, 5 = 3LN3, 6 = 3LL3
PT ratio	U14	1.0 to 6500.0
CT primary current	I17	1 to 50000 A
Power demand period	D11	1,2,5,10,15,20,30,60 min 255 = external synchronization 2
The number of demand periods	F47	1 – 15
Volt/ampere demand period	C12	0 to 1800 sec
Averaging buffer size	S41	8, 16, 32
Reset enable/disable	R42	0 = disable, 1 = enable
Nominal frequency	Q51	50, 60

Parameter	Identifier	Range
Maximum demand load current	Q52	0 to 50000 A (0 = CT primary current)

[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] Synchronization of power demand interval can be made through communications using the Synchronize power demand interval command (see Table 5-23)

4.3 Instrument Status

Table 4-5 Read Request

Message type (ASCII)				
3				
Message body (hexadecimal)				
Request - no body				
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	8	Not used	00000000
2	8	1	Not used	0
3	9	1	Relay status	See Table 4-6

Table 4-6 Relay Status

Bit	Description
0-2	N/A (permanently set to 1)
3	Relay status

Bit meaning: 0 = relay operated, 1 = relay released

4.4 Reset/Clear Functions

These operations can be also performed by using the direct write requests instead of the specific request '4' (see Section 5.11).

Table 4-7 Write Request

Message type (ASCII)				
4				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	1	Reset function	See Table 4-8
2	1	2	Target	See Table 4-8 (the field can be omitted if it is equal to 0)

Table 4-8 Reset/Clear Functions

Function	Description	Target
1	Clear total energy registers	0
2	Clear total maximum demand registers	0 = all maximum demands 1 = power demands 2 = volt/ampere demands
3-4	Reserved	
5	Clear event/time counters	0 = all counters 1-4 = counter #1 - #4

Function	Description	Target
6	Clear Min/Max log	0
7-F	Reserved	

4.5 Reset the Instrument (warm restart)

This request causes the instrument to perform full reset and restart, the same as when the instrument is turned on. No response is expected.

Table 4-9 Write Request

Message type (ASCII)
8
Message body
Request - no body
Response - no response

4.6 Read Firmware Version Number

Table 4-10 Read Request

Message type (ASCII)				
9				
Message body (decimal)				
Request - no body				
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	3	Firmware version	300-399

4.7 Extended Instrument Status

Table 4-11 Read Request

Message type (ASCII)				
?				
Message body (hexadecimal)				
Request - no body				
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	4	Relay status	See Table 4-12
2	4	4	Not used	0
3	8	4	Not used	0
4	12	4	Setpoints status	See Table 4-13
5	16	4	Log status	See Table 4-14
6	20	36	Not used	0

Table 4-12 Relay Status

Bit	Description
0	Relay status
1-15	Not used (permanently set to 0)

Bit meaning: 0 = relay released, 1 = relay operated

Table 4-13 Setpoints Status

Bit	Description
0	Setpoint # 1 status
1	Setpoint # 2 status
2	Setpoint # 3 status
3	Setpoint # 4 status
4	Setpoint # 5 status
5	Setpoint # 6 status
6	Setpoint # 7 status
7	Setpoint # 8 status
8	Setpoint # 9 status
9	Setpoint # 10 status
10	Setpoint # 11 status
11	Setpoint # 12 status
12	Setpoint # 13 status
13	Setpoint # 14 status
14	Setpoint # 15 status
15	Setpoint # 16 status

Bit meaning: 0 = setpoint is released, 1 = setpoint is operated

Table 4-14 Log Status

Bit	Description
0	Reserved
1	New Min/Max log
2-15	Not used (permanently set to 0)

Bit meaning: 0 = no new logs, 1 = new log recorded (the new log flag is reset when the user reads the first log record after the flag has been set)

4.8 Pulsing Setpoints

Table 4-15 Read Request

Message type (ASCII)				
G				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0 (see Table 4-17)
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0 (see Table 4-17)
2	2	2	Output parameter ID	See Table 4-18
3	4	4	For energy pulsing = number of unit-hours per pulse, otherwise - permanently set to 0	0-9999

Table 4-16 Write Request

Message type (ASCII)				
g				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0 (see Table 4-17)
2	2	2	Output parameter ID	See Table 4-18
3	4	4	For energy pulsing = number of unit-hours per pulse, otherwise - set to 0	0-9999

Table 4-17 Pulse Outputs

Pulsing output ID	Output allocation
0	Relay

Table 4-18 Pulsing Output Parameters

Pulsing parameter ID	Identifier
None	0
kWh import	1
kWh export	2
kvarh import	4
kvarh export	5
kvarh total (absolute)	6
kVAh total	7

4.9 Min/Max Log

The Min/Max log read request is supported only for compatibility with other models of instruments. Because the Min/Max log is not time stamped in the PM130EH, this request returns you only values of the Min/Max log parameters which you can read directly via extended data registers (see Table 5-7).

Table 4-19 Read Request

Message type (ASCII)					
O					
Message body (hexadecimal)					
Request					
Field	**Offset**	**Length**	**Parameter**		**Range**
1	0	4	Start Min/Max parameter ID		See Table 5-7
2	4	2	The number of subsequent parameters to read		1-12
Response					
Field	**Offset**	**Length**	**Parameter**		**Range**
1	0	2	The number of parameters in message		1-12
2	2	2	Log parameter #1	Second	0
3	4	2		Minute	0
4	6	2		Hour	0
5	8	2		Day	0
6	10	2		Month	0
7	12	2		Year	0
8	14	8		Parameter value	See Table 5-7
9	22	2	Log parameter #2	Second	0
10	24	2		Minute	0
11	26	2		Hour	0
12	28	2		Day	0
13	30	2		Month	0
14	32	2		Year	0
15	34	8		Parameter value	See Table 5-7
. . .					
79	222	2	Log parameter #12	Second	0
80	224	2		Minute	0
81	226	2		Hour	0
82	228	2		Day	0
83	230	2		Month	0
84	232	2		Year	0
85	234	8		Parameter value	See Table 5-7

This request allows you to obtain the Min/Max log parameters. Up to 12 parameters can be read in one packet from a single parameter group. The available Min/Max log parameters are listed in Table 5-7. The time stamp is not available in the PM130EH and is padded with zeros.

5 DIRECT READ/WRITE REQUESTS

5.1 General

This chapter describes the instrument data locations (registers) that are addressed directly using register indexes. These registers can be accessed by using universal direct read/write requests instead of specific ASCII requests, which use different formats for accessing different data locations.

Data (register) indexes are given in a 4-digit hexadecimal format. All data are transmitted in ASCII hexadecimal notation as 2-character (UINT8, 8-bit unsigned byte), 4-character (16-bit unsigned UINT16 or signed INT16 integer) or 8-character (32-bit unsigned UINT32 or signed INT32 long integer) numbers. Negative numbers are transmitted in 2-complement code. Register type in the tables below shows an actual data size for data accessed using variable-size direct read/write requests. When long-size direct read/write request is used, an actual data size is ignored and all registers are transmitted in 8-character format as long signed (INT32) or unsigned (UINT32) integers.

5.1.1 Long-Size Direct Read/Write

Table 5-1 Read Request

Message type (ASCII)				
'A'				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT16	Start point (register) ID to read	0x0000 - 0xFFFF
2	4	UINT8	The number of contiguous data items to read	1-30 (0x01-0x1E)
Response				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT8	Number of data items in the message	1-30 (0x01-0x1E)
2	2	INT32	Data #1 value	
3	10	INT32	Data #2 value	
…	…	…	…	
31	234	INT32	Data #30 value	

Table 5-2 Write Request

Message type (ASCII)				
'a'				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT16	Point (register) ID to write	0x0000 - 0xFFFF
2	4	INT32	Data value to write	

In long-size direct read/write messages, all data items are read and written as long unsigned (UINT32) or signed (INT32) integers, which are represented in messages by 8-digit hexadecimal numbers, regardless of the actual data size.

By using a long-size direct read request, up to 30 contiguous parameters can be read at once. A write request allows for writing only one data location at a time.

5.1.2 Variable-Size Direct Read/Write

Table 5-3 Read Request

Message type (ASCII)				
'X'				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT16	Start point (register) ID to read	0x0000 - 0xFFFF
2	4	UINT8	The number of contiguous data items to read	1-61 (0x01-0x3D)
Response				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT8	Number of data items in the message	1-61 (0x01-0x3D)
2	2	INT8/16/32	Data #1 value	
3		INT8/16/32	Data #2 value	
...	...	...	...	
60		INT8/16/32	Data #60 value	

Table 5-4 Write Request

Message type (ASCII)				
'x'				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT16	Start point (register) ID to write	0x0000 - 0xFFFF
2	4	UINT8	The number of contiguous data items to write	1-61 (0x01-0x3D)
3	6	INT8/16/32	Data #1 value	
4		INT8/16/32	Data #2 value	
...	...	...	...	
60		INT8/16/32	Data #60 value	
Request				
Field	**Offset**	**Type**	**Parameter**	**Range**
1	0	UINT16	Start point (register) ID written	0x0000 - 0xFFFF
2	4	UINT8	The number of data items written	1-61 (0x01-0x3D)

With variable-size direct read/write messages, data items are read and written as 2, 4 or 8-character hexadecimal numbers. The actual data size is indicated for each data location. When written, the data format should be exactly the same as indicated.

The number of parameters that can be read or written by a single read/write request depends on the size of each data item. The total length of all parameters should not exceed 240 characters.

5.1.3 User Assignable Registers

The instrument contains 120 user assignable registers in the range of addresses 0x8000 to 0x8077 (see Table 5-5). You can map any of these registers to either register address, accessible in the instrument through direct read/write requests. Registers that reside in different locations may be accessed by a single request by re-mapping them to adjacent addresses in the user assignable registers area.

The actual addresses of the user assignable registers, which are accessed via points 0x8000 to 0x8077, are specified in the user assignable register map. It occupies addresses 0x8100 to 0x8177 (see Table 5-6), where the map register 0x8100 should contain the actual address of the register accessed via assignable register 0x8000, register 0x8101 should contain the actual address of the register accessed via assignable register 0x8001, and so on. Note that the user assignable registers and the user register map addresses may not be re-mapped.

Table 5-5 User Assignable Registers

Register	Register contents	Type	R/W	Range
0x8000	Assigned register #0	[1]	[1]	[1]
0x8001	Assigned register #1	[1]	[1]	[1]
…	…	…		
0x8077	Assigned register #119	[1]	[1]	[1]

[1] Depends on the mapped register

Table 5-6 User Assignable Register Map

Register	Register contents	Type	R/W	Range
0x8100	Mapped address for register 0x8000	UINT16	R/W	0x0000 - 0xFFFF
0x8101	Mapped address for register 0x8001	UINT16	R/W	0x0000 - 0xFFFF
…	…	…		
0x8177	Mapped address for register 0x8077	UINT16	R/W	0x0000 - 0xFFFF

To build your own register map, write to map registers (0x8100 to 0x8177) the actual addresses you want to read from or write to via the assignable area (0x8000 to 0x8077). For example, if you want to read registers 0x0C00 (real-time voltage of phase A) and 0x1700 (kWh import) via registers 0x8000-0x8001, do the following:

- write 0x0C00 to register 0x8100
- write 0x1700 to register 0x8101

Reading from registers 0x8000-0x8001 will return the voltage reading in register 0x8000, and the kWh reading in register 0x8001.

5.2 Extended Data Registers

Table 5-7 Extended Data Table

Parameter	Point ID	Type	R/W	Unit	Range[1]
None					
None	0x0000	UINT16	R		0
Relays					
Relay status (bitmap)	0x0800	UINT16	R		See Table 4-12
Pulse counters					
Pulse counter #1	0x0A00	UINT32	R/W		0 to 99999
Pulse counter #2	0x0A01	UINT32	R/W		0 to 99999
Pulse counter #3	0x0A02	UINT32	R/W		0 to 99999
Pulse counter #4	0x0A03	UINT32	R/W		0 to 99999
Real-time values per phase					
Voltage L1/L12 [4]	0x0C00	UINT32	R	V	0 to Vmax
Voltage L2/L23 [4]	0x0C01	UINT32	R	V	0 to Vmax
Voltage L3/L31 [4]	0x0C02	UINT32	R	V	0 to Vmax
Current L1	0x0C03	UINT32	R	A	0 to Imax
Current L2	0x0C04	UINT32	R	A	0 to Imax
Current L3	0x0C05	UINT32	R	A	0 to Imax
kW L1	0x0C06	INT32	R	kW	-Pmax to Pmax
kW L2	0x0C07	INT32	R	kW	-Pmax to Pmax
kW L3	0x0C08	INT32	R	kW	-Pmax to Pmax
kvar L1	0x0C09	INT32	R	kvar	-Pmax to Pmax
kvar L2	0x0C0A	INT32	R	kvar	-Pmax to Pmax
kvar L3	0x0C0B	INT32	R	kvar	-Pmax to Pmax
kVA L1	0x0C0C	UINT32	R	kVA	0 to Pmax
kVA L2	0x0C0D	UINT32	R	kVA	0 to Pmax
kVA L3	0x0C0E	UINT32	R	kVA	0 to Pmax
Power factor L1	0x0C0F	INT16	R	0.001	-999 to 1000
Power factor L2	0x0C10	INT16	R	0.001	-999 to 1000
Power factor L3	0x0C11	INT16	R	0.001	-999 to 1000

Parameter	Point ID	Type	R/W	Unit	Range[1]
Voltage THD L1/L12 [5]	0x0C12	UINT16	R	0.1%	0 to 9999
Voltage THD L2/L23 [5]	0x0C13	UINT16	R	0.1%	0 to 9999
Voltage THD L3 [5]	0x0C14	UINT16	R	0.1%	0 to 9999
Current THD L1	0x0C15	UINT16	R	0.1%	0 to 9999
Current THD L2	0x0C16	UINT16	R	0.1%	0 to 9999
Current THD L3	0x0C17	UINT16	R	0.1%	0 to 9999
K-Factor L1	0x0C18	UINT16	R	0.1	10 to 9999
K-Factor L2	0x0C19	UINT16	R	0.1	10 to 9999
K-Factor L3	0x0CA	UINT16	R	0.1	10 to 9999
Current TDD L1	0x0C1B	UINT16	R	0.1%	0 to 1000
Current TDD L2	0x0C1C	UINT16	R	0.1%	0 to 1000
Current TDD L3	0x0C1D	UINT16	R	0.1%	0 to 1000
Voltage L12	0x0C1E	UINT32	R	V	0 to Vmax
Voltage L23	0x0C1F	UINT32	R	V	0 to Vmax
Voltage L31	0x0C20	UINT32	R	V	0 to Vmax
Real-time total values					
Total kW	0x0F00	INT32	R	kW	-Pmax to Pmax
Total kvar	0x0F01	INT32	R	kvar	-Pmax to Pmax
Total kVA	0x0F02	UINT32	R	kVA	0 to Pmax
Total PF	0x0F03	INT16	R	0.001	-999 to 1000
Real-time auxiliary values					
Reserved	0x1000	UINT32	R		0
Neutral current	0x1001	UINT32	R	A	0 to Imax
Frequency	0x1002	UINT16	R	0.01Hz	0 to 10000 [3]
Voltage unbalance	0x1003	UINT16	R	1%	0 to 300
Current unbalance	0x1004	UINT16	R	1%	0 to 300
Phasors [6]					
Voltage L1/L12	0x1080	UINT32	R	V	0 to Vmax
Voltage L2/L23	0x1081	UINT32	R	V	0 to Vmax
Voltage L3/L31	0x1082	UINT32	R	V	0 to Vmax
Reserved	0x1083	UINT32	R	V	0 to Vmax
Current L1	0x1084	UINT32	R	A	0 to Imax
Current L2	0x1085	UINT32	R	A	0 to Imax
Current L3	0x1086	UINT32	R	A	0 to Imax
Reserved	0x1087	UINT32	R	A	0 to Imax
V1/V12 Voltage angle	0x1088	UINT16	R	0.1º	-180.0 to 180.0
V2/V23 Voltage angle	0x1089	UINT16	R	0.1º	-180.0 to 180.0
V3/V31 Voltage angle	0x108A	UINT16	R	0.1º	-180.0 to 180.0
Reserved	0x108B	UINT16	R		-180.0 to 180.0
I1 Current angle	0x108C	UINT16	R	0.1º	-180.0 to 180.0
I2 Current angle	0x108D	UINT16	R	0.1º	-180.0 to 180.0
I3 Current angle	0x108E	UINT16	R	0.1º	-180.0 to 180.0
Reserved	0x108F	UINT16	R		-180.0 to 180.0
Average values per phase					
Voltage L1/L12 [4]	0x1100	UINT32	R	V	0 to Vmax
Voltage L2/L23 [4]	0x1101	UINT32	R	V	0 to Vmax
Voltage L3/L31 [4]	0x1102	UINT32	R	V	0 to Vmax
Current L1	0x1103	UINT32	R	A	0 to Imax
Current L2	0x1104	UINT32	R	A	0 to Imax
Current L3	0x1105	UINT32	R	A	0 to Imax
kW L1	0x1106	INT32	R	kW	-Pmax to Pmax
kW L2	0x1107	INT32	R	kW	-Pmax to Pmax
kW L3	0x1108	INT32	R	kW	-Pmax to Pmax
kvar L1	0x1109	INT32	R	kvar	-Pmax to Pmax
kvar L2	0x110A	INT32	R	kvar	-Pmax to Pmax
kvar L3	0x110B	INT32	R	kvar	-Pmax to Pmax
kVA L1	0x110C	UINT32	R	kVA	0 to Pmax
kVA L2	0x110D	UINT32	R	kVA	0 to Pmax
kVA L3	0x110E	UINT32	R	kVA	0 to Pmax
Power factor L1	0x110F	INT16	R	0.001	-999 to 1000
Power factor L2	0x1110	INT16	R	0.001	-999 to 1000

Parameter	Point ID	Type	R/W	Unit	Range[1]
Power factor L3	0x1111	INT16	R	0.001	-999 to 1000
Voltage THD L1/L12 [5]	0x1112	UINT16	R	0.1%	0 to 9999
Voltage THD L2/L23 [5]	0x1113	UINT16	R	0.1%	0 to 9999
Voltage THD L3 [5]	0x1114	UINT16	R	0.1%	0 to 9999
Current THD L1	0x1115	UINT16	R	0.1%	0 to 9999
Current THD L2	0x1116	UINT16	R	0.1%	0 to 9999
Current THD L3	0x1117	UINT16	R	0.1%	0 to 9999
K-Factor L1	0x1118	UINT16	R	0.1	10 to 9999
K-Factor L2	0x1119	UINT16	R	0.1	10 to 9999
K-Factor L3	0x11A	UINT16	R	0.1	10 to 9999
Current TDD L1	0x111B	UINT16	R	0.1%	0 to 1000
Current TDD L2	0x111C	UINT16	R	0.1%	0 to 1000
Current TDD L3	0x111D	UINT16	R	0.1%	0 to 1000
Voltage L12	0x111E	UINT32	R	V	0 to Vmax
Voltage L23	0x111F	UINT32	R	V	0 to Vmax
Voltage L31	0x1120	UINT32	R	V	0 to Vmax
Average total values					
Total kW	0x1400	INT32	R	kW	-Pmax to Pmax
Total kvar	0x1401	INT32	R	kvar	-Pmax to Pmax
Total kVA	0x1402	UINT32	R	kVA	0 to Pmax
Total PF	0x1403	INT16	R	0.001	-999 to 1000
Average auxiliary values					
Reserved	0x1500	UINT32	R		0
Neutral current	0x1501	UINT32	R	A	0 to Imax
Frequency	0x1502	UINT16	R	0.01Hz	0 to 10000 [3]
Voltage unbalance	0x1503	UINT16	R	1%	0 to 300
Current unbalance	0x1504	UINT16	R	1%	0 to 300
Present demands					
Volt demand L1/L12 [4]	0x1600	UINT32	R	V	0 to Vmax
Volt demand L2/L23 [4]	0x1601	UINT32	R	V	0 to Vmax
Volt demand L3/L31 [4]	0x1602	UINT32	R	V	0 to Vmax
Ampere demand L1	0x1603	UINT32	R	A	0 to Imax
Ampere demand L2	0x1604	UINT32	R	A	0 to Imax
Ampere demand L3	0x1605	UINT32	R	A	0 to Imax
Block kW import demand	0x1606	UINT32	R	kW	0 to Pmax
Reserved	0x1607	UINT32	R		0
Block kVA demand	0x1608	UINT32	R	kVA	0 to Pmax
Sliding window kW import demand	0x1609	UINT32	R	kW	0 to Pmax
Reserved	0x160A	UINT32	R		0
Sliding window kVA demand	0x160B	UINT32	R	kVA	0 to Pmax
Reserved	0x160C	UINT32	R		0
Reserved	0x160D	UINT32	R		0
Reserved	0x160E	UINT32	R		0
Accumulated kW import demand	0x160F	UINT32	R	kW	0 to Pmax
Reserved	0x1610	UINT32	R		0
Accumulated kVA demand	0x1611	UINT32	R	kVA	0 to Pmax
Predicted sliding window kW import demand	0x1612	UINT32	R	kW	0 to Pmax
Reserved	0x1613	UINT32	R		0
Predicted sliding window kVA demand	0x1614	UINT32	R	kVA	0 to Pmax
PF (import) at maximum sliding window kVA demand	0x1615	UINT16	R	0.001	0 to 1000
Total energies					
kWh import	0x1700	UINT32	R	kWh	0 to 10^8-1
kWh export	0x1701	UINT32	R	kWh	0 to 10^8-1
Reserved	0x1702-0x1703	UINT32	R		0
kvarh import	0x1704	UINT32	R	kvarh	0 to 10^8-1
kvarh export	0x1705	UINT32	R	kvarh	0 to 10^8-1
Reserved	0x1706-0x1707	UINT32	R		0

Parameter	Point ID	Type	R/W	Unit	Range[1]
kVAh total	0x1708	UINT32	R	kVAh	0 to 10^8-1
Phase energies					
kWh import L1	0x1800	UINT32	R	kWh	0 to 10^8-1
kWh import L2	0x1801	UINT32	R	kWh	0 to 10^8-1
kWh import L3	0x1802	UINT32	R	kWh	0 to 10^8-1
kvarh import (inductive) L1	0x1803	UINT32	R	kvarh	0 to 10^8-1
kvarh import (inductive) L2	0x1804	UINT32	R	kvarh	0 to 10^8-1
kvarh import (inductive) L3	0x1805	UINT32	R	kvarh	0 to 10^8-1
kVAh L1	0x1806	UINT32	R	kVAh	0 to 10^8-1
kVAh L2	0x1807	UINT32	R	kVAh	0 to 10^8-1
kVAh L3	0x1808	UINT32	R	kVAh	0 to 10^8-1
Fundamental real-time values per phase					
Voltage L1/L12	0x2900	UINT32	R	V	0 to Vmax
Voltage L2/L23	0x2901	UINT32	R	V	0 to Vmax
Voltage L3/L31	0x2902	UINT32	R	V	0 to Vmax
Current L1	0x2903	UINT32	R	A	0 to Imax
Current L2	0x2904	UINT32	R	A	0 to Imax
Current L3	0x2905	UINT32	R	A	0 to Imax
kW L1	0x2906	INT32	R	kW	-Pmax to Pmax
kW L2	0x2907	INT32	R	kW	-Pmax to Pmax
kW L3	0x2908	INT32	R	kW	-Pmax to Pmax
kvar L1	0x2909	INT32	R	kvar	-Pmax to Pmax
kvar L2	0x290A	INT32	R	kvar	-Pmax to Pmax
kvar L3	0x290B	INT32	R	kvar	-Pmax to Pmax
kVA L1	0x290C	UINT32	R	kVA	0 to Pmax
kVA L2	0x290D	UINT32	R	kVA	0 to Pmax
kVA L3	0x290E	UINT32	R	kVA	0 to Pmax
Power factor L1	0x290F	INT16	R	0.001	-999 to 1000
Power factor L2	0x2910	INT16	R	0.001	-999 to 1000
Power factor L3	0x2911	INT16	R	0.001	-999 to 1000
Fundamental total real-time values					
Total fundamental kW	0x2A00	INT32	R	kW	-Pmax to Pmax
Total fundamental kvar	0x2A01	INT32	R	kvar	-Pmax to Pmax
Total fundamental kVA	0x2A02	UINT32	R	kVA	0 to Pmax
Total fundamental PF	0x2A03	INT16	R	0.001	-999 to 1000
Minimum real-time values per phase (M)					
Voltage L1/L12 [4]	0x2C00	UINT32	R	V	0 to Vmax
Voltage L2/L23 [4]	0x2C01	UINT32	R	V	0 to Vmax
Voltage L3/L31 [4]	0x2C02	UINT32	R	V	0 to Vmax
Current L1	0x2C03	UINT32	R	A	0 to Imax
Current L2	0x2C04	UINT32	R	A	0 to Imax
Current L3	0x2C05	UINT32	R	A	0 to Imax
Minimum real-time total values (M)					
Total kW	0x2D00	INT32	R	kW	-Pmax to Pmax
Total kvar	0x2D01	INT32	R	kvar	-Pmax to Pmax
Total kVA	0x2D02	UINT32	R	kVA	0 to Pmax
Total PF [2]	0x2D03	UINT16	R	0.001	0 to 1000
Minimum real-time auxiliary values (M)					
Reserved	0x2E00	UINT32	R		0
Neutral current	0x2E01	UINT32	R	A	0 to Imax
Frequency	0x2E02	UINT16	R	0.01Hz	0 to 10000 [3]
Maximum real-time values per phase (M)					
Voltage L1/L12 [4]	0x3400	UINT32	R	V	0 to Vmax
Voltage L2/L23 [4]	0x3401	UINT32	R	V	0 to Vmax
Voltage L3/L31 [4]	0x3402	UINT32	R	V	0 to Vmax
Current L1	0x3403	UINT32	R	A	0 to Imax
Current L2	0x3404	UINT32	R	A	0 to Imax
Current L3	0x3405	UINT32	R	A	0 to Imax
Maximum real-time total values (M)					
Total kW	0x3500	INT32	R	kW	-Pmax to Pmax

Parameter	Point ID	Type	R/W	Unit	Range[1]
Total kvar	0x3501	INT32	R	kvar	-Pmax to Pmax
Total kVA	0x3502	UINT32	R	kVA	0 to Pmax
Total PF [2]	0x3503	UINT16	R	0.001	0 to 1000
Maximum real-time auxiliary values (M)					
Reserved	0x3600	UINT32	R		0
Neutral current	0x3601	UINT32	R	A	0 to Imax
Frequency	0x3602	UINT16	R	0.01Hz	0 to 10000 [3]
Maximum demands (M)					
Max. Volt demand L1/L12 [4]	0x3700	UINT32	R	V	0 to Vmax
Max. Volt demand L2/L23 [4]	0x3701	UINT32	R	V	0 to Vmax
Max. Volt demand L3/L31 [4]	0x3702	UINT32	R	V	0 to Vmax
Max. Ampere demand L1	0x3703	UINT32	R	A	0 to Imax
Max. Ampere demand L2	0x3704	UINT32	R	A	0 to Imax
Max. Ampere demand L3	0x3705	UINT32	R	A	0 to Imax
Reserved	0x3706-0x3708	UINT32	R		0
Max. sliding window kW import demand	0x3709	UINT32	R	kW	0 to Pmax
Reserved	0x370A	UINT32	R		0 to Pmax
Max. sliding window kVA demand	0x370B	UINT32	R	kVA	0 to Pmax

1 For parameter limits, see Note[1] to Table 4-1

2 New absolute Min/Max value (lag or lead).

3 The actual frequency range is 45.00 - 65.00 Hz.

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 In the 4LN3, 4LL3, 3LN3, 3LL3 and 3DIR2 wiring modes, the harmonic voltages will represent line-to-neutral voltages; in the 3OP2 and 3OP3 wiring modes, they will comprise L12 and L23 line-to-line voltages.

6 Available in Version 3.55 and later. Phase angles are referenced to Voltage V1 in 4-wire (4LN3, 4LL3, 3LN3 and 3LL3 wiring modes), and to Voltage V12 in 3-wire connections (3DIR2, 3OP2 and 3OP3 wiring modes).

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

5.3 Basic Setup Registers

Table 5-8 Basic Setup Registers

Parameter	Register	Type	R/W	Range
Wiring mode [1]	0x8600	UINT16	R/W	0 = 3OP2, 1 = 4LN3, 2 = 3DIR2, 3 = 4LL3, 4 = 3OP3, 5 = 3LN3, 6 = 3LL3
PT ratio	0x8601	UINT16	R/W	10 to 65000 × 0.1
CT primary current	0x8602	UINT16	R/W	1 to 50000 A
Power demand period	0x8603	UINT16	R/W	1,2,5,10,15,20,30,60 min, 255 = external synchronization [2]
Volt/ampere demand period	0x8604	UINT16	R/W	1 to 1800 sec
Averaging buffer size	0x8605	UINT16	R/W	8, 16, 32
Reset enable/disable	0x8606	UINT16	R/W	0 = disable, 1 = enable
Reserved	0x8607	UINT16	R	Read as 65535
The number of demand periods	0x8608	UINT16	R/W	1 to 15
Reserved	0x8609	UINT16	R	Read as 65535
Reserved	0x860A	UINT16	R/W	Read as 65535
Nominal frequency	0x860B	UINT16	R/W	50, 60 Hz
Maximum demand load current	0x860C	UINT16	R/W	0 to 50000A (0 = CT primary current)

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] Synchronization of power demand interval can be made through communications using the Synchronize power demand interval command (see Table 5-28).

5.4 User Selectable Options Setup

Table 5-9 User Selectable Options Registers

Parameter	Register	Type	R/W	Range
Power calculation mode	0x8700	UINT16	R/W	0 = using reactive power 1 = using non-active power
Energy roll value [1]	0x8701	UINT16	R/W	0 = 1×10^4 kWh 1 = 1×10^5 kWh 2 = 1×10^6 kWh 3 = 1×10^7 kWh 4 = 1×10^8 kWh
Phase energy calculation mode	0x8702	UINT16	R/W	0 = disable, 1 = enable

[1] For short energy readings (see Table 4-1), the maximum roll value will be 1×10^8 for positive readings and 1×10^7 for negative readings.

5.5 Communications Setup

Table 5-10 Communications Setup Registers

Parameter	Register	Type	R/W	Range
Reserved	0x8500	UINT16	R	Read as 65535
Interface	0x8501	UINT16	R/W	2 = RS-485 (not changeable)
Address	0x8502	UINT16	R/W	0 to 99
Baud rate	0x8503	UINT16	R/W	0 = 110 bps 1 = 300 bps 2 = 600 bps 3 = 1200 bps 4 = 2400 bps 5 = 4800 bps 6 = 9600 bps 7 = 19200 bps
Data format	0x8504	UINT16	R/W	0 = 7 bits/even parity 1 = 8 bits/no parity 2 = 8 bits/even parity

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.

5.6 Alarm/Event Setpoints

Table 5-11 Setpoint Setup Locations

Setpoint number	Registers
Setpoint #1	0x8200-0x8205
Setpoint #2	0x8206-0x820B
Setpoint #3	0x820C-0x8211
Setpoint #4	0x8212-0x8217
Setpoint #5	0x8218-0x821D
Setpoint #6	0x821E-0x8223
Setpoint #7	0x8224-0x8229
Setpoint #8	0x822A-0x822F
Setpoint #9	0x8230-0x8235

Setpoint number	Registers
Setpoint #10	0x8236-0x820B
Setpoint #11	0x823C-0x8241
Setpoint #12	0x8242-0x8247
Setpoint #13	0x8248-0x824D
Setpoint #14	0x824E-0x8253
Setpoint #15	0x8254-0x8259
Setpoint #16	0x825A-0x825F

Table 5-12 Setpoint Setup Registers

Parameter	Offset	Type	R/W	Range
Trigger ID	+0	UINT16	R/W	See Table 5-13
Action	+1	UINT16	R/W	See Table 5-14
Operate delay	+2	UINT16	R/W	0-9999 (×0.1 sec)
Release delay	+3	UINT16	R/W	0-9999 (×0.1 sec)
Operate limit	+4	INT32	R/W	See Table 5-13
Release limit	+5	INT32	R/W	See Table 5-13

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 the event when the setpoint is to be disabled), it is recommended to write all the setpoint registers using a single request, or to disable the setpoint before writing into separate registers. Each written value is checked for compatibility with the other setpoint parameters; if the new value does not conform to these, the request will be rejected.
3. Operate and release limits for the trigger parameters and their ranges are indicated in Table 5-13. Limits indicated as N/A are read as zeros. When writing, they can be omitted or should be written as zeros.
4. When a setpoint action is directed to a relay allocated to output energy pulses, an attempt to re-allocate it for a setpoint will result in a negative response.

Table 5-13 Setpoint Triggers

Trigger parameter	Trigger ID	Unit	Range [1]
None	0x0000		N/A
Phase reversal			
Positive phase rotation reversal [2]	0x8901		N/A
Negative phase rotation reversal [2]	0x8902		N/A
High/low real-time values on any phase			
High voltage [4]	0x0E00	V	0 to Vmax
Low voltage [4]	0x8D00	V	0 to Vmax
High current	0x0E01	A	0 to Imax
Low current	0x8D01	A	0 to Imax
High voltage THD [5]	0x0E07	0.1%	0 to 9999
High current THD	0x0E08	0.1%	0 to 9999
High K-Factor	0x0E09	0.1	10 to 9999
High current TDD	0x0E0A	0.1%	0 to 1000
High/low real-time auxiliary values			
High frequency	0x1002	0.01 Hz	0 to 10000 [3]
Low frequency	0x9002	0.01 Hz	0 to 10000 [3]
High/low average values per phase			
High current L1	0x1103	A	0 to Imax
High current L2	0x1104	A	0 to Imax
High current L3	0x1105	A	0 to Imax
Low current L1	0x9103	A	0 to Imax
Low current L2	0x9104	A	0 to Imax
Low current L3	0x9105	A	0 to Imax
High/low average values on any phase			
High voltage [4]	0x1300	V	0 to Vmax
Low voltage [4]	0x9200	V	0 to Vmax
High current	0x0301	A	0 to Imax
Low current	0x8201	A	0 to Imax

Trigger parameter	Trigger ID	Unit	Range [1]
High/low average total values			
High total kW import	0x1406	kW	0 to Pmax
High total kW export	0x1407	kW	0 to Pmax
High total kvar import	0x1408	kvar	0 to Pmax
High total kvar export	0x1409	kvar	0 to Pmax
High total kVA	0x1402	kVA	0 to Pmax
Low total PF lag	0x9404	0.001	0 to 1000
Low total PF lead	0x9405	0.001	0 to 1000
High/low average auxiliary values			
High neutral current	0x1501	A	0 to Imax
High frequency	0x1502	0.01 Hz	0 to 10000 [3]
Low frequency	0x9502	0.01 Hz	0 to 10000 [3]
High present demands			
High volt demand L1/L12 [4]	0x1600	V	0 to Vmax
High volt demand L2/L23 [4]	0x1601	V	0 to Vmax
High volt demand L3/L31 [4]	0x1602	V	0 to Vmax
High ampere demand L1	0x1603	A	0 to Imax
High ampere demand L2	0x1604	A	0 to Imax
High ampere demand L3	0x1605	A	0 to Imax
High block kW demand	0x1606	kW	0 to Pmax
High block kVA demand	0x1608	kVA	0 to Pmax
High sliding window kW demand	0x1609	kW	0 to Pmax
High sliding window kVA demand	0x160B	kVA	0 to Pmax
High accumulated kW demand	0x160F	kW	0 to Pmax
High accumulated kVA demand	0x1611	kVA	0 to Pmax
Predicted kW demand (import)	0x1612	kW	0 to Pmax
Predicted kVA demand	0x1614	kVA	0 to Pmax

[1] For 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

[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] In the 4LN3, 4LL3, 3LN3, 3LL3 and 3DIR2 wiring modes, the harmonic voltages will represent line-to-neutral voltages; in the 3OP2 and 3OP3 wiring modes, they will comprise L12 and L23 line-to-line voltages.

Table 5-14 Setpoint Actions

Action	ID
No action	0x0000
Operate relay	0x3000
Increment counter #1	0x4000
Increment counter #2	0x4001
Increment counter #3	0x4002
Increment counter #4	0x4003
Count operating time using counter #1 [1]	0x4400
Count operating time using counter #2 [1]	0x4401
Count operating time using counter #3 [1]	0x4402
Count operating time using counter #4 [1]	0x4403

[1] This action converts a common event counter to the time counter which measures time at 0.1 hour resolution while the setpoint is in the operated state. Each time counter has a non-volatile shadow counter which counts time at 1 second resolution before the corresponding time counter is incremented.

5.7 Relay Operation Control Registers

These registers allow the user to manually override relay operation that is normally operated via alarm setpoints.

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 5-15 Relay Operation Control Registers

Parameter	Register	Type	R/W	Range
Relay control status	0x8400	UINT16	R/W	See Table 5-16

Table 5-16 Relay Operation Status

Operation status	ID
Normal operation	0
Force operate	1
Force release	2

5.8 Instrument Options Registers

Table 5-17 Instrument Options Registers

Parameter	Register	Type	R/W	Range
Options 1 register	0x7F00	UINT16	R	See Table 5-18
Options 2 register	0x7F01	UINT16	R	See Table 5-18

Table 5-18 Instrument Options

Options register	Bit	Description
Options1	0	120V option
	1	690V option
	2-4	Reserved
	5	150% current over-range
	6-8	Reserved
	9	Relays option
	10-15	Reserved
Options 2	0-2	Number of relays - 1
	3-15	Reserved

5.9 Extended Status Registers

Table 5-19 Extended Status Registers

Parameter	Register	Type	R/W	Range
Relay status	0x7D00	UINT16	R	See Table 4-12
Reserved	0x7D01	UINT16	R	Read as 0000
Reserved	0x7D02	UINT16	R	Read as 0000
Setpoint status	0x7D03	UINT16	R	See Table 4-13
Log status	0x7D04	UINT16	R	See Table 4-14

5.10 Alarm Status Registers

Table 5-20 Alarm Status Registers

Parameter	Register	Type	R/W	Range
Setpoint alarm status	0x7E00	UINT16	R	See Table 5-21
Self-check alarm status	0x7E01	UINT16	R	See Table 5-22

The setpoint alarm register stores the status of the operated setpoints by setting the appropriate bits to 1. The alarm status bits can be reset all together by writing zero to the setpoint alarm register. It is possible to reset each alarm status bit separately by writing back the contents of the alarm register with a corresponding alarm bit set to 0.

The self-check alarm register indicates possible problems with the instrument hardware or setup configuration. The hardware problems are indicated by the appropriate bits, which are set whenever the instrument fails self-test diagnostics, or in the event of loss of power. The setup configuration problems are indicated by the dedicated bit, 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.

Writing a zero to the self-check alarm register clears hardware fault bits. The configuration corrupt status bit is also reset automatically when you change setup either via the front panel or through communications.

Table 5-21 Setpoint Alarm Status

Bit	Description
0	Alarm #1
1	Alarm #2
2	Alarm #3
3	Alarm #4
4	Alarm #5
5	Alarm #6
6	Alarm #7
7	Alarm #8
8	Alarm #9
9	Alarm #10
10	Alarm #11
11	Alarm #12
12	Alarm #13
13	Alarm #14
14	Alarm #15
15	Alarm #16

Bit meaning: 1 = setpoint has been operated

Table 5-22 Self-check Alarm Status

Bit	Description
0	Reserved
1	ROM error
2	RAM error
3	Watchdog timer reset
4	Sampling failure
5	Out of control trap
6	Reserved
7	Timing failure
8	Loss of power (power up)
9	External reset (warm restart)
10	Configuration corrupted
11-15	Reserved

5.11 Reset/Synchronization Registers

Table 5-23 Reset/Synchronization Registers

Action	Register	Type	R/W	Range
Clear total energy registers	0xA000	UINT16	W	0
Clear total maximum demand registers	0xA001	UINT16	W	0 = all maximum demands 1 = power demands 2 = volt/ampere demands
Reserved	0xA002-0xA003	UINT16		
Clear event/time counters	0xA004	UINT16	W	0 = all counters 1-4 = counter #1 - #4
Clear Min/Max log	0xA005	UINT16	W	0
Reserved	0xA006-0xA00F	UINT16		
Synchronize power demand interval [1]	0xA010	UINT16	W	0

[1] 1) If the power demand period is set to External Synchronization (see Table 5-8), writing a zero to this location will simulate an external synchronization pulse denoting the start of the next demand interval. The synchronization requests should not follow in intervals of less than 30 seconds, or the request will be rejected.

2) If the power demand period is specified in minutes, writing a zero to this location provides synchronization of the instrument's internal timer with the time of reception of the master's request. If the time expired from the beginning of the current demand interval is more than 30 seconds, the new demand interval starts immediately, otherwise synchronization is delayed until the next demand interval.

NOTES