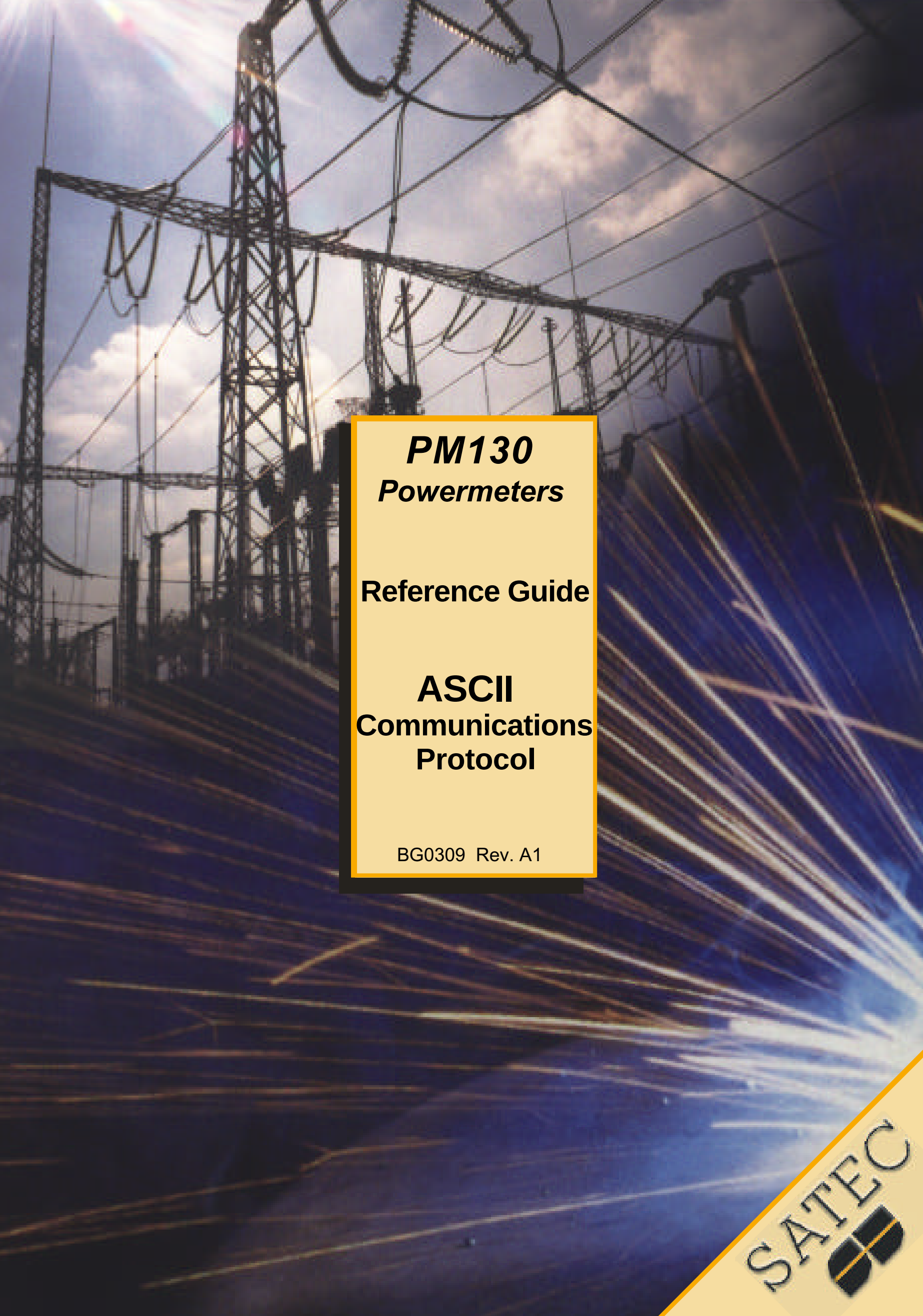

PM130
Powermeters

Reference Guide

ASCII
Communications Protocol

BG0309 Rev. A1

SATEC

SERIES PM130 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.

This book is copyrighted. No part of this book may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the manufacturer.

BG0309 Rev.A1

Table of Contents

1 GENERAL

This document specifies the ASCII serial communications protocol used to transfer data between a master computer station and the PM130. The document provides the complete information necessary to develop a third-party communications software capable of communication with the Series PM130 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 PM130 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

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.

In a decimal notation, the parameters are transferred in a decimal representation as is, i.e., no conversion is needed. When a value is between 0 and 1, a decimal point is placed in the data field. When the whole value exceeds the field range, it is divided by 1000 and truncated to the right. A decimal point is placed after the thousands to denote that the value has been truncated and must be multiplied by 1000 before it will be processed.

In a hexadecimal notation, all parameters are whole binary numbers of a 1-byte, 2-byte or 4-byte length. Each byte is transferred as two hexadecimal digits in ASCII notation (i.e., ASCII printable characters 0-9, A-F are used to represent hexadecimal digits 0h-9h, 0ah-0fh). Each byte is transmitted high order digit first. Each 2-byte and 4-byte parameter is transmitted high order bytes first. Negative numbers are transmitted in 2-complement code.

To represent numbers between 0 and 1, a modulus method is used. Fractional numbers are divided by a modulus and stored in the Powermeter as whole numbers. The modulus depends on the number of decimal digits in the fractional part, i.e., on the value precision. The modulus is given in the form ×0.1, ×0.01 or ×0.001. For example, the frequency value of 50.01 Hz having the modulus of ×0.01 will be received from the instrument as the whole number of 5001. To process the value received from the instrument in this format, the value must be multiplied by the modulus. To write such a number to the instrument, the number must be divided by the modulus.

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: [Σ(each byte - 22H)] mod 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	30h	Read basic data registers
1	31h	Read basic setup
2	32h	Write basic setup
3	33h	Read instrument status
4	34h	Reset/clear functions
8	38h	Reset the instrument
9	39h	Read version number
?	3F	Read extended status
G	47h	Read pulsing setpoint (E)
g	67h	Write pulsing setpoint (E)
O	4Fh	Read Min/Max log

(E) - available in the PM130E

Table 2-2 Direct Read/Write ASCII Requests

Message type		Description
Char	ASCII Hex	
A	41h	Long-size direct read
a	61h	Long-size direct write
X	58h	Variable-size direct read
x	78h	Variable-size direct write

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	Range ①
1	0	4	Voltage L1/L12 ⑥	V/kV ②	0 to Vmax
2	4	4	Voltage L2/L21 ⑥	V/kV ②	0 to Vmax
3	8	4	Voltage L3/L31 ⑥	V/kV ②	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 (P)	kW/MW ②	-Pmax to Pmax
8	33	6	kW L2 (P)	kW/MW ②	-Pmax to Pmax
9	39	6	kW L3 (P)	kW/MW ②	-Pmax to Pmax
10	45	4	Power factor L1 (P)	0.01	-.99 to 1.00 ④
11	49	4	Power factor L2 (P)	0.01	-.99 to 1.00 ④
12	53	4	Power factor L3 (P)	0.01	-.99 to 1.00 ④
13	57	6	kW total (P)	kW/MW ②	-Pmax to Pmax
14	63	4	Power factor total (P)	0.01	-.99 to 1.00 ④
15	67	6	kWh import (E)	MWh ③	0 to 99999.
16	73	5	Neutral (unbalanced) current	A	0 to Imax
17	78	4	Frequency	0.1 Hz	45.0 to 65.0
18	82	6	kvar L1 (P)	kvar/Mvar②	-Pmax to Pmax
19	88	6	kvar L2 (P)	kvar/Mvar②	-Pmax to Pmax
20	94	6	kvar L3 (P)	kvar/Mvar②	-Pmax to Pmax
21	100	6	kVA L1 (P)	kVA/MVA ②	0 to Pmax
22	106	6	kVA L2 (P)	kVA/MVA ②	0 to Pmax
23	112	6	kVA L3 (P)	kVA/MVA ②	0 to Pmax
24	118	6	kvarh net (E)	Mvarh ③	-9999. to 99999.
25	124	6	kvar total (E)	kvar/Mvar ②	-Pmax to Pmax
26	130	6	kVA total (E)	kVA/MVA ②	0 to Pmax
27	136	6	Maximum sliding window kW demand ⑤ (E)	kW/MW ②	0 to Pmax
28	142	6	Accumulated kW demand (E)	kW/MW ②	0 to Pmax
29	148	5	Maximum ampere demand L1	A	0 to Imax
30	153	5	Maximum ampere demand L2	A	0 to Imax
31	158	5	Maximum ampere demand L3	A	0 to Imax
32	163	2	Reserved		0
33	165	6	kWh export (E)	MWh ③	0 to 99999.
34	171	6	Maximum sliding window kVA demand⑤ (E)	kVA/MVA ②	0 to Pmax
35	177	4	Reserved		
36	181	4	Reserved		
37	185	4	Reserved		
38	189	4	Reserved		
39	193	4	Reserved		
40	197	4	Reserved		
41	201	8	kVAh (E)	MVAh ③	0 to 99999.99
42	209	6	Present sliding window kW demand ⑤ (E)	kW/MW ②	0 to Pmax
43	215	6	Present sliding window kVA demand ⑤ (E)	kVA/MVA ②	0 to Pmax
44	221	4	PF at maximum KVA demand (E)	0.01	0 to 1.00
45	225	4	Reserved		
46	229	4	Reserved		

47	233	4	Reserved		

Fields indicated by an N/A mark are padded with ASCII zeros.

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 (50% 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 When the value width is greater than the field resolution, the reading is converted to higher units and transmitted with a decimal point. The right-most digits of the reading are truncated.

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.

(P) available in the PM130P and PM130E

(E) available in the PM130E

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

Parameter	Identifier	Range
CT primary current	I17	1 to 50000 A
Power demand period (E)	D11	1,2,5,10,15,20,30,60 min 255 = external synchronization ②
The number of demand periods (E)	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
Reserved	Q52	

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)

(E) available in the PM130E

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 (E)	0
2	Clear total maximum demand registers	0 = all maximum demands 1 = power demands (E) 2 = volt/ampere demands
3-4	Reserved	
5	Clear event/time counters	0 = all counters 1-4 = counter #1 - #4
6	Clear Min/Max log	0
7-F	Reserved	

(E) available in the PM130E

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 PM130, 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 PM130 and is padded with zeros.

5 DIRECT READ/WRITE REQUESTS

5.1 General

This chapter describes the instrument data locations that are addressed directly using data location indexes. These locations can be accessed by using universal direct read/write requests instead of specific ASCII requests. A data index is a 4-digit hexadecimal number, which actually comprises a two-digit data group identifier followed by a two-digit location offset within a group. All data are transmitted in ASCII hexadecimal notation. Negative numbers are transmitted in 2-complement code.

5.1.1 Long-Size Direct Read/Write

Table 5-1 Read Request

Message type (ASCII)				
A				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1 2	0 4	4 2	Start data index to read The number of contiguous data items to read	0000h - FFFFh 1-30 (01h - 1Eh)
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1 2 3 ... 31	0 2 10 ... 234	2 8 8 ... 8	Number of data items in the message Data #1 value Data #2 value ... Data #30 value	1-30 (01h - 1Eh)

Table 5-2 Write Request

Message type (ASCII)				
a				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	4	Data index to write	0000h - FFFFh
2	4	8	Data value to write	

In long-size direct read/write messages, all data items are read and written as long signed 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**	**Length**	**Parameter**	**Range**
1 2	0 4	4 2	Start data index to read The number of contiguous data items to read	0000h - FFFFh 1-61 (01h - 3Dh)
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1 2 3 ... 60	0 2 ... 	2 2/4/8 2/4/8 ... 2/4/8	Number of data items in the message Data #1 value Data #2 value ... Data #60 value	1-61 (01h - 3Dh)

Table 5-4 Write Request

Message type (ASCII)				
x				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1 2 2 3 ... 60	0 4 2 ... 	4 2 2/4/8 2/4/8 ... 2/4/8	Start data index to write The number of contiguous data items to write Data #1 value Data #2 value ... Data #60 value	0000h - FFFFh 1-61 (01h - 3Dh)
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1 2	0 4	4 2	Start data index written The number of data items written	0000h - FFFFh 1-61 (01h - 3Dh)

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 indexes 8000h to 8077h (see Table 5-5). You can map any of these registers to either register index, 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 indexes of the user assignable registers which are accessed via indexes 8000h to 8077h are specified in the user assignable register map. It occupies indexes 8100h to 8177h (see Table 5-6), where the map register 8100h should contain the actual index of the register accessed via assignable register 8000h, register 8101h should contain the actual index of the register accessed via assignable register 8001h, and so on. Note that the user assignable register indexes and the user register map indexes may not be re-mapped.

Table 5-5 User Assignable Registers

Data index (hex)	Register contents	Length	Direction	Range
8000h	User definable data 0	①	①	①
8001h	User definable data 1	①	①	①
8002h	User definable data 2	①	①	①
...	...	...		
8077h	User definable data 119	①	①	①

① - depends on the mapped register

Table 5-6 User Assignable Register Map

Data index (hex)	Register contents	Length	Direction	Range
8100h	Data index for user data 0	4	R/W	0000h-FFFFh
8101h	Data index for user data 1	4	R/W	0000h-FFFFh
8102h	Data index for user data 2	4	R/W	0000h-FFFFh
...	...	...		
8177h	Data index for user data 119	4	R/W	0000h-FFFFh

To build your own register map, write to map registers (8100h to 8177h) the actual addresses you want to read from or write to via the assignable area (8000h to 8077h). For example, if you want to read registers 0C00h (real-time voltage of phase A) and 1700h (kWh import) via indexes 8000h-8001h, do the following:

- write 0C00h to register 8100h
- write 1700h to register 8101h

Reading from registers 8000h-8001h will return the voltage reading in register 8000h, and the kWh reading in register 8001h.

5.2 Extended Data Registers

Table 5-7 Extended Data Table

Parameter	Data index	Length	Direc-tion	Unit	Range ①
None					
None	0000h	4	R		0
Relays					
Relay status	0800h	4	R		see Table 4-12
Event/time counters					
Counter #1	0A00h	8	R/W		0 to 99999
Counter #2	0A01h	8	R/W		0 to 99999
Counter #3	0A02h	8	R/W		0 to 99999
Counter #4	0A03h	8	R/W		0 to 99999
Real-time values per phase (power values - P)					
Voltage L1/L12 ④	0C00h	8	R	V	0 to Vmax
Voltage L2/L23 ④	0C01h	8	R	V	0 to Vmax
Voltage L3/L31 ④	0C02h	8	R	V	0 to Vmax
Current L1	0C03h	8	R	A	0 to Imax
Current L2	0C04h	8	R	A	0 to Imax
Current L3	0C05h	8	R	A	0 to Imax
kW L1	0C06h	8	R	kW	-Pmax to Pmax
kW L2	0C07h	8	R	kW	-Pmax to Pmax
kW L3	0C08h	8	R	kW	-Pmax to Pmax
kvar L1	0C09h	8	R	kvar	-Pmax to Pmax
kvar L2	0C0Ah	8	R	kvar	-Pmax to Pmax
kvar L3	0C0Bh	8	R	kvar	-Pmax to Pmax
kVA L1	0C0Ch	8	R	kVA	0 to Pmax
kVA L2	0C0Dh	8	R	kVA	0 to Pmax

Parameter	Data index	Length	Direc-tion	Unit	Range ①
kVA L3	0C0Eh	8	R	kVA	0 to Pmax
Power factor L1	0C0Fh	4	R	0.001	-999 to 1000
Power factor L2	0C10h	4	R	0.001	-999 to 1000
Power factor L3	0C11h	4	R	0.001	-999 to 1000
Reserved	0C12h	4	R		
Reserved	0C13h	4	R		
Reserved	0C14h	4	R		
Reserved	0C15h	4	R		
Reserved	0C16h	4	R		
Reserved	0C17h	4	R		
Reserved	0C18h	4	R		
Reserved	0C19h	4	R		
Reserved	0C1Ah	4	R		
Reserved	0C1Bh	4	R		
Reserved	0C1Ch	4	R		
Reserved	0C1Dh	4	R		
Voltage L12	0C1Eh	8	R	V	0 to Vmax
Voltage L23	0C1Fh	8	R	V	0 to Vmax
Voltage L31	0C20h	8	R	V	0 to Vmax
Real-time total values (P)					
Total kW	0F00h	8	R	kW	-Pmax to Pmax
Total kvar	0F01h	8	R	kvar	-Pmax to Pmax
Total kVA	0F02h	8	R	kVA	0 to Pmax
Total PF	0F03h	4	R	0.001	-999 to 1000
Reserved	0F04h	4	R		0
Reserved	0F05h	4	R		0
Real-time auxiliary values					
Reserved	1000h	8	R		0
Neutral current	1001h	8	R	A	0 to Imax
Frequency ③	1002h	4	R	0.01 Hz	0 to 10000
Voltage unbalance (P)	1003h	4	R	%	0 to 300
Current unbalance (P)	1004h	4	R	%	0 to 300
Average values per phase (power values - P)					
Voltage L1/L12 ④	1100h	8	R	V	0 to Vmax
Voltage L2/L23 ④	1101h	8	R	V	0 to Vmax
Voltage L3/L31 ④	1102h	8	R	V	0 to Vmax
Current L1	1103h	8	R	A	0 to Imax
Current L2	1104h	8	R	A	0 to Imax
Current L3	1105h	8	R	A	0 to Imax
kW L1	1106h	8	R	kW	-Pmax to Pmax
kW L2	1107h	8	R	kW	-Pmax to Pmax
kW L3	1108h	8	R	kW	-Pmax to Pmax
kvar L1	1109h	8	R	kvar	-Pmax to Pmax
kvar L2	110Ah	8	R	kvar	-Pmax to Pmax
kvar L3	110Bh	8	R	kvar	-Pmax to Pmax
kVA L1	110Ch	8	R	kVA	0 to Pmax
kVA L2	110Dh	8	R	kVA	0 to Pmax
kVA L3	110Eh	8	R	kVA	0 to Pmax
Power factor L1	110Fh	4	R	0.001	-999 to 1000
Power factor L2	1110h	4	R	0.001	-999 to 1000
Power factor L3	1111h	4	R	0.001	-999 to 1000
Reserved	1112h	4	R		
Reserved	1113h	4	R		
Reserved	1114h	4	R		
Reserved	1115h	4	R		
Reserved	1116h	4	R		
Reserved	1117h	4	R		
Reserved	1118h	4	R		
Reserved	1119h	4	R		
Reserved	111Ah	4	R		

Parameter	Data index	Length	Direc-tion	Unit	Range ①
Reserved	111Bh	4	R		
Reserved	111Ch	4	R		
Reserved	111Dh	4	R		
Voltage L12	110Eh	8	R	V	0 to Vmax
Voltage L23	110Fh	8	R	V	0 to Vmax
Voltage L31	1120h	8	R	V	0 to Vmax
Average total values (P)					
Total kW	1400h	8	R	kW	-Pmax to Pmax
Total kvar	1401h	8	R	kvar	-Pmax to Pmax
Total kVA	1402h	8	R	kVA	0 to Pmax
Total PF	1403h	4	R	0.001	-999 to 1000
Reserved	1404h	4	R		0
Reserved	1405h	4	R		0
Average auxiliary values					
Reserved	1500h	8	R		0
Neutral current	1501h	8	R	A	0 to Imax
Frequency ③	1502h	4	R	0.01 Hz	0 to 10000
Voltage unbalance (P)	1503h	4	R	%	0 to 300
Current unbalance (P)	1504h	4	R	%	0 to 300
Present demands					
Volt demand L1/L12 (P) ④	1600h	8	R	V	0 to Vmax
Volt demand L2/L23 (P) ④	1601h	8	R	V	0 to Vmax
Volt demand L3/L31 (P) ④	1602h	8	R	V	0 to Vmax
Ampere demand L1	1603h	8	R	A	0 to Imax
Ampere demand L2	1604h	8	R	A	0 to Imax
Ampere demand L3	1605h	8	R	A	0 to Imax
Block kW demand (E)	1606h	8	R	kW	0 to Pmax
Reserved	1607h	8	R		0
Block kVA demand (E)	1608h	8	R	kVA	0 to Pmax
Sliding window kW demand (E)	1609h	8	R	kW	0 to Pmax
Reserved	160Ah	8	R		0
Sliding window kVA demand (E)	160Bh	8	R	kVA	0 to Pmax
Reserved	160Ch	8	R		0
Reserved	160Dh	8	R		0
Reserved	160Eh	8	R		0
Accumulated kW demand (E)	160Fh	8	R	kW	0 to Pmax
Reserved	1610h	8	R		0
Accumulated kVA demand (E)	1611h	8	R	kVA	0 to Pmax
Predicted sliding window kW demand (E)	1612h	8	R	kW	0 to Pmax
Reserved	1613h	8	R		0
Predicted sliding window kVA demand (E)	1614h	8	R	kVA	0 to Pmax
PF at maximum sliding window kVA demand (E)	1615h	4	R	0.001	0 to 1000
Total energies (E)					
kWh import	1700h	8	R	kWh	0 to 10^8-1
kWh export	1701h	8	R	kWh	0 to 10^8-1
Reserved	1702h	8	R		0
Reserved	1703h	8	R		0
kvarh import	1704h	8	R	kvarh	0 to 10^8-1
kvarh export	1705h	8	R	kvarh	0 to 10^8-1
Reserved	1706h	8	R		0
Reserved	1707h	8	R		0
kVAh total	1708h	8	R	kVAh	0 to 10^8-1
Phase energies (E)					
kWh import L1	1800h	8	R	kWh	0 to 10^8-1
kWh import L2	1801h	8	R	kWh	0 to 10^8-1
kWh import L3	1802h	8	R	kWh	0 to 10^8-1
kvarh import (inductive) L1	1803h	8	R	kvarh	0 to 10^8-1

Parameter	Data index	Length	Direc-tion	Unit	Range ①
kvarh import (inductive) L2	1804h	8	R	kvarh	0 to 10^8-1
kvarh import (inductive) L3	1805h	8	R	kvarh	0 to 10^8-1
kVAh L1	1806h	8	R	kVAh	0 to 10^8-1
kVAh L2	1807h	8	R	kVAh	0 to 10^8-1
kVAh L3	1808h	8	R	kVAh	0 to 10^8-1
Reserved					
Reserved	2900h	8	R		
Reserved	2901h	8	R		
Reserved	2902h	8	R		
Reserved	2903h	8	R		
Reserved	2904h	8	R		
Reserved	2905h	8	R		
Reserved	2906h	8	R		
Reserved	2907h	8	R		
Reserved	2908h	8	R		
Reserved	2909h	8	R		
Reserved	290Ah	8	R		
Reserved	290Bh	8	R		
Reserved	290Ch	8	R		
Reserved	290Dh	8	R		
Reserved	290Eh	8	R		
Reserved	290Fh	4	R		
Reserved	2910h	4	R		
Reserved	2911h	4	R		
Reserved					
Reserved	2A00h	8	R		
Reserved	2A01h	8	R		
Reserved	2A02h	8	R		
Reserved	2A03h	4	R		
Minimum real-time values per phase (M)					
Voltage L1/L12 ④	2C00h	8	R	V	0 to Vmax
Voltage L2/L23 ④	2C01h	8	R	V	0 to Vmax
Voltage L3/L31 ④	2C02h	8	R	V	0 to Vmax
Current L1 (P)	2C03h	8	R	A	0 to Imax
Current L2 (P)	2C04h	8	R	A	0 to Imax
Current L3 (P)	2C05h	8	R	A	0 to Imax
Minimum real-time total values (M) (P)					
Total kW	2D00h	8	R	kW	-Pmax to Pmax
Total kvar	2D01h	8	R	kvar	-Pmax to Pmax
Total kVA	2D02h	8	R	kVA	0 to Pmax
Total PF ②	2D03h	4	R	0.001	0 to 1000
Minimum real-time auxiliary values (M)					
Reserved	2E00h	8	R		0
Neutral current (P)	2E01h	8	R	A	0 to Imax
Frequency (P) ③	2E02h	4	R	0.01 Hz	0 to 10000
Minimum demands (M) - Reserved					
Reserved	2F00h	8	R		0
Reserved	2F01h	8	R		0
Reserved	2F02h	8	R		0
Reserved	2F03h	8	R		0
Reserved	2F04h	8	R		0
Reserved	2F05h	8	R		0
Reserved	2F06h	8	R		0
Reserved	2F07h	8	R		0
Reserved	2F08h	8	R		0
Reserved	2F09h	8	R		0
Reserved	2F0Ah	8	R		0
Reserved	2F0Bh	8	R		0
Maximum real-time values per phase (M)					

Parameter	Data index	Length	Direc-tion	Unit	Range ①
Voltage L1/L12 ④	3400h	8	R	V	0 to Vmax
Voltage L2/L23 ④	3401h	8	R	V	0 to Vmax
Voltage L3/L31 ④	3402h	8	R	V	0 to Vmax
Current L1 (P)	3403h	8	R	A	0 to Imax
Current L2 (P)	3404h	8	R	A	0 to Imax
Current L3 (P)	3405h	8	R	A	0 to Imax
Maximum real-time total values (M) (P)					
Total kW	3500h	8	R	kW	-Pmax to Pmax
Total kvar	3501h	8	R	kvar	-Pmax to Pmax
Total kVA	3502h	8	R	kVA	0 to Pmax
Total PF ②	3503h	4	R	0.001	0 to 1000
Maximum real-time auxiliary values (M)					
Reserved	3600h	8	R		0
Neutral current (P)	3601h	8	R	A	0 to Imax
Frequency (P) ③	3602h	4	R	0.01 Hz	0 to 10000
Maximum demands (M)					
Max. volt demand L1/L12 (P) ④	3700h	8	R		0 to Vmax
Max. volt demand L2/L23 (P) ④	3701h	8	R		0 to Vmax
Max. volt demand L3/L31 (P) ④	3702h	8	R		0 to Vmax
Max. ampere demand L1	3703h	8	R	A	0 to Imax
Max. ampere demand L2	3704h	8	R	A	0 to Imax
Max. ampere demand L3	3705h	8	R	A	0 to Imax
Reserved	3706h	8	R		0
Reserved	3707h	8	R		0
Reserved	3708h	8	R		0
Maximum sliding window kW demand (E)	3709h	8	R	kW	0 to Pmax
Reserved	370Ah	8	R		0
Maximum sliding window kVA demand (E)	370Bh	8	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.

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

(P) available in the PM130P and PM130E

(E) available in the PM130E

5.3 Basic Setup Registers

Table 5-8 Basic Setup Registers

Parameter	Data index	Length	Direction	Range
Wiring mode ①	8600h	4	R/W	0 = 3OP2, 1 = 4LN3, 2 = 3DIR2, 3 = 4LL3, 4 = 3OP3, 5 = 3LN3, 6 = 3LL3
PT ratio	8601h	4	R/W	10 to 65000 × 0.1
CT primary current	8602h	4	R/W	1 to 50000 A
Power demand period (E)	8603h	4	R/W	1,2,5,10,15,20,30,60 min 255 = external synchronization ②
Volt/ampere demand period	8604h	4	R/W	1 to 1800 sec
Averaging buffer size	8605h	4	R/W	8, 16, 32
Reset enable/disable	8606h	4	R/W	0 = disable, 1 = enable

Parameter	Data index	Length	Direction	Range
Reserved	8607h	4	R	Read as 65535
The number of demand periods (E)	8608h	4	R/W	1 to 15
Reserved	8609h	4	R	Read as 65535
Reserved	860Ah	4	R	Read as 65535
Nominal frequency	860Bh	4	R/W	50, 60 Hz
Reserved	860Ch	4	R	Read as 65535

① For the wiring mode options, see Note to Table 4-4

② Synchronization of power demand interval can be made through communications using the Synchronize power demand interval command (see Table 5-28)

(E) available in the PM130E

5.4 User Selectable Options Setup

Table 5-9 User Selectable Options Registers

Parameter	Data index	Length	Direction	Range
Power calculation mode (P)	8700h	4	R/W	0 = using reactive power 1 = using non-active power
Energy roll value (E) ①	8701h	4	R/W	0 = 1×10^4 1 = 1×10^5 2 = 1×10^6 3 = 1×10^7 4 = 1×10^8
Phase energy calculation mode (E)	8702h	4	R/W	0 = disable, 1 = enable

(P) available in the PM130P and PM130E (in the PM130, read as 65535)

(E) available in the PM130E (in the PM130 and PM130P, read as 65535)

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	Data index	Length	Direction	Range
Reserved	8500h	4	R	Read as 65535
Interface	8501h	4	R/W	2 = RS-485 (not changeable)
Address	8502h	4	R/W	0 to 99
Baud rate	8503h	4	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	8504h	4	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	Setup indexes (hex)
Setpoint #1	8200h-8205h
Setpoint #2	8206h-820Bh
Setpoint #3	820Ch-8211h
Setpoint #4	8212h-8217h
Setpoint #5	8218h-821Dh
Setpoint #6	821Eh-8223h
Setpoint #7	8224h-8229h
Setpoint #8	822Ah-822Fh
Setpoint #9	8230h-8235h
Setpoint #10	8236h-820Bh
Setpoint #11	823Ch-8241h
Setpoint #12	8242h-8247h
Setpoint #13	8248h-824Dh
Setpoint #14	824Eh-8253h
Setpoint #15	8254h-8259h
Setpoint #16	825Ah-825Fh

Table 5-12 Setpoint Setup Registers

Parameter	Offset	Length	Direction	Range
Trigger ID	+0	4	R/W	see Table 5-13
Action	+1	4	R/W	see Table 5-14
Operate delay	+2	4	R/W	0-9999 (×0.1 sec)
Release delay	+3	4	R/W	0-9999 (×0.1 sec)
Operate limit	+4	8	R/W	see Table 5-13
Release limit	+5	8	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 index (hex)	Unit	Range ①
None	0000h		N/A
Phase reversal			
Positive phase rotation reversal ②	8901h		N/A
Negative phase rotation reversal ②	8902h		N/A
High/low real-time values on any phase			
High voltage ④	0E00h	V	0 to Vmax
Low voltage ④	8D00h	V	0 to Vmax
High current	0E01h	A	0 to Imax

Trigger parameter	Trigger index (hex)	Unit	Range ①
Low current	8D01h	A	0 to Imax
Reserved	0E07h		
Reserved	0E08h		
Reserved	0E09h		
Reserved	0E0Ah		
High/low real-time auxiliary values			
High frequency ③	1002h	0.01 Hz	0 to 10000
Low frequency ③	9002h	0.01 Hz	0 to 10000
High/low average values per phase			
High current L1	1103h	A	0 to Imax
High current L2	1104h	A	0 to Imax
High current L3	1105h	A	0 to Imax
Low current L1	9103h	A	0 to Imax
Low current L2	9104h	A	0 to Imax
Low current L3	9105h	A	0 to Imax
High/low average values on any phase			
High voltage ④	1300h	V	0 to Vmax
Low voltage ④	9200h	V	0 to Vmax
High current	0301h	A	0 to Imax
Low current	8201h	A	0 to Imax
High/low average total values (P)			
High total kW import	1406h	kW	0 to Pmax
High total kW export	1407h	kW	0 to Pmax
High total kvar import	1408h	kvar	0 to Pmax
High total kvar export	1409h	kvar	0 to Pmax
High total kVA	1402h	kVA	0 to Pmax
Low total PF lag	9404h	0.001	0 to 1000
Low total PF lead	9405h	0.001	0 to 1000
High/low average auxiliary values			
High neutral current	1501h	A	0 to Imax
High frequency ③	1502h	0.01 Hz	0 to 10000
Low frequency ③	9502h	0.01 Hz	0 to 10000
High present demands			
High volt demand L1/L12 (P) ④	1600h	V	0 to Vmax
High volt demand L2/L23 (P) ④	1601h	V	0 to Vmax
High volt demand L3/L31 (P) ④	1602h	V	0 to Vmax
High ampere demand L1	1603h	A	0 to Imax
High ampere demand L2	1604h	A	0 to Imax
High ampere demand L3	1605h	A	0 to Imax
High block kW demand (E)	1606h	kW	0 to Pmax
High block kVA demand (E)	1608h	kVA	0 to Pmax
High sliding window kW demand (E)	1609h	kW	0 to Pmax
High sliding window kVA demand (E)	160Bh	kVA	0 to Pmax
High accumulated kW demand (E)	160Fh	kW	0 to Pmax
High accumulated kVA demand (E)	1611h	kVA	0 to Pmax
Predicted kW demand (import) (E)	1612h	kW	0 to Pmax
Predicted kVA demand (E)	1614h	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.

(P) available in the PM130P and PM130E

(E) available in the PM130E

Table 5-14 Setpoint Actions

Action	ID (hex)
No action	0000h
Operate relay	3000h
Increment counter #1	4000h
Increment counter #2	4001h
Increment counter #3	4002h
Increment counter #4	4003h
Count operating time using counter #1 ①	4400h
Count operating time using counter #2 ①	4401h
Count operating time using counter #3 ①	4402h
Count operating time using counter #4 ①	4403h

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	Data index	Length	Direction	Range
Relay control status	8400h	4	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	Data index	Length	Direction	Range
Options 1 register	7F00h	4	R	see Table 5-18
Options 2 register	7F01h	4	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

Options 2	10-15 0-2 3-15	Reserved Number of relays - 1 Reserved

5.9 Extended Status Registers

Table 5-19 Extended Status Registers

Parameter	Data index	Length	Direction	Range
Relay status	7D00h	4	R	see Table 4-12
Reserved	7D01h	4	R	read as 0000
Reserved	7D02h	4	R	read as 0000
Setpoint status	7D03h	4	R	see Table 4-13
Log status	7D04h	4	R	see Table 4-14

5.10 Alarm Status Registers

Table 5-20 Alarm Status Registers

Parameter	Data index	Length	Direction	Range
Setpoint alarm status	7E00h	4	R/W	see Table 5-21
Self-check alarm status	7E01h	4	R/W	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.

Hardware fault bits can be reset by writing zero to the self-check alarm register. 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

Bit	Description
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	Data index	Length	Direction	Range
Clear total energy registers (E)	A000h	4	W	0
Clear total maximum demand registers	A001h	4	W	0 = all maximum demands 1 = power demands (E) 2 = volt/ampere demands
Reserved	A002h - A003h	4		
Clear event/time counters	A004h	4	W	0 = all counters 1-4 = counter #1 - #4
Clear Min/Max log	A005h	4	W	0
Reserved	A006h - A00Fh	4		
Synchronize power demand interval (E) ①	A010h	4	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.

(E) - available in the PM130E