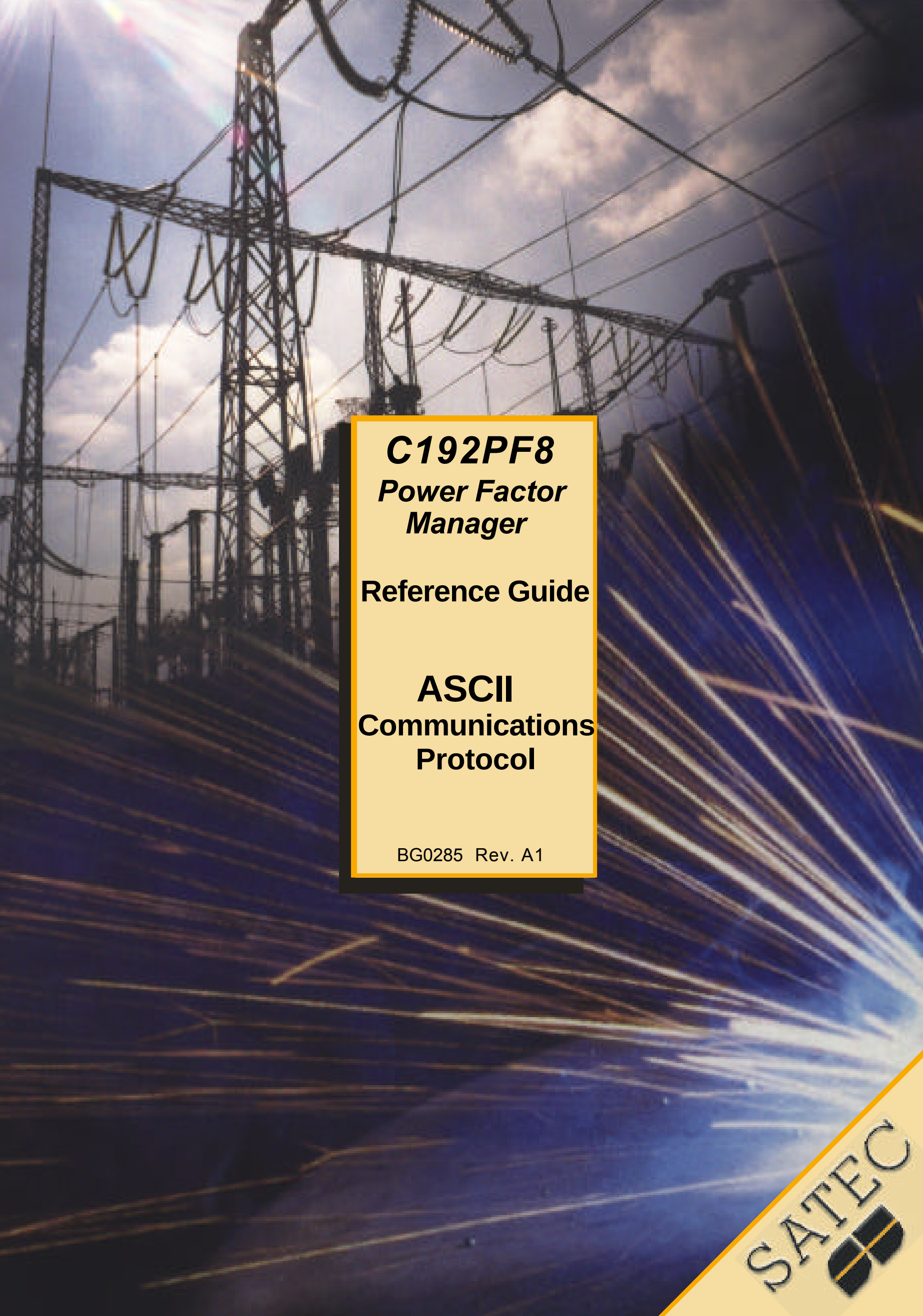

C192PF8

Power Factor Manager

Reference Guide

ASCII
Communications Protocol

BG0285 Rev. A1

C192PF8 POWER FACTOR MANAGER

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.

BG0285 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 C192PF8. The document provides the complete information necessary to develop third-party communications software capable of communication with the Series C192PF8 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 C192PF8 Powermeters, Installation and Operation Manual".

IMPORTANT

1. 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. In the 4LN3, 3LN3 and 4LL3 wiring modes, harmonic voltages will be line-to-neutral voltages; in other modes, they will be line-to-line voltages, and voltage THD will not account for multiples of the third harmonic. In the 3OP2 and 3OP3 wiring modes, voltage THD will be given only for phases L12 and L23.

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 $\times 0.1$, $\times 0.01$ or $\times 0.001$. For example, the frequency value of 50.01 Hz having the modulus of $\times 0.01$ 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: $[\Sigma(\text{each byte - 22H})] \bmod 5CH + 22H$

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	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
?	3Fh	Read extended status
B	42h	Read analog output allocation
b	62h	Write analog output allocation
D	44h	Read digital input allocation
d	64h	Write digital input allocation
G	47h	Read pulsing setpoint
g	67h	Write pulsing setpoint
H	48h	Read phase harmonics
O	4Fh	Read Min/Max log

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 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 demand ⑤	kW/MW	0 to Pmax
28	142	6	Accum. kW 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	Status inputs (hex)		See Table 4-13
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	%	0.0 to 999.
36	181	4	Voltage THD L2/L23	%	0.0 to 999.
37	185	4	Voltage THD L3/L31	%	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 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 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

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

① The parameter limits are as follows:

Imax (20% over-range) = 1.2 × CT primary current [A]

Direct wiring (PT Ratio = 1):

Vmax (690 V input option) = 828.0 V
Vmax (120 V input option) = 144.0 V
Pmax = (Imax × Vmax × 3) [kW x 0.001] if wiring mode is 4LN3 or 3LN3
Pmax = (Imax × Vmax × 2) [kW x 0.001] if wiring mode is 4LL3, 3OP2, 3DIR2, 3OP3, 3LL3 or 2LL1

Wiring via PTs (PT Ratio > 1):

Vmax (690 V input option) = 144 × PT Ratio [V]
Vmax (120 V input option) = 144 × PT Ratio [V]
Pmax = (Imax × Vmax × 3)/1000 [MW x 0.001] if wiring mode is 4LN3 or 3LN3
Pmax = (Imax × Vmax × 2)/1000 [MW x 0.001] if wiring mode is 4LL3, 3OP2, 3DIR2, 3OP3, 3LL3 or 2LL1

② When ASCII compatibility mode is disabled (see Section 5.5), voltages, currents and powers are always transmitted with a decimal point at highest resolution available for the field. For direct wiring (PT Ratio = 1), voltages are transmitted in volts, currents in amperes, and powers in kilowatts. For wiring via PT (PT Ratio > 1), voltages are transmitted in kilovolts, currents in amperes, and powers in megawatts. When the value is greater than the field width, the right most digits of the fractional part are truncated. For the best available resolution, see Note ② to Table 5-7.

When ASCII compatibility mode is enabled, the C192PF8 provides a fully downward-compatible response using a lower resolution for voltages, currents and powers - 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.

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, 7 = 2LL1
PT ratio	U14	1.0 to 6500.0
CT primary current	I17	1 to 6500 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
Maximum demand load current	Q52	0 to 6,500 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
2LL1 - 2-wire line to line connection using 1 PT (1 element)

② Synchronization of power demand interval can be made through a digital input or via communications using the Synchronize power demand interval command (see Table 5-24)

NOTE

WIRING MODE, PT RATIO and CT PRIMARY CURRENT are protected from being changed while the PFC is running. Writing to these locations will result in a negative response with the exception code XM (illegal operation).

4.3 Instrument Status

This request is supported only for compatibility with older instruments. It allows to read the status of the first four relays. To read the status of the all eight relays, use the extended status request (see Section 4.7) or extended data registers (see Section 5.2).

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	Relay #4 status
1	Relay #3 status
2	Relay #2 status
3	Relay #1 status

Bit meaning: 0 = relay is energized, 1 = relay is not energized

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
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	440-459

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	Status inputs	see Table 4-13
4	12	4	Setpoints status	see Table 4-14
5	16	4	Log status	see Table 4-15
6	20	36	Not used	0

Table 4-12 Relay Status

Bit	Description
0	Relay #1 status
1	Relay #2 status
2	Relay #3 status
3	Relay #4 status
4	Relay #5 status
5	Relay #6 status
6	Relay #7 status
7	Relay #8 status
8-15	Not used (permanently set to 0)

Bit meaning: 0 = relay is not energized, 1 = relay is energized

Table 4-13 Status Inputs

Bit	Description
0	Status input
1-15	Not used (permanently set to 0)

Bit meaning: 0 = contact open, 1 = contact closed

Table 4-14 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 4-15 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 Analog Output Allocation

Table 4-16 Read Request

Message type (ASCII)				
B				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Analog channel number	0
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Analog channel number	0
2	2	4	Output parameter index	see Table 4-18
3	6	8	Zero scale (0/4 mA)	see Table 4-18
4	14	8	Full scale (20 mA)	see Table 4-18

Table 4-17 Write Request

Message type (ASCII)				
b				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Analog channel number	0
2	2	4	Output parameter index	see Table 4-18
3	6	8	Zero scale (0/4 mA)	see Table 4-18
4	14	8	Full scale (20 mA)	see Table 4-18

Except for the signed power factor (see Note 3 to Table 4-18), the output scale is linear within the value range. The scale range will be inverted if the full scale specified is less than the zero scale.

Table 4-18 Analog Output Parameters

Parameter	Data index	Length	Unit ②	Scale range ①
None				
None	0000h	4		0
Real-time values per phase				
Voltage L1/L12 ⑤	0C00h	8	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	0C01h	8	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	0C02h	8	0.1V/1V	0 to Vmax
Current L1	0C03h	8	0.01A	0 to Imax
Current L2	0C04h	8	0.01A	0 to Imax
Current L3	0C05h	8	0.01A	0 to Imax
Real-time total value				
Total kW	0F00h	8	0.001kW/1kW	-Pmax to Pmax
Total kvar	0F01h	8	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	0F02h	8	0.001kVA/1kVA	0 to Pmax
Total PF ④	0F03h	4	0.001	-999 to 1000
Total PF Lag	0F04h	4	0.001	-999 to 1000
Total PF Lead	0F05h	4	0.001	-999 to 1000
Real-time auxiliary values				
Frequency ③	1002h	4	0.01Hz	0 to 10000
Average values per phase				
Voltage L1/L12 ⑤	1100h	8	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	1101h	8	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	1102h	8	0.1V/1V	0 to Vmax
Current L1	1103h	8	0.01A	0 to Imax
Current L2	1104h	8	0.01A	0 to Imax
Current L3	1105h	8	0.01A	0 to Imax

Parameter	Data index	Length	Unit ②	Scale range ①
Average total values				
Total kW	1400h	8	0.001kW/1kW	-Pmax to Pmax
Total kvar	1401h	8	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	1402h	8	0.001kVA/1kVA	0 to Pmax
Total PF ④	1403h	4	0.001	-999 to 1000
Total PF Lag	1404h	4	0.001	-999 to 1000
Total PF Lead	1405h	4	0.001	-999 to 1000
Average auxiliary values				
Neutral current	1501h	8	0.01A	0 to Imax
Frequency ③	1502h	4	0.01Hz	0 to 10000
Present demands				
Accumulated kW demand (import)	160Fh	8	0.001kW/1kW	0 to Pmax
Accumulated kVA demand	1611h	8	0.001kVA/1kVA	0 to Pmax

① For parameter limits, see Note ① to Table 4-1.

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

③ The actual frequency range is 45.00 to 65.00 Hz.

④ The output scale for signed (bi-directional) power factor is symmetrical with regard to ±1.000 and is linear from -0 to -1.000, and from 1.000 to +0 (note that -1.000 ≡ +1.000). Negative power factor is output as [-1.000 minus measured value], and non-negative power factor is output as [+1.000 minus measured value]. To define the entire range for power factor from -0 to +0, the scales would be specified as -0/0. Because 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).

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

4.9 Digital Input Allocation

Table 4-19 Read Request

Message type (ASCII)				
D				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Digital input group ID	see Table 4-21
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Digital input group ID	see Table 4-21
2	2	2	Allocation mask	see Table 4-22

Table 4-20 Write Request

Message type (ASCII)				
d				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Digital input group ID	see Table 4-21
2	2	2	Allocation mask	see Table 4-22

Table 4-21 Digital Input Groups

Group ID	Description
0	Status inputs ①
1	Pulse inputs ①
2	Not used (read as 0) ①
3	External synchronization pulse input

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

NOTE

When a digital input is allocated for the external synchronization pulse, it is automatically configured as a pulse input; otherwise it is configured as a status input.

Table 4-22 Digital Inputs Allocation Mask

Bit number	Description
0	Digital input allocation status
1-15	Not used

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

4.10 Pulsing Setpoints

Table 4-23 Read Request

Message type (ASCII)				
G				
Message body (hexadecimal)				
Request				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0-7 (see Table 4-25)
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0-7 (see Table 4-25)
2	2	2	Output parameter ID	see Table 4-26
3	4	4	For energy pulsing = number of unit-hours per pulse, otherwise - permanently set to 0	0-9999

Table 4-24 Write Request

Message type (ASCII)				
g				
Message body (hexadecimal)				
Request/Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Pulse output ID	0-7 (see Table 4-25)
2	2	2	Output parameter ID	see Table 4-26
3	4	4	For energy pulsing = number of unit-hours per pulse, otherwise - set to 0	0-9999

Table 4-25 Pulse Outputs

Pulsing output ID	Output allocation
0	Relay #1
1	Relay #2
2	Relay #3
3	Relay #4
4	Relay #5
5	Relay #6
6	Relay #7
7	Relay #8

Table 4-26 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

4.11 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 C192PF8, this request yields only the Min/Max log parameters which can be read directly via extended data registers (see Table 5-7).

Table 4-27 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 C192PF8 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	0	4	Start data index to read	0000h - FFFFh
2	4	2	The number of contiguous data items to read	1-30 (01h - 1Eh)
Response				
Field	**Offset**	**Length**	**Parameter**	**Range**
1	0	2	Number of data items in the message	1-30 (01h - 1Eh)
2	2	8	Data #1 value	
3	10	8	Data #2 value	
...	...	...	...	
31	234	8	Data #30 value	

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	Direction	Unit	Range ①
None					
None	0000h	4	R		0
Status inputs					
Status inputs	0600h	4	R		see Table 4-13
Relays					
Relay status	0800h	4	R		see Table 4-12
Event/time counters					
Event counter #1	0A00h	8	R/W		0 to 99999
Event counter #2	0A01h	8	R/W		0 to 99999
Event counter #3	0A02h	8	R/W		0 to 99999
Event counter #4	0A03h	8	R/W		0 to 99999
PFC relay operation (switching cycles) counters					
Relay operation counter #1	0A04h	8	R/W		0 to 99999
Relay operation counter #2	0A05h	8	R/W		0 to 99999
Relay operation counter #3	0A06h	8	R/W		0 to 99999
Relay operation counter #4	0A07h	8	R/W		0 to 99999
Relay operation counter #5	0A08h	8	R/W		0 to 99999
Relay operation counter #6	0A09h	8	R/W		0 to 99999
Relay operation counter #7	0A0Ah	8	R/W		0 to 99999
Relay operation counter #8	0A0Bh	8	R/W		0 to 99999

Parameter	Data index	Length	Direction	Unit	Range ①
Real-time values per phase					
Voltage L1/L12 ⑤	0C00h	8	R	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	0C01h	8	R	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	0C02h	8	R	0.1V/1V	0 to Vmax
Current L1	0C03h	8	R	0.01A	0 to Imax
Current L2	0C04h	8	R	0.01A	0 to Imax
Current L3	0C05h	8	R	0.01A	0 to Imax
kW L1	0C06h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L2	0C07h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L3	0C08h	8	R	0.001kW/1kW	-Pmax to Pmax
kvar L1	0C09h	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L2	0C0Ah	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L3	0C0Bh	8	R	0.001kvar/1kvar	-Pmax to Pmax
kVA L1	0C0Ch	8	R	0.001kVA/1kVA	0 to Pmax
kVA L2	0C0Dh	8	R	0.001kVA/1kVA	0 to Pmax
kVA L3	0C0Eh	8	R	0.001kVA/1kVA	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
Voltage THD L1/L12	0C12h	4	R	0.1%	0 to 9999
Voltage THD L2/L23	0C13h	4	R	0.1%	0 to 9999
Voltage THD L3/L31	0C14h	4	R	0.1%	0 to 9999
Current THD L1	0C15h	4	R	0.1%	0 to 9999
Current THD L2	0C16h	4	R	0.1%	0 to 9999
Current THD L3	0C17h	4	R	0.1%	0 to 9999
K-Factor L1	0C18h	4	R	0.1	10 to 9999
K-Factor L2	0C19h	4	R	0.1	10 to 9999
K-Factor L3	0C1Ah	4	R	0.1	10 to 9999
Current TDD L1	0C1Bh	4	R	0.1%	0 to 1000
Current TDD L2	0C1Ch	4	R	0.1%	0 to 1000
Current TDD L3	0C1Dh	4	R	0.1%	0 to 1000
Voltage L12	0C1Eh	8	R	0.1V/1V	0 to Vmax
Voltage L23	0C1Fh	8	R	0.1V/1V	0 to Vmax
Voltage L31	0C20h	8	R	0.1V/1V	0 to Vmax
Real-time total values					
Total kW	0F00h	8	R	0.001kW/1kW	-Pmax to Pmax
Total kvar	0F01h	8	R	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	0F02h	8	R	0.001kVA/1kVA	0 to Pmax
Total PF	0F03h	4	R	0.001	-999 to 1000
Total PF lag	0F04h	4	R	0.001	0 to 1000
Total PF lead	0F05h	4	R	0.001	0 to 1000
Total kW import	0F06h	8	R	0.001kW/1kW	0 to Pmax
Total kW export	0F07h	8	R	0.001kW/1kW	0 to Pmax
Total kvar import	0F08h	8	R	0.001kvar/1kvar	0 to Pmax
Total kvar export	0F09h	8	R	0.001kvar/1kvar	0 to Pmax
Real-time auxiliary values					
Reserved	1000h	8	R		0
Neutral current	1001h	8	R	0.01A	0 to Imax
Frequency ④	1002h	4	R	0.01Hz	0 to 10000
Voltage unbalance	1003h	4	R	1%	0 to 300
Current unbalance	1004h	4	R	1%	0 to 300
Average values per phase					
Voltage L1/L12 ⑤	1100h	8	R	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	1101h	8	R	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	1102h	8	R	0.1V/1V	0 to Vmax
Current L1	1103h	8	R	0.01A	0 to Imax
Current L2	1104h	8	R	0.01A	0 to Imax

Parameter	Data index	Length	Direction	Unit	Range ①
Current L3	1105h	8	R	0.01A	0 to Imax
kW L1	1106h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L2	1107h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L3	1108h	8	R	0.001kW/1kW	-Pmax to Pmax
kvar L1	1109h	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L2	110Ah	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L3	110Bh	8	R	0.001kvar/1kvar	-Pmax to Pmax
kVA L1	110Ch	8	R	0.001kVA/1kVA	0 to Pmax
kVA L2	110Dh	8	R	0.001kVA/1kVA	0 to Pmax
kVA L3	110Eh	8	R	0.001kVA/1kVA	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
Voltage THD L1/L12	1112h	4	R	0.1%	0 to 9999
Voltage THD L2/L23	1113h	4	R	0.1%	0 to 9999
Voltage THD L3/L31	1114h	4	R	0.1%	0 to 9999
Current THD L1	1115h	4	R	0.1%	0 to 9999
Current THD L2	1116h	4	R	0.1%	0 to 9999
Current THD L3	1117h	4	R	0.1%	0 to 9999
K-Factor L1	1118h	4	R	0.1	10 to 9999
K-Factor L2	1119h	4	R	0.1	10 to 9999
K-Factor L3	111Ah	4	R	0.1	10 to 9999
Current TDD L1	111Bh	4	R	0.1%	0 to 1000
Current TDD L2	111Ch	4	R	0.1%	0 to 1000
Current TDD L3	111Dh	4	R	0.1%	0 to 1000
Voltage L12	110Eh	8	R	0.1V/1V	0 to Vmax
Voltage L23	110Fh	8	R	0.1V/1V	0 to Vmax
Voltage L31	1120h	8	R	0.1V/1V	0 to Vmax
Average total values					
Total kW	1400h	8	R	0.001kW/1kW	-Pmax to Pmax
Total kvar	1401h	8	R	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	1402h	8	R	0.001kVA/1kVA	0 to Pmax
Total PF	1403h	4	R	0.001	-999 to 1000
Total PF lag	1404h	4	R	0.001	0 to 1000
Total PF lead	1405h	4	R	0.001	0 to 1000
Total kW import	1406h	8	R	0.001kW/1kW	0 to Pmax
Total kW export	1407h	8	R	0.001kW/1kW	0 to Pmax
Total kvar import	1408h	8	R	0.001kvar/1kvar	0 to Pmax
Total kvar export	1409h	8	R	0.001kvar/1kvar	0 to Pmax
Average auxiliary values					
Reserved	1500h	8	R		0
Neutral current	1501h	8	R	0.01A	0 to Imax
Frequency ④	1502h	4	R	0.01Hz	0 to 10000
Voltage unbalance	1503h	4	R	1%	0 to 300
Current unbalance	1504h	4	R	1%	0 to 300
Present demands					
Volt demand L1/L12 ⑤	1600h	8	R	0.1V/1V	0 to Vmax
Volt demand L2/L23 ⑤	1601h	8	R	0.1V/1V	0 to Vmax
Volt demand L3/L31 ⑤	1602h	8	R	0.1V/1V	0 to Vmax
Ampere demand L1	1603h	8	R	0.01A	0 to Imax
Ampere demand L2	1604h	8	R	0.01A	0 to Imax
Ampere demand L3	1605h	8	R	0.01A	0 to Imax
Block kW demand	1606h	8	R	0.001kW/1kW	0 to Pmax
Reserved	1607h	8	R		0
Block kVA demand	1608h	8	R	0.001kVA/1kVA	0 to Pmax
Sliding window kW demand	1609h	8	R	0.001kW/1kW	0 to Pmax
Reserved	160Ah	8	R		0

Parameter	Data index	Length	Direction	Unit	Range ①
Sliding window kVA demand	160Bh	8	R	0.001kVA/1kVA	0 to Pmax
Reserved	160Ch	8	R		0
Reserved	160Dh	8	R		0
Reserved	160Eh	8	R		0
Accumulated kW demand	160Fh	8	R	0.001kW/1kW	0 to Pmax
Reserved	1610h	8	R		0
Accumulated kVA demand	1611h	8	R	0.001kVA/1kVA	0 to Pmax
Predicted sliding window kW demand	1612h	8	R	0.001kW/1kW	0 to Pmax
Reserved	1613h	8	R		0
Predicted sliding window kVA demand	1614h	8	R	0.001kVA/1kVA	0 to Pmax
PF at maximum sliding window kVA demand	1615h	4	R	0.001	0 to 1000
Total energies					
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					
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
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
Fundamental's (H01) real-time values per phase					
Voltage L1/L12 ⑥	2900h	8	R	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑥	2901h	8	R	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑥	2902h	8	R	0.1V/1V	0 to Vmax
Current L1	2903h	8	R	0.01A	0 to Imax
Current L2	2904h	8	R	0.01A	0 to Imax
Current L3	2905h	8	R	0.01A	0 to Imax
kW L1	2906h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L2	2907h	8	R	0.001kW/1kW	-Pmax to Pmax
kW L3	2908h	8	R	0.001kW/1kW	-Pmax to Pmax
kvar L1	2909h	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L2	290Ah	8	R	0.001kvar/1kvar	-Pmax to Pmax
kvar L3	290Bh	8	R	0.001kvar/1kvar	-Pmax to Pmax
kVA L1	290Ch	8	R	0.001kVA/1kVA	0 to Pmax
kVA L2	290Dh	8	R	0.001kVA/1kVA	0 to Pmax
kVA L3	290Eh	8	R	0.001kVA/1kVA	0 to Pmax
Power factor L1	290Fh	4	R	0.001	-999 to 1000
Power factor L2	2910h	4	R	0.001	-999 to 1000
Power factor L3	2911h	4	R	0.001	-999 to 1000
Fundamental's (H01) real-time total values					
Total kW	2a00h	8	R	0.001kW/1kW	-Pmax to Pmax
Total kvar	2a01h	8	R	0.001kvar/1kvar	-Pmax to Pmax

Parameter	Data index	Length	Direction	Unit	Range ①
Total kVA	2a02h	8	R	0.001kVA/1kVA	0 to Pmax
Total PF	2a03h	4	R	0.001	-999 to 1000
Minimum real-time values per phase (M)					
Voltage L1/L12 ⑤	2C00h	8	R	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	2C01h	8	R	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	2C02h	8	R	0.1V/1V	0 to Vmax
Current L1	2C03h	8	R	0.01A	0 to Imax
Current L2	2C04h	8	R	0.01A	0 to Imax
Current L3	2C05h	8	R	0.01A	0 to Imax
Minimum real-time total values (M)					
Total kW	2D00h	8	R	0.001kW/1kW	-Pmax to Pmax
Total kvar	2D01h	8	R	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	2D02h	8	R	0.001kVA/1kVA	0 to Pmax
Total PF ③	2D03h	4	R	0.001	0 to 1000
Minimum real-time auxiliary values (M)					
Reserved	2E00h	8	R		0
Neutral current	2E01h	8	R	0.01A	0 to Imax
Frequency ④	2E02h	4	R	0.01Hz	0 to 10000
Minimum demands (M) - Reserved					
Reserved	2F00h-2F0Bh	8	R		0
Maximum real-time values per phase (M)					
Voltage L1/L12 ⑤	3400h	8	R	0.1V/1V	0 to Vmax
Voltage L2/L23 ⑤	3401h	8	R	0.1V/1V	0 to Vmax
Voltage L3/L31 ⑤	3402h	8	R	0.1V/1V	0 to Vmax
Current L1	3403h	8	R	0.01A	0 to Imax
Current L2	3404h	8	R	0.01A	0 to Imax
Current L3	3405h	8	R	0.01A	0 to Imax
Maximum real-time total values (M)					
Total kW	3500h	8	R	0.001kW/1kW	-Pmax to Pmax
Total kvar	3501h	8	R	0.001kvar/1kvar	-Pmax to Pmax
Total kVA	3502h	8	R	0.001kVA/1kVA	0 to Pmax
Total PF ③	3503h	4	R	0.001	0 to 1000
Maximum real-time auxiliary values (M)					
Reserved	3600h	8	R		0
Neutral current	3601h	8	R	0.01A	0 to Imax
Frequency ④	3602h	4	R	0.01Hz	0 to 10000
Maximum demands (M)					
Max. volt demand L1/L12 ⑤	3700h	8	R	0.1V/1V	0 to Vmax
Max. volt demand L2/L23 ⑤	3701h	8	R	0.1V/1V	0 to Vmax
Max. volt demand L3/L31 ⑤	3702h	8	R	0.1V/1V	0 to Vmax
Max. ampere demand L1	3703h	8	R	0.01A	0 to Imax
Max. ampere demand L2	3704h	8	R	0.01A	0 to Imax
Max. ampere demand L3	3705h	8	R	0.01A	0 to Imax
Reserved	3706h	8	R		0
Reserved	3707h	8	R		0
Reserved	3708h	8	R		0
Max. sliding window kW demand	3709h	8	R	0.001kW/1kW	0 to Pmax
Reserved	370Ah	8	R		0
Max. sliding window kVA demand	370Bh	8	R	0.001kVA/1kVA	0 to Pmax

① For parameter limits, see Note ① to Table 4-1.

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

③ New absolute min/max value (lag or lead).

④ The actual frequency range is 45.00 - 65.00 Hz.

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

⑥ When the 4LN3, 4LL3 or 3LN3 wiring mode is selected, the harmonic voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages. The line-to-line harmonic voltages in the 3DIR2, 3LL3 and 2LL1 wiring modes, and the L31 harmonic voltage in the 3OP2 and 3OP3 wiring modes will be calculated accurately if the voltages are balanced.

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

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, 7 = 2LL1
PT ratio	8601h	4	R/W	10 to 65000 × 0.1
CT primary current	8602h	4	R/W	1 to 6500 A
Power demand period	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
Reserved	8607h	4	R	Read as 65535
The number of demand periods	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
Maximum demand load current	860Ch	4	R/W	0 to 6500 A (0 = CT primary current)

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

② Synchronization of power demand interval can be made through a digital input or via communications using the Synchronize power demand interval command (see Table 5-24).

NOTE

WIRING MODE, PT RATIO and CT PRIMARY CURRENT are protected from being changed while the PFC is running. Writing to these locations will result in a negative response with the exception code XM (illegal operation).

5.4 User Selectable Options Setup

Table 5-9 User Selectable Options Registers

Parameter	Data index	Length	Direction	Range
Power calculation mode	8700h	4	R/W	0 = using reactive power 1 = using non-active power
Energy roll value 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	8702h	4	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	Data index	Length	Direction	Range
Reserved	8500h	4	R	Read as 65535
Reserved	8501h	4	R	Read as 65535
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
Reserved	8505h- 8507h	4	R	Read as 65535
ASCII compatibility mode	8508h	4	R/W	0 = disabled, 1 = enabled (see Note ② to Table 4-1)

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 in 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 ②	Range ①
None	0000h		N/A
Status inputs			
Status input ON	0600h		N/A
Status input OFF	8600h		N/A
Phase reversal			
Positive phase rotation reversal ③	8901h		N/A
Negative phase rotation reversal ③	8902h		N/A
No-volt trigger			
No-volt	0908h		N/A
High/low real-time values on any phase			
High voltage ⑤	0E00h	0.1V/1V	0 to Vmax
Low voltage ⑤	8D00h	0.1V/1V	0 to Vmax
High current	0E01h	0.01A	0 to Imax
Low current	8D01h	0.01A	0 to Imax
High voltage THD	0E07h	0.1%	0 to 9999
High current THD	0E08h	0.1%	0 to 9999
High K-Factor	0E09h	0.1	10 to 9999
High current TDD	0E0Ah	0.1%	0 to 1000
High L-L voltage	0E0Bh	0.1V/1V	0 to Vmax
Low L-L voltage	8D0Bh	0.1V/1V	0 to Vmax
High/low real-time auxiliary values			
High frequency ④	1002h	0.01Hz	0 to 10000
Low frequency ④	9002h	0.01Hz	0 to 10000
High/low average values per phase			
High current L1	1103h	0.01A	0 to Imax
High current L2	1104h	0.01A	0 to Imax
High current L3	1105h	0.01A	0 to Imax
Low current L1	9103h	0.01A	0 to Imax
Low current L2	9104h	0.01A	0 to Imax
Low current L3	9105h	0.01A	0 to Imax

Trigger parameter	Trigger index (hex)	Unit ②	Range ①
High/low average values on any phase			
High voltage ⑤	1300h	0.1V/1V	0 to Vmax
Low voltage ⑤	9200h	0.1V/1V	0 to Vmax
High current	0301h	0.01A	0 to Imax
Low current	9201h	0.01A	0 to Imax
High L-L voltage	130Bh	0.1V/1V	0 to Vmax
Low L-L voltage	920Bh	0.1V/1V	0 to Vmax
High/low average total values			
High total kW import	1406h	0.001kW/1kW	0 to Pmax
High total kW export	1407h	0.001kW/1kW	0 to Pmax
High total kvar import	1408h	0.001kvar/1kvar	0 to Pmax
High total kvar export	1409h	0.001kvar/1kvar	0 to Pmax
High total kVA	1402h	0.001kVA/1kVA	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	0.01A	0 to Imax
High frequency ④	1502h	0.01Hz	0 to 10000
Low frequency ④	9502h	0.01Hz	0 to 10000
High present demands			
High volt demand L1/L12 ⑤	1600h	0.1V/1V	0 to Vmax
High volt demand L2/L23 ⑤	1601h	0.1V/1V	0 to Vmax
High volt demand L3/L31 ⑤	1602h	0.1V/1V	0 to Vmax
High ampere demand L1	1603h	0.01A	0 to Imax
High ampere demand L2	1604h	0.01A	0 to Imax
High ampere demand L3	1605h	0.01A	0 to Imax
High block kW demand	1606h	0.001kW/1kW	0 to Pmax
High block kVA demand	1608h	0.001kVA/1kVA	0 to Pmax
High sliding window kW demand	1609h	0.001kW/1kW	0 to Pmax
High sliding window kVA demand	160Bh	0.001kVA/1kVA	0 to Pmax
High accumulated kW demand	160Fh	0.001kW/1kW	0 to Pmax
High accumulated kVA demand	1611h	0.001kVA/1kVA	0 to Pmax
Predicted kW demand (import)	1612h	0.001kW/1kW	0 to Pmax
Predicted kVA demand	1614h	0.001kVA/1kVA	0 to Pmax

① For parameter limits, see Note ① to Table 4-1.

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

③ The setpoint is operated when the actual phase sequence does not match the indicated phase rotation.

④ The actual frequency range is 45.00 - 65.00 Hz.

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

Table 5-14 Setpoint Actions

Action	ID (hex)
No action	0000h
Operate relay #1	3000h
Operate relay #2	3001h
Operate relay #3	3002h
Operate relay #4	3003h
Operate relay #5	3004h
Operate relay #6	3005h
Operate relay #7	3006h
Operate relay #8	3007h
Assert local alarm	3200h
Hard switch-off (immediate release) of the PFC capacitor banks	3300h
Soft switch-off (in turn release) of the PFC capacitor banks	3400h
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 that 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 setpoint relay operations. Either relay may be manually forced operated or released using commands sent via communications.

NOTES

1. 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.
2. A relay is energized when forced operated, and is de-energized when forced released.

Table 5-15 Relay Operation Control Registers

Parameter	Data index	Length	Direction	Range
Relay #1 control status	8400h	4	R/W	see Table 5-16
Relay #2 control status	8401h	4	R/W	see Table 5-16
Relay #3 control status	8402h	4	R/W	see Table 5-16
Relay #4 control status	8403h	4	R/W	see Table 5-16
Relay #5 control status	8404h	4	R/W	see Table 5-16
Relay #6 control status	8405h	4	R/W	see Table 5-16
Relay #7 control status	8406h	4	R/W	see Table 5-16
Relay #8 control status	8407h	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
	2-5	N/A
	6	Analog output 0/4-20 mA
	7-8	N/A
	9	Relays option
	10	Digital input option
	11-12	N/A
	13	ASCII compatibility mode enabled (see Table 5-10)
	14-15	N/A
Options 2	0-2	Number of relays - 1
	3-6	Number of digital inputs - 1
	7-15	N/A

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
Status inputs	7D02h	4	R	see Table 4-13
Setpoint status	7D03h	4	R	see Table 4-14
Log status	7D04h	4	R	see Table 4-15
Reserved	7D05h	4	R	0
Reserved	7D06h	4	R	0
Reserved	7D07h	4	R	0
PFC operating mode	7D08h	4	R	0 = OFF 1 = AUTO 1 (self adapting mode) 2 = AUTO 2 (optimizing mode) 3 = Manual 4 = Shut Down
PFC status	7D09h	4	R	see Table 5-20

Table 5-20 PFC Status

Code	Status	Meaning
0	Ready	A switching program is complete
1	Alarm	Operations are stopped by an alarm setpoint
2	Busy	Waiting for a switching delay
3	Low power	Insufficient reactive power to trigger PFC
4	Excessive inductive load (automatic mode)	Non-compensated inductive load
5	Excessive capacitive load (automatic mode)	Non-compensated capacitive load
6	Full (manual mode)	All capacitor banks are switched in
7	Idle (manual mode)	All capacitor banks are switched off
8	OFF	The PFC is switched off

5.10 Alarm Status Registers

Table 5-21 Alarm Status Registers

Parameter	Data index	Length	Direction	Range
Setpoint alarm status	7E00h	4	R/W	see Table 5-22
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 5-22 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 5-23 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 5-24 Reset/Synchronization Registers

Action	Data index	Length	Direction	Range
Clear total energy registers	A000h	4	W	0
Clear total maximum demand registers	A001h	4	W	0 = all maximum demands 1 = power demands 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 ①	A010h	4	W	0
Clear the PFC relay operation counters	A011h	4	W	0 = all PFC relay counters 1-8 = counter #1 - #8

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. This function is not permitted if the external synchronization is implemented by hardware, i.e., the digital input is configured as an external synchronization pulse input.

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.

5.12 Power Factor Controller Setup

Table 5-25 Power Factor Controller Setup Registers

Parameter	Data Index	Length	Direction	Range
Operating mode	8800h	4	R/W	0 = OFF 1 = AUTO 1 (self-adapting mode) 2 = AUTO 2 (optimizing mode) 3 = Manual
Setpoint trigger	8801h	4	R/W	0 = true power factor 1 = power factor displacement (fundamental harmonic's power factor)
Operational setpoints	8802h	4	R/W	0 = PF1 1 = PF1 and PF2 (switching via a digital input)
Nominal voltage of the capacitor banks	8803h	4	R/W	1V to 999V if PT RATIO = 1 100 to 9999 x 0.01kV if PT RATIO > 1 0 = disable automatic adjusting of the capacitor bank powers to the measured line voltage (assumed that those have been adjusted manually)
Low target PF1	8804h	4	R/W	-500 to 500 x 0.001
High target PF1	8805h	4	R/W	-500 to 500 x 0.001
Low target PF2	8806h	4	R/W	-500 to 500 x 0.001
High target PF2	8807h	4	R/W	-500 to 500 x 0.001
Setpoint operate delay	8808h	4	R/W	1 to 600 sec
Switch-on time (connection interval)	8809h	4	R/W	3 to 600 sec
Switch-off time (disconnection interval)	880Ah	4	R/W	3 to 600 sec
Reconnection time (discharge time)	880Bh	4	R/W	5 to 600 sec
Size of the capacitor bank #1	880Ch	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #2	880Dh	4	R/W	1 to 999 kvar 0 = not used, -1 = permanently switched in
Size of the capacitor bank #3	880Eh	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #4	880Fh	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #5	8810h	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #6	8811h	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #7	8812h	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in
Size of the capacitor bank #8	8813h	4	R/W	1 to 999 kvar, 0 = not used, -1 = permanently switched in

NOTE

The PFC setup registers except of operating mode are protected from being changed while the PFC is running. Writing to these locations will result in a negative response with the exception code XM (illegal operation).

5.13 PFC Manual Control Register

This register allows the user to manually connect/disconnect the capacitor banks by issuing commands through communications when the PFC operates in the manual mode.

Table 5-26 PFC Manual Control Register

Parameter	Data Index	Length	Direc-tion	Range
PFC command register	8830h	4	W	1 = switch in (connect) a capacitor bank 2 = switch off (disconnect) a capacitor bank

NOTES

1. If the PFC is not in the manual mode or a previous user command was not yet completed, the instrument will respond with the exception code XM (illegal operation).
2. If a requested command cannot be completed because of an alarm condition or because there are no additional capacitor banks that can be operated, the command is discarded. No error is reported.

NOTES