SERIES PM172EH POWERMETERS

COMMUNICATIONS

Modbus 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.

REVISION HISTORY

Rev.A2 (F/W Version 4.93.2 or later):

Added a firmware build number (register 2563) (see Table 5-4).
Added Voltage unbalance trigger (see Table 5-32).
Added Low battery alarm (see Table 5-13).

BG0363 REV.A2

Table of Contents

1 GENERAL

This document specifies a subset of the Modbus serial communications protocol used to transfer data between a master computer station and the PM172EH. The document provides the complete information necessary to develop third-party communications software capable of communication with the Series PM172EH Powermeters. Additional information concerning communications operation, configuring the communications parameters, and communications connections is found in "PM172EH Series Powermeter, 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 4LN3, 4LL3, 3LN3 and 3LL3 wiring modes, harmonic voltages will be line-to-neutral voltages; in other modes, they will be line-to-line voltages. In a 3-wire direct connection, harmonic voltages and waveforms will represent line-to-neutral voltages as they appear on the instrument's input transformers. In 3OP2 and 3OP3 wiring modes, voltage harmonics and waveforms will be given only for phases L12 and L23.
3. Most of the advanced features are configured using multiple setup parameters that can be accessed in some contiguous registers. When writing the setup registers, it is recommended to write all the registers at once using a single request, or to clear (zero) the setup before writing into separate registers.

2 MODBUS FRAMING

2.1 Transmission Mode

The protocol uses the Modbus Remote Terminal Unit (RTU) transmission mode. In RTU mode, data is sent in 8-bit binary characters. The 8 bit even parity or 8 bit no parity data format must be selected when configuring the instrument communications. The data format is shown in the following table.

Table 2-1 RTU Data Format

Field	No. of bits
Start bit	1
Data bits [1]	8
Parity (optional)	1
Stop bit	1

[1] Least significant bit first

2.2 The RTU Frame Format

Frame synchronization is maintained in RTU transmission mode by simulating a synchronization message. The receiving device monitors the elapsed time between receptions of characters. If three and one-half character times elapse without a new character or completion of the frame, then the device flushes the frame and assumes that the next byte received will be an address. The frame format is defined below.

The maximum query and response message length is 256 bytes including check characters.

RTU Message Frame Format

T1 T2 T3	Address	Function	Data	CRC Check	T1 T2 T3
	8 bits	8 bits	N * 8 bits	16 bits	

2.3 Address Field

The address field contains a user assigned address (1-247) of the instrument that is to receive a message. Address 0 is used in broadcast mode to transmit to all instruments (broadcast mode is available only for functions 06 and 16). In this case all instruments receive the message and take action on the request, but do not issue a response. In the PM172EH, the broadcast mode is supported only for register addresses 287-294 and 301-302 (reset energies and maximum demands) and 3404-3415 (reset/clear registers).

2.4 Function Field

The function field contains a function code that tells the instrument what action to perform. Function codes used in the protocol are shown below in Table 2-2.

Table 2-2 Modbus Function Codes

Code (decimal)	Meaning in Modbus	Action
03	Read holding registers	Read multiple registers
04	Read input registers	Read multiple registers
06	Preset single register	Write single register
16	Preset multiple registers	Write multiple registers
08	Loop-back test	Communications test

NOTE Broadcast mode available only for functions code 06 and 16.

2.5 Data Field

The data field contains information needed by the instrument to perform a specific function, or data collected by the instrument in response to a query.

IMPORTANT Fields composed of two bytes are sent in the order high byte first, low byte second.

2.6 Error Check Field

The error check field contains the Cyclical Redundancy Check (CRC) word. For detailed information about CRC calculation, refer to the “Modicon Modbus Protocol Reference Guide”. It can be downloaded from the Modicon’s Web site at www.modicon.com.

3 MODBUS MESSAGE FORMATS

3.1 Function 03 - Read Multiple Registers

This command allows the user to obtain contents of up to 125 contiguous registers from a single data table.

Request

Instrument Address	Function (03)	Starting Address	Word Count	Error Check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Starting Address Address of the first register to be read
Word Count The number of contiguous words to be read

Response

Instrument Address	Function (03)	Byte Count	Data Word 1	...	Data Word N	Error Check
1 byte	1 byte	1 byte	2 bytes	...	2 bytes	2 bytes

The byte count field contains quantity of bytes to be returned.

3.2 Function 04 - Read Multiple Registers

This command allows the user to obtain contents of up to 125 contiguous registers from a single data table. It can be used instead of function 03.

Request

Instrument Address	Function (04)	Starting Address	Word Count	Error Check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Starting Address Address of the first register to be read
Word Count The number of contiguous words to be read

Response

Instrument Address	Function (04)	Byte Count	Data Word 1	...	Data Word N	Error Check
1 byte	1 byte	1 byte	2 bytes	...	2 bytes	2 bytes

The byte count field contains quantity of bytes to be returned.

3.3 Function 06 - Write Single Register

This command allows the user to write the contents of a data register in any data table where a register can be written.

Request

Instrument Address	Function (06)	Starting Address	Data Word	Error check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Starting Address Address of the register to be written
Data Value Data to be written to the register

Response

The normal response is the retransmission of the write request.

3.4 Function 16 - Write Multiple Registers

This request allows the user to write the contents of multiple contiguous registers to a single data table where registers can be written.

Request

Instrument Address	Function (16)	Starting Address	Word Count	Byte Count
1 byte	1 byte	2 bytes	2 bytes	1 byte

Data Word 1	...	...	...	Data Word N	Error Check
2 bytes	...	...	...	2 bytes	2 bytes

Starting Address Address of the first register to be written
Word Count The number of contiguous words to be written
Byte Count The number of bytes to be written

Response

Instrument Address	Function (16)	Starting Address	Word Count	Error Check
1 byte	1 byte	2 bytes	1 word	2 bytes

3.5 Function 08 - Loop-back Communications Test

The purpose of this request is to check the communications link between the specified instrument and PC.

Request

Instrument Address	Function (08)	Diagnostic Code (0)	Data	Error Check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Diagnostic Code Designates action to be taken in Loop-back test. The protocol supports only Diagnostic Code 0 - return query data.

Data Query data. The data passed in this field will be returned to the master through the instrument. The entire message returned will be identical to the message transmitted by the master, field-per-field.

Response

Instrument Address	Function (08)	Diagnostic Code (0)	Data	Error Check
1 byte	1 byte	2 bytes	2 bytes	2 bytes

The normal response is the re-transmission of a test message.

3.6 Exception Responses

The instrument sends an exception response when errors are detected in the received message. To indicate that the response is notification of an error, the high order bit of the function code is set to 1.

Exception Response

Instrument Address	Function (high order bit is set to 1)	Exception Code	Error Check
1 byte	1 byte	1 byte	2 byte

Exception response codes:

01 - Illegal function
02 - Illegal data address
03 - Illegal data value
06 - Busy, rejected message. The message was received without errors, but the instrument is being programmed from the keypad (only for requests accessing setup registers).

NOTE When the character framing, parity, or redundancy check detects a communication error, processing of the master's request stops. The instrument will not act on or respond to the message.

4 PROTOCOL IMPLEMENTATION

4.1 Modbus Register Addresses

The PM172EH Modbus registers are referred to by using addresses in the range of 0 to 65535. From within the Modbus applications, the PM172EH Modbus registers can be accessed by simulating holding registers of the Modicon 584, 884 or 984 Programmable Controller, using a 5-digit “4XXXX” or 6-digit “4XXXXX” addressing scheme. To map the PM172EH register address to the range of the Modbus holding registers, add a value of 40001 to the PM172EH register address. When a register address exceeds 9999, use a 6-digit addressing scheme by adding 400001 to the PM172EH register address.

4.2 Data Formats

The PM172EH uses three data formats to pass data between a master application and the instrument: a 16-bit integer format, a 32-bit modulo 10000 format, and a 32-bit long integer format.

4.2.1 16-bit Integer Format

A 16-bit data is transmitted in a single 16-bit Modbus register as unsigned (UINT16) or signed (INT16) integer (whole) numbers without conversion or using pre-scaling to accommodate large-scale and fractional numbers to a 16-bit register format. Scaling can be made using either the LIN3 linear conversion, or decimal pre-scaling to pass fractional numbers in integer format.

Non-scaled data

The data will be presented exactly as retrieved by the communications program from the instrument. The value range for unsigned data is 0 to 65535; for signed data the range is -32768 to 32767.

LIN3 (Linear) Scaling

This conversion maps the raw data received by the communications program in the range of 0-9999 onto the user-defined LO scale/HI scale range. The conversion is carried out according to the formula:

$$\text{Engineering\_Units\_Value} = \frac{\text{Raw\_Data} \times (\text{HI} - \text{LO})}{9999} + \text{LO}$$

where:

Engineering_Units_Value	-	the true value in engineering units
Raw_Data	-	the raw input data in the range of 0 - 9999
LO, HI	-	the data low and high scales in engineering units

When data conversion is necessary, the HI and LO scales, and data conversion method are indicated for the corresponding registers.

CONVERSION EXAMPLES

1. Voltage readings

a) Assume device settings (690V input, direct wiring): PT ratio = 1.

Voltage engineering scales (see Note 1 to Table 5-1):

HI = Vmax = 828.0 × PT ratio = 828.0 × 1 = 828.0V
LO = 0V

If the raw data reading is 1449 then the voltage reading in engineering units will be as follows:

Volts reading = 1449 × (828.0 - 0)/9999 + 0 = 120.0V

b) Assume device settings (wiring via PT): PT ratio = 14,400V : 120V = 120.

Voltage engineering scales:

HI = Vmax = 144.0 × PT ratio = 144 × 120 = 17,280V
LO = 0V

If the raw data reading is 8314 then the voltage reading in engineering units will be as follows:

Volts reading = 8314 × (17,280 - 0)/9999 + 0 = 14,368V

2. Current readings

Assume device settings: CT primary current = 200A; current input overload = 120% (6A).

Current engineering scales:

HI = Imax = CT primary current × 1.2 = 200.00 × 1.2 = 240.00A
LO = 0A

If the raw data reading is 250 then the current reading in engineering units will be as follows:

Amps reading = 250 × (240.00 - 0)/9999 + 0 = 6.00A

3. Power readings

a) Assume device settings (690V input, direct wiring): wiring configuration 4LN3; PT = 1; CT primary current = 200A.

Active Power engineering scales:

HI = Pmax = Vmax × Imax × 3 = 828.0 × (200.00 × 1.2) × 3 = 596,160W = 596.160kW
LO = -Pmax = -596.160kW

If the raw data reading is 5500 then the power reading in engineering units will be as follows:

Watts reading = 5500 × (596.160 - (-596.160))/9999 + (-596.160) = 59.682kW

If the raw data reading is 500 then the power reading in engineering units will be as follows:

Watts reading = 500 × (596.160 - (-596.160))/9999 + (-596.160) = -536.538kW

b) Assume device settings (wiring via PT): wiring configuration 4LL3; PT = 120; CT primary current = 200A.

Active Power engineering scales:

HI = Pmax = Vmax × Imax × 2 = (144 × 120) × (200.00 × 1.2) × 2/1000 = 8294kW
LO = -Pmax = -8294kW

If the raw data reading is 5500 then the power reading in engineering units will be as follows:

Watts reading = 5500 × (8294 - (-8294))/9999 + (-8294) = 830kW

If the raw data reading is 500 then the power reading in engineering units will be as follows:

Watts reading = 500 × (8294 - (-8294))/9999 + (-8294) = -7465kW

4. Power Factor readings

Power factor engineering scales:

HI = 1.000.
LO = -1.000.

If the raw data reading is 8900 then the power factor in engineering units will be as follows:

Power factor reading = 8900 × (1.000 - (-1.000))/9999 + (-1.000) = 0.78

Decimal Scaling

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

4.2.2 32-bit Modulo 10000 Format

The short energy registers 287-294, and 301-302 are transmitted in two contiguous 16-bit registers in modulo 10000 format. The first (low order) register contains the value mod 10000, and the second (high order) register contains the value/10000. To get the true energy reading, the high order register value should be multiplied by 10,000 and added to the low order register.

4.2.3 32-bit Long Integer Format

In a 32-bit long integer format, data is transmitted in two adjacent 16-bit Modbus registers as unsigned (UINT32) or signed (INT32) long integer (whole) numbers. The first register contains the low-order word (lower 16 bits) and the second register contains the high order word (higher 16 bits) of the 32-bit long number. The low-order word always starts at an even Modbus address. The value range for unsigned data is 0 to 4,294,967,295; for signed data the range is -2,147,483,648 to 2,147,483,647.

A 32-bit data can be transmitted without conversion as is, or by using decimal pre-scaling to transform fractional numbers to an integer format as described above (see Decimal Scaling in Section 4.2.1).

4.3 User Assignable Registers

The PM172EH contains the 120 user assignable registers in the address range of 0 to 119 (see Table 4-1), any of which you can map to either register address accessible in the instrument. Registers that reside in different locations may be accessed by a single request by re-mapping them to adjacent addresses in the user assignable registers area.

The actual addresses of the assignable registers which are accessed via addresses 0 to 119 are specified in the user assignable register map (see Table 4-2). This map occupies addresses from 120 to 239, where map register 120 should contain the actual address of the register accessed via assignable register 0, register 121 should contain the actual address of the register accessed via assignable register 1, and so on. Note that the assignable register addresses and the map register addresses may not be re-mapped.

To build your own register map, write to map registers (120 to 239) the actual addresses you want to read from or write to via the assignable area (0 to 119). Note that long word registers should always be aligned at even addresses. For example, if you want to read registers 7136 (real-time voltage of phase A, word) and 7576/7577 (kWh import, long word) via registers 0-2, then do the following:

- write 7576 to register 120
- write 7577 to register 121
- write 7136 to register 122

Reading from registers 0-2 will return the kWh reading in registers 0 (low word) and 1 (high word), and the voltage reading in register 2.

Table 4-1 User Assignable Registers

Address	Register contents	Type
0	Assigned register #0	INT16
1	Assigned register #1	INT16
2	Assigned register #2	INT16
...	...	...
119	Assigned register #119	INT16

Table 4-2 User Assignable Register Map

Address	Register contents	Type	R/W	Range
120	Mapped address for register #0	UINT16	R/W	256 to 65535
121	Mapped address for register #1	UINT16	R/W	256 to 65535
122	Mapped address for register #2	UINT16	R/W	256 to 65535
...	...	...	...	...
239	Mapped address for register #119	UINT16	R/W	256 to 65535

4.4 Configuring and Accessing Log Files

Configuring Memory for Logging

To use the onboard data logging, allocate a separate log partition for each specific data you want to be recorded in your instrument. The PM172EH provides concurrent recording data in 12 different memory partitions, one of which is intended to record event log data, two partitions - for waveform recording, and the others to store 8 different data logs using different sets of data parameters. Additionally, the two last data logs #7 and #8 can be configured to automatically record TOU monthly and daily profile data respectively using season TOU tariffs. Refer to Section 5.19 for information on how to allocate a memory partition for your specific data. Refer to Section 5.20 on how to configure a set of parameters to be recorded to each data log.

Each memory partition you allocated for logging is organized as a sequential file of records where all data is recorded in chronological order with a time and date stamp. When a partition is filled up, recording can be stopped or can continue over the oldest records if you specified a partition with a wrap-around (circular) attribute. TOU profile log partitions are automatically configured as wrap-around.

Each record within a log file has a unique sequence number that guards against missing or duplicated records when reading the log file. This number is incremented (modulo 65536) with each log and will not be replicated within the following 65535 logs. If a record is missing because of a communication problem, the read sequence for the log can be restored from the record with the desired sequence number.

Accessing Log Files

Each log file has a separate file read pointer which always points to the current file record that will be read next, and a separate register window which gives access to the record pointed to by this pointer. Initially, the read pointer is associated with the oldest record in the file. Reading a record via the file window returns the current record data, and then the pointer automatically advances to the following record in the file. Consequent requests addressed to the file window will return a new record each time in the direction from the oldest record to the more recent records. Because the file window advances automatically after the instrument responds to the master request (regardless of the number of registers in the window being accessed), the entire window must be read at once using a single request.

After the last record of the file has been read, the file read pointer is automatically shifted to the beginning of the file. Using circular read requests always allows you to read the entire log file regardless of the current file status. You can simply poll the file window registers just as you poll ordinal data in your SCADA applications, without the need to manipulate the file pointer. Refer to Sections 5.29, 5.30 and 5.31 for information on read requests you can use to access your log files.

A log file can be read both in an arbitrary order and in sequence as explained above. To access the log records in a random order, the file read pointer can be re-written with the desired sequence number to point to the desired record. Refer to Sections 5.5 and 5.6 for information on how to check the log file status and how to re-write the file read pointer. Writing to the memory partition command register (see Section 5.6) allows you to force the file pointer to point to the oldest record in the file or to the first new, unread record in the file. You can also use the instrument reset registers (see Section 5.7) to restore the file read pointer to the oldest record in your log file if you want to re-read the file from the beginning.

IMPORTANT: Take into consideration the fact that in a wrap-around (circular) log partition, the oldest records may be overwritten by the most recent records since you have read either log status register. An attempt to point to the particular record directly by using its sequence number may fail if the addressed record has just been overwritten.

4.5 Password Protection

The PM172EH has a password protection option allowing you to protect your setups, cumulative registers and logs from being changed or cleared through communications. You can disable or enable password protection for communications via the front panel. For details, refer to your instrument Installation and Operation Manual. When password protection is enabled, the user password you set in your instrument should be written into the communications password register (see Section 5.23) before another write request will be issued. If the correct password is not supplied while password protection is enabled, the instrument will respond to all write requests with the exception code 01 (illegal operation). It is recommended to clear the password register after you have completed your changes in order to activate password protection.

5 POWERMETER REGISTERS DESCRIPTION

5.1 Basic Data Registers (16-bit)

Table 5-1 Basic Data Registers

Parameter	Register	Type	R/W	Unit [2]	Scale [1]		Con-version
					Low	High	
Voltage L1/L12 [6]	256	UINT16	R	0.1V/1V	0	Vmax	LIN3
Voltage L2/L23 [6]	257	UINT16	R	0.1V/1V	0	Vmax	LIN3
Voltage L3/L31 [6]	258	UINT16	R	0.1V/1V	0	Vmax	LIN3
Current L1	259	UINT16	R	0.01A	0	Imax	LIN3
Current L2	260	UINT16	R	0.01A	0	Imax	LIN3
Current L3	261	UINT16	R	0.01A	0	Imax	LIN3
kW L1	262	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
kW L2	263	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
kW L3	264	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
kvar L1	265	UINT16	R	0.001kvar/1kvar	-Pmax	Pmax	LIN3
kvar L2	266	UINT16	R	0.001kvar/1kvar	-Pmax	Pmax	LIN3
kvar L3	267	UINT16	R	0.001kvar/1kvar	-Pmax	Pmax	LIN3
kVA L1	268	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
kVA L2	269	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
kVA L3	270	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
Power factor L1	271	UINT16	R	0.001	-1.000	1.000	LIN3
Power factor L2	272	UINT16	R	0.001	-1.000	1.000	LIN3
Power factor L3	273	UINT16	R	0.001	-1.000	1.000	LIN3
Total power factor	274	UINT16	R	0.001	-1.000	1.000	LIN3
Total kW	275	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
Total kvar	276	UINT16	R	0.001kvar/1kvar	-Pmax	Pmax	LIN3
Total kVA	277	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
Neutral current	278	UINT16	R	0.01A	0	Imax	LIN3
Frequency	279	UINT16	R	0.01Hz	45.00	65.00	LIN3
Max. kW import sliding window demand [5]	280	UINT16	R/W	0.001kW/1kW	-Pmax	Pmax	LIN3
Accumulated kW import demand	281	UINT16	R/W	0.001kW/1kW	-Pmax	Pmax	LIN3
Max. kVA sliding window demand [5]	282	UINT16	R/W	0.001kVA/1kVA	-Pmax	Pmax	LIN3
Accumulated kVA demand	283	UINT16	R/W	0.001kVA/1kVA	-Pmax	Pmax	LIN3
Max. ampere demand L1	284	UINT16	R/W	0.01A	0	Imax	LIN3
Max. ampere demand L2	285	UINT16	R/W	0.01A	0	Imax	LIN3
Max. ampere demand L3	286	UINT16	R/W	0.01A	0	Imax	LIN3
kWh import (low)	287	UINT16	R/W	1kWh	0	9999	NONE
kWh import (high)	288	UINT16	R/W	10,000 kWh	0	9999	NONE
kWh export (low)	289	UINT16	R/W	1kWh	0	9999	NONE
kWh export (high)	290	UINT16	R/W	10,000 kWh	0	9999	NONE
+kvarh net (low) [3]	291	UINT16	R/W	1kvarh	0	9999	NONE
+kvarh net (high) [3]	292	UINT16	R/W	10,000 kvarh	0	9999	NONE
-kvarh net (low) [4]	293	UINT16	R/W	1kvarh	0	9999	NONE
-kvarh net (high) [4]	294	UINT16	R/W	10,000 kvarh	0	999	NONE
Voltage THD L1/L12	295	UINT16	R	0.1%	0	999.9	LIN3
Voltage THD L2/L23	296	UINT16	R	0.1%	0	999.9	LIN3
Voltage THD L3/L31	297	UINT16	R	0.1%	0	999.9	LIN3
Current THD L1	298	UINT16	R	0.1%	0	999.9	LIN3
Current THD L2	299	UINT16	R	0.1%	0	999.9	LIN3
Current THD L3	300	UINT16	R	0.1%	0	999.9	LIN3
kVAh (low)	301	UINT16	R/W	1kVAh	0	9999	NONE
kVAh (high)	302	UINT16	R/W	10,000 kVAh	0	9999	NONE
Present kW sliding window demand [5]	303	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
Present kVA sliding window demand [5]	304	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
PF at maximum kVA import sliding window demand	305	UINT16	R	0.001	-1.000	1.000	LIN3
Current TDD L1	306	UINT16	R	0.1%	0	100.0	LIN3
Current TDD L2	307	UINT16	R	0.1%	0	100.0	LIN3
Current TDD L3	308	UINT16	R	0.1%	0	100.0	LIN3

[1] The parameter limits are as follows:

Imax (×120% 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

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

Wiring via PTs (PT Ratio > 1):

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

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

3 Positive readings of kvarh net

4 Negative readings of kvarh net

5 To get block interval demand readings, specify the number of demand periods equal to 1 (see Table 5-19)

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.

NOTE: Writing a zero to one of registers 280-286 causes reset of all maximum demands. Writing a zero to one of registers 287-294 and 301-302 causes reset of all accumulated energies. This does not apply to the TOU system registers.

5.2 Extended Data Registers (16/32-bit)

The following table lists all registers containing the data measured by the instrument. Notice that these registers are arranged into groups, which are not located at adjacent addresses. You can re-map these registers into adjacent addresses to access multiple data from different data groups by using a single request. Refer to Section 4.3 for information on the user assignable registers. All data can be read either as 16-bit unsigned integer numbers using LIN3 conversion to get true values in engineering units, or as 32-bit long signed or unsigned integer numbers with scaling using multipliers to transmit fractional numbers. Note that in both cases, pulse and energy counters are transmitted as 32-bit unsigned long integers.

Along with the register address, the table shows for each data item its point identifier (ID). This is a one word containing a data group ID in the high byte and the parameter offset in a group in the low byte. Data IDs are used to specify input or output parameters whenever a data parameter specification is needed.

Table 5-2 Extended Data Registers

Parameter	UINT16		INT32	Point ID	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.					Low	High
None								
None	6656		11776-11777	0x0000	R		0	0
Event flags								
Event flags (bitmap)	6776		12160-12161	0x0300	R		0	255
Status inputs								
Status inputs (bitmap)	6896		12544-12545	0x0600	R		0	3
Relays								
Relay status (bitmap)	6976		12800-12801	0x0800	R		0	3
Pulse counters								
Counter #1	7056-7057		13056-13057	0x0A00	R/W		0	999999
Counter #2	7058-7059		13058-13059	0x0A01	R/W		0	999999
Counter #3	7060-7061		13060-13061	0x0A02	R/W		0	999999
Counter #4	7062-7063		13062-13063	0x0A03	R/W		0	999999
Real-time values per phase								
Voltage L1/L12 [6]	7136	LIN3	13312-13313	0x0C00	R	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	7137	LIN3	13314-13315	0x0C01	R	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	7138	LIN3	13316-13317	0x0C02	R	0.1V/1V	0	Vmax
Current L1	7139	LIN3	13318-13319	0x0C03	R	0.01A	0	Imax

Parameter	UINT16		INT32	Point ID	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.					Low	High
Current L2	7140	LIN3	13320-13321	0x0C04	R	0.01A	0	Imax
Current L3	7141	LIN3	13322-13323	0x0C05	R	0.01A	0	Imax
kW L1	7142	LIN3	13324-13325	0x0C06	R	0.001kW/1kW	-Pmax	Pmax
kW L2	7143	LIN3	13326-13327	0x0C07	R	0.001kW/1kW	-Pmax	Pmax
kW L3	7144	LIN3	13328-13329	0x0C08	R	0.001kW/1kW	-Pmax	Pmax
kvar L1	7145	LIN3	13330-13331	0x0C09	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	7146	LIN3	13332-13333	0x0C0A	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	7147	LIN3	13334-13335	0x0C0B	R	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	7148	LIN3	13336-13337	0x0C0C	R	0.001kVA/1kVA	0	Pmax
kVA L2	7149	LIN3	13338-13339	0x0C0D	R	0.001kVA/1kVA	0	Pmax
kVA L3	7150	LIN3	13340-13341	0x0C0E	R	0.001kVA/1kVA	0	Pmax
Power factor L1	7151	LIN3	13342-13343	0x0C0F	R	0.001	-1.000	1.000
Power factor L2	7152	LIN3	13344-13345	0x0C10	R	0.001	-1.000	1.000
Power factor L3	7153	LIN3	13346-13347	0x0C11	R	0.001	-1.000	1.000
Voltage THD L1/L12	7154	LIN3	13348-13349	0x0C12	R	0.1%	0	999.9
Voltage THD L2/L23	7155	LIN3	13350-13351	0x0C13	R	0.1%	0	999.9
Voltage THD L3/L31	7156	LIN3	13352-13353	0x0C14	R	0.1%	0	999.9
Current THD L1	7157	LIN3	13354-13355	0x0C15	R	0.1%	0	999.9
Current THD L2	7158	LIN3	13356-13357	0x0C16	R	0.1%	0	999.9
Current THD L3	7159	LIN3	13358-13359	0x0C17	R	0.1%	0	999.9
K-Factor L1	7160	LIN3	13360-13361	0x0C18	R	0.1	1.0	999.9
K-Factor L2	7161	LIN3	13362-13363	0x0C19	R	0.1	1.0	999.9
K-Factor L3	7162	LIN3	13364-13365	0x0C1A	R	0.1	1.0	999.9
Current TDD L1	7163	LIN3	13366-13367	0x0C1B	R	0.1%	0	100.0
Current TDD L2	7164	LIN3	13368-13369	0x0C1C	R	0.1%	0	100.0
Current TDD L3	7165	LIN3	13370-13371	0x0C1D	R	0.1%	0	100.0
Voltage L12	7166	LIN3	13372-13373	0x0C1E	R	0.1V/1V	0	Vmax
Voltage L23	7167	LIN3	13374-13375	0x0C1F	R	0.1V/1V	0	Vmax
Voltage L31	7168	LIN3	13376-13377	0x0C20	R	0.1V/1V	0	Vmax
Real-time total values								
Total kW	7256	LIN3	13696-13697	0x0F00	R	0.001kW/1kW	-Pmax	Pmax
Total kvar	7257	LIN3	13698-13699	0x0F01	R	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	7258	LIN3	13700-13701	0x0F02	R	0.001kVA/1kVA	0	Pmax
Total PF	7259	LIN3	13702-13703	0x0F03	R	0.001	-1.000	1.000
Real-time auxiliary values								
Reserved	7296		13824-13825	0x1000	R		0	0
Neutral current	7297	LIN3	13826-13827	0x1001	R	0.01A	0	Imax
Frequency [3]	7298	LIN3	13828-13829	0x1002	R	0.01Hz	0	100.00
Voltage unbalance	7299	LIN3	13830-13831	0x1003	R	1%	0	300
Current unbalance	7300	LIN3	13832-13833	0x1004	R	1%	0	300
Average values per phase								
Voltage L1/L12 [6]	7336	LIN3	13952-13953	0x1100	R	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	7337	LIN3	13954-13955	0x1101	R	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	7338	LIN3	13956-13957	0x1102	R	0.1V/1V	0	Vmax
Current L1	7339	LIN3	13958-13959	0x1103	R	0.01A	0	Imax
Current L2	7340	LIN3	13960-13961	0x1104	R	0.01A	0	Imax
Current L3	7341	LIN3	13962-13963	0x1105	R	0.01A	0	Imax
kW L1	7342	LIN3	13964-13965	0x1106	R	0.001kW/1kW	-Pmax	Pmax
kW L2	7343	LIN3	13966-13967	0x1107	R	0.001kW/1kW	-Pmax	Pmax
kW L3	7344	LIN3	13968-13969	0x1108	R	0.001kW/1kW	-Pmax	Pmax
kvar L1	7345	LIN3	13970-13971	0x1109	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	7346	LIN3	13972-13973	0x110A	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	7347	LIN3	13974-13975	0x110B	R	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	7348	LIN3	13976-13977	0x110C	R	0.001kVA/1kVA	0	Pmax
kVA L2	7349	LIN3	13978-13979	0x110D	R	0.001kVA/1kVA	0	Pmax
kVA L3	7350	LIN3	13980-13981	0x110E	R	0.001kVA/1kVA	0	Pmax
Power factor L1	7351	LIN3	13982-13983	0x110F	R	0.001	-1.000	1.000
Power factor L2	7352	LIN3	13984-13985	0x1110	R	0.001	-1.000	1.000
Power factor L3	7353	LIN3	13986-13987	0x1111	R	0.001	-1.000	1.000
Voltage THD L1/L12	7354	LIN3	13988-13989	0x1112	R	0.1%	0	999.9
Voltage THD L2/L23	7355	LIN3	13990-13991	0x1113	R	0.1%	0	999.9
Voltage THD L3/L31	7356	LIN3	13992-13993	0x1114	R	0.1%	0	999.9
Current THD L1	7357	LIN3	13994-13995	0x1115	R	0.1%	0	999.9

Parameter	UINT16		INT32	Point	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.		ID			Low	High
Current THD L2	7358	LIN3	13996-13997	0x1116	R	0.1%	0	999.9
Current THD L3	7359	LIN3	13998-13999	0x1117	R	0.1%	0	999.9
K-Factor L1	7360	LIN3	14000-14001	0x1118	R	0.1	1.0	999.9
K-Factor L2	7361	LIN3	14002-14003	0x1119	R	0.1	1.0	999.9
K-Factor L3	7362	LIN3	14004-14005	0x111A	R	0.1	1.0	999.9
Current TDD L1	7363	LIN3	14006-14007	0x111B	R	0.1%	0	100.0
Current TDD L2	7364	LIN3	14008-14009	0x111C	R	0.1%	0	100.0
Current TDD L3	7365	LIN3	14010-14011	0x111D	R	0.1%	0	100.0
Voltage L12	7366	LIN3	14012-14013	0x111E	R	0.1V/1V	0	Vmax
Voltage L23	7367	LIN3	14014-14015	0x111F	R	0.1V/1V	0	Vmax
Voltage L31	7368	LIN3	14016-14017	0x1120	R	0.1V/1V	0	Vmax
Average total values								
Total kW	7456	LIN3	14336-14337	0x1400	R	0.001kW/1kW	-Pmax	Pmax
Total kvar	7457	LIN3	14338-14339	0x1401	R	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	7458	LIN3	14340-14341	0x1402	R	0.001kVA/1kVA	0	Pmax
Total PF	7459	LIN3	14342-14343	0x1403	R	0.001	-1.000	1.000
Average auxiliary values								
Reserved	7496		14464-14465	0x1500	R		0	0
Neutral current	7497	LIN3	14466-14467	0x1501	R	0.01A	0	Imax
Frequency [3]	7498	LIN3	14468-14469	0x1502	R	0.01Hz	0	100.00
Voltage unbalance	7499	LIN3	14470-14471	0x1503	R	1%	0	300
Current unbalance	7500	LIN3	14472-14473	0x1504	R	1%	0	300
Present demands								
Volt demand L1/L12 [6]	7536	LIN3	14592-14593	0x1600	R	0.1V/1V	0	Vmax
Volt demand L2/L23 [6]	7537	LIN3	14594-14595	0x1601	R	0.1V/1V	0	Vmax
Volt demand L3/L31 [6]	7538	LIN3	14596-14597	0x1602	R	0.1V/1V	0	Vmax
Ampere demand L1	7539	LIN3	14598-14599	0x1603	R	0.01A	0	Imax
Ampere demand L2	7540	LIN3	14600-14601	0x1604	R	0.01A	0	Imax
Ampere demand L3	7541	LIN3	14602-14603	0x1605	R	0.01A	0	Imax
Block kW demand	7542	LIN3	14604-14605	0x1606	R	0.001kW/1kW	0	Pmax
Block kvar import demand	7543	LIN3	14606-14607	0x1607	R	0.001kvar/1kvar	0	Pmax
Block kVA demand	7544	LIN3	14608-14609	0x1608	R	0.001kVA/1kVA	0	Pmax
Sliding window kW demand	7545	LIN3	14610-14611	0x1609	R	0.001kW/1kW	0	Pmax
Sliding window kvar import demand	7546	LIN3	14612-14613	0x160A	R	0.001kvar/1kvar	0	Pmax
Sliding window kVA demand	7547	LIN3	14614-14615	0x160B	R	0.001kVA/1kVA	0	Pmax
Reserved	7548		14616-14617	0x160C	R		0	0
Reserved	7549		14618-14619	0x160D	R		0	0
Reserved	7550		14620-14621	0x160E	R		0	0
Accumulated kW demand (import)	7551	LIN3	14622-14623	0x160F	R	0.001kW/1kW	0	Pmax
Accumulated kvar import demand	7552	LIN3	14624-14625	0x1610	R	0.001kvar/1kvar	0	Pmax
Accumulated kVA demand	7553	LIN3	14626-14627	0x1611	R	0.001kVA/1kVA	0	Pmax
Predicted sliding window kW demand (import)	7554	LIN3	14628-14629	0x1612	R	0.001kW/1kW	0	Pmax
Predicted sliding window kvar import demand	7555	LIN3	14630-14631	0x1613	R	0.001kvar/1kvar	0	Pmax
Predicted sliding window kVA demand	7556	LIN3	14632-14633	0x1614	R	0.001kVA/1kVA	0	Pmax
PF (import) at maximum kVA sliding window demand	7557	LIN3	14634-14635	0x1615	R	0.001	-1.000	1.000
Block kW export demand	7558	LIN3	14636-14637	0x1616	R	0.001kW/1kW	0	Pmax
Block kvar export demand	7559	LIN3	14638-14639	0x1617	R	0.001kvar/1kvar	0	Pmax
Sliding window kW export demand	7560	LIN3	14640-14641	0x1618	R	0.001kW/1kW	0	Pmax
Sliding window kvar export demand	7561	LIN3	14642-14643	0x1619	R	0.001kvar/1kvar	0	Pmax
Accumulated kW export demand	7562	LIN3	14644-14645	0x161A	R	0.001kW/1kW	0	Pmax
Accumulated kvar export demand	7563	LIN3	14646-14647	0x161B	R	0.001kvar/1kvar	0	Pmax
Predicted sliding window kW export demand	7564	LIN3	14648-14649	0x161C	R	0.001kW/1kW	0	Pmax

Parameter	UINT16		INT32	Point ID	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.					Low	High
Predicted sliding window kvar export demand	7565	LIN3	14650-14651	0x161D	R	0.001kvar/1kvar	0	Pmax
Total energies								
kWh import	7576-7577		14720-14721	0x1700	R	kWh	0	10^9-1
kWh export [5]	7578-7579		14722-14723	0x1701	R	kWh	0	10^9-1
Reserved	7580-7583		14724-14727	0x1702-0x1703	R		0	0
kvarh import	7584-7585		14728-14729	0x1704	R	kvarh	0	10^9-1
kvarh export [5]	7586-7587		14730-14731	0x1705	R	kvarh	0	10^9-1
Reserved	7588-7591		14732-14735	0x1706-0x1707	R		0	0
kVAh total	7592-7593		14736-14737	0x1708	R	kVAh	0	10^9-1
Reserved	7594-7601		14738-14745	0x1709-0x170C	R		0	0
Harmonic kWh import	7602-7603		14746-14747	0x170D	R	kWh	0	10^9-1
Harmonic kWh export	7604-7605		14748-14749	0x170E	R	kWh	0	10^9-1
Reserved	7606-7609		14750-14753	0x170F-0x1710	R		0	0
Harmonic kVAh	7610-7611		14754-14755	0x1711	R	kVAh	0	10^9-1
Phase energies								
kWh import L1	7616-7617		14848-14849	0x1800	R	kWh	0	10^9-1
kWh import L2	7618-7619		14850-14851	0x1801	R	kWh	0	10^9-1
kWh import L3	7620-7621		14852-14853	0x1802	R	kWh	0	10^9-1
kvarh import L1	7622-7623		14854-14855	0x1803	R	kvarh	0	10^9-1
kvarh import L2	7624-7625		14856-14857	0x1804	R	kvarh	0	10^9-1
kvarh import L3	7626-7627		14858-14859	0x1805	R	kvarh	0	10^9-1
kVAh total L1	7628-7629		14860-14861	0x1806	R	kVAh	0	10^9-1
kVAh total L2	7630-7631		14862-14863	0x1807	R	kVAh	0	10^9-1
kVAh total L3	7632-7633		14864-14865	0x1808	R	kVAh	0	10^9-1
L1/L12 voltage harmonics								
Harmonic H01	7656	LIN3	14976-14977	0x1900	R	0.01%	0	100.00
Harmonic H02	7657	LIN3	14978-14979	0x1901	R	0.01%	0	100.00
...	...			...				
Harmonic H40	7695	LIN3	14054-14055	0x193E	R	0.01%	0	100.00
L2/L23 voltage harmonics								
Harmonic H01	7696	LIN3	15104-15105	0x1A00	R	0.01%	0	100.00
Harmonic H02	7697	LIN3	15106-15107	0x1A01	R	0.01%	0	100.00
...	...			...				
Harmonic H40	7735	LIN3	15182-15183	0x1A3E	R	0.01%	0	100.00
L3 voltage harmonics								
Harmonic H01	7736	LIN3	15232-15233	0x1B00	R	0.01%	0	100.00
Harmonic H02	7737	LIN3	15234-15235	0x1B01	R	0.01%	0	100.00
...	...			...				
Harmonic H40	7775	LIN3	15310-15311	0x1B3E	R	0.01%	0	100.00
L1 current harmonics								
Harmonic H01	7776	LIN3	15360-15361	0x1C00	R	0.01%	0	100.00
Harmonic H02	7777	LIN3	15362-15363	0x1C01	R	0.01%	0	100.00
...	...			...				

Parameter	UINT16		INT32	Point	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.		ID			Low	High
Harmonic H40	7815	LIN3	15438-15439	0x1C3E	R	0.01%	0	100.00
L2 current harmonics								
Harmonic H01	7816	LIN3	15488-15489	0x1D00	R	0.01%	0	100.00
Harmonic H02	7817	LIN3	15490-15491	0x1D01	R	0.01%	0	100.00
...	...			...				
Harmonic H40	7855	LIN3	15566-15567	0x1D3E	R	0.01%	0	100.00
L3 current harmonics								
Harmonic H01	7856	LIN3	15616-15617	0x1E00	R	0.01%	0	100.00
Harmonic H02	7857	LIN3	15618-15619	0x1E01	R	0.01%	0	100.00
...	...			...				
Harmonic H40	7895	LIN3	15694-15695	0x1E3E	R	0.01%	0	100.00
Fundamental's (H01) real-time values per phase								
Voltage L1/L12 [7]	8296	LIN3	17024-17025	0x2900	R	0.1V/1V	0	Vmax
Voltage L2/L23 [7]	8297	LIN3	17026-17027	0x2901	R	0.1V/1V	0	Vmax
Voltage L3/L31 [7]	8298	LIN3	17028-17029	0x2902	R	0.1V/1V	0	Vmax
Current L1	8299	LIN3	17030-17031	0x2903	R	0.01A	0	Imax
Current L2	8300	LIN3	17032-17033	0x2904	R	0.01A	0	Imax
Current L3	8301	LIN3	17034-17035	0x2905	R	0.01A	0	Imax
kW L1	8302	LIN3	17036-17037	0x2906	R	0.001kW/1kW	-Pmax	Pmax
kW L2	8303	LIN3	17038-17039	0x2907	R	0.001kW/1kW	-Pmax	Pmax
kW L3	8304	LIN3	17040-17041	0x2908	R	0.001kW/1kW	-Pmax	Pmax
kvar L1	8305	LIN3	17042-17043	0x2909	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	8306	LIN3	17044-17045	0x290A	R	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	8307	LIN3	17046-17047	0x290B	R	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	8308	LIN3	17048-17049	0x290C	R	0.001kVA/1kVA	0	Pmax
kVA L2	8309	LIN3	17050-17051	0x290D	R	0.001kVA/1kVA	0	Pmax
kVA L3	8310	LIN3	17052-17053	0x290E	R	0.001kVA/1kVA	0	Pmax
Power factor L1	8311	LIN3	17054-17055	0x290F	R	0.001	-1.000	1.000
Power factor L2	8312	LIN3	17056-17055	0x2910	R	0.001	-1.000	1.000
Power factor L3	8313	LIN3	17058-17059	0x2911	R	0.001	-1.000	1.000
Harmonic real-time total values								
Total fundamental kW	8336	LIN3	17152-17153	0x2A00	R	0.001kW/1kW	-Pmax	Pmax
Total fundamental kvar	8337	LIN3	17154-17155	0x2A01	R	0.001kvar/1kvar	-Pmax	Pmax
Total fundamental kVA	8338	LIN3	17156-17157	0x2A02	R	0.001kVA/1kVA	0	Pmax
Total fundamental PF	8339	LIN3	17158-17159	0x2A03	R	0.001	-1.000	1.000
Total harmonic kW	8340	LIN3	17160-17161	0x2A04	R	0.001kW/1kW	-Pmax	Pmax
Reserved	8341	LIN3	17162-17162	0x2A05	R		0	0
Total harmonic kVA	8342	LIN3	17164-17163	0x2A06	R	0.001kVA/1kVA	0	Pmax
Reserved	8343	LIN3	17166-17164	0x2A07	R		0	0
Minimum real-time values per phase (M)								
Voltage L1/L12 [6]	8416	LIN3	17408-17409	0x2C00	R	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	8417	LIN3	17410-17411	0x2C01	R	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	8418	LIN3	17412-17413	0x2C02	R	0.1V/1V	0	Vmax
Current L1	8419	LIN3	17414-17415	0x2C03	R	0.01A	0	Imax
Current L2	8420	LIN3	17416-17417	0x2C04	R	0.01A	0	Imax
Current L3	8421	LIN3	17418-17419	0x2C05	R	0.01A	0	Imax
Reserved					R		0	0
Voltage THD L1/L12	8434	LIN3	17444-17445	0x2C12	R	0.1%	0	999.9
Voltage THD L2/L23	8435	LIN3	17446-17447	0x2C13	R	0.1%	0	999.9
Voltage THD L3/L31	8436	LIN3	17448-17449	0x2C14	R	0.1%	0	999.9
Current THD L1	8437	LIN3	17450-17451	0x2C15	R	0.1%	0	999.9
Current THD L2	8438	LIN3	17452-17453	0x2C16	R	0.1%	0	999.9
Current THD L3	8439	LIN3	17454-17455	0x2C17	R	0.1%	0	999.9
K-Factor L1	8440	LIN3	17456-17457	0x2C18	R	0.1	1.0	999.9
K-Factor L2	8441	LIN3	17458-17459	0x2C19	R	0.1	1.0	999.9
K-Factor L3	8442	LIN3	17460-17461	0x2C1A	R	0.1	1.0	999.9
Current TDD L1	8443	LIN3	17462-17463	0x2C1B	R	0.1%	0	100.0
Current TDD L2	8444	LIN3	17464-17465	0x2C1C	R	0.1%	0	100.0
Current TDD L3	8445	LIN3	17466-17467	0x2C1D	R	0.1%	0	100.0
Minimum real-time total values (M)								
Total kW	8456	LIN3	17536-17537	0x2D00	R	0.001kW/1kW	-Pmax	Pmax
Total kvar	8457	LIN3	17538-17539	0x2D01	R	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	8458	LIN3	17540-17541	0x2D02	R	0.001kVA/1kVA	0	Pmax

Parameter	UINT16		INT32	Point ID	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.					Low	High
Total PF [4]	8459	LIN3	17542-17543	0x2D03	R	0.001	0	1.000
Minimum real-time auxiliary values (M)								
Reserved	8496		17664-17665	0x2E00	R		0	0
Neutral current	8497	LIN3	17666-17667	0x2E01	R	0.01A	0	Imax
Frequency [3]	8498	LIN3	17668-17669	0x2E02	R	0.01Hz	0	100.00
Maximum real-time values per phase (M)								
Voltage L1/L12 [6]	8736	LIN3	18432-18433	0x3400	R	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	8737	LIN3	18434-18435	0x3401	R	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	8738	LIN3	18436-18437	0x3402	R	0.1V/1V	0	Vmax
Current L1	8739	LIN3	18438-18439	0x3403	R	0.01A	0	Imax
Current L2	8740	LIN3	18440-18441	0x3404	R	0.01A	0	Imax
Current L3	8741	LIN3	18442-18443	0x3405	R	0.01A	0	Imax
Reserved					R		0	0
Voltage THD L1/L12	8754	LIN3	18468-18469	0x3412	R	0.1%	0	999.9
Voltage THD L2/L23	8755	LIN3	18470-18471	0x3413	R	0.1%	0	999.9
Voltage THD L3/L31	8756	LIN3	18472-18473	0x3414	R	0.1%	0	999.9
Current THD L1	8757	LIN3	18474-18475	0x3415	R	0.1%	0	999.9
Current THD L2	8758	LIN3	18476-18477	0x3416	R	0.1%	0	999.9
Current THD L3	8759	LIN3	18478-18479	0x3417	R	0.1%	0	999.9
K-Factor L1	8760	LIN3	18480-18481	0x3418	R	0.1	1.0	999.9
K-Factor L2	8761	LIN3	18482-18483	0x3419	R	0.1	1.0	999.9
K-Factor L3	8762	LIN3	18484-18485	0x341A	R	0.1	1.0	999.9
Current TDD L1	8763	LIN3	18486-18487	0x341B	R	0.1%	0	100.0
Current TDD L2	8764	LIN3	18488-18489	0x341C	R	0.1%	0	100.0
Current TDD L3	8765	LIN3	18490-18491	0x341D	R	0.1%	0	100.0
Maximum real-time total values (M)								
Total kW	8776	LIN3	18560-18561	0x3500	R	0.001kW/1kW	-Pmax	Pmax
Total kvar	8777	LIN3	18562-18563	0x3501	R	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	8778	LIN3	18564-18565	0x3502	R	0.001kVA/1kVA	0	Pmax
Total PF [6]	8779	LIN3	18566-18567	0x3503	R	0.001	0	1.000
Maximum real-time auxiliary values (M)								
Reserved	8816		18688-18689	0x3600	R		0	
Neutral current	8817	LIN3	18680-18681	0x3601	R	0.01A	0	Imax
Frequency [3]	8818	LIN3	18682-18683	0x3602	R	0.01Hz	0	100.00
Maximum demands (M)								
Max. volt demand L1/L12 [6]	8856	LIN3	18816-18817	0x3700	R	0.1V/1V	0	Vmax
Max. volt demand L2/L23 [6]	8857	LIN3	18818-18819	0x3701	R	0.1V/1V	0	Vmax
Max. volt demand L3/L31 [6]	8858	LIN3	18820-18821	0x3702	R	0.1V/1V	0	Vmax
Max. ampere demand L1	8859	LIN3	18822-18823	0x3703	R	0.01A	0	Imax
Max. ampere demand L2	8860	LIN3	18824-18825	0x3704	R	0.01A	0	Imax
Max. ampere demand L3	8861	LIN3	18826-18827	0x3705	R	0.01A	0	Imax
Reserved	8862-8864		18828-18833	0x3706-0x3708	R		0	0
Max. sliding window kW import demand	8865	LIN3	18834-18835	0x3709	R	0.001kW/1kW	0	Pmax
Max. sliding window kvar import demand	8866	LIN3	18836-18837	0x370A	R	0.001kvar/1kvar	0	Pmax
Max. sliding window kVA demand	8867	LIN3	18838-18839	0x370B	R	0.001kVA/1kVA	0	Pmax
Reserved	8868-8870		18840-18845	0x370C-0x370E-	R		0	0
Max. sliding window kW export demand	8871	LIN3	18846-18847	0x370F	R	0.001kW/1kW	0	Pmax
Max. sliding window kvar export demand	8872	LIN3	18848-18849	0x3710	R	0.001kvar/1kvar	0	Pmax
TOU system parameters								
Active tariff	9056		19456-19457	0x3C00	R		0	15
Active profile	9057		19458-19459	0x3C01	R		0	15
TOU energy register #1								
Tariff #1 register	9096 9097		19584-19585	0x3D00	R	[7]	0	10^9-1
Tariff #2 register	9098 9099		19586-19587	0x3D01	R	[7]	0	10^9-1
...	...		...	...				

Parameter	UINT16		INT32	Point ID	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.					Low	High
Tariff #16 register	9126 9127		19614-19615	0x3D0F	R	[7]	0	10^9-1
TOU energy register #2								
Tariff #1 register	9136 9137		19712-19713	0x3E00	R	[7]	0	10^9-1
Tariff #2 register	9138 9139		19714-19715	0x3E01	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9166 9167		19742-19743	0x3E0F	R	[7]	0	10^9-1
TOU energy register #3								
Tariff #1 register	9176 9177		19840-19841	0x3F00	R	[7]	0	10^9-1
Tariff #2 register	9178 9179		19842-19843	0x3F01	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9206 9207		19870-19871	0x3F0F	R	[7]	0	10^9-1
TOU energy register #4								
Tariff #1 register	9216 9217		19968-19969	0x4000	R	[7]	0	10^9-1
Tariff #2 register	9218 9219		19970-19971	0x4001	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9246 9247		19998-19999	0x400F	R	[7]	0	10^9-1
TOU energy register #5								
Tariff #1 register	9256 9257		20096-20097	0x4100	R	[7]	0	10^9-1
Tariff #2 register	9258 9259		20098-20099	0x4101	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9286 9287		20126-20127	0x410F	R	[7]	0	10^9-1
TOU energy register #6								
Tariff #1 register	9296 9297		20224-20225	0x4200	R	[7]	0	10^9-1
Tariff #2 register	9298 9299		20226-20227	0x4201	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9326 9327		20254-20255	0x420F	R	[7]	0	10^9-1
TOU energy register #7								
Tariff #1 register	9336 9337		20352-20353	0x4300	R	[7]	0	10^9-1
Tariff #2 register	9338 9339		20354-20355	0x4301	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9366 9367		20382-20383	0x430F	R	[7]	0	10^9-1
TOU energy register #8								
Tariff #1 register	9376 9377		20480-20481	0x4400	R	[7]	0	10^9-1
Tariff #2 register	9378 9379		20482-20483	0x4401	R	[7]	0	10^9-1
...	...		...	...				
Tariff #16 register	9406 9407		20510-20511	0x440F	R	[7]	0	10^9-1
TOU maximum demand register #1 (M)								
Tariff #1 register	9536	LIN3	20992-20993	0x4800	R	0.001kW/1kW	0	Pmax
Tariff #2 register	9537	LIN3	20994-20995	0x4801	R	0.001kW/1kW	0	Pmax
...	...		...	...				
Tariff #16 register	9551	LIN3	21022-21023	0x480F	R	0.001kW/1kW	0	Pmax
TOU maximum demand register #2 (M)								
Tariff #1 register	9576	LIN3	21120-21121	0x4900	R	0.001kW/1kW	0	Pmax

Parameter	UINT16		INT32	Point	R/W	Unit[2]	Range/Scale[1]	
	Reg.	Conv.		ID			Low	High
Tariff #2 register	9577	LIN3	21122-21123	0x4901	R	0.001kW/1kW	0	Pmax
...	...		...	...				
Tariff #16 register	9591	LIN3	21150-21151	0x490F	R	0.001kW/1kW	0	Pmax
TOU maximum demand register #3 (M)								
Tariff #1 register	9616	LIN3	21248-21249	0x4A00	R	0.001kVA/1kVA	0	Pmax
Tariff #2 register	9617	LIN3	21250-21251	0x4A01	R	0.001kVA/1kVA	0	Pmax
...	...		...	...				
Tariff #16 register	9631	LIN3	21278-21279	0x4A0F	R	0.001kVA/1kVA	0	Pmax
L1/L12 voltage harmonic angles [8]								
Harmonic H01 angle	10656	LIN3	24576-24577	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10657	LIN3	24578-24579	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10695	LIN3	24654-24655	0x6427	R	0.1 degree	-180.0	180.0
L2/L23 voltage harmonic angles [8]								
Harmonic H01 angle	10696	LIN3	24704-24705	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10697	LIN3	24706-24707	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10735	LIN3	24782-24783	0x6427	R	0.1 degree	-180.0	180.0
L3 voltage harmonic angles [8]								
Harmonic H01 angle	10736	LIN3	24832-24833	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10737	LIN3	24834-24835	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10775	LIN3	24910-24911	0x6427	R	0.1 degree	-180.0	180.0
L1 current harmonic angles [8]								
Harmonic H01 angle	10816	LIN3	25088-25089	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10817	LIN3	25099-25091	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10855	LIN3	25166-25167	0x6427	R	0.1 degree	-180.0	180.0
L2 current harmonic angles [8]								
Harmonic H01 angle	10856	LIN3	25216-25216	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10857	LIN3	25218-25219	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10895	LIN3	25294-25295	0x6427	R	0.1 degree	-180.0	180.0
L3 current harmonic angles [8]								
Harmonic H01 angle	10896	LIN3	25344-25345	0x6400	R	0.1 degree	-180.0	180.0
Harmonic H02 angle	10897	LIN3	25346-25347	0x6401	R	0.1 degree	-180.0	180.0
...	...			...				
Harmonic H40 angle	10935	LIN3	25422-25423	0x6427	R	0.1 degree	-180.0	180.0
Generic TOU season tariff energy registers - only as a reference for TOU profile logs								
Season tariff #1 register				0x7000	R		0	10^9-1
Season tariff #2 register				0x7001	R		0	10^9-1
...				...				
Season tariff #16 register				0x700F	R		0	10^9-1
Generic TOU season tariff maximum demand registers - only as a reference for TOU profile logs								
Season tariff #1 register		LIN3		0x7100	R		0	Pmax
Season tariff #2 register		LIN3		0x7101	R		0	Pmax
...				...				
Season tariff #16 register		LIN3		0x710F	R		0	Pmax

1 For the parameter limits, see Note [1] to Table 5-1.

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 - 65.00 Hz.

4 Absolute min/max value (lag or lead).

5 The exported energy registers are read as positive unsigned long (32-bit) integers.

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

7 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.

8 Harmonic angles are referenced to the fundamental voltage harmonic H01 on the same phase.

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

5.3 Min/Max Log Registers (32-bit)

Table 5-3 Min/Max Log Registers

Parameter	Registers	Type
Minimum real-time values per phase		
Min. Voltage L1/L12	35840-35841	INT32
Timestamp	35842-35843	UINT32
Min. Voltage L2/L23	35844-35845	INT32
Timestamp	35846-35847	UINT32
Min. Voltage L3/L31	35848-35849	INT32
Timestamp	35850-35851	UINT32
Min. Current L1	35852-35853	INT32
Timestamp	35854-35855	UINT32
Min. Current L2	35856-35857	INT32
Timestamp	35858-35859	UINT32
Min. Current L3	35860-35861	INT32
Timestamp	35862-35863	UINT32
Reserved	35864-35911	
Min. Voltage THD L1/L12	35912-35913	INT32
Timestamp	35914-35915	UINT32
Min. Voltage THD L2/L23	35916-35917	INT32
Timestamp	35918-35919	UINT32
Min. Voltage THD L3/L31	35920-35921	INT32
Timestamp	35922-35923	UINT32
Min. Current THD L1	35924-35925	INT32
Timestamp	35926-35927	UINT32
Min. Current THD L2	35928-35929	INT32
Timestamp	35930-35931	UINT32
Min. Current THD L3	35932-35933	INT32
Timestamp	35934-35935	UINT32
Min. Current K-Factor L1	35936-35937	INT32
Timestamp	35938-35939	UINT32
Min. Current K-Factor L2	35940-35941	INT32
Timestamp	35942-35943	UINT32
Min. Current K-Factor L3	35944-35945	INT32
Timestamp	35946-35947	UINT32
Min. Current TDD L1	35948-35949	INT32
Timestamp	35950-35951	UINT32
Min. Current TDD L2	35952-35953	INT32
Timestamp	35954-35955	UINT32
Min. Current TDD L3	35956-35957	INT32
Timestamp	35958-35959	UINT32
Minimum real-time total values		
Min. Total kW	36096-36097	INT32
Timestamp	36098-36099	UINT32
Min. Total kvar	36100-36101	INT32
Timestamp	36102-36103	UINT32
Min. Total kVA	36104-36105	INT32
Timestamp	36106-36107	UINT32
Total PF	36108-36109	INT32
Timestamp	36110-36111	UINT32
Minimum real-time auxiliary values		
Reserved	36352-36355	INT32
Min. Neutral current	36356-36357	INT32
Timestamp	36358-36359	UINT32
Min. Frequency	36360-36361	INT32
Timestamp	36362-36362	UINT32
Maximum real-time values per phase		
Max. Voltage L1/L12	36864-36865	INT32
Timestamp	36866-36867	UINT32
Max. Voltage L2/L23	36868-36869	INT32
Timestamp	36870-36871	UINT32
Max. Voltage L3/L31	36872-36873	INT32
Timestamp	36874-36875	UINT32

Parameter	Registers	Type
Max. Current L1	36876-36877	INT32
Timestamp	36878-36879	UINT32
Max. Current L2	36880-36881	INT32
Timestamp	36882-36883	UINT32
Max. Current L3	36884-36885	INT32
Timestamp	36886-36887	UINT32
Reserved	36889-36935	
Max. Voltage THD L1/L12	36936-36937	INT32
Timestamp	36938-36939	UINT32
Max. Voltage THD L2/L23	36940-36941	INT32
Timestamp	36942-36943	UINT32
Max. Voltage THD L3/L31	36944-36945	INT32
Timestamp	36946-36947	UINT32
Max. Current THD L1	36948-36949	INT32
Timestamp	36950-36951	UINT32
Max. Current THD L2	36952-36953	INT32
Timestamp	36954-36955	UINT32
Max. Current THD L3	36956-36957	INT32
Timestamp	36858-36959	UINT32
Max. Current K-Factor L1	36960-36961	INT32
Timestamp	36962-36963	UINT32
Max. Current K-Factor L2	36964-36965	INT32
Timestamp	36966-36967	UINT32
Max. Current K-Factor L3	36968-36969	INT32
Timestamp	36970-36971	UINT32
Max. Current TDD L1	36972-36973	INT32
Timestamp	36974-36975	UINT32
Max. Current TDD L2	36976-36977	INT32
Timestamp	36978-36979	UINT32
Max. Current TDD L3	36980-36981	INT32
Timestamp	36982-36983	UINT32
Maximum real-time total values		
Max. Total kW	37120-37121	INT32
Timestamp	37122-37123	UINT32
Max. Total kvar	37124-37125	INT32
Timestamp	37126-37127	UINT32
Total kVA	37128-37129	INT32
Timestamp	37130-37131	UINT32
Max. Total PF	37132-37133	INT32
Timestamp	37134-37135	UINT32
Maximum real-time auxiliary values		
Reserved	37376-37379	INT32
Max. Neutral current	37380-37381	INT32
Timestamp	37382-37383	UINT32
Max. Frequency	37384-37385	INT32
Timestamp	37386-37387	UINT32
Maximum demands (M)		
Max. volt demand L1/L12	37632-37633	INT32
Timestamp	37634-37635	UINT32
Max. volt demand L2/L23	37636-37637	INT32
Timestamp	37638-37639	UINT32
Max. volt demand L3/L31	37640-37641	INT32
Timestamp	37642-37643	UINT32
Max. ampere demand L1	37644-37645	INT32
Timestamp	37646-37647	UINT32
Max. ampere demand L2	37648-37649	INT32
Timestamp	37650-37651	UINT32
Max. ampere demand L3	37652-37653	INT32
Timestamp	37654-37657	UINT32
Reserved	37656-37667	INT32
Max. sliding window kW import demand	37668-37669	INT32
Timestamp	37670-37671	UINT32
Reserved	37672-37675	INT32
Max. sliding window kVA demand	37676-37677	INT32

Parameter	Registers	Type
Timestamp	37678-37679	UINT32
Reserved	37680-37691	INT32
Max. sliding window kW export demand	37692-37693	INT32
Timestamp	37694-37695	UINT32
TOU maximum demand register #1		
Max. Demand Tariff #1 register	38144-38145	INT32
Timestamp	38146-38147	UINT32
Max. Demand Tariff #2 register	38148-38149	INT32
Timestamp	38150-38151	UINT32
...	...	
Max. Demand Tariff #16 register	38204-38205	INT32
Timestamp	38206-38207	UINT32
TOU maximum demand register #2		
Max. Demand Tariff #1 register	38400-38401	INT32
Timestamp	38402-38403	UINT32
Max. Demand Tariff #2 register	38404-38405	INT32
Timestamp	38406-38407	UINT32
...	...	
Max. Demand Tariff #16 register	38460-38461	INT32
Timestamp	38462-38463	UINT32
TOU maximum demands register #3		
Max. Demand Tariff #1 register	38656-38657	INT32
Timestamp	38658-38659	UINT32
Max. Demand Tariff #2 register	38650-38651	INT32
Timestamp	38652-38653	UINT32
...	...	
Max. Demand Tariff #16 register	38716-38717	INT32
Timestamp	38718-38719	UINT32

1. Timestamp is given in local time in a UNIX-style time format: it represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000.

2. The Min/Max log parameters are read in 32-bit registers. For the value ranges and scales, refer to Table 5-2.

5.4 Instrument Status Registers

Table 5-4 Instrument Status Registers

Parameter	Register	Type	R/W	Range
Instrument reset register [1]	2560	UINT16	R/W	0 (when read) 65535 (when written) = reset the instrument
Reserved	2561-2562	UINT16	R	Read as 0
Firmware build number [2]	2563	UINT16	R	0-65535
Reserved	2564	UINT16	R	Read as 0
Firmware version number	2565	UINT16	R	0-65535
Instrument options 1	2566	UINT16	R	See Table 5-5
Instrument options 2	2567	UINT16	R	See Table 5-5
Relay status	3452	UINT16	R	See Table 5-6
Event flags	3453	UINT16	R	See Table 5-7
Status inputs	3454	UINT16	R	See Table 5-8
Setpoints status	3455	UINT16	R	See Table 5-9
Log status	3456	UINT16	R	See Table 5-10
Data log status	3457	UINT16	R	See Table 5-11
Reserved	3458-3473	UINT16	R	Read as 0
Setpoint alarm status	3474	UINT16	R/W	See Table 5-12
Self-check alarm status	3475	UINT16	R/W	See Table 5-13
Reserved	3476-3483	UINT16	R	Read as 0
Active serial port number	3484	UINT16	R	0 = Port 1, 1 = Port 2
Battery status	3485	UINT16	R	0 = low, 1 = normal

1 Writing a value of 65535 into register 2560 will cause the instrument to perform a warm restart.
2 Available starting with F/W Version 4.93.2 or later.

Table 5-5 Instrument Options

Options register	Bit	Description
Options 1	0	120V option
	1	690V option
	2-5	Zeros
	6	Analog output 0/4-20 mA
	7	Analog output 0-1 mA
	8	Analog output ±1 mA
	9	Relays option
	10	Digital inputs option
	11	Reserved
	12	Setup is secured by a password (see Section 4.5)
	13	Reserved
	14	Analog expander output ±1 mA
	15	Reserved
Options 2	0-2	Number of relays - 1
	3-6	Number of digital inputs - 1
	7-8	Number of analog outputs - 1
	9-13	Reserved
	14-15	Memory module size: 10 = 512 Kbytes

Table 5-6 Relay Status

Bit	Description
0	Relay #1 status
1	Relay #2 status
2-15	Not used (permanently set to 0)

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

Table 5-7 Event Flags

Bit	Description
0	Event flag #1
1	Event flag #2
2	Event flag #3
3	Event flag #4
4	Event flag #5

5	Event flag #6
6	Event flag #7
7	Event flag #8
8-15	Not used (permanently set to 0)

Bit meaning: 0 = flag is cleared, 1 = flag is set

Table 5-8 Status Inputs

Bit	Description
0	Status input #1
1	Status input #2
2-15	Not used (permanently set to 0)

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

Table 5-9 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 5-10 Log Status

Bit	Description
0	Reserved
1	New Min/Max Log
2	New event log
3	New data log (any)
4	New waveform log #1
5	New waveform log #2
6-15	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)

Table 5-11 Data Log Status

Bit	Description
0	New data log #1
1	New data log #2
2	New data log #3
3	New data log #4
4	New data log #5
5	New data log #6
6	New data log #7
7	New data log #8
4-15	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)

Table 5-12 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

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.

Table 5-13 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	RTC time-synchronization required
12	Low battery [1]
13-15	Reserved

[1] Available starting with F/W version 4.93.2 or later.

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 and RTC synchronization bit are also reset automatically when you change setup or update RTC either via the front panel or through communications.

5.5 Memory Allocation Status Registers

Table 5-14 Memory Allocation Status Registers

Parameter	Register	Type	R/W	Range
Memory partitions map	3500, 3501	UINT32	R	See Table 5-15
Monthly profile log partition map	3502, 3503	UINT32	R	See Table 5-15

Parameter	Register	Type	R/W	Range
Daily profile log partition map	3504, 3505	UINT32	R	See Table 5-15
Total memory size, Byte	3506, 3507	UINT32	R	524288
Free memory size, Byte	3508, 3509	UINT32	R	0 - 505568
The total number of event log records	3510	UINT16	R	0 - 65535
The total number of data log #1 records	3511	UINT16	R	0 - 65535
The total number of data log #2 records	3512	UINT16	R	0 - 65535
The total number of data log #3 records	3513	UINT16	R	0 - 65535
The total number of data log #4 records	3514	UINT16	R	0 - 65535
The total number of data log #5 records	3515	UINT16	R	0 - 65535
The total number of data log #6 records	3516	UINT16	R	0 - 65535
The total number of data log #7 records	3517	UINT16	R	0 - 65535
The total number of data log #8 records	3518	UINT16	R	0 - 65535
Reserved	3519-3526	UINT16	R	0
The total number of waveform log #1 records	3527	UINT16	R	0 - 65535
The total number of waveform log #2 records	3528	UINT16	R	0 - 65535
The number of new event log records	3529	UINT16	R	0 - 65535
The number of new data log #1 records	3530	UINT16	R	0 - 65535
The number of new data log #2 records	3531	UINT16	R	0 - 65535
The number of new data log #3 records	3532	UINT16	R	0 - 65535
The number of new data log #4 records	3533	UINT16	R	0 - 65535
The number of new data log #5 records	3534	UINT16	R	0 - 65535
The number of new data log #6 records	3535	UINT16	R	0 - 65535
The number of new data log #7 records	3536	UINT16	R	0 - 65535
The number of new data log #8 records	3537	UINT16	R	0 - 65535
Reserved	3538-3545	UINT16	R	0
The number of new waveform log #1 records	3546	UINT16	R	0 - 65535
The number of new waveform log #2 records	3547	UINT16	R	0 - 65535

The total number of records shows all the records logged in the memory partition. The number of new records indicates the number of records never read before.

Table 5-15 Memory Partitions Allocation Map

Memory Partition/Sub-partition	Bit
Event log	0
Data log #1	1
Data log #2	2
Data log #3	3
Data log #4	4
Data log #5	5
Data log #6	6
Data log #7	7
Data log #8	8
Reserved	9-16
Waveform log #1	17
Waveform log #2	18
Reserved	19-31
TOU Monthly Profile Log. Energy Reg. #1	0
TOU Monthly Profile Log. Energy Reg. #2	1
TOU Monthly Profile Log. Energy Reg. #3	2
TOU Monthly Profile Log. Energy Reg. #4	3
TOU Monthly Profile Log. Energy Reg. #5	4
TOU Monthly Profile Log. Energy Reg. #6	5
TOU Monthly Profile Log. Energy Reg. #7	6
TOU Monthly Profile Log. Energy Reg. #8	7
Reserved	8-15
TOU Monthly Profile Log. Max. Demand Reg. #1	16
TOU Monthly Profile Log. Max. Demand Reg. #2	17
TOU Monthly Profile Log. Max. Demand Reg. #3	18
Reserved	19-31
TOU Daily Profile Log. Energy Reg. #1	0
TOU Daily Profile Log. Energy Reg. #2	1
TOU Daily Profile Log. Energy Reg. #3	2
TOU Daily Profile Log. Energy Reg. #4	3
TOU Daily Profile Log. Energy Reg. #5	4

Memory Partition/Sub-partition	Bit
TOU Daily Profile Log. Energy Reg. #6	5
TOU Daily Profile Log. Energy Reg. #7	6
TOU Daily Profile Log. Energy Reg. #8	7
Reserved	8-15
TOU Daily Profile Log. Max. Demand Reg. #1	16
TOU Daily Profile Log. Max. Demand Reg. #2	17
TOU Daily Profile Log. Max. Demand Reg. #3	18
Reserved	19-31

Bit meaning: 0 = partition is not allocated, 1 = partition is allocated

5.6 Memory Status/Control Registers

Table 5-16 Memory Status/Control Register Locations

Memory Partition	Registers (see Table 5-17)
Event log	28160-28167
Data log #1	28168-28175
Data log #2	28176-28183
Data log #3	28184-28191
Data log #4	28192-28199
Data log #5	28200-28207
Data log #6	28208-28215
Data log #7	28216-28223
Data log #8	28224-28231
Reserved	28232-28295
Waveform log #1	28296-28303
Waveform log #2	28304-28311
Reserved	28312-28415
TOU Monthly Profile Log. Energy Reg. #1	28416-28423
TOU Monthly Profile Log. Energy Reg. #2	28424-28431
TOU Monthly Profile Log. Energy Reg. #3	28432-28439
TOU Monthly Profile Log. Energy Reg. #4	28440-28447
TOU Monthly Profile Log. Energy Reg. #5	28448-28455
TOU Monthly Profile Log. Energy Reg. #6	28456-28463
TOU Monthly Profile Log. Energy Reg. #7	28464-28471
TOU Monthly Profile Log. Energy Reg. #8	28472-28479
Reserved	28480-28543
TOU Monthly Profile Log. Max. Demand Reg. #1	28544-28551
TOU Monthly Profile Log. Max. Demand Reg. #2	28552-28559
TOU Monthly Profile Log. Max. Demand Reg. #3	28560-28567
Reserved	28568-28671
TOU Daily Profile Log. Energy Reg. #1	28672-28679
TOU Daily Profile Log. Energy Reg. #2	28680-28687
TOU Daily Profile Log. Energy Reg. #3	28688-28695
TOU Daily Profile Log. Energy Reg. #4	28696-28703
TOU Daily Profile Log. Energy Reg. #5	28704-28711
TOU Daily Profile Log. Energy Reg. #6	28712-28719
TOU Daily Profile Log. Energy Reg. #7	28720-28727
TOU Daily Profile Log. Energy Reg. #8	28728-28735
Reserved	28736-28799
TOU Daily Profile Log. Max. Demand Reg. #1	28800-28807
TOU Daily Profile Log. Max. Demand Reg. #2	28808-28815
TOU Daily Profile Log. Max. Demand Reg. #3	28816-28823
Reserved	28824-28927

If data log partition #7 is configured as a TOU monthly profile partition, registers 28216-28223 are mapped to registers 28416-28423 for the first TOU monthly profile sub-partition allocated for TOU energy register #1, or for the first following available TOU register if register #1 is not configured.

If data log partition #8 is configured as a TOU daily profile partition, registers 28224-28231 are mapped to registers 28672-28679 for the first TOU daily profile sub-partition allocated for TOU energy register #1, or for the first following available TOU register if register #1 is not configured.

Table 5-17 Log Partition's Status/Control Window Registers

Parameter	Offset	Type	R/W	Range
Log partition status	+0	UINT16	R	Bit-mapped register: bit 0 = 0 - non-wrap partition = 1 - wrap-around partition bit 4 = 1 - TOU monthly profile partition bit 5 = 1 - TOU daily profile partition bit 9 = 1 - reading after the end of file: the read pointer has rolled over the end of a log file, that is, the file is being re-read from the beginning. This bit is cleared when the read pointer [+6] points to a new record, or either command register [+6] or [+7] is written.
The total number of records logged in the partition/sub-partition	+1	UINT16	R	0 to 65535. Returns the total number of logged records available in the partition.
The number of the new records never read before	+2	UINT16	R	0 to 65535. Returns the number of records from the first new one never read before and until the end of the log file.
The next sequence number to be used when the next log event will take place	+3	UINT16	R	0 to 65535 (increments modulo 65536 with each log). Returns the sequence number that will be applied to the next record being logged.
The sequence number of the first (oldest) record in the log file	+4	UINT16	R	0 to 65535. Returns the sequence number of the oldest record in the log file.
The sequence number of the first new record never read before	+5	UINT16	R	0 to 65535. Returns the sequence number of the first new (most recent) record that has never been read. If this number is equal to the contents of register [+3], there are no newest records never read before.
The sequence number of the current record to be read	+6	UINT16	R/W[1]	0 to 65535. Points to the record that will be read via the partition read window. Can be overwritten to point to the desired record.
Command register	+7	UINT16	R/W	This is a write-only register. Write value: 0 = automatically restores the read sequence to the beginning of the log file, that is puts the read pointer to the first (oldest) record in the log file (actually, safely copies the contents of the register [+4] to the register [+6]). 1 = automatically sets the read sequence to the first new record never read before, that is puts the read pointer to the record following the last one whenever read. If there are new records in the partition, this actually copies the contents of the register [+5] to the register [+6]. If there are no new records, the register [+5] will point to the first (oldest) record in the log file as if the command register was written with zero. Read as 0.

[1] If there is no record in the log file that matches the written sequence number, the instrument will respond with the exception code 03 (invalid data).

5.7 Reset/Clear Registers

Table 5-18 Reset/Clear Registers

Function	Register	Type	R/W	Reset value
Clear total energy registers	3404	UINT16	W	0
Clear total maximum demand registers	3405	UINT16	W	0 = all maximum demands 1 = power demands 2 = volt/ampere demands
Clear TOU energy registers	3406	UINT16	W	0
Clear TOU maximum demand registers	3407	UINT16	W	0
Clear pulse counters	3408	UINT16	W	0 = all counters 1-4 = counter #1 - #4
Clear Min/Max log	3409	UINT16	W	0
Clear event log	3410	UINT16	W	0
Clear data log	3411	UINT16	W	0-7 = data log #1 - #8 16 = all data logs
Clear waveform log #1	3412	UINT16	W	0
Clear waveform log #2	3413	UINT16	W	0
Reserved	3414	UINT16		
Restore event log read pointer	3415	UINT16	W	0
Restore data log read pointer	3416	UINT16	W	0-7 = data log #1 - #8 16-23, 32-34 = monthly profile data log #7 (the same as 6) 48-55, 64-66 = daily profile data log #8 (the same as 7)
Restore waveform log #1 read pointer	3417	UINT16	W	0
Restore waveform log #2 read pointer	3418	UINT16	W	0

5.8 Basic Setup Registers

Table 5-19 Basic Setup Registers

Parameter	Register	Type	R/W	Range
Wiring mode [1]	2304	UINT16	R/W	0 = 3OP2, 1 = 4LN3, 2 = 3DIR2, 3 = 4LL3, 4 = 3OP3, 5 = 3LN3, 6 = 3LL3, 7 = 2LL1, 8=3BLN3, 9=3BLL3, 10=2LN3
PT ratio	2305	UINT16	R/W	10 to 65000 × 0.1
CT primary current	2306	UINT16	R/W	1 to 10000 A
Power demand period	2307	UINT16	R/W	1,2,5,10,15,20,30,60 min, 255 = external synchronization [2]
Volt/ampere demand period	2308	UINT16	R/W	0 to 1800 sec
Averaging buffer size	2309	UINT16	R/W	8, 16, 32
Reset enable/disable	2310	UINT16	R/W	0 = disabled, 1 = enabled
Reserved	2311	UINT16	R	Read as 65535
The number of demand periods	2312	UINT16	R/W	1 to 15
Reserved	2313	UINT16	R	Read as 65535
The number of pre-event cycles for the waveform log #1	2314	UINT16	R/W	1 to 8
Nominal frequency	2315	UINT16	R/W	50, 60 Hz
Maximum demand load current	2316	UINT16	R/W	0 to 10000 A (0 = CT primary current)
Reserved	2317-2319	UINT16	R	Read as 65535
The number of cycles in one waveform series for the waveform log #1 [3]	2320	UINT16	R/W	16 to 1280
Reserved	2321	UINT16	R	Read as 65535
Nominal secondary voltage (L-L)	2322	UINT16	R/W	10 to 690 V

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)
3BLN3 -
3BLL3 -
2LN3 - 4-wire WYE using 2 PTs (2 element), 3 CTs (3 element), line-to-neutral voltage readings

2 Synchronization of power demand interval can be made through a digital input.

3 The waveform recorder logs waveforms in series of records. A compound waveform can have as more as 1280 cycles recorded in 80 consequent records, each record comprising 16 waveform cycles sampled at a rate of 32 samples per cycle.

5.9 User Selectable Options Setup Registers

Table 5-20 User Selectable Options Registers

Parameter	Register	Type	R/W	Range
Power calculation mode	2376	UINT16	R/W	0 = using reactive power, 1 = using non-active power
Energy roll value [1]	2377	UINT16	R/W	0 = 1×10^4 1 = 1×10^5 2 = 1×10^6 3 = 1×10^7 4 = 1×10^8 5 = 1×10^9
Phase energy calculation mode	2378	UINT16	R/W	0 = disabled, 1 = enabled
Analog output option	2379	UINT16	R/W	0 = none 1 = 0-20 mA 2 = 4-20 mA 3 = 0-1 mA 4 = ±1 mA

Analog expander output [2]	2380	UINT16	R/W	0 = none 1 = 0-20 mA 2 = 4-20 mA 3 = 0-1 mA 4 = ±1 mA
Battery	2381	UINT16	R/W	0 = OFF, 1 = ON
Reserved	2382-2384	UINT16	R/W	Read as 65535
Harmonic power/energy calculation mode	2385	UINT16	R/W	0 = disabled, 1 = enabled

[1] For short energy registers (see Table 5-1), the maximum roll value will be 1×10^8 for positive readings and 1×10^7 for negative readings.

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

5.10 Communications Setup Registers

Table 5-21 Communications Setup Registers

Port	Parameter	Register	Type	R/W	Range
Port #1	Communication protocol	2344	UINT16	R/W	0 = ASCII 1 = Modbus RTU 3 = DNP3.0
	Interface	2345	UINT16	R/W	0 = RS-232 2 = RS-485
	Address	2346	UINT16	R/W	1 to 247
	Baud rate	2347	UINT16	R/W	0 = 110 bps 1 = 300 bps 2 = 600 bps 3 = 1200 bps 4 = 2400 bps 5 = 4800 bps 6 = 9600 bps 7 = 19200 bps
	Data format	2348	UINT16	R/W	1 = 8 bits/no parity 2 = 8 bits/even parity
	Flow control (handshaking)	2349	UINT16	R/W	0 = no flow control 1 = software (XON/XOFF) 2 = hardware (CTS)
	RTS control	2350	UINT16	R/W	0 = RTS is not used 1 = RTS is permanently asserted 2 = RTS is controlled by the meter (asserted during the transmission)
Port #2	Communication protocol	2352	UINT16	R	0 = ASCII 1 = Modbus RTU 3 = DNP3.0
	Interface	2353	UINT16	R/W	2 = RS-485
	Address	2354	UINT16	R/W	1 to 247
	Baud rate	2355	UINT16	R/W	0 = 110 bps 1 = 300 bps 2 = 600 bps 3 = 1200 bps 4 = 2400 bps 5 = 4800 bps 6 = 9600 bps 7 = 19200 bps
	Data format	2356	UINT16	R/W	1 = 8 bits/no parity 2 = 8 bits/even parity
	Reserved	2357-2358	UINT16		

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.

5.11 Analog Output Setup Registers

Table 5-22 Analog Output Allocation Registers

Channel	Registers (see Table 5-23)
Channel #1	3148-3150
Channel #2	3151-3153

Table 5-23 Analog Channel Allocation Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	see Table 5-26
Zero scale (0-4 mA)	+1	UINT16	R/W	see Table 5-26
Full scale (1/20 mA)	+2	UINT16	R/W	see Table 5-26

1. Except for the signed power factor (see Note 3 to Table 5-26), the output scale is linear within the value range. The scale range will be inverted if the full scale specified is less than the zero scale.
2. For bi-directional analog output (±1 mA), the zero scale corresponds to the center of the scale range (0 mA) and the direction of the current matches the sign of the output parameter. For signed (bi-directional) values, such as powers and signed power factor, the scale is always symmetrical with regard to 0 mA, and the full scale corresponds to +1 mA output for positive readings and to -1 mA output for negative readings. For these, the zero scale (0 mA output) is permanently set in the instrument to zero for all parameters except the signed power factor for which it is set to 1.000. In the write request, the zero scale is ignored. No error will occur when you attempt to change it. Unsigned parameters are output within the current range 0 to +1 mA and can be scaled using both zero and full scales as in the case of single-ended analog output.

5.12 Analog Expander Setup Registers

Table 5-24 Analog Expander Channel Registers

Channel	Registers (see Table 5-25)
Channel #1	3196-3198
Channel #2	3199-3201
Channel #3	3202-3204
Channel #4	3205-3207
Channel #5	3208-3210
Channel #6	3211-3213
Channel #7	3214-3216
Channel #8	3217-3219
Channel #9	3220-3222
Channel #10	3223-3225
Channel #11	3226-3228
Channel #12	3229-3231
Channel #13	3232-3234
Channel #14	3235-3237

Table 5-25 Analog Channel Allocation Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	see Table 5-26
Zero scale (0-4 mA)	+1	UINT16	R/W	see Table 5-26
Full scale (20 mA)	+2	UINT16	R/W	see Table 5-26

Except for the signed power factor (see Note 3 to Table 5-26), 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.

NOTE

Analog expander outputs settings will not be in effect until the analog expander output is globally enabled. To activate the analog expander output, set the analog expander option to the enabled state in the user selectable options setup (see Section 5.3).

Table 5-26 Analog Output Parameters

Output parameter	Point ID	Type	Unit [2]	Scale [1]		Con-version
				Low	High	
None						
Output disabled	0x0000	UINT16		N/A	N/A	NONE
Real-time values per phase						
Voltage L1/L12 [5]	0x0C00	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L2/L23 [5]	0x0C01	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L3/L31 [5]	0x0C02	UINT16	0.1V/1V	0	Vmax	LIN3
Current L1	0x0C03	UINT16	0.01A	0	Imax	LIN3
Current L2	0x0C04	UINT16	0.01A	0	Imax	LIN3
Current L3	0x0C05	UINT16	0.01A	0	Imax	LIN3
Real-time total values						
Total kW	0x0F00	UINT16	0.001kW/1kW	-Pmax	Pmax	LIN3
Total kvar	0x0F01	UINT16	0.001kvar/1kvar	-Pmax	Pmax	LIN3
Total kVA	0x0F02	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
Total PF [4]	0x0F03	UINT16	0.001	-1.000	1.000	LIN3
Total PF Lag	0x0F04	UINT16	0.001	0	1.000	LIN3
Total PF Lead	0x0F05	UINT16	0.001	0	1.000	LIN3
Real-time auxiliary values						
Frequency	0x1002	UINT16	0.01Hz	0	100.00 [3]	LIN3
Average values per phase						
Voltage L1/L12 [5]	0x1100	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L2/L23 [5]	0x1101	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L3/L31 [5]	0x1102	UINT16	0.1V/1V	0	Vmax	LIN3
Current L1	0x1103	UINT16	0.01A	0	Imax	LIN3
Current L2	0x1104	UINT16	0.01A	0	Imax	LIN3
Current L3	0x1105	UINT16	0.01A	0	Imax	LIN3
Average total values						
Total kW	0x1400	UINT16	0.001kW/1kW	-Pmax	Pmax	LIN3
Total kvar	0x1401	UINT16	0.001kvar/1kvar	-Pmax	Pmax	LIN3
Total kVA	0x1402	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
Total PF [4]	0x1403	UINT16	0.001	-1.000	1.000	LIN3
Total PF Lag	0x1404	UINT16	0.001	0	1.000	LIN3
Total PF Lead	0x1405	UINT16	0.001	0	1.000	LIN3
Average auxiliary values						
Neutral current	0x1501	UINT16	0.01A	0	Imax	LIN3
Frequency	0x1502	UINT16	0.01Hz	0	100.00 [3]	LIN3
Present demands						
kW import accumulated demand	0x160F	UINT16	0.001kW/1kW	0	Pmax	LIN3
kvar import accumulated demand	0x1610	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
kVA accumulated demand	0x1611	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
kW export accumulated demand	0x161A	UINT16	0.001kW/1kW	0	Pmax	LIN3
kvar export accumulated demand	0x161B	UINT16	0.001kvar/1kvar	0	Pmax	LIN3

1 For parameter limits, see Note [1] to Table 5-1.

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 -0.001/0.001 or -0.001/0.

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.

5.13 Digital Inputs Allocation Registers

Table 5-27 Digital Inputs Allocation Registers

Parameter	Register	Type	R/W	Range
Status inputs allocation mask	3292	UINT16	R [1]	See Table 5-28
Pulse inputs allocation mask	3293	UINT16	R/W	See Table 5-28
Not used	3294	UINT16	R [1]	Read as 0
External demand synchronization input mask	3295	UINT16	R/W	See Table 5-28
Time synchronization input mask	3296	UINT16	R/W	See Table 5-28

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

NOTES

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

Table 5-28 Digital Inputs Allocation Mask

Bit	Description
0	Digital input # 1 allocation status
1	Digital input # 2 allocation status
2-15	Not used (read as 0)

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

5.14 Timers Setup Registers

Table 5-29 Timers Setup Registers

Parameter	Register	Type	R/W	Range
Timer #1 time interval	3300	UINT16	R/W	1-9999 sec, 0 = timer disabled
Timer #2 time interval	3301	UINT16	R/W	1-9999 sec, 0 = timer disabled

5.15 Alarm/Event Setpoints Registers

Table 5-30 Setpoint Registers

Setpoint	Setup registers (see Table 5-31)
Setpoint #1	352-395
Setpoint #2	396-439
Setpoint #3	440-483
Setpoint #4	484-527
Setpoint #5	528-571
Setpoint #6	572-615
Setpoint #7	616-659
Setpoint #8	660-703
Setpoint #9	704-747
Setpoint #10	748-791
Setpoint #11	792-835
Setpoint #12	836-879
Setpoint #13	880-923
Setpoint #14	924-967
Setpoint #15	968-1011
Setpoint #16	1012-1055

Table 5-31 Setpoint Setup Registers

Parameter		Offset	Type	Range
Condition #1	Logical operator	+0	UINT16	0 = OR
	Trigger ID	+1	UINT16	see Table 5-32
	Reserved	+2, 3	UINT16	0 (N/A)
	Operate limit	+4, 5	INT32	see Table 5-32
	Release limit	+6, 7	INT32	see Table 5-32
Condition #2	Logical operator	+8	UINT16	0 = OR, 1 = AND
	Trigger ID	+9	UINT16	see Table 5-32
	Reserved	+10, 11	UINT16	0 (N/A)
	Operate limit	+12, 13	INT32	see Table 5-32
	Release limit	+14, 15	INT32	see Table 5-32
Condition #3	Logical operator	+16	UINT16	0 = OR, 1 = AND
	Trigger ID	+17	UINT16	see Table 5-32
	Reserved	+18, 19	UINT16	0 (N/A)
	Operate limit	+20, 21	INT32	see Table 5-32
	Release limit	+22, 23	INT32	see Table 5-32
Condition #4	Logical operator	+24	UINT16	0 = OR, 1 = AND
	Trigger ID	+25	UINT16	see Table 5-32
	Reserved	+26, 27	UINT16	0 (N/A)
	Operate limit	+28, 29	INT32	see Table 5-32
	Release limit	+30, 31	INT32	see Table 5-32
Action #1	Action type	+32	UINT16	see Table 5-33
	Action target	+33	UINT16	see Table 5-33
Action #2	Action type	+34	UINT16	see Table 5-33
	Action target	+35	UINT16	see Table 5-33
Action #3	Action type	+36	UINT16	see Table 5-33
	Action target	+37	UINT16	see Table 5-33
Action #4	Action type	+38	UINT16	see Table 5-33
	Action target	+39	UINT16	see Table 5-33
Delays	Reserved	+40	UINT16	0 (N/A)
	Operate delay	+41	UINT16	0-9999 (x 0.1 sec)
	Release delay	+42	UINT16	0-9999 (x 0.1 sec)
	Reserved	+43	UINT16	0 (N/A)

1. The setpoint is disabled when the first trigger ID 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 disable the setpoint before writing into separate registers. Each value being written 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 conversion scales are indicated in Table 5-29. Each limit value occupies two contiguous registers, the first of which (low word) contains the limit value, and the second (high word) is reserved for long parameters. This register is always read as zero. When written, its value is ignored.
4. Limits indicated in Table 5-29 by a N/A mark are read as zeros. When writing, they can be omitted or should be written as zeros.
5. 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 5-32 Setpoint Trigger Parameters

Trigger parameter	Trigger ID	Type	Unit [2]	Limit/scale [1]		Con-version
				Low	High	
None						
None	0x0000	UINT16		N/A	N/A	NONE
Voltage disturbance						
Voltage disturbance [6]	0x0100	UINT16	%	1	100	LIN3
Event flags						
Event flag #1 ON	0x0300	UINT16		N/A	N/A	NONE
Event flag #2 ON	0x0301	UINT16		N/A	N/A	NONE
Event flag #3 ON	0x0302	UINT16		N/A	N/A	NONE
Event flag #4 ON	0x0303	UINT16		N/A	N/A	NONE
Event flag #5 ON	0x0304	UINT16		N/A	N/A	NONE
Event flag #6 ON	0x0305	UINT16		N/A	N/A	NONE

Trigger parameter	Trigger ID	Type	Unit [2]	Limit/scale [1]		Con-version
				Low	High	
Event flag #7 ON	0x0306	UINT16		N/A	N/A	NONE
Event flag #8 ON	0x0307	UINT16		N/A	N/A	NONE
Event flag #1 OFF	0x8300	UINT16		N/A	N/A	NONE
Event flag #2 OFF	0x8301	UINT16		N/A	N/A	NONE
Event flag #3 OFF	0x8302	UINT16		N/A	N/A	NONE
Event flag #4 OFF	0x8303	UINT16		N/A	N/A	NONE
Event flag #5 OFF	0x8304	UINT16		N/A	N/A	NONE
Event flag #6 OFF	0x8305	UINT16		N/A	N/A	NONE
Event flag #7 OFF	0x8306	UINT16		N/A	N/A	NONE
Event flag #8 OFF	0x8307	UINT16		N/A	N/A	NONE
Internal events						
kWh import pulse	0x0400	UINT16		N/A	N/A	NONE
kWh export pulse	0x0401	UINT16		N/A	N/A	NONE
kvarh import pulse	0x0403	UINT16		N/A	N/A	NONE
kvarh export pulse	0x0404	UINT16		N/A	N/A	NONE
kvarh total pulse	0x0405	UINT16		N/A	N/A	NONE
kVAh total pulse	0x0406	UINT16		N/A	N/A	NONE
Start new demand interval	0x0407	UINT16		N/A	N/A	NONE
Start new tariff interval	0x0408	UINT16		N/A	N/A	NONE
Start new volt/ampere demand interval	0x0409	UINT16		N/A	N/A	NONE
Start new sliding window demand interval	0x040A	UINT16		N/A	N/A	NONE
Timers						
Timer #1	0x0500	UINT16		N/A	N/A	NONE
Timer #2	0x0501	UINT16		N/A	N/A	NONE
Status inputs						
Status input #1 ON	0x0600	UINT16		N/A	N/A	NONE
Status input #2 ON	0x0601	UINT16		N/A	N/A	NONE
Status input #1 OFF	0x8600	UINT16		N/A	N/A	NONE
Status input #2 OFF	0x8601	UINT16		N/A	N/A	NONE
Pulse inputs						
Pulse input #1	0x0700	UINT16		N/A	N/A	NONE
Pulse input #2	0x0701	UINT16		N/A	N/A	NONE
Relay status						
Relay #1 ON	0x0800	UINT16		N/A	N/A	NONE
Relay #2 ON	0x0801	UINT16		N/A	N/A	NONE
Relay #1 OFF	0x8800	UINT16		N/A	N/A	NONE
Relay #2 OFF	0x8801	UINT16		N/A	N/A	NONE
Phase reversal						
Positive phase rotation reversal [3]	0x8901	UINT16		N/A	N/A	NONE
Negative phase rotation reversal [3]	0x8902	UINT16		N/A	N/A	NONE
Pulse counters						
High pulse counter #1	0x0A00	UINT32		0	10^6-1	NONE
High pulse counter #2	0x0A01	UINT32		0	10^6-1	NONE
High pulse counter #3	0x0A02	UINT32		0	10^6-1	NONE
High pulse counter #4	0x0A03	UINT32		0	10^6-1	NONE
Time/Date parameters						
Day of week	0x0B02	UINT16		1=Sun	7=Sat	NONE
Year	0x0B03	UINT16		0	99	NONE
Month	0x0B04	UINT16		1	12	NONE
Day of month	0x0B05	UINT16		1	31	NONE
Hour	0x0B06	UINT16		0	23	NONE
Minutes	0x0B07	UINT16		0	59	NONE
Seconds	0x0B08	UINT16		0	59	NONE
High/low real-time values per phase						
High current L1	0x0C03	UINT16	0.01A	0	Imax	LIN3
High current L2	0x0C04	UINT16	0.01A	0	Imax	LIN3
High current L3	0x0C05	UINT16	0.01A	0	Imax	LIN3
Low current L1	0x8C03	UINT16	0.01A	0	Imax	LIN3
Low current L2	0x8C04	UINT16	0.01A	0	Imax	LIN3
Low current L3	0x8C05	UINT16	0.01A	0	Imax	LIN3

Trigger parameter	Trigger ID	Type	Unit [2]	Limit/scale [1]		Con-version
				Low	High	
High/low real-time values on any phase						
High voltage [5]	0x0E00	UINT16	0.1V/1V	0	Vmax	LIN3
Low voltage [5]	0x8D00	UINT16	0.1V/1V	0	Vmax	LIN3
High current	0x0E01	UINT16	0.01A	0	Imax	LIN3
Low current	0x8D01	UINT16	0.01A	0	Imax	LIN3
High voltage THD	0x0E07	UINT16	0.1%	0	999.9	LIN3
High current THD	0x0E08	UINT16	0.1%	0	999.9	LIN3
High K-Factor	0x0E09	UINT16	0.1	1.0	999.9	LIN3
High current TDD	0x0E0A	UINT16	0.1%	0	100.0	LIN3
High/low real-time auxiliary values						
High frequency	0x1002	UINT16	0.01Hz	0	100.00[4]	LIN3
Low frequency	0x9002	UINT16	0.01Hz	0	100.00[4]	LIN3
High voltage unbalance [7]	0x1003	UINT16	1%	0	300	LIN3
High/low average values per phase						
High current L1	0x1103	UINT16	0.01A	0	Imax	LIN3
High current L2	0x1104	UINT16	0.01A	0	Imax	LIN3
High current L3	0x1105	UINT16	0.01A	0	Imax	LIN3
Low current L1	0x9103	UINT16	0.01A	0	Imax	LIN3
Low current L2	0x9104	UINT16	0.01A	0	Imax	LIN3
Low current L3	0x9105	UINT16	0.01A	0	Imax	LIN3
High/low average values on any phase						
High voltage [5]	0x1300	UINT16	0.1V/1V	0	Vmax	LIN3
Low voltage [5]	0x9200	UINT16	0.1V/1V	0	Vmax	LIN3
High current	0x1301	UINT16	0.1V/1V	0	Vmax	LIN3
Low current	0x9201	UINT16	0.1V/1V	0	Vmax	LIN3
High/low average total values						
High total kW import	0x1406	UINT16	0.001kW/1kW	-Pmax	Pmax	LIN3
High total kW export	0x1407	UINT16	0.001kW/1kW	-Pmax	Pmax	LIN3
High total kvar import	0x1408	UINT16	0.001kvar/1kvar	-Pmax	Pmax	LIN3
High total kvar export	0x1409	UINT16	0.001kvar/1kvar	-Pmax	Pmax	LIN3
High total kVA	0x1402	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
Low total PF Lag	0x9404	UINT16	0.001	0	1.000	LIN3
Low total PF Lead	0x9405	UINT16	0.001	0	1.000	LIN3
High/low average auxiliary values						
High neutral current	0x1501	UINT16	0.01A	0	Imax	LIN3
High frequency	0x1502	UINT16	0.01Hz	0	100.00[4]	LIN3
Low frequency	0x9502	UINT16	0.01Hz	0	100.00[4]	LIN3
High voltage unbalance [7]	0x1503	UINT16	1%	0	300	LIN3
High present demands						
High volt demand L1/L12 [5]	0x1600	UINT16	0.1V/1V	0	Vmax	LIN3
High volt demand L2/L23 [5]	0x1601	UINT16	0.1V/1V	0	Vmax	LIN3
High volt demand L3/L31 [5]	0x1602	UINT16	0.1V/1V	0	Vmax	LIN3
High ampere demand L1	0x1603	UINT16	0.01A	0	Imax	LIN3
High ampere demand L2	0x1604	UINT16	0.01A	0	Imax	LIN3
High ampere demand L3	0x1605	UINT16	0.01A	0	Imax	LIN3
High block kW import demand	0x1606	UINT16	0.001kW/1kW	0	Pmax	LIN3
High block kvar import demand	0x1607	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High block kVA demand	0x1608	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
High sliding window kW import demand	0x1609	UINT16	0.001kW/1kW	0	Pmax	LIN3
High sliding window kvar import demand	0x160A	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High sliding window kVA demand	0x160B	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
High accumulated kW import demand	0x160F	UINT16	0.001kW/1kW	0	Pmax	LIN3
High accumulated kvar import demand	0x1610	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High accumulated kVA demand	0x1611	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
High predicted kW import demand	0x1612	UINT16	0.001kW/1kW	0	Pmax	LIN3
High predicted kvar import demand	0x1613	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High predicted kVA demand	0x1614	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
High block kW export demand	0x1616	UINT16	0.001kW/1kW	0	Pmax	LIN3
High block kvar export demand	0x1617	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High sliding window kW export demand	0x1618	UINT16	0.001kW/1kW	0	Pmax	LIN3
High sliding window kvar export demand	0x1619	UINT16	0.001kvar/1kvar	0	Pmax	LIN3

Trigger parameter	Trigger ID	Type	Unit [2]	Limit/scale [1]		Con-version
				Low	High	
High accumulated kW export demand	0x161A	UINT16	0.001kW/1kW	0	Pmax	LIN3
High accumulated kvar export demand	0x161B	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
High predicted kW export demand	0x161C	UINT16	0.001kW/1kW	0	Pmax	LIN3
High predicted kvar export demand	0x161D	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
Setpoint status						
Setpoint #1 ON	0x7C00	UINT16		N/A	N/A	NONE
Setpoint #2 ON	0x7C01	UINT16		N/A	N/A	NONE
Setpoint #3 ON	0x7C02	UINT16		N/A	N/A	NONE
Setpoint #4 ON	0x7C03	UINT16		N/A	N/A	NONE
Setpoint #5 ON	0x7C04	UINT16		N/A	N/A	NONE
Setpoint #6 ON	0x7C05	UINT16		N/A	N/A	NONE
Setpoint #7 ON	0x7C06	UINT16		N/A	N/A	NONE
Setpoint #8 ON	0x7C07	UINT16		N/A	N/A	NONE
Setpoint #9 ON	0x7C08	UINT16		N/A	N/A	NONE
Setpoint #10 ON	0x7C09	UINT16		N/A	N/A	NONE
Setpoint #11 ON	0x7C0A	UINT16		N/A	N/A	NONE
Setpoint #12 ON	0x7C0B	UINT16		N/A	N/A	NONE
Setpoint #13 ON	0x7C0C	UINT16		N/A	N/A	NONE
Setpoint #14 ON	0x7C0D	UINT16		N/A	N/A	NONE
Setpoint #15 ON	0x7C0E	UINT16		N/A	N/A	NONE
Setpoint #16 ON	0x7C0F	UINT16		N/A	N/A	NONE

1 For parameter limits, see Note[1] to Table 5-1

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.

6 Operate limit for the voltage disturbance trigger specifies the voltage deviation allowed in percentage of the nominal secondary line-to-line voltage. The tested voltage refers to line-to-line voltage in 3OP2 and 3OP3 wiring modes, and to line-to-neutral voltage in other modes. See Section 5.8, Basic Setup, for information on setting the nominal voltage in your meter.

7 Available starting with F/W Version 4.93.2 or later.

Table 5-33 Setpoint Actions

Action	Action type	Action Target
No action	0x00	0x00
Set event flag #1	0x20	0x00
Set event flag #2	0x20	0x01
Set event flag #3	0x20	0x02
Set event flag #4	0x20	0x03
Clear event flag #1	0x21	0x00
Clear event flag #2	0x21	0x01
Clear event flag #3	0x21	0x02
Clear event flag #4	0x21	0x03
Operate relay #1 [1]	0x30	0x00
Operate relay #2 [1]	0x30	0x01
Increment counter #1	0x40	0x00
Increment counter #2	0x40	0x01
Increment counter #3	0x40	0x02
Increment counter #4	0x40	0x03
Clear counter #1	0x41	0x00
Clear counter #2	0x41	0x01
Clear counter #3	0x41	0x02
Clear counter #4	0x41	0x03
Clear all counters	0x64	0x00
Reset total energy	0x60	0x00
Reset all total maximum demands	0x61	0x00
Reset power maximum demands	0x61	0x01
Reset volt/ampere maximum demands	0x61	0x02

Action	Action type	Action Target
Reset TOU energy	0x62	0x00
Reset TOU maximum demands	0x63	0x00
Clear Min/Max registers	0x65	0x00
Event log [2]	0x70	0x00
Data log #1	0x71	0x00
Data log #2	0x71	0x01
Data log #3	0x71	0x02
Data log #4	0x71	0x03
Data log #5	0x71	0x04
Data log #6	0x71	0x05
Data log #7	0x71	0x06
Data log #8	0x71	0x07
Waveform log #1	0x72	0x00
Waveform log #2	0x73	0x00

1 Operate/release actions via relays are automatically recorded to the event log whenever an electrical quantity, status input, or phase reversal trigger is used.

2 Either setpoint transition (both operate and release) is recorded to the event log.

5.16 Pulsing Setpoints Registers

Table 5-34 Pulsing Registers

Relay	Setup registers (see Table 5-35)
Relay #1	2892-2893
Relay #2	2894-2895

Table 5-35 Pulsing Setup Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	see Table 5-36
Number of unit-hours per pulse	+1	UINT16	R/W	1-9999

Table 5-36 Pulsing Output Parameters

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

5.17 Relay Operation Control Registers

These registers allow the user to manually override setpoint relay operations. Either relay may be manually 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 manually operated, and is de-energized when manually released.

Table 5-37 Relay Operation Control Registers

Parameter	Register	Type	R/W	Range
Relay #1 control status	3244	UINT16	R/W	see Table 5-38
Relay #2 control status	3245	UINT16	R/W	see Table 5-38

Table 5-38 Relay Operation Status

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

5.18 Pulse Counters Setup Registers

Table 5-39 Pulse Counters Registers

Counter	Setup registers (see Table 5-40)
Counter #1	2940-2941
Counter #2	2942-2943
Counter #3	2944-2945
Counter #4	2946-2947

Table 5-40 Pulse Counter Setup Registers

Parameter	Offset	Type	R/W	Range
Associated digital input ID	+0	UINT16	R/W	see Table 5-41
Scale factor (number of units per input pulse)	+1	UINT16	R/W	1-9999

Table 5-41 Digital Inputs Identifiers

Discrete input	ID
Not allocated	0
Digital input # 1	1
Digital input # 2	2

5.19 Log Memory Partitions Setup Registers

Table 5-42 Memory Partitions Setup Registers

Partition Number	Memory partition	Setup registers (see Table 5-43)
0	Event log	3660-3665
1	Data log #1	3668-3673
2	Data log #2	3676-3681
3	Data log #3	3684-3689
4	Data log #4	3692-3697
5	Data log #5	3700-3705
6	Data log #6	3708-3713
7	Data log #7	3716-3721
8	Data log #8	3724-3729

Table 5-43 Partition Setup Registers

Parameter	Offset	Type	R/W	Range
The number of records in the partition	+0	UINT16	R/W	0-65535, 0 = delete a partition
The number of log parameters in the record for a data log partition	+1	UINT16	R/W	1-16 (for event log and waveform log partitions, write 0)
Partition type	+2	UINT16	R/W	0 = non-wrap 1 = wrap around 16 = TOU monthly profile log (partition #7 only) 32 = TOU daily profile log (partition #8 only)
Record size, byte	+3	UINT16	R	
Partition size, byte	+4, 5	UINT32	R	0-505568

These registers allow you to allocate a memory partition for logging and to specify the partition size and type. Before allocating a partition, it is recommended to check the available memory by reading the extended memory status registers. To help you in planning memory, Table 5-44 shows the record size for each partition.

Note that the existing partition may not be resized. To change the partition properties, you should first delete a partition and then reallocate it with the desirable properties. To delete a partition, write zero into the first partition's register.

Data log partitions #7 and #8 can be configured as TOU monthly and daily profile log partitions respectively. Both will be set as wrap-around partitions. Before you configure the partition as a profile partition, set up your TOU registers, daily profiles and calendars. The memory for a profile log is allocated automatically in accordance with the number of TOU registers you defined in the TOU setup. For each TOU energy and maximum demand register, a separate log sub-partition will be allocated within a parent log partition. Each of these can be accessed and read individually (see Section 5.24). The number of log parameters in the record should specify the maximum number of active season tariffs. The file record size will be set in accordance with this number. If you specified it as less than the actual number of tariffs that may be in effect within a tariff season, then only part of the tariff registers will be recorded to the profile.
When allocating a memory partition, all partition registers must be written at once using a single request. After reallocation of memory, the instrument performs the memory optimization and will not respond to the host requests for approximately 1 second per 128 Kbytes of memory.

Writing into registers at offsets +3, +4 and +5 does not affect the register contents. No error will occur.

Table 5-44 Partitions' Record Size

Partition	Record size, byte
Event log	14
Data log	8 + 4 * (NUMBER OF PARAMETERS)
Waveform log	6240

5.20 Data Log Setup Registers

Table 5-45 Data Log Setup Registers

Partition	Registers (see Table 5-46)
Data log #1	1792-1807
Data log #2	1808-1823
Data log #3	1824-1839
Data log #4	1840-1855
Data log #5	1856-1871
Data log #6	1872-1887
Data log #7	1888-1903
Data log #8	1904-1919

Table 5-46 Data Log Setup

Parameter	Offset	Type	R/W	Range
Log parameter #1 ID	+0	UINT16	R/W	See Table 5-2
Log parameter #2 ID	+1	UINT16	R/W	See Table 5-2
Log parameter #3 ID	+2	UINT16	R/W	See Table 5-2
Log parameter #4 ID	+3	UINT16	R/W	See Table 5-2
Log parameter #5 ID	+4	UINT16	R/W	See Table 5-2
Log parameter #6 ID	+5	UINT16	R/W	See Table 5-2
Log parameter #7 ID	+6	UINT16	R/W	See Table 5-2
Log parameter #8 ID	+7	UINT16	R/W	See Table 5-2
Log parameter #9 ID	+8	UINT16	R/W	See Table 5-2
Log parameter #10 ID	+9	UINT16	R/W	See Table 5-2
Log parameter #11 ID	+10	UINT16	R/W	See Table 5-2
Log parameter #12 ID	+11	UINT16	R/W	See Table 5-2
Log parameter #13 ID	+12	UINT16	R/W	See Table 5-2
Log parameter #14 ID	+13	UINT16	R/W	See Table 5-2
Log parameter #15 ID	+14	UINT16	R/W	See Table 5-2
Log parameter #16 ID	+15	UINT16	R/W	See Table 5-2

1. Parameters that can be selected for data log are listed in Table 5-2. Before setting up the parameters for any data log, the memory partition must be allocated for the log (see Section 5.19). When writing the data log setup registers, only parameters that are specified in the partition record setup will be written. When reading registers, those that are not defined in the data log setup will be read as zeros.
2. If a partition has been allocated as a TOU profile log partition, the data log setup for the partition cannot be written. Write requests will be ignored. A read request will return identifiers of the TOU season tariff energy registers 28672 to 28687.

5.21 Real Time Clock Registers

Table 5-47 RTC Registers

Parameter	Register	Type	R/W	Range
Seconds	4352	UINT16	R/W	0-59
Minutes	4353	UINT16	R/W	0-59
Hour	4354	UINT16	R/W	0-23
Day of month	4355	UINT16	R/W	1-31
Month	4356	UINT16	R/W	1-12
Year	4357	UINT16	R/W	0-99
Day of week	4358	UINT16	R/W	1-7 (1=Sunday)

The day of week is not checked when written. It is set automatically when you change the date.

5.22 Time Zone Information Registers

Table 5-48 Time Zone Registers

Parameter	Register	Type	R/W	Range
Daylight savings time (DST) option	4320	UINT16	R/W	0 = disable DST (use standard time only), 1 = enable DST
DST start month	4321	UINT16	R/W	1 - 12
DST start week of the month	4322	UINT16	R/W	1 - 4 = 1st, 2nd, 3rd and 4th week, 5 = the last weekday in the month
DST start weekday	4323	UINT16	R/W	1-7 (1= Sun, 7 = Sat)
DST end month	4324	UINT16	R/W	1 - 12
DST end week of the month	4325	UINT16	R/W	1 - 4 = 1st, 2nd, 3rd and 4th week, 5 = the last weekday in the month
DST end weekday	4326	UINT16	R/W	1-7 (1= Sun, 7 = Sat)

5.23 Communications Password Register

Table 5-49 Password Register

Parameter	Register	Type	R/W	Range
Communications password	2575	UINT16	R/W	Write: 0 to 65535 Read: 0 = access permitted 65535 = authorization required

5.24 Event Flags Control Registers

Table 5-50 User Event Flags Registers

Parameter	Register	Type	R/W	Range
Event flag #1	2916	UINT16	W	0-1
Event flag #2	2917	UINT16	W	0-1
Event flag #3	2918	UINT16	W	0-1
Event flag #4	2919	UINT16	W	0-1
Event flag #5	2920	UINT16	W	0-1
Event flag #6	2921	UINT16	W	0-1
Event flag #7	2922	UINT16	W	0-1
Event flag #8	2923	UINT16	W	0-1

Through these registers, event flags can be only written. To read event flags all together, use register 6776 (Table 5-2) or 3453 (Table 5-4).

5.25 TOU System Registers Setup

Table 5-51 TOU System Setup Registers

TOU system register	Setup registers (see Table 5-52)
TOU energy register #1	4564-4565
TOU energy register #2	4566-4567
TOU energy register #3	4568-4569
TOU energy register #4	4570-4571
TOU energy register #5	4572-4573
TOU energy register #6	4574-4575
TOU energy register #7	4576-4577
TOU energy register #8	4578-4579
TOU maximum demand register #1	4580-4581
TOU maximum demand register #2	4582-4583
TOU maximum demand register #3	4584-4585

Table 5-52 TOU Register Setup

Parameter	Offset	Type	R/W	Range
TOU register input identifier	+0	UINT16	R/W	See Tables 5-53, 5-54
For a pulse input = number of unit-hours per pulse. Otherwise, set to 0.	+1	UINT16	R/W	0-9999

1. Each TOU register consists of 16 tariff registers.
2. If a pulse input is assigned to an energy register, the register's input ID must be written first.

Table 5-53 TOU Energy Registers Inputs

Register input	Input ID
None	0
kWh import	1
kWh export	2
N/A	3
N/A	4
kvarh import	5
kvarh export	6
N/A	7
N/A	8
kVAh total	9
Pulse input #1	10
Pulse input #2	11

Table 5-54 TOU Demand Registers Inputs

Register input	Input ID
None	0
Maximum kW import sliding window demand	1
Maximum kW export sliding window demand	2
Maximum kvar import sliding window demand	3
Maximum kvar export sliding window demand	4
Maximum kVA export sliding window demand	5

5.26 TOU Daily Profiles Registers

Table 5-55 TOU Daily Profiles Registers

TOU daily profile	Setup registers (see Table 5-56)
TOU daily profile #1	2048-2063
TOU daily profile #2	2064-2079
TOU daily profile #3	2080-2095
TOU daily profile #4	2096-2111
TOU daily profile #5	2112-2127

TOU daily profile	Setup registers (see Table 5-56)
TOU daily profile #6	2128-2143
TOU daily profile #7	2144-2159
TOU daily profile #8	2160-2175
TOU daily profile #9	2176-2191
TOU daily profile #10	2192-2207
TOU daily profile #11	2208-2223
TOU daily profile #12	2224-2239
TOU daily profile #13	2240-2255
TOU daily profile #14	2256-2271
TOU daily profile #15	2272-2287
TOU daily profile #16	2288-2303

Table 5-56 TOU Profile Setup Registers

Parameter		Offset	Type	R/W	Range
1st tariff change	Tariff start time	+0	UINT16	R/W	0
	Active tariff number	+1	UINT16	R/W	0-15
2nd tariff change	Tariff start time	+2	UINT16	R/W	See Table 5-57
	Active tariff number	+3	UINT16	R/W	0-15
3rd tariff change	Tariff start time	+4	UINT16	R/W	See Table 5-57
	Active tariff number	+5	UINT16	R/W	0-15
4th tariff change	Tariff start time	+6	UINT16	R/W	See Table 5-57
	Active tariff number	+7	UINT16	R/W	0-15
5th tariff change	Tariff start time	+8	UINT16	R/W	See Table 5-57
	Active tariff number	+9	UINT16	R/W	0-15
6th tariff change	Tariff start time	+10	UINT16	R/W	See Table 5-57
	Active tariff number	+11	UINT16	R/W	0-15
7th tariff change	Tariff start time	+12	UINT16	R/W	See Table 5-57
	Active tariff number	+13	UINT16	R/W	0-15
8th tariff change	Tariff start time	+14	UINT16	R/W	See Table 5-57
	Active tariff number	+15	UINT16	R/W	0-15

Table 5-57 Tariff Start Time Register

Parameter	Bits	Range
Tariff start minute	0-7	0-45
Tariff start hour	8-15	0-23

The daily start time for each tariff is specified with a resolution of 15 minutes. If another value is specified, it will be truncated to the lower value divisible by 15 minutes. No error will occur. The first daily tariff change time is always 00:00. It is preserved internally and cannot be changed.

5.27 TOU Calendar Registers

Table 5-58 TOU Calendars Registers

TOU calendar	Calendar month	Setup registers (see Table 5-59)
TOU calendar #1	January	4368-4375
	February	4376-4383
	March	4384-4391
	April	4392-4399
	May	4400-4407
	June	4408-4415
	July	4416-4423
	August	4424-4431
	September	4432-4439
	October	4440-4447
	November	4448-4455
	December	4456-4463

TOU calendar #2	January	4464-4471
	February	4472-4479
	March	4480-4487
	April	4488-4495
	May	4496-4503
	June	4504-4511
	July	4512-4519
	August	4520-4527
	September	4528-4535
	October	4536-4543
	November	4544-4551
	December	4552-4559

Table 5-59 TOU Calendar Setup Registers

Parameter	Offset	Type	R/W	Range
1-4 day profiles	+0	UINT16	R/W	See Table 5-60
5-8 day profiles	+1	UINT16	R/W	See Table 5-60
9-12 day profiles	+2	UINT16	R/W	See Table 5-60
13-16 day profiles	+3	UINT16	R/W	See Table 5-60
17-20 day profiles	+4	UINT16	R/W	See Table 5-60
21-24 day profiles	+5	UINT16	R/W	See Table 5-60
25-28 day profiles	+6	UINT16	R/W	See Table 5-60
29-31 day profiles	+7	UINT16	R/W	See Table 5-60

Table 5-60 TOU Calendar Profile Format

Parameter	Bits	Range
1st day profile number	0-3	0-15
2nd day profile number	4-7	0-15
3rd day profile number	8-11	0-15
4th day profile number	12-15	0-15

Each profile register defines daily profiles for four days of month.

5.28 TOU Calendar Years Registers

These registers allow to associate calendar years with two TOU annual calendars.

Table 5-61 TOU Calendar Years Registers

Parameter	Register	Type	R/W	Range
1st annual calendar year	4560	UINT16	R/W	0-99
2nd annual calendar year	4561	UINT16	R/W	0-99

5.29 Event Log Registers

These registers allow you to circularly read a packet of consequent records from the event log file. From 1 to 12 event log records can be read at a time via the event log windows, which comprise registers 29440 through 29559. Reading from either register window always returns the next logged event record. All registers within one window must be read at once using a single request. After reading an event log window, the partition queue pointer is shifted forward until the end of the log file. After the last record has been read, the file pointer is automatically restored to the beginning of the log file so that the next read request will return the first (oldest) event. To point to an arbitrary record, use the log partition status/control registers (see Section 5.6).

Table 5-62 Event Log Windows Locations

Event log window	Registers (see Table 5-63)
Event log window #1	29440-29449
Event log window #2	29450-29459
Event log window #3	29460-29469
Event log window #4	29470-29479
Event log window #5	29480-29489
Event log window #6	29490-29499
Event log window #7	29500-29509
Event log window #8	29510-29519
Event log window #9	29520-29529
Event log window #10	29530-29539
Event log window #11	29540-29549
Event log window #12	29550-29559

Table 5-63 Event Log Window Registers

Parameter	Offset	Type	R/W	Range
Record status	+0	UINT16	R	Bit-mapped register: bit 0 = 1 - the end record is being read (the end of a log file reached) bit 1 = 1 - reading after the end of file: the read pointer has rolled over the end of a log file, i.e., the file is being re-read from the beginning. This bit is cleared when a new record is being read, or the read sequence has changed by overwriting the partition pointer. bit 8 = 1 - no records logged in the partition bit 9 = 1 - the record is corrupted bit 15 = 1 - read error (detailed by bits 8-9)
Record sequence number	+1	UINT16	R	0 to 65535 (increments modulo 65536 with each log)
Timestamp [1]	+2, +3	UINT32	R	Local time (UNIX-style)
Fractional seconds portion of timestamp	+4	UINT16	R	0-990 ms (at 10 ms resolution)
Event cause	+5	UINT16	R	See Table 5-64
Log value (32-bit register) [2]	+6, +7	UINT32	R	See Table 5-64
Event effect	+8	UINT16	R	See Table 5-64
Reserved	+9	UINT16	R	0

[1] Timestamp is given in local time in a UNIX-style time format: it represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000.

[2] For the log value size and range, refer to Table 5-29.

NOTES:

1. If a requested record is corrupted (the redundant check fails), the record is reported with all zeros (except the sequence number) and the bits 9 and 15 in the status indication word being set to 1.
2. If a record is requested when the log file is empty, the record is reported with all zeros and bits 8 and 15 in the status indication word being set to 1.

Table 5-64 Event Log Parameters

Event cause	Event cause code		Log value	Event effect
	High byte: cause code	Low byte: event origin (location)		
Setpoint event	Trigger parameter ID high byte (see Table 5-32)	Trigger parameter ID low byte (see Table 5-32)	Trigger parameter value (see Table 5-32)	0xE100-0xE10F, 0xE200-0xE20F (see Table 5-66)
Communications	0x5B	Data location code (see Table 5-65)	N/A	See Table 5-66
Front panel	0x5C	Data location code (see Table 5-65)	N/A	See Table 5-66
Self-check	0x5D	Data location code (see Table 5-65)	N/A	See Table 5-66
Self-update	0x5E	8 = RTC	N/A	0xF500 = RTC set
External event	0x63	0 = power down, 8 = power up	N/A	N/A

Table 5-65 Data Location Codes

Location code	Description
3	Data keeping memory
4	Factory setup
5	Access setup
6	Basic setup
7	Communications setup
8	Real-time clock
9	Digital inputs allocation
10	Pulse counters allocation
11	Analog output setup
12	Analog expander setup
14	Timers setup
15	Display options
16	Event/alarm setpoints
17	Pulsing setpoints
18	User assignable register map
20	Data log setup
21	Memory partitions setup
22	TOU energy registers setup
23	TOU demand registers setup
24	TOU daily profiles
25	TOU calendar
26	TOU calendar years
27	Relay control registers
28	User selectable options
31	DNP 3.0 class 0 map
32	DNP 3.0 options setup
33	DNP 3.0 events setup
34	DNP 3.0 event setpoints
35	Calibration registers
36	Time zone information

Table 5-66 Event Effect Codes

Effect code	Description
0x6000	Clear energy registers
0x6100	Clear all demand registers
0x6101	Clear power demand registers
0x6100	Clear volt/ampere demand registers
0x6200	Clear TOU energy registers
0x6300	Clear TOU demand registers
0x6400	Clear all counters
0x6401-0x6404	Clear counters #1-#4
0x6500	Clear Min/Max log registers
0x6600	Clear Event log
0x6700-0x6707	Clear Data log #1-#8
0x6700	Clear all data logs
0x6800	Clear Waveform log #1
0x6900	Clear Waveform log #2
0xE100-0xE10F	Setpoint #1-#16 operated
0xE200-0xE20F	Setpoint #1-#16 released

Effect code	Description
0xF100-0xF10F	Setpoint #1-#16 cleared
0xF500	RTC set

5.30 Data Log Registers

These registers allow you to circularly read consequent records from the event log file. Each data log file is accessed via a separate register window. Reading from either register window always returns the next logged record from the corresponding data log. All registers within one window must be read at once using a single request. After reading a log window, the partition queue pointer is shifted forward until the end of the log file. After the last record has been read, the file pointer is automatically restored to the beginning of the log file so that the next read request will return the first (oldest) record. To point to an arbitrary record, use the data log partition status/control registers (see Section 5.6).

Table 5-67 Data Log Window Locations

Data log number	Registers (see Table 5-68)
Data log #1	29696-29735
Data log #2	29736-29775
Data log #3	29776-29815
Data log #4	29816-29855
Data log #5	29856-29895
Data log #6	29896-29935
Data log #7	29936-29975
Data log #8	29976-30015
Reserved	30016-30335
TOU Monthly Profile Log. Energy Reg. #1	30336-30375
TOU Monthly Profile Log. Energy Reg. #2	30376-30415
TOU Monthly Profile Log. Energy Reg. #3	30416-30455
TOU Monthly Profile Log. Energy Reg. #4	30456-30495
TOU Monthly Profile Log. Energy Reg. #5	30496-30535
TOU Monthly Profile Log. Energy Reg. #6	30536-30575
TOU Monthly Profile Log. Energy Reg. #7	30576-30615
TOU Monthly Profile Log. Energy Reg. #8	30616-30655
Reserved	30656-30975
TOU Monthly Profile Log. Max. Demand Reg. #1	30976-31015
TOU Monthly Profile Log. Max. Demand Reg. #2	31016-31055
TOU Monthly Profile Log. Max. Demand Reg. #3	31056-31095
Reserved	31096-31615
TOU Daily Profile Log. Energy Reg. #1	31616-31655
TOU Daily Profile Log. Energy Reg. #2	31656-31695
TOU Daily Profile Log. Energy Reg. #3	31696-31735
TOU Daily Profile Log. Energy Reg. #4	31736-31775
TOU Daily Profile Log. Energy Reg. #5	31776-31815
TOU Daily Profile Log. Energy Reg. #6	31816-31855
TOU Daily Profile Log. Energy Reg. #7	31856-31895
TOU Daily Profile Log. Energy Reg. #8	31896-31935
Reserved	31936-32255
TOU Daily Profile Log. Max. Demand Reg. #1	32256-32295
TOU Daily Profile Log. Max. Demand Reg. #2	32296-32335
TOU Daily Profile Log. Max. Demand Reg. #3	32336-32375
Reserved	32376-32895

If data log partition #7 is configured as a TOU monthly profile partition, registers 29936-29975 are mapped to registers 30336-30375 for the first TOU monthly profile sub-partition allocated for TOU energy register #1, or if this register is not configured, for the following first available TOU register.

If data log partition #8 is configured as a TOU daily profile partition, registers 29976-30015 are mapped to registers 31616-31655 for the first TOU daily profile sub-partition allocated for TOU energy register #1, or if this register is not configured, for the following first available TOU register.

Table 5-68 Data Log Window Registers

Parameter	Offset	Type	R/W	Range
Record status	+0	UINT16	R	Bit-mapped register: bit 0 = 1 - the end record is being read (the end of a log file reached) bit 1 = 1 - reading after the end of file: the read pointer has rolled over the end of a log file, i.e., the file is being re-read from the beginning. This bit is cleared when a new record is being read, or the read sequence has changed by overwriting the partition pointer. bit 8 = 1 - no records logged in the partition bit 9 = 1 - the record is corrupted bit 15 = 1 - read error (detailed by bits 8-9)
Record sequence number	+1	UINT16	R	0 to 65535 (increments modulo 65536 with each log)
Timestamp [1]	+2, 3	UINT32	R	Local time (UNIX-style)
Fractional seconds portion of timestamp	+4	UINT16	R	0-990 ms (at 10 ms resolution)
Event setpoint ID	+5	UINT16	R	0 = TOU profile log, 1 to 16
Parameter #1 value [2]	+6, 7	INT32	R	See Table 5-2
Parameter #2 value [2]	+8, 8	INT32	R	See Table 5-2
Parameter #3 value [2]	+10, 11	INT32	R	See Table 5-2
Parameter #4 value [2]	+12, 13	INT32	R	See Table 5-2
Parameter #5 value [2]	+14, 15	INT32	R	See Table 5-2
Parameter #6 value [2]	+16, 17	INT32	R	See Table 5-2
Parameter #7 value [2]	+18, 19	INT32	R	See Table 5-2
Parameter #8 value [2]	+20, 21	INT32	R	See Table 5-2
Parameter #9 value [2]	+22, 23	INT32	R	See Table 5-2
Parameter #10 value [2]	+24, 25	INT32	R	See Table 5-2
Parameter #12 value [2]	+26, 27	INT32	R	See Table 5-2
Parameter #13 value [2]	+28, 29	INT32	R	See Table 5-2
Parameter #13 value [2]	+30, 31	INT32	R	See Table 5-2
Parameter #14 value [2]	+32, 33	INT32	R	See Table 5-2
Parameter #15 value [2]	+34, 35	INT32	R	See Table 5-2
Parameter #16 value [2]	+36, 37	INT32	R	See Table 5-2
Reserved	+38, 39	INT32		0

[1] Timestamp is given in local time in a UNIX-style time format: it represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000.

[2] The log parameters are read in 32-bit registers. For the value ranges and scales, refer to Table 5-2.

NOTES:

1. If a requested record is corrupted (the redundant check fails), the record is reported with all zeros (except the sequence number) and bits 9 and 15 in the status indication word as being set to 1.
2. If a record is requested when the log file is empty, the record is reported with all zeros and bits 8 and 15 in the status indication word as being set to 1.
3. The parameters that reside outside of the specified partition record size will be read as zeros.

5.31 Waveform Capture/Log Registers

Table 5-69 Waveform Header Windows

Waveform header window	Registers (see Table 5-70)
Real-time waveform capture channel V L1/L12	35456-35471
Real-time waveform capture channel V L2/L23	35472-35487
Real-time waveform capture channel V L3	35488-35503
Real-time waveform capture channel I L1	35504-35519
Real-time waveform capture channel I L2	35520-35535
Real-time waveform capture channel I L3	35536-35551
Waveform log #1 channel V L1/L12	35552-35567
Waveform log #1 channel V L2/L23	35568-35583
Waveform log #1 channel V L3	35584-35599
Waveform log #1 channel I L1	35600-35615
Waveform log #1 channel I L2	35616-35631

Waveform header window	Registers (see Table 5-70)
Waveform log #1 channel I L3	35632-35647
Waveform log #2 channel V L1/L12	35648-35663
Waveform log #2 channel V L2/L23	35664-35679
Waveform log #2 channel V L3	35680-35695
Waveform log #2 channel I L1	35696-35711
Waveform log #2 channel I L2	35712-35727
Waveform log #2 channel I L3	35728-35743

Table 5-70 Waveform Capture Window Registers

Parameter	Offset	Type	R/W	Range
Command/Status indication	+0	UINT16	R	Bit-mapped register: bit 0 = 1 - the end record is being read (the end of a log file reached) bit 1 = 1 - reading after the end of file: the read pointer has rolled over the end of a log file, i.e., the file is being re-read from the beginning. This bit is cleared when a new record is being read, or the read sequence has changed by overwriting the partition pointer. bit 8 = 1 - no records logged in the partition bit 9 = 1 - the record is corrupted bit 15 = 1 - read error (detailed by bits 8-9)
The record sequence number in the log file	+1	UINT16	R	0 to 65535 (increments modulo 65536 with each log record)
The record timestamp [1]	+2, 3	UINT32	R	Local time (UNIX-style)
Fractional seconds portion of timestamp (milliseconds)	+4	UINT16	R	0-990 (at 10 ms resolution)
Trigger event setpoint ID	+5	UINT16	R	1 to 16 = setpoint #1-#16, 0 = real-time waveform
The waveform series (compound waveform) number	+6	UINT16	R	1 to 65535 (rolls over to 1 after 65535). Each series can comprise up to 80 contiguous records of a compound waveform
The record sequence number in the waveform series	+7	UINT16	R	0 to 79
Analog input full scale, engineering units (volts/amperes) (ANALOG_SCALE)	+8, 9	UINT32	R	For the analog input scale units and range, refer to those of voltage and current in Table 5-2
Digital full scale for the channel, sample code (DIGITAL_SCALE)	+10	UINT16	R	1023 (10 bit A/D), 4095 (12 bit A/D), 8191 (13 bit A/D). Corresponds to twice the analog input full scale range.
Zero offset, code (ZERO_OFFSET)	+11	UINT16	R	Corresponds to the center of the digital sample's full scale range
Sampling frequency	+12	UINT16	R	0 to 6500 x 0.01Hz
Trigger sample point offset in the waveform series	+13	UINT16	R	0-511 (corresponds to the first record in the series)
Reserved	+14,15	UINT16	R	0

Registers at offsets +0,+1, +5 to +7, and +13 are applicable only for waveform log records. For real-time waveforms these are read as zeros.

[1] Timestamp is given in local time in a UNIX-style time format: it represents the number of seconds since midnight (00:00:00), January 1, 1970. The time is valid after January 1, 2000. Record timestamp shows the time for the last sample point in the waveform record.

To convert digital samples to their analog equivalents in input measurement units (volts, amps), the following scaling should be applied:

$$\text{ANALOG\_SAMPLE [Volts / Amps]} = \frac{(\text{DIGITAL\_SAMPLE} - \text{ZERO\_OFFSET}) \times \text{ANALOG\_SCALE} \times 2}{\text{DIGITAL\_SCALE}}$$

NOTES

1. If a record is requested when the log file is empty, the record is reported with all zeros and bits 8 and 15 in the status indication word being set to 1.

2. Phase voltage will be line-to-line voltage in 3OP2 and 3OP3 wiring modes, and line-to-neutral voltage in other configurations.

Table 5-71 Waveform Samples Registers

Parameter	Address	Type	R/W	Range
Waveform sample point #1	6144	INT16	R	0 to 1023/8191
Waveform sample point #2	6145	INT16	R	0 to 1023/8191
Waveform sample point #3	6146	INT16	R	0 to 1023/8191
...	...			
Waveform sample point #512	6655	INT16	R	0 to 1023/8191

Through these registers you can capture and read the real-time waveforms (4 cycles x 128 samples per cycle), and the recorded historical waveform logs - the Waveform log #1 (16 cycles x 32 samples per cycle records), and the Waveform log #2 (4 cycles x 128 samples per cycle records). The waveform samples are read via the register window 6144-6655 (see Table 5-71) that can map a record for a single input channel (voltage or current waveform on either phase). To reload this window with a sampled waveform, a corresponding waveform header window should be accessed (see Table 5-69).

Real-time Waveform Capture

The real-time waveforms can be captured simultaneously on both voltage and current channels for a single phase. To capture two waveforms on a selected phase, the first register (at offset +0) in the voltage waveform header window for this phase (register 35456, 35472, or 35488) should be accessed by reading this register or by reading the entire header window. Before responding to your request, the instrument reloads both the waveform header and waveform samples window with data corresponding to the voltage waveform. Data in these windows does not change until the first (command/status indication) register in either of the waveform header windows is read.

To reload the waveform header and samples windows with the current waveform data, read the first register in the current waveform header window for the same phase.

To capture and read waveform data on another phase, repeat the above steps for the phase you want to access.

Historical Waveform Logs

The historical waveform logs contain waveform records sampled at high (128 samples per cycle in Waveform log #2) or lower frequency (32 samples per cycle in Waveform log #1) that are captured and logged to a file on some event triggers. Each record contains six waveforms of voltage and current on three phases.

Recorded waveforms are mapped and accessed through register windows in the same manner as the real-time waveforms (see above). On log files organization and managing, see Section 4.4, Configuring and Accessing Log Files. Before reloading waveform window registers with data for a selected channel, the required record must be obtained from the log file to the communications buffer. This is made automatically when you reload the voltage waveform on phase L1, i.e., when you read the register at offset +0 in the voltage waveform header on phase L1 for the corresponding log file (registers 35552, 35648). Data in this buffer does not change until you read this register once again. Each time you access this register, the next record is read form the file and locked to the communications buffer. To reload waveform windows with data for the current channel or with data for another phase, read the command/status indication register in the voltage or current header window for the corresponding channel.

Waveform log files are accessed in a circular manner. When the last record in the file is being read, bit 0 in the status indication register in the waveform header windows is set to 1. If you continue reading after the end of a file, the file pointer rolls over to the beginning of the file and the first (oldest) record is returned with bit 1 in the status indication register being set to 1.

NOTES