SERIES PM296/RPM096 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 Versions 2.26.2/2.36.2 and 2.27/2.37 or later):

Added a firmware build number (register 2563, Table 5-7).
Added setpoint status triggers SP1-SP16 (Table 5-2).
Added Low battery alarm (Table 5-18)

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1 GENERAL

This document specifies a subset of the Modbus serial communications protocol used to transfer data between a master computer station and the PM296/RPM096. The document provides the complete information necessary to develop a third-party communications software capable of communication with the Series PM296/RPM096 Powermeters. Additional information concerning communications operation, configuring the communications parameters, and communications connections is found in "Series PM296/RPM096 Powermeters, Installation and Operation Manual".

IMPORTANT

1. The voltage parameters throughout the protocol can represent line-to-neutral or line-to-line voltages depending on the wiring mode selected in the instrument. 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. In 4LN3, 4LL3, 3LN3 and 3LL3 wiring modes, harmonic voltages will represent line-to-neutral voltages. In a 3-wire direct connection, harmonic voltages will represent line-to-neutral voltages as they appear on the instrument's input transformers. In a 3-wire open delta connection, harmonic voltages will comprise L12 and L23 line-to-line voltages.
2. 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.
3. Most of the instrument's advanced features are configured using multiple setup parameters that can be accessed in certain 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 PM296/RPM096, the broadcast mode is supported only for register addresses 287-294 and 301-302 (reset energies and maximum demands), 3404-3415 (reset/clear registers), and 4352-4358 (real-time clock 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. The start of the message is ignored in calculating the CRC. The CRC-16 error check sequence is implemented as described in the following paragraphs.

The message (data bits only, disregarding start/stop and optional parity bits) is considered one continuous binary number whose most significant bit (MSB) is transmitted first. The message is pre-multiplied by x^{16} (shifted left 16 bits), and then divided by $x^{16} + x^{15} + x^2 + 1$ expressed as a binary number (11000000000000101). The integer quotient digits are ignored and the 16-bit remainder (initialized to all ones at the start to avoid the case of all zeros being an accepted message) is appended to the message (MSB first) as the two CRC check bytes. The resulting message including CRC, when divided by the same polynomial ($x^{16} + x^{15} + x^2 + 1$) at the receiver will give a zero remainder if no errors have occurred. (The receiving unit recalculates the CRC and compares it to the transmitted CRC). All arithmetic is performed modulo two (no carries).

The device used to serialize the data for transmission will send the conventional LSB or right-most bit of each character first. In generating the CRC, the first bit transmitted is defined as the MSB of the dividend. For convenience, and since there are no carries used in the arithmetic, let's assume while computing the CRC that the MSB is on the right. To be consistent, the bit order of the generating polynomial must be reversed. The MSB of the polynomial is dropped since it affects only the quotient and not the remainder. This yields 1010 0000 0000 0001 (Hex A001). Note that this reversal of the bit order will have no effect whatever on the interpretation or bit order of characters external to the CRC calculations.

The step by step procedure to form the CRC-16 check bytes is as follows:

1. Load a 16-bit register with all 1's.
2. Exclusive OR the first 8-bit byte with the low order byte of the 16-bit register, putting the result in the 16-bit register.
3. Shift the 16-bit register one bit to the right.

4a. If the bit shifted out to the right (flag) is one, exclusive OR the generating polynomial 1010 000 000 0001 with the 16-bit register.

4b. If the bit shifted out to the right is zero, return to step 3.

5. Repeat steps 3 and 4 until 8 shifts have been performed.
6. Exclusive OR the next 8-bit byte with the 16-bit register.
7. Repeat step 3 through 6 until all bytes of the message have been exclusive ORed with the 16-bit register and shifted 8 times.
8. When the 16-bit CRC is transmitted in the message, the low order byte will be transmitted first, followed by the high order byte.

For detailed information about CRC calculation, refer to the Modbus Protocol Reference Guide.

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 error, 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 PM296/RPM096 Modbus registers are referred to by using addresses in the range of 0 to 65535. From within the Modbus applications, the PM296/RPM096 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 PM296/RPM096 register address to the range of the Modbus holding registers, add a value of 40001 to the PM296/RPM096 register address. When a register address exceeds 9999, use a 6-digit addressing scheme by adding 400001 to the PM296/RPM096 register address.

4.2 Data Formats

The PM296/RPM096 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 or signed 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.

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 = ×200%.

Current engineering scales:

HI = Imax = CT primary current × 2 = 200.00 × 2 = 400.00A
LO = 0A

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

Amps reading = 250 × (400.00 - 0)/9999 + 0 = 10.00A

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 × 2) × 3 = 993,600W = 993.6kW
LO = -Pmax = -993.6kW

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

Watts reading = 5500 × (993.6 - (-993.6))/9999 + (-993.6) = 99.469kW

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

Watts reading = 500 × (993.6 - (-993.6))/9999 + (-993.6) = -894.23kW

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 × 2) × 2/1000 = 13824kW
LO = -Pmax = -13824kW

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

Watts reading = 5500 × (13824 - (-13824))/9999 + (-13824) = 1384kW

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

Watts reading = 500 × (13824 - (-13824))/9999 + (-13824) = -12441kW

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

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.

Negative values are transmitted in a two's complement code. This means that a negative value is added to 4,294,967,296, that is 2 to power 32.

Fractional numbers are pre-multiplied by 10 to power N, where N is the number of decimal places, and are transmitted as whole numbers.

If your Modbus driver does not support a 32-bit long integer format, you can read the two 16-bit registers separately, and then convert them into a 32-bit value as follows (using C notation):

32-bit value = (signed short)high_order_register × 65536L + (unsigned short)low_order_register

EXAMPLES

1. Unsigned 32-bit Values

If you read unsigned Voltage V1 of 69,000V from registers 13952-13953, then the register readings will be as follows:

(13952) = 3464
(13953) = 1

The 32-bit value is (1 x 65536 + 3464) = 69000V.

2. Signed 32-bit Values

If you read signed kW of -789kW from registers 14336-14337, then the register readings will be:

(14336) = 64747 (unsigned)
(14337) = 65535 (unsigned) or -1(signed value).

To take the high order register as a signed value, compare it with 32767. If the value is less or equal to 32767, use it as is. If it is greater than 32767, then this is a negative number in a two's complement code (like in our example) - just subtract it from 65536 to get the original negative value.

The 32-bit reading is (-1 x 65536 + 64747) = -789kW.

Decimal pre-scaling can be 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 or signed 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 PM296/RPM096 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 PM296/RPM096 provides concurrent recording data in 19 different memory partitions, one of which is intended to record event log data and the others to store 16 different data logs using different sets of data parameters. Additionally, the two last data logs #15 and #16 can be configured to automatically record TOU monthly and daily profile data respectively using season TOU tariffs. Refer to Section 5.21 for information on how to allocate a memory partition for your specific data. Refer to Section 5.22 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.

The instrument offers you two different techniques for accessing your log files. The first provides sequential reading of a file records until the end of a file is reached. When a record is requested after the end of a file, the response message will contain a zero record with an exception code indicating the end of a log file. Opposed to this, the second method provides circular file reading, i.e., when a record is requested after the end of a file, 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 5.23, 5.25 and 5.37 for information on sequential read requests you can use to access your log files, and to Sections 5.24, 5.26 and 5.38 for information on circular read requests.

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 5.9 and 5.10 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 5.10) 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 5.6) 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 PM296/RPM096 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 5.35) 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

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. sliding window kW demand [5]	280	UINT16	R/W	0.001kW/1kW	-Pmax	Pmax	LIN3
Accumulated kW demand	281	UINT16	R/W	0.001kW/1kW	-Pmax	Pmax	LIN3
Max. sliding window kVA 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	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 sliding window kW demand [5]	303	UINT16	R	0.001kW/1kW	-Pmax	Pmax	LIN3
Present sliding window kVA demand [5]	304	UINT16	R	0.001kVA/1kVA	-Pmax	Pmax	LIN3
PF at maximum kVA 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 (100% over-range) = 2 × CT primary current [A]
Imax aux (100% over-range) = 2 × Auxiliary CT primary current [A/mA]

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 or 3LL3

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 or 3LL3

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 5-2).

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

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 data 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, for example, when selecting analog output parameters or reading Min/Max log records.

Extended data can be read, written or/and used as event triggers for event/alarm setpoints. A direction attribute shows allowable usage of the registers as follows: R = read, W = write, A = analog (numeric) trigger, B = binary (digital) trigger, N = new value trigger. On using data for triggering events, see Section 5.15.

Table 5-2 16-bit Extended Data Registers

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
None								
None	6656		11776-11777	0	R		0	0
Special Inputs								
Voltage disturbance [7]				0x0100	A	%	0	100
Phase rotation [8]				0x0101	A		0	2
User event flags (bitmap)								
Event flags (Table 5-12)	6776		12160-12161	0x0300	R		0	4095
Event flag #1				0x0300	B			
Event flag #2				0x0301	B			
Event flag #3				0x0302	B			
Event flag #4				0x0303	B			
Event flag #5				0x0304	B			
Event flag #6				0x0305	B			
Event flag #7				0x0306	B			
Event flag #8				0x0307	B			
Internal events (bitmap)								
kWh import pulse				0x0400	B			
kWh export pulse				0x0401	B			
kvarh import pulse				0x0402	B			

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
kvarh export pulse				0x0403	B			
kvarh total pulse				0x0404	B			
kVAh total pulse				0x0405	B			
Start new power demand interval				0x0406	B			
Start new tariff interval				0x0407	B			
Start new volt/ampere demand interval				0x0408	B			
Start new sliding window demand interval				0x0409	B			
New month				0x040A	B			
Timers								
Timer #1				0x0500	B			
Timer #2				0x0501	B			
Timer #3				0x0502	B			
Timer #4				0x0503	B			
Status inputs (bitmap)								
Status inputs (Table 5-13)	6896		12544-12545	0x0600	R		0	4095
Status input #1				0x0600	B			
Status input #2				0x0601	B			
Status input #3				0x0602	B			
Status input #4				0x0603	B			
Status input #5				0x0604	B			
Status input #6				0x0605	B			
Status input #7				0x0606	B			
Status input #8				0x0607	B			
Status input #9				0x0608	B			
Status input #10				0x0609	B			
Status input #11				0x060A	B			
Status input #12				0x060B	B			
Pulse inputs (bitmap)								
Pulse input #1				0x0700	B			
Pulse input #2				0x0701	B			
Pulse input #3				0x0702	B			
Pulse input #4				0x0703	B			
Pulse input #5				0x0704	B			
Pulse input #6				0x0705	B			
Pulse input #7				0x0706	B			
Pulse input #8				0x0707	B			
Pulse input #9				0x0708	B			
Pulse input #10				0x0709	B			
Pulse input #11				0x070A	B			
Pulse input #12				0x070B	B			
Relays (bitmap)								
Relay status (Table 5-11)	6976		12800-12801	0x0800	R		0	63
Relay #1 status				0x0800	B			
Relay #2 status				0x0801	B			
Relay #3 status				0x0802	B			
Relay #4 status				0x0803	B			
Relay #5 status				0x0804	B			
Relay #6 status				0x0805	B			
Pulse counters								
Pulse counter #1	7056-7057		13056-13057	0x0A00	R/W/B		0	10^9-1
Pulse counter #2	7058-7059		13058-13059	0x0A01	R/W/B		0	10^9-1
Pulse counter #3	7060-7061		13060-13061	0x0A02	R/W/B		0	10^9-1
Pulse counter #4	7062-7063		13062-13063	0x0A03	R/W/B		0	10^9-1
Pulse counter #5	7064-7065		13064-13065	0x0A04	R/W/B		0	10^9-1
Pulse counter #6	7066-7067		13066-13067	0x0A05	R/W/B		0	10^9-1
Pulse counter #7	7068-7069		13068-13069	0x0A06	R/W/B		0	10^9-1

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Pulse counter #8	7070-7071		13070-13071	0x0A07	R/W/B		0	10^9-1
Pulse counter #9	7072-7073		13072-13073	0x0A08	R/W/B		0	10^9-1
Pulse counter #10	7074-7075		13074-13075	0x0A09	R/W/B		0	10^9-1
Pulse counter #11	7076-7077		13076-13077	0x0A0A	R/W/B		0	10^9-1
Pulse counter #12	7078-7079		13078-13079	0x0A0B	R/W/B		0	10^9-1
Pulse counter #13	7080-7081		13080-13081	0x0A0C	R/W/B		0	10^9-1
Pulse counter #14	7082-7083		13082-13083	0x0A0D	R/W/B		0	10^9-1
Pulse counter #15	7084-7085		13084-13085	0x0A0E	R/W/B		0	10^9-1
Pulse counter #16	7086-7087		13086-13087	0x0A0F	R/W/B		0	10^9-1
Time/Date parameters								
Packed date [9]				0x0B00	A		000101	991231
Packed time [10]				0x0B01	A		000000	235959
Day of week				0x0B02	A		1= Sun	7=Sat
Year				0x0B03	A		0	99
Month				0x0B04	A		1	12
Day of month				0x0B05	A		1	31
Hour				0x0B06	A		0	23
Minute				0x0B07	A		0	59
Second				0x0B08	A		0	59
Real-time values per phase								
Voltage L1/L12 [6]	7136	LIN3	13312-13313	0x0C00	R/A	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	7137	LIN3	13314-13315	0x0C01	R/A	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	7138	LIN3	13316-13317	0x0C02	R/A	0.1V/1V	0	Vmax
Current L1	7139	LIN3	13318-13319	0x0C03	R/A	0.01A	0	Imax
Current L2	7140	LIN3	13320-13321	0x0C04	R/A	0.01A	0	Imax
Current L3	7141	LIN3	13322-13323	0x0C05	R/A	0.01A	0	Imax
kW L1	7142	LIN3	13324-13325	0x0C06	R/A	0.001kW/1kW	-Pmax	Pmax
kW L2	7143	LIN3	13326-13327	0x0C07	R/A	0.001kW/1kW	-Pmax	Pmax
kW L3	7144	LIN3	13328-13329	0x0C08	R/A	0.001kW/1kW	-Pmax	Pmax
kvar L1	7145	LIN3	13330-13331	0x0C09	R/A	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	7146	LIN3	13332-13333	0x0C0A	R/A	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	7147	LIN3	13334-13335	0x0C0B	R/A	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	7148	LIN3	13336-13337	0x0C0C	R/A	0.001kVA/1kVA	0	Pmax
kVA L2	7149	LIN3	13338-13339	0x0C0D	R/A	0.001kVA/1kVA	0	Pmax
kVA L3	7150	LIN3	13340-13341	0x0C0E	R/A	0.001kVA/1kVA	0	Pmax
Power factor L1	7151	LIN3	13342-13343	0x0C0F	R/A	0.001	-1.000	1.000
Power factor L2	7152	LIN3	13344-13345	0x0C10	R/A	0.001	-1.000	1.000
Power factor L3	7153	LIN3	13346-13347	0x0C11	R/A	0.001	-1.000	1.000
Voltage THD L1/L12	7154	LIN3	13348-13349	0x0C12	R/A	0.1%	0	999.9
Voltage THD L2/L23	7155	LIN3	13350-13351	0x0C13	R/A	0.1%	0	999.9
Voltage THD L3	7156	LIN3	13352-13353	0x0C14	R/A	0.1%	0	999.9
Current THD L1	7157	LIN3	13354-13355	0x0C15	R/A	0.1%	0	999.9
Current THD L2	7158	LIN3	13356-13357	0x0C16	R/A	0.1%	0	999.9
Current THD L3	7159	LIN3	13358-13359	0x0C17	R/A	0.1%	0	999.9
K-Factor L1	7160	LIN3	13360-13361	0x0C18	R/A	0.1	1.0	999.9
K-Factor L2	7161	LIN3	13362-13363	0x0C19	R/A	0.1	1.0	999.9
K-Factor L3	7162	LIN3	13364-13365	0x0C1A	R/A	0.1	1.0	999.9
Current TDD L1	7163	LIN3	13366-13367	0x0C1B	R/A	0.1%	0	100.0
Current TDD L2	7164	LIN3	13368-13369	0x0C1C	R/A	0.1%	0	100.0
Current TDD L3	7165	LIN3	13370-13371	0x0C1D	R/A	0.1%	0	100.0
Voltage L12	7166	LIN3	13372-13373	0x0C1E	R/A	0.1V/1V	0	Vmax
Voltage L23	7167	LIN3	13374-13375	0x0C1F	R/A	0.1V/1V	0	Vmax
Voltage L31	7168	LIN3	13376-13377	0x0C20	R/A	0.1V/1V	0	Vmax
Real-time low values on any phase								
Low voltage [6]	7176	LIN3	13440-13441	0x0D00	R/A	0.1V/1V	0	Vmax
Low current	7177	LIN3	13442-13443	0x0D01	R/A	0.01A	0	Vmax
Low kW	7178	LIN3	13444-13445	0x0D02	R/A	0.001kW/1kW	0	Vmax
Low kvar	7179	LIN3	13446-13447	0x0D03	R/A	0.001kvar/1kvar	0	Imax
Low kVA	7180	LIN3	13448-13449	0x0D04	R/A	0.001kVA/1kVA	0	Imax

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Low PF Lag	7181	LIN3	13450-13451	0x0D05	R/A	0.001	0	Imax
Low PF Lead	7182	LIN3	13452-13453	0x0D06	R/A	0.001	-Pmax	Pmax
Low voltage THD	7183	LIN3	13454-13455	0x0D07	R/A	0.1%	-Pmax	Pmax
Low current THD	7184	LIN3	13456-13457	0x0D08	R/A	0.1%	-Pmax	Pmax
Low K-Factor	7185	LIN3	13458-13459	0x0D09	R/A	0.1	-Pmax	Pmax
Low current TDD	7186	LIN3	13460-13461	0x0D0A	R/A	0.1%	-Pmax	Pmax
Low L-L voltage	7187	LIN3	13462-13463	0x0D0B	R/A	0.1V/1V	0	Vmax
Real-time high values on any phase								
High voltage [6]	7216	LIN3	13568-13569	0x0E00	R/A	0.1V/1V	0	Vmax
High current	7217	LIN3	13570-13571	0x0E01	R/A	0.01A	0	Vmax
High kW	7218	LIN3	13572-13573	0x0E02	R/A	0.001kW/1kW	0	Vmax
High kvar	7219	LIN3	13574-13575	0x0E03	R/A	0.001kvar/1kvar	0	Imax
High kVA	7220	LIN3	13576-13577	0x0E04	R/A	0.001kVA/1kVA	0	Imax
High PF Lag	7221	LIN3	13578-13579	0x0E05	R/A	0.001	0	Imax
High PF Lead	7222	LIN3	13580-13581	0x0E06	R/A	0.001	-Pmax	Pmax
High voltage THD	7223	LIN3	13582-13583	0x0E07	R/A	0.1%	-Pmax	Pmax
High current THD	7224	LIN3	13584-13585	0x0E08	R/A	0.1%	-Pmax	Pmax
High K-Factor	7225	LIN3	13586-13587	0x0E09	R/A	0.1	-Pmax	Pmax
High current TDD	7226	LIN3	13588-13589	0x0E0A	R/A	0.1%	-Pmax	Pmax
High L-L voltage	7227	LIN3	13590-13591	0x0E0B	R/A	0.1V/1V	0	Vmax
Real-time total values								
Total kW	7256	LIN3	13696-13697	0x0F00	R/A	0.001kW/1kW	-Pmax	Pmax
Total kvar	7257	LIN3	13698-13699	0x0F01	R/A	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	7258	LIN3	13700-13701	0x0F02	R/A	0.001kVA/1kVA	0	Pmax
Total PF	7259	LIN3	13702-13703	0x0F03	R/A	0.001	-1.000	1.000
Total PF lag	7260	LIN3	13704-13705	0x0F04	R/A	0.001	-1.000	1.000
Total PF lead	7261	LIN3	13706-13707	0x0F05	R/A	0.001	-1.000	1.000
Total kW import	7262	LIN3	13708-13709	0x0F06	R/A	0.001kW/1kW	0	Pmax
Total kW export	7263	LIN3	13710-13711	0x0F07	R/A	0.001kW/1kW	0	Pmax
Total kvar import	7264	LIN3	13712-13713	0x0F08	R/A	0.001kvar/1kvar	0	Pmax
Total kvar export	7265	LIN3	13714-13715	0x0F09	R/A	0.001kvar/1kvar	0	Pmax
3-phase average voltage [6]	7266	LIN3	13716-13717	0x0F0A	R/A	0.1V/1V	0	Vmax
3-phase average L-L voltage	7267	LIN3	13718-13719	0x0F0B	R/A	0.1V/1V	0	Vmax
3-phase average current	7268	LIN3	13720-13721	0x0F0C	R/A	0.01A	0	Imax
Real-time auxiliary values								
Auxiliary current	7296	LIN3	13824-13825	0x1000	R/A	0.01A/mA	0	Imax aux
Neutral current	7297	LIN3	13826-13827	0x1001	R/A	0.01A	0	Imax
Frequency [4]	7298	LIN3	13828-13829	0x1002	R/A	0.01Hz	0	100.00
Voltage unbalance	7299	LIN3	13830-13831	0x1003	R/A	1%	0	300
Current unbalance	7300	LIN3	13832-13833	0x1004	R/A	1%	0	300
DC voltage	7301	LIN3	13834-13835	0x1005	R/A	0.01V	0	9999.00
Average values per phase								
Voltage L1/L12 [6]	7336	LIN3	13952-13953	0x1100	R/A	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	7337	LIN3	13954-13955	0x1101	R/A	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	7338	LIN3	13956-13957	0x1102	R/A	0.1V/1V	0	Vmax
Current L1	7339	LIN3	13958-13959	0x1103	R/A	0.01A	0	Imax
Current L2	7340	LIN3	13960-13961	0x1104	R/A	0.01A	0	Imax
Current L3	7341	LIN3	13962-13963	0x1105	R/A	0.01A	0	Imax
kW L1	7342	LIN3	13964-13965	0x1106	R/A	0.001kW/1kW	-Pmax	Pmax
kW L2	7343	LIN3	13966-13967	0x1107	R/A	0.001kW/1kW	-Pmax	Pmax
kW L3	7344	LIN3	13968-13969	0x1108	R/A	0.001kW/1kW	-Pmax	Pmax
kvar L1	7345	LIN3	13970-13971	0x1109	R/A	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	7346	LIN3	13972-13973	0x110A	R/A	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	7347	LIN3	13974-13975	0x110B	R/A	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	7348	LIN3	13976-13977	0x110C	R/A	0.001kVA/1kVA	0	Pmax
kVA L2	7349	LIN3	13978-13979	0x110D	R/A	0.001kVA/1kVA	0	Pmax
kVA L3	7350	LIN3	13980-13981	0x110E	R/A	0.001kVA/1kVA	0	Pmax
Power factor L1	7351	LIN3	13982-13983	0x110F	R/A	0.001	-1.000	1.000
Power factor L2	7352	LIN3	13984-13985	0x1110	R/A	0.001	-1.000	1.000
Power factor L3	7353	LIN3	13986-13987	0x1111	R/A	0.001	-1.000	1.000
Voltage THD L1/L12	7354	LIN3	13988-13989	0x1112	R/A	0.1%	0	999.9
Voltage THD L2/L23	7355	LIN3	13990-13991	0x1113	R/A	0.1%	0	999.9
Voltage THD L3	7356	LIN3	13992-13993	0x1114	R/A	0.1%	0	999.9
Current THD L1	7357	LIN3	13994-13995	0x1115	R/A	0.1%	0	999.9
Current THD L2	7358	LIN3	13996-13997	0x1116	R/A	0.1%	0	999.9
Current THD L3	7359	LIN3	13998-13999	0x1117	R/A	0.1%	0	999.9
K-Factor L1	7360	LIN3	14000-14001	0x1118	R/A	0.1	1.0	999.9
K-Factor L2	7361	LIN3	14002-14003	0x1119	R/A	0.1	1.0	999.9

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
K-Factor L3	7362	LIN3	14004-14005	0x111A	R/A	0.1	1.0	999.9
Current TDD L1	7363	LIN3	14006-14007	0x111B	R/A	0.1%	0	100.0
Current TDD L2	7364	LIN3	14008-14009	0x111C	R/A	0.1%	0	100.0
Current TDD L3	7365	LIN3	14010-14011	0x111D	R/A	0.1%	0	100.0
Voltage L12	7366	LIN3	14012-14013	0x111E	R/A	0.1V/1V	0	Vmax
Voltage L23	7367	LIN3	14014-14015	0x111F	R/A	0.1V/1V	0	Vmax
Voltage L31	7368	LIN3	14016-14017	0x1120	R/A	0.1V/1V	0	Vmax
Average low values on any phase								
Low voltage [6]	7376	LIN3	14080-14081	0x1200	R/A	0.1V/1V	0	Vmax
Low current	7377	LIN3	14082-14083	0x1201	R/A	0.01A	0	Vmax
Low kW	7378	LIN3	14084-14085	0x1202	R/A	0.001kW/1kW	0	Vmax
Low kvar	7379	LIN3	14086-14087	0x1203	R/A	0.001kvar/1kvar	0	Imax
Low kVA	7380	LIN3	14088-14089	0x1204	R/A	0.001kVA/1kVA	0	Imax
Low PF Lag	7381	LIN3	14090-14091	0x1205	R/A	0.001	0	Imax
Low PF Lead	7382	LIN3	14092-14093	0x1206	R/A	0.001	-Pmax	Pmax
Low voltage THD	7383	LIN3	14094-14095	0x1207	R/A	0.1%	-Pmax	Pmax
Low current THD	7384	LIN3	14096-14097	0x1208	R/A	0.1%	-Pmax	Pmax
Low K-Factor	7385	LIN3	14098-14099	0x1209	R/A	0.1	-Pmax	Pmax
Low current TDD	7386	LIN3	14100-14101	0x120A	R/A	0.1%	-Pmax	Pmax
Low L-L voltage	7387	LIN3	14102-14103	0x120B	R/A	0.1V/1V	0	Vmax
Average high values on any phase								
High voltage [6]	7416	LIN3	14208-14209	0x1300	R/A	0.1V/1V	0	Vmax
High current	7417	LIN3	14210-14211	0x1301	R/A	0.01A	0	Vmax
High kW	7418	LIN3	14212-14213	0x1302	R/A	0.001kW/1kW	0	Vmax
High kvar	7419	LIN3	14214-14215	0x1303	R/A	0.001kvar/1kvar	0	Imax
High kVA	7420	LIN3	14216-14217	0x1304	R/A	0.001kVA/1kVA	0	Imax
High PF Lag	7421	LIN3	14218-14219	0x1305	R/A	0.001	0	Imax
High PF Lead	7422	LIN3	14220-14221	0x1306	R/A	0.001	-Pmax	Pmax
High voltage THD	7423	LIN3	14222-14223	0x1307	R/A	0.1%	-Pmax	Pmax
High current THD	7424	LIN3	14224-14225	0x1308	R/A	0.1%	-Pmax	Pmax
High K-Factor	7425	LIN3	14226-14227	0x1309	R/A	0.1	-Pmax	Pmax
High current TDD	7426	LIN3	14228-14229	0x130A	R/A	0.1%	-Pmax	Pmax
High L-L voltage	7427	LIN3	14230-14231	0x130B	R/A	0.1V/1V	0	Vmax
Average total values								
Total kW	7456	LIN3	14336-14337	0x1400	R/A	0.001kW/1kW	-Pmax	Pmax
Total kvar	7457	LIN3	14338-14339	0x1401	R/A	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	7458	LIN3	14340-14341	0x1402	R/A	0.001kVA/1kVA	0	Pmax
Total PF	7459	LIN3	14342-14343	0x1403	R/A	0.001	-1.000	1.000
Total PF lag	7460	LIN3	14344-14345	0x1404	R/A	0.001	-1.000	1.000
Total PF lead	7461	LIN3	14346-14347	0x1405	R/A	0.001	-1.000	1.000
Total kW import	7462	LIN3	14348-14349	0x1406	R/A	0.001kW/1kW	0	Pmax
Total kW export	7463	LIN3	14350-14351	0x1407	R/A	0.001kW/1kW	0	Pmax
Total kvar import	7464	LIN3	14352-14353	0x1408	R/A	0.001kvar/1kvar	0	Pmax
Total kvar export	7465	LIN3	14354-14355	0x1409	R/A	0.001kvar/1kvar	0	Pmax
3-phase average voltage [6]	7466	LIN3	14356-14357	0x140A	R/A	0.1V/1V	0	Vmax
3-phase average L-L voltage	7467	LIN3	14358-14359	0x140B	R/A	0.1V/1V	0	Vmax
3-phase average current	7468	LIN3	14360-14361	0x140C	R/A	0.01A	0	Imax
Average auxiliary values								
Auxiliary current	7496	LIN3	14464-14465	0x1500	R/A	0.01A/mA	0	Imax aux
Neutral current	7497	LIN3	14466-14467	0x1501	R/A	0.01A	0	Imax
Frequency [4]	7498	LIN3	14468-14469	0x1502	R/A	0.01Hz	0	100.00
Voltage unbalance	7499	LIN3	14470-14471	0x1503	R/A	1%	0	300
Current unbalance	7500	LIN3	14472-14473	0x1504	R/A	1%	0	300
DC voltage	7501	LIN3	14474-14475	0x1505	R/A	0.01V	0	9999.00
Present demands								
Volt demand L1/L12 [6]	7536	LIN3	14592-14593	0x1600	R/A	0.1V/1V	0	Vmax
Volt demand L2/L23 [6]	7537	LIN3	14594-14595	0x1601	R/A	0.1V/1V	0	Vmax
Volt demand L3/L31 [6]	7538	LIN3	14596-14597	0x1602	R/A	0.1V/1V	0	Vmax
Ampere demand L1	7539	LIN3	14598-14599	0x1603	R/A	0.01A	0	Imax
Ampere demand L2	7540	LIN3	14600-14601	0x1604	R/A	0.01A	0	Imax
Ampere demand L3	7541	LIN3	14602-14603	0x1605	R/A	0.01A	0	Imax
kW import block demand	7542	LIN3	14604-14605	0x1606	R/A	0.001kW/1kW	0	Pmax
kvar import block demand	7543	LIN3	14606-14607	0x1607	R/A	0.001kvar/1kvar	0	Pmax
kVA block demand	7544	LIN3	14608-14609	0x1608	R/A	0.001kVA/1kVA	0	Pmax
kW import sliding window demand	7545	LIN3	14610-14611	0x1609	R/A	0.001kW/1kW	0	Pmax
kvar import sliding window demand	7546	LIN3	14612-14613	0x160A	R/A	0.001kvar/1kvar	0	Pmax

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
kVA sliding window demand	7547	LIN3	14614-14615	0x160B	R/A	0.001kVA/1kVA	0	Pmax
kW import thermal demand	7548	LIN3	14616-14617	0x160C	R/A	0.001kW/1kW	0	Pmax
kvar import thermal demand	7549	LIN3	14618-14619	0x160D	R/A	0.001kvar/1kvar	0	Pmax
kVA thermal demand	7550	LIN3	14620-14621	0x160E	R/A	0.001kVA/1kVA	0	Pmax
kW import accumulated demand	7551	LIN3	14622-14623	0x160F	R/A	0.001kW/1kW	0	Pmax
kvar import accumulated demand	7552	LIN3	14624-14625	0x1610	R/A	0.001kvar/1kvar	0	Pmax
kVA accumulated demand	7553	LIN3	14626-14627	0x1611	R/A	0.001kVA/1kVA	0	Pmax
kW import predicted sliding window demand	7554	LIN3	14628-14629	0x1612	R/A	0.001kW/1kW	0	Pmax
kvar import predicted sliding window demand	7555	LIN3	14630-14631	0x1613	R/A	0.001kvar/1kvar	0	Pmax
kVA predicted sliding window demand	7556	LIN3	14632-14633	0x1614	R/A	0.001kVA/1kVA	0	Pmax
PF (import) at maximum kVA sliding window demand	7557	LIN3	14634-14635	0x1615	R/A	0.001	-1.000	1.000
kW export block demand	7558	LIN3	14636-14637	0x1616	R/A	0.001kW/1kW	0	Pmax
kvar export block demand	7559	LIN3	14638-14639	0x1617	R/A	0.001kvar/1kvar	0	Pmax
kW export sliding window demand	7560	LIN3	14640-14641	0x1618	R/A	0.001kW/1kW	0	Pmax
kvar export sliding window demand	7561	LIN3	14642-14643	0x1619	R/A	0.001kvar/1kvar	0	Pmax
kW export accumulated demand	7562	LIN3	14644-14645	0x161A	R/A	0.001kW/1kW	0	Pmax
kvar export accumulated demand	7563	LIN3	14646-14647	0x161B	R/A	0.001kvar/1kvar	0	Pmax
kW export predicted sliding window demand	7564	LIN3	14648-14649	0x161C	R/A	0.001kW/1kW	0	Pmax
kvar export predicted sliding window demand	7565	LIN3	14650-14651	0x161D	R/A	0.001kvar/1kvar	0	Pmax
kW export thermal demand	7560	LIN3	14652-14653	0x161E	R/A	0.001kW/1kW	0	Pmax
kvar export thermal demand	7561	LIN3	14654-14655	0x161F	R/A	0.001kvar/1kvar	0	Pmax
Total energies								
kWh import	7576-7577		14720-14721	0x1700	R	kWh	0	10^9-1
kWh export	7578-7579		14722-14723	0x1701	R	kWh	0	10^9-1
kWh net	7580-7581		14724-14725	0x1702	R	kWh	-10^9+1	10^9-1
kWh total	7582-7583		14726-14727	0x1703	R	kWh	0	10^9-1
kvarh import	7584-7585		14728-14729	0x1704	R	kvarh	0	10^9-1
kvarh export	7586-7587		14730-14731	0x1705	R	kvarh	0	10^9-1
kvarh net	7588-7589		14732-14733	0x1704	R	kvarh	-10^9+1	10^9-1
kvarh total	7590-7591		14734-14735	0x1705	R	kvarh	0	10^9-1
kVAh total	7592-7593		14736-14737	0x1708	R	kVAh	0	10^9-1
L1/L12 phase voltage harmonics								
Harmonic H01	7656	LIN3	14976-14977	0x1900	R/A	0.01%	0	100.00
Harmonic H02	7657	LIN3	14978-14979	0x1901	R/A	0.01%	0	100.00
...	...			. . .				
Harmonic H40	7695	LIN3	14054-14055	0x1927	R/A	0.01%	0	100.00
L2/L23 phase voltage harmonics								
Harmonic H01	7696	LIN3	15104-15105	0x1A00	R/A	0.01%	0	100.00
Harmonic H02	7697	LIN3	15106-15107	0x1A01	R/A	0.01%	0	100.00
...	...			. . .				
Harmonic H40	7735	LIN3	15182-15183	0x1A27	R/A	0.01%	0	100.00
L3 phase voltage harmonics								
Harmonic H01	7736	LIN3	15232-15233	0x1B00	R/A	0.01%	0	100.00
Harmonic H02	7737	LIN3	15234-15235	0x1B01	R/A	0.01%	0	100.00
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Harmonic H40	7775	LIN3	15310-15311	0x1B27	R/A	0.01%	0	100.00
L1 phase current harmonics								

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Harmonic H01	7776	LIN3	15360-15361	0x1C00	R/A	0.01%	0	100.00
Harmonic H02	7777	LIN3	15362-15363	0x1C01	R/A	0.01%	0	100.00
...	...			. . .				
Harmonic H40	7815	LIN3	15438-15439	0x1C27	R/A	0.01%	0	100.00
L2 phase current harmonics								
Harmonic H01	7816	LIN3	15488-15489	0x1D00	R/A	0.01%	0	100.00
Harmonic H02	7817	LIN3	15490-15491	0x1D01	R/A	0.01%	0	100.00
...	...			. . .				
Harmonic H40	7855	LIN3	15566-15567	0x1D27	R/A	0.01%	0	100.00
L3 phase current harmonics								
Harmonic H01	7856	LIN3	15616-15617	0x1E00	R/A	0.01%	0	100.00
Harmonic H02	7857	LIN3	15618-15619	0x1E01	R/A	0.01%	0	100.00
...	...			. . .				
Harmonic H40	7895	LIN3	15694-15695	0x1E27	R/A	0.01%	0	100.00
L1/L12 phase harmonic voltages (odd harmonics)								
Harmonic H01	7896	LIN3	15744-15745	0x1F00	R/A	0.1V/1V	0	Vmax
Harmonic H03	7897	LIN3	15746-15747	0x1F01	R/A	0.1V/1V	0	Vmax
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Harmonic H39	7915	LIN3	15782-15783	0x1F13	R/A	0.1V/1V	0	Vmax
L2/L23 phase harmonic voltages (odd harmonics)								
Harmonic H01	7936	LIN3	15872-15873	0x2000	R/A	0.1V/1V	0	Vmax
Harmonic H03	7937	LIN3	15874-15875	0x2001	R/A	0.1V/1V	0	Vmax
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Harmonic H39	7955	LIN3	15910-15911	0x2013	R/A	0.1V/1V	0	Vmax
L3 phase harmonic voltages (odd harmonics)								
Harmonic H01	7976	LIN3	16000-16001	0x2100	R/A	0.1V/1V	0	Vmax
Harmonic H03	7977	LIN3	16002-16003	0x2101	R/A	0.1V/1V	0	Vmax
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Harmonic H39	7995	LIN3	16038-16039	0x2113	R/A	0.1V/1V	0	Vmax
L1 phase harmonic current (odd harmonics)								
Harmonic H01	8016	LIN3	16128-16129	0x2200	R/A	0.01A	0	Imax
Harmonic H03	8017	LIN3	16130-16131	0x2201	R/A	0.01A	0	Imax
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Harmonic H39	8035	LIN3	16166-16167	0x2213	R/A	0.01A	0	Imax
L2 phase harmonic current (odd harmonics)								
Harmonic H01	8056	LIN3	16256-16257	0x2300	R/A	0.01A	0	Imax
Harmonic H03	8057	LIN3	16258-16259	0x2301	R/A	0.01A	0	Imax
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Harmonic H39	8075	LIN3	16294-16295	0x2313	R/A	0.01A	0	Imax
L3 phase harmonic current (odd harmonics)								
Harmonic H01	8096	LIN3	16384-16385	0x2400	R/A	0.01A	0	Imax
Harmonic H03	8097	LIN3	16386-16387	0x2401	R/A	0.01A	0	Imax
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Harmonic H39	8115	LIN3	16422-16423	0x2413	R/A	0.01A	0	Imax
Harmonic total kW (odd harmonics)								
Harmonic H01	8136	LIN3	16512-16513	0x2500	R/A	0.001kW/1kW	-Pmax	Pmax
Harmonic H03	8137	LIN3	16514-16515	0x2501	R/A	0.001kW/1kW	-Pmax	Pmax
. . .	...			. . .				
Harmonic H39	8155	LIN3	16550-16551	0x2513	R/A	0.001kW/1kW	-Pmax	Pmax
Harmonic total kvar (odd harmonics)								
Harmonic H01	8176	LIN3	16640-16641	0x2600	R/A	0.001kvar/1kvar	-Pmax	Pmax
Harmonic H03	8177	LIN3	16642-16643	0x2601	R/A	0.001kvar/1kvar	-Pmax	Pmax
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Harmonic H39	8195	LIN3	16678-16679	0x2613	R/A	0.001kvar/1kvar	-Pmax	Pmax
Harmonic total PF (odd harmonics)								
Harmonic H01	8216	LIN3	16768-16769	0x2700	R/A	0.001	-1.000	1.000
Harmonic H03	8217	LIN3	16770-16771	0x2701	R/A	0.001	-1.000	1.000
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Harmonic H39	8235	LIN3	16806-16807	0x2713	R/A	0.001	-1.000	1.000
Minimum real-time values per phase (M)								
Voltage L1/L12 [6]	8416	LIN3	17408-17409	0x2C00	R/N	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	8417	LIN3	17410-17411	0x2C01	R/N	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	8418	LIN3	17412-17413	0x2C02	R/N	0.1V/1V	0	Vmax
Current L1	8419	LIN3	17414-17415	0x2C03	R/N	0.01A	0	Imax
Current L2	8420	LIN3	17416-17417	0x2C04	R/N	0,01A	0	Imax
Current L3	8421	LIN3	17418-17419	0x2C05	R/N	0,01A	0	Imax
kW L1	8422	LIN3	17420-17421	0x2C06	R/N	0.001kW/1kW	-Pmax	Pmax

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
kW L2	8423	LIN3	17422-17423	0x2C07	R/N	0.001kW/1kW	-Pmax	Pmax
kW L3	8424	LIN3	17424-17425	0x2C08	R/N	0.001kW/1kW	-Pmax	Pmax
kvar L1	8425	LIN3	17426-17427	0x2C09	R/N	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	8426	LIN3	17428-17429	0x2C0A	R/N	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	8427	LIN3	17430-17431	0x2C0B	R/N	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	8428	LIN3	17432-17433	0x2C0C	R/N	0.001kVA/1kVA	0	Pmax
kVA L2	8429	LIN3	17434-17435	0x2C0D	R/N	0.001kVA/1kVA	0	Pmax
kVA L3	8430	LIN3	17436-17437	0x2C0E	R/N	0.001kVA/1kVA	0	Pmax
Power factor L1 [3]	8431	LIN3	17438-17439	0x2C0F	R/N	0.001	-1.000	1.000
Power factor L2 [3]	8432	LIN3	17440-17441	0x2C10	R/N	0.001	-1.000	1.000
Power factor L3 [3]	8433	LIN3	17442-17443	0x2C11	R/N	0.001	-1.000	1.000
Voltage THD L1/L12	8434	LIN3	17444-17445	0x2C12	R/N	0.1%	0	999.9
Voltage THD L2/L23	8435	LIN3	17446-17447	0x2C13	R/N	0.1%	0	999.9
Voltage THD L3	8436	LIN3	17448-17449	0x2C14	R/N	0.1%	0	999.9
Current THD L1	8437	LIN3	17450-17451	0x2C15	R/N	0.1%	0	999.9
Current THD L2	8438	LIN3	17452-17453	0x2C16	R/N	0.1%	0	999.9
Current THD L3	8439	LIN3	17454-17455	0x2C17	R/N	0.1%	0	999.9
K-Factor L1	8440	LIN3	17456-17457	0x2C18	R/N	0.1	1.0	999.9
K-Factor L2	8441	LIN3	17458-17459	0x2C19	R/N	0.1	1.0	999.9
K-Factor L3	8442	LIN3	17460-17461	0x2C1A	R/N	0.1	1.0	999.9
Current TDD L1	8443	LIN3	17462-17463	0x2C1B	R/N	0.1%	0	100.0
Current TDD L2	8444	LIN3	17464-17465	0x2C1C	R/N	0.1%	0	100.0
Current TDD L3	8445	LIN3	17466-17467	0x2C1D	R/N	0.1%	0	100.0
Voltage L12	8446	LIN3	17468-17469	0x2C1E	R/N	0.1V/1V	0	Vmax
Voltage L23	8447	LIN3	17470-17471	0x2C1F	R/N	0.1V/1V	0	Vmax
Voltage L31	8448	LIN3	17472-17473	0x2C20	R/N	0.1V/1V	0	Vmax
Minimum real-time total values (M)								
Total kW	8456	LIN3	17536-17537	0x2D00	R/N	0.001kW/1kW	-Pmax	Pmax
Total kvar	8457	LIN3	17538-17539	0x2D01	R/N	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	8458	LIN3	17540-17541	0x2D02	R/N	0.001kVA/1kVA	0	Pmax
Total PF [3]	8459	LIN3	17542-17543	0x2D03	R/N	0.001	0	1.000
Total PF lag	8460	LIN3	17544-17545	0x2D04	R/N	0.001	0	1.000
Total PF lead	8461	LIN3	17546-17547	0x2D05	R/N	0.001	0	1.000
Minimum real-time auxiliary values (M)								
Auxiliary current	8496	LIN3	17664-17665	0x2E00	R/N	0.01A/mA	0	Imax aux
Neutral current	8497	LIN3	17666-17667	0x2E01	R/N	0.01A	0	Imax
Frequency [4]	8498	LIN3	17668-17669	0x2E02	R/N	0.01Hz	0	100.00
Voltage unbalance	8499	LIN3	17670-17671	0x2E03	R/N	1%	0	300
Current unbalance	8500	LIN3	17672-17673	0x2E04	R/N	1%	0	300
DC voltage	8501	LIN3	17674-17675	0x2E05	R/N	0.01V	0	9999.00
Minimum demands (M) - Reserved								
Reserved	8536-8552		17792-17793 - 18824-18825	0x2F00-0x2F12	R		0	0
Programmable Min/Max minimum registers (M)								
Register #1	8576	LIN3	17664-17665	0x3000	R/N	[5]	[5]	[5]
Register #2	8577	LIN3	17666-17667	0x3001	R/N	[5]	[5]	[5]
. . .	...		...	. . .				
Register #16	8590	LIN3	14470-14471	0x300F	R/N	[5]	[5]	[5]
Maximum real-time values per phase (M)								
Voltage L1/L12 [6]	8736	LIN3	18432-18433	0x3400	R/N	0.1V/1V	0	Vmax
Voltage L2/L23 [6]	8737	LIN3	18434-18435	0x3401	R/N	0.1V/1V	0	Vmax
Voltage L3/L31 [6]	8738	LIN3	18436-18437	0x3402	R/N	0.1V/1V	0	Vmax
Current L1	8739	LIN3	18438-18439	0x3403	R/N	0.01A	0	Imax
Current L2	8740	LIN3	18440-18441	0x3404	R/N	0.01A	0	Imax
Current L3	8741	LIN3	18442-18443	0x3405	R/N	0.01A	0	Imax
kW L1	8742	LIN3	18444-18445	0x3406	R/N	0.001kW/1kW	-Pmax	Pmax
kW L2	8743	LIN3	18446-18447	0x3407	R/N	0.001kW/1kW	-Pmax	Pmax
kW L3	8744	LIN3	18448-18449	0x3408	R/N	0.001kW/1kW	-Pmax	Pmax
kvar L1	8745	LIN3	18450-18451	0x3409	R/N	0.001kvar/1kvar	-Pmax	Pmax
kvar L2	8746	LIN3	18452-18453	0x340A	R/N	0.001kvar/1kvar	-Pmax	Pmax
kvar L3	8747	LIN3	18454-18455	0x340B	R/N	0.001kvar/1kvar	-Pmax	Pmax
kVA L1	8748	LIN3	18456-18457	0x340C	R/N	0.001kVA/1kVA	0	Pmax
kVA L2	8749	LIN3	18458-18459	0x340D	R/N	0.001kVA/1kVA	0	Pmax
kVA L3	8750	LIN3	18460-18461	0x340E	R/N	0.001kVA/1kVA	0	Pmax
Power factor L1 [3]	8751	LIN3	18462-18463	0x340F	R/N	0.001	-1.000	1.000
Power factor L2 [3]	8752	LIN3	18464-18465	0x3410	R/N	0.001	-1.000	1.000
Power factor L3 [3]	8753	LIN3	18466-18467	0x3411	R/N	0.001	-1.000	1.000
Voltage THD L1/L12	8754	LIN3	18468-18469	0x3412	R/N	0.1%	0	999.9

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Voltage THD L2/L23	8755	LIN3	18470-18471	0x3413	R/N	0.1%	0	999.9
Voltage THD L3	8756	LIN3	18472-18473	0x3414	R/N	0.1%	0	999.9
Current THD L1	8757	LIN3	18474-18475	0x3415	R/N	0.1%	0	999.9
Current THD L2	8758	LIN3	18476-18477	0x3416	R/N	0.1%	0	999.9
Current THD L3	8759	LIN3	18478-18479	0x3417	R/N	0.1%	0	999.9
K-Factor L1	8760	LIN3	18480-18481	0x3418	R/N	0.1	1.0	999.9
K-Factor L2	8761	LIN3	18482-18483	0x3419	R/N	0.1	1.0	999.9
K-Factor L3	8762	LIN3	18484-18485	0x341A	R/N	0.1	1.0	999.9
Current TDD L1	8763	LIN3	18486-18487	0x341B	R/N	0.1%	0	100.0
Current TDD L2	8764	LIN3	18488-18489	0x341C	R/N	0.1%	0	100.0
Current TDD L3	8765	LIN3	18490-18491	0x341D	R/N	0.1%	0	100.0
Voltage L12	8766	LIN3	18492-18493	0x341E	R/N	0.1V/1V	0	Vmax
Voltage L23	8767	LIN3	18494-18495	0x341F	R/N	0.1V/1V	0	Vmax
Voltage L31	8768	LIN3	18496-18497	0x3420	R/N	0.1V/1V	0	Vmax
Maximum real-time total values (M)								
Total kW	8776	LIN3	18560-18561	0x3500	R/N	0.001kW/1kW	-Pmax	Pmax
Total kvar	8777	LIN3	18562-18563	0x3501	R/N	0.001kvar/1kvar	-Pmax	Pmax
Total kVA	8778	LIN3	18564-18565	0x3502	R/N	0.001kVA/1kVA	0	Pmax
Total PF [3]	8779	LIN3	18566-18567	0x3503	R/N	0.001	0	1.000
Total PF lag	8780	LIN3	18568-18569	0x3504	R/N	0.001	0	1.000
Total PF lead	8781	LIN3	18570-18571	0x3505	R/N	0.001	0	1.000
Maximum real-time auxiliary values (M)								
Auxiliary current	8816	LIN3	18688-18689	0x3600	R/N	0.01A/mA	0	Imax aux
Neutral current	8817	LIN3	18680-18681	0x3601	R/N	0.01A	0	Imax
Frequency [4]	8818	LIN3	18682-18683	0x3602	R/N	0.01Hz	0	100.00
Voltage unbalance	8819	LIN3	18684-18685	0x3603	R/N	1%	0	300
Current unbalance	8820	LIN3	18686-18687	0x3604	R/N	1%	0	300
DC voltage	8821	LIN3	18688-18689	0x3605	R/N	0.01V	0	9999.00
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	LIN3	18828-18829	0x3706	R		0	0
Reserved	8863	LIN3	18830-18831	0x3707	R		0	0
Reserved	8864	LIN3	18832-18833	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
Max. kW import thermal demand	8868	LIN3	18840-18841	0x370C	R	0.001kW/1kW	0	Pmax
Max. kvar import thermal demand	8869	LIN3	18842-18843	0x370D	R	0.001kvar/1kvar	0	Pmax
Max. kVA thermal demand	8870	LIN3	18844-18845	0x370E	R	0.001kVA/1kVA	0	Pmax
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
Max. kW export thermal demand	8873	LIN3	18840-18841	0x3711	R	0.001kW/1kW	0	Pmax
Max. kvar export thermal demand	8874	LIN3	18842-18843	0x3712	R	0.001kvar/1kvar	0	Pmax
Programmable Min/Max maximum registers (M)								
Register #1	8896	LIN3	18944-18945	0x3800	R/N	[5]	[5]	[5]
Register #2	8897	LIN3	18946-18947	0x3801	R/N	[5]	[5]	[5]
. . .	...		...	. . .				
Register #16	8911	LIN3	18974-18975	0x380F	R/N	[5]	[5]	[5]
TOU system parameters								
Active tariff	9056		19456-19457	0x3C00	R/A		0	15
Active profile	9057		19458-19459	0x3C01	R/A		0	15
TOU energy register #1								
Tariff #1 register	9096-9097		19584-19585	0x3D00	R	[5]	-10^9+1	10^9-1

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Tariff #2 register	9098-9099		19586-19587	0x3D01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9126-9127		19614-19615	0x3D0F	R	[5]	-10^9+1	10^9-1
TOU energy register #2								
Tariff #1 register	9136-9137		19712-19713	0x3E00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9138-9139		19714-19715	0x3E01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9166-9167		19742-19743	0x3E0F	R	[5]	-10^9+1	10^9-1
TOU energy register #3								
Tariff #1 register	9176-9177		19840-19841	0x3F00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9178-9179		19842-19843	0x3F01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9206-9207		19870-19871	0x3F0F	R	[5]	-10^9+1	10^9-1
TOU energy register #4								
Tariff #1 register	9216-9217		19968-19969	0x4000	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9218-9219		19970-19971	0x4001	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9246-9247		19998-19999	0x400F	R	[5]	-10^9+1	10^9-1
TOU energy register #5								
Tariff #1 register	9256-9257		20096-20097	0x4100	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9258-9259		20098-20099	0x4101	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9286-9287		20126-20127	0x410F	R	[5]	-10^9+1	10^9-1
TOU energy register #6								
Tariff #1 register	9296-9297		20224-20225	0x4200	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9298-9299		20226-20227	0x4201	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9326-9327		20254-20255	0x420F	R	[5]	-10^9+1	10^9-1
TOU energy register #7								
Tariff #1 register	9336-9337		20352-20353	0x4300	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9338-9339		20354-20355	0x4301	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9366-9367		20382-20383	0x430F	R	[5]	-10^9+1	10^9-1
TOU energy register #8								
Tariff #1 register	9376 9377		20480-20481	0x4400	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9378 9379		20482-20483	0x4401	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9406 9407		20510-20511	0x440F	R	[5]	-10^9+1	10^9-1
TOU energy register #9								
Tariff #1 register	9656-9657		21376-21377	0x4B00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9658-9659		21378-21379	0x4B01	R	[5]	-10^9+1	10^9-1
...	...		...	...				

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Tariff #16 register	9686-9687		21406-21407	0x4B0F	R	[5]	-10^9+1	10^9-1
TOU energy register #10								
Tariff #1 register	9696-9697		21504-21505	0x4C00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9698-9699		21506-21507	0x4C01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9726-9727		21534-21535	0x4C0F	R	[5]	-10^9+1	10^9-1
TOU energy register #11								
Tariff #1 register	9736-9737		21632-21633	0x4D00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9738-9739		21634-21635	0x4D01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9766-9767		21662-21663	0x4D0F	R	[5]	-10^9+1	10^9-1
TOU energy register #12								
Tariff #1 register	9776-9777		21760-21761	0x4E00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9778-9779		21762-21763	0x4E01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9806-9807		21790-21791	0x4E0F	R	[5]	-10^9+1	10^9-1
TOU energy register #13								
Tariff #1 register	9816-9817		21888-21889	0x4F00	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9818-9819		21890-21891	0x4F01	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9846-9847		21918-21919	0x4F0F	R	[5]	-10^9+1	10^9-1
TOU energy register #14								
Tariff #1 register	9856-9857		22016-22017	0x5000	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9858-9859		22018-22019	0x5001	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9886-9887		22046-22047	0x500F	R	[5]	-10^9+1	10^9-1
TOU energy register #15								
Tariff #1 register	9896-9897		22144-22145	0x5100	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9898-9899		22146-22147	0x5101	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9926-9927		22174-22175	0x510F	R	[5]	-10^9+1	10^9-1
TOU energy register #16								
Tariff #1 register	9936-9937		22272-22273	0x5200	R	[5]	-10^9+1	10^9-1
Tariff #2 register	9938-9939		22274-22275	0x5201	R	[5]	-10^9+1	10^9-1
...	...		...	...				
Tariff #16 register	9966-9967		22302-22303	0x520F	R	[5]	-10^9+1	10^9-1
TOU maximum demand register #1 (M)								
Tariff #1 register	9536	LIN3	20992-20993	0x4800	R/N	[5]	0	Pmax
Tariff #2 register	9537	LIN3	20994-20995	0x4801	R/N	[5]	0	Pmax
...	...		...	...				
Tariff #16 register	9551	LIN3	21022-21023	0x480F	R/N	[5]	0	Pmax
TOU maximum demand register #2 (M)								
Tariff #1 register	9576	LIN3	21120-21121	0x4900	R/N	[5]	0	Pmax
Tariff #2 register	9577	LIN3	21122-21123	0x4901	R/N	[5]	0	Pmax
...	...		...	...				

Parameter	UINT16		INT32	Point	R/W	Unit [2]	Range/Scale [1]	
	Reg.	Conv.	Register	ID			Low	High
Tariff #16 register	9591	LIN3	21150-21151	0x490F	R/N	[5]	0	Pmax
TOU maximum demand register #3 (M)								
Tariff #1 register	9616	LIN3	21248-21249	0x4A00	R/N	[5]	0	Pmax
Tariff #2 register	9617	LIN3	21250-21251	0x4A01	R/N	[5]	0	Pmax
...	...		...	...				
Tariff #16 register	9631	LIN3	21278-21279	0x4A0F	R/N	[5]	0	Pmax
TOU season tariff energy registers - only as a reference for TOU profile logs								
Season tariff #1 register				0x7000	R	[5]	-10^9+1	10^9-1
Season tariff #2 register				0x7001	R	[5]	-10^9+1	10^9-1
...				...				
Season tariff #16 register				0x700F	R	[5]	-10^9+1	10^9-1
TOU season tariff maximum demand registers - only as a reference for TOU profile logs								
Season tariff #1 register		LIN3		0x7100	R	0.001kVA/1kVA	0	Pmax
Season tariff #2 register		LIN3		0x7101	R	0.001kVA/1kVA	0	Pmax
...				...				
Season tariff #16 register		LIN3		0x710F	R	0.001kVA/1kVA	0	Pmax
Setpoint status (bitmap) [11]								
Setpoints status			27648-27649	0x7C00	R			
Setpoint #1 status				0x7C00	B			
Setpoint #2 status				0x7C01	B			
Setpoint #3 status				0x7C02	B			
Setpoint #4 status				0x7C03	B			
Setpoint #5 status				0x7C04	B			
Setpoint #6 status				0x7C05	B			
Setpoint #7 status				0x7C06	B			
Setpoint #8 status				0x7C07	B			
Setpoint #9 status				0x7C08	B			
Setpoint #10 status				0x7C09	B			
Setpoint #11 status				0x7C0A	B			
Setpoint #12 status				0x7C0B	B			
Setpoint #13 status				0x7C0C	B			
Setpoint #14 status				0x7C0D	B			
Setpoint #15 status				0x7C0E	B			
Setpoint #16 status				0x7C0F	B			

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

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

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

4 The actual frequency range is 45.00 - 65.00 Hz.

5 The Programmable Min/Max register, TOU energy and TOU maximum demand register unit and range match those of the input parameter for which the register is allocated.

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 Operate limit for the voltage disturbance trigger specifies the voltage deviation allowed in percentage of nominal (full scale) voltage, which refers to line-to-line voltage in 3OP2 and 3OP3 wiring modes, and to line-to-neutral voltage in other modes. The nominal voltage is 120 × PT Ratio VRMS for instruments with the 120V input option, and 380 × PT Ratio VRMS for instruments with the 690V input option.

8 The phase rotation limits: 0 = error, 1 = positive rotation, 2 = negative rotation.

9 Packed date format: year × 10000 + month × 100 + day of month.

10 Packed time format: hour × 10000 + minute × 100 + second.

11 Available starting with F/W Versions 2.27.2/2.37.2 or later.

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

5.3 Basic Setup Registers

Table 5-3 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

Parameter	Register	Type	R/W	Range
PT ratio	2305	UINT16	R/W	10 to 65000 × 0.1
CT primary current	2306	UINT16	R/W	1 to 5000 A
Power demand period	2307	UINT16	R/W	1,2,5,10,15,20,30,60 min, 255 = external synchronization
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 = disable, 1 = enable
Auxiliary CT primary current	2311	UINT16	R/W	1 to 5000 A/mA
The number of demand periods	2312	UINT16	R/W	1 to 15
Thermal demand time constant	2313	UINT16	R/W	10 to 36000 x 0.1sec
The number of pre-event cycles for the waveform recorder	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 10,000 A (0 = CT primary current)
Reserved	2317	UINT16	R	Read as 65535
DC voltage offset [2]	2318	UINT16	R/W	0 to 9999 (default 0)
DC voltage full scale [2]	2319	UINT16	R/W	0 to 9999 (default 20, 100 or 300)
The number of cycles in a waveform series for Waveform Log #1.	2320	UINT16	R/W	0 to 2560 (will be rounded to a nearest bigger number multiple of 16), 0 = auto-select [3]

[1] The wiring mode options are as follows:

3OP2 - 3-wire open delta using 2 CTs (2 element)
4LN3 - 4-wire WYE using 3 PTs (3 element), line to neutral voltage readings
3DIR2 - 3-wire direct connection using 2 CTs (2 element)
4LL3 - 4-wire WYE using 3 PTs (3 element), line to line voltage readings
3OP3 - 3-wire open delta using 3 CTs (2 1/2 element)
3LN3 - 4-wire WYE using 2 PTs (2 1/2 element), line to neutral voltage readings
3LL3 - 4-wire WYE using 2 PTs (2 1/2 element), line to line voltage readings

[2] To get true DC voltage readings, set the offset to zero and the full scale to 20, 100 or 300 V according to your order.

[3] The waveform recorder logs waveforms in series of records. A compound waveform can have as more as 2560 cycles recorded in 160 consequent records, each record comprising 16 waveform cycles. When the number of cycles is defined as zero, the instrument automatically selects the size of a waveform series. By default, a waveform series is assumed to consist of a single 16-cycle record. When a record is triggered by a voltage disturbance event and the disturbance lasts for more time than a 16-cycle record can include, the disturbance event is assumed to be a single long-duration event. In that case, the recorder will continue storing a waveform in the following adjacent records while the voltage wave shape is still non-stationary. The total number of records in a compound waveform will be limited only by the allocated memory.

5.4 User Selectable Options Setup Registers

Table 5-4 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 = disable, 1 = enable
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 option	2381	UINT16	R/W	0 = battery OFF, 1 = battery ON
Reserved	2382	UINT16	R	Read as 65535
Thermal demand option	2383	UINT16	R/W	0 = disable, 1 = enable

[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.

5.5 Communications Setup Registers

Table 5-5 Communications Setup Registers

Comm. Port	Parameter	Register	Type	R/W	Range
Port #1	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
	Incoming flow control (handshaking)	2349	UINT16	R/W	0 = no handshaking 1 = software handshaking (XON/XOFF protocol) 2 = hardware handshaking (CTS protocol)
	Outgoing flow control (RTS/DTR)	2350	UINT16	R/W	0 = RTS signal not used 1 = RTS permanently asserted (DTR mode) 2 = RTS asserted during the transmission
Port #2	Protocol	2352	UINT16	R/W	0 = ASCII 1 = Modbus RTU 3 = DNP3.0
	Interface	2353	UINT16	R/W	1 = RS-422 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.

5.6 Reset/Clear Registers

Table 5-6 Reset/Clear Registers

Function	Register	Type	R/W	Reset value

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 1-16 = counter #1 - #16
Clear Min/Max log	3409	UINT16	W	0
Clear event log	3410	UINT16	W	0
Clear data log	3411	UINT16	W	0-7 = 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 queue pointer	3415	UINT16	W	0
Restore data log queue pointer	3416	UINT16	W	0-15 = data logs #1 - #16 16-31 = monthly profile logs for TOU energy registers #1 - #16 32-34 = monthly profile logs for TOU maximum demand registers #1 - #3 48-63 = daily profile logs for TOU energy registers #1 - #16 64-66 = daily profile logs for TOU maximum demand registers #1 - #3
Restore waveform log #1	3417	UINT16	W	0
Restore waveform log #2	3418	UINT16	W	0

5.7 Instrument Status Registers

Table 5-7 Instrument Status Registers

Parameter	Register	Type	R/W	Unit	Range
Instrument reset register [1]	2560	UINT16	R/W		0 (when read) 65535 (when written) = reset the instrument
Reserved	2561	UINT16	R		Read as 0
Relay status	2562	UINT16	R		see Table 5-8
Firmware build number [2]	2563	UINT16	R		0-99
Status inputs	2564	UINT16	R		see Table 5-11
Firmware version number	2565	UINT16	R		0-65535
Instrument options 1	2566	UINT16	R		see Table 5-9
Instrument options 2	2567	UINT16	R		see Table 5-9

1 Writing a value of 65535 into register 2560 will cause the instrument to perform a warm restart.

2 Available starting with F/W Versions 2.26.2/2.36.2 and 2.27.2/2.37.2 or later.

Table 5-8 Relay Status

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

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

Table 5-9 Instrument Options

Options register	Bit	Description
Options1	0	120V option
	1	690V option

Options register	Bit	Description
	2-3	N/A
	4	100% current over-range
	5	N/A
	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	Auxiliary current option
	12	Setup is secured by a password (see Section 4.5)
	13	ASCII compatibility mode enabled
	14	Analog expander output ±1 mA
	15	N/A
Options 2	0-2	Number of relays - 1
	3-6	Number of digital inputs - 1
	7-8	Number of analog outputs - 1
	9-10	N/A
	11-12	DC voltage input option: 01 = 20V, 10=100V, 11 = 300V
	13	N/A
	14-15	Memory module size: 11 = 1024 Kbytes

5.8 Extended Status Registers

Table 5-10 Extended Status Registers

Parameter	Register	Type	R/W	Value range
Relay status	3452	UINT16	R	see Table 5-11
User event flags	3453	UINT16	R	see Table 5-12
Status inputs	3454	UINT16	R	see Table 5-13
Setpoints status	3455	UINT16	R	see Table 5-14
Log status	3456	UINT16	R	see Table 5-15
Data log status	3457	UINT16	R	see Table 5-16
Reserved	3458-3473	UINT16	R	Read as 0
Setpoint alarm status	3474	UINT16	R/W	see Table 5-17
Self-check alarm status	3475	UINT16	R/W	see Table 5-18
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

Table 5-11 Relay Status

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

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

Table 5-12 User 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 = OFF, 1 = ON

Table 5-13 Status Inputs

Bit	Description
0	Status input #1
1	Status input #2
2	Status input #3
3	Status input #4
4	Status input #5
5	Status input #6
6	Status input #7
7	Status input #8
8	Status input #9
9	Status input #10
10	Status input #11
11	Status input #12
12-15	Not used (permanently set to 0)

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

Table 5-14 Setpoints Status

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

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

Table 5-15 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 5-16 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
8	New data log #9
9	New data log #10
10	New data log #11
11	New data log #12
12	New data log #13
13	New data log #14
14	New data log #15
15	New data log #16

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 5-17 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 5-18 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 Versions 2.26.2/2.36.2 and 2.27.2/2.37.2 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.

5.9 Memory Allocation Status Registers

Table 5-19 Memory Allocation Status Registers

Parameter	Register	Type	R/W	Range
Memory partitions map	3500-3501	UINT32	R	See Table 5-20
Monthly profile log partition map	3502-3503	UINT32	R	See Table 5-20
Daily profile log partition map	3504-3505	UINT32	R	See Table 5-20
Total memory size, Byte	3506-3507	UINT32	R	1048576
Free memory size, Byte	3508-3509	UINT32	R	0 - 1048576
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
The total number of data log #9 records	3519	UINT16	R	0 - 65535
The total number of data log #10 records	3520	UINT16	R	0 - 65535
The total number of data log #11 records	3521	UINT16	R	0 - 65535
The total number of data log #12 records	3522	UINT16	R	0 - 65535
The total number of data log #13 records	3523	UINT16	R	0 - 65535
The total number of data log #14 records	3524	UINT16	R	0 - 65535
The total number of data log #15 records	3525	UINT16	R	0 - 65535
The total number of data log #16 records	3526	UINT16	R	0 - 65535
The number of logged records in the waveform log #1	3527	UINT16	R	0 - 65535
The number of logged records in the waveform log #2	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
The number of new data log #9 records	3538	UINT16	R	0 - 65535
The number of new data log #10 records	3539	UINT16	R	0 - 65535
The number of new data log #11 records	3540	UINT16	R	0 - 65535
The number of new data log #12 records	3541	UINT16	R	0 - 65535
The number of new data log #13 records	3542	UINT16	R	0 - 65535
The number of new data log #14 records	3543	UINT16	R	0 - 65535
The number of new data log #15 records	3544	UINT16	R	0 - 65535
The number of new data log #16 records	3545	UINT16	R	0 - 65535
The number of new records in the waveform log #1	3546	UINT16	R	0 - 65535
The number of new records in the waveform log #2	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 5-20 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
Data log #9	9
Data log #10	10
Data log #11	11
Data log #12	12
Data log #13	13
Data log #14	14

Memory Partition/Sub-partition	Bit
Data log #15	15
Data log #16	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
TOU Monthly Profile Log. Energy Reg. #9	8
TOU Monthly Profile Log. Energy Reg. #10	9
TOU Monthly Profile Log. Energy Reg. #11	10
TOU Monthly Profile Log. Energy Reg. #12	11
TOU Monthly Profile Log. Energy Reg. #13	12
TOU Monthly Profile Log. Energy Reg. #14	13
TOU Monthly Profile Log. Energy Reg. #15	14
TOU Monthly Profile Log. Energy Reg. #16	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
TOU Daily Profile Log. Energy Reg. #6	5
TOU Daily Profile Log. Energy Reg. #7	6
TOU Daily Profile Log. Energy Reg. #8	7
TOU Daily Profile Log. Energy Reg. #9	8
TOU Daily Profile Log. Energy Reg. #10	9
TOU Daily Profile Log. Energy Reg. #11	10
TOU Daily Profile Log. Energy Reg. #12	11
TOU Daily Profile Log. Energy Reg. #13	12
TOU Daily Profile Log. Energy Reg. #14	13
TOU Daily Profile Log. Energy Reg. #15	14
TOU Daily Profile Log. Energy Reg. #16	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 = a partition is not allocated, 1 = a partition is allocated

5.10 Memory Partition Status/Control Registers

Table 5-21 Partitions' Status/Control Register Locations

Memory Partition	Registers
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
Data log #9	28232-28239
Data log #10	28240-28247
Data log #11	28248-28255
Data log #12	28256-28263
Data log #13	28264-28271
Data log #14	28272-28279
Data log #15	28280-28287

Memory Partition	Registers
Data log #16	28288-28295
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
TOU Monthly Profile Log. Energy Reg. #9	28480-28487
TOU Monthly Profile Log. Energy Reg. #10	28488-28495
TOU Monthly Profile Log. Energy Reg. #11	28496-28503
TOU Monthly Profile Log. Energy Reg. #12	28504-28511
TOU Monthly Profile Log. Energy Reg. #13	28512-28519
TOU Monthly Profile Log. Energy Reg. #14	28520-28527
TOU Monthly Profile Log. Energy Reg. #15	28528-28535
TOU Monthly Profile Log. Energy Reg. #16	28536-28543
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
TOU Daily Profile Log. Energy Reg. #9	28736-28743
TOU Daily Profile Log. Energy Reg. #10	28744-28751
TOU Daily Profile Log. Energy Reg. #11	28752-28759
TOU Daily Profile Log. Energy Reg. #12	28760-28767
TOU Daily Profile Log. Energy Reg. #13	28768-28775
TOU Daily Profile Log. Energy Reg. #14	28776-28783
TOU Daily Profile Log. Energy Reg. #15	28784-28791
TOU Daily Profile Log. Energy Reg. #16	28792-28799
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 #15 is configured as a TOU monthly profile partition, registers 28280-28287 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 28288-28295 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 5-22 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.

Parameter	Offset	Type	R/W	Range
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).

5.11 Analog Output Setup Registers

Table 5-23 Analog Output Allocation Registers

Channel	Registers (see Table 5-24)
Channel #1	3148-3150
Channel #2	3151-3153

Table 5-24 Analog Channel Allocation Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	See Table 5-27
Zero scale (0-4 mA)	+1	UINT16	R/W	See Table 5-27
Full scale (1/20 mA)	+2	UINT16	R/W	See Table 5-27

1. Except for the signed power factor (see Note 3 to Table 5-27), 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 5-25 Analog Expander Channel Registers

Channel	Registers (see Table 5-26)
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 5-26 Analog Channel Allocation Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	See Table 5-27
Zero scale (0-4 mA)	+1	UINT16	R/W	See Table 5-27
Full scale (20 mA)	+2	UINT16	R/W	See Table 5-27

Except for the signed power factor (see Note 3 to Table 5-27), 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 5-27 Analog Output Parameters

Output parameter	Point ID	Type	Unit [2]	Scale [1]		Con-version
				Low	High	
None						
None	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
Voltage THD L1/L12	0x0C12	UINT16	0.1%	0	999.9	LIN3
Voltage THD L2/L23	0x0C13	UINT16	0.1%	0	999.9	LIN3
Voltage THD L3	0x0C14	UINT16	0.1%	0	999.9	LIN3
Current THD L1	0x0C15	UINT16	0.1%	0	999.9	LIN3
Current THD L2	0x0C16	UINT16	0.1%	0	999.9	LIN3
Current THD L3	0x0C17	UINT16	0.1%	0	999.9	LIN3
K-Factor L1	0x0C18	UINT16	0.1	1.0	999.9	LIN3
K-Factor L2	0x0C19	UINT16	0.1	1.0	999.9	LIN3
K-Factor L3	0x0C1A	UINT16	0.1	1.0	999.9	LIN3
Current TDD L1	0x0C1B	UINT16	0.1%	0	100.0	LIN3
Current TDD L2	0x0C1C	UINT16	0.1%	0	100.0	LIN3
Current TDD L3	0x0C1D	UINT16	0.1%	0	100.0	LIN3
Voltage L12	0x0C1E	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L23	0x0C1F	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L31	0x0C20	UINT16	0.1V/1V	0	Vmax	LIN3
Real-time total values						
Total kW	0x0F00	UINT16	0.001kW/1kW	-Pmax	Pmax	LIN3

Output parameter	Point ID	Type	Unit [2]	Scale [1]		Con-version
				Low	High	
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						
Auxiliary current	0x1000	UINT16	0.01A/mA	0	Imax aux	LIN3
Neutral current	0x1001	UINT16	0.01A	0	Imax	LIN3
Frequency [3]	0x1002	UINT16	0.01Hz	0	100.00	LIN3
DC voltage	0x1005	UINT16	0.01V	0	9999.00	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
Voltage L12	0x111E	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L23	0x111F	UINT16	0.1V/1V	0	Vmax	LIN3
Voltage L31	0x1120	UINT16	0.1V/1V	0	Vmax	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
3-phase average voltage [5]	0x140A	UINT16	0.1V/1V	0	Vmax	LIN3
3-phase average L-L voltage	0x140B	UINT16	0.1V/1V	0	Vmax	LIN3
3-phase average current	0x140C	UINT16	0.01A	0	Imax	LIN3
Average auxiliary values						
Auxiliary current	0x1500	UINT16	0.01A/mA	0	Imax aux	LIN3
Neutral current	0x1501	UINT16	0.01A	0	Imax	LIN3
Frequency [3]	0x1502	UINT16	0.01Hz	0	100.00	LIN3
Present demands						
Accumulated kW import demand	0x160F	UINT16	0.001kW/1kW	0	Pmax	LIN3
Accumulated kvar import demand	0x1610	UINT16	0.001kvar/1kvar	0	Pmax	LIN3
Accumulated kVA demand	0x1611	UINT16	0.001kVA/1kVA	0	Pmax	LIN3
Accumulated kW export demand	0x161A	UINT16	0.001kW/1kW	0	Pmax	LIN3
Accumulated kvar export 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 5-28 Digital Inputs Allocation Registers

Parameter	Register	Type	R/W	Range
Status inputs allocation mask	3292	UINT16	R [1]	See Table 5-29
Pulse inputs allocation mask	3293	UINT16	R/W	See Table 5-29
Not used	3294	UINT16	R [1]	Read as 0

External demand synchronization input mask	3295	UINT16	R/W	See Table 5-29
Time synchronization input mask	3296	UINT16	R/W	See Table 5-29

[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 5-29 Digital Inputs Allocation Mask

Bit number	Description
0	Digital input # 1 allocation status
1	Digital input # 2 allocation status
2	Digital input # 3 allocation status
3	Digital input # 4 allocation status
4	Digital input # 5 allocation status
5	Digital input # 6 allocation status
6	Digital input # 7 allocation status
7	Digital input # 8 allocation status
8	Digital input # 9 allocation status
9	Digital input # 10 allocation status
10	Digital input # 11 allocation status
11	Digital input # 12 allocation status
12-15	Not used

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

5.14 Timers Setup Registers

Table 5-30 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
Timer #3 time interval	3302	UINT16	R/W	1-9999 sec, 0 = timer disabled
Timer #4 time interval	3303	UINT16	R/W	1-9999 sec, 0 = timer disabled

5.15 Alarm/Event Setpoints Registers

Table 5-31 Setpoint Registers

Setpoint	Setup registers (see Table 5-32)
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 5-32 Setpoint Setup Registers

Parameter		Offset	Type	Range
Condition #1	Logical operator	+0	UINT16	0 = OR
	Trigger ID	+1	UINT16	See Table 5-2
	Relational operator	+2	UINT16	See Table 5-33
	Reserved	+3	UINT16	0 (N/A)

Parameter		Offset	Type	Range
	Operate limit	+4, +5	UINT32	See Table 5-2
	Release limit	+6, +7	UINT32	See Table 5-2
Condition #2	Logical operator	+8	UINT16	0 = OR, 1 = AND
	Trigger ID	+9	UINT16	See Table 5-2
	Relational operator	+10	UINT16	See Table 5-33
	Reserved	+11	UINT16	0 (N/A)
	Operate limit	+12, +13	UINT32	See Table 5-2
	Release limit	+14, +15	UINT32	See Table 5-2
Condition #3	Logical operator	+16	UINT16	0 = OR, 1 = AND
	Trigger ID	+17	UINT16	See Table 5-2
	Relational operator	+18	UINT16	See Table 5-33
	Reserved	+19	UINT16	0 (N/A)
	Operate limit	+20, +21	UINT32	See Table 5-2
	Release limit	+22, +23	UINT32	See Table 5-2
Condition #4	Logical operator	+24	UINT16	0 = OR, 1 = AND
	Trigger ID	+25	UINT16	See Table 5-2
	Relational operator	+26	UINT16	See Table 5-33
	Reserved	+27	UINT16	0 (N/A)
	Operate limit	+28, +29	UINT32	See Table 5-2
	Release limit	+30, +31	UINT32	See Table 5-2
Action #1	Action type	+32	UINT16	see Table 5-34
	Action target	+33	UINT16	see Table 5-34
Action #2	Action type	+34	UINT16	see Table 5-34
	Action target	+35	UINT16	see Table 5-34
Action #3	Action type	+36	UINT16	see Table 5-34
	Action target	+37	UINT16	see Table 5-34
Action #4	Action type	+38	UINT16	see Table 5-34
	Action target	+39	UINT16	see Table 5-34
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 parameter 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 to disable the setpoint before writing into separate registers. Each written value is checked for compatibility with the other setpoint parameters; if the new value does not conform to these, the request will be rejected.
3. Operate and release limits for trigger parameters, their ranges and measurement units are indicated in Table 5-2. Two contiguous registers are allocated in the setup for each setpoint limit. All limits, except for counters and packed date and time, are read/written as 16-bit integer values through the first (low order) register. The second (high order) register is always read as zero. When written, its value is ignored. Whenever it is indicated for the trigger, a LIN3 conversion is used to accommodate large-scale and fractional numbers to a 16-bit register format. Counters and packed date and time are read/written as 32-bit unsigned long integers in two registers.
4. Limits for binary triggers (B) and new value triggers (N) are read as zeros. When writing, they can be omitted or should be written as zeros. Release limits for special inputs (voltage disturbance and phase rotation) and for date/time parameters are not used. Write them as zeros.
5. When a setpoint action is directed to a relay allocated to output energy pulses, an attempt to re-allocate it for a setpoint will result in a negative response.

Table 5-33 Relational Operators

Relational operator	Operate condition	Release condition	Setpoint limits	Used with triggers of type
0 = NONE	N/A	N/A	Not used	A, B, N
1 = GREATER OR EQUAL	Over operate limit	Under release limit	Both limits active	A
2 = LESS OR EQUAL	Under operate limit	Over release limit	Both limits active	A
3 = EQUAL	Equal	Not equal	Release limit not used	A
4 = NOT EQUAL	Not equal	Equal	Release limit not used	A
5 = ON	Binary status ON	Binary status OFF	Not used	B
6 = OFF	Binary status OFF	Binary status ON	Not used	B
7 = NEW	New Min/Max value	N/A	Not used	N

A = analog (numeric) trigger, B = binary (digital) trigger, N = new value trigger.

Table 5-34 Setpoint Actions

Action type		Action target	
Description	**ID**	**Description**	**ID**
No action	0x00	N/A	0
Set user event flag	0x20	Flag number	0-7 = flags #1-#8
Reset user event flag	0x21	Flag number	0-7 = flags #1-#8
Operate relay	0x30	Relay number	0-5 = relays #1-#6
Increment counter	0x40	Counter number	0-15 = counter #1-#16
Decrement counter	0x41	Counter number	0-15 = counter #1-#16
Clear counter	0x42	Counter number	0-15 = counter #1-#16
Reset total energy registers	0x60	N/A	0
Reset total maximum demand registers	0x61	N/A	0 = reset all maximum demands 1 = reset power maximum demands 2 = reset volt/ampere maximum demands
Reset TOU energy	0x62	N/A	0
Reset TOU demands	0x63	N/A	0
Clear all counters	0x64	N/A	0
Clear Min/Max registers	0x65	N/A	0
Event logging	0x70	Setpoint transition mode	0 = log on operate setpoint 1 = log on release setpoint 2 = log on either transition (both operate and release)
Data logging	0x71	Data log number	0-15 = data log #1-#16
Waveform log #1	0x72	N/A	0
Waveform log #2	0x73	N/A	0

5.16 Pulsing Setpoints Registers

Table 5-35 Pulsing Registers

Relay	Setup registers (see Table 5-36)
Relay #1	2892-2893
Relay #2	2894-2895
Relay #3	2896-2895
Relay #4	2898-2899
Relay #5	2900-2901
Relay #6	2902-2903

Table 5-36 Pulsing Setup Registers

Parameter	Offset	Type	R/W	Range
Output parameter ID	+0	UINT16	R/W	see Table 5-37
Number of unit-hours per pulse	+1	UINT16	R/W	1-9999

Table 5-37 Pulsing Output Parameters

Pulsing parameter ID	Identifier
None	0
kWh import	1
kWh export	2
kWh total (absolute)	3
kvarh import	4
kvarh export	5
kvarh total (absolute)	6
kVAh total	7
Start power demand interval	8
Start tariff interval	9

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 5-38 Relay Operation Control Registers

Parameter	Register	Type	R/W	Range
Relay #1 control status	3244	UINT16	R/W	see Table 5-39
Relay #2 control status	3245	UINT16	R/W	see Table 5-39
Relay #2 control status	3246	UINT16	R/W	see Table 5-39
Relay #2 control status	3247	UINT16	R/W	see Table 5-39
Relay #2 control status	3248	UINT16	R/W	see Table 5-39
Relay #2 control status	3249	UINT16	R/W	see Table 5-39

Table 5-39 Relay Operation Status

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

5.18 Pulse Counters Setup Registers

Table 5-40 Pulse Counters Registers

Counter	Setup registers (see Table 5-41)
Counter #1	2940-2941
Counter #2	2942-2943
Counter #3	2944-2945
Counter #4	2946-2947
Counter #5	2948-2949
Counter #6	2950-2951
Counter #7	2952-2953
Counter #8	2954-2955
Counter #9	2956-2957
Counter #10	2958-2959
Counter #11	2960-2961
Counter #12	2962-2963
Counter #13	2964-2965
Counter #14	2966-2967
Counter #15	2968-2969
Counter #16	2970-2977

Table 5-41 Pulse Counter Setup Registers

Parameter	Offset	Type	R/W	Range
Associated digital input ID	+0	UINT16	R/W	Se Table 5-42
Scale factor (number of units per input pulse)	+1	UINT16	R/W	1-9999

Table 5-42 Digital Inputs Identifiers

Input ID	Description
0	Not allocated
1	Digital input # 1
2	Digital input # 2
3	Digital input # 3
4	Digital input # 4
5	Digital input # 5
6	Digital input # 6
7	Digital input # 7
8	Digital input # 8
9	Digital input # 9
10	Digital input # 10
11	Digital input # 11
12	Digital input # 12

5.19 User Event Flags Registers

Table 5-43 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 5-10).

5.20 Programmable Min/Max Log Setup Registers

Table 5-44 Programmable MIn/Max Log Setup Registers

Parameter	Register	Type	R/W	Range
Data ID for Min/Max log register #1	2972	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #2	2973	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #3	2974	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #4	2975	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #5	2976	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #6	2977	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #7	2978	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #8	2979	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #9	2980	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #10	2981	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #11	2982	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #12	2983	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #13	2984	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #14	2985	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #15	2986	UINT16	R/W	See Table 5-2
Data ID for Min/Max log register #16	2987	UINT16	R/W	See Table 5-2

These registers allow you to associate any of the 16 programmable Min/Max log registers with either harmonic parameter listed in Table 5-2.

5.21 Log Memory Partitions Setup Registers

Table 5-45 Memory Partitions Setup Registers

Partition Number	Memory partition	Setup registers (see Table 5-46)
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
9	Data log #9	3732-3737
10	Data log #10	3740-3745
11	Data log #11	3748-3753
12	Data log #12	3756-3761
13	Data log #13	3764-3769
14	Data log #14	3772-3777
15	Data log #15 (can be configured as a TOU monthly profile log partition)	3780-3785
16	Data log #16 (can be configured as a TOU daily profile log partition)	3788-3793
17	Waveform log #1	3796-3801
18	Waveform log #2	3804-3809

Table 5-46 Partition Setup Registers

Parameter	Offset	Type	R/W	Range
The number of records in the partition	+0	UINT16	R/W	0-65535, 0 = delete partition
The number of log parameters in the record for a data log partition (for an event log partition, write 0)	+1	UINT16	R/W	0-16
Partition type	+2	UINT16	R/W	0 = non-wrap 1 = wrap around 16 = TOU monthly profile log (partition #15 only) 32 = TOU daily profile log (partition #16 only)
Record size, byte	+3	UINT16	R	
Partition size, byte	+4 +5	UINT32	R	0-1048576

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 5-47 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 #15 and #16 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, you should set up your TOU registers, daily profiles and calendars. The memory for a profile log will be 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 5.26). 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 5-47 Partitions' Record Size

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

5.22 Data Log Setup Registers

Table 5-48 Data Log Setup Registers

Partition	Registers (see Table 5-49)
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
Data log #9	1920-1935
Data log #10	1936-1951
Data log #11	1952-1967
Data log #12	1968-1983
Data log #13	1984-1999
Data log #14	2000-2015

Data log #15	2016-2031
Data log #16	2032-2047

Table 5-49 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 5.21). 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.

5.23 Event Log Registers (Sequential Access)

These registers allow you to read the packet of consequent records from the event log partition. From 1 to 10 event log records can be read at a time via the event log windows, which comprise registers 3916 through 4035. Reading from either event log window always returns the next logged event. All registers within one window must be read at once using a single request. After reading each record, the partition queue pointer is shifted forward until the last logged record has been read. After that, the exception code 98 is returned in the window register at offset +0. It should be checked before accepting the record. To restore the queue to the origin, a zero must be written to the event log queue reset register (see Section 5.6).

Table 5-50 Event Log Windows Registers

Event log window	Registers (see Table 5-51)
Event log window #1	3916-3927
Event log window #2	3928-3939
Event log window #3	3940-3951
Event log window #4	3952-3963
Event log window #5	3964-3975
Event log window #6	3976-3987
Event log window #7	3988-3999
Event log window #8	4000-4011
Event log window #9	4012-4023
Event log window #10	4024-4035

Table 5-51 Event Log Window Registers

Parameter	Offset	Type	R/W	Range
Second	+0	UINT16	R	0-59, 97 = record corrupted 98 = no more events 99 = no events logged
Minute	+1	UINT16	R	0-59
Hour	+2	UINT16	R	0-23
Day	+3	UINT16	R	1-31
Month	+4	UINT16	R	1-12
Year	+5	UINT16	R	0-99
Event cause	+6	UINT16	R	see Table 5-52

Event origin	+7	UINT16	R	see Table 5-52
Log value (16-bit register/32-bit counter) [1]	+8, +9	UINT32	R	see Table 5-52
Event effect	+10	UINT16	R	see Table 5-52
Event target	+11	UINT16	R	see Table 5-52

[1] The log value can be read in one or two registers depending on the value type. For the value length and conversion scales, refer to Table 5-2.

Table 5-52 Event Log Parameters

Event cause	Event cause code	Event origin (location)	Log value	Event effect	Event target
Setpoint event	Trigger parameter ID high byte (see Table 5-2)	Trigger parameter ID low byte (see Table 5-2)	Trigger parameter value (see Table 5-2)	225 = setpoint operated 226 = setpoint released	Setpoint number = 0-15
Setpoint activity	90	Setpoint number = 0-15	0	Setpoint action type (see Table 5-34	See Table 5-34
Comm. activity	91	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Front panel activity	92	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Self-check	93	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Self-update	94	8 = RTC	0	245 = RTC set	0
Hardware failure	98	Diagnostic code (see Table 5-57)	0	0	0
External event	99	0 = power down 8 = power up	0	0	0

5.24 Event Log Registers (Circular Access)

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 5.10).

Table 5-53 Event Log Windows Locations

Event log window	Registers (see Table 5-54)
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 5-54 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]	+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 (milliseconds)	+4	UINT16	R	0-990 (at 10 ms resolution)
Event cause	+5	UINT16	R	see Table 5-54
Log value (32-bit register) [2]	+6, +7	INT32	R	see Table 5-54
Event effect	+8	UINT16	R	see Table 5-54
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 5-2.

NOTES:

1. If a requested record is corrupted (the redundant check fails), the record is reported with all zeros (except the sequence number) and 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 5-55 Event Log Parameters

Event cause	Event cause code		Log value	Event effect	
	High byte: cause code	Low byte: event origin (location)		High byte: effect code	Low byte: target code
Setpoint event	Trigger parameter ID high byte (see Table 5-2)	Trigger parameter ID low byte (see Table 5-2)	Trigger parameter value (see Table 5-2)	225 = setpoint operated 226 = setpoint released	Setpoint number = 0-15
Setpoint activity	90	Setpoint number = 0-15	0	Setpoint action type (see Table 5-34	See Table 5-34
Comm. activity	91	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Front panel activity	92	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Self-check	93	Data location code (see Table 5-56)	0	See Table 5-58	See Table 5-58
Self-update	94	8 = RTC	0	245 = RTC set	0
Hardware failure	98	Diagnostic code (see Table 5-57)	0	0	0
External event	99	0 = power down 8 = power up	0	0	0

Table 5-56 Data Location Codes

Location code	Description
0-2	Reserved
3	Data keeping memory
4	Factory setup
5	Access setup
6	Basic setup
7	Communications setup
8	Real-time clock

Location code	Description
9	Discrete inputs allocation
10	Pulse counters allocation
11	Multiplexed analog outputs setup
12	External analog outputs setup
13	Reserved
14	Timers setup
15	Display options
16	Event/alarm setpoints
17	Pulsing setpoints
18	User assignable register map
19	Programmable Min/Max log setup
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
29	Reserved
30	Reserved
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 5-57 Diagnostic Codes

Diagnostic code	Description
0	Power down
1	ROM error
2	RAM error
3	Watch dog timer reset
4	Sampling failure
5	Out of control trap
6	Reserved
7	Timing failure
8	Power up

Table 5-58 Event Effect Codes

Effect code	Description	Target
96	Clear energy registers	0
97	Clear demand registers	0 = all demands 1 = power demands 2 = volt/ampere demands
98	Clear TOU energy registers	0
99	Clear TOU demand registers	0
100	Clear counters	0 = clear all counters 1-16 = counter #1-#16
101	Clear Min/Max log registers	0
102	Clear event log	0
103	Clear data log	0-15 = log #1-#16 16 = clear all data logs
104	Clear waveform log #1	0
105	Clear waveform log #2	0
225	Setpoint operated	0-15 = setpoint #1-#16
226	Setpoint released	0-15 = setpoint #1-#16
241	Setpoint disabled	0-15 = setpoint #1-#16
242	Setup cleared	0
243	Setup set by default	0
244	Setup changed	0
245	RTC set	0

5.25 Data Log Registers (Sequential Access)

Data log records are read via a data log window, one for each data log partition. Reading from this window always returns the next record logged in the partition. All registers within one window must be read at once using a single request. After reading each record, the partition queue pointer is shifted forward until the last logged record has been read. After that, the exception code 98 is returned in the record's first register. It should be checked before accepting the record. To restore the queue to the origin, a zero must be written to the partition queue reset register (see Section 5.6).

NOTE. The PM296/RPM096 offers you another mechanism to access data logs, allowing you to read records in a circular manner without a need to manipulate the file pointer. In this event, the file pointer is automatically restored to the file origin after the last file record has been read (see Section 5.26).

Table 5-59 Data Logs Window Registers

Data log window	Registers (see Table 5-60)
Data log #1 window	1120-1161
Data log #2 window	1162-1203
Data log #3 window	1204-1245
Data log #4 window	1246-1287
Data log #5 window	1288-1329
Data log #6 window	1330-1371
Data log #7 window	1372-1413
Data log #8 window	1414-1455
Data log #9 window	1456-1497
Data log #10 window	1498-1539
Data log #11 window	1540-1581
Data log #12 window	1582-1623
Data log #13 window	1624-1665
Data log #14 window	1666-1707
Data log #15 window	1708-1749
Data log #16 window	1750-1791

Table 5-60 Data Log Window Registers

Parameter	Offset	Type	R/W	Range
Trigger setpoint number	+0	UINT16	R	1-16, 97 = record corrupted 98 = no more records 99 = no records logged
Hundredths of second	+1	UINT16	R	0-99
Second	+2	UINT16	R	0-59
Minute	+3	UINT16	R	0-59
Hour	+4	UINT16	R	0-23
Day	+5	UINT16	R	1-31
Month	+6	UINT16	R	1-12
Year	+7	UINT16	R	0-99
Reserved	+8	UINT16	R	0
The number of parameters in the record	+10	UINT16	R	1-16
Log parameter #1 value [1]	+11 +12	UINT32	R	see Table 5-2
Log parameter #2 value [1]	+13 +14	UINT32	R	see Table 5-2
...				
Log parameter #16 value [1]	+40 +41	UINT32	R	see Table 5-2

[1] The log parameter value is read as a 16-bit register or a 32-bit counter. For the value range and conversion scales, refer to Table 5-2.

When reading the data log window registers, those that reside outside of the specified partition record size will be read as zeros. The actual number of parameters in the record is indicated in the log window register at offset +10.

5.26 Data Log Registers (Circular Access)

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 5.9).

Table 5-61 Data Log Window Locations

Data log number	Registers (see Table 5-62)
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
Data log #9	30016-30055
Data log #10	30056-30095
Data log #11	30096-30135
Data log #12	30136-30175
Data log #13	30176-30215
Data log #14	30216-30255
Data log #15	30256-30295
Data log #16	30296-30335
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
TOU Monthly Profile Log. Energy Reg. #9	30656-30695
TOU Monthly Profile Log. Energy Reg. #10	30696-30735
TOU Monthly Profile Log. Energy Reg. #11	30736-30775
TOU Monthly Profile Log. Energy Reg. #12	30776-30815
TOU Monthly Profile Log. Energy Reg. #13	30816-30855
TOU Monthly Profile Log. Energy Reg. #14	30856-30895
TOU Monthly Profile Log. Energy Reg. #15	30896-30935
TOU Monthly Profile Log. Energy Reg. #16	30936-30975
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
TOU Daily Profile Log. Energy Reg. #9	31936-31975
TOU Daily Profile Log. Energy Reg. #10	31976-32015
TOU Daily Profile Log. Energy Reg. #11	32016-32055
TOU Daily Profile Log. Energy Reg. #12	32056-32095
TOU Daily Profile Log. Energy Reg. #13	32096-32135
TOU Daily Profile Log. Energy Reg. #14	32136-32175
TOU Daily Profile Log. Energy Reg. #15	32176-32215
TOU Daily Profile Log. Energy Reg. #16	32216-32255
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 #15 is configured as a TOU monthly profile partition, registers 30256-30295 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 #16 is configured as a TOU daily profile partition, registers 30296-30335 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 5-62 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]	+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 (milliseconds)	+4	UINT16	R	0-990 (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, +9	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.

5.27 Min/Max Log Registers (16-bit registers)

These registers allow you to read time-stamped Min/Max logs in 16-bit Modbus registers using LIN3 conversion. From 1 to 12 adjacent records can be read at a time via the Min/Max log windows. The starting window #1 can be mapped to any Min/Max log parameter listed in Table 5-2 by writing the parameter ID to the Min/Max log mapping register. This register must be written before reading the Min/Max log windows. Note that through Min/Max log windows, you can read only adjacent parameters within the same Min/Max log data group. Reading parameters outside of the selected Min/Max log data group will return zero.

Table 5-63 Min/Max Log Windows Registers

Min/Max log window	Registers (see Table 5-64)
Min/Max log window #1	4174-4181
Min/Max log window #2	4182-4189
Min/Max log window #3	4190-4197
Min/Max log window #4	4198-4205
Min/Max log window #5	4206-4213
Min/Max log window #6	4214-4221
Min/Max log window #7	4222-4229
Min/Max log window #8	4230-4237
Min/Max log window #9	4238-4245
Min/Max log window #10	4246-4253
Min/Max log window #11	4254-4261
Min/Max log window #12	4262-4269

Table 5-64 Min/Max Log Window Registers

Parameter	Offset	Type	R/W	Range
Second	+0	UINT16	R	0-59
Minute	+1	UINT16	R	0-59
Hour	+2	UINT16	R	0-23
Day	+3	UINT16	R	1-31
Month	+4	UINT16	R	1-12
Year	+5	UINT16	R	0-99
Parameter value [2]	+6	UINT16	R	see Table 5-2
Reserved	+7	UINT16	R	0

[1] The Min/Max parameter value is read in a 16-bit register. For the value range and conversion scales, refer to Table 5-2.

Table 5-65 Min/Max Log Mapping Register

Parameter	Register	Type	R/W	Range
Min/Max log start parameter ID for window #1	4172	UINT16	R/W	see Table 5-2

5.28 Min/Max Log Registers (32-bit registers)

These registers allow you to read time-stamped Min/Max logs in 32-bit Modbus registers without mapping.

Table 5-66 Min/Max Log Registers

Parameter	Registers	Type	Unit	Range
Minimum real-time values per phase				
Min. Voltage L1/L12 [6] Timestamp	35840-35841 35842-35843	INT32 UINT32	0.1V/1V	0 to Vmax
Min. Voltage L2/L23 [6] Timestamp	35844-35845 35846-35847	INT32 UINT32	0.1V/1V	0 to Vmax
Min. Voltage L3/L31 [6] Timestamp	35848-35849 35850-35851	INT32 UINT32	0.1V/1V	0 to Vmax
Min. Current L1 Timestamp	35852-35853 35854-35855	INT32 UINT32	0.01A	0 to Imax
Min. Current L2 Timestamp	35856-35857 35858-35859	INT32 UINT32	0.01A	0 to Imax
Min. Current L3 Timestamp	35860-35861 35862-35863	INT32 UINT32	0.01A	0 to Imax
Min. kW L1 Timestamp	35864-35865 35866-35867	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Min. kW L2 Timestamp	35868-35869 35870-35871	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Min. kW L3 Timestamp	35872-35873 35874-35875	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Min. kvar L1 Timestamp	35876-35877 35878-35879	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Min. kvar L2 Timestamp	35880-35881 35882-35883	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Min. kvar L3	35884-35885	INT32	0.001kvar/1kvar	-Pmax to Pmax

Parameter	Registers	Type	Unit	Range
Timestamp	35886-35887	UINT32		
Min. kVA L1 Timestamp	35888-35889 35890-35891	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Min. kVA L2 Timestamp	35892-35893 35894-35895	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Min. kVA L3 Timestamp	35896-35897 35898-35899	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Min. Power factor L1 [3] Timestamp	35900-35901 35902-35903	INT32 UINT32	0.001	0 to 1000
Min. Power factor L2 [3] Timestamp	35904-35905 35906-35907	INT32 UINT32	0.001	0 to 1000
Min. Power factor L3 [3] Timestamp	35908-35909 35910-35911	INT32 UINT32	0.001	0 to 1000
Min. Voltage THD L1/L12 Timestamp	35912-35913 35914-35915	INT32 UINT32	0.1%	0 to 9999
Min. Voltage THD L2/L23 Timestamp	35916-35917 35918-35919	INT32 UINT32	0.1%	0 to 9999
Min. Voltage THD L3 Timestamp	35920-35921 35922-35923	INT32 UINT32	0.1%	0 to 9999
Min. Current THD L1 Timestamp	35924-35925 35926-35927	INT32 UINT32	0.1%	0 to 9999
Min. Current THD L2 Timestamp	35928-35929 35930-35931	INT32 UINT32	0.1%	0 to 9999
Min. Current THD L3 Timestamp	35932-35933 35934-35935	INT32 UINT32	0.1%	0 to 9999
Min. K-Factor L1 Timestamp	35936-35937 35938-35939	INT32 UINT32	0.1	10 to 9999
Min. K-Factor L2 Timestamp	35940-35941 35942-35943	INT32 UINT32	0.1	10 to 9999
Min. K-Factor L3 Timestamp	35944-35945 35946-35947	INT32 UINT32	0.1	10 to 9999
Min. Current TDD L1 Timestamp	35948-35949 35950-35951	INT32 UINT32	0.1%	0 to 1000
Min. Current TDD L2 Timestamp	35952-35953 35954-35955	INT32 UINT32	0.1%	0 to 1000
Min. Current TDD L3 Timestamp	35956-35957 35958-35959	INT32 UINT32	0.1%	0 to 1000
Min. Voltage L12 Timestamp	35960-35961 35962-35963	INT32 UINT32	0.1V/1V	0 to Vmax
Min. Voltage L23 Timestamp	35964-35965 35966-35967	INT32 UINT32	0.1V/1V	0 to Vmax
Min. Voltage L31 Timestamp	35968-35969 35970-35971	INT32 UINT32	0.1V/1V	0 to Vmax
Minimum real-time total values				
Min. Total kW Timestamp	36096-36097 36098-36099	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Min. Total kvar Timestamp	36100-36101 36102-36103	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Min. Total kVA Timestamp	36104-36105 36106-36107	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Min. Total PF [3] Timestamp	36108-36109 36110-36111	INT32 UINT32	0.001	0 to 1000
Min. Total PF Lag Timestamp	36112-36113 36114-36115	INT32 UINT32	0.001	0 to 1000
Min. Total PF Lead Timestamp	36116-36117 36118-36119	INT32 UINT32	0.001	0 to 1000
Minimum real-time auxiliary values				
Min. Auxiliary current Timestamp	36352-36353 36354-36355	INT32 UINT32	0.01A/mA	0 to Imax aux
Min. Neutral current Timestamp	36356-36357 36358-36359	INT32 UINT32	0.01A	0 to Imax
Min. Frequency [4] Timestamp	36360-36361 36362-36363	INT32 UINT32	0.01Hz	0 to 10000
Min. Voltage unbalance Timestamp	36364-36365 36366-36367	INT32 UINT32	1%	0 to 300
Min. Current unbalance Timestamp	36368-36369 36370-36371	INT32 UINT32	1%	0 to 300

Parameter	Registers	Type	Unit	Range
Min. DC voltage Timestamp	36372-36373 36374-36375	INT32 UINT32	0.01V	0 to 999900
Programmable Min/Max minimum registers				
Min. Register #1 Timestamp	36608-36609 36610-36311	INT32 UINT32	⑤	
Min. Register #2 Timestamp	36612-36313 36614-36315	INT32 UINT32	⑤	
...	...			
Min. Register #16 Timestamp	36668-36669 36670-36671	INT32 UINT32	⑤	
Maximum real-time values per phase				
Max. Voltage L1/L12 [6] Timestamp	36864-36865 36866-36867	INT32 UINT32	0.1V/1V	0 to Vmax
Max. Voltage L2/L23 [6] Timestamp	36868-36869 36870-36871	INT32 UINT32	0.1V/1V	0 to Vmax
Max. Voltage L3/L31 [6] Timestamp	36872-36873 36874-36875	INT32 UINT32	0.1V/1V	0 to Vmax
Max. Current L1 Timestamp	36876-36877 36878-36879	INT32 UINT32	0.01A	0 to Imax
Max. Current L2 Timestamp	36880-36881 36882-36883	INT32 UINT32	0.01A	0 to Imax
Max. Current L3 Timestamp	36884-36885 36886-36887	INT32 UINT32	0.01A	0 to Imax
Max. kW L1 Timestamp	36888-36889 36890-36891	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Max. kW L2 Timestamp	36892-36893 36894-36895	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Max. kW L3 Timestamp	36896-36897 36898-36899	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Max. kvar L1 Timestamp	36900-36901 36902-36903	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Max. kvar L2 Timestamp	36904-36905 36906-36907	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Max. kvar L3 Timestamp	36908-36909 36910-36911	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Max. kVA L1 Timestamp	36912-36913 36914-36915	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Max. kVA L2 Timestamp	36916-36817 36918-36919	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Max. kVA L3 Timestamp	36920-36921 36922-36923	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Max. Power factor L1 [3] Timestamp	36924-36925 36926-36927	INT32 UINT32	0.001	0 to 1000
Max. Power factor L2 [3] Timestamp	36928-36929 36930-36931	INT32 UINT32	0.001	0 to 1000
Max. Power factor L3 [3] Timestamp	36932-36933 36934-36935	INT32 UINT32	0.001	0 to 1000
Max. Voltage THD L1/L12 Timestamp	36936-36937 36938-36939	INT32 UINT32	0.1%	0 to 9999
Max. Voltage THD L2/L23 Timestamp	36940-36941 36942-36943	INT32 UINT32	0.1%	0 to 9999
Max. Voltage THD L3 Timestamp	36944-36945 36946-36947	INT32 UINT32	0.1%	0 to 9999
Max. Current THD L1 Timestamp	36948-36949 36950-36951	INT32 UINT32	0.1%	0 to 9999
Max. Current THD L2 Timestamp	36952-36953 36954-36955	INT32 UINT32	0.1%	0 to 9999
Max. Current THD L3 Timestamp	36956-36957 36858-36959	INT32 UINT32	0.1%	0 to 9999
Max. K-Factor L1 Timestamp	36960-36961 36962-36963	INT32 UINT32	0.1	10 to 9999
Max. K-Factor L2 Timestamp	36964-36965 36966-36967	INT32 UINT32	0.1	10 to 9999
Max. K-Factor L3 Timestamp	36968-36969 36970-36971	INT32 UINT32	0.1	10 to 9999
Max. Current TDD L1 Timestamp	36972-36973 36974-36975	INT32 UINT32	0.1%	0 to 1000

Parameter	Registers	Type	Unit	Range
Max. Current TDD L2 Timestamp	36976-36977 36978-36979	INT32 UINT32	0.1%	0 to 1000
Max. Current TDD L3 Timestamp	36980-36981 36982-36983	INT32 UINT32	0.1%	0 to 1000
Max. Voltage L12 Timestamp	36984-36985 36986-36987	INT32 UINT32	0.1V/1V	0 to Vmax
Max. Voltage L23 Timestamp	36988-36989 36990-36991	INT32 UINT32	0.1V/1V	0 to Vmax
Max. Voltage L31 Timestamp	36992-36993 36994-36995	INT32 UINT32	0.1V/1V	0 to Vmax
Maximum real-time total values				
Max. Total kW Timestamp	37120-37121 37122-37123	INT32 UINT32	0.001kW/1kW	-Pmax to Pmax
Max. Total kvar Timestamp	37124-37125 37126-37127	INT32 UINT32	0.001kvar/1kvar	-Pmax to Pmax
Max. Total kVA Timestamp	37128-37129 37130-37131	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Max. Total PF [3] Timestamp	37132-37133 37134-37135	INT32 UINT32	0.001	0 to 1000
Max. Total PF Lag Timestamp	37136-37137 37138-37139	INT32 UINT32	0.001	0 to 1000
Max. Total PF Lead Timestamp	37140-37141 37142-37143	INT32 UINT32	0.001	0 to 1000
Maximum real-time auxiliary values				
Max. Auxiliary current Timestamp	37376-37377 37378-37379	INT32 UINT32	0.01A/mA	0 to Imax aux
Max. Neutral current Timestamp	37380-37381 37382-37383	INT32 UINT32	0.01A	0 to Imax
Max. Frequency [4] Timestamp	37384-37385 37386-37387	INT32 UINT32	0.01Hz	0 to 10000
Max. Voltage unbalance Timestamp	37388-37389 37390-37391	INT32 UINT32	1%	0 to 300
Max. Current unbalance Timestamp	37392-37393 37394-37395	INT32 UINT32	1%	0 to 300
Max. DC voltage Timestamp	37396-37397 37398-37399	INT32 UINT32	0.01V	0 to 999900
Maximum demands (M)				
Max. volt demand L1/L12 [6]	37632-37633	INT32	0.1V/1V	0 to Vmax
Timestamp	37634-37635	UINT32		
Max. volt demand L2/L23 [6] Timestamp	37636-37637 37638-37639	INT32 UINT32	0.1V/1V	0 to Vmax
Max. volt demand L3/L31 [6] Timestamp	37640-37641 37642-37643	INT32 UINT32	0.1V/1V	0 to Vmax
Max. ampere demand L1 Timestamp	37644-37645 37646-37647	INT32 UINT32	0.01A	0 to Imax
Max. ampere demand L2 Timestamp	37648-37649 37650-37651	INT32 UINT32	0.01A	0 to Imax
Max. ampere demand L3 Timestamp	37652-37653 37654-37655	INT32 UINT32	0.01A	0 to Imax
Reserved	37656-37657 37658-37659	INT32 UINT32		0
Reserved	37660-37661 37662-37663	INT32 UINT32		0
Reserved	37664-37665 37666-37667	INT32 UINT32		0
Max. kW import sliding window demand Timestamp	37668-37669 37670-37671	INT32 UINT32	0.001kW/1kW	0 to Pmax
Max. kvar import sliding window demand Timestamp	37672-37673 37674-37675	INT32 UINT32	0.001kvar/1kvar	0 to Pmax
Max. kVA sliding window demand Timestamp	37676-37677 37678-37679	INT32 UINT32	0.001kVA/1kVA	0 to Pmax
Max. kW import thermal demand Timestamp	37680-37681 37682-37683	INT32 UINT32	0.001kW/1kW	0 to Pmax
Max. kvar import thermal demand Timestamp	37684-37685 37686-37687	INT32 UINT32	0.001kvar/1kvar	0 to Pmax
Max. kVA thermal demand Timestamp	37688-37689 37690-37691	INT32 UINT32	0.001kVA/1kVA	0 to Pmax

Parameter	Registers	Type	Unit	Range
Max. kW export sliding window demand Timestamp	37692-37693 37694-37695	INT32 UINT32	0.001kW/1kW	0 to Pmax
Max. kvar export sliding window demand Timestamp	37696-37687 37698-37699	INT32 UINT32	0.001kvar/1kvar	0 to Pmax
Max. kW export thermal demand Timestamp	37700-37701 37702-37703	INT32 UINT32	0.001kW/1kW	0 to Pmax
Max. kvar export thermal demand Timestamp	37704-37705 37706-37707	INT32 UINT32	0.001kvar/1kvar	0 to Pmax
Programmable Min/Max maximum registers				
Max. Register #1 Timestamp	37888-37889 37890-37891	INT32 UINT32	⑤	
Max. Register #2 Timestamp	37892-37893 37894-37895	INT32 UINT32	⑤	
...	...			
Max. Register #16 Timestamp	37948-37949 37950-37951	INT32 UINT32	⑤	
TOU maximum demand register #1				
Max. Demand Tariff #1 register Timestamp	38144-38145 38146-38147	INT32 UINT32	⑤	0 to Pmax
Max. Demand Tariff #2 register Timestamp	38148-38149 38150-38151	INT32 UINT32	⑤	0 to Pmax
...	...			
Max. Demand Tariff #16 register Timestamp	38204-38205 38206-38207	INT32 UINT32	⑤	0 to Pmax
TOU maximum demand register #2				
Max. Demand Tariff #1 register Timestamp	38400-38401 38402-38403	INT32 UINT32	⑤	0 to Pmax
Max. Demand Tariff #2 register Timestamp	38404-38405 38406-38407	INT32 UINT32	⑤	0 to Pmax
...	...			
Max. Demand Tariff #16 register Timestamp	38460-38461 38462-38463	INT32 UINT32	⑤	0 to Pmax
TOU maximum demand register #3				
Max. Demand Tariff #1 register Timestamp	38656-38657 38658-38659	INT32 UINT32	⑤	0 to Pmax
Max. Demand Tariff #2 register Timestamp	38650-38651 38652-38653	INT32 UINT32	⑤	0 to Pmax
...	...			
Max. Demand Tariff #16 register Timestamp	38716-38717 38718-38719	INT32 UINT32	⑤	0 to Pmax

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.

1 The Min/Max log parameters are read in 32-bit registers. 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 New absolute min/max value (lag or lead).

4 The actual frequency range is 45.00 - 65.00 Hz.

5 The Programmable Min/Max register and TOU maximum demand register unit and range match those of the input parameter for which the register is allocated.

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.

5.29 Real Time Clock Registers

Table 5-67 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

Parameter	Register	Type	R/W	Range
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.

5.30 Time Zone Information Registers

Table 5-68 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)

5.31 TOU System Registers Setup

Table 5-69 TOU System Setup Registers

TOU system register	Setup registers (see Table 5-70)
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 5-70 TOU Register Setup

Parameter	Offset	Type	R/W	Range
TOU register input identifier	+0	UINT16	R/W	see Tables 5-71, 5-72
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 5-71 TOU Energy Registers Inputs

Register input	Input ID
None	0
kWh import	1
kWh export	2
kWh net	3
kWh total	4
kvarh import	5
kvarh export	6
kvarh net	7
kvarh total	8
kVAh total	9
Pulse input #1	10
Pulse input #2	11
Pulse input #3	12
Pulse input #4	13
Pulse input #5	14

Register input	Input ID
Pulse input #6	15
Pulse input #7	16
Pulse input #8	17
Pulse input #9	18
Pulse input #10	19
Pulse input #11	20
Pulse input #12	21

Table 5-72 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 sliding window demand	5
Maximum kW import thermal demand	6
Maximum kW export thermal demand	7
Maximum kvar import thermal demand	8
Maximum kvar export thermal demand	9
Maximum kVA thermal demand	10

5.32 TOU Daily Profiles Registers

Table 5-73 TOU Daily Profiles Registers

TOU daily profile	Setup registers (see Table 5-74)
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 #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 5-74 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 5-75
	Active tariff number	+3	UINT16	R/W	0-15
3rd tariff change	Tariff start time	+4	UINT16	R/W	see Table 5-75
	Active tariff number	+5	UINT16	R/W	0-15
4th tariff change	Tariff start time	+6	UINT16	R/W	see Table 5-75
	Active tariff number	+7	UINT16	R/W	0-15
5th tariff change	Tariff start time	+8	UINT16	R/W	see Table 5-75
	Active tariff number	+9	UINT16	R/W	0-15
6th tariff change	Tariff start time	+10	UINT16	R/W	see Table 5-75
	Active tariff number	+11	UINT16	R/W	0-15
7th tariff change	Tariff start time	+12	UINT16	R/W	see Table 5-75
	Active tariff number	+13	UINT16	R/W	0-15
8th tariff change	Tariff start time	+14	UINT16	R/W	see Table 5-75
	Active tariff number	+15	UINT16	R/W	0-15

Table 5-75 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.

5.33 TOU Calendar Registers

Table 5-76 TOU Calendars Registers

TOU calendar	Calendar month	Setup registers (see Table 5-77)
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 5-77 TOU Calendar Setup Registers

Parameter	Offset	Type	R/W	Range
1-4 day profiles	+0	UINT16	R/W	see Table 5-78
5-8 day profiles	+1	UINT16	R/W	see Table 5-78
9-12 day profiles	+2	UINT16	R/W	see Table 5-78
13-16 day profiles	+3	UINT16	R/W	see Table 5-78
17-20 day profiles	+4	UINT16	R/W	see Table 5-78
21-24 day profiles	+5	UINT16	R/W	see Table 5-78
25-28 day profiles	+6	UINT16	R/W	see Table 5-78
29-31 day profiles	+7	UINT16	R/W	see Table 5-78

Table 5-78 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.

5.34 TOU Calendar Years Registers

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

Table 5-79 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

5.35 Communications Password Register

Table 5-80 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

5.36 Phase Harmonics Registers

These registers are preserved for compatibility with Series 290HD instruments. All the harmonics parameters can be read through extended data registers (see Table 5-2).

Table 5-81 Phase Harmonics Registers

Harmonics channel	Registers (see Table 5-82)
V L1/L12 harmonics	2816-2858
V L2/L23 harmonics	3072-3114
V L3 harmonics	3328-3370
I L1 harmonics	3584-3626
I L2 harmonics	3840-3882
I L3 harmonics	4096-4138

Table 5-82 Phase Harmonics

Parameter	Offset	Type	R/W	Range/Scale [1]	Conversion
Channel RMS value	+0	UINT16	R	0 to $Vmax^2/Imax$ V/A	LIN3
Fundamental frequency	+1	UINT16	R	0 to 100.00 Hz	LIN3
THD	+2	UINT16	R	0 to 100.00 %	LIN3
Harmonic H01 (reference)	+3	UINT16	R	0 to 100.00 %	LIN3
Harmonic H02	+4	UINT16	R	0 to 100.00 %	LIN3
Harmonic H03	+5	UINT16	R	0 to 100.00 %	LIN3
...	...				
Harmonic H40	+42	UINT16	R	0 to 100.00 %	LIN3

[1] For the RMS value limits and representation, see Notes [1] and [2] to Table 5-1.

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

5.37 Waveform Capture/Log Registers (Sequential Access)

Table 5-83 Waveform Header Windows

Waveform header window	Registers (see Tables 5-84 - 5-86)
Real-time waveform capture, channel V L1/L12	4608-4617
Real-time waveform capture, channel V L2/L23	4864-4873
Real-time waveform capture, channel V L3	5120-5129
Real-time waveform capture, channel I L1	5376-5385
Real-time waveform capture, channel I L2	5632-5641
Real-time waveform capture, channel I L3	5888-5897
Waveform log #1, channel V L1/L12	4624-4633
Waveform log #1, channel V L2/L23	4880-4889
Waveform log #1, channel V L3	5136-5145
Waveform log #1, channel I L1	5392-5401
Waveform log #1, channel I L2	5648-5657
Waveform log #1, channel I L3	5904-5913
Waveform log #2, channel V L1/L12	4640-4650

Waveform log #2, channel V L2/L23	4896-4906
Waveform log #2, channel V L3	5152-5162
Waveform log #2, channel I L1	5408-5418
Waveform log #2, channel I L2	5664-5674
Waveform log #2, channel I L3	5920-5930

Table 5-84 Real-time Waveform Header Registers

Parameter	Offset	Type	R/W	Range/Scale [1]	Conversion
Capture code	+0	UINT16	R	0	NONE
Second	+1	UINT16	R	0 to 59	NONE
Minute	+2	UINT16	R	0 to 59	NONE
Hour	+3	UINT16	R	0 to 23	NONE
Day of month	+4	UINT16	R	1 to 31	NONE
Month	+5	UINT16	R	1 to 12	NONE
Year	+6	UINT16	R	0 to 99	NONE
Channel RMS value	+7	UINT16	R	0 to Vmax[2]/Imax V/A	LIN3
Fundamental frequency	+8	UINT16	R	0 to 100.0 Hz	LIN3
THD	+9	UINT16	R	0 to 100.0 %	LIN3

[1] For the RMS value limits and representation, see Notes [1] and [2] to Table 5-1.

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

Table 5-85 Waveform Log #1 Header Registers

Parameter	Offset	Type	R/W	Range/Scale	Conversion
Capture code: trigger setpoint number	+0	UINT16	R	1-16, 98 = no more waveforms, 99 = no waveforms logged	NONE
Hundredth of second	+1	UINT16	R	0 to 99	NONE
Second	+2	UINT16	R	0 to 59	NONE
Minute	+3	UINT16	R	0 to 59	NONE
Hour	+4	UINT16	R	0 to 23	NONE
Day of month	+5	UINT16	R	1 to 31	NONE
Month	+6	UINT16	R	1 to 12	NONE
Year	+7	UINT16	R	0 to 99	NONE
Reserved	+8	UINT16	R	0	LIN3
Sampling frequency	+9	UINT16	R	0 to 100.0 Hz	LIN3
Reserved	+10	UINT16	R	0	LIN3

Table 5-86 Waveform Log #2 Header Registers

Parameter	Offset	Type	R/W	Range/Scale [1]	Conversion
Capture code: trigger setpoint number	+0	UINT16	R	1-16, 98 = no more waveforms, 99 = no waveforms logged	NONE
Second	+1	UINT16	R	0 to 59	NONE
Minute	+2	UINT16	R	0 to 59	NONE
Hour	+3	UINT16	R	0 to 23	NONE
Day of month	+4	UINT16	R	1 to 31	NONE
Month	+5	UINT16	R	1 to 12	NONE
Year	+6	UINT16	R	0 to 99	NONE
Channel RMS value	+7	UINT16	R	0 to Vmax[2]/Imax V/A	LIN3
Fundamental frequency	+8	UINT16	R	0 to 100.0 Hz	LIN3
THD	+9	UINT16	R	0 to 100.0 %	LIN3

[1] For the RMS value limits and representation, see Notes [1] and [2] to Table 5-1.

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

These requests allow you to capture and read the real-time waveforms (4 cycles x 128 samples per cycle), and the recorded historical waveform logs – Waveform #1 (16 cycles x 32 samples/cycle records) and Waveform log #2 (4 cycles x 128 samples/cycle records). The waveform samples are read via the samples window (see Table 5-89) 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 should be read (Tables 5-84 - 5-86).

Each waveform sample is represented by a value in the range of 0 to 1023 for a voltage waveform and 0 to 8191 for a current waveform. A value of 0 corresponds to the highest negative amplitude of the measured signal, and a value of 1023/8191 corresponds to the highest positive amplitude.

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 should be accessed (register 4608, 4864, or 5120) 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 (capture code) 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 a rate of 32 samples per cycle in Waveform log #1 or at a rate of 128 samples per cycle in Waveform log #2, which 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 4624, 4640). 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 capture code register in the voltage or current header window for the corresponding channel.

Waveform log files are accessed in a sequential manner. When you continue reading after the end of a file, the exception code 98 is returned in the header record's first field. It should be checked before the record will be proceeded. To restore the pointer to the first record in the log file, write zero into register 3417 or 3418 (see Section 5.6).

5.38 Waveform Capture/Log Registers (Circular Access)

Table 5-87 Waveform Header Windows

Waveform header window	Registers (see Tables 5-57- 5-60)
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 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 5-88 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 160 contiguous records of a compound waveform
The record sequence number in the waveform series	+7	UINT16	R	0 to 159
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	INT16	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 to +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 5-89 Waveform Samples Registers

Parameter	Address	Type	R/W	Range
Waveform sample point #1	6144	INT16	R	+/- 1023/8191
Waveform sample point #2	6145	INT16	R	+/- 1023/8191

Waveform sample point #3	6146	INT16	R	+/- 1023/8191
...	...			
Waveform sample point #512	6655	INT16	R	+/- 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 - Waveform log #1 (16 cycles x 32 samples per cycle records) and Waveform log #2 (4 cycles x 128 samples per cycle records). The waveform samples are read via the register window 6144-6655 (see Table 5-89) 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 5-87).

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 Log

The historical waveform logs contain waveform records sampled at a rate of 32 samples per cycle in Waveform log #1 or at a rate of 128 samples per cycle in Waveform log #2, which 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