GEH-6508B

POWER LEADER™ Power Management Control System

Modbus® Concentrator Protocol Reference

GEH-6508

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WARNINGS Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

CAUTIONS Caution notices are used for situations in which equipment might be damaged if care is not taken.

NOTES Notes call attention to information that is especially significant to understanding and operating the equipment.

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REFERENCES Modbus RTU is a registered trademark of AEG Schneider Automation.

For details of the Modbus RTU protocol, refer to PI-MBUS-300 Rev. E from Modicon/AEG Schneider Automation.

For details of RS485 communications, refer to the EIA-485 standard.

For installation and configuration details of the Modbus Concentrator, please refer to GEH-6491, *Modbus Concentrator User's Guide.*

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Chapter 1 - Introduction

1-1 Overview

This document describes the Modbus RTU (Remote Terminal Unit) communication protocol used by the POWER LEADER™ Modbus Concentrator. This document is intended to be used as a reference for creation and integration of customized power management systems using the Modbus RTU protocol and the Modbus Concentrator.

The Modbus Concentrator is a communication protocol converter compatible with Power Management Control System(PMCS) version 5.0 or later. The Concentrator is used to provide Modbus RTU network compatibility for all POWER LEADER devices with commnet communications. Once installed and configured (see GEH-6491 for details) the Concentrator seamlessly integrates POWER LEADER devices with commnet communications into new or existing Modbus RTU networks. Using the Modbus Concentrator, the wealth of information in these devices is now available in standard Modbus RTU register maps and may be accessed using simple commands fully compatible with the Modbus RTU protocol standard. This manual will tell you how and where to find the information you need.

Modbus RTU is an industry standard protocol used in devices such as Multilin relays, GE Fanuc PLCs, and PML Meters. *This document describes only the protocol and register maps for the Modbus Concentrator and POWER LEADER devices with commnet communications connected to a Modbus Concentrator.* Please refer to the Modbus RTU protocol documentation for other devices as appropriate.

1-2 Implementation Basics

The Modbus Concentrator implements a subset of the Modicon Modbus RTU protocol standard. Modbus is a master-slave protocol, which means that a single host/ master device (typically a computer with an RS485 card, a GE Ethernet Gateway, or a PLC) initiates and controls all communication with the other devices on the network. *The Modbus Concentrator as well as all of the commnet devices connected to a Modbus Concentrator, are always considered to be Modbus Slaves.*

The hardware interface is implemented as 2-wire RS-485. In a 2-wire link, data is transmitted and received over the same lines. In such a half-duplex link, data is transmitted and received in separate time siices. Also, per the EIA-485 standard, the number of devices that can be connected on a single communication channel is limited to 32 (including the master). Please refer to GEH-6502, *PMCS Network Architecture Guide* and the EIA-485 standard for complete details of the physical interface including cabling, termination, and shielding.

1-3 Modbus RTU Message Format

The Modbus RTU protocol is strictly based upon a transaction scheme where a master device generates a query and a slave device replies with a response. Each query and response message transaction consists of the following four parts:

I. Device Address - This is the first byte of each Modbus RTU transmission. The device address is a number limited to the range of 0-247 and is associated with a single device configured with a matching address. This device receives and processes the transmission from the master. Only the addressed slave device responds to a transmission beginning with this address.

The Modbus Concentrator requires a special convention for device addressing. Commnet devices connected to the Concentrator must be configured with commnet addresses in the range of 300-514. Devices with commnet addresses outside of this range are not recognized by the Concentrator. Commnet addresses in the valid range of 300-514 are then mapped to equivalent Modbus addresses in the range of 33-247 (simply subtract 267 from the commnet address to determine the equivalent Mod bus address). Addresses 1-32 are reserved for Modbus Concentrators and native Modbus devices. Refer to GEH-6491, *Modbus Concentrator User's Guide* for complete details.

Note that a Device Address of 0 indicates a broadcast command. The broadcast command is not recognized or supported by the Modbus Concentrator.

2. Function Code - This is the second byte of each transmission and represents the commanded action to the slave device (for queries from the master) or the action that was taken by the slave device (for responses from the slave). Codes between 1 and 127 are defined as Modbus RTU functions. The subset of these functions recognized by the Modbus Concentrator is described in *Chapter 2 -Modbus Function Codes.*

If a slave device responds with a function code with the most significant bit (MSB) equal to 1 (or equivalently a function code greater than 127), then the slave device did not perform the commanded action and is signaling an error response.

3.Data - This field contains a variable number of bytes, depending on the fucntion performed. Data may contain addresses, actual points, or setpoints.

4.CRC - This is a 2-byte error-checking code, known as a Cyclic Redundancy Check. The Modbus RTU standard required each message to have a two-byte CRC (commonly known as CRC-16 for 16 bits of error checking) to be appended to every transmission.

If the Modbus Concentrator detects a CRC error in a received Modbus message, the Concentrator does not respond to the message. An error in the CRC calculation indicated that one or more bytes of the transmission were received incorrectly , so the entire transmission is ignored, preventing an unintended operation.

The CRC-16 calculation is an industry standard method used for error detection. An algorithm is included here to assist programmers in situations where no standard CRC-16 calculation routines are available.

CRC-16Algorithm

Once the following algorithm is complete, the working register "A" will contain the CRC value to be transmitted. Note that this algorithm requires the characteristic polynomial to be reverse bit ordered. The MSBit of the characteristic polynomial is dropped since it does not affect the value of the remainder. The following symbols are used in the algorithm:

--->	data transfer
A	16 bit ·working- reg-ister
AL	low order byte of A
AH	**hirzh** order bvte of A
CRC	16 bit CRC-16 value
I, i	loop counters
{+)	logical exclusive or operator
Di	i-th data byte (I= 0 to N-i)
G	16 bit characteristic pol$_1$11omial =1010000000000001 with I\lSBit dropped and bit order reversed
shr(x)	shift right (the LSbit of the low order byte of x shifts into a carry flag, a '0' is shifted into the MSbit of the high order byte of x, all other bits shift right one location.

Algorithm:

1. FFFF hex--->A
2. 0 ---> i
3. 0 ---> j
4. Di (+) AL--->AL
5. j+l --->j
6. shr(A)
7. Is there a carry? No: go to 8.
   Yes: G (+) A--->A
8. Isj = 8? No: go to 3.
   Yes: go to 9.
9. i + 1---> I
10. Is i = N? No: go to 3.
    Yes: go to 11.
11. A---> CRC

1-4 Message Framing and Timing

Each 8 bits of data in a Modbus RTU message are sent as part of a 11-bit byte, with the extra bits used for framing of each byte transmitted. The master device should have the port settings set to N-8-1 (no parity, 8 data bits, l stop bit).

Per the Modbus RTU standard, all messages must start with a silent interval of at least 3.5 character times (or equivalently 38.5 bit times), followed by the device address. For example, at 19200 baud the minimum delay between messages is:

$$(3.5\text{characters})(11\ \text{bits/character})\left(\frac{1\text{s}}{19200\text{bits}}\right) = 2.01\text{ms}$$

Modbus RTU messages must be transmitted as a continuous stream. If a silent interval of more than 3.5 character times occur before the message is complete, s the receiving device resets the link and assumes that the next byte received is the start of a new message. Similarly, if fewer than 3.5 character times elapse between messages, the receiving device considers the second message a continuation of the previous one, resulting in an error.

The Modbus Concentrator, upon detecting an appropriate silent time, readies itself to recognize the next received byte as the device address. If the device address is the same as the Concentrator address or the equivalent Modbus address of an attached POWER LEADER device, the Concentrator receives the rest of the query from the master and responds appropriately.

A typical Modbus RTU message appears as follows (the 3.5 character time interval is explicitly shown below but often implied in other diagrams):

Silent Interval	Device Address (1 byte)	Function Code (1 byte)	Data (n bytes)	CRC-16 (2 bytes)

1-5 Register Groupings

Device registers are divided into the following categories. All registers are defined as read only except for coils.

- Fixed-Value registers: These contain information that is very unlikely to change, such as rating plug value, serial number, and factory configuration options. These registers have addresses starting at 0000. Use the Read Hoiding Registers (Function Code 03) command to read this data.
- Actual value registers: These hold dynamic information such as metering values and have address starting at 1000. Use the Read Input Registers (Function Code 04) commond to read this data.
- Event registers: These store event-specific data for abnormal behavior such as a circuit breaker trip and have addresses starting at 2000. Use the Read Input Registers (Function Code 04) command to read this data.
- Setpoint registers: These store configuration information or programmed parameters that are user programmable and have adress starting at 3000. Use the Read Holding Registers (Function Code 03) command to read this data.
- Coils: These read/write registers are used to implement supervisory control through remote commands and are addressed sequentially. Use the Read Coil Status (Function Code 01) Force Single Coil (Function Code 05) Commands to read this data and perform remote control respectively.

1-6 Data Conventions

All registers are composed of 16 bits (2 bytes) per the Modbus RTU protocol standard. All integer values less than 256 are stored in the lower byte of the register.

All data is transmitted with the high byte first except for the CRC-16 which is transmitted low byte first.

1-7 Format for Floating Point and long Integer Data Types

Register in the Modbus Protocol are 16-bit quantities. Since long integers and floating point data formats are 32-bit quantities, it is necessary to store these quantities in 2 registers. The following information describes the register, byte and bit ordering of floating point and long integer format transmitted by the ABB Modbus Concentrator.

Floating Point Number Format

Floating point values, in the ABB Modbus Concentrator, follow the IEEE Floating Point Standard. This standard is readily available in compuiter communication text books. The followning summarizes the IEEE format.

IEEE Floating Point Number-Single Precision (32 bits)		
bit 31	bits 30.....23	bits 22.....**O**
Sign	Exponent	Fraction

Due to Modbus protocol' 'transmission rules, the order of the bytes of floating point numbers transmitted by the concentrator via Modbus protocol is rearranged (register x is transmitted before register x + I). Floating point values will be transmitted as 1st byte, 0th byte, 3rd byte and 2nd byte from the Modbus Concentrator. *This format is compatible with Wonderware servers.*

Modbus Concentrator Transmission of Floating Point Value in Modbus Protocol			
bits 15.....8	bits **7.....0**	bits 31 24	bits 23.....16
1st byte	0th byte	3rd byte	2nd byte
Register x		Register x + 1	

Long Integers

Long Integers will follow the same byte ordering format outlined for floating point numbers.

Note: Data values in the Concentrator are constantly being updated. Therefore, both registers of a floating point or long integer value must be read together. If the Concentrator receives a read request for one but not both of the two registers which represent a floating point or a long integer value, the Concentrator will return Exception Code 84 - Partial Register Access Error.

2-1 Supported Functions

All Modbus Concentrator supports a subset of the Modbus RTU Protocol. The listed query commands are listed in Table 1.

Both monitoring and control are possible using read and write functions. All function codes are listed in decimal numbers and strictly follow the protocol format described below. Remember to convert all fields to hexadecimal format for actual queries and responses.

Read Coil Status (Function Code 01)

This command reads and reports the status of discrete l/O (coils) in the addressed device. The query message specifies the address of the starting coil and the number of coils to be read.

Device Address	Func 01	Coil Start Address	# of Coils	CRC-16

An example of a Read Coil Status command where the master is requesting the status of coils 3-6 from a device at address 100:

64h	01h	00h	03h	00h	04h	CRC-lo	CRC-hi

Response

The response includes the count of the number of bytes of data and the status of each requested coil.

Device Address	Func 01	Byte Count	Coil Data	CRC-16

Coil data is reported with the lowest numbered coil (specified by the start address in the request) reported in the least significant bit (LSB) of the first coil data byte. The standard convention 1 = ON and O = OFF is used unless specified otherwise in the device register map. Each coil is reported sequentially in the bits of the coil data. Thus, the eighth coil would be reported in the MSB of the first byte of coil data and the ninth coil ,vouid be reported in the LSB of the second byte of coil data and so forth. If the returned number of coils is not a multiple of 8, the remaining bits in the final data byte will be padded with zeros (toward the high order end of the byte).

An example of a response to the previous query would be (coils 6 and 4 are off and coils 5 and 3 are on in this example):

64h	01h	01h	05h	CRC-lo	CRC-hi

Use this command to read setpoints or fixed value registers. It specifies the starting register and the number of registers to be read.

Device Address	Func 03	Start Addres	# of Registers	CRC-16

An example of a Read Holding Registers command where the master requests registers 3010-3012 from a device at address 100:

64h	03h	0Bh	C2h	00h	03h	CRC-lo	CRC-hi

Response

The response includes the number of bytes of data, followed by the register data composed of two-bytes for each requested register. Thus, the first byte of register data is the high byte of the register specified by the start address, and the second byte of register data is the low byte. Subsequent holding registers follow.

Device Address	Func 03	Byte Count	Register Data	CRC-16

An example of a response to the previous query would be:

64h	03h	06h	02h	2Bh	00h	00h	00h	66h	CRC-lo	CRC-hi

register 3010 contents are 022Bh, register 3011

Function Code	Command	Purpose	Register Groups
01	Read Coil Status	Reading the status of discrete 1/0.	Command coils
03	Read Holding Registers	Reading the setpoint registers.	Fixed value registers. setpoint
04	Read Input Registers	Reading actual value registers	registers Actual value registers and
05	Force Single Coil	Setting the single coil or executing single	event registers Command coils
56	Retransmit last message	command Retransmit last message	N/A

contents are 0000h, and register 3012 contents are 0066h in this example)

Read Input Registers (Function Code 04)

Use this command to read dynamic value or event registers. It specifies the starting register and the number of registers to be read.

Device Address	Func 03	Start Addres	# of Registers	CRC-16

An example of a Read Input Registers command where the master requests registers 1058-1060 from a device at address 100:

64h	01h	00h	03h	00h	04h	CRC-lo	CRC-hi

Response

The response includes the number of bytes of data, followed by the register data composed of two-bytes for each requested register. Thus, the first byte of register data is the high byte of the register specified by the start address, and the second byte of register data is the low byte. Dynamic value and event registers follow.

Device Address	Func 03	Byte Count	Register Data	CRC-16

An example of a response to the previous query would be (register 1058 contents are FFFFh, register 1059 contents are AO1Ah, and register 1060 contents are 11B1h in this example):

64h	04h	06h	FFh	FFh	A0h	10h	11h	B1h	CRC-lo	CRC-hi

Force Single Coil (Function Code 05}

Use this command to perform remote control. This command sets a single coil to either ON or OFF. Coils are a term that have historically represented discrete PLC outputs but may also represent any remote command to a device that may have no actual coils present. The request message specifies the coil reference and the ON or OFF status to be forced. Use FF00h in the force data to force a coil on (or execute a command). Use 0000h to force a coil off.

Device Address	Func 05	Coil Address	Force Data	CRC-16

An example of a Force Single Coil command where the n1aster ·wants to execute a conunand designated as coil 4 for a device at address I00:

64h	05h	00h	04h	FFh	00h	CRC-lo	CRC-hi

NOTE: Data values in the Concentrator are constantly being updated. Therefore both registers of a floating point or long integer data type value must be read together. If the Concentrator receives a read request for one but not both of the two registers representing a floating point or long integer value, it will return
Exception Code 84 - Partial Register Access Error.

Response

The response simply echoes the query message.

Device Address	Func 05	Coil Addres	Force Data	CRC-16

Retransmit Last Message (Function Code 56)

This command requests the slave device to retransmit the last response. The request contains only the address of the slave.

Device Address	Func 56	Error Check

Response

The response contains the last response transmitted with the function code changed to 56.

Device Address	Func 56	Last Packet Data	Force Data

2-2 Exception Codes

Exception codes are returned by the Modbus Concentrator if an error is detected in the query. The following exception codes are supported.

01h	Invalid function
02h	Invalid register
06h	Slave busy
84h	Partial register access error, Attempt was made to read 1 register of a 2 register data type (e.g floating point or long integer).
85h	Write protect violation
88h	Invalid coil

3-1 How to use the Register Maps

This chapter is composed of comprehensive register maps describing the details of the data available in each POWER LEADER device attached to the modbus RTU netvwrk through a Modbus Concentrator. To find the appropriate data, first locate the section of the tables for the device of interest. Once the device is located, determine if the desired data is categorized as Dynamic Value, Setpoint, Fixed Value, or Coil type data. Scan through the appropriate table or tables to find the register numbers and details of the desired data.

3-2 Enhanced MicroVersa Trip-C and Enhanced MicroVersa Trip-D

Table 2: Enhanced MicroVersa Trip-C and Enhanced MicroVersa Trip-D
Dynamic Value Registers.

EMVT-C/D Register Number	Contents	Units/Value/Range	Type R/W	Format
1000	Number of pending events	0 to 8	RO	Unsigned Integer
1001	Energy Overflow Flag	1 = Overflow 0= No overflow -1 = Multiple Overflows	RO	Signed Integer
1002	RMS Current Phase A	Amps	RO	Float
1004	RMS Current Phase B	Amps	RO	Float
1006	RMS Current Phase C	Amps	RO	Float
1008	RMS Current Phase N	Amps	RO	Float
1010	RMS Voltage l-N Phase A	Volts	RO	Float
1012	RMS *Voltage* L-N Phase 8	Volts	RO	float
1014	RMS Voltage L-N Phase C	Volts	RO	Float
1016	RMS Voltage L-L Phase A-B	Volts	RO	Float
1018	RMS Voltage L-l Phase 8-C	Volts	RO	Float
1020	RMS Voltage L-L Phase C-A	Volts	RO	Float
1022	Real Power Phase A	kW	RO	Float
1024	Real Power Phase B	kW	RO	Float
1026	Real Power Phase C	kW	RO	Float
1028	Total Real Power	kW	RO	Float
1030	Reactive Power Phase A	kVar	RO	Float
1032	i=lP::irth1P PrnMPr Ph::icP R	kVar	RO	Float
1034	Reactive Power Phase C	kVar	RO	Float
1036	Total Reactive Power	kVar	RO	Float
1038	Apparent Power Phase A	kVA	RO	Float
1040	Apparent Power Phase B	kVA	RO	Float
1042	Apparent Power Phase *C*	kVA	RO	Float
1044	Total Apparent Power	kVA	RO	Float
1046	Energy	kWh	RO	Float
1048	Power Demand	kW	RO	Float
1050	Peak Power Demand	kW	RO	Float
1052	Power Factor	N/A	RO	Float lead(-), lag(+)
1054	Frequency	Hz	RO	Float

Chapter 3 - Register Maps

EMVT-C/D Register Number	Contents	Units/Value/Range	Type R/W	Format
1056	Breaker Status	Bitmapped to O to FFFFh	RO	If the bit Is 1, the condition exists, bO . Current unbalance trip b1 . Undervoltage trip b2 . Voltage unbalance b3 · Power reversal trip b4 . Instantaneous trip b5 : Short time trip b6 . Long time trip b7 · Ground fault trip b8 . Breaker closed b9 . Breaker in short time pick up condition b10: Breaker in long time pick up condition b11: Breaker in ground fault pickup condition b12 . Overvoltage trip condition b13: Breaker opened remotely Bit 14 and 15 are used to decode which phase caused the tnp in overvoltage or undervoltage trip condition only Bit15/Bit14 0/0 Phase N 0/1 Phase A 1/0: Phase 8 1/1. Phase C
1057	Breaker Failure Status	Bitmapped to O to FFFF	RO	If the bit is 1, the condition exists, b0: NVM failure in the ground fault unit b1 : ROM failure in the ground fault unit b2 : RAM failure in ground fault unit b3 : A/D converter failure in the ground fault unit b4 : NVM failure on the protection unit b5: ROM failure on the protection board b6 : RAM failure on the protection board b7: A/D converter failure on protection board b8:Medium voltage ground fault unit is connected b9: unused b10: IPC failure on the metering board b11 . NVM failure on the metering board b12: Interrupt failure on the metering board b13: ROM failure on the metering board b14 : RAM failure on the metering board b15: A/D converter failure on metering board
1058	**Inst. trips count**	**N/A**	RO	Unsigned Integer
1059	Short time trips count	**N/A**	RO	Unsigned Integer
1060	Long time trips count	**N/A**	RO	Unsigned Integer
1061	Ground fault trips count	**N/A**	RO	Unsigned Integer
1062 **1064**	Previous Accumulated Energy Energy Cleared Status	**kWh** Oto1	RO RO	Float O - Not cleared 1 Cleared

Table 3: Enhanced MicroVersaTrip-C and Enhanced MicroVersaTrip-D Setpoint Registers

Register#	Contents	Unit/Values/	R/W	Format
3000	Hour	**Range** Hours, 0 to 23	RO	Unsigned Integer
3001	Minute	Minutes. 0 to 59	RO	Unsigned Integer
3002	Seconds	Seconds, 0 to 59	RO	Unsigned Integer
3003	Reserved for password protection	Always OOh	RO	Unsigned Integer
3004	Reserved	Always OOh	RO	Unsigned Integer
3005	Reserved	Always OOh	RO	Unsigned Integer
3006	Current Sensor Rating	Amps	RO	Unsigned Integer
3007	Rating Plug Value	Amps	RO	Float
3009	PT Rating	Volts	RO	Float
3011	long Time Pickup	0 5 - 1 1. step O 05	RO	float
3013	long time delay	1-4; step 1	RO	Unsigned Integer
3014	Short time pickup	0 75-9 9, step O 05	RO	Float
3016	Short time delay	0 12	RO	Value Band I^2T 0 OFF N/A 1 1 In 2 2 In 3 3 In 4 4 In 17 1 Out 18 2 Out 19 3 Out 20 4 Out
3017	Ground fault pickup	0 2 - 0 6, step O 01	RO	Float
3019	Ground fault delay	0-12	RO	Value Band I^2T 0 OFF N/A 1 1 In 2 2 In 3 3 In 4 4 In 17 1 Out 18 2 Out 19 3 Out 20 4 Out
3020	Inst Pickup	1 5 - 15 0, step 0 5, 0=OFF	RO	float
3022	Neutral Protection Factor	0 - 100% %	RO	Applicable only for 4 wire 0 OFF i e No protection provided 50 - For use when the neutral conductor is smaller than phases 100-For use when the neutral conductor is same size as phases
3023	Under Voltage Setpoint	50 90%; step 1%	RO	Unsigned Integer
3024	Under Voltage Time Delay	0 - 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3025	Over Voltage Setpoint	110 - 150%, step 1%	RO	Unsigned Integer
3026	Over Voltage Time Delay	0 - 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3027	Voltage Unbalance Setpoint	10 - 50%, step 1%	RO	Unsigned Integer
3028	Voltage Unbalance Time Delay	0 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3029	Current Unbalance Setpoint	10 - 50%; step 1%	RO	Unsigned Integer
3030	Current Unbalance Time Delay	0 - 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3031	Power Reversal Setpoint	1 - 999 kW; step 1 kW	RO	Unsigned Integer
3032	Power Reversal Time Delay	0 - 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3033	Power flow direction	0 1	RO	0 - line to load; 1-load to line
3034	Demand Time Interval	5 - 60, step 5 minutes	RO	Unsigned Integer
3035	PT Connection	0 - Delta, 1 - Wye	RO	Unsigned Integer

Table 4: Enhanced MicroVersaTrip-C and Enhanced MicroVersaTrip-D Fixed Value Registers

Register#	Contents	Units/Vaiue/Range	R/W	Format
0000	Product Id	Always 08h	RO	Unsigned Integer
OOOi	Not assigned	Always OOh	RO	Unsigned Integer
0002	Commnet Address	300 to 514	R0	Unsigned Integer
0003	Modbus Address	33 - 247	RO	Unsigned Integer
0004	Not assigned	Always 00h	RO	Unsigned Integer
0005	Not assigned	Always 00h	RO	Unsigned Integer
0006	Trip Unit Options	Bitmapped 0 to FFFFh	RO	If the bit is 1, option is enabled, otherwise option is disabled b0: Over current Protection b1: Switchable Ground Fault Function (3 wire only) b2: Short time pickup characteristics (1 Rating plug, 0 LT pickup) b3 : Instantaneous Protection b4 : Not Assigned b5 : Protective Relays b6: ANSI/UL (0 · UL 1 ANSI) b7: Not assigned b8: Ground Fault Protection b9:Targets b10 :Short Time Function b11 : Metering Limited b12: Metering Full b13: Commnet Communication b14: Ground Fault Curve (0 Normal Curve, 1-W-Curve) b15 : PT Connection (0 Delta, 1 - Wye)
0007	Frame Size	Amps(2000, 3200, 4000, 5000, 6400)	RO	Unsigned Integer
0008	Relay optwns	Bitmapped 0 to FFFFh	RO	If the bit is 1, option is enabled. otherwise option is disabled b0-b4 : Not assigned b5 : Trip operations counter b6: 3/4 Wire mode (1- 4 wire, O - 3 wire) b7: Switchable inst/Short time functmn bB : Current unbalance only relay b9:ZS1 Ground fault ZSI selected b10: ZS2 - Short time ZS! selected b11-b15: Not assigned
0009	Protective Relay Options	Bitmapped 0 to FFFFh	RO	If the bit is 1, option is enabled, otherwise option is disabled bO · Current Unbalance Protective Relay b1 : Under Voltage b2 : Voltage Unbalance b3 : Power Reversal b4 : Wye Flag (O - Delta, 1 · Wye) b5 : Over Voltage
0010	Software revision number	####, 0000 to 99.99	RO	4 digit BCD with decimal between 2nd and 3rd places
0011	Product revision number	0Ch to 0Dh	RO	OC · RMS9C; OD · RMS90

Table 5: Enhanced MicroVersaTrip-C and Enhanced MicroVersaTrip-D Command Coils

Coil#	Contents	Modbus Usage
0	Energy/VAA-Hour Clear Peak	Force ON (FFOO) to clear energy (Unreadable Coil)
1	Demand Clear	Force ON (FFOO) to clear peak demand (Unreadable Coil)
2	Reset Inst trip counter	Force ON (FFOO) to clear inst trip count (Unreadable Coil)
3	Reset short time trip count	Force ON (FFOO) to clear short time trip count (Unreadable Coil)
4	Reset Long time trip counter	Force ON (FFOO) to clear long time trip count (Unreadable Coil)
5	Reset ground fault trip count	Force ON !FFOO) to ciear ground fault trip count (Unreadable Coil)

3-3 Spectra MicroVersaTrip

Table 6: Spectra MicroVersaTrip Dynamic Value Registers

Spectra MVT Register#	Contents	Units/Value/Range	R/W	Format
1000	Number of pending events	0 to8	RO	Unsigned Integer
1001	Not assigned	Always OOh	RO	Unsigned Integer
1002	RMS Current Phase A	Amps	RO	Float
1004	RMS Current Phase B	Amps	RO	Float
1006	RMS Current Phase C	Amps	RO	Fioat
1008	RMS Voltage L-N Phase A	Volts	RO	Float
1010	RMS Voltage L-N Phase B	Volts	RO	Float
1012	RMS Voltage L-N Phase C	Volts	RO	Float
1014	RMS Voltage L-L Phase A-B	Volts	RO	Float
1016	RMS Voltage L-L Phase B-C	Volts	RO	Float
1018	RMS Voltage L-L Phase C-A	Volts	RO	Float
1020	Real Power Phase A	kW	RO	Float
1022	Real Power Phase B	kW	RO	Float
1024	Real Power Phase C	kW	RO	Float
1026	Total Real Power	kW	RO	Float
1028	Reactive Power Phase A	kVar	RO	Float
1030	Reactive Power Phase B	kVar	RO	Float
1032	Reactive Power Phase C	kVar	RO	Float
1034	Total Reactive Power	kVar	RO	Float
1036	Apparent Power Phase A	kVA	RO	Float
1038	Apparent Power Phase B	kVA	RO	Float
1040	Apparent Power Phase C	kVA	RO	Float
1042	Total Apparent Power	kVA	RO	Float
1044 - 1049	Not Assigned			
1050	Power Factor	N/A	RO	FloatLead(-), Lag(+)
1052	Frequency	Hz	RO	Float

Spectra MVT Register#	Contents	Units/Value/Range	R/W	Format
1054	Breaker Status	Bitmapped to 0 to FFFFh	RO	If the bit is 1, the condition exists. b0 : Current unbalance trip b1 : Undervoltage trip b2: Voltage unbalance b3 : Power reversal trip b4 : Instantaneous trip b5 : Short time trip b6 : Long time trip b7: Ground fault trip b8 : Breaker closed b9 : Breaker in short time pick up condition b10 : Breaker in long time pick up condition b11 : Breaker in ground fault pickup condition b12 : Overvoltage trip condition b13: Breaker opened remotely Bit 14 and 15 are used to decode which phase caused the trip m overvoltage or undervoltage trip condition only Bit 15 Bit 14 0 0 Phase N 0 1 Phase A 1 0 Phase B 1 1 Phase C
1055	Breaker Failure Status	Bitrnapped to 0 to FFFF	RO	If the bit 1s 1, the condition exists. b0 · NVM failure m the ground fault unit b1 . ROM failure in the ground fault umt b2 . RAM failure in ground fault unit b3 : NO converter failure in the ground fault unit b4 · NVM failure on the protection unit b5 ROM failure on the protection board b6 : RAM failure on the protection board b7: A/D converter failure on protection board b8-b15, not used
1058	Energy	kWh	RO	Float
1060	Energy Overflow Flag	1 = Overflow 0= No overflow -1 Multiple Overflows	RO	Signed Integer

Table 7: Spectra MicroVersaTrip Set Point Registers

MVT Register#	Contents	Units/Value/Range	R/W	Format
3000	Hour	Hours 0 to 23	RO	Unsigned Integer
3001	Minute	Minutes 0 to 59	RO	Unsigned Integer
3002	Seconds	Seconds 0 to 59	RO	Unsigned Integer
3003	Reserved for password protection	Always 00h	RO	Unsigned Integer
3004	Reserved	Always 00h	RO	Unsigned Integer
3005	Reserved	Always 00h	RO	Unsigned Integer
3006	Current Sensor Rating	Amps	RO	Unsigned Integer
3007	Rating Plug Value	Amps	RO	Float
3009	PT Rating	Volts	RO	Float
3011	Long Time Pickup	0 5 - 1 0, step 0 05	RO	Float
3013	Long time delay	1-4, step 1	RO	Unsigned Integer
3014	Short time pickup	1 5- 9 0, step O 5	RO	Float
3016	Short time delay	0-12	RO	Value Band ĺT 0 OFF N/A 1 1 In 2 2 In 3 3 In 4 4 In 17 1 Out 18 2 Out 19 3 Out 20 4 Out
3017	Ground fault pickup	O 2 - 0.6; step O 05	RO	Float
3019	Ground fault Delay	0-12	RO	Value Band ĺT 0 OFF N/A 1 1 In 2 2 In 3 3 In 4 4 In 17 1 Out 18 2 Out 19 3 Out 20 4 Out
3020	Inst Pickup	1 5 · 10 0, step O 5	RO	Float
3022	Under Voltage Setpoint	50- 90%; step 1%	RO	Unsigned Integer
3023	Undei Voltage Time Delay	0 - 15 sec; step 1 sec, 0=OFF	RO	Unsigned Integer
3024	Over Voltage Setpoint	110-150%; step 1%	RO	Unsigned Integer
3025	Over Voltage Time Delay	0 - 15 sec, step 1 sec, O=OFF	RO	Unsigned Integer
3026	Voltage Unbalance Setpoint	10- 50%; step 1%	RO	Unsigned Integer
3027	Voltage Unbalance Time Delay	O - 15 sec; step 1 sec, O=OFF	RO	Unsigned Integer
3028	Current Unbalance Setpoint	10- 50%; step 1%	RO	Unsigned Integer
3029	Current Unbalance Time Delay	0- 15 sec; step 1 sec, O=OFF	RO	Unsigned Integer
3030	Power Reversal Setpoint	10 - 7200 kW; step 10 kW	RO	Unsigned Integer
3031	Power Reversal Time Delay	0- 15 sec; step 1 sec, 0=0FF	RO	Unsigned Integer
3032	Powm flow direction	0-1	RO	0 - Line to load, 1 · Load to line
3033	PT Connection	0 - Delta; 1 - Wye	RO	Unsigned Integer

Chapter 3 - Register Maps

Table 8: Spectra MicroVersaTrip Fixed Value Registers

MVT Register#	Contents	Units/Value/Range	R/W	Format
0000	Product Id	Always 03h	RO	Unsigned Integer
0001	Not assigned	Always 00h	RO	Unsigned Integer
0002	Commnet Address	300 to 514	RO	Unsigned Integer
0003	Modbus Address	33- 247	RO	Unsigned Integer
0004	Not assigned	Always 00h	RO	Unsigned Integer
0005	Not assigned	Always 00h	RO	Unsigned Integer
0006	Trip Unit Options	Bitmapped 0 to FFFFh	RO	If the bit is 1, option is enabled, otherwise option is disabled b0 : Overcurrent Protectlon b1 : Long time pickup fixed b2 : Long time delay fixed b3 : Instantaneous Function b4 : Instantaneous limited b5 : Protective Relays b6-b7: not assigned b8:Ground Fault function b9:Targets b10:Short Time Function b11:Metering limited b12:Metering Full b13:Commnet Communication b14:not assigned b15 : PT Connection(0 - Delta, 1 - Wye)
0007	Current Sensor	Amps (150. 400,600,800, 1200)	RO	Unsigned Integer
0008	Frame Type	O-1	RO	0 G Frame. 1 F Frame
0009	Protective Relay Options	8itmapped Oto FFFFh	RO	If the bit 1s 1. option is enabled, otherwise option is disabled b0 - b3 : not assigned b4-Wye Flag (0 - Delta, 1 - Wye) b5 - b15: not assigned
0010	Software revision number	#### 00 00 to 99 99	RO	4 digit BCD with decimal between 2nd and 3rd places
0011	Product revision number	#### DO DO to99 99	RO	4 digit BCD with decimal between 2nd and 3rd places

Table 9: Spectra MicroVersaTrip Command Coils

Coil Number	Contents	Modbus Usage
0	Display Address	Force ON (FFOO) to display address at device for 5 seconds (Unreadable Coil)

3-4 POWER LEADER EPM

Table 10: POWER LEADER EPM
Dynamic Value Registers

PLEPIVI Register#	**Contents**	**Units/Value/Range**	**R/W**	**Format**
1000	Number of pending events	0 to 8	RO	Unsigned Integer
1001	Not assigned	Always 0	RO	Unsigned Integer
1002	KVA max, total of all phases	kva	RO	Float
1004	KW max, total of all phases	kw	RO	Float
1006	KVAR lag max, total of all phases	kvar	RO	Float
1008	KVAR lead max, total of all phases	kvar	RO	Float
1010	CURRENT max, phase A	amp	RO	Float
1012	CURRENT max, phase B	amp	RO	Float
1014	CURRENT max, phase C	amp	RO	Float
1016	KVARH lag, total of all phases	kvarh	RO	Float
1018	KVARH lead, total of all phases	kvarh	RO	Float
1020	KWH, total of all phases	kwh	RO	Float
1022	KOH, total of all phases	kqh Q=(sqrt(3)*var+W)/2	RO	Float
1024	KVAH, total of all phases	kvah	RO	Float
1026	PF avg since last reset, total of all phases	Dimensionless	RO	Float
1028	PF, total of all phases, @KVAmax	Dimensionless	RO	Float
1030	KVA, totai of aii phases (demandj	kva	RO	Float
1032	KW, total of all phases (demand)	kw	RO	Float
1034	KVAR lag, total of all phases (demand)	kvar	RO	Float
1036	KVAR lead, total of all phases (demand)	kvar	RO	Float
1038	CURRENT, phase A(demand)	amp	RO	Float
1040	CURRENT, phase B (demand)	amp	RO	Float
1042	CURRENT, phase C (demand)	amp	RO	Float
1044	PF, total of all phases (over last demand invl)	Dimensionless	RO	Float
1046	KW, phase A	kw	RO	Float
1048	KW, phase B	kw	RO	Float
1050	KW, phase C	kw	RO	Float
1052	KVAR, phase A	kvar	RO	Float
1054	KVAR, phase B	kvar	RO	Float
1056	KVAR, phase C	kvar	RO	Float
1058	KVA, phase A	kva	RO	Float
1060	KVA, phase B	kva	RO	Float
1062	KVA, phase C	kva	RO	Float
1064	PF, phase A	Dimensionless	RO	Float
1066	PF, phase B	Dimensionless	RO	Float
1068	PF, phase C	Dimensioniess	RO	Float
1070	KVA, total of all phases	Kva	RO	Float
1072	KW, total of all phases	Kw	RO	Float
1074	KVAR, total of all phases	kvar	RO	Float
1076	VOLTAGE L-N phase A-N	volt	RO	Float
1078	VOLTAGE L-N phase 8-N	volt	RO	Float
1080	VOLTAGE L-N phase C-N	volt	RO	Float
1082	VOLTAGE L-L phase A-8	volt	RO	Float

PLEPM Register#	Contents	Units/Value/Range	R/W	Format
1084	VOLTAGE L-L phase B-C	volt	RO	Float
1086	VOLTAGE L-L phase C-A	volt	R0	Float
1088	PF total of all phases	Dimensionless	RO	Float
1090	KW, total of all phases,@KVAmax	**kw**	RO	Float
1092	CURRENT phase A	amp	RO	Float
1094	CURRENT phase B	amp	RO	Float
1096	CURRENT phase C	amp	RO	Float
1098	CURRENT neutral	amp	RO	Float
1100	FREQUENCY phase A	Hz	RO	Float
1102	Time left in demand interval	second	RO	Unsigned Integer
1103	Number of demand resets	Non-volatile count of demand resets since commissioning Range of 0 to 255 with wrap to 0 on the 256th demand reset. Cleared when meter initialize is executed	RO	Unsigned Integer
1104	Number of power failures	Non-volatile count of power failures since commissioning Range of 0 to 255 with wrap to 0 on the 256th power failures. Cleared when meter initialize is executed	RO	Unsigned Integer
1105	Meter error flags	bitmapped	RO	b1: 1=AII energy lost b4: 1 =Internal comm error b7: 1=Energy data loss (<12hr)
1106	Voltage phase loss errors	bitmapped	RO	b0: 1=A-N voltage lost b1: 1=8-N voltage lost b2: 1=C-N voltage lost
1107	lead/lag PF qualifier for total of all phases (inst)	enumerated data	RO	Unsigned Integer 0=lagging 1=leading
1108	lead/lag PF qualifier for phase A (inst)	enumerated data	RO	Unsigned Integer 0=lagging 1=leading
1109	lead/lag PF qualifier for phase B (inst)	enumerated data	RO	Unsigned Integer 0=lagging 1=leading
1110	lead/lag PF qualifier for phase C (inst)	enumerated data	RO	Unsigned Integer 0=lagging 1=leading
1111	Data resetting flags	bitmapped	RO	Indicates the occurrence of one or more locally or remotely commanded reset operations May only be cleared remotely. b0: Demand reset b1: Energy reset b2. Meter initialize b3: Errors clear
1112	Previous Accumulated Wh	Wh	RO	Float
1114	Previous Accumulated varh lagging	varh	RO	Float
1116	Previous Accumulated varh leading	varh	RD	Float
1118	Data Cleared Status	0 to 1	RO	0-Not Cleared 1- Cleared

PLEPM Register #	Contents	Units/Value/Range	R/W	Format
3000	Hour	Hours; 0 to 23	RO	Unsigned fnteger
3001	Minute	Minutes, 0 to 59	RO	Unsigned Integer
3002	Seconds	Seconds, O to 59	RO	Unsigned Integer
3003	Password	Always 00h	RO	Unsigned Integer
3004	not assigned	Always 00h	RO	Unsigned Integer
3005	Pulse value interval time for pulse KYZ output 1	Units are kWh, kVAh, kvarh, or kOh, see appropriate pulse units register below O =off, range up to 999 999999	RO	Float
3007	Pulse value interval time for pulse KYZ output 2	Units are kWh, kVAh, kvarh, or kQh, see appropriate pulse units register below O = off, range up to 999 999999	RO	Float
3009	Pulse units for KYZ output 1	Enumerated data	RO	00h. kVAh 01h. kWh 02h. kvarh 03h · kQh
3010	Pulse units for KYZ output 2	Enumerated data	RO	00h kVAh 01h: kWh 02h: kvarh 03h: kOh
3011	Programming fiags	Bitmapped 0000 to FFFFFFFFh	RO	b0 · 1=Access to Data Resetting menu restricted b1 · 1=Access to Data Formatting menu restricted b2 . 1=Access to KYZ Pulse Setup menu restricted b3: 1=Access to Configuration menu restricted b4 · 1=Access to Commnet Address Setup restricted b5-7 · unused b8 : 1=leading zeros enabled b9 : 1=Single meter configuration allowed b10 : 1=unused b11 : 1=Pulse Outputs menu disabled (no pulse output option installed) b12 : unused b13 1=Test Mode active edge (rising edge if set) b14 : 1=Reserved for manufacturing b15 . unused b16-23 . spare for later development b24 : 1=Access to Demand Reset restricted b25 : 1=Access to Energy Reset restricted b26 : 1=Access to Meter Initialize restricted b27 : 1=Access to Errors Clear restricted b28-31 : unused
3013	Demand interval length	Minutes; 15,20.30, or 60	RO	Unsigned Integer
3014	Number of subintefVals	Number 1 to 6, valid combinations of demand interval length and number of subintervals listed below: Demand/Number of subintervals 15 / 1,3 20 /1,2,4 30 / 1,2,3,6 60 / 1,2,3,4,6	RO	Unsigned Integer
3015	Display scrol time	Seconds 00 to 99 (00 means auto scroll disabled)	RO	Unsigned Integer

Chapter 3 - Register Maps

PLEPM Register#	Contents	Units/Value/Range	*R/W*	Format
3016	Meter configuration	Enumerated type	RO	1 : 2 element delta 120V 2.2 5 element wye 120V 3: 3 element wye 120V 5. 2 element delta 240V 6. 2 5 element wye 240V 7: 3 element wye 240V 11: 2 element delta 480V 13: 2 element delta 600V 54. 2 5 element wye 69V 55· 3 element wye 69V 56: 2 5 element wye 277V 57: 3 element wye 277V 58: 2 5 element wye 345V 59· 3 element wye 345V
3017	Potential transformer ratio	PTR:1	RO	Float
3019	Current transformer ratio	CTR:1	RO	Float
3021	Energy display format	Enumerated data	RO	40h: XXXX 41h:XXXXX 42h · XXXX XX 50h: XXXXX 51h XXXXX X 60h XXXXXX
3022	Demand display format	Enumerated data	RO	30h: XXX 31h:XXXX 32h: XXX XX 33h: XXXXXX 40h: XXXX 41h: XXXX X 42h: XXXX XX 50h: XXXXX 51h : XXXXX X 60h: XXXXXX
3023	Voltage display format	Enumerated data	RO	Same as demand display format
3024	Amps display format	Enumerated data	RO	Same as demand display format
3025	Energy display scale {kWH, MWH)	Enumerated data	RO	4Dh : M ($X10^6$) 6Bh : k ($X10^3$)
3026	Demand display scale (W, kW,MW)	Enumerated data	RO	40h: M ($X10^6$) 6Bh : k ($X10^3$) 20h : unit ($X10^0$)
3027	Voltage display scale (V, kV)	Enumerated data	RO	6Bh k (X1n3) 20h . unit ($X10^0$)
3028	Amps display scale (A, kA)	Enumerated data	RO	6Bh : k ($X10^3$) 20h . unit IX10^0)
3029	Local faceplate password	Encoded 6 character string Password is comprised of 6 digits with the encoding scheme as shown 00-00-00 to 99-99-99 12-34·56 would be encoded as D4D3D2D1D0CFh	RO	Encoding scheme. 0 D5h 1 D4h 2 D3h 3 D2h 4 D1h 5 D0h 6 CFh 7 CEh 8 CDh 9 CCh
3032	Number of watchdog resets or software traps in EPM	Number 0 to FFh	RO	Counter indicating number of internal watchdog resets and software traps Used for diagnostics

Table 12: POWER LEADER EPM
Fixed Value Registers

PLEPM Register#	Contents	Units/Value/Range	R/W	Format
0000	Product 10	Always 0Eh	RO	Unsigned Integer
0001	Not assigned	Always 00h	RO	Unsigned Integer
0002	Commnet address	300 to 514	RO	Unsigned Integer
0003	Modbus address	33 to 247	RO	Unsigned Integer
0004	Serial Number	Number	RO	Unsigned long
0006	Motherboard firmware revision number	#### 00 00 to 99 99	RO	4 character string with decimal implied between 2nd and 3rd places
0008	Commnet card firmware revision number	#### 00 00 to 99 99	RO	4 digit BCD with decimal between 2nd and 3rd places
0009	Commnet class	Always 80h	RO	Unsigned Integer

Table 13: POWER LEADER EPM
Command Coils

PLEPM Coil#	Contents	Modbus Usage
0	Demand reset	Force ON (FF00) to perform demand reset (Unreadable Coil)
1	Meter initialize	Force ON (FF00) to perform meter initialize (Unreadable Coil)
2	Energy reset	Force ON (FF00) to perform clear accumulated energy (Unreadable Coil)
3	Errors clear	Force ON (FF00) to clear all errors (Unreadable Coil)

3-5 Spectra ECM

Table 14: Spectra ECM Dynamic Value Registers

ECM Register Number	Contents	Units/Value/Range	Type R/W	Format
1000	Number of pending events	0 to 8	RO	Unsigned Integer
1001	Not assigned	Always 0	RO	Unsigned Integer
1002	Current in phase A	Amps, 0to 24000 amps	RO	Float
1004	Current in phase B	Amps; 0 to 24000 amps	RO	Fioat
1006	Current in phase C	Amps, 0 to 24000 amps	RO	Float
1008	Unbalance ratio	%, 0to 1600%	RO	Unsigned Integer
1009	Ground current	Amps, 0 to 25.5 amps	RO	Float
1011	Average current	Amps, 0 to 24000 amps	RO	Float
1013	Motor load	% of full load amps 0 to 2000%	RO	Unsigned Integer
1014	Motor status	Enumerated data 0 to FFh	RO	Unsigned Integer 00h : motor stopped (contractor(s) open) 01h : motor running normally (I_{PH} ≤ 100% of FLC) - Contractor 1 02h : motor in overload (I_{PH} > 100% of FLC) - Contractor 1 03h : motor running normally (I_{PH} ≤ 100% of FLC) - Contractor 2 04h : motor in overload (I_{PH} > 100% of FLC) - Contractor 2
1015	Tnp status	Enumerated data 0 to FFh	RO	Unsigned Integer 00h not tripped 01h overload 04h ground fault 06h · phase unbalance 0Bh · Commanded
1016	Control status	Bitmapped 0 to FFFFh	RO	If the specified bit is 1, the control is asserted The voltage at the input depends on whether or not the corresponding invert bit is set b0: run 1 b1 run 2 b2 reset b3 auto b4 : advanced auto b5-7 : reserved b8 : external auto b9 : external run 2 b10: extemal run 1 b11 external reset b12-15: reserved
1017	Contactor status	Bitmapped 0 to FFh	RO	If the specified drive bit is 1, the contactor drive is asserted If the specified sense bit is 1, the contactor is closed The voitage at the input depends on whether or not the corresponding invert bit is set bO. contactor 1 drive b1 : contactor 1 sense b2 : contactor 2 drive b3 : contactor 2 sense
1018	Breaker status (open/closed)	Bitmapped 0 to FFh	RO	If the specified bit is 1, the breaker is closed The voltage at the input depends on whether or not the corresponding invert bit Is set bO: breaker status

1019	ECM status	Bitmapped 0 to FFh	R0	If the specified bit is 1, the condition *is* true or the output Is asserted bO: pickupcondition (average phase current above FLA) b1 . start inhibited b2 green drive b3 . shunt trip
1020	Cause of last trip	Enumerated data 0 to FFh	RO	Unsigned Integer 00h : no trip recorded 01h: overload 04h : ground fault 06h : phase unbalance 08h : commanded
1021	Pretrip phase A current	Amps, 0 to 24000 amps	R0	Float
1023	Pretrip phase B current	Amps, O to 24000 amps	R0	Float
1025	Pretrip phase C current	Amps; O to 24000 amps	RO	Float
1027	Pretrip unbalance ratio	%; 0 to 1600%	R0	Unsigned Integer
1028	Pretrip ground current	Amps, 0 to 25 5 amps	RO	Float
1030	Open / Short status	Bitmapped O to FF	RO	If the bit is set then the condition is asserted b0: Phase A shorted b1:Phase A opened b2·Phase B shorted b3:Phase B open b4:Phase C shorted b5:Phase C open b6:Ident resistor invalid b7:Ident resistor open
1031	BIT status	Bitmapped 0 to FF	RO	If the bit is 1 then the condition is asserted b0:Memory test fault b1:Open/ short test fault b2:Start inhibited b3:Contactor not responding b4: Config error b5:Control voltage low b6:Illegal interrupt b7:Illegal opcode

Table 15: Spectra ECM Setpoint Registers

ECM Register Number	Contents	Units/Value/Range	Type R/W	Format
3000	Hour	Hours; O to 23	R0	Unsigned Integer
3001	Minute	Minutes; O to 59	R0	Unsigned Integer
3002	Seconds	Seconds, O to 59	RO	Unsigned Integer
3003	Password	Aiways OOh	R0	Unsigned integer
3004	not assigned	Always OOh	R0	Unsigned Integer
3005	Full load current	Amps; 1 to 1200	R0	Unsigned Integer
3006	Configuration	Bitmapped 0 to FF	R0	b0 : 0=ground fault protection disabled, 1=enabled b1 : 0=phase unbalance protection disabled, 1=enabled b3 b2 Class 1 1 not used 1 1 class 10 1 1 class 20 1 1 class 30 b4-7 : reserved b8-11 : control module table index -1, OFh = open/none, b11 = MSB. b12-15 : display module table index -1, OFh = open/none, b15 = MSB.

Table 16: Spectra ECM Fixed Value Registers

ECM Register#	Contents	Units/Value/Range	R/W	Format
0000	Product ID	Always 10h	RO	Unsigned Integer
0001	Not assigned	Always 00h	RO	Unsigned Integer
0002	Commnet address	300 to 514	RO	Unsigned Integer
0003	Modbus address	33 to 247	RO	Unsigned Integer
0004	Hardware revision number	1#11#1, 00 00 to 99 99	RO	4 digit BCD with decimal between 2nd and 3rd places
0005	Software revision number	##.##; 00 00 to 99 99	RO	4 digit BCD with decimal between 2nd and 3rd places
0006	Commnet class	Always 80h	RO	Unsigned Integer
0007	Rating piug rating	Amps; 1 to 1200 amps	RO	Unsigned integer
0008	Current unbalance protection threshold	%, 5 to 100%	RO	Unsigned Integer
0009	Current unbalance trip level	%, 5 to 100%	RO	Unsigned Integer
0010	Current unbalance trip delay	seconds, 0 to 25 5 sec	RO	Float
0012	Ground fault trip level	amps, 0 1 to 25 5 amps	RO	Float
0014	Ground fault trip delay	seconds; 0 to 25 5 sec	RO	Float
0016	Software time constant	10 seconds, 10 to 2550 sec	RO	Unsigned Integer
0017	Hardware time constant	10 seconds; 10 to 2550 sec	RO	Unsigned Integer
0018	locked rotor current divided by fulf load current (ILR/IFL)	Dimensionless, 1 to 20	RO	Unsigned Integer
0019	Basic trip threshold	normalized temperature units 0 01 to 2 55 NTU	RO	Float
0021	Local input polarity invert	Bitmapped 0 to FFh	RO	If the bit is 1, the presence of a voltage at the specified input indicates the input is not asserted or the condition is not true (bit=1 means negative logic at this input) b0 : Run 1 b1: Run 2 b2 . Reset b3: Auto b4 Contractor 1 sense b5 Contractor 2 sense b6 : Breaker sense
0022	External input polarity invert	Bitmapped 0 to FFh	RO	If the bit is 1, the presence of a voltage at the specified input indicates the input is not asserted or the condition is not true (bit=1 means negative logic at this input) b0 : Reserved b1 : Reserved b2: Run 1 b3: Reset

Table 17: Spectra ECM Command Coils

ECM Coil#	Contents	Modbus Usage
1	Fast start contactor 2	Force ON (FFOO) to fast close contactor 2 (Readable Coil)
2	Reverse start contactor 2	Force ON (FFOO) to reverse close contactor 2. (Readable Coil)
5	Reset ECM	Force ON (FFOO) to reset ECM. (Unreadable Coil)
6	Start contactor 1	Force ON (FFOO) to close contactor 1 (Readable Coil)
7	Stop contactor 1 & 2	Force ON (FFOO) to open contactors 1 and 2 (Readable Coil)
8	Initialize temperature variable	Force ON (FFOO) to reset thermal memory in ECM (Unreadable Coil)
14	Trip ECM contactor	Force ON (FFOO) to trip ECM contactor (Readable Coil)

3-6 POWER LEADER Meter

Table 18: POWER LEADER Meter Dynamic Value Registers

PLM Register#	Contents	Units/Value/Range	R/W	Format
1000	Number of Pending Events	Oto 8	RO	Unsigned Integer
1001	Energy Overflow Flag	1 = Overflow 0 = No overflow -1= Multiple Overflows	AO	Signed Integer
1002	Current Phase A	5 to 6000 amps	RO	Float
1004	Current Phase B	5 to 6000 amps	RO	Float
1006	Current Phase C	5 to 6000 amps	RO	Float
1008	Current Max Phase A	5 to 6000 amps	RO	Float
1010	Current Max Phase B	5 to 6000 amps	RO	Float
1012	Current Max Phase C	5 to 6000 amps	RO	Float
1014	Current, Phase A (demand)	5 to 6000 amps	RO	Float
1016	Current, Phase B (demand)	5 to 6000 amps	RO	Float
1018	Current, Phase C (demand)	5 to 6000 amps	RO	Float
1020	RMS Voltage L-N, phase A-N	120 to 14,400 volts	RO	Float
1022	RMS Voltage L-N, phase B-N	120 to 14,400 volts	RO	Float
1024	RMS Voltage L-N, phase C-N	120 to 14,400 volts	RO	Float
1026	RMS Voltage L-L, phase A-B	120 to 14,400 volts	RO	Float
1028	RMS Voltage L-L, phase B-C	120 to 14,400 volts	RO	Float
1030	RMS Voltage L-L, phase C-A	120 to 14,400 volts	RO	Float
1032	KW, phase A	KW	RO	Float
1034	KW, phase B	KW	RO	Float
1036	KW, phase C	KW	RO	Float
1038	Total Power	KW	RO	Float
1040	KVAR, phase A	KVAR	RO	Float
1042	KVAR, phase B	KVAR	RO	Float
1044	KVAR, phase C	KVAR	RO	Float
1046	Total Reactive Power	KVAR	RO	Float
1048	KVA, phase A	KVA	RO	Float
1050	KVA phase B	KVA	RO	Float
1052	KVA, phase C	KVA	RO	Float
1054	Total Apparent Power	KVA	RO	Float
1056	Total Power Factor	No Units	RO	Float
1058	Watt Demand Peak	KW	RO	Float
1060	Power Demand	KW	RO	Float
1062	Energy	KWH	RO	Float
1064	Reactive Energy	KVARH	RO	Float
1066	Frequency	HZ	RO	Float
1068	Harmonic Distortion	0- 100%	RO	Fioat
1070	Previous Accumulated Energy	kWh	RO	Float
1072	Previous Accumulated Reactive	kvarh	RO	Float
1074	Energy Cleared Status	0 - Not Cleared 1 - Cleared	RO	Unsigned Integer
1075	Reactive Energy Cleared Status	0 - Not Cleared 1 - Cleared	RO	Unsigned Integer

Chapter 3 - Register Maps

PLM Register#	Contents	Units/Value/Range	R/W	Format
1076	Reactive Energy Overflow Flag	1 = Overflow 0 = No overflow -1= Multiple Overflows	RO	Signed Integer
1088	Waveform Capture Status	0 = Normal Operations 1 = WFC Failed	RO	Unsigned Integer
1089	Waveform Capture Availability	0 = no waveform captured yet 1 = waveform present	RO	Unsigned Integer
1090	Waveform Channel	1 - Phase A 2 - Phase B 3 - Phase C	RO	Unsigned Integer
1091-1345	Waveform samples #0 through #127	Each sample takes two registers	RO	Float
1347	Wave Capture Hour	0-23	RO	Unsigned Integer
1348	Wave Capture Minute Wave	0-59	RO	Unsigned Integer
1349	Capture Second	0-59	RO	Unsigned Integer
1350	Wave Capture Milliseconds	milliseconds 0 - 999	RO	Unsigned Integer

Table 19: POWER LEADER Meter Setpoint Registers

PLM Register#	Contents	Units/Value/Range	R/W	Format
3000	Hours	Hours; 0-23	RO	Unsigned Int
3001	Minute	Minutes, 0-59	RO	Unsigned Int
3002	Seconds	Seconds, 0-59	RO	Unsigned Int
3003	Password	N/A	RO	Unsigned Int
3004	CT Ratio Primary	5. 5 to 100: 5 A in increments of 5A; 100: 5 to 300. 5 A in increments of 50A, 300· 5 A to 800. 5 A in increments of 100A, then· 1000:(5)A 3000·(5) A 1200:(5) A 1500 3200(5) A (5) A 1600:(5) A 4000:(5) A 2000.(5) A 2500: 5000(5) A (5) A 6000·(5) A	RO	Unsigned Int
3005	CT Ratio Secondary	Always 5	RO	Unsigned Int
3006	PT Ratio Primary	120(120)V 720.(120)V 2160(120)V 208·(120)V 840(120)V 2280(120)V 240(120)V 960:(120)V 2400:(120)V 277'(120)V 1080.(120)V 4160.(120)V 288(120)V 1200.(120)V 4200.(120)V 360(120)V 1320.(120)V 4800.(120)V 380(120)V 1440(120)V 7200.(120)V 415:(120)V 1560:(120)V 8400:(120)V 460:(120)V 1680·(120)V 12000(120)V 480.(120)V 1800:(120)V 14400(120)V 515:(120)V 1920(120)V 600.(120)V 2040.(120)V	RO	Unsigned Int
3007	PT Ratio Secondary	Always 120	RO	Unsigned Int
3008	DELTA/WYE connection	0=WYE, 1=DELTA	R/W	Unsigned Int
3009	Current unbalance trip setpoint	trip setpoint =10% to 50% by steps of 1% (bytes 4&5) (Meter does not support waveform capture with this function asserted)	R/W	Unsigned Int
3010	Current unbalance trip time delay	trip time delay = 1-60 sec in 1 sec increments (Meter does not support waveform capture with this function asserted)	R/W	Unsigned Int
3011	Current unbalance alarm setpoint	alarm setpoint =10% to 50% by steps ot 1% (bytes 8&9) (Meter does not support waveform capture with this function asserted)	R/W	Unsigned Int
3012	Current unbalance alarm time delay	alarm time delay= 1-60 sec in 1 sec increments (Meter does not support waveform capture with this function asserted)	R/W	Unsigned Int
3013	Voltage unbalance trip setpoint	see current unbalance trip setpoint for description	RO	Unsigned Int
3014	Voltage unbalance trip time delay	see current unbalance trip time delay for description	RO	Unsigned Int
3015	Voltage unbalance alarm setpoint	see current unbalance alarm setpoint for description	RO	Unsigned Int
3016	Voltage unbalance alarm time	see current unbalance alarm time delay for description	RO	Unsigned Int
3017	delay Overvoltage trip setpoint	see current unbalance trip setpoint for description except value is 110-150% in steps of 1%	RO	Unsigned Int
3018	Overvoltage trip time delay	see current unbalance alarm time delay for description	RO	Unsigned Int
3019	Overvoltage alarm setpoint	see current unbalance alarm setpoint for description except value is 110-150% in steps of 1%	RO	Unsigned Int
3020	Overvoltage alarm time delay	see current unbalance alarm time delay for description	RO	Unsigned Int
3021	Undervoltage trip setpoint	see current unbalance trip setpoint for description except value is 50-90% in steps of 1%	RO	Unsigned Int
3022	Undervoltage trip time delay	see current unbalance trip time delay for description	RO	Unsigned Int
3023	Undervoltage alarm setpoint	see current unbalance alarm setpoint for description except value is 50-90% in steps of 1%	RO	Unsigned Int
3024	Undervoltage alarm time delay	see current unbalance alarm time delay for description	RO	Unsigned Int

PLM Register#	Contents	Units/Value/Range	R/W	Format
3025	Power Reversal Trip Setpoint	trip setpoint = 10kW to 1MW, steps of 10kW	RO	Float
3027	Power Reversal Trip Time Delay	trip time delay = 1 to 60 sec in steps of 1 sec	RO	Unsigned Int
3028	Power Reversal Alarm Setpoint	trip setpoint = 10kW to 1MW, steps of 10kW	RO	Float
3030	Power Reversal Alarm Time Delay	trip time delay = 1 to 60 sec in steps of 1 sec	RO	Unsigned Int
3031	Overcurrent Relay Alarm Setpoint	see current unbalance alarm setpoint for description except values are from 10-110% in steps of 1%	RO	Unsigned Int
3032	Overcurrent Relay Alarm Time Delay	see current unbalance alarm time delay for description	RO	Unsigned Int
3033	Overcurrent Relay Wavef arm Setpoint	see current unbalance trip setpoint with the following exceptions When bit 2 of byte 1=1 then waveform stepoint = 110-150% in steps of 1% Overcurrent waveform capture enable ON/OFF is indicated by the presence or absence of this setpoint, if stepoint =0 then OFF.	RO	Unsigned Int
3034	Demand Time Period	15 or 30 minutes	RO	Unsigned Int

Table 20: POWER LEADER Meter Fixed Value Registers

PLM Register#	Contents	Units/Value/Range	R/W	Format
0000	Product ID	Always = 00 05h	RO	Unsigned Integer
0001	Not assigned	Always 00h	RO	Unsigned Integer
0002	Commnet Address	Range = 300-514	RO	Unsigned Integer
0003	Modbus Address	Range= 33 to 247	RO	Unsigned Integer
0004	Options	Byte 0 Options Bit 0 Meter, Relay, Waveform Bit 1 Meter, Relay Bit 2 Meter, Waveform Bit 3 Meter	RO	Bitmapped

Table 21: POWER LEADER Meter Command Coils

PLM Coil#	Contents	Modbus Usage
0	Energy Varh Clear	Force ON (FFOO) to clear energy (Unreadable Coil)
1	Peak Current Clear	Force ON (FFOO) to clear peak current (Unreadable Coil)
2	Peak Watt Demand Clear	Force ON (FFOO) to clear peak demand. (Unreadable Coil)
3	Waveform Capture Trigger	Force ON (FFOO) to trigger waveform capture.(manually request waveform data from meter) (Unreadable Coil)
4	Waveform Capture Clear	Force ON (FFOO) to clear waveform capture (required to resume automatic waveform capture after waveform successfully transferred to host) (Unreadable Coil)

3-7 POWER LEADER MDP

Table 22: POWER LEADER MDP Dynamic Value Registers

MDP Register#	Contents	Units/Value/Range	R/W	Format
1000	Number of pending events	0-8	RO	Integer
1001	LED Status	Bitmapped 0 to 00FFh	RO	A bit set to 1 indicates the corresponding LED is ON b0: Ready b1: Phase A b2: Phase B b3: Phase C b4. Ground b5: TOC Trip b6: IOC Trip b7: Pickup
1002	Hardware Status	Bitmapped O to FFFFh	RO	b0: Breaker Status; 1 = Open, 0 = Closed b1: Ext Input, Block Ground, 1 = Active b2: Ext Input, Block IOC, 1 = Active b3: Settings Status 1 = Settings Changed but not entered, 0 = Settings Normal b4: Undefined b5: Undefined b6: Undefined b7: Relay Status, 1 = Fatal Error, O = OK
1003	Phase A current	Amps 5A version: 0 - 10 Amps 1A version: 0 - 2 Amps	RO	Float
1005	Phase B current	Amps, Same as Phase A	RO	Float
1007	Phase C current	Amps; Same as Phase A	RO	Float
1009	Ground current	Amps 5A version. O - 3 Amps 1A Version: 0 - 7 Amps	RO	Float
1011	Phase A trip current	Amps; Same as Phase A	RO	Float
1013	Phase B trip current	Amps; Same as Phase A	RO	Float
1015	Phase C trip current	Amps, Same as Phase A	RO	Float
1017	Ground trip current	Amps, Same as Ground Current	RO	Float
1019	Trip time	Seconds, O - 999 99	RO	Float
1021	Breaker Status	Dimensionless 0 to 01h	RO	Unsigned Integer 00h. Closed 01h: Open
1022	Relay Hardware Status	Dimensionless 0 to 04h	RO	Unsigned Integer 00h: Relay is OK 01h: Relay not responding to read 02 h: Relay not responding to write 03h: Relay reports an error in command 04h: Fatal error in Relay
1023	Phase A current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers; ex: 00.90)
1025	Phase B current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers; ex: 00.90)
1027	Phase C current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX.XX (Decimal implied between registers: ex: 00.90)
1029	Ground current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers; ex: 00.90)
1031	Phase A trip current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers; ex: 00 90)
1033	Phase B trip current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers; ex: 00 90)

MDP Register#	Contents	Units/Value/Range	R/W	Format
1035	Phase C tnp current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes, XX XX (Decimal implied between registers, ex: 00 90)
1037	Ground trip current in multiples of tap in ASCII	Dimensionless	RO	4 ASCII bytes; XX XX (Decimal implied between registers, ex: 0D 90)
1039	Trip time in ASCII	Dimensionless	RO	6 ASCII bytes, XXXX XX (Decimal implied between 2nd and 3rd registers, ex: 100 90) Most significant byte of first register is undefined

Table 23: POWER LEADER MDP Setpoint Registers

MOP Register#	Contents	Units/Value/Range	R/W	Format
3000	Hour	0-23	RO	Integer
3001	Minute	0-59	RO	Integer
3002	Seconds	0-59	RO	Integer
3003	Password	N/A	RO	Integer
3004	Phase Curve Selection	N/A	RO	Unsigned Integer 00h: Not used 01h: Long Time Inverse 02h: Very Inverse 03h: Extremely Inverse 04h: Inverse
3005	Phase Definite Time	Seconds	RO	Float (set to 0 if not used)
3007	Ground Curve Selection	N/A	RO	Unsigned Integer 00h: Not used 01h: Long Time Inverse 02h: Very Inverse 03h: Extremely Inverse 04h: Inverse
3008	Ground Definite Time	Seconds	RO	Float(set to 0 if not used)
3010	Output Selection	N/A	RO	Unsigned Integer 00h: A 01h: B
3011	Ground Time Dial	Dimensionless 5A: 0 5 - 10 in steps of 5 1A: 0 05 - 1.0 in steps of 05	RO	Float
3013	Ground IOC Delay	Seconds; 0 - 1 55	RO	Float
3015	Ground TOG pickup	Amps 5A: 0 5- 4 375 in steps of 0 125 1A: 0 1- 0 875 in steps of 0 025	RO	Float
3017	Ground IOC pickup	TOC x; 0- 31	RO	Float
3019	Phase Time Dial	Seconds 5A O 5 - 10 in steps of O 5 1A: 0 05 - 1.0 in steps of 05	RO	Float
3021	Phase IOC Delay	Seconds; 0 - 1 55	RO	Float
3023	Phase TOC pickup	Amps 5A: 1.5 - 13 12 in steps of 0 375 1A: 0 3 - 2 625 in steps of 0 075	RO	Float
3025	Phase IOC pickup	TOC x; O - 31	RO	Float

MOP Register#	Contents	Units/Value/Range	R/W	Format
3027	Ground Time Dial	Bitmapped 0000h to 00FF	RO	If the bit is enabled, switch is in ON position Disabled means switch Is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4: Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)
3028	Ground IOC Delay	Bitmapped	RO	If the bit is enabled, switch is in ON position Disabied means switch is OFF. b0: Switch 1 b1. Switch 2 b2· Switch 3 b3: Switch 4 b4: Switch 5 b5-b15 undefined (Switch 1 is topmost switch on faceplate)
3029	Ground TOC Pickup	Bitmapped	RO	If the bit is enabled, switch is in ON position Disabled means switch is OFF b0: Switch 1 b1: Switch 2 b2. Switch 3 b3 Switch 4 b4· Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)
3030	Ground iOC Pickup	Bitmapped	RO	if the bit Is enabled, switch is in ON position Disabled means svvitch is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4: Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)
3031	Phase Time Dial	Bitmapped	RO	if the bit Is enabled, switch is in ON position Disabled means svvitch is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4. Switch 5 b5-b15. undefined (Switch 1 is topmost switch on faceplate)
3032	Phase IOC Delay	Bitmapped	RO	If the bit is enabled, switch is in ON position Disabled means switch is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4: Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)
3033	Phase TOC Picku	Bitmapped	RO	If the bit is enabled, switch is in ON position Disabled means switch is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4: Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)

MOP Register#	Contents	Units/Value/Range	R/W	Format
3034	Phase IOC pickup	Bitmapped	R0	If the bit is enabled, switch Is in ON position Disabled meansswitch is OFF b0: Switch 1 b1: Switch 2 b2: Switch 3 b3: Switch 4 b4: Switch 5 b5-b15: undefined (Switch 1 is topmost switch on faceplate)

Table 24: POWER LEADER MDP Fixed Value Registers

MDP Register#	Contents	Units/Value	R/W	Format Code
0000	Product 10	Always ODh	RO	Unsigned Integer
0001	Not assigned	Always 0	RO	Unsigned Integer
0002	Commnet Address	N/A	RO	Unsigned Integer
0003	Modbus Address	N/A	RO	Unsigned Integer
0004	MOP Software Version	N/A	RO	4 digit packed BCD with decimal between 2nd and 3rd dig;ts
0005	Model	N/A	RO	Unsigned Integer 00h 1 Amp 01h 5 Amp
0006	Ground Settings Scale	Dimensionless 0 to 03h		Unsigned integer 00h· Nominal 01h Divide by 2 02h Multiply by 3 03h· Divide by 5
0007	COC Product Revision	####; 00 00 to 99 99	RO	4 digit packed BCD with decimal between 2nd and 3rd digits
0008	COC Software Revision	####; 00 00 to 99 99	RO	4 digit packed BCD with decimal between 2nd and 3rd digits

Table 25: POWER LEADER MDP Command Coils

MDP Coil#	Contents	Modbus Usage
0	**Reset an event**	Force ON (FF00) to reset the event (unreadable Coil)
1	Trip breaker	Force ON (FF00) to trip the breaker (Readable Coil)
2	Close breaker	Force ON (FF00) to close the breaker (Readable Coil)

3-8 Modbus Concentrator

The Modbus Concentrator setpoint registers may be read to determine its current configuration.

MOOCONC Register#	Contents	Units/Vaiue/Range	Type RiW	Format
3000	Hour	0-23	RW	Unsigned Integer
3001	Minute	0-59	RW	Unsigned Integer
3002	Seconds	0-59	RW	Unsigned Integer
3003	Reserved for Password	Always 0h	RO	Unsigned Integer
3004	Reserved	Always 0h	RO	Unsigned Integer
3005	Reserved	Always 0h	RO	Unsigned Integer
3006	Commnet Address offset	Always 267	RO	Unsigned Integer
3007	Reserved	Always 0h	RO	Unsigned Integer
3008	Reserved	Always 0h	RO	Unsigned Integer
3009	Commnet addr - Device 1 Segment 1	300-514	RO	Unsigned Integer
3010	Commnet addr - Device 2 Segment 1	300-514	RO	Unsigned Integer
3011	Commnet addr - Device 3 Segment 1	300-514	RO	Unsigned Integer
3012	Commnet addr - Device 4 Segment 1	300-514	RO	Unsigned Integer
3013	Commnet addr - Device 1 Segment 2	300-514	RO	Unsigned Integer
3014	Commnet addr - Device 2 Segment 2	300-514	RO	Unsigned Integer
3015	Commnet addr - Device 3 Segment 2	300-514	RO	Unsigned Integer
3016	Commnet addr - Device 4 Segment 2	300-514	RO	Unsigned Integer
3017	Commnet addr - Device 1 Segment 3	300-514	RO	Unsigned Integer
3018	Commnet addr - Device 2 Segment 3	300-514	RO	Unsigned Integer
3019	Commnet addr - Device 3 Segment 3	300-514	RO	Unsigned Integer
3020	Commnet addr - Device 4 Segment 3	300-514	RO	Unsigned Integer
3021	Commnet addr - Device 1 Segment 4	300-514	RO	Unsigned Integer
3022	Commnet addr - Device 2 Segment 4	300-514	RO	Unsigned fnteger
3023	Commnet addr - Device 3 Segment 4	300-514	RO	Unsigned Integer
3024	Commnet addr - Device 4 Segment 4	300-514	RO	Unsigned Integer
3025	Commnet addr - Device 1 Segment 5	300-514	RO	Unsigned Integer
3026	Commnet addr - Device 2 Segment 5	300-514	RO	Unsigned Integer
3027	Commnet addr - Device 3 Segment 5	300-514	RO	Unsigned Integer
3028	Commnet addr - Device 4 Segment 5	300-514	RO	Unsigned Integer
3029	Commnet addr - Device 1 Segment 6	300-514	RO	Unsigned Integer
3030	Commnet addr - Device 2 Segment 6	300-514	RO	Unsigned Integer
3031	Commnet addr - Device 3 Segment 6	300-514	RO	Unsigned Integer
3032	Commnet addr - Device 4 Segment 6	300-514	RO	Unsigned Integer
3033	Commnet addr - Device 1 Segment 7	300-514	RO	Unsigned Integer
3034	Commnet addr - Device 2 Segment 7	300-514	RO	Unsigned Integer
3035	Commnet addr - Device3 Segment 7	300-514	RO	Unsigned Integer
3036	Commnet addr - Device 4 Segment 7	300-514	RO	Unsigned Integer
3037	Commnet addr - Device 1 Segment 8	300-514	RO	Unsigned Integer
3038	Commnet addr - Device 2 Segment 8	300-514	RO	Unsigned Integer
3039	Commnet addr - Device 3 Segment 8	300-514	RO	Unsigned Integer
3040	Commnet addr - Device 4 Segment 8	300-514	RO	Unsigned Integer

Chapter 4 - Events

4-1 Event Handling

Events are information of exceptional nature, such as a circuit breaker trip. The Modbus Concentrator stores up to 8 of the most recent events from each device in a special buffer for immediate access by the master. For each of the 8 events, eleven registers of data are used to fully describe the details of the event. Events are stored in event registers in chronological order, with EVENT 1 being the oldest event and EVENT n being the newest.

The following scheme is recommended for systems with high priority event monitoring. The master should regularly query the *Number of Active Events* register (address 1000) for each device attached to the Concentrator using the Read Input Registers (Function Code 04) command. This register contains the number of events that have not yet been read by the master. If this register is not zero, this indicates that events are present and the master should then query the appropriate number of registers from the event data table as shown below using the Read Input Registers (Function Code 04) command. The event data table is the exactly same for all devices connected to the Modbus Concentrator. If a query of register 1000 returns 0, the master need not poll the event registers.

Event registers are automatically cleared after the host reads them. If another event occurs before the master reads all the existing events, the new event data will be placed in the EVENT 1 register and the older event register contents are shifted to higher number event registers. It is recommended that the master read events starting with EVENT 1.

Each status and event message is time stamped to a 10-millisecond accuracy. Events are stored in the same format for all devices. A host request to read only part of an event register set (such as only the event code) is returned with an exception code.

All Devices
Table 27: Format of Event Registers

Register#	Contents	Units/Value/Range	R/W	Format
2000	Event Code - EVENT 1	0-256	RO	Unsigned Integer
2001	Hour	0-23	RO	Unsigned Integer
2002	Minute	0-59	RO	Unsigned Integer
2003	Seconds	0-59	RO	Unsigned Integer
2004	Milliseconds	msecs	RO	Unsigned Integer
2005	Event specific data 1			
2006	Event specific data 2			
2007	Event specific data 3			
2008	Event specific data 4			
2009	Event specific data 5			
2010	Event specific data 6			
2011	Event code - EVENT 2	0-256	RO	Unsigned Integer
2012	Hour	0-23	RO	Unsigned Integer
2013	Minute	0-59	RO	Unsigned Integer
2014	Seconds	0-59	RO	Unsigned Integer
2015	Milliseconds	msecs	RO	Unsigned Integer
2016	Event specific data 1			
2017	Event specific data 2			
2018	Event specific data 3			
2019	Event specific data 4			
2020	Event specific data 5			
2021	Event specific data 6			
2077	Event code - EVENT 8	0-256	RO	Unsigned Integer
2078	Hour	0-23	RO	Unsigned Integer
2079	Minute	0-59	RO	Unsigned Integer
2080	Seconds	0-59	RO	Unsigned Integer
2081	Milliseconds	msecs	RO	Unsigned Integer
2082	Event specific data 1			
2083	Event specific data 2			
2084	Event specific data 3			
2085	Event specif1c data 4			
2086	Event specific data 5			
2087	Event specific data 6			

Chapter 4 - Events

Once an event has been read (all 11 registers) use the Table 28 to interpret the meaning of the event code.

All Devices

Table 28: Interpretation of Event Codes

Event Code (Hex)	Meaning	EMVTC/D	MVT	PLEPM	ECM	MOP	PLM
1	long Time Overcurrent Trip					X	
2	Short Time O/C trip						
3	Instantaneous O/C Trip					X	
4	G/F Trip				X	X	
5	G/F Inst. Trip					X	
6	Curr Unbal trip				X		X
7	Volt Unbal Trip						X
8	O/V trip						X
9	U/V Trip						X
A	Power Reversal trip						X
B	External Relay trip						
C	Remote open event						
D	Remote close event						
E	Curr Unbal Alarm						X
F	Volt Unbal Alarm						X
10	O/V Alarm						X
11	U/V alarm						X
12	Power Reversal Alarm						X
13	O/C alarm						X
14	Waveform captured on request						X
15	O/C waveform capture						X
16 to FF	Unused						
100	Voltage Phase Loss			X			
101 to 112	Unused						
113	Overload Trip				X		
114	Commanded Trip				X		
115 to 1FF	Unused						
200	Internal Communication Error			X		X	
201	Internal Communication Recovered			X		X	
202 to 207	Unused						
208	Configuration Change	X	X	X		X	
209	Device has opened for reasons other than an event caused by programmer	X	X			X	
20A	Address Conflict Detected	X	X	X		X	
20B to 21E	Unused						
21F	Hardware Failure (Device Specific data attached)	X	X	X	X	X	X
220	Phase A Short				X		
221	Phase A Open				X		
222	Phase B Short				X		
223	Phase B Open				X		
224	Phase C Short				X		
225	Phase C Open				X		
226	Ident Resistor Invalid				X		
227	Ident Resistor Open				X		

Event Code (Hex)	Meaning	EMVTC/D	MVT	PLEPM	ECM	MOP	PLM
228 to 22F	Unused						
230	Class Changed				X		
231	FLA Adjust Changed				X		
232	Unbalance Switch changed				X		
233	Ground Fault switch				X		
234 to 237	changed Unused						
238 to 23F	Unused and Reserved for ECM				X		
240 to 241	Unused						
242	Remote setpoint change Failed			X			
243	Partial energy loss error			X			
244	Complete energy loss error			X			
245	Meter errors cleared locally			X			
246	Meter initialized locally			X			
247	Demand reset locally			X			
248	Unused (by EPM)						
249	Unspecified general failure			X			
24A to 24F	Unused						
280	NVM Failure on Protection board	X					
281	ROM Failure on Protection board	X					
282	RAM Failure on Protection board	X					
283	A/D Converter Failure on Protection board	X					
284 to 287	Unused						
288	IPC Failure on Metering Board	X					
289	NVM Failure on Metering Board	X					
28A	Interrupt Failure on Metering Board	X					
28B	ROM Failure on Metering Board	X					
28C	RAM Failure on Metering Board	X					
280	A/D Converter failure on Metering Board	X					
28E to 28F	Unused						
300	Current Unbalance Trip	X	X				
301	Under Voltage Trip	X	X				
302	Voltage Unbalance Trip	X	X				
303	Power Reversal Trip	X	X				
304	Instantaneous Trip	X	X				
305	Short Time Trip	X	X				
306	Long Time Trip	X	X				
307	Ground Fault Trip	X	X				
308	Overvoltage Protective Relay trip	X	X				
309	Device Remotely opened		X				
30A	Device Remotely ciosed		X				
30B	UVR trip	X	X				
30C	Shunt trip	X	X				
30D to 400	Unused						

Chapter 4 - Events

Additional data may be revelant to each event code. Use the table below to interpret the additional data specific to each event code.

All Devices
Table 29: Interpretation of Event Codes

Event Code (Hex)	Meaning	Reg. 1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6
1	Long Time Overcurrent Trip	LSB -Event Phase	Fauit Current MDP-ASCII	Fault Current MDP-ASCII			
2	Short Time 0/C trip						
3	Instantaneous 0/C Trip	LSB-Event Phase	Fault Current MDP-ASCII	Fault Current MDP-ASCII			
4	G/F Trip		Fault Current MDP -ASCII ECM- Zero Sequence Current - Format	Fault Current MDP- ASCII ECM- Zero Sequence Current Format			
5	G/F Inst Trip		Fault Current MDP -ASCII	Fault Current MDP- ASCII			
6	Curr Unbal trip		ECM -Difference Current-Format	ECM- Difference Current Format			
7	Volt Unbal Trip						
8	O/Vtrip	LSB -Event Phase					
g	U/V trip	LSB -Event Phase					
A	Power Reversal trip	LSB -Event Phase					
B	External Relay trip						
C	Remote open event						
0	Remote close event						
E	Curr UnbalAlarm						
F	Volt UnbalAlarm	LSB -Event Phase					
10	*ON*Alarm	LSB -Event Phase					
11	UN alarm	LSB -Event Phase					
12	Power ReversalAlarm	LSB -Event Phase					
13	0/C alarm						
14	Waveform captured on request						
15	0/C waveform capture	LSB -Event Phase					
100	Voltage Phase Loss	LSB -Voltage Loss Phase					
101-112	No additional data						
113	Overload Trip		ECM -Largest Phase current	ECM -Largest Phase current			
114	Commanded Trip						

Event Code (Hex)	Meaning	Reg. 1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6
200	Internal Communication Error					EPM: BO Old Data, data from device is not up to date B1:Busy Flag, Previously commanded transaction still in progress B5 Data Not Ready, the first full set of data is not yet acquired by the device Remaining Bits Unused MDP: BO Relay OK B1: Relay not responding to read B2: Relay not responding to write B3: Relay reports error in command B4: Fatal Error in Relay	
201	Internal Communication Restored					EPM: BO Old Data, data from device is not up to date B1.Busy Flag, Previously commanded transaction still in progress B5 Data Not Ready, the first full set of data is not yet acquired by the device Remaining Bits. Unused MDP B0.Relay OK B1. Relay not responding to read B2 Relay not responding to write B3· Relay reports error in command B4 Fatal Error in Relay	
202-207	No additional data						
208	Configuration Change					EPM and MDP- Address of changed Setpoint	
209	Device has opened for reasons other than an event caused by programmer						
20A	Address Conflict Detected						
20B-21E	No additional data						
21F	Hardware failure/BIT Failure					RMS6, 9C/D, PLM: B3:A/D Converter Failure B2: NVM Failure B1: ROM Failure B0: RAM Failure MDP: B14: EPROM Checksum Test Failure	PLM-Value of 01 for POWER TRAC
220	Phase A Short					ECM: Value 5 : Open/Short Rating Plug Wire Value 0Ah: Start Inhibited Value 0Bh: Contactor not responding Value 0Ch: Configuration error	

Chapter 4 - Events

Event Code (Hex)	Meaning	Reg. 1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6
221	Phase A Open					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value 0Ch Configuration error	
222	Phase B Short					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
223	Phase B Open					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
224	Phase C Short					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
225	Phase C Open					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
226	Ident Resistor Invalid					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
227	Ident Resistor Open					ECM Value 5 Open/Short Rating Plug Wire Value 0Ah. Start Inhibited Value 0Bh. Contactor not responding Value OCh Configuration error	
228-229	No additionat data						
230	Class Changed					Value of new class using SPR 10h codes.	

Event Code (Hex)	Meaning	Reg.1	Reg.2	Reg.3	Reg.4	Reg.5	Reg.6
231	FLA Adjust Changed					Value of new FLA setting in the units of percentage	
232	Unbalance Switch changed					Bit 0: 0 (disabled) or 1 (enabled)	
233	Ground Fault switch changed					Bit 0: 0 (disabled) or 1 (enabled)	
234-241	No additional data						
242	Remote setpoint change Failed						
243	Partial energy loss error						
244	Complete energy loss error						
245	Meter errors cleared locally						
246	Meter initialized locally						
247	Demand reset locally						
248	Unspecified general failure						
249-27F	No additionai data						
280	NVM Failure on Protection board					RMS9C/D Status Byte 1&2[1]	RMS9C/D Status Byte3-LSB[2]
281	ROM Failure on Protection board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte3-LSB
282	RAM Failure on Protection board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte3-LSB

Status byte 1: Bits 4-7 are device dependent : The interpretation listed here is for low voltage devices as RMS 9C and 9D support only low voltage device specific function

Bit	Meaning
0	Current Unbalance Trip
1	Under Voltage Trip
2	Voltage Unbalance Trip
3	Power Reversal Trip
4	Instantaneous Trip
5	Short Time Trip
6	Long Time Trip
	Ground Fault Trip

0	Breaker position closed
1	Breaker in short time pickup condition
2	Breaker in long time pickup condition
3	Breaker in ground fault pickup condition
4	Overvoltage trip
5	Breaker opened remotely

Bit 7	Bit 6	Phase
0	0	N
0	1	A
	0	B
		C

Event Code (Hex)	Meaning	Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5	Reg. 6
283	A/D Converter Failure on Protection board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
284-287	No additional data						
288	IPC Failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
289	NVM Failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
28A	Interrupt Failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
28B	ROM Failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
28C	RAM Failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
28D	A/D Converter failure on Metering Board					RMS9C/D Status Byte 1&2	RMS9C/D Status Byte 3-LSB
28E-2FF	No additional data						
300	Current Unbalance Trip					RMS6, RMS9C/D CSR Value	
301	Under Voltage Trip					RMS6, RMS9C/D CSR Value	
302	Voltage Unbalance Trip					RMS6, RMS9C/D CSR Value	
303	Power Reversal Trip					RMS6, RMSC/D CSR Value	
304	Instantaneous Trip		Threshold Values	Threshold Values		RMS6, RMSC/D CSR Value	
305	Short Time Trip	Faulted Phase	Fault Current	Fault Current		RMS6, RMSC/D CSR Value	
306	Long Time Trip	Faulted Phase	Fault Current	Fault Current		RMS6, RMSC/D CSR Value	
307	Ground Fault Trip		Fault Current	Fault Current		RMS6, RMSC/D CSR Value	
308	Overvoltage Protective Relay trip					RMS6, RMSC/D CSR Value	
309	Device Remotely opened						
30A	Device Remotely closed						
30B	UVR trip	Faulted Phase				RMS6, RMSC/D CSR Value	
30C	Shunt trip	Faulted Phase				RMS6, RMSC/D CSR Value	

Chapter 5 - Time Synchronization

Chapter 6 - Customer Service

5–1 Time Synchronization

The Modbus Concentrator provides sophisticated time synchronization capabilities that may be utilized through a Preset Multiple Registers command. This command is only supported for time synchronization of the Modbus Concentrator. By synchronizing the Modbus Concentrator, all devices connected to the Concentrator are also automatically synchronized, Time synchronization of individual devices is not supported.

The format of the Preset Multiple Registers command is as follows:

Device Address	Func 16 (10h)	Starting Address	Number of Registers	Byte Count	Data	Error Check

An example of a command to synchronize the a Concentrator at address 21 to 3:44:55 p.m. would be as follows (notice the required conversion of 3:00 p.m. to 15:00 military time):

15h	10h	0Bh	B8h	00h	03h	06h	00h	15h	00h	2Ch	00h	37h	CRC-lo	CRC-hi

The Concentrator will respond with the quantity of registers preset, which should always be 3:

Device Address	Func 16 (10h)	Starting Address	Number of Registers	Error Check

An example of a response to the above command would be:

15h	10h	0Bh	B8h	00h	03h	CRC-lo	CRC-hi

6-1 Customer Service

Contact the ED&C Customer Support Center at 800-843-3742 with any questions or problems with this reference.

These instructions do not cover all details or variations in equipment nor do they provide for every possible contingency that may be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to the ABB Inc.

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