SIEMENS

4700 Power Meter

SEAbus Plus™ Protocol

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Due to the evolving nature of the product,
this document is subject to change without
notice, and should be considered preliminary.

Communications Protocol

for the

Siemens 4700 Power Meter

Document Number
AED-01-002-003-0493

Siemens Energy & Automation, Inc.

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1 INTRODUCTION

This introduction gives you a brief overview of this document. It also briefly describes the 4300 power meter and the SEAbus protocol under which it operates.

1.1 About This Document

This document defines the communications protocol for the Siemens 4700 power meter. It describes how the SEAbus ™ protocol passes commands, information, and data between the meter and a master device such as the Siemens Power Monitor™ display and monitoring unit. Following this introduction, it describes the communications packets of the 4700 protocol:

1.2 About the 4700 Power Meter

The Siemens 4700 power meter is derived from the CD Power Measurements 3710 meter, manufactured by Power Measurements, Ltd. of Canada. The Siemens version, the model 4700, is available in a single configuration that measures

- line-to-neutral voltage on three phases with averaging
- line-to-line voltage on three phases with averaging
- amps on three phases with averaging
- a fourth current input
- frequency
- kilowatts and megawatts
- total kilowatt-hours, total megawatt-hours
- kilowatt demand
- kilovolt amperes
- kilovolt amperes (reactive)
- kilovolt ampere (reactive) hours
- auxiliary voltage input
- power factor

For more information about the 4700 power meter, refer to *Electronic Metering Package: 4700 Power Meter* (manual no. SG-6018).

1.3 About the SEAbus Plus Protocol

The SEAbus protocol is a software communications protocol for two-wire, RS-485 networks. An RS-485 network consists of a single-bus master and up to 32 slave devices. Short communications packets consisting of 8 to 260 characters can be sent and received at various speeds. Adding SEAbus communications to a device provides remote access to the information collected by the device. All configuration and setup procedures that are possible at the device can also be executed from the remote location over the communications link.

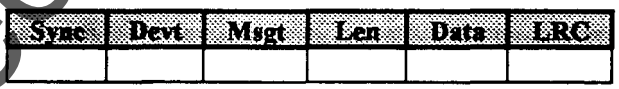
In a SEAbus system, only one master device is attached to the bus, but you may have up to 32 slave devices. A master device (such as the Siemens Power Monitor™ display and monitoring unit) initiates all communication by sending packets addressed to slave devices. *The slave devices do not initiate communication or send unsolicited packets under any circumstances.* The packet from the master device may request data, configuration information, a configuration update, or one of several other types of data packet, depending upon the nature of the slave device. If the packet sent to the slave device is a request for information, the slave responds by sending a packet with the requested information back to the master device. Only one packet is sent at a time.

Information is sent as 8-bit, with 1 stop bit and no parity. You can set the baud rate to any one of several values, and you must meet certain timing constraints of the protocol. The specifications for the timing and other parameters are provided in *Design Guidelines for the SEAbus™ and SEAbus Plus™ Communications Protocol* (Document No. AED-01-003-002-0992).

1.3.1 Structure of Data Packets

This section briefly describes the SEAbus data packet. For detailed information about data packets, refer to the SEAbus design guidelines cited above.

In general, a SEAbus packet consists of a 4-byte header, a data field of varying length, and a trailing byte as illustrated here:



The bytes in a SEAbus packet are defined as follows:

Sync The Sync byte indicates the direction of the data transmission. Use a value of 14h(exadecimal) for master-to-slave transmissions and a value of 27h for slave-to-master transmissions.

Devt The Devt (address) byte contains the address code of the type of device (indirect addressing).

Msgt The Msgt byte indicates which type of data the packet contains. Section

Len The Len byte indicates the number of bytes in the following Data field of the packet. Values for Len range from 3 to 255. (Note that Len is never less than 3 in SEAbus Plus packets because they all contain the two-byte cyclical redundancy check and the inverted Sync byte.)

Data The Data bytes contain the information of interest that is being transmitted by the communications protocol. The Data field can contain as many as 255 bytes.

LRC The LRC byte is the checksum byte. It contains the inverted sum of all bytes except the Sync byte.

Note: All values that require two words are sent least significant word first and most significant word second. All words are composed of two bytes and are sent least significant byte first and most significant byte second. For example, the 4-byte value 12345678h is divided into two words: the least significant word is 5678h and the most significant word is 1234h. Each word is divided into two bytes, which are sent least significant byte first and most significant byte second; therefore, the least significant word is sent 78h first and 56h second, and the entire 4-byte value is sent 78h 56h 34h 12h.

The packets on the next page illustrate, respectively, a request for long real-time data from a 4700 power meter with an address of 120 and a response to that request from the meter:

Request Packet

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	03h	01h	78h	85h

Response Packet

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	03h	6Bh	78h C4h 01h 00h C4h 01h 00h C4h 01h 00h C4h 01h 00h 0Fh 03h 00h 0Fh 03h 00h 0Fh 03h 00h 0Fh 03h 00h 67h 0Ah 8Bh 0Ah 68h 0Ah 73h 0Ah 64h 00h A6h 04h 00h B7h 04h 00h A8h 04h 00h 08h 0Eh 00h B3h 04h 00h C4h 04h 00h B4h 04h 00h 2Ch 0Eh 00h AAh 00h 00h ADh 00h 00h ABh 00h 00h 03h 02h 00h 00h 00h 00h 63h 58h 02h 78h 00h 00h 00h 00h 85h 7Ah 53h 00h 0Eh 21h 00h 00h EDh 52h 20h 00h 07h 00h 00h 04h D8h 00h 00h 00h 00h C1h 64h 00h 00h	AAh

If you want more information about the SEAbus protocol or the 4700 power meter, refer to the following related documents:

- *Design Guidelines for the SEAbus™ and SEAbus Plus™ Communications Protocols* (Document No. 01-003-002-0992)
- *Electronic Metering Package: 4700 Power Meter* (manual no. SG-6018)

2 SETUP PACKETS

The packets discussed in this chapter are required to set up the 4700 power meter for operation. They are used to set up and change most of the user-programmable parameters of the meter. When the meter receives setup packets, it stores the information in nonvolatile EEPROM, where it is retained even when the power is turned off. Refer to the *Electronic Metering Package: 4700 Power Meter* (manual no. SG-6018) for a more detailed description of the meter's setup parameters.

2.1 Setup Data

The following packet is a request for the present setup (or configuration) data from the 4700 power meter:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	0Ah	01h	addr	lrc

The meter responds to this packet by returning the following packet containing the setup data:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	0Ah	37h/43h*	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Device type code (An integer representation of 4700, or 125Ch.)	4700	n/a
04h-05h	Software revision code (A 16-bit value with each 4-bit nibble representing a digit in the version number x.x.x.x [for example, 2001h for version 2.0.0.1].)	2000h...9999h	n/a
06h	Feature code (An 8-bit value to represent any special features.)	0...255	n/a
07h-09h	Not used	n/a	n/a
0Ah-0Dh	Volt scale	0...999999	volts
0Eh-0Fh	Not used	n/a	n/a
10h-11h	Amp scale	0...9999	amps

(table continues)

Data Byte No.	Description	Range of Values	Unit
12h-13h	Baud rate	1 = 300 baud 2 = 1200 baud 3 = 2400 baud 4 = 4800 baud 5 = 9600 baud 6 = 19,200 baud	n/a
14h-15h	Volt mode	0 = wye 1 = delta 2 = single phase 3 = demo	n/a
16h-17h	Password	0...9999	n/a
18h-19h	Phase sequence	0 = ABC 1 = ACB	n/a
1Ah-1Dh	Snapshot interval	0...4294967295	seconds
1Eh-1Fh	Demand period length (0 = demand sync mode)	0...99	minutes
20h-21h	Number of demand periods	1...15	minutes
22h	I out range	0 = 0...20mA 1 = 4...20mA	n/a
23h	I out key (refer to the table at the end of this section)	0...25	n/a
24h-25h	Frequency standard	0...30000	tenths of Hertz
26h-29h	I out scale	0...999999	n/a
2Ah-2Bh	Serial port	0 = RS-232 1 = RS-485	n/a
2Ch-2Dh†	Number of KW hours per pulse of Relay #3 (Zero indicates that the relay does not pulse. With software version 2.3.0.4 or later, these bytes are ignored [not used].)	0...32767	kilowatt-hours
2Eh-2Fh	Log status (currently, only the LSB is used) bits 15-12 = Log changes on input #4 bits 11-8 = Log changes on input #3 bits 7-4 = Log changes on input #2 bits 3-0 = Log changes on input #1	0 = not logging 1= logging	n/a
30h-31h†	Number of KVAR hours per pulse of Relay #2 (Zero indicates that the relay does not pulse. With software version 2.3.0.4 or later, these bytes are ignored [not used].)	0...32767	kilovar-hours
32h-35h	Auxiliary voltage (Vaux) input scale	0...999999	volts
36h-37h	Fourth current input (I4) scale	0...9999	amps
38h-39h*	Mode of relay #1	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a

(table continues)

Data Byte No.	Description	Range of Values	Unit
3Ah-3Bh*	If mode is "setpoint", length of pulse from relay #1 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)
3Ch-3Dh*	Mode of relay #2	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a
3Eh-3Fh*	If mode is "setpoint", length of pulse from relay #2 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)
40h-41h*	Mode of relay #3	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a
42h-43h*	If mode is "setpoint", length of pulse from relay #3 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)

† These bytes are ignored in the packet with software 2.3.0.4 or later.
* These bytes appear in the packet *only* with software version 2.3.0.4 or later.

The following packet is issued to change the meter's present setup parameters:

Sync	Dest	Msgt	Len	Data	LRC
14h	FEh	0Bh	2Eh/3Ah*	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h	New device address	1...254	n/a
03h-06h	Volt scale	0...999999	volts
07h-08h	Not used	n/a	n/a
09h-0Ah	Amp scale	0...9999	amps

(table continues)

Data Byte No.	Description	Range of Values	Unit
0Bh-0Ch	Baud rate	1 = 300 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19,200	volts
0Dh-0Eh	Volt mode	0 = wye 1 = delta 2 = single phase 3 = demo	n/a
0Fh-10h	Phase sequence	0 = ABC 1 = ACB	n/a
11h-14h	Snapshot interval	0...4294967295	seconds
15h-16h	Demand period length (0 = demand sync mode)	0...99	minutes
17h-18h	Number of demand periods	1...15	minutes
19h	I out range	0 = 0-20mA 1 = 4-20mA	n/a
1Ah	I out key (refer to the table at the end of this section)	0...25	n/a
1Bh-1Ch	Frequency standard	0...30000	tenths of Hertz
1Dh-20h	I out scale	0...999999	n/a
21h-22h	Not used	n/a	n/a
23h-24h†	Number of KW hours per pulse of Relay #3 (Zero indicates that the relay does not pulse. With software version 2.3.0.4 or later, these bytes are ignored [not used].)	0...32767	kilowatt-hours
25h-26h	Enable/disable logging status	0 = do not log 1 = log status changes	n/a
27h-28h†	Number of KVARH hours per pulse of Relay #2 (Zero indicates that the relay does not pulse. With software version 2.3.0.4 or later, these bytes are ignored [not used].)	0...32767	kilovar-hours
29h-2Ch	Auxiliary voltage (Vaux) input scale	0...999999	volts
2Dh-2Eh	Fourth current input (I4) scale	0...9999	amps
2Fh-30h*	Mode of relay #1	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a

(table continues)

Data Byte No.	Description	Range of Values	Unit
31h-32h*	If mode is "setpoint", length of pulse from relay #1 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)
33h-34h*	Mode of relay #2	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a
35h-36h*	If mode is "setpoint", length of pulse from relay #2 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)
37h-38h*	Mode of relay #3	0 = Setpoint 1 = KWH pulse 2 = KVARH pulse	n/a
39h-3Ah*	If mode is "setpoint", length of pulse from relay #3 (0 = stay latched); or if mode is "KWH pulse", number of kilowatt-hours per pulse; or if mode is KVARH pulse, number of kilovar-hours per pulse.	0...65535	seconds (if mode is "setpoint"); kilowatt-hours (if mode is KWHR per pulse); KVARHR (if mode is KVARHR)

† These bytes are ignored in the packet with software 2.3.0.4 or later.

* These bytes appear in the packet *only* with software version 2.3.0.4 or later.

The two preceding packets each contain a byte (I out key) that indicates to which measured parameter the meter's analog current output will be proportional. The following table shows you the parameters represented by the range of values for that byte.

I out Key	Measured Parameter
0	Volts on phase A (or phase A-B for Delta connection)
1	Volts on phase B (or phase B-C for Delta connection)
2	Volts on phase A (or phase C-A for Delta connection)
3	Current on phase A
4	Current on phase B
5	Current on phase C
6	Kilowatts on phase A
7	Kilowatts on phase B
8	Kilowatts on phase C
9	KVA on phase A
10	KVA on phase B

(table continues)

I out Key	Measured Parameter
11	KVA on phase C
12	KVAR on phase A
13	KVAR on phase B
14	KVAR on phase C
15	Average volts
16	Average current
17	Total kilowatts
18	Total KVA
19	Total KVAR
20	Power factor
21	Kilowatt demand
22	Amp demand
23	Frequency
24	Auxiliary voltage
25	Fourth current input (I_4)

2.2 Time and Date Packets

The following packet is a request for the present time and date setting from the meter:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	0Dh	01h	addr	lrc

The meter responds to the request for time and date by returning the following packet:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	0Dh	0Dh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Device type code (An integer representation of 4700, or 125Ch.)	4700	n/a
04h-05h	Software revision code (A 16-bit value with each 4-bit nibble representing a digit in the version number x.x.x.x [for example, 2001h for version 2.0.0.1].)	2000h...9999h	n/a
06h	Feature code (An 8-bit value to represent any special features.)	0...255	n/a
07h	Not used	n/a	n/a
08h	Year (modulo)	0...99	years
09h	Month	1...12	months

(table continues)

Data Byte No.	Description	Range of Values	Unit
0Ah	Day	1...31	days
0Bh	Hour	0...23	hours
0Ch	Minute	0...59	minutes
0Dh	Second	0...59	seconds

The following packet is issued to change the meter's present time and date:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	07h	0Bh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h	Year (modulo)	0...99	years
03h	Month	1...12	months
04h	Day	1...31	days
05h	Hour	0...23	hours
06h	Minute	0...59	minutes
07h	Second	0...59	seconds
08h-0Bh	Snapshot time	0...4294967295	seconds

Note: You can use this packet as a "broadcast" message to synchronize all 4700 meters (software version 2.0.0.1 or later) on the communications bus.

2.3 Setpoint Parameters

The following packet is a request for the meter's present setpoint parameters:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	0Eh	05h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Not used	n/a	n/a
04h	Number of setpoints in packet	1...15	n/a
05h	Number of first setpoint	1...17	n/a

Note: The number of setpoints in the packet (byte 04h) falls within the range of 1-15, which means that two requests must be made to extract all of the setpoint data. The "Number of first setpoint" (byte 05h) indicates from which setpoint the sequence of setpoints begins in each packet. For example, if you request the first fifteen setpoints in one packet followed by the last two setpoints in the next packet, the numbers of the first setpoints in the two packets are 1 and 16, respectively.

The meter responds to the request for setpoint parameters by returning the following packet:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	0Eh	xxh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Device type code (An integer representation of 4700, or 125Ch.)	4700	n/a
04h-05h	Software revision code (A 16-bit value with each 4-bit nibble representing a digit in the version number x.x.x.x [for example, 2001h for version 2.0.0.1].)	2000h...9999h	n/a
06h	Feature code (An 8-bit value to represent any special features.)	0...255	n/a
07h	Not used	n/a	n/a
08h	Number of setpoints in packet	1...15	n/a
09h	Number of first setpoint	1...17	n/a
0Ah-19h • • • EAh-F9h	Information about the setpoint. Each setpoint encompasses 16 bytes of data, which are appropriated as follows: • 4 bytes to set the low limit • 4 bytes to set the high limit • 2 bytes to release the setpoint's time delay • 2 bytes to operate the setpoint's time delay • 2 bytes to identify the relay number (1-3) • 2 bytes to identify the parameter by key code (refer to the table at the end of this section)	n/a	n/a

The following packet is issued to change the meter's setpoint parameters:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	0Fh	xxh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Not used	n/a	n/a
04h	Number of setpoints in packet	1...15	n/a
05h	Number of first setpoint	1...17	n/a
06h-15h • • • E6h-F5h	Information about the setpoint. Each setpoint encompasses 16 bytes of data, which are appropriated as follows: • 4 bytes to set the low limit • 4 bytes to set the high limit • 2 bytes to release the setpoint's time delay • 2 bytes to operate the setpoint's time delay • 2 bytes to identify the relay number (1-3) • 2 bytes to identify the parameter by key code (refer to the table at the end of this section)	n/a	n/a

Notice that two of the sixteen bytes for each setpoint contain a key code for the particular setpoint parameter. The following table shows you the code for each parameter:

Key	Setpoint Parameter
0	Not used
1	Over Voltage
2	Under Voltage
3	Voltage Unbalance
4	Over Current
5	Current Unbalance
6	Over KVA
7	Over KW Forward
8	Over KW Reverse
9	Over KVAR Forward
10	Over KW Demand
11	Over Amp Demand
12	Over Frequency
13	Under Frequency
14	Over Vaux
15	Under Vaux
16	Phase Reversal
17	Under PF Lagging
18	Under PF Leading
19	Over I4
20	Over KVAR Reverse

3 DATA EXTRACTION PACKETS

This chapter presents the packets used to extract data from the 4700 power meter. They include status packets and short and long real-time data packets. This chapter also presents the alarm status bytes in data packets that are returned from the meter.

3.1 Short Real-Time Data

The following packet is a request for the meter's short real-time data:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	04h	01h	addr	lrc

The meter responds to this request for data by returning the following packet containing short real-time data:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	04h	21h		lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-04h	Average voltage, line-neutral (undefined in Delta mode)	0...999999	volts
05h-07h	Average voltage, line-line	0...999999	volts
08h-09h	Average amps	0...9999	amperes
0Ah-0Ch	Total KVA (vector sum over each phase)	-999999...999999	kilovolt-amperes
0Dh-0Fh	Total kilowatts (vector sum over each phase)	-999999...999999	kilowatts
10h-12h	Total KVAR (vector sum over each phase)	-999999...999999	kilovolt-amperes (reactive)
13h-15h	Kilowatt demand	-999999...999999	kilowatts
16h	Power factor	-99...-60 leading 60...100 lagging	percent
17h-18h	Amp demand	-9999...9999	amperes
19h-21h	Alarm status bytes (refer to section 3.4 below)	n/a	n/a

Note: All 2-byte and 3-byte values are stored least significant byte (LSB) first, most significant byte (MSB) last. Any values that are not available (for example, L-N voltage in a Delta configuration) are returned as undefined.

3.2 Long Real-Time Data

The following packet is a request for the meter's long real-time data:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	03h	01h	addr	lrc

The meter responds to this request for data by returning the following packet containing long real-time data:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	03h	6Bh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h-04h	L-N voltage, phase 1 (undefined in Delta mode)	0...999999	volts
05h-07h	L-N voltage, phase 2 (undefined in Delta mode)	0...999999	volts
08h-0Ah	L-N voltage, phase 3 (undefined in Delta mode)	0...999999	volts
0Bh-0Dh	Average voltage, L-N (undefined in Delta mode)	0...999999	volts
0Eh-10h	L-L voltage, phase 1-2	0...999999	volts
11h-13h	L-L voltage, phase 2-3	0...999999	volts
14h-16h	L-L voltage, phase 3-1	0...999999	volts
17h-19h	Average voltage, L-L	0...999999	volts
1Ah-1Bh	Phase 1 amps	0...9999	amps
1Ch-1Dh	Phase 2 amps	0...9999	amps
1Eh-1Fh	Phase 3 amps (undefined in single-phase, 3-wire mode)	0...9999	amps
20h-21h	Average amps	0...9999	amps
22h-23h	Amps on fourth current input (I4)	0...9999	amps
24h-26h	Kilowatts, phase 1-2 (undefined in Delta mode)	-999999...999999	kilowatts
27h-29h	Kilowatts, phase 2-3 (undefined in Delta mode)	-999999...999999	kilowatts
2Ah-2Ch	Kilowatts, phase 3-1 (undefined in Delta mode)	-999999...999999	kilowatts
2Dh-2Fh	Total kilowatts (vector sum over each phase)	-999999...999999	kilowatts
30h-32h	KVA phase 1-2 (undefined in Delta mode)	0...999999	kilovolt-amperes
33h-35h	KVA phase 2-3 (undefined in Delta mode)	0...999999	kilovolt-amperes
36h-38h	KVA phase 3-1 (undefined in Delta mode)	0...999999	kilovolt-amperes
39h-3Bh	Total KVA (vector sum over each phase)	0...999999	kilovolt-amperes

(table continues)

Data Byte No.	Description	Range of Values	Unit
3Ch-3Eh	KVAR phase 1-2 (undefined in Delta mode)	-999999...999999	kilovolt-amperes (reactive)
3Fh-41h	KVAR phase 2-3 (undefined in Delta mode)	-999999...999999	kilovolt-amperes (reactive)
42h-44h	KVAR phase 3-1 (undefined in Delta mode)	-999999...999999	kilovolt-amperes (reactive)
45h-47h	Total KVAR (vector sum over each phase)	-999999...999999	kilovolt-amperes (reactive)
48h-4Ah	Kilowatt demand	-999999...999999	kilowatts
4Bh	Power factor	-99...-60 leading 60...100 lagging	percent
4Ch-4Dh	Frequency	400...700	Hertz
4Eh-50h	Auxiliary voltage	0...999999	volts
51h-52h	Amp demand	0...9999	amperes
53h-56h	Forward kilowatt hours since last cleared (Prior to software version 2.3.0.4, these bytes returned kilowatt hours total)	0...1,000,000,000	kilowatt hours
57h-5Ah	Reverse kilowatt hours since last cleared	0...1,000,000,000	kilowatt hours
5Bh-5Eh	Forward KVARH since last cleared (Prior to software version 2.3.0.4, these bytes returned KVARH total)	0...1,000,000,000	kilovolt-ampere hours (reactive)
5Fh-67h	Alarm status bytes (refer to section 3.4 below)	n/a	n/a
68h-6Bh	Reverse KVARH since last cleared (Software versions 2.3.0.4 and later)	0...1,000,000,000	kilovolt-ampere hours (reactive)

Note: All 4-byte values are stored least significant word first with the least significant byte of each word first. All 2-byte and 3-byte values are stored least significant byte first, most significant byte last. Any values that are not available (for example, L-N voltage in a Delta configuration) are returned as undefined.

3.3 Status Packets

The following packet is a request for the meter's status information:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	0Ch	01h	addr	lrc

The meter responds by returning the following packet containing the status information:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	0Ch	01h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1..254	n/a
02h-0Ah	Alarm status (refer to section 3.4 below)	n/a	n/a

3.4 Alarm Status Bytes

This section describes the nine alarm status bytes contained in data packets that are returned from the meter. Alarm status bytes are included at the end of status packets and short and long real-time data packets to alert the master device to alarm conditions and new events as quickly as possible.

Byte 1

Bit #	Status of . . .
0 (LSB)	setpoint 1
1	setpoint 2
2	setpoint 3
3	setpoint 4
4	setpoint 5
5	setpoint 6
6	setpoint 7
7 (MSB)	setpoint 8

0 = setpoint normal; 1 = setpoint active

Byte 2

Bit #	Status of . . .
0 (LSB)	setpoint 9
1	setpoint 10
2	setpoint 11
3	setpoint 12
4	setpoint 13
5	setpoint 14
6	setpoint 15
7 (MSB)	setpoint 16

0 = setpoint normal; 1 = setpoint active

Byte 3

Bit #	Status of . . .
0 (LSB)	setpoint 17
1	not used
2	relay 1
3	relay 2
4	relay 3
5	discrete input S1
6	discrete input S2
7 (MSB)	discrete input S3

Setpoint: 0 = normal; 1 = active
Relay: 0 = released; 1 = operated
Discrete input: 0 = ground; 1 = 120VAC

Byte 4

Bit #	Status of . . .
0 (LSB)	discrete input S4
1	flag alrm stat. chng.
2	flag new event
3	flag new min/max
4	flag diagnostic fail.
5	flag new snapshot
6	not used
7 (MSB)	not used

Discrete input: 0 = ground; 1 = 120VAC
Flag: 0 = normal; 1 = asserted

Byte 5 Comprises a counter that is increased by one each time a new event is added to the 4700 power meter event log. The caller can compare the last value it received with the new value, to determine how many new events must be read. The range of this byte is 0-255.

Bytes 6-9 Comprise the discrete input (S1) counter. A count of the number discrete input S1 toggles. The range of values is 0-4294967295.

4 LOG PACKETS

This chapter presents the packets used to retrieve event logs and snapshot logs stored by the 4700 power meter. The meter can store up to 50 events and 100 snapshots. These logs contain too much information to fit into one packet; each log packet can contain as many as nineteen event records or four snapshot records. Packets from the master device specify which information is wanted. Refer to the *Electronic Metering Package: 4700 Power Meter* (manual no. SG-6018) for a more detailed description of the meter's setup parameters.

4.1 Event Log

The following packet is a request for events stored by the meter. It prompts the meter to return information for as many as nineteen events, beginning with the event number identified in the request.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	12h	04h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h	Not used	n/a	n/a
03h-04h	Number of the first event requested	0...49 (0 is the number of the most recent event and 49 is the oldest)	n/a

The next packet requests the "next event," the oldest event that has been logged but has not been previously requested using this packet type.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	13h	01h	addr	lrc

The meter responds to both of the preceding packets with the following packet, varying the Msgt byte (either 12h or 13h) to match the specific request. When returned in response to Msgt 13h, this packet returns information about only one event.

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	12h/13h	xxh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h-03h	Device type code (An integer representation of 4700, or 125Ch.)	4700	n/a
04h-05h	Software revision code (A 16-bit value with each 4-bit nibble representing a digit in the version number x.x.x.x [for example, 2001h for version 2.0.0.1].)	2000h...9999h	n/a
06h	Feature code (An 8-bit value to represent any special features.)	0...255	n/a
07h	Not used	n/a	n/a
08h-09h	Number of last recorded event	0...49 (0 is the most recent event and 49 is the oldest event)	n/a
0Ah-0Bh	Number of last event in packet	0...49	n/a
0Ch-0Dh	Number of events in packet (Packet contains as many events as are available, beginning with the first event requested.)	0...19	events
0Eh-19h • • • E6h-F1h	Information about the event. Each event encompasses 12 bytes of data, which are appropriated as follows: • 4 bytes = time of event (compressed format) • 1 byte = year of event (modulo 100) • 1 byte = event flag event • 2 bytes = event code value • 4 bytes = event log value	n/a	n/a

The three tables on this page and the next provide values for the bytes in the event information of the preceding packet.

Compressed Time Format

Bit Position	Description	Range of Values
31-30	Not used	n/a
29-26	Months	1...12
25-21	Days	1...31
20-16	Hours	0...23
15-10	Minutes	0...59
09-04	Seconds	0...59
03-00	Not used	n/a

Event Flag Value

Bit Position	Description	Range of Values
7	Status of relay #3	0 = Operated 1 = Released
6	Status of relay #2	0 = Operated 1 = Released
5	Status of relay #1	0 = Operated 1 = Released
4-3	Relay number	00 = Relay #0 01 = Relay #1 10 = Relay #2 11 = Relay #3
2	Setpoint status	0 = Inactive 1 = Active
1-0	General information	00 = No data 01 = Front Panel Event 10 = Comm Packet Event 11 = Forced Relay Operation

Event Code Value

01 - Setpoint Over Voltage
02 - Setpoint Under Voltage
03 - Setpoint Voltage Unbalance
04 - Setpoint Over Amperage
05 - Setpoint Amperage Unbalance
06 - Setpoint Over KVA
07 - Setpoint Over KW
08 - Setpoint Over KW Reverse
09 - Setpoint Over KVAR
10 - Setpoint Over KW Demand
11 - Setpoint Over Amp Demand
12 - Setpoint Over Frequency (×10)
13 - Setpoint Under Frequency (×10)
14 - Setpoint Over Vaux
15 - Setpoint Under Vaux
16 - Setpoint Phase Reversal
17 - Setpoint Under PF Lagging
18 - Setpoint Under PF Leading
19 - Setpoint Over I4
32 - Setpoint Over Voltage Phase A
33 - Setpoint Over Voltage Phase B
34 - Setpoint Over Voltage Phase C
36 - Setpoint Under Voltage Phase A
37 - Setpoint Under Voltage Phase B
38 - Setpoint Under Voltage Phase C
40 - Setpoint Volt. Unbalance Phase A
41 - Setpoint Volt. Unbalance Phase B
42 - Setpoint Volt. Unbalance Phase C
44 - Setpoint Over Amperage Phase A
45 - Setpoint Over Amperage Phase B
46 - Setpoint Over Amperage Phase C
48 - Setpoint Amp. Unbalance Phase A
49 - Setpoint Amp. Unbalance Phase B
50 - Setpoint Amp. Unbalance Phase C
257 - Time Set
258 - Setup Changed
259 - Alarms Changed
260 - Power Up/Reset
261 - Relay Control
262 - Cleared Max/Min
263 - Cleared Hours
268 - Factory Clear
269 - Firmware Revision
270 - NV Failure
271 - Frequency Failure
272 - Hydro Failure
273 - Setpoint Failure
274 - Front Panel Failure
275 - Propack Failure
276 - ISR Failure
277 - Init Failure
278 - Calc Failure
279 - Timer Failure
280 - Status Input Failure
281 - Status Input #1 - Normal
282 - Status Input #2 - Normal
283 - Status Input #3 - Normal
284 - Status Input #4 - Normal
285 - Status Input #1 - Active
286 - Status Input #2 - Active
287 - Status Input #3 - Active
288 - Status Input #4 - Active

4.2 Request Snapshot Log

The following packet is a request for data snapshots stored by the meter. It prompts the meter to return information for as many as four snapshots, beginning with the event number identified in the request.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	10h	05h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	4700 address	1...254	n/a
02h-03h	Not used	n/a	n/a
04h-05h	Number of the first snapshot requested	0...99 (0 is the number of the most recent snapshot and 99 is the oldest)	n/a

The next packet requests the "next snapshot," the oldest snapshot that has been logged but has not been previously requested using this packet type.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	11h	01h	addr	lrc

The meter responds to both of the preceding packets with the following packet, varying the Msgt byte (either 10h or 11h) to match the specific request. When returned in response to Msgt 11h, this packet returns information about only one snapshot.

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	10h/11h	xxh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h-03h	Device type code (An integer representation of 4700, or 125Ch.)	4700	n/a
04h-05h	Software revision code (A 16-bit value with each 4-bit nibble representing a digit in the version number x.x.x.x [for example, 2001h for version 2.0.0.1].)	2000h...9999h	n/a
06h	Feature code (An 8-bit value to represent any special features.)	0...255	n/a
07h	Not used	n/a	n/a
08h-09h	Number of last recorded snapshot	0...99 (0 is the most recent snapshot and 99 is the oldest)	
0Ah-0Bh	Number of last snapshot in packet	0...99	n/a
0Ch-0Dh	Number of snapshots in packet (packet contains as many snapshots as are available, beginning with the first snapshot requested)	1...4	snapshots
0Eh-41h • • • AAh-DDh	Information about the snapshot. Each snapshot encompasses 52 bytes of data, which are appropriated as follows: • 4 bytes = time of snapshot (compressed format) • 4 bytes = average voltage (L-L or L-N) • 4 bytes = average amps • 4 bytes = kilowatts • 4 bytes = KVAR • 4 bytes = kilowatt demand • 4 bytes = amp demand • 2 bytes = power factor • 2 bytes = frequency • 4 bytes = auxiliary voltage • 4 bytes = kilowatt-hours • 4 bytes = KVAR hours • 4 bytes = kilowatts reverse • 4 bytes = not used	n/a	n/a

The following table defines the values of bits in the four bytes that comprise the time of the snapshot.

Compressed Time Format

Bit Position	Description	Range of Values
31-30	Not used	n/a
29-26	Months	1...12
25-21	Days	1...31
20-16	Hours	0...23
15-10	Minutes	0...59
09-04	Seconds	0...59
03-00	Not used	n/a

5 MINIMUM AND MAXIMUM DATA PACKETS

This chapter presents the packets used to retrieve minimum and maximum values stored by the 4700 power meter. These packets include requests and responses for both minimum and maximum values, with and without a subsequent resetting of those values.

5.1 Minimum Data Values

The following packet is a request for the meter's minimum data values. It does **not** reset any of the values it returns.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Bh	01h	addr	lrc

The next packet requests the same minimum data values as the preceding packet, and in addition, it subsequently resets all values to the meter's present values for each quantity.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Ch	01h	addr	lrc

The meter responds to both of the preceding two packets with the following packet, varying the Msgt byte (either 1Bh or 1Ch) to match the specific request. When returned in response to Msgt 1Ch, it resets all minimum data values and their times to the meter's present values and times for each quantity.

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	1Bh/1Ch	8Bh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h-04h	Minimum L-N voltage, phase 1 (undefined in Delta mode)	0...999999	volts
05h-07h	Minimum L-N voltage, phase 2 (undefined in Delta mode)	0...999999	volts
08h-0Ah	Minimum L-N voltage, phase 3 (undefined in Delta mode)	0...999999	volts
0Bh-0Dh	Average minimum L-N voltage (undefined in Delta mode)	0...999999	volts
0Eh-10h	Minimum L-L voltage, phase 1-2	0...999999	volts
11h-13h	Minimum L-L voltage, phase 2-3	0...999999	volts
14h-16h	Minimum L-L voltage, phase 3-1	0.. 999999	volts

(table continues)

Data Byte No.	Description	Range of Values	Unit
17h-19h	Average minimum L-L voltage	0...999999	volts
1Ah-1Bh	Minimum amperage, phase 1-2	-9999...9999	amps
1Ch-1Dh	Minimum amperage, phase 2-3	-9999...9999	amps
1Eh-1Fh	Minimum amperage, phase 3-1	-9999...9999	amps
20h-21h	Minimum average phase amperage	-9999...9999	amps
22h-24h	Minimum total kilowatts (vector sum over each phase	-999999...999999	kilowatts
25h-27h	Minimum total KVA (vector sum over each phase)	0...999999	kilovolt-amperes
28h-2Ah	Minimum total KVAR (vector sum over each phase)	-999999...999999	kilovolt-amperes
2Bh-2Dh	Minimum kilowatt demand	-999999...999999	kilowatts
2Eh	Minimum power factor	-99...-60 leading 60...100 lagging	percent
2Fh-30h	Minimum frequency	400...700	tenths of Hertz
31h-33h	Minimum auxiliary voltage	0...999999	volts
34h-35h	Minimum amp demand	0...9999	amps
36h-37h	Minimum amperage on fourth current input (I4)	0...9999	amps
38h-3Bh	Time and date of minimum L-N voltage on phase 1 (undefined in Delta mode)	(see table below)	n/a
3Ch-3Fh	Time and date of minimum L-N voltage on phase 2 (undefined in Delta mode)	(see table below)	n/a
40h-43h	Time and date of minimum L-N voltage on phase 3 (undefined in Delta mode)	(see table below)	n/a
44h-47h	Time and date of minimum L-N average voltage (undefined in Delta mode)	(see table below)	n/a
48h-4Bh	Time and date of minimum L-L phase 1-2 voltage	(see table below)	n/a
4Ch-4Fh	Time and date of minimum L-L phase 2-3 voltage	(see table below)	n/a
50h-53h	Time and date of minimum L-L phase 3-1 voltage	(see table below)	n/a
54h-57h	Time and date of minimum L-L average voltage	(see table below)	n/a
58h-5Bh	Time and date of minimum phase 1-2 amperage	(see table below)	n/a
5Ch-5Fh	Time and date of minimum phase 2-3 amperage	(see table below)	n/a
60h-63h	Time and date of minimum phase 3-1 amperage	(see table below)	n/a
64h-67h	Time and date of minimum average amperage	(see table below)	n/a
68h-6Bh	Time and date of minimum total kilowatts	(see table below)	n/a
6Ch-6Fh	Time and date of minimum total KVA	(see table below)	n/a
70h-73h	Time and date of minimum total KVAR	(see table below)	n/a
74h-77h	Time and date of minimum kilowatt demand	(see table below)	n/a
78h-7Bh	Time and date of minimum power factor	(see table below)	n/a
7Ch-7Fh	Time and date of minimum frequency	(see table below)	n/a
80h-83h	Time and date of minimum auxiliary voltage	(see table below)	n/a
84h-87h	Time and date of minimum amp demand	(see table below)	n/a
88h-8Bh	Time and date of minimum I4 amperage	(see table below)	n/a

Note: All 4-byte values are stored least significant word first with the least significant byte of each word first. All 2-byte and 3-byte values are stored least significant byte first, most significant byte last. Any values that are not available (for example, L-N voltage in a Delta configuration) are returned as undefined.

The following table tells you the bit positions for all 4-byte time values.

Compressed Time Format

Bit Position	Description	Range of Values
31-30	Not used	n/a
29-26	Months	1...12
25-21	Days	1.. 31
20-16	Hours	0...23
15-10	Minutes	0...59
09-04	Seconds	0...59
03-00	Not used	n/a

5.2 Maximum Data Values

The following packet is a request for the meter's maximum data values. It does **not** reset any of the values it returns.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Dh	01h	addr	lrc

The next packet requests the same maximum data values as the preceding packet, and in addition, it subsequently resets all values to the meter's present values for each quantity.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Eh	01h	addr	lrc

The meter responds to both of the preceding packets with the following packet, varying the Msgt byte (either 1Dh or 1Eh) to match the specific request. When returned in response to Msgt 1Eh, it resets all maximum data values and their times to the meter's present values and times for each quantity.

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	1Dh/1Eh	8Bh	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	
02h-04h	Maximum L-N voltage, phase 1 (undefined in Delta mode)	0...999999	volts
05h-07h	Maximum L-N voltage, phase 2 (undefined in Delta mode)	0...999999	volts
08h-0Ah	Maximum L-N voltage, phase 3 (undefined in Delta mode)	0...999999	volts
0Bh-0Dh	Average maximum L-N voltage (undefined in Delta mode)	0...999999	volts
0Eh-10h	Maximum L-L voltage, phase 1-2	0...999999	volts
11h-13h	Maximum L-L voltage, phase 2-3	0...999999	volts
14h-16h	Maximum L-L voltage, phase 3-1	0...999999	volts
17h-19h	Average maximum L-L voltage	0...999999	volts
1Ah-1Bh	Maximum amperage, phase 1-2	-9999...9999	amps
1Ch-1Dh	Maximum amperage, phase 2-3	-9999...9999	amps
1Eh-1Fh	Maximum amperage, phase 3-1	-9999...9999	amps
20h-21h	Maximum average phase amperage	-9999...9999	amps
22h-24h	Maximum total kilowatts (vector sum over each phase	-999999...999999	kilowatts
25h-27h	Maximum total KVA (vector sum over each phase)	0...999999	kilovolt-amperes
28h-2Ah	Maximum total KVAR (vector sum over each phase)	-999999...999999	kilovolt-amperes
2Bh-2Dh	Maximum kilowatt demand	-999999...999999	kilowatts
2Eh	Maximum power factor	-99...-60 leading 60...100 lagging	percent
2Fh-30h	Maximum frequency	400...700	tenths of Hertz
31h-33h	Maximum auxiliary voltage	0...999999	volts
34h-35h	Maximum amp demand	0...9999	amps
36h-37h	Maximum amperage on fourth current input (I4)	0...9999	amps
38h-3Bh	Time and date of maximum L-N voltage on phase 1 (undefined in Delta mode)	(see table below)	n/a

(table continues)

Data Byte No.	Description	Range of Values	Unit
3Ch-3Fh	Time and date of maximum L-N voltage on phase 2 (undefined in Delta mode)	(see table below)	n/a
40h-43h	Time and date of maximum L-N voltage on phase 3 (undefined in Delta mode)	(see table below)	n/a
44h-47h	Time and date of maximum L-N average voltage (undefined in Delta mode)	(see table below)	n/a
48h-4Bh	Time and date of maximum L-L phase 1-2 voltage	(see table below)	n/a
4Ch-4Fh	Time and date of maximum L-L phase 2-3 voltage	(see table below)	n/a
50h-53h	Time and date of maximum L-L phase 3-1 voltage	(see table below)	n/a
54h-57h	Time and date of maximum L-L average voltage	(see table below)	n/a
58h-5Bh	Time and date of maximum phase 1-2 amperage	(see table below)	n/a
5Ch-5Fh	Time and date of maximum phase 2-3 amperage	(see table below)	n/a
60h-63h	Time and date of maximum phase 3-1 amperage	(see table below)	n/a
64h-67h	Time and date of maximum average amperage	(see table below)	n/a
68h-6Bh	Time and date of maximum total kilowatts	(see table below)	n/a
6Ch-6Fh	Time and date of maximum total KVA	(see table below)	n/a
70h-73h	Time and date of maximum total KVAR	(see table below)	n/a
74h-77h	Time and date of maximum kilowatt demand	(see table below)	n/a
78h-7Bh	Time and date of maximum power factor	(see table below)	n/a
7Ch-7Fh	Time and date of maximum frequency	(see table below)	n/a
80h-83h	Time and date of maximum auxiliary voltage	(see table below)	n/a
84h-87h	Time and date of maximum amp demand	(see table below)	n/a
88h-8Bh	Time and date of minimum I4 amperage	(see table below)	n/a

Note: All 4-byte values are stored least significant word first with the least significant byte of each word first. All 2-byte and 3-byte values are stored least significant byte first, most significant byte last. Any values that are not available (for example, L-N voltage in a Delta configuration) are returned as undefined.

The following table tells you the bit positions for all 4-byte time values.

Compressed Time Format

Bit Position	Description	Range of Values
31-30	Not used	n/a
29-26	Months	1...12
25-21	Days	1...31
20-16	Hours	0...23
15-10	Minutes	0...59
09-04	Seconds	0...59
03-00	Not used	n/a

6 COMMAND PACKETS

This chapter presents the packets used to control specific functions of the 4700 power meter, including clearing KW hours, KVAR hours, and the discrete input counter, as well as controlling the relays.

6.1 Clear KW Hours

The following packet is issued to clear the KW-hour reading stored by the meter:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	16h	01h	addr	lrc

6.2 Clear KVAR Hours

The following packet is issued to clear the KVAR-hour reading stored by the meter:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	17h	01h	addr	lrc

6.3 Clear Discrete Input Counter

The following packet is issued to clear the count from discrete input #1:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Fh	01h	addr	lrc

6.4 Control Relays

The following packet is issued to control any of the three relays used by the meter:

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	1Fh	05h	addr	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h-03h	Relay number	1...3	n/a
04h-05h	Relay command	0 = Relay returns to setpoint control 1 = Relay is operated by operator 2 = Relay is released by operator	n/a

7 WAVEFORM CAPTURE PACKETS

The following packet is a request to retrieve waveform data from the 4700 power meter.

Sync	Devt	Msgt	Len	Data	LRC
14h	FEh	22h	02h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h	Channel number requested **Returns** **Channel** **Wye or Delta** 0 V_1 V_{ab} 1 I_1 I_1 2 V_2 n/a 3 I_2 I_2 4 V_3 V_{cb} 5 I_3 I_3 6 I_4 I_4 7 V_{aux} V_{aux}	0...7	n/a

The meter responds to this request by returning the following packet:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	22h	C6h	....	lrc

Data Byte No.	Description	Range of Values	Unit
01h	Device address	1...254	n/a
02h	Channel number returned	0...7	n/a
03h-04h	Number of waveform samples in packet (2 samples per 3 bytes of data)	128	n/a
05h-06h	Delay between waveform samples	130	µs
07h ...	12-bit waveform samples. (Two samples are stored across three bytes. Specifically, the first byte contains the *lower eight bits of the **second** sample*. The second byte contains the *upper four bits of the **second** sample* in its lower four bits, and it contains the *lower four bits of the **first** sample* in its upper four bits. The third byte contains the *upper eight bits of the **first** sample*.)	0...4095	volts or amps

Consider the following example of a response packet containing waveform data:

Sync	Devt	Msgt	Len	Data	LRC
27h	FEh	22h	C6h	78h 02h 80h 00h 82h 00h C4h 42h 31h . . .	D9h

Bytes 7 through 9 in the Data field contain the data from the first pair of samples returned. Accordingly, sample #1 has a value of 708, and sample #2 has a value of 788.