GE Electronic Protection Instrumentation and Control System Host Interface

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INTRODUCTION

The Electronic Protection, Instrumentation and Control system is used in AKD-8 switchgear applications to monitor electrical distribution parameters. The system allows the user to monitor these parameters locally at the switchgear as well as remotely at a host computer.

Figure 1 shows the components contained in the Electronic Protection, Instrumentation and Control system. The dashed lines represent components housed within the switchgear. Each Breaker Programmer Unit (BPU) measures the electrical parameters for that breaker. This information is communicated to the Field Programming Unit (FPU) via the internal communication bus. The FPU serves as the user interface to the system.

The FPU also provides an interface to the host computer. This is achieved through an RS-232 port located at the back of the FPU and brought out to the cable section of the switchgear as shown in Figure 2. Two remote communication options are available. Direct hardwired connection is possible if the host computer is within 50 feet of the FPU. Otherwise, modems are required and communication takes place over a telephone line. If specified, the modem will be mounted in the switchgear and connected to the FPU. In this case, the terminals for the telephone connection will be mounted in the cable section as shown in Figure 3. At the host computer, the cable will terminate into another modem. The modem will be connected to the computer to create a complete link.

Figure 4 illustrates the process of accessing data from the Electronic Protection, Instrumentation and Control system. There are three steps in this process:

1. The host requests specific information about a particular breaker from the FPU.
2. The FPU solicits the information from that breaker.
3. The FPU then transmits the response to the host.

Each transaction must be completed before the next request can be initiated.

This document describes in detail the protocol which is to be followed for communications between the Electronic Protection, Instrumentation and Control system and a host computer.

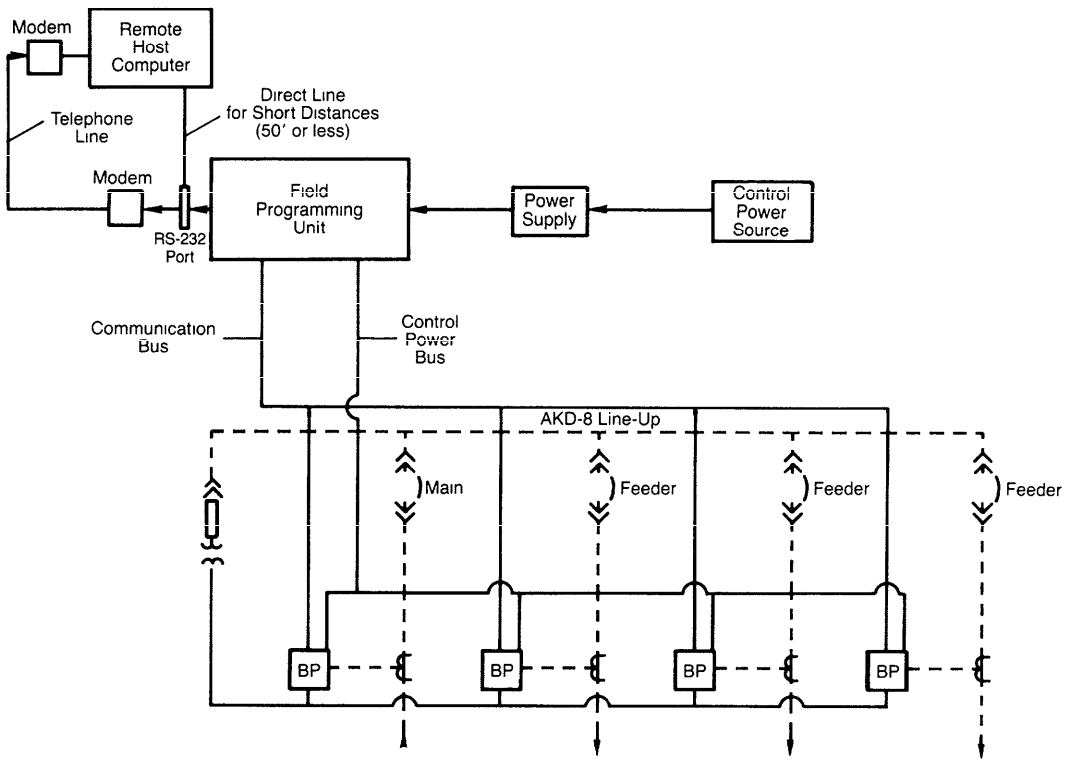


Figure 1. Electronic Protection, Instrumentation and Control System in AKD-8 Switchgear

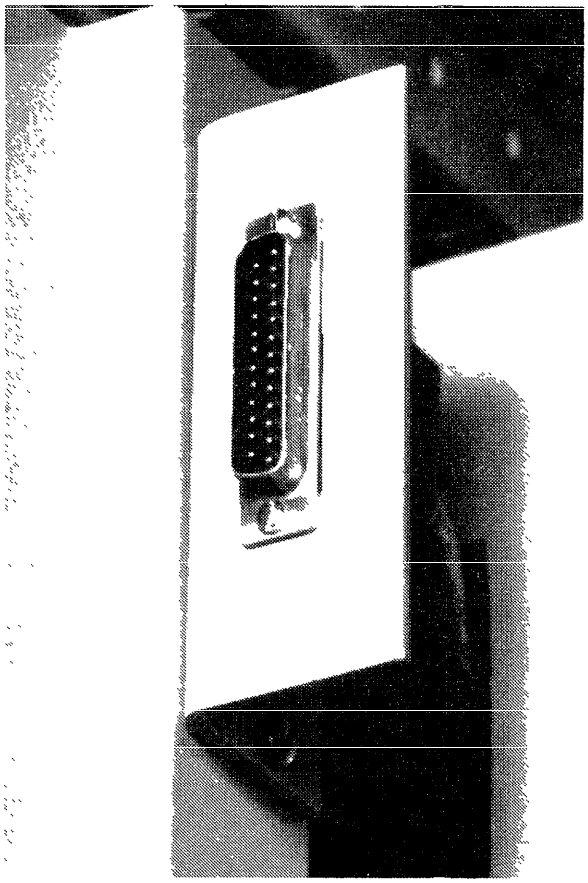


Figure 2.
RS-232 Port Location

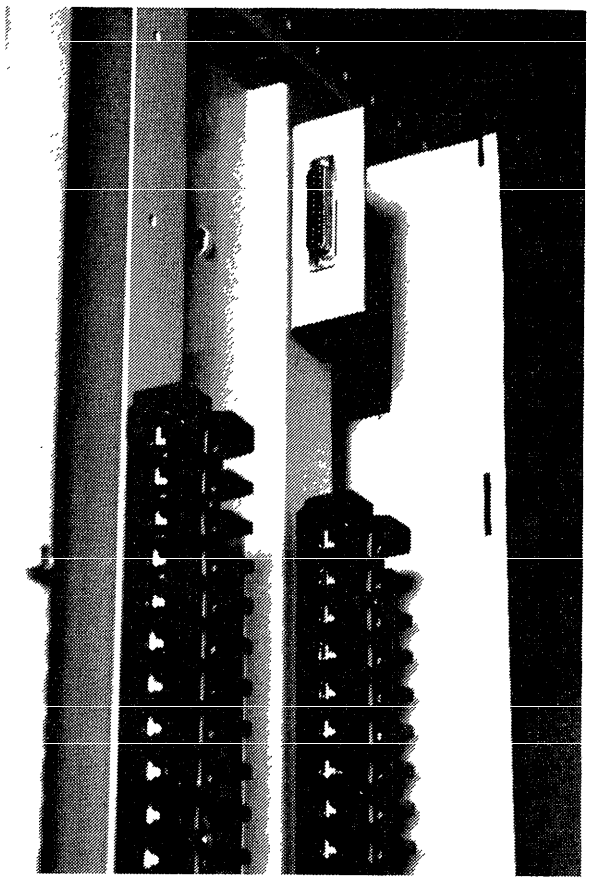
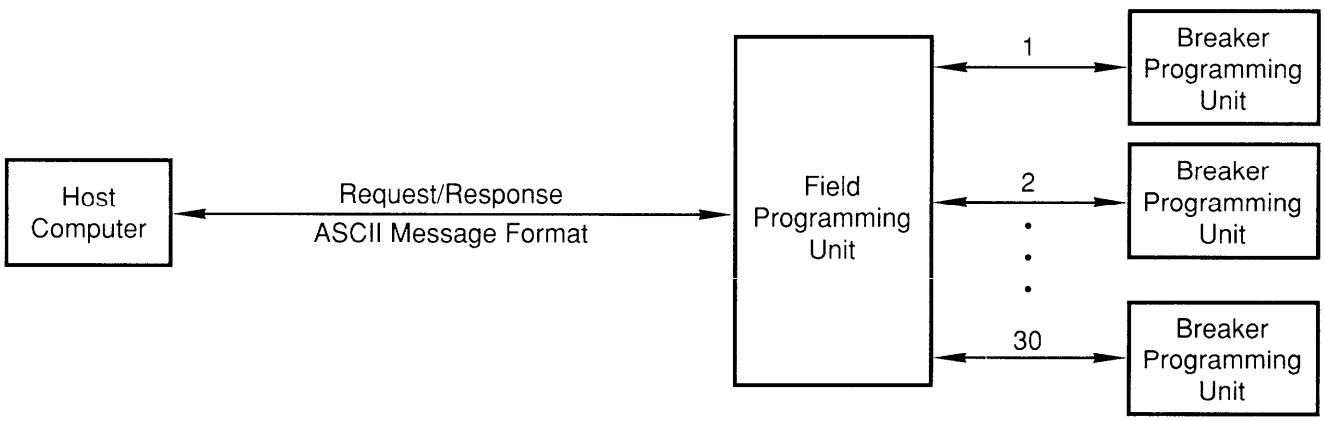


Figure 3.
Terminations for Phone Lines and Discrete Contacts



Note: Modems can be added at the host and FPU if the communication distance exceeds 50 feet.

Figure 4. Communication Process

DEFINITION OF TERMS

ACK	ACKnowledge character
ADC	Analog to Digital Converter
Checksum	Arithmetic sum of the least seven bits of the ASCII message body (see Message Format)
DCE	Data Circuit-terminating Equipment
Delimiter	Marker between two different fields of data
Discrete	On/off type of input that is monitored by the FPU
DTE	Data Terminal Equipment
EIA	Electronic Industries Association
FPU	Field Programming Unit
GF	Ground Fault
Handshake	Technique of communication between two devices when the rate of data being sent is much faster than the rate at which the receiving device can process the data
Homenet	GE Proprietary Home Bus Protocol Network
Host	Host computer, such as a VAX, IBMPC
IACK	Immediate ACKnowledgement
INT	Metering interrupt failure. Indicates a malfunction in the voltage input waveforms.
IPC	Inter Processor Communication
kVA	kiloVoltAmps
kVAR	kiloVolt Amperes Reactive
kW	kilowatts
NACK	Negative ACKnowledge character
NVM	Non Volatile Memory
OPN	Open
PF	Power Factor
RAM	Random Access Memory
RMS	Root Mean Square
ROM	Read Only Memory
RS-232-C	Interconnection standard between DCE and DTE published by Electronic Industries Association, Washington, D.C.
Two's complement	The number which when added to another, results in a sum of zero

EIA RS-232-C PROTOCOL

The FPU provides a standard, full duplex protocol, EIA RS-232-C, for host communication. The FPU has a Data Terminal Equipment (DTE) interface and may be connected directly to a Data Circuit-terminating Equipment (DCE) device (i.e., modem). A "null modem" connection must be used to connect directly to another DTE.

The EIA RS-232-C protocol is only for communications up to 50 feet when using a shielded cable. The FPU requires only the send, receive and ground lines to be connected. The pinout for the EIA RS-232-C connector is:

Pin No.	Signal Name
1	Frame ground
2	Transmit data output*
3	Receive data input*
4	Request to send output
5	Clear to send input
6	Data set ready input
7	Signal ground*
8	Carrier detect input
20	Data terminal ready output

*Signal required by the FPU.

INFORMATION PROTOCOL

Half duplex communication is used in the host communication protocol, therefore the host and the FPU cannot communicate simultaneously. The host must initiate the transaction. The FPU will then reply with the requested data. The host must wait for one transaction to be completed before initiating another request.

Each message body must begin with a "Start of Text" character (02) and be terminated by the "End of Text" charact (03). The mesage body consists of system data as well as a checksum field.

Upon receipt of the message a checksum test is performed. If the checksum test is successful, an "ACKnowledge" character (06) is sent indicating a valid reception. If an error is detected by the checksum test, a Negative ACKnowledge character (21) is sent. A NACK should be assumed by the sender if the ACK is not received within one second. The FPU will retry a negative acknowledged message up to three times. If the message reply is not initiated within ten seconds, the sending station should assume a NACK.

The following example illustrates a valid transaction:

Host ▸ FPU : 02 Current Request, Breaker Address, Checksum 03
FPU ▸ Host : 06
FPU ▸ Host : 02 Current Reply, Breaker Address, PhA Current, PhB Current, PhC Current, Checksum 03 Carriage return
Host ▸ FPU : 06

The host computer can take advantage of the standard XON/XOFF communication "handshaking". This handshaking is used when the FPU is transmitting data to the host. When the Host Input Buffer is almost full, the host sends an XOFF character (19) and the FPU will stop transmission. The host will continue with its processing and send an XON character (17) when it is ready to receive more data. Upon receipt of the XON character, the FPU will resume data transmission.

All transmissions originating at the FPU, messages and acknowledges, are terminated with a carriage return character (13). This character allows the host terminal drivers to respond to the transmission and pass the information to the application program. Note that the carriage return has no meaning and is not to be treated as a message delimiter. The carriage return should be used only to get the attention of the host computer.

MESSAGE FORMAT

The body of a message is encoded using ASCII characters. For example, the number 27 is represented by the ASCII characters for 2 and 7. The message body is divided into fields delimited by an ASCII comma. The first field is the message number, and the last field is the checksum. The message number is an unsigned integer number between 1 and 65535. The checksum field is determined as follows:

1. The sum of the least significant seven bits of each ASCII character in the message body (including commas) is calculated.
2. The resultant sum is limited to the least significant 8 bits; the most significant bits are dropped.
3. The two's complement of the remaining bits is calculated. Note that adding the checksum and the least significant bits of the resultant sum will yield zero.
4. The checksum field is the ASCII equivalent of the complement. For example, if the checksum value is 14 decimal, the checksum field is: (ASCII) 1 (ASC11) 4.

MESSAGE DESCRIPTIONS

The functions which may be accessed via the host communication interface are:

- Metering
- Status reporting
- Setpoints
- Event recording/annunciation
- System setup

Metering Messages

The host can access the metering values for any breaker in the GE switchgear with the Electronic Protection, Instrumentation and Control System.

From Host to FPU | *From FPU to Host*

1. RMS Phase Current Request
Description: RMS phase current request

Field Name	Type	Units	Range
Breaker address	String	None	①

2. RMS Phase Current Values Reply
Description: RMS phase current values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Phase A current	Value	Amps	0-8000
Phase B current	Value	Amps	0-8000
Phase C current	Value	Amps	0-8000

3. RMS Phase Voltage Request (Line —Neutral)
Description: RMS phase voltage request

Field Name	Type	Units	Range
Breaker address	String	None	①

4. RMS Phase Voltage Values (Line —Neutral) Reply
Description: RMS phase voltage values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Phase A voltage	Value	Volts	0-27600
Phase B voltage	Value	Volts	0-27600
Phase C voltage	Value	Volts	0-27600

5. RMS Phase Voltage Request (Line —Line)
Description: RMS phase voltage request

Field Name	Type	Units	Range
Breaker address	String	None	①

6. RMS Phase Voltage Values (Line — Line) Reply
Description: RMS phase voltage values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Phase A-B voltage	Value	Volts	0-27600
Phase B-C voltage	Value	Volts	0-27600
Phase C-A voltage	Value	Volts	0-27600

① Two to five alpha numeric, user-defined at the FPU.

7. Power Request
Description: Power request

Field Name	Type	Units	Range
Breaker address	String	None	①

8. Power Values Reply
Description: Power values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Real power	Value	Kw	0-99999.9②
Reactive power	Value	Kvar	0-99999.9②
Total power-a	Value	Kva	0-99999.9②
Total power-b	Value	Kva	0-99999.9②
Total power-c	Value	Kva	0-99999.9②
Power factor-a	Value	None	0-1.00
Power factor-b	Value	None	0-1.00
Power factor-c	Value	None	0-1.00
PF lead/lag-a	String	None	"leading"/ "lagging"
PF lead/lag-b	String	None	"leading"/ "lagging"
PF lead/lag-c	String	None	"leading"/ "lagging"

9. Energy and Demand Request
Description: Energy and demand request

Field Name	Type	Units	Range
Breaker address	String	None	①

10. Energy and Demand Values Reply
Description: Energy and demand values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Energy reading	Value	Kwh	0-99999.9②
Energy reset time	String	Date, ytime	mm/dd/yyyy③ hh:mm③
Demand reading	Value	Kw	0-99999.9②
Peak demand reading	Value	Kw	0-99999.9②
Peak demand time	String	Date, time	mm/dd/yyyy③ hh:mm③

11. Frequency Request
Description: Frequency request

Field Name	Type	Units	Range
Breaker address	String	None	①

12. Frequency Values Reply
Description: Frequency values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Frequency	Value	Hz	40.0-70.0

13. Capacity Request
Description: Capacity request

Field Name	Type	Units	Range
Breaker address	String	None	①

14. Capacity Values Reply
Description: Capacity values reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Peak capacity	Value	None	0-99999.9②
Peak capacity time	String	Date, time	mm/dd/yyyy③ hh:mm③

① Two to five alpha numeric, user-defined at the FPU.
② These values are dependent on the system and may exceed the limit shown.
③ Note that the FPU suppresses leading zeros in all fields at the time and date.

Status Messages

The status of any breaker may be requested from the host. The messages used to request the status are described below.

From FPU to Host | *From Host to FPU*

20. Status Request
Description: Status request message

Field Name	Type	Units	Range
Breaker address	String	None	①

21. Status Reply (See Figure 5)
Description: Status report reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Status flag count	Value	None	1-18
Flags	String(s)	None	2-4 alpha defined below

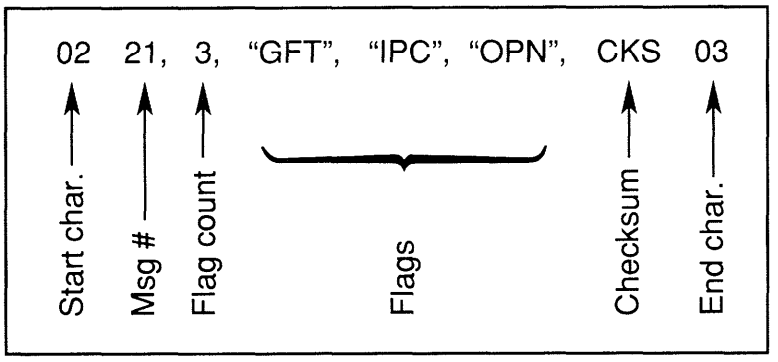


Figure 5. Status Reply Example

Status flags (1-18) — Any combination of the following:

"GFT"	Ground Fault Trip
"LTT"	Long Time Trip
"STT"	Short Time Trip
"LTP"	Long Time Pickup
"IT"	Instantaneous Trip
"PAF"	ADC protection self test fail
"PRAF"	RAM protection self test fail
"PROF"	ROM protection self test fail
"PNF"	NVM protection self test fail
"AF"	ADC metering self test fail
"RAF"	RAM metering self test fail
"ROF"	ROM metering self test fail
"NF"	NVM metering self test fail
"INT"	INT metering self test fail
"IPC"	IPC failure
"UV"	Under Voltage
"VU"	Voltage Unbalance
"CU"	Current Unbalance
"PWR"	Power Reversal
"OPN"	Breaker is open
"CLS"	Breaker is closed

Protective Relaying Setpoint Messages

The setpoints for the four protective relays may be examined using the following messages.

31. Under Voltage Setpoint Request
Description: Under voltage request

Field Name	Type	Units	Range
Breaker address	String	None	①

32. Under Voltage Setpoint Reply
Description: Under voltage setpoint reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Setpoint	Value	Percent	50-90
Time delay	Value	Seconds	1-15, 0-off

34. Current Unbalance Setpoint Request
Description: Current unbalance request

Field Name	Type	Units	Range
Breaker address	String	None	①

35. Current Unbalance Setpoint Reply
Description: Current unbalance setpoint reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Setpoint	Value	Percent	5-50
Time delay	Value	Seconds	1-15, 0-off

① Two to five alpha numeric, user-defined at the FPU.

From FPU to Host | *From Host to FPU*

37. Voltage Unbalance Setpoint Request
Description: Voltage unbalance request

Field Name	Type	Units	Range
Breaker address	String	None	①

38. Voltage Unbalance Setpoint Reply
Description: Voltage unbalance setpoint reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Setpoint	Value	Percent	5-50
Time delay	Value	Seconds	1-15, 0-off

40. Power Reversal Setpoint Request
Description: Power reversal request

Field Name	Type	Units	Range
Breaker address	String	None	①

41. Power Reversal Setpoint Reply
Description: Power reversal setpoint reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Setpoint	Value	Kw	1-7200
Time Delay	Value	Seconds	1-15, 0-off

Event Messages

The FPU keeps a queue of power system events. The host can access these events with the following messages.

50. Number of Events Request
Description: Request for the number of events in the queue

Field Name	Type	Units	Range
None	—	—	—

51. Number of Events Reply
Description: Number of events in the queue

Field Name	Type	Units	Range
Number of events	Value	None	0-64

52. Send the Oldest Events
Description: Send the oldest events

Field Name	Type	Units	Range
Number of events to send	Value	None	1-64

53. Send the Newest Events
Description: Send the newest events

Field Name	Type	Units	Range
Number of events to send	Value	None	1-64

54. Send All Events
Description: Send all events

Field Name	Type	Units	Range
None	—	—	—

55. Events Reply
Description: Events in chronological order (Latest, oldest or as stored in the event memory)

Field Name	Type	Units	Range
Event 1	String	(41 characters)	
(Text same as displayed on FPU; Format: 20 characters, space, 20 characters (no commas in actual message)			
Events 2 through 64 as above			

① Two to five alpha numeric, user-defined at the FPU.

System Setup

The host may request the following system setup information from the FPU.

From Host to FPU | *From FPU to Host*

60. System Information Request
Description: Request for system information

Field Name	Type	Units	Range
None	—	—	—

61. System Information Reply
Description: System information reply

Field Name	Type	Units	Range
Date	String	Day	mm/dd/yyyy②
Time of day	String	Time	hh:mm:ss②
Demand interval	Value	Minutes	5, 15, 30, 60
Host communications setup	String		See below

The host communications setup string provides information about the baud rate, the data bits, the stop bits and the parity. The possible strings for each of these fields are:

Baud Rate Values	Data Bit Values	Stop Bit Values	Parity Value
300 Baud	Eight Data Bits	Two Stop Bits	Even Parity
600 Baud	Seven Data Bits	One Stop Bit	Odd Parity
1200 Baud			No Parity
2400 Baud			
4800 Baud			
9600 Baud			

A sample FPU response to a System Information Request would be:
02 61, 9/15/1988, 10:54:15, 15, 9600 Baud, Eight Data Bits, One Stop Bit, Odd Parity, checksum 03.

62. Request for Number of Breakers
Description: Request for number of breakers

Field Name	Type	Units	Range
None	—	—	—

63. Number of Breakers Reply
Description: Number of breakers reply

Field Name	Type	Units	Range
Number of breakers	Value	None	0-30

64. Request for Breaker Addresses
Description: Request for breaker addresses

Field Name	Type	Units	Range
None	—	—	—

65. Breaker Addresses Reply
Description: Breaker addresses reply

Field Name	Type	Units	Range
Breaker address	String	None	①

66. Programmer System Information Request
Description: Programmer system information request

Field Name	Type	Units	Range
Breaker address	String	None	①

67. Programmer System Information
Description: Programmer system information reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Demand selected	String	None	"off"/"on"
Potential connect	String	None	"Y"/"DELTA"
Potential transformer rating	Value	Volts	120-14800
Breaker online	String	None	"online"/"offline"

① Two to five alpha numeric, user-defined at the FPU.
② Note that the FPU suppresses leading zeros in all fields of the time and date.

From Host to FPU | *From FPU to Host*

68. Programmer Current Sensor Rating Request
Description: Programmer current sensor rating request

Field Name	Type	Units	Range
Breaker address	String	None	①

69. Programmer Current Sensor Rating Reply
Description: Programmer current sensor rating reply

Field Name	Type	Units	Range
Breaker address	String	None	①
Current sensor rating	Value	Amps	70-4000

Discrete Inputs

The host can monitor discrete inputs on the FPU. These inputs are optional on the FPU.

71. Discrete Input Request
Description: Request for discrete input status

Field Name	Type	Units	Range
None	—	—	—

72. Discrete Input Status Reply
Description: Discrete input status reply

Field Name	Type	Units	Range
Input 1	Value	None	0-open, 1-closed
Input 2-16	Value	None	0-open, 1-closed

Reset Messages

The host can request the FPU to reset three stored values. They are energy, peak capacity and peak demand. To prevent accidental clearing the host must send two messages in sequence to reset the data. First the reset request must be sent to the FPU. This is acknowledged by the FPU. Next the general reset confirm message must be sent. When this is acknowledged by the FPU, the stored value is reset. The messages used to reset the values are described below.

80. Reset Energy Request
Description: Reset energy request

Field Name	Type	Units	Range
Breaker Address	String	None	①

81. Reset Energy Reply
Description: Awaiting confirmation of request

Field Name	Type	Units	Range
None	—	—	—

82. Reset Peak Demand Request
Description: Reset peak demand request

Field Name	Type	Units	Range
Breaker address	String	None	①

83. Reset Peak Demand Reply
Description: Awaiting confirmation of request

Field Name	Type	Units	Range
None	—	—	—

84. Reset Peak Capacity Request
Description: Reset peak capacity request

Field Name	Type	Units	Range
Breaker address	String	None	①

85. Reset Peak Capacity Reply
Description: Awaiting confirmation of request

Field Name	Type	Units	Range
None	—	—	—

① Two to five alpha numeric, user-defined at the FPU.

From Host to FPU

86. Confirm Reset Request
Description: Confirm reset request

Field Name	Type	Units	Range
Breaker address	String	None	①

From FPU to Host

87. Confirm Reset Reply
Description: Data has been reset reply

Field Name	Type	Units	Range
None	—	—	—

Error Messages

The FPU issues the following message when an error condition happens.

From Host to FPU

99. Error Report
Description: Error report and description

Field Name	Type	Units	Range
Error description	Text	—	—

The error descriptions and their meanings are:

- "Breaker undefined" — Breaker address is not in FPU data base.
- "Breaker not online" — Breaker is not set to "activated" in the FPU data base. The breaker must be online before FPU will communicate with it.
- "Breaker option not enabled" — This breaker does not have the option(s) required for this message.
- "Breaker did not respond" — Communication failure. Check to insure the breaker controller is functioning correctly.
- "No events stored" — Events requested could not be returned.
- "Request value out of range" — Command number not known.

① Two to five alpha numeric, user-defined at the FPU.

Summary of Messages

Message Number	Host Request	FPU Response	Message Number
1	RMS Phase Current Request	RMS Phase Current Reply	2
3	RMS Phase Voltage (L-N) Request	RMS Phase Voltage (L-N) Reply	4
5	RMS Phase Voltage (L-L) Request	RMS Phase Voltage (L-L) Reply	6
7	Power Request	Power Reply	8
9	Energy and Demand Request	Energy and Demand Reply	10
11	Frequency Request	Frequency Reply	12
13	Capacity Request	Capacity Reply	14
20	Status Request	Status Reply	21
31	Under Voltage Setpoint Request	Under Voltage Setpoint Reply	32
34	Current Unbalance Setpoint Request	Current Unbalance Setpoint Reply	35
37	Voltage Unbalance Setpoint Request	Voltage Unbalance Setpoint Reply	38
40	Power Reversal Setpoint Request	Power Reversal Setpoint Reply	41
50	Number of Events Request	Number of Events Reply	51
52	Send Oldest Events Request	Events Reply	55
53	Send Newest Events Request	Events Reply	55
54	Send All Events Request	Events Reply	55
60	FPU System Information Request	FPU System Information Reply	61
62	Number of Breakers Request	Number of Breakers Reply	63
64	Breaker Addresses Request	Breaker Addresses Reply	65
66	Programmer System Info Request	Programmer System Info Reply	67
68	Programmer Sensor Rating Request	Programmer Sensor Rating Reply	69
71	Discrete Input Request	Discrete Input Reply	72
80	Reset Energy Request	Reset Energy Reply	81*
82	Reset Peak Demand Request	Reset Peak Demand Reply	83*
84	Reset Peak Capacity Request	Reset Peak Capacity Reply	85*
86	Confirm Reset Request	Confirm Reset Reply	87
99	Error Report		

*Note that host confirmation message number 86 is required to complete the request.

Host Request and FPU Response Messages

Message Number	Requesting Message	Direction
1	RMS Phase Current Request	Host ➧ FPU
2	RMS Phase Current Reply	FPU ➧ Host
3	RMS Phase Voltage (L-N) Request	Host ➧ FPU
4	RMS Phase Voltage (L-N) Reply	FPU ➧ Host
5	RMS Phase Voltage (L-L) Request	Host ➧ FPU
6	RMS Phase Voltage (L-L) Reply	FPU ➧ Host
7	Power Request	Host ➧ FPU
8	Power Reply	FPU ➧ Host
9	Energy and Demand Request	Host ➧ FPU
10	Energy and Demand Reply	FPU ➧ Host
11	Frequency Request	Host ➧ FPU
12	Frequency Reply	FPU ➧ Host
13	Capacity Request	Host ➧ FPU
14	Capacity Reply	FPU ➧ Host
20	Status Request	Host ➧ FPU
21	Status Reply	FPU ➧ Host
31	Under Voltage Setpoint Request	Host ➧ FPU
32	Under Voltage Setpoint Reply	FPU ➧ Host
34	Current Unbalance Setpoint Request	Host ➧ FPU
35	Current Unbalance Setpoint Reply	FPU ➧ Host
37	Voltage Unbalance Setpoint Request	Host ➧ FPU
38	Voltage Unbalance Setpoint Reply	FPU ➧ Host
40	Power Reversal Setpoint Request	Host ➧ FPU
41	Power Reversal Setpoint Reply	FPU ➧ Host
50	Number of Events Request	Host ➧ FPU
51	Number of Events Reply	FPU ➧ Host
52	Send Oldest Events Request	Host ➧ FPU
53	Send Newest Events Request	Host ➧ FPU
54	Send All Events Request	Host ➧ FPU
55	Events Reply	FPU ➧ Host
60	FPU System Information Request	Host ➧ FPU
61	FPU System Information Reply	FPU ➧ Host
62	Number of Breakers Request	Host ➧ FPU
63	Number of Breakers Reply	FPU ➧ Host
64	Breaker Addresses Request	Host ➧ FPU
65	Breaker Addresses Reply	FPU ➧ Host
66	Programmer System Info Request	Host ➧ FPU
67	Programmer System Info Reply	FPU ➧ Host
68	Programmer Sensor Rating Request	Host ➧ FPU
69	Programmer Sensor Rating Reply	FPU ➧ Host
71	Discrete Input Request	Host ➧ FPU
72	Discrete Input Reply	FPU ➧ Host
80	Reset Energy Request	Host ➧ FPU
81	Reset Energy Reply	FPU ➧ Host
82	Reset Peak Demand Request	Host ➧ FPU
83	Reset Peak Demand Reply	FPU ➧ Host
84	Reset Peak Capacity Request	Host ➧ FPU
85	Reset Peak Capacity Reply	FPU ➧ Host
86	Confirm Reset Request	Host ➧ FPU
87	Confirm Reset Reply	FPU ➧ Host
99	Error Report	FPU ➧ Host

All Messages in Sequence by Message Number

CODE DESCRIPTION

Transmitting a Message:

1. Initialize the UART to the proper baud rate, parity, stop bits.
2. Formulate the request message string: Header, Request, Breaker Name.
3. Compute the checksum:
   - Add all the string variables (including commas) together.
   - AND the result with OOFF Hex.
   - Determine the two's complement of the result.
4. Complete the message string: Header, Request, Breaker Name, Checksum, End of Text.
5. Load the message one byte at a time to the UART, and send it.
6. Wait for a time out period.
7. If no reply is received, try three times.
8. If reply is received, is it an ACK? If not, send message again.

Receiving a Message:

1. Monitor the UART Receive Data Flag. If data is received, unload it one byte at a time.
2. Add the message bytes (including commas) together. AND the result with OOFF Hex.
3. Add the result of #2 to the checksum field. If the result is not zero, the transmission is in error; send a NACK.
4. If the result is zero, strip the checksum and process the message.

TROUBLESHOOTING GUIDE

Problem: No response from the FPU

Solution:
1. Check the RS-232 connection from the host to the FPU.
2. Insure that FPU has been powered up and the RS-232 port has been configured correctly.
3. Verify that the baud rate range is valid per Electronic Protection, Instrumentation and Control system requirements.
4. Insure that the null modem connection has been implemented for direct connect lines.

Problem: Marginal response

Solution:
1. Check for noisy phone line. Eliminate modems on either end and try direct connect with null modem connection and check quality of communication.
2. FPU configuration may not have been defined. Go to system setup and redefine the Host Communication parameters.

Problem: Loss of Data

Solution: Host may not have been able to keep up with data from the FPU. Use XON and XOFF to control the data flow.

CUSTOMER SERVICE

Questions and problems should be addressed to:

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