

BECO2200-M3420
Communication Data Base for M-3420 Integrated Protection System
Device I.D. = 33

Specifications presented herein are thought to be accurate at the time of publication but are subject to change without notice.

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Rev	1	Preliminary release.
Rev	2	9/29/95 Added warning for MODBUS address selection conflicts.
Rev	3	3/6/96 Added definition page. Added extended time code information for IRIG-B support. For controls with version V02.XX.XX and up. Changed host and DSP version number encoding. Added mask bits for programmable target leds. Added mask bits for expanded relay I/O. The following communications points were either added, modified or redefined: 0-3 0-4 3-135 4-36 -> 4-50 6-61 -> 6-80 8-35 -> 8-36 and corresponding points for remaining targets. 7-56 -> 7-200
Rev	4	9/30/96 Added Line-Ground to Line-Line convert selection to point 3-129 for V02.XX.XX and up controls.
Rev	5	10/18/96 Added MODBUS support for READ HOLDING REGISTER function (03) for V02.XX.XX and up controls.

When the appropriate communication interface hardware is connected and the proper initialization of the communication options are complete, the data defined herein can be accessed and modified by remote communications.

The following definitions apply to the data tables in this specification:

"TYPE POINT" are the "type" number and "point" numbers used in the protocol to refer to the variable listed.

"SCALE FACTOR" is the factor by which an integer value read from the control is divided to get the value of the variable in the indicated "UNITS".

Points marked with a (U) appended to the scale factor field should be taken as unsigned value (0-65535) before scaling.

"UNITS" unit of the described data point.

"W/R/M" is the read, Write, Reset and Master reset indicator.

All points defined as "NOT USED" can be read and will return 0 for data.

All points defined as Write can also be read.

If not listed otherwise, a point is READ-ONLY.

W indicates a point that may be altered by a WRITE command.

R indicates a point that may be altered by a RESET command.

M indicates a point that will be reset by a MASTER RESET command.

"RANGE/INCREMENT" indicates the valid range and increments of the integer data field variable for WRITE commands.

Consult the controls Specification Sheet for unscaled setpoint ranges and increments.

"DESCRIPTION" description of communication point.

Notes:

Multipoint writes are not supported.

Multipoint reads are supported.

Reading a NOT USED point which is within the defined range of a type will return 0 for data with no error.

Two byte data words are transmitted and must be received most significant (high-order) byte first.

Communication is effectively half duplex in that a request packet is transmitted and a response packet received. Further requests should not be sent until the previous packets response is received. Communication ports are fixed at 8 data bits, no parity and 2 stop bits unless otherwise noted.

If communication security is enabled, the communication channel is locked on power up and remains locked until commanded to unlock or until the communication access code is changed to 9999 (Disable communication security) locally. When locked only TYPE 0 points may be read and only TYPE 0 point 35 written (0-35). Attempts to read or write other points while the communication channel is locked will return a system error code 6, "Communication locked". To open (unlock) the communication channel, the correct communication access code must be written to 0-35.

A write response packet will always return OK (no error) if data is between 0 and 9999 even if the incorrect access code is given.

Writing an incorrect access code or writing 9999, with security enabled will unconditionally lock the communication channel.

The communication channel is also locked if security is enabled and no communication activity occurs for ~2.5 minutes.

Type 7 points are reserved for factory use.

DO NOT attempt to write or read from these points, unexpected operations may result!

MODBUS COMMUNICATION PROTOCOL FOR M-3420

This document along with BECO2200 and BECO2200-M3420 document describes the implementation of the MODBUS protocol as it relates to the M3420 IPS control.

The M-3420 may be programmed to support a subset of the MODBUS protocol. The following restrictions apply:

1. MODBUS protocol is only supported on COM2 (rear RS232) and COM3 (rear RS485). COM1 (front RS232) is fixed BECO2200 protocol only.
2. Parity is supported on COM3 only, valid selections for COM3 are 8,N,2, 8,O,1 or 8,E,1. COM2 communication must be 8 data, no parity, 2 stop.
3. Only RTU mode is implemented, ASCII mode is not supported.
4. Standard baud rates from 300-9600 are supported.
5. Only the following 4 MODBUS commands are supported:
 - 1) Read Holding register (Function 03)
 - 2) Read Input register (Function 04)
 - 3) Force Single Coil (Function 05)
 - 4) Preset Single Register (Function 06)
6. Oscillograph record downloading is not supported as MODBUS does not support large enough packets.

The various communication points may be accessed by translating the BECO2200-M3420 data base Type and Point Number to an equivalent MODBUS register. For example: To read 46DT pickup setpoint, (TYPE 3, POINT NUMBER 43) we would convert the two fields to hex then concatenate the type and point to get 032B(hex) and convert to decimal. Reading address 811 (base 10) would give us this point. According to MODBUS definition, this would be register 812.

No more than 15 contiguous points should be read with one request.

Read input register (04) may be used to retrieve any point defined as readable in BECO2200.

Read holding register (03) is identical to read input register and returns the same data.

Preset single register is used to write any point defined as writeable in BECO2200.

Force single coil is used to simulate the RESET and MASTER RESET command as defined in BECO2200. Sending a force single coil with data equal ON (FF00) to a resetable point will simulate RESET. Sending a force single coil with data equal to ON (FF00) to a MASTER RESET point simulates a MASTER RESET.

The following exception code are implemented:

ILLEGAL FUNCTION	01	
ILLEGAL DATA ADDRESS	02	
ILLEGAL DATA VALUE		03
SLAVE DEVICE BUSY	06	
COMM PORT LOCKED	16 (10hex) *	

SLAVE DEVICE BUSY is returned if control is in the local mode.

COMM PORT LOCKED is a BECKWITH ELECTRIC CO. extension code used to identify if the communication port is locked.

Care must be taken when choosing communication addresses if simultaneous use of BECO2200 and MODBUS protocol is desired. Addresses above 200 are reserved for group addressing when any port is configured for BECO2200. Consult the BECO2200 protocol document for further information on group addressing. If possible, communication addresses should be set only between 1-200 to avoid communication conflicts.

CONTROL INFORMATION

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
0-00	1				Control identification (Device type)
0-01	1U				Control serial number
0-02	1				Control communication address
0-03	100				Software version number (Major and minor) For example: V01.34.28 0-03 -> 134
0-04	1				Software version number (Build) See 0-03. 0-04 -> 28
0-05	1				User control number
0-06					User line 1 text Most significant 2 ASCII characters of 24 character user line 1 (Character position 1 & 2)
0-07					User line 1 text Next significant 2 ASCII characters of 24 character user line 1 (Character position 3 & 4)
0-08 -> 0-17					User line 1 text Next significant 2 ASCII characters of 24 character user line 1 (Character position 5 & 24)
0-18					User line 2 text see 0-06
0-19					User line 2 text see 0-07
0-20 -> 0-29					User line 2 text see 0-08 -> 0-17
0-30	1				Communication channel lock status 0 = comm channel unlocked 1 = comm channel locked
0-31					Not used
0-32	1				Options software
0-33	1				Options hardware

0-34					Dip switch (Factory use)
0-35	1		W	0-9999 / 1	Unlock comm channel access code read returns 0
0-36	1				Checksum setpoints
0-37	1				Checksum calibration
0-38	1U				Checksum ROM *
0-39					Not used
0-40					Not used

Notes:

* Not used at present.

STATUS

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
1-00	1U				Input status Bit 0 Input 1 (52b) Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6 Fuse Status Bit 7-15 Not used (0) 0=OFF 1=ON(Circuit closed)
1-01	1U				Output status Bit 0 Out 1 Bit 1 Out 2 Bit 2 Out 3 Bit 3 Out 4 Bit 4 Out 5 Bit 5 Out 6 Bit 6 Out 7 Bit 7 Out 8 Bit 8-15 Not used (0)
1-02	1U				Front panel LED status 0=OFF 1=ON Bit 0 TIME SYNC Bit 1 BREAKER CLOSED Bit 2 OSC. TRIGGERED Bit 3 TARGET Bit 4-15 Not used (0)
1-03					Not used
1-04	10	VOLTS			Phase A voltage
1-05	10	VOLTS			Phase B voltage
1-06	10	VOLTS			Phase C voltage
1-07	10	VOLTS			Phase N voltage
1-08	10	VOLTS			Positive sequence voltage
1-09	10	VOLTS			Negative sequence voltage
1-10	10	VOLTS			Zero Sequence voltage
1-11					Not used
1-12					Not used

1-13					Not used
1-14					Not used
1-15					Not used
1-16	1000	AMPS			Phase A line side current
1-17	1000	AMPS			Phase B line side current
1-18	1000	AMPS			Phase C line side current
1-19	1000	AMPS			Phase N line side current
1-20	1000	AMPS			Phase a neutral side current
1-21	1000	AMPS			Phase b neutral side current
1-22	1000	AMPS			Phase c neutral side current
1-23	1000	AMPS			Aux current
1-24					Not used
1-25	1000	AMPS			Positive sequence current
1-26	1000	AMPS			Negative sequence current
1-27	1000	AMPS			Zero sequence current
1-28	100	AMPS			Phase A-a differential current
1-29	100	AMPS			Phase B-b differential current
1-30	100	AMPS			Phase C-c differential current
1-31	100	AMPS			Ground differential current (signed)
1-32					Not used
1-33	100	HZ			Frequency 0 = Disabled (unmeasurable)
1-34	10	%			Volts per hertz
1-35					Not used
1-36					Not used
1-37	10000	PU			Real power Most significant word

1-38					Real power Least significant word Note:1-37 and 1-38 must be combined to form a signed long integer for example: 1-37 = 65534 or fffeHEX 1-38 = 25804 or 64ccHEX would be -10.5268 PU
1-39	10000	PU			Reactive power Most significant word
1-40					Reactive power Least significant word Note:1-39 and 1-40 must be combined to form a signed long integer for example: 1-39 = 0 or 0000HEX 1-40 = 21589 or 5455HEX would be 2.1589 PU
1-41	100				Power Factor (-) = LEAD (+) = LAG
1-42					Not used
1-43					Not used
1-44					Not used
1-45					Not used
1-46					Not used
1-47					Not used
1-48					Not used
1-49					Not used
1-50					Not used
1-51					Not used
1-52					Not used
1-53					Not used
1-54					Not used
1-55	100	OHMS			Positive sequence resistance Most significant word
1-56					Positive sequence resistance Least significant word

1-57	100	OHMS			Positive sequence reactance Most significant word
1-58					Positive sequence reactance Least significant word
1-59					Not used
1-60	1U				Function status Most significant word Bit 0 51N Bit 1 59 #1 Bit 2 59 #2 Bit 3 59N #1 Bit 4 59N #2 Bit 5 60FL Bit 6 67N Bit 7 81 #1 Bit 8 81 #2 Bit 9 81 #3 Bit 10 81 #4 Bit 11 87 Bit 12 87GD Bit 13 EXT #1 Bit 14 EXT #2 Bit 15 Future (0)
1-61	1U				Function status Least significant word Bit 0 24DT #1 Bit 1 24DT #2 Bit 2 24IT Bit 3 27 #1 Bit 4 27 #2 Bit 5 32 #1 Bit 6 32 #2 Bit 7 40 #1 Bit 8 40 #2 Bit 9 46DT Bit 10 46IT Bit 11 50 Bit 12 50N Bit 13 50/27 Bit 14 50BF Bit 15 51V Note: The two function status words represent which detectors are picked up (not necessarily timed out).

1-62	1U				Function timer Most significant word Bit 0 51N Bit 1 59 #1 Bit 2 59 #2 Bit 3 59N #1 Bit 4 59N #2 Bit 5 60FL Bit 6 67N Bit 7 81 #1 Bit 8 81 #2 Bit 9 81 #3 Bit 10 81 #4 Bit 11 87 Bit 12 87GD Bit 13 EXT #1 Bit 14 EXT #2 Bit 15 Future (0)
1-63	1U				Function timer Least significant word Bit 0 24DT #1 Bit 1 24DT #2 Bit 2 24IT Bit 3 27 #1 Bit 4 27 #2 Bit 5 32 #1 Bit 6 32 #2 Bit 7 40 #1 Bit 8 40 #2 Bit 9 46DT Bit 10 46IT Bit 11 50 Bit 12 50N Bit 13 50/27 Bit 14 50BF Bit 15 51V Note: The two function timer words represent which detectors timers are timed out.
1-64	1U				Remote target LED status Most significant word See 1-62
1-65	1U				Remote target LED status Least significant word See 1-63
1-66 -> 1-99					Not used

CONFIGURATION

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
2-00	1U		W	0-65535 / 1	59 #1 RMS overvoltage enable Outputs/Blocking Bit 0 Out 1 Bit 1 Out 2 Bit 2 Out 3 Bit 3 Out 4 Bit 4 Out 5 Bit 5 Out 6 Bit 6 Out 7 Bit 7 Out 8 Bit 8 In 1 Bit 9 In 2 Bit 10 In 3 Bit 11 In 4 Bit 12 In 5 Bit 13 In 6 Bit 14 Fuse Loss Bit 15 Not used (0) Writing 0 disables function, At least one OUT must be selected to enable function.
2-01	1U		W	0-65535 / 1	59 #2 RMS overvoltage enable see 2-00
2-02					Not used
2-03					Not Used
2-04	1U		W	0-65535 / 1	59N #1 RMS Neutral overvoltage see 2-00
2-05	1U		W	0-65535 / 1	59N #2 RMS Neutral overvoltage see 2-00
2-06	1U		W	0-65535 / 1	27 #1 RMS undervoltage see 2-00
2-07	1U		W	0-65535 / 1	27 #2 RMS undervoltage see 2-00
2-08					Not used
2-09					Not used
2-10					Not used
2-11					Not used
2-12					Not used

2-13					Not used
2-14	1U		W	0-65535 / 1	50 Instantaneous overcurrent see 2-00
2-15	1U		W	0-65535 / 1	50N Instantaneous neutral overcurrent see 2-00
2-16	1U		W	0-65535 / 1	51V Inverse time overcurrent see 2-00
2-17	1U		W	0-65535 / 1	51N Inverse time neutral overcurrent see 2-00
2-18	1U		W	0-65535 / 1	67N Ground directional overcurrent see 2-00
2-19	1U		W	0-65535 / 1	46DT Negative sequence overcurrent see 2-00
2-20	1U		W	0-65535 / 1	46IT Negative sequence overcurrent see 2-00
2-21	1U		W	0-65535 / 1	87 Phase differential see 2-00
2-22	1U		W	0-65535 / 1	87GD Ground differential see 2-00
2-23	1U		W	0-65535 / 1	50/27 Inadvertent energization see 2-00
2-24	1U		W	0-65535 / 1	50BF Breaker failure see 2-00
2-25	1U		W	0-65535 / 1	81 #1 Over/under frequency see 2-00
2-26	1U		W	0-65535 / 1	81 #2 Over/under frequency see 2-00
2-27	1U		W	0-65535 / 1	81 #3 Over/under frequency see 2-00
2-28	1U		W	0-65535 / 1	81 #4 Over/under frequency see 2-00

2-29	1U		W	0-65535 / 1	24DT #1 Volts per hertz see 2-00
2-30	1U		W	0-65535 / 1	24DT #2 Volts per hertz see 2-00
2-31	1U		W	0-65535 / 1	24IT Volts per hertz see 2-00
2-32	1U		W	0-65535 / 1	32 #1 Directional power see 2-00
2-33	1U		W	0-65535 / 1	32 #2 Directional power see 2-00
2-34					Not used
2-35					Not used
2-36	1U		W	0-65535 / 1	40 #1 Loss of field see 2-00
2-37	1U		W	0-65535 / 1	40 #2 Loss of field see 2-00
2-38					Not used
2-39					Not used
2-40	1U		W	0-65535 / 1	60FL V.T. Fuse loss see 2-00
2-41					Not used
2-42					Not used
2-43					Not used
2-44	1U		W	0-65535 / 1	EXT #1 External see 2-00
2-45	1U		W	0-65535 / 1	EXT #2 External see 2-00

SETPOINTS

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
3-00	1	VOLTS	W	5-200 / 1	59 #1 Pickup
3-01	1	CYCLES	W	1-8160 / 1	59 #1 Delay
3-02	1	VOLTS	W	5-200 / 1	59 #2 Pickup
3-03	1	CYCLES	W	1-8160 / 1	59 #2 Delay
3-04					Not used
3-05					Not used
3-06					Not used
3-07					Not used
3-08	10	VOLTS	W	50-2000 / 1	59N #1 Pickup
3-09	1	CYCLES	W	1-8160 / 1	59N #1 Delay
3-10	10	VOLTS	W	50-2000 / 1	59N #2 Pickup
3-11	1	CYCLES	W	1-8160 / 1	59N #2 Delay
3-12	1	VOLTS	W	5-200 / 1	27 #1 Pickup
3-13	1	CYCLES	W	1-8160 / 1	27 #1 Delay
3-14	1	VOLTS	W	5-200 / 1	27 #2 Pickup
3-15	1	CYCLES	W	1-8160 / 1	27 #2 Delay
3-16					Not used
3-17					Not used
3-18					Not used
3-19					Not used
3-20	10	AMPS	W	if C.T. secondary rating = 5Amp 10-2400 / 1 if C.T. secondary rating = 1Amp 2-480 / 1	50 Pickup
3-21					Not used

3-22	10	AMPS	W	if C.T. secondary rating = 5Amp 10-2400 / 1 if C.T. secondary rating = 1Amp 2-480 / 1	50N Pickup
3-23					Not used
3-24					Not used
3-25					Not used
3-26					Not used
3-27					Not used
3-28					Not used
3-29	100	AMPS	W	if C.T. secondary rating = 5Amp 50-1200 / 1 if C.T. secondary rating = 1Amp 10-240 / 1	51V Pickup
3-30	1		W	1-4 / 1	51V Curve type ** 1 = Definite time 2 = Inverse 3 = Very inverse 4 = Extremely inverse
3-31	10		W	5 - 110 / 1	51V Time dial **
3-32	1		W	1 - 3 / 1	Voltage control 1 = Disable 2 = Voltage control 3 = Voltage restraint
3-33	1	VOLTS	W	5 - 200 / 1	Voltage control level if 3-32 = 2
3-34					Not used
3-35					Not used
3-36	100	AMPS	W	if C.T. secondary rating = 5Amp 50-1200 / 1 if C.T. secondary rating=1Amp 10-240 / 1	51N Pickup

3-37	1		W	1-4 / 1	51N Curve type ** 1 = Definite time 2 = Inverse 3 = Very inverse 4 = Extremely inverse
3-38	10		W	5 - 110 / 1	51N Time dial **
3-39					Not used
3-40					Not used
3-41					Not used
3-42					Not used
3-43	1	%	W	3-100 / 1	46DT Pickup
3-44	1	CYCLES	W	1-8160 / 1	46DT Delay
3-45	1	%	W	3-100 / 1	46IT Pickup
3-46	1		W	1-95 / 1	46IT Time dial
3-47	1	CYCLES	W	600-65500 / 1	46 Definite max time
3-48	100	AMPS	W	if C.T. secondary rating = 5Amp 20-300 / 1 if C.T. secondary rating = 1Amp 4-60 / 1	87 Pickup
3-49	1	%	W	1-100 / 1	87 Slope
3-50	1	CYCLES	W	1-8160 / 1	87 Delay
3-51					Not used
3-52					Not used
3-53					Not used
3-54	100	AMPS	W	if C.T. secondary rating = 5Amp 50-1500 / 1 if C.T. secondary rating = 1Amp 10-300 / 1	50/27 Pickup
3-55	1	VOLTS	W	40-130 / 1	50/27 Voltage control
3-56	1	CYCLES	W	1-8160 / 1	50/27 Pickup delay

3-57	1	CYCLES	W	1-8160 / 1	50/27 Dropout delay
3-58	1		W	0 - 1 / 1	50BF Phase initiate 0 = disable 1 = enable
3-59	100	AMPS	W	if C.T. secondary rating = 5Amp 10-1000 / 1 if C.T. secondary rating =1Amp 2-200 / 1	50BF Phase pickup
3-60	1		W	0 - 1 / 1	50BF Neutral initiate 0 = disable 1 = enable
3-61	100	AMPS	W	if C.T. secondary rating = 5Amp 10-1000 / 1 if C.T. secondary rating =1Amp 2-200 / 1	50BF Neutral pickup
3-62	1U		W	0-255 / 1	50BF Input initiate Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6-15 Not used (0)
3-63	1U		W	0-255 / 1	50BF Output initiate Bit 0 Out 1 Bit 1 Out 2 Bit 2 Out 3 Bit 3 Out 4 Bit 4 Out 5 Bit 5 Out 6 Bit 6 Out 7 Bit 7 Out 8 Bit 8-15 Not used (0)
3-64	1	CYCLES	W	1-8160 / 1	50BF Delay
3-65	100	HZ	W	if nominal frequency = 60Hz 5000-6700 / 1 excluding 6000 else if nominal frequency=50 Hz 4000-5700 / 1 excluding 5000	81 #1 Pickup

3-66	1	CYCLES	W	2-65500 / 1	81 #1 Delay
3-67	100	HZ	W	if nominal frequency = 60Hz 5000-6700 / 1 excluding 6000 else if nominal frequency=50Hz 4000-5700 / 1 excluding 5000	81 #2 Pickup
3-68	1	CYCLES	W	2-65500 / 1	81 #2 Delay
3-69	100	HZ	W	if nominal frequency = 60Hz 5000-6700 / 1 excluding 6000 else if nominal frequency = 50Hz 4000-5700 / 1 excluding 5000	81 #3 Pickup
3-70	1	CYCLES	W	2-65500 / 1	81 #3 Delay
3-71	100	HZ	W	if nominal frequency = 60Hz 5000-6700 / 1 excluding 6000 else if nominal frequency = 50Hz 4000-5700 / 1 excluding 5000	81 #4 Pickup
3-72	1	CYCLES	W	2-65500 / 1	81 #4 Delay
3-73	1	%	W	100-200 / 1	24DT #1 Pickup
3-74	1	CYCLES	W	30-8160 / 1	24DT #1 Delay
3-75	1	%	W	100-200 / 1	24DT #2 Pickup
3-76	1	CYCLES	W	30-8160 / 1	24DT #2 Delay
3-77	1	%	W	100-200 / 1	24IT Pickup
3-78	1		W	1-4 / 1	24IT Curve **
3-79	10		W	if curve=1 (3-78) 10-1000 / 10 else if curve=2,3,4 0-90	24IT Time dial **
3-80	1	SEC	W	1-999 / 1	24IT Reset rate

3-81	1000	PU	W	(-3000)-3000 / 1 excluding 1,0,-1	32 #1 Pickup
3-82	1	CYCLES	W	1-8160 / 1	32 #1 Delay
3-83	1000	PU	W	(-3000)-3000 / 1 excluding 1,0,-1	32 #2 Pickup
3-84	1	CYCLES	W	1-8160/1	32 #2 Delay
3-85					Not used
3-86					Not used
3-87					Not used
3-88					Not used
3-89	10	OHMS	W	if C.T. secondary rating = 5Amp 1-1000 / 1 if C.T. secondary rating =1Amp 5-5000 / 1	40 #1 Diameter
3-90	10	OHMS	W	if C.T. secondary rating = 5Amp -500-500 / 1 if C.T. secondary rating = 1Amp -2500-2500 / 1	40 #1 Offset
3-91	1	W		0-1 / 1	40 #1 Voltage control enable 0 = disable 1 = enable
3-92	1	CYCLES	W	1-8160 / 1	40 #1 Delay
3-93	10	OHMS	W	if C.T. secondary rating = 5Amp 1-1000 / 1 if C.T. secondary rating = 1Amp 5-5000 / 1	40 #2 Diameter
3-94	10	OHMS	W	if C.T. secondary rating = 5Amp -500-500 / 1 if C.T. secondary rating = 1Amp -2500-2500 / 1	40 #2 Offset

3-95	1		W	0-1 / 1	40 #2 Voltage control enable 0 = disable 1 = enable
3-96	1	CYCLES	W	1-8160 / 1	40 #2 Delay
3-97	1	VOLTS	W	5-200 / 1	40 Voltage control
3-98					Not used
3-99					Not used
3-100					Not used
3-101					Not used
3-102					Not used
3-103					Not used
3-104					Not used
3-105					Not used
3-106	1U		W	0-255 / 1	60FL Input initiate Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6 Fuse loss Bit 7-15 Not used (0)
3-107	1	CYCLES	W	1-8160 / 1	60FL Delay
3-108					Not used.
3-109					Not used.
3-110					Not used.
3-111					Not used.
3-112					Not used.
3-113					Not used.
3-114					Not used.
3-115					Not used.

3-116	100	AMPS	W	if C.T. secondary rating = 5Amp 20-1000 / 1 if C.T. secondary rating = 1Amp 4-200 / 1	87GD Pickup
3-117					Not used
3-118	100		W	10-799 / 1	87GD CT Ratio Correction
3-119	1	CYCLES	W	1-8160 / 1	87GD Delay
3-120	1U		W	0-255 / 1	EXT #1 Input initiate Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6-15 Not used (0)
3-121	1	CYCLES	W	1-8160 / 1	EXT #1 Delay
3-122	1U		W	0-255 / 1	EXT #2 Input initiate Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6 Fuse loss Bit 6-15 Not used (0)
3-123	1	CYCLES	W	1-8160 / 1	EXT #2 Delay
3-124					Not used
3-125					Not used.
3-126					Not used.
3-127					Not used.
3-128	1				Nominal frequency * 0 = 50HZ 1 = 60HZ

3-129	1		W	0-1 / 1	V.T. Configuration 0 = Line to Line 1 = Line to Ground 2 = Line-Gnd to Line-Line convert
3-130	1		W	0-1 / 1	Delta-Y Transform 0 = Disable 1 = Enable
3-131	1				C.T. Secondary rating * 0 = 1Amp 1 = 5Amp
3-132	1				Phase rotation * 0 = ACB 1 = ABC
3-133					Not used
3-134					Not used
3-135	1		W	0-1 / 1	27/59 Magnitude calculate 0 = RMS 1 = DFT
3-136	1	CYCLES	W	2-8160 / 1	Sealin Delay
3-137	10		W	10-65500 / 1	V.T. Phase ratio
3-138	10		W	10-65500 / 1	V.T. Neutral ratio
3-139	1		W	1-65500 / 1	C.T. Phase ratio
3-140	1		W	1-65500 / 1	C.T. Neutral ratio
3-141					Not used
3-142	1U		W	0-255 / 1	Input status active state Bit0 = 0 IN1 active closed Bit0 = 1 IN1 active open Bit1-bit5 same as above for IN2-IN6 Bit6-Bit15 not used (0)
3-144					Not used.
3-145					Not used.
3-146	1	VOLTS	W	60-140 / 1	Nominal voltage
3-147	100	AMPS	W	50-600 / 1	Nominal current
3-148					Not used

3-149					Not used
3-150					Not used

Notes:

*** Note:** These points are read only.

**** Note:** When writing these points, curve should always proceed time dial.

MISCELLANEOUS

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
4-00	1		W	0-1 / 1	Clock control If write 0 = Stop 1 = Run Read returns 0
4-01	1		W	0-99 / 1	Year
4-02	1		W	1-12 / 1	Month
4-03	1		W	1-31 / 1	Date
4-04	1		W	1-7 / 1	Day 1 = Sun ... 7 = Sat
4-05	1		W	0-23 / 1	Hour
4-06	1		W	0-59 / 1	Minute
4-07	1		W	0-59 / 1	Second
4-08					Not used
4-09					Not used
4-10					Not used
4-11	1	DEGREES CELSIUS			Internal temperature
4-12					Not used
4-13					Not used
4-14	1		R		OUT1 counter
4-15	1		R		OUT2 counter
4-16	1		R		OUT3 counter
4-17	1		R		OUT4 counter
4-18	1		R		OUT5 counter
4-19	1		R		OUT6 counter
4-20	1		R		OUT7 counter
4-21	1		R		OUT8 counter

4-22	1		R		Alarm counter
4-23	1				Powerloss counter
4-24	1		R		Last selftest error code
4-25	1		R		Last selftest error code -1
4-26	1		R		Last selftest error code -2
4-27	1		R	0-59 / 1	Last selftest error code -3
4-28	1		R	0-59 / 1	Clear target led (if all tripping conditions cleared.) if read = 0 tripping conditions are cleared, OK to reset. else read = 1 tripping conditions are still active, do not reset
4-29	1		R		Clear target history
4-30	1		R		Clear oscillograph recorder
4-31	1		R		Last comm error code
4-32	1				Target LED status 0 = off 1 = on
4-33	1				Calibration checksum
4-34	1				Setpoint checksum
4-35	1		R		Receive packet errors
4-36	1				IRIG-B Time Sync status 0 = Invalid 1 = Valid

4-37 -> 4-48					Present Time encoded as an ASCII string. * DD-MMM-YYYY HH:MM:SS.TTT For example: 03-Mar-1990 12:15:03.468 4-37 = 12339 or 3033HEX or '0''3' 4-38 = 11597 or 2d4dHEX or '-'M' 4-39 = 24946 or 6172HEX or 'a''r' 4-40 = 11569 or 2d31HEX or '-'1' 4-41 = 14649 or 3939HEX or '9''9' 4-42 = 12320 or 3020HEX or '0'' ' 4-43 = 12594 or 3132HEX or '1''2' 4-44 = 14896 or 3a30HEX or ':'1' 4-45 = 13626 or 353aHEX or '5'':' 4-46 = 12339 or 3033HEX or '0''3' 4-47 = 11828 or 2E34HEX or '.'"4' 4-48 = 13880 or 3638HEX or '6''8'
4-49					Not used
4-50					Not used

* Present time will return the local time from the RTC chip with .TTT = .000 if IRIG-B time sync status 4-36 is 0, if IRIG-B sync status is valid these points will return full time information.

TIMERS

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
5-00	1	CYCLES			59 #1 Phase A timer
5-01	1	CYCLES			59 #1 Phase B timer
5-02	1	CYCLES			59 #1 Phase C timer
5-03	1	CYCLES			59 #2 Phase A timer
5-04	1	CYCLES			59 #2 Phase B timer
5-05	1	CYCLES			59 #2 Phase C timer
5-06					Not used
5-07					Not used
5-08					Not used
5-09					Not used
5-10					Not used
5-11					Not used
5-12	1	CYCLES			59N #1 timer
5-13	1	CYCLES			59N #2 timer
5-14	1	CYCLES			27 #1 Phase A timer
5-15	1	CYCLES			27 #1 Phase B timer
5-16	1	CYCLES			27 #1 Phase C timer
5-17	1	CYCLES			27 #2 Phase A timer
5-18	1	CYCLES			27 #2 Phase B timer
5-19	1	CYCLES			27 #2 Phase C timer
5-20					Not used
5-21					Not used
5-22					Not used
5-23					Not used
5-24					Not used

5-25					Not used
5-26					Not used
5-27					Not used
5-28					Not used
5-29	1	%			51V Phase A timer
5-30	1	%			51V Phase B timer
5-31	1	%			51V Phase C timer
5-32					Not used
5-33					Not used
5-34	1	%			51N timer
5-35					Not used
5-36					Not used
5-37					Not used
5-38					Not used
5-39					Not used
5-40	1	CYCLES			46DT timer
5-41	1	%			46IT timer
5-42	1	CYCLES			46 max delay timer
5-43	1	CYCLES			87 Phase A timer
5-44	1	CYCLES			87 Phase B timer
5-45	1	CYCLES			87 Phase C timer
5-46	1	CYCLES			87GD timer
5-47					Not used
5-48	1	CYCLES			50/27 pickup timer
5-49	1	CYCLES			50/27 dropout timer
5-50	1	CYCLES			50BF timer
5-51	1	CYCLES			81 #1 timer

5-52	1	CYCLES			81 #2 timer
5-53	1	CYCLES			81 #3 timer
5-54	1	CYCLES			81 #4 timer
5-55	1	CYCLES			24DT #1 timer
5-56	1	CYCLES			24DT #2 timer
5-57	1	%			24IT timer
5-58	1	CYCLES			32 #1 timer
5-59	1	CYCLES			32 #2 timer
5-60					Not used
5-61					Not used
5-62	1	CYCLES			40 #1 timer
5-63	1	CYCLES			40 #2 timer
5-64					Not used
5-65					Not used
5-66					Not used
5-67					Not used
5-68					Not used
5-69					Not used
5-70	1	CYCLES			60FL timer
5-71	1	CYCLES			EXT #1 timer
5-72	1	CYCLES			EXT #2 timer
5-73					Not used
5-74					Not used
5-75					Not used
5-76					Not used
5-77					Not used
5-78					Not used

5-79					Not used
5-80	1	CYCLES			Out1 Sealin timer
5-81	1	CYCLES			Out2 Sealin timer
5-82	1	CYCLES			Out3 Sealin timer
5-83	1	CYCLES			Out4 Sealin timer
5-84	1	CYCLES			Out5 Sealin timer
5-85	1	CYCLES			Out6 Sealin timer
5-86	1	CYCLES			Out7 Sealin timer
5-87	1	CYCLES			Out8 Sealin timer
5-88					Not used
5-89					Not used
5-90					Not used
5-91					Not used
5-92					Not used
5-93					Not used
5-94					Not used
5-95					Not used

OSCILLOGRAPH RECORDER

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
6-00	1		W	1-4 / 1	Number of partitions * 1 = 1 @ 170 Cycles 2 = 2 @ 112 Cycles 3 = 3 @ 84 Cycles 4 = 4 @ 68 Cycles
6-01	1		W	0-255 / 1	Trigger inputs ** Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6-15 Not used (0)
6-02	1		W	0-255 / 1	Trigger outputs Bit 0 Out 1 Bit 1 Out 2 Bit 2 Out 3 Bit 3 Out 4 Bit 4 Out 5 Bit 5 Out 6 Bit 6 Out 7 Bit 7 Out 8 Bit 8-15 Not used (0)
6-03	1	%	W	5-95 / 1	Post trigger delay *
6-04	1		W	0-1 / 1	Recorder trigger inhibit 0 = recorder active (running) 1 = recorder trigger inhibit when read: Bit 0 Inhibit by COM1 Bit 1 Inhibit by COM2 Bit 2 Inhibit by COM3 Bit 3-15 Not used (0)
6-05	1		W	0-2 / 1	Recorder status If read 0 = no records available 1 = at least 1 record available (follows OSC REC led) If write 0 = Do nothing 1 = Remotely trigger recorder 2 = Clear all records

6-06	1				Record #1 status (latest) 0 = untriggered (Cleared) 1 = triggered, full record (Available for downloading) 2 = triggered, incomplete record (Available for downloading)
6-07	1				Record #2 status 0 = untriggered 1 = triggered, full record (Available for downloading) 2 = triggered, incomplete record (Available for downloading)
6-08	1				Record #3 status 0 = untriggered 1 = triggered, full record (Available for downloading) 2 = triggered, incomplete record (Available for downloading)
6-09	1				Record #4 status 0 = untriggered 1 = triggered, full record (Available for downloading) 2 = triggered, incomplete record (Available for downloading)
6-10					Not used
6-11					Not used
6-12					Not used
6-13					Not used
6-14	1U		W***	0 - 65535 / 1	Download Record #1 block
6-15	1U		W***	0 - 65535 / 1	Download Record #2 block
6-16	1U		W***	0 - 65535 / 1	Download Record #3 block
6-17	1U		W***	0 - 65535 / 1	Download Record #4 block
6-18					Not used
6-19					Not used

6-20 -> 6-29					<p>Record #1 date and time stamp encoded as an ASCII string. DD-MMM-YYYY HH:MM:SS:TTT For example: 03-Mar-1990 12:15:03</p> <p>6-20 = 12339 or 3033HEX or '0''3' 6-21 = 11597 or 2d4dHEX or '-''M' 6-22 = 24946 or 6172HEX or 'a''r' 6-23 = 11569 or 2d31HEX or '-''1' 6-24 = 14649 or 3939HEX or '9''9' 6-25 = 12320 or 3020HEX or '0'' ' 6-26 = 12594 or 3132HEX or '1''2' 6-27 = 14896 or 3a30HEX or ':'''1' 6-28 = 13626 or 353aHEX or '5'':' 6-29 = 12339 or 3033HEX or '0''3'</p>
6-30 -> 6-39					<p>Record #2 date and time stamp see 6-20</p>
6-40 -> 6-49					<p>Record #3 date and time stamp see 6-20</p>
6-50 -> 6-59					<p>Record #4 date and time stamp see 6-20</p>
6-60					Not used
6-61 -> 6-62	****				<p>Record #1 extended time stamp encoded as ASCII string. 10's 100's and 1000's. For example: 03-Mar-1990 12:15:03.468</p> <p>6-61 = 11828 or 2E34HEX or '.'''4' 6-62 = 13880 or 3638HEX or '6''8'</p>
6-63 -> 6-64	****				<p>Record #2 extended time stamp see 6-61</p>
6-65 -> 6-66	****				<p>Record #3 extended time stamp see 6-61</p>
6-67 -> 6-68	****				<p>Record #4 extended time stamp see 6-61</p>
6-69					Not used.

6-70 -> 6-80					Not used.
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Notes:

- * Changing the number of partitions automatically reset the post trigger delay setting to %5 and clears all previously stored records.

**** Trigger bits are OR'ed to create multiple trigger options. An incomplete record only occurs when the trigger appears before the buffer is full. This can happen if triggered immediately on power up or when partition is switched and the post trigger delay is set very small.**

***** Downloading should not be attempted until record is checked for availability. A block request is sent by the master with a write formatted packet. This data point is the block number of the requested record. The slave will respond with a large packet (134 bytes) containing the address, bytecount, system/data error status and 130 bytes of data and the checksum. The first two data bytes being an echo of the block number the remaining 128 bytes the data block. The master must read the number of partitions data point (6-00) to determine how many blocks to request. ex: If partitions is set to 1, there are 512 blocks (block 0 - block 511).**

Also, the oscillograph recorder MUST be inhibited from triggering before any block is requested (6-04). Be sure to un-inhibit triggering when downloading is completed or if downloading is aborted.

<u>Partitions</u>	<u>Blocks</u>	<u>Record size</u>
1	0-511	65536
2	0-337	43264
3	0-253	32512
4	0-205	26368

It is up to the master to re-request bad packets and do all the error checking.

****** Extended time information will read XX:XX:XX.000 (i.e. zeros) if IRIG-B signal is invalid or not used.**

TARGET INFORMATION

TYPE POINT	SCALE FACTOR	UNITS	W/R/M	RANGE/INCREMENT	DESCRIPTION
8-00	1U				Target #1 relay status Bit 0 Out 1 Bit 1 Out 2 Bit 2 Out 3 Bit 3 Out 4 Bit 4 Out 5 Bit 5 Out 6 Bit 6 Out 7 Bit 7 Out 8 Bit 8-15 Not used (0) If point reads 0 target is cleared.
8-01	1U				Target #1 input status Bit 0 Input 1 Bit 1 Input 2 Bit 2 Input 3 Bit 3 Input 4 Bit 4 Input 5 Bit 5 Input 6 Bit 6 Fuse loss Bit 7-15 Not used (0)
8-02	1U				Target #1 Function status Most significant word Bit 0 51N Bit 1 59 #1 Bit 2 59 #2 Bit 3 59N #1 Bit 4 59N #2 Bit 5 60FL Bit 6 67N Bit 7 81 #1 Bit 8 81 #2 Bit 9 81 #3 Bit 10 81 #4 Bit 11 87 Bit 12 87GD Bit 13 EXT #1 Bit 14 EXT #2 Bit 15 Future (0)

8-03	1U				Target #1 Function status Least significant word Bit 0 24DT #1 Bit 1 24DT #2 Bit 2 24IT Bit 3 27 #1 Bit 4 27 #2 Bit 5 32 #1 Bit 6 32 #2 Bit 7 40 #1 Bit 8 40 #2 Bit 9 46DT Bit 10 46IT Bit 11 50 Bit 12 50N Bit 13 50/27 Bit 14 50BF Bit 15 51V Note: The two function status words represent which detectors are picked up (not necessarily timed out) at the time the target is tagged.
8-04	1U				Target #1 Function timer Most significant word Bit 0 51N Bit 1 59 #1 Bit 2 59 #2 Bit 3 59N #1 Bit 4 59N #2 Bit 5 60FL Bit 6 67N Bit 7 81 #1 Bit 8 81 #2 Bit 9 81 #3 Bit 10 81 #4 Bit 11 87 Bit 12 87GD Bit 13 EXT #1 Bit 14 EXT #2 Bit 15 Future (0)

8-05	1U				Target #1 Function timer Least significant word Bit 0 24DT #1 Bit 1 24DT #2 Bit 2 24IT Bit 3 27 #1 Bit 4 27 #2 Bit 5 32 #1 Bit 6 32 #2 Bit 7 40 #1 Bit 8 40 #2 Bit 9 46DT Bit 10 46IT Bit 11 50 Bit 12 50N Bit 13 50/27 Bit 14 50BF Bit 15 51V Note: The two function timer words represent which detectors timer are timed out at the time the target is tagged.
8-06					Not used.
8-07					Not used.
8-08	1U				Target #1 59 #1 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)
8-09	1U				Target #1 59 #2 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)

8-10	1U				Target #1 27 #1 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)
8-11	1U				Target #1 27 #2 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)
8-12	1U				Target #1 87 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)
8-13					Not used.
8-14					Not used.
8-15	1U				Target #1 50 Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0) Note:Timer and status will follow each other.

8-16	1U				Target #1 51V Phase status/timer Bit 0 Phase A timer Bit 1 Phase B timer Bit 2 Phase C timer Bit 3-7 Not used (0) Bit 8 Phase A status Bit 9 Phase B status Bit 10 Phase C status Bit 11-15 Not used (0)
8-17					Not used.
8-18					Not used.
8-19	1000	AMPS			Target #1 Phase A line side current
8-20	1000	AMPS			Target #1 Phase B line side current
8-21	1000	AMPS			Target #1 Phase C line side current
8-22	1000	AMPS			Target #1 Phase N line side current
8-23					Not used.
8-24					Not used.
8-25 -> 8-36					Target #1 Target date and time stamp encoded as an ASCII string. DD-MMM-YYYY HH:MM:SS.TTT For example: 03-Mar-1990 12:15:03.982 8-25 = 12339 or 3033HEX or '0"3' 8-26 = 11597 or 2d4dHEX or '-'M' 8-27 = 24946 or 6172HEX or 'a"r' 8-28 = 11569 or 2d31HEX or '-'1' 8-29 = 14649 or 3939HEX or '9"9' 8-30 = 12320 or 3020HEX or '0" ' 8-31 = 12594 or 3132HEX or '1"2' 8-32 = 14896 or 3a30HEX or ':'1' 8-33 = 13626 or 353aHEX or '5":' 8-34 = 12339 or 3033HEX or '0"3' 8-35 = 15929 or 2E39HEX or '."9' 8-36 = 14386 or 3832HEX or '8"2'
8-37	1U				Target #2 relay status see 8-00

8-38	1U				Target #2 input status see 8-01
8-39	1U				Target #2 Function status see 8-02
8-40	1U				Target #2 Function status see 8-03
8-41	1U				Target #2 Function timer see 8-04
8-42	1U				Target #2 Function timer see 8-05
8-43					Not used.
8-44					Not used.
8-45	1U				Target #2 59 #1 Phase status/timer see 8-08
8-46	1U				Target #2 59 #2 Phase status/timer see 8-09
8-47	1U				Target #2 27 #1 Phase status/timer see 8-10
8-48	1U				Target #2 27 #2 Phase status/timer see 8-11
8-49	1U				Target #2 87 Phase status/timer see 8-12
8-50					Not used.
8-51					Not used.
8-52	1U				Target #2 50 Phase status/timer see 8-15
8-53	1U				Target #2 51V Phase status/timer see 8-16
8-54					Not used.

8-55					Not used.
8-56	1000	AMPS			Target #2 Phase A line side current see 8-19
8-57	1000	AMPS			Target #2 Phase B line side current see 8-20
8-58	1000	AMPS			Target #2 Phase C line side current see 8-21
8-59	1000	AMPS			Target #2 Phase N line side current see 8-22
8-60					Not used.
8-61					Not used.
8-62 -> 8-73					Target #2 Target date and time stamp see 8-25 -> 8-36
8-74 -> 8-110					Target #3 see above.
8-111 -> 8-147					Target #4 see above.
8-148 -> 8-184					Target #5 see above.
8-185 -> 8-221					Target #6 see above.
9-00 -> 9-36					Target #7 see above.
9-37 -> 9-73					Target #8 see above.
9-74 -> 9-110					Target #9 see above.
9-111 -> 9-147					Target #10 see above.
9-148 -> 9-184					Target #11 see above.
9-185 -> 9-221					Target #12 see above.

10-00 -> 10-36					Target #13 see above.
10-37 -> 10-73					Target #14 see above.
10-74 -> 10-110					Target #15 see above.
10-111 -> 10-147					Target #16 see above.
10-148 -> 10-184					Target #17 see above.
10-185 -> 10-221					Target #18 see above.
11-00 -> 11-36					Target #19 see above.
11-37 -> 11-73					Target #20 see above.
11-74 -> 11-110					Target #21 see above.
11-111 -> 11-147					Target #22 see above.
11-148 -> 11-184					Target #23 see above.
11-185 -> 11-221					Target #24 see above.
12-00 -> 12-36					Target #25 see above.
12-37 -> 12-73					Target #26 see above.
12-74 -> 12-110					Target #27 see above.
12-111 -> 12-147					Target #28 see above.
12-148 -> 12-184					Target #29 see above.
12-185 -> 12-					Target #30

221					see above.
13-00 -> 13-36					Target #31 see above.
13-37 -> 13-73					Target #32 see above.