INSTRUCTION MANUAL

FOR

GENERATOR PROTECTION SYSTEM BE1-GPS100

DISTRIBUTED NETWORK PROTOCOL (DNP3)

Publication: 9318700992
Revision: C 08/17

INTRODUCTION

This instruction manual provides detailed information about the BE1-GPS100 Generator Protection System with the Distributed Network Protocol (DNP3).

First Printing: May 2000

Printed in USA

August 2017

It is not the intention of this manual to cover all details and variations in equipment, nor does this manual provide data for every possible contingency regarding installation or operation. The availability and design of all features and options are subject to modification without notice. Should further information be required, contact Basler Electric.

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REVISION HISTORY

The following information provides a historical summary of the changes made to this instruction manual (9318700992). Revisions are listed in reverse chronological order.

Manual Revision and Date	Change
C, 08/17	• Added caution box about nonvolatile memory in Section 1.
B, 04/08	• Added manual part number and revision to footers.
A, 11/03	• Added generator fault and bus frequency points for “most recent” and “selected” faults to Table 5, *Analog Inputs.*
—, 05/00	• Initial release.

CONTENTS

SECTION 1 • GENERAL INFORMATION

Introduction

This document describes the Basler Electric Distributed Network Protocol (DNP) implementation in the BE1-GPS100 Generator Protection System. The BE1-GPS100 is classified as an intelligent electronic device (IED) that is capable of reacting or responding to specific requests conforming to a level two slave device, as defined in the DNP3 Subset Definitions Document. This manual contains a list of DNP data objects accessible by a master station.

NOTE

This implementation of DNP3 is fully compliant with DNP3 Subset Definition Level 2, contains many Subset Level 3 features, and contains some functionality even beyond Subset Level 3.

CAUTION

This product contains one or more *nonvolatile memory* devices. Nonvolatile memory is used to store information (such as settings) that needs to be preserved when the product is power-cycled or otherwise restarted. Established nonvolatile memory technologies have a physical limit on the number of times they can be erased and written. In this product, the limit is 100,000 erase/write cycles. During product application, consideration should be given to communications, logic, and other factors that may cause frequent/repeated writes of settings or other information that is retained by the product. Applications that result in such frequent/repeated writes may reduce the useable product life and result in loss of information and/or product inoperability.

References

- Instruction Manual for BE1-GPS100 Generator Protection System
- DNP3 Basic 4 Document Set
- DNP Subset Definitions Document
- The DNP website (www.DNP.org)

SECTION 2 • DEVICE PROFILE DOCUMENT

Table 2-1 provides a Device Profile Document in the standard format defined in the DNP3 subset definition document. The table, in combination with the implementation table provided in Section 3 and the point list tables provided in Section 5, provide a complete application configuration guide for including the BE1-GPS100 DNP protocol in any DNP environment.

Table 2-1. DNP Device Profile Document

DNP DEVICE PROFILE DOCUMENT

Vendor Name: Basler Electric Company

Device Name: BE1-GPS100 Generator Protection System

Highest DNP Level Supported:	Device Function:
DNP-L2.	☐ Master ☒ Slave

Notable objects, functions, and/or qualifiers supported in addition to the highest DNP levels supported (the complete list is described in DNP3 Implementation Table):

- For static (non-change-event) object requests, request qualifier codes 00 and 01 (start-stop), 07 and 08 limited quantity), and 17 and 28 (index) are supported in addition to request qualifier code 06 (no range – or all points).
- Static object requests sent with qualifiers 00,01,06,07, and 08, will be responded to with qualifiers 00 or 01.
- Static object requests sent with qualifiers 17 and 28 will be responded to with qualifiers 17 or 28.
- The read function code for object 102 (8-bit unsigned integer), variation 1, is supported.
- Time period when device requires time-synchronization from the master is configurable via object 41, point 30.
- Dead band for current change events is configurable via object 41, point 31.
- Dead band for voltage change events is configurable via object 41, point 32.
- Dead band for power change events is configurable via object 41, point 33.

Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted 292 Received 292	Transmitted 2048 Received 1024

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☒ None ☐ Fixed at ☐ Configurable	☒ None ☐ Fixed at ☐ Configurable, range _____ to _____

Requires Data Link Layer Confirmation:

☒ Never
☐ Always
☐ Sometimes If 'Sometimes', when?_____
☐ Configurable If 'Configurable', how?_____

Requires Application Layer Confirmation:

☐ Never
☐ Always (not recommended)
☒ When reporting Event Data (Slave devices only)
☒ When sending multi-fragment responses (Slave devices only)

DNP DEVICE PROFILE DOCUMENT

Timeouts while waiting for:

Data Link Confirm	☐ None	☒ Fixed at 3000 ms	☐ Variable	☐ Configurable
Complete Appl. Fragment	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable
Application Confirm	☐ None	☒ Fixed at 5000 ms	☐ Variable	☐ Configurable
Complete Appl. Response	☒ None	☐ Fixed at ____	☐ Variable	☐ Configurable

Sends/Executes Control Operations:

WRITE Binary Outputs	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
DIRECT OPERATE - NO ACK	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Count > 1	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Pulse Off	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Latch Off	☐ Never	☒ Always	☐ Sometimes	☐ Configurable
Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable
Clear Queue	☒ Never	☐ Always	☐ Sometimes	☐ Configurable

Reports Binary Input Change Events when no specific variation requested (Slave Only):
- ☐ Never
- ☒ Only time-tagged
- ☐ Only non-time-tagged
- ☐ Configurable to send both, one or the other (attach explanation)

Reports time-tagged Binary Input Change Events when no specific variation requested:
- ☐ Never
- ☒ Binary Input Change With Time
- ☐ Binary Input Change With Relative Time
- ☐ Configurable (attach explanation)

Master Expects Binary Input Change Events:
- ☐ Never
- ☐ Either time-tagged or non-time-tagged for a single event
- ☐ Both time-tagged and non-time-tagged for a single event
- ☐ Configurable (attach explanation)

Sends Unsolicited Responses (Slave Only):
- ☒ Never
- ☐ Configurable (attach explanation)
- ☐ Only certain objects
- ☐ Sometimes (attach explanation)
- ☐ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses (Slave Only):
- ☒ Never
- ☐ When Device Restarts
- ☐ When Status Flags Change

No other options are permitted.

Default Counter Object/Variation:
- ☒ No Counters Reported
- ☐ Configurable (attach explanation)
- ☐ Default Object
  Default Variation
- ☐ Point-by-point list attached

Counters Roll Over at:
- ☒ No Counters Reported
- ☐ Configurable (attach explanation)
- ☐ 16 Bits
- ☐ 32 Bits
- ☐ Other Value:
- ☐ Point- by-point list attached

Sends Multi-Fragment Responses (Slave Only): ☒ Yes ☐ No

SECTION 3 • IMPLEMENTATION TABLE

DNP Implementation Table

Table 3-1 identifies which object variations, function codes, and qualifiers the BE1-GPS100 DNP supports in both request messages and in response messages.

For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08 will be responded to with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded to with qualifiers 17 or 28.

For change-event objects, qualifiers 17 and 28 are always responded.

Table 3-1. DNP Implementation Table

OBJECT			**REQUEST** (BE1-GPS100 will parse)		**RESPONSE** (BE1-GPS100 will respond with)	
Object No.	Variation No.	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (hex)	Qualifier Codes (hex)
1	0	Binary Inputs – (Variation 0 is used to request default variation)	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)		
1	1 (default – see note 1)	Single-Bit Binary Input	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81 (response)	00,01 (start-stop) 17,28 (index)
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read)	06 (no range) 07,08 (limited qty)		
2	1	Binary Input Change without time	1 (read)	06 (no range) 07,08 (limited qty)	81 (response)	17,28 (index)
2	2 (default – see note 1)	Binary Input Change with time	1 (read)	06 (no range) 07,08 (limited qty)	81 (response)	17,28 (index)
10	0	Binary Output – (Variation 0 is used to request default variation)	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)		
10	2 (default – see note 1)	Binary Output Status	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir op Noack)	00,01 (start-stop) 07,08 (limited qty) 17,28 (index)	81	echo of request
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81(response)	00,01 (start-stop) 17,28 (index)
30	1	32-Bit Analog Input With Flag	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
30	2	16-Bit Analog Input With Flag	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)

OBJECT			REQUEST (BE1-GPS100 will parse)		RESPONSE (BE1-GPS100 will respond with)	
Object No.	Variation No.	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (hex)	Qualifier Codes (hex)
30	3 (default – see note 1)	32-Bit Analog Input Without Flag	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
30	4	16-Bit Analog Input Without Flag	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range) 07,08 (limited qty)		
32	1 (default – see note 1)	32-Bit Analog Input without time	1 (read)	06 (no range) 07,08 (limited qty)	81	17,28 (index)
32	2	16-Bit Analog Input without time	1 (read)	06 (no range) 07,08 (limited qty)	81	17,28 (index)
32	3	32-Bit Analog Input with time	1 (read)	06 (no range) 07,08 (limited qty)	81	17,28 (index)
32	4	16-Bit Analog Input with time	1 (read)	06 (no range) 07,08 (limited qty)	81	17,28 (index)
40	0	Analog Output Status – (Variation 0 is used to request default variation)	1	00,01 (start-stop) 06 (no range) 07,08 (limited qty) 17,28 (index)		
40	1	32-bit Analog Output Status	1 (read)	00,01 (start-stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
40	2 (default - see note 1)	16-bit Analog Output Status	1 (read)	00,01 (start-stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
41	1	32-bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir op noack)	00,01 (start-stop) 07,08 (limited qty) 17,28 (index)	81	echo of request
41	2	16-bit Analog Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir op noack)	00,01 (start-stop) 07,08 (limited qty) 17,28 (index)	81	echo of request
50	1	Time and Date	1 (read) 2 (write)	00,01 (start-stop) 06 (no range or all) 07 (limited qty=1) 08 (limited qty) 17,28 (index)	81	00,01 (start-stop) 17,28 (index)
60	1	Class 0 Data (Note 1) (Note 4)	1 (read)	06 (no range or all)	81	
60	2	Class 1 Data	1 (read)	06 (no range or all) 07,08 (limited qty)	81	
60	3	Class 2 Data	1 (read)	06 (no range or all) 07,08 (limited qty)	81	
60	4	Class 3 Data	1 (read)	06 (no range or all) 07,08 (limited qty)	81	
80	1	Internal Indications	2 (write)	00 (start-stop) (index must=7)		
102	1	8-Bit Unsigned Integer (Note 2)	1 (read)	00,01 (start- stop) 06 (no range) 07,08 (limited qty) 17,28 (index)	81(response)	00,01 (start-stop) 17,28 (index)
		No Object (function code only) (See Note 3)	13 (cold restart)			

OBJECT			REQUEST (BE1-GPS100 will parse)		RESPONSE (BE1-GPS100 will respond with)	
Object No.	Variation No.	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (hex)	Qualifier Codes (hex)
		No Object (function code only) (See Note 3)	14 (warm restart)			
		No Object (function code only)	23 (delay meas)			

Notes for Table 3-1:

1. A Default variation refers to the variation responded to when variation 0 is requested and/or in class 0, 1, 2, or 3 scans.
2. Object 102 is not included in Class 0 poll response.
3. A cold restart is implemented as a warm restart – the DNP process is restarted.
4. In Class 0, all Binary Inputs (object 1) are included, and a selected set of Analog Inputs (object 30). Binary Output Status points and Analog Output Status points are not included in Class 0.

SECTION 4 • CONFIGURATION PARAMETERS

DNP Configuration Parameters

These paragraphs describe configuration settings that may be verified/changed from the BE1-GPS100 front panel or using ASCII protocol commands.

Relay Style Number

BE1-GPS100 relays that support the DNP protocol must have a Style Number with the sixth character as a number 3. This can be verified by reading the relay Style Number via the front communication port using the RG-VER ASCII command. (Reference the BE1-GPS100 Instructional Manual, part number 9318700990).

Example:
>rg-ver
Model Number: BE1-GPS100
Style Number: E3N2H3
App Program: VER 1.01.00 08/26/99
Boot Program: VER 2.05 10/21/98
Serial Number: H00069997

BE1-GPS100 Slave Address

BE1-GPS100 relays support DNP through the rear RS-485 communication port, which is communication port 2 (COM2). This port supports Baud Rates: 1200, 2400, 4800, 9600, and 19200, and the default Baud Rate is 9600.

DNP Slave IED Address Range is from 0 to 65534. Address 65535 (hex FFFF) is used to broadcast messages to all devices. The communication address can be set by the SG-COM ASCII command. For more information about changing the relay parameters, refer to the *BE1-GPS100 Instructional Manual,* part number 9318700990.

Example: Set the BE1-GPS100 address to be 125, and baud rate to be 9600.

(In the following example, the operator's commands are in **bold**.)

>**a=**<**global_password**> <**enter**> //enter global password

>ACCESS GRANTED: GLOBAL

> **sg-com2=9600,a125** (**enter**)

>**exit** (**enter**)

>SAVE CHANGES (Y/N/C) ?

>**y** <**enter**>

>CHANGE COMM PARAMETERS

>

To verify port address, enter command

>**sg-com2** (**enter**)

>SG-COM2=9600, A125, P0,R1,X0

SECTION 5 • POINT LIST

TABLE OF CONTENTS

Tables

SECTION 5 • POINT LIST

Binary Input Points

Binary Input changes are scanned every eight milliseconds. Events are pending in the Slave application buffer until the Master device sends conformation that response with pending events was received. Table 5-1 describes the binary input points.

Table 5-1. Binary Input Points

Binary Input Points

Static Object Number: 1
Change Event Object Number: 2
Request Function Codes Supported: 1 (read)
Static Variation Reported When Variation 0 Requested: 1 (Binary Input Without Status)
Change Event Variation Reported When Variation 0 Requested: 2 (Binary Input Change With Time)

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
0	50TA Phase Tripped	1	
1	50TB Phase Tripped	1	
2	50TC Phase Tripped	1	
3	50T Neutral Tripped	1	
4	Breaker Failure Tripped	1	
5	51 Phase A Tripped	1	
6	51 Phase B Tripped	1	
7	51 Phase C Tripped	1	
8	51 Neutral Tripped	1	
9	151 Neutral Tripped	1	
10	46 Neg Seq Tripped	1	
11	43	1	
12	143	1	
13	243	1	
14	343	1	
15	Input Contact 1 State	1	
16	Input Contact 2 State	1	
17	Input Contact 3 State	1	
18	Input Contact 4 State	1	
19	62 Timer	1	
20	162 Timer	1	
21	262 Timer	1	
22	362 Timer	1	
23	101Trip Breaker Switch	1	
24	101Close Breaker Switch	1	
25	101Slip Contact	1	
26	Alarm Logic	1	
27	Alarm Major	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
28	Alarm Minor	1	
29	OUT1 Mon	1	
30	SG0	1	
31	SG1	1	
32	27A Trip	1	
33	27B Trip	1	
34	27C Trip	1	
35	27XT	1	
36	127A Trip	1	
37	127B Trip	1	
38	127C Trip	1	
39	127XT	1	
40	32 Trip	1	
41	132 Trip	1	
42	40 Trip	1	
43	140 Trip	1	
44	47T	1	
45	24T	1	
46	59A	1	
47	59B	1	
48	59C	1	
49	59XT	1	
50	159A	1	
51	159B	1	
52	159C	1	
53	159XT	1	
54	81T	1	
55	181T	1	
56	281T	1	
57	381T	1	
58	25	1	
59	60FL	1	
Hardware Output Status			
60	Output A	1	
61	Output 1	1	
62	Output 2	1	
63	Output 3	1	
64	Output 4	1	
65	Output 5	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
	Relay Trouble Alarms		
66	MPU Self test Failed	1	
67	EEProm Read/Write Fatal Error	1	
68	Analog problem detected	1	
69	Relay not calibrated or calibration checksum error	1	
70	SETTING defaults loaded	1	
71	Calibration defaults loaded	1	
	Programmable Alarms (See Note 1)		
72	Trip Circuit Monitor Alarm (OUT1 CKT OPEN)	1	
73	Breaker Fail Alarm	1	
74	Breaker Alarm 1	1	
75	Breaker Alarm 2	1	
76	Breaker Alarm 3	1	
77	P Demand Alarm	1	
78	N Demand Alarm	1	
79	Q Demand Alarm	1	
80	Group Override (0=Local Control, 1=Overide)	1	
81	CPU Overload Alarm	1	
82	Communication Error Alarm	1	
83	Clock Error Alarm	1	
84	MPU Reset Alarm	1	
85	Settings Changed	1	
86	EEPROM Non fatal error	1	
87	An override is active in one or more outputs	1	
88	Loss of IRIG	1	
89	SGC Active	1	
90	Virtual Output 13 Logic Alarm	1	
91	Virtual Output 14 Logic Alarm	1	
92	Virtual Output 15 Logic Alarm	1	
93	FLT RPT Time Out	1	
94	Logic=None Alarm	1	
95	Var Demand Alarm	1	
96	Watt Demand Alarm	1	
97	Freq Range Alarm	1	
98	Settings ‘ Changes Lost Alarm	1	
99	60 Fuse Alarm	1	
100	Volts/HZ Alarm	1	
	Indications Of Fault Trigger Logic Expressions		
101	Pickup Trigger expression state(1=TRUE,0=FALSE)	1	2

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
102	Trip Trigger expression state(1=TRUE,0=FALSE)	1	2
103	Logic Trigger expression state(1=TRUE,0=FALSE)	1	2
104	1 - New Fault triggered. Fault data will be saved as the Most Recent Fault Summary Report and available when this point becomes 0. 0 - The Most Recent Fault Summary Report available.	1	3

Notes for Table 5-1:

1. Any alarm from this Programmable Alarms group may be declared as major, minor, or logic alarm. Refer to ASCII Serial Command SG-LGC, SA-MAJ, and SA-MIN.
2. Refer to ASCII Serial Command SG-TRIGGER=<trip>,<pu>,<logic>.
3. The time stamp from transition 0 to 1 is the fault trigger time (equal to the time of the most recent Fault Summary Report).

   The time stamp from transition 1 to 0 is the time since the Fault Summary Report for the most recent fault is available (see object 30 points from 67 to 104).

   The total count of point 104 transitions from zero to one (new faults triggered) in response to a Class 1 request represents the number of faults that have occurred between two consecutive Class 1 scans. A Class 1 scan reports only the Most Recent Fault Summary Report as analog events of object 32, points 40 to 66. If there are more than one New Fault Triggered events in the Class 1 response, the previous Fault Summary Reports can be retrieved through the Select Fault Summary Report (see object 30, points 67 to 93).

Binary Output Status Points and Control Relay Output Blocks

Table 5-2 lists both the Binary Output Status Points (Object 10) and the Control Relay Output Blocks (Object 12). It is important to note that Binary Output Status Points are not included in Class 0.

Table 5-2. Binary Output Status Points and Control Relay Output Blocks

Binary Output Status Points:
Object Number: 10
Variations supported: 2
Request Function Codes supported: 1 (read)
Default Variation reported when variation 0 requested: 2 (Binary Output Status)

Control Relay Output Blocks
Object Number: 12
Variations supported: 1
Request Function Codes supported: 3 (select), 4 (operate), 5 (direct operate), 6 (direct operate, noack)

Point Index	Description	Control Codes And Their Description
0	Hardware Output A State	Latch On: Set Output x to state 1 Latch Off: Set Output x to state 0 Pulse On: Pulse output x to opposite of current state then restore to previous state (pulsed output is active 200 to 250 ms)
1	Hardware Output 1 State	
2	Hardware Output 2 State	
3	Hardware Output 3 State	
4	Hardware Output 4 State	
5	Hardware Output 5 State	
6	All Hardware Outputs State	
7	Hardware Output A Local Control	Latch On: Set Hardware Output x to relay logic or local control
8	Hardware Output 1 Local Control	
9	Hardware Output 2 Local Control	
10	Hardware Output 3 Local Control	

Point Index	Description	Control Codes And Their Description
11	Hardware Output 4 Local Control	
12	Hardware Output 5 Local Control	
13	All Hardware Outputs Local Control	
14	43 Virtual Switch Status	Latch On: Set x Selector Switch to 1 Latch Off: Set x Selector Switch to 0 Pulse On: Pulse x Selector Switch state to opposite of the current state then restore to previous state (pulsed input is active 200 to 250 ms).
15	143 Virtual Switch Status	
16	243 Virtual Switch Status	
17	343 Virtual Switch Status	
18	101 Virtual Breaker Control Switch	Close: Close Breaker (changes 101C Binary Input from 0 to 1 for 200 ms) Trip: Trip Breaker (changes 101T from 0 to 1 for 200 ms)
19	Setting Group 0	Latch On: Select Group 0 to be Active
20	Setting Group 1	Latch On: Select Group 1 to be Active
21	Local Setting Group Control Switch	Latch On: Return Setting Group Control to relay local logic

Notes for Table 5-2:

1. Reads of Points
   - Reads of points from 0 to 5 and 14 to 17 returns the current state of corresponding point.
   - Reads of points from 7 to 12 returns 1 if corresponding hardware output is under relay Local control, or 0 if output is override.
   - Reads of point 19 and 20 returns 1 if Setting Group is active. Notice that only one of these points can be active at any time.
   - Read of point 21 returns value 1 if the Setting Group Control is under relay local logic.
   - Reads of points 6, 13, and 18 always returns 0.
2. When used to control the points listed in Table 5-1, the Control Code field of object 12 is parsed as described in the following paragraphs.
   - If the Control Code is NULL, then the command will be accepted without any action being taken.
   - If Queue, and Clear sub-fields are not zero, the returned Control Status is 4 (Control operation not supported).
   - A Code sub-field of “Pulse On” (1) in combination with a value in the Trip/Close sub-field, form a Trip or Close value. A “Trip” value consists of a “PULSE ON” (1) in the Code sub-field and a 2 in the Trip/Close sub-field. This results in a value of 81(hex) in the Control Code field. A “Close” value consists of a “PULSE ON” (1) in the Code sub-field and a 1 in the Trip/Close sub-field. This results in a value of 41 (hex) in the Control Code field.
3. Valid Control Code values are:
   - 0x00 = No action will be taken.
   - 0x01 = Pulse output to opposite of current state, and then restore to previous state. Pulsed output is active 200 to 250 ms.
   - 0x03 = Latch On
   - 0x04 = Latch Off
   - 0x41 = Close (Breaker Close)
   - 0x81 = Trip (Breaker Open)

   All operations not defined above are invalid and will be rejected. If the Control Code is legal, but not supported for the requested point, the Status Return value is “Control operation not supported for this point” (value 4).
   - The Count, OnTime, and OffTime fields are ignored.
   - Arm timer value for all Select/Operate operations is 30 seconds.

It is important to notice that any control function may be rejected because of the relay internal state. When this happens, the Status Return value is “Request not accepted because of hardware problems” (value 6). One of the reasons for the rejection may be that that point Logic Function Block has the Logic (Control) Mode disabled.

For example: Control functions for the hardware output points (points 0 to 13) will be rejected if the Output Control for all hardware outputs is disabled.

The Logic (Control) Mode of any object 12 point can be changed (enabled/disabled) via the specific point of object 41 (Analog Output Control Blocks). Refer to Analog Output Status Points and Analog Output Control Block points from 23 to 29.

Analog Inputs

Table 5-3 lists the Analog Inputs (Objects 30 and 32). It is important to note that 16-bit and 32-bit variations of Analog Inputs, Analog Output Control Blocks, and Analog Output Statuses are transmitted through DNP as signed numbers. Even for analog input points that are not valid as negative values, the maximum positive representation for a 16-bit variation is $<2^{15}-1> = 32,767$. For a 32-bit variation the maximum positive representation is $<2^{31}-1> = 2,147,483,647$.

An analog change event will be generated if the point changes value by the absolute amount equal to or greater than the dead band. An analog change event, once generated, will be reported in one of the class polls (1, 2, 3, or none) as defined in the column *Change Event Assigned Class*.

Points not assigned to any class can be read as object 30 points in any supported variation or qualifier implemented for object 30.

Change events for analog inputs are reported in CURRENT mode (when a change is detected, the report of the change contains the current value of the time of the report, not the time the change was detected.

Table 5-3. Analog Inputs

Analog Inputs

Static Object Number : 30
Change Event Object Number : 32
Request Function Codes Supported: 1 (read)
Static Variation Reported When Variation 0 Requested: 3 (32-bit Analog Input without Flag)
Change Event Variation Reported When Variation 0 Requested: 1 (32-bit Analog Change Event without Time)

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
	Metering Values		
0	Phase A Current Magnitude	2	1,18,7
1	Phase B Current Magnitude	2	1,18,7
2	Phase C Current Magnitude	2	1,18,7
3	Ground Current Magnitude	2	1,18,7
4	Negative Sequence Current Magnitude	2	1,18,7
5	Neutral Current Magnitude	2	1,18,7
6	Phase Frequency	2	1,15
7	Auxiliary Frequency	2	1,15
8	Slip Frequency	none	1
9	Slip Angle	none	1
10	Power Factor (PF)	2	21
11	Power Factor Lead/Lag	2	20,22
12	Power Apparent	2	1,17,7
13	Power , Reactive Total (for phases A,B & C)	2	1,17,7

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
14	Power, True Total (for phases A,B & C)	2	1,17,7
15	Voltage, A-phase	2	1,16,7
16	Voltage, B-phase	2	1,16,7
17	Voltage, C-phase	2	1,16,7
18	Voltage, A-phase - B-phase	2	1,16,7
19	Voltage, B-phase - C-phase	2	1,16,7
20	Voltage, C-phase - A-phase	2	1,16,7
21	Voltage, Negative Sequence	2	1,16,7
22	Voltage, Zero Sequence	2	1,16,7
23	AUX Voltage Input	2	1,16,7
24	AUX Voltage Input 3rd Harmonic	2	1,16,7
Present (New) Demands			
25	Present Demand Current - Phase A	2	1,18,7
26	Present Demand Current - Phase B	2	1,18,7
27	Present Demand Current - Phase C	2	1,18,7
28	Present Demand Current - Neutral	2	1,18,7
29	Present Demand Current - Negative Sequence	2	1,18,7
30	Present Demand Reactive Power Total	2	1,17,7
31	Present Demand True Power Total	2	1,17,7
Breaker Data			
32	Breaker Duty Phase A	2	12
33	Breaker Duty Phase B	2	12
34	Breaker Duty Phase C	2	12
35	Breaker Operation Counter	2	13
Latched Targets			
36	Target Bits Part 1	1	6, 20
37	Target Bits Part 2	1	6, 20
38	Target Bits Part 3	1	6, 20
39	Target Bits Part 4	1	6, 20
Most Recent Fault Summary Report (Points 40 – 66)			
40	Fault Number	1	2,20
41	Fault Trigger Time Stamp-Part 1: days	1	3,20
42	Fault Trigger Time Stamp-Part 2: ms	1	3,20
43	Trigger (Event Type)	1	5,20
44	Active Setting Group	1	4,20
45	Relay Status - Part 1	1	19,20
46	Relay Status - Part 2	1	19,20
47	Relay Status - Part 3	1	19,20
48	Relay Status - Part 4	1	19,20
49	Relay Status - Part 5	1	19,20

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
50	Relay Status - Part 6	1	19,20
51	Target Flags Bits Part 1	1	6, 20
52	Target Flags Bits Part 2	1	6, 20
53	Target Flags Bits Part 3	1	6, 20
54	Target Flags Bits Part 4	1	6, 20
55	Clearing Time	1	8, 20
56	Breaker Operate Time	1	9, 20
57	Number of Oscillographic Reports	1	10, 20
58	Fault Current Phase A	1	1, 20
59	Fault Current Phase B	1	1,20
60	Fault Current Phase C	1	1, 20
61	Fault Current Neutral	1	1, 20
62	Fault Current Q	1	1, 20
63	Fault Voltage Phase A	1	1, 20
64	Fault Voltage Phase B	1	1, 20
65	Fault Voltage Phase C	1	1, 20
66	Fault Voltage Phase N	1	1, 20
Selected Fault Summary (For Selected Fault Number via Object 41) (Points 67- 93) (See Note 14)			
67	Fault Number	none	2
68	Fault Trigger Time Stamp-Part 1: days	none	3
69	Fault Trigger Time Stamp-Part 2: ms	none	3
70	Trigger (Event Type)	none	5
71	Active Setting Group	none	4
72	Relay Status - Part 1	none	19
73	Relay Status - Part 2	none	19
74	Relay Status - Part 3	none	19
75	Relay Status - Part 4	none	19
76	Relay Status - Part 5	none	19
77	Relay Status - Part 6	none	19
78	Target Flags Bits Part 1	none	6
79	Target Flags Bits Part 2	none	6
80	Target Flags Bits Part 3	none	6
81	Target Flags Bits Part 4	none	6
82	Clearing Time	none	8
83	Breaker Operate Time	none	9
84	Number of Oscillographic Records	none	10
85	Fault Current Phase A	none	1
86	Fault Current Phase B	none	1
87	Fault Current Phase C	none	1
88	Fault Current Neutral	none	1

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
89	Fault Current Q	none	1
90	Fault Voltage Phase A	none	1
91	Fault Voltage Phase B	none	1
92	Fault Voltage Phase C	none	1
93	Fault Voltage Phase N	none	1
Peak Demands (Historical Data)			
94	**Peak Demand Current Since Reset - Phase A**	none	1
95	Peak Demand Current Since Reset Phase A Time Stamp -part 1: days	none	11
96	Peak Demand Current Since Reset Phase A Time Stamp -part 2: ms	none	11
97	**Peak Demand Current Since Reset - Phase B**	none	1
98	Peak Demand Current Since Reset Phase B Time Stamp -part 1: days	none	11
99	Peak Demand Current Since Reset Phase B Time Stamp -part 2: ms	none	11
100	**Peak Demand Current Since Reset - Phase C**	none	1
101	Peak Demand Current Since Reset Phase C Time Stamp - part 1: days	none	11
102	Peak Demand Current Since Reset Phase C Time Stamp - part 2: ms	none	11
103	**Peak Demand Current Since Reset - Neutral Current**	none	1
104	Peak Demand Current Since Reset Neutral Time Stamp -part 1: days	none	11
105	Peak Demand Current Since Reset Neutral Time Stamp -part 2: ms	none	11
106	PEAK DEMAND CURRENT SINCE RESET NEGATIVE SEQUENCE CURRENT	none	1
107	Peak Demand Current Since Reset Negative Sequence Time Stamp -part 1: days	none	11
108	Peak Demand Current Since Reset Negative Sequence Time Stamp -part 2: ms	none	11
109	**Peak Demand True Power Since Reset**	none	1
110	Peak Demand True Power Since Reset Time Stamp -part 1: days	none	11
111	Peak Demand True Power Since Reset Time Stamp -part 2: ms	none	11
112	**Peak Demand Negative True Power Since Reset**	none	1
113	Peak Demand Negative True Power Since Reset Time Stamp -part 1: days	none	11
114	Peak Demand Negative True Power Since Reset Time Stamp -part 2 :ms	none	11
115	**Peak Demand Reactive Power Since Reset**	none	1
116	Peak Demand Reactive Power Since Reset Time Stamp -part 1: days	none	11

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
117	Peak Demand Reactive Power Since Reset Time Stamp -part 2: ms	none	11
118	**Peak Demand Negative Reactive Power Since Reset**	none	1
119	Peak Demand Negative Reactive Power Since Reset Time Stamp -part 1: days	none	11
120	Peak Demand Negative Reactive Power Since Reset Time Stamp -part 2: ms	none	11
121	**Today's Peak Demand Current - Phase A**	none	1
122	Today's Peak Demand Current - Phase A Time Stamp -part 1: days	none	11
123	Today's Peak Demand Current - Phase A Time Stamp -part 2: ms	none	11
124	**Today's Peak Demand Current - Phase B**	none	1
125	Today's Peak Demand Current - Phase B Time Stamp -part 1: days	none	11
126	Today's Peak Demand Current - Phase B Time Stamp -part 2: ms	none	11
127	**Today's Peak Demand Current - Phase C**	none	1
128	Today's Peak Demand Current - Phase C Time Stamp -part 1: days	none	11
129	Today's Peak Demand Current - Phase C Time Stamp -part 2: ms	none	11
130	Today's Peak Demand Neutral Current	none	1
131	Today's Peak Demand Neutral Current Time Stamp -part 1: days	none	11
132	Today's Peak Demand Neutral Current Time Stamp -part 2: ms	none	11
133	**Today's Peak Demand Negative Sequence Current**	none	1
134	Today's Peak Demand Negative Sequence Current Time Stamp -part 1: days	none	11
135	Today's Peak Demand Negative Sequence Current Time Stamp -part 2: ms	none	11
136	**Today's Peak Demand True Power**	none	1
137	Today's Peak True Power Time Stamp -part 1: days	none	11
138	Today's Peak True Power Time Stamp -part 2: ms	none	11
139	**Today's Peak Negative Demand True Power**	none	1
140	Today's Peak Negative Demand True Power Time Stamp -part 1: days	none	11
141	Today's Peak Negative Demand True Power Time Stamp -part 2: ms	none	11
142	**Today's Peak Demand Reactive Power**	none	1
143	Today's Peak Demand Reactive Power Time Stamp -part 1: days	none	11
144	Today's Peak Demand Reactive Power Time Stamp -part 2: ms	none	11

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
145	**Today's Peak Negative Demand Reactive Power**	none	1
146	Today's Peak Negative Demand Reactive Power Time Stamp -part 1: days	none	11
147	Today's Peak Negative Demand Reactive Power Time Stamp -part 2: ms	none	11
148	**Yesterdays Peak Demand Phase A Current**	none	1
149	Yesterdays Peak Demand Phase A current Time Stamp -part 1: days	none	11
150	Yesterdays Peak Demand Phase A current Time Stamp -part 2: ms	none	11
151	**Yesterdays Peak Demand Phase B Current**	none	1
152	Yesterdays Peak Demand Phase B current Time Stamp -part 1: days	none	11
153	Yesterdays Peak Demand Phase B current Time Stamp -part 2: ms	none	11
154	**Yesterdays Peak Demand Phase C Current**	none	1
155	Yesterdays Peak Demand Phase Current Time Stamp -part 1: days	none	11
156	Yesterdays Peak Demand Phase Current Time Stamp -part 2: ms	none	11
157	**Yesterdays Peak Demand Neutral Current**	none	1
158	Yesterdays Peak Demand Neutral current Time Stamp -part 1: days	none	11
159	Yesterdays Peak Demand Neutral current Time Stamp -part 2: ms	none	11
160	**Yesterdays Peak Demand Negative Sequence Current**	none	1
161	Yesterdays Peak Demand Negative Sequence current Time Stamp -part 1: days	none	11
162	Yesterdays Peak Demand Negative Sequence current Time Stamp -part 2: ms	none	11
163	**Yesterdays Peak Demand True Power**	none	1
164	Yesterdays Peak Demand True Power Time Stamp -part 1: days	none	11
165	Yesterdays Peak Demand True Power Time Stamp -part 2: ms	none	11
166	**Yesterdays Peak Negative Demand True Power**	none	1
167	Yesterdays Peak Negative Demand True Power Time Stamp -part 1: days	none	11
168	Yesterdays Peak Negative Demand True Power Time Stamp -part 2: ms	none	11
169	**Yesterdays Peak Demand Reactive Power**	none	1
170	Yesterdays Peak Demand Reactive Power Time Stamp -part 1: days	none	11

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
171	Yesterdays Peak Demand Reactive Power Time Stamp -part 2: ms	none	11
172	Yesterdays Peak Negative Demand Reactive Power	none	1
173	**Yesterdays Peak Negative Demand Reactive Power Time Stamp -part 1 : days**	none	11
174	Yesterdays Peak Negative Demand Reactive Power Time Stamp -part 2: ms	none	11
Most Recent Fault Summary Report (Points 175 – 176)			
175	Fault Generator Frequency	1	1,20
176	Fault Bus Frequency	1	1,20
Selected Fault Summary (For selected fault number via Object 41) (Points 177 – 178) (See Note 14)			
177	Fault Generator Frequency	none	1
178	Fault Bus Frequency	none	1

Notes for Table 5-3:

1. The multiplier of these analog data points is 0.01. Example if the data point is Current, 125 represents 1.25 amperes (125 centiamps).
   - CURRENT values are in Primary centiamps.
   - VOLTAGE values are in Primary centivolts.
   - REACTIVE power values are in Secondary centivars.
   - TRUE Power values are in Secondary centiwatts
   - FREQUENCIES are in centihertz
   - PHASE ANGLE is in centidegrees
   - FREQUENCY is in centihertz
2. Fault Number range is from 1 to 255. For example, after 255, fault number is going to be 1.
3. This time is a fault trigger time presented in relay's internal format: part 1 contains days (1 to 65535), and part 2 contains milliseconds (1 to 86,400,000) since January 1, 1984. This time is equal to the time of Binary Input Event "New Fault" triggered (transition from 0 to 1).

   Note that the Binary Input Event time stamp is presented in DNP time stamp format, since January 1, 1970.
4. Active setting group at time of fault (0 or 1).
5. Event type (value is 1, 2, 4, 8, or 16) reports the classification assigned to the fault event. Fault events are classified into five categories.
   1. **Breaker Failure** (Event Type value is 1): A fault was initiated by the pickup expression and the breaker failure trip became true before fault was cleared.
   2. **Trip** (Event Type value is 2): A fault was initiated by overcurrent pickup and the relay tripped to clear the fault.
   3. **Logic** (Event Type value is 4): A fault was detected as defined by the relay logic trigger expression, but no fault was detected as defined by the pickup expression.
   4. **Pickup** (Event Type value is 8): A fault was initiated by the pickup expression but the relay never tripped indicating that the fault was cleared by some other device.
   5. **RF=TRIG** (Event Type value is 16): A Fault was triggered by the ASCII command RF=TRIGGER received via the front or rear RS-232 communication port.
6. **Targets**: are bit mapped variables. (1= TRUE, 0=FALSE).
   If Targets are Latched, Table 5-4 represents the bit position of the element at the time the reading is taken.
   If Fault Report, these targets are logged to the fault report between the time that the trip expression became true until the end of the fault.

Table 5-4. Target Format

BIT	Part 1	Part 2	Part 3	Part 4
0	59A	SPARE	24	50TA
1	59B	81	27A	50TB
2	59C	181	27B	50TC
3	159A	281	27C	SPARE
4	159B	381	127A	SPARE
5	159C	SPARE	127B	SPARE
6	59X	SPARE	127C	50TN
7	159X	SPARE	27X	SPARE
8	60FL	SPARE	127X	SPARE
9	62	SPARE	32	SPARE
10	162	SPARE	132	51A
11	262	SPARE	40Q	51B
12	362	SPARE	140Q	51C
13	SPARE	SPARE	46	51N
14	SPARE	SPARE	47	151N
15	SPARE	SPARE	BF	SPARE

7. These analog points have configurable Change Event Dead bands via Analog Output Blocks (objects 41). Refer to the description of dead band in the paragraphs on *Analog Inputs* in this Section. For more information about dead band configuration see the notes under description of Analog Output Blocks, points 31, 32, and 33.
8. Fault Clearing Time is time in milliseconds from 0 to 60,000.
9. Breaker Operate Time is time in milliseconds from 0 to 60,000.
10. The number of recorded oscillographic records per fault (read value of this point) can be 1 or 2.
11. Time presented in relay internal format: part 1 contains days (1 to 65,535) and part 2 milliseconds (1 to 86,400,000) since January 1, 1984.
12. Point represents assigned phase accumulated breaker pole duty as a centipercent of the maximum duty (DMAX) that the breaker contacts can withstand before they need service.

    Breaker Accumulated Duty for Phase A, B, and C is calculated as ΣI or ΣI^2. This is defined by the Breaker Contact Duty Operation Mode 0/1/2 entered via the ASCII protocol command SB-DUTY. DMAX is defined through the same SB-DUTY command (for more information, see the BE1-GPS Instruction Manual, Section 4, *Protection And Control*). Value range is from 0 to 20,000 where 20,000 represents 200% of DMAX. Breaker duty default change event dead band value is 2.0.
13. This is the number of recorded breaker operations (0 – 99,999). If the operations counter exceeds 99,999, the counter will wrap back to zero. This value can be changed via object 41, point 8 to any value from 0 to 99,999. Default change event dead band is 1.
14. This Fault Summary must be requested via Object 41 using a valid fault number. If the fault number (1 to 255) does not exist, all reads of these data points will return 0.
15. Change event dead band is 0.01 HZ deviation). Refer to the description of dead band in the paragraphs on *Analog Inputs* in this Section.
16. Voltage default change event dead band is one percent of the nominal primary value.
17. Secondary power default change event dead band is 2.5% of the nominal secondary power.
18. Current default change event dead band is 2.5% of the nominal primary value.
19. Relay Status is shown in Table 5-5: (1=TRUE, 0=FALSE).

Table 5-5. Relay Status

BIT	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
0	50TPT	262	VOA	IN1	27PT	59PT
1	50TNT	362	VO1	IN2	127PT	159PT
2	BFT	43	VO2	IN3	27XT	59XT

BIT	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
3	51PT	143	VO3	IN4	127XT	159XT
4	51NT	243	VO4	101T	27PPU	59PPU
5	151NT	343	VO5	101C	127PPU	159PPU
6	46T	24T	VO6	101SC	27XPU	59XPU
7	50TPPU	24PU	VO7	SPARE	127XPU	159XPU
8	50TNPU	25	VO8	ALMLGC	32T	81T
9	BFPU	40T	VO9	ALMMAJ	132T	181T
10	51PPU	140T	VO10	ALMMIN	32PU	281T
11	51NPU	40PU	VO11	OUT1MON	132PU	381T
12	151NPU	140PU	VO12	SG0	SPARE3	SPARE5
13	46PU	SPARE1	VO13	SG1	SPARE4	SPARE6
14	62	SPARE2	VO14	TRSTKEY	47T	60FL
15	162	0	VO15	ARSTKEY	47PU	SPARE7

20. Change event dead band value is one.
21. Power factor range if from 0 to ±1,000, where value 1 represents 0.1%. Default change event dead band value is 10 (1%).
22. Power factor: leading is equal to 1, and lagging is equal to 0.

Analog Output Status Points and Control Blocks

Table 5-6 lists both the Analog Status Points (Object 40) and the Analog Output Control Blocks (Object 41). It is important to note that Analog Output Status Points are not included into Class 0.

The Return Status Value for object 41 for all control operations may be 6 (hardware problem) due to a value out of range, or a relay internal state. One of the reasons for rejection may be if another communication port or front panel HMI is actively programming. For more information, see the BE1-GPS Instruction Manual, Section 9, *Security, Command Descriptions, Setting Up Password Protection*.

Table 5-6. Analog Output Status Points and Control Blocks

Analog Output Status Points
Object Number: 40
Variations Supported: 1, 2
Request Function Codes supported: 1 (read)
Default Variation Reported When Variation 0 Requested: 2 (32-Bit Analog Output Status)

Analog Output Blocks
Object Number: 41
Variations Supported: 1, 2
Request Function Codes supported: 3 (select), 4 (operate), 5 (direct operate), 6 (direct operate, noack)

Index	Description	Notes
0	Breaker Accumulated Duty for Phase A	1, 15
1	Breaker Accumulated Duty for Phase B	1, 15
2	Breaker Accumulated Duty for Phase C	1, 15
3	Breaker Operations Alarm Count Setting	3, 15
Reset Controls For Demand Current Since Reset		
4	Peak Demand Current Since Reset - Phase A	6
5	Peak Demand Current Since Reset - Phase B	6
6	Peak Demand Current Since Reset - Phase C	6
7	Peak Demand Current Since Reset - Neutral	6
8	Peak Demand Current Since Reset - Negative Sequence	6
Reset Controls For Energy Data		
9	Three-phase varhours positive value	2a

Index	Description	Notes
10	Three-phase varhours negative value	2a
11	Three-phase watt-hours positive value	2b
12	Three-phase watt-hours negative value	2b
Reset Controls For Peak Demand Power Since Reset		
13	Peak Positive Demand True Power Since Reset	7b
14	Peak Negative Demand True Power Since Reset	7b
15	Peak Positive Demand reactive power Since Reset	7a
16	Peak Negative Demand reactive power Since Reset	7a
Alarm Reset Control		
17	Reset Major Alarms	4
18	Reset Minor Alarms	4
19	Reset Logic Alarms	4
20	Reset Relay Trouble Alarm	12
Miscellaneous Controls		
21	Target Status Reset Control	16
22	Fault Number for Selected Fault Summary Report	5
23	Hardware Output Logic Control Mode	11, 17
24	43 AUX Virtual Switch Logic Mode	8, 17
25	143 AUX Virtual Switch Logic Mode	8, 17
26	243 AUX Virtual Switch Logic Mode	8, 17
27	343 AUX Virtual Switch Logic Mode	8, 17
28	101 Virtual Breaker Control Switch	9, 17
29	Active Setting Group Control Mode	10, 17
30	Sync Time Period	13, 15
Configurable Analog Inputs' Change Event Dead Bands		
31	Current Change Event Dead band	14,15
32	Voltage Change Event Dead band	14,15
33	Power Change Event Dead band	14,15

Notes for Table 5-6:

1. This point represents assigned phase accumulated breaker pole duty as a centipercent of the maximum duty (DMAX) that the breaker contacts can withstand before they need service. Breaker Accumulated Duty for Phase A, B, and C is calculated as ΣI or ΣI^2. This is defined by Breaker Contact Duty Operation Mode 0/1/2 entered via ASCII protocol command SB-DUTY. DMAX is defined through the same SB-DUTY command (refer to INSTRUCTION MANUAL for BE1-GPS).

   Allowed value range is from 0 to 20,000, where 20,000 represents 200% of DMAX.

   Example: To change accumulated breaker duty for Phase B to 134 % of DMAX, set this point using appropriate request function code, with value 13400. A read of this point, will return a value of 13400 (134% of DMAX).

2a. This data point can only be set to 0 (Reset). Point read value represents primary reactive energy in KVARH. When value reaches ±1000 GVARH, it will roll over to 0, and accumulation will start again.

2b. This data point can only be set to 0 (Reset). Point read value represents primary true energy in KWH. When value reaches ±1000 GWH, it will roll over to 0, and accumulation will start again.

3. Read value of this point is a number of recorded breaker operations (0 – 99,999). If the operations counter exceeds 99,999, the counter will wrap back to 0 (zero). It acts as a counter, but is

implemented as analog object so that the initial value can be set or current value changed to any value from 0 to 99,999.

4. Major, Minor, and Logic Alarms are 32 bit mapped variables as described in Table 5-7. Writing value 0 will reset the alarms. Note that only latched alarms will be cleared.

Table 5-7. Alarm Status

Bit Mask (hex)	Name	Bit Mask (hex)	Name
00000001	OUT1 CKT OPEN	00010000	EE NON –FATAL ERR
00000002	Breaker Fail	00020000	OUTPUT OVERRIDE
00000004	Spare	00040000	LOSS OF IRIG
00000008	Spare	00080000	Setting Group Change Alarm Active
00000010	Breaker Alarm #1	00100000	VO13 LOGIC ALARM
00000020	Breaker Alarm #2	00200000	VO14 LOGIC ALARM
00000040	Breaker Alarm #3	00400000	VO15 LOGIC ALARM
00000080	P Demand	00800000	FLT RPT TIMEOUT
00000100	N Demand	01000000	LOGIC=NONE
00000200	Q Demand	02000000	VAR Demand Alarm
00000400	Group Override	04000000	WATT Demand Alarm
00000800	SYS I/O Delay	08000000	Frequency Range Alarm
00001000	Communication Error	10000000	Settings Changes Lost Alarm
00002000	Clock Error	20000000	Fuse Loss Alarm
00004000	uP Reset	40000000	Volts Per Hertz Alarm
00008000	Settings Changed	80000000	spare

5. Fault Number for Selected Fault Summary Report. This point value range is from 1 to 255. The Fault Summary Report for this selected fault number will be available as analog objects from point 67 to 93. If the Fault Summary Report for the Selected Fault does not exist in the relay at that time, the Return Status Value for object 41 will be 6 (hardware problem).
6. Read value is in primary centiamps (value 1 represents 0.01 A). For example: 670 represents 6.7 Amps. These points can only be set to value 0 (Reset).

7a. These points can only be set to value 0 (Reset). Point read value represents secondary Demand Reactive Power Since Reset in centivars [10^{-2} var]. For Example, 3500 represents secondary 35 vars.

7b. These points can only be set to value 0 (Reset). Point read value presents secondary Demand True Power Since Reset in centiwatts. For Example, 40000 represents secondary 400 W.

8. Logic Mode of AUX x43 switch can be 0 (disable), 1 (enable), 2 (on/off), and 3 (off/momentary on). (See ASCII command SL-43x in Instruction Manual for the BE1-GPS.) Depending on the Logic Mode value, AUX x43 Switch can or cannot be successfully controlled via the Control Relay Output Block x43.
9. Logic Mode of the 101 Breaker Control Switch can be 0 (disable) or 1 (enable). Depending on this point value, the 101 Virtual Breaker Control Switch can or can not be successfully controlled via Control Relay Output Block point for 101 Virtual Breaker Control Switch. (See ASCII command SL-101 in Instruction Manual for the BE1-GPS.)
10. Setting Group Mode can be 0 (disable), 1 (discrete select) or 2 (binary select). If the Setting Group is to be switched via object 12 (Control Relay Output Block), it must be first Enabled via this point. (See ASCII command SL-GROUP in Instruction Manual for the BE1-GPS.)
11. Hardware Output Logic Control Mode can be 0 (Disable) or 1 (Enable). If hardware outputs are to be controlled via object 12 (Control Relay Output Blocks), their control must be Enabled through this point. (See ASCII command CS/CO-OUT=ENA/DIS in Instruction Manual for the BE1-GPS.)
12. Relay Trouble Alarms can be reset by writing value 0 to this point. This is a 16-bit mapped variable and is described in Table 5-8. Only alarms with an asterisk (*) are implemented. These alarms can also be read as Binary Input (object 1) points.

Table 5-8. Relay Trouble Status Format

Bit Mask (hex)	Name	Bit Mask (hex)	Name
0001	(spare) Reserved for RAM FAILURE	0040	(spare) Reserved for PWR SUPPLY ERR
0002	(spare) Reserved for ROM FAILURE	0080	(spare) Reserved for WATCHDOG FAILURE
0004	(spare) Reserved for uP FAILURE	0100	SET DFLT LOADED*
0008	EEPROM FATAL ERROR *	0200	CALIBRATION DFLT LOADED*
0010	ANALOG FAILURE *	0400	spare
0020	CALIBRATION ERR *	0800	spare

13. Time period, in milliseconds, when the relay (slave) sets “NEED TIME” bit in first octet of the Application Response Header Internal Indication. When time is set by the Master via object 50 (write function), the relay resets this bit. Relay sets this bit again, periodically, if the time period is not zero. The default value on a Cold or Warm Restart is 0. This means that on Cold and Warm Restarts, this bit will never be set. Allowed value is from 0 to 2^{31}-1 = 2,147,483,647 milliseconds.
14. Change Event Dead band is programmable via this point. Point value must be entered as a percentage of primary nominal current (for point 31) or as a percentage of primary nominal voltage (for point 32), or as a percentage of secondary nominal power (for point 33). Allowed range is from 10 to 100 in steps of 1. This represents 1 to 10% in steps of 0.1%.

    Default Change Event Dead Bands are:

    - Current Default Change Event Dead Band is 2.5%
    - Voltage Default Change Event Dead Band is 1%
    - Power Default Change Event Dead Band is 2.5%

    Relay converts % into absolute amount of amperes, volts, watts, or vars by applying the following formulas:

    1. Phase Current Change Event Dead Band = Inom * CTP * % * 0.01
    2. Ground Current Change Event Dead Band = IGnom * CTG * %*0.01
    3. Phase to Neutral Voltage Change Event Dead Band = Vnom * VTP * %*0.01
    4. Aux Voltage Change Event Dead Band = Vnom * VTX * %*0.01
    5. Phase to Phase Voltage Change Event Dead Band = Vnom * VTP * % *0.01* √ 3
    6. Total Power Magnitude Change Event Dead Band = Vnom * Inom * % * 0.01* 3

    Where: CTP is Current CT Ratio, CTG is Ground Current CT Ratio, VTP is Voltage VT Ratio, and VTX is AUX voltage input VT Ratio.

    Examples:

    1. To configure Current Change Event Dead Band to 4% of primary nominal current, enter for point 31 the value 40.

       Relay converts this % into an ampere value. For a 5 ampere relay, and CTP ratio =120 turns, dead band value in amperes for Phase current 5*120*4 * 0.01 = 24 primary A (2400 centiamps).

       If CTG=100 turns, Ground Current Change Event Dead Band = 5*100*4 * 0.01 = 20 primary A.
    2. To configure Voltage Change Event Dead Band to 2% of primary nominal voltage enter for point 32 the value 20.

       Relay converts this % into a voltage value. For a VTP ratio =1000 turns, dead band value in volts for the Phase to Neutral Voltage Dead Band = 120 *1000 * 2 * 0.01 = 2400 V.

       If VTX=2000 than the Aux Voltage Change Event Dead Band=120 * 2000 * 2*0.01=4800 V.

       Phase-to-Phase Voltage Change Event Dead Band=120 *1000 * 2 * 0.01 *√ 3= 4152 V.
    3. To configure Total Power Change Event Dead Band to 4 % of secondary nominal power enter for point 33 the value 40.

       Relay converts this % into secondary watts value. For a 5 ampere relay, Power Change Event Dead Band = 120 * 5 * 4 * 0.01 = 24W.

       Total Power Change Event Dead Band = 120 * 5 * 4 * 0.01* 3 = 72W

15. This is a setting, and as such is active after being saved to a non-volatile memory. Saving to a non-volatile memory is performed immediately after a response to Master is sent, to prevent response time-out due to the saving operation.
16. This control point is used to reset Latched Targets reported in DNP as analog input objects Target Bits Part 1 to Part 4 (Analog Input Objects 36 – 39). The only allowed value to control this point is 0. Read value of this point is always 0.
17. Note that this data is a setting, and as such, it takes effect after being saved to a non-volatile memory.

    The procedure for saving data to a non-volatile memory is performed only once per request for all points requested to be changed through function Operate (4), Direct Operate (5), or Direct Operate No Ack (6).

    Saving to a non-volatile memory is not implemented on a per point basis because it would significantly prolong requested message processing time and cause response time-out. It is important to note that object 12 (Binary Output Status) points from 0 to 21 can be successfully controlled only if the function blocks mode are enabled at the time of parsing. This is the reason that in **the same request**, with FC= 5 or 6, specific Binary Output Status points **cannot** be first Enabled via the Mode point of object 41, and controlled immediately after that (object 12).

    Example: To control any 43 Aux Control Relay Output Block, Master should do the following steps:

    1. Enable control of x43 Aux Switch(s) via request(s) with FC=(3, 4) or 5 or 6 for specific point(s) of object 41.
    2. Control Binary Output Status point(s) (object 12) with via next request(s).

8-Bit Unsigned Integer, Object 102

Table 5-9 is the point list for Object 102, and lists the 8-Bit Unsigned Integer Points. Note that this object has only variation 1 and cannot be requested with default variation 0.

Table 5-9. Object 102, 8-Bit Unsigned Integer Points

8-Bit Unsigned Integer
Object Number: 102
Variations Supported: 1
Request Function Codes supported: 1 (read)

Index	Description
0 - 9	Model Number
10 - 28	Application Software Version Number and Date
29 - 47	Boot Software Version Number and Date
48 - 61	Serial Number
62 - 83	Style Number
84 - 99	Part Number
100 - 131	Relay ID
132 - 163	Station ID
164 – 171	Active Logic Name

Explanation:

Each point represents one character of a particular string.
Example: To read the Model Number, which is “BE1-GPS”, the returned read value for points 0 to 9 are:

Point	0	1	2	3	4	5	6	7	8	9
Read Value in ASCII format	B	E	1	-	G	P	S	NULL	NULL	NULL

Object 102 is not included in Class 0 poll response.

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