INSTRUCTION MANUAL

FOR

OVERCURRENT PROTECTION SYSTEM BE1-851

DISTRIBUTED NETWORK PROTOCOL (DNP3)

Basler Electric®

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INTRODUCTION

This instruction manual provides detailed information about the BE1-851 Overcurrent Protection System with the Distributed Network Protocol (DNP3).

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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 (9289900995). Revisions are listed in reverse chronological order.

Manual Revision and Date	Change
G, 03/17	• Added caution statement about nonvolatile memory.
F, 02/08	• Added information for style option 1, V and W.
E, 12/06	• Added cover photo. • Added manual part number and revision to footers. • Minor formatting corrections.
D, 04/05	• Added note to Table 1 for Point 24 made via Object 40/41. • Added Appendix for Binary Output Status Points and Control Relay Output Blocks.

CONTENTS

SECTION 1 • GENERAL INFORMATION

Introduction

This document describes the Basler Electric Distributed Network Protocol (DNP) implementation in the BE1-851 Overcurrent Protection System. BE1-851 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.

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.

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.

References

- Instruction Manual for BE1-851 Overcurrent 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 BE1-851 DNP protocol in any DNP environment.

Table 2-1. DNP3 Device Profile Document

DEVICE PROFILE DOCUMENT	
Vendor Name: Basler Electric Company	
Device Name: BE1-851 Overcurrent Protection System	
Highest DNP Level Supported: DNP-L2.	Device Function: ☐ 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 when device requires time-synchronization from the master is configurable via object 41, point 22. - Dead band for current analog inputs' events is configurable via object 41, point 23. - Control Relay Output Blocks may be operated as defined in Table 4 or Table 5. Table selection is made via object 40/41, point 24.	
Maximum Data Link Frame Size (octets): Transmitted 292 Received 292	Maximum Application Fragment Size (octets): Transmitted 2048 Received 1024
Maximum Data Link Re-tries: ☒ None ☐ Fixed at ☐ Configurable	Maximum Application Layer Re-tries: ☒ 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)	

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 BE1-851 DNP supports in both request messages and in response messages.

Static (non-change-event) object 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.

Change-event objects are always responded to with qualifiers 17 and 28.

Table 3-1. BE1-851 DNP Implementation Table

OBJECT			**REQUEST** (BE1-851 will parse)		**RESPONSE** (BE1-851 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)
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)

OBJECT			REQUEST (BE1-851 will parse)		RESPONSE (BE1-851 will respond with)	
Object No.	Variation No.	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (hex)	Qualifier Codes (hex)
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)			
		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 are included all Binary Inputs (object 1), 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 BE1-851 front panel or using ASCII protocol commands.

Relay Style Number

BE1-851 relays that support the DNP protocol must have a Style Number that ends with the 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 BE1-851 Instructional Manual, part number 9289900990).

Example:
>rg-ver
Model Number: BE1-851
Style Number: H5N1H3
App Program: VER 3.42.00 08/16/99
Boot Program: VER
Serial Number:H12345678

BE1-851 Slave Address

BE1-851 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 BE1-851 Instructional Manual, part number 9289900990.

Example: Set the BE1-851 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

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Tables

SECTION 5 • POINT LIST

Binary Input Points

Binary Input changes are scanned every four 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	50T Phase A Tripped	1	
1	50T Phase B Tripped	1	
2	50T Phase C Tripped	1	
3	150T Phase A Tripped	1	
4	150T Phase B Tripped	1	
5	150T Phase C Tripped	1	
6	50T Neutral Tripped	1	
7	150T Neutral Tripped	1	
8	50T Negative Sequence Tripped if Sensing Input Type is H 250 Neutral Tripped if Sensing Input Type is G	1	1
9	150T Negative sequence Tripped if Sensing Input Type is H 350 Neutral Tripped if Sensing Input Type is G	1	1
10	Breaker Failure Tripped	1	
11	51 Phase A Tripped	1	
12	51 Phase B Tripped	1	
13	51 Phase C Tripped	1	
14	51 Neutral Tripped	1	
15	51Q Tripped if Sensing Input Type is H. 151 Neutral Tripped if Sensing Input Type is G	1	1
16	62	1	
17	162	1	
18	43 (262 when style option 1 is V or W)	1	
19	143 (362 when style option 1 is V or W)	1	
20	243 (43 when style option 1 is V or W)	1	
21	343 (143 when style option 1 is V or W)	1	
22	79 Close Signal	1	
23	79 Running	1	
24	79 Locked Out	1	
25	79 Reclose Fail	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
26	79 Sequence Control Block	1	
27	Input Contact 1	1	
28	Input Contact 2	1	
29	Input Contact 3	1	
30	Input Contact 4	1	
31	101 Trip	1	
32	101 Close	1	
33	101 Slip Contact (0= Breaker Tripped, 1 = Breaker Is Closed)	1	
34	Logic Alarm	1	
35	Major Alarm	1	
36	Minor Alarm	1	
37	Output Trip Coil Monitor	1	
38	Setting Group 0 Active	1	
39	Setting Group 1 Active	1	
40	Setting Group 2 Active	1	
41	Setting Group 3 Active	1	
Hardware Output Status (points 42 – 47)			
42	Output A	1	
43	Output 1	1	
44	Output 2	1	
45	Output 3	1	
46	Output 4	1	
47	Output 5	1	
Programmable Alarms (points 48 – 73) See Note 3			
48	Trip Circuit Monitor Alarm	1	
49	Breaker Fail Alarm	1	
50	Recloser Fail Alarm	1	
51	Recloser Lockout	1	
52	Breaker Alarm 1	1	
53	Breaker Alarm 2	1	
54	Breaker Alarm 3	1	
55	P Demand Alarm	1	
56	N Demand Alarm	1	
57	Q Demand Alarm	1	
58	Group Override (0=Local Control, 1= Group Override)	1	
59	Sys I/O Delay Alarm	1	
60	Communication Error Alarm	1	
61	Clock Error Alarm	1	
62	MPU Reset Alarm	1	
63	Settings Changed	1	
64	EEPROM Non fatal error	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
65	An override is active in one or more outputs	1	
66	Loss of IRIG	1	
67	Setting Group Change Active alarm	1	
68	VO13 Logic Alarm	1	
69	VO14 Logic Alarm	1	
70	VO15 Logic Alarm	1	
71	FLT RPT Time Out	1	
72	Logic NONE alarm	1	
73	Settings Changes Lost due to Access Time Out	1	
Relay Trouble Alarms (points 74 - 78)			
74	EEPROM Read/Write Fatal Error	1	
75	Analog problem detected	1	
76	Relay not calibrated or calibration checksum error	1	
77	SETTING defaults loaded	1	
78	Calibration defaults loaded	1	
State Of Fault Trigger Logic Expressions (points 79 – 81) See Note 4			
79	Pick Up trigger expressions state (1=TRUE,0 =FALSE)	1	
80	Trip trigger logic expressions state (1=TRUE,0 =FALSE)	1	
81	Logic trigger expressions state (1=TRUE,0 =FALSE)	1	
82	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	2

Notes for Table 5-1:

1. This point’s mapping depends on Sensing Input Type (G or H) specified by relay Style Number.
2. The time stamp from transition 0 to 1 is a fault trigger time (equal to the time in the most recent Fault Summary Report).

   The time stamp from transition 1 to 0 is the time since fault data of the most recent fault is available (see object 30 points from 17 to 36).

   Total count of transitions from 0 to 1, reports the number of faults, which have occurred between two reporting. The missed Fault Summary Report Data can be retrieved through the Selected Fault Summary Report (see object 30, points from 52 to 71).
3. Any alarm from this Programmable Alarms group may be declared as a major, minor, or logic alarm. Refer to ASCII Serial Command SG-LGC, SA-MAJ, and SA-MIN.
4. Refer to ASCII Serial Command: SG-TRIGGER=<trip>,<pu>,<logic>.

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
8	Hardware Output 1 Local Control	
9	Hardware Output 2 Local Control	
10	Hardware Output 3 Local Control	
11	Hardware Output 4 Local Control	
12	Hardware Output 5 Local Control	
13	All Hardware Outputs Local Control	
14	43 Selector 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 Selector Switch Status	
16	243 Selector Switch Status (43 when style option 1 is V or W)	
17	343 Selector Switch Status (143 when style option 1 is V or W)	
18	Setting Group 0	Latch On: Select Group x to be Active
19	Setting Group 1	
20	Setting Group 2	
21	Setting Group 3	
22	Local Setting Group Control Switch	Latch On: Return Setting Group Control to relay local logic
23	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)

Notes for Table 5-2:

1. Read of Points
   - Reads of points from 0 to 5, 7 to 12, and 14 to 22 return the current state of corresponding point.
   - Reads of points from 6, 13, and 23 always return zero.

2- The following restrictions should be observed when using object 12 to control the points listed in Table 5-1.
   - The Control Code field of object 12 is parsed the following way:
     - 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 0 to 6.

Appendix for Binary Output Status Points and Control Relay Output Blocks

To enable Master, which can support only Trip and Close commands to control BE1-851 Control Relay Output Block points, second way of controlling Control Relay Output Blocks is added as presented in Table 5-3.

User can select old (legacy) Control Relay Output Blocks (Table 5-2) or a new (Table 5-3) via DNP object 41 point 24. Selection stays remembered in non-volatile memory. When Table 5-2 is selected, object 40, point 24 has value 1. When Table 5-3 is selected, object 40, point 24 has value 2. When selecting specific Control Relay Output Blocks table, object 41, point 24 must be set to 1 or 2 via function codes select/operate or only direct operate or direct operate, noack.
Notes:

- Old Control Relay Output Blocks (Table 5-2) has 24 points while new Control Relay Output Blocks (Table 5-3) has 35. The additional 11 points are added as a single function points to

support only pulsing control. New Control Relay Output Blocks (Table 5-3) has only complementary or single function indices and is DNP compliant.

- Reading values of points 0 to 23 are the same in the both Control Relay Output Blocks tables. Reading values of points 24 to 30 in the new Control Relay Output Blocks (Table 5-3) are the same as for points 0 to 6, and points 31 to 34 have the same reading values as points 14 to 17.

Table 5-3. Appendix for 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	Complementary (C) or Single (S) Function Index	Permitted Codes
0	Hardware Output A - Latch control	C	0x03(Latch On/NUL) or 0x41(PulseOn/Close) sets output to state 1 0x04 (Latch Off/NUL) or 0x81(PulseOn/Trip) sets output to state 0
1	Hardware Output 1- Latch control		
2	Hardware Output 2- Latch control		
3	Hardware Output 3 - - Latch control		
4	Hardware Output 4 - Latch control		
5	Hardware Output 5 - Latch control		
6	All Hardware Outputs' - Latch control		
7	Hardware Output A Local Control	S	0x03(Latch On/NUL) or 0x41(PulseOn/Close) sets output to relay logic
8	Hardware Output 1 Local Control		
9	Hardware Output 2 Local Control		
10	Hardware Output 3 Local Control		
11	Hardware Output 4 Local Control		
12	Hardware Output 5 Local Control		
13	All Hardware Outputs' Local Control		
14	43 Selector Switch Status - Latch control	C	0x03(Latch On/NUL) or 0x41(PulseOn/Close) sets Selector Switch to 1 0x04 (Latch Off/NUL) or 0x81(PulseOn/Trip) sets Selector Switch to 0
15	143 Selector Switch Status - Latch control		
16	243 Selector Switch Status - Latch control (43 when style option 1 is V or W)		

Point Index	Description	Complementary (C) or Single (S) Function Index	Permitted Codes
17	343 Selector Switch Status - Latch control (143 when style option 1 is V or W)		
18	Setting Group 0	S	0x03(Latch On/NUL) or 0x41(PulseOn/Close) selects group to be active
19	Setting Group 1		
20	Setting Group 2		
21	Setting Group 3		
22	Local Setting Group Control Switch	S	0x03(Latch On/NUL) or 0x41(PulseOn/Close) returns Setting Group Control to relay local logic
23	101 Virtual Breaker Control Switch	C	0x41(PulseOn/Close) Close breaker 0x81(PulseOn/Trip) Trip breaker
24	Hardware Output A – Pulse Control	S	0x81(Pulse On/Trip) or 0x01(Pulse On/NUL)
25	Hardware Output 1 - Pulse Control		Pulse output / Selector switch to opposite of current state then restore
26	Hardware Output 2 -Pulse Control		to previous state(pulsed output is active 200 to 250 ms)
27	Hardware Output 3 -Pulse Control		
28	Hardware Output 4 -Pulse Control		
29	Hardware Output 5 - Pulse Control		
30	All Hardware Outputs' - Pulse Control		
31	43 Selector Switch - Pulse Control		
32	143 Selector Switch -Pulse Control		
33	243 Selector Switch - Pulse Control (43 when style option 1 is V or W)		
34	343 Selector Switch - Pulse Control (143 when style option 1 is V or W)		

Analog Inputs

The following table lists Analog Inputs (Object 30/Object 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 $<2^{31}-1> = 2,147,483,647$.

It is important to note that not all analog points are reported in Class 0 (or any other class). These points are from point 52 to point 116. They have "none" in the column for "Event Class Assigned To" as shown in Table 5-4. They can be read from the BE1-851 as object 30, with any 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 5-4. 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
0	Primary Phase A Current Magnitude	2	1, 1*
1	Primary Phase B Current Magnitude	2	1, 1*
2	Primary Phase C Current Magnitude	2	1, 1*
3	Neutral Current Magnitude	2	1, 1*
4	Primary Negative Sequence Current Magnitude	2	1, 1*
5	Present Demand Current- Phase A	2	1, 1*
6	Present Demand Current- Phase B	2	1, 1*
7	Present Demand Current- Phase C	2	1, 1*
8	Present Neutral Demand Current	2	1, 1*
9	Present Negative Sequence Demand Current- Phase A	2	1, 1*
10	Breaker Duty – Phase A	2	12
11	Breaker Duty – Phase B	2	12
12	Breaker Duty – Phase C	2	12
13	Breaker Operation Counter	2	13
14	BF Status	1	15
15	Latched Targets- part 1	1	21
16	Latched Targets- part 2	1	21
The Most Recent Fault Summary Report			
17	Fault Number	1	2, 16
18	Fault Trigger Time Stamp – part 1 ; days	1	3, 16
19	Fault Trigger Time Stamp – part 2; ms	1	3, 16
20	Active Setting Group	1	4, 16
21	Trigger	1	5, 16
22	System Status – part 1	1	22
23	System Status – part 2	1	22
24	System Status – part 3	1	22
25	System Status – part 4	1	22
26	Targets- part 1	1	6, 16
27	Targets- part 2	1	6, 16
28	Reclose Status	1	7, 16
29	Fault Clearing Time	1	8, 16
30	Breaker Operate Time	1	9, 16
31	Number of Oscillographic Reports	1	10, 16
32	Phase A Fault Current	1	1, 16
33	Phase B Fault Current	1	1, 16
34	Phase C Fault Current	1	1, 16
35	Neutral Fault Current	1	1, 16

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
36	Negative Sequence Fault Current	1	1, 16
	Active Logic Name		
37	1st. character of Active Logic Name	3	16
38	2nd. character of Active Logic Name	3	16
39	3rd. character of Active Logic Name	3	16
40	4th. character of Active Logic Name	3	16
41	5th. character of Active Logic Name	3	16
42	6th. character of Active Logic Name	3	16
43	7th. character of Active Logic Name	3	16
44	8th. character of Active Logic Name	3	16
	Logic Function Blocks' settings		
45	Hardware Outputs' Control Mode	3	17, 16
46	43 Aux Virtual Switch Logic Mode	3	18,16
47	143 Aux Virtual Switch Logic Mode	3	18,16
48	243 Aux Virtual Switch Logic Mode (N/A when style option 1 is V or W)	3	18,16
49	343 Aux Virtual Switch Logic Mode (N/A when style option 1 is V or W)	3	18,16
50	Setting Group Logic Mode	3	19, 16
51	101 Breaker Switch Control Mode	3	20, 16
	Selected Fault Summary Report (See Note 14)		
52	Fault Number	none	2
53	Fault Trigger Time Stamp – part 1 ; days	none	3
54	Fault Trigger Time Stamp – part 2; ms	none	3
55	Active Setting Group	none	4
56	Trigger	none	5
57	System Status – part 1	none	22
58	System Status – part 2	none	22
59	System Status – part 3	none	22
60	System Status – part 4	none	22
61	Targets- part 1	none	6
62	Targets- part 2	none	6
63	Reclose Status	none	7
64	Fault Clearing Time	none	8
65	Breaker Operate Time	none	9
66	Number of Oscillographic Reports	none	10
67	Phase A Fault Current	none	1
68	Phase B Fault Current	none	1
69	Phase C Fault Current	none	1
70	Neutral Fault Current	none	1
71	Negative Sequence Fault Current	none	1

Demand Currents Historical Data
Peak Demand Current Since Reset

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
72	Phase A current	none	1
73	Phase A Time Stamp – part 1; days	none	11
74	Phase A Time Stamp – part 2; ms	none	11
75	Phase B current	none	1
76	Phase B Time Stamp – part 1; days	none	11
77	Phase B Time Stamp – part 2; ms	none	11
78	Phase C	none	1
79	Phase C Time Stamp – part 1 ; days	none	11
80	Phase C Time Stamp – part 2; ms	none	11
81	Neutral	none	1
82	Neutral Time Stamp – part 1 ; days	none	11
83	Neutral Time Stamp – part 2; ms	none	11
84	Negative Sequence	none	1
85	Negative Sequence Time Stamp – part 1 ; days	none	11
86	Negative Sequence Time Stamp – part 2; ms	none	11
	Today's Peak Demand Current		
87	Phase A current	none	1
88	Phase A Time Stamp – part 1; days	none	11
89	Phase A Time Stamp – part 2; ms	none	11
90	Phase B current	none	1
91	Phase B Time Stamp – part 1; days	none	11
92	Phase B Time Stamp – part 2; ms	none	11
93	Phase C	none	1
94	Phase C Time Stamp – part 1; days	none	11
95	Phase C Time Stamp – part 2; ms	none	11
96	Neutral	none	1
97	Neutral Time Stamp – part 1; days	none	11
98	Neutral Time Stamp – part 2; ms	none	11
99	Negative Sequence	none	1
100	Time Stamp – part 1; days	none	11
101	Time Stamp – part 2; ms	none	11
	Yesterday's Peak Demand Current		
102	Phase A current	none	1
103	Phase A Time Stamp – part 1; days	none	11
104	Phase A Time Stamp – part 2; ms	none	11
105	Phase B current	none	1
106	Phase B Time Stamp – part 1; days	none	11
107	Phase B Time Stamp – part 2; ms	none	11
108	Phase C	none	1
109	Phase C Time Stamp – part 1; days	none	11
110	Phase C Time Stamp – part 2; ms	none	11
111	Neutral	none	1
112	Neutral Time Stamp – part 1; days	none	11
113	Neutral Time Stamp – part 2; ms	none	11

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
114	Negative Sequence	none	1
115	Negative Sequence Time Stamp – part 1; days	none	11
116	Negative Sequence Time Stamp – part 2; ms	none	11

Notes for Table 5-4:

1. All current values are in primary centiamps (value 1 represents 0.01 ampere).

1*. Current analog input point generates an analog event if the current value is bigger than the "previous current value plus dead band", or smaller than the "previous current value minus dead band".

Dead band for an analog event is configurable via DNP Analog Output point 23, "Current Dead band". The default value for the dead band is set to be ±2.5% of the primary nominal current. For more information about dead band configuration, see the description in the following paragraphs *Analog Output Status Points and Control Blocks,* point 23, Note 14 for Table 5-9.

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).

Notice 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 or 2 or 3).

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 panel communication RS-232 port or rear RS-232 port.

6. Targets-part 1 and targets-part 2 are bit-mapped variables that report what targets were logged to the fault report between the time that the trip expression became true until the end of the fault. See Table 5-5 for the target format.

Table 5-5. Target Format

Value/Bit Mask	Part 1 Description	Part 2 Description
0001h	50TA	51A
0002h	50TB	51B
0004h	50TC	51C
0008h	50TN	51N
0010h	50TQ	51Q
0020h	62	262 (when style option 1 is V or W)
0040h	162	362 (when style option 1 is V or W)
0080h	BF	spare
0100h	150TA	151A

Value/Bit Mask	Part 1 Description	Part 2 Description
0200h	150TB	151B
0400h	150TC	151C
0800h	150TN	151N
1000h	150TQ	151Q
2000h	spare	spare
4000h	250TN	spare
8000h	350TN	spare

7. **Reclose Status** are bit mapped variables that report the state of the recloser shot counter prior to the fault that triggered the fault (see format in Table 5-6).

Table 5-6. Reclose Status Format

Value/Bit Mask	Description
0001h	Recloser active
0002h	Recloser Reset
0004h	Reclose Max Timing
0008h	Reclose Failure
0010h	Reclose Lockout
0020h	Reclose Wait
0040h	Reclose Enable
0080h	Reclose Max Enable
0100h	Reclose Fail Enable
0200h	Reclose Wait Enable
0400h	Reclose Timing 1
1000h	Reclose Timing 2
2000h	Reclose Timing 3
4000h	Reclose Timing 4
8000h	Reclose Timing Fail

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. A 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 BE1-851 Instruction Manual, Section 4, *Protection and Control*). Value range is from 0 to 20,000 where 20,000 represents 200% of DMAX. Delta of 20 centipercent will cause an event. This point can be changed via object 41. See the paragraph for *Analog Output Control Blocks, Note 9.*
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 15 to any value from 0 to 99,999. Delta of 1 will cause an event.
14. Selected Fault Summary Report contains fault data for fault number defined by the value of Analog Output Status (object 40) point 21 ”Fault Number for Selected Fault Summary Report”.

15. BF status is the bit mapped variable with format as described in Table 5-7. Delta of 1 deviation will cause en event.

Table 5-7. Breaker Failure Status Format

Value / Bit Mask (hex)	Description
0001	Breaker Operation Control State {1=Breaker Operation Enabled; 0= Breaker Operation Disabled}
0002	Breaker State {1=Breaker Opened; 0= Breaker Closed}

16. Delta of 1 bit (any change) will cause an event.
17. Read values for Hardware Output Control is 1 = Enabled, and 0=Disabled.
18. Read values for x43 AUX Virtual Switch Logic Mode are 0 for Disabled, 1 = ON/OFF PULSE, 2 = ON/OFF, and 3= OFF/MOMENTARY ON.
19. Read values for Setting Group Mode is 0= Disabled, 1=discrete select, and 2= binary select. Setting groups can be controlled via DNP object 12 if value is 1 or 2.
20. Read values for 101 Breaker Control Switch Mode is 0=Disabled and 1=Enabled.
21. Latched Targets Status format is described in Table 5-5 under Note 6 to Table 5-4. Delta of 1 deviation will cause an event. Latched Targets Status can be reset via object 41 point 7.
22. BE1-851 Relay System Status is represented as 4 part, 16-bit mapped variables. Four part System Status is described in Table 5-8. (For more information, see the BE1-851 Instruction Manual, Section 6, *Reporting and Alarm Functions*). Delta of 1 deviation will cause en event.

Table 5-8. System Status

Value/Bit Mask (hex)	Part 1 Description	Part 2 Description	Part 3 Description	Part 4 Description
0001h	50 Phase Tripped	BF Picked Up	Virtual Output A	Input Contact 1
0002h	150 Phase Tripped	51 Phase Picked Up	Virtual Output 1	Input Contact 2
0004h	50 Neutral Tripped	51 Neutral Picked UP	Virtual Output 2	Input Contact 3
0008h	150 Neutral Tripped	151 Neutral Picked Up for G Type 51 Q Picked Up for H Type	Virtual Output 3	Input Contact 4
0010h	250 Neutral Tripped for G Type 50Q Tripped for H Type	62 Tripped	Virtual Output 4	101 TRIP
0020h	350 Neutral Tripped for G Type 150Q Tripped for H Type	162 Tripped	Virtual Output 5	101 CLOSE
0040h	BF Tripped	43 (262 when style option 1 is V or W)	Virtual Output 6	101 SLIP CONTACT
0080h	51 Phase Tripped	143 (362 when style option 1 is V or W)	Virtual Output 7	HMI Reset Key
0100h	51 Neutral Tripped	243 (43 when style option 1 is V or W)	Virtual Output 8	Logic Alarm
0200h	151 Neutral Tripped for G Type 51 Q Tripped for H Type	343 (143 when style option 1 is V or W)	Virtual Output 9	Major Alarm
0400h	50 Phase Picked Up	79 Close	Virtual Output 10	Minor Alarm
0800h	150 Phase Picked Up	79 Enabled	Virtual Output 11	Output 1 Trip Coil Monitor
1000h	50 Neutral Picked Up	79 Lockout	Virtual Output 12	Setting Group 0
2000h	150 Neutral Picked Up	79 Reclose Fail	Virtual Output 13	Setting Group 1
4000h	250N Picked Up for G Type 50Q Picked Up for H Type	79 Block Output	Virtual Output 14	Setting Group 2

Value/Bit Mask (hex)	Part 1 Description	Part 2 Description	Part 3 Description	Part 4 Description
8000h	350N Picked Up for G Type 150Q Picked Up for H Type	Always False (zero)	Virtual Output 15	Setting Group 3

Analog Output Status Points and Control Blocks

Table 5-9 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 BE1-851 Instructional Manual, Section 7, *Communications, Command Descriptions, Changing Settings through the Serial Port*.

Table 5-9. 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: 1 (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	Hardware Output Logic Control Mode	1,2
1	43 Aux Virtual Switch Logic Mode	1,3
2	143 Aux Virtual Switch Logic Mode	1,3
3	243 Aux Virtual Switch Logic Mode (N/A when style option 1 is V or W)	1,3
4	343 Aux Virtual Switch Logic Mode (N/A when style option 1 is V or W)	1,3
5	Active Setting Group Control Mode	1,4
6	101 Breaker Control Switch Mode	1,5
7	Target Status Reset Control	6
8	Major Alarms Reset	7
9	Minor Alarms Reset	7
10	Logic Alarms Reset	7
11	Relay Trouble Alarms Reset	8
12	Breaker Accumulated Duty for Phase A	9
13	Breaker Accumulated Duty for Phase B	9
14	Breaker Accumulated Duty for Phase C	9
15	Breaker Operation Counter	10
16	Peak Demand Current Since Reset - Phase A	11
17	Peak Demand Current Since Reset - Phase B	11
18	Peak Demand Current Since Reset - Phase C	11
19	Peak Demand Current Since Reset - Neutral	11
20	Peak Demand Current Since Reset - Negative Sequence	11
21	Fault Number for Selected Fault Summary Report	12

Index	Description	Notes
22	Synchronization Time Period	13
23	Current Dead Band	14
24	'Control Relay Output Blocks' Table Selection	15

Notes for Table 5-9:

1. This data is a setting, and takes effect after being saved to non-volatile memory.

   Procedure of saving data to 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 NoAck (6).

   Saving to a non-volatile memory is not implemented 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 23 can be successfully controlled only if their function blocks mode are enabled in 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 its Mode point of object 41, and immediately after that controlled (object 12). For example: To control any 43 Aux Control Relay Output Block, Master should do the following steps:

   1. Enable control of 43x 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) via next request(s).

2. 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. For more information see the BE1-851 Instructional Manual, Section 11, *ASCII Command Interface, CS/CO-OUT=ENA/DIS* .
3. x43 AUX Virtual Switch Logic Mode can be 0 for Disabled, 1 = ON/OFF/PULSE, 2 = ON/OFF, and 3= OFF/MOMENTARY ON. Depending on the Logic Mode value, the AUX x43 Switch may or may not be successfully controlled via the Control Relay Output Blocks; points 14 to 17.
4. Setting Group Mode can be 0 (disable), 1 (discrete select) or 2 (binary select). If Setting Group is to be switched via object 12 (Control Relay Output Blocks), this must be first Enabled through this point.
5. Logic Mode of 101 Breaker Control Switch can be 0 (disabled) or 1 (enabled). Depending on Logic Mode value, 101 Switch can or cannot be successfully controlled via Control Relay Output Blocks; point 23.
6. Target Status Reset Control can only be reset (the only acceptable value to write to point 7 is 0). A read of this point returns 1 if there are active targets, or 0 if targets are not active. When resetting this point, latched Targets Status is also reset (see Analog Input Objects, points 15 and 16).
7. Major, Minor, and Logic Alarms are 32 bit mapped variables as described in Table 5-10. Writing value 0 will reset the alarms. Note that only latched alarms will be cleared. Programmable Alarms can be read as Binary Input (object 1) points from 48 to 73.

Table 5-10. 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	Reclose Fail	00040000	LOSS OF IRIG
00000008	Reclose Lockout	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	Setting Changes Lost due to Access Time Out

Bit Mask (hex)	Name	Bit Mask (hex)	Name
00000400	Group Override	04000000	Spare
00000800	SYS I/O Delay	08000000	spare
00001000	Communication Error	10000000	spare
00002000	Clock Error	20000000	spare
00004000	uP Reset	40000000	spare
00008000	Settings Changed	80000000	spare

8. 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 5-11. Only alarms with a star (∗) are implemented and can be read as Binary Input (object 1) points from 74 to 78.

Table 5-11. 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	spare
0008	EEPROM FATAL ERROR ∗	0200	spare
0010	ANALOG FAILURE ∗	0400	spare
0020	CALIBRATION ERR ∗	0800	spare

9. Point represents assigned phase accumulated breaker pole duty as a centipercent of the maximum duty (DMAX) 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.

   Allowed value range for points 12 to 14 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, using appropriate control function(s), set point 13 via object 41, Var1 or 2, to the value 13400.

   To read the value of Breaker Accumulated Duty for Phase B, use Read point 13, Obj 40, Var1 or 2. The returned value of 13400 means 134% of DMAX.

10. Read value of this point (15) is a number of recorded breaker operations (0 – 99999). If the operations counter exceeds 99,999, the counter will wrap back to zero. It acts as a counter, but is implemented as an analog object so that the initial value can be set or current value changed to any value from 0 to 99,999.

11. Peak Demand currents, points 16 to 20, can only be set to value 0 (Reset). Point read value presents Peak Demand current in centiamps. For Example :670 represents 6.7 A.

12. . Fault Number for Selected Fault Summary Report. This value range is from 1 to 255. The Fault Summary Report for this selected fault number will be available as an Analog Input object from point 52 to 71.

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 0 bit. Relay sets this bit again, periodically, if the time period is not zero. Default value on Cold and Warm Restarts 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. Current dead band for analog events is configurable via this point. “Current Dead Band “point value must be entered as a percentage of primary nominal current multiplied by 10. Allowed range is from 10 to 100, which represents from 1 to 10% in steps of 0.1%. Default value is 25 (2.5% of current primary nominal value).

    Example: To configure current dead band to 4 % of primary nominal current, enter 40 for this point value. The relay converts this value into a current value. For a 5 ampere relay, and phase CT ratio

=120 turns, dead band value in amperes for phase currents and Q current is 0.4 * 120 * 5 = 24 primary amps (2400 centiamps). Phase threshold = previous current value ±24 amperes. If the CT ratio for neutral is 12, then the utilized dead band for neutral current is 0.04 * 12 * 5 = 2.4 primary amperes (240 centiamps). Neutral threshold = previous neutral current value ±2.4 amps.

15. This point has a value 1 or 2 depending on Control Relay Output Blocks Table 5-2 or Table 5-3 selection. Default value of point 24 is 1 for Table 5-2 selection. When the user wants to apply Control Relay Output Blocks Table 5-3, point 24 must be set to 2. Point 24 (as object 41) must be set to 1 or 2 via function codes select/operate or only direct operate or direct operate, noack. Value of this point is stored in non-volatile memory.

8-Bit Unsigned Integer, Object 102

Table 5-12 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 5-12. 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

Explanation:

Each point represents one character of a particular string.
Example: To read the Model Number, which is “BE1-851”, 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	-	8	5	1	Null	Null	Null

Object 102 is not included in Class 0 poll response.

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