

INSTRUCTION MANUAL
FOR
OVERCURRENT PROTECTION SYSTEM
BE1-951
DISTRIBUTED NETWORK PROTOCOL
(DNP3)



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INTRODUCTION

This instruction manual provides detailed information about the BE1-951 Overcurrent Protection System with the Distributed Network Protocol (DNP3).

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REVISION HISTORY

The following information provides a historical summary of the changes made to this instruction manual (9328900992). Revisions are listed in reverse chronological order.

Manual Revision and Date	Change
E, 09/17	<ul style="list-style-type: none">• Added nonvolatile memory caution statement.
D, 06/07	<ul style="list-style-type: none">• Updated <i>Analog Inputs</i> table in Section 5.• Added manual part number and revision to footers.
C, 04/05	<ul style="list-style-type: none">• Added DNP Scaling, Energy points.
B, 11/03	<ul style="list-style-type: none">• Added generator fault bus frequency points for “most recent” and “selected” faults to Table 5, <i>Analog Inputs</i>.
A, 10/03	<ul style="list-style-type: none">• Added points 110 and 111 to Table 3, <i>Binary Input Points</i>.• Changed index assignments and added to the index list of Table 5, <i>Analog Inputs</i>.
—, 03/00	<ul style="list-style-type: none">• Initial release.



CONTENTS

SECTION 1 • GENERAL INFORMATION	1-1
SECTION 2 • DEVICE PROFILE DOCUMENT	2-1
SECTION 3 • IMPLEMENTATION TABLE	3-1
SECTION 4 • RELAY STYLE NUMBER AND ITS SLAVE DNP ADDRESS.....	4-1
SECTION 5 • POINT LIST	5-1
SECTION 6 • CONFIGURATION VIA ASCII PROTOCOL.....	6-1



SECTION 1 • GENERAL INFORMATION

Introduction

This document describes the Basler Electric Distributed Network Protocol (DNP) implementation in the BE1-951 Overcurrent Protection System. BE1-951 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 BE1-951 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 BE1-951 DNP protocol in any DNP environment.

Table 2-1. Device Profile Document

DEVICE PROFILE DOCUMENT	
Vendor Name: Basler Electric Company	
Device Name: BE1-951 Overcurrent Protection System	
Highest DNP Level Supported: DNP-L2.	Device Function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
<p>Notable objects, functions, and/or qualifiers supported in addition to the highest DNP levels supported (the complete list is described in DNP3 Implementation Table):</p> <ul style="list-style-type: none"> - 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. - Current Change Event Dead band is configurable via object 41, point 31, or ASCII Command. - Voltage Change Event Dead band is configurable via object 41, point 32, or ASCII Command. - Power Change Event Dead band is configurable via object 41, point 33, or ASCII Command. - Variation zero (default variation) for Analog Input Static object 30 and Change Event 32 is user configurable by ASCII Command. - Data Scaling is user configurable by ASCII Commands. 	
Maximum Data Link Frame Size (octets): Transmitted <u> 292 </u> Received <u> 292 </u>	Maximum Application Fragment Size (octets): Transmitted <u> 2048 </u> Received <u> 1024 </u>
Maximum Data Link Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at <input type="checkbox"/> Configurable	Maximum Application Layer Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at <input type="checkbox"/> Configurable, range _____ to _____
Requires Data Link Layer Confirmation: <input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes If 'Sometimes', when? _____ <input type="checkbox"/> Configurable If 'Configurable', how? _____	
Requires Application Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always (not recommended) <input checked="" type="checkbox"/> When reporting Event Data (Slave devices only) <input checked="" type="checkbox"/> When sending multi-fragment responses (Slave devices only)	

DEVICE PROFILE DOCUMENT

Timeouts while waiting for:

Data Link Confirm	<input type="checkbox"/> None	<input checked="" type="checkbox"/> Fixed at 3000 ms	<input type="checkbox"/> Variable	<input type="checkbox"/> Configurable
Complete Appl. Fragment	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Fixed at _____	<input type="checkbox"/> Variable	<input type="checkbox"/> Configurable
Application Confirm	<input type="checkbox"/> None	<input checked="" type="checkbox"/> Fixed at 5000 ms	<input type="checkbox"/> Variable	<input type="checkbox"/> Configurable
Complete Appl. Response	<input checked="" type="checkbox"/> None	<input type="checkbox"/> Fixed at _____	<input type="checkbox"/> Variable	<input type="checkbox"/> Configurable

Sends/Executes Control Operations:

WRITE Binary Outputs	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
SELECT/OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
DIRECT OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
DIRECT OPERATE - NO ACK	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Count > 1	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Pulse On	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Pulse Off	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Latch On	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Latch Off	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
Clear Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> 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 BE1-951 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. BE1-951 DNP Implementation Table

OBJECT			REQUEST (BE1-951 will parse)		RESPONSE (BE1-951 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 (BE1-951 will parse)		RESPONSE (BE1-951 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. Variation zero (default variation) for Analog Input Static object 32 and Change Event Object 32 is user configurable by ASCII Command as described in Section 6, *Configuration via ASCII Protocol*.
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 • RELAY STYLE NUMBER AND ADDRESS

Relay Basic Parameters for DNP Port

These paragraphs describe configuration settings that must be set to enable BE1-951 to support DNP. Other DNP configurable parameters via ASCII commands are described in section 6.

Relay Style Number

BE1-951 relays that support the DNP protocol must have a Style Number with the sixth character being 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 BE1-951 Instructional Manual, part number 9328900990).

Example:

```
>RG-VER
Model Number: BE1-951
Style Number: E4N2H3N
App Program: VER 2.57.00 03/10/05
Boot Program: VER 2.08.00 08/13/02
Serial Number:H12345678
```

BE1-951 Slave Address

BE1-951 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 BE1-951 Instructional Manual, part number 9328900990.

Example: Set the BE1-951 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

SECTION 5 • POINT LIST	5-1
Binary Input Points	5-1
Binary Input Points	5-1
Binary Output Status Points and Control Relay Output Blocks	5-5
Analog Inputs	5-6
Analog Inputs	5-7
Peak Demand Since Reset Phase A Current	5-10
Peak Demand Since Reset Phase B Current	5-10
Peak Demand Since Reset Phase C Current	5-10
Peak Demand Since Reset Neutral Current	5-10
Peak Demand Since Reset Negative Sequence Current	5-10
Peak Demand Since Reset True Power	5-10
Peak Demand Since Reset Negative True Power	5-11
Peak Demand Since Reset Negative Reactive Power	5-11
Today's Peak Demand Phase A Current	5-11
Today's Peak Demand Phase B Current	5-11
Today's Peak Demand Phase C Current	5-11
Today's Peak Demand Neutral Current	5-11
Today's Peak Demand Negative Sequence Current	5-11
Today's Peak Demand True Power	5-11
Today's Peak Negative Demand True Power	5-11
Today's Peak Demand Reactive Power	5-12
Today's Peak Negative Demand Reactive Power	5-12
Yesterdays Peak Demand Negative Sequence Current	5-12
Yesterdays Peak Demand True Power	5-12
Yesterdays Peak Negative Demand True Power	5-12
Yesterdays Peak Demand Reactive Power	5-12
Yesterdays Peak Negative Demand Reactive Power	5-13
Analog Output Status Points and Control Blocks	5-17
Analog Output Status Points	5-17
Analog Output Blocks	5-17
8-Bit Unsigned Integer, Object 102	5-21
8-Bit Unsigned Integer	5-21

Tables

Table 5-1. Binary Input Points	5-1
Table 5-2. Binary Output Status Points and Control Relay Output Blocks	5-5
Table 5-3. Analog Inputs	5-7
Table 5-4. Target Format	5-14
Table 5-5. Reclose Status Format	5-14
Table 5-6. Relay Status	5-15
Table 5-7. Scaling Factor Multiplier	5-16
Table 5-8. Analog Output Status Points and Control Blocks	5-17
Table 5-9. Alarm Status	5-18
Table 5-10. Relay Trouble Status Format	5-19
Table 5-11. Object 102, 8-Bit Unsigned Integer Points	5-21



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 confirmation 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	150TA Phase Tripped	1	
4	150TB Phase Tripped	1	
5	150TC Phase Tripped	1	
6	50T Neutral Tripped	1	
7	150T Neutral Tripped	1	
8	50T Negative Sequence Tripped	1	1
9	150T Negative sequence Tripped	1	1
10	Breaker Failure Tripped	1	
11	51 Phase Tripped	1	
12	51 Phase B Tripped	1	
13	51 Phase C Tripped	1	
14	51 Neutral Tripped	1	
15	151 Neutral Tripped	1	1
16	51Neg Seq Tripped	1	
17	43	1	
18	143	1	
19	243	1	
20	343	1	
21	79 Close Signal	1	
22	79 Running	1	
23	79 Locked Out	1	
24	79 Reclose Fail	1	
25	79 Sequence Control Block	1	
26	Input Contact 1 State	1	
27	Input Contact 2 State	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
28	Input Contact 3 State	1	
29	Input Contact 4 State	1	
30	62 Timer	1	
31	162 Timer	1	
32	101Trip Breaker Switch	1	
33	101Close Breaker Switch	1	
34	101Slip Contact	1	
35	Alarm Logic	1	
36	Alarm Major	1	
37	Alarm Minor	1	
38	OUT1 Mon	1	
39	SG0	1	
40	SG1	1	
41	SG2	1	
42	SG3	1	
43	27A	1	
44	27B	1	
45	27C	1	
46	27XT	1	
47	47T	1	
48	24T	1	
49	59A	1	
50	59B	1	
51	59C	1	
52	59XT	1	
53	81T	1	
54	181T	1	
55	281T	1	
56	381T	1	
57	481T	1	
58	581T	1	
59	25VM1	1	
60	25VM2	1	
61	25	1	
62	60FL	1	
Hardware Output Status (points 63 – 68)			
63	Output A	1	
64	Output 1	1	
65	Output 2	1	
66	Output 3	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
67	Output 4	1	
68	Output 5	1	
Relay Trouble Alarms (points 69 - 74)			
69	MPU Selftest Failed	1	
70	EEProm Read/Write Fatal Error	1	
71	Analog problem detected	1	
72	Relay not calibrated or calibration checksum error	1	
73	SETTING defaults loaded	1	
74	Calibration defaults loaded	1	
Indications of Fault Trigger Logic Expressions (points 75 – 77)			
75	Pickup Trigger expression state (1=TRUE,0=FALSE)	1	1
76	Trip Trigger expression state (1=TRUE,0=FALSE)	1	1
77	Logic Trigger expression state (1=TRUE,0=FALSE)	1	1
Programmable Alarms (points 78 – 73) See Note 3			
78	Trip Circuit Monitor Alarm	1	
79	Breaker Fail Alarm	1	
80	Recloser Fail	1	
81	Recloser Lockout	1	
82	Breaker Alarm 1	1	
83	Breaker Alarm 2	1	
84	Breaker Alarm 3	1	
85	P Demand Alarm	1	
86	N Demand Alarm	1	
87	Q Demand Alarm	1	
88	Group Override (0=Local Control, 1=Override)	1	
89	CPU Overload Alarm	1	
90	Communication Error Alarm	1	
91	Clock Error Alarm	1	
92	MPU Reset Alarm	1	
93	Settings Changed	1	
94	EEPROM Non fatal error	1	
95	An override is active in one or more outputs	1	
96	Loss of IRIG	1	
97	SGC Active	1	
98	Virtual Output 13 Logic Alarm	1	
99	Virtual Output 14 Logic Alarm	1	
100	Virtual Output 15 Logic Alarm	1	
101	FLT RPT Time Out	1	
102	Logic=None Alarm	1	
103	Var Demand Alarm	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or none)	Notes
104	Watt Demand Alarm	1	
105	Freq Range Alarm	1	
106	Changes Lost Alarm	1	
107	60 Fuse Alarm	1	
108	Volts/HZ Alarm	1	
109	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
110	32T	1	
111	159XT	1	

Notes for Table 5-1:

1. Ref ASCII Serial Command: SG-TRIGGER=trip, pu logic (Read/Set Trigger for Trip Pickup or Logic).
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 the most recent Fault Summary Report is available (see related Analog Input Object points).
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 related Analog Input Object points).
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.

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

Point Index	Description	Control Codes And Their Description
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)		
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	
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	
17	343 Selector Switch Status	
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. Reads of Points
 - Reads of points from 0 to 5, and 14 to 17 return the current state of corresponding point.
 - Reads of points from 7 to 12 will always return 1 if corresponding hardware output is under relay Local control or 0 if output is override.
 - Reads of points from 19 to 22 returns 1 if Setting group is active. Notice that only one of these points can be active (1) at a time.
 - Read of point 23 returns 1 if Setting Group Control is under relay's Local control.
 - 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

The following table lists Analog Inputs (Object 30). 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 $\langle 2^{15}-1 \rangle = 32,767$. For a 32-bit variation the maximum positive representation is $\langle 2^{31}-1 \rangle = 2,147,483,647$.

Read values of current, voltage, power, energy, breaker operations counter, and time points are scaled with user configurable scaling factors. Scaling factors enables reporting of data as 16-bit variation without data over-range flag set. See Note 23 in this paragraph and see Section 6.

An analog change event will be generated if the point changes its value by the absolute amount equal or bigger than the Dead band. Analog change events, once generated, will be reported in one of the class polls (1, 2, 3 or none) as defined in 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: User programmable (see Section 6). Default "variation 0" is 3 (32-bit Analog Input without Flag).			
Change Event Variation Reported When Variation 0 Requested: User programmable (see Section 6). Default "variation" is 1 (32-bit Analog Change Event without Time).			
Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
Metering Values (Points 0 to 30)			
0	Phase A Current Magnitude	2	16,23,23.1
1	Phase B Current Magnitude	2	16,23,23.1
2	Phase C Current Magnitude	2	16,23,23.1
3	Ground Current Magnitude	2	16,23,23.2
4	Negative Sequence Current Magnitude	2	16,23,23.1
5	Neutral Current Magnitude	2	16,23,23.1
6	Generator Frequency	2	1,15
7	Bus Frequency	2	1,15
8	Slip Frequency	none	1
9	Slip Angle	none	1
10	Power Factor (PF)	2	19
11	Power Factor Lead/Lag	2	18, 20
12	Power Apparent	2	16,23,23.5
13	Power, Reactive Phase A	2	16,23,23.5
14	Power, Reactive Phase B	2	16,23,23.5
15	Power, Reactive Phase C	2	16,23,23.5
16	Power, Reactive Total (for phases A, B, and C)	2	16,23,23.5
17	Power, True Phase A	2	16,23,23.5
18	Power, True Phase B	2	16,23,23.5
19	Power, True Phase C	2	16,23,23.5
20	Power, True Total (for phases A, B, and C)	2	16,23,23.5
21	Voltage, A-phase	2	16,23,23.3
22	Voltage, B-phase	2	16,23,23.3
23	Voltage, C-phase	2	16,23,23.3
24	Voltage, A-phase - B-phase	2	16,23,23.3
25	Voltage, B-phase - C-phase	2	16,23,23.3
26	Voltage, C-phase - A-phase	2	16,23,23.3
27	Voltage, Negative Sequence	2	16,23,23.3

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
28	Voltage, Zero Sequence	2	16,23,23.3
29	AUX Voltage Input	2	16,23,23.4
30	AUX Voltage Input 3rd Harmonic	2	16,23,23.4
Present (New) Demands (Points 31 to 37)			
31	Present Demand Current - Phase A	2	16,23,23.1
32	Present Demand Current - Phase B	2	16,23,23.1
33	Present Demand Current - Phase C	2	16,23,23.1
34	Present Demand Current - Neutral	2	16,23,23.1
35	Present Demand Current - Negative Sequence	2	16,23,23.1
36	Present Demand True Power	2	16,23,23.5
37	Present Demand True Power	2	16,23,23.5
Breaker Data (Points 38 to 41)			
38	Breaker Duty Phase A	2	12,17
39	Breaker Duty Phase B	2	12,17
40	Breaker Duty Phase C	2	12,17
41	Breaker Operation Counter	2	13,18,23, 23.7
Latched Targets (Points 42 to 45)			
42	Targets - Part 1	1	6, 18
43	Targets - Part 2	1	6, 18
44	Targets - Part 3	1	6, 18
45	Targets - Part 4	1	6, 18
Most Recent Fault Summary Report (Points 46 to 82)			
46	Fault Number	1	2,18
47	Fault Trigger Time Stamp-Part 1: days	1	3,18
48	Fault Trigger Time Stamp-Part 2: ms	1	3,18,23, 23.9
49	Trigger (Event Type)	1	5,18
50	Active Setting Group	1	4,18
51	Relay Status Part 1	1	22, 18
52	Relay Status Part 2	1	22, 18
53	Relay Status Part 3	1	22, 18
54	Relay Status Part 4	1	22, 18
55	Relay Status Part 5	1	22, 18
56	Relay Status Part 6	1	22, 18
57	Targets - Part 1	1	6, 18
58	Targets - Part 2	1	6, 18
59	Targets - Part 3	1	6, 18
60	Targets - Part 4	1	6, 18
61	Recloser Status	1	7, 18
62	Clearing Time	1	8, 18, 23, 23.8

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
63	Breaker Operate Time	1	9,18, 23, 23.8
64	Number of Oscillographic Reports	1	10, 18
65	Distance to fault	1	21, 18
66	Fault Current Phase A	1	23, 23.1
67	Fault Current Phase B	1	23, 23.1
68	Fault Current Phase C	1	23, 23.1
69	Fault Current Neutral	1	23, 23.2
70	Fault Current Q	1	23, 23.1
71	Fault Voltage Phase A	1	23, 23.3
72	Fault Voltage Phase B	1	23, 23.3
73	Fault Voltage Phase C	1	23, 23.3
74	Fault Voltage Auxiliary	1	23, 23.4
75	Fault Current Angle Phase A	1	1, 18
76	Fault Current Angle Phase B	1	1, 18
77	Fault Current Angle Phase C	1	1, 18
78	Fault Current Angle Neutral	1	1, 18
79	Fault Voltage Angle Phase A	1	1, 18
80	Fault Voltage Angle Phase B	1	1, 18
81	Fault Voltage Angle Phase C	1	1, 18
82	Fault Voltage Angle V4	1	1, 18
Selected Fault Summary Report (Points 83 to 119)			
83	Fault Number	none	2
84	Fault Trigger Time Stamp-Part 1	none	3
85	Fault Trigger Time Stamp-Part 2	none	3, 23, 23.9
86	Trigger (Event Type)	none	5
87	Active Setting Group	none	4
88	Relay Status Part 1	none	22
89	Relay Status Part 2	none	22
90	Relay Status Part 3	none	22
91	Relay Status Part 4	none	22
92	Relay Status Part 5	none	22
93	Relay Status Part 6	none	22
94	Target Flags Bits Part 1	none	6
95	Target Flags Bits Part 2	none	6
96	Target Flags Bits Part 3	none	6
97	Target Flags Bits Part 4	none	6
98	Recloser Status	none	7
99	Clearing Time	none	8, 18, 23, 23.8
100	Breaker Operate Time	none	9, 18, 23, 23.8

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
101	Number of Oscillographic Reports	none	10
102	Distance to fault	none	21
103	Fault Current Phase A	none	23, 23.1
104	Fault Current Phase B	none	23, 23.1
105	Fault Current Phase C	none	23, 23.1
106	Fault Current Neutral	none	23, 23.2
107	Fault Current Q	none	23, 23.1
108	Fault Voltage Phase A	none	23, 23.3
109	Fault Voltage Phase B	none	23, 23.3
110	Fault Voltage Phase C	none	23, 23.3
111	Fault Voltage Phase Auxiliary	none	23, 23.4
112	Fault Current Phase A Angle	none	1
113	Fault Current Phase B Angle	none	1
114	Fault Current Phase C Angle	none	1
115	Fault Current Neutral Angle	none	1
116	Fault Voltage Phase A Angle	none	1
117	Fault Voltage Phase B Angle	none	1
118	Fault Voltage Phase C Angle	none	1
119	Fault Voltage Auxiliary Angle	none	1
Demand Values Historical Data (Points 120 to 204)			
120	Peak Demand Since Reset Phase A Current	none	23, 23.1
121	Peak Demand Since Reset Phase A Time Stamp -part 1	none	11
122	Peak Demand Since Reset Phase A Time Stamp -part 2	none	11, 23, 23.9
123	Peak Demand Since Reset Phase B Current	none	23, 23.1
124	Peak Demand Since Reset Phase B Time Stamp -part 1	none	11
125	Peak Demand Since Reset Phase B Time Stamp -part 2	none	11, 23, 23.9
126	Peak Demand Since Reset Phase C Current	none	23, 23.1
127	Peak Demand Since Reset Phase C Time Stamp -part 1	none	11
128	Peak Demand Since Reset Phase C Time Stamp -part 2	none	11, 23, 23.9
129	Peak Demand Since Reset Neutral Current	none	23, 23.1
130	Peak Demand Since Reset Neutral Time Stamp -part 1	none	11
131	Peak Demand Since Reset Neutral Time Stamp -part 2	none	11, 23, 23.9
132	Peak Demand Since Reset Negative Sequence Current	none	23, 23.1
133	Peak Demand Since Reset Negative Sequence Time Stamp -part 1	none	11
134	Peak Demand Since Reset Negative Sequence Time Stamp -part 2	none	11, 23, 23.9
135	Peak Demand Since Reset True Power	none	23, 23.5
136	Peak Demand Since Reset True Power Time Stamp -part 1	none	11
137	Peak Demand Since Reset True Power Time Stamp -part 2	none	11,23, 23.9

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
138	Peak Demand Since Reset Negative True Power	none	23, 23.5
139	Peak Demand Since Reset Negative True Power Time Stamp -part 1	none	11
140	Peak Demand Since Reset Negative Demand True Power Time Stamp -part 2	none	11, 23, 23.9
141	Peak Demand Since Reset Reactive Power	none	23, 23.5
142	Peak Demand Since Reset Reactive Power Time Stamp - part 1	none	11
143	Peak Demand Since Reset Reactive Power Time Stamp - part 2	none	11, 23, 23.9
144	Peak Demand Since Reset Negative Reactive Power	none	23, 23.5
145	Peak Demand Since Reset Negative Reactive Power Time Stamp -part 1	none	11
146	Peak Demand Since Reset Negative Reactive Power Time Stamp -part 2	none	11, 23, 23.9
147	Today's Peak Demand Phase A Current	none	23, 23.1
148	Today's Peak Demand Phase A Current Time Stamp -part 1	none	11
149	Today's Peak Demand Phase A Current Time Stamp -part 2	none	11, 23, 23.9
150	Today's Peak Demand Phase B Current	none	23, 23.1
151	Today's Peak Demand Phase B Current Time Stamp -part 1	none	11
152	Today's Peak Demand Phase B Current Time Stamp -part 2	none	11, 23, 23.9
153	Today's Peak Demand Phase C Current	none	23, 23.1
154	Today's Peak Demand Phase C Current Time Stamp -part 1	none	11
155	Today's Peak Demand Phase C Current Time Stamp -part 2	none	11, 23, 23.9
156	Today's Peak Demand Neutral Current	none	23, 23.1
157	Today's Peak Demand Neutral Time Stamp -part 1	none	11
158	Today's Peak Demand Neutral Time Stamp -part 2	none	11, 23, 23.9
159	Today's Peak Demand Negative Sequence Current	none	23, 23.1
160	Today's Peak Demand Negative Sequence Time Stamp - part 1	none	11
161	Today's Peak Demand Negative Sequence Time Stamp - part 2	none	11, 23, 23.9
162	Today's Peak Demand True Power	none	23, 23.5
163	Today's Peak Demand True Power Time Stamp -part 1	none	11
164	Today's Peak Demand True Power Time Stamp -part 2	none	11, 23, 23.9
165	Today's Peak Negative Demand True Power	none	23, 23.5
166	Today's Peak Negative Demand True Power Time Stamp - part 1	none	11

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
167	Today's Peak Negative Demand True Power Time Stamp - part 2	none	11, 23, 23.9
168	Today's Peak Demand Reactive Power	none	23, 23.5
169	Today's Peak Demand Reactive Power Time Stamp -part 1	none	11
170	Today's Peak Demand Reactive Power Time Stamp -part 2	none	11, 23, 23.9
171	Today's Peak Negative Demand Reactive Power	none	23, 23.5
172	Today's Peak Negative Demand Reactive Power Time Stamp -part 1	none	11
173	Today's Peak Negative Demand Reactive Power Time Stamp -part 2	none	11, 23, 23.9
174	Yesterdays Peak Demand Phase A Current	none	23, 23.1
175	Yesterdays Peak Phase A current Time Stamp -part 1	none	11
176	Yesterdays Peak Phase A current Time Stamp -part 2	none	11, 23, 23.9
177	Yesterdays Peak Demand Phase B Current	none	23, 23.1
178	Yesterdays Peak Demand Phase B current Time Stamp - part 1	none	11
179	Yesterdays Peak Demand Phase B current Time Stamp - part 2	none	11, 23, 23.9
180	Yesterdays Peak Demand Phase C Current	none	23, 23.1
181	Yesterdays Peak Demand Phase Current Time Stamp -part 1	none	11
182	Yesterdays Peak Demand Phase Current Time Stamp -part 2	none	11, 23, 23.9
183	Yesterdays Peak Demand Neutral Current	none	23, 23.1
184	Yesterdays Peak Demand Neutral current Time Stamp - part 1	none	11
185	Yesterdays Peak Demand Neutral current Time Stamp - part 2	none	11, 23, 23.9
186	Yesterdays Peak Demand Negative Sequence Current	none	23, 23.1
187	Yesterdays Peak Demand Negative Sequence current Time Stamp -part 1	none	11
188	Yesterdays Peak Demand Negative Sequence current Time Stamp -part 2	none	11, 23, 23.9
189	Yesterdays Peak Demand True Power	none	23, 23.5
190	Yesterdays Peak Demand True Power Time Stamp -part 1	none	11
191	Yesterdays Peak Demand True Power Time Stamp -part 2	none	11, 23, 23.9
192	Yesterdays Peak Negative Demand True Power	none	23, 23.5
193	Yesterdays Peak Negative Demand True Power Time Stamp -part 1	none	11
194	Yesterdays Peak Negative Demand True Power Time Stamp -part 2	none	11, 23, 23.9
195	Yesterdays Peak Demand Reactive Power	none	23, 23.5

Index	Description	Change Event Assigned Class (1, 2, 3, or none)	Notes
196	Yesterdays Peak Demand Reactive Power Time Stamp - part 1	none	11
197	Yesterdays Peak Demand Reactive Power Time Stamp - part 2	none	11, 23, 23.9
198	Yesterdays Peak Negative Demand Reactive Power	none	23, 23.5
199	Yesterdays Peak Negative Demand Reactive Power Time Stamp -part 1	none	11
200	Yesterdays Peak Negative Demand reactive power Time Stamp -part 2	none	11, 23, 23.9
201	Total True Energy	2	18, 23, 23.6
202	Total Reverse True Energy	2	18, 23, 23.6
203	Total Reactive Energy	2	18, 23, 23.6
204	Total Reverse Reactive Energy	2	18, 23, 23.6
Most Recent Fault Summary Report (Points 205 – 206)			
205	Fault Generator Frequency	1	1,20
206	Fault Bus Frequency	1	1,20
Selected Fault Summary (For selected fault number via Object 41) (Points 207 – 208) (See Note 14)			
207	Fault Generator Frequency	none	1
208	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.
 - APPARENT power is in Secondary centIVA.
 - REACTIVE power values are in Secondary centivars.
 - TRUE Power values are in Secondary centiwatts
 - 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 since January 1, 1984 and Part 2 contains time since the last day midnight expressed in physical unit depending on user-selected scaling factor for time stamp (see Notes 23 and 23.9). The default unit is milliseconds (range from 0 to 86,400,000) for a default scaling factor of -3. The scaling factor range is from -3 to 1. When the scaling factor is 1, the range of reading Part 2 value is from 0 to 8640. This means that the value must be multiplied by 10 to be expressed in seconds. Note that Part 1 is always in days.
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 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	67N	24	50TA
1	59B	167N	27A	50TB
2	59C	67Q	27B	50TC
3	59X	167Q	27C	150TA
4	SPARE	67TA	SPARE	150TB
5	60FL	67TB	SPARE	150TC
6	62	67TC	SPARE	50TN
7	162	67TN	27X	150TN
8	SPARE	167TN	SPARE	50TQ
9	SPARE	67TQ	SPARE	150TQ
10	67A	81	SPARE	51A
11	67B	181	SPARE	51B
12	67C	281	SPARE	51C
13	167A	381	47	51N
14	167B	481	SPARE	151N
15	167C	581	BF	51Q

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

Table 5-5. 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 scaled with scaling factor for time period. See Notes 23 and 23.8. Default unit is millisecond (scaling factor -3) with default range from 0 to 60,000 milliseconds.
9. Breaker Operate Time is scaled with scaling factor for time period. See Notes 23 and 23.8. Default unit is millisecond (scaling factor -3) with default range from 0 to 60,000 milliseconds.
10. The number of recorded oscillographic records per fault (read value of this point) can be 1 or 2.
11. Demand time stamp is presented in relay's internal format. Part 1 is in days and part 2 must be scaled to seconds accordingly the scaling factor for the time stamp. See detailed explanation of time stamp format under Note 3 and scaling of time under Notes 23 and 23.9.
12. Point represents assigned phase accumulated breaker pole duty as a centipercents 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 BE1-951 Instruction Manual, Section 4, *Protection and Control*). Value range is from 0 to 20,000 where 20,000 represents 200% of DMAX.
13. Read value must be scaled with scaling factor for breaker operations counter. See Notes 23 and 23.7. Default unit is count (scaling factor is 0) with range from 0 to 99,999 counts. When operations counter exceeds 99,999, the counter will wrap back to zero.
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. Frequency Delta of 1 unit (.01 HZ deviation) will cause an event.
16. Voltage, Power and Current have configurable Change Event Dead Bands via Analog Output Blocks (objects 41). For details refer to the following paragraphs *Analog Output Status Points* and *Analog Output Control Blocks*, and see notes related to object 40 (41) points 31, 32, and 33. For ASCII command, refer to Section 6.
17. Delta of 20 counts in Breaker Duty deviation will cause an event.
18. Delta of 1 bit will cause an event.
19. Power factor range ± 1000 , Delta of 10 units will cause an event ($\pm 1\%$).
20. Power Factor: Leading = 1 and Lagging = 0.
21. Distance to fault value range is from -30000 to +30000, which represents an actual range of ± 300 units. The unit of measure is determined by the line of length parameter.
22. Relay Status is shown in Table 5-6: (1=TRUE, 0=FALSE).

Table 5-6. Relay Status

BIT	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
0	50TPT	50TQPU	VOA	IN1	ARSTKEY	159XT
1	150TPT	150TQPU	VO1	IN2	SG0	59XPU
2	50TNT	51PPU	VO2	IN3	SG1	159XPU
3	150TNT	151PPU	VO3	IN4	59PPU	81T
4	50TQT	51NPU	VO4	62	159PPU	181T
5	150TQT	151NPU	VO5	162	27PT	281T
6	BFT	51QPU	VO6	27XT	127PT	381T
7	51PT	43	VO7	27XPU	27PPU	481T
8	151PT	143	VO8	101T	127PPU	581T
9	51NT	79C	VO9	101C	47T	32T
10	151NT	79RNG	VO10	101SC	47PU	132T
11	51QT	79LO	VO11	ALMLGC	24T	BFPU
12	50TPPU	79RST	VO12	ALMMAJ	24PU	25VM1
13	150TPPU	79SCB	VO13	ALMMIN	59PT	LOGIC 0
14	50TNPU	32PU	VO14	OUT1MON	159PT	25
15	150TNPU	132PU	VO15	TRSTKEY	59XT	60FL

23. Read values of current, voltage, power, energy, breaker operations counter and time points must be multiplied to get the value expressed in physical units (ampere (A) for current, volt (V) for voltage, watt (W) for true power, VAR for reactive power, VA for apparent power, watt hour (Wh) for energy, varh for reactive energy, second for time, and counts for counter). The multiplier is defined as 10^x , where x can be from -2, -1, 0, 1, 2, 9. Henceforth, the exponent, x, will be referred to as a “scaling factor.” The selection of the scaling factor also determines the physical unit in which current, voltage, power, energy, breaker operation counter, and time points are to be reported to the master as presented in Table 5-7.

Table 5-7. Scaling Factor Multiplier

Scaling Factor	Reporting Unit	Number of Units (or Multiplier)
-3	milliunit	0.001
-2	centiunit	0.01
-1	deciunit	0.1
0	unit	1
1	10 unit	10
2	100 unit	100
3	kilounit	1000
4	10 kilounit	$10^4 = 10000$
5	100 kilounit	$10^5 = 100000$
6	megaunit	$10^6 = 1000000$
7	10 megaunit	$10^7 = 10000000$
8	100 megaunit	$10^8 = 100000000$
9	gigaunit	$10^9 = 1000000000$

Scaling factors are programmable via ASCII commands. Refer to Section 6 for detailed description. Read value of point is scaled with appropriate scaling factor as follows:

- 1 - Scaling factor for current (phase, negative sequence and neutral) (Note 23.1).
- 2 - Scaling factor for ground current (Note 23.2).
- 3 - Scaling factor for voltage (phase, line) (Note 23.3).
- 4 - Scaling factor for auxiliary voltage (Note 23.4).
- 5 - Scaling factor for power (Note 23.5).
- 6 - Scaling factor for energy (Note 23.6).
- 7 - Scaling factor for breaker operation counter (Note 23.7).
- 8 - Scaling factor for time period (Note 23.8).
- 9 - Scaling factor for relay's internal Time stamp's time (Note 23.9).

- 23.1 Default scaling factor for current is -2 meaning that current is reported in primary centiamperes.
- 23.2 Default scaling factor for ground current is -2 meaning that ground current is reported in centiamperes.
- 23.3 Default scaling factor is -2 meaning that voltage is reported in primary centivolts.
- 23.4 Default scaling factor is -2 meaning that auxiliary voltage is reported in centivolts.
- 23.5 All power points will present secondary or primary power as configured via ASCII command. Default settings for power point is secondary with scaling factor -2, meaning power is reported as secondary in centiwatts / centiVA / centiVAR.
- 23.6 Energy points always present primary value. Default scaling factor for energy is 3, meaning that energy is reported in kiloWh / kvarh/ kiloVAh.
- 23.7 Default scaling factor for breaker operation counter is 0 meaning that value is in counts.
- 23.8 Default scaling factor for time period is -3 meaning read value is in milliseconds.
- 23.9 Default scaling factor for time stamp's time (Part 2) is -3 meaning read value is in milliseconds.

Analog Output Status Points and Control Blocks

Table 5-8 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 BE1-951 Instructional Manual, Section 7, *Communications, Command Descriptions, Changing Settings Through the Serial Port*.

Scaling factors configured for analog input data apply for readings of Analog Output Status points too. Refer to Section 6 for DNP related ASCII commands.

Table 5-8. Analog Output Status Points and Control Blocks

Index	Description	Notes
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)		
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 Counter	3, 15
Reset Controls For Demand Current		
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	Total Reactive Energy	2
10	Total Reverse Reactive Energy	2
11	Total True Energy	2
12	Total Reverse True Energy	2
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

Index	Description	Notes
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 Band		
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 5-8:

1. This point represents assigned phase accumulated breaker pole duty as a centipercents 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 $\sum I$ or $\sum I^2$. This is defined by Breaker Contact Duty Operation Mode 0/1/2. It is entered via ASCII protocol command SB-DUTY. DMAX is defined through the same SB-DUTY command (refer to INSTRUCTION MANUAL for BE1-951).

Allowed value range is from 0 to 20000, where 20000 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).

2. Any value written to this data point will result in this point being set to 0 (reset). Point read value represents primary energy in scaled unit as described under *Analog Inputs* paragraph notes 23 and 23.6. The same scaling factor for energy is applied for Analog Input points
3. Read value must be scaled with scaling factor for breaker operations counter. See Notes 23 and 23.7 under the *Analog Inputs* paragraph. Default unit is count (scaling factor is 0) with range from 0 to 99,999 counts. Breaker operation counter value can be set only in default units (counts) to any value from 0 to 99999, but will be read accordingly to scale breaker operation counter factor.
4. Major, Minor, and Logic Alarms are 32 bit mapped variables as described in Table 5-9. Writing value 0 will reset the alarms. Note that only latched alarms will be cleared.

Table 5-9. 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

Bit Mask (hex)	Name	Bit Mask (hex)	Name
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	spare
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 46 to 74. 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 primary current in scaled unit. See Notes 23 and 23.1 under the *Analog Inputs* paragraph. These points can only be set to value 0 (Reset).
7. This point can only be set to value 0 (Reset). Point read value represents secondary or primary Peak Demand value Since Reset in scaled units as defined with power scaling factor and type setting. See Notes 23 and 23.5 under the *Analog Inputs* paragraph.
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 BE1-951.) 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 cannot 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 BE1-951.)
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 BE1-951.)
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 BE1-951.)
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 5-10. Only alarms with an asterisk (*) are implemented and can be read as Binary Input (object 1) points.

Table 5-10. 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 the 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. 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 amps, 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 = $Vnom * VTP * \% * 0.01 * \sqrt{3}$
6. Power Change Event Dead Band = $Vnom * Inom * \% * 0.01$
7. Total Power Change Event Dead Band = $Vnom * Inom * \% * 0.01 * 3$

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

Dead Band absolute amount is then scale to value accordingly with scaling factor. Here are examples when all scaling factors for currents, voltages, and power are defined to be 0 meaning reading value physical unit is amp / volt / watt / var).

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 then the Aux Voltage Change Event Dead Band= $120 * 2000 * 2 * 0.01 = 4800$ V.
Phase-to-Phase Voltage Change Event Dead Band= $120 * 1000 * 2 * 0.01 * \sqrt{3} = 4152$ V.
 3. To configure 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 = $120 * 5 * 4 * 0.01 = 24$ W.
Total Power Change Event Dead Band = $120 * 5 * 4 * 0.01 * 3 = 72$ W
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).

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 is 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).

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

- a. 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.
- b. Control Binary Output Status point(s) (object 12) with via next request(s).

8-Bit Unsigned Integer, Object 102

Table 5-11 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 5-11. 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 "BE1-951", 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	-	9	5	1	NULL	NULL	NULL

Object 102 is not included in Class 0 poll response.



SECTION 6 • CONFIGURATION VIA ASCII PROTOCOL

TABLE OF CONTENTS

SECTION 6 • CONFIGURATION VIA ASCII PROTOCOL.....	6-1
General	6-1
Commands for Data Scaling	6-1
SDNP-SFIV Command for Current and Voltage Scaling	6-2
SDNP-SFPE[=PType, SFP, SFE]	6-2
SDNP- SFCNTR Command for Breaker Operation Counter Scaling	6-2
SDNP-SFCNTR [= SFC]	6-3
SDNP-SFT[= SFTP, SFTS].....	6-3
SDNP-DB Command for Change Event Dead Band for Analog Inputs.....	6-3
SDNP-DB [= CDB, VDB, PDB].....	6-4
The SDNP-AIDV Command.....	6-4
SDNP- AIDV[= SAI_DV, CEAI_DV]	6-4
The SDNP Command.....	6-5

Tables

Table 6-1. Multiplier Table	6-1
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SECTION 6 • CONFIGURATION VIA ASCII PROTOCOL

General

The BE1-951 ASCII commands for DNP are:

<i>Name</i>	<i>Purpose</i>
SDNP-SFIV	Read/Set 4 scaling factors for currents (phase, neutral, negative-sequence) for ground currents, for voltages (phase, line) and for auxiliary voltages.
SDNP-SFPE	Read/Set power type, scaling factor for power and scaling factor for energy.
SDNP-SFCNTR	Read/Set breaker operation counter scaling factor.
SDNP-SFT	Read/Set scaling factors for any time period and for relay's internal time stamp's time (time stamp's Part 2).
SDNP-DB	Read/Set change event dead band for analog inputs.
SDNP-AIDV	Read/Set variation 0 (default variation) for Analog Input Static Object 30 and Change Event Object 32.
SDNP	Read all DNP configurable settings

If the style number for the BE1-951 relay does not include support for DNP, then the response to any of the above commands will be "DNP NOT IN STYLE NUMBER."

Commands for Data Scaling

Analog input and analog output status read values of current, voltage, power, energy, breaker operations counter and time points should be multiplied to get value expressed in physical units (ampere (A) for current, volt (V) for voltage, watt (W) for true power, var for reactive power, VA for apparent power, watt hour (Wh) for energy, varh for reactive energy, seconds for time and counts for counter). The multiplier is defined as 10^x where x can be from -2, -1, 0, 1, 2, 9. In the following text, the exponent "x" will be referred to as "scaling factor."

Selection of the scaling factor determines at the same time a physical unit in which current, voltage, power, energy, and breaker operations counter points are to be reported to master as presented in Table 6-1.

Table 6-1. Multiplier Table

Scaling Factor	Reporting Unit	Number of Units (or Multiplier)
-3	milliunit	0.001
-2	centiunit	0.01
-1	deciunit	0.1
0	unit	1
1	10 unit	10
2	100 unit	100
3	kilounit	1000
4	10 kilounit	$10^4 = 10000$
5	100 kilounit	$10^5 = 100000$
6	megaunit	$10^6 = 1000000$
7	10 megaunit	$10^7 = 10000000$
8	100 megaunit	$10^8 = 100000000$
9	gigaunit	$10^9 = 1000000000$

SDNP-SFIV Command for Current and Voltage Scaling

The unit for current is ampere (A) and unit for voltage is volt (V). For example, if reported current value is 400 and scaling factor was -2, this represents 400 centi-amperes. To convert centi-amperes to amperes (4 A), the read value must be multiplied by 0.01.

If scaling factor were 2, then the read value of 400 would present 40000 amperes.

The format of the ASCII command for selection of current and voltage scaling factors is:

SDNP-SFIV[=*SFPQA*, *SFGA*, *SFGA*, *SFAXV*]

where:

SFPQA Scaling factor for phase, negative-sequence, and neutral currents
SFGA Scaling factor for ground current
SFGA Scaling factor for phase and line voltages
SFAXV Scaling factor for auxiliary voltages

The allowed range for any of these scaling factors is from -2 to 3. The default scaling factor is -2 meaning the reporting default unit is centi-amperes/centi-volts for any current/voltage point.

The default settings for current and voltage scaling factors expressed by ASCII command are:

SDNP-SFIV = -2,-2,-2,-2.

Example 1:

If the user wants currents to be read in kA, ground current in 100 A (hundreds of amps), voltages in kilovolts and auxiliary voltages in volts, then the ASCII command for these settings would be:

SDNP-SFIV = 3,2,3,0.

SDNP-SFPE Command for Power and Energy Scaling

The unit for true power is watt (W), for reactive power is var, for apparent power is VA, for true energy is Wh (watt hour) and for reactive energy is varh. For example, if the reported power value is 1000 and the scaling factor was 6, this would represent 1000 megawatts. If the scaling factor for energy was 9, then 1000 would represent 1000 gigaWh.

The format of the ASCII command for selection for selection of power and energy scaling factor is:

SDNP-SFPE[=*PType*, *SFP*, *SFE*]

where:

Ptype The selection of secondary or primary power ('S'/P'). The default power is secondary in centiUnits (centiwatts /centivar/ centiVA).
SFP The scaling factor for power. The range is from -2 to 6.
SFE The scaling factor for energy. (Note: Only primary energy is reported.)

The default scaling factor for energy is 3 meaning the reporting default unit is kiloWh / kvarh. The allowed range for energy scaling factor is from 0 to 9. And the default settings for power and energy expressed by ASCII command are:

SDNP-SFPE=S,-2,3

SDNP- SFCNTR Command for Breaker Operation Counter Scaling

The breaker operation counter value has range from 0 to 99,999 counts.

The format of the ASCII command for selection of breaker operation counter scaling factor is:

SDNP-SFCNTR [= SFC]

where:

SFC The scaling factor from 0 to 3. The default value is 0.

The default settings for the breaker operation counter is expressed by the following ASCII command:

```
SDNP-SFCNTR=0
```

Reporting breaker operation counter as 16 bit analog input or output object without value over range status can be achieved already with a scaling factor 1 (SDNP-SFCNTR=1) to report in 10 counts (dekacounts). If read value is, for example 8000, then the master should multiply this by 10 to convert the value into counts. The converted value would be 80000 counts. Read status for 16 bit object is then, for scaling factor of 1, okay while in the case of scaling factor 0, the read value would be 32767 with status data overflow.

SDNP-SFT Command for Time Scaling

The time unit is seconds. The scaling factor range is from -3 to 1.

The user can scale time using the following ASCII command:

SDNP-SFT[= SFTP, SFTS]

where:

SFTP The scaling factor for any time period. It will be applied, for example, to fault clearing and breaker operate time. The range is from 0 to 60 000 ms.

SFTS The scaling factor of the relay's internal Time Stamp's time.

As described in the notes for *Analog Input Point List*, the time stamp is reported in the relay's internal format where Part 1 is the date and Part 2 is the time. The Date contains days since January 1, 1984 and Time contains time since the last day midnight expressed in scaled time units. The default time scaling factor is -3 meaning that reported time is in milliseconds with range from 0 to 86,400,000. The date of the time stamp is not a scaled value. For example, any demand or fault trigger time stamp analog input point is reported in that format.

The default time settings expressed with the ASCII command is:

```
SDNP- SFT= -3, -3
```

To be able to get valid time readings as a 16-bit variation object, the user can set the following settings:

```
SDNP- SFT = -2, 1
```

This means that the value 1 of clearing/breaker operate time represents 0.01 second, while value 1 of Part 2 of any time stamp represents 10 seconds.

SDNP-DB Command for Change Event Dead Band for Analog Inputs

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

The allowed range for the dead band value is from 1.0 to 10.0. This represents 1 to 10% of primary nominal value in steps of 0.1%.

The format of the ASCII command is:

SDNP-DB [= CDB, VDB, PDB]

where:

CDB The current dead band. The default value is 2.5%.
VDB The voltage dead band. The default value is 1%
PDB The power default change event. The default value is 2.5%.

Dead bands can be programmed also via Analog Output Status points as described under the *Analog Output Status* paragraph, Note 14.

Example:

Set dead bands so that absolute change of current value, expressed as 8.5% of nominal current value, causes new analog event to be generated. Set voltage and power dead bands to be 4.5 and 3.1, respectively.

SDNP- DB = 8.5,4.5,3.1

In this example, if primary current is 1000 amps, then the change of 85 amps ($85 + 1000 * 8.5 * 0.01$) will generate a new event. The dead band value is internally scaled accordingly with user defined scaling factor:

If the scaling factor for phase current were 0, a change of ± 85 amps would cause an AI event.
If the scaling factor for phase current were -2 , a change of ± 8500 centi-amps would cause an AI event.
If the scaling factor for phase current were -1 , a change of ± 850 deci-amps would cause an AI event.

The SDNP-AIDV Command

This command is used for reading/changing the default (zero) variation for Analog Input Static Object 30 and Change Event Object 32. A default variation refers to the variation responded to when variation 0 is requested and/or in class 0, 1, 2 or 3 scans.

The ASCII command format is:

SDNP- AIDV[= SAI_DV, CEAI_DV]

where:

SAI_DV The "Static Analog Input object Default Variation." The default variation for Object 30 is 3 (32 bit Analog Input without Flag).

Allowed variations (values) are:

1 for 32 bit Analog Input with Flag
2 for 16 bit Analog Input with Flag
3 for 32 bit Analog Input without Flag
4 for 16 bit Analog Input without Flag

CEAI_DV The Change Event Analog Input Object Default Variation. The default variation for Object 32 is 1 (32 bit Analog Input without Time).

Allowed variations (values) are:

1 for 32-bit Analog Input without Time
2 for 16-bit Analog Input without Time
3 for 32-bit Analog Input with Time
4 for 16-bit Analog Input with Time

The SDNP Command

This command reads all DNP configurable settings. The relay's response is as if multiple commands were received. The following is an example response:

```
SDNP-AID; SDNP-SFIV; SDNP-SFPE; SDNP-SFCNTR; SDNP-SFT; SDNP_DB
```



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