INSTRUCTION MANUAL

FOR

INTERTIE PROTECTION SYSTEM
BE1-IPS100

DISTRIBUTED NETWORK PROTOCOL
(DNP3)

Publication: 9365900991
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INTRODUCTION

This instruction manual provides detailed information about the BE1-IPS100 Intertie 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 (9365900991). Revisions are listed in reverse chronological order.

Manual Revision and Date	Change
E, 08/17	• Added caution box about nonvolatile memory in Section 1.
D, 12/08	• Added manual part number and revision to footers. • In Table 5-1, Index 0 through 5, removed “Primary” from the front of description.
C, 05/05	• Improved notes for Table 5, *Analog Inputs.*
B, 09/04	• Added binary points 215-220 to Table 3, *Binary Input Points* to support frequency pickup bits. • Added analog points 215-233 to Table 5, *Analog Inputs* to support positive-sequence voltage, positive-sequence current, and all metering angles.
A, 11/03	• Added generator fault and bus frequency points for “most recent” and “selected” faults.
—, 02/03	• Initial release.

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CONTENTS

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SECTION 1 • GENERAL INFORMATION

INTRODUCTION

This document describes the Basler Electric Distributed Network Protocol (DNP) implementation in the BE1-IPS100 Intertie Protection System. BE1-IPS100 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-IPS100 Intertie Protection System
- DNP3 Basic 4 Document Set
- DNP Subset Definitions Document
- The DNP website (www.DNP.org)

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SECTION 2 • DEVICE PROFILE DOCUMENT

Table 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-IPS100 DNP protocol in any DNP environment.

Table 2-1. DNP3 Device Profile Document

DEVICE PROFILE DOCUMENT

Vendor Name: Basler Electric

Device Name: BE1-IPS100 Intertie Protection System

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

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

- For static (non-change-event) object requests, request qualifier codes 00 and 01(start-stop), 07 and 08 limited quantity) and 17 and 28(index) are supported in addition to request qualifier code 06 (no range – or all points).
- Static object requests sent with qualifiers 00,01,06,07 and 08 will be responded to with qualifiers 00 or 01.
- Static object requests sent with qualifiers 17 and 28 will be responded to with qualifiers 17 or 28.
- The read function code for Object 102 (8-bit unsigned integer), variation 1, is supported.
- Time 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.
- Voltage Change Event Dead band is configurable via Object 41, point 32.
- Power Change Event Dead band is configurable via Object 41, point 33.

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

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☒ None	☒ None
☐ Fixed at	☐ Fixed at
☐ Configurable	☐ 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 3-2 identifies which object variations, function codes, and qualifiers the BE1-IPS100 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-IPS100 DNP Implementation Table

OBJECT			**REQUEST** (BE1-IPS100 will parse)		**RESPONSE** (BE1-IPS100 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-IPS100 will parse)		RESPONSE (BE1-IPS100 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.

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SECTION 4 ● CONFIGURATION PARAMETERS

DNP CONFIGURATION PARAMETERS

These paragraphs describe configuration settings that may be verified/changed from the BE1-IPS100 front panel or using ASCII protocol commands.

Relay Style Number

BE1-IPS100 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. (Refer to the BE1-IPS100 Instructional Manual, part number 9365900990).

Example:
>rg-ver
Model Number: BE1-IPS100
Style Number: E3N2H3
App Program: VER 1.00.00 09/27/02
Boot Program: VER 2.05 10/21/98
Serial Number: H12345678

BE1-IPS100 Slave Address

BE1-IPS100 relays support DNP through the rear RS-485 communication port, which is communication Port 2 (COM 2). 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-IPS100 Instructional Manual, part number 9365900990.

Example: Set the BE1-IPS100 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

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SECTION 5 ● POINT LIST

TABLE OF CONTENTS

Tables

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SECTION 5 ● POINT LIST

BINARY INPUT POINTS

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

Table 5-1. Binary Input Points

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

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
	System Status (points 0 – 95)		
0	50T Phase Tripped	1	
1	150T Phase Tripped	1	
2	50T Neutral Tripped	1	
3	150T Neutral Tripped	1	
4	50TQ Tripped	1	
5	150TQ Tripped	1	
6	Breaker Failure Tripped	1	
7	51 Phase Tripped	1	
8	151 Phase Tripped	1	
9	51 Neutral Tripped	1	
10	151 Neutral Tripped	1	
11	51Q Tripped	1	
12	50T Phase Picked-Up	1	
13	150T Phase Picked-Up	1	
14	50T Neutral Picked-Up	1	
15	150T Neutral Picked-Up	1	
16	50Q Picked-Up	1	
17	150Q Picked-Up	1	
18	51 Phase Picked-Up	1	
19	151 Phase Picked-Up	1	
20	51 Neutral Picked-Up	1	
21	151 Neutral Picked-Up	1	
22	51Q Picked-Up	1	
23	43	1	
24	143	1	
25	79 Close	1	
26	79 Enabled	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
27	79 Lockout	1	
28	79 Reclose Reset	1	
29	79 Block Output	1	
30	32 Picked-Up	1	
31	132 Picked-Up	1	
32	Virtual Output A	1	
33	Virtual Output 1	1	
34	Virtual Output 2	1	
35	Virtual Output 3	1	
36	Virtual Output 4	1	
37	Virtual Output 5	1	
38	Virtual Output 6	1	
39	Virtual Output 7	1	
40	Virtual Output 8	1	
41	Virtual Output 9	1	
42	Virtual Output 10	1	
43	Virtual Output 11	1	
44	Virtual Output 12	1	
45	Virtual Output 13	1	
46	Virtual Output 14	1	
47	Virtual Output 15	1	
48	Input Contact 1 State	1	
49	Input Contact 2 State	1	
50	Input Contact 3 State	1	
51	Input Contact 4 State	1	
52	62 Timer	1	
53	162 Timer	1	
54	27 Neutral Tripped	1	
55	27 Neutral Picked-Up	1	
56	101Trip Breaker Switch	1	
57	101Close Breaker Switch	1	
58	101Slip Contact	1	
59	Alarm Logic	1	
60	Alarm Major	1	
61	Alarm Minor	1	
62	OUT1 Mon	1	
63	Target Reset Key	1	
64	Alarm Reset Key	1	
65	SG0	1	
66	SG1	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
67	59 Phase Picked-Up	1	
68	159 Phase Picked-Up	1	
69	27 Phase Tripped	1	
70	127 Phase Tripped	1	
71	27 Phase Picked-Up	1	
72	127 Phase Picked-Up	1	
73	47 Phase Tripped	1	
74	47 Phase Picked-Up	1	
75	24 Volts per Hertz Tripped	1	
76	24 Volts per Hertz Picked-Up	1	
77	59 Phase Tripped	1	
78	159 Phase Tripped	1	
79	59 X Tripped	1	
80	159 X Tripped	1	
81	59 X Picked-Up	1	
82	159 X Picked-Up	1	
83	81T	1	
84	181T	1	
85	281T	1	
86	381T	1	
87	481T	1	
88	581T	1	
89	32 Tripped	1	
90	132 Tripped	1	
91	Breaker Failure Picked-Up	1	
92	25VM1	1	
93	LOGIC 0	1	
94	25 Tripped	1	
95	60FL	1	
Hardware Output Status (points 96 – 101)			
96	Output A	1	
97	Output 1	1	
98	Output 2	1	
99	Output 3	1	
100	Output 4	1	
101	Output 5	1	
Latched Targets (points 102-173)			
102	24 Volts per Hertz		
103	27 Phase A		
104	27 Phase B		

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
105	27 Phase C		
106	127 Phase A		
107	127 Phase B		
108	127 Phase C		
109	27 Neutral		
110	32A		
111	32B		
112	32C		
113	132A		
114	132B		
115	132C		
116	47		
117	Breaker Fail		
118	50T Phase A		
119	50T Phase B		
120	50T Phase C		
121	150T Phase A		
122	150T Phase B		
123	150T Phase C		
124	50T Neutral		
125	150T Neutral		
126	50TQ		
127	150TQ		
128	51 Phase A		
129	51 Phase B		
130	51 Phase C		
131	151 Phase A		
132	151 Phase B		
133	151 Phase C		
134	59 Phase A		
135	59 Phase B		
136	59 Phase C		
137	59 X		
138	159 X		
139	60 Fuse Loss		
140	62 Timer		
141	162 Timer		
142	67 Phase A		
143	67 Phase B		
144	67 Phase C		

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
145	167 Phase A		
146	167 Phase B		
147	167 Phase C		
148	67 Neutral		
149	167 Neutral		
150	67Q		
151	167Q		
152	67T Phase A		
153	67T Phase B		
154	67T Phase C		
155	67T Neutral		
156	167T Neutral		
157	67TQ		
158	81		
159	181		
160	281		
161	381		
162	481		
163	581		
164	159 Phase A		
165	159 Phase B		
166	159 Phase C		
167	Spare		
168	51 X		
169	151 X		
170	51Q		
171	167T Phase A		
172	167T Phase B		
173	167T Phase C		
Relay Trouble Alarms (points 174 - 179)			
174	EEProm Read/Write Fatal Error	1	
175	MPU Self-test Failed	1	
176	Analog problem detected	1	
177	Relay not calibrated or calibration checksum error	1	
178	SETTING defaults loaded	1	
179	Calibration defaults loaded	1	
Indications of Fault Trigger Logic Expressions (points 180 – 182)			
180	Pickup Trigger expression state (1=TRUE, 0=FALSE)	1	1
181	Trip Trigger expression state (1=TRUE, 0=FALSE)	1	1
182	Logic Trigger expression state (1=TRUE, 0=FALSE)	1	1

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
Programmable Alarms (points 183 – 214) See Note 3			
183	Trip Circuit Monitor Alarm	1	
184	Breaker Fail Alarm	1	
185	Recloser Fail	1	
186	Recloser Lockout	1	
187	Breaker Alarm 1	1	
188	Breaker Alarm 2	1	
189	Breaker Alarm 3	1	
190	P Demand Alarm	1	
191	N Demand Alarm	1	
192	Q Demand Alarm	1	
193	Group Override (0 = Local Control, 1 = Override)	1	
194	CPU Overload Alarm	1	
195	Communication Error Alarm	1	
196	Clock Error Alarm	1	
197	MPU Reset Alarm	1	
198	Settings Changed	1	
199	EEPROM Non fatal error	1	
200	An override is active in one or more outputs	1	
201	Loss of IRIG	1	
202	SGC Active	1	
203	Virtual Output 13 Logic Alarm	1	
204	Virtual Output 14 Logic Alarm	1	
205	Virtual Output 15 Logic Alarm	1	
206	FLT RPT Time Out	1	
207	Logic=None Alarm	1	
208	Var Demand Alarm	1	
209	Watt Demand Alarm	1	
210	Freq Range Alarm	1	
211	Changes Lost Alarm	1	
212	60 Fuse Alarm	1	
213	Volts/HZ Alarm	1	
214	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
215	81PU	1	
216	181PU	1	
217	281PU	1	
218	381PU	1	

Point Index	Description	Change Event Assigned Class (1,2,3 or None)	Notes
219	481PU	1	
220	581PU	1	

Notes for Table 5-1:

1. Refer to 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).

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.

To allow a master that can only support Trip and Close commands to control outputs that require latch on/ latch off function codes, a second set of points for the outputs has been created. These second set of outputs will latch on / latch off with the trip / close function codes, respectively.

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	Complimentary (C) or Single (S) Function Index	Control Codes and Their Description
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 (Pulse On/Close) sets output to relay logic

Point Index	Description	Complimentary (C) or Single (S) Function Index	Control Codes and Their Description
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	Hardware Output A - Pulse Control	S	0x81 (Pulse On/Trip) or 0x01 (Pulse On/NUL) Pulse output / Selector switch to opposite of current state then restore to previous state (pulsed output is active 200 to 250 ms)
15	Hardware Output 1 - Pulse Control		
16	Hardware Output 2 - Pulse Control		
17	Hardware Output 3 - Pulse Control		
18	Hardware Output 4 - Pulse Control		
19	Hardware Output 5 - Pulse Control		
20	All Hardware Outputs' - Pulse Control		
21	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
22	143 Selector Switch Status - Latch control		
23	43 Selector Switch - Pulse Control	S	0x81 (Pulse On/Trip) or 0x01 (Pulse On/NUL) Pulse output / Selector switch to opposite of current state then restore to previous state (pulsed output is active 200 to 250 ms)
24	143 Selector Switch - Pulse Control		
25	Setting Group 0	S	0x03 (Latch On/NUL)
26	Setting Group 1		
27	Setting Group L		
28	101 Virtual Breaker Control Switch	C	0x41 (PulseOn/Close) Close breaker 0x81 (PulseOn/Trip) Trip breaker

Notes for Table 5-2:

1. Reads of Points
   - Reads of points from 0 to 5, and 21 to 22 return the current state of corresponding point.
   - Read of points from 7 to 12 always returns 1 if corresponding hardware output is under relay Local control, or 0 if output is override.
   - Read of points from 25 to 26 returns 1 if setting group is active. Notice that only one of these points can be active (1) at a time.
   - Read of point 27 returns 1 if Setting Group Control is under relay's local control.
   - Read of points 6, 13, 20, and 28 always returns 0.

- Reading values of points 14 to 20 are the same as for points 0 to 6, and points 23 to 24 have the same reading values as points 21 to 22.

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 is 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, 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, On Time and Off Time 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 20) 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 27.

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 $<2^{15}-1> = 32,767$. For a 32-bit variation, the maximum positive representation is $<2^{31}-1> = 2,147,483,647$.

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, 23.1
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	2	1
9	Slip Angle	2	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
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

Index	Description	Change Event Assigned Class (1, 2, 3 or None)	Notes
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 47)			
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
46	Targets - Part 5	1	6, 18
47	Targets - Part 6	1	6, 18
Most Recent Fault Summary Report (Points 48 to 86)			
48	Fault Number	1	2, 18
49	Fault Trigger Time Stamp’s date - Part 1	1	3, 18
50	Fault Trigger Time Stamp’s time - Part 2	1	3, 18, 23, 23.9
51	Trigger (Event Type)	1	5, 18
52	Active Setting Group	1	4, 18
53	Relay Status Part 1	1	22, 18
54	Relay Status Part 2	1	22, 18
55	Relay Status Part 3	1	22, 18
56	Relay Status Part 4	1	22, 18
57	Relay Status Part 5	1	22, 18
58	Relay Status Part 6	1	22, 18
59	Targets - Part 1	1	6, 18
60	Targets - Part 2	1	6, 18
61	Targets - Part 3	1	6, 18
62	Targets - Part 4	1	6, 18
63	Targets - Part 5	1	6, 18
64	Targets - Part 6	1	6, 18
65	Recloser Status	1	7, 18

Index	Description	Change Event Assigned Class (1, 2, 3 or None)	Notes
66	Clearing Time	1	8, 18, 23, 23.8
67	Breaker Operate Time	1	8, 18, 23, 23.8
68	Number of Oscillographic Reports	1	10, 18
69	Distance to Fault	1	21, 18
70	Fault Current Phase A	1	16, 23, 23.1
71	Fault Current Phase B	1	16, 23, 23.1
72	Fault Current Phase C	1	16, 23, 23.1
73	Fault Current Ground	1	16, 23, 23.2
74	Fault Current Q	1	16, 23, 23.1
75	Fault Voltage Phase A	1	16, 23, 23.3
76	Fault Voltage Phase B	1	16, 23, 23.3
77	Fault Voltage Phase C	1	16, 23, 23.3
78	Fault Voltage Auxiliary	1	16, 23, 23.4
79	Fault Current Angle Phase A	1	1, 18
80	Fault Current Angle Phase B	1	1, 18
81	Fault Current Angle Phase C	1	1, 18
82	Fault Current Angle Neutral	1	1, 18
83	Fault Voltage Angle Phase A	1	1, 18
84	Fault Voltage Angle Phase B	1	1, 18
85	Fault Voltage Angle Phase C	1	1, 18
86	Fault Voltage Auxiliary Angle	1	1, 18
Selected Fault Summary Report (Points 87 to 125)			
87	Fault Number	3	2
88	Fault Trigger Time Stamp’s date - Part 1	3	3
89	Fault Trigger Time Stamp’s time - Part 2	3	3, 23, 23.9
90	Trigger (Event Type)	3	5
91	Active Setting Group	3	4
92	Relay Status Part 1	3	22
93	Relay Status Part 2	3	22
94	Relay Status Part 3	3	22
95	Relay Status Part 4	3	22
96	Relay Status Part 5	3	22
97	Relay Status Part 6	3	22
98	Target Flags Bits Part 1	3	6
99	Target Flags Bits Part 2	3	6
100	Target Flags Bits Part 3	3	6
101	Target Flags Bits Part 4	3	6
102	Target Flags Bits Part 5	3	6
103	Target Flags Bits Part 6	3	6
104	Recloser Status	3	7

Index	Description	Change Event Assigned Class (1, 2, 3 or None)	Notes
105	Clearing Time ms	3	8, 18, 23, 23.8
106	Breaker Operate Time	3	8, 18, 23, 23.8
107	Number of Oscillographic Reports	3	10
108	Distance to Fault	3	21
109	Fault Current Phase A	3	23, 23.1
110	Fault Current Phase B	3	123, 23.1
111	Fault Current Phase C	3	123, 23.1
112	Fault Current Ground	3	23, 23.2
113	Fault Current Q	3	123, 23.1
114	Fault Voltage Phase A	3	23, 23.3
115	Fault Voltage Phase B	3	123, 23.3
116	Fault Voltage Phase C	3	123, 23.3
117	Fault Voltage Auxiliary	3	23, 23.4
118	Fault Current Phase A Angle	3	1
119	Fault Current Phase B Angle	3	1
120	Fault Current Phase C Angle	3	1
121	Fault Current Phase N Angle	3	1
122	Fault Voltage Phase A Angle	3	1
123	Fault Voltage Phase B Angle	3	1
124	Fault Voltage Phase C Angle	3	1
125	Fault Voltage Auxiliary Angle	3	1
Demand Values Historical Data (Points 126 to 210)			
1126	**Peak Demand Since Reset Phase A Current**	3	23, 23.1
127	Peak Demand Since Reset Phase A Time Stamp's date - Part 1	3	11
128	Peak Demand Since Reset Phase A Time Stamp's time - Part 2	3	11, 23, 23.9
129	**Peak Demand Since Reset Phase B Current**	3	23, 23.1
130	Peak Demand Since Reset Phase B Time Stamp's date - Part 1	3	11
131	Peak Demand Since Reset Phase B Time Stamp's time - Part 2	3	11, 23, 23.9
132	**Peak Demand Since Reset Phase C Current**	3	23, 23.1
133	Peak Demand Since Reset Phase C Time Stamp's date - Part 1	3	11
134	Peak Demand Since Reset Phase C Time Stamp's time - Part 2	3	11, 23, 23.9
135	**Peak Demand Since Reset Neutral Current**	3	23, 23.1
136	Peak Demand Since Reset Neutral Time Stamp's date - Part 1	3	11
137	Peak Demand Since Reset Neutral Time Stamp's time - Part 2	3	11, 23, 23.9

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

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

Index	Description	Change Event Assigned Class (1, 2, 3 or None)	Notes
192	Yesterdays Peak Demand Negative-Sequence Current	3	23, 23.1
193	Yesterdays Peak Demand Negative-Sequence Current Time Stamp's date - Part 1	3	11
194	Yesterdays Peak Demand Negative-Sequence Current Time Stamp's time - Part 2	3	11, 23, 23.9
195	**Yesterdays Peak Demand True Power**	3	23, 23.5
196	Yesterdays Peak Demand True Power Time Stamp's date - Part 1	3	11
197	Yesterdays Peak Demand True Power Time Stamp's time - Part 2	3	11, 23, 23.9
198	**Yesterdays Peak Negative Demand True Power**	3	23, 23.5
199	Yesterdays Peak Negative Demand True Power Time Stamp's date - Part 1	3	11
200	Yesterdays Peak Negative Demand True Power Time Stamp's time - Part 2	3	11, 23, 23.9
201	**Yesterdays Peak Demand Reactive Power**	3	23, 23.5
202	Yesterdays Peak Demand Reactive Power Time Stamp's date - Part 1	3	11
203	Yesterdays Peak Demand Reactive Power Time Stamp's time - Part 2	3	11, 23, 23.9
204	**Yesterdays Peak Negative Demand Reactive Power**	3	23, 23.5
205	Yesterdays Peak Negative Demand Reactive Power Time Stamp's date - Part 1	3	11
206	Yesterdays Peak Negative Demand Reactive power Time Stamp's time - Part 2	3	11, 23, 23.9
207	Total True Energy	2	18, 23, 23.6
208	Total Reverse True Energy	2	18, 23, 23.6
209	Total Reactive Energy	2	18, 23, 23.6
210	Total Reverse Reactive Energy	2	18, 23, 23.6
Most Recent Fault Summary Reports (Points 211 – 212)			
211	Fault Generator Frequency	1	1
212	Fault Bus Frequency	1	1
Selected Fault Summary (For Selected Fault Number via Object 41) (Points 213 –214) (See Note 14)			
213	Fault Generator Frequency	3	1
214	Fault Bus Frequency	3	1
Positive-Sequence Metering Values (Points 213-214)			
215	Positive-Sequence Current	2	16, 23, 23.1
216	Positive-Sequence Voltage	2	16, 23, 23.1
Metering Angle Values (Points 215-233)			
217	Phase A Current Angle	2	24
218	Phase B Current Angle	2	24

Index	Description	Change Event Assigned Class (1, 2, 3 or None)	Notes
219	Phase C Current Angle	2	24
220	Ground Current Angle	2	24
221	Positive-Sequence Current Angle	2	24
222	Negative-Sequence Current Angle	2	24
223	Neutral Current (3I0) Angle	2	24
224	AN Voltage Angle	2	24
225	BN Voltage Angle	2	24
226	CN Voltage Angle	2	24
227	AB Voltage Angle	2	24
228	BC Voltage Angle	2	24
229	CA Voltage Angle	2	24
230	Positive-Sequence Voltage Angle	2	24
231	Negative-Sequence Voltage Angle	2	24
232	Neutral Voltage (3V0) Angle	2	24
233	Auxiliary Voltage Angle	2	24

Notes for Table 5-3:

1. Physical unit of this point is centiunit, meaning that read value must be multiplied by 0.01 to get value in physical unit hertz for frequency and degrees for phase angle.
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). Default unit is millisecond (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 meaning that the value must be multiplied by 10 to be expressed in seconds. Note that Part 1 is always in days.
4. The 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 the 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	Part 5	Part 6
0	159A	SPARE	59A	67N	24	50TA
1	159B	SPARE	59B	167N	27A	50TB
2	159C	SPARE	59C	67Q	27B	50TC
3	SPARE	SPARE	59X	167Q	27C	150TA
4	51N	SPARE	159X	67TA	127A	150TB
5	151N	SPARE	60FL	67TB	127B	150TC
6	51Q	SPARE	62	67TC	127C	50TN
7	167TA	SPARE	162	67TN	27X	150TN
8	167TB	SPARE	SPARE	167TN	32A	50TQ
9	167TC	SPARE	SPARE	67TQ	32B	150TQ
10	SPARE	SPARE	67A	81	32C	51A
11	SPARE	SPARE	67B	181	132A	51B
12	SPARE	SPARE	67C	281	132B	51C
BIT	**Part 1**	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**Part 6**
13	SPARE	SPARE	167A	381	132C	151A
14	SPARE	SPARE	167B	481	47	151B
15	SPARE	SPARE	167C	581	BF	151C

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 the format in 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. 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 centipercent of the maximum duty (D_{MAX}) 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. D_{MAX} is defined through the same SB-DUTY command. (For more information, see the BE1-IPS100

Instruction Manual, Section 4, *Protection and Control*). Value range is from 0 to 20,000 where 20,000 represents 200% of D_{MAX}.

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 (0.01 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 Control Blocks.* Also, 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 (±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 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). Multiplier is defined as 10^x where x can be from -2, -1, 0, 1, 2, . . . 9. In further text exponent “x” will be referred to as a “scaling factor.” Selection of scaling factor determines in the same time a physical unit in which current, voltage, power, energy, breaker operation counter and time points are to be reported to 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

Scaling Factor	Reporting Unit	Number of Units (or Multiplier)
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 centiamps.
23.2 Default scaling factor for ground current is -2 meaning that ground current is reported in centiamps.
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 / kiloVARh / 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.
24. The units of phase angle are in degrees. A phase delta of 1 unit (1 degree deviation) will cause an event.

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-IPS100 Instructional Manual, Section 11, *ASCII Command Interface, ASCII Command Interface*.

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

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	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		
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	7
14	Peak Negative Demand True Power Since Reset	7
15	Peak Positive Demand Reactive Power Since Reset	7
16	Peak Negative Demand Reactive Power Since Reset	7
Alarm Reset Control		
17	Reset Major Alarms	4
18	Reset Minor Alarms	4
19	Reset Logic Alarms	4
20	Reset Relay Trouble Alarm	12
Miscellaneous Controls		
21	Target Status Reset Control	16
22	Fault Number for Selected Fault Summary Report	5
23	Hardware Output Logic Control Mode	11, 17
24	43 AUX Virtual Switch Logic Mode	8, 17
25	143 AUX Virtual Switch Logic Mode	8, 17
26	101 Virtual Breaker Control Switch	9, 17

Index	Description	Notes
27	Active Setting Group Control Mode	10, 17
28	Sync Time Period	13, 15
Configurable Analog Inputs Change Event Dead Band		
29	Current Change Event Dead Band	14, 15
30	Voltage Change Event Dead Band	14, 15
31	Power Change Event Dead Band	14, 15

Notes for Table 5-8:

1. This point represents assigned phase accumulated breaker pole duty as a centipercent of the maximum duty (D_{MAX}) that the breaker contacts can withstand before they need service. Breaker Accumulated Duty for phase's 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. D_{MAX} is defined through the same SB-DUTY command (refer to the Instruction Manual for the BE1-IPS100).

   The allowed value range is from 0 to 20000, where 20000 represent 200% of D_{MAX}. Example: To change accumulated breaker duty for Phase B to 134% of D_{MAX}, set this point using appropriate request function code with the value of 13400. A read of this point, will return a value of 13400 (134% of D_{MAX}).
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	R-close 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	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	μP 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 87 to 125. 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 the Instruction Manual for the BE1-IPS100.) 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 the Instruction Manual for the BE1-IPS100.)
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 the Instruction Manual for the BE1-IPS100.)
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 the Instruction Manual for the BE1-IPS100.)
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 µP FAILURE)	0100	SET DFLT LOADED
0008	EEPROM FATAL ERROR *	0200	CALIBRATION DFLT LOADED
0010	ANALOG FAILURE *	0400	Spare
0020	CALIBRATION ERR *	0800	Spare

13. Time-period in milliseconds when the relay (slave) sets “NEED TIME” bit in first octet of the Application Response Header Internal Indication. When time is set by the Master via Object 50 (write function), the relay resets this 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). The 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

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

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 centi-amps).

   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.

   The 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.

   The 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 42 – 47). 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 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 are enabled at the time of parsing. This is the reason

that in **the same request**, with FC= 5 or 6, specific Binary Output Status points **can not** 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:

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

8-BIT UNSIGNED INTEGER, OBJECT 102

Table 5-11 is the point list for Object 102 and lists the 8-Bit Unsigned Integer Points. **Note:** 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
Index	**Description**
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-IPS100,” 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	-	I	P	S	1	0	0

Object 102 is not included in Class 0 poll response.

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SECTION 6 ● CONFIGURATION VIA ASCII PROTOCOL

TABLE OF CONTENTS

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SECTION 6 • CONFIGURATION VIA ASCII PROTOCOL

GENERAL

The BE1-IPS100 ASCII commands for DNP are:

Name	*Purpose*
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-IPS100 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-amps. To convert centi-amps to amps (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 were 9, then 1000 represents 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 / kiloVARh. The allowed range for energy scaling factor is from 0 to 9. 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 then, for example 8000, master should multiples this with 10 to convert the value in 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 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 that 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 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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