NOJA Power

DNP3 Protocol Implementation

Revision History

Rev	Author	Date	Comment
Draft	BOS	14-7-03	Draft release of DNP3 Protocol Manual.
Release	BOS	10-9-03	First release of DNP3 Protocol Manual.
Rev 02	BOS	19-5-04	Added SCADA port settings.
Rev 03	BOS	2-11-04	Added Binary Input, Binary Output and Analog Input Points. Updated SCADA Settings section to reflect new MPM and TELUS functionality.
Rev 04	KL	27-09-2006	Add logo.
Rev 05	OS	29-03-2007	Added Calls Failed to SCADA Counters.
Rev 06	BOS	18-06-09	Added new binary input points.
Rev 07	BOS	22-01-10	Added new Binary Input, Binary Counters and Analog Input points.

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Contents

Abbreviations

IED - Intelligent Electronic Device

RTS - Request To Send modem line

SBO - Select Before Operate

RBE - Report By Exception

CROB - Control Relay Output Block

1 INTRODUCTION

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

Functionality included in this implementation is based on the Triangle MicroWorks, Inc. Slave Source Code Library except for the following objects:

- Short Floating Point Analog representation;
  Obj30, var5; Obj32, var5, var7; Obj34, var3; Obj40, var3; Obj41 var3
- Long Floating Point Analog representation;
  Obj30, var6; Obj32, var6, var8; Obj40, var4; Obj41 var4
- Analog Output Points
  Obj40, all variations; Obj41, all variations
- Sequential File Transfer
  Obj 70, all variations
- Virtual Terminal Objects
  Obj 112, Obj 113

1.1 Applicability

This manual describes the DNP3 Protocol Implementation for MPM software versions from S02.03.04, build number 7335 onwards. If you have a software version earlier then this then this document does not apply. Please contact your NOJA Power representative for further information.

The software version and build number can be read from the MPM LCD screen by navigating to the Identification screen as described in the recloser user manual.

2 DNP V3.00 DEVICE PROFILE

The following table provides a "Device Profile Document" in the standard format defined in the DNP3 Subset Definitions Document. While it is referred to in the DNP3 Subset Definitions as a "Document," it is only a component of a total interoperability guide. This table, in combination with the following provides a complete interoperability / configuration guide

- Implementation Table, section 4
- Description of configuration methods and user-interface, section 7
- Point List Tables, sections 10, 11, 12, 13 and 14.

Table 2.1

<table>
<tr><td colspan="2">DNP V3.00
DEVICE PROFILE DOCUMENT
(Also see the Implementation Table)</td></tr>
<tr><td colspan="2">Vendor Name: NOJA Power Switchgear</td></tr>
<tr><td colspan="2">Device Name: Recloser Control (RC), using the Triangle MicroWorks, Inc. DNP3 Multi-Port Slave Source Code Library, version 3.00.</td></tr>
<tr><td>Highest DNP Level Supported:

For Requests: Level 3
For Responses: Level 3</td><td>Device Function:

☐ Master
☒ Slave</td></tr>
<tr><td colspan="2">Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached 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 received with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. Static object requests received with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event object requests, qualifiers 17 or 28 are always responded.

16-bit and 32-bit Analog Change Events with Time are supported.

The read function code for Object 50 (Time and Date), variation 1, is supported.

Sequential file transfer, Object 70, variations 3 through 7 are supported.

Analog Input Deadbands, Object 34, variations 1 through 3, are supported.</td></tr>
<tr><td>Maximum Data Link Frame Size (octets):

Transmitted: 292
Received 292</td><td>Maximum Application Fragment Size (octets):

Transmitted: 2048
Received: 2048</td></tr>
<tr><td>Maximum Data Link Re-tries:

☐ None
☐ Fixed at ____
☒ Configurable from 0 to 255 – See Link Max Retries, see section 7</td><td>Maximum Application Layer Re-tries:

☒ None
☐ Configurable</td></tr>
<tr><td colspan="2">Requires Data Link Layer Confirmation:

☐ Never
☐ Always
☐ Sometimes
☒ Configurable as: Never, Sometimes (only for multi-frame messages), or Always. See Link Confirmation Mode, section 7</td></tr>
</table>

DNP V3.00

DEVICE PROFILE DOCUMENT

(Also see the Implementation Table)

Requires Application Layer Confirmation:

- ☐ Never
- ☐ Always
- ☐ When reporting Event Data
- ☐ When sending multi-fragment responses
- ☐ Sometimes
- ☒ **Configurable as: "Only when reporting Event Data" or "When reporting event data and multi fragment messages". See Appl Cf Mode, section 7**

Timeouts while waiting for:

Data Link Confirm:	☐	None	☐	Fixed at ____	☐	Variable	☒	**Configurable, see Link Cf Timeout, section 7.**
Complete Appl. Fragment:	☒	**None**	☐	Fixed at ____	☐	Variable	☐	Configurable
Application Confirm:	☐	None	☐	Fixed at ____	☐	Variable	☒	**Configurable, see Appl Cf Timeout, section 7.**
Complete Appl. Response:	☒	**None**	☐	Fixed at ____	☐	Variable	☐	Configurable

Others:

Configurable, refer section 9

Transmission Delay:	see Tx Delay
Inter-character Timeout:	see Char Timeout

Configurable, refer section **7**

Need Time Delay:	see Appl Need Time Delay
Select/Operate Arm Timeout:	see SBO Timeout
Unsolicited response notification delay:	see C1, C2, C3 Delay
Unsolicited response retry delay:	see Unsol Retry Delay
Unsolicited offline interval:	see Unsol Offline Interval
Frozen Counter Event scanning period:	see Frz Ctr Scan Period

Varies depending on baud rate, refer section 6

Application File Timeout:	see ApplFileTimeout

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

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DEVICE PROFILE DOCUMENT

(Also see the Implementation Table)

Reports Binary Input Change Events when no specific variation requested: • Never • Only time-tagged • Only non-time-tagged ☒ **Configurable, see Binary Change Type, section 7.**	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
Sends Unsolicited Responses: • Never ☒ Configurable, see Unsolicited, section 7. • Only certain objects • Sometimes (attach explanation) ☒ ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: ☒ Never • When Device Restarts • When Status Flags Change No other options are permitted.
Default Counter Object/Variation: • No Counters Reported • Configurable ☒ Default Object: 20 Default Variation: 06 • 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 *Provision to be made for future counters requiring 32 bits*
Sends Multi-Fragment Responses: ☒ **Yes** • No	

3 DNP3 ELEMENTS STRUCTURE

3.1 DNP3 Objects structure

DNP3 Objects	
Name	***Number***
Binary Inputs	1, 2
Binary Outputs	10
Control Relay Output	12
Binary Counters	20, 21. 22, 23
Analog Inputs	30, 32, 34
Time and Date	50, 51, 52
Class	60
Sequential File Transfer	70
Internal Indications	80
Octet String	110, 111

3.2 SCADA Settings

Refer to “OSM Automatic Circuit Recloser User Manual” and “SCADA Interface Description” (NOJA-520) documents.

4 IMPLEMENTATION TABLE

The following table identifies the variations, function codes, and qualifiers supported 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 with qualifiers 00 or 01. Static object requests sent with qualifiers 17 or 28 will be responded with qualifiers 17 or 28. For change-event objects, qualifiers 17 or 28 are always responded except in the case of object 70 change events which respond with qualifier 1B or 5B.

In the table below text shaded as Subset Level 3 indicates Subset Level 3 functionality (beyond Subset Level 2), and text shaded as beyond Subset Level 3 indicates functionality beyond Subset Level 3.

Table 4.1

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
1	0	Binary Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
1	1	Binary Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
1	2 (default – see note 1)	Binary Input with Status	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
2	0	Binary Input Change (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
2	1	Binary Input Change without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
2	2 (default – see note 1)	Binary Input Change with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
2	3	Binary Input Change with Relative Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
10	0	Binary Output Status (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
10	1	Binary Output	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 1)
10	2 (default – see note 1)	Binary Output with Status	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
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)	129 (response)	echo of request
12	2	Pattern Control Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	7 (limited quantity)	129 (response)	echo of request

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
12	3	Pattern Mask	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	00, 01 (start-stop)	129 (response)	echo of request
20	0	Binary Counter (Variation 0 is used to request default variation)	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
20	1	32-Bit Binary Counter	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	2	16-Bit Binary Counter	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	5 (default – see note 1)	32-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
20	6	16-Bit Binary Counter without Flag	1 (read) 7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. cl. noack) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
21	0	Frozen Counter (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
21	1	32-Bit Frozen Counter	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
21	2	16-Bit Frozen Counter	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
21	5	32-Bit Frozen Counter with Time Of Freeze	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 1)
21	6	16-Bit Frozen Counter with Time Of Freeze	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 1)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
21	9 (default – see note 1)	32-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
21	10	16-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
22	0	Counter Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
22	1	32-Bit Counter Change Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	2	16-Bit Counter Change Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	5 (default – see note 1)	32-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
22	6	16-Bit Counter Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
23	1	32-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	2	16-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	5 (default – see note 1)	32-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	6	16-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
30	0	Analog Input (Variation 0 is used to request default variation)	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
30	1 (default – see note 1)	32-Bit Analog Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	2	16-Bit Analog Input	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	3	32-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
30	4	16-Bit Analog Input without Flag	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
32	0	Analog Change Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
32	2	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	3 (default – see note 1)	32-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	4	16-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
34	0	Analog Input Reporting Deadband (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
34	1 (default – see note 1)	16-Bit Analog Input Reporting Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
34	2	32-Bit Analog Input Reporting Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
50	0	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
50	1 (default – see note 1)	Time and Date	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
			2 (write)	00, 01 (start-stop) 07 (limited qty=1) 08 (limited qty) 17, 28 (index)		
51	1	Time and Date CTO			129 (response) 130 (unsol. resp)	07 (limited qty) (qty = 1)
52	2	Time Delay Fine			129 (response)	07 (limited qty) (qty = 1)
60	1	Class 0 Data	1 (read) 22 (assign class)	06 (no range, or all)		
60	2	Class 1 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	**Variation Number**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dsbl. unsol.) 22 (assign class)	06 (no range, or all)		
70	1	File Identifier	2 (write)	1b (free-format)	129 (response)	1B (free-format)
70	2	File Authentication	29 (authenticate)	5b (free-format)	129 (response)	5B (free-format)
70	3	File Command	25 (open)	5b (free-format)	129 (response)	5B (free-format)
70	4	File Command Status	27 (delete)	06 (no range, or all)	130 (unsol. resp)	5B (free-format)
70	5	File Transfer	1 (read)	07, 08 (limited qty)	129 (response)	5B (free-format)
70	6	File Transfer Status	22 (assign class)	5b (free-format)	130 (unsol. resp)	5B (free-format)
70	7	File Descriptor	26 (close)	06 (no range, or all)	129 (response)	1B (free-format)
80	0	Internal Indications (Variation 0 is used to request default variation)	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)		
80	1	Internal Indications	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 2)
			2 (write) (see note 4)	00 (start-stop) 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
110	string length	Octet String Object	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp))	17, 28 (index)
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 28 (index)		
			22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty)	129 (response)	00, 01 (start-stop)
		No Object (function code only) – See Note 3	13 (cold restart)			
		No Object (function code only)	14 (warm restart)			
		No Object (function code only)	23 (delay meas.)			

Note 1: A Default variation refers to the variation responded when variation 0 is requested and/or in class 0, 1, 2, or 3 scans. Default variations may be configurable; however, default settings for the configuration parameters are indicated in the table above.

Note 2: For static (non-change-event) objects, qualifiers 17 or 28 are only responded when a request is sent with qualifiers 17 or 28, respectively. Otherwise, static object requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. (For change-event objects, qualifiers 17 or 28 are always responded except for object 70 which responds with qualifier 1B or 5B.)

Note 3: A cold restart only affects the DNP process. The MPM itself is not restarted.

Note 4: Writes of Internal Indications are only supported for index 7 (Restart IIN1-7).

Note 5: Object 70 is only supported by MPM software versions S02.03.04 and above.

Note 6: Object 70 is only for use with NOJA Power proprietary software.

5 INTERNAL INDICATIONS

The following table lists Internal Indications (IINs), and the conditions that would cause them. Standard DNP3 IINs are reported in every response message.

This table lists standard DNP3 IINs.

Table 5.1

Internal Indications Object Number: **80** Request Function Codes supported: **1 (read), 2 (write)** Default Variation reported when variation 0 requested: **1**		
Point Index	Descriptions and Conditions	Writable?
0	IIN1-0 All Stations – set after a broadcast message (any message using a destination address of 0xfff0 or above) has been received. Does not indicate an error condition.	No
1	IIN1-1 Class 1 event data available. Can be set at any time and does not indicate an error condition.	No
2	IIN1-2 Class 2 event data available. Can be set at any time and does not indicate an error condition.	No
3	IIN1-3 Class 3 event data available. Can be set at any time and does not indicate an error condition.	No
4	IIN1-4 Time synchronization required. Can be set at any time and does not indicate an error condition.	No
5	IIN1-5 Local mode. Set if some points are uncontrollable via DNP.	No
6	IIN1-6 Device Trouble.	No
7	IIN1-7 Device restarts. Set only under specific conditions. Does not indicate an error condition.	Yes
8	IIN2-0 Function Unknown. Generally means that the function code (octet 2 of the request header) cannot be processed.	No
9	IIN2-1 Object Unknown. Generally means that the function code could be processed but the object group / variation could not be processed.	No
10	IIN2-2 Parameter Error. Generally indicates that both the function code and object group / variation could be processed but that the qualifier / range field is in error.	No
11	IIN2-3 Buffer Overflow. Indicates that an event buffer has overflowed, and that change events, of at least one type, have been lost.	No
12	IIN2-4 Already Executing. NOT SUPPORTED	NA
13	IIN2-5 Bad configuration.	No
14	IIN2-6 Reserved. Always 0.	NA
15	IIN2-7 Reserved. Always 0.	NA

6 BUFFER SIZE

Maximum number of events held in volatile RAM buffers:

- object 2 (binary) - 500 events;
- object 22 (counters) - 400 events;
- object 23 (frozen counters) - 350 events;
- object 32 (Analogue) - 350 events.

Summary number of events in basic realization is limited by 16K page RAM.

7 DNP3 SETTINGS

Table 7.1

Name	Explanation	Range	Default value	TELUS	MMI (Control)
Application Cold Restart Delay	The time, in ms, encoded in a response to a request from a master for a cold restart. The master is thereby notified to wait this amount of time after receiving the response before it can resume polling this device.	0 to 65530ms Step size 10 ms	5000ms	Yes	No
Application Warm Restart Delay	The time, in ms, encoded in a response to a request from a master for a warm restart. The master is thereby notified to wait this amount of time after receiving the response before it can resume polling this device.	0 to 65530ms Step size 10 ms	1000ms	Yes	No
Link Slave Address	The DNP Link address of this device.	0 to 65534 Step size 1	5	Yes	Yes
Link Confirmation Mode	This parameter is used to determine if or when the device may request confirmation from the DNP master of data link layer frames transmitted to the master.	never, sometimes, always	never	Yes	No
Link Confirmation Timeout	Timeout value, in seconds, used to wait for DNP master to confirm a previously transmitted link layer frame with a request for confirmation. This value is independent of ***Appl Cf Timeout***; if link confirmations are being used (see ***Link Cf Mode***), the application confirmation timer is not started until a link confirmation is received.	0 to 60s Step size 1s	3s	Yes	No
Link Maximum Retries	The maximum number of times this device will re-transmit a link layer frame for which a confirmation had been requested but not received within ***Link Cf Timeout***. Note that this number is in addition to the initial attempt to transmit the frame; i.e., if the value of this parameter is 2, then an unsuccessful transmission will send a total of 3 identical frames.	0 to 32767 Step size 1	2	Yes	No
Maximum Transmitted Frame Size	Maximum size of frame to transmit	64 to 292 octets step size 1	292	Yes	No
Validate Master Address	Specify whether or not to validate the master address in received frames. DNP3 frames contain both a master address field and a slave address field. If TMWDEFS_FALSE then TMW DNP3 SCL will not validate the master address and frames whose slave address matches a configured slave session will be accepted. Setting this to TMWDEFS_TRUE requires both master and slave addresses to match a local slave session before the frame is accepted.	On, Off	Off	Yes	No
Application Confirmation Mode	This parameter is used to determine if or when the device may request confirmation from the DNP master of application layer frames transmitted to the master.	Events (only when reporting event data) Events and Mult (when reporting events or multi fragment messages)	Events and Mult	Yes	No
Application Confirmation Timeout	Timeout value, in seconds, used to wait for DNP master to confirm a previous response to the master containing a request for confirmation. This value is independent of ***Link Cf Timeout***; if link confirmations are being used (see ***Link Cf Mode***), the application confirmation timer is not started until a link confirmation is received. This parameter is also used as part of the control for when an unconfirmed unsolicited response can be re-generated and re-transmitted. See Unsol Retry Delay. To ensure correct operation of confirm timeouts if ***Link Cf Mode*** is set to 'sometimes' or always' the MPM checks that Appl Cf Timeout >= ((Link Max Retries + 1) x Link Cf TO x 7). If the user enters a value less than this the MPM will overwrite it with the above value.	0 to 3600s Step Size 1s	84s	Yes	No

Name	Explanation	Range	Default value	TELUS	MMI (Control)
Application Need Time Delay	The amount of time, in minutes, after a DNP master executes a time synchronization with this device before this device sets the "need time" Internal Indication (IIN) bit to request another time synchronization. This value indicates the rate at which the internal clock of this device becomes out-of-sync with the master's clock. If this parameter is set to 0, the "need time" IIN bit will never be set.	0 to 69120 min Step Size 1min	1440 min	Yes	No
Application SBO Timeout (SBO = Select Before Operate)	Amount of time, in seconds, after a select command is received before which an operate command must be received. If this time is exceeded, the select will be aborted and any subsequent operate will not be executed.	0 to 3600s Step Size 1s	5s	Yes	No
Unsolicited Response	If On, unsolicited responses are permitted; if Off, they are not. If permitted, the device will transmit an initial null unsolicited response, and will continue to send it until an application layer confirmation of it is received from the DNP Master device. From that point on, the DNP Master must issue an "unsolicited enable" request message for one or more of the three event classes of data (class 1, 2, or 3) before any more unsolicited response messages will be transmitted. If false, then "unsolicited enable" and "unsolicited disable" messages from the DNP Master device will not be allowed – a "BAD CONFIGURATION" Internal Indication (IIN) response will be returned.	On, Off	Off	Yes	Yes
Unsolicited Response Master Address	Specifies the DNP link address destination (a DNP master) of unsolicited responses. If unsolicited responses are enabled (see ***Unsolicited***), then all unsolicited response messages, including the initial null unsolicited response, are transmitted to this address at startup.	0 to 65534 Step Size 1	3	Yes	Yes
Unsolicited Response Mask Class 1 Class 2 Class 3	Specify the initial/new state of the unsolicited event mask. This mask is used to determine which event class(es) will generate unsolicited responses. According to the DNP3 User Guide, unsolicited responses should be disabled until an 'Enable Unsolicited Response' request is received from the master. Hence this value should generally be 0, but some masters do not generate the 'Enable Unsolicited Response' message in which case they must be enabled here.	(0x00 –0x07) Any combination of 0x01 (Unsolicited for class 1 enabled) 0x02 (Unsolicited for class 2 enabled) 0x04 (Unsolicited for class 3 enabled)	0x00 (Unsolicited for class 1, 2, 3 disabled)	Yes	No
Unsolicited Response Events Class 1 Class 2 Class 3	Used to specify conditions under which an unsolicited response is generated. For each class, if the number of events occurring for that class meets or exceeds this value, then an unsolicited response will be generated (as long as the DNP Master device has enabled the class -- see ***Unsolicited***). Note that other conditions may cause an unsolicited response to be generated – see ***C1, C2, C3 Delay***.	1 to 255 Step Size 1	3 5 10	Yes	No
Unsolicited Response Delay Class 1 Class 2 Class 3	Used to specify conditions under which an unsolicited response is generated. For each class, if the amount of time since an event has occurred for that class meets or exceeds this value, then an unsolicited response will be generated (as long as the DNP Master device has enabled the class –see ***Unsolicited***). If the value for this parameter is 0 for a class, then this parameter is disabled for that class, and only ***C1, C2, C3 Events*** controls conditions under which will generate an unsolicited response for that class. Note that other conditions may cause an unsolicited response to be generated – see ***C1, C2, C3 Delay***.	0 to 86400s Step Size 1s	3s 5s 10s	Yes	No

Name	Explanation	Range	Default value	TELUS	MMI (Control)
Unsolicited Response Retry Delay	This parameter specifies the minimum amount of time between unsuccessfully confirmed unsolicited responses. If an unsolicited response is not confirmed within ***Appl Cf Timeout***, this parameter controls how soon another unsolicited response will be sent. If this parameter is zero or less than ***Appl Cf Timeout***, the "retry" unsolicited response will be sent as soon as ***Appl Cf Timeout*** expires. During the time set by ***Appl Cf Timeout***, any received read request received from the DNP Master device will be postponed until after ***Appl Cf Timeout*** has expired. If multiple read requests are received, only the last read request would be postponed; the previous read-requests will be ignored entirely. Once the number of retries is equal to ***Unsol Retries***, the interval between retries is then controlled by ***Unsol Offline Interval***, not ***Unsol Retry Delay***.	1 to 86400s Step Size 1s	60s	Yes	No
Unsolicited Response Retries	The maximum number of times this device will re-transmit an unsolicited response without receiving a confirmation from a Master at an interval defined by ***Unsol Retry Delay***. Once this value is reached, the unsolicited response will continue to be retransmitted but at a potentially different interval defined by ***Unsol Offline Interval***.	0 to 255 Step Size 1	255	Yes	No
Unsolicited Response Offline Interval	If an unsolicited response has been retried ***Unsol Max Retries*** times without a confirmation then this parameter defines the time interval between unsolicited retries from that point forward. It allows the interval between retries to be increased if no confirmation is being received while still allowing an infinite number of unsolicited retries.	0 to 86400s Step Size 1s	300s	Yes	No
Binary Input Object 01	Specifies the default variation for object 01, binary input. The default variation is used whenever variation 0 is requested, and in responses to class polls.	1 (without status), 2 (with status)	2	Yes	No
Binary Input Object 02	This value specifies the default variation for object 02, binary input change events. The default variation is used whenever variation 0 is requested, and in responses to class polls.	1 (without time), 2 (with time) 3 (with relative time)	2	Yes	No
Binary Output Object 10	This value specifies the default variation for object 10, binary output. The default variation is used whenever variation 0 is requested, and in responses to class polls.	1 (without status), 2 (with status)	2	Yes	No
Binary Counter Object 20	This value specifies the default variation for object 20, binary (running) counters. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32-bit binary counters with status) 2 (16-bit binary counters with status) 5 (32-bit binary counters without status) 6 (16-bit binary counters without status)	5	Yes	No
Binary Counter Object 21	This value specifies the default variation for object 21, frozen counters. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32-bit frozen counters with status) 2 (16-bit frozen counters with status) 5 (32-bit frozen counters with time) 6 (16-bit frozen counters with time) 9 (32-bit frozen counters without status) 10 (16-bit frozen counters without status)	9	Yes	No

Name	Explanation	Range	Default value	TELUS	MMI (Control)
Binary Counter Object 22	This value specifies the default variation for object 22, binary (running) counter change events. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32-bit binary counters without time) 2 (16-bit binary counters without time) 5 (32-bit binary counters with time) 6 (16-bit binary counters with time)	5	Yes	No
Binary Counter Object 23	This value specifies the default variation for object 23, frozen counter events. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32-bit binary counters without time) 2 (16-bit binary counters without time) 5 (32-bit binary counters with time) 6 (16-bit binary counters with time)	5	Yes	No
Analog Input Object 30	This value specifies the default variation for object 30, analog input. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32 bit analog with status), 2 (16 bit analog with status), 3 (32 bit analog without status), 4 (16 bit analog without status)	1	Yes	No
Analog Input Object 32	This value specifies the default variation for object 32, analog input change events. The default variation is used whenever variation 0 is requested, and in responses to class polls	1 (32 bit analog without time) 2 (16 bit analog without time) 3 (32 bit analog with time) 4 (16 bit analog with time)	3	Yes	No
Analog Input Object 34	This value specifies the default variation for object 34, analog input reporting deadband. The default variation is used whenever reads of variation 0 is requested.	1 (16 bit analog) 2 (32 bit analog)	1	Yes	No
Analogue Event Reporting	This values specifies whether to report all analogue events, or whether to report the last event.	Report All Events Report Last Event	Report All Events	Yes	No

Deadband values can be changed within the MPM over SCADA by DNP3 function code 22. Default deadbands are user set for all analog points and can be mapped into any particular configuration using TELUS software.

8 DNP3 COUNTER DISPLAY

8.1 DNP3 counter list

Table 8.1

Name	Explanation	TELUS	MMI	Able to be reset
Call Drop outs	The number of modem calls where MPM did not initiate hanging up	Yes	Yes	Yes
Calls Failed	The number of modem calls initiated by the MPM which have failed to connect.	Yes	Yes	Yes
Tx Frames	The number of DNP3 datalink frames transmitted	Yes	Yes	Yes
Rx Frames	The number of DNP3 datalink frames successfully received	Yes	Yes	Yes
Length Errors	The number of message packages received with a frame length error	Yes	Yes	Yes
CRC Errors	The number of messages received with a CRC error	Yes	Yes	Yes
C1 Buffer	Number of class 1 events buffered	Yes	Yes	No
C2 Buffer	Number of class 2 events buffered	Yes	Yes	No
C3 Buffer	Number of class 3 events buffered	Yes	Yes	No
C1 Timer	Time (in sec) until buffered class 1 events are transmitted	Yes	Yes	No
C2 Timer	Time (in sec) until buffered class 2 events are transmitted	Yes	Yes	No
C3 Timer	Time (in sec) until buffered class 3 events are transmitted	Yes	Yes	No

Notes:

1. Comms monitoring fields can be reset from MMI, TELUS or via SCADA CROB point.
2. If the class is not set for Unsolicited response (see UnsolSendMask, section DNP3 PROTOCOL VARIABLES) Timer state for the given class (MMI, TELUS Menus - *SCADA Counters*) is displayed as four asterisks.
3. If Unsolicited response is disabled, asterisks are displayed in all three counters of class timers.

9 SCADA SETTINGS

Refer also to “OSM Automatic Circuit Recloser User Manual” and “SCADA Interface Description (NOJA-520)”.

9.1 Port Settings

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Port Type	Port used for communications	RS232 RS485	RS232	RS232	RS232	Yes	Yes
Duplex Type	Defines whether Rx and Tx can occur at the same time (full duplex) or not (half duplex)	Half Full	Half	Full	Half	Yes	Yes
Parity	Sets parity for the communications channel	None Even Odd	None	None	None	Yes	Yes
Baud Rate	Sets the baud rate for the communications channel	300, 600, 1200, 2400, 4800, 9600, 19200	1200	19200	9600	Yes	Yes
CTS Mode	CTS behaviour depends on the ***Duplex Type*** setting. CTS is set high by the DCE (i.e. modem) in response to RTS set high by DTE (MPM).	Monitor High Monitor Low Ignore	Ignore	Monitor High	Monitor High	Yes	No
RTS Mode	Request To Send signal. Used for flow control / transmitter control. In ***Flow control*** mode the MPM asserts this signal to indicate it is ready to receive data. If MPM is not ready to receive data, it drops this signal. In PTT mode RTS is used to control the transmitter.	Ignore Control PTT Flow Control	Control PTT	Flow Control	Flow Control	Yes	No
RTS On Level	Sets which polarity is used to determine whether RTS is ON.	High Low	Low	Low	Low	Yes	No
DSR Mode	Monitor DSR signal. DSR is asserted when modem is ready for communication.	Monitor High Monitor Low Ignore	Ignore	Monitor High	Monitor High	Yes	No
DTR Mode	Data Terminal Ready signal. MPM asserts DTR when ready to begin communication. DTR Off causes the modem to hang Up. In Ignore mode do not control the DTR line. Set it in one predefined state. May be critical for some DCE devices.	Ignore Control	Ignore	Control	Control	Yes	No
DTR On Level	Sets which polarity is used to determine whether DTR is ON.	High Low	Low	Low	Low	Yes	No
DTR Low Time	Minimum period of time the DTR signal must be low before a modem responds to DTR high.	50 to 5000ms Step size 10ms	50ms	50ms	50ms	Yes	No
DCD Mode	Sets whether to monitor the Modem line DCD or to ignore it.	Monitor High Monitor Low Ignore	Monitor High	Monitor High	Monitor High	Yes	No
DCD fall time	Set duration the MPM will wait after loss of carrier before sending a hang up command or assuming the session has ended.	0 to 25500ms Step size 10ms	700	700	700	Yes	No
Tx Delay	Minimum time, in ms, after receiving a character through the physical communication port, before transmitting a character in response. This has particular use in multi-drop RS485 or radio-modem communication environments where the master must be given time to disable its transmitting hardware before it can be ready to receive a message from the slave device.	0 to 5000ms Step size 10ms	50ms	None	50ms	Yes	No

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Char Time Out	Maximum time, in chars length, between received bytes in a data link frame. After any byte is received in a data link frame, if this time is exceeded before another byte is received, then the current frame is rejected, and scanning for the beginning of another frame is immediately started.	0 – 255 Step size 1 0 – do not check	2	2	2	Yes	No
Inactivity Time	The number of seconds the MPM will wait without any activity in transmission line before showing the SCADA Port Status as disconnected.	0 to 600s Step size 1s	0	180	15	Yes	No
Modem is powered from external load	When this setting is On and the External Load is Off, the MPM will not try to use the communication device. When this setting is Off the MPM will not check the External Load status before making a connection.	On Off	On	On	On	Yes	No
Pre Tx Time	Pre transmission – interval between assertion of RTS and starting to send data.	0 to 5000ms Step size 10ms	250ms	0	250ms	Yes	No
Post Tx Time	Post Transmission – interval between sending last character of data and negating RTS.	0 to 5000ms Step size 10ms	50ms	0	50ms	Yes	No
CA	Collision avoidance is required for point to multi-point communication channels.	Enable Disable	Enable	Disable	Disable	Yes	No
CA Min Idle Time	This parameter provides a minimum time between retries to connect to master, and allows grading of groups of slaves (e.g. on a per feeder basis) communicating with the same master. Collision avoidance prevents multiple devices from attempting to go online at the same time after loss of connection and is only active if DCD Monitor is selected. Where DCD is asserted when a message is to be sent, Collision Avoidance is implemented as a time delay equal to (Min Idle Time + Max Rndm Delay x Random number). where: 'Random number' is between 0 and 1 and generated by the MPM automatically.	0 to 120000ms Step size 10ms	2000ms	-	2000ms	Yes	No
CA Max Random Delay	This parameter provides a maximum delay in addition to the Min Idle Time.	0 to 120000ms Step size 10ms	5000ms	-	5000ms	Yes	No

9.2 Radio Settings

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Preamble	Preamble is required by some radios for synchronisation purposes. If On the MPM will transmit characters prior to sending data.	On Off	On	Off	On	Yes	No
Char	Preamble ASCII character. Represented by its hexadecimal equivalent.	0x00 to 0xFF	0x55	-	0x55	Yes	No

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Last Char	Final ASCII character of the preamble, represented by its hexadecimal equivalent. With preamble enabled and default settings, data packest are preceded by 0x55, 0x55, 0x55, 0xFF. This is needed to distinguish end of preamble.	0x00 to 0xFF	0xFF	-	0xFF	Yes	No
Repeat	Number of times the preamble character is repeated, excluding the last character.	0 to 25 Step size 1	3	-	3	Yes	No

9.3 Modem Settings

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Dial Out	Enable MPM dial out	On Off	Off	On	Off	Yes	No
Autodial Interval	Interval between failure to connect to one number before initiating a call to the next. Setting to zero (0) disables the interval and the next number is dialled immediately the preceding number fails.	0 to 255s Step size 1s	0	3	0	Yes	No
Dial Numbers	A maximum of five telephone numbers for dialing out and connecting to a master. Each number can be a maximum of 18 characters; a comma (,) is used to generate a pause of 1 sec. If the first number fails to respond, the MPM waits for the Autodial Interval to expire and tries the next available number in the list.	5 strings, dialing chars*, without AT prefix each with 18 characters length.	-	-	-	Yes	No
Init String	Modem Initialization String.	Predefined AT commands without the AT prefix. 36 chars in length.	-	Z	-	Yes	No
Predial string	Set of modem commands sent to modem before dialling a number.	Dialing chars 18 characters in length without AT prefix.	-	D	-	Yes	No
Hang Up Command	The MPM has two methods of telling a modem to hang up. Using the DTR signal of the com port is the superior of the two. If you set ***DTR Ignore***, MPM will use this command.	Predefined AT commands without the AT prefix. 8 chars in length.	-	H	-	Yes	No
Off Hook Command	Command to make the modem go off-hook. This is sent to the modem immediately before the pre-dial string.	Predefined AT commands without the AT prefix. 8 chars in length.	-	H	-	Yes	No
Connection Timeout	The length of time the MPM will wait after dialling a number for a connection to be established.	0 to 255s Step size 1s	60s	60s	60s	Yes	No
Response Time	Determines how long the MPM will wait for a response from the modem after sending it a control command.	0 to 255s Step size 1s 0 – do not check	0	3s	0	Yes	No
Maximum Call Duration	Sets a maximum time for a call in minutes. This limits the length of a call to reduce call costs in situations where constant generation of events keeps the modem connected. If set to zero the timer is disabled.	0 to 60 mins. Step size 1 min.	-	0	-	Yes	No

Setting	Description	Range	Default for Radio	Default for Modem	Default for Direct	Acces-sible from TELUS	Acces-sible from MMI
Auto Answer On	AT command to enable auto-answer on the modem.	Predefined AT commands without the AT prefix. 8 chars in length.	-	SO=2	-	Yes	No
Auto Answer Off	AT command to disable auto-answer on the modem.	Predefined AT commands without the AT prefix. 8 chars in length.	-	SO=0	-	Yes	No

***** The following characters can be used in the pre-dial string and dial numbers:

Character	Description
0-9 # *	Dialling digits.
P	Pulse dialling.
T	Tone Dialling
, (comma)	Pause. Used to set a pause between digits.
; (semicolon)	Return to command state after dialling.
!	Hook flash.
@	Wait for 5 seconds before proceeding.
R	Reverse handshake (go on-line in auto-answer mode).
W	Waits for second dial tone.

9.4 SCADA Time Configuration

Time stamps within the SCADA protocol can be reported using Local Time or Greenwich Mean Time (GMT) time with an offset to account for the time zone. This will allow the MPM to display the local time while having GMT time reported back to the SCADA master.

SCADA time is set using the drop down box at the bottom of the SCADA settings screen. The default setting is Local. When GMT is selected the “Zone hours” box is enabled allowing the user to select their time zone as an offset of GMT time.

Note: This feature is only available with MPM software version S02.03.05 Build 6069 and later.

10 BINARY INPUT POINTS

Static (Steady-State) Object Number: **1**

Change Event Object Number: **2**

Request Function Codes supported: **1 (read), 22 (assign class)**

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)**

Status bits supported: **on-line, local forced data, state**

Note: All binary inputs are considered permanently online **On-line (0), local forced data (1)**.

Binary input change events are detected by the IED at the time they occur and are not subject to a scan rate. Time stamps associated with change events correspond to the time stamp appearing on the MMI or TELUS Event, CO Operation or Change Messages logs.

The value in the Default DNP ID column represents the default setting. This parameter is user configurable between 0 and 255, individual points can be selected for mapping or disabled using the TELUS software.

Changes to class allocation arising from use of DNP3 function 22 are saved to non-volatile memory.

Table 10.1

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
0	Indication	Dummy Control (Dummy)	Dummy Control ON	Dummy Control OFF	1	Digital
1	Indication	Lockout	All AR OCEF, AR SEF, AR SEF, ABR elements are set in the O1 state	Any one of AR OCEF, AR SEF, AR SEF, ABR elements is not set in the O1 state	1	Digital
2	Indication	Remote On (Remote_On)	Control mode is set Remote	Control mode is set Local. IIN1-5 Local mode indicator is set	1	Digital
3	Indication	AR initiated (AR(Any))	Any of AR OCEF, AR SEF, AR UV or ABR elements set in one of O2, O3 or O4 states	None of AR OCEF, AR SEF, AR UV or ABR elements set in O2, O3 or O4 states	2	Digital
4	Indication	Prot initiated (Prot(Any))	Logical OR of AR initiated and Pickup signals	No AR initiated or Pickup signals detected	2	Digital
Disabled	Indication	Local Control	Device is in Local Control mode		0	Digital
Disabled	Indication	Group 1 Trip	Trip request by Group 1 protection settings	No Group 1 protection trip request detected.	0	Digital
Disabled	Indication	Group 2 Trip	Trip request by Group 2 protection settings	No Group 2 protection trip request detected.	0	Digital
Disabled	Indication	Group 3 Trip	Trip request by Group 3 protection settings	No Group 3 protection trip request detected.	0	Digital
Disabled	Indication	Group 4 Trip	Trip request by Group 4 protection settings	No Group 4 protection trip request detected.	0	Digital
Pickup						
Disabled	Indication	Pickup (P(Any))	Pickup output of any of OC1+, OC2+, OC3+, OC1-, OC2-, OC3-, EF1+, EF2+, EF3+, EF1-EF2-, EF3-, SEF+, SEF–, EFLL, OCLL, UF, UV1, UV2, UV3 elements activated	No Pickup output of any element activated	0	Digital
Disabled	Indication	Pickup(OC_PhaseA)	Pickup of any OC element on A Phase is activated	Pickup of any OC element on A Phase is not activated	0	Digital
Disabled	Indication	Pickup(OC_PhaseB)	Pickup of any OC element on A Phase is activated	Pickup of any OC element on A Phase is not activated	0	Digital
Disabled	Indication	Pickup(OC_PhaseC)	Pickup of any OC element on A Phase is activated	Pickup of any OC element on A Phase is not activated	0	Digital
Disabled	Indication	Pickup(In)	Pickup of any EF, SEF, EFLL, element is activated	Pickup of any EF, SEF, EFLL, element is not activated	0	Digital
Disabled	Indication	P(OC1+)	Pickup output of OC1+ activated	Pickup output of OC1+ not activated	0	Digital
Disabled	Indication	P(OC2+)	Pickup output of OC2+ activated	Pickup output of OC2+ not activated	0	Digital

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
Disabled	Indication	P(OC3+)	Pickup output of OC3+ activated	Pickup output of OC3+ not activated	0	Digital
Disabled	Indication	P(OC1-)	Pickup output of OC1- activated	Pickup output of OC1- not activated	0	Digital
Disabled	Indication	P(OC2-)	Pickup output of OC2- activated	Pickup output of OC2- not activated	0	Digital
Disabled	Indication	P(OC3-)	Pickup output of OC3- activated	Pickup output of OC3- not activated	0	Digital
Disabled	Indication	P(EF1+)	Pickup output of EF1+ activated	Pickup output of EF1+ not activated	0	Digital
Disabled	Indication	P(EF2+)	Pickup output of EF2+ activated	Pickup output of EF2+ not activated	0	Digital
Disabled	Indication	P(EF3+)	Pickup output of EF3+ activated	Pickup output of EF3+ not activated	0	Digital
Disabled	Indication	P(EF1-)	Pickup output of EF1- activated	Pickup output of EF1- not activated	0	Digital
Disabled	Indication	P(EF2-)	Pickup output of EF2- activated	Pickup output of EF2- not activated	0	Digital
Disabled	Indication	P(EF3-)	Pickup output of EF3- activated	Pickup output of EF3- not activated	0	Digital
Disabled	Indication	P(SEF+)	Pickup output of SEF+ activated	Pickup output of SEF+ not activated	0	Digital
Disabled	Indication	P(SEF-)	Pickup output of SEF- activated	Pickup output of SEF- not activated	0	Digital
Disabled	Indication	P(OCLL)	Pickup output of OCLL activated	Pickup output of OCLL not activated	0	Digital
Disabled	Indication	P(EFLL)	Pickup output of EFLL activated	Pickup output of EFLL not activated	0	Digital
Disabled	Indication	P(UV1)	Pickup output of UV1 activated	Pickup output of UV1 not activated	0	Digital
Disabled	Indication	P(UV2)	Pickup output of UV2 activated	Pickup output of UV2 not activated	0	Digital
Disabled	Indication	P(UV3)	Pickup output of UV3 activated	Pickup output of UV3 not activated	0	Digital
Disabled	Indication	P(UF)	Pickup output of UF activated	Pickup output of UF not activated	0	Digital
Disabled	Indication	P(Uabc>)	Pickup output of Uabc> activated	Pickup output of Uabc> not activated	0	Digital
Disabled	Indication	P(Urst>)	Pickup output of Urst> activated	Pickup output of Urst> not activated	0	Digital
Disabled	Indication	P(Uabc<)	Pickup output of Uabc< activated	Pickup output of Uabc< not activated	0	Digital
Disabled	Indication	P(Urst<)	Pickup output of Urst< activated	Pickup output of Urst< not activated	0	Digital
Open						
5	Indication	Open (Open(Any))	PS=0 irrespective of source	PS=1 irrespective of source	1	Digital
Disabled	Indication	Open(OC_PhaseA)	Open due to any OC element trip on A Phase	Not Open due to any OC element trip on A Phase	0	Digital
Disabled	Indication	Open(OC_PhaseB)	Open due to any OC element trip on B Phase	Not Open due to any OC element trip on B Phase	0	Digital
Disabled	Indication	Open(OC_PhaseC)	Open due to any OC element trip on C Phase	Not Open due to any OC element trip on C Phase	0	Digital
Disabled	Indication	Open(In)	Open due to any EF, SEF, EFLL, trip	Not Open due to any EF, SEF, EFLL, trip	0	Digital
6	Indication	Open(Prot)	Open due to OC1+, OC2+, OC3+, OC1-, OC2-, OC3-, EF1+, EF2+, EF3+, EF1-, EF2-, EF3-, SEF+, SEF –, EFLL, OCLL, UF, UV1, UV2 or UV3 tripping	Not open due to OC1+, OC2+, OC3+, OC1-, OC2-, OC3-, EF1+, EF2+, EF3+, EF1-, EF2-, EF3-, SEF+, SEF –, EFLL, OCLL, UF, UV1, UV2 or UV3 tripping	1	Digital
7	Indication	Open(OC1+)	Open due to OC1+ tripping	Not open due to OC1+ tripping	2	Digital
8	Indication	Open(OC2+)	Open due to OC2+ tripping	Not open due to OC2+ tripping	2	Digital
9	Indication	Open(OC3+)	Open due to OC3+ tripping	Not open due to OC3+ tripping	2	Digital
Disabled	Indication	Open(OC1-)	Open due to OC1- tripping	Not open due to OC1- tripping	0	Digital
Disabled	Indication	Open(OC2-)	Open due to OC2- tripping	Not open due to OC2- tripping	0	Digital
Disabled	Indication	Open(OC3-)	Open due to OC3- tripping	Not open due to OC3- tripping	0	Digital
10	Indication	Open(EF1+)	Open due to EF1+ tripping	Not open due to EF1+ tripping	2	Digital
11	Indication	Open(EF2+)	Open due to EF2+ tripping	Not open due to EF2+ tripping	2	Digital
12	Indication	Open(EF3+)	Open due to EF3+ tripping	Not open due to EF3+ tripping	2	Digital
Disabled	Indication	Open(EF1-)	Open due to EF1- tripping	Not open due to EF1- tripping	0	Digital

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
Disabled	Indication	Open(EF2-)	Open due to EF2- tripping	Not open due to EF2- tripping	0	Digital
Disabled	Indication	Open(EF3-)	Open due to EF3- tripping	Not open due to EF3- tripping	0	Digital
13	Indication	Open(SEF+)	Open due to SEF+ tripping	Not open due to SEF+ tripping	2	Digital
Disabled	Indication	Open(SEF-)	Open due to SEF- tripping	Not open due to SEF- tripping	0	Digital
14	Indication	Open(OCLL)	Open due to OCLL tripping	Not open due to OCLL tripping	2	Digital
15	Indication	Open(EFLL)	Open due to EFLL tripping	Not open due to EFLL tripping	2	Digital
16	Indication	Open(UV1)	Open due to UV1 tripping	Not open due to UV1 tripping	2	Digital
17	Indication	Open(UV2)	Open due to UV2 tripping	Not open due to UV2 tripping	2	Digital
18	Indication	Open(UV3)	Open due to UV3 tripping	Not open due to UV3 tripping	2	Digital
Disabled	Indication	Open(UF)	Open due to UF tripping	Not open due to UF tripping	0	Digital
19	Indication	Open (Remote)	Open due to SCADA or I/O control signal	Not open due to SCADA or I/O control signal	2	Digital
Disabled	Indication	Open(SCADA)	Open due to SCADA control signal	Not open due to SCADA control signal	0	Digital
Disabled	Indication	Open(I/O)	Open due to I/O control signal	Not open due to I/O control signal	0	Digital
20	Indication	Open(Local)	Open due to MMI, PC control signal or manual tripping	Not open due to MMI, PC control signal or manual tripping	1	Digital
Disabled	Indication	Open(MMI)	Open due to MMI control signal	Not open due to MMI control signal	0	Digital
Disabled	Indication	Open(PC)	Open due to PC control signal	Not open due to PC control signal	0	Digital
Disabled	Indication	Open(Manual)	Open due to manual tripping (no origin detected)	Not open due to manual tripping	0	Digital
Disabled	Indication	Open(ABR AutoOpen)	Open due to ABR AutoOpen Operation	Not open due to ABR AutoOpen operation.	0	Digital
Alarms						
21	Indication	Alarm (A(Any))	Alarm output of any of OC1+, OC1-, EF1+, EF1-, SEF+, SEF-, UF, UV1, UV2, UV3 elements activated	No Alarm output of any elements activated	1	Digital
Disabled	Indication	A(OC1+)	Alarm output of OC1+ activated	Alarm output of OC1+ not activated	0	Digital
Disabled	Indication	A(OC1-)	Alarm output of OC1- activated	Alarm output of OC1- not activated	0	Digital
Disabled	Indication	A(EF1+)	Alarm output of EF1+ activated	Alarm output of EF1+ not activated	0	Digital
Disabled	Indication	A(EF1-)	Alarm output of EF1- activated	Alarm output of EF1- not activated	0	Digital
Disabled	Indication	A(SEF+)	Alarm output of SEF+ activated	Alarm output of SEF+ not activated	0	Digital
Disabled	Indication	A(SEF-)	Alarm output of SEF- activated	Alarm output of SEF- not activated	0	Digital
Disabled	Indication	A(UV1)	Alarm output of UV1 activated	Alarm output of UV1 not activated	0	Digital
Disabled	Indication	A(UV2)	Alarm output of UV2 activated	Alarm output of UV2 not activated	0	Digital
Disabled	Indication	A(UV3)	Alarm output of UV3 activated	Alarm output of UV3 not activated	0	Digital
Disabled	Indication	A(UF)	Alarm output of UF activated	Alarm output of UF not activated	0	Digital
Closed						
22	Indication	Closed (Closed(Any))	PS=1 irrespective of origin	PS=0 irrespective of origin	1	Digital
23	Indication	Closed(AR)	Closed due to AR OCEF, AR SEF, AR UV, ABR control signal	Not closed due to AR OCEF, AR SEF, AR UV, ABR control signal	2	Digital
Disabled	Indication	Closed(AR OCEF) (Closed(AR_OCEF))	Closed due to AR OCEF reclosing	Not closed due to AR OCEF reclosing	0	Digital
Disabled	Indication	Closed(AR SEF) (Closed(AR_SEF))	Closed due to AR SEF reclosing	Not closed due to AR SEF reclosing	0	Digital
Disabled	Indication	Closed(AR UV) (Closed(AR_ UV))	Closed due to AR UV reclosing	Not closed due to AR UV reclosing	0	Digital
Disabled	Indication	Closed(ABR)	Closed due to ABR closing	Not closed due to ABR closing	0	Digital
Disabled	Indication	Closed (Remote)	Closed due to SCADA or I/O control signal	Not closed due to SCADA or I/O control signal	0	Digital
Disabled	Indication	Closed (SCADA)	Closed due to SCADA control signal	Not closed due to SCADA control signal	0	Digital
24	Indication	Closed(I/O)	Closed due to I/O control signal	Not closed due to I/O control signal	2	Digital

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
25	Indication	Closed (Local)	Closed due to MMI, PC control signal or undefined close	Not closed due to MMI, PC control signal or undefined close	2	Digital
Disabled	Indication	Closed(MMI)	Closed due to MMI control signal	Not closed due to MMI control signal	0	Digital
Disabled	Indication	Closed(PC)	Close due to PC control signal	Not closed due to PC control signal	0	Digital
Disabled	Indication	Closed(undefined)	Closed state recognized after On (Power) or servicing	Open state recognized after On (Power) or servicing	0	Digital
Disabled	Indication	Closed(ABR AutoOpen)	Closed due to a ABR operation while an ABR Auto Open operation count is active	Not closed due to an ABR Auto Open operation.		
Status						
26	Indication	Group1 On (Grp1_On)	Active Group 1	Active Group 2, 3 or 4	1	Digital
27	Indication	Group2 On (Grp2_On)	Active Group 2	Active Group 1, 3 or 4	1	Digital
28	Indication	Group3 On (Grp3_On)	Active Group 3	Active Group 1,2 or 4	1	Digital
29	Indication	Group4 On (Grp4_On)	Active Group 4	Active Group 1, 2 or 3	1	Digital
30	Indication	Prot On (Prot_On)	Protection is switched On	Protection is switched Off	1	Digital
31	Indication	EF On (EF_On)	Earth overcurrent element is switched On	Earth overcurrent element is switched Off	1	Digital
32	Indication	SEF On (SEF_On)	Sensitive Earth fault element is switched On	Sensitive Earth fault element is switched Off	1	Digital
33	Indication	UV On (UV_On)	Undervoltage element is switched On	Undervoltage element is switched Off	1	Digital
Disabled	Indication	UF On (UF_On)	Underfrequency element is switched On	Underfrequency element is switched Off	0	Digital
34	Indication	CLP On (CLP_On)	Cold load pickup element is switched On	Cold load pickup element is switched Off	1	Digital
35	Indication	LL On (LL_On)	Live line element is switched on	Live line element is switched Off	1	Digital
36	Indication	AR On (AR_On)	OCEF, SEF and UV reclosing is switched On	OCEF, SEF and UV reclosing is switched Off	1	Digital
37	Indication	ABR On (ABR_On)	Automatic backfeed restoration is switched On	Automatic backfeed restoration f is switched Off	1	Digital
Malfunctions						
38	Indication	Malfunction	Any malfunction signal activated IIN1-6 Device Trouble Indicator set	No malfunction signal activated	1	Digital
Disabled	Indication	Ext load SC (ExtLoad_SC)	External load short circuit detected IIN1-6 Device Trouble Indicator set	External load short circuit not detected	0	Digital
Disabled	Indication	Driver SC (Driver_SC)	Driver short circuit detected IIN1-6 Device Trouble Indicator set	Driver short circuit not detected	0	Digital
Disabled	Indication	T_{Bt} sensor fault (T_{Bt}Sensor_Fault)	Battery Temperature sensor fault detected IIN1-6 Device Trouble Indicator set	Battery Temperature sensor fault not detected	0	Digital
Disabled	Indication	OSM coil SC (OSMCoil_SC)	OSM coil short circuit detected IIN1-6 Device Trouble Indicator set	OSM coil short circuit not detected	0	Digital
Disabled	Indication	Excessive T_o (Excessive_T_o)	Opening time (including driver registration time) exceeds 60ms: within 60ms after activation of T(E) control signal PS has been deactivated. IIN1-6 Device Trouble Indicator set	Excessive To signal is deactivated when PS is deactivated or when C(E) control signal is activated.	0	Digital
Disabled	Indication	Excessive T_c (Excessive_T_c)	Closing time (including driver recognition time) exceeds 100ms: within 100ms after activation of C(E) control signal PS has not been activated. IIN1-6 Device Trouble Indicator set	Excessive Tc signal is deactivated when PS is activated or when T(E) control signal is activated.	0	Digital

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
Disabled	Indication	MPM fault (MPM_Fault)	Internal fault of main processing module detected IIN1-6 Device Trouble Indicator set	No Internal fault of main processing module detected	0	Digital
Disabled	Indication	Bus Comms Error (BusComms_Err)	Internal Bus fault found IIN1-6 Device Trouble Indicator set	No internal Bus fault found	0	Digital
Disabled	Indication	Driver comms error (DriverComms_Err)	No response from driver IIN1-6 Device Trouble Indicator set	Driver OK	0	Digital
Disabled	Indication	PSM comms error (PSMComms_Err)	No response from PSM IIN1-6 Device Trouble Indicator set	PSM OK	0	Digital
Disabled	Indication	RTC comms error (RTCComms_Err)	No response from real time clock IIN1-6 Device Trouble Indicator set	Real time clock OK	0	Digital
Disabled	Indication	T_{mpm} comms error (T_{mpm}Comms_Err)	No response from MPM temperature sensor IIN1-6 Device Trouble Indicator set	MPM temperature sensor OK	0	Digital
Disabled	Indication	I/O1 comms error (I/O1Comms_Err)	No response from I/O1 IIN1-6 Device Trouble Indicator set	I/O1 OK	0	Digital
Disabled	Indication	I/O2 comms error (I/O2Comms_Err)	No response from I/O2 IIN1-6 Device Trouble Indicator set	I/O2 OK	0	Digital
Disabled	Indication	I/O1 fault (I/O1_Fault)	I/O1 internal fault detected IIN1-6 Device Trouble Indicator set	no I/O1 internal fault detected	0	Digital
Disabled	Indication	I/O2 fault (I/O2_Fault)	I/O2 internal fault detected IIN1-6 Device Trouble Indicator set	no I/O2 internal fault detected	0	Digital
Warnings						
39	Indication	Warning	Any warning signal activated	No warning signal activated	1	Digital
40	Indication	OSM coil Isolated (OSMCoil_Isolated)	OSM coil open circuit detected Setting the mechanical trip ring to the locked position causes an OSM Operating Coil (OC) warning event.	OSM coil open circuit not detected	2	Digital
Disabled	Indication	Standby	UPS controller set into Standby state	UPS controller not in Standby state	0	Digital
Disabled	Indication	Shutdown	UPS controller in Shutdown state	UPS controller not in Shutdown state	0	Digital
Disabled	Indication	Battery supply (Battery_Supply)	UPS is set into Battery supply mode due to loss of AC supply	UPS AC supply is OK	0	Digital
Disabled	Indication	AC supply (AC_Supply)	UPS is set into AC supply mode due to low battery volts	UPS battery is OK	0	Digital
Disabled	Indication	Driver not ready (Driver_NotReady)	Driver is not ready to execute next control signal	Driver is ready to execute next control signal	0	Digital
Disabled	Indication	Memory error (Memory_Err)	Corrupted memory cell found	No corrupted memory cell found	0	Digital
IO Modules						
Disabled	Indication	IO1 Input 1	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO1 Input 2	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO1 Input 3	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO1 Input 4	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO1 Input 5	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO1 Input 6	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 1	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 2	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 3	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 4	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 5	Input asserted	Input not asserted	0	Digital
Disabled	Indication	IO2 Input 6	Input asserted	Input not asserted	0	Digital

11 BINARY OUTPUT POINTS

Object Number: **10**

Request Function Codes supported: **1 (read)**

Default Variation reported when variation 0 requested: **2 (Binary Output Status)**

Status bits supported: **on-line, communications lost, local forced data, state**

Notes: The count, on-time, off-time, queue, and clear parameters are ignored for all points.

Condition(s) for Obj 10 var 2 status for each point is indicated below where applicable, also refer notes at the end of the table.

Control Relay Output Blocks

Object Number: **12**

Request Function Codes supported: **3 (select), 4 (operate), 5 (direct operate), 6 (direct operate, noack)**

Accepted control types are:

Control Type	Control Code	Accepted by
Pulse ON	0x01	All Points
Pulse OFF	0x02	All Points
Latch ON	0x03	All Points
Latch OFF	0x04	All Points
Close	0x41	On(DC)/Off(DC), Trip/Close
Trip	0x81	On(DC)/Off(DC), Trip/Close

The recommended control type is shown in the table below.

Set (1) Close, Pulse ON, Latch ON
Cleared (0) Trip, Pulse OFF, Latch OFF

The value in the Default DNP ID column represents the default setting. This parameter is user configurable between 0 and 255, individual points can be selected for mapping or disabled using TELUS software.

Table 11.1

Default DNP ID	Data group	Database ID	Set = 1	Clear = 0	Recommended control type	Data type
0	Control	On(DC)Off(DC) (On(DC), Off(DC))	Dummy Control ON	Dummy Control OFF	Can be used to test all control types	Digital
1	Control	Trip/Close (On(OSM), Off(OSM))	Close OSM	Trip OSM	CLOSE / TRIP	Digital
2	Control	On(Grp1)	Group 1 Active	No Action	Pulse ON	Digital
3	Control	On(Grp2)	Group 2 Active	No Action	Pulse ON	Digital
4	Control	On(Grp3)	Group 3 Active	No Action	Pulse ON	Digital
5	Control	On(Grp4)	Group 4 Active	No Action	Pulse ON	Digital
6	Control	On(Prot)/Off(Prot) (On(Prot), Off(Prot))	Protection ON	Protection OFF	Latch ON / OFF	Digital
7	Control	On(EF)Off(EF) (On(EF), Off(EF))	Earth Fault ON	Earth Fault OFF	Latch ON / OFF	Digital
8	Control	On(SEF)Off(SEF) (On(SEF), Off(SEF))	Sensitive Earth Fault ON	Sensitive Earth Fault OFF	Latch ON / OFF	Digital
9	Control	On(UV)Off(UV) (On(UV), Off(UV))	Under Voltage ON	Under Voltage OFF	Latch ON / OFF	Digital
Disabled	Control	On(UF)Off(UF) (On(UF), Off(UF))	Under Frequency ON	Under Frequency OFF	Latch ON / OFF	Digital
10	Control	On(CLP)Off(CLP) (On(CLP), Off(CLP))	Cold Load Pickup ON	Cold Load Pickup OFF	Latch ON / OFF	Digital
11	Control	On(LL)Off(LL) (On(LL), Off(LL))	Live Line ON	Live Line OFF	Latch ON / OFF	Digital
12	Control	On(AR)Off(AR) (On(AR), Off(AR))	Auto Reclose ON	Auto Reclose OFF	Latch ON / OFF	Digital
13	Control	On(ABR)Off(ABR) (On(ABR), Off(ABR))	Auto Backfeed Restoration ON	Auto Backfeed Restoration OFF	Latch ON / OFF	Digital
14	Control	Erase Fault Counters (Erase_FaultCtnrs)	Erase Fault Counters	No Action	Pulse ON	Digital

Default DNP ID	Data group	Database ID	Set = 1	Clear = 0	Recommended control type	Data type
15	Control	Erase Energy Meters (Erase_EnergyMeters)	Erase Energy Meters	No Action	Pulse ON	Digital
16	Control	Erase SCADA Counters (Erase_SCADACtnrs)	Erase SCADA comms counters*)	No Action	Pulse ON	Digital
Disabled	Control	Erase CO Operations (Erase_COOperations)	Erase CO Operations log from MPM	No Action	Pulse ON	Digital
Disabled	Control	Erase Event Log (Erase_EventLog)	Erase Event Log from MPM	No Action	Pulse ON	Digital
Disabled	Control	Erase Change Messages (Erase_ChMsgs)	Erase Change Messages log from MPM	No Action	Pulse ON	Digital
Disabled	Control	Erase Load Profile (Erase_LdProf)	Erase Load Profile from MPM	No Action	Pulse ON	Digital
IO Modules						
Disabled	Control	IO1 Output 1	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO1 Output 2	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO1 Output 3	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO1 Output 4	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO1 Output 5	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO1 Output 6	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 1	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 2	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 3	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 4	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 5	Output ON	Output OFF	Latch ON / OFF	Digital
Disabled	Control	IO2 Output 6	Output ON	Output OFF	Latch ON / OFF	Digital

Notes:

1. All controls except for On(DC)/Off(DC) and Trip OSM are rejected if RC is in Local Control mode.
2. When in Local Control mode, the status bits of all other CROB points are shown as offline.
3. The following conditions are necessary to control IO Modules from SCADA:
   - IO mode is enabled in I/O settings;
   - IO Output# has Type equal to Disable in I/O settings;
   - IO faults are absent;

   If I/O settings or system state does not match these conditions, RC sets IIN2-2 (Parameter Error).

*) This command does not clear C1-C3 Buffers.

12 BINARY COUNTERS

Static (Steady-State) Object Number: **20**
Change Event Object Number: **22**
Request Function Codes supported[*)]: **1 (read), 7 (freeze), 8 (freeze noack) 9 (freeze and clear), 10 (freeze and clear, noack), 22 (assign class)**

Static Variation reported when variation 0 requested: **6 (16-Bit Binary Counter without Flag)**
Change Event Variation reported when variation 0 requested: **1 (16-Bit Counter Change Event with Time)**

Frozen Counters
Static (Steady-State) Object Number: **21**
Change Event Object Number: **23**
Request Function Codes supported: **1 (read), 22 (assign class)**
Static Variation reported when variation 0 requested: **10 (16-Bit Frozen Binary without Flag)**
Change Event Variation reported when variation 0 requested: **6 (16-Bit Frozen Counter Event with Time)**

Note: Counter points are always considered online and the on-line status bit is always set. No other status bits are supported for counter objects.

The value in the Default DNP ID column represents the default setting. This parameter is user configurable between 0 and 255, individual points can be selected for mapping or disabled using TELUS software

Changes to class allocation arising from use of DNP3 function 22 are saved to non-volatile memory.

Time stamps associated with Fault counter change events correspond to the time stamps appearing in the MMI or TELUS CO Operations log.

Table 12.1

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Fault Counters								
0	Indication	OC A Trips (OC_A_Trips)	Overcurrent protection trips on A phase	0 to 65535	1	4	1	Analog
1	Indication	OC B Trips (OC_B_Trips)	Overcurrent protection trips on B phase	0 to 65535	1	4	1	Analog
2	Indication	OC C Trips (OC_C_Trips)	Overcurrent protection trips on C phase	0 to 65535	1	4	1	Analog
3	Indication	EF Trips (EF_Trips)	Earth Fault protection trips	0 to 65535	1	4	1	Analog
4	Indication	SEF Trips (SEF_Trips)	Sensitive Earth Fault Protection Trips	0 to 65535	1	4	1	Analog
5	Indication	UV Trips (UV_Trips)	Under Voltage protection Trips	0 to 65535	1	2	1	Analog
Disabled	Indication	UF Trips (UF_Trips)	Under Frequency protection trips	0 to 65535	1	0	0	Analog
Lifetime Counters								
6	Indication	CO Total (CO_Total)	Number of Close – Open operations	0 to 65535	1	20	1	Analog
7	Indication	Mechanical Wear (Mech_Wear)	Mechanical wear consumed; expressed as a percentage	0 to 100%	1	10 %	1	Analog
8	Indication	Max phase Contact Wear (MaxPhContact_ Wear)	Maximum vacuum Interrupter contact wear consumed on any one phase; expressed as a percentage	0 to 100%	1	10 %	1	Analog

[*)] Request Functions Code 9 (freeze and clear) and 10 (freeze and clear, noack) are supported for SCADA Counters only.

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Energy Meters								
Disabled	Indication	A +kVAh (A_+kVAh)	A phase total forward energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	B +kVAh (B_+kVAh)	B phase total forward energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	C +kVAh (C_+kVAh)	C phase total forward energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	A +kVArh (A_+kVArh)	A phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Analog
Disabled	Indication	B +kVArh (B_+kVArh)	B phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Analog
Disabled	Indication	C +kVArh (C_+kVArh)	C phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Analog
Disabled	Indication	A -kVAh (A_-kVAh)	A phase total reverse energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	B -kVAh (B_-kVAh)	B phase total reverse energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	C -kVAh (C_-kVAh)	C phase total reverse energy	0 to 999999999 kVAh	1	0	0	Analog
Disabled	Indication	A -kVArh (A_-kVArh)	A phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Analog
Disabled	Indication	B -kVArh (B_-kVArh)	B phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Analog
Disabled	Indication	C -kVArh (C_-kVArh)	C phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Analog
9	Indication	+kVAh	Three phase total forward energy	0 to 999999999 kVAh	1	100000 kVAh	3	Analog
Disabled	Indication	+kVArh	Three phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Analog
10	Indication	-kVAh	Three phase total reverse energy	0 to 999999999 kVAh	1	100000 kVAh	3	Analog
Disabled	Indication	-kVArh	Three phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Analog
Maximum Demand Indicators								
Disabled	Indication	MDI_(A)_Today	Maximum Demand recorded on A Phase between midnight and current time.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(B)_Today	Maximum Demand recorded on B Phase between midnight and current time.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(C)_Today	Maximum Demand recorded on C Phase between midnight and current time.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(A)_Yesterday	Maximum Demand recorded on A Phase for Yesterday.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(B)_Yesterday	Maximum Demand recorded on B Phase for Yesterday.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(C)_Yesterday	Maximum Demand recorded on C Phase for Yesterday.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(A)_Last_Week	Maximum Demand recorded on A Phase for Last Week.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(B)_Last_Week	Maximum Demand recorded on B Phase for Last Week.	0 to 7000A	1	0	0	Analog
Disabled	Indication	MDI_(C)_Last_Week	Maximum Demand recorded on C Phase for Last Week.	0 to 7000A	1	0	0	Analog

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
SCADA Counters								
Disabled	Indication	Call Drop outs (CallDrop Outs)	The number of modem calls where MPM did not initiate hanging up.	0 to 65535	1	0	0	Analog
Disabled	Indication	Calls Failed (Calls Failed)	Increments when Slave does not connect to the base station modem.	0 to 65535	1	0	0	Analog
11	Indication	Tx Frames (Tx_Frames)	Transmitted frame count	0 to 65535	1	1	0	Analog
12	Indication	Rx Frames (Rx_Frames)	Received frame count	0 to 65535	1	1	0	Analog
13	Indication	Length errors (Length_Errs)	Frame length error count	0 to 65535	1	1	0	Analog
14	Indication	CRC errors (CRC_Errs)	Frame CRC error count	0 to 65535	1	1	0	Analog

Note: Change event generation:
Change event is generated under conditions:
X = Last Reported Value;
Y = New Value;
D = Deadband Value;
Y > (X + D) or Y < (X - D)

13 ANALOG INPUT POINTS

The following table lists Analog Inputs (Object 30).

This implementation uses fixed deadband reporting, the value in the “Default Deadband” column represents the absolute amount by which the point must change before an analog change event will be generated. The value in the “Default Class” column represents the class (1, 2, 3, or none) in which detected change events will be reported. Only the default values for these items are documented here because the values may change in operation due to either local (user-interface) or remote (through DNP) configuration control.

Changes to class allocation arising from use of DNP3 function 22 are saved to non-volatile memory.

Changes to reporting deadband arising from use of DNP3 function 2 are saved to non-volatile memory.

Static (Steady-State) Object Number: **30**
Change Event Object Number: **32**
Reporting Deadband Object Number: **34**
Request Function Codes supported: **1 (read), 2 (write, deadbands only), 22 (assign class)**
Static Variation reported when variation 0 requested: **2 (16-Bit Analog Input).**
Change Event Variation reported when variation 0 requested: **3 (Analog Change Event with Time)**
Reporting Deadband Variation reported when variation 0 requested: **1 (16-Bit Reporting Deadband)**
Status bits supported: **over range, local forced data**

Note: Analog inputs are always considered online and the on-line status bit is always set.

Analog input change events are detected by the IED at the time they occur and are not subject to a scan rate. Time stamps associated with Analog change events depend on the analog in question. Measurement values are updated every 16 cycles of power frequency; a change event is generated if deadband is exceeded for any point. Protection related analog change events have time stamps that correspond to the related CO Operations event.

Object 32, Variations 1 and 2 can be configured to Report All Events, or Report Last Event.

The value in the Default DNP ID column represents the default setting. This parameter is user configurable between 0 and 255, individual points can be selected for mapping or disabled using TELUS software.

The values in the Range column represent analog values that may be transmitted depending on the ratings of the OSM connected to the RC cubicle. RC measurement accuracy is defined in the Specifications section of the OSM Automatic Circuit Recloser User Manual.

Multiplication scale factor shows on what coefficient it is necessary to multiply the obtained value to receive true.

Table 13.1

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Measured Data								
0	Indication	Ia	A phase current	0 to 7000 A	1	10 A	1	Analog
1	Indication	Ib	B phase current	0 to 7000 A	1	10 A	1	Analog
2	Indication	Ic	C phase current	0 to 7000 A	1	10 A	1	Analog
Disabled	Indication	Ua	Phase to earth voltage Ua	0 to 18.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Ub	Phase to earth voltage Ub	0 to 18.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Uc	Phase to earth voltage Uc	0 to 18.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Ur	Phase to earth voltage Ur	0 to 18.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Us	Phase to earth voltage Us	0 to 18.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Ut	Phase to earth voltage Ut	0 to 18.0 kV	0.001	0 kV	0	Analog
3	Indication	Uab	Line to Line voltage Uab	0 to 30.0 kV	0.001	0.5 kV	1	Analog
4	Indication	Ubc	Line to Line voltage Ubc	0 to 30.0 kV	0.001	0.5 kV	1	Analog
5	Indication	Uca	Line to Line voltage Uca	0 to 30.0 kV	0.001	0.5 kV	1	Analog
Disabled	Indication	Urs	Line to Line voltage Urs	0 to 30.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Ust	Line to Line voltage Ust	0 to 30.0 kV	0.001	0 kV	0	Analog
Disabled	Indication	Utr	Line to Line voltage Utr	0 to 30.0 kV	0.001	0 kV	0	Analog
6	Indication	In	Zero sequence current	0 to 7000 A	1	1A	1	Analog
Disabled	Indication	A kVA (A_kVA)	A phase kVA	0 to 65535 kVA	1	0 kVA	0	Analog
Disabled	Indication	B kVA (B_kVA)	B phase kVA	0 to 65535 kVA	1	0 kVA	0	Analog
Disabled	Indication	C kVA (C_kVA)	C phase kVA	0 to 65535 kVA	1	0 kVA	0	Analog
Disabled	Indication	A kW (A_kW)	A phase kW	0 to 65535 kW	1	0 kW	0	Analog
Disabled	Indication	B kW (B_kW)	B phase kW	0 to 65535 kW	1	0 kW	0	Analog
Disabled	Indication	C kW (C_kW)	C phase kW	0 to 65535 kW	1	0 kW	0	Analog
Disabled	Indication	A kVAr (A_kVAr)	A phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Analog
Disabled	Indication	B kVAr (B_kVAr)	B phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Analog
Disabled	Indication	C kVAr (C_kVAr)	C phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Analog
7	Indication	KVA	Three phase kVA	0 to 65535 kVA	1	500 kVA	2	Analog
8	Indication	KW	Three phase kW	0 to 65535 kW	1	500 kW	2	Analog
9	Indication	KVAr	Three phase kVAr	0 to 65535 kVAr	1	500 kVAr	2	Analog
10	Indication	F ABC (F_ABC)	ABC side frequency	45.00 to 65.00 Hz	0.001	0.1 Hz	1	Analog
Disabled	Indication	F RST (F_RST)	RST side frequency	45.00 to 65.00 Hz	0.001	0 Hz	0	Analog
11	Indication	PF	Three phase power factor	0.00 to 1.00	0.001	0.1	1	Analog
Disabled	Indication	A PF (A_PF)	A phase power factor	0.00 to 1.00	0.001	0	0	Analog
Disabled	Indication	B PF (B_PF)	B phase power factor	0.00 to 1.00	0.001	0	0	Analog
Disabled	Indication	C PF (C_PF)	C phase power factor	0.00 to 1.00	0.001	0	0	Analog
Disabled	Indication	ILGVT(A)	Last Good current Value Trapped on A Phase	0 to 7000A	1	0 A	0	Analog
Disabled	Indication	ILGVT(B)	Last Good current Value Trapped on B Phase	0 to 7000A	1	0 A	0	Analog

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Disabled	Indication	ILGVT(C)	Last Good current Value Trapped on C Phase	0 to 7000A	1	0 A	0	Analog
12	Indication	Phase seq. ABC (PhSeq_ABC)	Phase sequence from ABC side ABC = 1 ACB = 0 Unresolved = 2	0 to 2	1	1	1	Analog
Disabled	Indication	Phase seq. RST (PhSeq_RST)	Phase sequence from RST side RST = 1 RTS = 0 Unresolved = 2	0 to 2	1	0	0	Analog
Protection								
Disabled	Indication	DE OC (DE_OC)	OC power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Analog
Disabled	Indication	DE EF (DE_EF)	EF Power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Analog
Disabled	Indication	DE SEF (DE_SEF)	SEF Power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Analog
Disabled	Indication	Iamax Trip (Ia_max)	Maximum phase A current prior to any OCEF element trip	0 to 12000A	1	0	0	Analog
Disabled	Indication	Ibmax Trip (Ib_max)	Maximum phase B current prior to any OCEF element trip	0 to 12000A	1	0	0	Analog
Disabled	Indication	Iacax Trip (Ic_max)	Maximum phase C current prior to any OCEF element trip	0 to 12000A	1	0	0	Analog
Disabled	Indication	Inmax Trip (In_max)	Maximum In current prior to any OCEF element trip	0 to 12000A	1	0	0	Analog
Disabled	Indication	UVmin Trip	Minimum voltage prior to any UV elements trip	0 to 30.0kV	0.001	0kV	0	Analog
Disabled	Indication	UFmin Trip	Minimum frequency prior to UF element trip	45.00 to 65.00 Hz	0.001	0Hz	0	Analog
Lifetime Counters								
Disabled	Indication	CO Total (CO_Total)	Number of Close – Open Operations	0 to 65535	1	20	1	Analog
UPS Status								
13	Indication	Ubt	Battery voltage	10.0 to 16.0 V	0.001	1 V	1	Analog
14	Indication	Ibt	Battery charge current	-4.00 to +4.00 A	0.001	0.5 A	1	Analog
15	Indication	Cbt	Battery residual capacity	0 to 1.00	0.01	0.1	1	Analog
Identification								
16	Indication	OSM#	Recloser serial number	0 to 999999	1	1	1	Analog
Disabled	Indication	MPM#	Main processor Module serial number	0 to 99999	1	0	0	Analog

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Disabled	Indication	MPM software Build (MPM_SwBuild)	Main Processor Module software Build version	0 to 9999	1	0	0	Analog
Disabled	Indication	MPM software 1 (MPM_SwVer1)	Main Processor Module software for basic version[1)]	0 to 99	1	0	0	Analog
Disabled	Indication	MPM software 2 (MPM_SwVer2)	Main Processor Module software for modification version[1)]	0 to 99	1	0	0	Analog
Disabled	Indication	MPM software 3 (MPM_SwVer3)	Main Processor Module software for telecommunication version[1)]	0 to 99	1	0	0	Analog

Notes:

1. Data representation:

   (0 to 65535) – non-negative integer number occupies 2 bytes, except for Data base ID Ibt (–32768 to 32767)
   (0 to 4294967296) – non-negative integer number occupies 4 bytes.

2. Step value in Valid Range is equal 1*Multiplication scale factor.
3. Power values (single and three phase kVA, kVAr and kW) have a maximum range of 65535. Values higher than this are represented as 65535 and the 'Over-range' status bit is set to 1.
4. If there is a situation when it is not possible to calculate power factor or frequency, a value equal to 0xFFFF is transferred.
5. Valid Range is given as supplemental information.
6. Change event generation:
   Change event is generated under conditions:
   X = Last Reported Value;
   Y = New Value;
   D = Deadband Value;
   $Y > (X + D)$ or $Y < (X - D)$
7. Value of Iamax, Ibmax, Icmax or Inmax is updated when a new record is generated during a CO operation. These values are set to 0 whenever the recloser closes.
8. ILGVT points have a deadband range of -1 to 630A. When set to -1, the LGVT event is generated whenever the Pickup_LSD flag is set (supply is lost).

[1)] Refer to OSM Automatic Circuit User Manual for details.

14 OCTET STRING OBJECTS

The implementation supports DNP object 110 (octet strings). This object provides support for MMI password and the Main Processor Module software version.

Table 14.1

Default DNP ID	Database ID	Max string length	Permitted characters
0	MMI Password (MMI_Password)	4	A – Z; 1 – 9; space
1	Main Processor Module software version [1)] (MPM_SwVer)	40	A – Z; a – z; 1 – 9; space

[1)] Refer to OSM Automatic Circuit Recloser User Manual for details.