TAVRIDA ELECTRIC

DNP3 Protocol
Basic Version

USER GUIDE

Revision History			
Rev	**Author**	**Date**	**Comment**
01	TEL	12.06.2003	Creating of “DNP3 Protocol. Basic version. User Guide”
02	TEL	27.06.2003	Numerous changes were made
03	TEL	12.12.2003	The row with Object 60 Variation 0 is removed (page 15)
04	TEL	05.02.04	DNP3 Analog points and Note 7 are added (pages 35, 36)
05	TEL	31.08.04	Section 15 (File Object) is added. Binary Input and Output points (IO Modules) are added. Analog points (UVmin, UFmin) are added.

Approvals

Alexey Chaly	Technical Director
Neil O’Sullivan	Product Manager – Outdoor Products

Contents

ABBREVIATIONS

IED - Intelligent Electronic Device

RTS - Request To Send modem line

SBO - Select Before Operate

1 INTRODUCTION

This document is based on TEL document “DNP3 Protocol. Basic Version. Sales Specification”.

Functionality should be based on Triangle MicroWorks, Inc. Slave Source Code Library, but not proposed for this implementation of DNP3, is as follows:

- 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

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

2 CERTIFICATION

The DNP3 implementation as defined in this document must be tested by an accredited third party to comply with DNP3 Users Group document “DNP3-2001, Intelligent Electronic Device (IED) Certification Procedure, *Subset Level 2”.*

Prior to release, the requirements of the above reference document must be confirmed through TEL verification testing.

3 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 "Implementation table"
- Description of configuration methods and user-interface, section "DNP3 settings"
- Point List Tables, sections Binary input points, Binary output points, Binary counters, Analog input points and Octet string objects.

Table 3.1

<table>
<tr><td colspan="2">DNP V3.00
DEVICE PROFILE DOCUMENT
(Also see the Implementation Table)</td></tr>
<tr><td colspan="2">Vendor Name: Tavrida Electric</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 8</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 Cf Mode, section 8</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 8**

Timeouts while waiting for:

Data Link Confirm:	☐	None	☐	Fixed at ____	☐	Variable	☒	**Configurable, see Link Cf Timeout, section 8.**
Complete Appl. Fragment:	☒	**None**	☐	Fixed at ____	☐	Variable	☐	Configurable
Application Confirm:	☐	None	☐	Fixed at ____	☐	Variable	☒	**Configurable, see Appl Cf Timeout, section 8.**
Complete Appl. Response:	☒	**None**	☐	Fixed at ____	☐	Variable	☐	Configurable

Others:

Configurable, refer section 10

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

Configurable, refer section **8**

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 7

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

Reports Binary Input Change Events when no specific variation requested:

- Never
- Only time-tagged
- Only non-time-tagged
- ☒ **Configurable, see Binary Change Type, section 8.**

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

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DEVICE PROFILE DOCUMENT

(Also see the Implementation Table)

Sends Unsolicited Responses: Never ☒ **Configurable, see Unsolicited, section 8.** 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	

4 DNP3 ELEMENTS STRUCTURE

4.1 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
Internal Indications	80
Octet String	110, 111

4.2 SCADA Settings

Refer to "Recloser Control Cubicle RC/TEL-01E(S). Technical Manual - *Operation* (section 4.9.3)"

5 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 5.1

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)
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)

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	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)		
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		

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)**
			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) 27 (delete)	5b (free-format)		
70	4	File Command Status	1 (read) 22 (assign class) 26 (close) 30 (abort)	06 (no range, or all) 07, 08 (limited qty) 5b (free-format)	129 (response) 130 (unsol. resp)	5B (free-format)
70	5	File Transfer	1 (read) 2 (write) 22 (assign class)	06 (no range, or all) 07, 08 (limited qty) 5b (free-format)	129 (response) 130 (unsol. resp)	5B (free-format)
70	6	File Transfer Status	1 (read) 22 (assign class)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	5B (free-format)
70	7	File Descriptor	1 (read) 22 (assign class) 28 (get file info)	06 (no range, or all) 07, 08 (limited qty) 5b (free-format)	129 (response) 130 (unsol. resp)	5B (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 is implemented as a warm restart – the MPM is not restarted, but the DNP process is restarted.

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

Note 5: Object 70 is supported by the MPM software version S02.03.04.

6 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 6.1

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

7 BUFFER SIZE

Maximum number of events holding in volatile RAM buffers:

- object 2 - 500;
- object 22 - 400;
- object 23 - 350;
- object 32 - 350.

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

8 DNP3 SETTINGS

Table 8.1

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
Transmit Fragment Size	Maximum transmitted frame size	64 to 292 octets Step size 1	292	Yes	No
Validate Master Address	Specify whether or not to validate source address in received frames. DNP3 frames contain both a source address field and a destination address field. If Off the TMW DNP3 SCL does not validate the source address and frames whose destination address matches a configured slave session will be accepted. Setting this to On requires both source and destination 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

Name	Explanation	Range	Default value	TELUS	MMI (Control)
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 must check 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 should overwrite it with the above value.	0 to 3600s Step Size 1s	15s	Yes	No
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	This parameter specifies the DNP link address of the 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, will be transmitted to this address at startup.	0 to 65534 Step Size 1	3	Yes	Yes

Name	Explanation	Range	Default value	TELUS	MMI (Control)
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	This parameter is used to specify conditions under which an unsolicited response is generated. For each class, if the number of events that have 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***). 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	This parameter is 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
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

Name	Explanation	Range	Default value	TELUS	MMI (Control)
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	This value 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
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

Name	Explanation	Range	Default value	TELUS	MMI (Control)
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

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

9 DNP3 COUNTER DISPLAY

9.1 DNP3 counter list

Table 9.1

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
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 message 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.

10 SCADA SETTINGS

Refer to "Recloser Control Cubicle RC/TEL-01E(S). Technical Manual - *Operation* (section 4.9.3)"

11 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 11.1

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	Signal
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	Signal
2	Indication	Remote On (Remote_On)	Control mode is set Remote	Control mode is set Local. IIN1-5 Local mode indicator is set	1	Signal
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	Signal
4	Indication	Prot initiated (Prot(Any))	Logical OR of AR initiated and Pickup signals	No AR initiated or Pickup signals detected	2	Signal
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	Signal
Disabled	Indication	P(OC1+)	Pickup output of OC1+ activated	Pickup output of OC1+ not activated	0	Signal
Disabled	Indication	P(OC2+)	Pickup output of OC2+ activated	Pickup output of OC2+ not activated	0	Signal
Disabled	Indication	P(OC3+)	Pickup output of OC3+ activated	Pickup output of OC3+ not activated	0	Signal
Disabled	Indication	P(OC1-)	Pickup output of OC1- activated	Pickup output of OC1- not activated	0	Signal
Disabled	Indication	P(OC2-)	Pickup output of OC2- activated	Pickup output of OC2- not activated	0	Signal
Disabled	Indication	P(OC3-)	Pickup output of OC3- activated	Pickup output of OC3- not activated	0	Signal
Disabled	Indication	P(EF1+)	Pickup output of EF1+ activated	Pickup output of EF1+ not activated	0	Signal
Disabled	Indication	P(EF2+)	Pickup output of EF2+ activated	Pickup output of EF2+ not activated	0	Signal
Disabled	Indication	P(EF3+)	Pickup output of EF3+ activated	Pickup output of EF3+ not activated	0	Signal
Disabled	Indication	P(EF1-)	Pickup output of EF1- activated	Pickup output of EF1- not activated	0	Signal
Disabled	Indication	P(EF2-)	Pickup output of EF2- activated	Pickup output of EF2- not activated	0	Signal
Disabled	Indication	P(EF3-)	Pickup output of EF3- activated	Pickup output of EF3- not activated	0	Signal
Disabled	Indication	P(SEF+)	Pickup output of SEF+ activated	Pickup output of SEF+ not activated	0	Signal

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
Disabled	Indication	P(SEF-)	Pickup output of SEF- activated	Pickup output of SEF- not activated	0	Signal
Disabled	Indication	P(OCLL)	Pickup output of OCLL activated	Pickup output of OCLL not activated	0	Signal
Disabled	Indication	P(EFLL)	Pickup output of EFLL activated	Pickup output of EFLL not activated	0	Signal
Disabled	Indication	P(UV1)	Pickup output of UV1 activated	Pickup output of UV1 not activated	0	Signal
Disabled	Indication	P(UV2)	Pickup output of UV2 activated	Pickup output of UV2 not activated	0	Signal
Disabled	Indication	P(UV3)	Pickup output of UV3 activated	Pickup output of UV3 not activated	0	Signal
Disabled	Indication	P(UF)	Pickup output of UF activated	Pickup output of UF not activated	0	Signal
Disabled	Indication	P(Uabc>)	Pickup output of Uabc> activated	Pickup output of Uabc> not activated	0	Signal
Disabled	Indication	P(Urst>)	Pickup output of Urst> activated	Pickup output of Urst> not activated	0	Signal
Disabled	Indication	P(Uabc<)	Pickup output of Uabc< activated	Pickup output of Uabc< not activated	0	Signal
Disabled	Indication	P(Urst<)	Pickup output of Urst< activated	Pickup output of Urst< not activated	0	Signal
Open						
5	Indication	Open (Open(Any))	PS=0 irrespective of source	PS=1 irrespective of source	1	Signal
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	Signal
7	Indication	Open(OC1+)	Open due to OC1+ tripping	Not open due to OC1+ tripping	2	Signal
8	Indication	Open(OC2+)	Open due to OC2+ tripping	Not open due to OC2+ tripping	2	Signal
9	Indication	Open(OC3+)	Open due to OC3+ tripping	Not open due to OC3+ tripping	2	Signal
Disabled	Indication	Open(OC1-)	Open due to OC1- tripping	Not open due to OC1- tripping	0	Signal
Disabled	Indication	Open(OC2-)	Open due to OC2- tripping	Not open due to OC2- tripping	0	Signal
Disabled	Indication	Open(OC3-)	Open due to OC3- tripping	Not open due to OC3- tripping	0	Signal
10	Indication	Open(EF1+)	Open due to EF1+ tripping	Not open due to EF1+ tripping	2	Signal
11	Indication	Open(EF2+)	Open due to EF2+ tripping	Not open due to EF2+ tripping	2	Signal
12	Indication	Open(EF3+)	Open due to EF3+ tripping	Not open due to EF3+ tripping	2	Signal
Disabled	Indication	Open(EF1-)	Open due to EF1- tripping	Not open due to EF1- tripping	0	Signal
Disabled	Indication	Open(EF2-)	Open due to EF2- tripping	Not open due to EF2- tripping	0	Signal
Disabled	Indication	Open(EF3-)	Open due to EF3- tripping	Not open due to EF3- tripping	0	Signal
13	Indication	Open(SEF+)	Open due to SEF+ tripping	Not open due to SEF+ tripping	2	Signal
Disabled	Indication	Open(SEF-)	Open due to SEF- tripping	Not open due to SEF- tripping	0	Signal
14	Indication	Open(OCLL)	Open due to OCLL tripping	Not open due to OCLL tripping	2	Signal
15	Indication	Open(EFLL)	Open due to EFLL tripping	Not open due to EFLL tripping	2	Signal
16	Indication	Open(UV1)	Open due to UV1 tripping	Not open due to UV1 tripping	2	Signal
17	Indication	Open(UV2)	Open due to UV2 tripping	Not open due to UV2 tripping	2	Signal
18	Indication	Open(UV3)	Open due to UV3 tripping	Not open due to UV3 tripping	2	Signal
Disabled	Indication	Open(UF)	Open due to UF tripping	Not open due to UF tripping	0	Signal
19	Indication	Open (Remote)	Open due to SCADA or I/O control signal	Not open due to SCADA or I/O control signal	2	Signal
Disabled	Indication	Open(SCADA)	Open due to SCADA control signal	Not open due to SCADA control signal	0	Signal
Disabled	Indication	Open(I/O)	Open due to I/O control signal	Not open due to I/O control signal	0	Signal
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	Signal
Disabled	Indication	Open(MMI)	Open due to MMI control signal	Not open due to MMI control signal	0	Signal
Disabled	Indication	Open(PC)	Open due to PC control signal	Not open due to PC control signal	0	Signal
Disabled	Indication	Open(Manual)	Open due to manual tripping (no origin detected)	Not open due to manual tripping	0	Signal
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	Signal
Disabled	Indication	A(OC1+)	Alarm output of OC1+ activated	Alarm output of OC1+ not activated	0	Signal
Disabled	Indication	A(OC1-)	Alarm output of OC1- activated	Alarm output of OC1- not activated	0	Signal

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
Disabled	Indication	A(EF1+)	Alarm output of EF1+ activated	Alarm output of EF1+ not activated	0	Signal
Disabled	Indication	A(EF1-)	Alarm output of EF1- activated	Alarm output of EF1- not activated	0	Signal
Disabled	Indication	A(SEF+)	Alarm output of SEF+ activated	Alarm output of SEF+ not activated	0	Signal
Disabled	Indication	A(SEF-)	Alarm output of SEF- activated	Alarm output of SEF- not activated	0	Signal
Disabled	Indication	A(UV1)	Alarm output of UV1 activated	Alarm output of UV1 not activated	0	Signal
Disabled	Indication	A(UV2)	Alarm output of UV2 activated	Alarm output of UV2 not activated	0	Signal
Disabled	Indication	A(UV3)	Alarm output of UV3 activated	Alarm output of UV3 not activated	0	Signal
Disabled	Indication	A(UF)	Alarm output of UF activated	Alarm output of UF not activated	0	Signal
Closed						
22	Indication	Closed (Closed(Any))	PS=1 irrespective of origin	PS=0 irrespective of origin	1	Signal
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	Signal
Disabled	Indication	Closed(AR OCEF) (Closed(AR_OCEF))	Closed due to AR OCEF reclosing	Not closed due to AR OCEF reclosing	0	Signal
Disabled	Indication	Closed(AR SEF) (Closed(AR_SEF))	Closed due to AR SEF reclosing	Not closed due to AR SEF reclosing	0	Signal
Disabled	Indication	Closed(AR UV) (Closed(AR_ UV))	Closed due to AR UV reclosing	Not closed due to AR UV reclosing	0	Signal
Disabled	Indication	Closed(ABR)	Closed due to ABR closing	Not closed due to ABR closing	0	Signal
Disabled	Indication	Closed (Remote)	Closed due to SCADA or I/O control signal	Not closed due to SCADA or I/O control signal	0	Signal
Disabled	Indication	Closed (SCADA)	Closed due to SCADA control signal	Not closed due to SCADA control signal	0	Signal
24	Indication	Closed(I/O)	Closed due to I/O control signal	Not closed due to I/O control signal	2	Signal
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	Signal
Disabled	Indication	Closed(MMI)	Closed due to MMI control signal	Not closed due to MMI control signal	0	Signal
Disabled	Indication	Closed(PC)	Close due to PC control signal	Not closed due to PC control signal	0	Signal
Disabled	Indication	Closed(undefined)	Closed state recognized after On (Power) or servicing	Open state recognized after On (Power) or servicing	0	Signal
Status						
26	Indication	Group1 On (Grp1_On)	Active Group 1	Active Group 2, 3 or 4	1	Signal
27	Indication	Group2 On (Grp2_On)	Active Group 2	Active Group 1, 3 or 4	1	Signal
28	Indication	Group3 On (Grp3_On)	Active Group 3	Active Group 1,2 or 4	1	Signal
29	Indication	Group4 On (Grp4_On)	Active Group 4	Active Group 1, 2 or 3	1	Signal
30	Indication	Prot On (Prot_On)	Protection is switched On	Protection is switched Off	1	Signal
31	Indication	EF On (EF_On)	Earth overcurrent element is switched On	Earth overcurrent element is switched Off	1	Signal
32	Indication	SEF On (SEF_On)	Sensitive Earth fault element is switched On	Sensitive Earth fault element is switched Off	1	Signal
33	Indication	UV On (UV_On)	Undervoltage element is switched On	Undervoltage element is switched Off	1	Signal
Disabled	Indication	UF On (UF_On)	Underfrequency element is switched On	Underfrequency element is switched Off	0	Signal
34	Indication	CLP On (CLP_On)	Cold load pickup element is switched On	Cold load pickup element is switched Off	1	Signal
35	Indication	LL On (LL_On)	Live line element is switched on	Live line element is switched Off	1	Signal
36	Indication	AR On (AR_On)	OCEF, SEF and UV reclosing is switched On	OCEF, SEF and UV reclosing is switched Off	1	Signal
37	Indication	ABR On (ABR_On)	Automatic backfeed restoration is switched On	Automatic backfeed restoration f is switched Off	1	Signal
Malfunctions						
38	Indication	Malfunction	Any malfunction signal activated IIN1-6 Device Trouble Indicator set	No malfunction signal activated	1	Signal

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
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	Signal
Disabled	Indication	Driver SC (Driver_SC)	Driver short circuit detected IIN1-6 Device Trouble Indicator set	Driver short circuit not detected	0	Signal
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	Signal
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	Signal
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	Signal
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	Signal
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	Signal
Disabled	Indication	Bus Comms Error (BusComms_Err)	Internal Bus fault found IIN1-6 Device Trouble Indicator set	No internal Bus fault found	0	Signal
Disabled	Indication	Driver comms error (DriverComms_Err)	No response from driver IIN1-6 Device Trouble Indicator set	Driver OK	0	Signal
Disabled	Indication	PSM comms error (PSMComms_Err)	No response from PSM IIN1-6 Device Trouble Indicator set	PSM OK	0	Signal
Disabled	Indication	RTC comms error (RTCComms_Err)	No response from real time clock IIN1-6 Device Trouble Indicator set	Real time clock OK	0	Signal
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	Signal
Disabled	Indication	I/O1 comms error (I/O1Comms_Err)	No response from I/O1 IIN1-6 Device Trouble Indicator set	I/O1 OK	0	Signal
Disabled	Indication	I/O2 comms error (I/O2Comms_Err)	No response from I/O2 IIN1-6 Device Trouble Indicator set	I/O2 OK	0	Signal
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	Signal
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	Signal
Warnings						
39	Indication	Warning	Any warning signal activated	No warning signal activated	1	Signal
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	Signal
Disabled	Indication	Standby	UPS controller set into Standby state	UPS controller not in Standby state	0	Signal
Disabled	Indication	Shutdown	UPS controller in Shutdown state	UPS controller not in Shutdown state	0	Signal
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	Signal
Disabled	Indication	AC supply (AC_Supply)	UPS is set into AC supply mode due to low battery volts	UPS battery is OK	0	Signal

Default DNP ID	Data group	Database ID	Conditions when set (=1)	Conditions when clear (=0)	Default Class	Data type
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	Signal
Disabled	Indication	Memory error (Memory_Err)	Corrupted memory cell found	No corrupted memory cell found	0	Signal
IO Modules						
Disabled	Indication	IO1 input 1 (IO1I1)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO1 input 2 (IO1I2)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO1 input 3 (IO1I3)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO1 input 4 (IO1I4)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO1 input 5 (IO1I5)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO1 input 6 (IO1I6)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO2 input 1 (IO2I1)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO2 input 2 (IO2I2)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO3 input 3 (IO2I3)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO4 input 4 (IO2I4)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO5 input 5 (IO2I5)	Input asserted	Input not asserted	0	Signal
Disabled	Indication	IO6 input 6 (IO2I6)	Input asserted	Input not asserted	0	Signal

12 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 the TELUS software.

Table 12.1

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	Signal
1	Control	Trip/Close (On(OSM), Off(OSM))	Close OSM	Trip OSM	CLOSE / TRIP	Signal
2	Control	On(Grp1)	Group 1 Active	No Action	Pulse ON	Signal
3	Control	On(Grp2)	Group 2 Active	No Action	Pulse ON	Signal
4	Control	On(Grp3)	Group 3 Active	No Action	Pulse ON	Signal
5	Control	On(Grp4)	Group 4 Active	No Action	Pulse ON	Signal
6	Control	On(Prot)/Off(Prot) (On(Prot), Off(Prot))	Protection ON	Protection OFF	Latch ON / OFF	Signal
7	Control	On(EF)Off(EF) (On(EF), Off(EF))	Earth Fault ON	Earth Fault OFF	Latch ON / OFF	Signal
8	Control	On(SEF)Off(SEF) (On(SEF), Off(SEF))	Sensitive Earth Fault ON	Sensitive Earth Fault OFF	Latch ON / OFF	Signal
9	Control	On(UV)Off(UV) (On(UV), Off(UV))	Under Voltage ON	Under Voltage OFF	Latch ON / OFF	Signal
Disabled	Control	On(UF)Off(UF) (On(UF), Off(UF))	Under Frequency ON	Under Frequency OFF	Latch ON / OFF	Signal
10	Control	On(CLP)Off(CLP) (On(CLP), Off(CLP))	Cold Load Pickup ON	Cold Load Pickup OFF	Latch ON / OFF	Signal
11	Control	On(LL)Off(LL) (On(LL), Off(LL))	Live Line ON	Live Line OFF	Latch ON / OFF	Signal
12	Control	On(AR)Off(AR) (On(AR), Off(AR))	Auto Reclose ON	Auto Reclose OFF	Latch ON / OFF	Signal
13	Control	On(ABR)Off(ABR) (On(ABR), Off(ABR))	Auto Backfeed Restoration ON	Auto Backfeed Restoration OFF	Latch ON / OFF	Signal
14	Control	Erase Fault Counters (Erase_FaultCtnrs)	Erase Fault Counters	No Action	Pulse ON	Signal
15	Control	Erase Energy Meters (Erase_EnergyMeters)	Erase Energy Meters	No Action	Pulse ON	Signal
16	Control	Erase SCADA Counters (Erase_SCADACtnrs)	Erase SCADA comms counters*)	No Action	Pulse ON	Signal

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

Default DNP ID	Data group	Database ID	Set = 1	Clear = 0	Recommended control type	Data type
Disabled	Control	Erase CO Operations (Erase_COOperations)	Erase CO Operations log from MPM	No Action	Pulse ON	Signal
Disabled	Control	Erase Event Log (Erase_EventLog)	Erase Event Log from MPM	No Action	Pulse ON	Signal
Disabled	Control	Erase Change Messages (Erase_ChMsgs)	Erase Change Messages log from MPM	No Action	Pulse ON	Signal
Disabled	Control	Erase Load Profile (Erase_LdProf)	Erase Load Profile from MPM	No Action	Pulse ON	Signal
IO Modules						
Disabled	Control	IO1 Output 1 (IO1O1)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO1 Output 2 (IO1O2)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO1 Output 3 (IO1O3)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO1 Output 4 (IO1O4)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO1 Output 5 (IO1O5)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO1 Output 6 (IO1O6)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 1 (IO2O1)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 2 (IO2O2)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 3 (IO2O3)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 4 (IO2O4)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 5 (IO2O5)	Output ON	Output OFF	Latch ON / OFF	Signal
Disabled	Control	IO2 Output 6 (IO2O6)	Output ON	Output OFF	Latch ON / OFF	Signal

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 perform control of 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 doesn't match conditions written above, RC sets IIN2-2 (Parameter Error).

13 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 the 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 13.1

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	Numerical
1	Indication	OC B Trips (OC_B_Trips)	Overcurrent protection trips on B phase	0 to 65535	1	4	1	Numerical
2	Indication	OC C Trips (OC_C_Trips)	Overcurrent protection trips on C phase	0 to 65535	1	4	1	Numerical
3	Indication	EF Trips (EF_Trips)	Earth Fault protection trips	0 to 65535	1	4	1	Numerical
4	Indication	SEF Trips (SEF_Trips)	Sensitive Earth Fault Protection Trips	0 to 65535	1	4	1	Numerical
5	Indication	UV Trips (UV_Trips)	Under Voltage protection Trips	0 to 65535	1	2	1	Numerical
Disabled	Indication	UF Trips (UF_Trips)	Under Frequency protection trips	0 to 65535	1	0	0	Numerical
Lifetime Counters								
6	Indication	CO Total (CO_Total)	Number of Close – Open operations	0 to 65535	1	20	1	Numerical
7	Indication	Mechanical Wear (Mech_Wear)	Mechanical wear consumed; expressed as a percentage	0 to 100%	1	10 %	1	Numerical
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	Numerical
Energy Meters								
Disabled	Control	A +kVAh (A_+kVAh)	A phase total forward energy	0 to 999999999 kVAh	1	0	0	Numerical

*) 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
Disabled	Control	B +kVAh (B_+kVAh)	B phase total forward energy	0 to 999999999 kVAh	1	0	0	Numerical
Disabled	Control	C +kVAh (C_+kVAh)	C phase total forward energy	0 to 999999999 kVAh	1	0	0	Numerical
Disabled	Control	A +kVArh (A_+kVArh)	A phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Numerical
Disabled	Control	B +kVArh (B_+kVArh)	B phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Numerical
Disabled	Control	C +kVArh (C_+kVArh)	C phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Numerical
Disabled	Control	A -kVAh (A_-kVAh)	A phase total reverse energy	0 to 999999999 kVAh	1	0	0	Numerical
Disabled	Control	B -kVAh (B_-kVAh)	B phase total reverse energy	0 to 999999999 kVAh	1	0	0	Numerical
Disabled	Control	C -kVAh (C_-kVAh)	C phase total reverse energy	0 to 999999999 kVAh	1	0	0	Numerical
Disabled	Control	A -kVArh (A_-kVArh)	A phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Numerical
Disabled	Control	B -kVArh (B_-kVArh)	B phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Numerical
Disabled	Control	C -kVArh (C_-kVArh)	C phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Numerical
9	Control	+kVAh	Three phase total forward energy	0 to 999999999 kVAh	1	100000 kVAh	3	Numerical
Disabled	Control	+kVArh	Three phase reactive forward energy	0 to 999999999 kVArh	1	0	0	Numerical
10	Control	-kVAh	Three phase total reverse energy	0 to 999999999 kVAh	1	100000 kVAh	3	Numerical
Disabled	Control	-kVArh	Three phase reactive reverse energy	0 to 999999999 kVArh	1	0	0	Numerical
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	Numerical
11	Indication	Tx Frames (Tx_Frames)	Transmitted frame count	0 to 65535	1	1	0	Numerical
12	Indication	Rx Frames (Rx_Frames)	Received frame count	0 to 65535	1	1	0	Numerical
13	Indication	Length errors (Length_Errs)	Frame length error count	0 to 65535	1	1	0	Numerical
14	Indication	CRC errors (CRC_Errs)	Frame CRC error count	0 to 65535	1	1	0	Numerical

Note: Change event generation:

Change event is generated under conditions:

X = Last Reported Value;

Y = New Value;

D = Deadband Value;

$Y > (X + D)$ or $Y < (X - D)$

14 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.

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

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.

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.

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. Accuracy of RC measurement is defined in the Operation section of the Product Guide documentation.

Table 14.1

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	Numerical
1	Indication	Ib	B phase current	0 to 7000 A	1	10 A	1	Numerical
2	Indication	Ic	C phase current	0 to 7000 A	1	10 A	1	Numerical
Disabled	Indication	Ua	Phase to earth voltage Ua	0 to 18.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Ub	Phase to earth voltage Ub	0 to 18.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Uc	Phase to earth voltage Uc	0 to 18.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Ur	Phase to earth voltage Ur	0 to 18.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Us	Phase to earth voltage Us	0 to 18.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Ut	Phase to earth voltage Ut	0 to 18.0 kV	0.001	0 kV	0	Numerical
3	Indication	Uab	Line to Line voltage Uab	0 to 30.0 kV	0.001	0.5 kV	1	Numerical
4	Indication	Ubc	Line to Line voltage Ubc	0 to 30.0 kV	0.001	0.5 kV	1	Numerical
5	Indication	Uca	Line to Line voltage Uca	0 to 30.0 kV	0.001	0.5 kV	1	Numerical
Disabled	Indication	Urs	Line to Line voltage Urs	0 to 30.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Ust	Line to Line voltage Ust	0 to 30.0 kV	0.001	0 kV	0	Numerical
Disabled	Indication	Utr	Line to Line voltage Utr	0 to 30.0 kV	0.001	0 kV	0	Numerical

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
6	Indication	In	Zero sequence current	0 to 7000 A	1	1A	1	Numerical
Disabled	Indication	A kVA (A_kVA)	A phase kVA	0 to 65535 kVA	1	0 kVA	0	Numerical
Disabled	Indication	B kVA (B_kVA)	B phase kVA	0 to 65535 kVA	1	0 kVA	0	Numerical
Disabled	Indication	C kVA (C_kVA)	C phase kVA	0 to 65535 kVA	1	0 kVA	0	Numerical
Disabled	Indication	A kW (A_kW)	A phase kW	0 to 65535 kW	1	0 kW	0	Numerical
Disabled	Indication	B kW (B_kW)	B phase kW	0 to 65535 kW	1	0 kW	0	Numerical
Disabled	Indication	C kW (C_kW)	C phase kW	0 to 65535 kW	1	0 kW	0	Numerical
Disabled	Indication	A kVAr (A_kVAr)	A phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Numerical
Disabled	Indication	B kVAr (B_kVAr)	B phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Numerical
Disabled	Indication	C kVAr (C_kVAr)	C phase kVAr	0 to 65535 kVAr	1	0 kVAr	0	Numerical
7	Indication	KVA	Three phase kVA	0 to 65535 kVA	1	500 kVA	2	Numerical
8	Indication	KW	Three phase kW	0 to 65535 kW	1	500 kW	2	Numerical
9	Indication	KVAr	Three phase kVAr	0 to 65535 kVAr	1	500 kVAr	2	Numerical
10	Indication	F ABC (F_ABC)	ABC side frequency	45.00 to 65.00 Hz	0.001	0.1 Hz	1	Numerical
Disabled	Indication	F RST (F_RST)	RST side frequency	45.00 to 65.00 Hz	0.001	0 Hz	0	Numerical
11	Indication	PF	Three phase power factor	0.00 to 1.00	0.001	0.1	1	Numerical
Disabled	Indication	A PF (A_PF)	A phase power factor	0.00 to 1.00	0.001	0	0	Numerical
Disabled	Indication	B PF (B_PF)	B phase power factor	0.00 to 1.00	0.001	0	0	Numerical
Disabled	Indication	C PF (C_PF)	C phase power factor	0.00 to 1.00	0.001	0	0	Numerical
12	Indication	Phase seq. ABC (PhSeq_ABC)	Phase sequence from ABC side ABC = 1 ACB = 0 Unresolved = 2	0 to 2	1	1	1	Enumerable
Disabled	Indication	Phase seq. RST (PhSeq_RST)	Phase sequence from RST side RST = 1 RTS = 0 Unresolved = 2	0 to 2	1	0	0	Enumerable
Protection								
Disabled	Indication	DE OC (DE_OC)	OC power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Enumerable
Disabled	Indication	DE EF (DE_EF)	EF Power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Enumerable
Disabled	Indication	DE SEF (DE_SEF)	SEF Power flow direction Positive = 0 Negative = 1 Unresolved = 2	0 to 2	1	0	0	Enumerable
13	Indication	Iamax Trip (MaxIa)	Maximum phase A current prior to any OCEF element trip	0 to 12000 A	1	0	0	Numerical
14	Indication	Ibmax Trip (MaxIb)	Maximum phase B current prior to any OCEF element trip	0 to 12000 A	1	0	0	Numerical
15	Indication	Icmax Trip (MaxIc)	Maximum phase C current prior to any OCEF element trip	0 to 12000 A	1	0	0	Numerical
16	Indication	Inmax Trip (MaxIn)	Maximum In current prior to any OCEF elements trip	0 to 12000 A	1	0	0	Numerical
Disabled	Indication	UVmin Trip (MinUV)	Minimum voltage prior to any UV elements trip	0 to 30.0 kV	0.001	0 kV	0	Numerical

Default DNP ID	Data group	Database ID	Description	Valid Range	Multiplication scale factor	Default Reporting Deadband	Default Class	Data type
Disabled	Indication	UFmin Trip (MinUF)	Minimum frequency prior to UF element trip	45.00 to 65.00 Hz	0.001	0 Hz	0	Numerical
Lifetime Counters								
17	Indication	CO Total (CO_TotalA)	Number of Close – Open operations	0 to 65535	1	20	1	Numerical
UPS Status								
18	Indication	Ubt	Battery voltage	10.0 to 16.0 V	0.001	1 V	1	Numerical
19	Indication	Ibt	Battery charge current	-4.00 to +4.00 A	0.001	0.5 A	1	Numerical
20	Indication	Cbt	Battery residual capacity	0 to 1.00	0.01	0.1	1	Numerical
Identification								
21	Indication	OSM#	Recloser serial number	0 to 999999	1	1	1	Numerical
Disabled	Indication	MPM#	Main processor Module serial number	0 to 99999	1	0	0	Numerical
Disabled	Indication	MPM software Build (MPM_SwBuild)	Main Processor Module software Build version	0 to 9999	1	0	0	Numerical
Disabled	Indication	MPM software 1 (MPM_SwVer1)	Main Processor Module software for basic version[1)]	0 to 99	1	0	0	Numerical
Disabled	Indication	MPM software 2 (MPM_SwVer2)	Main Processor Module software for modification version[1)]	0 to 99	1	0	0	Numerical
Disabled	Indication	MPM software 3 (MPM_SwVer3)	Main Processor Module software for telecommunication version[1)]	0 to 99	1	0	0	Numerical

Notes:

1. Data representation:

   (0 to 65535) – non-negative integer number occupied 2 bytes, except for Data base ID Ibt (–32768 to 32767)
   (0 to 4294967296) – non-negative integer number occupied 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 (Refer to RC/TEL-01E(S) **Technical Manual,** *Operation,* section Measurement element) value equal 0xFFFF is transferred.
5. Valid Range is given as supplemental information. Refer to RC/TEL-01E(S) **Technical Manual** (sections *Technical Specification* and *Operation*) for details.
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 updating at the moment of new record generation during CO operations.

[1)] Refer to RC/TEL-01E(S) **Technical Manual** (section *Product Range*) for details.

15 FILE OBJECT

Static (Steady-State) Object Number: 70

Variations:

3 – File Command Object;
4 – File Command Status Object;
5 – File Transfer Object. Function codes;
6 – File Transfer Status;
7 – File Descriptor Object.

File implementation is based on “DNP Technical Bulletin 2000-001 Sequential File Transfer Objects”. The specific of the implementation is below.

15.1 File system

The files listed in Table 15.1 are RC file system that is based on RC structural tree.

Table 15.1

File name	RC Elements	Permissions	Comments
Settings			
grp1	Prot	R W	Protection group 1 settings.
grp2	Prot	R W	Protection group 2 settings.
grp3	Prot	R W	Protection group 3 settings.
grp4	Prot	R W	Protection group 4 settings.
sys	ME,MMI,UPS	R W	System settings.
scada	Control and indication	R W	SCADA settings.
Io	Control and indication	R W	IO Modules settings.
State			
State	ME, IO, UPS, ISC	R	Actual state of elements.
Logs			
co	MON	R	CO operation
chmsg	MON	R	Change messages
event	MON	R	Event log
ldprof	MON	R	Load profile

The settings files can be written or read as element with correspondence of column “Element”.

The Logs are dynamic files. They shall be locked after the file is opened.

Only new records since last read operation are returned from logs.

Each file contains at the beginning information about RC serial number and file version that allow RC and TELUS perform own and reliable file interpretation.

Delete function is not supported. Separate binary output points (see section 12) are provided to perform log erase operations.

The files are resided in root directory. Directory access operations are not supported.

DNP3 master can open only one file on slave simultaneously. The open file is locked for write operations. If it is necessary to write data to file during locked time the data is saved in separate buffer and rewrite to file after it would be unlocked.

The Log files (see Table above) are dynamic read-only objects. The returned file size for Logs is size in bytes of new records since last read operation.

The Operational Mode “append” is not supported.

Supported application layer function codes are listed in Table 15.2.

Table 15.2 - Supported application layer function codes

Function	Code Description
1	Read
2	Write
25	Open a File
26	Close a File
28	Get File Info
30	Abort

Assign class (function 22) and generation of events after change of files are not supported.

15.2 File Command Object

The file name field can contain names from Table 15.2. The file names are case-sensitive.

Time of creation is not used and returned as zero.

The following file permissions are applied to the files:

- R – owner read allowed;
- W – owner write allowed.

The file permissions are returned:

- If authentication key is correct or authentication is not used - with correspondence of authentication key and Table (above).
- If authentication is wrong – zero.

15.3 File Command Status Object

Optional ASCII Characters field that may be appended to the object after the status code are not supported.

16 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 16.1

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 RC/TEL-01E(S) **Technical Manual** (section *Product Range*) for details.

17 TEST MODES

There are two modes of DNP3 operation: Normal or Test. All below reflect the Test mode of DNP3 operation.

17.1 Service mode

Service mode is designated for using by technical personal and allows obtaining extended information about MPM working state and performing of adjustment works in the field.

Service mode is achievable through MPM serial port used for MPM – TELUS connection.

Service mode is symbol control mode, i.e. ASCII codes are used to send commands and retrieve replies from MPM. To control MPM in service mode can be used any terminal program running on PC.

To switch on MPM in service mode it is necessary:

- provide 5 sec inactivity on MPM serial port;
- send string “/SERVICE”.

After that MPM replies with message “Service mode is activated”.

To exit service mode the command “/EXIT” is used. MPM replies with message “Service mode is finished”

Service mode is automatically completed after 10 minutes inactivity on serial port with message “Service mode is terminated due to inactivity timeout”.

In the basic version functionality of the service mode is limited by modem control mode capabilities. In this mode all data sending to MPM are transmitted to RC serial port, which is used for modem control, and all data received from modem are transmitted to PC serial port. The mode is used for direct control of a modem through MPM without necessity of reconnection the modem from MPM to PC.

17.2 DNP3 test modes

The following test modes can be used:

- MPM sensor test mode is used to check DNP3 event generation based on protection functionality.
- DNP3 point test mode is used to control custom point assignments;

The test modes are used to perform test of DNP3 functionality under SCADA control and don’t require using of TELUS.

17.2.1 DNP3 sensor test mode

The mode is controlled through DNP3 string object with number 1000. Maximum string size is 256 symbols.

The following elements can be used for describing test:

- Test body, consisting of:
  - identification field [Test:N], where N – is test number, range 1-16;
  - test body elements in the format: Elem=Val, where “Elem” is parameter name, “=” is delimiter, “Val” is parameter value. Valid element names are:
    - Ia, Ib, Ic, I0 – phase current and zero current RMS values in amperes;
    - Ua, Ub, Uc, Ur, Us, Ut – phase RMS voltages in volts;
    - Freq is frequency value in Hz x 1000;
    - Time is time interval during test is executed. If Time is equal zero test is executed infinitely. Time value is in the ms, range: (0-65000) ms;
    - End – test completion condition that can range of values “Trip”, “Close”, “None”. Test can be completed on the competition condition or on Time condition if they are specified;
    - Angles are phase angles values for sensors. If angles are not defined then values 0, -120, 120 degrees are applied for Ia, Ib, Ic, Ua, Ub, Uc, Ur, Us, Ut correspondingly. If angles are used they must be loaded before test body.
- Angles body consisting of:
  - identification field [Angles:N], where N – is description number, range 1-16;
  - body in the format: Elem=Val, where “Elem” is parameter name, “=” is delimiter, “Val” is parameter value. Valid element names are the same as for sensors. Range of values [-360, 360].
- Test control consisting of:
  - identification field [Mode];
  - elements in the format: Elem=Val, where “Elem” is parameter name, “=” is delimiter, “Val” is parameter value. Valid element names are:
    - Enable – test mode is enabled/disabled;

- Uabc_ZeroAtTrip/ Urst_ZeroAtTrip – condition to automatically zero voltages from the given side at open state;
- I0. If I0=1 – zero sequence current is counted from phase currents, otherwise value is given in the test body is used;
- Driver. If equal to 1 – use OSM simulator, otherwise use real OSM.
- Run – is used to determine test number to start test sequence.

The test example:

[Angles:1] Ia=0 Ib=-120 Ic=120 Ua=0 Ub=-120 Uc=120 Ur=0 Us=-120 Ut=120

[Angles:2] Ia=90 Ib=-180 [Angles:3] Ia=180 Ib=-120 Ic=150

[Test:1] Angles=1 Ia=400 Ib=400 Ua=12000 Freq=50 Time=100 End=Trip

[Mode] Enable=1 Uabc_ZeroAtTrip=1 Urst_ZeroAtTrip=0 I0=1 Driver=1 Run=1

Several elements can be combined in the one string but summary size doesn't exceeded 256 bytes.

The sensor mode is started after reception of test control string with Enable=1.

The sensor test mode is completed if test control string contains Enable= 0 or after 10 minutes inactivity on SCADA connection.

17.2.2 DNP3 point test mode

The mode is used to set DNP3 point values with independence of their real values. The mode is designated for static object control, i.e. change event is not generated even the point belongs to class 1,2,3.

The mode is controlled through DNP3 string object with number 1001.

The following elements can be used for describing test:

- test body, consisting of elements in the format Elem=Val, where Elem is parameter name and Val is parameter value (optional):
  - for binary inputs – the short names of points and value ranges are from the Table 11.1;
  - for binary outputs – the short names of points and value ranges are from the Table 12.1;
  - for binary counters – the short names of points and value ranges are from the Table 13.1;
  - for analog inputs – the short names of points and value ranges are from the Table 14.1;
- Identification field Active, with range of values "1"/"0" that is used to control test start/competition conditions.

The test examples:

- for binary input points:
  Remote_On=1 Prot_initiated=0 Open(OC)=1 P(OC1+)=1
- for binary outputs:
  On(Prot) On(Grp1) Trip
- for binary counters:
  OC_A_Trips=5 +kVAh=100000
- for analog inputs:
  Ia=100 Ubc=11000 kVA=600
- Active:1

The test values are applicable to the points only if the points have active status, i.e. they are enabled in the settings.

There are no real control actions for binary outputs, i.e. Off(Prot) is only affected on binary output status value and on corresponding binary input value.

The several fields for different objects can be combined in the one string but string size doesn't exceeded 256 bytes.

The DNP3 point test mode is started if test control string contains Active=1 and completed if test control string contains Active=0 or after 10 minutes inactivity on SCADA connection.

It is supposed to use symbols "**=**" and "**:**".

It is inhibited to use both test modes simultaneously. If one of modes is started it is automatically terminate other test mode if it is required.