SIEMENS

Reyrolle
7SR10
Communication Protocols

V01.00

Manual

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C53000-L7040-C002-7



NOTE

For your own safety, observe the warnings and safety instructions contained in this document, if available.

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Preface

Purpose of the Manual

This manual contains information about:

- Communication within the Reyrolle device family and to higher-level control centers
- Setting parameters in Reydisp software
- Information on commissioning

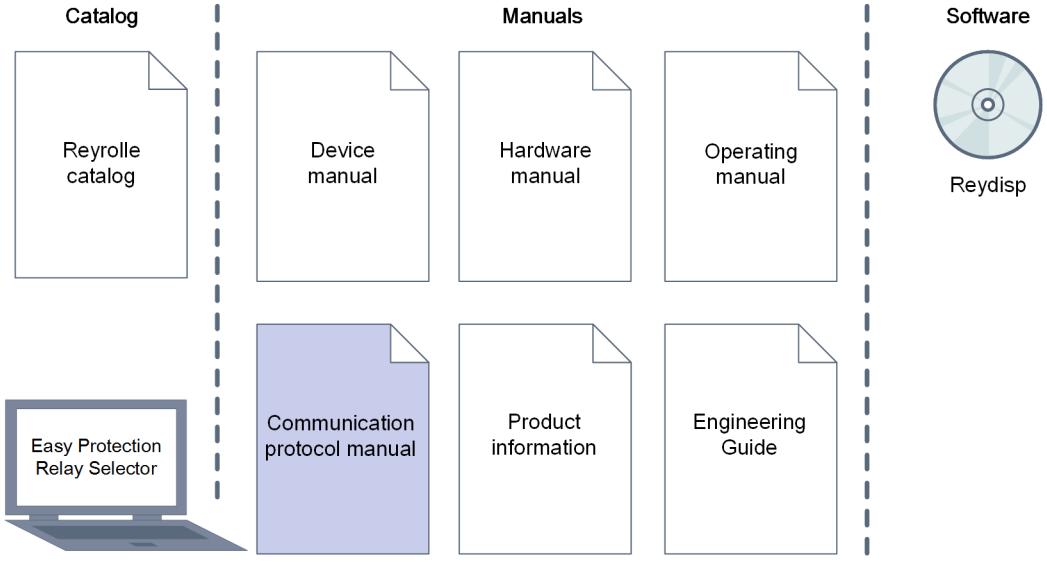
Target audience

This manual is mainly intended for protection system engineers, commissioning engineers, persons entrusted with the setting, testing and maintenance of automation, selective protection and control equipment, and operational crew in electrical installations and power plants.

Scope

This manual applies to the Reyrolle device family.

Further Documentation



[dw_reyrolle-catalog_furtherdocumentation_communicationprotocolmanual, 1, en_US]

- Device manual
  The device manual describes the functions and applications of a Reyrolle device. The printed manual for the device has the same informational structure.
- Hardware manual
  The hardware manual describes the hardware building blocks and device combinations of the Reyrolle device family.

- Operating manual
  The operating manual describes the basic principles and procedures for operating and installing the devices of the Reyrolle device family.
- Communication protocol manual
  The communication protocol manual contains a description of the protocols for communication within the Reyrolle device family and to higher-level network control centers.
- Product information
  The product information includes general information about device installation, technical data, limiting values for input and output modules, and conditions when preparing for operation. This document is provided with each Reyrolle device.
- Engineering Guide
  The engineering guide describes the essential steps when engineering with Reydisp. In addition, the engineering guide shows you how to load a planned configuration to a Reyrolle Communication Protocols device and update the functionality of the Reyrolle Communication Protocols device.
- Reyrolle catalog
  The Reyrolle catalog describes the Reyrolle devices and the system features.
- Easy Protection Relay Selector for Reyrolle and SIPROTEC
  This tool gives a quick guidance to find a protection relay of SIPROTEC 5, SIPROTEC 4, SIPROTEC Compact, Reyrolle which would fit your needs.

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Notes on safety

The document is not a complete index of all safety measures required for operation of the equipment (module or device). However, it comprises important information that must be followed for personal safety, as well as to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger:



DANGER

DANGER means that death or severe injury **will** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.



WARNING

WARNING means that death or severe injury **may** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.



CAUTION

CAUTION means that medium-severe or slight injuries **can** occur if the specified measures are not taken.

✧ Comply with all instructions, in order to avoid moderate or minor injuries.

NOTICE

NOTICE means that property damage **can** result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid property damage.



NOTE

Important information about the product, product handling or a certain section of the documentation which must be given attention.

OpenSSL

This product includes software developed by the OpenSSL Project for use in OpenSSL Toolkit (*http://www.openssl.org/*).

This product includes software written by Tim Hudson (*tjh@cryptsoft.com*).

This product includes cryptographic software written by Eric Young (*eay@cryptsoft.com*).

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1 Communication Modules

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1.1 Overview

The relay data communication facility is compatible with control and automation systems and PCs running Reydisp software. The relay can provide the following:

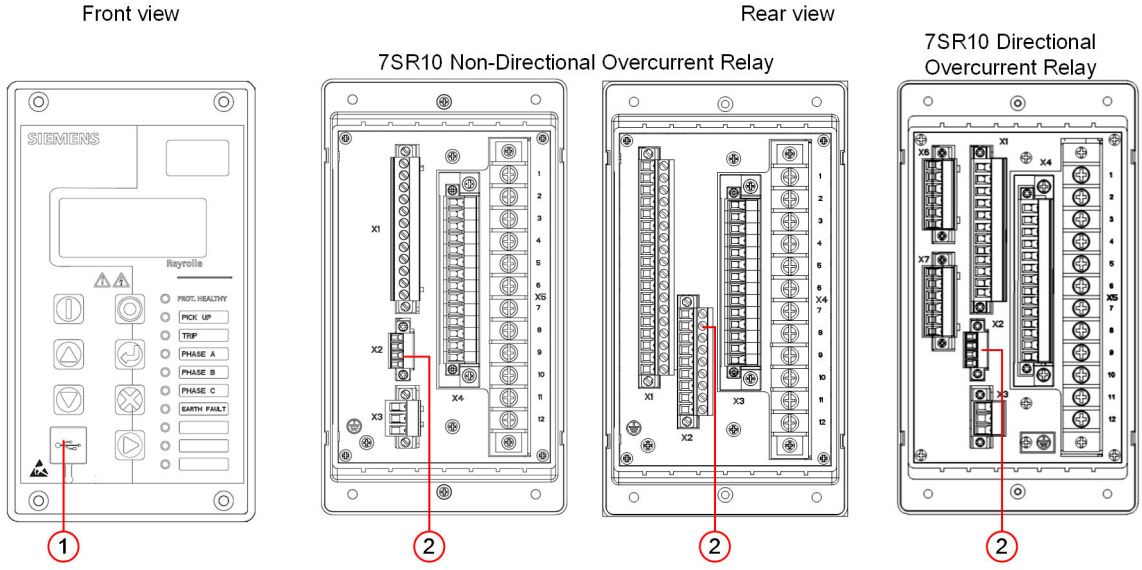
- Operational information
- Post-fault analysis
- Settings interrogation
- Editing facilities

This section describes how to use the communication interface with a control system or interrogating computer. Appropriate software within the control system or on the interrogating computer (for example, Reydisp Evolution or Reydisp Manager) is required to access the interface.

The relay data communication facility incorporates user selectable protocols to provide compatibility with control and automation systems.

This section specifies connection details and lists the events, commands, and measurands available in the IEC 60870-5-103, Modbus RTU, DNP3 protocols.

The Communications Interface for dialog communications by the Protection Engineer is provided by the Reydisp Evolution and Reydisp Manager software packages using the IEC 60870-5-103 protocol.



[dw_7SR10 communication Ports, 2, en_US]

Figure 1-1 7SR10 Argus Relay Communication Ports

(1) USB Port on front fascia
(2) RS485 port on rear side

The device provides 1 front USB communication interface (Com2) on the fascia and 1 RS485 (Com1) on the rear. The access to the communication settings for the USB port or RS485 port is available from the front menu structure via the keypad setting menu **`Communications`**. The communication settings for the RS485 port can also be done through Reydisp via the USB connection.

- Com2-USB
  This port is used for IEC 60870-5-103 (default setting) communication with the Reydisp software.
  Modbus RTU or DNP3 protocols are also available

- Com1-RS485

  This port can be used for IEC 60870-5-103 or Modbus RTU or DNP3 communications to a substation SCADA or integrated control system or engineer remote access.

  This port can also be used for connection to Reydisp software.

The ports can be independently mapped to the IEC 60870-5-103 or Modbus RTU or DNP3 protocol or switched OFF in the relay settings. The same protocol can be used simultaneously on both ports.

When connecting to Reydisp software the protocol for the relevant port must be set to IEC 60870-5-103.

1.2 USB Interface (Com2)

The USB communication port is connected using a standard USB cable having a type B connection to the relay and type A to the PC.

The PC requires a suitable USB driver to be installed, this is carried out automatically when the Reydisp software is installed. When the Reydisp software is running, with the USB cable connected to a device, an additional connection is shown in the Reydisp connection window. Connections to the USB port are not shown when they are not connected.

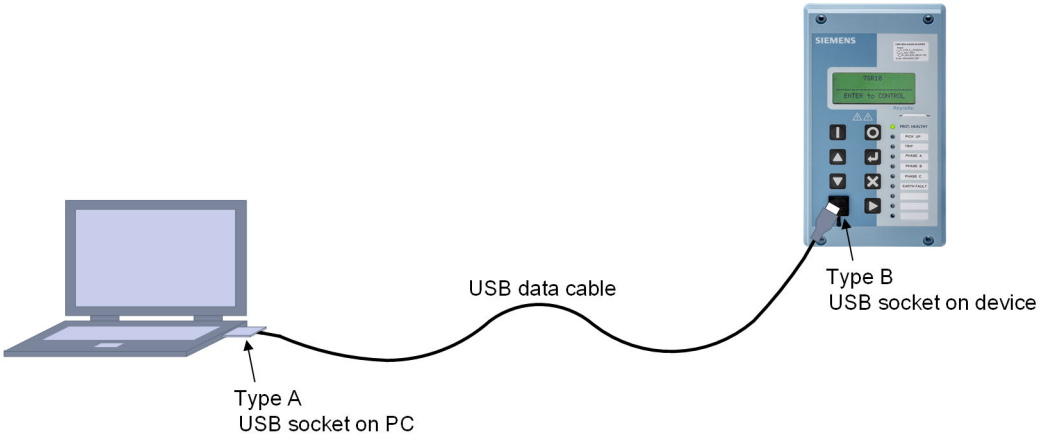
The USB communication interface on the relay is labelled COM 2 and its associated settings are available in the Data communications menu. When connecting to Reydisp using this connection, the default settings can be used without the need to first change any settings. Otherwise the COM 2 port must be set to IEC 60870-5-103 (the relay address and baud rate do not need to be set).

The following settings must be configured via the relay fascia when using the USB interface.

NOTE

Note that these settings are only visible on the relay fascia.

Description	Range	Default	Notes
COM2-USB Protocol *Selects protocol to use for COM2-USB*	OFF IEC 60870-5-103 Modbus RTU ASCII DNP3	IEC 60870-5-103	Reydisp software requires IEC 60870-5-103.
COM2-USB Station Address *IEC 60870-5-103 Station Address*	0 to 254 for IEC 60870-5-103, 1 to 247 for Modbus RTU, 0 to 65 534 for DNP3	0	An address within the range of the relevant protocol must be given to identify the relay. Each relay in a network must have a unique address.
COM2-USB Mode *Selects whether the port is Local or Remote.*	Local Local or Remote Remote	Local	



[dw_communication_front-USB-port_7sr10, 2, en_US]

Figure 1-2 Communication to Front USB Port

1.3 RS485 interface (Com1)

The 2 wire RS485 communication port is located on the rear side of the relay. It can be connected using a suitable RS485 120 Ω shielded twisted pair cable.

The RS485 electrical connection can be used in a single or multi-drop configuration. The RS485 master must support and use the Auto Device Enable (ADE) feature. The last device in the connection must be terminated correctly in accordance with the master device driving the connection. The relays are fitted with an internal terminating resistor which can be connected between A and B by fitting an external wire loop between terminals TERM and B on the X2 connector.

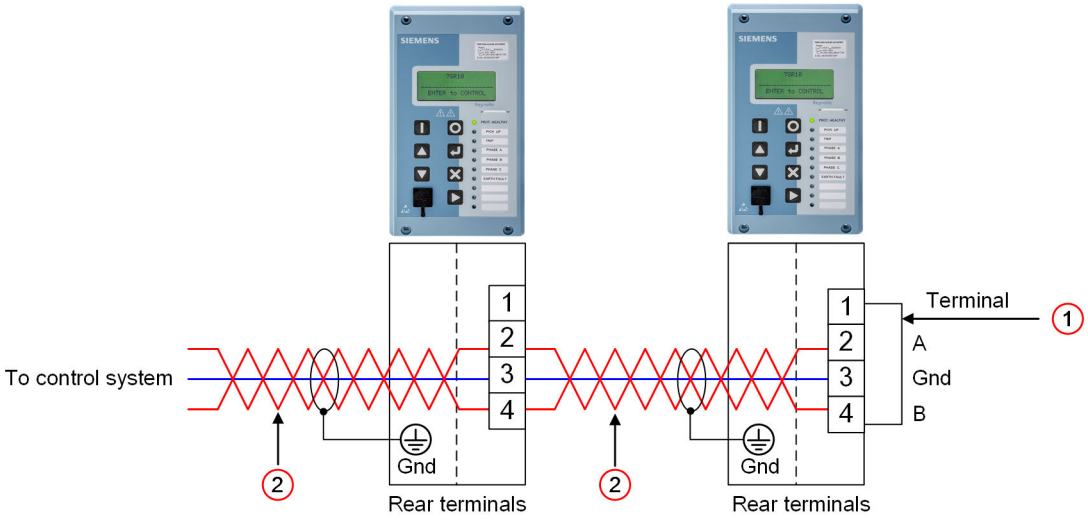
The polarity of the signal terminals is marked as A and B which is in line with the RS485 standard. When the bus is in the idle state and no communication is taking place, the polarity of terminal A is more positive than that of terminal B. These terminals can be used to identify the polarity of any equipment to be connected, typically measured at each terminal in turn to earth. *Figure 1-3* shows the connection of the device to a termination network at the end of the bus and suits the idle state.

The polarity marking is often found to be reversed or marked as ± on other equipment, so care is required. If the devices are connected in reverse, then communication to all devices is disturbed without any damage. If problems are experienced during commissioning, perform the connections in reverse.

The RS485 data comms link will be broken for that particular relay element if it is withdrawn from the case but the chain of communication to the other relays is maintained.

The maximum number of relays that can be connected to the bus is 64.

When using the RS485 interface, you must configure the following settings in the following settings on the **`communication`** menu:



1 External wire loop to include line terminating resistor

2 RS485 Shielded twisted pair

[dw_7SR10 typical RS485 connection, 4, en_US]

Figure 1-3 Communication to Multiple Devices from Control System using RS485

Table 1-1 RS485 interface (Com1)

Setting name	Range	Default	Setting	Notes
COM1-RS485 Protocol	OFF IEC 60870-5-103 Modbus RTU DNP3	IEC 60870-5-103	As Required	Sets the protocol used to communicate on the standard RS485 connection.
COM1-RS485 Station Address	0 to 254 for IEC 60870-5-103 1 to 247 for Modbus RTU 0 to 65534 for DNP3	0	–	An address must be given to identify the relay. Each relay must have a unique address.
COM1-RS485 baud rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400	19200	As Required	The baud rate set on all of the relays connected to the same RS485 bus must be the same as the one set on the master device.
COM1-RS485 Parity	NONE ODD EVEN	EVEN	As Required	The parity set on all of the relays connected to the same RS485 bus must be the same and in accordance with the master device.
COM1-RS485 Mode	Local Remote Local Or Remote	Remote	Remote	Selects whether the port is Local or Remote.
DNP3 Unsolicited Mode *Allows unsolicited event support in the relay. When Enabled, unsolicited event transmission can be controlled by the Master. When Disabled, Master requests are ignored.*	DISABLED ENABLED	DISABLED	As Required	Setting is only visible when COM1 Protocol is set to DNP3
DNP3 Destination Address *The address of the master to which unsolicited events will be sent.*	0 to 65534	0	As Required	Setting is only visible when COM1 Protocol is set to DNP3
DNP3 Application Timeout	5 to 300	10 s	–	–

1.4 Operating Mode

1.4.1 Operating Mode

The device has 3 operating modes:

- Local
- Remote
- Out of Service

These operating modes can be selected either from the setting **SYSTEM CONFIG** → **OPERATING MODE**, a binary input, or command.
The following table illustrates whether a function is **Enabled** (✓) or **Disabled** (✗) in each mode.

Table 1-2 Operating Mode Table

Function	Operating Mode		
	Local	Remote	Out of Service
Control			
Com1	✓ when Com1-Mode = Local	✓ when Com1-Mode = Remote	X
Com2 (USB)	✓ when Com2-Mode = Local	✓ when Com2-Mode = Remote	X
Fascia (Control Mode)	✓	X	X
Function key (n)	✓	✓ when F Key(n) Mode = Remote	X
Binary input (n)	✓ when BI (n) Mode = Local	✓ when BI (n) Mode = Remote	X
Binary outputs	✓	✓	X
Reporting			
Spontaneous			
IEC	✓	✓	X
DNP3	✓	✓	X
General interrogation			
IEC	✓	✓	X
DNP3	✓	✓	✓
MODBUS	✓	✓	✓
Change settings			
Com1	✓ when Com1-Mode = Local	✓ when Com1-Mode = Remote	✓
Com2 (USB)	✓ when Com2-Mode = Local	✓ when Com2-Mode = Remote	✓
Fascia	✓	✓	✓
Historical information			
Waveform Records	✓	✓	✓
Event Records	✓	✓	✓
Fault Information	✓	✓	✓
Setting Information	✓	✓	✓

2 IEC 60870-5-103

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2.1 Introduction

This section describes the IEC 60870-5-103 protocol implementation in the relays. This protocol is used for the communication with Reydisp software and can also be used for communication with a suitable control system. The control system or local PC acts as the master in the system with the relay operating as a slave responding to the master's commands. The implementation provides event indication, time synchronizing, commands and measurands and also supports the transfer of disturbance records.

This protocol can be set to use any or all of the relays hardware interfaces (USB and RS485) where fitted and is the standard protocol used by the USB port. The relay can communicate simultaneously on all ports regardless of protocol used.

The Station Address of the port being used must be set to a suitable address within the range 0 - 254 to enable communication. This can be set by the **`Communications Menu`**: ***`COM n-xxxxx Station Address`*** setting.

2.2 Cause of Transmission

The cause of transmission (COT) column of the **Information Number and Function** table lists the possible causes of transmission for these frames. The following abbreviations are used:

Table 2-1 Cause of Transmission

Abbreviation	Description
SE	Spontaneous event
T	Test mode
GI	General interrogation
Loc	Local operation
Rem	Remote operation
Ack	Command acknowledge
Nak	Negative command acknowledge



NOTE

The events listing a GI cause of transmission can be raised and cleared; other events are raised only.

2.3 Application Service Data Unit (ASDU) Type

The following table lists the possible Application Service Data Unit (ASDU) of the **Information Number and Function** table lists the possible ASDUs returned for a point.

Table 2-2 Application Service Data Unit Type

ASDU #	Description
1	Time-tagged message (monitoring direction)
2	Time-tagged message (relative time; monitoring direction)
3.1	Measurands I
4	Time-tagged measurand with relative time
5	Identification message
6	Time synchronization
7	General-interrogation Initialization
9	Measurands II
20	General command

2.4 Point List

The following subsections contain tables listing the data points available via the IEC60870-5-103 protocol.

The information shown below is the default configuration. This can be modified using the Communications Configuration Editor tool. Refer *5.1 Configuration* for more details.

2.4.1 Event Function (FUN) & Information (INF) Numbers

The following table lists the data points available via the IEC 60870-5-103 protocol.

Table 2-3 Event Function (FUN) & Information (INF) Numbers

FUN	INF	Description	ASDU	COT
60	4	Remote mode	1	SE, GI
			20	Ack, Nak
60	5	Out of Service mode	1	SE, GI
			20	Ack, Nak
60	6	Local mode	1	SE, GI
			20	Ack, Nak
60	7	Local or Remote mode	1	SE, GI
			20	Ack, Nak
60	12	Control received	1	SE
60	13	Command received	1	SE
60	128	Cold start	1	SE, GI
60	130	Restart	1	SE, GI
60	131	Expected restart	1	SE, GI
60	132	Unexpected restart	1	SE, GI
60	133	Reset start count	1	SE, GI
			20	Ack, Nak
60	135	Trigger Storage	1	SE, GI
60	136	Clear Waveform records	1	SE, GI
60	137	Clear fault records	1	SE
60	138	Clear event records	1	SE
60	140	Demand metering reset	1	SE
			20	Ack, Nak
60	170	General alarm 1	1	SE, GI
60	171	General alarm 2	1	SE, GI
60	172	General alarm 3	1	SE, GI
60	173	General alarm 4	1	SE, GI
60	174	General alarm 5	1	SE, GI
60	175	General alarm 6	1	SE, GI
60	182	Quick Logic E1	1	SE, GI
60	183	Quick Logic E2	1	SE, GI
60	184	Quick Logic E3	1	SE, GI
60	185	Quick Logic E4	1	SE, GI
60	214	Function Key 1	1	SE, GI
60	215	Function Key 2	1	SE, GI
70	5	Binary Input 5	1	SE, GI
70	6	Binary Input 6	1	SE, GI

FUN	INF	Description	ASDU	COT
70	7	Binary Input 7	1	SE, GI
70	8	Binary Input 8	1	SE, GI
70	9	Binary Input 9	1	SE, GI
75	1	Virtual Input 1	1	SE, GI
75	2	Virtual Input 2	1	SE, GI
75	3	Virtual Input 3	1	SE, GI
75	4	Virtual Input 4	1	SE, GI
75	5	Virtual Input 5	1	SE, GI
75	6	Virtual Input 6	1	SE, GI
75	7	Virtual Input 7	1	SE, GI
75	8	Virtual Input 8	1	SE, GI
80	1	Binary output 1	1	SE, GI
			20	Ack, Nak
80	2	Binary output 2	1	SE, GI
			20	Ack, Nak
80	3	Binary output 3	1	SE, GI
			20	Ack, Nak
80	4	Binary output 4	1	SE, GI
			20	Ack, Nak
80	5	Binary output 5	1	SE, GI
			20	Ack, Nak
80	6	Binary output 6	1	SE, GI
			20	Ack, Nak
90	1	LED 1	1	GI
90	2	LED 2	1	GI
90	3	LED 3	1	GI
90	4	LED 4	1	GI
90	5	LED 5	1	GI
90	6	LED 6	1	GI
90	7	LED 7	1	GI
90	8	LED 8	1	GI
90	9	LED 9	1	GI
91	1	LED PU 1	1	GI
91	2	LED PU 2	1	GI
91	3	LED PU 3	1	GI
91	4	LED PU 4	1	GI
91	5	LED PU 5	1	GI
91	6	LED PU 6	1	GI
91	7	LED PU 7	1	GI
91	8	LED PU 8	1	GI
91	9	LED PU 9	1	GI
160	2	Reset FCB	5	SE
160	3	Reset CU	5	SE
160	4	Start/Restart	5	SE
160	5	Power on	1	SE, GI
160	16	Auto-reclose active	1	SE, GI

FUN	INF	Description	ASDU	COT
160	19	LED and O/P Reset	1	SE
			20	Ack, Nak
160	22	Settings changed	1	SE
160	23	Settings G1 selected	1	SE, GI
			20	Ack, Nak
160	24	Settings G2 selected	1	SE, GI
			20	Ack, Nak
160	25	Settings G3 selected	1	SE, GI
			20	Ack, Nak
160	26	Settings G4 selected	1	SE, GI
			20	Ack, Nak
160	27	Binary input 1	1	SE, GI
160	28	Binary input 2	1	SE, GI
160	29	Binary input 3	1	SE, GI
160	30	Binary input 4	1	SE, GI
160	36	Trip Circuit Fail	1	SE, GI
160	38	VT Fuse Failure	2	SE, GI
160	51	Earth Fault Forward/Line	2	SE, GI
160	52	Earth Fault Reverse/Busbar	2	SE, GI
160	64	Start/pickup L1	2	SE, GI
160	65	Start/pickup L2	2	SE, GI
160	66	Start/pickup L3	2	SE, GI
160	67	Start/pickup N	2	SE, GI
160	68	General Trip	2	SE
160	69	Trip L1	2	S
160	70	Trip L2	2	SE
160	71	Trip L3	2	SE
160	74	Fault Forward/Line	2	SE
160	75	Fault Reverse/Busbar	2	SE
160	84	General start/pickup	2	SE, GI
160	85	Breaker Failure	2	SE
160	90	Trip I>	2	SE
160	91	Trip I>>	2	SE
160	92	Trip I_n>	2	SE
160	93	Trip I_n>>	2	SE
160	128	CB on by auto reclose	1	SE
183	10	51-1	2	SE, GI
183	11	50-1	2	SE, GI
183	12	51N-1	2	SE, GI
183	13	50N-1	2	SE, GI
183	14	51G-1	2	SE, GI
183	15	50G-1	2	SE, GI
183	16	51-2	2	SE, GI
183	17	50-2	2	SE, GI
183	18	51N-2	2	SE, GI
183	19	50N-2	2	SE, GI
183	20	51G-2	2	SE, GI

FUN	INF	Description	ASDU	COT
183	21	50G-2	2	SE, GI
183	22	51-3	2	SE, GI
183	23	50-3	2	SE, GI
183	24	51N-3	2	SE, GI
183	25	50N-3	2	SE, GI
183	26	51G-3	2	SE, GI
183	27	50G-3	2	SE, GI
183	28	51-4	2	SE, GI
183	29	50-4	2	SE, GI
183	30	51N-4	2	SE, GI
183	31	50N-4	2	SE, GI
183	32	51G-4	2	SE, GI
183	33	50G-4	2	SE, GI
183	34	50BF Stage 2	2	SE, GI
183	35	49 Alarm	2	SE, GI
183	36	49 Trip	2	SE, GI
183	40	60 CTS	2	SE, GI
183	41	51SEF-1	2	SE, GI
183	42	50SEF-1	2	SE, GI
183	43	51SEF-2	2	SE, GI
183	44	50SEF-2	2	SE, GI
183	45	51SEF-3	2	SE, GI
183	46	50SEF-3	2	SE, GI
183	47	51SEF-4	2	SE, GI
183	48	50SEF-4	2	SE, GI
183	49	SEF Out	2	SE, GI
			20	Ack, Nak
183	50	46IT	2	SE, GI
183	51	46DT	2	SE, GI
183	52	64H	2	SE, GI
183	53	E/F Out	2	SE, GI
			20	Ack, Nak
183	54	SEF Forward/Line	2	SE, GI
183	55	SEF Reverse/Busbar	2	SE, GI
183	56	50BF Stage 1	2	SE, GI
183	60	47-1	2	SE, GI
183	61	47-2	2	SE, GI
183	62	37-1	2	SE, GI
183	63	37-2	2	SE, GI
183	64	37G-1	2	SE, GI
183	65	37G-2	2	SE, GI
183	66	37SEF-1	2	SE, GI
183	67	37SEF-2	2	SE, GI
183	68	67SEF-1	2	SE, GI
183	69	67SEF-2	2	SE, GI
183	70	46BC	2	SE, GI
183	81	27/59-1	2	SE, GI

FUN	INF	Description	ASDU	COT
183	82	27/59-2	2	SE, GI
183	83	27/59-3	2	SE, GI
183	84	27/59-4	2	SE, GI
183	85	59NIT	2	SE, GI
183	86	59NDT	2	SE, GI
183	90	81-1	2	SE, GI
183	91	81-2	2	SE, GI
183	92	81-3	2	SE, GI
183	93	81-4	2	SE, GI
183	96	81HBL2	1	SE, GI
183	98	81I-THD	1	SE, GI
183	100	CB Alarm	1	SE, GI
183	101	Trip Circuit Fail 1	2	SE, GI
183	102	Trip Circuit Fail 2	2	SE, GI
183	103	Trip Circuit Fail 3	2	SE, GI
183	114	Close CB Failed	1	SE, GI
183	115	Open CB Failed	1	SE, GI
183	116	Reclaim	1	SE, GI
183	117	Lockout	1	SE, GI
183	119	Successful DAR Close	1	SE
183	120	Successful Man Close	1	SE
183	121	HotLine Working	1	SE, GI
			20	Ack, Nak
183	122	Inst Protection Out	1	SE, GI
			20	Ack, Nak
183	123	CB Total Trip Count	1	SE, GI
183	124	CB Delta Trip Count	1	SE, GI
183	125	CB Count To AR Block	1	SE, GI
183	126	Reset CB Total Trip Count	1	SE, GI
			20	Ack, Nak
183	127	Reset CB Delta Trip Count	1	SE, GI
			20	Ack, Nak
183	128	Reset CB Count To AR Block	1	SE, GI
			20	Ack, Nak
183	129	I^2t CB Wear	1	SE, GI
183	130	Reset I^2t CB Wear	1	SE, GI
			20	Ack, Nak
183	131	79 AR In progress	1	SE, GI
183	132	CB Frequent Ops Count	1	SE, GI
183	133	Reset CB Frequent Ops Count	1	SE, GI
			20	Ack, Nak
183	137	CB on by auto reclose	1	SE, GI
183	140	Cold Load Active	1	SE, GI
183	141	P/F Inst Protection Inhibited	1	SE, GI
183	142	E/F Inst Protection Inhibited	1	SE, GI
183	143	SEF Inst Protection Inhibited	1	SE, GI
183	144	Ext Inst Protection Inhibited	1	SE, GI

FUN	INF	Description	ASDU	COT
183	163	Trip Time Alarm	1	SE
183	164	Close Circuit Fail 1	2	SE, GI
183	165	Close Circuit Fail 2	2	SE, GI
183	166	Close Circuit Fail 3	2	SE, GI
183	167	Close Circuit Fail	2	SE, GI
183	171	60 CTS-I	2	SE, GI
183	172	Act Energy Exp	4	SE
183	173	Act Energy Exp	4	SE
183	174	React Energy Exp	4	SE
183	175	React Energy Imp	4	SE
183	176	Reset Energy Meters	1	SE
			20	Ack, Nak
183	177	Active Exp Meter Reset	1	SE
183	178	Active Imp Meter Reset	1	SE
183	179	Reactive Exp Meter Reset	1	SE
183	180	Reactive Imp Meter Reset	1	SE
183	181	CB Total Trip Count	4	SE
183	182	CB Delta Trip Count	4	SE
183	183	CB Count To AR Block	4	SE
183	184	CB Freq Ops Count	4	SE
183	221	Wattmetric Po>	1	SE, GI
183	222	37-PhA	2	SE, GI
183	223	37-PhB	2	SE, GI
183	224	37-PhC	2	SE, GI
183	225	50LC-1	2	SE, GI
183	226	50LC-2	2	SE, GI
183	227	50G LC-1	2	SE, GI
183	228	50G LC-2	2	SE, GI
183	229	50SEF LC-1	2	SE, GI
183	230	50SEF LC-2	2	SE, GI
183	231	50BF-PhA	2	SE, GI
183	232	50BF-PhB	2	SE, GI
183	233	50BF-PhC	2	SE, GI
183	234	50BF-EF	2	SE, GI
183	235	79 Last Trip Lockout	2	SE, GI
183	237	CB DBI	1	SE, GI
183	238	CB Travelling	1	SE, GI
183	239	I_n fault current	4	SE
183	240	I_a fault current	4	SE
183	241	I_b fault current	4	SE
183	242	I_c fault current	4	SE
183	243	I_g fault current	4	SE
183	244	I_{sef} fault current	4	SE
183	245	V_a fault voltage	4	SE
183	246	V_b fault voltage	4	SE

FUN	INF	Description	ASDU	COT
183	247	V_c fault voltage	4	SE
183	249	60 CTS-I-PhA	2	SE, GI
183	250	60 CTS-I-PhB	2	SE, GI
183	251	60 CTS-I-PhC	2	SE, GI
183	252	Trip PhA	2	SE, GI
183	253	Trip PhB	2	SE, GI
183	254	Trip PhC	2	SE, GI
185	37	27/59 PhA	2	SE, GI
185	38	27/59 PhB	2	SE, GI
185	39	27/59 PhC	2	SE, GI
185	43	General Trip	2	SE, GI
185	44	32-1	1	SE, GI
185	45	32-2	1	SE, GI
185	46	32S-1	1	SE, GI
185	47	32S-2	1	SE, GI
185	48	55-1	1	SE, GI
185	49	55-2	1	SE, GI
185	110	CB Wear CB A	4	SE
185	111	CB Wear CB B	4	SE
185	112	CB Wear CB C	4	SE
185	113	CB Wear CB A Remaining	4	SE
185	114	CB Wear CB B Remaining	4	SE
185	115	CB Wear CB C Remaining	4	SE
185	241	Start Count Alarm	1	SE, GI
186	1	50AFD PhA	1	SE, GI
186	2	50AFD PhB	1	SE, GI
186	3	50AFD PhC	1	SE, GI
186	4	50AFD	1	SE, GI
186	5	AFD Zone 1 Flash	1	SE, GI
186	6	AFD Zone 1	1	SE, GI
186	7	AFD Zone 2 Flash	1	SE, GI
186	8	AFD Zone 2	1	SE, GI
186	9	AFD Zone 3 Flash	1	SE, GI
186	10	AFD Zone 3	1	SE, GI
186	11	AFD Zone 4 Flash	1	SE, GI
186	12	AFD Zone 4	1	SE, GI
186	13	AFD Zone 5 Flash	1	SE, GI
186	14	AFD Zone 5	1	SE, GI
186	15	AFD Zone 6 Flash	1	SE, GI
186	16	AFD Zone 6	1	SE, GI
186	17	AFD Zone1 Count	4	SE
186	18	AFD Zone2 Count	4	SE
186	19	AFD Zone3 Count	4	SE
186	20	AFD Zone4 Count	4	SE
186	21	AFD Zone5 Count	4	SE
186	22	AFD Zone6 Count	4	SE
186	23	59.S1	1	SE,GI

FUN	INF	Description	ASDU	COT
186	24	59.S2	1	SE,GI
186	25	27.S1	1	SE,GI
186	26	27.S2	1	SE,GI
186	27	59V0	1	SE,GI
186	28	59.S1 Pickup	1	SE,GI
186	29	59.S2 Pickup	1	SE,GI
186	30	27.S1 Pickup	1	SE,GI
186	31	27.S2 Pickup	1	SE,GI
186	32	59 PhAB	1	SE,GI
186	33	59 PhBC	1	SE,GI
186	34	59 PhCA	1	SE,GI
186	35	27 PhAB	1	SE,GI
186	36	27 PhBC	1	SE,GI
186	37	27 PhCA	1	SE,GI
186	38	59V0 Pickup	1	SE,GI
186	39	81V 59V2 Pickup	1	SE,GI
186	40	81V 27V1 Pickup	1	SE,GI
186	41	Block 27/59	1	SE
			20	Ack,Nak
186	42	Vab Fault Voltage	4	SE
186	43	Vbc Fault Voltage	4	SE
186	44	Vca Fault Voltage	4	SE
186	45	81.S1 O/F	1	SE,GI
186	46	81.S1 U/F	1	SE,GI
186	47	81.S2 O/F	1	SE,GI
186	48	81.S2 U/F	1	SE,GI
186	49	81.S1 O/F Pickup	1	SE,GI
186	50	81.S1 U/F Pickup	1	SE,GI
186	51	81.S2 O/F Pickup	1	SE,GI
186	52	81.S2 U/F Pickup	1	SE,GI
186	53	81V Unblock	1	SE,GI
186	54	PI Trip	1	SE,GI
186	55	Loc 81V En	1	SE,GI
186	56	DDI Open	1	SE,GI
186	57	Vn Fault Voltage	4	SE
186	58	Cmd Trip	1	SE
			20	Ack,Nak
186	59	Direct Trip	1	SE,GI
200	1	CB 1	1	SE, GI
			20	Ack, Nak
200	6	CB 1 Opened	1	SE, GI
200	7	CB 1 Closed	1	SE, GI
200	150	User SP Command 1	1	SE, GI
			20	Ack, Nak
200	151	User SP Command 2	1	SE, GI
			20	Ack, Nak

FUN	INF	Description	ASDU	COT
200	152	User SP Command 3	1	SE, GI
			20	Ack, Nak
200	153	User SP Command 4	1	SE, GI
			20	Ack, Nak
200	154	User SP Command 5	1	SE, GI
			20	Ack, Nak
200	155	User SP Command 6	1	SE, GI
			20	Ack, Nak
200	156	User SP Command 7	1	SE, GI
			20	Ack, Nak
200	157	User SP Command 8	1	SE, GI
			20	Ack, Nak
200	158	User DP Command 1	1	SE, GI
			20	Ack, Nak
200	159	User DP Command 2	1	SE, GI
			20	Ack, Nak
200	160	User DP Command 3	1	SE, GI
			20	Ack, Nak
200	161	User DP Command 4	1	SE, GI
			20	Ack, Nak
200	162	User DP Command 5	1	SE, GI
			20	Ack, Nak
200	163	User DP Command 6	1	SE, GI
			20	Ack, Nak
200	164	User DP Command 7	1	SE, GI
			20	Ack, Nak
200	165	User DP Command 8	1	SE, GI
			20	Ack, Nak
200	200	CB 1 Trip & Reclose	1	SE, GI
			20	Ack, Nak
200	201	CB 1 Trip & Lockout	1	SE, GI
			20	Ack, Nak
200	255	Blocked By Interlocking	1	SE, GI
255	0	General Interrogation (GI) Initiation	7	Init. GI
255	0	General Interrogation (GI) End	8	End of GI
255	0	Time Synchronisation	6	Time Synch.

2.4.2 Measurands

The following measurand EVT and INF numbers are applicable to this device.

Table 2-4 Measurands

FUN	INF	Description	ASDU	COT
183	148	Measurand $I_{L1,2,3,}$ $V_{L1,2,3,}$ P, Q, F, $V_{L1-2,L2-3,L3-1}$ --- I_{L1} (2.4x) (Window 1%) I_{L2} (2.4x) (Window 1%) I_{L3} (2.4x) (Window 1%) V_{L1} (1.2x) (Window 1%) V_{L2} (1.2x) (Window 1%) V_{L3} (1.2x) (Window 1%) P (2.4x) (Window 1%) Q (2.4x) (Window 1%) F (1.2x) (Window 0.1%) V_{L1-2} (1.2x) (Window 1%) V_{L2-3} (1.2x) (Window 1%) V_{L3-1} (1.2x) (Window 1%) PF (1.2x) (Window 1%)	9	Cyclic - Refresh rate 5 seconds or value change greater than Window x %
183	236	Measurand Max $I_{a,b,c,}$ $V_{an,bn,cn}$ P, Q, $V_{ab,bc,ca}$ --- I_a Max (2.4x) (Window 1%) I_b Max (2.4x) (Window 1%) I_c Max (2.4x) (Window 1%) V_{an} Max_1 (1.2x) (Window 1%) V_{bn} Max_2 (1.2x) (Window 1%) V_{cn} Max_3 (1.2x) (Window 1%) P Max (2.4x) (Window 1%) Q Max (2.4x) (Window 1%) V_{ab} Max (1.2x) (Window 1%) V_{bc} Max (1.2x) (Window 1%) V_{ca} Max (1.2x) (Window 1%)	9	Cyclic - Refresh rate 5 seconds or value change greater than Window x %.

NOTE

Some of the events which are listed above (applicable for the variant) and not available in the device can be enabled through Communication Editor software.

3 Modbus RTU

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3.1 Protocol Characteristics

Description

This section describes the MODBUS-RTU protocol implementation in the relays. This protocol is used for the communication with a suitable control system.

This protocol can be set to use any or all of the relays hardware interfaces (USB and RS485) where fitted. The relay can communicate simultaneously on all ports regardless of protocol used.

The Station Address of the port being used must be set to a suitable address within the range 1 - 247 to enable communication. This can be set by the **`Communications Menu`** : ***`COM n-xxxxx Station Address`*** setting.

Definitions with shaded area are not available on all relay models.

3.2 Modbus Register Data Types

3.2.1 FLOAT_IEEE_754

The float data type conforms to the IEEE 754 floating point definition. This specifies that 32 bits of data will be formatted as a sign bit in the most significant bit (MSB) followed by an 8 bit exponent then a 23 bit mantissa, down to the least significant bit (LSB).

MSB																													LSB
Sign	Exponent								Mantissa																				

FLOAT_IEEE_754 IN DETAIL

The exponent is an 8 bit unsigned integer. To allow for negative exponents, it is offset by 127. Therefore the actual exponent is e - 127. The following table shows a detailed layout of the exponent.

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

The mantissa contains the fractional part of a number normalized to the form 1.xyz i.e. in this instance xyz. The mantissa represents the binary fraction of a number; therefore the MSB represents 2^{-1} (or $1/2^1$) and its LSB 2^{-23} (or $1/2^{23}$). The following table shows a detailed layout of the mantissa.

$1/2^1$	$1/2^2$	$1/2^3$	$1/2^4$		$1/2^{21}$	$1/2^{22}$	$1/2^{23}$
0.5	0.25	0.125	0.0625		4.768e-7	2.384e-7	1.192e-7

As an example 1,000,000 would be represented as follows (hex 49742400).

4				9				7				4				2				4				0				0			
0	1	0	0	1	0	0	1	0	1	1	1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0

This calculates out as:

Sign = +1

Exponent = 10010010_2 = 128 + 16 + 2 = 146, subtract 127 = 19

Mentissa = $1 + (1/2^1) + (1/2^2) + (1/2^3) + (1/2^5) + (1/2^{10}) + (1/2^{13})$

$= 1 + (7433/2^{13})$

= 1.907348632

Therefore Sign $\cdot 2^{\text{Exponent}} \cdot$ Mantissa $= 1 \cdot 2^{19} \cdot 1.907348632 = 1000000$

FLOAT_IEEE_754 & MODBUS

In this MODBUS implementation the 32 bit float is stored in 2 16 registers in Big-Endian format. As an example, if we take the hex representation of 1,000,000 as a float (from above) we have 49742400h. Assume this is stored in the registers 30001 and 30002, it would look as follows.

Address	**Value**
30001	4974
30002	2400

3.2.2 FP_32BITS_3DP

The FP_32BITS_3DP is a 32-bit integer fixed-point number containing 3 decimal places of information. It is used to send a real value to 3 decimal places as an integer. For example, if the value in a device is 123.456, it is sent as 123456. As it is an integer, negative numbers are sent as 2's complement.

FP_32BITS_3DP and MODBUS

In this Modbus implementation, the 32 bit value is stored in two 16-bit registers in Big-Endian format. For example, if you consider the hex representation of 123456, we have 1E240h.
The following table shows how the registers 30001 and 30002 are stored.

Table 3-1 FP_32BITS_3DP and Modbus

Address	Value
30001	1
30002	E240

On reception, these two 16-bit registers are interpreted in the correct order as a 32-bit integer.

3.2.3 UINT32

The UINT32 is a signed 32-bit integer. As it is an integer, negative numbers are sent as 2's complement.

UINT32 & MODBUS

In this Modbus implementation, the 32 bit value is stored in two 16-bit registers in Big-Endian format. As an example, if you consider the hex representation of -123456, in 2's complement, we have FFFE1DC0h.
The following table shows how the registers 30001 and 30002 are stored.

Address	Value
30001	FFFE
30002	1DC0

On reception, these two 16-bit registers are interpreted in the correct order as a 32-bit integer.

3.2.4 UINT16

The UINT16 is a signed 16-bit integer. As it is an integer, negative numbers are sent as 2's complement.

UINT16 & MODBUS

In this Modbus implementation, the 16-bit value is stored in a 16-bit register in big-endian format. For example, if you consider the hex representation of 5678, we have 162Eh.
The following table shows how the register 30001 is stored.

Table 3-2 UINT16 and Modbus

Address	Value
30001	162E

On reception, this 16-bit register is interpreted in the correct order as a 16-bit integer.

Truncation

The calculations are performed as 32-bit value. The 16-bit value is the lowest 16 bits of the 32-bit value. Therefore, when values overflow, the returned value is the lowest 16 bits of the calculated value. For example,

if the value is 85400 = 14D98h, then the value returned would be the lowest 16 bits = 4D98h which equals 19864.

3.2.5 EVENT

Modbus does not define a method for extracting the events, therefore a private method has been defined based on IEC 60870-5-103.

The EVENT register contains the earliest event record available. The following format describes the event record as 8 registers (16 bytes) of information. When this record is read, it is replaced with the next available record. Event records must be read completely, therefore the quantity value must be set to 8 before reading. A failure to read, results in an exception code 2. If no event record is present, then exception code 2 is returned. The EVENT register is polled regularly by the master for events.

The EVENTCOUNT register can be checked periodically to determine how many events are stored.

Format

The format of the event record is defined by the 0 byte. It signifies the type of record which is used to decode the event indications. The 0 byte can be one of the following:

Table 3-3 Format

Type	Description
1	Event
2	Event with relative time
4	Measurand event with relative time

The following table describes the fields in the event record.

Table 3-4 Event Record

Key	Description
FUN	Function type, as defined for IEC 60870-5-103
INF	Information number, as defined for IEC 60870-5-103
DPI	Measurand event with relative time, values: 1 = OFF 2 = ON
ms L	Time stamp in milliseconds low byte
ms H	Time stamp in milliseconds high byte
Mi	Time stamp in minutes (MSB = invalid, time not set > 23 h)
Ho	Time stamp in hours (MSB = Summer time flag)
RT L	Relative time low byte
RT H	Relative time high byte
F# L	Fault number low byte
F# H	Fault number high byte
Meas	Measurand format R32.23, sent least significant byte first

The following tables show the fields in the different event records as they are returned:

Table 3-5 Event Type 1 Format

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Content	1	0	FUN	INF	DPI	0	0	0	0	0	0	0	ms L	ms H	Mi	Ho

Table 3-6 Event Type 2 Format

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Content	2	0	FUN	INF	DPI	RT L	RT H	F # L	F # H	0	0	0	ms L	ms H	Mi	Ho

Table 3-7 Event Type 4 Format

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Content	4	0	FUN	INF	Meas				0	0	0	0	ms L	ms H	Mi	Ho

3.2.6 EVENTCOUNT

The EVENTCOUNT register contains the current number of events in the relay's event buffer. On reception, the register is intepreted as a 16-bit integer.

3.2.7 TIME_METER

The TIME_METER register contains the devices time. The time is read or written in one step, therefore the quantity is 4 registers. The failure to read or write results in an exception code 2.
The following table shows the time format is 8 bytes and describes the fields in the time.

Table 3-8 Time Meter

Key	Description
ms L	Time stamp in milliseconds low byte
ms H	Time stamp in milliseconds high byte
Mi	Time stamp in minutes (MSB = invalid, time not set > 23 h)
Ho	Time stamp in hours (MSB = Summer time flag)
Da	Time stamp in days
Mo	Time stamp in months
Ye L	Time stamp in years low byte
Ye H	Time stamp in years high byte (Not used)

The following table shows the time fields as return.

Table 3-9 Time Format

Byte	0	1	2	3	4	5	6	7
Content	ms L	ms H	Mi	Ho	Da	Mo	Ye L	Ye H

3.2.8 STR32 & STR64

3.2.8.1 BITSTRING

A bit string (or bit-array) is a method of compactly storing a number of bits of data. In this instance, you can store up to 16 bit values, for example the states of binary inputs in a single 16-bit register. The first bit value is stored in the least significant bit (LSB) of the register. The 16th value is stored in the most significant bit (MSB). The bit values can only be 0 or 1. Any unused bits are set to 0.

BITSTRING & MODBUS

In Modbus implementation, the 16-bit value is stored in a 16-bit register in big-endian format. For example, if the bits 1, 3, 9, and 12 are set, then the binary representation is 0000100100000101 giving a hex representation of 0905h.

The following table shows how the register 30001 is stored:

Table 3-10 Bit String

Address	Value
30001	0905

On reception, the register is intepreted in the correct order as a 16-bit integer.

3.3 Points List

3.3.1 Coils (Read/Write Binary Values)

The following table shows the default configuration. You can modify the default configuration using the **Communications Configuration Editor** tool.

Table 3-11 Coils (Read/Write Binary Values)

Address	Description
00001	Binary output 1
00002	Binary output 2
00003	Binary output 3
00004	Binary output 4
00005	Binary output 5
00006	Binary output 6
00100	LED reset (Write only location)
00101	Setting G1 selected
00102	Setting G2 selected
00103	Setting G3 selected
00104	Setting G4 selected
00109	CB 1
00110	CB 1 Trip and Reclose
00111	CB 1 Trip and Lockout
00112	Auto-reclose active
00113	HotLine Working
00114	E/F Out
00115	SEF Out
00116	Inst Protection Out
00118	Reset CB Total Trip Count
00119	Reset CB Delta Trip Count
00120	Reset CB Count To AR Block
00121	Reset CB Frequent Ops Count
00123	Reset I^2t CB Wear
00126	Demand metering reset
00154	Reset Energy Meters
00155	Remote mode
00156	Out of Service Mode
00157	Local mode
00158	Local and Remote
00165	Reset Start Count
00180	CB 1 Opened
00181	CB 1 Closed
00200	User SP Command 1
00201	User SP Command 2
00202	User SP Command 3
00203	User SP Command 4
00204	User SP Command 5
00205	User SP Command 6

Address	Description
00206	User SP Command 7
00207	User SP Command 8
00208	User DP Command 1
00209	User DP Command 2
00210	User DP Command 3
00211	User DP Command 4
00212	User DP Command 5
00213	User DP Command 6
00214	User DP Command 7
00215	User DP Command 8
00226	Block 27/59
00227	Cmd Trip

3.3.2 Inputs (Read Only Binary values)

Table 3-12 Inputs (Read Only Binary values)

Address	Description
10001	Binary Input 1
10002	Binary Input 2
10003	Binary Input 3
10004	Binary Input 4
10005	Binary Input 5
10006	Binary Input 6
10007	Binary Input 7
10008	Binary Input 8
10009	Binary Input 9
10102	Remote Mode
10103	Out Of Service Mode
10104	Local Mode
10105	Local & Remote
10110	General Trip
10111	Trip Circuit Fail
10112	Start/Pick-up L1
10113	Start/Pick-up L2
10114	Start/Pick-up L3
10115	General Start/Pick-up
10116	VT Fuse Failure
10117	Earth Fault Forward/Line
10118	Earth Fault Reverse/Busbar
10119	Start/Pick-up N
10120	Fault Forward/Line
10121	Fault Reverse/Busbar
10122	51-1
10123	50-1
10124	51N-1
10125	50N-1

Address	Description
10126	51G-1
10127	50G-1
10128	51-2
10129	50-2
10130	51N-2
10131	50N-2
10132	51G-2
10133	50G-2
10134	51-3
10135	50-3
10136	51N-3
10137	50N-3
10138	51G-3
10139	50G-3
10140	51-4
10141	50-4
10142	51N-4
10143	50N-4
10144	51G-4
10145	50G-4
10146	50BF Stage 2
10147	49-Alarm
10148	49-Trip
10149	60 CTS
10150	46IT
10151	46DT
10152	47-1
10153	47-2
10154	46BC
10155	27/59-1
10156	27/59-2
10157	27/59-3
10158	27/59-4
10159	59NIT
10160	59NDT
10161	81-1
10162	81-2
10163	81-3
10164	81-4
10167	64H
10168	37-1
10169	37-2
10171	Auto-reclose active
10172	CB on by auto reclose
10173	Reclaim
10174	Lockout
10175	HotLine Working

Address	Description
10176	Inst Protection Out
10177	CB Total Trip Count
10178	CB Delta Trip Count
10179	CB Count To AR Block
10180	I^2t CB Wear
10181	79 AR In progress
10182	Cold Load Active
10183	E/F Out
10184	P/F Inst Protection Inhibited
10185	E/F Inst Protection Inhibited
10186	SEF Inst Protection Inhibited
10187	Ext Inst Protection Inhibited
10202	51SEF-1
10203	50SEF-1
10204	51SEF-2
10205	50SEF-2
10206	51SEF-3
10207	50SEF-3
10208	51SEF-4
10209	50SEF-4
10210	SEF Out
10211	Trip Circuit Fail 1
10212	Trip Circuit Fail 2
10213	Trip Circuit Fail 3
10214	CB Total Trip Count
10215	CB Delta Trip Count
10216	CB Count To AR Block
10217	CB Frequent Ops Count
10218	I^2t CB Wear
10219	CB 1 Opened
10220	CB 1 Closed
10283	Close Circuit Fail 1
10284	Close Circuit Fail 2
10285	Close Circuit Fail 3
10286	Close Circuit Fail
10288	SEF Forward/Line
10289	SEF Reverse/Busbar
10290	General Alarm 1
10291	General Alarm 2
10292	General Alarm 3
10293	General Alarm 4
10294	General Alarm 5
10295	General Alarm 6
10302	Quick Logic E1
10303	Quick Logic E2
10304	Quick Logic E3
10305	Quick Logic E4

Address	Description
10334	60 CTS-I
10335	81HBL2
10336	37G-1
10337	37G-2
10338	37SEF-1
10339	37SEF-2
10367	50BF Stage 1
10368	Wattmetric Po>
10369	37-PhA
10370	37-PhB
10371	37-PhC
10372	50 LC-1
10373	50 LC-2
10374	50G LC-1
10375	50G LC-2
10376	50SEF LC-1
10377	50SEF LC-2
10378	50BF-PhA
10379	50BF-PhB
10380	50BF-PhC
10381	50BF-EF
10383	60 CTS-I-PhA
10384	60 CTS-I-PhB
10385	60 CTS-I-PhC
10390	Trip PhA
10391	Trip PhB
10392	Trip PhC
10401	27/59 PhA
10402	27/59 PhB
10403	27/59 PhC
10410	CB Alarm
10431	67SEF-1
10432	67SEF-2
10501	Virtual Input 1
10502	Virtual Input 2
10503	Virtual Input 3
10504	Virtual Input 4
10505	Virtual Input 5
10506	Virtual Input 6
10507	Virtual Input 7
10508	Virtual Input 8
10601	LED 1
10602	LED 2
10603	LED 3
10604	LED 4
10605	LED 5
10606	LED 6

Address	Description
10607	LED 7
10608	LED 8
10609	LED 9
10701	LED PU 1
10702	LED PU 2
10703	LED PU 3
10704	LED PU 4
10705	LED PU 5
10706	LED PU 6
10707	LED PU 7
10708	LED PU 8
10709	LED PU 9
10800	Cold Start
10802	Re-Start
10803	Power On
10804	Expected Restart
10805	Unexpected Restart
10806	Reset Start Count
10900	User SP Command 1
10901	User SP Command 2
10902	User SP Command 3
10903	User SP Command 4
10904	User SP Command 5
10905	User SP Command 6
10906	User SP Command 7
10907	User SP Command 8
10908	User DP Command 1
10909	User DP Command 2
10910	User DP Command 3
10911	User DP Command 4
10912	User DP Command 5
10913	User DP Command 6
10914	User DP Command 7
10915	User DP Command 8
10916	32-1
10917	32-2
10918	32S-1
10919	32S-2
10920	55-1
10921	55-2
11073	CB DBI
11074	CB Travelling
11075	Close CB Failed
11076	Open CB Failed
11077	Start Count Alarm
11078	50AFD PhA
11079	50AFD PhB

Address	Description
11080	50AFD PhC
11081	50AFD
11082	AFD Zone 1 Flash
11083	AFD Zone 1
11084	AFD Zone 2 Flash
11085	AFD Zone 2
11086	AFD Zone 3 Flash
11087	AFD Zone 3
11088	AFD Zone 4 Flash
11089	AFD Zone 4
11090	AFD Zone 5 Flash
11091	AFD Zone 5
11092	AFD Zone 6 Flash
11093	AFD Zone 6
11118	81I-THD
11120	59.S1
11121	59.S2
11122	27.S1
11123	27.S2
11124	59V0
11125	59 PhAB
11126	59 PhBC
11127	59 PhCA
11128	27 PhAB
11129	27 PhBC
11130	27 PhCA
11131	59V0 Pickup
11132	81V 59V2 Pickup
11133	81V 27V1 Pickup
11134	81.S1 O/F
11135	81.S1 U/F
11136	81.S2 O/F
11137	81.S2 U/F
11138	81V Unblock
11139	PI Trip
11140	Loc 81V En
11141	DDI Open

3.3.3 Input Registers (Read Only Registers)

Table 3-13 Input Registers (Read Only Registers)

Address	Description	Format	Mult	Description
30001	Event Count	EVENTCOUNT	0.000000	Events Counter
30002	Event	EVENT	0.000000	8 Registers
30010	V_{ab} Primary	FP_32BITS_3DP	1.000000	V_{ab} V
30012	V_{bc} Primary	FP_32BITS_3DP	1.000000	V_{bc} V

Address	Description	Format	Mult	Description
30014	V_{ca} Primary	FP_32BITS_3DP	1.000000	V_{ca} V
30016	V_a Primary	FP_32BITS_3DP	1.000000	V_a V
30018	V_b Primary	FP_32BITS_3DP	1.000000	V_b V
30020	V_c Primary	FP_32BITS_3DP	1.000000	V_c V
30022	V_a Secondary	FP_32BITS_3DP	1.000000	V_a V
30024	V_b Secondary	FP_32BITS_3DP	1.000000	V_b V
30026	V_c Secondary	FP_32BITS_3DP	1.000000	V_c V
30034	V_{ab} Nominal	FP_32BITS_3DP	1.000000	V_{ab} Degrees
30036	V_{bc} Nominal	FP_32BITS_3DP	1.000000	V_{bc} Degrees
30038	V_{ca} Nominal	FP_32BITS_3DP	1.000000	V_{ca} Degrees
30040	V_a Nominal	FP_32BITS_3DP	1.000000	V_a Degrees
30042	V_b Nominal	FP_32BITS_3DP	1.000000	V_b Degrees
30044	V_c Nominal	FP_32BITS_3DP	1.000000	V_c Degrees
30048	V_{zps}	FP_32BITS_3DP	1.000000	V_{zps} V
30050	V_{pps}	FP_32BITS_3DP	1.000000	V_{pps} V
30052	V_{nps}	FP_32BITS_3DP	1.000000	V_{nps} V
30054	V_{zps}	FP_32BITS_3DP	1.000000	V_{zps} Degrees
30056	V_{pps}	FP_32BITS_3DP	1.000000	V_{pps} Degrees
30058	V_{nps}	FP_32BITS_3DP	1.000000	V_{nps} Degrees
30060	Frequency	FP_32BITS_3DP	1.000000	Frequency Hz
30064	I_a Primary	FP_32BITS_3DP	1.000000	I_a A
30066	I_b Primary	FP_32BITS_3DP	1.000000	I_b A
30068	I_c Primary	FP_32BITS_3DP	1.000000	I_c A
30070	I_a Secondary	FP_32BITS_3DP	1.000000	I_a A
30072	I_b Secondary	FP_32BITS_3DP	1.000000	I_b A
30074	I_c Secondary	FP_32BITS_3DP	1.000000	I_c A
30076	I_a Nominal	FP_32BITS_3DP	1.000000	I_a xI_n
30078	I_b Nominal	FP_32BITS_3DP	1.000000	I_b xI_n
30080	I_c Nominal	FP_32BITS_3DP	1.000000	I_c xI_n
30082	I_a Nominal	FP_32BITS_3DP	1.000000	I_a Degrees
30084	I_b Nominal	FP_32BITS_3DP	1.000000	I_b Degrees
30086	I_c Nominal	FP_32BITS_3DP	1.000000	I_c Degrees
30088	I_n Primary	FP_32BITS_3DP	1.000000	I_n A
30090	I_n Secondary	FP_32BITS_3DP	1.000000	I_n A
30092	I_n Nominal	FP_32BITS_3DP	1.000000	I_n xI_{nom}
30094	I_g Primary	FP_32BITS_3DP	1.000000	I_g A
30096	I_g Secondary	FP_32BITS_3DP	1.000000	I_g A
30098	I_g Nominal	FP_32BITS_3DP	1.000000	I_g xI_{nom}
30100	I_{zps} Nominal	FP_32BITS_3DP	1.000000	I_{zps} xI_n
30102	I_{pps} Nominal	FP_32BITS_3DP	1.000000	I_{pps} xI_n
30104	I_{nps} Nominal	FP_32BITS_3DP	1.000000	I_{nps} xI_n

Address	Description	Format	Mult	Description
30106	I_{zps} Nominal	FP_32BITS_3DP	1.000000	I_{zps} Degrees
30108	I_{pps} Nominal	FP_32BITS_3DP	1.000000	I_{pps} Degrees
30110	I_{nps} Nominal	FP_32BITS_3DP	1.000000	I_{nps} Degrees
30112	Active Power A	FP_32BITS_3DP	0.000001	A Phase W
30114	Active Power B	FP_32BITS_3DP	0.000001	B Phase W
30116	Active Power C	FP_32BITS_3DP	0.000001	C Phase W
30118	P (3P)	FP_32BITS_3DP	0.000001	3 Phase W
30120	Reactive Power A	FP_32BITS_3DP	0.000001	Phase A VAr
30122	Reactive Power B	FP_32BITS_3DP	0.000001	Phase B VAr
30124	Reactive Power C	FP_32BITS_3DP	0.000001	Phase C VAr
30126	Q (3P)	FP_32BITS_3DP	0.000001	3 Phase VAr
30128	Apparent Power A	FP_32BITS_3DP	0.000001	Phase A VA
30130	Apparent Power B	FP_32BITS_3DP	0.000001	Phase B VA
30132	Apparent Power C	FP_32BITS_3DP	0.000001	Phase C VA
30134	S (3P)	FP_32BITS_3DP	0.000001	3 Phase VA
30136	Power Factor A	FP_32BITS_3DP	1.000000	Phase A
30138	Power Factor B	FP_32BITS_3DP	1.000000	Phase B
30140	Power Factor C	FP_32BITS_3DP	1.000000	Phase C
30142	Power Factor(3P)	FP_32BITS_3DP	1.000000	3 Phase
30144	Act Energy Exp	UINT32	1.000000	Act Energy Exp
30146	Act Energy Imp	UINT32	1.000000	Act Energy Imp
30148	React Energy Exp	UINT32	1.000000	React Energy Exp
30150	React Energy Imp	UINT32	1.000000	React Energy Imp
30152	Thermal Status Ph A	UINT16	1.000000	Thermal Status Ph A %
30153	Thermal Status Ph B	UINT16	1.000000	Thermal Status Ph B %
30154	Thermal Status Ph C	UINT16	1.000000	Thermal Status Ph C %
30167	Fault Records	UINT16	1.000000	Fault Records
30168	Event Records	UINT16	1.000000	Event Records
30169	Waveform Records	UINT16	1.000000	Waveform Records
30170	V_{ab} Secondary	FP_32BITS_3DP	1.000000	V_{ab} V
30172	V_{bc} Secondary	FP_32BITS_3DP	1.000000	V_{bc} V
30174	V_{ca} Secondary	FP_32BITS_3DP	1.000000	V_{ca} V
30176	V_n Primary	FP_32BITS_3DP	1.000000	V_n V
30178	V_n Secondary	FP_32BITS_3DP	1.000000	V_n V
30180	V_n Secondary	FP_32BITS_3DP	1.000000	V_n Degrees
30193	I Phase A Max	FP_32BITS_3DP	1.000000	I_a Max Demand
30195	I Phase B Max	FP_32BITS_3DP	1.000000	I_b Max Demand
30197	I Phase C Max	FP_32BITS_3DP	1.000000	I_c Max Demand
30199	P 3P Max	FP_32BITS_3DP	0.000001	Power Max Demand
30201	Q 3P Max	FP_32BITS_3DP	0.000001	VARs Max Demand
30207	I_{sef} Primary	FP_32BITS_3DP	1.000000	I_{sef} A
30209	I_{sef} Secondary	FP_32BITS_3DP	1.000000	I_{sef} A

Address	Description	Format	Mult	Description
30211	I_{sef} Nominal	FP_32BITS_3DP	1.000000	I_{sef} xInom
30241	CB Total Trip Count	UINT32	1.000000	CB Total Trip Count
30243	CB Delta Trip Count	UINT32	1.000000	CB Delta Trip Count
30245	CB Count To AR Block	UINT32	1.000000	CB Count to AR Block
30247	CB Frequent Ops Count	UINT32	1.000000	CB Frequent Ops Count
30301	I_a Last Trip	FP_32BITS_3DP	1.000000	I_a Fault
30303	I_b Last Trip	FP_32BITS_3DP	1.000000	I_b Fault
30305	I_c Last Trip	FP_32BITS_3DP	1.000000	I_c Fault
30307	V_a Last Trip	FP_32BITS_3DP	1.000000	V_a Fault
30309	V_b Last Trip	FP_32BITS_3DP	1.000000	V_b Fault
30311	V_c Last Trip	FP_32BITS_3DP	1.000000	V_c Fault
30313	I_n Last Trip	FP_32BITS_3DP	1.000000	I_n Fault
30315	I_g Last Trip	FP_32BITS_3DP	1.000000	I_g Fault
30317	I_{sef} Last Trip	FP_32BITS_3DP	1.000000	I_{sef} Fault
30319	V Phase A Max	FP_32BITS_3DP	1.000000	V_a Max Demand
30321	V Phase B Max	FP_32BITS_3DP	1.000000	V_b Max Demand
30323	V Phase C Max	FP_32BITS_3DP	1.000000	V_c Max Demand
30325	V Phase AB Max	FP_32BITS_3DP	1.000000	V_{ab} Max Demand
30327	V Phase BC Max	FP_32BITS_3DP	1.000000	V_{bc} Max Demand
30329	V Phase CA Max	FP_32BITS_3DP	1.000000	V_{ca} Max Demand
30341	LED1-n	BITSTRING	0.000000	Led 1-16 status
30342	LED1-n	BITSTRING	0.000000	Led 17-32 status
30343	INP1-n	BITSTRING	0.000000	Input 1-16 status
30344	INP1-n	BITSTRING	0.000000	Input 17-32 status
30345	OUT1-n	BITSTRING	0.000000	Output 1-16 status
30346	OUT1-n	BITSTRING	0.000000	Output 17-32 status
30347	VRT1-n	BITSTRING	0.000000	Virtual 1-16 status
30348	VRT1-n	BITSTRING	0.000000	Virtual 17-32 status
30349	EQN1-n	BITSTRING	0.000000	Equation 1-16 status
30350	EQN1-n	BITSTRING	0.000000	Equation 17-32 status
30354	CB Wear A	FP_32BITS_3DP	0.000001	CB Wear A
30356	CB Wear B	FP_32BITS_3DP	0.000001	CB Wear B
30358	CB Wear C	FP_32BITS_3DP	0.000001	CB Wear C
30360	CB Wear A Remaining	FP_32BITS_3DP	1.000000	CB Wear A Remaining
30362	CB Wear B Remaining	FP_32BITS_3DP	1.000000	CB Wear B Remaining
30364	CB Wear C Remaining	FP_32BITS_3DP	1.000000	CB Wear C Remaining
30366	CB Wear Minimum	FP_32BITS_3DP	1.000000	CB Wear Minimum
30380	StartCount	FP_32BITS_3DP	1.000000	Start Count
30382	Start Count Target	FP_32BITS_3DP	1.000000	Start Count Target

Address	Description	Format	Mult	Description
30390	Freq Last Trip	FP_32BITS_3DP	1.000000	Freq Last Trip
30392	Active Setting Group	UINT16	1.000000	Active Setting Group
30400	Frequency Max	FP_32BITS_3DP	1.000000	Frequency Max
30402	S 3P Max	FP_32BITS_3DP	0.000010	S 3P Max
30468	CB Trip Time Meter	FP_32BITS_3DP	1.000000	CB Trip Time
30484	AFDZone1Count	UINT32	1.000000	AFD Zone 1 Count
30486	AFDZone2Count	UINT32	1.000000	AFD Zone 2 Count
30488	AFDZone3Count	UINT32	1.000000	AFD Zone 3 Count
30490	AFDZone4Count	UINT32	1.000000	AFD Zone 4 Count
30492	AFDZone5Count	UINT32	1.000000	AFD Zone 5 Count
30494	AFDZone6Count	UINT32	1.000000	AFD Zone 6 Count
30496	V_{ab} Last Trip	FP_32BITS_3DP	1.000000	V_{ab} Last Trip
30498	V_{bc} Last Trip	FP_32BITS_3DP	1.000000	V_{bc} Last Trip
30500	V_{ca} Last Trip	FP_32BITS_3DP	1.000000	V_{ca} Last Trip
30502	V_{n} Last Trip	FP_32BITS_3DP	1.000000	V_{n} Last Trip
30578	I_{a} THD	FP_32BITS_3DP	1.000000	81THD Ia %
30580	I_{b} THD	FP_32BITS_3DP	1.000000	81THD Ib %
30582	I_{c} THD	FP_32BITS_3DP	1.000000	81THD Ic %

3.3.4 Holding Registers (Read Write Registers)

Table 3-14 Holding Registers (Read Write Registers)

Address	Description		Format	Mult	Description
40001	Time		TIME_METER	0.000000	Time

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4.1 Protocol Characteristics

4.1.1 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 in fact a table, and only a component of a total interoperability guide. The table, in combination with the Implementation Table provided and the Point List Tables provided should provide a complete configuration/interoperability guide for communicating with a device implementing the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library.

<table>
<tr><td colspan="2">DNP V3.0
DEVICE PROFILE DOCUMENT</td></tr>
<tr><td colspan="2">Vendor Name: Siemens Protection Devices Ltd.</td></tr>
<tr><td colspan="2">Device Name: 7SR10, using the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library, Version 3.</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 07 and 08 (limited quantity), and 17 and 28 (index) are supported. Static object requests sent with qualifiers 07, or 08, will be responded with qualifiers 00 or 01.
Output Event Objects 11 is supported.</td></tr>
<tr><td>Maximum Data Link Frame Size (octets):
Transmitted: 256
Received: 256</td><td>Maximum Application Fragment Size (octets):
Transmitted: 2048
Received: 2048</td></tr>
<tr><td>Maximum Data Link Re-tries:
☐None
☐Fixed (3)
☒Configurable from 0 to 65535 (Default 3)</td><td>Maximum Application Layer Re-tries:
☒None
☐Configurable</td></tr>
</table>

Requires Data Link Layer Confirmation: ☐Never ☐Always ☐Sometimes **☒Configurable as: Never, Only for multi-frame messages, or Always**
Requires Application Layer Confirmation: ☐Never ☐Always **☒When reporting Event Data (Slave devices only)** **☒When sending multi-fragment responses (Slave devices only)** ☐Sometimes ☐Configurable as: “Only when reporting event data”, or “When reporting event data or multi-fragment messages.”
Timeouts while waiting for: Data Link Confirm: ☐None ☐Fixed at ____ ☐Variable **☒Configurable (2 sec)** Complete Appl. Fragment: **☒None** ☐Fixed at ____ ☐Variable ☐Configurable Application Confirm: ☐None ☐Fixed at ____ ☐Variable **☒Configurable (10 sec)** Complete Appl. Response: **☒None**☐ Fixed at ____ ☐Variable ☐Configurable Others: **Transmission Delay, (Configurable, default 0 sec)** **Select/Operate Arm Timeout, (Configurable, default 5 sec)** **Need Time Interval, (Configurable, default 30 minutes)** **Unsolicited Notification Delay, (Configurable, default 5 seconds)** **Unsolicited Response Retry Delay, (Configurable (between 3 - 9), default 5 seconds)** **Unsolicited Offline Interval, (Configurable, default 30 seconds)** **Binary Change Event Scan Period, (Polled; Not Applicable)** **Double Bit Change Event Scan Period, (Polled - Not Applicable)** **Analog Change Event Scan Period, (Polled - Not Applicable)** **Counter Change Event Scan Period, (Polled - Not Applicable)** **Frozen Counter Change Event Scan Period, (Polled - Not Applicable)** **String Change Event Scan Period, (Polled - Not Applicable)** **Virtual Terminal Event Scan Period, (Polled - Not Applicable)**
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 Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation.	
Reports Binary Input Change Events when no specific variation requested: ☐Never ☐Only time-tagged ☐Only non-time-tagged ☒**Configurable to send one or the other**	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** ☐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 Default Variation: ____ ☒**Point-by-point list attached**	Counters Roll Over at: ☐No Counters Reported ☐Configurable (attach explanation) ☐16 Bits ☒**32 Bits** ☐Other Value: _____ ☒**Point-by-point list attached**
Sends Multi-Fragment Responses: ☒**Yes** ☐No ☐Configurable	
Sequential File Transfer Support: File Transfer Support ☐Yes ☒**No** Append File Mode ☐Yes ☒**No** Custom Status Code Strings ☐Yes☒**No** Permissions Field ☐Yes ☒**No** File Events Assigned to Class ☐Yes ☒**No** File Events Send Immediately ☐Yes ☒**No** Multiple Blocks in a Fragment ☐Yes ☒**No** Max Number of Files Open **0**	

4.2 Implementation Table

The following table identifies which object variations, function codes, and qualifiers the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library supports in both request messages and in response messages. For static (non-change-event) objects, requests sent with qualifiers 00, 01, 06, 07, or 08, will be responded with qualifiers 00 or 01. 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.

In the table below, underlined text as 00, 01 (start stop) indicates Subset Level 3 functionality (beyond Subset Level 2).

In the table below, italic text as *07, 08 (limited qty)* indicates functionality beyond Subset Level 3.

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 – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*		
1	1	Binary Input	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 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)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
2	0	Binary Input Change – Any 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)

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)
3	0	Double Bit Input – Any Variation	*1 (read)* *22 (assign class)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*		
3	1 (default – see note 1)	Double Bit Input	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
3	2	Double Bit Input with Status	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
4	0	Double Bit Input Change – Any Variation	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*		
4	1	Double Bit Input Change without Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
4	2	Double Bit Input Change with Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
4	3 (default – see note 1)	Double Bit 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 – Any Variation	1 (read) *22 (assign class)*	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 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)
10	1	Binary Output	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
			2 (write)	*00, 01 (start-stop)*		
10	2 (default – see note 1)	Binary Output Status	1(read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 1)*
11	0	Binary Output Change – Any Variation	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*		
11	1	Binary Output Change without Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
11	2 (default – see note 1)	Binary Output Change with Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
12	0	Control Relay Output Block	*22 (assign class)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*		
12	1	Control Relay Output Block	3 (select) 4 (operate) 5 (direct op) 6 (dir. op, noack)	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
13	0	Binary Output Command – Any Variation	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*		
13	1 (default – see note 1)	Binary Output Command without Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
13	2	Binary Output Command Event with Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
20	0	Binary Counter - Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*		
			7 (freeze) 8 (freeze noack) 9 (freeze clear) 10 (frz. clr. noack)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)*		
20	1	32-Bit Binary Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
20	2	16-Bit Binary Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
20	3	32-Bit Delta Counter (with Flag)				
20	4	16-Bit Delta Counter (with Flag)				

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	5 (default – see note 1)	32-Bit Binary Counter (without Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
20	6	16-Bit Binary Counter (without Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
20	7	32-Bit Delta Counter (without Flag)				
20	8	16-Bit Delta Counter (without Flag)				
21	0	Frozen Counter - Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*		
21	1	32-Bit Frozen Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
21	2	16-Bit Frozen Counter (with Flag)	1 (read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
21	3	32-Bit Frozen Delta Counter (with Flag)				
21	4	16-Bit Frozen Delta Counter (with Flag)				

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	5	32-Bit Frozen Counter (without Time of Freeze)	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 2)*
21	6	16-Bit Frozen Counter (without Time of Freeze)	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 2)*
21	7	32-Bit Frozen Delta Counter (with Time of Freeze)				
21	8	16-Bit Frozen Delta Counter (with Time of Freeze)				
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, 27, 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, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
21	11	32-Bit Frozen Delta Counter (without Flag)				
21	12	16-Bit Frozen Delta Counter (without Flag)				
22	0	Counter Change Event - Any Variation	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)
22	1 (default - see note 1)	32-Bit Counter Change Event (without Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. response)	17, 28 (index)
22	2	16-Bit Counter Change Event (without Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. response)	17, 28 (index)
22	3	32-Bit Delta Counter Change Event (without Time)				
22	4	16-Bit Delta Counter Change Event (without Time)				
22	5	32-Bit Counter Change Event (with Time)	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. response)*	*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. response)*	*17, 28 (index)*
22	7	32-Bit Delta Counter Change Event (with Time)				
22	8	16-Bit Delta Counter Change Event (with Time)				
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 (default - see note 1)	32-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
23	2	16-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response)	17, 28 (index)
23	3	32-Bit Frozen Delta Counter Event				
23	4	16-Bit Frozen Delta Counter Event				

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)
23	5	32-Bit Frozen Counter Event (with Time)	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. response)*	*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. response)*	*17, 28 (index)*
23	7	32-Bit Frozen Delta Counter Event (with Time)				
23	8	16-Bit Frozen Delta Counter Event (with Time)				
30	0	Analog Input - Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*		
30	1	32-Bit Analog Input	1(read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
30	2 (default - see note 1)	16-Bit Analog Input	1(read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
30	3	32-Bit Analog Input (without Flag)	1(read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*
30	4	16-Bit Analog Input (without Flag)	1(read)	00, 01 (start-stop) 06 (no range, or all) *07, 08 (limited qty)* *17, 27, 28 (index)*	129 (response)	00, 01 (start-stop) *17, 28 (index – see note 2)*

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)
30	5	short floating point	*1(read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 2)*
30	6	long floating point	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
31	0	Frozen Analog Input - Any Variation				
31	1	32-Bit Frozen Analog Input				
31	2	16-Bit Frozen Analog Input				
31	3	32-Bit Frozen Analog Input (with Time of freeze)				
31	4	16-Bit Frozen Analog Input (with Time of freeze)				
31	5	32-Bit Frozen Analog Input (without Flag)				
31	6	16-Bit Frozen Analog Input (without Flag)				
32	0	Analog Change Event – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1 (default – see note 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	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)*
32	5	short floating point 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	6	long floating point 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	7	short floating point 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	8	long floating point Analog Change Event with Time	*1 (read)*	*06 (no range, or all)* *07, 08 (limited qty)*	*129 (response)* *130 (unsol. resp)*	*17, 28 (index)*
33	0	Frozen Analog Event - Any Variation				
33	1	32-Bit Frozen Event Input				
33	2	16-Bit Frozen Event Input				
33	3	32-Bit Frozen Event Input (with Time)				
33	4	16-Bit Frozen Analog Event (with Time)				
33	5	Short Floating Point Frozen Analog Event				
33	6	Long Floating Point Frozen Analog Event				
33	7	Extended Floating Point Frozen Analog Event				

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)
34	0	Analog Input 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, 27, 28 (index)*		
34	1	16-bit Analog Input Deadband	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
			2(write)	*00, 01 (start-stop)* *07, 08 (limited qty)* *17, 27, 28 (index)*		
34	2 (default - see note 1)	32-bit Analog Input Deadband	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
			2(write)	*00, 01 (start-stop)* *07, 08 (limited qty)* *17, 27, 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)
34	3	Short Floating Point Analog Input Deadband	*1 (read)*	*00, 01 (start-stop)* *06 (no range, or all)* *07, 08 (limited qty)* *17, 27, 28 (index)*	*129 (response)*	*00, 01 (start-stop)* *17, 28 (index – see note 1)*
			2(write)	*00, 01 (start-stop)* *07, 08 (limited qty)* *17, 27, 28 (index)*		
50	0	Time and Date				
50	1 (default – see note 1)	Time and Date	1(read)	07, (limited qty = 1)	129 (response)	07 (limited qty = 1)
			2(write)	*00, 01 (start-stop)* *07, 08 (limited qty)* *17, 27, 28 (index)*		
50	3	Time and Date Last Recorded Time	*2(write)*	*07 (limited qty)*		
51	1	Time and Date CTO			129 (response) 130 (unsol. resp)	07 (limited qty) (qty = 1)
51	2	Unsynchronized Time and Date CTO			129 (response) 130 (unsol. resp)	07 (limited qty) (qty = 1)
52	1	Time Delay Coarse			129 (response)	07 (limited qty) (qty = 1)
52	2	Time Delay Fine			129 (response)	07 (limited qty) (qty = 1)
60	0	Not Defined				
60	1	Class 0 Data	1 (read)	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 (dab. 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	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.) 21 (dab. 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)		
			20 (enbl. unsol.) 21 (dab. unsol.) 22 (assign class)	06 (no range, or all)		
80	1	Internal Indications	1 (read)	00, 01 (start-stop)	129 (response)	00, 01 (start-stop)
			2 (write) (see note 3)	00 (start-stop) index=7		
	No Object (function code only)		13 (cold restart)			
	-		-			
	No Object (function code only)		23 (delay meas.)			
	No Object (function code only)		24 (record current time)			

NOTE

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 are configurable; however, default settings for the configuration parameters are indicated in the table above.

NOTE

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.)

NOTE

Note 3: Writes of Internal Indications are only supported for index 7 (Restart IIN1-7)

4.3 Point List

4.3.1 Overview

The tables below identify all the default data points provided by the implementation of the Triangle Micro-Works, Inc. DNP 3.0 Slave Source Code Library.

This protocol can be set to use any or all of the relays hardware interfaces (USB and RS485) where fitted. The relay can communicate simultaneously on all ports regardless of protocol used.

The Station Address of the port being used must be set to a suitable address within the range 0 - 65534 to enable communication. This can be set by the Communications Menu : **`COM n-xxxxx Station Address`** setting.

The information shown below is the default configuration. This can be modified using the Communications Configuration Editor tool.

4.3.2 Binary Input Points

The default binary input event buffer size is set to allow 100 events. Binary inputs are by default returned in a class zero interrogation.

Note, not all points listed here apply to all builds of devices.

Binary Input Points	
Static (Steady-State) Object Number	1 (Packed Format)
Change Event Object Number	1 (w/o Time)
Static Variation reported when variation 0 requested	1 (Binary Input w/o status) or 2 (Binary Input with status1 (Binary Input w/o status) or 2 (Binary Input with status
Change Event Variation reported when variation 0 requested	1 (Binary Input Change w/o Time) or 2 (Binary Input Change with Absolute Time) or 3 (Binary Input Change with Relative Time)

Table 4-1 Binary Input Points

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
1	Binary Input 1	0,2	2	2
2	Binary Input 2	0,2	2	2
3	Binary Input 3	0,2	2	2
4	Binary Input 4	0,2	2	2
5	Binary Input 5	0,2	2	2
6	Binary Input 6	0,2	2	2
7	Binary Input 7	0,2	2	2
8	Binary Input 8	0,2	2	2
9	Binary Input 9	0,2	2	2
35	Remote Mode	0,2	2	2
36	Out Of Service Mode	0,2	2	2
37	Local Mode	0,2	2	2
38	Local & Remote	0,2	2	2
40	General Trip	0,2	2	2
41	Trip Circuit Fail	0,2	2	2

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
42	Start/Pick-up L1	0,2	2	2
43	Start/Pick-up L2	0,2	2	2
44	Start/Pick-up L3	0,2	2	2
45	General Start/Pick-up	0,2	2	2
46	VT Fuse Failure	0,2	2	2
47	Earth Fault Forward/Line	0,2	2	2
48	Earth Fault Reverse/Busbar	0,2	2	2
49	Start/Pick-up N	0,2	2	2
50	Fault Forward/Line	0,2	2	2
51	Fault Reverse/Busbar	0,2	2	2
52	51-1	0,2	2	2
53	50-1	0,2	2	2
54	51N-1	0,2	2	2
55	50N-1	0,2	2	2
56	51G-1	0,2	2	2
57	50G-1	0,2	2	2
58	51-2	0,2	2	2
59	50-2	0,2	2	2
60	51N-2	0,2	2	2
61	50N-2	0,2	2	2
62	51G-2	0,2	2	2
63	50G-2	0,2	2	2
64	60 CTS	0,2	2	2
65	46IT	0,2	2	2
66	46DT	0,2	2	2
67	47-1	0,2	2	2
68	47-2	0,2	2	2
69	46BC	0,2	2	2
70	27/59-1	0,2	2	2
71	27/59-2	0,2	2	2
72	27/59-3	0,2	2	2
73	27/59-4	0,2	2	2
74	59NIT	0,2	2	2
75	59NDT	0,2	2	2
76	81-1	0,2	2	2
77	81-2	0,2	2	2
78	81-3	0,2	2	2
79	81-4	0,2	2	2
80	Auto-reclose active	0,2	2	2
81	CB on by auto reclose	0,2	2	2
82	Reclaim	0,2	2	2
83	Lockout	0,2	2	2
86	51-3	0,2	2	2
87	50-3	0,2	2	2

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
88	51N-3	0,2	2	2
89	50N-3	0,2	2	2
90	51G-3	0,2	2	2
91	50G-3	0,2	2	2
92	51-4	0,2	2	2
93	50-4	0,2	2	2
94	51N-4	0,2	2	2
95	50N-4	0,2	2	2
96	51G-4	0,2	2	2
97	50G-4	0,2	2	2
98	Cold Load Active	0,2	2	2
99	E/F Out	0,2	2	2
100	P/F Inst Protection Inhibited	0,2	2	2
101	E/F Inst Protection Inhibited	0,2	2	2
102	SEF Inst Protection Inhibited	0,2	2	2
103	Ext Inst Protection Inhibited	0,2	2	2
117	51SEF-1	0,2	2	2
118	50SEF-1	0,2	2	2
119	51SEF-2	0,2	2	2
120	50SEF-2	0,2	2	2
121	51SEF-3	0,2	2	2
122	50SEF-3	0,2	2	2
123	51SEF-4	0,2	2	2
124	50SEF-4	0,2	2	2
125	SEF Out	0,2	2	2
126	Trip Circuit Fail 1	0,2	2	2
127	Trip Circuit Fail 2	0,2	2	2
128	Trip Circuit Fail 3	0,2	2	2
129	CB Total Trip Count	0,2	2	2
130	CB Delta Trip Count	0,2	2	2
131	CB Count To AR Block	0,2	2	2
132	CB Frequent Ops Count	0,2	2	2
133	I^2t CB Wear	0,2	2	2
207	Close Circuit Fail 1	0,2	2	2
208	Close Circuit Fail 2	0,2	2	2
209	Close Circuit Fail 3	0,2	2	2
210	Close Circuit Fail	0,2	2	2
211	50BF Stage 1	0,2	2	2
212	50BF Stage 2	0,2	2	2
213	49-Alarm	0,2	2	2
214	49-Trip	0,2	2	2
215	64H	0,2	2	2
217	37-1	0,2	2	2
218	37-2	0,2	2	2

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
219	CB Alarm	0,2	2	2
223	SEF Forward/Line	0,2	2	2
224	SEF Reverse/Busbar	0,2	2	2
225	General Alarm 1	0,2	2	2
226	General Alarm 2	0,2	2	2
227	General Alarm 3	0,2	2	2
228	General Alarm 4	0,2	2	2
229	General Alarm 5	0,2	2	2
230	General Alarm 6	0,2	2	2
237	Quick Logic E1	0,2	2	2
238	Quick Logic E2	0,2	2	2
239	Quick Logic E3	0,2	2	2
240	Quick Logic E4	0,2	2	2
269	60 CTS-I	0,2	2	2
270	81HBL2	0,2	2	2
271	37G-1	0,2	2	2
272	37G-2	0,2	2	2
273	Wattmetric Po>	0,2	2	2
274	37-PhA	0,2	2	2
275	37-PhB	0,2	2	2
276	37-PhC	0,2	2	2
277	50 LC-1	0,2	2	2
278	50 LC-2	0,2	2	2
279	50G LC-1	0,2	2	2
280	50G LC-2	0,2	2	2
281	50SEF LC-1	0,2	2	2
282	50SEF LC-2	0,2	2	2
283	50BF-PhA	0,2	2	2
284	50BF-PhB	0,2	2	2
285	50BF-PhC	0,2	2	2
286	50BF-EF	0,2	2	2
287	79 Last Trip Lockout	0,2	2	2
288	60 CTS-I-PhA	0,2	2	2
289	60 CTS-I-PhB	0,2	2	2
290	60 CTS-I-PhC	0,2	2	2
291	Trip PhA	0,2	2	2
292	Trip PhB	0,2	2	2
293	Trip PhC	0,2	2	2
302	27/59 PhA	0,2	2	2
303	27/59 PhB	0,2	2	2
304	27/59 PhC	0,2	2	2
330	32-1	0,2	2	2
331	32-2	0,2	2	2
332	32S-1	0,2	2	2

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
333	32S-2	0,2	2	2
334	55-1	0,2	2	2
335	55-2	0,2	2	2
371	67SEF-1	0,2	2	2
372	67SEF-2	0,2	2	2
373	37SEF-1	0,2	2	2
374	37SEF-2	0,2	2	2
411	Setting G1 selected	0,2	2	2
412	Setting G2 selected	0,2	2	2
413	Setting G3 selected	0,2	2	2
414	Setting G4 selected	0,2	2	2
420	79 AR In progress	0,2	2	2
422	HotLine Working	0,2	2	2
425	Inst Protection Out	0,2	2	2
427	CB 1	0,2	2	2
501	Virtual Input 1	0,2	2	2
502	Virtual Input 2	0,2	2	2
503	Virtual Input 3	0,2	2	2
504	Virtual Input 4	0,2	2	2
505	Virtual Input 5	0,2	2	2
506	Virtual Input 6	0,2	2	2
507	Virtual Input 7	0,2	2	2
508	Virtual Input 8	0,2	2	2
601	LED 1	0,2	2	2
602	LED 2	0,2	2	2
603	LED 3	0,2	2	2
604	LED 4	0,2	2	2
605	LED 5	0,2	2	2
606	LED 6	0,2	2	2
607	LED 7	0,2	2	2
608	LED 8	0,2	2	2
609	LED 9	0,2	2	2
701	LED PU 1	0,2	2	2
702	LED PU 2	0,2	2	2
703	LED PU 3	0,2	2	2
704	LED PU 4	0,2	2	2
705	LED PU 5	0,2	2	2
706	LED PU 6	0,2	2	2
707	LED PU 7	0,2	2	2
708	LED PU 8	0,2	2	2
709	LED PU 9	0,2	2	2
801	Binary Output 1	0,2	2	2
802	Binary Output 2	0,2	2	2
803	Binary Output 3	0,2	2	2

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
804	Binary Output 4	0,2	2	2
805	Binary Output 5	0,2	2	2
806	Binary Output 6	0,2	2	2
871	Cold Start	0,2	2	2
873	Re-Start	0,2	2	2
874	Power On	0,2	2	2
875	Expected Restart	0,2	2	2
876	Unexpected Restart	0,2	2	2
877	Reset Start Count	0,2	2	2
890	CB 1 Opened	0,2	2	2
891	CB 1 Closed	0,2	2	2
900	User SP Command 1	0,2	2	2
901	User SP Command 2	0,2	2	2
902	User SP Command 3	0,2	2	2
903	User SP Command 4	0,2	2	2
904	User SP Command 5	0,2	2	2
905	User SP Command 6	0,2	2	2
906	User SP Command 7	0,2	2	2
907	User SP Command 8	0,2	2	2
1063	CB DBI	0,2	2	2
1064	CB Travelling	0,2	2	2
1065	Close CB Failed	0,2	2	2
1066	Open CB Failed	0,2	2	2
1067	Start Count Alarm	0,2	2	2
1068	50AFD PhA	0,2	2	2
1069	50AFD PhB	0,2	2	2
1070	50AFD PhC	0,2	2	2
1071	50AFD	0,2	2	2
1072	AFD Zone 1 Flash	0,2	2	2
1073	AFD Zone 1	0,2	2	2
1074	AFD Zone 2 Flash	0,2	2	2
1075	AFD Zone 2	0,2	2	2
1076	AFD Zone 3 Flash	0,2	2	2
1077	AFD Zone 3	0,2	2	2
1078	AFD Zone 4 Flash	0,2	2	2
1079	AFD Zone 4	0,2	2	2
1080	AFD Zone 5 Flash	0,2	2	2
1081	AFD Zone 5	0,2	2	2
1082	AFD Zone 6 Flash	0,2	2	2
1083	AFD Zone 6	0,2	2	2
1108	81I-THD	0,2	2	2

4.3.3 Double Bit Input Points

The default double bit input event buffer size is set to allow 100 events. Double bit inputs are by default returned in a class zero interrogation.

Note, not all points listed here apply to all builds of devices.

Double Bit Input Points	
Static (Steady-State) Object Number	3
Change Event Object Number	4
Static Variation reported when variation 0 requested	1 (Double Bit Input w/o status) or 2 (Double Bit Input with status)
Change Event Variation reported when variation 0 requested	1 (Double Bit Input Change w/o Time) or 2 (Double Bit Input Change with Absolute Time) or 3 (Double Bit Input Change with Relative Time)

Table 4-2 Double Bit Input Points

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 3	Default Variation Event Object 4
0	CB 1	0,2	1	3
10	User DP Command 1	0,2	1	3
11	User DP Command 2	0,2	1	3
12	User DP Command 3	0,2	1	3
13	User DP Command 4	0,2	1	3
14	User DP Command 5	0,2	1	3
15	User DP Command 6	0,2	1	3
16	User DP Command 7	0,2	1	3
17	User DP Command 8	0,2	1	3

4.3.4 Binary Output Status Points and Control Relay Output Blocks

The following table lists both the Binary Output Status Points (Object 10) and the Control Relay Output Blocks (Object 12).

While Binary Output Status Points are included here for completeness, they are not often polled by DNP3 Masters. Binary Output Status points are not recommended to be included in class 0 polls.

As an alternative, it is recommended that “actual” state values of Control Relay Output Block points be looped around and mapped as Binary Inputs. (The “actual” status value, as opposed to the “commanded” status value, is the value of the actuated control. For example, a DNP control command may be blocked through hardware or software mechanisms; in this case, the actual status value would indicate the control failed because of the blocking. Looping Control Relay Output Block actual status values as Binary Inputs has several advantages:

- it allows actual statuses to be included in class 0 polls
- it allows change event reporting of the actual statuses, which is a more efficient and time-accurate method of communicating control values
- and it allows reporting of time-based information associated with controls, including any delays before controls are actuated, and any durations if the controls are pulsed

The default select/control buffer size is large enough to hold 10 of the largest select requests possible. Binary outputs are by default not returned in a class zero interrogation.

Note, not all points listed here apply to all builds of devices.

Binary Output Status Points	
Static (Steady-State) Object Number	10
Change Event Object Number	11
Control Relay Output Blocks (CROB) Object Number	12
Binary Output Command Event Object Number	13
Static Variation reported when variation 0 requested	1 (Binary Output w/o status) or 2 (Binary Output with status)
Change Event Variation reported when variation 0 requested	1 (Binary Output event w/o Time) or 2 (Binary Output Event with time)
Command Event Variation reported when variation 0 requested	1 (Command Status w/o Time) or 2 (Command Status with time)

Table 4-3 Binary Output Status Points

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
1	RL 1	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
2	RL 2	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
3	RL 3	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
4	RL 4	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
5	RL 5	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
6	RL 6	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
33	LED reset, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
34	Settings Group 1	0	2	2	0	1	Pulse On Latch On Paired Close	Latch On
35	Settings Group 2	0	2	2	0	1	Pulse On Latch On Paired Close	Latch On
36	Settings Group 3	0	2	2	0	1	Pulse On Latch On Paired Close	Latch On
37	Settings Group 4	0	2	2	0	1	Pulse On Latch On Paired Close	Latch On
42	Auto-reclose on/off	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off
43	Hot Line Working on/off	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off
44	E/F off/on	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off
45	SEF off/on	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
46	Inst Protection off/on	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off
48	Reset CB Total Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
49	Reset CB Delta Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
50	Reset CB Count To AR Block, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
51	Reset CB Frequent Ops Count, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
53	Reset I^2t CB Wear	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
54	CB 1	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off Latch On Latch Off
55	CB 1 Trip & Reclose, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
56	CB 1 Trip & Lockout, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
59	Demand metering reset, write only location.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
87	Reset Energy Meters	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
88	Remote mode	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
89	Service mode	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
90	Local mode	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
91	Local & Remote	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
98	Reset Start Count (Action)	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On Latch On
99	User SP Command 1.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
100	User SP Command 2.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
101	User SP Command 3.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
102	User SP Command 4.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
103	User SP Command 5.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
104	User SP Command 6.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
105	User SP Command 7.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
106	User SP Command 8.	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On
107	User DP Command 1.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
108	User DP Command 2.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
109	User DP Command 3.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
110	User DP Command 4.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 10	Default Variation Event Object 11	Default Command Event Object 13 Assigned Class (1, 2, 3 or none)	Default Variation Command Event Object 13	CROB Supported Opera-tions	Default CROB Opera-tions
111	User DP Command 5.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
112	User DP Command 6.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
113	User DP Command 7.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
114	User DP Command 8.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Paired Close Paired Trip	Pulse On Pulse Off
115	CB-1 Open	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On Latch On
116	CB-1 Close	0	2	2	0	1	Pulse On Latch On Paired Close	Pulse On Latch On

4.3.5 Counters

The following table lists both Binary Counters (Object 20) and Frozen Counters (Object 21). When a freeze function is performed on a Binary Counter point, the frozen value is available in the corresponding Frozen Counter point. The default Binary Counter and Frozen Counter event buffer sizes are set to 30.

The “Default Deadband,” and the “Default Change Event Assigned Class” columns are used to represent the absolute amount by which the point must change before a Counter change event will be generated, and once generated in which class poll (1, 2, 3, or none) will the change event be reported.

The default counter event buffer size is set 30. The counter event mode is set to Most Recent, only most recent event for each point is stored.

Counters are by default returned in a class zero interrogation.

Note, not all points listed here apply to all builds of devices.

Counters	
Static (Steady-State) Object Number	20
Change Event Object Number	22
Static Variation reported when variation 0 requested	1 (32-Bit Counter with Flag) or 2 (16-Bit Counter with Flag) or 5 (32-Bit Counter w/o Flag) or 6 (16-Bit Counter w/o Flag)
Change Event Variation reported when variation 0 requested	1 (32-Bit Counter Event with Flag) or 2 (16-Bit Counter Event with Flag) or 5 (32-Bit Counter Event with Flag and Time) or 6 (16-Bit Counter Event with Flag and Time)
Frozen Counters	
Static (Steady-State) Object Number	21
Change Event Object Number	23
Static Variation reported when variation 0 requested	1 (32-Bit Frozen Counter with Flag) or 2 (16-Bit Frozen Counter with Flag) or 5 (32-Bit Frozen Counter with Flag and Time) or 6 (16-Bit Frozen Counter with Flag and Time) or 9 (32-Bit Frozen Counter w/o Flag) or 10 (16-Bit Frozen Counter w/o Flag)
Change Event Variation reported when variation 0 requested	1 (32-Bit Frozen Counter Event with Flag) or 2 (16-Bit Frozen Counter Event with Flag) or 5 (32-Bit Frozen Counter Event with Flag and Time) or 6 (16-Bit Frozen Counter Event with Flag and Time)

Table 4-4 Counters

		Counter						Frozen Counter		
Point Index	**Description**	**Default Change Event Assigned Class (1, 2, 3 or none)**	**Default Variation Static Object 20**	**Default Variation Event Object 22**	**Dead-band**	**I_s Reset-table**	**I_s Freez-able**	**Default Change Event Assigned Class (1, 2, 3 or none)**	**Default Variation Static Object 21**	**Default Variation Event Object 23**
0	Waveform Records	0,3	5	1	1		✓	0,2	9	1
1	Fault Records	0,3	5	1	1		✓	0,2	9	1
2	Event Records	0,3	5	1	1		✓	0,2	9	1
3	Data Log Records	0,3	5	1	1		✓	0,2	9	1
5	StartCount	0,3	5	1	1	✓	✓	0,2	9	1
6	Start Count Target	0,3	5	1	1		✓	0,2	9	1

		Counter						Frozen Counter		
Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 20	Default Variation Event Object 22	Dead-band	I_s Reset-table	I_s Freez-able	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 21	Default Variation Event Object 23
7	Active Setting Group	0,3	5	1	1		✓	0,2	9	1
11	CB Total Trip Count	0,3	5	1	1	✓	✓	0,2	9	1
16	CB Delta Trip Count	0,3	5	1	1	✓	✓	0,2	9	1
17	CB Count To AR Block	0,3	5	1	1	✓	✓	0,2	9	1
18	CB Frequent Ops Count	0,3	5	1	1	✓	✓	0,2	9	1
21	E1 Counter	0,3	5	1	1		✓ ✔	0,2	9	1
22	E2 Counter	0,3	5	1	1		✓	0,2	9	1
23	E3 Counter	0,3	5	1	1		✓	0,2	9	1
24	E4 Counter	0,3	5	1	1		✓	0,2	9	1
37	AFD Zone1 Count	0,3	5	1	1	✓	✓	0,2	9	1
38	AFD Zone2 Count	0,3	5	1	1	✓	✓	0,2	9	1
39	AFD Zone3 Count	0,3	5	1	1	✓	✓	0,2	9	1
40	AFD Zone4 Count	0,3	5	1	1	✓	✓	0,2	9	1
41	AFD Zone5 Count	0,3	5	1	1	✓	✓	0,2	9	1
42	AFD Zone6 Count	0,3	5	1	1	✓	✓	0,2	9	1

4.3.6 Analog Inputs

The following table lists analog inputs (Object 30). It is important to note that 16-bit and 32-bit variations of analog inputs, Analog Output Control Blocks, and Analog Output Statuses are transmitted through DNP as signed numbers.

The “Default Deadband,” and the “Default Change Event Assigned Class” columns are used to represent the absolute amount by which the point must change before an Analog change event will be generated, and once generated in which class poll (1, 2, 3, or none) will the change event be reported.

The default analog input event buffer size is set 30. The analog input event mode is set to Most Recent, only most recent event for each point is stored.

Analog inputs are by default returned in a class zero interrogation.

Note, not all points listed here apply to all builds of devices.

Analog Inputs	
Static (Steady-State) Object Number	30

Change Event Object Number	32
Analog input Deadband	34
Static Variation reported when variation 0 requested	1 (32-Bit analog input with Flag) or 2 (16-Bit analog input with Flag) or 3 (32-Bit analog input w/o Flag) or 4 (16-Bit analog input w/o Flag) or 5 (Single Precision, floating point analog input with Flag)
Change Event Variation reported when variation 0 requested	1 (32-Bit Analog Change Event w/o Time) or 2 (16-Bit analog input w/o Time) or 3 (32-Bit analog input with Time) or 4 (16-Bit analog input with Time) or 5 (Single Precision, floating point analog input w/o Time) or 7 (Single Precision, floating point analog input with Time)
Analog input Reporting Deadband Variation reported when variation 0 requested	1 (16-Bit) or 2 (32-Bit) or 3 (Single Precision, floating point)

Table 4-5 Analog Inputs

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 30	Default Variation Event Object 32	Default Multiplier	Default Deadband
0	Frequency	0,3	2	4	100.000	1.000
1	V_{ab} Primary	0,3	2	4	0.010	100.000
2	V_{bc} Primary	0,3	2	4	0.010	100.000
3	V_{ca} Primary	0,3	2	4	0.010	100.000
4	V_{a} Primary	0,3	2	4	0.010	100.000
5	V_{b} Primary	0,3	2	4	0.010	100.000
6	V_{c} Primary	0,3	2	4	0.010	100.000
7	V_{a} Secondary	0,3	2	4	10.000	1.000
8	V_{b} Secondary	0,3	2	4	10.000	1.000
9	V_{c} Secondary	0,3	2	4	10.000	1.000
21	V_{zps}	0,3	2	4	10.000	1.000
22	V_{pps}	0,3	2	4	10.000	1.000
23	V_{nps}	0,3	2	4	10.000	1.000
31	I_{a} Primary	0,3	2	4	1.000	100.000
32	I_{b} Primary	0,3	2	4	1.000	100.000
33	I_{c} Primary	0,3	2	4	1.000	100.000
34	I_{a} Secondary	0,3	2	4	100.000	0.100
35	I_{b} Secondary	0,3	2	4	100.000	0.100
36	I_{c} Secondary	0,3	2	4	100.000	0.100
37	I_{a} Nominal	0,3	2	4	100.000	0.100
38	I_{b} Nominal	0,3	2	4	100.000	0.100
39	I_{c} Nominal	0,3	2	4	100.000	0.100
43	I_{n} Primary	0,3	2	4	1.000	100.000
44	I_{n} Secondary	0,3	2	4	100.000	0.100

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 30	Default Variation Event Object 32	Default Multiplier	Default Deadband
45	I_n Nominal	0,3	2	4	100.000	0.100
46	I_g Primary	0,3	2	4	1.000	100.000
47	I_g Secondary	0,3	2	4	1000.000	0.100
48	I_g Nominal	0,3	2	4	1000.000	0.100
51	I_{zps} Nominal	0,3	2	4	100.000	0.100
52	I_{pps} Nominal	0,3	2	4	100.000	0.100
53	I_{nps} Nominal	0,3	2	4	100.000	0.100
57	Active power A	0,3	2	4	10.000	1000000.000
58	Active power B	0,3	2	4	10.000	1000000.000
59	Active power C	0,3	2	4	10.000	1000000.000
60	P (3P)	0,3	2	4	10.000	1000000.000
61	Reactive power A	0,3	2	4	10.000	1000000.000
62	Reactive power B	0,3	2	4	10.000	1000000.000
63	Reactive power C	0,3	2	4	10.000	1000000.000
64	Q (3P)	0,3	2	4	10.000	1000000.000
65	Apparent power A	0,3	2	4	10.000	1000000.000
66	Apparent power B	0,3	2	4	10.000	1000000.000
67	Apparent power C	0,3	2	4	10.000	1000000.000
68	S (3P)	0,3	2	4	10.000	1000000.000
71	Power factor A	0,3	2	4	1000.000	0.100
72	Power factor B	0,3	2	4	1000.000	0.100
73	Power factor C	0,3	2	4	1000.000	0.100
74	Power factor(3P)	0,3	2	4	1000.000	0.100
75	Act Energy Exp	0,3	1	3	1.000	Disabled
76	Act Energy Imp	0,3	1	3	1.000	Disabled
77	React Energy Exp	0,3	1	3	1.000	Disabled
78	React Energy Imp	0,3	1	3	1.000	Disabled
81	Thermal Status Ph A	0,1	4	4	100.000	1.000
82	Thermal Status Ph B	0,1	4	4	100.000	1.000
83	Thermal Status Ph C	0,1	4	4	100.000	1.000
95	Active Setting Group	0,3	2	4	1.000	1.000
99	V_{ab} Secondary	0,3	2	4	10.000	1.000

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 30	Default Variation Event Object 32	Default Multiplier	Default Deadband
100	V_{bc} Secondary	0,3	2	4	10.000	1.000
101	V_{ca} Secondary	0,3	2	4	10.000	1.000
102	V_{n} Primary	0,3	2	4	0.010	100.000
103	V_{n} Secondary	0,3	2	4	10.000	1.000
108	I Phase A Max	0,3	2	4	1.000	100.000
109	I Phase B Max	0,3	2	4	1.000	100.000
110	I Phase C Max	0,3	2	4	1.000	100.000
111	P 3P Max	0,3	2	4	10.000	1000000.000
112	Q 3P Max	0,3	2	4	10.000	1000000.000
115	Isef Primary	0,3	2	4	1.000	10.000
116	I_{sef} Secondary	0,3	2	4	1000.000	0.050
117	I_{sef} Nominal	0,3	2	4	1000.000	0.050
135	CB Total Trip Count	0,3	1	3	1.000	1.000
136	CB Delta Trip Count	0,3	1	3	1.000	1.000
137	CB Count To AR Block	0,3	1	3	1.000	1.000
138	CB Frequent Ops Count	0,3	1	3	1.000	1.000
165	I_{a} Last Trip	0,3	1	3	1.000	Disabled
166	I_{b} Last Trip	0,3	1	3	1.000	Disabled
167	I_{c} Last Trip	0,3	1	3	1.000	Disabled
168	V_{a} Last Trip	0,3	1	3	1.000	Disabled
169	V_{b} Last Trip	0,3	1	3	1.000	Disabled
170	V_{c} Last Trip	0,3	1	3	1.000	Disabled
171	I_{n} Last Trip	0,3	1	3	1.000	Disabled
172	I_{g} Last Trip	0,3	1	3	1.000	Disabled
173	I_{sef} Last Trip	0,3	1	3	1.000	Disabled
174	V Phase A Max	0,3	2	4	0.010	100.000
175	V Phase B Max	0,3	2	4	0.010	100.000
176	V Phase C Max	0,3	2	4	0.010	100.000
177	V Phase AB Max	0,3	2	4	0.010	100.000
178	V Phase BC Max	0,3	2	4	0.010	100.000
179	V Phase CA Max	0,3	2	4	0.010	100.000
184	CB Wear A	0,3	1	3	100.000	1000000.000
185	CB Wear B	0,3	1	3	100.000	1000000.000
186	CB Wear C	0,3	1	3	100.000	1000000.000
187	CB Wear A Remaining	0,3	1	3	1.000	1.000
188	CB Wear B Remaining	0,3	1	3	1.000	1.000

Point Index	Description	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 30	Default Variation Event Object 32	Default Multiplier	Default Deadband
189	CB Wear C Remaining	0,3	1	3	1.000	1.000
190	CB Wear Minimum	0,3	1	3	1.000	1.000
192	Freq Last Trip	0,3	5	7	1.000	1.000
196	Frequency Max	0,3	2	4	100.000	1.000
197	S 3P Max	0,3	2	4	10.000	1000000.000
294	Ia THD	0,3	2	4	100.000	0.100
295	Ib THD	0,3	2	4	100.000	0.100
296	Ic THD	0,3	2	4	100.000	0.100
330	CB Trip Time Meter	0,3	2	4	1000.000	0.010

4.4 Additional Settings

The following relay settings are provided for configuration of the DNP3 implementation when available and are common to all ports using this protocol.

Table 4-6 Additional Settings

Setting Name	Range/Options	Default	Setting	Notes
Unsolicited Mode	DISABLED, ENABLED	DISABLED	As required	Setting is only visible when any port Protocol is set to DNP3.
Destination Address	0 - 65534	0	As required	Setting is only visible when DNP3 Unsolicited Events set to Enabled.
DNP3 Application Timeout	5, 6, ... 299, 300	10 s	As required	Setting is only visible when any port Protocol is set to DNP3.

5 Configuration

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5.1 Configuration

The data points and control features which are possible within the relay are fixed and can be transmitted over one or more communication channels protocols in the default format described earlier in this document. The default data transmitted is not always directly compatible with the needs of the substation control system and require some tailoring. This can be done by you with the Reydisp software Communications Editor tool.

The Communications Editor is provided to allow the user to configure the communication protocols Files in Reyrolle brand Relays manufactured by Siemens protection devices.

The editor supports configuring DNP3, IEC 60870-5-103, IEC 60870-5-101 and Modbus protocols.

The editor allows configuration files to be retrieved from the relay, edited, and then uploaded back to the relay. Files can also be saved to and loaded from disc to work offline. The protocols are stored in a Reyrolle protection device Comms file (RPDC), which is stored locally, so that the editor can be used when the relay is not connected.

The tool allows the following under each protocol:

DNP3

- Data points to be enabled or disabled.
- Changing the point numbers for the binary inputs, Double Bit Inputs, binary outputs, Counters and analog inputs.
- Changing their assigned class and static and event variants.
- Specifying inclusion in a Class 0 poll.
- Setting Binary points to be inverted before transmission.
- Setting the Control Relay Output Block (CROB) commands that can be used with a binary output (Object 12).
- Specifying a dead-band outside which Analog Events are generated.
- Specifying a multiplier that is applied to an analog value before transmission.
- Configuring a Counter's respective Frozen Counter.

IEC 60870-5-103

- Data points to be enabled or disabled.
- Changing the point numbers function type (FUN) and Information (INF), returned by each point.
- Changing the text returned to Reydisp for display in its event viewer.

MODBUS

- Changing the Addresses for the Coils, Inputs and Registers
- Changing the format of the instrument returned in a register, for example, 16 bit or 32 bit.
- Specifying a multiplier that is applied to an analog value before transmission.



NOTE

As MODBUS points are polled they do not need to be enabled or disabled.

You can check if the relay contains user configured communication files via a meter in the relay menus. Pressing the Enter and down arrow buttons on the fascia, then scrolling down, the number of files stored in the relay is displayed. The file name can also be viewed by pressing the Cancel and Test/Reset buttons together when in the relay Instruments menu. You must ensure when naming the file, they use a unique file name including the version number.

Refer to the Communications Editor User Guide for further guidance.

A Firmware and Hardware Revision History

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A.1 Revision History

Firmware 7SR1002/7SR1003

Year/Month	Firmware Version	Description of Change
2024/06	2437H80001R5d-2k	Firmware maintenance
2023/10	2437H80001R5c-2j	Firmware maintenance
2022/04	2437H80001R5a-2i	Firmware maintenance
2021/07	2437H80001R4m-2h	Support for new hardware variant and firmware maintenance
2021/02	2437H80001R4l-2g	Addition of functions & firmware maintenance
2020/11	2437H80001R4k-2g	Firmware maintenance
2019/12	2437H80001R4k-2f	Firmware maintenance
2019/01	2437H80001R4j-2e	Firmware maintenance
2018/05	2437H80001R4h-2d	Firmware maintenance
2017/09	2437H80001R4d-2c	Data communications improvements
2017/04	2437H80001R4c-2b	Minor modification in analog
2016/11	2437H80001R4b-2b	Support for Reydisp Manager tool
2015/09	2437H80001R4b-2a	Addition of AR variants
2015/06	2437H80001R4b-1f	81THD function added
2015/03	2437H80001R4b-1e	Addition of non-directional SEF device variants
2015/02	2437H80001R4b-1d	First maintenance
2013/11	2436H80015R2d-1a	First release

Firmware 7SR1004

Year/Month	Firmware Version	Description of Change
2025/11	2437H80008R5e-1j	59NVD Function - Settings range extension
2025/08	2437H80008R5e-1i	CEI-016 voltage & frequency functions added
2024/06	2437H80008R5d-1h	Firmware maintenance
2023/10	2437H80008R5c-1g	Firmware maintenance
2022/07	2437H80008R5b-1g	Firmware maintenance
2022/02	2437H80008R4n-1f	Firmware maintenance
2021/09	2437H80008R4m-1e	Fault recorder upgraded
2020/11	2437H80008R4k-1d	Firmware maintenance
2020/03	2437H80008R4k-1c	Addition of directional sensitive earth fault (67SEF) – measured 3V0/I0-Φ
2019/12	2437H80008R4j-1c	Firmware maintenance
2019/05	2437H80008R4j-1b	50AFD, 50LC, ITHD, Watt-metric functions added
2018/06	2437H80008R4h-1a	First release

Hardware 7SR1002/7SR1003

Year/Month	Hardware Version	Description of Change
2024/08	7SR10/EE	Fifth release (Revised look and feel)
2022/04		Fourth release (Addition of 3 BI, 3 BO variant)
2021/08		Third release (Addition of new power-supply variant)
2019/08		Second release
2015/01	7SR10/DD	First release

Hardware 7SR1004

Year/Month	Hardware Version	Description of Change
2024/08	7SR10/EE	Third release (Revised look and feel)
2019/08		Second release
2018/07	7SR10/DD	First release

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