

7SR210

7SR210x-1xAxx-0DA0

Non-Directional Overcurrent Relay

Document Release History

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2015/12	Software Revision - 2435H85008R8b-7f EN100+ compatibility
2015/06	Software Revision - 2435H85008R8a-7f Added Arc Flash Detector functionality, including Fast Overcurrent detection and SARC IEC 61850 logical nodes. Added Load Blinding functionality applied to Phase Overcurrent elements Added additional protocol datapoints for 60870-5-103, DNP3 and Modbus.

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1. Introduction

This section describes how to use the Communication Interface with a control system or interrogating computer.

The interface is compatible with control and automation systems using industry standard communications protocols **DNP3**, **IEC 60870-5-103**, **IEC 61850** and **MODBUS-RTU**. Note, not all protocols are available on all devices.

Reydisp Evolution or Reydisp Manager Software is available, for computers running Microsoft Windows™, to connect to devices to provide operational information, post-fault analysis, setting interrogation and editing facilities etc. Configuration software can be downloaded from our website <http://www.siemens.com/energy>.

This section specifies connection details and lists the information available through the individual protocols.

2. Physical Connection

2.1 Introduction

The relay provides one “Front” USB communication interface (Com2) located on the fascia and one RS485 (Com1) located on the “Rear” as standard. An additional module may be fitted as an ordering option to provide extra rear serial port(s) or two Ethernet channels. Modules are available for serial fibre optic, RS232 and RS485. These modules provide one (Com3) or two (Com3 and Com4) additional ports. The optional EN100 Ethernet module, available in optical and electrical versions, supports the IEC 61850 protocol and Reydisp access through the network (LAN port) interface.

A detailed description of the ports is given below.

- COM1-RS485: This port can be used for IEC60870-5-103, MODBUS-RTU or DNP3 communications to a substation SCADA or integrated control system or for engineer remote access. This port can also be used for connection to Reydisp software.
- COM2-USB: This port is used for IEC60870-5-103 (default setting) communication with the Reydisp software.
An ASCII protocol is also available through this port, the main use of this protocol is to allow the Relay firmware to be updated via the front connection.
MODBUS-RTU or the optional DNP3 protocols are also available.
- COM3: Where fitted, an additional rear serial fibre optic, RS232 or RS485 port.
This port can be used for IEC60870-5-103, MODBUS-RTU or DNP3 communications to a substation SCADA or integrated control system or for engineer remote access. This port can also be used for connection to Reydisp software.
- COM4: As COM3.
- COM3-LAN: When the Ethernet module is fitted, in addition to IEC61850 a LAN connection is provided to allow the Reydisp software to connect to the Relay via the network. This port only supports the IEC60870-5-103 protocol.

Any or all serial ports can be mapped to the IEC60870-5-103, DNP3 or MODBUS-RTU protocol at any one time, protocols available will depend upon relay model. The optional ethernet port uses IEC 61850 protocol and can also provide an IEC 60870-5-103 protocol connection to Reydisp. Any port not required can be disabled by setting its protocol to OFF.

When connecting to Reydisp Evolution software the protocol for the relevant port should be set to IEC60870-5-103.

2.2 USB Interface (COM2)

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

The PC will require a suitable USB driver to be installed; this will be 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. Connections to these devices are not shown when they are not connected.

The USB communication interface on the relay is labelled Com 2 and its associated settings are located 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.

Access to the communication settings for the USB port is only available from the relay front fascia via the key pad setting menu COMMUNICATIONS MENU.

Setting Name	Range/Options	Default	Setting	Notes
COM2-USB Protocol	OFF IEC60870-5-103 MODBUS-RTU ASCII DNP3	IEC60870-5-103		Reydisp software requires IEC60870-5-103.
COM2-USB Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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	Local Local or Remote Remote	Local		Refer to Appendix 1 , page 93, for further explanation

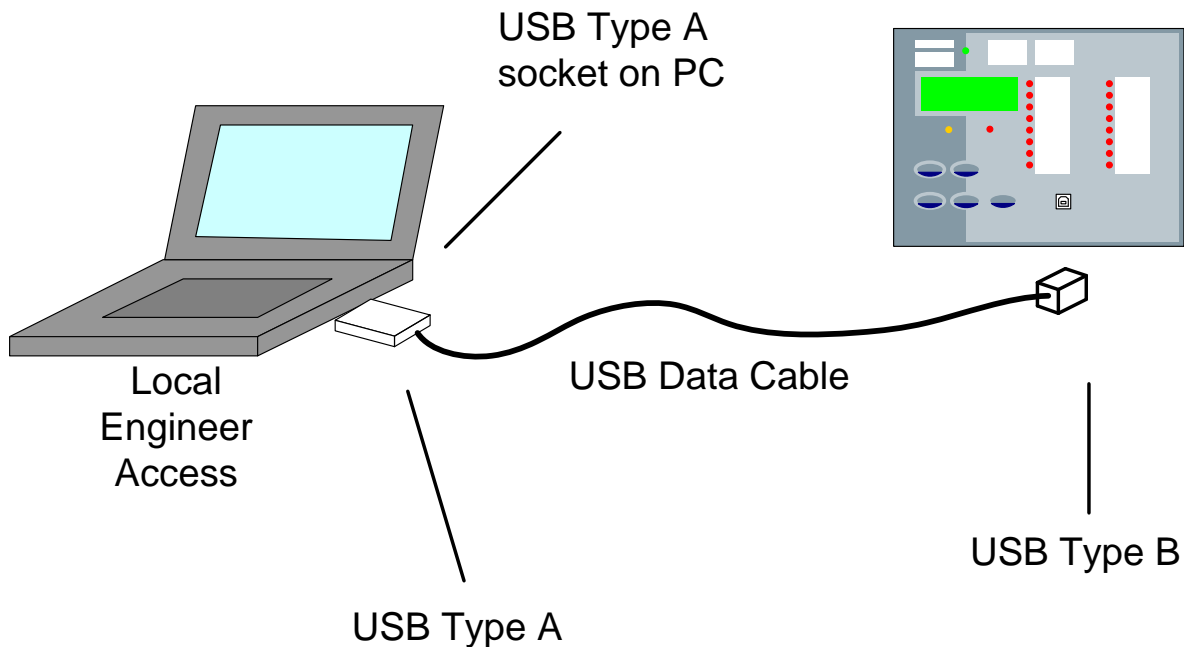


Fig. 2-1 Communication to Front USB Port

2.3 RS485 Interface (COM1)

The 2-wire RS485 communication port is located on the rear of the relay and can be connected using a suitable RS485 120 Ohm screened 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. This can be done via the internal 120 ohm terminating resistor, which can be connected between 14 (A) and 18 (B) by fitting an external wire loop between terminals 18 and 20 on the power supply module.

The polarity of the signal terminals is marked as A and B in line with the RS485 standard. The polarity is that when the bus is in the quiescent state and no communication is taking place, the B terminal is more positive than A. This can be used to identify the polarity of any equipment to be connected, typically measured at each terminal in turn to ground. Connection of the device to a termination network at the end of the bus will also be to suit the quiescent state as shown in the diagram below.

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, communication to all devices will be disturbed but no damage will occur. If problems are experienced during commissioning, the connections should be tried in reverse.

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

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 following settings, on the COMMUNICATIONS MENU, must be configured when using the RS485 interface.

Setting Name	Range/Options	Default	Setting	Notes
COM1-RS485 Protocol	OFF IEC60870-5-103 MODBUS-RTU DNP3	IEC60870-5-103		The protocol used to communicate on the standard RS485 connection.
COM1-RS485 Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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.
COM1-RS485 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400	19200		The baud rate set on all of the relays connected to the control system must be the same as the one set on the master device.
COM1-RS485 Parity	NONE ODD EVEN	EVEN		The parity set on all of the relays connected to the control system must be the same and in accordance with the master device.
COM1-RS485 Mode	Local Local or Remote Remote	Remote		Refer to Appendix 1 , page 93, for further explanation

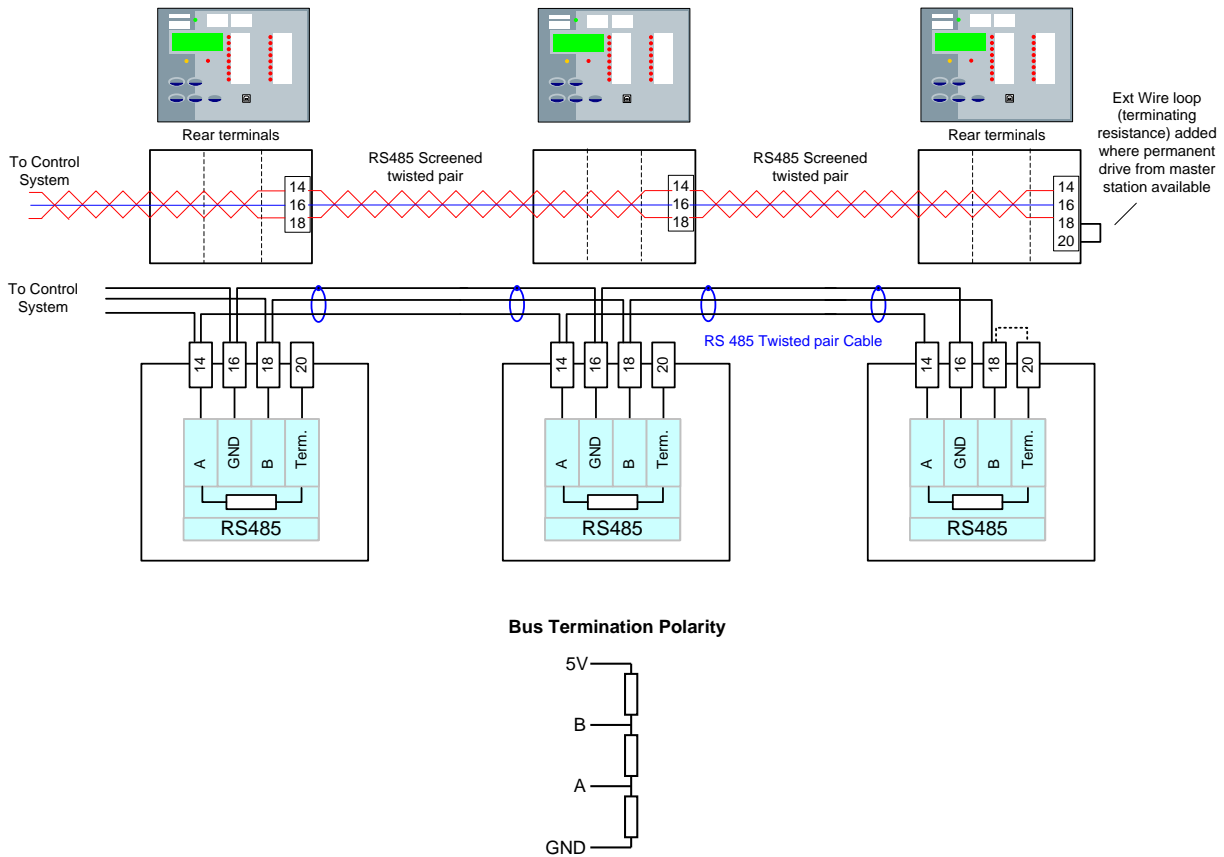


Fig. 2-2 Communication to Multiple Devices using RS485 (Standard Port)

2.4 Serial Fibre Optic Interface (COM3 & COM4)

When connecting via the optional fibre optic interface the selection of fibre-optic cable is important. Fibres must be terminated with ST™ (BFOC/2.5) connectors.

The recommended type is 62.5/125µm glass fibre. Communication distances over 1 km are achievable using this type of fibre.

A budget loss calculation should be made for all installations. The following table gives the launch power and receiver sensitivity of each of the fibre optic communication ports on the Relay when used with specific fibre optic types.

Fibre Type	Tx Launch Power (dB)		RX Receive Sensitivity (dB)	
	Min	Max	Min	Max
62.5/125µm	-11.7	-15.7	-24	-9.2
1mm Polymer	-6.4	-10.4	-24	-9.2
200µm PCS	-2.8	-6.8	-24	-9.2

Factors to be considered when calculating fibre-optic transmission distances:

- Transmitter launch power.
- Attenuation, based on light frequency, fibre material and fibre diameter. (Consult fibre manufacturers' data for actual values of fibre attenuation).
- Number of intermediate connectors and splices. Fibre cables are supplied on reels of finite length which may necessitate additional jointing. Typical losses at connectors are 0.5-1.0dB each. This allows for normal age related deterioration. Typical losses at splices are <0.3dB. (Consult fibre manufacturers' data for actual values).

- Receiver sensitivity. The light power at the receiver must be above the sensitivity of the receiver in order that effective communication can occur.
- A 3dB safety margin is usually allowed after the budget calculation is performed.

Following installation and prior to putting into service the actual losses should be measured for each fibre using a calibrated light source and meter. Measured and calculated values can be compared.

The following table can be used to record budget calculations:

A	Launch power	dB
B	Fibre Type	
C	Loss (dB/km)	dB/km
D	Length	km
E	Total fibre loss (CxD)	dB
F	No. of Splices	
G	Loss at each splice	dB
H	Total loss at splices (FxG)	dB
I	No. of connectors	
J	Loss per connector	dB
K	Total loss at connectors (IxJ)	dB
L	Total losses (E+H+K)	dB
M	Receive power budget (A-L)	dB
N	Safety Margin	dB
O	Device Receive Sensitivity	dB

The following settings, on the **COMMUNICATIONS MENU**, must be configured when using the fibre Optic Com3 interface.

Setting Name	Range/Options	Default	Setting	Notes
COM3 Protocol	OFF IEC60870-5-103 MODBUS-RTU DNP3	IEC60870-5-103		The protocol used to communicate on the standard RS485 connection.
COM3 Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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.
COM3 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400 57600 115200	19200		The baud rate set on all of the relays connected to the control system must be the same as the one set on the master device.
COM3 Parity	NONE ODD EVEN	EVEN		The parity set on all of the relays connected to the control system must be the same and in accordance with the master device.

Setting Name	Range/Options	Default	Setting	Notes
COM3 Line Idle	LIGHT ON LIGHT OFF	LIGHT OFF		Sets the fibre optic line idle state.
COM3 Data Echo ^{#1}	ON OFF	OFF		Set to ON when relays are connected in a fibre-optic ring configuration.
COM3 Mode	Local Local or Remote Remote	Remote		Refer to Appendix 1 , page 93, for further explanation

The following settings, on the **COMMUNICATIONS MENU**, must be configured when using the fibre Optic Com4 interface

Setting Name	Range/Options	Default	Setting	Notes
COM4 Protocol	OFF IEC60870-5-103 MODBUS-RTU DNP3	IEC60870-5-103		The protocol used to communicate on the standard RS485 connection.
COM4 Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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.
COM4 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400	19200		The baud rate set on all of the relays connected to the control system must be the same as the one set on the master device.
COM4 Parity	NONE ODD EVEN	EVEN		The parity set on all of the relays connected to the control system must be the same and in accordance with the master device.
COM4 Line Idle	LIGHT ON LIGHT OFF	LIGHT OFF		Sets the fibre optic line idle state.
COM4 Data Echo ^{#1}	ON OFF	OFF		Set to ON when relays are connected in a fibre-optic ring configuration.
COM4 Mode	Local Local or Remote Remote	Remote		Refer to Appendix 1 , page 93, for further explanation

#1 In ring mode, echo = on, the whole fibre optic data comms link will be interrupted if the relay element is withdrawn from the case.

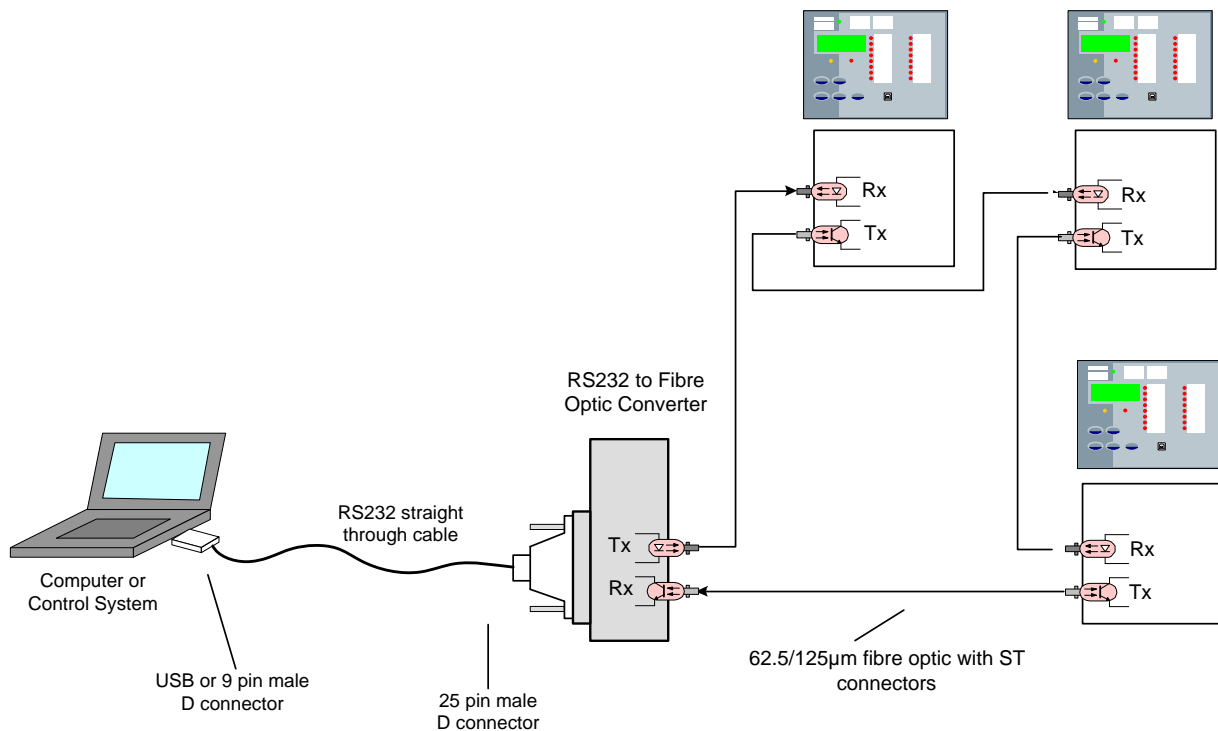


Fig. 2-3 Communication to Multiple Devices using Fibre-optic Ring Network

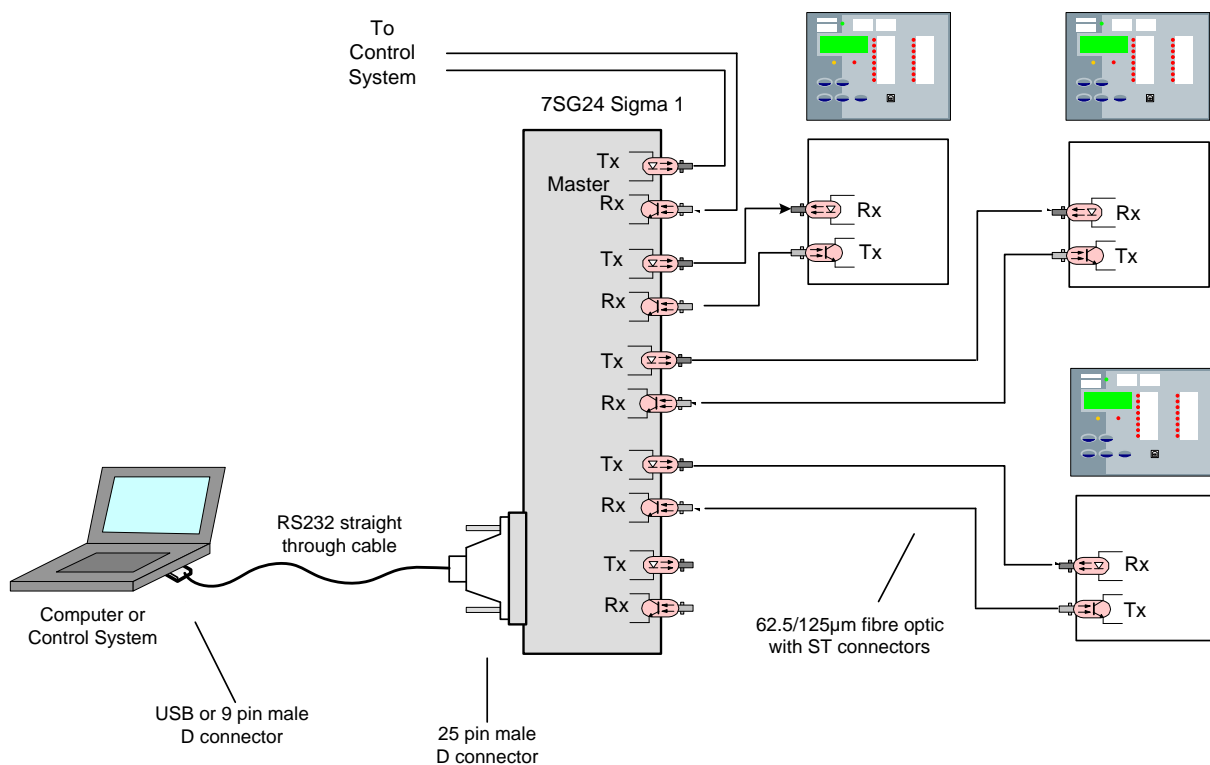


Fig. 2-4 Communication to Multiple Devices from Control System and Laptop using Fibre-optic Star Network

2.5 Optional Rear RS485 (COM3)

The following settings, on the COMMUNICATIONS MENU, must be configured when using the electrical 2-wire RS485 Com3 interface.

Setting Name	Range/Options	Default	Setting	Notes
COM3 Protocol	OFF IEC60870-5-103 MODBUS-RTU DNP3	IEC60870-5-103		The protocol used to communicate on the standard RS485 connection.
COM3 Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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.
COM3 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400 57600 115200	19200		The baud rate set on all of the relays connected to the control system must be the same as the one set on the master device.
COM3 Parity	NONE ODD EVEN	EVEN		The parity set on all of the relays connected to the control system must be the same and in accordance with the master device.
COM3 Line Idle	LIGHT ON LIGHT OFF	LIGHT OFF	LIGHT OFF	Not applicable for RS 485 or RS 232 option, set to OFF.
COM3 Data Echo ^{#1}	ON OFF	OFF	OFF	Not applicable for RS 485 or RS 232 option, set to OFF.
COM3 Mode	Local Local or Remote Remote	Remote		Refer to Appendix 1 , page 93, for further explanation

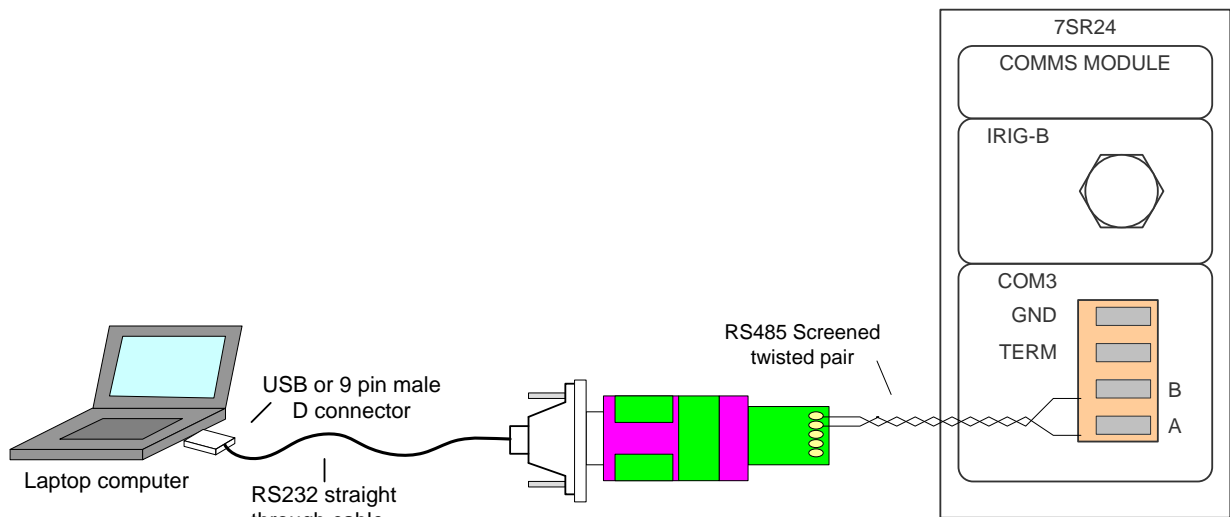


Fig. 2-5 Additional (Optional) Rear RS485 + IRIG-B Connection to a PC

2.6 Optional Rear RS232 (COM3)

The following settings, on the COMMUNICATIONS MENU, must be configured when using the electrical RS232 Com3 interface.

Setting Name	Range/Options	Default	Setting	Notes
COM3 Protocol	OFF IEC60870-5-103 MODBUS-RTU DNP3	IEC60870-5-103		The protocol used to communicate on the standard RS485 connection.
COM3 Station Address	0 - 254 for IEC60870-5-103 1 - 247 for Modbus RTU 0 - 65534 for DNP3.0	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.
COM3 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400 57600 115200	19200		The baud rate set on all of the relays connected to the control system must be the same as the one set on the master device.
COM3 Parity	NONE ODD EVEN	EVEN		The parity set on all of the relays connected to the control system must be the same and in accordance with the master device.
COM3 Line Idle	LIGHT ON LIGHT OFF	LIGHT OFF	LIGHT OFF	Not applicable for RS 485 or RS 232 option, set to OFF.
COM3 Data Echo ^{#1}	ON OFF	OFF	OFF	Not applicable for RS 485 or RS 232 option, set to OFF.
COM3 Mode	Local Local or Remote Remote	Remote		Refer to Appendix 1 , page 93, for further explanation

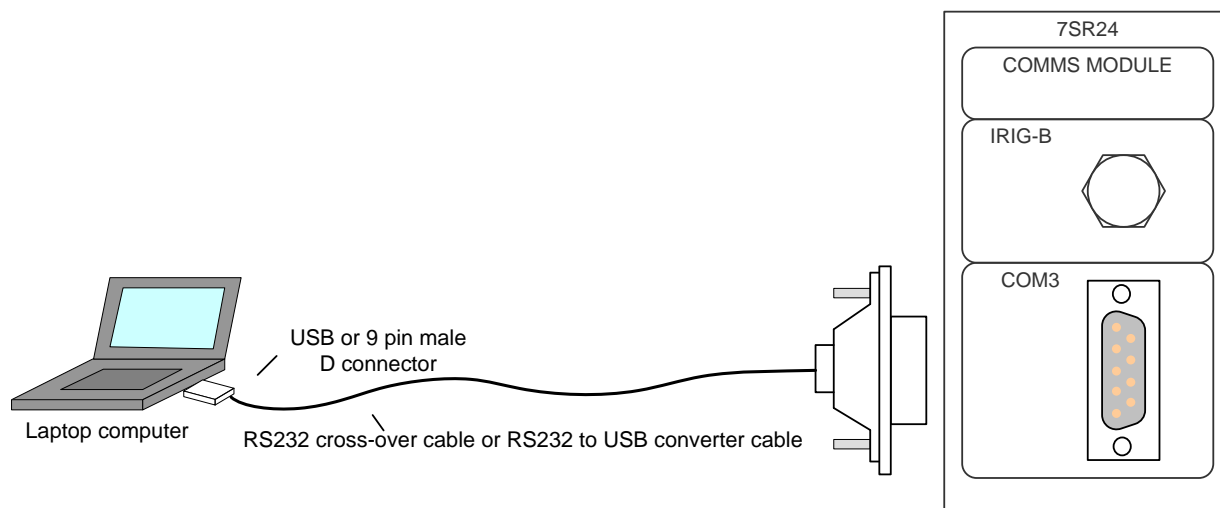


Fig. 2-6 Additional (Optional) Rear RS232 + IRIG-B Connection to a PC

Pin	Relay Function
1	Not Connected
2	Receive Data (RXD)
3	Transmit Data (TXD)

Pin	Relay Function
4	Output Supply +5V 50mA
5	Signal Ground (GND)
6	Output Supply +5V 50mA
7	Linked to 8 (volts free)
8	Linked to 7 (volts free)
9	Output Supply +5V 50mA

Fig. 2-7 RS232 Data Comms Pin Connections

2.7 Optional Rear EN100 Ethernet Module (COM3)

The optional ethernet interface is primarily provided for support of IEC 61850 Protocol. Support for IEC 60870-5-103 is also provided over this interface to allow connection with Reydisp Evolution and Reydisp Manager Software for interrogation, editing and download of relay settings and other data. Ordering options are available with two RJ45 electrical connectors or with two duplex LC fibre optic connectors.

Setting Name	Range/Options	Default	Setting	Notes
LAN Protocol	OFF IEC60870-5-103	IEC60870-5-103		Sets the protocol used to communicate on the LAN port.

If this setting is set to off, access to relay data using Reydisp Evolution and Reydisp Manager Software via the Ethernet interface is not available.

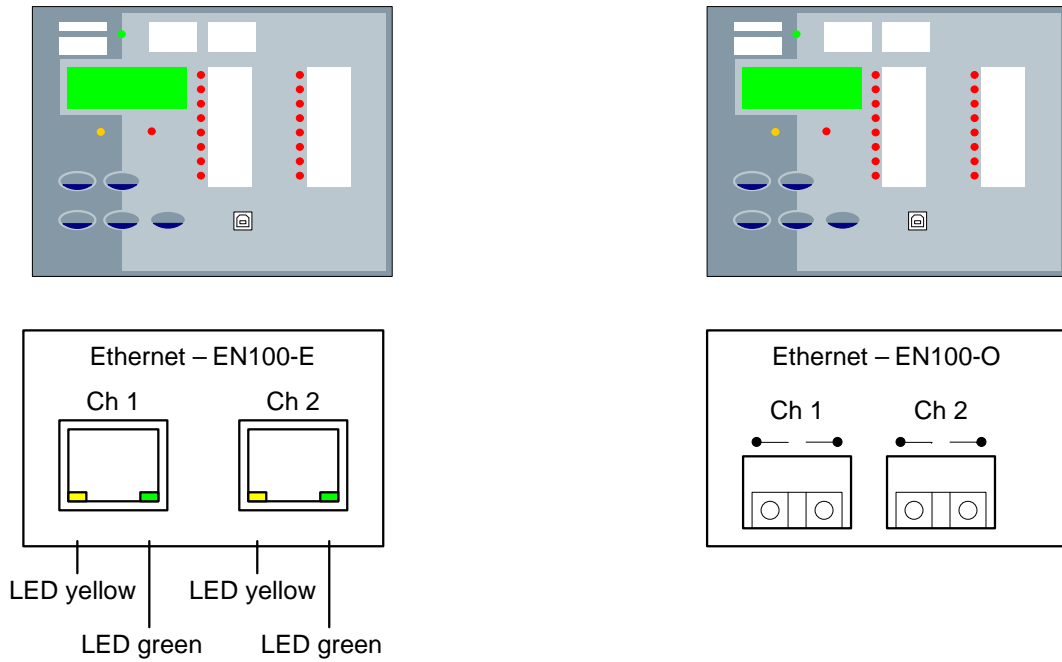
Connections to the optional EN100 Ethernet module are made on the rear underside of the relay.

Connections are made to either RJ45 sockets (electrical) or Duplex LC (fibre optic) connectors. Fibre cables should be 62.5/125µm (or 50/125µm) multimode with LC connectors.

The two types of EN100 module work slightly differently. The optical version contains an Ethernet switch to control the two channels. The switch will manage data from either channel as an Ethernet switch would in a network. The electrical version connects through one channel until it detects a break in the data traffic. After a delay it will swap to the other channel to try and re-establish communication. Either method can be thought of as providing for redundancy.

While a 61850 session is established, an operator can simultaneously connect to the device via [Reydisp Evolution](#) or a web browser through the EN100 module.

Configuration of 61850 communication is via the [Reydisp Manager](#) software package.



EN100 Module – RJ45 Interface

EN100 Module – Duplex-LC Interface

Green LED (Physical Link)

Off – No link

On – Link present

Yellow LED (Activity)

Off – No traffic

On/flashing - Traffic

Fig. 2-8 EN100 Ethernet Module

3. IEC 60870-5-103 Definitions

3.1 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 information, time synchronising, 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, Fibre Optic, RS232, RS485 and Ethernet) 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.

3.2 Cause of Transmission

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

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

3.3 Application Service Data Unit (ASDU) Type

The Application Service Data Unit (ASDU) column of the “[Information Number and Function](#)” table lists the possible ASDUs returned for a point.

ASDU #	Description
1	Time tagged message (monitor direction)
2	Time tagged message (relative time) (monitor direction)
3.1	Measurands I
4	Time-tagged measurands with relative time
5	Identification message
6	Time synchronisation
7	General Interrogation Initialization
9	Measurands II
20	General command

3.4 Point List

The following sub-sections 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 [section 9](#) for details.

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

The following Event EVT and INF numbers apply to this device.

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 & Remote	1	SE, GI
			20	Ack, Nak
60	12	Control Received	1	SE
60	13	Command Received	1	SE
60	128	Cold Start	1	SE
60	129	Warm Start	1	SE
60	130	Re-Start	1	SE
60	131	Expected Restart	1	SE, GI
60	132	Unexpected Restart	1	SE, GI
60	133	Reset Start Count	1	SE
			20	Ack, Nak
60	135	Trigger Storage	1	SE
60	136	Clear Waveform Records	1	SE
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	176	General Alarm 7	1	SE, GI
60	177	General Alarm 8	1	SE, GI
60	178	General Alarm 9	1	SE, GI
60	179	General Alarm 10	1	SE, GI
60	180	General Alarm 11	1	SE, GI
60	181	General Alarm 12	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

FUN	INF	Description	ASDU	COT
60	185	Quick Logic E4	1	SE, GI
60	186	Quick Logic E5	1	SE, GI
60	187	Quick Logic E6	1	SE, GI
60	188	Quick Logic E7	1	SE, GI
60	189	Quick Logic E8	1	SE, GI
60	190	Quick Logic E9	1	SE, GI
60	191	Quick Logic E10	1	SE, GI
60	192	Quick Logic E11	1	SE, GI
60	193	Quick Logic E12	1	SE, GI
60	194	Quick Logic E13	1	SE, GI
60	195	Quick Logic E14	1	SE, GI
60	196	Quick Logic E15	1	SE, GI
60	197	Quick Logic E16	1	SE, GI
60	214	Function Key 1	1	SE
60	215	Function Key 2	1	SE
60	216	Function Key 3	1	SE
60	217	Function Key 4	1	SE
60	218	Function Key 5	1	SE
60	219	Function Key 6	1	SE
61	1	General Alarm 13	1	SE, GI
61	2	General Alarm 14	1	SE, GI
61	3	General Alarm 15	1	SE, GI
61	4	General Alarm 16	1	SE, GI
61	5	General Alarm 17	1	SE, GI
61	6	General Alarm 18	1	SE, GI
61	7	General Alarm 19	1	SE, GI
61	8	General Alarm 20	1	SE, GI
70	5	Binary Input 5	1	SE, GI
70	6	Binary Input 6	1	SE, GI
70	7	Binary Input 7	1	SE, GI
70	8	Binary Input 8	1	SE, GI
70	9	Binary Input 9	1	SE, GI
70	10	Binary Input 10	1	SE, GI
70	11	Binary Input 11	1	SE, GI
70	12	Binary Input 12	1	SE, GI
70	13	Binary Input 13	1	SE, GI
70	14	Binary Input 14	1	SE, GI
70	15	Binary Input 15	1	SE, GI
70	16	Binary Input 16	1	SE, GI
70	17	Binary Input 17	1	SE, GI
70	18	Binary Input 18	1	SE, GI
70	19	Binary Input 19	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

FUN	INF	Description	ASDU	COT
75	7	Virtual Input 7	1	SE, GI
75	8	Virtual Input 8	1	SE, GI
75	9	Virtual Input 9	1	SE, GI
75	10	Virtual Input 10	1	SE, GI
75	11	Virtual Input 11	1	SE, GI
75	12	Virtual Input 12	1	SE, GI
75	13	Virtual Input 13	1	SE, GI
75	14	Virtual Input 14	1	SE, GI
75	15	Virtual Input 15	1	SE, GI
75	16	Virtual Input 16	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
80	7	Binary Output 7	1	SE, GI
			20	Ack, Nak
80	8	Binary Output 8	1	SE, GI
			20	Ack, Nak
80	9	Binary Output 9	1	SE, GI
			20	Ack, Nak
80	10	Binary Output 10	1	SE, GI
			20	Ack, Nak
80	11	Binary Output 11	1	SE, GI
			20	Ack, Nak
80	12	Binary Output 12	1	SE, GI
			20	Ack, Nak
80	13	Binary Output 13	1	SE, GI
			20	Ack, Nak
80	14	Binary Output 14	1	SE, GI
			20	Ack, Nak
80	15	Binary Output 15	1	SE, GI
			20	Ack, Nak
80	16	Binary Output 16	1	SE, GI
			20	Ack, Nak
90	1	LED 1	1	SE, GI
90	2	LED 2	1	SE, GI
90	3	LED 3	1	SE, GI
90	4	LED 4	1	SE, GI
90	5	LED 5	1	SE, GI
90	6	LED 6	1	SE, GI
90	7	LED 7	1	SE, GI

FUN	INF	Description	ASDU	COT
90	8	LED 8	1	SE, GI
91	1	LED PU 1	1	SE, GI
91	2	LED PU 2	1	SE, GI
91	3	LED PU 3	1	SE, GI
91	4	LED PU 4	1	SE, GI
91	5	LED PU 5	1	SE, GI
91	6	LED PU 6	1	SE, GI
91	7	LED PU 7	1	SE, GI
91	8	LED PU 8	1	SE, 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	19	LED Reset	1	SE
			20	Ack, Nak
160	22	Settings changed	1	SE
160	23	Setting G1 selected	1	SE, GI
			20	Ack, Nak
160	24	Setting G2 selected	1	SE, GI
			20	Ack, Nak
160	25	Setting G3 selected	1	SE, GI
			20	Ack, Nak
160	26	Setting 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	64	Start/Pick-up L1	2	SE, GI
160	65	Start/Pick-up L2	2	SE, GI
160	66	Start/Pick-up L3	2	SE, GI
160	67	Start/Pick-up N	2	SE, GI
160	68	General Trip	2	SE
160	69	Trip L1	2	SE
160	70	Trip L2	2	SE
160	71	Trip L3	2	SE
160	84	General Start/Pick-up	2	SE, GI
160	85	Breaker Failure	2	SE
160	90	Trip I>	2	SE
160	91	Trip I>>	2	SE
160	92	Trip In>	2	SE
160	93	Trip In>>	2	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

FUN	INF	Description	ASDU	COT
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
183	21	50G-2	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	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	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	56	50BF Stage 1	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	70	46BC	2	SE, GI
183	96	81HBL2	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	110	Setting G5 selected	1	SE, GI
			20	Ack, Nak
183	111	Setting G6 selected	1	SE, GI
			20	Ack, Nak
183	112	Setting G7 selected	1	SE, GI
			20	Ack, Nak
183	113	Setting G8 selected	1	SE, GI
			20	Ack, Nak
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	120	Successful Man Close	1	SE
183	123	CB Total Trip Count	1	SE, GI
183	124	CB Delta Trip Count	1	SE, GI
183	126	Reset CB Total Trip Count	1	SE
			20	Ack, Nak

FUN	INF	Description	ASDU	COT
183	127	Reset CB Delta Trip Count	1	SE
			20	Ack, Nak
183	129	I ² t CB Wear	1	SE, GI
183	130	Reset I ² t CB Wear	1	SE
			20	Ack, Nak
183	140	Cold Load Active	1	SE, GI
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	181	CB Total Trip Count	4	SE
183	182	CB Delta Trip Count	4	SE
183	222	37-PhA	2	SE, GI
183	223	37-PhB	2	SE, GI
183	224	37-PhC	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	In 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	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	9	CB Phase A Trip Count	4	SE
185	10	CB Phase B Trip Count	4	SE
185	11	CB Phase C Trip Count	4	SE
185	12	CB E/F Trip Count	4	SE
185	43	General Trip	2	SE, GI
185	171	User Output 1	1	SE, GI
185	172	User Output 2	1	SE, GI
185	173	User Output 3	1	SE, GI
185	174	User Output 4	1	SE, GI
185	175	User Output 5	1	SE, GI
185	176	User Output 6	1	SE, GI
185	177	User Output 7	1	SE, GI
185	178	User Output 8	1	SE, GI

FUN	INF	Description	ASDU	COT
185	179	User Output 9	1	SE, GI
185	180	User Output 10	1	SE, GI
185	181	User Output 11	1	SE, GI
185	182	User Output 12	1	SE, GI
185	183	User Output 13	1	SE, GI
185	184	User Output 14	1	SE, GI
185	185	User Output 15	1	SE, GI
185	186	User Output 16	1	SE, GI
185	187	User Output 17	1	SE, GI
185	188	User Output 18	1	SE, GI
185	189	User Output 19	1	SE, GI
185	190	User Output 20	1	SE, GI
185	191	User Output 21	1	SE, GI
185	192	User Output 22	1	SE, GI
185	193	User Output 23	1	SE, GI
185	194	User Output 24	1	SE, GI
185	195	User Output 25	1	SE, GI
185	196	User Output 26	1	SE, GI
185	197	User Output 27	1	SE, GI
185	198	User Output 28	1	SE, GI
185	199	User Output 29	1	SE, GI
185	200	User Output 30	1	SE, GI
185	201	User Output 31	1	SE, GI
185	202	User Output 32	1	SE, GI
185	238	E/F In	2	SE, GI
185	239	SEF In	2	SE, GI
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

FUN	INF	Description	ASDU	COT
200	1	CB 1	1	SE
			20	Ack, Nak
200	6	CB 1 Opened	1	SE, GI
			20	Ack, Nak
200	7	CB 1 Closed	1	SE, GI
			20	Ack, Nak
200	150	User SP Command 1	1	SE, GI
			20	Ack, Nak
200	151	User SP Command 2	1	SE, GI
			20	Ack, Nak
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
			20	Ack, Nak
200	159	User DP Command 2	1	SE
			20	Ack, Nak
200	160	User DP Command 3	1	SE
			20	Ack, Nak
200	161	User DP Command 4	1	SE
			20	Ack, Nak
200	162	User DP Command 5	1	SE
			20	Ack, Nak
200	163	User DP Command 6	1	SE
			20	Ack, Nak
200	164	User DP Command 7	1	SE
			20	Ack, Nak
200	165	User DP Command 8	1	SE
			20	Ack, Nak
200	255	Blocked By Interlocking	1	SE, GI
60	4	Remote Mode	0	SE, GI
60	5	Out Of Service Mode	0	SE, GI
60	6	Local Mode	0	SE, GI
60	7	Local & Remote	0	SE, GI
60	12	Control Received	0	SE
60	13	Command Received	0	SE
60	128	Cold Start	0	SE
60	129	Warm Start	0	SE
60	130	Re-Start	0	SE

FUN	INF	Description	ASDU	COT
60	131	Expected Restart	0	SE, GI
60	132	Unexpected Restart	0	SE, GI
60	133	Reset Start Count	0	SE
60	135	Trigger Storage	0	SE
60	136	Clear Waveform Records	0	SE
60	137	Clear Fault Records	0	SE
60	138	Clear Event Records	0	SE
60	140	Demand metering reset	0	SE
60	170	General Alarm 1	0	SE, GI
60	171	General Alarm 2	0	SE, GI
60	172	General Alarm 3	0	SE, GI
60	173	General Alarm 4	0	SE, GI
60	174	General Alarm 5	0	SE, GI
60	175	General Alarm 6	0	SE, GI
60	176	General Alarm 7	0	SE, GI
60	177	General Alarm 8	0	SE, GI
60	178	General Alarm 9	0	SE, GI
60	179	General Alarm 10	0	SE, GI
60	180	General Alarm 11	0	SE, GI
60	181	General Alarm 12	0	SE, GI
60	182	Quick Logic E1	0	SE, GI
60	183	Quick Logic E2	0	SE, GI
60	184	Quick Logic E3	0	SE, GI
60	185	Quick Logic E4	0	SE, GI
60	186	Quick Logic E5	0	SE, GI
60	187	Quick Logic E6	0	SE, GI
60	188	Quick Logic E7	0	SE, GI
60	189	Quick Logic E8	0	SE, GI
60	190	Quick Logic E9	0	SE, GI
60	191	Quick Logic E10	0	SE, GI
60	192	Quick Logic E11	0	SE, GI
60	193	Quick Logic E12	0	SE, GI
60	194	Quick Logic E13	0	SE, GI
60	195	Quick Logic E14	0	SE, GI
60	196	Quick Logic E15	0	SE, GI
60	197	Quick Logic E16	0	SE, GI
60	214	Function Key 1	0	SE
60	215	Function Key 2	0	SE
60	216	Function Key 3	0	SE
60	217	Function Key 4	0	SE
60	218	Function Key 5	0	SE
60	219	Function Key 6	0	SE
61	1	General Alarm 13	0	SE, GI
61	2	General Alarm 14	0	SE, GI
61	3	General Alarm 15	0	SE, GI
61	4	General Alarm 16	0	SE, GI
61	5	General Alarm 17	0	SE, GI
61	6	General Alarm 18	0	SE, GI
61	7	General Alarm 19	0	SE, GI

FUN	INF	Description	ASDU	COT
61	8	General Alarm 20	0	SE, GI
70	5	Binary Input 5	0	SE, GI
70	6	Binary Input 6	0	SE, GI
70	7	Binary Input 7	0	SE, GI
70	8	Binary Input 8	0	SE, GI
70	9	Binary Input 9	0	SE, GI
70	10	Binary Input 10	0	SE, GI
70	11	Binary Input 11	0	SE, GI
70	12	Binary Input 12	0	SE, GI
70	13	Binary Input 13	0	SE, GI
70	14	Binary Input 14	0	SE, GI
70	15	Binary Input 15	0	SE, GI
70	16	Binary Input 16	0	SE, GI
70	17	Binary Input 17	0	SE, GI
70	18	Binary Input 18	0	SE, GI
70	19	Binary Input 19	0	SE, GI
75	1	Virtual Input 1	0	SE, GI
75	2	Virtual Input 2	0	SE, GI
75	3	Virtual Input 3	0	SE, GI
75	4	Virtual Input 4	0	SE, GI
75	5	Virtual Input 5	0	SE, GI
75	6	Virtual Input 6	0	SE, GI
75	7	Virtual Input 7	0	SE, GI
75	8	Virtual Input 8	0	SE, GI
75	9	Virtual Input 9	0	SE, GI
75	10	Virtual Input 10	0	SE, GI
75	11	Virtual Input 11	0	SE, GI
75	12	Virtual Input 12	0	SE, GI
75	13	Virtual Input 13	0	SE, GI
75	14	Virtual Input 14	0	SE, GI
75	15	Virtual Input 15	0	SE, GI
75	16	Virtual Input 16	0	SE, GI
80	1	Binary Output 1	0	SE, GI
80	2	Binary Output 2	0	SE, GI
80	3	Binary Output 3	0	SE, GI
80	4	Binary Output 4	0	SE, GI
80	5	Binary Output 5	0	SE, GI
80	6	Binary Output 6	0	SE, GI
80	7	Binary Output 7	0	SE, GI
80	8	Binary Output 8	0	SE, GI
80	9	Binary Output 9	0	SE, GI
80	10	Binary Output 10	0	SE, GI
80	11	Binary Output 11	0	SE, GI
80	12	Binary Output 12	0	SE, GI
80	13	Binary Output 13	0	SE, GI
80	14	Binary Output 14	0	SE, GI
80	15	Binary Output 15	0	SE, GI
80	16	Binary Output 16	0	SE, GI

FUN	INF	Description	ASDU	COT
90	1	LED 1	0	SE, GI
90	2	LED 2	0	SE, GI
90	3	LED 3	0	SE, GI
90	4	LED 4	0	SE, GI
90	5	LED 5	0	SE, GI
90	6	LED 6	0	SE, GI
90	7	LED 7	0	SE, GI
90	8	LED 8	0	SE, GI
91	1	LED PU 1	0	SE, GI
91	2	LED PU 2	0	SE, GI
91	3	LED PU 3	0	SE, GI
91	4	LED PU 4	0	SE, GI
91	5	LED PU 5	0	SE, GI
91	6	LED PU 6	0	SE, GI
91	7	LED PU 7	0	SE, GI
91	8	LED PU 8	0	SE, GI
160	2	Reset FCB	0	SE
160	3	Reset CU	0	SE
160	4	Start/Restart	0	SE
160	5	Power On	0	SE, GI
160	16	Auto-reclose active	1	SE, GI
			20	Ack, Nak
160	19	LED Reset	0	SE
160	22	Settings changed	0	SE
160	23	Setting G1 selected	0	SE, GI
160	24	Setting G2 selected	0	SE, GI
160	25	Setting G3 selected	0	SE, GI
160	26	Setting G4 selected	0	SE, GI
160	27	Binary Input 1	0	SE, GI
160	28	Binary Input 2	0	SE, GI
160	29	Binary Input 3	0	SE, GI
160	30	Binary Input 4	0	SE, GI
160	36	Trip Circuit Fail	0	SE, GI
160	64	Start/Pick-up L1	0	SE, GI
160	65	Start/Pick-up L2	0	SE, GI
160	66	Start/Pick-up L3	0	SE, GI
160	67	Start/Pick-up N	0	SE, GI
160	68	General Trip	0	SE
160	69	Trip L1	0	SE
160	70	Trip L2	0	SE
160	71	Trip L3	0	SE
160	84	General Start/Pick-up	0	SE, GI
160	85	Breaker Failure	0	SE
160	90	Trip I>	0	SE
160	91	Trip I>>	0	SE
160	92	Trip In>	0	SE
160	93	Trip In>>	0	SE
160	128	CB on by auto reclose	1	SE
183	10	51-1	0	SE, GI

FUN	INF	Description	ASDU	COT
183	11	50-1	0	SE, GI
183	12	51N-1	0	SE, GI
183	13	50N-1	0	SE, GI
183	14	51G-1	0	SE, GI
183	15	50G-1	0	SE, GI
183	16	51-2	0	SE, GI
183	17	50-2	0	SE, GI
183	18	51N-2	0	SE, GI
183	19	50N-2	0	SE, GI
183	20	51G-2	0	SE, GI
183	21	50G-2	0	SE, GI
183	34	50BF Stage 2	0	SE, GI
183	35	49-Alarm	0	SE, GI
183	36	49-Trip	0	SE, GI
183	41	51SEF-1	0	SE, GI
183	42	50SEF-1	0	SE, GI
183	43	51SEF-2	0	SE, GI
183	44	50SEF-2	0	SE, GI
183	49	SEF Out	0	SE, GI
183	50	46IT	0	SE, GI
183	51	46DT	0	SE, GI
183	52	64H	0	SE, GI
183	53	E/F Out	0	SE, GI
183	56	50BF Stage 1	0	SE, GI
183	62	37-1	0	SE, GI
183	63	37-2	0	SE, GI
183	64	37G-1	0	SE, GI
183	65	37G-2	0	SE, GI
183	70	46BC	0	SE, GI
183	96	81HBL2	0	SE, GI
183	100	CB Alarm	0	SE, GI
183	101	Trip Circuit Fail 1	0	SE, GI
183	102	Trip Circuit Fail 2	0	SE, GI
183	103	Trip Circuit Fail 3	0	SE, GI
183	110	Setting G5 selected	0	SE, GI
183	111	Setting G6 selected	0	SE, GI
183	112	Setting G7 selected	0	SE, GI
183	113	Setting G8 selected	0	SE, GI
183	114	Close CB Failed	0	SE, GI
183	115	Open CB Failed	0	SE, GI
183	116	Reclaim	0	SE, GI
183	117	Lockout	0	SE, GI
183	119	Successful DAR Close	1	SE
183	120	Successful Man Close	0	SE
183	121	HotLine Working	1	SE, GI
			20	Ack, Nak
183	122	Inst Protection Out	1	SE, GI
			20	Ack, Nak

FUN	INF	Description	ASDU	COT
183	123	CB Total Trip Count	0	SE, GI
183	124	CB Delta Trip Count	0	SE, GI
183	125	CB Count To AR Block	1	SE, GI
183	126	Reset CB Total Trip Count	0	SE
183	127	Reset CB Delta Trip Count	0	SE
183	128	Reset CB Count To AR Block	1	SE
			20	Ack, Nak
183	129	1 st CB Wear	0	SE, GI
183	130	Reset 1 st CB Wear	0	SE
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
			20	Ack, Nak
183	137	CB on by auto reclose	1	SE, GI
183	140	Cold Load Active	0	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
183	163	Trip Time Alarm	0	SE
183	164	Close Circuit Fail 1	0	SE, GI
183	165	Close Circuit Fail 2	0	SE, GI
183	166	Close Circuit Fail 3	0	SE, GI
183	167	Close Circuit Fail	0	SE, GI
183	171	60 CTS-I	0	SE, GI
183	181	CB Total Trip Count	0	SE
183	182	CB Delta Trip Count	0	SE
183	183	CB Count To AR Block	4	SE
183	184	CB Freq Ops Count	4	SE
183	222	37-PhA	0	SE, GI
183	223	37-PhB	0	SE, GI
183	224	37-PhC	0	SE, GI
183	231	50BF-PhA	0	SE, GI
183	232	50BF-PhB	0	SE, GI
183	233	50BF-PhC	0	SE, GI
183	234	50BF-EF	0	SE, GI
183	235	79 Last Trip Lockout	0	SE, GI
183	237	CB DBI	0	SE, GI
183	238	CB Travelling	0	SE, GI
183	239	In Fault Current	0	SE
183	240	Ia Fault Current	0	SE
183	241	Ib Fault Current	0	SE
183	242	Ic Fault Current	0	SE
183	243	Ig Fault Current	0	SE
183	249	60 CTS-I-PhA	0	SE, GI
183	250	60 CTS-I-PhB	0	SE, GI
183	251	60 CTS-I-PhC	0	SE, GI
183	252	Trip PhA	0	SE, GI
183	253	Trip PhB	0	SE, GI

FUN	INF	Description	ASDU	COT
183	254	Trip PhC	0	SE, GI
185	9	CB Phase A Trip Count	0	SE
185	10	CB Phase B Trip Count	0	SE
185	11	CB Phase C Trip Count	0	SE
185	12	CB E/F Trip Count	0	SE
185	43	General Trip	0	SE, GI
185	171	User Output 1	0	SE, GI
185	172	User Output 2	0	SE, GI
185	173	User Output 3	0	SE, GI
185	174	User Output 4	0	SE, GI
185	175	User Output 5	0	SE, GI
185	176	User Output 6	0	SE, GI
185	177	User Output 7	0	SE, GI
185	178	User Output 8	0	SE, GI
185	179	User Output 9	0	SE, GI
185	180	User Output 10	0	SE, GI
185	181	User Output 11	0	SE, GI
185	182	User Output 12	0	SE, GI
185	183	User Output 13	0	SE, GI
185	184	User Output 14	0	SE, GI
185	185	User Output 15	0	SE, GI
185	186	User Output 16	0	SE, GI
185	187	User Output 17	0	SE, GI
185	188	User Output 18	0	SE, GI
185	189	User Output 19	0	SE, GI
185	190	User Output 20	0	SE, GI
185	191	User Output 21	0	SE, GI
185	192	User Output 22	0	SE, GI
185	193	User Output 23	0	SE, GI
185	194	User Output 24	0	SE, GI
185	195	User Output 25	0	SE, GI
185	196	User Output 26	0	SE, GI
185	197	User Output 27	0	SE, GI
185	198	User Output 28	0	SE, GI
185	199	User Output 29	0	SE, GI
185	200	User Output 30	0	SE, GI
185	201	User Output 31	0	SE, GI
185	202	User Output 32	0	SE, GI
185	238	E/F In	0	SE, GI
185	239	SEF In	0	SE, GI
185	241	Start Count Alarm	0	SE, GI
186	1	50AFD PhA	0	SE, GI
186	2	50AFD PhB	0	SE, GI
186	3	50AFD PhC	0	SE, GI
186	4	50AFD	0	SE, GI
186	5	AFD Zone 1 Flash	0	SE, GI
186	6	AFD Zone 1	0	SE, GI
186	7	AFD Zone 2 Flash	0	SE, GI

FUN	INF	Description	ASDU	COT
186	8	AFD Zone 2	0	SE, GI
186	9	AFD Zone 3 Flash	0	SE, GI
186	10	AFD Zone 3	0	SE, GI
186	11	AFD Zone 4 Flash	0	SE, GI
186	12	AFD Zone 4	0	SE, GI
186	13	AFD Zone 5 Flash	0	SE, GI
186	14	AFD Zone 5	0	SE, GI
186	15	AFD Zone 6 Flash	0	SE, GI
186	16	AFD Zone 6	0	SE, GI
186	17	AFD Zone1 Count	0	SE
186	18	AFD Zone2 Count	0	SE
186	19	AFD Zone3 Count	0	SE
186	20	AFD Zone4 Count	0	SE
186	21	AFD Zone5 Count	0	SE
186	22	AFD Zone6 Count	0	SE
200	1	CB 1	0	SE
200	6	CB 1 Opened	0	SE, GI
200	7	CB 1 Closed	0	SE, GI
200	150	User SP Command 1	0	SE, GI
200	151	User SP Command 2	0	SE, GI
200	152	User SP Command 3	0	SE, GI
200	153	User SP Command 4	0	SE, GI
200	154	User SP Command 5	0	SE, GI
200	155	User SP Command 6	0	SE, GI
200	156	User SP Command 7	0	SE, GI
200	157	User SP Command 8	0	SE, GI
200	158	User DP Command 1	0	SE
200	159	User DP Command 2	0	SE
200	160	User DP Command 3	0	SE
200	161	User DP Command 4	0	SE
200	162	User DP Command 5	0	SE
200	163	User DP Command 6	0	SE
200	164	User DP Command 7	0	SE
200	165	User DP Command 8	0	SE
200	200	CB 1 Trip & Reclose	1	SE
			20	Ack, Nak
200	201	CB 1 Trip & Lockout	1	SE
			20	Ack, Nak
200	255	Blocked By Interlocking	0	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.

3.4.2 Measurands

The following Measurand EVT and INF numbers apply to this device.

FUN	INF	Description	ASDU	COT
183	148	Measurand $I_{L1,2,3}$, $V_{L1,2,3}$, P, Q, F --- I_{L1} (2.4x) (Window 5%) I_{L2} (2.4x) (Window 5%) I_{L3} (2.4x) (Window 5%) V_{L1} (1.2x) (Window 1%) V_{L2} (1.2x) (Window 5%) V_{L3} (1.2x) (Window 5%) P (2.4x) (Window 5%) Q (2.4x) (Window 5%) F (1.2x) (Window 0.1%) --- Note - Fields V_{Lx} , P and Q will always be zero.	9	Cyclic - Refresh rate 5 seconds or value change greater than Window x %.

3.4.3 Disturbance Recorder Actual Channel (ACC) Numbers

The following Disturbance Recorder channel numbers apply to this device.

FUN	ACC	Description
182	5	la
182	6	lb
182	7	lc
182	8	lg1

4. MODBUS Definitions

4.1 Introduction

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

This protocol can be set to use any or all of the relays hardware interfaces (USB, Fibre Optic, RS232 and RS485). 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.

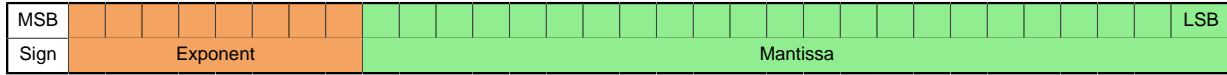
Communication via MODBUS over Ethernet requires external devices. Please refer to the documents **TCPIP Catalogue Sheet** and **TCPIP Interface Technical Guidance Notes** for more information.

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

4.2 MODBUS Register Data Types

4.2.1 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).



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.

$\frac{1}{2^1}$	$\frac{1}{2^2}$	$\frac{1}{2^3}$	$\frac{1}{2^4}$																	$\frac{1}{2^{21}}$	$\frac{1}{2^{22}}$	$\frac{1}{2^{23}}$
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	0	0	0	0

This calculates out as:

Sign = +1

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

$$\begin{aligned}
 \text{Mantissa} &= 1 + \frac{1}{2^1} + \frac{1}{2^2} + \frac{1}{2^3} + \frac{1}{2^5} + \frac{1}{2^{10}} + \frac{1}{2^{13}} \\
 &= 1 + \frac{4096 + 2048 + 1024 + 256 + 8 + 1}{2^{13}} = 1 + \frac{7433}{2^{13}} = 1.907348632
 \end{aligned}$$

Therefore $Sign * 2^{Exponent} * Mantissa = 1 * 2^{19} * 1.907348632 = 1000000$

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

Address	Value
30002	2400

On reception these two registers should be interpreted in the correct order as IEEE754 floating point representation.

4.2.2 FP_32BITS_3DP

The FP_32BITS_3DP is a 32 bit integer fixed point value, 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 will be sent as 123456. As it is an integer, negative numbers are sent as 2's complement.

FP_32BITS_3DP & MODBUS

In this MODBUS implementation the 32 bit value is stored in 2 16 registers in Big-Endian format. As an example, if we take the hex representation of 123456, we have 1E240h. Assume this is stored in the registers 30001 and 30002, it would look as follows:

Address	Value
30001	1
30002	E240

On reception these two registers should be interpreted in the correct order as a 32 bit integer.

4.2.3 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 2 16 bit registers in Big-Endian format. As an example, if we take the hex representation of -123456, in 2's complement, we have FFFE1DC0h. Assume this is stored in the registers 30001 and 30002, it would look as follows:

Address	Value
30001	FFFE
30002	1DC0

On reception these two registers should be interpreted in the correct order as a 32 bit integer.

4.2.4 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. As an example, if we take the hex representation of 5678 we have 162Eh. Assume this is stored in the register 30001, it would look as follows:

Address	Value
30001	162E

On reception this register should be interpreted as a 16 bit integer.

Truncation

Calculations are performed as 32 bit. 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, the value returned would be the lowest 16 bits = 4D98h which equals 19864.

4.2.5 EVENT

MODBUS does not define a method for extracting events; therefore a private method has been defined based on that defined by IEC60870-5-103.

The EVENT register contains the earliest event record available. The event record is 8 registers (16 bytes) of information, whose format is described below. When this record has been read it will be replaced by the next available record. Event records must be read completely; therefore the quantity value must be set to 8 before reading. Failing to do this will result in an exception code 2. If no event record is present the exception code 2 will be returned. The EVENT register should be polled regularly by the master for events.

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

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

Format

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

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.

Key	Description
FUN	Function Type, as defined for IEC870-5-103.
INF	Information Number, as defined for IEC870-5-103.
DPI	Measurand Event with Relative Time, values 1 = OFF, 2 = ON.
ms L	Time Stamp Milliseconds low byte.
ms H	Time Stamp Milliseconds high byte.
Mi	Time Stamp Minutes (MSB = invalid, time not set > 23 hours).
Ho	Time Stamp 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.

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

Event Type 1 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

Event Type 2 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

Event Type 4 Format.

4.2.6 EVENTCOUNT

The EVENTCOUNT register contains the current number of events in the relay's event buffer.

On reception this register should be interpreted as a 16 bit integer.

4.2.7 TIME_METER

The TIME_METER register contains the device's time. The time must be read or written in one step; therefore the quantity should be 4 registers. Failing to do this will result in an exception code 2. The time format is 8 bytes as follows.

The following table describes the fields in the time.

Key	Description
ms L	Time Stamp Milliseconds low byte.
ms H	Time Stamp Milliseconds high byte.
Mi	Time Stamp Minutes (MSB = invalid, time not set > 23 hours).
Ho	Time Stamp Hours (MSB = Summer time flag).
Da	Time Stamp Days.
Mo	Time Stamp Months.
Ye L	Time Stamp Years low byte.
Ye H	Time Stamp Years high byte (Not Used).

The following table shows the fields in the time as they are returned.

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

Time Format.

4.2.8 STR32 & STR64

4.2.9 BITSTRING

A Bit-String (or Bit-Array) is a method of compactly storing a number of bits of data. In this instance we 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 would be in the Most Significant Bit (MSB). Bit values can only be zero or one. Any unused bits will be set to zero.

BITSTRING & MODBUS

In this MODBUS implementation the 16 bit value is stored in a 16 bit register in Big-Endian format. As an example, assume bits 1, 3, 9 and 12 are set. The binary representation of this would be 0000100100000101_2 giving a hex representation of 0905h. Assume this is stored in the register 30001, it would look as follows:

Address	Value
30001	0905

On reception this register should be interpreted as a 16 bit integer.

4.3 Point List

The information shown below is the default configuration. This can be modified using the Communications Configuration Editor tool, refer [section 9](#) for details.

4.3.1 Coils (Read Write Binary values)

Address	Name
00001	Binary Output 1
00002	Binary Output 2
00003	Binary Output 3
00004	Binary Output 4
00005	Binary Output 5
00006	Binary Output 6
00007	Binary Output 7
00008	Binary Output 8
00009	Binary Output 9
00010	Binary Output 10
00011	Binary Output 11
00012	Binary Output 12
00013	Binary Output 13
00014	Binary Output 14
00015	Binary Output 15
00016	Binary Output 16
00101	Setting G1 selected
00102	Setting G2 selected
00103	Setting G3 selected
00104	Setting G4 selected
00105	Setting G5 selected
00106	Setting G6 selected
00107	Setting G7 selected
00108	Setting G8 selected
00109	CB 1
00112	Auto-reclose active
00113	HotLine Working
00114	E/F Out
00115	SEF Out
00116	Inst Protection Out
00155	Remote Mode
00156	Out Of Service Mode
00157	Local Mode
00158	Local & 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

Address	Name
00203	User SP Command 4
00204	User SP Command 5
00205	User SP Command 6
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

4.3.2 Inputs (Read Only Binary values)

Address	Name
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
10010	Binary Input 10
10011	Binary Input 11
10012	Binary Input 12
10013	Binary Input 13
10014	Binary Input 14
10015	Binary Input 15
10016	Binary Input 16
10017	Binary Input 17
10018	Binary Input 18
10019	Binary Input 19
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
10119	Start/Pick-up N
10122	51-1

Address	Name
10123	50-1
10124	51N-1
10125	50N-1
10126	51G-1
10127	50G-1
10128	51-2
10129	50-2
10130	51N-2
10131	50N-2
10132	51G-2
10133	50G-2
10146	50BF Stage 2
10147	49-Alarm
10148	49-Trip
10150	46IT
10151	46DT
10154	46BC
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
10176	Inst Protection Out
10177	CB Total Trip Count
10178	CB Delta Trip Count
10179	CB Count To AR Block
10180	Inst 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
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

Address	Name
10217	CB Frequent Ops Count
10218	!^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
10290	General Alarm 1
10291	General Alarm 2
10292	General Alarm 3
10293	General Alarm 4
10294	General Alarm 5
10295	General Alarm 6
10296	General Alarm 7
10297	General Alarm 8
10298	General Alarm 9
10299	General Alarm 10
10300	General Alarm 11
10301	General Alarm 12
10302	Quick Logic E1
10303	Quick Logic E2
10304	Quick Logic E3
10305	Quick Logic E4
10306	Quick Logic E5
10307	Quick Logic E6
10308	Quick Logic E7
10309	Quick Logic E8
10310	Quick Logic E9
10311	Quick Logic E10
10312	Quick Logic E11
10313	Quick Logic E12
10314	Quick Logic E13
10315	Quick Logic E14
10316	Quick Logic E15
10317	Quick Logic E16
10334	60 CTS-I
10335	81HBL2
10336	37G-1
10337	37G-2
10367	50BF Stage 1
10369	37-PhA
10370	37-PhB
10371	37-PhC
10378	50BF-PhA
10379	50BF-PhB
10380	50BF-PhC
10381	50BF-EF
10383	60 CTS-I-PhA

Address	Name
10384	60 CTS-I-PhB
10385	60 CTS-I-PhC
10390	Trip PhA
10391	Trip PhB
10392	Trip PhC
10410	CB Alarm
10411	General Alarm 13
10412	General Alarm 14
10413	General Alarm 15
10414	General Alarm 16
10415	General Alarm 17
10416	General Alarm 18
10417	General Alarm 19
10418	General Alarm 20
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
10509	Virtual Input 9
10510	Virtual Input 10
10511	Virtual Input 11
10512	Virtual Input 12
10513	Virtual Input 13
10514	Virtual Input 14
10515	Virtual Input 15
10516	Virtual Input 16
10601	LED 1
10602	LED 2
10603	LED 3
10604	LED 4
10605	LED 5
10606	LED 6
10607	LED 7
10608	LED 8
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
10800	Cold Start
10801	Warm Start

Address	Name
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
11020	User Output 1
11021	User Output 2
11022	User Output 3
11023	User Output 4
11024	User Output 5
11025	User Output 6
11026	User Output 7
11027	User Output 8
11028	User Output 9
11029	User Output 10
11030	User Output 11
11031	User Output 12
11032	User Output 13
11033	User Output 14
11034	User Output 15
11035	User Output 16
11036	User Output 17
11037	User Output 18
11038	User Output 19
11039	User Output 20
11040	User Output 21
11041	User Output 22
11042	User Output 23
11043	User Output 24
11044	User Output 25
11045	User Output 26
11046	User Output 27
11047	User Output 28

Address	Name
11048	User Output 29
11049	User Output 30
11050	User Output 31
11051	User Output 32
11071	E/F In
11072	SEF In
11073	CB DBI
11074	CB Travelling
11075	Close CB Failed
11076	Open CB Failed
11077	Start Count Alarm
11078	50AFD PhA
11079	50AFD PhB
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

4.3.3 Input Registers (Read Only Registers)

Address	Name	Format	Mult	Description
30001	Event Count	EVENTCOUNT	0.000000	Events Counter
30002	Event	EVENT	0.000000	8 Registers
30060	Frequency	FP_32BITS_3DP	1.000000	Frequency Hz
30064	Ia Primary	FP_32BITS_3DP	1.000000	Ia A
30066	Ib Primary	FP_32BITS_3DP	1.000000	Ib A
30068	Ic Primary	FP_32BITS_3DP	1.000000	Ic A
30070	Ia Secondary	FP_32BITS_3DP	1.000000	Ia A
30072	Ib Secondary	FP_32BITS_3DP	1.000000	Ib A
30074	Ic Secondary	FP_32BITS_3DP	1.000000	Ic A
30076	Ia Nominal	FP_32BITS_3DP	1.000000	Ia xIn
30078	Ib Nominal	FP_32BITS_3DP	1.000000	Ib xIn
30080	Ic Nominal	FP_32BITS_3DP	1.000000	Ic xIn
30082	Ia Nominal	FP_32BITS_3DP	1.000000	Ia Degrees
30084	Ib Nominal	FP_32BITS_3DP	1.000000	Ib Degrees
30086	Ic Nominal	FP_32BITS_3DP	1.000000	Ic Degrees
30088	In Primary	FP_32BITS_3DP	1.000000	In A

Address	Name	Format	Mult	Description
30090	In Secondary	FP_32BITS_3DP	1.000000	In A
30092	In Nominal	FP_32BITS_3DP	1.000000	In xInom
30094	Ig Primary	FP_32BITS_3DP	1.000000	Ig A
30096	Ig Secondary	FP_32BITS_3DP	1.000000	Ig A
30098	Ig Nominal	FP_32BITS_3DP	1.000000	Ig xInom
30100	Izps Nominal	FP_32BITS_3DP	1.000000	Izps xIn
30102	Ipps Nominal	FP_32BITS_3DP	1.000000	Ipps xIn
30104	Inps Nominal	FP_32BITS_3DP	1.000000	Inps xIn
30106	Izps Nominal	FP_32BITS_3DP	1.000000	Izps Degrees
30108	Ipps Nominal	FP_32BITS_3DP	1.000000	Ipps Degrees
30110	Inps Nominal	FP_32BITS_3DP	1.000000	Inps Degrees
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
30193	I Phase A Max	FP_32BITS_3DP	1.000000	Ia Max Demand
30195	I Phase B Max	FP_32BITS_3DP	1.000000	Ib Max Demand
30197	I Phase C Max	FP_32BITS_3DP	1.000000	Ic Max Demand
30203	Ig Max	FP_32BITS_3DP	1.000000	Ig Max Demand
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	Ia Last Trip	FP_32BITS_3DP	1.000000	Ia Fault
30303	Ib Last Trip	FP_32BITS_3DP	1.000000	Ib Fault
30305	Ic Last Trip	FP_32BITS_3DP	1.000000	Ic Fault
30313	In Last Trip	FP_32BITS_3DP	1.000000	In Fault
30315	Ig Last Trip	FP_32BITS_3DP	1.000000	Ig Fault
30331	CB Ph A Trip Count	UINT32	1.000000	CB Phase A Trip Count
30333	CB Ph B Trip Count	UINT32	1.000000	CB Phase B Trip Count
30335	CB Ph C Trip Count	UINT32	1.000000	CB Phase C Trip Count
30337	CB E/F Trip Count	UINT32	1.000000	CB EF Trip Count
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

Address	Name	Format	Mult	Description
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
30392	Active Setting Group	UINT16	1.000000	Active Setting Group
30400	Frequency Max	FP_32BITS_3DP	1.000000	Frequency Max
30468	CB Trip Time Meter	FP_32BITS_3DP	1.000000	CB Trip Time

4.3.4 Holding Registers (Read Write Registers)

Address	Name	Format	Mult	Description
40001	Time	TIME_METER	0.000000	Time
40060	Frequency	FP_32BITS_3DP	1.000000	Frequency Hz
40064	Ia Primary	FP_32BITS_3DP	1.000000	Ia A
40066	Ib Primary	FP_32BITS_3DP	1.000000	Ib A
40068	Ic Primary	FP_32BITS_3DP	1.000000	Ic A
40070	Ia Secondary	FP_32BITS_3DP	1.000000	Ia A
40072	Ib Secondary	FP_32BITS_3DP	1.000000	Ib A
40074	Ic Secondary	FP_32BITS_3DP	1.000000	Ic A
40076	Ia Nominal	FP_32BITS_3DP	1.000000	Ia xIn
40078	Ib Nominal	FP_32BITS_3DP	1.000000	Ib xIn
40080	Ic Nominal	FP_32BITS_3DP	1.000000	Ic xIn
40082	Ia Nominal	FP_32BITS_3DP	1.000000	Ia Degrees
40084	Ib Nominal	FP_32BITS_3DP	1.000000	Ib Degrees
40086	Ic Nominal	FP_32BITS_3DP	1.000000	Ic Degrees
40088	In Primary	FP_32BITS_3DP	1.000000	In A
40090	In Secondary	FP_32BITS_3DP	1.000000	In A
40092	In Nominal	FP_32BITS_3DP	1.000000	In xInom
40094	Ig Primary	FP_32BITS_3DP	1.000000	Ig A
40096	Ig Secondary	FP_32BITS_3DP	1.000000	Ig A
40098	Ig Nominal	FP_32BITS_3DP	1.000000	Ig xInom
40100	Izps Nominal	FP_32BITS_3DP	1.000000	Izps xIn
40102	Ipps Nominal	FP_32BITS_3DP	1.000000	Ipps xIn
40104	Inps Nominal	FP_32BITS_3DP	1.000000	Inps xIn
40106	Izps Nominal	FP_32BITS_3DP	1.000000	Izps Degrees
40108	Ipps Nominal	FP_32BITS_3DP	1.000000	Ipps Degrees
40110	Inps Nominal	FP_32BITS_3DP	1.000000	Inps Degrees
40152	Thermal Status Ph A	UINT16	1.000000	Thermal Status Ph A %
40153	Thermal Status Ph B	UINT16	1.000000	Thermal Status Ph B %
40154	Thermal Status Ph C	UINT16	1.000000	Thermal Status Ph C %
40167	Fault Records	UINT16	1.000000	Fault Records
40168	Event Records	UINT16	1.000000	Event Records
40169	Waveform Records	UINT16	1.000000	Waveform Records
40193	I Phase A Max	FP_32BITS_3DP	1.000000	Ia Max Demand
40195	I Phase B Max	FP_32BITS_3DP	1.000000	Ib Max Demand
40197	I Phase C Max	FP_32BITS_3DP	1.000000	Ic Max Demand
40203	Ig Max	FP_32BITS_3DP	1.000000	Ig Max Demand

Address	Name	Format	Mult	Description
40241	CB Total Trip Count	UINT32	1.000000	CB Total Trip Count
40243	CB Delta Trip Count	UINT32	1.000000	CB Delta Trip Count
40245	CB Count To AR Block	UINT32	1.000000	CB Count to AR Block
40247	CB Frequent Ops Count	UINT32	1.000000	CB Frequent Ops Count
40301	Ia Last Trip	FP_32BITS_3DP	1.000000	Ia Fault
40303	Ib Last Trip	FP_32BITS_3DP	1.000000	Ib Fault
40305	Ic Last Trip	FP_32BITS_3DP	1.000000	Ic Fault
40313	In Last Trip	FP_32BITS_3DP	1.000000	In Fault
40315	Ig Last Trip	FP_32BITS_3DP	1.000000	Ig Fault
40331	CB Ph A Trip Count	UINT32	1.000000	CB Phase A Trip Count
40333	CB Ph B Trip Count	UINT32	1.000000	CB Phase B Trip Count
40335	CB Ph C Trip Count	UINT32	1.000000	CB Phase C Trip Count
40337	CB E/F Trip Count	UINT32	1.000000	CB EF Trip Count
40341	LED1-n	BITSTRING	0.000000	Led 1-16 status
40342	LED1-n	BITSTRING	0.000000	Led 17-32 status
40343	INP1-n	BITSTRING	0.000000	Input 1-16 status
40344	INP1-n	BITSTRING	0.000000	Input 17-32 status
40345	OUT1-n	BITSTRING	0.000000	Output 1-16 status
40346	OUT1-n	BITSTRING	0.000000	Output 17-32 status
40347	VRT1-n	BITSTRING	0.000000	Virtual 1-16 status
40348	VRT1-n	BITSTRING	0.000000	Virtual 17-32 status
40349	EQN1-n	BITSTRING	0.000000	Equation 1-16 status
40350	EQN1-n	BITSTRING	0.000000	Equation 17-32 status
40354	CB Wear A	FP_32BITS_3DP	0.000001	CB Wear A
40356	CB Wear B	FP_32BITS_3DP	0.000001	CB Wear B
40358	CB Wear C	FP_32BITS_3DP	0.000001	CB Wear C
40360	CB Wear A Remaining	FP_32BITS_3DP	1.000000	CB Wear A Remaining
40362	CB Wear B Remaining	FP_32BITS_3DP	1.000000	CB Wear B Remaining
40364	CB Wear C Remaining	FP_32BITS_3DP	1.000000	CB Wear C Remaining
40366	CB Wear Minimum	FP_32BITS_3DP	1.000000	CB Wear Minimum
40368	Active Setting Group	UINT16	1.000000	Active Setting Group
40394	Ia 2nd Harmonic Nominal	FP_32BITS_3DP	1.000000	81HBL2 PhA xIn
40396	Ib 2nd Harmonic Nominal	FP_32BITS_3DP	1.000000	81HBL2 PhB xIn
40398	Ic 2nd Harmonic Nominal	FP_32BITS_3DP	1.000000	81HBL2 PhC xIn
40401	Event Count	EVENTCOUNT	0.000000	Events Counter
40402	Event	EVENT	0.000000	8 Registers
40404	Frequency Max	FP_32BITS_3DP	1.000000	Frequency Max
40472	CB Trip Time Meter	FP_32BITS_3DP	1.000000	CB Trip Time

5. DNP3 Definitions

5.1 Device Profile

The following table provides a “Device Profile Document” in the standard format defined in the DNP 3.0 Subset Definitions Document. While it is referred to in the DNP 3.0 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 in Section 5.2 (beginning on page 58), and the Point List Tables provided in Section 5.3 (beginning on page 64), should provide a complete configuration/interoperability guide for communicating with a device implementing the Triangle MicroWorks, Inc. DNP 3.0 Slave Source Code Library.

DNP V3.0 DEVICE PROFILE DOCUMENT (Also see the DNP 3.0 Implementation Table in Section 5.2 , beginning on page 58).	
Vendor Name: Siemens Protection Devices Ltd.	
Device Name: 7SR210, using the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library, Version 3.	
Highest DNP Level Supported: For Requests: Level 3 For Responses: Level 3	Device Function: <input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
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 Object 11 is supported.	
Maximum Data Link Frame Size (octets): Transmitted: 256 Received: 256	Maximum Application Fragment Size (octets): Transmitted: 2048 Received: 2048
Maximum Data Link Re-tries: <input type="checkbox"/> None <input type="checkbox"/> Fixed (3) <input checked="" type="checkbox"/> Configurable from 0 to 65535 (Default 3)	Maximum Application Layer Re-tries: <input checked="" type="checkbox"/> None <input type="checkbox"/> Configurable
Requires Data Link Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input checked="" type="checkbox"/> Configurable as: Never, Only for multi-frame messages, or Always	
Requires Application Layer Confirmation: <input type="checkbox"/> Never <input type="checkbox"/> Always <input checked="" type="checkbox"/> When reporting Event Data (Slave devices only) <input checked="" type="checkbox"/> When sending multi-fragment responses (Slave devices only) <input type="checkbox"/> Sometimes <input type="checkbox"/> Configurable as: “Only when reporting event data”, or “When reporting event data or multi-fragment messages.”	
Timeouts while waiting for: Data Link Confirm: <input type="checkbox"/> None <input type="checkbox"/> Fixed at ____ <input type="checkbox"/> Variable <input checked="" type="checkbox"/> Configurable (2sec) Complete Appl. Fragment: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at ____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable Application Confirm: <input type="checkbox"/> None <input type="checkbox"/> Fixed at ____ <input type="checkbox"/> Variable <input checked="" type="checkbox"/> Configurable (10sec) Complete Appl. Response: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at ____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable	
Others: Transmission Delay, (Configurable, default 0 sec) Select/Operate Arm Timeout, (Configurable, default 5 sec) Need Time Interval, (Configurable, default 30 minutes)	

DNP V3.0 DEVICE PROFILE DOCUMENT (Also see the DNP 3.0 Implementation Table in Section 5.2 , beginning on page 58).																																																								
<p>Unsolicited Notification Delay, (Configurable, default 5 seconds)</p> <p>Unsolicited Response Retry Delay, (Configurable (between 3 - 9), default 5 seconds)</p> <p>Unsolicited Offline Interval, (Configurable, default 30 seconds)</p> <p>Binary Change Event Scan Period, (Polled, Not Applicable)</p> <p>Double Bit Change Event Scan Period, (Polled - Not Applicable)</p> <p>Analog Change Event Scan Period, (Polled - Not Applicable)</p> <p>Counter Change Event Scan Period, (Polled - Not Applicable)</p> <p>Frozen Counter Change Event Scan Period, (Polled - Not Applicable)</p> <p>String Change Event Scan Period, (Unsupported - Not Applicable)</p> <p>Virtual Terminal Event Scan Period, (Unsupported - Not Applicable)</p>																																																								
<p>Sends/Executes Control Operations:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">WRITE Binary Outputs</td> <td style="width: 15%;"><input checked="" type="checkbox"/> Never</td> <td style="width: 15%;"><input type="checkbox"/> Always</td> <td style="width: 15%;"><input type="checkbox"/> Sometimes</td> <td style="width: 15%;"><input type="checkbox"/> Configurable</td> </tr> <tr> <td>SELECT/OPERATE</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>DIRECT OPERATE</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>DIRECT OPERATE - NO ACK</td> <td><input type="checkbox"/> Never</td> <td><input checked="" type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Count > 1</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Pulse On</td> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input checked="" type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Pulse Off</td> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input checked="" type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Latch On</td> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input checked="" type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Latch Off</td> <td><input type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input checked="" type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Queue</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> <tr> <td>Clear Queue</td> <td><input checked="" type="checkbox"/> Never</td> <td><input type="checkbox"/> Always</td> <td><input type="checkbox"/> Sometimes</td> <td><input type="checkbox"/> Configurable</td> </tr> </table> <p>Attach explanation if "Sometimes" or "Configurable" was checked for any operation.</p>		WRITE Binary Outputs	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	SELECT/OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	DIRECT OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	DIRECT OPERATE - NO ACK	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Count > 1	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Pulse On	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Pulse Off	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Latch On	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Latch Off	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable	Clear Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable
WRITE Binary Outputs	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
SELECT/OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
DIRECT OPERATE	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
DIRECT OPERATE - NO ACK	<input type="checkbox"/> Never	<input checked="" type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Count > 1	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Pulse On	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Pulse Off	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Latch On	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Latch Off	<input type="checkbox"/> Never	<input type="checkbox"/> Always	<input checked="" type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
Clear Queue	<input checked="" type="checkbox"/> Never	<input type="checkbox"/> Always	<input type="checkbox"/> Sometimes	<input type="checkbox"/> Configurable																																																				
<p>Reports Binary Input Change Events when no specific variation requested:</p> <p><input type="checkbox"/> Never</p> <p><input type="checkbox"/> Only time-tagged</p> <p><input type="checkbox"/> Only non-time-tagged</p> <p><input checked="" type="checkbox"/> Configurable to send one or the other</p>	<p>Reports time-tagged Binary Input Change Events when no specific variation requested:</p> <p><input type="checkbox"/> Never</p> <p><input type="checkbox"/> Binary Input Change With Time</p> <p><input type="checkbox"/> Binary Input Change With Relative Time</p> <p><input checked="" type="checkbox"/> Configurable</p>																																																							
<p>Sends Unsolicited Responses:</p> <p><input type="checkbox"/> Never</p> <p><input checked="" type="checkbox"/> Configurable</p> <p><input type="checkbox"/> Only certain objects</p> <p><input type="checkbox"/> Sometimes (attach explanation)</p> <p><input checked="" type="checkbox"/> ENABLE/DISABLE UNSOLICITED Function codes supported</p>	<p>Sends Static Data in Unsolicited Responses:</p> <p><input checked="" type="checkbox"/> Never</p> <p><input type="checkbox"/> When Device Restarts</p> <p><input type="checkbox"/> When Status Flags Change</p> <p>No other options are permitted.</p>																																																							
<p>Default Counter Object/Variation:</p> <p><input type="checkbox"/> No Counters Reported</p> <p><input checked="" type="checkbox"/> Configurable</p> <p><input type="checkbox"/> Default Object</p> <p>Default Variation: _____</p> <p><input checked="" type="checkbox"/> Point-by-point list attached</p>	<p>Counters Roll Over at:</p> <p><input type="checkbox"/> No Counters Reported</p> <p><input type="checkbox"/> Configurable (attach explanation)</p> <p><input type="checkbox"/> 16 Bits</p> <p><input checked="" type="checkbox"/> 32 Bits</p> <p><input type="checkbox"/> Other Value: _____</p> <p><input checked="" type="checkbox"/> Point-by-point list attached</p>																																																							
<p>Sends Multi-Fragment Responses:</p> <p><input checked="" type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Configurable</p>																																																								
<p>Sequential File Transfer Support:</p>																																																								

DNP V3.0		
DEVICE PROFILE DOCUMENT		
(Also see the DNP 3.0 Implementation Table in Section 5.2 , beginning on page 58).		
File Transfer Support	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Append File Mode	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Custom Status Code Strings	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Permissions Field	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
File Events Assigned to Class	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
File Events Send Immediately	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Multiple Blocks in a Fragment	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Max Number of Files Open	0	

5.2 Implementation Table

The following table identifies which object variations, function codes, and qualifiers the Triangle MicroWorks, Inc. DNP 3.0 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, text shaded as **00, 01 (start stop)** indicates Subset Level 3 functionality (beyond Subset Level 2).

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

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation	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)
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	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 2
			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 2
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
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 Event - Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
13	1 (default - see note 1)	Binary Output Command Event 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. cl. 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)				
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

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
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)				
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)		
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. resp)	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. resp)	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. resp)	17, 28 (index)
22	6	16-Bit Counter Change Event (with Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130	17, 28 (index)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
					(unsol. resp)	
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				
23	5	32-Bit Frozen Counter Event (with Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	6	32-Bit Frozen Counter Event (with Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	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
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 2
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)				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
32	0	Analog Change Event - Any Variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1	32Bit-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	16Bit-Analog Change Event (without Time)	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	3	32Bit-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 (default - see note 1)	16Bit-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 Analog Event (without Time)				
33	2	16-Bit Frozen Analog Event (without Time)				
33	3	32-Bit Frozen Analog Event (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				
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 2
			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 2
			2 (write)	00, 01 (start-stop) 07, 08 (limited qty) 17, 27, 28 (index)		
34	3	Short Floating Point Analog Input Deadband	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty)	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	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
				17, 27, 28 (index)		
			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, 08 (limited qty)	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)	(limited qty = 1)
51	2	Unsynchronized Time and Date CTO			129 (response) 130 (unsol. resp)	(limited qty = 1)
52	1	Time Delay Coarse			129 (response)	(limited qty = 1)
52	2	Time Delay Fine			129 (response)	(limited 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)		
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)	14 (warm restart)			
		No Object (function code only)	23 (delay meas.)			
		No Object (function code only)	24 (record current time)			

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

5.3 Point List

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

This protocol can be set to use any or all of the relays hardware interfaces (USB, Fibre Optic, RS232 and RS485). 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.

Communication via DNP3 over Ethernet requires external devices. Please refer to the documents **TCPIP Catalogue Sheet** and **TCPIP Interface Technical Guidance Notes** for more information.

The information shown below is the default configuration. This can be modified using the Communications Configuration Editor tool, refer [section 9](#) for details.

5.3.1 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 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)				
Point Index	Name (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
10	Binary Input 10	0,2	2	2
11	Binary Input 11	0,2	2	2
12	Binary Input 12	0,2	2	2
13	Binary Input 13	0,2	2	2
14	Binary Input 14	0,2	2	2
15	Binary Input 15	0,2	2	2
16	Binary Input 16	0,2	2	2
17	Binary Input 17	0,2	2	2
18	Binary Input 18	0,2	2	2
19	Binary Input 19	0,2	2	2
35	Remote Mode	0,2	2	2

Binary Input PointsStatic (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 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)**

Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 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
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
49	Start/Pick-up N	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
65	46IT	0,2	2	2
66	46DT	0,2	2	2
69	46BC	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
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
125	SEF Out	0,2	2	2
126	Trip Circuit Fail 1	0,2	2	2

Binary Input PointsStatic (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 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)**

Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 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 ² t 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
219	CB Alarm	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
231	General Alarm 7	0,2	2	2
232	General Alarm 8	0,2	2	2
233	General Alarm 9	0,2	2	2
234	General Alarm 10	0,2	2	2
235	General Alarm 11	0,2	2	2
236	General Alarm 12	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
241	Quick Logic E5	0,2	2	2
242	Quick Logic E6	0,2	2	2
243	Quick Logic E7	0,2	2	2
244	Quick Logic E8	0,2	2	2
245	Quick Logic E9	0,2	2	2
246	Quick Logic E10	0,2	2	2
247	Quick Logic E11	0,2	2	2

Binary Input PointsStatic (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 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)**

Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
248	Quick Logic E12	0,2	2	2
249	Quick Logic E13	0,2	2	2
250	Quick Logic E14	0,2	2	2
251	Quick Logic E15	0,2	2	2
252	Quick Logic E16	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
274	37-PhA	0,2	2	2
275	37-PhB	0,2	2	2
276	37-PhC	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
310	General Alarm 13	0,2	2	2
311	General Alarm 14	0,2	2	2
312	General Alarm 15	0,2	2	2
313	General Alarm 16	0,2	2	2
314	General Alarm 17	0,2	2	2
315	General Alarm 18	0,2	2	2
316	General Alarm 19	0,2	2	2
317	General Alarm 20	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
415	Setting G5 selected	0,2	2	2
416	Setting G6 selected	0,2	2	2
417	Setting G7 selected	0,2	2	2
418	Setting G8 selected	0,2	2	2
420	79 AR In progress	0,2	2	2
422	HotLine Working	0,2	2	2

Binary Input PointsStatic (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 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)**

Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 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
509	Virtual Input 9	0,2	2	2
510	Virtual Input 10	0,2	2	2
511	Virtual Input 11	0,2	2	2
512	Virtual Input 12	0,2	2	2
513	Virtual Input 13	0,2	2	2
514	Virtual Input 14	0,2	2	2
515	Virtual Input 15	0,2	2	2
516	Virtual Input 16	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
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
801	Binary Output 1	0,2	2	2
802	Binary Output 2	0,2	2	2
803	Binary Output 3	0,2	2	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
807	Binary Output 7	0,2	2	2
808	Binary Output 8	0,2	2	2

Binary Input PointsStatic (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 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)**

Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
809	Binary Output 9	0,2	2	2
810	Binary Output 10	0,2	2	2
811	Binary Output 11	0,2	2	2
812	Binary Output 12	0,2	2	2
813	Binary Output 13	0,2	2	2
814	Binary Output 14	0,2	2	2
815	Binary Output 15	0,2	2	2
816	Binary Output 16	0,2	2	2
871	Cold Start	0,2	2	2
872	Warm 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
1010	User Output 1	0,2	2	2
1011	User Output 2	0,2	2	2
1012	User Output 3	0,2	2	2
1013	User Output 4	0,2	2	2
1014	User Output 5	0,2	2	2
1015	User Output 6	0,2	2	2
1016	User Output 7	0,2	2	2
1017	User Output 8	0,2	2	2
1018	User Output 9	0,2	2	2
1019	User Output 10	0,2	2	2
1020	User Output 11	0,2	2	2
1021	User Output 12	0,2	2	2
1022	User Output 13	0,2	2	2
1023	User Output 14	0,2	2	2
1024	User Output 15	0,2	2	2
1025	User Output 16	0,2	2	2

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 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)				
Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 1	Default Variation Event Object 2
1026	User Output 17	0,2	2	2
1027	User Output 18	0,2	2	2
1028	User Output 19	0,2	2	2
1029	User Output 20	0,2	2	2
1030	User Output 21	0,2	2	2
1031	User Output 22	0,2	2	2
1032	User Output 23	0,2	2	2
1033	User Output 24	0,2	2	2
1034	User Output 25	0,2	2	2
1035	User Output 26	0,2	2	2
1036	User Output 27	0,2	2	2
1037	User Output 28	0,2	2	2
1038	User Output 29	0,2	2	2
1039	User Output 30	0,2	2	2
1040	User Output 31	0,2	2	2
1041	User Output 32	0,2	2	2
1061	E/F In	0,2	2	2
1062	SEF In	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

5.3.2 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)				
Point Index	Name (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

5.3.3 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 DNP 3.0 Masters. Binary Output Status points are not recommended to be included in class 0 polls.

As an alternative, it is recommended that “actual” status 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)								
Point Index	Name (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 Operations	Default CROB Operations
1	RL 1	0	2	2	0	1	Pulse On Latch On Close	Pulse On
2	RL 2	0	2	2	0	1	Pulse On Latch On Close	Pulse On
3	RL 3	0	2	2	0	1	Pulse On Latch On Close	Pulse On
4	RL 4	0	2	2	0	1	Pulse On Latch On Close	Pulse On
5	RL 5	0	2	2	0	1	Pulse On Latch On Close	Pulse On
6	RL 6	0	2	2	0	1	Pulse On Latch On Close	Pulse On
7	RL 7	0	2	2	0	1	Pulse On Latch On Close	Pulse On
8	RL 8	0	2	2	0	1	Pulse On Latch On Close	Pulse On
9	RL 9	0	2	2	0	1	Pulse On Latch On Close	Pulse On
10	RL 10	0	2	2	0	1	Pulse On Latch On Close	Pulse On
11	RL 11	0	2	2	0	1	Pulse On Latch On Close	Pulse On
12	RL 12	0	2	2	0	1	Pulse On Latch On Close	Pulse On
13	RL 13	0	2	2	0	1	Pulse On Latch On Close	Pulse On
14	RL 14	0	2	2	0	1	Pulse On Latch On Close	Pulse On
15	RL 15	0	2	2	0	1	Pulse On Latch On Close	Pulse On

Binary Output Status PointsStatic (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)**

Point Index	Name (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 Operations	Default CROB Operations
16	RL 16	0	2	2	0	1	Pulse On Latch On Close	Pulse On
33	LED reset, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
34	Settings Group 1	0	2	2	0	1	Pulse On Latch On Close	Latch On
35	Settings Group 2	0	2	2	0	1	Pulse On Latch On Close	Latch On
36	Settings Group 3	0	2	2	0	1	Pulse On Latch On Close	Latch On
37	Settings Group 4	0	2	2	0	1	Pulse On Latch On Close	Latch On
38	Settings Group 5	0	2	2	0	1	Pulse On Latch On Close	Latch On
39	Settings Group 6	0	2	2	0	1	Pulse On Latch On Close	Latch On
40	Settings Group 7	0	2	2	0	1	Pulse On Latch On Close	Latch On
41	Settings Group 8	0	2	2	0	1	Pulse On Latch On Close	Latch On
42	Auto-reclose on/off	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close 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 Close 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	Pulse On Pulse Off Latch On Latch Off

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)								
Point Index	Name (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 Operations	Default CROB Operations
							Close Trip	
45	SEF off/on	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off Latch On Latch Off
46	Inst Protection off/on	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close 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 Close	Pulse On
49	Reset CB Delta Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
50	Reset CB Count To AR Block, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
51	Reset CB Frequent Ops Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
53	Reset I ² t CB Wear	0	2	2	0	1	Pulse On Latch On Close	Pulse On
54	CB 1	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close 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 Close	Pulse On
56	CB 1 Trip & Lockout, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
59	Demand metering reset, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
88	Remote mode	0	2	2	0	1	Pulse On Latch On Close	Pulse On

Binary Output Status PointsStatic (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)**

Point Index	Name (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 Operations	Default CROB Operations
89	Service mode	0	2	2	0	1	Pulse On Latch On Close	Pulse On
90	Local mode	0	2	2	0	1	Pulse On Latch On Close	Pulse On
91	Local & Remote	0	2	2	0	1	Pulse On Latch On Close	Pulse On
94	Reset CB Phase A Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
95	Reset CB Phase B Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
96	Reset CB Phase C Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
97	Reset CB EF Trip Count, write only location.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
98	Reset Start Count (Action)	0	2	2	0	1	Pulse On Latch On Close	Pulse On Latch On
99	User SP Command 1.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
100	User SP Command 2.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
101	User SP Command 3.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
102	User SP Command 4.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
103	User SP Command 5.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
104	User SP Command 6.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
105	User SP Command 7.	0	2	2	0	1	Pulse On Latch On Close	Pulse On

Binary Output Status PointsStatic (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)**

Point Index	Name (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 Operations	Default CROB Operations
106	User SP Command 8.	0	2	2	0	1	Pulse On Latch On Close	Pulse On
107	User DP Command 1.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
108	User DP Command 2.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
109	User DP Command 3.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
110	User DP Command 4.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
111	User DP Command 5.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
112	User DP Command 6.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
113	User DP Command 7.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off Close Trip	Pulse On Pulse Off
114	User DP Command 8.	0	2	2	0	1	Pulse On Pulse Off Latch On Latch Off	Pulse On Pulse Off

Binary Output Status PointsStatic (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)**

Point Index	Name (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 Operations	Default CROB Operations
							Close Trip	
115	CB-1 Open	0	2	2	0	1	Pulse On Latch On Close	Pulse On Latch On
116	CB-1 Close	0	2	2	0	1	Pulse On Latch On Close	Pulse On Latch On

5.3.4 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)**

Point Index	Name (Description)	Counter						Frozen Counter		
		Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 20	Default Variation Event Object 22	Deadband	Is Resettable	Is Freezable	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
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
12	CB Ph A Trip Count	0,3	5	1	1	✓	✓	0,2	9	1
13	CB Ph B Trip Count	0,3	5	1	1	✓	✓	0,2	9	1
14	CB Ph C Trip Count	0,3	5	1	1	✓	✓	0,2	9	1
15	CB E/F 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
25	E5 Counter	0,3	5	1	1		✓	0,2	9	1
26	E6 Counter	0,3	5	1	1		✓	0,2	9	1
27	E7 Counter	0,3	5	1	1		✓	0,2	9	1
28	E8 Counter	0,3	5	1	1		✓	0,2	9	1
29	E9 Counter	0,3	5	1	1		✓	0,2	9	1
30	E10 Counter	0,3	5	1	1		✓	0,2	9	1

CountersStatic (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 CountersStatic (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)**

		Counter						Frozen Counter		
Point Index	Name (Description)	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 20	Default Variation Event Object 22	Deadband	Is Resettable	Is Freezable	Default Change Event Assigned Class (1, 2, 3 or none)	Default Variation Static Object 21	Default Variation Event Object 23
31	E11 Counter	0,3	5	1	1	✓	✓	0,2	9	1
32	E12 Counter	0,3	5	1	1	✓	✓	0,2	9	1
33	E13 Counter	0,3	5	1	1	✓	✓	0,2	9	1
34	E14 Counter	0,3	5	1	1	✓	✓	0,2	9	1
35	E15 Counter	0,3	5	1	1	✓	✓	0,2	9	1
36	E16 Counter	0,3	5	1	1	✓	✓	0,2	9	1

5.3.5 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 InputsStatic (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)**

Point Index	Name (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
31	Ia Primary	0,3	2	4	1.000	100.000
32	Ib Primary	0,3	2	4	1.000	100.000
33	Ic Primary	0,3	2	4	1.000	100.000
34	Ia Secondary	0,3	2	4	100.000	0.100
35	Ib Secondary	0,3	2	4	100.000	0.100
36	Ic Secondary	0,3	2	4	100.000	0.100
37	Ia Nominal	0,3	2	4	100.000	0.100
38	Ib Nominal	0,3	2	4	100.000	0.100
39	Ic Nominal	0,3	2	4	100.000	0.100
43	In Primary	0,3	2	4	1.000	100.000
44	In Secondary	0,3	2	4	100.000	0.100
45	In Nominal	0,3	2	4	100.000	0.100
46	Ig Primary	0,3	2	4	1.000	100.000
47	Ig Secondary	0,3	2	4	1000.000	0.100
48	Ig Nominal	0,3	2	4	1000.000	0.100
51	Izps Nominal	0,3	2	4	100.000	0.100
52	Ipps Nominal	0,3	2	4	100.000	0.100
53	Inps Nominal	0,3	2	4	100.000	0.100
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
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
113	Ig Max	0,3	2	4	1.000	100.000
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	Ia Last Trip	0,3	1	3	1.000	Disabled
166	Ib Last Trip	0,3	1	3	1.000	Disabled

Analog InputsStatic (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)**

Point Index	Name (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
167	Ic Last Trip	0,3	1	3	1.000	Disabled
171	In Last Trip	0,3	1	3	1.000	Disabled
172	Ig Last Trip	0,3	1	3	1.000	Disabled
180	CB Ph A Trip Count	0,3	1	3	1.000	1.000
181	CB Ph B Trip Count	0,3	1	3	1.000	1.000
182	CB Ph C Trip Count	0,3	1	3	1.000	1.000
183	CB E/F Trip Count	0,3	1	3	1.000	1.000
184	CB Wear A	0,3	1	3	0.000	1000000.000
185	CB Wear B	0,3	1	3	0.000	1000000.000
186	CB Wear C	0,3	1	3	0.000	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
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
196	Frequency Max	0,3	2	4	100.000	1.000
330	CB Trip Time Meter	0,3	2	4	1000.000	0.010

5.4 Additional Settings

The following relay settings are provided for configuration of the DNP 3.0 implementation when available and are common to all ports using this protocol.

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	10s	As Required	Setting is only visible when any port Protocol is set to DNP3.

6. Not Applicable

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7. IEC61850 Protocol Support

7.1 Introduction

The relay can optionally be provided with IEC61850 comms.

For further details refer to the following publications:

- Model Implementation Conformance Statement (MICS)
- Protocol Implementation Conformance Statement (PICS)
- Protocol Implementation Extra Information for Testing (PIXIT)

8. Serial Modems

8.1 Introduction

The communications interface has been designed to allow data transfer via modems. A suitable Modem can be connected directly to the Relay's serial interface, for example RS232, RS485 or fibre-optic port where fitted.

8.2 Connecting a Modem to the Relay(s)

RS232C defines devices as being either Data Terminal Equipment (DTE) e.g. computers, or data Communications Equipment (DCE), e.g. modems, where one is designed to be connected to the other.

The optional RS232 port of the Relay is wired as a DTE device and can therefore be connected directly to a Modem.

The 7XV5652 RS232 fibre-optic converter is wired as a DCE device, the same as a Modem. Where two DCE devices e.g. the modem and the fibre-optic converter are being connected together a null terminal connector is required which switches various control lines. The fibre-optic converter is then connected to the relay Network Tx to Relay Rx and Network Rx to Relay Tx.

8.3 Setting the Remote Modem

The exact settings of the modem are dependent on the type of modem. Although most modems support the basic Hayes "AT" command format, different manufacturers use different commands for the same functions. In addition, some modems use DIP switches to set parameters, others are entirely software configured.

Before applying settings, the modem's factory default settings should be applied, to ensure it is in a known state.

Several factors must be considered to allow remote dialling to the relays. The first is that the modem at the remote end must be configured as auto answer. This will allow it to initiate communications with the relays. Next, the user should set the data configuration at the local port, i.e. baud rate and parity, so that communication will be at the same rate and format as that set on the relay and the error correction is disabled.

Auto-answer usually requires two parameters to be set. The auto-answer setting should be switched on and the number of rings after which it will answer. The Data Terminal Ready (DTR) settings should be forced on. This tells the modem that the device connected to it is ready to receive data.

The parameters of the modem's RS232C port are set to match those set on the relay, set baud rate and parity to be the same as the settings on the relay and number of data bits to be 8 and stop bits 1. Note, although the device may be able to communicate with the modem at, for example, 19200 bps, the modem may only be able to transmit over the telephone lines at 14400 bps. Therefore, a baud rate setting on which the modem can transmit should be chosen. In the above example, a baud rate of 9600 should be chosen.

As the modems are required to be transparent, simply passing on the data sent from the controller to the device and vice versa, error correction and buffering is turned off.

Finally, the settings selected for configuration should be stored in the modem's memory for power on defaults.

8.4 Connecting to the Remote Modem

Once the remote modem has been configured correctly, it should be possible to make connection to the relay.

Where a "dial-up" modem system is installed the settings on the remote modem are fixed so the local modem should negotiate with it on connection, choosing suitable matching settings. Where this is not possible the local modem should be set with settings equivalent to those of the remote modem as described above.

9. Configuration

The data points and control features which are possible within the relay is fixed and can be transmitted over the communication channel(s) 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 will require some tailoring; this can be done by the user with the Reydisp software Communications Editor tool.

The Communications Editor is provided to allow its users to configure the Communication Protocol's Files in Reyrolle brand Relays manufactured by Siemens Protection Devices Limited (SPDL).

The editor supports configuring DNP3, IEC60870-5-103, IEC60870-5-101 and MODBUS protocols.

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

DNP3

The tool will allow:

- Data Points to be enabled or disabled.
- Changing the point numbers for the Binary Inputs, Double Bit Inputs, Binary Outputs, Counters and Analogue 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 Analogue Events will be generated.
- Specifying a multiplier that will be applied to an analogue value before transmission.
- Configuring a Counter's respective Frozen Counter.

IEC60870-5-103

The tool will allow:

- 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

Note, as MODBUS points are polled they do not need to be enabled or disabled.

The tool will allow:

- Changing the Addresses for the Coils, Inputs and Registers.
- Changing the format of the instrument returned in a register, e.g. 16 or 32 bit.
- Specifying a multiplier that will be applied to an analogue value before transmission.

The user 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. The user must ensure when naming the file, they use a unique file name including the version number.

Please refer to the Communications Editor User Guide for further guidance.

10. Glossary

Baud Rate

Data transmission speed.

Bit

The smallest measure of computer data.

Bits Per Second (bps)

Measurement of data transmission speed.

Data Bits

A number of bits containing the data. Sent after the start bit.

Data Echo

When connecting relays in an optical ring architecture, the data must be passed from one relay to the next, therefore when connecting in this method all relays must have the Data Echo ON.

EN100

Siemens' Ethernet communications module supporting IEC61850, available in optical and electrical versions.

Ethernet

A computer networking technology.

Full-Duplex Asynchronous Communications

Communications in two directions simultaneously.

Half-Duplex Asynchronous Communications

Communications in two directions, but only one at a time.

Hayes "AT"

Modem command set developed by Hayes Microcomputer products, Inc.

LAN

Local Area Network. A computer network covering a small geographic area.

LC

Fibre optic connector type designed by Lucent Technologies, Inc.

Line Idle

Determines when the device is not communicating if the idle state transmits light.

Modem

MODulator / DEModulator device for connecting computer equipment to a telephone line.

Parity

Method of error checking by counting the value of the bits in a sequence, and adding a parity bit to make the outcome, for example, even.

Parity Bit

Bit used for implementing parity checking. Sent after the data bits.

RS232C

Serial Communications Standard. Electronic Industries Association Recommended Standard Number 232, Revision C.

RS485

Serial Communications Standard. Electronic Industries Association Recommended Standard Number 485.

Start Bit

Bit (logical 0) sent to signify the start of a byte during data transmission.

Stop Bit

Bit (logical 1) sent to signify the end.

USB

Universal Serial Bus standard for the transfer of data.

WAN

Wide Area Network. A computer network covering a large geographic area.

Appendix 1

The operating mode of the device is set via the setting, or through a command sent to a communications port. There are four options; **Local**, **Remote**, **Local or Remote** and **Service**.

The following table illustrates whether a function is Enabled (✓) or Disabled (✗) in each mode.

Function	Operation Mode		
	Local	Remote	Service
Control			
Com1	✓ when Com1-Mode = Local	✓ when Com1-Mode = Remote	✗
Com2 (USB)	✓ when Com2-Mode = Local	✓ when Com2-Mode = Remote	✗
Com3	✓ when Com3-Mode = Local	✓ when Com3-Mode = Remote	✗
Com4	✓ when Com4-Mode = Local	✓ when Com4-Mode = Remote	✗
Fascia (Control Mode)	✓	✗	✗
Function Key (n)	✓	✓ when F Key(n) Mode = Remote	✗
Binary Input (n)	✓ when BI (n) Mode = Local	✓ when BI (n) Mode = Remote	✓
Binary Outputs	✓	✓	✗
Reporting			
Spontaneous			
IEC	✓	✓	✗
DNP3	✓	✓	✗
General Interrogation			
IEC	✓	✓	✗
DNP3	✓	✓	✗
MODBUS	✓	✓	✓
Change Settings			
Com1	✓ when Com1-Mode = Local	✓ when Com1-Mode = Remote	✓
Com2 (USB)	✓ when Com2-Mode = Local	✓ when Com2-Mode = Remote	✓
Com3	✓ when Com3-Mode = Local	✓ when Com3-Mode = Remote	✓
Com4	✓ when Com4-Mode = Local	✓ when Com4-Mode = Remote	✓
Fascia	✓	✓	✓
Historical Information			
Waveform Records	✓	✓	✓
Event Records	✓	✓	✓
Fault Information	✓	✓	✓
Setting Information	✓	✓	✓

Fig. A1 Operating Mode Table

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