

7SR11 and 7SR12

Data Communications

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Section 1: Introduction

The relay data communication facility is compatible with control and automation systems and PCs running Reydisp software. The relay can provide operational information, post-fault analysis, settings interrogation and editing facilities. This section describes how to use the Communication Interface with a control system or interrogating computer. Appropriate software within the control system or on the interrogating computer (e.g. Reydisp Evolution) is required to access the interface.

This section specifies connection details and lists the events, commands and measurands available. For further information regarding the IEC60870-5-103 interface, reference should be made to the separate Informative Communications Interface manual.

The Communications Interface for dialogue communications by the Protection Engineer is provided by the Reydisp Evolution software package, also available from the website, using the IEC60870-5-103 protocol.

Section 2: Physical Connection

The relay range provides one 'Front' USB communication interface (Com2) located on the fascia and one RS485 (Com1) located on the 'Rear'. 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**. The communication settings for the RS485 port are available from the relay front fascia via the key pad setting menu or through Reydisp via the USB connection.

1. Com2-USB: this port is used for IEC60870-5-103 (default setting) communication with the Reydisp software. An ASCII protocol, the main use of which is to allow firmware to be updated from the front connection, is also available through this port.
2. Com1-RS485: this port can be used for IEC60870-5-103 or MODBUS RTU or DNP 3.0 communications to a substation SCADA or integrated control system or engineer remote access.

The ports can be independently mapped to the IEC60870-5-103 or MODBUS RTU or DNP3.0 protocol or switched OFF in the relay settings. The same protocol can be used simultaneously on both ports.

SPDL can provide a range of interface devices, please refer to product portfolio catalogue.

Full details of the interface devices can be found by referring to the website www.siemens.com/energy.

2.1 Communication ports

2.1.1 USB Interface

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 in the Reydisp connection window, connections to the USB port are not shown when they are not connected.

The USB communication interface on the relay is labelled Com 2 and its associated settings are 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, otherwise the Com 2 port must be set to IEC60870-5-103 (the relay address and baud rate do not need to be set).

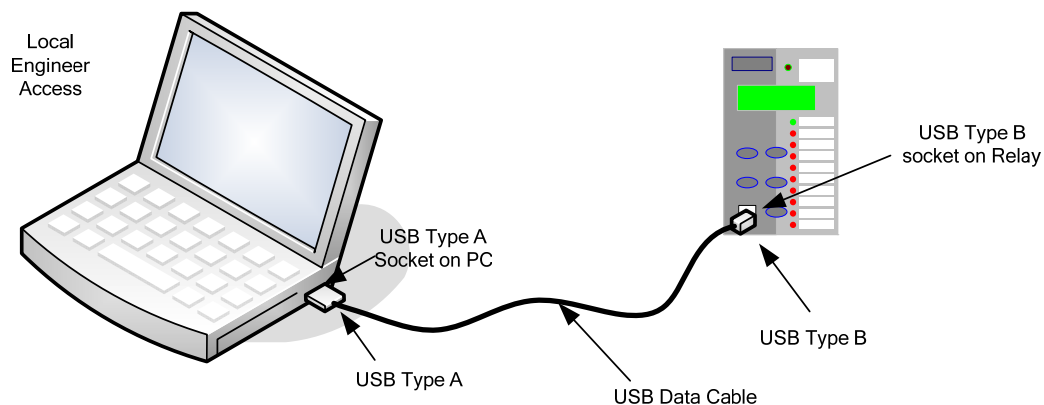


Figure 6-1 Communication to Front USB Port

RS485 Interface

The 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. The relays are fitted with an internal terminating resistor which can be connected between A and B by fitting an external wire loop between terminals 18 and 20 on the power supply module.

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

The following settings must be configured via the relay fascia when using the RS485 interface. The shaded settings are only visible when DNP3.0 is selected.

Setting name	Range	Default	Setting	Notes
Station Address	0 ... 254 (IEC60870-5-103) 0 ... 247 (MODBUS) 0 ... 65534 (DNP3)	0	1...	An address must be given to identify the relay. Each relay must have a unique address.
COM1-RS485 Protocol	OFF, IEC60870-5-103, MODBUS-RTU, DNP3.0	IEC60870-5-103	As Required	Sets the protocol used to communicate on the RS485 connection.
COM1-RS485 Baud Rate	75 110 150 300 600 1200 2400 4800 9600 19200 38400	19200	As Required	The baud rate set on all of the relays connected to the same RS485 bus must be the same as the one set on the master device.
COM1-RS485 Parity	NONE, ODD, EVEN	EVEN	As Required	The parity set on all of the relays connected to the same RS485 bus must be the same and in accordance with the master device.
COM1-RS485 Mode	Local, Remote, Local Or Remote	Remote	Remote	Selects whether the port is Local or Remote.
Unsolicited Mode	DISABLED ENABLED	DISABLED	As Required	Setting is only visible when COM1 Protocol is set to DNP3
Destination Address	0 ... 65534	0	As Required	Setting is only visible when COM1 Protocol is set to DNP3

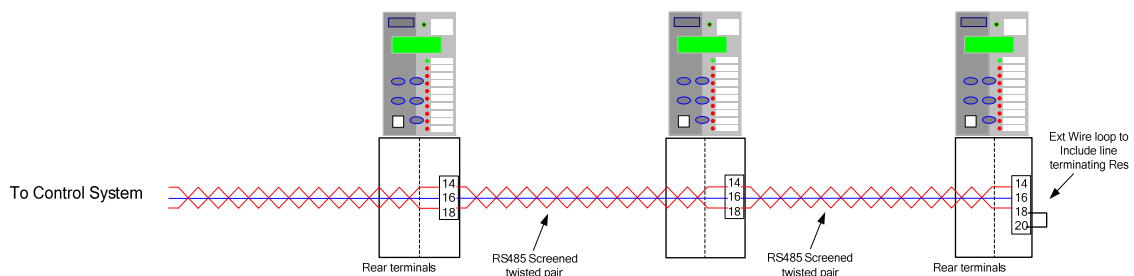


Figure 6-2 Communication to Multiple Devices from Control System using RS485

Section 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 and is the standard protocol used by the USB port. The relay can communicate simultaneously on all ports regardless of protocol used.

Each relay must be given an address to enable communication and can be set by the *Communication Interface:Relay Address*. A relay with the default address of **0** will not be able to communicate.

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.

ASDU Type

Abbreviation	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

Information Number and Function

The following table lists information number and function definitions together with a description of the message and function type and cause of transmission that can result in that message. The table shows all events available from the relay range.

Note that not all events are available on all relay models.

Function	Information Number	Description	ASDU Type	Cause of Transmission
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 Mode	1	SE, GI
			20	Ack, Nak
60	12	Control Received	1	SE
60	13	Command Received	1	SE
60	128	Cold Start	1	SE, GI
60	129	Warm Start	1	SE, GI
60	130	Re-Start	1	SE, GI
60	131	Expected Restart	1	SE, GI
60	132	Unexpected Restart	1	SE, GI
60	133	Reset Start Count	1	SE, GI
			20	Ack, Nak
60	135	Trigger Storage	1	SE
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	182	Quick Logic E1	1	SE, GI
60	183	Quick Logic E2	1	SE, GI
60	184	Quick Logic E3	1	SE, GI
60	185	Quick Logic E4	1	SE, GI
70	5	Binary Input 5	1	SE, GI
70	6	Binary Input 6	1	SE, GI
75	1	Virtual Input 1	1	SE, GI
75	2	Virtual Input 2	1	SE, GI
75	3	Virtual Input 3	1	SE, GI
75	4	Virtual Input 4	1	SE, GI
75	5	Virtual Input 5	1	SE, GI
75	6	Virtual Input 6	1	SE, GI
75	7	Virtual Input 7	1	SE, GI
75	8	Virtual Input 8	1	SE, GI
80	1	Binary Output 1	1	SE, GI
			20	Ack, Nak
80	2	Binary Output 2	1	SE, GI
			20	Ack, Nak
80	3	Binary Output 3	1	SE, GI

Function	Information Number	Description	ASDU Type	Cause of Transmission
			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
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
90	8	LED 8	1	SE, GI
90	9	LED 9	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
91	9	LED PU 9	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	16	Auto-reclose active (In/Out)	1	SE, GI
			20	Ack, Nak
160	19	LEDs reset (Reset Flag & Outputs)	1	SE
			20	Ack, Nak
160	22	Settings changed	1	SE
160	23	Settings Group 1 Select	1	SE, GI
			20	Ack, Nak
160	24	Settings Group 2 Select	1	SE, GI
			20	Ack, Nak
160	25	Settings Group 3 Select	1	SE, GI
			20	Ack, Nak
160	26	Settings Group 4 Select	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

Function	Information Number	Description	ASDU Type	Cause of Transmission
160	36	Trip circuit fail	1	SE, GI
160	38	VT Fuse Failure	1	SE, GI
160	51	Earth Fault Forward/Line	2	SE, GI
160	52	Earth Fault Reverse/Busbar	2	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	74	Fault Forward/Line	2	SE, GI
160	75	Fault Reverse/Busbar	2	SE, GI
160	84	General Starter/Pick Up	2	SE, GI
160	85	Circuit breaker fail	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
160	128	CB on by auto reclose	1	SE
160	130	Reclose Blocked	1	SE,GI
183	0	Data lost	1	SE
183	10	51-1	2	SE, GI
183	11	50-1	2	SE, GI
183	12	51N-1	2	SE, GI
183	13	50N-1	2	SE, GI
183	14	51G-1	2	SE, GI
183	15	50G-1	2	SE, GI
183	16	51-2	2	SE, GI
183	17	50-2	2	SE, GI
183	18	51N-2	2	SE, GI
183	19	50N-2	2	SE, GI
183	20	51G-2	2	SE, GI
183	21	50G-2	2	SE, GI
183	22	51-3	2	SE, GI
183	23	50-3	2	SE, GI
183	24	51N-3	2	SE, GI
183	25	50N-3	2	SE, GI
183	26	51G-3	2	SE, GI
183	27	50G-3	2	SE, GI
183	28	51-4	2	SE, GI
183	29	50-4	2	SE, GI
183	30	51N-4	2	SE, GI
183	31	50N-4	2	SE, GI
183	32	51G-4	2	SE, GI
183	33	50G-4	2	SE, GI
183	34	50BF Stage 2	2	SE, GI
183	35	49-Alarm	2	SE, GI
183	36	49-Trip	2	SE, GI

Function	Information Number	Description	ASDU Type	Cause of Transmission
183	40	60CTS	2	SE, GI
183	41	51SEF-1	2	SE, GI
183	42	50SEF-1	2	SE, GI
183	43	51SEF-2	2	SE, GI
183	44	50SEF-2	2	SE, GI
183	45	51SEF-3	2	SE, GI
183	46	50SEF-3	2	SE, GI
183	47	51SEF-4	2	SE, GI
183	48	50SEF-4	2	SE, GI
183	49	SEF Out/In	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	EF Out/In	2	SE, GI
			20	Ack, Nak
183	54	SEF Forward/Line	2	SE, GI
183	55	SEF Reverse/Bus	2	SE, GI
183	56	50BF Stage 1	2	SE, GI
183	60	47-1	2	SE, GI
183	61	47-2	2	SE, GI
183	62	37-1	2	SE, GI
183	63	37-2	2	SE, GI
183	64	37G-1	2	SE, GI
183	65	37G-2	2	SE, GI
183	66	37SEF-1	2	SE, GI
183	67	37SEF-2	2	SE, GI
183	70	46BC	2	SE, GI
183	81	27/59-1	2	SE, GI
183	82	27/59-2	2	SE, GI
183	83	27/59-3	2	SE, GI
183	84	27/59-4	2	SE, GI
183	85	59NIT	2	SE, GI
183	86	59NDT	2	SE, GI
183	90	81-1	2	SE, GI
183	91	81-2	2	SE, GI
183	92	81-3	2	SE, GI
183	93	81-4	2	SE, GI
183	96	81HBL2	1	SE, GI
183	101	Trip Circuit Fail 1	2	SE, GI
183	102	Trip Circuit Fail 2	2	SE, GI
183	103	Trip Circuit Fail 3	2	SE, GI
183	114	Close CB Failed	1	SE
183	115	Open CB Failed	1	SE
183	116	Reclaim	1	SE, GI
183	117	Lockout	1	SE, GI
183	119	Successful DAR Close	1	SE
183	120	Successful Man Close	1	SE
183	121	Hotline Working	1	SE, GI
			20	Ack, Nak

Function	Information Number	Description	ASDU Type	Cause of Transmission
183	122	Inst Protection Out	1	SE, GI
			20	Ack, Nak
183	123	CB Total Trip Count	1	SE, GI
183	124	CB Delta Trip Count	1	SE, GI
183	125	CB Count To AR Block	1	SE, GI
183	126	Reset CB Total Trip Count	1	SE
			20	Ack, Nak
183	127	Reset CB Delta Trip Count	1	SE
			20	Ack, Nak
183	128	Reset CB Count To AR Block	1	SE
			20	Ack, Nak
183	129	I ^Δ 2t CB Wear	1	SE, GI
183	130	Reset I ^Δ 2t CB Wear	1	SE
			20	Ack, Nak
183	131	79 AR In Progress	1	SE, GI
183	132	CB Frequent Ops Count	1	SE, GI
183	133	Reset CB Frequent Ops Count	1	SE
			20	Ack, Nak
183	140	Cold Load Active	1	SE, GI
183	141	P/F Inst Protection Inhibited	1	SE, GI
183	142	E/F Inst Protection Inhibited	1	SE, GI
183	143	SEF Inst Protection Inhibited	1	SE, GI
183	144	Ext Inst Protection Inhibited	1	SE, GI
183	163	Trip Time Alarm	1	SE
183	164	Close Circuit Fail 1	2	SE
183	165	Close Circuit Fail 2	2	SE
183	166	Close Circuit Fail 3	2	SE
183	167	Close Circuit Fail	2	SE
183	171	60 CTS-I	2	SE
183	172	Act Energy Exp	4	SE
183	173	Act Energy Imp	4	SE
183	174	React Energy Exp	4	SE
183	175	React Energy Imp	4	SE
183	176	Reset Energy Meters	1	SE
			20	Ack, Nak
183	177	Active Exp Meter Reset	1	SE
183	178	Active Imp Meter Reset	1	SE
183	179	Reactive Exp Meter Reset	1	SE
183	180	Reactive Imp Meter Reset	1	SE
183	181	CB Total Trip Count	4	SE
183	182	CB Delta Trip Count	4	SE
183	183	CB Count To AR Block	4	SE
183	184	CB Freq Ops Count	4	SE
183	221	Wattmetric Po>	1	SE, GI
183	222	37-PhA	2	SE, GI
183	223	37-PhB	2	SE, GI
183	224	37-PhC	2	SE, GI
183	225	50 LC-1	2	SE, GI
183	226	50 LC-2	2	SE, GI
183	227	50G LC-1	2	SE, GI

Function	Information Number	Description	ASDU Type	Cause of Transmission
183	228	50G LC-2	2	SE, GI
183	229	50SEF LC-1	2	SE, GI
183	230	50SEF LC-2	2	SE, GI
183	231	50BF-PhA	2	SE, GI
183	232	50BF-PhB	2	SE, GI
183	233	50BF-PhC	2	SE, GI
183	234	50BF-EF	2	SE, GI
183	235	79 Last Trip Lockout	2	SE, GI
183	239	In Fault Current	4	SE
183	240	Ia Fault Current	4	SE
183	241	Ib Fault Current	4	SE
183	242	Ic Fault Current	4	SE
183	243	Ig Fault Current	4	SE
183	244	Isef Fault Current	4	SE
183	245	Va Fault Voltage	4	SE
183	246	Vb Fault Voltage	4	SE
183	247	Vc Fault Voltage	4	SE
183	249	60 CTS-I-PhA	2	SE, GI
183	250	60 CTS-I-PhB	2	SE, GI
183	251	60 CTS-I-PhC	2	SE, GI
200	1	CB 1	1	SE, GI
			20	Ack, Nak
200	200	Trip & Reclose	1	SE
			20	Ack, Nak
200	201	Trip & Lockout	1	SE
			20	Ack, Nak
200	255	Blocked by Interlocking	1	SE, GI
255	0	Time Synchronisation	6	Time Synchronisation
255	0	GI Initiation	7	End of GI
255	0	End of GI	8	End of GI

Measurand

Function	Information Number	Description	Function Type	Cause of Transmission
183	148	Measurand $I_{L1,2,3}$, $V_{L1,2,3}$, V_{L1-2} , $L2-3$, $L3-1$, P , Q , F , I_{L1} (2.4 x) I_{L2} (2.4 x) I_{L3} (2.4 x) V_{L1} (1.2 x) V_{L2} (1.2 x) V_{L3} (1.2 x) P (2.4 x) Q (2.4 x) F (1.2 x)	9	Cyclic – Refresh rate 5 seconds or value change greater than 1%

Disturbance Recorder Actual Channel (ACC) Numbers

Function	ACC Number	Description
182	0	Global
182	1	Va
182	2	Vb
182	3	Vc
182	4	Not Used

182	5	la
182	6	lb
182	7	lc
182	8	lg1

Events List by Relay Model – 7SR11

FUN	INF	Event	7SR1101-1xA12-xCA0	7SR1101-3xA12-xCA0	7SR1102-1xA12-xAA0	7SR1102-1xA12-xCA0	7SR1102-1xA12-xDA0	7SR1102-3xA12-xCA0	7SR1102-3xA12-xDA0	7SR1103-1xA12-xCA0	7SR1103-1xA12-xDA0	7SR1103-3xA12-xCA0	7SR1103-3xA12-xDA0
60	4	Remote Mode	.	.	.	.	.	.	.	.	.	.	.
60	5	Out of Service Mode	.	.	.	.	.	.	.	.	.	.	.
60	6	Local Mode	.	.	.	.	.	.	.	.	.	.	.
60	7	Local & Remote	.	.	.	.	.	.	.	.	.	.	.
60	12	Control Received	.	.	.	.	.	.	.	.	.	.	.
60	13	Command Received	.	.	.	.	.	.	.	.	.	.	.
60	128	Cold Start	.	.	.	.	.	.	.	.	.	.	.
60	129	Warm Start	.	.	.	.	.	.	.	.	.	.	.
60	130	Re-Start	.	.	.	.	.	.	.	.	.	.	.
60	131	Expected Restart	.	.	.	.	.	.	.	.	.	.	.
60	132	Unexpected Restart	.	.	.	.	.	.	.	.	.	.	.
60	133	Reset Start Count	.	.	.	.	.	.	.	.	.	.	.
60	135	Trigger Storage	.	.	.	.	.	.	.	.	.	.	.
60	136	Clear Waveform Records	.	.	.	.	.	.	.	.	.	.	.
60	137	Clear Fault Records	.	.	.	.	.	.	.	.	.	.	.
60	138	Clear Event Records	.	.	.	.	.	.	.	.	.	.	.
60	140	Demand metering reset	.	.	.	.	.	.	.	.	.	.	.
60	170	General Alarm 1	.	.	.	.	.	.	.	.	.	.	.
60	171	General Alarm 2	.	.	.	.	.	.	.	.	.	.	.
60	172	General Alarm 3	.	.	.	.	.	.	.	.	.	.	.
60	173	General Alarm 4	.	.	.	.	.	.	.	.	.	.	.
60	174	General Alarm 5	.	.	.	.	.	.	.	.	.	.	.
60	175	General Alarm 6	.	.	.	.	.	.	.	.	.	.	.
60	182	Quick Logic E1	.	.	.	.	.	.	.	.	.	.	.
60	183	Quick Logic E2	.	.	.	.	.	.	.	.	.	.	.
60	184	Quick Logic E3	.	.	.	.	.	.	.	.	.	.	.
60	185	Quick Logic E4	.	.	.	.	.	.	.	.	.	.	.
70	5	Binary Input 5	.	.	.	.	.	.	.	.	.	.	.
70	6	Binary Input 6	.	.	.	.	.	.	.	.	.	.	.
75	1	Virtual Input 1	.	.	.	.	.	.	.	.	.	.	.
75	2	Virtual Input 2	.	.	.	.	.	.	.	.	.	.	.
75	3	Virtual Input 3	.	.	.	.	.	.	.	.	.	.	.
75	4	Virtual Input 4	.	.	.	.	.	.	.	.	.	.	.
75	5	Virtual Input 5	.	.	.	.	.	.	.	.	.	.	.
75	6	Virtual Input 6	.	.	.	.	.	.	.	.	.	.	.
75	7	Virtual Input 7	.	.	.	.	.	.	.	.	.	.	.
75	8	Virtual Input 8	.	.	.	.	.	.	.	.	.	.	.
80	1	Binary Output 1	.	.	.	.	.	.	.	.	.	.	.
80	2	Binary Output 2	.	.	.	.	.	.	.	.	.	.	.
80	3	Binary Output 3	.	.	.	.	.	.	.	.	.	.	.
80	4	Binary Output 4	.	.	.	.	.	.	.	.	.	.	.
80	5	Binary Output 5	.	.	.	.	.	.	.	.	.	.	.
80	6	Binary Output 6	.	.	.	.	.	.	.	.	.	.	.
80	7	Binary Output 7	.	.	.	.	.	.	.	.	.	.	.
80	8	Binary Output 8	.	.	.	.	.	.	.	.	.	.	.
90	1	LED 1	.	.	.	.	.	.	.	.	.	.	.
90	2	LED 2	.	.	.	.	.	.	.	.	.	.	.
90	3	LED 3	.	.	.	.	.	.	.	.	.	.	.
90	4	LED 4	.	.	.	.	.	.	.	.	.	.	.

FUN	INF	Event	7SR1101-1xA12-xCA0	7SR1101-3xA12-xCA0	7SR1102-1xA12-xAA0	7SR1102-1xA12-xCA0	7SR1102-1xA12-xDA0	7SR1102-3xA12-xCA0	7SR1102-3xA12-xDA0	7SR1103-1xA12-xCA0	7SR1103-1xA12-xDA0	7SR1103-3xA12-xCA0	7SR1103-3xA12-xDA0
90	5	LED 5	.	.	.	.	.	.	.	.	.	.	.
90	6	LED 6	.	.	.	.	.	.	.	.	.	.	.
90	7	LED 7	.	.	.	.	.	.	.	.	.	.	.
90	8	LED 8	.	.	.	.	.	.	.	.	.	.	.
90	9	LED 9	.	.	.	.	.	.	.	.	.	.	.
91	1	LED PU 1	.	.	.	.	.	.	.	.	.	.	.
91	2	LED PU 2	.	.	.	.	.	.	.	.	.	.	.
91	3	LED PU 3	.	.	.	.	.	.	.	.	.	.	.
91	4	LED PU 4	.	.	.	.	.	.	.	.	.	.	.
91	5	LED PU 5	.	.	.	.	.	.	.	.	.	.	.
91	6	LED PU 6	.	.	.	.	.	.	.	.	.	.	.
91	7	LED PU 7	.	.	.	.	.	.	.	.	.	.	.
91	8	LED PU 8	.	.	.	.	.	.	.	.	.	.	.
91	9	LED PU 9	.	.	.	.	.	.	.	.	.	.	.
160	2	Reset FCB	.	.	.	.	.	.	.	.	.	.	.
160	3	Reset CU	.	.	.	.	.	.	.	.	.	.	.
160	4	Start/Restart	.	.	.	.	.	.	.	.	.	.	.
160	5	Power On	.	.	.	.	.	.	.	.	.	.	.
160	16	Auto-reclose active	.	.	.	.	.	.	.	.	.	.	.
160	19	LED Reset	.	.	.	.	.	.	.	.	.	.	.
160	22	Settings changed	.	.	.	.	.	.	.	.	.	.	.
160	23	Setting Group 1 selected	.	.	.	.	.	.	.	.	.	.	.
160	24	Setting Group 2 selected	.	.	.	.	.	.	.	.	.	.	.
160	25	Setting Group 3 selected	.	.	.	.	.	.	.	.	.	.	.
160	26	Setting Group 4 selected	.	.	.	.	.	.	.	.	.	.	.
160	27	Binary Input 1	.	.	.	.	.	.	.	.	.	.	.
160	28	Binary Input 2	.	.	.	.	.	.	.	.	.	.	.
160	29	Binary Input 3	.	.	.	.	.	.	.	.	.	.	.
160	30	Binary Input 4	.	.	.	.	.	.	.	.	.	.	.
160	36	Trip Circuit Fail	.	.	.	.	.	.	.	.	.	.	.
160	64	Start/Pick-up L1	.	.	.	.	.	.	.	.	.	.	.
160	65	Start/Pick-up L2	.	.	.	.	.	.	.	.	.	.	.
160	66	Start/Pick-up L3	.	.	.	.	.	.	.	.	.	.	.
160	67	Start/Pick-up N	.	.	.	.	.	.	.	.	.	.	.
160	68	General Trip	.	.	.	.	.	.	.	.	.	.	.
160	69	Trip L1	.	.	.	.	.	.	.	.	.	.	.
160	70	Trip L2	.	.	.	.	.	.	.	.	.	.	.
160	71	Trip L3	.	.	.	.	.	.	.	.	.	.	.
160	84	General Start/Pick-up	.	.	.	.	.	.	.	.	.	.	.
160	85	Circuit Breaker Failure	.	.	.	.	.	.	.	.	.	.	.
160	90	Trip I>	.	.	.	.	.	.	.	.	.	.	.
160	91	Trip I>>	.	.	.	.	.	.	.	.	.	.	.
160	92	Trip In>	.	.	.	.	.	.	.	.	.	.	.
160	93	Trip In>>	.	.	.	.	.	.	.	.	.	.	.
160	128	CB on by auto reclose	.	.	.	.	.	.	.	.	.	.	.
160	130	Reclose blocked	.	.	.	.	.	.	.	.	.	.	.
183	0	Data Lost	.	.	.	.	.	.	.	.	.	.	.
183	10	51-1	.	.	.	.	.	.	.	.	.	.	.
183	11	50-1	.	.	.	.	.	.	.	.	.	.	.
183	12	51N-1	.	.	.	.	.	.	.	.	.	.	.
183	13	50N-1	.	.	.	.	.	.	.	.	.	.	.

FUN	INF	Event	7SR1101-1xA12-xCA0	7SR1101-3xA12-xCA0	7SR1102-1xA12-xAA0	7SR1102-1xA12-xCA0	7SR1102-1xA12-xDA0	7SR1102-3xA12-xCA0	7SR1102-3xA12-xDA0	7SR1103-1xA12-xCA0	7SR1103-1xA12-xDA0	7SR1103-3xA12-xCA0	7SR1103-3xA12-xDA0
183	14	51G-1	*		*	*	*			*	*		
183	15	50G-1	*		*	*	*			*	*		
183	16	51-2			*	*	*	*	*	*	*	*	*
183	17	50-2			*	*	*	*	*	*	*	*	*
183	18	51N-2			*	*	*	*	*	*	*	*	*
183	19	50N-2			*	*	*	*	*	*	*	*	*
183	20	51G-2	*		*	*	*			*	*		
183	21	50G-2	*		*	*	*			*	*		
183	34	50BF Stage 2			*	*	*	*	*	*	*	*	*
183	35	49-Alarm			*	*	*	*	*	*	*	*	*
183	36	49-Trip			*	*	*	*	*	*	*	*	*
183	40	60 CTS			*	*	*	*	*	*	*	*	*
183	41	51SEF-1		*				*	*	*	*	*	*
183	42	50SEF-1		*				*	*	*	*	*	*
183	43	51SEF-2		*				*	*	*	*	*	*
183	44	50SEF-2		*				*	*	*	*	*	*
183	49	SEF Out/In		*				*	*	*	*	*	*
183	50	46IT			*	*	*	*	*	*	*	*	*
183	51	46DT			*	*	*	*	*	*	*	*	*
183	52	64H	*	*		*	*	*	*	*	*	*	*
183	53	E/F Out/In	*		*	*	*	*	*	*	*	*	*
183	62	37-1	*		*	*	*	*	*	*	*	*	*
183	63	37-2	*	*		*	*	*	*	*	*	*	*
183	70	46BC			*	*	*	*	*	*	*	*	*
183	96	81HBL2	*		*	*	*	*	*	*	*	*	*
183	101	Trip Circuit Fail 1	*	*	*	*	*	*	*	*	*	*	*
183	102	Trip Circuit Fail 2	*	*	*	*	*	*	*	*	*	*	*
183	103	Trip Circuit Fail 3	*	*	*	*	*	*	*	*	*	*	*
183	114	Close CB Failed	*	*		*	*	*	*	*	*	*	*
183	115	Open CB Failed	*	*		*	*	*	*	*	*	*	*
183	116	Reclaim	*	*		*	*	*	*	*	*	*	*
183	117	Lockout	*	*		*	*	*	*	*	*	*	*
183	119	Successful DAR Close				*	*	*	*	*	*	*	*
183	120	Successful Man Close	*	*		*	*	*	*	*	*	*	*
183	121	Hotline Working				*	*	*	*	*	*	*	*
183	122	Inst Protection Out				*	*	*	*	*	*	*	*
183	123	CB Total Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	124	CB Delta Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	125	CB Count To AR Block				*	*	*	*	*	*	*	*
183	126	Reset CB Total Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	127	Reset CB Delta Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	128	Reset CB Count To AR Block				*	*	*	*	*	*	*	*
183	129	I ² t CB Wear			*	*	*	*	*	*	*	*	*
183	130	Reset I ² t CB Wear			*	*	*	*	*	*	*	*	*
183	131	79 AR In progress				*	*	*	*	*	*	*	*
183	132	CB Frequent Ops Count				*	*	*	*	*	*	*	*
183	133	Reset CB Frequent Ops Count				*	*	*	*	*	*	*	*
183	140	Cold Load Active				*	*	*	*	*	*	*	*
183	141	P/F Inst Protection Inhibited				*	*	*	*	*	*	*	*
183	142	E/F Inst Protection Inhibited				*	*	*	*	*	*	*	*
183	143	SEF Inst Protection Inhibited				*	*	*	*	*	*	*	*

FUN	INF	Event	7SR1101-1xA12-xCA0	7SR1101-3xA12-xCA0	7SR1102-1xA12-xAA0	7SR1102-1xA12-xCA0	7SR1102-1xA12-xDA0	7SR1102-3xA12-xCA0	7SR1102-3xA12-xDA0	7SR1103-1xA12-xCA0	7SR1103-1xA12-xDA0	7SR1103-3xA12-xCA0	7SR1103-3xA12-xDA0
183	144	Ext Inst Protection Inhibited					*		*		*		*
183	163	Trip Time Alarm	*	*	*	*	*	*	*	*	*	*	*
183	164	Close Circuit Fail 1	*	*	*	*	*	*	*	*	*	*	*
183	165	Close Circuit Fail 2	*	*	*	*	*	*	*	*	*	*	*
183	166	Close Circuit Fail 3	*	*	*	*	*	*	*	*	*	*	*
183	167	Close Circuit Fail	*	*	*	*	*	*	*	*	*	*	*
183	171	60 CTS-I											
183	181	CB Total Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	182	CB Delta Trip Count	*	*	*	*	*	*	*	*	*	*	*
183	183	CB Count To AR Block											
183	184	CB Freq Ops Count	*	*	*	*	*	*	*	*	*	*	*
183	222	37-PhA	*	*		*	*	*	*	*	*	*	*
183	223	37-PhB	*	*		*	*	*	*	*	*	*	*
183	224	37-PhC	*	*		*	*	*	*	*	*	*	*
183	225	50 LC-1				*	*	*	*	*	*	*	*
183	226	50 LC-2				*	*	*	*	*	*	*	*
183	227	50G LC-1				*	*	*	*	*	*	*	*
183	228	50G LC-2				*	*	*	*	*	*	*	*
183	229	50SEF LC-1						*					*
183	230	50SEF LC-2						*					*
183	231	50BF-PhA	*	*	*	*	*	*	*	*	*	*	*
183	232	50BF-PhB	*	*	*	*	*	*	*	*	*	*	*
183	233	50BF-PhC	*	*	*	*	*	*	*	*	*	*	*
183	234	50BF-EF	*	*	*	*	*	*	*	*	*	*	*
183	235	79 Last Trip Lockout				*		*		*		*	
183	239	In Fault Current			*	*	*	*	*	*	*	*	*
183	240	Ia Fault Current			*	*	*	*	*	*	*	*	*
183	241	Ib Fault Current			*	*	*	*	*	*	*	*	*
183	242	Ic Fault Current			*	*	*	*	*	*	*	*	*
183	243	Ig Fault Current	*		*	*			*	*			
183	244	Isef Fault Current		*				*				*	*
183	249	60 CTS-I-PhA	*	*	*	*	*	*	*	*	*	*	*
183	250	60 CTS-I-PhB	*	*	*	*	*	*	*	*	*	*	*
183	251	60 CTS-I-PhC	*	*	*	*	*	*	*	*	*	*	*
200	1	CB 1	*	*	*	*	*	*	*	*	*	*	*
200	200	CB 1 Trip & Reclose				*		*		*		*	
200	201	CB 1 Trip & Lockout				*		*		*		*	
200	255	Blocked By Interlocking	*	*	*	*	*	*	*	*	*	*	*
255	0	Time Synchronisation	*	*	*	*	*	*	*	*	*	*	*
255	0	GI Initiation	*	*	*	*	*	*	*	*	*	*	*
255	0	End of GI	*	*	*	*	*	*	*	*	*	*	*

Events List by Relay Model – 7SR12

FUN	INF	Event													
			7SR1204-2xA12-xCA0	7SR1204-4xA12-xCA0	7SR1205-2xA12-xCA0	7SR1205-2xA12-xDA0	7SR1205-4xA12-xCA0	7SR1205-4xA12-xDA0	7SR1206-2xA12-xCA0	7SR1206-2xA12-xDA0	7SR1206-4xA12-xCA0	7SR1206-4xA12-xDA0			
60	4	Remote Mode	.	.	.	.	.	.	.	.	.	.	.	.	.
60	5	Out of Service Mode	.	.	.	.	.	.	.	.	.	.	.	.	.
60	6	Local Mode	.	.	.	.	.	.	.	.	.	.	.	.	.
60	7	Local & Remote	.	.	.	.	.	.	.	.	.	.	.	.	.
60	12	Control Received	.	.	.	.	.	.	.	.	.	.	.	.	.
60	13	Command Received	.	.	.	.	.	.	.	.	.	.	.	.	.
60	128	Cold Start	.	.	.	.	.	.	.	.	.	.	.	.	.
60	129	Warm Start	.	.	.	.	.	.	.	.	.	.	.	.	.
60	130	Re-Start	.	.	.	.	.	.	.	.	.	.	.	.	.
60	131	Expected Restart	.	.	.	.	.	.	.	.	.	.	.	.	.
60	132	Unexpected Restart	.	.	.	.	.	.	.	.	.	.	.	.	.
60	133	Reset Start Count	.	.	.	.	.	.	.	.	.	.	.	.	.
60	135	Trigger Storage	.	.	.	.	.	.	.	.	.	.	.	.	.
60	136	Clear Waveform Records	.	.	.	.	.	.	.	.	.	.	.	.	.
60	137	Clear Fault Records	.	.	.	.	.	.	.	.	.	.	.	.	.
60	138	Clear Event Records	.	.	.	.	.	.	.	.	.	.	.	.	.
60	140	Demand metering reset	.	.	.	.	.	.	.	.	.	.	.	.	.
60	170	General Alarm 1	.	.	.	.	.	.	.	.	.	.	.	.	.
60	171	General Alarm 2	.	.	.	.	.	.	.	.	.	.	.	.	.
60	172	General Alarm 3	.	.	.	.	.	.	.	.	.	.	.	.	.
60	173	General Alarm 4	.	.	.	.	.	.	.	.	.	.	.	.	.
60	174	General Alarm 5	.	.	.	.	.	.	.	.	.	.	.	.	.
60	175	General Alarm 6	.	.	.	.	.	.	.	.	.	.	.	.	.
60	182	Quick Logic E1	.	.	.	.	.	.	.	.	.	.	.	.	.
60	183	Quick Logic E2	.	.	.	.	.	.	.	.	.	.	.	.	.
60	184	Quick Logic E3	.	.	.	.	.	.	.	.	.	.	.	.	.
60	185	Quick Logic E4	.	.	.	.	.	.	.	.	.	.	.	.	.
70	5	Binary Input 5								.	.	.	.	.	.
70	6	Binary Input 6								.	.	.	.	.	.
75	1	Virtual Input 1	.	.	.	.	.	.	.	.	.	.	.	.	.
75	2	Virtual Input 2	.	.	.	.	.	.	.	.	.	.	.	.	.
75	3	Virtual Input 3	.	.	.	.	.	.	.	.	.	.	.	.	.
75	4	Virtual Input 4	.	.	.	.	.	.	.	.	.	.	.	.	.
75	5	Virtual Input 5	.	.	.	.	.	.	.	.	.	.	.	.	.
75	6	Virtual Input 6	.	.	.	.	.	.	.	.	.	.	.	.	.
75	7	Virtual Input 7	.	.	.	.	.	.	.	.	.	.	.	.	.
75	8	Virtual Input 8	.	.	.	.	.	.	.	.	.	.	.	.	.
80	1	Binary Output 1	.	.	.	.	.	.	.	.	.	.	.	.	.
80	2	Binary Output 2	.	.	.	.	.	.	.	.	.	.	.	.	.
80	3	Binary Output 3	.	.	.	.	.	.	.	.	.	.	.	.	.
80	4	Binary Output 4	.	.	.	.	.	.	.	.	.	.	.	.	.
80	5	Binary Output 5	.	.	.	.	.	.	.	.	.	.	.	.	.
80	6	Binary Output 6	.	.	.	.	.	.	.	.	.	.	.	.	.
80	7	Binary Output 7								.	.	.	.	.	.
80	8	Binary Output 8								.	.	.	.	.	.
90	1	LED 1	.	.	.	.	.	.	.	.	.	.	.	.	.
90	2	LED 2	.	.	.	.	.	.	.	.	.	.	.	.	.
90	3	LED 3	.	.	.	.	.	.	.	.	.	.	.	.	.
90	4	LED 4	.	.	.	.	.	.	.	.	.	.	.	.	.

FUN	INF	Event														
			7SR1204-2xA12-xCA0	7SR1204-4xA12-xCA0	7SR1205-2xA12-xCA0	7SR1205-2xA12-xDA0	7SR1205-4xA12-xCA0	7SR1205-4xA12-xDA0	7SR1206-2xA12-xCA0	7SR1206-2xA12-xDA0	7SR1206-4xA12-xCA0	7SR1206-4xA12-xDA0				
90	5	LED 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90	6	LED 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90	7	LED 7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90	8	LED 8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90	9	LED 9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	1	LED PU 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	2	LED PU 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	3	LED PU 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	4	LED PU 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	5	LED PU 5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	6	LED PU 6	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	7	LED PU 7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	8	LED PU 8	.	.	.	.	.	.	.	.	.	.	.	.	.	.
91	9	LED PU 9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	2	Reset FCB	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	3	Reset CU	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	4	Start/Restart	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	5	Power On	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	16	Auto-reclose active	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	19	LED Reset	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	22	Settings changed	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	23	Setting G1 selected	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	24	Setting G2 selected	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	25	Setting G3 selected	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	26	Setting G4 selected	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	27	Binary Input 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	28	Binary Input 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	29	Binary Input 3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	30	Binary Input 4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	36	Trip Circuit Fail	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	38	VT Fuse Failure	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	51	Earth Fault Forward/Line	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	52	Earth Fault Reverse/Busbar	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	64	Start/Pick-up L1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	65	Start/Pick-up L2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	66	Start/Pick-up L3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	67	Start/Pick-up N	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	68	General Trip	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	69	Trip L1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	70	Trip L2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	71	Trip L3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	74	Fault Forward/Line	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	75	Fault Reverse/Busbar	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	84	General Start/Pick-up	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	85	Circuit Breaker Failure	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	90	Trip I>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	91	Trip I>>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	92	Trip In>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	93	Trip In>>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	128	CB on by auto reclose	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	130	Reclose blocked	.	.	.	.	.	.	.	.	.	.	.	.	.	.

FUN	INF	Event										
			7SR1204-2xA12-xCA0	7SR1204-4xA12-xCA0	7SR1205-2xA12-xCA0	7SR1205-2xA12-xDA0	7SR1205-4xA12-xCA0	7SR1205-4xA12-xDA0	7SR1206-2xA12-xCA0	7SR1206-2xA12-xDA0	7SR1206-4xA12-xCA0	7SR1206-4xA12-xDA0
183	0	Data Lost	•	•	•	•	•	•	•	•	•	•
183	10	51-1			•	•	•	•	•	•	•	•
183	11	50-1			•	•	•	•	•	•	•	•
183	12	51N-1			•	•	•	•	•	•	•	•
183	13	50N-1			•	•	•	•	•	•	•	•
183	14	51G-1	•		•	•	•	•	•	•	•	•
183	15	50G-1	•		•	•	•	•	•	•	•	•
183	16	51-2			•	•	•	•	•	•	•	•
183	17	50-2			•	•	•	•	•	•	•	•
183	18	51N-2			•	•	•	•	•	•	•	•
183	19	50N-2			•	•	•	•	•	•	•	•
183	20	51G-2	•		•	•	•	•	•	•	•	•
183	21	50G-2	•		•	•	•	•	•	•	•	•
183	22	51-3			•	•	•	•	•	•	•	•
183	23	50-3			•	•	•	•	•	•	•	•
183	24	51N-3			•	•	•	•	•	•	•	•
183	25	50N-3			•	•	•	•	•	•	•	•
183	26	51G-3	•		•	•	•	•	•	•	•	•
183	27	50G-3	•		•	•	•	•	•	•	•	•
183	28	51-4			•	•	•	•	•	•	•	•
183	29	50-4			•	•	•	•	•	•	•	•
183	30	51N-4			•	•	•	•	•	•	•	•
183	31	50N-4			•	•	•	•	•	•	•	•
183	32	51G-4	•		•	•	•	•	•	•	•	•
183	33	50G-4	•		•	•	•	•	•	•	•	•
183	34	50BF Stage 2			•	•	•	•	•	•	•	•
183	35	49-Alarm			•	•	•	•	•	•	•	•
183	36	49-Trip			•	•	•	•	•	•	•	•
183	40	60 CTS			•	•	•	•	•	•	•	•
183	41	51SEF-1		•			•	•			•	•
183	42	50SEF-1		•			•	•			•	•
183	43	51SEF-2		•			•	•			•	•
183	44	50SEF-2		•			•	•			•	•
183	45	51SEF-3		•			•	•			•	•
183	46	50SEF-3		•			•	•			•	•
183	47	51SEF-4		•			•	•			•	•
183	48	50SEF-4		•			•	•			•	•
183	49	SEF Out/In		•			•	•			•	•
183	50	46IT			•	•	•	•	•	•	•	•
183	51	46DT			•	•	•	•	•	•	•	•
183	52	64H	•	•	•	•	•	•	•	•	•	•
183	53	E/F Out/In	•		•	•	•	•	•	•	•	•
183	54	SEF Forward/Line		•			•	•			•	•
183	55	SEF Reverse/Busbar		•			•	•			•	•
183	60	47-1			•	•	•	•	•	•	•	•
183	61	47-2			•	•	•	•	•	•	•	•
183	62	37-1	•	•	•	•	•	•	•	•	•	•
183	63	37-2	•	•	•	•	•	•	•	•	•	•
183	70	46BC			•	•	•	•	•	•	•	•
183	81	27/59-1	•	•	•	•	•	•	•	•	•	•
183	82	27/59-2	•	•	•	•	•	•	•	•	•	•

FUN	INF	Event										
			7SR1204-2xA12-xCA0	7SR1204-4xA12-xCA0	7SR1205-2xA12-xCA0	7SR1205-2xA12-xDA0	7SR1205-4xA12-xCA0	7SR1205-4xA12-xDA0	7SR1206-2xA12-xCA0	7SR1206-2xA12-xDA0	7SR1206-4xA12-xCA0	7SR1206-4xA12-xDA0
183	83	27/59-3	.	.	.	.	.	.	.	.	.	.
183	84	27/59-4	.	.	.	.	.	.	.	.	.	.
183	85	59NIT	.	.	.	.	.	.	.	.	.	.
183	86	59NDT	.	.	.	.	.	.	.	.	.	.
183	90	81-1	.	.	.	.	.	.	.	.	.	.
183	91	81-2	.	.	.	.	.	.	.	.	.	.
183	92	81-3	.	.	.	.	.	.	.	.	.	.
183	93	81-4	.	.	.	.	.	.	.	.	.	.
183	96	81HBL2	.	.	.	.	.	.	.	.	.	.
183	101	Trip Circuit Fail 1	.	.	.	.	.	.	.	.	.	.
183	102	Trip Circuit Fail 2	.	.	.	.	.	.	.	.	.	.
183	103	Trip Circuit Fail 3	.	.	.	.	.	.	.	.	.	.
183	114	Close CB Failed	.	.	.	.	.	.	.	.	.	.
183	115	Open CB Failed	.	.	.	.	.	.	.	.	.	.
183	116	Reclaim	.	.	.	.	.	.	.	.	.	.
183	117	Lockout	.	.	.	.	.	.	.	.	.	.
183	119	Successful DAR Close	.	.	.	.	.	.	.	.	.	.
183	120	Successful Man Close	.	.	.	.	.	.	.	.	.	.
183	121	Hotline Working	.	.	.	.	.	.	.	.	.	.
183	122	Inst Protection Out	.	.	.	.	.	.	.	.	.	.
183	123	CB Total Trip Count	.	.	.	.	.	.	.	.	.	.
183	124	CB Delta Trip Count	.	.	.	.	.	.	.	.	.	.
183	125	CB Count To AR Block	.	.	.	.	.	.	.	.	.	.
183	126	Reset CB Total Trip Count	.	.	.	.	.	.	.	.	.	.
183	127	Reset CB Delta Trip Count	.	.	.	.	.	.	.	.	.	.
183	128	Reset CB Count To AR Block	.	.	.	.	.	.	.	.	.	.
183	129	I^2t CB Wear	.	.	.	.	.	.	.	.	.	.
183	130	Reset I^2t CB Wear	.	.	.	.	.	.	.	.	.	.
183	131	79 AR In progress	.	.	.	.	.	.	.	.	.	.
183	132	CB Frequent Ops Count	.	.	.	.	.	.	.	.	.	.
183	133	Reset CB Frequent Ops Count	.	.	.	.	.	.	.	.	.	.
183	140	Cold Load Active	.	.	.	.	.	.	.	.	.	.
183	141	P/F Inst Protection Inhibited	.	.	.	.	.	.	.	.	.	.
183	142	E/F Inst Protection Inhibited	.	.	.	.	.	.	.	.	.	.
183	143	SEF Inst Protection Inhibited	.	.	.	.	.	.	.	.	.	.
183	144	Ext Inst Protection Inhibited	.	.	.	.	.	.	.	.	.	.
183	163	Trip Time Alarm	.	.	.	.	.	.	.	.	.	.
183	164	Close Circuit Fail 1	.	.	.	.	.	.	.	.	.	.
183	165	Close Circuit Fail 2	.	.	.	.	.	.	.	.	.	.
183	166	Close Circuit Fail 3	.	.	.	.	.	.	.	.	.	.
183	167	Close Circuit Fail	.	.	.	.	.	.	.	.	.	.
183	171	60 CTS-I	.	.	.	.	.	.	.	.	.	.
183	172	Act Energy Exp	.	.	.	.	.	.	.	.	.	.
183	173	Act Energy Imp	.	.	.	.	.	.	.	.	.	.
183	174	React Energy Exp	.	.	.	.	.	.	.	.	.	.
183	175	React Energy Imp	.	.	.	.	.	.	.	.	.	.
183	176	Reset Energy Meters	.	.	.	.	.	.	.	.	.	.
183	177	Active Exp Meter Reset	.	.	.	.	.	.	.	.	.	.
183	178	Active Imp Meter Reset	.	.	.	.	.	.	.	.	.	.
183	179	Reactive Exp Meter Reset	.	.	.	.	.	.	.	.	.	.

FUN	INF	Event										
			7SR1204-2xA12-xCA0	7SR1204-4xA12-xCA0	7SR1205-2xA12-xCA0	7SR1205-2xA12-xDA0	7SR1205-4xA12-xCA0	7SR1205-4xA12-xDA0	7SR1206-2xA12-xCA0	7SR1206-2xA12-xDA0	7SR1206-4xA12-xCA0	7SR1206-4xA12-xDA0
183	180	Reactive Imp Meter Reset	*	*	*	*	*	*	*	*	*	*
183	181	CB Total Trip Count	*	*	*	*	*	*	*	*	*	*
183	182	CB Delta Trip Count	*	*	*	*	*	*	*	*	*	*
183	183	CB Count To AR Block	*	*	*	*	*	*	*	*	*	*
183	184	CB Freq Ops Count	*	*	*	*	*	*	*	*	*	*
183	221	Wattmetric Po>	*	*	*	*	*	*	*	*	*	*
183	222	37-PhA			*	*	*	*	*	*	*	*
183	223	37-PhB			*	*	*	*	*	*	*	*
183	224	37-PhC			*	*	*	*	*	*	*	*
183	225	50 LC-1	*	*	*	*	*	*	*	*	*	*
183	226	50 LC-2	*	*	*	*	*	*	*	*	*	*
183	227	50G LC-1	*	*	*	*	*	*	*	*	*	*
183	228	50G LC-2	*	*	*	*	*	*	*	*	*	*
183	229	50SEF LC-1		*						*	*	*
183	230	50SEF LC-2		*						*	*	*
183	231	50BF-PhA			*	*	*	*	*	*	*	*
183	232	50BF-PhB			*	*	*	*	*	*	*	*
183	233	50BF-PhC			*	*	*	*	*	*	*	*
183	234	50BF-EF			*	*	*	*	*	*	*	*
183	235	79 Last Trip Lockout				*		*		*		*
183	239	In Fault Current			*	*	*	*	*	*	*	*
183	240	Ia Fault Current			*	*	*	*	*	*	*	*
183	241	Ib Fault Current			*	*	*	*	*	*	*	*
183	242	Ic Fault Current			*	*	*	*	*	*	*	*
183	243	Ig Fault Current	*		*	*		*	*	*	*	
183	244	Isef Fault Current	*	*			*	*	*	*	*	*
183	245	Va Fault Voltage	*	*	*	*	*	*	*	*	*	*
183	246	Vb Fault Voltage	*	*	*	*	*	*	*	*	*	*
183	247	Vc Fault Voltage	*	*	*	*	*	*	*	*	*	*
183	249	60 CTS-I-PhA			*	*	*	*	*	*	*	*
183	250	60 CTS-I-PhB			*	*	*	*	*	*	*	*
183	251	60 CTS-I-PhC			*	*	*	*	*	*	*	*
200	1	CB 1	*	*	*	*	*	*	*	*	*	*
200	200	CB 1 Trip & Reclose				*		*		*		*
200	201	CB 1 Trip & Lockout				*		*		*		*
200	255	Blocked By Interlocking	*	*	*	*	*	*	*	*	*	*
255	0	Time Synchronisation	*	*	*	*	*	*	*	*	*	*
255	0	GI Initiation	*	*	*	*	*	*	*	*	*	*
255	0	End of GI	*	*	*	*	*	*	*	*	*	*

Section 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 the RS485 port. The relay can communicate simultaneously on all ports regardless of protocol used.

Each relay must be given an address to enable communication and can be set by the *Communication Interface:Relay Address*.

Note that not all definitions are available on all relay models.

Coils (Read Write Binary values)

Address	Description
00001	Binary Output 1
00002	Binary Output 2
00003	Binary Output 3
00004	Binary Output 4
00005	Binary Output 5
00006	Binary Output 6
00007	Binary Output 7
00008	Binary Output 8
00100	LED Reset (Write only location)
00101	Settings Group 1
00102	Settings Group 2
00103	Settings Group 3
00104	Settings Group 4
00109	CB 1
00110	CB 1 Trip & Reclose
00111	CB 1 Trip & Lockout
00112	Auto-reclose on/off
00113	Hot Line Working on/off
00114	E/F off/on
00115	SEF off/on
00116	Inst Protection off/on
00118	Reset CB Total Trip Count
00119	Reset CB Delta Trip Count
00120	Reset CB Count To AR Block
00121	Reset CB Frequent Ops Count
00123	Reset I ² t CB Wear
00126	Demand metering reset
00154	Reset Energy Meters
00155	Remote mode
00156	Service mode
00157	Local mode
00158	Local & Remote
00165	Reset Start Count

Inputs (Read Only Binary values)

10001	Binary Input 1
10002	Binary Input 2
10003	Binary Input 3
10004	Binary Input 4
10005	Binary Input 5
10006	Binary Input 6
10102	Remote mode
10103	Service mode
10104	Local mode
10105	Local & Remote mode
10111	Trip Circuit Fail
10112	A-Starter
10113	B-Starter
10114	C-Starter
10115	General Starter
10116	VTS Alarm
10117	Earth Fault Forward/Line
10118	Earth Fault Reverse/Busbar
10119	Start/Pick Up N
10120	Fault Forward/Line
10121	Fault Reverse/Busbar
10122	51-1
10123	50-1
10124	51N-1
10125	50N-1
10126	51G-1
10127	50G-1
10128	51-2
10129	50-2
10130	51N-2
10131	50N-2
10132	51G-2
10133	50G-2
10134	51-3
10135	50-3
10136	51N-3
10137	50N-3
10138	51G-3
10139	50G-3
10140	51-4
10141	50-4
10142	51N-4
10143	50N-4
10144	51G-4
10145	50G-4
10146	50BF Stage 2
10147	49 Alarm
10148	49 Trip
10149	60 CTS
10150	46IT
10151	46DT
10152	47-1
10153	47-2
10154	46BC
10155	27/59-1
10156	27/59-2
10157	27/59-3
10158	27/59-4
10159	59NIT
10160	59NDT
10161	81-1
10162	81-2
10163	81-3

10164	81-4
10167	64H
10168	37-1
10169	37-2
10171	AR Active
10172	CB on by AR
10173	Reclaim
10174	Lockout
10175	Hot Line Working
10176	Inst Protection Out
10177	CB Trip Count Maint
10178	CB Trip Count Delta
10179	CB Trip Count Lockout
10180	I ² t CB Wear
10181	79 AR In Progress
10182	Cold Load Active
10183	E/F Protection Out
10184	P/F Inst Protection Inhibited
10185	E/F Inst Protection Inhibited
10186	SEF Inst Protection Inhibited
10187	Ext Inst Protection Inhibited
10202	51SEF-1
10203	50SEF-1
10204	51SEF-2
10205	50SEF-2
10206	51SEF-3
10207	50SEF-3
10208	51SEF-4
10209	50SEF-4
10210	SEF Out
10211	Trip Circuit Fail 1
10212	Trip Circuit Fail 2
10213	Trip Circuit Fail 3
10214	CB Total Trip Count
10215	CB Delta Trip Count
10216	CB Count to AR Block
10217	CB Frequent Ops Count
10218	I ² t CB Wear
10219	CB Open
10220	CB Closed
10283	Close Circuit Fail 1
10284	Close Circuit Fail 2
10285	Close Circuit Fail 3
10286	Close Circuit Fail
10288	SEF Forward/Line
10289	SEF Reverse/Busbar
10290	General Alarm 1
10291	General Alarm 2
10292	General Alarm 3
10293	General Alarm 4
10294	General Alarm 5
10295	General Alarm 6
10302	Quick Logic E1
10303	Quick Logic E2
10304	Quick Logic E3
10305	Quick Logic E4
10334	60 CTS-I
10335	81HBL2
10336	37G-1
10337	37G-2
10338	37SEF-1
10339	37SEF-2

10367	50BF-1
10368	Wattmetric Po>
10369	37-PhA
10370	37-PhB
10371	37-PhC
10372	50 LC-1
10373	50 LC-2
10374	50G LC-1
10375	50G LC-2
10376	50SEF LC-1
10377	50SEF LC-2
10378	50BF-PhA
10379	50BF-PhB
10380	50BF-PhC
10381	50BF-EF
10382	79 Last Trip Lockout
10383	60 CTS-I-PhA
10384	60 CTS-I-PhB
10385	60 CTS-I-PhC
10501	Virtual Input 1
10502	Virtual Input 2
10503	Virtual Input 3
10504	Virtual Input 4
10505	Virtual Input 5
10506	Virtual Input 6
10507	Virtual Input 7
10508	Virtual Input 8
10601	LED 1
10602	LED 2
10603	LED 3
10604	LED 4
10605	LED 5
10606	LED 6
10607	LED 7
10608	LED 8
10609	LED 9
10701	LED PU 1
10702	LED PU 2
10703	LED PU 3
10704	LED PU 4
10705	LED PU 5
10706	LED PU 6
10707	LED PU 7
10708	LED PU 8
10709	LED PU 9
10800	Cold Start
10801	Warm Start
10802	Re-Start
10803	Power On
10804	SW Forced Restart
10805	Unexpected Restart
10806	Reset Start Count

Registers

Address	Name	Format	Multiplier	Description
30001	No. of Events In Store	1 Register	0	Events Counter
30002	Event Record	8 Registers ²	0	8 Registers
30010	Vab Primary	FP_32BITS_3DP ¹	1	Vab V
30012	Vbc Primary	FP_32BITS_3DP ¹	1	Vbc V
30014	Vca Primary	FP_32BITS_3DP ¹	1	Vca V
30016	Phase A Primary Volt	FP_32BITS_3DP ¹	1	Va V
30018	Phase B Primary Volt	FP_32BITS_3DP ¹	1	Vb V
30020	Phase C Primary Volt	FP_32BITS_3DP ¹	1	Vc V
30022	Phase a Secondary Volt	FP_32BITS_3DP ¹	1	Va V

Address	Name	Format	Multiplier	Description
30024	Phase b Secondary Volt	FP 32BITS 3DP ¹	1	Vb V
30026	Phase c Secondary Volt	FP 32BITS 3DP ¹	1	Vc V
30034	Phase ab Nominal Volt	FP 32BITS 3DP ¹	1	Vab Degrees
30036	Phase bc Nominal Volt	FP 32BITS 3DP ¹	1	Vbc Degrees
30038	Phase ca Nominal Volt	FP 32BITS 3DP ¹	1	Vca Degrees
30040	Phase a Nominal Volt	FP 32BITS 3DP ¹	1	Va Degrees
30042	Phase b Nominal Volt	FP 32BITS 3DP ¹	1	Vb Degrees
30044	Phase c Nominal Volt	FP 32BITS 3DP ¹	1	Vc Degrees
30048	Vzps	FP 32BITS 3DP ¹	1	Vzps xVn
30050	Vpps	FP 32BITS 3DP ¹	1	Vpps xVn
30052	Vnps	FP 32BITS 3DP ¹	1	Vnps xVn
30054	Vzps	FP 32BITS 3DP ¹	1	Vzps Degrees
30056	Vpps	FP 32BITS 3DP ¹	1	Vpps Degrees
30058	Vnps	FP 32BITS 3DP ¹	1	Vnps Degrees
30060	Frequency	FP 32BITS 3DP ¹	1	Frequency Hz
30064	Phase A Primary Curr	FP 32BITS 3DP ¹	1	Ia A
30066	Phase B Primary Curr	FP 32BITS 3DP ¹	1	Ib A
30068	Phase C Primary Curr	FP 32BITS 3DP ¹	1	Ic A
30070	Phase a Secondary Curr	FP 32BITS 3DP ¹	1	Ia A
30072	Phase b Secondary Curr	FP 32BITS 3DP ¹	1	Ib A
30074	Phase c Secondary Curr	FP 32BITS 3DP ¹	1	Ic A
30076	Phase A Nominal	FP 32BITS 3DP ¹	1	Ia xIn
30078	Phase B Nominal	FP 32BITS 3DP ¹	1	Ib xIn
30080	Phase C Nominal	FP 32BITS 3DP ¹	1	Ic xIn
30082	Phase A Nominal	FP 32BITS 3DP ¹	1	Ia Degrees
30084	Phase B Nominal	FP 32BITS 3DP ¹	1	Ib Degrees
30086	Phase C Nominal	FP 32BITS 3DP ¹	1	Ic Degrees
30088	Earth Primary Curr	FP 32BITS 3DP ¹	1	In A
30090	In Secondary	FP 32BITS 3DP ¹	1	In A
30092	In Nominal	FP 32BITS 3DP ¹	1	In xIn
30094	Ig Primary	FP 32BITS 3DP ¹	1	Ig A
30096	Ig Secondary	FP 32BITS 3DP ¹	1	Ig A
30098	Ig Nominal	FP 32BITS 3DP ¹	1	Ig xIn
30100	Izps Nominal	FP 32BITS 3DP ¹	1	Izps xIn
30102	Ipps Nominal	FP 32BITS 3DP ¹	1	Ipps xIn
30104	Inps Nominal	FP 32BITS 3DP ¹	1	Inps xIn
30106	Izps Nominal	FP 32BITS 3DP ¹	1	Izps Degrees
30108	Ipps Nominal	FP 32BITS 3DP ¹	1	Ipps Degrees
30110	Inps Nominal	FP 32BITS 3DP ¹	1	Inps Degrees
30112	Active Power A	FP 32BITS 3DP ¹	0.000001	A Phase W
30114	Active Power B	FP 32BITS 3DP ¹	0.000001	B Phase W
30116	Active Power C	FP 32BITS 3DP ¹	0.000001	C Phase W
30118	3P Power	FP 32BITS 3DP ¹	0.000001	3 Phase W
30120	Reactive Power A	FP 32BITS 3DP ¹	0.000001	A Phase VAR
30122	Reactive Power B	FP 32BITS 3DP ¹	0.000001	B Phase VAR
30124	Reactive Power C	FP 32BITS 3DP ¹	0.000001	C Phase VAR
30126	3P Reactive Power Q	FP 32BITS 3DP ¹	0.000001	3 Phase VAR
30128	Apparent Power A	FP 32BITS 3DP ¹	0.000001	A Phase VA
30130	Apparent Power B	FP 32BITS 3DP ¹	0.000001	B Phase VA
30132	Apparent Power C	FP 32BITS 3DP ¹	0.000001	C Phase VA
30134	3P Apparent Power	FP 32BITS 3DP ¹	0.000001	3 Phase VA
30136	Power Factor A	FP 32BITS 3DP ¹	1	Phase A
30138	Power Factor B	FP 32BITS 3DP ¹	1	Phase B
30140	Power Factor C	FP 32BITS 3DP ¹	1	Phase C
30142	3P Power Factor	FP 32BITS 3DP ¹	1	3 Phase
30152	Thermal Status Ph A	UINT16 ³	1	%
30153	Thermal Status Ph B	UINT16 ³	1	%
30154	Thermal Status Ph C	UINT16 ³	1	%
30167	Fault Records	UINT16 ³	1	Fault Records
30168	Event Records	UINT16 ³	1	Event Records
30169	Waveform Records	UINT16 ³	1	Waveform Records
30170	Vab Secondary Volt	FP 32BITS 3DP ¹	1	Vab V
30172	Vbc Secondary Volt	FP 32BITS 3DP ¹	1	Vbc V

Address	Name	Format	Multiplier	Description
30174	Vca Secondary Volt	FP_32BITS_3DP ¹	1	Vca V
30176	Vn Primary	FP_32BITS_3DP ¹	1	Vn V
30178	Vn Secondary	FP_32BITS_3DP ¹	1	Vn V
30180	Vn Secondary	FP_32BITS_3DP ¹	1	Vn Degrees
30193	I Phase A Max	FP_32BITS_3DP ¹	1	Ia Max Demand
30194	I Phase B Max	FP_32BITS_3DP ¹	1	Ib Max Demand
30195	I Phase C Max	FP_32BITS_3DP ¹	1	Ic Max Demand
30196	P 3P Max	FP_32BITS_3DP ¹	0.000001	Power Max Demand
30197	Q 3P Max	FP_32BITS_3DP ¹	0.000001	VARs Max Demand
30207	Isef Primary	FP_32BITS_3DP ¹	1	Isef A
30209	Isef Secondary	FP_32BITS_3DP ¹	1	Isef A
30211	Isef Nominal	FP_32BITS_3DP ¹	1	Isef xIn
30241	CB Total Trip Count	UINT32 ⁴	1	CB Total Trip Count
30243	CB Delta Trip Count	UINT32 ⁴	1	CB Delta Trip Count
30245	CB Count to AR Block	UINT32 ⁴	1	CB Count to AR Block
30247	CB Frequent Ops Count	UINT32 ⁴	1	CB Frequent Ops Count
30301	Ia Last Trip	FP_32BITS_3DP ¹	1	Ia Fault
30303	Ib Last Trip	FP_32BITS_3DP ¹	1	Ib Fault
30305	Ic Last Trip	FP_32BITS_3DP ¹	1	Ic Fault
30307	Va Last Trip	FP_32BITS_3DP ¹	1	Va Fault
30309	Vb Last Trip	FP_32BITS_3DP ¹	1	Vb Fault
30311	Vc Last Trip	FP_32BITS_3DP ¹	1	Vc Fault
30313	In Last Trip	FP_32BITS_3DP ¹	1	In Fault
30317	Isef Last Trip	FP_32BITS_3DP ¹	1	Isef Fault
30319	V Phase A Max	FP_32BITS_3DP ¹	1	Va Max Demand
30321	V Phase B Max	FP_32BITS_3DP ¹	1	Vb Max Demand
30323	V Phase C Max	FP_32BITS_3DP ¹	1	Vc Max Demand
30341	LED1-n	BITSTRING ⁵	0	Led 1-16 status
30342	LED1-n	BITSTRING ⁵	0	Led 17-32 status
30343	INP1-n	BITSTRING ⁵	0	Input 1-16 status
30344	INP1-n	BITSTRING ⁵	0	Input 17-32 status
30345	OUT1-n	BITSTRING ⁵	0	Output 1-16 status
30346	OUT1-n	BITSTRING ⁵	0	Output 17-32 status
30347	VRT1-n	BITSTRING ⁵	0	Virtual 1-16 status
30348	VRT1-n	BITSTRING ⁵	0	Virtual 17-32 status
30349	EQN1-n	BITSTRING ⁵	0	Equation 1-16 status
30350	EQN1-n	BITSTRING ⁵	0	Equation 17-32 status
30354	CB Wear A	FP_32BITS_3DP ¹	0.000001	CB Wear A
30356	CB Wear B	FP_32BITS_3DP ¹	0.000001	CB Wear B
30358	CB Wear C	FP_32BITS_3DP ¹	0.000001	CB Wear C
30380	StartCount	FP_32BITS_3DP ¹	1	Start Count
30382	Start Count Target	FP_32BITS_3DP ¹	1	Start Count Target

1) FP_32BITS_3DP: 2 registers - 32 bit fixed point, a 32 bit integer containing a value to 3 decimal places e.g. 50000 sent = 50.000

2) Sequence of 8 registers containing an event record. Read address 30002 for 8 registers (16 bytes), each read returns the earliest event record and removes it from the internal store. Repeat this process for the number of events in the register 30001, or until no more events are returned. (the error condition exception code 2)

3) UINT16: 1 register - standard 16 bit unsigned integer

4) UINT32: 2 registers - 32bit unsigned integer

5) BITSTRING: Sequence of bits showing the status of 1-16 items. For example, if 9 inputs are used, bits 1-9 show the status of inputs 1-9 respectively. Unused bits are set to zero.

Holding Registers (Read Write values)

Address	Description
40001	Time Meter

Event Record

MODBUS does not define a method for extracting events; therefore a private method has been defined based on that defined by [4] IEC60870-5-103.

Register 30001 contains the current number of events in the relays event buffer. Register 30002 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 address should be polled regularly by the master for events.

Event 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

Section 5: DNP3.0 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 in Section 5.2 and the Point List Tables provided in Section 5.3 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 Section 5.2.)	
Vendor Name: Siemens Protection Devices Ltd.	
Device Name: 7SR1 , using the Triangle MicroWorks, Inc. DNP3 Slave Source Code Library, Version 3.	
Highest DNP Level Supported:	Device Function:
For Requests: Level 3 For Responses: Level 3	<input type="checkbox"/> Master <input checked="" type="checkbox"/> Slave
<p>Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):</p> <p>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.</p> <p>16-bit, 32-bit and Floating Point Analog Change Events with Time may be requested. Analog Input Deadbands, Object 34, variations 1 through 3, are supported. Output Event Objects 11, 13, are supported.</p>	
Maximum Data Link Frame Size (octets):	Maximum Application Fragment Size (octets):
Transmitted: 256 Received 256	Transmitted: 2048 Received 2048
Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
<input type="checkbox"/> None <input checked="" type="checkbox"/> Fixed (3) <input type="checkbox"/> Configurable from 0 to 65535	<input checked="" type="checkbox"/> None <input type="checkbox"/> Configurable
Requires Data Link Layer Confirmation:	
<input checked="" type="checkbox"/> Never <input type="checkbox"/> Always <input type="checkbox"/> Sometimes <input 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."	

DNP V3.0 DEVICE PROFILE DOCUMENT (Also see the DNP 3.0 Implementation Table Section 5.2.)	
Timeouts while waiting for: Data Link Confirm: <input type="checkbox"/> None <input checked="" type="checkbox"/> Fixed at 2sec <input type="checkbox"/> Variable <input type="checkbox"/> Configurable. 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 checked="" type="checkbox"/> Fixed at 10sec <input type="checkbox"/> Variable <input type="checkbox"/> Configurable. Complete Appl. Response: <input checked="" type="checkbox"/> None <input type="checkbox"/> Fixed at _____ <input type="checkbox"/> Variable <input type="checkbox"/> Configurable	
Others: Transmission Delay, (0 sec) Select/Operate Arm Timeout, (5 sec) Need Time Interval, (30 minutes) Application File Timeout, (60 sec) Unsolicited Notification Delay, (5 seconds) Unsolicited Response Retry Delay, (between 3 – 9 seconds) Unsolicited Offline Interval, (30 seconds) Binary Change Event Scan Period, (Polled, Not Applicable) Double Bit Change Event Scan Period, (Unsupported - Not Applicable) Analog Change Event Scan Period, (Unsupported - Not Applicable) Counter Change Event Scan Period, (Unsupported - Not Applicable) Frozen Counter Change Event Scan Period, (Unsupported - Not Applicable) String Change Event Scan Period, (Unsupported - Not Applicable) Virtual Terminal Event Scan Period, (Unsupported - Not Applicable)	
Sends/Executes Control Operations: 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	
Attach explanation if 'Sometimes' or 'Configurable' was checked for any operation.	
Reports Binary Input Change Events when no specific variation requested: <input type="checkbox"/> Never <input type="checkbox"/> Only time-tagged <input type="checkbox"/> Only non-time-tagged <input checked="" type="checkbox"/> Configurable to send one or the other	Reports time-tagged Binary Input Change Events when no specific variation requested: <input type="checkbox"/> Never <input type="checkbox"/> Binary Input Change With Time <input type="checkbox"/> Binary Input Change With Relative Time <input checked="" type="checkbox"/> Configurable
Sends Unsolicited Responses: <input type="checkbox"/> Never <input checked="" type="checkbox"/> Configurable <input type="checkbox"/> Only certain objects <input type="checkbox"/> Sometimes (attach explanation) <input checked="" type="checkbox"/> ENABLE/DISABLE UNSOLICITED Function codes supported	Sends Static Data in Unsolicited Responses: <input checked="" type="checkbox"/> Never <input type="checkbox"/> When Device Restarts <input type="checkbox"/> When Status Flags Change No other options are permitted.
Default Counter Object/Variation: <input type="checkbox"/> No Counters Reported <input checked="" type="checkbox"/> Configurable <input type="checkbox"/> Default Object Default Variation: <input type="checkbox"/> Point-by-point list attached	Counters Roll Over at: <input type="checkbox"/> No Counters Reported <input type="checkbox"/> Configurable (attach explanation) <input type="checkbox"/> 16 Bits <input checked="" type="checkbox"/> 32 Bits <input type="checkbox"/> Other Value: _____ <input type="checkbox"/> Point-by-point list attached

DNP V3.0 DEVICE PROFILE DOCUMENT (Also see the DNP 3.0 Implementation Table Section 5.2.)		
Sends Multi-Fragment Responses:		
<input checked="" type="checkbox"/>	Yes	
<input type="checkbox"/>	No	
<input type="checkbox"/>	Configurable	
Sequential File Transfer Support:		
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 Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
1	0	Binary Input – Any Variation	1 (read) 22 (assign class)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index)		
1	1 (default – see note 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	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	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 (default – see note 1)	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)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
3	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)		
10	1	Binary Output	1 (read) 1 (write)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index) 00, 01 (start-stop)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 1)
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 (default – see note 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	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)		

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
12	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	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 Input – Any Variation	1 (read) 22 (assign class) 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) 17, 27, 28 (index) 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)				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
20	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)
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 with 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 1)
21	6	16-Bit Frozen Counter with Time Of Freeze	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 27, 28 (index)	129 (response)	00, 01 (start-stop) 17, 28 (index – see note 1)
21	7	32-Bit Frozen Delta Counter with Time Of Freeze				
21	8	16-Bit Frozen Delta Counter with Time Of Freeze				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
21	9 (default – see note 1)	32-Bit Frozen Counter without Flag	1 (read)	00, 01 (start-stop) 06 (no range, or all) 07, 08 (limited qty) 17, 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 (unsol. resp)	17, 28 (index)
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	0	Frozen Counter Event (Variation 0 is used to request default variation)	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
23	1 (default – see note 1)	32-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	2	16-Bit Frozen Counter Event	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
23	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)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
23	6	16-Bit Frozen Counter Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
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	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 (default – see note 1)	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 1)
31	0	Frozen Analog Input – Any Variation				
31	1	32-Bit Frozen Analog input				
31	2	16-Bit Frozen Analog input				
31	3	32-Bit Frozen Analog input with Time of freeze				
31	4	16-Bit Frozen Analog input with Time of freeze				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
31	5	32-Bit Frozen Analog input without Flag				
31	6	16-Bit Frozen Analog input without Flag				
32	0	Analog Change Event – Any Variation	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
32	1 <small>(default – see note 1)</small>	32-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	2	16-Bit Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	3	32-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	4	16-Bit Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	5	short floating point Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	6	long floating point Analog Change Event without Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	7	short floating point Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
32	8	long floating point Analog Change Event with Time	1 (read)	06 (no range, or all) 07, 08 (limited qty)	129 (response) 130 (unsol. resp)	17, 28 (index)
33	0	Frozen Analog Event – Any Variation				
33	1	32-Bit Frozen 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				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
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) 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)		
50	0	Time and Date				
50	1 (default – see note 1)	Time and Date	1 (read)	07, (limited qty = 1)	129 (response)	07 (limited qty = 1)
			2 (write)	07 (limited qty = 1)		
50	3	Time and Date Last Recorded Time	2 (write)	07 (limited qty)		
51	1	Time and Date CTO			129 (response) 130 (unsol. Resp)	07 (limited qty = 1)
51	2	Unsyncronised Time and Date CTO			129 (response) 130 (unsol. Resp)	07 (limited qty = 1)

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
52	1	Time Delay Coarse			129 (response)	07 (limited qty = 1)
52	2	Time Delay Fine			129 (response)	07 (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.)	06 (no range, or all)		
			21 (dab. unsol.)			
			22 (assign class)			
60	3	Class 2 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.)	06 (no range, or all)		
			21 (dab. unsol.)			
			22 (assign class)			
60	4	Class 3 Data	1 (read)	06 (no range, or all) 07, 08 (limited qty)		
			20 (enbl. unsol.)	06 (no range, or all)		
			21 (dab. unsol.)			
			22 (assign class)			
70	1	File Transfer				
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		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	1	Short Floating Point				
100	2	Long Floating Point				
100	3	Extended Floating Point				

OBJECT			REQUEST (Library will parse)		RESPONSE (Library will respond with)	
Object Number	Variation Number	Description	Function Codes (dec)	Qualifier Codes (hex)	Function Codes (dec)	Qualifier Codes (hex)
101	1	Small Packed Binary-Coded Decimal				
101	2	Medium Packed Binary-Coded Decimal				
101	3	Large Packed Binary-Coded Decimal				
		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)			

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.

The default binary input event buffer size is set to allow 100 events.

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

5.3.1 Binary Input Points

Binary Inputs are by default returned in a class zero interrogation.

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
1	Binary Input 1	2
2	Binary Input 2	2
3	Binary Input 3	2
4	Binary Input 4	2
5	Binary Input 5	2
6	Binary Input 6	2
35	Remote mode	2

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
36	Service mode	2
37	Local mode	2
38	Local & Remote	2
41	Trip Circuit Fail	2
42	A-Starter	2
43	B-Starter	2
44	C-Starter	2
45	General Starter	2
46	VTS Alarm	2
47	Earth Fault Forward/Line	2
48	Earth Fault Reverse/Busbar	2
49	Start/Pick-up N	2
50	Fault Forward/Line	2
51	Fault Reverse/Busbar	2
52	51-1	2
53	50-1	2
54	51N-1	2
55	50N-1	2
56	51G-1	2
57	50G-1	2
58	51-2	2
59	50-2	2
60	51N-2	2
61	50N-2	2
62	51G-2	2
63	50G-2	2
64	CTS Alarm	2
65	46IT	2
66	46DT	2
67	47-1	2
68	47-2	2
69	46BC	2
70	27/59-1	2
71	27/59-2	2
72	27/59-3	2

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
73	27/59-4	2
74	59NIT	2
75	59NDT	2
76	81-1	2
77	81-2	2
78	81-3	2
79	81-4	2
80	Auto-reclose active	2
81	CB on by auto reclose	2
82	Reclaim	2
83	Lockout	2
86	51-3	2
87	50-3	2
88	51N-3	2
89	50N-3	2
90	51G-3	2
91	50G-3	2
92	51-4	2
93	50-4	2
94	51N-4	2
95	50N-4	2
96	51G-4	2
97	50G-4	2
98	Cold Load Active	2
99	E/F Protection Out	2
100	P/F Inst Protection Inhibited	2
101	E/F Inst Protection Inhibited	2
102	SEF Inst Protection Inhibited	2
103	Ext Inst Protection Inhibited	2
117	51SEF-1	2
118	50SEF-1	2
119	51SEF-2	2
120	50SEF-2	2
121	51SEF-3	2
122	50SEF-3	2

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
123	51SEF-4	2
124	51SEF-4	2
125	SEF Out	2
126	Trip Circuit Fail 1	2
127	Trip Circuit Fail 2	2
128	Trip Circuit Fail 3	2
129	CB Total Trip Count	2
130	CB Delta Trip Count	2
131	CB Count to AR Block	2
132	CB Frequent Ops Count	2
133	I ² t CB Wear	2
207	Close Circuit Fail 1	2
208	Close Circuit Fail 2	2
209	Close Circuit Fail 3	2
210	Close Circuit Fail	2
211	50BF-1	2
212	50BF-2	2
213	49 Alarm	2
214	49 Trip	2
215	64H	2
217	37-1	2
218	37-2	2
222	Trip Time Alarm	2
223	SEF Forward / Line	2
224	SEF Reverse / Busbar	2
225	General Alarm 1	2
226	General Alarm 2	2
227	General Alarm 3	2
228	General Alarm 4	2
229	General Alarm 5	2
230	General Alarm 6	2
237	Quick Logic E1	2
238	Quick Logic E2	2
239	Quick Logic E3	2
240	Quick Logic E4	2
269	60 CTS-I	2
270	81HBL2	2
271	37G-1	2
272	37G-2	2
273	Wattmetric Po>	2

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
274	37-PhA	2
275	37-PhB	2
276	37-PhC	2
277	50 LC-1	2
278	50 LC-2	2
279	50G LC-1	2
280	50G LC-2	2
281	50SEF LC-1	2
282	50SEF LC-2	2
283	50BF-PhA	2
284	50BF-PhB	2
285	50BF-PhC	2
286	50BF-EF	2
287	79 Last Trip Lockout	2
288	60 CTS-I-PhA	2
289	60 CTS-I-PhB	2
290	60 CTS-I-PhC	2
373	37SEF-1	2
374	37SEF-2	2
411	Settings Group 1	2
412	Settings Group 2	2
413	Settings Group 3	2
414	Settings Group 4	2
422	Hot Line Working On/Off	2
425	Inst Protection Off/On	2
427	CB 1	2
501	Virtual Input 1	2
502	Virtual Input 2	2
503	Virtual Input 3	2
504	Virtual Input 4	2
505	Virtual Input 5	2
506	Virtual Input 6	2
507	Virtual Input 7	2
508	Virtual Input 8	2
601	LED 1	2
602	LED 2	2
603	LED 3	2
604	LED 4	2
605	LED 5	2
606	LED 6	2
607	LED 7	2
608	LED 8	2
609	LED 9	2
701	LED PU 1	2
702	LED PU 2	2
703	LED PU 3	2
704	LED PU 4	2
705	LED PU 5	2

Binary Input Points		
Static (Steady-State) Object Number: 1		
Change Event Object Number: 2		
Default Static Variation reported when variation 0 requested: 2 (Binary Input with flags)		
Default Change Event Variation reported when variation 0 requested: 2 (Binary Input with absolute time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
706	LED PU 6	2
707	LED PU 7	2
708	LED PU 8	2
709	LED PU 9	2
801	RL 1	2
802	RL 2	2
803	RL 3	2
804	RL 4	2
805	RL 5	2
806	RL 6	2
807	RL 7	2
808	RL 8	2
871	Cold start	2
872	Warm Start	2
873	Re-Start	2
874	Power On	2
875	SW Forced Restart	2
876	Unexpected Restart	2
877	Reset Start Count	2

5.3.2 Double Bit Binary Input Points

Double Bit Binary Inputs are by default returned in a class zero interrogation.

Double Bit Input Points		
Static (Steady-State) Object Number: 3		
Change Event Object Number: 4		
Default Static Variation reported when variation 0 requested: 1 (Double Bit Binary Input packed format)		
Default Change Event Variation reported when variation 0 requested: 3 (Double Bit Binary Input Event with relative time)		
Point Index	Name/Description	Default Change Event Assigned Class (1, 2, 3 or none)
0	CB 1	2

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. It is recommended that Binary Output Status points represent the most recent DNP “commanded” value for the corresponding Control Relay Output Block point. Because many, if not most, Control Relay Output Block points are controlled through pulse mechanisms, the value of the output status may in fact be meaningless. 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 returned in a class zero interrogation.

Point Index	Name/Description	Supported Control Relay Output Block Fields
1	Binary Output 1	Pulse On/ Latch On
2	Binary Output 2	Pulse On/ Latch On
3	Binary Output 3	Pulse On/Latch Off
4	Binary Output 4	Pulse On/Latch Off
5	Binary Output 5	Pulse On/Latch Off
6	Binary Output 6	Pulse On/Latch Off
7	Binary Output 7	Pulse On/Latch Off
8	Binary Output 8	Pulse On/Latch Off
33	LED Reset	Pulse On/Latch Off
34	Settings Group 1	Pulse On/Latch Off
35	Settings Group 2	Pulse On/Latch Off
36	Settings Group 3	Pulse On/Latch Off
37	Settings Group 4	Pulse On/Latch Off
42	Auto-reclose on/off	Pulse On/Pulse Off/Latch On/Latch Off
43	Hot line working on/off	Pulse On/Pulse Off/Latch On/Latch Off
44	E/F off/on	Pulse On/Pulse Off/Latch On/Latch Off
45	SEF off/on	Pulse On/Pulse Off/Latch On/Latch Off
46	Inst Protection off/on	Pulse On/Pulse Off/Latch On/Latch Off
48	Reset CB Total Trip Count	Pulse On/Latch Off
49	Reset CB Delta Trip Count	Pulse On/Latch Off
50	Reset CB Count to AR Block	Pulse On/Latch Off
51	Reset Frequent Ops Count	Pulse On/Latch Off
53	Reset I ² t CB Wear	Pulse On/Latch Off

Point Index	Name/Description	Supported Control Relay Output Block Fields
54	CB 1	Pulse On/Pulse Off/Latch On/Latch Off
55	CB 1 Trip & Reclose	Pulse On/Latch Off
56	CB 1 Trip & Lockout	Pulse On/Latch Off
59	Demand metering reset	Pulse On/Latch Off
87	Reset Energy Meters	Pulse On/Latch Off
88	Remote mode	Pulse On/Latch Off
89	Service mode	Pulse On/Latch Off
90	Local mode	Pulse On/Latch Off
91	Local & Remote	Pulse On/Latch Off
98	Reset Start Count	Pulse On/Latch On

5.3.4 Analogue 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.

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

Analog Inputs						
Static (Steady-State) Object Number: 30						
Change Event Object Number: 32						
Default Static Variation reported when variation 0 requested: 2 (16-Bit Analog Input with Flag)						
Default Change Event Variation reported when variation 0 requested: 4 (16-Bit Analog Change Event with Time)						
Point #	Default Class	Default Static Variant	Default Event Variant	Name	Scaling Factor	Deadband
0	3	2	4	Frequency	100.0	1
1	3	2	4	Vab Primary	0.001	1000
2	3	2	4	Vbc Primary	0.001	1000
3	3	2	4	Vca Primary	0.001	1000
4	3	2	4	Va Primary	0.001	1000
5	3	2	4	Vb Primary	0.001	1000
6	3	2	4	Vc Primary	0.001	1000
7	3	2	4	Va Secondary	100.0	1
8	3	2	4	Vb Secondary	100.0	1
9	3	2	4	Vc Secondary	100.0	1
21	3	2	4	Vzps	10.0	1
22	3	2	4	Vpps	10.0	1
23	3	2	4	Vnps	10.0	1
31	3	2	4	Ia Primary	1	100
32	3	2	4	Ib Primary	1	100
33	3	2	4	Ic Primary	1	100
34	3	2	4	Ia Secondary	100.0	0.1
35	3	2	4	Ib Secondary	100.0	0.1
36	3	2	4	Ic Secondary	100.0	0.1
37	3	2	4	Ia Nominal	100.0	0.1
38	3	2	4	Ib Nominal	100.0	0.1

Analog Inputs						
Static (Steady-State) Object Number: 30						
Change Event Object Number: 32						
Default Static Variation reported when variation 0 requested: 2 (16-Bit Analog Input with Flag)						
Default Change Event Variation reported when variation 0 requested: 4 (16-Bit Analog Change Event with Time)						
Point #	Default Class	Default Static Variant	Default Event Variant	Name	Scaling Factor	Deadband
39	3	2	4	Ic Nominal	100.0	0.1
43	3	2	4	In Primary	1	100
44	3	2	4	In Secondary	100.0	0.1
45	3	2	4	In Nominal	100.0	0.1
46	3	2	4	Ig Primary	1	100
47	3	2	4	Ig Secondary	1000.0	0.1
48	3	2	4	Ig Nominal	1000.0	0.1
51	3	2	4	Izps Nominal	100.0	0.1
52	3	2	4	Ipps Nominal	100.0	0.1
53	3	2	4	Inps Nominal	100.0	0.1
57	3	2	4	Active Power A	0.00001	1000000
58	3	2	4	Active Power B	0.00001	1000000
59	3	2	4	Active Power C	0.00001	1000000
60	3	2	4	P (3P)	0.00001	1000000
61	3	2	4	Reactive Power A	0.00001	1000000
62	3	2	4	Reactive Power B	0.00001	1000000
63	3	2	4	Reactive Power C	0.00001	1000000
64	3	2	4	Q (3P)	0.00001	1000000
65	3	2	4	Apparent Power A	0.00001	1000000
66	3	2	4	Apparent Power B	0.00001	1000000
67	3	2	4	Apparent Power C	0.00001	1000000
68	3	2	4	S (3P)	0.00001	1000000
71	3	2	4	Power Factor A	1000	0.1
72	3	2	4	Power Factor B	1000	0.1
73	3	2	4	Power Factor C	1000	0.1
74	3	2	4	Power Factor(3P)	1000	0.1
81	3	2	4	Thermal Status Ph A	100.0	1
82	3	2	4	Thermal Status Ph B	100.0	1
83	3	2	4	Thermal Status Ph C	100.0	1
99	3	2	4	Vab Secondary	10.0	1
100	3	2	4	Vbc Secondary	10.0	1
101	3	2	4	Vca Secondary	10.0	1
102	3	2	4	Vn Primary	0.01	100
103	3	2	4	Vn Secondary	10.0	1
108	3	2	4	Ia Max Demand	1	100
109	3	2	4	Ib Max Demand	1	100
110	3	2	4	Ic Max Demand	1	100
111	3	2	4	P 3P Max Demand	0.00001	1000000
112	3	2	4	Q 3P Max Demand	0.00001	1000000
113	3	2	4	Ig Max	1	100
114	3	2	4	Isef Max	1	10
115	3	2	4	Isef Primary	1	10
116	3	2	4	Isef Secondary	1000.0	0.05
117	3	2	4	Isef Nominal	1000.0	0.05
135	3	2	4	CB Total Trip Count	1	1
136	3	2	4	CB Delta Trip Count	1	1
137	3	2	4	CB Count to AR Block	1	1
138	3	2	4	CB Frequent Ops Count	1	1
165	3	1	3	Ia Last Trip	1	0
166	3	1	3	Ib Last Trip	1	0
167	3	1	3	Ic Last Trip	1	0
168	3	1	3	Va Last Trip	1	0
169	3	1	3	Vb Last Trip	1	0
170	3	1	3	Vc Last Trip	1	0

Analog Inputs						
Static (Steady-State) Object Number: 30						
Change Event Object Number: 32						
Default Static Variation reported when variation 0 requested: 2 (16-Bit Analog Input with Flag)						
Default Change Event Variation reported when variation 0 requested: 4 (16-Bit Analog Change Event with Time)						
Point #	Default Class	Default Static Variant	Default Event Variant	Name	Scaling Factor	Deadband
171	3	1	3	In Last Trip	1	0
172	3	1	3	Ig Last Trip	1	0
173	3	1	3	Isef Last Trip	1	0
174	3	2	4	Va Max	0.01	100
175	3	2	4	Vb Max	0.01	100
176	3	2	4	Vc Max	0.01	100
177	3	2	4	Vab Max	0.01	100
178	3	2	4	Vbc Max	0.01	100
179	3	2	4	Vca Max	0.01	100
184	3	2	4	CB Wear A	0.0001	1000000
185	3	2	4	CB Wear B	0.0001	1000000
186	3	2	4	CB Wear C	0.0001	1000000

5.3.5 Binary Counters

The following table lists the Counters (Object 20).

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.

Counters are by default not returned in a class zero interrogation.

Counters						
Static (Steady-State) Object Number: 20						
Change Event Object Number: 22						
Default Static Variation reported when variation 0 requested: 5 (32-Bit Counter without Flag)						
Default Change Event Variation reported when variation 0 requested: 1 (32-Bit Change Event with Flag)						
Point #	Default Class	Default Static Variant	Default Event Variant	Name	Scaling Factor	Deadband
0	3	5	1	Waveform Records		1
1	3	5	1	Fault Records		1
2	3	5	1	Event Records		1
3	3	5	1	Data Log Records		1
4	3	5	1	Number User Files		1
5	3	5	1	Start Count		1
6	3	5	1	Start Count Target		1
7	3	5	1	Active Setting Group		1
11	3	5	1	CB Total Trip Count		1
16	3	5	1	CB Delta Trip Count		1
17	3	5	1	CB Count To AR Block		1
18	3	5	1	CB Frequent Ops Count		1
21	3	5	1	E1 Counter		1
22	3	5	1	E2 Counter		1
23	3	5	1	E3 Counter		1
24	3	5	1	E4 Counter		1

5.3.6 Frozen Counters

The following table lists the Frozen Counters (Object 21).

The "Default Change Event Assigned Class" column is used to define which class poll (1, 2, 3, or none) the change event will be reported.

Note the point number of the Frozen Counter must match that of the corresponding Counter.

Frozen Counters are by default not returned in a class zero interrogation.

Frozen Counters					
Static (Steady-State) Object Number: 21					
Change Event Object Number: 23					
Default Static Variation reported when variation 0 requested: 9 (32-Bit Counter without Flag)					
Default Change Event Variation reported when variation 0 requested: 1 (32-Bit Change Event with Flag)					
Point #	Default Class	Default Static Variant	Default Event Variant	Name	Resettable
0	2	9	1	Waveform Records	<input type="checkbox"/>
1	2	9	1	Fault Records	<input type="checkbox"/>
2	2	9	1	Event Records	<input type="checkbox"/>
3	2	9	1	Data Log Records	<input type="checkbox"/>
4	2	9	1	Number User Files	<input type="checkbox"/>
5	2	9	1	Start Count	<input checked="" type="checkbox"/>
6	2	9	1	Start Count Target	<input type="checkbox"/>
7	2	9	1	Active Setting Group	<input type="checkbox"/>
11	2	9	1	CB Total Trip Count	<input checked="" type="checkbox"/>
16	2	9	1	CB Delta Trip Count	<input checked="" type="checkbox"/>
17	2	9	1	CB Count To AR Block	<input checked="" type="checkbox"/>
18	2	9	1	CB Frequent Ops Count	<input checked="" type="checkbox"/>
21	2	9	1	E1 Counter	<input type="checkbox"/>
22	2	9	1	E2 Counter	<input type="checkbox"/>
23	2	9	1	E3 Counter	<input type="checkbox"/>
24	2	9	1	E4 Counter	<input type="checkbox"/>

Section 6: Modems

The communications interface has been designed to allow data transfer via modems. However, IEC 60870-5-103 defines the data transfer protocol as an 11 bit format of 1 start, 1 stop, 8 data and even parity, which is a mode most commercial modems do not support. High performance modems will support this mode, but are expensive. For this reason, a parity setting is provided to allow use of easily available and relatively inexpensive commercial modems. This will result in a small reduction in data security and the system will not be compatible with true IEC 60870-5-103 control systems.

6.1.1 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. In this case, two DCE devices (the modem and the fibre-optic converter) are being connected together, so 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.

6.1.2 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 say 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 this 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.

If possible, Data Carrier Detect (DCD) should be forced on, as this control line will be used by the Fibre-optic converter.

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

6.1.3 Connecting to the Remote Modem

Once the remote modem has been configured correctly, it should be possible to dial up the modem and make connection to the relay. As the settings on the remote modem are fixed the local modem should negotiate with it on connection, choosing suitable matching settings. If it cannot do this, the local modem should be set with settings equivalent to those of the remote modem as described above.

Section 7: 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 section. 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 comms editor tool.

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

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

The editor allows configuration files to be retrieved from the relay, edited, then uploaded back to the relay. Files may also be saved/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, Binary Outputs and Analogue Inputs.
- Changing their assigned class and object variants.
- Setting Binary points to be inverted before transmission.
- Setting the Control Relay Output Block (CROB) commands that can be used with a Binary Output.
- Specifying a dead-band outside which Analogue Events will be generated.
- Specifying a multiplier that will be applied to an analogue value before transmission.

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-RTU

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.

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

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 Comms Editor Technical Manual for further guidance.

Section 8: Glossary

ASDU

Application Service Data Unit.

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.

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.

Line Idle

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

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.