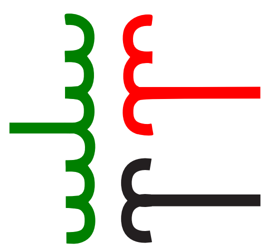
ERL

T-PRO 2000

Transformer Protection Relay



User Manual

Version 1.0 Rev 0

Preface

Information in this document is subject to change without notice.

This manual is part of a complete set of product documentation that includes detailed drawings and operation. Users should evaluate the information in the context of the complete set of product documentation and their particular applications. ERLPhase assumes no liability for any incidental, indirect or consequential damages arising from the use of this documentation.

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Using This Guide

This User Manual describes the installation and operation of the T-PRO 2000 transformer protection relay. It is intended to support the first time user and clarify the details of the equipment.

The manual uses a number of conventions to denote special information:

Example	Describes
Start>Settings>Control Panel	Choose the Control Panel submenu in the Settings submenu on the Start menu.
Right-click	Click the right mouse button.
Recordings	Menu items and tabs are shown in italics.
Service	User input or keystrokes are shown in bold.
Text boxes similar to this one	Relate important notes and information.
..	Indicates more screens.
▶	Indicates further drop-down menu, click to display list.
	Indicates a warning.

Table of Contents

Acronyms

ASG- Active Setting Group

CT- Current Transformer

DCE- Data Communication Equipment

GPS- Global Positioning System

GUI- Graphical User Interface

HMI- Human Machine Interface

ICD- file extension (.ICD) for IED Capability Description

IEC- International Electro technical Commission

IED- Intelligent Electronic Device

IP- Internet Protocol (IP) address

IRIG-B- Inter-Range Instrumentation Group time codes

LED- Light-emitting Diode

LCD- Liquid Crystal Display

LHS- Left Hand Side

ROCOD - Rate of Change of Differential

RHS- Right Hand Side

RTU- Remote Terminal Unit

SCADA- Supervisory Control And Data Acquisition

SG- Setting Group

TCP- Transmission Control Protocol

TDR - Transient Disturbance Recording

UI - User Interface

VI - Virtual Input

Version Compatibility

For version compatibility, refer to the following documents on the ERLPhase website, www.erlphase.com:

D05931R01.00 - T-PRO 2000 Firmware User Release Description

PC System Requirements and Software Installation

Hardware

The minimum hardware requirements are:

- 1 GHz processor
- 2 GB RAM
- 20 GB available hard disk space
- USB port
- Serial communication port

Operating System

One of the following 64-bit operating systems must be installed and functional prior to installing the applications:

- Microsoft Windows 10
- Microsoft Windows 11

Software Installation

All required software for user interface, settings and record analysis is available directly from the ERLPhase website. The following relevant software and documentation is available:

- T-PRO Offliner
- Relay Control Panel
- ERL 61850 Configurator Tool
- RecordGraph
- RecordBase View
- USB Driver
- T-PRO 2000 User Manual

Anti-virus/Anti-spyware Software

If an anti-virus/anti-spyware software on your local system identifies any of the ERLPhase applications as a “potential threat”, it will be necessary to configure your anti-virus/anti-software to classify it as “safe” for its proper operation. Please consult the appropriate anti-virus/anti-spyware software documentation to determine the relevant procedure.

1 Overview

1.1 Introduction

The T-PRO 2000 is a microprocessor-based relay providing protection, monitoring, logging and recording functions suitable for power transformers in transmission and distribution substations, generator transformers, industrial and utility transformers, auto-transformers and grounding transformers.

The ERLPhase software operates in two distinct modes: Online and Offline, each serving specific user requirements:

1. Online Mode – Relay Control Panel

The Relay Control Panel is the online interface that enables direct communication with the relay. It allows users to:

Change, review, and retrieve relay settings

View event logs, fault records, and metering data

Store records to a predefined location

Trigger and retrieve disturbance recordings

2. Offline Mode – T-PRO Offliner

The T-PRO Offliner is the offline configuration tool, used to:

Create new relay setting files

Review and edit existing settings without requiring a live connection to the relay

This dual-mode approach ensures flexibility for both field operations and offline engineering analysis.

T-PRO Offliner is the offline tool which enables the user to create and review relay settings.

We also Provide a Record Graph software tool which enables the users to view and analyze fault waveforms for detailed disturbance and event analysis.

In addition to the protection functions T-PRO 2000 provides fault recording (32 samples / cycle) for analysis of the power system after a disturbance has occurred. The triggers for fault recording are established by programming the output matrix. The Output Matrix allows any internal relay function, external input or GOOSE messaging input to initiate record.

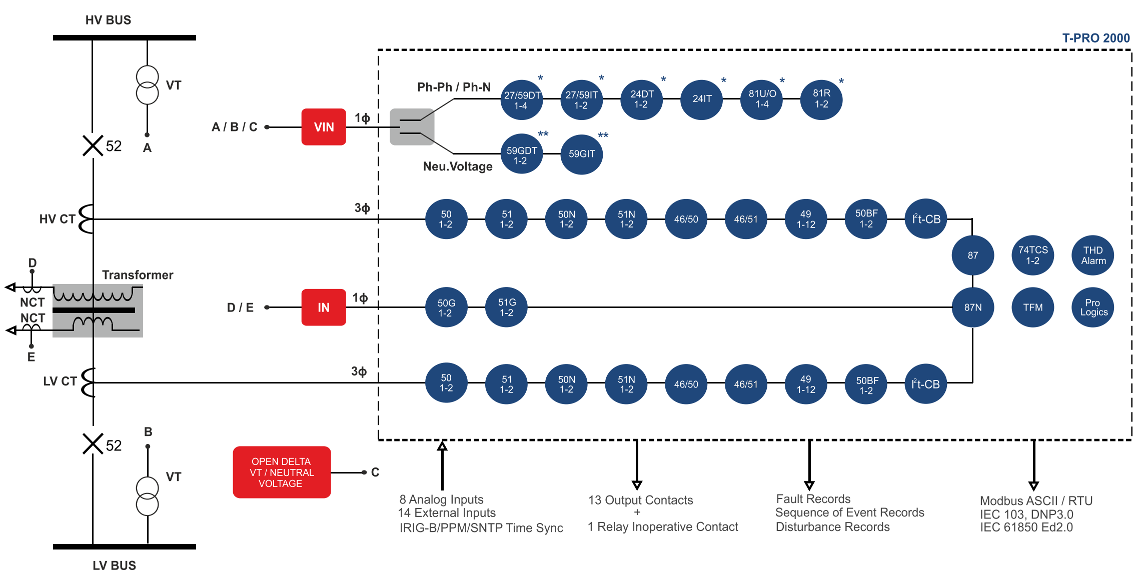
The relay offers percentage restrained current differential protection (87) with user-defined restraint characteristics along with 2nd and 5th harmonic restraint to block operation during inrush and over excitation conditions, preventing false tripping.

Unrestrained high current differential setting, which provides fast tripping for severe internal faults exceeding a preset threshold.

In addition to differential protection, the relay also includes basic current, voltage, and frequency-based protections, supported by a library of commonly used IEEE and IEC inverse time characteristics, enabling comprehensive and coordinated transformer protection.

To provide a complete package of protection and control, T-PRO 2000 provides other functions and features such as:

- Low Impedance Restricted Earth Fault (87N) / High Impedance Restricted Earth Fault (50G)
- Breaker failure Protection (50BF)
- Thermal Overload
- TFM (Through Fault Monitoring)
- THD (Total Harmonic Distortion)
- 24 ProLogic statements
- 30 Virtual Inputs
- 8 Setting Groups



Note 1: VIN (1ϕ Voltage Input) - can be Connected From Either HV (Marked as A) / LV (Marked as B) / Open Delta (Marked as C)

Note 2: IN (1ϕ Neutral Current Input) - can be Connected From Either HV (Marked as D) / LV (Marked as E)

Note 3: ** Marked Fn get enabled - when VIN Input is Neutral Voltage

* Marked Fn get enabled - when VIN Input is Ph-Ph / Ph-N

Figure 1.1: T-PRO 2000 Relay Functional Line Diagram

1.2 Front View

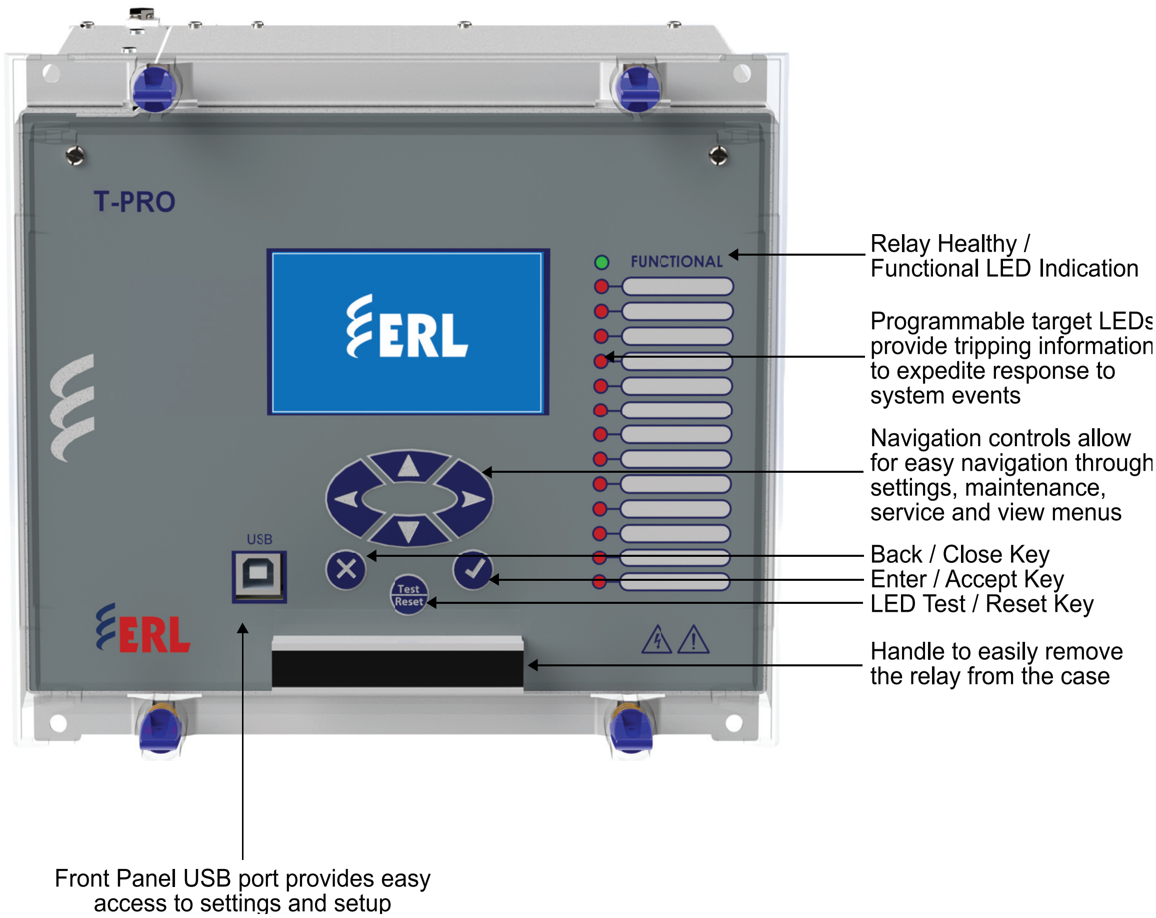


Figure 1.2: T-PRO 2000 Relay Front View

1.3 Rear View

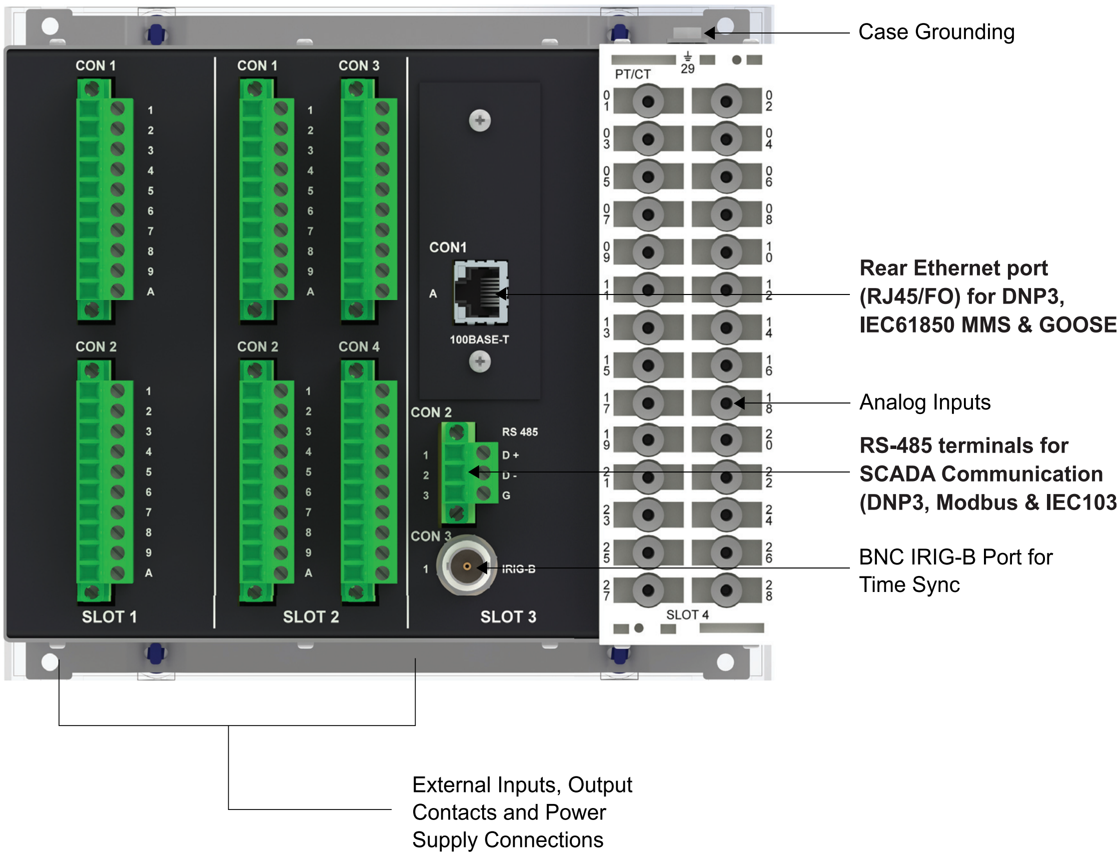


Figure 1.3: T-PRO 2000 Relay Rear View

AC Current and Voltage Inputs

The T-PRO 2000 relay is provided with terminal blocks for 1 AC Voltage and 7 AC Currents. 1A and 5A terminals are provided with isolated neutral and CT Secondary is site selectable.

The complete schematics are available in “Mechanical Drawings” on page Appendix H-1 and “AC Schematic Drawings” on page Appendix I-1.

External Inputs

The T-PRO 2000 relay has 14 External Inputs.

External dc voltage of either 24, 48, 110 or 220 Vdc nominal are possible depending on the range requested. Selection of specific voltage is factory selectable.

Output Relay Contacts

The T-PRO 2000 Relay has 14 Output Contacts. In which Contact's 1 to 13 are programmable and has breaker tripping capability and contact 14 is used as a watch Dog contact which indicates relay Healthy Status. The contacts are isolated from each other and are provided with settable dropout timers (0-20 sec) which applies for the Self Reset.

Relay Inoperative Alarm Output

If the relay becomes inoperative, then the Relay Inoperative Alarm output contact 14 (change Over Contact) operates and all tripping functions are blocked.

1.4 Model Options/Ordering

- The relay is available as an E8 size and flush mount type along with standard IRIG-B /SNTP time sync. For details see “Mechanical Drawings” on page Appendix H-1
- The relay is available with optional Ethernet ports for PRP (RJ45/FO).
- The external inputs are 24, 48, 110, 220 Vdc rated. The Auxiliary supply is 20-60 Vdc or 80-300 Vdc rated.
- All of the above options must be specified at the time of ordering.

Refer to www.erlphase.com for the ordering template.

2 Installation and Safety Instructions

2.1 Introduction

This section deals with the installation of the T-PRO 2000 when first delivered. The section covers the physical mounting, AC and DC wiring and the Communication wiring.

The following symbols are used in this manual and on the unit. They should be understood before working on the unit:

Caution: refer to equipment documentation

Caution: risk of electric shock

Protective Earth (or Ground) Terminal

Autoranging power supply

Both direct and alternating current

> The equipment ratings, operating instructions and installation instructions shall be checked before commissioning or maintenance. It is the responsibility of the user to ensure that the equipment is installed, operated and used for its intended function in the manner specified in this manual. If this is not the case then any safety protection provided by the equipment may be impaired.

2.2 Physical Mounting

The relay is 177 mm/ 6.96 Inch (H) x 225 mm/ 8.16 Inch (W) x 207 mm/ 8.85 Inch wide. A complete mechanical drawing is shown, for details see “Mechanical Drawings” in Appendix H

To install the relay the following is needed:

- E8 cutout (159 mm/6.25 Inch (H) x 201.5 mm/7.93 Inch (W))
- M4 screws and nuts

Case Grounding

WARNING!

The case-grounding terminal also known as the protective earth located at the top left corner of the relay case must be connected to the station ground (The grounding terminal can be found at slot 4, terminal number 29), for details see “T-PRO 2000 Relay Rear View” on page 1-4. The integrity of the protective earth connection must be ensured before performing any other actions. This connection must not be removed while the unit is energized.

2.3 Power Supply

A wide range power supply is standard. The relay power supply is provided with nominal operating ranges of:

- 24-48 Vdc (-15%/+20%)
- 80V-250 Vdc / 100-240 Vac (±20% for Vdc, -10%/+5% for Vac)

To protect against a possible short circuit in the supply use an inline fuse or circuit breaker with a 5A rating. Ensure that the chassis is grounded for proper operation and safety.

There are no power switches on the relay. When the power supply is connected, the relay starts its initialization process and takes approx. 90 seconds to complete the boot up process (indicated by glowing green Relay Functional LED).

WARNING!

Before initializing the power supply, ensure the relay is properly grounded. Connect the relay grounding terminal to the station ground located at the top left corner of the relay case (The grounding terminal can be found at slot 4, terminal number 29), for details see “T-PRO 2000 Relay Rear View” on page 1-4 of the manual.

2.4 AC and DC Wiring

For details see “AC Schematic Drawings” in Appendix I and “DC Schematic Drawings” in Appendix J.

> Ensure the power supply input and the AC and DC wires are de-energized before working on the wiring. Failure to do so could result in electric shock.
>
> CT circuits shall be short-circuited before working on the current input wires.

2.5 Communication Wiring

EIA-485

The relay's serial port (32) is an EIA RS-485 Data Communications Equipment (DCE) device. This allows them to be connected directly to other relays in parallel and communicated to a PC serial port with a standard straight-through male-to-female serial cable with RS485 to RS232 converter. RS 485 cable can work for a maximum of 1.2km with a single IED. Shielded cable is recommended, for pin-out see "Communication Port Details" on page 3-15.

Ethernet Port

100BASE Ethernet Port (31A) with RJ-45/FO receptacle on rear side of the relay can be used with CAT5 or CAT5e straight or ST type FO for SCADA Communications. The maximum distance that RJ45 cable can support is 100meters (328 feet).

USB

COM 1 on the front panel is a standard USB-B connector. This port is the Maintenance port of the relay. This is a USB 2.0 Full Speed interface and can be connected to a PC with a standard USB peripheral cable (A style to B style).

IRIG-B

IRIG-B on the rear panel (331) accepts both modulated and un-modulated IRIG -B standard time signals with or without the IEEE 1344 extensions. The IRIG-B connector on the back of the relay is BNC type. SNTP Time sync through RJ-45/FO can also be achieved.

> Shielded wire shall be used for all connections that run outside of the panel in which the T-PRO is installed. The shield must be grounded only at one end at the point where the cable enters the panel. The IRIG input is the ONLY exception which uses unbalanced co-axial cable.

3 Setup and Communications

3.1 Introduction

This chapter discusses setting up and communicating with the relay including the following:

- Power supply
- Inter-Range Instrumentation Group time codes (IRIG-B) time input
- Communicating with the relay using a network link, a direct serial link and a modem link (internal, external)
- Using Relay Control Panel to access the relay's user interface
- Using HyperTerminal to access the relay's maintenance menu
- Setting the Baud rate
- Accessing the relay's Supervisory Control And Data Acquisition (SCADA) services

3.2 Power Supply

See "Power Supply" on page 2-3 and "Case Grounding" on page 2-2 for details regarding the power supply.

3.3 Time Sources

The T-PRO 2000 relay supports the use of modulated or unmodulated IRIG-B time signals (external), primary/secondary SNTP network based time synchronization (external) and manually configurable system time based on a free running internal oscillator. The internal free running oscillator is always present on the T-PRO 2000 and in the absence of any external time source, will become the default mode of time synchronization.

IRIG–B

An externally applied IRIG-B time source will have the highest order of precedence, and will typically offer the highest available time accuracy, when derived from an external GPS satellite source. The T-PRO 2000 will also process derived IRIG-B style signals generated from alternate time sources, using time quality information to differentiate. The LED output selection on the front panel is available for ongoing presence of a valid IRIG-B time source indication and is evident in data records.

The relay is equipped to handle modulated or un-modulated GPS satellite time IRIG-B signals. The IRIG-B time signal is connected to the BNC connection on the back of the relay. Setting is required to differentiate between modulated or un-modulated signal. This has to be manually changed by the user as per the input provided.

When the relay is drawn out from its case, jumpers are accessible behind the IRIG-B connect. If the J5 and J6 jumpers are positioned to short pins 1 and 2, then the IRIG-B port is configured to accept a modulated signal. If the J5 and J6 jumpers are positioned to short pins 2 and 3, then the IRIG-B port is configured to accept an un-modulated signal. By default the jumper selection is positioned to modulated signal.

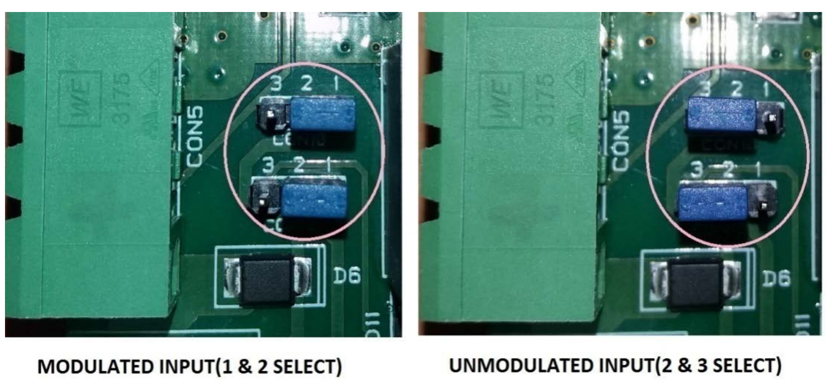


Figure 3.1: IRIG-B Port Selection for modulated and un-modulated input

If the IRIG-B signal contains year information, enable the IEEE 1344 extension on the *Utilities* > *Time* screen in Relay Control Panel. If the IRIG-B signal does not contain the year extension, this setting should be disabled.

SNTP SYNC

An SNTP time source has a lower order of precedence from a valid IRIG-B source. SNTP operation (primary and secondary) requires network access and the selection and configuration of suitable SNTP network sources. The SNTP time may be configured for re-synchronization cycles ranging from 1 minute to 36 hours, adjusting the T-PRO 2000 system time to an accuracy of +/- 5 milliseconds in ideal network conditions. The LED output selection on the front panel is available for ongoing presence of a SNTP time source indication and is evident in data records.

The RCP time screen provides means to enable SNTP time source, set the poll interval, set the timeout interval and set the server IP addresses.

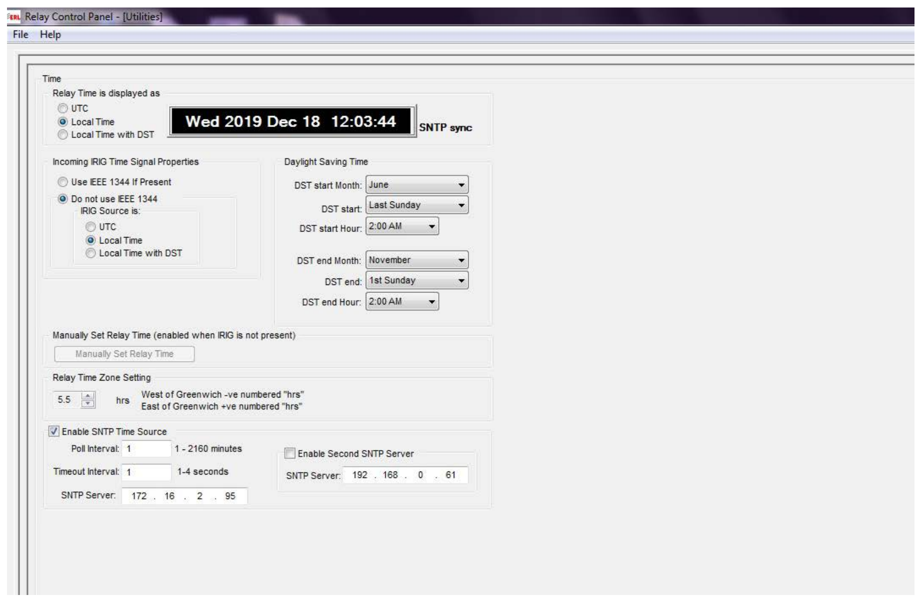


Figure 3.2: SNTP sync settings in RCP

If neither a valid IRIG-B nor SNTP source is present, then the relay will use the RTC time from the internal clock as the time source. The RTC is the lowest priority time source.

The IED comes equipped with an internal free-running oscillator used to generate a 1 PPS time signal in the absence of any alternate available time source. Use of this oscillator as the primary IED time source requires manual time configuration, with the general accuracy subject to user input parameters, and is recommended primarily for stand-alone, unsynchronized applications. The internal oscillator carries a lifetime accuracy (including temperature effects and aging) of +/-50 ppm.

3.4 Communicating with the Relay

Connect to the relay to access its user interface and supervisory control and data acquisition (SCADA) services by:

- Front USB 2.0 interface (user interface and maintenance)
- Rear Panel Ethernet network link (User interface and SCADA)
- Rear panel serial link (RS485 serial link to SCADA only)

The relay has a front panel USB port and Rear Ethernet Ports (Copper / FO Port 31A & Port 31B) for user interface and SCADA, 1 rear RS485 Port (Port 32) to provide direct access to SCADA services.

The relay user interface is accessed through the Relay Control Panel.

3.5 USB Link

The PC must be appropriately configured for USB communication.

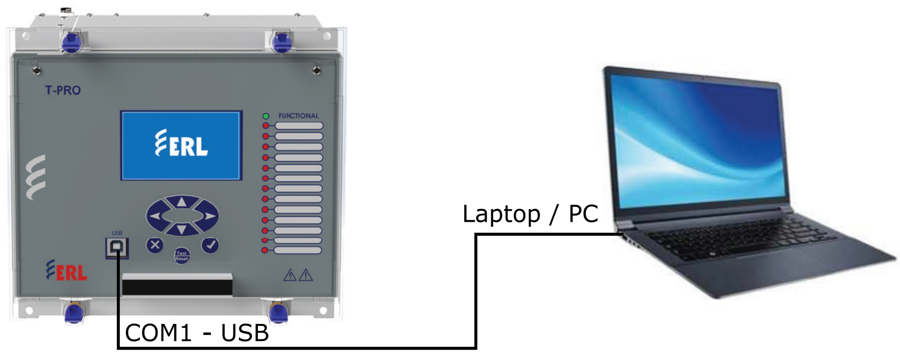


Figure 3.3: USB Link

USB Driver Installation

To create a USB link between the relay and the computer, connect the PC to the front USB port of the T-PRO 2000. Windows 10 and 11 often automatically detect and install drivers for USB devices using Windows Update.

Now check ports in Device Manager

Start > Control Panel > Device Manager > Ports (COM & LPT)

Find the “T-PRO2000 Series Relay” port, note COM port number which is installed Ex: COM 6.

Open Relay Control Panel.

Click the Add new Button. The Add New Relay Window will open. Select the “Add New Modem/Serial Link” Button.

A Window will appear. Select the “Add” Button.

“Add Hardware Wizard” Window will open. Click Next twice and click the “Have Disk” button.

Browse the Null_mdm file from the path: C:\Program Files (x86)\ERLPhase\Relay Control Panel

Then click ok and Next.

Select the COM Port at which the relay was connected. Click Next and Finish.

Now come to the “Add New Relay” Window and select the COM # in the Serial Link to which the Relay is connected. The Baud Rate is Default as “115200”.

Click the "Get Information From Relay" Button to Collect the Information from Relay. After the information is retrieved, enter relay name and click save button

3.6 Network Link

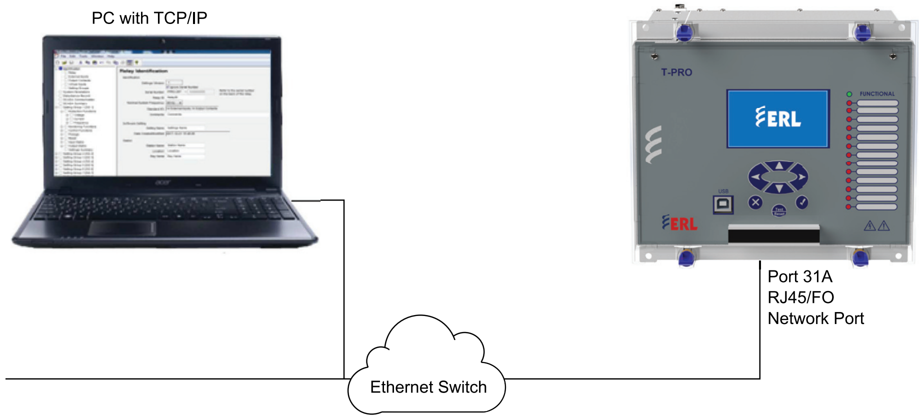


Figure 3.4: Network Link

Access both the relay's user interface and DNP3/61850 SCADA services simultaneously with the Ethernet TCP/IP LAN link through the network port Port 31A. The rear Port is 100BASE-T copper interface with an RJ45 connector or FO with ST connector interface.

DNP3 SCADA services can also be accessed over the LAN, for details see Table 3.4: Communication Port Details.

Connect to the Ethernet LAN using a Cat 5 or above cable with an RJ-45 connector on both ends in straight fashion.

If an FO connector is used on the IED, then an Ethernet switch with an ST and RJ45 connector to communicate with the device.

By default, the Port 31 is assigned with an IP address of 192.168.100.80. If this address is not suitable, it may be modified using Relay's interface accessed through the Terminal Utility ("Using Terminal to Access the Relay's Maintenance Menu" on page 3-10) or Front LCD display in Change/Service mode. If IP address is changed, then the relay will restart automatically.

3.7 Accessing the Relay's SCADA Service

The relay supports IEC 60870-5-103 slave, DNP3(Level 2), IEC 61850 and Modbus slave SCADA protocols as a standard feature on all T-PRO series relays. The DNP3 is available through a direct serial link or the Ethernet LAN on top of either TCP or UDP protocols. The Modbus implementation supports both Remote Terminal Unit (RTU) binary and ASCII modes and is available through a direct RS485 serial link.

The relay rear serial Port CON 32 is dedicated for use with Modbus slave, IEC 60870-5-103 slave or DNP3 serial protocols. The serial port uses standard RS-485 signaling. An external RS-485 <-> RS-232 converter can be used to connect to an RS-232 network.

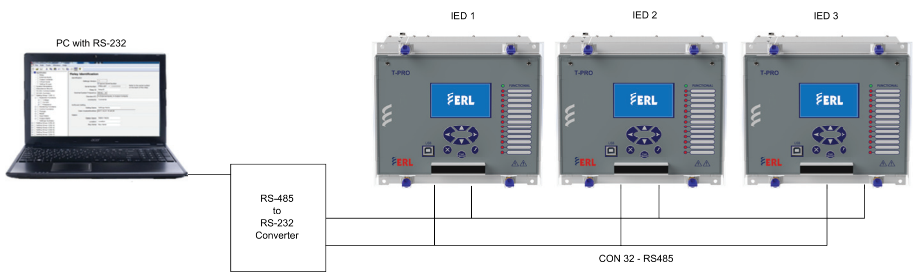


Figure 3.5: RS485 Connection diagram

The DNP3 and IEC 61850 protocols can also be run across the Ethernet LAN. Both DNP over TCP and DNP over UDP are supported. For details on connecting to the Ethernet LAN see "Network Link" on page 3-8.

Complete details on the Modbus and IEC 60870-5-103 protocol services can be found in the Appendices, for details see "Modbus RTU Communication Protocol" on page Appendix E-1 and "IEC 103 Device Profile" on page Appendix G-1.

Protocol Selection

To select the desired SCADA protocol go to T-PRO Offliner SCADA communication section. Select the desired SCADA protocol and set the corresponding parameters.

Communication Parameters

The serial port's communication parameters are set in the T-PRO Offliner SCADA communication section. Both the baud rate and the parity bit can be configured. The number of data bits and stop bits are determined automatically by the selected SCADA protocol. Modbus ASCII uses 7 data bits. Modbus RTU, IEC 60870-5-103 and DNP3 Serial use 8 data bits. All protocols use 1 stop bit except in the case where either Modbus protocol is used with no parity; this uses 2 stop bits, as defined in the Modbus Standard.

3.8 Using Terminal to Access the Relay's Maintenance Menu

This section describes how to configure a standard Windows VT-100 terminal program on the PC for use with the relay.

The computer must be connected to the relay via the front USB Port for access to all of the Maintenance functions.

The relay is accessed using a standard VT-100 terminal style program on the computer, eliminating the need for specialized software. Any terminal program that fully supports VT-100 emulation and provides z-modem file transfer services can be used. HyperTerminal PE, is used here as an example.

Configure the terminal program as described in Table 3.1: Terminal Program Setup and link it to the appropriate serial port, modem or TCP/IP socket on the computer.

Table 3.1: Terminal Program Setup

Baud rate	Default fixed baud rate 115,200 N81 (no parity, 8 data bits, 1 stop bit).
Data bits	8
Parity	None
Stop bits	1
Flow control	Hardware or Software. Hardware flow control is recommended. The relay automatically supports both on all its serial ports.
Function, arrow and control keys	Terminal keys
Emulation	VT100
Font	Use a font that supports line drawing (e.g. Terminal or MS Line Draw). If the menu appears outlined in odd characters, the font selected is not supporting line drawing characters.

To configure HyperTerminal follow these instructions:

In Windows 10 or Windows 11,open HyperTerminal PE;

If "Default Telnet Program?" windows pops up,

Check "Don't ask me this question again"
Hit *No*.

First time use of HyperTerminal will ask for "Location Information".

Fill with appropriate information, e.g.:

"What country/region are you in now"
Choose "Canada"
"What area code (or city code) are you are in now?"

Enter “306”
“If you need to specify a carrier code, what is it?”
Enter “”, i.e. leave blank
“If you dial a number to access an outside line, what is it?”
Enter “”.
“The phone system at this location uses:”
Choose “Tone dialing”.

Hit *OK*.

First time use of HyperTerminal will show “Phone and Modem Options”.

Hit *Cancel*.

HyperTerminal will show initially “Connection Description”.

Enter a name for the relay, e.g: “TPRO2000”.

Hit *OK*.

In the window “Connect To”

“Connect using”

Choose “COM#”, where “#” was obtained previously in Section 2.5 USB Link, after installing the USB driver.

Let’s assume in this case it is COM3.

In the window “COM3 Properties” choose:

“115200”

“8”

“None”

“1”

“Hardware”

Hit *Apply* then hit *OK*

At this time the connection should already be established.

Hit *Enter* in the terminal window.

Login as **maintenance** in lower case.

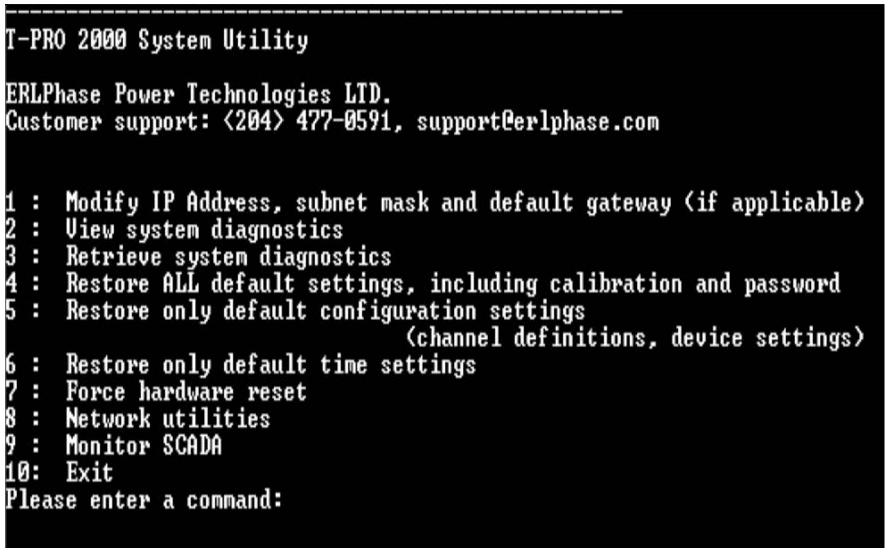


Figure 3.6: Maintenance Menu

Maintenance Menu Commands

The Maintenance menu is available on both Serial USB and Ethernet network connection.

Table 3.2: Maintenance Menu Commands

Modify IP address	Modifies the LAN IP addresses, network mask, default gateway and IEC61850 network port assignment.
View system diagnostic	Displays the internal status log.
Retrieve system diagnostics	Automatically packages up the internal status log plus setting and setup information and downloads it in compressed form to the computer. This file can then be sent to our customer support to help diagnose a problem.
Restore settings (commands 4, 5 and 6)	Use these commands to force the system back to default values, if a problem is suspected due to the unit's settings, calibration and/or setup parameters. NOTE: If Command 4 is performed, the unit must be re-calibrated before being put back into service. Please contact ERLPhase Technical Support for calibration instructions.
Force hardware reset	Manually initiates a hardware reset. Note that the communication link is immediately lost and cannot be reestablished until the unit completes its start-up.

Table 3.2: Maintenance Menu Commands	
Network utilities	If this command is prompted it Enters into the network utilities Submenu listed in the Table 3.3: Network Utilities Menu Commands
Monitor SCADA	Shows real time display of SCADA data.

Table 3.3: Network Utilities Menu Commands	
View protocol statistics	View IP, TCP and UDP statistics
View active socket states	View current states of active sockets
View routing tables	View routing tables
Ping	Check network connection to given point
Exit network utilities	Exit network utilities menu and return to Maintenance Menu Commands

3.9 Firmware Update

Contact ERLPhase Power Technologies Ltd., for instructions on Firmware update.

3.10 Communication Port Details

Table 3.4: Communication Port Details

Location	Port	Function
Front Panel	USB	USB-B receptacle, high speed USB 2.0 interface Used for user interface access Default fixed baud rate 115200 8 N 1 (8 Data Bits, No Parity, 1 Stop Bit)
Rear Panel	31A	RJ-45 receptacle or ST type optical receptacle (factory configured). 100Base-T or 100Base-FX (1300nm, multimode) Ethernet interface. Used for user interface access or IEC61850 or DNP3 SCADA access through Ethernet LAN. SNTP time sync is also available.
Rear Panel	31B	Additional port for PRP communication as an ordering option (RJ45/ FO)
Rear Panel	32	RS-485. Used for SCADA communication (MODBUS or IEC103 or DNP3). Default setting: 9600 7 N 1 (7 Data Bits, No Parity, 1 Stop Bit)
Rear Panel	331	BNC receptacle, IRIG-B interface. Modulated or un-modulated, 65 ohm impedance

Table 3.5: RS485 Connections to Pins on the Relay Port

Signal Name	Direction PC ↔ Relay	Pin # on the Relay Port
D+	↔	1
D-	↔	2
G		3

Note:

If multiple IEDs are connected in daisy chain method, the end unit should be connected with an external 120Ω load resistance.

4 Using the Relay (Getting Started)

This section provides information on the start-up sequence and ways to interface with the relay. Descriptions of the Front Panel Display, Terminal Mode and Metering Data are provided.

4.1 Start-up Sequence

When the power supply is connected, the following initialization initializing sequence takes place:

- After 5 seconds "ERL logo with Booting…" displayed in the LCD
- At 70th second "ERL logo with Loading Firmware…" displayed in the LCD
- At 80th second all the LEDs blink once and from now onwards the DSP is actively protecting the system.
- At 100th second the Functional Green LED comes ON and it indicates that the relay is capable of recording and communicating with the user.
- Unit Restarted event displayed in the LCD.

4.2 Front Panel Display

The front panel display of the IED allows the user to interact with the unit to obtain immediate system information. User interface is provided through a graphical LCD screen, LEDs and a push button keypad. The level of interaction and system access is controlled through a series of access level; VIEW, CHANGE and SERVICE, with each requiring a unique password allowing differing levels of accessibility. Additionally, the IED front panel provides a USB Type B port, used in general unit communications and controlled service access.

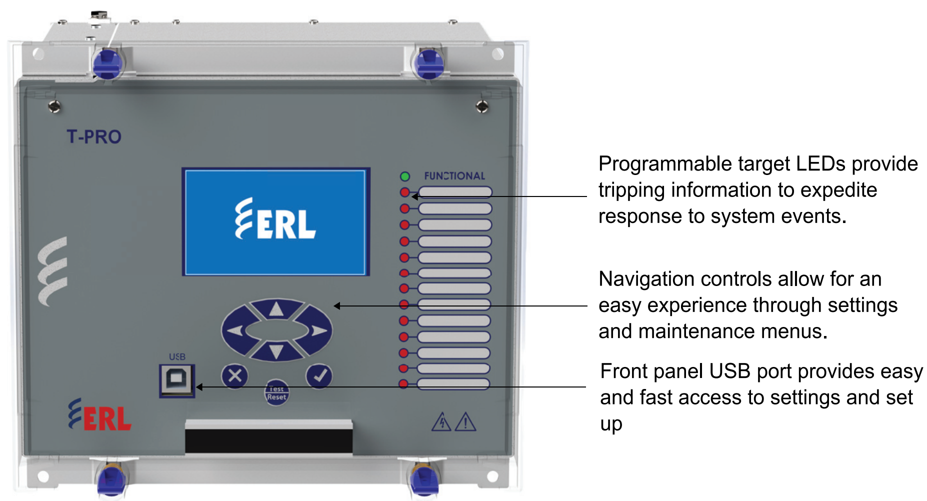


Figure 4.1: Front Panel Display

LED Indicators

Table 4.1: Description of LED Indicators	
Relay Functional (LED 1)	Indicates the relay is functional. When the Relay Functional green LED goes on, the rear Relay Inoperative contact opens and the protective functions become functional.
LED 2-14	Programmable for any Functions, ProLogics, Virtual Inputs, External Inputs and Time Sync.

Target LED assignments are configurable by the user through the Offliner settings (output matrix configuration).

Push Buttons

Table 4.2: Identification of Push Buttons	
Up, Down, Right, Left, Enter, Cancel, Test/Reset	Used to navigate the front panel screens, select, change settings, save settings etc.

Display

To login into the LCD menu structure, follow these steps:

First, press the Enter button (check mark) on the front panel. The following screen will appear.

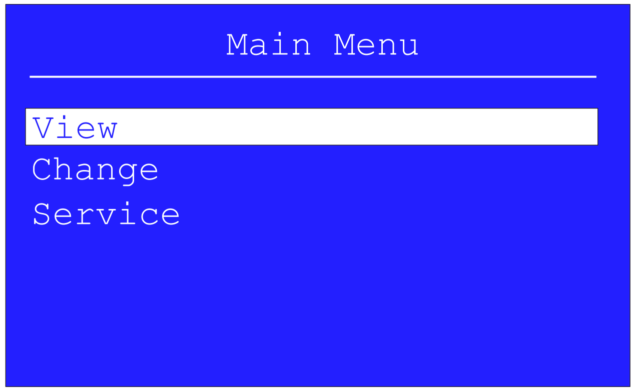


Figure 4.2: View / Change / Service: Choice Menu

Choose View, Change or Service access level and press Enter.

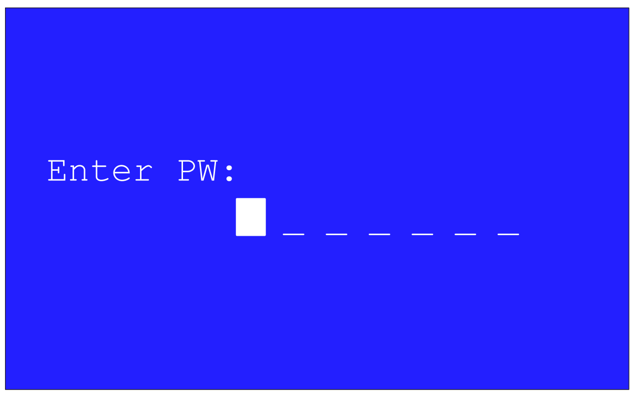


Figure 4.3: Enter Password (only required for Change and Service)

Enter the password for the given access level (see defaults below). Use the Up and Down arrows to scroll through characters. Once the correct character is selected, press the Right arrow button to select the character and move to the next character. Once the password has been entered, repeatedly press the Right arrow button until the field is filled. If correct password is entered, user will be granted access to the front panel menus.

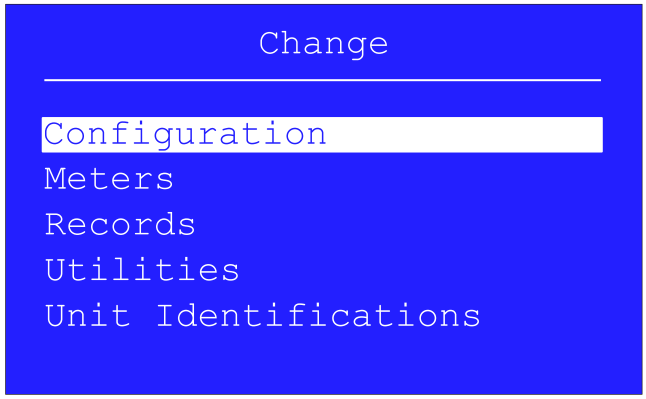


Figure 4.4: Main Menu

Note: The default passwords are (remove quotation marks)

View Access - no password required

Change Access "change"

Service Access "service"

Passwords may contain = . + - 0-9 a-z and A-Z

Table 4.3: Navigation of the LCD Screen

Menu Item	Access Level Required [1]
Main Screen	
View / Change / Service: Choice Menu	
Enter Password	(C,S)
Main Menu	
Configuration	
System Parameters	
Nameplate	(C,S)
Winding data	(C,S)
Voltage Input Connection	(C,S)
Current Input Connection	(C,S)
Input 1	(C,S)
Input 2	(C,S)
IN	(C,S)
IN REF	(C,S)
General	(C,S)
Min Voltage Threshold	
Display Backlight Timeout	(C,S)
Setting Group	
Functions	
Active SG	
87 Differential	(C,S)
87N Neutral Differential	(C,S)
Thermal Overload	
Fn. 49-1	(C,S)
Fn. 49-2	(C,S)
Fn. 49-3	(C,S)
Fn. 49-4	(C,S)
Fn. 49-5	(C,S)
Fn. 49-6	(C,S)
Fn. 49-7	(C,S)
Fn. 49-8	(C,S)
Fn. 49-9	(C,S)

Table 4.3: Navigation of the LCD Screen

Menu Item			Access Level Required [1]
		Fn. 49-10	(C,S)
		Fn. 49-11	(C,S)
		Fn. 49-12	(C,S)
	Total Harmonic Dist		
		Fn. THD	(C,S)
	Through Fault Monitor		(C,S)
	Phase OC		
		Fn. 50-1	(C,S)
		Fn. 50-2	(C,S)
		Fn. 51-1	(C,S)
		Fn. 51-2	(C,S)
	Derived Neutral OC		
		Fn. 50N-1	(C,S)
		Fn. 50N-2	(C,S)
		Fn. 51N-1	(C,S)
		Fn. 51N-2	(C,S)
	Measured Neutral OC		
		Fn. 50G-1/REF	(C,S)
		Fn. 50G-2/REF	(C,S)
		Fn. 51G-1	(C,S)
		Fn. 51G-2	(C,S)
	Negative Sequence OC		
		Fn. 46/50	(C,S)
		Fn. 46/51	(C,S)
	Breaker Failure		
		Fn. 50BF - Input -1	(C,S)
		Fn. 50BF - Input -2	(C,S)
	Phase U/O Voltage		
		Fn. 27/59DT - 1	(C,S)
		Fn. 27/59DT - 2	(C,S)
		Fn. 27/59DT - 3	(C,S)
		Fn. 27/59DT - 4	(C,S)

Table 4.3: Navigation of the LCD Screen

Menu Item					Access Level Required [1]
				Fn. 27/59IT - 1	(C,S)
				Fn. 27/59IT - 2	(C,S)
			Over Flux		
				Fn. 24DT - 1	(C,S)
				Fn. 24DT - 2	(C,S)
				Fn. 24IT	(C,S)
			Measured Neutral OV		
				Fn. 59GDT - 1	(C,S)
				Fn. 59GDT - 2	(C,S)
				Fn. 59GIT	(C,S)
			Frequency		
				Fn. 81OF/UF-1	(C,S)
				Fn. 81OF/UF-2	(C,S)
				Fn. 81OF/UF-3	(C,S)
				Fn. 81OF/UF-4	(C,S)
				Fn. 81R-1	(C,S)
				Fn. 81R-2	(C,S)
			Trip Ckt Supervision		
				Fn. 74TCS_1	(C,S)
				Fn. 74TCS_2	(C,S)
			CB Cond. Monitoring		
				Fn. I^2t-CB HV	(C,S)
				Fn. I^2t-CB LV	(C,S)
		Disturbance Record			(C,S)
	Metering				
		Meter Display Option			(C,S)
		Analog			
			Analog Inputs		
			DiffCurr		
			SeqMonCurr		
			Harmonics		
		Digital			

Table 4.3: Navigation of the LCD Screen

Menu Item				Access Level Required [1]
			External Inputs	
			Digital Outputs	
			Virtual Inputs	
			ProLogic Inputs	
			Alarms	
	Records			
		View Events		
		View Faults		
	Utilities			
		Time		
			Date & Time	(C,S)
			Display Time as	(C,S)
			DST	(C,S)
			UTC Offset	(C,S)
			SNTP	(C,S)
			Incoming IRIG Properties	(C,S)
		Communication		
			USB(Serial)	(C,S)
			RS485(CON 2)	(C,S)
			Ethernet(CON 3)	(C,S)
		Erase Records		(C,S)
		Maintenanace		
			Through Fault	(C,S)
			I^2t HV	(C,S)
			I^2t LV	(C,S)
		Calibration		
			Voltage & Current Channels	(C,S)
		Password Settings		
			Change PW	(S)
			PW Access Timer	(S)
			PW Enable/DIsable	(S)
		Test Mode		

Table 4.3: Navigation of the LCD Screen

Menu Item	Access Level Required [1]
Test Mode Selection - Enable	(S)
Digital Output Control	(S)
LED Control	(S)
Contrast Control	(S)
Virtual Input Control	(S)
Relay Identifications	

1. All front panel menus may be viewed with View rights. Items marked as C or S require Change or Service rights in order to modify and save changes.

4.3 Relay Control Panel

RCP is used for all user interface. A short description of the RCP configuration to connect to a relay is given here. Please refer to the Relay Control Panel User Manual for details.

Metering

The RCP displays the following metering parameters

- Phase wise - current and voltage magnitude and angle
- Phase-wise winding currents for HV, LV
- 87 and 87N operating and restraint currents
- Sequence currents for all inputs
- Frequency
- 2nd and 5th harmonic magnitudes for all inputs and windings
- I^2t Accumulated, Last operated
- Through Fault monitoring
- THD%, V/F
- All protection function statuses
- All Virtual Input, External Input, ProLogic and Output Contact statuses

The metering display in RCP has a resolution of three decimals for both measured and calculated analog values.

Configure USB Link for Relay Control Panel

Follow this sequence to configure RCP for USB link to the relay.

1. Execute.
   Relay Control Panel.exe
2. Execute.
   T-PRO Offliner.exe
3. Install Null Modem Driver.
   Please refer to the Relay Control Panel User Manual for details.
4. Run Relay Control Panel.
   Go to:
   Start > *All Programs* > *ERLPhase* > *Relay Control Panel* > *Relay Control Panel*
   First time RCP is run.
   Hit *Add New*.
   "Add New Relay"
      Choose Communication > Direct Serial Link.
      Hit *Get Information From Relay.*
      Then RCP will communicate with the T-PRO and retrieve information to fill required fields.
      When this is done, hit *Save Relay*.

If the window “Relay already exists...” pops up, you may need to rename the relay changing the “Relay Name” in the “Relay Definition” category, before saving.

After first time, in “Select Relay”, choose relay and hit *Connect*.In “Relay Password Prompt”

Choose desired access level, enter appropriate password

Note: Default passwords are listed below (remove the quotation marks)

View Access “view”

Change Access “change”

Service Access “service”

Relay Control Panel Structure

The basic structure of the Relay Control Panel information, including basic actions available, is given below:

Table 4.4: Relay Control Panel Structure

			Access Level	
		View	**Change**	**Service**
Relay Control Panel				
Records			Trigger Fault	Trigger Fault
			Trigger Event	Trigger Event
Faults			Clear Faults	Clear Faults
Events			Erase	Erase
Metering				
	Analog			
	Diff Curr			
	Seq Mon Curr			
	Harmonics			
	Diff			
	Voltage			
	Current			
	Thermal			
	Frequency			
	Monitoring			
	External			
	Prologics			
	Outputs			
	Virtual			

Table 4.4: Relay Control Panel Structure

	Utilities				
		Unit Identification			
		Settings Group		Save	Save
		Time			
		Analog Input Calibration	N/A	N/A	
		Virtual Inputs	N/A	Latch/Pulse	Latch/Pulse
		Outputs			
		Maintenance	N/A	N/A	Close/Open
		Passwords	N/A	N/A	
		Through Faults		Save	Save
	Configuration				
		Present Settings	(Get From Relay)		
		Saved Settings		(Load to Relay)	(Load to Relay)

Notice that some options are not available (N/A) depending on the access level.

5 Protection, Recording and Logging Functions

This section describes the equations and algorithms that are define the T-PRO 2000 relay protection functions.

The available functions are 87, 87N, 49(1 to 12), 50 HV(1 to 2), 51 HV(1 to 2), 50 LV(1 to 2), 51 LV(1 to 2), 50N HV(1 to 2), 50N LV(1 to 2), 51N HV(1 to 2), 51N LV(1 to 2), 50G/REF (1 to 2), 51G (1 to 2), 46/50 (HV & LV), 46/51(HV & LV), 27/59DT (1 to 4), 27/59IT (1 to 2), 24DT (1 to 2), 24IT, 59G DT(1 to 2), 59G IT, 81U/O (1 to 4), 81R (1 to 2), 50BF (1 to 2), THD Alarm, TFM, 74 TCS(1 to 2), I^2t-CB and ProLogic. These functions are explained below with setting ranges and logic diagrams.

The protection functions have user-settable pick-up and drop-off delays. The Pick up and Trip outputs are initiated when the function's input value exceeds the set pick-up value. When Pick up or Trips occur, programmable front LEDs turn on and output contacts close. The mapping of protection functions to LEDs and output contacts is performed in the Output Matrix. The output contacts and LEDs are user configurable for Self Reset, Latched or Pulsed.

All functions use the fundamental component of the analog inputs, except for THD Alarm and harmonic restraint of the 87N function.

A complete list of the settings and their range values can be found in “IED Settings and Ranges” in Appendix B.

5.1 Current Protection Functions

87 Differential

Differential protection is the most universally applied form of transformer protection. The electrical area enclosed within the High Voltage (HV), Low Voltage (LV) side CTs define the zone of protection. The element uses a percent restraint slope characteristic where the sensitivity of the element has in inverse relationship to the fault level, in particular for faults external to the transformer zone (i.e., through faults). The slope characteristic is a general requirement of differential protection due to various CT ratio, angle and saturation errors that tend to magnify at higher fault levels. Figure 5.1: on page 5-2 shows the differential slope characteristic in the relay.

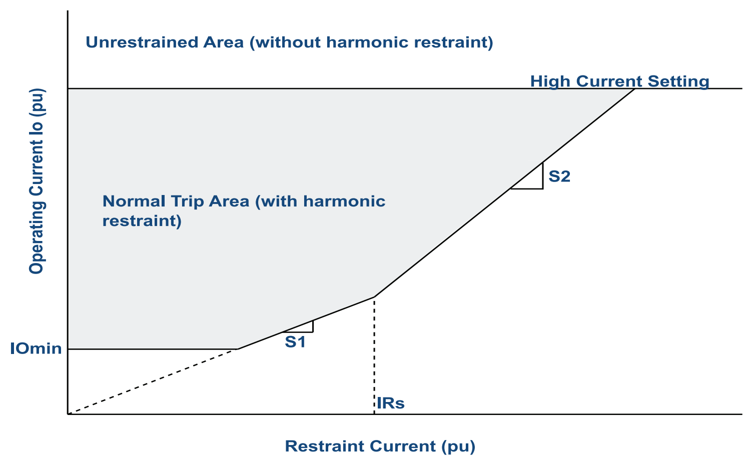


Figure 5.1: Differential Protection Slope Characteristic

Operating Current = IO = $|I_{HV} + I_{LV}|$ for each of phases A, B and C (i.e., Operating Current is the phasor sum of all transformer windings). (1)

where

I_{HV} is the current from the high voltage side

I_{LV} is the current from the low voltage side

Restraint Current (IR) = [|I1x| + |I2x| / 2 (2)

where x represents phase A, B or C for each of 2 sets of current inputs

In order to allow a more sensitive yet secure differential operation, the T-PRO slope characteristic is supplemented with Delta Phase and Rate of Change of Differential (ROCOD) supervision. Descriptions of these supervisions are provided later in this section.

Transformer Energizing Inrush Restraint (2nd Harmonic)

Second harmonic current is present in the magnetizing inrush current of an transformer being energized. Since inrush current is typically greater than the 87 trip setting, a high ratio of the 2nd harmonic to fundamental current is used to restrain the 87.

The 2nd harmonic restraining only occurs if the calculated IO and IR currents are in the 87 Normal Trip Area. However, if the IO exceeds the High Current Setting, then the 2nd harmonic will not be examined and the trip will not be blocked. Typical I2 setting for 2nd harmonic restraint is 0.05 to 1.00 per unit.

Note that the T-PRO will not calculate a harmonic restraint value if the fundamental winding current is less than 5% of nominal. Therefore care must be taken to ensure that the IOmin setting is always set above 0.25 A for a 5 A relay or 0.05 A for a 1 A relay. This calculation should be performed on each CT input.

2nd Harmonic Restraint Blocking

There are four modes available for 2nd Harmonic Restraint blocking on the T-PRO 2000: off, cross, phase and 2 out of 3.

When the 2nd harmonic restraint setting is set to off, 2nd harmonic restraint is not considered at all and the 87 will trip even when energizing 2nd harmonics are present.

When the 2nd harmonic restraint setting is set to cross blocking, the 2nd harmonic restraint blocks the 87 trip for all three phases when the ratio I2nd /Ifundamental exceeds the I2 setting in any one phase.

When the 2nd harmonic restraint setting is set to phase blocking, the 2nd harmonic restraint will block the 87 trip only for the phases in which the ratio I2nd /Ifundamental exceeds the I2 setting. This means that one, two or all three phases of the 87 trip may be blocked (phase-wise blocking).

When the 2nd harmonic restraint setting is set to 2 out of 3 blocking, the 2nd harmonic restraint blocks all three phases of the 87 trip when any 2 phases experience a I2nd/Ifundamental ratio exceeding the I2 setting.

For three single-phase transformer applications, the I2 cross-blocking is usually disabled to ensure the transformer will trip correctly if energizing onto a fault. Since the 2nd harmonic calculation is carried out on the internal zero sequence eliminated delta currents, any single-phase fault will produce predominantly fundamental fault current in two phases, thereby allowing the relay to trip correctly.

As shown in Figure 5.2: on page 5-4, the 2nd harmonic restraint signal is stretched for 5 milliseconds in the first cycle upon transformer energization. This stretch timer prevents possible momentary reset of the 2nd harmonic blocking signal due to the current transition in the first cycle. Note that this logic only becomes active when the transformer is de-energized or very lightly loaded for more than 10 seconds.

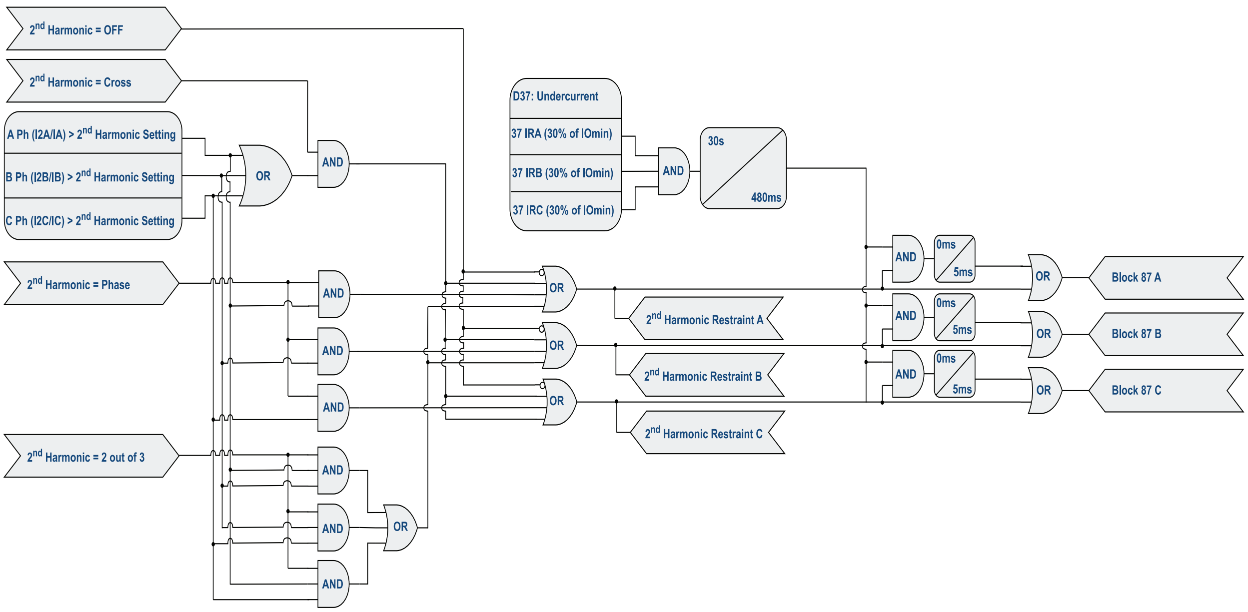


Figure 5.2: Second Harmonic Restraint Logic

Over-fluxing Restraint (5th Harmonic)

The presence of a significant amount of 5th harmonic current in a transformer is typical due to over-fluxing caused by an overvoltage or low frequency condition. Overfluxing may produce unbalanced currents in the transformer that could cause a false differential current. If 5th harmonic restraint is Enabled, then a high ratio of 5th harmonic current to fundamental current will block the 87 trip. The 5th harmonic blocking will only occur if the calculated operate and restraint currents are in the normal trip area. If the operate current exceeds the High Current Setting, then the 5th harmonic will not be examined and the trip will not be blocked.

Typical setting for 5th harmonic restraint is 0.05 to 1.00 PU.

Table 5.1: 87 Transformer Differential Setting Functions

IO_{min}	Per unit minimum current that operates the device 87.
IRs	Per unit point on the restraint axis of the differential characteristic where Slope 1 and Slope 2 intersect.
S1	Slope of first part of characteristic meeting IOmin and Slope 2.
S2	Slope of second part of characteristic which meets the end of Slope 1 and the High Current Unrestrained Setting.
I_2nd / I_ fund Ratio	Ratio of 2nd harmonic current to fundamental to provide energizing harmonic restraint.
I_5th / I_ fund Ratio	Ratio of 5th harmonic current to fundamental to provide transformer overexcitation harmonic restraint.

Table 5.1: 87 Transformer Differential Setting Functions	
High Current Setting	Per unit level of the unrestrained high set differential; operates if a heavy fault occurs in the transformer, irrespective of harmonic content.

Table 5.2: 87 Transformer Differential Setting Ranges	
87 Transformer Differential	Enable/disable
IO_{min} (per unit)	0.10 to Minimum of (IRs * S1/100, 1.00)
IRs (per unit)	(IOmin * 100/S1) to 50.00
S1 (%)	IOmin * 100/IRs to Minimum of (S2, 100)
S2 (%)	Maximum of (S1, 30) to 200
87 Alarm Pickup (per unit)	0.05 to 0.50
87 Alarm Delay (seconds)	0.00 to 99.00
High Current Setting (per unit)	3 * IOmin to 100.00
2nd Harmonic	Off, Cross, Phase, 2 out of 3
I_2nd / I_ fund Ratio Setting (per unit)	0.05 to 1.00
5th Harmonic	Enable/disable
I_5th / I_ fund Ratio\ Setting (per unit)	0.05 to 1.00

HV and LV winding current calculations

The T-PRO 2000 has 2 sets of three-phase current inputs that can be summed to obtain the total current flowing into or out of a transformer winding. The inputs can be configured for use with CTs of different ratios and connections.

This flexibility requires that certain mathematical corrections be carried out on the currents prior to summing them in order to derive the total winding and transformer current. This process includes three steps:

1. Selection of a reference current input
2. Phase Corrections
3. Magnitude Corrections

The three steps are described in the following sections.

1. Selection of reference current input

The HV main transformer winding is consider as Reference current input (at 0). The reference transformer winding will always be either Wye 0 or Delta 0. All causes of current phase shift, due to connections of the transformer and/or CTs, shall be corrected in the relay algorithm to be in phase with the reference. Consider the following example in Figure 5.3: on page 5-6:

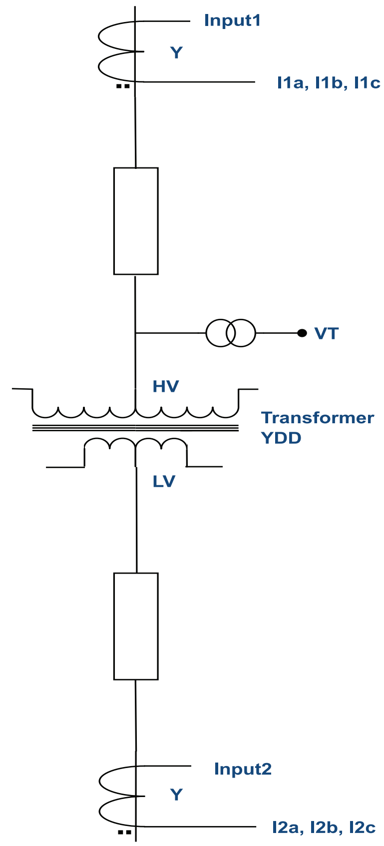


Figure 5.3: Example of 2-Winding Transformer Application Using 2 Inputs

2. Phase Corrections

There are two phase corrections required, one for the transformer winding and one for CT connections. Rather than correcting both separately, the total correction required on each winding/CT combination is determined. Although the reference transformer winding is fixed at 0, it still must be added to its CT angle to obtain the total winding angle to be corrected.

Table 5.3: Example, Transformer Current Correction

Winding	Voltage (KV)	XFMR Winding	XFMR Winding Phase	Curr. Input	Physical CT Conn.	CT Phase	CT Turns Ratio	CT Ratio With Factor	Total Phase Shift	Phase Correction Required
HV	230	Y	0^0(ref)	#1	Y	0^0	200 :1	200 :1	0^0	0^0
LV	115	Δ	-30^0	#2	Δ	-30^0	450 :1	259.8 :1	-60^0	$+60^0$

Observe that CT input 2 in our example is connected in a delta configuration. Currents from delta CTs are √3 larger than from Y connected CTs at the relay. The T-PRO will automatically take the delta CT setting into account and correct for the √3 factor.

The formulas for the phase shift corrections are in “Current Phase Correction Table” in Appendix L.

Our example of Table 5.3: on page 5-6 would use the following Current Phase Correction formulas (from “Current Phase Correction Table” in Appendix L).

Table 5.4: Example

Input 1 **0^0 Correction**	**Input 2** **60^0 Correction**
$IA = \frac{2Ia - Ib - Ic}{3}$ $IB = \frac{-Ia + 2Ib - Ic}{3}$ $IC = \frac{-Ia - Ib + 2Ic}{3}$	$IA = \frac{Ia - 2Ib + Ic}{3}$ $IB = \frac{Ia + Ib - 2Ic}{3}$ $IC = \frac{-2Ia + Ib + Ic}{3}$

The process of correcting current angles mathematically creates virtual “Delta” connections from the current inputs. Another benefit of this process is the elimination of zero sequence current, leaving only positive sequence and negative sequence currents as operating quantities. We will refer to these compensated currents as Delta Compensated Currents as we progress through the example.

3. Magnitude Mismatch Corrections

The next step is to correct the ratio mismatch of each current input. There are three ratio corrections required:

- CT Ratio Mismatch Correction
- CT Connection Correction
- Transformer Ratio Correction

The Magnitude Mismatch Correction Factor is applied on each current input referenced to the first CT input on the transformer reference side as follows:

Magnitude_Mismatch_Correction_Factor[i] = (3)

$$\frac{PhysicalCTRoot3Factor[i] \times VoltageLevel[i] \times CTRatio[i]}{Voltage[REF] \times CTRatio[REF]}$$

where

i = current input being considered

PhysicalCTRoot3Factor[i] = 1.0 for a Y connected CT, $1/\sqrt{3}$ for Delta connected CT

VoltageLevel[i] = Voltage level of the input being considered

CTRatio[i] = CT ratio of the input being considered

Voltage[REF] = Primary voltage level of the reference (PT) side

CTRatio[REF] = CT ratio of the first current input on the reference (PT) side

After the three corrections steps are complete, the phase and mismatch corrections have been performed. In our example, no summation is needed since each side of the transformer only has one CT input.

In our example, the relay calculates the HV, LV Delta Compensated Currents for use in the 87 function of our example as follows:

IHVa = I1A	ILVa = I2A
IHVb = I1B	ILVb = I2B
IHVc = I1C	ILVc = I2C

Delta Phase Dot Product Differential Supervision (Patent Pending)

The slope characteristic of the transformer differential operates on Kirchoff's current principle. This principle states that for any current entering a node (or in our case transformer zone), there must be equal current leaving the zone if no faults are present within the zone. The protected zone is defined as the area between all of the CTs that are used to measure each and every current entering or leaving the transformer zone.

In the ideal situation the differential slope characteristic could be set to securely produce a differential trip only for internal faults. However in practice, CT current measurement errors caused by CT saturation, DC offsets or sympathetic inrush of parallel transformer banks can disrupt this current measurement balance and could cause the relay to trip incorrectly during normal operations or external faults.

Analysis of extensive dynamic simulations has shown that even with current distortion due to a variety of measurement error factors, the phase angle of the current is maintained. Therefore, phase angle differences can be used to reliably identify faults as being internal or external to the transformer zone; this fact is the basis of the Delta Phase Dot Product (DPDT) algorithm. Note that DPDT cannot produce a trip output on its own; it can only give the differential slope characteristic permission to trip.

The current angles of the faulted and unfaulted phase current inputs for an external fault are close to 180 degrees apart. However, since it's recognized that there could be CT phase angle errors, the boundary condition has been set conservatively to ±90 degrees. This boundary is fixed and has no user settings associated with it.

DPDT is performed on a per-phase basis on the HV and LV Delta Compensated Currents (i.e., HVA and LVA are compared only to each other, HVB and LVB are compared only to each other, HVC and LVC are compared only to each other.)

The relay checks to see if the compared currents are more or less than 90 from each other. If all compared currents are within the 90 or less of each other, the relay recognizes the condition as an Internal fault. If the difference current also enters the trip area of the slope characteristic, the 87 will trip.

However, if one or more the currents are greater than 90 from any of the other compared currents, this is recognized as an External fault and the 87 will be Blocked from tripping, even if the difference current enters the trip area of the slope characteristic.

The method used to compare current angles is the mathematical dot product. This concept makes use of the angular relationship present in Kirchhoff's current law.

In mathematical terms, if Phasor A and Phasor B are considered, then: A * B = AB Cos ()

Where: (theta) is the angle between the two phasors.

Phasors A and B are normalized to a value of 1.0 and then the dot product is applied and analyzed:

- Any >90, the dot product will be negative (Block 87 trip).
- All <90, the dot product will be positive (allow 87 trip).

To ensure the current phasor has enough magnitude to be reliably used, a current level detector for each current input is fixed at 5% of $I_{nominal}$ (i.e., 0.25 A for 5 A nominal, 0.05 A for 1 A nominal relay). If any current is below the 5% threshold, the current angle will not be calculated in DPDT. In the case where only one current input is above this current threshhold (such as when energizing an offline transformer), the DPDT algorithm will not inhibit the 87 slope. This means that if a transformer fault occurs upon energization or if a permanent fault is present, the T-PRO will trip correctly. Figure 5.4: illustrates transformer internal and external faults and the current angle comparisons.

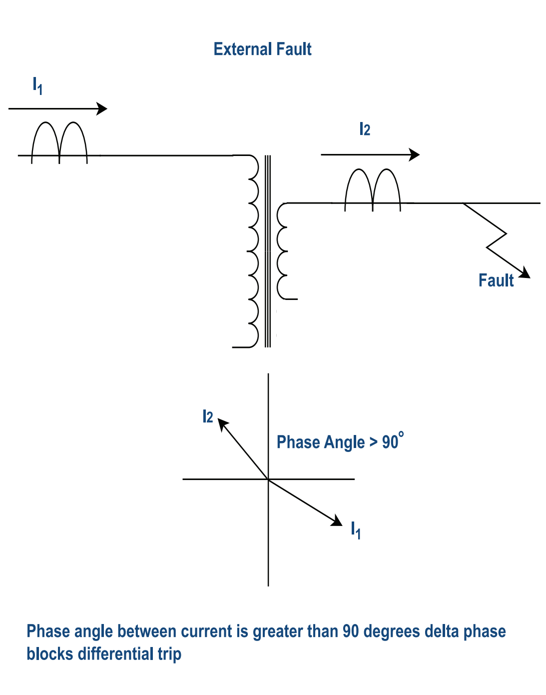


Figure 5.4: Delta Phase Dot Product supervision for External and Internal Fault Conditions

Rate of Change of Differential Supervision (ROCOD)

If the positive rate of change of IO (IOperate) exceeds the positive rate of change of IR (IRestraint) for three consecutive points within the first cycle of a fault, the ROCOD supervision will allow the 87 to trip if the fault goes into the trip area of the slope characteristic.

Figure 5.5: Rate Of Change Of Operating And Restraint Quantities shows how the dio/dt and the dIr/dt quantities vary during an internal and during an external fault. Normally, for an internal fault, the dIo/dt quantity will be greater than the dIr/dt quantity. On the other hand, if an external fault occurs, dIo/dt will be less than dIr/dt.

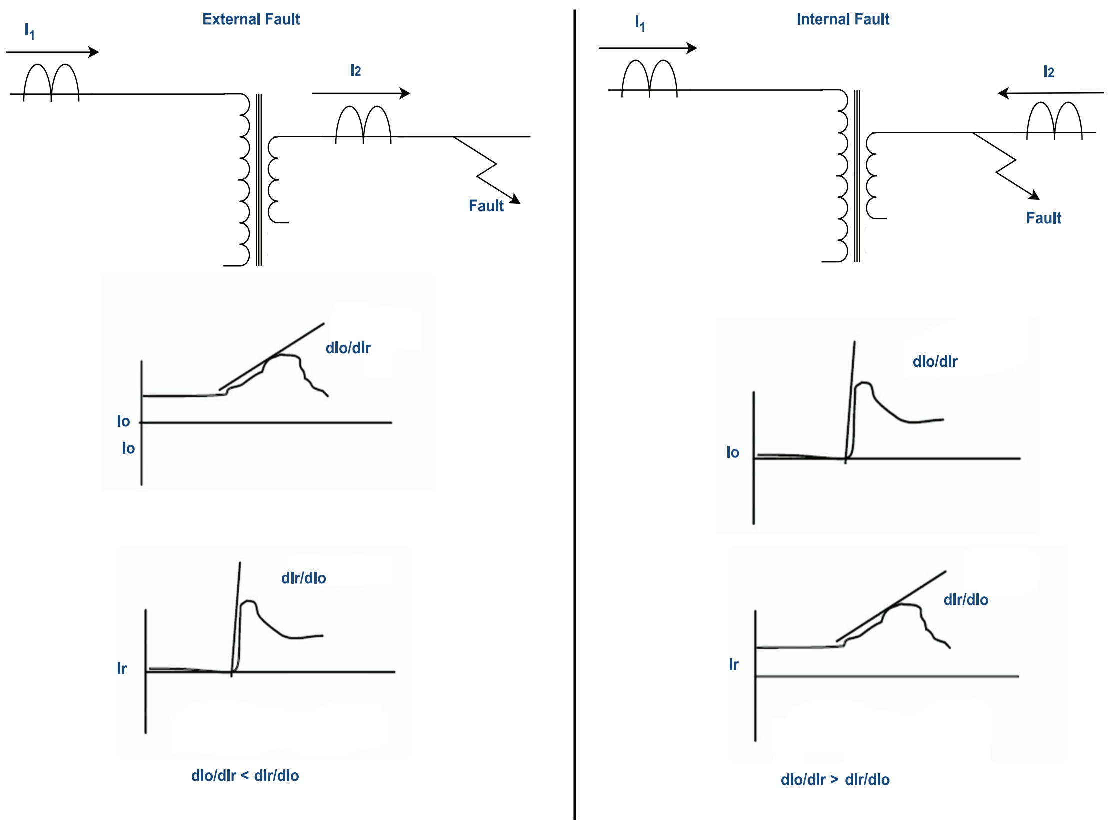


Figure 5.5: Rate Of Change Of Operating And Restraint Quantities

All of the components of the T-PRO differential function are summarized in Figure 5.6: Transformer Differential Protection Logical Overview.

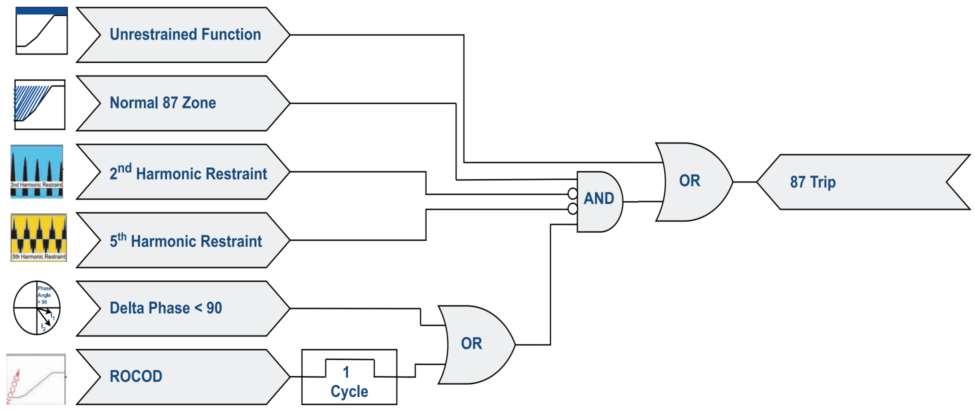


Figure 5.6: Transformer Differential Protection Logical Overview

87 Alarm

The 87 Alarm Function provides an alarm with pickup and delay settings and it is indented to use to detect any CT open condition during normal load condition. The Alarm operates as a flat characteristic (similar to IOmin setting) and it does not consider the S1 and S2 slope regions. If IO exceeds the 87 Alarm Pickup setting for a duration greater than the pickup delay, then the 87 Alarm will operate.

The 87 Alarm is available in the Output Matrix for output contact triggering, record triggering and assignment to the Alarm LED. The 87 Alarm provides phase information. It is also available as a ProLogic input.

87N Neutral Differential

Neutral Differential protection (87N), which is also called Restricted Earth Fault, provides sensitive protection of the transformer or auto-transformer for internal winding to ground faults. The function is restricted to detecting ground faults only within the zone between by the CTs that define the 87N zone.

Since the phase differential (87) operates only on positive and negative sequence currents, it may not be sensitive enough to detect all internal ground faults, especially on the lower 1/3 of the transformer winding. However, the 87N operates on zero sequence current only and has good sensitivity for detecting these faults.

To intentionally limit the current for winding to ground faults a ground resistor is often connected between the transformer neutral and ground. It should be noted that the grounding resistance can reduce the sensitivity of 87N by an amount that can be calculated.

The principle of operation of the 87N is to compare the phasor of the transformer neutral current (IN) to the phasor of the residual of the winding's 3-phase currents (3I0). Again using Kirchoff's law, if these are not equal and subtractive, then there is an internal ground fault on that winding.

Note the winding 3-phase CTs must be Wye connected. Delta CT's cannot be used as they would trap the zero sequence current making it unavailable to the 87N function.)

The 87N characteristic consists of a slope characteristic and Delta Phase Dot Product supervision.

The 87N function can be used on a normal grounded transformer connection, a delta connected transformer winding with a grounding bank contained within the its zone or on an auto-transformer.

87N Operating Current (IO)

For a Regular Wye Transformer: $IO = |IA + IB + IC + IN|$ (4)

For an Auto-Transformer: $IO = |HV_{3I0} + LV_{3I0} + IN|$ (5)

87N Restraint Current (IR)

For a Regular Wye Transformer: $IR = (|IN| + |IA + IB + IC|) / 2$ (6)

For an Auto-Transformer: $IR = (|HV_{3I0}| + |LV_{3I0}| + |IN|) / 2$ (7)

IA, IB and IC are the phase currents,

Where
IN is the current from the neutral CT
3_{I0} is the residual derived from the 3-phase currents of the respective winding(s)
And where:
Operate current IO = 0 (ideally) for external ground faults
Operate current IO > 0 for internal ground faults

Note: All current reference directions for any 87 or 87N function are into the transformer.

For an auto-transformer, the HV_{3I0} and LV_{3I0} are normalized by the CT ratios on both sides of the transformer to derive each primary current. The normalized currents are then directly summed. The different voltage levels need not be considered for the 87N of an auto-transformer. The per unit settings are calculated using the reference HV side as the base.

The 87N base current is calculated as:

(1000 * MVA) / (sqrt (3) * Ref_Side_kVL-L) (8)

The differential currents are calculated as:

IO (pu) = IO primary amps / Ibase (9)

IR (pu) = IR primary amps / Ibas (10)

The settings depend on the value of the neutral grounding resistor (if used) and assumptions regarding CT saturation for external faults.

Table 5.5: 87N Neutral Differential Setting Functions	
IO_{min}	Per unit minimum level that operates the device 87N.
IRs	Per unit point on the restraint axis of the differential characteristic where Slope 1 and Slope 2 intersect.
S1	Slope of first part of characteristic meeting IOmin and Slope 2.
S2	Slope of second part of characteristic meeting Slope 1

Table 5.6: 87N Neutral Differential Setting Ranges	
87N	Enable/Disable
IO_{min} (per unit)	0.10 to Min (IRs * S1/100, 1.00)
IRs (per unit)	(IOmin * 100/S1) to 50.00
S1 (%)	IOmin * 100/IRs to Min(S2, 100)
S2 (%)	Max(S1, 30) to 200
CT Turns Ratio	1.00 to 50000.00

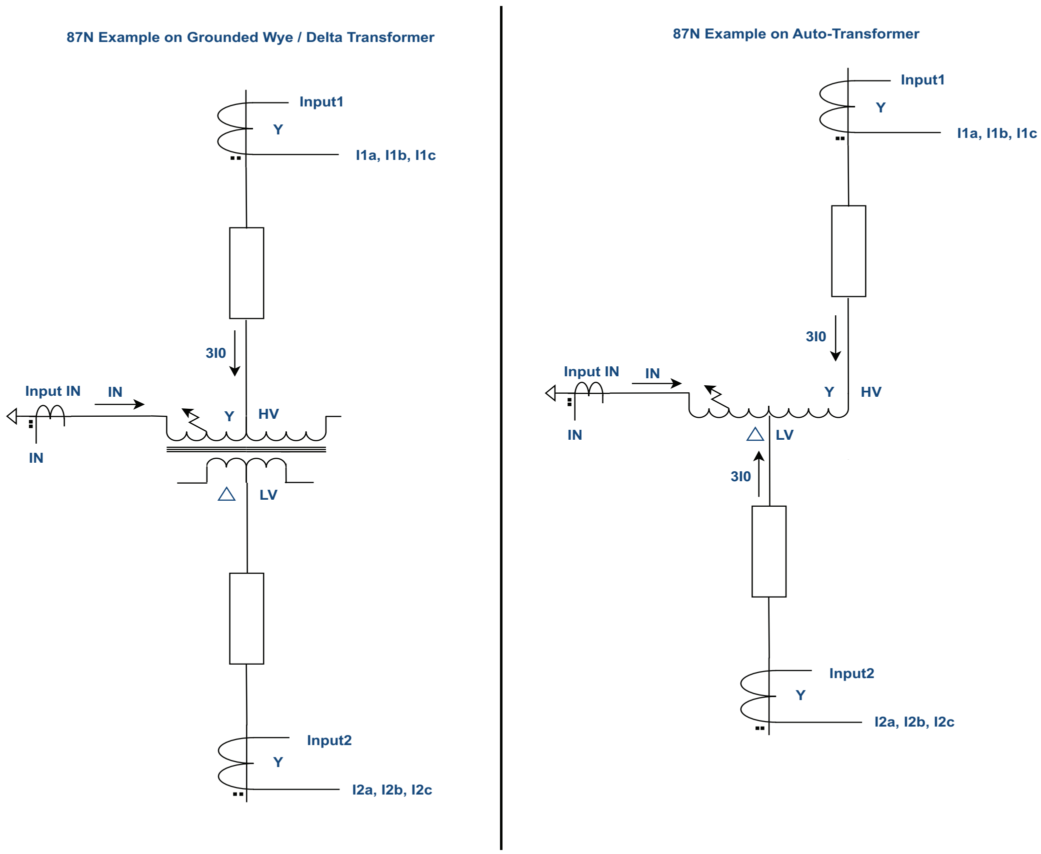


Figure 5.7: 87N Application Examples

49-1 to 49-12 Thermal Overload

Thermal overload protection safeguards transformer windings from excessive insulation damage caused by prolonged heavy loading. It employs 12 identical devices that continuously monitor winding current levels, enabling automatic load shedding or restoration based on the detected current conditions.

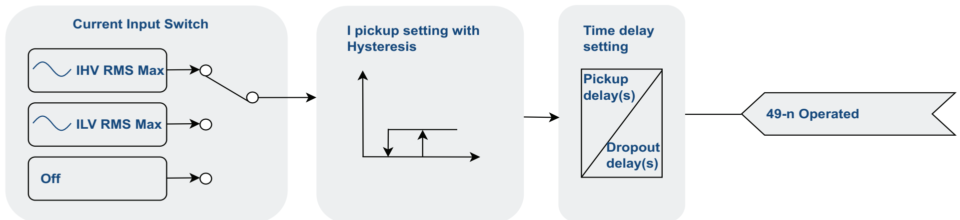


Figure 5.8: Thermal Overload Protection Logic Diagram

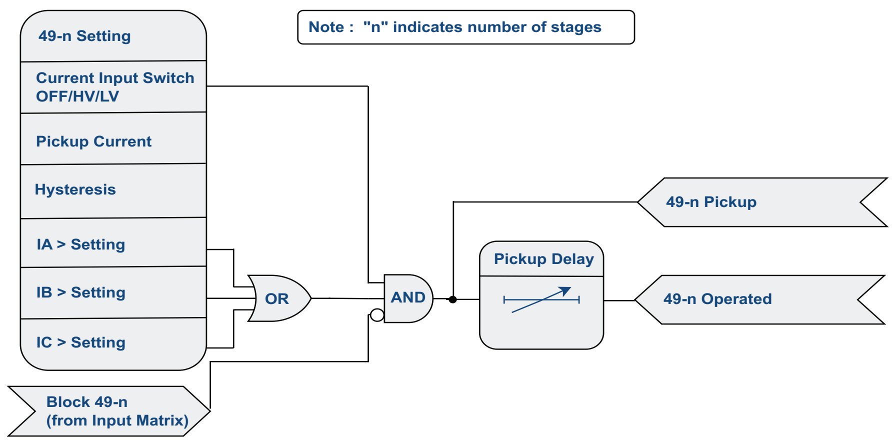


Figure 5.9: Thermal Overload Function Logic Diagram

Figure 5.8:shows the components of the 49 Thermal Overload function. The Current Input Switch activates the 49 device which is used to detect high loading conditions of any of the transformer windings. The 49 tolerates the thermal overload for a specified definite time before the element operates. When the loading drops below the 49 pickup, the hysteresis maintains the output until the current drops further, below the level determined by the hysteresis setting, for the duration of the dropout delay timer.

Each individual 49 device can be configured to activate one of the 17 programmable target LEDs for alarm or indication purposes. Additionally, operating information for the 49 function is available on the HMI display, in Relay Control Panel events, fault logs, and recordings.

Table 5.7: 49 Thermal Overload Setting Ranges	
Current Input Switch	Off, HV, LV

Table 5.7: 49 Thermal Overload Setting Ranges	
Pickup (A)	0.05 to 10.00 (1A) 0.25 to 50.00 (5A)
Hyteresis (A)	0.01 to (0.2 * I Pickup)
Pickup Delay (seconds)	0.00 to 1800.00
Dropout Delay (seconds)	0.00 to 1800.00

50DT Definite Time Phase Overcurrent

The Phase Overcurrent function (50) provides instantaneous or definite time lag protection to the protected equipment. The current and time settings for the operation of the function are user defined. This function operates based on the measured analog input current where Each phase is compared with the set value and If the measured current is greater than the set pick-up value, the relay will operate after the set time delay. It includes dedicated protection functions for both the HV and LV sides, each with two stages which can be configured Independently as required. In this configuration, Input 1 is fixed as the HV side and Input 2 as the LV side. This assignment is predefined and can be viewed under the System Parameters page in the Offliner tool.

The function has an additional “Inrush Blocking” feature. This blocks the operation of the function when the second harmonic current is present over the fundamental. This Inrush logic works based on the 2nd harmonic setting defined under the 87 Functionality.

Each element (50HV-1, 50HV-2, 50LV-1, 50LV-2) can be independently inhibited via an external input status which can be configured from the input matrix. This is useful in comprehensive blocking schemes.

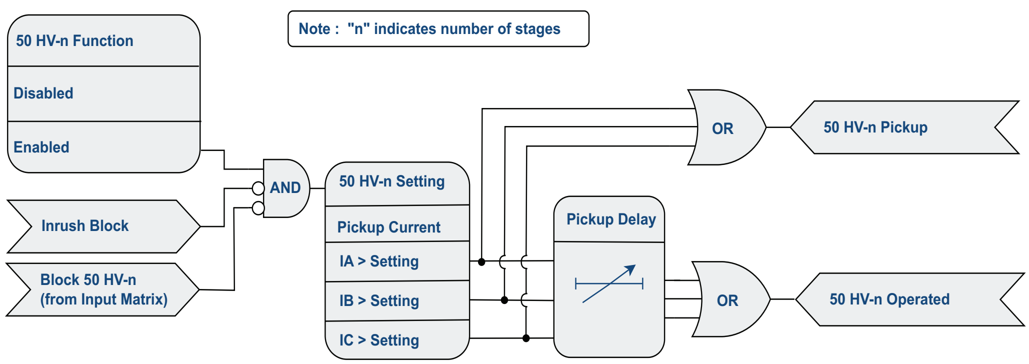


Figure 5.10: 50DT HV Function Logic

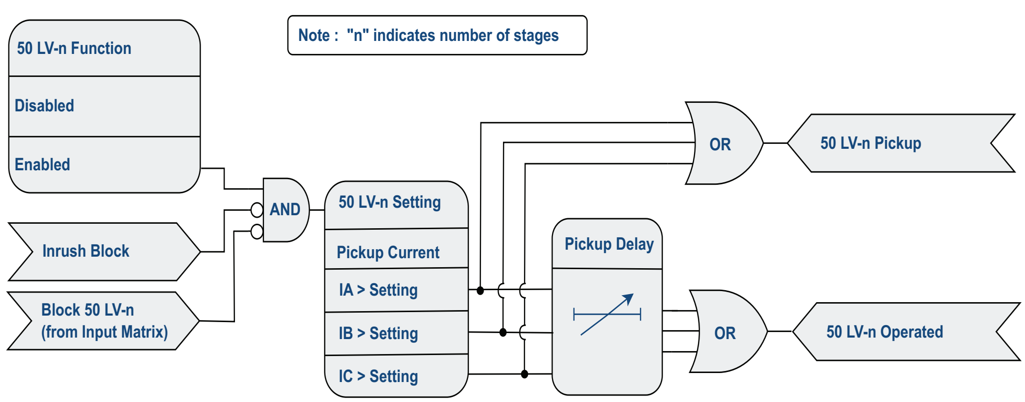


Figure 5.11: 50DT LV Function Logic

Table 5.8: 50DT HV Instantaneous Phase Overcurrent Settings	
Setting Description	**Setting Range**
50HV-1,2	Enabled/Disabled
Pickup I>>	0.05 to 25.00 A (1A) 0.25 to 125.00A (5A)
Pickup Delay	0.00 to 999.99 s
Inrush Blocking	Enabled/Disabled

Table 5.9: 50DT LV Instantaneous Phase Overcurrent Settings	
Setting Description	**Setting Range**
50LV-1,2	Enabled/Disabled
Pickup I>>	0.05 to 25.00 A (1A) 0.25 to 125.00A (5A)
Pickup Delay	0.00 to 999.99 s
Inrush Blocking	Enabled/Disabled

51IT Inverse Time Phase Overcurrent

Relay co-ordination can be achieved by means of adjusting Time Multiplier Settings (TMS), current setting or a combination of both time and current. Based on the fault, the relay can be used with current grading. If fault current is approximately constant then time grading can be used. For grid connected stations combination of both is used. When Zsource (the impedance between the relay and the power source) is small compared to that of the protected section ZL, there is an appreciable difference between the current for a fault at the far end of the section (Esource / (Zsource+Zline), and the current for a fault at the near end (Esource/Zsource). When operating time is inversely proportional to the current, the relay operates faster for a fault nearer the power source, and the operating time is more for a fault at far end. Grading by time is used in rare cases since it can often lead to excessive fault clearance time at substations where the fault level is high. For these reasons the most commonly applied characteristic in coordinating Overcurrent relays is the IDMTL type.

This function operates based on the measured analog input current . It includes dedicated protection functions for both the HV and LV sides, each with two stages which can be configured Independently as required. The HV & LV configuration Remains the same as Defined in the 50 function. Function 51 provides five IEC inverse time curve types, three IEEE inverse time curve types of Overcurrent protection and one user- defined curve as well as definite time delayed protection also i.e. DTL. The equation and the parameters of Function 51HV and 51LV are listed in below.

Pickup:

$$T(I) = \left(B + \frac{A}{\left(\left(\frac{I}{I_{Pickup}} \right)^{p} - 1 \right)} \right) TMS$$

Reset:

$$T(I) = \left(\frac{TR}{1 - \left(\frac{I}{I_{Pickup}} \right)^{2}} \right) TMS$$

The function has an additional “Inrush Blocking” feature. This blocks the operation of the function when the second harmonic current is present over the fundamental & this Inrush logic works based on the 2nd harmonic setting defined under the 87 Functionality.

Each element (51) can be independently inhibited via external input status which can be configured from input matrix. This will help in achieving comprehensive blocking schemes.

User can define the reset delay for the relay; It can be set as DTL or by ANSI delay. Setting of the timer to a value other than zero, delays the resetting of the protection element timers for this period. This may be useful in special applications especially in cable feeders. By providing the setting, fault clearance gets reduced for intermittent faults.

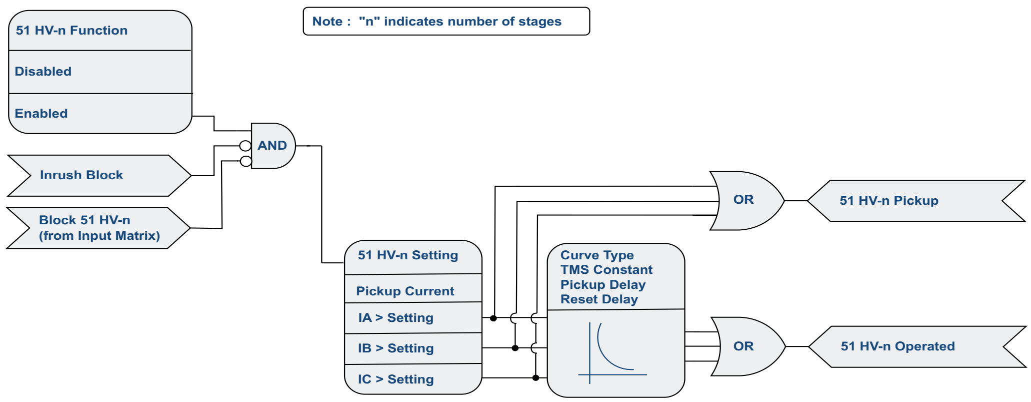


Figure 5.12: 51IT HV Function Logic

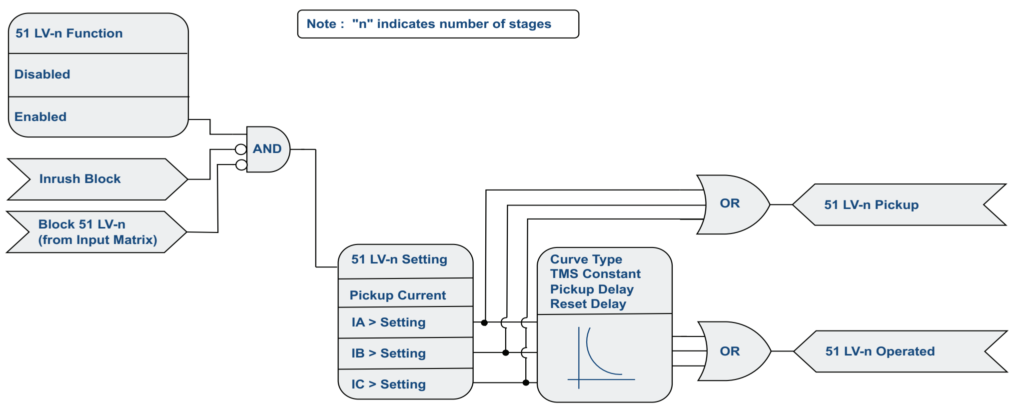


Figure 5.13: 51IT LV Function Logic

Table 5.10: 51IT HV Inverse Time Phase Overcurrent Settings

Setting Description	Setting Range
51HV-1,2	Enabled/Disabled
Pickup I>>	For IDMTL curve type selection: 0.05 to 10.00A (1A) 0.25 to 50.00A (5A) For DTL curve type selection: 0.05 to 25.00A (1A) 0.25 to 125.00A (5A)

Table 5.10: 51IT HV Inverse Time Phase Overcurrent Settings	
Curve Type	DTL, IEC Standard Inverse-1, IEC Standard Inverse-3, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99 s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics

Table 5.11: 51IT LV Inverse Time Phase Overcurrent Settings

Setting Description	Setting Range
51LV-1,2	Enabled/Disabled
Pickup I>>	For IDMTL curve type selection: 0.05 to 10.00A (1A) 0.25 to 50.00A (5A) For DTL curve type selection: 0.05 to 25.00A (1A) 0.25 to 125.00A (5A)
Curve Type	DTL, IEC Standard Inverse-1, IEC Standard Inverse-3, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99 s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics

Table 5.11: 51IT LV Inverse Time Phase Overcurrent Settings

p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics

50NDT Definite Time Derived Neutral Overcurrent

Neutral Overcurrent provides protection for line-to-ground faults. Derived neutral Overcurrent (50NDT) provides instantaneous and definite time lag protection to the equipment. Relay internally sums all three phase currents and calculates 3I0 current flowing in the neutral. The function operates on the derived neutral current. User can define the current and time setting for the function operation. It includes dedicated protection functions for both the HV and LV sides, each with two stages which can be configured Independently as required. In this configuration, Input 1 is fixed as the HV side and Input 2 as the LV side. This assignment is predefined and can be viewed under the System Parameters page in the Offliner too.

Derived neutral current is compared with the set value of current. If calculated current is greater than the pickup current, the function will operate after the set time delay. The function has an additional feature of “Inrush Blocking”. This is provided to block the function from operation when second harmonic current is present over the fundamental. This Inrush logic works based on the 2nd harmonic setting defined under the 87 Functionality.

Each element (50N HV-1, 50N HV-2, 50N LV-1, 50N LV-2) can be independently inhibited via external input status which can be configured from input matrix. This will help in achieving comprehensive blocking schemes.

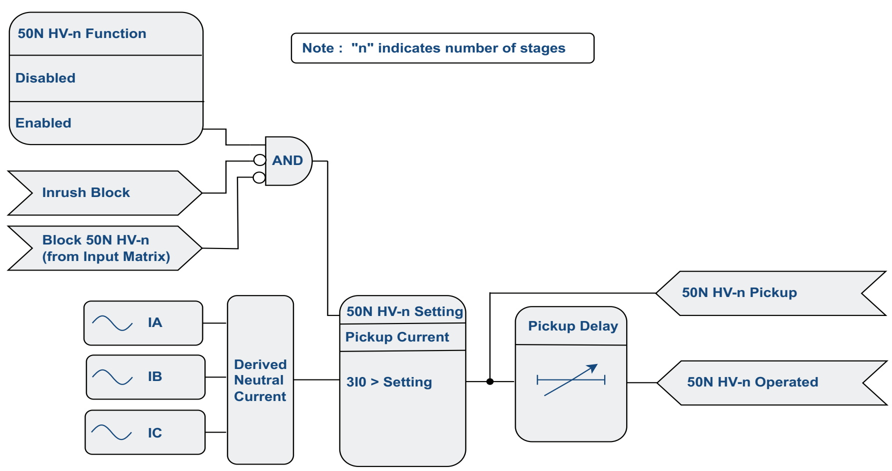


Figure 5.14: 50NDT HV Function Logic

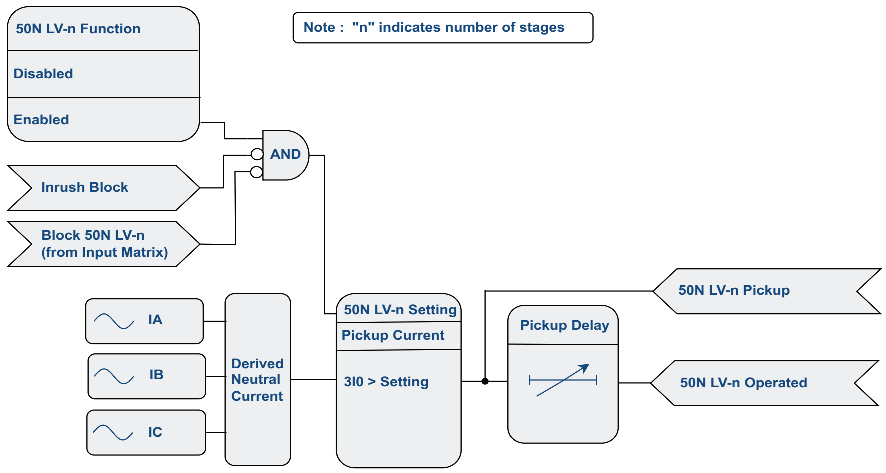


Figure 5.15: 50NDT LV Function Logic

Table 5.12: 50NDT HV Definite Time Derived Neutral Overcurrent Settings

Setting Description	Setting Range
50N HV - 1,2	Enabled/Disabled
Pickup IN>	0.05 to 25.00 A (1A) 0.25 to 125.00 A (5A)
Pickup Delay	0.00 to 999.99 s
Inrush Blocking	Enabled/Disabled

Table 5.13: 50NDT LV Definite Time Derived Neutral Overcurrent Settings

Setting Description	Setting Range
50N LV - 1,2	Enabled/Disabled
Pickup IN>	0.05 to 25.00 A (1A) 0.25 to 125.00 A (5A)
Pickup Delay	0.00 to 999.99 s
Inrush Blocking	Enabled/Disabled

51NIT Inverse Time Derived Neutral Overcurrent

Neutral overcurrent provides protection for line-to-ground faults. All the Curve & Definitions are the same as the 51IT Phase Overcurrent except that this function uses 3I0 rather than phase current for its operation. The equation of the functions 51NIT HV and 51NIT LV are given below as:

Pickup:

$$T(I) = \left(B + \frac{A}{\left(\left(\frac{I_N}{I_{NPickup}} \right)^p - 1 \right)} \right) TMS$$

Reset:

$$T(I) = \left(\frac{TR}{1 - \left(\frac{I_N}{I_{NPickup}} \right)^2} \right) TMS$$

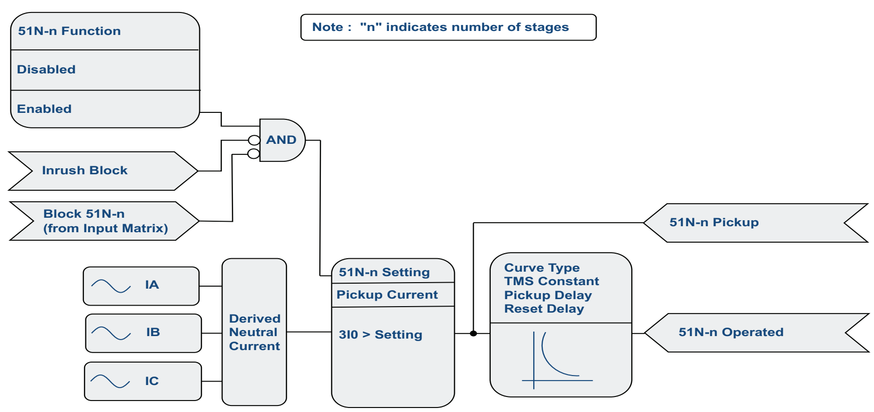


Figure 5.16: 51NIT HV Function Logic

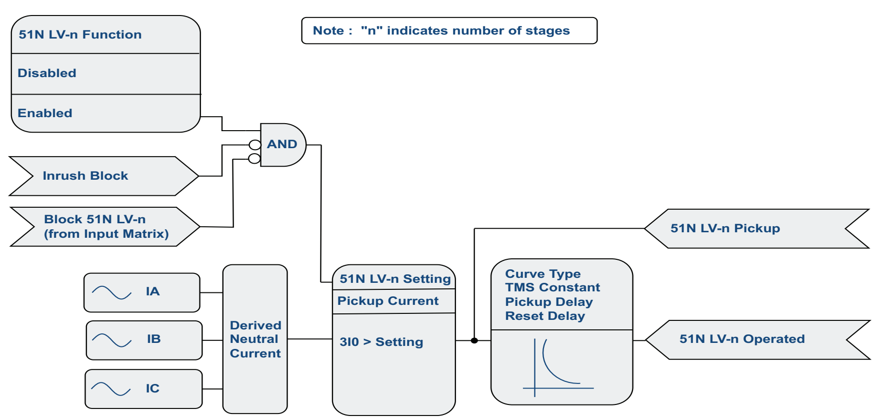


Figure 5.17: 51NIT LV Function Logic

Table 5.14: 51NIT HV Inverse Time Derived Neutral Overcurrent Settings

Setting Description	Setting Range
51N HV - 1,2	Enabled/Disabled
Pickup IN>	For IDMTL curve type selection: 0.05 to 10.00A (1A) 0.25 to 50.00A (5A) For DTL curve type selection: 0.05 to 25.00A (1A) 0.25 to 125.00A (5A)
Curve Type	DTL, IEC Standard Inverse-1, IEC Standard Inverse-3, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99 s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics
Inrush Blocking	Enable/Disable

Table 5.15: 51NIT LV Inverse Time Derived Neutral Overcurrent Settings

Setting Description	Setting Range
51N LV - 1,2	Enabled/Disabled
Pickup IN>	For IDMTL curve type selection: 0.05 to 10.00A (1A) 0.25 to 50.00A (5A) For DTL curve type selection: 0.05 to 25.00A (1A) 0.25 to 125.00A (5A)

Table 5.15: 51NIT LV Inverse Time Derived Neutral Overcurrent Settings	
Curve Type	DTL, IEC Standard Inverse-1, IEC Standard Inverse-3, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99 s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics
Inrush Blocking	Enable/Disable

50GDT Definite Time Measured Neutral Overcurrent/ High Impedance REF

This function provides both Instantaneous and definite time lag protection against neutral overcurrent conditions based on the measured Neutral analog input current if the set value is reached then the function operates after a user Defined time delay. The behavior of this function is governed by the selected IN REF scheme:

- Low Impedance Scheme: The function operates as a traditional neutral overcurrent protection based on the measured residual current. (The measurement type used here is a DFT output Defined internally)
- High Impedance Scheme: The function operates as a high-impedance Restricted Earth Fault (REF) protection, providing sensitive fault detection within the protected zone. (The measurement type used here is a True RMS output instead of DFT Because True RMS output capture's Proper Waveform including distortion, harmonics, and DC offset-ensuring sensitive and reliable operation during internal earth faults.)

The scheme selection (Low or High Impedance) is configurable via system Parameters page in offliner tool and the measurement type changes automatically in accordance with the Scheme Selection.

Note: this Measurement type is common for both 50G & 51G

It includes dedicated protection functions with two stages (50G-1/REF, 50G-2/REF) which can be configured Independently as required & can be independently inhibited via an external input status which can be configured from the input matrix. This is useful in comprehensive blocking schemes.

The function has an additional "Inrush Blocking" feature. This blocks the operation of the function when the second harmonic current is present over the fundamental & this Inrush logic works based on the 2nd harmonic setting defined under the 87 Functionality.

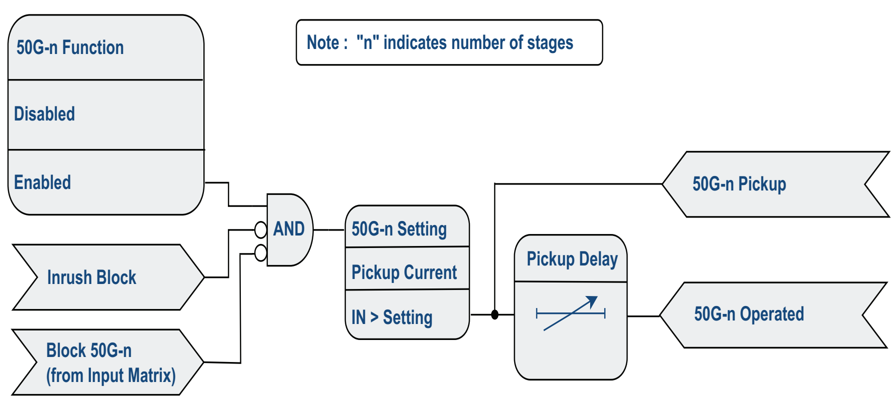


Figure 5.18: 50GDT Function Logic

Table 5.16: 50GDT Measured Neutral Overcurrent/High Impedance REF settings	
Setting Description	**Setting Range**
50G/REF - 1,2	Enabled/Disabled
Pickup IG>	0.05 to 25.00 A (1A) 0.25 to 125.00 A (5A)
Pickup Delay	0.00 to 999.99 s
Inrush Blocking	Enabled/Disabled

51GIT Inverse Time Measured Neutral Overcurrent

All the curve definitions are the same as the 51N phase overcurrent function except that this function uses Measured Neutral Over Current For its operation. It includes dedicated protection functions with two stages (51G-1, 51G-2) which can be configured, inhibited individually and feature's a Inrush blocking as Defined earlier in the above sections

The measure type is already Defined with a Note in the 50GDT Function Section.

The equation of the functions 50GIT is given below as:

Pickup:

$$T(I) = TMS\left[B + \frac{A}{\left(\frac{IG}{IG_{Pickup}}\right)^{\rho} - 1}\right]$$

Reset:

$$T(I) = TMS\left[\frac{TR}{1-\left(\frac{IG}{IG_{Pickup}}\right)^{2}}\right]$$

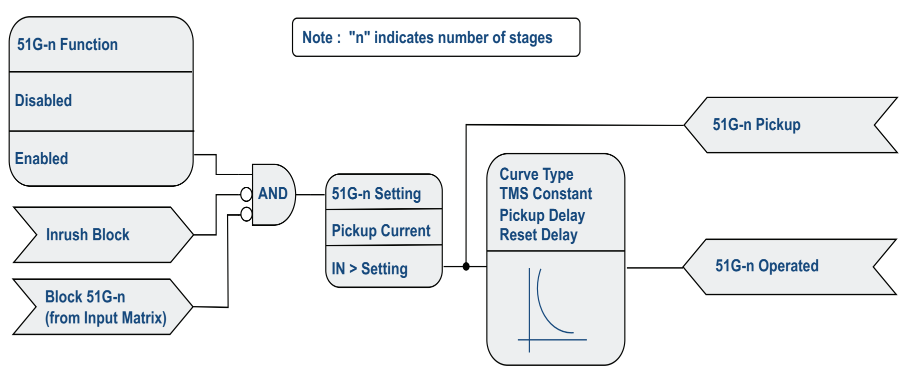


Figure 5.19: 51GIT Function Logic

Table 5.17: 51GIT Inverse Time Measured Neutral Overcurrent Settings	
Setting Description	**Setting Range**
51G - 1,2	Enabled/Disabled

Table 5.17: 51GIT Inverse Time Measured Neutral Overcurrent Settings

Pickup IG>	For IDMTL curve type selection: 0.05 to 10.00A (1A) 0.25 to 50.00A (5A) For DTL curve type selection: 0.05 to 25.00A (1A) 0.25 to 125.00A (5A)
Curve Type	DTL, IEC Standard Inverse-1, IEC Standard Inverse-3, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99 s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics
Inrush Blocking	Enable/Disable

46/50DT Definite Time Negative Sequence Overcurrent

Negative Sequence Overcurrent provides protection for any unbalanced faults. The 46-50 function definitions are similar to that of 50N except that it uses the calculated negative sequence current as the input to the Function Operation.

It includes dedicated protection functions for both the HV and LV sides, which can be configured Independently as per user requirement & can be Inhibited via external input status which can be configured from input matrix. This will help in achieving comprehensive blocking schemes.

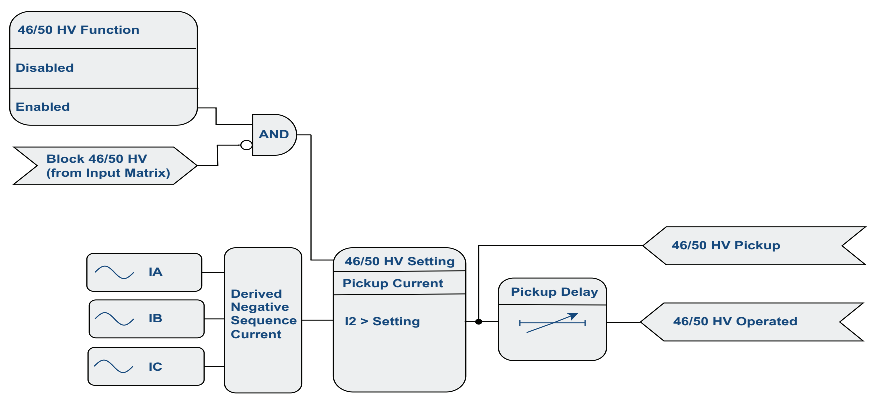


Figure 5.20: 46/50DT HV Function Logic

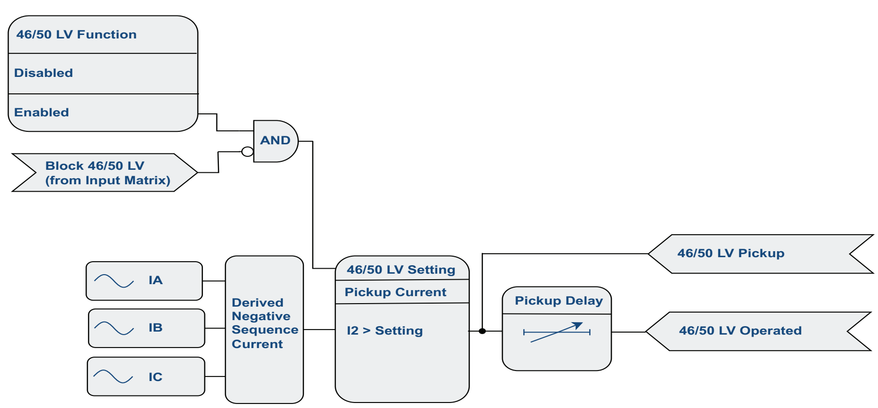


Figure 5.21: 46/50DT LV Function Logic

Table 5.18: 46/50DT HV Definite Time Negative Sequence Overcurrent Settings

Setting Description	Setting Range
46/50 HV	Enabled/Disabled
Pickup I2>>	0.05 to 25.00 A (1A) 0.25 to 125.00A (5A)
Pickup Delay	0.00 to 999.99 s

Table 5.19: 46/50DT LV Definite Time Negative Sequence Overcurrent Settings

Setting Description	Setting Range
46/50 LV	Enabled/Disabled
Pickup I2>>	0.05 to 25.00 A (1A) 0.25 to 125.00A (5A)
Pickup Delay	0.00 to 999.99 s

46/51IT Inverse Time Negative Sequence Overcurrent

All the curve definitions are the same as the 51N Phase Overcurrent Function except standard inverse is merged to one curve. The only difference is that this function uses the negative sequence current (I_2) rather than phase current for its Functional Operation. It also includes dedicated protection functions for both the HV and LV sides which can be configured Independently as per user requirement.

The same can be Inhibited via external input status which can be configured from input matrix. This will help in achieving comprehensive blocking schemes. The equations for 46/51HV, 46/51LV are as given below:

Pickup:

$$T(I) = \left(B + \frac{A}{\left(\left(\frac{I_2}{I_{2Pickup}}\right)^p - 1\right)} \right) TMS$$

Reset:

$$T(I) = \left(\frac{TR}{1 - \left(\frac{I_2}{I_{2Pickup}}\right)^2} \right) TMS$$

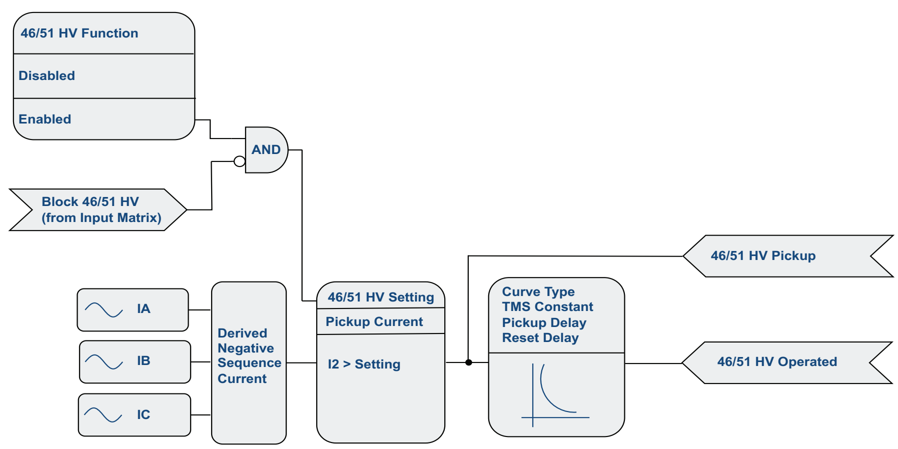


Figure 5.22: 46/51IT HV Function Logic

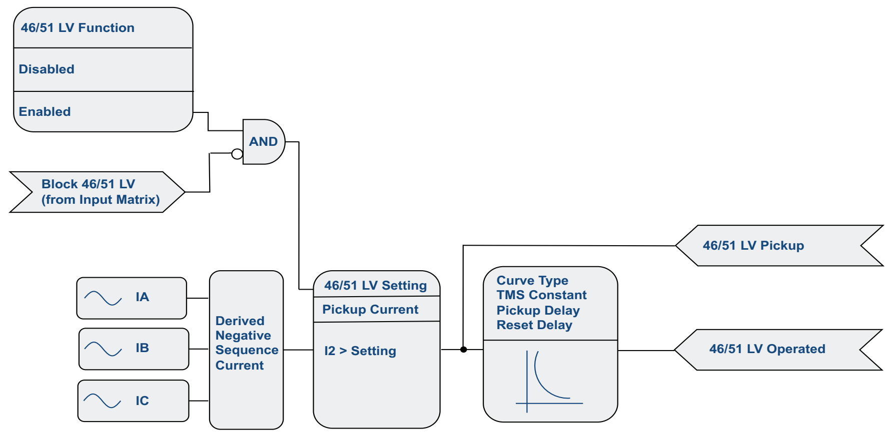


Figure 5.23: 46/51IT LV Function Logic

Table 5.20: 46/51IT HV Inverse Time Negative Sequence Overcurrent Settings	
Setting Description	**Setting Range**
46/51 HV	Enabled/Disabled
Pickup I2>>	0.05 to 10.00 A (1A) 0.25 to 50.00 A (5A)
Curve Type	DTL, IEC Standard Inverse, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics

Table 5.21: 46/51IT LV Inverse Time Negative Sequence Overcurrent Settings

Setting Description	Setting Range
46/51 LV	Enabled/Disabled
Pickup I2>>	0.05 to 10.00 A (1A) 0.25 to 50.00 A (5A)
Curve Type	DTL, IEC Standard Inverse, IEC Very Inverse, IEC Extremely Inverse, IEC Long Time Inverse, IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00 to 999.99s
Reset Delay	DTL or ANSI Decay
Reset DTL Delay	0.0 to 99.9s
A	0.0010 to 1000.0000 settable if chosen for user defined characteristics
B	0.0000 to 10.0000 settable if chosen for user defined characteristics
p	0.01 to 100.00 settable if chosen for user defined characteristics
TR	0.10 to 150.00 settable if chosen for user defined characteristics

50BF Breaker Failure

The T-PRO relay includes a dedicated breaker fail (50BF) function for both side's HV & LV where Input 1 is HV and Input 2 is LV. This function is designed to detect a circuit breaker's failure to open when commanded and ensures timely fault clearance through backup protection mechanisms. The breaker fail logic is identical for both inputs.

Components of the Breaker Fail Function:

The 50BF function consists of the following configurable parts:

1. Initiating Elements:

The initiating logic is defined through the Output Matrix screen.

These elements determine what triggers the breaker fail detection.

For example, if the CT connected to Input 1 associated with the HV transformer winding, then its 50BF function will be triggered by signals mapped to the BFI-HV column in the Output Matrix.

For example, if the CT connected to Input 2 is associated with the LV transformer winding, then its 50BF function will be triggered by signals mapped to the BFI-LV column in the Output Matrix.

2. 52A Breaker Status: (Auxiliary Contact Monitoring)

The logic can utilize the 52A auxiliary contact to determine whether the breaker has opened.

The 52A status can be sourced from:

- Any of the relay's External Inputs, or A ProLogic statement.
- A 52B contact may also be used by inverting its logic in ProLogic to emulate a 52A signal.

3. Current Detection (Optional):

If enabled (configured via the offline tool), the breaker fail logic also checks whether the breaker current exceeds a defined pickup setting.

This method complements the 52A contact monitoring to ensure breaker failure is reliably detected under load conditions.

Once the initiating conditions (52A status and/or current detection) are met, the following delays are applied:

- **Pickup Delay 1**

  Typically used for a re-trip attempt, especially when the output is connected to the breaker's backup trip coil.

- **Pickup Delay 2**

  Generally used to trip adjacent breakers to ensure full fault isolation if the main breaker fails to clear the fault.

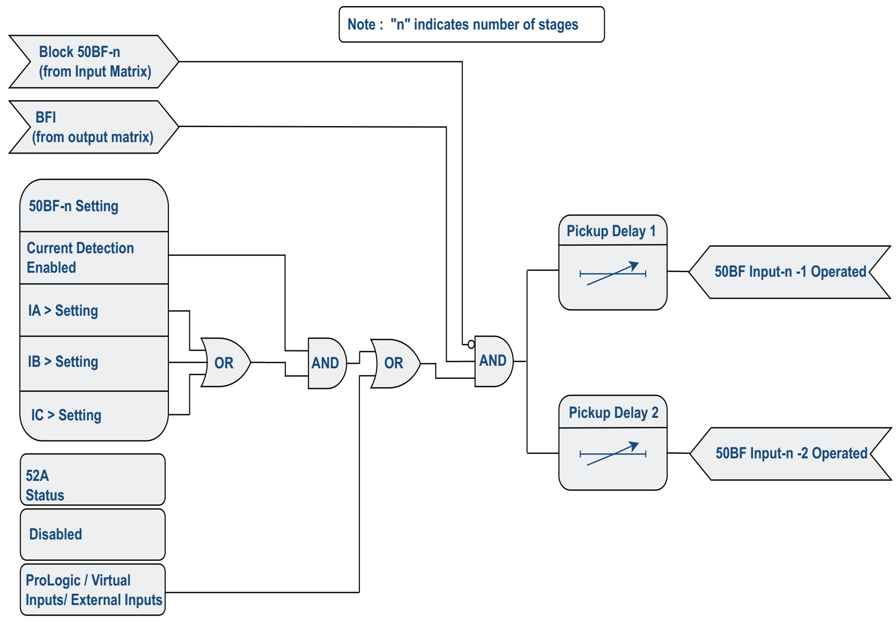


Figure 5.24: 50BF Function Logic

Table 5.22: 50BF Breaker Failure Settings	
Setting Description	**Setting Range**
Pickup Delay 1	0.01 to 99.99s
Pickup Delay 2	0.01 to 99.99s
Current Detection	Enable/Disable
Breaker Current Pickup	0.10 to 50.00A for 5A CT 0.02 to 10.00A for a 1A CT
52-A Breaker Status	Disabled, EI 1 to EI 14, PL1 to PL24, VI1 to VI 30

5.2 Voltage Protection Functions

This section describes the functional Logic implementation of protective functions such as 27/59DT (1 to 4), 27/59IT(1 to 2), 24DT (1 to 2), 24IT, 59GDT (1 to 2), and 59GIT, which are designed to monitor voltage levels within the power system and act accordingly. These voltage protection functions play a critical role in maintaining system stability and preventing damage to electrical equipment caused by abnormal voltage conditions, such as Overvoltage or Undervoltage.

Each voltage protection function is individually provided with a hysteresis % setting and a reset delay setting described below:

Hysteresis - The drop-out value of the voltage protection function is primarily determined by the percentage hysteresis setting, which helps prevent chattering of the protection system during minor fluctuations around the threshold voltage level.

Reset Delay - delays the reactivation or reset of the protection function after the voltage returns to a normal range. This helps ensure system stability and prevents the function from resetting too quickly during transient events.

Together, hysteresis and reset delay contribute to reducing nuisance operations and ensure a more stable and resilient voltage protection scheme.

27/59DT - Definite Time Under/ Overvoltage

The Definite Time Under/Over voltage (UV/OV) protection function is designed to monitor and respond to voltage anomalies in a power system. It features four programmable stages, each of which can be configured as Either under or Over voltage Function. It also includes both time-delayed and instantaneous protection elements to ensure a fast and coordinated response to voltage deviations.

- **Undervoltage (UV)** - Whenever the injected voltage is equal to or less than the precise pick-up value, this function operates after a set time delay.
- **Over Voltage (OV)** - Whenever the injected voltage value is equal to or greater than the precise pick-up value, this function operates after a set time delay.

Note: This function becomes active when the voltage input selection is set to either Ph-N or Ph-Ph, which can be configured on the System Parameters page.

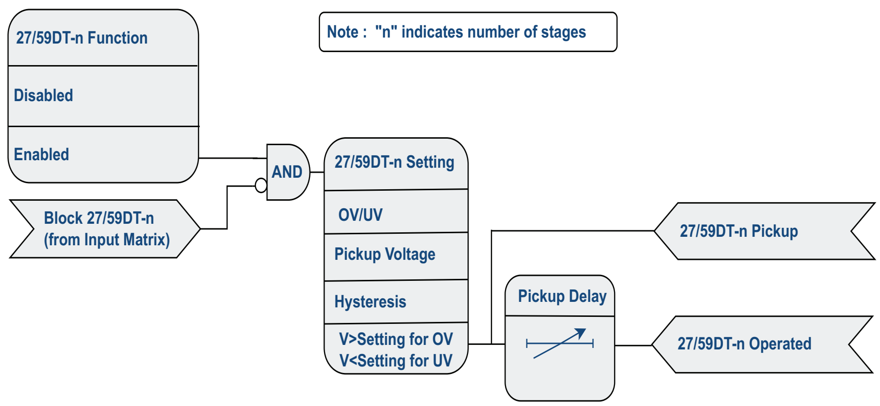


Figure 5.25: 27/59DT Function Logic

Table 5.23: 27/59DT - Definite Time Phase Under/Overvoltage Settings	
Setting Description	**Setting Range**
27/59DT-1, 2, 3, 4	Enable/Disable
Function Selection	UV or OV
Pickup V	3.0V to 250.0V
Hysteresis	1% to 80%
Pickup DTL Delay	0.00s to 999.99s
Reset DTL Delay	0.00s to 999.99s

27/59IT - Inverse Time Under/ Overvoltage

The Inverse Time Under/Overvoltage (UV/OV) function provides time-delayed protection based on the magnitude of voltage deviation using selectable time-voltage characteristic curves. This function offers two configurable stages, each of which can be set independently as either an Undervoltage or Overvoltage stage.

- **Definition of Inverse Time Characteristic:** The relay's trip time is inversely proportional to the deviation from the nominal voltage. A greater deviation (whether higher or lower) results in a faster response, while a smaller deviation causes a longer trip time.
- **Pick-Up Setting:** This defines the voltage threshold at which the relay activates. Depending on whether it's set for Over or Under voltage, the relay will respond when the system voltage exceeds or drops below this value.
- **Time-Voltage Curve Characteristic:** Various curve options are available, including DTL, IEC Standard Inverse, IEC Extremely Inverse, and IEC Long-Time Inverse, to tailor the relay's response to different under voltage levels. Additionally, a user-defined curve allows for customized time-voltage characteristics.
- **TMS Setting:** The Time Multiplier Setting (TMS) adjusts the relay's operating time according to the selected Time Voltage Characteristic curve. This feature is essential for ensuring proper coordination between the relay and other protective devices in the system.

Note: This function becomes active when the voltage input selection is set to either Ph-N or Ph-Ph, which can be configured on the System Parameters page.

For 27IT(UV), the pickup time is determined by the following equation:

$$T(V) = TMS\left[B + \frac{A}{1 - \left(\frac{V}{V_{Pickup}}\right)^{p}}\right]$$

For 59IT(OV), the pickup time is determined by the following equation:

$$T(V) = TMS\left[B + \frac{A}{\left(\frac{V}{V_{Pickup}}\right)^{p} - 1}\right]$$

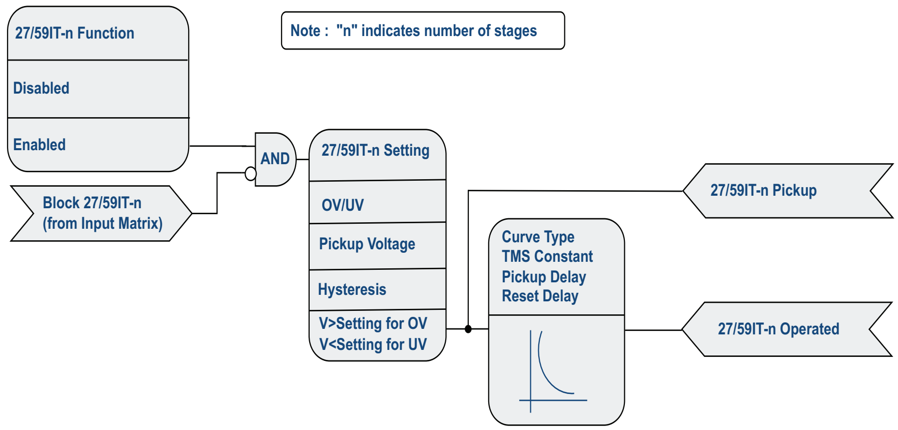


Figure 5.26: 27/59IT Function Logic

Table 5.24: 27/59IT - Inverse Time Phase Under/Overvoltage Settings	
Setting Description	**Setting Range**
27/59IT-1,2	Enable or Disable
Function Selected	UV or OV
Pickup V	3.0V to 250.0V
Hysteresis	1% to 80%
Curve Type	DTL, IEC Standard Inverse, IEC Extreme Inverse, IEC Long Time Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00s to 999.99s
Reset DTL Delay	0.00s to 999.99s
A	0.1 to 50.0
B	0.0 to 10.0
p	0.1 to 10.0

24DT - Definite Time Overflux

The over flux protection is used to detect the overflux condition in electrical equipment, which can damage equipment such as transformers and generators. These are caused due to the increase in voltage and decrease in frequency.

The magnetic flux density is directly proportional to voltage and inversely to its frequency, defined by the following equation:

$\Phi = V/F$

Whenever the injected (fundamental) value reaches the same or above the precise pick up (V/F) value, this function operates after a configurable pickup timer. There are two stages provided, 24DT-1 and 24DT-2.

Note: This function becomes active when the voltage input selection is set to either Ph-N or Ph-Ph, which can be configured on the System Parameters page.

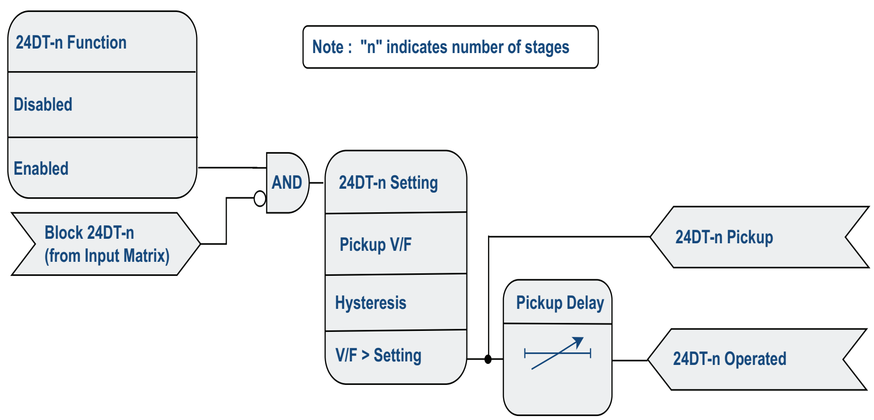


Figure 5.27: 24DT Function Logic

Table 5.25: 24DT - Definite Time Overflux settings	
Setting Description	**Setting Range**
24DT-1, 2	Enable/Disable
Pickup V/F	1.00 to 2.00 pu
Hysteresis	1 to 80%
Pickup DTL Delay	0.05 to 999.99 s
Reset DTL Delay	0.00 to 999.99 s

24IT - Inverse Time Overflux

The over flux protection is used to detect the overflux condition in electrical equipment, which can damage equipment such as transformers and generators. These are caused due to the increase in voltage and decrease in frequency.

It is provided with only one programmable stage for 24IT function.

The magnetic flux density is directly proportional to voltage and inversely to its frequency, defined by the following equation:

Φ = V/F

- **Definition of Inverse Time Characteristic:** The trip time decreases as the V/F ratio increases, providing a faster response for more severe over flux conditions.
- **Pick-Up Setting:** The protection activates when the V/F ratio reaches or exceeds the set pickup value.
- **Time - Inverse Curve Characteristic:** Various curve options are available, including DTL, Inverse Curve, IEC Extremely Inverse-1, IEEE Extremely Inverse-1,IEEE Extremely Inverse-2,IEEE Extremely Inverse-3 to tailor the relay's response to different values of V/F.

  Additionally, a user-defined curve allows for customized time-voltage characteristics.
- **TMS Setting:** The Time Multiplier Setting (TMS) adjusts the relay's operating time according to the selected Time Voltage Characteristic curve. This feature is essential for ensuring proper coordination between the relay and other protective devices in the system

Note: This function becomes active when the voltage input selection is set to either Ph-N or Ph-Ph, which can be configured

The configurable inverse time characteristics are defined by the following equations.

For the IEC Extremely Inverse 1 Curve:

$$T = \left(\frac{A}{(M^2 - 1)^2}\right) TMS$$

For the IEEE Extremely Inverse 1-3 Curves:

$$T = e^{-(M \times 100 - K)/C}$$

Where M and K are defined by:

$$M = \left[\frac{(V/F)}{(V_n/(F_n))B}\right]$$

$$K = A + ((TMS \times 10) - 1)2.5$$

For the Inverse Curve:

$$T = \frac{InverseK}{(N - Pickup)^2}$$

Where N is defined as:

$$N = \left[\frac{(V/F)}{(V_n/(F_n))}\right]$$

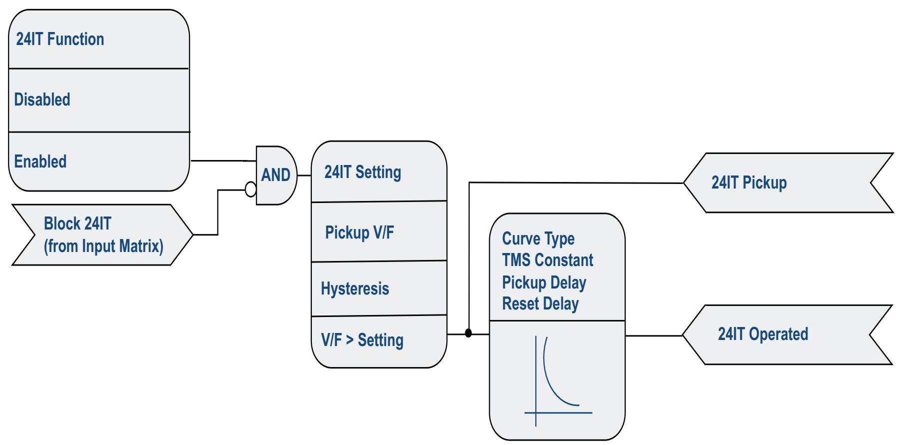


Figure 5.28: 24IT - Inverse Time Overflux Logic

Table 5.26: 24IT - Inverse Time Overflux settings

Setting Description	Setting Range
24IT	Enable/Disable
Pickup V/F	1.00 to 1.50 pu
Hysteresis	1 to 80%
Curve Type	DTL, Inverse Curve, IEC Extremely Inverse 1, IEEE Extremely Inverse 1, IEEE Extremely Inverse 2, IEEE Extremely Inverse 3, User defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.05 to 999.99 s
Reset DTL Delay	0.0 to 99.9 s
A	Automatically configured based on curve
B	Automatically configured based on curve
C	Automatically configured based on curve
Inverse K	0.01 to 99.90

Table 5.26: 24IT - Inverse Time Overflux settings	
User defined set point - X1 User defined set point - Y1	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X2 User defined set point - Y2	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X3 User defined set point - Y3	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X4 User defined set point - Y4	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X5 User defined set point - Y5	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X6 User defined set point - Y6	1.00 to 3.00 pu 0.00 to 9999.99 s
User defined set point - X7 User defined set point - Y7	1.00 to 3.00 pu 0.00 to 9999.99 s

59GDT - Definite Time Measured Residual Overvoltage

The 59GDT relay features two individually programmable stages—59GDT-1 and 59GDT-2. It provides zero-sequence overvoltage protection using a broken-delta potential transformer (PT) configuration. This element is specifically designed for ungrounded or high-impedance grounded systems, where traditional neutral overcurrent protection may be ineffective or insufficiently sensitive for reliable ground fault detection.

This protection scheme activates when the Measured voltage at the analog input exceeds the set 59G pickup level. Once this threshold is crossed, the 59G element operates after a user-defined time delay.

Note: This function becomes active only when the voltage input selection is set to Neutral Voltage, which can be configured on the System Parameters page.

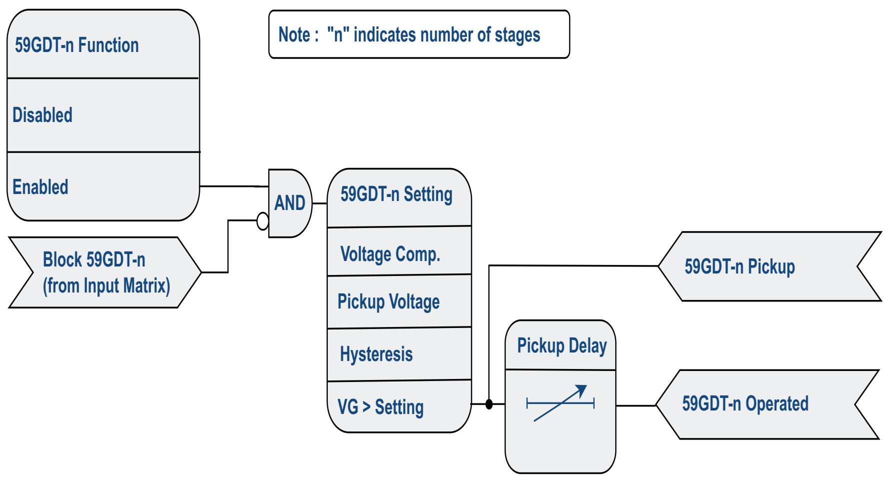


Figure 5.29: 59GDT Function Logic

Table 5.27: 59GDT - Definite Time Measured Residual Overvoltage Settings	
Setting Description	**Setting Range**
59GDT-1, 2	Enabled/Disabled
Voltage Compensation	0.0V to 15.0V
Pickup VG	1.0V to 250.0V
Hysteresis	1% to 80%
Pickup DTL Delay	0.00s to 999.99s
Reset DTL Delay	0.00s to 999.99s

59GIT - Measured Residual Inverse Time Overvoltage

The 59GIT element provides zero-sequence overvoltage protection using a broken delta potential transformer (PT) configuration. It is designed for ungrounded or high impedance grounded systems, where neutral overcurrent protection is either not applicable or lacks the sensitivity required for reliable ground fault detection. It is provided with only one Programmable stage for 59GIT function.

- **Definition of Inverse Time Characteristic:** The relay’s trip time is inversely proportional to the Increase in the Measured voltage level.
- **Pickup setting:** when the Measured voltage at the analog input exceeds the set 59G pickup level this function gets picked up.
- **Time -Voltage Curve characteristic:** Various curve options are available, including DTL, IEC Standard Inverse, IEC Extreme Inverse, IEC Long time Inverse to tailor the relay's response to different voltage values.

  Additionally, a user-defined curve allows for customized time-voltage characteristics.
- **TMS Setting:** The Time Multiplier Setting (TMS) adjusts the relay's operating time according to the selected Time Voltage Characteristic curve. This feature is essential for ensuring proper coordination between the relay and other protective devices in the system.

Note: This function becomes active only when the voltage input selection is set to Neutral Voltage, which can be configured on the System Parameters page.

The equation for the function 59GIT is given as below:

$$T(V_G) = TMS\left[B + \frac{A}{\left(\frac{V_G}{V_{GPickup}}\right)^{\rho} - 1}\right]$$

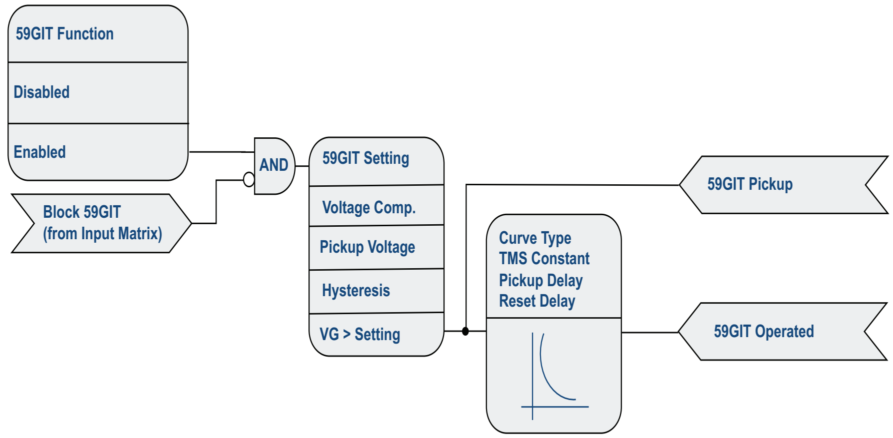


Figure 5.30: 59GIT Function Logic

Table 5.28: 59GIT - Inverse Time Measured Residual Overvoltage Settings	
Setting Description	**Setting Range**
Voltage Compensation	0.0V to 15.0V
Pickup VG	1.0V to 250.0V
Hysteresis	1% to 80%
Curve Type	DTL, IEC Standard Inverse, IEC Extreme Inverse, IEC Long Time Inverse, User Defined
TMS	0.01 to 10.00
Pickup DTL Delay	0.00s to 999.99s
Reset DTL Delay	0.00s to 999.99s
A	0.1 to 50.0
B	0.0 to 10.0
p	0.1 to 10.0

5.3 Frequency Protection Functions

81U/O Under/ Over frequency

In modern power systems, frequency protection plays a critical role in maintaining system stability and avoiding damage to equipment.

There are four separate configurable stages available for frequency protection 81U/O (1 to 4). Each stage can be independently set and configured as either Under Frequency (UF) or Over Frequency (OF) protection based on system requirements. This flexibility allows for precise and responsive control across a range of operating conditions.

Over frequency: Over frequency arises due to an excess of power generation in the system. This situation can typically be corrected by reducing power output using the governor control or through manual intervention. If left unchecked, over frequency can lead to equipment damage or system instability.

Under frequency: Under frequency occurs when there is an excessive load compared to the available generation. During such overload conditions:

- The generation capability is exceeded, causing a drop in system frequency.
- The power system can only survive if load shedding is performed to bring demand in line with available generation.
- If the load continues to exceed the generation, the frequency will drop further, potentially causing a system collapse.
- The rate of frequency decay depends on:
- The amount of overload,
- The response time of corrective mechanisms,
- The characteristics of the load and generation.

Frequency can decay within seconds, making manual intervention impractical. Therefore, automatic load shedding systems must be employed to quickly disconnect non-critical loads and stabilize the system.

Operation of Frequency Protection Functions:

The Over Frequency (81O) protection function operates when the measured frequency reaches or exceeds the set pickup value.

The Under Frequency (81U) function activates when the frequency falls to or below the pickup value.

The dropout of each function depends on the hysteresis setting, which prevents chattering and allows for stable operation.

The hysteresis value (in Hz) can be customized by the user to suit the application and operational preferences.

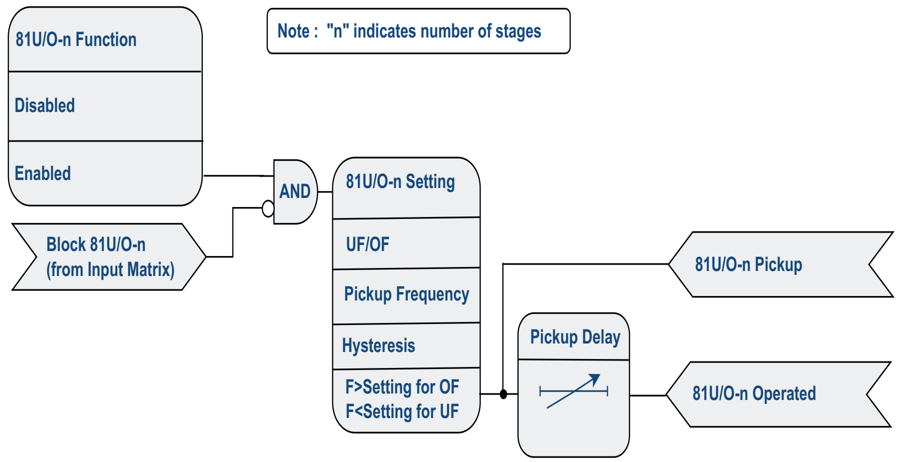


Figure 5.31: 81 U/O Function Logic

Table 5.29: 81U/O - Under/Over Frequency Settings	
Setting Description	**Setting Range**
81/U/O-1, 2, 3, 4	Enabled/Disabled
Function Selection	UF or OF
Pickup F	40.00 to 49.99 for 50Hz UF 50.01 to 60.00 for 50Hz OF 50.00 to 59.99 for 60Hz UF 60.01 to 70.00 for 60Hz OF
Hysteresis	0.01 to 2.00Hz
Pickup Delay	0.05 to 999.99s

81R Rate of change of frequency

The Rate of Change of Frequency (ROCOF) protection, designated as 81R, is a crucial function in modern power systems for the fast and accurate detection of frequency instability. Unlike conventional frequency protection (81U/81O), which responds to absolute frequency deviations, ROCOF protection monitors how rapidly the frequency changes over time—typically measured in Hertz per second (Hz/s).It consist of two Independent configurable stages 81R(1 to 2).

Rate of change of frequency (ROCOF or df/dt):- It is used for fast load shedding, to speed up operation time in over- and under-frequency situations and to detect loss of grid. For example a centralized dedicated load shedding relay can be omitted and replaced with distributed load shedding, if all outgoing feeders are equipped with protection devices.

A special application for ROCOF is to detect loss of grid (loss of mains, islanding). The more the remaining load differs from the load before the loss of grid, the better the ROCOF function detects the situation.

Operation:

Whenever the rate of change of frequency reaches same or above (If set Pickup is Positive values) the pickup value, then this function gets operated.

Whenever the rate of change of frequency reaches same or below (If set Pickup is Negative values) the pickup value, then this function gets operated.

The dropout frequency mainly depends on the % hysteresis.

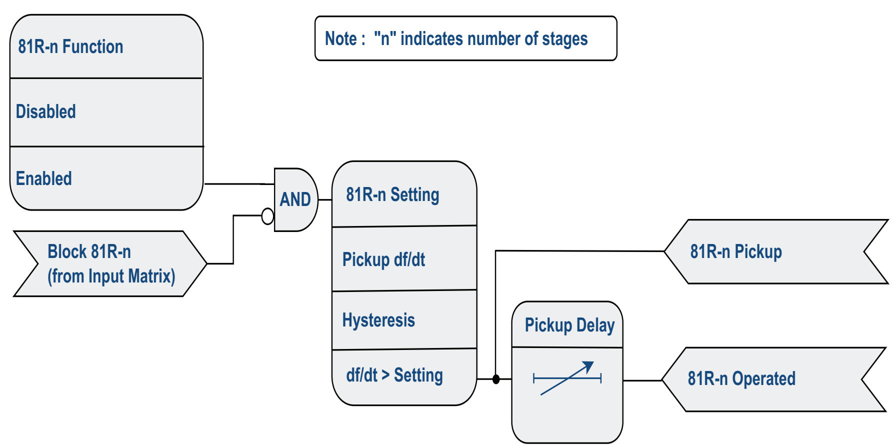


Figure 5.32: 81R Function Logic

Table 5.30: 81R Rate of Change of Frequency Settings	
Setting Description	**Setting Range**
81R-1,2	Enabled/Disabled
Pickup df/dt	-10.0 to -0.1Hz/s or 0.1 to 10.0Hz/s
Hysteresis	1 to 80%
Pickup Delay	0.20 to 999.99s

5.4 Monitoring Functions

THD Alarm

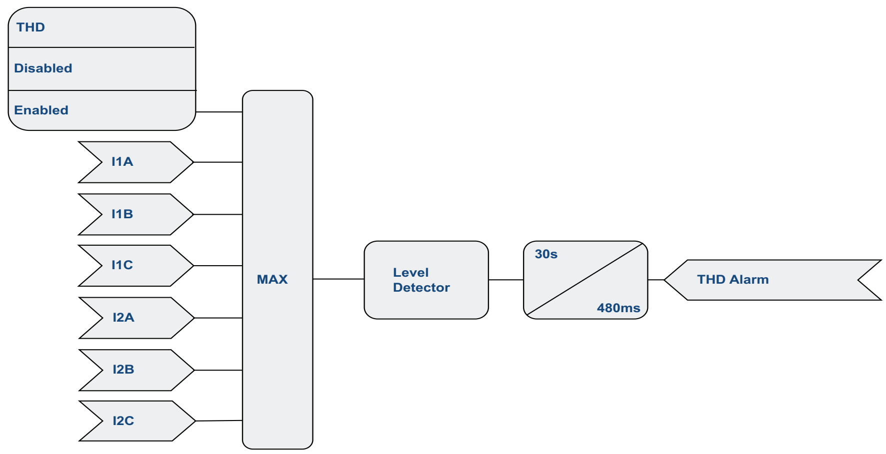


Figure 5.33: THD Function Logic

The THD Alarm function alerts you to the degree of current waveform distortion and therefore harmonic content.

For example, a THD setting of 10% means that the THD function operates if the total harmonic distortion exceeds 10% of the fundamental in any of the fundamental protection currents.

THD = 100% times the square root of the sum of the squares of the current harmonics (2nd – 8th) divided by the fundamental current value.

THD is defined as:

$$THD = \frac{\sqrt{\sum_{n=2}^{8} I_n^2}}{I_1} \times 100 \qquad (6)$$

where:

I1 is the fundamental component

n=2 to n=8 are the harmonics components

The inputs to this function are the THD values of all the current input channels that are connected to the transformer. The channels that are not connected to the transformer (e.g. for recording only) or channels with low fundamental signals (less than 14% of nominal current) are not calculated for THD. The alarm is activated if the highest THD found exceeds the setting.

There is a built-in fixed time delay of from 30 seconds pickup and 1 – 10 seconds dropout to ensure that this is not a transient fault condition. The THD is executed in a slow rate, once per second. The THD values are calculated from the 32 samples buffer rather than the decimated 8 samples buffer because higher harmonics content (up to the 8th) can be included with 32 samples.

Table 5.31: Total Harmonic Distortion (THD) Alarm

THD Alarm	Enable/disable
Pickup (%)	5.0 to 100.0

Through Fault Monitor

The Through Fault Monitor function in T-PRO is used to analyze the thermal and mechanical effects of through faults on the transformer. The monitored quantities include the duration of each through fault, the current peak RMS value and the accumulated I^2t value of each phase during each through fault event. The total number of the through faults and the total accumulated I^2t values of each phase over the transformer life are also monitored.

The overall through fault monitor scheme is shown in the following figure.

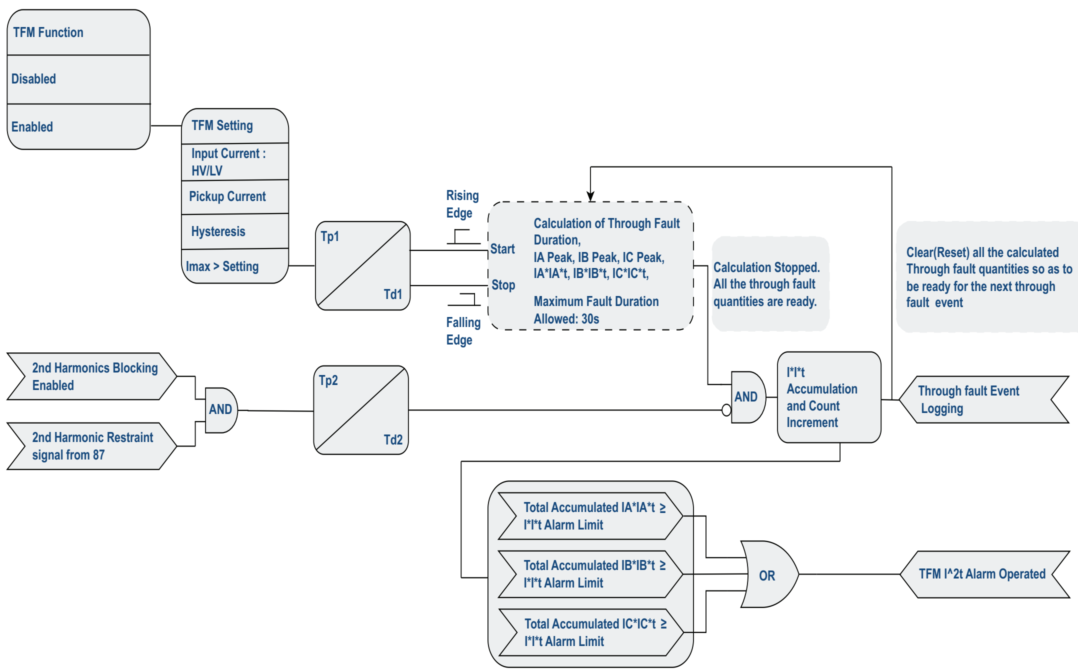


Figure 5.34: TFM Scheme Function Logic

The through fault duration is defined as the time from when the input current Imax (the maximum current amongst phase A, B and C) exceeds the pickup threshold to when I_{max} drops below the pickup threshold - hysteresis. Note that the maximum allowed through fault duration is 30 seconds, this is to avoid the through fault event may never stop in case the pickup setting is set improperly so that the through fault event might be triggered under some load conditions. Pickup delay Tp1 and dropout delay Td1 are set to zero by default, however they can be set to other values based on the user's needs.

The2nd harmonic restraint logic output from device 87 is used to block the creation of through fault events on magnetizing inrush. The pickup and dropout timer (Tp2 and Td2) are used to distinguish between the 2nd harmonics caused by the fault transient and 2nd harmonics caused by transformer energization inrush. 2nd harmonics in the fault current only last for a very short period of time (e.g. 1 cycle or shorter) and 2nd harmonics in the inrush current last for quite a long time (e.g. a second or even longer). "2nd Harmonics Content in Fault Current" on page 5-57 shows an example of 2nd harmonics existing for a short time on load to fault transition.

Tp2 setting (default to 20ms) is used to ensure that the 2nd harmonic blocking will be only applied on the inrush current. Td2 setting is used to stretch the 2nd harmonics blocking signal once it picks up ensure that cannot reset too soon after the onset of inrush.

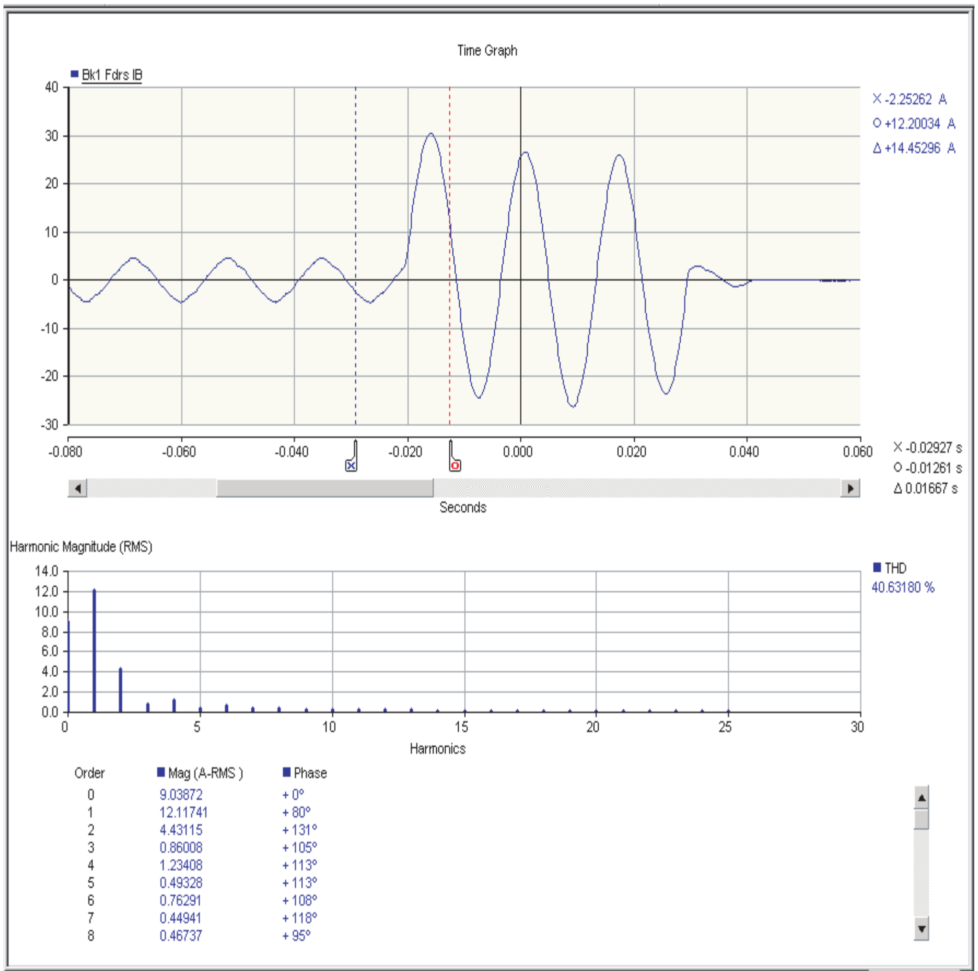


Figure 5.35: 2nd Harmonics Content in Fault Current

An alarm will be issued when the total accumulated I^2t value of any phase exceeds the preset threshold. When this occurs, some maintenance to the transformer should probably be scheduled. After that is completed, the total accumulated I^2t value should be reset. The I^2t alarm limit threshold may also need to be adjusted accordingly after successive accumulated I^2t values have been reached.

The through fault events and the associated monitored quantities can be viewed in the Event Log. The values are Through Fault Peak and Through Fault I*I*t in Relay Control Panel. To avoid data loss of the through fault events, *Event Auto Save* feature in the *Record Length* settings should be enabled.

Table 5.32: Through Fault Monitor Setting Ranges

Through Fault Monitor	Enable/Disable
Input Current	HV or LV
Pickup Level (A)	0.25 to 50.00A for 5A 0.05 to 10.00A for 1A
Hysteresis (A)	0.00 to (0.2 * Pickup)
Pickup Delay (Tp1, seconds)	0.00 to 99.99
Dropout Delay (Td1, seconds)	0.00 to 99.99
I*I*t Alarm Limit (kA^2*s)	0.1 to 9999.9
2nd Harmonics Block	Enable/Disable
2nd Harmonics Block Pickup Timer (Tp2, seconds)	0.00 to 99.99
2nd Harmonics Dropout Timer (Td2, seconds)	0.00 to 99.99

74TCS - Trip Circuit Supervision

Trip Circuit Supervision generates a trip circuit failure/unhealthy alarm, either if the trip circuit auxiliary supply is disconnected or the breakage of trip circuit connection.

74TCS function detects trip circuit failure when 74TCS asserts and followed by the drop-off timer unit operation. The drop-off timer delay can be set using 74TCS DTL setting value. On expiry of the drop-off delay, the final operate output of the function is issued. The 74TCS is externally initiated via an External Input, configured on the Input Matrix. If the 74TCS initiation is not configured in the Input Matrix, the function cannot operate.

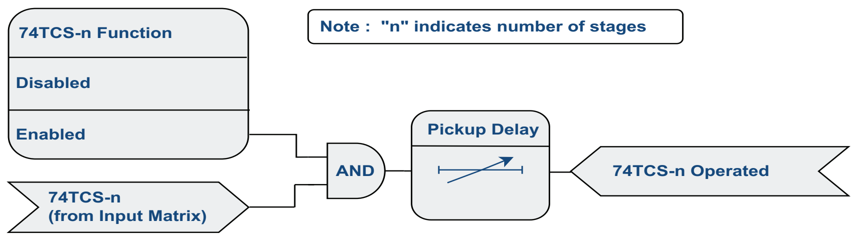


Figure 5.36: 74TCS Function Logic

Settings

Table 5.33: 74TCS - Trip Circuit Supervision Settings	
Setting Description	**Setting Range**
TCS-1	Enabled/disabled
Name	Configurable text string. Max 12 characters.
Dropoff Delay	0.00s to 9.99s
TCS-2	Enabled/disabled
Name	Configurable text string. Max 12 characters.
Dropoff Delay	0.00s to 9.99s

TCS Schemes

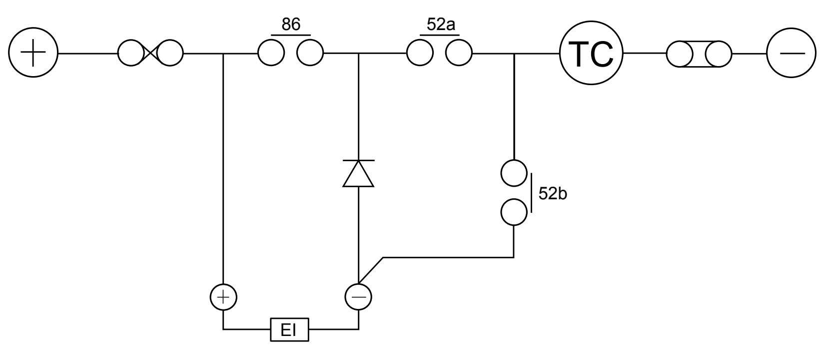


Figure 5.37: TCS Scheme 1

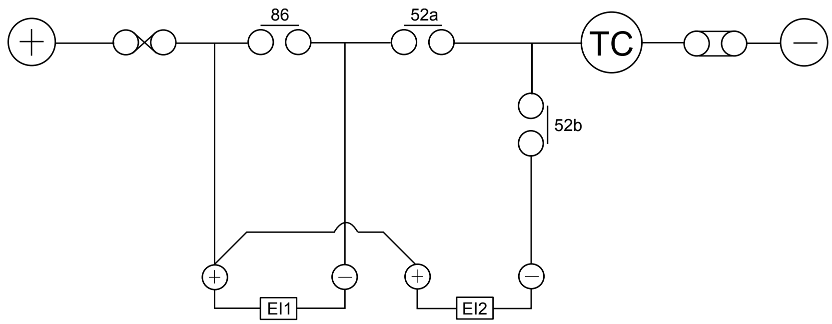


Figure 5.38: TCS Scheme 2

74TCS Using ProLogic

If the Trip Coil Supervision function is required for more than two coils, it can be achieved using ProLogics. The above mentioned schemes can be achieved using the ProLogic feature, as shown in the figures below.

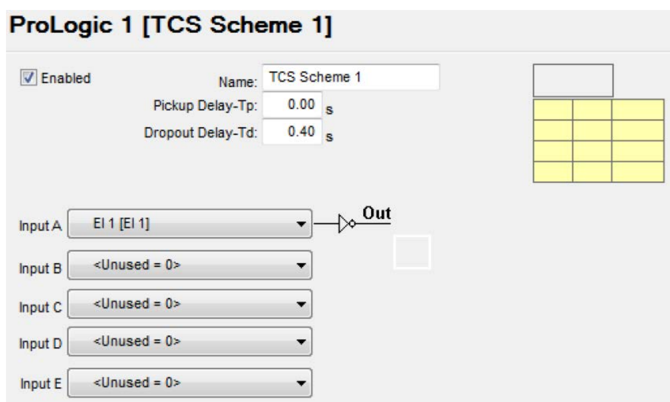


Figure 5.39: ProLogic TCS Scheme 1

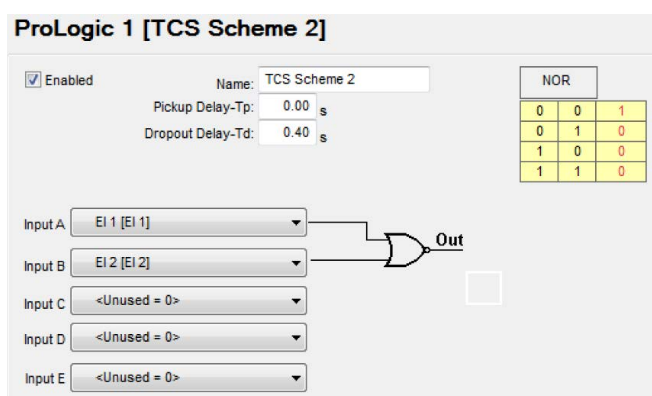


Figure 5.40: ProLogic TCS Scheme 2

The Output Contact and LED can be assigned for ProLogic 1 to generate an alarm during Trip Circuit unhealthy condition.

I^2t - CB Condition

The I^2t function is used for monitoring the wear and tear of the breaker due to fault interruptions. The I^2t value is accumulated for every operation and stored in the non-volatile memory. The write time interval is 0.5 seconds. A fixed maximum write time of 20 seconds prevents the I^2t function from constantly writing to non-volatile memory. Therefore if the start signal is held on for longer than 20 seconds the accumulator stops accumulating and stops writing to the flash memory. The output of the I^2t function is only available in the Event Log, the Output Matrix or in the ProLogic input list.

The terminal UI and SCADA interfaces show the accumulated value of each breaker I^2t function and value of last operation. The terminal UI also includes the time of last reset/preset.

The following figure shows the I^2t function's logic diagram. The accumulation is started when the trip coil of the breaker is energized (breaker starts to open), and is stopped when the trip coil of the breaker is de-energized. The breaker open/close is determined by the tripping of the following functions:

- 50 HV/LV Trip, 51 HV/LV Trip
- 50N HV/LV Trip, 51N HV/LV Trip
- 46/50 HV/LV Trip, 46/51 HV/LV Trip
- 50G Trip, 51G Trip
- 49 Trip
- 50BF Trip

The current that is used for accumulation is the maximum current among phase A, B and C. An event message is generated when the accumulated I^2t value is above the limit.

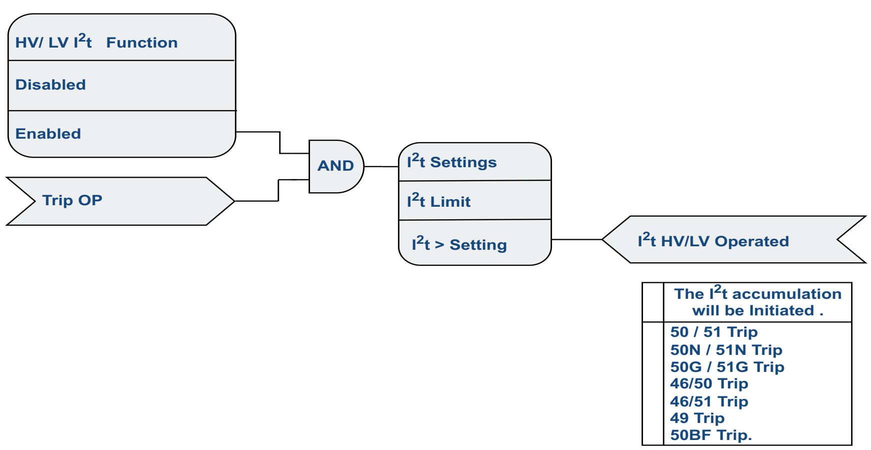


Figure 5.41: I^2T Function Logic

Settings

Table 5.34: I^2t HV/LV CB Condition Settings	
Setting Description	**Setting Range**
I^2t I^2T HV	Enabled/Disabled
I^2t Limit	0.1 to 99999.9 kA^2s
I^2T LV	Enabled/Disabled
I^2T Limit	0.1 to 99999.9 kA^2s

5.6 ProLogic

The relay includes 24 ProLogic functions. A ProLogic is a user customizable logic statement which can be created using any of the protection functions, External Inputs, Virtual Inputs or other ProLogics. These inputs are placed into Boolean-like statements. A graphical function logic interface is provided for creating the ProLogic logic. Each ProLogic handles up to 5 inputs to generate one ProLogic statement. The results from these statements are mapped to Output Contacts using the Output Matrix.

The ProLogic control statements are used to create Boolean-like logic. The possible gates are AND, NAND, OR, NOR, XOR, XNOR, and SR-LATCH. The control can be time delay pickup and or time delay dropout, and can drive the front panel target LED. Twenty-four ProLogic control statements outputs are available and can be used in the output matrix to customize the relay to specific needs. Inputs to ProLogic are all the elements plus previous ProLogic statements for logic nesting usage.

The example, for details see Figure 5.42: ProLogic on page 5-63, shows A to E inputs are status points of devices that are user-selectable. Each ProLogic output can be given a specific name, pickup and reset time delay.

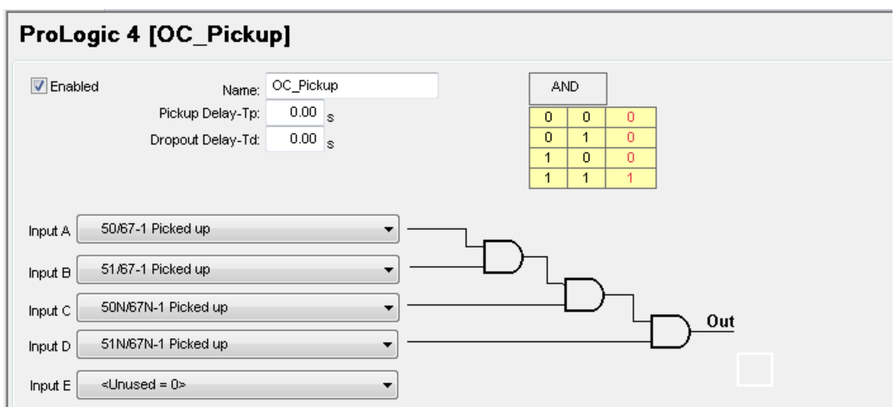


Figure 5.42: ProLogic

Table 5.35: ProLogic Setting Functions	
Name	Give the ProLogic a meaningful name
Pickup Delay	Delay time from pickup to operate. 0.00 to 999.00 s
Dropout Delay	Delay time from dropout to ProLogic status of low. 0.00 to 999.00 s
A, B, C, D, E	Relay elements as input statements
Operators	Boolean-type logic gates

5.7 Setting Group Change Control Statement

The T-PRO 2000 relay supports eight configurable setting groups (SG1 to SG8). Each group allows the user to modify all relay setting parameters, with the exception of physical connections such as inputs, which remain fixed across all groups.

Setting group changes can be initiated in the following ways:

- Via any of the 14 dedicated Digital Inputs available per setting group
- Through the Relay Control Panel
- Using the relay's front panel display interface

The digital inputs for group selection function similarly to LEDs and output signals. When a group change is initiated, the relay requires approximately 0.5 seconds to process and activate the new group. During this transition period, the previous setting group remains fully operational, ensuring uninterrupted protection and control.

The currently active setting group (ASG) can be viewed through:

- The Relay Control Panel
- The relay’s front panel
- Stored records maintained by the relay, which include the active group identifier

Active Setting Group

Setting Group 1 is configured as the factory default setting group for the relay. The relay also retains the currently active setting group in non-volatile memory, allowing it to automatically restore the last active group after a power interruption. This ensures the relay resumes operation with the same configuration that was active prior to the power loss.

Default Setting

The user can manually change the active setting group at any time. When a manual change is initiated, it takes precedence over any automatic setting group change that may be configured.

Setting Group Change Through RCP

The setting group can be changed using the Relay Control Panel, with either Change or Service access level, using the following path:

Relay Control Panel > Utilities > Settings Group

In this tab, choose desired setting group number and Click *Save*.

Group Change Through LCD

The setting group can also be changed using the relay display interface, after login in with the Change or Service access level, using the following path:

Main Menu > Configuration > Setting Group> Active

In this screen, hit Enter and choose the desired setting group number using Up and Down keys, and then click Enter.

Setting Group Change During Setting Load

The user can change the active setting group while loading settings from Relay Control Panel. Relay Control Panel prompts the user for a setting group to active while loading the setting. The same setting group may be used or the user may switch to a different setting group.

Manual Settings Change

Relay settings can be manually modified via the LCD interface. Upon accepting a change request, the relay logs the event and queues the new setting file for activation. Once queued, the relay begins loading the new configuration for all protection functions.

In addition, the relay updates the supplementary settings—including channel names, Prologic names, front panel LED target activation rules, and record initiation rules—which are sent to the interface processor.

When the setting load process is complete, an event is logged to confirm successful application. It is important to note that there is an approximate five-second delay between the load request and its completion. During this brief period, some supplementary settings may be temporarily applied to the previous configuration.

> The Protection processor does not have any interruption in service.

Automatic Settings Change

The relay configuration changes during a relay-initiated setting change, but the protection function operations are not disrupted. Since the relay setting file does not change, the interface processor uses the new setting group supplementary setting information at the same time as the protection processor switches to the new setting group. An event is logged to show when the new setting group is in service.

5.8 Recording Functions

Introduction

The relay has high speed fault recording and logging functions to allow the user to analyze faults and to review the operation of the overall protection scheme.

Fault Recording

The relay provides DFR-quality fault recording, capturing input signal waveforms and external input states at a rate of 32 samples per cycle. Each record also contains the timing of the internal logic produced by the relay (e.g. Device 51 trip). Obtain this information by retrieving the records from the relay via Relay Control Panel and view them by using the Record Graph software.

The quantities recorded are:

- 8 analog channels (7 Currents and 1 voltage) @ 32 samples/cycle which captures up to the 8th order of harmonic: 6 Phase current, 1 SEF current, 3 Phase voltage and 1 Vsync
- Voltage and current at 32 samples/cycle: 6 derived analog channels (3 operating currents, 3 restraint currents all are magnitude quantities in per unit) @ 8 samples/cycle. These derived analog channels can be displayed on a differential trajectory graph
- External digital inputs at 32 samples per cycle
- Relay Output internal logic signals at 8 samples/cycle
- 10 summation channels (3-phase HV, LV currents, HV, LV 3I0 currents and HV REF IO and IR quantities) @ 32 samples/cycle up to the 8th order of harmonic
- 30 Virtual Inputs at 8 samples/cycle
- 24 ProLogic signals at 8 samples/cycle
- Active setting group

Record Initiation

Recording can be initiated automatically by the relay when a fault or abnormal condition is detected. Set the relay to initiate a fault record on activation of any of its trip or alarm functions or on assertion of any external digital inputs.

The assignment of fault record initiation to the various relay functions is done through the relay's Output Matrix settings.

A recording can also be initiated manually through the Relay Control Panel.

The commands Trigger Fault and Trigger Event are available under the following path:

Relay Control Panel > Records

Record Duration and Extension

The length of each record is information by the Record Length setting. Fault record lengths can be set between 1 and 10 seconds. Pre-trigger times can be fixed from 0.1 to 2 seconds for fault records and are included as part of the normal record length.

The T-PRO 2000 relay has a inbuilt Auto DR Extension Feature where the relay automatically extends a fault record when consecutive triggers occur close together. If a new trigger is detected while a recording is already in progress, the relay stretches the ongoing record to include the full post-trigger duration of the latest event—up to a maximum of 12 seconds for fault records.

If a subsequent trigger occurs too late in the existing recording—such that there's not enough time remaining to capture the full post-trigger data within the 10-second limit—the relay creates a new, overlapping record to ensure complete data capture for both events.

The normal record lengths settings can be set from either the HMI or the Offliner Settings software and accessible in Menu below.

Configuration>Disturbance record setting >Record Length

Record Storage

The T-PRO compresses records on the fly, achieving a typical lossless compression rate of 4:1. As a result, the T-PRO 2000 can store up to 20 numbers (Record length of 10 Sec Each) of fault recordings in non-volatile storage. If the storage is full, new records automatically overwrite the oldest, ensuring that the recording function is always available.

Record Retrieval and Deletion

A list of stored records is available through the Relay Control Panel in the Records tab. From Relay Control Panel user can retrieve the record and delete or leave on the relay, graph the record, export the record to COMTRADE/ PTI & CSV formats. Records are named by combining the Unit ID setting with the date and time of the initiating record trigger.

To delete a record from storage, right-click on the record and select Delete, or alternatively, select the record and press the <Del> key. User can also do group deleting and group transferring. To select multiple records:

1. Select a record

2. Hold the <Shift> key.

3. Continue selecting records until all desired records are selected.

4. Press the <Del> key. A message asks "Are user sure user want to delete multiple records from the relay?" shown above. Select Delete and the files are deleted.

When a record is retrieved from the relay using the Relay Control Panel program, it is automatically transferred and saved to the user's PC. The record is stored in the local path defined in the "Recordings Folder" in the Folder Placement as shown in Figure 5.43: Recordings folder. This ensures all retrieved records are organized and readily accessible in the specified directory on the user's machine.

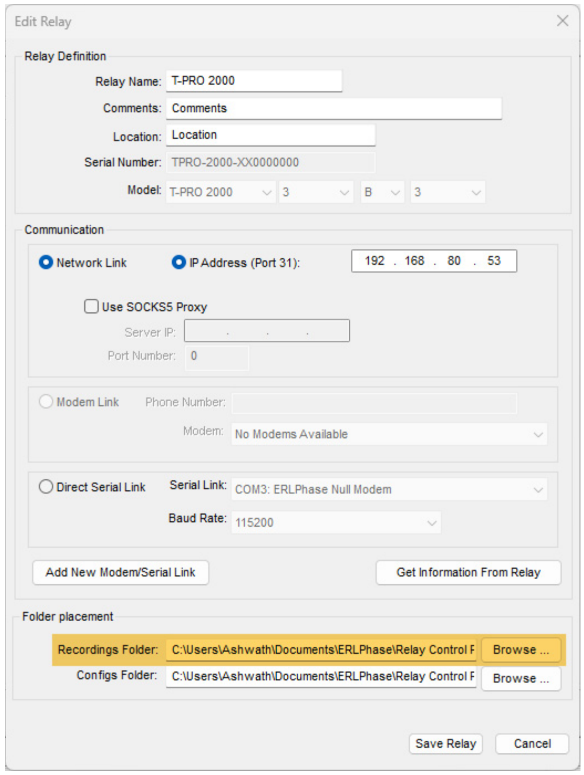


Figure 5.43: Recordings folder

Event Recording

The event log can be stored as Records. The user can either

create an event record manually by using the Trigger Event Tab in the Record's page of RCP or Automatically create a Event Record with file extension as .tpe by using a Feature called Event Auto save (trigger's Event Record for every 1000 records approx).

5.9 Event Log

The T-PRO 2000 maintains a log of events in a 1000 entry circular log. Each entry contains the time Logged events include trips, alarms, external input information plus internal events such as setting changes. Fault information and classification information is included in event messages where appropriate. For example, the event log entry for a function trip might be:

2019 DEC 25, 15:34:19.832: 51-1 ABC Operated.

The event log can be viewed in three ways:

•Relay Front HMI

•Relay Control Panel interface is in the Events tab

•SCADA protocols included in the T-PRO allow the SCADA server/client access to Trip and Alarm event data.

Although the event log is circular, you may ensure events are not lost by checking the Event Auto Save box in the Disturbance Record setting screen of T-PRO Offliner. When this option is selected, as the event log approaches 1000 events approx, it will save the Events to an Record file with an ".tpe" Extension Making the event log ready to capture up to 1000 new events.

This display is a snapshot of the event list which must be manually refreshed to display new events that occur while the display is up.

There is a list of Event Messages, for details see "Event Messages" in Appendix D.

5.10 Fault Log

The T-PRO stores a log of faults in a 20 entry circular log. Each entry contains the time of the fault, fault type, faulted phase, fault quantities as per the below table. Fault log will be triggered only for trip condition and it won't log for an alarm condition.

Table 5.36: Fault Log

Fault Type	Fault Quantities
87 Differential	87 IO, 87 IR magnitude
87N Differential	87N IO, 87 IR magnitude
27/59DT Definite Time Under/Over Voltage	VIN Phasors
27/59IT Inverse Time Under/Over Voltage	VIN Phasors
24DT Definite Time Overflux	VIN Phasors, V/F pu
24IT Inverse Time Overflux	VIN Phasors, V/F pu
59GDT Definite Time Measured Residual Overvoltage	VIN Phasors
59GIT Inverse Time Measured Residual Overvoltage	VIN Phasor
50DT HV Phase Overcurrent 50DT LV Phase Overcurrent 51IT HV Phase Overcurrent 51IT LV Phase Overcurrent	I1A,I1B,I1C Phasors I2A,I2B,I2C Phasors I1A,I1B,I1C Phasors I2A,I2B,I2C Phasors
50NDT HV Derived Neutral Overcurrent 50NDT LV Derived Neutral Overcurrent 51NIT HV Derived Neutral Overcurrent 51NIT LV Derived Neutral Overcurrent	I1A,I1B,I1C, Input-1 3I0 Phasors I2A,I2B,I2C, Input-2 3I0 Phasors I1A,I1B,I1C, Input-1 3I0 Phasors I2A,I2B,I2C, Input-2 3I0 Phasors
46/50DT HV Negative Sequence Overcurrent 46/50DT LV Negative Sequence Overcurrent 46/51IT HV Negative Sequence Overcurrent 46/51IT LV Negative Sequence Overcurrent	I1A,I1B,I1C Phasors I2A,I2B,I2C Phasors I1A,I1B,I1C Phasors I2A,I2B,I2C Phasors
50GDT Measured Neutral Overcurrent /High Impedance REF 50GIT Measured Neutral Overcurrent	IN Phasor IN Phasor
49 Thermal Overload	I1A,I1B,I1C,I2A,I2B,I2C Phasors
81 U/O Frequency	VIN Phasors, Frequency
81R ROCOF	VIN Phasors, dF/dt

The fault log can be viewed in three ways:

- Relay Front HMI
- Relay Control Panel interface is in the Events tab
- 61850 SCADA protocol included in the T-PRO allow the SCADA client access to Fault log data

6 Data Communications

6.1 Introduction

This chapter deals with data communications with the relay. First, the SCADA protocol is discussed, and it is then followed by the IEC 61850 communication standard.

The SCADA protocol deals with the Modbus, IEC 60870-5-103 and DNP3 protocols. The SCADA configuration and its settings are described. The parameters for SCADA communications are defined using T-PRO Offliner software. Finally, details on how to monitor SCADA communications are given for maintenance and troubleshooting of the relay.

6.2 SCADA Protocols

Modbus Protocol

The relay supports either a Modbus RTU or Modbus ASCII SCADA connection. Modbus is available exclusively via a direct serial link. Serial Modbus communications can be utilized exclusively via serial Port 122, an RS-232 DCE DB9F port located on the back of the relay. An external RS-232 to RS-485 converter can be used to connect the relay to an RS-485 network. For details on connecting to serial Port, see “Communicating with the Relay” on page 3-5 and “Communication Port Details” on page 3-15.

The data points available for Modbus SCADA interface are fixed and are not selectable by the user. Complete details regarding the Modbus protocol emulation and data point lists can be found in “Modbus RTU Communication Protocol” in Appendix E.

IEC 103 Protocol

The relay supports IEC 60870-5-103 SCADA connection. IEC 103 is available via a RS485 serial link.

Serial IEC 103 communications can be utilized exclusively via serial CON 32 (RS485 port) is located on the rear of the relay. An external RS-485 to RS-232 converter can be used to connect the relay to an RS- 232 network. For details on connecting to serial Port, see “Communicating with the Relay” on page 3-5 and “Communication Port Details” on page 3-15.

Complete details regarding the IEC 103 protocol emulation and data point lists can be found in “IEC 103 Device Profile” in Appendix G.

DNP Protocol

The relay supports a DNP3 (Level 2) SCADA connection. DNP3 is available via a direct serial link or an Ethernet LAN connection using either TCP or UDP.

Serial DNP communications can be utilized exclusively via serial Port CON 32. Port CON 32 is an RS-485 DCE DB9F port located on the back of the relay. An external RS-485 to RS-232 converter can be used to connect the relay to an RS-485 network. For details on connecting to serial Port, see “Communicating with the Relay” on page 3-5 and “Communication Port Details” on page 3-15.

DNP communications can be used with multiple masters when it is utilized with TCP. For details on connecting to the Ethernet LAN, see “Network Link” on page 3-8.

The data points available for DNP SCADA interface are user configurable. Complete details regarding the DNP3 protocol emulation and data point lists can be found in “DNP3 Device Profile” in Appendix F

Offliner SCADA Configuration

Open the Offliner application and highlight the SCADA Communication selection. The screen appears as follows.

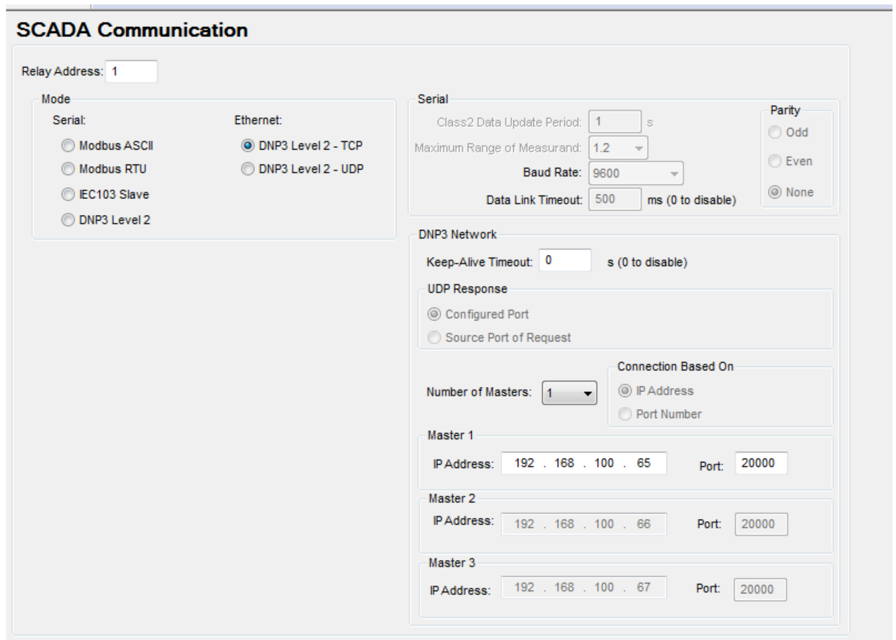


Figure 6.1: SCADA Communications

The configuration of SCADA communication parameters via the Offliner application is very intuitive. Several settings options are progressively visible and available depending on other selections. As noted before, there is no field to configure the number of data and stop bits. These values are fixed as follows:

- Modbus Serial – 7 data bits, 1 stop bit
- DNP Serial – 8 data bits, 1 stop bit

IEC 61850

For more details on the IEC 61850 standard, and it's implementation on the T-PRO 2000, see "IEC 61850 Implementation Overview" on page 9-1 and "IEC 61850 Conformance Statements and Data Mapping Specification" in Appendix L' on page Appendix L-1.

7 Settings and Analysis Software

This section describes the supporting software used to set the relay parameters and to analyze records. There are three main software tools used for these purposes: T-PRO 2000 Offliner Setting Software, RecordGraph and ERL 61850 IED Configurator. The T-PRO 2000 Offliner software will be described at length, while the RecordGraph and ERL 61850 IED Configurator tools will be briefly introduced.

T-PRO 2000 Offliner is used to configure all of the protection and system parameter variables on the IED. Setting files are created locally on a personal computer with the Offliner software and then are sent to the IED through Relay Control Panel (see “Relay Control Panel” on page 4-10) via a communication link (see “Communicating with the Relay” on page 3-5).

RecordGraph is a powerful record analysis tool used to analyze both high-speed Fault Recordings and low-speed Swing Recordings. RecordGraph provides many useful tools including fault impedance plotting and harmonic analysis.

RecordBase View is a Windows-based software tool for displaying and managing records from ERLPhase recorders and relays.

The RecordBase Central Station software provides automated collection, storage and network-wide access to fault and disturbance data produced by supported ERLPhase recorders and relays. It is available for purchase.

The ERL 61850 IED Configurator is used to configure ERLPhase IEC 61850 based devices for substation automation. This tool helps the user to map data from remote GOOSE into ERLPhase IED data, to perform GOOSE mapping from ERLPhase IEDs to other devices and to map the required RCB (Report Control Block) datasets for SCADA.

7.1 T-PRO 2000 Offliner Setting Software

Introduction

Offliner is used to configure all of the protection and system parameter variables on the IED. The following section provides a full breakdown of the user interface and all of the features available within the software.

More detailed information about relay settings and protection functions are provided in Chapter 5.

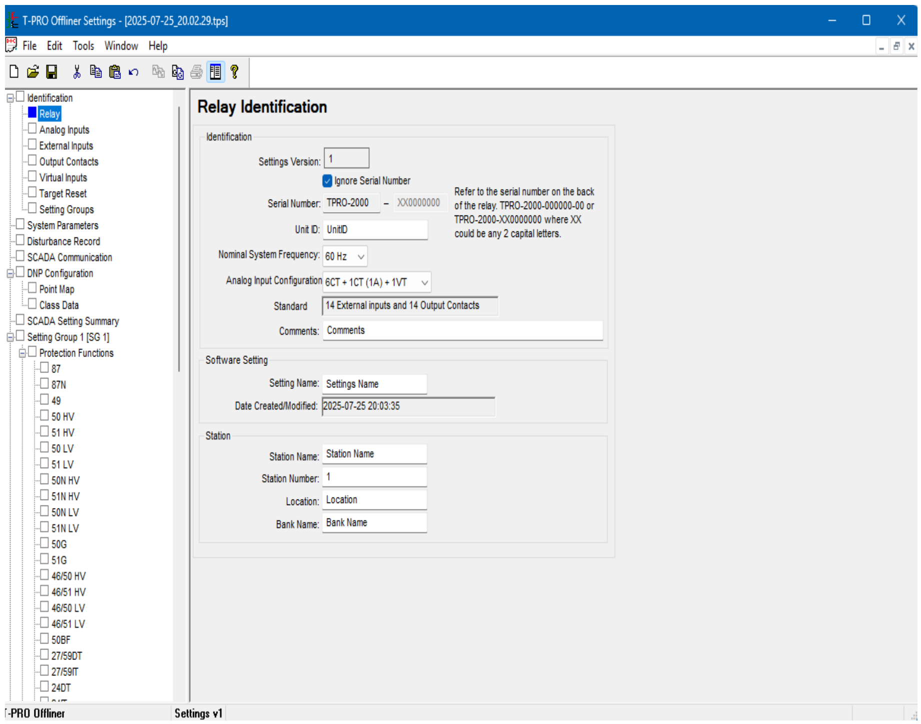


Figure 7.1: T-PRO 2000 Offliner Software

Menu and Toolbar

The Offliner software includes the following menu and system tool bar.

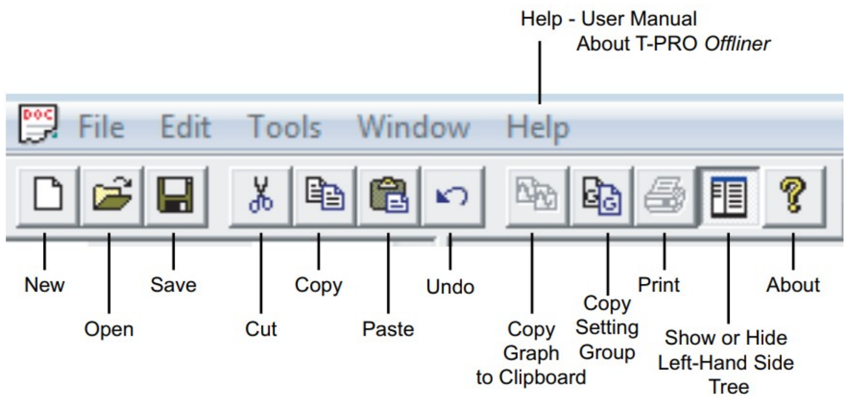


Figure 7.2: Top Tool Bar

Table 7.1: Windows Menu		
Windows Menu	**Sub Menu**	**Comment**
Document Menu (Icon)	Restore	Restores active window to previous size
	Move	Allows user to move active window
	Size	Allows user to resize active window
	Minimize	Makes the active window as small as possible
	Maximize	Makes the active window as large as possible
	Close	Closes the active Offliner setting document
	Next	Switches to the next open Offliner setting file, if more than setting file is being edited

Table 7.1: Windows Menu		
File Menu	New	Opens up a default setting file of the most recent setting version
	Open	Open an existing setting file
	Close	Closes the active Offliner setting document
	Save	Saves the active setting file
	Save As	Saves the active setting file with a new name or location
	Convert to Newer	Convert an older setting version to a newer version.
	Print	Prints graphs or setting summary depending on active screen
	Print Preview	Provides a print preview of the setting summary
	Print Setup	Changes printers or print options
	1-8	The eight most recently accessed setting files
	Exit	Quits the program
Edit Menu	Undo	Undo last action
	Cut	Cut the selection
	Copy	Copy the selection
	Paste	Insert clipboard contents
	Copy Graph	Copy the graph for the active screen to the clipboard
	Copy Setting Group	Copy values from one Setting Group to another
Tools	Options	Display and Print Only Enabled Protection Devices
Window	Cascade	Cascades all open windows
	Tile	Tiles all open windows
	Hide/Show Tree	If this option is checked then the LHS Tree view will be hidden
	1-9, More Windows	Allows access to all open Offliner setting files. The active document will have a check beside it
Help	User Manual	Displays the user manual
	About Offliner	Displays the Offliner version
Toolbar		
New	Create a new document of the most recent setting version	
Open	Open an existing document	

Table 7.1: Windows Menu	
Save	Save the active document
Cut	Cut selection
Copy	Copy the selection
Paste	Insert clipboard contents
Undo	Undo last action
Copy Graph	Copy the graph for the active screen to the clipboard
Copy Setting Group	Brings up the Copy Inputs dialog box
Show/Hide LHS Tree	If this option is checked then the LHS Tree view will be hidden
Print	Prints Graphs or the setting summary, depending on which seen is selected
About	Displays the Offliner version

Offliner Keyboard Shortcuts

The following table lists the keyboard shortcuts that Offliner provides.

Table 7.2: Keyboard Shortcuts	
Ctrl+N	Opens up a default setting file of the most recent setting version
Ctrl+O	Open an existing setting file
Ctrl+P	Print summary
Ctrl+S	Saves the active setting file
Ctrl+Z	Undo
Ctrl+X	Cut
Ctrl+C	Copy
Ctrl+V	Paste
Ctrl+F4	Closes the active Offliner setting document
Ctrl+F6	Switches to the next open Offliner setting file, if more than one setting file is being edited
F6	Toggles between the LHS Tree view and HRS screen
F10, Alt	Enables menu keyboard short-cuts
F1	Displays the user manual

Graphing Protection Functions

Grid On/Grid Off

The graph can be viewed with the grid on or off by clicking the Grid On or Grid Off button. A right-click on the trace of the curve gives the user the x and y coordinates.

Refresh

This button will manually refresh the graph if it has been zoomed.

Print Graph

To print a particular graph, click the *Print Graph* button.

Zoom on Graphs

Graphs can be zoomed to bring portions of the traces into clearer display. Right-click on any graph and drag to form a small box around the graph area. When the user releases the mouse, the trace assumes a new zoom position determined by the area of the zoom coordinates.

To undo the zoom on the graph, click the Refresh button.

Displaying Co-ordinates

At any time the user may right-click on the graph to display the co-ordinates of the point the user selected.

Handling Backward Compatibility

Offliner Settings displays the version number in the second pane on the bottom status bar. The settings version is a natural number (1, 2, 3, 4, etc.).

The Offliner Settings is backward compatible; open and edit older settings files and convert older settings files to a newer version. Offliner settings handles forward conversion only — it converts an older setting file to a newer setting file.

Converting a Settings File

1. Open the setting file to convert.
2. In the *File* menu, select *Convert to Newer...* and then select the *version x* (where x is the newer version). A dialog box pops up prompting Offliner for a new file name. Use either the same file name or enter a new file name. The conversion process inserts default values for any newly added devices in the new setting file. When the conversion is complete, Offliner Settings displays the new file.
3. When the new file has been opened, it must be re-saved in order for the conversion to complete successfully.

> After converting to a new File Version, the newly converted file must be opened and re-saved in order for the conversion to complete properly.

Sending a New Setting File to the Relay

1. Make sure the settings version and the serial number of the relay in the setting file match. The relay will reject the setting file if either the serial number or the settings version do not match.

> A "serial number discrepancy" message may appear. This is to ensure that the user is aware of the exact relay in which settings are to be loaded. If this happens, check the relay serial number in the LCD identification screen. Type this serial number into the T-PRO 2000 Serial No. box in the Identification tab display area of Offliner Settings. Alternately the user may check the Ignore Serial Number check box to bypass serial number supervision.

2. Check the serial number and the settings version of the relay. The Device Serial Number and Required Settings Version on the Identification screen indicate the serial number and the settings version of the relay.

Tree View - Introduction

The following sections describe the tree view, which provide access to the various setting screens. This section will not describe individual settings, but will provide a general description of where to find the individual settings. For a detailed description of the individual settings see Chapter 5.

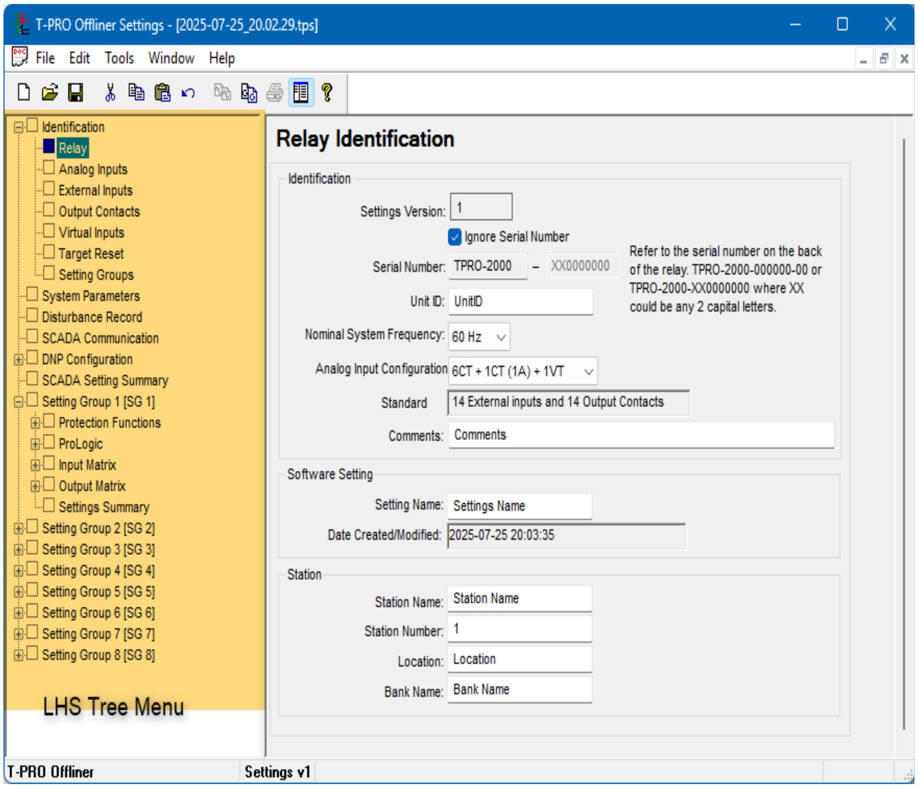


Figure 7.3: Relay Identification

In the LHS Menu Tree there are a series of menu headings that may have sub menus associated with them. Clicking on an item in the left hand side tree view will display its corresponding menu in the RHS view. Similarly, the user can use the arrow keys to scroll through the menu tree.

> The serial number of the relay must match the one in the setting file, or the setting will be rejected by the relay. This feature ensures that the correct setting file is applied to the right relay.
>
> The user can choose to ignore the serial number enforcement in the identification screen. The relay only checks for proper relay type and setting version if the ignore serial number has been chosen.

Identification

The first screen presents all the menu items in the left menu tree. Access the menu items by clicking the tabs at the top of the screen or the item on the left menu tree.

Table 7.3: Identification	
Identification	
Settings Version	Indicates the settings version number, fixed.
Ignore Serial Number	Bypass serial number check, if enabled.
Serial Number	Available at back of each relay.
Unit ID	User-defined up to 20 characters.
Nominal System Frequency	60 Hz or 50 Hz
Analog Input Configuration	6CT+1CT(1A)+1VT or 6CT+1CT(5A)+1VT
Standard I/O	Indicates standard I/O values, fixed.
Comments	User-defined up to 78 characters.
Software Setting	
Setting Name	User-defined up to 20 characters.
Date Created/Modified	Indicates the last time settings were entered.
Station	
Station Name	User-defined up to 20 characters.
Location	User-defined up to 20 characters.
Bay Name	User-defined up to 20 characters.

Important Note

Nominal System Frequency can be set to either 50 Hz or 60 Hz. Ensure setting selection matches that of target the relay.

The serial number of the relay must match the one in the setting file, or the setting will be rejected by the relay. This feature ensures that the correct setting file is applied to the right relay.

Choose to ignore the serial number enforcement in the identification screen by checking the *Ignore Serial Number* check box. The relay only checks for proper relay type and setting version if the ignore serial number has been chosen, requires relay firmware version 1.0 or greater.

External Inputs

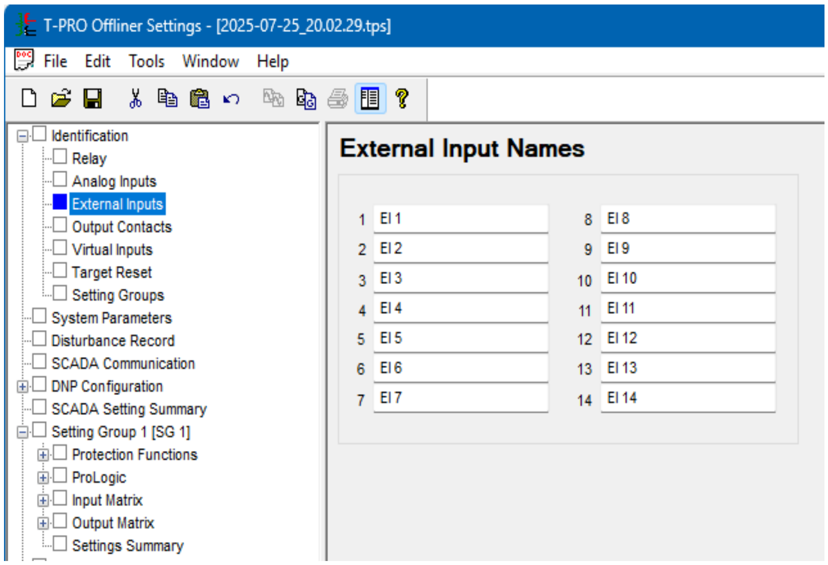


Figure 7.4: External Inputs

External Input Names screen allows the user to define meaningful names for 14 external digital inputs.

Table 7.4: External Input Names	
1 to 14	User-defined

Output Contacts

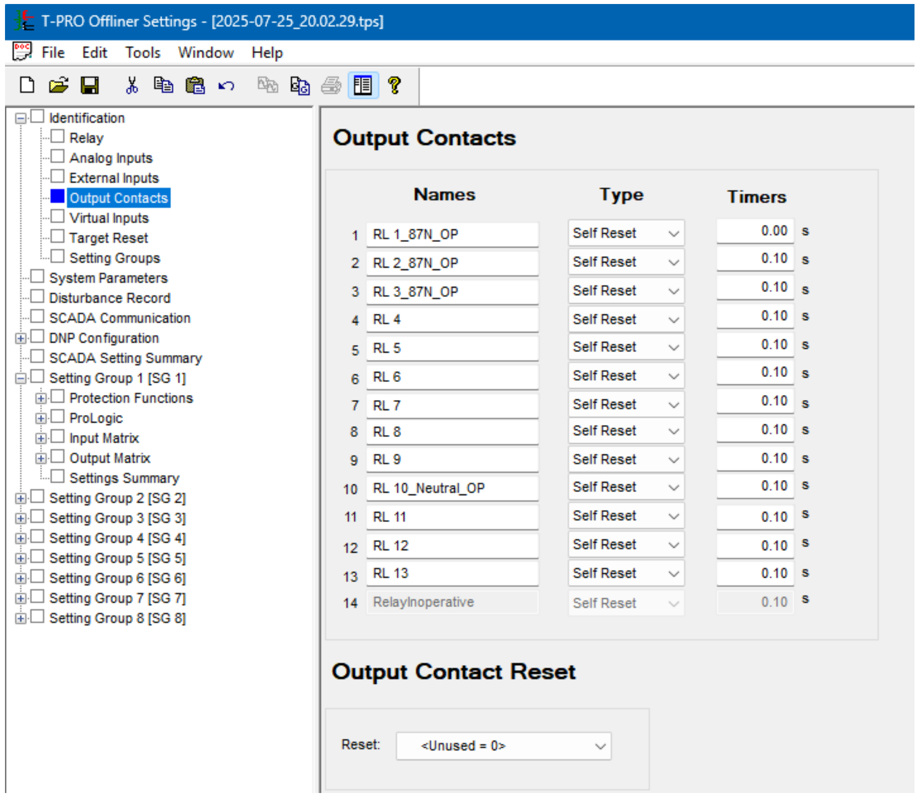


Figure 7.5: Output Contacts

The Output Contacts are also identified during the setting procedure using meaningful names. The dropout delay time settings are made here.

Table 7.5: Output Contact Names	
Outputs 1 to 14	User-defined
Type (per output)	Self Reset or Latched or Pulsed
Dropout Timer (per output)	0.00 to 1.00 s
Output Contact Reset	Any EI, PL, VI

The Output Contacts screen allows for configuration of each Output Contact’s name and reset type. It also allows for configuration of a global Output Contact Reset input which is used to externally reset all latched Output Contacts.

Each Output Contact may be given a unique user-configurable Name.

If the Output Contact is set to the Self Reset type, it will close for the duration that the associated function is High, plus the duration of the configured Timer.

If the Output Contact is set to the Latched Reset type it will close when the associated function goes High and will remain closed until the user manually resets it. A latched Output Contact can be reset either by the Front Panel, Relay

Control Panel's *Utilites>Outputs* Output Contact clear function or by the Output Contact Reset setting.

If the output contact is configured as "Pulsed Reset" type, it will close (go high) for a default duration of 1 second when the associated function becomes active (high). If a timer is configured, the output will generate a high pulse (default 1 second duration) followed by a low state at every configured interval, as long as the associated function signal remains high.

Virtual Inputs

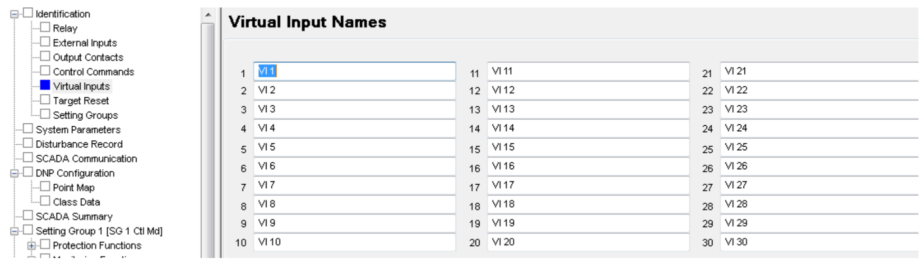


Figure 7.6: Virtual Inputs

Table 7.6: Virtual Inputs	
Virtual Inputs 1 to 30	User-defined

The relay can control its internal functions and connected devices both locally and remotely. Thirty general purpose logic points are accessible via DNP3 and the UI. The 30 virtual inputs are individually controlled and include a set, reset and pulse function. The latch state is retained during setting changes and relay power down conditions. Use the DNP3 functions such as SBO (select before operate), Direct Operate, or Direct Operate with no acknowledge to control virtual inputs.

Use virtual inputs to:

- control circuit breakers
- enable or disable reclosing
- enable or disable under-frequency load shedding
- change setting groups
- provide interlocking between local/remote supervisory control

Target Reset

The Target Reset screen is used for configuration of each LED Reset Type and an external Target Reset input.

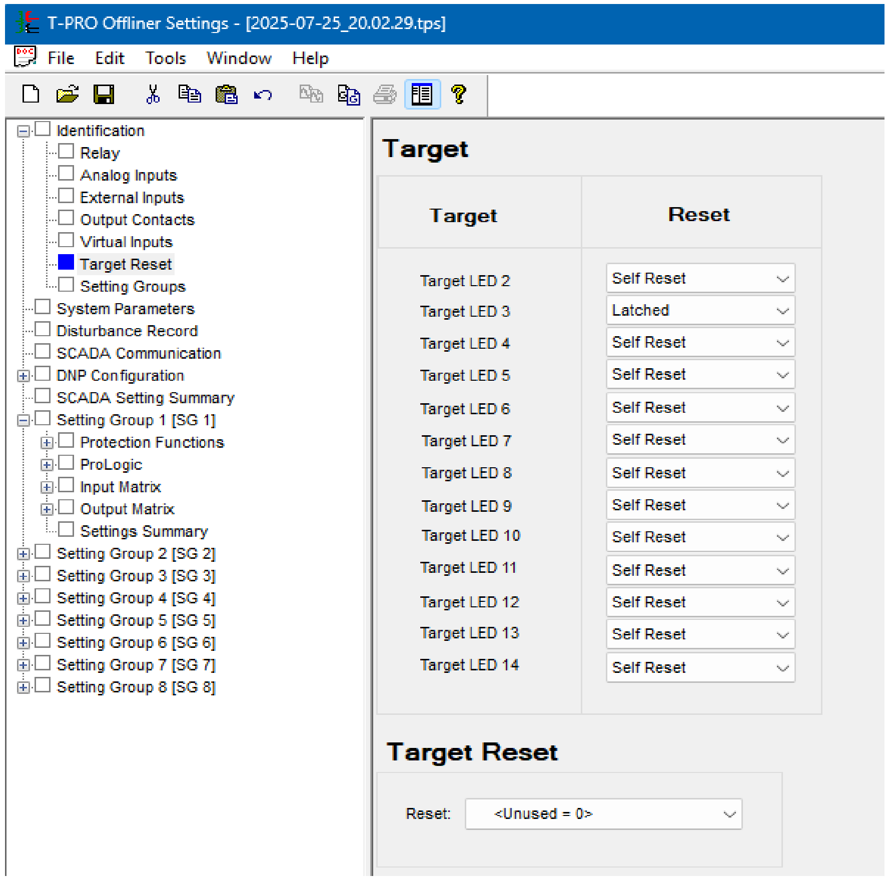


Figure 7.7: Target Reset

Table 7.7: Target Reset Settings	
Target Reset Type (LED 2 to 14)	Self Reset, Latched
Target Reset	
Reset	Any EI, VI or PL

Setting Groups

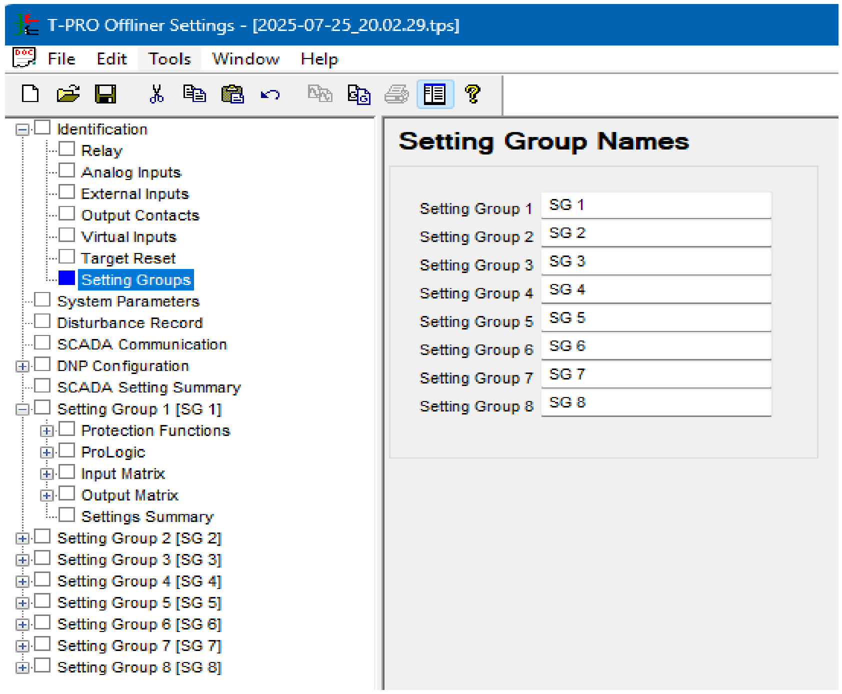


Figure 7.8: Setting Groups

Table 7.8: Setting Groups	
Setting Groups 1 to 8	User-defined

System Parameters

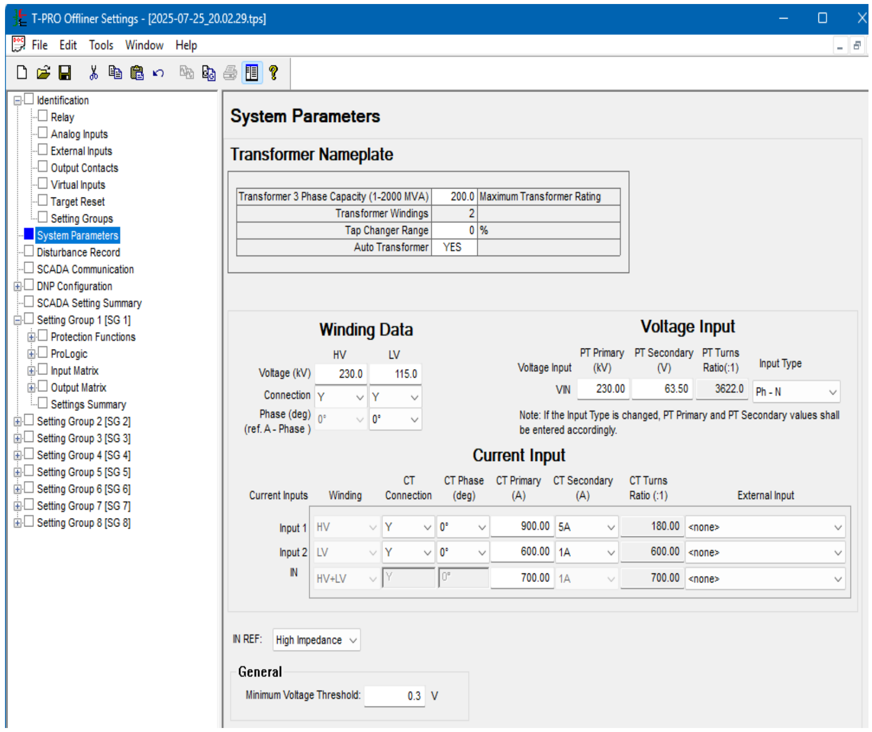


Figure 7.9: System Parameters.

Table 7.9: System Parameters			
Transformer 3 Phase Capacity	200.0	MVA	1.0 to 2000.0
Transformer Winding	2		
Tap Changer Range	0	%	-100 to 100
Auto Transformer	YES		YES or NO
Winding Data			
HV			
Voltage	230.0	kV	115.0 to 2000.0
Connection	Y		Delta or Y
Phase	0°		
LV			
Voltage	115.0	kV	1.0 to 230.0
Connection	Y		Delta or Y
Phase	0°		DY, YD, YY connection: 0°, 30°, 60°, 90°, 120°, 150°, 180°, -150°, -120°, -90°, -60°, -30° DD connection: 0°, 60°, 120°, 180°, -120°, -60°
Voltage Input Connection (VIN)			

Table 7.9: System Parameters			
PT Primary	230.0	kV	1.0 to 2000.0
PT Secondary	63.5	V	40.0 to 160.0
PT Turns Ratio	3622.0	:1	1.0 to 50000.0
Input Type	Ph - N		Ph - N, Ph - Ph, Neutral Voltage
CT Input Connections			
Current Input 1			
Winding	HV		HV or LV
Connection	Y		Delta or Y
Phase	0°		Y connection: 0°, 60°, 120°, 180°, -120°, -60° Delta connection> 30°, 90°, 150°, -150°, -90°, -30°
CT Primary	900.0	A	1.00 to 50000.00
CT Secondary	5	A	1A or 5A
CT Turns Ratio (:1)	180.0	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
Current Input 2			
Winding	HV		HV or LV
Connection	Y		Delta or Y
Phase	0°		Y connection: 0°, 60°, 120°, 180°, -120°, -60° Delta connection: 30°, 90°, 150°, -150°, -90°, -30°
CT Primary	600.00	A	1.00 to 50000.00
CT Secondary	1	A	1A or 5A
CT Turns Ratio (:1)	600.00	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
Current IN			
Winding	HV+LV		
CT Primary	700.00	A	1.00 to 50000.00
CT Secondary	1	A	1A or 5A
CT Turns Ratio (:1)	700.00	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
IN REF	High Impedance		High Impedance or Low Impedance
General			
Minimum Voltage Threshold	0.3	V	0.0 to 2.9

SCADA Communication

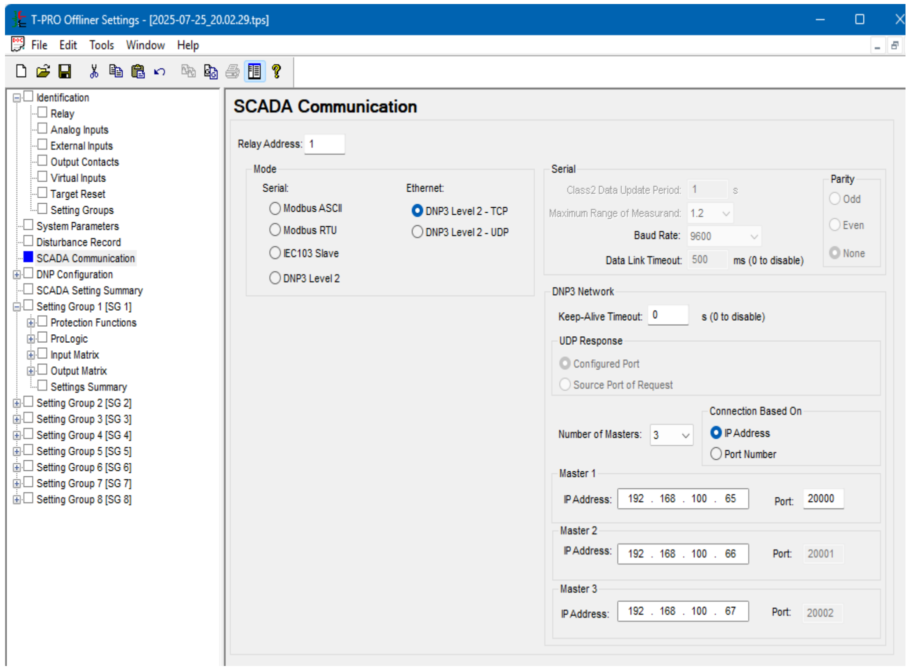


Figure 7.10: SCADA Communication

The relay has configurable SCADA communication parameters for both Serial and Ethernet (TCP and UDP). For DNP3 Level 2 (TCP) up to 3 independent Masters are supported.

DNP Configuration - Point Map

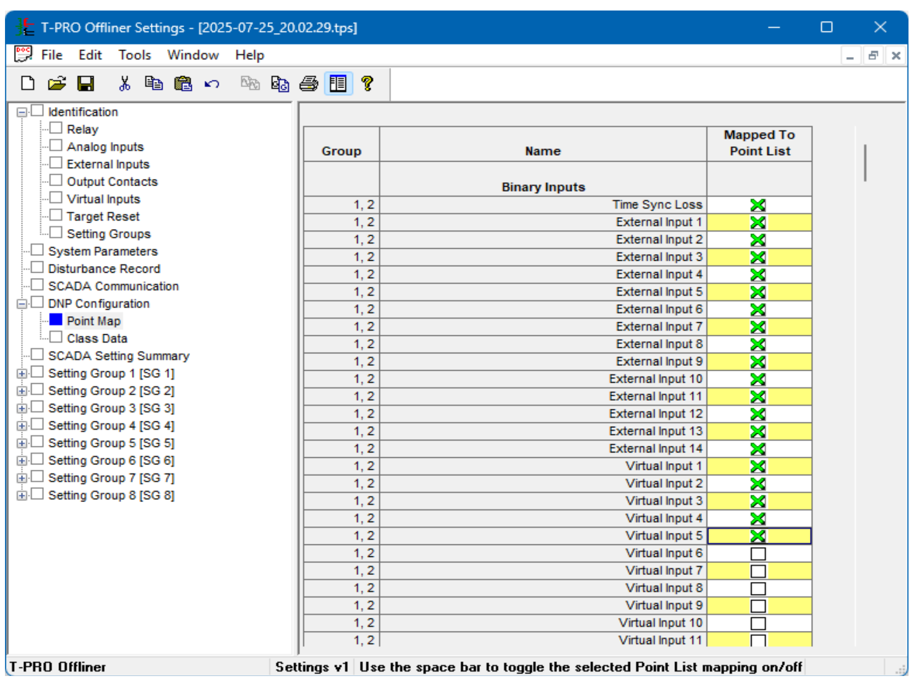


Figure 7.11: Point Map

The relay has configurable DNP point mapping. On the Point Map screen, any of the configurable points may be added or removed from the Point List by clicking (or using the cursor keys and space bar on the keyboard) on the associated check box. A green 'X' denotes that the item will be mapped to the Point List.

The list contains separate sections for Binary Inputs, Binary Outputs, and Analog Inputs. The list is scrollable by using the scroll control on the right hand side.

DNP Configuration - Class Data

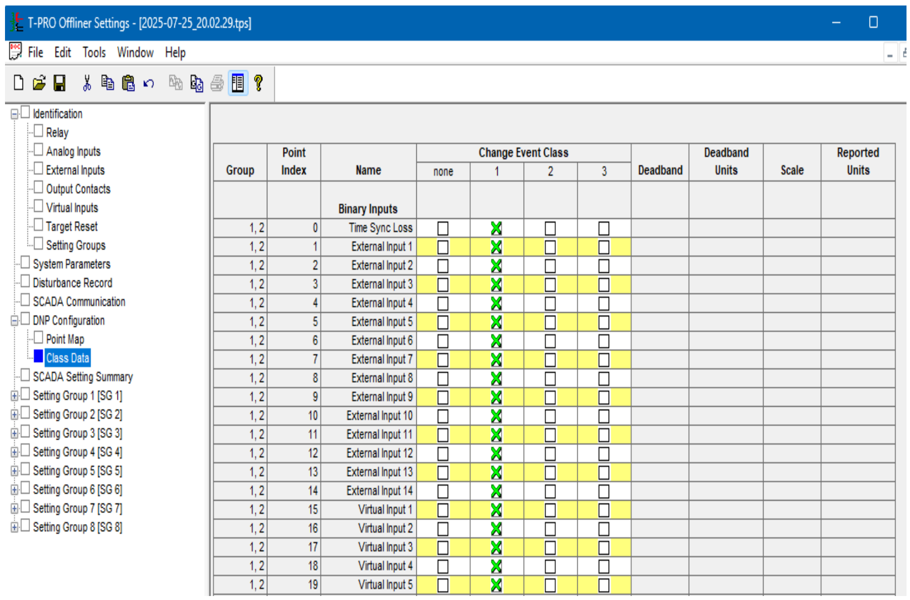


Figure 7.12: Class Data

Class data for each DNP point can be assigned on the Class Data screen. Only Points which were mapped in the Point Map screen will appear here. Sections for Binary Inputs and Analog Inputs appear here; Binary Outputs cannot be assigned a Class. The list is scrollable by using the scroll control on the right hand side.

In addition to assigning a Change Event Class to each mapped point, most Analog Inputs can also be assigned a Deadband and Scaling factor.

Disturbance Record

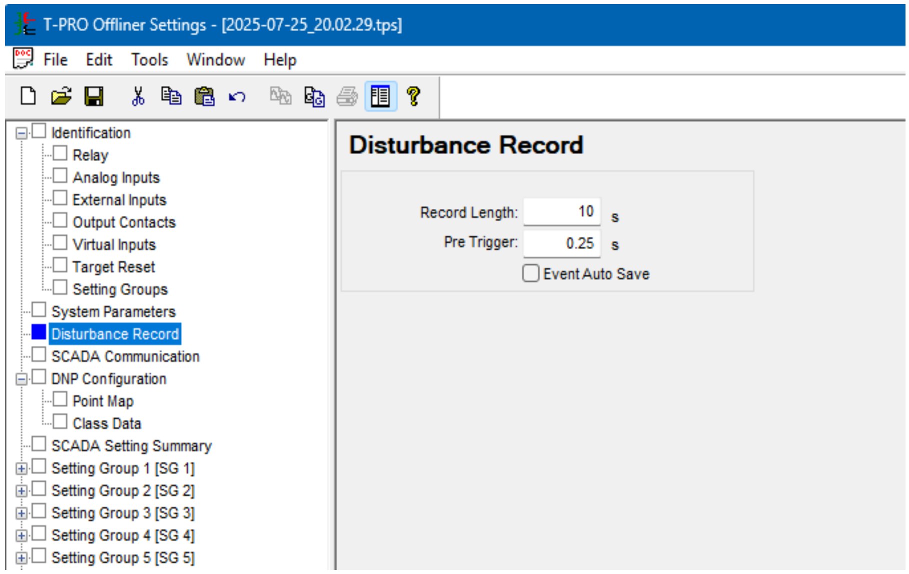
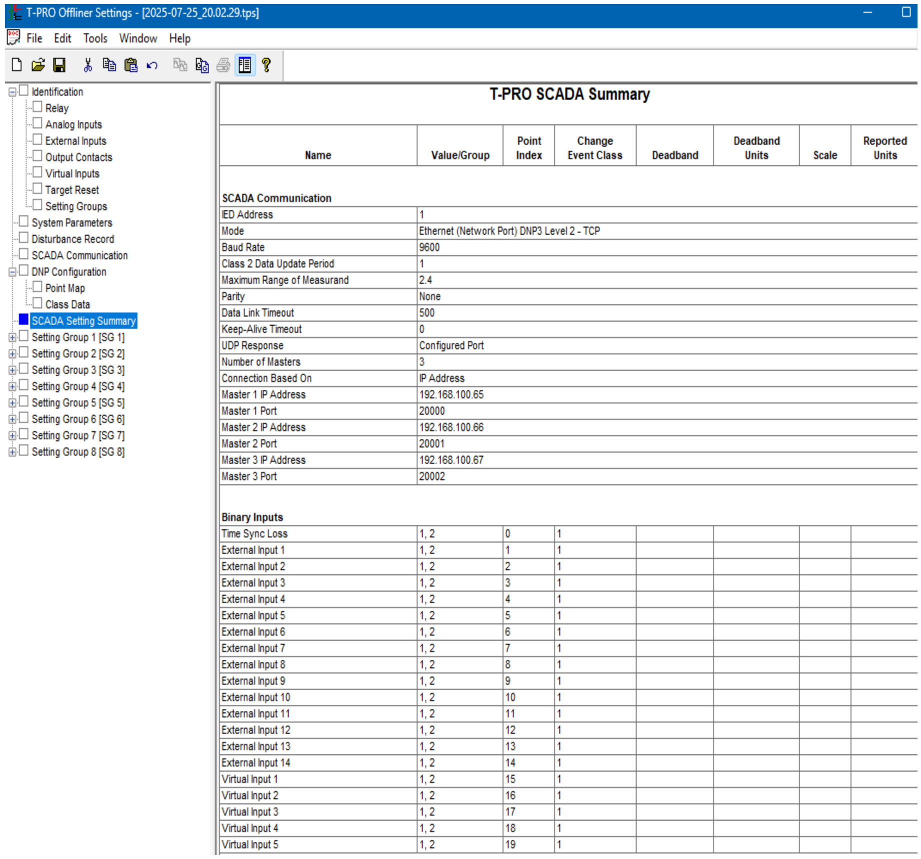


Figure 7.13: Record Length

Table 7.10: Record Length	
Fault	
Fault Record Length	1 to 10 seconds
Pre-Trigger	0.10 to 2 seconds
Event Auto Save	Enabled/Disabled

SCADA Settings Summary



Name	Value/Group	Point Index	Change Event Class	Deadband	Deadband Units	Scale	Reported Units
SCADA Communication							
IED Address	1						
Mode	Ethernet (Network Port) DNP3 Level 2 - TCP						
Baud Rate	9600						
Class 2 Data Update Period	1						
Maximum Range of Measurand	2.4						
Parity	None						
Data Link Timeout	500						
Keep-Alive Timeout	0						
UDP Response	Configured Port						
Number of Masters	3						
Connection Based On	IP Address						
Master 1 IP Address	192.168.100.65						
Master 1 Port	20000						
Master 2 IP Address	192.168.100.66						
Master 2 Port	20001						
Master 3 IP Address	192.168.100.67						
Master 3 Port	20002						
Binary Inputs							
Time Sync Loss	1, 2	0	1				
External Input 1	1, 2	1	1				
External Input 2	1, 2	2	1				
External Input 3	1, 2	3	1				
External Input 4	1, 2	4	1				
External Input 5	1, 2	5	1				
External Input 6	1, 2	6	1				
External Input 7	1, 2	7	1				
External Input 8	1, 2	8	1				
External Input 9	1, 2	9	1				
External Input 10	1, 2	10	1				
External Input 11	1, 2	11	1				
External Input 12	1, 2	12	1				
External Input 13	1, 2	13	1				
External Input 14	1, 2	14	1				
Virtual Input 1	1, 2	15	1				
Virtual Input 2	1, 2	16	1				
Virtual Input 3	1, 2	17	1				
Virtual Input 4	1, 2	18	1				
Virtual Input 5	1, 2	19	1				

Figure 7.14: SCADA Settings Summary

This screen provides a summary of the current SCADA settings as set in the working setting file. This includes SCADA Communication parameters and (if the SCADA mode is set to DNP) Binary Input, Binary Output, and Analog Input information including Deadband and Scaling factors.

This SCADA Summary screen is scrollable and can be printed.

Setting Groups

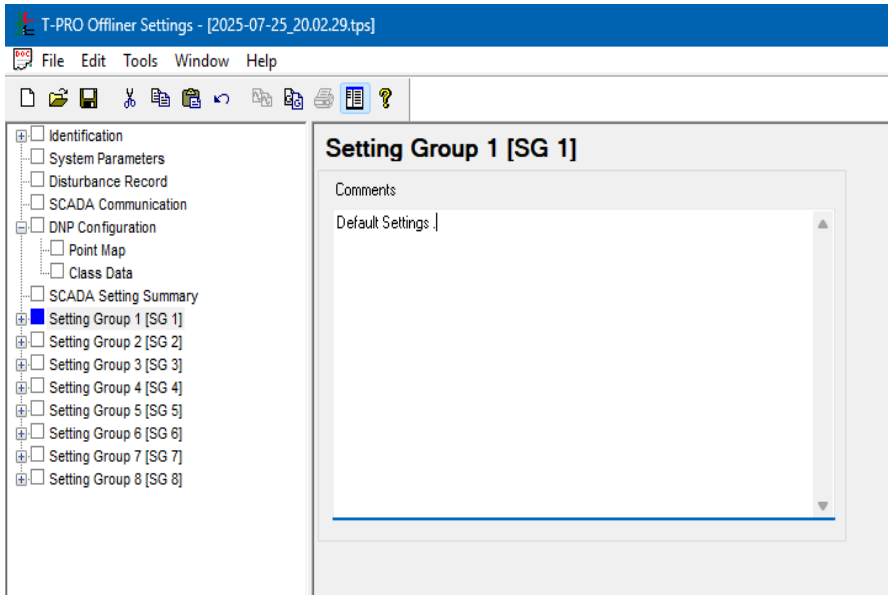


Figure 7.15: Setting Groups Comments

The relay has 8 setting groups (SG). The user can change all relay setting parameters except the physical connections such as input or output parameters in each setting group.

Protection, Monitoring and Control Functions

The Protection, Monitoring and Control Function sections provide all of the settings for the individual protection functions.

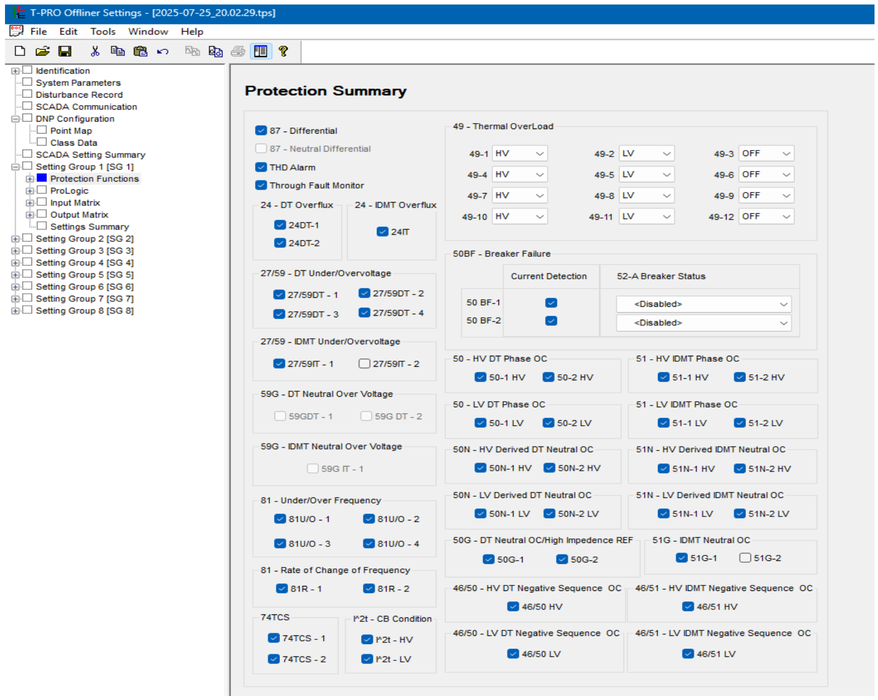


Figure 7.16: Protection Functions

For a detailed descriptions of each function see “Protection, Recording and Logging Functions” on page 5-1.

ProLogic

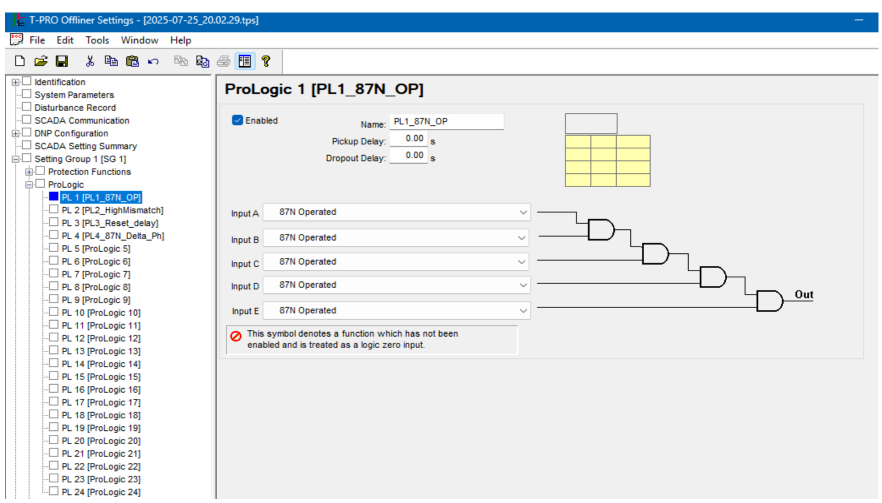


Figure 7.17: ProLogic

Apply ProLogic to multiple inputs to create an output based on qualified inputs. ProLogic enables up to 24 ProLogic control statements and programs those logics to output contacts. The user can name the function being created and set a pickup and dropout delay. Start with input A by selecting any of the relay functions using the list for up to 5 possible inputs. Put these inputs into AND, NAND, OR, NOR, XOR, NXOR and LATCH logics by clicking on the gate. Invert the input by clicking on the input line.

The output of ProLogic 1 can be nested into ProLogic 2 and so forth. If described, the user can illuminate the front target LED on operation of this function by enabling this feature. The operation of the ProLogic statements are recorded in the events logs.

Input Matrix

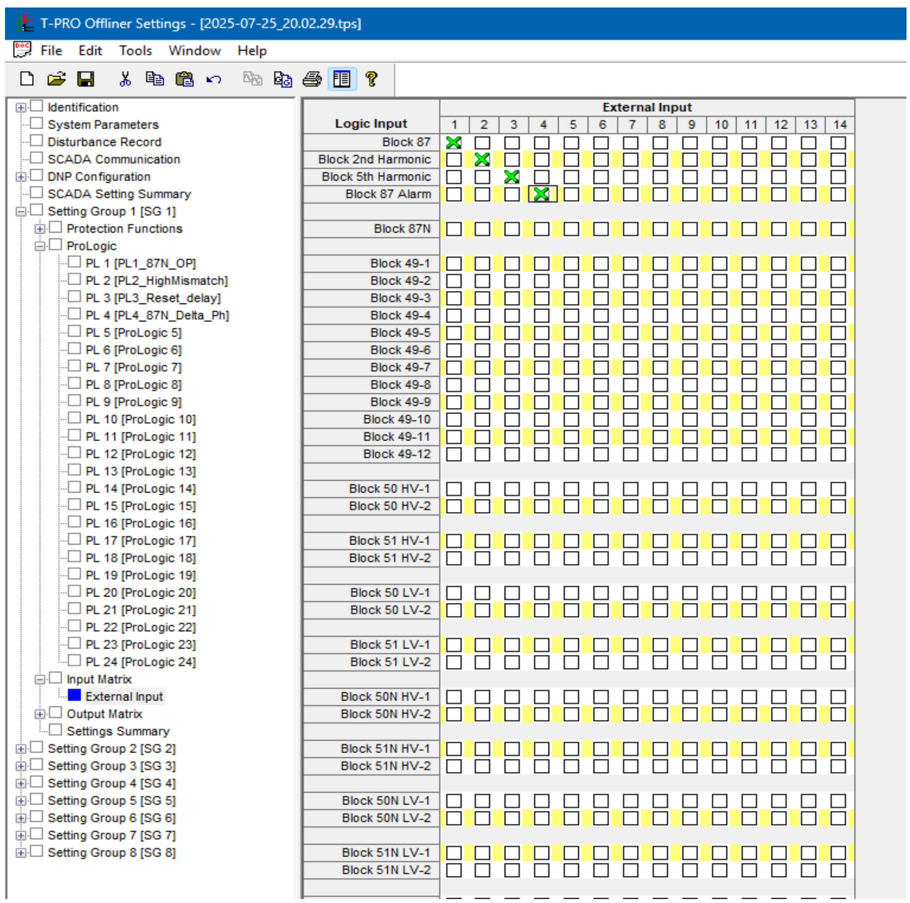


Figure 7.18: Input Matrix

The Input Matrix is used to assign External Inputs to block individual functions from operating, 74TCS function operation and to change setting group with External inputs.

Output Matrix

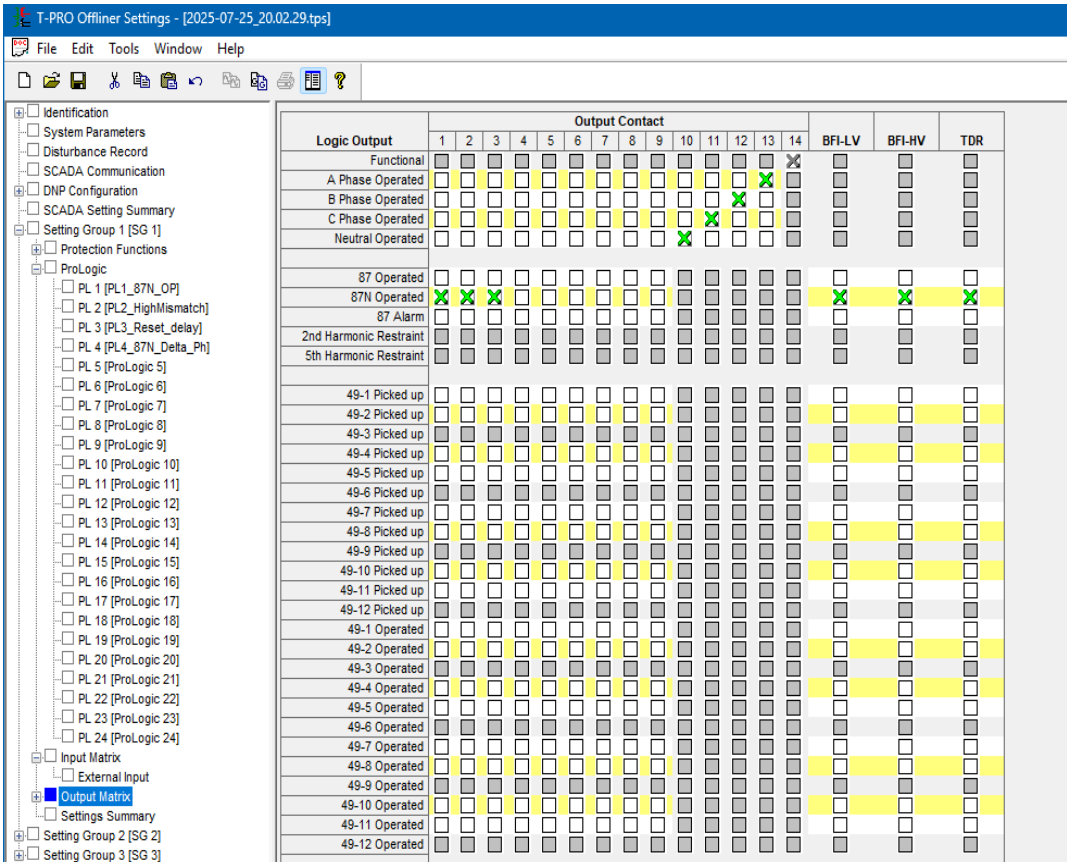


Figure 7.19: Relay Output Matrix

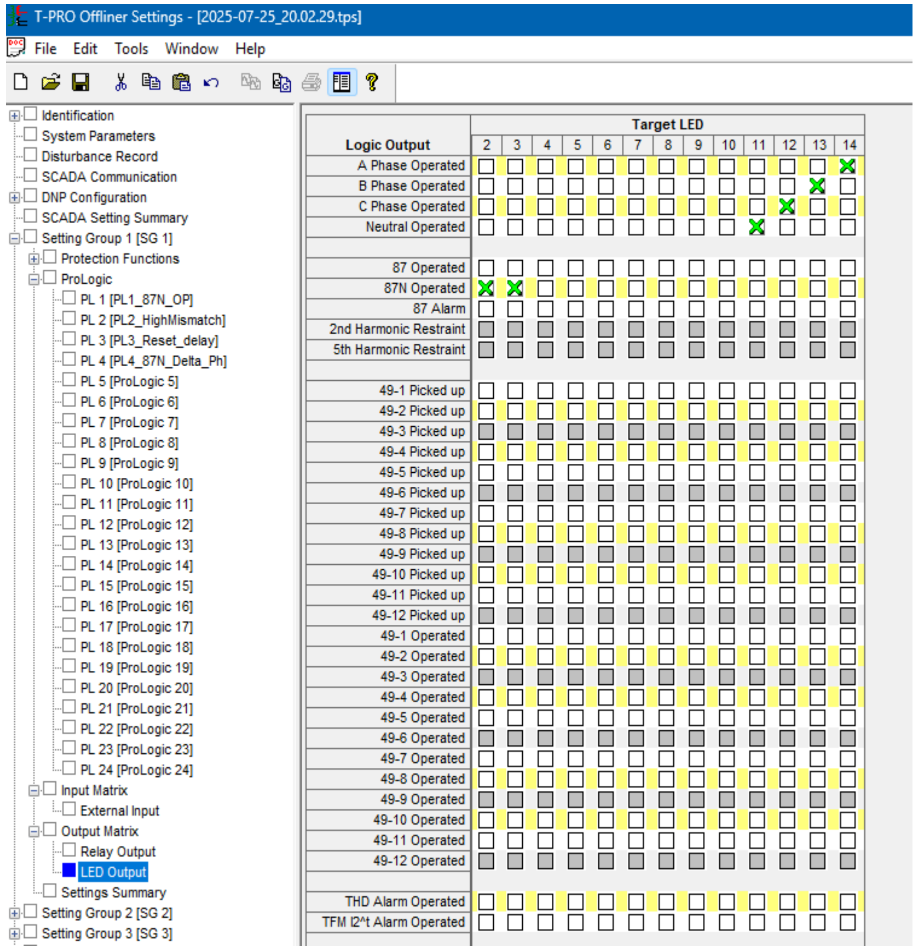


Figure 7.20: LED Output Matrix

The Relay Output and LED Output matrices determines which function initiates which output relay and LED. All output relays have an individual user-selectable stretch time, except those outputs identified as communication initiation outputs. They can have their time delay characteristics changed. Functions also initiate recording as required.

For a particular function to operate correctly, it must be enabled and must also have its logic output assigned to at least one output contact if it is involved in a tripping function.

Print the entire output matrix by selecting Print under the File menu. This printout is produced on 2 pages.

Settings Summary

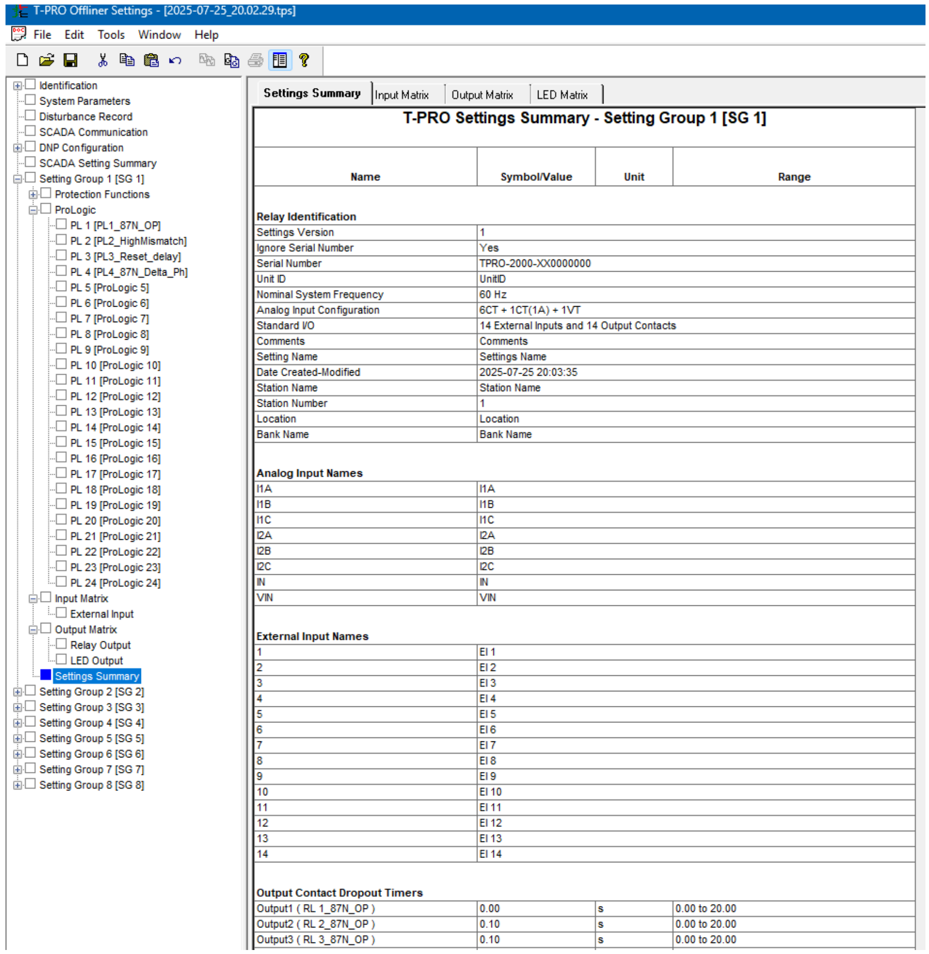


Figure 7.21: Settings Summary

Select *Settings Summary* to view and print the relay settings in text form, for details see “IED Settings and Ranges” in Appendix B.

7.2 RecordGraph Software

Introduction

RecordGraph is a tool that is used to display and analyze records from ERL relays and recorders. Use it to graphically view the data recorded during faults and swings. RecordGraph provides many powerful analysis tools including:

- Timeline view
- Overlay view
- Phasor view
- Symmetrical Component view
- Harmonic view
- Sub-Harmonic view
- Differential view
- Absolute Time view

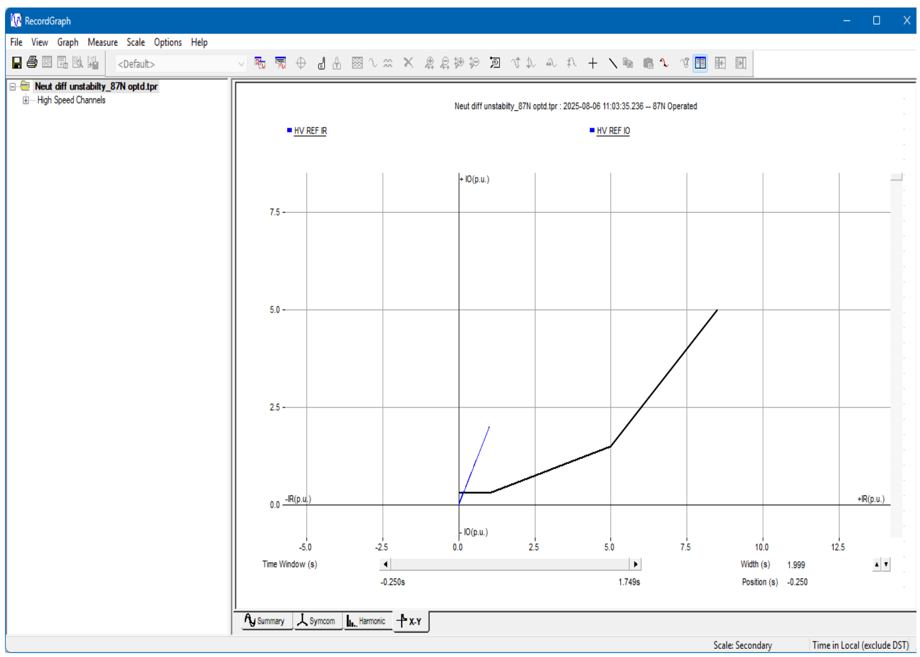


Figure 7.22: RecordGraph

Launching RecordGraph from Relay Control Panel

1. Go to the *Records* screen in Relay Control Panel.
2. Select one or more remote records on the relay. Press the *Get from Relay* Button to retrieve the records from the relay and to store them locally. Select one or more local records and press the *Graph* button to launch the record(s) in RecordGraph.
   OR
   Double-click on a remote record to directly graph it in RecordGraph

For further instructions on how to use the software, refer to the RecordGraph Manual.

7.3 RecordBase View Software

Introduction

RecordBase View is a Windows-based software tool for displaying and managing records from ERL relays and recorders. RecordBase View features include:

- Record displays and analysis
- Storage and management of records in database
- Record summaries including event lists and user annotation
- COMTRADE, PTI and Excel export
- Windows Explorer integration
- Compatibility with RecordBase Server database

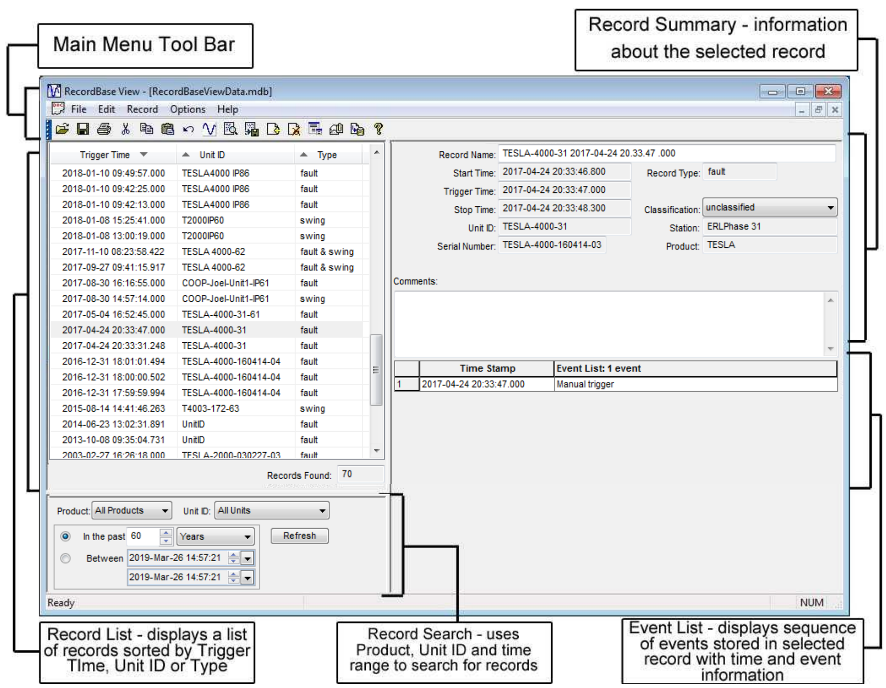


Figure 7.23: RecordBase View

> For further instructions on how to use the software, refer to the RecordBase View User Manual.

7.4 RecordBase Central Station Software

The RecordBase Central Station software provides automated collection, storage and network-wide access to fault and disturbance data produced by supported ERL recorders and relays. RecordBase ensures the recording data is automatically brought to a secure central location and is made available to staff throughout your company for display and analysis.

The RecordBase Central Station software is available for purchase. For more information, visit the ERLPhase website: www.erlphase.com

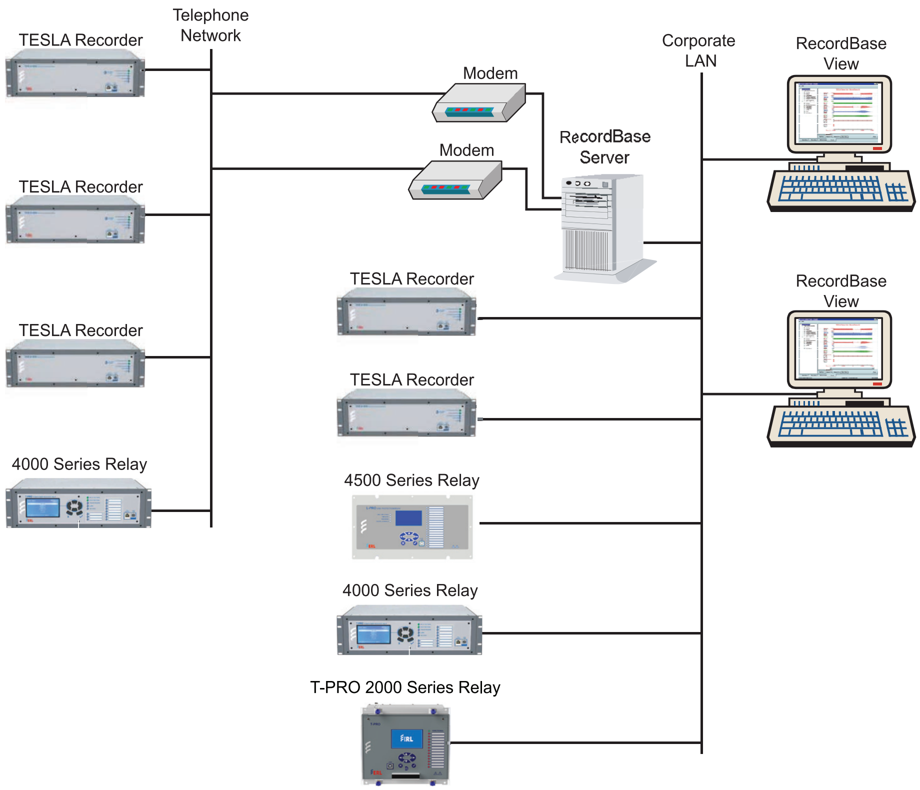


Figure 7.24: RecordBase System Overview

For further instructions on how to use the software, refer to the RecordBase Central Station User Manual.

8 Acceptance Test Guide

8.1 Introduction

The acceptance test section is a guide for tests that should be performed upon first delivery of the relay, prior to applying in-service settings. Once in-service settings are applied, ERL recommends that the user test enabled functions to ensure the designed application is fulfilled.

This section deals with the Acceptance Testing and the T-PRO 2000 Acceptance Test Procedure.

First, the acceptance testing describes the test equipment requirements, testing the external inputs and testing the output relay contacts.

8.2 Acceptance Testing

ERL relays are fully tested before leaving the factory. A visual inspection of the relay and its packaging is recommended on receipt to ensure the relay was not damaged during shipping.

> The electronics in the relay contain static sensitive devices and are not user-serviceable. If the front of the relay is opened for any reason exposing the electronics, take extreme care to ensure that the user and the relay are solidly grounded.

Generally an analog metering check, as well as testing the I/O (External Inputs and Output Contacts) is sufficient to ensure the functionality of the relay. Further tests can be performed on delivery and acceptance of the purchaser's option according to the published relay specifications in "IED Settings and Ranges" in Appendix B.

Test Equipment Requirements

- 1 ac voltage sources (variable frequency capability)
- 6 ac current sources
- 1 ohmmeter
- 1 - 300 Vdc test supply

> Set nominal CT secondary current to either 5 A or 1 A, and nominal system frequency to either 60 Hz or 50 Hz.

Calibration

The T-PRO is calibrated before it leaves the factory and should only be re-calibrated as per ERLPhase recommendation. Please contact ERLPhase Technical Support for instructions.

Testing the External Inputs

To test the external inputs connect the relay using Relay Control Panel, *Metering>Status*. This screen displays the status of the Input. If the relay is 110V dc variant place a voltage of 110 V dc nominal, (135 V dc maximum), to each of the external inputs in turn causes the input to change from Low to High status. These inputs are polarity sensitive and this screen has a 0.5 second update rate.

Testing the Output Relay Contacts

Access the T-PRO service level in Relay Control Panel. Open the *Utilities>Outputs* tab screen. To toggle outputs you first need to enter *Test Mode* by selecting the *Relay in Test Mode* check box. When you check the box, a message will appear prompting you to confirm that you really want to enter this mode. Once you enter Test Mode, the functional green LED on the front of the T-PRO will blink and it will remain blinking until you exit Test Mode. The protection functions cannot access the output contacts in Test Mode; they are controllable only by the user via Relay Control Panel. To toggle a particular output, select it from the drop down list and then click on the *Closed* button. You can verify the contact is closed with an ohmmeter. The contact will remain closed until you either click the *Open* button or exit Test Mode.

9 IEC 61850 Implementation Overview

9.1 Introduction

The IEC 61850 standard defines a suite of protocols that permit substation equipment from different manufacturers to communicate with each other. ERL is dedicated to developing IEC 61850-based devices that can be used as part of an open and versatile communications network for power system automation.

The IEC 61850 defines an Ethernet-based protocol used in power systems for data communication. Power systems implement a number of devices for protection, measurement, detection, alarms, and monitoring. System implementation is often slowed down by the fact that the devices produced by different manufacturers are incompatible, since they do not support the same communication protocols. The problems associated with this incompatibility are quite serious, and result in increased costs for protocol integration and system maintenance.

The IEC 61850 is a broad ranging standard which encompasses the entire scope of power system automation, from the highest level of substation design to the lowest level of the communication protocol implementation on IEDs. The IEC 61850 Standard also defines a standard Engineering Process which is an iterative process which allows for the implementation and management of power system automation.

Some key concepts which are discussed further in the following sections are:

- Substation Configuration Language (see Section 9.2)
- The Engineering Process (see Section 9.3)
- Edition 2.0 Implementation (see Section 9.4)

Parts of the Standard

The IEC 61850 Standard is comprised of many parts. The parts of the standard which are most relevant to the implementation in this device are:

- IEC 61850-6 Edition 2.0: Configuration description language for communication in electrical substations related to IEDs
- IEC 61850-7-2 Edition 2.0: Basic information and communication structure – Abstract communication service interface (ACSI)
- IEC 61850-7-3 Edition 2.0: Basic communication structure – Common data classes
- IEC 61850 -7-4 Edition 2.0: Basic communication structure – Compatible logical node classes and data object classes

9.2 The Substation Configuration Language (SCL)

The Substation Configuration Language (SCL) is an XML based language which provides the basis for interoperable data exchange between IEDs from different vendors and between configuration tools. The SCL file structure is comprised of five main parts:

- Header - defines file information history
- Communication - defines access points and network configurations
- Substation - defines the substation equipment and provides coordinates for locating equipment on a Single Line Diagram
- IED - provides the definition of the IED(s) including the Services, Logical Devices, Logical Nodes, DataSets, Report Control Blocks, GOOSE Control Blocks and Sampled Value Control Blocks
- DataType Templates - contains the templates which define common data used within the data model

There are multiple types of SCL files which are used for different applications within the Engineering Process. Each type of SCL file is constructed using the sections defined above, but not all SCL file types contain all five sections (for example, the CID file type does not include a Substation section).

The SCL File types are:

- SSD - System Specification Description.
  Data exchange from a system specification tool to the system configuration tool.
- SED - System Exchange Description.
  Data exchange between system configuration tools of different projects.
- SCD - System Configuration Description.
  Data exchange from the system configuration tool to IED configuration tools.
- ICD - IED Configuration Description.
  Data exchange from the IED configuration tool to the system configuration tool. Defines the IEDs capabilities and Data Model.
- IID - Instantiated IED Description.
  Data exchange from the IED configuration tool to the system configuration tool which contains add-on and/or modified values.
- CID - Configured IED Description.
  Data exchange from the IED configuration tool to the IED.

ERL 61850 IED Configurator supports all of the SCL File types which are directly related to IED configuration (SCD, ICD, IID and CID).

9.3 The Engineering Process

The IEC 61850 standard defines an Engineering Process which is used to manage and implement substation automation. The basic Engineering Process is shown in the diagrams below. For further details, refer to IEC 61850-6 Edition 2.0.

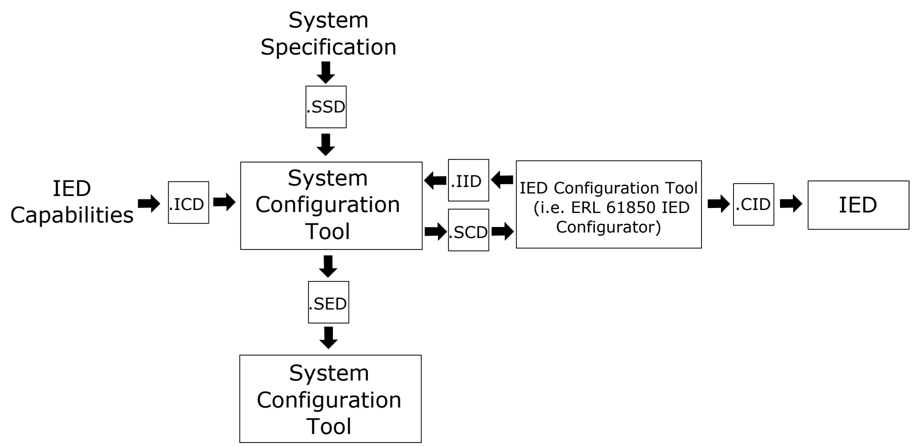


Figure 9.1: The Engineering Process

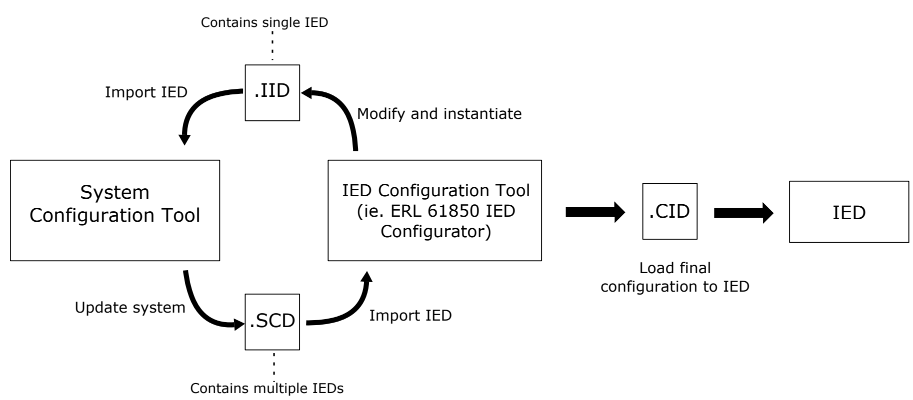


Figure 9.2: Iterations between IED Configuration Tool and System Configuration tool

ERL 61850 IED Configurator supports import and export of CID, ICD, IID and SCD, thus making it compatible with the Engineering Process. Refer to the ERL 61850 IED Configurator user manual for more details.

Note: Importing SCD files which contain mapping to ERL Devices which use IEC 61850 Edition 1.0 is not fully supported and is not recommended. ERL devices which support IEC 61850 Edition 2.0 fully support the SCD import feature and thus are compatible with System Configuration Tools as part of the Engineering Process.

9.4 IEC 61850 Edition 2.0 Implementation

The T-PRO 2000, starting with firmware version 1.0, uses the second edition of the 61850 Standard. Edition 2.0 of the standard provides many new functionalities. The major changes which have been implemented in the T-PRO 2000 from Edition 2.0 of the standard are described below.

Test Features

IEC 61850 Edition 2.0 introduced two new test features: Simulation and Mode Control. Simulation is an IED level test feature which allows the IED to subscribe to simulated GOOSE messages from test-set devices. The Mode Control is an LD level test feature (for testing LDs independently) which allows the LD to process or ignore incoming “test” data. These two features are described in detail below.

Simulation

Edition 2.0 introduced a new Simulation function. Simulation allows for 61850 publisher devices to publish “simulated” GOOSE messages, and for 61850 subscriber devices to subscribe to these “simulated” GOOSE. The devices which publish simulated GOOSE are typically test-set devices used for testing and commissioning. A simulated GOOSE means a GOOSE message with the “Simulation/Test” flag set to True. The T-PRO 2000 has the ability to subscribe to simulated GOOSE, but does not publish any simulated messages.

Figure 9.3 shows the basic flow of how Simulation subscription works for GOOSE subscription.

Setting the IED into Simulation mode allows for the IED to subscribe to both real and simulated GOOSE messages simultaneously. The simulation mode is controlled by the SYS/LPHD1.Sim attribute. If the LPHD1.Sim attribute is set to True via a control command, then the IED may begin to subscribe to Simulated GOOSE messages.

When the IED is in Simulation mode (LPHD1.Sim = True), then the IED will continue to subscribe to real GOOSE (see diagram 2 in Figure 9.3). However, once a simulated GOOSE has been received, the IED will ignore the real GOOSE message if a duplicate real and simulated GOOSE exist simultaneously (see diagram 3 in Figure 9.3). The simulation mode works on a per-GOOSE subscription basis.

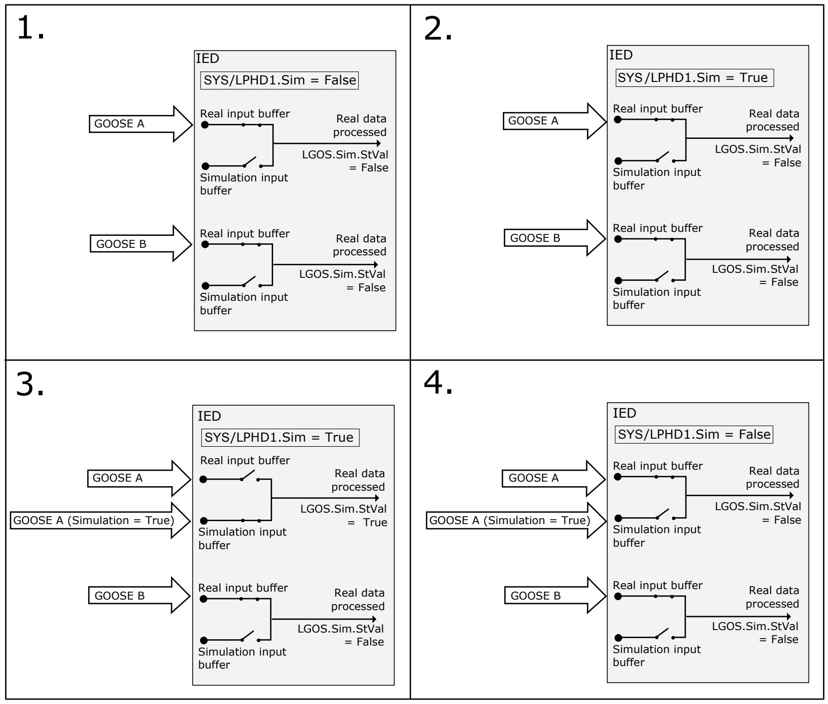


Figure 9.3: Simulated GOOSE processing

For example, imagine a T-PRO 2000 is subscribing to GOOSE A and GOOSE B simultaneously (see diagram 1 in Figure 9.3) and then the IED is then set into simulation mode (see diagram 2). The IED will continue to subscribe to the real GOOSE messages as no simulated messages have been received yet. Next, a test-set publisher begins to publish GOOSE A (Simulation = True) and while the real GOOSE A and GOOSE B are still being published on the network (see diagram 3). The IED will successfully subscribe to GOOSE A (Simulation = True) and GOOSE B, but GOOSE A will be ignored. If the test-set stops publishing GOOSE A (Simulation = True) the IED will not return to subscribing to the real GOOSE A until the simulation mode is manually turned off (see diagram 4).

In order to monitor the simulation state of the device, monitor the LGOS.Sim.StVal attribute for each GOOSE subscription (see “Subscription Supervision via LGOS” on page 9-7 for more details). LGOS.Sim.StVal = True is an indication that only simulated GOOSE will be accepted for this particular GOOSE subscription. Once the LPHD1.Sim is set back to FALSE, all LGOS.Sim.StVal attributes will change back to FALSE.

Mode Control

The use of the Mod data object was expanded in Edition 2.0 (appended by TISSUE #671) to included the following Modes:

- On
- Blocked
- Test
- Test/Blocked
- Off

The T-PRO 2000 implementation currently supports the use of modes On, Test and Test/Blocked. Control the mode via a control command to change the value of the LLN0.Mod data object. The LLN0.Mod may only be controlled for subscription Logical Devices on the T-PRO 2000.

The LLN0.Mod value determines how incoming data is processed and how data quality output is published. It also determines how control commands are processed. For example, a subscription LD will only process incoming data with q.test = True if the LLN0.Mod is also set to Test or Test/Blocked.

The status of the LLN0.Mod object is reflected in the Beh object for all LNs within the LD. If any LD LLN0.Mod is set to Test or Test/Blocked, the front panel “Test Mode” LED will be turned on.

For further details regarding the behavior different modes, refer to IEC 61850-7-4 Annex A (appended by TISSUE #671).

Table 9.1: Mode Implementation on the T-PRO 2000 (based on Table A.2 in IEC 61850-7-4 (Edition 2) Appended by TISSUE #671)

	Mode		
	On	**Test**	**Test/Blocked**
Output to process via a non-61850 link	Yes	Yes	No
Output of FC, ST, MX (issued independently from Beh)	Value is relevant. q is relevant.	Value is relevant. q.test=true	Value is relevant. q.test=true
Response to Normal Command from Client	Positive Acknowledgement	Negative Acknowledgement	Negative Acknowledgement
Response to TEST Command from Client	Negative Acknowledgement	Positive Acknowledgement	Positive Acknowledgement
Incoming Data with Validity = Good and Test = False and operatorBlocked = false	Process as Valid	Process as Valid	Process as Valid
Incoming Data with Validity = Good and Test = True and operatorBlocked = false	Process as Invalid	Process as Valid	Process as Valid

Subscription Supervision via LGOS

A new logical nodes, LGOS has been added in Edition 2.0 to provide the ability to supervise GOOSE subscription statuses. The LGOS LN is used to monitor GOOSE subscriptions.

One LGOS LN is created for each GOOSE Control Block which the IED subscribes to. The data objects of the LGOS LN are described in the table below:

Table 9.2: LGOS LN

Data Object	Description
NdsCom	Subscription needs commissioning
St	Status of the subscription (True = active, False = not active). If LGOS.St = False, this means that this GOOSE has not been received for 2x Time Allowed to Live.
SimSt	Status showing if simulated messages are received and accepted (see “Simulation” on page 9-4)
LastStNum	Last state number received
ConfRevNum	Expected configuration revision number
GoCBRef	Reference to the subscribed GOOSE control block

Subscription Supervision in the Event Log

The LGOS logical nodes are used to indicate GOOSE Communication Alarms in the Event Log. When the LGOS.St attribute transitions states, an event is logged into the TESLA event log with the indexed logical node name. This indexed logical node may be used to troubleshoot communication issues.

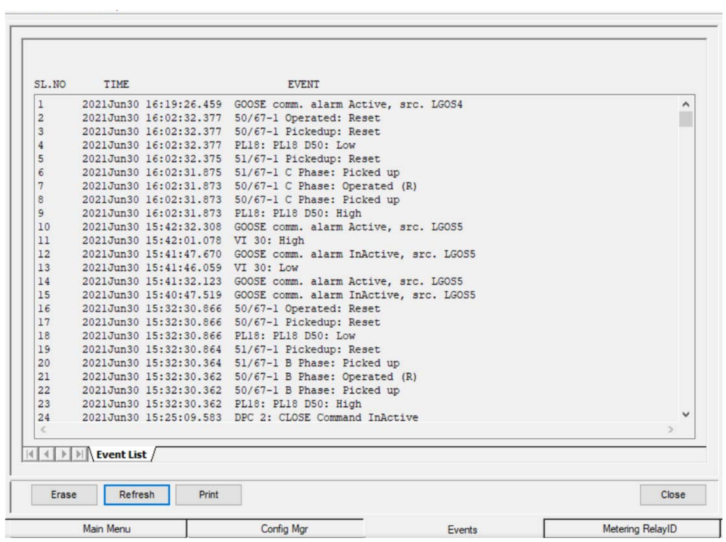


Figure 9.4: Event Log Subscription Supervision

Subscription to *ldName*

There are two Logical Device naming methods (LDName), used for object references, described in IEC 61850-6 Edition 2.0. These methods are:

- Product-related naming
- Function-related naming

In product-related naming, the LDName is comprised of the *IED name* and the *LDevice inst* attribute. ERL IEDs only use product-related naming for Logical Device naming. For example, for an T-PRO 2000 with the IED name "MyT-PRO", the LDName for the Protection LD would be:

LDName = IED name/LDevice inst = **MyTPRO/Protection**

In function-related naming, the LDName is derived from the *LDevice ldName* attribute. For IEDs to support the use of *ldName*, they must support the free setting of the Logical Device names. ERL IEDs do not support free setting of the Logical Device names, and so do not use the *ldName* attribute. However, Edition 2.0 ERL IEDs do support subscribing to data from other vendor's IEDs which use the function-related naming via the *ldName* attribute.

Data from an IED which uses the *ldName* attribute may be mapped to the ERL Edition 2.0 IED for subscription. The *ldName* attribute shows in the ldName column on the GOOSE Subscription screen in ERL 61850 IED Configurator.

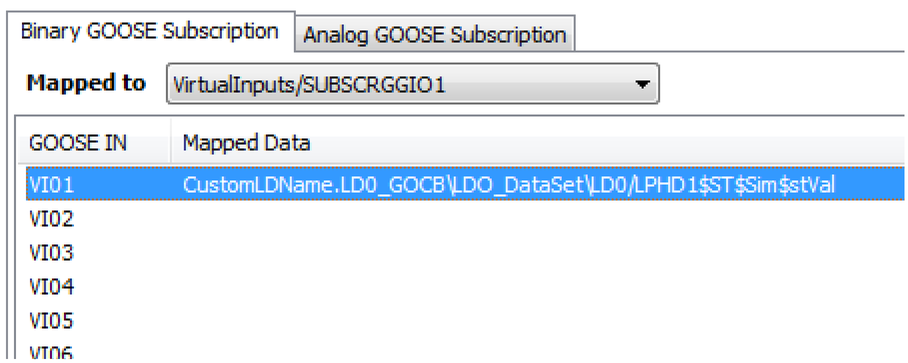


Figure 9.5: Mapping from IED which uses ldName attribute

> **Note:** Edition 1.0 does not support the *ldName* attribute, so Edition 1.0 IEDs cannot subscribe to Edition 2.0 IEDs which use the ldName attribute. See "Mapping Edition 2.0 Data to an Edition 1.0 IED" on page 9-10 for other a summary of Edition 2.0 to 1.0 mapping incompatibilities.

Subscription to Fixed-Length GOOSE

In IEC 61850 Edition 2.0, fixed-length encoded GOOSE messages were introduced. This is an optimized version of GOOSE encoding which uses a fixed length offset for each field of the GOOSE packet. If a GOOSE Control Block has the fixedOffs attribute set to True, this indicates that the GOOSE message uses fixed-length encoding.

ERL IEDs do not support publishing the fixed-length encoded GOOSE messages (fixedOffs attribute is always set to False). However, ERL IEDs can subscribe to GOOSE messages from other vendors which use fixed-length encoded GOOSE messages.

The fixed-length GOOSE subscription is backwards compatible, meaning that even ERL devices which use Edition 1.0 of the standard can subscribe to fixed-length GOOSE messages.

IED Name Length

Edition 2.0 of the IEC 61850 standard allows for longer IED names. The maximum *IED name* length allowed according to the standard is 64 characters. However, this is limited by the total maximum allowed length for LDName references which is also limited 64 characters. The LDName is defined as *IED name/LDevice inst* (see “Subscription to ldName” on page 9-8). The total *IED name* + *LDevice inst* character count may not exceed 64 characters. This is handled automatically in ERL 61850 IED Configurator. The software ensures that *IED name* length does cause the maximum length for the LDName to be exceeded. For example, if the longest *LDevice inst* name is 10 characters long, then *IED name* length is limited to 54 characters, so that *IED name* + *LDevice inst* does not exceed 64 characters.

Common Data Classes

In Edition 2.0 of the IEC 61850 Standard some new Common Data Classes (CDC) were added and others were updated. The only CDC change in Edition 2.0 which affects the T-PRO 2000 implementation is the LLN0.Beh data object was changed from CDC Type INS to ENS. The T-PRO 2000 uses the ENS CDC type for LLN0.Beh as required by Edition 2.0.

Edition 1.0 Compatibility

In general, Edition 1.0 and Edition 2.0 devices are compatible with each other for GOOSE mapping. However, there are some backward compatibility issues which the user should be aware of before attempting mapping between Edition 1.0 and Edition 2.0 devices.

Mapping Edition 1.0 Data to an Edition 2.0 IED

There are no compatibility issues when mapping data from an Edition 1.0 ERL IED to an Edition 2.0 ERL IED. The Edition 2.0 of the IEC 61850 Standard is designed to handle this forward-compatibility case.

Mapping Edition 2.0 Data to an Edition 1.0 IED

Edition 2.0 of the IEC 61850 introduced some backward-compatibility limitations when mapping to an Edition 1.0 IED. The user should be aware of these limitations before configuring mapping Edition 2.0 data to an Edition 1.0 IED.

In order to map data from an Edition 2.0 IED to an Edition 1 IED, the following restrictions must be followed:

- The IED Name on the Edition 2.0 IED (publisher) must be limited such that *IED Name + Longest LD Inst* does not exceed 32 characters. This restriction is not enforced by ERL IEC 61850 Configurator, it is the responsibility of the user to ensure name length on the Edition 2.0 IED is not too long.
- The Edition 2.0 publisher cannot use function-related naming (i.e. *ldName* attribute). Edition 1.0 does not support the *ldName* attribute. If the Edition 2.0 publisher uses the *ldName* attribute, then its data may not be mapped to an Edition 1.0 ERL IED. ERL 61850 IED Configurator prevents this mapping when attempted by the user. The T-PRO 2000 does not support publishing the *ldName* attribute, so this condition only applies when mapping with third party vendors who support the *ldName* attribute.
- In Edition 2.0 of the standard, new CDCs were introduced which may cause backward-compatibility issues. These new CDCs do not apply to the implementation in the T-PRO 2000 and therefore this should not cause any issues when mapping between ERL Edition 1.0 and 2.0 devices. However, the user should be aware when mapping from other vendor’s IEDs that there may be issues if using data from CDCs which are newly introduced in Edition 2.0.

Appendix A IED Specifications

T-PRO 2000 Specifications		
Item	**Quantity/Specs**	**Note**
General		
Overvoltage Category	Overvoltage Category III	
Pollution Degree	Pollution Degree 2	
Insulation Class	Class I	
Ingress Protection	IP 5X (Front) IP 1X (Rear) IP 2X (Rear) - Optional with protective cover	
Nominal Frequency	50 or 60 Hz	
Operate Time	Less than 35ms	Including output relay operation
Power Supply	Nominal Voltage: High Range Supply Option: 110 - 250 Vdc, 100 - 240 Vac Low Range Supply Option: 24 - 48 Vdc Voltage Tolerance: High Range Supply Option: ±20% for Vdc, -10%/+5% for Vac Low Range Supply Option: -15%/+20% Power Consumption: <8VA (AC) <8W (DC)	
Memory	Settings and records are stored in non-volatile memory	Records are stored in a circular buffer
Sampling Rate - Analog and Digital Inputs	32 samples/cycle for recording 8 samples /cycle for protection	Records up to the 8th Harmonic
A/D Resolution	16 bits, 65536 counts full scale	
Operating Temperature	-25°C to 55°C continuous	LCD contrast impaired for temperatures below -20°C and above 60° C
Protection Functions		
87, 87N, 49(1 to 12), 50 HV(1 to 2), 51 HV(1 to2), 50 LV(1 to 2), 51 LV(1 to 2), 50N HV(1 to 2), 50N LV(1 to 2), 51N HV(1 to 2), 51N LV(1 to 2),50G/REF (1 to 2), 51G (1 to 2), 46/50 (HV& LV), 46/51(HV & LV), 27/59DT (1 to 4), 27/59IT (1 to 2), 24DT (1 to 2),24IT, 59G DT(1 to 2), 59G IT, 81U/O (1 to 4), 81R (1 to 2), 50BF (1 to 2),THD Alarm, TFM, 74 TCS(1 to 2), I^2t-CB and ProLogic	7 current inputs 1 voltage inputs	

T-PRO 2000 Specifications

Item	Quantity/Specs	Note
ProLogic^{TM}	24 statements per setting group	5 inputs per ProLogic^{TM} statement
Setting Groups	8 Setting Groups	
Recording		
Transient (Fault)	32 s/c oscillography of all analog and external input channels	User-configurable 1 to 10 seconds Record length and 0.1 to 2.00 seconds pre-fault length. Pre-fault length ranges varies with respect to Record lenght settings.
Events	1000 events circular log with 1ms resolution	A compressed event record can be created 1000 events with manual trigger.
Record Capacity	20 records of a combination of transient and event records	
Inputs & Outputs		
Analog Voltage Inputs 1 Phase-Voltage Input	Nominal Voltage - across input channel: Vn = 63.5 Vrms (Ph-n) or 110 Vrms (Ph-Ph) Full Scale/Continuous: 175 Vrms (Ph-n) or 247 Vrms (Ph-Ph) Burden: <0.15VA @ Vn	
Analog Current Inputs 2 sets of 3-phase current inputs, 1 single phase current input for REF (7 current channels)	Phase CTs Nominal Current: In = 1 Arms or 5 Arms Full Scale/Continuous: 4x In = 4 Arms or 20 Arms Maximum full-scale rating: 100x In for 1 second symmetrical Burden: <0.1 VA @ 1 Arms, <0.5VA @ 5 Arms	
	REF CT Nominal Current: In = 1 Arms or 5 Arms Full Scale/Continuous: 2x In = 2 Arms or 10 Arms Maximum full-scale rating: 4x In for 1 second symmetrical Burden: <1 VA @ 1 Arms, <2VA @ 5 Arms	

T-PRO 2000 Specifications

Item	Quantity/Specs	Note
External Inputs	14 isolated inputs Isolation: 2kV optical isolation Burden: <0.2W @ 110V DC Turn-on Voltage: 24Vdc nominal = 19 Vdc 48 Vdc nominal = 38 Vdc 110 Vdc nominal = 88 Vdc 220 Vdc nominal = 175 Vdc	Optional 24, 48, 110 or 220 Vdc nominal, externally wetted. All inputs can be on continuously. Specified voltages are over full ambient temperature range.
Output Relays (contacts)	13 programmable outputs (13NO and 1CO - Watchdog) Make: 30 A as per IEEE C37.90 Carry (all outputs active): 8 A Break: 0.9 A at 125 Vdc resistive 0.35 A at 250 Vdc resistive	Externally wetted
Virtual Inputs	30 Virtual Inputs	
Interface & Communication		
Front Display	128 x 64 pixels graphics LCD	
Front Panel Indicators	14 LEDs: 13 programmable, 1 fixed	Fixed: Relay Functional
Front User Interface	USB port	Full Speed USB 2.0, 480 Mbps
Rear User Interface	Port 31A: 100Mbps-T,RJ45/100Mbps-Fx, ST Port 31B: 100Mbps-T,RJ45/100Mbps-Fx, ST (PRP) Port 32: RS-485 (2400bps to 57600bps)	100 Mbps Copper/FO Ethernet port Serial RS485 Port
SCADA Interface	IEC61850 (Ethernet) or DNP3 (RS-485 or Ethernet) or Modbus (RS-485) or IEC 60870-5-103 (RS-485)	Rear port
Time Sync	Port 331: IRIG-B, 1 BNC connector/unit, SNTP	Modulated or unmodulated, jumper selection
Self Checking/Relay Inoperative	RL14: 1CO contact configurable	Closed when relay inoperative
Physical		
Weight	6kg/13.228 lbs	
Dimensions	E8 case: 177mm Height x 207mm Width x 225mm Depth	6.96 Inch Height x 8.16 Inch Width x 8.85 Inch Depth
Mounting	Horizontal Rack Mount E8 case: 159mm Height x 201.5mm Width	 6.25 Inch Height x 7.93 Inch Width

T-PRO 2000 Specifications

Item	Quantity/Specs	Note
Time Synchronization		
External Time Source	Synchronized using IRIG-B input (modulated or unmodulated) 1PPM SNTP	In the absence of an external time source, the relay maintains time with a maximum 20ppm at a constant temperature of 25C. The relay can detect loss of re-establishment of external time source and automatically switch between internal and external time.
Overall T-PRO Accuracies		
Differential Element	±5.0% of set value IO min from 0.10 to 1.0 per unit (pu)	
Current	±2.5% of inputs from 0.1 to 1.0 x nominal current (In)	
	± 1.0% of inputs from 1.0 to 4.0 x nominal current (In)	
Voltage	± 1.0% of inputs of nominal voltage (Vn)	
Frequency Elements	Frequency Elements | ±0.003 Hz (fixed level) / ±0.05 Hz (df/dt)	
Timers	±2.5% of set value plus 1.00 to 1.50 cycles of inherent delay	
Inverse Overcurrent Timers	±2.5% or ±1 cycle of selected curve	
Definite Overcurrent Timers	±2.5% or ±1 cycle non-directional	
	±2.5% or ±1.5 cycle directional	

Type Tests

Test	Description: Type Test	Description: Test Points	Test Level
Electromagnetic Compatibility			
IEC 60255-26 IEC 61000-4-2	Electrostatic discharge	Enclosure air	+/- 8 kV
		Enclosure contact	+/- 6 kV
IEC 60255-26 IEC 61000-4-3	Radiated Interference (Electromagnetic field immunity)	Enclosure ports	10 V/m: 80-1000 MHz & 1.4 GHz - 2.7 GHz
IEC 60255-26 IEC 61000-4-4	Electrical Fast Transient	AC/DC power ports	+/- 4 kV
		AC voltage & current ports	
		External I/P & O/P ports	
IEC 60255-26 IEC 61000-4-18	Slow Damped Oscillatory / High Frequency Distur-bance / 1 MHz Burst Distur-bance	AC/DC power ports	+/- 2.5kV (Common Mode) +/- 1kV (Differential Mode)
		AC voltage & current ports	
		External I/P & O/P ports	
IEC 60255-26 IEC 61000-4-8	Power Frequency Mag-netic Field	Enclosure	30A/m Continuous (60 sec) 300A/m Pulse (3 sec)
IEC 60255-26 CISPR 11 & 32 FCC 15 - ICES 003	Conducted Emissions	Power ports	Criteria - A
	Radiated Emissions	Enclosure	Criteria - A
IEC 60255-26 IEC 61000-4-6	Conducted Disturbances induced by RF (Conducted Susceptibility)	AC/DC power ports	10Vrms: 150kHz – 80MHz
		AC voltage & current ports	
		External I/P & O/P ports	
IEC 60255-26 IEC 61000-4-11	AC Voltage Dips	AC power port	100% reduction for 10ms
IEC 60255-26 IEC 61000-4-11	AC Voltage Interrupts	AC power port	100% reduction for 5000ms
IEC 60255-26 IEC 61000-4-6	DC Voltage Dips	DC power port	100% reduction for 50ms
IEC 60255-26 IEC 61000-4-6	DC Voltage Interrupts	DC power port	100% reduction for 5000ms
IEC 60255-26 IEC 61000-4-6	AC Ripple on DC Input Power	DC power port	10% of Rated DC Value with 100Hz
Safety			
IEC 60255-27:2013 Cl.No. 10.6.4.3	Dielectric/HiPot	AC/DC power ports	2kV AC/min
		AC voltage & current ports	
		External I/P & O/P ports	

Type Tests

Test	Description		Test Level
	Type Test	Test Points	
IEC 60255-27:2013 Cl.No.10.6.4.4	Insulation Resistance	AC/DC power ports	>100MΩ @ 500 Vdc/min
		AC voltage & current ports	
		External I/P & O/P ports	
IEC 60255-27:2013 Cl.No.10.6.4.5.1	Protective Bonding Resistance	Enclosure	
IEC 60255-27:2013 Cl.No. 10.6.4.2	HV Impulse	AC/DC power ports	+/- 5 kV
		AC voltage & current ports	
		External I/P & O/P ports	
Mechanical			
IEC 60068-2-6 IEC 60255-21-6	Vibration Response	Enclosure	Class 1: Frequency 10-150Hz Displacement: 0.035mm (peak) Acceleration: 0.5g Sweep rate: 1octave/min No. of Axis: 3 (X, Y & Z) No. of Sweep Cycles: 1/axis
IEC 60068-2-27 IEC 60255-21-2	Shock Response	Enclosure	Class 1: Acceleration: 5g Pulse Width: 11ms Pulse Sweep: 1/2 sine wave No. of Shocks: 3/direction No. of Directions: 2/axis No. of Axis: 3 (X, Y & Z) Total No. of Shocks: 18 + 18
IEC 60068-2-27 IEC 60255-21-2	Bump	Enclosure	Class 1: 10g, 1000 pulses per direction per axis
IEC 60255-21-3	Seismic	Enclosure	Class 1: For X-axis: Displacement: 3.5mm (peak) Acceleration: 1.0g Sweep rate: 1octave/min For Y-axis: Displacement: 1.5mm (peak) Acceleration: 0.5g Sweep rate: 1 octave/min
Environmental Tests			
IEC 60068-2-1	Cold - operational and storage	Enclosure	-10°C for 16hr -25°C for 16hr
IEC 60068-2-2	Hot - operational and storage	Enclosure	+55°C for 16hr +70°C for 16hr
IEC 60068-2-78	Damp heat - steady state	Enclosure	+40°C for 240 hrs
IEC 60068-2-30	Damp heat - steady cyclic	Enclosure	+25C and +55 C, 6 cycles

A.1 IDMTL Element Operating Time Curves

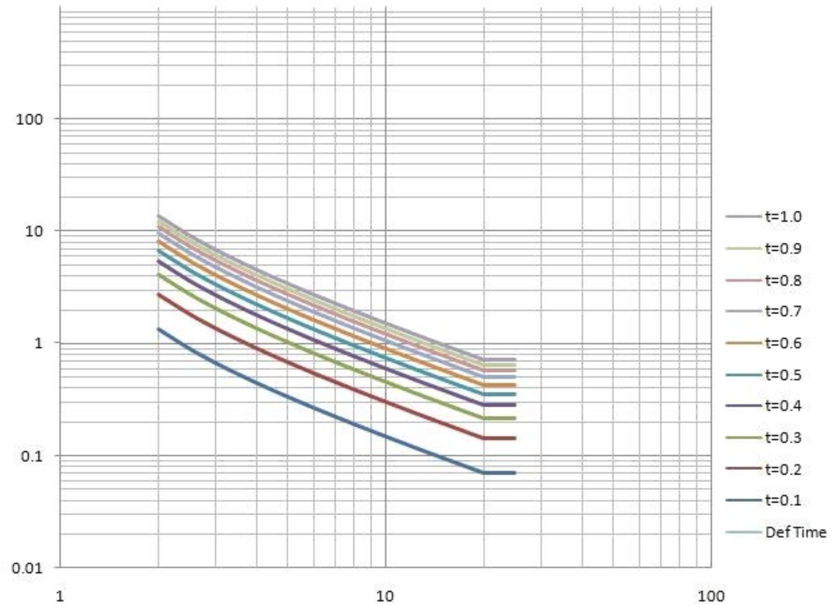


Figure A.1: IEC Very Inverse

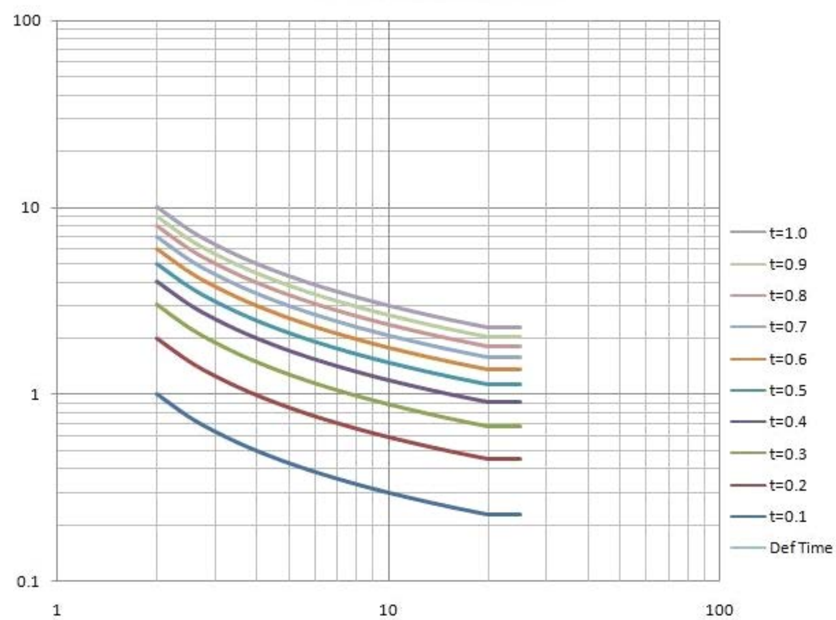


Figure A.2: IEC Standard Inverse 3

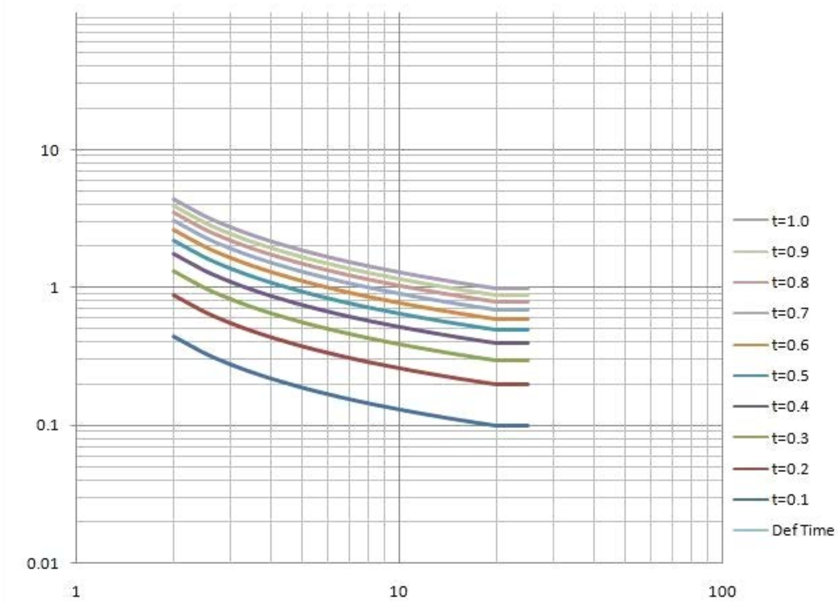


Figure A.3: IEC Standard Inverse 1

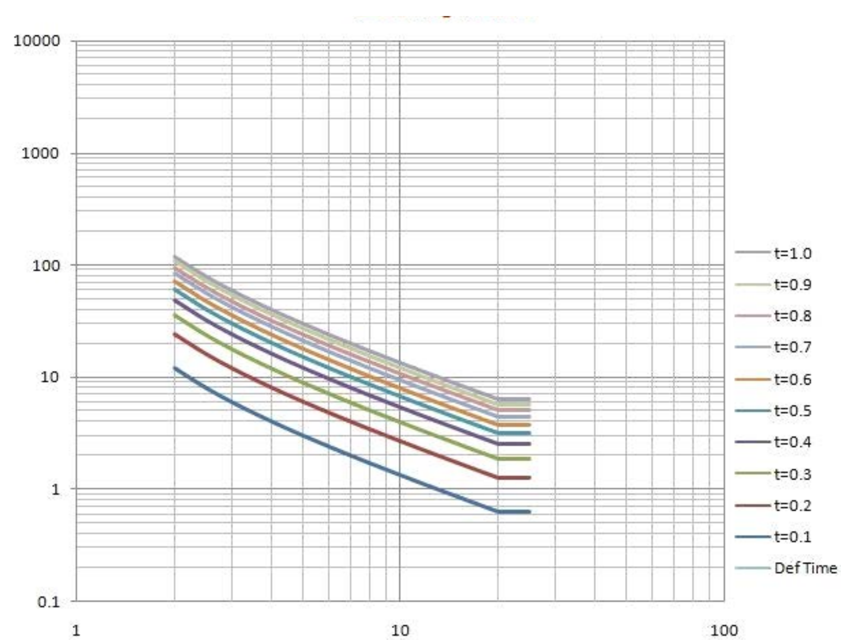


Figure A.4: IEC Long Inverse

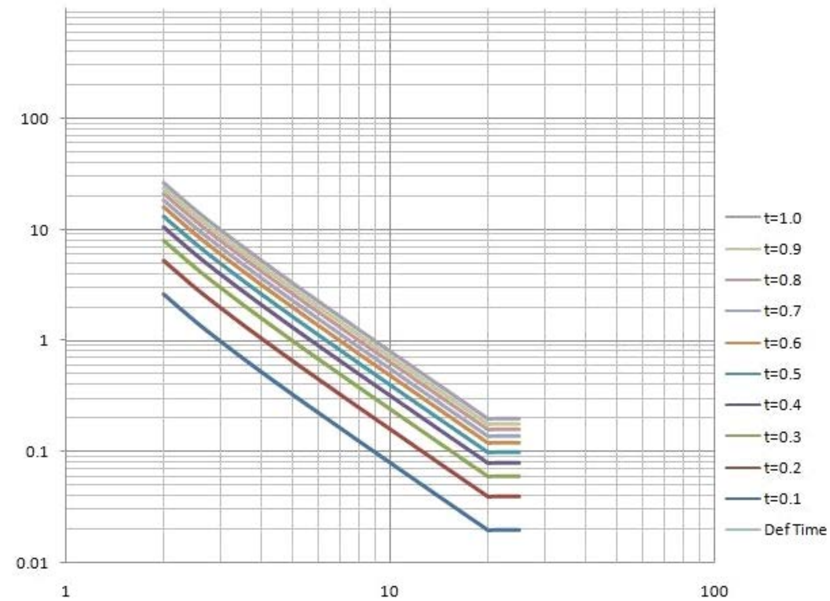


Figure A.5: IEC Extremely Inverse

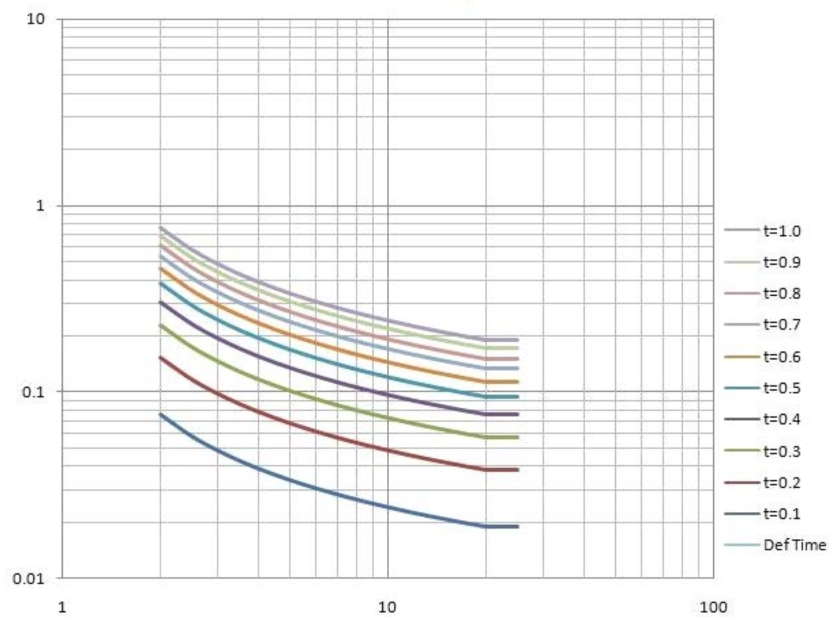


Figure A.6: IEEE Moderately Inverse

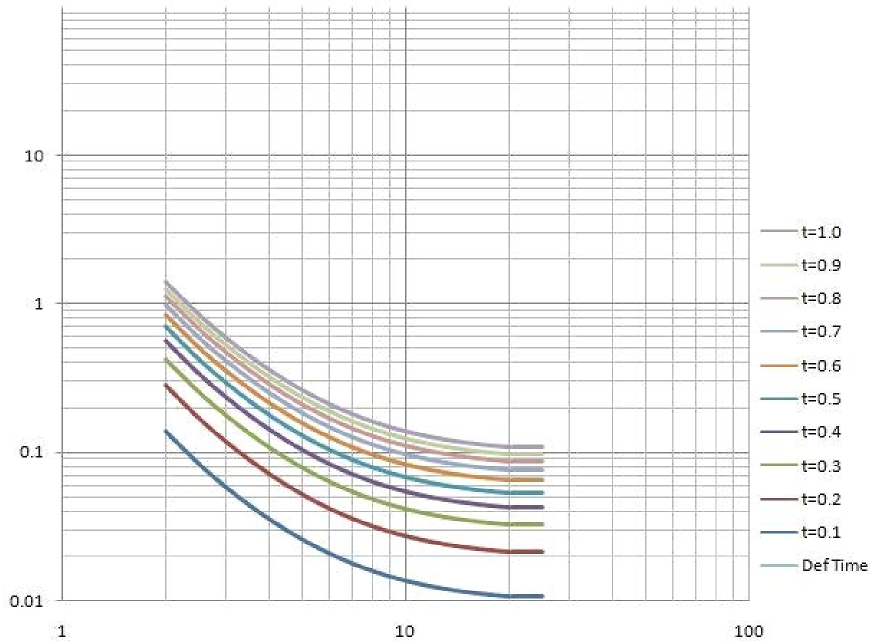


Figure A.7: IEEE Very Inverse

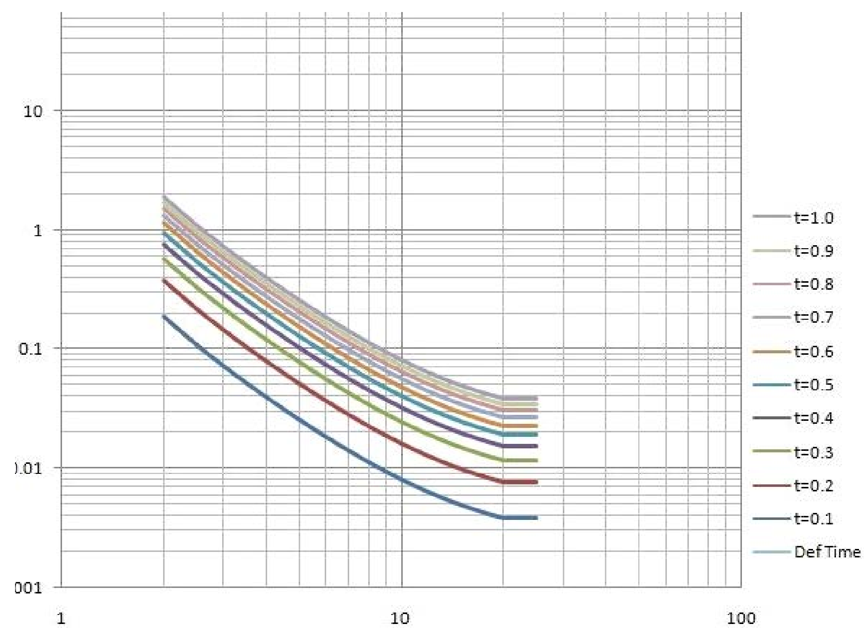


Figure A.8: IEEE Extremely Inverse

Appendix B IED Settings and Ranges

B.1 Settings and Ranges

The Offliner software provides the user to view and print a compact summary of the settings defined in each Setting Group, for a given device. The user can view the summary by selecting the Settings Summary option (last item) under each Setting Group listed in the Offliner application.

The summary includes general data from the Relay Identification screen, as well as all the user-defined names of inputs (e.g. current, voltage, virtual) and control outputs, and ProLogic definitions. It also includes all the user-defined settings along with their respective units and permissible value range.

The following pages illustrate the Settings Summary for Settings Group 1.

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Relay Identification			
Settings Version	1		
Ignore Serial Number	Yes		
Serial Number	TPRO-2000-XX0000000		
Unit ID	UnitID		
Nominal System Frequency	50 Hz		
Analog Input Configuration	6CT + 1CT(1A) + 1VT		
Standard I/O	14 External Inputs and 14 Output Contacts		
Comments	Comments		
Setting Name	Settings Name		
Date Created/Modified	2024-06-27 11:18:00		
Station Name	Station Name		
Station Number	1		
Location	Location		
Bank Name	Bank Name		
Analog Input Names			
I1A	I1A		
I1B	I1B		
I1C	I1C		
I2A	I2A		
I2B	I2B		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
I2C	I2C		
IN	IN		
VIN	VIN		
External Input Names			
1	EI 1		
2	EI 2		
3	EI 3		
4	EI 4		
5	EI 5		
6	EI 6		
7	EI 7		
8	EI 8		
9	EI 9		
10	EI 10		
11	EI 11		
12	EI 12		
13	EI 13		
14	EI 14		
Output Contact Dropout Timers			
Output 1 (RL 1)	0.10	s	0.00 to 20.00
Output 2 (RL 2)	0.10	s	0.00 to 20.00
Output 3 (RL 3)	0.10	s	0.00 to 20.00
Output 4 (RL 4)	0.10	s	0.00 to 20.00
Output 5 (RL 5)	0.10	s	0.00 to 20.00
Output 6 (RL 6)	0.10	s	0.00 to 20.00
Output 7 (RL 7)	0.10	s	0.00 to 20.00
Output 8 (RL 8)	0.10	s	0.00 to 20.00
Output 9 (RL 9)	0.10	s	0.00 to 20.00
Output 10 (RL 10)	0.10	s	0.00 to 20.00
Output 11 (RL 11)	0.10	s	0.00 to 20.00
Output 12 (RL 12)	0.10	s	0.00 to 20.00
Output 13 (RL 13)	0.10	s	0.00 to 20.00
Output 14 (RelayInoperative)	0.10	s	0.00 to 20.00
Output Contact Reset Type			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Output 1	Self Reset		
Output 2	Self Reset		
Output 3	Self Reset		
Output 4	Self Reset		
Output 5	Self Reset		
Output 6	Self Reset		
Output 7	Self Reset		
Output 8	Self Reset		
Output 9	Self Reset		
Output 10	Self Reset		
Output 11	Self Reset		
Output 12	Self Reset		
Output 13	Self Reset		
Output 14	Self Reset		
Output Contact Reset			
Reset	<Unused =0>		
Virtual Input Names			
1	VI 1		
2	VI 2		
3	VI 3		
4	VI 4		
5	VI 5		
6	VI 6		
7	VI 7		
8	VI 8		
9	VI 9		
10	VI 10		
11	VI 11		
12	VI 12		
13	VI 13		
14	VI 14		
15	VI 15		
16	VI 16		
17	VI 17		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
18	VI 18		
19	VI 19		
20	VI 20		
21	VI 21		
22	VI 22		
23	VI 23		
24	VI 24		
25	VI 25		
26	VI 26		
27	VI 27		
28	VI 28		
29	VI 29		
30	VI 30		
Target			
Target LED 2	Self Reset		
Target LED 3	Self Reset		
Target LED 4	Self Reset		
Target LED 5	Self Reset		
Target LED 6	Self Reset		
Target LED 7	Self Reset		
Target LED 8	Self Reset		
Target LED 9	Self Reset		
Target LED 10	Self Reset		
Target LED 11	Self Reset		
Target LED 12	Self Reset		
Target LED 13	Self Reset		
Target LED 14	Self Reset		
Target Reset			
Reset	<Unused =0>		
Setting Group Names			
Setting Group 1	SG 1		
Setting Group 2	SG 2		
Setting Group 3	SG 3		
Setting Group 4	SG 4		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Setting Group 5	SG 5		
Setting Group 6	SG 6		
Setting Group 7	SG 7		
Setting Group 8	SG 8		
System Parameters			
Transformer 3 Phase Capacity	100.0	MVA	1.0 to 2000.0
Transfomer Winding	2		
Tap Changer Range	0	%	-100 to 100
Auto Transformer	NO		YES or NO
Winding Data			
HV			
Voltage	230.0	kV	115.0 to 2000.0
Connection	Y		Delta or Y
Phase	0°		
LV			
Voltage	115.00	kV	1.0 to 230.0
Connection	Y		Delta or Y
Phase	0°		DY, YD, YY connection: 0°, 30°, 60°, 90°, 120°, 150°, 180°, -150°, -120°, -90°, -60°, -30° DD connection: 0°, 60°, 120°, 180°, -120°, -60°
Voltage Input Connection (VIN)			
PT Primary	230.0	kV	1.0 to 2000.0
PT Secondary	63.5	V	40.0 to 160.0
PT Turns Ratio	2000.0	:1	1.0 to 50000.0
Input Type	Ph - N		Ph - N, Ph - Ph, Neutral Voltage
CT Input Connections			
Current Input 1			
Winding	HV		HV
Connection	Y		Delta or Y

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Phase	0°		Y connection: 0°, 60°, 120°, 180°, -120°, -60° Delta connection: 30°, 90°, 150°, -150°, -90°, -30°
CT Primary	500.00	A	1.00 to 50000.00
CT Secondary	1	A	1A or 5A
CT Turns Ratio (:1)	500.00	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
Current Input 2			
Winding	LV		LV
Connection	Y		Delta or Y
Phase	0°		Y connection: 0°, 60°, 120°, 180°, -120°, -60° Delta connection: 30°, 90°, 150°, -150°, -90°, -30°
CT Primary	1000.00	A	1.00 to 50000.00
CT Secondary	1	A	1A or 5A
CT Turns Ratio (:1)	1000.00	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
Current IN			
Winding	HV		HV or LV
CT Primary	500.00	A	1.00 to 50000.00
CT Secondary	1	A	1A or 5 A
CT Turns Ratio (:1)	500.00	-	1.00 to 50000.00
External Input Selection	<Not Used>		Not Used, EI 1 to EI 14
IN REF	Low Impedance		High Impedance or Low Impedance

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
General			
Minimum Voltage Threshold	0.3	V	0.0 to 2.9
Disturbance Record			
Record Length	1	s	1 to 10
Pre Trigger	0.25	s	0.10 to 0.90
Event Auto Save	Disabled		
Setting Group 1 [SG 1]			
Comments: Default Settings			
Protection Summary			
87	Disabled		
87N Enalbed	Disabled		
49-1	OFF		
49-2	OFF		
49-3	OFF		
49-4	OFF		
49-5	OFF		
49-6	OFF		
49-7	OFF		
49-8	OFF		
49-9	OFF		
49-10	OFF		
49-11	OFF		
49-12	OFF		
THD	Disabled		
Through Fault Monitor	Disabled		
50-1 HV	Disabled		
50-2 HV	Disabled		
51-1 HV	Disabled		
51-2 HV	Disabled		
50-1 LV	Disabled		
50-2 LV	Disabled		
51-1 LV	Disabled		
51-2 LV	Disabled		
50N-1 HV	Disabled		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50N-2 HV	Disabled		
51N-1 HV	Disabled		
51N-2 HV	Disabled		
50N-1 LV	Disabled		
50N-2 LV	Disabled		
51N-1 LV	Disabled		
51N-2 LV	Disabled		
50G-1	Disabled		
50G-2	Disabled		
51G-1	Disabled		
51G-2	Disabled		
46/50 HV	Disabled		
46/51 HV	Disabled		
46/50 LV	Disabled		
46/50 LV	Disabled		
50BF-1	Disabled		
50BF-2	Disabled		
27/59DT-1	Disabled		
27/59DT-2	Disabled		
27/59DT-3	Disabled		
27/59DT-4	Disabled		
27/59IT-1	Disabled		
27/59IT-2	Disabled		
24DT-1	Disabled		
24DT-2	Disabled		
24IT	Disabled		
59GDT-1	Disabled		
59GDT-2	Disabled		
59GIT	Disabled		
81U/O-1	Disabled		
81U/O-2	Disabled		
81U/O-3	Disabled		
81U/O-4	Disabled		
81R-1	Disabled		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
81R-2	Disabled		
74TCS-1	Disabled		
74TCS-2	Disabled		
I^2t-CB HV	Disabled		
I^2t-CB LV	Disabled		
87 Differential			
87	Disabled		
IOmin	0.30	pu	0.10 to 1.00
Input 1	0.15	A	-
Input 2	0.15	A	-
87 Alarm Pickup	0.10	pu	0.05 to 0.50
87 Alarm Delay	1.00	Sec	0.00 to 99.00
IRs	5.00	pu	1.00 to 50.00
S1	30.00	%	6.00 to 100.00
S2	100.00	%	30.00 to 200.00
High Current Setting	10.00	pu	0.90 to 100.00
2nd Harmonic	Off		
I_2nd / I_fund Ratio	0.20	-	0.05 to 1.00
5th Harmonic	Disabled		
I_5th_I_fund Ratio	0.30	-	0.05 to 1.00
87N - Neutral Differential			
87N	Disabled		
IOmin	0.30	pu	0.10 to 1.00
IOmin	0.15	A	-
IRs	5.00	pu	1.00 to 50.00
S1	30.00	%	6.00 to 100.00
S2	100.0	%	30.00 to 200.00
Neutral CT Turns Ratio	500.00	:1	1.00 to 10000.00
49-1 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Dropout Delay(s)	0.00	s	-
49-2 - Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-3 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-4 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-5 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-6 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-7 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-8 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-9 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-10 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-11 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
49-12 Thermal Overload			
Current Input Switch	OFF		OFF, HV, LV
Pickup	1.20	A	-
Hysteresis	0.11	A	-
Pickup Delay(s)	0.00	s	-
Dropout Delay(s)	0.00	s	-
50DT HV - Definite Time Phase Overcurrent			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50 HV-1	Disabled		
Pickup I>>	10.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
50 HV-2	Disabled		
Pickup I>>	10.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
51IT HV - Inverse Time Phase Overcurrent			
51 HV-1	Disabled		
Pickup I>>	1.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
51 HV-2	Disabled		
Pickup I>>	1.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
50DT LV - Definite Time Phase Overcurrent			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50 LV-1	Disabled		
Pickup I>>	10.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
50 LV-2			
Pickup I>>	10.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
51IT LV - Inverse Time Phase Overcurrent			
51 LV-1	Disabled		
Pickup I>>	1.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
51 LV-2	Disabled		
Pickup I>>	1.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
50NDT HV - Definite Time Derived Neutral Overcurrent			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50N HV-1	Disabled		
Pickup IN>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
50N HV-2	Disabled		
Pickup IN>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
51NIT HV - Inverse Time Derived Neutral Overcurrent			
51N HV-1	Disabled		
Pickup IN>	0.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
51N HV-2	Disabled		
Pickup IN>	0.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
50NDT LV - Definite Time Derived Neutral Overcurrent			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50N LV-1	Disabled		
Pickup IN>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
50N LV-2	Disabled		
Pickup IN>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
51NIT LV - Inverse Time Derived Neutral Overcurrent			
51N LV-1	Disabled		
Pickup IN>	0.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
51N LV-2	Disabled		
Pickup IN>	0.20	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
Measurement			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Measurement	DFT		
50GDT - Definite Time Neutral Overcurrent / High Impedance REF			
50G-1	Disabled		
Pickup IG>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
50G-2	Disabled		
Pickup IG>	1.00	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
Inrush Blocking	Disabled		
51GIT - Inverse Time Measured Neutral Overcurrent			
51G-1	Disabled		
Pickup IG>	10.00	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
Inrush Blocking	Disabled		
51G-2	Disabled		
Pickup IG>	10.00	A	0.05 to 10.00
Curve Type	IEC standard inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	DTL		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Inrush Blocking	Disabled		
46/50DT HV - Definite Time Negative Sequence Overcurrent			
46/50 HV	Disabled		
Pickup I2>>	0.25	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
46/51IT HV - Inverse Time Negative Sequence Overcurrent			
46/51 HV	Disabled		
Pickup I2>	0.25	A	0.05 to 10.00
Curve Type	IEC Standard Inverse		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	ANSI Decay		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
46/50DT LV - Definite Time Negative Sequence Overcurrent			
46/50 LV	Disabled		
Pickup I2>>	0.25	A	0.05 to 25.00
Pickup Delay	0.00	s	0.00 to 999.99
46/51IT LV - Inverse Time Negative Sequence Overcurrent			
46/51 LV	Disabled		
Pickup I2>	0.25	A	0.05 to 10.00
Curve Type	IEC Standard Inverse		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset Delay	ANSI Decay		
Reset DTL Delay	0.0	s	0.0 to 99.9
A	0.1400	-	-
B	0.0000	-	-
p	0.02	-	-
TR	13.50	-	0.10 to 150.00
50BF - Breaker Failure			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
50BF Input-1			
Pickup Delay1	0.20	s	0.01 to 99.99
Pickup Delay2	0.40	s	0.01 to 99.99
Current Detection	Disabled		
Breaker Current Pickup	1.00	A	0.02 to 10.00
Breaker Status	<Disabled>		Disabled, EI 1 to EI 14, PL 1 to PL 24, VI 1 to VI 30
50BF Input-2			
Pickup Delay1	0.20	s	0.01 to 99.99
Pickup Delay2	0.40	s	0.01 to 99.99
Current Detection	Disabled		
Breaker Current Pickup	1.00	A	0.02 to 10.00
Breaker Status	<Disabled>		Disabled, EI 1 to EI 14, PL 1 to PL 24, VI 1 to VI 30
27/59DT - Definite Time Phase Under/Over Voltage			
27/59DT-1	Disabled		
Function Selection	UV		
Pickup V	51.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup Delay	0.20	s	0.00 to 999.99
Reset Delay	0.00	s	0.00 to 999.99
27/59DT-2	Disabled		
Function Selection	UV		
Pickup V	51.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup Delay	0.20	s	0.00 to 999.99
Reset Delay	0.00	s	0.00 to 999.99
27/59DT-3	Disabled		
Function Selection	UV		
Pickup V	51.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup Delay	0.20	s	0.00 to 999.99

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Reset Delay	0.00	s	0.00 to 999.99
27/59DT-4	Disabled		
Function Selection	UV		
Pickup V	51.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup Delay	0.20	s	0.00 to 999.99
Reset Delay	0.00	s	0.00 to 999.99
27/59IT - Inverse Time Phase Under/Over Voltage			
27/59IT-1	Disabled		
Function Selection	UV		
Pickup V	55.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Curve Type	IEC Standard Inverse		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
A	1.0	-	0.1 to 50.0
B	0.0	-	0.0 to 10.0
p	1.0	-	0.1 to 10.0
27/59IT-2	Disabled		
Function Selection	UV		
Pickup V	55.0	V	3.0 to 250.0
Hysteresis	1	%	1 to 80
Curve Type	IEC Standard Inverse		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
A	1.0	-	0.1 to 50.0
B	0.0	-	0.0 to 10.0
p	1.0	-	0.1 to 10.0
24DT - Definite Time Overflux			
24DT-1	Disabled		
Pickup V/F	1.10	pu	1.00 to 2.00
Hysteresis	1	%	1 to 80

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Pickup DTL Delay	0.20	s	0.05 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
24DT-2	Disabled		
Pickup V/F	1.10	pu	1.00 to 2.00
Hysteresis	1	%	1 to 80
Pickup DTL Delay	0.20	s	0.05 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
24IT - Inverse Time Overflux			
24IT	Disabled		
Pickup V/F	1.10	pu	1.00 to 1.50
Hysteresis	1	%	1 to 80
Curve Type	IEEE Extremely Inverse-3		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.05 to 999.99
Reset DTL Delay	0.00	s	0.0 to 99.9
A	108.75		
B	1.00		
C	2.4490		
Inverse of K	0.10		
X1	1.10	s	1.00 to 3.00
X2	1.15	s	1.00 to 3.00
X3	1.20	s	1.00 to 3.00
X4	1.25	s	1.00 to 3.00
X5	1.30	s	1.00 to 3.00
X6	1.35	s	1.00 to 3.00
X7	1.40	s	1.00 to 3.00
Y1	70.00	s	0.00 to 9999.99
Y2	60.00	s	0.00 to 9999.99
Y3	50.00	s	0.00 to 9999.99
Y4	40.00	s	0.00 to 9999.99
Y5	30.00	s	0.00 to 9999.99
Y6	20.00	s	0.00 to 9999.99
Y7	10.00	s	0.00 to 9999.99
59GDT - Definite Time Measured Residual Over Voltage			

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
59GDT-1	Disabled		
Voltage Compensation	0.0	V	0.0 to 15.0
Pickup VG	10.0	V	1.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup Delay	0.20	s	0.00 to 999.99
Reset Delay	0.00	s	0.00 to 999.99
59GDT-2	Disabled		
Voltage Compensation	0.0	V	0.0 to 15.0
Pickup VG	10.0	V	1.0 to 250.0
Hysteresis	1	%	1 to 80
Pickup DTL Delay	0.20	s	0.00 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
59GIT - Inverse Time Measured Residual Over Voltage			
59GIT	Disabled		
Voltage Compensation	0.0	V	0.0 to 15.0
Pickup VG	66.7	V	1.0 to 250.0
Hysteresis	1	%	1 to 80
Curve Type	IEC Standard Inverse		
TMS	1.00	-	0.01 to 10.00
Pickup DTL Delay	10.00	s	0.00 to 999.99
Reset DTL Delay	0.00	s	0.00 to 999.99
A	1.0	-	0.1 to 50.0
B	0.0	-	0.0 to 10.0
p	1.0	-	0.1 to 10.0
81U/O - Under/Over Frequency			
81U/O-1	Disabled		
Function Selection	UF		
Pickup F	49.0	Hz	40.00 to 49.99
Hysteresis	0.05	Hz	0.01 to 2.00
Pickup Delay	2.00	s	0.05 to 999.99
81U/O-2	Disabled		
Function Selection	UF		
Pickup F	49.0	Hz	40.00 to 49.99
Hysteresis	0.05	Hz	0.01 to 2.00

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Pickup Delay	2.00	s	0.05 to 999.99
81U/O-3	Disabled		
Function Selection	UF		
Pickup F	49.0	Hz	40.00 to 49.99
Hysteresis	0.05	Hz	0.01 to 2.00
Pickup Delay	2.00	s	0.05 to 999.99
81U/O-4	Disabled		
Function Selection	UF		
Pickup F	49.0	Hz	40.00 to 49.99
Hysteresis	0.05	Hz	0.01 to 2.00
Pickup Delay	2.00	s	0.05 to 999.99
81R - Rate of Change of Frequency			
81R-1	Disabled		
Pickup df/dt	-0.5	Hz/s	-10.0 to 10.0
Hysteresis	1	%	1 to 80
Pickup Delay	1.00	s	0.20 to 999.99
81R-2	Disabled		
Pickup df/dt	-0.5	Hz/s	-10.0 to 10.0
Hysteresis	1	%	1 to 80
Pickup Delay	1.00	s	0.20 to 999.99
THD - Total Harmonic Distortion			
THD	Disabled		
Pickup	10.0	%	5.0 to 100.0
TFM - Through Fault Monitor			
Through Fault Monitor	Disabled		
Input Current	HV		HV, LV
Pickup Level	10.00	A	0.05 to 10.00
Hysteresis	0.02	A	0.01 to 2.00
Pickup Delay (Tp1)	0.00	s	0.00 to 99.99
Dropout Delay (Td1)	0.00	s	0.00 to 99.99
I*I*t Alarm Limit	1000.0	kA*kA*s	0.1 to 9999.9
2nd Harmonics Blocking	Disabled		
Pickup Delay (Tp2)	0.00	s	0.00 to 99.99

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Dropout Delay (Td2)	0.00	s	0.00 to 99.99
74TCS - Trip Circuit Supervision			
74TCS-1 [TCS 1]	Disabled		
Drop-off Delay	0.40	s	0.00 to 9.99
74TCS-2 [TCS 2]	Disabled		
Drop-off Delay	0.40	s	0.00 to 9.99
HV I^2t-CB Condition			
HV I^2t	Disabled		
I^2t Limit	99999.9	kA^2s	0.1 to 99999.9
LV I^2t-CB Condition			
LV I^2t	Disabled		
I^2t Limit	99999.9	kA^2s	0.1 to 99999.9
PL 1 [ProLogic 1]			
ProLogic 1	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 2 [ProLogic 2]			
ProLogic 2	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 3 [ProLogic 3]			
ProLogic 3	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 4 [ProLogic 4]			
ProLogic 4	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
PL 5 [ProLogic 5]			
ProLogic 5	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 6 [ProLogic 6]			
ProLogic 6	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 7 [ProLogic 7]			
ProLogic 7	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 8 [ProLogic 8]			
ProLogic 8	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 9 [ProLogic 9]			
ProLogic 9	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 5			
Input E	<Unused = 0>		
PL 10 [ProLogic 10]			
ProLogic 10	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 11 [ProLogic 11]			
ProLogic 11	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 12 [ProLogic 12]			
ProLogic 12	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 13 [ProLogic 13]			
ProLogic 13	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 14 [ProLogic 14]			
ProLogic 14	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 15 [ProLogic 15]			
ProLogic 15	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 16 [ProLogic 16]			
ProLogic 16	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 17 [ProLogic 17]			
ProLogic 17	Disabled		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 18 [ProLogic 18]			
ProLogic 18	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 19 [ProLogic 19]			
ProLogic 19	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 20 [ProLogic 20]			
ProLogic 20	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 21 [ProLogic 21]			
ProLogic 21	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
PL 22 [ProLogic 22]			
ProLogic 22	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 23 [ProLogic 23]			
ProLogic 23	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		
PL 24 [ProLogic 24]			
ProLogic 24	Disabled		
Pickup Delay-Tp	0.00	s	0.00 to 999.00
Dropout Delay-Td	0.00	s	0.00 to 999.00
Operator 1			
Input A	<Unused = 0>		

T-PRO Settings Summary - Setting Group 1 [SG 1]			
Name	**Symbol/Value**	**Unit**	**Range**
Operator 2			
Input B	<Unused = 0>		
Operator 3			
Input C	<Unused = 0>		
Operator 4			
Input D	<Unused = 0>		
Operator 5			
Input E	<Unused = 0>		

Appendix C Hardware Description

The relay is designed and manufactured with high quality features and recording components for a complete feeder protection package. The following information describes the main hardware components of the relay

Fascia Board (FB):

The FB contains LED's and It also has 7 keys (The keypad is used to navigate the menus on the display to control relay operation by a local user).

Mother Board (MB):

The mother board contains graphical LCD, USB interface and the interface connectors to interface to all the boards.

CPU Board (CPUB):

The CPUB has System on Module and it contains high speed dual core processor which performs the entire relay operation. The CPUB is interfaced to Mother Board, which manages the protection features of the relay. The dual core processor manages the user interface and system control features of the relay and RTC backup battery.

The CPUB provides the following functionality:

- DSP processor subsystem manages the protection features of the relay with the floating point arithmetic to provide fast capture and manipulation of data.
- ARM processor subsystem performs the post processing activity like disturbance recording, logging fault & event, communication protocol support, LCD HMI and PC interface activity.
- NOR and NAND Flash memory supports field software upgrades.
- Settings and records are stored in non-volatile memory.
- Runs on a Real Time Operating System (RTOS).
- Provides Ethernet ports, RS-485 port and USB interface.
- Time synchronism co-processor with modulated and un-modulated IRIG-B(input selection through jumper).
- High speed inbuilt link is provided between the DSP and ARM processor subsystems.
- Sophisticated fault detection.

Analog Input Board (AIB):

AIB has 8 channel analog inputs (7 current transformer inputs and 1 voltage transformer inputs). It provides the analog to digital conversion of ac analog current & voltage inputs. The sampling rate is fixed at 32 samples/cycle. Each channel is simultaneously sampled using 16-bit analog to digital converters. The digitized data is sent to the CPUB for processing of protection algorithms.

Power Supply Board (PSB):

SMPS provides the power supply for the entire unit. The switching frequency is 132 kHz and it reduces the transformer size with no noticeable impact on EMI, accurate programmable current limit, fully integrated soft-start for minimum start-up stress. The two power supply operating ranges are 20 – 60Vdc and 80 -300 Vdc, 100-240 Vac, +/-10%, 50/60 Hz. This wide operating range provides easier installation by eliminating power supply ordering options. It also has 4 digital input channels (Inputs are optically isolated, externally wetted and ordering option with the voltage level of 24 / 48 / 110 / 220 Vdc selection), 3 normally open contact outputs and 1 Change over contact which acts as watch dog for relay healthiness. This board is interfaced to the mother board.

Digital Input Board (DIB):

This board contains 14 digital input channels (Inputs are optically isolated, externally wetted and ordering option with the voltage level of 24 / 48 / 110 / 220 Vdc selection). This board is interfaced to the mother board.

Digital Output Board (DOB):

This board contains 13 normally open contact outputs for relaying, alarms & control and 1 CO contact as watchdog for relay healthiness monitoring. This board is interfaced to the mother board.

Appendix D Event Messages

The following is a list of event messages that are created in the relay for events including trips, alarms, external input assertions, and internal events such as setting changes. This list is referred to from multiple places in this manual.

Event	ID	Class	Record	Notify	Log	Log Parame-ters (Table-3a & 3b)	LCD Message
87 Operated	0	Operated	config	LED : ON(config)	config	-	87 Operated
87N Operated	1	Operated	config	LED : ON(config)	config	-	87N Operated
2nd Harmonic Restraint	2	Operated	config	LED : ON(config)	config	-	2nd Harmonic Restraint
5th Harmonic Restraint	3	Operated	config	LED : ON(config)	config	-	5th Harmonic Restraint
87 Unrestrained	4	Operated	config	LED : ON(config)	config	-	87 Unrestrained
87 Delta Phase	5	Operated	config	LED : ON(config)	config	-	87 Delta Phase
87 ROCOD	6	Operated	config	LED : ON(config)	config	-	87 ROCOD
87N Delta Phase	7	Operated	config	LED : ON(config)	config	-	87N Delta Phase
87 Alarm	8	Operated	config	LED : ON(config)	config	-	87 Alarm
49-1 Picked up	9	Picked up	config	LED : ON(config)	config	-	49-1 Picked up
49-2 Picked up	10	Picked up	config	LED : ON(config)	config	-	49-2 Picked up
49-3 Picked up	11	Picked up	config	LED : ON(config)	config	-	49-3 Picked up
49-4 Picked up	12	Picked up	config	LED : ON(config)	config	-	49-4 Picked up
49-5 Picked up	13	Picked up	config	LED : ON(config)	config	-	49-5 Picked up
49-6 Picked up	14	Picked up	config	LED : ON(config)	config	-	49-6 Picked up
49-7 Picked up	15	Picked up	config	LED : ON(config)	config	-	49-7 Picked up
49-8 Picked up	16	Picked up	config	LED : ON(config)	config	-	49-8 Picked up
49-9 Picked up	17	Picked up	config	LED : ON(config)	config	-	49-9 Picked up
49-10 Picked up	18	Picked up	config	LED : ON(config)	config	-	49-10 Picked up
49-11 Picked up	19	Picked up	config	LED : ON(config)	config	-	49-11 Picked up
49-12 Picked up	20	Picked up	config	LED : ON(config)	config	-	49-12 Picked up
49-1 Operated	21	Operated	config	LED : ON(config)	config	-	49-1 Operated
49-2 Operated	22	Operated	config	LED : ON(config)	config	-	49-2 Operated
49-3 Operated	23	Operated	config	LED : ON(config)	config	-	49-3 Operated

49-4 Operated	24	Operated	config	LED : ON(config)	config	-	49-4 Operated
49-5 Operated	25	Operated	config	LED : ON(config)	config	-	49-5 Operated
49-6 Operated	26	Operated	config	LED : ON(config)	config	-	49-6 Operated
49-7 Operated	27	Operated	config	LED : ON(config)	config	-	49-7 Operated
49-8 Operated	28	Operated	config	LED : ON(config)	config	-	49-8 Operated
49-9 Operated	29	Operated	config	LED : ON(config)	config	-	49-9 Operated
49-10 Operated	30	Operated	config	LED : ON(config)	config	-	49-10 Operated
49-11 Operated	31	Operated	config	LED : ON(config)	config	-	49-11 Operated
49-12 Operated	32	Operated	config	LED : ON(config)	config	-	49-12 Operated
50BF HV Initiate	33	Operated	config	LED : ON(config)	config	-	50BF HV Initiate
50BF LV Initiate	34	Operated	config	LED : ON(config)	config	-	50BF LV Initiate
50BF-INPUT1-1 Operated	35	Operated	config	LED : ON(config)	config	-	50BF-INPUT1-1 Operated
50BF-INPUT1-2 Operated	36	Operated	config	LED : ON(config)	config	-	50BF-INPUT1-2 Operated
50BF-INPUT2-1 Operated	37	Operated	config	LED : ON(config)	config	-	50BF-INPUT2-1 Operated
50BF-INPUT2-2 Operated	38	Operated	config	LED : ON(config)	config	-	50BF-INPUT2-2 Operated
50-HV-1 Pickedup	39	Pickedup	config	LED : ON(config)	config	-	50-HV-1 Pickedup
50-HV-2 Pickedup	40	Pickedup	config	LED : ON(config)	config	-	50-HV-2 Pickedup
50-HV-1 Oper-ated	41	Operated	config	LED : ON(config)	config	-	50-HV-1 Oper-ated
50-HV-2 Oper-ated	42	Operated	config	LED : ON(config)	config	-	50-HV-2 Oper-ated
51-HV-1 Pickedup	43	Picked Up	config	LED : ON(config)	config	-	51-HV-1 Pickedup
51-HV-2 Pickedup	44	Pickedup	config	LED : ON(config)	config	-	51-HV-2 Pickedup
51-HV-1 Oper-ated	45	Operated	config	LED : ON(config)	config	-	51-HV-1 Oper-ated
51-HV-2 Oper-ated	46	Operated	config	LED : ON(config)	config	-	51-HV-2 Oper-ated
50-LV-1 Pickedup	47	Pickedup	config	LED : ON(config)	config	-	50-LV-1 Pickedup
50-LV-2 Pickedup	48	Pickedup	config	LED : ON(config)	config	-	50-LV-2 Pickedup
50-LV-1 Oper-ated	49	Operated	config	LED : ON(config)	config	-	50-LV-1 Oper-ated
50-LV-2 Oper-ated	50	Operated	config	LED : ON(config)	config	-	50-LV-2 Oper-ated

51-LV-1 Pickedup	51	Picked Up	config	LED : ON(config)	config	-	51-LV-1 Pickedup
51-LV-2 Pickedup	52	Pickedup	config	LED : ON(config)	config	-	51-LV-2 Pickedup
51-LV-1 Oper-ated	53	Operated	config	LED : ON(config)	config	-	51-LV-1 Oper-ated
51-LV-2 Oper-ated	54	Operated	config	LED : ON(config)	config	-	51-LV-2 Oper-ated
50N-HV-1 Pickedup	55	Picked Up	config	LED : ON(config)	config	-	50N-HV-1 Pickedup
50N-HV-2 Pickedup	56	Pickedup	config	LED : ON(config)	config	-	50N-HV-2 Pickedup
50N-HV-1 Oper-ated	57	Operated	config	LED : ON(config)	config	-	50N-HV-1 Oper-ated
50N-HV-2 Oper-ated	58	Operated	config	LED : ON(config)	config	-	50N-HV-2 Oper-ated
51N-HV-1 Pickedup	59	Picked Up	config	LED : ON(config)	config	-	51N-HV-1 Pickedup
51N-HV-2 Pickedup	60	Pickedup	config	LED : ON(config)	config	-	51N-HV-2 Pickedup
51N-HV-1 Oper-ated	61	Operated	config	LED : ON(config)	config	-	51N-HV-1 Oper-ated
51N-HV-2 Oper-ated	62	Operated	config	LED : ON(config)	config	-	51N-HV-2 Oper-ated
50N-LV-1 Pickedup	63	Pickedup	config	LED : ON(config)	config	-	50N-LV-1 Pickedup
50N-LV-2 Pickedup	64	Pickedup	config	LED : ON(config)	config	-	50N-LV-2 Pickedup
50N-LV-1 Oper-ated	65	Operated	config	LED : ON(config)	config	-	50N-LV-1 Oper-ated
50N-LV-2 Oper-ated	66	Operated	config	LED : ON(config)	config	-	50N-LV-2 Oper-ated
51N-LV-1 Pickedup	67	Picked Up	config	LED : ON(config)	config	-	51N-LV-1 Pickedup
51N-LV-2 Pickedup	68	Pickedup	config	LED : ON(config)	config	-	51N-LV-2 Pickedup
51N-LV-1 Oper-ated	69	Operated	config	LED : ON(config)	config	-	51N-LV-1 Oper-ated
51N-LV-2 Oper-ated	70	Operated	config	LED : ON(config)	config	-	51N-LV-2 Oper-ated
50G-1 Pickedup	71	Picked Up	config	LED : ON(config)	config	-	50G-1 Pickedup
50G-2 Pickedup	72	Pickedup	config	LED : ON(config)	config	-	50G-2 Pickedup
50G-1 Operated	73	Operated	config	LED : ON(config)	config	-	50G-1 Operated
50G-2 Operated	74	Operated	config	LED : ON(config)	config	-	50G-2 Operated

51G-1 Pickedup	75	Picked Up	config	LED : ON(config)	config	-	51G-1 Pickedup
51G-2 Pickedup	76	Pickedup	config	LED : ON(config)	config	-	51G-2 Pickedup
51G-1 Operated	77	Operated	config	LED : ON(config)	config	-	51G-1 Operated
51G-2 Operated	78	Operated	config	LED : ON(config)	config	-	51G-2 Operated
46/50-HV Pickedup	79	Pickedup	config	LED : ON(config)	config	-	46/50-HV Pickedup
46/50-HV Oper-ated	80	Operated	config	LED : ON(config)	config	-	46/50-HV Oper-ated
46/51-HV Pickedup	81	Pickedup	config	LED : ON(config)	config	-	46/51-HV Pickedup
46/51-HV Oper-ated	82	Operated	config	LED : ON(config)	config	-	46/51-HV Oper-ated
46/50-LV Pickedup	83	Picked Up	config	LED : ON(config)	config	-	46/50-LV Pickedup
46/50-LV Oper-ated	84	Operated	config	LED : ON(config)	config	-	46/50-LV Oper-ated
46/51-LV Pickedup	85	Pickedup	config	LED : ON(config)	config	-	46/51-LV Pickedup
46/51-LV Oper-ated	86	Operated	config	LED : ON(config)	config	-	46/51-LV Oper-ated
24DT-1 Pickedup	87	Picked Up	config	LED : ON(config)	config	-	24DT-1 Pickedup
24DT-2 Pickedup	88	Pickedup	config	LED : ON(config)	config	-	24DT-2 Pickedup
24DT-1 Oper-ated	89	Operated	config	LED : ON(config)	config	-	24DT-1 Oper-ated
24DT-2 Oper-ated	90	Operated	config	LED : ON(config)	config	-	24DT-2 Oper-ated
24IT Pickedup	91	Pickedup	config	LED : ON(config)	config	-	24IT Pickedup
24IT Operated	92	Operated	config	LED : ON(config)	config	-	24IT Operated
59GDT-1 Pickedup	93	Pickedup	config	LED : ON(config)	config	-	59GDT-1 Pickedup
59GDT-2 Pickedup	94	Pickedup	config	LED : ON(config)	config	-	59GDT-2 Pickedup
59GDT-1 Oper-ated	95	Operated	config	LED : ON(config)	config	-	59GDT-1 Oper-ated
59GDT-2 Oper-ated	96	Operated	config	LED : ON(config)	config	-	59GDT-2 Oper-ated
59GIT Pickedup	97	Pickedup	config	LED : ON(config)	config	-	59GIT Pickedup
59GIT Operated	98	Operated	config	LED : ON(config)	config	-	59GIT Operated
TFM I2T ALARM Oper-ated	99	Operated	config	LED : ON(config)	config	-	TFM I2T ALARM Operated

Through Fault Peak	100	Operated	config	LED : ON(config)	config	-	Through Fault Peak
Through Fault I2t	101	Operated	config	LED : ON(config)	config	-	Through Fault I2t
74TCS-1 Oper-ated	102	Operated	config	LED : ON(config)	config	-	74TCS-1 Oper-ated
74TCS-2 Oper-ated	103	Operated	config	LED : ON(config)	config	-	74TCS-2 Oper-ated
THD Operated	104	Operated	config	LED : ON(config)	config	-	THD Operated
I2T-HV Oper-ated	105	Operated	config	LED : ON(config)	config	-	I2T-HV Oper-ated
I2T-LV Operated	106	Operated	config	LED : ON(config)	config	-	I2T-LV Operated
27DT-1 Pickedup	107	Pickedup	config	LED : ON(config)	config	-	27DT-1 Pickedup
27DT-2 Pickedup	108	Pickedup	config	LED : ON(config)	config	-	27DT-2 Pickedup
27DT-3 Pickedup	109	Pickedup	config	LED : ON(config)	config	-	27DT-3 Pickedup
27DT-4 Pickedup	110	Pickedup	config	LED : ON(config)	config	-	27DT-4 Pickedup
27DT-1 Oper-ated	111	Operated	config	LED : ON(config)	config	-	27DT-1 Oper-ated
27DT-2 Oper-ated	112	Operated	config	LED : ON(config)	config	-	27DT-2 Oper-ated
27DT-3 Oper-ated	113	Operated	config	LED : ON(config)	config	-	27DT-3 Oper-ated
27DT-4 Oper-ated	114	Operated	config	LED : ON(config)	config	-	27DT-4 Oper-ated
27IT-1 Pickedup	115	Pickedup	config	LED : ON(config)	config	-	27IT-1 Pickedup
27IT-2 Pickedup	116	Pickedup	config	LED : ON(config)	config	-	27IT-2 Pickedup
27IT-1 Operated	117	Operated	config	LED : ON(config)	config	-	27IT-1 Operated
27IT-2 Operated	118	Operated	config	LED : ON(config)	config	-	27IT-2 Operated
59DT-1 Pickedup	119	Pickedup	config	LED : ON(config)	config	-	59DT-1 Pickedup
59DT-2 Pickedup	120	Pickedup	config	LED : ON(config)	config	-	59DT-2 Pickedup
59DT-3 Pickedup	121	Pickedup	config	LED : ON(config)	config	-	59DT-3 Pickedup
59DT-4 Pickedup	122	Pickedup	config	LED : ON(config)	config	-	59DT-4 Pickedup
59DT-1 Oper-ated	123	Operated	config	LED : ON(config)	config	-	59DT-1 Oper-ated
59DT-2 Oper-ated	124	Operated	config	LED : ON(config)	config	-	59DT-2 Oper-ated

59DT-3 Oper-ated	125	Operated	config	LED : ON(config)	config	-	59DT-3 Oper-ated
59DT-4 Oper-ated	126	Operated	config	LED : ON(config)	config	-	59DT-4 Oper-ated
59IT-1 Pickedup	127	Pickedup	config	LED : ON(config)	config	-	59IT-1 Pickedup
59IT-2 Pickedup	128	Pickedup	config	LED : ON(config)	config	-	59IT-2 Pickedup
59IT-1 Operated	129	Operated	config	LED : ON(config)	config	-	59IT-1 Operated
59IT-2 Operated	130	Operated	config	LED : ON(config)	config	-	59IT-2 Operated
81U-1 Pickedup	131	Pickedup	config	LED : ON(config)	config	-	81U-1 Pickedup
81U-2 Pickedup	132	Pickedup	config	LED : ON(config)	config	-	81U-2 Pickedup
81U-3 Pickedup	133	Pickedup	config	LED : ON(config)	config	-	81U-3 Pickedup
81U-4 Pickedup	134	Pickedup	config	LED : ON(config)	config	-	81U-4 Pickedup
81U-1 Operated	135	Operated	config	LED : ON(config)	config	-	81U-1 Operated
81U-2 Operated	136	Operated	config	LED : ON(config)	config	-	81U-2 Operated
81U-3 Operated	137	Operated	config	LED : ON(config)	config	-	81U-3 Operated
81U-4 Operated	138	Operated	config	LED : ON(config)	config	-	81U-4 Operated
81O-1 Pickedup	139	Pickedup	config	LED : ON(config)	config	-	81O-1 Pickedup
81O-2 Pickedup	140	Pickedup	config	LED : ON(config)	config	-	81O-2 Pickedup
81O-3 Pickedup	141	Pickedup	config	LED : ON(config)	config	-	81O-3 Pickedup
81O-4 Pickedup	142	Pickedup	config	LED : ON(config)	config	-	81O-4 Pickedup
81O-1 Operated	143	Operated	config	LED : ON(config)	config	-	81O-1 Operated
81O-2 Operated	144	Operated	config	LED : ON(config)	config	-	81O-2 Operated
81O-3 Operated	145	Operated	config	LED : ON(config)	config	-	81O-3 Operated
81O-4 Operated	146	Operated	config	LED : ON(config)	config	-	81O-4 Operated
81R-1 Pickedup	147	Pickedup	config	LED : ON(config)	config	-	81R-1 Pickedup
81R-2 Pickedup	148	Pickedup	config	LED : ON(config)	config	-	81R-2 Pickedup
81R-1 Operated	149	Operated	config	LED : ON(config)	config	-	81R-1 Operated
81R-2 Operated	150	Operated	config	LED : ON(config)	config	-	81R-2 Operated
IEC 61850 Comm Alarm	151	Operated	config	LED : ON(config)	None	-	IEC 61850 Comm Alarm
Time Sync Loss	152	Operated	config	LED : ON(config)	config	-	Time Sync Loss
External I/P 1	153	General	None	None	None	-	-
External I/P 2	154	General	None	None	None	-	-
External I/P 3	155	General	None	None	None	-	-
External I/P 4	156	General	None	None	None	-	-
External I/P 5	157	General	None	None	None	-	-
External I/P 6	158	General	None	None	None	-	-

External I/P 7	159	General	None	None	None	-	-
External I/P 8	160	General	None	None	None	-	-
External I/P 9	161	General	None	None	None	-	-
External I/P 10	162	General	None	None	None	-	-
External I/P 11	163	General	None	None	None	-	-
External I/P 12	164	General	None	None	None	-	-
External I/P 13	165	General	None	None	None	-	-
External I/P 14	166	General	None	None	None	-	-
Local setting change (GL)	167	General	No	None	Yes	Incl. New & Old Group Numbers	-
User Setting group Change	168	General	No	None	Yes	Incl. New & Old Group Numbers	-
New Settings Loaded, Active Group n	169	General	No	None	Yes	Incl. New Group Num-ber	-
Clear Pickup	170	General	No	None	No	-	-
Clear Operate	171	General	No	None	No	-	-
ProLogic1	172	General	config	LED : ON(config)	config	-	-
ProLogic2	173	General	config	LED : ON(config)	config	-	-
ProLogic3	174	General	config	LED : ON(config)	config	-	-
ProLogic4	175	General	config	LED : ON(config)	config	-	-
ProLogic5	176	General	config	LED : ON(config)	config	-	-
ProLogic6	177	General	config	LED : ON(config)	config	-	-
ProLogic7	178	General	config	LED : ON(config)	config	-	-
ProLogic8	179	General	config	LED : ON(config)	config	-	-
ProLogic9	180	General	config	LED : ON(config)	config	-	-
ProLogic10	181	General	config	LED : ON(config)	config	-	-
ProLogic11	182	General	config	LED : ON(config)	config	-	-
ProLogic12	183	General	config	LED : ON(config)	config	-	-
ProLogic13	184	General	config	LED : ON(config)	config	-	-
ProLogic14	185	General	config	LED : ON(config)	config	-	-
ProLogic15	186	General	config	LED : ON(config)	config	-	-
ProLogic16	187	General	config	LED : ON(config)	config	-	-
ProLogic17	188	General	config	LED : ON(config)	config	-	-
ProLogic18	189	General	config	LED : ON(config)	config	-	-
ProLogic19	190	General	config	LED : ON(config)	config	-	-

ProLogic20	191	General	config	LED : ON(config)	config	-	-
ProLogic21	192	General	config	LED : ON(config)	config	-	-
ProLogic22	193	General	config	LED : ON(config)	config	-	-
ProLogic23	194	General	config	LED : ON(config)	config	-	-
ProLogic24	195	General	config	LED : ON(config)	config	-	-

Note 1:

Apart from the above, following X86 /ARM generated events are also displayed & logged, although they are not generated from DSP:

- Last event ID in the table above +1: Recalibration (RECALIBRATION_EVID)
- Last event ID in the table above +2: Unit restarted (UNIT_RESTARTED_EVID)
- Last event ID in the table above +3: User logged in (USER_LOGIN_EVID)
- Last event ID in the table above +4: Manual operation relay output (MANUAL_OUTPUT_EVID)

Appendix E Modbus RTU Communication Protocol

The SCADA port supports Modicon Modbus protocols. All metering values available through the terminal user interface are also available via the Modbus protocol. Additionally, the Modbus protocol support the reading of the unit time and time of the readings and provides access to trip and alarm events, include fault location information.

A "Hold Readings" function is available to freeze all metering readings into a snapshot (see Force Single Coil function, address 0).

Modbus Memory Map - Common for T-PRO 2000

Table E.1: Read Discrete Inputs (Function Code 02)

Channel	Address	Value	
Status I/P 1- Present state	10001	0: OFF	1: ON
Status I/P 2- Present state	10002	0: OFF	1: ON
Status I/P 3- Present state	10003	0: OFF	1: ON
Status I/P 4- Present state	10004	0: OFF	1: ON
Status I/P 5- Present state	10005	0: OFF	1: ON
Status I/P 6- Present state	10006	0: OFF	1: ON
Status I/P 7- Present state	10007	0: OFF	1: ON
Status I/P 8- Present state	10008	0: OFF	1: ON
Status I/P 9- Present state	10009	0: OFF	1: ON
Status I/P 10- Present state	10010	0: OFF	1: ON
Status I/P 11- Present state	10011	0: OFF	1: ON
Status I/P 12- Present state	10012	0: OFF	1: ON
Status I/P 13- Present state	10013	0: OFF	1: ON
Status I/P 14- Present state	10014	0: OFF	1: ON
Status I/P 1- Change of state	10257	0: OFF	1: ON
Status I/P 2- Change of state	10258	0: OFF	1: ON
Status I/P 3- Change of state	10259	0: OFF	1: ON
Status I/P 4- Change of state	10260	0: OFF	1: ON
Status I/P 5- Change of state	10261	0: OFF	1: ON
Status I/P 6- Change of state	10262	0: OFF	1: ON
Status I/P 7- Change of state	10263	0: OFF	1: ON
Status I/P 8- Change of state	10264	0: OFF	1: ON
Status I/P 9- Change of state	10265	0: OFF	1: ON
Status I/P 10- Change of state	10266	0: OFF	1: ON
Status I/P 11- Change of state	10267	0: OFF	1: ON
Status I/P 12- Change of state	10268	0: OFF	1: ON
Status I/P 13- Change of state	10269	0: OFF	1: ON
Status I/P 14- Change of state	10270	0: OFF	1: ON

Table E.2: Read Discrete Inputs (Function Code 02)			
Channel	**Address**	**Value**	
Virtual Input1	10513	0: OFF	1: ON
Virtual Input2	10514	0: OFF	1: ON
Virtual Input3	10515	0: OFF	1: ON
Virtual Input4	10516	0: OFF	1: ON
Virtual Input5	10517	0: OFF	1: ON
Virtual Input6	10518	0: OFF	1: ON
Virtual Input7	10519	0: OFF	1: ON
Virtual Input8	10520	0: OFF	1: ON
Virtual Input9	10521	0: OFF	1: ON
Virtual Input10	10522	0: OFF	1: ON
Virtual Input11	10523	0: OFF	1: ON
Virtual Input12	10524	0: OFF	1: ON
Virtual Input13	10525	0: OFF	1: ON
Virtual Input14	10526	0: OFF	1: ON
Virtual Input15	10527	0: OFF	1: ON
Virtual Input16	10528	0: OFF	1: ON
Virtual Input17	10529	0: OFF	1: ON
Virtual Input18	10530	0: OFF	1: ON
Virtual Input19	10531	0: OFF	1: ON
Virtual Input20	10532	0: OFF	1: ON
Virtual Input21	10533	0: OFF	1: ON
Virtual Input22	10534	0: OFF	1: ON
Virtual Input23	10535	0: OFF	1: ON
Virtual Input24	10536	0: OFF	1: ON
Virtual Input25	10537	0: OFF	1: ON
Virtual Input26	10538	0: OFF	1: ON
Virtual Input27	10539	0: OFF	1: ON
Virtual Input28	10540	0: OFF	1: ON
Virtual Input29	10541	0: OFF	1: ON
Virtual Input30	10542	0: OFF	1: ON

Table E.3: Read Holding Registers (Function Code 03)			
Channel	**Address**	**Units**	**Scale**
T-PRO Clock Time (UTC) – Note: Read all in same query to ensure consistent time reading data			
Milliseconds now	40001	0 – 999	1
Seconds now	40002	0 – 59	1
Minutes now	40003	0 – 59	1
Hours now	40004	0 – 23	1
Day of year now	40005	1 – 365	1
Year since 1900	40006	90 – 137	1
Synchronized to IRIG-B	40007	0: No & 1: Yes	1
Synchronized to SNTP	40008	0: No & 1: Yes	1
Time of Acquisition (UTC) – Note: Read all in same query to ensure consistent time reading data			
Milliseconds now	40009	0 – 999	1
Seconds now	40010	0 – 59	1
Minutes now	40011	0 – 59	1
Hours now	40012	0 – 23	1

Table E.3: Read Holding Registers (Function Code 03)			
Channel	**Address**	**Units**	**Scale**
Day of year now	40013	1 – 365	1
Year since 1900	40014	90 – 137	1
Synchronized to IRIG-B	40015	0: No & 1: Yes	1
Synchronized to SNTP	40016	0: No & 1: Yes	1
Local time offset	40017	2's compliment half hours, North America is negative	1

Table E.4: Write Single Coil (Function Code 05)			
Channel	**Type**	**Address**	**Value**
Only the "hold readings" coil can be forced. When active, this coil locks all coil, input and holding register readings simultaneously at their present values. When inactive, coil, input and holding register values will read their most recently available state.			
Hold Readings	Read/Write	01	0000: Readings update normally (inactive) FF00: Hold readings (active)

Table E.5: Write Single Register (Function Code 06)			
Channel	**Address**	**Value**	**Scale**
Event record message control (See below in Table 9 and 10 for detail of use)			
Refresh event log list	40513	No data required	(Not applicable)
Acknowledge the current event & get the next event	40514	No data required	(Not applicable)
Get the next event (without acknowledge)	40515	No data required	(Not applicable)

Table E.6: Diagnostic sub functions (Function Code 08)	
Return Query Data (Sub function 00)	This provides echo of the submitted message
Restart Communication Option (Sub function 01)	This restarts the Modbus communication process.

Table E.6: Diagnostic sub functions (Function Code 08)	
Force listen only mode (Sub function 04)	No response is returned. IED enters “Listen Only” mode. This mode can be excited by the “Restart Communication Option” command

Table E.7: Write Multiple Registers (Function Code 16)			
Channel	**Address**	**Units**	**Scale**
T-PRO Clock Time (UTC) – Note: Must write to all the registers in same query			
Milliseconds now	40001	0 – 999	1
Seconds now	40002	0 – 59	1
Minutes now	40003	0 – 59	1
Hours now	40004	0 – 23	1
Day of year now	40005	1 – 365	1
Year since 1900	40006	90 – 137	1

Table E.8: Report Slave ID (Function Code 17)			
A fixed response is returned by the relay, including system model, version and issue numbers.			
Channel	**Type**	**Bytes**	**Value**
Model Number	Read only	0 and 1	0 x 07D0 = 2000 decimal
Version Number	Read only	2 and 3	Version Number
Issue Number	Read only	4 and 5	Issue Number

Note:

1. T-PRO relay model number is 2000
2. Version and issue are positive integers, say X and Y

Table E.9: Accessing	
All T-PRO event messages displayed in the Event log are available via Modbus	
Refresh event list	(Function code 6, address 40513): Fetches the latest events from the T-PRO’s event log and makes them available for Modbus access. The most recent event becomes the current event available for reading.
Acknowledge current event and Get next event	(Function code 6, address 40514): Clears the event from the read registers and places the next event into them. An acknowledged event is no longer available for reading.

Table E.9: Accessing	
Get next event	(Function code 6, address 40515): Places the next event in the read registers without acknowledging the current event. The current event will appear in the list when ***Refresh event list*** is used
Size of current event message	(Function code 3, address 40516): Indicates the number of 16 bit registers used to contain the current event. Event data is stored with two characters per register. A reading of zero indicates that there are no unacknowledged events available in the current set. (Note: The ***Refresh event list*** function can be used to check for new events that have occurred since the last ***Refresh event list***.)
Read event message	(Function code 3, address 40517 to 40576): Contains the current event message. Two ASCII characters are packed into each 16bit register. All unused registers in the set are set to 0.

Table E.10: Sample Event Record

Register	Value		Meaning
	Low Byte	High Byte	
40516	0x00	0x14	Event text size = 20 (0x14 hex)
40517	0x32	0x30	‘2’, ‘0’
40518	0x32	0x35	‘2’, ‘5’
40519	0x4A	0x75	'J', 'u'
40520	0x6E	0x33	'n', '3'
40521	0x30	0x20	'0', ' '
40522	0x30	0x36	' ', '6'
40523	0x3A	0x35	':','5'
40524	0x35	0x3A	'5',':'
40525	0x33	0x38	'3','8'
40526	0x2E	0x34	'.','4'
40527	0x35	0x35	'5','5'
40528	0x30	0x20	':','5'
40529	0x35	0x30	'0',' '
40530	0x48	0x56	'H','V'
40531	0x2D	0x31	'-','1'

Table E.10: Sample Event Record			
Register	Value		Meaning
	Low Byte	High Byte	
40532	0x20	0x41	' ','A'
40533	0x42	0x43	'B','C'
40534	0x20	0x50	' ','P'
40535	0x68	0x61	'h','a'
40536	0x73	0x65	's','e'
40537	0x3A	0x20	':' ,' '
40538	0x4F	0x70	'O','p'
40539	0x65	0x72	'e','r'
40540	0x61	0x74	'a','t'
40541	0x65	0x64	'e','d'

Modbus Memory Map - Variant specific

Modbus memory map specific to a T-PRO 2000 relay can be referred from the table as listed below:

Table E.11: T-PRO 2000 Specific Modbus Memory Map			
Read Coil Status (Function Code 01)			
Channel	**Address**	**Value**	
Hold Readings	**1**	**0: Readings not held**	**1: Readings held**
Reserved	**257**	**Reserved**	**Reserved**
87 Operated	513	0: OFF	1: ON
87N Operated	514	0: OFF	1: ON
87 High Mismatch	515	0: OFF	1: ON
87N High Mismatch	516	0: OFF	1: ON
2nd Harmonic Restraint	517	0: OFF	1: ON
5nd Harmonic Restraint	518	0: OFF	1: ON
87 Unrestrained	519	0: OFF	1: ON
87 Delta Phase	520	0: OFF	1: ON
87 ROCOD	521	0: OFF	1: ON
87N Delta Phase	522	0: OFF	1: ON
87 Alarm	523	0: OFF	1: ON
49-1 Picked up	524	0: OFF	1: ON
49-2 Picked up	525	0: OFF	1: ON
49-3 Picked up	526	0: OFF	1: ON
49-4 Picked up	527	0: OFF	1: ON
49-5 Picked up	528	0: OFF	1: ON

Table E.11: T-PRO 2000 Specific Modbus Memory Map			
Read Coil Status (Function Code 01)			
Channel	**Address**	**Value**	
49-6 Picked up	529	0: OFF	1: ON
49-7 Picked up	530	0: OFF	1: ON
49-8 Picked up	531	0: OFF	1: ON
49-9 Picked up	532	0: OFF	1: ON
49-10 Picked up	533	0: OFF	1: ON
49-11 Picked up	534	0: OFF	1: ON
49-12 Picked up	535	0: OFF	1: ON
49-1 Operated	536	0: OFF	1: ON
49-2 Operated	537	0: OFF	1: ON
49-3 Operated	538	0: OFF	1: ON
49-4 Operated	539	0: OFF	1: ON
49-5 Operated	540	0: OFF	1: ON
49-6 Operated	541	0: OFF	1: ON
49-7 Operated	542	0: OFF	1: ON
49-8 Operated	543	0: OFF	1: ON
49-9 Operated	544	0: OFF	1: ON
49-10 Operated	545	0: OFF	1: ON
49-11 Operated	546	0: OFF	1: ON
49-12 Operated	547	0: OFF	1: ON
THD Operated	548	0: OFF	1: ON
TFM I^2t Alarm Operated	549	0: OFF	1: ON
50-HV-1 Picked up	550	0: OFF	1: ON
50-HV-2 Picked up	551	0: OFF	1: ON
50-HV-1 Operated	552	0: OFF	1: ON
50-HV-2 Operated	553	0: OFF	1: ON
51-HV-1 Picked up	554	0: OFF	1: ON
51-HV-2 Picked up	555	0: OFF	1: ON
51-HV-1 Operated	556	0: OFF	1: ON
51-HV-2 Operated	557	0: OFF	1: ON
50-LV-1 Picked up	558	0: OFF	1: ON
50-LV-2 Picked up	559	0: OFF	1: ON
50-LV-1 Operated	560	0: OFF	1: ON
50-LV-2 Operated	561	0: OFF	1: ON
51-LV-1 Picked up	562	0: OFF	1: ON
51-LV-2 Picked up	563	0: OFF	1: ON
51-LV-1 Operated	564	0: OFF	1: ON
51-LV-2 Operated	565	0: OFF	1: ON
50N-HV-1 Picked up	566	0: OFF	1: ON
50N-HV-2 Picked up	567	0: OFF	1: ON
50N-HV-1 Operated	568	0: OFF	1: ON
50N-HV-2 Operated	569	0: OFF	1: ON
51N-HV-1 Picked up	570	0: OFF	1: ON
51N-HV-2 Picked up	571	0: OFF	1: ON
51N-HV-1 Operated	572	0: OFF	1: ON
51N-HV-2 Operated	573	0: OFF	1: ON
50N-LV-1 Picked up	574	0: OFF	1: ON
50N-LV-2 Picked up	575	0: OFF	1: ON
50N-LV-1 Operated	576	0: OFF	1: ON
50N-LV-2 Operated	577	0: OFF	1: ON
51N-LV-1 Picked up	578	0: OFF	1: ON
51N-LV-2 Picked up	579	0: OFF	1: ON
51N-LV-1 Operated	580	0: OFF	1: ON

Table E.11: T-PRO 2000 Specific Modbus Memory Map			
Read Coil Status (Function Code 01)			
Channel	**Address**	**Value**	
51N-LV-2 Operated	581	0: OFF	1: ON
50G-1 Picked up	582	0: OFF	1: ON
50G-2 Picked up	583	0: OFF	1: ON
50G-1 Operated	584	0: OFF	1: ON
50G-2 Operated	585	0: OFF	1: ON
51G-1 Picked up	586	0: OFF	1: ON
51G-2 Picked up	587	0: OFF	1: ON
51G-1 Operated	588	0: OFF	1: ON
51G-2 Operated	589	0: OFF	1: ON
46/50-HV Picked up	590	0: OFF	1: ON
46/50-HV Operated	591	0: OFF	1: ON
46/51-HV Picked up	592	0: OFF	1: ON
46/51-HV Operated	593	0: OFF	1: ON
46/50-LV Picked up	594	0: OFF	1: ON
46/50-LV Operated	595	0: OFF	1: ON
46/51-LV Picked up	596	0: OFF	1: ON
46/51-LV Operated	597	0: OFF	1: ON
50BF HV Initiated	598	0: OFF	1: ON
50BF LV Initiated	599	0: OFF	1: ON
50BF INPUT1-1 Operated	600	0: OFF	1: ON
50BF INPUT1-2 Operated	601	0: OFF	1: ON
50BF INPUT2-1 Operated	602	0: OFF	1: ON
50BF INPUT2-2 Operated	603	0: OFF	1: ON
27DT-1 Picked up	604	0: OFF	1: ON
27DT-2 Picked up	605	0: OFF	1: ON
27DT-3 Picked up	606	0: OFF	1: ON
27DT-4 Picked up	607	0: OFF	1: ON
27DT-1 Operated	608	0: OFF	1: ON
27DT-2 Operated	609	0: OFF	1: ON
27DT-3 Operated	610	0: OFF	1: ON
27DT-4 Operated	611	0: OFF	1: ON
27IT-1 Picked up	612	0: OFF	1: ON
27IT-2 Picked up	613	0: OFF	1: ON
27IT-1 Operated	614	0: OFF	1: ON
27IT-2 Operated	615	0: OFF	1: ON
59DT-1 Picked up	616	0: OFF	1: ON
59DT-2 Picked up	617	0: OFF	1: ON
59DT-3 Picked up	618	0: OFF	1: ON
59DT-4 Picked up	619	0: OFF	1: ON
59DT-1 Operated	620	0: OFF	1: ON
59DT-2 Operated	621	0: OFF	1: ON
59DT-3 Operated	622	0: OFF	1: ON
59DT-4 Operated	623	0: OFF	1: ON
59IT-1 Picked up	624	0: OFF	1: ON
59IT-2 Picked up	625	0: OFF	1: ON
59IT-1 Operated	626	0: OFF	1: ON
59IT-2 Operated	627	0: OFF	1: ON
24DT-1 Picked up	628	0: OFF	1: ON
24DT-2 Picked up	629	0: OFF	1: ON
24DT-1 Operated	630	0: OFF	1: ON
24DT-2 Operated	631	0: OFF	1: ON
24IT Picked up	632	0: OFF	1: ON

Table E.11: T-PRO 2000 Specific Modbus Memory Map			
Read Coil Status (Function Code 01)			
Channel	**Address**	**Value**	
24IT Operated	633	0: OFF	1: ON
59G-1 Picked up	634	0: OFF	1: ON
59G-2 Picked up	635	0: OFF	1: ON
59G-1 Operated	636	0: OFF	1: ON
59G-2 Operated	637	0: OFF	1: ON
59GIT Picked up	638	0: OFF	1: ON
59GIT Operated	639	0: OFF	1: ON
81U-1 Picked up	640	0: OFF	1: ON
81U-2 Picked up	641	0: OFF	1: ON
81U-3 Picked up	642	0: OFF	1: ON
81U-4 Picked up	643	0: OFF	1: ON
81U-1 Operated	644	0: OFF	1: ON
81U-2 Operated	645	0: OFF	1: ON
81U-3 Operated	646	0: OFF	1: ON
81U-4 Operated	647	0: OFF	1: ON
81O-1 Picked up	648	0: OFF	1: ON
81O-2 Picked up	649	0: OFF	1: ON
81O-3 Picked up	650	0: OFF	1: ON
81O-4 Picked up	651	0: OFF	1: ON
81O-1 Operated	652	0: OFF	1: ON
81O-2 Operated	653	0: OFF	1: ON
81O-3 Operated	654	0: OFF	1: ON
81O-4 Operated	655	0: OFF	1: ON
81R-1 Picked up	656	0: OFF	1: ON
81R-2 Picked up	657	0: OFF	1: ON
81R-1 Operated	658	0: OFF	1: ON
81R-2 Operated	659	0: OFF	1: ON
74TCS-1 Operated	660	0: OFF	1: ON
74TCS-2 Operated	661	0: OFF	1: ON
I^2t HV Operated	662	0: OFF	1: ON
I^2t LV Operated	663	0: OFF	1: ON
Time Sync Loss	664	0: OFF	1: ON
IEC61850 Comm Alarm	665	0: OFF	1: ON
ProLogic1	666	0: OFF	1: ON
ProLogic2	667	0: OFF	1: ON
ProLogic3	668	0: OFF	1: ON
ProLogic4	669	0: OFF	1: ON
ProLogic5	670	0: OFF	1: ON
ProLogic6	671	0: OFF	1: ON
ProLogic7	672	0: OFF	1: ON
ProLogic8	673	0: OFF	1: ON
ProLogic9	674	0: OFF	1: ON
ProLogic10	675	0: OFF	1: ON
ProLogic11	676	0: OFF	1: ON
ProLogic12	677	0: OFF	1: ON
ProLogic13	678	0: OFF	1: ON
ProLogic14	679	0: OFF	1: ON
ProLogic15	680	0: OFF	1: ON
ProLogic16	681	0: OFF	1: ON
ProLogic17	682	0: OFF	1: ON
ProLogic18	683	0: OFF	1: ON
ProLogic19	684	0: OFF	1: ON

Table E.11: T-PRO 2000 Specific Modbus Memory Map			
Read Coil Status (Function Code 01)			
Channel	**Address**	**Value**	
ProLogic20	685	0: OFF	1: ON
ProLogic21	686	0: OFF	1: ON
ProLogic22	687	0: OFF	1: ON
ProLogic23	688	0: OFF	1: ON
ProLogic24	689	0: OFF	1: ON
Relay O/P1	690	0: OFF	1: ON
Relay O/P2	691	0: OFF	1: ON
Relay O/P3	692	0: OFF	1: ON
Relay O/P4	693	0: OFF	1: ON
Relay O/P5	694	0: OFF	1: ON
Relay O/P6	695	0: OFF	1: ON
Relay O/P7	696	0: OFF	1: ON
Relay O/P8	697	0: OFF	1: ON
Relay O/P9	698	0: OFF	1: ON
Relay O/P10	699	0: OFF	1: ON
Relay O/P11	700	0: OFF	1: ON
Relay O/P12	701	0: OFF	1: ON
Relay O/P13	702	0: OFF	1: ON
Relay O/P14	703	0: OFF	1: ON

In the below table no.12, Scale value should be divided with the metering data obtained from Modbus.

Table E.12: Read Holding Registers (Function Code 03)			
Channel	**Address**	**Units**	**Scale**
I1A Magnitude	40257	A	100
I1A Angle	40258	Degrees	1
I1B Magnitude	40259	A	100
I1B Angle	40260	Degrees	1
I1C Magnitude	40261	A	100
I1C Angle	40262	Degrees	1
I2A Magnitude	40263	A	100
I2A Angle	40264	Degrees	1
I2B Magnitude	40265	A	100
I2B Angle	40266	Degrees	1
I2C Magnitude	40267	A	100
I2C Angle	40268	Degrees	1
IN Magnitude	40269	A	100
IN Angle	40270	Degrees	100
VIN Magnitude	40271	KV	100
VIN Angle	40272	Degrees	1
IHV A Magnitude	40273	A	1
IHV A Angle	40274	Degrees	100
IHV B Magnitude	40275	A	1
IHV B Angle	40276	Degrees	100
IHV C Magnitude	40277	A	1
IHV C Angle	40278	Degrees	100
ILV A Magnitude	40279	A	1

Table E.12: Read Holding Registers (Function Code 03)			
Channel	**Address**	**Units**	**Scale**
ILV A Angle	40280	Degrees	100
ILV B Magnitude	40281	A	1
ILV B Angle	40282	Degrees	100
ILV C Magnitude	40283	A	1
ILV C Angle	40284	Degrees	100
3I0 HV Magnitude	40285	A	1
3I0 HV Angle	40286	Degrees	100
3I0 LV Magnitude	40287	A	1
3I0 LV Angle	40288	Degrees	100
I1 Positive Sequence Magnitude	40289	A	1
I1 Negative Sequence Magnitude	40290	A	1
I1 Zero Sequence Magnitude	40291	A	1
I2 Positive Sequence Magnitude	40292	A	1
I2 Negative Sequence Magnitude	40293	A	1
I2 Zero Sequence Magnitude	40294	A	1
87 Ia Operating Magnitude	40295	A	1
87 Ib Operating Magnitude	40296	A	1
87 Ic Operating Magnitude	40297	A	1
87 Ia Restraint Magnitude	40298	A	1
87 Ib Restraint Magnitude	40299	A	1
87 Ic Restraint Magnitude	40300	A	1
IN REF IO Magnitude	40301	A	1
IN REF IR Magnitude	40302	A	1
49_HV Current RMS Current	40303	A	1
49_LV Current RMS Current	40304	A	1
HV IA 2ndHarmonic Magnitude	40305	%	1
HV IB 2ndHarmonic Magnitude	40306	%	1
HV IC 2ndHarmonic Magnitude	40307	%	1
LV IA 2nd Harmonic Magnitude	40308	%	1
LV IB 2nd Harmonic Magnitude	40309	%	1
LV IC 2nd Harmonic Magnitude	40310	%	1
I1a 2nd Harmonic Magnitude	40311	%	1
I1b 2nd Harmonic Magnitude	40312	%	1
I1c 2nd Harmonic Magnitude	40313	%	1
I2a 2nd Harmonic Magnitude	40314	%	1
I2b 2nd Harmonic Magnitude	40315	%	1
I2c 2nd Harmonic Magnitude	40316	%	1
I1a 5th Harmonic Magnitude	40317	%	1
I1b 5th Harmonic Magnitude	40318	%	1
I1c 5th Harmonic Magnitude	40319	%	1
I2a 5th Harmonic Magnitude	40320	%	1
I2b 5th Harmonic Magnitude	40321	%	1
I2c 5th Harmonic Magnitude	40322	%	1
THD	40323	%	1
I^2t A Accumulated	40324	kA^2s	1
I^2t B Accumulated	40325	kA^2s	1
I^2t C Accumulated	40326	kA^2s	1
Through Fault Count	40327	-	1
V/F	40328	pu	1
Frequency	40329	Hz	10
I^2t HV Accumulated	40330	kA^2s	1
I^2t HV for last operation	40331	kA^2s	1
I^2t LV Accumulated	40332	kA^2s	1
I^2t LV for last operation	40333	kA^2s	1

Appendix F DNP3 Device Profile

Device Properties

This document shows the device capabilities and the current value of each parameter for the default unit configuration as defined in the default configuration file.

1.1 Device Identification	Capabilities	Current Value	If configurable, list methods
1.1.1 Device Function:	● Master ● Outstation	● Outstation	
1.1.2 Vendor Name:		ERLPhase Power Technologies	
1.1.3 Device Name:		T-PRO 2000	
1.1.4 Device manufacturer's hardware version string:		NA	
1.1.5 Device manufacturer's software version string:		NA	
1.1.6 Device Profile Document Version Number:		v0.01, Jun 17, 2024	
1.1.7 DNP Levels Supported for:	Masters Only Requests Responses ☐ ☐ None ☐ ☐ Level 1 ☐ ☐ Level 2 ☐ ☐ Level 3 Outstations Only Requests and Responses ☐ None ☐ Level 1 ☒ Level 2 ☐ Level 3		
1.1.8 Supported Function Blocks:	☐ Self-Address Reservation ☐ Object 0 - attribute objects ☐ Data Sets ☐ File Transfer ☐ Virtual Terminal ☐ Mapping to IEC 61850 Object Models defined in a DNP3 XML file		

1.1 Device Identification	**Capabilities**	**Current Value**	**If configurable, list methods**
1.1.9 Notable Additions:	• Start-stop (qualifier codes 0x00 and 0x01), limited quantity (qualifier codes 0x07 and 0x08) and indices (qualifier codes 0x17 and 0x28) for Binary Inputs, Binary Outputs and Analog Inputs (object groups 1, 10 and 30) • 32-bit and 16-bit Analog Inputs with and without flag (variations 1, 2, 3 and 4) • 32-bit and 16-bit Analog Input events with time (variations 3 and 4)		
1.1.10 Methods to set Configurable Parameters:	☐ XML - Loaded via DNP3 File Transfer ☐ XML - Loaded via other transport mechanism ☐ Terminal - ASCII Terminal Command Line ☒ Software - Vendor software named T-PRO 2000 Offliner ☐ Proprietary file loaded via DNP3 file transfer ☐ Proprietary file loaded via other transport mechanism ☐ Direct - Keypad on device front panel ☐ Factory - Specified when device is ordered ☐ Protocol - Set via DNP3 (e.g. assign class) ☐ Other - explain _________________		
1.1.11 DNP3 XML files available On-Line:	Rd Wr Filename Description of Contents ☐ dnpDP.xml Complete Device Profile ☐ dnpDPcap.xml Device Profile Capabilities ☐ dnpDPcfg.xml Device Profile config.values ☐ ☐ _____*.xml ___________________ *The Complete Device Profile Document contains the capabilities, Current Value, and configurable methods columns. *The Device Profile Capabilities contains only the capabilities and configurable methods columns. *The Device Profile Config. Values contains only the Current Value column.	Not supported	
1.1.12 External DNP3 XML files available Off-line:	Rd Wr Filename Description of Contents ☐ ☐ dnpDP.xml Complete Device Profile ☐ ☐ dnpDPcap.xml Device Profile Capabilities ☐ ☐ dnpDPcfg.xml Device Profile config. values ☐ ☐ _______*.xml ___________________ *The Complete Device Profile Document contains the capabilities, Current Value, and configurable methods columns. *The Device Profile Capabilities contains only the capabilities and configurable methods columns. *The Device Profile Config. Values contains only the Current Value column.	Not supported	
1.1.13 Connections Supported:	☒ Serial (complete section 1.2) ☒ IP Networking (complete section 1.3) ☐ Other, explain ______________________		

1.2 Serial Connections	Capabilities	Current Value	If configurable, list methods
1.2.1 Port Name	CON 2		
1.2.2 Serial Connection Parameters:	☐ Asynchronous - 8 Data Bits, 1 Start Bit, 1 Stop Bit, No Parity ☒ Other, explain - Asynchronous with selectable parity	Parity - None	T-PRO 2000 Offliner
1.2.3 Baud Rate:	☐ Fixed at _______ ☐ Configurable, range _______ to _______ ☒ Configurable, selectable from 2400, 4800, 9600, 19200, 38400 and 57600 ☐ Configurable, other, describe______________	9600	T-PRO 2000 Offliner
1.2.4 Hardware Flow Control (Handshaking): *Describe hardware signaling requirements of the interface.* *Where a transmitter or receiver is inhibited until a given control signal is asserted, it is considered to require that signal prior to sending or receiving characters.* *Where a signal is asserted prior to transmitting, that signal will be maintained active until after the end of transmission.* *Where a signal is asserted to enable reception, any data sent to the device when the signal is not active could be discarded.*	☐ None **RS-232 / V.24 / V.28 Options:** Before Tx, Asserts: ☐ RTS ☐ DTR Before Rx, Asserts: ☐ RTS ☐ DTR Always Asserts: ☐ RTS ☐ DTR Before Tx, Requires: Asserted / Deasserted ☐ / ☐ CTS ☐ / ☐ DCD ☐ / ☐ DSR ☐ / ☐ RI ☐ / ☐ Rx Inactive Before Rx, Requires: Asserted / Deasserted ☐ / ☐ CTS ☐ / ☐ DCD ☐ / ☐ DSR ☐ / ☐ RI Always Ignores: ☐ CTS ☐ DCD ☐ DSR ☐ RI ☐ Other, explain ____________ **RS-422 / V.11 Options:** ☐ Requires Indication before Rx ☐ Asserts Control before Tx ☐ Other, explain ____________ **RS-485 Options:** ☐ Requires Rx inactive before Tx ☐ Other, explain ____________	Not Supported	
1.2.5 Interval to Request Link Status:	☒ Not Supported ☐ Fixed at_________ seconds ☐ Configurable, range _____ to ______ seconds ☐ Configurable, selectable from __,__,__ seconds ☐ Configurable, other, describe______________		
1.2.6 Supports DNP3 Collision Avoidance:	☒ No ☐ Yes, explain ______________________		

1.2 Serial Connections	Capabilities	Current Value	If configurable, list methods
1.2.7 Receiver Inter-character Timeout:	☒ Not checked ☐ No gap permitted ☐ Fixed at _____ bit times ☐ Fixed at _____ ms ☐ Configurable, range ____ to ____ bit times ☐ Configurable, range ____ to ____ ms ☐ Configurable, Selectable from __,__,__bit times ☐ Configurable, Selectable from ___, ___, ___ ms ☐ Configurable, other, describe______________ ☐ Variable, explain ____		
1.2.8 Inter-character gaps in transmission:	☒ None (always transmits with no inter-character gap) ☐ Maximum _____ bit times ☐ Maximum _____ ms		

1.3 IP Networking	Capabilities	Current Value	If configurable, list methods
1.3.1 Port Name	CON 1 Network		
1.3.2 Type of End Point:	☐ TCP Initiating (Master Only) ☒ TCP Listening (Outstation Only) ☐ TCP Dual (required for Masters) ☒ UDP Datagram (required)	Not configured for DNP	T-PRO 2000 Offliner
1.3.3 IP Address of this Device:		192.168.0.63	T-PRO 2000 Offliner
1.3.4 Subnet Mask:		255.255.255.0	T-PRO 2000 Offliner
1.3.5 Gateway IP Address:		192.168.0.1	T-PRO 2000 Offliner
1.3.6 Accepts TCP Connections or UDP Datagrams from:	☒ Allows all (show as *.*.*.* in 1.3.7) ☒ Limits based on an IP address ☒ Limits based on list of IP addresses ☐ Limits based on a wildcard IP address ☐ Limits based on list of wildcard IP addresses ☐ Other validation, explain_________________	Limits based on an IP address	T-PRO 2000 Offliner
1.3.7 IP Address(es) from which TCP Connections or UDP Datagrams are accepted:		192.168.1.1	T-PRO 2000 Offliner
1.3.8 TCP Listen Port Number:	☐ Not Applicable (Master w/o dual end point) ☐ Fixed at 20,000 ☒ Configurable, range 1025 to 32737 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	20,000	T-PRO 2000 Offliner
1.3.9 TCP Listen Port Number of remote device:	☒ Not Applicable (Outstation w/o dual end point) ☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	NA	
1.3.10 TCP Keep-alive timer:	☐ Fixed at ___________ms ☒ Configurable, range 5 to 3,600 s ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe______________	Disabled	T-PRO 2000 Offliner
1.3.11 Local UDP port:	☐ Fixed at 20,000 ☒ Configurable, range 1025 to 32737 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________ ☐ Let system choose (Master only)	20,000	T-PRO 2000 Offliner
1.3.12 Destination UDP port for DNP3 Requests (Master Only):		NA	
1.3.13 Destination UDP port for initial unsolicited null responses (UDP only Outstations):	☒ None ☐ Fixed at 20,000 ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	NA	

1.3 IP Networking	Capabilities	Current Value	If configurable, list methods
1.3.14 Destination UDP port for responses:	☐ None ☐ Fixed at 20,000 ☒ Configurable, range 1025 to 32737 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe_______________ ☐ Use source port number	20,000	T-PRO 2000 Offliner
1.3.15 Multiple master connections (Outstations Only):	☒ Supports multiple masters (Outstations only) If supported, the following methods may be used: ☒ Method 1 (based on IP address) - required ☒ Method 2 (based on IP port number) - recommended ☒ Method 3 (browsing for static data) - optional	Method 1 (based on IP address)	T-PRO 2000 Offliner
1.3.16 Time synchronization support:	☐ DNP3 LAN procedure (function code 24) ☐ DNP3 Write Time (not recommended over LAN) ☐ Other, explain _________________________ ☒ Not Supported		

1.4 Link Layer	Capabilities	Current Value	If configurable, list methods
1.4.1 Data Link Address:	☐ Fixed at______ ☒ Configurable, range 1 to 65519 ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	1	T-PRO 2000 Offliner
1.4.2 DNP3 Source Address Validation:	☒ Never ☐ Always, one address allowed (shown in 1.4.3) ☐ Always, any one of multiple addresses allowed ☐ (each selectable as shown in 1.4.3) ☐ Sometimes, explain________________		
1.4.3 DNP3 Source Address(es) expected when Validation is Enabled:	☐ Configurable to any 16 bit DNP Data Link Address value ☐ Configurable, range _______ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	NA	
1.4.4 Self Address Support using address 0xFFFC:	☐ Yes (only allowed if configurable) ☒ No	NA	
1.4.5 Sends Confirmed User Data Frames:	☐ Always ☐ Sometimes, explain _____________________ ☐ Never ☒ Configurable, either always or never		T-PRO 2000 Offliner (to disable, set Data Link Time-out to 0)
1.4.6 Data Link Layer Confirmation Timeout:	☐ None ☐ Fixed at __ ms ☒ Configurable, range 0 to 2,000 ms ☐ Configurable, selectable from____________ms ☐ Configurable, other, describe______________ ☐ Variable, explain _______________________	500 ms	T-PRO 2000 Offliner
1.4.7 Maximum Data Link Retries:	☐ Never Retries ☒ Fixed at 3 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	3	
1.4.8 Maximum number of octets Transmitted in a Data Link Frame:	☒ Fixed at 292 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	292	
1.4.9 Maximum number of octets that can be Received in a Data Link Frame:	☒ Fixed at 292 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	292	

1.5 Application Layer		**Capabilities**	**Current Value**	**If configurable, list methods**
1.5.1	Maximum number of octets Transmitted in an Application Layer Fragment other than File Transfer:	☒ Fixed at 2048 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	2048	
1.5.2	Maximum number of octets Transmitted in an Application Layer Fragment containing File Transfer:	☐ Fixed at ___________ ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	NA	
1.5.3	Maximum number of octets that can be Received in an Application Layer Fragment:	☒ Fixed at 2048 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________	2048	
1.5.4	Timeout waiting for Complete Application Layer Fragment:	☐ None ☒ Fixed at 2,000 ms ☐ Configurable, range _______ to _______ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe______________ ☐ Variable, explain ______________________	2,000 ms	
1.5.5	Maximum number of objects allowed in a single control request for CROB (group 12):	☒ Fixed at 16 ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________ ☐ Variable, explain ______________________	16	
1.5.6	Maximum number of objects allowed in a single control request for Analog Outputs (group 41):	☐ Fixed at _ ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________ ☐ Variable, explain ______________________	Analog Outputs not supported	
1.5.7	Maximum number of objects allowed in a single control request for Data Sets (groups 85,86,87):	☐ Fixed at __ ☐ Configurable, range ________ to _______ ☐ Configurable, selectable from ____,____,____ ☐ Configurable, other, describe______________ ☐ Variable, explain ______________________	Data Sets not supported	
1.5.8	Supports mixing object groups (AOBs, CROBs and Data Sets) in the same control request:	☐ Not applicable - controls are not supported ☐ Yes ☒ No	Analog Outputs not supported	

1.6 Fill Out The Following Items For Outstations Only	Capabilities	Current Value	If configurable, list methods
1.6.1 Timeout waiting for Application Confirm of solicited response message:	☐ None ☒ Fixed at 5,000 ms ☐ Configurable, range _______ to _______ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe______________ ☐ Variable, explain _______________________	5,000 ms	
1.6.2 How often is time synchronization required from the master?	☒ Never needs time ☐ Within ______ seconds after IIN1.4 is set ☐ Periodically every _______ seconds		
1.6.3 Device Trouble Bit IIN1.6:	☐ Never used ☒ Reason for setting: Unable to access requested data or execute CROB, assuming a valid request has been received		
1.6.4 File Handle Timeout:	☒ Not applicable, files not supported ☐ Fixed at______ ms ☐ Configurable, range _______ to _______ms ☐ Configurable, selectable from ___,___,___ms ☐ Configurable, other, describe______________ ☐ Variable, explain _______________________		
1.6.5 Event Buffer Overflow Behaviour:	☐ Discard the oldest event ☒ Discard the newest event ☐ Other, explain _________________________		
1.6.6 Event Buffer Organization:	• Single buffer for the Object Groups 2 and 32, size 200.		
1.6.7 Sends Multi-Fragment Responses:	☒ Yes ☐ No		
1.6.8 DNP Command Settings preserved through a device reset:	☐ Assign Class ☐ Analog Deadbands ☐ Data Set Prototypes ☐ Data Set Descriptors	Not supported	

1.7 **Outstation Unsolicited Response Support**	**Capabilities**	**Current Value**	**If configurable, list methods**
1.7.1 Supports Unsolicited Reporting:	☒ Not Supported ☐ Configurable, selectable from On and Off	NA	

1.8 Outstation Performance		Capabilities	Current Value	If configurable, list methods
1.8.1	Maximum Time Base Drift (milliseconds per minute):		NA, not synchronized by DNP	
1.8.2	When does outstation set IIN1.4?	☒ Never ☐ Asserted at startup until first Time Synchronization request received ☐ Periodically, range ____to____ seconds ☐ Periodically, selectable from ____,____,___ seconds ☐ Range ____to____ seconds after last time sync ☐ Selectable from___,___,___seconds after last time sync ☐ When time error may have drifted by range ____to____ ms ☐ When time error may have drifted by selectable from ____,____,___	NA	
1.8.3	Maximum Internal Time Reference Error when set via DNP (ms):		NA	
1.8.4	Maximum Delay Measurement error (ms):		NA	
1.8.5	Maximum Response time (ms):		300 ms - TCP mode (for the case all supported points mapped to the DNP point lists)	T-PRO 2000 Offliner
1.8.6	Maximum time from start-up to IIN 1.4 assertion (ms):		NA	
1.8.7	Maximum Event Time-tag error for local Binary and Double-bit I/O (ms):		• 0.5208 ms for 60Hz systems • 0.6250 ms for 50 Hz systems	
1.8.8	Maximum Event Time-tag error for local I/O other than Binary and Double-bit data types (ms):		• 0.5208 ms for 60Hz systems • 0.6250 ms for 50 Hz systems	

Capabilities and Current Settings for Device Database

The following tables identify the capabilities and current settings for each DNP3 data type. Each data type also provides a table defining the data points available in the device, default point lists configuration and a description of how this information can be obtained in case of customized point configuration.

2.1 Single-Bit Binary Inputs Static (Steady-State) Group Number: 1 Event Group Number: 2	**Capabilities**	**Current Value**	**If configurable, list methods**
2.1.1 Static Variation reported when variation 0 requested:	☒ Variation 1 - Single-bit Packed format ☐ Variation 2 - Single-bit with flag ☐ Based on point Index (add column to table below)		
2.1.2 Event Variation reported when variation 0 requested:	☐ Variation 1 - without time ☒ Variation 2 - with absolute time ☐ Variation 3 - with relative time ☐ Based on point Index (add column to table below)		
2.1.3 Event reporting mode:	☐ Only most recent ☒ All events		
2.1.4 Binary Inputs included in Class 0 response:	☒ Always ☐ Never ☐ Only if point is assigned to Class 1, 2, or 3 ☐ Based on point Index (add column to table below)		T-PRO 2000 Offliner
2.1.5 Definition of Binary Input Point List:	☐ Fixed, list shown in table below ☒ Configurable ☐ Other, explain_____________________	Complete list is shown in the table below; points excluded from the default configuration are marked with '*'	T-PRO 2000 Offliner

Notes	1. Binary Inputs are scanned with 1 ms resolution. 2. Binary Input data points are user selectable; the data points available in the device for any given Binary Input point selection can be obtained through the T-PRO 2000 Offliner software (see SCADA Setting Summary).

Point Index	Name	Default Class Assigned to Events (1, 2, 3 or none)	Name for State when value is 0	Name for State when value is 1	Description
0	Time Sync Loss	1	Inactive	Active	
1	External Input 1	1	Inactive	Active	
2	External Input 2	1	Inactive	Active	
3	External Input 3	1	Inactive	Active	
4	External Input 4	1	Inactive	Active	
5	External Input 5	1	Inactive	Active	
6	External Input 6	1	Inactive	Active	
7	External Input 7	1	Inactive	Active	
8	External Input 8	1	Inactive	Active	
9	External Input 9	1	Inactive	Active	
10	External Input 10	1	Inactive	Active	
11	External Input 11	1	Inactive	Active	
12	External Input 12	1	Inactive	Active	
13	External Input 13	1	Inactive	Active	
14	External Input 14	1	Inactive	Active	
15	Virtual Input 1	1	Inactive	Active	
16	Virtual Input 2	1	Inactive	Active	
17	Virtual Input 3	1	Inactive	Active	
18	Virtual Input 4	1	Inactive	Active	
19	Virtual Input 5	1	Inactive	Active	
20	Virtual Input 6	1	Inactive	Active	
21	Virtual Input 7	1	Inactive	Active	
22	Virtual Input 8	1	Inactive	Active	
23	Virtual Input 9	1	Inactive	Active	
24	Virtual Input 10	1	Inactive	Active	
25	Virtual Input 11	1	Inactive	Active	
26	Virtual Input 12	1	Inactive	Active	
27	Virtual Input 13	1	Inactive	Active	
28	Virtual Input 14	1	Inactive	Active	
29	Virtual Input 15	1	Inactive	Active	
30	Virtual Input 16	1	Inactive	Active	
31	Virtual Input 17	1	Inactive	Active	

32	Virtual Input 18	1	Inactive	Active	
33	Virtual Input 19	1	Inactive	Active	
34	Virtual Input 20	1	Inactive	Active	
35	Virtual Input 21	1	Inactive	Active	
36	Virtual Input 22	1	Inactive	Active	
37	Virtual Input 23	1	Inactive	Active	
38	Virtual Input 24	1	Inactive	Active	
39	Virtual Input 25	1	Inactive	Active	
40	Virtual Input 26	1	Inactive	Active	
41	Virtual Input 27	1	Inactive	Active	
42	Virtual Input 28	1	Inactive	Active	
43	Virtual Input 29	1	Inactive	Active	
44	Virtual Input 30	1	Inactive	Active	
45	ProLogic 1	1	Inactive	Active	
46	ProLogic 2	1	Inactive	Active	
47	ProLogic 3	1	Inactive	Active	
48	ProLogic 4	1	Inactive	Active	
49	ProLogic 5	1	Inactive	Active	
50	ProLogic 6	1	Inactive	Active	
51	ProLogic 7	1	Inactive	Active	
52	ProLogic 8	1	Inactive	Active	
53	ProLogic 9	1	Inactive	Active	
54	ProLogic 10	1	Inactive	Active	
55	ProLogic 11	1	Inactive	Active	
56	ProLogic 12	1	Inactive	Active	
57	ProLogic 13	1	Inactive	Active	
58	ProLogic 14	1	Inactive	Active	
59	ProLogic 15	1	Inactive	Active	
60	ProLogic 16	1	Inactive	Active	
61	ProLogic 17	1	Inactive	Active	
62	ProLogic 18	1	Inactive	Active	
63	ProLogic 19	1	Inactive	Active	
64	ProLogic 20	1	Inactive	Active	
65	ProLogic21	1	Inactive	Active	
66	ProLogic22	1	Inactive	Active	

67	ProLogic23	1	Inactive	Active	
68	ProLogic24	1	Inactive	Active	
69	87 Operated	1	Inactive	Active	
70	87N Operated	1	Inactive	Active	
71	2nd Harmonic Restraint	1	Inactive	Active	
72	5nd Harmonic Restraint	1	Inactive	Active	
73	87 Unrestrained	1	Inactive	Active	
74	87 Alarm	1	Inactive	Active	
75	49-1 Operated	1	Inactive	Active	
76	49-2 Operated	1	Inactive	Active	
77	49-3 Operated	1	Inactive	Active	
78	49-4 Operated	1	Inactive	Active	
79	49-5 Operated	1	Inactive	Active	
80	49-6 Operated	1	Inactive	Active	
81	49-7 Operated	1	Inactive	Active	
82	49-8 Operated	1	Inactive	Active	
83	49-9 Operated	1	Inactive	Active	
84	49-10 Operated	1	Inactive	Active	
85	49-11 Operated	1	Inactive	Active	
86	49-12 Operated	1	Inactive	Active	
87	THD Operated	1	Inactive	Active	
88	Through Fault Monitor Alarm Operated	1	Inactive	Active	
89	Through Fault Monitor Peak Operated	1	Inactive	Active	
90	Through Fault Monitor I^2t Operated	1	Inactive	Active	
91	50-HV-1 Operated	1	Inactive	Active	
92	50-HV-2 Operated	1	Inactive	Active	
93	51-HV-1 Operated	1	Inactive	Active	
94	51-HV-2 Operated	1	Inactive	Active	
95	50-LV-1 Operated	1	Inactive	Active	
96	50-LV-2 Operated	1	Inactive	Active	
97	51-LV-1 Operated	1	Inactive	Active	
98	51-LV-2 Operated	1	Inactive	Active	
99	50N-HV-1 Operated	1	Inactive	Active	

100	50N-HV-2 Operated	1	Inactive	Active	
101	51N-HV-1 Operated	1	Inactive	Active	
102	51N-HV-2 Operated	1	Inactive	Active	
103	50N-LV-1 Operated	1	Inactive	Active	
104	50N-LV-2 Operated	1	Inactive	Active	
105	51N-LV-1 Operated	1	Inactive	Active	
106	51N-LV-2 Operated	1	Inactive	Active	
107	50G-1 Operated	1	Inactive	Active	
108	50G-2 Operated	1	Inactive	Active	
109	51G-1 Operated	1	Inactive	Active	
110	51G-2 Operated	1	Inactive	Active	
111	45/50-HV Operated	1	Inactive	Active	
112	46/51-HV Operated	1	Inactive	Active	
113	46/50-LV Operated	1	Inactive	Active	
114	46/51-LV Operated	1	Inactive	Active	
115	50BF-HV Initiaded	1	Inactive	Active	
116	50BF-LV Initiated	1	Inactive	Active	
117	50BF-INPUT1-1	1	Inactive	Active	
118	50BF-INPUT1-2	1	Inactive	Active	
119	50BF-INPUT2-1	1	Inactive	Active	
120	50BF-INPUT2-2	1	Inactive	Active	
121	27DT-1 Operated	1	Inactive	Active	
122	27DT-2 Operated	1	Inactive	Active	
123	27DT-3 Operated	1	Inactive	Active	
124	27DT-4 Operated	1	Inactive	Active	
125	27IT-1 Operated	1	Inactive	Active	
126	27IT-2 Operated	1	Inactive	Active	
127	59DT-1 Operated	1	Inactive	Active	
128	59DT-2 Operated	1	Inactive	Active	
129	59DT-3 Operated	1	Inactive	Active	
130	59DT-4 Operated	1	Inactive	Active	
131	59IT-1 Operated	1	Inactive	Active	
132	59IT-2 Operated	1	Inactive	Active	
133	24DT-1 Operated	1	Inactive	Active	
134	24DT-2 Operated	1	Inactive	Active	
135	24IT Operated	1	Inactive	Active	

136	59GDT-1 Operated	1	Inactive	Active	
137	59GDT-2 Operated	1	Inactive	Active	
138	59GIT Operated	1	Inactive	Active	
139	81U-1 Operated	1	Inactive	Active	
140	81U-2 Operated	1	Inactive	Active	
141	81U-3 Operated	1	Inactive	Active	
142	81U-4 Operated	1	Inactive	Active	
143	81O-1 Operated	1	Inactive	Active	
144	81O-2 Operated	1	Inactive	Active	
145	81O-3 Operated	1	Inactive	Active	
146	81O-4 Operated	1	Inactive	Active	
147	81R-1 Operated	1	Inactive	Active	
148	81R-2 Operated	1	Inactive	Active	
149	74TCS-1 Operated	1	Inactive	Active	
150	74TCS-2 Operated	1	Inactive	Active	
151	I^2t HV Operated	1	Inactive	Active	
152	I^2t LV Operated	1	Inactive	Active	
153	Output Contact 1	1	Open	Closed	
154	Output Contact 2	1	Open	Closed	
155	Output Contact 3	1	Open	Closed	
156	Output Contact 4	1	Open	Closed	
157	Output Contact 5	1	Open	Closed	
158	Output Contact 6	1	Open	Closed	
159	Output Contact 7	1	Open	Closed	
160	Output Contact 8	1	Open	Closed	
161	Output Contact 9	1	Open	Closed	
162	Output Contact 10	1	Open	Closed	
163	Output Contact 11	1	Open	Closed	
164	Output Contact 12	1	Open	Closed	
165	Output Contact 13	1	Open	Closed	
166	Output Contact 14	1	Open	Closed	
167	87 PhA Operated	1	Inactive	Active	
168	87 PhB Operated	1	Inactive	Active	
169	87 PhC Operated	1	Inactive	Active	
170	2nd Harmonic Restraint PhA Operated	1	Inactive	Active	

171	2nd Harmonic Restraint PhB Operated	1	Inactive	Active	
172	2nd Harmonic Restraint PhC Operated	1	Inactive	Active	
173	5th Harmonic Restraint PhA Operated	1	Inactive	Active	
174	5th Harmonic Restraint PhB Operated	1	Inactive	Active	
175	5th Harmonic Restraint PhC Operated	1	Inactive	Active	
176	87 Unrestraint PhA Operated	1	Inactive	Active	
177	87 Unrestraint PhB Operated	1	Inactive	Active	
178	87 Unrestraint PhC Operated	1	Inactive	Active	
179	87 Alarm A Operated	1	Inactive	Active	
180	87 Alarm B Operated	1	Inactive	Active	
181	87 Alarm C Operated	1	Inactive	Active	
182	TFM Alarm A Operated	1	Inactive	Active	
183	TFM Alarm B Operated	1	Inactive	Active	
184	TFM Alarm C Operated	1	Inactive	Active	
185	50-HV-1 A Operated	1	Inactive	Active	
186	50-HV-1 B Operated	1	Inactive	Active	
187	50-HV-1 C Operated	1	Inactive	Active	
188	50-HV-2 A Operated	1	Inactive	Active	
189	50-HV-2 B Operated	1	Inactive	Active	
190	50-HV-2 C Operated	1	Inactive	Active	
191	51-HV-1 A Operated	1	Inactive	Active	
192	51-HV-1 B Operated	1	Inactive	Active	
193	51-HV-1 C Operated	1	Inactive	Active	
194	51-HV-2 A Operated	1	Inactive	Active	
195	51-HV-2 B Operated	1	Inactive	Active	
196	51-HV-2 C Operated	1	Inactive	Active	
197	50-LV-1 A Operated	1	Inactive	Active	
198	50-LV-1 B Operated	1	Inactive	Active	
199	50-LV-1 C Operated	1	Inactive	Active	
200	50-LV-2 A Operated	1	Inactive	Active	
201	50-LV-2 B Operated	1	Inactive	Active	
202	50-LV-2 C Operated	1	Inactive	Active	

203	51-LV-1 A Operated	1	Inactive	Active	
204	51-LV-1 B Operated	1	Inactive	Active	
205	51-LV-1 C Operated	1	Inactive	Active	
206	51-LV-2 A Operated	1	Inactive	Active	
207	51-LV-2 B Operated	1	Inactive	Active	
208	51-LV-2 C Operated	1	Inactive	Active	
209	50BF - INPUT1-1 A Operated	1	Inactive	Active	
210	50BF - INPUT1-1 B Operated	1	Inactive	Active	
211	50BF - INPUT1-1 C Operated	1	Inactive	Active	
212	50BF - INPUT1-2 A Operated	1	Inactive	Active	
213	50BF - INPUT1-2 B Operated	1	Inactive	Active	
214	50BF - INPUT1-2 C Operated	1	Inactive	Active	
215	50BF - INPUT2-1 A Operated	1	Inactive	Active	
216	50BF - INPUT2-1 B Operated	1	Inactive	Active	
217	50BF - INPUT2-1 C Operated	1	Inactive	Active	
218	50BF - INPUT2-2 A Operated	1	Inactive	Active	
219	50BF - INPUT2-2 B Operated	1	Inactive	Active	
220	50BF - INPUT2-2 C Operated	1	Inactive	Active	

2.2 Binary Output Status And Control Relay Output Block Binary Output Status Group Number: 10 CROB Group Number: 12	**Capabilities**	**Current Value**	**If configurable, list methods**
2.2.1 Minimum pulse time allowed with Trip, Close, and Pulse On commands:	☒ Fixed at 0.000 ms (hardware may limit this further) ☐ Based on point Index (add column to table below)		
2.2.2 Maximum pulse time allowed with Trip, Close, and Pulse On commands:	☒ Fixed at 0.000 ms (hardware may limit this further) ☐ Based on point Index (add column to table below)		
2.2.3 Binary Output Status included in Class 0 response:	☒ Always ☐ Never ☐ Only if point is assigned to Class 1, 2, or 3 ☐ Based on point Index (add column to table below)		
2.2.4 Reports Output Command Event Objects:	☒ Never ☐ Only upon a successful Control ☐ Upon all control attempts	Not supported	
2.2.5 Event Variation reported when variation 0 requested:	☐ Variation 1 - without time ☐ Variation 2 - with absolute time ☐ Based on point Index (add column to table below)	Not supported	T-PRO 2000 Offliner (See Note 2 below)

2.2 Binary Output Status And Control Relay Output Block Binary Output Status Group Number: 10 CROB Group Number: 12		**Capabilities**	**Current Value**	**If configurable, list methods**
2.2.6	Command Event Variation reported when variation 0 requested:	☐ Variation 1 - without time ☐ Variation 2 - with absolute time ☐ Based on point Index (add column to table below)	Not supported	T-PRO 2000 Offliner (See Note 2 below)
2.2.7	Command Event reporting mode:	☐ Only most recent ☐ All events	Not supported	
2.2.8	Maximum Time between Select and Operate:	☐ Not Applicable ☒ Fixed at 10 seconds ☐ Configurable, range ______ to ______ seconds ☐ Configurable, selectable from___,___,___seconds ☐ Configurable, other, describe______________ ☐ Variable, explain _______________________ ☐ Based on point Index (add column to table below)	10 s	
2.2.9	Definition of Binary Output Status/Control relay output block (CROB) Point List:	☐ Fixed, list shown in table below ☒ Configurable ☐ Other, explain_____________________	**Complete list is shown in the table below; points excluded from the default configuration are marked with '*'**	T-PRO 2000 Offliner

NOTES	1. Binary Outputs are scanned with 500 ms resolution. 2. Events are not supported for Binary Outputs (group 10), but most of Binary Output points can be mapped to Binary Inputs (group 2) with full Event and Class Data support. See T-PRO 2000 Offliner/DNP Configuration/Point Map screen for complete point lists and configuration options. 3. Virtual Inputs (default Binary Output points 14-43) can be used to control relay output contacts. See T-PRO 2000 Offliner/Setting Group X/Output Matrix screen for configuration options. 4. Binary Output data points are user selectable; the data points available in the device for any given Binary Output point selection can be obtained through the T-PRO 2000 Offliner software (see SCADA Setting Summary).

Point Index	Name	Supported Control Operations											Name for State when value is 0	Name for State when value is 1	Default Class Assigned to Events (1, 2, 3 or none)		Description
		Select/Operate	Direct Operate	Direct Operate - No Ack	Pulse On / NUL	Pulse Off	Latch On / NUL	Latch Off / NUL	Trip	Close	Count > 1	Cancel Currently Running Operation			Change	Command	
0	Output contact 1	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
1	Output contact 2	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
2	Output contact 3	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
3	Output contact 4	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
4	Output contact 5	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
5	Output contact 6	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
6	Output contact 7	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
7	Output contact 8	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
8	Output contact 9	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
9	Output contact 10	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
10	Output contact 11	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
11	Output contact 12	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
12	Output contact 13	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
13	Output contact 14	-	-	-	-	-	-	-	-	-	-	-	Open	Closed	None	None	
14	Virtual Input 1	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
15	Virtual Input 2	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
16	Virtual Input 3	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
17	Virtual Input 4	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
18	Virtual Input 5	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
19	Virtual Input 6	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
20	Virtual Input 7	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
21	Virtual Input 8	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
22	Virtual Input 9	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
23	Virtual Input 10	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
24	Virtual Input 11	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
25	Virtual Input 12	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
26	Virtual Input 13	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
27	Virtual Input 14	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
28	Virtual Input 15	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
29	Virtual Input 16	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
30	Virtual Input 17	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s

Point Index	Name	Supported Control Operations											Name for State when value is 0	Name for State when value is 1	Default Class Assigned to Events (1, 2, 3 or none)		Description
		Select/Operate	Direct Operate	Direct Operate - No Ack	Pulse On / NUL	Pulse Off	Latch On / NUL	Latch Off / NUL	Trip	Close	Count > 1	Cancel Currently Running Operation			Change	Command	
31	Virtual Input 18	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
32	Virtual Input 19	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
33	Virtual Input 20	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
34	Virtual Input 21	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
35	Virtual Input 22	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
36	Virtual Input 23	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
37	Virtual Input 24	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
38	Virtual Input 25	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
39	Virtual Input 26	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
40	Virtual Input 27	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
41	Virtual Input 28	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
42	Virtual Input 29	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s
43	Virtual Input 30	Y	Y	Y	Y	-	Y	Y	-	-	-	-	Inactive	Active	None	None	Pulse duration fixed at 1 s

2.3 Analog Input Points Static (Steady-State) Group Number: 30 Event Group Number: 32	**Capabilities**	**Current Value**	**If configurable, list methods**
2.3.1 Variation reported when variation 0 requested:	☐ Variation 1 - 32-bit with flag ☐ Variation 2 - 16-bit with flag ☒ Variation 3 - 32-bit without flag ☒ Variation 4 - 16-bit without flag ☐ Variation 5 - single-precision floating point with flag ☐ Variation 6 - double-precision floating point with flag ☐ Based on point Index (add column to table below)		
2.3.2 Event Variation reported when variation 0 requested:	☒ Variation 1 - 32-bit without time ☒ Variation 2 - 16-bit without time ☐ Variation 3 - 32-bit with time ☐ Variation 4 - 16-bit with time ☐ Variation 5 - single-precision floating point w/o time ☐ Variation 6 - double-precision floating point w/o time ☐ Variation 7 - single-precision floating point with time ☐ Variation 8 - double-precision floating point with time ☐ Based on point Index (add column to table below)		
2.3.3 Event reporting mode:	☐ Only most recent ☒ All events		
2.3.4 Analog Inputs Included in Class 0 response:	☒ Always ☐ Never ☐ Only if point is assigned to Class 1, 2, or 3 ☐ Based on point Index (add column to table below)		
2.3.5 How Deadbands are set:	☐ A. Global Fixed ☐ B. Configurable through DNP ☒ C. Configurable via other means ☐ D. Other, explain ________________________ ☐ Based on point Index - column specifies which of the options applies, B, C, or D		T-PRO 2000 Offliner
2.3.6 Analog Deadband Algorithm: *simple - just compares the difference from the previous reported value*	☒ Simple ☐ Integrating ☐ Other, explain __________________________		
2.3.7 Definition of Analog Input Point List:	☐ Fixed, list shown in table below ☒ Configurable ☐ Other, explain_____________________	**Default list is shown in table below**	T-PRO 2000 Offliner

NOTES	1. Analog Inputs are scanned with 500 ms resolution. 2. Nominal values in calculations for the following table are based on Secondary voltage * PT ratio for voltage channels, and either 1 A or 5A secondary current * CT ratio for current channels dependent upon the format of CT installed in the T-PRO. 3. Analog Input data points are user selectable; the data points available in the device for any given Analog Input point selection can be obtained through the T-PRO 2000 Offliner software (see SCADA Setting Summary).

Point Index	Name	Default Class Assigned to Events (1, 2, 3 or none)	Transmitted Value[a]		Scaling[b]		Scale Units	Resolution[c] (default/ maximal)	Dead band (default/(range))	Dead band Units
			Minimum	Maximum	Multiplier (default/ (range))	Offset				
0	I1A Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
1	I1A Angle	2	-18,000	-18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
2	I1B Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
3	I1B Angle	2	-18,000	18,000	0.1 / (0.01 – 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
4	I1C Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
5	I1C Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
6	I2A Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
7	I2A Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
8	I2B Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
9	I2B Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
10	I2C Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
11	I2C Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
12	IN Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
13	IN Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
14	VIN Magnitude	2	0	Configurable	0.1 / (0.00001 - 1.0)	0.0	kV	0.1 / 0.00001	2.0 / (0.1 to 100.0)	kV
15	VIN Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
16	IHV A Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
17	IHV A Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
18	IHV B Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
19	IHV B Angle	2	-18,000	18,000	0.1 / (0.01 – 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
20	IHV C Magnitude	2	0	Configurable	1.0 / (0.1 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
21	IHV C Angle	2	-18,000	18,000	0.01 / (0.01 – 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
22	ILV A Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
23	ILV A Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
24	ILV B Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
25	ILV B Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
26	ILV C Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
27	ILV C Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0.0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
28	3I0 HV Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
29	3I0 HV Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees
30	3I0 LV Magnitude	2	0	Configurable	1.0 / (0.01 – 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
31	3I0 LV Angle	2	-18,000	18,000	0.1 / (0.01 - 1.0)	0	degrees	0.1 / 0.01	0.5 / (0.1 to 180.0)	degrees

Point Index	Name	Default Class Assigned to Events (1, 2, 3 or none)	Transmitted Value[a]		Scaling[b]		Scale Units	Resolution[c] (default/ maximal)	Dead band (default/(range))	Dead band Units
			Minimum	Maximum	Multiplier (default/ (range))	Offset				
32	I1 Positive Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
33	I1 Negative Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
34	I1 Zero Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
35	I2 Positive Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
36	I2 Negative Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
37	I2 Zero Sequence Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
38	87 IA Operating Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
39	87 IB Operating Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
40	87 IC Operating Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
41	87 IA Restraint Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
42	87 IB Restraint Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
43	87 IC Restraint Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
44	87N IN REF IO Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
45	87N IN REF IR Magnitude	2	0	Configurable	1.0 / (0.01 - 1000)	0	A	1.0 / 0.01	2.0 / (0.1 to 100.0)	A
46	49_HV Current RMS Current	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	0.02 / (0.02 to 2.0)	A
47	49_LV Current RMS Current	2	0	Configurable	1.0 / (0.01 - 1000)	0.0	A	1.0 / 0.01	0.02 / (0.02 to 2.0)	A
48	HV IA 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
49	HV IB 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
50	HV IC 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
51	LV IA 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
52	LV IB 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
53	LV IC 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
54	I1A 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
55	I1B 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
56	I1C 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
57	I2A 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
58	I2B 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
59	I2C 2nd Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
60	I1A 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal

Point Index	Name	Default Class Assigned to Events (1, 2, 3 or none)	Transmitted Value[a]		Scaling[b]		Scale Units	Resolution[c] (default/ maximal)	Dead band (default/(range))	Dead band Units
			Minimum	Maximum	Multiplier (default/ (range))	Offset				
61	I1B 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
62	I1C 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
63	I2A 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
64	I2B 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
65	I2C 5th Harmonic Magnitude	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
66	THD	2	0	Configurable	0.01 / (0.01 - 1.0)	0	%	0.01 / 0.01	Dead band - 2.0 / (0.1 to 100.0)	% of nominal
67	Accumulated IA*IA*t	2	0	65,535	0.001 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
68	Accumulated IB*IB*t	2	0	65,535	0.001 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
69	Accumulated IC*IC*t	2	0	65,535	0.001 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
70	Through Fault Count	2	0	32767	1.0	0.0	NA	1.0 / 1.0	Dead band - 1 (1 to 32767)	NA
71	V/F	2	0	Configurable	0.1 / (0.01 - 1.0)	0.0	pu	0.1 / 0.001	Dead band - 0.02 / (0.01 to 3.00)	pu
72	Frequency	2	0	Max F x 100	0.01 / (0.001 - 1.0)	0.0	Hz	0.01 / 0.001	Dead band - 0.05 / (0.01 to 60.00)	Hz
73	I2T HV Accumulated	2	0	Configurable	0.01 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
74	I2T HV Last Operation	2	0	Configurable	0.01 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
75	I2T LV Accumulated	2	0	Configurable	0.01 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s
76	I2T LV Last Operation	2	0	Configurable	0.01 / (0.001 - 1.0)		kA*kA*s	0.001 / 0.001	Dead band - 0.1 / (0.1 to 99999.9)	kA^2s

a. *The minimum and maximum transmitted values are the lowest and highest values that the outstation will report in DNP analog input objects. These values are integers if the outstation transmits only integers. If the outstation is capable of transmitting both integers and floating-point, then integer and floating-point values are required for the minimums and maximums.*
For example, a pressure sensor is able to measure 0 to 500 kPa. The outstation provides a linear conversion of the sensor's output signal to integers in the range of 0 to 25000 or floating-point values of 0 to 500.000. The sensor and outstation are used in an application where the maximum possible pressure is 380 kPa. For this input, the minimum transmitted value would be stated as 0 / 0.0 and the maximum transmitted value would be stated as 19000 / 380.000

b. *The scaling information for each point specifies how data transmitted in integer variations (16 bit and 32 bit) is converted to engineering units when received by the Master (i.e. scaled according to the equation: scaled value = multiplier * raw + offset). Scaling is not applied to Floating point variations since they are already transmitted in engineering units.*

c. *Resolution is the smallest change that may be detected in the value due to quantization errors and is given in the units shown in the previous column. This parameter does not represent the accuracy of the measurement.*

2.4 Octet String Points Static (Steady-State) Group Number: 110 Event Group Number: 111	**Capabilities**	**Current Value**	**If configurable, list methods**
2.4.1 Event reporting mode *:	☐ Only most recent ☐ All events	Not supported	
2.4.2 Octet Strings Included in Class 0 response:	☐ Always ☐ Never ☐ Only if point is assigned to Class 1, 2, or 3 ☐ Based on point Index (add column to table below)	Not supported	
2.4.3 Definition of Octet String Point List:	☐ Fixed, list shown in table below ☐ Configurable (current list may be shown in table below) ☐ Other, explain Used for Event Log access as described below		

* Object 110 and 111 are Octet String Object used to provide access to the Event Log text of the relay. Object 110 always contains the most recent event in the relay. Object 111 is the corresponding change event object.

As stated in the DNP specifications, the variation of the response object represents the length of the string. The string represents the ASCII values of the event text.

Implementation Table

The following implementation table identifies which object groups and variations, function codes and qualifiers the device supports in both requests and responses. The *Request* columns identify all requests that may be sent by a Master, or all requests that must be parsed by an Outstation. The *Response* columns identify all responses that must be parsed by a Master, or all responses that may be sent by an Outstation.

NOTE	The implementation table must list all functionality required by the device whether Master or Outstation as defined within the DNP3 IED Conformance Test Procedures. Any functionality beyond the highest subset level supported is indicated by highlighted rows. Any Object Groups not provided by an outstation or not processed by a Master are not indicated (note these Object Groups will still be parsed).

DNP Object Group & Variation			**Request** **Outstation parses**		**Response** **Outstation can issue**	
Group Num	**Var Num**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
1	0	Binary Input - Any Variation	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
1	1	Binary Input - Packed format	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
1	2	Binary Input - With flags	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
2	0	Binary Input Event - Any Variation	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
2	1	Binary Input Event - Without time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
2	2	Binary Input Event - With absolute time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
2	3	Binary Input Event - With relative time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
10	0	Binary Output - Any Variation	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
10	2	Binary Output - Output Status with flag	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
12	1	Binary Command - Control relay output block (CROB)	**3** (select) **4** (operate) **5** (direct op) **6** (dir. op, no ack)	**17, 28** (index)	**129** (response)	Echo of request

DNP Object Group & Variation			Request Outstation parses		Response Outstation can issue	
Group Num	**Var Num**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
20	0		**1** (read) **7** (freeze) **8** (freeze noack) **9** (freeze clear) **10** (frz. cl. noack)	**06** (no range, or all)	**129** (response)	
20	1				**129** (response)	
20	2				**129** (response)	
20	5				**129** (response)	
20	6				**129** (response)	
21	0		**1** (read)	**06** (no range, or all)		
21	1				**129** (response)	
21	2				**129** (response)	
21	9				**129** (response)	
21	10				**129** (response)	
22	0		**1** (read)	**06** (no range, or all) **07, 08** (limited qty)		
22	1				**129** (response)	
22	2				**129** (response)	
30	0	Analog Input - Any Variation	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
30	1	Analog Input - 32-bit with flag	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
30	2	Analog Input - 16-bit with flag	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
30	3	Analog Input - 32-bit without flag	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
30	4	Analog Input - 16-bit without flag	**1** (read)	**06** (no range, or all) **00, 01** (start-stop) **07, 08** (limited qty) **17, 28** (index)	**129** (response)	**00, 01** (start-stop)
32	0	Analog Input Event - Any Variation	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
32	1	Analog Input Event - 32-bit without time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
32	2	Analog Input Event - 16-bit without time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
32	3	Analog Input Event - 32-bit with time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
32	4	Analog Input Event - 16-bit with time	**1** (read)	**06** (no range, or all) **07, 08** (limited qty)	**129** (response)	**17, 28** (index)
40	0		**1** (read)	**06** (no range, or all)	**129** (response)	

DNP Object Group & Variation			Request Outstation parses		Response Outstation can issue	
Group Num	**Var Num**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
40	2				**129** (response)	
41	2		**3** (select) **4** (operate) **5** (direct op) **6** (dir. op, no ack)	**17, 28** (index)	**129** (response)	
50	1		**2** (write)	**07** (limited qty = 1)	**129** (response)	
51	1					
51	2	Time and Date CTO - Absolute time, unsynchronized			**129** (response)	**07** (limited qty) (qty = 1)
52	1	Time Delay - Coarse			**129** (response)	**07** (limited qty) (qty = 1)
52	2					
60	1	Class Objects - Class 0 data	**1** (read)	**06** (no range, or all)	**129** (response)	**00, 01** (start-stop)
60	2	Class Objects - Class 1 data	**1** (read)	**06** (no range, or all)	**129** (response)	**17, 28** (index)
60	3	Class Objects - Class 2 data	**1** (read)	**06** (no range, or all)	**129** (response)	**17, 28** (index)
60	4	Class Objects - Class 3 data	**1** (read)	**06** (no range, or all)	**129** (response)	**17, 28** (index)
80	1	Internal Indications - Packet format	**2** (write)	**00** (start-stop) (index = 7)	**129** (response)	
110	0	Octet String	**1** (read)	**06** (no range, or all)	**129** (response)	**07** (limited only)
111	0	Octet String Event	**1** (read)	**06** (no range, or all)	**129** (response)	**07** (limited only)
No Object (function code only)			**13** (cold restart)		**129** (response)	
No Object (function code only)			**14** (warm restart)		**129** (response)	
No Object (function code only)			**23** (delay meas.)		**129** (response)	

Appendix G IEC 103 Device Profile

G.1 Device Properties

This document shows the device capabilities and the current value of each parameter for the default unit configuration as defined in the default configuration file.

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IEC60870 Function Type & COT Descriptions

This ASDU is used to send events with a real value. For example, fault current / voltage of T-PRO 2000 relays are send using this ASDU.

FUN	INF	Description	GI	TYP	COT	DIR	TPRO 2000
163	189	I1A Fault current	x	4	1,9	-	x
163	190	I1B Fault current	x	4	1,9	-	x
163	191	I1C Fault current	x	4	1,9	-	x
163	192	I2A Fault current	x	4	1,9	-	x
163	193	I2B Fault current	x	4	1,9	-	x
163	194	I2C Fault current	x	4	1,9	-	x
163	195	IN Fault current	x	4	1,9	-	x
163	196	V1 Fault Voltage	x	4	1,9	-	x
163	197	%V/F Fault Voltage	x	4	1,9	-	x
163	198	87 IA Operating Fault current	x	4	1,9	-	x
163	199	87 IB Operating Fault current	x	4	1,9	-	x
163	200	87 IC Operating Fault current	x	4	1,9	-	x
163	201	87 IA Restraint Fault current	x	4	1,9	-	x
163	202	87 IB Restraint Fault current	x	4	1,9	-	x
163	203	87 IC Restraint Fault current	x	4	1,9	-	x
163	204	87N IN REF IO Fault current	x	4	1,9	-	x
163	205	87N IN REF IR Fault current	x	4	1,9	-	x
163	206	Frequency	x	4	1,9	-	x
163	207	dF/dT Fault Frequency	x	4	1,9	-	x

163	208	INRMS Fault Frequency	x	4	1,9	-	x
163	209	Input1 3IO Fault current	x	4	1,9	-	x
163	210	Input2 3IO Fault current	x	4	1,9	-	x

IEC60870 Public and Private Codes

This section contains the event & command codes:

KEY: **FUN** Function Type

INF Information Number

GI Event supports General Interrogation x = supported

TYP ASDU Type

COT Cause of Transmission

DIR Direction of event Raised Only (RO), Raised / Cleared (RC) or Double Point Travelling, Cleared, Raised or Unknown (DP)

x Supported

- Not supported

FUN	INF	Description	GI	TYP	COT	DIR
163	2	Reset FCB	-	5	3	RO
163	3	Reset CU	-	5	4	RO
163	4	Start/Restart	-	5	5	RO
163	5	Power ON	-	5	6	RO
163	19	LEDs reset	-	1	1, 11, 12, 20, 21	RO
163						
163	22	Settings changed	x	1	1, 9, 11, 12	RC
163	23	Setting G1 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	24	Setting G2 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	25	Setting G3 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	26	Setting G4 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	27	Setting G5 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	28	Setting G6 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	29	Setting G7 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	30	Setting G8 selected	x	1	1, 9, 11, 12, 20, 21	RC
163	147	Measurand I (IN, VN)	x	3	2	-

163	148	Measurand II (I1 A, I1 B, I1 C, I2 A, I2 B, I2 C)	x	9	2	-
163	160	Output1	x	1	1, 9, 12, 20, 21	RC
163	161	Output2	x	1	1, 9, 12, 20, 21	RC
163	162	Output3	x	1	1, 9, 12, 20, 21	RC
163	163	Output4	x	1	1, 9, 12, 20, 21	RC
163	164	Output5	x	1	1, 9, 12, 20, 21	RC
163	165	Output6	x	1	1, 9, 12, 20, 21	RC
163	166	Output7	x	1	1, 9, 12, 20, 21	RC
163	167	Output8	x	1	1, 9, 12, 20, 21	RC
163	168	Output9	x	1	1, 9, 12, 20, 21	RC
163	169	Output10	x	1	1, 9, 12, 20, 21	RC
163	170	Output11	x	1	1, 9, 12, 20, 21	RC
163	171	Output12	x	1	1, 9, 12, 20, 21	RC
163	172	Output13	x	1	1, 9, 12, 20, 21	RC
163	173	Output14	x	1	1, 9, 12, 20, 21	RC
163	174	Status Input1	x	1	1, 9	RC
163	175	Status Input2	x	1	1, 9	RC
163	176	Status Input3	x	1	1, 9	RC
163	177	Status Input4	x	1	1, 9	RC
163	178	Status Input5	x	1	1, 9	RC
163	179	Status Input6	x	1	1, 9	RC
163	180	Status Input7	x	1	1, 9	RC
163	181	Status Input8	x	1	1, 9	RC
163	182	Status Input9	x	1	1, 9	RC
163	183	Status Input10	x	1	1, 9	RC
163	184	Status Input11	x	1	1, 9	RC
163	185	Status Input12	x	1	1, 9	RC
163	186	Status Input13	x	1	1, 9	RC
163	187	Status Input14	x	1	1, 9	RC
163	188	Disturbance record stored	-	1	1, 12, 20, 21	RO
163	189	I1A Fault current	x	4	1,9	-
163	190	I1B Fault current	x	4	1,9	-
163	191	I1C Fault current	x	4	1,9	-

163	192	I2A Fault current	x	4	1,9	-
163	193	I2B Fault current	x	4	1,9	-
163	194	I2C Fault current	x	4	1,9	-
163	195	IN Fault current	x	4	1,9	-
163	196	V1 Fault Voltage	x	4	1,9	-
163	197	%V/F Fault Voltage	x	4	1,9	-
163	198	87 IA Operating Fault current	x	4	1,9	-
163	199	87 IB Operating Fault current	x	4	1,9	-
163	200	87 IC Operating Fault current	x	4	1,9	-
163	201	87 IA Restraint Fault current	x	4	1,9	-
163	202	87 IB Restraint Fault current	x	4	1,9	-
163	203	87 IC Restraint Fault current	x	4	1,9	-
163	204	87N IN REF IO Fault current	x	4	1,9	-
163	205	87N IN REF IR Fault current	x	4	1,9	-
163	206	Frequency	x	4	1,9	-
163	207	dF/dT Fault Frequency	x	4	1,9	-
163	208	IG RMS Fault Frequency	x	4	1,9	-
163	209	Input1 3I0	x	4	1,9	-
163	210	Input2 3I0	x	4	1,9	-
164	64	A-starter	x	2	1, 9	RC
164	65	B-starter	x	2	1, 9	RC
164	66	C-starter	x	2	1, 9	RC
164	67	E-starter	x	2	1, 9	RC
164	68	General trip	-	2	1	RO
164	69	A-general trip	-	2	1	RO
164	70	B-general trip	-	2	1	RO
164	71	C-general trip	-	2	1	RO
164	84	General starter	x	2	1	RO
164	85	Breaker Failure	x	2	1	RO
164	90	P/F General LS Trip (51)	-	2	1	RO
164	91	P/F General HS Trip (50)	-	2	1	RO
164	92	E/F General LS Trip (51N, 51G)	-	2	1	RO
164	93	E/F General HS Trip (50N, 50G)	-	2	1	RO

164	160	Through Fault Monitor Operated	-	2	1	RO
164	161	Through Fault Monitor Peak Operated	-	2	1	RO
164	162	Through Fault Monitor I2t Oper-ated	-	2	1	RO
164	163	50-HV-1 Picked up	-	2	1	RC
164	164	50-HV-2 Picked up	-	2	1	RC
164	165	50-HV-1 Operated	-	2	1	RO
164	166	50-HV-2 Operated	-	2	1	RO
164	167	50-LV-1 Picked up	-	2	1	RC
164	168	50-LV-2 Picked up	-	2	1	RC
164	169	50-LV-1 Operated	-	2	1	RO
164	170	50-LV-2 Operated	-	2	1	RO
164	171	51-HV-1 Picked up	-	2	1	RC
164	172	51-HV-2 Picked up	-	2	1	RC
164	173	51-HV-1 Operated	-	2	1	RO
164	174	51-HV-2 Operated	-	2	1	RO
164	175	51-LV-1 Picked up	-	2	1	RC
164	176	51-LV-2 Picked up	-	2	1	RC
164	177	51-LV-1 Operated	-	2	1	RO
164	178	51-LV-2 Operated	-	2	1	RO
164	179	50N-HV-1 Picked up	-	2	1	RC
164	180	50N-HV-2 Picked up	-	2	1	RC
164	181	50N-HV-1 Operated	-	2	1	RO
164	182	50N-HV-2 Operated	-	2	1	RO
164	183	50N-LV-1 Picked up	-	2	1	RC
164	184	50N-LV-2 Picked up	-	2	1	RC
164	185	50N-LV-1 Operated	-	2	1	RO
164	186	50N-LV-2 Operated	-	2	1	RO
164	187	51N-HV-1 Picked up	-	2	1	RC
164	188	51N-HV-2 Picked up	-	2	1	RC
164	189	51N-HV-1 Operated	-	2	1	RO
164	190	51N-HV-2 Operated	-	2	1	RO
164	191	51N-LV-1 Picked up	-	2	1	RC
164	192	51N-LV-2 Picked up	-	2	1	RC

164	193	51N-LV-1 Operated	-	2	1	RO
164	194	51N-LV-2 Operated	-	2	1	RO
164	195	50G-1 Picked up	-	2	1	RC
164	196	50G-2 Picked up	-	2	1	RC
164	197	50G-1 Operated	-	2	1	RO
164	198	50G-2 Operated	-	2	1	RO
164	199	51G-1 Picked up	-	2	1	RC
164	200	51G-2 Picked up	-	2	1	RC
164	201	51G-1 Operated	-	2	1	RO
164	202	51G-2 Operated	-	2	1	RO
164	203	46/50-HV Picked up	-	2	1	RC
164	204	46/50-LV Picked up	-	2	1	RC
164	205	46/50-HV Operated	-	2	1	RO
164	206	46/50-LV Operated	-	2	1	RO
164	207	46/51-HV Picked up	-	2	1	RC
164	208	46/51-LV Picked up	-	2	1	RC
164	209	46/51-HV Operated	-	2	1	RO
164	210	46/51-LV Operated	-	2	1	RO
164	211	49-1 Picked up	-	2	1	RC
164	212	49-2 Picked up	-	2	1	RC
164	213	49-3 Picked up	-	2	1	RC
164	214	49-4 Picked up	-	2	1	RC
164	215	49-5 Picked up	-	2	1	RC
164	216	49-6 Picked up	-	2	1	RC
164	217	49-7 Picked up	-	2	1	RC
164	218	49-8 Picked up	-	2	1	RC
164	219	49-9 Picked up	-	2	1	RC
164	220	49-10 Picked up	-	2	1	RC
164	221	49-11 Picked up	-	2	1	RC
164	222	49-12 Picked up	-	2	1	RC
164	223	49-1 Operated	-	2	1	RO
164	224	49-2 Operated	-	2	1	RO
164	225	49-3 Operated	-	2	1	RO
164	226	49-4 Operated	-	2	1	RO
164	227	49-5 Operated	-	2	1	RO
164	228	49-6 Operated	-	2	1	RO

164	229	49-7 Operated	-	2	1	RO
164	230	49-8 Operated	-	2	1	RO
164	231	49-9 Operated	-	2	1	RO
164	232	4910 Operated	-	2	1	RO
164	233	49-11 Operated	-	2	1	RO
164	234	49-12 Operated	-	2	1	RO
164	235	Circuit Breaker Failure HV Initi-ated	-	2	1	RO
164	236	Circuit Breaker Failure LV Initi-ated	-	2	1	RO
164	237	Circuit Breaker Failure 50BF-1-1	-	2	1	RO
164	238	Circuit Breaker Failure 50BF-1-2	-	2	1	RO
164	239	Circuit Breaker Failure 50BF-2-1	-	2	1	RO
164	240	Circuit Breaker Failure 50BF-2-2	-	2	1	RO
164	241	Trip Circuit Supervision (TCS-1)	x	1	1,9	RC
164	242	Trip Circuit Supervision (TCS-2)	x	1	1,9	RC
164	243	I2T HV Operated	-	2	1	RO
164	244	I2T LV Operated	-	2	1	RO
178	68	General trip	-	2	1	RO
178	160	87 Operated	-	2	1	RO
178	161	87N Operated	-	2	1	RO
178	162	2nd Harmonic Restraint	-	2	1	RO
178	163	5nd Harmonic Restraint	-	2	1	RO
178	164	87 Unrestrained	-	2	1	RO
178	165	87 Delta Phase	-	2	1	RO
178	166	87 ROCOD	-	2	1	RO
178	167	87 IN Delta Phase	-	2	1	RO
178	168	87 Alarm	-	2	1	RO
165	68	General trip	-	2	1	RO
165	84	General starter	x	2	1,9	RC
165	160	27DT-1 Picked up	-	2	1	RC
165	161	27DT-2 Picked up	-	2	1	RC

165	162	27DT-3 Picked up	-	2	1	RC
165	163	27DT-4 Picked up	-	2	1	RC
165	164	27DT-1 Operated	-	2	1	RO
165	165	27DT-2 Operated	-	2	1	RO
165	166	27DT-3 Operated	-	2	1	RO
165	167	27DT-4 Operated	-	2	1	RO
165	168	27IT-1 Picked up	-	2	1	RC
165	169	27IT-2 Picked up	-	2	1	RC
165	170	27IT-1 Operated	-	2	1	RO
165	171	27IT-2 Operated	-	2	1	RO
165	172	59DT-1 Picked up	-	2	1	RC
165	173	59DT-2 Picked up	-	2	1	RC
165	174	59DT-3 Picked up	-	2	1	RC
165	175	59DT-4 Picked up	-	2	1	RC
165	176	59DT-1 Operated	-	2	1	RO
165	177	59DT-2 Operated	-	2	1	RO
165	178	59DT-3 Operated	-	2	1	RO
165	179	59DT-4 Operated	-	2	1	RO
165	180	59IT-1 Picked up	-	2	1	RC
165	181	59IT-2 Picked up	-	2	1	RC
165	182	59IT-1 Operated	-	2	1	RO
165	183	59IT-2 Operated	-	2	1	RO
165	184	24DT-1 Picked up	-	2	1	RC
165	185	24DT-2 Picked up	-	2	1	RC
165	186	24DT-1 Operated	-	2	1	RO
165	187	24DT-2 Operated	-	2	1	RO
165	188	24IT Picked up	-	2	1	RC
165	189	24IT Operated	-	2	1	RO
165	190	59G-1 Picked up	-	2	1	RC
165	191	59G-2 Picked up	-	2	1	RC
165	192	59G-1 Operated	-	2	1	RO
165	193	59G-2 Operated	-	2	1	RO
165	194	59GIT Picked up	-	2	1	RC
165	195	59GIT Operated	-	2	1	RO
165	196	THD-1 Operated	-	1	1	RO

166	68	General trip	-	2	1	RO
166	84	General starter	x	2	1,9	RC
166	160	81U-1 Picked up	-	2	1	RC
166	161	81U-2 Picked up	-	2	1	RC
166	162	81U-3 Picked up	-	2	1	RC
166	163	81U-4 Picked up	-	2	1	RC
166	164	81U-1 Operated	-	2	1	RO
166	165	81U-2 Operated	-	2	1	RO
166	166	81U-3 Operated	-	2	1	RO
166	167	81U-4 Operated	-	2	1	RO
166	168	81O-1 Picked up	-	2	1	RC
166	169	81O-2 Picked up	-	2	1	RC
166	170	81O-3 Picked up	-	2	1	RC
166	171	81O-4 Picked up	-	2	1	RC
166	172	81O-1 Operated	-	2	1	RO
166	173	81O-2 Operated	-	2	1	RO
166	174	81O-3 Operated	-	2	1	RO
166	175	81O-4 Operated	-	2	1	RO
166	176	81R-1 Picked up	-	2	1	RC
166	177	81R-2 Picked up	-	2	1	RC
166	178	81R-1 Operated	-	2	1	RO
166	179	81R-2 Operated	-	2	1	RO
163	211	IRIG_B Synchronization	x	1	1,9	RC
163	212	SNTP Synchronization	x	1	1,9	RC

Appendix H Mechanical Drawings

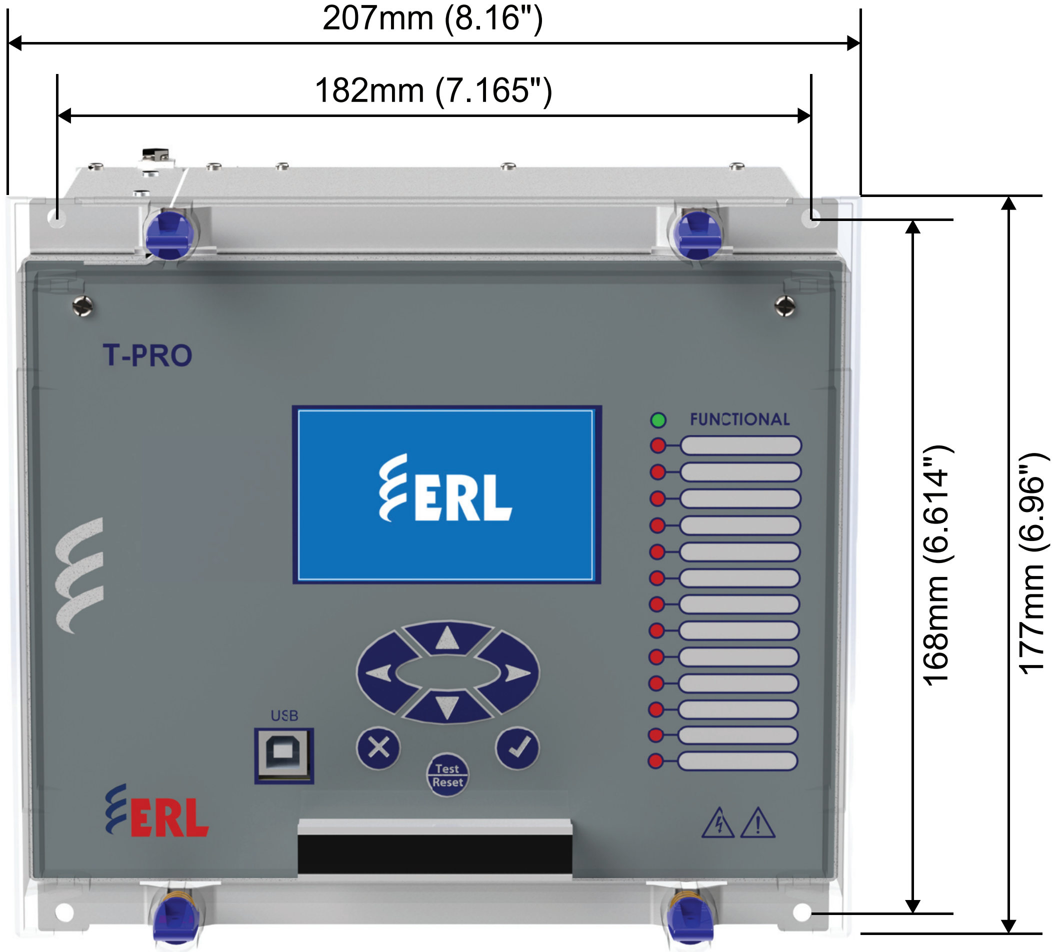

Figure H.1: Front View Drawing

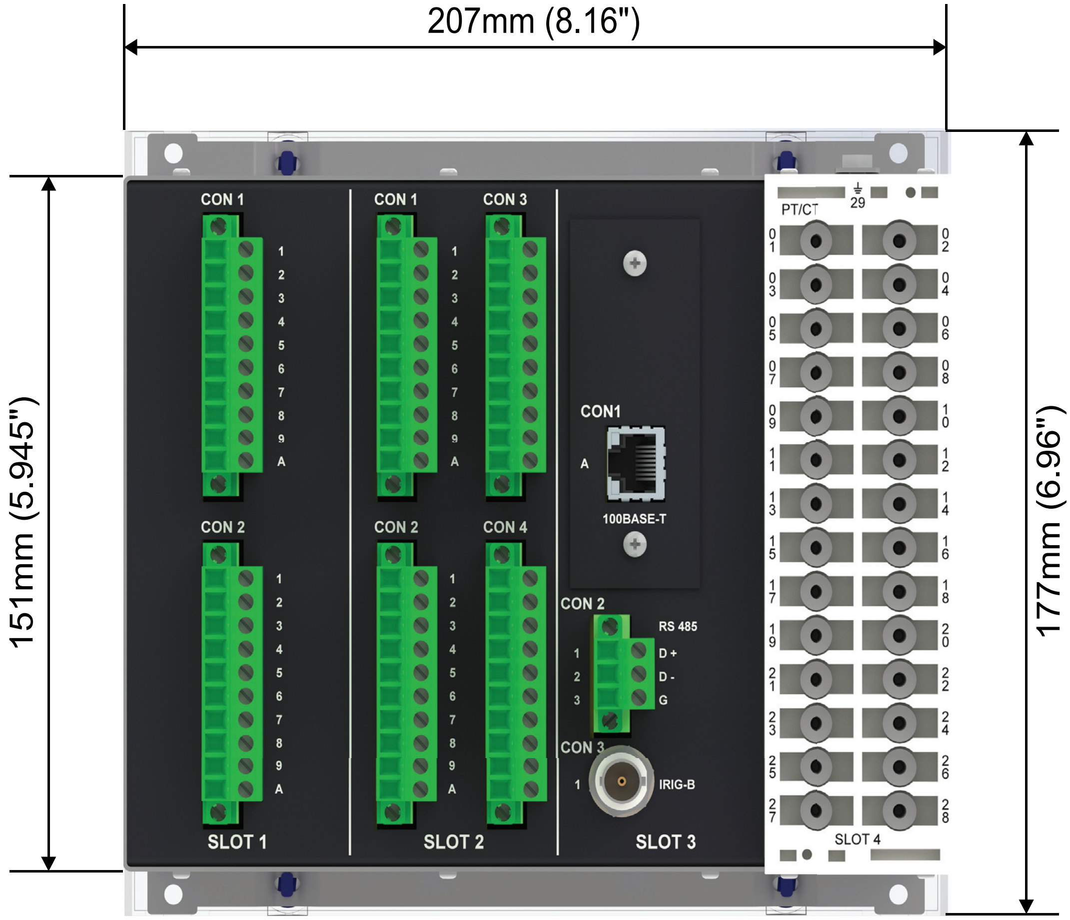

Figure H.2: Rear Panel Drawing

Appendix I AC Schematic Drawings

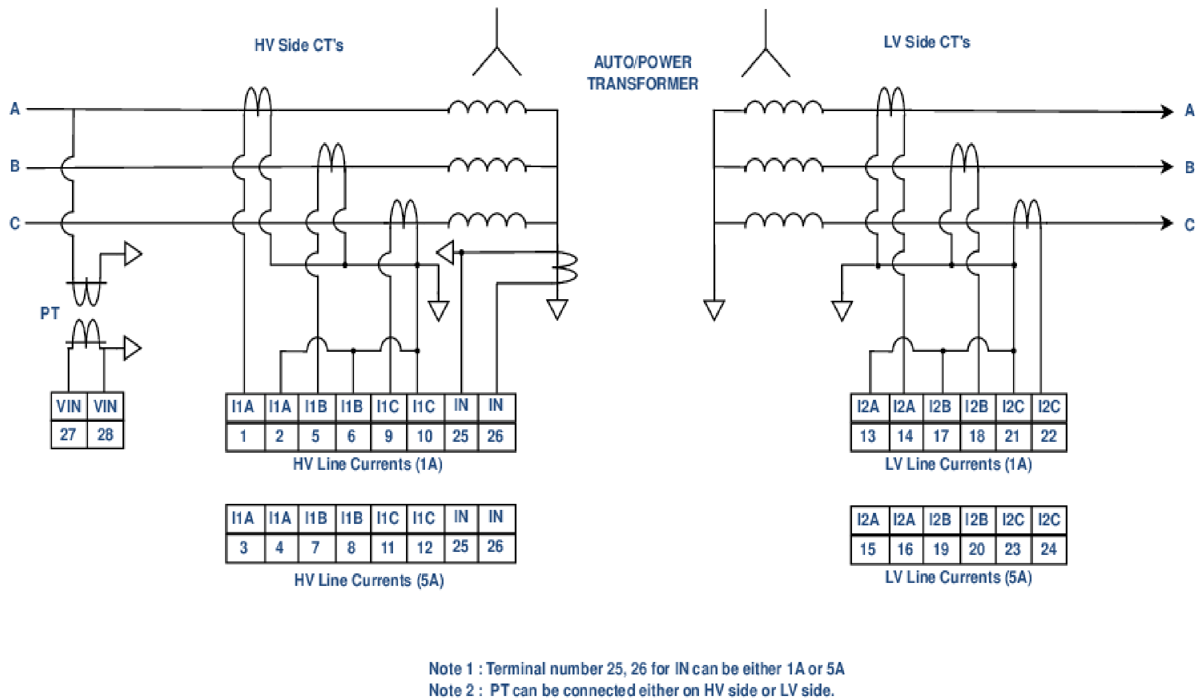

Figure I.1: T-PRO 2000 AC Schematic

Appendix J DC Schematic Drawings

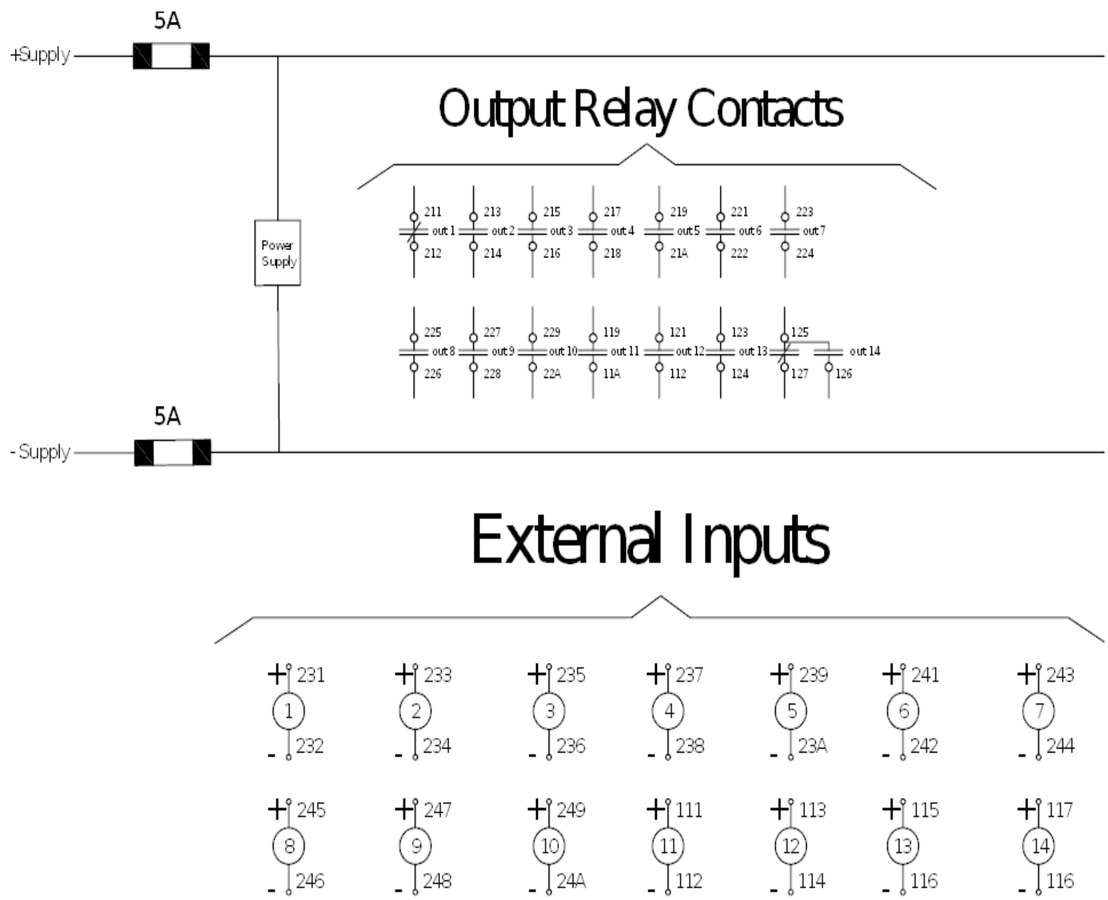

Figure J.1: T-PRO 2000 DC Schematic

Appendix K Connection Diagram

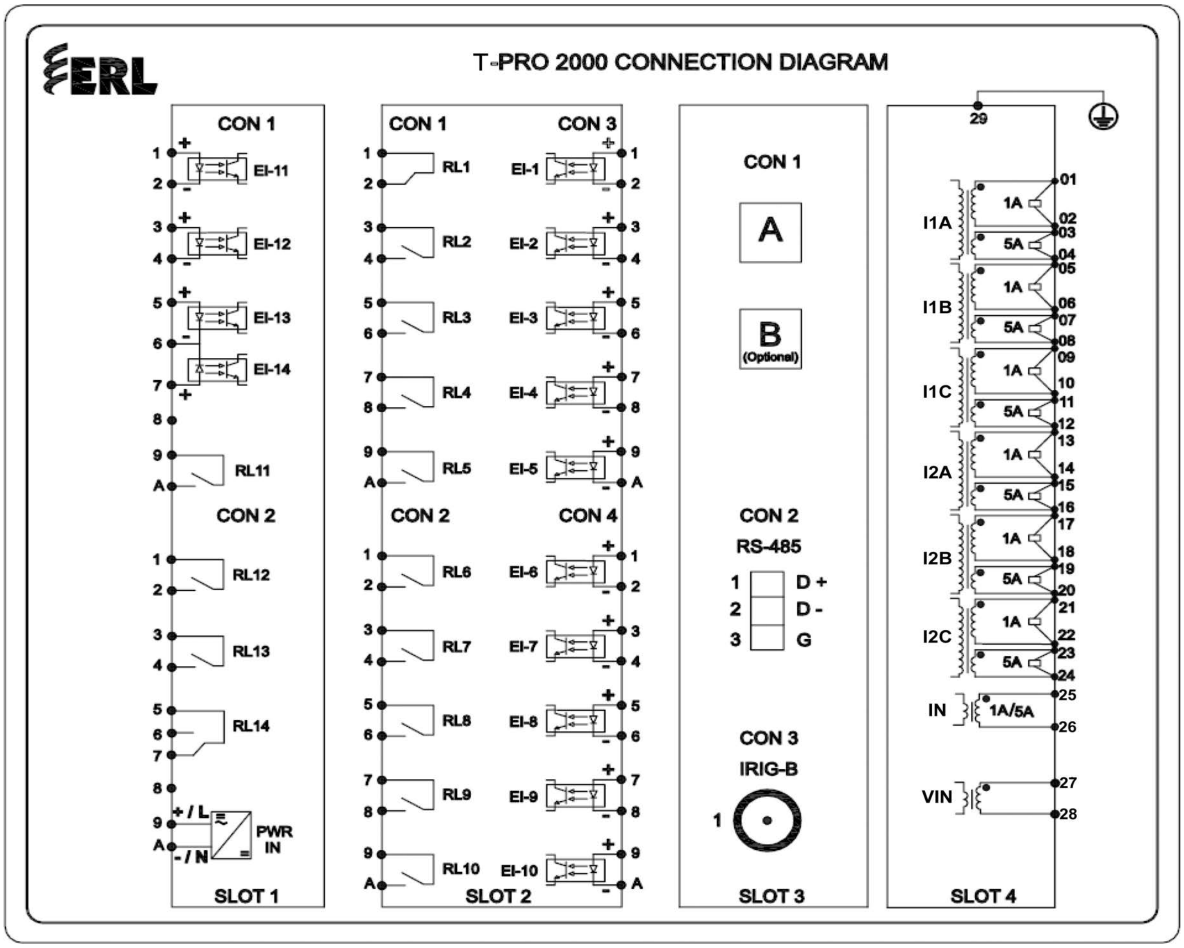

Figure K.1: T-PRO 2000 Connection Diagram

Appendix L IEC 61850 Conformance Statements and Data Mapping Specification

L.1 Protocol Implementation Conformance Statement (PICS)

Protocol Implementation Conformance Statement

for the IEC 61850 interface in T-PRO 2000

Document Version[1]: D05917R00.00

Date: 2025-01-17

Based upon UCAIUG PICS Template version 2.3

UCA International Users Group

Testing Sub Committee

1. The version shown in the user manual differs slightly in formatting to the official released version.

General

The following ACSI conformance statements are used to provide an overview and details about T-PRO 2000, with firmware v1.0:

-ACSI basic conformance statement,

-ACSI models conformance statement,

-ACSI service conformance statement

The statements specify the communication features mapped to IEC 61850-8-1 and IEC 61850-9-2.

ACSI basic conformance statement

The basic conformance statement is defined in Table L.1, “Basic conformance statement”.

Table L.1: Basic conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
Client-Server roles				
B11	**Server** side (of TWO-PARTY-APPLICA-TION-ASSOCIATION)	-	YES	
B12	**Client** side of (TWO-PARTY-APPLICA-TION-ASSOCIATION)		-	
SCSMs supported				
B21	**SCSM**: IEC 61850-8-1 used		YES	
B22	**SCSM**: IEC 61850-9-1 used	-	-	Deprecated Ed2
B23	**SCSM**: IEC 61850-9-2 used			
B24	**SCSM**: other		NO	
Generic substation event model (GSE)				
B31	**Publisher** side	-	YES	
B32	**Subscriber** side	YES	-	
Transmission of sampled value model (SVC)				
B41	**Publisher** side	-		
B42	**Subscriber** side		-	

– = not applicable
YES = supported
NO or empty = not supported

ACSI Models Conformance Statement

The ACSI models conformance statement is defined in Table L.2, "ACSI models conformance statement".

Table L.2: ACSI models conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
If **Server** side (B11) and/or **Client** side (B12) supported				
M1	**Logical device**		YES	c1
M2	**Logical node**		YES	c1
M3	**Data**		YES	c1
M4	**Data set**		YES	c2
M5	**Substitution**		NO	
M6	**Setting group control**		NO	
	Reporting			
M7	**Buffered report control**		YES	
M7-1	sequence-number		YES	
M7-2	report-time-stamp		YES	
M7-3	reason-for-inclusion		YES	
M7-4	data-set-name		YES	
M7-5	data-reference		YES	
M7-6	buffer-overflow		YES	
M7-7	entryID		YES	
M7-8	BufTm		YES	
M7-9	IntgPd		YES	
M7-10	GI		YES	
M7-11	conf-revision		YES	
M8	**Unbuffered report control**		YES	
M8-1	sequence-number		YES	
M8-2	report-time-stamp		YES	
M8-3	reason-for-inclusion		YES	
M8-4	data-set-name		YES	
M8-5	data-reference		YES	
M8-6	BufTm		YES	
M8-7	IntgPd		YES	
M8-8	GI		YES	
M8-9	conf-revision		YES	

Table L.2: ACSI models conformance statement				
		Client/ Subscriber	**Server/ Publisher**	**Value/ Comments**
	Logging		NO	
M9	**Log control**		NO	
M9-1	IntgPd		NO	
M10	**Log**		NO	
M11	**Control**		YES	
M17	**File Transfer**		YES	
M18	**Application association**		YES	c1
M19	**GOOSE Control Block**		YES	
M20	**Sampled Value Control Block**		NO	
c1 Server must be Y if B11=Yes; Client must be Y if B12=Y c2 Server must be Y if M7-Y or M8=Y or M9=Y or M19=Y or M20=Y				
If **GSE** (B31/32) is supported				
M12	**GOOSE**	YES	YES	
M13	**GSSE**			Deprecated Ed2
If **SVC** (B41/42) is supported				
M14	**Multicast SVC**		NO	
M15	**Unicast SVC**		NO	
For all IEDs				
M16	**Time**		YES	
YES = service is supported NO or empty = service is not supported				

ACSI Service Conformance Statement

The ACSI service conformance statement is defined in ACSI service Conformance statement (depending on the statements in Table L.1, “Basic conformance statement” and Table L.2, “ACSI models conformance statement”).

Table L.3: ACSI service Conformance statement

	Ed.	Services	AA: TP/MC	Client (C)	Server (S)	Comments
Server: if B11=Y or B12=Y						
S1	1,2	GetServerDirectory (LOGICAL-DEVICE)	TP		YES	
Application association: if B11=Y or B12=Y						
S2	1,2	Associate			YES	
S3	1,2	Abort			YES	
S4	1,2	Release			YES	
Logical device: if M1=Y						
S5	1,2	GetLogicalDeviceDirectory	TP		YES	
Logical node: if M2=Y						
S6	1,2	GetLogicalNodeDirectory	TP		YES	
S7	1,2	GetAllDataValues	TP		YES	
Data: if M3=Y						
S8	1,2	GetDataValues	TP		YES	
S9	1,2	SetDataValues	TP		NO	
S10	1,2	GetDataDirectory	TP		YES	
S11	1,2	GetDataDefinition	TP		YES	
Data set: if M4=Y						
S12	1,2	GetDataSetValues	TP		YES	
S13	1,2	SetDataSetValues	TP		NO	Deprecated in Ed2
S14	1,2	CreateDataSet	TP		NO	
S15	1,2	DeleteDataSet	TP		NO	
S16	1,2	GetDataSetDirectory	TP		YES	

Table L.3: ACSI service Conformance statement

	Ed.	Services	AA: TP/MC	Client (C)	Server (S)	Comments
Substitution: if M5=Y						
S17	1,2	SetDataValues	TP		NO	
Setting group control: if M6=Y						
S18	1,2	SelectActiveSG	TP		NO	
S19	1,2	SelectEditSG	TP		NO	
S20	1,2	SetEditSGValues	TP		NO	
S21	1,2	ConfirmEditSGValues	TP		NO	
S22	1,2	GetEditSGValues	TP		NO	
S23	1,2	GetSGCBValues	TP		NO	
Reporting: If M7=Y or M8=Y						
Buffered report control block (BRCB); If M7=Y						
S24	1,2	Report	TP		YES	
S24-1	1,2	data-change (dchg)			YES	
S24-2	1,2	quality-change (qchg)			YES	
S24-3	1,2	data-update (dupd)			YES	
S25	1,2	GetBRCBValues	TP		YES	
S26	1,2	SetBRCBValues	TP		YES	
Unbuffered report control block (URCB) If M8=Y						
S27	1,2	Report	TP		YES	
S27-1	1,2	data-change (dchg)			YES	
S27-2	1,2	quality-change (qchg)			YES	
S27-3	1,2	data-update (dupd)			YES	
S28	1,2	GetURCBValues	TP		YES	
S29	1,2	SetURCBValues	TP		YES	
Logging: If M9=Y or M10=Y						
Log control block; If M9=Y						
S30	1,2	GetLCBValues	TP		NO	
S31	1,2	SetLCBValues	TP		NO	
Log; If M10=Y						
S32	1,2	QueryLogByTime	TP		NO	

Table L.3: ACSI service Conformance statement						
	Ed.	**Services**	**AA: TP/MC**	**Client (C)**	**Server (S)**	**Comments**
S33	1,2	QueryLogAfter	TP		NO	
S34	1,2	GetLogStatusValues	TP		NO	

Generic substation event model (GSE): If M19=Y						
GOOSE						
S35	1,2	SendGOOSEMessage	MC		YES	
GOOSE-CONTROL-BLOCK						
S36	1,2	GetGoReference	TP		NO	
S37	1,2	GetGOOSEElementNumber	TP		NO	
S38	1,2	GetGoCBValues	TP		YES	
S39	1,2	SetGoCBValues	TP		NO	
GSSE						
S40	1	SendGSSEMessage	MC	-	-	Deprecated in Edition 2
GSSE-CONTROL-BLOCK						
S41	1	GetReference	TP	-	-	Deprecated in Edition 2
S42	1	GetGSSEElementNumber	TP	-	-	Deprecated in Edition 2
S43	1	GetGsCBValues	TP	-	-	Deprecated in Edition 2
S44	1	SetGsCBValues	TP	-	-	Deprecated in Edition 2

Transmission of sampled value model (SVC): If M20=Y						
Multicast SV						
S45	1,2	SendMSVMessage	MC		NO	
Multicast Sampled Value Control Block						
S46	1,2	GetMSVCBValues	TP		NO	
S47	1,2	SetMSVCBValues	TP		NO	
Unicast SV						
S48	1,2	SendUSVMessage	TP		NO	
Unicast Sampled Value Control Block						
S49	1,2	GetUSVCBValues	TP		NO	
S50	1,2	SetUSVCBValues	TP		NO	

Table L.3: ACSI service Conformance statement

	Ed.	Services	AA: TP/MC	Client (C)	Server (S)	Comments
Control: If M11=Y						
S51	1,2	Select			NO	
S52	1,2	SelectWithValue	TP		NO	
S53	1,2	Cancel	TP		NO	
S54	1,2	Operate	TP		YES	
S55	1,2	CommandTermination	TP		NO	
S56	1,2	TimeActivatedOperate	TP		NO	

File transfer: If M17=Y						
S57	1,2	GetFile	TP		YES	
S58	1,2	SetFile	TP		NO	
S59	1,2	DeleteFile	TP		YES	
S60	1,2	GetFileAttributeValues	TP		YES	
S61	1,2	GetServerDirectory (FILE-SYSTEM)	TP		YES	

Time						
T1	1,2	Time resolution of internal clock			10 (1ms)	Nearest negative power of 2^{-n} in seconds (number 0..24)
T2	1,2	Time accuracy of internal clock			T3	TL (ms)(low accuracy), T3 <7 (c1) T0 (ms)(<=10ms), 7 <= T3 < 10 (c1) T1 (μs)(<=1ms), 10<= T3 < 13 T2 (μs)(<=100μs), 13 <= T3 < 15 T3 (μs)(<=25μs), 15 <= T3 < 18 T4 (μs)(<=4μs), 18 <= T3 < 20 T5 (μs)(<=1μs), 20 <= T3 < 25
T3	1,2	Supported TimeStamp resolution	-		16 (25 μs)	Nearest value of 2^{-n} in seconds (number 0...24)
c1 TL may only be specified for Ed2. If Ed1 has accuracy which is better than 1 second but is not T1 then declare T0.						

L.2 Model Implementation Conformance Statement (MICS)

Model Implementation Conformance Statement (MICS)
for the IEC 61850 Edition 2 server interface in T-PRO 2000

Document Version[1]: D05918R00.00
Date: 2025-01-17

Based upon
UCA International Users Group
Testing Sub Committee

MICS template for Server Test Procedures First edition and Edition 2 servers
Template version 1.2

1. The formatting of the official version of this document differs slightly from the version shown here in the user manual, but the content is the same.

Introduction

This model implementation conformance statement is applicable for T-PRO 2000, with firmware v1.0.

This MICS document specifies the modelling extensions compared to IEC 61850 Edition 2. For the exact details on the standardized model please compare the ICD substation configuration file: "ERLTPRO2000.icd", version 4 revision 8.

Table L.4, "Logical Nodes List" contains the list of implemented logical nodes.

Logical Nodes List

The following table contains the list of logical nodes implemented in the device:

Table L.4: Logical Nodes List
L: System Logical Nodes
LPHD (Physical device information)
LLN0 (Logical node zero)
LGOS (GOOSE Subscription)
P: Logical Nodes for protection functions
PTOF (Overfrequency)
PTUF (Underfrequency)
PFRC (Rate of change of frequency)
PTOC (Time overcurrent)
PIOC (Instantaneous overcurrent)
PTUV (Undervoltage)
PTOV (Overvoltage)
PVPH (Volts per Hz)
PDIF (Differential)
PTTR (Thermal overload)
PHAR (Harmonic restraint)
PTUC (Undercurrent)
R: Logical nodes for protection related functions
RBRF (Breaker failure)
RTFM (Through Fault Monitoring)
RDRE (Disturbance record function)
G: Logical Nodes for generic references
GGIO (Generic process I/O)

M: Logical Nodes for metering and measurement
MSQI (Sequence and Imbalance)
MMXU (Measurement)
MMXN (Differential Measurement)
MHAI (Harmonic Measurement)
C: Logical Nodes for Supervisory Control
CALH (Alarm Handling)

Logical Node Extensions

The following table use:

M: Data is mandatory in the IEC-61850-7-4 Ed.2.

O: Data is optional in the IEC-61850-7-4 Ed.2 and is used in the device.

E: Data is an extension to the IEC-61850-7-4 Ed.2.

New Logical Nodes

New logical nodes have the descriptions in the Name plate.

RTCS - Trip Circuit Supervision

RTCS class				
Name	**Description**			
D74TCSRTCS	Trip Circuit Supervision, indexed D74TCSRTCS 1 - D74TCSRTCS2.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Status Information				
Op	ACT	General indication (Operated)	E	

RCBC - Circuit Breaker Condition

RCBC class				
Name	**Description**			
I2TRCBC	I2t-CB Condition, indexed I2TRCBC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
I2TAcc	MV	I2T Accumulated Value	E	
I2TLstOp	MV	I2T Last Operated Value	E	
Status Information				
Op	ACT	I2T Operated	E	

RTHD - Total Harmonic Distortion

RTHD class				
Name	**Description**			
THDRTHD	Total Harmonic Distortion, indexed THDRTHD 1 - THDRTHD 2.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Status Information				
Op	ACT	General indication (Operated)	E	

RUVC - Under Voltage Counter

				RUVC class
Name	**Description**			
UVCRUVC	Under Voltage Counter, indexed UVCRUVC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
Acc	MV	Under Voltage Counter value	E	
Status Information				
Op	ACT	General indication (Counter Operated)	E	

ROVC- Over Voltage Counter

ROVC class				
Name	**Description**			
OVCROVC	Over Voltage Counter, indexed OVCROVC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
Acc	MV	Over Voltage Counter value	E	
Status Information				
Op	ACT	General indication (Counter Operated)	E	

RUFC - Under Frequency Counter

RUFC class				
Name	**Description**			
UFCRUFC	Under Frequency Counter, indexed UFCRUFC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
Acc	MV	Under frequency counter value	E	
Status Information				
Op	ACT	General indication (Counter Operated)	E	

ROFC - Over Frequency Counter

ROFC class				
Name	**Description**			
OFCROFC	Over Frequency Counter, indexed OFCROFC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
Acc	MV	Over frequency counter value	E	
Status Information				
Op	ACT	General indication (Counter Operated)	E	

REIC - External Input Counter

REIC class				
Name	**Description**			
EIREIC	External Input Counter, indexed EIREIC1.			
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
Data Objects				
Common Logical Node Information				
Beh	ENS	Behaviour	M	
Measured Values				
Acc	MV	External Input counter value	E	
Status Information				
Op	ACT	General indication (Counter Operated)	E	

L.3 TISSUES Implementation Conformance Statement (TICS)

Introduction

This document provides a template for the Tissues conformance statement. According to the UCA IUG QAP the Tissue conformance statement is required to perform a conformance test and is referenced on the certificate.

This document is applicable for T-PRO 2000 with firmware v1.0.

Document Version[1]: D05916R00.00
Date: 2025-01-17

Mandatory Edition 2 Tissues

Below tables give an overview of the applicable mandatory Tissues. Items in *italic* are brief interpretations provided by the UCA International Users Group to aid in interpretation and is not normative. The original TISSUE should consulted for details of changes.

Table L.5: Mandatory Edition 2 Tissues

Tissue	Description	Implemented Y/na
Part 6		
658	Tracking related features *EntryID and CST missing, these are checked by schema*	na
663	FCDA element cannot be a “functionally constrained logical node” *doName now mandatory in FCDA element,* *SCT: refuse to make empty doName? ICT: Refuse SCD*	Y
668	Autotransformer modeling *Autotransformer model in substation section has changed*	na
687	SGCB ResvTms *SettingControl has added attribute resvTms* *see also TISSUE 845*	na
719	ConfDataSet - maxAttributes definition is confusing *maxAttributes now means max count of FCDA in dataset*	Y
721	Log element name *LN0/Log now has optional attribute “name”*	na
768	bType VisString65 is missing *VisString65 added as SCL BasicType*	na
779	object references *“@” as first character in object references now allowed*	na
788	SICS S56 from optional to mandatory *SICS S56=”Interpret IED capabilities and prohibit unsupported usage”*	na

1. The formatting of the official version of this document differs slightly from the version shown here in the user manual, but the content is the same.

Table L.5: Mandatory Edition 2 Tissues		
Tissue	**Description**	**Implemented Y/na**
789	ConfLdName as services applies to both server and client *Many changes made to Services section*	na
804	valKind and IED versus System configuration *valImport missing/false DAI means ICT shall ignore value in SCD and SCT shall not change from ICD/IID value. Instance section inherits from DA/BDA element.*	na
806	Max length of log name inconsistent between -6 and -7-2 *LogControl.logName and Log.name restricted to 32 chars*	na
807	Need a way to indicate if “Owner” present in RCB *Services/ReportSettings@owner added*	Y
823	ValKind for structured data attributes *valKind is prohibited on structured attributes*	Y
824	Short addresses on structured data attributes *sAddr is now allowed for structured attributes*	na
825	Floating point value *Server shall support <Val> with exponential notation*	na
845	SGCB ResvTms *Services/SettingGroups/SGEdit added attribute resvTms* *Services/SettingGroups/ConfSG added attribute resvTms* *See also TISSUE 687*	na
853	SBO and ProtNs *DA[@name=SBO] element shall have ProtNS element*	na
855	Recursive SubFunction *Substation section extension must be tolerated*	na
856	VoltageLevel frequency and phases *Substation section extension must be tolerated*	na
857	Function/SubFunction for ConductingEquipment *Substation section extension must be tolerated*	na
886	Missing 8-1 P-types *“tP_IP_UDP_PORT” and “tP_IP_TCP_PORT” added*	na
901	tServices as AP or as IED element *Rules for contents of AP/Server/Services are now defined*	Y
936	SupSubscription parameter usage is difficult *SupSubscription “max” replaced by “maxGo” and “maxSv”*	Y
1147	tServices - FileHandling not consistent with -7-2 *Services/FileHandling now means only support for GetFile and GetFileAttributeValues and NOT SetFile/DeleteFile*	Y
1185	Valkind value Conf for EX FC data *valKind=Conf is allowed for dataNs*	na
1284	SCSM mapping may require a communication section in an ICD file *Server IEDs supporting client/server associations to 61850-8-1 shall include a <Communication> section*	Y

Table L.5: Mandatory Edition 2 Tissues

Tissue	Description	Implemented Y/na
1328	Limitation on the size of data type templates identifiers *Identifer now limited to 255 characters*	Y
1395	Client LN attributes *ReportControl/RptEnabled/ClientLN@ldInst shall be “LD0” for pure clients (without any Logical Devices)*	na
1402	ExtRef during engineering *an ExtRef.intAddr attribute value unequal to empty string (pre-scribed or filled by the IED tool) is the flag indicating that the ExtRef shall not be deleted by the system tool. The system tool can however remove the link to the source IED* <<applicable for SCL tool test>>	na
1415	SICS-S110 IID import mandatory for Edition2 *only the import of data model modifications and CF value changes is mandatory for system tool* <<applicable for SCL tool test>>	na
1419	Support of ldName on other IEDs *SICS I212 is now mandatory*	Y
1444	Need to support fixed and SCT controlled Datasets *Services/xxxSetttings@datSet=fix now means “data set pointed by Control Block cannot be altered from ICD/IID* value <<appli-cable for SCL tool test>>	na
1445	ConfReportControl and a fixed ReportSettings *Control block capabilities must be consistent* *<<applicable for SCL tool test>>*	na
1450	originalSclXxx computation rules *Ed2 ICD/IID files specifying SCL@version=2007 SHALL include originalSCLVersion=2007 and originalSCLRevision as attributes of the <IED>element*	Y
1485	Need to supercede Tissue 1398 to clarify SCT behavior *Same as TISSUE 1450 <<applicable for SCL tool test>>*	na
Part 7-1		
828	Data model namespace revision IEC 61850-7-4:2007[A] *Both 2007 and 2007A are allowed for namespace name*	Y
948	Enumeration (string) values format *Enums are limited to 127 characters from Basic-Latin and Latin-1 character sets*	Y
1151	simulated GOOSE disappears after 1st appearance when LPHD.Sim = TRUE *New LGOS state machine defined, but TISSUE is not IntOp2, therefore TISSUE is optional if LGOS is used*	Y
1396	The use and configuration flow of LGOS and LSVS is unclear *If Services/SupSubscription@maxGo > 1 then at least 1 LGOS must exist. Same for maxSv/LSVS.* *If maxGo > count(LGOS) then SCT can create additional LGOS. Same for maxSv/LSVS*	Y

Table L.5: Mandatory Edition 2 Tissues

Tissue	Description	Implemented Y/na
1447	Restriction on ENUMtypes in SCL *If a ENUM DA limits write or configuration to a subset, then that subset must be declared*	na
1457	Multiple DOI nodes with the same name *LN can have no more than one DOI with same name*	Y
1468	Re-use DO from other LN *allow standard or private dataNs*	na
1491	CmdBlk blocks itself? *The data CmdBlk shall have no effect on the controllable data Mod or CmdBlk*	na
1495	GetVariableAccessAttributes error code *Return MMS error access/object-non-existent if the object does not exist*	Y
Part 7-2		
728	BRCB: could PurgeBuf be set when RptEna=TRUE? *PurgeBuf while RptEna=true is prohibited*	Y
778	AddCause values – add value not-supported *Align 7-2 with 8-1 (nothing new to 8-1)*	na
780	What are unsupported trigger option at a control block? *All control blocks must support all trigger options*	Y
783	TimOper Resp- ; add Authorization check *Clarifies Time-Operated Controls*	na
786	AddCause values 26 and 27 are switched *Annex B.2 has wrong AddCause values*	na
820	Mandatory ACSI services (use for PICS template) *Model entries M18 (Application Association), M19 (GCB), M20 (SVCB) are new. Services S17 (Substitution) and S61 (Get-ServerDirectory) are new. Services S1, S3, S4, S5, S6, S8, S16, S18, S23, S36, S37, S41, S42 are changed.*	Y
858	typo in enumeration ServiceType *Tracking serviceType now has GetLogicalNodeDirectory*	na
861	dchg of ConfRev attribute *Clarifies (tracking) BTS.confRev is AFTER BRCB change*	na
1050	GTS Phycomaddr definition in SCL *(Tracking) GTS needs a special structure for SCL*	na
1071	Length of DO name *Private DO name length shall be <=12 including instance*	Y
1127	Missing owner attribute in BTS and UTS *NSD files for 61850-7-3 show owner in (tracking) BTS/UTS*	na
1202	GI not optional *GI support is mandatory for both URCB and BRCB*	Y
1232	EntryID needs clarification *Segments of a report shall have same identifiers*	Y

Table L.5: Mandatory Edition 2 Tissues		
Tissue	**Description**	**Implemented Y/na**
1242	NTS definition *NTS.resv have been added*	na
1307	Segmented report with Buffer overflow *Segments of a report shall have identical buf-overflow value*	Y
1428	MTS and NTS should use svOptFlds *MTS.optFlds and NTS.optFlds now have bType=SvOptFlds*	na
1630	Attributes in CDC=LTS do not match 8-1 definition *Order of attributes in LTS changed to:* *logEna, logRef, datSet, oldEntrTm, newEntrTm, oldEnt, newEnt, trgOps, intgPd*	na
Part 7-3		
697	persistent command / PulseConfig *PulseConfig adds enum “persistent-feedback”* *DPC.cmdQual==”persistent” is conditionally allowed*	na
698	Wrong case is BAC.dB attribute *attribute renamed from “dB” to “db”*	na
711	blkEna freeze data update while setting its quality to operater-Blocked *Mode=Blocked shall not cause q.operatorBlocked*	na
722	Units for 'h' and 'min' not in UnitKind enumeration. *New unit enums 84=hours, 85=minutes*	na
919	Presence Condition for sVC *svC may be valKind=Conf in ICD file*	na
925	Presence of i or f attribute - Problem with writing *New constructed attribute class "AnalogueValueCtl"*	na
926	Presence Conditions within RangeConfig *All or none of hhLim+hLim+lLim+llLim shall be present*	Y
954	Data attributes with FC=CF should have trgOp=dchg *Some INS and HST and CSG attributes missing dchg*	Y
1078	CMV.t update if rangeAng changed *Add rangeAng to“reasons-to-update-timestamp-of-CMV”*	na
1565	db = 0 behaviour *db=0 not longer suppresses reporting*	na
1578	dataAttribute NameSpace content *Attributes with FC=EX must be initialized in ICD/IID file*	Y
Part 7-4		
671	mistake in definition of Mod & Beh *Beh=on, q=test should be “Processed as valid”*	Y
674	CDC of ZRRC.LocSta is wrong *ZRRC LocSta should be CDC=SPC*	na
676	Same data object name used with different CDC *LCCH.Fer renamed to FerCh, LCCH.RedFer to RedFerCh*	na

Table L.5: Mandatory Edition 2 Tissues

Tissue	Description	Implemented Y/na
677	MotStr is used with different CDC in PMMS and SOPM LN classes *Rename SOPM.MotStr to MotStrNum*	na
679	Remove CycTrMod Enum *Enum is no longer used, use TrMod instead*	na
680	SI unit for MHYD.Cndct *Change unit from S/cm^2 to S/m*	na
681	Enum PIDAlg *Typographical error, invalid XML syntax*	na
682	ANCR.ParColMod *ParColMod enum values text have changed*	na
683	Enum QVVR.IntrDetMth *IntrDetMth enum values text have changed*	na
685	Enum ParTraMod *ParTraMod enum values text have changed*	na
686	New annex H - enums types in XML *Many changes have been made to enumeration names*	Y
694	Data object CmdBlk *CmdBlk semantics have changed*	na
696	LSVS.St (Status of subscription) *LSVS.St is now mandatory*	Y
712	interpretation of quality operatorBlocked *Mode and Behavior semantics have changed*	na
713	DO Naming of time constants in FFIL *Many DO names in FFIL have changed*	na
714	Enums for ShOpCap and SwOpCap *Type for YPSH.ShOpCap and XSWI.SwOpCap have changed*	na
715	RBDR.ChNum1 *RBDR.ChNum1 changes from optional to conditional*	na
716	TAXD text for condition *TAXD.SmRte condition for inclusion has changed*	na
724	ANCR.Auto *ANCR.Auto changes from mandatory to optional*	na
725	Loc in LN A-group *Loc changes to optional, LocKey/LocSta conditions change*	na
734	LLN0.OpTmh vs. LPHD.OpTmh *LLN0.OpTmh deleted, LPHD.OpTmH added as conditional*	na
736	PFSign *MMXU.PFSign enum is extended with 3=Excitation*	na
742	GAPC.Str, GAPC.Op and GAPC.StrVal *Objects have instance indicator removed (ex, Str1 to Str)*	na

Table L.5: Mandatory Edition 2 Tissues

Tissue	Description	Implemented Y/na
743	CCGR.PmpCtl and CCGR.FanCtl *Object have instance indicator added (ex:PmpCtl to PmpCtl1)*	na
744	LN STMP, EEHealth and EEName *Removed STMP.EEHealth and STMP.EEName*	na
772	LPHD.PwrUp/PwrDn should be transient *These objects are now transient*	na
773	Loc, LocKey and LocSta YPSH and YLTC *Add Loc, LocKey and LocSta in YLTC and YPSH (optional)*	na
774	ITCI.LocKey *Add ITCI.LocKey as optional*	na
776	LPHD.OutOv/InOv and LCCH.OutOv/InOv *Clarified: stays true until buffer space again available*	na
800	Misspelling in CSYN *CSYN.VInvTmms renamed to CSYN.VIntvTmms*	na
802	CCGR and Harmonized control authority *Add Loc, LocKSta to every controllable LN (e.g. FSPT)*	na
808	Presence condition of ZMoT.DExt and new DOs *Change ZMOT.DExt to optional; add TotThmSt and MotSt*	na
831	Setting of ConfRevNum in LGOS *Add RxConfRevNum to LGOS and LSVS*	Y
838	Testing in Beh=Blocked *Change sematic of Beh=Blocked to allow controls to be acknowledged even when LN is blocked.*	na
844	MFLK.PhPiMax, MFLK.PhPiLoFil, MFLK.PhPiRoot DEL->WYE *Change these NFLK objects from cdc=DEL to cdc=WYE*	na
877	QVUB -settings should be optional *Change QVUB.UnbDetMth and QVUB.StrVal to optional*	na
908	ARIS.StrSeq – transient *Change ARIS.StrSeq to transient*	na
909	Remove ANCR.ColOpR and ColOpL *Replace ANCR.ColOpR and ANCR.ColOpL with ANCR.Col-Chg. Add YEFN.ColChg*	na
912	Clarification of PwrRtg/VARtg *Change many DOs in YPTR, and ZGEN, see name space 2007A2.nsd for final result*	na
920	Resetable Counter is NOT resetable *Change GGIO.CntRs to CntVal; Same for FCNT*	na
932	Rename AVCO.SptVol to AVCO.VolSpt	na
933	Presence of LCCH.RedFerCh and RedRxCnt *Change the presence condition of LCCH.RedChLiv*	na
939	Change CDC for ANCR.FixCol *Change ANCR.FixCol from APC to ASG*	na

Table L.5: Mandatory Edition 2 Tissues		
Tissue	**Description**	**Implemented Y/na**
991	LGOS: GoCBRef (as well as LSVS.SvCBRanre ef) should be mandatory *LGOS.GoCBRef and LSVS.SvCBRef are now both mandatory*	Y
1007	PTRC as fault indicator - Update of description required *PTRC.Tr and Op and Str conditional (at least 1 of group)*	na
1044	TapChg in AVCO *AVCO.TapChg is now optional*	na
1077	Rename DOnames within LTIM *LTIM.TmChgDayTm, changed to TmChgDay;* *LTIM.TmChgStdTm changed to TmChgStd*	na
1256	New DO for LTIM to set time “manually” *Add LTIM.TmSet*	na
1331	Mod, Beh and Health with q=TEST, client can't receive their states *Mod while in Blocked will always be processed*	Y
1426	Add two DO for leap seconds in LTIM *LTIM.Leap added,*	na
1456	Annex A and Mod/Beh/Health *Mod.stVal writes always igore test bits in controls*	Y
1568	ISAF.AlmReset ->transient *Change ISAF.AmlReset to transient*	na

Note: TISSUE 675, 735, 772, 775, 776, 878 are not relevant for conformance testing

Part 8-1		
770	GoID type mitmatch 18.1.1 and 18.1.2.5.2 *GoID string length is now 129*	Y
784	Tracking of control (CTS) *Tracking CTS has been added*	na
817	Fixed-length GOOSE float encoding *GOOSE float is encoded Tag-0x87, length=5, first octet=8*	na
827	Mandatory ACSI services (Part of 7-2 TISSUE resolution) *Change Table 111 (ServicesSupported): Add initiate, abort, and release. Change conditions for defineNamedVariables.*	Y
834	File dir name length 64 *Filename length changed from 32 to 64*	Y
951	Encoding of Owner attribute *xRCB.owner is encoded as 4 octets(IPv4) or 16 octets(IPv6)*	na
1040	More associate error codes *3 additional associate error codes added*	Y

1178	Select Response+ is non-null value *Response to SBO read should be <CO_CtrlObjectRef>*	na
1324	The response- for DeleteNamedVariableList is not defined *numDeleted=0; error=service/object-constraint-conflict*	na
1345	Fixed-length GOOSE ASN.1 length encoding *GOOSE publisher shall always encode minimum size legth field*	na
1441	Optonal fields in buffered reports *Writing BRCB.optFld shall not cause a purgeBuf operation*	Y
1442	Journal variableTag for ReasonCode *Example in the standard is incorrect*	na
1453	Purge buffer on write to BRCB *PurgeBuf only occurs if different value is written*	Y
1454	Reports can be transmitted before write (RptEna=true) is con-firmed	na
1495	GetVariableAccessAttributes error code Return MMS error access/object-non-existent if the object does not exist	Y
1500	the response for DeleteNamedVariableList with a non-existent LN is not specified *CreateDataSet/DefineNamedVariableList specifying a non-existing LD/LN shall fail with access/object-non-existent*	na
1626	PICS for Information Report is incorrect MMS ServicesSupported "informationReport" should be optional for servers because they never receive InformationReport requests. It is only required for clients which process reports or control command-termination	Y

L.4 Protocol Implementation eXtra Information for Testing (PIXIT)

Protocol Implementation eXtra Information for Testing (PIXIT) for the IEC 61850 Edition 2 server interface in
T-PRO 2000

Document Version[1]: D05915R00.00
Date: 2025-01-17

Based Upon UCAIug Server PIXIT
Template version 20

1. The formatting of the official version of this document differs slightly from the version shown here in the user manual, but the content is the same.

PIXIT for Server

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in T-PRO 2000 with firmware version v1.0.

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10. The PIXIT entries contain information which is not available in the PICS, MICS, TICS documents or SCL file.

Each table specifies the PIXIT for applicable ACSI service model as structured in IEC 61850-10. The "Ed" column indicates if the entry is applicable for IEC 61850 Edition 1 and/or Edition 2. A hyphen ("-") in the Ed column indicates the PIXIT entry is not applicable for any version.

PIXIT for DOCUMENTATION

ID	Ed	Description	Value / Clarification
Do1	2	How to expose required firmware versions not present in the datamodel	Firmware version and ICD file compatibility listed in the firmware release notes.

PIXIT for ASSOCIATION MODEL

ID	Ed	Description	Value / Clarification
As1	1	Maximum number of clients that can set-up an association simultaneously	4
As2	1,2	TCP_KEEPALIVE value. The recommended range is 1...20s	5 seconds
As3	1,2	Lost connection detection time	20 seconds
As4	-	Authentication is not supported yet	
As5	1,2	What association parameters are necessary for successful association: Called value: Calling values:	Transport selector Y Session selector Y Presentation selector Y AP Title N AE Qualifier N other Transport selector Y Session selector Y Presentation selector Y AP Title N AE Qualifier N other
As6	1,2	If association parameters are necessary for association, describe the correct Called values: e.g. Calling parameters: e.g.	Transport selector 0001 Session selector 0001 Presentation selector 00000001 other Transport selector 0001 Session selector 0001 Presentation selector 00000001 other
As7	1,2	What is the maximum and minimum MMS PDU size	Max MMS PDU size 32,000 Min MMS PDU size 1300
As8	1,2	What is the maximum start up time after a power supply interrupt	180 seconds
As9	1,2	Does this device function only as test equipment? (test equipment need not have a non-volatile configuration; but it cannot be part of the substation automation system)	N

PIXIT for SERVER MODEL

ID	Ed	Description	Value / Clarification
Sr1	1,2	Which analogue value (MX) quality bits are supported (can be set by server)	Validity: Y Good, N Invalid, N Reserved, N Questionable Detail Quality N Overflow N OutofRange N BadReference N Oscillatory N Failure N OldData N Inconsistent N Inaccurate Miscellaneous: Y Source Y Test N OperatorBlocked
Sr2	1,2	Which status value (ST) quality bits are supported (can be set by server)	Validity: Y Good, N Invalid, N Reserved, N Questionable Detail Quality N BadReference N Oscillatory N Failure N OldData N Inconsistent N Inaccurate Miscellaneous: Y Source Y Test N Operator- Blocked
Sr3	-	What is the maximum number of data object references in one GetDataValues request	Deprecated
Sr4	-	What is the maximum number of data object references in one SetDataValues request	Deprecated
Sr5	1	Which Mode values are supported [a]	On Y [On-Blocked] N Test Y Test/Blocked Y Off N

a. IEC 61850-6:2009 clause 9.5.6 states that if only a subrange of the enumeration value set is supported, this shall be indicated within an ICD file by an enumeration type, where the unsupported values are missing

PIXIT for DATA SET MODEL

ID	Ed	Description	Value / Clarification
Ds1	1	What is the maximum number of data elements in one data set (compare ICD setting)	128
Ds2	1	How many persistent data sets can be created by one or more clients (this number includes predefined datasets)	CreateDataSet not supported.
Ds3	1	How many non-persistent data sets can be created by one or more clients	CreateDataSet not supported.

PIXIT for SUBSTITUTION MODEL

ID	Ed	Description	Value / Clarification
Sb1	1	Are substituted values stored in volatile memory	Not Supported

PIXIT for SETTING GROUP CONTROL MODEL

ID	Ed	Description	Value / Clarification
Sg1	1	What is the number of supported setting groups for each logical device	Not Supported
Sg2	1,2	What is the effect of when and how the non-volatile storage is updated (compare IEC 61850-8-1 §16.2.4)	Not Supported
Sg3	1	Can multiple clients edit the same setting group	Not Supported
Sg4	1	What happens if the association is lost while editing a setting group	Not Supported
Sg5	1	Is EditSG value 0 allowed	Not Supported
Sg6	2	When ResvTms is not present how long is an edit setting group locked	Not Supported

PIXIT for REPORTING MODEL

ID	Ed	Description	Value / Clarification
Rp1	1	The supported trigger conditions are (compare PICS)	integrity Y data change Y quality change Y data update Y general interrogation Y *Trigger option Data Update (dupd) is supported by the IED. However, data model doesn't contain any CDC DA with trigger dupd=true. Therefore, such an event will not be possible to generate.
Rp2	1	The supported optional fields are	sequence-number Y report-time-stamp Y reason-for-inclusion Y data-set-name Y data-reference Y buffer-overflow Y entryID Y conf-rev Y segmentation Y
Rp3	1,2	Can the server send segmented reports (when not supported the device shall refuse an association request with a smaller than minimum PDU size)	Y
Rp4	1,2	Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 §14.2.2.9)	Send report immediately
Rp5	1	Multi client URCB approach (compare IEC 61850-7-2:2003 §14.2.1)	Each URCB is visible to all clients
Rp6	-	What is the format of EntryID	Deprecated
Rp7	1,2	What is the buffer size for each BRCB or how many reports can be buffered	Buffer size is 50,000 bytes for each BRCB
Rp8	-	Pre-configured RCB attributes that are dynamic, compare SCL report settings	Deprecated
Rp9	1	May the reported data set contain: - structured data objects - data attributes	 Y Y
Rp10	1,2	What is the scan cycle for binary events. Is this fixed, configurable?	3 ms Fixed
Rp11	1	Does the device support to pre-assign a RCB to a specific client in the SCL	N

ID	Ed	Description	Value / Clarification
Rp12	2	After restart of the server is the value of ConfRev restored from the original configuration or retained prior to restart	Restored from original configuration
Rp13	1,2	Does the server accept any client to configure / enable a BRCB with ResvTms=-1? What fields are used to do the identification?	N
Rp14	1,2	When BRCB.ResvTms is exposed, what is the default value for BRCB.ResvTms if client does not write (must be > 0) When BRCB.ResvTms is not exposed, what is the internal reservation time-(must be >= 0)	N/A 0 seconds
Rp15	2	Is data model db=0 supported	N

PIXIT for LOGGING MODEL

ID	Ed	Description	Value / Clarification
Lg1	1,2	What is the default value of LogEna (Compare IEC 61850-8-1 §17.3.3.2.1, the default value should be FALSE)	Not Supported
Lg2	-	What is the format of EntryID	Deprecated
Lg3	1,2	Are there multiple Log Control Blocks that specify the Journaling of the same MMS NamedVariable and TrgOps and the Event Condition (Compare IEC 61850-8-1 §17.3.3.3.2)	Not Supported
Lg4	-	Pre-configured LCB attributes that cannot be changed online	Deprecated, the information is already available in SCL
Lg5	1	Which TrgOps are supported for logging (note Ed2 and up requires support for all TrgOps)	Not Supported

PIXIT for GOOSE PUBLISH MODEL

ID	Ed	Description	Value / Clarification
Gp1	1,2	Can the test (Ed1) / simulation (Ed2) flag in the published GOOSE be set	N
Gp2	1	What is the behaviour when the GOOSE publish configuration is incorrect	NdsCom=T DUT keeps GoEna=F
Gp3	1,2	Published FCD supported common data classes are	SPS, ENS, ACD, LPL, DPL, ACT, INS, ORG, SPC Arrays are not supported
Gp4	1,2	What is the maximum value of TAL (maxTime) Is it fixed or configurable	Configurable by ICT MaxTime 120,000ms
Gp5	1,2	What is the fastest retransmission time	2 ms
Gp6	-	Can the GOOSE publish be turned on / off by using SetGoCBValues(GoEna)	Deprecated See PICS - SetGoCBValues
Gp7	1,2	What is the initial GOOSE sqNum after restart	sqNum = 0
Gp8	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y Y
Gp9	1,2	Does Server or ICT refuse GOOSE payload dataset length greater than SCSM supports?	Y – ICT refuses

PIXIT for GOOSE SUBSCRIBE MODEL

ID	Ed	Description	Value / Clarification
Gs1	1,2	What elements of a subscribed GOOSE message are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions. Notes: • the VLAN tag may be removed by an Ethernet switch and shall not be checked • the simulation flag shall always be checked (Ed2)	Y destination MAC address Y APPID Y gocbRef Y timeAllowedtoLive N datSet N goID N T Y stNum NsqNum Y simulation / test N confRev Y ndsCom Y numDatSetEntries Y out-of-order dataset members
Gs2	1,2	When is a subscribed GOOSE marked as lost (TAL = time allowed to live value from the last received GOOSE message)	message does not arrive by 2x TAL
Gs3	1,2	What is the behaviour when one or more subscribed GOOSE messages is not received or syntactically incorrect (missing GOOSE)	Syntactically incorrect messages (Incorrect stNum increment) received within the TAL are discarded, message will be processed after TAL expires and syntactically correct message is not received.
Gs4	1,2	What is the behaviour when a subscribed GOOSE message is out-of-order	Older messages are discarded
Gs5	1,2	What is the behaviour when a subscribed GOOSE message is duplicated	First message will process and second message will discard.
Gs6	1	Does the device subscribe to GOOSE messages with/without the VLAN tag	Y, with the VLAN tag Y, without the VLAN tag
Gs7	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y Y
Gs8	1,2	Subscribed FCD supported common data classes are	SPS, ACD, ACT, SPC Arrays are not supported
Gs9	1,2	Are subscribed GOOSE with test=T (Ed1) / simulation=T (Ed2) accepted in test/simulation mode	Y
Gs10	1,2	Max number of dataset members	Fixed at 60
Gs11	1	Is Fixed-length encoded GOOSE supported	Y
Gs12	2	Is IEC 62351-6 security supported	N

PIXIT for GOOSE PERFORMANCE

ID	Ed	Description	Value / Clarification	
Gf1	1,2	Performance class	P2 = 10ms P3 = 20ms	
Gf2	1,2	GOOSE ping-pong processing method	Scan cycle based	
Gf3	1,2	Application logic scan cycle (ms)	Max.	4ms (GOOSE PUB) 100us (GOOSE SUBS)
			Min.	100us (GOOSE PUB) 100us (GOOSE PUB)
Gf4	1	Maximum number of data attributes in GOOSE dataset (value and quality has to be counted as separate attributes)	Such that dataset does not exceed GOOSE: 1000 Bytes	

PIXIT for CONTROL MODEL

ID	Ed	Description	Value / Clarification
Ct1	1	What control models are supported (compare ICD file enums for Ed2)	Dons: Y SBOns: N DOes: N SBOes: N
Ct2	1,2	Is the control model fixed, configurable and/or dynamic	Fixed
Ct3	-	Is TimeActivatedOperate supported (compare PICS or SCL)	Deprecated
Ct4	-	Is “operate-many” supported (compare sboClass)	Deprecated, see sboClass in datamodel (ICD)
Ct5	1	Will the DUT activate the control output when the test attribute is set in the SelectWithValue and/or Operate request (when N test procedure Ctl2 is applicable)	N
Ct6	-	What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request	Deprecated
Ct7	-	Is pulse configuration supported (compare pulseConfig)	Deprecated
Ct8	1	What is the behaviour of the DUT when the check conditions are set Is this behaviour fixed, configurable, online changeable	Check conditions are not checked.

ID	Ed	Description	Value / Clarification
Ct9	1,2	Which additional cause diagnosis are supported	N Unknown N Not-supported N Blocked-by-switching-hierar-chy N Select-failed N Invalid-position N Position-reached N Step-limit N Blocked-by-Mode N Blocked-by-process N Blocked-by-interlocking N Blocked-by-synchrocheck N Command-already-in-execu-tion N Blocked-by-health N 1-of-n-control N Abortion-by-cancel N Time-limit-over N Abortion-by-trip N Object-not-selected Edition 1 specific values: N Parameter-change-in-execu-tion (Ed1 semantics) Edition 2 specific values: N Object-already-selected N No-access-authority N Ended-with-overshoot N Abortion-due-to-deviation N Abortion-by-communication-loss N Blocked-by-command N None N Locked-by-other-client N Parameter-change-in-execu-tion (Ed2 semantics)
Ct10	1,2	How to force a “test-not-ok” respond with SelectWithValue request	Not Supported
Ct11	1,2	How to force a “test-not-ok” respond with Select request	Not Supported
Ct12	1,2	How to force a “test-not-ok” respond with Operate request	Not supported
Ct13	1,2	Which origin categories are supported / accepted	Y bay-control Y station-control Y remote-control Y automatic-bay Y automatic-station Y automatic-remote Y maintenance Y process
Ct14	1,2	What happens if the orCat value is not supported or invalid	DOns: Operate response-

ID	Ed	Description	Value / Clarification
Ct15	1,2	Does the IED accept a SelectWithValue / Operate with the same control value as the current status value Is this behaviour configurable	DOns: N Configurable: N
Ct16	1	Does the IED accept a select/operate on the same control object from 2 different clients at the same time	DOns: N
Ct17	1	Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (Tissue #334)	Not Suported
Ct18	1	Deprecated	
Ct19	-	Can a control operation be blocked by Mod=Off or [On-] Blocked (Compare PIXIT-Sr5)	Deprecated
Ct20	1,2	Does the IED support local / remote operation	N
Ct21	1,2	Does the IED send an InformationReport with LastApplError as part of the Operate response- for control with normal security	DOns: N
Ct22	2	How to force a "parameter-change-in-execution"	Not Supported
Ct23	1,2	How many SBOns/SBOes control objects can be selected at the same time?	Not Supported
Ct24	1,2	Can a controllable object be forced to keep its old state e.g. Internal Controllable Objects may not be accessible to force this, whereas a switch like Circuit Breaker outside the DUT can?	N
Ct25	1,2	When CDC=DPC is supported, is it possible to have DPC (Controllable Double Point) go to the intermediate state? (00)	N/A
Ct26	1,2	Name an enhanced security point (if any) with a finite operate timeout specify the timeout (in milliseconds)	Ld/Ln.DataObject, xxx or No DOes points have timeout DOes: No SBOes: No
Ct27	2	Does the IED support control objects with external signals?	DOns: N SBOns: N DOes: N SBOes: N
Ct28		Deprecated, kept as placeholder	

PIXIT for TIME SYNCHRONIZATION MODEL

ID	Ed	Description	Value / Clarification
Tm1	1	What time quality bits are supported (may be set by the IED)	Y LeapSecondsKnown Y ClockFailure Y ClockNotSynchronized
Tm2	1,2	Describe the behaviour when all time server(s) cease to respond What is the time server lost detection time	IRIG – next second SNTP – Configurable “Poll Interval” + 5*” Timeout Interval”
Tm3	1,2	How long does it take to take over the new time from time server	From ‘no sync’ to ‘SNTP sync’: it takes approximately 5 seconds For the same SNTP time master time adjustment: it takes “Poll Interval” + 5*” Timeout Interval” to get the new time from the same time server.
Tm4	1,2	When is the time quality bit “Clock-Failure” set	Bit is set, when no IRIG-B or SNTP is detected
Tm5	1	When is the time quality bit “Clock not Synchronized” set	Bit is set, when No IRIG-B, SNTP is detected Unlocked IRIG-B is detected
Tm6	-	Is the timestamp of a binary event adjusted to the configured scan cycle	Deprecated
Tm7	1	Does the device support time zone and daylight saving	Y
Tm8	1,2	Which attributes of the SNTP response packet are validated	N Leap indicator not equal to 3 Y Mode is equal to SERVER Y OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp Y RX/TX timestamp fields are checked for reasonableness Y SNTP version 3 and/or 4 N other (describe)
Tm9	1,2	Do the COMTRADE files have local time or UTC time and is this configur-able	COMTRADE files are not supported on the IED. Native Records may be converted to COMTRADE via software tools. It is configurable to display either Local or UTC time.

PIXIT for FILE TRANSFER MODEL

ID	Ed	Description	Value / Clarification
Ft1	1	What is the structure of files and directories Where are the COMTRADE files stored Are COMTRADE files zipped and what files are included in each zip file	Flat file system with pseudo folders (Ed2) COMTRADE files are not stored on the IED
Ft2	1,2	Directory names are separated from the file name by	“/”
Ft3	1	The maximum file name size including path (recommended 64 chars)	64 chars
Ft4	1,2	Are directory/file name case sensitive	Y
Ft5	1,2	Maximum file size for SetFile	SetFile Not Supported
Ft6	1	Is the requested file path included in the MMS fileDirectory respond file name	Y But client is not allowed to use any path names that contain anything other than “/” In that case Server will return response with zero files. (Ed2: always complete path)
Ft7	1	Is the wild card supported in the MMS fileDirectory request	Yes, wild card = *
Ft8	1,2	Is it allowed that 2 clients get a file at the same time	Y same file Y different files
Ft9	1,2	Which files can be deleted	No restriction for deleting files

PIXIT for SERVICE TRACKING MODEL

ID	Ed	Description	Value / Clarification
Tr1	2	Which ACSI services are tracked by LTRK.GenTrk	Not Supported

L.5 Data Mapping Specifications

T-PRO Logical Device

The T-PRO 2000 has the following IEC 61850 logical devices (LD) defined in its ICD file:

- Protection
- Measurements
- Records
- System
- Subscription
- FaultData
- SYS

T-PRO Logical Node Summary

Table L.6: T-PRO 2000 Logical Nodes defines the list of logical nodes (LN) for the T-PRO logical devices.

Note: System logical nodes (group L) are not shown here

Table L.6: T-PRO 2000 Logical Nodes

LD Name	LN Name	LN Description	Comments	Data Reference
PROTECTION FUNCTIONS				
Protection	D87TPDIF1	Differential	Differential	PDIF
Protection	D87NPDIF1	Differential	Differential Neutral Delta Phase	PDIF
Protection	D2HPHAR1	Harmonic Restraint	2nd Harmonic Restraint	PHAR
Protection	D5HPHAR2	Harmonic Restraint	5th Harmonic Restraint	PHAR
Protection	D87HSPHAR1	Harmonic Restraint	2nd Harmonic Inrush Block	PHAR
Protection	D87DPPDIF2	Differential	Differential Delta Phase	PDIF
Protection	D87RCDPDIF3	Differential	Differential ROCOD	PDIF
Protection	D87NDPPDIF2	Differential	Differential	PDIF
Protection	D87AlmPDIF4	Differential	Differential Alarm	PDIF

Protection	D49PTTR1	Thermal overload	Thermal overload-1	PTTR
Protection	D49PTTR2	Thermal overload	Thermal overload-2	PTTR
Protection	D49PTTR3	Thermal overload	Thermal Overload-3	PTTR
Protection	D49PTTR4	Thermal overload	Thermal overload-4	PTTR
Protection	D49PTTR5	Thermal overload	Thermal overload-5	PTTR
Protection	D49PTTR6	Thermal overload	Thermal overload-6	PTTR
Protection	D49PTTR7	Thermal overload	Thermal overload-7	PTTR
Protection	D49PTTR8	Thermal overload	Thermal overload-8	PTTR
Protection	D49PTTR9	Thermal overload	Thermal overload-9	PTTR
Protection	D49PTTR10	Thermal overload	Thermal overload-10	PTTR
Protection	D49PTTR11	Thermal overload	Thermal overload-11	PTTR
Protection	D49PTTR12	Thermal overload	Thermal overload-12	PTTR
Protection	D50HVPIOC1	Instantaneous overcurrent	Inst. Phase Overcurrent HV-1	PIOC
Protection	D50HVPIOC2	Instantaneous overcurrent	Inst. Phase Overcurrent HV-2	PIOC
Protection	D51HVPTOC1	Time overcurrent	IDMTL Phase Overcurrent HV-1	PTOC
Protection	D51HVPTOC2	Time overcurrent	IDMTL Phase Overcurrent HV-2	PTOC
Protection	D50LVPIOC1	Instantaneous overcurrent	Inst. Phase Overcurrent LV-1	PIOC
Protection	D50LVPIOC2	Instantaneous overcurrent	Inst. Phase Overcurrent LV-2	PIOC
Protection	D51LVPTOC1	Time overcurrent	IDMTL Phase Overcurrent LV-1	PTOC
Protection	D51LVPTOC2	Time overcurrent	IDMTL Phase Overcurrent LV-2	PTOC
Protection	D50NHVPIOC1	Instantaneous overcurrent	Inst. Derived Neutral Overcurrent HV-1	PIOC

Protection	D50NHVPIOC2	Instantaneous overcurrent	Inst. Derived Neutral Overcurrent HV-2	PIOC
Protection	D51NHVPTOC1	Time overcurrent	IDMTL Derived Neutral Overcurrent HV-1	PTOC
Protection	D51NHVPTOC2	Time overcurrent	IDMTL Derived Neutral Overcurrent HV-2	PTOC
Protection	D50NLVPIOC1	Instantaneous overcurrent	Inst. Derived Neutral Overcurrent LV-1	PIOC
Protection	D50NLVPIOC2	Instantaneous overcurrent	Inst. Derived Neutral Overcurrent LV-2	PIOC
Protection	D51NLVPTOC1	Time overcurrent	IDMTL Derived Neutral Overcurrent LV-1	PTOC
Protection	D51NLVPTOC2	Time overcurrent	IDMTL Derived Neutral Overcurrent LV-2	PTOC
Protection	D50GPIOC1	Instantaneous overcurrent	Inst. Measured Neutral Overcurrent / High Impedance REF-1	PIOC
Protection	D50GPIOC2	Instantaneous overcurrent	Inst. Measured Neutral Overcurrent / High Impedance REF-2	PIOC
Protection	D51GPTOC1	Time overcurrent	IDMTL Measured Neutral Overcurrent-1	PTOC
Protection	D51GPTOC2	Time overcurrent	IDMTL Measured Neutral Overcurrent-2	PTOC
Protection	D4650HVPIOC1	Instantaneous overcurrent	Inst. Negative Sequence Overcurrent HV	PIOC
Protection	D4650LVPIOC1	Instantaneous overcurrent	Inst. Negative Sequence Overcurrent LV	PIOC
Protection	D4651HVPTOC1	Time overcurrent	IDMTL Negative Sequence Overcurrent HV	PTOC
Protection	D4651LVPTOC1	Time overcurrent	IDMTL Negative Sequence Overcurrent LV	PTOC
Protection	D27DTPTUV1	Undervoltage	DTL Under Voltage-1	PTUV

Protection	D27DTPTUV2	Undervoltage	DTL Under Voltage-2	PTUV
Protection	D27DTPTUV3	Undervoltage	DTL Under Voltage-3	PTUV
Protection	D27DTPTUV4	Undervoltage	DTL Under Voltage-4	PTUV
Protection	D27ITPTUV1	Undervoltage	IDMTL Under Voltage-1	PTUV
Protection	D27ITPTUV2	Undervoltage	IDMTL Under Voltage-2	PTUV
Protection	D59DTPTOV1	Overvoltage	DTL Over Voltage-1	PTOV
Protection	D59DTPTOV2	Overvoltage	DTL Over Voltage-2	PTOV
Protection	D59DTPTOV3	Overvoltage	DTL Over Voltage-3	PTOV
Protection	D59DTPTOV4	Overvoltage	DTL Over Voltage-4	PTOV
Protection	D59ITPTOV1	Overvoltage	IDMTL Over Voltage-1	PTOV
Protection	D59ITPTOV2	Overvoltage	IDMTL Over Voltage-2	PTOV
Protection	D24DTPVPH1	Volts per Hz	Definite Time Overflux-1	PVPH
Protection	D24DTPVPH2	Volts per Hz	Definite Time Overflux-2	PVPH
Protection	D24ITPVPH1	Volts per Hz	Inverse Time Overflux	PVPH
Protection	D59GDTPTOV1	Overvoltage	DTL Measured Residual Over Voltage-1	PTOV
Protection	D59GDTPTOV2	Overvoltage	DTL Measured Residual Over Voltage-2	PTOV
Protection	D59GITPTOV1	Overvoltage	IDMTL Measured Residual Over Voltage	PTOV
Protection	D81UFPTUF1	Under Frequency	Under Frequency-1	PTUF
Protection	D81UFPTUF2	Under Frequency	Under Frequency-2	PTUF
Protection	D81UFPTUF3	Under Frequency	Under Frequency-3	PTUF
Protection	D81UFPTUF4	Under Frequency	Under Frequency-4	PTUF
Protection	D81OFPTOF1	Over Frequency	Over Frequency-1	PTOF
Protection	D81OFPTOF2	Over Frequency	Over Frequency-2	PTOF
Protection	D81OFPTOF3	Over Frequency	Over Frequency-3	PTOF

Protection	D81OFPTOF4	Over Frequency	Over Frequency-4	PTOF
Protection	D81RPFRC1	Rate of Change of Frequency	Rate of Change of Frequency-1	PFRC
Protection	D81RPFRC2	Rate of Change of Frequency	Rate of Change of Frequency-2	PFRC
Protection	D50BFI1RBRF1	Breaker failure	Breaker failure-1-D1	RBRF
Protection	D50BFI1RBRF2	Breaker failure	Breaker failure-1-D2	RBRF
Protection	D50BFI2RBRF1	Breaker failure	Breaker failure-2-D1	RBRF
Protection	D50BFI2RBRF2	Breaker failure	Breaker failure-2-D2	RBRF
Protection	DTFAlmRTFM1	New LN: R-LN Group; T-Through; F-Fault; M-Monitor	Through Fault Monitor Alarm	RTFM
Protection	DTFPeakRTFM1	New LN: R-LN Group; T-Through; F-Fault; M-Monitor	Through Fault Monitor Peak	RTFM
Protection	DTFI2tRTFM2	New LN: R-LN Group; T-Through; F-Fault; M-Monitor	Through Fault Monitor I2T	RTFM
Protection	DI2tHVRCBC1	New LN: R-LN Group; C-Circuit; B-Breaker; C-Condition	Circuit Breaker Condition HV	RCBC
Protection	DI2tLVRCBC1	New LN: R-LN Group; C-Circuit; B-Breaker; C-Condition	Circuit Breaker Condition LV	RCBC
Protection	D74TCSRTCS1	New LN: R-LN Group; T-Trip; C-Circuit; S-Supervision	Trip Circuit Supervision-1	RTCS
Protection	D74TCSRTCS2	New LN: R-LN Group; T-Trip; C-Circuit; S-Supervision	Trip Circuit Supervision-2	RTCS

Protection	DTHDRTHD1	New LN: R-LN Group; T-Total; H-Harmonic; D-Distortion	Total Harmonic Distortion-1	RTHD
MEASUREMENTS				
Measurements	I1_3PhMMXU1	Measurements	I1-3 phase metering data	MMXU
Measurements	I2_3PhMMXU2	Measurements	I2-3 phase metering data	MMXU
Measurements	INMMXU1	Measurements	Neutral current metering data	MMXU
Measurements	VINMMXU1	Measurements	VIN Metering data	MMXU
Measurements	IHVMMXU3	Measurements	HV Winding current data	MMXU
Measurements	ILVMMXU4	Measurements	LV Winding current data	MMXU
Measurements	IO87MMXU1	Measurements	87 Operating current	MMXU
Measurements	IR87MMXU2	Measurements	87 Restraint current	MMXU
Measurements	TFI2tMMXU3	Measurements	I2T Accumulated phase wise info.	MMXU
Measurements	IO87NMMXN1	Non-phase-related measurement	87N IN REF Operating Current	MMXN
Measurements	IR87NMMXN2	Non-phase-related measurement	87N IN REF Restraint Current	MMXN
Measurements	IHV49MMXN3	Non-phase-related measurement	49 HV Current data	MMXN
Measurements	ILV49MMXN4	Non-phase-related measurement	49 LV Current data	MMXN
Measurements	HV2HaMHAI1	Harmonics or interharmonics	HV 2nd Harmonic data	MHAI
Measurements	LV2HaMHAI2	Harmonics or interharmonics	LV 2nd Harmonic data	MHAI
Measurements	I1_2HaMHAI3	Harmonics or interharmonics	I1-2nd Harmonic data	MHAI
Measurements	I2_2HaMHAI4	Harmonics or interharmonics	I2-2nd Harmonic data	MHAI

Measurements	I1_5HaMHAI5	Harmonics or interharmonics	I1-5th Harmonic data	MHAI
Measurements	I2_5HaMHAI6	Harmonics or interharmonics	I2-5th Harmonic data	MHAI
Measurements	MTHDMAHI1	Harmonics or interharmonics	THD %	MHAI
Measurements	IHV3I0MSQI1	Sequence and imbalance	HV 3I0 Metering data	MSQI
Measurements	ILV3I0MSQI2	Sequence and imbalance	LV 3I0 Metering data	MSQI
Measurements	I1SeqMSQI1	Sequence and imbalance	I1 Sequence metering data	MSQI
Measurements	I2SeqMSQI2	Sequence and imbalance	I2 Sequence metering data	MSQI
Measurements	MVHzMMXU1	Measurements	V/F (pu)	MMXU
Measurements	TFMMTHR1	New LN: M-LN Group; T-Through; F-Fault; M-Monitor	Through fault Monitor Count	MTHR
RECORDS				
Records	DRRDRE1	Disturbance recorder	Transient Records	RDRE
SYSTEM				
System	IRIGGGIO1	Generic Process I/O	Status of IRIG-B	GGIO
System	SNTPGGIO2	Generic Process I/O	Status of SNTP	GGIO
System	HEALTHGGIO 1	Generic Process I/O	Relay Health	GGIO
System	ComAlmGGIO 4	Generic Process I/O	Status of IEC61850 Com. Alarm	GGIO
System	EIGGIO1	Generic Process I/O	Status of External Inputs (1-14)	GGIO
System	OCGGIO2	Generic Process I/O	Status of Output Contacts (1-14)	GGIO

System	LEDGGIO3	Generic Process I/O	LED Status (1-14)	GGIO
System	PLGGIO1	Generic Process I/O	Status of Prologics (1-24)	GGIO
System	VIGGIO1	Generic Process I/O	Virtual Inputs - Status (1-30)	GGIO
FAULTDATA				
FaultData	D87TIOMMXU1	Measurement	87 Differential Operating current	MMXU
FaultData	D87TIRMMXU2	Measurement	87 Differential Restraint current	MMXU
FaultData	D87NIOMMXN1	Non-phase-related measurement	87N IN REF Operating Current	MMXN
FaultData	D87NIRMMXN2	Non-phase-related measurement	87N IN REF Restraint Current	MMXN
FaultData	D49HVMMXU1	Measurement	49 HV-1 Current data	MMXU
FaultData	D49LVMMXU1	Measurement	49 LV-1 Current data	MMXU
FaultData	D49HVMMXU2	Measurement	49 HV-2 Current data	MMXU
FaultData	D49LVMMXU2	Measurement	49 LV-2 Current data	MMXU
FaultData	D49HVMMXU3	Measurement	49 HV-3 Current data	MMXU
FaultData	D49LVMMXU3	Measurement	49 LV-3 Current data	MMXU
FaultData	D49HVMMXU4	Measurement	49 HV-4 Current data	MMXU
FaultData	D49LVMMXU4	Measurement	49 LV-4 Current data	MMXU
FaultData	D49HVMMXU5	Measurement	49 HV-5 Current data	MMXU
FaultData	D49LVMMXU5	Measurement	49 LV-5 Current data	MMXU
FaultData	D49HVMMXU6	Measurement	49 HV-6 Current data	MMXU
FaultData	D49LVMMXU6	Measurement	49 LV-6 Current data	MMXU
FaultData	D49HVMMXU7	Measurement	49 HV-7 Current data	MMXU
FaultData	D49LVMMXU7	Measurement	49 LV-7 Current data	MMXU
FaultData	D49HVMMXU8	Measurement	49 HV-8 Current data	MMXU
FaultData	D49LVMMXU8	Measurement	49 LV-8 Current data	MMXU

FaultData	D49HVMMXU9	Measurement	49 HV-9 Current data	MMXU
FaultData	D49LVMMXU9	Measurement	49 LV-9 Current data	MMXU
FaultData	D49HVMMXU10	Measurement	49 HV-10 Current data	MMXU
FaultData	D49LVMMXU10	Measurement	49 LV-10 Current data	MMXU
FaultData	D49HVMMXU11	Measurement	49 HV-11 Current data	MMXU
FaultData	D49LVMMXU11	Measurement	49 LV-11 Current data	MMXU
FaultData	D49HVMMXU12	Measurement	49 HV-12 Current data	MMXU
FaultData	D49LVMMXU12	Measurement	49 LV-12 Current data	MMXU
FaultData	D50HVMMXU1	Measurement	50-1 HV Current data	MMXU
FaultData	D50HVMMXU2	Measurement	50-2 HV Current data	MMXU
FaultData	D50LVMMXU1	Measurement	50-1 LV Current data	MMXU
FaultData	D50LVMMXU2	Measurement	50-2 LV Current data	MMXU
FaultData	D51HVMMXU1	Measurement	51-1 HV Current data	MMXU
FaultData	D51HVMMXU2	Measurement	51-2 HV Current data	MMXU
FaultData	D51LVMMXU1	Measurement	51-1 LV Current data	MMXU
FaultData	D51LVMMXU2	Measurement	51-2 LV Current data	MMXU
FaultData	D50NHVMMXU1	Measurement	50N-1 HV Current data	MMXU
FaultData	D50NHVMMXU2	Measurement	50N-2 HV Current data	MMXU
FaultData	D50NLVMMXU1	Measurement	50N-1 LV Current data	MMXU
FaultData	D50NLVMMXU2	Measurement	50N2 LV Current data	MMXU
FaultData	D51NHVMMXU1	Measurement	51N-1 HV Current data	MMXU
FaultData	D51NHVMMXU2	Measurement	51N-2 HV Current data	MMXU
FaultData	D51NLVMMXU1	Measurement	51N-1 LV Current data	MMXU
FaultData	D51NLVMMXU2	Measurement	51N-2 LV Current data	MMXU
FaultData	D50GMMXU1	Measurement	50G-1 Current data	MMXU
FaultData	D50GRMSMMXU1	Measurement	50G-1 RMS Current data	MMXU
FaultData	D50GMMXU2	Measurement	50G-2 Current data	MMXU

FaultData	D50GRMSMMXU2	Measurement	50G-2 RMS Current data	MMXU
FaultData	D51GMMXU1	Measurement	51G-1 Current data	MMXU
FaultData	D51GRMSMMXU1	Measurement	51G-1 RMS Current data	MMXU
FaultData	D51GMMXU2	Measurement	51G-2 Current data	MMXU
FaultData	D51GRMSMMXU2	Measurement	51G-2 RMS Current data	MMXU
FaultData	D4650HVMMXU1	Measurement	46/50 HV Current data	MMXU
FaultData	D4650LVMMXU2	Measurement	46/50 LV Current data	MMXU
FaultData	D4651HVMMXU1	Measurement	46/51 HV Current data	MMXU
FaultData	D4651LVMMXU2	Measurement	46/51 LV Current data	MMXU
FaultData	D24DT1MSQI1	Sequence and Imbalance	24 DT-1 VIN Positive Seq. Voltage	MSQI
FaultData	D24DT2MSQI2	Sequence and Imbalance	24 DT-2 VIN Positive Seq. Voltage	MSQI
FaultData	D24ITMSQI1	Sequence and Imbalance	24 IT VIN Positive Seq. Voltage	MSQI
FaultData	D59GDTMMXU1	Measurement	59G-1 DT Voltage data	MMXU
FaultData	D59GDTMMXU2	Measurement	59G-2 DT Voltage data	MMXU
FaultData	D59GITMMXU1	Measurement	59G IT Voltage data	MMXU
FaultData	D27DTMMXU1	Measurement	27-1 DT Under Voltage data	MMXU
FaultData	D27DTMMXU2	Measurement	27-2 DT Under Voltage data	MMXU
FaultData	D27DTMMXU3	Measurement	27-3 DT Under Voltage data	MMXU
FaultData	D27DTMMXU4	Measurement	27-4 DT Under Voltage data	MMXU
FaultData	D27ITMMXU1	Measurement	27-1 IT Under Voltage data	MMXU

FaultData	D27ITMMXU2	Measurement	27-2 IT Under Voltage data	MMXU
FaultData	D59DTMMXU1	Measurement	59-1 DT Over Voltage data	MMXU
FaultData	D59DTMMXU2	Measurement	59-2 DT Over Voltage data	MMXU
FaultData	D59DTMMXU3	Measurement	59-3 DT Over Voltage data	MMXU
FaultData	D59DTMMXU4	Measurement	59-4 DT Over Voltage data	MMXU
FaultData	D59ITMMXU1	Measurement	59-1 IT Over Voltage data	MMXU
FaultData	D59ITMMXU2	Measurement	59-2 IT Over Voltage data	MMXU
FaultData	D81UFMMXU1	Measurement	81U-1 Under Frequency data	MMXU
FaultData	D81UFMMXU2	Measurement	81U-2 Under Frequency data	MMXU
FaultData	D81UFMMXU3	Measurement	81U-3 Under Frequency data	MMXU
FaultData	D81UFMMXU4	Measurement	81U-4 Under Frequency data	MMXU
FaultData	D81OFMMXU1	Measurement	81O-1 Over Frequency data	MMXU
FaultData	D81OFMMXU2	Measurement	81O-2 Over Frequency data	MMXU
FaultData	D81OFMMXU3	Measurement	81O-3 Over Frequency data	MMXU
FaultData	D81OFMMXU4	Measurement	81O-4 Over Frequency data	MMXU
FaultData	D81RMMXU1	Measurement	81R-1 ROC Frequency data	MMXU
FaultData	D81RMMXU2	Measurement	81R-2 ROC Frequency data	MMXU
SUBSCRIPTION				

Subscription	SUBSCRGGIO2	Generic Process I/O	Status of Goose Subscription	GGIO

Logical Node Specifications

The following sections provide detailed spec information on the T-PRO 2000xAy logical device and logical nodes as defined in the Table L.6: T-PRO 2000 Logical Nodes.

Common Logical Node information is not shown here. Only the data that are provided from the T-PRO application to the IEC 61850 sub-system are listed here.

Protection Logical Device

D87TPDIF1

This section defines the logical node data for D87TPDIF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87TPDIF1.ST.Op.general	Operate (87T Operated)	D87_OPERATED_STATUS_ID	STATUS_HANDLER
D87TPDIF1.ST.Op.phsA	Operate (87T Operated) Phase A	D87_PHA_OPERATED_STATUS_ID	STATUS_HANDLER
D87TPDIF1.ST.Op.phsB	Operate (87T Operated) Phase B	D87_PHB_OPERATED_STATUS_ID	STATUS_HANDLER
D87TPDIF1.ST.Op.phsC	Operate (87T Operated) Phase C	D87_PHC_OPERATED_STATUS_ID	STATUS_HANDLER

D87NPDIF1

This section defines the logical node data for D87NPDIF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87NPDIF1.ST.Op.general	Operate (87N IN Operated)	D87N_IN_OPERATED_STATUS_ID	STATUS_HANDLER

D2HPHAR1

This section defines the logical node data for D2HPHAR1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D2HPHAR1.ST.Str.general	Operate (2nd Harmonic Operated)	D2ND_HARMONIC_RESTRAINT_STATUS_ID	STATUS_HANDLER

D5HPHAR2

This section defines the logical node data for D5HPHAR2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D5HPHAR2.ST.Str.general	Operate (5^{TH} Harmonic Operated)	D5TH_HARMONIC_RESTRAINT_STATUS_ID	STATUS_HANDLER

D87HSPHAR1

This section defines the logical node data for D87HSPHAR1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87HSPHAR1.ST.Str.general	Operate (87 Unrestraint Operated)	D87_UNRESTRAINED_STATUS_ID	STATUS_HANDLER
D87HSPHAR1.ST.Str.PhsA	Operate (87 Unrestraint Operated) Phase A	D87_UNRESTRAINED_PHA_OPERATED_STATUS_ID	STATUS_HANDLER
D87HSPHAR1.ST.Str.PhsB	Operate (87 Unrestraint Operated) Phase B	D87_UNRESTRAINED_PHB_OPERATED_STATUS_ID	STATUS_HANDLER
D87HSPHAR1.ST.Str.PhsC	Operate (87 Unrestraint Operated) Phase C	D87_UNRESTRAINED_PHC_OPERATED_STATUS_ID	STATUS_HANDLER

D87DPPDIF2

This section defines the logical node data for D87DPPDIF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87DPPDIF2.ST.Op.general	Operate (87 DELTA Phase Operated)	D87_DELTA_PHASE_STATUS_ID	STATUS_HANDLER
D87DPPDIF2.ST.Op.PhsA	Operate (87 DELTA Phase Operated) Phase A	D87_DELTA_PHASE_A_PH_STATUS_ID	STATUS_HANDLER
D87DPPDIF2.ST.Op.PhsB	Operate (87 DELTA Phase Operated) Phase B	D87_DELTA_PHASE_B_PH_STATUS_ID	STATUS_HANDLER
D87DPPDIF2.ST.Op.PhsC	Operate (87 DELTA Phase Operated) Phase C	D87_DELTA_PHASE_C_PH_STATUS_ID	STATUS_HANDLER

D87RCDPDIF3

This section defines the logical node data for D87RCDPDIF3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87RCDPDIF3.ST.Op.general	Operate (87 ROCOD Operated)	D87_ROCOD_STATUS_ID	STATUS_HANDLER
D87RCDPDIF3.ST.Op.PhsA	Operate (87 ROCOD Operated) Phase A	D87_ROCOD_A_PHASE_STATUS_ID	STATUS_HANDLER
D87RCDPDIF3.ST.Op.PhsB	Operate (87 ROCOD Operated) Phase B	D87_ROCOD_B_PHASE_STATUS_ID	STATUS_HANDLER
D87RCDPDIF3.ST.Op.PhsC	Operate (87 ROCOD Operated) Phase C	D87_ROCOD_C_PHASE_STATUS_ID	STATUS_HANDLER

D87NDPPDIF2

This section defines the logical node data for D87NDPPDIF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87NDPPDIF2.ST.Op.general	Operate (87 N IN DELTA Phase Operated)	D87N_IN_DELTA_PHASE_STATUS_ID	STATUS_HANDLER

D87AlmPDIF4

This section defines the logical node data for D87AlmPDIF4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D87AlmPDIF4.ST.Op.general	Operate (87 Alarm Operated)	D87_ALARM_STATUS_ID	STATUS_HANDLER
D87AlmPDIF4.ST.Op.PhsA	Operate (87 Alarm Operated) Phase A	D87_ALARM_A_PH_STATUS_ID	STATUS_HANDLER
D87AlmPDIF4.ST.Op.PhsB	Operate (87 Alarm Operated) Phase B	D87_ALARM_B_PH_STATUS_ID	STATUS_HANDLER
D87AlmPDIF4.ST.Op.PhsC	Operate (87 Alarm Operated) Phase C	D87_ALARM_C_PH_STATUS_ID	STATUS_HANDLER

D49PTTR1

This section defines the logical node data for D49PTTR1 of the Protection logical device

Data Name	Description	IEC61850 Index	Source
D49PTTR1.ST.Str.general	Start (49-1 Picked up)	D49_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR1.ST.Op.general	Operate (49-1 Operated)	D49_1_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR2

This section defines the logical node data for D49PTTR2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR2.ST.Str.general	Start (49-2 Picked up)	D49_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR2.ST.Op.general	Operate (49-2 Operated)	D49_2_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR3

This section defines the logical node data for D49PTTR3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR3.ST.Str.general	Start (49-3 Picked up)	D49_3_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR3.ST.Op.general	Operate (49-3 Operated)	D49_3_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR4

This section defines the logical node data for D49PTTR4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR4.ST.Str.general	Start (49-4 Picked up)	D49_4_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR4.ST.Op.general	Operate (49-4 Operated)	D49_4_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR5

This section defines the logical node data for D49PTTR5 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR5.ST.Str.general	Start (49-5 Picked up)	D49_5_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR5.ST.Op.general	Operate (49-5 Operated)	D49_5_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR6

This section defines the logical node data for D49PTTR6 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR6.ST.Str.general	Start (49-6 Picked up)	D49_6_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR6.ST.Op.general	Operate (49-6 Operated)	D49_6_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR7

This section defines the logical node data for D49PTTR7 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR7.ST.Str.general	Start (49-7 Picked up)	D49_7_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR7.ST.Op.general	Operate (49-7 Operated)	D49_7_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR8

This section defines the logical node data for D49PTTR8 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR8.ST.Str.general	Start (49-8 Picked up)	D49_8_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR8.ST.Op.general	Operate (49-8 Operated)	D49_8_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR9

This section defines the logical node data for D49PTTR9 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR9.ST.Str.general	Start (49-9 Picked up)	D49_9_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR9.ST.Op.general	Operate (49-9 Operated)	D49_9_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR10

This section defines the logical node data for D49PTTR10 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR10.ST.Str.general	Start (49-10 Picked up)	D49_10_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR10.ST.Op.general	Operate (49-10 Operated)	D49_10_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR11

This section defines the logical node data for D49PTTR11 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR11.ST.Str.general	Start (49-11 Picked up)	D49_11_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR11.ST.Op.general	Operate (49-11 Operated)	D49_11_OPERATED_STATUS_ID	STATUS_HANDLER

D49PTTR12

This section defines the logical node data for D49PTTR12 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D49PTTR12.ST.Str.general	Start (49-12 Picked up)	D49_12_PICKEDUP_STATUS_ID	STATUS_HANDLER
D49PTTR12.ST.Op.general	Operate (49-12 Operated)	D49_12_OPERATED_STATUS_ID	STATUS_HANDLER

D50HVPIOC1

This section defines the logical node data for D50HVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50HVPIOC1.ST.Str.general	Start (50HV-1 Picked up)	D50_HV_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Str.phsA	Start (50HV-1 Picked up) Phase A	D50_HV_1_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Str.phsB	Start (50HV-1 Picked up) Phase B	D50_HV_1_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Str.phsC	Start (50HV-1 Picked up) Phase C	D50_HV_1_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Op.general	Operate (50HV-1 Operated)	D50_HV_1_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Op.phsA	Operate (50HV-1 Operated) Phase A	D50_HV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Op.phsB	Operate (50HV-1 Operated) Phase B	D50_HV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC1.ST.Op.phsC	Operate (50HV-1 Operated) Phase C	D50_HV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D50HVPIOC2

This section defines the logical node data for D50HVPIOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50HVPIOC2.ST.Str.general	Start (50HV-2 Picked up)	D50_HV_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Str.phsA	Start (50HV-2 Picked up) Phase A	D50_HV_2_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Str.phsB	Start (50HV-2 Picked up) Phase B	D50_HV_2_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Str.phsC	Start (50HV-2 Picked up) Phase C	D50_HV_2_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Op.general	Operate (50HV-2 Operated)	D50_HV_2_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Op.phsA	Operate (50HV-2 Operated) Phase A	D50_HV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Op.phsB	Operate (50HV-2 Operated) Phase B	D50_HV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50HVPIOC2.ST.Op.phsC	Operate (50HV-2 Operated) Phase C	D50_HV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D51HVPTOC1

This section defines the logical node data for D51HVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51HVPTOC1.ST.Str.general	Start (51HV-1 Picked up)	D51_HV_1PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Str.phsA	Start (51HV-1 Picked up) Phase A	D51_HV_1_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Str.phsB	Start (51HV-1 Picked up) Phase B	D51_HV_1_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Str.phsC	Start (51HV-1 Picked up) Phase C	D51_HV_1_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Op.general	Operate (51HV-1 Operated)	D51_HV_1_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Op.phsA	Operate (51HV-1 Operated) Phase A	D51_HV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Op.phsB	Operate (51HV-1 Operated) Phase B	D51_HV_1_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC1.ST.Op.phsC	Operate (51HV-1 Operated) Phase C	D51_HV_1_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D51HVPTOC2

This section defines the logical node data for D51HVPTOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51HVPTOC2.ST.Str.general	Start (51HV-2 Picked up)	D51_HV_2PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Str.phsA	Start (51HV-2 Picked up) Phase A	D51_HV_2_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Str.phsB	Start (51HV-2 Picked up) Phase B	D51_HV_2_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Str.phsC	Start (51HV-2 Picked up) Phase C	D51_HV_2_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Op.general	Operate (51HV-2 Operated)	D51_HV_2_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Op.phsA	Operate (51HV-2 Operated) Phase A	D51_HV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Op.phsB	Operate (51HV-2 Operated) Phase B	D51_HV_2_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51HVPTOC2.ST.Op.phsC	Operate (51HV-2 Operated) Phase C	D51_HV_2_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D50LVPIOC1

This section defines the logical node data for D60LVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50LVPIOC1.ST.Str.general	Start (50LV-1 Picked up)	D50_LV_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Str.phsA	Start (50LV -1 Picked up) Phase A	D50_LV_1_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Str.phsB	Start (50LV -1 Picked up) Phase B	D50_LV_1_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Str.phsC	Start (50LV -1 Picked up) Phase C	D50_LV_1_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Op.general	Operate (50LV -1 Operated)	D50_LV_1_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Op.phsA	Operate (50LV -1 Operated) Phase A	D50_LV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Op.phsB	Operate (50LV -1 Operated) Phase B	D50_LV_1_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC1.ST.Op.phsC	Operate (50LV -1 Operated) Phase C	D50_LV_1_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D50LVPIOC2

This section defines the logical node data for D50LVPIOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50LVPIOC2.ST.Str.general	Start (50LV-2 Picked up)	D50_LV_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Str.phsA	Start (50LV -2 Picked up) Phase A	D50_LV_2_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Str.phsB	Start (50LV -2 Picked up) Phase B	D50_LV_2_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Str.phsC	Start (50LV -2 Picked up) Phase C	D50_LV_2_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Op.general	Operate (50LV -2 Operated)	D50_LV_2_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Op.phsA	Operate (50LV -2 Operated) Phase A	D50_LV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Op.phsB	Operate (50LV -2 Operated) Phase B	D50_LV_2_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D50LVPIOC2.ST.Op.phsC	Operate (50LV -2 Operated) Phase C	D50_LV_2_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D51LVPTOC1

This section defines the logical node data for D51LVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51LVPTOC1.ST.Str.general	Start (51LV -1 Picked up)	D51_LV_1PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Str.phsA	Start (51LV -1 Picked up) Phase A	D51_LV_1_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Str.phsB	Start (51LV -1 Picked up) Phase B	D51_LV_1_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Str.phsC	Start (51LV -1 Picked up) Phase C	D51_LV_1_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Op.general	Operate (51LV -1 Operated)	D51_LV_1_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Op.phsA	Operate (51LV -1 Operated) Phase A	D51_LV_1_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Op.phsB	Operate (51LV -1 Operated) Phase B	D51_LV_1_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC1.ST.Op.phsC	Operate (51LV -1 Operated) Phase C	D51_LV_1_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D51LVPTOC2

This section defines the logical node data for D51LVPTOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51LVPTOC2.ST.Str.general	Start (51LV -2 Picked up)	D51_LV_2PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Str.phsA	Start (51LV -2 Picked up) Phase A	D51_LV_2_A_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Str.phsB	Start (51LV -2 Picked up) Phase B	D51_LV_2_B_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Str.phsC	Start (51LV -2 Picked up) Phase C	D51_LV_2_C_PHASE_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Op.general	Operate (51LV -2 Operated)	D51_LV_2_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Op.phsA	Operate (51LV -2 Operated) Phase A	D51_LV_2_A_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Op.phsB	Operate (51LV -2 Operated) Phase B	D51_LV_2_B_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER
D51LVPTOC2.ST.Op.phsC	Operate (51LV -2 Operated) Phase C	D51_LV_2_C_PHASE_OPERATED_STATUS_ID	STATUS_HANDLER

D50NHVPIOC1

This section defines the logical node data for D50NHVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50NHVPIOC1.ST.Str.general	Start (50NHV-1 Picked up)	D50N_HV_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50NHVPIOC1.ST.Op.general	Operate (50NHV-1 Operated)	D50N_HV_1_OPERATED_STATUS_ID	STATUS_HANDLER

D50NHVPIOC2

This section defines the logical node data for D50NHVPIOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50NHVPIOC2.ST.Str.general	Start (50NHV-2 Picked up)	D50N_HV_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50NHVPIOC2.ST.Op.general	Operate (50NHV-2 Operated)	D50N_HV_2_OPERATED_STATUS_ID	STATUS_HANDLER

D50NLVPIOC1

This section defines the logical node data for D50NLVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50NLVPIOC1.ST.Str.general	Start (50NLV-1 Picked up)	D50N_LV_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50NLVPIOC1.ST.Op.general	Operate (50NLV -1 Operated)	D50N_LV_1_OPERATED_STATUS_ID	STATUS_HANDLER

D50NLVPIOC2

This section defines the logical node data for D50NLVPIOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50NLVPIOC2.ST.Str.general	Start (50NLV-2 Picked up)	D50N_LV_2_PICKEDUP_STATUS	STATUS_HANDLER
D50NLVPIOC2.ST.Op.general	Operate (50NLV -2 Operated)	D50N_LV_2_OPERATED_STATUS	STATUS_HANDLER

D51NHVPTOC1

This section defines the logical node data for D51NHVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51NHVPTOC1.ST.Str.general	Start (51N HV-1 Picked up)	D51N_HV_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51NHVPTOC1.ST.Op.general	Operate (51N HV-1 Operated)	D51N_HV_1_OPERATED_STATUS_ID	STATUS_HANDLER

D51NHVPTOC2

This section defines the logical node data for D51NHVPTOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51NHVPTOC2.ST.Str.general	Start (51N HV-2 Picked up)	D51N_HV_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51NHVPTOC2.ST.Op.general	Operate (51N HV -2 Operated)	D51N_HV_2_OPERATED_STATUS_ID	STATUS_HANDLER

D51NLVPTOC1

This section defines the logical node data for D51NLVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51NLVPTOC1.ST.Str.general	Start (51N LV -1 Picked up)	D51_LV_1PICKEDUP_STATUS_ID	STATUS_HANDLER
D51NLVPTOC1.ST.Op.general	Operate (51N LV -1 Operated)	D51_LV_1_OPERATED_STATUS_ID	STATUS_HANDLER

D51NLVPTOC2

This section defines the logical node data for D51NLVPTOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51NLVPTOC2.ST.Str.general	Start (51N LV -2 Picked up)	D51N_LV_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51NLVPTOC2.ST.Op.general	Operate (51N LV -2 Operated)	D51N_LV__2_OPERATED_STATUS_ID	STATUS_HANDLER

D50GPIOC1

This section defines the logical node data for D50GPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50GPIOC1.ST.Str.general	Start (50G -1 Picked up)	D50G_IN_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50GPIOC1.ST.Op.general	Operate (50G -1 Operated)	D50G_IN_1_OPERATED_STATUS_ID	STATUS_HANDLER

D50GPIOC2

This section defines the logical node data for D50GPIOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50GPIOC2.ST.Str.general	Start (50G -2 Picked up)	D50G_IN_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D50GPIOC2.ST.Op.general	Operate (50G -2 Operated)	D50G_IN_2_OPERATED_STATUS_ID	STATUS_HANDLER

D51GPTOC1

This section defines the logical node data for D51GPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51GPTOC1.ST.Str.general	Start (51G -1 Picked up)	D51G_IN_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51GPTOC1.ST.Op.general	Operate (51G -1 Operated)	D51G_IN_1_OPERATED_STATUS_ID	STATUS_HANDLER

D51GPTOC2

This section defines the logical node data for D51GPTOC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D51GPTOC2.ST.Str.general	Start (51G -2 Picked up)	D51G_IN_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D51GPTOC2.ST.Op.general	Operate (51G -2 Operated)	D51G_IN_2_OPERATED_STATUS_ID	STATUS_HANDLER

D4650HVPIOC1

This section defines the logical node data for D4650HVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D4650HVPIOC1.ST.Str.general	Start (4650 HV Picked up)	D46_50_HV_PICKEDUP_STATUS_ID	STATUS_HANDLER
D4650HVPIOC1.ST.Op.general	Operate (4650 HV Operated)	D46_50_HV_OPERATED_STATUS_ID	STATUS_HANDLER

D4650LVPIOC1

This section defines the logical node data for D4650LVPIOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D4650LVPIOC1.ST.Str.general	Start (4650 LV Picked up)	D46_50_LV_PICKEDUP_STATUS_ID	STATUS_HANDLER
D4650LVPIOC1.ST.Op.general	Operate (4650 LV Operated)	D46_50_LV_OPERATED_STATUS_ID	STATUS_HANDLER

D4651HVPTOC1

This section defines the logical node data for D4651HVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D4651HVPTOC1.ST.Str.general	Start (4651 HV Picked up)	D46_50_HV_PICKEDUP_STATUS_ID	STATUS_HANDLER
D4651HVPTOC1.ST.Op.general	Operate (4651 HV Operated)	D46_50_HV_OPERATED_STATUS_ID	STATUS_HANDLER

D4651LVPTOC1

This section defines the logical node data for D4651LVPTOC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D4651LVPTOC1.ST.Str.general	Start (4651 LV Picked up)	D46_50_LV_PICKEDUP_STATUS_ID	STATUS_HANDLER
D4651LVPTOC1.ST.Op.general	Operate (4651 LV Operated)	D46_50_LV_OPERATED_STATUS_ID	STATUS_HANDLER

D27DTPTUV1

This section defines the logical node data for D27DTPTUV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27DTPTUV1.ST.Str.general	Start (27DT-1 Picked up)	D27DT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D27DTPTUV1.ST.Op.general	Operate (27DT-1 Operated)	D27DT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D27DTPTUV2

This section defines the logical node data for D27DTPTUV2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27DTPTUV2.ST.Str.general	Start (27DT-2 Picked up)	D27DT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D27DTPTUV2.ST.Op.general	Operate (27DT-2 Operated)	D27DT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D27DTPTUV3

This section defines the logical node data for D27DTPTUV3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27DTPTUV3.ST.Str.general	Start (27DT-3 Picked up)	D27DT_3_PICKEDUP_STATUS_ID	STATUS_HANDLER
D27DTPTUV3.ST.Op.general	Operate (27DT-3 Operated)	D27DT_3_OPERATED_STATUS_ID	STATUS_HANDLER

D27DTPTUV4

This section defines the logical node data for D27DTPTUV4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27DTPTUV4.ST.Str.general	Start (27DT-4 Picked up)	D27DT_4_PICKEDUP_STATUS_ID	STATUS_HANDLER

D27DTPTUV4.ST.Op.general	Operate (27DT-4 Operated)	D27DT_4_OPERATED_STATUS_ID	STATUS_HANDLER

D27ITPTUV1

This section defines the logical node data for D27ITPTUV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27ITPTUV1.ST.Str.general	Start (27IT-1 Picked up)	D27IT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D27ITPTUV1.ST.Op.general	Operate (27IT-1 Operated)	D27IT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D27ITPTUV2

This section defines the logical node data for D27ITPTUV2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D27ITPTUV2.ST.Str.general	Start (27IT-2 Picked up)	D27IT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D27ITPTUV2.ST.Op.general	Operate (27IT-2 Operated)	D27IT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D59DTPTOV1

This section defines the logical node data for D59DTPTOV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59DTPTOV1.ST.Str.general	Start (59DT-1 Picked up)	D59DT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59DTPTOV1.ST.Op.general	Operate (59DT -1 Operated)	D59DT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D59DTPTOV2

This section defines the logical node data for D59DTPTOV2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59DTPTOV2.ST.Str.general	Start (59DT -2 Picked up)	D59DT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59DTPTOV2.ST.Op.general	Operate (59DT -2 Operated)	D59DT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D59DTPTOV3

This section defines the logical node data for D59DTPTOV3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59DTPTOV3.ST.Str.general	Start (59DT -3 Picked up)	D59DT_3_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59DTPTOV3.ST.Op.general	Operate (59DT -3 Operated)	D59DT_3_OPERATED_STATUS_ID	STATUS_HANDLER

D59DTPTOV4

This section defines the logical node data for D59DTPTOV4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59DTPTOV4.ST.Str.general	Start (59DT -4 Picked up)	D59DT_4_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59DTPTOV4.ST.Op.general	Operate (59DT -4 Operated)	D59DT_4_OPERATED_STATUS_ID	STATUS_HANDLER

D59ITPTOV1

This section defines the logical node data for D59ITPTOV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59ITPTOV1.ST.Str.general	Start (59IT-1 Picked up)	D59IT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59ITPTOV1.ST.Op.general	Operate (59IT-1 Operated)	D59IT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D59ITPTOV2

This section defines the logical node data for D59ITPTOV2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59ITPTOV2.ST.Str.general	Start (59IT -2 Picked up)	D59IT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59ITPTOV2.ST.Op.general	Operate (59IT -2 Operated)	D59IT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D24DTPVPH1

This section defines the logical node data for D24DTPVPH1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D24DTPVPH1.ST.Str.general	Start (24DT-1 Picked up)	D24DT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D24DTPVPH1.ST.Op.general	Operate (24DT-1 Operated)	D24DT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D24DTPVPH2

This section defines the logical node data for D24DTPVPH2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D24DTPVPH2.ST.Str.general	Start (24DT-2 Picked up)	D24DT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D24DTPVPH2.ST.Op.general	Operate (24DT-2 Operated)	D24DT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D24ITPVPH1

This section defines the logical node data for D24ITPVPH1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D24ITPVPH1.ST.Str.general	Start (24IT Picked up)	D24IT_PICKEDUP_STATUS_ID	STATUS_HANDLER

D24ITPVPH1.ST.Op.general	Operate (24IT Operated)	D24IT_OPERATED_STATUS_ID	STATUS_HANDLER

D59GDTPTOV1

This section defines the logical node data for D59GDTPTOV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59GDTPTOV1.ST.Str.general	Start (59GDT-1 Picked up)	D59GDT_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59GDTPTOV1.ST.Op.general	Operate (59GDT-1 Operated)	D59GDT_1_OPERATED_STATUS_ID	STATUS_HANDLER

D59GDTPTOV2

This section defines the logical node data for D59GDTPTOV2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59GDTPTOV2.ST.Str.general	Start (59GDT-2 Picked up)	D59GDT_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59GDTPTOV2.ST.Op.general	Operate (59GDT-2 Operated)	D59GDT_2_OPERATED_STATUS_ID	STATUS_HANDLER

D59GITPTOV1

This section defines the logical node data for D59GITPTOV1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D59GITPTOV1.ST.Str.general	Start (59GIT Picked up)	D59GIT_PICKEDUP_STATUS_ID	STATUS_HANDLER
D59GITPTOV1.ST.Op.general	Operate (59GIT Operated)	D59GIT_OPERATED_STATUS_ID	STATUS_HANDLER

D81UFPTUF1

This section defines the logical node data for D81UFPTUF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source

D81UFPTUF1.ST.Str.general	Start (81UF-1 Picked up)	D81U_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81UFPTUF1.ST.Op.general	Operate (81UF-1 Operated)	D81U_1_ OPERATED _STATUS_ID	STATUS_HANDLER

D81UFPTUF2

This section defines the logical node data for D81UFPTUF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81UFPTUF2.ST.Str.general	Start (81UF-2 Picked up)	D81U_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81UFPTUF2.ST.Op.general	Operate (81UF-2 Operated)	D81U_2_ OPERATED _STATUS_ID	STATUS_HANDLER

D81UFPTUF3

This section defines the logical node data for D81UFPTUF3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81UFPTUF3.ST.Str.general	Start (81UF-3 Picked up)	D81U_3_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81UFPTUF3.ST.Op.general	Operate (81UF-3 Operated)	D81U_3_ OPERATED _STATUS_ID	STATUS_HANDLER

D81UFPTUF4

This section defines the logical node data for D81UFPTUF4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81UFPTUF4.ST.Str.general	Start (81UF-4 Picked up)	D81U_4_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81UFPTUF4.ST.Op.general	Operate (81UF-4 Operated)	D81U_4_ OPERATED _STATUS_ID	STATUS_HANDLER

D81OFPTOF1

This section defines the logical node data for D81OFPTOF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81OFPTOF1.ST.Str.general	Start (81OF-1 Picked up)	D81O_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81OFPTOF1.ST.Op.general	Operate (81OF-1 Operated)	D81O_1_ OPERATED _STATUS_ID	STATUS_HANDLER

D81OFPTOF2

This section defines the logical node data for D81OFPTOF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81OFPTOF2.ST.Str.general	Start (81OF-2 Picked up)	D81O_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81OFPTOF2.ST.Op.general	Operate (81OF-2 Operated)	D81O_2_ OPERATED _STATUS_ID	STATUS_HANDLER

D81OFPTOF3

This section defines the logical node data for D81OFPTOF3 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81OFPTOF3.ST.Str.general	Start (81OF-3 Picked up)	D81O_3_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81OFPTOF3.ST.Op.general	Operate (81OF-3 Operated)	D81O_3_ OPERATED _STATUS_ID	STATUS_HANDLER

D81OFPTOF4

This section defines the logical node data for D81OFPTOF4 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81OFPTOF4.ST.Str.general	Start (81OF-4 Picked up)	D81O_4_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81OFPTOF4.ST.Op.general	Operate (81OF-4 Operated)	D81O_4_ OPERATED _STATUS_ID	STATUS_HANDLER

D81RPFRC1

This section defines the logical node data for D81RPFRC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81RPFRC1.ST.Str.general	Start (81ROCOF-1 Picked up)	D81R_1_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81RPFRC1.ST.Op.general	Operate (81 ROCOF-1 Operated)	D81R_1_ OPERATED _STATUS_ID	STATUS_HANDLER

D81RPFRC2

This section defines the logical node data for D81RPFRC2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D81RPFRC2.ST.Str.general	Start (81ROCOF-2 Picked up)	D81R_2_PICKEDUP_STATUS_ID	STATUS_HANDLER
D81RPFRC2.ST.Op.general	Operate (81 ROCOF-2 Operated)	D81R_2_ OPERATED _STATUS_ID	STATUS_HANDLER

Logical Nodes for Protection Functions (LN Group R...)

D50BFI1RBRF1

This section defines the logical node data for D50BFI1RBRF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50BFI1RBRF1.ST.OpEx.general	Operate (50BF1-1 Operated)	D50BF_INPUT1_1_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF1.ST.OpEx.phsA	Operate (50BF1-1 Operated) Phase A	D50BF_INPUT1_1_A_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF1.ST.OpEx.phsB	Operate (50BF1-1 Operated) Phase B	D50BF_INPUT1_1_B_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF1.ST.OpEx.phsC	Operate (50BF1-1 Operated) Phase C	D50BF_INPUT1_1_C_OPERATED_STATUS_ID	STATUS_HANDLER

D50BFI1RBRF2

This section defines the logical node data for D50BFI1RBRF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50BFI1RBRF2.ST.OpEx.general	Operate (50BF1-2 Operated)	D50BF_INPUT1_2_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF2.ST.OpEx.phsA	Operate (50BF1-2 Operated) Phase A	D50BF_INPUT1_2_A_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF2.ST.OpEx.phsB	Operate (50BF1-2 Operated) Phase B	D50BF_INPUT1_2_B_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI1RBRF2.ST.OpEx.phsC	Operate (50BF1-2 Operated) Phase C	D50BF_INPUT1_2_C_OPERATED_STATUS_ID	STATUS_HANDLER

D50BFI2RBRF1

This section defines the logical node data for D50BFI2RBRF1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50BFI2RBRF1.ST.OpEx.general	Operate (50BF2-1 Operated)	D50BF_INPUT2_1_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI2RBRF1.ST.OpEx.phsA	Operate (50BF2-1 Operated) Phase A	D50BF_INPUT2_1_A_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI2RBRF1.ST.OpEx.phsB	Operate (50BF2-1 Operated) Phase B	D50BF_INPUT2_1_B_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI2RBRF1.ST.OpEx.phsC	Operate (50BF2-1 Operated) Phase C	D50BF_INPUT2_1_C_OPERATED_STATUS_ID	STATUS_HANDLER

D50BFI2RBRF2

This section defines the logical node data for D50BFI2RBRF2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D50BFI2RBRF2.ST.OpEx.general	Operate (50BF2-2 Operated)	D50BF_INPUT2_2_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI2RBRF2.ST.OpEx.phsA	Operate (50BF2-2 Operated) Phase A	D50BF_INPUT2_2_A_OPERATED_STATUS_ID	STATUS_HANDLER
D50BFI2RBRF2.ST.OpEx.phsB	Operate (50BF2-2 Operated) Phase B	D50BF_INPUT2_2_B_OPERATED_STATUS_ID	STATUS_HANDLER

D50BFI2RBRF2.ST.OpEx.phsC	Operate (50BF2-2 Operated) Phase C	D50BF_INPUT2_2_C_OPERATED_STATUS_ID	STATUS_HANDLER

DTFAlmRTFM1

This section defines the logical node data for DTFAlmRTFM1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DTFAlmRTFM1.ST.Op.general	Operate (TF Alm Operated)	DTFM_ALARM_OPERATED_STATUS_ID	STATUS_HANDLER
DTFAlmRTFM1.ST.Op.phsA	Operate (TF Alm Operated) Phase A	DTFM_ALARM_A_OPERATED_STATUS_ID	STATUS_HANDLER
DTFAlmRTFM1.ST.Op.phsB	Operate (TF Alm Operated) Phase B	DTFM_ALARM_B_OPERATED_STATUS_ID	STATUS_HANDLER
DTFAlmRTFM1.ST.Op.phsC	Operate (TF Alm Operated) Phase C	DTFM_ALARM_C_OPERATED_STATUS_ID	STATUS_HANDLER

DTFPeakRTFM1

This section defines the logical node data for DTFPeakRTFM1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DTFPeakRTFM1.ST.Op.general	Operate (TF peak Operated)	DTFM_PEAK_OPERATED_STATUS_ID	STATUS_HANDLER

DTFI2tRTFM2

This section defines the logical node data for DTFI2tRTFM2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DTFI2tRTFM2.ST.Op.general	Operate (TF I2t Operated)	DTFM_I2T_OPERATED_STATUS_ID	STATUS_HANDLER

DI2tHVRCBC1

This section defines the logical node data for DI2tHVRCBC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DI2tHVRCBC1.ST.Op.general	Operate (TF I2t Operated)	DI2T_HV_OPERATED_STATUS_ID	STATUS_HANDLER
DI2tHVRCBC1MXI2TAccmagf	I2t HV Accumulated	I2T_HV_ACCMULATED_METER_ID	SRC_METER
DI2tHVRCBC1MXI2TLstOpmagf	I2t HV Last Operation	I2T_HV_LAST_OPERATION_METER_ID	SRC_METER

DI2tLVRCBC1

This section defines the logical node data for DI2tLVRCBC1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DI2tLVRCBC1.ST.Op.general	Operate (TF I2t Operated)	DI2T_LV_OPERATED_STATUS_ID	STATUS_HANDLER
DI2tLVRCBC1MXI2TAccmagf	I2t LV Accumulated	I2T_LV_ACCMULATED_METER_ID	SRC_METER
DI2tLVRCBC1MXI2TLstOpmagf	I2t LV Last Operation	I2T_LV_LAST_OPERATION_METER_ID	SRC_METER

D74TCSRTCS1

This section defines the logical node data for D74TCSRTCS1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D74TCSRTCS1.ST.Op.general	Operate (74TCSRTCS-1 Operated)	D74TCS_1_OPERATED_STATUS_ID	STATUS_HANDLER

D74TCSRTCS2

This section defines the logical node data for D74TCSRTCS2 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
D74TCSRTCS2.ST.Op.general	Operate (74TCSRTCS-2 Operated)	D74TCS_2_OPERATED_STATUS_ID	STATUS_HANDLER

DTHDRTHD1

This section defines the logical node data for DTHDRTHD1 of the Protection logical device.

Data Name	Description	IEC61850 Index	Source
DTHDRTHD1.ST.Op.general	Operate (THD-1 Operated)	DTHD_1_OPERATED_STATUS_ID	STATUS_HANDLER

Logical Nodes for Measurements & DR (LN Group M... R...)

I1_3PhMMXU1

This section defines the logical node data for I1_3PhMMXU1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I1_3PhMMXU1.MX.A.phsA.cVal.mag.f	I1A - Magnitude	I1A_MAG_METER_ID	METER
I1_3PhMMXU1.MX.A.phsA.cVal.ang.f	I1A - Angle	I1A_ANG_METER_ID	METER
I1_3PhMMXU1.MX.A.phsB.cVal.mag.f	I1B - Magnitude	I1B_MAG_METER_ID	METER
I1_3PhMMXU1.MX.A.phsB.cVal.ang.f	I1B - Angle	I1B_ANG_METER_ID	METER
I1_3PhMMXU1.MX.A.phsC.cVal.mag.f	I1C - Magnitude	I1C_MAG_METER_ID	METER
I1_3PhMMXU1.MX.A.phsC.cVal.ang.f	I1C - Angle	I1C_ANG_METER_ID	METER

I2_3PhMMXU2

This section defines the logical node data for I2_3PhMMXU2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I2_3PhMMXU2.MX.A.phsA.cVal.mag.f	I2A - Magnitude	I2A_MAG_METER_ID	METER
I2_3PhMMXU2.MX.A.phsA.cVal.ang.f	I2A - Angle	I2A_ANG_METER_ID	METER
I2_3PhMMXU2.MX.A.phsB.cVal.mag.f	I2B - Magnitude	I2B_MAG_METER_ID	METER
I2_3PhMMXU2.MX.A.phsB.cVal.ang.f	I2B - Angle	I2B_ANG_METER_ID	METER
I2_3PhMMXU2.MX.A.phsC.cVal.mag.f	I2C - Magnitude	I2C_MAG_METER_ID	METER
I2_3PhMMXU2.MX.A.phsC.cVal.ang.f	I2C - Angle	I2C_ANG_METER_ID	METER

INMMXU1

This section defines the logical node data for INMMXU1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
INMMXU1.MX.A.neut.cVal.mag.f	IN - Magnitude	IN_MAG_METER_ID	METER
INMMXU1.MX.A.neut.cVal.ang.f	IN - Angle	IN_ANG_METER_ID	METER

VINMMXU1

This section defines the logical node data for VINMMXU1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
VINMMXU1.MX.PhV.net.cVal.mag.f	VIN - Magnitude	VIN_MAG_METER_ID	METER
VINMMXU1.MX.PhV.net.cVal.ang.f	VIN - Angle	VIN_ANG_METER_ID	METER
VINMMXU1.MX.Hz.mag.f	VIN Positive Sequence Frequency	FREQUENCY_METER_ID	METER

IHVMMXU3

This section defines the logical node data for IHVMMXU3 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IHVMMXU3.MX.A.phsA.cVal.mag.f	IHV A - Magnitude	IHVA_MAG_METER_ID	METER
IHVMMXU3.MX.A.phsA.cVal.ang.f	IHV A - Angle	IHVA_ANG_METER_ID	METER
IHVMMXU3.MX.A.phsB.cVal.mag.f	IHV B - Magnitude	IHVB_MAG_METER_ID	METER
IHVMMXU3.MX.A.phsB.cVal.ang.f	IHV B - Angle	IHVB_ANG_METER_ID	METER
IHVMMXU3.MX.A.phsC.cVal.mag.f	IHV C - Magnitude	IHVC_MAG_METER_ID	METER
IHVMMXU3.MX.A.phsC.cVal.ang.f	IHV C - Angle	IHVC_ANG_METER_ID	METER

ILVMMXU4

This section defines the logical node data for ILVMMXU4 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source

ILVMMXU4.MX.A.phsA.cVal.mag.f	ILV A - Magnitude	ILVA_MAG_METER_ID	METER
ILVMMXU4.MX.A.phsA.cVal.ang.f	ILV A - Angle	ILVA_ANG_METER_ID	METER
ILVMMXU4.MX.A.phsB.cVal.mag.f	ILV B - Magnitude	ILVB_MAG_METER_ID	METER
ILVMMXU4.MX.A.phsB.cVal.ang.f	ILV B - Angle	ILVB_ANG_METER_ID	METER
ILVMMXU4.MX.A.phsC.cVal.mag.f	ILV C - Magnitude	ILVC_MAG_METER_ID	METER
ILVMMXU4.MX.A.phsC.cVal.ang.f	ILV C - Angle	ILVC_ANG_METER_ID	METER

IO87MMXU1

This section defines the logical node data for IO87MMXU1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IO87MMXU1.MX.A.phsA.cVal.mag.f	IA Operating Current	IA_OPER_METER_ID	METER
IO87MMXU1.MX.A.phsB.cVal.mag.f	IB Operating Current	IB_OPER_METER_ID	METER
IO87MMXU1.MX.A.phsC.cVal.mag.f	IC Operating Current	IC_OPER_METER_ID	METER

IR87MMXU2

This section defines the logical node data for IR87MMXU2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IR87MMXU2.MX.A.phsA.cVal.mag.f	IA Restraint Current	IA_RESTR_METER_ID	METER
IR87MMXU2.MX.A.phsB.cVal.mag.f	IB Restraint Current	IB_RESTR_METER_ID	METER
IR87MMXU2.MX.A.phsC.cVal.mag.f	IC Restraint Current	IC_RESTR_METER_ID	METER

TFI2tMMXU3

This section defines the logical node data for TFI2tMMXU3 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
TFI2tMMXU3.MX.A.phsA.cVal.mag.f	I2T A Phase Accumulated Current	I2TA_ACCUM_METER_ID	METER
TFI2tMMXU3.MX.A.phsB.cVal.mag.f	I2T B Phase Accumulated Current	I2TB_ACCUM_METER_ID	METER

TFI2tMMXU3.MX.A.phsC.cVal.mag.f	I2T C Phase Accumulated Current	I2TC_ACCUM_METER_ID	METER

IO87NMMXN1

This section defines the logical node data for IO87NMMXN1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IO87NMMXN1.MX.Amp.mag.f	87N IN REF Operating Current	IN_REF_IO_METER_ID	METER

IR87NMMXN2

This section defines the logical node data for IR87NMMXN2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IR87NMMXN2.MX.Amp.mag.f	87N IN REF Restraint Current	IN_REF_IR_METER_ID	METER

IHV49MMXN3

This section defines the logical node data for IHV49MMXN3 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IHV49MMXN3.MX.Amp.mag.f	49 HV Current	D49_IHV_CURRENT_METER_ID	METER

ILV49MMXN4

This section defines the logical node data for ILV49MMXN4 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
ILV49MMXN4.MX.Amp.mag.f	49 LV Current	D49_ILV_CURRENT_METER_ID	METER

HV2HaMHAI1

This section defines the logical node data for HV2HaMHAI1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
HV2HaMHAI1.MX.HA.phsAHar[2].cVal.mag.f	HV 2nd Harmonic A Phase Current	IAHV_2ND_HARM_MAG_METER_ID	METER
HV2HaMHAI1.MX.HA.phsBHar[2].cVal.mag.f	HV 2nd Harmonic B Phase Current	IBHV_2ND_HARM_MAG_METER_ID	METER
HV2HaMHAI1.MX.HA.phsCHar[2].cVal.mag.f	HV 2nd Harmonic C Phase Current	ICHV_2ND_HARM_MAG_METER_ID	METER

LV2HaMHAI2

This section defines the logical node data for LV2HaMHAI2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
LV2HaMHAI2.MX.HA.phsAHar[2].cVal.mag.f	LV 2nd Harmonic A Phase Current	IALV_2ND_HARM_MAG_METER_ID	METER
LV2HaMHAI2.MX.HA.phsBHar[2].cVal.mag.f	LV 2nd Harmonic B Phase Current	IBLV_2ND_HARM_MAG_METER_ID	METER
LV2HaMHAI2.MX.HA.phsCHar[2].cVal.mag.f	LV 2nd Harmonic C Phase Current	ICLV_2ND_HARM_MAG_METER_ID	METER

I1_2HaMHAI3

This section defines the logical node data for I12_HaMHAI3 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I1_2HaMHAI3.MX.HA.phsAHar[2].cVal.mag.f	I1 2nd Harmonic A Phase Current	I1A_2ND_HARM_MAG_METER_ID	METER
I1_2HaMHAI3.MX.HA.phsBHar[2].cVal.mag.f	I1 2nd Harmonic B Phase Current	I1B_2ND_HARM_MAG_METER_ID	METER
I1_2HaMHAI3.MX.HA.phsCHar[2].cVal.mag.f	I1 2nd Harmonic C Phase Current	I1C_2ND_HARM_MAG_METER_ID	METER

I2_2HaMHAI4

This section defines the logical node data for I2_2HaMHAI4 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I2_2HaMHAI4.MX.HA.phsAHar[2].cVal.mag.f	I2 2nd Harmonic A Phase Current	I2A_2ND_HARM_MAG_METER_ID	METER

I2_2HaMHAI4.MX.HA.phsBHar[2].cVal.mag .f	I2 2nd Harmonic B Phase Current	I2B_2ND_HARM_MAG_M ETER_ID	METER
I2_2HaMHAI4.MX.HA.phsCHar[2].cVal.mag .f	I2 2nd Harmonic C Phase Current	I2C_2ND_HARM_MAG_M ETER_ID	METER

I1_5HaMHAI5

This section defines the logical node data for I1_5HaMHAI5 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I1_5HaMHAI5.MX.HA.phsAHar[5].cVal.mag .f	I1 5TH Harmonic A Phase Current	I1A_5TH_HARM_MAG_M ETER_ID	METER
I1_5HaMHAI5.MX.HA.phsBHar[5].cVal.mag .f	I1 5TH Harmonic B Phase Current	I1B_5TH_HARM_MAG_M ETER_ID	METER
I1_5HaMHAI5.MX.HA.phsCHar[5].cVal.mag .f	I1 5TH Harmonic C Phase Current	I1C_5TH_HARM_MAG_M ETER_ID	METER

I2_5HaMHAI6

This section defines the logical node data for I2_5HaMHAI6 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I2_5HaMHAI6.MX.HA.phsAHar[5].cVal.mag .f	I2 5TH Harmonic A Phase Current	I2A_5TH_HARM_MAG_M ETER_ID	METER
I2_5HaMHAI6.MX.HA.phsBHar[5].cVal.mag .f	I2 5TH Harmonic B Phase Current	I2B_5TH_HARM_MAG_M ETER_ID	METER
I2_5HaMHAI6.MX.HA.phsCHar[5].cVal.mag .f	I2 5TH Harmonic C Phase Current	I2C_5TH_HARM_MAG_M ETER_ID	METER

MTHDMHAI1

This section defines the logical node data for MTHDMHAI1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
MTHDMHAI1.MX.ThdPhV.phsA.mag.f	THD %	THD_METER_ID	METER

IHV3I0MSQI1

This section defines the logical node data for IHV3I0MSQI1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
IHV3I0MSQI1.MX.SeqA.c3.cVal.mag.f	HV 3I0 - Magnitude	HV_3I0_MAG_METER_ID	METER
IHV3I0MSQI1.MX.SeqA.c3.cVal.ang.f	HV 3I0 - Angle	HV_3I0_ANG_METER_ID	METER

ILV3I0MSQI2

This section defines the logical node data for ILV3I0MSQI2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
ILV3I0MSQI2.MX.SeqA.c3.cVal.mag.f	LV 3I0 - Magnitude	LV_3I0_MAG_METER_ID	METER
ILV3I0MSQI2.MX.SeqA.c3.cVal.ang.f	LV 3I0 - Angle	LV_3I0_ANG_METER_ID	METER

I1SeqMSQI1

This section defines the logical node data for I1SeqMSQI1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I1SeqMSQI1.MX.SeqA.c1.cVal.mag.f	I1 Positive Sequence Current	I1_POS_METER_ID	METER
I1SeqMSQI1.MX.SeqA.c2.cVal.mag.f	I1 Negative Sequence Current	I1_NEG_METER_ID	METER
I1SeqMSQI1.MX.SeqA.c3.cVal.mag.f	I1 Zero Sequence Current	I1_ZERO_METER_ID	METER

I2SeqMSQI2

This section defines the logical node data for I2SeqMSQI2 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
I2SeqMSQI2.MX.SeqA.c1.cVal.mag.f	I2 Positive Sequence Current	I2_POS_METER_ID	METER
I2SeqMSQI2.MX.SeqA.c2.cVal.mag.f	I2 Negative Sequence Current	I2_NEG_METER_ID	METER
I2SeqMSQI2.MX.SeqA.c3.cVal.mag.f	I2 Zero Sequence Current	I2_ZERO_METER_ID	METER

MVHzMMXU1

This section defines the logical node data for MVHzMMXU1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
MVHzMMXU1.MX.VHz.mag.f	V/F %	V_F_METER_ID	METER

TFMMTHR1

This section defines the logical node data for TFMMTHR1 of the Measurements logical device.

Data Name	Description	IEC61850 Index	Source
TFMMTHR1.MX.Tmp01.mag.f	Number of Through Faults count	THRUFLT_COUNT_METER_ID	METER

DRRDRE1

This section defines the logical node data for DRRDRE1 of the Records logical device.

Data Name	Description	IEC61850 Index	Source
DRRDRE1.ST.RcdStr.stVal	Disturbance Recording Started	RECORD_DIR_MEM_USED_RDID	SRC_RECORD_HANDLER
DRRDRE1.ST.RcdMade.stVal	Disturbance Recording Made	RECORD_MADE_RDID	SRC_RECORD_HANDLER
DRRDRE1.ST.FltNum.stVal	Fault Number	RECORD_FAULT_NUM_RDID	SRC_RECORD_HANDLER
DRRDRE1.ST.MemUsed.stVal	% Memory Used to store DR	RECORD_START_RDID	SRC_RECORD_HANDLER

Logical Nodes for Generic References (LN Group G...)

IRIGGGIO1

This section defines the logical node data IRIGGGIO1 of the System logical device.

Data Name	Description	IEC61850 Index	Source
IRIGGGIO1.ST.Ind1.stVal	IRIG-B Functional Status Info.	IRIG_B_EVID	EVENT_HANDLER

SNTPGGIO2

This section defines part of the logical node data for the logical node SNTPG-GIO2 of System logical device.

Data Name	Description	IEC61850 Index	Source
SNTPGGIO2.ST.Ind2.stVal	SNTP Functional Status Info.	SNTP_EVID	EVENT_HANDLER

HEALTHYGGIO3

This section defines the logical node data for the logical node HEALTHYG-GIO3 of the System logical device.

Data Name	Description	IEC61850 Index	Source
HEALTHYGGIO3.ST.Ind3.stVal	Relay Healthy Status Info.	LED1_STATUS_ID	STATUS_HANDLER

ComAlmGGIO4

This section defines the logical node data for the logical node ComAlmGGIO4 of the System logical device.

Data Name	Description	IEC61850 Index	Source
ComAlmGGIO4.ST.Ind1.stVal	IEC61850 Comm. Alarm Status Info.	GOOSE_COMM_ALARM_ON_EVID, GOOSE_COMM_ALARM_OFF_EVID	EVENT_HANDLER

EIGGIO1

This section defines the logical node data for the logical node EIGGIO1 of the System logical device.

Data Name	Description	IEC61850 Index	Source
EIGGIO1.ST.Ind1.stVal	External Input - 1	EXT_INPUT1_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind2.stVal	External Input - 2	EXT_INPUT2_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind3.stVal	External Input - 3	EXT_INPUT3_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind4.stVal	External Input - 4	EXT_INPUT4_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind5.stVal	External Input – 5	EXT_INPUT5_STATUS_ID	STATUS_HANDLER

EIGGIO1.ST.Ind6.stVal	External Input – 6	EXT_INPUT6_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind7.stVal	External Input – 7	EXT_INPUT7_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind8.stVal	External Input – 8	EXT_INPUT8_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind9.stVal	External Input – 9	EXT_INPUT9_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind10.stVal	External Input – 10	EXT_INPUT10_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind11.stVal	External Input – 11	EXT_INPUT11_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind12.stVal	External Input – 12	EXT_INPUT12_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind13.stVal	External Input – 13	EXT_INPUT13_STATUS_ID	STATUS_HANDLER
EIGGIO1.ST.Ind14.stVal	External Input - 14	EXT_INPUT14_STATUS_ID	STATUS_HANDLER

OCGGIO2

This section defines the logical node data for the logical node OCGGIO2 of the System logical device.

Data Name	Description	IEC61850 Index	Source
OCGGIO2.ST.Ind1.stVal	Output Contact - 1	OUT1_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind2.stVal	Output Contact - 2	OUT2_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind3.stVal	Output Contact - 3	OUT3_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind4.stVal	Output Contact - 4	OUT4_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind5.stVal	Output Contact - 5	OUT5_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind6.stVal	Output Contact - 6	OUT6_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind7.stVal	Output Contact - 7	OUT7_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind8.stVal	Output Contact - 8	OUT8_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind9.stVal	Output Contact – 9	OUT9_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind10.stVal	Output Contact – 10	OUT10_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind11.stVal	Output Contact – 11	OUT11_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind12.stVal	Output Contact – 12	OUT12_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind13.stVal	Output Contact – 13	OUT13_STATUS_ID	STATUS_HANDLER
OCGGIO2.ST.Ind14.stVal	Output Contact - 14	OUT14_STATUS_ID	STATUS_HANDLER

LEDGGIO3

This section defines the logical node data for the logical node LEDGGIO3 of the System logical device.

Data Name	Description	IEC61850 Index	Source
LEDGGIO3.ST.Ind1.stVal	LED Status- 1	LED1_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind2.stVal	LED Status- 2	LED2_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind3.stVal	LED Status- 3	LED3_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind4.stVal	LED Status- 4	LED4_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind5.stVal	LED Status- 5	LED5_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind6.stVal	LED Status- 6	LED6_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind7.stVal	LED Status- 7	LED7_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind8.stVal	LED Status- 8	LED8_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind9.stVal	LED Status- 9	LED9_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind10.stVal	LED Status- 10	LED10_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind11.stVal	LED Status- 11	LED11_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind12.stVal	LED Status- 12	LED12_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind13.stVal	LED Status- 13	LED13_STATUS_ID	STATUS_HANDLER
LEDGGIO3.ST.Ind14.stVal	LED Status- 14	LED14_STATUS_ID	STATUS_HANDLER

PLGGIO1

This section defines the logical node data for the logical node PLGGIO1 of the System logical device.

Data Name	Description	IEC61850 Index	Source
PLGGIO1.ST.Ind1.stVal	Prologic - 1	PROLOGIC1_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind2.stVal	Prologic – 2	PROLOGIC2_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind3.stVal	Prologic – 3	PROLOGIC3_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind4.stVal	Prologic – 4	PROLOGIC4_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind5.stVal	Prologic – 5	PROLOGIC5_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind6.stVal	Prologic – 6	PROLOGIC6_STATUS_ID	STATUS_HANDLER

PLGGIO1.ST.Ind7.stVal	Prologic – 7	PROLOGIC7_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind8.stVal	Prologic – 8	PROLOGIC8_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind9.stVal	Prologic – 9	PROLOGIC9_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind10.stVal	Prologic – 10	PROLOGIC10_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind11.stVal	Prologic – 11	PROLOGIC11_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind12.stVal	Prologic – 12	PROLOGIC12_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind13.stVal	Prologic – 13	PROLOGIC13_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind14.stVal	Prologic – 14	PROLOGIC14_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind15.stVal	Prologic – 15	PROLOGIC15_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind16.stVal	Prologic – 16	PROLOGIC16_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind17.stVal	Prologic – 17	PROLOGIC17_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind18.stVal	Prologic – 18	PROLOGIC18_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind19.stVal	Prologic – 19	PROLOGIC19_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind20.stVal	Prologic – 20	PROLOGIC20_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind21.stVal	Prologic – 21	PROLOGIC21_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind22.stVal	Prologic – 22	PROLOGIC22_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind23.stVal	Prologic – 23	PROLOGIC23_STATUS_ID	STATUS_HANDLER
PLGGIO1.ST.Ind24.stVal	Prologic – 24	PROLOGIC24_STATUS_ID	STATUS_HANDLER

Logical Nodes for Virtual Elements (LN Group G...)

VIGGIO1

This section defines the logical node data for the logical node VIGGIO1 of the System logical device.

Data Name	Description	IEC61850 Index	Source
VIGGIO1.ST.Ind1.stVal	Virtual Input – 1	VI1_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind2.stVal	Virtual Input – 2	VI2_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind3.stVal	Virtual Input – 3	VI3_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind4.stVal	Virtual Input – 4	VI4_STATUS_ID	STATUS_HANDLER

VIGGIO1.ST.Ind5.stVal	Virtual Input – 5	VI5_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind6.stVal	Virtual Input – 6	VI6_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind7.stVal	Virtual Input – 7	VI7_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind8.stVal	Virtual Input – 8	VI8_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind9.stVal	Virtual Input – 9	VI9_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind10.stVal	Virtual Input – 10	VI10_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind11.stVal	Virtual Input – 11	VI11_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind12.stVal	Virtual Input – 12	VI12_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind13.stVal	Virtual Input – 13	VI13_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind14.stVal	Virtual Input – 14	VI14_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind15.stVal	Virtual Input – 15	VI15_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind16.stVal	Virtual Input – 16	VI16_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind17.stVal	Virtual Input – 17	VI17_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind18.stVal	Virtual Input – 18	VI18_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind19.stVal	Virtual Input – 19	VI19_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind20.stVal	Virtual Input – 20	VI20_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind21.stVal	Virtual Input – 21	VI21_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind22.stVal	Virtual Input – 22	VI22_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind23.stVal	Virtual Input – 23	VI23_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind24.stVal	Virtual Input – 24	VI24_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind25.stVal	Virtual Input – 25	VI25_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind26.stVal	Virtual Input – 26	VI26_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind27.stVal	Virtual Input – 27	VI27_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind28.stVal	Virtual Input – 28	VI28_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind29.stVal	Virtual Input – 29	VI29_STATUS_ID	STATUS_HANDLER
VIGGIO1.ST.Ind30.stVal	Virtual Input – 30	VI30_STATUS_ID	STATUS_HANDLER

Logical Nodes for Fault Data (LN Group G…)

D87TIOMMXU1

This section defines the logical node data for the logical node D87TIOM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D87TIOMMXU1.MX.A.phsA.cVal.mag.f	87 IO A Phase Current	D87_IO_A_MAG_FDID	FAULT_LOG
D87TIOMMXU1.MX.A.phsB.cVal.mag.f	87 IO B Phase Current	D87_IO_B_MAG_FDID	FAULT_LOG
D87TIOMMXU1.MX.A.phsC.cVal.mag.f	87 IO C Phase Current	D87_IO_C_MAG_FDID	FAULT_LOG

D87TIRMMXU2

This section defines the logical node data for the logical node D87TIRM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D87TIRMMXU2.MX.A.phsA.cVal.mag.f	87 IR A Phase Current	D87_IR_A_MAG_FDID	FAULT_LOG
D87TIRMMXU2.MX.A.phsB.cVal.mag.f	87 IR B Phase Current	D87_IR_B_MAG_FDID	FAULT_LOG
D87TIRMMXU2.MX.A.phsC.cVal.mag.f	87 IR C Phase Current	D87_IR_C_MAG_FDID	FAULT_LOG

D87NIOMMXN1

This section defines the logical node data for the logical node D87NIOM-MXN1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D87NIOMMXN1.MX.Amp.mag.f	87N REF Operating Current	D87N_REF_IO_FDID	FAULT_LOG

D87NIOMMXN2

This section defines the logical node data for the logical node D87NIRM-MXN2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D87NIRMMXN2.MX.Amp.mag.f	87N REF Restraint Current	D87N_REF_IR_FDID	FAULT_LOG

D49HVMMXU1

This section defines the common HV logical node data for the logical node D49HVMMXU1 of the FaultData logical device for 49-1 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU1.MX.A.phsA.cVal.mag.f	49-1 HV A phase Magnitude	D49_1_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU1.MX.A.phsA.cVal.ang.f	49-1 HV A phase Angle	D49_1_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU1.MX.A.phsB.cVal.mag.f	49-1 HV B phase Magnitude	D49_1_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU1.MX.A.phsB.cVal.ang.f	49-1 HV B phase Angle	D49_1_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU1.MX.A.phsC.cVal.mag.f	49-1 HV C phase Magnitude	D49_1_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU1.MX.A.phsC.cVal.ang.f	49-1 HV C phase Angle	D49_1_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU1

This section defines the common LV logical node data for the logical node D49LVMMXU1 of the FaultData logical device for 49-1 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU1.MX.A.phsA.cVal.mag.f	49-1 LV A phase Magnitude	D49_1_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU1.MX.A.phsA.cVal.ang.f	49-1 LV A phase Angle	D49_1_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU1.MX.A.phsB.cVal.mag.f	49-1 LV B phase Magnitude	D49_1_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU1.MX.A.phsB.cVal.ang.f	49-1 LV B phase Angle	D49_1_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU1.MX.A.phsC.cVal.mag.f	49-1 LV C phase Magnitude	D49_1_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU1.MX.A.phsC.cVal.ang.f	49-1 LV C phase Angle	D49_1_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU2

This section defines the common HV logical node data for the logical node D49HVMMXU2 of the FaultData logical device for 49-2 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU2.MX.A.phsA.cVal.mag.f	49-2 HV A phase Magnitude	D49_2_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU2.MX.A.phsA.cVal.ang.f	49-2 HV A phase Angle	D49_2_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU2.MX.A.phsB.cVal.mag.f	49-2 HV B phase Magnitude	D49_2_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU2.MX.A.phsB.cVal.ang.f	49-2 HV B phase Angle	D49_2_IHV_B_ANG_FDID	FAULT_LOG

D49HVMMXU2.MX.A.phsC.cVal.mag.f	49-2 HV C phase Magnitude	D49_2_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU2.MX.A.phsC.cVal.ang.f	49-2 HV C phase Angle	D49_2_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU2

This section defines the common LV logical node data for the logical node D49LVMMXU2 of the FaultData logical device for 49-2 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU2.MX.A.phsA.cVal.mag.f	49-2 LV A phase Magnitude	D49_2_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU2.MX.A.phsA.cVal.ang.f	49-2 LV A phase Angle	D49_2_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU2.MX.A.phsB.cVal.mag.f	49-2 LV B phase Magnitude	D49_2_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU2.MX.A.phsB.cVal.ang.f	49-2 LV B phase Angle	D49_2_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU2.MX.A.phsC.cVal.mag.f	49-2 LV C phase Magnitude	D49_2_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU2.MX.A.phsC.cVal.ang.f	49-2 LV C phase Angle	D49_2_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU3

This section defines the common HV logical node data for the logical node D49HVMMXU3 of the FaultData logical device for 49-3 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU3.MX.A.phsA.cVal.mag.f	49-3 HV A phase Magnitude	D49_3_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU3.MX.A.phsA.cVal.ang.f	49-3 HV A phase Angle	D49_3_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU3.MX.A.phsB.cVal.mag.f	49-3 HV B phase Magnitude	D49_3_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU3.MX.A.phsB.cVal.ang.f	49-3 HV B phase Angle	D49_3_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU3.MX.A.phsC.cVal.mag.f	49-3 HV C phase Magnitude	D49_3_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU3.MX.A.phsC.cVal.ang.f	49-3 HV C phase Angle	D49_3_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU3

This section defines the common LV logical node data for the logical node D49LVMMXU3 of the FaultData logical device for 49-3 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU3.MX.A.phsA.cVal.mag.f	49-3 LV A phase Magnitude	D49_3_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU3.MX.A.phsA.cVal.ang.f	49-3 LV A phase Angle	D49_3_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU3.MX.A.phsB.cVal.mag.f	49-3 LV B phase Magnitude	D49_3_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU3.MX.A.phsB.cVal.ang.f	49-3 LV B phase Angle	D49_3_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU3.MX.A.phsC.cVal.mag.f	49-3 LV C phase Magnitude	D49_3_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU3.MX.A.phsC.cVal.ang.f	49-3 LV C phase Angle	D49_3_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU4

This section defines the common HV logical node data for the logical node D49HVMMXU4 of the FaultData logical device for 49-4 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU4.MX.A.phsA.cVal.mag.f	49-4 HV A phase Magnitude	D49_4_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU4.MX.A.phsA.cVal.ang.f	49-4 HV A phase Angle	D49_4_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU4.MX.A.phsB.cVal.mag.f	49-4 HV B phase Magnitude	D49_4_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU4.MX.A.phsB.cVal.ang.f	49-4 HV B phase Angle	D49_4_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU4.MX.A.phsC.cVal.mag.f	49-4 HV C phase Magnitude	D49_4_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU4.MX.A.phsC.cVal.ang.f	49-4 HV C phase Angle	D49_4_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU4

This section defines the common LV logical node data for the logical node D49LVMMXU4 of the FaultData logical device for 49-4 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU4.MX.A.phsA.cVal.mag.f	49-4 LV A phase Magnitude	D49_4_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU4.MX.A.phsA.cVal.ang.f	49-4 LV A phase Angle	D49_4_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU4.MX.A.phsB.cVal.mag.f	49-4 LV B phase Magnitude	D49_4_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU4.MX.A.phsB.cVal.ang.f	49-4 LV B phase Angle	D49_4_ILV_B_ANG_FDID	FAULT_LOG

D49LVMMXU4.MX.A.phsC.cVal.mag.f	49-4 LV C phase Magnitude	D49_4_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU4.MX.A.phsC.cVal.ang.f	49-4 LV C phase Angle	D49_4_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU5

This section defines the common HV logical node data for the logical node D49HVMMXU5 of the FaultData logical device for 49-5 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU5.MX.A.phsA.cVal.mag.f	49-5 HV A phase Magnitude	D49_5_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU5.MX.A.phsA.cVal.ang.f	49-5 HV A phase Angle	D49_5_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU5.MX.A.phsB.cVal.mag.f	49-5 HV B phase Magnitude	D49_5_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU5.MX.A.phsB.cVal.ang.f	49-5 HV B phase Angle	D49_5_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU5.MX.A.phsC.cVal.mag.f	49-5 HV C phase Magnitude	D49_5_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU5.MX.A.phsC.cVal.ang.f	49-5 HV C phase Angle	D49_5_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU5

This section defines the common LV logical node data for the logical node D49LVMMXU5 of the FaultData logical device for 49-5 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU5.MX.A.phsA.cVal.mag.f	49-5 LV A phase Magnitude	D49_5_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU5.MX.A.phsA.cVal.ang.f	49-5 LV A phase Angle	D49_5_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU5.MX.A.phsB.cVal.mag.f	49-5 LV B phase Magnitude	D49_5_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU5.MX.A.phsB.cVal.ang.f	49-5 LV B phase Angle	D49_5_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU5.MX.A.phsC.cVal.mag.f	49-5 LV C phase Magnitude	D49_5_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU5.MX.A.phsC.cVal.ang.f	49-5 LV C phase Angle	D49_5_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU6

This section defines the common HV logical node data for the logical node D49HVMMXU6 of the FaultData logical device for 49-6 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU6.MX.A.phsA.cVal.mag.f	49-6 HV A phase Magnitude	D49_6_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU6.MX.A.phsA.cVal.ang.f	49-6 HV A phase Angle	D49_6_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU6.MX.A.phsB.cVal.mag.f	49-6 HV B phase Magnitude	D49_6_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU6.MX.A.phsB.cVal.ang.f	49-6 HV B phase Angle	D49_6_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU6.MX.A.phsC.cVal.mag.f	49-6 HV C phase Magnitude	D49_6_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU6.MX.A.phsC.cVal.ang.f	49-6 HV C phase Angle	D49_6_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU6

This section defines the common LV logical node data for the logical node D49LVMMXU6 of the FaultData logical device for 49-6 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU6.MX.A.phsA.cVal.mag.f	49-6 LV A phase Magnitude	D49_6_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU6.MX.A.phsA.cVal.ang.f	49-6 LV A phase Angle	D49_6_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU6.MX.A.phsB.cVal.mag.f	49-6 LV B phase Magnitude	D49_6_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU6.MX.A.phsB.cVal.ang.f	49-6 LV B phase Angle	D49_6_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU6.MX.A.phsC.cVal.mag.f	49-6 LV C phase Magnitude	D49_6_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU6.MX.A.phsC.cVal.ang.f	49-6 LV C phase Angle	D49_6_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU7

This section defines the common HV logical node data for the logical node D49HVMMXU7 of the FaultData logical device for 49-7 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU7.MX.A.phsA.cVal.mag.f	49-7 HV A phase Magnitude	D49_7_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU7.MX.A.phsA.cVal.ang.f	49-7 HV A phase Angle	D49_7_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU7.MX.A.phsB.cVal.mag.f	49-7 HV B phase Magnitude	D49_7_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU7.MX.A.phsB.cVal.ang.f	49-7 HV B phase Angle	D49_7_IHV_B_ANG_FDID	FAULT_LOG

D49HVMMXU7.MX.A.phsC.cVal.mag.f	49-7 HV C phase Magnitude	D49_7_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU7.MX.A.phsC.cVal.ang.f	49-7 HV C phase Angle	D49_7_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU7

This section defines the common LV logical node data for the logical node D49LVMMXU7 of the FaultData logical device for 49-7 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU7.MX.A.phsA.cVal.mag.f	49-7 LV A phase Magnitude	D49_7_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU7.MX.A.phsA.cVal.ang.f	49-7 LV A phase Angle	D49_7_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU7.MX.A.phsB.cVal.mag.f	49-7 LV B phase Magnitude	D49_7_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU7.MX.A.phsB.cVal.ang.f	49-7 LV B phase Angle	D49_7_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU7.MX.A.phsC.cVal.mag.f	49-7 LV C phase Magnitude	D49_7_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU7.MX.A.phsC.cVal.ang.f	49-7 LV C phase Angle	D49_7_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU8

This section defines the common HV logical node data for the logical node D49HVMMXU8 of the FaultData logical device for 49-8 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU8.MX.A.phsA.cVal.mag.f	49-8 HV A phase Magnitude	D49_8_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU8.MX.A.phsA.cVal.ang.f	49-8 HV A phase Angle	D49_8_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU8.MX.A.phsB.cVal.mag.f	49-8 HV B phase Magnitude	D49_8_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU8.MX.A.phsB.cVal.ang.f	49-8 HV B phase Angle	D49_8_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU8.MX.A.phsC.cVal.mag.f	49-8 HV C phase Magnitude	D49_8_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU8.MX.A.phsC.cVal.ang.f	49-8 HV C phase Angle	D49_8_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU8

This section defines the common LV logical node data for the logical node D49LVMMXU8 of the FaultData logical device for 49-8 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU8.MX.A.phsA.cVal.mag.f	49-8 LV A phase Magnitude	D49_8_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU8.MX.A.phsA.cVal.ang.f	49-8 LV A phase Angle	D49_8_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU8.MX.A.phsB.cVal.mag.f	49-8 LV B phase Magnitude	D49_8_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU8.MX.A.phsB.cVal.ang.f	49-8 LV B phase Angle	D49_8_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU8.MX.A.phsC.cVal.mag.f	49-8 LV C phase Magnitude	D49_8_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU8.MX.A.phsC.cVal.ang.f	49-8 LV C phase Angle	D49_8_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU9

This section defines the common HV logical node data for the logical node D49HVMMXU9 of the FaultData logical device for 49-9 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU9.MX.A.phsA.cVal.mag.f	49-9 HV A phase Magnitude	D49_9_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU9.MX.A.phsA.cVal.ang.f	49-9 HV A phase Angle	D49_9_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU9.MX.A.phsB.cVal.mag.f	49-9 HV B phase Magnitude	D49_9_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU9.MX.A.phsB.cVal.ang.f	49-9 HV B phase Angle	D49_9_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU9.MX.A.phsC.cVal.mag.f	49-9 HV C phase Magnitude	D49_9_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU9.MX.A.phsC.cVal.ang.f	49-9 HV C phase Angle	D49_9_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU9

This section defines the common LV logical node data for the logical node D49LVMMXU9 of the FaultData logical device for 49-9 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU9.MX.A.phsA.cVal.mag.f	49-9 LV A phase Magnitude	D49_9_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU9.MX.A.phsA.cVal.ang.f	49-9 LV A phase Angle	D49_9_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU9.MX.A.phsB.cVal.mag.f	49-9 LV B phase Magnitude	D49_9_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU9.MX.A.phsB.cVal.ang.f	49-9 LV B phase Angle	D49_9_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU9.MX.A.phsC.cVal.mag.f	49-9 LV C phase Magnitude	D49_9_ILV_C_MAG_FDID	FAULT_LOG

D49LVMMXU9.MX.A.phsC.cVal.ang.f	49-9 LV C phase Angle	D49_9_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU10

This section defines the common HV logical node data for the logical node D49HVMMXU10 of the FaultData logical device for 49-10 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU10.MX.A.phsA.cVal.mag.f	49-10 HV A phase Magnitude	D49_10_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU10.MX.A.phsA.cVal.ang.f	49-10 HV A phase Angle	D49_10_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU10.MX.A.phsB.cVal.mag.f	49-10 HV B phase Magnitude	D49_10_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU10.MX.A.phsB.cVal.ang.f	49-10 HV B phase Angle	D49_10_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU10.MX.A.phsC.cVal.mag.f	49-10 HV C phase Magnitude	D49_10_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU10.MX.A.phsC.cVal.ang.f	49-10 HV C phase Angle	D49_10_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU10

This section defines the common LV logical node data for the logical node D49LVMMXU10 of the FaultData logical device for 49-10 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU10.MX.A.phsA.cVal.mag.f	49-10 LV A phase Magnitude	D49_10_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU10.MX.A.phsA.cVal.ang.f	49-10 LV A phase Angle	D49_10_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU10.MX.A.phsB.cVal.mag.f	49-10 LV B phase Magnitude	D49_10_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU10.MX.A.phsB.cVal.ang.f	49-10 LV B phase Angle	D49_10_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU10.MX.A.phsC.cVal.mag.f	49-10 LV C phase Magnitude	D49_10_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU10.MX.A.phsC.cVal.ang.f	49-10 LV C phase Angle	D49_10_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU11

This section defines the common HV logical node data for the logical node D49HVMMXU11 of the FaultData logical device for 49-11 HV Function.

Data Name	Description	IEC61850 Index	Source

D49HVMMXU11.MX.A.phsA.cVal.mag.f	49-11 HV A phase Magnitude	D49_11_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU11.MX.A.phsA.cVal.ang.f	49-11 HV A phase Angle	D49_11_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU11.MX.A.phsB.cVal.mag.f	49-11 HV B phase Magnitude	D49_11_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU11.MX.A.phsB.cVal.ang.f	49-11 HV B phase Angle	D49_11_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU11.MX.A.phsC.cVal.mag.f	49-11 HV C phase Magnitude	D49_11_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU11.MX.A.phsC.cVal.ang.f	49-11 HV C phase Angle	D49_11_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU11

This section defines the common LV logical node data for the logical node D49LVMMXU11 of the FaultData logical device for 49-11 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU11.MX.A.phsA.cVal.mag.f	49-11 LV A phase Magnitude	D49_11_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU11.MX.A.phsA.cVal.ang.f	49-11 LV A phase Angle	D49_11_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU11.MX.A.phsB.cVal.mag.f	49-11 LV B phase Magnitude	D49_11_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU11.MX.A.phsB.cVal.ang.f	49-11 LV B phase Angle	D49_11_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU11.MX.A.phsC.cVal.mag.f	49-11 LV C phase Magnitude	D49_11_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU11.MX.A.phsC.cVal.ang.f	49-11 LV C phase Angle	D49_11_ILV_C_ANG_FDID	FAULT_LOG

D49HVMMXU12

This section defines the common HV logical node data for the logical node D49HVMMXU12 of the FaultData logical device for 49-12 HV Function.

Data Name	Description	IEC61850 Index	Source
D49HVMMXU12.MX.A.phsA.cVal.mag.f	49-12 HV A phase Magnitude	D49_12_IHV_A_MAG_FDID	FAULT_LOG
D49HVMMXU12.MX.A.phsA.cVal.ang.f	49-12 HV A phase Angle	D49_12_IHV_A_ANG_FDID	FAULT_LOG
D49HVMMXU12.MX.A.phsB.cVal.mag.f	49-12 HV B phase Magnitude	D49_12_IHV_B_MAG_FDID	FAULT_LOG
D49HVMMXU12.MX.A.phsB.cVal.ang.f	49-12 HV B phase Angle	D49_12_IHV_B_ANG_FDID	FAULT_LOG
D49HVMMXU12.MX.A.phsC.cVal.mag.f	49-12 HV C phase Magnitude	D49_12_IHV_C_MAG_FDID	FAULT_LOG
D49HVMMXU12.MX.A.phsC.cVal.ang.f	49-12 HV C phase Angle	D49_12_IHV_C_ANG_FDID	FAULT_LOG

D49LVMMXU12

This section defines the common LV logical node data for the logical node D49LVMMXU12 of the FaultData logical device for 49-12 LV Function.

Data Name	Description	IEC61850 Index	Source
D49LVMMXU12.MX.A.phsA.cVal.mag.f	49-12 LV A phase Magnitude	D49_12_ILV_A_MAG_FDID	FAULT_LOG
D49LVMMXU12.MX.A.phsA.cVal.ang.f	49-12 LV A phase Angle	D49_12_ILV_A_ANG_FDID	FAULT_LOG
D49LVMMXU12.MX.A.phsB.cVal.mag.f	49-12 LV B phase Magnitude	D49_12_ILV_B_MAG_FDID	FAULT_LOG
D49LVMMXU12.MX.A.phsB.cVal.ang.f	49-12 LV B phase Angle	D49_12_ILV_B_ANG_FDID	FAULT_LOG
D49LVMMXU12.MX.A.phsC.cVal.mag.f	49-12 LV C phase Magnitude	D49_12_ILV_C_MAG_FDID	FAULT_LOG
D49LVMMXU12.MX.A.phsC.cVal.ang.f	49-12 LV C phase Angle	D49_12_ILV_C_ANG_FDID	FAULT_LOG

D50HVMMXU1

This section defines the logical node data for the logical node D50HVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50HVMMXU1.MX.A.phsA.cVal.mag.f	50-1 HV A Phase Magnitude	D50_HV_1_A_MAG_FDID	FAULT_LOG
D50HVMMXU1.MX.A.phsA.cVal.ang.f	50-1 HV A Phase Angle	D50_HV_1_A_ANG_FDID	FAULT_LOG
D50HVMMXU1.MX.A.phsB.cVal.mag.f	50-1 HV B Phase Magnitude	D50_HV_1_B_MAG_FDID	FAULT_LOG
D50HVMMXU1.MX.A.phsB.cVal.ang.f	50-1 HV B Phase Angle	D50_HV_1_B_ANG_FDID	FAULT_LOG
D50HVMMXU1.MX.A.phsC.cVal.mag.f	50-1 HV C Phase Magnitude	D50_HV_1_C_MAG_FDID	FAULT_LOG
D50HVMMXU1.MX.A.phsC.cVal.ang.f	50-1 HV C Phase Angle	D50_HV_1_C_ANG_FDID	FAULT_LOG

D50HVMMXU2

This section defines the logical node data for the logical node D50HVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50HVMMXU2.MX.A.phsA.cVal.mag.f	50-2 HV A Phase Magnitude	D50_HV_2_A_MAG_FDID	FAULT_LOG
D50HVMMXU2.MX.A.phsA.cVal.ang.f	50-2 HV A Phase Angle	D50_HV_2_A_ANG_FDID	FAULT_LOG

D50HVMMXU2.MX.A.phsB.cVal.mag.f	50-2 HV B Phase Magnitude	D50_HV_2_B_MAG_FDID	FAULT_LOG
D50HVMMXU2.MX.A.phsB.cVal.ang.f	50-2 HV B Phase Angle	D50_HV_2_B_ANG_FDID	FAULT_LOG
D50HVMMXU2.MX.A.phsC.cVal.mag.f	50-2 HV C Phase Magnitude	D50_HV_2_C_MAG_FDID	FAULT_LOG
D50HVMMXU2.MX.A.phsC.cVal.ang.f	50-2 HV C Phase Angle	D50_HV_2_C_ANG_FDID	FAULT_LOG

D50LVMMXU1

This section defines the logical node data for the logical node D50LVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50LVMMXU1.MX.A.phsA.cVal.mag.f	50-1 LV A Phase Magnitude	D50_LV_1_A_MAG_FDID	FAULT_LOG
D50LVMMXU1.MX.A.phsA.cVal.ang.f	50-1 LV A Phase Angle	D50_ LV_1_A_ANG_FDID	FAULT_LOG
D50LVMMXU1.MX.A.phsB.cVal.mag.f	50-1 LV B Phase Magnitude	D50_LV_1_B_MAG_FDID	FAULT_LOG
D50LVMMXU1.MX.A.phsB.cVal.ang.f	50-1 LV B Phase Angle	D50_LV_1_B_ANG_FDID	FAULT_LOG
D50LVMMXU1.MX.A.phsC.cVal.mag.f	50-1 LV C Phase Magnitude	D50_LV_1_C_MAG_FDID	FAULT_LOG
D50LVMMXU1.MX.A.phsC.cVal.ang.f	50-1 LV C Phase Angle	D50_LV_1_C_ANG_FDID	FAULT_LOG

D50LVMMXU2

This section defines the logical node data for the logical node D50LVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50LVMMXU2.MX.A.phsA.cVal.mag.f	50-2 LV A Phase Magnitude	D50_LV_2_A_MAG_FDID	FAULT_LOG
D50LVMMXU2.MX.A.phsA.cVal.ang.f	50-2 LV A Phase Angle	D50_LV_2_A_ANG_FDID	FAULT_LOG
D50LVMMXU2.MX.A.phsB.cVal.mag.f	50-2 LV B Phase Magnitude	D50_LV_2_B_MAG_FDID	FAULT_LOG
D50LVMMXU2.MX.A.phsB.cVal.ang.f	50-2 LV B Phase Angle	D50_LV_2_B_ANG_FDID	FAULT_LOG
D50LVMMXU2.MX.A.phsC.cVal.mag.f	50-2 LV C Phase Magnitude	D50_LV_2_C_MAG_FDID	FAULT_LOG
D50LVMMXU2.MX.A.phsC.cVal.ang.f	50-2 LV C Phase Angle	D50_LV_2_C_ANG_FDID	FAULT_LOG

D51HVMMXU1

This section defines the logical node data for the logical node D51HVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51HVMMXU1.MX.A.phsA.cVal.mag.f	51-1 HV A Phase Magnitude	D51_HV_1_A_MAG_FDID	FAULT_LOG
D51HVMMXU1.MX.A.phsA.cVal.ang.f	51-1 HV A Phase Angle	D51_HV_1_A_ANG_FDID	FAULT_LOG
D51HVMMXU1.MX.A.phsB.cVal.mag.f	51-1 HV B Phase Magnitude	D51_HV_1_B_MAG_FDID	FAULT_LOG
D51HVMMXU1.MX.A.phsB.cVal.ang.f	51-1 HV B Phase Angle	D51_HV_1_B_ANG_FDID	FAULT_LOG
D51HVMMXU1.MX.A.phsC.cVal.mag.f	51-1 HV C Phase Magnitude	D51_HV_1_C_MAG_FDID	FAULT_LOG
D51HVMMXU1.MX.A.phsC.cVal.ang.f	51-1 HV C Phase Angle	D51_HV_1_C_ANG_FDID	FAULT_LOG

D51HVMMXU2

This section defines the logical node data for the logical node D51HVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51HVMMXU2.MX.A.phsA.cVal.mag.f	51-2 HV A Phase Magnitude	D51_HV_2_A_MAG_FDID	FAULT_LOG
D51HVMMXU2.MX.A.phsA.cVal.ang.f	51-2 HV A Phase Angle	D51_HV_2_A_ANG_FDID	FAULT_LOG
D51HVMMXU2.MX.A.phsB.cVal.mag.f	51-2 HV B Phase Magnitude	D51_HV_2_B_MAG_FDID	FAULT_LOG
D51HVMMXU2.MX.A.phsB.cVal.ang.f	51-2 HV B Phase Angle	D51_HV_2_B_ANG_FDID	FAULT_LOG
D51HVMMXU2.MX.A.phsC.cVal.mag.f	51-2 HV C Phase Magnitude	D51_HV_2_C_MAG_FDID	FAULT_LOG
D51HVMMXU2.MX.A.phsC.cVal.ang.f	51-2 HV C Phase Angle	D51_HV_2_C_ANG_FDID	FAULT_LOG

D51LVMMXU1

This section defines the logical node data for the logical node D51LVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51LVMMXU1.MX.A.phsA.cVal.mag.f	51-1 LV A Phase Magnitude	D51_LV_1_A_MAG_FDID	FAULT_LOG

D51LVMMXU1.MX.A.phsA.cVal.ang.f	51-1 LV A Phase Angle	D51_ LV_1_A_ANG_FDID	FAULT_LOG
D51LVMMXU1.MX.A.phsB.cVal.mag.f	51-1 LV B Phase Magnitude	D51_LV_1_B_MAG_FDID	FAULT_LOG
D51LVMMXU1.MX.A.phsB.cVal.ang.f	51-1 LV B Phase Angle	D51_LV_1_B_ANG_FDID	FAULT_LOG
D51LVMMXU1.MX.A.phsC.cVal.mag.f	51-1 LV C Phase Magnitude	D51_LV_1_C_MAG_FDID	FAULT_LOG
D51LVMMXU1.MX.A.phsC.cVal.ang.f	51-1 LV C Phase Angle	D51_LV_1_C_ANG_FDID	FAULT_LOG

D51LVMMXU2

This section defines the logical node data for the logical node D51LVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51LVMMXU2.MX.A.phsA.cVal.mag.f	51-2 LV A Phase Magnitude	D51_LV_2_A_MAG_FDID	FAULT_LOG
D51LVMMXU2.MX.A.phsA.cVal.ang.f	51-2 LV A Phase Angle	D51_LV_2_A_ANG_FDID	FAULT_LOG
D51LVMMXU2.MX.A.phsB.cVal.mag.f	51-2 LV B Phase Magnitude	D51_LV_2_B_MAG_FDID	FAULT_LOG
D51LVMMXU2.MX.A.phsB.cVal.ang.f	51-2 LV B Phase Angle	D51_LV_2_B_ANG_FDID	FAULT_LOG
D51LVMMXU2.MX.A.phsC.cVal.mag.f	51-2 LV C Phase Magnitude	D51_LV_2_C_MAG_FDID	FAULT_LOG
D51LVMMXU2.MX.A.phsC.cVal.ang.f	51-2 LV C Phase Angle	D51_LV_2_C_ANG_FDID	FAULT_LOG

D50NHVMMXU1

This section defines the logical node data for the logical node D50NHVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NHVMMXU1.MX.A.phsA.cVal.mag.f	50N-1 HV A Phase Magnitude	D50N_HV_1_A_MAG_FDID	FAULT_LOG
D50NHVMMXU1.MX.A.phsA.cVal.ang.f	50N-1 HV A Phase Angle	D50N_HV_1_A_ANG_FDID	FAULT_LOG
D50NHVMMXU1.MX.A.phsB.cVal.mag.f	50N-1 HV B Phase Magnitude	D50N_HV_1_B_MAG_FDID	FAULT_LOG
D50NHVMMXU1.MX.A.phsB.cVal.ang.f	50N-1 HV B Phase Angle	D50N_HV_1_B_ANG_FDID	FAULT_LOG
D50NHVMMXU1.MX.A.phsC.cVal.mag.f	50N-1 HV C Phase Magnitude	D50N_HV_1_C_MAG_FDID	FAULT_LOG
D50NHVMMXU1.MX.A.phsC.cVal.ang.f	50N-1 HV C Phase Angle	D50N_HV_1_C_ANG_FDID	FAULT_LOG

D50NHV3I0MSQI1

This section defines the logical node data for the logical node D50NHV3I0MSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NHV3I0MSQI1.MX$SeqA.c3.cVal.mag.f	50N-1 HV 3I0 Phase Magnitude	D50N_HV_1_3I0_MAG_FDID	FAULT_LOG
D50NHV3I0MSQI1.MX$SeqA.c3.cVal.ang.f	50N-1 HV 3I0 Phase Angle	D50N_HV_1_3I0_ANG_FDID	FAULT_LOG

D50NHVMMXU2

This section defines the logical node data for the logical node D50NHVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NHVMMXU2.MX.A.phsA.cVal.mag.f	50N-2 HV A Phase Magnitude	D50N_HV_2_A_MAG_FDID	FAULT_LOG
D50NHVMMXU2.MX.A.phsA.cVal.ang.f	50N-2 HV A Phase Angle	D50N_HV_2_A_ANG_FDID	FAULT_LOG
D50NHVMMXU2.MX.A.phsB.cVal.mag.f	50N-2 HV B Phase Magnitude	D50N_HV_2_B_MAG_FDID	FAULT_LOG
D50NHVMMXU2.MX.A.phsB.cVal.ang.f	50N-2 HV B Phase Angle	D50N_HV_2_B_ANG_FDID	FAULT_LOG
D50NHVMMXU2.MX.A.phsC.cVal.mag.f	50N-2 HV C Phase Magnitude	D50N_HV_2_C_MAG_FDID	FAULT_LOG
D50NHVMMXU2.MX.A.phsC.cVal.ang.f	50N-2 HV C Phase Angle	D50N_HV_2_C_ANG_FDID	FAULT_LOG

D50NHV3I0MSQI2

This section defines the logical node data for the logical node D50NHV3I0MSQI2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NHV3I0MSQI2.MX$SeqA.c3.cVal.mag.f	50N-2 HV 3I0 Phase Magnitude	D50N_HV_2_3I0_MAG_FDID	FAULT_LOG
D50NHV3I0MSQI2.MX$SeqA.c3.cVal.ang.f	50N-2 HV 3I0 Phase Angle	D50N_HV_2_3I0_ANG_FDID	FAULT_LOG

D50NLVMMXU1

This section defines the logical node data for the logical node D50NLVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source

D50NLVMMXU1.MX.A.phsA.cVal.mag.f	50N-1 LV A Phase Magnitude	D50N_LV_1_A_MAG_FDID	FAULT_LOG
D50NLVMMXU1.MX.A.phsA.cVal.ang.f	50N-1 LV A Phase Angle	D50N_ LV_1_A_ANG_FDID	FAULT_LOG
D50NLVMMXU1.MX.A.phsB.cVal.mag.f	50N-1 LV B Phase Magnitude	D50N_LV_1_B_MAG_FDID	FAULT_LOG
D50NLVMMXU1.MX.A.phsB.cVal.ang.f	50N-1 LV B Phase Angle	D50N_LV_1_B_ANG_FDID	FAULT_LOG
D50NLVMMXU1.MX.A.phsC.cVal.mag.f	50N-1 LV C Phase Magnitude	D50N_LV_1_C_MAG_FDID	FAULT_LOG
D50NLVMMXU1.MX.A.phsC.cVal.ang.f	50N-1 LV C Phase Angle	D50N_LV_1_C_ANG_FDID	FAULT_LOG

D50NLV3I0MSQI1

This section defines the logical node data for the logical node D50NLV3I0MSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NLV3I0MSQI1.MX$SeqA.c3.cVal.mag.f	50N-1 LV 3I0 Phase Magnitude	D50N_LV_1_3I0_MAG_FDID	FAULT_LOG
D50NLV3I0MSQI1.MX$SeqA.c3.cVal.ang.f	50N-1 LV 3I0 Phase Angle	D50N_LV_1_3I0_ANG_FDID	FAULT_LOG

D50NLVMMXU2

This section defines the logical node data for the logical node D50NLVMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NLVMMXU2.MX.A.phsA.cVal.mag.f	50N-2 LV A Phase Magnitude	D50N_LV_2_A_MAG_FDID	FAULT_LOG
D5N0LVMMXU2.MX.A.phsA.cVal.ang.f	50N-2 LV A Phase Angle	D50N_LV_2_A_ANG_FDID	FAULT_LOG
D50NLVMMXU2.MX.A.phsB.cVal.mag.f	50N-2 LV B Phase Magnitude	D50N_LV_2_B_MAG_FDID	FAULT_LOG
D50NLVMMXU2.MX.A.phsB.cVal.ang.f	50N-2 LV B Phase Angle	D50N_LV_2_B_ANG_FDID	FAULT_LOG
D50NLVMMXU2.MX.A.phsC.cVal.mag.f	50N-2 LV C Phase Magnitude	D50N_LV_2_C_MAG_FDID	FAULT_LOG
D50NLVMMXU2.MX.A.phsC.cVal.ang.f	50N-2 LV C Phase Angle	D50N_LV_2_C_ANG_FDID	FAULT_LOG

D50NLV3I0MSQI2

This section defines the logical node data for the logical node D50NLV3I0MSQI2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50NLV3I0MSQI2.MX$SeqA.c3.cVal.mag.f	50N-2 LV 3I0 Phase Magnitude	D50N_LV_2_3I0_MAG_FDID	FAULT_LOG
D50NLV3I0MSQI2.MX$SeqA.c3.cVal.ang.f	50N-2 LV 3I0 Phase Angle	D50N_LV_2_3I0_ANG_FDID	FAULT_LOG

D51NHVMMXU1

This section defines the logical node data for the logical node D51NHVM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NHVMMXU1.MX.A.phsA.cVal.mag.f	51N-1 HV A Phase Magnitude	D51N_HV_1_A_MAG_FDID	FAULT_LOG
D51NHVMMXU1.MX.A.phsA.cVal.ang.f	51N-1 HV A Phase Angle	D51N_HV_1_A_ANG_FDID	FAULT_LOG
D51NHVMMXU1.MX.A.phsB.cVal.mag.f	51N-1 HV B Phase Magnitude	D51N_HV_1_B_MAG_FDID	FAULT_LOG
D51NHVMMXU1.MX.A.phsB.cVal.ang.f	51N-1 HV B Phase Angle	D51N_HV_1_B_ANG_FDID	FAULT_LOG
D51NHVMMXU1.MX.A.phsC.cVal.mag.f	51N-1 HV C Phase Magnitude	D51N_HV_1_C_MAG_FDID	FAULT_LOG
D51NHVMMXU1.MX.A.phsC.cVal.ang.f	51N-1 HV C Phase Angle	D51N_HV_1_C_ANG_FDID	FAULT_LOG

D51NHV3I0MSQI1

This section defines the logical node data for the logical node D51NHV3I0MSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NHV3I0MSQI1.MX$SeqA.c3.cVal.mag.f	51N-1 HV 3I0 Phase Magnitude	D51N_HV_1_3I0_MAG_FDID	FAULT_LOG
D51NHV3I0MSQI1.MX$SeqA.c3.cVal.ang.f	51N-1 HV 3I0 Phase Angle	D51N_HV_1_3I0_ANG_FDID	FAULT_LOG

D51NHVMMXU2

This section defines the logical node data for the logical node D51NHVM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NHVMMXU2.MX.A.phsA.cVal.mag.f	51N-2 HV A Phase Magnitude	D51N_HV_2_A_MAG_FDID	FAULT_LOG
D51NHVMMXU2.MX.A.phsA.cVal.ang.f	51N-2 HV A Phase Angle	D51N_HV_2_A_ANG_FDID	FAULT_LOG

D51NHVMMXU2.MX.A.phsB.cVal.mag.f	51N-2 HV B Phase Magnitude	D51N_HV_2_B_MAG_FDID	FAULT_LOG
D51NHVMMXU2.MX.A.phsB.cVal.ang.f	51N-2 HV B Phase Angle	D51N_HV_2_B_ANG_FDID	FAULT_LOG
D51NHVMMXU2.MX.A.phsC.cVal.mag.f	51N-2 HV C Phase Magnitude	D51N_HV_2_C_MAG_FDID	FAULT_LOG
D51NHVMMXU2.MX.A.phsC.cVal.ang.f	51N-2 HV C Phase Angle	D51N_HV_2_C_ANG_FDID	FAULT_LOG

D51NHV3I0MSQI2

This section defines the logical node data for the logical node D51NHV3I0MSQI2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NHV3I0MSQI2.MX$SeqA.c3.cVal.mag.f	51N-2 HV 3I0 Phase Magnitude	D51N_HV_2_3I0_MAG_FDID	FAULT_LOG
D51NHV3I0MSQI2.MX$SeqA.c3.cVal.ang.f	51N-2 HV 3I0 Phase Angle	D51N_HV_2_3I0_ANG_FDID	FAULT_LOG

D51NLVMMXU1

This section defines the logical node data for the logical node D51NLVMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NLVMMXU1.MX.A.phsA.cVal.mag.f	51N-1 LV A Phase Magnitude	D51N_LV_1_A_MAG_FDID	FAULT_LOG
D51NLVMMXU1.MX.A.phsA.cVal.ang.f	51N-1 LV A Phase Angle	D51N_ LV_1_A_ANG_FDID	FAULT_LOG
D51NLVMMXU1.MX.A.phsB.cVal.mag.f	51N-1 LV B Phase Magnitude	D51N_LV_1_B_MAG_FDID	FAULT_LOG
D51NLVMMXU1.MX.A.phsB.cVal.ang.f	51N-1 LV B Phase Angle	D51N_LV_1_B_ANG_FDID	FAULT_LOG
D51NLVMMXU1.MX.A.phsC.cVal.mag.f	51N-1 LV C Phase Magnitude	D51N_LV_1_C_MAG_FDID	FAULT_LOG
D51NLVMMXU1.MX.A.phsC.cVal.ang.f	51N-1 LV C Phase Angle	D51N_LV_1_C_ANG_FDID	FAULT_LOG

D51NLV3I0MSQI1

This section defines the logical node data for the logical node D51NLV3I0MSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NLV3I0MSQI1.MX$SeqA.c3.cVal.mag.f	51N-1 LV 3I0 Phase Magnitude	D51N_LV_1_3I0_MAG_FDID	FAULT_LOG

D51NLV3I0MSQI1.MX$SeqA.c3.cVal.ang.f	51N-1 LV 3I0 Phase Angle	D51N_LV_1_3I0_ANG_FDID	FAULT_LOG

D51NLVMMXU2

This section defines the logical node data for the logical node D51NLVM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NLVMMXU2.MX.A.phsA.cVal.mag.f	51N-2 LV A Phase Magnitude	D51N_LV_2_A_MAG_FDID	FAULT_LOG
D51NLVMMXU2.MX.A.phsA.cVal.ang.f	51N-2 LV A Phase Angle	D51N_LV_2_A_ANG_FDID	FAULT_LOG
D51NLVMMXU2.MX.A.phsB.cVal.mag.f	51N-2 LV B Phase Magnitude	D51N_LV_2_B_MAG_FDID	FAULT_LOG
D51NLVMMXU2.MX.A.phsB.cVal.ang.f	51N-2 LV B Phase Angle	D51N_LV_2_B_ANG_FDID	FAULT_LOG
D51NLVMMXU2.MX.A.phsC.cVal.mag.f	51N-2 LV C Phase Magnitude	D51N_LV_2_C_MAG_FDID	FAULT_LOG
D51NLVMMXU2.MX.A.phsC.cVal.ang.f	51N-2 LV C Phase Angle	D51N_LV_2_C_ANG_FDID	FAULT_LOG

D51NLV3I0MSQI2

This section defines the logical node data for the logical node D51NLV3I0MSQI2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51NLV3I0MSQI2.MX$SeqA.c3.cVal.mag.f	51N-2 LV 3I0 Phase Magnitude	D51N_LV_2_3I0_MAG_FDID	FAULT_LOG
D51NLV3I0MSQI2.MX$SeqA.c3.cVal.ang.f	51N-2 LV 3I0 Phase Angle	D51N_LV_2_3I0_ANG_FDID	FAULT_LOG

D50GMMXU1

This section defines the logical node data for the logical node D50GMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50GMMXU1.MX.A.neut.cVal.mag.f	50G-1 IN Magnitude	D50GIN_1_IN_MAG_FDID	FAULT_LOG
D50GMMXU1.MX.A.neut.cVal.ang.f	50G-1 IN Angle	D50GIN_1_IN_ANG_FDID	FAULT_LOG

D50GMMXU2

This section defines the logical node data for the logical node D50GMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50GMMXU2.MX.A.neut.cVal.mag.f	50G-2 IN Magnitude	D50GIN_2_IN_MAG_FDID	FAULT_LOG
D50GMMXU2.MX.A.neut.cVal.ang.f	50G-2 IN Angle	D50GIN_2_IN_ANG_FDID	FAULT_LOG

D51GMMXU1

This section defines the logical node data for the logical node D51GMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51GMMXU1.MX.A.neut.cVal.mag.f	51G-1 IN Magnitude	D51GIN_1_IN_MAG_FDID	FAULT_LOG
D51GMMXU1.MX.A.neut.cVal.ang.f	51G-1 IN Angle	D51GIN_1_IN_ANG_FDID	FAULT_LOG

D51GMMXU2

This section defines the logical node data for the logical node D51GMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51GMMXU2.MX.A.neut.cVal.mag.f	51G-2 IN Magnitude	D51GIN_2_IN_MAG_FDID	FAULT_LOG
D51GMMXU2.MX.A.neut.cVal.ang.f	51G-2 IN Angle	D51GIN_2_IN_ANG_FDID	FAULT_LOG

D50GRMSMMXU1

This section defines the logical node data for the logical node D50GRMSM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50GRMSMMXU1.MX.A.net.cVal.mag.f	50G-1 IN RMS Magnitude	D50GIN_1_IN_RMS_MAG_FDID	FAULT_LOG

D50GRMSMMXU2

This section defines the logical node data for the logical node D50GRMSM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D50GRMSMMXU2.MX.A.net.cVal.mag.f	50G-2 IN RMS Magnitude	D50GIN_2_IN_RMS_MAG_FDID	FAULT_LOG

D51GRMSMMXU1

This section defines the logical node data for the logical node D51GRMSM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51GRMSMMXU1.MX.A.net.cVal.mag.f	51G-1 IN RMS Magnitude	D51GIN_1_IN_RMS_MAG_FDID	FAULT_LOG

D51GRMSMMXU2

This section defines the logical node data for the logical node D51GRMSM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D51GRMSMMXU2.MX.A.net.cVal.mag.f	51G-2 IN RMS Magnitude	D51GIN_2_IN_RMS_MAG_FDID	FAULT_LOG

D4650HVMMXU1

This section defines the logical node data for the logical node D4650HVM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D4650HVMMXU1.MX.A.phsA.cVal.mag.f	4650 HV A Phase Magnitude	D46_50_HV_1_A_MAG_FDID	FAULT_LOG
D4650HVMMXU1.MX.A.phsA.cVal.ang.f	4650 HV A Phase Angle	D46_50_HV_1_A_ANG_FDID	FAULT_LOG
D4650HVMMXU1.MX.A.phsB.cVal.mag.f	4650 HV B Phase Magnitude	D46_50_HV_1_B_MAG_FDID	FAULT_LOG
D4650HVMMXU1.MX.A.phsB.cVal.ang.f	4650 HV B Phase Angle	D46_50_HV_1_B_ANG_FDID	FAULT_LOG
D4650HVMMXU1.MX.A.phsC.cVal.mag.f	4650 HV C Phase Magnitude	D46_50_HV_1_C_MAG_FDID	FAULT_LOG
D4650HVMMXU1.MX.A.phsC.cVal.ang.f	4650 HV C Phase Angle	D46_50_HV_1_C_ANG_FDID	FAULT_LOG

D4650LVMMXU2

This section defines the logical node data for the logical node 4650LVM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D4650LVMMXU2.MX.A.phsA.cVal.mag.f	4650 LV A Phase Magnitude	D46_50_LV_1_A_MAG_FDID	FAULT_LOG
D4650LVMMXU2.MX.A.phsA.cVal.ang.f	4650 LV A Phase Angle	D46_50_LV_1_A_ANG_FDID	FAULT_LOG

D4650LVMMXU2.MX.A.phsB.cVal.mag.f	4650 LV B Phase Magnitude	D46_50_LV_1_B_MAG_FDID	FAULT_LOG
D4650LVMMXU2.MX.A.phsB.cVal.ang.f	4650 LV B Phase Angle	D46_50_LV_1_B_ANG_FDID	FAULT_LOG
D4650LVMMXU2.MX.A.phsC.cVal.mag.f	4650 LV C Phase Magnitude	D46_50_LV_1_C_MAG_FDID	FAULT_LOG
D4650LVMMXU2.MX.A.phsC.cVal.ang.f	4650 LV C Phase Angle	D46_50_LV_1_C_ANG_FDID	FAULT_LOG

D4651HVMMXU1

This section defines the logical node data for the logical node D4651HVM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D4651HVMMXU1.MX.A.phsA.cVal.mag.f	4651 HV A Phase Magnitude	D46_51_HV_1_A_MAG_FDID	FAULT_LOG
D4651HVMMXU1.MX.A.phsA.cVal.ang.f	4651 HV A Phase Angle	D46_51_HV_1_A_ANG_FDID	FAULT_LOG
D4651HVMMXU1.MX.A.phsB.cVal.mag.f	4651 HV B Phase Magnitude	D46_51_HV_1_B_MAG_FDID	FAULT_LOG
D4651HVMMXU1.MX.A.phsB.cVal.ang.f	4651 HV B Phase Angle	D46_51_HV_1_B_ANG_FDID	FAULT_LOG
D4651HVMMXU1.MX.A.phsC.cVal.mag.f	4651 HV C Phase Magnitude	D46_51_HV_1_C_MAG_FDID	FAULT_LOG
D4651HVMMXU1.MX.A.phsC.cVal.ang.f	4651 HV C Phase Angle	D46_51_HV_1_C_ANG_FDID	FAULT_LOG

D4651LVMMXU2

This section defines the logical node data for the logical node D4651LVM-MXU2 of the TPRO FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D4651LVMMXU2.MX.A.phsA.cVal.mag.f	4651 LV A Phase Magnitude	D46_51_LV_1_A_MAG_FDID	FAULT_LOG
D4651LVMMXU2.MX.A.phsA.cVal.ang.f	4651 LV A Phase Angle	D46_51_LV_1_A_ANG_FDID	FAULT_LOG
D4651LVMMXU2.MX.A.phsB.cVal.mag.f	4651 LV B Phase Magnitude	D46_51_LV_1_B_MAG_FDID	FAULT_LOG
D4651LVMMXU2.MX.A.phsB.cVal.ang.f	4651 LV B Phase Angle	D46_51_LV_1_B_ANG_FDID	FAULT_LOG
D4651LVMMXU2.MX.A.phsC.cVal.mag.f	4651 LV C Phase Magnitude	D46_51_LV_1_C_MAG_FDID	FAULT_LOG
D4651LVMMXU2.MX.A.phsC.cVal.ang.f	4651 LV C Phase Angle	D46_51_LV_1_C_ANG_FDID	FAULT_LOG

D24DTMSQI1

This section defines the logical node data for the logical node D24DTMSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D24DTMSQI1.MX.SeqV.c1.cVal.mag.f	24-1 DT Magnitude	D24DT_1_VIN_MAG_FDID	FAULT_LOG
D24DTMSQI1.MX.SeqV.c1.cVal.ang.f	24-1 DT Angle	D24DT_1_VIN_ANG_FDID	FAULT_LOG
D24DTMSQI1.MX.ImbNgA.mag.f	% V/F	D24DT_1_V_F_FDID	FAULT_LOG

D24DTMSQI2

This section defines the logical node data for the logical node D24DTMSQI2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D24DTMSQI2.MX.SeqV.c1.cVal.mag.f	24-2 DT Magnitude	D24DT_2_VIN_MAG_FDID	FAULT_LOG
D24DTMSQI2.MX.SeqV.c1.cVal.ang.f	24-2 DT Angle	D24DT_2_VIN_ANG_FDID	FAULT_LOG
D24DTMSQI2.MX.ImbNgA.mag.f	% V/F	D24DT_2_V_F_FDID	FAULT_LOG

D24ITMSQI1

This section defines the logical node data for the logical node D24ITMSQI1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D24ITMSQI1.MX.SeqV.c1.cVal.mag.f	24 IT Magnitude	D24IT_1_VIN_MAG_FDID	FAULT_LOG
D24ITMSQI1.MX.SeqV.c1.cVal.ang.f	24 IT Angle	D24IT_1_VNI_ANG_FDID	FAULT_LOG
D24ITMSQI1.MX.ImbNgA.mag.f	% V/F	D24IT_1_V_F_FDID	FAULT_LOG

D59GDTMMXU1

This section defines the logical node data for the logical node D59GDTM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59GDTMMXU1.MX.phV.net.cVal.mag.f	59G-1 DT Magnitude	D59NDT_VIN_MAG_FDID	FAULT_LOG

D59GDTMMXU1.MX.phV.net.cVal.ang.f	59G-1 DT Angle	D59NDT_VIN_ANG_FDID	FAULT_LOG

D59GDTMMXU2

This section defines the logical node data for the logical node D59GDTM-MXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59GDTMMXU2.MX.phV.net.cVal.mag.f	59G-2 DT Magnitude	D59DT_VIN_MAG_FDID	FAULT_LOG
D59GDTMMXU2.MX.phV.net.cVal.ang.f	59G-2 DT Angle	D59DT_VIN_ANG_FDID	FAULT_LOG

D59GITMMXU1

This section defines the logical node data for the logical node D59GITM-MXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59GITMMXU1.MX.phV.net.cVal.mag.f	59G IT Magnitude	D59NIT_VIN_MAG_FDID	FAULT_LOG
D59GITMMXU1.MX.phV.net.cVal.ang.f	59G IT Angle	D59NIT_VIN_ANG_FDID	FAULT_LOG

D27DTMMXU1

This section defines the logical node data for the logical node D27DTMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27DTMMXU1.MX.PhV.net.cVal.mag.f	27 DT-1 Magnitude	D27DT_1_VIN_MAG_FDID	FAULT_LOG
D27DTMMXU1.MX.PhV.net.cVal.ang.f	27 DT-1 Angle	D27DT_1_VIN_ANG_FDID	FAULT_LOG

D27DTMMXU2

This section defines the logical node data for the logical node D27DTMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27DTMMXU2.MX.PhV.net.cVal.mag.f	27 DT-2 Magnitude	D27DT_2_VIN_MAG_FDID	FAULT_LOG
D27DTMMXU2.MX.PhV.net.cVal.ang.f	27 DT-2 Angle	D27DT_2_VIN_ANG_FDID	FAULT_LOG

D27DTMMXU3

This section defines the logical node data for the logical node D27DTMMXU3 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27DTMMXU3.MX.PhV.net.cVal.mag.f	27 DT-3 Magnitude	D27DT_3_VIN_MAG_FDID	FAULT_LOG
D27DTMMXU3.MX.PhV.net.cVal.ang.f	27 DT-3 Angle	D27DT_3_VIN_ANG_FDID	FAULT_LOG

D27DTMMXU4

This section defines the logical node data for the logical node D27DTMMXU4 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27DTMMXU4.MX.PhV.net.cVal.mag.f	27 DT-4 Magnitude	D27DT_4_VIN_MAG_FDID	FAULT_LOG
D27DTMMXU4.MX.PhV.net.cVal.ang.f	27 DT-4 Angle	D27DT_4_VIN_ANG_FDID	FAULT_LOG

D27ITMMXU1

This section defines the logical node data for the logical node D27ITMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27ITMMXU1.MX.PhV.net.cVal.mag.f	27 IT-1 Magnitude	D27IT_1_VIN_MAG_FDID	FAULT_LOG
D27ITMMXU1.MX.PhV.net.cVal.ang.f	27 IT-1 Angle	D27IT_1_VIN_ANG_FDID	FAULT_LOG

D27ITMMXU2

This section defines the logical node data for the logical node D27ITMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D27ITMMXU2.MX.PhV.net.cVal.mag.f	27 IT-2 Magnitude	D27IT_2_VIN_MAG_FDID	FAULT_LOG
D27ITMMXU2.MX.PhV.net.cVal.ang.f	27 IT-2 Angle	D27IT_2_VIN_ANG_FDID	FAULT_LOG

D59DTMMXU1

This section defines the logical node data for the logical node D59DTMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59DTMMXU1.MX.PhV.net.cVal.mag.f	59 DT-1 Magnitude	D59DT_1_VIN_MAG_FDID	FAULT_LOG
D59DTMMXU1.MX.PhV.net.cVal.ang.f	59 DT-1 Angle	D59DT_1_VIN_ANG_FDID	FAULT_LOG

D59DTMMXU2

This section defines the logical node data for the logical node D59DTMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59DTMMXU2.MX.PhV.net.cVal.mag.f	59 DT-2 Magnitude	D59DT_2_VIN_MAG_FDID	FAULT_LOG
D59DTMMXU2.MX.PhV.net.cVal.ang.f	59 DT-2 Angle	D59DT_2_VIN_ANG_FDID	FAULT_LOG

D59DTMMXU3

This section defines the logical node data for the logical node D59DTMMXU3 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59DTMMXU3.MX.PhV.net.cVal.mag.f	59 DT-3 Magnitude	D59DT_3_VIN_MAG_FDID	FAULT_LOG
D59DTMMXU3.MX.PhV.net.cVal.ang.f	59 DT-3 Angle	D59DT_3_VIN_ANG_FDID	FAULT_LOG

D59DTMMXU4

This section defines the logical node data for the logical node D59DTMMXU4 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59DTMMXU4.MX.PhV.net.cVal.mag.f	59 DT-4 Magnitude	D59DT_4_VIN_MAG_FDID	FAULT_LOG
D59DTMMXU4.MX.PhV.net.cVal.ang.f	59 DT-4 Angle	D59DT_4_VIN_ANG_FDID	FAULT_LOG

D59ITMMXU1

This section defines the logical node data for the logical node D59ITMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59ITMMXU1.MX.PhV.net.cVal.mag.f	59 IT-1 Magnitude	D59IT_1_VIN_MAG_FDID	FAULT_LOG

D59ITMMXU1.MX.PhV.net.cVal.ang.f	59 IT-1 Angle	D59IT_1_VIN_ANG_FDID	FAULT_LOG

D59ITMMXU2

This section defines the logical node data for the logical node D59ITMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D59ITMMXU2.MX.PhV.net.cVal.mag.f	59 IT-2 Magnitude	D59IT_2_VIN_MAG_FDID	FAULT_LOG
D59ITMMXU2.MX.PhV.net.cVal.ang.f	59 IT-2 Angle	D59IT_2_VIN_ANG_FDID	FAULT_LOG

D81UFMMXU1

This section defines the logical node data for the logical node D81UFMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81UFMMXU1.MX.PhV.net.cVal.mag.f	81U -1 Magnitude	D81U_1_VIN_MAG_FDID	FAULT_LOG
D81UFMMXU1.MX.PhV.net.cVal.ang.f	81U -1 Angle	D81U_1_VIN_ANG_FDID	FAULT_LOG
D81UFMMXU1.MX.Hz.mag.f	81U -1 Frequency	D81U_1_FREQUENCY_FDID	FAULT_LOG

D81UFMMXU2

This section defines the logical node data for the logical node D81UFMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81UFMMXU2.MX.PhV.net.cVal.mag.f	81U -2 Magnitude	D81U_2_VIN_MAG_FDID	FAULT_LOG
D81UFMMXU2.MX.PhV.net.cVal.ang.f	81U -2 Angle	D81U_2_VIN_ANG_FDID	FAULT_LOG
D81UFMMXU2.MX.Hz.mag.f	81U -2 Frequency	D81U_2_FREQUENCY_FDID	FAULT_LOG

D81UFMMXU3

This section defines the logical node data for the logical node D81UFMMXU3 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81UFMMXU3.MX.PhV.net.cVal.mag.f	81U -3 Magnitude	D81U_3_VIN_MAG_FDID	FAULT_LOG
D81UFMMXU3.MX.PhV.net.cVal.ang.f	81U -3 Angle	D81U_3_VIN_ANG_FDID	FAULT_LOG

D81UFMMXU3.MX.Hz.mag.f	81U -3 Frequency	D81U_3_FREQUENCY_FDID	FAULT_LOG

D81UFMMXU4

This section defines the logical node data for the logical node D81UFMMXU4 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81UFMMXU4.MX.PhV.net.cVal.mag.f	81U -4 Magnitude	D81U_4_VIN_MAG_FDID	FAULT_LOG
D81UFMMXU4.MX.PhV.net.cVal.ang.f	81U -4 Angle	D81U_4_VIN_ANG_FDID	FAULT_LOG
D81UFMMXU4.MX.Hz.mag.f	81U -4 Frequency	D81U_4_FREQUENCY_FDID	FAULT_LOG

D81OFMMXU1

This section defines the logical node data for the logical node D81OFMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81OFMMXU1.MX.PhV.net.cVal.mag.f	81O -1 Magnitude	D81O_1_VIN_MAG_FDID	FAULT_LOG
D81OFMMXU1.MX.PhV.net.cVal.ang.f	81O -1 Angle	D81O_1_VIN_ANG_FDID	FAULT_LOG
D81OFMMXU1.MX.Hz.mag.f	81O -1 Frequency	D81O_1_FREQUENCY_FDID	FAULT_LOG

D81OFMMXU2

This section defines the logical node data for the logical node D81OFMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81OFMMXU2.MX.PhV.net.cVal.mag.f	81O -2 Magnitude	D81O_2_VIN_MAG_FDID	FAULT_LOG
D81OFMMXU2.MX.PhV.net.cVal.ang.f	81O-2 Angle	D81O_2_VIN_ANG_FDID	FAULT_LOG
D81OFMMXU2.MX.Hz.mag.f	81O -2 Frequency	D81O_2_FREQUENCY_FDID	FAULT_LOG

D81OFMMXU3

This section defines the logical node data for the logical node D81OFMMXU3 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81OFMMXU3.MX.PhV.net.cVal.mag.f	81O -3 Magnitude	D81O_3_VIN_MAG_FDID	FAULT_LOG

D81OFMMXU3.MX.PhV.net.cVal.ang.f	81O -3 Angle	D81O_3_VIN_ANG_FDID	FAULT_LOG
D81OFMMXU3.MX.Hz.mag.f	81O -3 Frequency	D81O_3_FREQUENCY_FDID	FAULT_LOG

D81OFMMXU4

This section defines the logical node data for the logical node D81UFMMXU4 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81OFMMXU4.MX.PhV.net.cVal.mag.f	81O-4 Magnitude	D81O_4_VIN_MAG_FDID	FAULT_LOG
D81OFMMXU4.MX.PhV.net.cVal.ang.f	81O-4 Angle	D81O_4_VIN_ANG_FDID	FAULT_LOG
D81OFMMXU4.MX.Hz.mag.f	81O-4 Frequency	D81O_4_FREQUENCY_FDID	FAULT_LOG

D81RMMXU1

This section defines the logical node data for the logical node D81RMMXU1 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81RMMXU1.MX.PhV.net.cVal.mag.f	81R -1 Magnitude	D81R_1_VIN_MAG_FDID	FAULT_LOG
D81RMMXU1.MX.PhV.net.cVal.ang.f	81R -1 Angle	D81R_1_VIN_ANG_FDID	FAULT_LOG
D81RMMXU1.MX.Hz.mag.f	81R -1 Frequency	D81R_1_FREQUENCY_FDID	FAULT_LOG

D81RMMXU2

This section defines the logical node data for the logical node D81RMMXU2 of the FaultData logical device.

Data Name	Description	IEC61850 Index	Source
D81RMMXU2.MX.PhV.net.cVal.mag.f	81R -2 Magnitude	D81R_2_VIN_MAG_FDID	FAULT_LOG
D81RMMXU2.MX.PhV.net.cVal.ang.f	81R -2 Angle	D81R_2_VIN_ANG_FDID	FAULT_LOG
D81RMMXU2.MX.Hz.mag.f	81R -2 Frequency	D81R_2_FREQUENCY_FDID	FAULT_LOG

Logical Nodes For Subscription

This section defines the logical node data for the logical node SUBSCRGGIO2 of the Subscription logical device.

Note: Common Logical Node information is not shown here. Only the data that are provided from the T-PRO application to the IEC 61850 sub-system are listed here.

Data Name	Description	IEC61850 Index	Source
SUBSCRGGIO2STInd1$stVal	Subscription Input– 1	VI1_ID = 0	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd2$stVal	Subscription Input– 2	VI1_ID + 1	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd3$stVal	Subscription Input– 3	VI1_ID + 2	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd4$stVal	Subscription Input– 4	VI1_ID + 3	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd5$stVal	Subscription Input– 5	VI1_ID + 4	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd6$stVal	Subscription Input– 6	VI1_ID + 5	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd7$stVal	Subscription Input– 7	VI1_ID + 6	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd8$stVal	Subscription Input– 8	VI1_ID + 7	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd9$stVal	Subscription Input– 9	VI1_ID + 8	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd10$stVal	Subscription Input– 10	VI1_ID + 9	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd11$stVal	Subscription Input– 11	VI1_ID + 10	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd12$stVal	Subscription Input– 12	VI1_ID + 11	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd13$stVal	Subscription Input– 13	VI1_ID + 12	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd14$stVal	Subscription Input– 14	VI1_ID + 13	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd15$stVal	Subscription Input– 15	VI1_ID + 14	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd16$stVal	Subscription Input– 16	VI1_ID + 15	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd17$stVal	Subscription Input– 17	VI1_ID + 16	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd18$stVal	Subscription Input– 18	VI1_ID + 17	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd19$stVal	Subscription Input– 19	VI1_ID + 18	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd20$stVal	Subscription Input– 20	VI1_ID + 19	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd21$stVal	Subscription Input– 21	VI1_ID + 20	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd22$stVal	Subscription Input– 22	VI1_ID + 21	SRC_SERVER_GOOSE

SUBSCRGGIO2STInd23$stVal	Subscription Input– 23	VI1_ID + 22	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd24$stVal	Subscription Input– 24	VI1_ID + 23	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd25$stVal	Subscription Input– 25	VI1_ID + 24	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd26$stVal	Subscription Input– 26	VI1_ID + 25	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd27$stVal	Subscription Input– 27	VI1_ID + 26	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd28$stVal	Subscription Input– 28	VI1_ID + 27	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd29$stVal	Subscription Input– 29	VI1_ID + 28	SRC_SERVER_GOOSE
SUBSCRGGIO2STInd30$stVal	Subscription Input– 30	VI1_ID + 29	SRC_SERVER_GOOSE