SIEMENS

SITIPE

Automated Testing
V2.41

User Manual

Contents

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Siemens internal address of the OSS package:
https://wse06.siemens.com/content/P0013429/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2Fcontent%2FP0013429%2FShared%20Documents%2FSubstationAutomationProtection%2FDigital%20Substation%2FSITIPE%2FSITIPE%5FAT%2F08%20%2D%20OpenSource&FolderCTID=0x0120004DBADFD3CC75E449B14A8B2EE8AFCEEB&View=%7B3CE569A9%2DADA6%2D40C9%2D9717%2DAEE999F0121A%7D

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Indicates that death or severe personal injury will result if proper precautions are not taken.

WARNING

Indicates that death or severe personal injury may result if proper precautions are not taken.

CAUTION

With a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

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NOTICE

Indicates that an unintended result or situation can occur if the relevant information is not taken into account.

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Figures

Tables

1. Purpose and Features

1.1. Purpose

SITIPE[1] Automated Testing is a computer aided test system to integrate and ease the steps of Functional Testing for substation automation, Telecontrol and protection panels manufactured by Siemens.

SITIPE Automated Testing uses USB Panel Test Modules to simulate electrical outputs of Substation Equipment, as well as read the electrical outputs of the System under Test. It also provides functionality to send and receive network telegrams according to IEC 60870-5-101 / -104, IEC 61850-8-1 MMS and IEEE DNP3.0. Additionally, SITIPE AT provides functionality to save achieved Test Results and to export them into a Word Document with selectable Level of Detail.

The goal is to simplify the Functional Test for Testing Personal and therefore decrease the total cost of the Testing Process.

1.2. Test scenarios

1.2.1. Switchbox Test and Simulation

The Switchbox Test and Simulation Features of SITIPE AT may be used to manually execute the steps involved in Functional Testing.

The user may send signals to the System under Test by Switching PTM Outputs or by sending network telegrams to it.

The user may also monitor the electrical outputs of the System under Test or receive telegrams sent from the System.

SITIPE AT also provides flexible Simulation Functions to simulate the behavior of Primary Substation Equipment like Circuit Breakers, Disconnectors or Earthing Switches.

This Test Scenario does not provide any level of Process Automation and you have to execute all steps on your own.

1.2.2. Closed Loop Test

The Closed Loop Test Features of SITIPE AT may be used to automate the steps involved in Functional Testing.

A Test Case is formed of at least one Test Step. A Test Step consists of Preconditions, Sinks and a Source.

During a closed loop test, the System is set into a certain Situation (Preconditions). A trigger situation is setup (Source). Afterwards the System reactions (Sinks) are evaluated based on configured expectations.

For example, consider a Test for a Remote Circuit Breaker ON Command:

[1] SITIPE: Siemens Totally Integrated Power Engineering

Usually a Circuit Breaker Command Telegram is issued from the Control Center to the System and a device issues the actual electrical command to the circuit breaker on a binary output / connected terminal. It then monitors the correct command execution and sends the position change telegram to the Control Center. After correct command execution, it sends a confirmation of the Command back to the Control Center.

You could therefore create a Test Case with a Test Step called “ON” with the following items:

Precondition: Start Simulation Functions

Source / Trigger condition: Send network telegram via -101, -104 or DNP3.0 network interface.

Sinks:

- Is the circuit breaker command issued on the correct terminal in the cabinet in time?
- Is the position change of the Switchgear reported to the Control Center correctly?
- Is the command execution confirmed to the Control Center correctly?

This is a basic application of a SITIPE AT Closed Loop Test, enabling you to fully automate the steps involved in this Test Sequence.

1.3. Feature Overview

SITIPE AT includes the following Features to ease your Functional Test:

- **Excel Configuration Workbook**
  - Macros for easy Modeling of Test Interfaces, Test Objects and Test Sequences
  - Automated Signal List Excel Import to import Telegrams and Test Objects,
  - Automated TIPT Version 1 Excel Import to import PTMs, electrical Signals and Simulation Functions from Automated Testing Version 1 (TIPT)
  - Automated Interlocking Table Excel Import to create Interlocking Test Sequences automatically
- **Communication Interfaces** to simulate Control Center or Central Devices:
  - IEC 60870-5 -101/-104 Master over Serial and Ethernet,
  - IEC 61850-8-1 MMS Client over Ethernet,
  - IEEE DNP3.0 Master over Serial and Ethernet,
  - Modbus Master over Ethernet,
  - Support for common Telegram Datatypes:
    - Monitoring: Single and Double Indications, Step Position Information, Measured Values, Integrated Totals
    - Control: Single and Double Commands, Step Commands, Analog Setpoints
    - Support for Select-Before-Operate commands / set points
  - Unified “Event list” User Interface for Control and Monitoring of Telegrams
- **Electrical Process Interface** (Binary Inputs and Outputs) - USB Panel Test Module
  - Up to 50 PTMs supported per PC (2400 Signals)
  - With distributed PCs (TCP Master/Slave) up to 200 PTMs supported (9600 Signals)
  - User Interface to control and monitor PTM Channels manually (PTM Control)
  - PTM Control includes security functionality to disable unused Binary outputs, to prevent switching dangerous voltage on (e.g. 220Vdc)
- **Simulation Functions** (extendable plugins)
  - Circuit Breaker,
  - Disconnector,
  - Earthing Switch,
  - 3 phase selective Circuit Breaker with Lockout Functionality,
  - Crisis Mass-Indication Switching (el. Double and Single Indications 0 ... 100%)
  - Bay Single line to draw Bay simulation functions in a Single Line diagram
  - Single Indication for electrical single points inside a Bay Single line
  - SR Flip Flop, for Set/Reset and Lockout scenarios
  - Delayed Output for simultaneous switching of multiple PTM outputs
- **Closed Loop Test** for Automated Test Sequences
  - Full access to all electrical and communication Interfaces in Test Steps
  - Manual Dialogues are provided for manual Steps involved (Key switching etc.)
  - Organized Test Results on a Test Case / Test Object relation
- **Test Protocol Wizard** to create Word Documents containing Test Results
  - Customizable Level of Detail
  - Customizable Document Style by Word Template
  - Customizable Language Support using Dictionary
- **Auto save / Project Reload** of Test Configuration and Test Results locally

- **XML Import / Export** for Archiving of Test Configuration and achieved Test Results
- **Backwards compatible Project Reload and XML Import** down to SITIPE AT V2.20

2. Glossary of Terms and Abbreviations

FAT	**F**actory **A**cceptance **T**est
IEC	**I**nternational **E**lectrotechnical **C**ommission
IED	Intelligent Electronic Device, e.g. a Protection Device or Remote Terminal Unit (RTU)
IP	The Internet Protocol. IP is the routing protocol for inter-networking. An IP may also describe the IP address of certain computing equipment in a network.
I/O	Input / Output of signals
MRT	**M**ean **R**esidence **T**ime
NTP	**N**etwork **T**ime **P**rotocol
PTM	**P**anel **T**est **M**odule
SITIPE AT	**S**iemens **T**otally **I**ntegrated **P**ower **E**ngineering **A**utomated **T**esting
System under Test	A substation automation and protection system consisting of Protection or Automation Devices as well as Station Gateway, HMI, Network Infrastructure and Panel components (e.g. Terminals). SITIPE AT connects to the System under Test to simulate Substation behavior. Therefore the electrical and networking I/O interfaces from the substation to the System under Test are used.
Select-Before-Operate	Regarding Telecontrol communication: Command and set point execution mode, where first a SELECT has to be sent by the Master, then the remote system opens a command window. After positive SELECT activation confirmation of the system, a subsequent EXECUTE command has to be issued within the selection time window to really trigger command execution.
TCP	The “Transmission Control Protocol”. TCP is one of the main protocols of the Internet Protocol suite. It provides a reliable, ordered and error-checked delivery of a data stream between applications.
Test Sink	A system reaction expected after execution of a Test Source.
Test Source	A condition triggering the System under Test to react.
Test Precondition	A condition to set on the System under Test, before the Test Source is executed and Test Sinks are monitored.
USB	**U**niversal **S**erial **B**us
USB_PTM_IO	**U**SB **P**anel **T**est **M**odule
VI	LabVIEW **V**irtual **I**nstrument, a small Software Module in LabVIEW Graphics Code

3. Equipment

3.1. Panel Test Module - USB_PTM_IO

USB Panel Test Module (USB_PTM_IO)

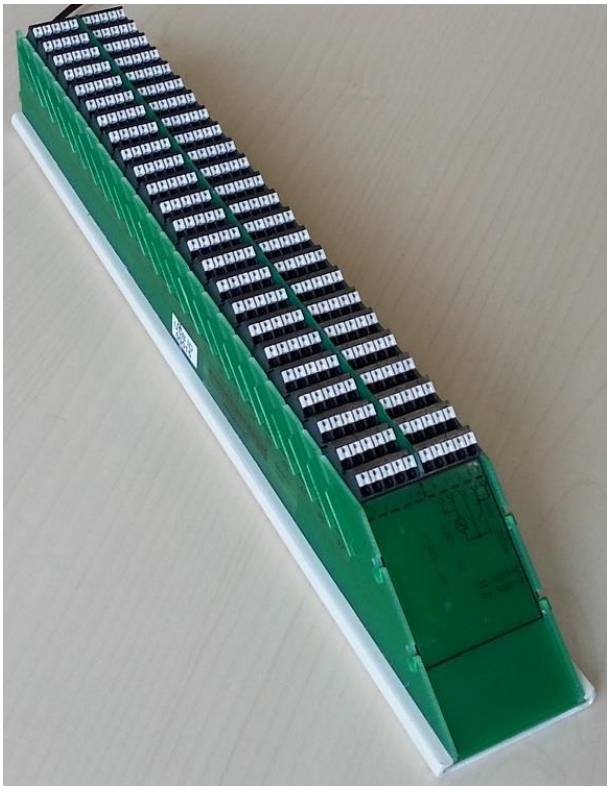


Figure 1: USB_PTM_IO

Test device for testing of signal paths and function test of panels.

3.1.1. Intended use of Device

The USB_PTM_IO is intended for use in a laboratory environment. It serves as test equipment for function tests and factory acceptance tests (FAT) of substation automation-, telecommunication- and generator protection panels.

For the function tests each USB_PTM_IO needs to be fixed inside a customer cable duct of a panel.

	**WARNING** • Do not connect device I/Os directly to mains voltage! • Never use device I/Os without external current limiting mechanism! • Do not use the device outside of a panel or fire protection housing! • Do not use as handheld device or without mounting!

3.1.2. Technical Data

Power supply: Over USB ⎓ 5 V

Power consumption: max 300mA

Dimensions (length x width x height): 303mm x 50mm x 53mm

Weight: 475g

3.1.3. Contact

Manufacturer: **Siemens AG**
EM DG SYS R&D IE

Postbox 48 06
90026 Nuremberg
GERMANY

Tel.: +49 (911) 433 0

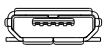
3.1.4. Ratings

3.1.4.1. Power Supply:

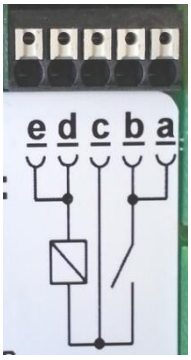
- Over USB ⎓5 V, max 300mA
- I/O max Ratings:
  220 V DC - 30 mA continuous operation (Short-circuit protection at 160 to 240 mA)
  200 V AC - 30 mA continuous operation (Short-circuit protection at 160 to 240 mA)

	**CAUTION** The I/O current needs to be limited to 5A! Only use secondary voltage. Never connect to mains voltage.

3.1.4.2. Connectors

1.  • Micro-B USB connector

2.



- 48 I/O Ports, each with 5 push-in contacts a,b,c,d,e:

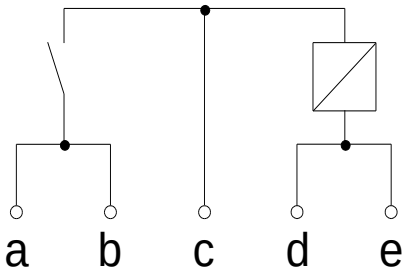


Figure 2: USB_PTM_IO Connectors

- The USB_PTM_IO provides 48 I/Os which are independent and insulated of each other.
- Inputs and Outputs are bi-directional
- The semiconductor switch for digital output between a/b and c is short circuit proof. In case of short-circuit it gets highly resistive. To reset its state after a short-circuit it has to be switched off and on again (using PTM software or power-up reset).
- Wiring examples can be found in chapter **3.1.5.3**.

The modules are connected to the test PC using USB. The maximum USB cable length is 3 m.

There are three different operation modes: Binary Output, Binary Output with monitoring and Binary Input. Please see the inside wiring of the ports above and Figure 5 on page 25 as reference.

1. **Binary Output**
   For this operation mode only the positive potential needs to be connected to connection **a/b**. The switched potential is available on pin c.
2. **Binary Output with monitoring function**
   Using this mode the positive potential needs to be connected to **a/b**. The switched potential is available on **c**. Additionally the monitoring function is realized by connecting the related negative potential to **d/e**. If the binary output switch is switched, the binary input should become high. If this isn't the case either the switch is damaged or it was switched through a short circuit in the panel resulting. A short circuit through an output results in a highly resistive output.
3. **Binary Input**
   For this operation mode one potential needs to be connected to **d/e** and the opposing potential needs to be connected to **c**. Connection **a/b** should be left unconnected.

⚠	**CAUTION** • Wiring has to be done under voltage free condition! • Always maintain protection against direct contact for the connections. (This means the maximum length for the wire end ferrule must not exceed 10 mm and it must always be completely inserted into the clamp.)

Only use cable with wire end ferrule. The following wire cross sections are allowed:

	MIN	MAX
-w/ wire end ferrule, DIN 46228 pt 1	0.25 mm²	1.5 mm²
-w/ plastic collar ferrule, DIN 46228 pt 4	0.25 mm²	0.75 mm²

CAUTION

I/O power supply (command voltage) using isolated limited secondary circuits which are derived by line voltage of overvoltage category II up to 300 V only.

I/O current has to be limited to 5 A.

3.1.4.3. Requirements for external circuits

External circuits connected to the I/O terminals need to fulfill all requirements for overvoltage category II. All external circuits have to fulfill basic insulation. Protection against direct contact has to be maintained at all times.

3.1.4.4. Environmental conditions

- Indoor use only
- max height 2000 m
- temperature +5° to 40°C
- max. relative humidity: 80 % (no condensation)
- I/O power supply (command voltage) using isolated limited secondary circuits which are derived by line voltage of overvoltage category II up to 300 V.
- Pollution Degree 2

3.1.4.5. Impact stress:

CAUTION

The USB_PTM_IO is a built-in type device. Therefore it only fulfills limited requirements in terms of mechanical stress. The device was tested with a maximum mechanical force of 1 J (IK06) according to IEC/EN 61010-1 section 8.2.2.

3.1.5. Installation

3.1.5.1. Placement of the modules

The modules have to be placed inside the customer cable ducts of a panel. In the cable duct each USB_PTM_IO device has to be fixed using cable ties and adhesive backed cable tie mounts. The cable tie mounts in the picture are of dimensions 12.7 mm x 12.7 mm (length x width).

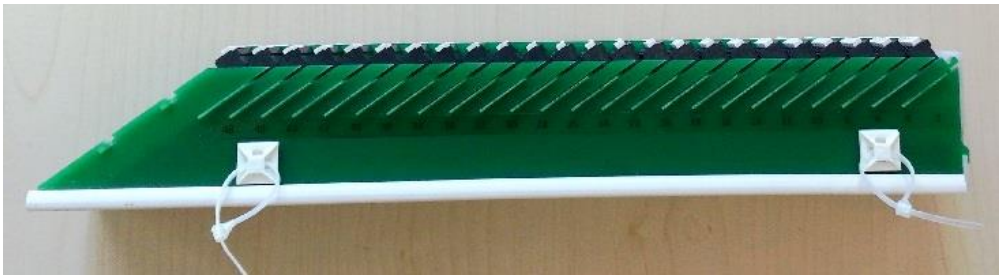


Figure 3: USB_PTM_IO with cable ties

Recommendation for cable tie mounts:

Panduit Adhesive Backed Cable Tie Mounts – ABM1M-A-C

Figure 4: USB_PTM_IO in cable duct

3.1.5.2. Connecting to Power Supply

USB

The USB Module itself is powered over USB:
⎓5 V, max 300mA

CAUTION
Maximum USB cable length is 3 m. The USB wires must provide basic insulation.

Command Voltage

Maximum Ratings:

- 220 V DC, continuous operation 30 mA (Short-circuit protection at 160 to 240 mA)
- 200 V AC, continuous operation 30 mA (Short-circuit protection at 160 to 240 mA)

	**WARNING** For connection of the command voltage to the I/O ports a power supply with galvanic isolation to the power grid has to be used: Use isolated limited secondary circuits derived from line voltages of overvoltage category II up to 300 V only! Protection: Power supply has to be limited to 5 A.
	**WARNING** Assembly and disassembly of the device and wiring changes is permitted under voltage free condition only!

3.1.5.3. Connecting to test object / panel

Numbering of ports: Example for external wiring:

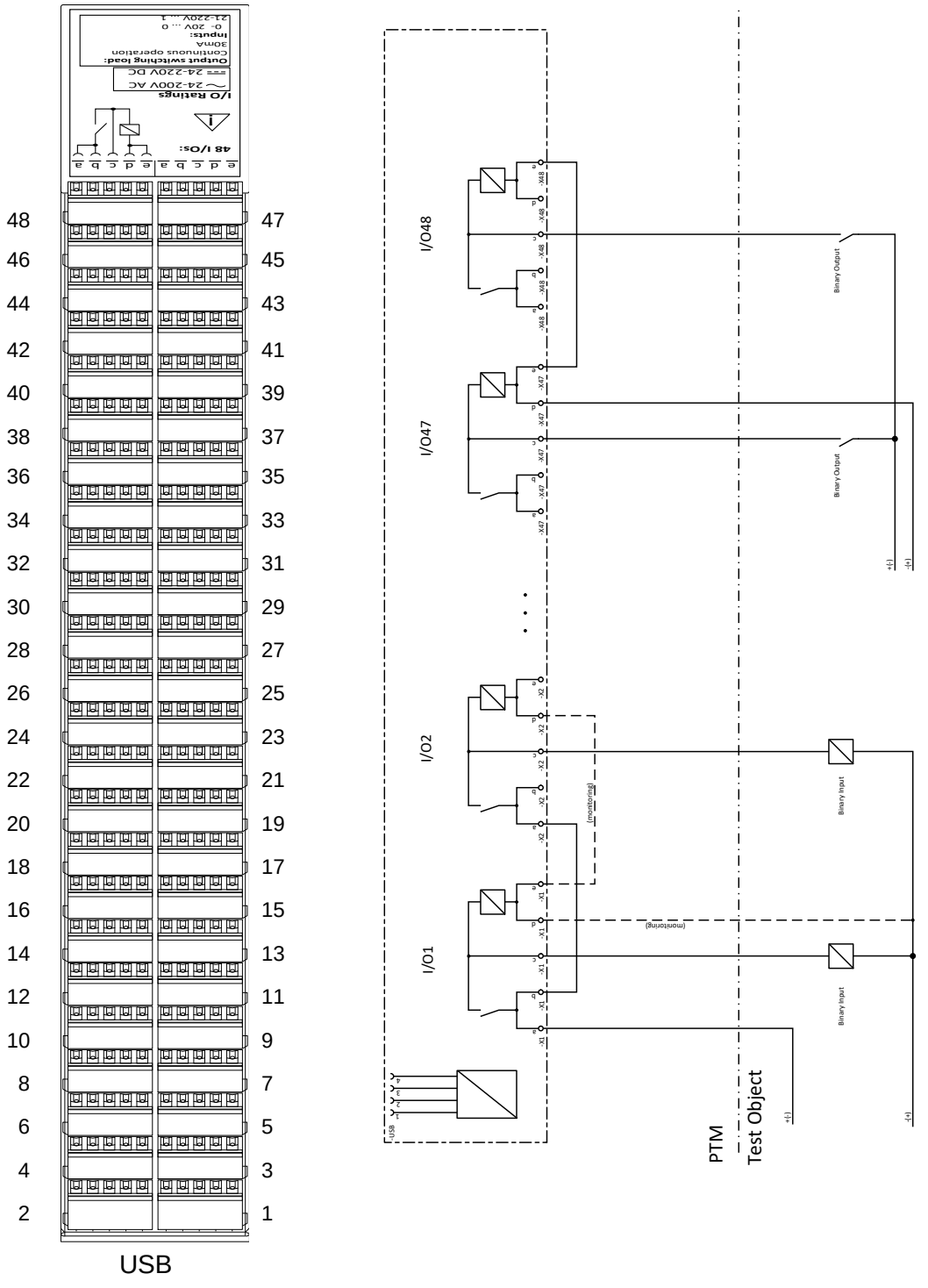


Figure 5 Port numbering and external wiring example – USB_PTM_IO

3.1.5.4. Requirements for connecting wires

USB

The USB cable length may not exceed 3 m. The cable must provide basic insulation

Command Voltage

WARNING

- Connecting and disconnecting of device I/O ports has to be done under voltage-free condition!
- For the connection of the IO ports only insulated cables have to be used. (Nominal voltage U0/U: 300/500V, Proof voltage 2000 V)

For the 5-pole push-in clamps of the I/O ports only wires with wire end ferrule and the following wire cross sections are allowed:

	MIN	**MAX**
-w/ wire end ferrule, DIN 46228 pt 1	0.25 mm²	1.5 mm²
-w/ plastic collar ferrule, DIN 46228 pt 4	0.25 mm²	0.75 mm²

WARNING

It is necessary to always maintain protection against direct contact. (This means the maximum length for the wire end ferrule must not exceed 10 mm and it must always be inserted completely into the clamp.)

3.1.5.5. Requirements for external devices

For the command voltage a power supply with galvanic isolation to the power grid has to be used. The output current of the power supply has to be limited to 5A. For additional protection of the primary side of the power supply please follow the manufacturer's instructions.

3.1.5.6. Requirements for ventilation

CAUTION

The device is intended for use without ventilation. The temperature must not exceed 40° C. Make sure not to place the device next to other heat sources.

3.1.5.7. General Remark

	**WARNING** The installer of the panel where the USB_PTM_IO is used is solely responsible for the security of the system.

3.1.6. Operation

3.1.6.1. Symbols

Explanation of the Symbols used on the device and the manual can be found in the preface of the document.

The functions of the USB_PTM_IO module are controlled using a pc and the controlling Software SITIPE AT / PTM Control. The module itself has no physical controls.

3.1.6.2. Cleaning of the device

The device may only be cleaned using a damp cloth under voltage free condition!

3.1.6.3. General Remark

	**WARNING** If the device is used in a way other than described in this manual the protection of the device may be affected.

3.1.7. Service and Maintenance

The device is service free. It may not be repaired. Faulty devices need to be replaced.

3.1.8. Unintended use

	**WARNING** • Do not connect device I/Os directly to mains voltage! • Never use device I/Os without external current limiting mechanism! • Do not use the device outside of a panel or fire protection housing! • Do not use as handheld device or without mounting!

3.1.9. Lifetime

The devices expected lifetime is 10 to 12 years for re-use of the device and a MRT (mean residence time) of 20 days in each panel per use.

The lifetime is derived from the maximum number of connection processes for the I/O push-in clamps of the device.

3.2. USB Equipment, System Limits

Property	Value
Max. Number of PTMs / PC	50
Max. Number of PTMs / Test System	50 (Single PC) / 200 (using Master/Slave Functionality)
Max. Number of el. Data points	2400 (Single PC) / 9600 (using Master/Slave Functionality)
Max. Number of Hub-Levels Path between Root Hub and PTM	5
Type of USB Hubs	Active USB Hub with Power Supply **Recommendation:** Industry Hub suited for 2A Output Current
Time Precision Direct Test PC connection	1 ms
Time Precision If applicable, Slave->Master connection	1ms, time stamping is done on the Slave PC; Please care on Quality of Network Synchronization (NTP) and network latency delays

Table 1 System Limits of USB Equipment

We recommend Industry Type USB Hubs for optimal connection conditions. It is known that certain hubs only provide 16 child devices. Therefore the selection of USB Hubs is critical to the proper Functionality of PTMs.

Please note: USB 3.0 Host Controllers have been reported to only support a few number of connected USB devices. Additionally, on Windows 7 Systems, USB 3.0 is not fully supported, so no precise Time stamping is available if you use Master/Slave Architecture or multiple USB Host Controllers.

4. Installation

To install the Software, the Installation of the Basic Package, as well as the Installation of the USB PTM IO Driver is necessary. For a Software update, only a reinstallation of the Basic Package is needed, the USB PTM IO Driver does not have to be changed.

Two installation packages are available:

- Install_SITIPE_AT.zip
  Main installation package including:
  - SITIPE AT incl. Master
  - SITIPE AT Test Protocol Wizard
  - USB PTM IO Driver
  - USB PTM Test / Change ID Tool
  - USB PTM Firmware Update
  - User Manual
  - Installers for needed Software Packages:
    - National Instruments LabVIEW Runtime Engine 2018 f2, NI-VISA Runtime 18.0
    - Microsoft Visual C++ 2013 Redistributable,
    - Microsoft .Net Framework 4.5.2
- Install_SITIPE_AT_Slave.zip
  Slave installation package
  - SITIPE AT Slave
  - USB PTM IO Driver
  - USB PTM Test / Change ID Tool
  - USB PTM Firmware Update
  - User Manual
  - Installers for needed Software Packages:
    - National Instruments LabVIEW Runtime Engine 2018 f2 and NI-VISA Runtime 18.0
    - Microsoft Visual C++ 2013 Redistributable
    - Microsoft .Net Framework 4.5.2

The main package is mandatory for an Automated Test. The Slave package can be used to connect PTMs of remote PCs to a Test System running SITIPE AT from the Main package.

To install a package, download its zip file and extract the zip-file to a folder destination of your choice. Afterwards execute **setup.exe** to initiate the Software Installation.

4.1. Software System Requirements

4.1.1. SITIPE AT incl. Master

System Component	Minimum Required Component	Recommended Component
Processor	Pentium III/Celeron 866 MHz (or equivalent) or later (32-bit) Pentium 4 G1 (or equivalent) or later (64-bit)	Intel Core i5 CPU 2.0 GHz (minimum 2 Cores)
RAM	1 GB	4 GB
Screen Solution	1024 x 768	1920 x 1080, 2 Screens recommended
Operating System	Windows 10 / 7 SP1 (32- and 64-bit)	Windows 10
Disk space	700 MB (620 MB LabVIEW Runtime, ~ 80 MB SITIPE AT)	
Peripherals	1 x USB Port (USB 2.0 required on Windows 7, full USB 3.0 Support on Windows 10) Communication Interfaces to System under Test (Ethernet, Serial Port) if applicable: Communication Interface to Slave PCs (Ethernet / Wi-Fi)	
Installed Software	Microsoft Office Word and Excel 2007 or newer with VBA installed PDF Reader to open the User Manual Redistributables (included in Setup): NI LabView Runtime Engine 2018 Microsoft .Net Framework 4.5.2 NI VISA 18.0 Microsoft Visual C++ 2013 Microsoft .Net Framework 4.5.2	

Table 2 System Requirements SITIPE AT incl. Master

For Master/Slave Setups or Multiple USB Host Controllers in use:

If PTMs are connected to USB 3.0 Host Controllers on a Windows 7 System, an old Time stamping method is used. Therefore timestamps in a Master/Slave Setup / Multiple USB Host Controller Setup will be wrong. SITIPE AT informs you about this. Connect PTMs only to USB 2.0 Host Controllers on Windows 7 Systems. Use Windows 10 on Systems which only provide USB 3.0 Ports.

USB 3.0 Ports can be identified by their **blue** connector color.

4.1.2. SITIPE AT Slave

System Component	Minimum Required Component	Recommended Component
Processor	Pentium III/Celeron 866 MHz (or equivalent) or later (32-bit) Pentium 4 G1 (or equivalent) or later (64-bit)	
RAM	256 MB	1 GB
Screen Solution	1024 x 768	
Operating System	Windows 10 / 7 SP1 (32- and 64-bit)	Windows 10
Disk space	640 MB (620 MB LabVIEW Runtime, ~ 20 MB SITIPE AT Slave)	
Peripherals	1 x USB Port (USB 2.0 required on Windows 7 Systems; full USB 3.0 support only on Windows 10) Communication Interface to Master Test PC (Ethernet / Wi-Fi)	
Installed Software	PDF Reader to open the User Manual Redistributables (included in Setup): NI LabView Runtime Engine 2018 Microsoft .Net Framework 4.5.2 NI VISA 18.0 Microsoft Visual C++ 2013	Remote Desktop Connection for Remote Control of Slave PC

Table 3 System Requirements SITIPE AT Slave

4.2. Main Package

The basic installation package includes the following components:

Run **setup.exe** to install the Software. If a security warning occurs, press Run:

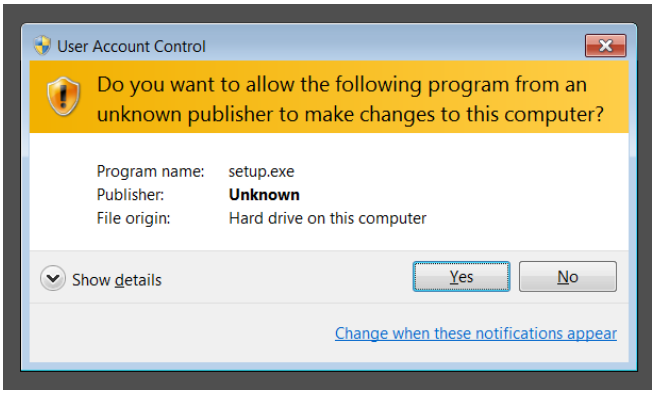


Figure 6 AT Installation Windows Security Warning

Afterwards the Installation Wizard opens. Go through the Installation Steps by Pressing **Next >>**.

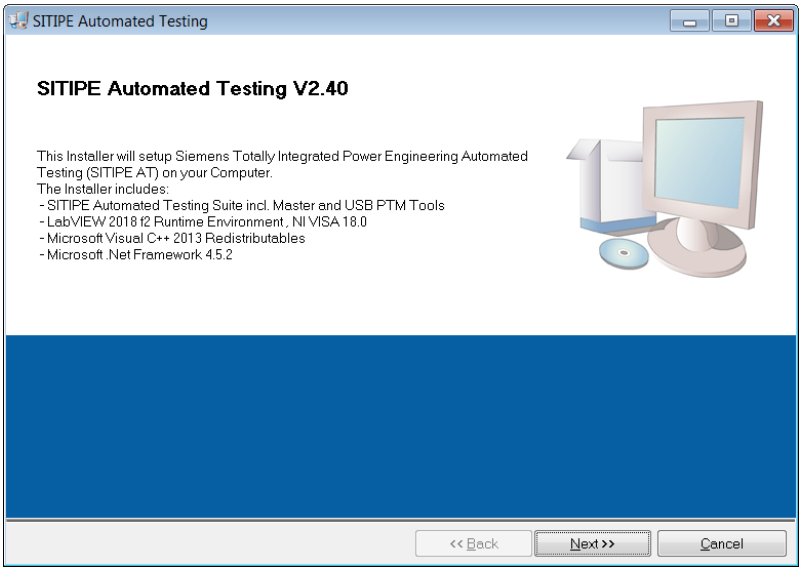


Figure 7 SITIPE AT Installation Introduction

Select an Installation Directory for all SITIPE Automated Testing Files. You may also select a Destination Path for all National Instruments Components, like the LabVIEW runtime.

Select the Destination directories and proceed with **Next>>**.

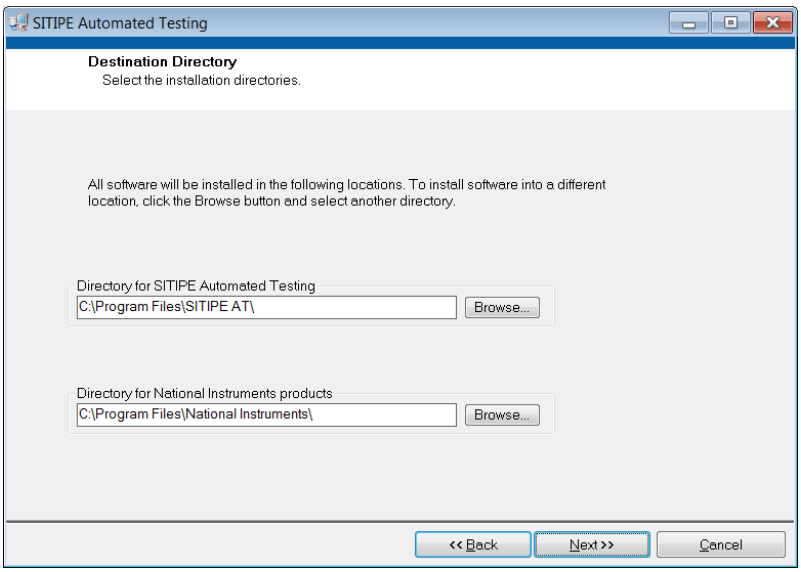


Figure 8 Installation Directory Dialogue

In order to install SITIPE AT, you need to accept the SITIPE AT License Agreement, as well as the two License Agreements for National Instruments Software. Please do so by selecting **I accept the above 2 License Agreement(s)**.

Proceed by Pressing **Next >>**.

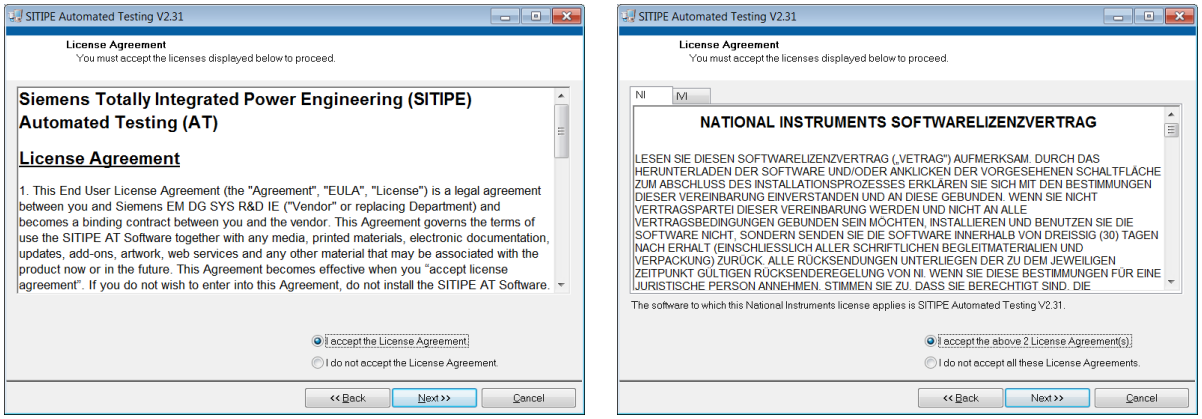


Figure 9 Installation License Agreements

The Wizard shows you an Installation Overview now. Start the Installation Process by Pressing **Next >>**.

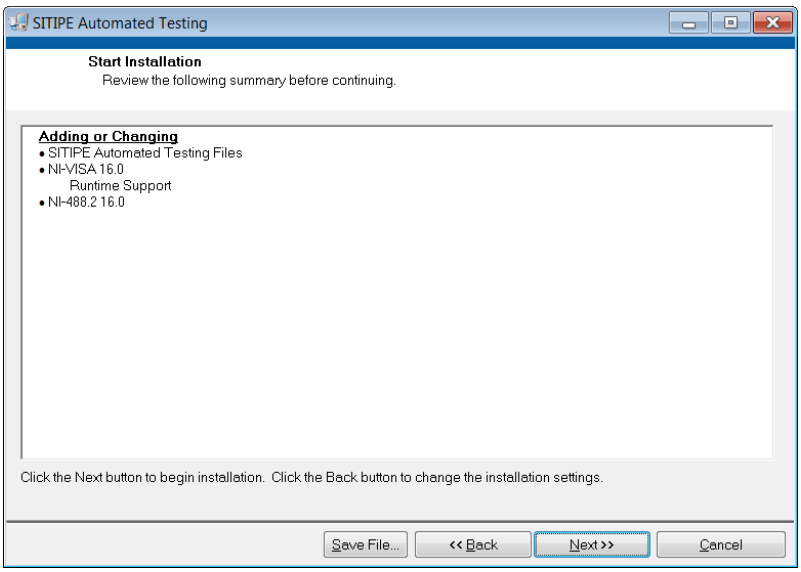


Figure 10 Installation Overview

After the Installation is finished, a finish message is shown. Proceed with **Next >>**.

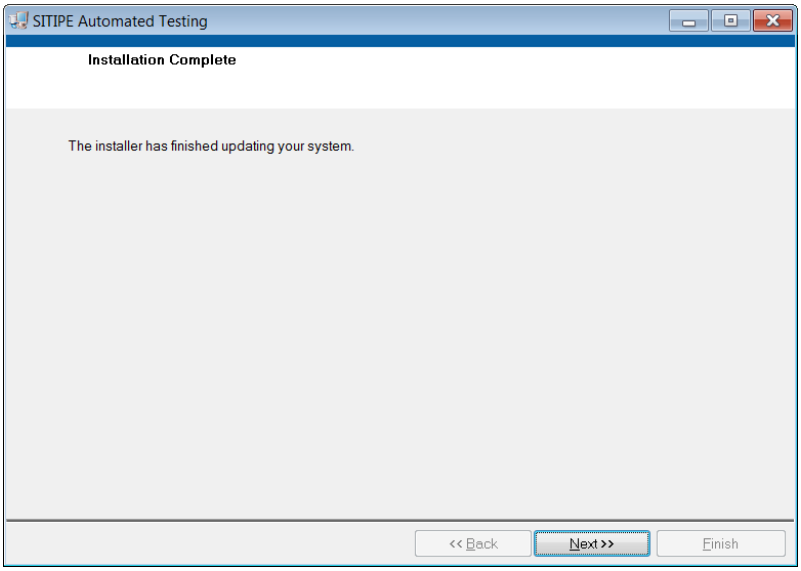


Figure 11 Installation finished

After this step, the installation is done. Now additional installers for USB PTM Driver, Microsoft Visual C++ 2010, 2012 and 2013 Redistributable and Microsoft .NET Framework 4.5.2 are started.

The USB PTM Driver Installation is checked and the driver installation starts, if the driver is not yet installed. See chapter **4.4.1** for more details.

The Installation for the Visual C++ 2013 Redistributables, as well as the Microsoft .Net Framework 4.5.2 is started. Please acknowledge upcoming License Agreements. Please proceed by installing those components, as they are needed for the operation of SITIPE AT.

After this step, the installation is finished and the Wizard may ask to restart the PC. Do so by pressing **Restart**.

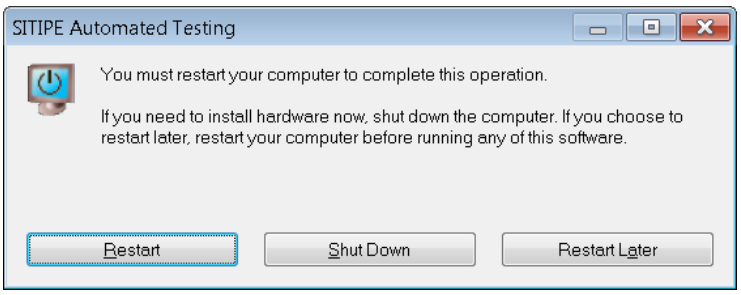


Figure 12 Installation Restart Dialogue

4.3. Slave Package

The Master/Slave solution is suggested for use cases with more than 100 PTMs involved or distances > 3m from PTM to PC. The Functionality is described more deeply in Chapter **5.2**.

To operate a SITIPE AT Slave PC, a separate, smaller Software Package is available. You may download it from the SITIPE SharePoint.

Please note: For a Master/Slave Setup, the SITIPE AT Main Package has to be installed on at least one PC. This PC has to be connected to all Slave PCs using an Ethernet Connection.

Run **setup.exe** to install the Software. If a security warning occurs, press Run:

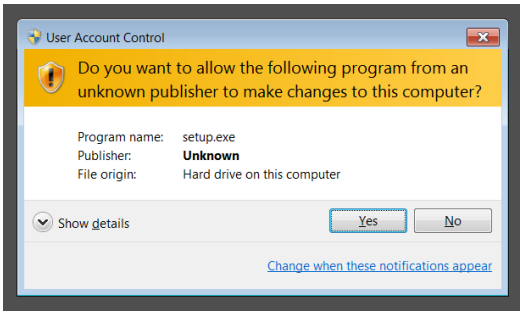


Figure 13 AT Slave Installation Windows Security Warning

Afterwards the Installation Wizard opens. Go through the Installation Steps by Pressing **Next >>**.

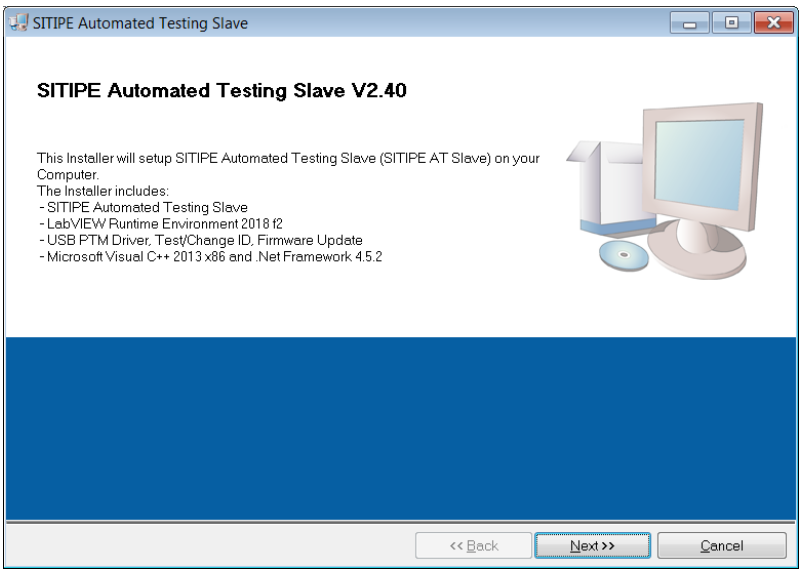


Figure 14 SITIPE AT Slave Installation Introduction

Select an Installation Directory for all SITIPE Automated Testing Files. You may also select a Destination Path for all National Instruments Components, like the LabVIEW runtime.

Select the Destination directories and proceed with **Next>>**.

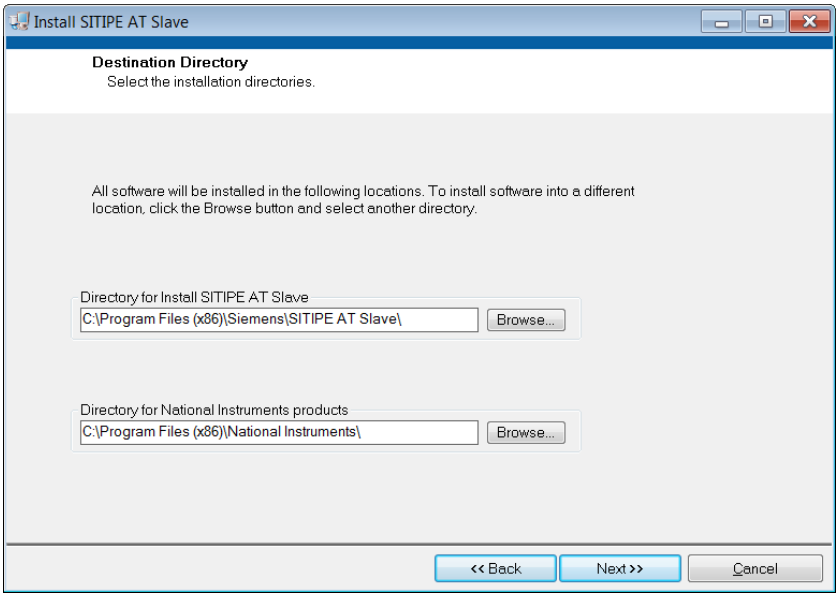


Figure 15 Installation Directory Dialogue

In order to install SITIPE AT Slave, you need to accept the SITIPE AT License Agreement, as well as the two License Agreements for National Instruments Software. Please do so by selecting **I accept the above 2 License Agreement(s)**.

Proceed by Pressing **Next >>**.

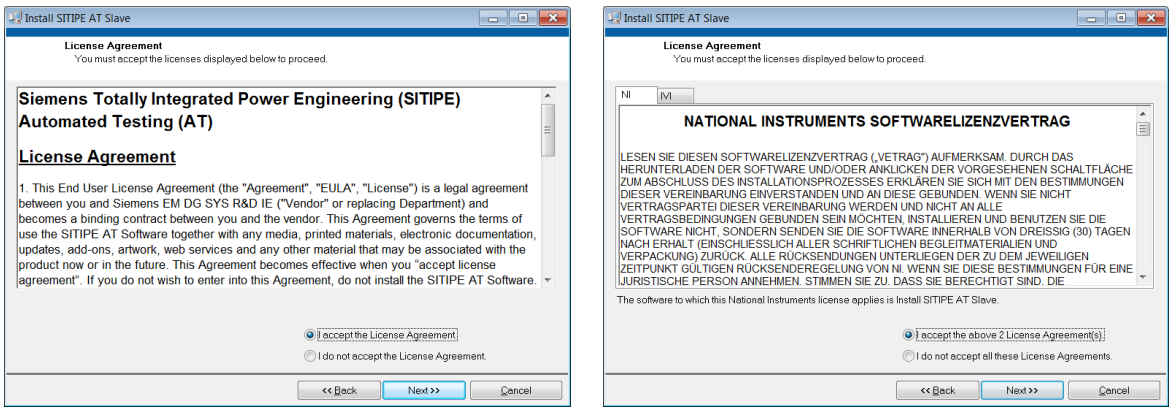


Figure 16 Installation License Agreements

The Wizard shows you an Installation Overview now. Start the Installation Process by Pressing **Next >>**.

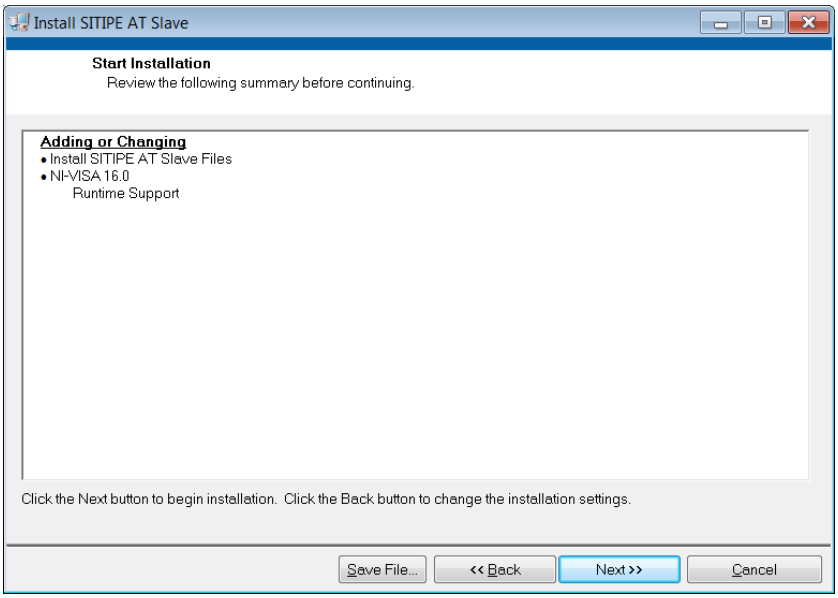


Figure 17 Installation Overview

After the Installation is finished, a finish message is shown. Proceed with **Next >>**.

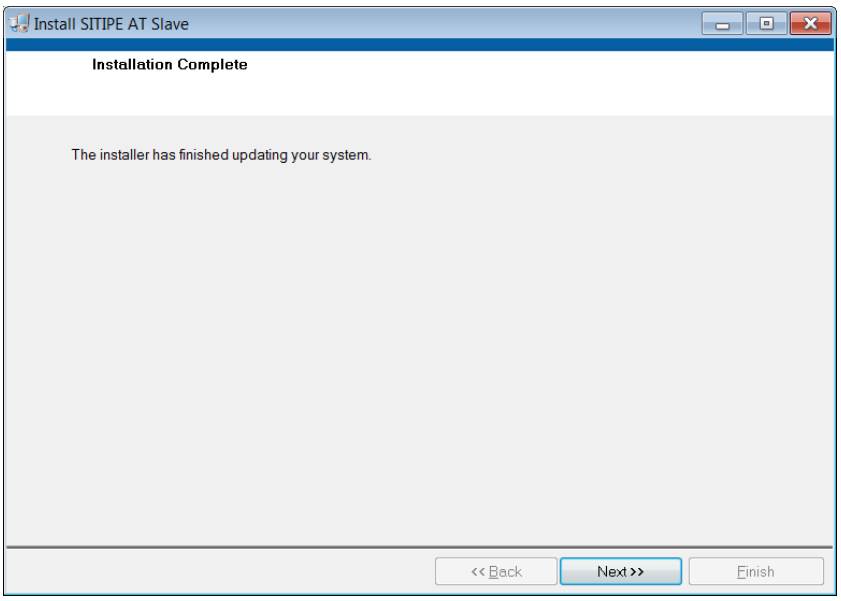


Figure 18 Installation finished

After this step, the installation is done and additional installers for USB PTM Driver and Microsoft Visual C++ 2013 Redistributable and Microsoft .Net Framework 4.5.2 are started.

The USB PTM Driver Installation is checked and the driver installation starts, if the driver is not yet installed. See chapter **4.4.1** for more details.

The Installation for the Visual C++ 2013 and Microsoft .Net Framework 4.5.2 is started. Please acknowledge upcoming License Agreements. Please proceed by installing those components, as they are needed for the operation of SITIPE AT.

The AT Slave setup will register a SITIPE AT Slave Windows Event Log source for event logging. This is done by the executable “CreateATWinEventLogSource.exe”. Please allow the upcoming Security request for this. This will allow AT Slave to log events to the Windows Event log.

After this step, the installation is finished and the Wizard may ask to restart the PC. Do so by pressing **Restart**.

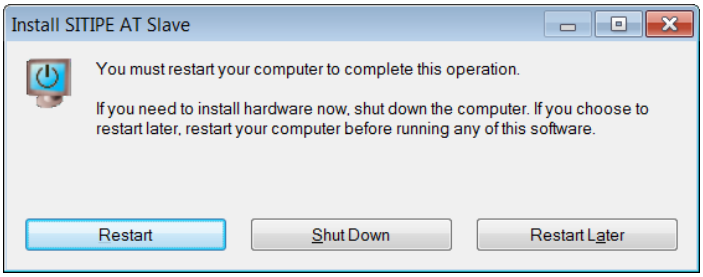


Figure 19 Installation Restart Dialogue

4.4. PTM Tools

SITIPE AT Packages come with 3 Tools for setup and configuration of USB PTM IO Devices. They are available in the **Windows Start menu** / **All Programs** / **Siemens** / **SITIPE Automated Testing** / **Tools** /.

4.4.1. USB PTM IO Driver

The USB PTM IO Driver is installed right after the Installation of SITIPE AT. You are asked for some system confirmations, shown in this chapter. Please accept them for a successful driver installation.

If you need to execute the installation at a later point in time, you can access it from the Windows Start menu. Start it by executing **SITIPE Automated Testing / Tools / Install USB PTM Driver**.

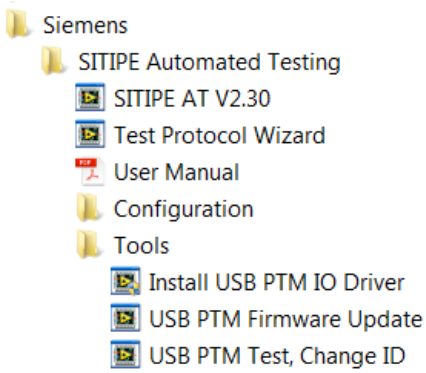


Figure 20 SITIPE Automated Testing Start Menu Entries

Windows may ask for confirmation in a User Account Control Dialogue. Agree by Pressing **Yes**.

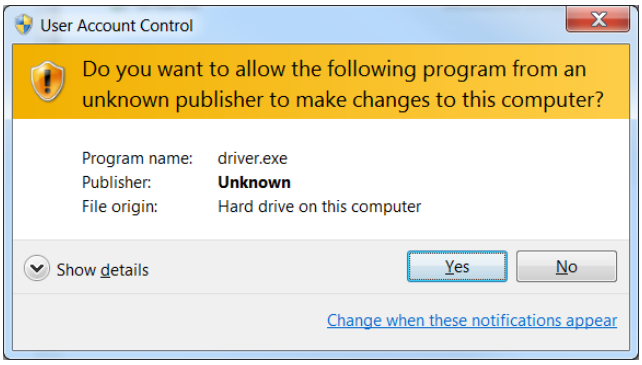


Figure 21 USB PTM IO Driver Installation Windows User Account Control Dialogue

Windows will install the driver automatically, since it is digitally signed for Siemens AG.

The USB PTM IO Driver is installed now.

- In delivery state, all modules have the same hardware ID 00000
- Never connect multiple modules with the same USB ID to your PC
- Change the USB ID with the PTM Tool USB PTM Test, described in chapter **4.4.2**.

4.4.2. USB PTM Test / Change USB ID

Use this tool for USB PTM maintenance and setup.

The tool offers the following Functionality:

- Change USB PTM Hardware ID

- Get an overview on PTMs connected to the PC
- Set module outputs manually
- Observe module inputs
- Execute a self test on a PTM (set PTM output, check whether its input reacts)

From the **Windows Start menu** / **All Programs** / **Siemens** / **SITIPE Automated Testing** / **Tools** / **USB PTM Test, Change ID**.

The USB Test Program will start.

4.4.2.1. Change USB PTM Hardware ID

PTMs are delivered with the Hardware ID 00000 by default. For correct addressing each PTM has to be assigned a unique Hardware ID. The Hardware ID has to be unique throughout the whole Testing Project. No two PTMs with the same Hardware ID can be connected to the system at a time. Use this tool to change the Hardware ID.

If multiple modules are connected, the module has to be selected first using the list box **Modules**. To change the ID press the “Change ID” button in the upper right corner of the window.

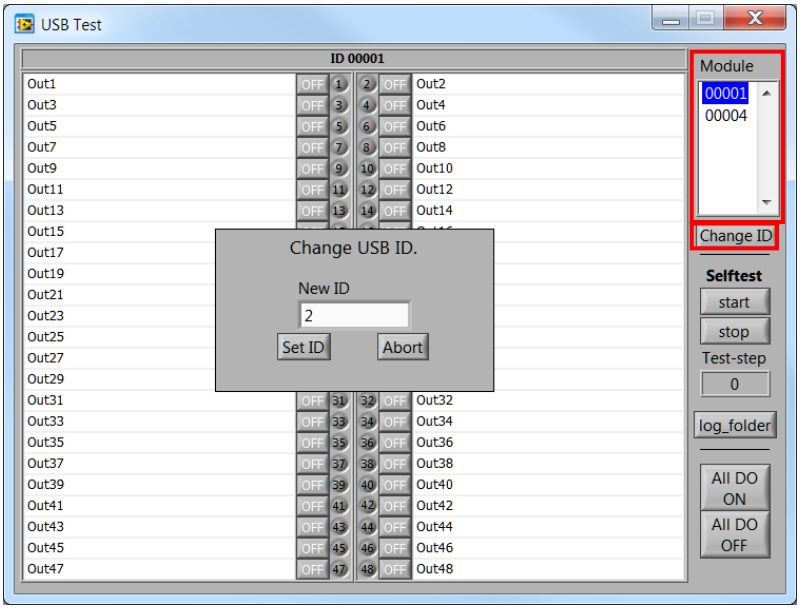


Figure 22 Change USB ID

Enter any integer number between 1 and 65535 as the hardware id. Preceding zeros can be dropped. To program the new ID press the “Set ID” button. The following dialog will appear.

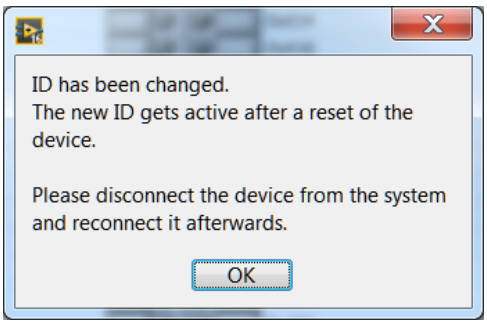


Figure 23 Change ID Process complete

At this point the device has to be reconnected in order to make the ID change effective. If an ID is set-up which was never connected before the driver dialog will appear. From now on the module has the new ID until it is changed again using the USB Configuration Tool.

4.4.2.2. Switch PTM Outputs / Observe Inputs

The tool user interface is similar to PTM Control. Therefore you may switch PTM output channels by pressing the **ON** / **OFF** – Buttons. Indications from the PTM inputs are shown on the LEDs with the channel number. They light up yellow if they are high.

4.4.2.3. Execute USB PTM Self test / ALL DO ON / ALL DO OFF

If the PTM is wired like it's delivered, you may execute a self test to check its proper functionality.

Therefore, press **Start** in the Self-Test section. Each PTM output will be put into HIGH state and the PTM input will be observed, if it indicates this HIGH state within a given time window of 50 milliseconds. The Self test can be interrupted by pressing the **Stop** button. Below the stop button test steps are counted during the self-test. If the PTM is working properly, an **OK** LED with green background color lights up. Below the **OK** indication the **log_file** button gives access to the log folder containing logs of the self test.

You can also set all PTM outputs to ON state using the **All DO ON** button. If the PTM channels are connected with output monitoring, their corresponding Input will light up.

It's also possible to switch all PTM outputs off by pressing the **All DO OFF** button.

4.4.3. Update USB PTM Firmware

USB PTMs are delivered with the latest USB PTM Firmware. However, in some cases the Firmware needs to be updated. For example, if you use a very old USB PTM or a Firmware Update is proposed by the SITIPE AT Development Team.

This chapter describes the steps needed to update the USB PTM Firmware. A SITIPE AT Basic Installation or SITIPE AT Slave Installation is a prerequisite for these steps.

Open the USB PTM Firmware Update Tool from the Start menu: **Windows Start menu** > **All Programs** > **Siemens** > **SITIPE AT** > **Tools** > **USB PTM Firmware Update**.

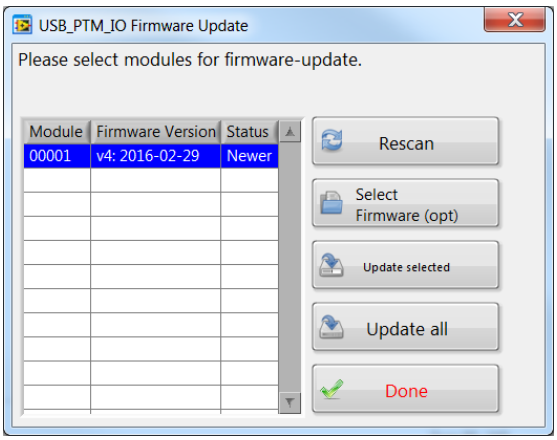


Figure 24 USB PTM Firmware Update Tool

The list on the left-hand side lists all USB PTMs connected to the PC together with their Firmware status.

If you want to update the Firmware using a specific Firmware File, press the **Select Firmware (opt)** button. You are asked for confirmation and afterwards you may select the Firmware File using the File Dialogue.

The SITIPE AT Main / SITIPE AT Slave packages come with the current PTM Firmware Binary File. It is located in **<Package Installation Directory>\USBPTM FW Update\CFG\Flash.bin**.

You may update specific PTMs or all PTMs connected to the PC. Press **Update Selected** to update the PTMs selected in the List on the left-hand side. Press **Update all** to update all PTMs connected to the PC.

After the update has run, the updated PTMs need to be unplugged and replugged to the PC. The Firmware should be updated by then. You may verify this by Pressing the **Rescan** button. Close the Firmware Update Tool using the **Done** button / close window button.

5. Software Functions

5.1. Basic Functionality

5.1.1. Main Window

SITIPE AT Main Window is the main entry point to the SITIPE AT Software. Open SITIPE AT from the Desktop or Start menu Shortcut SITIPE AT (**Windows Start menu** / **All Programs** / **Siemens** / **SITIPE Automated Testing** /). The Main Window is opened:

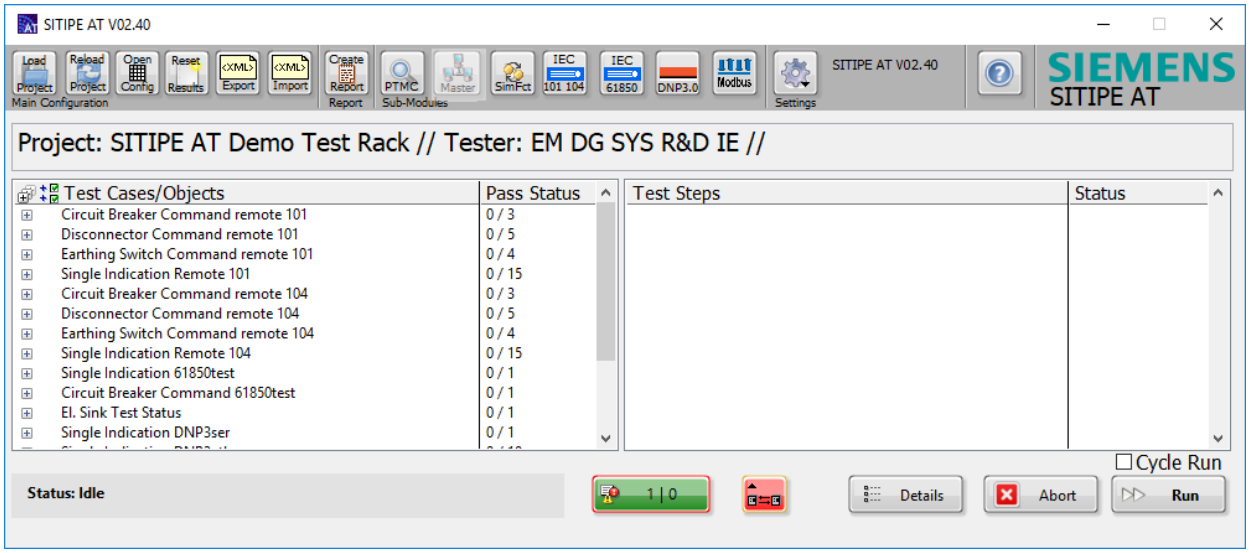


Figure 25 SITIPE AT Main Window

The Main Window gives access to all Functionality provided by SITIPE AT. The following chapters describe it in detail.

5.1.1.1. Configuration

SITIPE AT has to be configured correctly in order to execute a proper test. Refer to chapter 6 for details on the correct configuration.

You have to load a Configuration in order to configure the Test Model with all Signals and other related information. After a Configuration is loaded, SITIPE AT saves it to a local path and reloads it, if SITIPE AT is closed and restarted at another point in time.

The following points describe how to load, reload, export and import the Configuration as well as how to clear the Test Results.

5.1.1.1.1. Loading a Project

Load a Project using the Load Project button in the upper-left corner of SITIPE AT Main Window.

SITIPE AT provides functionality to import the Test Configuration using an **Excel Workbook** (see chapter **6.2**). A File Dialogue is opened. Select your Excel Configuration Workbook path and press **OK** to continue.

Afterwards SITIPE AT loads the Configuration. This configuration is saved locally, so SITIPE AT can reload when you close and reopen it at any point in time, without reparsing the Excel File again.

Please note: All Test Results will be lost, when you load a new Configuration.

5.1.1.1.2. Reloading a Project

Press the **Reload Project** button to reload the Configuration Excel Workbook, which was previously loaded. This button appears disabled and grayed out, if no Configuration Excel Workbook was loaded in before.

Please note: All Test Results will be lost, when you reload the Configuration.

5.1.1.1.3. Open Configuration Workbook

Press the **Open Config** button to open Excel and load the Configuration Workbook to make changes on the Configuration. This button appears disabled and grayed out, if no Configuration Excel Workbook was loaded in before.

5.1.1.1.4. Reset Results

SITIPE AT keeps all Test Results in a local file together with the Test Configuration. You can remove all Test Results by Pressing **Reset Results** button left next to the **XML Export** button.

Please note: This step will **remove ALL** test results. No data recovery is provided.

5.1.1.1.5. XML Export / Import

The SITIPE AT Configuration together with all Test Results can be exported to a XML[2]-File. This file can be imported on another machine using the XML Import Functionality.

Export the XML File using the **XML Export** button. Specify a Destination path for the XML File afterwards and press OK. The XML File will be saved afterwards.

If you want to import a XML File, press the **XML Import** button. Specify a path to the XML File and press OK. The XML file will be loaded afterwards.

Please note: Loading a XML file will cause a **data loss** of all previous Test Results. There is no Merge-Functionality provided.

5.1.1.2. Create Report

SITIPE AT is able to automatically create a Test Report Document in the Word Document format, based on Closed Loop Test Results. Press the **Create Report** button to open up Test Protocol Wizard. Please refer to chapter **5.3** for further details on Test Protocol Wizard.

5.1.1.3. Settings

SITIPE AT provides a Settings Menu to modify its behavior. Access the Menu in SITIPE AT Main Window by Pressing the **Settings** button right next to the Software version indicator.

Settings are saved locally on the PC, so they are kept if SITIPE AT is restarted.

[2] XML: Extensible Markup Language, a Plain Text File format for structured data exchange

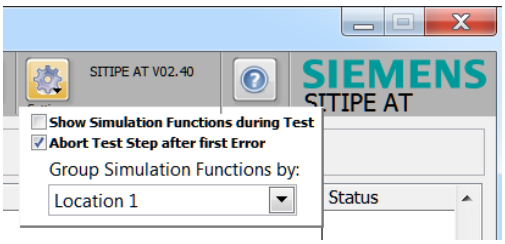


Figure 26 Settings Menu in SITIPE AT Main Window

5.1.1.3.1. Show Simulation Functions during Test

If this checkbox is selected, the Windows of the Simulation Functions are shown, whenever they are started during a Test. Deselect the checkbox to keep simulation function windows hidden, when they are started.

Note: Disable this checkbox, if you used BaySingleLine.vi Simulation Functions. Opening the window directly from the Simulation Menu is recommended.

Default value: **not checked**

5.1.1.3.2. Abort Test Step after first Error

If this checkbox is selected, a Test step will abort, whenever an error occurs. The Test will go on with the next Test Step. Deselect the checkbox to continue Test Steps even if an error occurs.

Default value: **checked**

5.1.1.3.3. Group Simulation Functions

Simulation Function Windows are shown grouped by a Location Field in the Simulation Overview Window. Select the Field to group by using the Dropdown-List. Refer to chapter **5.1.8.3** for more information on the Simulation Overview Window.

Default value: **Location 1**

5.1.1.4. Network Interface Status Indicator

SITIPE AT provides several network interfaces for Communication with the System under Test. Currently IEC 60870-5 -101 / -104, IEC 61850-8-1 MMS, DNP3.0 Serial and Ethernet, Modbus Ethernet Communication is supported.

Use the Network Interface Status Indicator to get an Overview on the Connection status of the configured Network Interfaces.

The indicator is located at the bottom of SITIPE AT Main Window, next to the Details button. It is colored Green, if all Network Interfaces are connected properly. If at least one Network Interface failed, the indicator color changes to red.

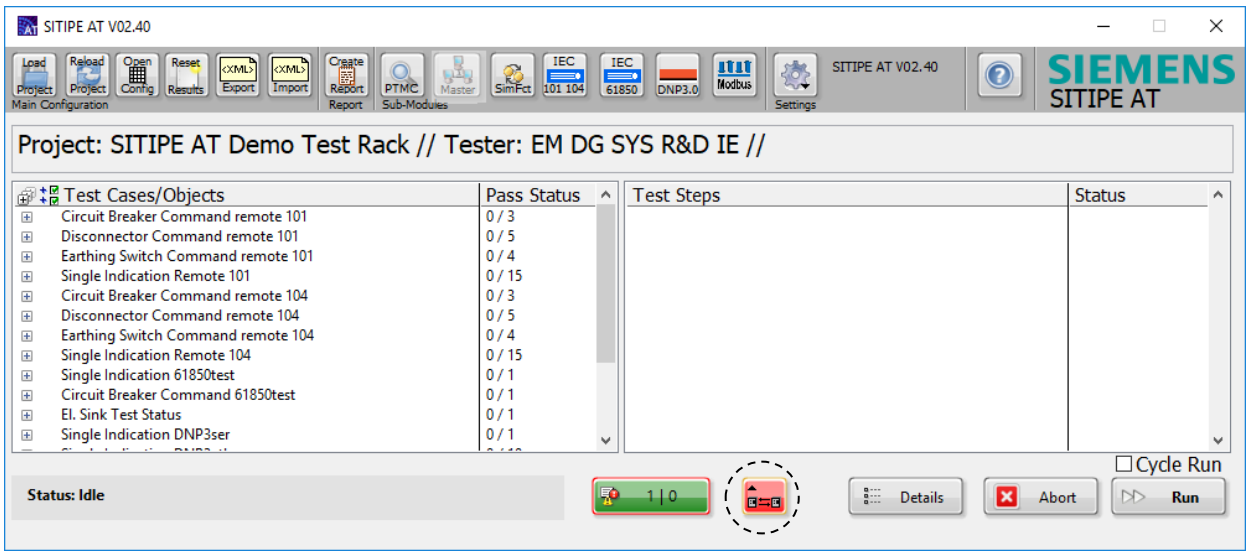


Figure 27 Network Interface Status Indicator in SITIPE AT Main Window

Click on the indicator to get a detailed status for all configured Network Interfaces. Checkmark-Symbols (✓) mark connected interfaces, X-Symbols (✗) mark failed interfaces. The Dialogue also shows the configured Address, Baud rate, Link address etc. for the Test Interfaces.

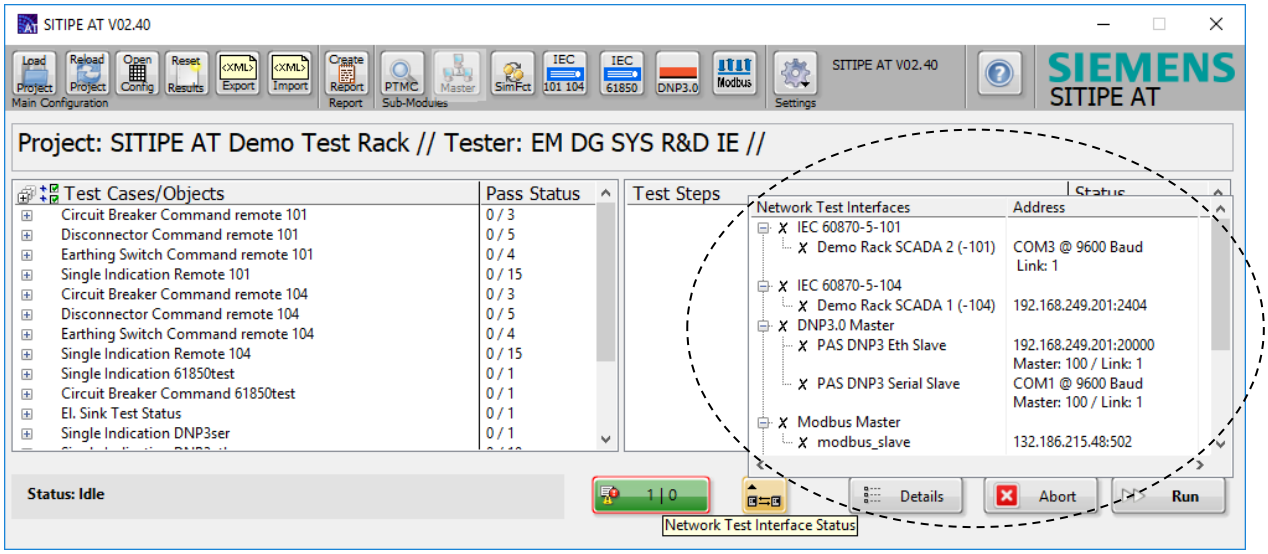


Figure 28 Network Interface Status Detail dialogue in SITIPE AT Main Window

5.1.1.5. Help button

Press the Help button to open the SITIPE AT User Manual in your default PDF reader to get further information on SITIPE AT Functionality.

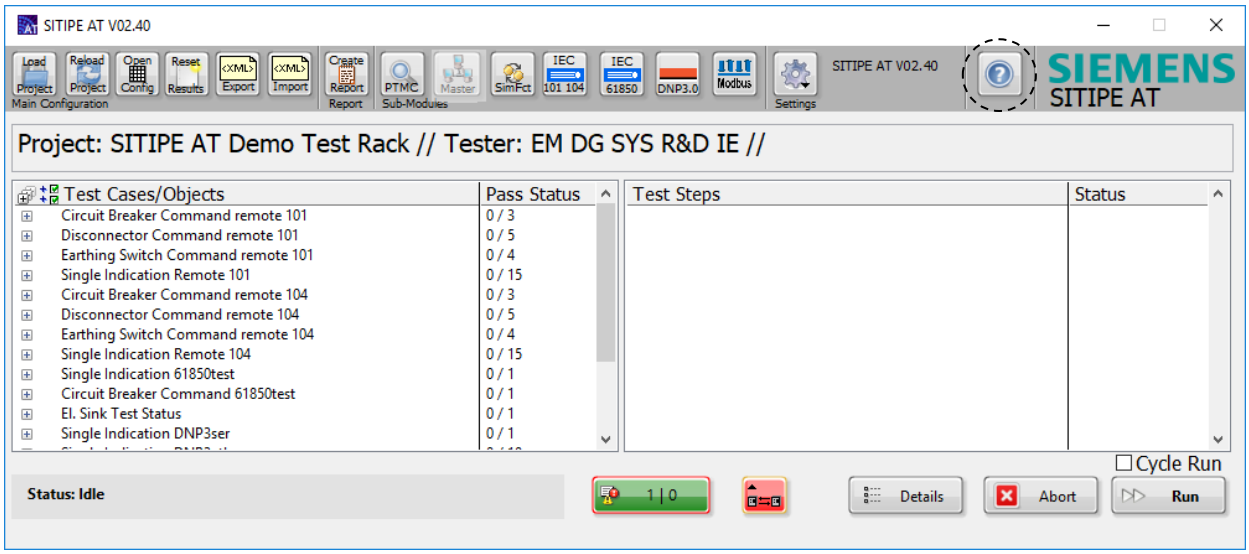


Figure 29 SITIPE AT Main Window and Help button

5.1.2. Runtime and Configuration Log

SITIPE AT is keeping track of certain events happening to the test system. Logging is split in a runtime log and a configuration log. The number of runtime errors and configuration errors is indicated in the log button of the SITIPE AT Main Window (see Figure 30). The logs are kept on hard disk, so no information is lost if SITIPE AT is restarted.

Press the Logs button to open the Logs window. The logs window consists of the runtime and configuration logs. These parts are described in the following two subchapters.

If configuration errors are found during loading of an Excel configuration, the Logs windows tab ‘Configuration’ is automatically opened, showing the errors.

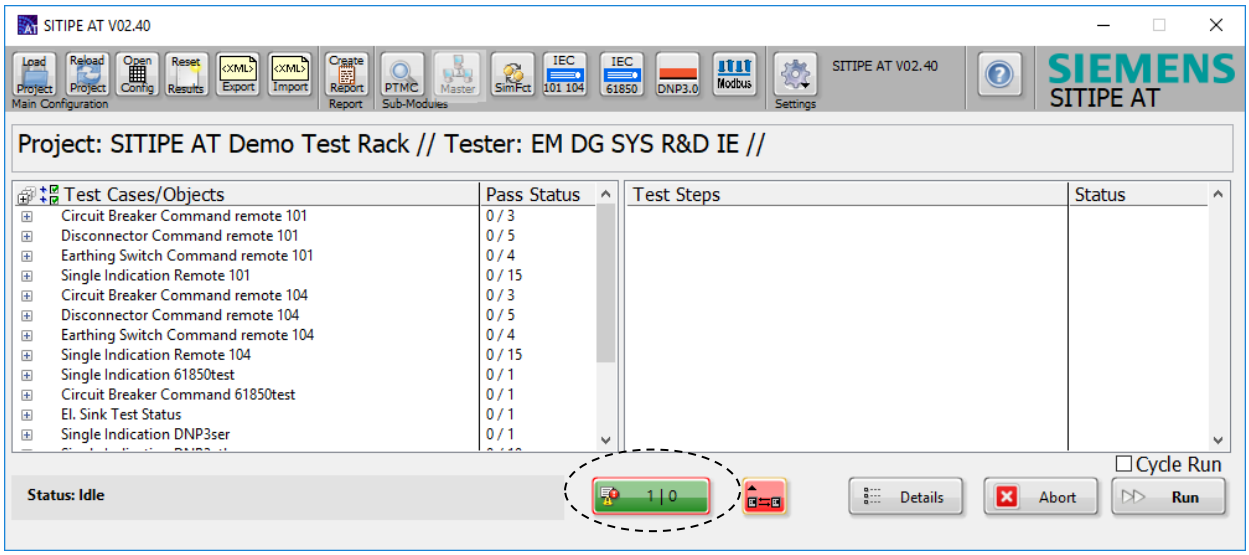


Figure 30 SITIPE AT Main Window and log button

5.1.2.1. Logs Window, Tab Runtime

The runtime log is filled whenever an event occurs during normal operation of SITIPE AT, e.g. loading a new configuration file containing some errors.

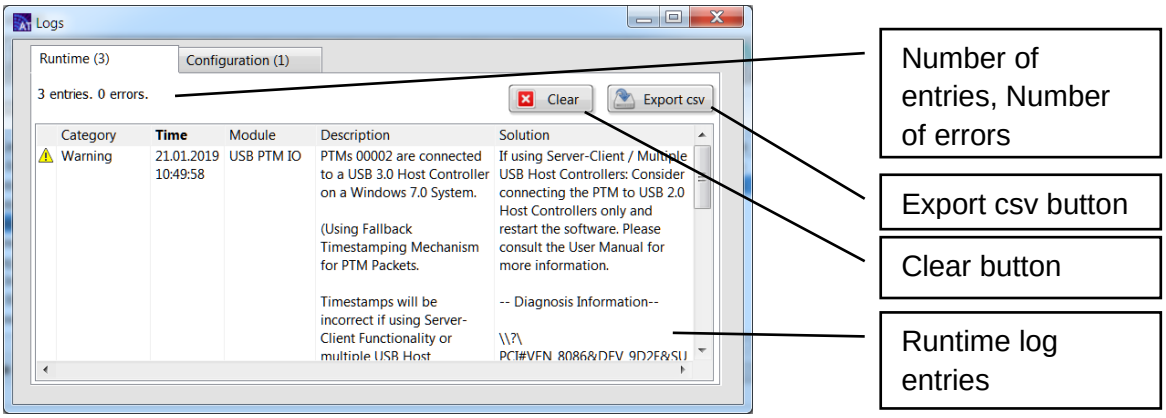


Figure 31 Logs Window, Tab Runtime

The runtime logs tab contains of the following elements:

- **Runtime log entries**: Lists all entries of the runtime log. Entries are categorized by the event priority (Error, Warning, Information). A proper event description is given, additionally a proper solution is given if possible as a recommendation for you.
- **Number of entries / Errors indicator**: Gives a count of entries of the log. Additionally the number of critical runtime errors is listed.
- **Clear button**: Clears the runtime log, removing all entries from the list and from the hard disk log memory.
- **Export csv button**: Exports all runtime log entries to a Comma-Separated-Values File (CSV), which can be opened with a Spreadsheet Program like e.g. Microsoft Excel. On pressing, a file dialogue will ask for the destination path where to save the file.

Sorting

By default, most recent entries are shown by ordering by the time column. Click on a column header to sort by the column. You can reverse the sorting by clicking the column header again.

5.1.2.2. Logs Window, Tab Configuration

The configuration log is filled, whenever a new Excel configuration file is loaded. If any errors are found during loading of the Excel Configuration, the Logs window automatically opens with this Tab open.

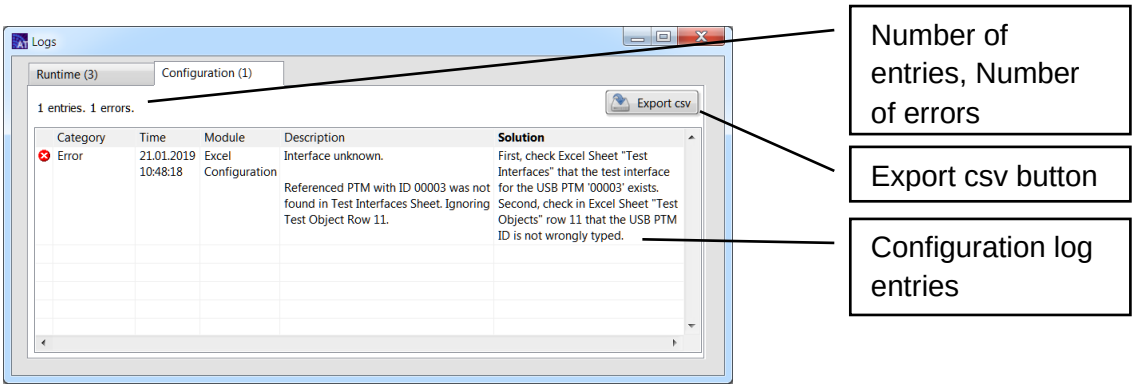


Figure 32 Logs Window, Tab Configuration

The configuration logs tab consists of the following elements:

- **Configuration log entries**: Lists all entries of the configuration log. Entries are categorized by the event priority (Error, Warning, Information). A proper event description is given, additionally a proper solution is given if possible as a recommendation for you.
- **Number of entries / Errors indicator**: Gives a count of entries of the log. Additionally the number of critical configuration errors is listed.
- **Export csv button**: Exports all configuration log entries to a Comma-Separated-Values File (CSV), which can be opened with a Spreadsheet Program like e.g. Microsoft Excel. On pressing, a file dialogue will ask for the destination path where to save the file.

Clearing the configuration log, like the runtime log, is not allowed, since you would lose the information, whether a Configuration is 100% valid.

Sorting
By default, the log is sorted by the Category column, giving Errors at the top of the list. Click on a column header to sort by the column. You can reverse the sorting by clicking the column header again.

5.1.3. PTM Control

Use PTM Control to set PTM outputs or to monitor PTM inputs.

The sub module PTM Control can be opened from SITIPE AT Main Window. Press the PTMC button to start it. This button appears disabled and grayed out, if no PTMs were configured for this Project.

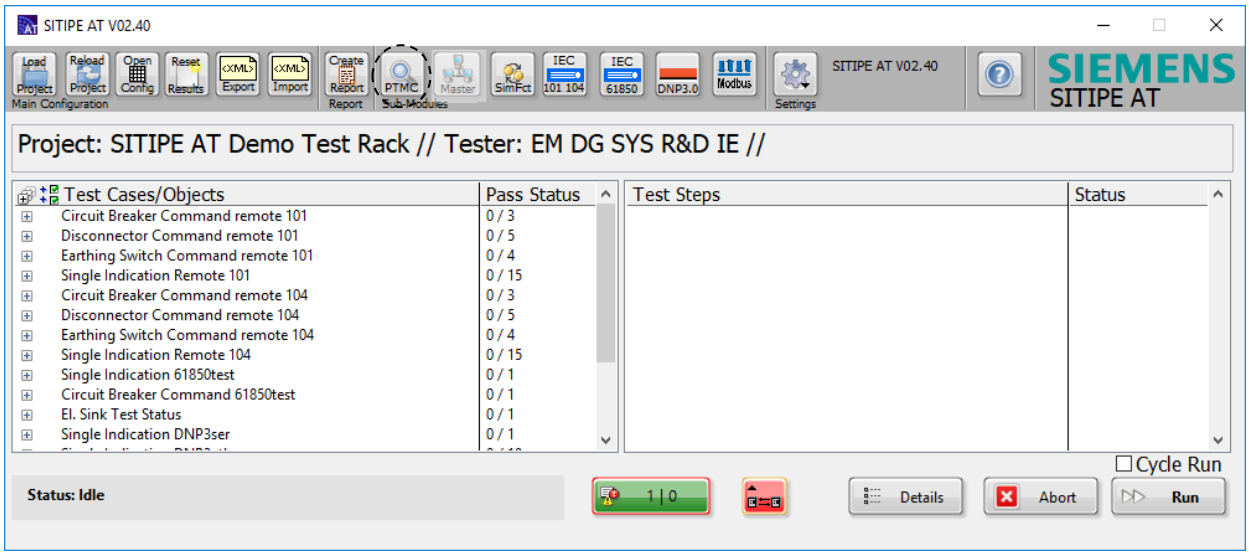


Figure 33 PTMC Button in SITIPE AT Main Window

The following chapters describe PTM Control Functionality in detail.

5.1.3.1. Signal Label, Input and Output

In general, PTM Control lists signals, with a Signal Label, PTM output button and PTM input indicator LED.

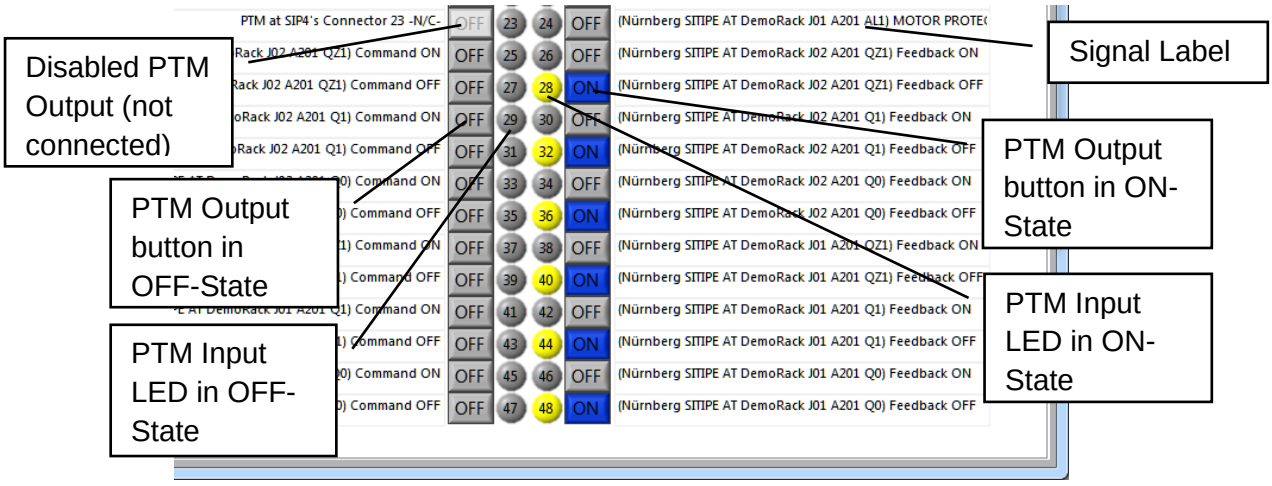


Figure 34 Illustration of Signal Label, Input and Output for PTM Channels

The current state of the PTM input is shown on its PTM Input Indicator LED. If the Signal is HIGH, the LED lights up yellow. If the Signal is LOW, the LED is shown in grey color.

The current state of the PTM output is shown on the PTM Output Button. If the Output is HIGH, the Output Button is labeled “ON” and has a blue background color. If the Output is LOW, the Output Button is labeled “OFF” and has a grey background color. Press the button to switch the PTM output directly.

5.1.3.2. PTM View

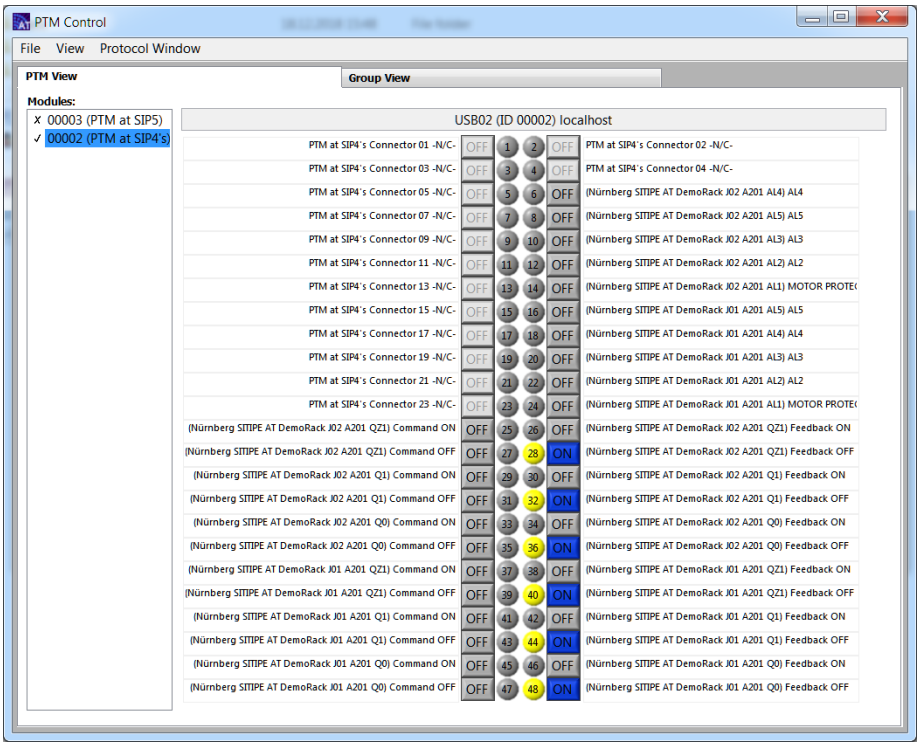


Figure 35 PTM Control PTM View

The PTM View gives a quick overview on the 48 I/O channels of a PTM from a birds-eye perspective. If a PTM is currently disconnected, its channels will be grayed out in this view.

Switch PTM outputs by pressing the output button (blue = ON). PTM outputs which were not assigned in the configuration are disabled and grayed out by default for security reasons. Enable those by Clicking the Menu Item **View** > **Enable unassigned PTM outputs**. You can also disable this afterwards here.

Monitor PTM inputs by the according LED (yellow = ON state).

To view another PTM, select it from the Modules list on the left-hand side.

The list of modules also indicates the connection status of a PTM by the symbol placed in front of the PTM number:

Symbol	Description
✓	PTM connected to the Test System on the local PC
🖳	PTM connected to the Test System using a Slave PC
✗	PTM not connected

Table 4 PTM Control PTM Status symbols

5.1.3.3. Group View

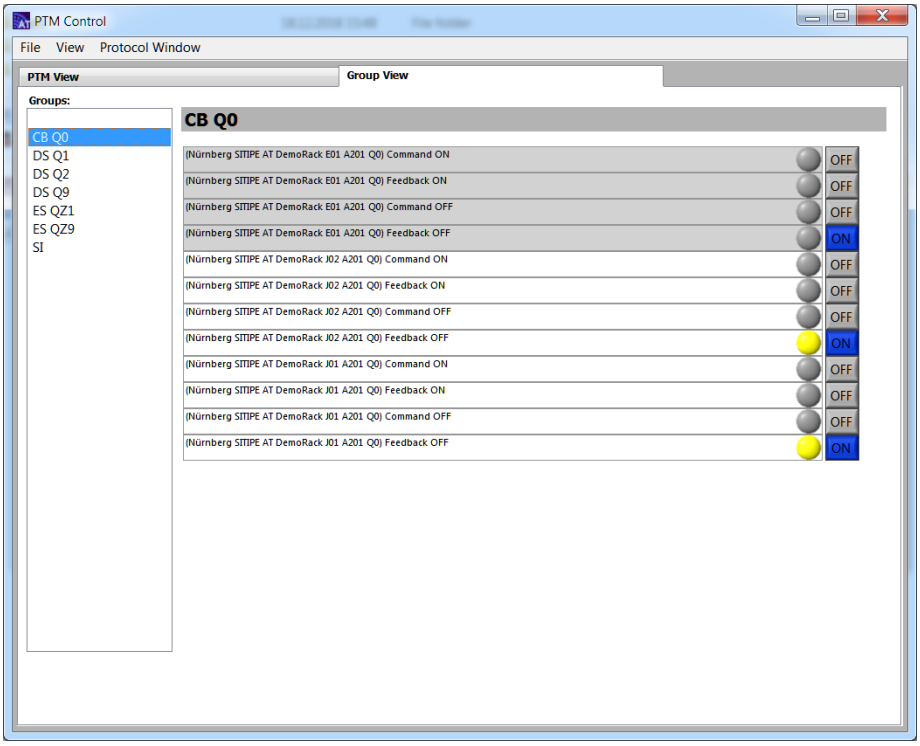


Figure 36 PTM Control Group View

The Group View gives a quick overview on the I/O channels of grouped signals.

Signals are associated to groups based on the Configuration Parameter “Group”. Please consult the Configuration chapter for more detailed information.

If a PTM is currently disconnected, its signals in a group are grayed-out, like in the Picture above for the signals “E01 A201 Q0 Command ON” etc.

To show signals of another group, select the desired group in the Groups list on the left hand side. Signals not associated to a group are located in the Empty group by default. The empty group is the uppermost group in the List.

5.1.3.4. Protocol Window

The Protocol Window lists all changes on PTM input and output channels together with their state and timestamp.

Open the Protocol Window using the PTM Control Menu bar **Protocol Window** > **Show**.

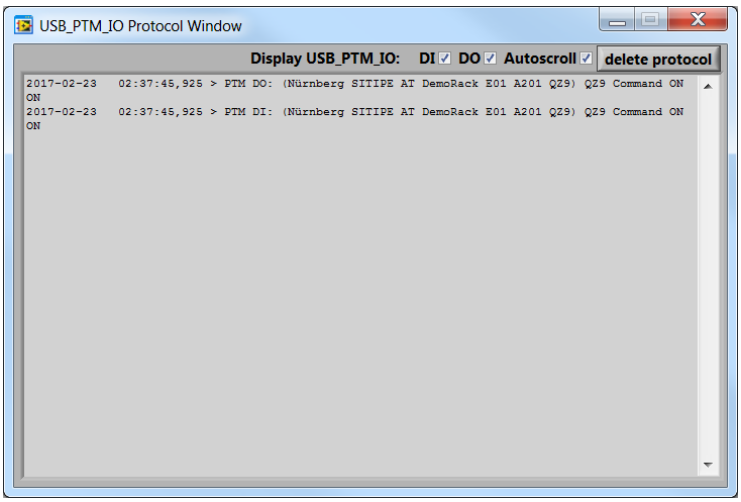


Figure 37 PTM Control Protocol Window

By default, the Protocol Window lists changes on both PTM Inputs and PTM Outputs. You can alter this behavior by removing / placing checkmarks in the Fields **DI** (PTM Inputs) or **DO** (PTM Outputs). Place a checkmark in those fields to see the information. Uncheck them to filter out the changes for Binary Inputs (DI) or Binary Outputs (DO) of PTMs.

The text frame automatically scrolls, as more contents is added. You may alter this behavior by removing / placing the checkmark in the Field **Autoscroll**.

Delete the Protocol History by pressing the **delete Protocol**-Button.

The Protocol Window is configured to stay always on top of all windows, to ensure its visibility. You can disable this functionality in the PTM Control Menu bar **Protocol Window** > **Always on Top**.

5.1.3.5. Changing the Label font size

You can adjust the font size of the Labels, buttons and indicators in PTM View and Group View according to your needs. Three font sizes are available: 14pt (default), 18pt and 24pt.

You can change the setting in the Menu **View > Font size for Channel labels >**

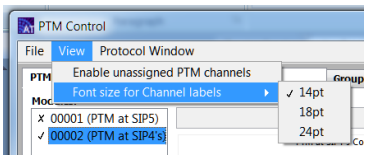


Figure 38 Menu to change PTMC font size

5.1.4. IEC 60870-5 -101 / -104 Master Dialogue

SITIPE AT provides functionality to send and receive telegrams on IEC 60870-5-101 (Serial) or -104 (Ethernet) Interfaces to simulate Control Center behavior.

You have to configure SITIPE AT for your desired -101 / -104 Interfaces in advance. Please consult chapter 6 for more details on Configuration.

5.1.4.1. Dialogue

Press the **IEC 101 104** button in the Sub-Modules section of the SITIPE AT Main Window to open the **IEC 60870-5 -101 / -104 Master** Dialogue. The button appears disabled and grayed out, if no -101 / -104 Interfaces were configured.

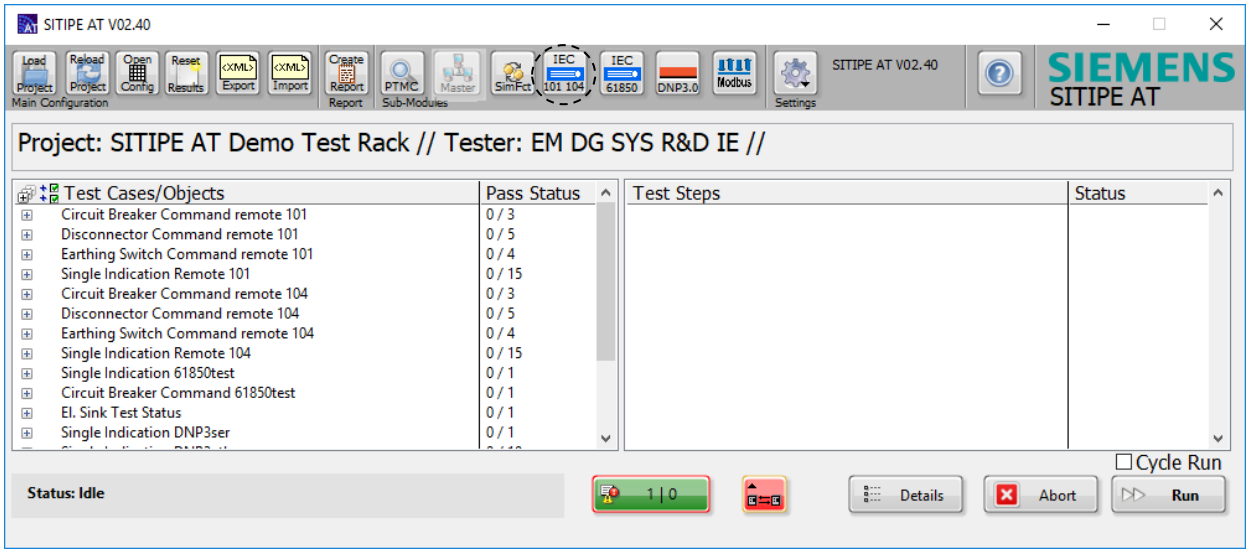


Figure 39 SITIPE AT Main Window and IEC 101 104 button

The **IEC 60870-5 -101 / -104 Master** Dialogue is opened.

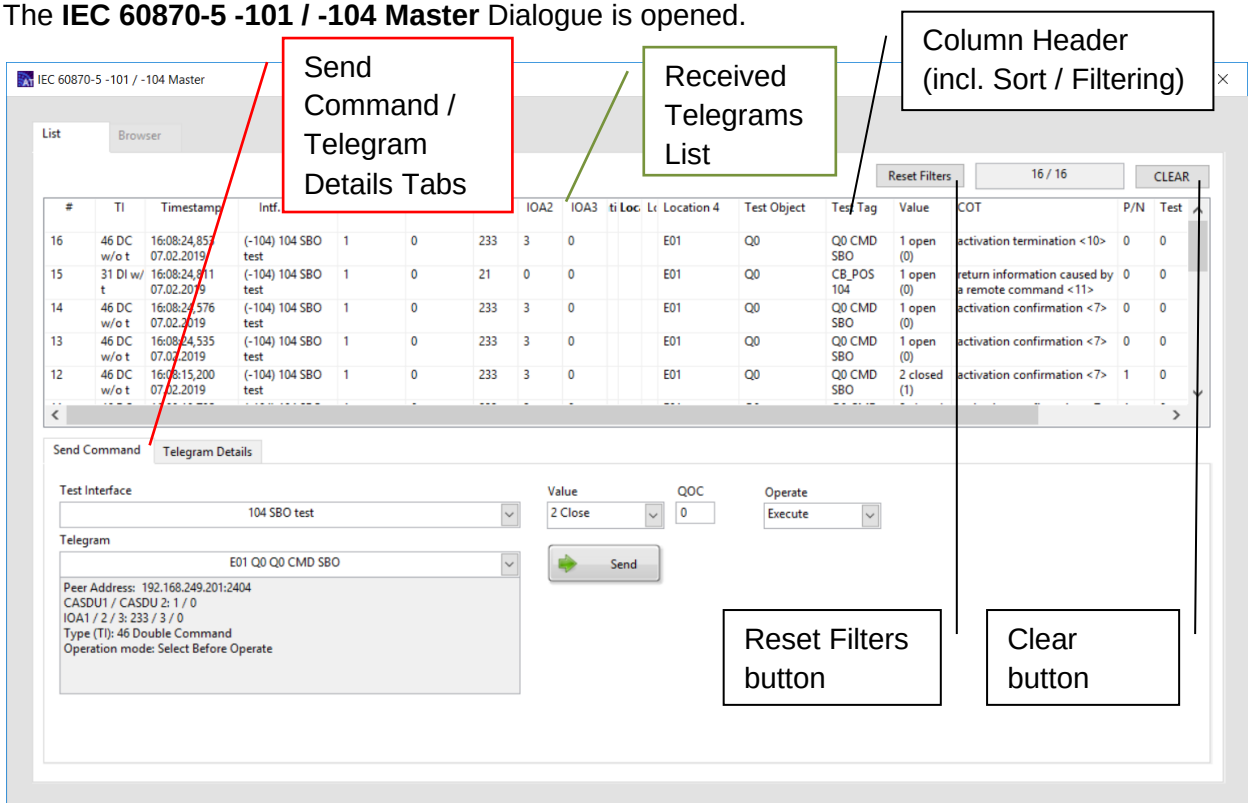


Figure 40 IEC 60870-5 -101 / -104 Master Dialogue

Element	Description
Received Telegrams List	This list shows all telegrams received on the configured -101 / -104 Interfaces sorted by the Timestamp by default.
Send Command Tab	Use this Tab to send commands / set point commands etc. to the System.
Telegram Details Tab	Use this Tab to acquire additional information on the Telegram selected in the Received Telegrams list. This information is driver dependent.
Number of Telegrams	This indicator shows the number of telegrams shown versus the total number of Telegrams received via -101 / -104 Interfaces.
Reset Filters button	Press this button to reset filters applied on the List columns.
Column Header incl. Filtering	Click on the header to sort by this column. Press on the appearing button to apply filters on the current column of the List. Filtered columns are indicated by a gray background color.
Clear all button	Press this button to clear the telegram history for -101 / -104 telegrams of all interfaces.

Table 5 Elements of the IEC 60870-5 -101 / -104 Master Dialogue

5.1.4.2. Telegram columns

The dialogue provides rich information on the received Telegrams. The following table gives an overview on the meaning of the List columns:

Column title	Description
#	The telegram number. These numbers are assigned incrementally. They are not reset when the window is cleared.
TI	Type Identification. This Column gives information on the Telegram Type. This is according to the 60870 standard series. Valid values are listed in chapter **7.1.1**.
Timestamp	The System Time, when this telegram was received. **Please note**: This value may differ from the Timestamp contained in the telegram. This value can be accessed by the Telegram Details Tab.
Intf. Name	The Test Interface Name on which this telegram was received.
CASDU1 CASDU2	Configured Common Application Service Data Unit 1 and 2 of the telegram.

Column title	Description
IOA1 IOA2 IOA3	Configured Information Object Address Bytes of the telegram.
Location 1 Location 2 Location 3 Location 4	The Location configured for the Test Object, to which this Telegram belongs.
Test Object	The Name of the Test Object to which this Telegram belongs.
Test Tag	The Test Tag which can be used in Closed Loop Test Cases to get this Telegram.
Value	The value shipping together with the Telegram. The value is formatted as follows: <60870 Standard Value> <Written Description> (<Value received from Driver>)
COT	Cause of transmission of the Telegram. Valid values are listed in chapter **7.1.1**.
P/N	The value of the Positive / Negative Bit. True means negative.
Test	The value of the Test bit.
BL	The value of the Blocked Bit.
SB	The value of the substituted Bit.
NT	The value of the Not Topical Bit.
OV	The value of the Overflow Bit.

Table 6 Telegram column Description for -101/-104 Telegrams

5.1.4.3. Filtering Telegrams

You may filter the received telegrams list by column values. You can apply filters to multiple columns to hide irrelevant telegrams. Filtered columns are indicated with a gray background color.

In order to filter on a column value, move the mouse over the respective column and press the appearing **Filter button**. The Filter menu for this column is opened. It is shown in Figure 41.

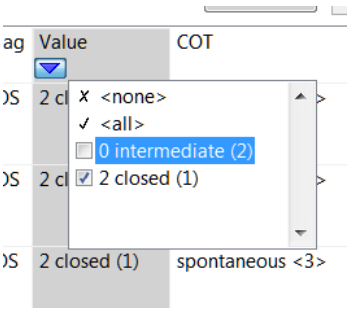


Figure 41 Filter menu

The Filter menu provides the Items **<none>**, **<all>** and all unique values of the column in a list. Place a checkmark for items you want to have on your filtered list. If you want to deselect all values, select the **<none>** Item. If you want to select all values, select the **<all>** Item.

The list shown in the Figure 41 will only show Telegrams with value “2 closed (1)”.

5.1.4.4. Sorting Telegrams

The Received Telegrams List can be sorted by one column in ascending(**>**) or descending (**<**) direction. Click on a column header in order to sort by this column. Press another time to reverse the sorting direction.

5.1.4.5. Send Command Tab

Use this Tab to send Commands to the System using the -101/-104 Interfaces. In order to send a command, select the Send Command tab in the -101 / -104 Master Dialogue.

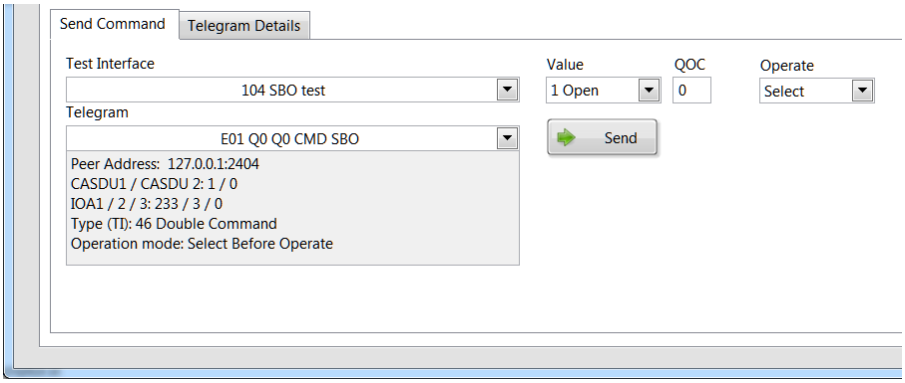


Figure 42 -101 / -104 Send Command Tab

The Dialogue is shown in Figure 42. The following table describes the user interface elements of the dialogue:

Element	Description
Test Interface	Select the Test interface on which you want to send a telegram using this Dropdown-Menu.
Telegram	This list provides the configured Telegrams which can be sent (e.g. Double Command, Single Command etc.) for the selected Virtual Interface.

	Select a Telegram using this Dropdown-Menu.
Value	Specify a value in this dropdown menu or field. The format of the input control depends on the configured Data type for the Command Telegram.
QOC	Specify a Qualifier of Command in this field according to the 60870 Standard. Valid values are listed in chapter **7.1.1**.
Operate	If the telegram is configured with Select-Before-Operate execution, this menu becomes enabled. You can choose between sending “SELECT”, “EXECUTE” or even cancel a previous selection. Default value: Direct execution
Send button	Press this button to send the telegram.

Table 7 IEC 60870-5 -101 / -104 Dialogue User Interface Elements

If a Command execution fails, a Telegram with the Command Identification and P/N Bit equal to 1 is generated. This may be the case if the station blocks a Command due to Interlocking logics or a Control Authority set to Local Control.

5.1.4.6. Telegram Details Tab

Use this tab to acquire additional information on the Telegram selected in the **Received Telegrams List**. Click on a Telegram to open the Tab. It can also be opened by selected the **Telegram Details** Tab directly.

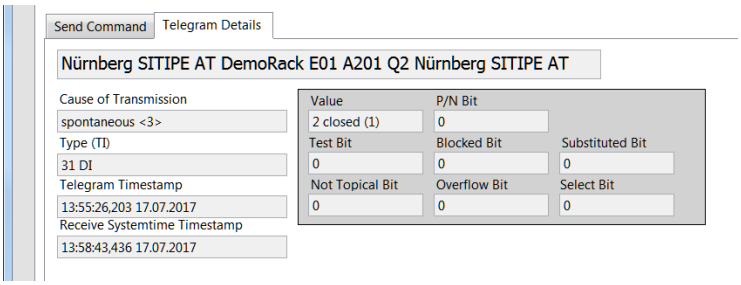


Figure 43 Telegram Details Tab of -101/ -104 Dialogue

5.1.5. IEC 61850 Client Dialogue

SITIPE AT provides functionality to send and receive telegrams via IEC 61850-8-1 MMS to simulate the behavior of a Control Center or a Central Device (e.g. a missing SICAM PAS).

You have to configure SITIPE AT for the connection to the desired IEDs. Please consult chapter 6 for more details on Configuration.

5.1.5.1. Dialogue

Press the **IEC 61850** button in the Sub-Modules section of the SITIPE AT Main Window to open the **IEC 61850 MMS Client** Dialogue. The button appears disabled and grayed out, if no – IEC 61850 IED Test Interfaces were configured.

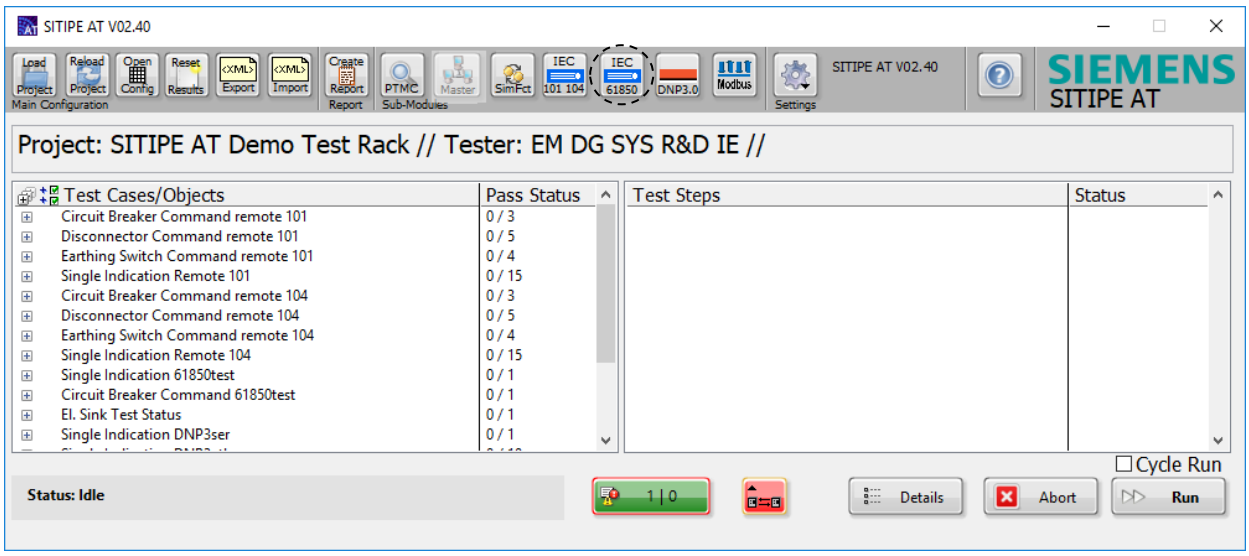


Figure 44 SITIPE AT Main Window and IEC 61850 button

The **IEC 61850 MMS Client** Dialogue is opened.

Figure 45 and Table 8 illustrate the parts of the dialogue.

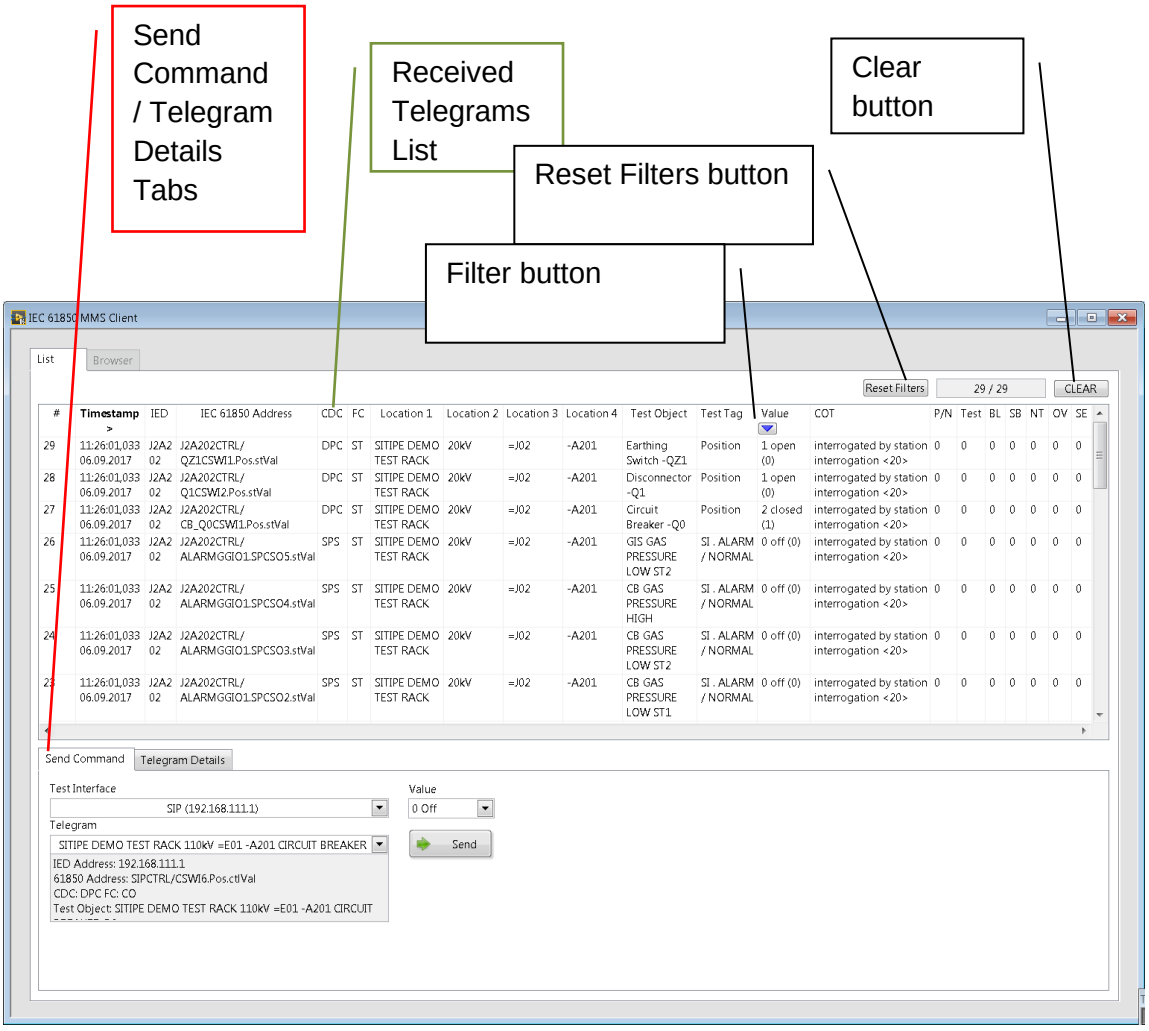


Figure 46 IEC 61850 MMS Client Dialogue

Element	Description
Received Telegrams List	This list shows all telegrams received from the configured 61850 IED Test Interfaces sorted by the Timestamp by default.
Send Command Tab	Use this Tab to send commands / set point commands etc. to the System.
Telegram Details Tab	Use this Tab to acquire additional information on the Telegram selected in the Received Telegrams list. This information is driver dependent.
Number of Telegrams	This indicator shows the number of telegrams shown versus the total number of Telegrams received from 61850 IED Test Interfaces.
Reset Filters button	Press this button to reset filters applied on the List columns.
Filter button	Use this button to apply filters on the current column of the List. Filtered columns are indicated by a gray background color.
Clear all button	Press this button to clear the telegram history for 61850 MMS telegrams of all interfaces.

Table 8 Parts of the IEC 61850 MMS Client Dialogue

5.1.5.2. Telegram Columns

Column title	Description
#	The telegram number. These numbers are assigned incrementally. They are not reset when the window is cleared.
Timestamp	The System Timestamp when this Telegram was received. This value may differ from the Timestamp transferred with the Telegram. To get this value, open the Telegram details tab.
IED	The 61850 IED Test Interface which sent this Telegram.
IEC 61850 Address	The 61850 Address in the format LogicalDevice/LogicalNode.DataObject.DataAttribute DataObject and DataAttribute may appear several Times. Instance numbers, Prefixes, Suffixes and renaming are allowed. So an address “SIP5/Q0_CSWI1.Pos.stVal” is also valid. Please consult Appendix chapter **7.1.2.2** for predefined Logical Nodes, their Data1a Objects and assigned Common Data Classes.

Column title	Description
CDC	The Common Data Class of this Data Object. A list of supported Common Data Classes and its associated Data Attributes is given in the Appendix chapter **7.1.2.3**.
FC	The Functional Constraint detected for this Data Attribute. A list of supported Functional Constraints is given in the Appendix chapter **7.1.2.4**.
Location 1 Location 2 Location 3 Location 4	The Location configured for the Test Object, to which this Telegram belongs.
Test Object	The Name of the Test Object to which this Telegram belongs.
Test Tag	The Test Tag which can be used in Closed Loop Test Cases to get this Telegram.
Value	The value shipping together with the Telegram. The value is formatted as follows: <61850 Standard Value> <Written Description> (<Value received from Driver>)
COT	Cause of transmission of the Telegram. Valid values are listed in chapter **7.1.2.1**.
P/N	The value of the Positive / Negative Bit. True means negative.
Test	The value of the Test bit.
BL	The value of the Blocked Bit.
SB	The value of the substituted Bit.
NT	The value of the Not Topical Bit.
OV	The value of the Overflow Bit.

Table 9 IEC 61850-8-1 MMS Receive Telegram Columns

5.1.5.3. Filtering Telegrams

You may filter the received telegrams list by column values. You can apply filters to multiple columns to hide irrelevant telegrams. Filtered columns are indicated with a gray background color.

In order to filter on a column value, move the mouse over the respective column and press the appearing **Filter button**. The Filter menu for this column is opened. It is shown in Figure 47.

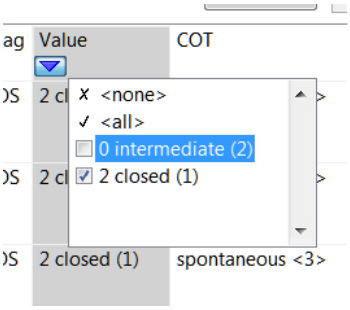


Figure 47 Filter menu

The Filter menu provides the Items **<none>**, **<all>** and all unique values of the column in a list. Place a checkmark for items you want to have on your filtered list. If you want to deselect all values, select the **<none>** Item. If you want to select all values, select the **<all>** Item.

The list shown in the Figure 47 will only show Telegrams with value “2 closed (1)”.

5.1.5.4. Sorting Telegrams

The Received Telegrams List can be sorted by one column in ascending(**>**) or descending (**<**) direction. Click on a column header in order to sort by this column. Press another time to reverse the sorting direction.

5.1.5.5. Send Command Tab

Use this Tab to send Commands to an IED Test Interfaces using IEC 61850 MMS. In order to send a command, select the Send Command tab in the **61850 MMS Client** Dialogue.

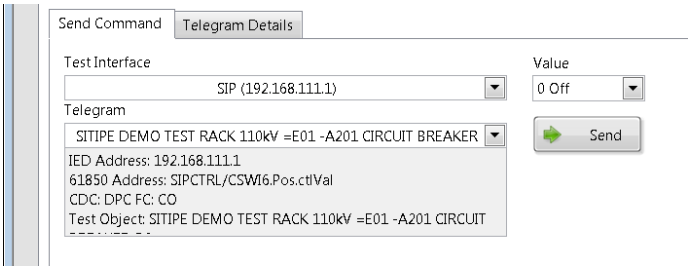


Figure 48 IEC 61850 MMS Send Command Tab

The Dialogue is shown in Figure 48. The following table describes the user interface elements of the dialogue:

Element	Description
Test Interface	Select the 61850 IED Test Interface which will be the Destination for the Command.
Telegram	This list provides all 61850 MMS Telegrams with Functional Constraint (FC) CO (Command) or SP (Set point). Select a Telegram using this Dropdown-Menu.
Value	Specify a value in this dropdown menu or field. The format of the input control depends on the Data type of the DataAttribute to be controlled. For Boolean DataAttributes, the Dialogue shows a dropdown-Menu. Otherwise a Field for a numeric Entry is shown.
Send button	Press this button to send the telegram.

Table 10 Elements of the 61850 MMS Client Send Command Tab

If a Command execution fails, a Telegram with the Command Identification and P/N Bit equal to 1 is generated. This may be the case if the IED blocks a Command due to Interlocking logics or a Device key switch turned to local control authority.

5.1.5.6. Telegram Details Tab

Use this tab to acquire additional information on the Telegram selected in the **Received Telegrams List**. Click on a Telegram to open the Tab. It can also be opened by selected the **Telegram Details** Tab directly.

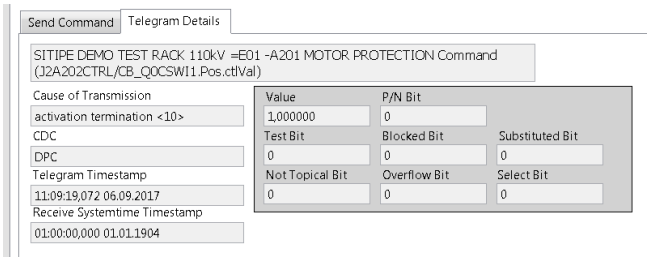


Figure 49 61850 MMS Client Telegram Details Tab

5.1.6. DNP3.0 Master Dialogue

SITIPE AT provides functionality to send and receive telegrams on DNP3.0 Master Interfaces via a Serial or Ethernet Connection to simulate Control Center behavior.

You have to configure SITIPE AT for your desired DNP3.0 Interfaces in advance. Please consult chapter 6 for more details on Configuration.

Please note: The DNP3.0 Driver is configured to scan connected devices for Class 0, 1, 2, 3 Telegrams. Therefore all information is gathered from the devices. Solicited / Spontaneous

Communication is currently not configured. Please contact SITIPE AT Development team for further information.

5.1.6.1. DNP3.0 Dialogue

Press the **DNP3.0** button in the Sub-Modules section of the SITIPE AT Main Window to open the **DNP3.0 Master** Dialogue. The button appears disabled and grayed out, if no DNP3.0 Interfaces were configured.

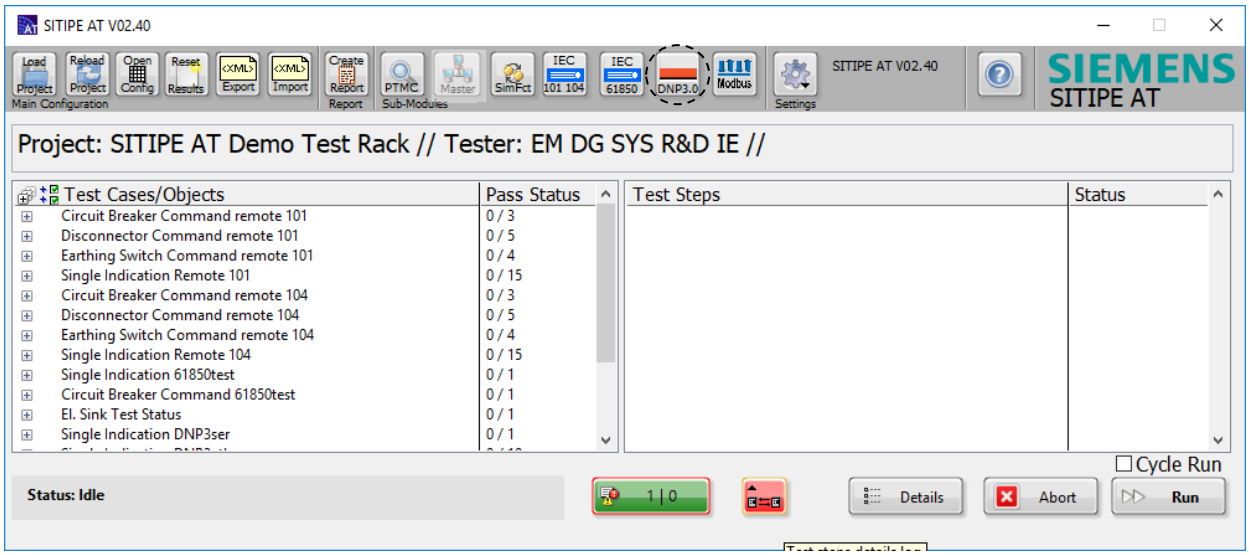


Figure 50 SITIPE AT Main Window with DNP3.0 button

The **DNP3.0 Master** Dialogue is opened. Figure 51 illustrates the parts of the Dialogue.

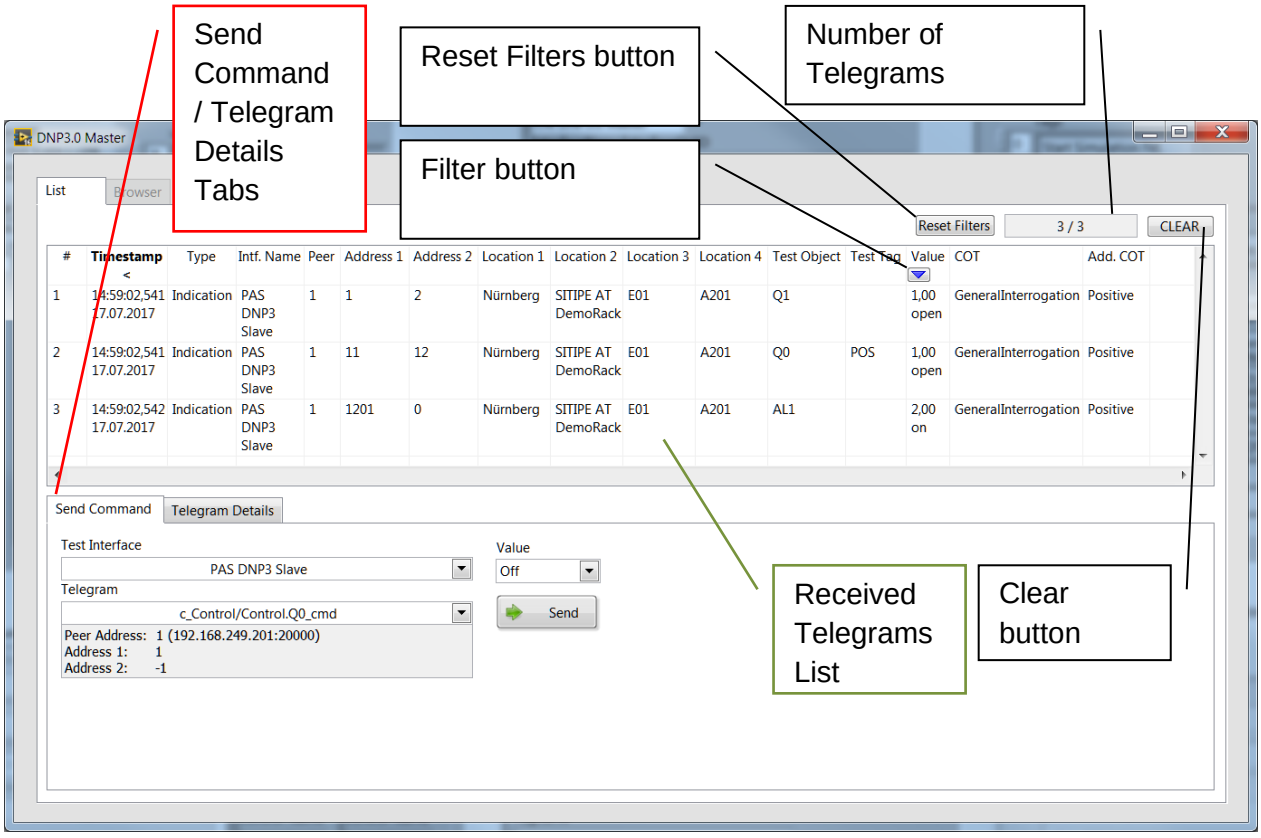


Figure 51 DNP3.0 Master Dialogue

Element	Description
Received Telegrams List	This list shows all telegrams received on the configured -101 / -104 Interfaces sorted by the Timestamp by default.
Send Command Tab	Use this Tab to send commands / set point commands etc. to the System.
Telegram Details Tab	Use this Tab to acquire additional information on the Telegram selected in the Received Telegrams list. This information is driver dependent.
Number of Telegrams	This indicator shows the number of telegrams shown versus the total number of Telegrams received via -101 / -104 Interfaces.
Reset Filters button	Press this button to reset filters applied on the List columns.
Filter button	Use this button to apply filters on the current column of the List. Filtered columns are indicated by a gray background color.
Clear all button	Press this button to clear the telegram history for -101 / -104 telegrams of all interfaces.

Table 11 Elements of the DNP3.0 Master Dialogue

5.1.6.2. Telegram columns

Column title	Description
#	The telegram number. These numbers are assigned incrementally. They are not reset when the window is cleared.
Timestamp	The System Time, when this telegram was received. **Please note**: This value may differ from the Timestamp contained in the telegram. This value can be accessed by the Telegram Details Tab.
Type	Type of the Telegram. Can be Indication or Command Response.
Intf. Name	The Test Interface Name on which this telegram was received.
Peer	The Peer Link address of the Test Interface on which this telegram was received
Address 1 Address 2	Configured Information Object Address Bytes of the telegram.

Column title	Description
Location 1 Location 2 Location 3 Location 4	The Location configured for the Test Object, to which this Telegram belongs.
Test Object	The Name of the Test Object to which this Telegram belongs.
Test Tag	The Test Tag which can be used in Closed Loop Test Cases to get this Telegram.
Value	The value shipping together with the Telegram. The value is formatted as follows: <DNP3.0 Standard value> <Written Description>
COT	Cause of transmission of the Telegram. Valid values are listed in chapter **7.1.3.1**.
Add. COT	Additional Cause of Transmission information of the Telegram. Valid values are listed in chapter **7.1.3.2**

Table 12 Telegram column Description for DNP3.0 Telegrams

5.1.6.3. Filtering Telegrams

You may filter the received telegrams list by column values. You can apply filters to multiple columns to hide irrelevant telegrams. Filtered columns are indicated with a gray background color.

In order to filter on a column value, move the mouse over the respective column and press the appearing **Filter button**. The Filter menu for this column is opened. It is shown in Figure 52.

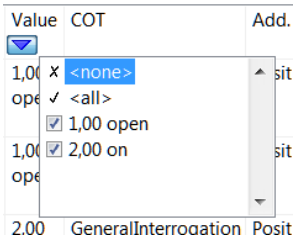


Figure 52 Filter menu

The Filter menu provides the Items **<none>**, **<all>** and all unique values of the column in a list. Place a checkmark for items you want to have on your filtered list. If you want to deselect all values, select the **<none>** Item. If you want to select all values, select the **<all>** Item.

The filter shown in Figure 52 will show all values of the column.

5.1.6.4. Sorting Telegrams

The Received Telegrams List can be sorted by one column in ascending(**>**) or descending (**<**) direction. Click on a column header in order to sort by this column. Press another time to reverse the sorting direction.

5.1.6.5. Send command Tab

Use this Tab to send Commands to the System using the DNP3.0 Master Interfaces. In order to send a command, select the Send Command tab in the DNP3.0 Master Dialogue.

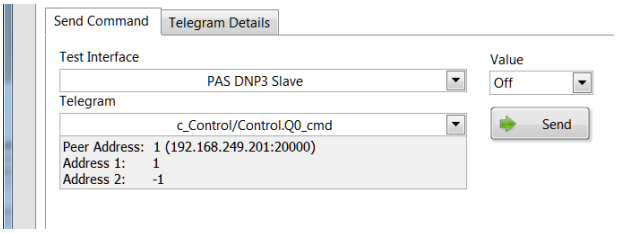


Figure 53 Send Command Tab (DNP3.0 Master)

The Dialogue is shown in Figure 53. The following table describes the user interface elements of the dialogue:

Element	Description
Test Interface	Select the Test interface on which you want to send a telegram using this Dropdown-Menu.
Telegram	This list provides the configured Telegrams which can be sent (e.g. Double Command, Single Command etc.) for the selected Virtual Interface. Select a Telegram using this Dropdown-Menu.
Value	Specify a value in this dropdown menu or field. The format of the input control depends on the configured Data type for the Command Telegram.
Send button	Press this button to send the telegram.

Table 13 IEC 60870-5 -101 / -104 Dialogue User Interface Elements

If a Command execution fails, a Telegram with the Command Identification and Additional Cause of Transmission (Add. COT) equal to 1 is generated. This may be the case if the station blocks a Command due to Interlocking logics or a Control Authority set to Local Control.

5.1.6.6. Telegram Details Tab

Use this tab to acquire additional information on the Telegram selected in the **Received Telegrams List**. Click on a Telegram to open the Tab. It can also be opened by selected the **Telegram Details** Tab directly.

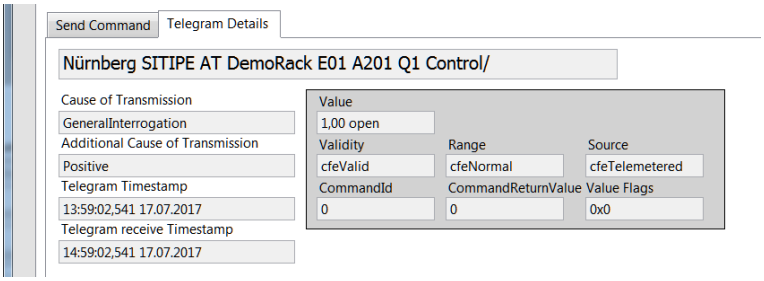


Figure 54 Telegram Details Tab (DNP3.0)

5.1.7. Modbus Master Dialogue

SITIPE AT provides functionality to send and receive telegrams on Modbus Master Interfaces via Ethernet Connection.

You have to configure SITIPE AT for your desired Modbus Interfaces in advance. Please consult chapter 6 for more details on Configuration.

5.1.7.1. Modbus Dialogue

Press the **Modbus** button in the Sub-Modules section of the SITIPE AT Main Window to open the **Modbus Master** Dialogue. The button appears disabled and grayed out, if no Modbus Interfaces were configured.

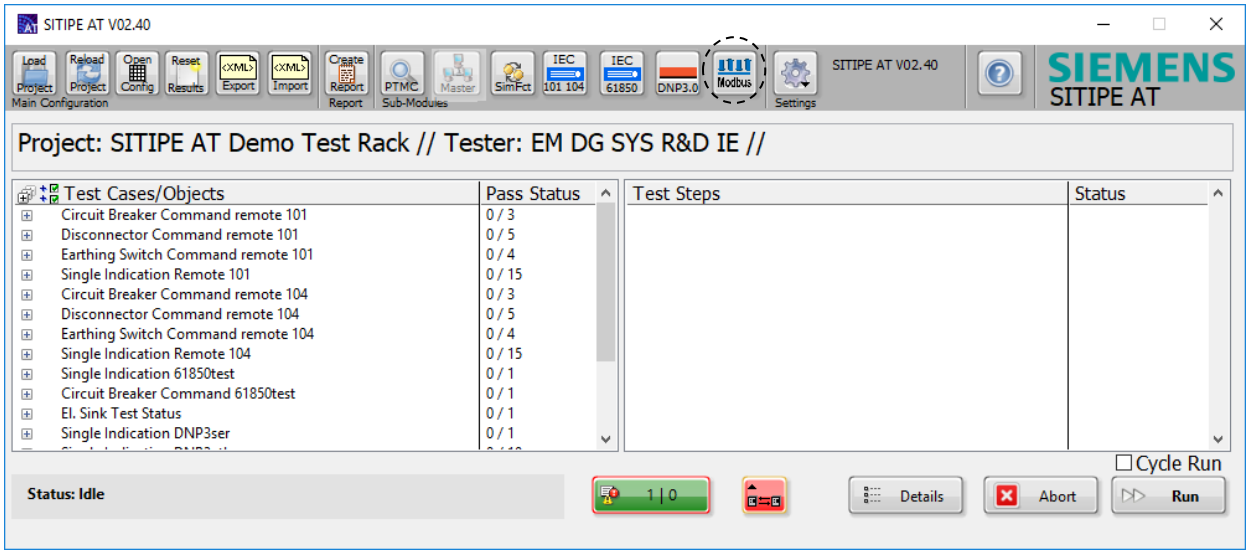


Figure 55 SITIPE AT Main Window with Modbus button

The **Modbus Master** Dialogue is opened. Figure 56 illustrates the parts of the Dialogue.

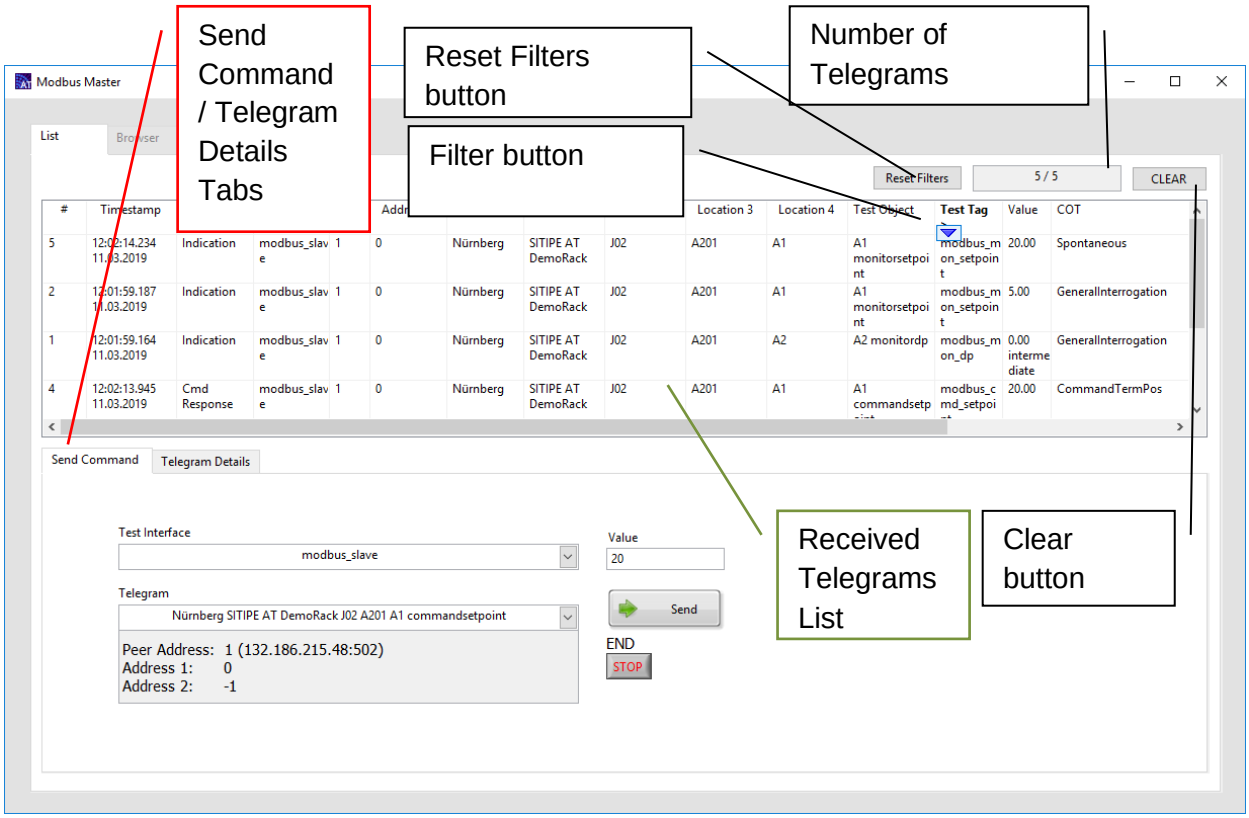


Figure 56 Modbus Master Dialogue

Element	Description
Received Telegrams List	This list shows all telegrams received on the configured Modbus Interfaces sorted by the Timestamp by default.
Send Command Tab	Use this Tab to send commands / set point commands etc. to the System.
Telegram Details Tab	Use this Tab to acquire additional information on the Telegram selected in the Received Telegrams list. This information is driver dependent.
Number of Telegrams	This indicator shows the number of telegrams shown versus the total number of Telegrams received via Modbus Interfaces.
Reset Filters button	Press this button to reset filters applied on the List columns.
Filter button	Use this button to apply filters on the current column of the List. Filtered columns are indicated by a gray background color.
Clear all button	Press this button to clear the telegram history for Modbus telegrams of all interfaces.

Table 14 Elements of the Modbus Master Dialogue

5.1.7.2. Telegram columns

Column title	Description
#	The telegram number. These numbers are assigned incrementally. They are not reset when the window is cleared.
Timestamp	The System Time, when this telegram was received. **Please note**: This value may differ from the Timestamp contained in the telegram. This value can be accessed by the Telegram Details Tab.
Type	Type of the Telegram. Can be Indication or Command Response.
Intf. Name	The Test Interface Name on which this telegram was received.
Peer	The Slave ID of the Test Interface on which this telegram was received
Address 1	Configured Information Object Address Bytes of the telegram.
Location 1 Location 2 Location 3 Location 4	The Location configured for the Test Object, to which this Telegram belongs.
Test Object	The Name of the Test Object to which this Telegram belongs.
Test Tag	The Test Tag which can be used in Closed Loop Test Cases to get this Telegram.
Value	The value shipping together with the Telegram. The value is formatted as follows: <Modbus Standard value> <Written Description>
COT	Cause of transmission of the Telegram. Valid values are listed in chapter **7.1.3.1**.
Add. COT	Additional Cause of Transmission information of the Telegram. Valid values are listed in chapter **7.1.3.2**
Register	Modbus register from/to which information are received/sent. Register values can be Coil, Input Register, Holding Register or Input status
DataType	Type of data sent or received. Values are listed in chapter

Table 15 Telegram column Description for Modbus Telegrams

5.1.7.3. Filtering Telegrams

You may filter the received telegrams list by column values. You can apply filters to multiple columns to hide irrelevant telegrams. Filtered columns are indicated with a gray background color.

In order to filter on a column value, move the mouse over the respective column and press the appearing **Filter button**. The Filter menu for this column is opened. It is shown in Figure 57.

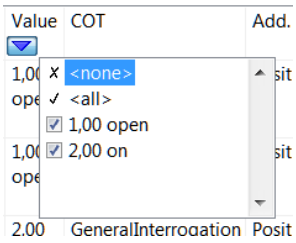


Figure 57 Filter menu

The Filter menu provides the Items **<none>**, **<all>** and all unique values of the column in a list. Place a checkmark for items you want to have on your filtered list. If you want to deselect all values, select the **<none>** Item. If you want to select all values, select the **<all>** Item.

The filter shown in the Figure 57 will show all values of the column.

5.1.7.4. Sorting Telegrams

The Received Telegrams List can be sorted by one column in ascending(**>**) or descending (**<**) direction. Click on a column header in order to sort by this column. Press another time to reverse the sorting direction.

5.1.7.5. Send command Tab

Use this Tab to send Commands to the System using the Modbus Master Interfaces. In order to send a command, select the Send Command tab in the Modbus Master Dialogue.

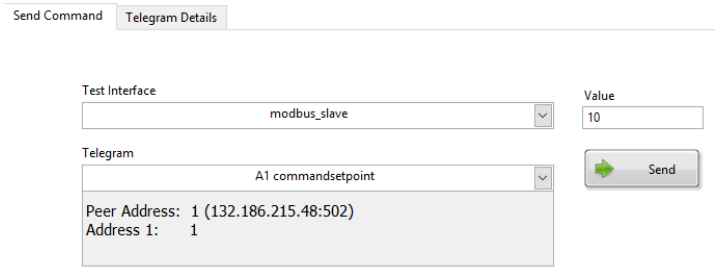


Figure 58 Send Command Tab (Modbus Master)

The Dialogue is shown in Figure 58. The following table describes the user interface elements of the dialogue:

Element	Description
Test Interface	Select the Test interface on which you want to send a telegram using this Dropdown-Menu.

Telegram	This list provides the configured Telegrams which can be sent (e.g. Double Command, Single Command, Command SetPoints etc.) for the selected Virtual Interface. Select a Telegram using this Dropdown-Menu.
Value	Specify a value in this dropdown menu or field. The format of the input control depends on the configured Data type for the Command Telegram.
Send button	Press this button to send the telegram.

Table 16 Modbus Dialogue User Interface Elements

If a Command execution fails, a Telegram with the Command Identification and Additional Cause of Transmission (Add. COT) equal to 1 is generated. This may be the case if the station blocks a Command due to Interlocking logics or a Control Authority set to Local Control.

5.1.7.6. Telegram Details Tab

Use this tab to acquire additional information on the Telegram selected in the **Received Telegrams List**. Click on a Telegram to open the Tab. It can also be opened by selected the **Telegram Details** Tab directly.

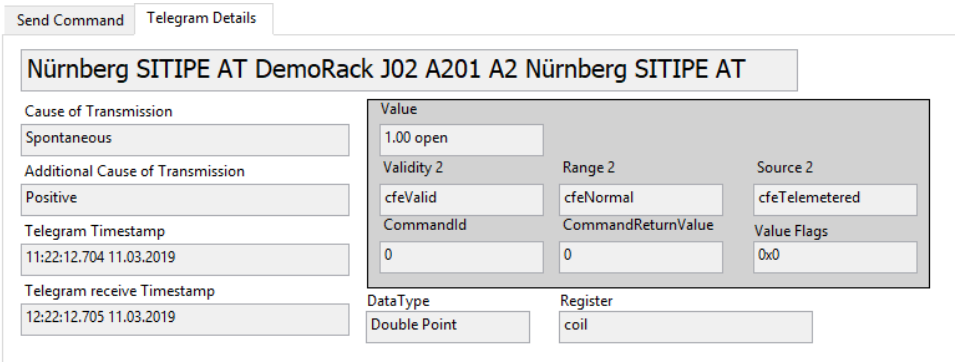


Figure 59 Telegram Details Tab for Modbus Dialogue

5.1.8. Simulation

SITIPE AT provides simulation functionality to simulate behavior of Primary Switching Devices like Circuit Breakers, Disconnectors or Earthing Switches.

SITIPE AT loads Simulation Functions as LabVIEW Virtual Instruments (Vis), located in the File Location <SITIPE_AT_InstallPath>/Simulation. The installation package includes Simulation Functions for Circuit Breakers, Disconnectors, Earthing Switches and the Crisis VI for Mass-Indication switching. You may put additional Simulation Function Vis into this folder as you need.

5.1.8.1. Opening Simulation Functions

Simulation Functions are started automatically when a Configuration is loaded. You can start/stop simulation functions from the User Interface, as well as from Closed Loop Tests.

Press the Sim. Fct. Button in the Main Window in order to open the Simulation Engine Window.

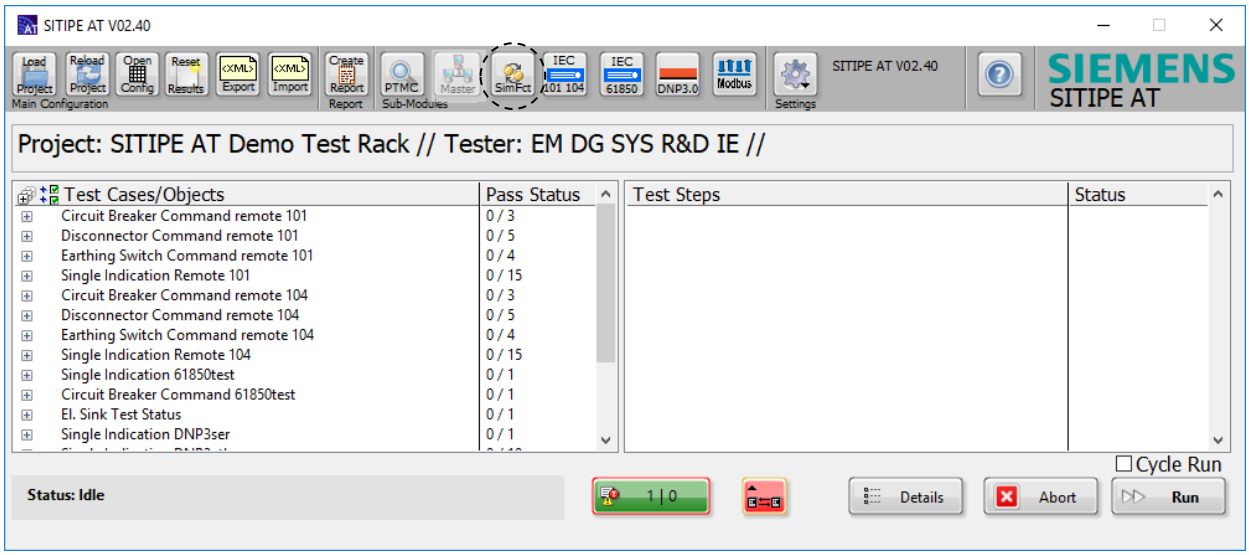


Figure 60 Sim Fct. button in SITIPE AT Main Window

The Simulation Engine Window is opened:

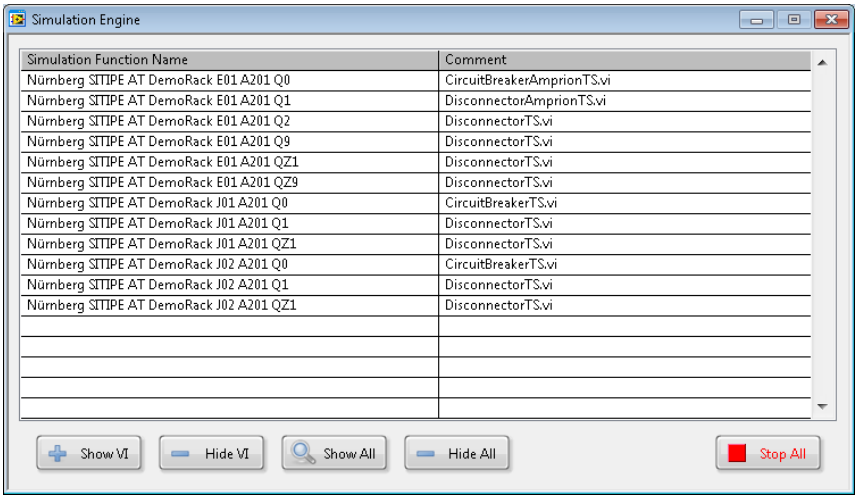


Figure 61 Simulation Engine Window

This window lists all Simulation Functions and their Simulation VI.

Use the button **Show VI**, **Hide VI** and **Hide All** to show or hide the Simulation Function Windows.

Use the **Show All** button to open the Simulation Overview Window (see chapter **5.1.8.3**), which provides a grouped overview on all Simulation Functions.

The button **Stop All** stops all simulation functions and closes all simulation windows, including the Simulation Engine and Simulation Overview window. You may start simulation functions by pressing the Sim Fct. Button in the User Interface again.

5.1.8.2. Delivered Simulation Functions

SITIPE AT contains a pool of predefined simulation functions for frequently used test objects, like circuit breakers and disconnectors. Additional simulation functions can be developed upon.

All these Simulation Functions provide Transient Suppression, to filter signal disturbances on the Command Inputs with a Filter time of 15ms by default. The value can be changed in the Test Object configuration, as well as during runtime inside a Test Case. Please consult chapter 6 for further Details on Configuration.

The following chapters describe the behavior of the delivered Simulation Functions in detail.

5.1.8.2.1. CircuitBreakerTS.vi

This simulation function simulates the behavior of a Circuit Breaker and uses the standard symbol to indicate its current state.

The simulation function directly reacts to pulses on its Command PTM inputs and runs for a defined circuit time. You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

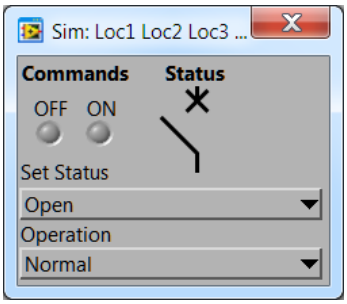


Figure 62 User Interface of CircuitBreakerTS.vi

The window provides the following elements:

- Window Title: Simulation Function Name
- Command buttons:
  - OFF, issues a Command to Switch OFF to the simulation function
  - ON, issues a Command to Switch ON to the simulation function
- Status indicator: Shows the current state of the simulation function (DIFF, OFF, ON, DISTURBED)
- Set Status Dropdown Menu: Change the current state of the simulation function without passing a command sequence (without intermediate state)
- Operation dropdown menu: Select an operation mode using this dropdown menu. This enables you to simulate malfunctions of the device, like a gear malfunction or a DISTURBED state.

5.1.8.2.2. CircuitBreakerAmprionTS.vi

This simulation function is similar to the CircuitBreakerTS.vi Simulation Function. The only difference is the symbol to indicate the device state. The symbol was chosen according to the Amprion Standard icons.

The simulation function directly reacts to pulses on its Command PTM inputs and runs for a defined circuit time. You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

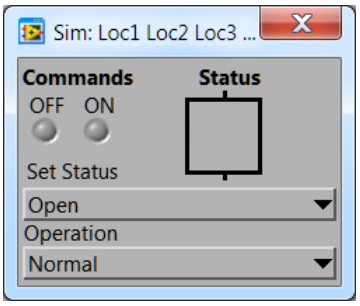


Figure 63 User Interface of CircuitBreakerAmprionTS.vi

The window provides the following elements:

- Window Title: Simulation Function Name
- Command buttons:
  - OFF, issues a Command to Switch OFF to the simulation function
  - ON, issues a Command to Switch ON to the simulation function
- Status indicator: Shows the current state of the simulation function (DIFF, OFF, ON, DISTURBED)
- Set Status Dropdown Menu: Change the current state of the simulation function without passing a command sequence (without intermediate state)
- Operation dropdown menu: Select an operation mode using this dropdown menu. This enables you to simulate malfunctions of the device, like a gear malfunction or a DISTURBED state.

5.1.8.2.3. DisconnectorTS.vi

This simulation function simulates the behavior of a Disconnector and uses the standard symbol to indicate its current state.

The simulation function can be configured for Persistent Commands, as well as Pulse commands. If you choose the persistent command, the simulation function runs only for the time, the command signal potential is high.

The Simulation Function runs for a defined circuit time. The running process is indicated by the progress bar below the status symbol.

You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

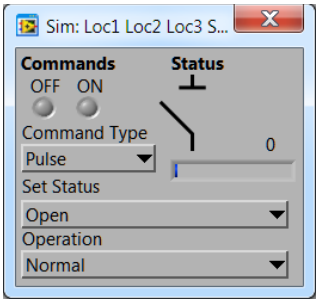


Figure 64 User Interface of DisconnectorTS.vi

The window provides the following elements:

- Window Title: Simulation Function Name
- Command buttons:
  - OFF, issues a Command to Switch OFF to the simulation function
  - ON, issues a Command to Switch ON to the simulation function
- Command Type:
  - Persistent: This command type executes the switching, while the command signal is HIGH. The execution stops, when the signal changes to LOW, no matter if the switching is completed.
  - Pulse: This command type executes the switching completely after a command signal is HIGH.
- Status indicator: Shows the current state of the simulation function (DIFF, OFF, ON, DISTURBED)
- Set Status Dropdown Menu: Change the current state of the simulation function without passing a command sequence (without intermediate state)
- Runtime progress bar: This progress bar, located below the status indicator, indicates the runtime process of the Disconnector.
- Operation dropdown menu: Select an operation mode using this dropdown menu. This enables you to simulate malfunctions of the device, like a gear malfunction or a DISTURBED state.

5.1.8.2.4. DisconnectorAmprionTS.vi

This simulation function is similar to the DisconnectorTS.vi Simulation Function. The only difference is the symbol to indicate the device state.

The simulation function can be configured for Persistent Commands, as well as Pulse commands. If you choose the persistent command, the simulation function runs only for the time, the command signal potential is high.

The Simulation Function runs for a defined circuit time. The running process is indicated by the progress bar below the status symbol.

You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

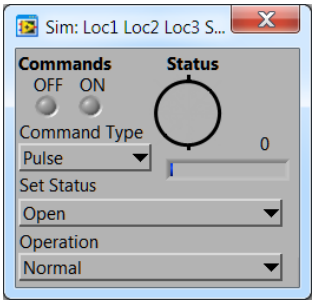


Figure 65 User Interface of DisconnectorAmprionTS.vi

The window provides the following elements:

- Window Title: Simulation Function Name
- Command buttons:
  - OFF, issues a Command to Switch OFF to the simulation function

  - ON, issues a Command to Switch ON to the simulation function
- Command Type:
  - Persistent: This command type executes the switching, while the command signal is HIGH. The execution stops, when the signal changes to LOW, no matter if the switching is completed.
  - Pulse: This command type executes the switching completely after a command signal is HIGH.
- Status indicator: Shows the current state of the simulation function (DIFF, OFF, ON, DISTURBED)
- Set Status Dropdown Menu: Change the current state of the simulation function without passing a command sequence (without intermediate state)
- Runtime progress bar: This progress bar, located below the status indicator, indicates the runtime process of the Disconnector.
- Operation dropdown menu: Select an operation mode using this dropdown menu. This enables you to simulate malfunctions of the device, like a gear malfunction or a DISTURBED state.

5.1.8.2.5. EarthingSwitchTS.vi

This simulation function simulates the behavior of an Earthing Disconnector Switch and uses the standard symbol to indicate its current state. The behavior is similar to DisconnectorTS.vi, with exception of the status Symbol indicator.

The simulation function can be configured for Persistent Commands, as well as Pulse commands. If you choose the persistent command, the simulation function runs only for the time, the command signal potential is high.

The Simulation Function runs for a defined circuit time. The running process is indicated by the progress bar below the status symbol.

You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

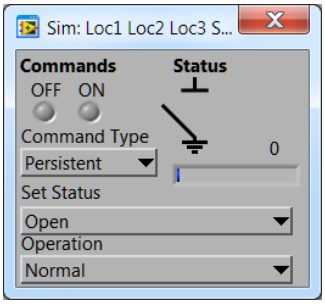


Figure 66 User Interface of EarthingSwitchTS.vi

The window provides the following elements:

- Window Title: Simulation Function Name
- Command buttons:
  - OFF, issues an Command to Switch OFF to the simulation function

    - ON, issues an Command to Switch ON to the simulation function
- Command Type:
    - Persistent: This command type executes the switching, while the command signal is HIGH. The execution stops, when the signal changes to LOW, no matter if the switching is completed.
    - Pulse: This command type executes the switching completely after a command signal is HIGH.
- Status indicator: Shows the current state of the simulation function (DIFF, OFF, ON, DISTURBED)
- Set Status Dropdown Menu: Change the current state of the simulation function without passing a command sequence (without intermediate state)
- Runtime progress bar: This progress bar, located below the status indicator, indicates the runtime process of the Disconnector.
- Operation dropdown menu: Select an operation mode using this dropdown menu. This enables you to simulate malfunctions of the device, like a gear malfunction or a DISTURBED state.

5.1.8.2.6. Crisis.vi / Electrical Mass Switching

This simulation function toggles a high number of electrical Single- and Double Indication Signals on PTMs to test the System response. The user can select a percentage of Signals to toggle. For Single Indications you may toggle from OFF to ON and backwards, for Double Indications you can toggle from 01 to 10 and backwards.

The Crisis Function identifies all Single Indication Test Objects of the Test Configuration by their electrical Single Point Information, with Test Tags ***differing*** from Feedback ON / Feedback OFF (so all other electrical single points are treated as Single Indications). Double Indications are identified by the electrical Double Point information containing Test Tags Feedback ON, Feedback OFF inside of Test Objects.

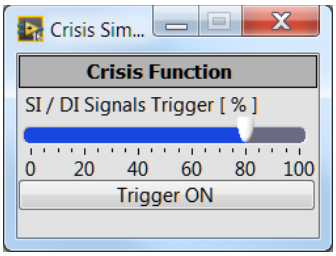


Figure 67 User Interface of Crisis.vi

The window provides the following elements:

- Window Title: Simulation Function Name (Crisis Simulation)
- Slider **SI / DI Signals Trigger [%]**: Select the percentage of Signals to trigger between 0% (no signal to trigger) and 100% (all signals to trigger)
- Button **Trigger ON**: Press this button to switch in the on direction (SI OFF -> ON, DI 01 -> 10). Afterwards this button changes its title to **TRIGGER OFF**. Therefore you may switch all signals off (SI ON -> OFF, DI 10 -> 01)

5.1.8.2.7. BaySingleline.vi / Flexible Single Line Visualization

Use BaySingleline.vi to visualize the status of Bay simulation functions in the style of a Singleline diagram.

This simulation function supports the following features:

- Typical oriented Configuration based on a simple, well-documented XML file
- Reloading XML file using the refresh button, to apply positioning changes
- Status visualization of a flexible number of simulation functions
- Load a custom BMP, JPEG or PNG background image file (Single line structure)
- Zooming in/out by flexible degree (E.g. to visualize 1 ½ CB with many sim. functions)
- Positioning of Simulation Function indicators by X and Y coordinates
- Rotation of Simulation Function indicators by a flexible angle in degrees (e.g. 90°, 270°)
- Border cropping for Simulation Function indicators
- Flexible drawing of Texts with font customization including Placeholder replacement for %loc1%, %loc2%, %loc3%, %loc4% and %objectname% based on BaySingleline.vi Test Object address

Figure 68 shows BaySingleline.vi instance for the example “Double Busbar” bay:

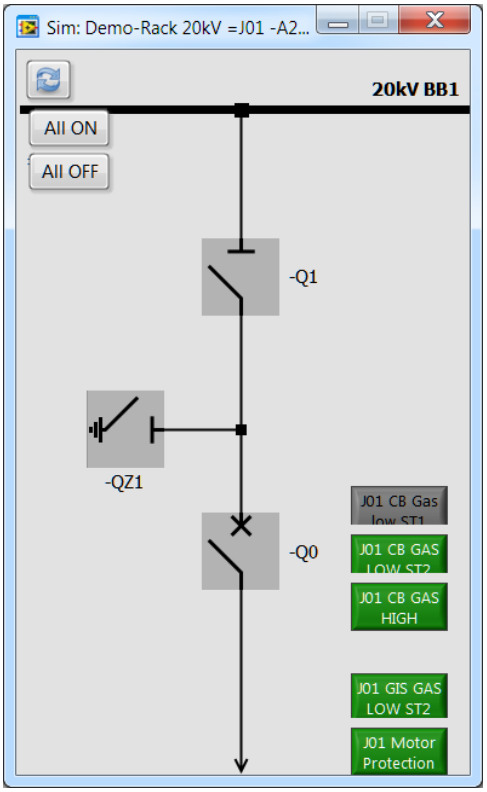


Figure 68 Flexible User Interface of BaySingleline.vi for an example bay SimTypical_2BB.xml

Please note: The Simulation Overview window may hide the BaySingleline.vi when a Test Case is started. In order to change this behavior, please disable the setting “Show Simulation Functions during Test”. As a consequence, Simulation Overview Window will not be opened automatically, when the simulation functions are started inside a Test Case. Please open your BaySingleline.vi manually from the Simulation Engine Window.

BaySingleline.vi writes a log file into the directory containing the XML file or into the %temp% directory if errors occurred during XML parsing.

5.1.8.2.8. SingleIndication.vi / Electrical Single Point control and visualization

SingleIndication.vi provides an easy solution to visualize and control the status of electrical Single Points wired to one PTM Channel. The PTM Single point has to be assigned to the Test Tag “SP” (Single Point).

You may use SingleIndication.vi in combination with BaySingleline.vi to have a complete overview on the switchgear and single indications of a Bay.

SingleIndication.vi supports the following features:

- Default value parameter to set the value to apply on start time
- Label Parameter to display a short descriptive text on the button
- offColor, onColor parameters to influence the color of the off/on states of the button (default: green OFF, red ON)
- textColor parameter to influence the color of the text (default: white)
- TransientSuppression parameter to suppress disturbances on the signal line by a defined software filter time
- LatchTime parameter to latch a signal after the falling edge for a defined time
- Disabled parameter to lock the indication button for user Input (indication functionality)

Figure 69 shows an example SingleIndication.vi instance:

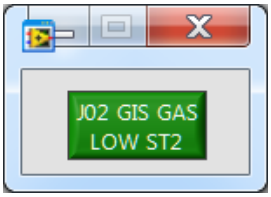


Figure 69 Simple User Interface of SingleIndication.vi

5.1.8.2.9. 3PhCircuitBreakerTS.vi / 3-phase selective, lockable Circuit Breaker

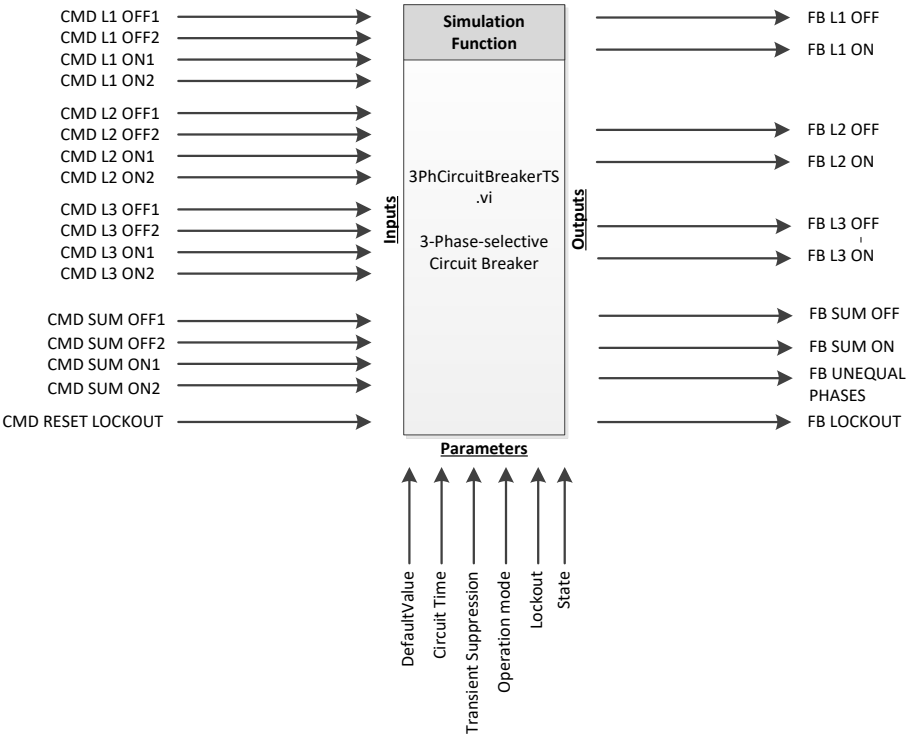


Figure 70 Inputs, Outputs and Parameters of 3PhCircuitBreakerTS.vi

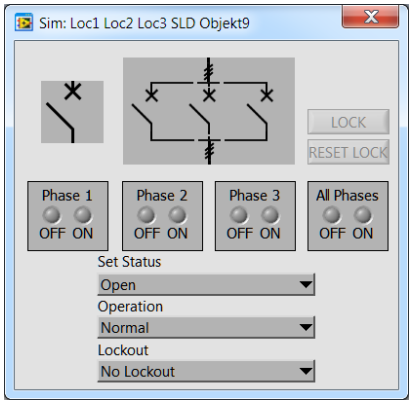


Figure 71 User Interface of the 3 phase selective lockable Circuit Breaker

This simulation function simulates the behavior of a Circuit Breaker with the capability to switch phases individually. The simulation function status is indicated with a single-phase status symbol and a 3-phase status. The single-phase status is shown on Singleline representations of the simulation function.

The simulation function starts in the ON or off position, defined by the Default Value parameter. It directly reacts to pulses on the phase individual command off1, off2, on1 and on2 signals. All signals can be configured optionally.

Switching happens for the specified circuit time including the intermediate position. Pulses are software-filtered for 15ms by default. The operation mode can be changed to simulate gear malfunctions or a disturbed state.

Lockout functionality is implemented, so the signal CMD SUM OFF1 will trigger the off command sequence and the circuit breaker will be locked for future ON commands. The lock then has to be removed with the CMD RESET LOCKOUT signal.

5.1.8.2.10. ManualDisconnectorTS.vi / Disconnector with Ask Permission

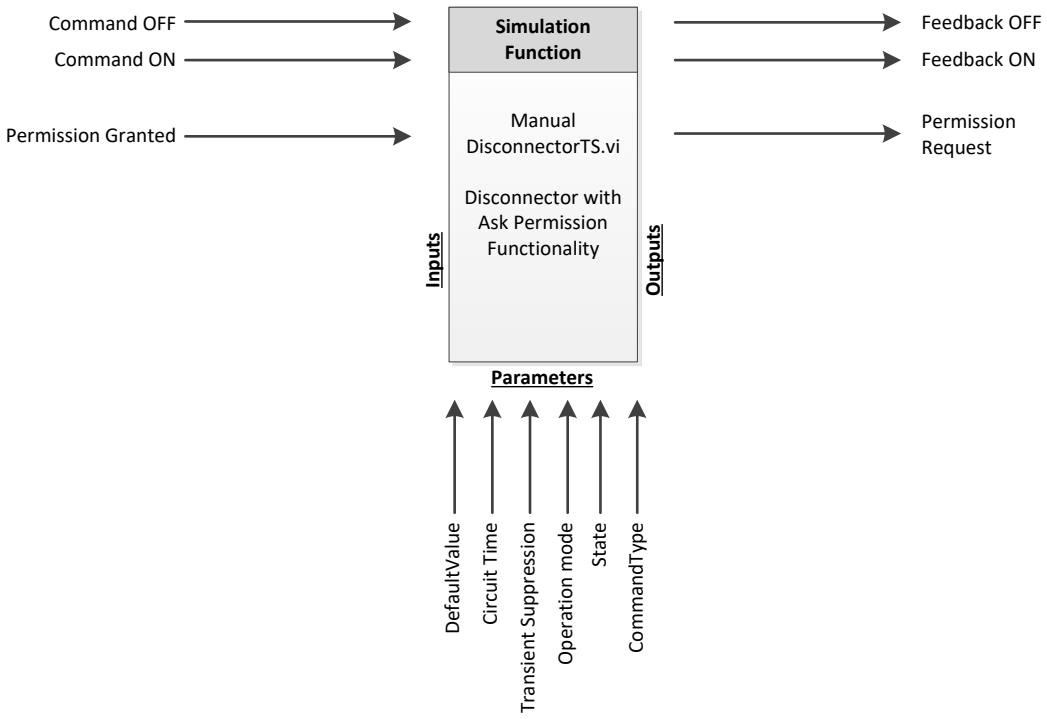


Figure 72 Inputs, Outputs and Parameters of ManualDisconnectorTS.vi

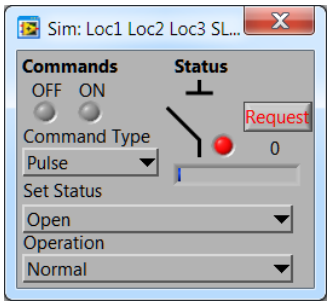


Figure 73 User Interface of ManualDisconnectorTS.vi

This simulation function simulates the behavior of a Disconnector and uses the standard symbol to indicate its current state. It resembles functionality of DisconnectorTS.vi with additional functionality to request a Switching Permission with a Binary Output and to receive the permission with a Binary Input.

Permission Functionality: A PTM binary output “Request” is activated, when the Request button is pressed. If the permission is given, the PTM binary input “Permission Granted” is activated, which will enable any switching functionality. The current Permission status is indicated with the LED in the status symbol. A red LED indicates “No Permission”, a green LED indicates “Permission granted”.

The simulation function can be configured for Persistent Commands, as well as Pulse commands. If you choose the persistent command, the simulation function runs only for the time, the command signal potential is high.

The Simulation Function runs for a defined circuit time. The running process is indicated by the progress bar below the status symbol. An input channel software filtering is enabled by default, it can be configured with the Transient Suppression Parameter.

You may change the operation mode to a malfunction mode, to simulate disturbed behavior.

5.1.8.2.11. SRFlipFlop.vi

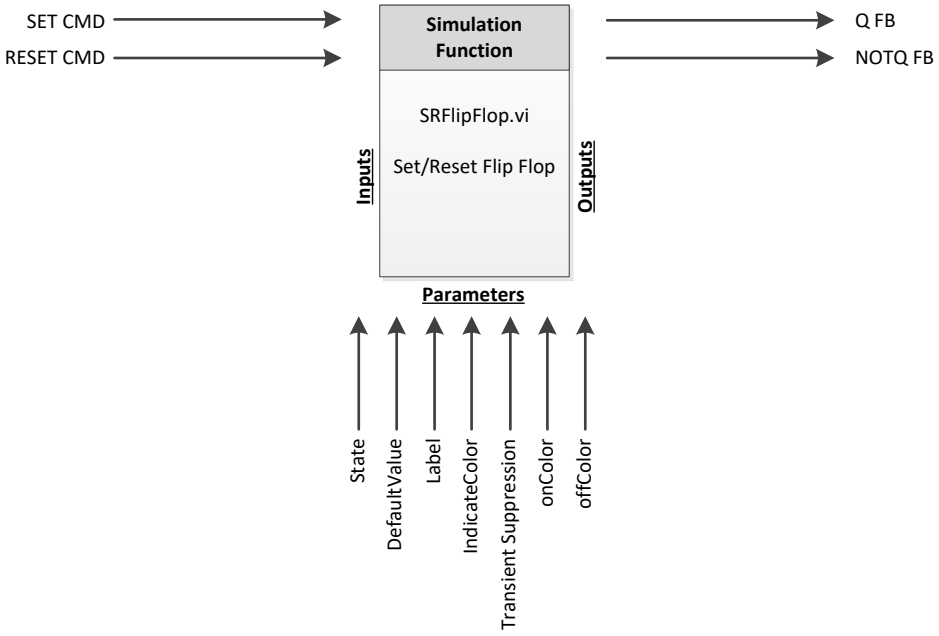


Figure 74 Inputs, Outputs and Parameters of SRFlipFlop.vi

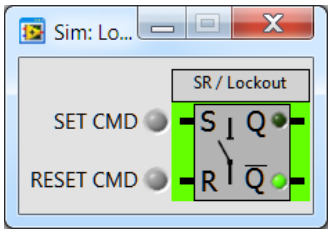


Figure 75 User Interface of SRFlipFlop.vi

SRFlipFlop.vi provides an easy solution to simulate the latching behavior of an SR flipflop, commonly known from digital technology. If the SET CMD signal is applied, the Q FB signal output is held in HIGH state until a RESET CMD occurs, which results in the Q FB signal becoming low again. An inverted NOTQ signal is also available.

You may use this simulation function to indicate the status of fast switching signals on the user interface, for example in conjuction with BaySingleline.vi single line visualization.

SRFlipFlop.vi supports the following features:

- Default value parameter to set the value to apply on start time
- Label Parameter to display a short descriptive text above the SR flipflop box.
- offColor, onColor parameters to influence the background color and LED state the indicate the current status. (default: no background color switching,
  LEDs are green at OFF state, red at ON state)

- indicateColor parameter to enable or disable background color indication of the switch state
- Transient suppression as a software filtering for disturbances on the input signals

5.1.8.2.12. Tapchanger.vi

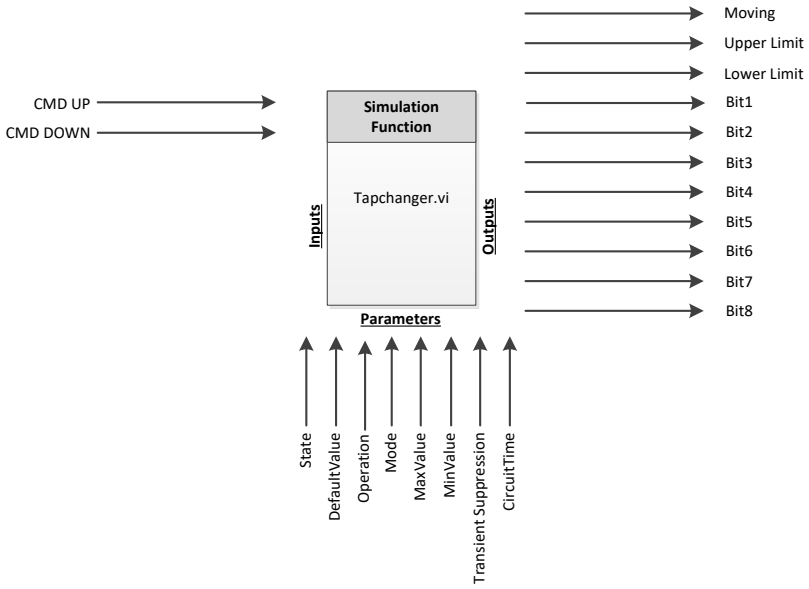


Figure 76 Inputs, Outputs and Parameters of Tapchanger.vi

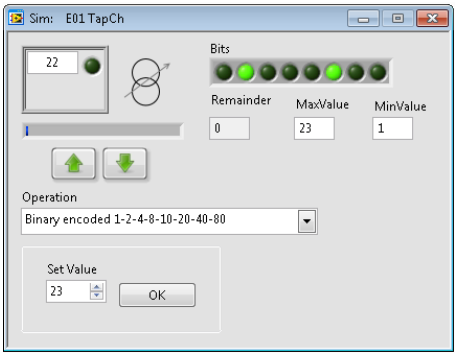


Figure 77 User Interface of Tapchanger.vi

Tapchanger.vi simulates the behavior of a Tapchanger with up to 8 bit. The simulation function supports encoding of the bits in Binary encoded (1-2-4-8-10-20-40-80), BCD (2 digits) or Binary (1-2-4-8-16-32-64-128).

The value represented by the simulation can be manipulated with the Up Command and Down command, which increase or the decrease the internal stored value by 1. The signal “Moving” is high, as long as a command sequence (Up/Down) is executed. The duration of a command sequence can be altered with the CircuitTime Parameter.

Tapchanger.vi supports the following features:

- Default value parameter to set the value to apply on start time
- Transient suppression as a software filtering for disturbances on the input signals

- Encoding in Binary encoded (1-2-4-8-10-20-40-80), BCD (2 digits) or Binary (1-2-4-8-16-32-64-128)
- Moving Signal indicating command runtime
- Upper Limit and Lower Limit signals indicating the MaxValue or MinValue boundary is reached.

5.1.8.2.13. DelayedOutput.vi

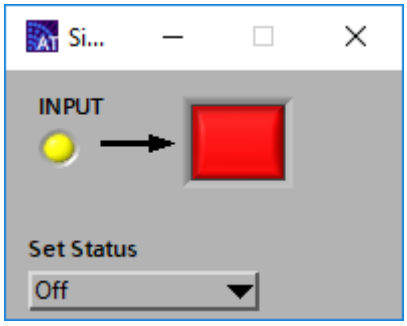


Figure 78 User Interface of DelayedOutput.vi

DelayedOutput.vi simulates switching of many PTM output channels when an PTM input channel gets high i.e when a positive potential is applied across an input channel. The electrical datapoint representing the input channel of PTM must have TAG Name as “INPUT”. The TAG Name of all the electrical datapoints which acts as output channels for this simulation function must be mentioned as part of simulation parameter “Outputs”. Example: Outputs=TAG Name1;TAG Name2;TAG Name3. CircuitTime can also be mentioned as part of simulation parameter (Default value for CircuitTime is 50ms).

DelayedOutput.vi supports the following features:

- The simulation function waits for time equal to CircuitTime before switching the output channels when there is a change in input channel. If the input channel state changes faster than the circuit time, the output channels do not change faster. It always waits for time defined in CircuitTime. The output channel state is always in sync with latest input channel state after the circuit time.
- Transient suppression as a software filtering for disturbances on the input signals
- Setting output channel state to On/Off irrespective of the input channel state by selecting Set Status dropdown value on the simulation window. This changes the Output channel state immediately.
- Setting output channel state to On/Off irrespective of the input channel state by clicking the Input button on the simulation window. This changes the Output channel state after time equal to circuit time.

5.1.8.3. Simulation Overview Window

The Simulation Overview Window shows all simulation function windows grouped by their substation location.

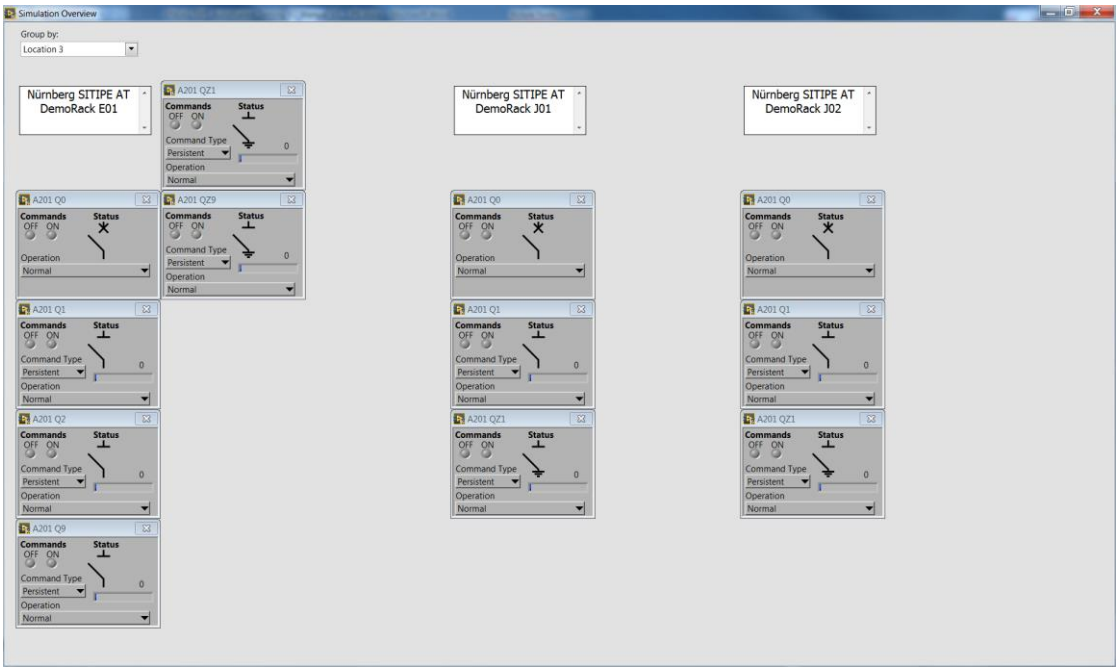


Figure 79 Simulation Overview Window

The Window opens automatically, when the Setting “Show Simulation Functions during Test” is activated simulation functions are started during a test. You may open the window manually from the Simulation Engine window using the button **Show All**.

The grouping criteria can be chosen in the Group by Dropdown-Menu located in the upper left corner. The grouping algorithm concatenates all location elements until the Group by criterion. All simulation functions are grouped by the same concatenated location.

Example:

Location 1	Location 2	Location 3	Location 4	Object Name
Nürnberg	SITIPE AT Demo Rack	E01	A201	Q0
Region	Station name	field name	device name	Switching device

Table 17 Simulation Group Example

Group by: Location 3 (Field Name).

The resulting group name is Nürnberg SITIPE AT Demo Rack E01. The screenshot in Figure 79 shows the groups for this example.

5.1.9. Closed Loop Test

A closed loop test can be used to automatically test a system. Therefore Preconditions, a Trigger Source and Sinks are configured for each Test Step inside a Test Case and a Test Case is associated to Test Objects.

5.1.9.1. Test Case selection

The configured Test Cases are listed in SITIPE AT Main Window in the Test Cases / Objects Tree Control. The associated Test Objects for a Test Case are displayed as children of the Test Case in the tree control.

For each Test Case the Pass status is displayed in the right-hand column. The Pass status for a specific Test Object inside a Test Case is also shown in the right-hand column. The Pass status column is colored for Test Cases depending on their status:

- White Test Case not yet executed or only executed on some child Test Objects
- Green Test Case was passed for all associated Test Objects
- Red Test Case has failed for at least one associated Test Object

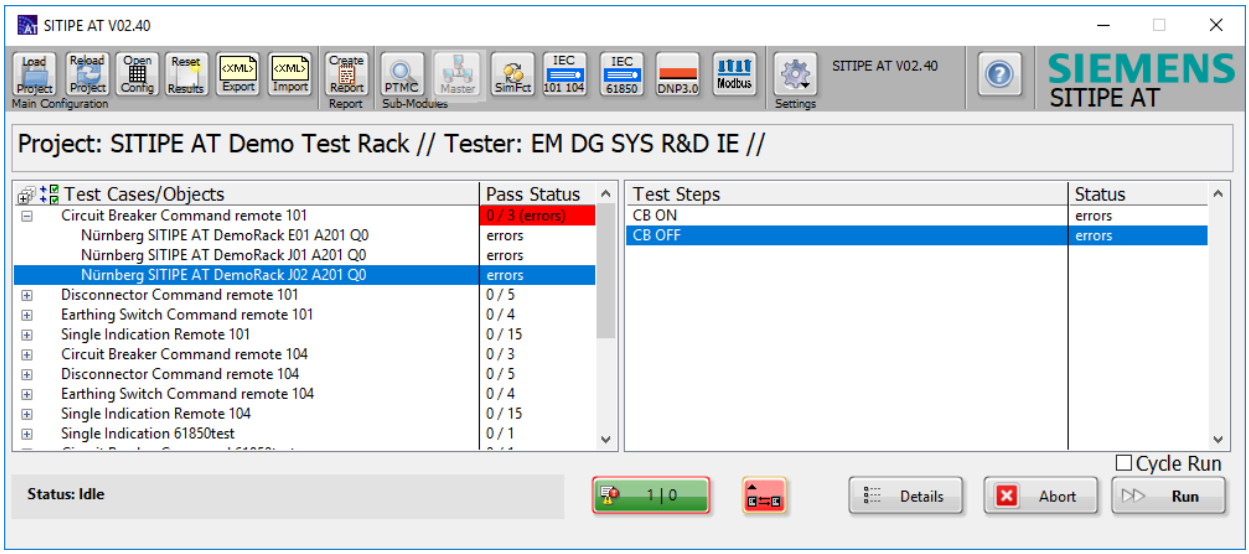


Figure 80 Test Cases, assigned Test Objects and Test Steps in SITIPE AT Main Window

Expand the tree for a Test Case by pressing it's **+** button. Collapse the tree by pressing its **–** button. You can expand/collapse all Test Cases by pressing the button in the header row. You can select/deselect all Test Cases by pressing the button in the header row.

To list the steps of a Test Case, select a child Test Object. The Test Steps will be displayed in the Test Steps List on the right-hand side. The status of each Test Step is displayed in the right-hand column behind the Test Step name.

To select a Test Case for the Test, left-click on it in the Test Case tree control. You may select multiple test cases by pressing and holding the STRG/CTRL key and selecting the Test Cases in the control. You can also select a range of Test Cases by pressing and holding the SHIFT key and selecting the start and end of the range in the control.

5.1.9.2. Operating the Test

The Test is operated using the buttons in the lower-right corner of the SITIPE AT Main Window.

Use the **Run** button to start the Test for the selected Test Cases.

If you want to run the test in a cycle, that means over and over again, place a checkmark in the **Cycle Run** checkbox. The test selection will be executed in a loop until you deselect the **Cycle Run** checkbox or you press the **Abort** button.

Use the **Abort** button to stop a running Test.

5.1.9.3. Test Step Log

The Test Step Log shows all information retrieved during a Test Step.

Open the Test Step Log by pressing the **Details** button in SITIPE AT Main Window.

The Test Step Log Window is opened. Figure 81 illustrates the different elements of the window. Table 18 describes their meaning in detail.

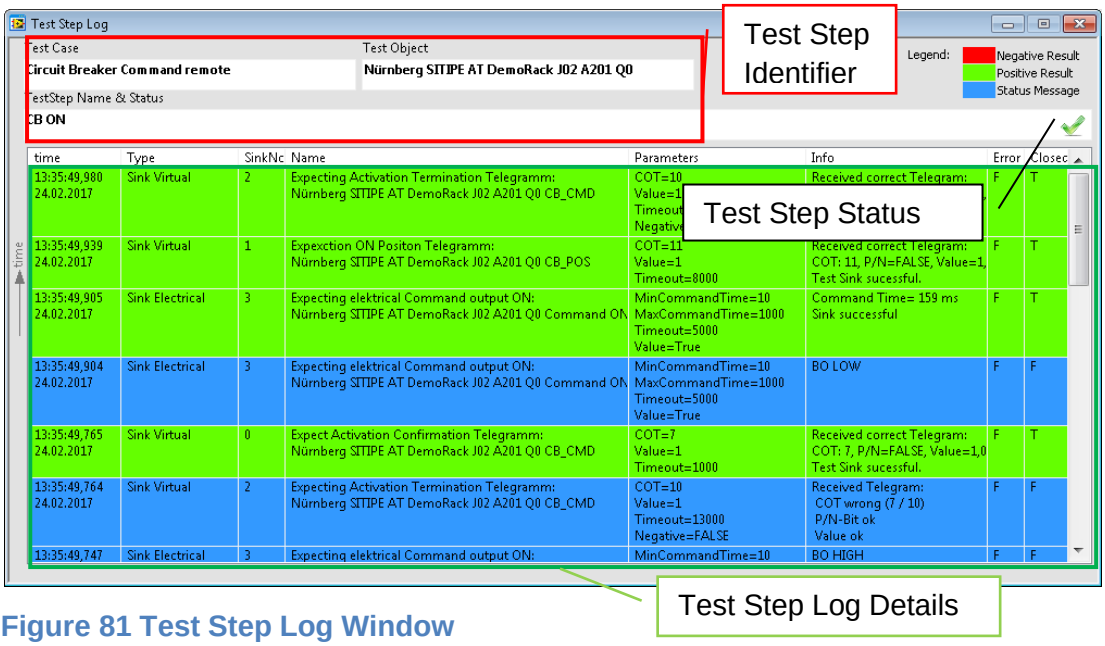


Figure 81 Test Step Log Window

Element	Description
Test Step Identifier	This section describes the Test Case Name, the tested Test Object and the Test Step Name
Test Step Status	This item indicates, whether the Test Step is not yet executed failed passed

Element	Description
Test Step Log Details	This element lists all information retrieved during the Test Step. The latest information is the uppermost entry. Scroll through the history using the scrollbar on the right-hand edge of the table. The rows are colored to indicate their status. If the result is positive, the row is shown green. If the result was negative, the row is shown in red. Otherwise the information is a status message shown in blue. Each row shows its **timestamp**, the **type of the information element**, the number (**SinkNo**) and **descriptive name** of the element and its configured **parameters**. The information from the Test System is shown in the Column **Info**. The column **error** indicates, whether an error occurred. The column **closed** indicates, whether the described software module was finished at this point in time.

Table 18 Test Step Log User Interface Elements

5.1.10. AT Master

Some Projects require a high number of PTMs or distances of more than 3m (USB max. wire length) has to be covered. A direct USB connection of PTMs and the Test PC is not sufficient in this case. SITIPE AT provides a Master/Slave Functionality based on TCP/IP communication to overcome this issue.

The Master Slave Concept provides a way to redirect PTM information from Slave PCs to Master PCs which execute Automated Tests. The AT Master/Slave technology supports multiple AT Slaves communicating with multiple AT Masters simultaneously. So PTMs can be connected to a slave and a master can grab a subset of the slave PTMs for its Testing Project. Other masters may access the leftover PTMs, but only one master can control a PTM at a time.

Figure 82 illustrates the concept of one Test PC connected to the station network interfaces (-104, -101, 61850, DNP3.0 etc.), some PTMs and the slave PCs with additional PTMs.

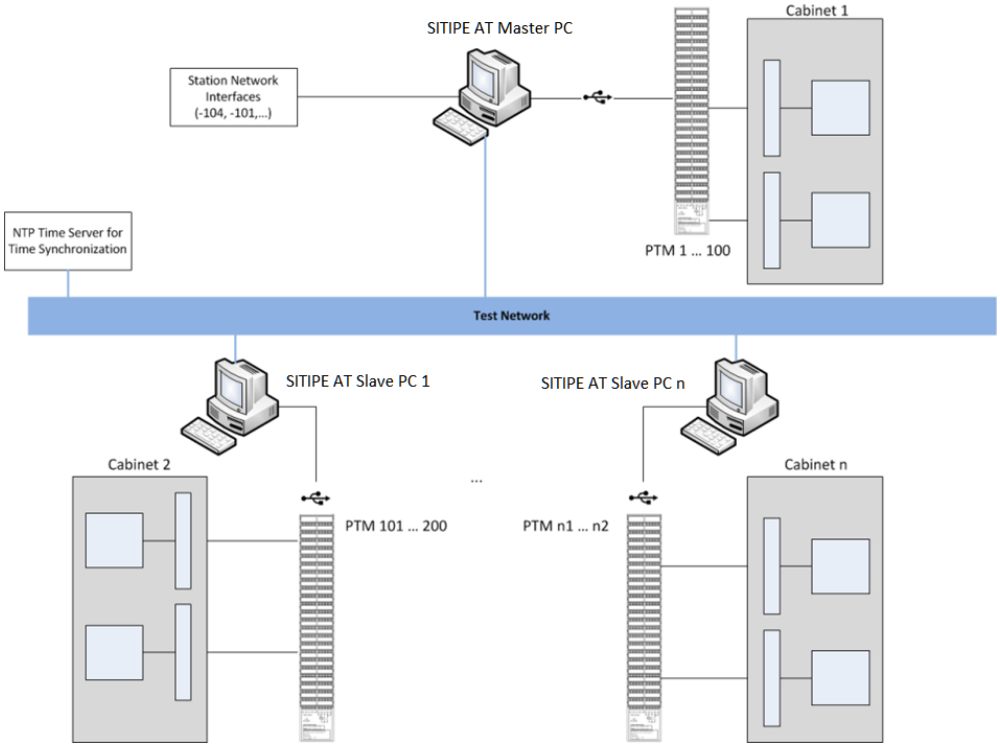


Figure 82 SITIPE AT Master / Slave Architecture

The Slave PCs run the additional Software Package SITIPE AT Slave. This software sends its changes of Binary inputs to connected SITIPE AT Masters. If a SITIPE AT Master sends binary outputs to a Slave, it redirects those Packets to its connected PTMs.

For correct and precise timestamps of the PTM packets, all Test PCs shall be synchronized by NTP. If no time source is available in the Test environment, a NTP server can be hosted on the Test Master PC and all Test Slaves have to be synchronized to this NTP server.

Please consider the following limitations:

- PTM IDs have to be unique across the whole Test System. This includes different Master/Slave PCs.
- No PTM can be connected to 2 SITIPE AT Masters. PTMs are locked to one connected Master, another Master trying to use the PTM would be refused.
- The Default listener Port on SITIPE AT Slaves is 23000. You can change this setting in the Slave Settings dialogue. (see 5.2.3)
- AT Master/Slave technology contains algorithms to equalize timestamp differences of the master/slave PCs local clocks. In order to ensure proper timestamping, using an NTP server for time synchronization is recommended.

5.1.10.1. Setup of a SITIPE AT Master

The Master Functionality is integrated in the SITIPE AT Software. It is automatically started if PTMs are configured as Slave PTMs with an IP Address and TCP Port of the Slave PC. For Excel configuration see 6.2.3.1.

5.1.10.2. Master Dialog

SITIPE AT provides a AT Master dialog to analyze the Master status. It gives information on connected slaves, their PTMs and the master connection log. You can also start/stop the master from this point. You can open it from the SITIPE AT Main Control Window:

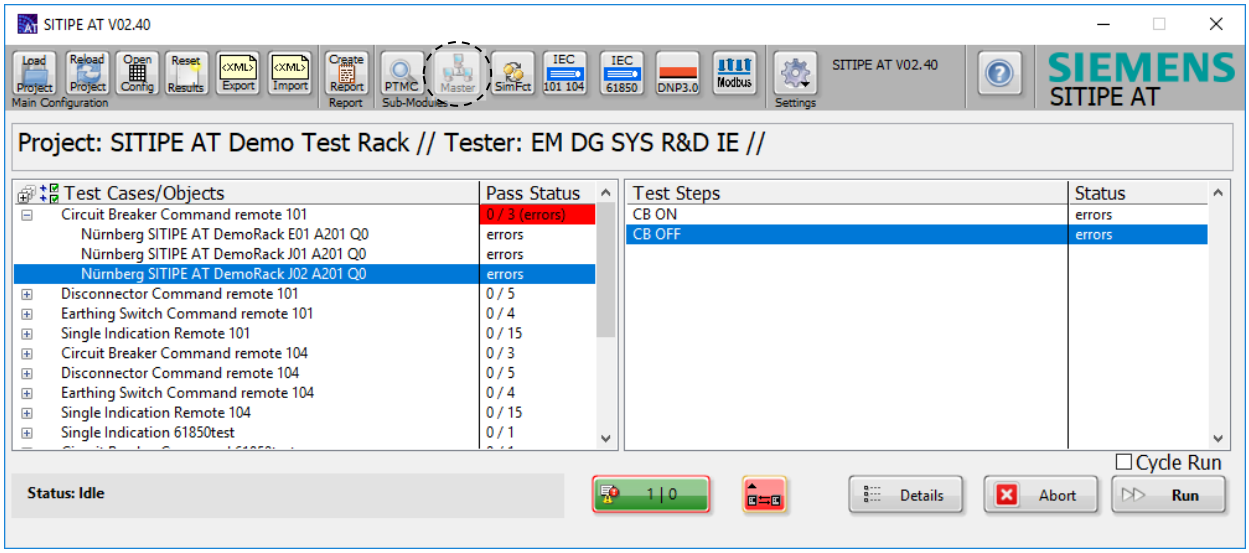


Figure 83 SITIPE AT Main Window and Master button

The SITIPE AT Master Dialog is opened:

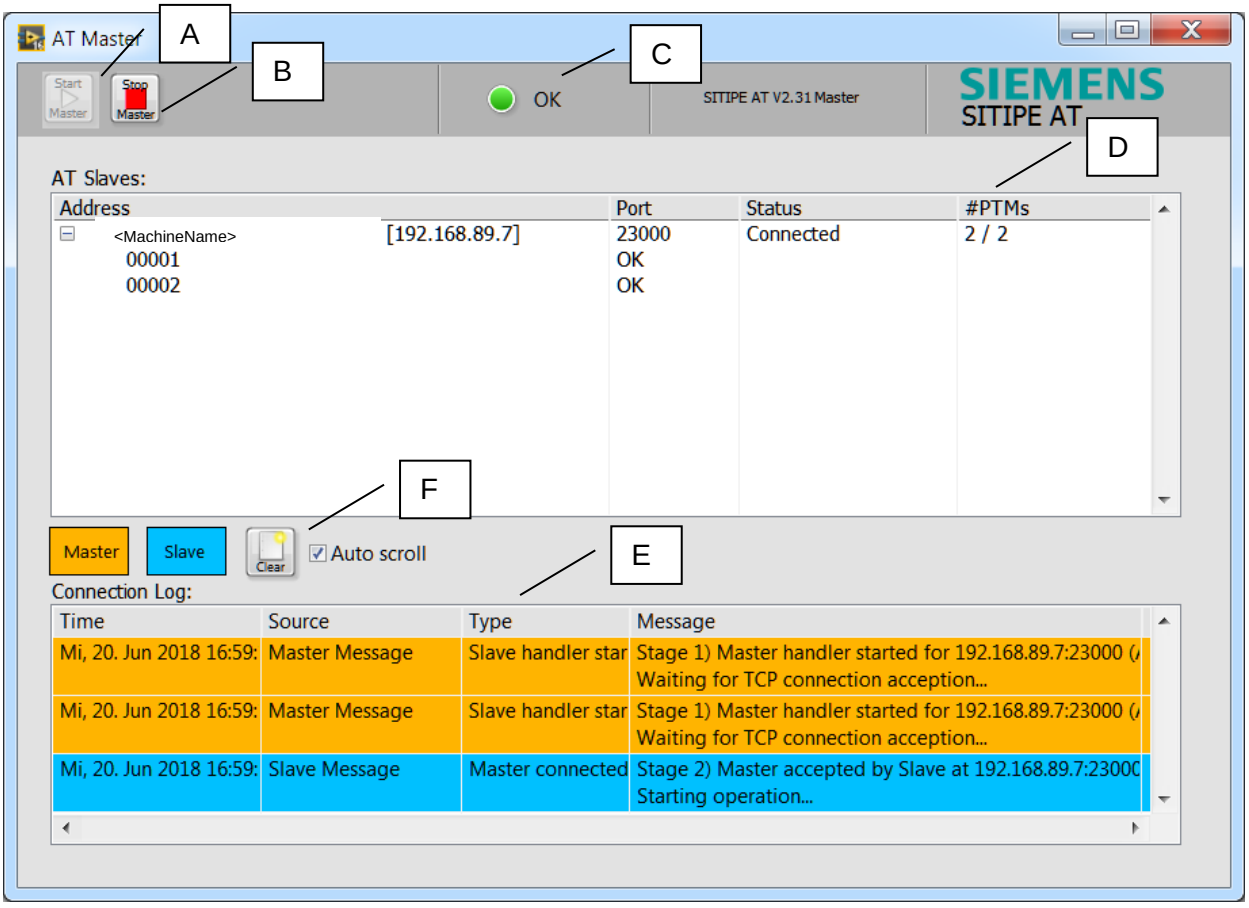


Figure 84 SITIPE AT Master Dialog

The following listing describes the different elements of the dialog:

Letter	Element	Description
A / B	Start / Stop buttons	Use these buttons to start or stop the master connections.
C	Master status	Shows, whether the master is running correctly or errors occurred.
D	AT Slaves overview	Shows the slaves configured for the master and their status. Also lists the connection status of the PTMs connected to the slaves.
E	Connection log	Lists all events that occurred on the master. If the information does not fit in the control, you can display it in an extra message window by double clicking the entry in the control.
F	Clear and AutoScroll controls	Press the clear button in order to remove all entries from the connection log indicator. Check the AutoScroll checkbox to automatically scroll to the most recent entry, whenever a message appears.

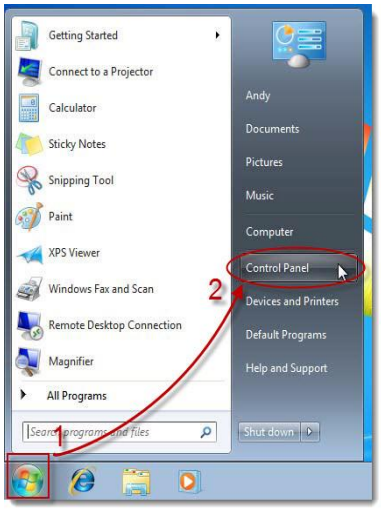
Table 19 Master Dialog User Interface Elements

5.1.10.3. AT Master Firewall Troubleshooting

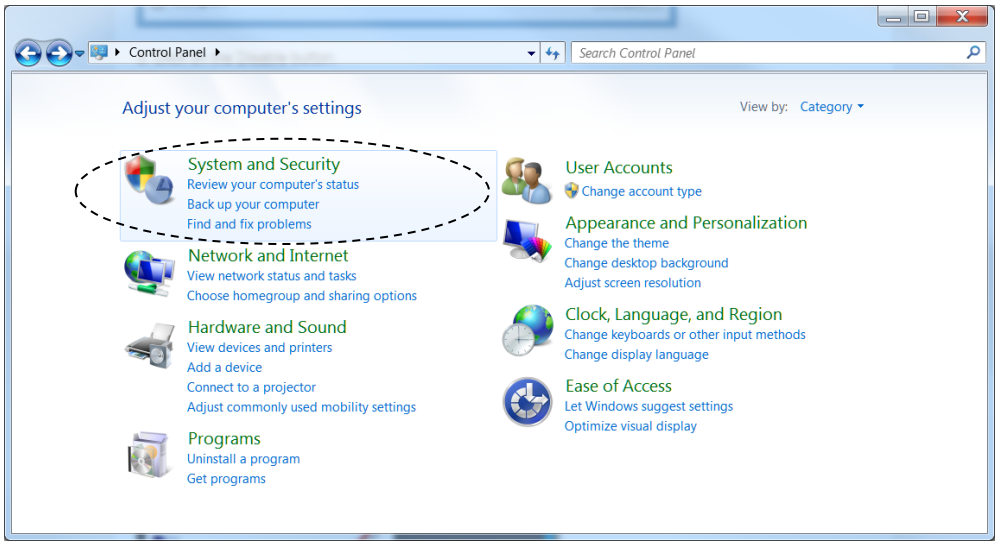
SITIPE AT Master can only communicate to slaves, if the Firewall allows the communication. If a Firewall blocks the communication, an Exception Rule has to be created for SITIPE AT. The following Steps describe **Adding a Firewall Exception Rule** for the Windows Firewall, which is enabled by default from Windows Vista upwards.

Please note: Allowing a Program to communicate through Windows Firewall may be forbidden due to Company IT restrictions. Please consult your local IT department, if you are unsure to configure your Firewall for SITIPE AT Communication.

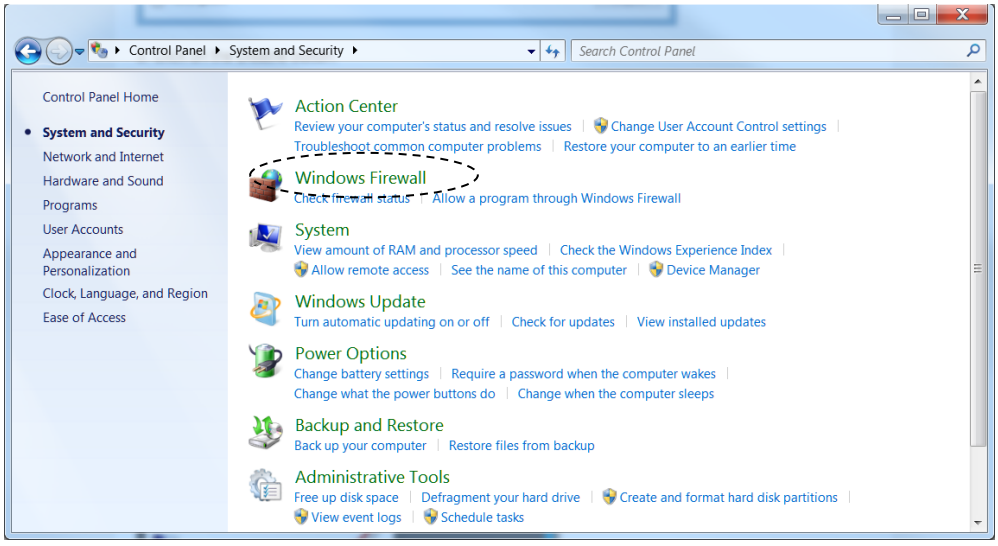
1) In order to add a Firewall Exception Rule for SITIPE AT, open the Windows Control Panel from the Start menu:



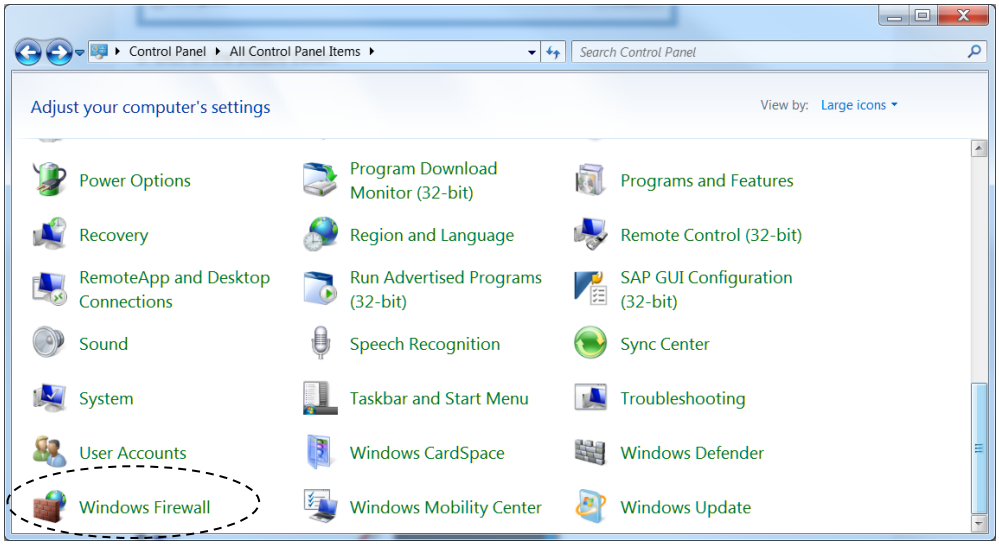
2) If you are in the Category View, Open the **System and Security** Category.



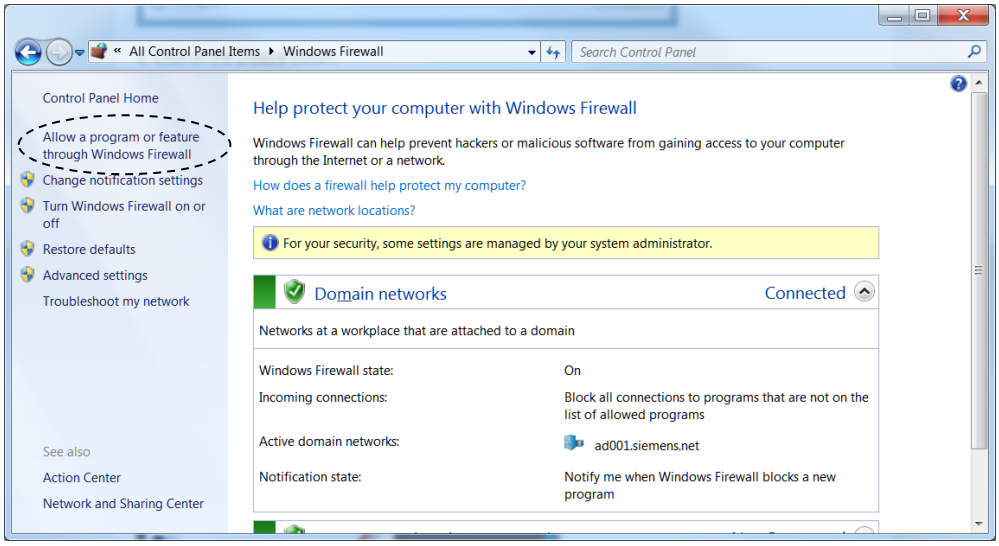
3) Now select **Windows Firewall** from the **System and Security** Category.



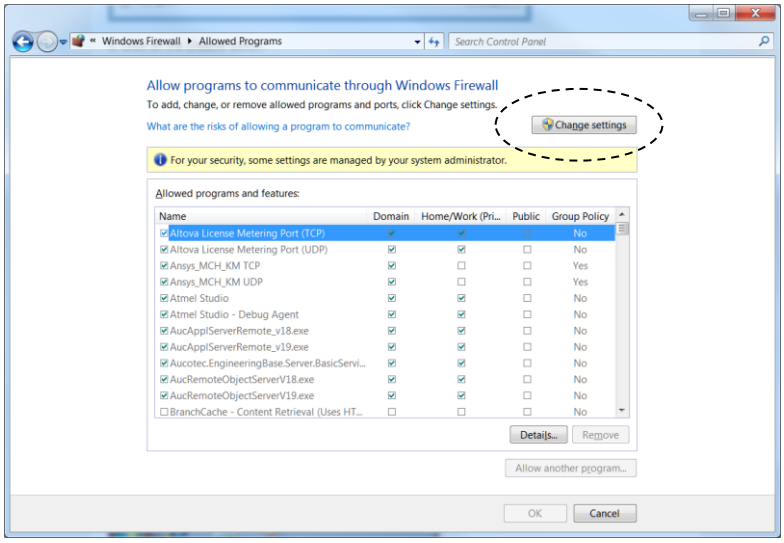
4) If you opened the Control Panel in the “Large Icons” or “Small Icons” View, select **Windows Firewall** directly.



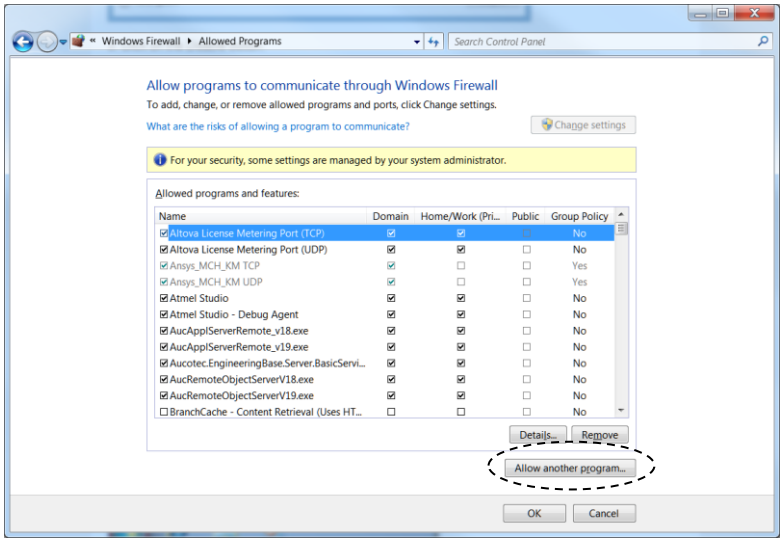
5) No select **Allow a program or feature through Windows Firewall** in the Windows Firewall Window.



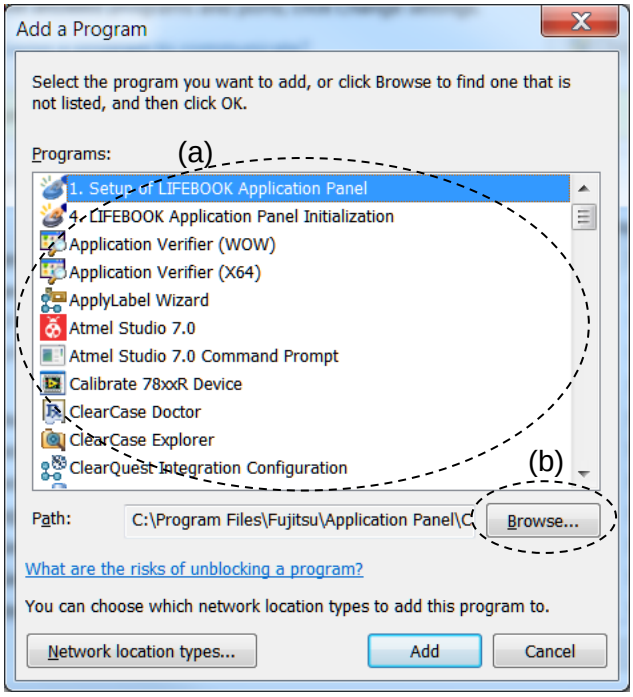
6) The “**Allow programs to communicate through Windows Firewall”** Dialogue is opened. Select **Change Settings** there and acknowledge an upcoming windows security dialogue.



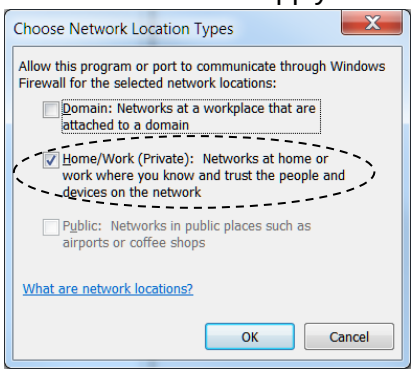
7) Now press the button “**Allow another program**”.



8) The “Add a Program” Dialogue opens. Select SITIPE AT in the List of Programs (a) or browse for TIPT.exe in the SITIPE AT Installation Path using the **Browse...** (b) button.



9) Select **Network location types...** to open a subsequent Dialogue to select for which network Types this rule will apply. The selection Home/Work (Private) will work in most cases. Press OK to apply the selection.



10) In the Add a Program Dialogue, press **Add** to add SITIPE AT to the List of Allowed Programs to communicate.

5.1.10.4. Setup of a NTP Server

SITIPE AT Master/Slave Functionality needs all PCs in a Test Network to be time-synchronized. This chapter recommends a solution, if you do not already have a time synchronization tool in use.

NOTICE

These settings should only be done on Test Systems and thus with confirmation of your local IT department. Especially creating new users can harm the security of the system badly.

We recommend Meinberg NTP, which is a free software you can download at https://www.meinbergglobal.com/english/sw/ntp.htm

For the first installation steps, please refer to the manual available at http://www.satsignal.eu/ntp/setup.html until the step “Files have been saved”.

Then follow these instructions:

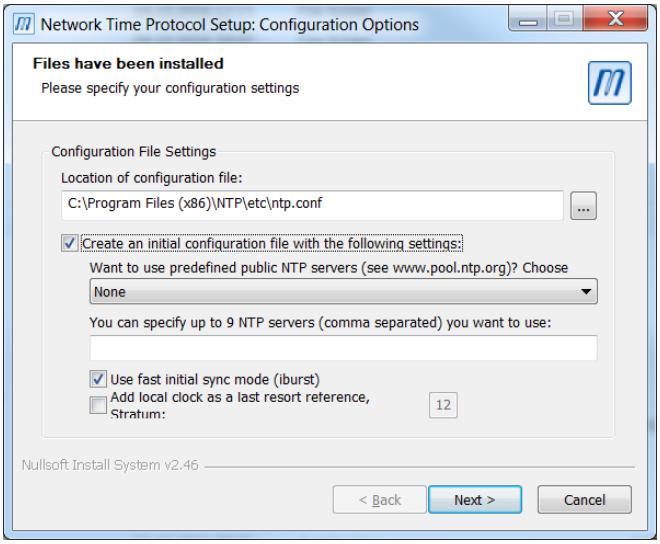


Figure 85 NTP Installation Step 1

Please specify the path to the ntp.conf file. An example file for slaves can be found in the <SITIPE AT installation directory>/data/ntp.conf. For masters, just use the default file, created by the installer.

Then press “Next >”.

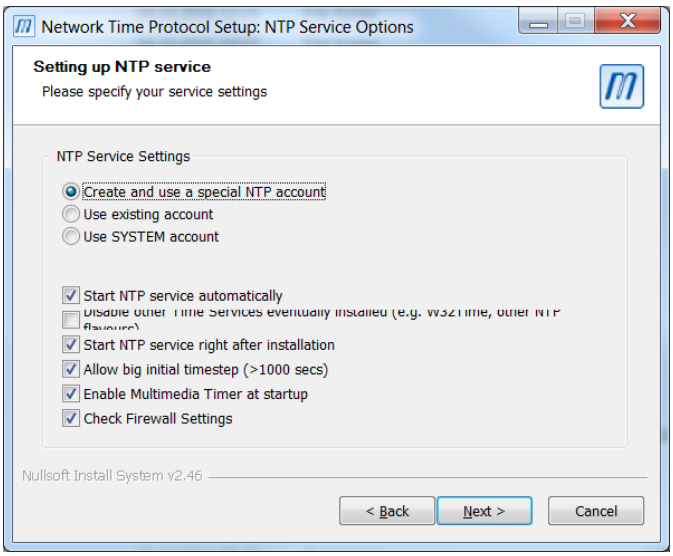


Figure 86 NTP Settings

Please do the same selections as in Figure 86.

Then press “Next >”.

In the following step, specify a username and password for the NTP user.

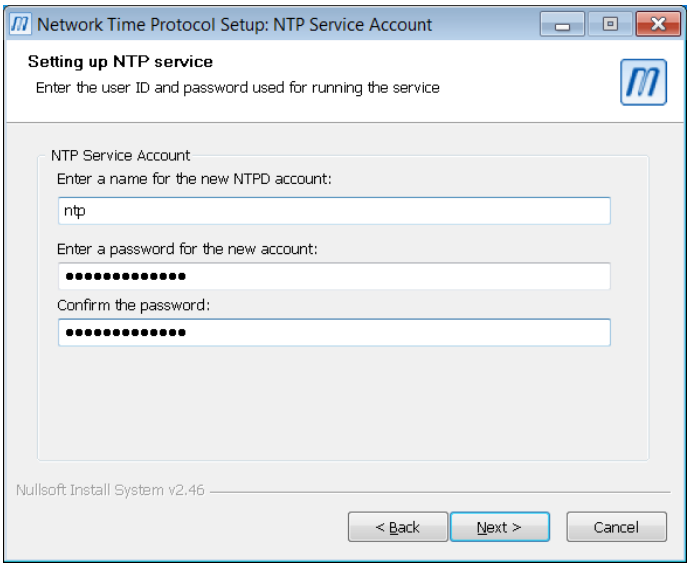


Figure 87 NTP User creation

Afterwards the installer starts the ntp service and ntp should be correctly running as a service. For further support, please refer to the manual described at the top of this chapter.

5.2. AT Slave

SITIPE AT Slave is a standalone software package, which just contains basic slave functionality in order to redirect PTM I/O information. Download and installation are described in chapter **4.3**.

It may be run on a small machine controlled via a windows remote desktop connection.

After installation, start SITIPE AT Slave from the Desktop Shortcut or from **Windows Start menu** > **All Programs** > **Siemens** > **SITIPE Automated Testing** > **SITIPE AT Slave**.

5.2.1. User Interface Elements

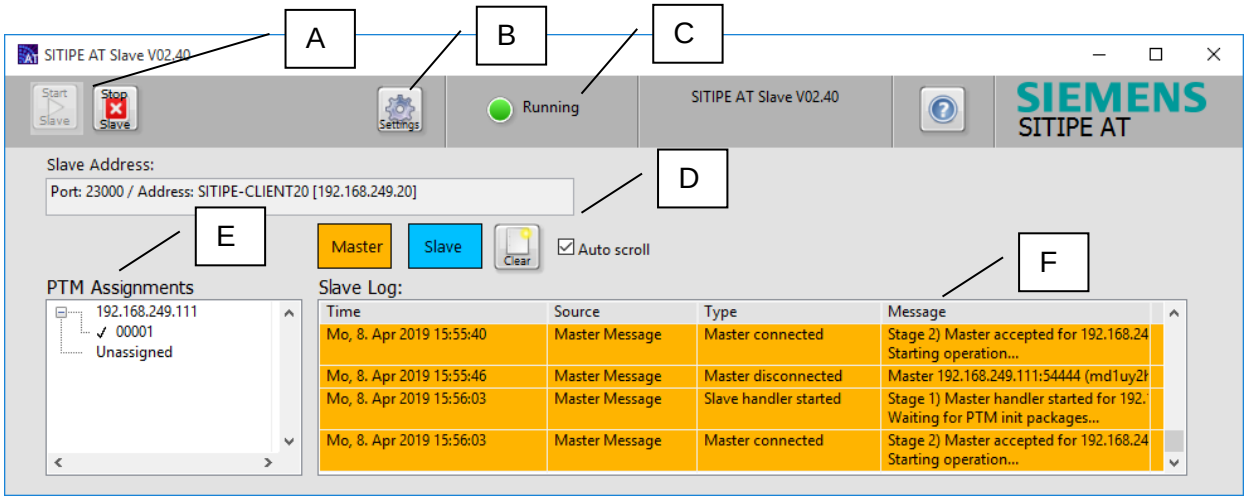


Figure 88 AT Slave User Interface

SITIPE AT Slave provides the following user interface elements to control its operation:

Letter	Element	Description
A	Connect / Disconnect buttons	Use these buttons to start or stop the SITIPE AT Slave and its TCP Listener.
B	Settings button	Press this button in order to open the settings dialogue for slave configuration. You may change the TCP Port or select network interface(s) used for Master/Slave communication.
C	Slave status indicator	This LED indicator shows whether the Slave is running correctly or not.
D	Slave address indicator	Shows the TCP port and IP of the slave. Use this configuration in order to configure AT Masters to connect to this slave.

Letter	Element	Description
E	PTM Assignments indicator	Shows the connection status of the PTMs connected to the Slave. This indicator also shows the assignments of PTMs to connected AT Master PCs.
F	Slave log	Lists all events that occurred on the slave. If the information does not fit in the control, you can get it by double clicking the entry in the control.

Table 20 AT Slave User Interface Elements

5.2.2. Slave behavior

SITIPE AT Slave is designed to be run on a remote machine without user interface interaction. Therefore the slave settings are saved locally and if SITIPE AT Slave is restarted, the TCP listener is re-started automatically.

If the connection is lost while a slave is in operation, connected AT masters will try to re-establish the connection every 5 seconds.

5.2.3. Settings Dialogue

You may change the configuration of SITIPE AT Slave in order to customize its communication behavior.

Open the settings dialogue from the SITIPE AT Slave User Interface.

Apply settings changes by pressing the OK button. This will trigger a restart of the AT Slave with the new settings. The dialogue also checks for Port conflicts with the TCP Port.

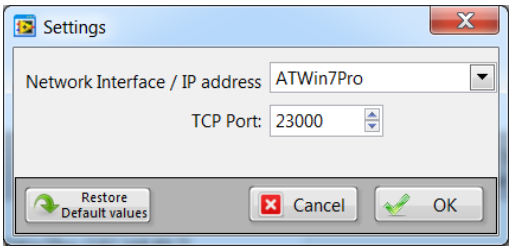


Figure 89 AT Slave settings dialogue

5.2.3.1. Network Interface / IP address

Select the network interface to listen for connecting SITIPE AT Masters. AT Slave listenes on all available network interfaces by default. You can select a single network interface and its according IP in the dropdown list. You may apply such a setting to be in line with local IT requirements.

Default setting: <Computer Name> indicating to listen on all network interfaces available.

5.2.3.2. TCP Port

Select the TCP Port to listen for SITIPE AT Masters. The default value is 23000, but this may conflict with other applications running on your machine. You can set in a range from 0 ... 65565.

Please note: The TCP Port has to be enabled for communication in your PCs Firewall.

Default setting: 23000

5.2.4. Starting AT Slave together with windows

SITIPE AT Slave can be started when a user logs into windows.

Just open the following path and add a shortcut to SitipeATSlave.exe there:

```
%APPDATA%\Microsoft\Windows\Start Menu\Programs\Startup
```

Please note: This setting is done for the user currently logged into windows.

5.2.5. AT Slave Firewall Troubleshooting

A SITIPE AT Slave can only communicate with SITIPE AT Masters, if the Firewall allows the communication. If a Firewall blocks the communication, an Exception Rule has to be created for SITIPE AT Slave.

Please note: Allowing a Program to communicate through Windows Firewall may be forbidden due to Company IT restrictions. Please consult your local IT department, if you are unsure to configure your Firewall for SITIPE AT Communication.

5.2.5.1. Firewall question at AT Slave start

When SITIPE AT Slave is started the first time, the following Windows Security Alert will appear:

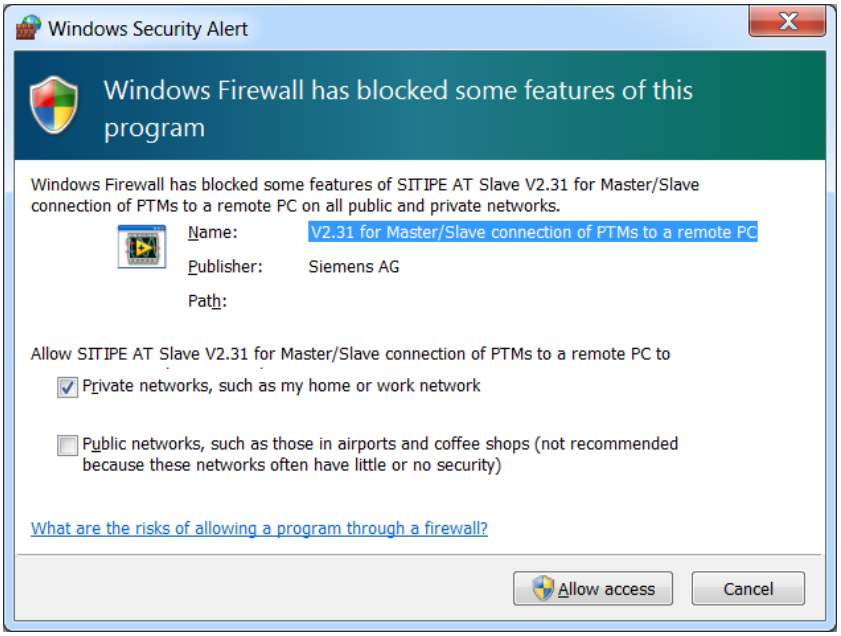


Figure 90 Windows Firewall alert for SITIPE AT Slave

You may allow the access to your network, in accordance to your local IT guidelines.

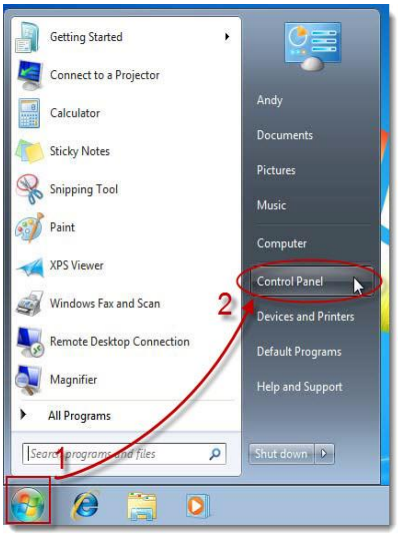
If you do not allow the Access, the Slave is not available for communication with AT Masters.

5.2.5.2. Adding a Firewall Exception Rule for Windows Firewall

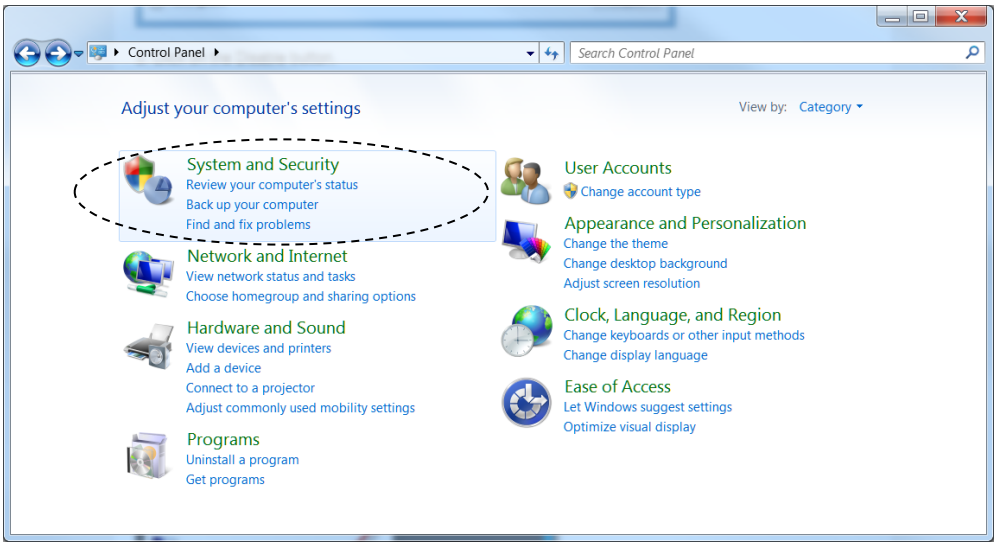
Follow the following steps if the dialogue shown in the above chapter did not appear, or you did not allow access in the first place.

The following Steps describe **Adding a Firewall Exception Rule** for the Windows Firewall, which is enabled by default from Windows Vista upwards.

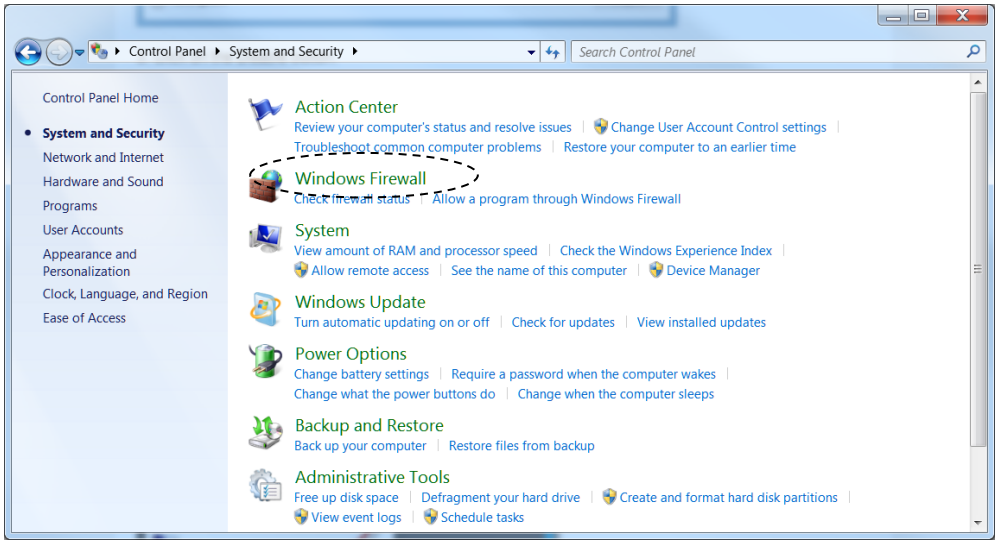
1) In order to add a Firewall Exception Rule for SITIPE AT Slave, open the Windows Control Panel from the Start menu:



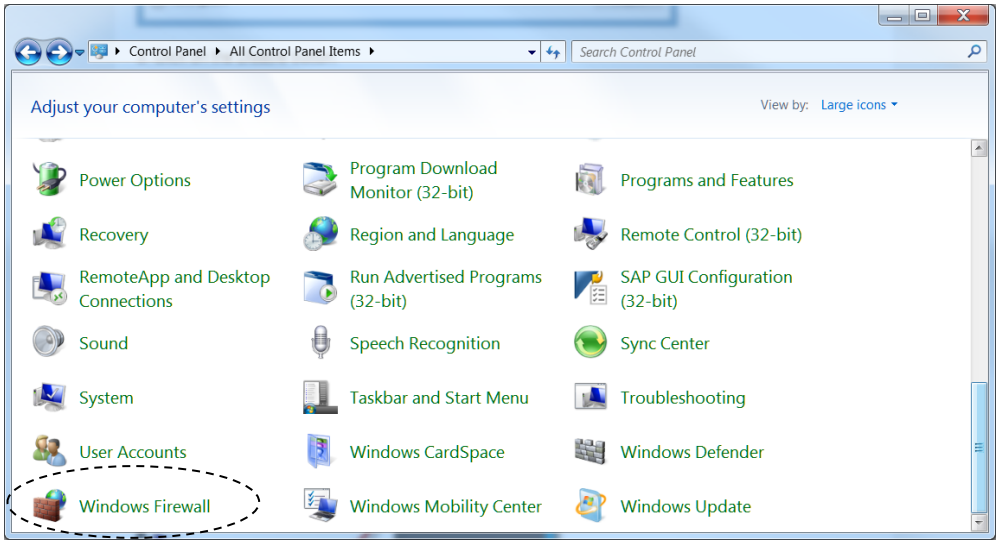
2) If you are in the Category View, Open the **System and Security** Category.



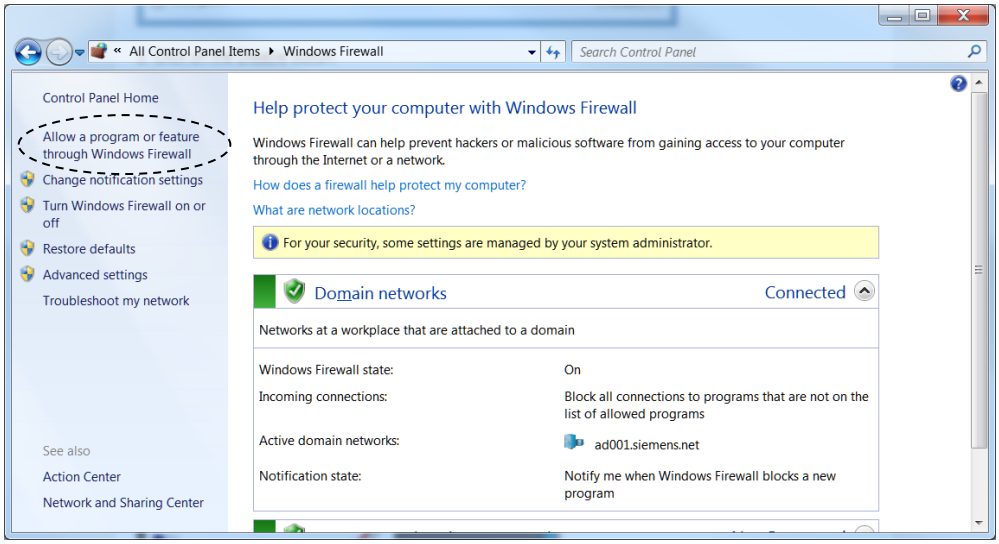
3) Now select **Windows Firewall** from the **System and Security** Category.



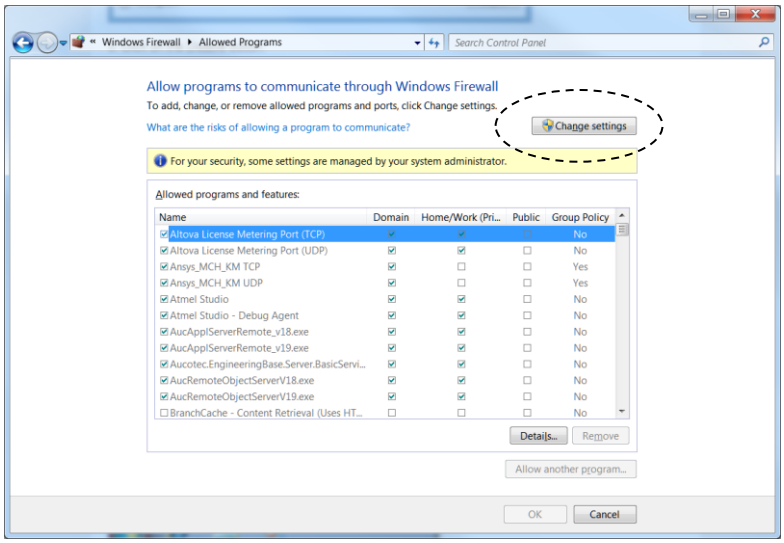
4) If you opened the Control Panel in the “Large Icons” or “Small Icons” View, select **Windows Firewall** directly.



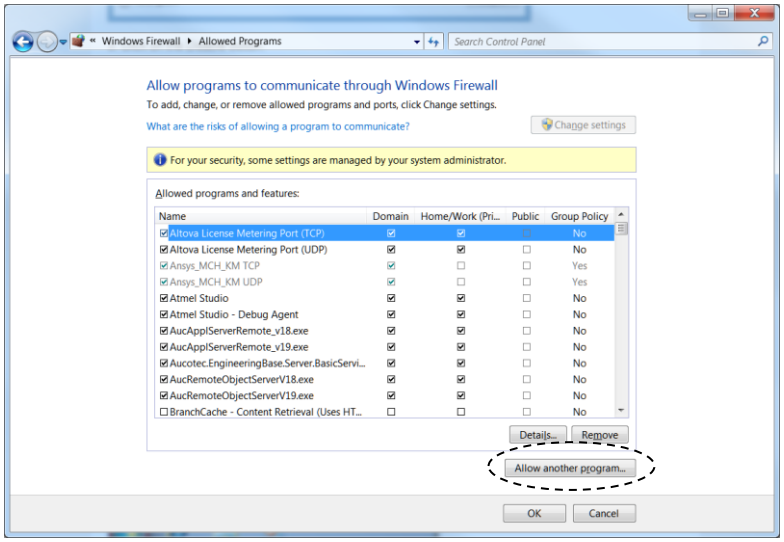
5) No select **Allow a program or feature through Windows Firewall** in the Windows Firewall Window.



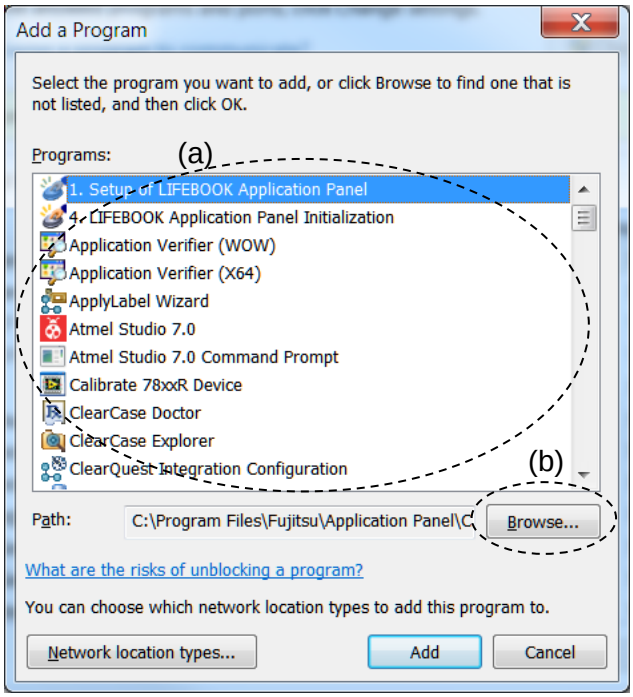
6) The “**Allow programs to communicate through Windows Firewall”** Dialogue is opened. Select **Change Settings** there and acknowledge an upcoming windows security dialogue.



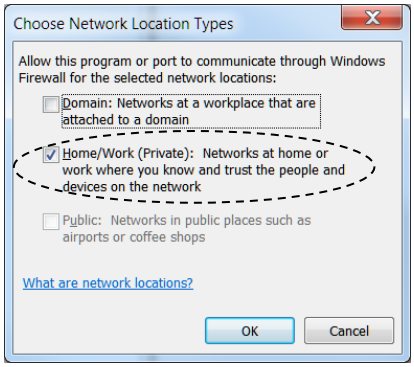
7) Now press the button “**Allow another program**”.



8) The “Add a Program” Dialogue opens. Select SITIPE AT Slave in the List of Programs (a) or browse for SitipeATSlave.exe in the SITIPE AT Slave Installation Path using the **Browse...** (b) button.



9) Select **Network location types...** to open a subsequent Dialogue to select for which network Types this rule will apply. The selection Home/Work (Private) will work in most cases. Press OK to apply the selection.



10) In the Add a Program Dialogue, press **Add** to add SITIPE AT Slave to the List of Allowed Programs to communicate.

5.3. Test Protocol Wizard

The Test Protocol Wizard provides Functionality to automatically create Test Protocols of an executed Closed Loop Test in Form of a Microsoft Word Document.

The Tool offers the following Functionality:

- Specify the Level of Detail for the Report; This may range from “Test Case -> OK / Failed” to a detailed step-by-step output
- Specify a customized Dictionary with Translations for words commonly used, as well as regionalized date/time format
- Specify a Word Format Template to suit your standard document format

Please note: The Test Protocol wizard is using an Interface to Microsoft Word. Therefore a Microsoft Word Installation of at least Microsoft Office 2007 is a Prerequisite for the Test Protocol Wizard.

Open Test Protocol Wizard from the **Windows Start menu** > **Siemens** > **SITIPE Automated Testing** > **Test Protocol Wizard**.

It is also possible to open Test Protocol Wizard directly from SITIPE AT Main Window.

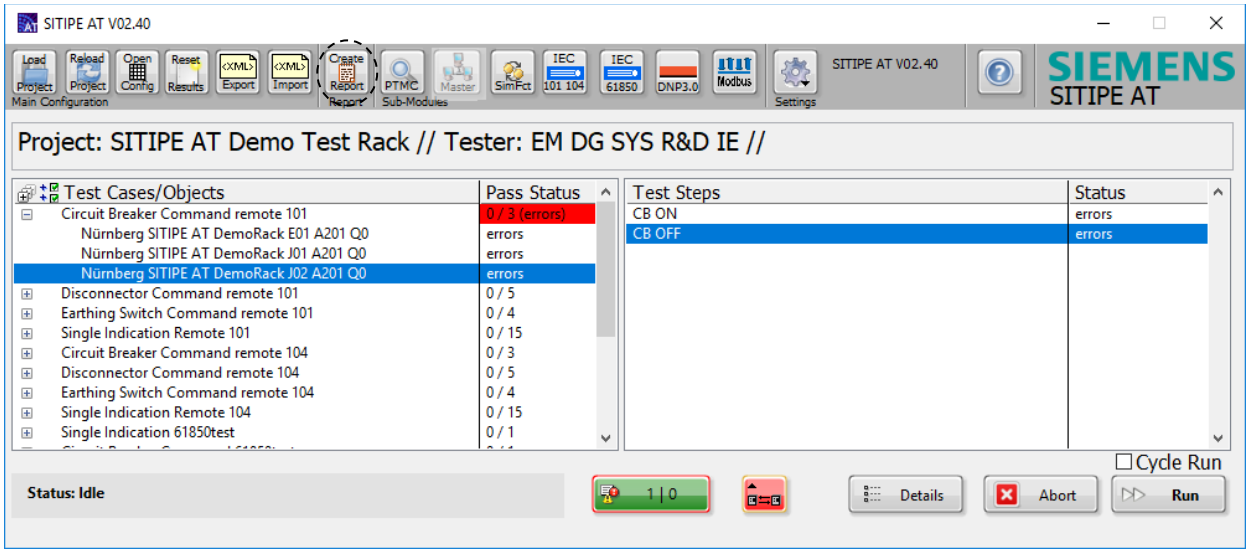


Figure 91 SITIPE AT Main Window and Report button

5.3.1. User Interface Elements

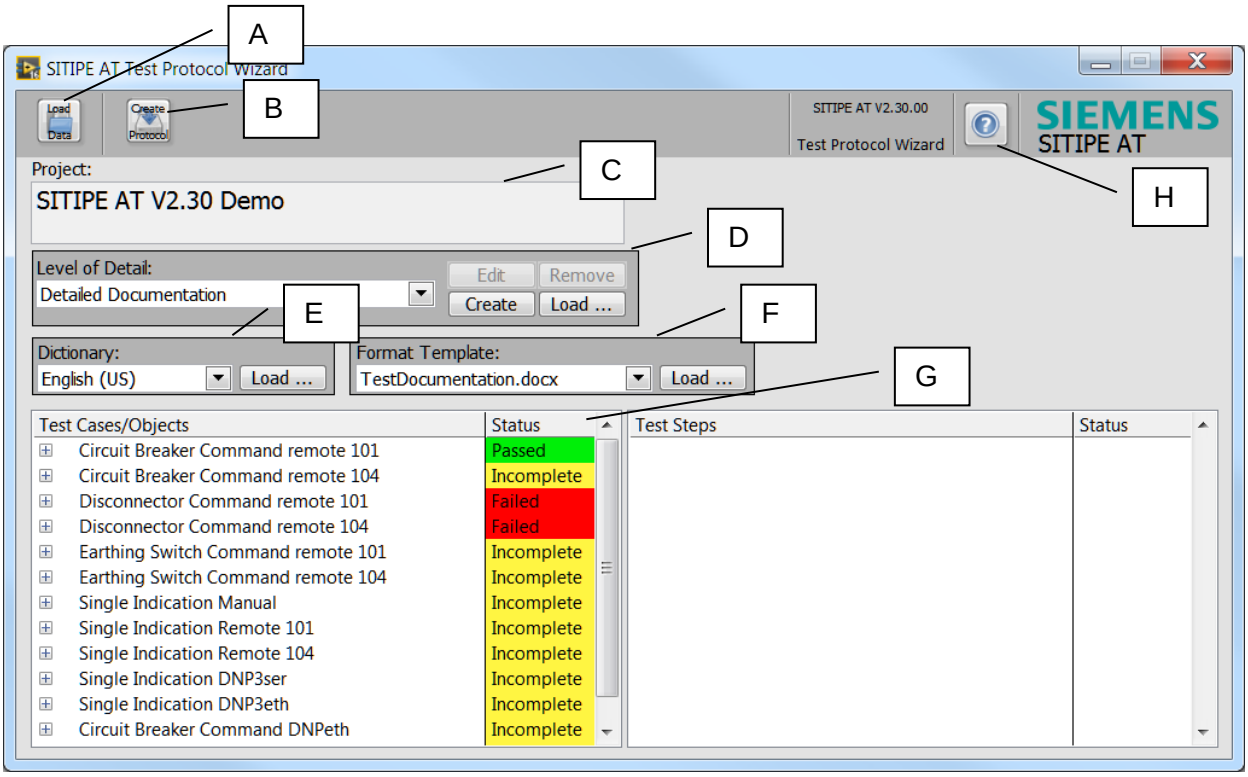


Figure 92 Test Protocol Wizard User Interface

The Test Protocol Wizard provides the following user interface elements to control its operation:

Letter	Element	Description
A	**Load Data** button	Use this button to load a Project File (*.dat, *.xml) containing Test Results.
B	**Create Protocol** button	Use this button to create a Protocol based on the setting specified below.
C	Project Name Indicator	Shows the Name of the Project retrieved from the Project File.

Letter	Element	Description
D	Level of Detail Area	Use the Dropdown-Menu to select a Level of Detail for the Protocol. The Level of Detail Area provides the following Buttons: • **Edit** Change an existing Level of Detail • **Remove** Remove an existing custom Level of Detail from the Dropdown List • **Create** Create a new Level of Detail • **Load…** Load a Level of Detail file into the Program **Please note**: Predefined Levels of Detail are loaded from <SitipeATPath>\TestProtocolWizard\LevelsOfDetail\. These Levels of Detail cannot be changed. But you can create a new custom Level of Detail using an existing LoD as Template.
E	Dictionary Area	Use the Dropdown-Menu to select a dictionary for the preferred language of the Protocol. Use the “Load…”-Button to load an existing Dictionary File.
F	Format Template Area	Use the Dropdown-Menu to select a Word Format Template File. Use the “Load…”-Button to load an existing Word Format Template File.
H	Help button	Press this help button to open the SITIPE AT User Manual in your default PDF Reader for further Information.

Table 21 Test Protocol Wizard User Interface Elements

5.3.2. Level of Detail

A Level of Detail defines how much information is included in the Protocol.

The Level of Detail may range from the Test Case Name and it’s Result down to all information available, including Test Steps and their Step Elements like Preconditions, Sinks and Source.

SITIPE AT Test Protocol Wizard is delivered with 3 predefined Levels of Detail:

- Official Documentation, contains only necessary information for an official document
- Detailed Test Information, contains all information available
- Detailed Test Information without Test Step Information, contains all information available excluding information on the Test Steps

5.3.2.1. Available Information Elements

The following table lists all information elements available for the Test Protocol:

Element Name	Description	Mandatory?	Example
Test Case Name	Name of the Test Case	Yes	“Interlocking Test”
Test Case Description	Free Text Description of the Test Case	No	“Sets Disconnectors in defined Position and tests, whether a Circuit Breaker command executed by the System.”
Test Case Result	The overall result of the Test Case, combined from the Result for all its Test Objects	No	“Successful”, “Incomplete”, “Failed”
Test Case Information	Detailed information about the result of the Test Case.	No	“1 Tests passed. 3 Tests Failed.”
Test Object Name	The Name of the Test Object which was tested.	No	“Circuit Breaker 1”
Test Object Result	The result of the Test for this Test Object.	No	“Successful”, “Incomplete”, “Failed”
Test Step Name	The Name of the Test Step	No	“Test 104 Command”
Test Step Result	The Result of the Test Step	No	“Successful”, Incomplete”, “Failed”
Test Step Information	Detailed information about the result of the Test Step.	No	“Sink Activation Termination failed”
Sub Step Name	Name of a Test Step Precondition, Source or Sink	No	“Setting Disconnector Position”
Sub Step Result	Result of the Test Step Sub step	No	“Sink failed”
Sub Step Information	Detailed information on the result of the Sub Step	No	“Cause of Transmission does not Match.”

Table 22 Available information elements for a Test Protocol

5.3.2.2. Creating a new Level of Detail

You can create a new Level of Detail by pressing the “Create...”-Button in the Level of Detail Area of the Test Protocol Wizard. This will open the “Create Level of Detail”-Dialog:

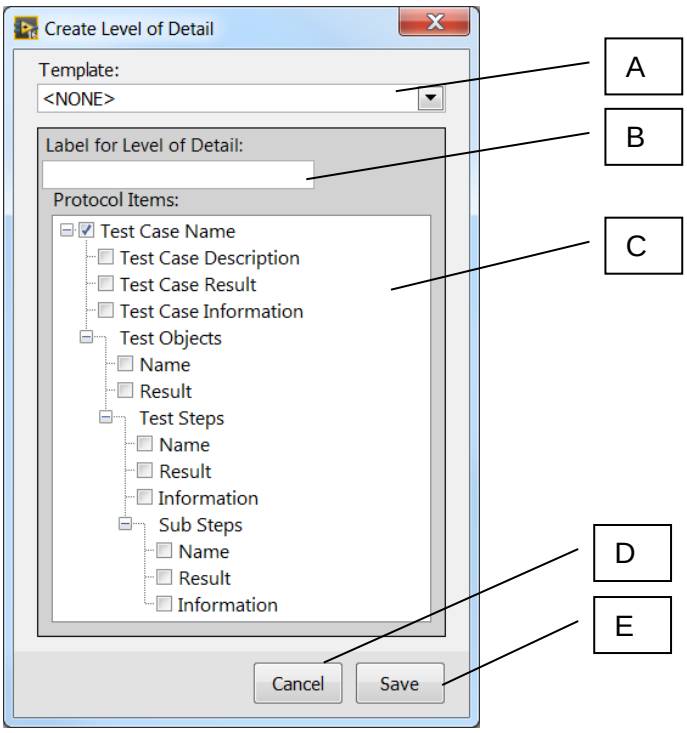


Figure 93 Test Protocol Level of Detail Dialog

The Level of Detail Dialog provides the following user interface elements:

Letter	Element	Description
A	Template Dropdown-Menu	You may select a template for your Level of Detail from the list of already existing Levels of Detail here.
B	Label control	Use this control to enter a meaningful name for the Level of Detail. This label will describe the Level of Detail in the Level-Of-Detail-Dropdown-Menu of Test Protocol Wizard.
C	Protocol Items Tree	Select which information elements should be part of the protocol here by making tick marks in the related checkbox
D	Save button	Use this button to open a Save-File-Dialog to save the Level of Detail File to a Destination of your choice.
E	Cancel button	Use this button to exit the Dialog without saving the Level of Detail.

Table 23 Level of Detail Dialog User Interface Elements

5.3.3. Dictionary

Dictionaries are plain text files used to customize the Protocol output according to your regional and language needs.

SITIPE AT Test Protocol Wizard comes with the dictionary for ENGLISH (US) (Protocol_EnglishUS.cfg). If you need a special documentation in your language, you may copy

this example file and adjust the translation to your needs. The file is located in “<SITIPE AT Installation Directory>/TestProtocolWizard/dictionaries/”.

Load a customized file in the Dictionaries Area using the **Load...** button.

5.3.4. Word Template

A Word Template is used to format the Protocol in a predefined way. Select the Template to load in the **Format Template Area**. SITIPE AT comes with an Example Template File located in “<SITIPE AT Installation Directory>\TestProtocolWizard\Templates”.
Load a customized Word Template by Pressing the **Load...** button.

5.3.4.1. Information Placeholders

A Word File can contain some predefined Placeholders, which will be replaced with Test information by SITIPE AT Test Protocol Wizard. The following Table lists those Placeholders:

Placeholder	Description
%DATE%	The current Date formatted using the Dictionary variable value of “DateFormatStr”.
%TIME%	The current Time formatted using the Dictionary variable value of “TimeFormatStr”.
%PROJECTNAME%	Name of the Project according to the Project File.
%TESTERNAME%	Name of the Tester executing the Test, according to the Project File.
%DOCUMENTTITLE%	The Title of the Document using the Dictionary variable value of “DocumentTitle”

Table 24 Word Template Placeholders

5.3.4.2. Format Styles

A Word Template may define the following Format Styles for the different elements of the Test Results.

Format Template Name	Description of content	Recommended Value
Test Case Information	Description of a Test Case and Information on Test Case Result (e.g. “3 / 4 passed.”)	Arial 12pt, black, left justified
Test Case Result	Result of a Test Case	Arial 12 pt, bold, black, left justified
Test Heading 1	Headline of a Test Case	Arial 14pt, bold, left justified
Test Object	Name of a Test Object in the Test Result Table	Arial 12pt, black, left justified
Test Step	Name of a Test Step	Arial 12 pt, black, left justified, indent left 1cm
Test Sub Step	Name of a Sub Test Step	Arial 12pt, black, left justified, indent left 1,5cm
Test Table	Column Headers for a Test Table	Arial 12pt, black, space before 6pt, space after 6pt

Table 25 Format Styles of a Word Template

6. Configuration

6.1. Basics

6.1.1. Basic Principles

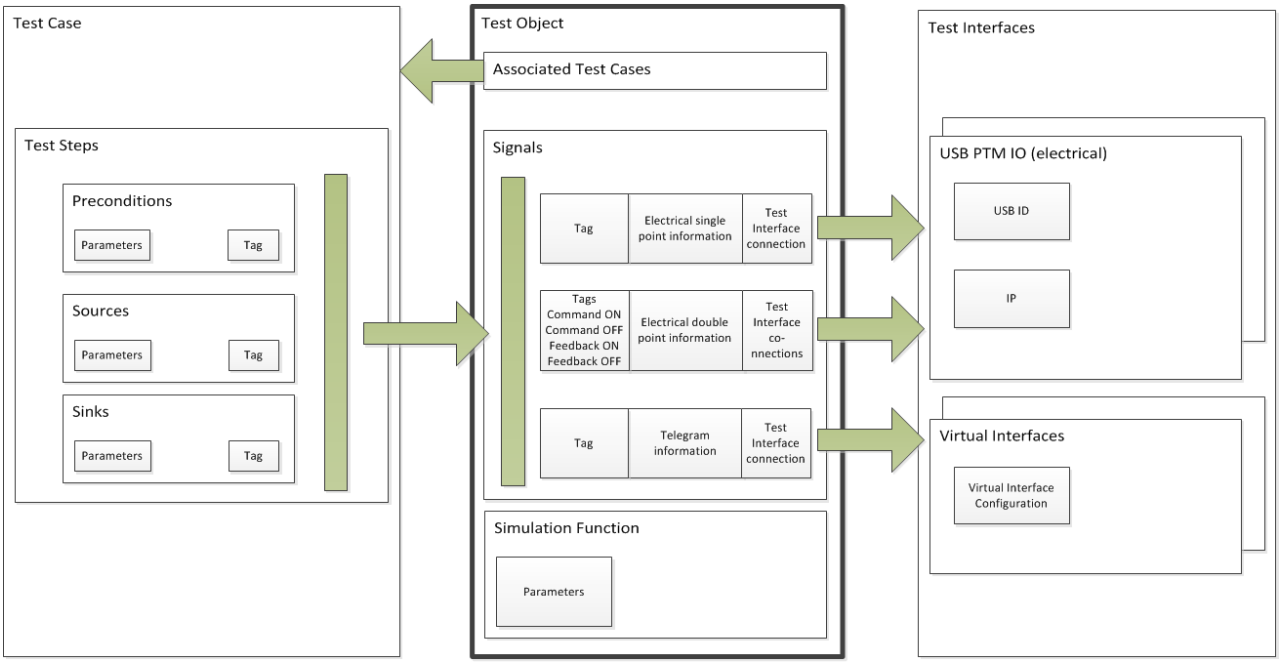


Figure 94 Testing Model

Automated Testing follows same basic concepts to build a Test Model.

The Concept consists of the following components:

Component	Description
Test Object	A Test Object describes a component of the substation, like a Circuit Breaker, a Disconnector or a Single Indication. It can consist of different test points, a simulation function and the Test Cases to be executed for this Test Object.
Signal / Test Point	A Signal is a defined point of a System under Test, which should be inspected (System output/Test Input) or triggered (System input/Test Output). Signals may be electrical single binary inputs or outputs, electrical double point information, or network telegrams (e.g. -104, -101, DNP3.0 telegrams) with a defined Address. Each signal is addressed in Test Cases by a defined Test Tag, which should be the same for Test Objects with similar behavior (e.g. the Feedback ON of Circuit Breakers).

Test Interface	A Test Interface describes the Interface used by the Test System to access test points of a certain type. There are electrical interfaces, namely USB Panel Test Modules and network interfaces, like -104, -101, 61850 IEDs or DNP3.0.
Simulation Function	A Simulation Function is used to simulate the behavior of Primary substation equipment. Examples are Circuit Breakers, Disconnectors, Earthing Switches or Tap changers.
Test Case	A Test Case describes a test for a defined Scenario. It consists of Test Steps. Each element uses Test Tags to address Signals indirectly. Therefore one Test Case may be used for a number of similar Test Objects and does not have to be recreated for each Test Object.
Test Step	A Test Step consists of 3 Elements: Preconditions, Sinks and Sources. Preconditions are the prerequisites for a Test Step to be taken, before the Test starts. Sinks are the signals and their target state, for which the test is done. Sources are the signals, with which the test is started.

Table 26 Test Model Components

6.1.2. Workflow

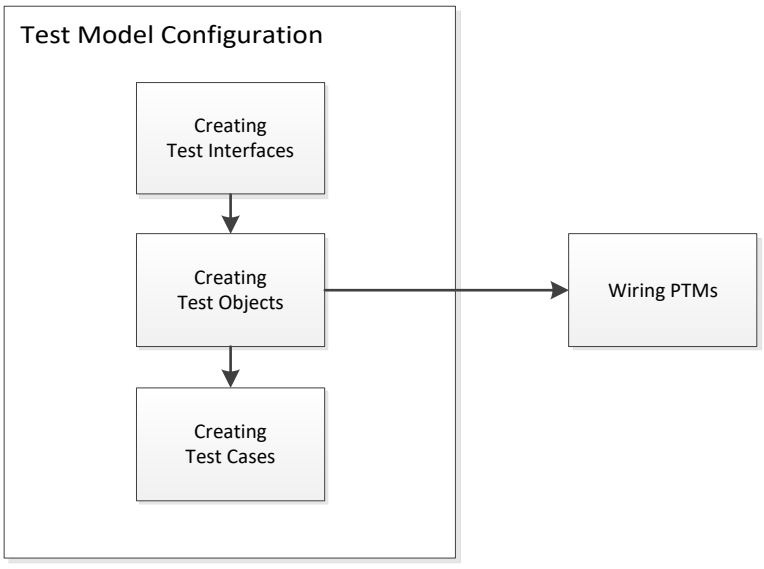


Figure 95 Test Model Configuration Workflow

The Test Model Configuration follows a streamlined workflow:

1. Import the Customer Signal List in the Configuration Workbook.
2. Create Test Interfaces based on the Interfaces to the System Under Test (electrical or network interfaces)
3. Create Test Objects defining Signals / Test Points for a defined component of a substation. Also configure simulation functions for components, which will be simulated during the test.

4. You may export a PTM wiring list to wire the PTMs to the System under Test at this point in time.
5. Create Test Cases defining Test Scenarios and connect Test Objects to them.

6.1.3. Available Test Parameters

The following Test Parameters may be configured in a Parameter=Value notation:

Location / Parameter	Possible Values	Default value	Description
Manual Preconditions, Sources & Sinks			
			No parameters defined. Instructions and Texts can be entered directly.
Wait	1…2,1x10^9	0	Wait time afterwards in [ms].
Electrical Precondition/ Source			
Value	0, 1 / ON, OFF	OFF	Value of the Binary Signal
Wait	1…2,1x10^9	0	Wait time afterwards in [ms].
Impulse	0…1x10^9	0	Sets the Impulse duration for Impulse output of the Value. If this parameter is nonzero, the following procedure is executed: Set to Value -> wait <impulse duration> -> reset to invert of Value The level of the Binary Output, before execution of this Precondition/Source is not evaluated. In the consequence, if the value is on before and an ON-impulse is issued, the system will only see the OFF-edge after the impulse duration. If this parameter is omitted or 0, the PTM output is statically switched to the desired Value.
Sequence	e.g. 10T,15F,10T, 15F for a 10ms HIGH, 15ms LOW, 10 ms HIGH, 15 ms LOW Shattering Signal	<empty>	Use this parameter to output a shattering signal, which is switched in the sequence you define. The following format has to be fulfilled: <durationInMs><T/F>,<durationInMs><T/F>,… Replace <durationInMs> with the Time in Milliseconds you want the Potential to stay. Replace <T/F> with T for a True (HIGH) state, or F for a False (LOW) state. You may define a flexible number of elements for a sequence. The Value parameter is not evaluated in Sequence mode, so the last sequence element defines the lasting state of the PTM BO.
Virtual Precondition / Source			
QOC	0..255	0	Qualifier of Command / Originator
Value	0, 1, <any analog>	0	Value of the simulated telegram.

Location / Parameter	Possible Values	Default value	Description
	Off, Open, On, Close		Values written as strings are automatically converted to numeric telegram values, so prefer this method please. For DNP3.0 Telegrams, 1 is off and 2 is on. For -104 / -101 and 61850 Telegrams Off is 0 and 1 is On.
Operate	Select, Execute, Cancel, SBO(select before operate)	Execute	For IEC -101/-104 Signals: Select before operate functionality; If a command on the remote system is configured for Select-Before-Operate execution: Send a telegram with SELECT Flag, to open a command timeframe. Wait for a positive activation confirmation, then send a second command with EXECUTE within the timeframe and the system will process it. You can also CANCEL a previous selection by giving Operate=Cancel. Giving Operate=SBO(select before operate) directly sends two commands in a row: one with SELECT and one with execute, without waiting for positive confirmation after the SELECT command.
Wait	1…2,1x10^9	0	Wait time afterwards in [ms].
Test Parameters Precondition / Source			
*see Simulation Function Instructions, Chapter **6.1.4.1***			
Wait	1…2,1x10^9	0	Wait time afterwards in Milliseconds.
Electrical Sink			
Value	True, False	True	Expected value of this signal.
NegativeTest	True, False	False	Set to true if this Binary Signal should not occur.
MinCommandTime	1…2,1x10^9	1000	Minimum time in [ms] this signal should be high continuously
MaxCommandTime	1…2,1x10^9	2000	Maximum time in [ms] this signal should be high continuously;
Timeout	1…2,1x10^9	4000	Timeout for the Sink in [ms] if nothing will be observed.
checkStatus	True, False	False	Enable this Parameter to enable CheckStatus Mode. In CheckStatus Mode, the sink only checks whether the electrical Data point is in the right Position, without waiting for a change on the line. All Parameters except Timeout are ignored. Use Timeout to observe whether the signal is constantly in the desired state for the time specified. Since Timeout is 4000ms by default, the signal has to be constantly in the desired state for 4seconds. You may disable signal constancy observation by setting timeout=0.
			Persistent command monitoring: Set maxCommandTime=-1, minCommandTime=minimum the Signal should be high continuously, Timeout=time greater than minCommandTime

Location / Parameter	Possible Values	Default value	Description
Virtual Sink			
COT	-1..63	-1	Cause of Transmission for the expected telegram. -1 means COT will not be checked. This value depends on the Protocol Specific COT valid values. See chapter **7.1**.
Value	0, 1, 2, 3, <any analog> intermediate Off, Open, Opened, On, Close, Closed disturbed	0	Value of the expected telegram. Values written as strings are automatically converted to numeric Telegram values, so prefer this method please. For DNP3.0 Telegrams: Off is 1 and On is 2; Intermediate is 0 and Disturbed is 3; For -104/-101 and 61850 Telegrams, Off is 0 and 1 is On. Intermediate is 2 and Disturbed 3.
Tolerance	Floating Point value	0.0	Tolerance band in which the Telegram value has to fall. The Value has to fall in the area of ***Value +/- Tolerance***. Use this Parameter for Tests on any analog value Telegram, which you expect to be not directly transmitted with the exact value specified by the Parameter **Value**.
Negative	True, False	False	Value of the P/N Bit for expected telegram.
Timeout	1…2,1x10^9	4000	Timeout for the Sink if nothing will be observed.

Table 27 Available Test Parameters

6.1.4. Simulation Function Configuration

SITIPE AT supports Simulation Functions to simulate substation objects like Circuit Breakers, Disconnectors, Earthing Switches or the Crisis Functionality for Mass-Indication switching.

In Addition, SITIPE AT provides a Bay Single line simulation function for single line visualization and a SingleIndication.vi to visualize and control the status of electrical single points.

Simulation Functions are Plugins. A Simulation function is a LabVIEW Virtual Instrument (Vi) loaded from the Path <SITIPE_AT_InstallPath>/Simulation. You are free to add additional Simulation Vis to this folder at any time. The following two chapters provide information on the control of simulation functions.

6.1.4.1. Simulation Function Instructions

Simulation Functions can be controlled in Test Steps. For some Instructions the controlled Test Object may be specified by specifying the Location 1 ... Location 4 and the Test Object Name in the Last 5 columns of the configuration Table. If this option is omitted, the Test Object currently under Test will be controlled.

The following table lists the Control Instructions offered by SITIPE AT. A specific Simulation Function is free to interpret your input. Please refer to the next chapter for detailed information on available Parameters and possible Values for the delivered Simulation Functions.

Instruction	Value	Specify Test Object?
Sim.Start all		
Sim.Stop all		
Sim.Set State	Value string	YES
Sim.Set Operation Mode	Value string	YES
Sim.Set Parameters	ParameterName=ValueString	YES

Table 28 Simulation Function Instructions

Values for the parameters “State” and “Operation”, which are the most common ones, can be specified directly. All other values may be given by a Parameter = Value association.

6.1.4.2. Simulation Function Description

SITIPE AT comes with a variety of Simulation Functions. The delivered simulation functions are described in Chapter 5.1.8.2.

Simulation Functions are configured with the SW.Simulation information type in a Test Object. They reference to specific signals, which are addressed by Test Tags. If a Test Tag is not assigned in a Test Object, the simulation function does not use it.

The following table describes the Simulation Vis, their parameters and available Test Tags.

Parameters have to be configured in the SW.Simulation row with a key=value assignment. E.g. DefaultValue=1 for the DefaultValue Parameter of an instance of CircuitBreakerTS.vi.

For color values (e.g. SingleIndication.vi or SRFlipFlop.vi), please use RGB notation. So the parameter value has to be parameterized as <red>**,** <green>**,**<blue>, with <red> <green> <blue> as numeric values from 0…255. The color is created by mixing those values together.

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
CircuitBreakerTS.vi CircuitBreaker AmprionTS.vi	**State**	"Intermediate" "Diff" "On" "Ein" "Off" "Aus" "Disturbed" "Stör" "Stoer"	Yes	NO	Off
	Operation	"Normal" "Gear Malfunction Open" "Gear Malfunction Closed" "Gear Malfunction Intermediate" "Disturbed"	Yes	NO	Normal
	Parameter "**CircuitTime**"	<IntegerNumeric> [ms]	Yes		50
	Parameter "**transient Suppression**"	<IntegerNumeric> [ms]	Yes	Yes	15
	Parameter "**DefaultValue**"	{0;1} Off; ON	No		Off
	Test Tags (Signals)	Command OFF, Command ON Feedback OFF Feedback ON	No		-

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
DisconnectorTS.vi Disconnector AmprionTS.vi EarthingSwitchTS.vi Manual DisconnectorTS.vi	**State**	"Intermediate" "Diff" "On" "Ein" "Off" "Aus" "Disturbed" "Stör" "Stoer"	Yes	NO	Off
	Operation	"Normal" "Gear Malfunction Open" "Gear Malfunction Closed" "Gear Malfunction Intermediate" "Disturbed"	Yes	NO	Normal
	Parameter "**CircuitTime**"	<IntegerNumeric> [ms]	Yes		1500
	Parameter "**transient Suppression**"	<IntegerNumeric> [ms]	Yes	Yes	15
	Parameter "**CommandType**"	"Persistent" "Persistent Command" "Pulse" "Pulse Command"	Yes	NO	Pulse
	Parameter "**DefaultValue**"	<IntegerNumeric> Value from 0 to CircuitTime; 0 = OFF, 1 = ON; else is intermediate	No		Off
	Test Tags (Signals)	Command OFF, Command ON Permission Request *(only manual DC)* Feedback OFF Feedback ON Permission Granted *(only manual DC)*	No		-
Crisis.vi	**State**	"On", "Off"	Yes	no	Off
	Parameter "**Percentage**"	0…100 (integer value)	Yes	no	80%
BarySingleline.vi	Mandatory Parameter "**xmlpath**"	"<path>" to an XML file (see 6.1.4.3)	No	No	-
SingleIndication.vi	**State**	"On", "Off"	Yes	no	Off
	Parameter "**DefaultValue**" to specify startup value	{0, 1} -> OFF; ON	No	No	0 -> OFF
	Parameter "**Label**" to specify a descriptive button text (default: full Test Object address)	"<any string>"	No	No	-

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
	Parameter "**onColor**" to specify color in RGB for on state	"255,0,0" (red) , "0,0,0" (black)	No	No	red (255,0,0)
	Parameter "**offColor**" to specify color in RGB for off sate	"11,138,0" (green), "0,0,0" (black)	No	No	green (11,138,0)
	Parameter "**textColor**" to specify color in RGB for the button text	"255,255,255" (white), "0,0,0" (black)	No	No	white (255,255,255)
	Parameter "**transientSuppression**" to filter disturbances	<IntegerNumeric> [ms]	Yes	Yes	15
	Parameter "**latchTime**" to latch signals for a defined time	<IntegerNumeric> [ms]	Yes	Yes	0
	Parameter "**Disabled**" to disable the button for user input	"True", "False"	No	Yes	False
	Test Tags (Signals)	SP	No		-
3PhCircuitBreakerTS.vi	**State** 3phase, single phase or multiple phases. Specify multiple phase status with a semicolon (;) separated list	"Intermediate" "Diff" "On" "Ein" "Off" "Aus" "Disturbed" "Stör" phase1={on,off,intermediate, disturbed};phase2={...};phase3={...}	Yes	NO	Off
	DefaultValue The state off the 3 phases at the start of the simulation	"On", "Off"	No	No	Off
	Operation Special behavior modes for disturbed mode (directly applied) or gear malfunctions (apply on commands)	"Normal" "Gear Malfunction Open" "Gear Malfunction Closed" "Gear Malfunction Intermediate" "Disturbed"	Yes	NO	Normal
	Parameter "**CircuitTime**" Runtime of the intermediate state	<IntegerNumeric> [ms]	Yes		50
	Parameter "**transientSuppression**" Software filter time for the inputs	<IntegerNumeric> [ms]	Yes	Yes	15

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
	Parameter "**Lockout**" Enable or disable lockout functionality	0 – no lockout functionality 1 – Lockout On, Sum Off1	Yes	no	0 – no lockout
	Test Tags (Signals)	CMD L1 OFF1 CMD L1 OFF2 CMD L1 ON1 CMD L1 ON2 CMD L2 OFF1 CMD L2 OFF2 CMD L2 ON1 CMD L2 ON2 CMD L3 OFF1 CMD L3 OFF2 CMD L3 ON1 CMD L3 ON2 CMD RESET LOCKOUT CMD SUM OFF1 CMD SUM OFF2 CMD SUM ON1 CMD SUM ON2 FB L1 OFF FB L1 ON FB L2 OFF FB L2 ON FB L3 OFF FB L3 ON FB LOCKOUT FB SUM OFF FB SUM ON FB UNEQUAL PHASES	No	Yes	-
SRFlipFlop.vi	**State**	"On", "Off"	Yes	no	Off
	Parameter "**DefaultValue**" to specify startup value	{0, 1} -> OFF; ON	No	No	0 -> OFF
	Parameter "**Label**" to show a descriptive title	"<any string>"	No	No	no label
	Parameter "**IndicateColor**" to set, whether a background color indicates the current state	"True", "False"	Yes	No	False
	Parameter "**transientSuppression**" Software filter time for the inputs	<IntegerNumeric> [ms]	Yes	Yes	15

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
	Parameter "**onColor**" to specify background and LED color in RGB for on state	"255,0,0" (red) , "0,0,0" (black)	No	No	red (255,0,0)
	Parameter "**offColor**" to specify background and LED color in RGB for off sate	"11,138,0" (green), "0,0,0" (black)	No	No	green (100,255,0)
	Test Tags (Signals)	SET CMD RESET CMD Q FB NOTQ FB	No		-
TapChanger.vi	State	<Integer Numeric>	Yes	No	0
	Parameter "**DefaultValue**" to specify startup value	<Integer Numeric>	No	No	1
	Parameter "**Transient Suppression**" Software filter time for the inputs	<IntegerNumeric> [ms]	Yes	Yes	50
	Parameter "**CircuitTime**" Runtime of a up/down command sequence	<IntegerNumeric> [ms]	Yes		500
	Mode Bit encoding BCD, Binary encoded or Binary	"Encoded", "BCD", "Binary"	No	NO	"Encoded"
	Operation	see Mode startup parameter	Yes	No	
	MaxValue the maximum reachable value	<IntegerNumeric>	Yes	No	165
	MinValue the minimum reachable value	<IntegerNumeric>	Yes	No	0

Simulation Function VI Name	Information Object	Possible Values	Change at runtime?	Case sensitive?	Default value
	Test Tags (Signals) **Note (see below)**	CMD UP CMD Down Bit1 Bit2 Bit3 Bit4 Bit5 Bit6 Bit7 Bit8 Moving Upper Limit Lower Limit			
DelayedOutput.vi	**State**	"On" "Off"	Yes	No	Off
	Parameter "**CircuitTime**"	<IntegerNumeric> [ms]	No	No	50
	Parameter "**transient Suppression**"	<IntegerNumeric> [ms]	No	No	15
	Parameter **"Output"**	Test Tags of output signal	No		
	Test Tags (Signals)	Input	No		-

Table 29 Simulation Function VIs, Parameters and Value List

Note:

For Tapchanger.vi, please **do not use** electrical Tapchanger information for the Test Tags, as they are deprecated since SITIPE AT V02.41. Instead, please use Electrical Single Point informations to create the Test Tags.

6.1.4.3. Configuration of BaySingleline.vi

BaySingleline.vi configuration is done with a XML file. You specify the path to the XML file inside of the Excel configuration. The following chapter describes how to parameterize the XML file.

The software package comes with 2 example XML files for a Double Busbar (SimTypical_2BB.xml) and a Feeder (SimTypical_Feeder.xml) as well as PNG pictures and PND Paint.net Files which were used to draw those PNG pictures. You can take those files as a basis for your custom single line diagrams. The XML files contain a similar documentation as this one as well.

The XML File consists of three parts:

a) <Singleline> part specifying general Singleline information
b) <simFunc /> elements for each Simulation Function to visualize
c) <text> elements for invidual text drawing

6.1.4.3.1. General Singleline configuration

The general Singleline configuration is done in the root <singleLine> element.

<SingleLine> Attributes:

- **bgsrc** the Path to the background image file (PNG, JPEG or BMP)
- **zoom** the Zoom factor

a) **bgsrc** (mandatory)

Define a path to the background image file here. This image file will be loaded first and then simulation function status indicators and texts will be drawn on top of the image.

The path may be relative to the XML file or absolute including the Driver letter for the file system location.

b) **zoom** (optional)

Define the zoom level here to zoom out or in to the picture. The default value is 1.0, meaning no zoom is applied. A value smaller than “1.0” results in zooming out. A value greater than “1.0” results in zooming in.

The zoom level will be applied to all coordinates, so you do not have to take them into account for x and y coordinates of the simulation functions or texts.

c) Overall <singleLine> Example:

Example for SimTypical_Feeder.xml with a PNG background image, located in the XML file folder:

```
<singleLine bgsrc="SimTypical Feeder.png" zoom="1">
```

6.1.4.3.2. Simulation Function placement

A flexible number of simulation functions can be placed inside a BaySingleline.vi. Place a <simFunc /> element for each simulation function element to be drawn. <simFunc /> elements have to be children of the root <singleLine> element.

<SimFunc /> Attributes:

- **Loc1**, **loc2**, **loc3**, **loc4** and **objectname** to specify the Test Object Address
- **posX** and **posY** to specify the positioning x and y coordinates
- **Rotation** to rotate the indicator by a flexible degree
- **Border** for cropping of the indicator image to remove any border

a) **Loc1**, **loc2**, **loc3**, **loc4** (optional)

Specify the location 1 ... location 4 address elements of the Unique Test Object Identifier to identify the simulation function. If you leave a parameter empty or do not define it, it is taken over from the Unique Test Object Identifer refering the BaySingleline.vi. This enables you to use one Bay typical XML file for multiple bays, since the Test Object Location 1... Location4 will be different for the BaySingleline.vi Test Objects.

Example:

	Location 1	Location 2	Location 3	Location 4	Object name
Description:	Region / Project	Voltage Level	Bay Name	Cabinet or Device	Signal Name or Switching Device
Example:	SITIPE Demo Test Rack	110kV	=E01	-A201	SF6 LOSS

b) **Objectname** (mandatory)

Specify the objectname for the simulation function you want to visualize in the singleline. If the Test Object contains multiple simulation functions, they are numbered with ##<number>. Specify the number in this attribute to identify the simulation function uniquely.

Example: “Q0”

c) **posX**, **posY** (mandatory)

Specify the leftmost and topmost numeric x coordinate (horizontal) and y coordinate (vertical) to position the simulation function indicator.

Coordinates are 0-based on the leftmost, topmost point of the background picture. So you may use a drawing program like Paint, Paint.net or GIMP to findout the correct coordinates.

Take the individual size of the simulation function to be drawn into account. The delivered Circuit Breaker, Disconnector and Earthing Switch function have a size of 65x65 pixels. The SingleIndication.vi has a size of 80x40 pixels.

Example: posX=”150” posY=”153” to position at X 150 and Y 153 pixels.

d) **rotation** (optional)

Specify the desired rotation in degrees to apply on the simulation function indicator in counter clockwise direction. By default, no rotation (0°) is applied.

Example: A value of “90” value result in a counter clockwise right angle rotation. A value of “270” results in a clockwise right angle rotation.

e) **Border** (optional)

Specify any border thickness in pixels to crop this border from the drawn simulation function indicator. By default, no border is cropped.

The delivered simulation functions CircuitBreaker, Disconnector and Earthing Switch have invisible border of 3 pixels. Use this parameter to cut this border away for a cleaner drawing.

Example: “3” to remove the invisible border for CircuitBreakers, Disconnectors and Earthing Switchs.

f) Overall <simFunc /> Example:

Example for SimTypical_Feeder.xml with a EarthingSwitch “QZ1” rotated in clockwise direction and cropping of a 3 pixel border positioned at 55 X and 279 Y.

```
<simFunc objectname="QZ1"  posX="55"  posY="279"      border="3"
     rotation="270" />
```

6.1.4.3.3. Text drawing

You can place any text inside the drawing to add information using <text> elements. <text> Elements have to be child elements of the root <singleline> element.

<Text> Attributes:

- **posX** and **posY** to specify the positioning x and y coordinates
- **Orientation** to specify a text stacking or clockwise/counterclockwise rotation
- **Fontsize** to set the font size of the text
- **Textcolor** to specify the color of the text
- **Bold** to enable bold style drawing of the text

a) Text content (mandatory)

Specify the text to display between the opening <text> and closing </text> tags.

The placeholders %loc1%, %loc2%, %loc3%, %loc4%, %objectname% are automatically replaced with their respective values taken from the BaySingleline.vi Test Object address.

b) **posX**, **posY** (mandatory)

Specify the leftmost and topmost numeric x coordinate (horizontal) and y coordinate (vertical) to position the text.

Coordinates are 0-based on the leftmost, topmost point of the background picture. So you may use a drawing program like Paint, Paint.net or GIMP to findout the correct coordinates.

Example: posX=”290” posY=”20” to position at X 290 pixels and Y 20 pixels.

c) **Orientation** (optional)

Sets the orientation of the text. The default value is 0 which results in no rotation.

Example: Choose from “0” (no rotation), “1” (letters stacked over each other), “2” (rotation in clockwise direction), “3” (rotation in counter clockwise direction)

d) **Fontsize** (optional)

Specify the fontsize in numeric points (pt) for the text with the fixed font “Tahoma”. The font size 18 pt is the default.

Example: “48” for a text with a quite big size.

e) **Textcolor** (optional)

Specify the color of the text in RGB notation. Black is the default text color.

Example: 233,0,0 for a red text

f) **Bold** (optional)

Specify this parameter to draw the text in bold style. The text is drawn non-bold by default.

Example: Bold=”true” to draw the text in bold style.

g) Overall <text> Example:

Example for SimTypical_Feeder.xml with a text %loc2% BB1” at 290 pixels X and 20 pixels Y coordinates, with font size 18pt and drawn in bold style. The %loc2% placeholder is automatically replaced, e.g. with the voltage level “20kV”. So the resulting text could be “20kV BB1”.

```
<text posX="290" posY="20" fontsize="18" bold="true">%loc2% BB1</text>
```

6.2. Excel Configuration

SITIPE AT is able to load all Test Parameters from an Excel Workbook containing information on the Project, Test Interfaces, Test Objects and Test Cases in different Worksheets. The Template Workbook can be found in the windows start menu entry of SITIPE AT > Configuration > “Configuration Template Workbook”. An example configuration workbook is also located there in the Windows start menu SITIPE AT > Configuration > “Example Configuration Workbook”.

The Test Model may be configured manually using the integrated Dialogs or by typing information in the respective tables. An automatic import of a customer Signal List is also provided.

The following chapters describe the configuration of those Parameters in the different worksheets of the Template SITIPE AT Parameter Workbook.

6.2.1. Configuration Dialogues

The SITIPE AT Parameter Workbook comes with Configuration Dialogues to simplify the Test Model Configuration using User Interface Dialogues. The Dialogues provide simple error detection and support you with a streamlined interface.

All Configuration Dialogues can be found in the Ribbon “SITIPE AT” in the Excel Ribbon Bar. Figure 96 shows a typical Excel ribbon bar containing the SITIPE AT Ribbon.

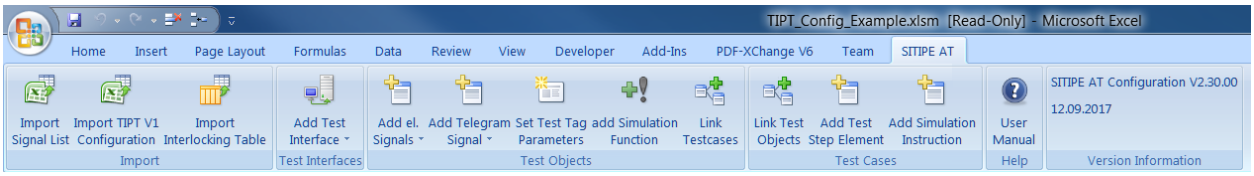


Figure 96 SITIPE AT Ribbon in the Excel Ribbon Bar

In order to use the Configuration Dialogues, you have to enable Macros for the Workbook. This has to be done, when the Workbook is opened. An information bar similar to the one shown in Figure 97 may appear. Press “Options…” and then select “Enable this content” in the following dialogue window shown in Figure 98.

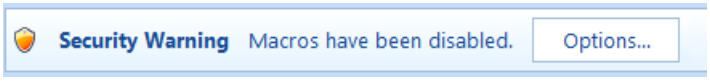


Figure 97 Macro Security Warning

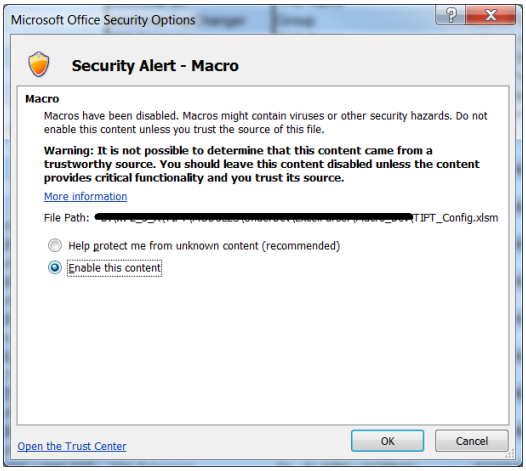


Figure 98 Macro Security Options

6.2.2. Worksheet “Project Information”

General Project Information can be inserted in the Worksheet “Project Information”.

Project Name and the Tester Name can be inserted in the respective fields.

6.2.3. Worksheet “Test Interfaces”

Test Interfaces are used to send and receive information of the System under Test.

Supported Test Interfaces include electrical Interfaces (Panel Test Modules), Network Interfaces for IEC 60870-5 -101 Communication (Serial) or -104 (Ethernet), Network Interfaces for IEEE DNP3.0 Communication (Serial or Ethernet) or IEC 61850-8-1 IEDs (MMS Communication).

Test Interfaces are configured in the Worksheet “Test Interfaces”.

There is more than one interface type. Therefore there are lines at the top of the table describing the headlines for the different interface types.

6.2.3.1. Electrical Interface, USB PTM IO

A USB PTM IO is used to output binary signals and to recognize binary signals from the System under Test. A USB PTM IO is identified by its unique five characters long USB ID which can go from 00001 to 65535. Additionally a PTM can be described by an interface Name.

If you use the SITIPE AT Master/Slave Functionality and the PTM is connected to a slave PC, then you have to enter the slave PC IP address and TCP Port in the IP and Port columns. You

can retrieve this Slave Address information from the AT Slave User Interface (see chapter 5.2.1)

	A	B	C	D	E
1	Interface Name	Interface Type	Column1	Column2	Column3
4		USBPTM	USBID	IP	Port
8	PTM at SIP5	USBPTM	00001	192.168.89.7	23000
9	PTM at SIP4's	USBPTM	00002		
17					
18					

Figure 99 Test Interface configuration for AT slave and local USB PTMs

6.2.3.2. Network Interface, IEC 60870-5-101

SITIPE AT is able to send and receive IEC 60870-5-101 telegrams using a serial connection. In order to create a -101 Interface you have to configure a unique interface name, select the interface type IEC 60870-5-101 and enter interface information. The interface name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure the following interface settings:

- COM-Interface to be used (supported: COM1, COM2, COM3, COM4)
- The configured Baud rate in Bit/s
- The Communication pier Link address
- whether to use Cause of Transmission with Originator address (TRUE (2 Byte COT) or FALSE (1Byte COT), TRUE is default)
- Which station SITIPE AT simulates (Station A or Station B, A is default).
- The length of the Linkaddress in Byte (0, 1, 2; 1 Byte is the default)
- Originator Address with valid values from 0 to 255 (default is 0)

	A	B	C	D	E	F	G	H	I
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4	Column5	Column6	Column7
2		IEC 60870-5-101	COMInterface	Baudrate	Link Address	COT Use Originator Address (TRUE Default)	Station (A Default, B possible)	Link Address Length in Byte (1 default)	Originator Address
10	CControlcenter IEC101 1	IEC 60870-5-101	COM1	9600	1	TRUE	A	1	3

Figure 100 Test Interface configuration for a -101 Interface

6.2.3.3. Network Interface, IEC 60870-5-104

SITIPE AT is able to establish IEC 60870-5-104 Masters to send and receive telegrams using an Ethernet connection.

In order to create a -104 Interface you have to configure a unique Interface Name, select the Interface type IEC 60870-5-104 and enter the interface information. The interface name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure the IP of the network interface of the Testing PC (Own IP) and the IP and Port of the remote device (Remote IP, Remote Port). The default Port for -104 communication is 2404. The own IP field can be left empty. The network interface to communicate is then detected automatically. Configure Originator Address for the 104 Interface. Possible values ranges from 0 to 255 (default is 0)

	A	B	C	D	E	F	G
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4	Column5
3		IEC 60870-5-104	own IP		Remote IP	Remote Port	Originator Address
9	Demo Rack SCADA 1 (104)	IEC 60870-5-104	192.168.43.125		192.168.43.124	2404	1

Figure 101 Test Interface configuration for a -104 Interface

6.2.3.4. Network Interface, DNP3.0 Ethernet

SITIPE AT is able to establish a DNP3.0 Master to send and receive telegrams on an Ethernet Interface.

In order to create a DNP3.0 Ethernet Interface you have to configure a unique Interface Name, select the Interface type DNP3.0 Ethernet and enter the interface information.

Create DNP3.0 Test Interfaces for each connected Device. SITIPE AT will group devices with similar properties (Communication Ethernet / Serial and same Master Link Address) to one Interface Instance automatically.

The interface name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure the Master Link Address for the simulated DNP3.0 Master. Configure the Peer Link Address of the connected Device.

Configure the IP and Port of the remote device (Remote IP, Remote Port). The default Port for DNP3.0 communication is 20000.

	A	B	C	D	E	F	G
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4	Column5
4		DNP3.0 Ethernet	Master Link Address	Peer Link Address	Remote IP	Remote Port	
12	PAS DNP3 Eth Slave	DNP3.0 Ethernet	100	1	192.168.249.201	20000	
13							

Figure 102 Test Interface configuration for a DNP3.0 Ethernet Interface

6.2.3.5. Network Interface, DNP3.0 Serial

SITIPE AT is able to establish a DNP3.0 Master to send and receive telegrams on a Serial Interface.

In order to create a DNP3.0 Serial Interface you have to configure a unique Interface Name, select the Interface type DNP3.0 Serial and enter the interface information. Create DNP3.0 Test Interfaces for each connected Device.

The interface name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure the Master Link Address for the simulated DNP3.0 Master. Configure the Peer Link Address of the connected Device.

Configure Com Interface (e.g. COM1) and Baud rate for the Serial Communication. SITIPE AT only supports the Baud rates: 1200, 2400, 4800, 9600, 19200 Baud.

Two modes for RTS line Handling are supported:

- RTS Line constantly ON (“**CONSTANT”)**
- Use Telegram Preconditioning Time and Post conditioning Time. So the RTS line will be hold for Preconditioning Time + Data send time + Post conditioning Time.

For the latter, write those times in Milliseconds separated by a semicolon. E.g. “300;400” for a Preconditioning Time of 300 milliseconds and a Post conditioning Time of 400 milliseconds.

	A	B	C	D	E	F	G
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4	Column5
5		DNP3.0 Serial	Master Link Address	Peer Link Address	COMInterface	Baudrate	RTS
13	PAS DNP3 Serial Slave	DNP3.0 Serial	100	1	COM1	9600	CONSTANT
14							

Figure 103 Test Interface Configuration for a DNP3.0 Serial Interface

6.2.3.6. Network Interface, IEC 61850 IED

	A	B	C	D	E	F
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4
7		IEC 61850 IED	IP	Redundant IP 1	Redundant IP 2	Redundant IP 3
8	SIP5	IEC 61850 IED	192.168.111.2			
9						

Figure 104 Test Interface Configuration for a 61850 IED Interface

SITIPE AT is able to establish a 61850 Client to connect to Intelligent Electronic Devices (IEDs) using the IEC 61850-8-1 MMS Standard.

In order to create a 61850 IED you have to configure a unique IED Name, select the Interface type IEC 61850 IED and enter the interface information. Create IEC 61850 IED Test Interfaces for each connected Device.

The interface name / IED Name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure at least the IP address to connect to. Redundant IP 1, 2 and 3 are optional. They can be used for redundancy tests, if the connection to the main IP address is failing.

6.2.3.7. Network Interface, Modbus Ethernet

SITIPE AT is able to establish a Modbus Master to send and receive telegrams on an Ethernet Interface.

In order to create a Modbus Ethernet Interface, you have to configure a unique Interface Name, select the Interface type Modbus Ethernet and enter the interface information.

Create Modbus Test Interfaces for each connected Device. SITIPE AT will group devices with similar properties (same Remote IP Address) to one Interface Instance automatically.

The interface name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.

Configure the IP and Port of the remote device (Remote IP, Remote Port). The default Port for Modbus communication is 502.

Configure SlaveID, unique ID for each of the slave devices connected. Default Slave ID is 1.

Configure Scan Groups, each scan group must contain Register name, Start address and End Address. Scan group count is automatically configured. Each scan group determines the all slave register address that will be scanned periodically for any change.

ScanGroupCount gives the number of scan groups configured for the Modbus Interface.

	A	B	C	D	E	F	G	H	I
1	Interface Name	Interface Type	Column1	Column2	Column3	Column4	Column5	Column6	Column7
7		Modbus Ethernet	Remote IP	Remote Port	SlaveID	ScanGroupCount	Register	Start Address	End Address
18	modbus_slave	Modbus Ethernet	132.186.215.48	502	1	1	Coil	0	6

Figure 105 Test Interface configuration for a Modbus Ethernet Interface

6.2.3.8. Test Interface Configuration Dialogues

The Configuration Workbook offers an “Add Test Interface”-Menu in the SITIPE AT Ribbon. Select the Interface Type you want to add and the dialogue is opened.

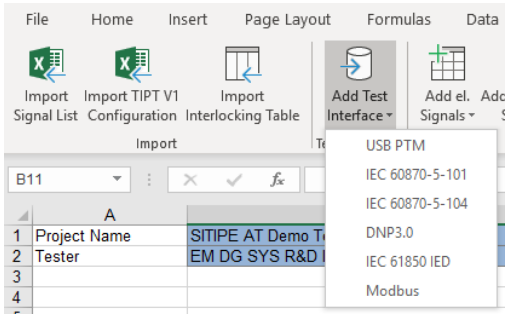


Figure 106 Add Test Interface Menu

6.2.3.8.1. Add USB PTM

This dialogue creates a USB PTM Test Interface based in the input information you deliver.

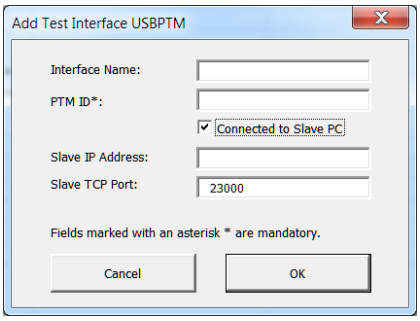


Figure 107 Add Test Interface USBPTM Dialogue

After you input the needed information, press “OK” to create the USB PTM Test Interface. Press “Cancel” to close the dialogue without creating a new USB PTM Test Interface.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
Interface Name	NO	String	Descriptive Name for the USBPTM like “PTM Cabinet 1”
PTM ID	YES	Integer Numeric	The unique Hardware ID of the USB PTM.
Connected to Slave PC	NO	Boolean	Place a checkmark in this checkbox, if the PTM is connected to a slave PC using SITIPE AT Master/Slave Functionality.
Slave IP Address	YES, if Connected to SlavePC is checked	String, IPv4 Address	Enter the IP address of the slave PC, where this PTM will be connected to. This field is only visible if “Connected to Slave PC” is checked.

Element	Mandatory?	Data type	Description
Slave TCP Port	Yes, if Connected to Slave PC is checked	Integer 0 … 65565;	Enter the TCP Port on which the AT Slave is running; The default TCP Port is 23000. The Port setting on master and slave have to match in order to establish a connection correctly.

Table 30 Add USBPTM Input Fields

If you use the SITIPE AT Master/Slave Functionality and the PTM is connected to a slave PC, then you have to enter the slave PC IP address and TCP Port in the IP and Port columns. You can retrieve this Slave Address information from the AT Slave User Interface (see chapter 5.2.1)

6.2.3.8.2. Add IEC 60870-5-101 Network Interface

This dialogue creates a -101 Test Interface for serial connection based on the information you deliver.

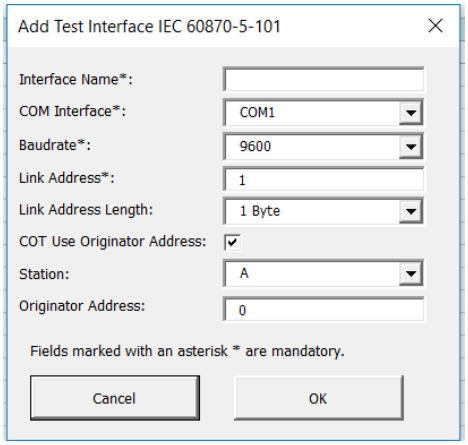


Figure 108 Add Test Interface IEC 60870-5-101 Dialogue

After you input the needed information, press “OK” to create the -101 Interface. Press “Cancel” to close the dialogue without creating a new Test Interface. On click of COT Use Originator Address checkmark additional row Originator Address must also be configured.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
Interface Name	YES	String	A unique interface name for the Interface. This name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.
COM Interface	YES	String	The name of the PCs COM-Interface to be used for the serial connection. Supported Interfaces are COM1, COM2, COM3 or COM4

Element	Mandatory?	Data type	Description
Baud rate	YES	Integer Numeric	The Baud rate in Bit/s for the serial connection. Typical values are 9600, 19200, 57600 etc.
Link address	YES	Integer Numeric	The Link address of the connected device.
Link address length	YES	0, 1, 2	The length of the link address in Byte. 1 Byte is the Default value.
COT Use Originator Address	YES	Boolean	Specifies, whether the originator address is transmitted in the Cause Of Transmission (COT) field of -101 Telegrams. This makes the COT field 2 Byte long, otherwise its transmitted with 1 Byte.
Station	YES	A, B	Specifies whether this station is station A or station B. (Expert Parameter). Station A is the default.
Originator Address	No	Integer Numeric	Specified Originator address is transmitted in COT field. Value ranges from 0 to 255.Default value is 0.

Table 31 Add IEC 60870-5-101 Interface Fields

6.2.3.8.3. Add IEC 60870-5-104 Network Interface

This dialogue creates a -104 Test Interface for Ethernet connection based on the information you deliver.

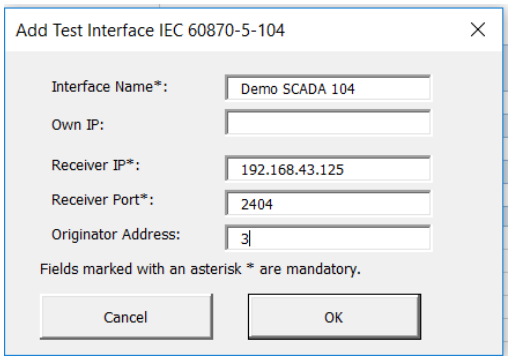


Figure 109 Add Test Interface IEC 60870-5-104 Dialogue

After you input the needed information, press “OK” to create the -104 Interface. Press “Cancel” to close the dialogue without creating a new Test Interface.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
Interface Name	YES	String	A unique interface name for the Interface. This name will be used to reference the Interface in

Element	Mandatory?	Data type	Description
			Telegrams configured in the Worksheet “Test Objects”.
Own IP	NO	String, IPv4 Address	The IP Address of the network interface on the Test PC to be used. If left empty, the network interface is detected automatically based on the windows network settings.
Receiver IP	YES	String, IPv4	The IP address of the remote device in IPv4 notation.
Receiver Port	YES	Integer numeric	The TCP Port of the remote device, which should be used for communication. The default Port for IEC -104 communication is Port 2404.
Originator Address	NO	Integer numeric	Originator address of the 104 interface. Value ranges from 0 to 255.Default value is 0.

Table 32 Add IEC 60870-5-104 Interface Fields

6.2.3.8.4. Add DNP3.0 Network Interface

This dialogue creates a DNP3.0 Test Interface for Serial or Ethernet connection based on the information you deliver.

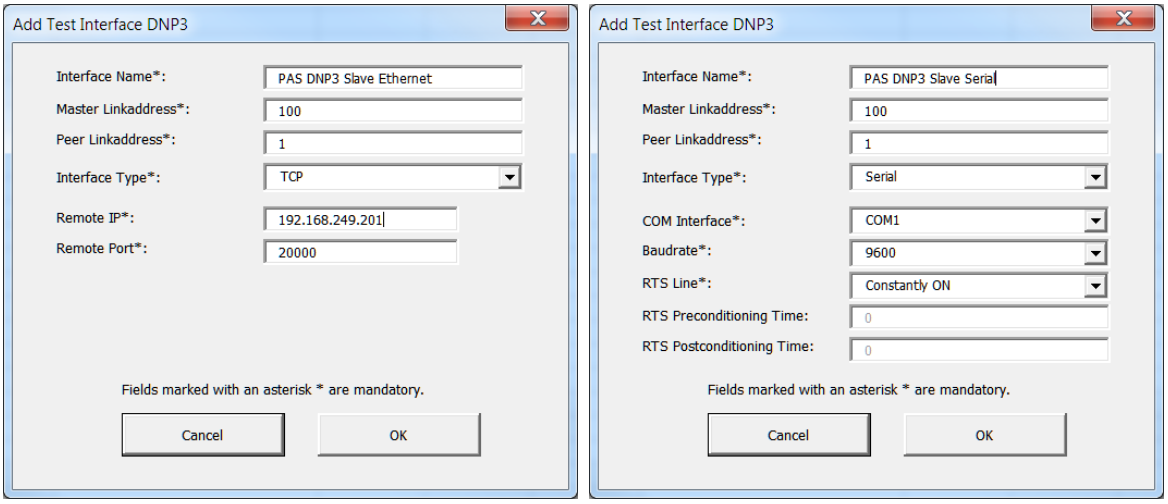


Figure 110 Add Test Interface DNP3.0 Dialogue

After you input the needed information, press “OK” to create the DNP3.0 Interface. Press “Cancel” to close the dialogue without creating a new Test Interface.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
Interface Name	YES	String	A unique interface name for the Interface. This name will be used to reference the Interface in

Element	Mandatory?	Data type	Description
			Telegrams configured in the Worksheet “Test Objects”.
Master Link Address	YES	Integer Numeric	The Master Link address of the Master Interface to be established
Peer Link Address	YES	Integer Numeric	The Link Address of the Peer device to connect to.
Interface Type	YES	TCP or Serial	Select TCP for an Ethernet connection to the Peer. Select Serial if you use a Serial / COM Interface for Connection. Depending on the selection, input fields are shown
(TCP) Remote IP	YES	IPv4 Address	IP Address of the connected Device
(TCP) Port	YES	Integer Numeric	The Port of the connected Device to connect to.
(Serial) Com Interface	YES		The COM Interface to be used for serial communication (COM1…COM256)
(Serial) Baud rate	YES		The baud rate speed for communication (supported: 1200, 2400, 4800, 9600, 19200)
(Serial) RTS Line	YES		Either Constantly On, or “Use preconditioning and Postconditiong Delay”
(Serial) Pre- and Post Conditioning Time	YES	Integer Numeric	Time in milliseconds to enable (Pre) the RTS line before data sending and to hold it enabled after data sending (Post)

Table 33 Add DNP3.0 Interface Fields

6.2.3.8.5. Add IEC 61850 IED Network Interface

This dialogue creates an IEC 61850 IED Test Interface for a connection to an IED using the IEC 61850 MMS Client of SITIPE AT.

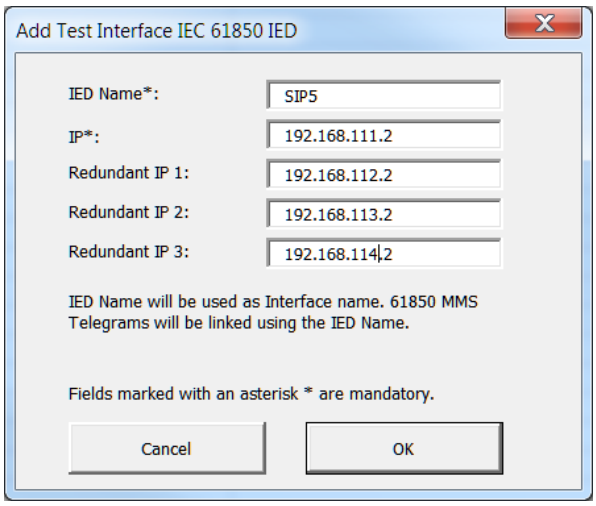


Figure 111 Add Test Interface IEC 61850 IED Dialogue

After you input the needed information, press “OK” to create the IEC 61850 IED Interface. Press “Cancel” to close the dialogue without creating a new Test Interface.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
IED Name	YES	String	The system-wide unique name for the IED. This name will be used to reference the Interface in Telegrams configured in the Worksheet “Test Objects”.
IP	YES	IPv4 Address	IP Address of the connected Device
Redundant IP 1	NO	IPv4 Address	Redundant IP Address 1 of the connected Device used as standby if connection to the other IP addresses fails.
Redundant IP 2	NO	IPv4 Address	Redundant IP Address 2 of the connected Device used as standby if connection to the other IP addresses fails.
Redundant IP 3	NO	IPv4 Address	Redundant IP Address 3 of the connected Device used as standby if connection to the other IP addresses fails.

Table 34 Add IEC 61850 IED Interface Fields

6.2.3.8.6. Add Modbus Network Interface

This dialogue creates a Modbus Test Interface for Ethernet connection based on the information you deliver.

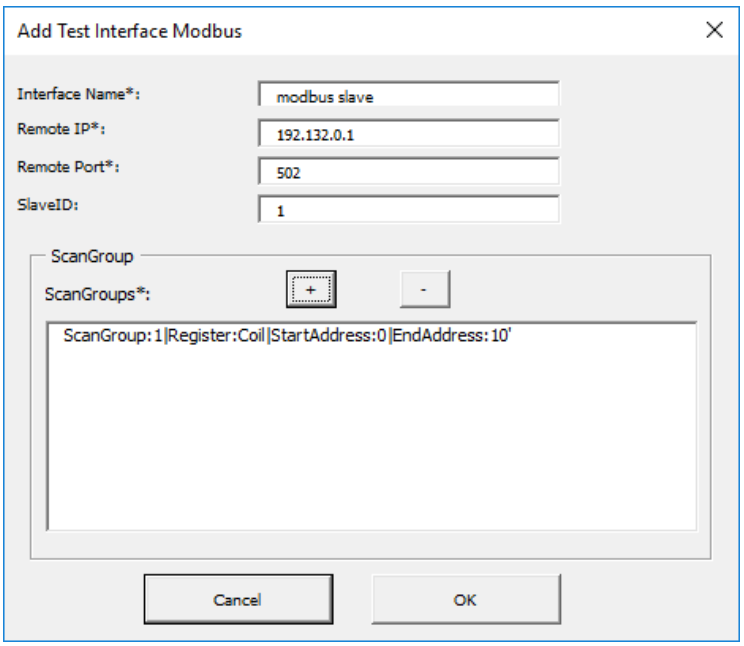


Figure 112 Add Test Interface Modbus Dialogue

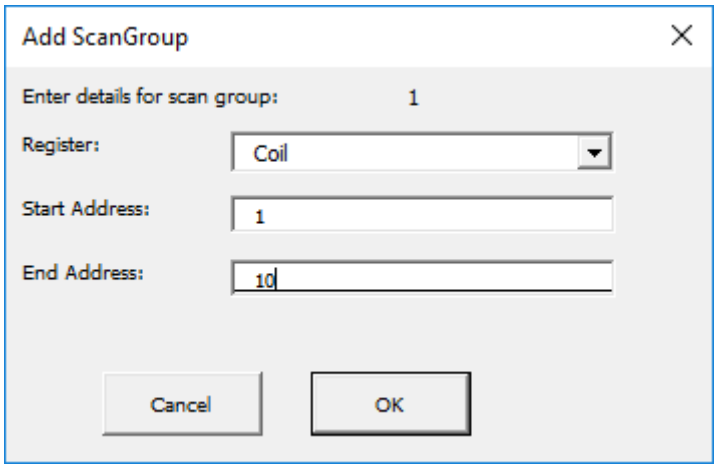


Figure 113 Add ScanGroup Dialogue

To add scan groups details by press on the **'+'** button in the Modbus Interface dialogue. This opens new dialogue, Add Scan dialogue. Enter Register, Start and End Address as required, press "OK" to create the scan groups for Modbus Interface. Select a scangroup row and press on **'-'** button to delete the already added scan group.

After you input the needed information, press "OK" to create the Modbus Interface. Press "Cancel" to close the dialogue without creating a new Test Interface.

The following table lists the input fields and the expected information:

Element	Mandatory?	Data type	Description
Interface Name	YES	String	A unique interface name for the Interface. This name will be used to reference the

Element	Mandatory?	Data type	Description
			Interface in Telegrams configured in the Worksheet “Test Objects”.
Remote IP	YES	IPv4 Address	IP Address of the connected Slave Device
Remote Port	YES	Integer Numeric	The Port of the connected slave Device.
Slave ID	NO	Integer Numeric	Unique ID of connected slave device. Default value is 1
ScanGroupDetail: Register	Yes	String	Registers can take values of Coil, Input Status, Holding Register and Input Register.
ScanGroupDetail: Start Address	Yes	Integer Numeric	Address on selected Register from where scan is started
ScanGroupDetail: End Address	Yes	Integer Numeric	Address on selected Register until where scan must be done.

Table 35 Add Modbus Interface Fields

6.2.4. Worksheet “Test Objects”

Test Objects describe Station Objects like Devices (Circuit Breakers, Disconnectors ...) or Information Points (Telegrams, Alarms).

Test Objects are configured in the Worksheet “Test Objects”.

They contain the following information:

- The Test Cases which should be executed on the Test Object.
- The Signals connected to this Test Object. A signal may be an electrical signal wired to a PTM or a telegram sent/received by a network test interface.
  Signals are described by a general **Tag** to be indirectly referenced in Test Cases, the **Signal information (address)** and the **connection to a Test Interface** (Network interface or a PTM for electrical signals)
- A Simulation Function and its corresponding Parameters. This can describe a Circuit Breaker runtime, its default position etc.
- Test Tag Parameters to preconfigure parameters for certain Test Tags depending on the Test Object

Since there is more than one signal type, the columns of the table can have different headlines. They are listed at the top of the table for the different information types. Filter by the Column “info-Type” to get only data for only information type and its headlines for the different columns.

For each Component of a Test Object (Signal, Test Case, Simulation or Test Tag Parameter Description) there is one row identified by the same unique object identifier.

6.2.4.1. Unique Object Identifier

A Test Object is identified by a unique object identifier. It consists of 4 Location levels and the object name entered in the first 5 columns of the Test Objects entry.

6.2.4.2. Electrical Single Point Information

Electrical Single point information contains one binary electrical signal connected to a USB PTM IO.

Create a new row in the table and enter “electrical SP” as Info-Type to create an Electrical Single Point Information. Enter the following information for the Signal:

- Unique Test Object Identifier, see chapter **6.2.4.1**
- Group: a Group Name if this signal should be shown within a group in the PTM Control Window.
- Tag Name*: a general Test Tag for the signal to be referenced by Test Cases
- Signal Name*: a descriptive Name for the Signal
- PTM USB ID*: the five-character USB ID of the PTM where the signal is connected
- PTM Channel*: the PTM Channel (1 to 48) where the signal is connected to
- Terminal: The Terminal on the Terminal block.

Parameters marked with an asterisk (*) are mandatory.

6.2.4.3. Electrical Double Point Information

Electrical Double Point information contains up to four binary electrical signals connected to a USB PTM IO to represent commands and feedbacks of Primary switching Devices like Circuit Breakers and Disconnectors.

Create a new row in the table and select “electrical DP” as Info-Type to create an Electrical Double Point Information. Enter the following information for the Signal:

- Unique Test Object Identifier, see chapter **6.2.4.1**
- Group: a Group Name if these Signals should be shown within a group in the PTM Control Window.
- Information for the Test Tags “Command ON”, “Command OFF”, “Feedback ON”, “Feedback OFF”
    - PTM USB ID**: five character USB ID of the PTM where the signal is connected
    - PTM Channel**: the PTM Channel (1 to 48) where the signal is connected
    - Terminal: the Terminal on the Terminal block.

Parameters marked with two asterisks (**) are mandatory if the respective Tag is used.

6.2.4.4. Electrical Tap Changer Information

Tap Change information contains a flexible number of binary electrical signals to represent the tap changer state.

Create a new row in the table and select “electrical Tap Changer” as Info-Type to create an Electrical Tapchanger Information.

The number of bits for a Tap changer is not predefined. Each bit is described by a mandatory PTM USB ID and PTM Channel as well as optional Terminal information. Empty bit columns are not interpreted as Bits. The order goes from LSB (Leftmost column) to MSB (rightmost column). The Table is prepared for up to 8 Bits. If more Bits are needed, columns have to be added to the named table in Excel.

6.2.4.5. IEC 60870-5-101 Telegram

-101 Telegrams describe information distributed using an IEC 60870-5-101 network interface described in the “Test Interfaces”-Worksheet.

Create a new row in the table and select “-101 Telegram” as Info-Type to create a -101 Telegram. Enter the following information for the Signal:

- Unique Test Object Identifier, see chapter **6.2.4.1**
- Tag Name*: a general Tag for the signal to be referenced by Test Cases
- Virtual Interface Name*: The Name of the IEC -104 test interface specified in the worksheet “Test Interfaces” which should be used to send/receive this telegram
- Signal Name*: a descriptive Name for the Signal
- CASDU1*, CASDU2*: Numeric value, Common Application Service Data Unit 1 and 2 of the Telegram Interface
- IOA1*, IOA2*, IOA3*: Numeric Value, Information Object Address 1, 2 and 3 of the Telegram Information / Numeric
- Type Identifier*, the numeric Type Identifier for the Telegram Information as defined by the standard. Supported numeric Values and their meaning are noted in the Appendix chapter 7.1.1.2
- Send? (deprecated parameter): supported for backwards compatibility with SITIPE AT V2.20; Telegram direction is inferred automatically from Type Identifier since SITIPE AT V2.30
- Command Operation Mode: Set to “Select before operate (SBO)” to enable select-before-operate functionality for this command or set point. The default value is “EXECUTE” which configures the command for direct execution.

Parameters marked with an asterisk (*) are mandatory.

6.2.4.6. IEC 60870-5-104 Telegram

-104 Telegrams describe information distributed using an IEC 60870-5-104 network interface described in the “Test Interfaces”-Worksheet.

Create a new row in the table and select “-104 Telegram” as Info-Type to create a -104 Telegram. Enter the following information for the Signal:

- Unique Test Object Identifier, see chapter **6.2.4.1**
- Tag Name*: a general Tag for the signal to be referenced by Test Cases
- Virtual Interface Name*: The Name of the IEC -104 test interface specified in the worksheet “Test Interfaces” which should be used to send/receive this telegram
- Signal Name*: a descriptive Name for the Signal
- CASDU1*, CASDU2*: Numeric value, Common Application Service Data Unit 1 and 2 of the Telegram Interface

- IOA1*, IOA2*, IOA3*: Numeric Value, Information Object Address 1, 2 and 3 of the Telegram Information / Numeric
- Type Identifier*, the numeric Type Identifier for the Telegram Information as defined by the standard. Supported numeric Values and their meaning are noted in the Appendix chapter 7.1.1.2
- Send? (deprecated parameter): supported for backwards compatibility with SITIPE AT V2.20; Telegram direction is inferred automatically from Type Identifier since SITIPE AT V2.30
- Command Operation Mode: Set to “Select before operate (SBO)” to enable select-before-operate functionality for this command or set point. The default value is “EXECUTE” which configures the command for direct execution.

Parameters marked with an asterisk (*) are mandatory.

6.2.4.7. DNP3.0 Telegram

DNP3.0 Telegrams describe information distributed using a DNP3.0 Ethernet or Serial interface described in the “Test Interfaces”-Worksheet.

Please note: The DNP3.0 Driver is configured to scan connected devices for Class 0, 1, 2, 3 Telegrams. Therefore all information is gathered from the devices. Solicited / Spontaneous Communication is currently not configured. Please contact SITIPE AT Development team for further information.

Create a new row in the table and select “DNP3.0 Telegram” as Info-Type to create a DNP3.0 Telegram. Enter the following information for the Signal:

- Unique Test Object Identifier*, see chapter **6.2.4.1**
- Tag Name*: a general Tag for the signal to be referenced by Test Cases
- Virtual Interface Name*: The Name of the network interface specified in the worksheet “Test Interfaces” which should be used to send/receive this telegram
- Signal Name: a descriptive Name for the Signal
- Data type*: The data type of the telegram. Possible Values:
    - Monitoring Direction:
        - Monitoring.Single Point
        - Monitoring.Double Point
        - Monitoring.Single Command Status
        - Monitoring.Analog Measurement Value
        - Monitoring.Analog Measurement Value Frozen
        - Monitoring.Analog Setpoint Status
        - Monitoring.Counter Value
        - Monitoring.Counter Value Frozen
    - Control Direction
        - Control.Single Command
        - Control.Double Command
        - Control.Analog Setpoint 16bit
        - Control.Analog Setpoint 32bit
        - Control.Analog Setpoint Short Float
        - Control.Analog Setpoint Long Float
        - Control.Double Command Variable Time

        - Control.Double Command Variable
- Address1*, Address2: Numeric Value, Information Object Address of the Telegram Information / Numeric (Address 2 only valid for Double Indications)
- Only for commands:
    - Command Operation Mode, valid values:
        - Direct Operation
        - Direct Operation w/o Confirmation
        - Select Before Operate
    - Command Qualifier, valid values:
        - Pulse ON
        - Pulse OFF
        - Latch ON
        - Latch OFF

Parameters marked with an asterisk (*) are mandatory.

6.2.4.8. IEC 61850 MMS Telegram

IEC 61850 MMS Telegrams describe information residing in a 61850 IED described in the “Test Interfaces”-Worksheet. Telegrams may be in send- or receive-direction.

Create a new row in the table and select “61850 MMS Telegram” as Info-Type to create an IEC 61850-8-1 MMS Telegram. Enter the following information for the Signal:

- Unique Test Object Identifier*, see chapter **6.2.4.1**
- Tag Name*: a general Tag for the signal to be referenced by Test Cases
- Virtual Interface Name*: The Name of IEC 61850 IED specified in the worksheet “Test Interfaces” which should be connected to send/receive this telegram
- Signal Name: a descriptive Name for the Signal
- 61850 Address*:
    - The 61850 Address of the Telegram in the following form:
      LogicalNode/LogicalDevice.DataObject.DataAttribute
      SITIPE AT is compatible to IEC 61850 Edition 2 Standard. So the Address may be specified using the renaming mechanisms provided by the standard.
- CDC:
    - The Common Data Class to be used for this Telegram.
    - This Parameter is only mandatory, if 61850 Signal Renaming is used or the Logical Node / Data Object is not list in the List of Defined Logical Nodes (see Appendix **7.1.2.2**)
    - Please note: Only the CDCs listed in Appendix **7.1.2.3** are supported in the IEC 61850 Client run by SITIPE AT.

Parameters marked with an asterisk (*) are mandatory.

6.2.4.9. Modbus Telegram

Modbus Telegrams describe information distributed using a Modbus Ethernet described in the “Test Interfaces”-Worksheet.

Create a new row in the table and select “add Modbus Telegram” as Info-Type to create a Modbus Telegram. Enter the following information for the Signal:

- Unique Test Object Identifier*, see chapter **6.2.4.1**
- Tag Name*: a general Tag for the signal to be referenced by Test Cases
- Virtual Interface Name*: The Name of the network interface specified in the worksheet “Test Interfaces” which should be used to send/receive this telegram
- Signal Name: a descriptive Name for the Signal
- Data type*: The data type of the telegram. Possible Values:
    - Monitoring Direction:
        - Monitoring.Single Point
        - Monitoring.Double Point
        - Monitoring.Analog SignedInt 16bit
        - Monitoring.Analog SignedInt 32bit
        - Monitoring.Analog ShortFloat 32bit
        - Monitoring.Analog UnSignedInt 16bit
        - Monitoring.Analog UnSignedInt 32bit
        - Monitoring.Accu SignedInt 16bit
        - Monitoring.Accu SignedInt 32bit
        - Monitoring.Accu UnSignedInt 16bit
        - Monitoring.Accu UnSignedInt 32bit
    - Control Direction
        - Control.Single Command
        - Control.Double Command
        - Control.Analog Setpoint SignedInt 16bit
        - Control.Analog Setpoint SignedInt 32bit
        - Control.Analog Setpoint UnSignedInt 16bit
        - Control.Analog Setpoint UnSignedInt 32bit
        - Control.Analog Setpoint ShortFloat 32bit
- Address*: Numeric Value, Information Object Address of the Telegram Information
- Register*: Modbus register from/to which information must be received/sent. Register can take below values:
    - Coil (For both monitoring and control direction)
    - Input Status (Only for monitoring direction)
    - Holding Register (For both monitoring and control direction)
    - Input Register (Only for monitoring direction)

Parameters marked with an asterisk (*) are mandatory.

6.2.4.10. Simulation Function Configuration

Some Primary Switching Devices like Circuit Breakers or Disconnectors can be simulated by SITIPE AT.

To configure a simulation function for a Test Object, create a new row in the table and select “SW.Simulation” as Info-Type.

Enter the Virtual Instrument Name of the Simulation Function in Column1 (Simulation VI Name) and the respective Simulation Parameters as ParameterName=ParameterValue pairs in the following columns.

6.2.4.11. Associated Test Cases

A Test Object can be tested automatically if it's assigned to a Test Case.

To list the Test Cases for the Test Object, create a new row in the table and select "SW.TestCases" as Info-Type. Then list the Names of the Test Cases in the following columns. If you want to assign more Test Cases to the Test Object, than the Table provides as columns, create another row with Info-Type "SW.TestCases" and specify the additional Test Cases" there.

6.2.4.12. Test Tag Parameters

A Test Tag may be preconfigured with certain Test Parameters. If the Test Tag is used in a Test Case, the information will be inherited from the Test Object and not be taken from the Test Step. See chapter **6.1.3** for a complete list of available Test Parameters for certain Test Tag Types).

6.2.4.13. Test Object Configuration Dialogues

Use these dialogues to construct Test Objects (e.g. Circuit Breakers, Single Indications etc.) consisting of electrical information, telegrams, simulation functions and Test Case links.

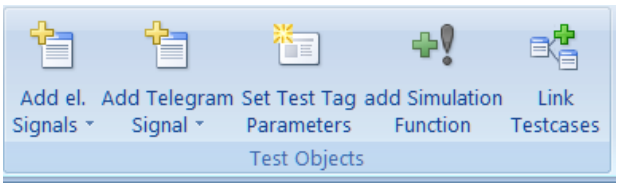


Figure 114 Test Objects Dialogue Options in the SITIPE AT Ribbon

The following dialogues are available for Test Object configuration:

- Menu Add Electrical Signals, to add signals connected to a USB PTM to a Test Object. Select the preferred Signal Type in the Menu. It is shown in Figure 115.
- Menu Add Telegram Signal, to add a telegram signal to a Test Object. Select the preferred Telegram Type in the Menu. It is shown in Figure 116
- Set Test Tag Parameters, to configure Parameters for a specific Test Tag that will not be taken from the Test Case, but from this configuration.
- Add Simulation Function, to configure the Simulation Function for a primary device like a Circuit Breaker or Disconnector.
- Link Testcases, to select the Test Cases to be executed for a specific Test Object.

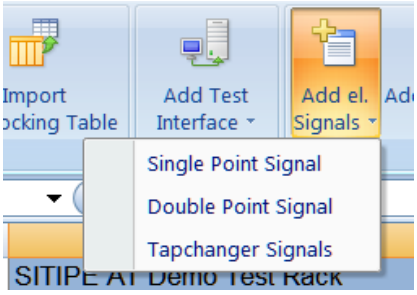


Figure 115 Add electrical Signals Menu

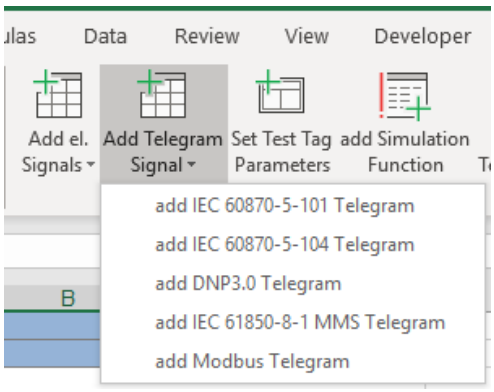


Figure 116 Add virtual Signals Menu

6.2.4.13.1. Test Object Identifier

The Dialogues use the Unique Object Identifier, consisting of Location 1, 2, 3, 4 and the Test Object to address the Test Objects. If the Excel selection is currently on a row in the Worksheet "Test Object", the Unique Object Identifier will be taken from this row by default. Figure 117 shows an example for that. You can select another element in each dropdown menu, or you enter a value manually to create a new Test Object.

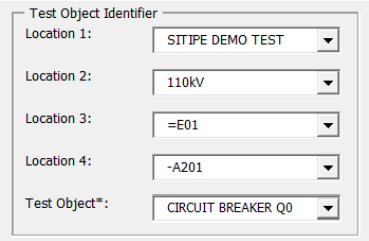


Figure 117 Test Object Identifier Fields

6.2.4.13.2. Add electrical Single Point Signal

Use this dialogue to add a new electrical signal to a Test Object, which describes one Single Point Information.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

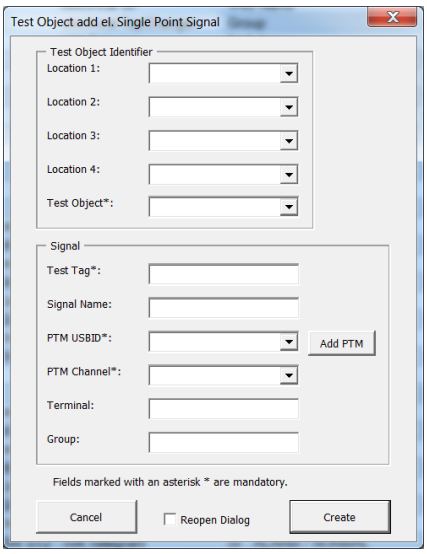


Figure 118 Add electrical Single Point Signal Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the signal.
PTM USBID	YES	Integer Numeric	The Hardware USB ID of the PTM, where the signal is connected to. If the PTM is not yet in the Dropdown-List, add it by pressing “Add PTM”. The “Add USB PTM”-Dialogue described in **6.2.3.8.1** will be opened.
PTM Channel	YES	Integer Numeric	Select a channel of the PTM in the range from 1 to 48, where the signal is connected to.
Terminal	NO	String	Place the Terminal in the cabinet, where the signal is coming from, here.
Group	NO	String	Use this field to group different signals in the PTMC group view together. Signals with the same group will be shown together, no matter to which PTM they are connected to.

Table 36 Add electrical Single Point Signal Dialogue Fields

6.2.4.13.3. Add electrical Double Point Signal

Use this dialogue to add a new electrical signal to a Test Object, which contains up to four electrical signals describing a Switching Device like a Circuit Breaker.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

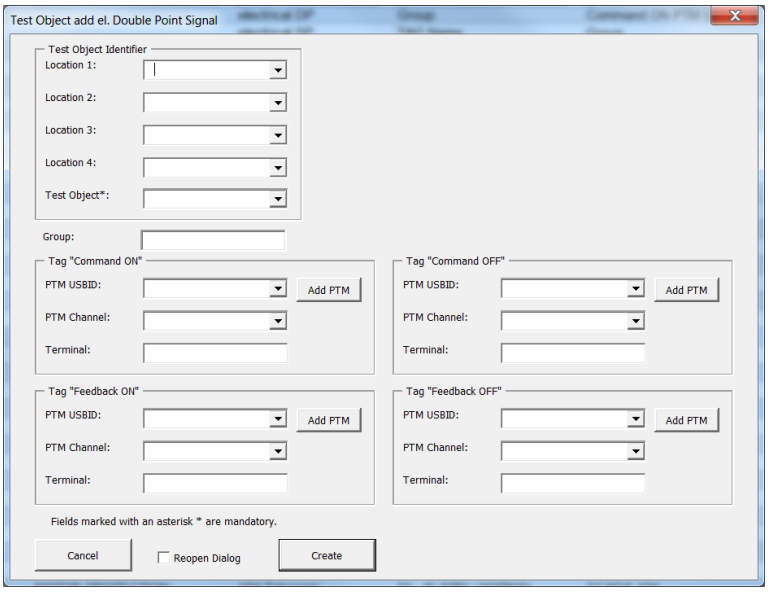


Figure 119 Add electrical Double Point signal Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Since the signals are fixed associated to Test Tags “Command ON”, “Command OFF”, “Feedback ON”, “Feedback OFF”, you have to enter the information in the right fields. You may leave fields empty, if you do not need it.

Element	Mandatory?	Data type	Description
Group	NO	String	Use this field to group different signals in the PTM Control group view together. Signals with the same group will be shown together, no matter to which PTM they are connected to.
PTM USBID (Command ON/ OFF, Feedback ON/OFF)	YES, if tag is used	Integer Numeric	The Hardware USB ID of the PTM, where the signal is connected to. If the PTM is not yet in the Dropdown-List, add it by pressing “Add PTM”. The “Add USB PTM”-Dialogue described in **6.2.3.8.1** will be opened.

Element	Mandatory?	Data type	Description
PTM Channel	YES, if tag is used	Integer Numeric	Select a channel of the PTM in the range from 1 to 48, where the signal is connected to.
Terminal	NO	String	Place the Terminal in the cabinet, where the signal is coming from, here.

Table 37 Add electrical Double Point Signal Dialogue Fields

6.2.4.13.4. Add electrical Tap changer Signals

Use this dialogue to add a new electrical signal to a Test Object, which contains a flexible number of electrical signals to describe the Bits of a Tap changer for example.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

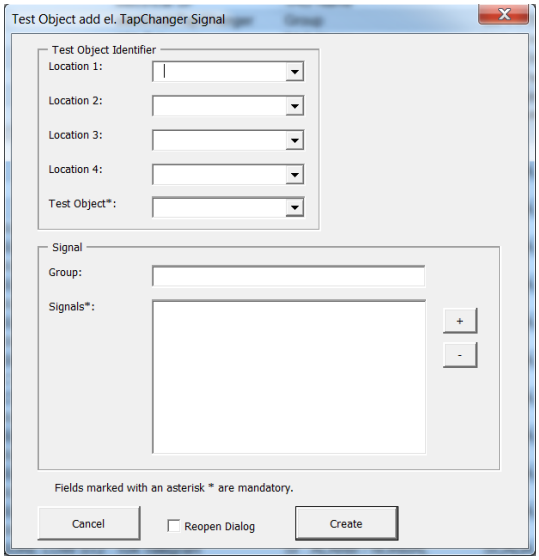


Figure 120 Add electrical Tap Changer Signal Dialogue

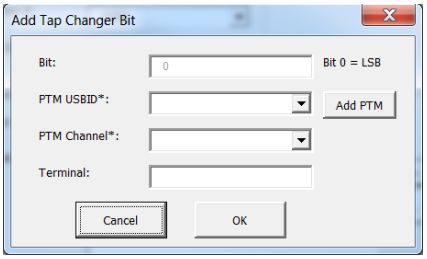


Figure 121 Add Tap changer Bit Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Group	NO	String	Use this field to group different signals in the PTMC group view together. Signals with the same group will be shown together, no matter to which PTM they are connected to.

Element	Mandatory?	Data type	Description
Signals	YES		Add a bit to this Signal by pressing “+”. The Add Tap changer Bit Dialogue will be opened. Figure 121 shows this Dialogue. Remove bits by pressing “-“. At least one Bit has to be configured.
Add Tap changer Bit Dialogue			Enter the information for the Bit here. The Bit number is preselected by the dialogue. Press “OK” to add the Bit to the list. Press “Cancel” to close the Dialogue without adding the Bit.
PTM USBID	YES	Integer Numeric	The Hardware USB ID of the PTM, where the signal is connected to. If the PTM is not yet in the Dropdown-List, add it by pressing “Add PTM”. The “Add USB PTM”-Dialogue described in **6.2.3.8.1** will be opened.
PTM Channel	YES	Integer Numeric	Select a channel of the PTM in the range from 1 to 48, where the signal is connected to.
Terminal	NO	String	Place the Terminal in the cabinet, where the signal is coming from, here.

Table 38 Add electrical Tap changer Signal Dialogue Fields

6.2.4.13.5. Add IEC 60870-5-101 Telegram

Use this dialogue to add a new IEC 60870-5-101 Telegram signal to a Test Object.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

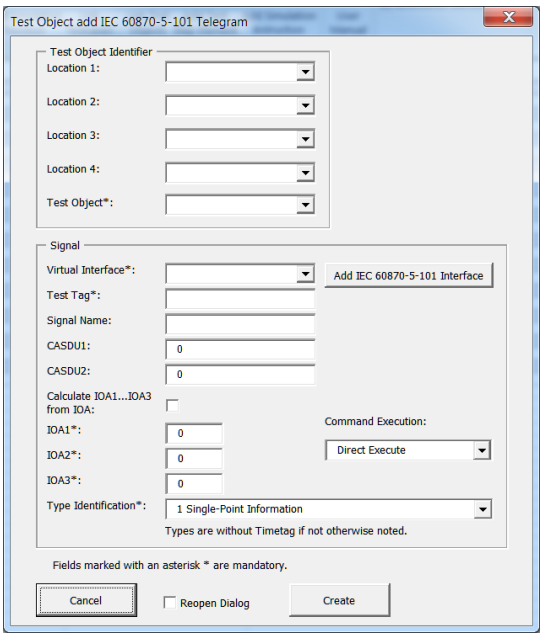


Figure 122 Add IEC 60870-5-101 Telegram Dialogue

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Virtual Interface	YES		Select the IEC 60870-5-101 Test Interface here. If it is not in the list, add it by Pressing “Add IEC 60870-5-101 Interface”. The Dialogue described in chapter **6.2.3.8.2** is opened.
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the Signal.
CASDU1	YES	Integer Numeric	Common Application Service data Unit Byte 1 of the Telegram
CASDU2	NO	Integer Numeric	Common Application Service data Unit Byte 2 of the Telegram
Calculate IOA1…IOA3 from IOA		Boolean	Make a checkmark in this checkbox, if you have an IOA and the dialogue should calculate IOA1, IOA2 and IOA3 for you.
IOA	YES	Integer Numeric	Information Object Address. This field is only visible if “Calculate IOA1…IOA3 from IOA” is checked.
IOA1	YES	Integer Numeric	Information Object Address Byte 1 (LSB). This field has to be filled only, if IOA is not filled.

Element	Mandatory?	Data type	Description
IOA2	YES	Integer Numeric	Information Object Address Byte 2. This field has to be filled only, if IOA is not filled.
IOA3	YES	Integer Numeric	Information Object Address Byte 3 (MSB). This field has to be filled only, if IOA is not filled.
Type Identification	YES		Select the Data point Type here. You can only choose the supported values from the Dropdown-Menu. Appendix chapter 7.1.1.2 provides a full list of supported Type Identifiers.
Command Execution	No		Only valid for Command/ Set point telegrams: Configure whether the command is executed directly (Direct Execute) or with SELECT-Before-Operate method. This enables the influence on the SELECT field in the telegram User interface also. Default Value: Direct Execute

Table 39 Add IEC 60870-5-101 Telegram Dialogue Fields

6.2.4.13.6. Add IEC 60870-5-104 Telegram

Use this dialogue to add a new IEC 60870-5-104 Telegram signal to a Test Object.

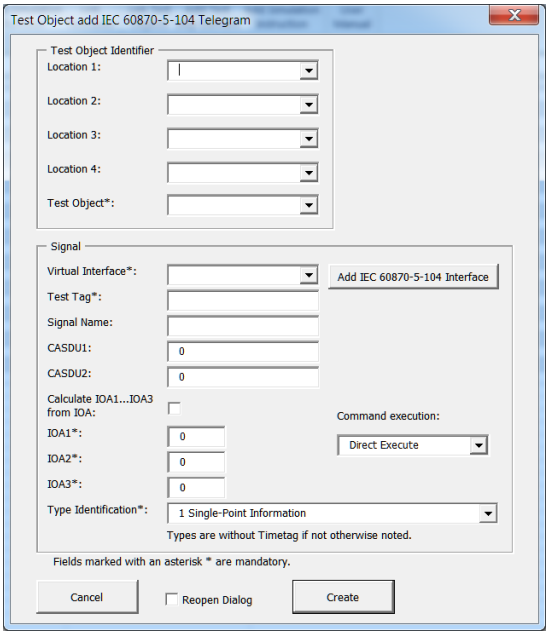


Figure 123 Add IEC 60870-5-104 Telegram Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Virtual Interface	YES		Select the IEC 60870-5-104 Test Interface here. If it is not in the list, add it by Pressing “Add IEC 60870-5-104 Interface”. The Dialogue described in chapter **6.2.3.8.2** is opened.
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the Signal.
CASDU1	YES	Integer Numeric	Common Application Service data Unit Byte 1 of the Telegram
CASDU2	NO	Integer Numeric	Common Application Service data Unit Byte 2 of the Telegram
Calculate IOA1…IOA3 from IOA		Boolean	Make a checkmark in this checkbox, if you have an IOA and the dialogue should calculate IOA1, IOA2 and IOA3 for you.

Element	Mandatory?	Data type	Description
IOA	YES	Integer Numeric	Information Object Address. This field is only visible if “Calculate IOA1…IOA3 from IOA” is checked.
IOA1	YES	Integer Numeric	Information Object Address Byte 1 (LSB). This field has to be filled only, if IOA is not filled.
IOA2	YES	Integer Numeric	Information Object Address Byte 2. This field has to be filled only, if IOA is not filled.
IOA3	YES	Integer Numeric	Information Object Address Byte 3 (MSB). This field has to be filled only, if IOA is not filled.
Type Identification	YES		Select the Data point Type here. You can only choose the supported values from the Dropdown-Menu. Appendix chapter 7.1.1.2 provides a full list of supported Type Identifiers.
Command Execution	No		Only valid for Command / Set point telegrams: Configure whether the command is executed directly (Direct Execute) or with SELECT-Before-Operate method. This enables the influence on the SELECT field in the telegram User interface also. Default Value: Direct Execute

Table 40 Add IEC 60870-5-104 Telegram Dialogue Fields

6.2.4.13.7. Add DNP3.0 Telegram

Use this dialogue to add a new DNP3.0 Telegram to a Test Object.

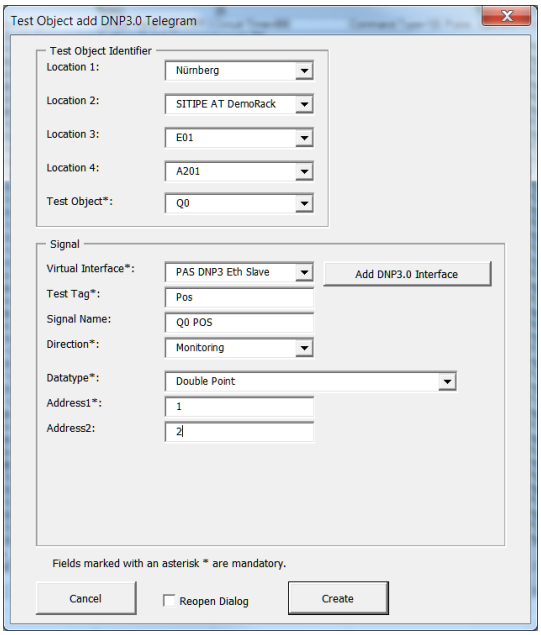


Figure 124 Add DNP3.0 Telegram Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Virtual Interface	YES		Select the DNP3.0Test Interface here. If it is not in the list, add it by Pressing “Add DNP3.0 Interface”. The Dialogue described in chapter **6.2.3.8.4** is opened.
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the Signal.
Direction	YES		Either Monitoring or Control Direction.
Data type	YES		Select the Data type of the Telegram here. The values shown depend on the direction of the telegram.
Address 1	YES	Integer Numeric	The numeric address 1 of the telegram.
Address2	NO	Integer Numeric	The numeric address 2 of the telegram. Only mandatory for Double Indications and Double Commands.
(Control) Command Operation Mode	YES		Either direct operation, direct operation without confirmation or Select Before Operate (SBO)
(Control) Command Qualifier	YES		Either Pulse ON, Pulse OFF or Latch ON, Latch OFF. Pulse ON is default.

Table 41 Add DNP3.0 Telegram Dialogue Fields

6.2.4.13.8. Add Modbus Telegram

Use this dialogue to add a new Modbus Telegram to a Test Object.

Please Note: Monitoring data type address must fall within the configured scan group specified for Modbus interface.

For example, for monitoring Double point datatype with Address = 2, the Modbus interface for it must have a scan group with register= Coil, and address range must include 2 and 3. For monitoring Analog SignedInt 16bit datatype with Address= 6, the Modbus interface for it must have a scan group with register= Holding Register and address range must include 6.

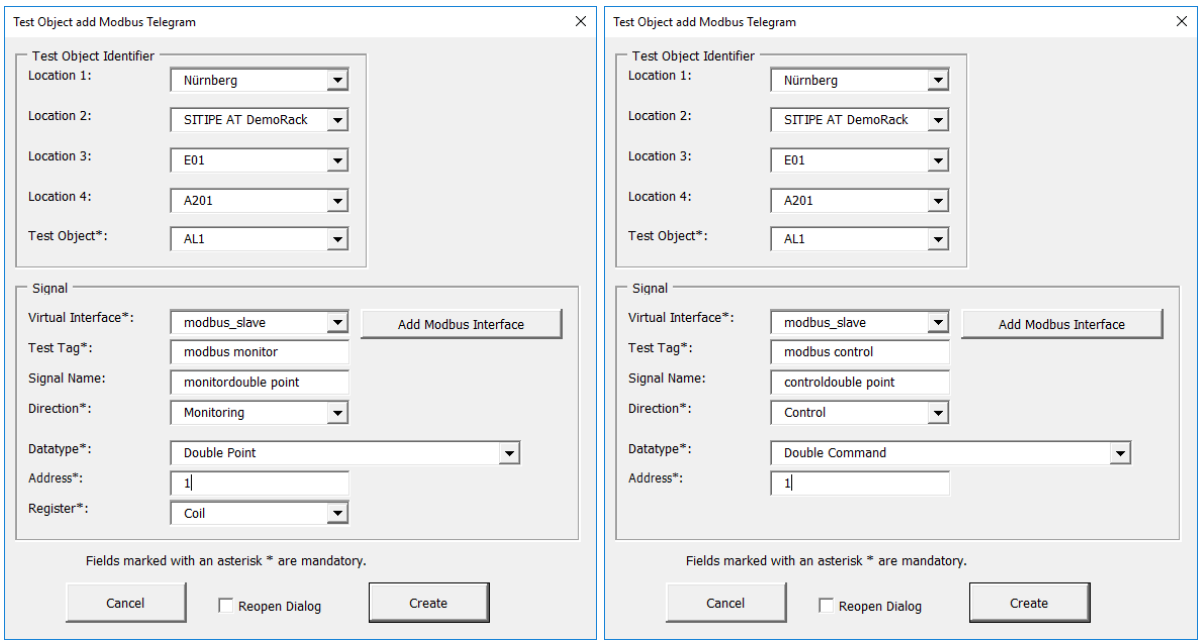


Figure 125 Add Modbus Telegram Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Virtual Interface	YES		Select the Modbus Test Interface here. If it is not in the list, add it by Pressing “Add Modbus Interface”. The Dialogue described in chapter **6.2.3.8.6** is opened.
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the Signal.
Direction	YES		Either Monitoring or Control Direction.
Data type	YES		Select the Data type of the Telegram here. The values shown depend on the direction of the telegram.
Address	YES	Integer Numeric	The numeric address of the telegram.
Register	Yes		Applicable only for monitoring direction. Select from the values shown.

Table 42 Add Modbus Telegram Dialogue Fields

Note: For Control direction, register is set based on the datatype selected. For Single and Double command, register is set as Coil. For all other datatypes, Holding Register is set.

6.2.4.13.9. Add IEC 61850-8-1 MMS Telegram

Use this dialogue to add a new DNP3.0 Telegram to a Test Object.

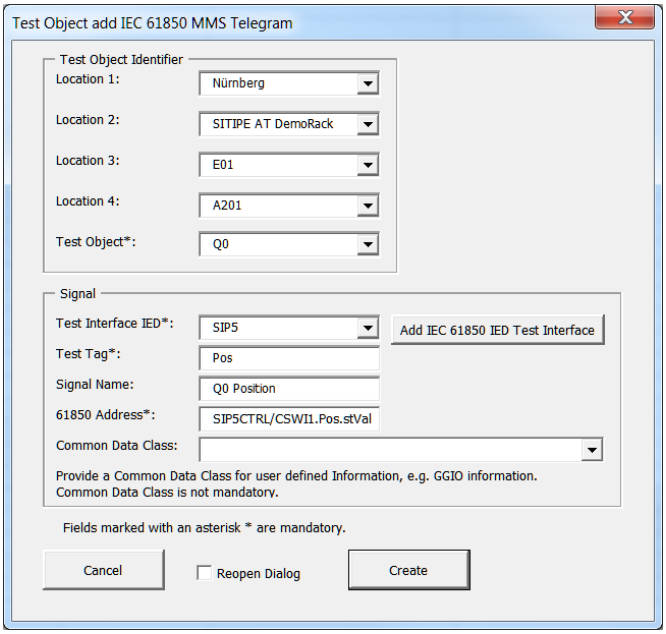


Figure 126 Add IEC 61850-8-1 MMS Telegram Dialogue

Press “Create” to create the Signal. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Signal.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Test Interface IED	YES	String	Select the 61850 IED defined in the Test Interfaces Sheet here. If it is not in the list, add it by Pressing “Add IEC 61850 IED Test Interface”. The Dialogue described in chapter **6.2.3.8.5** is opened.
Test Tag	YES	String	The Test Tag to reference this Signal in a Test Case. This should be the same for similar signals like Single Indications.
Signal Name	NO	String	A descriptive name for the Signal.

Element	Mandatory?	Data type	Description
61850 Address	YES	String	The IEC 61850 MMS Address of the Telegram in the following Form: LogicalDevice/LogicalNode.DataObject.DataAttribute DataObject and DataAttribute may appear several Times. Instance numbers, Prefixes, Suffixes and renaming are allowed. So an address “SIP5/Q0_CSWI1.Pos.stVal” is also valid.
CDC	NO		Specify the Common Data Class of the Data Object here. This field is only mandatory, if the 61850 Address does not reference a predefined Logical Node and Data Object (refer to Appendix **7.1.2.2**). This may be the case for renamed Data Objects or Logical Nodes.

Table 43 Add IEC 61850-8-1 Telegram Dialogue Fields

6.2.4.13.10. Set Test Tag Parameters

Use this dialogue to set Test Parameters for a Test Tag. These Parameters will be used in a Test Case and the information there will be overwritten by this Test Object Specific Parameter.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

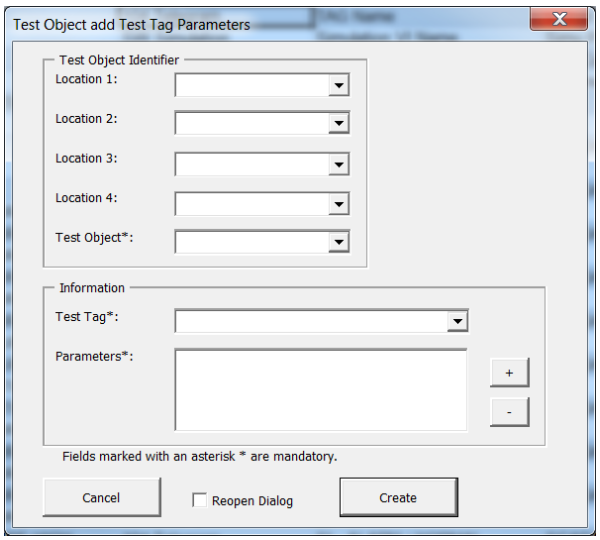


Figure 127 Add Test Tag Parameters Dialogue

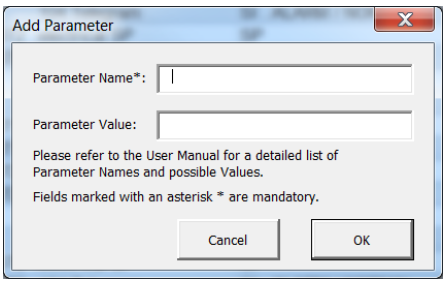


Figure 128 Add Parameter Dialogue

Press “Create” to create the Test Tag Parameters. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating the new Test Tag Parameters.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Test Tag	YES	String	Select the Test Tag here. If it is not in the list, you can type it manually in this field.
Parameters	YES		Add Parameters by Pressing “+”. The “Add Parameter”-Dialogue will be opened. This dialogue is shown in Figure 128. Remove Parameters from the List by Pressing “-“
Add Parameter Dialogue			Enter the Parameter information here. Press “OK” to add the Parameter to the list. Press “Cancel” to close the Dialogue without adding the Parameter.
Parameter Name	Yes	String	Enter the name of the Parameter here. A full List of Parameters is available in chapter **6.1.3**.
Parameter Value	No	String	Enter the value for the Parameter here, if one is specified.

Table 44 Add Test Tag Parameters Fields

6.2.4.13.11. Add Simulation Function

Use this dialogue to configure the Simulation Function for Devices like Circuit Breakers, Disconnectors, Earthing Switches or Tap changers.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

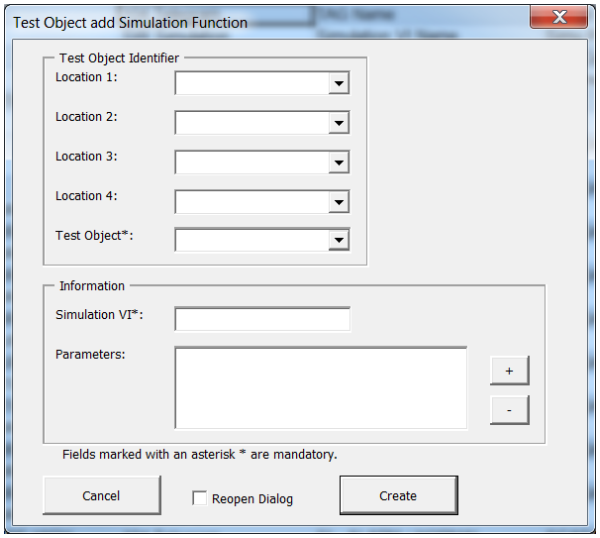


Figure 129 Add Simulation Function Dialogue

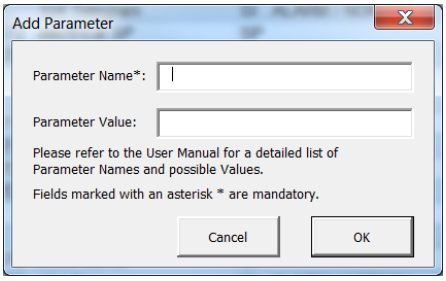


Figure 130 Add Parameter Dialogue

Press “Create” to create the Simulation Function. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new Simulation Function.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Data type	Description
Simulation VI	YES	String	Enter the Filename of the Simulation VI here. Delivered Simulation Functions are listed in chapter 5.1.8.2.
Parameters	YES		Add Parameters by Pressing “+”. The “Add Parameter”-Dialogue will be opened. This dialogue is shown in Figure 130. Remove Parameters from the List by Pressing “-“
Add Parameter Dialogue			Enter the Parameter information here. Press “OK” to add the Parameter to the list. Press “Cancel” to close the Dialogue without adding the Parameter.
Parameter Name	Yes	String	Enter the name of the Parameter here. A full List of Parameters may be taken from the individual Simulation Function Manual. (For a delivered simulation function, see chapter **6.1.4**)
Parameter Value	No	String	Enter the value for the Parameter here, if one is specified.

Table 45 Add Simulation Function Fields

6.2.4.13.12. Link Test cases

Use this dialogue to select Test Cases to be executed for a specific Test Object.

If your Excel selection is currently placed on a Test Object row in the Test Objects Sheet, the Test Object identifier is automatically preselected for you.

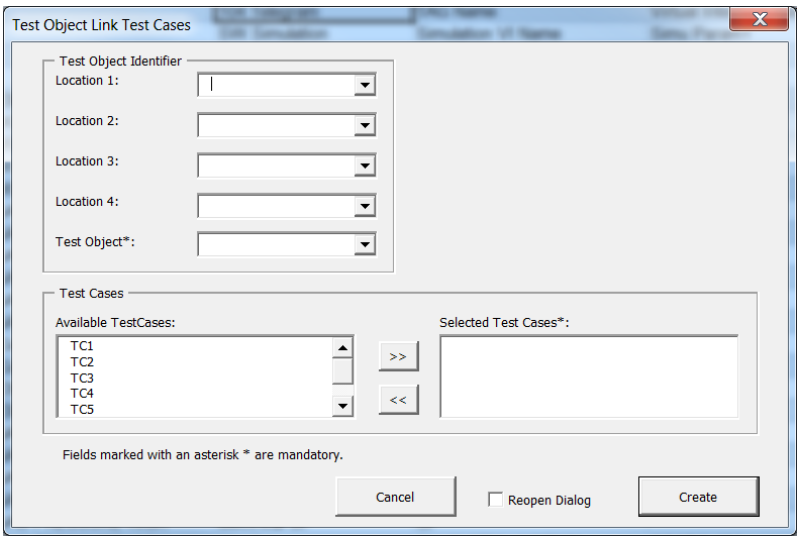


Figure 131 Link Test Cases Dialogue

Press “Create” to link the Test Cases to the Test Object. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new association.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter **6.2.4.13.1**.

Element	Mandatory?	Description
Available Test Cases		This list contains all Test Cases available in the Test Configuration (Worksheet Test Cases), without the Test Cases already selected for this Test Object.
Selected Test Cases	YES	This list contains all Test Cases selected for this Test Object. Add Test Cases to this list by pressing “>>”. Remove Test Cases from this list by pressing “<<”.

Table 46 Link Test Cases Fields

6.2.5. Worksheet “Test Cases”

Test Cases are used to Test individual Test Objects automatically. They address Test Object Signals indirectly using Test Tags to be applicable to more than one Test Object.

A Test Case consists of Test Steps consisting of Test Elements (Preconditions, Sinks and Sources). Since a Test Case may have more than one Test Step and a Test Step may have more than one Test element, a Test Case may span over a range of rows in the Table. Figure 132 shows an Example Test Case with its Test Steps and associated Test Step Elements.

	Test Case Name	Test Case Description	Step Number	Step Name	Element type	Element type detail	Name	Tag
314	-D1 -F201 Auto LS Befehl von GSL V0B54	Funktionstest des LS Befehls über die GSL Fernwirkschnittstelle	1	01 EIN o. Ver.	precondition	test parameters	Start Simulation Fkt.	Start Simulation Fkt.
315	-D1 -F201 Auto LS Befehl von GSL V0B54		1	01 EIN o. Ver.	source	virtual	GSL Befehl	Command GSL V0B54
316	-D1 -F201 Auto LS Befehl von GSL V0B54		1	01 EIN o. Ver.	sink	electrical	Befehlsausgabe	Command ON
317	-D1 -F201 Auto LS Befehl von GSL V0B54		1	01 EIN o. Ver.	sink	virtual	Activation Confirmation	Command GSL V0B54
318	-D1 -F201 Auto LS Befehl von GSL V0B54		1	01 EIN o. Ver.	sink	virtual	SST ON	Feedback GSL V0B54
319	-D1 -F201 Auto LS Befehl von GSL V0B54		1	01 EIN o. Ver.	sink	virtual	Activation Termination	Command GSL V0B54
320	-D1 -F201 Auto LS Befehl von GSL V0B54		2	02 AUS o. Ver.	source	virtual	GSL Befehl	Command GSL V0B54
321	-D1 -F201 Auto LS Befehl von GSL V0B54		2	02 AUS o. Ver.	sink	electrical	Befehlsausgabe	Command OFF
322	-D1 -F201 Auto LS Befehl von GSL V0B54		2	02 AUS o. Ver.	sink	virtual	Activation Confirmation	Command GSL V0B54
323	-D1 -F201 Auto LS Befehl von GSL V0B54		2	02 AUS o. Ver.	sink	virtual	SST OFF	Feedback GSL V0B54
324	-D1 -F201 Auto LS Befehl von GSL V0B54		2	02 AUS o. Ver.	sink	virtual	Activation Termination	Command GSL V0B54

Figure 132 Example Test Case with Test Steps and Test Step Elements

6.2.5.1. Test Case Name and Description

Specify a Test Case Name and a descriptive Text in the first two columns of the Test Case row.

The descriptive Text only has to be entered in the first row of the Test Case and does not have to be repeated in the subsequent Test Case rows.

6.2.5.2. Test Steps

Test Steps describe the sequent steps for the Test Case.

Every Test Step can be given a Step Number. Test Steps are then executed from the lowest Test Step Number upwards.

A Test Step Name is mandatory for each Test Step row. It has to be repeated for every element row belonging to an individual Test Step.

6.2.5.3. Element Types

A Test Step Element can have one of the following three types:

- Precondition: Describes all prerequisites for a Test step, like setting the right Positions for Disconnectors in Case of an Interlocking Test.
- Sink: Describes all Signals and their status for the Test Step success.
- Source: Describes the Signal to be triggered, when the Test Step is started.

6.2.5.4. Element type details

A Test Step Element has a defined Element type detail depending on the Type of information it is connected to. The following four Element Type details are defined:

- Electrical: States that the information is to be processed using the electrical Interface.
- Virtual: States that the information is to be processed using a network interface.
- Manual: States that the information is to be processed manually by the Tester using the Human-Machine-Interface (HMI).
- Test Parameters: States a SITIPE AT Test Parameter change for a Test.

6.2.5.5. Name and Tag of Test step element

Give a mandatory Name for the Test Step Element and assign it a Tag. The Tag is used to reference signals of Test Objects connected to the Test Case in a general way.

6.2.5.6. Test Object Referencing

By default, the Test Object is determined by the Test Object currently under Test. Test Tags are then referenced to this Test Object. If you want to control or monitor a Test Tag or

Simulation Function of a specific Test Object, enter its Location 1, 2, 3, 4 and Test Object Name in the rightmost columns of the Table. The Testing System will then look for Test Tags / Simulation Functions in the specified Test Object rather than in the Test Object currently under Test.

This is useful for collection/group indications (a lot of electrical inputs, but only one telegram) or to control a specific simulation function for e.g. interlocking tests.

6.2.5.7. Test Case Configuration Dialogues

Use these dialogues to easily construct Test Cases for SITIPE AT.

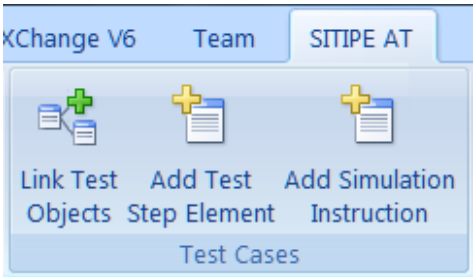


Figure 133 Test Case Configuration Dialogues in SITIPE AT Ribbon

The following Dialogues are available for Test Case configuration:

- Link Test Objects, to link a specific Test Case to a selection of Test Objects.
- Add Test Step Element, to create a Test Step element (Precondition, Source or Sink) **with exception** of a Simulation Instruction Element.
- Add Simulation Instruction, to create a Simulation Instruction Test Step element (Precondition or Source).

6.2.5.7.1. Test Step Identifier

A Test Step Element is identified by its associated Test Case and the underlying Test Step. Figure 134 shows an example for that. You can select another element in each dropdown menu, or you enter a value manually to create a new Test Case or Test Step.

Give a descriptive Text for the Test Case Contents using the Test Case Description Field. This information can be used in the Test Protocol later on.

You can specify the execution order of Test Steps by assigning them a Test Step Number. Test Steps are executed from Number 1 upwards.

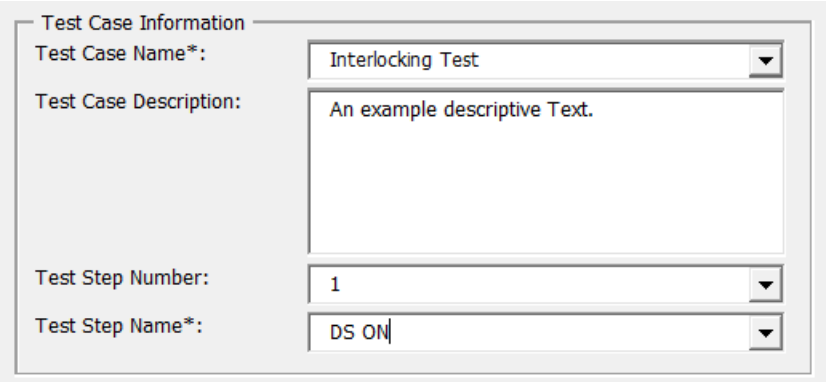


Figure 134 Test Object Identifier Fields

6.2.5.7.2. Link Test Objects

Use this dialogue to manage Test Objects linked to a selected Test Case. The macro also allows you to remove links between Test Objects and a Test Case.

If your Excel selection is currently placed on a Test Case row in the Test Cases Sheet, the Test Step identifier is automatically preselected for you.

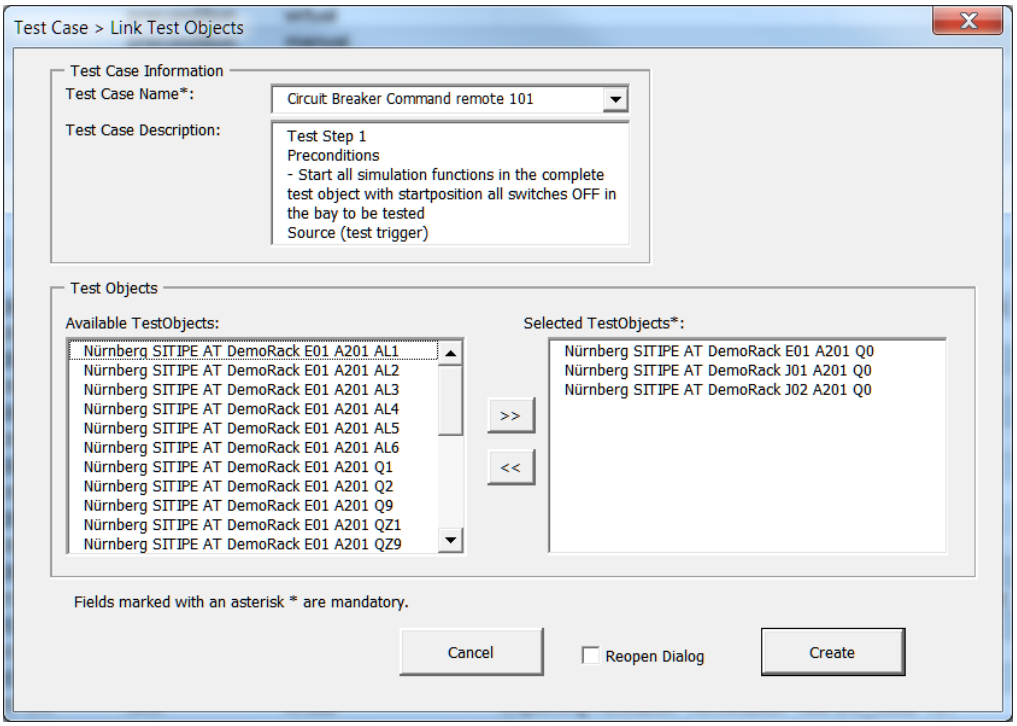


Figure 135 Link Test Objects Dialogue

Press “Create” to link the Test Objects to the Test Case. If you want to reopen the Dialogue after the Creation Process is finished, place a checkmark in “Reopen Dialog”. Press “Cancel” to close the Dialogue without creating a new association.

The following table describes the Fields and expected information with exception of the Test Object Identifier, described in chapter 6.2.4.13.1.

Element	Mandatory?	Description
Available Test Objects		This list contains all Test Objects available in the Test Configuration (Worksheet Test Objects), without the Test Objects already linked to this Test Case.
Selected Test Objects	YES	This list contains all Test Objects selected for this Test Case. Add Test Objects to this list by pressing “>>”. Remove Test Objects from this list by pressing “<<”.

Table 47 Link Test Cases Fields

6.2.5.7.3. Add Test Step Element

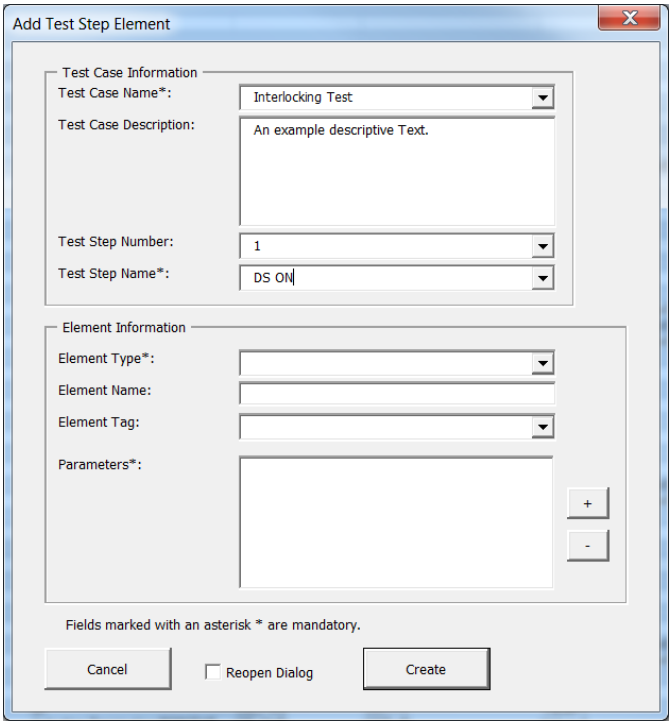


Figure 136 Add Test Step Element Dialogue

Use this dialogue to add a Test step element to the Test. A Test Step element may be a Test Precondition, Test Source or Test Sink. Preconditions are conditions to setup, to bring the system in a defined state. A test source is a condition the Test System sets up to trigger a reaction on the System under Test. A Test Sink is a system reaction that is expected after the Test Source is executed.

During a Test Step, its Preconditions are setup, then the Test Source is triggered and afterwards the Test Sinks are monitored for the correct System reaction.

If your Excel selection is currently placed on a Test Case row in the Test Cases Sheet, the Test Step identifier is automatically preselected for you.

The following table describes the Fields and expected information with exception of the Test Step Identifier, described in chapter 6.2.5.7.1.

Element	Mandatory?	Data type	Description
Element Type	Yes		The Type of the element you want to add. You may select a Precondition, Source or Sink of Electrical, Virtual or Manual Type
Element Name	No	String	Enter a descriptive text for this element here. This text can be used in the Test Protocol later on.
Element Tag	No	String	Specify a Test Tag for this element in this field. A Test Tag may be used to address the Test Point of the Test Object indirectly.
Parameters	Yes		Specify at least one Parameter for detailed description of the Test Element here. Add Parameters by Pressing the “+”-Button. The Add Test Element Parameter is opened. Remove Parameters by selecting them in the List and Pressing the “-“-Button.

Table 48 Add Test Step Elements Fields

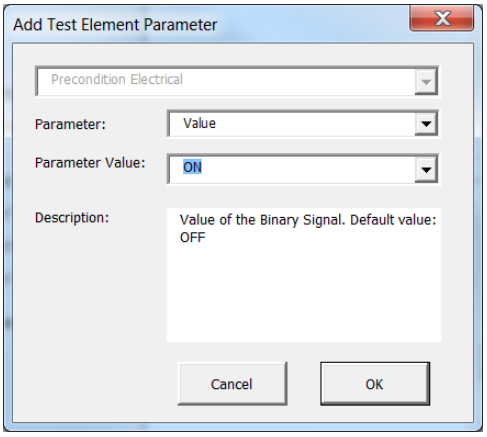


Figure 137 Add Test Element Parameter Dialogue

Element	Mandatory?	Data type	Description
Parameter	Yes		Select a Parameter for the Element type chosen in the Test Step Elements Dialogue here. Available Parameters for the Element Types are listed in Chapter **6.1.3**
Parameter Value	No		Depending on the Parameter you selected, you can either enter a value manually or select a value from the List. Refer to Chapter **6.1.3** for a detailed description of Test Parameters and possible Values.

Element	Mandatory?	Data type	Description
Description	No		This field provides help information on the Parameter and its possible values.

Table 49 Add Test Step Parameter Fields

6.2.5.7.4. Add Test Step Simulation Instruction

Use this dialogue to control the Simulation Feature or a specified Simulation Function inside a Test Step. You may start or stop the Simulation Engine, as well as set the State, Operation Mode or Parameters of a running Simulation Function.

If your Excel selection is currently placed on a Test Case row in the Test Cases Sheet, the Test Step identifier is automatically preselected for you.

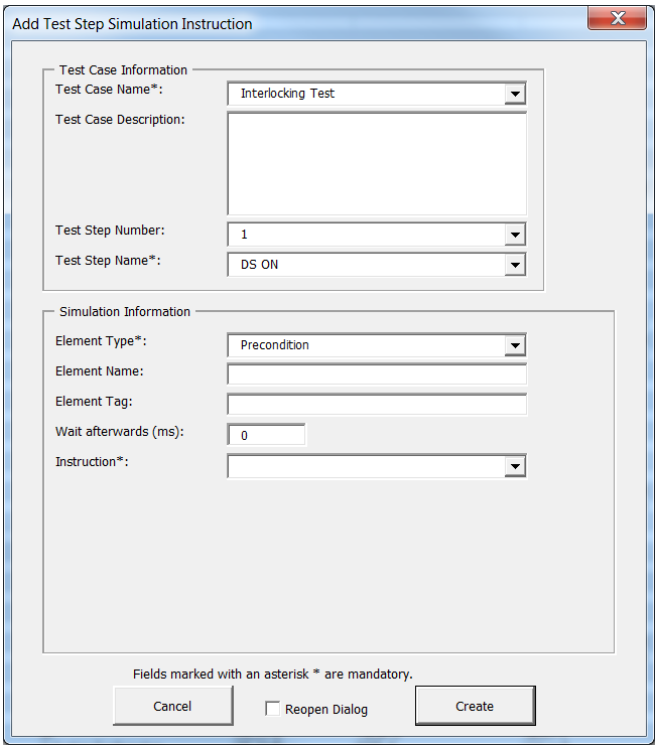


Figure 138 Test Step Simulation Instruction Dialogue

The following table describes the Fields and expected information with exception of the Test Step Identifier, described in chapter 6.2.5.7.1.

Element	Mandatory?	Data type	Description
Element Type	Yes		The Type of the element you want to add. You may select a Precondition or Source of Type “Test Parameters”.
Element Name	No	String	Enter a descriptive text for this element here. This text can be used in the Test Protocol later on.

Element	Mandatory?	Data type	Description
Element Tag	No	String	Specify a Test Tag for this element in this field. A Test Tag may be used to address the Test Point of the Test Object indirectly.
Instruction	Yes		Select a Simulation Instruction from this list. You may choose from the following values: • Sim.Start all, Starts all configured simulation functions • Sim.Stop all, Stops all configured simulation functions • Sim.Set State, sets the State of a Simulation Function (e.g. “OFF”) • Sim.Set Operation, sets the Operation of a Simulation Function (e.g. “Gear Malfunction Closed”) • Sim.Set Parameters, sets Parameters of a Simulation Function The form mask changes, depending on your selection.
Value	Yes		This field is displayed for the Instructions “Sim.Set State” or “Sim.Set Operation”. Select a value from the list or enter a value manually. Possible values for those Fields are provided by the Documentation of the specific Simulation Function used. For built-in Simulation Functions, this information can be found in chapter **6.1.4**.
Parameters	Yes		This field is displayed for the Instruction “Sim.Set Parameters”. Add Parameters by Pressing the “+”-Button. The “Add Parameters Dialogue” is opened. Remove Parameters from the list by selecting them and Pressing the “-“-Button.
Specify Test Object To Control			This checkbox is displayed for the Instructions “Sim.Set State”, “Sim.Set Operation” and “Sim.Set Parameters”. By default, a Test element is applied to the Test Object currently under Test. If you want to control a Simulation Function of a specific Test Object, select this checkbox. Provide the Unique Object Identifier in the fields below the checkbox. Refer to chapter

Element	Mandatory?	Data type	Description
			6.2.4.1 for more information on Test Object Identification.

Table 50 Add Test Step Simulation Instruction Fields

6.2.6. Import Macros

The following chapter describes several Macros to import data automatically into the SITIPE AT Excel Workbook. The following macros are provided with SITIPE AT:

- Import Signal List, to import any customer signal list into SITIPE AT including Test Objects, their telegram addresses and wiring information. The macro can be configured flexibly to cover several signal list formats.
- Import TIPT Version 1 Excel Configuration, to import Excel configuration files used for TIPT Version 1 configuration. This includes the main configuration file containing the signal labels and PTMs, as well as the optional indication table containing the simulation function configuration.
- Import Interlocking Table, to import an interlocking table for an automatic creation of Test Cases for Interlocking Tests. The created Test cases setup simulation functions in a desired state, bring up a manual source and sink. So the Interlocking Test executes stepwise and collects the Test result manually. The format of the Workbook to import is predefined. See Template InterlockingTemplate.xlsx.

6.2.6.1. Signal List Import Macro

This Macro imports a customer Signal list into the Test Configuration.

The Macro includes the following Functionality:

- Test Objects and Test Interfaces will be created automatically.
- The Import Macro is designed flexibly, so Signal lists with different structures can be read.
- The Signal list structure is remembered inside the Workbook. If the Signal list is changed, it can be reloaded easily.
- The Macro is able to create the following information types:
  - Test Interfaces:
    - -101,
    - -104,
    - IEC 61850 IEDs for 61850-8-1 MMS communication
    - DNP3.0
    - Panel Test Modules (PTMs)
  - Test Objects Signals:
    - Electrical Single Point Information and Double Point Information wired to PTMs
    - -101 Telegrams
    - -104 Telegrams
    - IEC 61850-8-1 MMS Telegrams
    - DNP3.0 Telegrams

Please note: The Macro **does not** provide a merging feature. When the Signal list is processed, all Information in the Sheets “Test Interfaces” and “Test Objects” will be deleted. Only Test Object Software Parameters like Test Case links, Simulation Functions and Test Tag Parameters will be kept. If Test Object Identifiers changed in the mean time, you have to make these changes on the Software Parameters manually.

An example Signal List is delivered in the SITIPE AT Software Package. It may be a good foundation for your custom signal list. The Example Signal List can be found in the windows start menu entry of SITIPE AT > “Template Signal List”.

6.2.6.1.1. Restrictions

The Macro is designed for a specific type of Signal Lists, where all information is contained in one excel worksheet. All information for each signal shall be contained in a row.

The following information is needed for each signal in different columns:

- Location 1, Location 2, Location 3, Location 4 and Signal / Object name to form an Unique Object Identifier (see chapter 6.2.4.1); Object name is mandatory, Locations are optional
- Signal value (Values “OPEN”, “CLOSED” for Double Point Signals of Switching Devices)
- Information Type, Defined Values:
  - “DI”, Double Indication (System Input with 2 binary Signals)
  - “DC”, Double Command (System Output with 2 binary Signals)
  - “SI”, Single Indication (System Input with 1 binary Signal)
  - “SC”, Single Command (System output with 1 binary Signal)
  - “MV”, Metered Value (1 Signal with Counter readings)
  - “AV”, Analog Value (1 Signal containing a Measured Value)

Telegram Data type is derived from Information Type. The mapping is given in Table 51 below the list.

Information Type	**IEC 60870-5-101/-104 Type Identifier (TI)**	**IEC 61850-8-1 MMS Common Data Class**	**IEEE DNP3.0 Data type**
SI Single Indication	30 Single Point with Time tag	SPS Single Point Status	Monitoring.Single Point
SC Single Command	45 Single Point Command without Time tag	SPC Single Point Controllable	Control.Single Command
DI Double Indication	31 Double Point with Time tag	DPC Double Point Controllable	Monitoring.Double Point
DC Double Command	46 Double Command without Time tag	DPC Double Point Controllable	Control.Double Command

Information Type	IEC 60870-5-101/-104 Type Identifier (TI)	IEC 61850-8-1 MMS Common Data Class	IEEE DNP3.0 Data type
MV Metered Value	37 Integrated Totals with Time tag	BCR Binary Counter Reading	Monitoring.Counter Value
AV Analog Value	34 Measured Value, normalized with Time tag	MV Measured Value	Monitoring.Analog Measurement Normalized

Table 51 Mapping of Signal list Information Type to Telegram Datatypes

6.2.6.1.2. Signal List Import Dialogue

In order to open the Signal List Import Wizard, select “Import Signal List” in the SITIPE AT Ribbon.

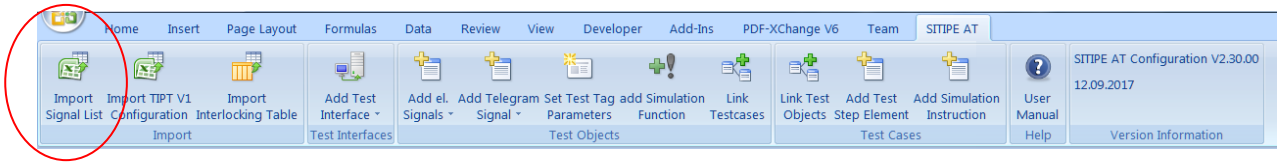


Figure 139 Import Signal List Button in SITIPE AT Ribbon

The Import Signal List Dialogue is opened:

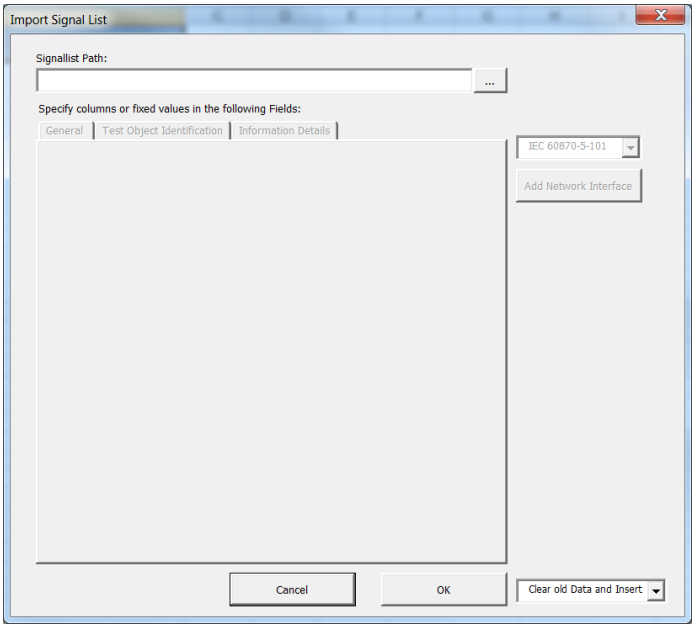


Figure 140 Import Signal List Dialogue

Load a Signal List Excel Workbook by Pressing the “...”-Button next to “Signallist Path:”. It will be opened directly. Please perform the steps in **6.2.6.1.4** Configuring the Signal List Structure and Adding Network Interfaces in order to configure the Signal List Structure.

You may select whether to delete all data currently existing in the configuration workbook or to append the signal list data to the configuration workbook, by selecting the Operation mode. See **6.2.6.1.3** Selecting the Operation Mode for further details.

Afterwards you may start the Signal List Processing by Pressing “OK”. Press “Cancel” if you want to leave the dialogue without making any changes to your Test Configuration Workbook.

6.2.6.1.3. Selecting the Operation Mode

The Macro supports three Operation Modes:

- Clear old Data and Insert:
  - Removes all data currently existing in the configuration workbook
- Update Test Objects and keep Software Parameters
  - Removes all Test Object configuration with exception of all data for information types “SW.TestCases”, “SW.Simulation” and “SW.Test Tag Parameters” in the Test Object Worksheet
- Append:
  - Does not remove any data currently existing in the configuration workbook. Data from the Signal List is appended to the Worksheets “Test Interfaces” and “Test Objects”

The default operation mode is “Clear old Data and Insert”. You can change the operation mode using the Drop-Down-List next to the **OK**-Button.

6.2.6.1.4. Configuring the Signal List Structure

The basic dialogue consists of the three pages described in this chapter.

Page “General”

This page is used to enter the Project Name and the Name of the Person, who is Testing the System (Tester Name). Figure 141 shows some example input in this Page.

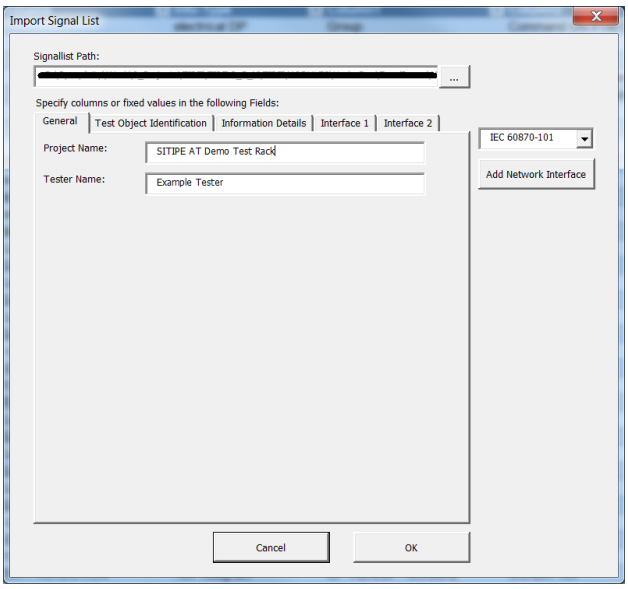


Figure 141 General Page in Import Signal List Dialogue

Page “Test Object Identification”

Enter information to identify Test Objects on this Page. The Test Object Name is a mandatory field. Location 1, 2, 3 and Location 4 are optional and may be used on purpose. Signal rows with an empty Test Object cell will be ignored by the macro.

You can select the data column directly in Excel using the "…"-Button next to the text field. Please select the uppermost row with data, so the Macro is able to read all data from the Signal List. You may enter fixed values in the text fields if no row-based data is available.

Table 52 gives an example for the values that could be in these columns.

	Location 1	Location 2	Location 3	Location 4	Object name
Description:	Region / Project	Voltage Level	Bay Name	Cabinet or Device	Signal Name or Switching Device
Example:	SITIPE Demo Test Rack	110kV	=E01	-A201	SF6 LOSS

Table 52 Examples for Location 1 ... 4 and Object name

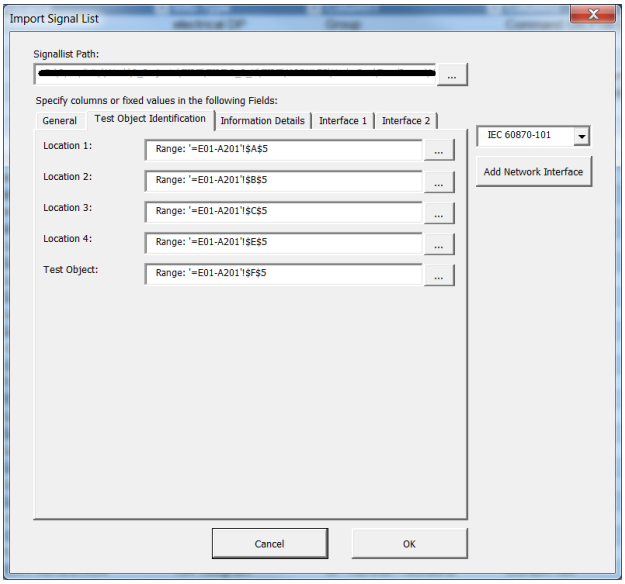


Figure 142 Test Object Identification Page in Import Signal List Dialogue

Page "Information Details"

Use this page to enter information on Information Type, Signal Value, PTM ID and PTM Channel.

You can select the data column directly in Excel using the "…"-Button next to the text field. Please select the uppermost row with data, so the Macro is able to read all data from the Signal List. You may enter fixed values in the text fields if no row-based data is available.

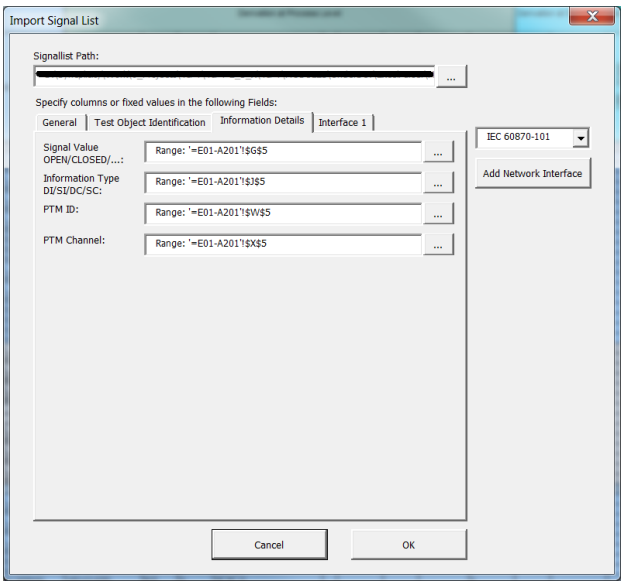


Figure 143 Information Details Page in Import Signal List Dialogue

The following Table lists the fields and the expected information in the columns:

Field	Valid values	Information Description
Signal value (mandatory)	“OPEN”, “CLOSED” for electrical Double Point Information; this value is flexible for other Information Types	These values are used to associate Circuit Breaker / Disconnector Double Point Indications / commands to electrical DP signals automatically.
Information type (mandatory)	“DI” Double Indication (into system); “DC” Double Command (out of system); “SI” Single Indication(into system); “SC” Single Command (out of system); other values will be ignored	These values are used to differentiate the signals into single / double point signals and to get the information direction (to or from the system).
PTM ID	00001 to 65536	These values are used to assign a PTM to the signal.
PTM Channel	1 to 48	These values are used to assign a PTM channel to the signal.
Terminal	any string value; e.g. “-X01:01”	The terminal of the System, to which the PTM channel is wired.

Table 53 Information Details Fields and expected information

6.2.6.1.5. Adding Network Interfaces

You can add up to 15 network interfaces to the Signal List Import, to import telegram addresses directly.

In order to add a network interface, select the Interface Type in the dropdown-List on the right hand side and press “Add Network Interface”. Enter an Interface Name in the following dialogue prompt. Keep in mind, that Interface Names must be unique for Network Interfaces.

An Interface page is added to the dialogue. You may now enter the Interface specific information there. Please refer to the Interface specific Chapters for a detailed description of the information which should be contained in the data columns.

- -101: Interface **6.2.3.8.2**, Telegram **6.2.4.13.5**
- -104: Interface **6.2.3.8.3**, Telegram **6.2.4.13.6**
- DNP3.0: Interface **6.2.3.8.4**, Telegram **6.2.4.13.7**
- 61850 MMS: Interface **6.2.3.8.5**, Telegram **6.2.4.13.9**

For Fields accepting row-based data, you can select the data column directly in Excel using the "…"-Button next to the text field. Please select the uppermost row with data, so the Macro is able to read all data from the Signal List. You may enter fixed values in the text fields if no row-based data is available.

To remove a network interface from the dialogue, press "Delete this Network Interface".

6.2.6.2. Import TIPT Version 1 Excel Configuration Macro

This Feature provides Functionality to import Excel Configuration for SITIPE AT Version 1.

The Macro can import the following workbooks:

- Main Configuration Workbook (mandatory): all PTM channels, their Signal Names and Grouping, as well as PTM Hardware Ids
- Indication Workbook (optional): Configuration of Simulation Functions for Circuit Breakers / Disconnectors / Earthing Switches etc.

If no indication workbook is loaded, the macro creates Test Objects with electrical Single Point Information.

If an Indication Table is loaded, the Macro will create Test Objects with Double Point Information and a Simulation Function "CircuitBreaker.vi" for all contained items. All other items will be created as Test Objects with electrical Single Point Information.

Open the Macro from the SITIPE AT Ribbon:

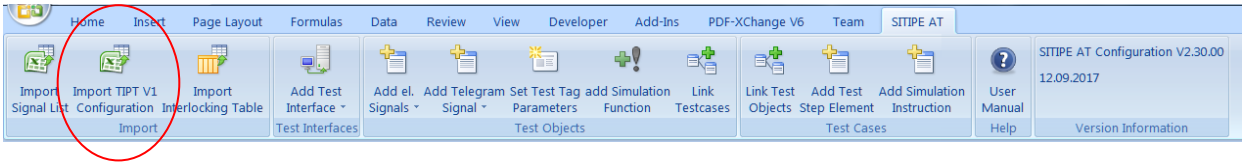


Figure 144 Import TIPT V1 Configuration Button in SITIPE AT Ribbon

The **Import TIPT V1 Configuration Data** – Dialogue opens:

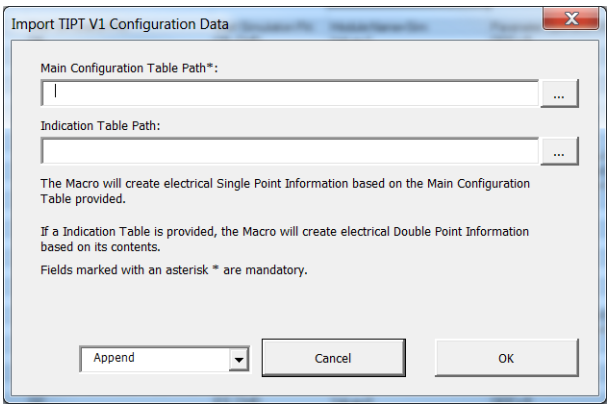


Figure 145 Import SITIPE AT V1 Configuration Data Dialogue

Specify a path to the Main Configuration as well as to the indication table (if wanted). Use the **…**-Buttons to open a File Dialogue to get the path.

Specify the Operation Mode using the Dropdown-List next to the **Cancel**-Button. The Macro supports two Operation Modes:

- Clear old Data and Insert:
  - Removes all data currently existing in the configuration workbook, with exception of all data for information types “SW.TestCases”, “SW.Simulation” and “SW.Test Tag Parameters” in the Test Object Worksheet
- Append:
  - Does not remove any data currently existing in the configuration workbook. Data from the Signal List is appended to the Worksheets “Test Interfaces” and “Test Objects”

The default operation mode is “Append”.

After you entered the File Paths, press the **OK**-Button to start processing the input files.

The Processing consists of the following steps:

1. Clear all old data from the Configuration Workbook, if the operation mode “Clear old Data and Insert” is chosen.
2. Create PTM Test Interfaces based on the entries in the Main Configuration Workbook, Sheet “USB Modules”
3. Create Test Objects with electrical Single Point Information for all Items in the Main Configuration Workbook, Sheet “Configuration”, that have no matching entry in the Indication Table
4. Create Test Objects with electrical Double Point Information for all Items in the Main Configuration Workbook, Sheet “Configuration”, with a Matching entry in the Indication Table
   a. The Test Object name, Location4 and Group are retrieved from the first electrical Test point row.
   b. A Simulation Function is configured, with the correct Circuit Time and Default Value. The built-in Simulation Function “CircuitBreakerTS.vi” is selected by default. You may change this afterwards.

The matching of Indication and Main Configuration Entry is done based on the PTM USB Index and the PTM Channel provided in both tables.

6.2.6.3. Import Interlocking Table

Use this macro to import an interlocking table for an automatic creation of Test Cases for Interlocking Tests. The Macro is able to process a Workbook with multiple selectable Worksheets, which need to fulfill the formatting restrictions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**SITIPE AT Interlocking Template**					**Preconditions**								
2	Available Simulation States:					**Loc1**								
3	**Off**				*Off (01)*	**Loc2**								
4	**On**				*On (10)*	**Loc3**		E01	E01	E01	E01	E01	E01	
5	**Intm.**				*Intermediate (00)*	**Loc4**		A201	A201	A201	A201	A201	A201	
6	**Dist.**				*Disturbed (11)*	**Test Object**	Local/Remote Switch	Q0	Q1	Q2	Q9	QZ1	QZ9	
7	**Test Object under Test**					**Command**								**Expected Reaction**
8	**Loc1**	**Loc2**	**Loc3**	**Loc4**	**Test Object**									
9			E01	A201	Q0	Remote On	Remote	**Off**	Off	Off	Off	Off	Off	On
10			E01	A201	Q0	Remote On	Remote	**Off**	On	On	On	Off	Off	On
11			E01	A201	Q0	Remote Off	Remote	**On**	Off	Off	Off	Off	Off	Off
12			E01	A201	Q0	Remote Off	Remote	**On**	On	On	On	Off	Off	Off
13			E01	A201	Q0	Local On	Remote	**Off**	Off	Off	Off	Off	Off	Off
14			E01	A201	Q0	Local Off	Remote	**On**	Off	Off	Off	Off	Off	On
15			E01	A201	Q0	Remote On	Remote	**Off**	Intm.	Off	Off	Off	Off	Off
16			E01	A201	Q1	Remote On	Remote	Off	**Off**	Off	Off	Off	Off	On
17			E01	A201	Q1	Remote On	Remote	On	**Off**	Off	Off	Off	Off	Off
18			E01	A201	Q1	Remote Off	Remote	Off	**On**	Off	Off	Off	Off	Off
19			E01	A201	Q1	Remote Off	Remote	On	**On**	Off	Off	Off	Off	On
20			E01	A201	Q1	Local On	Remote	Off	**Off**	Off	Off	Off	Off	Off
21			E01	A201	Q1	Local Off	Remote	Off	**On**	Off	Off	Off	Off	On
22			E01	A201	Q1	Remote On	Remote	Off	**Off**	Intm.	Off	Off	Off	Off
23			E01	A201	Q2	Remote On	Remote	Off	Off	**Off**	Off	Off	Off	On
24			E01	A201	Q2	Remote On	Remote	On	Off	**Off**	Off	Off	Off	Off
25			E01	A201	Q2	Remote Off	Remote	Off	Off	**On**	Off	Off	Off	Off
26			E01	A201	Q2	Remote Off	Remote	On	Off	**On**	Off	Off	Off	On
27			E01	A201	Q2	Local On	Remote	Off	Off	**Off**	Off	Off	Off	Off
28			E01	A201	Q2	Local Off	Remote	Off	Off	**On**	Off	Off	Off	On
29			E01	A201	Q2	Remote On	Remote	Off	Off	**Off**	Dist.	Off	Off	Off
30			E01	A201	Q9	Remote On	Remote	Off	Off	Off	**Off**	Off	Off	On
31			E01	A201	Q9	Remote On	Remote	On	Off	Off	**Off**	Off	Off	Off
32			E01	A201	Q9	Remote Off	Remote	Off	Off	Off	**On**	Off	Off	Off
33			E01	A201	Q9	Remote Off	Remote	On	Off	Off	**On**	Off	Off	On
34			E01	A201	Q9	Local On	Remote	Off	Off	Off	**Off**	Off	Off	Off
35			E01	A201	Q9	Local Off	Remote	Off	Off	Off	**On**	Off	Off	On
36														
37			E01	A201	QZ1	Remote On	Remote	Off	Off	Off	Off	**Off**	Off	On
38			E01	A201	QZ1	Remote On	Remote	Off	On	Off	Off	**Off**	Off	Off
39			E01	A201	QZ1	Remote Off	Remote	Off	Off	Off	Off	**On**	Off	Off
40			E01	A201	QZ1	Remote Off	Remote	Off	On	Off	Off	**On**	Off	On
41			E01	A201	QZ1	Local On	Remote	Off	Off	Off	Off	**Off**	Off	Off
42			E01	A201	QZ1	Local Off	Remote	Off	Off	Off	Off	**On**	Off	On

E01 J01 J02

Figure 146 Example Interlocking Worksheet for an Interlocking Import

The Macro will create Test Cases for each Test Object in the Interlocking Table. The Test Cases will be in the following style:

- Test steps for each command row
- Flexible Number of Preconditions:
  - Manual Preconditions: Manual Preconditions like “Setup a Key switch” are created, if the Location 1… Location 4 are left empty in the precondition area.
  - Simulation Function Instructions: A simulation state is setup, if Location 1… Location 4 have a non-empty value
- A Manual Source: SITIPE AT will show a dialogue to acknowledge containing the value in the command column. Use this dialogue to check, that all preconditions were setup correctly and to send the command afterwards.
- A manual sink: SITIPE AT will show a dialogue to acknowledge containing the value in the expected reaction column. Use this dialogue to generate the Test result, based on the system reactions you observed.

6.2.6.3.1. Restrictions

The macro is designed for a specific Excel workbook with a predefined format. The Macro can process multiple worksheets within the Excel workbook, but all worksheets have to fulfill the formatting restrictions. Figure 147 shows an Interlocking Table fulfilling the format restrictions. It is delivered with the SITIPE AT Installation. You may find it in the **Windows Start menu** > **Siemens** > **SITIPE Automated Testing** > **Configuration** > **Example Interlocking Workbook**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**SITIPE AT Interlocking Template**					**Preconditions**								
2	Available Simulation States:					**Loc1**								
3	**Off**				*Off (01)*	**Loc2**								
4	**On**				*On (10)*	**Loc3**		E01	E01	E01	E01	E01	E01	
5	**Intm.**				*Intermediate (00)*	**Loc4**		A201	A201	A201	A201	A201	A201	
6	**Dist.**				*Disturbed (11)*	**Test Object**	Local/Remote Switch	Q0	Q1	Q2	Q9	QZ1	QZ9	
7	**Test Object under Test**					**Command**								**Expected Reaction**
8	**Loc1**	**Loc2**	**Loc3**	**Loc4**	**Test Object**									
9			E01	A201	Q0	Remote On	Remote	**Off**	Off	Off	Off	Off	Off	On
10			E01	A201	Q0	Remote On	Remote	**Off**	On	On	On	Off	Off	On
11			E01	A201	Q0	Remote Off	Remote	**On**	Off	Off	Off	Off	Off	Off
12			E01	A201	Q0	Remote Off	Remote	**On**	On	On	On	Off	Off	Off
13			E01	A201	Q0	Local On	Remote	**Off**	Off	Off	Off	Off	Off	Off
14			E01	A201	Q0	Local Off	Remote	**On**	Off	Off	Off	Off	Off	On
15			E01	A201	Q0	Remote On	Remote	**Off**	Intm.	Off	Off	Off	Off	Off
16			E01	A201	Q1	Remote On	Remote	Off	**Off**	Off	Off	Off	Off	On
17			E01	A201	Q1	Remote On	Remote	On	**Off**	Off	Off	Off	Off	Off
18			E01	A201	Q1	Remote Off	Remote	Off	**On**	Off	Off	Off	Off	Off
19			E01	A201	Q1	Remote Off	Remote	On	**On**	Off	Off	Off	Off	On
20			E01	A201	Q1	Local On	Remote	Off	**Off**	Off	Off	Off	Off	Off
21			E01	A201	Q1	Local Off	Remote	Off	**On**	Off	Off	Off	Off	On
22			E01	A201	Q1	Remote On	Remote	Off	**Off**	Intm.	Off	Off	Off	Off
23			E01	A201	Q2	Remote On	Remote	Off	Off	**Off**	Off	Off	Off	On
24			E01	A201	Q2	Remote On	Remote	On	Off	**Off**	Off	Off	Off	Off
25			E01	A201	Q2	Remote Off	Remote	Off	Off	**On**	Off	Off	Off	Off
26			E01	A201	Q2	Remote Off	Remote	On	Off	**On**	Off	Off	Off	On
27			E01	A201	Q2	Local On	Remote	Off	Off	**Off**	Off	Off	Off	Off
28			E01	A201	Q2	Local Off	Remote	Off	Off	**On**	Off	Off	Off	On
29			E01	A201	Q2	Remote On	Remote	Off	Off	**Off**	Dist.	Off	Off	Off
30			E01	A201	Q9	Remote On	Remote	Off	Off	Off	**Off**	Off	Off	On
31			E01	A201	Q9	Remote On	Remote	On	Off	Off	**Off**	Off	Off	Off
32			E01	A201	Q9	Remote Off	Remote	Off	Off	Off	**On**	Off	Off	Off
33			E01	A201	Q9	Remote Off	Remote	On	Off	Off	**On**	Off	Off	On
34			E01	A201	Q9	Local On	Remote	Off	Off	Off	**Off**	Off	Off	Off
35			E01	A201	Q9	Local Off	Remote	Off	Off	Off	**On**	Off	Off	On
36														
37			E01	A201	QZ1	Remote On	Remote	Off	Off	Off	Off	**Off**	Off	On
38			E01	A201	QZ1	Remote On	Remote	Off	On	Off	Off	**Off**	Off	Off
39			E01	A201	QZ1	Remote Off	Remote	Off	Off	Off	Off	**On**	Off	Off
40			E01	A201	QZ1	Remote Off	Remote	Off	On	Off	Off	**On**	Off	On
41			E01	A201	QZ1	Local On	Remote	Off	Off	Off	Off	**Off**	Off	Off
42			E01	A201	QZ1	Local Off	Remote	Off	Off	Off	Off	**On**	Off	On

E01 J01 J02

Figure 147 Example Interlocking Table fulfilling the Formatting restrictions

The following restrictions apply:

- Preconditions:
  - are listed from column G to the column containing “expected reaction”
  - Location 1… Location 4 and Test Object Name are to be written in rows 2 to 6
  - Items with Location 1… Location 4 are treated as manual preconditions; Items with Location 1… Location 4 filled will create a simulation function instruction to set the state of a Test Object simulation function.
  - The value for the individual manual/simulation precondition will be combined from the header and the content cell from row 9 on.
- Test Object under Test:
  - Is described in Location 1… Location 4 + Test Object Name in columns A to E
  - The Macro creates a Test Case per Test Object under Test
  - For each row, a Test Step is created
  - The Macro ignores rows with an empty Object Name
- Command:
  - Is to be written in column F9 downwards;
  - The value of the **command** cell will be used in the manual source, which is created from it
- Expected reaction:

- The column for the expected reaction is found by exactly this string. It determines the last cell of the precondition table, which is one to the left of the expected reaction column.
- The value of the **expected reaction** cell will be used in the manual sink, which is created from it.

Please note: The macro does not provide a merging feature. Therefore it just appends the new Test cases to the Test Cases worksheet. The user has to care about deleting old interlocking schemes from the table.

6.2.6.3.2. Import Interlocking Table Dialogue

Open the Macro by pressing the **Import Interlocking Table** button in the SITIPE AT ribbon.

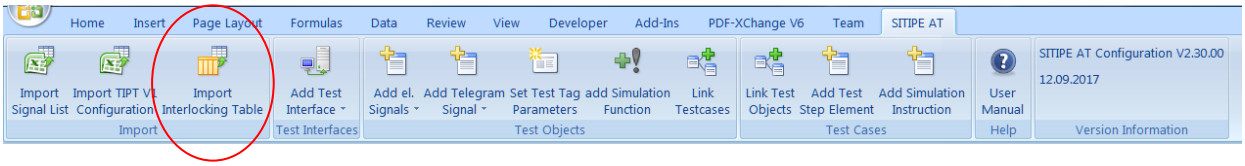


Figure 148 Import Interlocking Table Macro in SITIPE AT Ribbon

The **Import Interlocking Table** Dialogue is opened. It is shown in Figure 149.

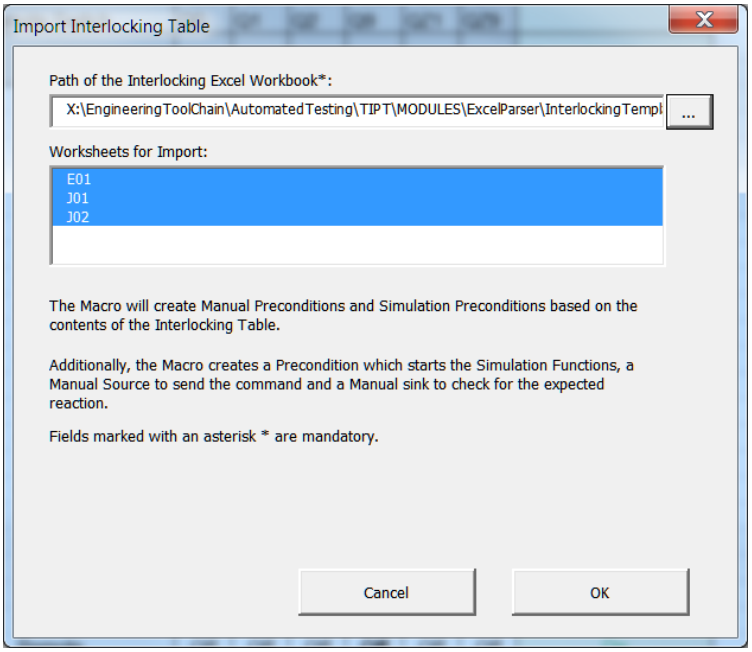


Figure 149 Import Interlocking Table Dialogue

Select an Interlocking Workbook using the **…** Button. Enter the path in the following file dialogue. The Workbook is afterwards loaded, and the existing worksheets are listed in the list **Worksheets for Import.** The macro will parse all worksheets by default. You may unselect a worksheet, which does not contain interlocking information.

Press OK to start processing the Interlocking Workbook. This may take some time, depending on your PC setup. The dialogue shows progress bars to indicate the Progress.

7. Appendix

7.1. Protocol Specifics

This chapter describes properties and attributes unique to Virtual Interfaces. It is applicable to all parts of the Document.

7.1.1. IEC 60870-5 -101 / -104 Master

7.1.1.1. Known Issues

For IEC 60870-5-101 the following limitations apply:

- Linkaddress range is from 1…254, even if linkaddress length = 2 bytes is configured
- Currently only balanced mode is supported
- Information Object Address length is a fixed value of 3. Other IOA lengths are not supported.
- Only COM Ports 1…4 are supported. Please configure your Test PCs serial port accordingly.

A feature request to fix those limitations can be given to the SITIPE AT product lifecycle management.

7.1.1.2. Type Identifier (TI)

Process Information in Monitoring Direction:

Value	Description	Time Information
1	Single-Point Information	NONE
3	Double-Point Information	
5	Step position Information	
7	Bitstring of 32 Bit	
9	Measured Value, normalized	
11	Measured Value, scaled	
13	Measured Value, short floating point	
15	Integrated Totals	
20	Packed single-point Information with status change detection	
21	Measured Value, normalized without Quality descriptor	
30	Single-Point Information	Yes, CP56Time2a

Value	Description	Time Information
31	Double-Point Information	
32	Step position Information	
33	Bitstring of 32 Bit	
34	Measured Value, normalized	
35	Measured Value, scaled	
36	Measured Value, short floating point	
37	Integrated Totals	
38	Event of protection equipment	Yes, CP56Time2a
39	Packed single-point Information with status change detection	
40	Measured Value, normalized without Quality descriptor	

Table 54 Supported IEC 60870-5 -101/-104 Monitoring Telegram Datatypes

Process Information in Control Direction:

Value	Description	Time Information
45	Single Command	NONE
46	Double Command	
47	Regulating Step Command	
48	Set point command, normalized value	
49	Set point command, scaled value	
50	Set point command, short floating point	
51	Bit string of 32 bit	
58	Single Command	Yes, CP56Time2a
59	Double Command	
60	Regulating Step Command	
61	Set point command, normalized value	

Value	Description	Time Information
62	Set point command, scaled value	
63	Set point command, short floating point	
64	Bit string of 32 bit	

Table 55 Supported IEC 60870-5 -101/-104 Control Telegram Data types

7.1.1.3. Cause of Transmission (COT)

Value	Description
0	Not used
1	Periodic, cyclic
2	Background scan
3	Spontaneous
4	Initialized
5	Request or Requested
6	Activation
7	Activation Confirmation
8	Deactivation
9	Deactivation Confirmation
11	Return information caused by a remote command
12	Return information caused by a local command
13	File Transfer
20	Interrogated by station interrogation
21 … 36	Interrogated by group1…16 interrogation
37	Requested by general counter request
38 … 41	Requested by group 1…4 counter request
44	Unknown Type Identification

Value	Description
45	Unknown Cause of Transmission
46	Unknown CASDU
47	Unknown IOA

Table 56 Supported IEC 60870-5 -101/-104 Cause of Transmission

7.1.1.4. Qualifier of Command (QOC)

Value	Description
0	Without additional specification
1	Short output time
2	Long output time

Table 57 Supported IEC 60870-5 -101/-104 Qualifier of Command

7.1.2. IEC 61850-8-1 MMS Client

7.1.2.1. Cause of Transmission (COT)

Value	Description
0	Not used
1	Periodic, cyclic
2	Background scan
3	Spontaneous
4	Initialized
5	Request or Requested
6	Activation
7	Activation Confirmation
8	Deactivation
9	Deactivation Confirmation
11	Return information caused by a remote command
12	Return information caused by a local command
13	File Transfer

Value	Description
20	Interrogated by station interrogation
21 … 36	Interrogated by group1…16 interrogation
37	Requested by general counter request
38 … 41	Requested by group 1…4 counter request
44	Unknown Type Identification
45	Unknown Cause of Transmission
46	Unknown CASDU
47	Unknown IOA

Table 58 Supported IEC 61850 Client Cause of Transmission

7.1.2.2. Predefined Logical Nodes and Data Objects (LN)

This List is used to map mostly used Logical Nodes to Common Data Classes. In the consequence the User does not have to specify a CDC for Attributes of those Logical nodes.

The List may be extended in the File IEC61850Setup.str in the Directory <SITIPE AT Installation Path>\data\61850\. Please note, that no additional CDCs are supported in the IEC 61850 MMS Client, even if you define them in IEC61850Setup.str.

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
LPHD	Physical Device Information	PhyNam	DPL
		PhyHealth	INS
		OutOv	SPS
		Proxy	SPS
		InOv	SPS
		NumPwrUp	INS
		WrmStr	INS
		WacTrg	INS
		PwrUp	SPS
		PwrDn	SPS
		PwrSupAlm	SPS
		RsStat	SPC
LLN0	Logical Node Zero	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		Loc	SPS

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
		OpTmh	INS
		Diag	SPC
		LEDRs	SPC
		SGCB	SGCB
CSWI	Switch Controller	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		Loc	SPS
		OpCntRs	INC
		PosA	DPC
		PosB	DPC
		PosC	DPC
		Pos	DPC
		OpOpn	ACT
		OpCls	ACT
XCBR	Circuit Breaker	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		Loc	SPS
		EEHealth	INS
		OpCnt	INS
		Pos	DPC
		BlkOpn	SPC
		BlkCls	SPC
		ChaMotEna	SPC
		CBOpCap	INS
		POWCap	INS
		MaxOpCap	INS
CILO	Interlocking	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EnaOpn	SPS
		EnaCls	SPS
XSWI	Circuit Switch	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		Loc	SPS
		EEHealth	INS
		OpCnt	INS
		Pos	DPC
		BlkOpn	SPC
		BlkCls	SPC
		ChaMotEna	SPC
		SwTyp	INS
		SwOpCap	INS
		MaxOpCap	INS

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
GGIO	Generic Process I/O	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EEHealth	INS
		Loc	SPS
		OpCntRs	INC
		AnIn	MV
		SPCSO	SPC
		DPCSO	DPC
		ISCSO	INC
		IntIn	INS
		Alm	SPS
		Ind	SPS
TCTR	Current Transformer	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EEHealth	INS
		OpTmh	INS
		Amp	SAV
TVTR	Voltage Transformer	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EEHealth	INS
		OpTmh	INS
		Vol	SAV
		FuFail	SPS
MMXU	Measurement	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EEHealth	INS
		TotW	MV
		TotVAr	MV
		TotVA	MV
		TotPF	MV
		Hz	MV
		PPV	DEL
		PhV	WYE
		A	WYE
		W	WYE
		VAr	WYE
		VA	WYE
		PF	WYE
		Z	WYE
MMTR	Metering	Mod	INC
		Beh	INS
		Health	INS

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
		EEHealth	INS
		TotVAh	BCR
		TotWh	BCR
		TotVArh	BCR
		SupWh	BCR
		SupVArh	BCR
		DmdWh	BCR
		DmdVArh	BCR
MSQI	Sequence & Imbalance	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		EEHealth	INS
		SeqA	SEQ
		SeqV	SEQ
		DQ0Seq	SEQ
		ImbA	WYE
		ImbNgA	MV
		ImbNgV	MV
		ImbPPV	DEL
		ImbV	WYE
		ImbZroA	MV
		ImbZroV	MV
		MaxImbA	MV
		MaxImbPPV	MV
		MaxImbV	MV
IHMI	Human Machine Interface	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
PTOC	Time Overcurrent	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		Str	ACD
		Op	ACT
PTTR	Thermal Overload	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		Amp	MV
		TmpRl	MV
		Tmp	MV
		LodRsvAlm	MV
		LodRsvTr	MV
		AgeRat	MV
		Str	ACD
		Op	ACT
		AlmThm	ACT

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
PHAR	Harmonic Restraint	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		Str	ACD
RBRF	Breaker Failure	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		Str	ACD
		OpEx	ACT
		OpIn	ACT
RREC	Autoreclosing	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		BlkRec	SPC
		ChkRec	SPC
		AutoRecSt	INS
		Auto	SPS
		Op	ACT
PTRC	Protection Trip Conditioning	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		Tr	ACT
		Op	ACT
		Str	ACD
PIOC	Instantaneous Overcurrent	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		Str	ACD
		Op	ACT
RFLO	Fault Locator	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		FltZ	CMV
		FltDiskm	MV
		FltLoop	INS
RDRE	Disturbance Recorder Function	Mod	INC
		Beh	INS
		Health	INS

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
		NamPlt	LPL
		OpCntRs	INC
		RcdMade	SPS
		FltNum	INS
		GriFltNum	INS
RADR	Disturbance Recorder Channel Analogue	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		ChTr	SPS
RBDR	Disturbance Recorder Channel Binary	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		OpCntRs	INC
		ChTr	SPS
CALH	Alarm Handling	Mod	INC
		Beh	INS
		Health	INS
		NamPlt	LPL
		GrAlm	SPS
		GrWrn	SPS
		AlmLstOr	SPS
RPSB	Power Swing Detection / Blocking	Mod	INC
		Beh	INS
		Health	INS
		OpCntRs	INC
		Str	ACD
		Op	ACT
		BlkZn	SPS
ATCC	Automatic Tap Changer Control	Mod	INC
		Beh	INS
		Health	INS
		Loc	SPS
		OpCntRs	INC
		TapChg	BSC
		TapPos	ISC
		ParOp	DPC
		LTCBlk	SPC
		LTCDragRs	SPC
		VRed1	SPC
		VRed2	SPC
		CtlV	MV
		LodA	MV
		CircA	MV
		PhAng	MV
		HiCtlV	MV
		LoCtlV	MV
		HiDmdA	MV

LN (abbreviated)	LN (written)	DataObject	Assigned Common Data Class (CDC)
		Auto	SPS
		HiTapPos	INS
		LoTapPos	INS
		BndCtr	ASG
ANCR	Neutral Current Regulator	Mod	INC
		Beh	INS
		Health	INS
		Loc	SPS
		OpCntRs	INC
		TapChg	BSC
		RCol	SPC
		LCol	SPC
		Auto	SPS
RSYN	Synchronism-Check or Synchronising	Mod	INC
		Beh	INS
		Health	INS
		RHz	SPC
		LHz	SPC
		RV	SPC
		LV	SPC
		Rel	SPS
		VInd	SPS
		AngInd	SPS
		HzInd	SPS
		SynPrg	SPS
		DifVClc	MV
		DifHzClc	MV
		DifAngClc	MV

Table 59 Predefined Logical Nodes and Data Objects of SITIPE AT 61850 MMS Client

7.1.2.3. Supported Common Data Classes (CDC)

This chapter lists all supported Common Data Classes, its supported Data Attributes, their Functional Constraints, Data type and support of Quality and Time Property.

Quality, Time, Originator cannot be defined as Data points. They are shown in the Data Attribute directly.

For Controllable Classes, Select Before Operate (SBO) and Control Attributes are read implicitly. This includes origin, ctlNum, ctlModel, sboTimeout, SBOw, Oper and Cancel. You do not need to map those Attributes to execute a Command successfully.

The Datatypes are Boolean, Integer or Floating Point Number. For Boolean values, only 0 and 1 are available.

CDC (abbrev.)	CDC (written)	Data Attribute (DA)	Functional Constraint (FC)	Expected Data type	Quality?	Time?
SPS	Single Point Status	stVal	ST	Boolean	Y	Y
DPS	Double Point Status	stVal	ST	Boolean	Y	Y
INS	Integer Status	stVal	ST	Integer	Y	Y
ACT	Protection Activation Information	General	ST	Boolean	Y	Y
		phsA	ST	Boolean	Y	Y
		phsB	ST	Boolean	Y	Y
		phsC	ST	Boolean	Y	Y
		neut	ST	Boolean	Y	Y
ACD	Directional Protection Activation Information	General	ST	Boolean	Y	Y
		dirGeneral	ST	Integer	Y	Y
		phsA	ST	Boolean	Y	Y
		dirPhsA	ST	Integer	Y	Y
		phsB	ST	Boolean	Y	Y
		dirPhsB	ST	Integer	Y	Y
		phsC	ST	Boolean	Y	Y
		dirPhsC	ST	Integer	Y	Y
		neut	ST	Boolean	Y	Y
		dirNeut	ST	Integer	Y	Y
MV	Measured Value	mag.f	MX	Floating Point	Y	Y
CMV	Complex Measured Value	cVal.mag.f	MX	Floating Point	Y	Y
SAV	Sampled Value	instMag.f	MX	Floating Point	Y	Y
WYE	Collection of Measurands	phsA.cVal.mag.f	MX	Floating Point	Y	Y
		phsB.cVal.mag.f	MX	Floating Point	Y	Y
		phsC.cVal.mag.f	MX	Floating Point	Y	Y
		neut.cVal.mag.f	MX	Floating Point	Y	Y
		net.cVal.mag.f	MX	Floating Point	Y	Y
		res.cVal.mag.f	MX	Floating Point	Y	Y
DEL	Delta	phsAB.cVal.mag.f	MX	Floating Point	Y	Y
		phsBC.cVal.mag.f	MX	Floating Point	Y	Y
		phsCA.cVal.mag.f	MX	Floating Point	Y	Y
SEQ	Sequence	c1.cVal.mag.f	MX	Floating Point	Y	Y
		c2.cVal.mag.f	MX	Floating Point	Y	Y
		c3.cVal.mag.f	MX	Floating Point	Y	Y

CDC (abbrev.)	CDC (written)	Data Attribute (DA)	Functional Constraint (FC)	Expected Data type	Quality?	Time?
		seqT	MX	Integer	Y	Y
BCR	Binary Counter Reading	actVal	ST	Integer	Y	Y
		frVal	ST	Integer	Y	Y
SPC	Controllable Single Point	stVal	ST	Boolean	Y	Y
		ctlVal	CO	Boolean	Y	Y
		ctlNum	CO/ST	Integer		
		ctlModel	CF	Integer		
		sboTimeout	CF	Integer		
		Oper	See CDC **Oper**			
		SBOw	See CDC **SBOw**			
		Cancel	See CDC **Cancel**			
DPC	Controllable Double Point	stVal	ST	Integer	Y	Y
		ctlVal	CO	Boolean	Y	Y
		ctlNum	CO/ST	Integer		
		ctlModel	CF	Integer		
		sboTimeout	CF	Integer		
		Oper	See CDC **Oper**			
		SBOw	See CDC **SBOw**			
		Cancel	See CDC **Cancel**			
INC	Controllable Integer Status	stVal	ST	Integer	Y	Y
		ctlVal	CO	Integer	Y	Y
		ctlNum	CO/ST	Integer		
		ctlModel	CF	Integer		
		sboTimeout	CF	Integer		
		Oper	See CDC **Oper**			
		SBOw	See CDC **SBOw**			
		Cancel	See CDC **Cancel**			
ISC	Integer Controlled Step Position Information	ctlVal	CO	Integer	Y	Y
		valWTr	See CDC **valWTr**			
		ctlNum	CO/ST	Integer		
		ctlModel	CF	Integer		
		valWTr	See CDC **valWTr**			
		Oper	See CDC **Oper**			
BSC	Binary Controlled Step Position Information	ctlVal	CO	Integer	Y	Y
		ctlNum	CO/ST	Integer		
		ctlModel	CF	Integer		
		valWTr	See CDC **valWTr**			
		Oper	See CDC **Oper**			
APC	Controllable Analog Set point Information	setMag.f	SP/MX	Floating Point		Y
		ctlModel	CF	Integer		
SGCB	Setting Group	NumOfSG	SP	Integer	Y	Y
		ActSG	SP	Integer	Y	Y
		EditSG	SP	Integer	Y	Y
		CnfEdit	SP	Boolean	Y	Y
SPG	Single Point Setting	stVal	SP/ST	Boolean	Y	Y

CDC (abbrev.)	CDC (written)	Data Attribute (DA)	Functional Constraint (FC)	Expected Data type	Quality?	Time?
ING	Integer Status Setting	stVal	SP/ST	Integer	Y	Y
ASG	Analogue Setting	setMag.f	SP/MX	Floating Point	Y	Y
Oper		ctlVal	CO	Integer		
		ctlNum	CO	Integer		
		Test	CO	Boolean		
		Check	CO	Integer	Y	Y
SBOw		ctlVal	CO	Integer		
		ctlNum	CO	Integer		
		Test	CO	Boolean		
		Check	CO	Integer	Y	Y
Cancel		ctlVal	CO	Integer		
		ctlNum	CO	Integer		
		Test	CO	Boolean		
ValWTr		posVal	ST	Integer	Y	Y
		transInd	ST	Boolean	Y	Y

Table 60 Supported CDCs and Data Attributes for 61850 MMS Client

7.1.2.4. Supported Functional Constraints (FC)

The 61850 MMS Client of SITIPE AT supports the following Functional Constraints:

- ST – Status Information
- MX – Measurands
- CO – Control
- SP – Set point
- SG – Set configuration group
- SE – Edit configuration group
- SV – substitution
- CF – Configuration
- DC – Description
- EX – Extension

Control (CO) and Setpoints (SP) Data Attributes can be manipulated by Sending a Command using the Send Command Tab of 61850 MMS Client Dialogue or using virtual sources in a Closed Loop Test.

7.1.3. DNP3.0 Master/ Modbus Master

Please note: The DNP3.0 Driver is configured to scan connected devices for Class 0, 1, 2, 3 Telegrams. Therefore all information is gathered from the devices. Solicited / Spontaneous Communication is currently not configured. Please contact SITIPE AT Development team for further information.

7.1.3.1. Cause of Transmission (COT)

Value	Description
0	Not defined
1	Spontaneous
2	Periodic
3	Initialized
4	Buffered
8	General Interrogation
9	Request
10	Count Value Request
16	Select
17	Select Confirmation Positive
18	Select Confirmation Negative
19	Command
20	Command Confirmation Positive
21	Command Confirmation Negative
25	Abort
26	Abort Confirmation Positive
27	Abort Confirmation Negative
29	Release Request
30	Release Request Confirmation Positive
31	Release Request Confirmation Negative
32	Organizatory Information
33	Information Loss
34	Return Information
35	Command Termination Positive

Value	Description
36	Command Termination Negative
37	Abort Termination Positive
38	Abort Termination Negative
39	Select Termination Positive
40	Select Termination Negative
41	Release Request Termination Positive
42	Release Request Termination Negative
45	Select Expired
46	Select Timeout
47	Command Timeout
48	Abort Timeout
49	Command Finished
50	Abort Finished

Table 61 Supported Communication Frontend / Modbus/ DNP3.0 Master Cause of Transmission

7.1.3.2. Additional Cause of Transmission (Add. COT)

Value	Value Decimal	Description
0x00	0	Positive
0x20	32	Command Release Error
0x21	33	Command Reset Error
0x22	34	Output Time Error
0x23	35	Command Check Error
0x24	36	Counter Release Error
0x25	37	Unknown IO Channel
0x26	38	Too many active Commands
0x27	39	Wrong Command Type

Value	Value Decimal	Description
0x28	40	Wrong Data Type
0x29	41	Command not Accepted
0x40	64	One out of N Error (Hardware)
0x41	65	Read back Check Error
0x42	66	Command Relays Power Failure
0x43	67	Release Relays Disconnect Failure
0x44	68	Output Register Implausible
0x50	80	Voltage Test Failure
0x51	81	Current Test Failure
0x52	82	Wrong Operation Output
0x53	83	Command Output Power Failure
0x60	96	Interlock Diagnosis
0x61	97	Switching Error Protection Interlock
0x62	98	Parameter Error
0x63	99	Authority Violation
0x64	100	Command Too Old
0x65	101	No Process Output Object
0x66	102	Output Blockage Set
0x67	103	Module Hardware Error
0x68	104	IO Channel Hardware Error
0x69	105	Overload
0x70	112	Upper Bound Reached
0x71	113	Lower Bound Reached
0x72	114	Plausibility Error
0x73	115	Synchronization Precondition Failure

Value	Value Decimal	Description
0x74	116	Device Status
0x75	117	State Already Reached
0x76	118	Monitoring Time Expired
0x77	119	Acquisition Blockage Set
0x78	120	Chatter Disable Active
0x79	121	One Out of N Error (Software)
0xC4	196	Synchro Check Interlock
0xC5	197	No Synchrocheck Interlock
0xC6	198	Synchrocheck No Interlock
0xC7	199	No Synchrocheck No Interlock

Table 62 Supported Communication Frontend / DNP3.0 /Modbus Master Additional Cause of Transmission