Grid Automation Products

SAM600 Process Bus I/O System
Engineering Manual
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Safety information

Observe the following safety instructions when using the product.

⚠️ Before first usage, read the product documentation in order to ensure safe and reliable operation of SAM600 products.

⚠️ Dangerous voltages can occur on the connectors, even though auxiliary voltages are disconnected.

⚠️ Each SAM600 product must be safely connected to ground using the ground strap.

⚠️ Only a competent electrician is allowed to carry out the electrical installation.

⚠️ Always follow national and local electrical safety regulations.

⚠️ Non-observance of the safety information can result in death, personal injury or substantial property damage.

⚠️ Whenever changes in parameter settings are applied to SAM600 modules, take measures to avoid inadvertent tripping or malfunction of connected protection and control devices.
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Section 1  Introduction

1.1  This manual

The engineering manual contains instructions on how to engineer a SAM600 system using PCM Protection and Control IED manager and various tools within the tool framework. This manual provides instructions on how to set up a PCM600 project and insert a SAM600 system to the project structure. This manual also recommends a sequence for the engineering of a SAM600 system.

1.2  Intended audience

The engineering manual addresses system and project engineers involved in the engineering process of a project, and installation and commissioning personnel, who use technical data during engineering, installation and commissioning, and in normal service.

The system engineer or system integrator must have a basic knowledge of communication in protection and control systems and thorough knowledge of the specific communication protocol IEC 61850.

1.3  Related documents

The following product documentation is available for the SAM600.

Table 1: SAM600 product documentation

<table>
<thead>
<tr>
<th>SAM600 Product documentation</th>
<th>Document number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAM600 Product Guide</td>
<td>1MRK 511 428-BEN</td>
</tr>
<tr>
<td>SAM600 Engineering Manual</td>
<td>1MRK 511 431-UEN</td>
</tr>
<tr>
<td>SAM600 Operation Manual</td>
<td>1MRK 511 429-UEN</td>
</tr>
<tr>
<td>SAM600 Cyber Security Deployment Guideline</td>
<td>1MRK 511 430-UEN</td>
</tr>
<tr>
<td>SAM600 Accessory List</td>
<td>1MRK 511 432-BEN</td>
</tr>
<tr>
<td>SAM600 Safety Leaflet</td>
<td>1KHL511872-UEN</td>
</tr>
<tr>
<td>SAM600-TS Wiring Diagram</td>
<td>1KHL511910</td>
</tr>
<tr>
<td>SAM600-VT Wiring Diagram</td>
<td>1KHL511911</td>
</tr>
<tr>
<td>SAM600-CT Wiring Diagram</td>
<td>1KHL511912</td>
</tr>
</tbody>
</table>
1.4 Document symbols and conventions

1.4.1 Symbols

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader of important facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. It is important that the user fully complies with all warning and cautionary notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- HMI menu paths are presented in bold. For example, select **Main menu** or **Settings**.
- Parameter names are shown in *italics*. For example, the function can be enabled and disabled with the *Operation* setting.
Section 2  Engineering tool set

2.1  Introduction

This chapter describes the engineering process as outlined in IEC 61850-6 Edition 2. In general IEC 61850-4 defines three roles for engineering tools, which allows combining more than one role in a single tool.

- **System Configuration Tools** (SCT) define the dataflow between a SAM600 system and other equipment in an IEC61850 system. Common topics for several IED and logical associations of functions embedded in the IED which control and supervise the primary process are configured.

According to IEC 61850-6 Edition 2, SCT handle the following SCL sections:

- Substation section including references to logical nodes on SAM600 systems
- Communication section including project specific instance addresses
- Datasets and control blocks, as allowed by a SAM600 system capabilities
- Allocation of data flow and report control block instances to clients, as allowed by a SAM600 system capabilities
- Creating SAM600 system input sections from system engineering without binding to SAM600 system internal signals
- Reorganizing the *DataTypeTemplate* section to keep the type identifiers unique and the template section short. The instance information is unchanged when the templates are expanded in SAM600 system instances

- **IED Configuration Tools** (ICT) handle a specific device configuration and downloading a respective SAM600 system configuration to the target device. The configuration generated from an ICT can be imported to a SCT for further engineering.

The following data model changes are allowed by ICT according to IEC 61850-6 Edition 2:

- Addition of logical devices, logical nodes or DATA within logical nodes
- Removal of logical devices, logical nodes or DATA, which are not referenced by clients or bound to the primary system description (substation section)
2.2 SAM600 system engineering

The system engineering of the substation automation system in IEC 61850 based substations is done either using a top-down or a bottom-up approach.

- In the top-down engineering process, the system integrator selects the appropriate library ICD files representing a SAM600 system type and builds the SCD according to the substation design. In this phase, the substation configuration includes all SAM600 systems, single-line diagrams, sample value links between the devices and the event definitions (datasets). The SCD file is imported to a SAM600 IED configuration tool where a SAM600 system is parameterized and configured according to the application or power system specifications.

- In the bottom-up approach, the workflow starts from a SAM600 IED configuration tool which creates the set of SAM600 systems and exports the initial IID files to the System Configuration Tool. The IID file contains default values of single-line diagrams, datasets for event reporting and MSVCB’s for the communication between server SAM600 systems.

  In simple cases, default values meet the customer specifications. In the System Configuration Tool, the system engineer creates sample value links and customizes the details of single-line diagrams and datasets as per the requirements. The SCT exports the SCD file back to a SAM600 IED configuration tool where then a SAM600 configuration is finalized.

SAM600 supports the bottom-up engineering workflow.

2.2.1 SAM600 system configuration with PCM600

PCM600 is used for various tasks in a SAM600 system engineering process, see Figure 1.

- SAM600 system engineering management
  - Organizing the bay SAM600 systems in the structure of the substation by defining voltage levels and bays below the substation. A PCM600 project can have only one substation.
  - Configuring or updating the SAM600 modules by using the Configuration Wizard, see Section 4.4.1 or Composition Upgrade Tool, see Section 5.3.
  - Configuring the parameters and setting values for a SAM600 system itself and for the process functionality by using the Parameter Setting Tool. For more information, see Section 5.1.
Engineering tool set

- Communication Engineering
  - Sampled Values can be configured with the PCM600 built in SV Stream and Port Configuration Tool.

- Service Engineering
  - Listing the existing SAM600 system internal events and process events by using the Event Viewer Tool, see Section 7.
  - Interact with SAM600 system via commands, see Section 5.6.

SAM600-specific functionalities like Indicate Modules, Get Serial Number, Set Simulation Mode and Reset to Factory Default are available to support the engineering, commissioning and operational phase of the project.

Once the engineering of a SAM600 system is done, the results are written to a SAM600 system. Conversely, engineering information can be uploaded from a SAM600 system for various purposes.

The connection between the physical SAM600 system and PCM600 is established via USB link.
## Section 3 Engineering process

### 3.1 SAM600 engineering process

The recommended sequences for a SAM600 engineering process is shown in the following workflow, see Figure 2. Those workflow steps are described in various sections throughout this document.

![Figure 2: SAM600 system engineering workflow](image)

- **Start**
- **Create Project**
- **Configuration Wizard**
  - Configure SAM600 IED by selecting Hardware Modules and selecting the ports for SAM600 System Bus
  - Parametrization
  - Sampled value and port configuration
- **PST**
- **SV Stream and Port Configuration**
- **Write to SAM600 IED**
- **End**

*Figure 2: SAM600 system engineering workflow*
Section 4  Setting up a project

4.1  PCM600 projects

A typical project in PCM600 contains a plant structure including one or several SAM600 system objects, where each SAM600 system object contains the engineering data created or modified using different PCM600 tools.

Several projects can be created and managed by PCM600, whereas only one project can be active at a time. Several types of SAM600 systems can be managed in one PCM600 project.

4.2  Connectivity packages and modules

A Connectivity Package contains the complete description of a SAM600 system data signals, parameters and protocol addresses for a certain SAM600 system type.

The SAM600 system module contains the specific SAM600 system version type data and communication interface description.

Install PCM600 before installing the Connectivity Packages. After installing Connectivity Packages, install the required SAM600 system modules.

PCM600 version 2.7 Hot Fix 2 or newer must be used with SAM600 version 1.10.

In the PCM600 Update Manager, the Connectivity Package, SAM600 system module and product documentation are available.

Windows User Account Settings need to be set to the lowest level before installing a SAM600 Connectivity Package.

The following procedure is recommended for installing Connectivity Packages and SAM600 system modules.

1. Close PCM600 before running a SAM600 system Connectivity Package installation
2. Install a SAM600 system series Connectivity Package base
3. Select and install the required SAM600 system modules
4. Install the documentation
4.3 Building a plant structure

A plant structure is used to identify each SAM600 system in its location within the substation organization. It is a geographical image of the substation and the bays within the substation. The organization structure for a SAM600 systems may differ from the structure of the primary equipment in the substation. In PCM600 it is possible to set up five levels of hierarchical structure for a SAM600 system identification, see Figure 3.

![Figure 3: PCM600: Plant Structure](image)

The different plant structure levels are available for the selected project. Several SAM600 systems are possible within a bay, for example one control SAM600 system and two protection SAM600 systems.

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>Project name</td>
</tr>
<tr>
<td>Substation</td>
<td>Name of the substation</td>
</tr>
<tr>
<td>Voltage Level</td>
<td>Grid type or part in the substation to which a SAM600 system belongs to</td>
</tr>
<tr>
<td>Bay</td>
<td>Bay within the voltage level</td>
</tr>
<tr>
<td>SAM600 system</td>
<td>Selection of a SAM600 system used in the bay</td>
</tr>
</tbody>
</table>
Once a plant structure is built, the name of each level in the structure should be renamed by the names or identifications used in the grid. Use the right mouse button to build the plant structure by selecting the elements from the context menu. Rename the level after insertion using the Rename possibility or the Object Properties. Figure 3 shows the start of a project with single SAM600 system placed, before renaming the level.

The plant structure corresponding to the complete grid includes the required SAM600 systems.

The following procedure can be followed for building a plant structure.

1. Right-click on the Plant Structure, select New and Create from Template ..., or
2. Right-click on the Plant Structure, select New, General and select either SAM600 system Group or Substation
3. Click View in the menu bar and select Object Types. Select the required elements and drag and drop them into the Plant Structure.
4.4 Instantiating a SAM600 system

4.4.1 Configuration wizard

Depending on the installed Connectivity Package, the context menu or the Object Types view shows the possible available SAM600 systems to insert on the bay level Plant Structure, see Figure 4.

On the bay level Plant Structure it is possible to insert a SAM600 system in online or offline mode.

- **Online mode:** When a SAM600 system is connected to PCM600 and the communication is established, PCM600 reads the configuration from the physical SAM600 system. PCM600 reads hardware modules, serial numbers, and SAM600 system information from a SAM600 system.

- **Offline mode:** When the physical SAM600 system is not available or not connected to PCM600, the engineering steps are done without any synchronization with a SAM600 system. The offline configuration in PCM600 is synchronized with the physical SAM600 system at a later state by connecting a SAM600 system to PCM600 and downloading the configuration.

The green check mark next to a SAM600 icon in Figure 4 indicates that the communication between a SAM600 system object in PCM600 and the physical SAM600 system is established.

![Project Explorer](image)

*Figure 4: Plant structure with online SAM600 system*

- Import a template into a SAM600 system available in the template library as a *.pcmt file.
- Import a pre-configured SAM600 system configuration available as a *.pcmi file.

The detailed instructions are found in the PCM600 online help.
4.5 Inserting an SAM600 system in online mode

Follow the procedure to insert an SAM600 system in online mode:

1. Right-click on the Bay, navigate to New and select SAM600 system application type.
2. Select and click a SAM600 system, see Figure 5. A SAM600 system Configuration Wizard dialog box appears.

![Figure 5: PCM600: SAM600 system insertion](image)

It is possible to drag a SAM600 system from the Object Types window to the Bay level.

3. Select the Online Configuration radio button, see Figure 6.

![Figure 6: PCM600: Configuration mode selection wizard](image)
4. Select *USB* from the **IED protocol** drop-down list, see Figure 7.

For SAM600, only USB IED protocol is supported.

![PCM600: Communication protocol selection wizard](image)

*Figure 7: PCM600: Communication protocol selection wizard*

5. Select the available port from the **COM Port Selection** drop-down list to configure, see Figure 8.

The *Hardware Module ID* shows the serial number of the physically SAM600 connected module. The *Hardware Module Type* indicates the type of the physically connected SAM600 module.

![PCM600: Communication port selection wizard](image)

*Figure 8: PCM600: Communication port selection wizard*

**Only SAM600 USB connections that are available will be shown in the COM Port Selection drop down list.**
6. Click the **Scan** button to scan or read the SAM600 hardware modules and the connection topology for a SAM600 system that is online, see **Figure 9**.

![Figure 9: PCM600: Hardware Module and connection topology detected](image)

If the SAM600 module connected to PCM600 is already configured, then the topology information is fetched from the configuration on the SAM600 system. If the SAM600 system is in factory default settings, then the physical topology is discovered.

7. Click the **Next** button to open a SAM600 system - Summary Page, see **Figure 10**. The dialog box displays **Custom Name, Module Type, Hardware Type, Serial Number** and **Available Ports** details. It is possible to cancel the insertion using **Cancel** button or confirm the configuration and do the insertion using **Finish** button.

![Figure 10: PCM600: SAM600 system Setup completion wizard](image)
If an error occurs, cancel the insertion and reinsert a SAM600 system into PCM600.

When the online configuration is completed, a SAM600 system physical deployment is initiated in PCM600. To get the current parameter and communication settings, the configuration has to be read from a SAM600 system. With this step a SAM600 system object in PCM600 has the same configuration data as the physical SAM600 system.

### 4.6 Inserting a SAM600 system in offline mode

In offline mode, a user can start preparing a configuration even if a SAM600 is not physically available. Setting up a SAM600 system in offline mode is similar to inserting an SAM600 system in online mode.

Follow the procedure to insert a SAM600 system in offline mode:

1. Right-click on the **Bay**, navigate to **New** and select SAM600 system application type.
2. Select and click a SAM600 system. A SAM600 system Configuration Wizard dialog box appears.
   
   It is possible to drag a SAM600 system from the Object Types window to the Bay level.

3. Select the **Offline Configuration** radio button, see Figure 11.

   ![Figure 11: PCM600: Configuration mode selection wizard](image)

4. Select **USB** from the IED protocol drop-down list, see Figure 12.
For SAM600, only USB is supported.

5. Select the available port from the COM Port Selection drop-down list to configure, see Figure 13.

In the offline mode it is not mandatory to select the USB port if not available at the engineering phase. The selected port will be used later to write the configuration to the SAM600 system.

6. Click the Next button to open a SAM600 system - Composition Selection Page.

7. Select the Module Type, Hardware Type (available for SAM600-CT), and the Version from the respective drop-down lists, also enter the Serial Number and Custom Name in the respective fields, see Figure 14.
Setting up a project

Figure 14: PCM600: Composition selection page wizard

It is not mandatory to enter the Serial Number if not available at this stage of the configuration phase. If required, modify the default Custom name.

A SAM600 system consists at least one module of any type (SAM600-CT or SAM600-VT or SAM600-TS) and can have up to 10 SAM600 modules. The amount of analog processing modules (SAM600-CT, SAM600-VT) per SAM600 system is limited to 7. The amount of time synchronization modules (SAM600-TS) is limited to 3 per SAM600 system.

8. Click the Next button to open a SAM600 system Bus Port Selection Page.
9. Select the Custom Name from the drop-down list set in the previous page according to the intended physical arrangement of a SAM600 system. After disposing the order of modules by assigning the Custom Name, select the ports for a SAM600 system bus connection between the Hardware Modules, see Figure 15.

Figure 15: SAM600: Bus port selection page wizard
If the Custom Name disposing or a SAM600 system bus connection is not appropriate, validation errors are displayed.

The ports are logical grouped into two groups (Group 1=X101, X104 and Group 2=X103, X102) consisting of a RJ45 and SFP communication port each. Out of one group only one port can be configured as SAM600 system bus port.

10. Click the **Next** button to open a SAM600 system - Summary Page, see Figure 16. The Summary Page dialog box displays **Custom Name**, **Module Type**, **Hardware Type**, **Serial Number** and **Available Ports** details. It is possible to cancel the insertion using **Cancel** button or confirm the configuration and do the insertion using **Finish** button.

![Figure 16: PCM600: SAM600 system Setup completion wizard](image)

### 4.6.1 Technical key

Both a SAM600 system and a SAM600 system object in PCM600 have a technical key. The purpose of the technical key is to prevent from writing a configuration to a wrong SAM600 system. The technical key in SAM600 system and PCM600 must match to write the configuration. Each SAM600 system in a PCM600 project must have a unique technical key and therefore it is not possible to set the same technical key for several SAM600 systems in the same PCM600 project.

The default technical key created by PCM600 follows IEC 81346 naming convention.
The technical key property in PCM600 corresponds to a SAM600 system name attribute in SCL files. Changing a SAM600 system name attribute value outside PCM600 may cause the loss of data when SCL files are imported.

![Figure 17: Set technical key menu at a SAM600 system level](image)

A dialog box appears with the technical key concept information.

1. Click the OK button. PCM600 reads technical key from a SAM600 system and the technical key editor dialog box appears, see Figure 18.

![Figure 18: PCM600: Technical key editor](image)
The following selections are possible using the Technical Key Editor.

- Use the existing technical key in SAM600 system
- Use the existing technical key defined for a SAM600 system object in PCM600
- Set a user defined technical key, which changes the technical key for both the physical SAM600 system and SAM600 system object in PCM600

The maximum length of the technical key for IEC 61850 Edition 2 is 64 characters, where the recommended length is less than 32 characters.

2. Click the OK button to confirm the selection. It is not possible to set a user defined name or select the Technical Key in SAM600 system if the value already exists in the PCM600 project. A warning message is displayed on adding the duplicate technical key.

### 4.6.2 SAM600 serial numbers

The Serial Number of a SAM600 module is a global unique module identifier within the module type. The serial numbers of SAM600 modules have to be entered before writing the configuration to a SAM600 system.

The serial number can be set using one of the following scenarios:

- SAM600 System Configuration Wizard (only in offline mode), see Figure 14.
- Composition Upgrade Tool
- PCM600 Object Properties
- Get Serial Number command at a SAM600 system level (only in online mode)

If the entered serial number is incorrect, the appropriate validation errors are displayed.
Section 5  SAM600 engineering

5.1 Parameter setting tool

It is possible to read the Parameters from the SAM600 system using Parameter Setting Tool (PST), see Figure 19. Parameters read from the SAM600 system are displayed in the IED Value field of PST, see Figure 20. For more details, see PCM600 online help. Also the parameters in PCM600 can be modified using PST.

To export parameters from PST, both XRIIO and CSV file formats are supported.

Figure 19: Parameter Setting Tool
Section 5
SAM600 engineering

The organization of parameters in a tree structure is visible in the plant structure by expanding the tree. For each function, parameters are organized in basic and advanced groups in which the advanced settings are used for application optimization.

During the Common Write action, both basic and advanced settings are written to a SAM600 system.

- **Global parameters for a SAM600 system**
  
  Several settings like time synchronization related parameters need to be set in a consistent way within a SAM600 system. Possible parameters are *Power System Frequency* and *Time Synchronization Mode*.

  Global parameters can be set on a SAM600 system level where the specific parameter settings are derived for the dependent SAM600 modules.
• **SAM600 module specific parameters**

Module specific settings are set on a SAM600 module level. Possible parameters are *Transducer Values* as parameters related to digital equation settings.

In addition, there are some parameters appearing on both levels. Parameter changes on SAM600 system level are propagated to all SAM600 modules each time. Parameter changes on SAM600 module level affect related module parameters. Possible parameters are *Trigger Levels for binary inputs* and *Active High or Active Low state for binary inputs*.

### 5.2 SAM600 SV stream and port configuration

Sampled Value stream and Port Configuration is a tool used for merging the current and or voltage signals in a single IEC 61850-9-2LE stream and for defining the output. This is a PCM600 tool which can be launched from a SAM600 system context menu, see Figure 21. It is possible to subscribe external SV streams and to publish those over available SAM600 ports.

![Figure 21: PCM600: SV Stream and Port Configuration tool from SAM600 system context menu](image)

SAM600 system does not support system engineering with IED Configuration Engineering Tool (IEC) of PCM600.
- Define SAM600 SV streams

To add a sample value stream, right click on the Content Definition Port tab. A stream with a default name is added into the system which can be modified if required. Based on the hardware modules configured during a SAM600 system creation, sample value streams lists the potential sources for currents and voltages.

SV streams can be added in the Content Definition tab of the SV Stream and Port Configuration window, see Figure 22.

![Figure 22: Add SV Streams in Content Definition](image)

The options that are available when a stream is added is shown in Table 3.

<table>
<thead>
<tr>
<th>Voltage Module</th>
<th>Current Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td>Four voltages and four currents are added to the stream</td>
</tr>
<tr>
<td>✓</td>
<td>✗</td>
<td>Four voltages and four invalid currents are added to the stream</td>
</tr>
<tr>
<td>✗</td>
<td>✓</td>
<td>Four currents and four invalid voltages are added to the stream</td>
</tr>
</tbody>
</table>
SAM600 modules for current and voltage measurements can be merged by selecting the required SAM600 modules from the respective fields, see Figure 23.

![Figure 23: PCM600: Selecting Voltage and/or current modules for merging](image)

- **Define external SV Stream**

  A SAM600 system has the capability to subscribe any external IEC 61850-9-2LE sample value stream on any port. Those external streams can be published on any other available SAM600 port, called bridging.

  To add a sample value stream, right click on the **Source Port** tab. A stream with default name is added into the system, see Figure 24.

![Figure 24: Add SV Stream in Source Port Assignment](image)

  Configure the SV streams that need to be bridged.

![Figure 25: Define SV Streams](image)
**SMVID** - The sampled value ID of the stream to be bridged.

**Source Port** - The SAM600 system port the bridged stream shall be subscribed.

There are two stream types available, see Figure 25.

- **F4000S1I4U4** - This stream carries 4000 9-2 samples per sec with 50Hz system frequency. It carries four current and four voltage samples.
- **F4800S1I4U4** - This stream carries 4800 9-2 samples per second with 60Hz system frequency. It carries four current and four voltage samples

A SAM600 module cannot receive more than eight bridged streams either to a single port or to a different ports.

- **Port Assignment** - In the Destination Port assignment tab, the ports of SAM600 streams and streams which are bridged through a SAM600 system are defined, see Figure 26.

**Figure 26**

![Figure 26: PCM600: Define publishing ports between the streams and the SAM600 modules](image)

A SAM600 module cannot use more than eight source streams for its configured sent streams.

Maximum of 10 streams per SAM600 module can be configured.
SMVID and MAC address of SAM600 streams can be edited from the **Object Properties** section, see Figure 27. The minimum length of SMVID is one character and maximum length is 34 characters.

- For each destination port assignment of any SAM600 stream a new sample value control block will be instantiated.

- For a SAM600 system with single module only three of the available four ports can be used to send streams. The fourth port will be disabled. Ensure that this fourth port is not configured in PST as PTP port for time synchronization.

![Figure 27: PCM600: Modify SAM600 stream fields](image-url)
5.3 Composition upgrade tool

An existing SAM600 configuration can be modified, extended or updated at any time. This is achieved using Composition Upgrade Tool which can be launched from a SAM600 system context menu, see Figure 28.

![Figure 28: PCM600: Composition Upgrade Tool](image)

It is possible to update *Serial Number*, *Custom Name* of the Hardware Module and also SAM600 system bus connections.

It is possible to add or remove SAM600 modules to or from the SAM600 configuration. In case SAM600 modules are removed which are used to provide sample value information the respective configuration will be automatically updated. The user will be informed and asked to confirm the update, see Figure 29.

![Figure 29: System consistency update by changed system configuration](image)
5.4 Exporting and importing SCL files

5.4.1 Exporting SCL files from PCM600

A SAM600 system included in the project needs to be configured to export SCL files from PCM600.

5.4.1.1 Exporting SCD files

Follow the procedure to export SCD files from PCM600:

1. Select the Substation in the Plant Structure, see Figure 30.

2. Right-click on the Substation, and select Export... The Export window appears.

3. Select the location to store the SCD file with the required file name.

4. Click the Save button. The SCL Export Options dialog box appears, see Figure 31.

5. Click the Export button to export SCD file to the chosen location.
5.4.1.2 Exporting ICD or CID files

Follow the procedure to export ICD or CID files from PCM600:

1. Select a SAM600 system in the **Plant Structure**.
2. Right-click on a SAM600 system, and select **Export**... The **Export** window appears.
3. Select the file format from the **Save as type** drop-down list to export the file, see **Figure 32**.

- Configured IED Description (*.cid) is used for the IEC 61850 structure as needed for a SAM600 system at runtime.
- IED Capability Description (*.icd) is used for the IEC 61850 structure.

![Figure 32: Export window](image)
4. Click the Save button. The SCL Export Options window appears, see Figure 33.

![Figure 33: SCL Export Options](image)

5. Click the Export button to export ICD or CID files to the chosen location.

5.4.2 Importing SCL files to PCM600

PCM600 is able to import SCD, ICD and CID files.

All SCL files imported in PCM600 must include the original subnetwork of type “ABB-USB”. In case a System Tool will remove this subnetwork the SCD import will fail or be refused by PCM600.

Follow the procedure to import an SCD file to PCM600:

1. Select the Substation in the Plant Structure.
2. Right-click on the Substation, and select Import…. The Import window appears.
3. Select the file to be imported from the saved location.
4. Click the Open button. The SCL Import Options dialog box appears, see Figure 34.
5. Configure Import options.
   - Select *Ignore Substation Section* to ignore the sub-station section in the SCD file while importing.
   - Select *Don’t import IEDs of unknown type* to disable the import of unknown IED types (for example third-party IEDs).
   - Select *Replace unknown IED types with generic IEC 61850 object type* to replace unknown IED types with IED type “Generic IEC 61850 IED”. Use this option if you need to import third-party IEDs into PCM600.
   - Select *Ignore PCM Object Type* if the IED type is modified outside PCM600.

6. Click the **Import** button to import SCD file to the PCM600.

### 5.4.2.1 Importing ICD or CID files

Follow the procedure to import an ICD or CID file to PCM600:

1. Select the **IED** in the **Plant Structure**.
2. Right-click on the **IED**, and select **Import...**. The **Import** window appears.
3. Select the file to be imported from the saved location.
4. Click the **Open** button. The **SCL Import Options** window appears, see Figure 34.
5. Configure Import options. For more information, see Section 5.4.2.
6. Click the **Import** button to import ICD or CID files to the PCM600.
5.5 Object properties

When a SAM600 system is selected, its properties are shown in the Object Properties section. Similarly, when Plant Structure is expanded and objects under it are selected, its properties are also shown in the Object Properties section, in which some of the field values are editable.

5.6 Miscellaneous SAM600 tools

SAM600 supports additional features like **Get Serial Number**, **Set Time**, **Simulation Mode**, and **Reset to factory default**. These are designed to achieve a specific purpose.

All miscellaneous tools in PCM600 requires an online connection to a SAM600 system.

Status of the action performed on the SAM600 Commands are displayed on the PCM600 output window.

5.6.1 Get serial number

Get Serial Number tool can be launched from a SAM600 system configuration context menu. This tool will read the Serial Number of all the hardware modules configured in a SAM600 system and assign it to the corresponding hardware module.

It is also possible to assign the serial number manually to the SAM600 module which is then assigned to the corresponding hardware module. Validation errors to be taken care before the serial numbers are assigned to the hardware modules.

**Identify Module** option in Get Serial Number functionality identifies the physical module when selected. When Identify Module is selected, the LEDs on the corresponding hardware module flashes for 20 seconds.

5.6.2 Set time

**Set Time** can be launched from a SAM600 system configuration context menu, see Figure 35. This sets the system time on SAM600-TS module of a SAM600 system to the local PC time. This menu appears if there is at least one SAM600-TS is available in a SAM600 system.
5.6.3 Simulation mode

Simulation Mode can be launched either from a SAM600 system configuration or Hardware Configuration context menu, see Figure 36 and Figure 37. This sets the SAM600 module into Simulation Mode. When a SAM600 module is in simulation mode, the respective hardware module in the PCM600 plant structure indicates this with orange coloring. The quality of the effected streams will be set to Substituted and the LEDs of the effected module will start flashing.

Simulation Mode is applicable only for SAM600-VT and SAM600-CT.

In this state the SAM600 modules will simulate nominal analog values.
5.6.4 **Reset to factory default**

**Reset to Factory Default** can be launched from a SAM600 system configuration context menu, see Figure 38. This clears the configuration including sample values, events and set the parameters, technical key to its default value. The physical topology is retained as it is.
5.6.5 Indicate module

Indicate Module action can be launched from the module context menu, see Figure 39. This tool identifies the physical hardware module in a SAM600 system. When Indicate Module option is selected, LEDs on the corresponding hardware module flashes for 20 seconds.

This command can also be launched from Get Serial Number tool.

![Figure 39: PCM600: Indicate Module](image)
Section 6  Communication with PCM600 and SAM600 system

The communication between PCM600 and SAM600 system is independent of the communication protocol used within the substation. The communication media for SAM600 system is USB.

Any USB on a SAM600 module can be used to connect PCM600 in order to establish a connection with a SAM600 system.

Access to a SAM600 system is possible only through PCM600 and a physical connection to any SAM600 module in a SAM600 system is through USB, see Figure 40.

Figure 40: SAM600 system communication with PCM600
6.1 Common write

Once a SAM600 system engineering is completed, the system writes the configuration to a SAM600 system.

Perform Common Write action from a SAM600 system context menu by selecting Write to IED… option, see Figure 41.

![Figure 41: PCM600: Common Write](image)

Common Write collects information from the hardware modules, configured ports, parameters along with already configured sampled values and write the configuration to a SAM600 system. The process is shown in the below flow chart, see Figure 42.
The following attribute values are validated when the Common Write action is initiated from PCM600:

- Technical Key
- Number of SAM600 modules
- Type of SAM600 modules
- Serial Number
- Order of SAM600 modules
- Interconnection between SAM600 modules

The above mentioned attribute values are confirmed for the Common Write to start. If there are any discrepancies during the above validations, along with the additional confirmation from the user, Common Write is aborted and the appropriate error message is displayed on the PCM600 output window.

![Diagram of PCM600: Common Write Flow chart]

*Figure 42: PCM600: Common Write Flow chart*
6.2 Common read

Perform Common Read from a SAM600 system context menu by selecting Read from IED… option, see Figure 43.

![Project Explorer]

Figure 43: PCM600: Common Read

Common Read collects information from SAM600 system related to configuration, parameters, sampled value streams and reconstruct the same in PCM600. Common Read will not read the topology or the interconnection between the modules. The process is shown in the below flow chart, see Figure 44.

The following attribute values are validated when Common Read action is initiated from PCM600:

- Technical Key
- Number of SAM600 modules
- Type of SAM600 modules
- Serial Number
- Order of SAM600 modules
- Interconnection between SAM600 modules
- Configuration existence in SAM600 system
The above mentioned attribute values are confirmed for the Common Read to start. If there are any discrepancies during the above validation, common read is aborted and appropriate error message is displayed on the PCM600 output window.

Common Read cannot be performed on modules that has factory default values.
Event Viewer tool

The Event Viewer Tool can be launched from a SAM600 system context menu. Event viewer will list all the internal and process events of a SAM600 system, see Figure 45.

It is possible to set the number of events to be read from each SAM600 hardware module. The value need to be set in the “Read Event per Module” property under “Misc” tab in the Object Properties window.

For more information, refer to PCM600 online help.
# Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1PPS</td>
<td>One Pulse Per Second</td>
</tr>
<tr>
<td>AC</td>
<td>Alternating Current</td>
</tr>
<tr>
<td>AIS</td>
<td>Air Isolated Switchgear</td>
</tr>
<tr>
<td>BMC</td>
<td>Best Master Clock</td>
</tr>
<tr>
<td>DC</td>
<td>Direct Current</td>
</tr>
<tr>
<td>FOCS</td>
<td>Fiber Optic Current Sensor</td>
</tr>
<tr>
<td>FTDI</td>
<td>Future Technology Devices International Ltd. (<a href="http://www.ftdichip.com/">http://www.ftdichip.com/</a>)</td>
</tr>
<tr>
<td>GIS</td>
<td>Gas Isolated Switchgear</td>
</tr>
<tr>
<td>ICT</td>
<td>IED Configuration Tool</td>
</tr>
<tr>
<td>IEC 61850</td>
<td>Substation Automation Communication Standard</td>
</tr>
<tr>
<td>IED</td>
<td>Intelligent Electronic Device</td>
</tr>
<tr>
<td>IID</td>
<td>Instantiated IED Description</td>
</tr>
<tr>
<td>LE</td>
<td>IEC 61850-9-2LE Light Edition</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>MAC</td>
<td>Media Access Control</td>
</tr>
<tr>
<td>MSVCB</td>
<td>Multicast Sample Value Control Block</td>
</tr>
<tr>
<td>PCM600</td>
<td>Protection and Control IED Manager</td>
</tr>
<tr>
<td>PTP</td>
<td>IEEE 1588 Precision Time Protocol</td>
</tr>
<tr>
<td>RCB</td>
<td>Report Control Block</td>
</tr>
<tr>
<td>SAM600</td>
<td>SAM600 Standalone Merging Unit</td>
</tr>
<tr>
<td>SAMU</td>
<td>Standalone Merging Unit</td>
</tr>
<tr>
<td>SCD</td>
<td>Substation Communication Description</td>
</tr>
<tr>
<td>SCL</td>
<td>System Configuration Description Language</td>
</tr>
<tr>
<td>SCT</td>
<td>System Configuration Tool</td>
</tr>
<tr>
<td>SFP</td>
<td>Small Form-Factor Pluggable</td>
</tr>
<tr>
<td>SMVID</td>
<td>Sample Value Identifier</td>
</tr>
<tr>
<td>SST</td>
<td>System Specification Tool</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>SV</td>
<td>Sample Value</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>UTC</td>
<td>Coordinated Universal Time</td>
</tr>
</tbody>
</table>
Appendix A  

SAM600 parameter settings

The following tables list the SAM600 parameter settings. Parameters can be set for each SAM600 module individually or globally for the whole SAM600 system. In some instances global settings can be overwritten by module-individual settings.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Power system frequency</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The frequency of the power system of a connected SAM600 module.</td>
<td></td>
</tr>
<tr>
<td>Module Type</td>
<td>SAM600-CT and SAM600-VT</td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 System</td>
<td></td>
</tr>
<tr>
<td>Value Range</td>
<td>50 or 60</td>
<td>Hz</td>
</tr>
<tr>
<td>Default</td>
<td>50</td>
<td>Hz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter: Primary nominal transducer value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Rated voltage or current on the primary side of the measurement transformer. For the SAM600-VT it is defined as the line-line value.</td>
</tr>
<tr>
<td>Module Type</td>
<td>SAM600-CT and SAM600-VT</td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 Module</td>
</tr>
</tbody>
</table>
| Value Range | SAM600-CT: 1..65000  
SAM600-VT: 1..1100 | A  
kV |
| Default | SAM600-CT: 1000  
SAM600-VT: 110 | A  
kV |
### Parameter Settings

#### Secondary nominal transducer value

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Rated voltage or current on the secondary side of the measurement transformer. For the SAM600-VT it is defined as the line-line value.</td>
<td></td>
</tr>
<tr>
<td>Module Type</td>
<td>SAM600-CT and SAM600-VT</td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 Module</td>
<td></td>
</tr>
<tr>
<td>Value Range</td>
<td>- SAM600-CT-1 (constant)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>- SAM600-CT-5 (constant)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>- SAM600-VT: {100, 110, 115, 120, 125}</td>
<td>V</td>
</tr>
<tr>
<td>Default</td>
<td>SAM600-VT: 110</td>
<td>V</td>
</tr>
</tbody>
</table>

#### Neutral phase

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Module Type</th>
<th>Level</th>
<th>Value Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Defines how the neutral phase voltage or current is determined.</td>
<td>SAM600-CT and SAM600-VT</td>
<td>SAM600 System, can be re-defined per SAM600 Module</td>
<td>Calculated, Measured</td>
<td>Calculated</td>
</tr>
<tr>
<td>Value Range</td>
<td>Calculated, Measured</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default</td>
<td>Calculated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Digital inputs rated voltage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Module Type</th>
<th>Level</th>
<th>Value Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The setting defines the voltage level for high potential on digital inputs.</td>
<td>SAM600-CT and SAM600-VT</td>
<td>SAM600 System, can be re-defined per SAM600 Module</td>
<td>24, 48, 110, 125</td>
<td>110</td>
</tr>
<tr>
<td>Value Range</td>
<td>24, 48, 110, 125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## SAM600 Parameter Settings

### Test switch activation level

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test switch activation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The setting defines whether the test switch indication is detected on a low or high potential of the digital input channel 1.</td>
</tr>
<tr>
<td>Module Type</td>
<td>SAM600-CT and SAM600-VT</td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 System, can be re-defined per SAM600 Module</td>
</tr>
<tr>
<td>Value Range</td>
<td>Low potential, High potential, Input disabled</td>
</tr>
<tr>
<td>Default</td>
<td>High potential</td>
</tr>
</tbody>
</table>

### Fuse failure activation level

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Fuse failure activation level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The setting defines whether the fuse failure indication is detected on a low or high potential of the digital input channels 2 to 4.</td>
</tr>
<tr>
<td>Module Type</td>
<td>SAM600-VT</td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 System, can be re-defined per SAM600 Module</td>
</tr>
<tr>
<td>Value Range</td>
<td>Low potential, High potential, Input disabled</td>
</tr>
<tr>
<td>Default</td>
<td>Low potential</td>
</tr>
</tbody>
</table>

### Time synchronization mode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Time synchronization mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>The parameter defines the synchronization mode for a SAM600 system.</td>
</tr>
<tr>
<td>Module Type</td>
<td>all</td>
</tr>
<tr>
<td>Level</td>
<td>SAM600 System</td>
</tr>
<tr>
<td>Value Range</td>
<td>Local, Pulse per second, Grandmaster clock with GPS, Master clock</td>
</tr>
<tr>
<td>Default</td>
<td>Local</td>
</tr>
</tbody>
</table>
### SAM600 Parameter Settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Module Type</th>
<th>Level</th>
<th>Value Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAM600 System Technical Key</strong></td>
<td>Identifier of a SAM600 system.</td>
<td>all</td>
<td>SAM600 System</td>
<td>String[64]</td>
<td>AA0B0Q0KF0</td>
</tr>
<tr>
<td><strong>Customer-provided name</strong></td>
<td>Designator of a module.</td>
<td>all</td>
<td>SAM600 Module</td>
<td>String[48]</td>
<td>empty string</td>
</tr>
<tr>
<td><strong>Serial number</strong></td>
<td>Globally unique SAM600 identification.</td>
<td>all</td>
<td>SAM600 Module</td>
<td>String [10]</td>
<td>empty string</td>
</tr>
</tbody>
</table>

First two characters are alphabets and remaining are 8 digits.
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