APPLICATION NOTE

Typical-Based Engineering with DIGSI 5

APN-100, Edition 1

SIEMENS

SIPROTEC Application

APN-100, Edition 1

Content

1. Introduction

Substation engineering can be a complex and lengthy process. Substations contain bays which are protected by protection devices. As the substation contains multiple bays with the same characteristics, the devices protecting the bays also require the same configuration.

Standardization and the subsequent preparation and utilization of typical solutions are increasingly being adopted by both customers and engineering teams. The demand for quick and efficient preparation of Protection Devices configurations is on the rise. However, it is important to acknowledge that changes may inevitably occur during factory testing and commissioning phases. Given the prevalence of numerous devices with similar characteristics in substations, it becomes imperative for engineering tools to facilitate efficient "inheritance" or mass changes. One of the approaches to answer these challenges is Typical Based Engineering.

1.1. Previously defined workflow in DIGSI 5

Until DIGSI 5 V9.30, the engineer configured a single device and made multiple copies based on the number of bays. Also, there was no mechanism to see an overview of the same settings across all devices with a possibility to modify the settings. The problem could occur when some configurations had to be modified manually on a few devices that were created by the copy process as DIGSI 5 did not support the typical-child relationship.

1.2. Typical-based engineering in DIGSI 5

DIGSI 5 V9.40 introduces a typical-based engineering. 2 new device characteristics are introduced: the typical device as the typical master device and the child device. The child devices of a typical device stay linked to it. Therefore, it is possible to copy changes made to the typical master device to all child devices with one click if required.

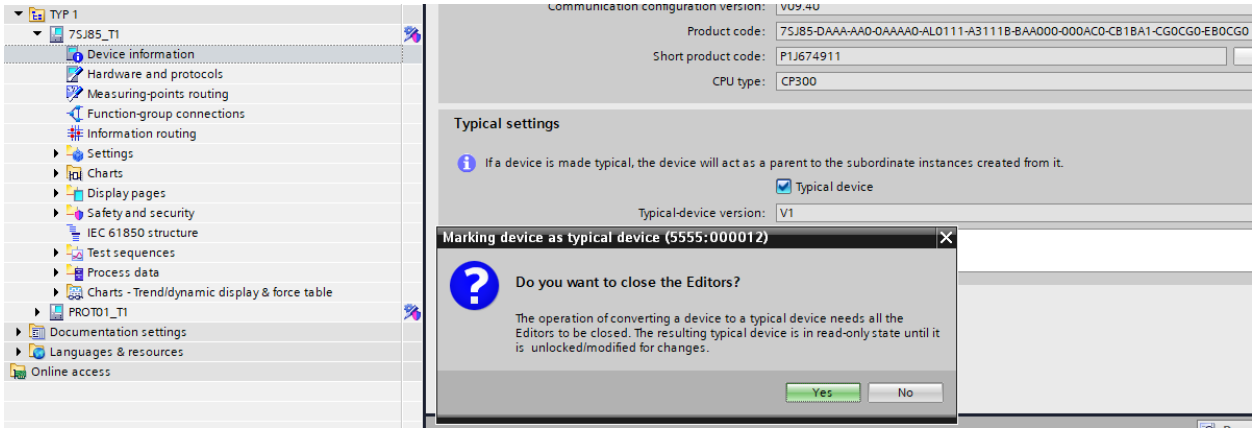
If you wish to make changes to the typical master device, create a new version. It is now possible to fully edit this revised version. Modify this revised version as necessary. After completing the modifications, you apply the changes to the child devices via the option Update child device. In a single click, you can update the child device to any version from the available typical version. A good strategy for reducing the number of typical devices is to create typical master devices with high functionality. In the child devices, you can switch-off a functionality that is no longer needed in the instances.

Thus, the process simplifies the manual modification of devices at the substations and increases the overall efficiency.

2. Configuration Workflow

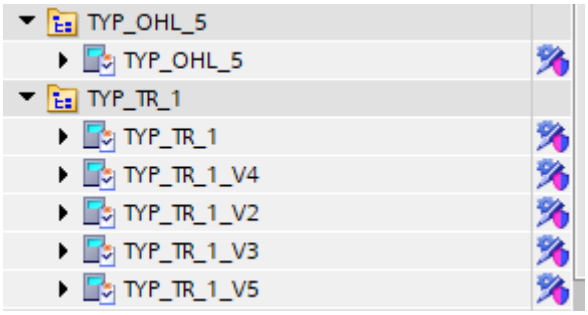
2.1. Creating a Typical Device

After parameterization of the first device click on Device Information and select “Typical Device”



Picture 1 – Create Typical Device

The device is marked as a typical device and is in a read-only state. A typical folder is created in the project tree on the successful creation of a typical device. All further versions of the Typical device will be stored inside the same Folder. The typical folder is named by its typical device name at the time of creation.



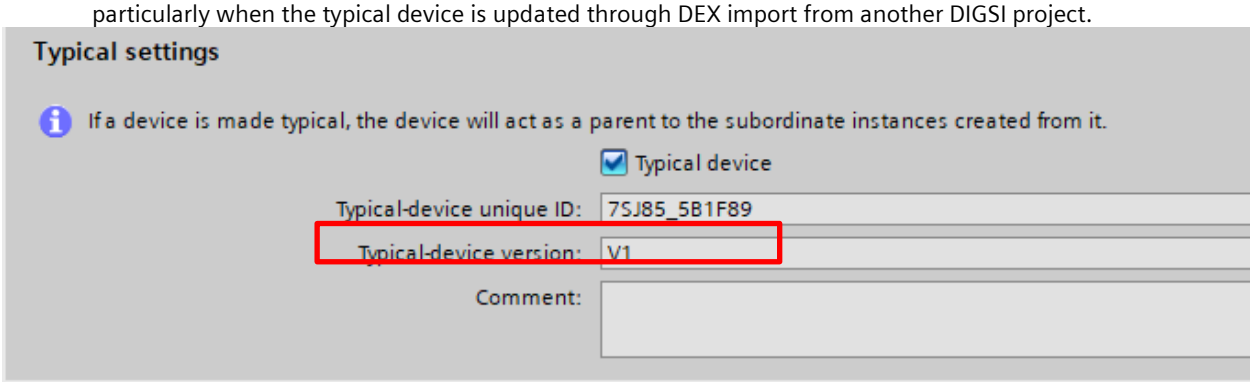
Picture 2 – One Folder for each Typical Device

Important considerations by creation of Typical Device:

- Ensure that the device you wish to mark as typical device is consistent as a prerequisite. The check box Typical device can only be marked when the device is consistent (there is one exception, Process Bus Client – see *2.1.1 Applicability for Process Bus Client*).
- You can create a typical device only from DIGSI 5 V9.40 and higher.
- The created typical device is in a read-only state. You are allowed to edit only IEC 61580 name and device display Name.
- The creation of a typical device is only supported from the device configuration V7.50 and higher.
- The section Typical settings is not available for the centralized busbar devices.
- To revert the device back to a normal device, you can uncheck the check box Typical device. A notification dialog appears that lists the linked child devices and notifies that -they will no longer be linked.
- A typical device will not appear in the list of available devices in the IEC station. However, only child devices can be used in the IEC61850 station.

Following fields are available for Typical Devices:

- *Typical-device unique ID*
  The Typical-device unique ID field is visible only when the device is marked as a typical device. The field Typical-device unique ID appears and displays the unique identifier of the typical device. The unique ID remains the same for all variants of the typical device. The unique identifier is useful in identifying the related typical devices, particularly when the typical device is updated through DEX import from another DIGSI project.



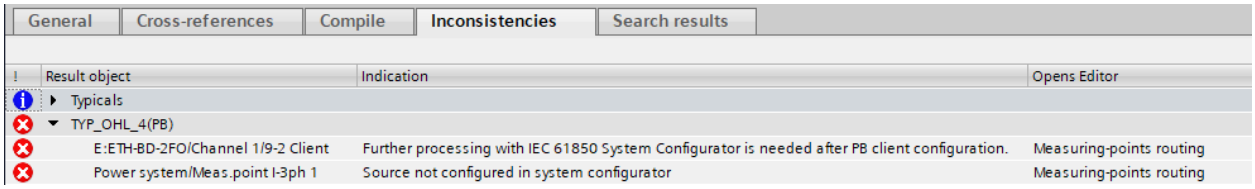
Picture 3 – Typical settings

- *Typical-device version*
  Version of the typical device. Details regarding the versions – see *2.3 Modifying a Typical Device*

- *Comment*
  You can optionally enter the desired comments for the respective device in the Comments text box. An error message appears if you enter text containing a special character or exceed the maximum allowed text length

2.1.1. Applicability for Process Bus Client

Typical Based Engineering can be used for Process Bus applications. There are no differences in workflow for Merging Unit. To complete Process Bus Client Configuration, it is necessary to configure SMV in IEC61850 System Configurator. Typical Device is not a part of the IEC 61850 System Configurator and therefore it is not possible to complete the whole configuration for Clones only. Process Bus Client Devices allows creation of the Typical even with inconsistencies.



Picture 4 – Allowed inconsistencies for Process Bus Client

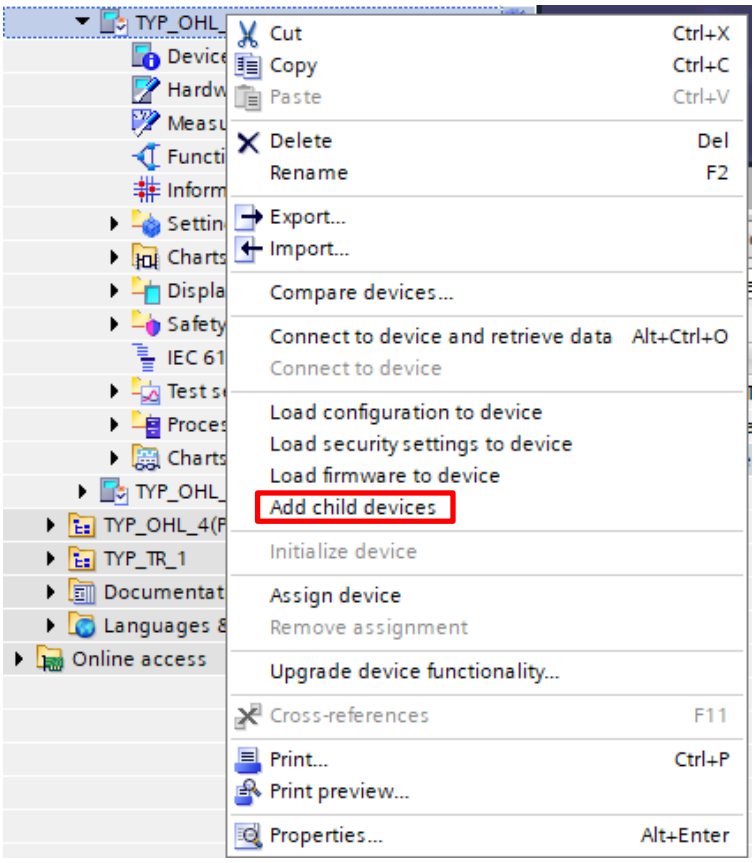
Process Bus Client Child Devices will be created with inconsistencies that will be resolved after the completion of SMV configuration in IEC61850 System Configurator.

2.2. Adding a Child Device

You can create the child devices from a typical device. The project tree displays the child devices once they are added. The option "Add child device" appears in the context menu only for the typical devices. New child devices have the same configuration as typical devices. You can create a maximum number of 50 child devices at a time from a typical device.

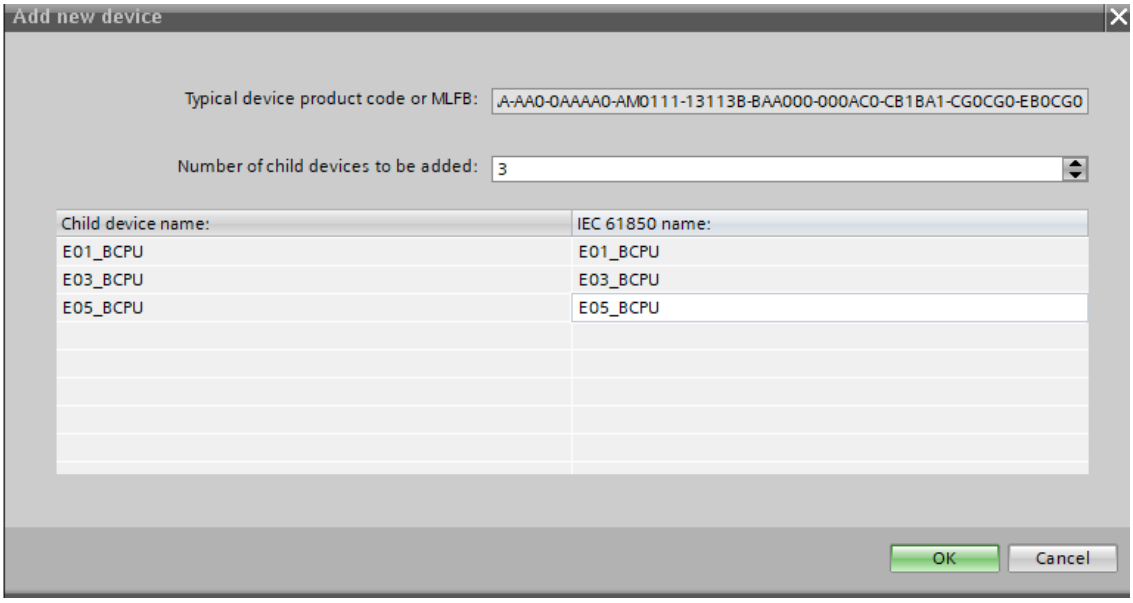
Adding a Child Device:

- Select the typical device for which you wish to add a child device.
- Right-click the typical device.
- Select Add child device from the context menu.



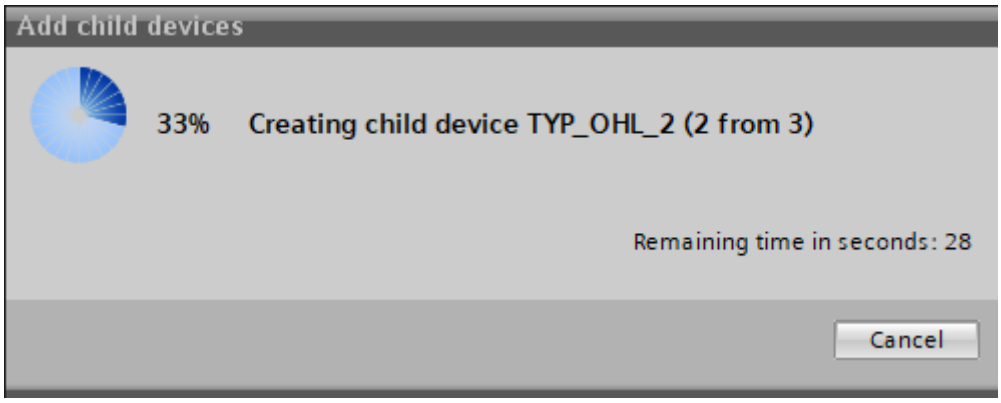
Picture 5 – Add child Device

The dialog Add new device appears.
The read-only field Typical device product code or MLFB displays the product code or the MLFB of the device.
Enter the required number of child devices in the field Child devices to be added.
You can also increment or decrement the count via the list box based on your requirement. The column Child device name displays the names of the child devices that are created. You can rename the Child device name by entering a valid text in the respective cell.
The column IEC 61850 name displays the IEC 61850 details of the corresponding child devices that are created. You can rename the IEC 61850 name by entering a valid text in the respective cell. You must enter a valid Child device name and IEC 61850 name. If your text contains a special character or exceeds the maximum text length, you will see a tooltip message.



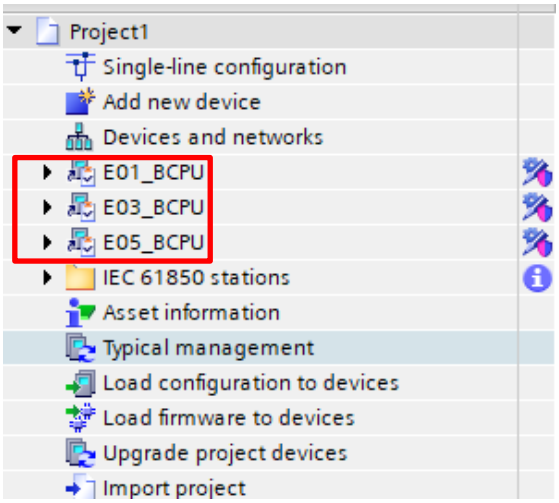
Picture 6 – Dialog Add new device

During the child-device creation, when you click Cancel, the child devices created until that point are created (a count is shown in the progress window) and the remaining count of the devices to be created is canceled.



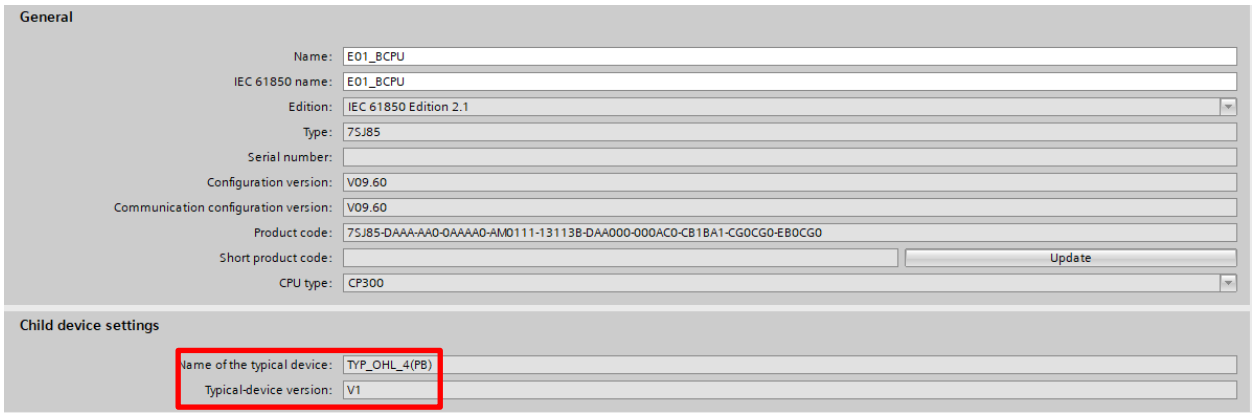
Picture 7 – Creation of Child Device

The created child devices are added to the project.



Picture 8– Child devices are added to the project

Select the *Device Information* tab for the created child devices to view the Child-device settings section.



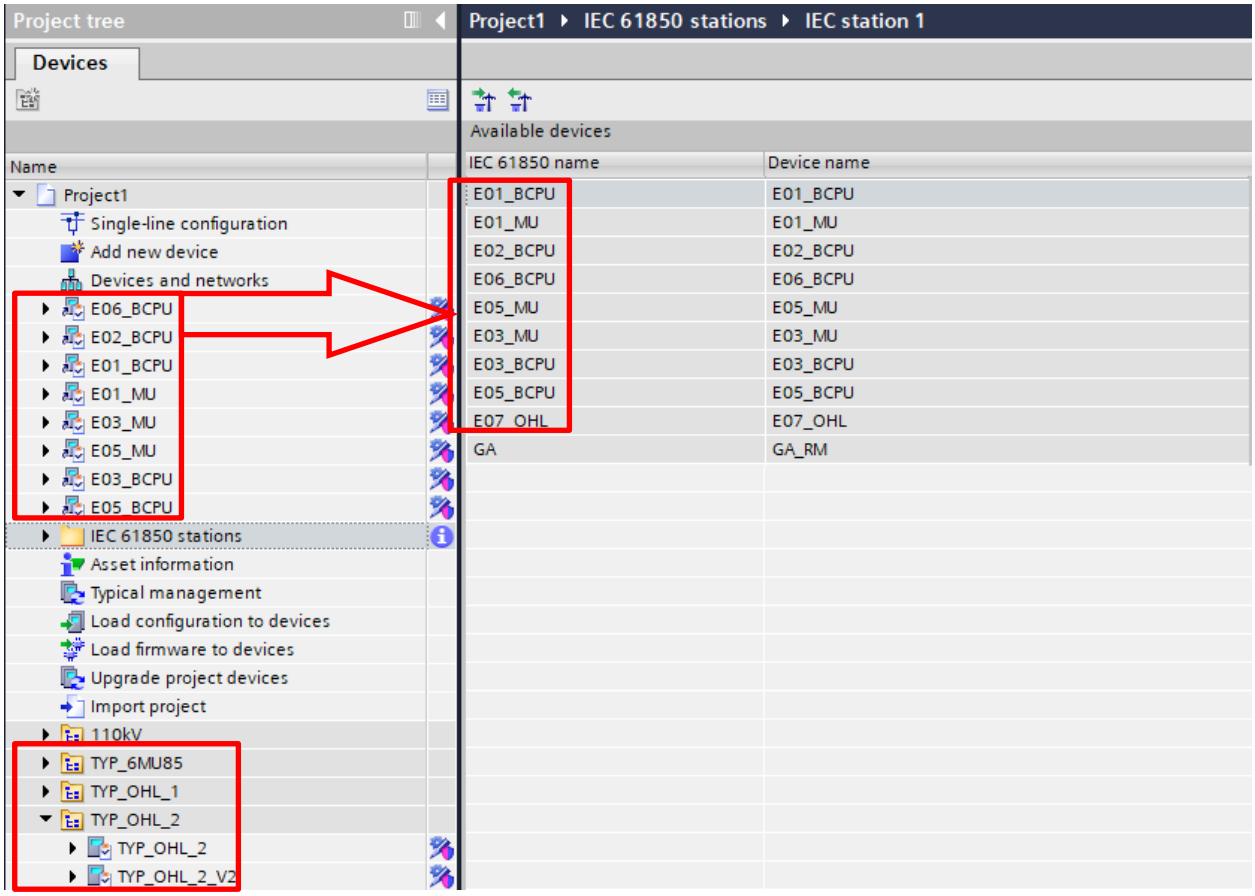
Picture 9 – Properties of child Device

Following fields are available for Child Devices:

- *Name of the typical Device*
- *Typical Device Version*

You can modify *Name* and *IEC61850 Name* of the Child Device. Child Device is editable.

Unlike Typical Devices, Child devices are available in System Configurator.



Picture 10 – Considerations of IEC61850 configuration

2.3. Modifying a Typical Device

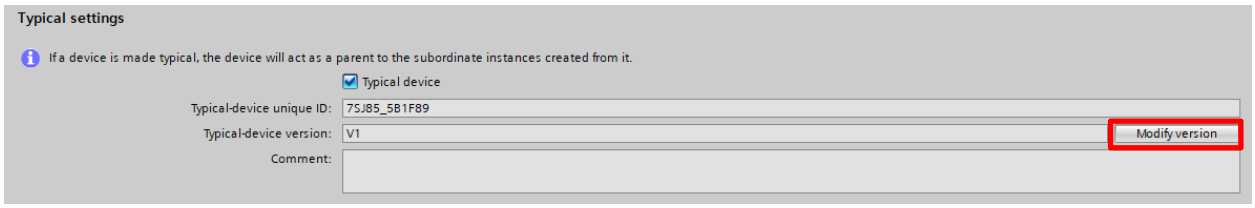
By default, the typical device is in read-only mode. If you wish to make modifications to the typical device configuration, you must create a new version of the typical device to make the necessary changes. Accordingly, you can also apply the changes on the child devices. DIGSI 5 V9.40 and higher, allows you to create a maximum of 5 new versions for each typical device with the same Typical-device unique ID.

Creating Typical-Device Version

- Select the typical device for which you wish to create a new version.
- Double-click Device information in the typical device folder.

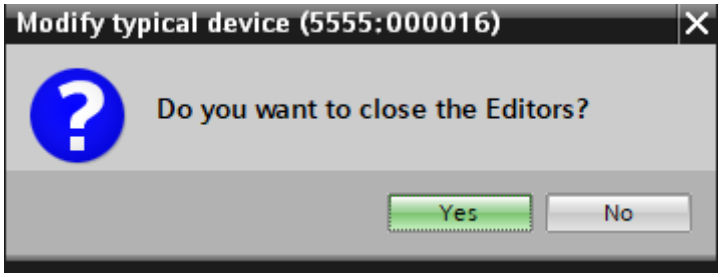
The tab Device information is displayed in the working area.

Click Modify version.



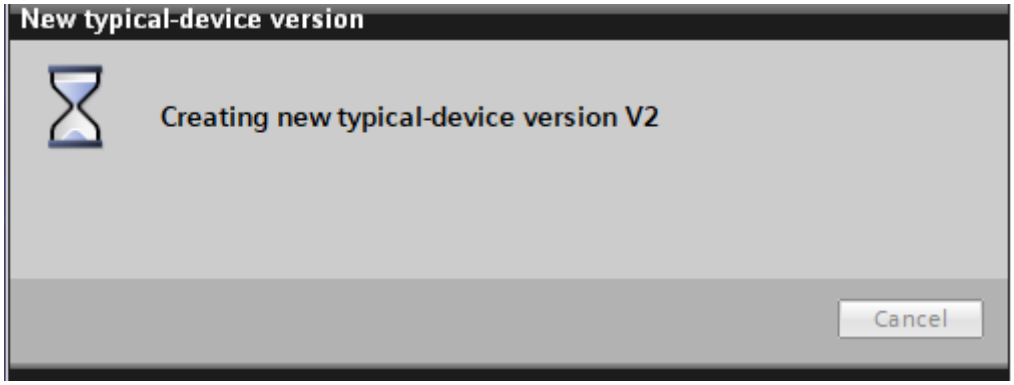
Picture 11 – Modify Version

A dialog appears notifying you to close all Editors.



Picture 12 – Confirmation

Click Yes to proceed by closing all the editors.

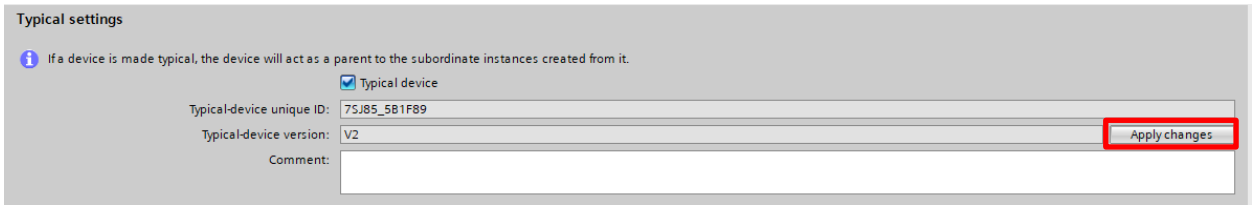


Picture 13 – Process: Creation of new version.

The dialog displays the successful creation of the typical device with new version. Click OK.

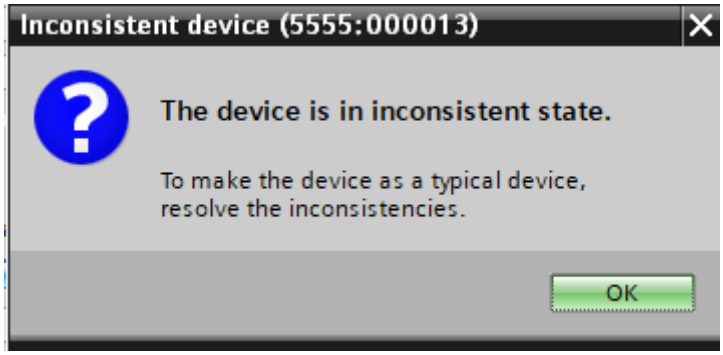
You are directed to the tab Device information of the new typical device with new version.

Make the necessary modifications and click Apply changes.



Picture 14 – Apply changes for new version

If the device has no inconsistencies, then dialog Apply changes to typical appears. Click Yes to proceed by closing all the editors. If the device has an inconsistency, a warning dialog Inconsistent device appears. Click OK to resolve the device inconsistency.

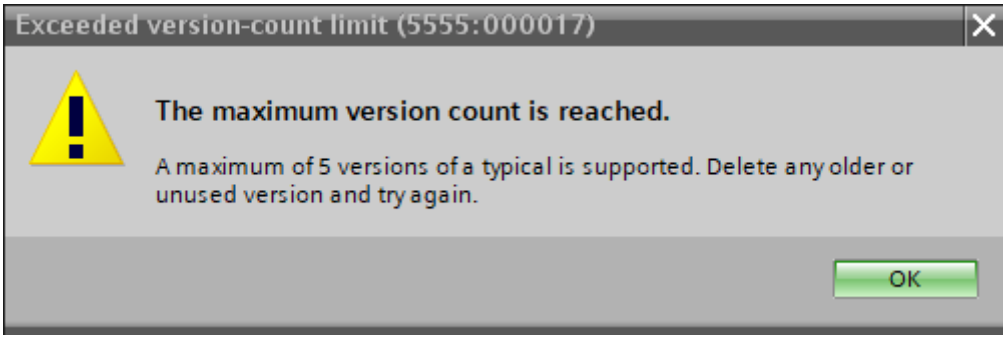


Picture 15 – Inconsistent state

Important considerations by modifying of Typical Device:

- When the creation of the new version of the typical device is in progress, the context menu *Add child device* is disabled until you select the option *Apply changes*.
- Make sure to mark the settings as the specific settings for the changes made in the child device (Details regarding the Specific Settings - see *2.4.3 Non-updatable parameters (Specific Settings)*
- DIGSI 5 allows you to create a maximum of 5 new versions for each typical device with the same Typical-device unique ID.

If you need to create more than 5 Versions – you have to delete one of the existing versions:



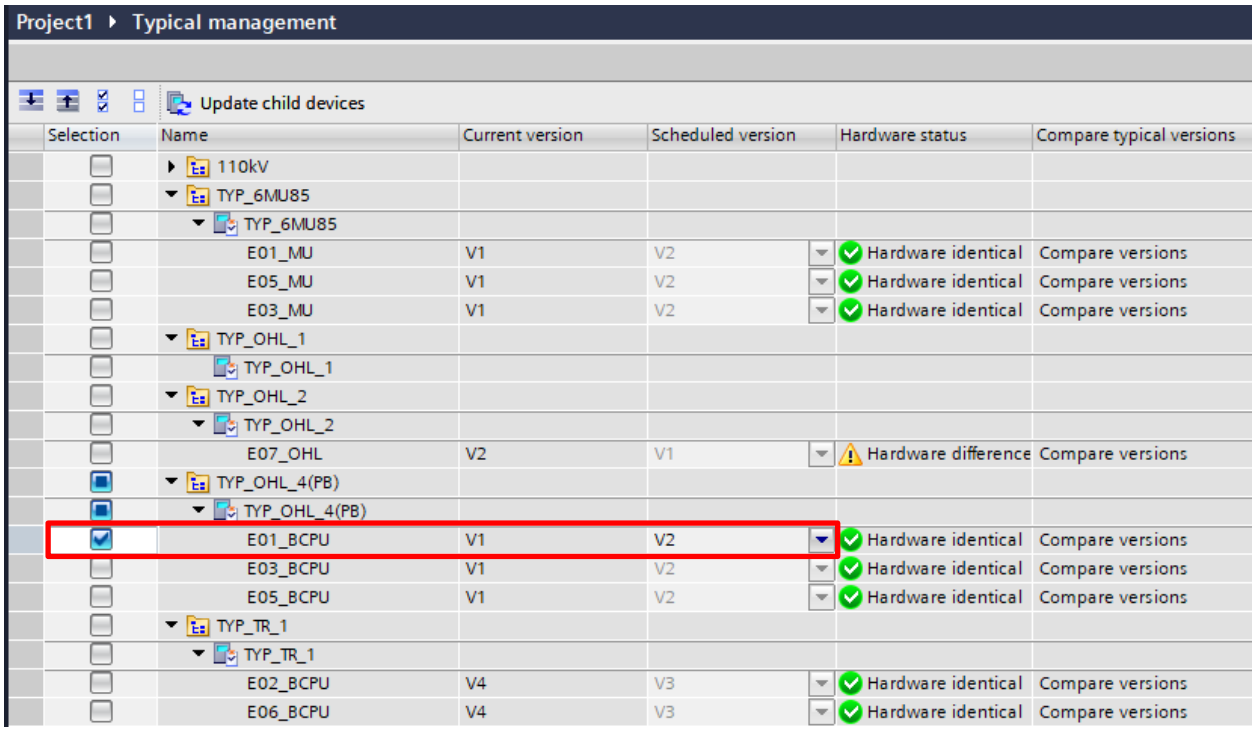
Picture 16 – The maximum version count is reached

2.4. Updating a Child Devices

2.4.1. Typical Management Editor

You can update the child-device configuration to another version or the latest version of the typical device. In the project tree, open the Editor Typical Management Editor

Select the child devices by selecting the check box in the column Selection. Select the version from the list box of the column Scheduled version and click Update child devices.



Picture 17 – Typical Management Editor

The dialog Update child devices appears.

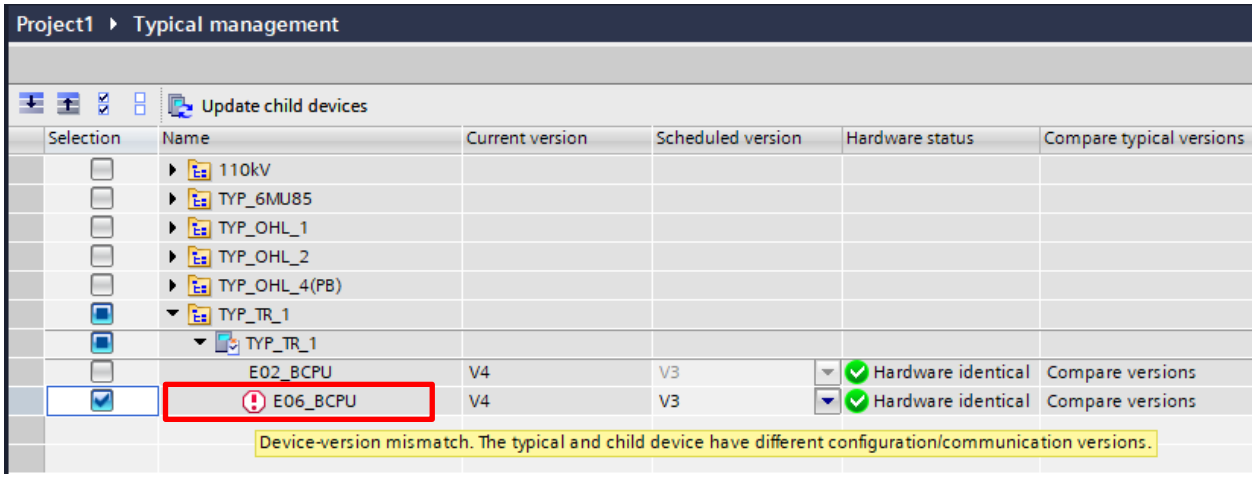
Picture 18 – Update child devices

Click OK to update the child device configuration. Click Cancel if you do not wish to continue.

During device update, when you click Cancel, the child devices up to that point are updated (a count is shown in the progress window) and the updating process for the remaining child devices is canceled.

The dialog Update child devices displays the status of the child devices that have been successfully updated and canceled. Also, the corresponding cell of the updated child device displays the latest updated version in the column Current version of the typical device.

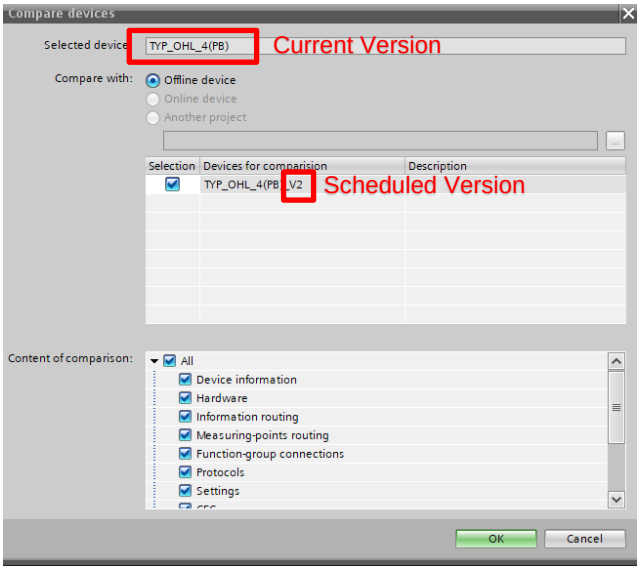
Ensure that the current and scheduled typical versions of the child device have the same configurations and communication versions for the update to be successful (you can use Upgrade project devices Editor to synchronize the versions).



Picture 19 – Mismatching of configurations/communication versions

2.4.1. Compare Versions

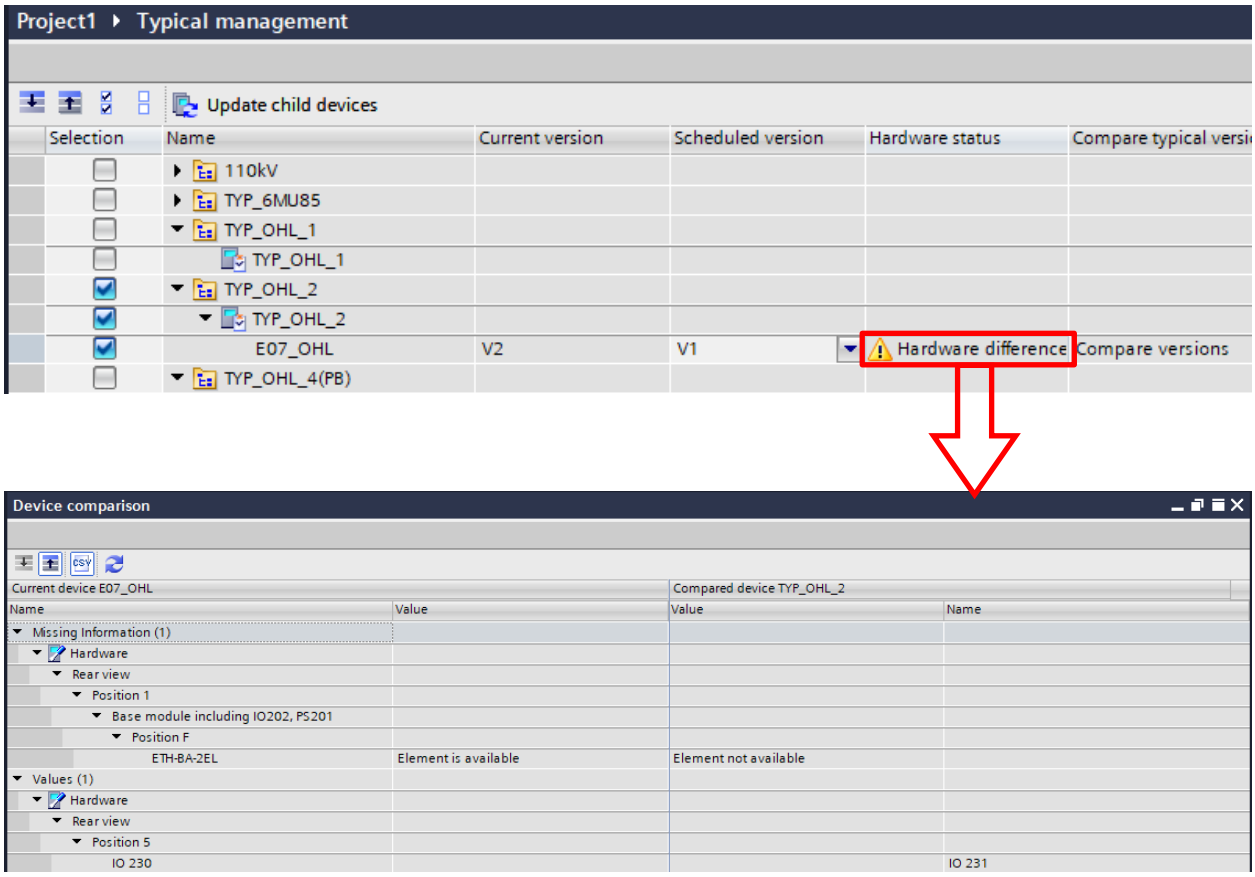
The column Compare devices allows you to compare the current typical version of the child device with the selected Scheduled version of the typical device. Unlike standard compare function only versions of dedicated device can be compared.



Picture 20 – Compare Versions

2.4.2. Updating the Child-Device Hardware Configuration via Typical Device.

It is possible to update the hardware configuration of the child device using a typical device from the Editor Typical management. In case there are Hardware Differences it will be shown in column Hardware Status of Typical Management Editor. To review details device must be selected in column Selection.



Picture 21 – Compare Versions

You can exchange the hardware module or configuration of the child device through the typical device. When updating a child device with hardware differences, a confirmation dialog appears, informing you that the update will modify the hardware configurations of the child device to match the selected scheduled typical device version.

Click OK to proceed. Click Cancel if you do not wish to proceed.

During the update process, the following hardware updates will occur in the child device:

- Any hardware module that exists only in the child device and not in the typical device is removed.
- Any hardware module that is present only in the typical device will be added to the child device.
- If the hardware module in the child device is different from the typical device, then the hardware module in the child device will be replaced with the typical-device hardware.

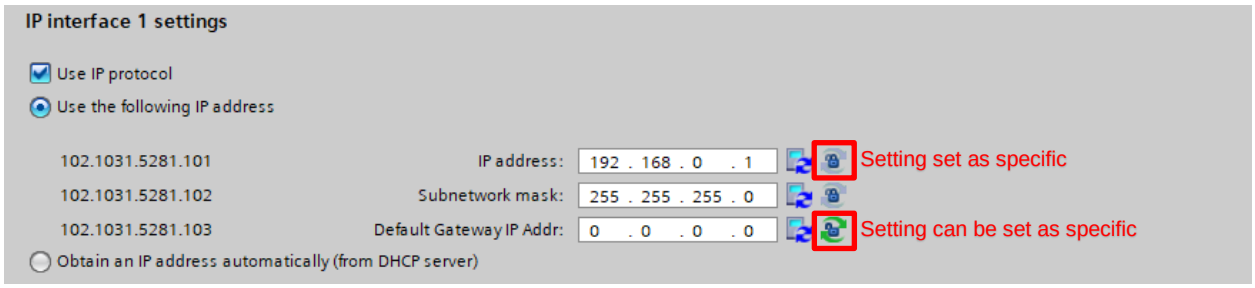
However, the settings marked as specific settings (see *2.4.3 Non-updatable parameters* in the child device does not change during the update.

2.4.3. Non-updatable parameters (Specific Settings)

A specific setting will prevent changes when a child device is updated from a new version of a typical device. With this feature in DIGSI 5, you can select the different parameters in the group Settings and set them as specific settings. The specific setting is applicable only for typical devices and typical child devices. You can see this specific settings icon in the Editor **Protocol settings**.

The specific settings are used in the following scenarios:

- If you wish to keep a few settings unchanged in child device during the update process.
- If you wish to keep a few settings unique for each device, such as the IP address.



Picture 22 – Specific Settings

It is not possible to set the device settings and time settings as specific settings

Different behaviors are shown in the Table:

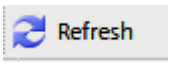
Specific Settings Status		Updating Child Device Actions
Typical	**Child**	
		On update, the specific settings marked in the typical device are updated as the specific settings in the child device. However, the values are not updated
		On update, the specific settings marked in the child device will remain unchanged. The specific settings marked in the child device cannot be overwritten by a typical device setting.
		On update, the specific settings marked in the child device remain unchanged.

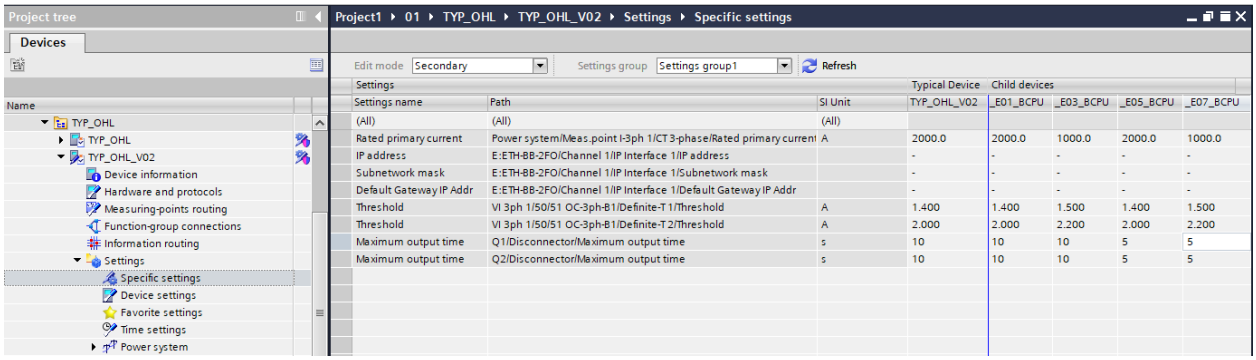
2.4.4. Specific Settings Editor

This Editor provides an overview of the Specific settings in the typical child device, which are write-protected against the change from the typical master device. The Editor Specific settings provides the information for those settings that are marked as specific settings in the typical device and the corresponding typical child devices if available.

When the device is marked as a typical device, the Editor Specific settings is listed under the Editor Settings. You can compare the settings value of the typical child device with its parent typical device. Also, it is possible to update the setting values of the typical child device. This Editor Specific setting provides you the option to edit multiple setting values in numerous child devices at once.

You are allowed to edit the setting values of the typical device only when the device is in the editable mode. Even if the typical device does not include a child device, the Editor Specific settings is visible in the project tree. The Editor Specific settings does not allow you to mark or unmark the settings as specific settings.

Elements	Explanation
Edit mode	By default, this field displays the parameter values of the selected setting mode of the typical device. From the list box, you can select other modes according to your preferences.
Settings group	By default, this field displays the Settings group 1. You can select the settings groups if available according to your preferences from the list box.
Settings name	This read-only field displays the list of all attribute names that are marked as specific settings either in a typical device or in a typical child device.
SI unit	This read-only column displays the unit system for the parameter values in the column Settings name.
Path	This column displays the path of the respective parameter settings in the form FG/FN/FB/Setting.
Typical device	This read-only column displays the typical device values. You can edit the column Typical device only if the typical device is in the editable mode.
Child devices	By default, this editable field displays the value of the child devices for the corresponding parameter in column Settings name. If you wish to change the value, select the cell, and enter the new value within the defined range. Notes: - If you move the mouse pointer over the cell, the permissible range of values of the setting is shown as a tooltip. - If you enter an invalid value for the corresponding attribute value in the column Settings name, the tooltip displays an error message along with the actual defined range.
	Click the Refresh icon. Only then, the latest settings marked as a specific setting appear in this Editor.



Picture 23 – Specific Settings Editor

The setting values displayed for the parent typical device are editable only if the typical device is in editable mode.

- The column Child devices is visible only if the child devices are added to the typical device.
- The curve settings are not supported.
- If an attribute has the value type ENC, you can modify the value by selecting the option from the list box.
- If an attribute has a Boolean setting, you can set it to true or false according to your preference.
- The value - in the column Child devices indicates the non-availability of the Settings group for the respective device. The tooltip also displays the respective message.

2.4.5. Update of the Display Pages

Starting from the version 9.60 Display Title is Protected from the update. You can instantiate the Titles individually for each feeder. During the child-device update, the display-page content of the child device is updated to the preferred scheduled version of the typical device. However, despite the update, the original name of the display pages of the child device remains unchanged.

If the typical device has more display pages than the child device, then the updated child device includes those display pages with their original names as mentioned in the typical device.

2.5. Exchange of the files in Typical Based Engineering

2.5.1. Exporting

The export of the typical device or child device with one of the TCF, DSP5, RIO, XRIO, ICD, SEQ5, and UAT formats works similar to the export of the normal device.

The export behavior for files other than TEA-X and DEX5 remains unchanged for the typical devices.

2.5.1.1. Exporting a TEA-X File

You can select the TEA-X format in the dialog 25.6.9 Export for both the typical devices and child devices.

The exported TEA-X file of the typical device contains additional details such as ID, version, and the comments mentioned in the section Typical settings. The exported TEA-X file of the child device additionally provides details such as ID and version of the typical device to which it is linked. For more information about the export of TEA-X files, refer to 21.2.2 Configuring the TEA-X Export

Only the typical device in a consistent state can be exported.

2.5.1.2. Exporting a DEX File

You can select the DEX format in the dialog 25.6.9 Export for both the typical devices and child devices.

The exported DEX file of the typical device contains additional details such as ID, version, and the comments mentioned in the section Typical settings. The exported DEX file of the child device additionally provides details such as ID and version of the typical device to which it is linked. The DEX5 format can be used only for individual SIPROTEC 5 devices.

If you wish to export the typical device which is in editable mode, then a warning message appears informing that the export is not allowed. You are recommended to select the option Apply changes in the section Typical settings of the Device information page.

2.5.2. Importing

A typical device supports the import files of the formats TEA-X, DEX5, DSP5, SEQ5, and UAT. However, the import of the file is allowed only when the typical device is in edit mode.

The import is not supported for any file format when the device is in a read-only state.

2.5.2.1. TEAX File Import

Before importing data, you must select the typical device or the child device to which you wish to import the data. You can import data into DIGSI 5 in the TEA-X format.

The following table illustrates the import of TEA-X files from various devices:

Importing within the same Project (Update an existing Device)					Import to a New Project
Source File	**Normal Device**	**Typical Device (Read-only)**	**Typical Device (Read-only)**	**Child Device**	
Typical Device	X	X	X	X	**OK** [1]
Typical Child Device	X	X	X	**OK** [2]	**OK** [3]
Normal Device	**OK**	X	X	X	**OK**

1) A typical device is created with the same ID and version.
2) The file is imported only if the typical IDs and the versions of both the child devices are the same.
3) A new typical child device is created with the same parent ID and version

You are allowed to import the TEA-X file only when a new version of the typical device is being created.

2.5.2.2. Importing a DEX5 File

You can import data into DIGSI 5 in the DEX5 format. For more information, refer to 21.3.4 Configuring the DEX5 Import. The following table shows the import results based on the source file provided by the device within the same project or a different project:

Source File	Import to another Project	Import to a new Project
Typical device	When you import a file with the same typical-device ID and Typical-device version of the typical devices in the project, there are 2 possible outcomes based on the device version count: - Scenario 1: If the typical-device version count is below its maximum count of 5, a confirmation dialog appears. – Click Yes to import the file and create a new updated version of the parent typical device. – Click No to create a new typical device. – Click Cancel if you do not want to continue. - Scenario 2: If the typical-device version count has exceeded a maximum count of 5, then a confirmation dialog appears. – When you click OK, it deletes the oldest version of the typical device by default and creates an updated version of the parent typical device. – Click Cancel if you do not want to continue.	A typical device is created with the same parent ID and version.
Typical child device	A child device is created with the same parent ID and version.	A child device is created with the same parent ID and version.

2.5.3. Typical-exchange

Typical-exchange is a feature that allows the replication of device configurations within the same project or across projects. The process is facilitated using export and import of DEX5 or TEA-X file formats. Siemens recommends using the DEX5 format for typical device exchange. Siemens recommends keeping all relevant typical devices in a single DIGSI 5 project for ease of access.

To perform a typical exchange, you must export the DEX5 file of the preferred typical device from the project and import it into a new project to create a new typical device with the same configuration. Child devices can be created within the new project. Any modifications required can be made in the base project. The modified typical devices can also be exported and imported into working projects to create a new version of the typical device.

3. Summary

Starting from the V9.40 DIGSI 5 supports typical-based engineering approach.

It reduces the need for starting from scratch in each project allowing fast creation of the device's configuration out of the typical configuration. It minimizes the chances of errors and inconsistencies that can arise when creating entirely "unique" configuration for each individual device and every project. While typical-based engineering provides a foundation, it can still be flexible and adaptable to meet specific requirements for each device.

The process simplifies the manual modification of devices at the substations, allowing mass editing of the configurations, reduce time for configuration and increases the overall efficiency.

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