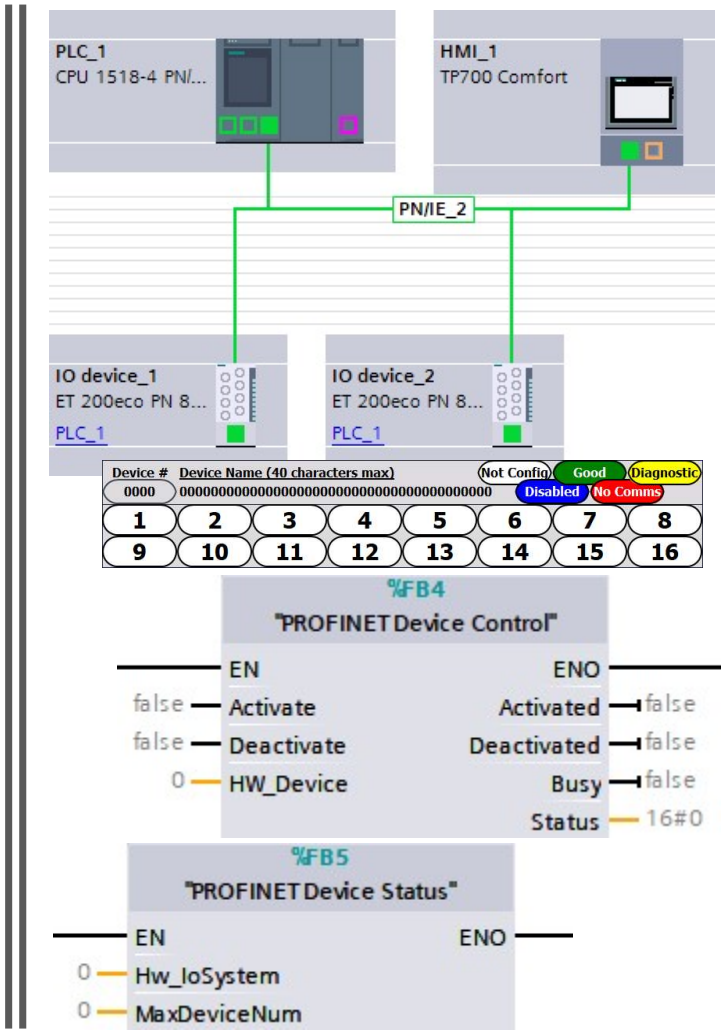

PROFINET Device Library with FBs and HMI Faceplates

Revised May 1, 2020

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Preface

This tech note is a follow-up to the "PROFINET Device Status and Control" tech note with a continuing focus in FB or Function Block form available from a Library, on the application of monitoring the communication status of PROFINET IO-Devices from a Siemens PROFINET IO-Controller and the Enabling and Disabling of communication to a PROFINET IO-Device, with accompanying HMI Faceplates . TIA Portal V16 software was used in the creation of this document. If you need further assistance, please don't hesitate to contact us at C&E.

General Scope

Siemens has been using Function Blocks or FBs since the S5 series of PLC from the early 1980s and is a staple that provides the ability to consolidate repetitive program code into a single instruction, which can be called multiple times with each instance call storing the results in the form of an instance Data Block for later evaluation. This is no different than adding an IEC Timer instruction to your code and assigning it a unique name (instance) to create the necessary memory space (instance Data Block) to function.

From large production lines and machines to the smallest of manufacturing equipment, distributed I/O systems using PROFINET allow for quick deployment and diagnostic capabilities. It is critical to know if individual PROFINET IO-devices are powered and communicating. The C&E Advanced Technologies Library provides a single FB that monitors the Status of every IO-Device on a PROFINET network. If you have more than one PROFINET network on a Siemens S7-1500 CPU, then call the FB with a separate instance Data Block. There are companion Comfort Panel HMI Faceplates with a PROFINET status indications for each PROFINET IO-Device numbered from 1 to 512. Also, the library includes a FB that controls the Activation and Deactivation of an individual IO-Device.

CEAT Library PROFINET Status & Control V16

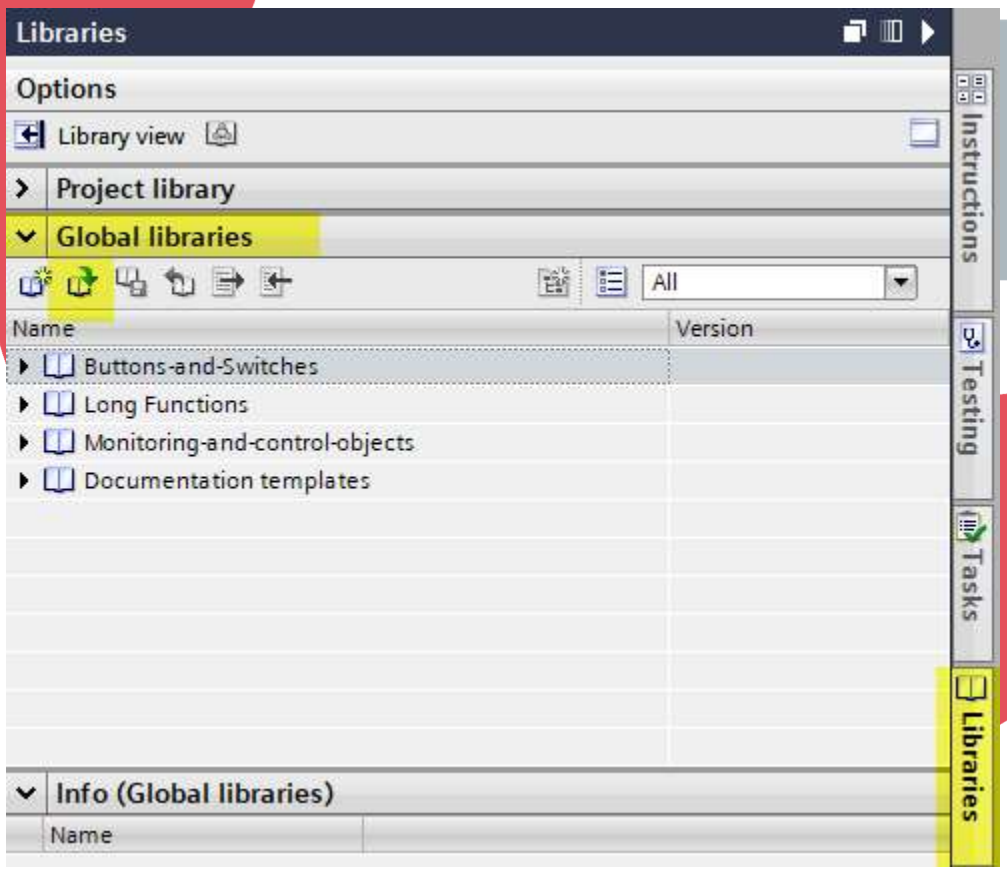
Anything you create is a TIA Portal V16 project can be placed into one or more appropriately named Libraries. Items from a library created in V16 can be accessed and used from any other TIA Portal V16 or later project. Here is a list of the individual items that can be stored and grouped in a Library:

PLC: OBs, FCs, FBs, DBs, PLC Data Types, PLC Tag Tables, Watch Tables, Traces, Technology Objects, Software Units, External Source Files, CPU itself, Individual I/O Modules, the entire PLC station.

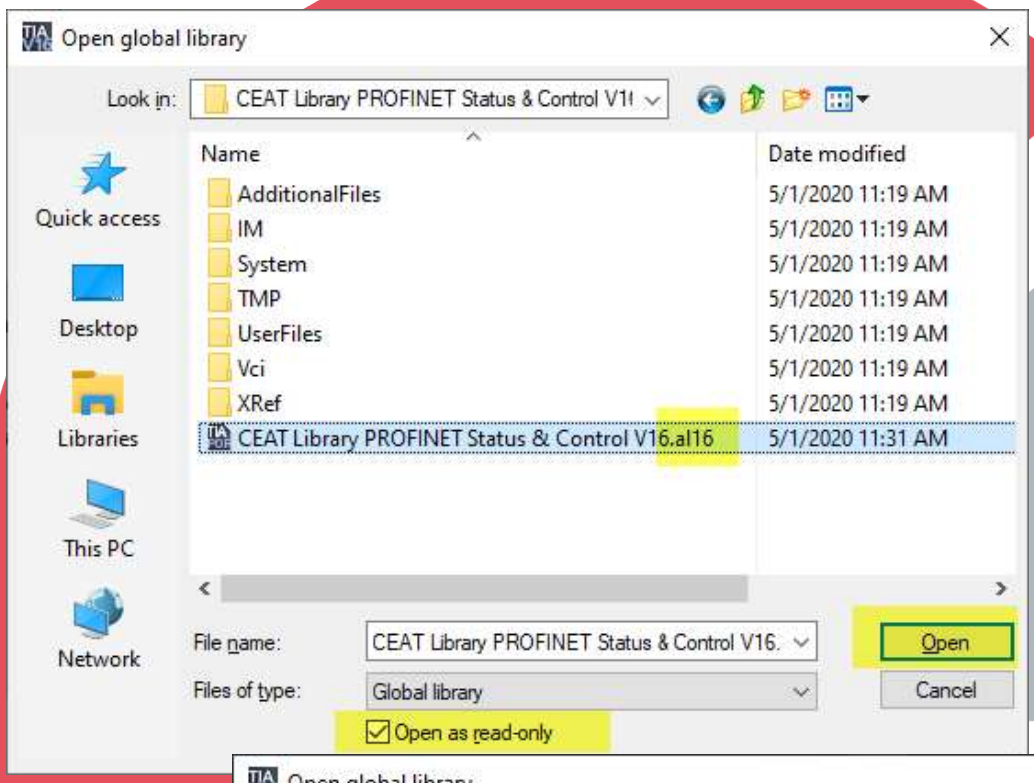
HMI: Screens, Templates, Pop-up Screens, Slide-in Screens, Global Screen, Permanent Area, HMI Tag Tables, Text Lists, Graphics Lists, Discrete Alarms, Analog Alarms, Alarm Classes, Alarm Groups, Recipes, Scripts, Reports, Scheduled Tasks, Cycles, User Groups, Users, Individual screen objects, Grouped screen objects, Faceplates, the entire HMI station.

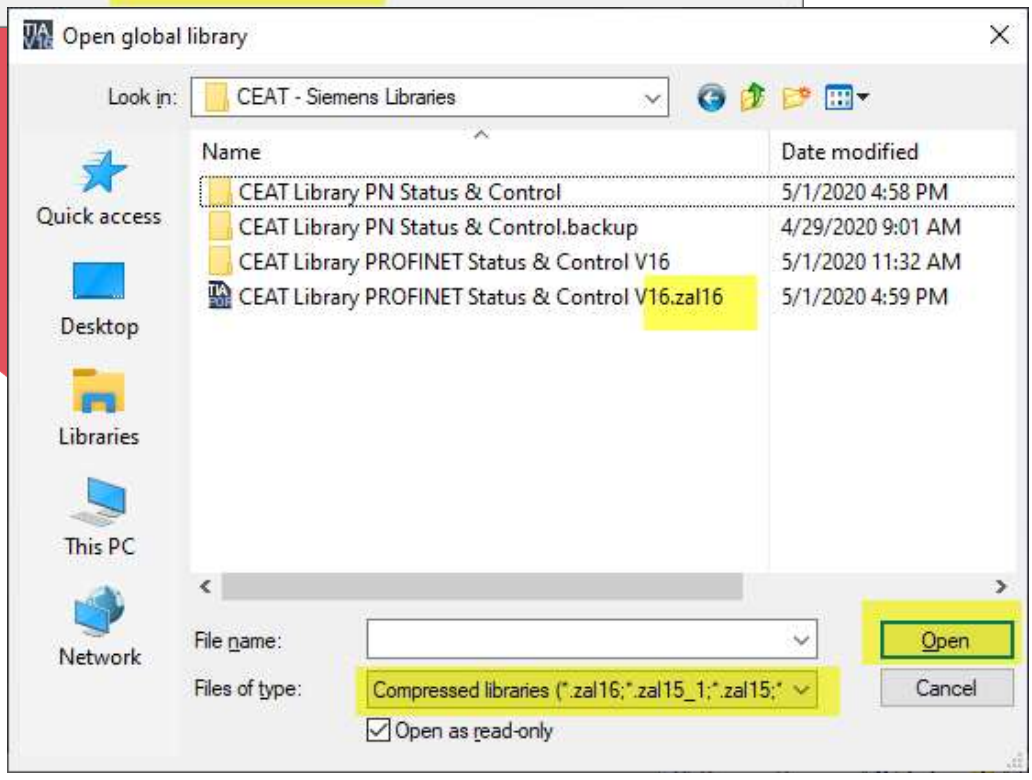
Drive Stations, I/O Stations, 3rd Party Stations

Libraries can be viewed by clicking on the vertical Libraries button at the right-hand side of the Task Cards. Included in TIA Portal are a few Global Libraries. To open a C&E Advanced Technologies library, click on the Open Global Library icon, second from the left.

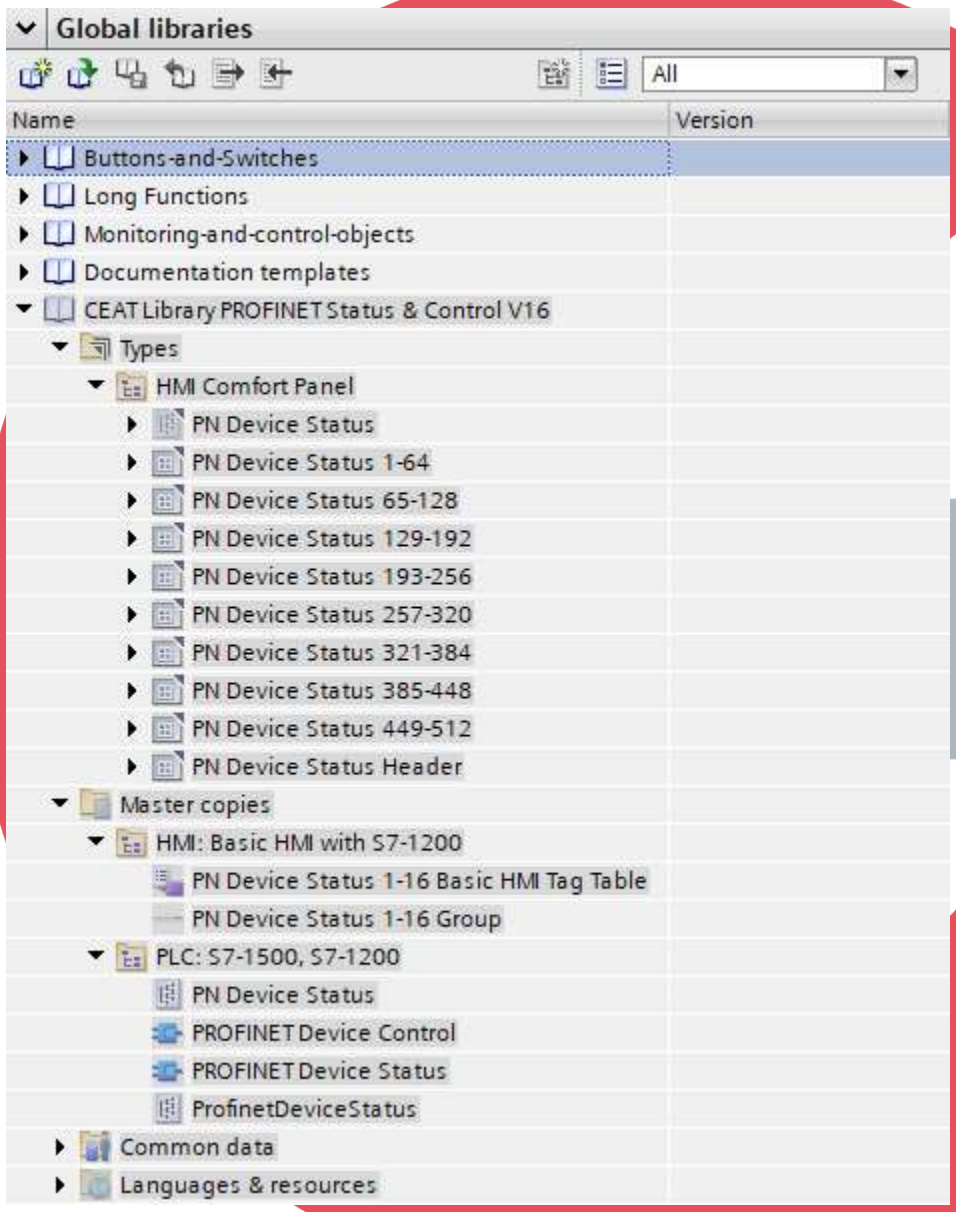


Browse until you locate the Folder “CEAT Library PROFINET Status & Control V16.” Open the folder and you should see the file name with the extension al16. Single Click on the file. Please note by default, the “Open as read-only” box is checked. Leave it checked and click on the Open button. If you have yet to open this library, then it will be in its original single file form as an archived library. Choose the Compressed Libraries and locate the zal16 in lieu of the al16 file.



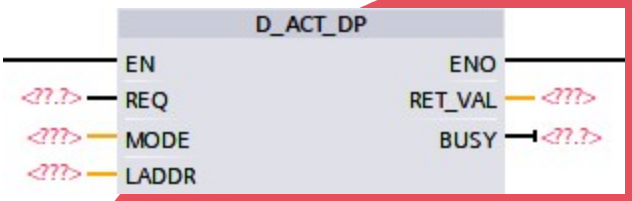


Library items are grouped together. Located under “Master Copies -> PLC: S7-1500, S7-1200” are two PLC Data Types and two Function Blocks. Located under “Master Copies -> HMI: Basic HMI with S7-1200” is a Basic HMI Tag Table and a grouped HMI Screen Object for a Basic HMI panel. Located under “Types -> HMI Comfort Panel” are Faceplates that can be used in a Comfort HMI panel.

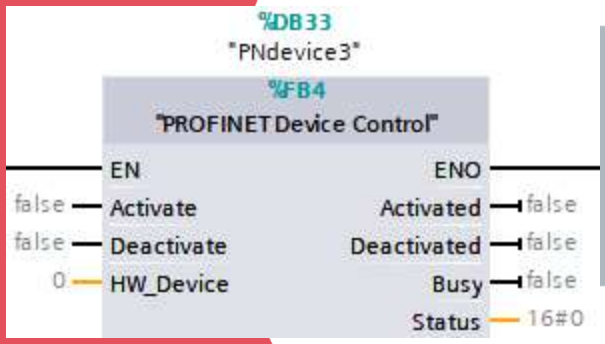


FB – PROFINET Device Control

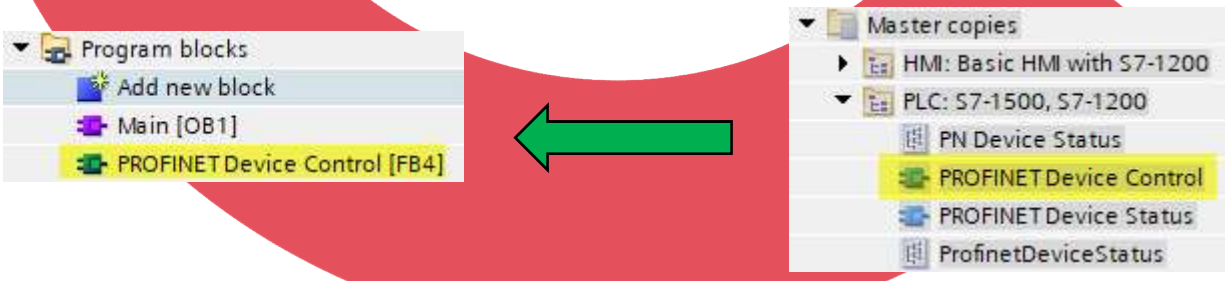
In the previous tech note “PROFINET Device Status and Control”, the D_ACT_DP was illustrated and described as the instruction to use for Activating and Deactivating a PROFINET IO-Device using MODEs 1 and 2 respectively, and MODE 0 to confirm if the IO-Device has been activated or deactivated.



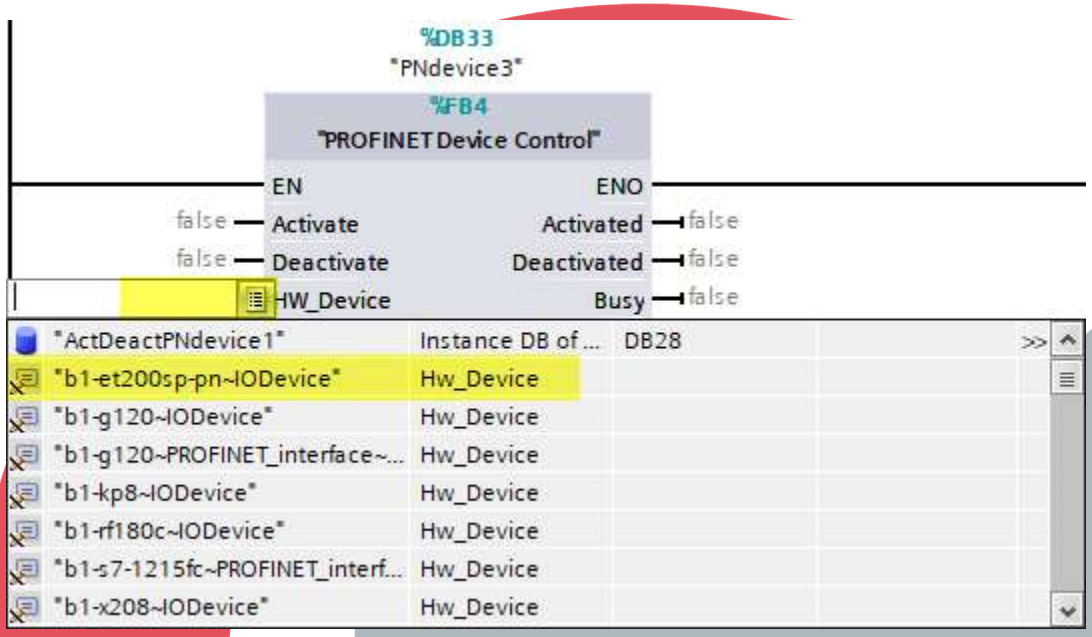
It is desirable to have a bit to evaluate if a device is activated or deactivated as confirmation. Additional logic is required to effectively control the activation, deactivation, and information that all three modes would provide. The “PROFINET Device Control” Function Block was created to provide an interface for activating and deactivating a single PROFINET IO-Device, integrating the DP_ACT_DP instruction. The input pins Activate and Deactivate have replaced the MODE. Separate Activated and Deactivated output pins have been provided in addition to Busy and Status (which is RET_VAL).



From the Library, click and drag the “PROFINET Device Control” function block to the Program Blocks folder of the S7-1200 or S7-1500 PLC Station. Then, open OB1 and drag “PROFINET Device Control” onto a free Network.



As was true in the previous tech note for the DP_ACT_DP input pin LADDR, click on the input pin Hw_Device to get the popup list where you can scroll down until you find the Hw_Device data type for the respective PROFINET IO-Device. Here, the b1-et200sp-pn device is selected.

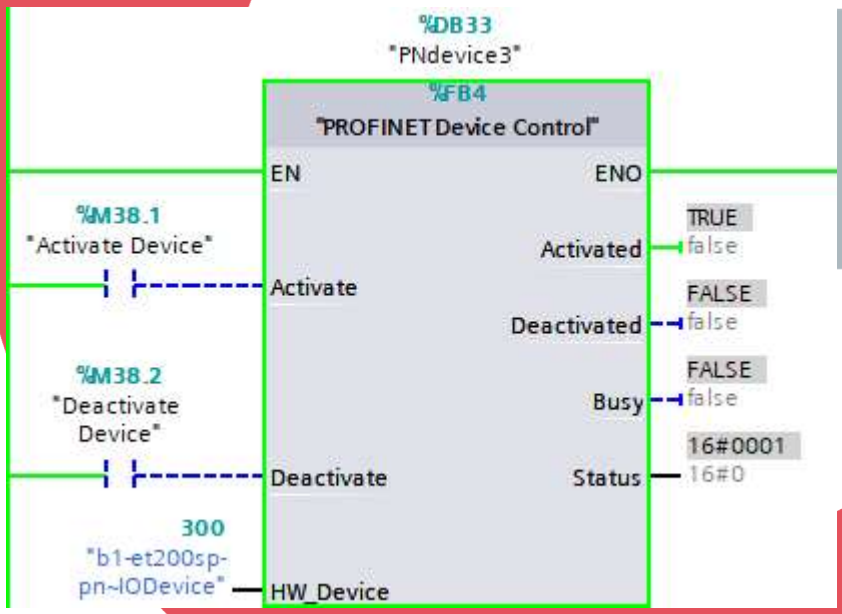


After power is applied to the CPU, the EN enable input will execute the “PROFINET Device Control” instruction every scan. With both Activate and Deactivate input pins FALSE, the instruction will execute MODE 0 to check if the device at Hw_Device is Activated or Deactivated.

Providing a TRUE at the Deactivate input pin will cause the instruction to execute MODE 2. With success, the Activated output pin will go FALSE and the Deactivated output pin will go TRUE. MODE 2 is only executed one time. You must set the Deactivate input pin FALSE and then TRUE again if you want to execute another Deactivation of the device.

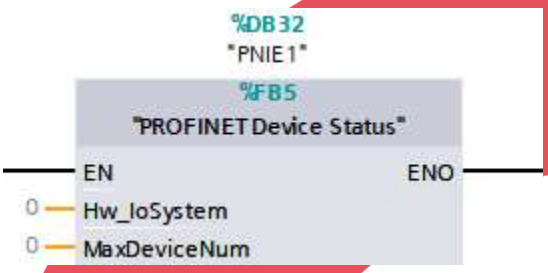
If the Deactivate input pin is TRUE and at a point later in time the Activate input pin is made TRUE, MODE 1 will be executed, provided a Deactivation is not taking place. With success, the Deactivated output pin will go false and the Activated output pin will go TRUE. MODE 1 is only executed one time. You must set the Activate input pin FALSE and then TRUE again if you want to execute another Activation of the device.

If you want the device to be deactivated immediately after power is applied, then ensure the Memory address or Data Block address used at the Deactivate input pin is TRUE. It may be necessary to set the respective address as retentive to retain the TRUE value, before power is cycled.

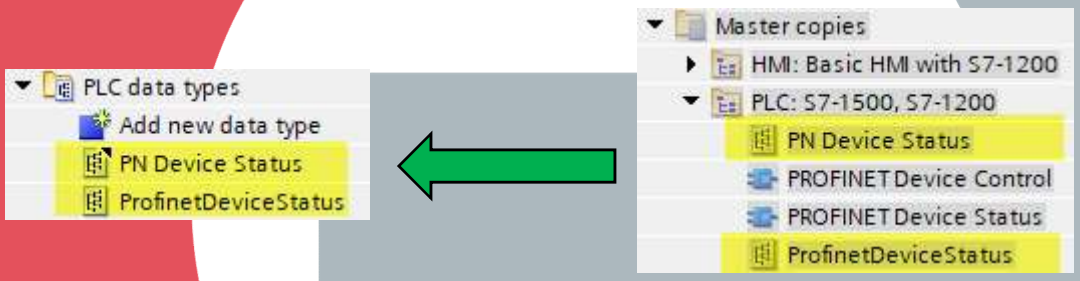


FB – PROFINET Device Status

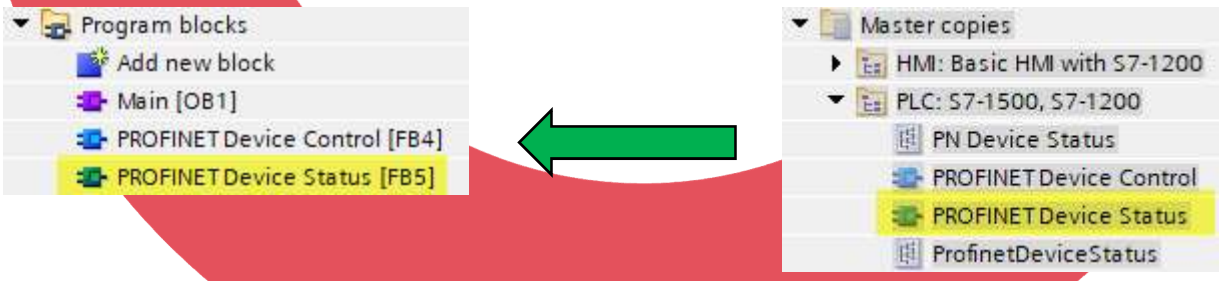
All five modes of the DeviceStates instruction have been combined into a single Function Block called "PROFINET Device Status" with each instance Data Block for each PROFINET network used by the CPU, reducing the amount of code required and the time to create a Global Data Block holding the status of each mode for the PROFINET Network.



First, from the Library, click and drag the "PN Device Status" and "ProfinetDeviceStatus" data types to the PLC Data Types folder of the S7-1200 or S7-1500 PLC Station.



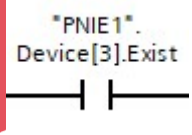
Second, click and drag the "PROFINET Device Status" function block to the Program Blocks folder of the S7-1200 or S7-1500 PLC Station. Then, open OB1 and drag "PROFINET Device Status" onto a free Network.



It has an input pin for the Hw_IoSystem data type that was discussed in the previous tech note for the LADDR input pin of the DeviceStates instruction. The MaxDeviceNum input pin is an UINT or Unsigned Integer data type for the maximum number of devices to scan. Enter a value from 1 to 1023 for the maximum device number as determined from the Network View. The purpose of the MaxDeviceNum input is to combine the results from each of the five MODEs of the DeviceStates instruction mentioned in the previous tech note, into two new arrays in the Static area of the FB, called Device[#] and Station[#]. Enter a value of 500 to populate array positions 1 to 500. Any entered value greater than 1023 will be considered a value of 1023. If the default value is left unchanged at 0, then the FB will populate array positions 1 to 16 as the maximum number of devices the S7-1200 PROFINET IO-Controller can scan is 16.

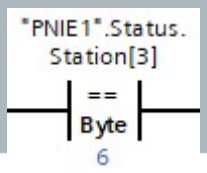
The Device array is for the individual status bits of each PROFINET device, using the PLC Data Type "ProfinetDeviceStatus". Please note the arrangement of the individual states are not in sequential order per the MODE number. For example, PROFINET Device 3's Exist bit from the "PNIE1" named PROFINET network can be used in a network to allow active process alarms to occur knowing there is good communications to that device.

Device	Array[0..1023] of "ProfinetDeviceStatus"
Device[0]	"ProfinetDeviceStatus"
Device[1]	"ProfinetDeviceStatus"
Disabled	Bool
Configured	Bool
Exist	Bool
Faulty	Bool
Problem	Bool
Device[2]	"ProfinetDeviceStatus"



The Station array is the binary representation of the individual states in a Byte data type, per the order in the Device array of the individual states as bits 0 to 4. The name Status, in the Static area of the Function Block interface declaration area, uses the "PN Device Status" data type, which includes the Station array. A comparison instruction of the Station status can be used in a network.

Status	"PN Device Status"
Station	Array[0..1023] of Byte
Station[0]	Byte
Station[1]	Byte
Station[2]	Byte
Station[3]	Byte



Both Faulty and Problem are true if the PROFINET IO-Controller has not detected the PROFINET IO-Device (no communications), or if good communications exist and there is a diagnostic on the IO-Device. Therefore, you can expect the binary representation of the Status for each device to be as follows:

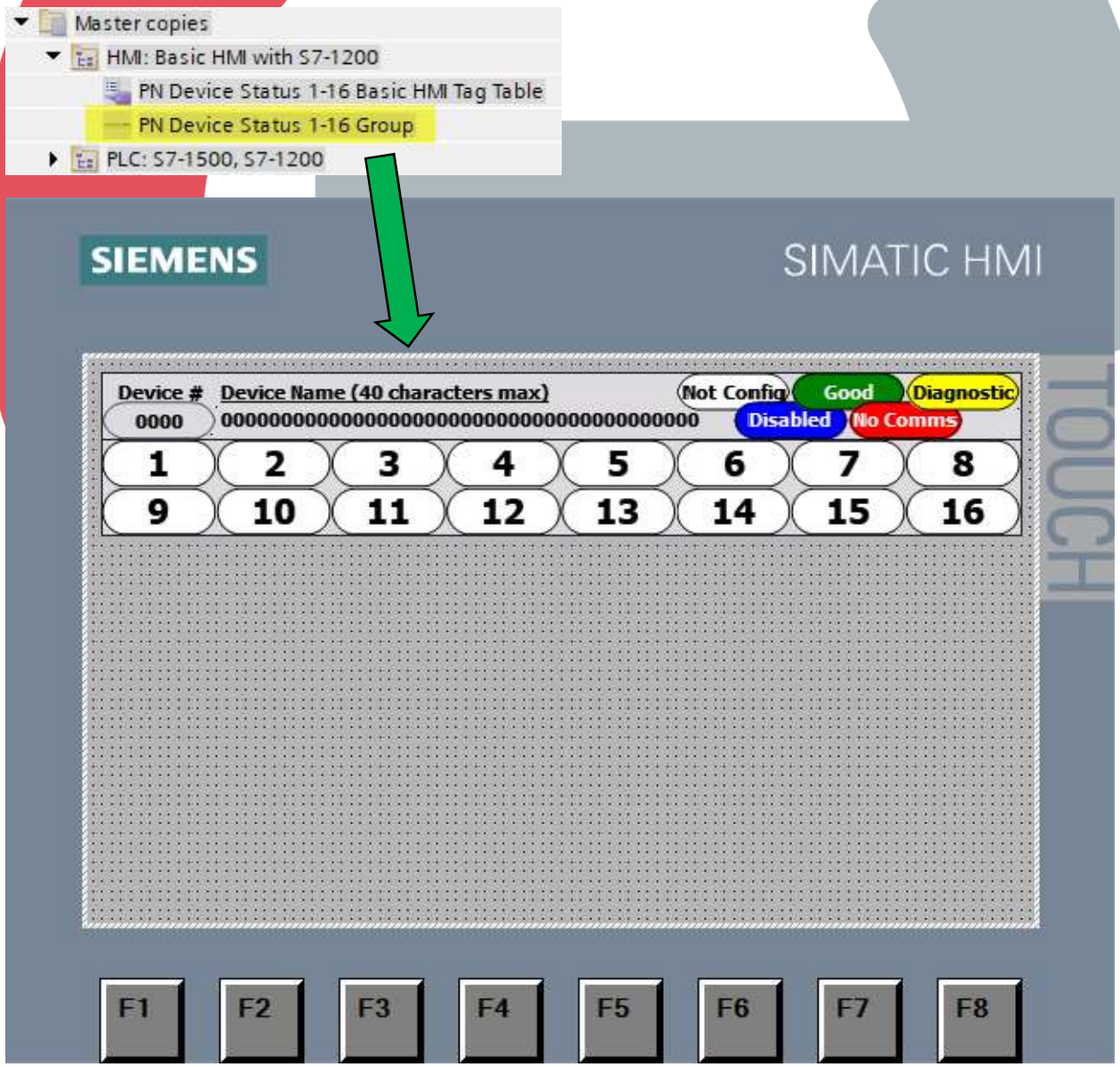
		Problem	Faulty	Exist	Configured	Disabled
	Bit	4	3	2	1	0
	Value	16	8	4	2	1
Not Configured	0	0	0	0	0	0
Disabled	3	0	0	0	1	1
Good Communication	6	0	0	1	1	0
No Communication	26	1	1	0	1	0
Diagnostic	30	1	1	1	1	0

A Text List and/or a Graphic List can be used in a Siemens HMI Panel to display the status of a device.

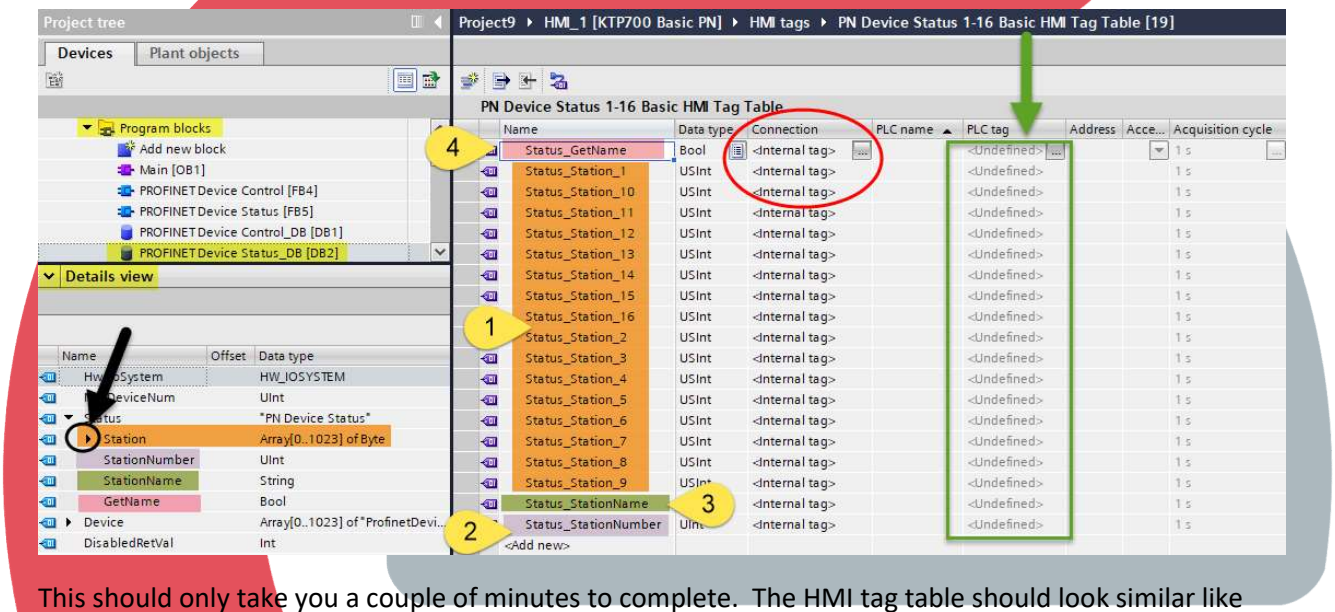
Basic HMI Panel – PN Device Status 1-16

When a Siemens S7-1200 PLC is used, a Siemens Basic HMI Panel is usually paired with the S7-1200. Although a feature rich PLC, the S7-1200 does not have the built-in System Diagnostics like the S7-1500. The S7-1200 PLC is typically used for small machines and is usually paired with a Basic HMI Panel for an inexpensive system. Two items in the library have been created just for the Basic HMI Panel for use with the instance data block of the "PROFINET Device Status" function block. First, from the Library, click and drag the "PN Device Status 1-16 Basic HMI Tag Table" to the HMI Tags folder of the Basic HMI station.

Second, click and drag the "PN Device Status 1-16 Group" onto a 7" or larger Basic HMI screen.



The grouped HMI objects have already linked to the “PN Device Status 1-16 Basic HMI Tag Table”. Open this tag table. Please note under the Connection column that each HMI tag is currently an Internal Tag. These 19 tags must be linked to the Status area in the instance data block name that was assigned to “PROFINET Device Status” function block. In this example, the instance data block is the same name as the function block with the “_DB” added to the end. In the program Blocks folder, single click on the instance data block to display the items in the Details View window below. Drag each element name from the Details View into the PLC Tag column location (as indicated by the green box and green arrow) for each matching HMI tag name. For the Station array, click on the black arrow to expand the array.

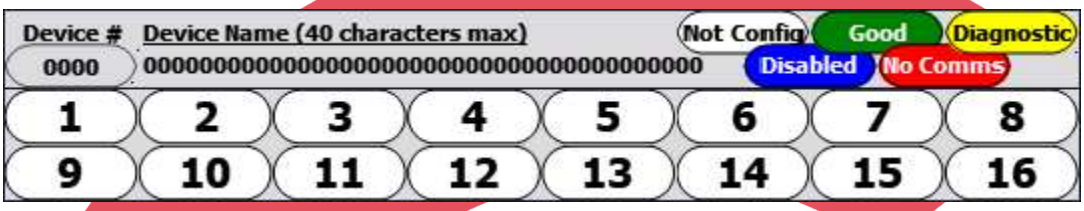


This should only take you a couple of minutes to complete. The HMI tag table should look similar like the following screen shot. Please note the HMI tags are now connected to the PLC and the Acquisition Cycle column tag update rates are set to one second by default. Modify each to 100ms.

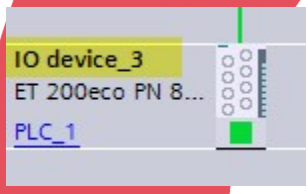
PN Device Status 1-16 Basic HMI Tag Table

Name	Data type	Connection	PLC name	PLC tag	Address	Acce...	Acquisition cycle
Status_GetName	Bool	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.GetName		<sy...	1 s
Status_Station_1	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[1]		<sy...	1 s
Status_Station_10	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[10]		<sy...	1 s
Status_Station_11	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[11]		<sy...	1 s
Status_Station_12	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[12]		<sy...	1 s
Status_Station_13	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[13]		<sy...	1 s
Status_Station_14	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[14]		<sy...	1 s
Status_Station_15	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[15]		<sy...	1 s
Status_Station_16	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[16]		<sy...	1 s
Status_Station_2	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[2]		<sy...	1 s
Status_Station_3	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[3]		<sy...	1 s
Status_Station_4	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[4]		<sy...	1 s
Status_Station_5	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[5]		<sy...	1 s
Status_Station_6	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[6]		<sy...	1 s
Status_Station_7	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[7]		<sy...	1 s
Status_Station_8	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[8]		<sy...	1 s
Status_Station_9	Byte	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.Station[9]		<sy...	1 s
Status_StationName	String	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.StationName		<sy...	1 s
Status_StationNumber	UInt	HMI_Connection_1	PLC_1	"PROFINET Device Status_DB".Status.StationNumber		<sy...	1 s
<Add new>							

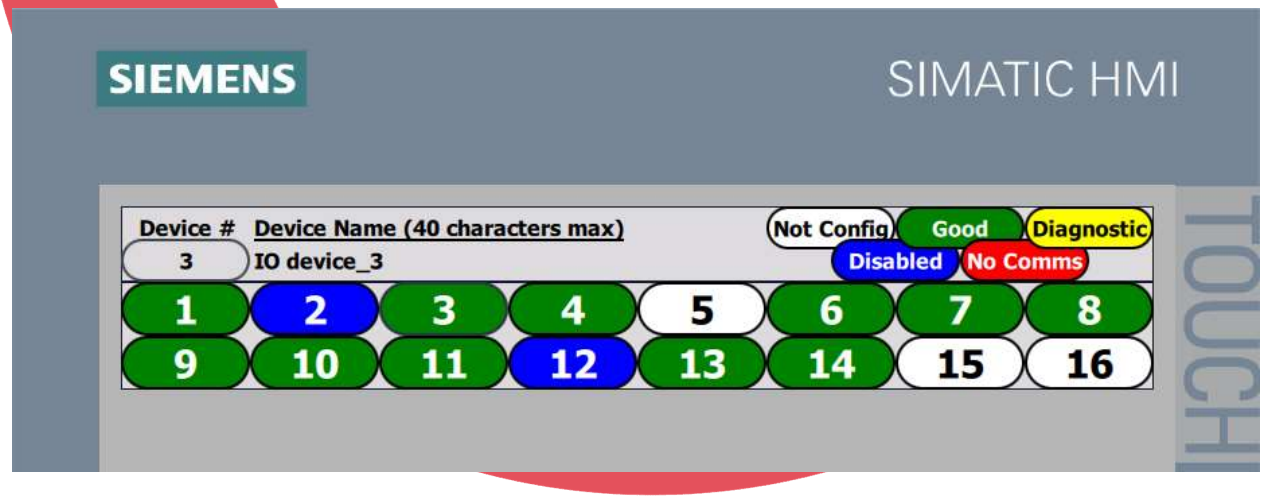
Each numbered, pill shaped oval represents the Device number of each PROFINET IO-Device and provides the device status per the color key located in the upper right-hand corner. You will notice the color codes correspond to the color code table in the "FB - PROFINET Device Status" section of this tech note. For a configured IO-Device that is not communicating, the Red "No Comms" indication will flash to alert you to loss in communications.



Each pill shaped oval is also a push button. Pressing and releasing each button will request the PLC for the Device Name corresponding to the Device Number and display it in the header above. The Device Name is found on the Device in the Network View.

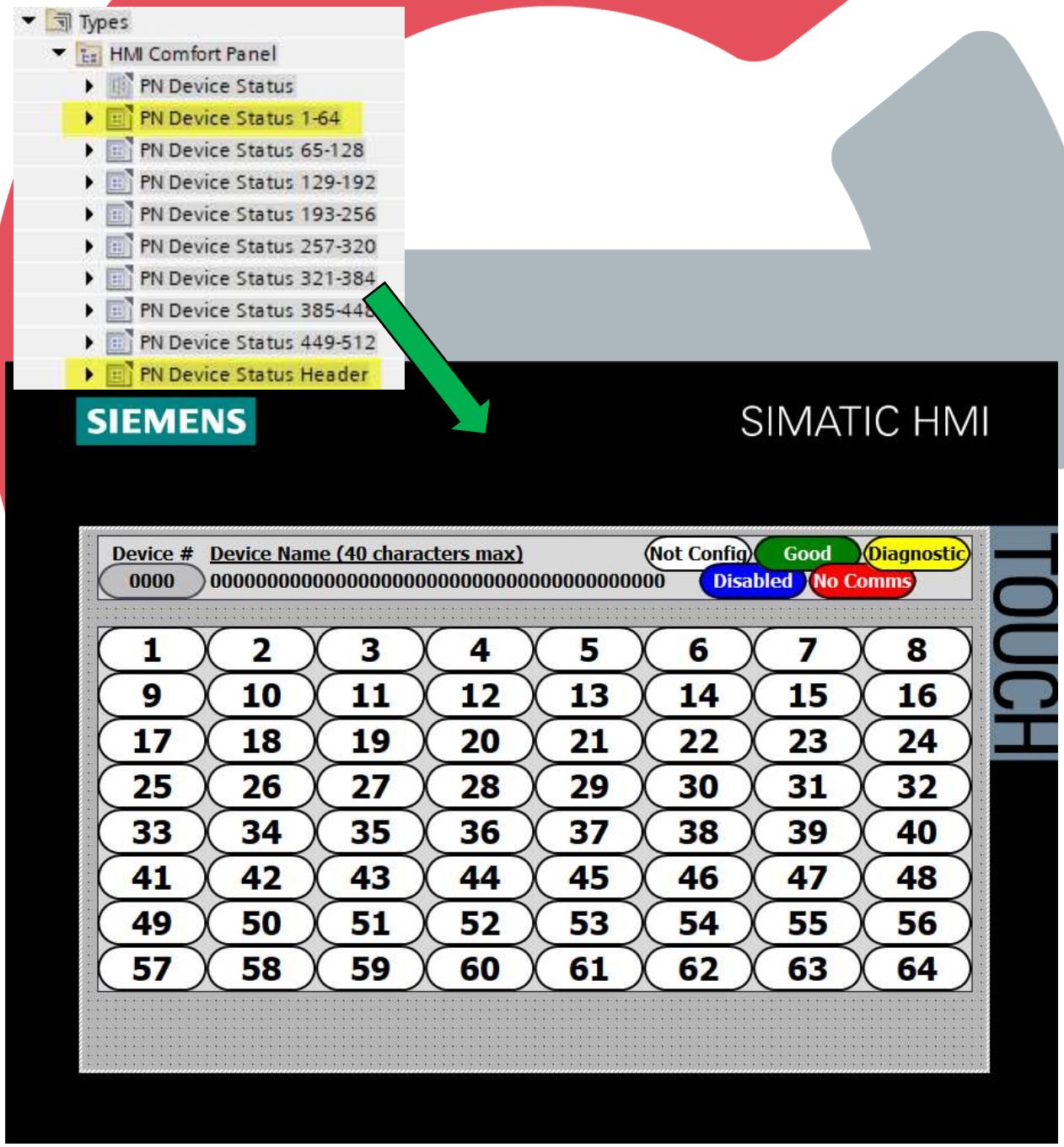


Here is an example from the runtime simulation of a KTP700 Basic HMI panel. Please note nothing has been configured on the PROFINET Network for devices 5, 15, and 16. IO-Devices 2 and 12 have be deactivated or disabled. The rest of the IO-Devices are communicating with the PROFINET IO-Controller of the S7-1200. When the pill shaped oval button is pressed and released, the IO-Device number and name appear in the header above.

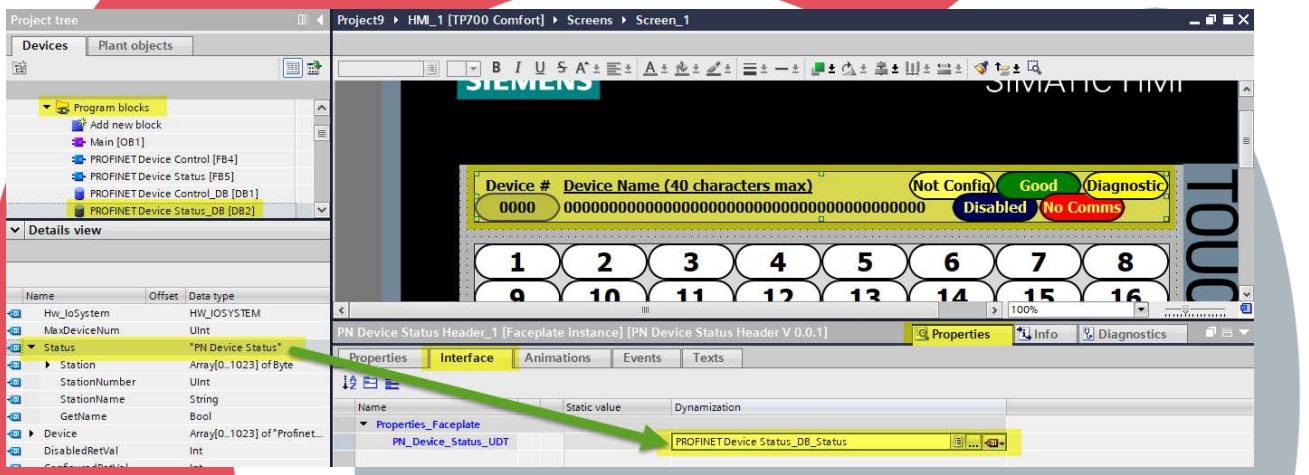


Comfort HMI Panel – PN Device Status xx-xx Faceplates

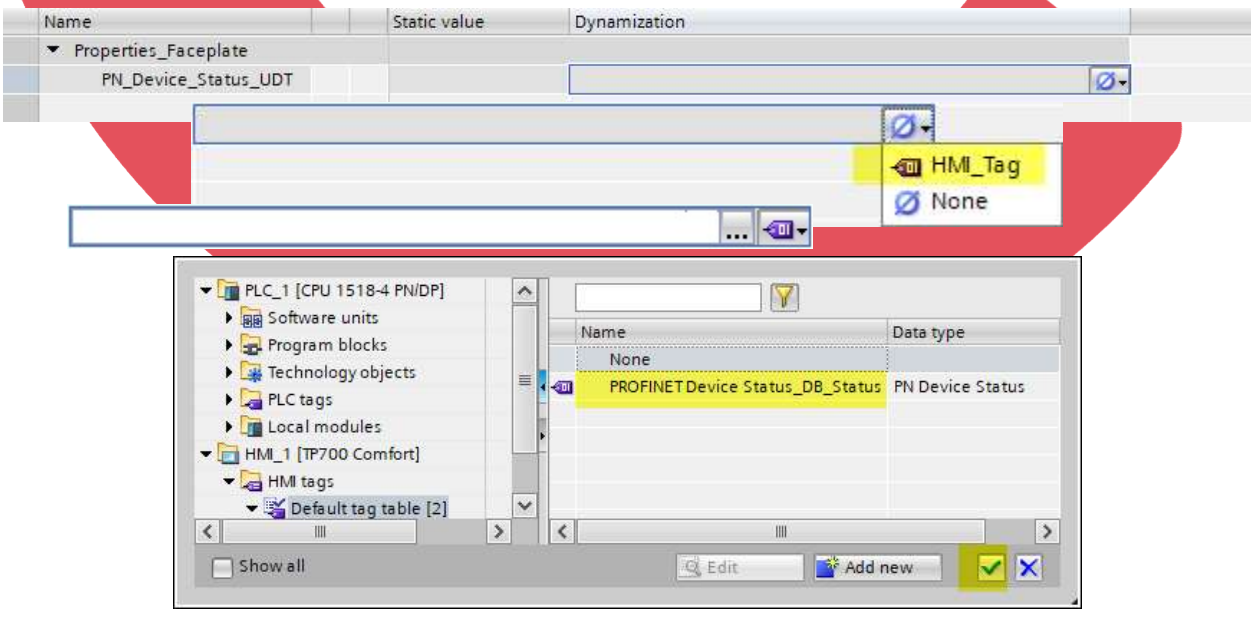
When a Siemens S7-1500 PLC is used, a Siemens Comfort HMI Panel is usually paired with the S7-1500. Even though the S7-1500 already has the built-in System Diagnostics that provides you the ability to drill down into a single IO-Device on a PROFINET Network to locate the diagnostic using the Systems Diagnostic View screen object. Currently, the largest number of PROFINET IO-Devices that a Siemens S7-1500 PROFINET IO-Controller can support is 512. Eight Faceplates have been created with 64 IO-Devices and has been sized to fit on a seven-inch Comfort HMI Panel and work with the instance data block of the "PROFINET Device Status" function block. From the Library, click and drag the "PN Device Status Header" and "PN Device Status 1-64" onto an HMI screen.



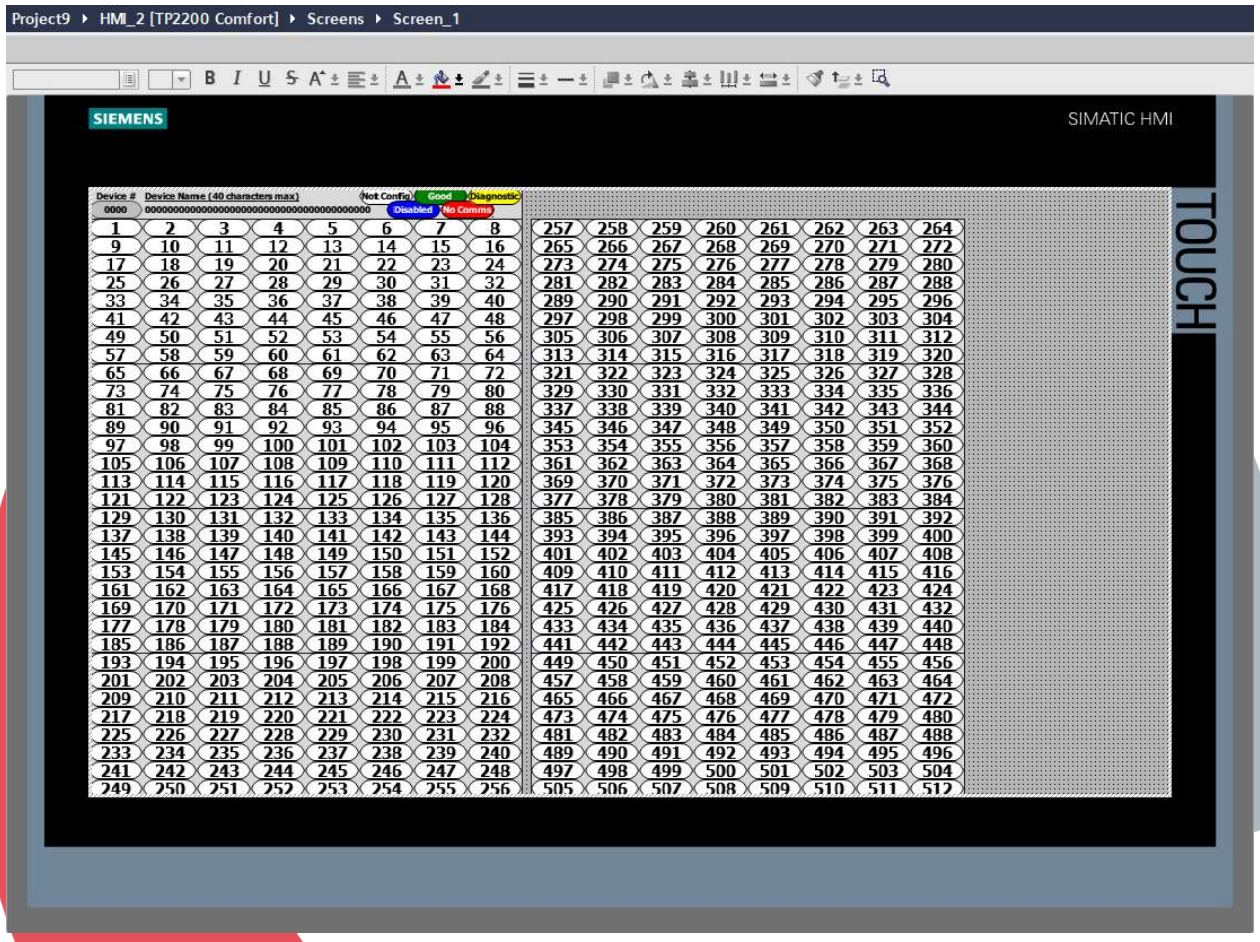
If using more than one group of 64 IO-Devices, then you can choose to place the “PN Device Status Header” onto a Template screen and reference that template for each screen containing a “PN Device Status xx-xx” faceplate. Unlike the Basic HMI panel where 19 individual tag names had to be dragged into the HMI tag table one at a time, only a single PLC tag name needs to be dragged over this time. It is the PLC Data Type (or User Data Type - UDT) called “PN Device Status” that is used by the “PROFINET Device Status” function block and by all faceplates in the library. In this example, the same instance data block illustrated in the Basic HMI example is used. Ensure the “PN Device Status Header” has focus on the HMI screen with the Properties Tab and Interface lower level tab selected in the Inspector Window. Single click on the instance data block to display the items in the Details View window below. Drag the “Status” element name from the Details View into the Dynamization field.



You can repeat this drag and drop for each “PN Device Status xx-xx” faceplate. Or, since the PLC tag has already been added to the HMI Tag Table, you can click on the field itself to give focus. Next, click on the drop-down list with the slashed circle. Then, click on the box with the three dots and select the same HMI tag that was used in before in the header, and click on the checkmark button.



The faceplates can be resized allowing more than one group of 64 IO-Devices to be displayed on a common screen on a larger Comfort HMI Panel. Here is a screen shot of 22” TP2200 Comfort HMI.



References and Useful Links

Siemens trial software provides for a 21-day trial license and can be downloaded from the following Siemens Industry Online Support web links. Please note the PLC, Safety, and HMI are on the same installation "DVDs". If you do not have one, you will need to create a login (one-time). This is required to download the *.exe file for each trial software.

STEP7 Basic/Professional V16… and

STEP7 Safety Basic/Advanced V16… and

WinCC Basic/Comfort/Advanced and WinCC Unified V16

PLCSIM V16 is on its own installation "DVD"

https://support.industry.siemens.com/cs/document/109772803/simatic-step-7-incl-safety-and-wincc-v16-trial-download?dti=0&pnid=24462&lc=en-US

Startdrive Advanced V16

https://support.industry.siemens.com/cs/document/109771710/sinamics-startdrive-v16?dti=0&pnid=13438&lc=en-US

Acknowledgments

Screenshots are of Siemens STEP7 Professional V16 in the TIA Portal V16 software framework.