

Tank-Vessel Application Profibus Notes





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# 1 Overview

This Engineering Note demonstrates the integration of the METTLER TOLEDO IND360's Tank/Vessel Application with a Profibus PLC. Go to [www.mt.com/ind-ind360-downloads](http://www.mt.com/ind-ind360-downloads) to download all the necessary files and documents.

## ***NOTICE***

**NOTE: THE CONFIGURATION USED IN THIS SAMPLE CODE IS BASED ON THE DEFAULT SETTINGS:**

<b>SIEMENS TIA PORTAL:</b>	<b>V14 SP1</b>
<b>SAI DATA FORMAT:</b>	<b>2-BLOCK FORMAT, 8-BLOCK FORMAT</b>
<b>GSD FILE:</b>	<b>MT1153.GSD</b>
<b>IND360 DEVICE FIRMWARE VERSION:</b>	<b>V1.00.0012</b>

It is recommended to integrate one IND360 into the PLC Profibus network and go through the sample code to understand the functionality of each Function Block.

# 2 Setup of Project Development Environment

## 2.1. Hardware Integration

Connect the PLC and IND360 with the appropriate PROFIBUS DP cable.

## 2.2. Open the Sample Code

To open and use the "IND360\_PBDP\_TANKVESSEL\_V1\_00.ap14" sample code, the Siemens TIA Portal version 14 SP1 or higher must be used. All the required GSD files will be installed automatically when the sample code is opened.

## 2.3. Use the Correct Project

Two projects are included in one sample code, each using a different SAI data format:

- "S7-1200 SAI 2 Block" uses S7-1200 series PLC with IND360 Tank Vessel Application enabled and communicates in SAI 2-Block data format.

- "S7-1200 SAI 8 Block" uses S7-1200 series PLC with IND360 Tank Vessel Application enabled and communicates in SAI 8-Block data format.

Choose the project most relevant to your PLC type to download into the PLC. Make sure the IND360 PLC Communication data format (SAI 2 or 8 Block) is configured appropriately.

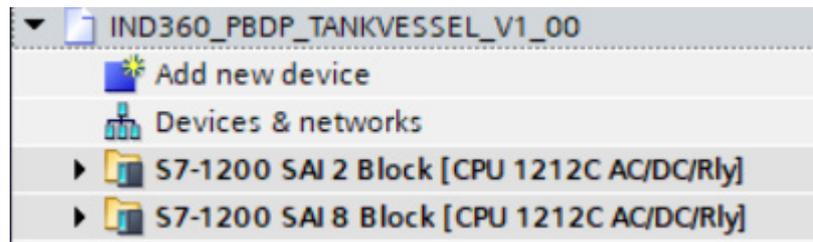


Figure 1: Two Projects in the Sample Code

To change the PLC model: Access **Device Configuration** under the project folder, right click on the current controller, select **Change Device**, and choose the new controller as well as its firmware version.

Compile and download the project into the controller.

## 3 SAI Data Structure in Device Overview

In the **Device Overview**, the SAI input and output data structure has been assigned with the respective I and Q addresses as shown in Figure 2. For more details on SAI data structure, please refer to the **Standard Application Interface (SAI) Transmitters Reference Guide**, in English, which can be downloaded from the IND360 Download Page at [www.mt.com/ind-ind360-downloads](http://www.mt.com/ind-ind360-downloads).

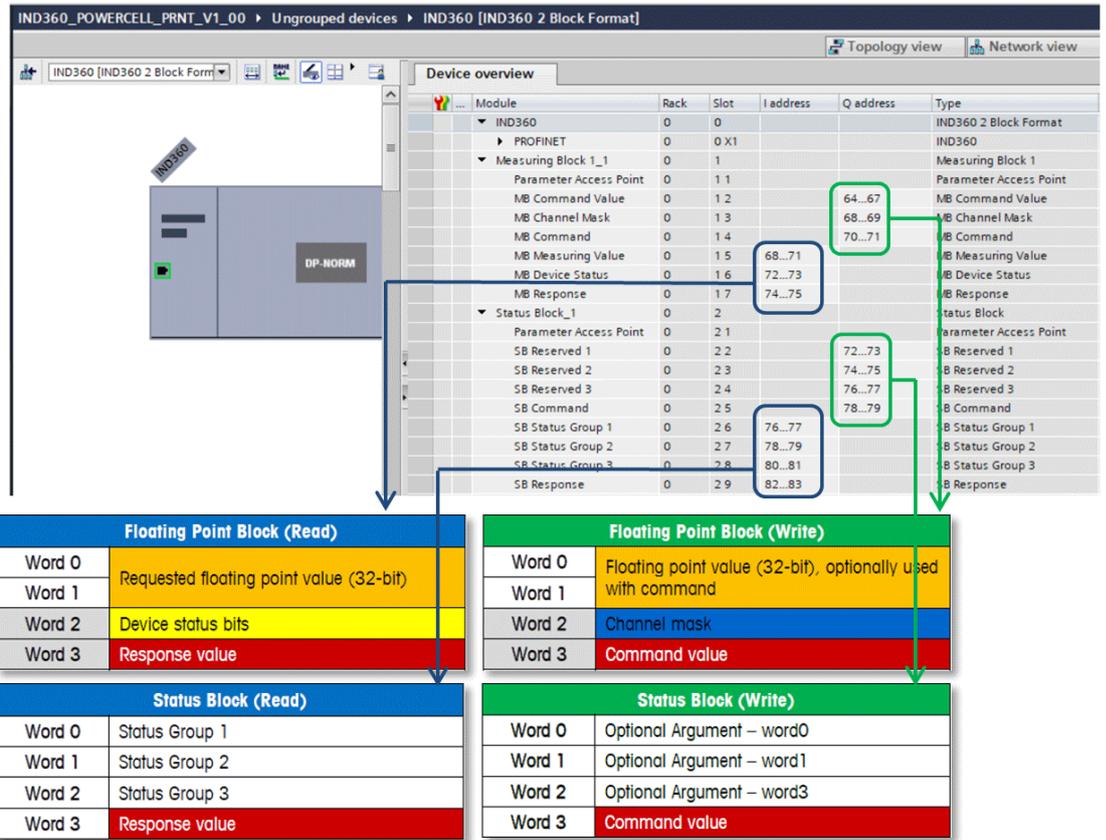
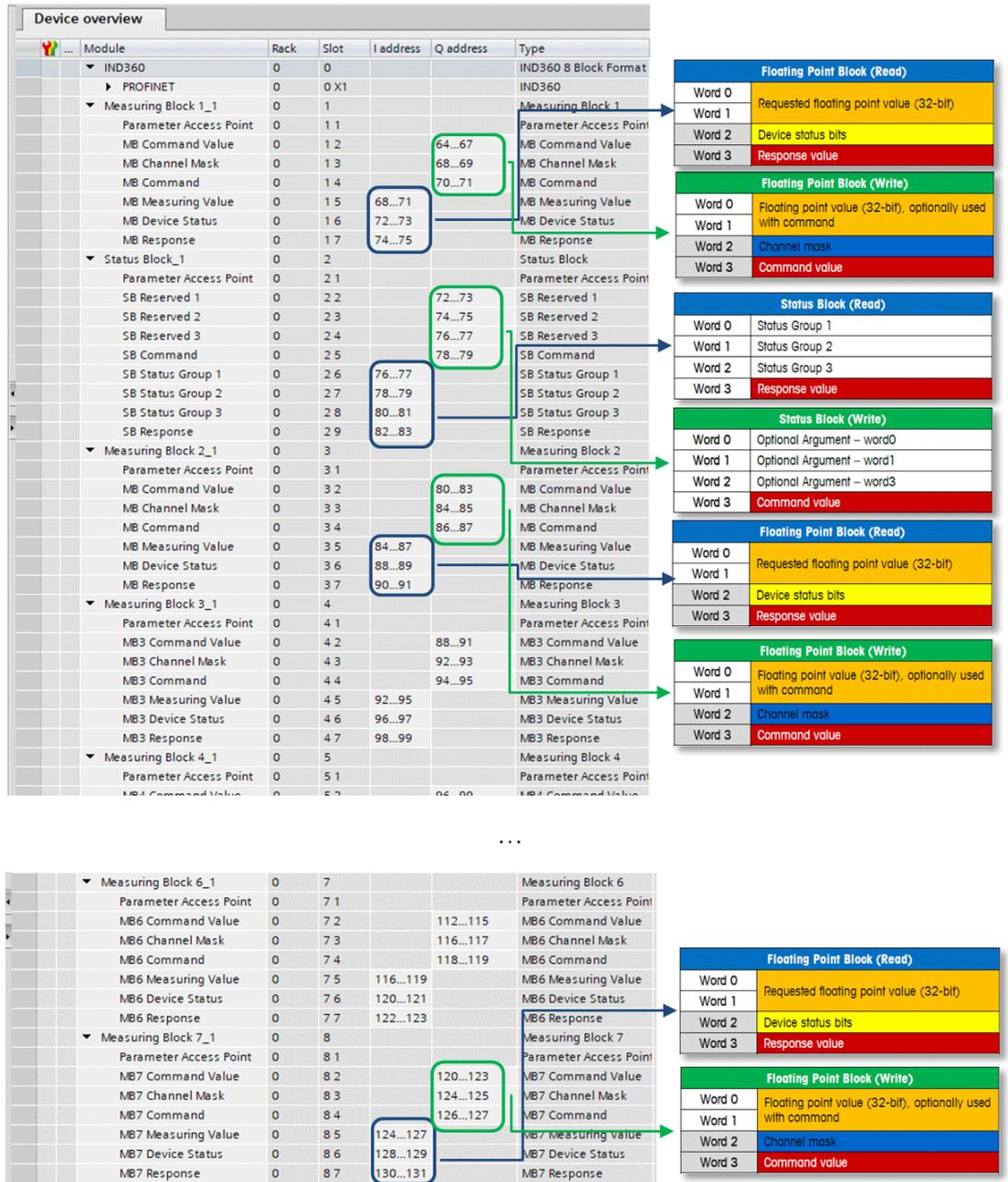


Figure 2: 2-Block SAI Data Structure as Shown in the Device Overview



**Figure 3: 8-Bock SAI Data Structure as Shown in the Device Overview**

The I and Q addresses above will be used as input parameters in section 4, below.

# 4 Application Function Blocks

Please refer to the **IND360 Tank Vessel Application Software User's Guide** for a fuller description of the application's functionality. This application user manual can be downloaded from the IND360 download page ([www.mt.com/ind-ind360-downloads](http://www.mt.com/ind-ind360-downloads)).

## 4.1. Tank Vessel Application Control

This is the function block used to read and write the upper and lower limits, to receive alarms, and to start and stop the application. In this sample code, this function block is assigned with IO addresses from the Measuring Block 1 (referred to as Measuring Block 1\_1 in the **TIA Portal Device Overview**). If the PLC communication is set up as SAI 8 Block format, these function block IO addresses can also be assigned to any other Measuring Block.

Before executing this function block, make sure the tank vessel application is enabled under the PAC Management setup menu.

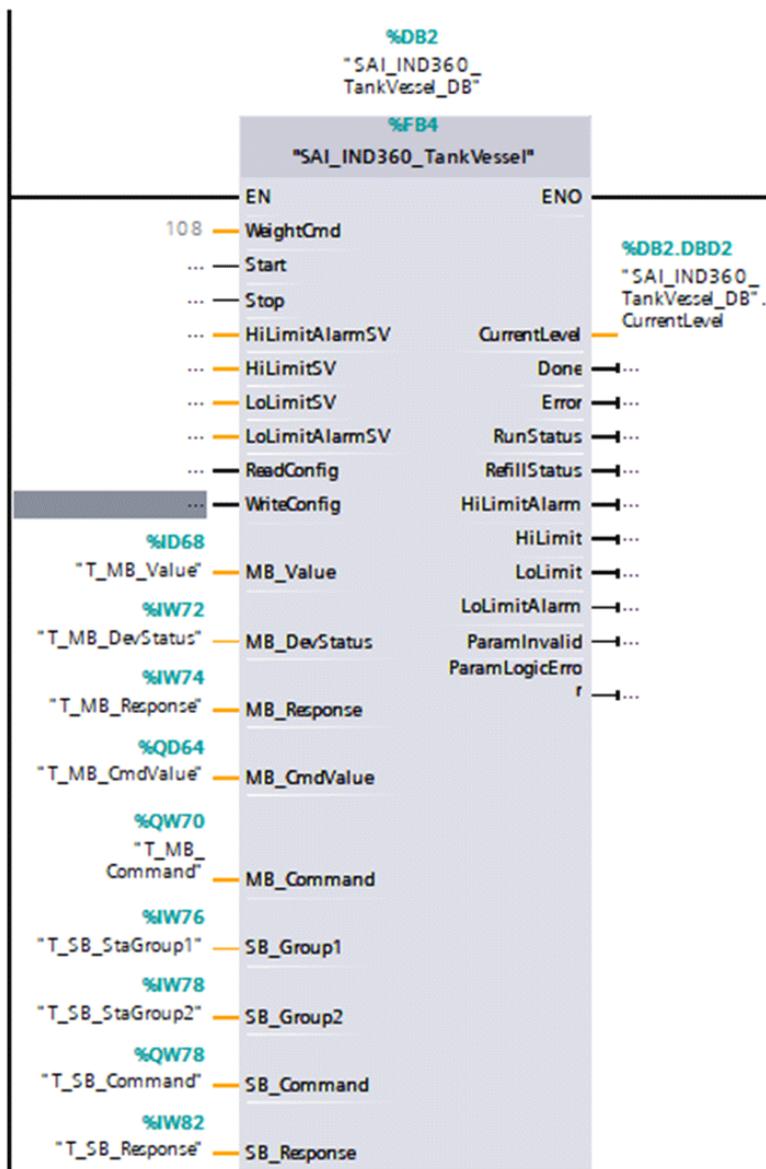


Figure 4: 8-SAI\_IND360\_TankVessel Function Block

Table 1: SAI\_IND360\_TankVessel Function Block Parameters

Parameters	Data Type	Values	Description
<b>Input</b>			
WeightCmd	Word	107	Report material level in gross weight
		108 (default)	Report material level in percentage
		0,1	Report the scale default (gross), gross weight
		2	Report the scale tare weight value
		3	Report the scale net weight value
Start	Bool		Trigger this bit to start the automatic level monitoring and control by the IND360. Upon successful execution of this command, the input bit will be reset and the output DONE bit will be turned ON.

Parameters	Data Type	Values	Description
Stop	Bool		Trigger this bit to stop the automatic level monitoring and control by the IND360. Upon successful execution of this command, the input bit will be reset and the output DONE bit will be turned ON.
HiLimitAlarmSV	REAL	e.g. "90.0"	This is the highest extreme material level where the IND360 will trigger an alarm. Potential risk of over-filling (e.g. due to malfunction of refill pump). This setting, along with the other limit and alarm settings will be written to the IND360 when the WriteConfig bit is triggered. Similarly, triggering the ReadConfig bit will update all the limits and alarms to the PLC DataBlock.
HiLimit	REAL	e.g. "80.0"	When material level exceeds this limit, the REFILL signal turns OFF, and remains OFF until the level falls below LoLimit again. This setting, along with the other limit and alarm settings will be written to the IND360 when the WriteConfig bit is triggered. Similarly, triggering the ReadConfig bit will update all the limits and alarms to the PLC DataBlock.
LoLimit	REAL	e.g. "50.0"	When material level falls below this limit, the REFILL signal turns ON, and remains ON until the level exceeds the HiLimit. This setting, along with the other limit and alarm settings will be written to the IND360 when the WriteConfig bit is triggered. Similarly, triggering the ReadConfig bit will update all the limits and alarms to the PLC DataBlock.
LoLimitAlarmSV	REAL	e.g. "10.0"	This is the lowest extreme material level where the material level is considered critically low. This setting, along with the other limit and alarm settings will be written to the IND360 when the WriteConfig bit is triggered. Similarly, triggering the ReadConfig bit will update all the limits and alarms to the PLC DataBlock.
MB_Value	Real		Refer to Device Overview, input address of MB Measuring Value
MB_DevStatus	Word		Refer to Device Overview, input address of MB Device Status
MB_Response	Word		Refer to Device Overview, input address of MB Response
MB_CmdValue	Real		Refer to Device Overview, output address of MB Command Value
MB_Command	Word		Refer to Device Overview, output address of MB Command
SB_Group1	Word		Refer to Device Overview, input address of SB Status Group 1
SB_Group2	Word		Refer to Device Overview, input address of SB Status Group 2
SB_Command	Word		Refer to Device Overview, output address of SB Command
SB_Response	Word		Refer to Device Overview, input address of SB Response

Parameters	Data Type	Values	Description
<b>Output</b>			
CurrentLevel	Real		Real-time weight value, can be material level percentage or gross weight according to the input WeightCmd.
Done	Bool	0	Start/Stop/ReadConfig/WriteConfig command is in process, or has failed
		1	Start/Stop/ReadConfig/WriteConfig command is successful
Error	Bool	0	Start/Stop/ReadConfig/WriteConfig command is in process, or success
		1	Start/Stop/ReadConfig/WriteConfig command has failed
RunStatus	Bool	0	Tank/Vessel level monitoring and control application has not started
		1	Tank/Vessel level monitoring and control application is running
RefillStatus	Bool	0	Refill signal is OFF
		1	Refill signal is ON
HiLimitAlarm	Bool	0	Application alarm is OFF
		1	Application alarm is ON, check the Refill line
HiLimit	Bool	0	Upper Limit is OFF
		1	Upper Limit is ON
LoLimit	Bool	0	Lower Limit is OFF
		1	Lower Limit is ON
LoLimitAlarm	Bool	0	Application alarm is OFF
		1	Application alarm is ON, check the Refill line

## 4.2. Cyclic Weight Data Processing

This function block is available in the "S7-1200 SAI 8 Block" project. It occupies Measuring Block 2 (referred to as Measuring Block 2\_1 in the **TIA Portal Device Overview**) I/O addresses. Its I/O addresses can also be assigned to other Measuring Blocks, such as 3, 4 ... 7.

This function block reads in all the important real-time, cyclical weighing data such as weight value, Data OK bit, Motion bit, Net mode bit and critical alarm bit.

Set the scale command bits one at a time to trigger different commands such as tare stable, zero stable, tare immediate, zero immediate, preset tare and clear tare. A successful execution of a scale command will set the Done bit on, else the Error bit will be set on instead.

The cyclic weight data can be reported automatically immediately after any scale command. The type of weight data (gross, net, or tare) reported depends on the setting for WeightCmd. By default, the WeightCmd is decimal "3" and the function block will return a net weight value immediately after any scale command such as tare or zero. Similarly, if the WeightCmd parameter is configured as decimal "0" or "1," the function block will then return a gross weight after any scale command.

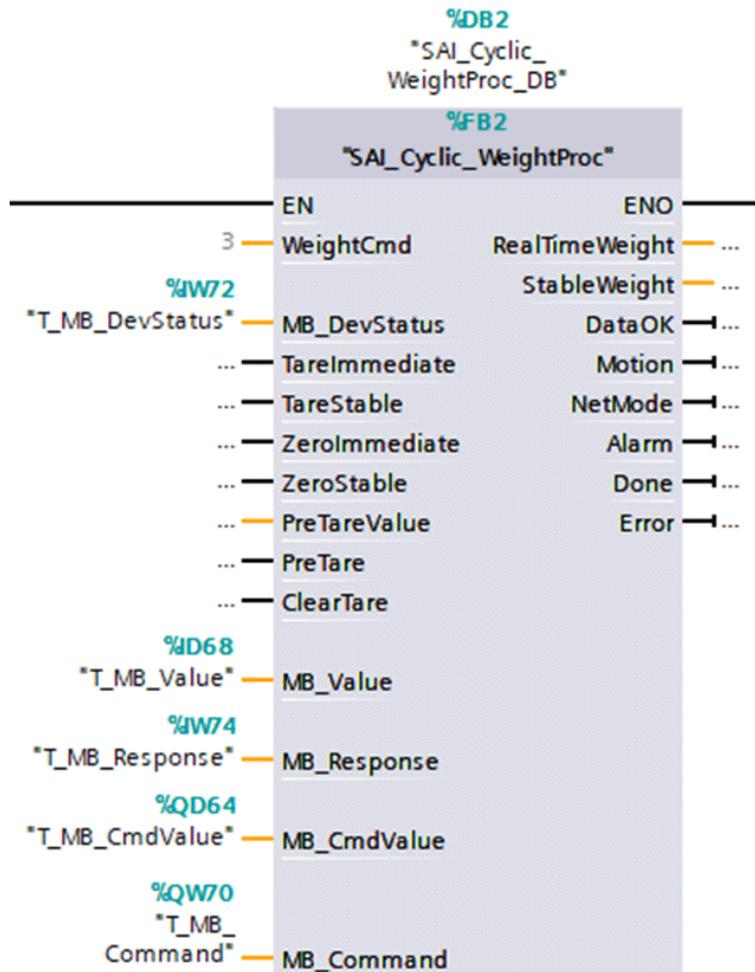


Figure 5: 8-SAI\_Cyclic\_WeightProc Function Block

Table 2: SAI\_Cyclic\_Weight\_Proc Function Block Parameters

Input Parameters	Data Type	Values	Description
WeightCmd	Word	0, 1	Report gross weight value
		2	Report tare weight value
		<b>3 (default)</b>	<b>Report net weight value</b>
		5	Report gross weight value (with internal resolution)
		6	Report tare weight value (with internal resolution)
		7	Report net weight value (with internal resolution)
MB_DevStatus	Word		Refer to Device Overview, input address of MB Device Status
TareImmediate	Bool		Trigger this bit to perform immediate tare command. This tare command does not check for stability criteria. Upon completion of this command, the input bit will be reset.
TareStable	Bool		Trigger this bit to perform stable tare command. This tare command requires the weight value to remain stable within the stability criteria (+- 1d within 0.3 second) for a predefined timeout range (3 seconds by default), failing which, the command will return an error. Upon completion

Input Parameters	Data Type	Values	Description
			of this command, the input bit will be reset.
ZeroImmediate	Bool		Trigger this bit to perform immediate zero command. The zero command can only be executed when the weight value is within the zero range (+-2% by default). Else, the command will return an error. Upon completion of this command, the input bit will be reset.
ZeroStable	Bool		Trigger this bit to perform a stable zero command. This zero command requires the weight value to remain stable within the stability criteria (+-1d within 0.3 second) for a predefined timeout range (3 seconds by default). Furthermore the weight value has to be in the zero range to trigger this command, failing either condition; the command will return an error. Upon completion of this command, the input bit will be reset.
PreTareValue	Real		The preset tare value, which must be configured before issuing the PreTare command. Valid PreTare value is between scale's zero point up to maximum capacity.
PreTare	Bool		Trigger this bit to perform a preset tare command. The PreTareValue must be configured prior to issuing this PreTare command. Upon completion of this command, the input bit will be reset.
ClearTare	Bool		Trigger this bit to perform a clear tare command. This command removes the tare and brings the scale into gross mode. Upon completion of this command, the input bit will be reset.
MB_Value	Real		Refer to Device Overview, input address of MB Measuring Value
MB_Response	Word		Refer to Device Overview, input address of MB Response
MB_CmdValue	Real		Refer to Device Overview, output address of MB Command Value
MB_Command	Word		Refer to Device Overview, output address of MB Command
Output Parameters	Data Type	Values	Description
RealTimeWeight	Real		Real-time weight value, can be gross, tare or net weight
StableWeight	Real		Stable weight value, the last real-time weight during Motion = 0
DataOK	Bool	0	This bit is set to 0 when the device is still operational but the reported value cannot be guaranteed to be valid. The following conditions cause the Data Okay bit to be set to 0: <ul style="list-style-type: none"> <li>• Device is powering up</li> <li>• Device is in setup mode</li> <li>• Device is in test mode</li> <li>• Over capacity condition occurs</li> </ul>

Input Parameters	Data Type	Values	Description
			When the A/D converter is at its limit Product-dependent over capacity that occurs when the device determines it cannot trust the weight <ul style="list-style-type: none"> <li>Under capacity condition occurs</li> </ul> When the A/D converter is at its limit Product-dependent under capacity that occurs when the device determines it cannot trust the weight
		1	Weight data is normal, valid
Motion	Bool	0	Weight value is stable
		1	Weight value is in motion
NetMode	Bool	0	Weighing is in gross mode
		1	Weighing is in net mode
Alarm	Bool	0	No alarm
		1	Also called the RedAlert alarm. If this bit is true, this indicates that the control device should stop until the source of the alarm is evaluated and corrected. The control system should use a Field Value command or evaluate the RedAlert status block to determine the nature of the alarm.
Done	Bool	0	Zero, tare or clear tare command is in process, or has failed
		1	Zero, tare or clear tare command is successful
Error	Bool	0	Zero, tare or clear tare command is in process, or has succeeded
		1	Zero, tare or clear tare command is not completed due to error

# 5 Using the Sample Code

## 5.1. Hardware Configurations

- Under **Devices & networks > Network view**, add (or drag over) an IND360.

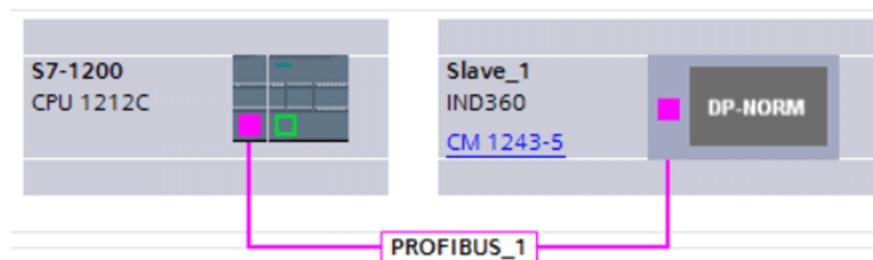
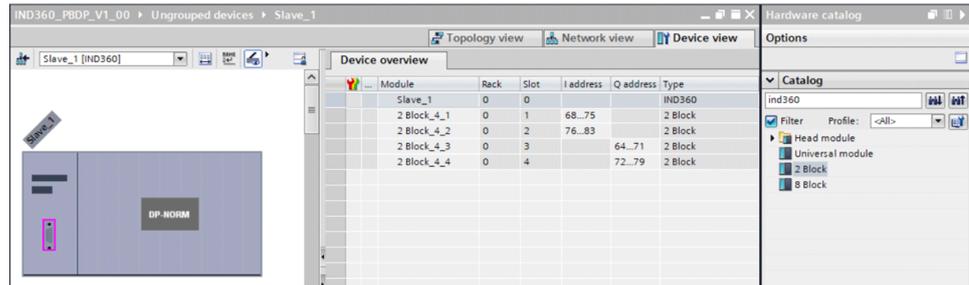


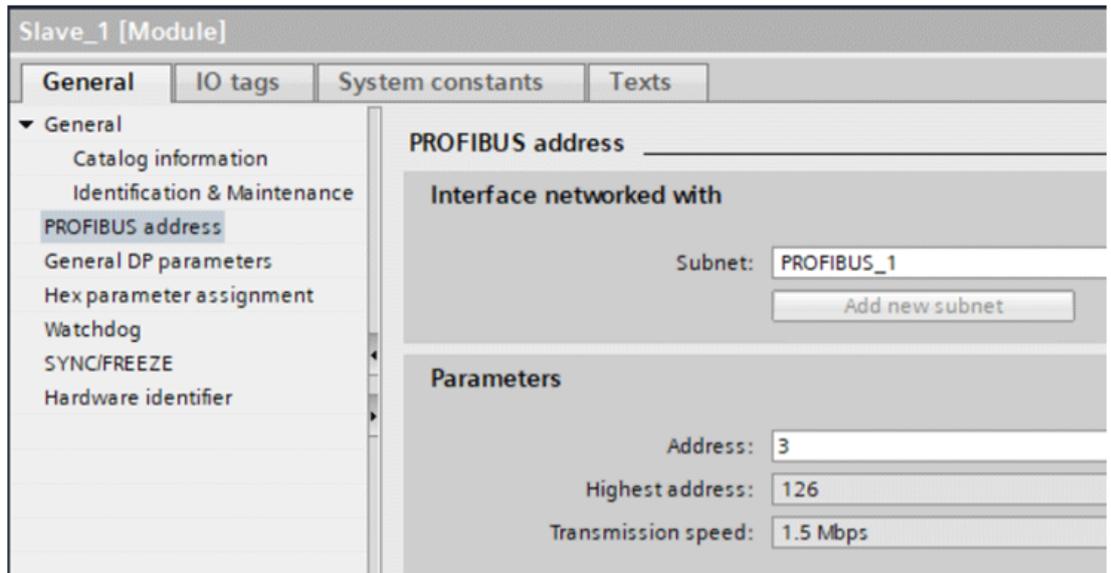
Figure 6: Add a Profibus Device in the Network View

- Under **Devices & networks > Device view**, select the 2 Block (or 8 Block) data structure from the Hardware Catalog.



**Figure 7: Select the 2-Block Data Structure**

- Assign the Profibus Node Address for the IND360.



**Figure 8: Assign the Profibus Node Address**

- The sample code follows the default I and Q address assignments shown below. To minimize the modification to the code, consider using the same I and Q address assignments.

Module	Rack	Slot	I address	Q address	Type
Slave_1	0	0			IND360
2 Block_4_1	0	1	68...75		2 Block
2 Block_4_2	0	2	76...83		2 Block
2 Block_4_3	0	3		64...71	2 Block
2 Block_4_4	0	4		72...79	2 Block

**Figure 9: The Profibus Device I and Q Addresses**

## 5.2. PLC Settings

Under the **PLC device properties > System and clock memory**, check "Enable the use of system memory byte." (Note that this feature is not available in the S7-300 series PLC.)

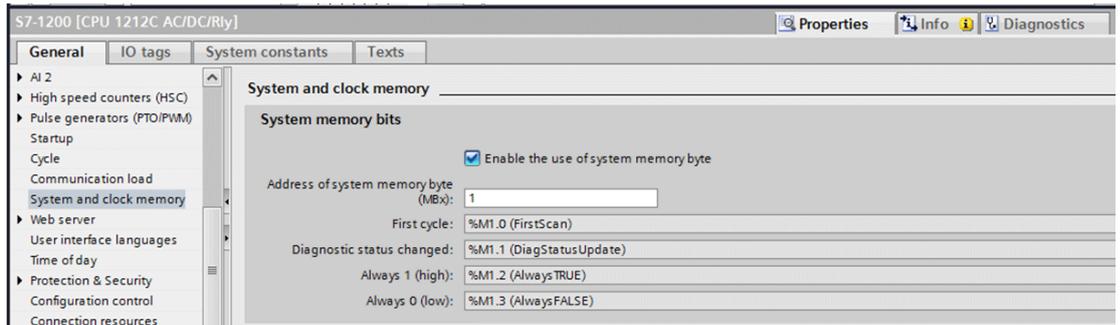


Figure 10: PLC Properties – Enable the Use of System Memory Byte

## 5.3. Duplicate Programming Files

1. The required program blocks:
  - a. MT\_IND\_TankApplication (FC)
  - b. SAI\_IND360\_TankVessel (FB), SAI\_IND360\_TankVessel\_DB (DB)
  - c. Optional, for SAI 8-Block only: SAI\_Cyclic\_WeightProc (FB), SAI\_Cyclic\_WeightProc\_DB (DB)
2. Delete the other unused program blocks in MT\_IND360\_Application.
3. Duplicate the IND360 under the PLC tags.

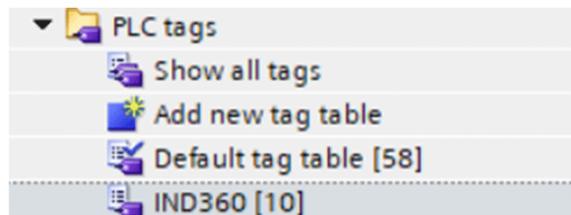


Figure 11: Duplicate the PLC Tags

4. Lastly, in the Main (OB1) call up the function "MT\_IND\_TankApplication".

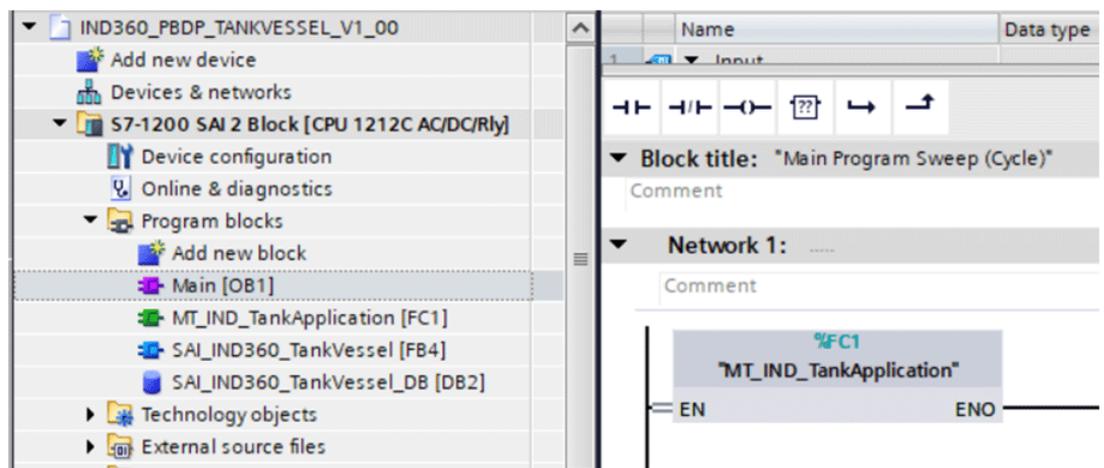


Figure 12: Call Up "MT\_IND\_TankApplication" in the Main OB

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