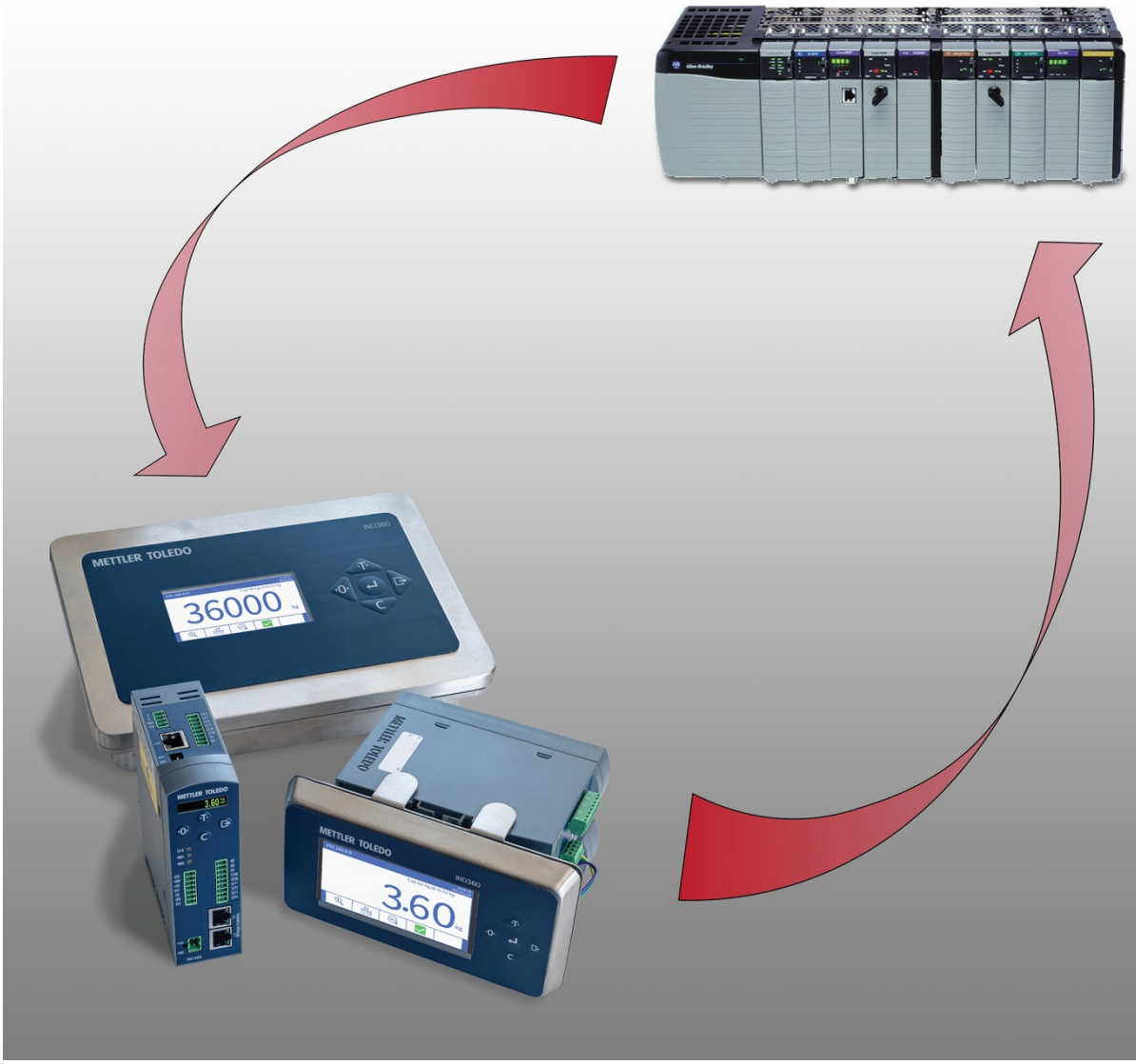
Engineering Note

IND360

Tank-Vessel Application EtherNet/IP Notes



METTLER TOLEDO

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Contents

1 Setup of Project Development Environment 1

1.1. Confirm EDS Installation 1

1.2. Import Example as a New Project 2

1.3. Import an Example to an Existing Project 3

1.4. Configure Controller Type 4

2 Add-On Instructions (AOI) 5

2.1. Tank/Vessel Application 5

2.2. Alibi Memory 8

3 Steps to Add New IND360s 9

4 Steps to Use 8 Block Format Instead of 2 Block Format 12

5 Frequently Asked Questions 13

This Engineering Note demonstrates the integration of the METTLER TOLEDO IND360's Tank/Vessel Application with an EtherNet/IP PLC. Go to 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:	
Rockwell Studio5000:	Version 24
PLC:	1769-L30ER
SAI DATA FORMAT:	2-BLOCK FORMAT (DEFAULT), 8-BLOCK FORMAT
IND360 IP ADDRESS:	192.168.0.2
EDS FILE:	MT_IND360_EIP_V1.1_20200728
IND360 DEVICE FIRMWARE VERSION:	V2.01.0000

It is recommended to integrate one IND360 into the PLC EtherNet/IP network and go through the sample code to understand the functionality of each Add-On Instruction (AOI).

1 Setup of Project Development Environment

1.1. Confirm EDS Installation

This sample code project utilizes an EDS file for the IND360. These files can be found on www.mt.com/ind-ind360-downloads.

To confirm installation of IND360 AOP file:

1. In any Studio 5000 project, right click on **Ethernet** within the I/O Configuration folder in the controller organizer.
2. Select **New Module...**.

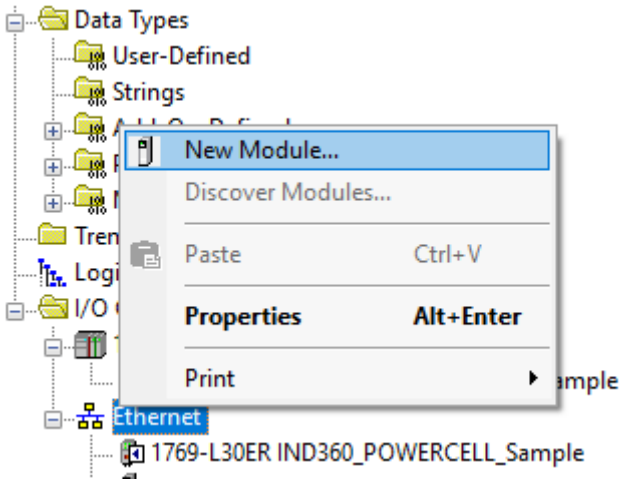

Figure 1-1: Try to add a new module to confirm EDS is installed

3. Search IND360

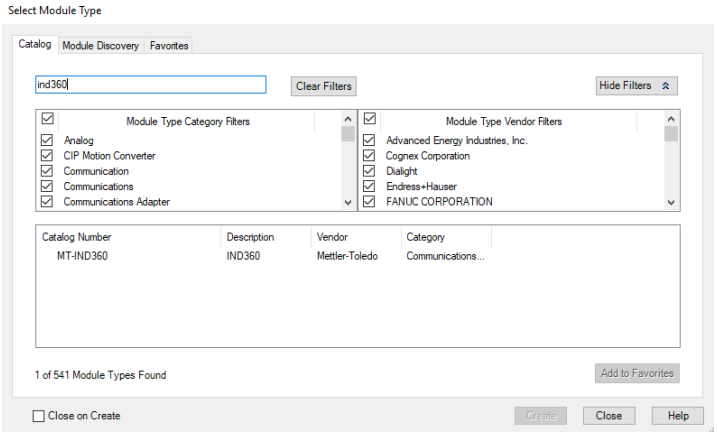

Figure 1-2: Search for IND360

If the EDS is installed, there should be an option for MT-IND360. If the search returns no results, follow these steps to install the AOP:

1. Go to the IND360 download page: www.mt.com/ind-IND360-downloads
2. Click the EDS file to begin the download.
3. Once the download is complete, unzip the folder
4. Use the EDS installation tool in Studio5000 to install the EDS.

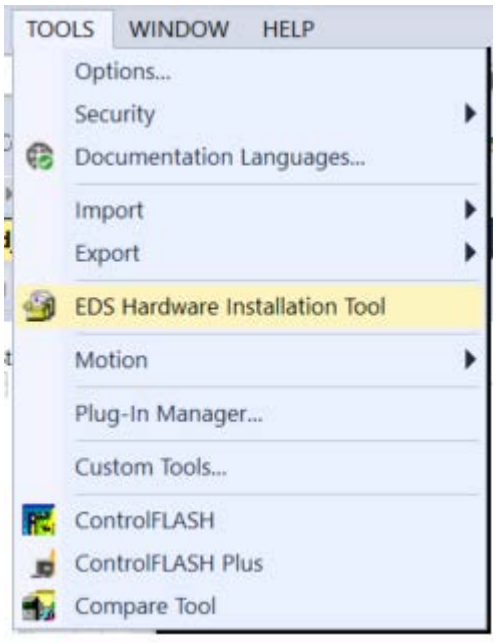

Figure 1-3: Use the EDS Hardware Installation Tool to complete installation

1.2. Import Example as a New Project

To import the examples, Studio5000 V24 or above is required.

1. To import the project to Studio5000, click **File-> Open.**
2. Select the .ACD file and click open. The project will load.

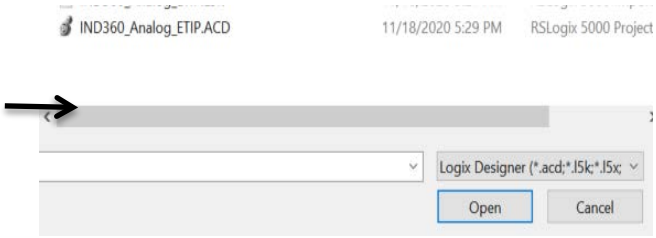

Figure 1-4: Import Project

1.3. Import an Example to an Existing Project

1. Add an MT-IND360 to the I/O Configuration in the existing project. See the first steps of Section 3 for more information on how to complete this. Using the name **IND360** and the IP Address **192.168.0.2** will require no changes to the sample code. If a different name or IP address is required, steps explaining what changes to make are provided below.

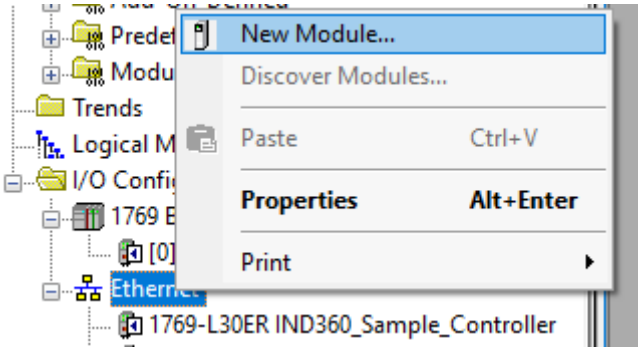

Figure 1-5: Add IND360 to the existing project

2. Copy the Add-On Instructions from the Add-On Instructions folder in the Controller Organizer of the sample project and paste in the same location in the existing project.

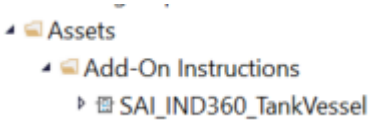

Figure 1-6: Copy/Paste AOIs

3. Copy the controller tags from the sample code project and paste in the controller tags of the existing project. Make sure not to copy the **IND360:I** and **IND360:O** tags since those are already present in the existing project.

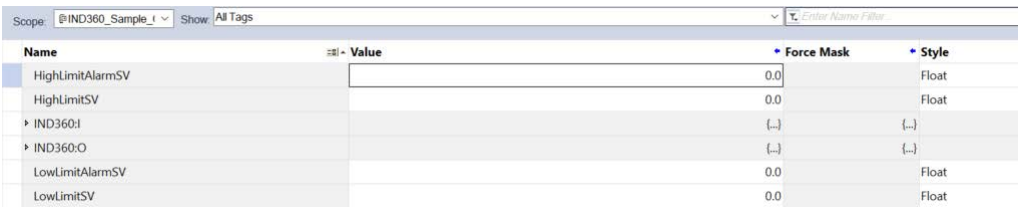

Figure 1-7: Copy/Paste Controller Tags

4. Copy the Main Program local tags from the sample project and paste in the tags for the existing project.

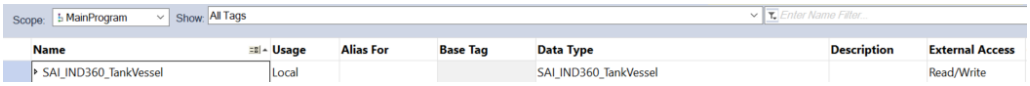

Figure 1-8: Copy/Paste Main Program Local Tags

5. Copy the **MT_IND_Application** routine from the sample project and paste in the existing project.

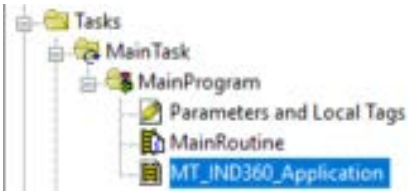

Figure 1-9: Copy/Paste the Routine

6. Make sure something in the existing project calls the MT_IND_Application. Any AOIs that automatically monitor weight conditions will not run if nothing calls this routine.
7. If a name other than **IND360** was used as the name of the transmitter in the project, replace every use of **IND360** in the AOI instances with the name given to the transmitter in the project.

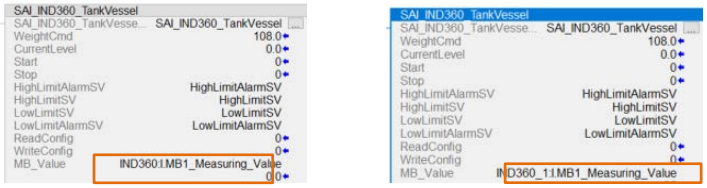

Figure 1-10: Example of name "IND360_1" used in project

1.4. Configure Controller Type

Please note that this is only necessary if using the sample code as the basis for the PLC project. If importing the routine and AOIs into an already existing project, this is unnecessary.

Right-click the project's controller, select **Properties**, and set the controller type.

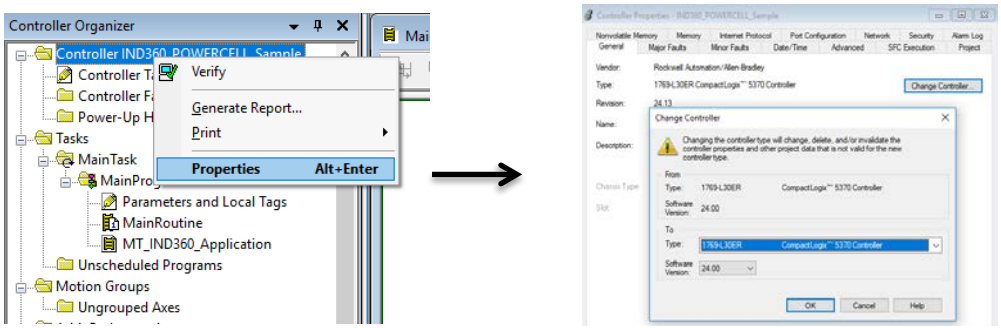

Figure 1-11: Configure controller type

Download the project to the controller and test.

2 Add-On Instructions (AOI)

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

2.1. Tank/Vessel Application

This AOI is used to read and write the upper and lower limits, to receive alarms, and to start and stop the Tank/Vessel application. In this sample code, the AOI uses Measuring Block 1 from the IND360 (referred to as **IND360:I.MB1** or **IND360:O.MB1** in the controller tags). If the PLC communication is set up as SAI 8 Block format, any Measuring Block (1-7) can be used.

Before using this AOI, make sure the Tank/Vessel application is enabled under the PAC Management setup menu in the IND360.

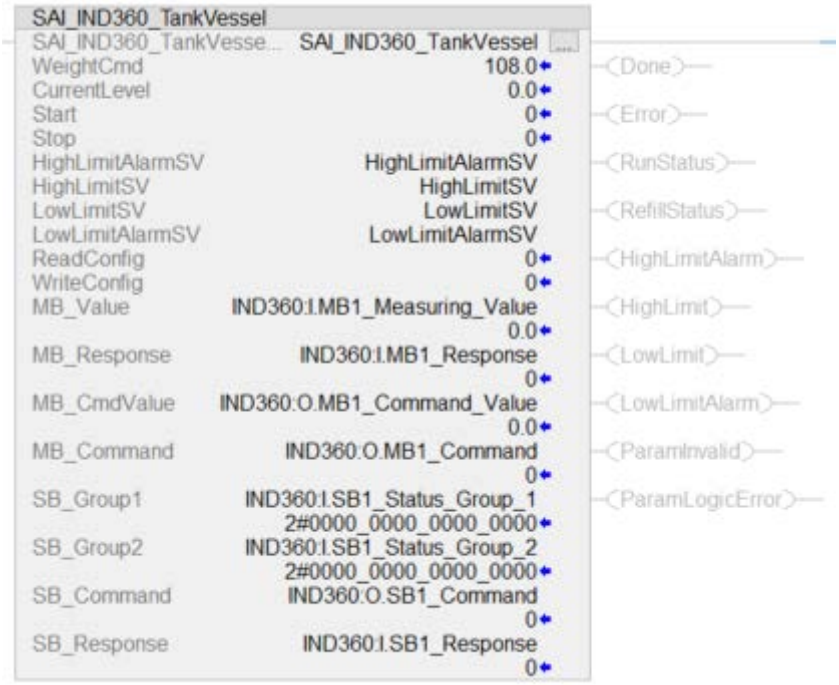

Figure 2-1: SAI_IND360_TankVessel AOI

Parameters	Data Type	Description
Input Parameters		
WeightCmd	INT	Use this value to request the IND360 to report weight. When a start command is sent, the IND360 stops reporting weight. This AOI will automatically restore this command once the Tank/Vessel application starts. It is recommended to use commands 107 or 108 here since those are the only values that will allow CurrentLevel to update. 107 = Report material level in gross weight 108 = Report material level as a percentage based on capacity 0,1 = Report the scale gross weight 2 = Report the scale tare weight 3 = Report the scale net weight
Start	BOOL	Set = 1 to start the automatic level monitoring and control by the IND360. Upon successful execution of this command, the Start input bit will be reset and the DONE output bit will be turned ON.
Stop	BOOL	Set = 1 to stop the automatic level monitoring and control by the IND360. Upon successful execution of this command, the Stop input bit will be reset and the DONE output bit will be turned ON.
ReadConfig	BOOL	Set = 1 to read the High Limit, High Limit Alarm, Low Limit and Low Limit alarm values from IND360 and store in the HighLimitSV, HighLimitAlarmSV, LowLimitSV and LowLimitAlarmSV tags respectively.
WriteConfig	BOOL	Set = 1 to write the values in the HighLimitSV, HighLimitAlarmSV, LowLimitSV and LowLimitAlarmSV tags to the IND360.
MB_Value	REAL	This should always be set to the MB1_Measuring_Value of the IND360. This will provide weight data for the AOI.
MB_Response	REAL	This should always be set to MB1_Response value of the IND360. Once a cyclic command is successfully executed, MB_Response = MB_Command. The AOI uses this information to detect if a command has been executed successfully or if an error has occurred.
SB_Group1	DINT	This should always be set to the SB1_Status_Group_1 of the IND360. This will provide status information for the Tank/Vessel Application.
SB_Group2	DINT	This should always be set to the SB1_Status_Group_2 of the IND360. This will provide alarm information for the Tank/Vessel Application.
SB_Response	DINT	This should always be set to SB1_Response value of the IND360. Once a cyclic command is successfully executed, SB_Response = SB_Command. The AOI uses this information to detect if a command has been executed successfully or if an error has occurred.
In/Out Parameters		
HighLimitAlarmSV	REAL	The highest material level where the IND360 will trigger an alarm. There is a serious potential risk of over-filling (e.g. due to malfunctioning refill pump) at this level. 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 from IND360.
HighLimitSV	REAL	When material level exceeds this limit, the REFILL signal turns OFF, and remains OFF until the level falls below LowLimit 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 from IND360.

Parameters	Data Type	Description
LowLimitAlarmSV	REAL	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 from IND360.
LowLimitSV	REAL	When material level falls below this limit, the REFILL signal turns ON, and remains ON until the level exceeds the HighLimit. 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 from IND360.
Output Parameters		
CurrentLevel	REAL	Current material level of the tank when the application is running. Reported either in gross weight (WeightCmd = 107) or as a percentage based on the tank capacity (WeightCmd = 108). If WeightCmd is set to any other value, CurrentLevel will not update even when the Tank/Vessel application is running.
Done	BOOL	Will be latched high when Start/Stop/ReadConfig/WriteConfig command is successful. Unlatched when Start/Stop/ReadConfig/WriteConfig command is in process, or has failed.
Error	BOOL	Will be latched high when Start/Stop/ReadConfig/WriteConfig command has failed. Unlatched when Start/Stop/ReadConfig/WriteConfig command is in process, or has succeeded.
RunStatus	BOOL	ON when Tank/Vessel application is running.
RefillStatus	BOOL	ON if the Tank/Vessel application is running and LowLimit has been triggered. Latched until HighLimit is triggered.
HighLimitAlarm	BOOL	ON if the high limit alarm level has been reached while the Tank/Vessel application is running. Check the process immediately to make sure there are no issues with the refill valve or elsewhere.
HighLimit	BOOL	ON if the high limit level has been reached while the Tank/Vessel application is running. Will cause RefillStatus to unlatch if it is latched.
LowLimit	BOOL	ON if the low limit level has been reached while the Tank/Vessel application is running. Will cause RefillStatus to latch if it is unlatched.
LowLimitAlarm	BOOL	ON if the low limit alarm level has been reached while the Tank/Vessel application is running. Check the process immediately to make sure there are no issues with the refill valve or elsewhere.
ParamInvalid	BOOL	ON if any of the parameters for the TankVessel application are invalid.
ParamLogicError	BOOL	ON if any of the parameters for the Tank/Vessel application cause a logic error.
MB_CmdValue	REAL	This should always be set to MB1_Command_Value tag of the IND360. Parameter sent along with the cyclic command to the IND360.
MB_Command	REAL	This should always be set to MB1_Command tag of the IND360. Value of the last cyclic command sent to the IND360. Once successfully executed, MB_Response = MB_Command.
SB_Command	DINT	This should always be set to SB1_Command tag of the IND360. Value of the last status command sent to the IND360. Once successfully executed, SB_Response = SB_Command.

2.2. Alibi Memory

This AOI can be used to read transactions stored in the alibi memory. Alibi memory is often used in legal for trade weighing applications and is a requirement in some regions of the world.

The Transaction ID of this AOI must first be set to the number of the transaction to be read. Once the Read_Alibi bit is set to 1, the stored data from the specified transaction is stored in the various output tags of this AOI.

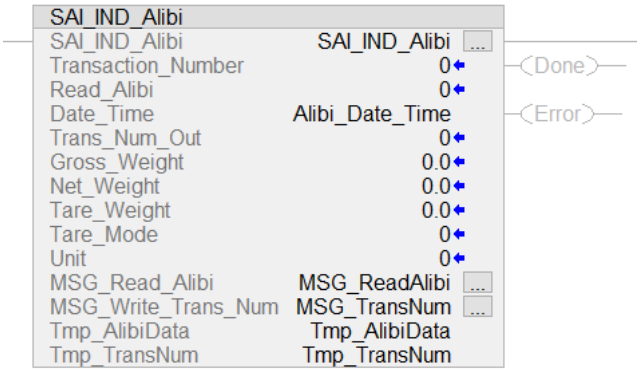

Figure 2-2 SAI_IND_Alibi AOI

Input Parameters	Data Type	Description
Transaction_Number	DINT	Enter the transaction number to be read from alibi memory
Read_Alibi	DINT	Set = 1 to read the alibi data of the transaction number
Output Parameters	**Data Type**	**Description**
Trans_Num_Out	DINT	The read transaction number from alibi memory. This can be used as a sort of handshake to confirm the transaction number read matches the transaction number requested.
Gross_Weight	REAL	The gross weight of the scale when the alibi record was written
Net_Weight	REAL	The net weight of the scale when the alibi record was written
Tare_Weight	REAL	The tare weight of the scale when the alibi record was written
Tare_Mode	SINT	0 = Tare, 1 = Pre-set Tare
Unit	SINT	0 = g, 1 = kg, 2 = lb, 3 = t, 4 = ton, 5 = lboz, 6 = otz, 7 = dwt, 8 = oz, 9 = mg, 10 = µg, 11 = cus
Done	BOOL	Latched high when the alibi read successfully completes. Unlatched when alibi read is triggered again.
Error	BOOL	Latched high if an error occurred and the alibi read could not complete. Unlatched when alibi read is triggered again. Check the errors of the messages for this AOI to troubleshoot
In/Out Parameters	**Data Type**	**Description**
Date_Time	STRING	IND360 system date and time when the alibi record was written. 20 character string. Format is "YYYY/MM/DD HH:MM:SS"

MSG_Read_Alibi	Message	**Message Type:** CIP Generic **Service Type:** Get Attribute Single **Class:** 412 (Hex) **Instance:** 1 **Attribute:** 5 (Hex) **Destination Element:** Tmp_AlibiData **Communication -> Path:** Browse for the appropriate IND360
MSG_TransNum	Message	**Message Type:** CIP Generic **Service Type:** Set Attribute Single **Class:** 412 (Hex) **Instance:** 1 **Attribute:** 4 (Hex) **Source Element:** Tmp_TransNum **Source Length:** 4 (Bytes) **Communication -> Path:** Browse for the appropriate IND360
Tmp_AlibiData	SINT[44]	Temporary value to hold all 44 bytes from the alibi record
Tmp_TransNum	DINT	Temporary value to send the transaction number to the CIP message

3 Steps to Add New IND360s

Because EtherNet/IP uses IP addresses to distinguish between devices, when multiple IND360s are networked the default IP address of each terminal must first be modified.

- Each IND360 must have a different IP address.

1. Click **Communication-> Industrial Ethernet -> IP Address** in the IND360 Advanced Service Mode in order to modify the IP address.

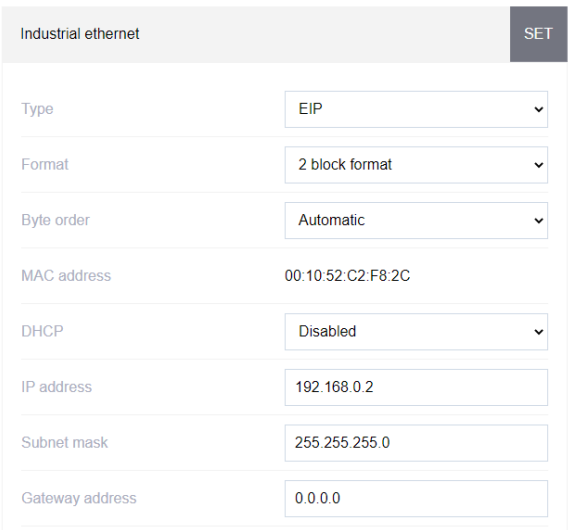

Figure 3-1: IND360 IP Address Menu

2. Add an MT-IND360 to **I / O Configuration-> Ethernet** in Studio5000.

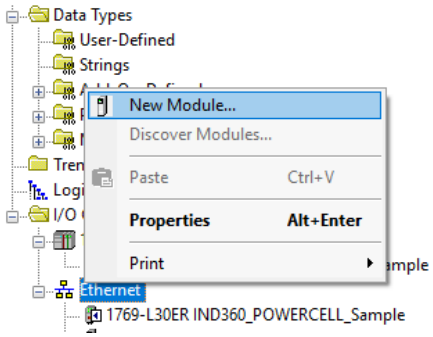

Figure 3-2: Add a device

3. Configure the name and IP address. Each device must have a unique name and IP address. Once the device is configured, click **Change**.

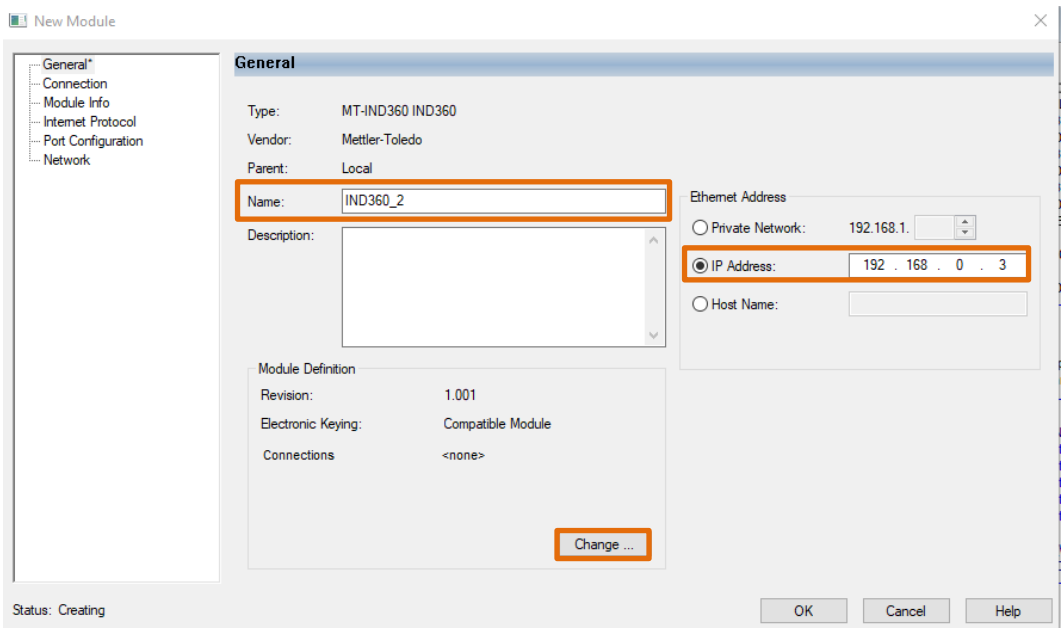

Figure 3-3: Configure name and IP address

4. Select **I/O 2 Block Format** to make the sample code function with minimal changes. Select 8 Block if it is necessary to receive multiple pieces of cyclic data simultaneously. For example, if it is required to read the gross weight, net weight and target weight at one time, 8 Block can easily accomplish this.

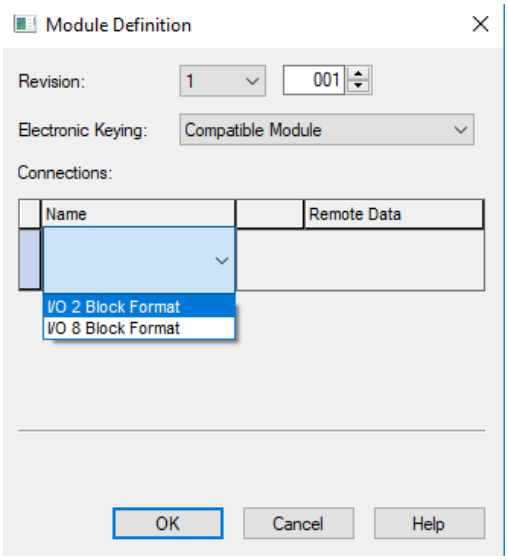

Figure 3-4: Module Definition Configuration

5. Copy the controller tags relating to the sample code and paste in the same location in order to create a duplicate set of tags. Please note that since all tags end with "_1", Studio 5000 will create duplicates that all end with "_2" instead.

Figure 3-5: Copy/Paste Tags to Create Duplicates

6. Copy and paste the Add-On Instructions and configure the instance name along with the input and output parameters. Each device must correspond to a unique instance of the AOI. As shown in the figure below, both devices call the AOI SAI_CheckAlive, but the corresponding instances are SAI_CheckAlive and SAI_CheckAlive_1. Notice that the Heartbeat parameter is also configured with different devices for these two instances. Refer to section 2, **Add-On Instructions (AOI)**, for information on configuring parameters for a particular AOI. Make sure that all tags for the second device for instance now end in "_2" as opposed to "_1" for the first device.

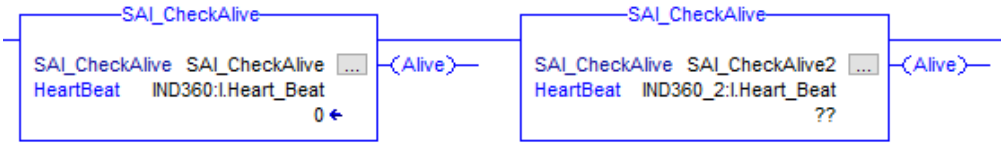

Figure 3-6: Two instances of the SAI_CheckAlive AOI for two IND360s

7. Repeat steps 1 to 6 until all devices are configured.

4 Steps to Use 8 Block Format Instead of 2 Block Format

The 8 Block Format for SAI is extremely powerful for viewing more information simultaneously, compared to the 2 Block Format. The sample code by default is configured for the 2 Block Format, but it is very simple to change the format:

1. Right click on the IND360 in the Controller Organizer.
2. Click **Properties**.

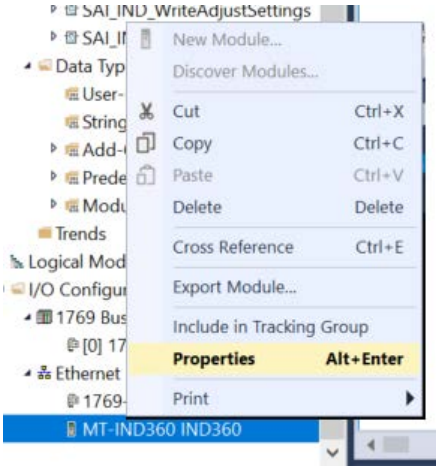

Figure 4-1 Select Properties

3. Click **Change** under the **Module Definition**.

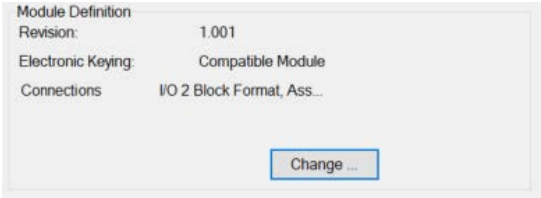

Figure 4-2 Click "Change"

4. Select the drop-down arrow next to **I/O 2 Block Format** and Select **I/O 8 Block Format**.

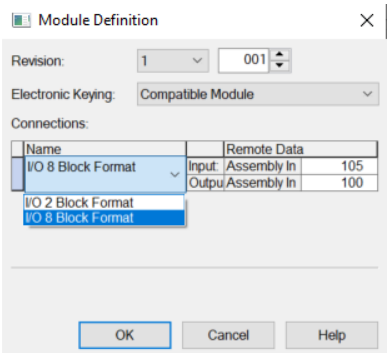

Figure 4-3 Select "I/O 8 Block Format"

At this point, the project has the IND360 configured for the 8 block format. No changes to the AOIs are required since the 8 Block Format simply expands upon the 2 Block format utilized by the AOIs. Now all references to IND360:I.MB1 and IND360:O.MB1in the sample code can be changed to IND360:I.MBx and IND360:O.MBx (where x is a value between 1 and 7) if it is necessary to use a specific Measuring Block for the Tank/Vessel application. The final step is to confirm that the IND360 itself is configured for the 8 block format. This setting can be found in the IND360 setup menu, or via the web interface, at **Communication > Industrial Ethernet > Format**.

5 Frequently Asked Questions

- **Q**: How do I access the parameters in the AOI variables within my PLC program?

  A: You can use the format "instance_name.parameter" to access parameters in your PLC program. For example, if we create an instance of the SAI_CheckAlive AOI and name the instance "IND360_Comm", we can monitor the alive bit by looking at "IND360_Comm.Alive"

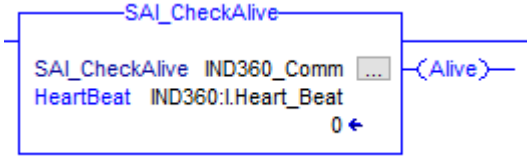

Figure 5-1: SAI_CheckAlive AOI with different instance name

- **Q**: Does my AOI instance always have to match the name of the AOI?

  A: No. The AOI instance can be named anything as long as the name is unique. They must be unique so that if we are using multiple of the same AOI, we can distinguish between them in the code. See Figure 4-1 for an example of an AOI instance name that does not match the AOI name but is still valid.

- **Q**: How do I know the source of the error in the SAI_IND360_TankVessel AOI?

  A: Typical errors in this AOI include:

  - **Logic Error**: Remember that the SV values must meet the criterion:

    HighLimitAlarmSV > HighLimitSV > LowLimitSV > LowLimitAlarmSV.

    If this criterion is not met, any execution of a ReadConfig or WriteConfig will fail until the issue is fixed.

  - **Tank/Vessel PAC is not enabled in the IND360**: Using either the local display or the web interface, acess **Application > PAC Management** in the IND360 menu system to enable to application.

- **Q**: An AOI is very close to what I want to do in my PLC logic, but I need to make a few changes. How can I do that?

  A: If it necessary to view or modify the logic of an AOI, simply use the Controller Organizer view in Studio 5000. Navigate to Add-On Instructions, expand the AOI you are interested in viewing, and double-click **Logic**. The Organizer view will show the ladder logic used in the AOI, and the logica can be changed as necessary for your particular application.

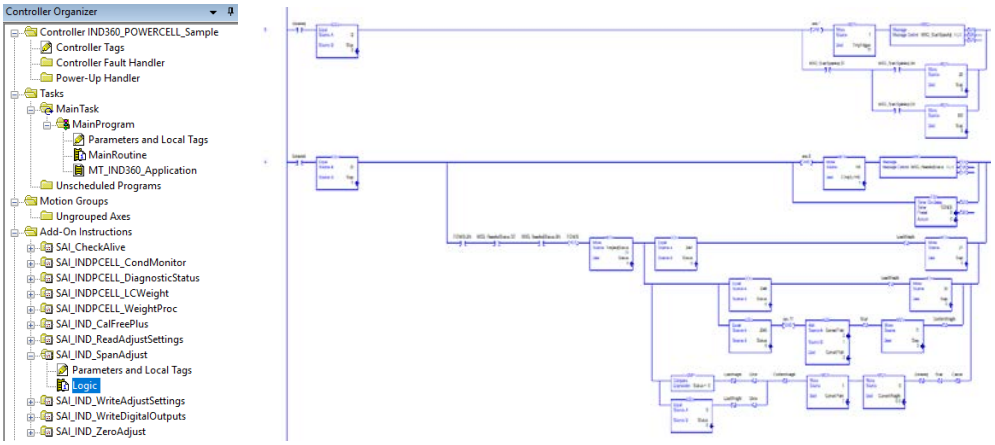

Figure 5-2: Example of AOI ladder logic

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