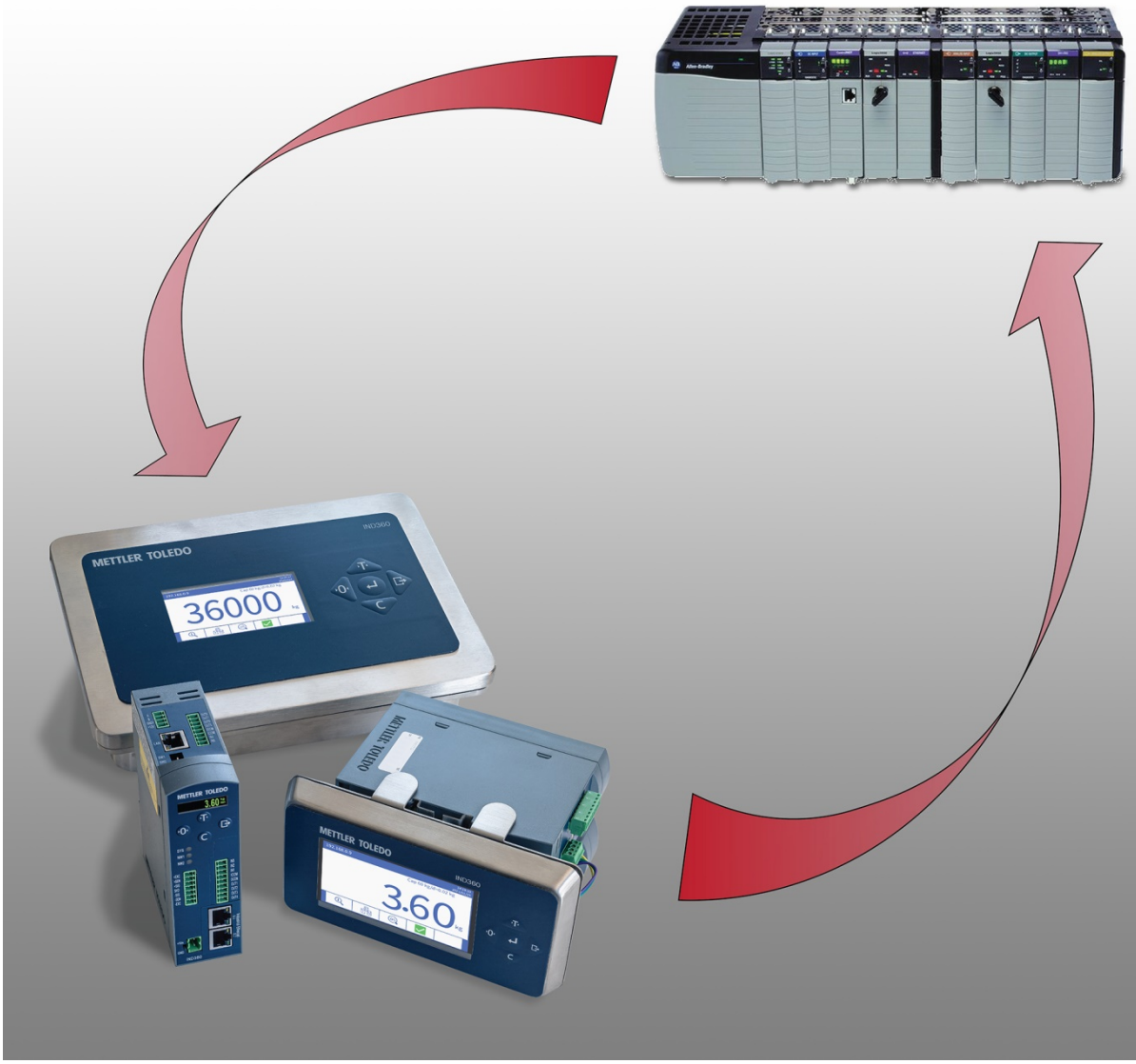
Engineering Note

IND360

Fill/Dose Application EtherNet/IP Note



METTLER TOLEDO

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- Declaration of Conformity is available at http://glo.mt.com/global/en/home/search/compliance.html/compliance/.

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This Engineering Note demonstrates the integration of the METTLER TOLEDO IND360's Fill/Dose 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...**

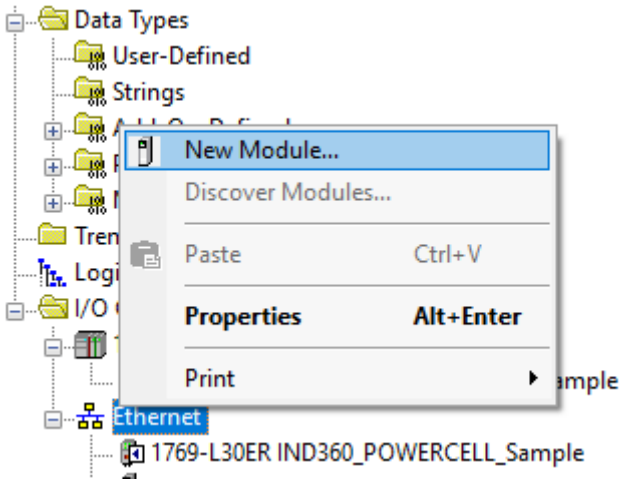

Figure 1-1: Try to add a new module to confirm EDS is installed

3. Search IND360

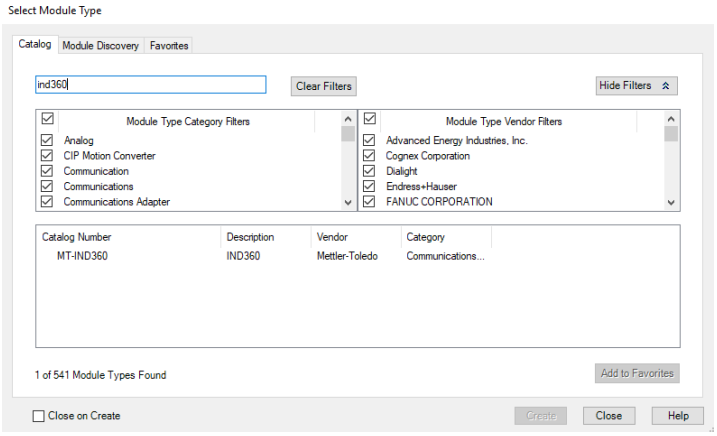

Figure 1-2: Search for IND360

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.

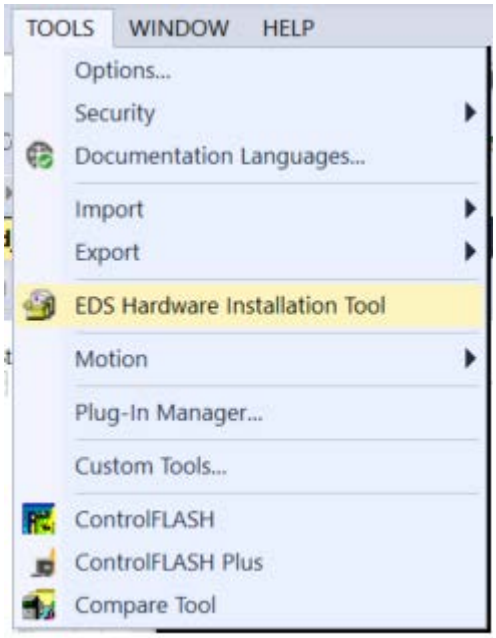

Figure 1-3: Use the EDS Hardware Installation Tool to complete installation

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.

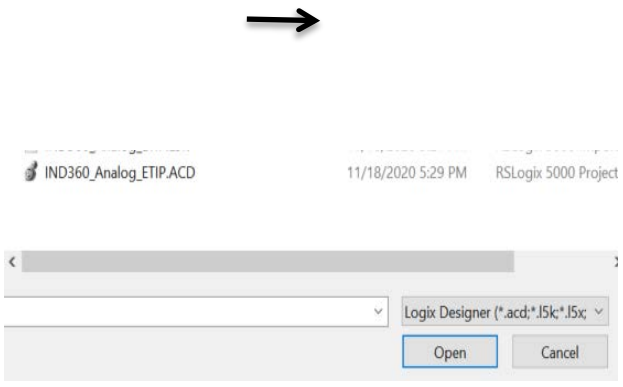

Figure 1-4: Import Project

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.

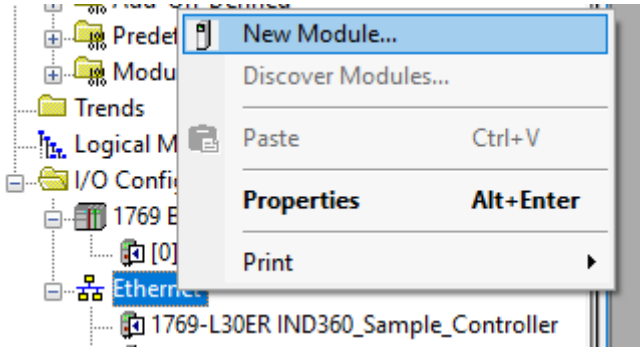

Figure 1-5: Add IND360 to the existing project

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.

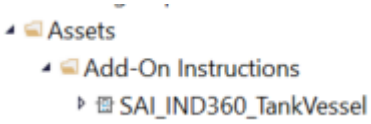

Figure 1-6: Copy/Paste AOIs

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.

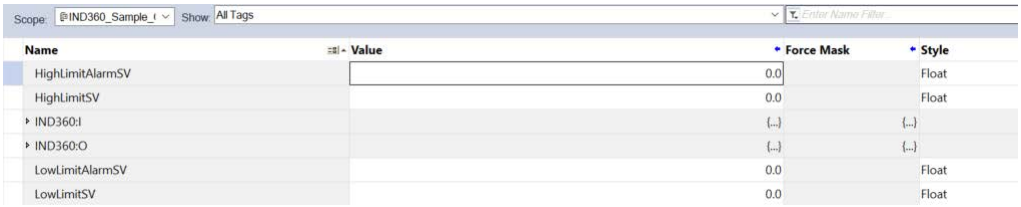

Figure 1-7: Copy/Paste Controller Tags

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.

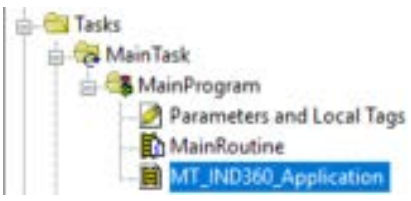

Figure 1-9: Copy/Paste the Routine

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.

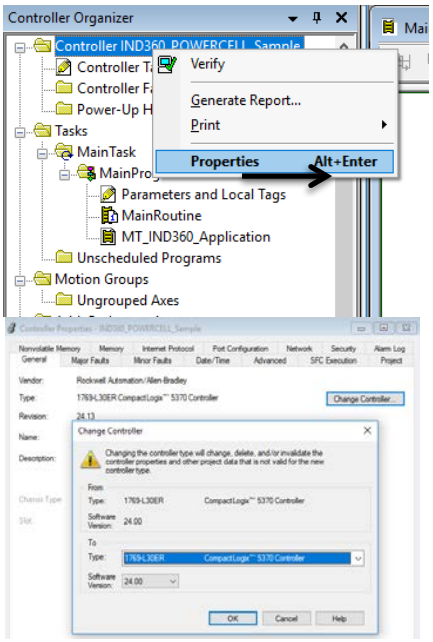

Figure 1-11: Configure controller type

Download the project to the controller and test.

2 Add-On Instructions (AOI)

Please refer to the **IND360 Fill/Dose 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. Fill/Dose Application

This AOI is used to read and write the configuration parameters, control the running state, and view process status of the Fill/Dose 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 Fill/Dose application is enabled under the PAC Management setup menu in the IND360.

Please note that this sample code is for reference only. You must thoroughly test any PLC code in your own controller and production environment to make sure it functions as you expect.

Figure 2-1: SAI_IND360_FillDose AOI

Parameters	Data Type	Description
Input Parameters		
Run_Command	BOOL	Trigger this bit to start one cycle of fill, fill-dump, dose or refill-dose. Upon successful execution of this command, the input bit will be reset.
Pause_Command	BOOL	Trigger this bit to pause the current cycle
Stop_Command	BOOL	Trigger this bit to stop the current cycle
Reset_Command	BOOL	Trigger this bit to transition to Idle state (all I/O turned off, captured tare weight is reset, application configuration is possible again)
Read_Config_Parameters	BOOL	Trigger this bit to read Fill/Dose configuration parameters from the IND360
Write_Config_Parameters	BOOL	Trigger this bit to write all Fill/Dose configuration parameters from PLC to IND360
Measuring_Value	REAL	This should always be set to the MB1_Measuring_Value of the IND360. This will provide weight data for the AOI.

Parameters	Data Type	Description
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.
Custom_Group_1	DINT	This should always be set to the SB1_Status_Group_1 of the IND360. This will provide status information for the Application.
Custom_Group_2	DINT	This should always be set to the SB1_Status_Group_2 of the IND360. This will provide alarm information for the Application.
Status_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		
WorkModeConfig	REAL	Operation mode: 0 – Fill Dump; 1 – Refill Dose; 2 – Fill; 3 – Dose
FeedSpeedsConfig	REAL	Number of feed speeds: 0 – One speed; 1 – Two speeds
OutputTypeConfig	REAL	Feed output type: 0 – Concurrent; 1 – Independent
CompleteModeConfig	REAL	Fill/Dump mode only. Decides whether the dump complete signal is triggered by the heel weight or by a set time. 0 – Weight Mode; 1 – Time Mode
TargetWeightConfig	REAL	Set target weight. Note that the target should be greater than the sum of Spill, Feed and Fast Feed. [0 – Capacity]
SpillWeightConfig	REAL	Spill sets the weight of material that will be added to (in a weigh-in cycle) or removed (in a weigh-out cycle) from the scale after all feeds are turned off. [-Capacity – Capacity]
FeedWeightConfig	REAL	Feed sets the weight of material that will be fed in a slow or normal speed rate. [0 – Capacity]
FastFeedWeightConfig	REAL	Fast Feed sets the weight of material that will be fed in a fast speed rate. Used with Two Speed filling only. [0 – Capacity]
HeelWeightConfig	REAL	Fill/dump only: Indicates the acceptable amount of material that might remain in the intermediate container for IND360 to consider it empty – for example, material stuck to the sides of a hopper. [0 – Capacity]

Parameters	Data Type	Description
TolerancePlusConfig	REAL	+ Tolerance sets the maximum permissible amount above the target weight. [0 – Capacity]
ToleranceMinusConfig	REAL	- Tolerance sets the minimum permissible amount below the target weight. [-Capacity - +Tolerance]
UpperLimitWeightConfig	REAL	Defines the upper limit for the automatic refill to stop. The refill signal will stay high until the upper limit is reached. [0 – Capacity]
LowerLimitWeightConfig	REAL	If a Dose is started and the material in the tank weighs less than Lower Limit, the refill signal will be triggered and stays high until the weight of material in the tank reaches the Upper Limit. [Target – UpperLimitWeightConfig]
ContainerTareMaxConfig	REAL	Container Tare Max sets the maximum weight of an empty container. Used when auto tare function is enabled. The empty container needs to be in this range for the fill operation to be started. [-Capacity – Capacity]
ContainerTareMinConfig	REAL	Container Tare Min sets the minimum weight of an empty container. Used when auto tare function is enabled. The empty container needs to be in this range for the fill operation to be started. [-Capacity – ContainerTareMaxConfig]
InhibitTimeConfig	REAL	Inhibit Time sets the amount of time that the comparator will have to wait before it is allowed to compare. This is used to ignore peaks in the weight signal when turning on feeds or switching between feed speeds. [0 – 9.99s]
StabilityTimeoutConfig	REAL	Optional parameter. Stability Timeout is the maximum length of time the program will wait for a stable weight reading after material dispensing has stopped. A value of 0 disables the timeout and will allow the IND360 to wait indefinitely for stability. [0 – 9.99s]
CompleteTimeConfig	REAL	Fill/Dump mode only, when complete mode is set to “Time mode”. Complete Time sets a fixed duration for the dump process to be executed. [0 – 9.99s]
ProcessTimeoutConfig	REAL	Set the maximum amount of time for the Fill or Dose cycle to complete [0 – 99999s]
Output Parameters		
RUN	BOOL	The filling/dosing cycle has been started.
Complete	BOOL	The cycle has been completed
Dump	BOOL	Dump sequence is running.
Refill	BOOL	Refill sequence is running.
Pause	BOOL	The cycle is paused.

Parameters	Data Type	Description
Feed	BOOL	Current speed is feed.
Fast_Feed	BOOL	Current speed is fast feed.
Spill	BOOL	Spill sequence is running.
Refill_Upper_Limit	BOOL	Upper refill limit reached.
Refill_Lower_Limit	BOOL	Lower refill limit reached.
Alarm	BOOL	An alarm is active.
Starting_Weight_Invalid	BOOL	Unable to start due to incorrect starting weight (e.g. start weight above target).
Initial_Feed_Timeout	BOOL	Initial feed timeout: weight value is not changing for predefined time after process is started.
Dump_Timeout	BOOL	Dump timeout exceeded. The Dump Timeout determines the maximum acceptable amount of time for the dump to complete.
AutoTare_Fault	BOOL	Auto tare failed due to container out of tare range.
Filling_Fault	BOOL	Fault happened during filling.
Dosing_Fault	BOOL	Fault happened during dosing
Process_Timeout	BOOL	Maximum allowed time (configurable) for fill/dose cycle exceeded.
Refill_Timeout	BOOL	Refill timeout exceeded. The Refill Timeout determines the maximum acceptable amount of time for the refill to complete.
Over_Plus_Tol	BOOL	The final weight is over the predefined positive tolerance.
Under_Min_Tol	BOOL	The final weight is below the predefined negative tolerance.
Jog	BOOL	Jog is being executed
Not_Enough_Material	BOOL	Insufficient material.
Max_Jog_Cycles	BOOL	There is a maximum number of jog cycles for automatic jog, this alert is raised when the maximum number has been exceeded to protect the equipment.
Filling_Dosing_Weight	REAL	The amount of material filled or dispensed in the last cycle.
Param_Invalid	BOOL	ON if any of the parameters for the application are invalid.
Param_Logic_Error	BOOL	ON if any of the parameters for the application cause a logic error.
MB_Comm_Val	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 loaded into the various output tags of this AOI.

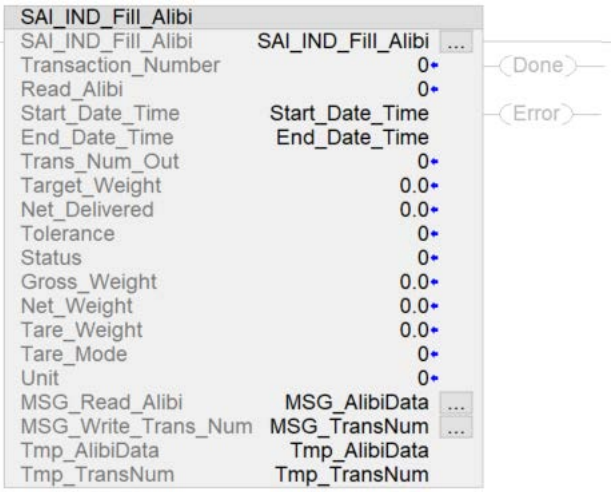

Figure 2-2 SAI_IND_Fill_Alibi AOI

Input Parameters	Data Type	Description
Transaction_Number	DINT	Enter the transaction number to be read from alibi memory
Read_Alibi	BOOL	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.
Target_Weight	REAL	Target weight value of the fill/dose cycle
Net_Delivered	REAL	Weight of material dispensed during fill/dose cycle. This is the value compared to the target to determine whether the cycle was within tolerance
Tolerance	SINT	1 = Under tolerance, 2 = within tolerance, 3 = over tolerance
Status	SINT	0 = Unstable, 1 = Stable, 2 = Stopped
Gross_Weight	REAL	The gross weight of the scale when the cycle completed
Net_Weight	REAL	The net weight of the scale when the cycle completed
Tare_Weight	REAL	The tare weight of the scale when the cycle completed

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.

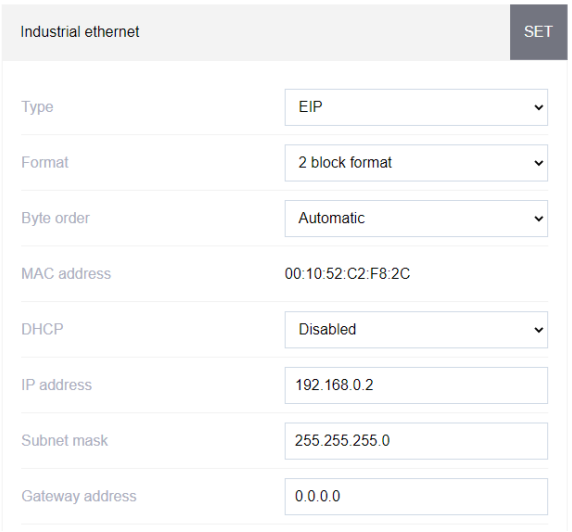

Figure 3-1: IND360 IP Address Menu

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

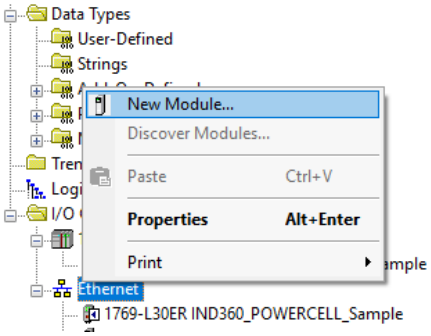

Figure 3-2: Add a device

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

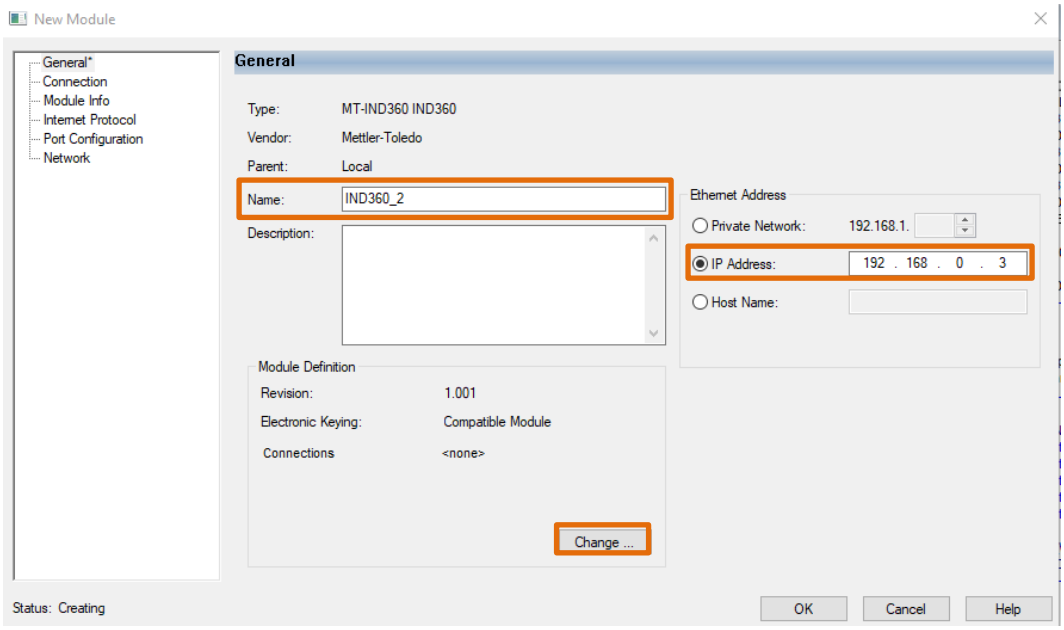

Figure 3-3: Configure name and IP address

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.

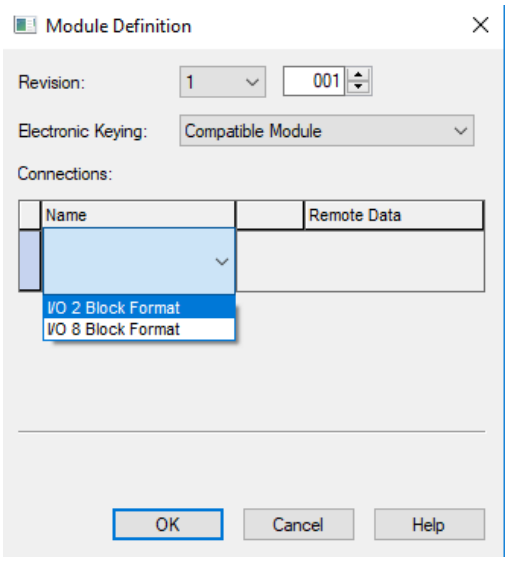

Figure 3-4: Module Definition Configuration

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.

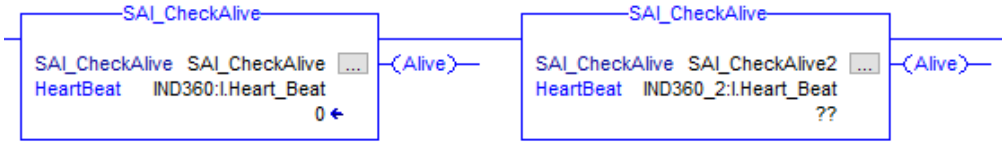

Figure 3-6: Two instances of the SAI_CheckAlive AOI for two IND360s

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**.

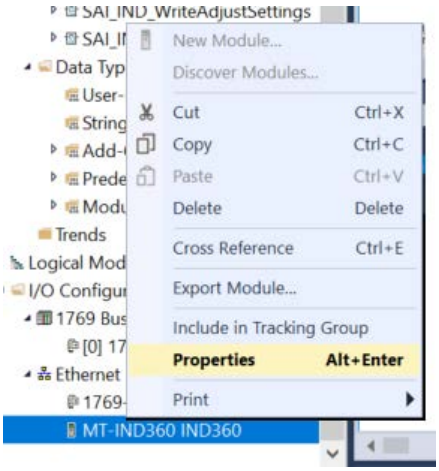

Figure 4-1 Select Properties

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

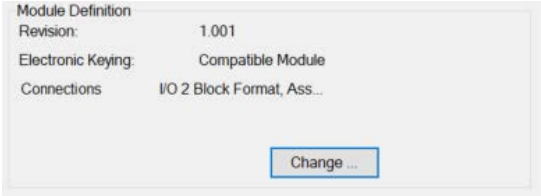

Figure 4-2 Click "Change"

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

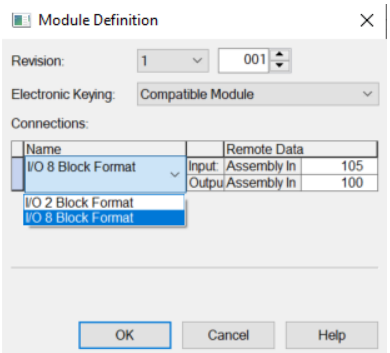

Figure 4-3 Select "I/O 8 Block Format"

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 Fill/Dose 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"

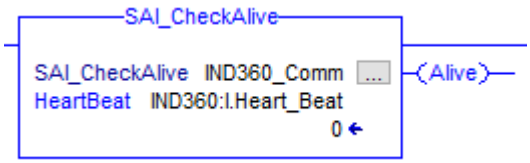

Figure 5-1: SAI_CheckAlive AOI with different instance name

- **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_FillDose AOI?

  A: Typical errors in this AOI include:

  - **Fill/Dose PAC is not enabled in the IND360**: Using either the local display or the web interface, access **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 logic can be changed as necessary for your particular application.

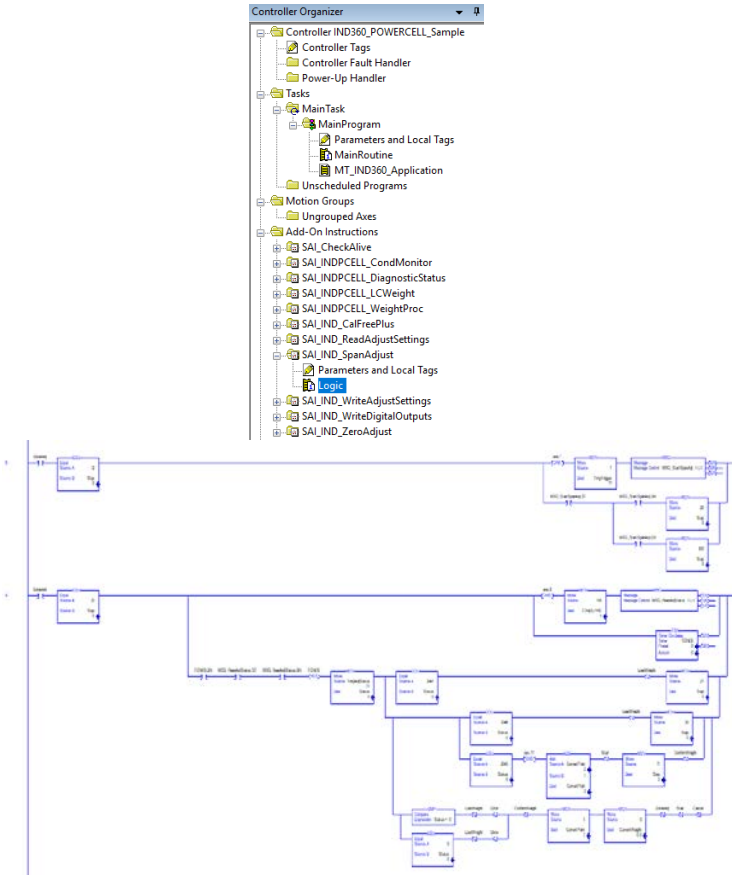

Figure 5-2: Example of AOI ladder logic