



Control IO-Link Master

IO-Link PDI to Modbus TCP Master

Application Note

This document provides an example of how to configure IO-Link PDI to a Modbus TCP Master using the Control IO-Link Master.

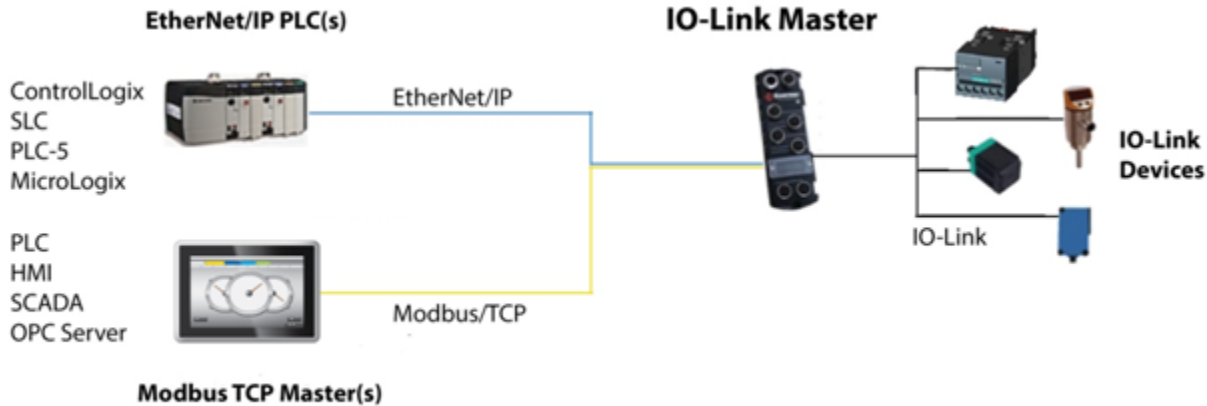
Introduction

This *Application Note* illustrates IO-Link PDI to Modbus TCP Master using:

- Control IO-Link Master (IOLM)
- ifm TD2807 Temperature Transmitter

Your implementation may vary depending on the Modbus TCP Master that you are setting up to operate with the IOLM.

The intent of this is to provide an example that you can use during initial installation of the IOLM.



The IOLM can provide connectivity of Process Data and Service Data from IO-Link sensors and actuators to a Modbus TCP Client. You can connect more than one Modbus client simultaneously. This connectivity is independent of using of the EtherNet/IP connections, which may be present on the same gateway at the same time. Clients running simultaneously do not affect each other when activated or deactivated.

Note: Links to other *Application Notes* point to the ftp://ftp.control.com/IO_Link_Master/4-EIP/Docs/ApplicationNotes subdirectory. *Application Notes* are typically protocol-based and function on multiple hardware platforms.

Audience

This *Application Note* is intended for system integrators or operators who are responsible for programming or configuring communications between the IOLM and a Modbus TCP Master.

Prerequisites

If you need procedures for the following, you can refer to the [appropriate User Guide](#) or the [IO-Link Master Initial Installation and Configuration Application Note](#).

- IOLM powered and connected to the network
- IOLM IP address configured
- If necessary, update the IOLM with the [latest images or applications](#).

Connecting the IO-Link Device

Use the following information to connect the IO-Link device and use the IOLM embedded web page to verify that the IO-Link device is operational.

1. If necessary, open your browser and enter the IOLM IP address.
2. Connect the IO-Link devices.
3. Click **Diagnostics | IO-Link**. If necessary, click **UPDATE** to refresh the page.
 - This image does not illustrate the complete **IO-Link Diagnostics** page.
 - A valid and operational IO-Link device v1.1 is connected to Port 1.
 - The IOLM has automatically negotiated a minimum Device Cycle Time with the sensor.
 - This device is measuring air temperature; The **Last Rx PDI Data (MS Byte First)** field displays 01h 10h, which converts to 27.2°C.

The screenshot shows the 'IO-Link Diagnostics' web page. At the top, there is a navigation bar with 'CONTROL' logo and tabs for 'Home', 'Diagnostics', 'Configuration', 'Advanced', 'Attached Devices', and 'Help'. The user is logged in as 'IO-Link Master 4-EDP'. Below the navigation bar, there are tabs for 'IO-LINK', 'ETHERNET/IP', and 'MODBUS/TCP'. The main content area is titled 'IO-Link Diagnostics' and includes buttons for 'UPDATE', 'STOP LIVE UPDATES', and 'RESET STATISTICS'. A table displays the status of four IO-Link ports. Port 1 is operational, while ports 2, 3, and 4 are inactive. The table also lists various device parameters for Port 1, such as vendor name, product name, serial number, hardware and firmware versions, IO-Link version, cycle times, and PDI data.

IO-LINK PORT STATUS	PORT 1	PORT 2	PORT 3	PORT 4
Port Name	IOLink Port 1	IOLink Port 2	IOLink Port 3	IOLink Port 4
Port Mode	IOLink	IOLink	IOLink	IOLink
Port Status	Operational, PDI Valid	Inactive	Inactive	Inactive
Device Vendor Name	ifm electronic gmbh			
Device Product Name	TD2807			
Device Serial Number	j0040120913			
Device Hardware Version	AA			
Device Firmware Version	104			
Device IO-Link Version	1.1			
Actual Cycle Time	4.0 ms			
Device Minimum Cycle Time	2.3 ms			
Configured Minimum Cycle Time	4 ms	4 ms	4 ms	4 ms
Data Storage Capable	Yes			
Automatic Data Storage Configuration	Disabled	Disabled	Disabled	Disabled
Auxiliary Input (AI) Bit Status	On	Off	Off	Off
Device PDI Data Length	2			
PDI Data Valid	Yes			
Last Rx PDI Data (MS Byte First)	01h, 10h			
Device PDO Data Length	0			

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4. Click **Configuration | Modbus/TCP**.

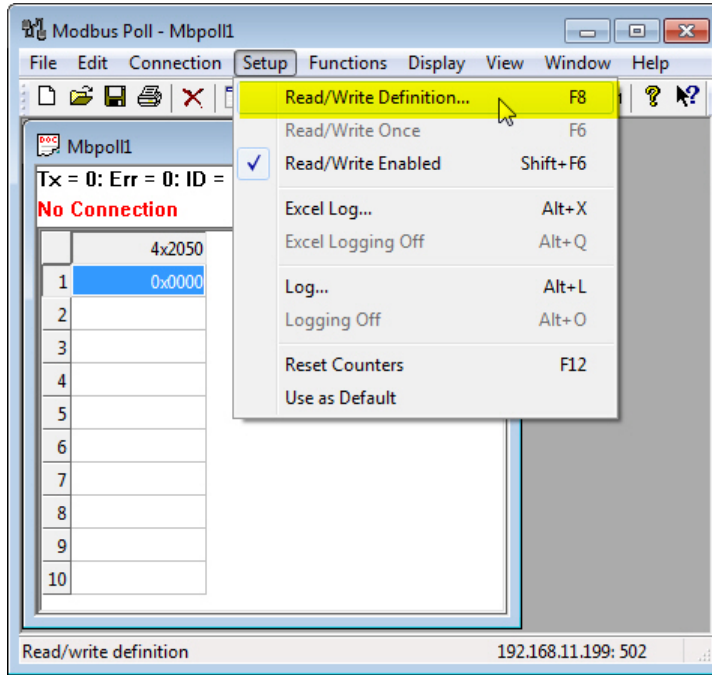
- The default values are sufficient for typical usage.
- Make sure that you review the details and note anything that may need to be changed, for example: the **PDI Byte-Swap Method** or the **Modbus Slave Mode Device ID**. If you are unsure as to whether swapping the byte order is required, you can wait and see if the data coming into your Modbus TCP client is correct. If 1234 displays as 3412, then you will need to return to this page and change the byte swap method.
- It is not necessary to change the **Data Block** sizes because if the number in those fields is larger than what is required, the IO-Link device is operational and there is no performance degradation.

MODBUS/TCP PORT CONFIG	PORT 1	PORT 2	PORT 3	PORT 4
	EDIT	EDIT	EDIT	EDIT
ISDU Data Settings:				
ISDU Response Timeout (1 - 10000)	20 sec	20 sec	20 sec	20 sec
Process Data Settings:				
PDI Data Block Size (To PLC)	36 bytes	36 bytes	36 bytes	36 bytes
PDI Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Include Digital I/O in PDI Data Block	false	false	false	false
PDO Data Block Size (From PLC)	32-bytes	32-bytes	32-bytes	32-bytes
PDO Byte-Swap Method	no byte-swap	no byte-swap	no byte-swap	no byte-swap
Append PDO to PDI Data	false	false	false	false
Clear Event Code In PDO Block	false	false	false	false
Clear Event Code After Hold Time	true	true	true	true
Active Event Hold Time (1 - 65535)	1000	1000	1000	1000
Event Hold Time Units	ms	ms	ms	ms
Clear Event Hold Time (1 - 65535)	500	500	500	500
Event Clear Time Units	ms	ms	ms	ms
Include Digital Output(s) in PDO Data Block	false	false	false	false
Transfer Mode Settings:				
Slave Mode Device ID (1 - 247)	1	1	1	1
PDI Receive Mode(s) (To PLC)	Slave	Slave	Slave	Slave
PDO Transmit Mode(s) (From PLC)	Slave	Slave	Slave	Slave

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- Open the Modbus Client, such as a PLC and begin configuring the Modbus Client using the following example. This example uses a PLC simulator (Modbus Poll) but **highlights** all of the parameters that are critical to Modbus TCP and that are common for all Modbus TCP Master (Client) configurations.



- Configure the Client setup:

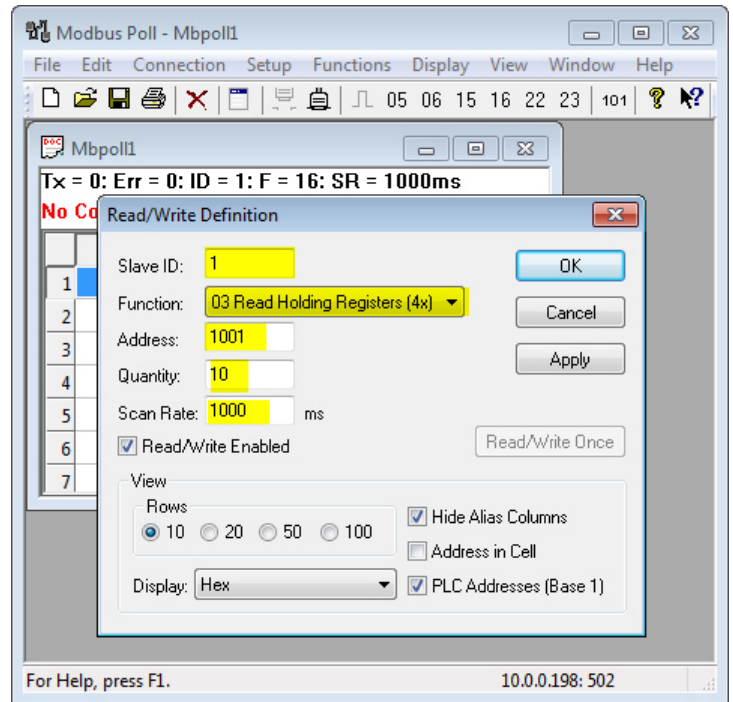
- Slave ID** - needs to match the Slave ID in the IOLM **Modbus/TCP Configuration** page (Step 4).
- Use **Function Code 03 (Read Holding Registers)** to read PDI data. Please note that some Modbus systems do not explicitly define function codes but function code 03 is very common.

- Address** (port specific PDI Data Block)

Port 1	...	Port 8
1000 (Base 0)	...	8000 (Base 0)
1001 (Base 1)		8001 (Base 1)

This example is on Port 1 and uses 1001 to access PDI data.

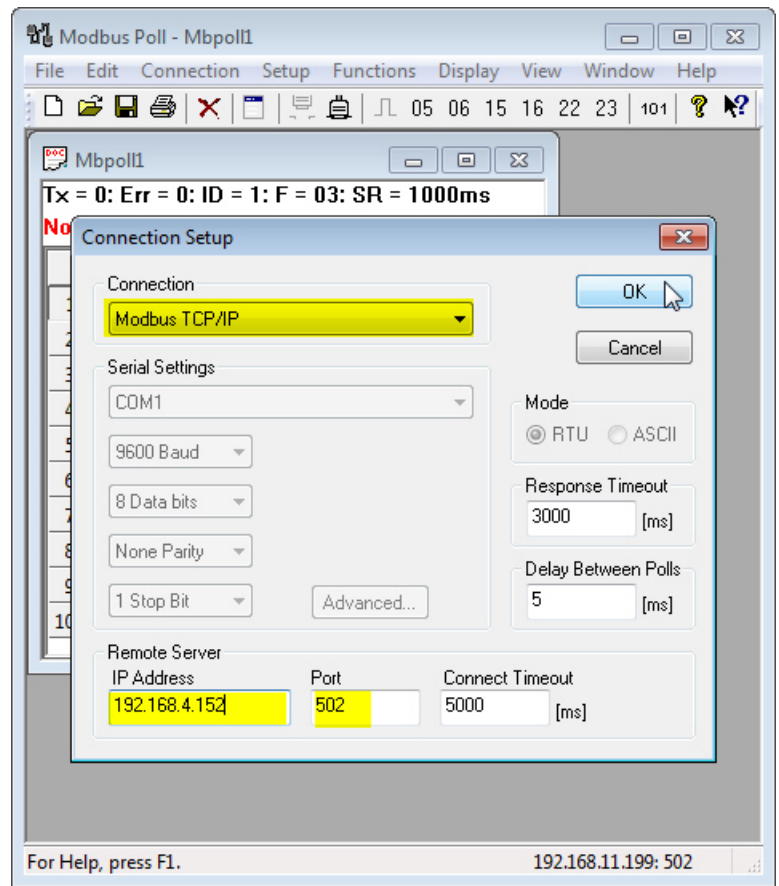
- Quantity – this is the number of words to display.
- Scan Rate – or also referred to as the polling rate.



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7. Configure the Client connection.

- The Remote Server IP Address is the IOLM IP address.
- Port 502 is the IOLM Port number.



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8. Verify that the PDI data is running and reflects information similar to this example.

The client is connected and polling once a second.

295 cycles have occurred with 0 errors.

Modbus Poll - Mbpoll1

File Edit Connection Setup Functions Display View Window Help

05 06 15 16 22 23 101

Mbpoll1

Tx = 295; Err = 0; ID = 1; F = 03; SR = 1000ms

	4x1000
1	0x0601
2	0x0000
3	0x0109
4	0x0000
5	0x0000
6	0x0000
7	0x0000
8	0x0000
9	0x0000
10	0x0000

For Help, press F1. 192.168.4.152: 502

status of PDI is good. See manual for details if desired.
no events are present at the moment. (good)
PDI = 109h = 265d => 26.5 deg C (79.7 degF)
this device only uses 16 bits of PDI. Most IO-link devices will only use 16 bits (2 bytes) yet the gateway is set to 36 bytes and everything is still working great. There are no problems.

9. Connect additional IO-Link devices to the remaining ports and repeat Steps 4 through 8 for each device.

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10. Verify that the devices are sending valid PDI data using the **IO-Link Diagnostics** page.

IO-Link Diagnostics STOP LIVE UPDATES RESET STATISTICS

After connecting one device to the Modbus Client (Modbus Poll), three more IO-Link devices were connected.

PDI data is displayed in the IO-Link Diagnostics page, if you scroll down the page.

IO-LINK PORT STATUS	3			PORT 4
Port Name	IOLink Port 1	IOLink Port 2	IOLink Port 3	IOLink Port 4
Port Mode	IOLink	IOLink	IOLink	IOLink
Port Status	Operational,PDI Valid	Operational,PDI Valid	Operational,PDI Valid	Operational,PDI Valid ←
Device Vendor Name	SICK AG	Pepperl+Fuchs GmbH	ifm electronic gmbh	Siemens AG
Device Product Name	WTB45C-3P2262	VDM28-8-L-IO/115b/136	TD2807	SIRIUS 3UG4832 Voltage Monitoring Relay for IO-Link
Device Serial Number	14250011	4000007343805	j0040120913	serial_number
Device Hardware Version	1.00	HW01.00	AA	1.0.0
Device Firmware Version	1.07	FW01.02	104	1.0.0
Device IO-Link Version	1.0	1.0	1.1	1.0
Actual Cycle Time	4.0 ms	4.0 ms	4.0 ms	10.0 ms
Device Minimum Cycle Time	2.3 ms	2.3 ms	2.3 ms	10.0 ms
Configured Minimum Cycle Time	4 ms	4 ms	4 ms	4 ms
Data Storage Capable	No	No	Yes	No
Automatic Data Storage Configuration	Disabled	Disabled	Disabled	Disabled
Auxiliary Input (AI) Bit Status	On	Off	On	Off
Device PDI Data Length	1	2	2	4
PDI Data Valid	Yes	Yes	Yes	Yes
Last Rx PDI Data (MS Byte First)	00h	01h,12h	01h,0ch	0dh,2ch,00h,f3h ←

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11. Verify that all of the ports are operating correctly as shown in this example.

This example shows four open sessions in the Modbus TCP Master. Each session is connected to the same IP address and Socket 502, but the Modbus memory address is different for each session.

IO-Link Port 1 PDI is at 1001, IO-Link Port 2 PDI is at 2001, and so forth. The Slave ID is 1 for all of the ports.

IO-LINK PORT STATUS		IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4
Port Name		IO-Link Port 1	IO-Link Port 2	IO-Link Port 3	IO-Link Port 4
Port Mode		IO-Link	IO-Link	IO-Link	IO-Link
Port Status		Operational, PDI Valid	Operational, PDI Valid	Operational, PDI Valid	Operational, PDI Valid
Device Vendor Name		SICK AG	Pepperl+Fuchs GmbH	ifm electronic gmbh	Siemens AG
Device Product Name		WTB45C-3P2262	VDM28-8-L-IO/1156/136	TD2807	SIRIUS 3UG4832 Voltage Monitoring Relay for IO-Link
Device Serial Number		14250011	40000007343805	j0040120913	serial_number
Device Hardware Version		1.00	HW01.00	AA	1.0.0
Device Firmware					

Session	Device	Address	Value	Description
1	PDI_4P_s1.mbp	4x1000	1536	photo optic proximity (ON/OFF) currently ON
2	PDI_4P_s2.mbp	4x2000	1536	laser distance sensor (dist. in cm) currently 274 cm
3	PDI_4P_s3.mbp	4x3000	1537	temperature probe (temperature in deg C) currently 26.6
4	PDI_4P_s4.mbp	4x4000	1536	voltage monitor (Electromotive force in Volts) currently 24.3 VDC

status of data 1536d (= 600h) or 1537d (= 601h) are both good

Tx = 21: Err = 0: ID = 1: F = 03: SR = 1000

Tx = 343: Err = 0: ID = 1: F = 03: SR = 1000

Tx = 342: Err = 0: ID = 1: F = 03: SR = 1000

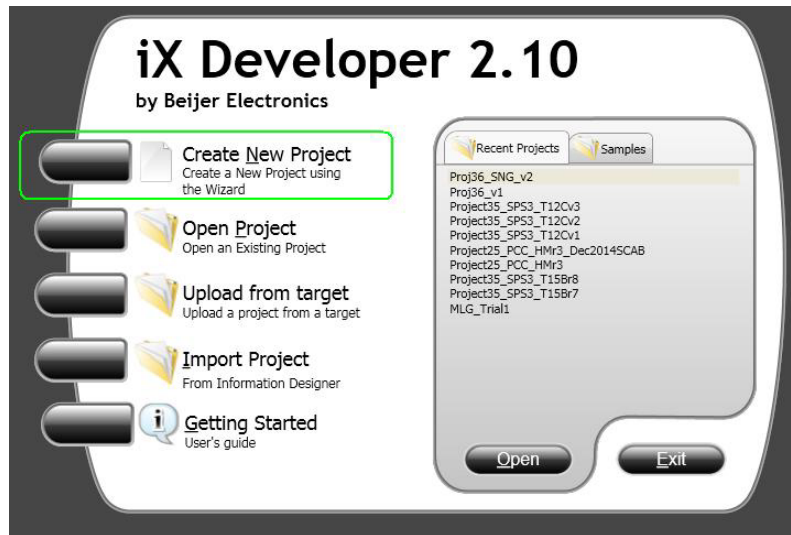
Tx = 342: Err = 0: ID = 1: F = 03: SR = 1000

192.168.4.14: 502

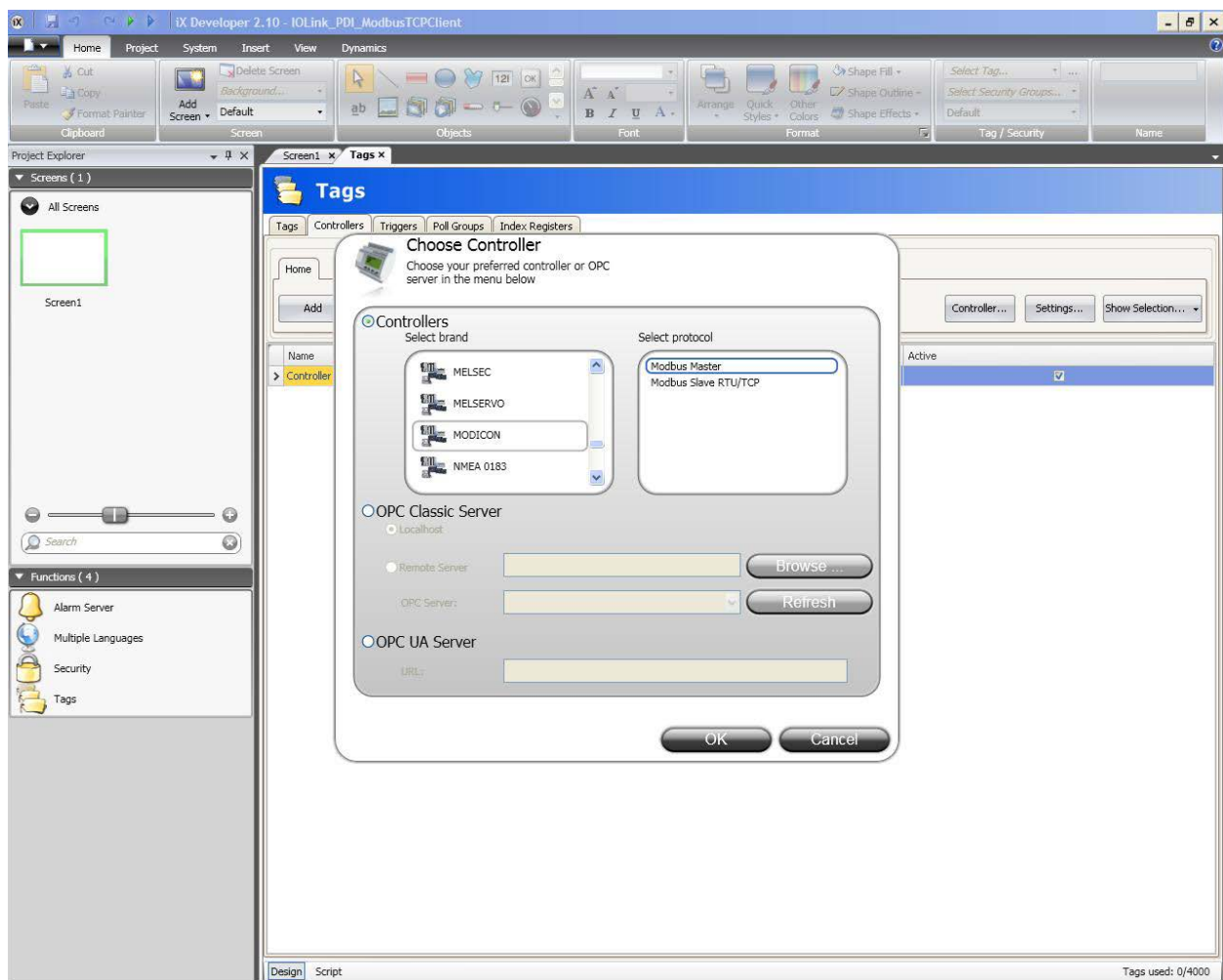
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- Open the HMI development software. This example illustrates HMI Client configuration using iX Developer 2.10.
- Create a new project.



- Configure the controller or driver communications method.



IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

15. At a minimum, you must configure the IOLM IP Address, Port 502, and the Node number (the Slave ID used in the IOLM **Modbus/TCP Configuration** page).

Methods for creating basic channel communication properties vary widely depending on your Modbus TCP Client.

The screenshot displays the iX Developer 2.10 interface. The main window is titled "Tags" and shows a configuration page for "Controller1". A "Modbus" dialog box is open, showing the "Stations" tab with the following data:

Station	IP Address	Port	Node
0	192.168.4.152	502	1

The background window shows a table with the following data:

Name	ID	Active
Controller1		<input checked="" type="checkbox"/>

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

16. Configure the Communications mode. This example illustrates **EtherNet/IP**.

The screenshot displays the iX Developer 2.10 interface for configuring a Modbus Master. The main window shows the 'Tags' tab with a table containing one entry: 'Controller1'. A 'Modbus Master' dialog box is open, showing the 'Settings' tab. The 'Communication mode' is set to 'Ethernet TCP/IP'. Other settings include: Default station: 0, Modbus protocol: RTU, 32-bit word mapping: Big-endian, Addressing: Decimal, Start address: 1-based, Silent time (ms): 0, Coils/input status bits per message (read): 128, Coils/input status bits per message (write): 1, Holding/input registers per message (read): 16, Holding/input registers per message (write): 8, Force function code 0x10: Disable, and String swap: Enable. The 'Communication mode' section is highlighted in yellow.

Name	Active
Controller1	<input checked="" type="checkbox"/>

Settings	Value
Communication mode	Ethernet TCP/IP
Default station	0
Modbus protocol	RTU
32-bit word mapping	Big-endian
Addressing	Decimal
Start address	1-based
Silent time (ms)	0
Coils/input status bits per message (read)	128
Coils/input status bits per message (write)	1
Holding/input registers per message (read)	16
Holding/input registers per message (write)	8
Force function code 0x10	Disable
String swap	Enable

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

17. Create specific tags for each device.

This HMI requires 4xxx be specified for the **Holding Register** memory space. Some systems may require that you specify memory blocks/type elsewhere and then you specify 1001 rather than 41001. The status for each port displays at 4X001 whereas the process data payload begins at 4X003, where X is the port number (1-8). These addresses may be shifted by +/- depending on whether your Modbus client is a base 0 or base 1 system.

The screenshot shows the 'Tags' configuration window in iX Developer 2.10. The window is titled 'Tags' and has tabs for 'Tags', 'Controllers', 'Triggers', 'Poll Groups', and 'Index Registers'. The 'Tags' tab is active, showing a table of tags. The table has columns for 'Tag', 'Data Type', 'Access Right', 'Data Type', 'Controller1', 'Description', 'Poll Group', 'Always Active', 'Non-volatile', and 'Initial Value'. The tags are organized into two groups: 'PDI_Stat' (status points) and 'PDI_Data' (data points) for each of the four ports (Pt1, Pt2, Pt3, Pt4). The 'PDI_Stat' tags have 'Data Type' of 'DEFAULT' and 'Access Right' of 'ReadWrite'. The 'PDI_Data' tags have 'Data Type' of 'DEFAULT' and 'Access Right' of 'ReadWrite'. The 'Controller1' column shows the controller address for each tag, ranging from 41001 to 44003. The 'Description' column provides a brief description for each tag, such as 'Status_p1' and 'Data_p1'. The 'Poll Group' column shows the group to which each tag belongs, all of which are 'PollGroup1'. The 'Always Active' and 'Non-volatile' columns have checkboxes, all of which are currently unchecked. The 'Initial Value' column is empty for all tags.

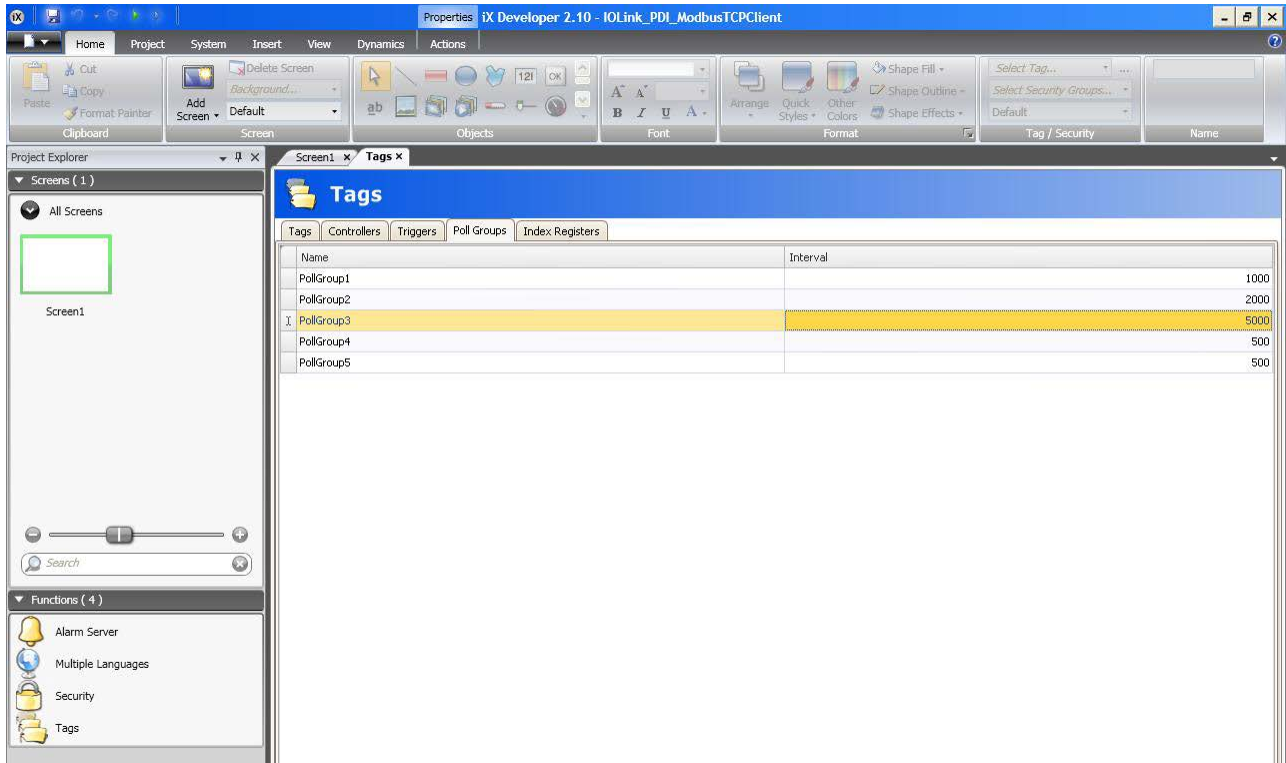
Tag	Data Type	Access Right	Data Type	Controller1	Description	Poll Group	Always Active	Non-volatile	Initial Value
PDI_Stat_Pt1	DEFAULT	ReadWrite	INT16	41001	Status_p1	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Data_Pt1	DEFAULT	ReadWrite	INT16	41003	PDI_p1	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Stat_Pt2	DEFAULT	ReadWrite	INT16	42001	Status_p2	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Data_Pt2	DEFAULT	ReadWrite	INT16	42003	Data_p2	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Stat_Pt3	DEFAULT	ReadWrite	INT16	43001	Status_p3	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Data_Pt3	DEFAULT	ReadWrite	INT16	43003	Data_p3	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Stat_Pt4	DEFAULT	ReadWrite	INT16	44001	Status_p4	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	
PDI_Data_Pt4	DEFAULT	ReadWrite	INT16	44003	Data_p4	PollGroup1	<input type="checkbox"/>	<input type="checkbox"/>	

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

18. Set the Polling Rate.

In this example, the frequency of data exchange is configured using Poll Groups. These Poll Groups were created with frequencies at 1Hz, 0.5Hz, 0.2Hz, and 2Hz (the poll rate used earlier).

All Modbus TCP Masters, whether they are a PLC, simulator, HMI, or other SCADA system software should be able to control the polling rate.

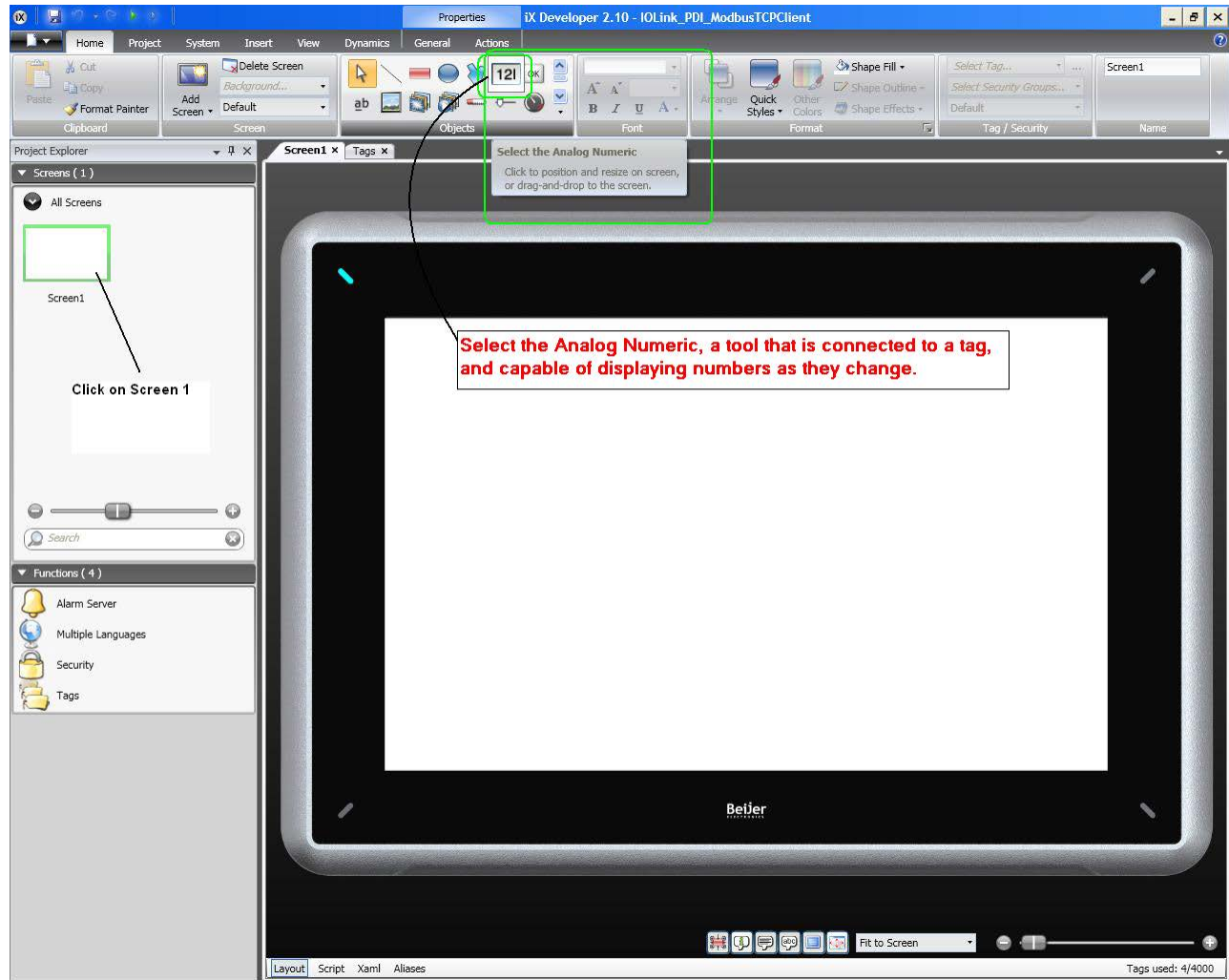


The screenshot displays the iX Developer 2.10 interface. The main window is titled "Tags" and shows a table of configured Poll Groups. The table has two columns: "Name" and "Interval". The "PollGroup3" row is highlighted in yellow, indicating it is the selected group. The intervals for the groups are: PollGroup1 (1000), PollGroup2 (2000), PollGroup3 (5000), PollGroup4 (500), and PollGroup5 (500).

Name	Interval
PollGroup1	1000
PollGroup2	2000
PollGroup3	5000
PollGroup4	500
PollGroup5	500

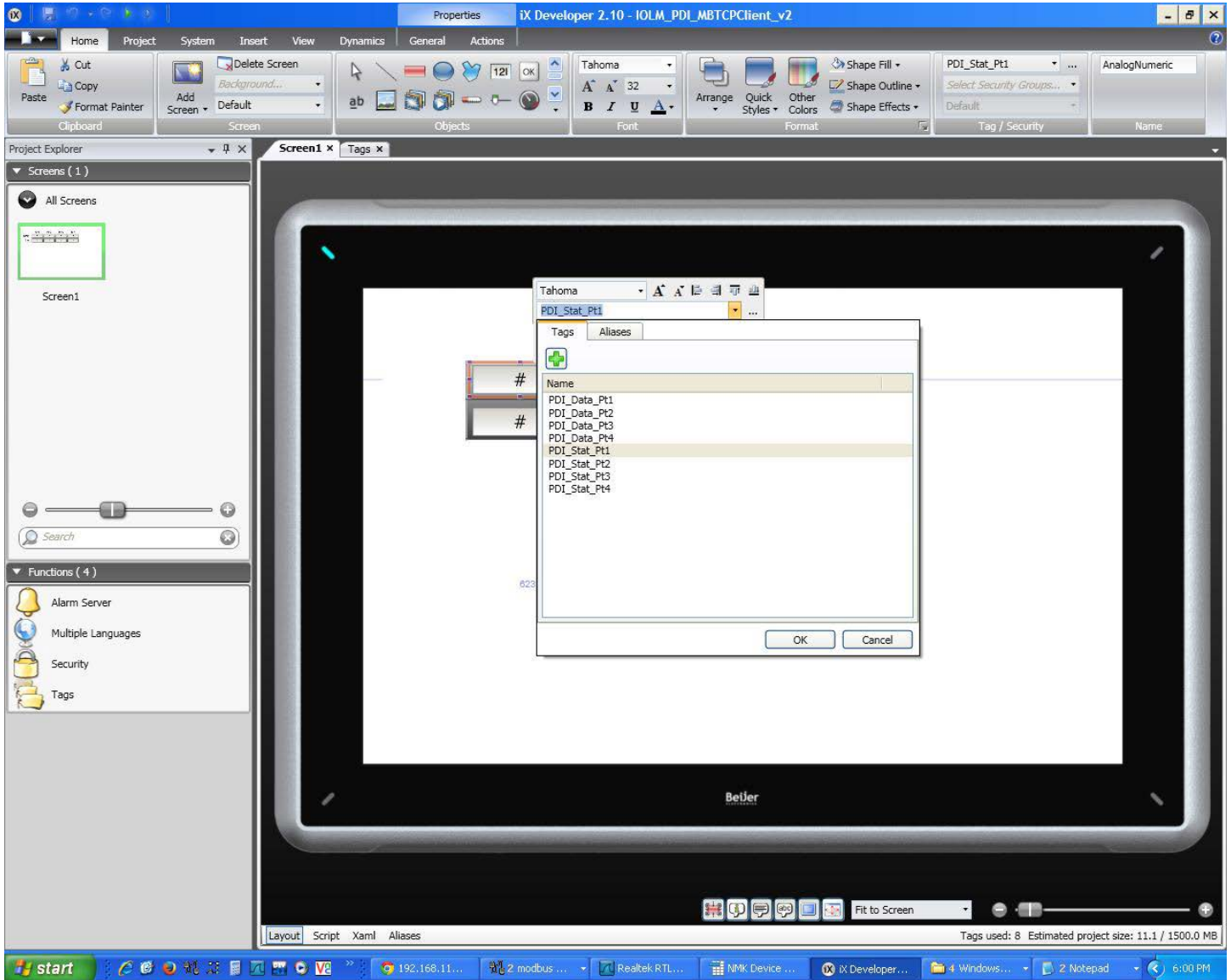
IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

19. Select the Analog Numeric, a tool that is connected to a tag, and capable of displaying numbers as they change.



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20. Select the tag.



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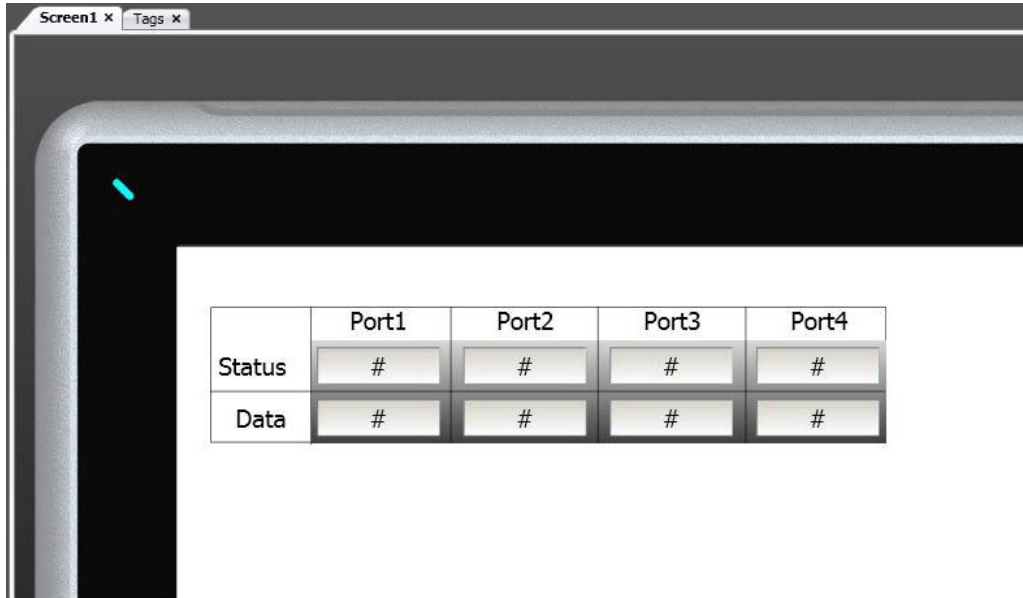
21. Compile and run the project.

The screenshot shows the iX Developer 2.10 interface. The main window displays a simulated screen with a table and a red text box. The table has columns for Port1, Port2, Port3, and Port4, and rows for Status and Data. A red box highlights the 'Compile and run the project' text.

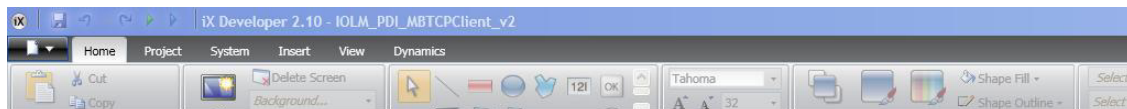
	Port1	Port2	Port3	Port4
Status	#	#	#	#.0
Data	#	#	#	#

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

22. Optionally, add labels, lines, and shading to make the data display more organized.



23. Run the program to see the data.



	Port1	Port2	Port3	Port4
Status	1537	1536	1537	1537
Data	0	29	266	277

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

24. Check the **Modbus/TCP Diagnostics** page to verify that messages are being received by the masters and that responses are being sent to the masters. If necessary, open the IO-Link Master web interface, and click **Diagnostics | Modbus/TCP**.

IO-Link PDI to Modbus TCP Master(s) and the Control IO-Link Master

192.168.4.56 IO-Link Master X
www.control.com/wp-conte X
IO-Link Master: page_modbi X
IO-Link Master: page_port_ X
Control Corporation - Device X

192.168.4.152/index.php/ModBus/TCP/Diag
★

Home
Diagnostics
Configuration
Advanced
Attached Devices
Help
IO-Link Master 4 Port Prototype
Logout

IO-LINK DIAGNOSTICS
ETHERNET/IP DIAGNOSTICS
MODBUS/TCP DIAGNOSTICS

Modbus/TCP Diagnostics

MODBUS/TCP INTERFACE DIAGNOSTICS	VALUES			
Active Connections	1			
Messages Received From Masters	5024			
Responses Sent To Masters	5024			
Broadcasts Received	0			
Invalid Message Length Errors	0			
Invalid Message Data Errors	0			
Invalid Message Address Errors	0			
Unknown Device ID Errors	0			
Invalid Protocol Type Errors	0			
Unsupported Function Code Errors	0			
Configuration Errors	0			
No Available Connection Errors	0			
System Resource Errors	0			
First Error String	No Error Detected			
Last Error String				
MODBUS/TCP PORT SPECIFIC DIAGNOSTICS	PORT 1	PORT 2	PORT 3	PORT 4
Active PDO Controller(s)				
PDO Writes to Offline or Read-Only Ports	0	0	0	0
ISDU Request Msgs from PLC(s)	0	0	0	0

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192.168.4.56 IO-Link Master X www.control.com/wp-conte X IO-Link Master: page_modbi X IO-Link Master: page_port X Control Corporation - Device X

192.168.4.152/index.php/ModBus/TCP/Diag

CONTROL Home Diagnostics Configuration Advanced Attached Devices Help IO-Link Master 4 Port Prototype Logout

IO-LINK DIAGNOSTICS ETHERNET/IP DIAGNOSTICS MODBUS/TCP DIAGNOSTICS

Modbus/TCP Diagnostics

PAUSE LIVE UPDATES RESET STATISTICS

MODBUS/TCP INTERFACE DIAGNOSTICS		VALUES			
Active Connections	1				
Messages Received From Masters	5024				
Responses Sent To Masters	5024				
Broadcasts Received	0				
Invalid Message Length Errors	0				
Invalid Message Data Errors	0				
Invalid Message Address Errors	0				
Unknown Device ID Errors	0				
Invalid Protocol Type Errors	0				
Unsupported Function Code Errors	0				
Configuration Errors	0				
No Available Connection Errors	0				
System Resource Errors	0				
First Error String	No Error Detected				
Last Error String					
MODBUS/TCP PORT SPECIFIC DIAGNOSTICS		PORT 1	PORT 2	PORT 3	PORT 4
Active PDO Controller(s)					
PDO Writes to Offline or Read-Only Ports	0	0	0	0	0
ISDU Request Msgs from PLC(s)	0	0	0	0	0