App Note
PTI 210 Module
AN1505
Rev1.0, 6/20/22

Using a IO210-BC Remote I/O bus coupler with a PTi210 Module

Introduction

When upgrading from an older generation drive such as an Epsilon EPP, to one of our newer drives like the Digitax M750, there is potential for not having enough digital I/O available on the Digitax M750 to perform the upgrade. This application note will go through the process of implementing our IO210-BC remote I/O bus coupler with our PTi210 Motion Control module to add additional digital I/O to your application.

The IO210-BC bus coupler can be accessed from a PTi210 module through its host drive using our RTMoE (Real Time Motion over Ethernet) messaging protocol. The PTi210 module does not support this protocol directly. Therefore, you must use our *Machine Control Studio* automation software to create what we call “Easy Mode Cyclic Links” to read and write to the remote I/O on the IO210-BC bus coupler.

Software Required

To use an IO210-BC bus coupler with a PTi210 module, please visit the “Downloads→Software” section of our website to download and install these software packages:

- *Machine Control Studio* (ver. 1.10.01+)
- *PowerTools Studio*
- *Connect* drive commissioning software[1]

[1]Connect software is not required to configure the data communication links and will only be used to download the IO210-BC configuration file (.sml file) in the event that the bus coupler needs to be replaced. See Addendum 1 for more details.

Reference Material

Visit the “Downloads→Software and Manuals→Digitax HD” section of our website to download the “Remote I/O RTMoE and Modbus TCP/IP User Guide”.

Demonstration Equipment and Objectives

The following demonstration equipment was used to create this Application Note:

- Digitax M750 AC Drive

- Unimotor HD model 067EDA300. Motor includes a Heidenhain EnDat encoder for position feedback.
- PTi210 Motion Control Module mounted into Slot 2 on the Digitax M750 drive
- IO210-BC Remote I/O coupler with Qty. 1, model number GT1238 8 channel digital input slice, Qty. 1 model number GT 2328 8 channel digital output slice.

The objective of this Application Note is to demonstrate how to access the digital inputs and outputs on the IO210-BC bus coupler using the RTMoE communication protocol.

Solution Summary

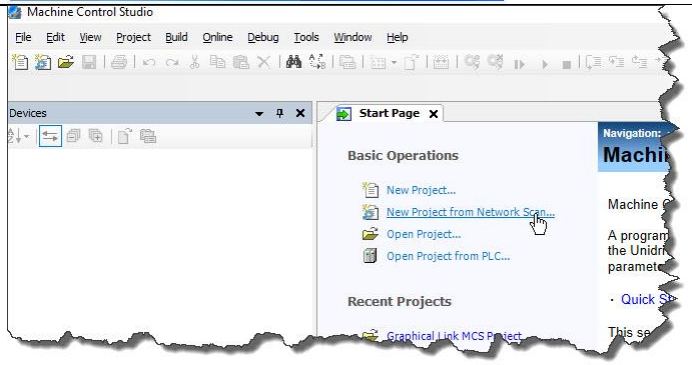
The steps that are required to use the IO210-BC Bus Coupler with a PTi210 module are as follows:

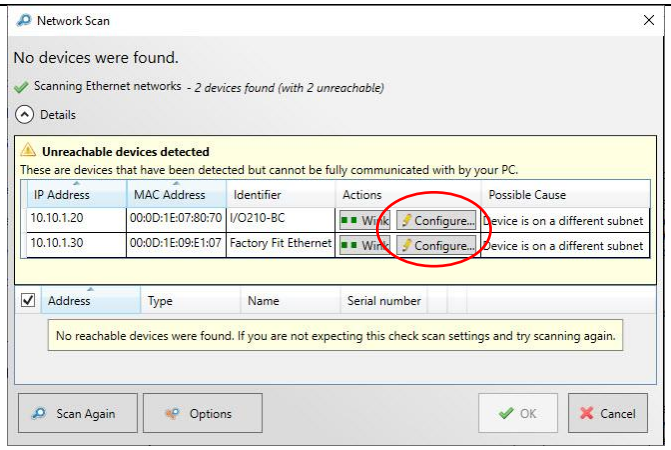
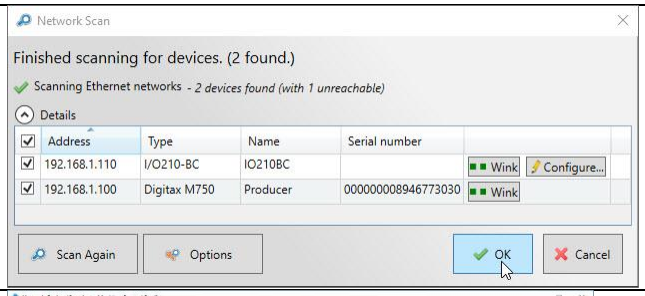
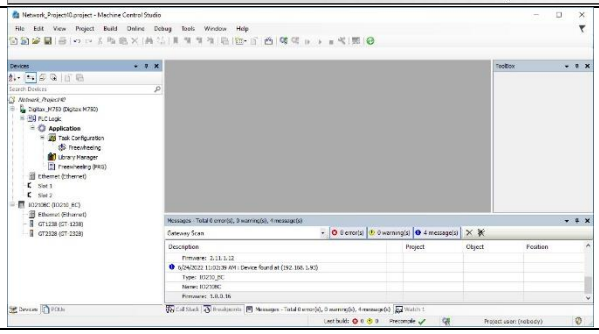
1. Assign a Static IP address to your development machine.
    a. The **192.168.1 subnetwork must be used** on the development machine.
    b. Do NOT assign the last octet of your PC's static IP address to be "100" as that is the default IP address of the IO210-BC bus coupler.
2. Use *Machine Control Studio* software to:
    a. Confirm the static IP addresses of both the host drive (the drive where the PTi210 module is installed) and the IO210-BC bus coupler.
    b. Create 2 cyclic links between the PTi210 host drive and the IO210-BC bus coupler using the Advanced Link Editor.
        i. 1 link to access the Control Word for the coupler and to write to the digital outputs on the coupler.
        ii. 1 link to read the Status Word from the coupler and to read the state of the digital inputs on the coupler.
    c. Download the link configuration file (.sml file) to the IO210-BC bus coupler.
3. Use PowerTools Studio software to:
    a. Create Easy Mode cyclic links to read and write to the IO210-BC bus coupler.
        i. Add code to a PowerTools Studio user program to create 1 Tx (Transmit) link and 1 Rx (Receive) link.
        ii. Define 2, 32-bit Bit Register variables. 1 to hold the state of the digital inputs on the coupler, the other to access the digital outputs on the coupler and to mask off the 8 output channels on the GT 2328 output slice.
        iii. Define 2 user Variables. 1 to access the IO210-BC Control Word and the other to read the IO210-BC Status Word.

iv. Modify the "*Parameter Access*" tool in PowerTools Studio software to map the 2 Bit Registers and the 2 User Variables to PTi210 user application menu 70 parameters.

Part 1: Creating Cyclic Links using Machine Control Studio software

Prior to beginning this step, please be sure to have assigned a Static IP Address to the computer that you are using to program the PTi210 module. The address you've chosen must use the 192.168.1.x subnetwork. The last octet of the address should be unique to any other device on the subnetwork. For example, use 192.168.1.200 for the development computer.

Step	Instruction	Notes
1	Open Machine Control Studio software.	
2	Begin a new project by clicking on "New project from network scan"	

3	It is likely that neither the PTi210 host drive nor the IO210-BC will have IP Addresses that are compliant with the 192.168.1 subnetwork that was assigned to the network card on your development computer. Click the “Configure” button to assign static IP Addresses to both the host drive and the IO210-BC bus coupler.	
4	Once the addresses for each device have been assigned, click on the “OK” button to add both devices to your new Machine Control Studio software project.	
5	This is what your Machine Control Studio project should look like.	

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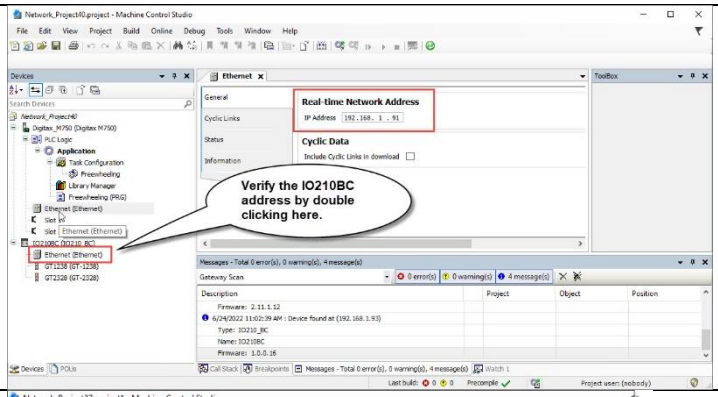
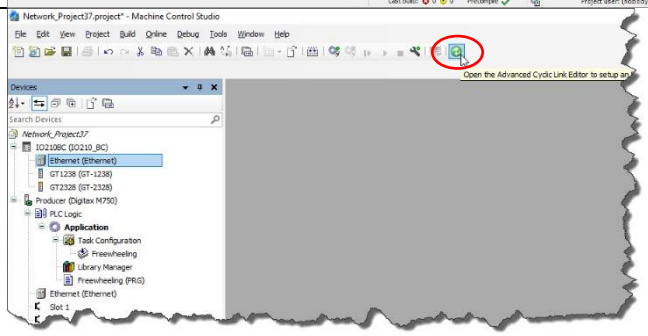
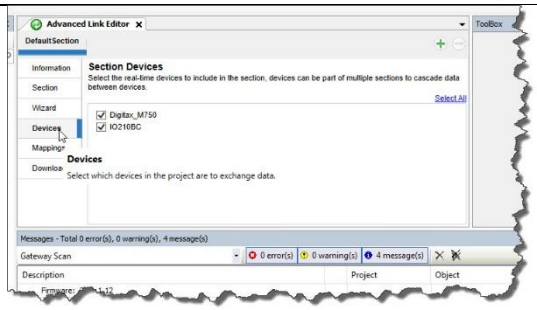
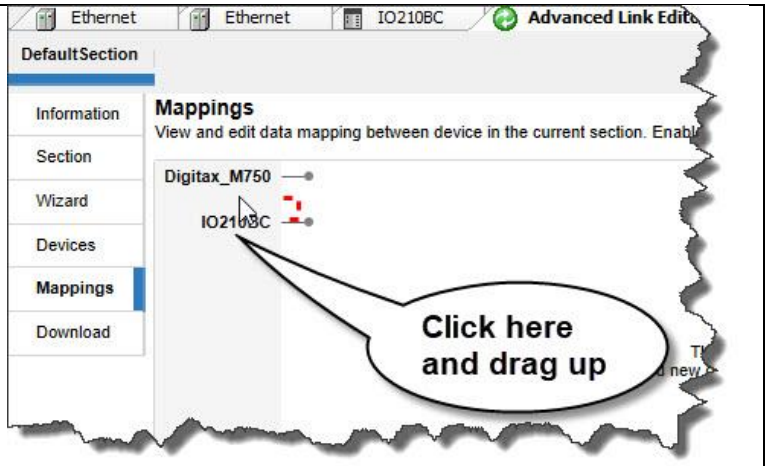
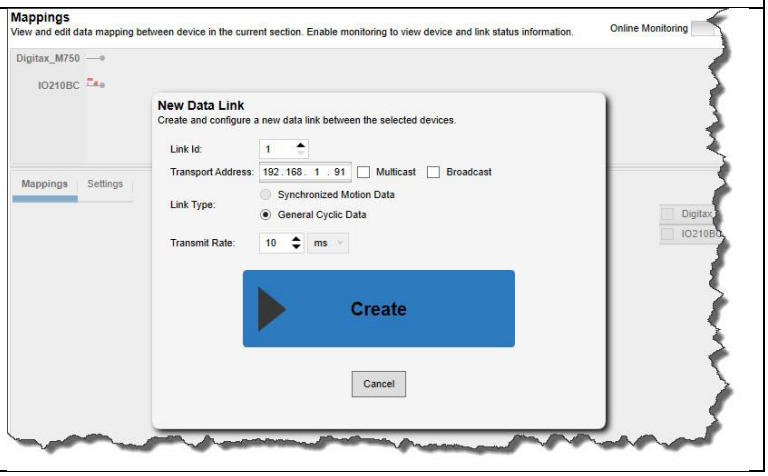
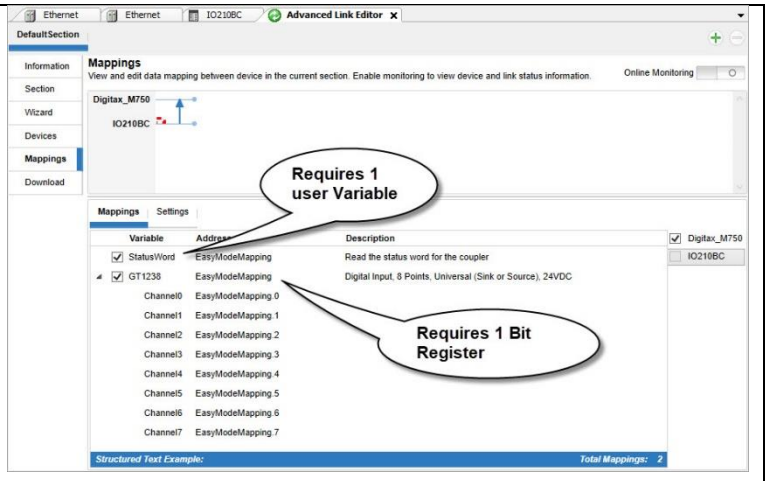
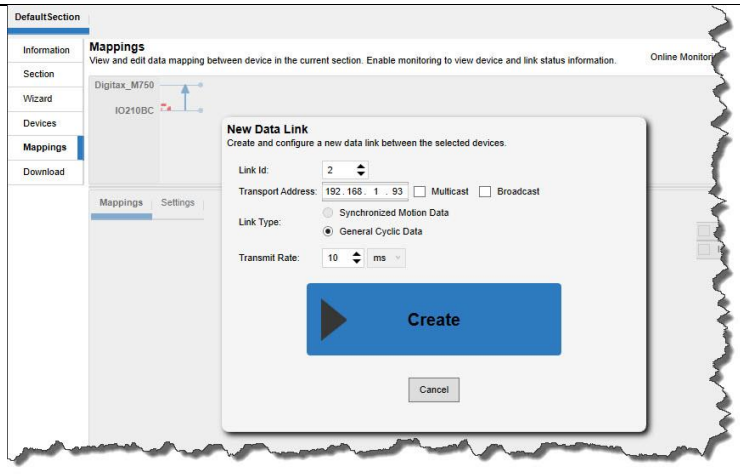
6	Verify that the IP Address for both the IO210-BC coupler and the Host drive are correct by double clicking on the “Ethernet” item from the project tree for each device.	
7	From the Machine Control Studio toolbar, click on the Advanced Link Editor icon as shown here.	
8	This is the interface for the Advanced Link Editor. Begin by clicking on the “Devices” step in the Editor as shown here. Place a check next to both the Digitax_M750 and the IO210BC to indicate that both of those devices will be sharing information using cyclic links.	

9	Click on the “Mappings” step. Here is where you’ll create the 2 links between the IO210BC and the Digitax_M750. To form the first link between the IO210BC and the Digitax M750, click on the **label** “IO210BC”, hold the mouse button down then draw a line up to the “Digitax_M750” label. Release the mouse button when the Digitax_M750 label is highlighted.	
10	When you release the mouse button, you’ll see a New Data Link message that looks like this. Click on the “Create” button to create the link.	

11	Once Link 1 has been created, the Mappings for that link will appear as shown here. The mapping for the "StatusWord" is going to require a PowerTools Studio user variable (Devices / Vars→Variables) to store the value of the Status Word from the coupler. If you expand the "GT1238" by clicking on the icon to the left of the link name, you'll see the 8 input channels available on that module. You'll need to create a Bit Register variable (Devices / Vars→Bits) in PowerTools Studio to hold the state of the 8 digital inputs on this link.	
12	Repeat steps 8 and 9 to form the link that will go *from* the Digitax_M750 *to* the IO210BC. Be sure to click the "Create" button to complete the creation of the second link.	

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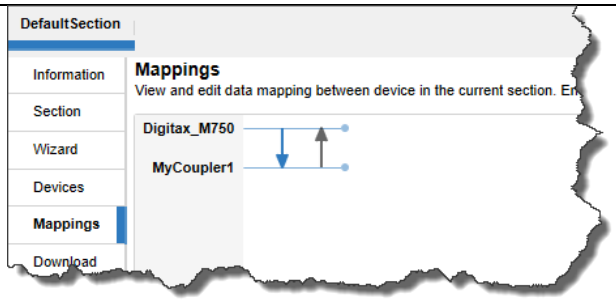
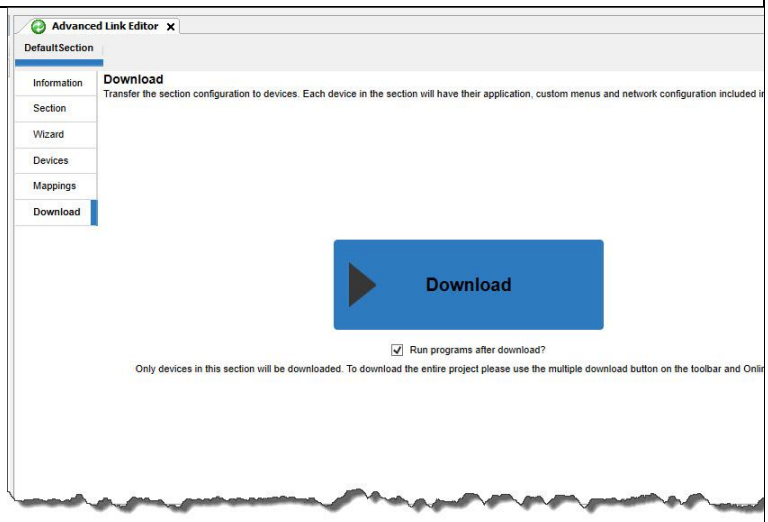
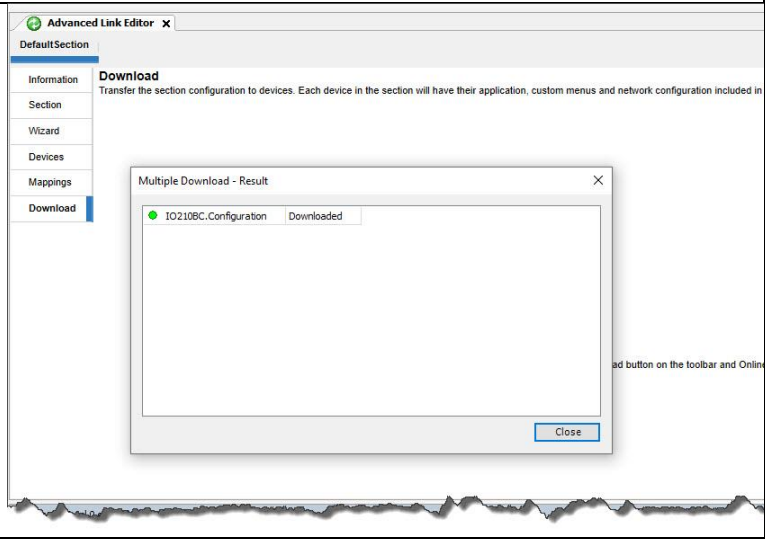
13	This is what the finished link mapping should look like.	
14	Click on the “Download” step of the Advanced Link Editor. Click on the Download button to transfer the link configuration file (the .sml file) to the IO210-BC bus coupler.	
15	If the download was successful, you will see a message that looks like this. You may save your Machine Control Studio project if desired, but this is the last requirement for using Machine Control Studio software for this project.	

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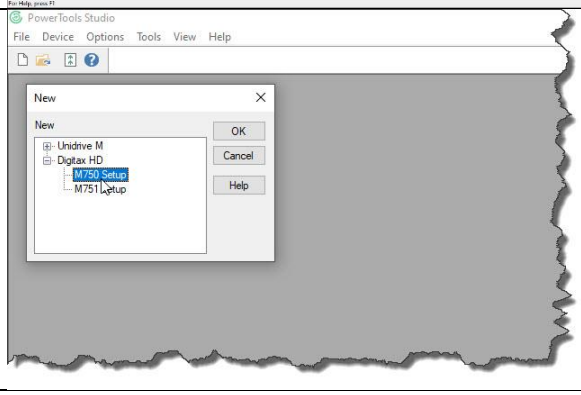
Part 2: Using PowerTools Studio to Map the Cyclic Links

As mentioned earlier, PowerTools Studio software does not support the RTMoE communication protocol directly. However, the PTi210 module contains program instructions that provide access to host drive (Digitax M750) menus and parameters.

In this part, you'll be creating a user program to include the code necessary to form the communication links between the Digitax M750 host drive and the IO210BC bus coupler.

Step	Instruction	Notes
1	Open PowerTools Studio software v. 1.06+	
2	Begin a new project by clicking "File→New" If you are using a Digitax HD, use the drop-down list to choose "M750 Setup" as shown.	

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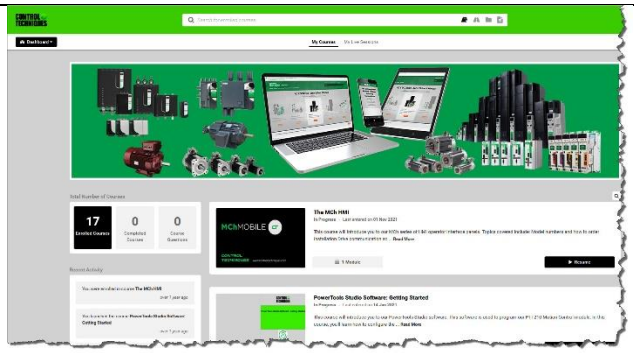
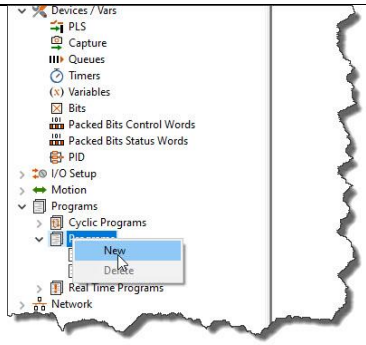
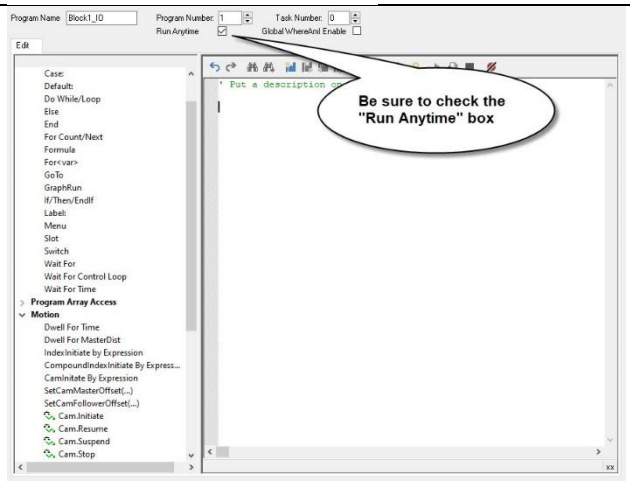
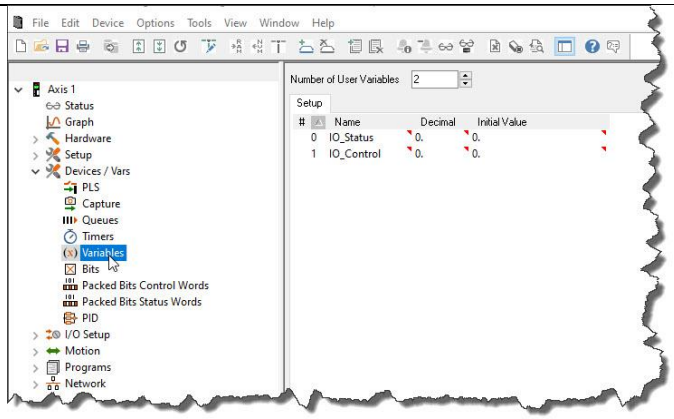
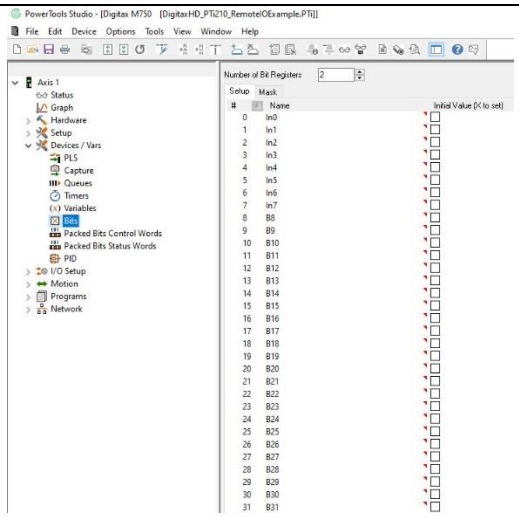
3	This Application Note is focused on using the IO210-BC bus coupler. As a result, it will not cover the complete commissioning of the Digitax M750 drive. For training on using PowerTools Studio software to commission the drive, please register to gain access to our online learning website “The Learning Center” by completing the form found on this page.	
4	Begin by right-clicking on the “Programs” view of the PowerTools Studio project tree. Click “New” A new user program will appear. Name the new user program “Block1_IO”.	
5	Here is the Program Editor for the Block1_IO program. This program will be used to create the 4-cyclic links used to read from and write to the IO210BC coupler. Check the “Run Anytime” box to enable the program to run even if the host drive is disabled.	

6	Next, create the 2 Variables and 2 Bit Registers that will be used to store the data for the cyclic links. Expand the “Devices / Vars” item on the PowerTools Studio project tree, and then click “Variables” Reduce the “Number of User Variables” to “2”, and then name the 2 variables as shown here.	
7	Click on the “Bits” menu item to create 2 Bit Registers that will be used to access the digital I/O on the coupler. Referring to Part 1, Step 10 on page 7, you’ll note that each digital I/O slice on the coupler requires a bit encoded variable to access the channels on the slice, hence the need for 2-bit registers. 1 for the inputs, the other for the outputs.	

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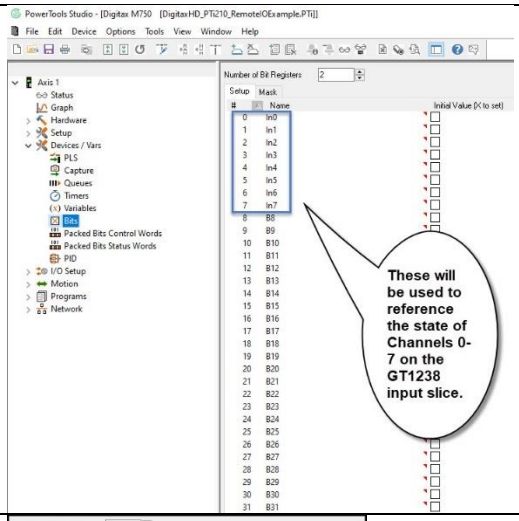
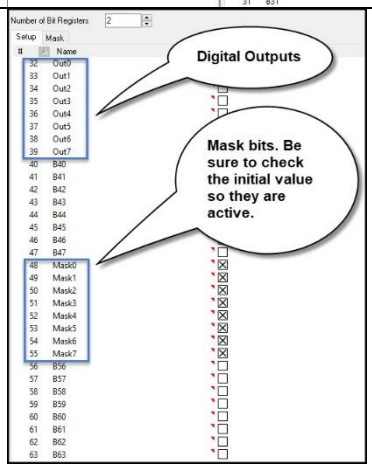
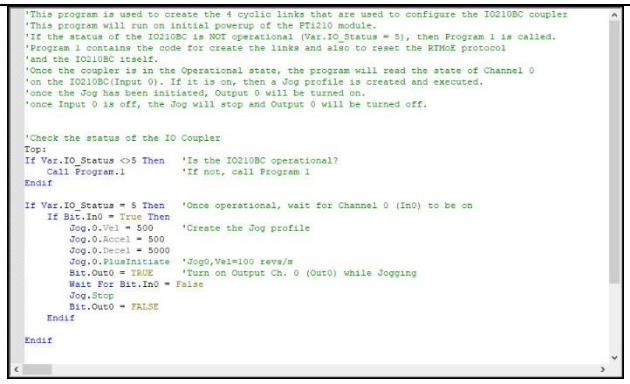
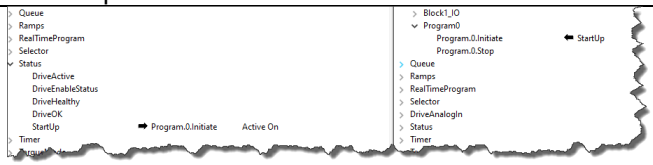
8	Begin with the bit register that will be used to access the digital inputs status. Change the “Name” for bits 0-7 to something reflective of the individual bits as these will become the names you’ll use for the digital inputs in your PowerTools Studio program.	
9	The second bit register variable begins with Bit #32. Bits 32-39 form the first Byte of this register. These bits will be used to write to the digital outputs on the GT-2328 output slice. To write to a digital output, the IO210BC requires that you mask off (select) those channels you’d like to use. That is done by masking off those bits. Mask bits 48-55 as shown here.	

10	Click on Program #0. Click on the “Run anytime” button so that Program #0 will run even if the host drive is disabled. The code for Program #0 is shown here. This program will run on powerup of the PTi210 module.	

11	You may copy and paste the code on the right directly into your program so long as you’ve named the variables exactly as used for this demonstration.
	If Red Dots (errors) appear, you’ll need to check your variable names.
		Top:
		If Var.IO_Status <>5 Then
		Call Program.1
		Endif
		
		If Var.IO_Status = 5 Then
		If Bit.In0 = True Then
		Jog.0.Vel = 500
		Jog.0.Accel = 500
		Jog.0.Decel = 5000
		Jog.0.PlusInitiate
		Bit.Out0 = TRUE
		Wait For Bit.In0 = False
		Jog.Stop
		Bit.Out0 = FALSE
		Endif
		
		Endif
		
		Goto Top:

12	To ensure that Program 0 runs on powerup, open the PowerTools Studio “I/O Setup→Assignments” screen and attach the Program.0.Initiate Destination to the Status→StartUp Source as shown here.	

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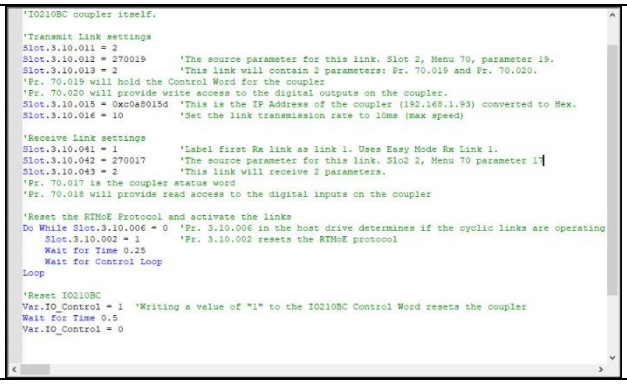
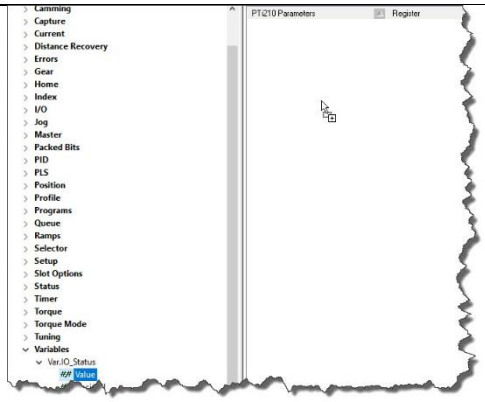
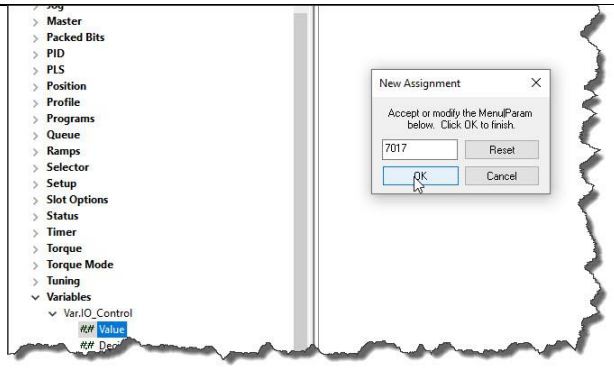
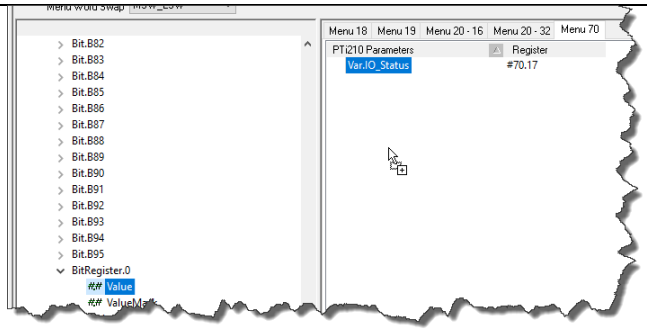
13	Open Program 1. Here is the code required to create the 4-cyclic links and to reset the RTMoE protocol and finally, the IO210BC coupler itself.	 'IO210BC coupler itself. 'Transmit Link settings Slot.3.10.011 = 2 Slot.3.10.012 = 270019 'The source parameter for this link. Slot 2, Menu 70, parameter 19. Slot.3.10.013 = 2 'This link will contain 2 parameters: Pr. 70.019 and Pr. 70.020. 'Pr. 70.019 will hold the Control Word for the coupler 'Pr. 70.020 will provide write access to the digital outputs on the coupler. Slot.3.10.015 = 0xc0a8015d 'This is the IP Address of the coupler (192.168.1.93) converted to Hex. Slot.3.10.016 = 10 'Set the link transmission rate to 10ms (max speed) 'Receive Link settings Slot.3.10.041 = 1 'Label first Rx link as link 1. Uses Easy Mode Rx Link 1. Slot.3.10.042 = 270017 'The source parameter for this link. Slo2 2, Menu 70 parameter 17 Slot.3.10.043 = 2 'This link will receive 2 parameters. 'Pr. 70.017 is the coupler status word 'Pr. 70.018 will provide read access to the digital inputs on the coupler 'Reset the RTMoE Protocol and activate the links Do While Slot.3.10.006 = 0 'Pr. 3.10.006 in the host drive determines if the cyclic links are operating Slot.3.10.002 = 1 'Pr. 3.10.002 resets the RTMoE protocol Wait for Time 0.25 Wait for Control Loop Loop 'Reset IO210BC Var.IO_Control = 1 'Writing a value of "1" to the IO210BC Control Word resets the coupler Wait for Time 0.5 Var.IO_Control = 0	
14	You may copy and paste this text into your program if the variable names match exactly.	'Transmit Link settings Slot.3.10.011 = 2 Slot.3.10.012 = 270019 Slot.3.10.013 = 2 Slot.3.10.015 = 0xc0a8015d Slot.3.10.016 = 10 'Receive Link settings Slot.3.10.041 = 1 Slot.3.10.042 = 270017 Slot.3.10.043 = 2 'Reset the RTMoE Protocol and activate the links Do While Slot.3.10.006 = 0 Slot.3.10.002 = 1 Wait for Time 0.25 Wait for Control Loop Loop 'Reset IO210BC Var.IO_Control = 1 Wait for Time 0.5 Var.IO_Control = 0	

15	Click on the “Menu 70” tab of the Parameter Access item. To map parameters to Menu 70, begin by expanding the “Variables” item in the Parameter Access view. Add the variable you created to store the coupler’s Status Word as the first mapping in Menu 70. To do that, click on your variable’s “Value”, and then drag it across the screen and drop it on the right side.	
16	When you release your mouse button to drop the parameter, you’ll see a suggested mapping address of “7017”. That means Menu 70, parameter 17. Accept that mapping by clicking “OK” as shown here.	
17	Next, map the *Value* of BitRegister.0 using the same procedure. Expand the “Bits” item and then the “Bit. Register0” item to locate the *Value* variable as shown here. Accept the mapping of “7018” after dropping the Value parameter on the right side of the screen.	

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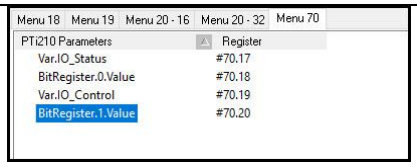
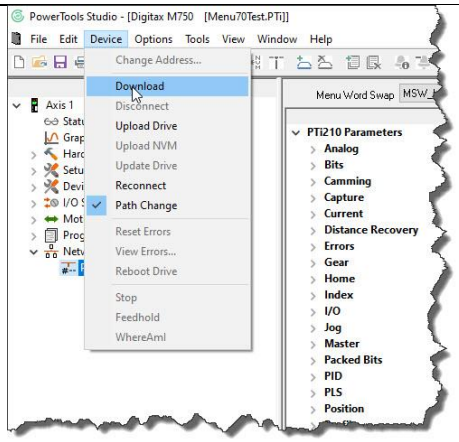
18	Repeat steps 14-16 to map the variable you created to store the coupler's Control Word and BitRegister.1 Your finished mapping should look like this.	
19	Save your PowerTools Studio project, and the click on "Device→Download" to download your project to the PTi210 module.	

Testing and Troubleshooting

Having followed this procedure, your IO210BC coupler should now be accessible from a PTi210 application.

Begin testing by using the Command prompt tool in Windows to ping both the host drive and the IO210-BC coupler as shown in Figure 1.

Figure 1

If you received replies from both devices, then the next step is to assess the status of the LED indicators on the IO210-BC coupler. The status LEDs are described in Figure 2.

5.2 I/O210-BC LED Indicator

Figure 5-1 LED Indicator

LED name	LED Function / Description	LED Colour
MOD	Bus Coupler's Status	Green/Red
LINK	Ethernet electrical link detected	Green
ACTIVE	Ethernet message exchange detected	Green
IOS	Internal Bus Status	Green/Red
System Power	Power supplied for system control circuits, coupler and modules	Green
Field power	Power supplied for the module IO points	Green

Figure 2

This information is found in section 5.2 of the "Remote IO User Guide".

Ideally all 4 of these LEDs will be solid Green.

You may find that both the MOD and IOS LEDs are Red. If that is the case:

- Remove power from the IO210BC.
- Remove power from the Digitax M750
- Re-apply power to the IO210BC
    - Wait until you see the IOS, and Active LEDs turn green. The MOD LED should be blinking Green.
- Re-apply power to the Digitax M750
- After approximately 15 seconds, all 4 LEDs should be solid Green indicating that the host drive is successfully communicating to the IO210BC using the links that were created in Program 1.

Use the Watch Window in PowerTools Studio software to check the status of the Status Word, Input 0 and Output 0.

To use the Watch Window, you must be connected (online) with the PTi210 module. To go online, click on “Device→Reconnect” as shown in Figure 3.

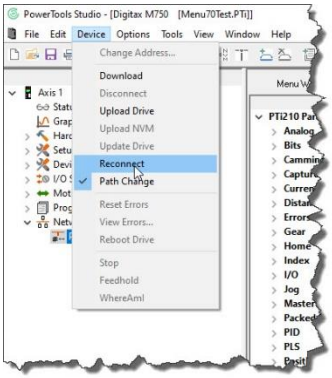


Figure 3

Once connected, open the Watch Window by clicking on its icon from the PowerTools Studio toolbar as shown in Figure 4.

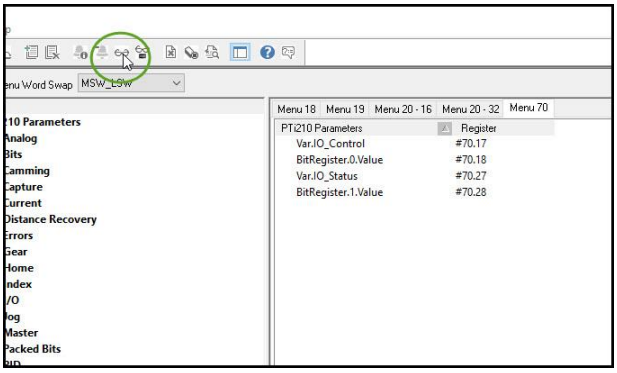


Figure 4

Build a new Watch Window by dragging and dropping the variables shown in Figure 5. The variables labelled “Bit.In0” and “Bit.Out_0” are the names chosen for Digital Input 0 and Digital Output 0 in Part 2, steps 11 – 12.

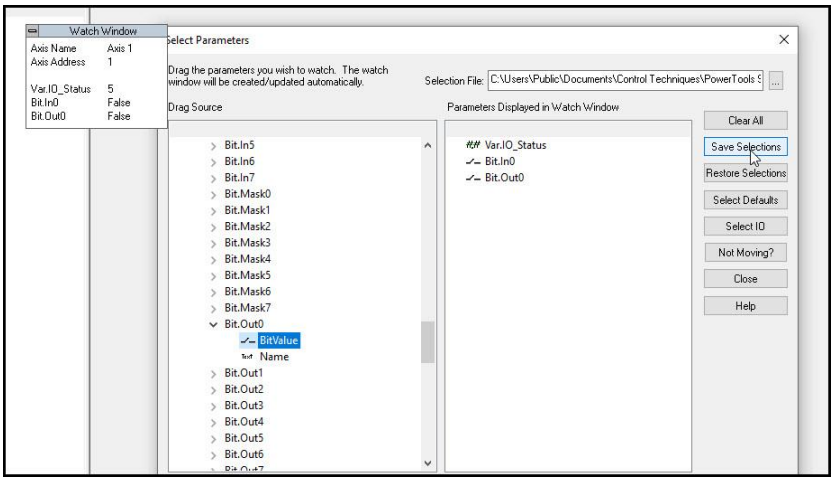


Figure 5

You may use the controls within the Watch Window editor to force variable values. For example, select the variable “Bit.Out0” from the list. To force it on, click on the checkbox that is shown in Figure 6, then click “Write”. The same method may be used to write a “1” to reset the IO210BC coupler by using the Control Word variable.

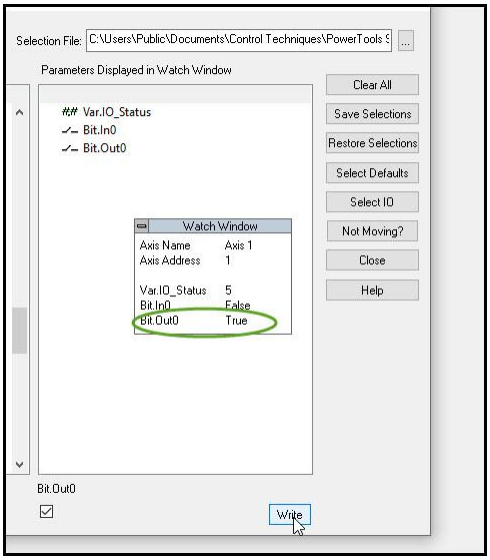


Figure 6

Once you are satisfied with the configuration of the Watch Window, click “Save Selections” and then “Close” as shown in Figure 7.

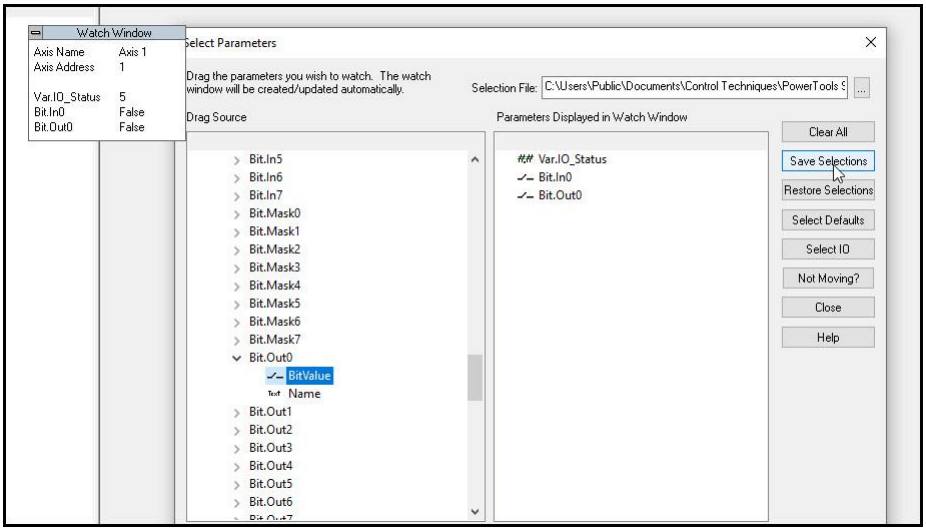


Figure 7

If you download new program code into the PTi210 module, you will lose access to the IO210BC. The MOD and IOS lights will both turn solid Red. To reset the system:

- Remove power from the Digitax M750
- Remove power from the IO210BC
- Re-apply power to the IO210-BC
    - Check to ensure that the IOS and Active LEDs are solid Green. The Link LED will be off and the MOD LED will be blinking Green.
- Re-apply power to the Digitax M750
    - The Link LED will turn solid Green.
    - The MOD LED will also turn solid Green after approximately 10 seconds
- The IO on the IO210BC will now be available to the PTi210.

Part 3: Using Remote I/O in PowerTools Studio

Now that you have access to the digital inputs and outputs on the coupler, they will be available for use in PowerTools Studio software.

There are 2 ways to access and use the I/O:

- Use the I/O Setup→Assignments tool in PowerTools Studio to assign sources and destinations to the channels.
- Access the channels directly from within a PowerTools Studio program.

Figure 8 shows an example of how to assign the Bit Variable “Bit.In0” to initiate Index #0.

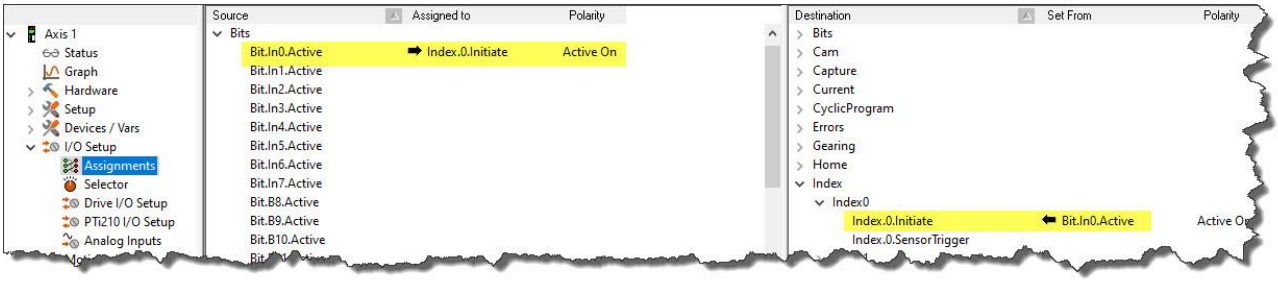


Figure 8

The code in Figure 9 comes from Program 0 that was created for this Application Note and provides an example of how to reference remote I/O points from within a Program.

```
If Var.IO_Status = 5 Then    'Once operational, wait for Channel 0 (In0) to be on
    If Bit.In0 = True Then
        Jog.0.Vel = 500      'Create the Jog profile
        Jog.0.Accel = 500
        Jog.0.Decel = 5000
        Jog.0.PlusInitiate   'Jog0,Vel=100 revs/m
        Bit.Out0 = TRUE      'Turn on Output Ch. 0 (Out0) while Jogging
        Wait For Bit.In0 = False
        Jog.Stop
        Bit.Out0 = FALSE
    Endif
```

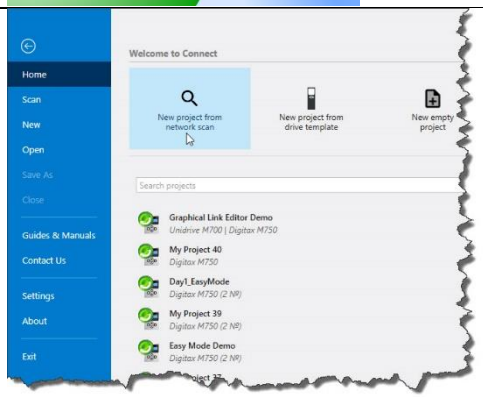
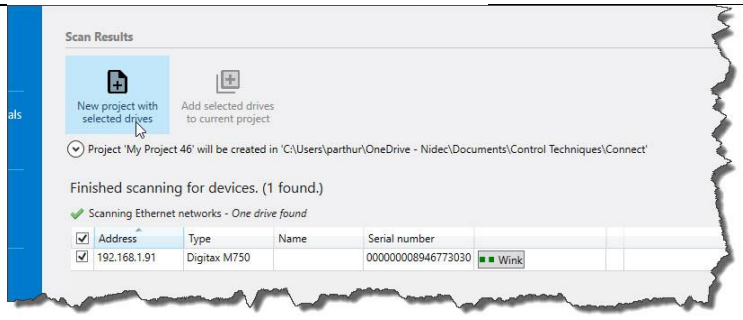
Figure 9

Addendum 1

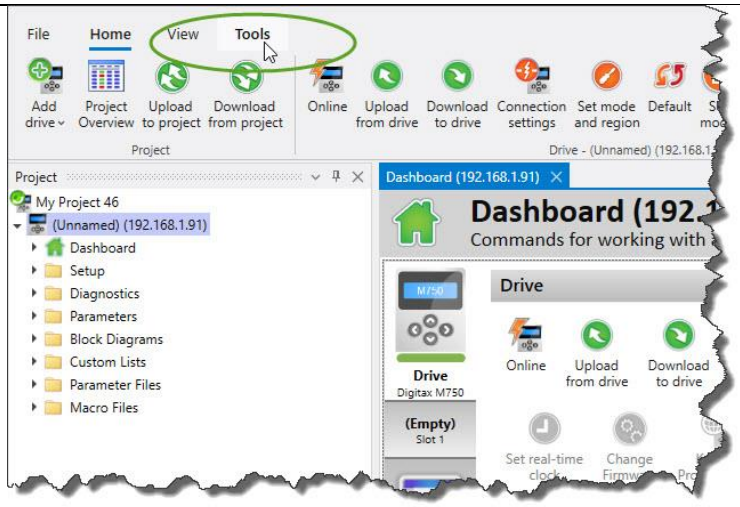
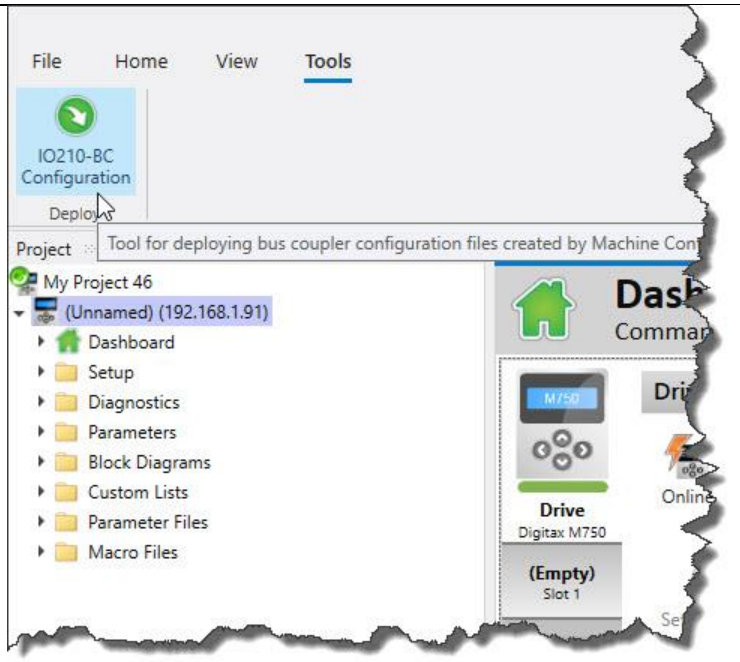
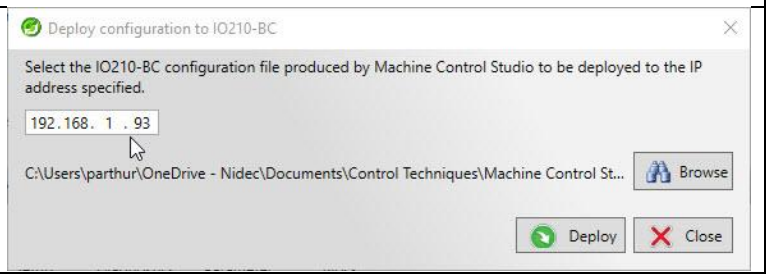
In the event that an IO210-BC Remote I/O coupler becomes damaged and needs to be replaced, you can use our Connect drive commissioning software to download the link configuration file (the .sml file) that was created using Machine Control Studio software during Part 1 of this Application Note.

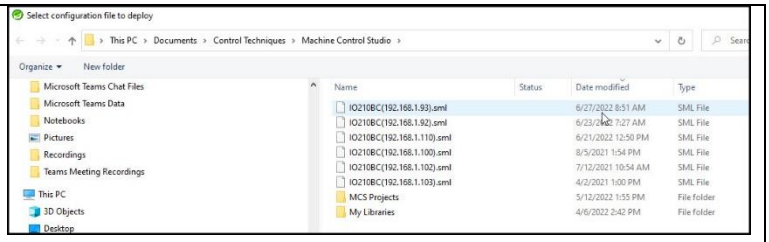
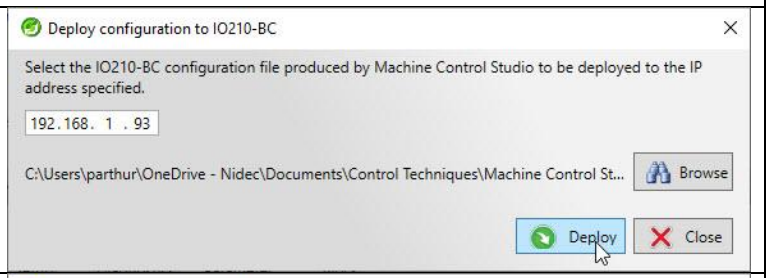
Before beginning this procedure, you must first assign a static IP Address to your computer's network card. The subnetwork *MUST be assigned as 192.168.1.*x where the x can be any value between 0 and 255 that is not already in use on the network.

After assigning a static IP Address to your computer, follow the steps below.

Step	Instruction	Notes
1	Open Connect software	
2	Create a new project for the host drive by selecting "New project from network scan" as shown here.	
3	Once the drive has been located, click on "New project with selected drives"	

CONTROL TECHNIQUES

4	Click on “Tools” from the Connect ribbon.	
5	Click on “IO210-BC configuration.	
6	In the screen that appears, begin by ensuring that the IP address matches that of the IO210BC bus coupler.	

7	The .sml file for the coupler is located in the same folder that Machine Control Studio software stores its projects. By default, that is the user/My Documents/Control Techniques/Machine Control Studio folder. Select the file with the .sml extension that has the latest edit date to be sure it is the correct configuration.	
8	Click “Deploy” to download the .sml file to the IO210BC coupler.	
9	If the file deployed correctly, you’ll see a confirmation message indicating such. Click “Close” to exit the deployment tool.