

Application Note



2500 Series® Programmable Automation Control System

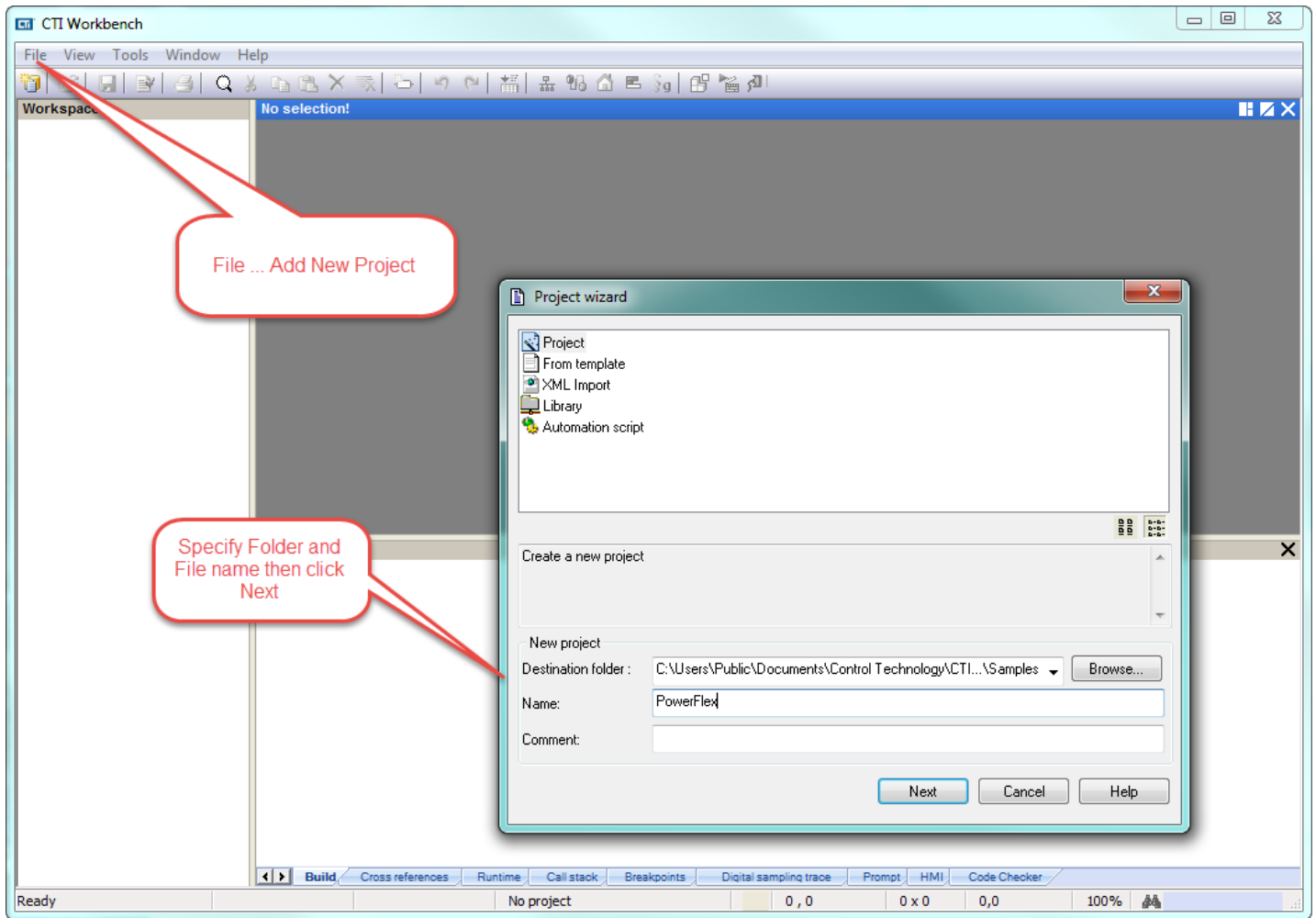
Communicating between 2500 Series® Processors and PowerFlex 525 Drives using Ethernet/IP and 2500P-ACP1

The 2500P-ACP1 Application Coprocessor supports Ethernet/IP communications with up to 40 Ethernet/IP devices via I/O Scanner, I/O Adapter, Explicit Message Adapter, and Tag Client interfaces. This Application Note shows how to configure the ACP1 for communications with a Rockwell PowerFlex 525 drive using Workbench.

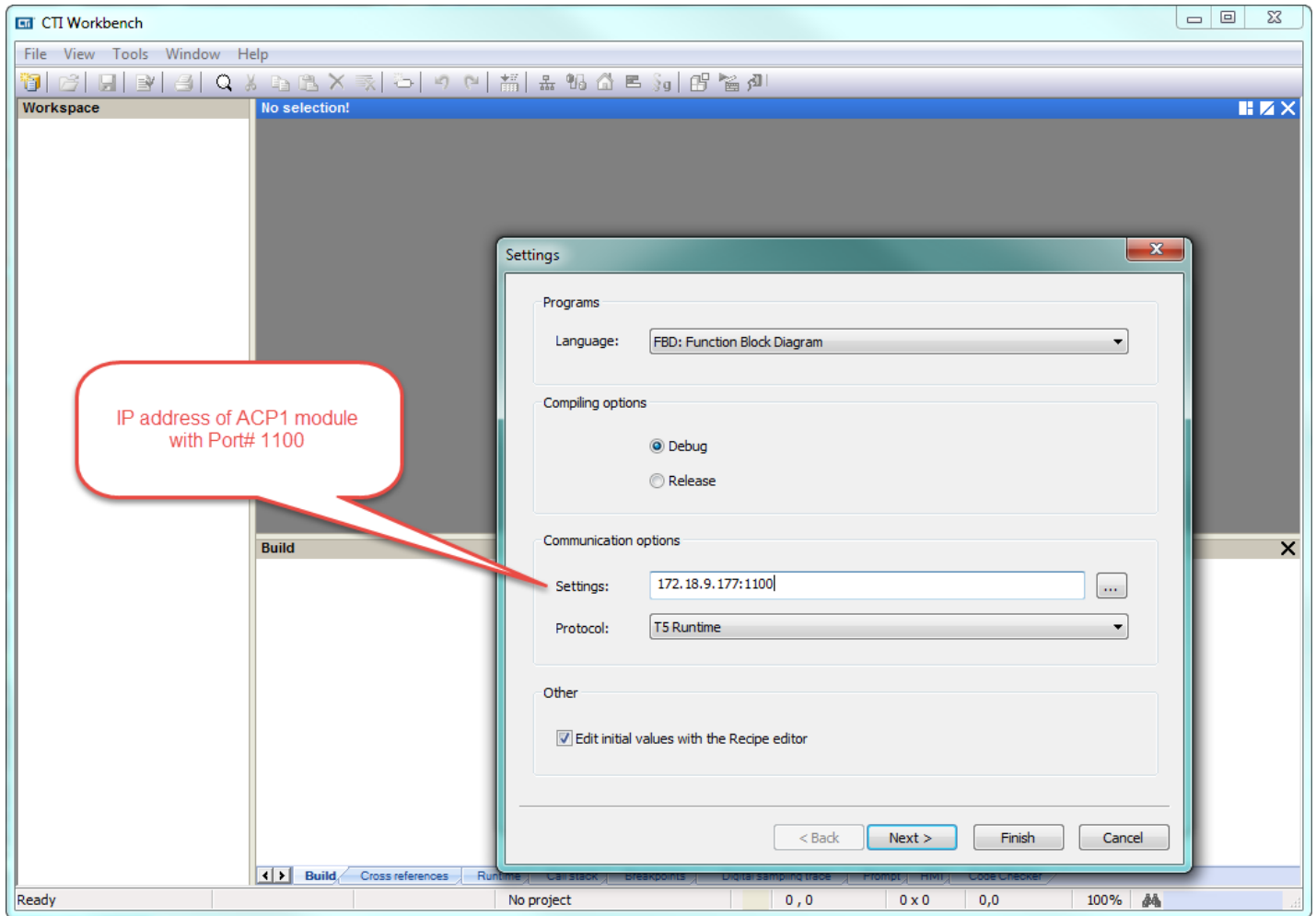
IMPORTANT NOTE: Configuring Ethernet/IP communications requires 2500P-ACP1 Firmware V3.03 or above, and Workbench V1.3 or above.



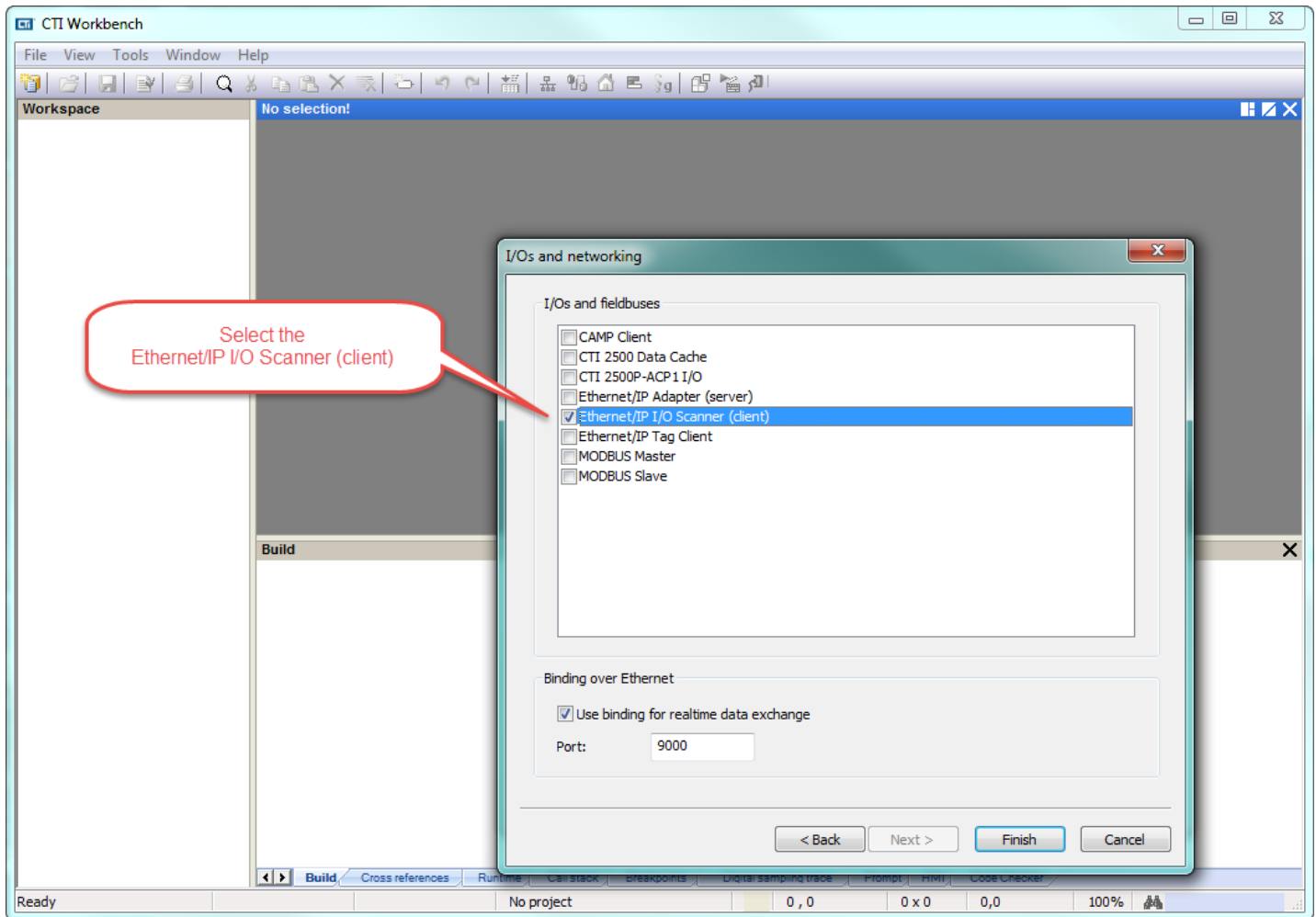
Step 1: Open a Project.



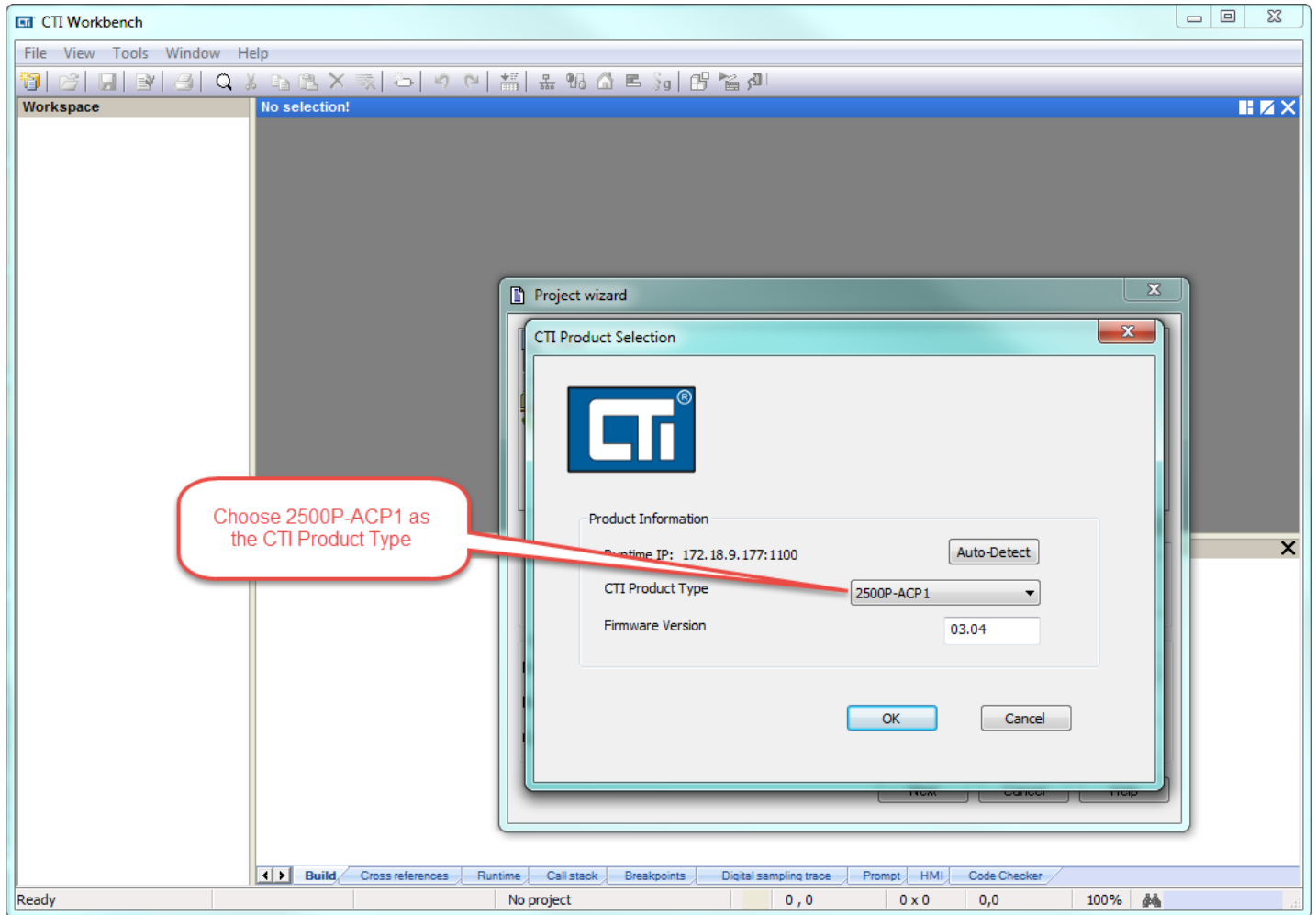
Step 2: Specify Target's (ACP1 module) IP address. **Language** specifies the start-up mode and can be changed later. **T5 Runtime** is the protocol native to Workbench and the ACP1 module (and the Zenon HMI software as well). Port# 1100 is the defined port for interface between Workbench and the ACP1 module. Then click **Next**.



Step 3: The ACP1 is the Scanner and the PowerFlex drive is the Adapter, so select **Ethernet/IP I/O Scanner (client)**. We are not using **Binding over Ethernet** but this can remain checked with the default Port# of 9000. (This is used for communications between ACP1 and similar devices using the Data Exchange protocol.) Then click **Finish**.



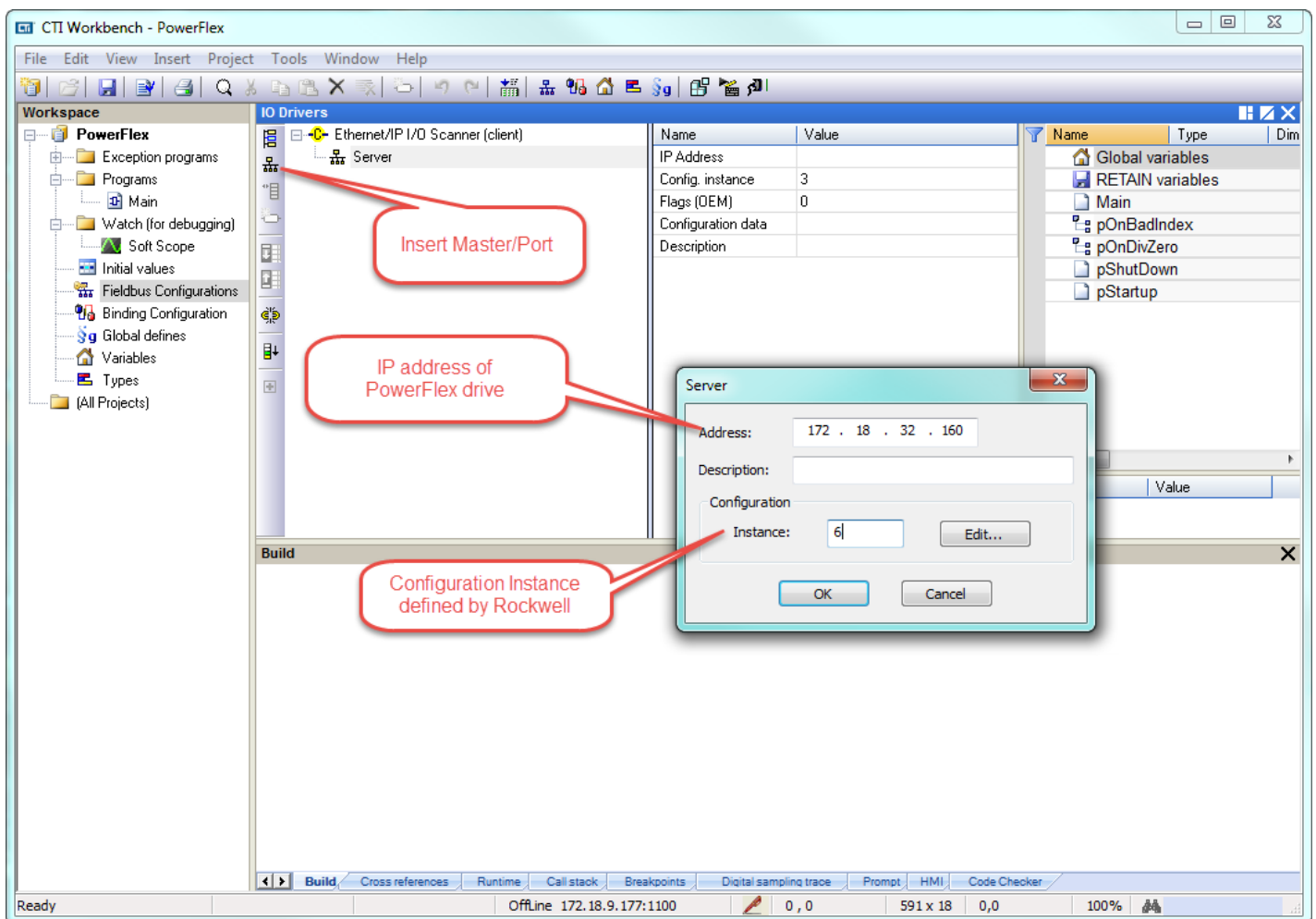
Step 4: If you are connected over the network, choosing **Auto-Detect** will connect to the specified IP address and return the **Firmware Version** of the ACP1 module. Choose 2500P-ACP1 as the **CTI Product Type** and then click **OK**.



Step 6: Click on the **Insert Master/Port** symbol, then type in the **Address** of the PowerFlex drive in the Server pop-up box. Add optional **Description**. The **Configuration Instance** is defined by Rockwell as “6” (ref. “PowerFlex 525 Embedded EtherNet/IP Adapter” User Manual, page 56). Then click **OK**.

Box	Assembly Instance	Size
Input	1 (This value is required.)	The value will vary based on the total number of [EN Data Out x] parameters used for your application, either in Single-drive mode (see details below) or Multi-drive mode (see Using Multi-Drive Mode on page 83).
Output	2 (This value is required.)	The value will vary based on the total number of [EN Data In x] parameters used for your application, either in Single-drive mode (see details below) or Multi-drive mode (see Using Multi-Drive Mode on page 83).
Configuration	6 (This value is required.)	0 (This value is required.)

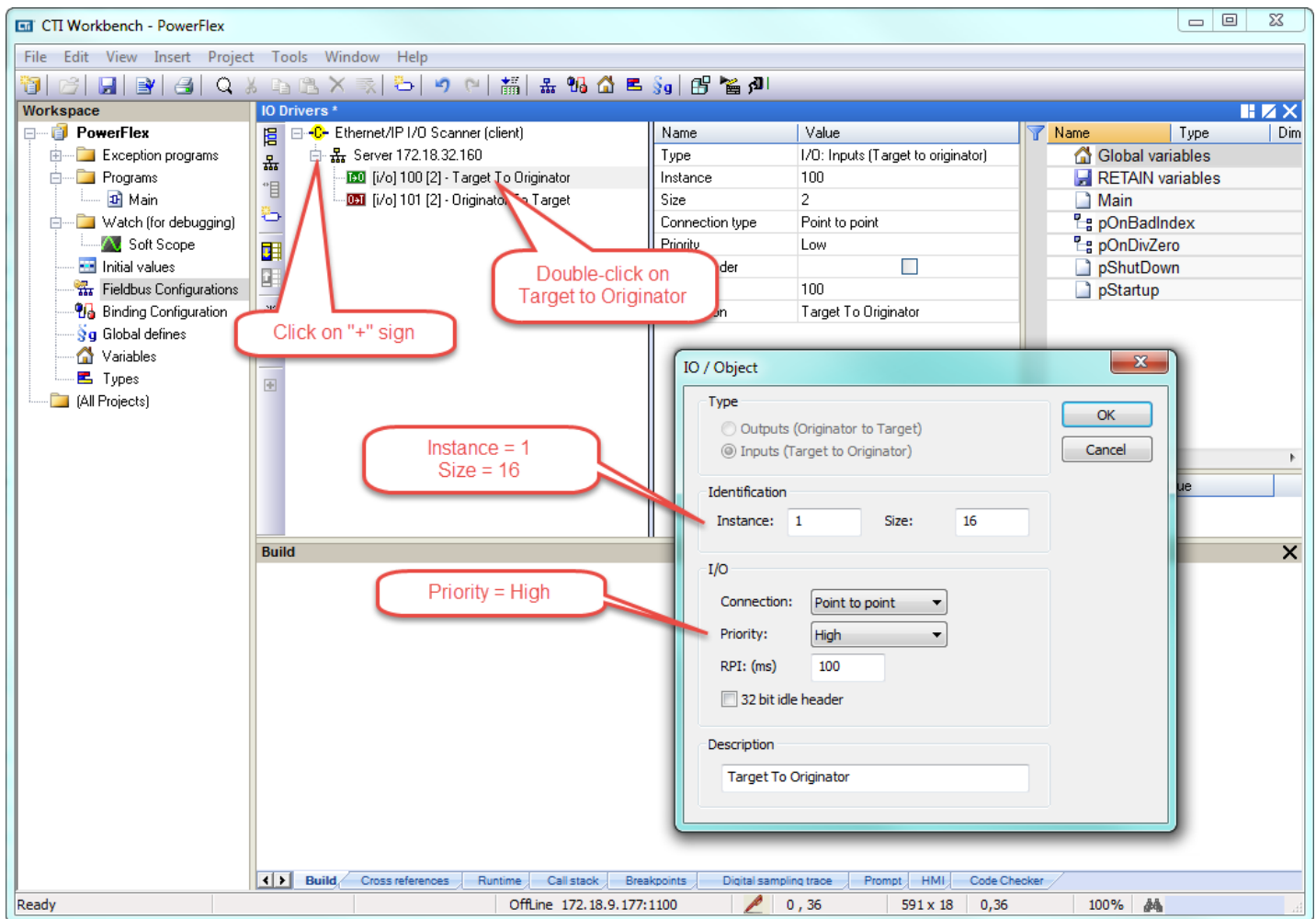
Enter the number of 16-bit words that are required for your I/O in the Input Size and Output Size boxes. Since the adapter always uses the 16-bit Logic Status, 16-bit Feedback, and two 16-bit words dedicated for memory allocation of the Generic Ethernet module profile, at least four 16-bit words must be set for the Input Size. The adapter also uses the 16-bit Logic Command and 16-bit Reference, requiring at least two 16-bit words for the Output Size. If any or all of the drive’s eight 16-bit Datalinks are used (see [Configuring a Master-Slave Hierarchy on page 31](#)), the Input and Output Size settings must be increased accordingly.



Step 7: Expand the **Server** and double-click the **Target to Originator** (Input). In the **IO/Object** pop-up box, change the **Instance** to "1" (refer to table in previous Step) and the **Size** (in bytes) to "16". Referring to the table below (page 62), we are using the Generic Profile for the Input which has up to 8 Integers. Change the **Priority** to "High" and leave the **32 bit idle header** unchecked. Then click **OK**.

**I/O Image for PowerFlex 525 Drives
(16-bit Logic Command/Status, Reference/Feedback, and Datalinks)**

INT	Output	Input Using...			
		INT	Drive Add-On Profile	INT	Generic Profile
0	Logic Command	0	Logic Status	0	Padword
1	Reference	1	Feedback	1	Padword
2	Datalink 1	2	Datalink 1	2	Logic Status
3	Datalink 2	3	Datalink 2	3	Feedback
4	Datalink 3	4	Datalink 3	4	Datalink 1
5	Datalink 4	5	Datalink 4	5	Datalink 2
		6		6	Datalink 3
		7		7	Datalink 4



Step 8: Double-click the **Originator to Target** for the Output definition. The 32 bit header is assumed here and therefore the **32 bit idle header** box is checked. The **Instance** and **Size** are similarly derived from the table referenced in the previous Steps. Once again, click **OK**.

The screenshot displays the CTI Workbench - PowerFlex interface. The **IO Drivers** window shows a table of configurations:

Name	Value
Type	I/O: Outputs (Originator to target)
Instance	101
Size	2
Connection type	Point to point
Priority	Low
32 bit header	<input checked="" type="checkbox"/>
RPI (ms)	100
Description	Originator To Target

The **IO / Object** dialog box is open, showing the following configuration:

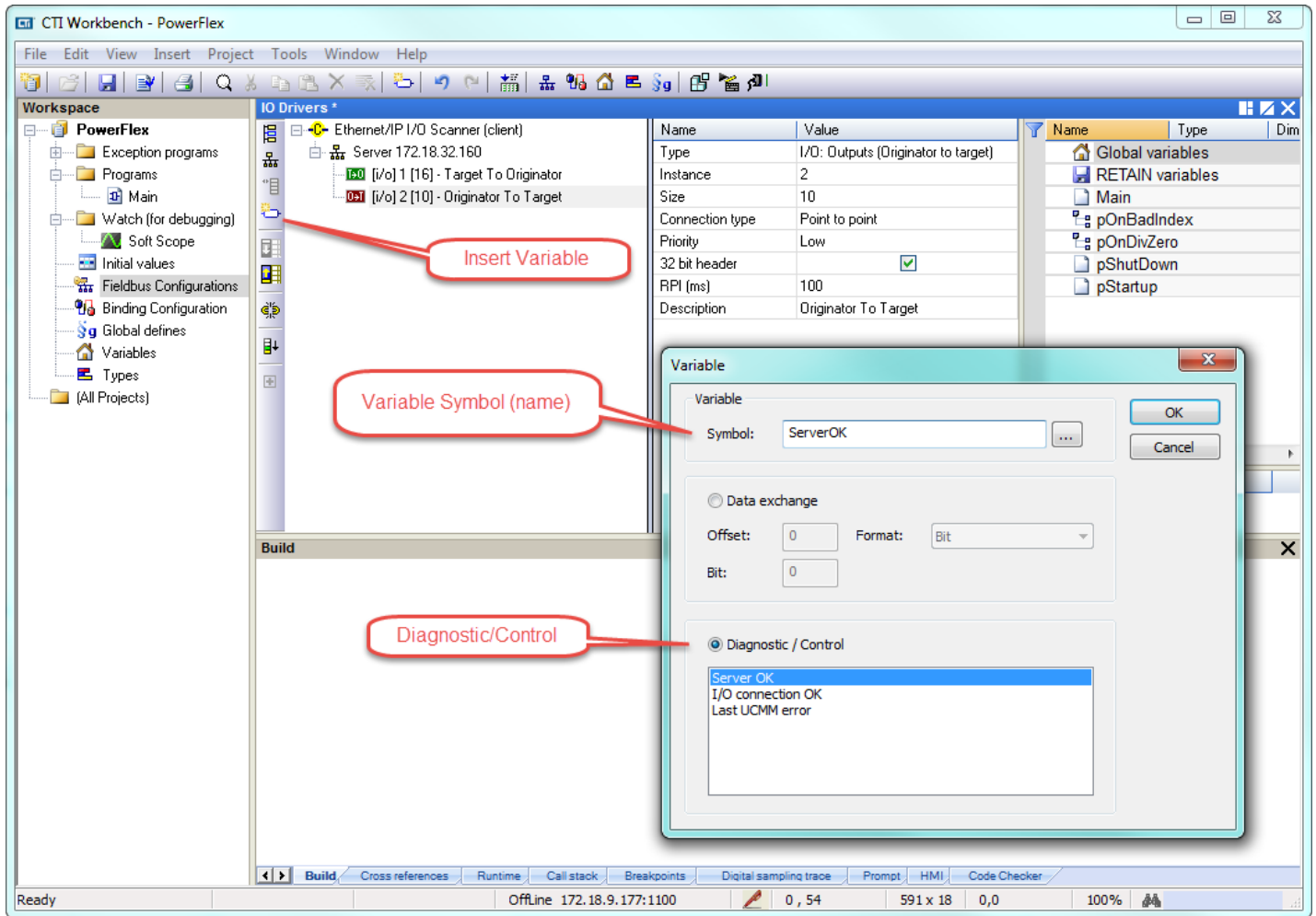
- Type: Outputs (Originator to Target)
- Identification: Instance: 2, Size: 10
- I/O: Connection: Point to point, Priority: High, RPI (ms): 100, 32 bit idle header
- Description: Originator To Target

Red callout boxes highlight the following actions and values:

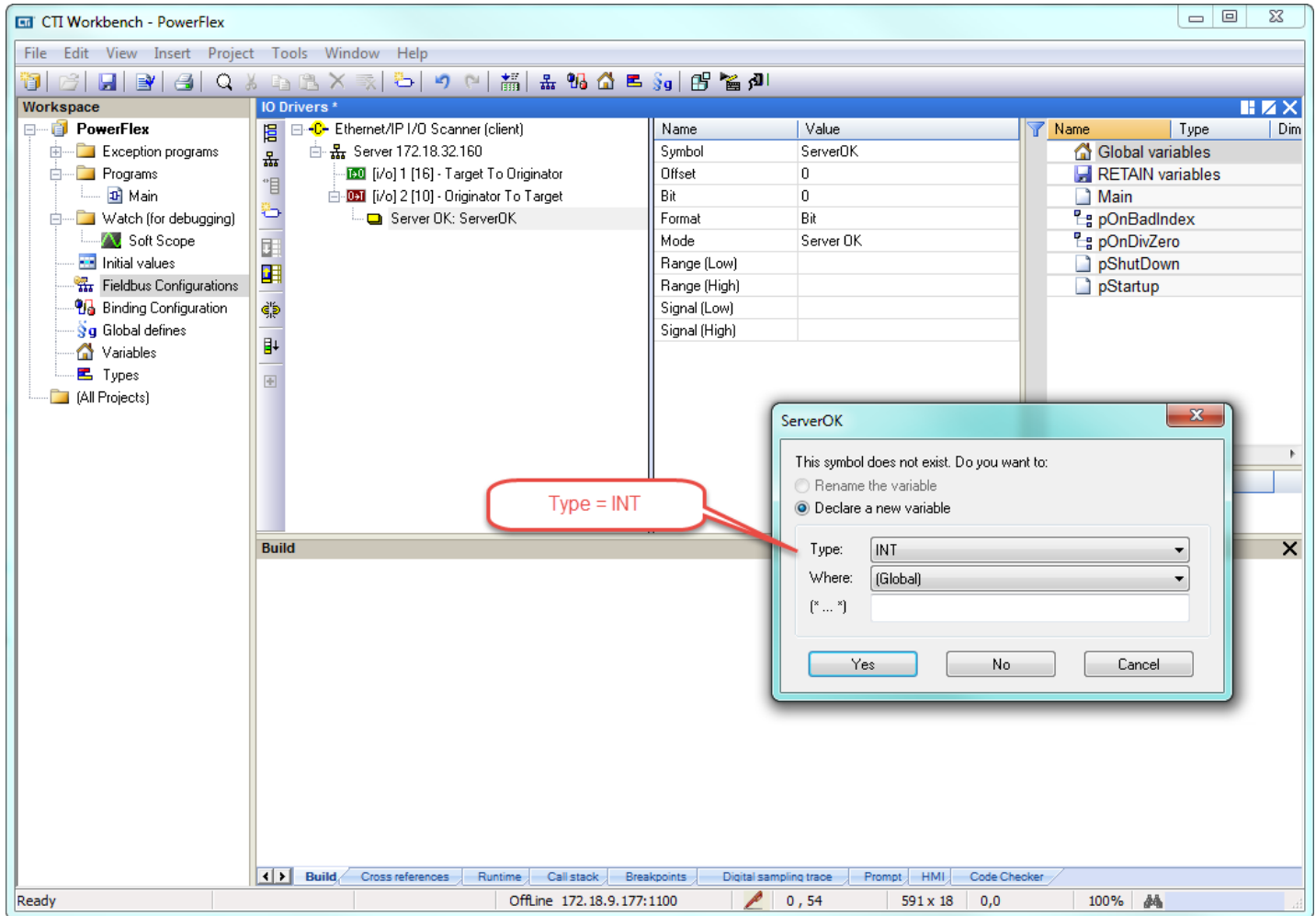
- "Double-click Originator To Target" points to the selected entry in the IO Drivers table.
- "Instance = 2 Size = 10" points to the Instance and Size fields in the IO / Object dialog.
- "Priority = High" points to the Priority dropdown menu in the IO / Object dialog.



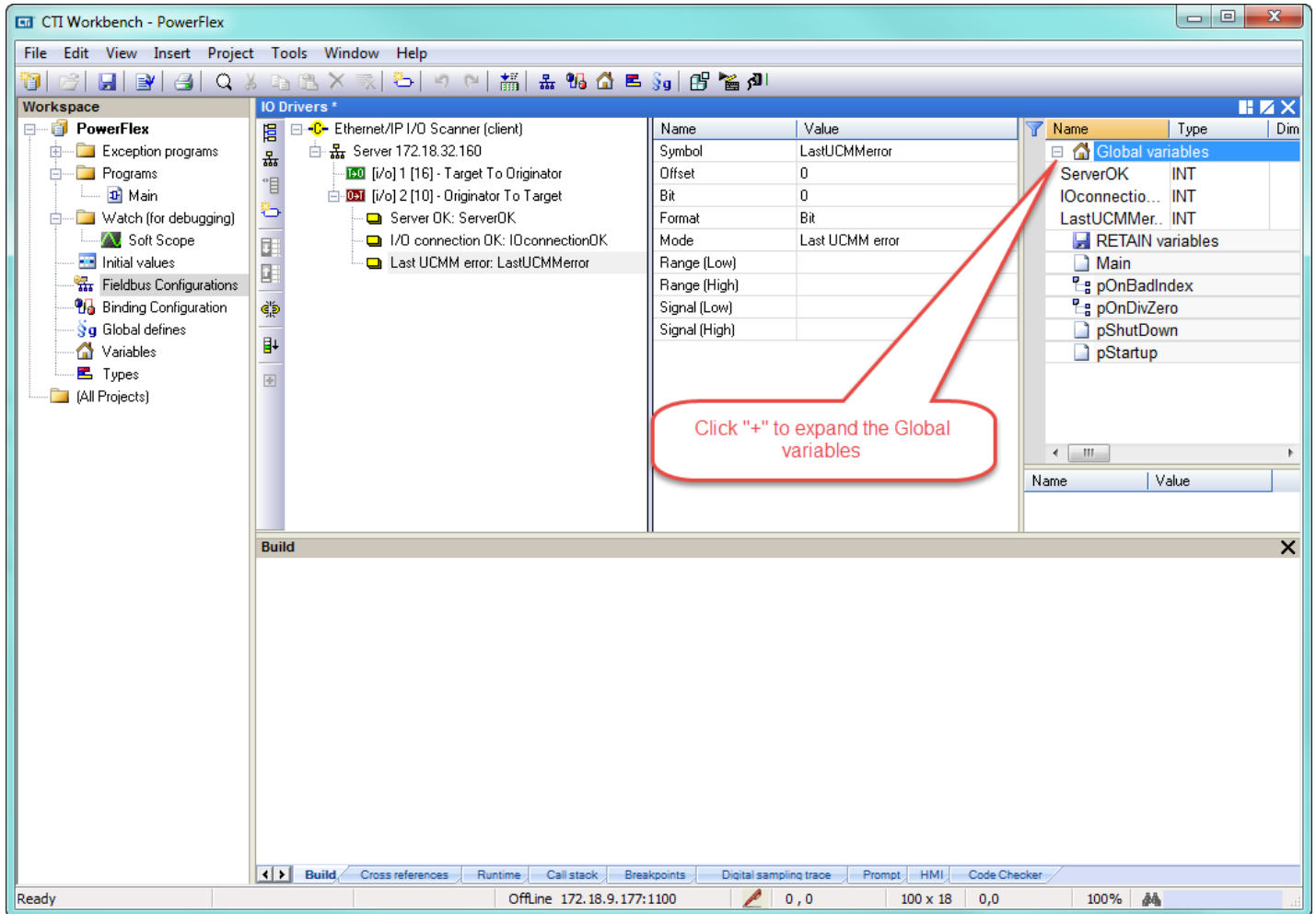
Step 9: There are three system variables we want to add; it does not matter if they are listed under **Target to Originator** or **Originator to Target**. Select **Insert Variable** and then the **Diagnostic/Control** button. Select one of the variables and type a name in the **Symbol** box. No spaces or punctuation allowed. Then select **OK**.



Step 10: A pop-up box appears with options to declare this new variable. Select **INT** in the **Type** drop down menu and leave the **Where** specified as **Global**. Then select **Yes**.



Step 11: Repeat the process for the other two system variables. These definitions will now appear in the **Global variables** window. (UCMM stands for Unconnected Message Manager)



Step 12: Now we can add the other variables for the PowerFlex drive. Referring to the chart in Step 7, add Logic Command (no spaces) as shown below. The **Originator to Target** section is highlighted so this variable will be added as an Output. It is the first variable in the table so it's **Offset** is zero. Change **Format** to **16 bit – signed** then click **OK**.

The screenshot shows the CTI Workbench - PowerFlex interface. The main window displays the IO Drivers configuration for an Ethernet/IP I/O Scanner (client). The IO Drivers table is as follows:

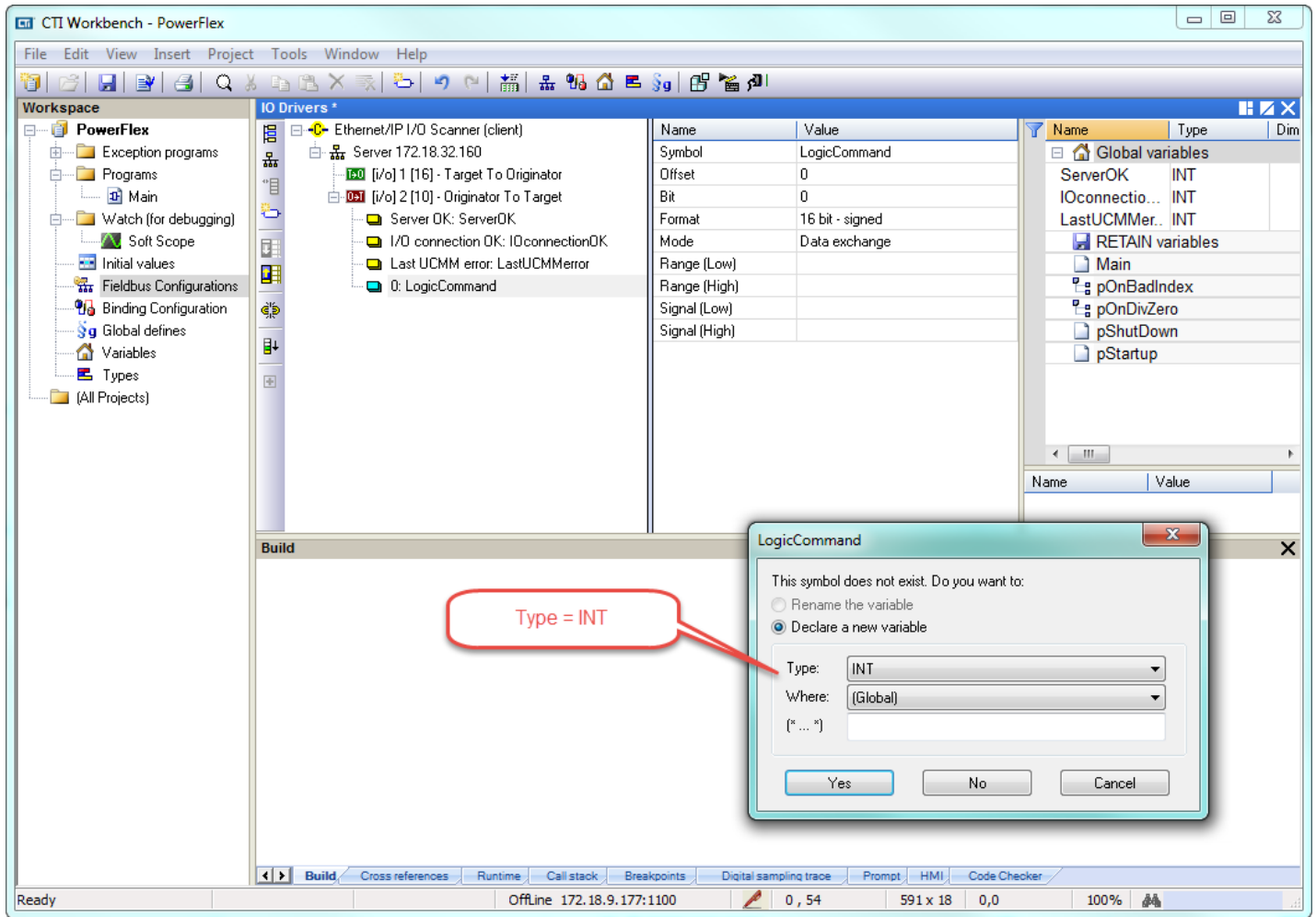
Name	Value
Type	I/O: Outputs (Originator to target)
Instance	2
Size	10
Connection type	Point to point
Priority	Low
32 bit header	<input checked="" type="checkbox"/>
RPI (ms)	100
Description	Originator To Target

The Variable dialog box is open, showing the following configuration:

- Variable: LogicCommand
- Symbol: LogicCommand
- Data exchange: Data exchange, Diagnostic / Control
- Offset: 0
- Format: 16 bit - signed
- Bit: 0

Red callouts highlight the 'Originator to Target' section in the IO Drivers table and the 'Symbol = LogicCommand', 'Offset = 0', and 'Format = 16-bit signed' settings in the Variable dialog box.

Step 13: Since this is a new variable, a pop-up appears. Change the **Type** to **INT** then click **Yes**.



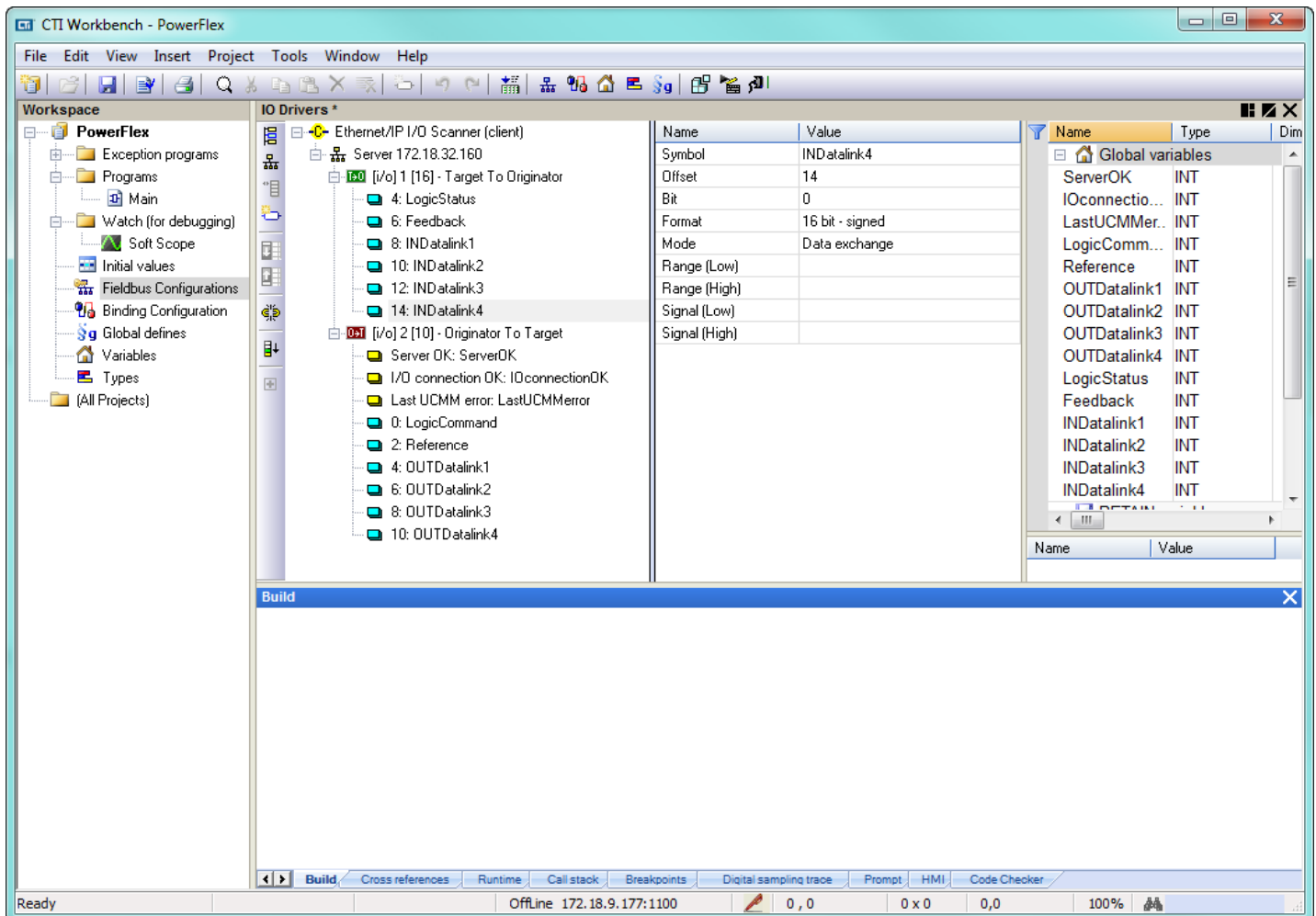
Step 14: Repeat Steps 12 & 13 for the other Output variables from the table in Step 7 with their respective **Offset** (in bytes):

Reference	2
OUTDatalink1	4
OUTDatalink2	6
OUTDatalink3	8
OUTDatalink4	10

Highlight the **Target to Originator** to add the Input variables. We are using the Generic Profile (third column) so must take account of the Padwords in the **Offset**:

LogicStatus	4
Feedback	6
INDatalink1	8
INDatalink2	10
INDatalink3	12
INDatalink4	14

The **Server** and **Global variables** should appear as in the picture below when finished.



Step 15: Compile the program (**Build Startup Project**) ... but have a Compile error due to incorrect Size in the Output definition. Change this to "12". Also notice that Priority set to Low so change to "High". Recompile with no errors.

The screenshot shows the CTI Workbench - PowerFlex interface. The main window displays the IO Drivers configuration for an Ethernet/IP I/O Scanner (client). The IO Drivers list includes:

- 8: INDataLink1
- 10: INDataLink2
- 12: INDataLink3
- 14: INDataLink4
- [i/o] 2 [10] - Originator To Target
- Server OK: ServerOK
- I/O connection OK: IOconnectionOK
- Last UCMM error: LastUCMMerror
- 0: LogicCommand
- 2: Reference
- 4: OUTDataLink1
- 6: OUTDataLink2
- 8: OUTDataLink3
- 10: OUTDataLink4

The Properties window for the selected driver shows the following configuration:

Name	Value
Type	I/O: Outputs (Originator to target)
Instance	2
Size	10
Connection type	Point to point
Priority	Low
32 bit header	<input checked="" type="checkbox"/>
RPI (ms)	100
Description	Originator to Target

The Build window shows the following error message:

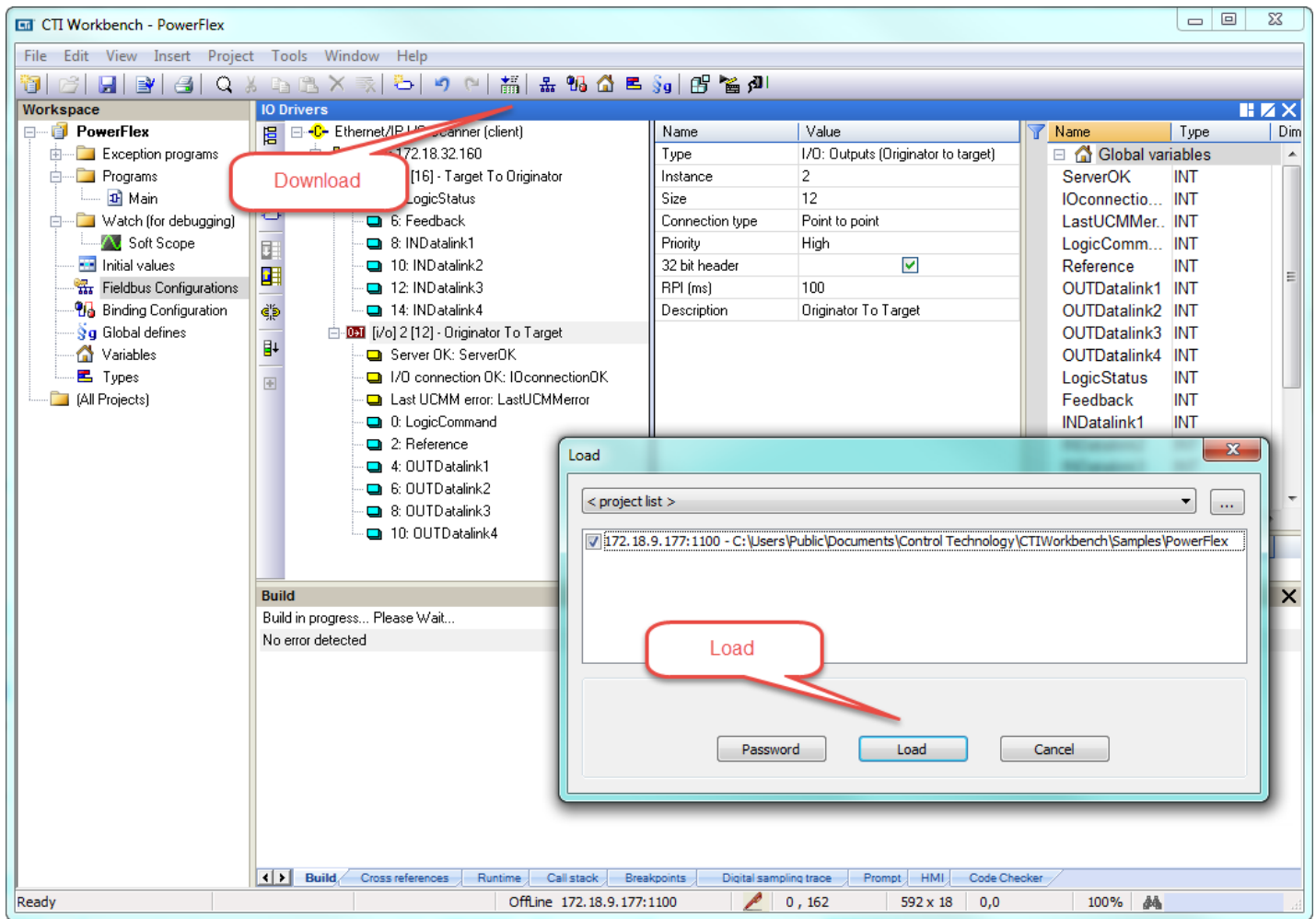
```
Build
pOnBadIndex
pOnDivZero
pShutDown
pStartup
Building application data...
Compiled for DEM specific runtime CTI_
< 1 BOOL/SINT; 15 INT; 1 DINT/REAL; 0 LINT/LREAL; 0 TIME; 2 STRING; ...CBC = c1649851 >
On Line Change is disabled
[EIPC]: (19): Invalid offset
< 15 I/Os >
Error(s) detected
```

Red callouts highlight the following changes:

- Build Startup Project**: Points to the Build button in the top toolbar.
- Priority = High**: Points to the Priority property in the Properties window, which is currently set to Low.
- Change to "12"**: Points to the Size property in the Properties window, which is currently set to 10.
- Compile error due to incorrect Output Size**: Points to the error message in the Build window: "[EIPC]: (19): Invalid offset".



Step 16: **Download** the project to the ACP1.



Step 17: Go **On Line** with the PowerFlex drive. Notice **Server OK** and **I/O connection OK** variables are both "1" and **Last UCM error** is "0".

The screenshot shows the CTI Workbench - PowerFlex interface. The main workspace displays the 'Ethernet/IP I/O Scanner (client)' configuration for 'Server 172.18.32.160'. The 'I/O Drivers' section is expanded to show 'I/O 2 [12] - Originator To Target' with a status of 'On Line' (indicated by a red 'On Line' callout box). The 'Server OK: ServerOK = 1' and 'I/O connection OK: IOconnectionOK = 1' variables are highlighted. The 'Last UCM error: LastUCMError = 0' is also visible. The 'Runtime' window shows a list of events, including 'Project in Memory: PowerFlex [V2]' and 'Mode Change: STOP to PAUSE [I/O running, application stopped]'. The 'Global variables' window shows the following values:

Name	Value	Type
ServerOK	1	INT
IOconnectio...	1	INT
LastUCMMer..	0	INT
LogicComm...	0	INT
Reference	0	INT
OUTDataLink1	0	INT
OUTDataLink2	0	INT
OUTDataLink3	0	INT
OUTDataLink4	0	INT
LogicStatus	1676	INT
Feedback	0	INT
INDatalink1	0	INT
INDatalink2	14	INT
INDatalink3	59	INT
INDatalink4	0	INT

The 'Runtime' window shows the following events:

#	Time	Project Name	Event description
1	1970/01/01 22:13:27.294	TEST3	Project in Memory: test3 [V7] Compiled: Wed Nov 25, 2015 17:12
1	1970/01/01 22:18:59.293	POWERFLEX	Project in Memory: PowerFlex [V2] Compiled: Wed Nov 25, 2015
2	1970/01/01 22:20:11.462	POWERFLEX	Mode Change: PAUSE to STDP [I/O stopped, application stoppe
3	1970/01/01 22:20:14.783	POWERFLEX	Project in Memory: PowerFlex [V2] Compiled: Wed Nov 25, 2015
1	1970/01/01 22:20:27.036	POWERFLEX	Program "PowerFlex [V2]" loaded successfully! [POWERFLEX]
2	1970/01/01 22:20:27.037	POWERFLEX	Managed shutdown initialized. [POWERFLEX]
3	1970/01/01 22:20:27.054	POWERFLEX	Driver T5EIPC: Ethernet/IP Scanner V9.0.0 [POWERFLEX]
4	1970/01/01 22:20:27.653	POWERFLEX	Mode Change: STOP to PAUSE [I/O running, application stoppe
5	1970/01/01 22:20:27.914	POWERFLEX	Project in Memory: PowerFlex [V2] Compiled: Wed Nov 25, 2015

The status bar at the bottom shows 'Ready' and 'STOP (172.18.9.177:1100)'.



Type the IP address of the ACP1 module into a browser's URL to connect to the webserver. Select the **Ethernet/IP CIP Statistics** to view the connection status.



2500P-ACP1 IEC-61131 Coprocessor

Wed Nov 25 2015 15:06:33

Ethernet/IP CIP Statistics

- [Main Menu](#)
- [Event Log](#)
- [Product Information](#)
- [Module Configuration](#)
- [Data File Manager](#)
- [Error Descriptions and Status](#)
- [Active Communication Sessions](#)
- [Communication Sessions History](#)
- [TCP/IP Statistics](#)
- [Ethernet Port Statistics](#)
- [CTI 2500 Data Cache Statistics](#)
- [CTI 2500P-ACP1 Normal IO Statistics](#)
- [Ethernet Switch Statistics](#)
- [Ethernet/IP CIP Statistics](#)
- [Display All Statistics](#)
- [Product Support](#)

Clear will reset collected values to zero.

Current Time: Thu Jan 01, 1970 22:24:29.036
 Last Counter Clear: Thu Jan 01, 1970 22:20:27.056

Client Connection Status

Server Address	o2t	t2o	Socket	Port	Process	UCMM	IO	Last UCMM Error
172.018.032.160	2	1	8	58924	IO Exch	Ready	Connected	
			UDP (port 44818)		UDP IO (Port 2222)			
Packets received:			0		2414			
Packets transmitted:			0		2413			
			TCP Servers		TCP Clients			
Packets received:			0		2			
Packets transmitted:			0		2			
Closes on failed receive:			0		0			
Closes on failed send:			0		0			
Connections Active:			0		1			
Successful Connections:			0		1			
Failed Connections:			0		0			

IO Data Receipt Statistics

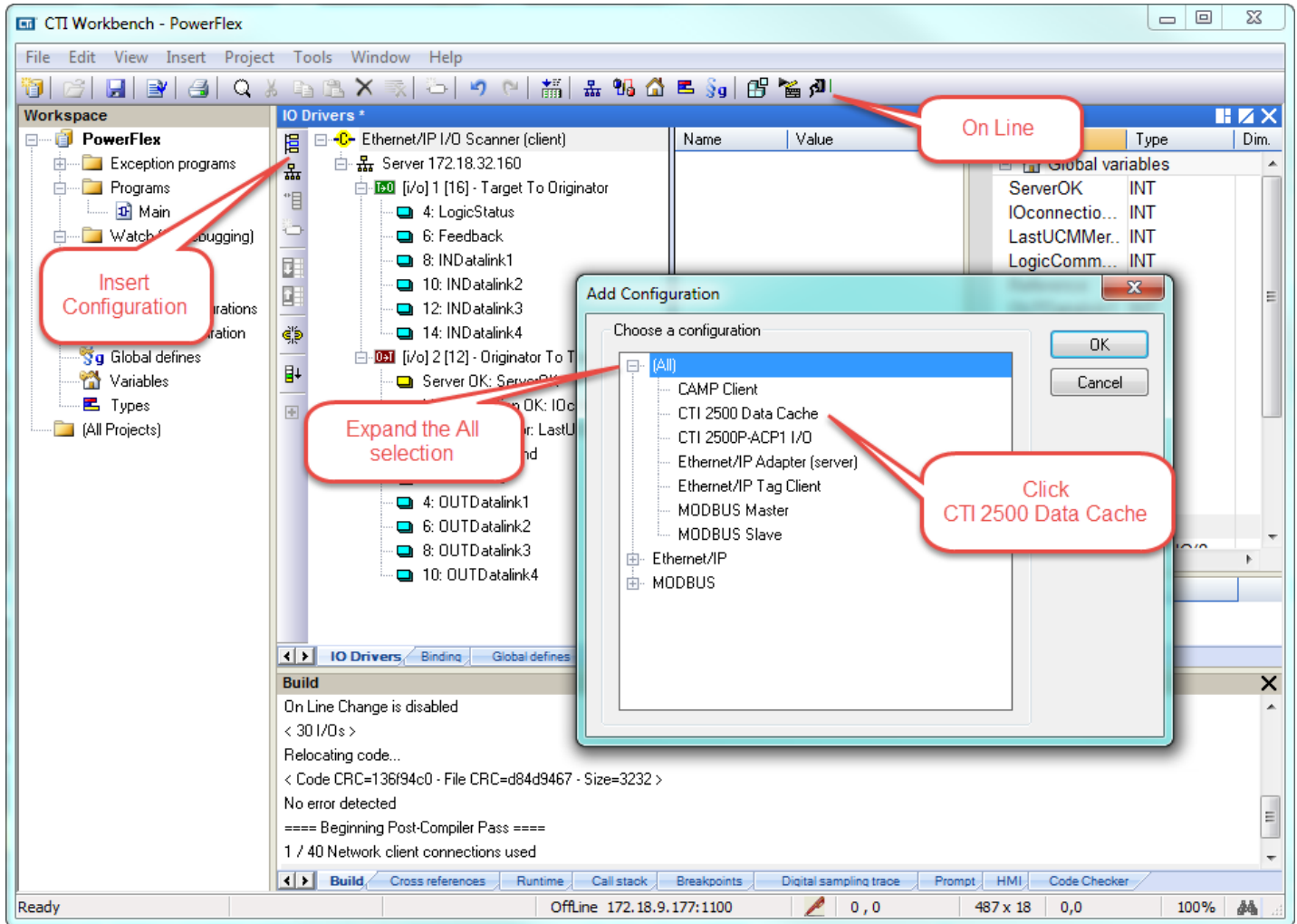
Lost record count: 0
 Max Records/Cycle: 1

No UCMM errors

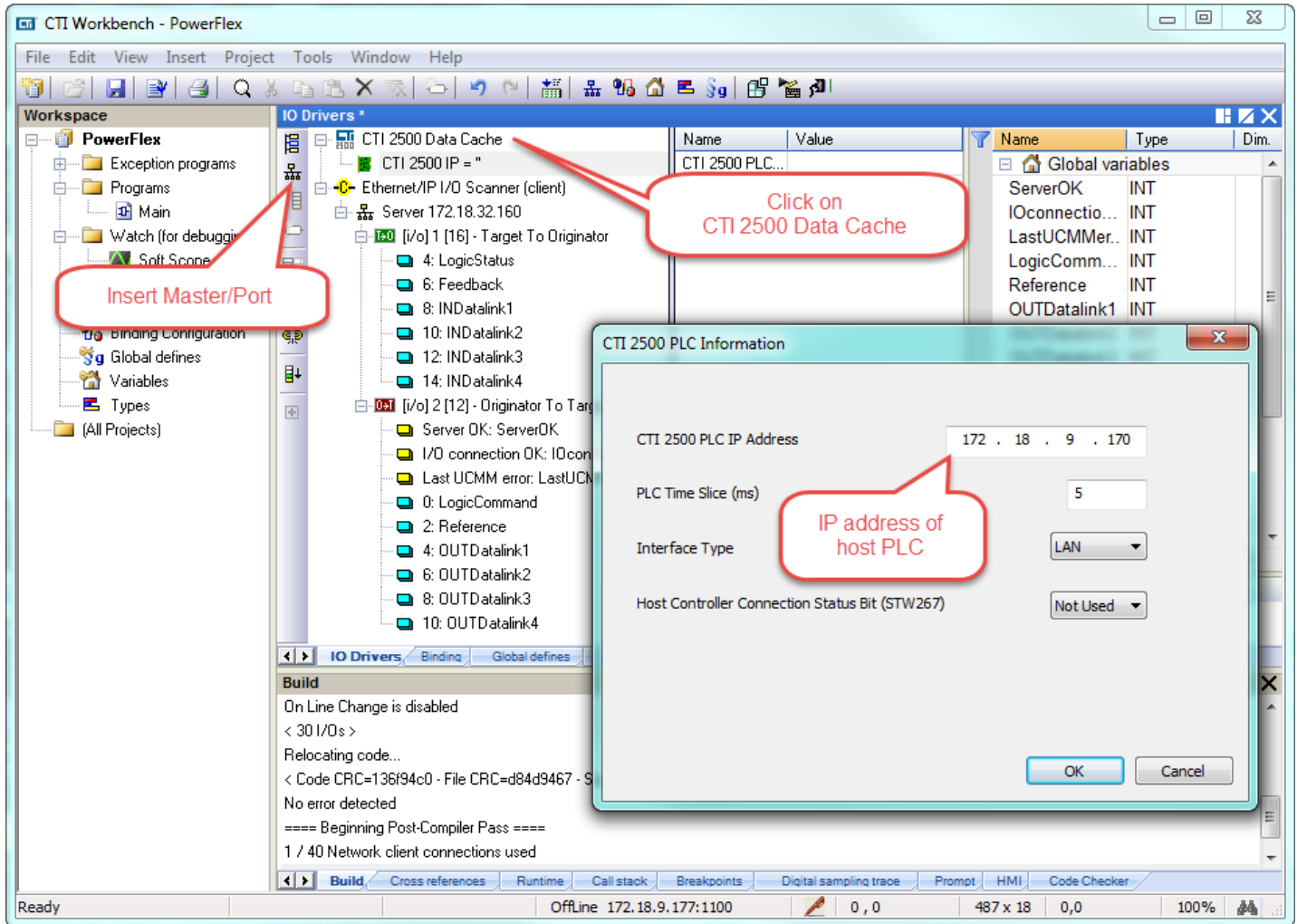
IO Connected



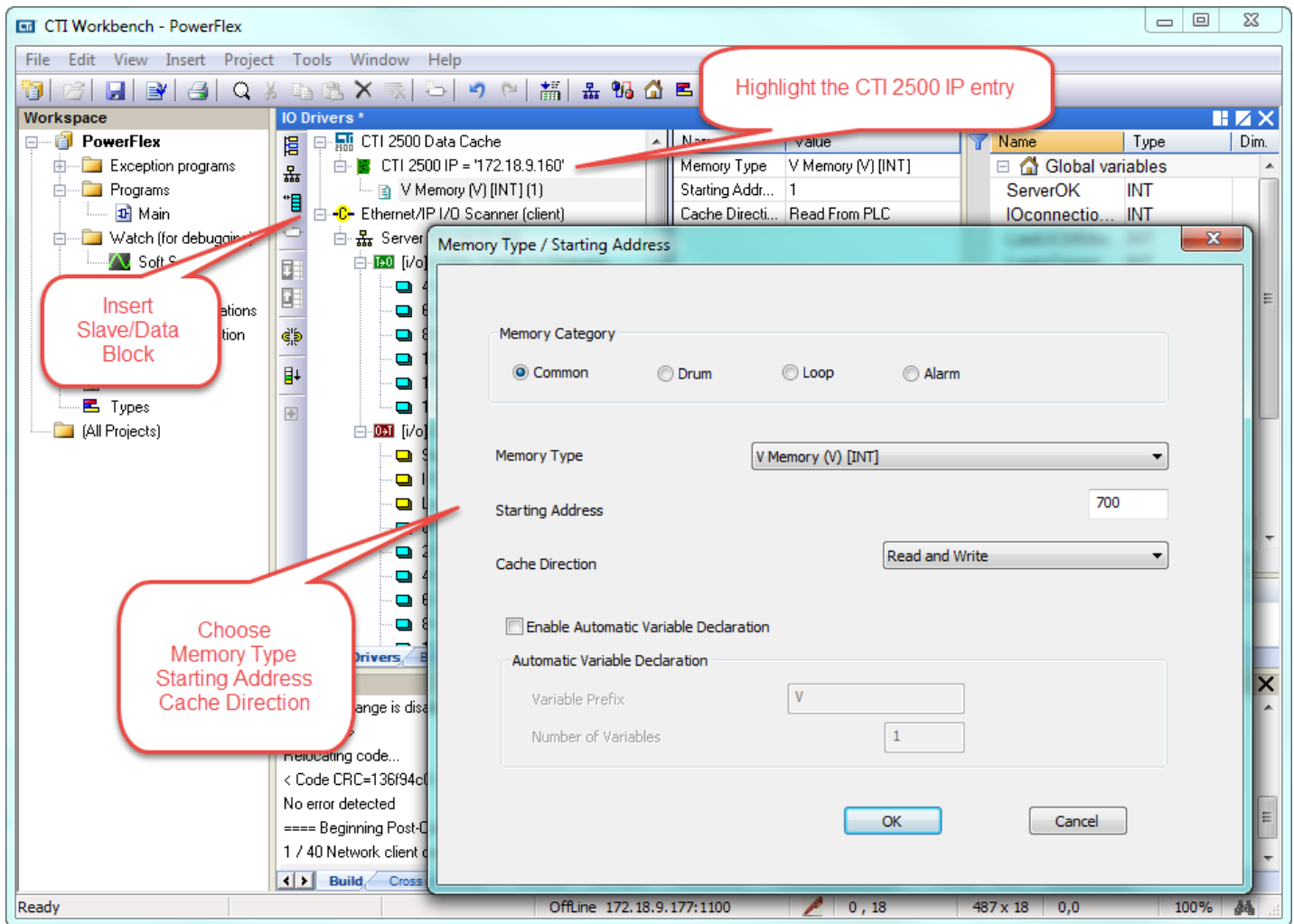
Step 18: The last task is to associate the variables defined in ACP1 to memory locations in the PLC. Click the **On Line** button to take the ACP1 off line, then in the IO Drivers window, click **Insert Configuration**, choose the **CTI 2500 Data Cache** option and click **OK**.



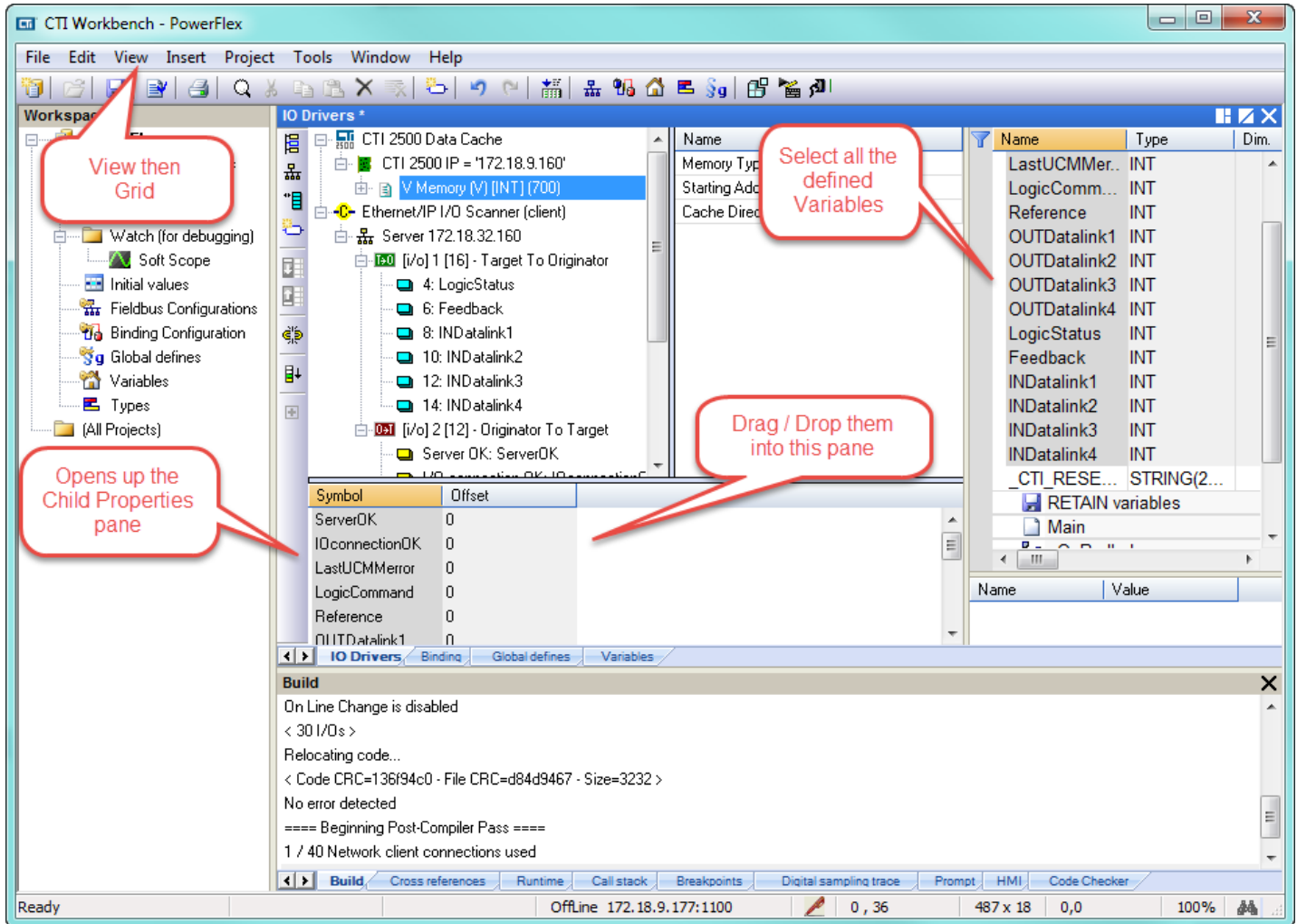
Step 19: Highlight the **CTI 2500 Data Cache** entry, then **Insert Master/Port**. In the pop-up window, enter the IP address of the Host PLC. Then click **OK**.



Step 20: Click on the **CTI 2500 IP = "xxx.xxx.xxx.xxx"** entry, then **Insert Slave/Data Block**. Choices for **Memory Type** include V-mem (INT, REAL, DINT), K-mem, X/Y/C, WX/WY, STW, TCP, TCC. **Starting Address** is V700 in this example. **Cache Direction** is either Read From PLC, Write to PLC, or Read and Write. Then click **OK**.



Step 21: If the **Child Properties** pane is not visible, select **View** from the toolbar, then the **Grid** option. Highlight the defined variables (click on first variable, hold down Shift, click on last variable) then drag/drop them into the Child Properties pane.



Step 22: Click on each Symbol (variable), type in the correct Offset, then hit Enter. Offsets increase by "1" since these variables are defined as INT.

The screenshot shows the CTI Workbench - PowerFlex interface. The main window displays the 'IO Drivers' configuration. A table lists symbols and their offsets. A red callout bubble points to the 'Offset' column with the text 'Click on Offset, type in number, then Enter'.

Symbol	Offset
IOconnectionDK	1
LastUCMError	2
LogicCommand	3
Reference	4
OUTDatalink1	5
OUTDatalink2	6
OUTDatalink3	7
OUTDatalink4	8
LogicStatus	9
Feedback	10
INDatalink1	11
INDatalink2	12
INDatalink3	0
INDatalink4	0

Global variables list:

- ServerOK INT
- IOconnectio... INT
- LastUCMMer... INT
- LogicComm... INT
- Reference INT
- OUTDatalink1 INT
- OUTDatalink2 INT
- OUTDatalink3 INT
- OUTDatalink4 INT
- LogicStatus INT
- Feedback INT
- INDatalink1 INT
- INDatalink2 INT
- INDatalink3 INT
- INDatalink4 INT
- _CTI_RESE... STRING(2...
- RETAIN variables

Build output:

```
< Code CRC=afc0fb83 - File CRC=1ccd6a59 - Size=3232 >
No error detected
==== Beginning Post-Compiler Pass ====
1 / 40 Network client connections used
==== Post-Compiler finished with 0 Error(s) and 0 Warning(s) ====
```



Step 23: As before, **Build Startup Project** to compile, then **Stop and download the new version**, and finally **On Line**.

The screenshot shows the CTI Workbench - PowerFlex interface. A dialog box titled "Bad version!" is open, displaying the following information:

Application	Time	CRC
Local application	V7 - 02/12/2015 - 17:19:19	CRC=16#c16d9851
Target application	V6 - 02/12/2015 - 16:25:43	CRC=16#c16d9851

The dialog box has three buttons: "Stop and download the new version", "Do On Line change", and "Do nothing". A red callout box labeled "Download" points to the "Stop and download the new version" button. Another red callout box labeled "On Line" points to the "Do On Line change" button. A third red callout box labeled "Build Startup Project" points to the "Build" button in the bottom toolbar. The background shows the workspace with a project tree on the left, a variable declaration table in the center, and a runtime log at the bottom.

Name	Value	Type
Memory Type	V Memory (V) [IN	
Starting Addr...	700	
Cache Directi...	Read and Write	
Local variables		
1	INT	
LastUCMMe...	0	INT
LogicComm...	0	INT
Reference	0	INT
OUTDatalink1	0	INT
OUTDatalink2	0	INT
OUTDatalink3	0	INT
OUTDatalink4	0	INT
LogicStatus	1676	INT
Feedback	0	INT
INDatalink1	0	INT
INDatalink2	14	INT
INDatalink3	59	INT
INDatalink4	0	INT
_CTI_RESE...	'3235303...	STRI
RETAIN variables		

#	Time	Project Name	Event description
6	1970/01/03 01:35:54.495	POWERFLEX	Mode Change: STOP to PAUSE (I/O runn
7	1970/01/03 01:35:57.534	POWERFLEX	Project in Memory: PowerFlex [V6] Compile
1	1970/01/03 02:29:47.296	POWERFLEX	Project in Memory: PowerFlex [V6] Compile



Open up WorkShop, connect to PLC, build a Data Window, and observe the values from the PowerFlex drive displayed. Tags can be added as desired.

The screenshot shows the 505 WorkShop software interface. The main window is titled "505 WorkShop - 505Program1" and contains a menu bar (File, Edit, View, Data, Diagnostics, PLC Utilities, Options, Window, Help) and a toolbar with various icons. A "DATA1 - 505Program1 (Online)" window is open, displaying a table of PLC tags and their values. The table has four columns: Row, Address, Tag, and Value. The "LogicStatus" tag at row 10 is highlighted with a red border. The status bar at the bottom indicates "Security: Disabled", "Path: 172.18.9.170 demo", "Mode: Online - Run", "Format: U16", and "NUM OVR".

Row	Address	Tag	Value
1	V700	ServerOK	1 U16
2	V701	IOconnectionOK	1 U16
3	V702		0 U16
4	V703		0 U16
5	V704		0 U16
6	V705		0 U16
7	V706		0 U16
8	V707		0 U16
9	V708		0 U16
10	V709	LogicStatus	1676 U16
11	V710		0 U16
12	V711		0 U16
13	V712		14 U16
14	V713		59 U16
15	V714		0 U16
16	V715		0 U16
17	V716		0 U16
18	V717		0 U16
19			
20			
21			
22			
23			
24			

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04DEC2015



Control Technology Inc.

5734 Middlebrook Pike, Knoxville, TN 37921-5962
Phone: +1.865.584.0440 Fax: +1.865.584.5720
www.controltechnology.com

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