

Application Note



2500 Series® Programmable Automation Control System

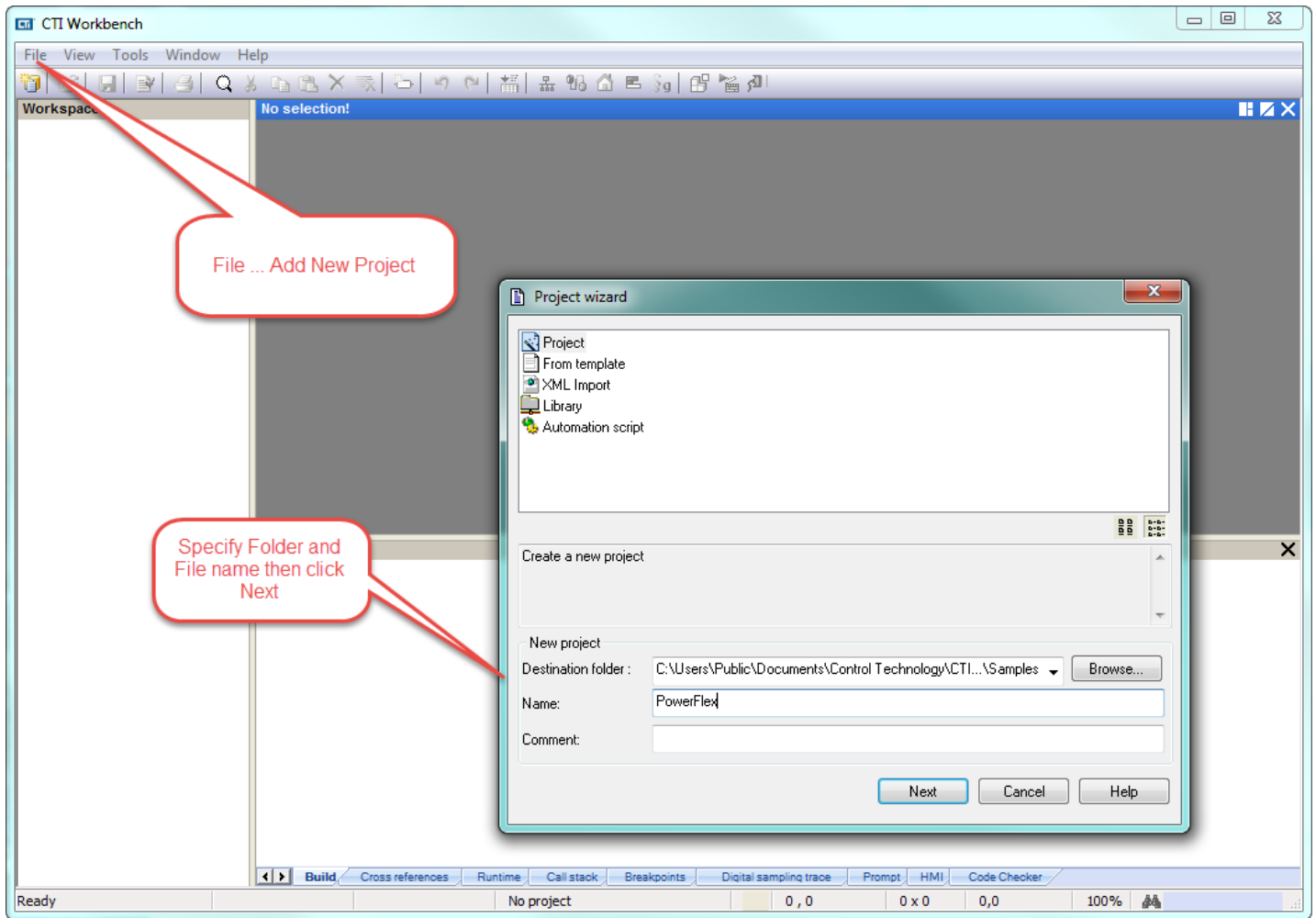
Communicating between 2500 Series® Processors and PowerFlex Drives using Ethernet/IP and 2500P-ACP1

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 drive using Workbench.

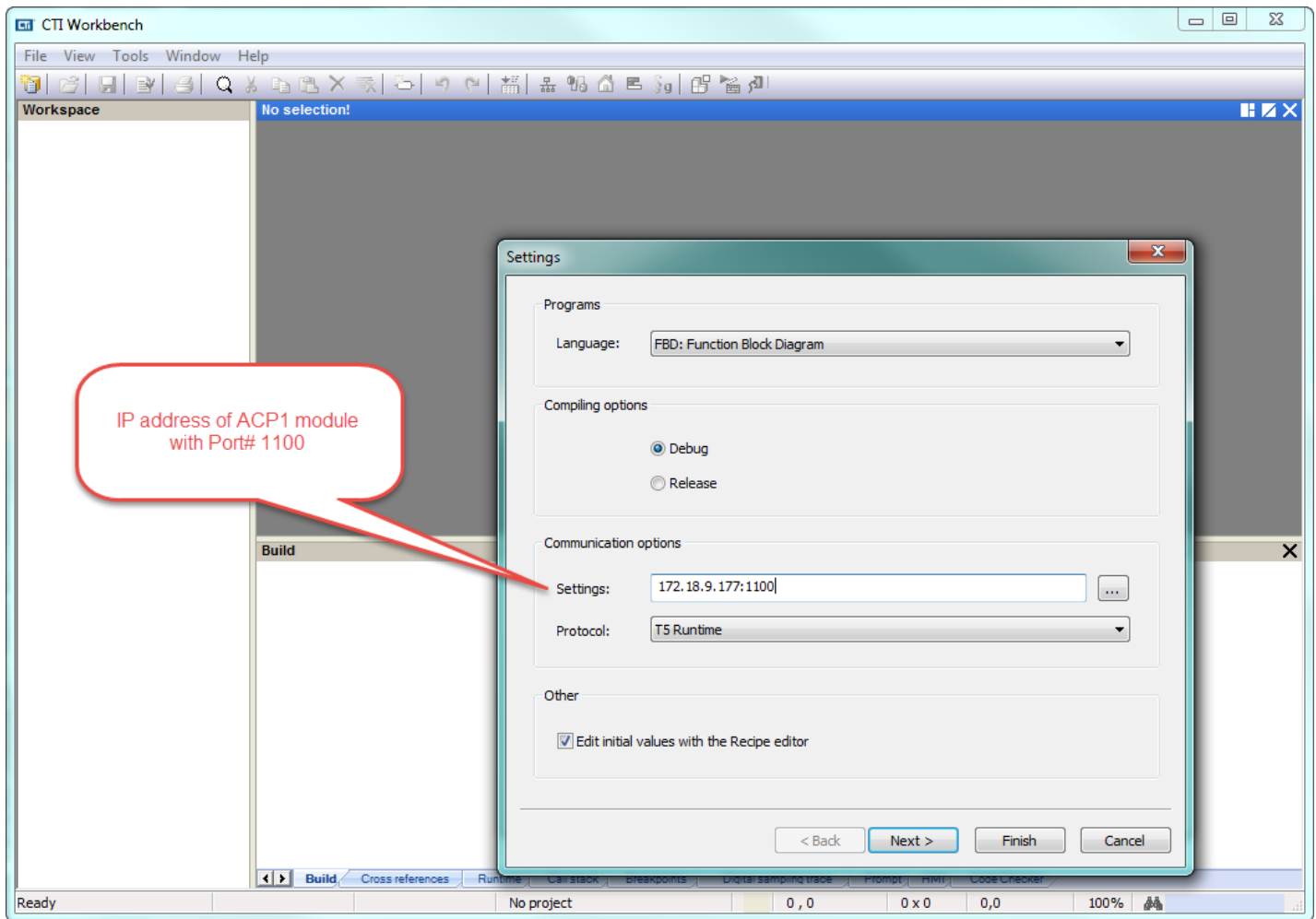
IMPORTANT NOTE: Configuring Ethernet/IP communications requires 2500P-ACP1 Firmware V3.03 or above, and Workbench V1.3 or above.



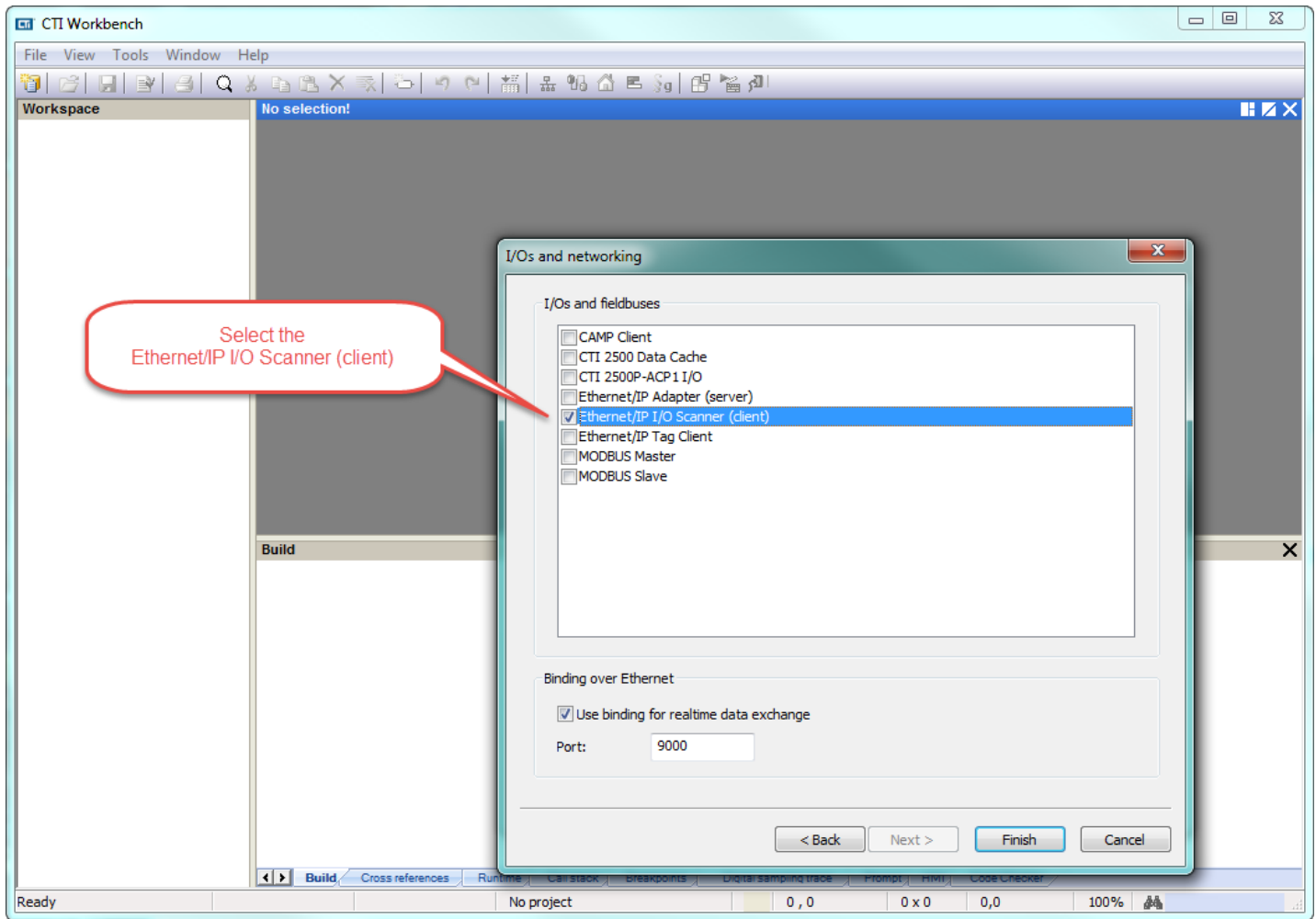
Step 1: Open a Project.



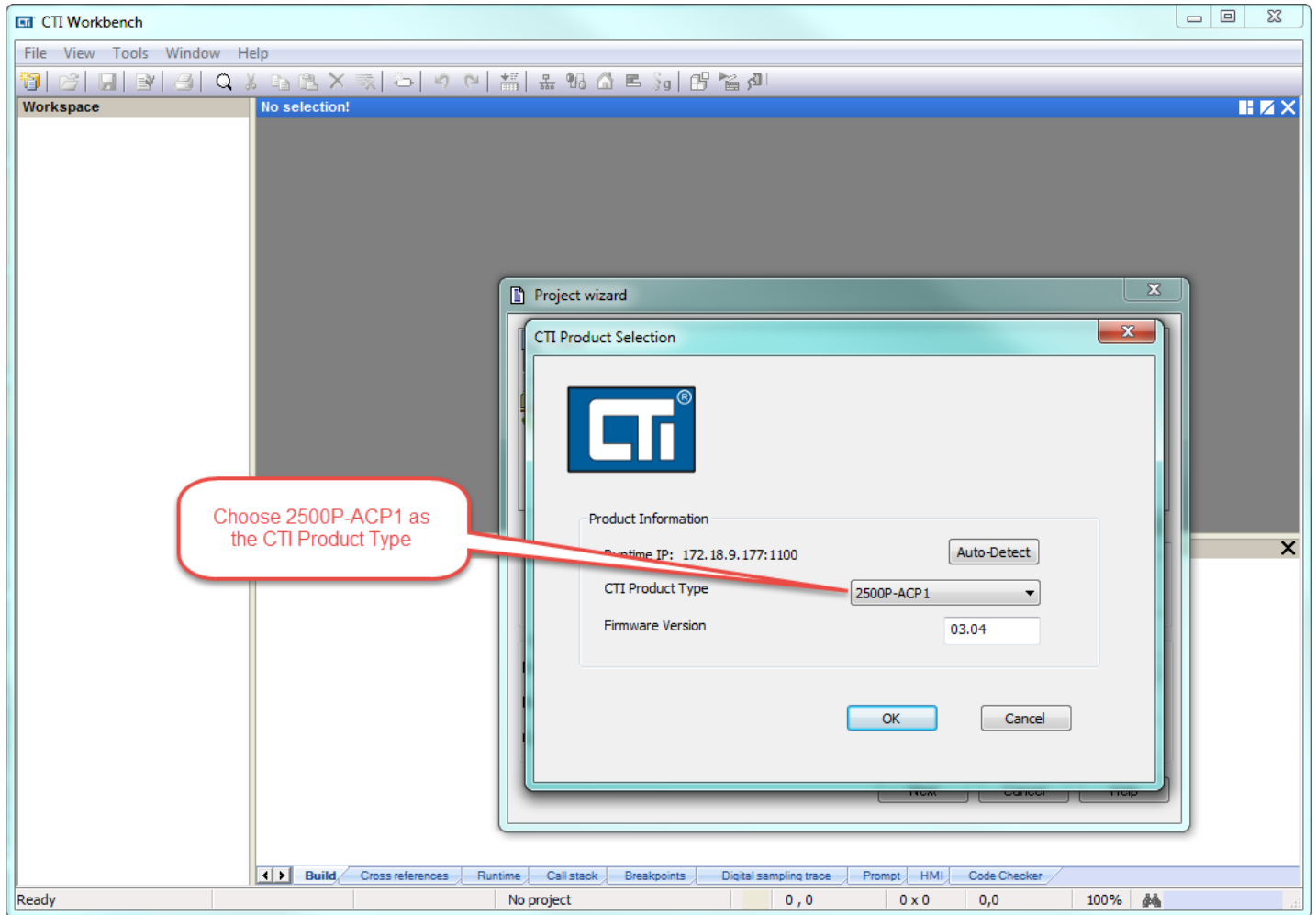
Step 2: Specify Target's (ACP1 module) IP address. **Language** specifies the start-up mode and can be changed later. **T5 Runtime** is the protocol native to Workbench and the ACP1 module (and the Zenon HMI software as well). Port# 1100 is the defined port for interface between Workbench and the ACP1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



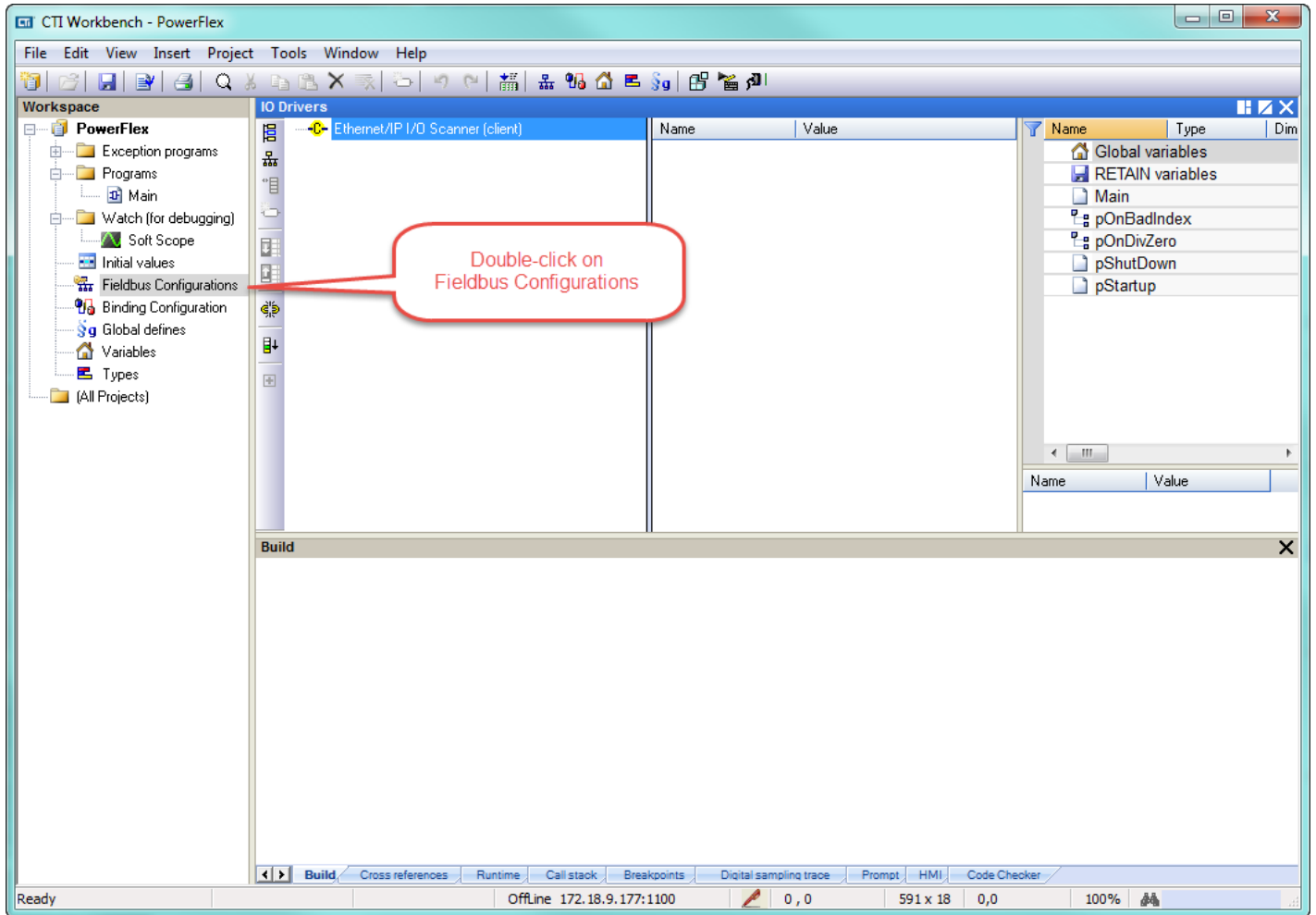
Step 3: The ACP1 is the Scanner and the PowerFlex drive is the Adapter, so select **Ethernet/IP I/O Scanner (client)**. We are not using **Binding over Ethernet** but this can remain checked with the default Port# of 9000. (This is used for communications between ACP1 and similar devices using the Data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



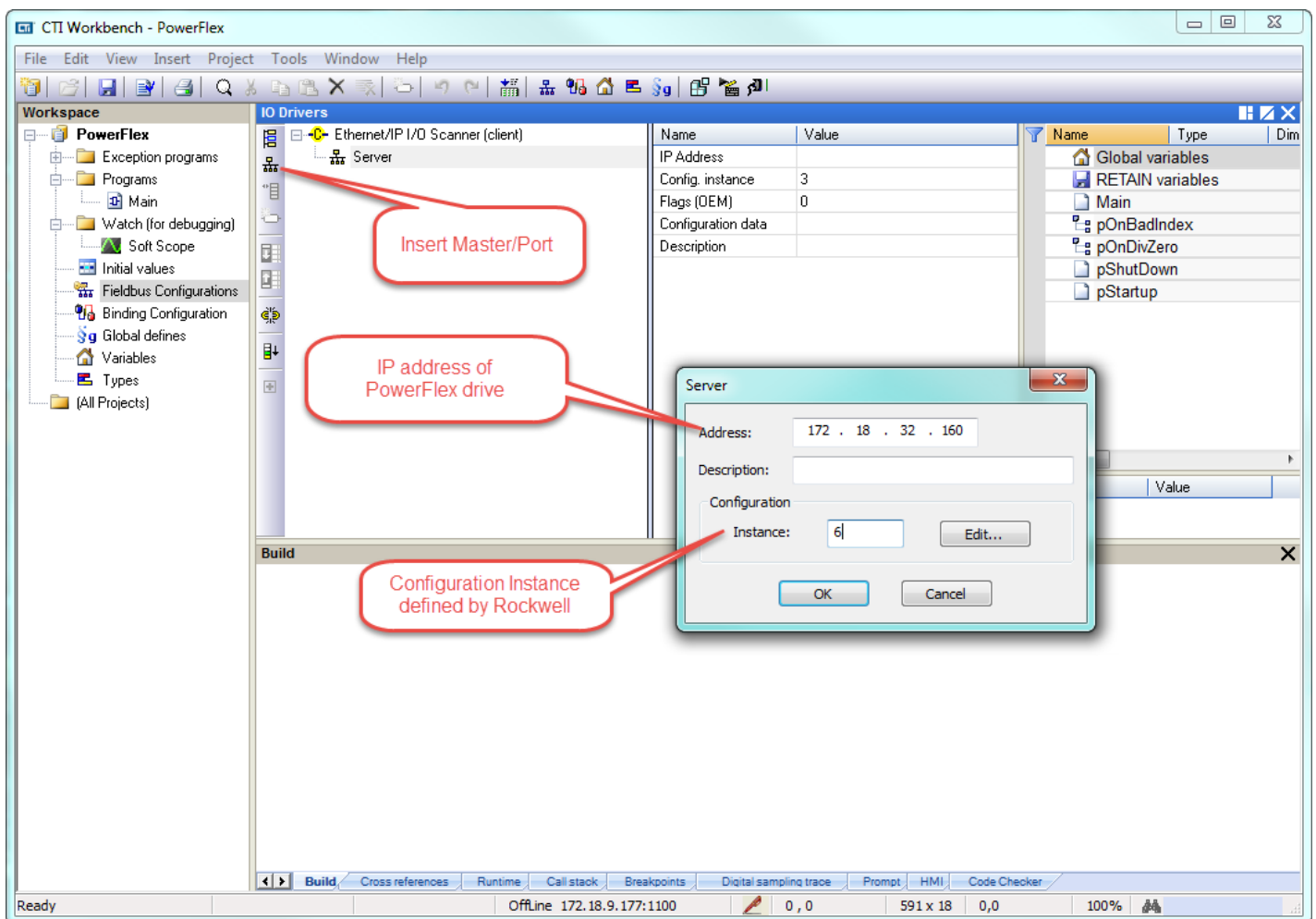
Step 5: Double-click on **Fieldbus Configurations**. Because we already specified the Ethernet/IP I/O Scanner (client) in Step 3, this driver automatically appears in the configuration window.



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.) |

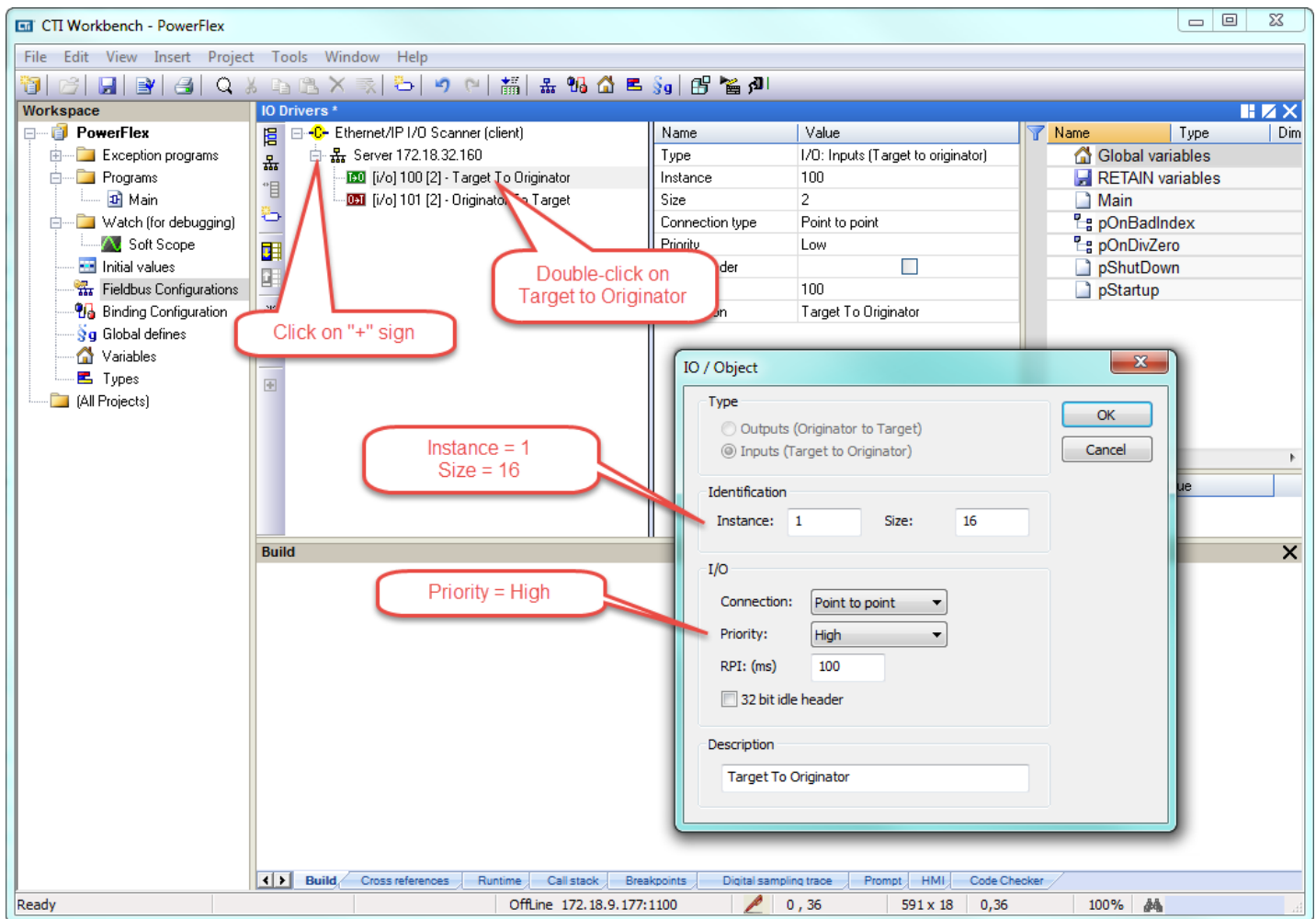
Enter the number of 16-bit words that are required for your I/O in the Input Size and Output Size boxes. Since the adapter always uses the 16-bit Logic Status, 16-bit Feedback, and two 16-bit words dedicated for memory allocation of the Generic Ethernet module profile, at least four 16-bit words must 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 shows the CTI Workbench - PowerFlex interface. The 'IO Drivers' window displays a table of IO objects:

| Name | Type |
|--------------------------------------|-------------------------------------|
| Server 172.18.32.160 | |
| [i/o] 1 [16] - Target To Originator | I/O: Outputs (Originator to target) |
| [i/o] 101 [2] - Originator To Target | I/O: Outputs (Originator to target) |

The 'IO / Object' dialog box is open, showing the configuration for the selected object:

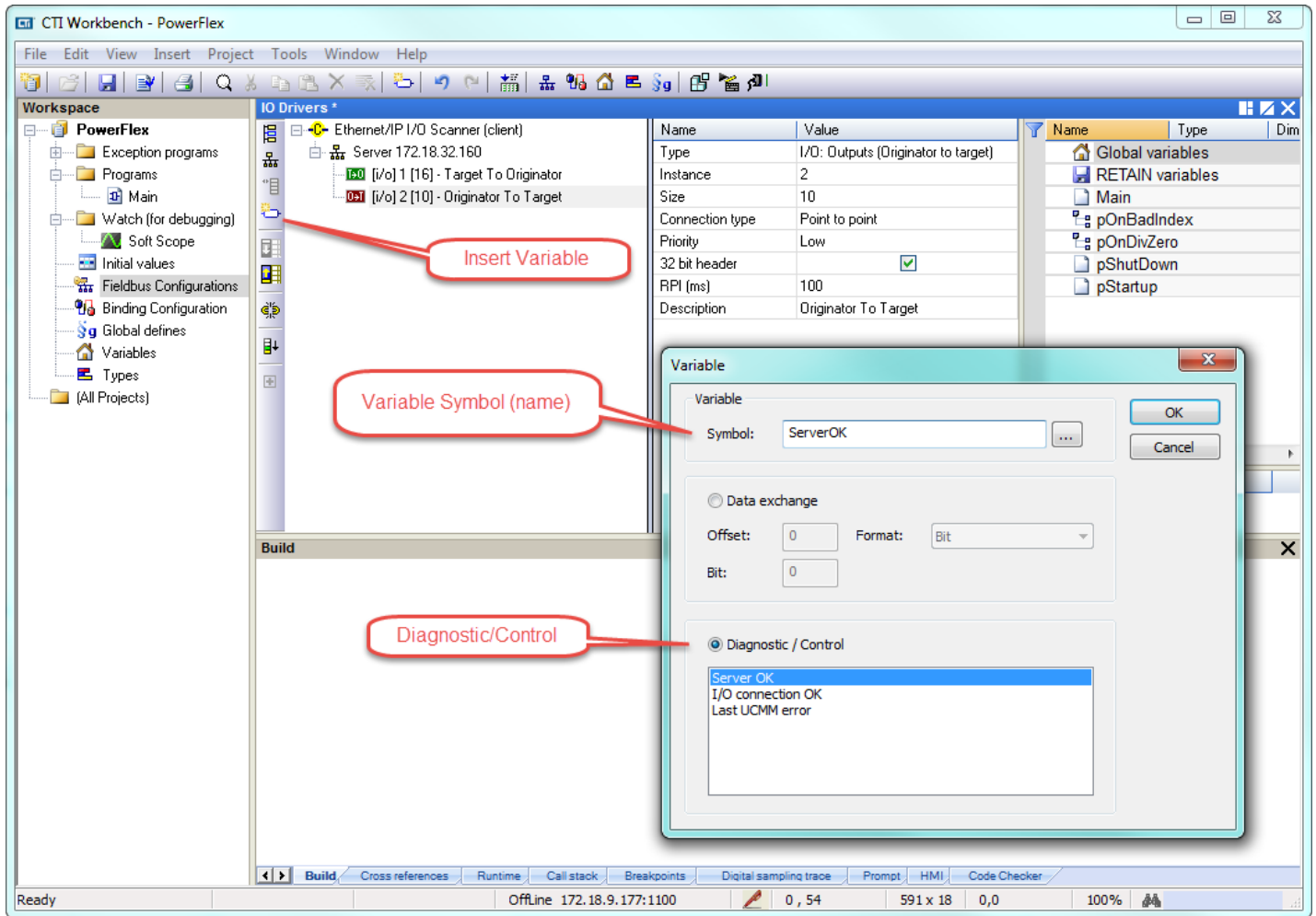
- Type: Outputs (Originator to Target)
- Identification: Instance: 2, Size: 10
- I/O: Connection: Point to point, Priority: High, RPI (ms): 100, 32 bit idle header
- Description: Originator To Target

Red callouts highlight the following actions and values:

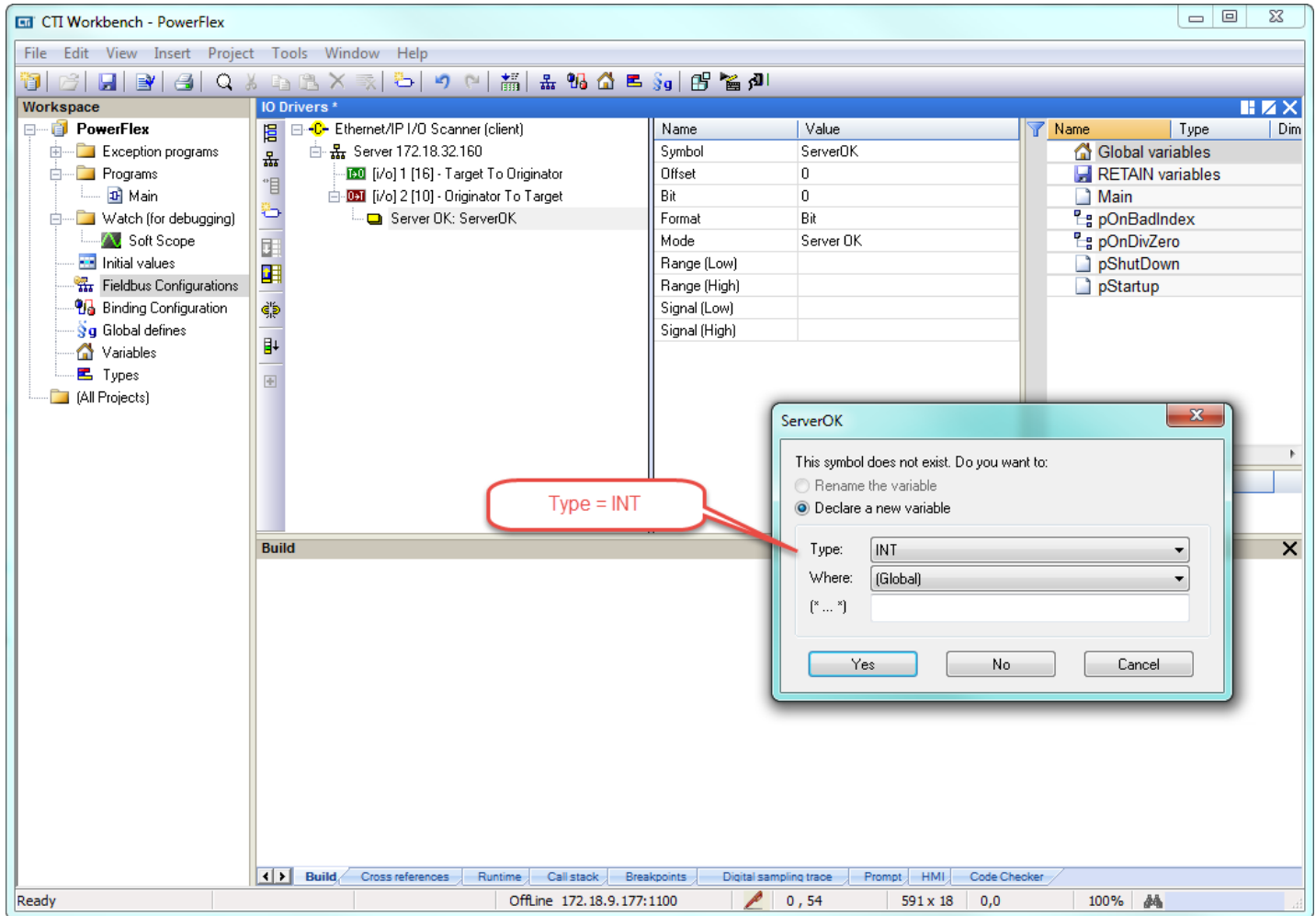
- Double-click Originator To Target
- Instance = 2, Size = 10
- Priority = High



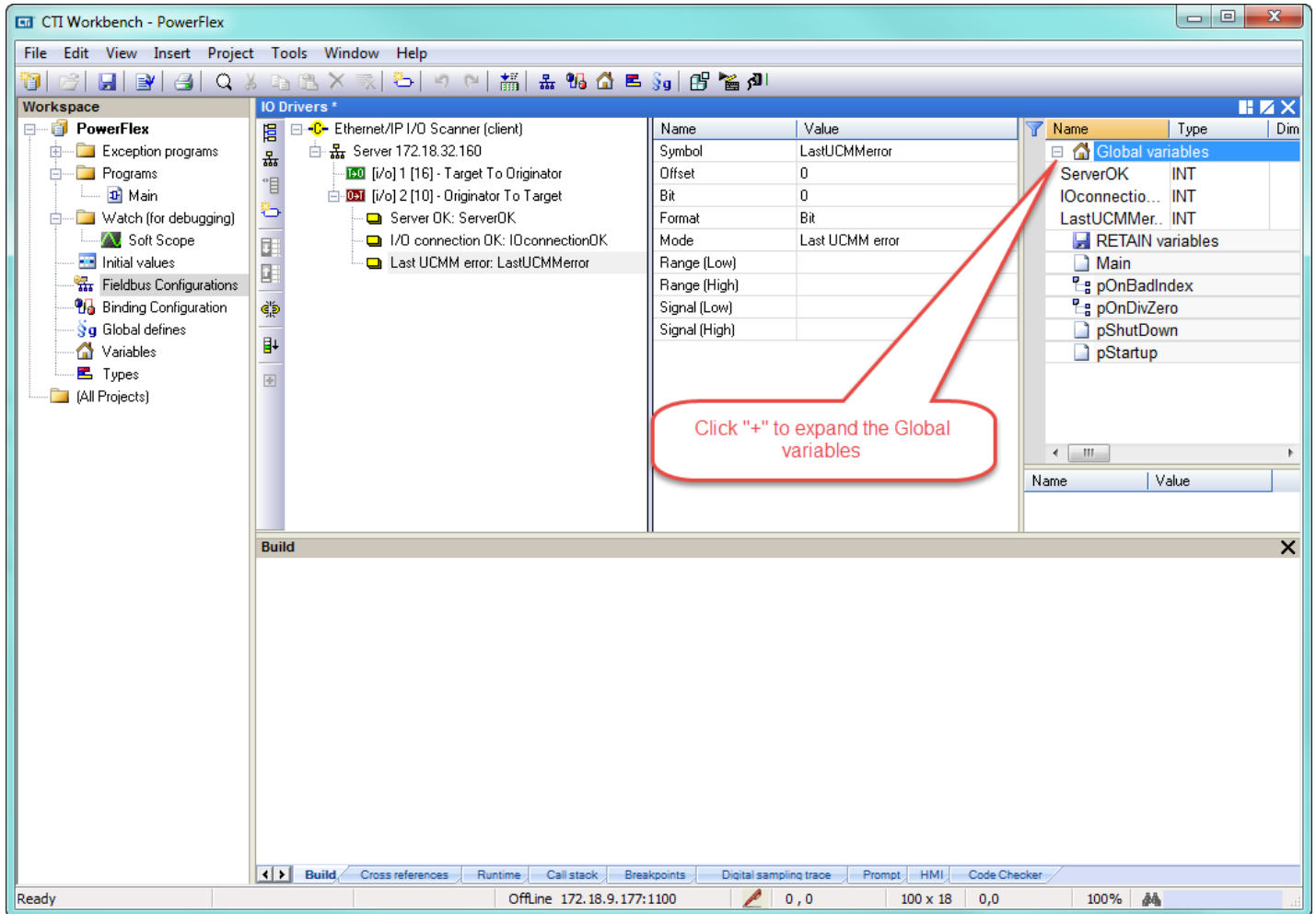
Step 9: There are three system variables we want to add; it does not matter if they are listed under **Target to Originator** or **Originator to Target**. Select **Insert Variable** and then the **Diagnostic/Control** button. Select one of the variables and type a name in the **Symbol** box. No spaces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



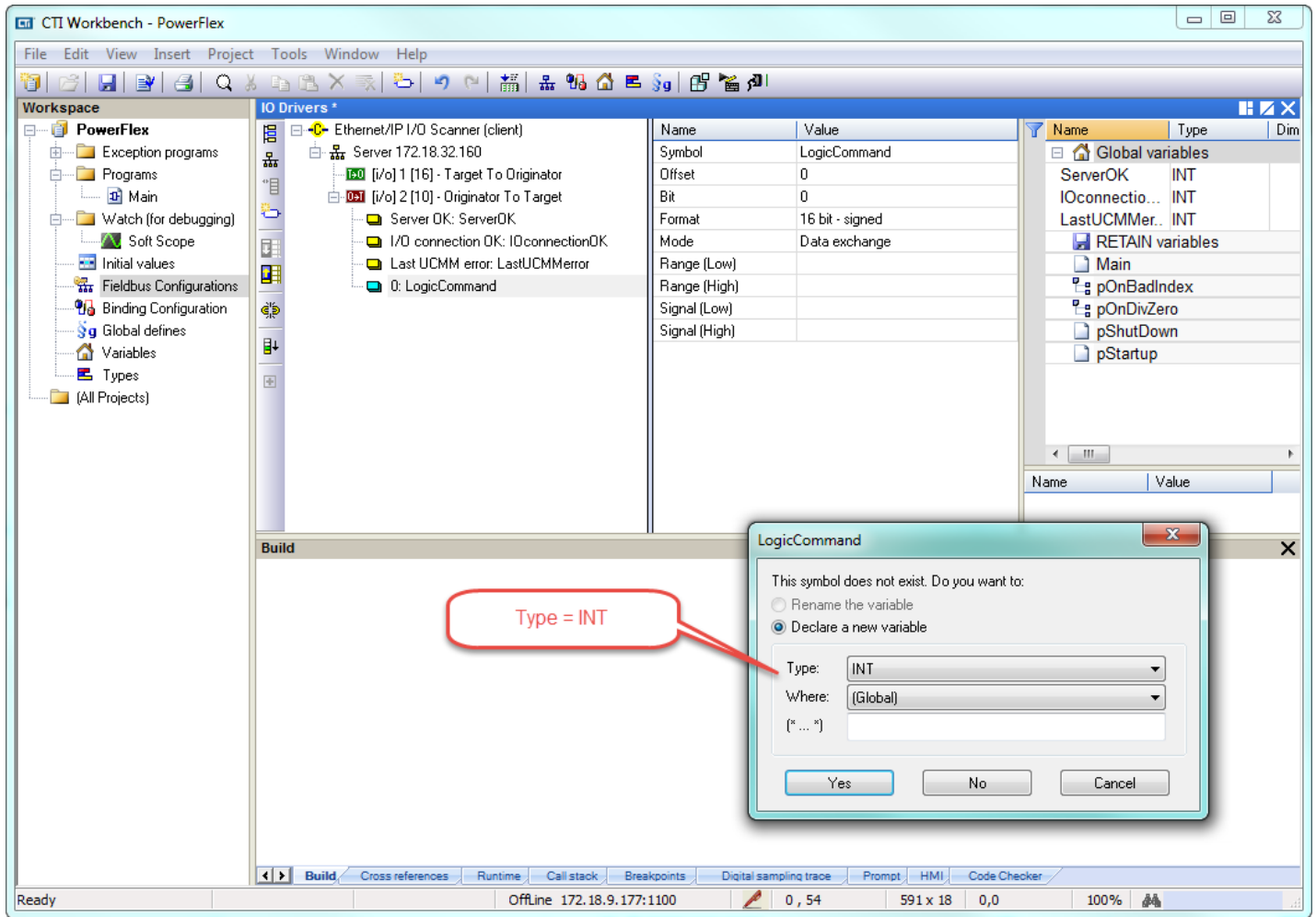
Step 12: Now we can add the other variables for the PowerFlex drive. Referring to the chart in Step 7, add Logic Command (no spaces) as shown below. The **Originator to Target** section is highlighted so this variable will be added as an Output. It is the first variable in the table so its **Offset**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

The screenshot shows the CTI Workbench - PowerFlex interface. The 'IO Drivers' window is open, displaying a table of variables. The 'Originator To Target' section is highlighted. A 'Variable' dialog box is open, showing the configuration for the 'LogicCommand' variable. The dialog has the following fields:

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

A red callout box points to the dialog with the text: "Symbol = LogicCommand, Offset = 0, Format = 16-bit signed". Another red callout box points to the 'Originator To Target' entry in the IO Drivers list with the text: "Insert Variable".

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



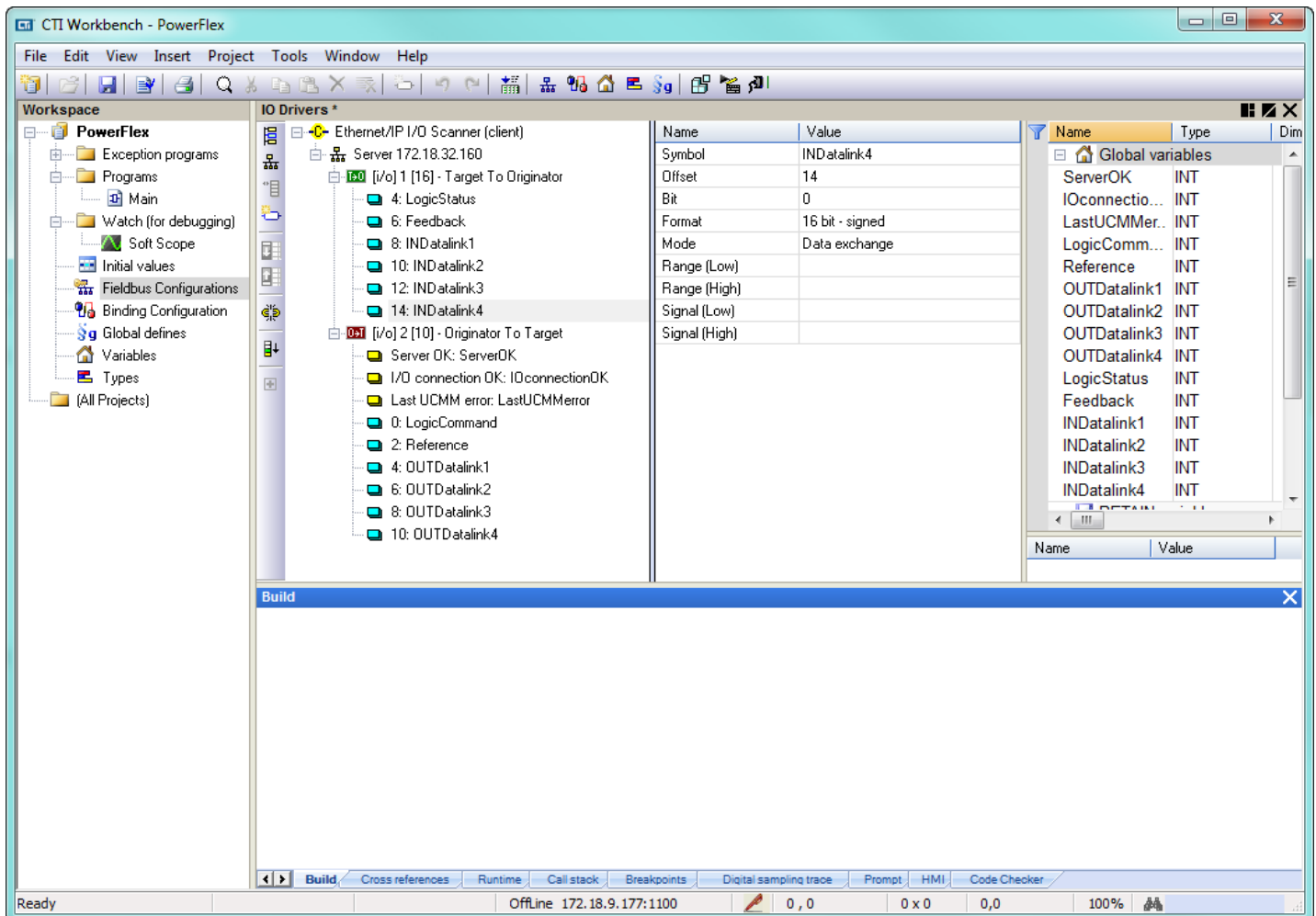
Step 14: Repeat Steps 12 & 13 for the other Output variables from the table in Step 7 with their respective **Offset** (in bytes):

| | |
|--------------|----|
| 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:

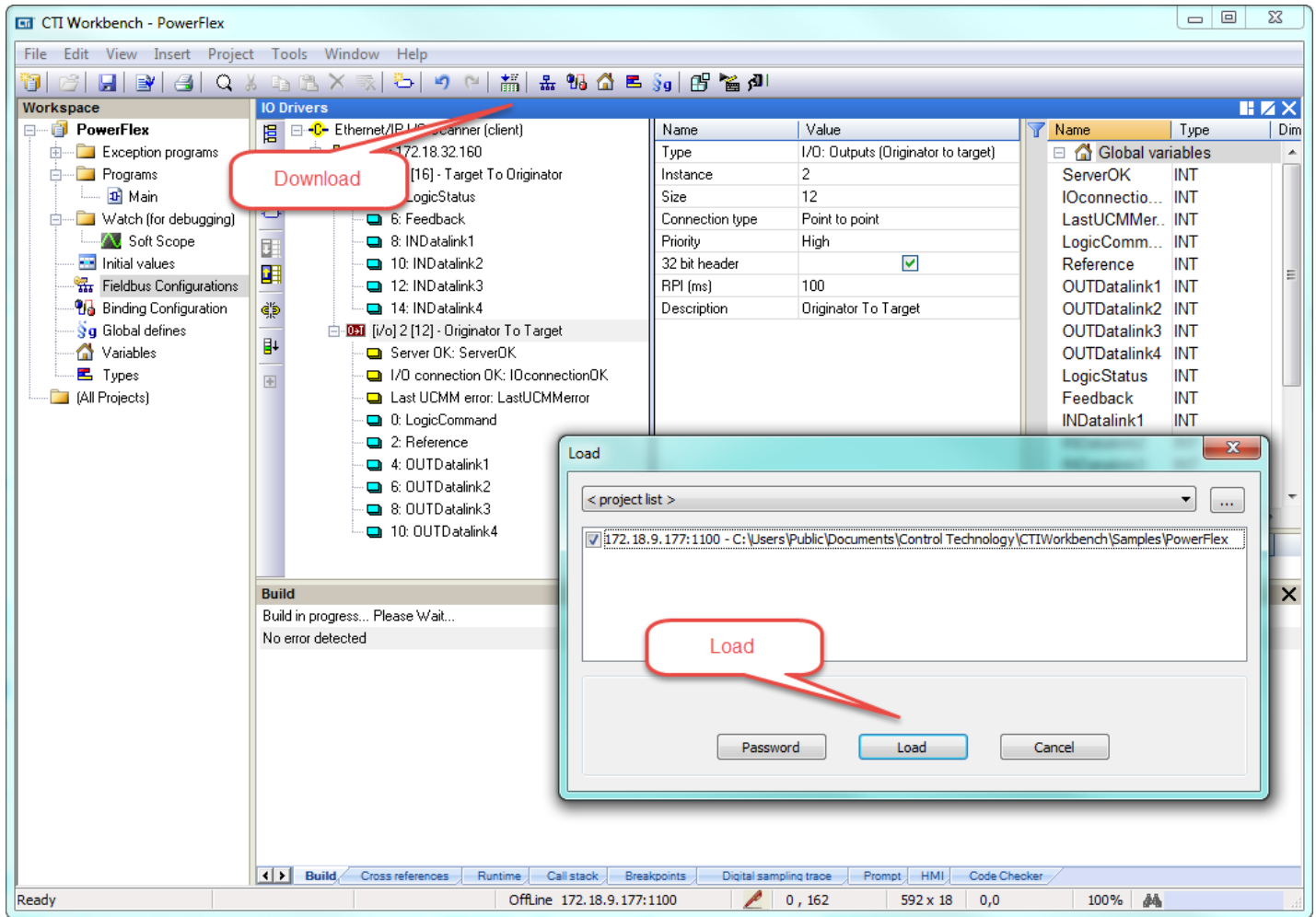
```
[EIPC]: (19): Invalid offset  
< 15 I/Os >
```

Red callouts highlight the following changes:

- Build Startup Project**: Points to the IO Drivers list.
- Priority = High**: Points to the Priority field in the Properties window.
- Change to "12"**: Points to the Size field in the Properties window.
- Compile error due to incorrect Output Size**: Points to the error message in the Build window.



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 UCMM error** is "0".

The screenshot displays the CTI Workbench - PowerFlex interface. The main workspace shows the configuration for an Ethernet/IP I/O Scanner (client) connected to Server 172.18.32.160. Two I/O drivers are listed:

- [i/o] 1 [16] - Target To Originator**: LogicStatus = 1676, INDatalink1 = 0, INDatalink2 = 14, INDatalink3 = 59, INDatalink4 = 0.
- [i/o] 2 [12] - Originator To Target**: Server OK: ServerOK = 1, I/O connection OK: IOconnectionOK = 1, Last UCMM error: LastUCMMerror = 0, LogicCommand = 0, Reference = 0, OUTdatalink1 = 0, OUTdatalink2 = 0, OUTdatalink3 = 0, OUTdatalink4 = 0.

The **[i/o] 2 [12] - Originator To Target** driver is selected, and its properties are shown in the right-hand table:

| Name | Value |
|-----------------|-------------------------------------|
| Type | I/O: Outputs (Originator to target) |
| Instance | 2 |
| Size | 12 |
| Connection type | Point to point |
| Priority | High |
| 32 bit header | <input checked="" type="checkbox"/> |
| RPI (ms) | 100 |
| Description | Originator To Target |

A red callout box labeled "On Line" points to the status of the selected driver. The **Global variables** table on the right 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 at the bottom shows a list of 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 STOP [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 indicates the system is Ready, running the STOP program (172.18.9.177:1100) with 0 I/O connections, 162 bytes of data, and 592 x 18 I/O points.



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

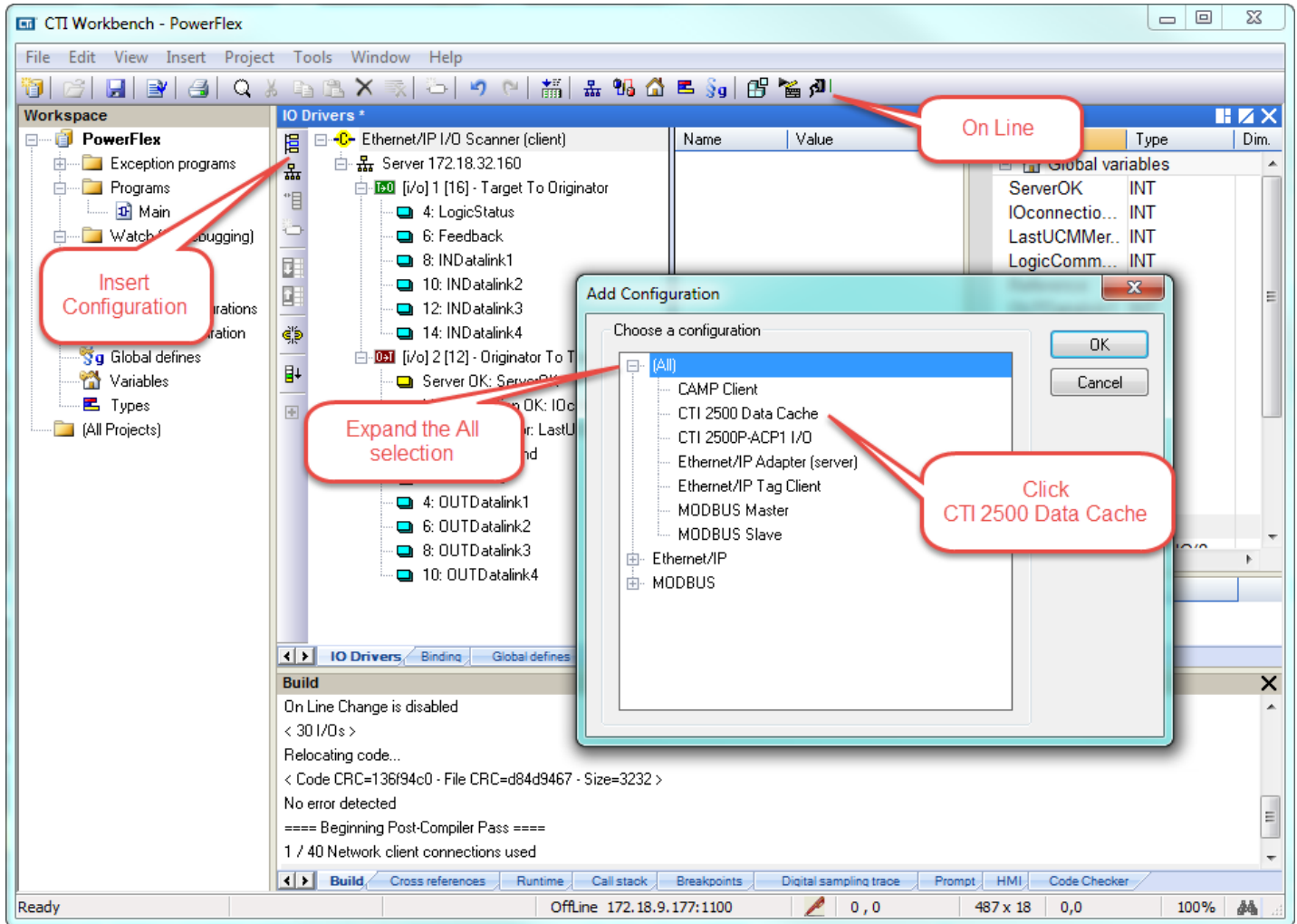
Lost record count: 0
 Max Records/Cycle: 1

No UCMM errors

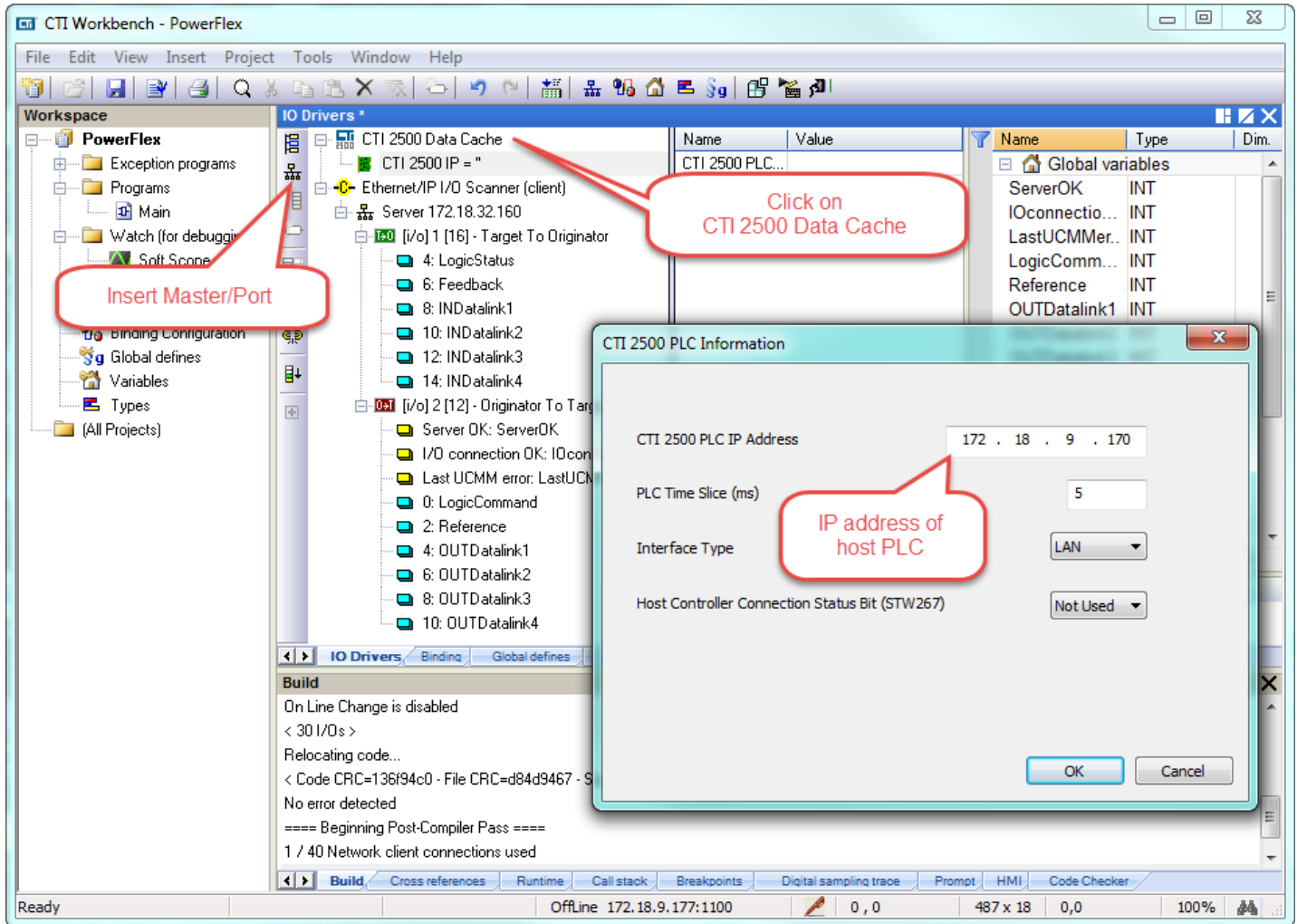
IO Connected



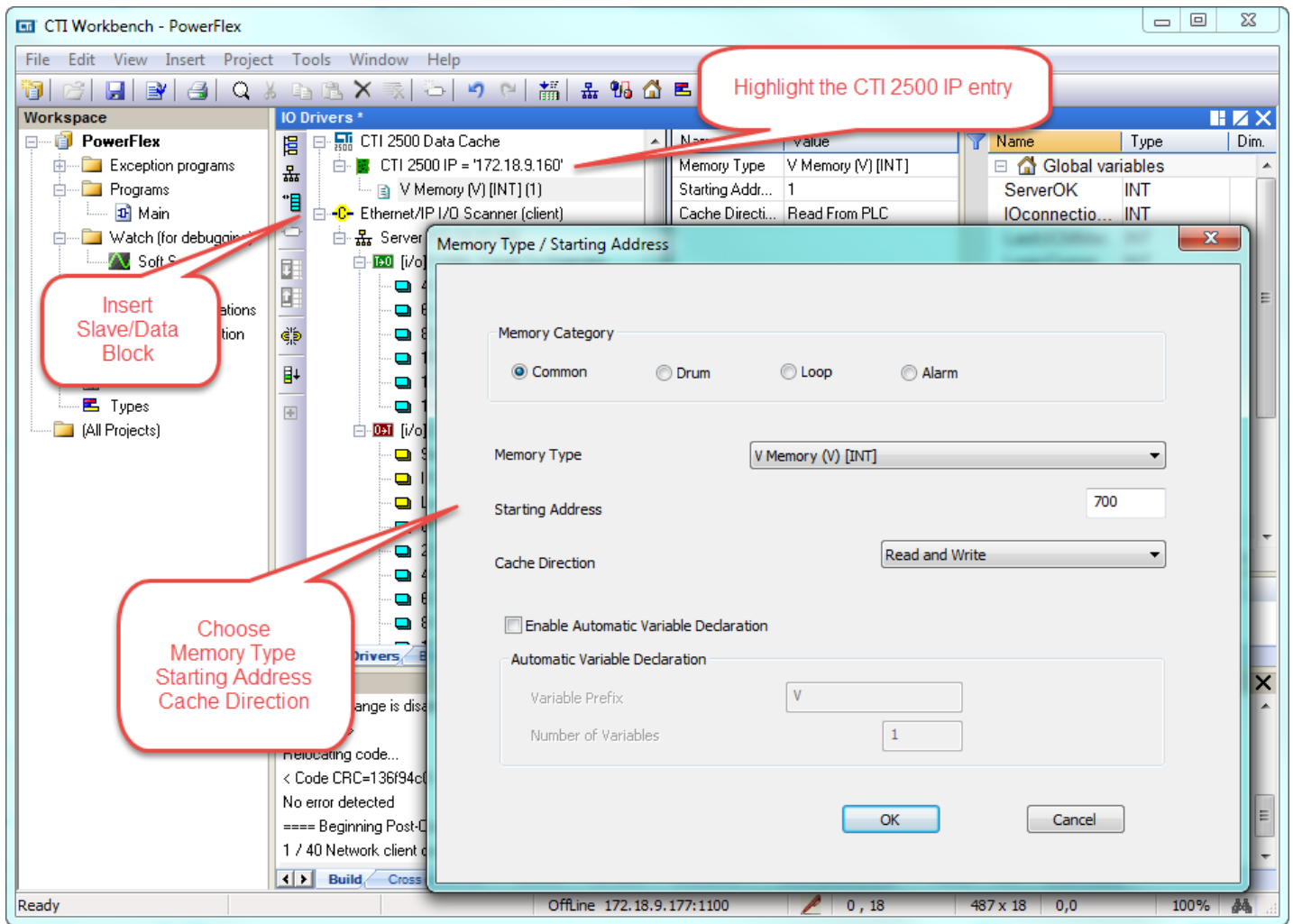
Step 18: The last task is to associate the variables defined in ACP1 to memory locations in the PLC. Click the **On Line** button to take the ACP1 off line, then in the IO Drivers window, click **Insert Configuration**, choose the **CTI 2500 Data Cache** option and click **OK**.



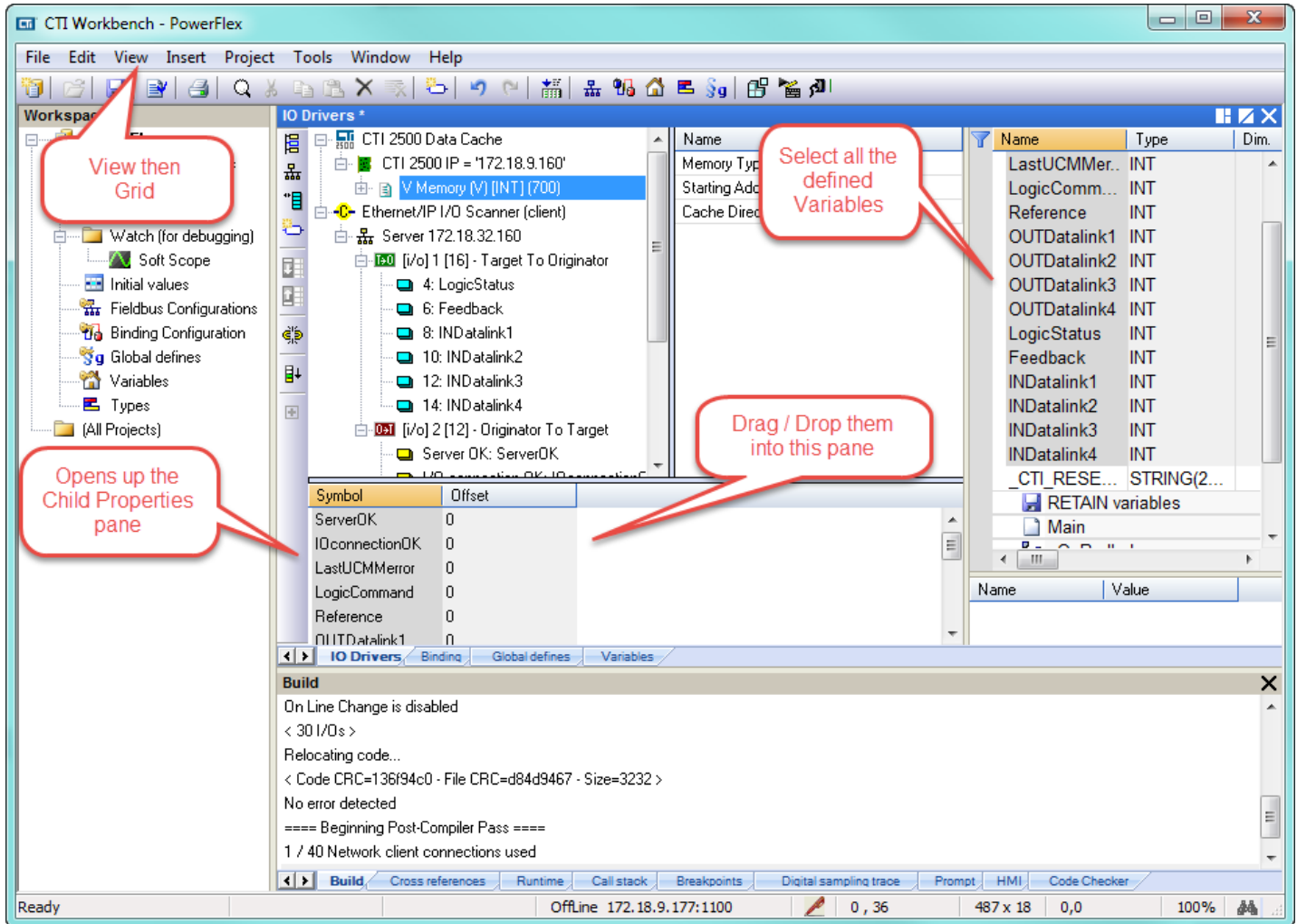
Step 19: Highlight the **CTI 2500 Data Cache** entry, then **Insert Master/Port**. In the pop-up window, enter the IP address of the Host PLC. Then click **OK**.



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:

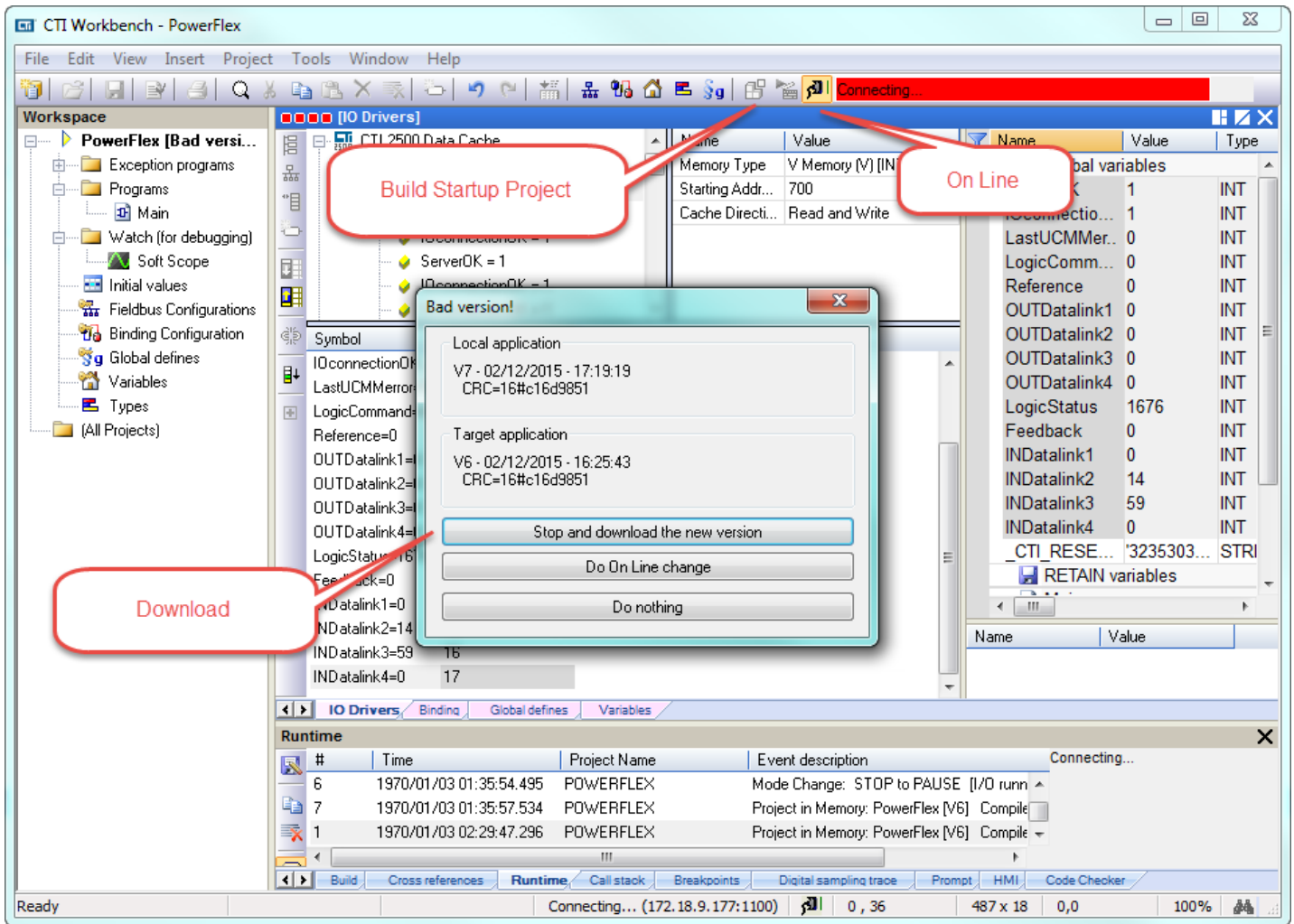
| Symbol | Offset |
|----------------|--------|
| IOconnectionDK | 1 |
| LastUCMError | 2 |
| LogicCommand | 3 |
| Reference | 4 |
| OUTDatalink1 | 5 |
| OUTDatalink2 | 6 |
| OUTDatalink3 | 7 |
| OUTDatalink4 | 8 |
| LogicStatus | 9 |
| Feedback | 10 |
| INDatalink1 | 11 |
| INDatalink2 | 12 |
| INDatalink3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

A red callout box with a pointer to the 'Offset' column contains the text: "Click on Offset, type in number, then Enter".

The interface also shows a 'Global variables' list on the right, including ServerOK, IOconnectio..., LastUCMmer..., LogicComm..., Reference, OUTDatalink1, OUTDatalink2, OUTDatalink3, OUTDatalink4, LogicStatus, Feedback, INDatalink1, INDatalink2, INDatalink3, and INDatalink4, all of type INT. A 'Build' window at the bottom shows the compilation status: "No error detected" and "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**.



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 has a menu bar with "File", "Edit", "View", "Data", "Diagnostics", "PLC Utilities", "Options", "Window", and "Help". Below the menu bar is a toolbar with various icons. The central area displays a "DATA1 - 505Program1 (Online)" window containing a table with the following data:

| 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 | | | |

At the bottom of the window, there is a status bar with the text "For Help, press F1" and "Security: Disabled Path: 172.18.9.170 demo Mode: Online - Run Format: U16 NUM OVR".

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