

Application Note



2500 Series® Programmable Automation Control System

Communicating between 2500 Series® Processors and E1 Plus Electronic Overload Relay using Ethernet/IP and 2500P-ACP1

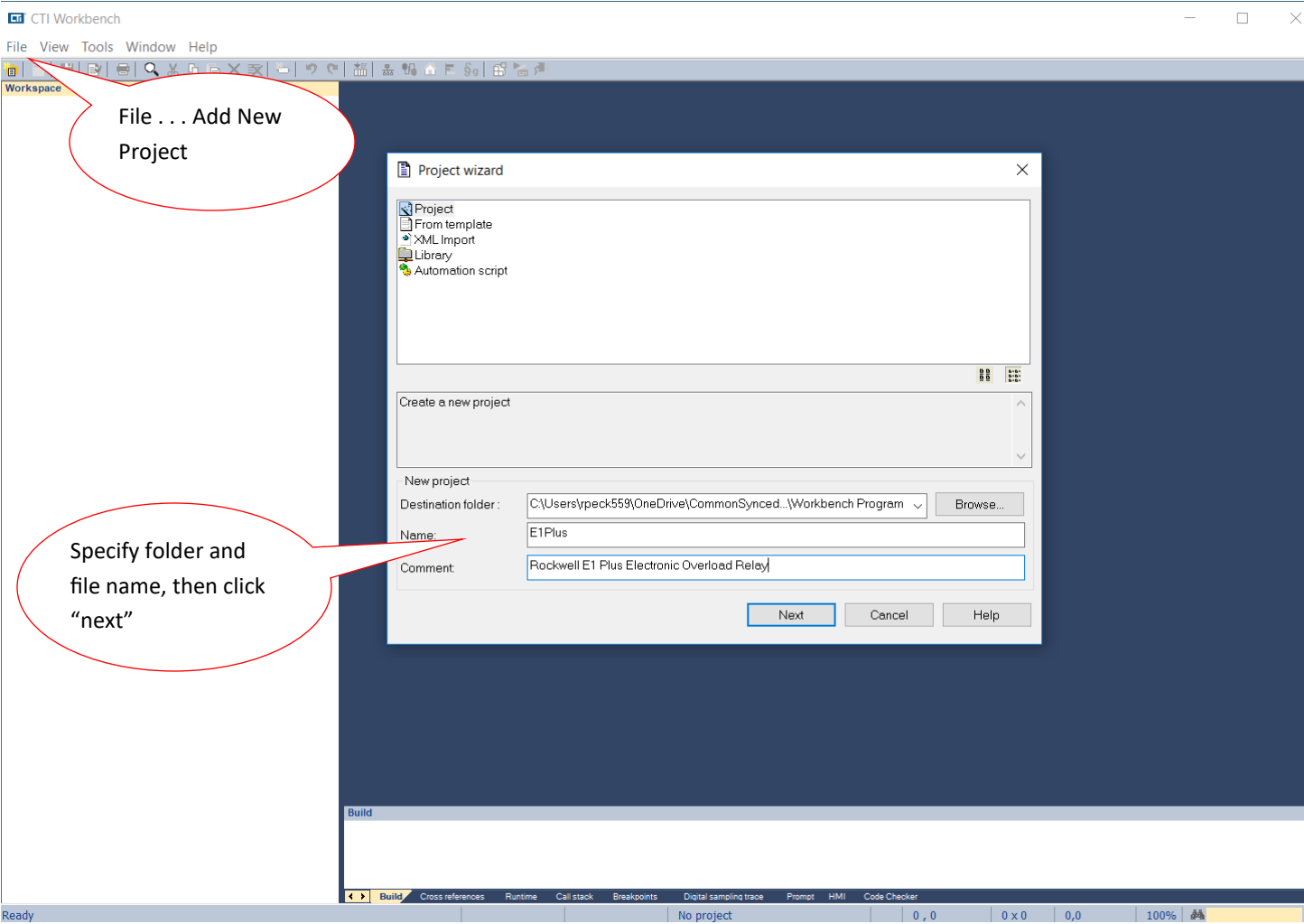
The 2500P-ACP1 Application Coprocessor supports Ethernet/IP communications with up to 40 Ethernet/IP devices via I/O Scanner, I/O Adapter, Explicit Message Adapter, and Tag Client interfaces. This Application Note shows how to configure the ACP1 for communications with Rockwell E1 Plus Electronic Overload Relay using the 193-ETN Ethernet/IP Side Mount Module. In this example we will use a data structure to hold the drive variables. Use of a data structure allows us to quickly add more drives into the application.

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

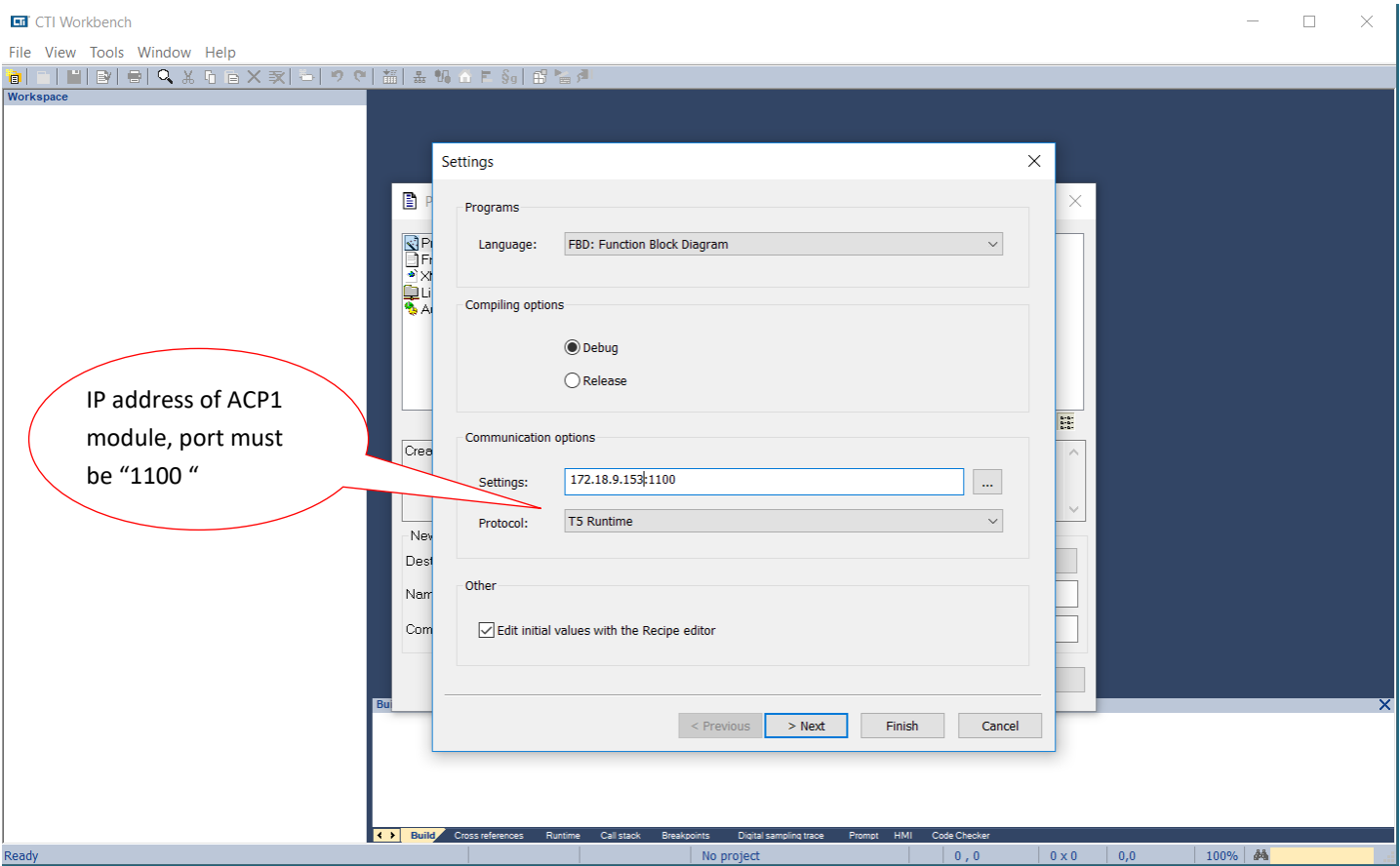


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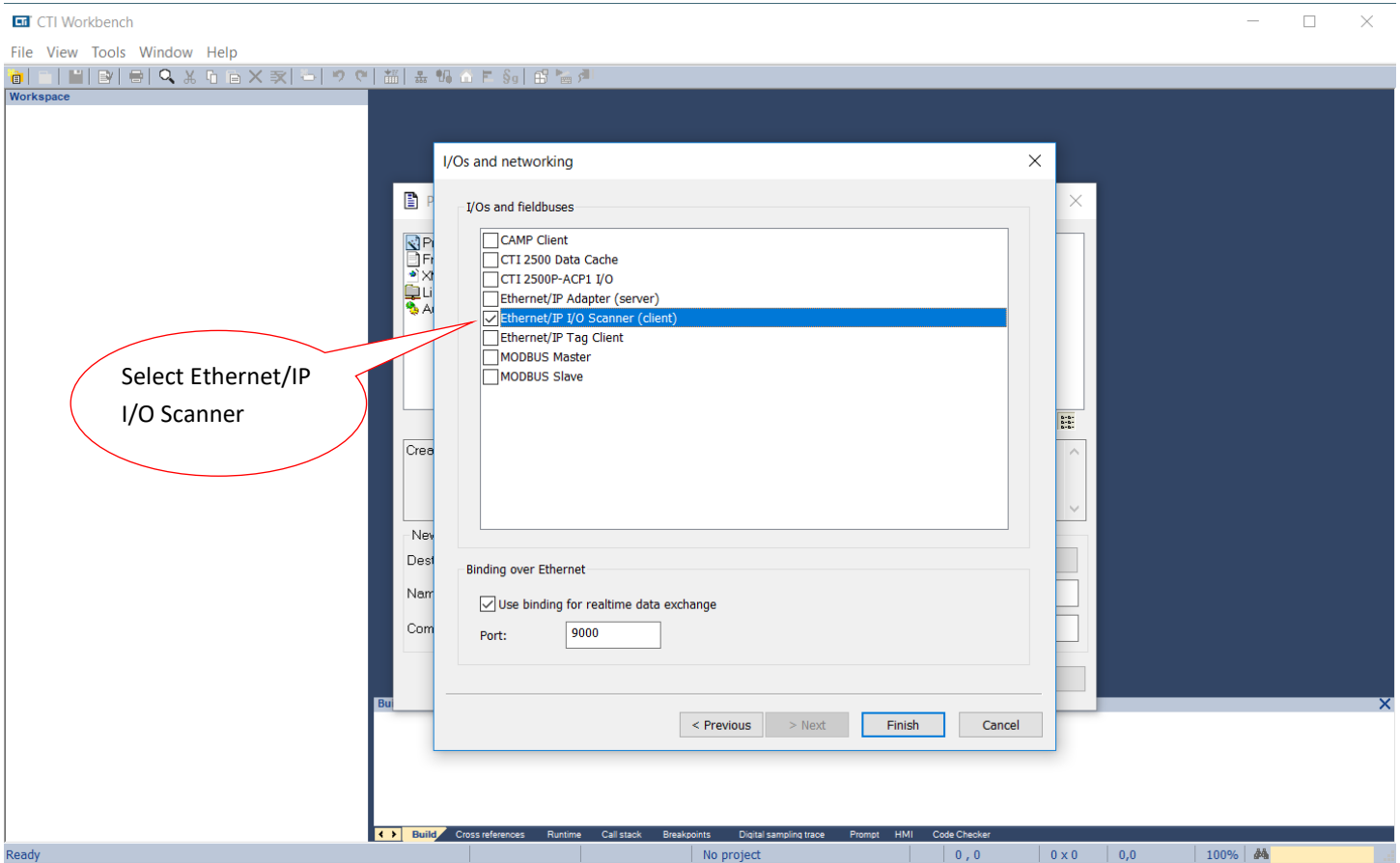
Step 1: Open a Project.



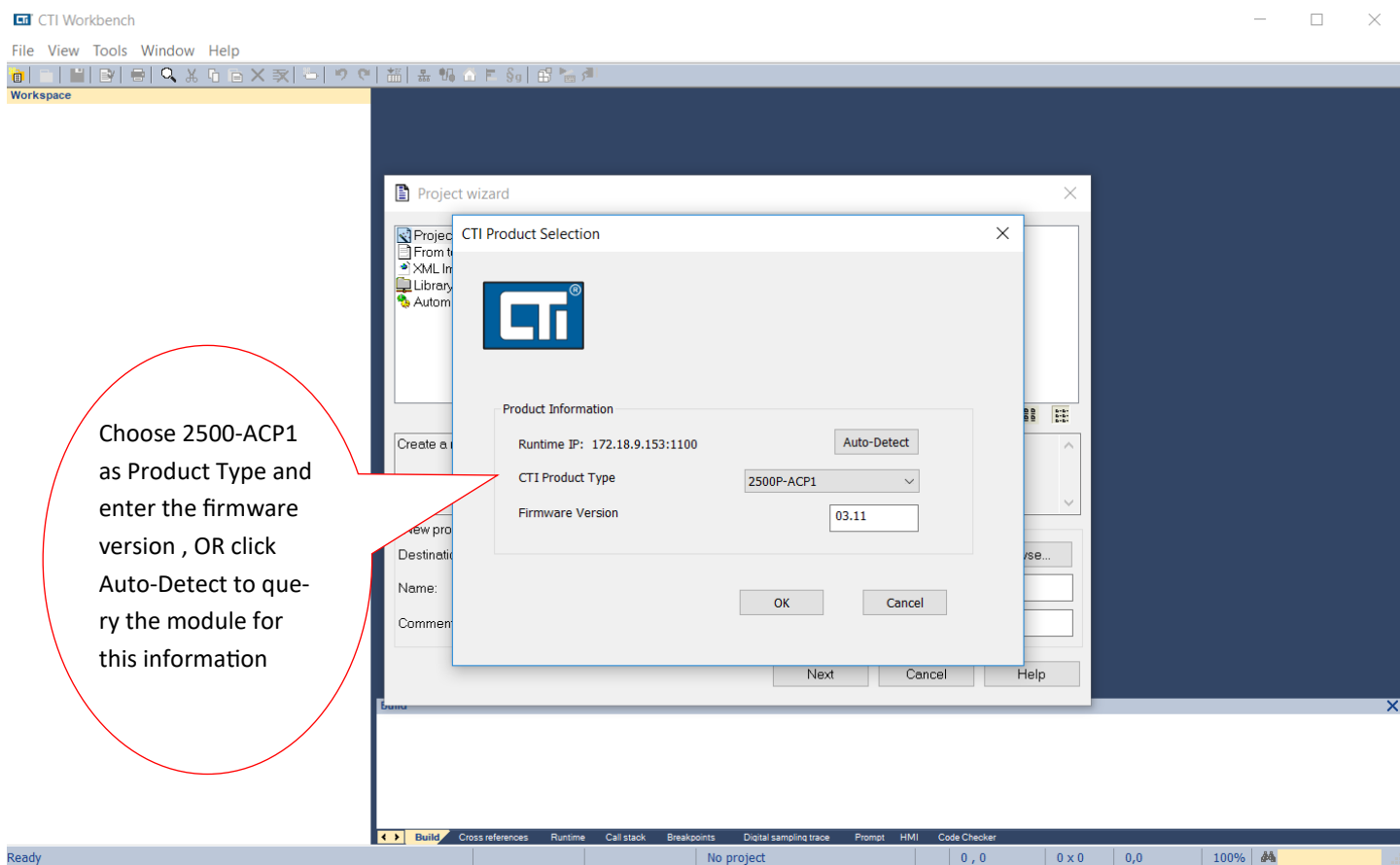
Step 2: Specify Target's (ACP1 module) IP address. **Language** specifies the start-up mode and can be changed later. **T5 Runtime** is the protocol native to Workbench and the ACP1 module (and the Zenon HMI software as well). Port# 1100 is the defined port for interface between Workbench and the ACP1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



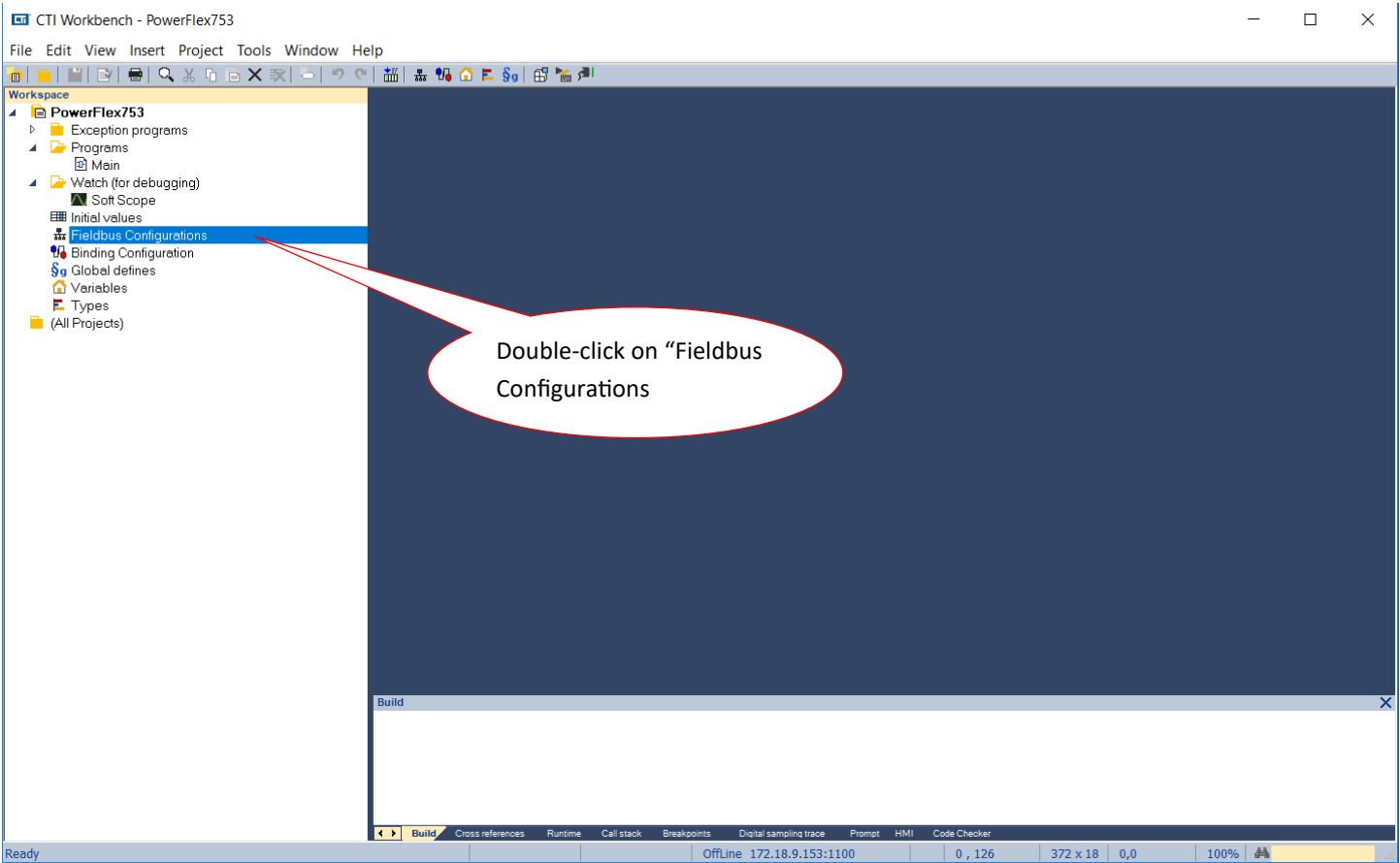
Step 3: The ACP1 is the Scanner and the E1Plus is the Adapter, so select **Ethernet/IP I/O Scanner (client)**. We are not using **Binding over Ethernet** but this can remain checked with the default Port# of 9000. (This is used for communications between ACP1 and similar devices using the Data Exchange 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 “120” (reference “Bulletin 193 E1 Plus EtherNet/IP Side Mount Module - 192-UM012B-EN-P June 2011” page 42—excerpt below). Then click **OK**.

CTI Workbench - E1Plus

File Edit View Insert Project Tools Window Help

Workspace

E1Plus

Exception programs

Programs

Main

Watch (for debugging)

Soft Scope

Initial values

Fieldbus Configurations

Binding Configuration

Global defines

Variables

Types

(All Projects)

IO Drivers

Ethernet/IP I/O Scanner (client)

Server

| Name | Value |
|-------------------|-------|
| IP Address | |
| Config. instan... | 3 |
| Flags (OEM) | 0 |
| Configuration ... | |
| Description | |

Click on "Insert Master/Port"

Server

Address: 172 . 18 . 9 . 95

Description: E1 Plus Electronic Overload Relay

Configuration

Instance: 120

Edit...

OK

Cancel

Enter the IP address, a name for the drive, and set Configuration Instance =120

| Type | Instance | Size | Connection type | Priority | 32 bit header | RPI (ms) |
|------|----------|------|-----------------|----------|---------------|----------|
| | | | | | | |

- Set the Connection Parameters. I/O data is accessed using Input Instances 50, 51, 106, 110 or 111 and Output Instances 2, 101 or 103. The size of the input connection and the output connection shall correspond to the size of the chosen instance. The E1 Plus configuration assembly instance is 120. In this example configuration data is not used, so the data size is set to 0.

Connection Parameters

Input:

Assembly Instance: 111

Size: 22 (8-bit)

Output:

Assembly Instance: 103

Size: 1 (8-bit)

Configuration:

Assembly Instance: 120

Size: 0 (8-bit)

Status Input:

Assembly Instance:

Size:

Status Output:

Assembly Instance:

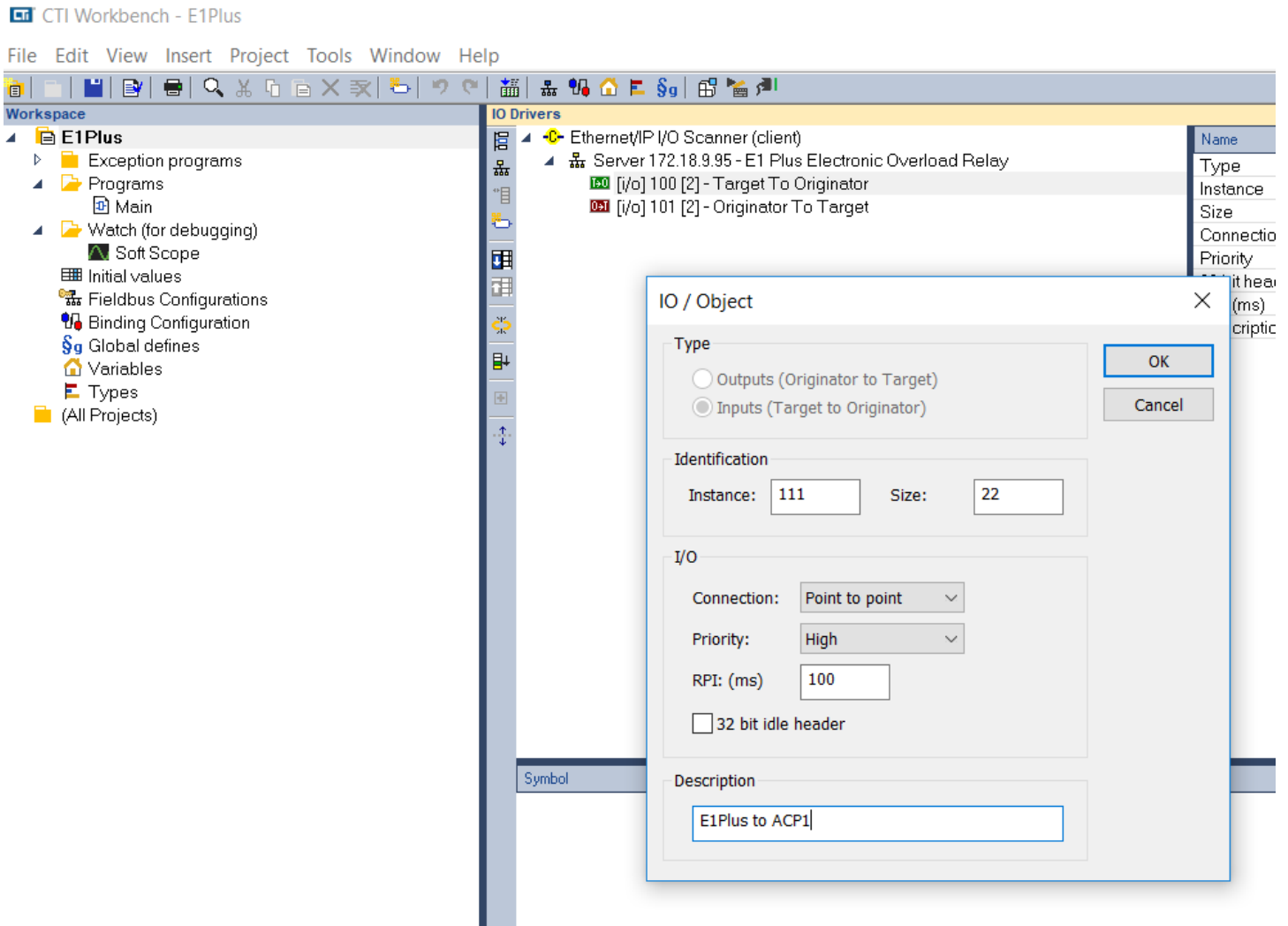
Size:

CTI

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Step 7: Expand the **Server** and double-click the **Target to Originator** (Input). In the **IO/Object** pop-up box, change the **Instance** to “111” and the **Size** (in bytes) to “22”. Referring to the table on page 10 (“Bulletin 193 E1 Plus EtherNet/IP Side Mount Module - 192-UM012B-EN-P June 2011”, page 84). Change the **Priority** to “High” and leave the **32 bit idle header** unchecked. In “Description” we usually enter “E1Plus to ACP1” to make it easy to remember the direction of this data. Then click **OK**.



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 Step. Enter “ACP1 to Drive” for description, then click **OK**.

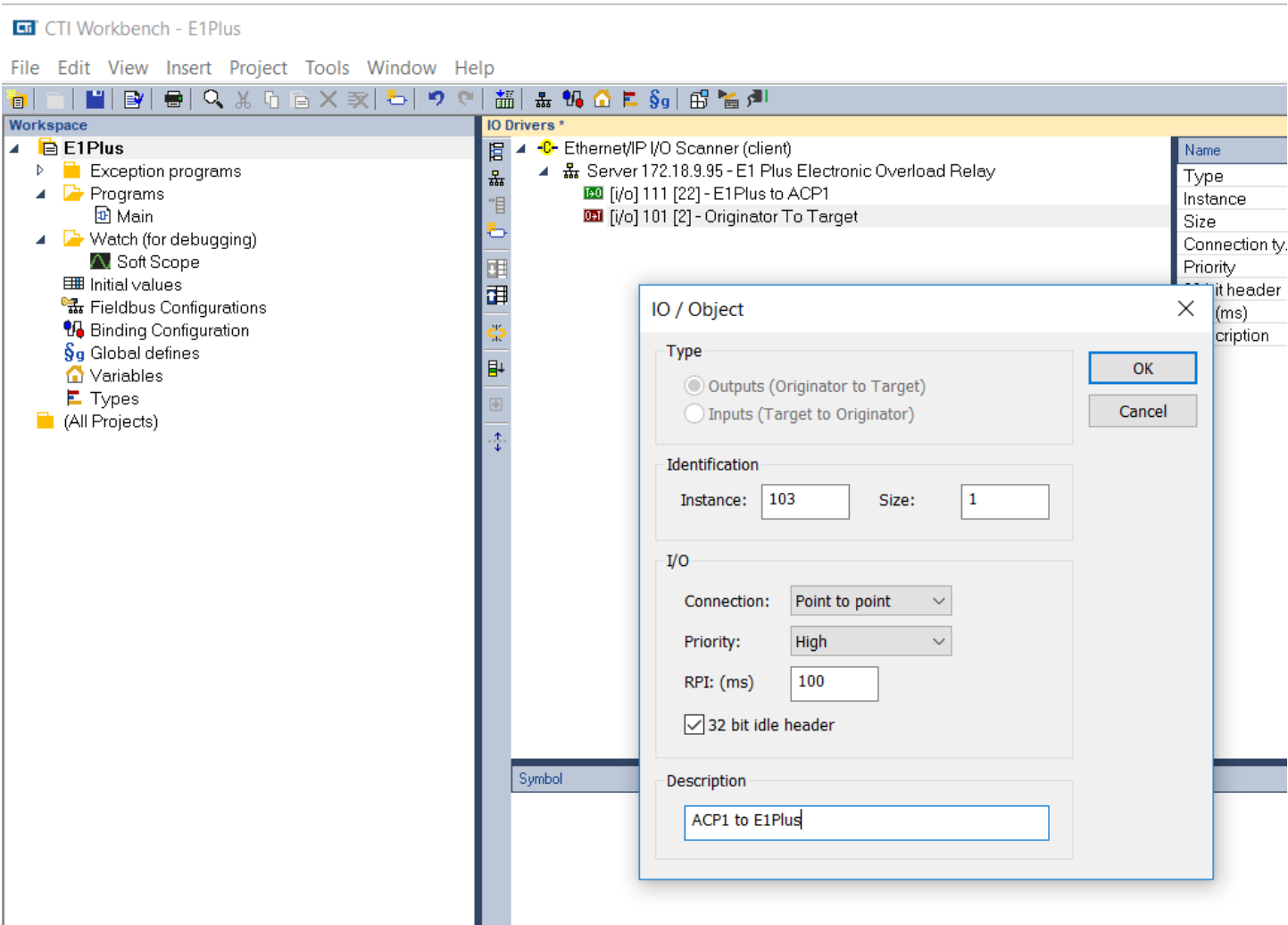


Table 22 - Instance 111 —Complete Motor Starter Input Assembly

| Byte | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|------|-----------------------------|-------|---------|---------|-------|------------|---------|---------|
| 0 | Motor Current | | Input 2 | Input 1 | | Out A Stat | Warning | Tripped |
| 1 | Unused | | | | | | | |
| 2 | Average % FLA (low byte) | | | | | | | |
| 3 | Average % FLA (high byte) | | | | | | | |
| 4 | %Therm Utilized (low byte) | | | | | | | |
| 5 | %Therm Utilized (high byte) | | | | | | | |
| 6 | Trip Status (low byte) | | | | | | | |
| 7 | Trip Status (high byte) | | | | | | | |
| 8 | Warning Status (low byte) | | | | | | | |
| 9 | Warning Status (high byte) | | | | | | | |
| 10 | Device Status (low byte) | | | | | | | |
| 11 | Device Status (high byte) | | | | | | | |
| 12 | Trip Log 0 (low byte) | | | | | | | |
| 13 | Trip Log 0 (high byte) | | | | | | | |
| 14 | Trip Log 1 (low byte) | | | | | | | |
| 15 | Trip Log 1 (high byte) | | | | | | | |
| 16 | Trip Log 2 (low byte) | | | | | | | |
| 17 | Trip Log 2 (high byte) | | | | | | | |
| 18 | Trip Log 3 (low byte) | | | | | | | |
| 19 | Trip Log 3 (high byte) | | | | | | | |
| 20 | Trip Log 4 (low byte) | | | | | | | |
| 21 | Trip Log 4 (high byte) | | | | | | | |

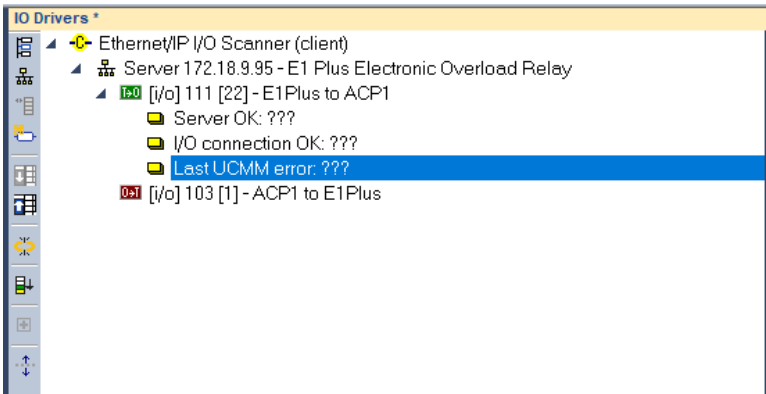
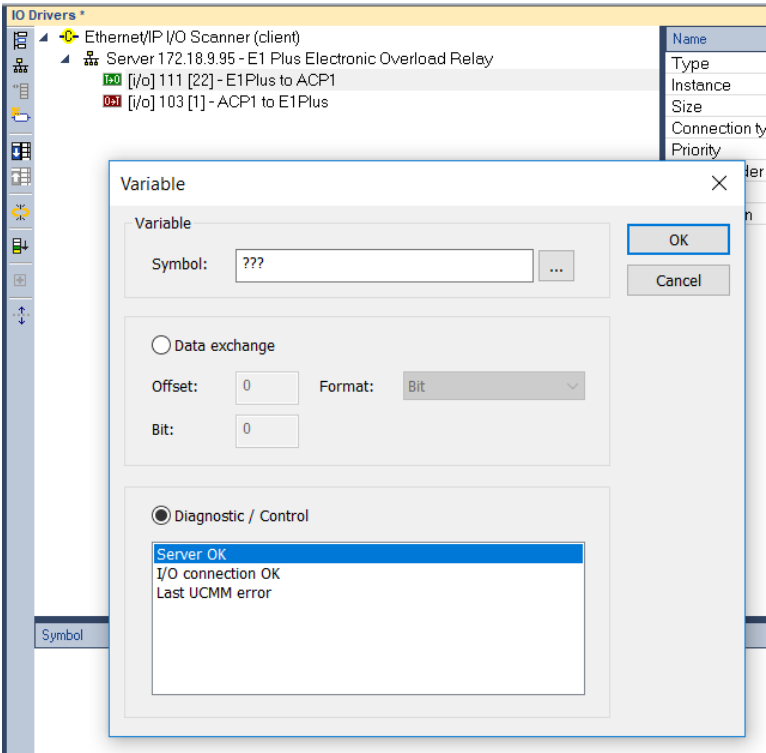
From Rockwell publication
193-UM012B-EN-P June
2011, pages 83-85

Table 17 - Instance 103 — Similar to Basic Starter Output Assembly from ODVA Starter Profile

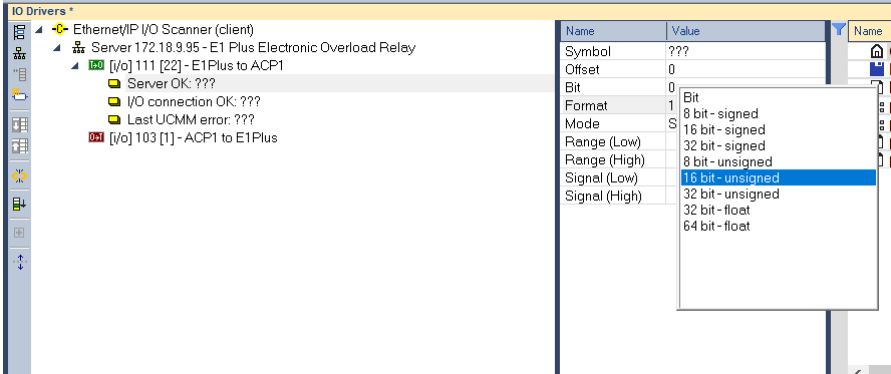
| Byte | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|------|-------|-------|-------|-------|-------|------------|-------|----------|
| 0 | | | | | | Trip Reset | | Output A |



Step 9: There are three system variables we want to add. Highlight the **E1Plus to ACP1** connection, right click and select “insert variable”. Click the Diagnostic/Control radio button and select “Server OK”, then click the OK button. Repeat this process to add the “I/O Connection OK” and “Last UCMM error” variables.

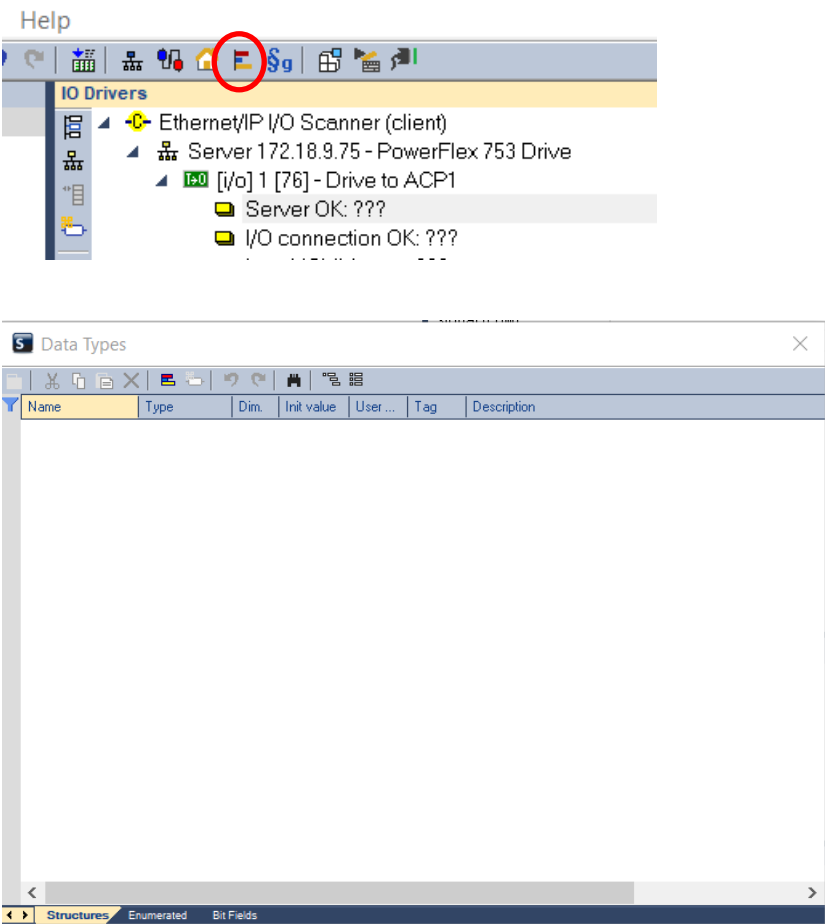


Step 10. Next we want to set all these driver variables as integers. To do this, highlight each variable in turn, and in the editing pane to the right, double-click the “format” field and set the format as “16-bit unsigned”. Do this for each of the three driver variables.

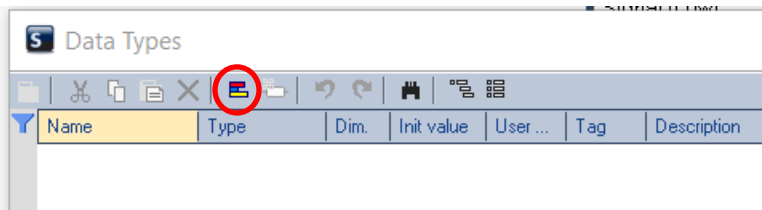


Step 11. Now we will create a data structure which holds all the variables for the E1Plus. Using a structure allows us to rapidly add multiple E1Plus devices into the application without creating a new set of variables for each instance.

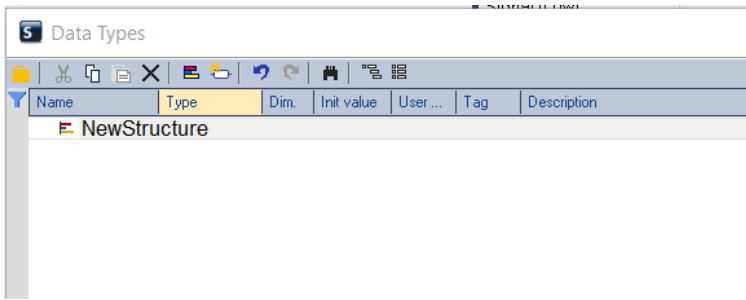
Open the data structure window by clicking on the icon in the toolbar. The “Data Types” window will open:



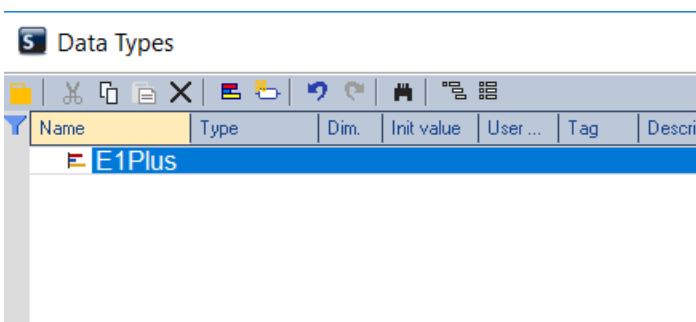
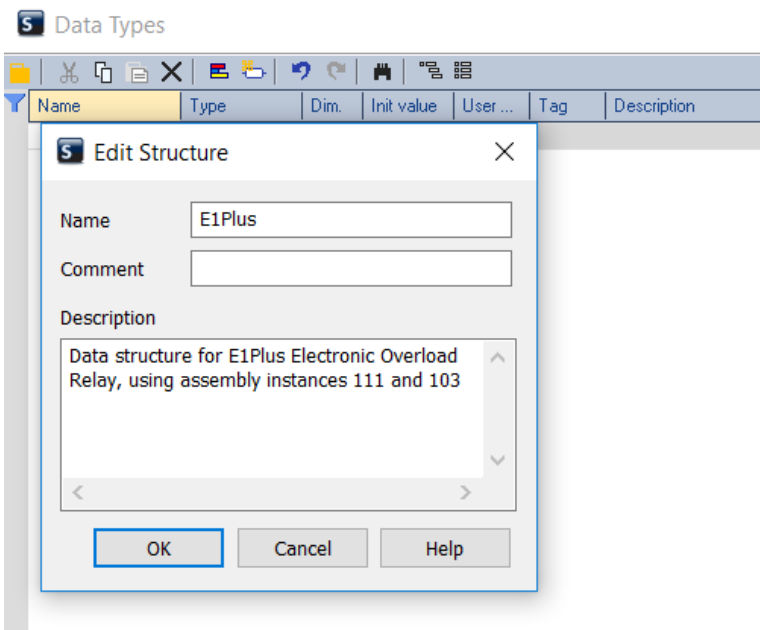
Click the “Insert Type” icon in the toolbar in the Data Type window.



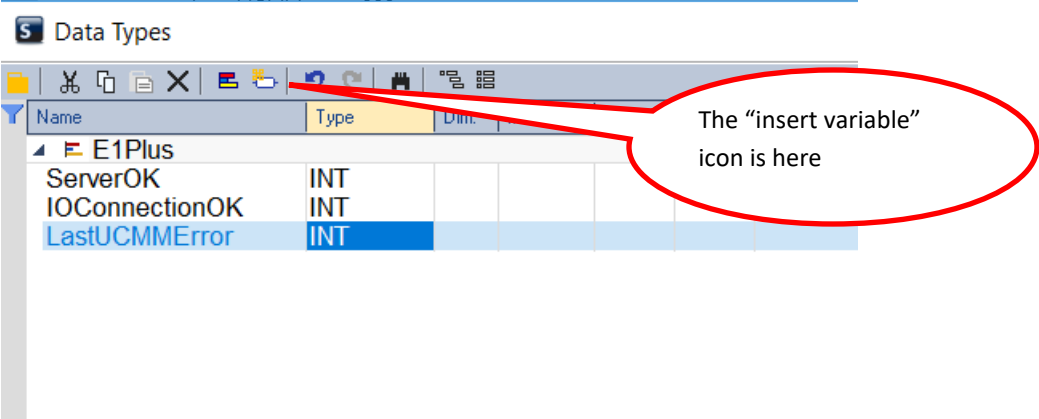
A NewStructure type will be created.



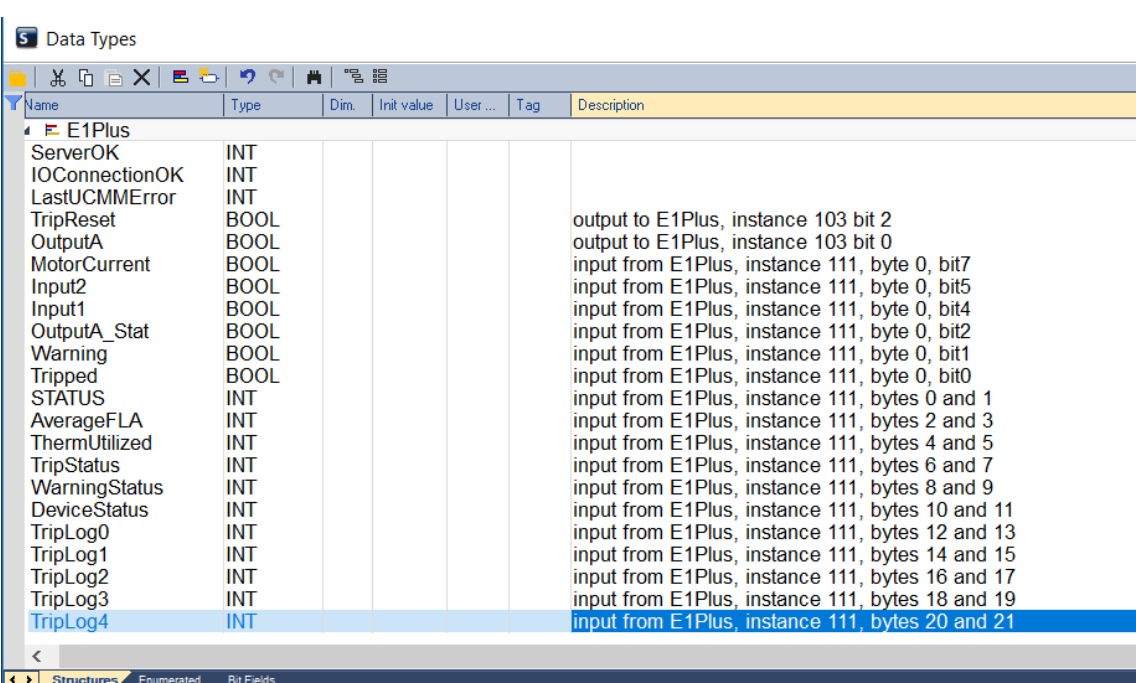
Double click the NewStructure name to bring up the editing box. Enter the name for the structure and a description. Click OK.



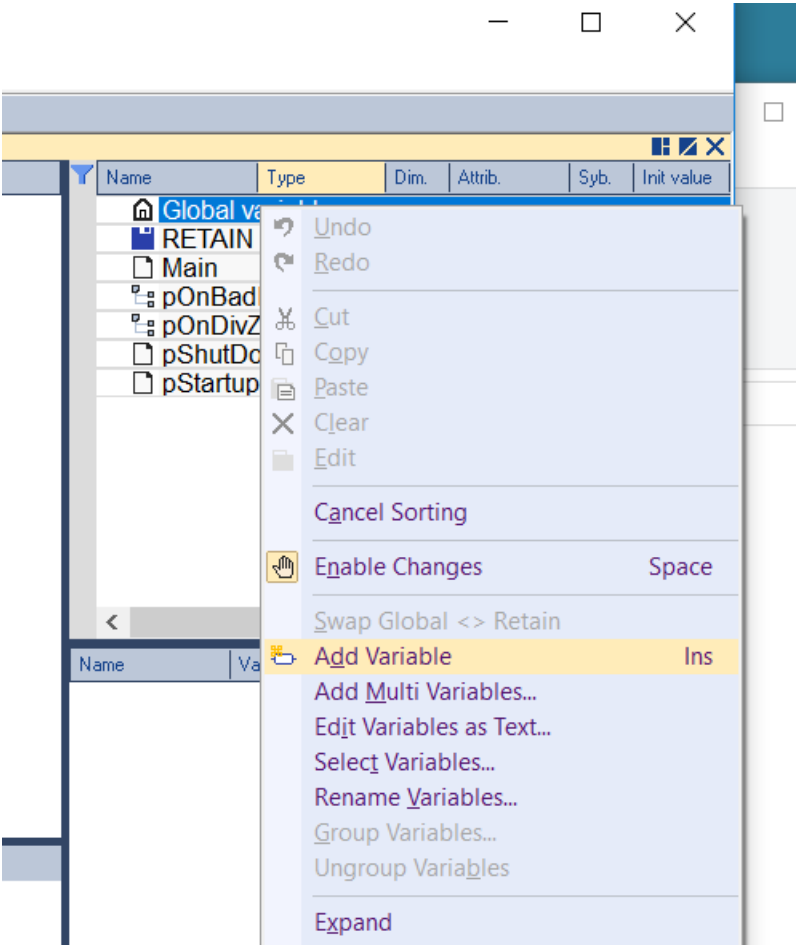
Now we will add the elements to the structure. Use the “Insert Variable” icon to add each element. First add the driver variable names which will be tied later to the driver variables. Set each type to “INT” (integer).



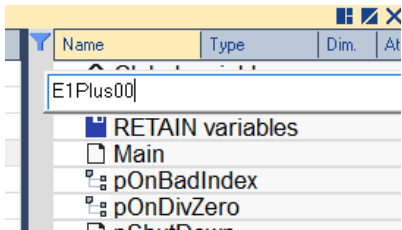
Referring to Table 22 and Table 17 on page 10, add all the other E1Plus parameters, first from Table 17 then from Table 22. “Output I/O” list, then from the “Input I/O—Generic” list. Set the type for each as shown below. Put a description if you want. Close the Data Type window when finished.



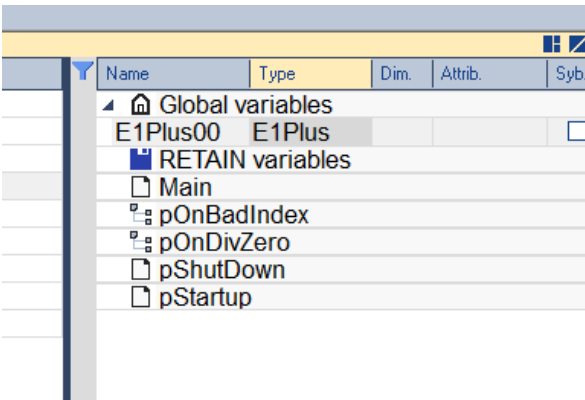
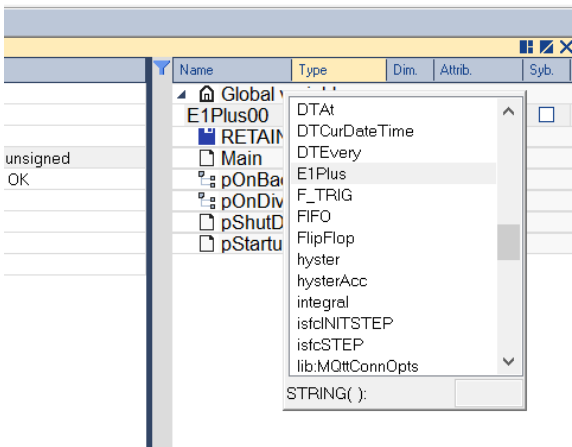
Step 12. Now we will attach the variables we created to the Ethernet/IP drive connection. First we need to create an instance of the structure for this drive. In the variable editing window, highlight “Global Variables” and right click. Select “Add Variable”



A “NewVar” will be created. Double-click on “NewVar” to rename the variable for this first drive. We’ll call it E1Plus00.



Now double-click on the “type” where it says BOOL, and select “E1Plus” from the drop-down box. This is the data structure we previously created.



Next, click and hold on the E1Plus00 name and drag it to the box below the variable list. Then expand the list by clicking the arrow to the left of “E1Plus00”.

| Name | Type | Dim. | Attrib. |
|------------------|--------|------|---------|
| Global variables | | | |
| E1Plus00 | E1Plus | | |
| RETAIN variables | | | |
| Main | | | |
| pOnBadIndex | | | |
| pOnDivZero | | | |
| pShutDown | | | |
| pStartup | | | |

| Name | Value |
|-----------------|-------|
| E1Plus00 | |
| .ServerOK | |
| .IOConnectionOK | |
| .LastUCMMErr | |
| .TripReset | |
| .OutputA | |
| .MotorCurrent | |
| .Input2 | |
| .Input1 | |
| .OutputA_Stat | |
| .Warning | |
| .Tripped | |
| .STATUS | |
| .AverageFLA | |
| .ThermUtilized | |
| .TripStatus | |
| .WarningStatus | |
| .DeviceStatus | |
| .TripLog0 | |
| .TripLog1 | |
| .TripLog2 | |
| .TripLog3 | |
| .TripLog4 | |

We will use this list to drag variable names over to our Ethernet/IP connections. First, drag the three driver variables (one at a time over to their corresponding locations in the “Drive to E1Plus” connection.

| IO Drivers * | |
|--|--|
| Ethernet/IP I/O Scanner (client) | |
| Server 172.18.9.95 - E1 Plus Electronic Overload Relay | |
| [i/o] 111 [22] - E1Plus to ACP1 | |
| Server OK: E1Plus00.ServerOK | |
| I/O connection OK: E1Plus00.IOConnectionOK | |
| LastUCMM error: E1Plus00.LastUCMMErr | |
| [i/o] 103 [1] - ACP1 to E1Plus | |

| Name | Value |
|---------------|-------|
| Symbol | E1 |
| Offset | 0 |
| Bit | 0 |
| Format | Bi |
| Mode | Le |
| Range (Low) | |
| Range (High) | |
| Signal (Low) | |
| Signal (High) | |



Next highlight the “ACP1 to E1Plus” connection. In the variable list, highlight the .TripReset and .OutputA variables. Drag these into the pane beneath the Ethernet/IP connections.

IO Drivers *

Ethernet/IP I/O Scanner (client)

Server 172.18.9.95 - E1 Plus Electronic Overload Relay

[i/o] 111 [22] - E1Plus to ACP1

Server OK: E1Plus00.ServerOK

I/O connection OK: E1Plus00.IOCConnectionOK

Last UCM error: E1Plus00.LastUCMMErr

[i/o] 103 [1] - ACP1 to E1Plus

| Name | Value |
|------------------|-------------------------------------|
| Type | I/O: Outputs (Originator to... |
| Instance | 103 |
| Size | 1 |
| Connection ty... | Point to point |
| Priority | High |
| 32 bit header | <input checked="" type="checkbox"/> |
| RPI (ms) | 100 |
| Description | ACP1 to E1Plus |


| Symbol | Offset | Bit | Format | Mode | Range |
|--------------------|--------|-----|--------|---------------|-------|
| E1Plus00.TripReset | 0 | 0 | Bit | Data exchange | |
| E1Plus00.OutputA | 0 | 0 | Bit | Data exchange | |

| Name | Type |
|---------------|------|
| Global variab | |
| E1Plus00 | E1PI |
| RETAIN vari | |
| Main | |
| pOnBadInde | |
| pOnDivZero | |
| pShutDown | |
| pStartup | |

| Name |
|------------------|
| E1Plus00 |
| .ServerOK |
| .IOCConnectionOK |
| .LastUCMMErr |
| .TripReset |
| .OutputA |
| .MotorCurrent |

For the E1Plus00.TripReset variable, double-click in the “bit” column and change the bit from 0 to 2, since this is bit 2 in byte 0 (see Table 17 on page 10).

| Symbol | Offset | Bit | Format | Mode |
|--------------------|--------|-----|--------|---------------|
| E1Plus00.TripReset | 0 | 2 | Bit | Data exchange |
| E1Plus00.OutputA | 0 | 0 | Bit | Data exchange |



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Step 13. Now repeat step 12, assigning the variables beginning with “MotorCurrent” and ending with “TripLog4” to the “E1Plus to ACP1” connection. Set the “offsets”, “bits”, and “formats” as shown below (from Table 22 on page 10).

IO Drivers *

Ethernet/IP I/O Scanner (client)

Server 172.18.9.95 - E1 Plus Electronic Overload Relay

[I/O] 111 [22] - E1Plus to ACP1

Server OK: E1Plus00.ServerOK

I/O connection OK: E1Plus00.IOCConnectionOK

Last UCMM error: E1Plus00.LastUCMMError

0.7: E1Plus00.MotorCurrent

0.5: E1Plus00.Input2

0.4: E1Plus00.Input1


0.2: E1Plus00.OutputA_Stat

0.1: E1Plus00.Warning

0.0: E1Plus00.TripLog4

| Name | Value |
|------------------|--------------------------------|
| Type | I/O: Inputs (Target to orig... |
| Instance | 111 |
| Size | 22 |
| Connection ty... | Point to point |
| Priority | High |
| 32 bit header | <input type="checkbox"/> |
| RPI (ms) | 100 |
| Description | E1Plus to ACP1 |

| Symbol | Offset | Bit | Format | Mode | Range |
|--------------------------|--------|-----|-------------------|-------------------|-------|
| E1Plus00.ServerOK | 0 | 0 | 16 bit - unsigned | Server OK | |
| E1Plus00.IOCConnectionOK | 0 | 0 | 16 bit - unsigned | I/O connection OK | |
| E1Plus00.LastUCMMError | 0 | 0 | 16 bit - unsigned | Last UCMM error | |
| E1Plus00.MotorCurrent | 0 | 7 | Bit | Data exchange | |
| E1Plus00.Input2 | 0 | 5 | Bit | Data exchange | |
| E1Plus00.Input1 | 0 | 4 | Bit | Data exchange | |
| E1Plus00.OutputA_Stat | 0 | 2 | Bit | Data exchange | |
| E1Plus00.Warning | 0 | 1 | Bit | Data exchange | |
| E1Plus00.Tripped | 0 | 0 | Bit | Data exchange | |
| E1Plus00.STATUS | 0 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.AverageFLA | 2 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.ThermUtilized | 4 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripStatus | 6 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.WarningStatus | 8 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.DeviceStatus | 10 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripLog0 | 12 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripLog1 | 14 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripLog2 | 16 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripLog3 | 18 | 0 | 16 bit - unsigned | Data exchange | |
| E1Plus00.TripLog4 | 20 | 0 | 16 bit - unsigned | Data exchange | |



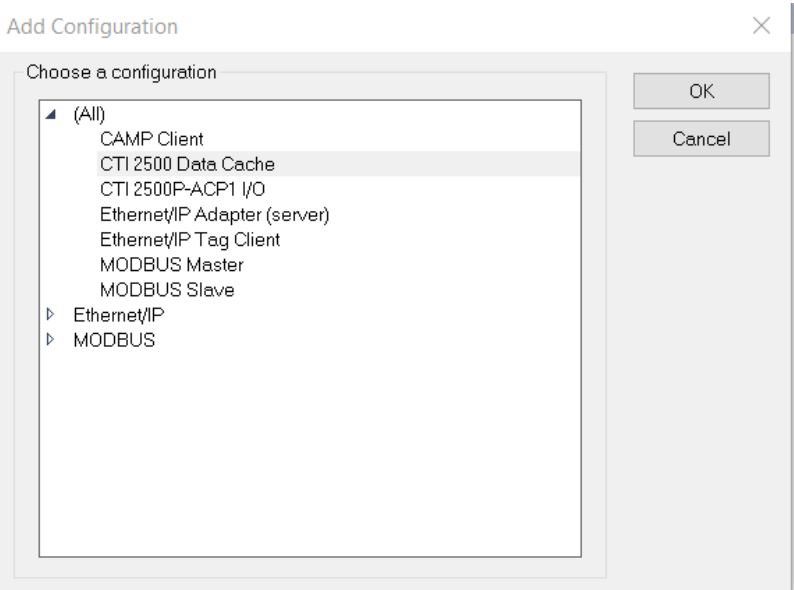
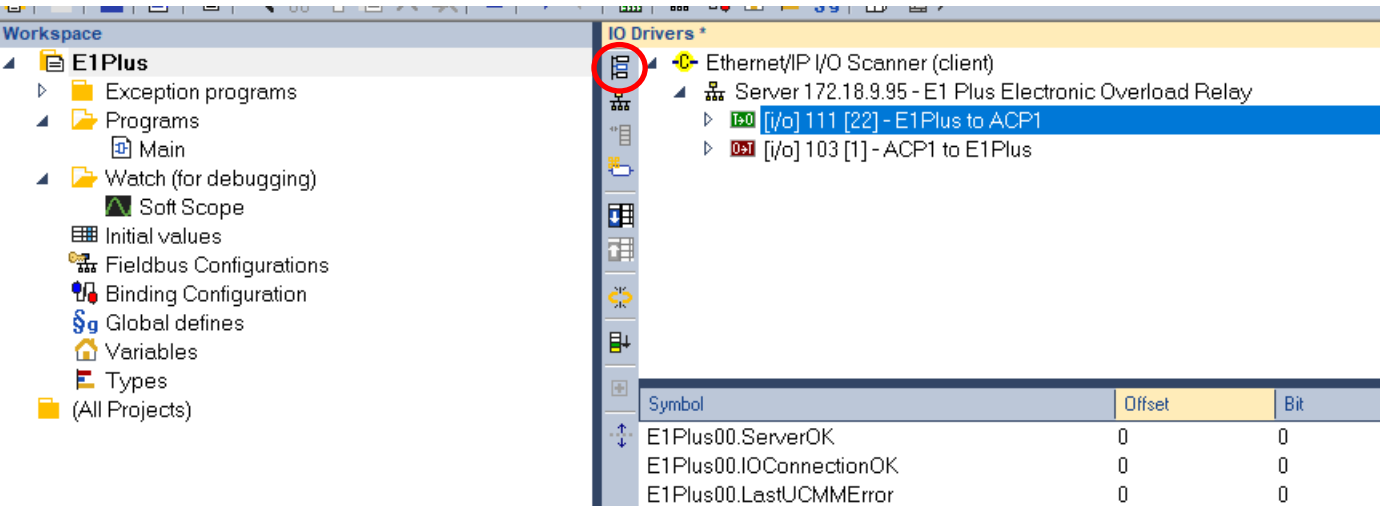
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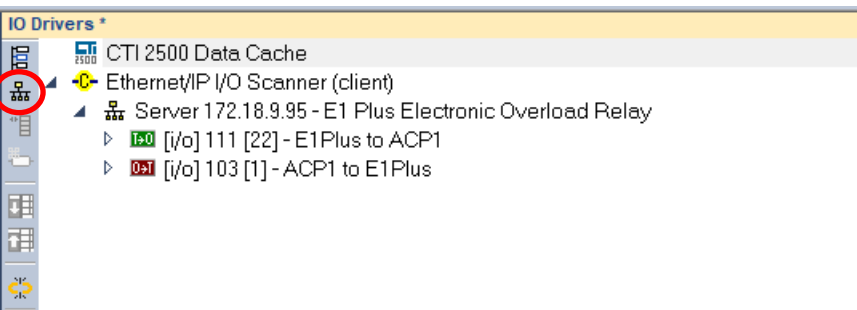
Step 14. OPTIONAL -do this step only if you want to read the drive setup data from a PLC and write the drive status data back to a PLC.

Open the fieldbus editing screen.

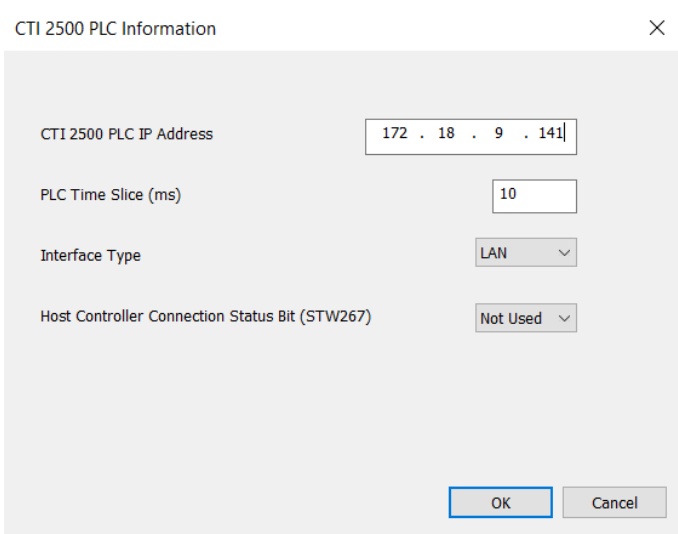
Click on the “Insert Configuration” icon. From the dropdown list, select CTI 2500 Data Cache. Then click OK.



Next, click the “Insert Master/Port” icon.



Complete the IP address information for the Host PLC you will be communicating with. Then click OK.



CTI 2500 PLC Information

CTI 2500 PLC IP Address: 172 . 18 . 9 . 141

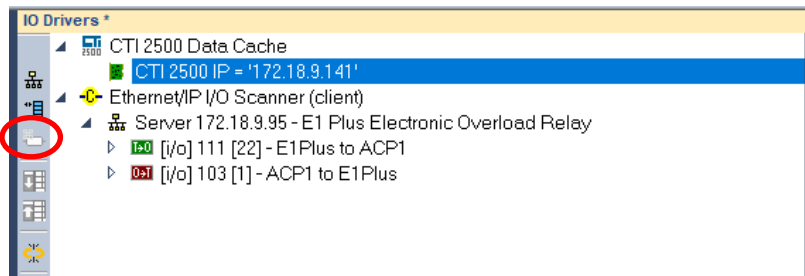
PLC Time Slice (ms): 10

Interface Type: LAN

Host Controller Connection Status Bit (STW267): Not Used

OK Cancel

Click on the “Insert Slave/Data Block” icon.



IO Drivers *

CTI 2500 Data Cache

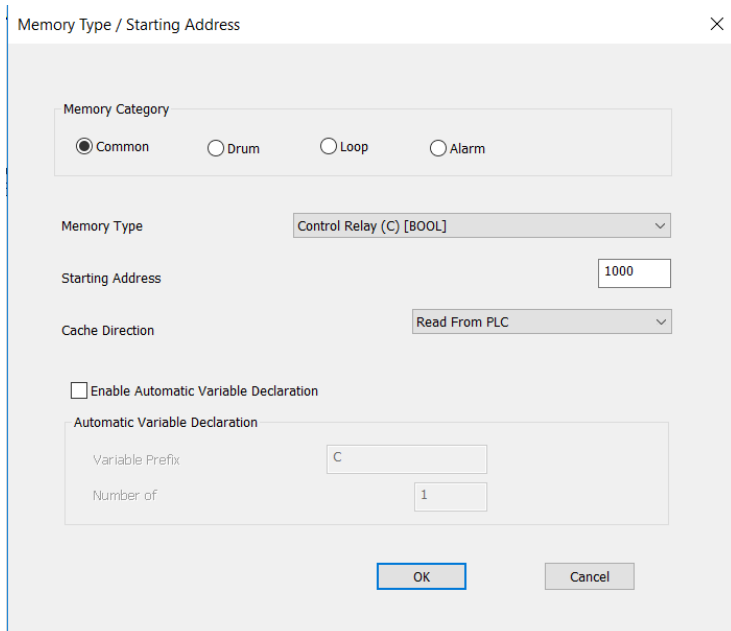
CTI 2500 IP = '172.18.9.141'

Ethernet/IP I/O Scanner (client)

Server 172.18.9.95 - E1 Plus Electronic Overload Relay

- [i/o] 111 [22] - E1Plus to ACP1
- [i/o] 103 [1] - ACP1 to E1Plus

Complete the information for memory type and starting address. Here we will read the drive command information from C-memory starting at C1000.



Memory Type / Starting Address

Memory Category

☒ Common ☐ Drum ☐ Loop ☐ Alarm

Memory Type: Control Relay (C) [BOOL]

Starting Address: 1000

Cache Direction: Read From PLC

☐ Enable Automatic Variable Declaration

Automatic Variable Declaration

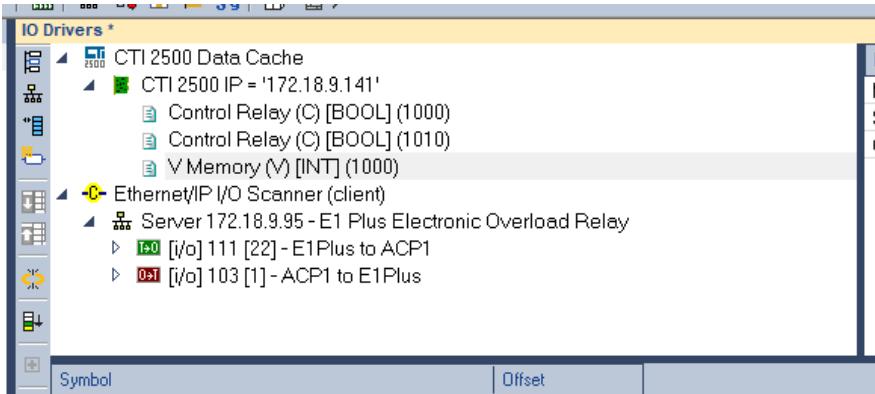
Variable Prefix: C

Number of: 1

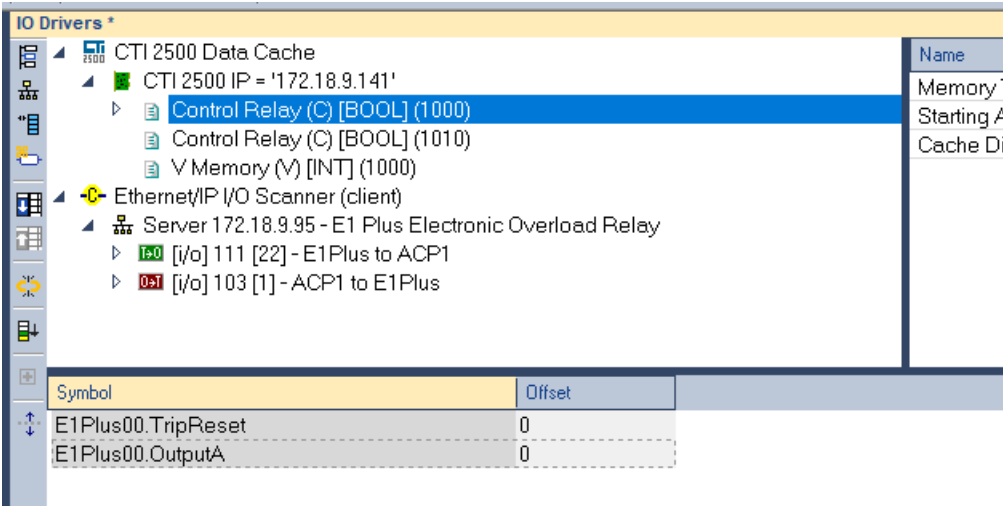
OK Cancel



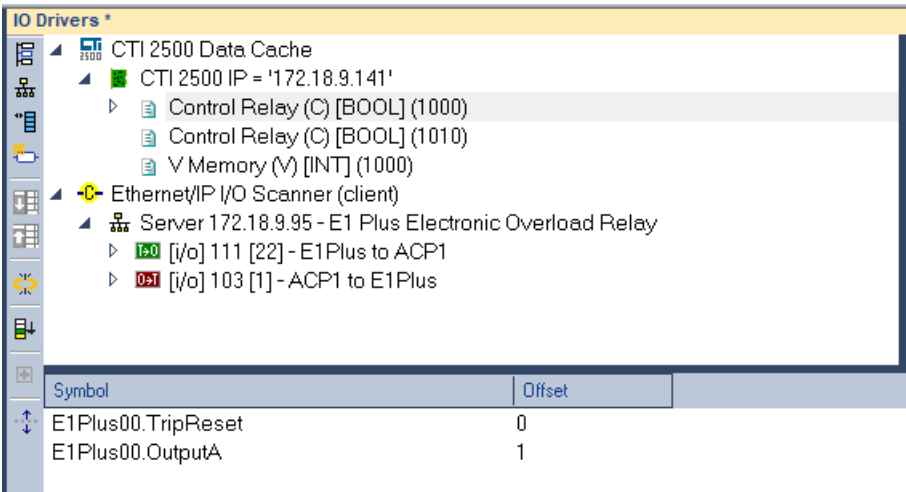
Click OK to proceed. Repeat the process to add a “Write to C-memory” block beginning at C1010. Repeat the process to add a “Write to V-memory” block beginning at V1000. This is where we’ll store the data read from the drive.



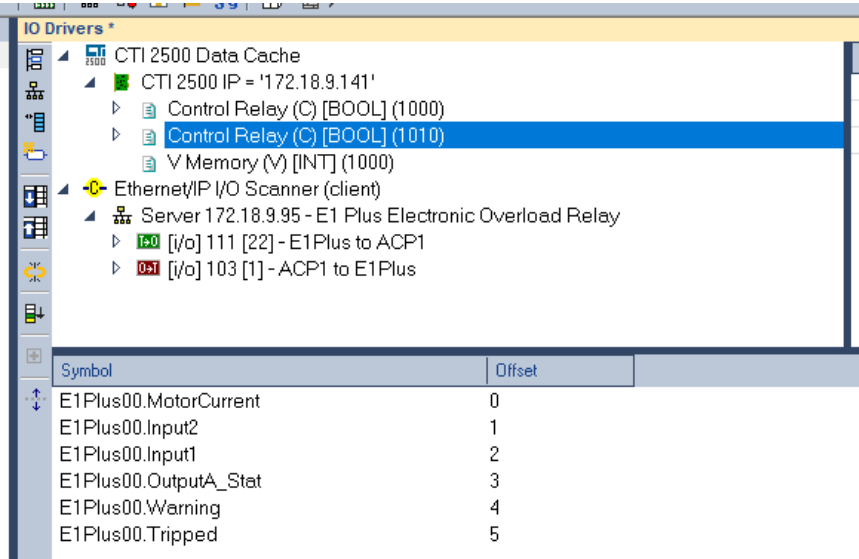
Now we will use the same “drag and drop” procedure we used in step 12, to populate the variables read from / written to the PLC. First highlight the “Read from Control Relay” block (the first block). From the variable list at the right, highlight the variables “.TripReset” and “.OutputA”. Drag these into the box below the fieldbus configurations:



Right-click the “Read from Control Relay” block and select “Renumber Offsets”. This will renumber the items into consecutive C-memory addresses.

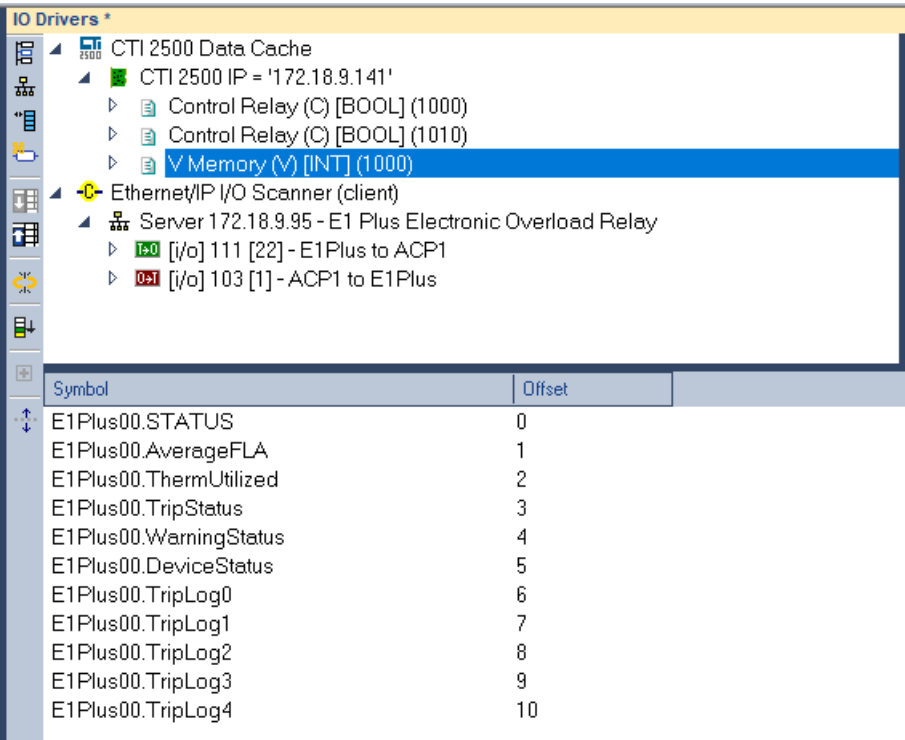


Now highlight the “Write to Control Relay” block (the second block). From the variable list at the right, highlight the variables “.MotorCurrent” through “.Tripped”. Drag these into the box below the fieldbus configurations. Do a renumber as we did in the previous step. The result should look like this:



| Symbol | Offset |
|-----------------------|--------|
| E1Plus00.MotorCurrent | 0 |
| E1Plus00.Input2 | 1 |
| E1Plus00.Input1 | 2 |
| E1Plus00.OutputA_Stat | 3 |
| E1Plus00.Warning | 4 |
| E1Plus00.Tripped | 5 |

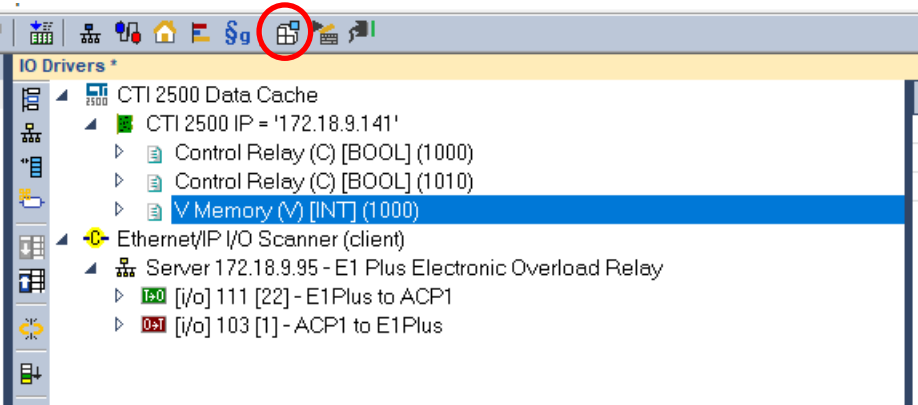
Repeat this process to populate the variables of “STATUS” through “TripLog4” to the Write to V-Memory block (third block). Do a renumber. The result should look like this:



| Symbol | Offset |
|------------------------|--------|
| E1Plus00.STATUS | 0 |
| E1Plus00.AverageFLA | 1 |
| E1Plus00.ThermUtilized | 2 |
| E1Plus00.TripStatus | 3 |
| E1Plus00.WarningStatus | 4 |
| E1Plus00.DeviceStatus | 5 |
| E1Plus00.TripLog0 | 6 |
| E1Plus00.TripLog1 | 7 |
| E1Plus00.TripLog2 | 8 |
| E1Plus00.TripLog3 | 9 |
| E1Plus00.TripLog4 | 10 |

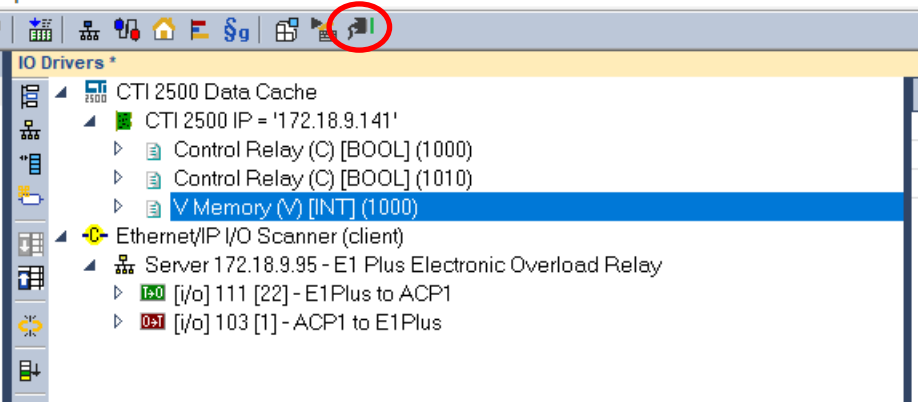


Step 15: Compile and Download. To compile, click the “Compile” icon at the top.

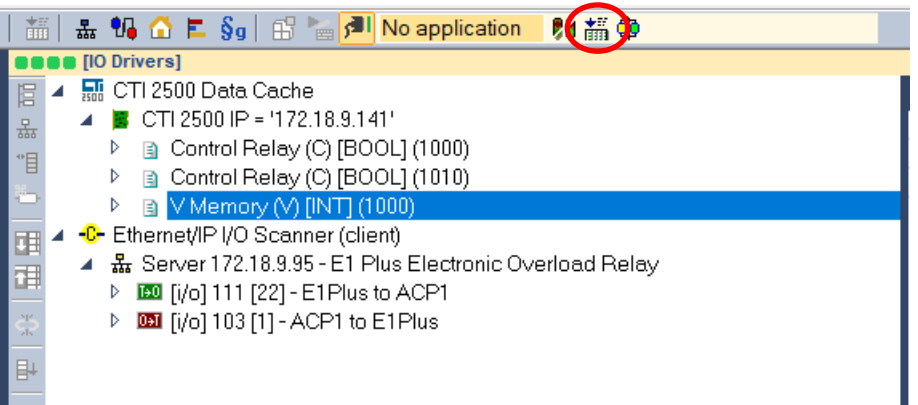


If there are no compile errors (shown in red in the “build” tab at the bottom), then we’re ready to download and run.

Click the “Online” icon at the top.



Then click the “download” icon:



After the download completes, click the “resume cycle to cycle” icon to start the program:

