

FANUC Robot **series**

**R-30*i*B Plus/R-30*i*B Mate Plus/
R-30*i*B Compact Plus CONTROLLER**

PLC Motion Interface OPERATOR'S MANUAL

B-84094EN/01

- **Original Instructions**

Thank you very much for purchasing FANUC Robot.

Before using the Robot, be sure to read the "FANUC Robot SAFETY HANDBOOK (B-80687EN)" and understand the content.

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan.

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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters. There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume. It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

SAFETY PRECAUTIONS

This chapter must be read before using the robot.

For detailed functions of the robot operation, read the relevant operator's manual to understand fully its specification.

For the safety of the operator and the system, follow all safety precautions when operating a robot and its peripheral equipment installed in a work cell.

For safe use of FANUC robots, you must read and follow the instructions in “FANUC Robot SAFETY HANDBOOK (B-80687EN)”.

1 DEFINITION OF USER

The personnel can be classified as follows.

Operator:

- Turns the robot controller power on/off
- Starts the robot program from operator panel

Programmer or Teaching operator:

- Operates the robot
- Teaches the robot inside the safety fence

Maintenance engineer:

- Operates the robot
 - Teaches the robot inside the safety fence
 - Maintenance (repair, adjustment, replacement)
-
- Operator is not allowed to work in the safety fence.
 - Programmer/Teaching operator and maintenance engineer is allowed to work in the safety fence. Works carried out in the safety fence include transportation, installation, teaching, adjustment, and maintenance.
 - To work inside the safety fence, the person must be trained on proper robot operation.

Table 1 lists the work outside the safety fence. In this table, the symbol “○” means the work allowed to be carried out by the worker.

Table 1 List of work outside the fence

	Operator	Programmer or Teaching operator	Maintenance engineer
Turn power ON/OFF to Robot controller	○	○	○
Select operating mode (AUTO, T1, T2)		○	○
Select remote/local mode		○	○
Select robot program with teach pendant		○	○
Select robot program with external device		○	○
Start robot program with operator's panel	○	○	○
Start robot program with teach pendant		○	○
Reset alarm with operator's panel		○	○
Reset alarm with teach pendant		○	○
Set data on teach pendant		○	
Teaching with teach pendant		○	
Emergency stop with operator's panel	○	○	○
Emergency stop with teach pendant	○	○	○
Maintain for operator's panel		○	
Maintain for teach pendant			○

In the robot operating, programming and maintenance, the operator, programmer/teaching operator and maintenance engineer take care of their safety using at least the following safety protectors.

- Use clothes, uniform, overall adequate for the work
- Safety shoes
- Helmet

2 DEFINITION OF SAFETY NOTATIONS

To ensure the safety of users and prevent damage to the machine, this manual indicates each precaution on safety with "**WARNING**" or "**CAUTION**" according to its severity. Supplementary information is indicated by "**NOTE**". Read the contents of each "**WARNING**", "**CAUTION**" and "**NOTE**" before using the robot.

Symbol	Definitions
 WARNING	Used if hazard resulting in the death or serious injury of the user will be expected to occur if he or she fails to follow the approved procedure.
 CAUTION	Used if a hazard resulting in the minor or moderate injury of the user, or equipment damage may be expected to occur if he or she fails to follow the approved procedure.
NOTE	Used if a supplementary explanation not related to any of WARNING and CAUTION is to be indicated.

- Check this manual thoroughly, and keep it handy for the future reference.

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1 PLC Motion INTERFACE OVERVIEW

1.1 OVERVIEW / DESCRIPTION

PLC Motion Interface provides a set of FANUC supplied Add-On Instructions (AOI) that allow a Programmable Logic Controller (PLC) to read the robot controller's status and issue motion commands to the robot. A PLC AOI can be deemed as a vendor supported function call that has well defined input/output parameters with a well-defined state transition diagram. Using these FANUC supplied AOIs, experienced PLC programmers can easily program a FANUC robot using PLC logic without creating TP programs on the robot controller.

The PLC Motion Interface has three parts: a set of FANUC AOIs for PLC, an EtherNet/IP transport and Robot controller PLC interfacing software.

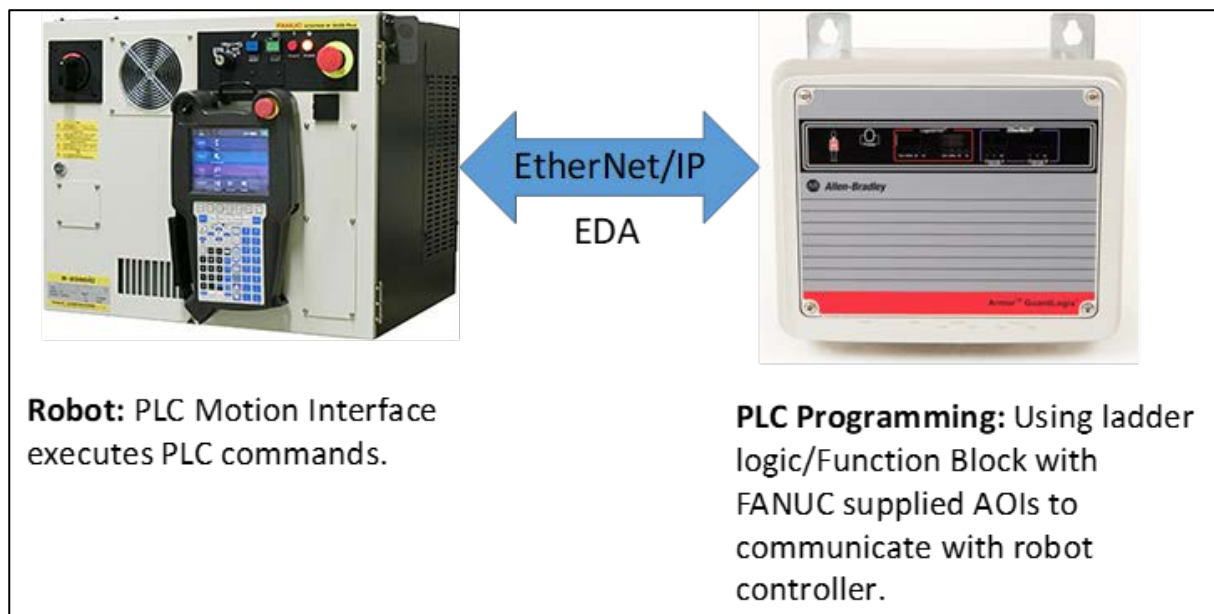


Fig. 1.1 PLC Motion Interface

The target market for this software is material handling with simple pick and place operations. The software is not designed for complicated processes that use real time sensor feedback to dynamically adjust the robot path, such as arc welding applications.

The FANUC PLC AOIs are designed to be PLCopen compliant, and therefore follow the standard defined by IEC 61131-3. Some robot specific functions, such as time before or distance before, are not defined by PLCopen. They are, none the less, important in robot applications, such as to open the gripper before the robot reaches its destination. Therefore, additional AOIs have been created to support these operations.

1.2 HARDWARE AND SOFTWARE REQUIREMENTS

1.2.1 PLC Controller

The new FANUC PLC AOIs are designed to work with Rockwell Studio 5000 and Rockwell/Allen-Bradley PLCs with version 30 or later firmware.

1.2.2 Robot Controller Software

An R30iB Plus or an R30iB Mate Plus controller with HandlingTool and the following software options:

- R784: Ethernet IP Adapter
- R822: Ethernet IP EDA
- R892: PLC Motion Interface

1.2.3 Communication

The PLC Motion Interface requires the following hardware:

- Ethernet connection with PLC controller

1.2.4 Compatibility

The PLC Motion Interface software is compatible with DCS, collision guard, and most other HandlingTool software options. However, this software is not designed for arc welding, sealing, spot welding, or painting applications.

As described in the next section, PLC Motion Interface uses fixed EDA Connection1 to communicate with the PLC and this connection cannot be changed.

NOTE

This option should not be installed if the existing EDA/EtherNet IP configuration cannot be modified.

1.3 LIMITATIONS

1.3.1 EtherNet/IP EDA Definition

The FANUC PLC Motion Interface option uses the robot controller's EtherNet/IP Adapter (R784) and EDA (R822) options to establish Ethernet communication between the robot controller and the PLC. Based on the EDA configuration, the EDA option creates an L5X file for Studio 5000 for the necessary TAG and user defined data types (UDT) for all the FANUC AOIs. Therefore, the attributes named in the EDA configuration file (EIPCFG.XML) are important since the TAGs are created based on these attributes.

Since the R30iB Plus and R30iB Mate Plus robot controllers have only one EDA configuration for its PLC/Ethernet IP connections, adding the FANUC PLC motion Interface to a robot controller with an existing EDA connection creates conflicts between the PLC Motion Interface and the existing EDA. Users should install the FANUC PLC motion Interface option only if they are willing to modify their existing EDA configuration.

NOTE

The PLC Motion Interface uses EDA Connection1. Therefore, connection 1 and its data mapping should not be modified. If you need EDA for other purposes, please use Connection2, Connection3, or Connection4.

If changing the existing EDA configuration is possible, you can install the PLC Motion Interface (R892). After applying the EIPCFG.XML for PLC Motion Interface, you can use other EDA connections (other than Connection1) to fulfil your I/O requirements.

1.3.2 Single Group Motion

Only one group is supported for the first release. However, extended axes are supported.

1.3.3 Hot Start

Hot start is not allowed for a controller running the PLC Motion interface software. If hot start is set to true, the PLC Motion Interface will post a “MS-017 Please Cycle Power” error when it receives the FRC_Initialize command. The PLC Motion Interface will disable the hot start so it will work after cycling power.

1.3.4 Short Motion Restriction

FANUC PLC Motion Interface is design for a simple Pick and Place application that does not support very short motion (motion with run time less than 40 ms). When the PLC motion software detects a PLC commanded motion that is shorter than the specified threshold, it will automatically lengthen the motion time to allow the PLC task time to process the motion.

1.3.5 Original Path Resume

The original path resume feature is disabled when the PLC Motion Interface is installed. Therefore, if the robot is jogged away from its path between PLC motion commands, the robot will go directly from its current jogged position to the next PLC command position. It does not go back to the original programed path.

1.3.6 Controller Backup/TP Programs Backup

When the PLC Motion Interface is running, it locks up a TP program to run the PLC motion commands. If you do a file backup or system backup at this time, the backup will fail, since the locked TP program cannot be backed up. You can issue the FRC_Abort PLC command to stop the PLC Motion Interface, thus allowing file backup to proceed.

2 CONTROLLER SETUP

2.1 HOST COMMUNICATION SETUP

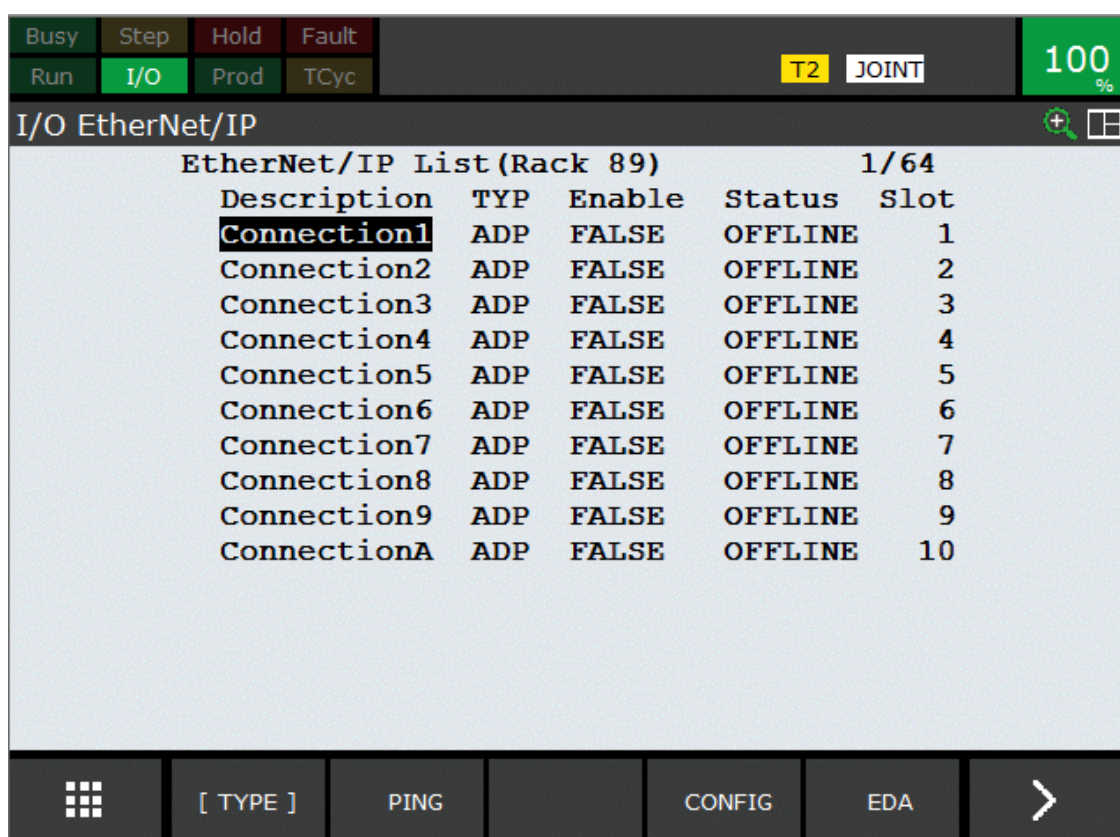
The robot controller should have one port connected to the Ethernet network and the port should be configured with a valid IP address. It is preferred to have the PLC and the robot controller on the same subnet to minimize the transmission delay. For setting up the host communication, please refer to “Ethernet Function OPERATOR’S MANUAL (B-82974EN)”.

2.2 EDA SETUP

The PLC Motion Interface uses Connection1 for its communication with the PLC. The PLC Motion Interface EDA has to be set up first, then additional EDA can be added on. If you have an existing EDA setup on the controller, you will have to redo your existing EDA setting in order to use the PLC Motion Interface.

Please refer to “EtherNet/IP OPERATOR’S MANUAL (B-82854EN)” if you have any question regarding setting up the EDA connection. The following step is for setting up the PLC Motion Interface EDA only. If you have additional EDA connections to setup, please refer to this manual.

To setup the PLC Motion Interface EDA, go to the I/O EtherNet/IP screen under I/O menu. Please set the Enable flag of Connection1 to FALSE so you can modify the EDA setting on Connection1.



Select Connection1 and press F4, CONFIG, to go to the adapter configuration page:

I/O EtherNet/IP + []

Adapter configuration : 1/3

Description : Connection1

Input size (words) : 4

Output size (words) : 4

Alarm Severity : WARN

Scanner IP : *****

API O=>T : 0

API T=>O : 0

[] [TYPE] [] [PREV] [] [?] []

HELP

Please make sure the Input size and Output size is set to 4, as a default. Then go to the DIO configuration menu to setup the corresponding DIO ports on rack 89. Cycle power after the DIO configuration is completed.

The following is an example of the DI configuration after setting up the EtherNet/IP ports.

Busy Step Hold Fault T2 JOINT 100%

Run I/O Prod TCyc

I/O Digital In + []

8/9

#	RANGE	RACK	SLOT	START	STAT.
1	DI [1- 8]	0	1	19	ACTIV
2	DI [9- 16]	0	1	27	ACTIV
3	DI [17- 22]	0	1	35	ACTIV
4	DI [23- 24]	0	0	0	UNASG
5	DI [25- 64]	0	2	1	ACTIV
6	DI [65- 104]	0	3	1	ACTIV
7	DI [105- 144]	0	4	1	ACTIV
8	DI [145- 208]	89	1	1	ACTIV
9	DI [209- 512]	0	0	0	UNASG

Device Name : EthernetIP

[] [TYPE] [MONITOR] [IN/OUT] [DELETE] [?] []

HELP

The DO configuration is similar to the screen that follows:

I/O Digital Out

8/9

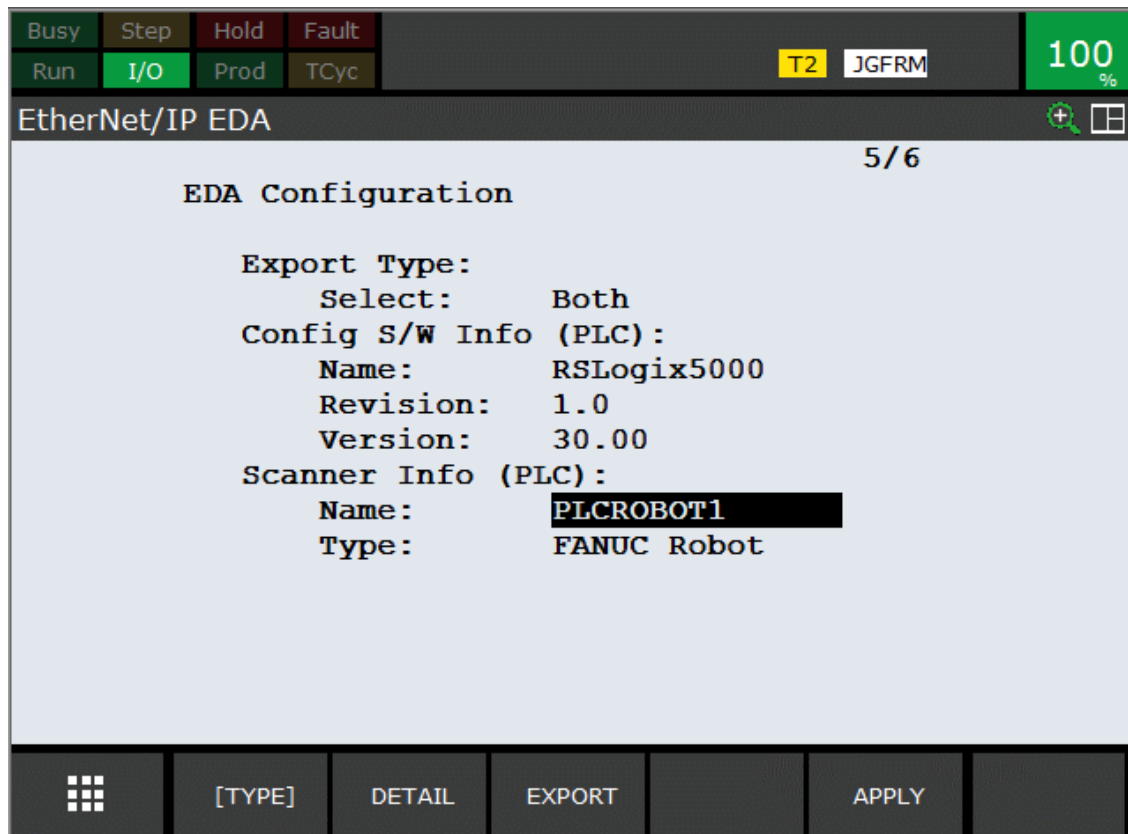
#	RANGE	RACK	SLOT	START	STAT.
1	DO[1- 8]	0	1	21	ACTIV
2	DO[9- 16]	0	1	29	ACTIV
3	DO[17- 20]	0	1	37	ACTIV
4	DO[21- 24]	0	0	0	UNASG
5	DO[25- 64]	0	2	1	ACTIV
6	DO[65- 104]	0	3	1	ACTIV
7	DO[105- 144]	0	4	1	ACTIV
8	DO[145- 208]	89	1	1	ACTIV
9	DO[209- 512]	0	0	0	UNASG

Device Name : EthernetIP

Set the variable, \$IO_AUTO_CFG from TRUE to FALSE. This will prevent auto mapping of DI/DO to RACK 89, SLOT 1, START 1. However, when this is set, users have to manually change the I/O Configuration when they setup additional EDA I/O.

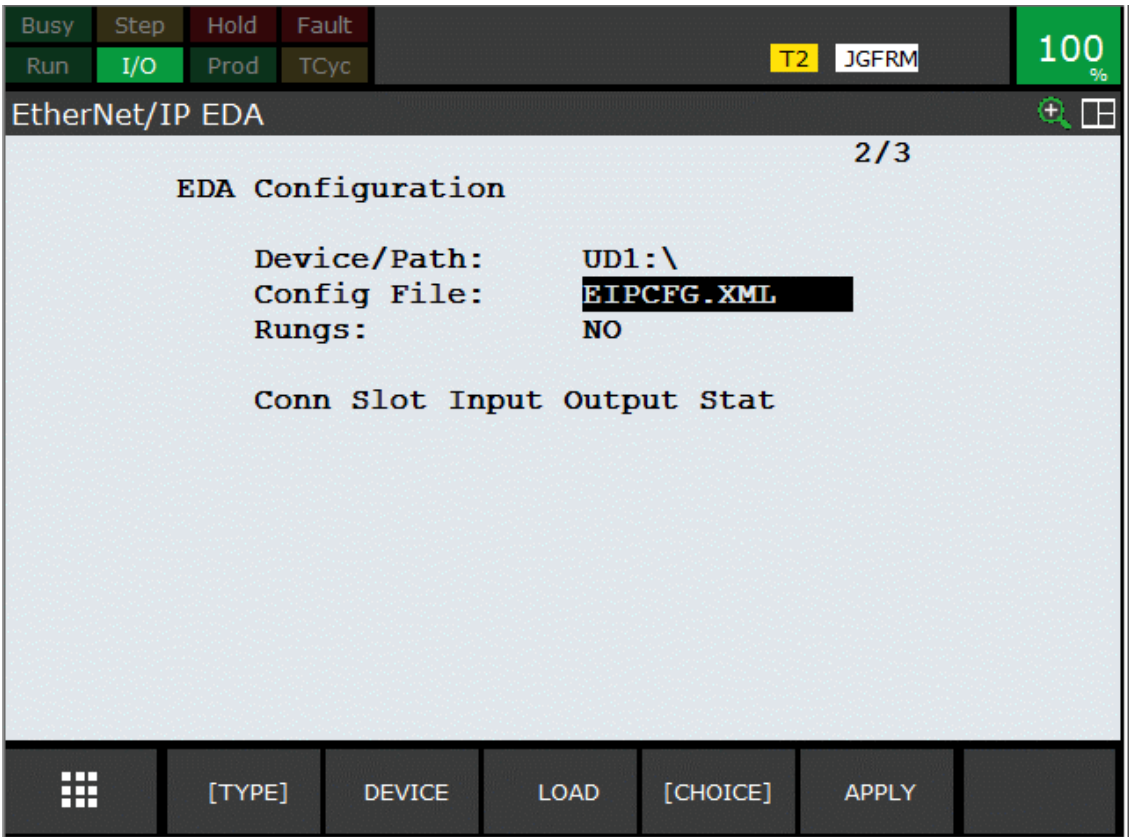
Go back to the EtherNet/IP List page, select connection1 and press the EDA, F5 key. You will see the page below. Make sure the RSLogix5000 version is firmware version 30 or higher and all your settings are similar to the page below. The PLC Scanner name (set at PLCROBOT1 in this example) should match the PLC connection name when you are setting up the PLC FANUC AOP connection in chapter 3. If a PLC is connected to multiple robot controllers, each controller should have its own unique name.

When the Scanner Info (PLC) Type is set to 'FANUC Robot', your Studio 5000 should use the Rockwell AOP for FANUC R30iB Plus V1.39 software in setting up the connection. See section 3.1.2 for more details.

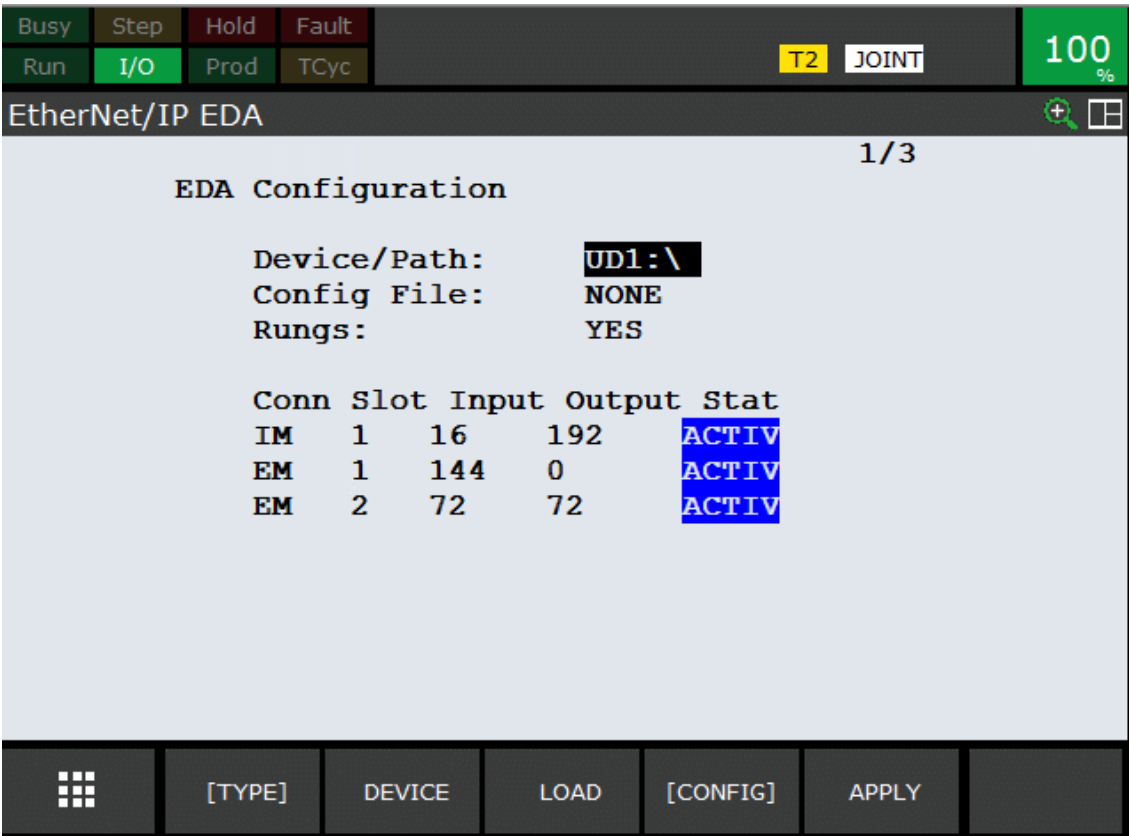


After checking that all of the fields are set correctly, press the DETAIL, F2 key to see the next EDA Configuration.

As shown in the following screen, please select the Device/Path where the PLC Motion Interface's EIPCFG.XML file resides, and select the XML file; then press F3, LOAD. After the load, you will need to Cycle power. You can find the EIPCFG.XML file as part of plcmotionsetup.zip file. The plcmotionsetup.zip file is provided from FANUC representatives.



After cold start, the EDA configuration menu will show the following:



At this point, setting up EDA Connection1 for the PLC Motion Interface is completed. Go back to the EtherNet/IP List page and set the Connection1's enable flag to TRUE. If you want to add more EDA connections to the PLC, you can modify Connection2 and follow the "EtherNet/IP OPERATOR'S MANUAL (B-82854EN)".

NOTE

Please do not edit/modify Connection1. Otherwise, the PLC Motion Interface will not work. Note that the PLC Motion Interface uses explicit message (EM) slot 1 and slot 2. Please do not use these slots when you are setting up your own EDA.

If you only have one connection setup for PLC Motion Interface, you do not need to export the L5X file from EDA menu since PLC Motion Interface option comes with a L5X file in its software load media. However, if you add other connections, you need to export the L5X file from EDA menu and use that L5X file to selectively import tags and UDTs into your Studio 5000 project that are required for the setup of additional connections.

3 FANUC AOIS SETUP

This section shows you how to set up your PLC project to use FANUC's AOIs. FANUC only supports Allen Bradley PLCs at this time and, therefore, we assume the reader is familiar with Rockwell Studio 5000 software.

It is important that your FANUC AOI version matches the robot controller's software. If the versions do not match, the robot controller will post an "Invalid PLC AOI version" error. Therefore, if you auto updated your controller's software, you will need to import the FANUC AOI from your software load media to your Studio 5000 project again so the versions match.

3.1 AOI INSTALLATION

3.1.1 Import FANUC AOIs

You can find FANUC AOI and its associated files are provided from FANUC representatives. The file name is plcmotionsetup.zip file. After unzipping the plcmotionsetup, you will find the following files:

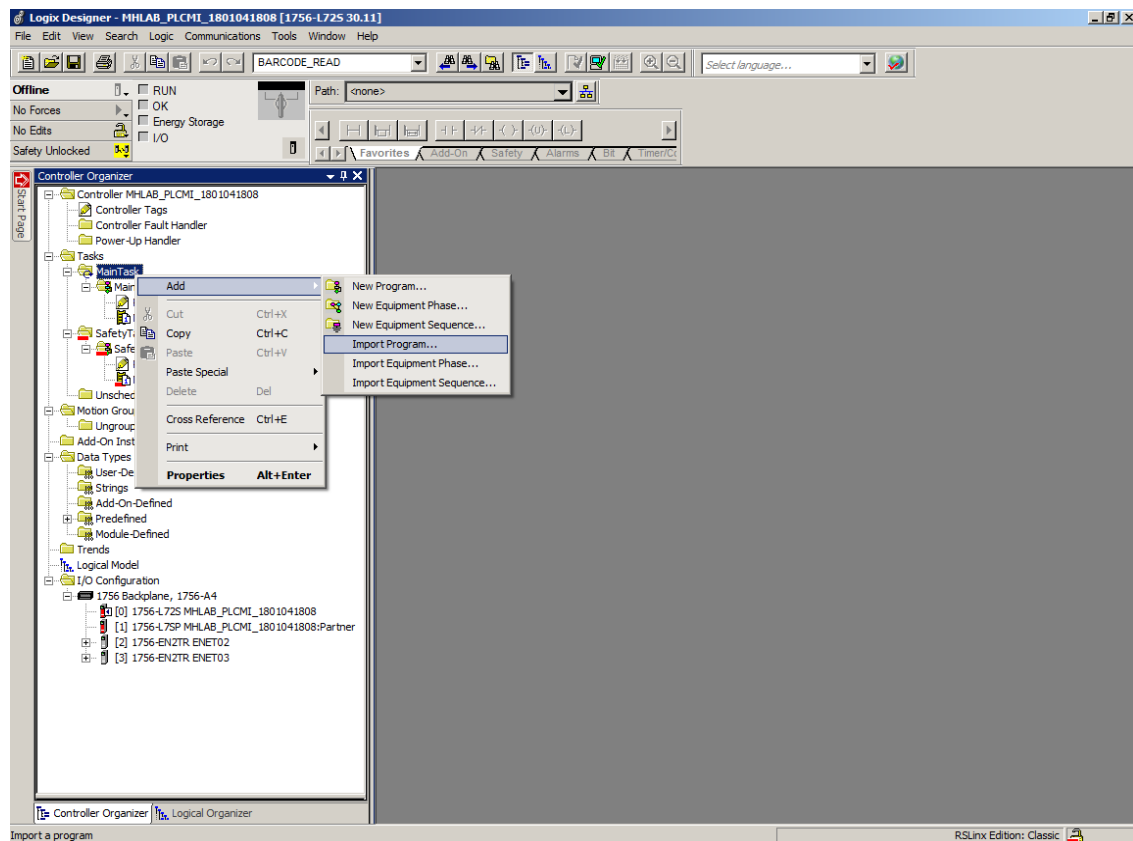
1. EIPCFG.xml
2. FANUC_AOIs_v1.0_L5x
3. plcrobot1.L5x

The EIPCFG.xml file is used to set EDA Connection1 on the robot controller. Please refer to section 2.2 EDA SETUP for details.

The FANUC_AOIs_v1_0.L5X is the FANUC AOI file for Studio 5000. The plcrobot1.L5X has all the tags required for FANUC AOIs. You will need to import both files to your Studio 5000 project.

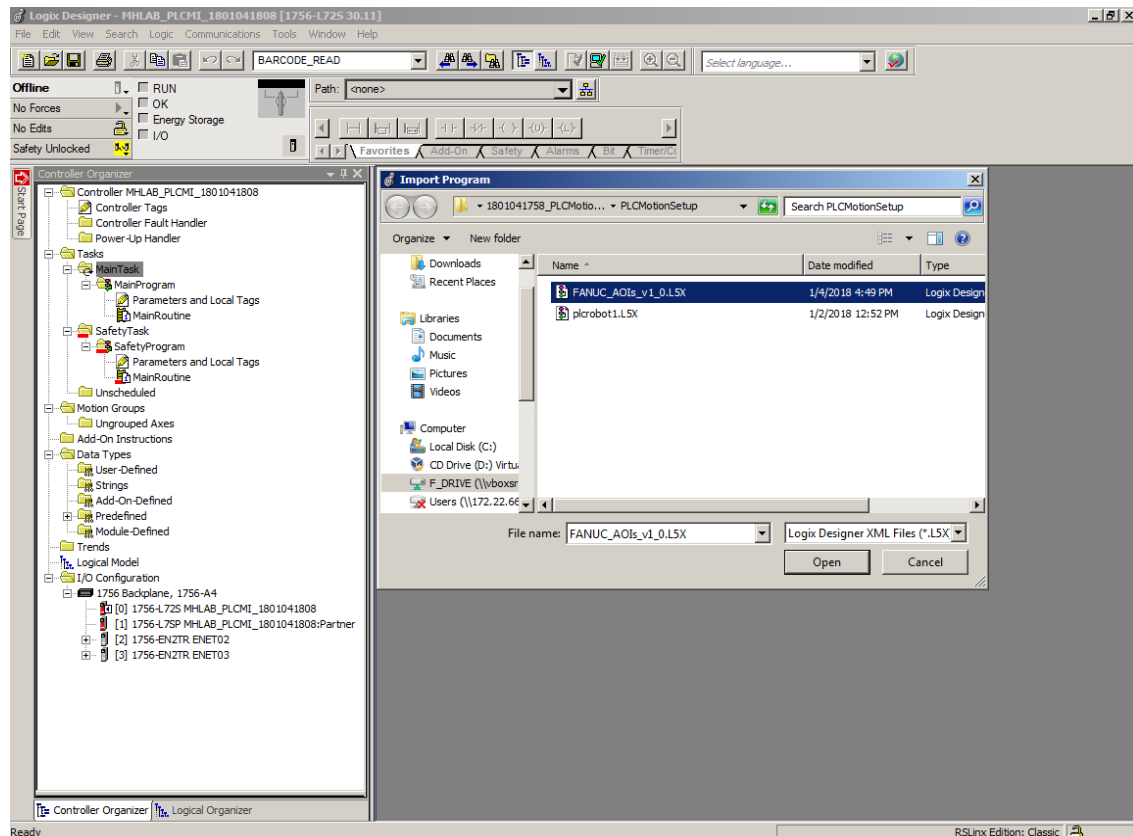
Please follow the steps outlined below to install the FANUC AOIs.

1. Import the FANUC_AOIs_v1_0.L5X to Studio 5000 as shown below.

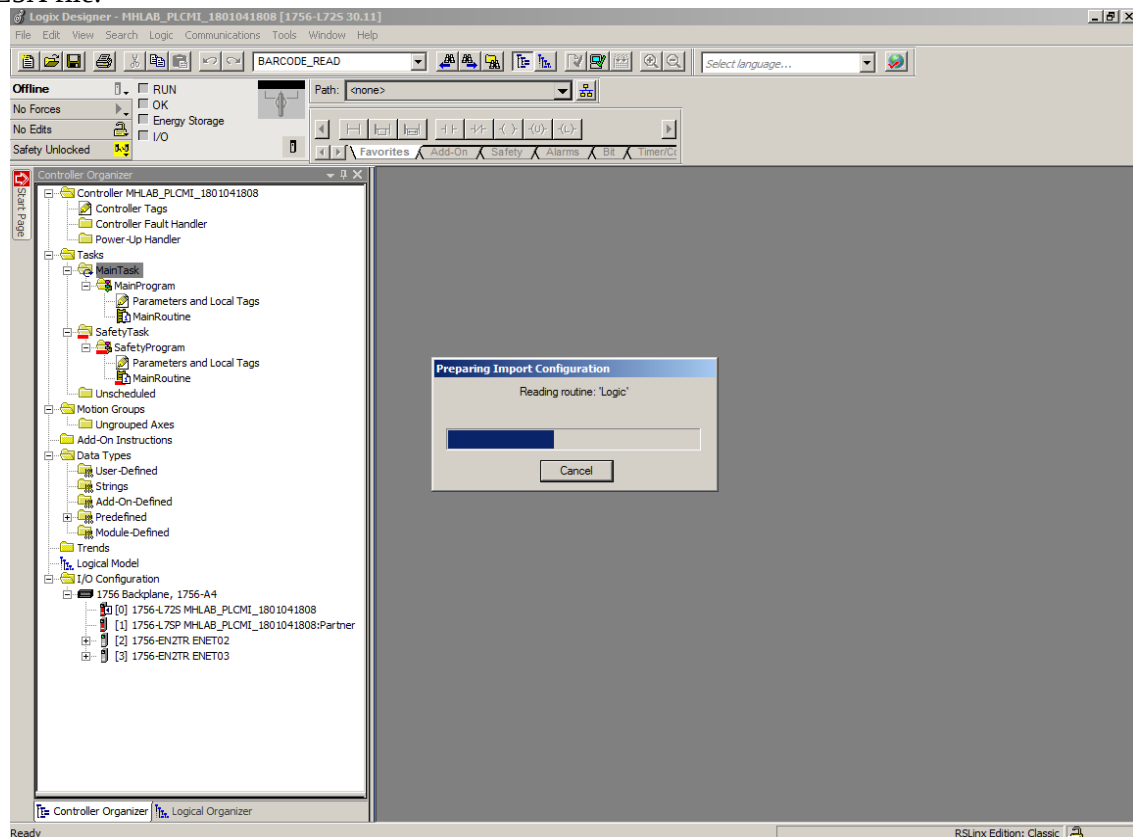


Studio 5000 shows a file page and all the available L5X files in the directory.

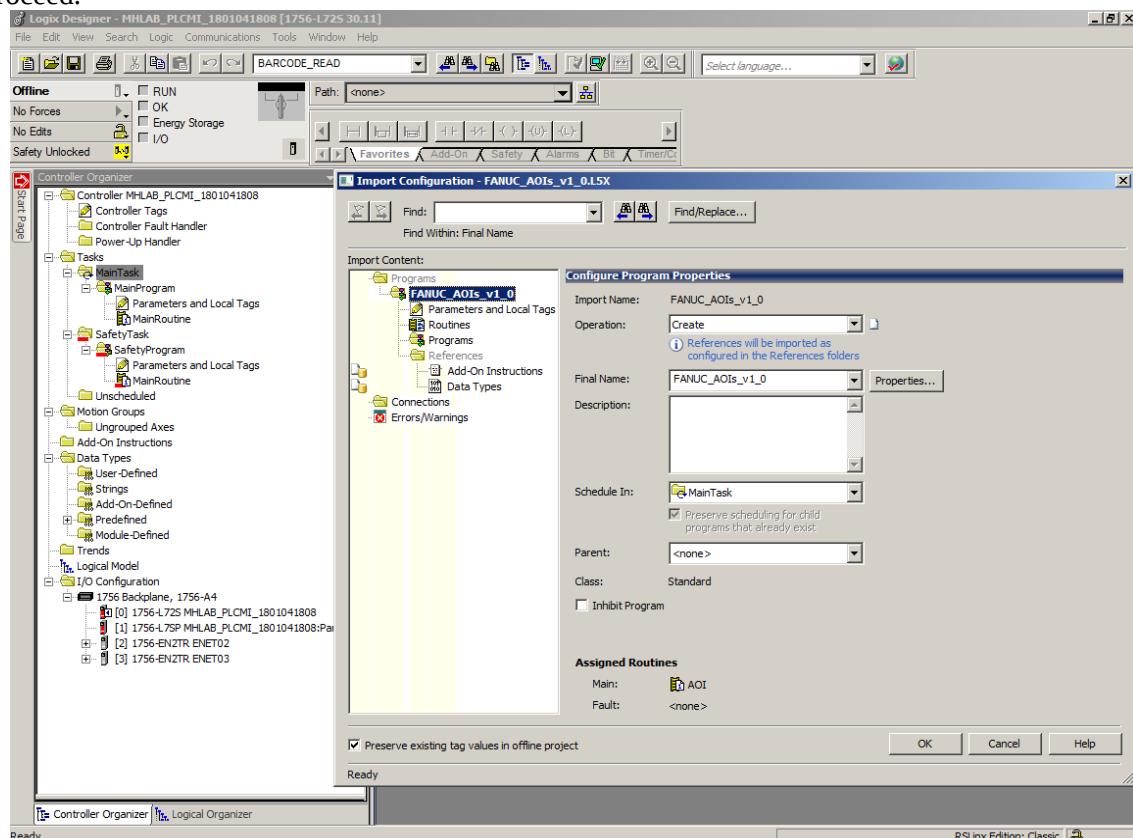
Change the directory where your FANUC_AOIs_v1.0_L5x is located and select the file.

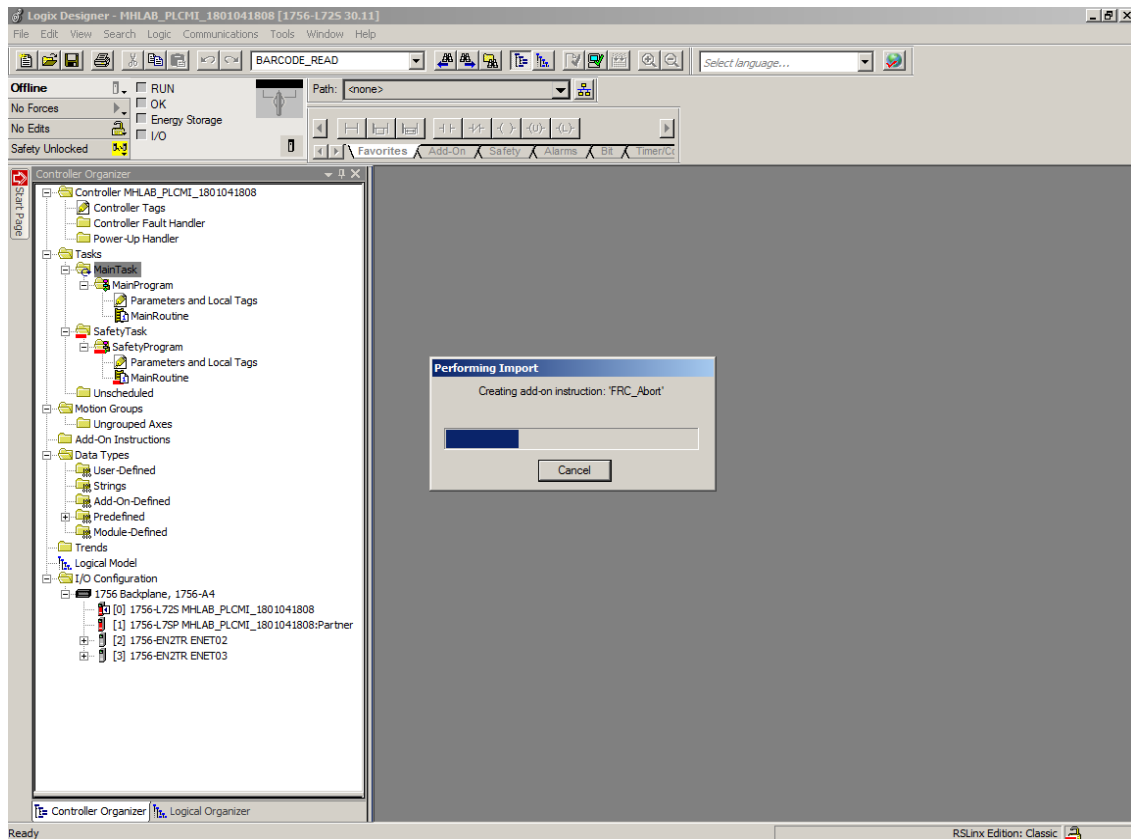


Once the file is selected, press the Open button at the bottom of the page. It will take some time to load the L5X file.

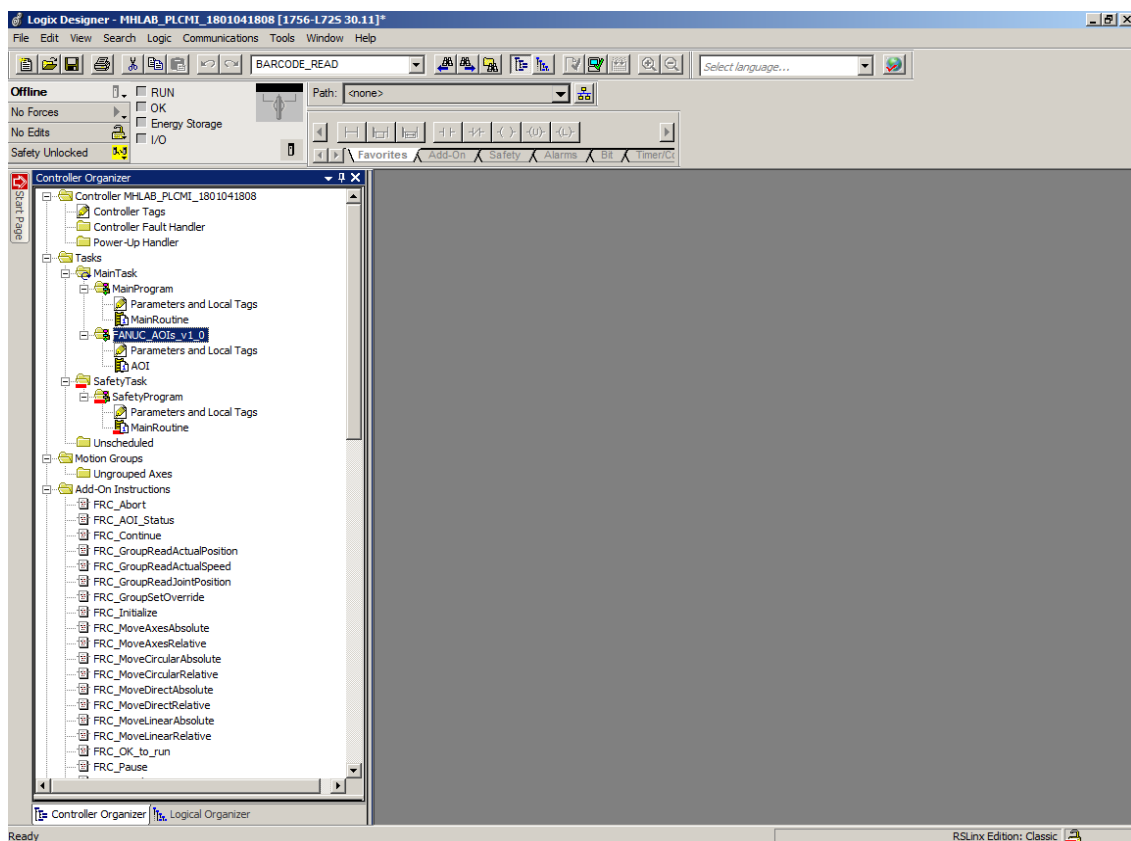


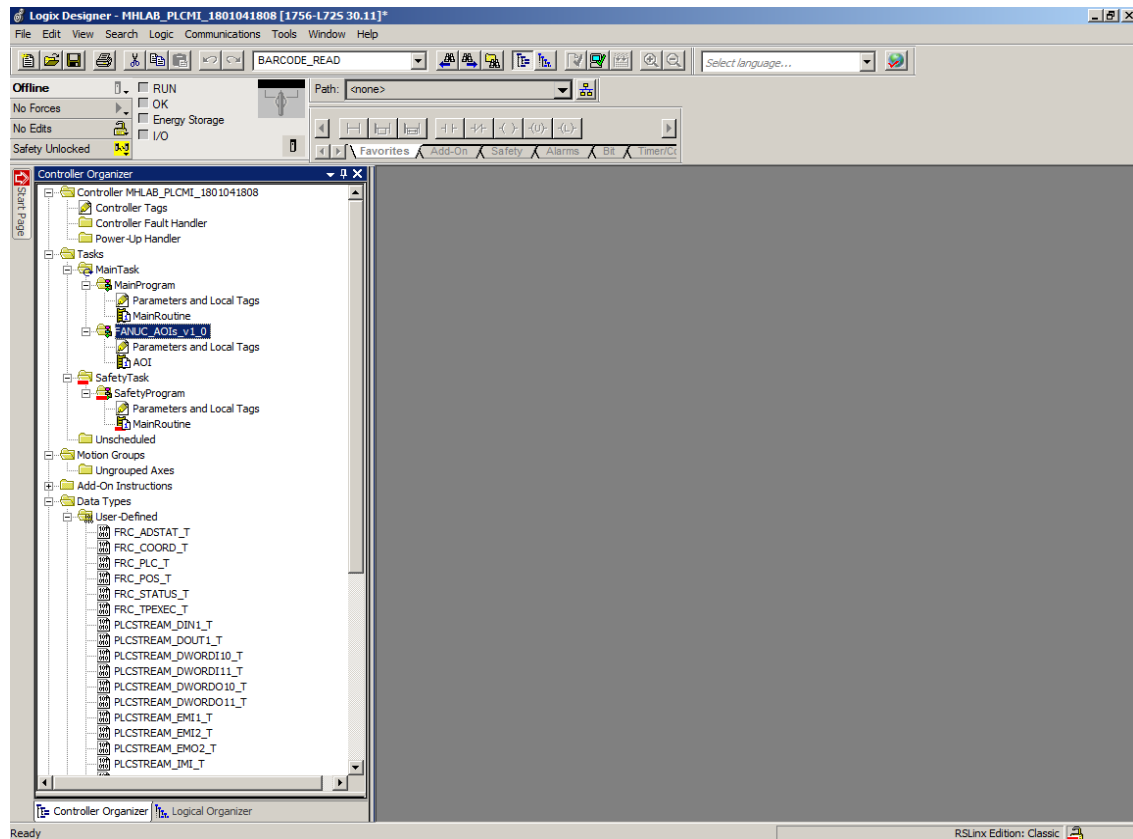
While loading, Studio 5000 will show the following page, press the OK button at the bottom of the page to proceed.



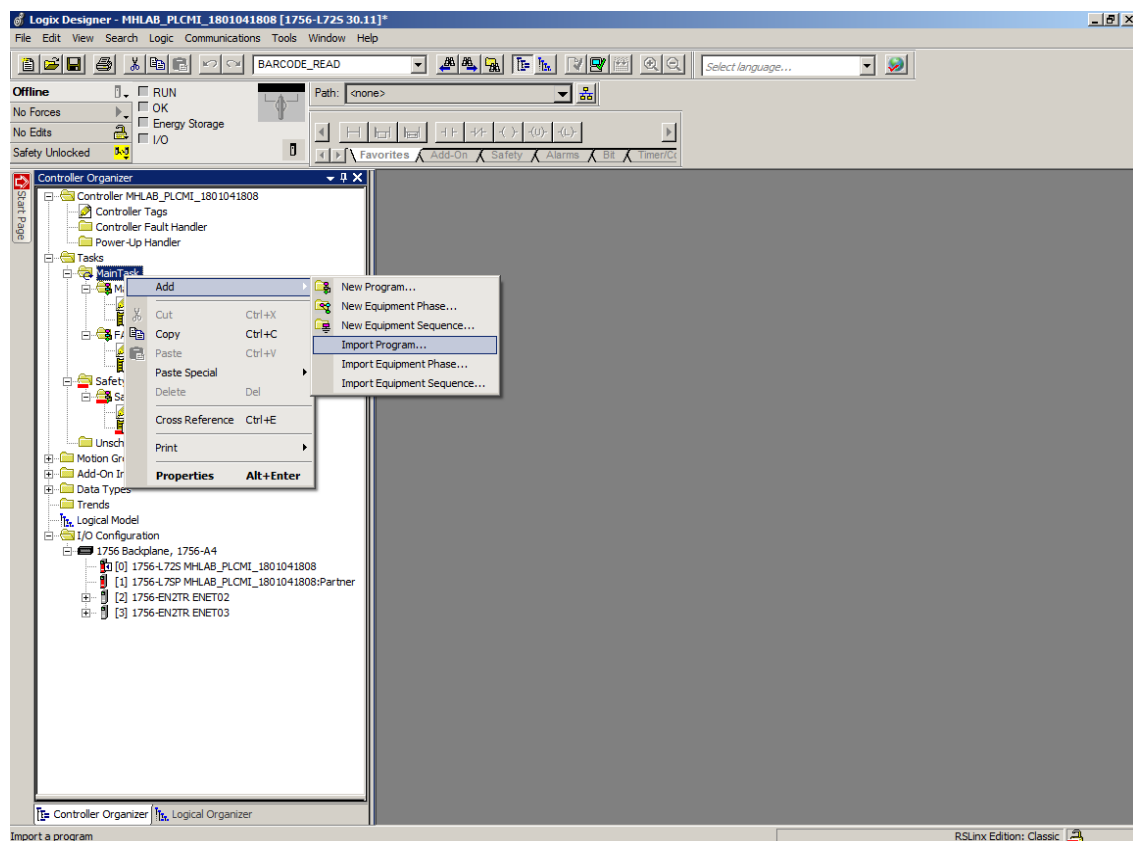


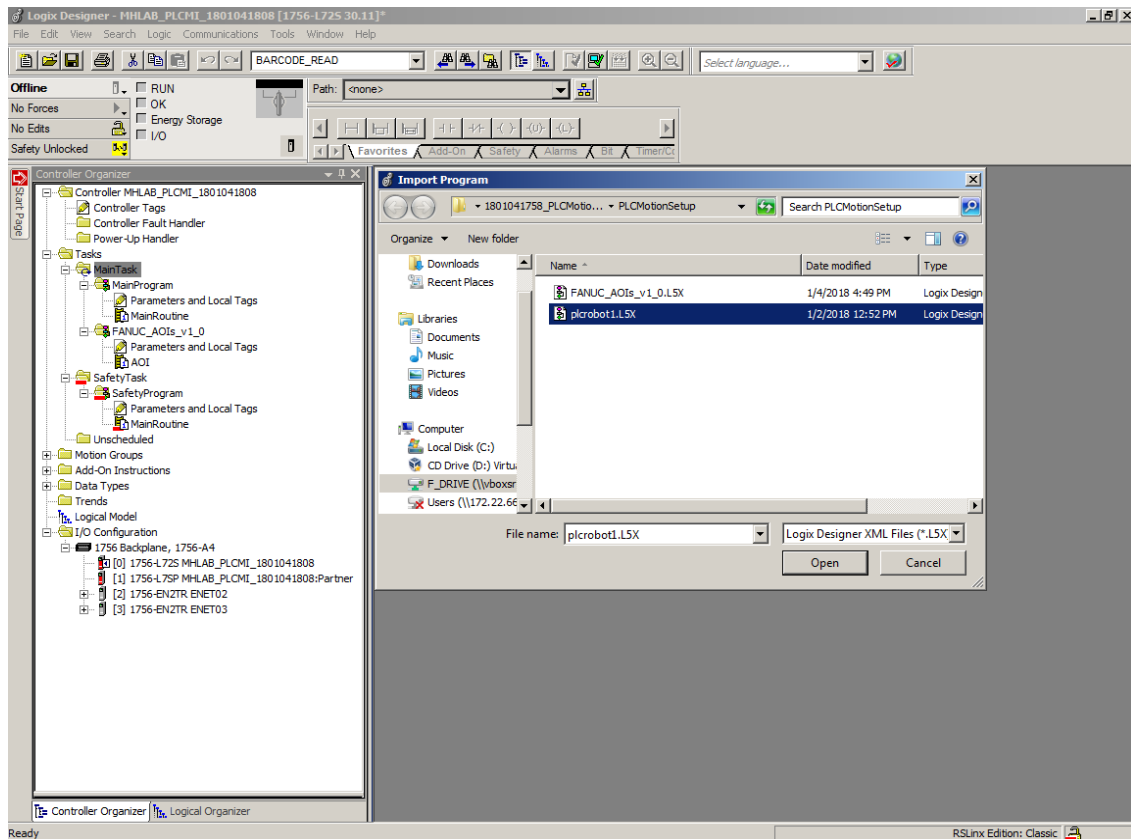
After the import of these AOIs, you should have all the new AOIs listed under Add-On Instructions and UDT (User Defined Data Type) as depicted in the following two screen shots.



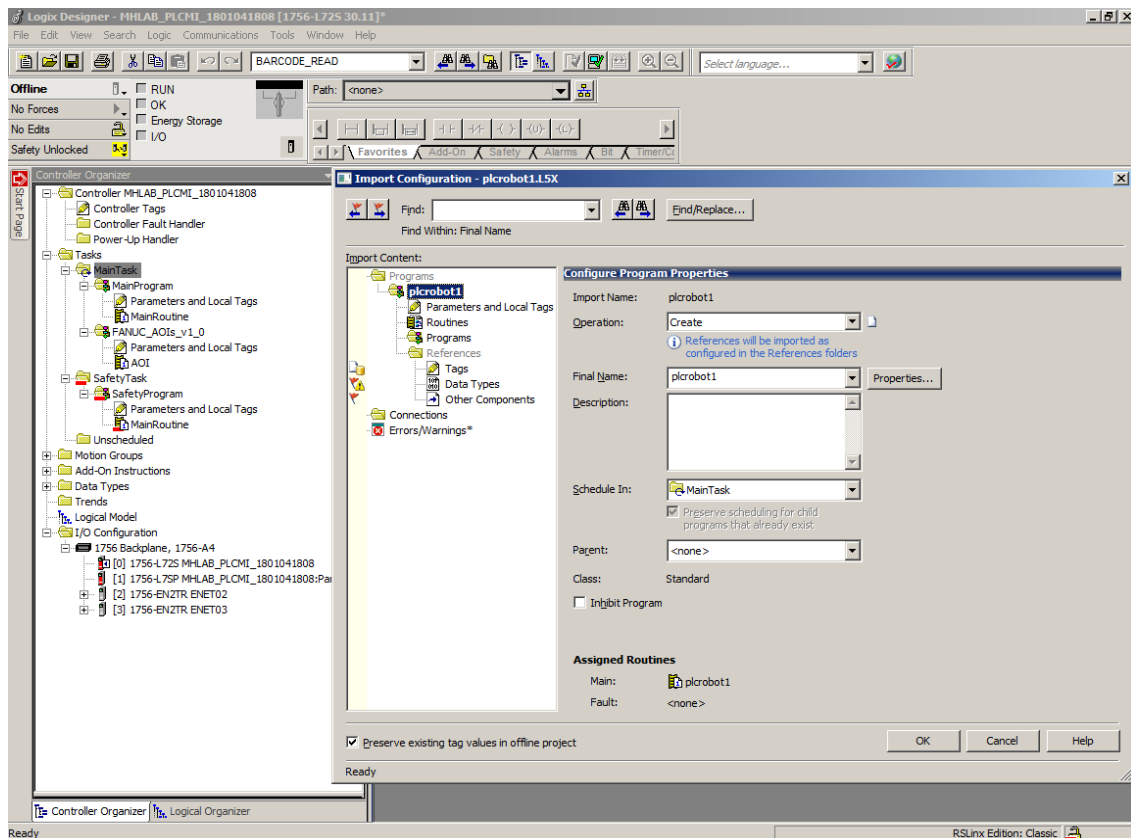


2. Follow the same procedure to Import the plcrobot1.L5X for all tags used by FANUC AOIs.

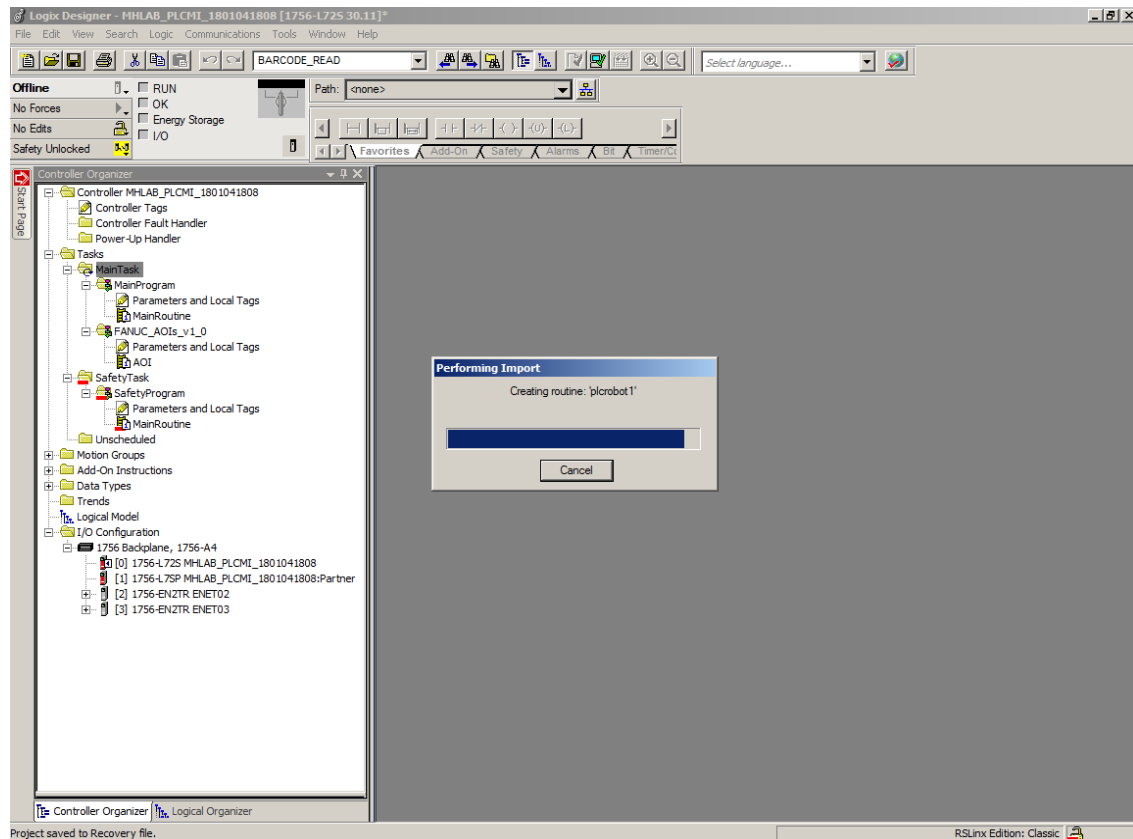




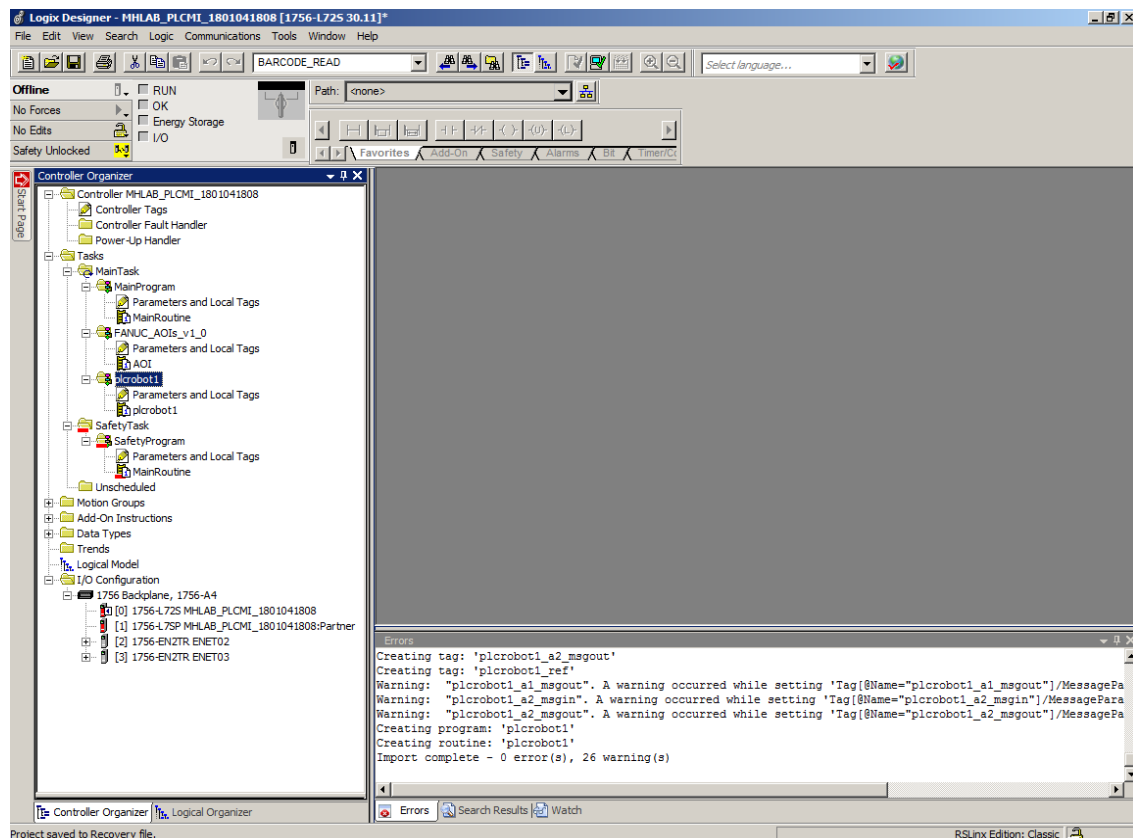
Press Open button at the bottom of this page will bring up the next page:



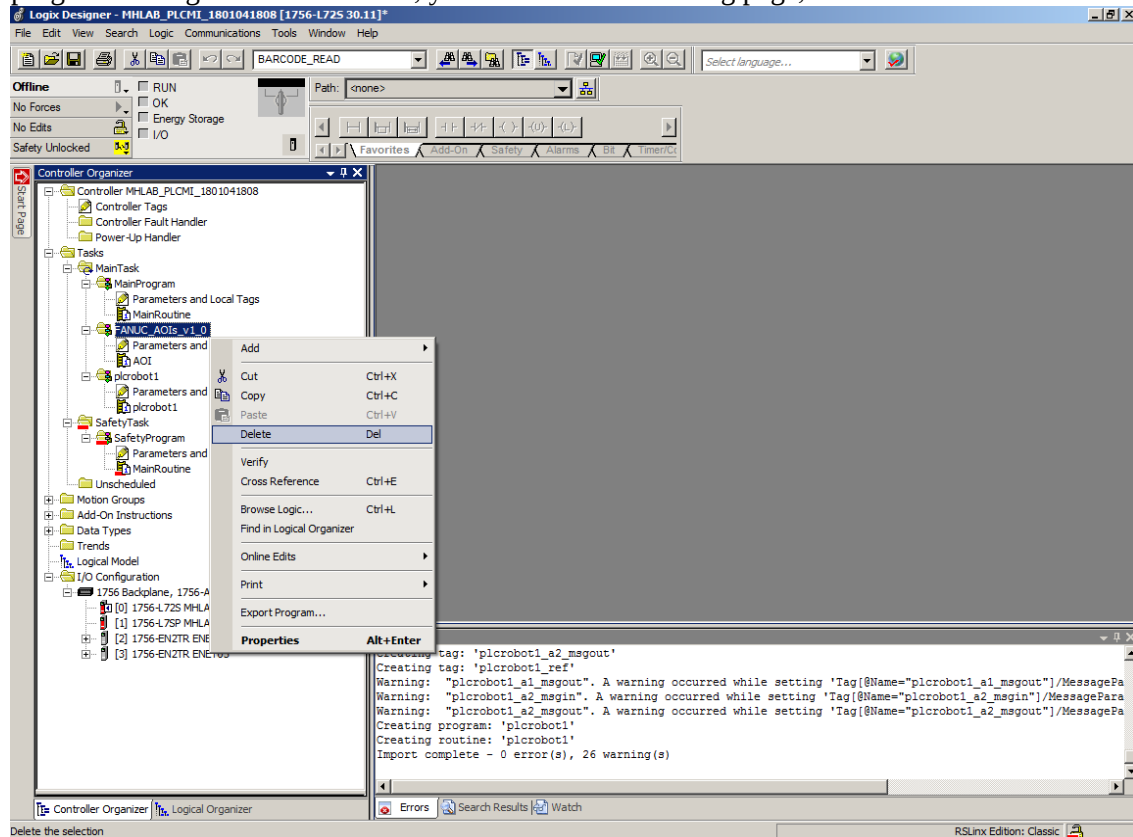
Press the OK button to load in the controller tags used by the FANUC AOIs.



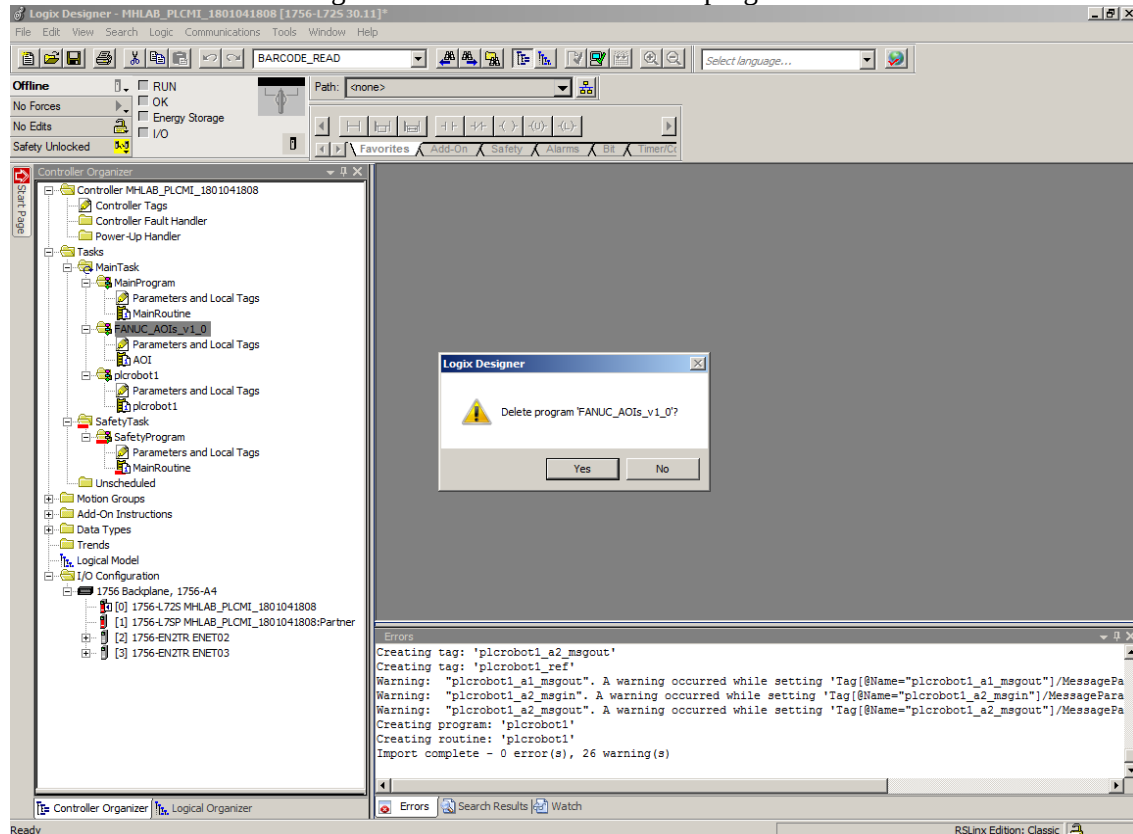
When the loading is completed, you will see a similar page in Studio 5000. Note that there are some warning errors posted and you can safely ignore these warnings.



3. Delete the FANUC_AOIs_v1_0 program. This program is used to group all AOIs together to simplify AOI importation. This program is no longer required. Select the FANUC_AOIs_V1_0 program and right click the mouse, you will see the following page, then click **Delete**.



Press the **Yes** button when asking for confirmation to delete the program.

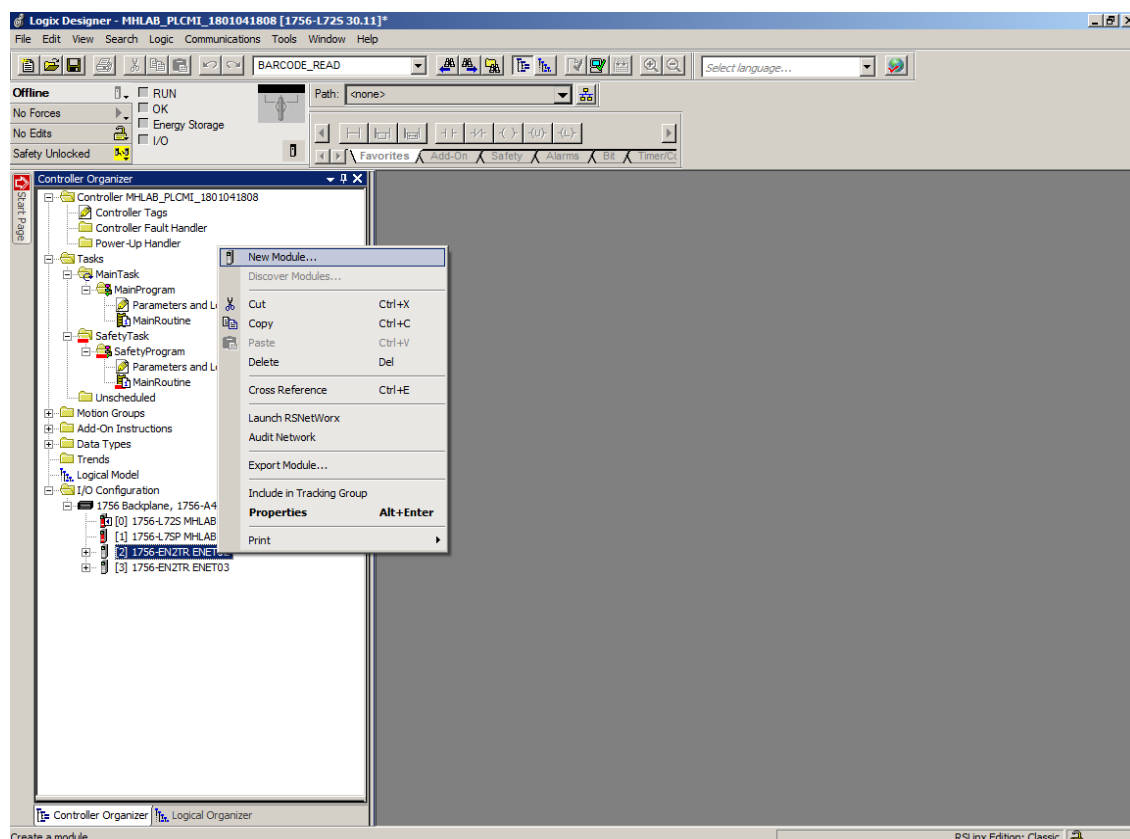


4. Delete the plcrobot1 program, for the same reason you deleted the FANUC_AOIs_v1_0 program. Please follow the same procedure as when deleting FANUC_AOIs_v1_0.

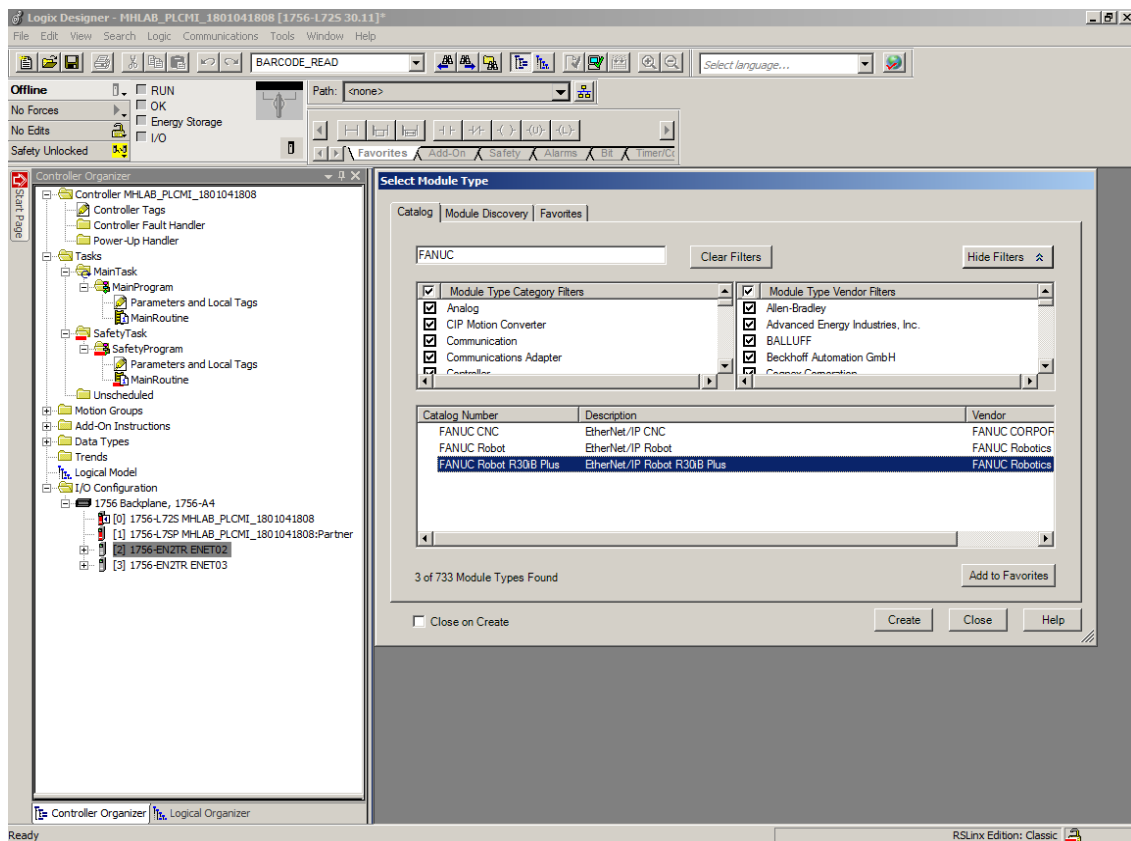
3.1.2 FANUC AOP and Implicit Message Setup

After installing the FANUC AOIs and tags, you will need to setup the implicit message and explicit message connection between the robot controller and the PLC on your Studio 5000 project. Please follow the steps outlined in this section to set up the connections.

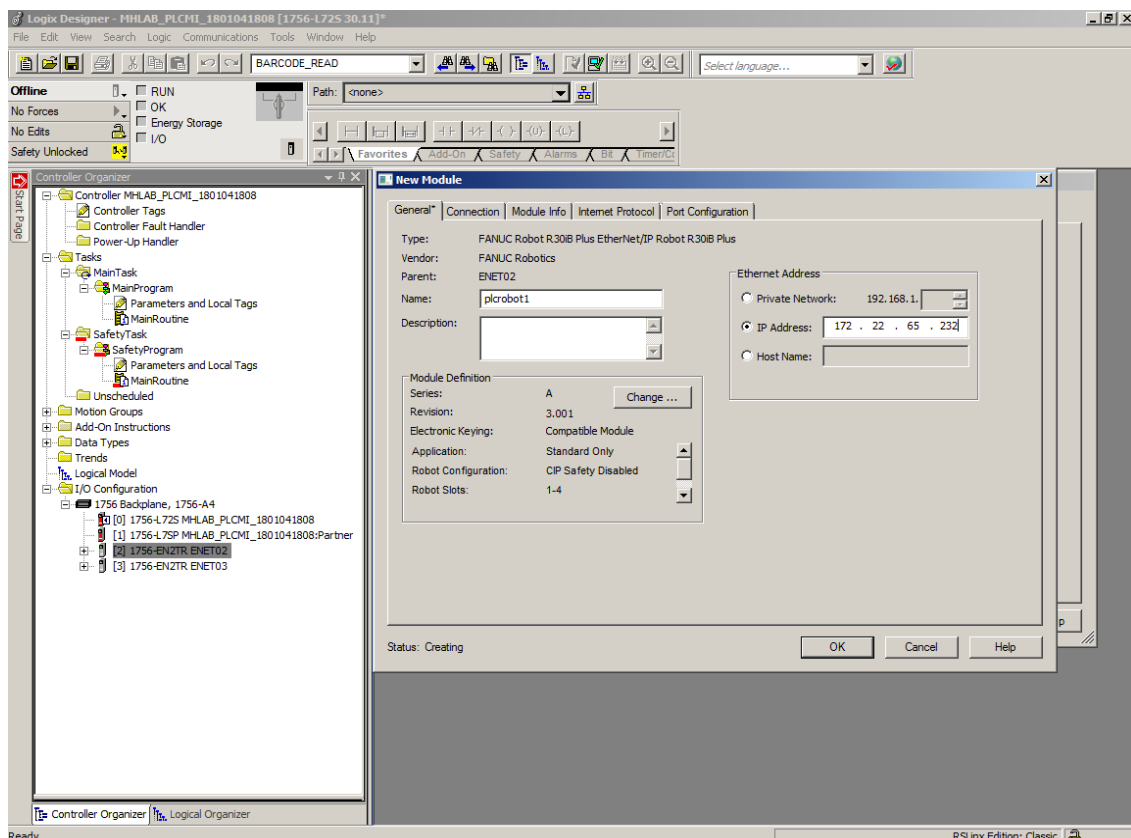
1. Add a new module in your PLC's backplane and go to the property of the new module:



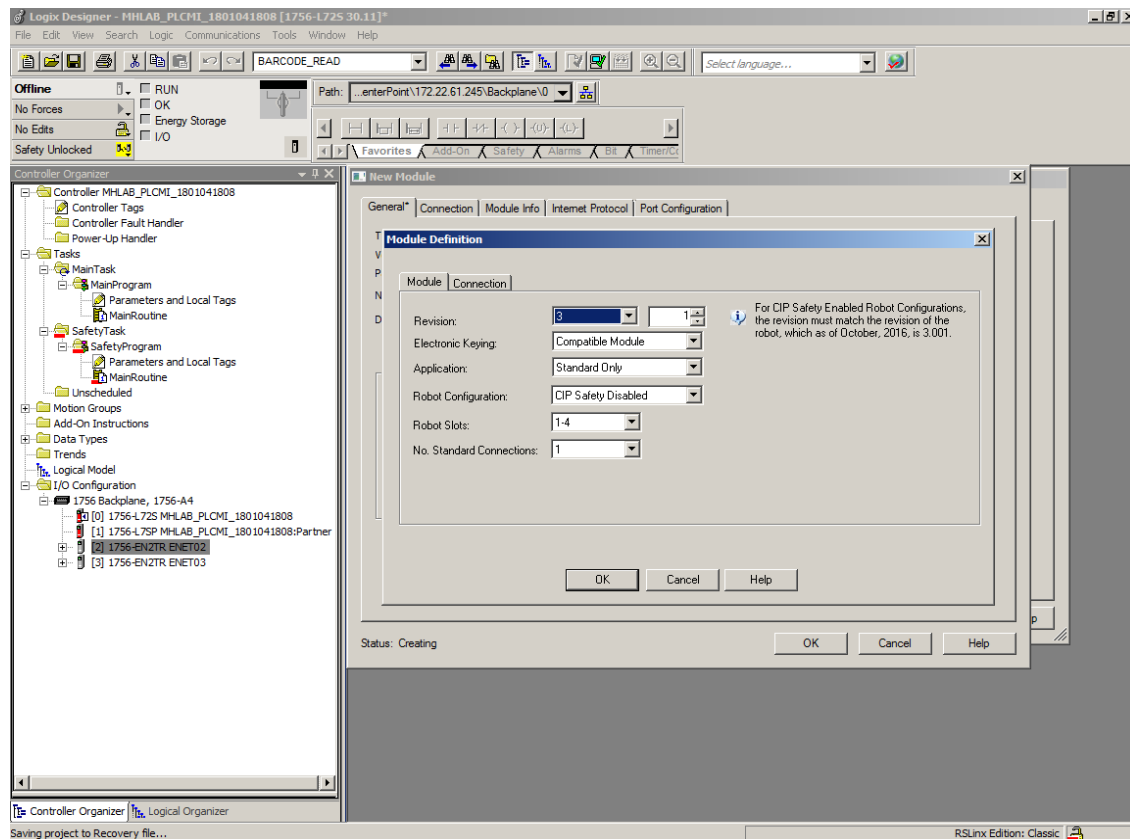
2. In the Select Module Type page, Type FANUC in the search window and select the FANUC Robot R30iB Plus entry and then press CREATE button. If you don't see the FANUC Robot R30iB Plus entry, you will have to install FANUC Robotics AOP V1.39 to your studio 5000 before running the PLC Motion Interface. Please refer to the "EtherNet/IP OPERATOR'S MANUAL (B-82854EN)" for details.



- Set the connection name to plcrobot1. This name has to match the PLC Scanner name in robot controller's EDA setup screen in section 2.2. Next, type in the robot controller's IP address. The robot controller's IP address is "172.22.65.232" in our example below:



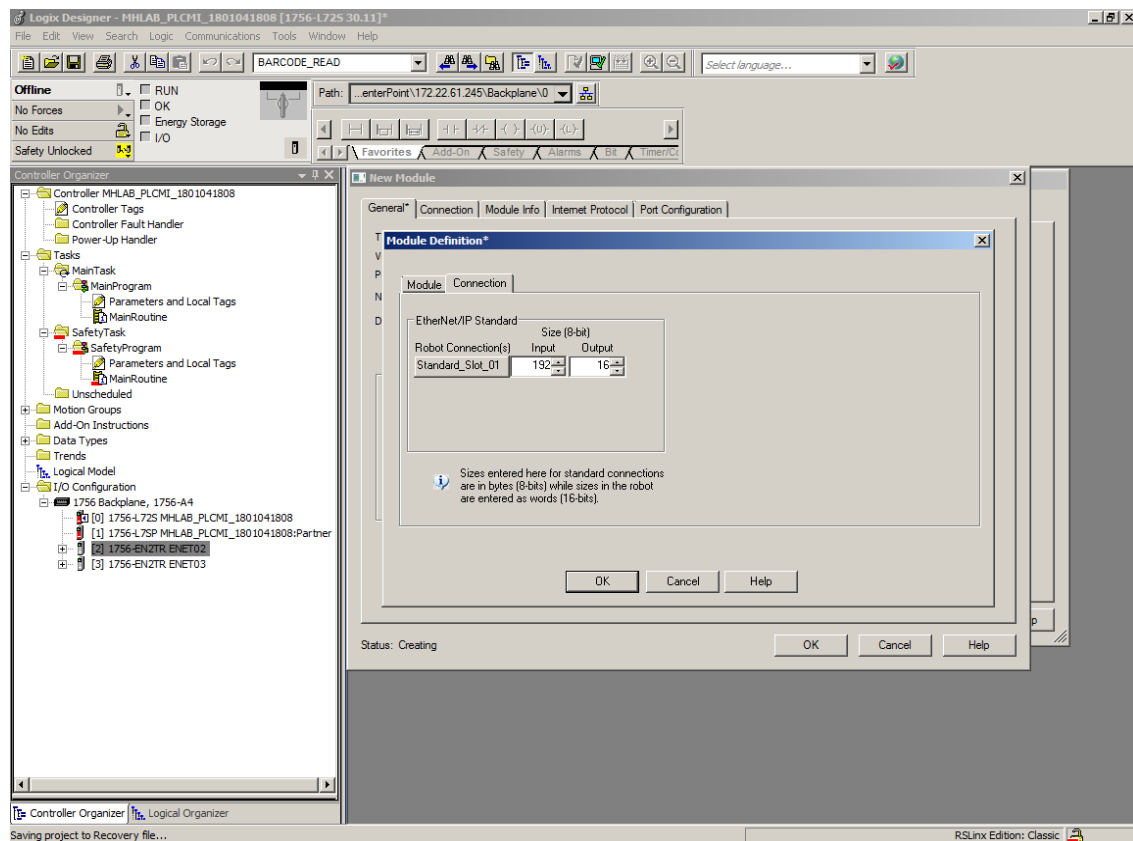
4. The following step is to setup the connection 1 I/O, which is used by PLC Motion Interface. If you have other I/O connections, such as safety I/O, you will have to add those connections here by changing the *No. Standard Connections* to 2 and changing *Application* to STANDARD + SAFETY. Please refer to the “EtherNet/IP OPERATOR’S MANUAL (B-82854EN)” for setting up extra connections. To setup the Connection 1 data size, press the **Change** button on the left hand side of the screen in the screen above, and you will get to the next screen:



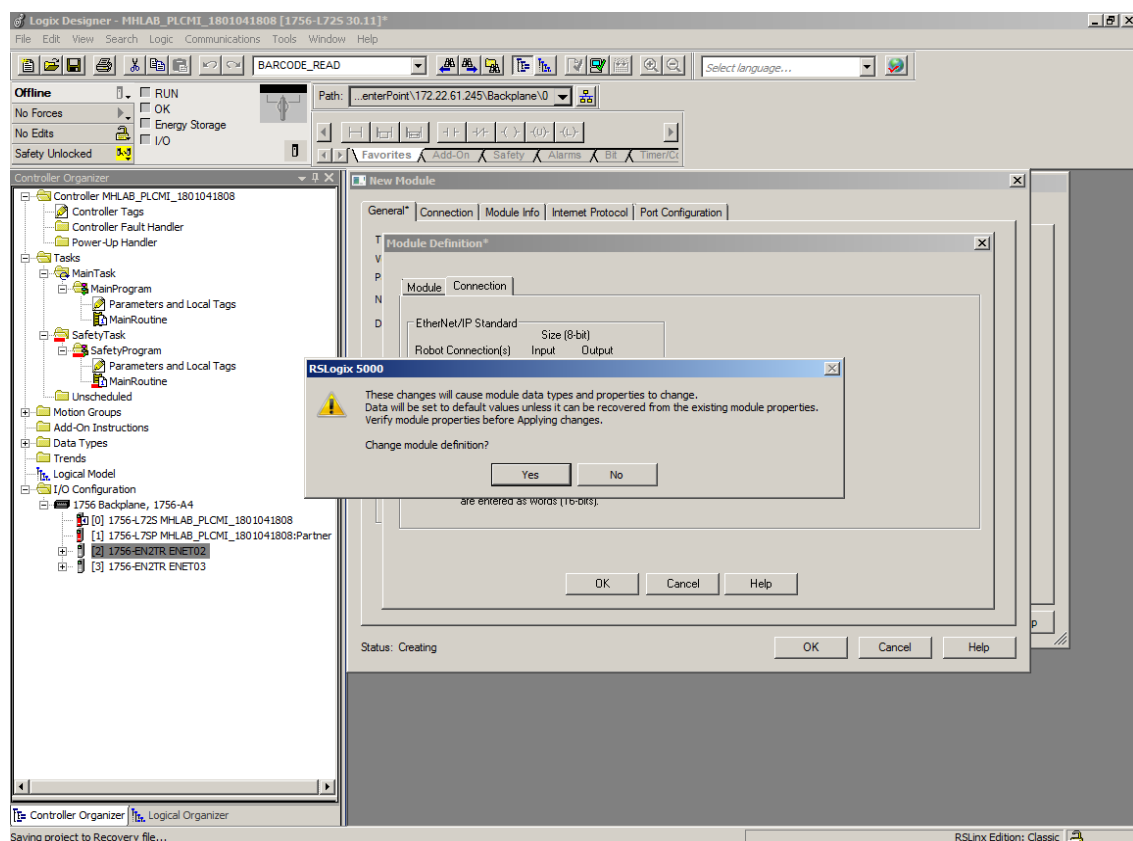
5. Go to the Connection bookmark and set the robot connection’s input size to 192 and the output size to 16 as depicted in the following screen.

NOTE

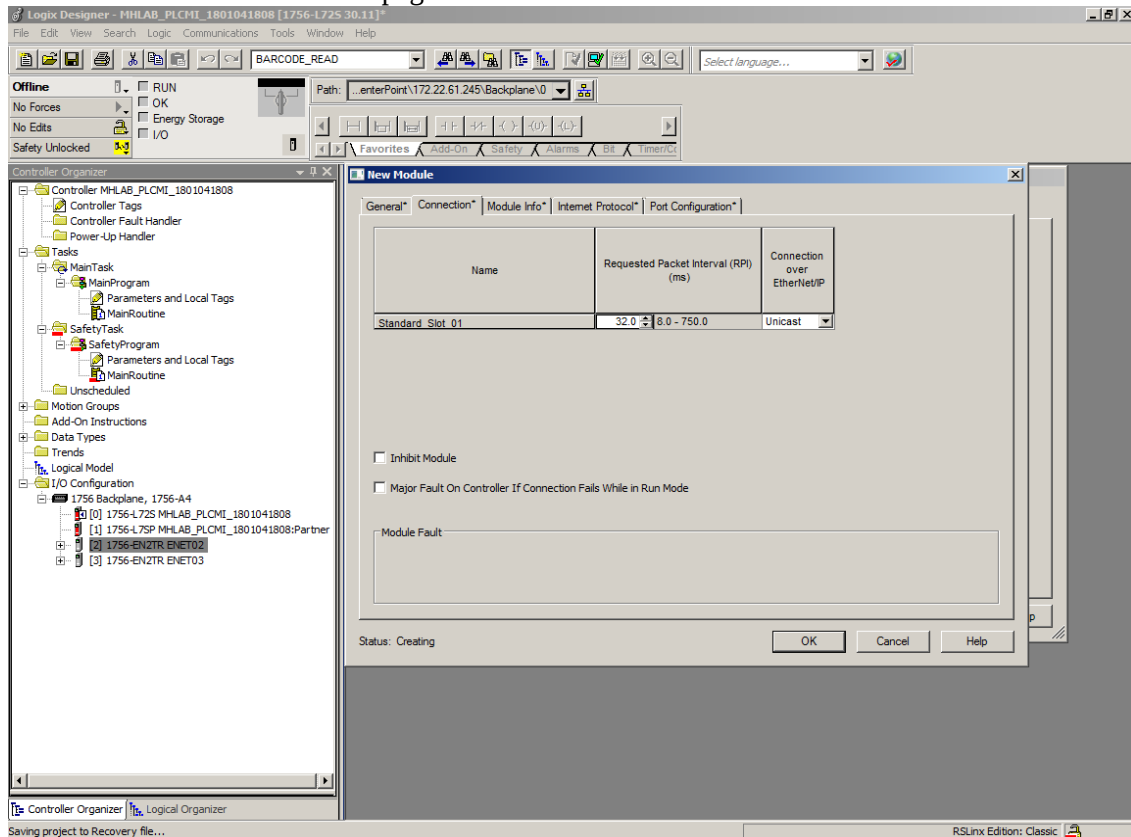
Note that in the future, the input/output size may change when a new AOI is added.



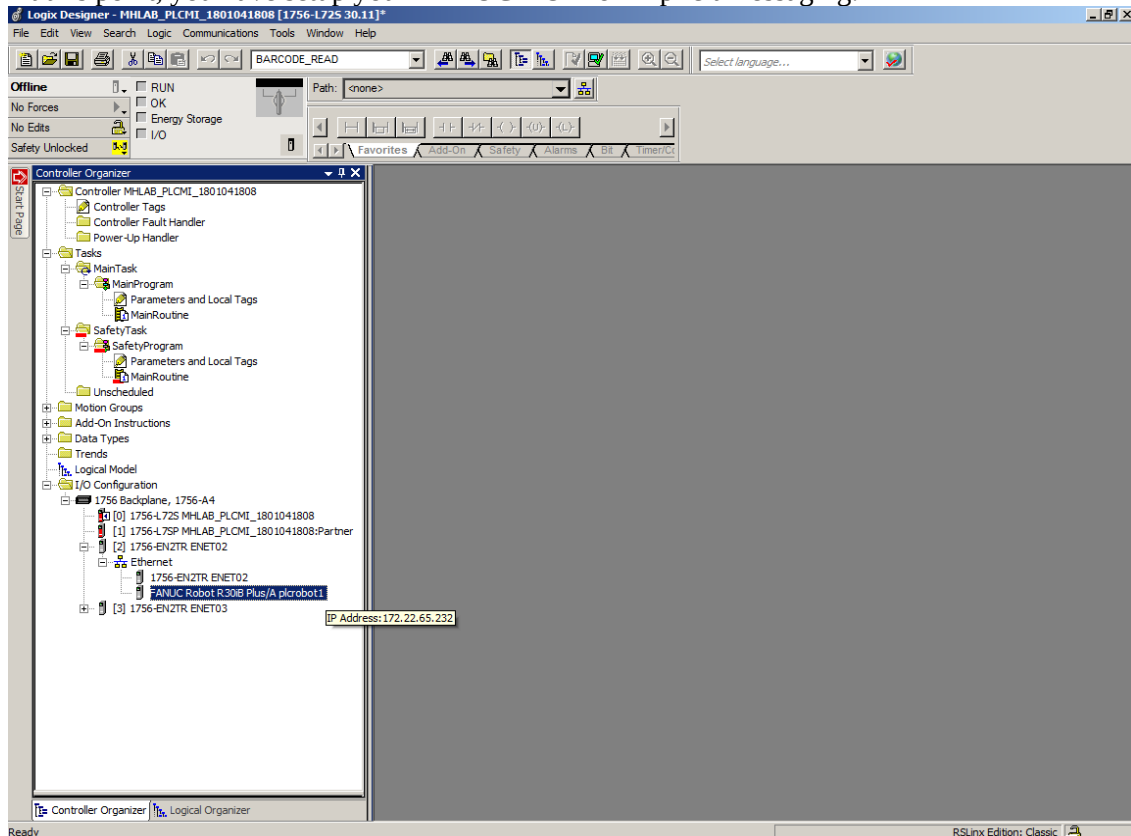
If the input and output size changed, you will see the following screen. Press the **Yes** button to accept the change and press **OK** button to get back to the property page.



6. Next, you need to setup the Request Packet Interval. Select the *Connection* bookmark in the properties page. You will see the following screen. Change the RPI interval to 32 (ms) and press the **OK** button at the bottom of the page.



7. At this point, you have setup your FANUC AOP for implicit messaging.

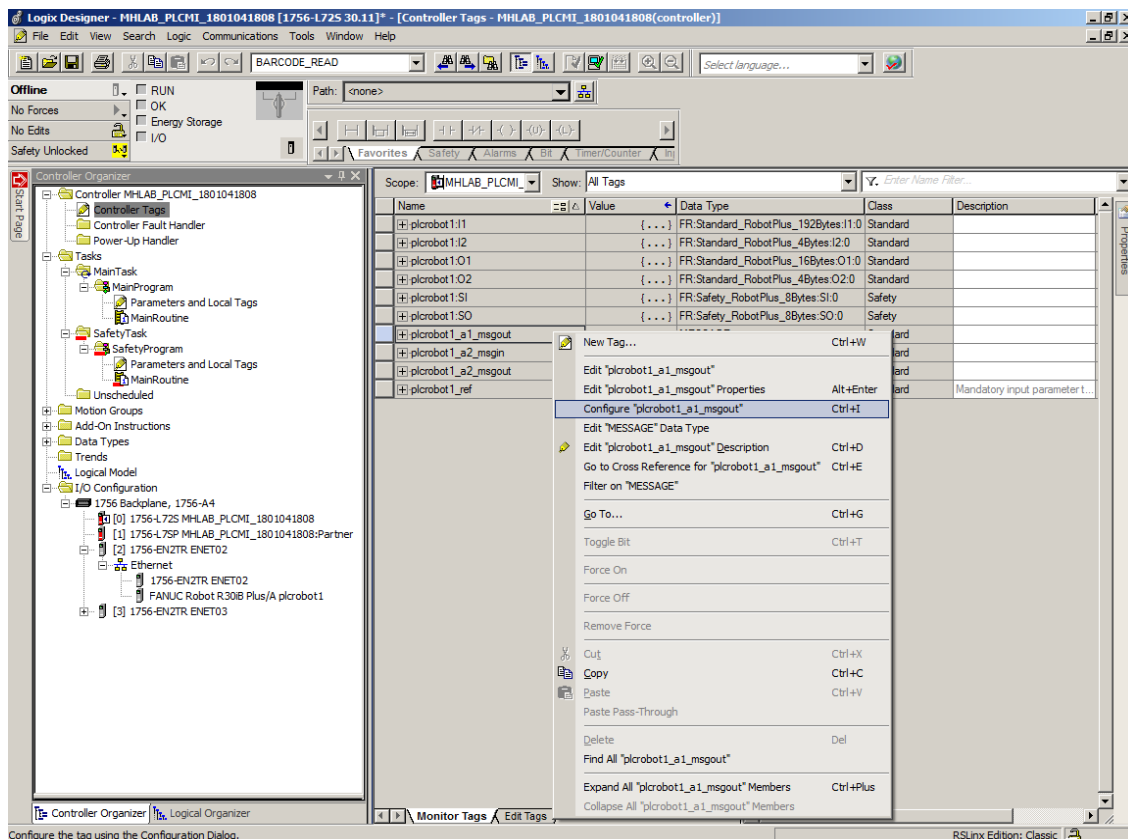


If your PLC is connected to multiple FANUC controllers, you need to repeat the same process for each controller with a different connection name and IP address, as shown in step 3.

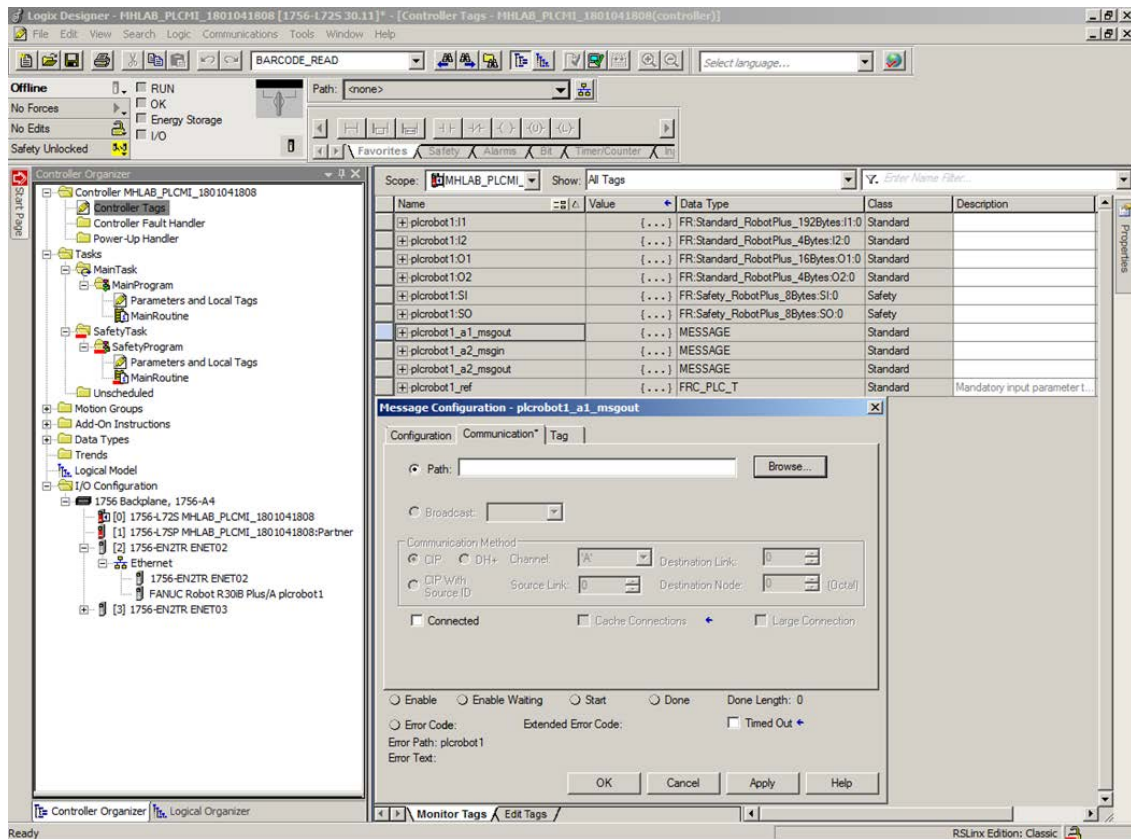
3.1.3 FANUC AOP and Explicit Message Setup

FANUC AOI utilizes three explicit messages. Please following the steps outlined below to setup these explicit messages.

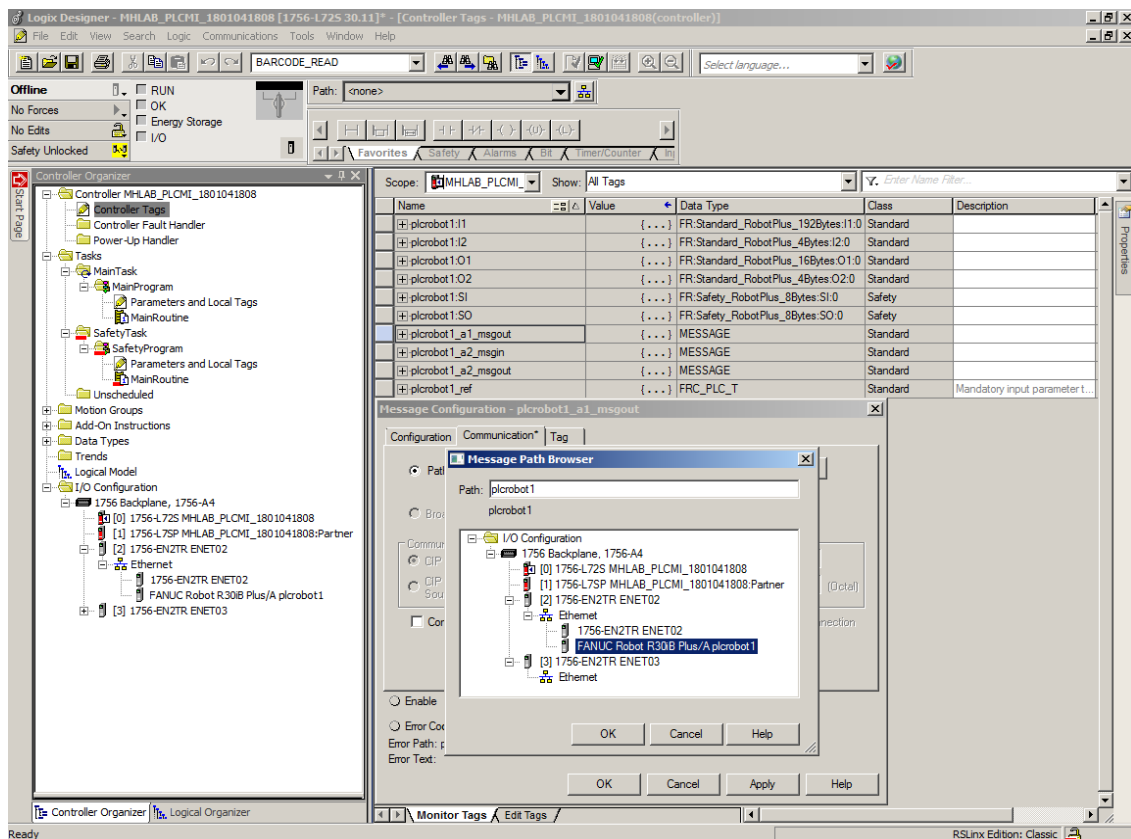
1. Double-click Controller Tags to bring up the list of controller tags, and select the plcrobot1_a1_msgout. Right mouse click to bring up the following menu. Select the Configure plcrobot1_a1_msgout and left-click on the mouse



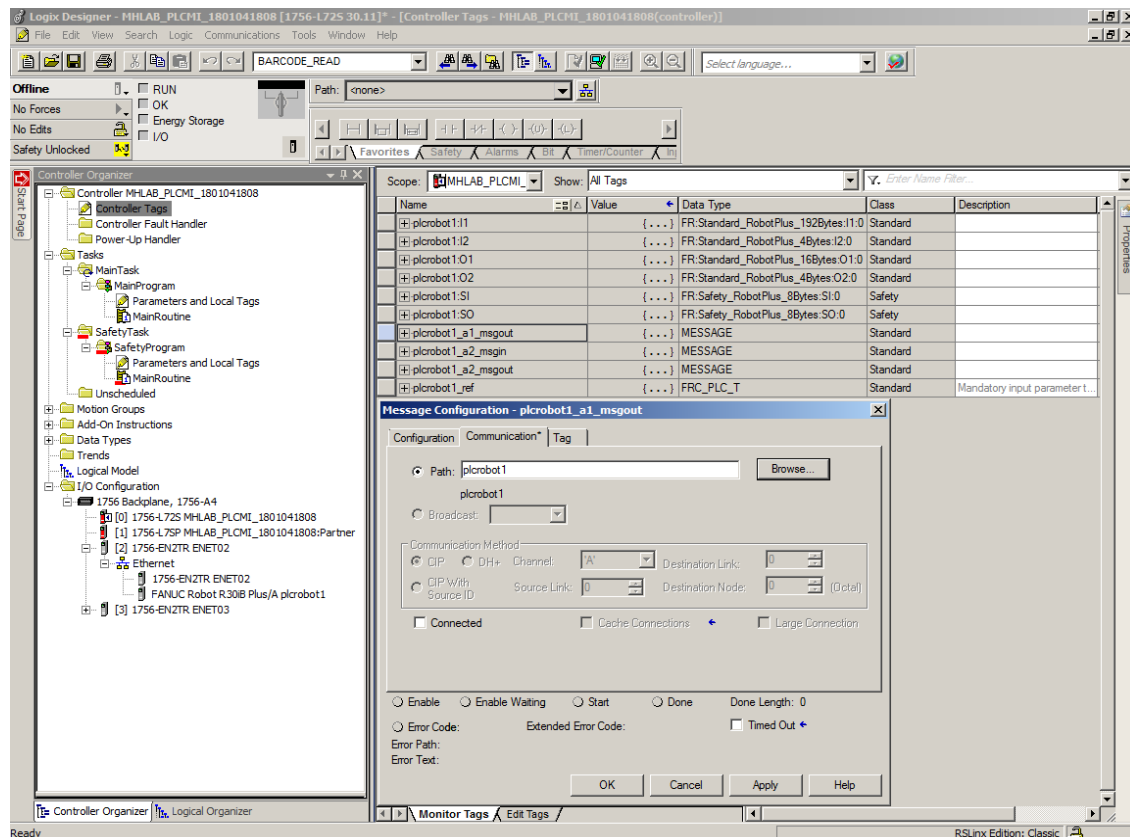
2. Left mouse click and select the Communication bookmark. You will see the following page:



3. Pressing the **Browse** button will bring up the following selections. Select the “FANUC Robot R30iB Plus/A plcrobot1” entry as depicted as below:



- Press the **OK** key to go back to the configuration page:



- Press the **OK** button again to complete the plcrobot1_a1_msgout explicit message setup.
- Repeat steps 1 to 4 to configure plcrobot1_a2_msgin and plcrobot1_a2_msgout explicit message tags.

If you have multiple FANUC robot controllers, please follow the same procedure to set up the explicit messages for any additional controllers.

3.2 CREATE A FANUC AOI TEMPLATE PROGRAM

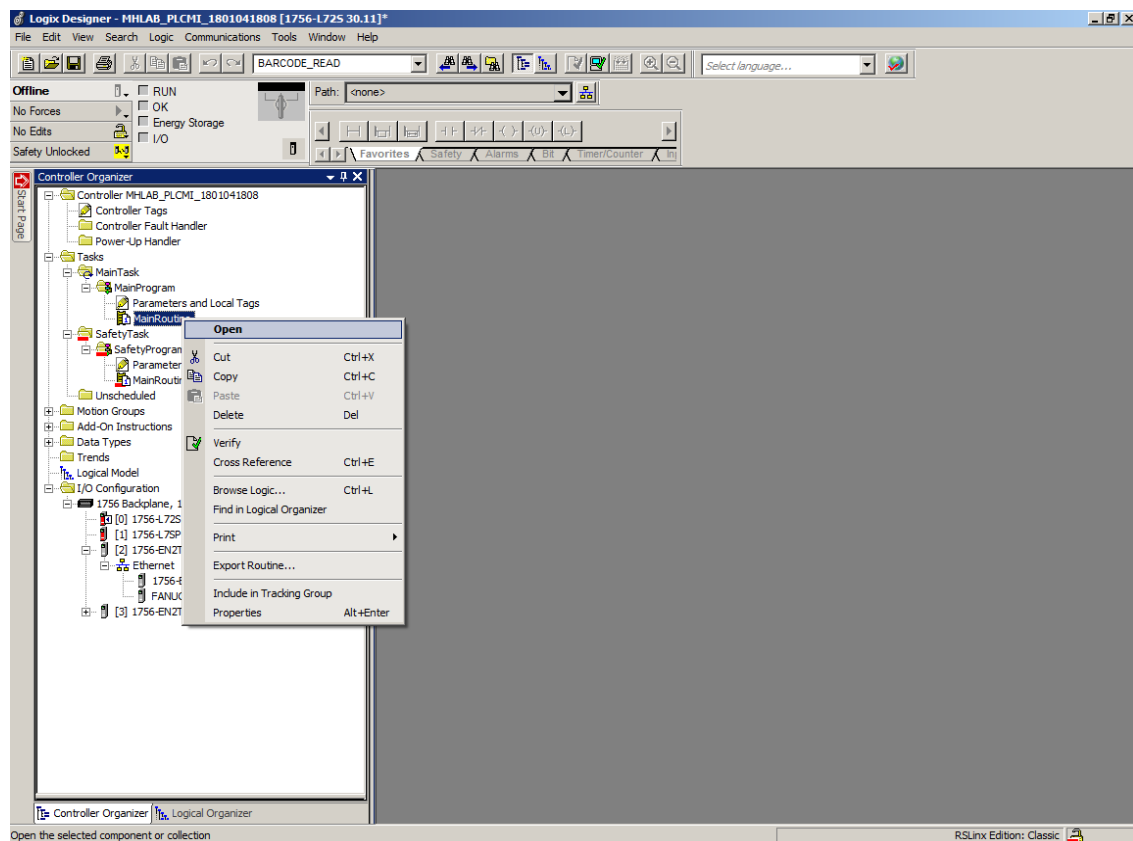
Any program that uses FANUC AOI will have the following program structure:

- Call `FRC_Initialize AOI` at the beginning of the program to establish the communication session with the robot controller.
- Call `FRC_Abort AOI` at the end of the program to stop the communication session. If the PLC program ends without calling `FRC_ABORT`, the robot controller will not be able to do a file backup or a system backup. You will have to cycle power on the robot controller to recover.
- Call `FRC_ReadGroupData` at the beginning of the run loop. This allows the PLC to read information set by the robot controller at beginning of the loop.
- Call `FRC_WriteGroupData` at the end of the run loop. This allows the PLC to send information to the robot controller for execution.

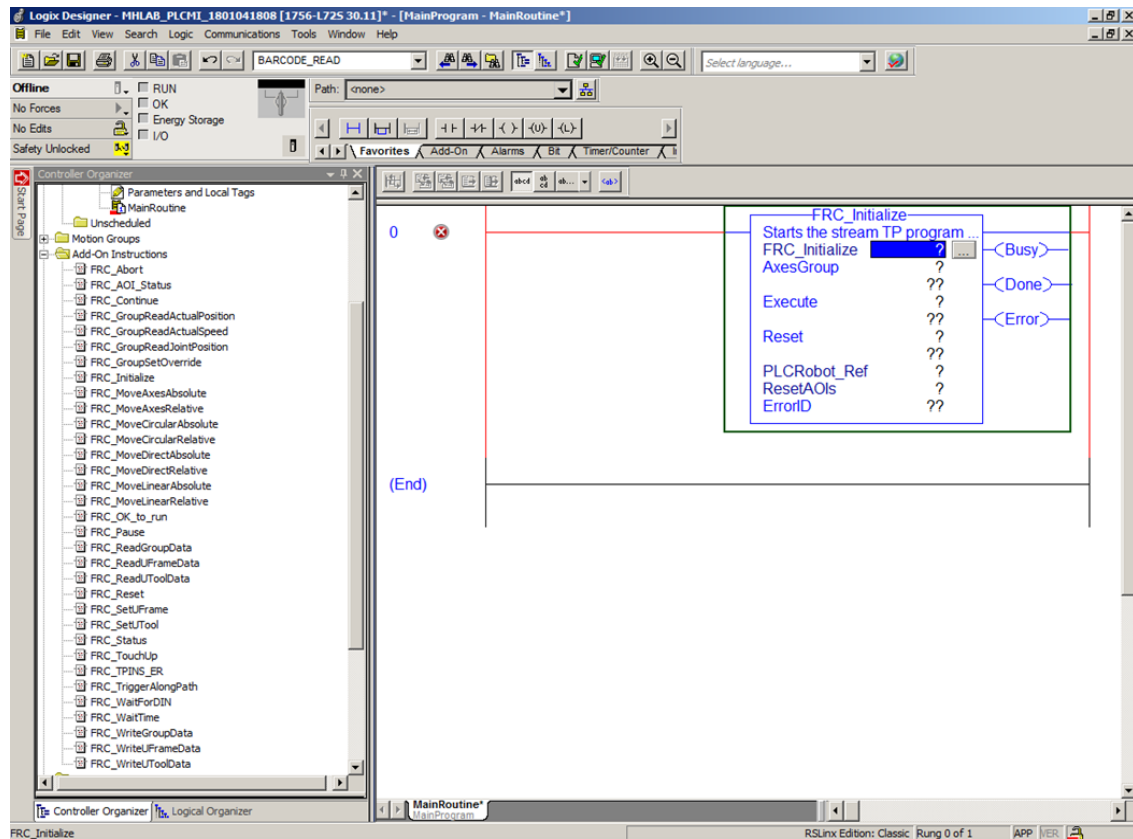
This section shows you a step-by-step procedure for creating the program structure outlined above. Once the program is created, you can use this program as a template for all your FANUC robot PLC program applications.

We assume that users are familiar with Studio 5000 and with ladder logic, so detailed key strokes are not documented here. We also do not include a detailed explanation of the input parameters for each AOI shown here. Please refer to the appendix to see a detail description of each parameter.

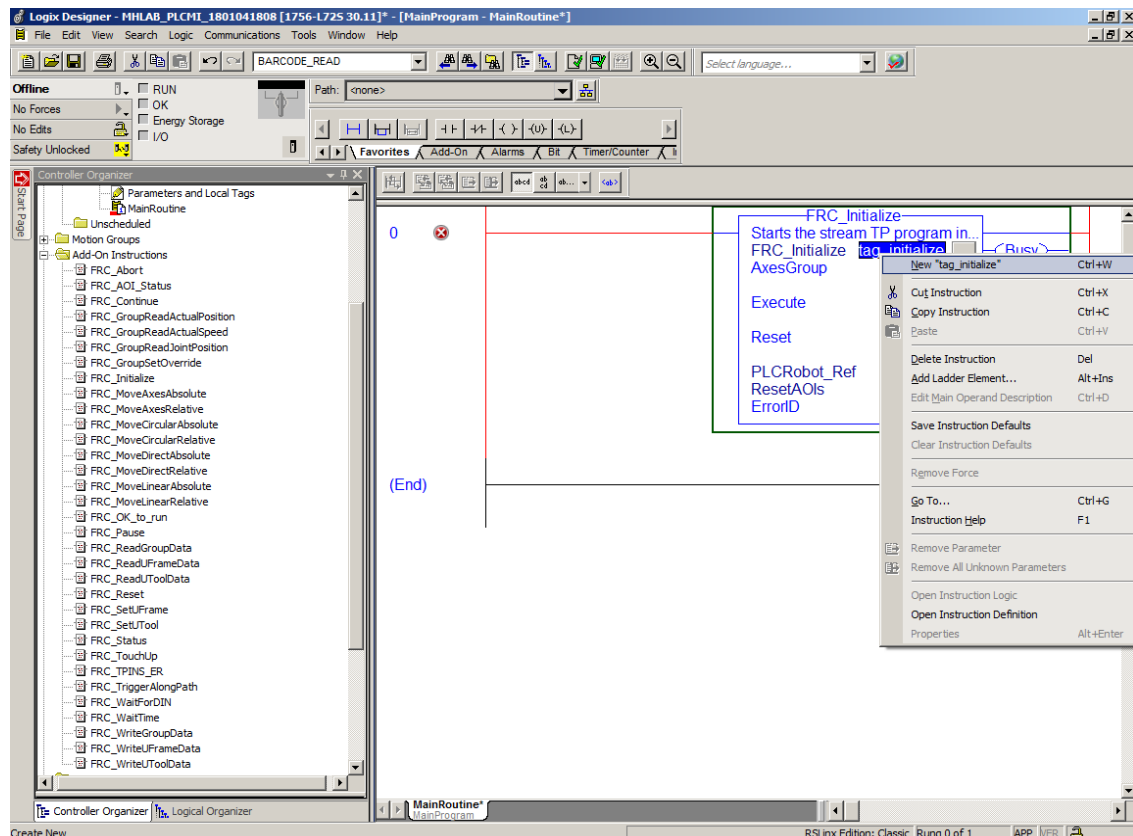
1. Create a new PLC program.

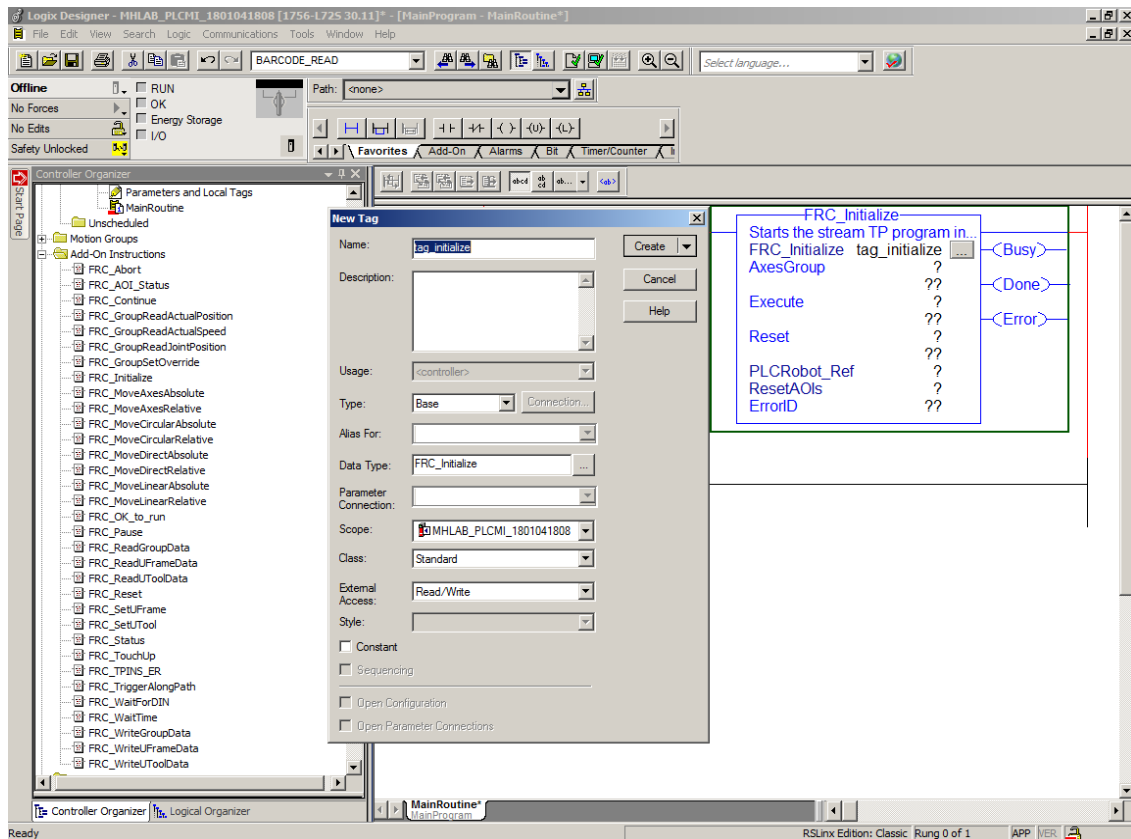




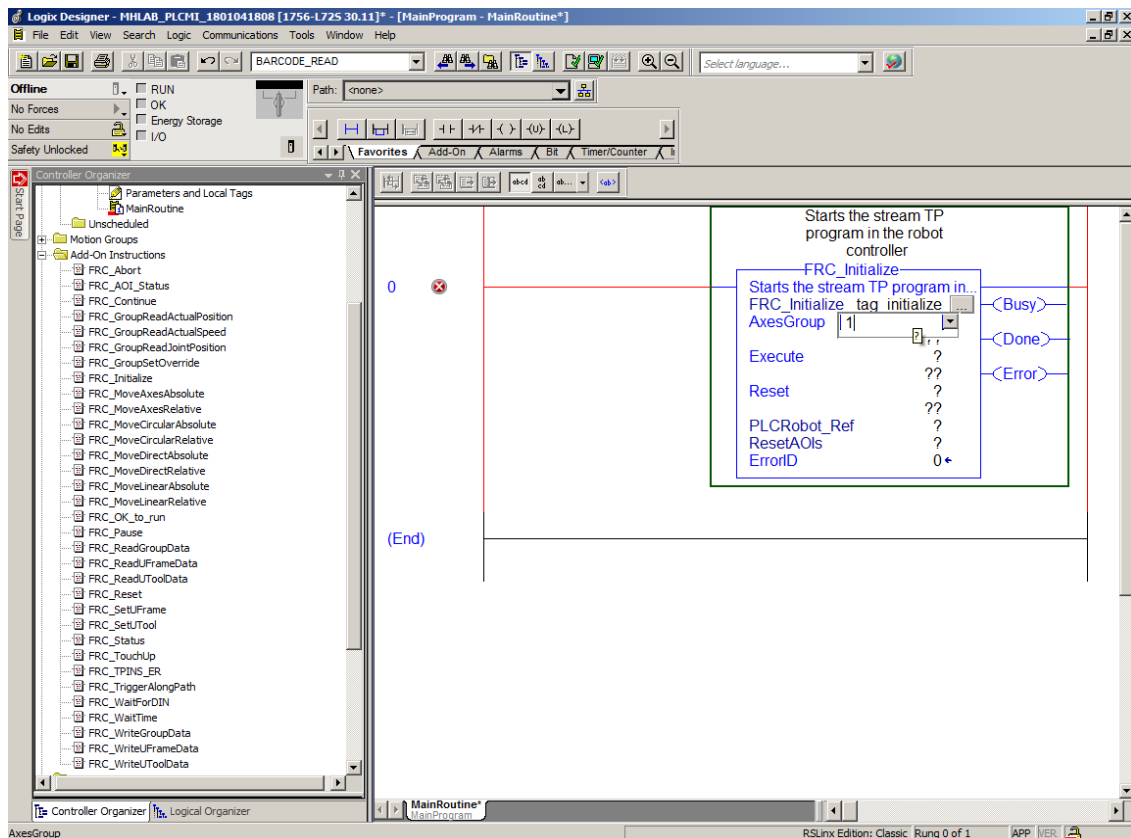


3. Add a tag name for the FRC_Initialize AOI and create the new tag.

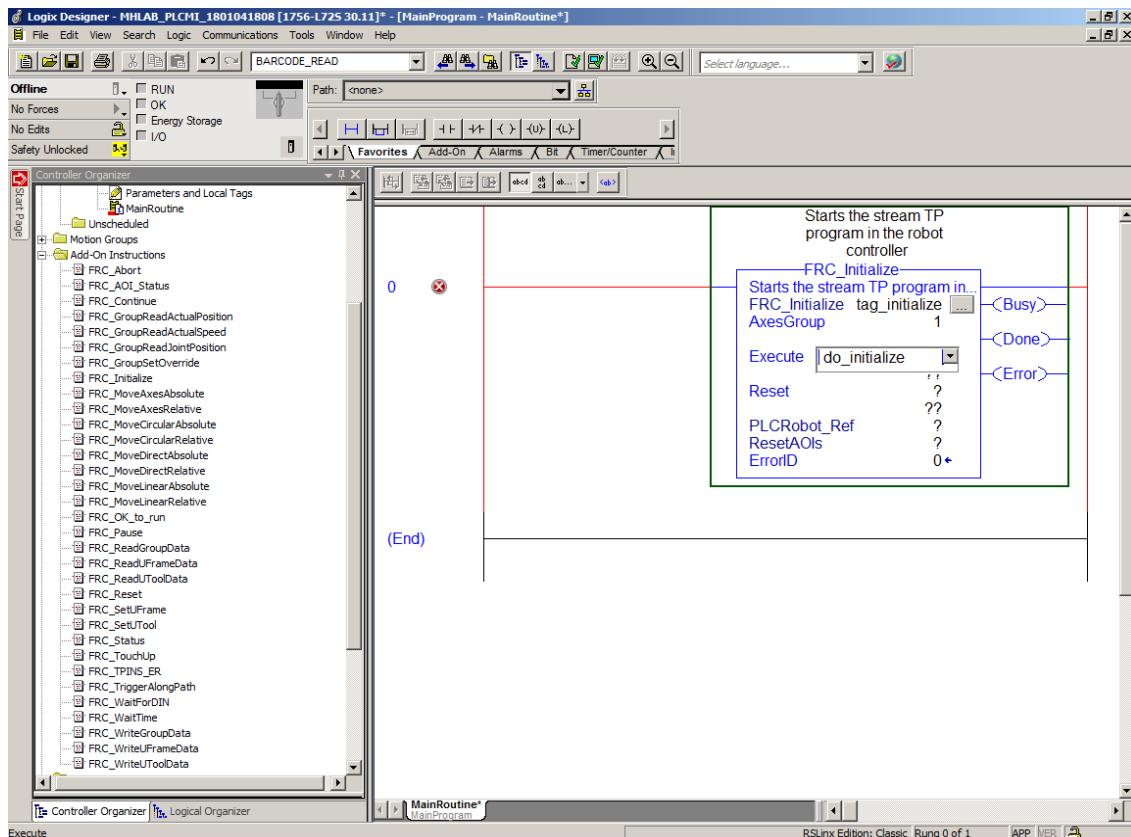




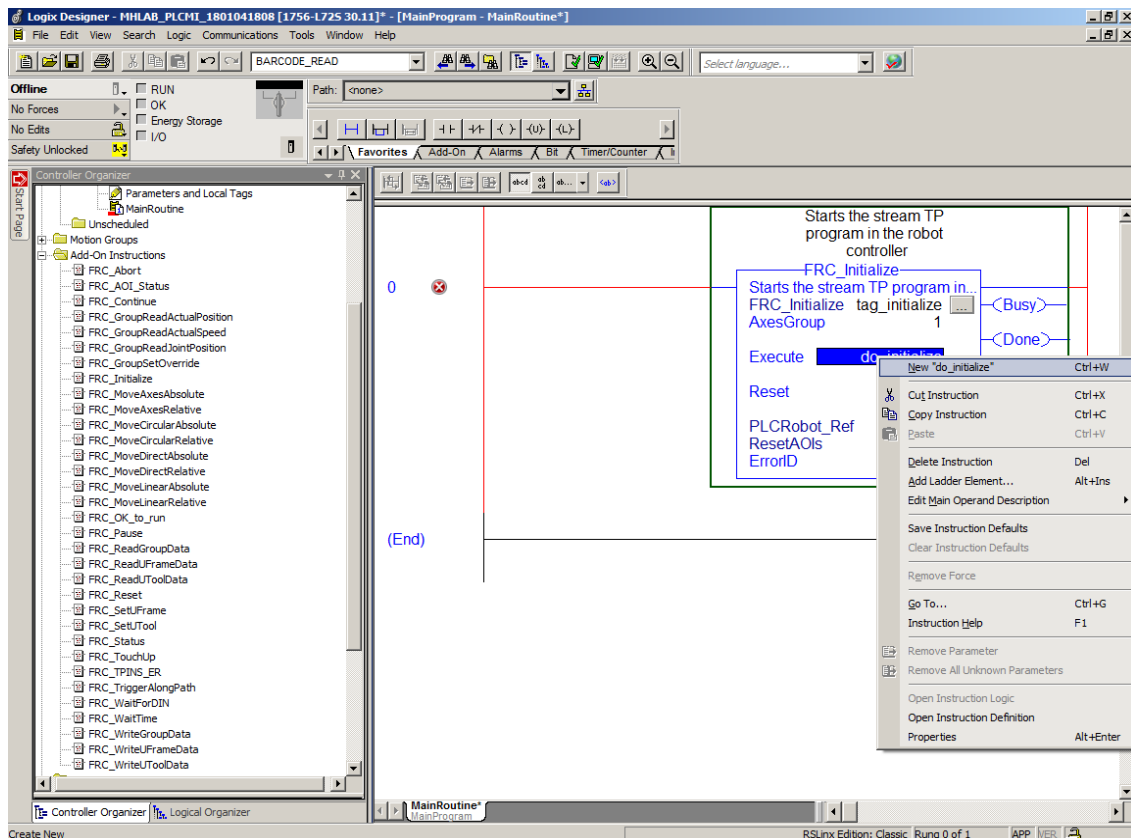
4. Since the robot controller has only 1 group, set the AxesGroup to 1 in the AOI.

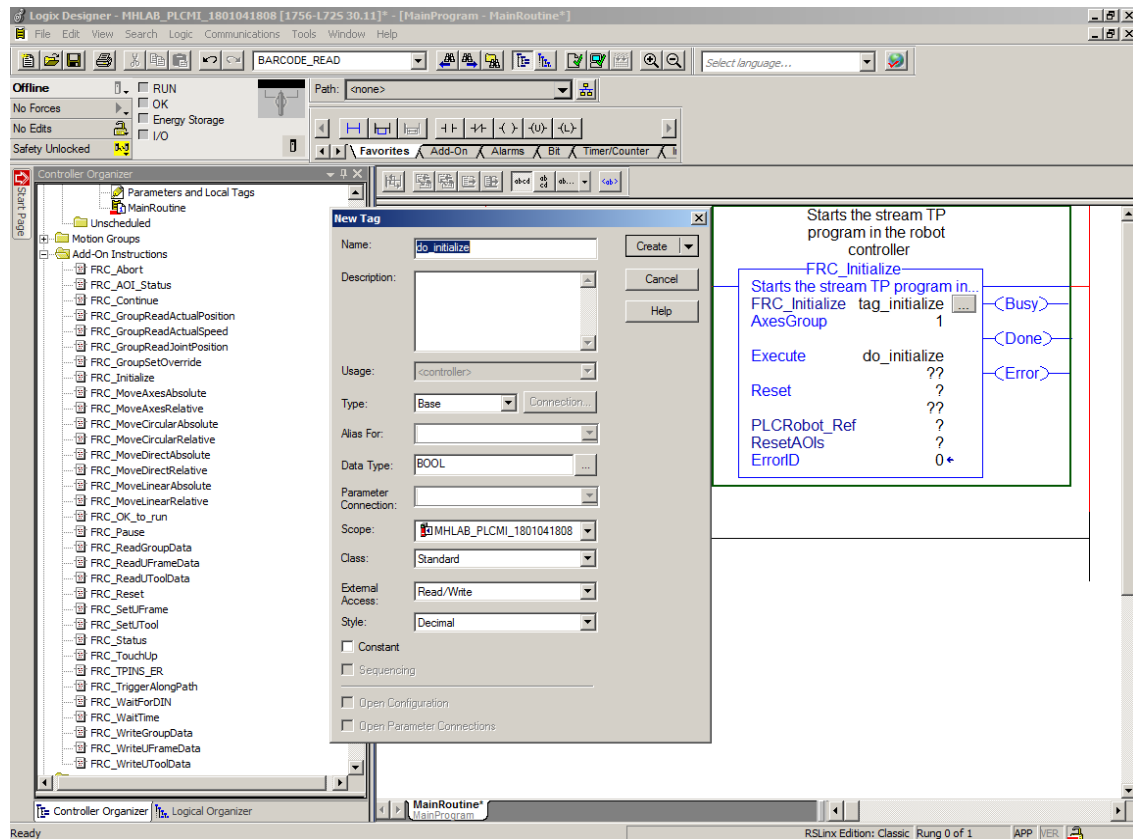


5. Set the Execute tag. The AOI will execute at the rising edge of the do_initialize tag.

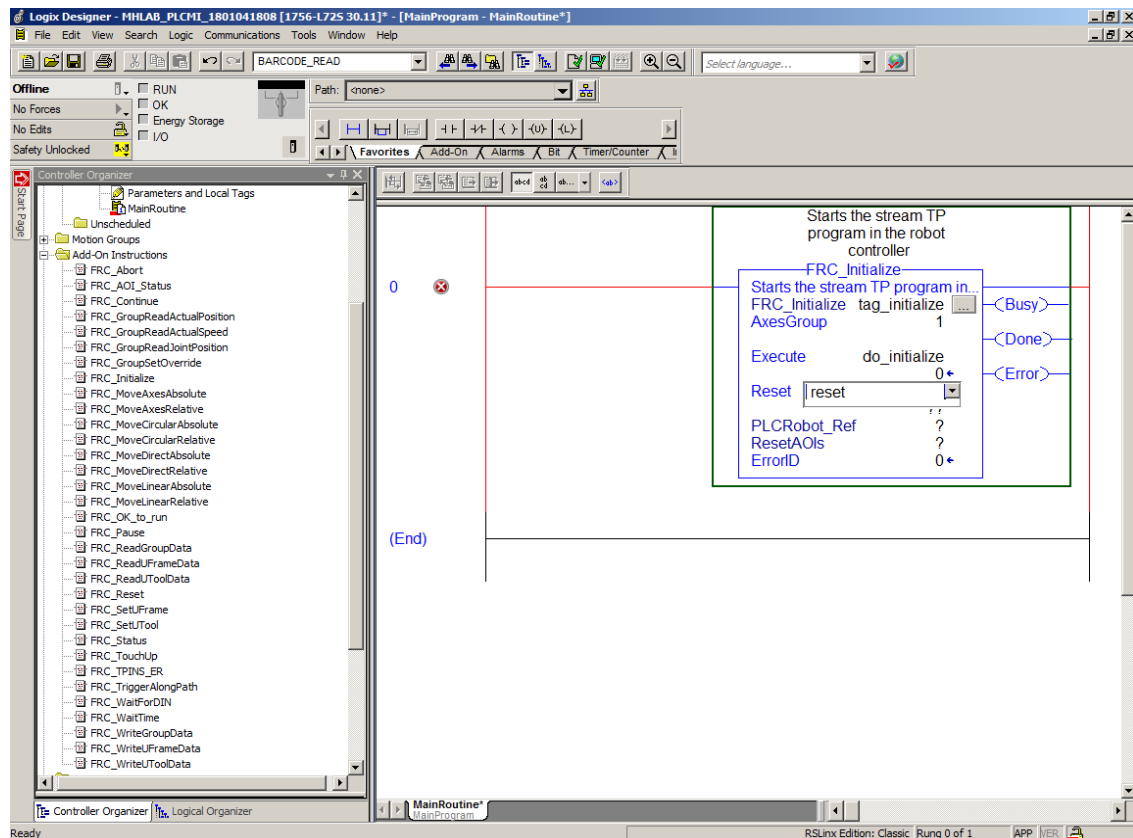


6. Create the “do_initialize” tag:

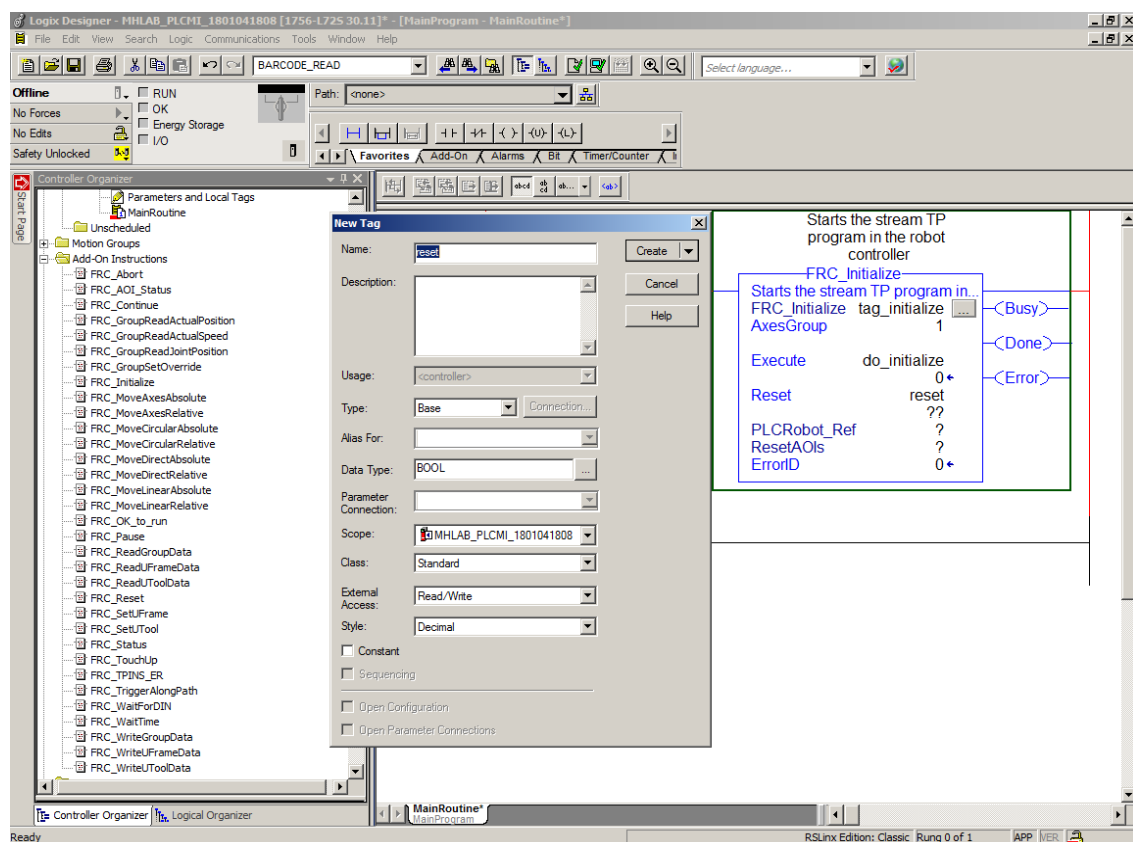
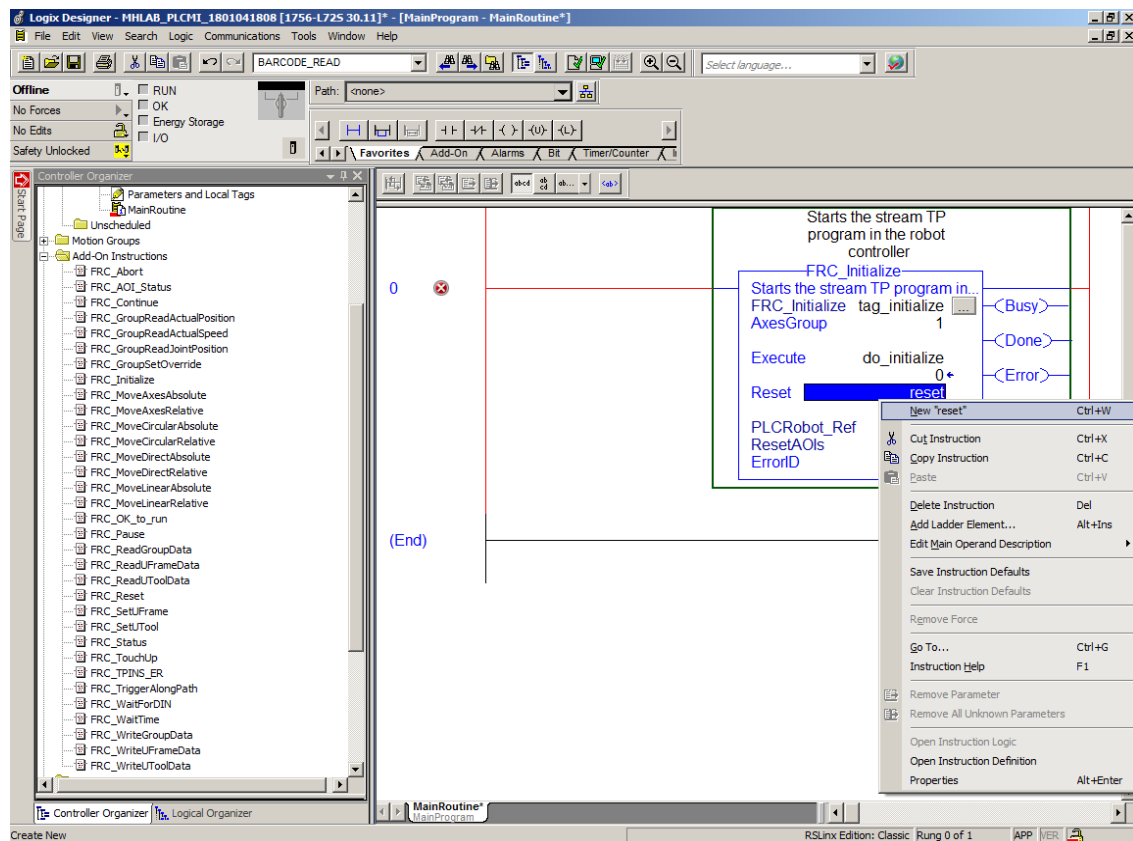




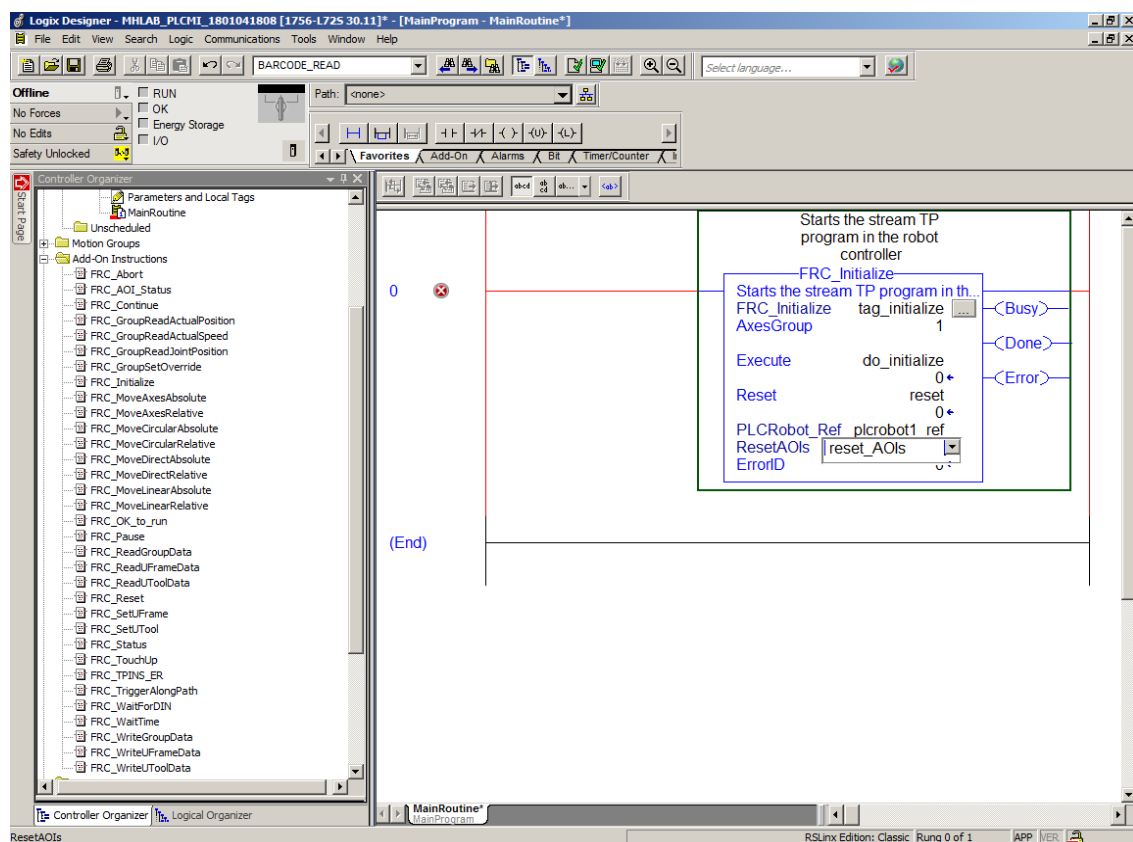
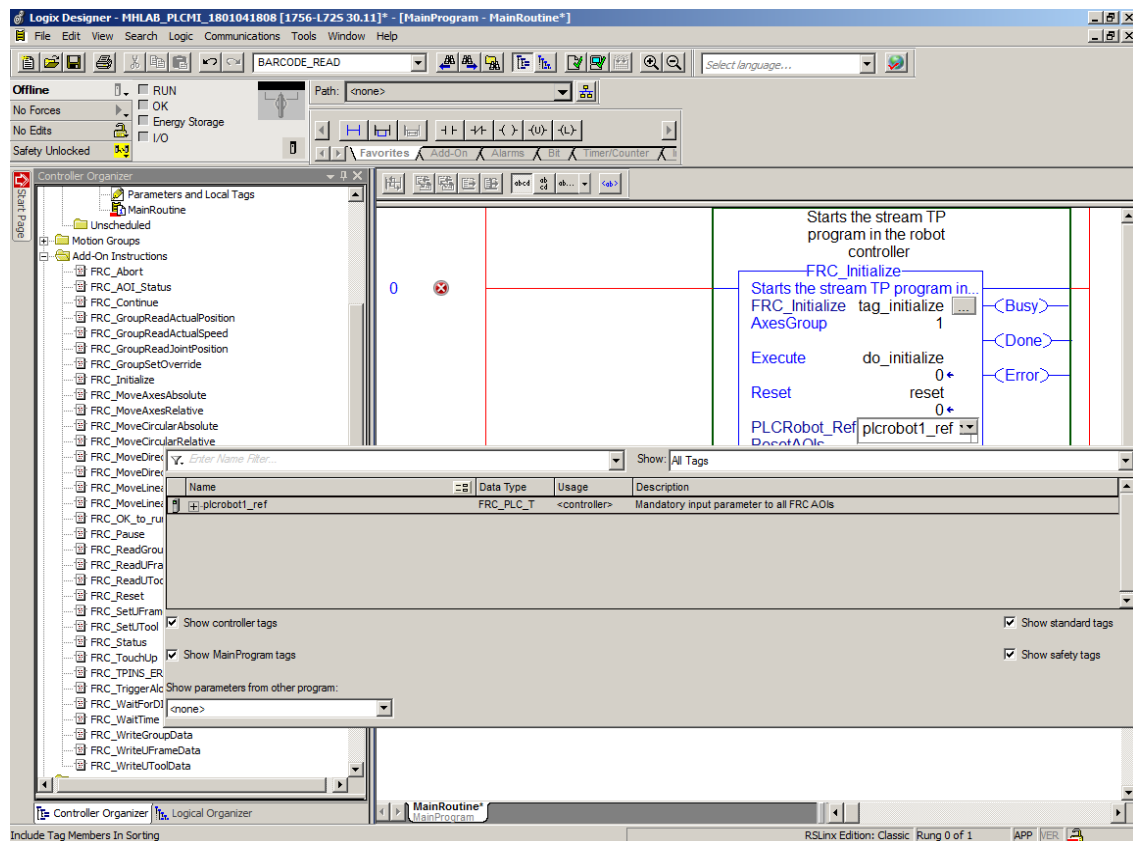
7. Add the reset tag. The AOI will reset its internal state when the Reset is set to TRUE.

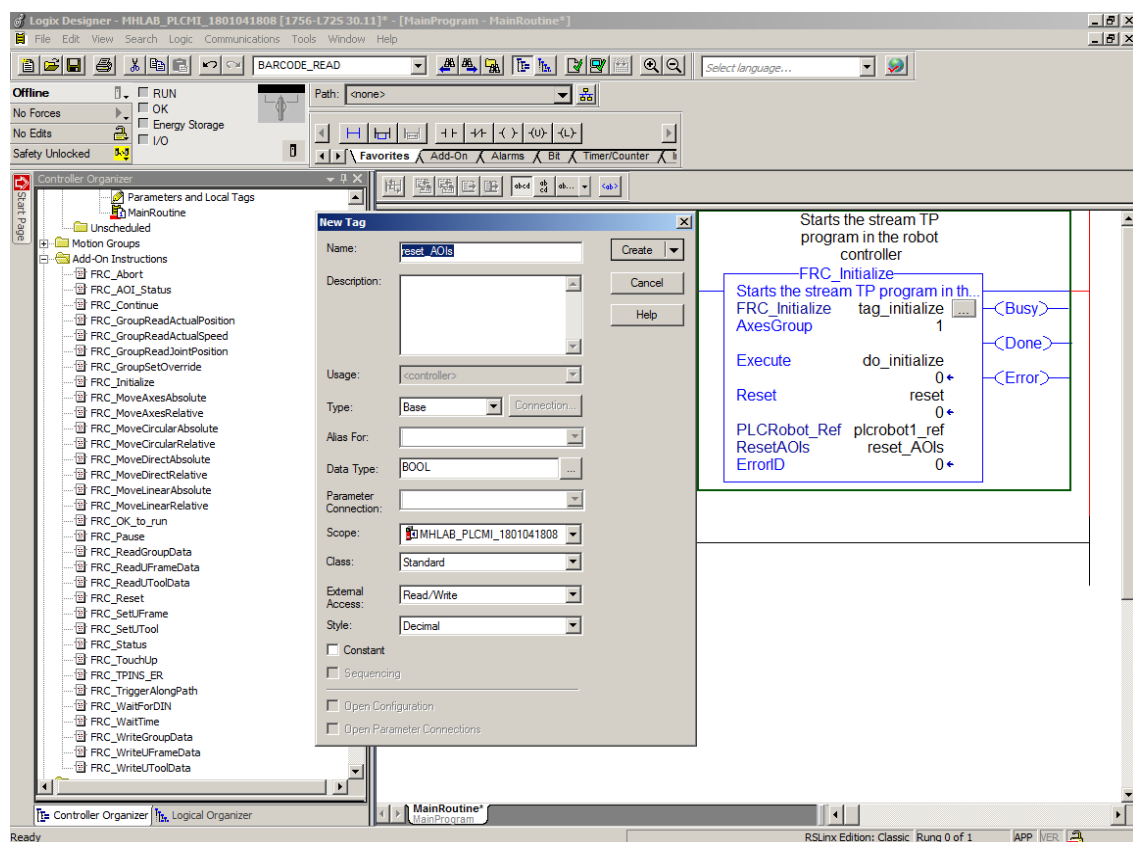
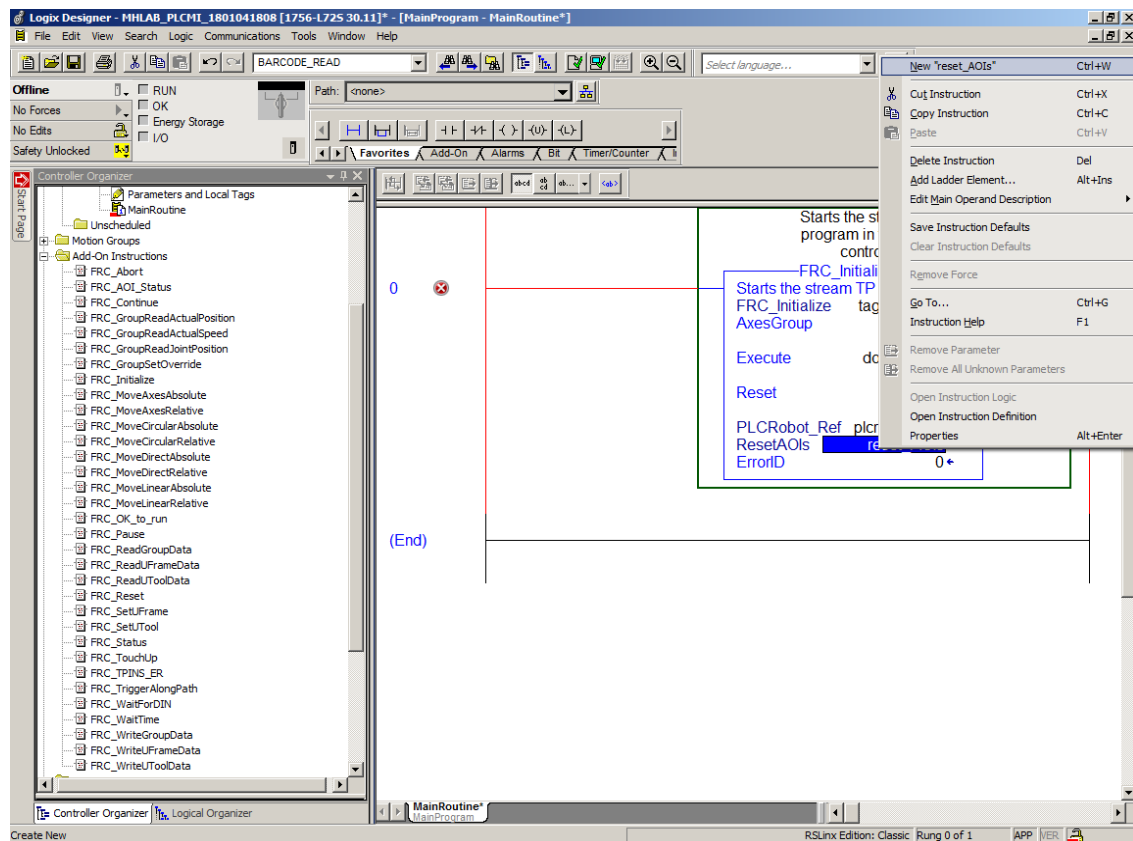


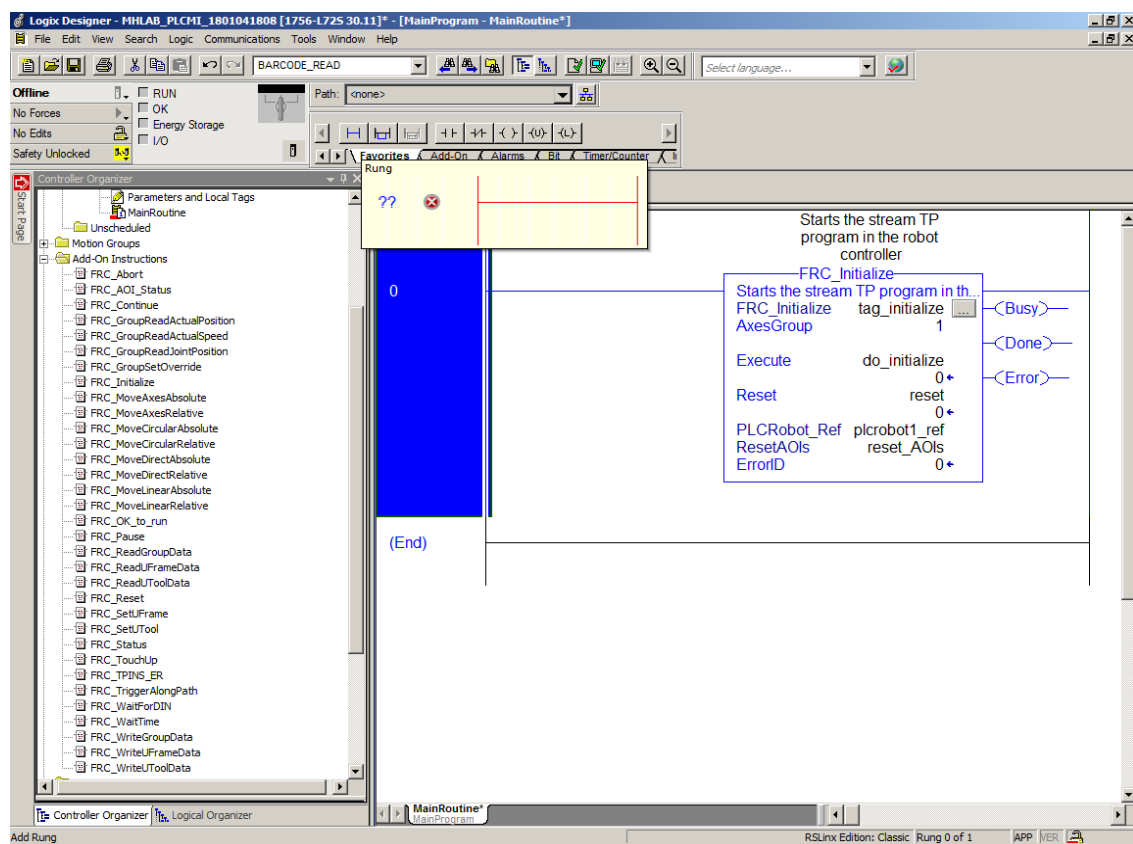
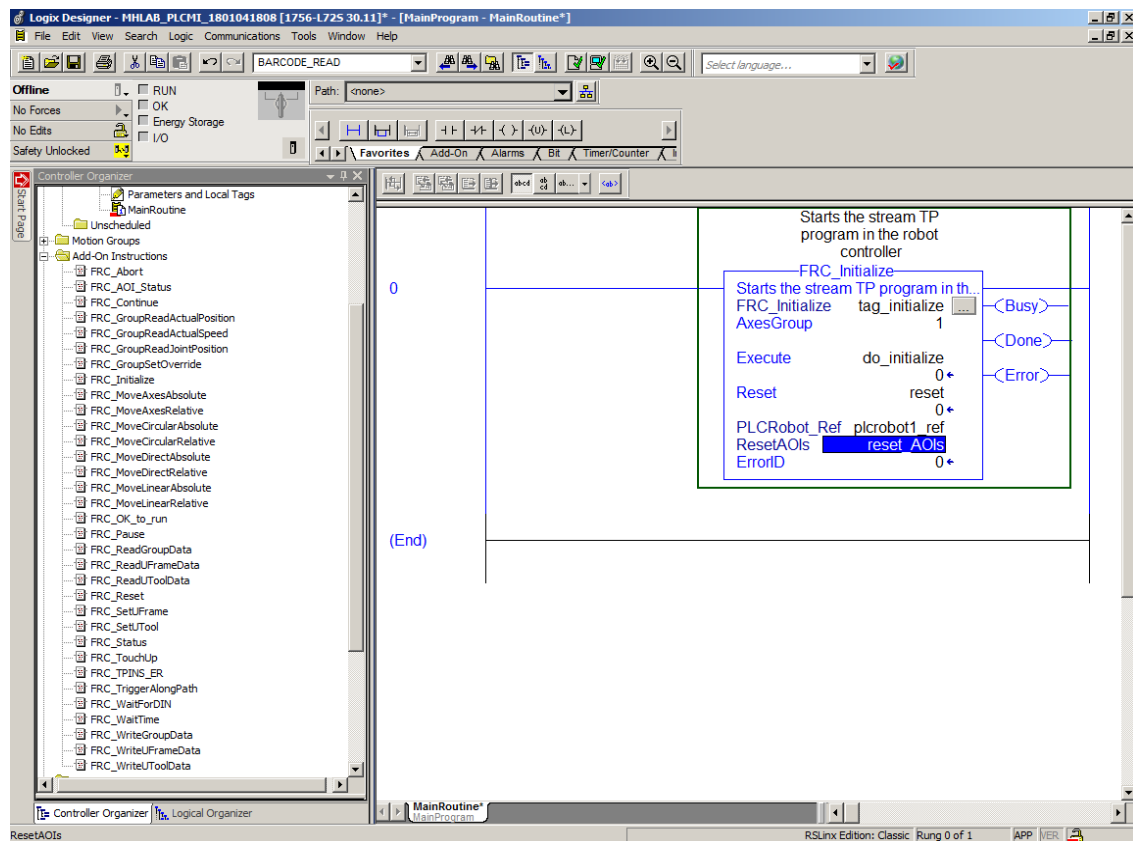
8. Create the reset tag:

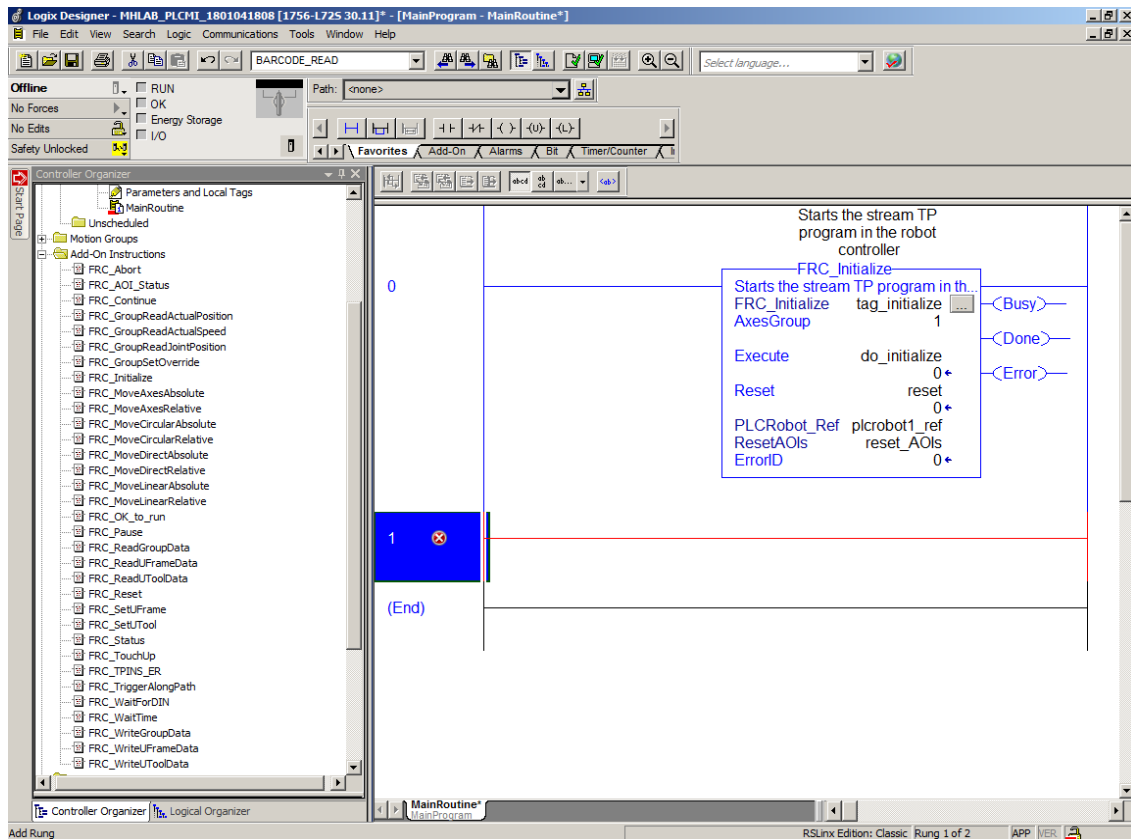


9. Set the PLCRobot_Ref input. This is a mandatory input for all FANUC AOIs.

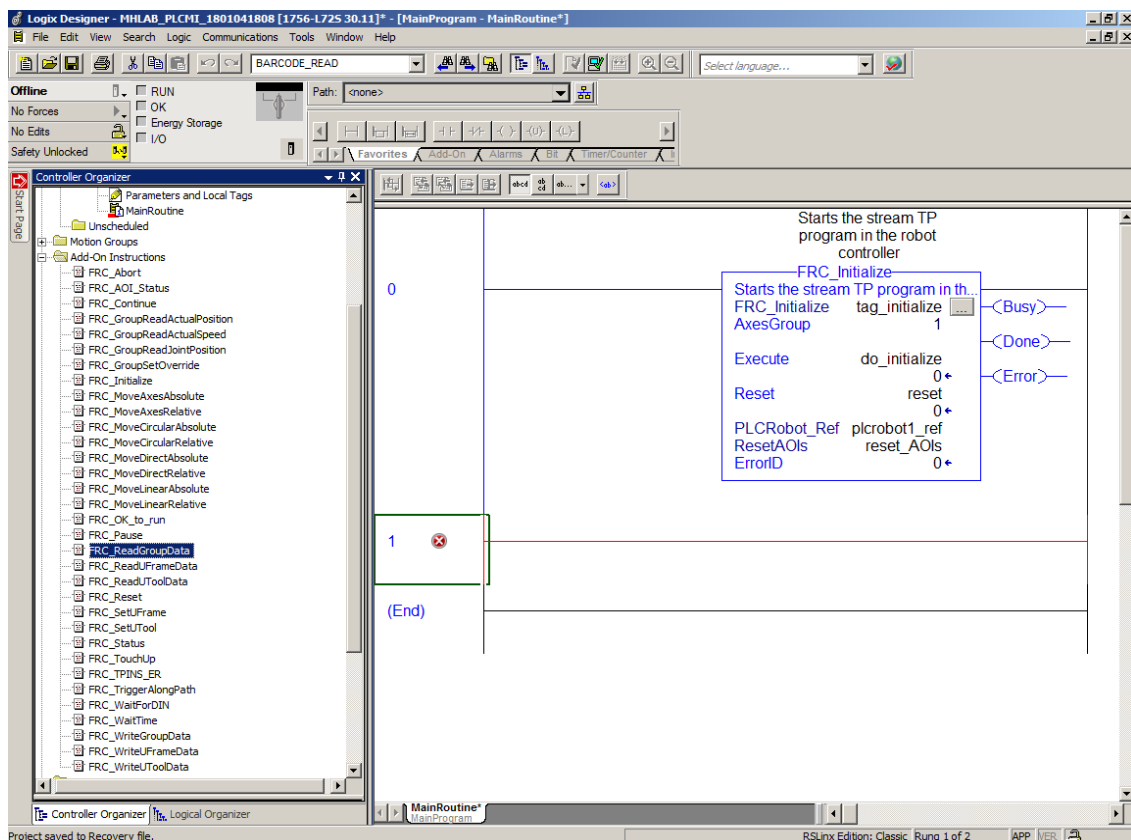




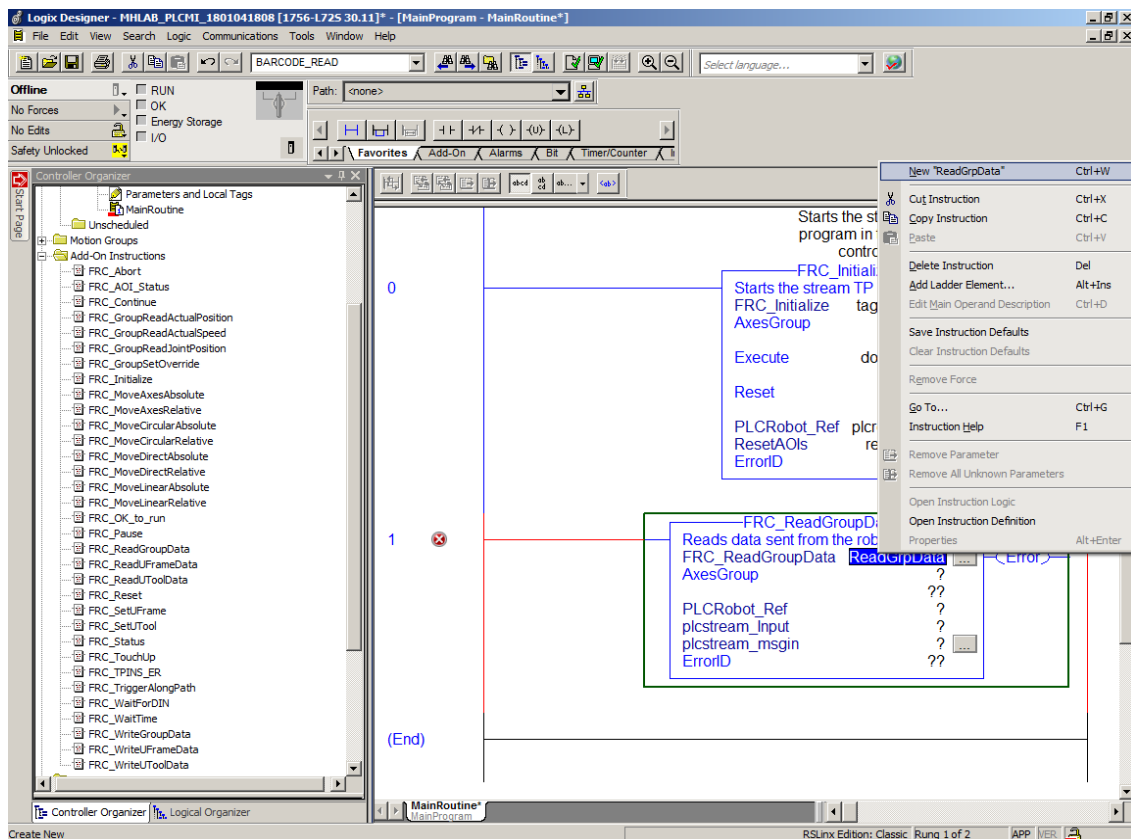
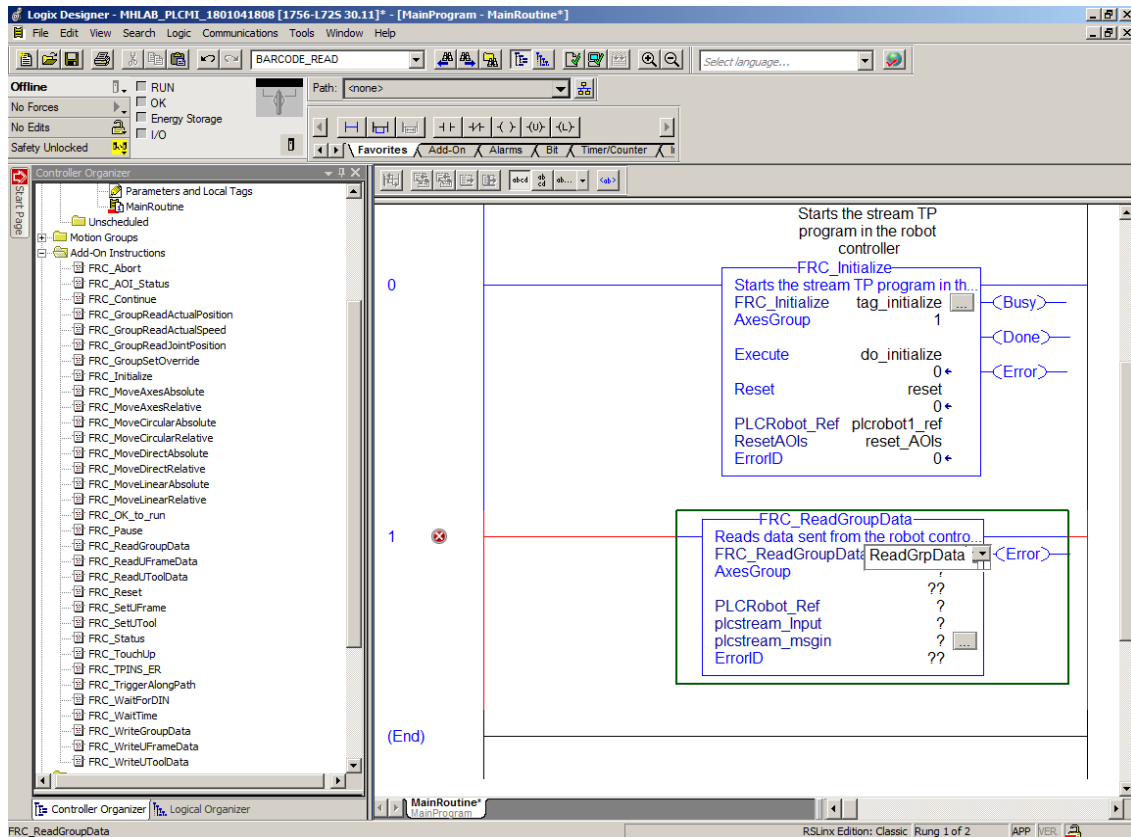


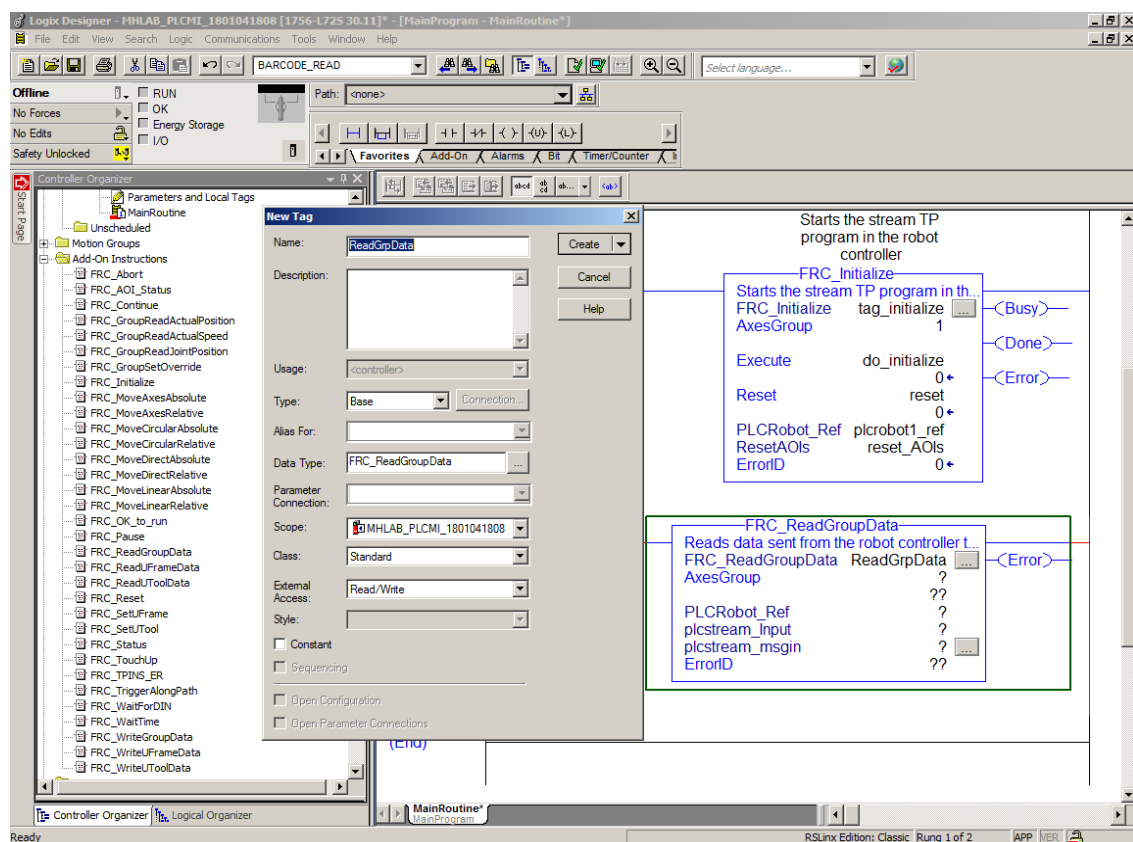
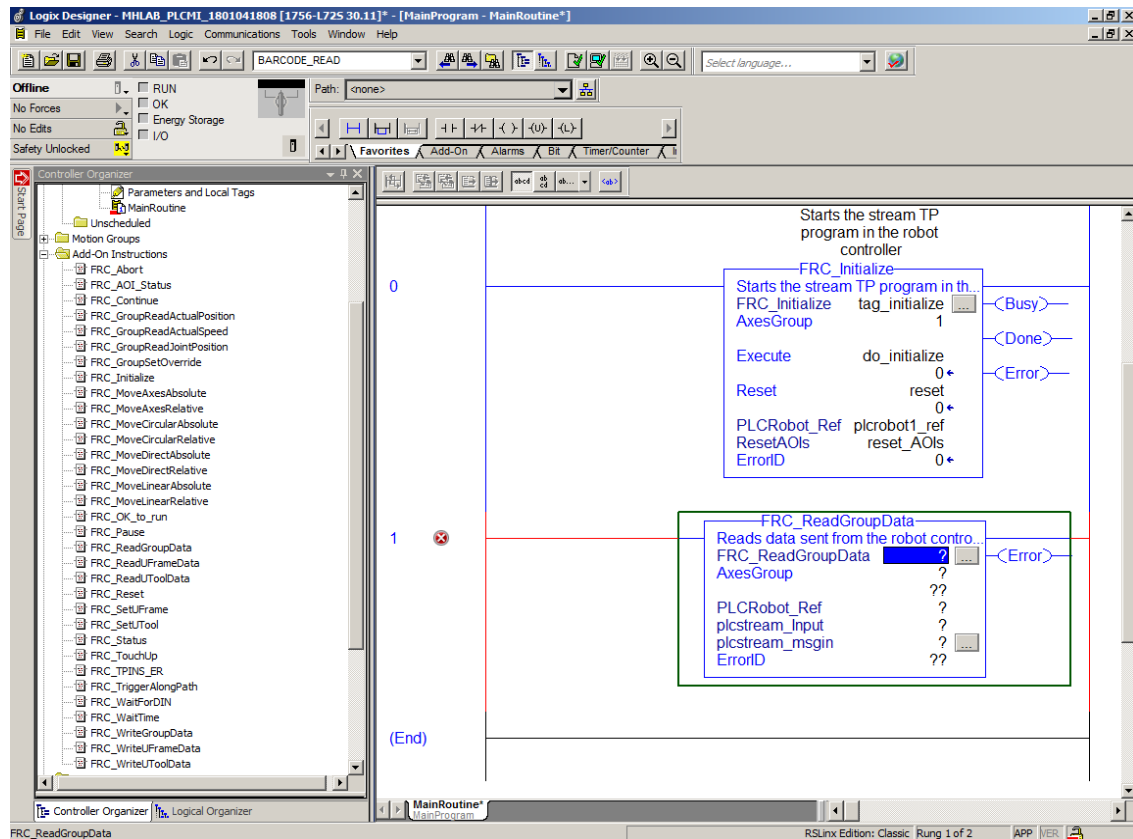


10. Add FRC_ReadGroupData AOI. This AOI is required for any PLC program that wants to communicate with the FANUC robot controller. This AOI copies the implicit message data from the robot controller to the PLC controller tags.

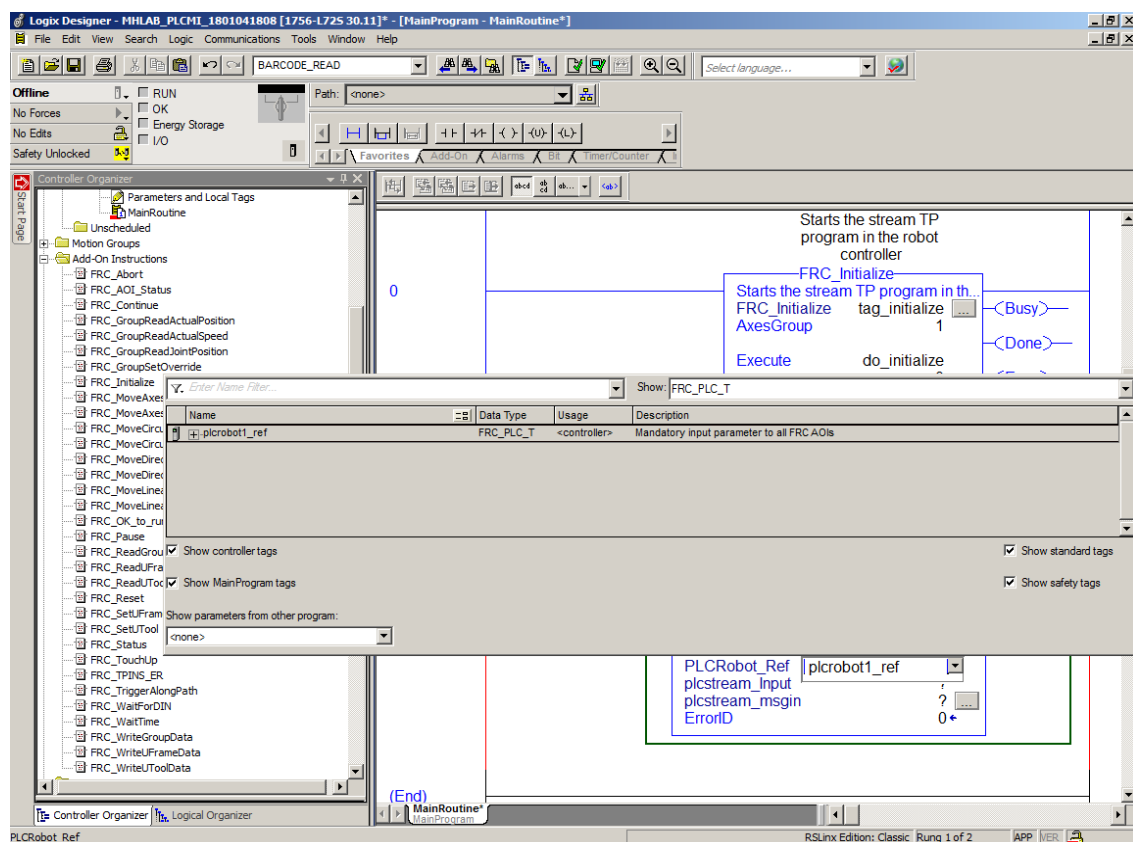
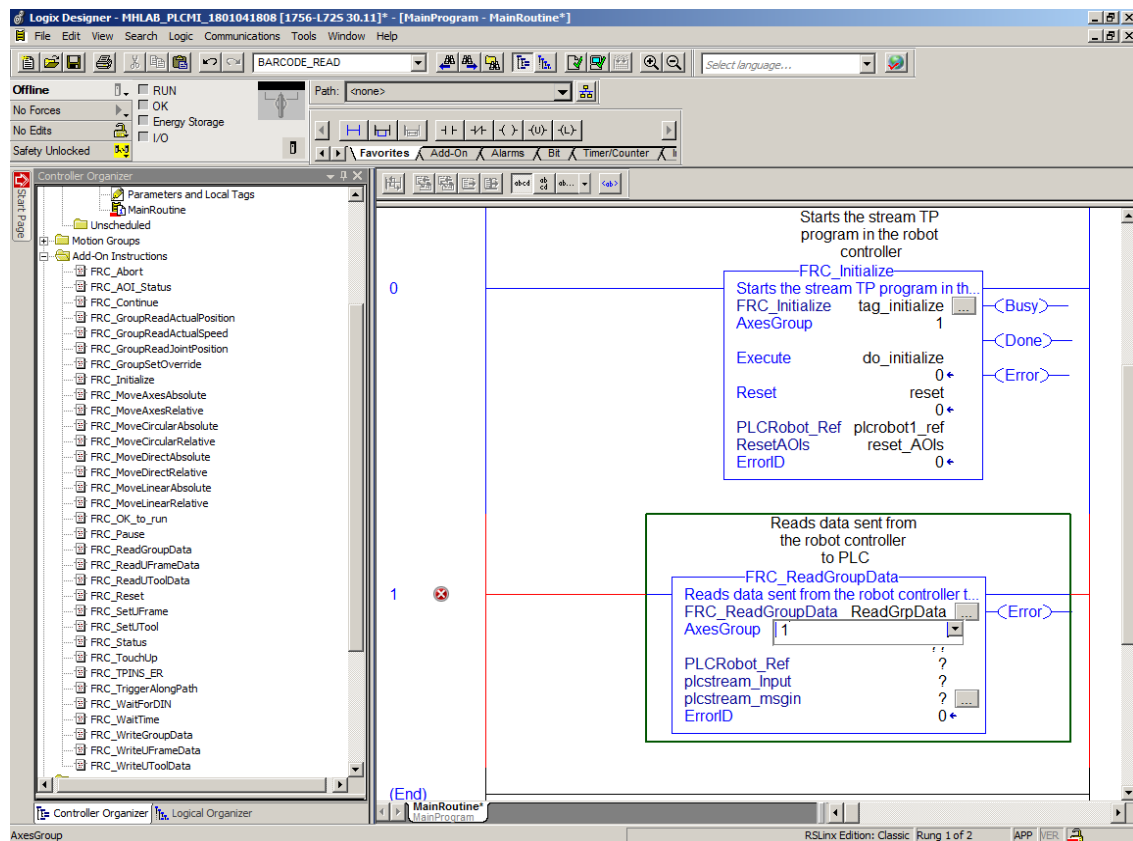


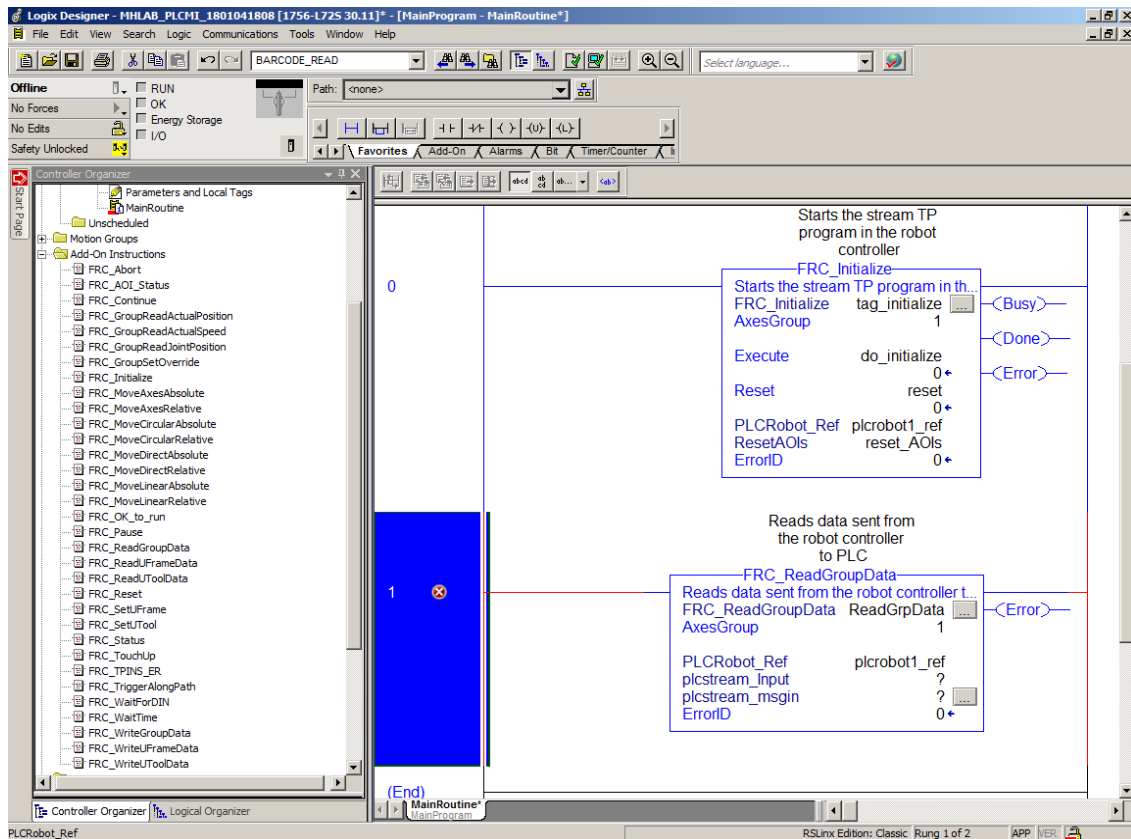
11. Add a new rung and then add the FRC_ReadGroupData AOI to the rung. Add a tag for the AOI and create it.



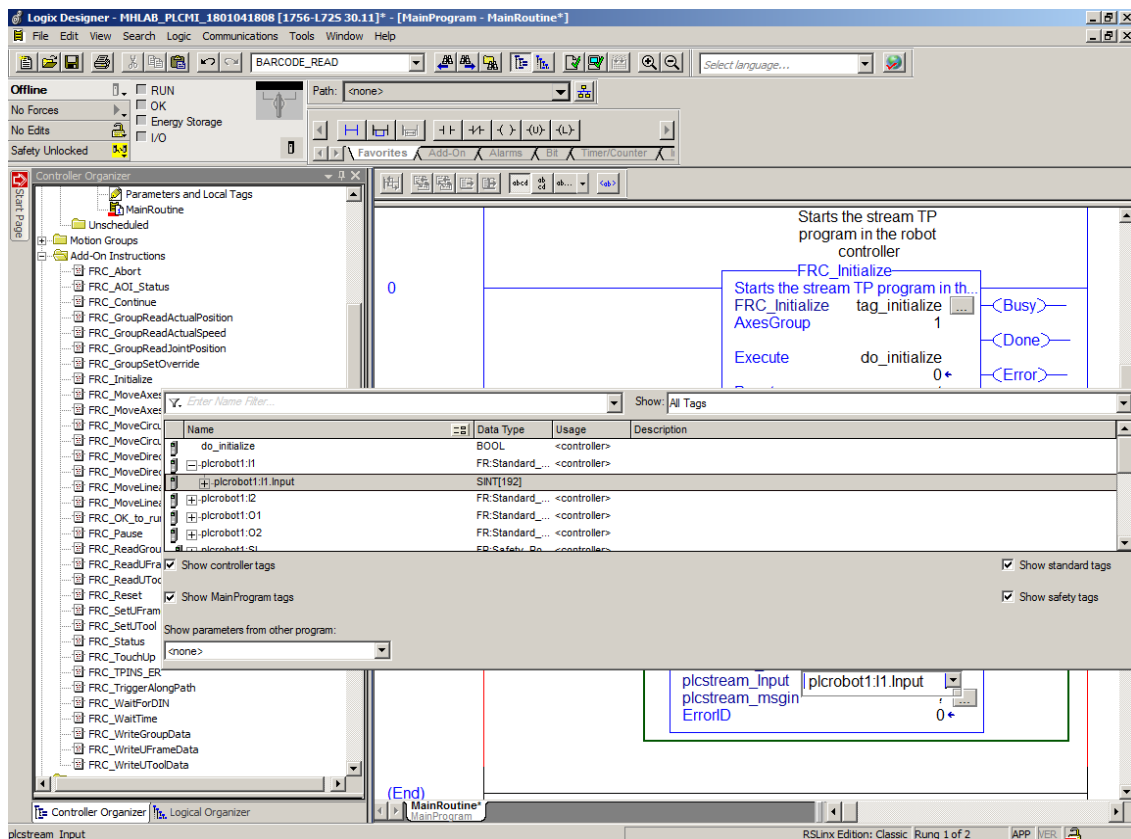


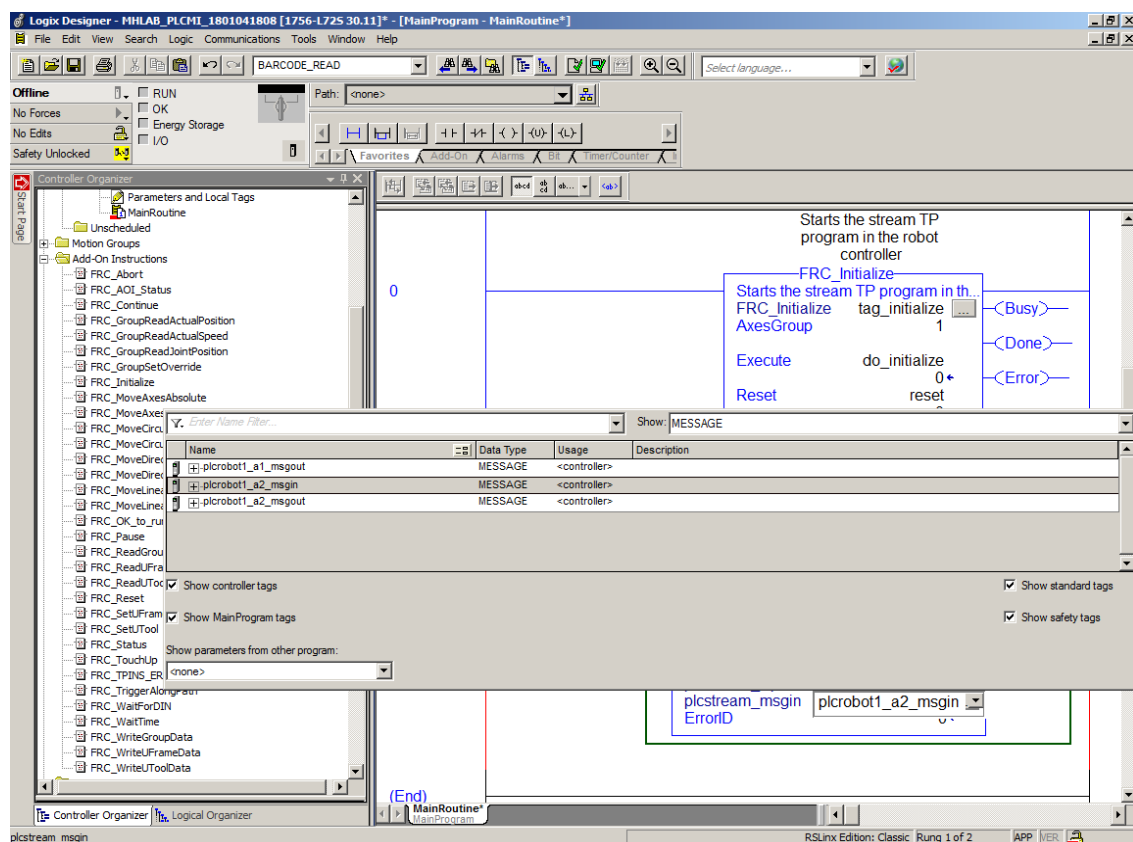
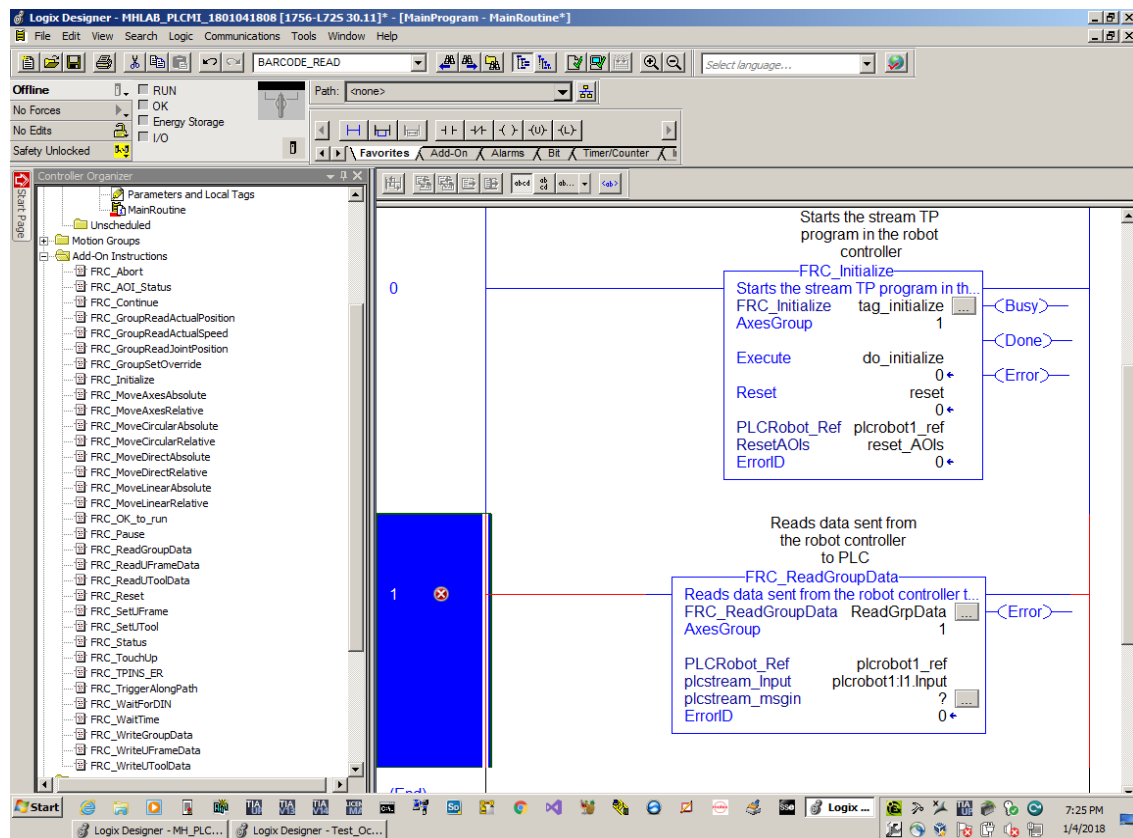
12. Set the AxesGroup to 1 and set PLCRobot_Ref input parameters. The procedure is the same as setting up FRC_Initialize.

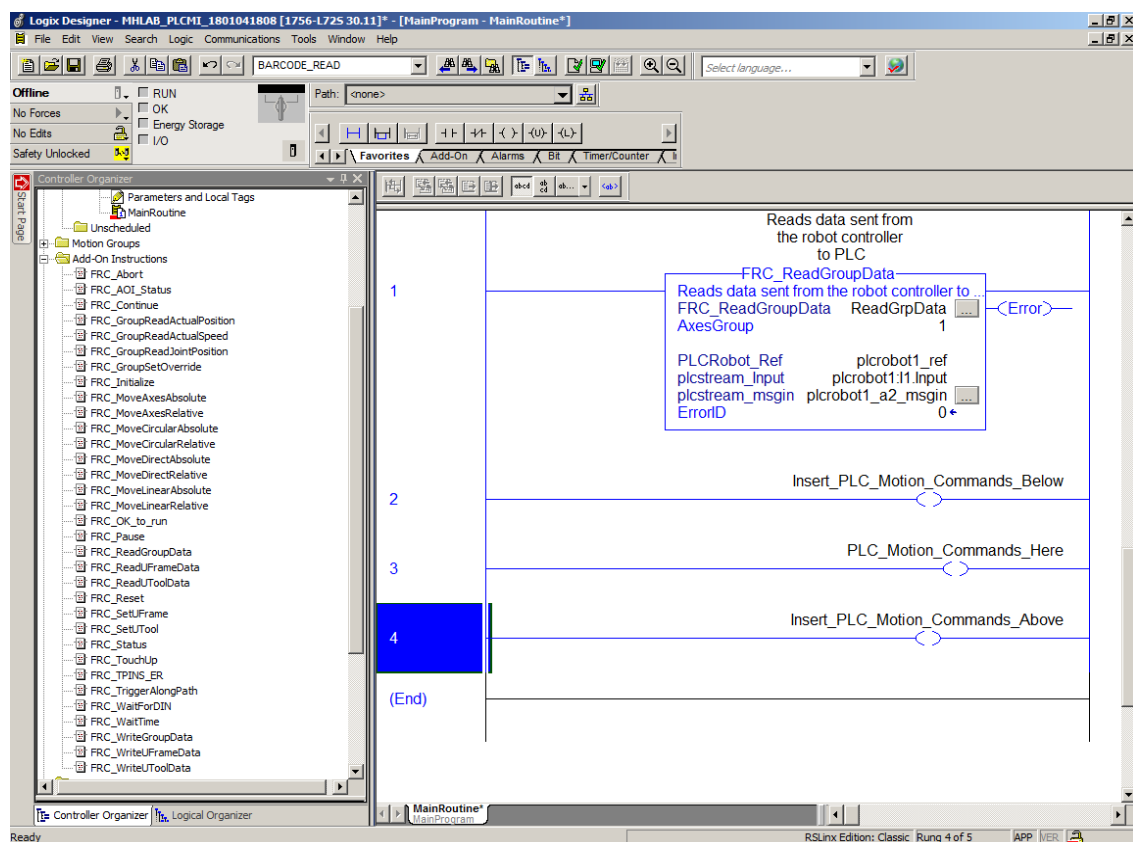
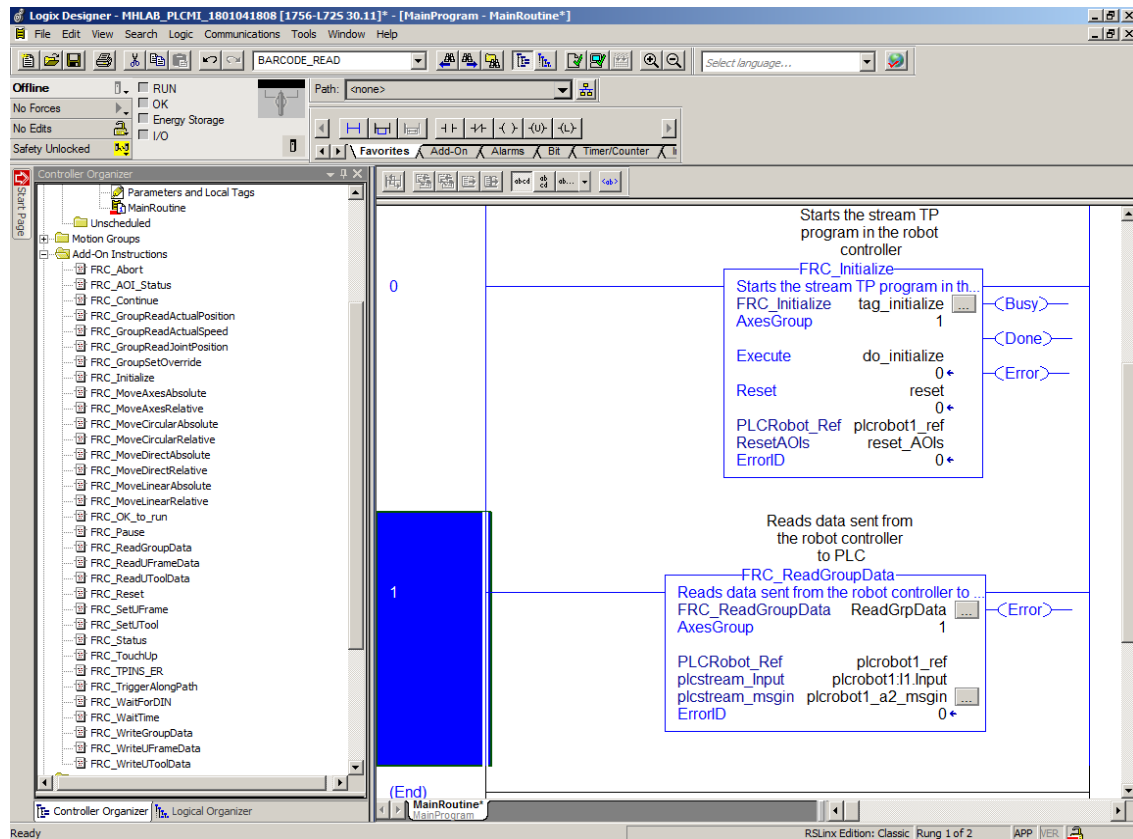


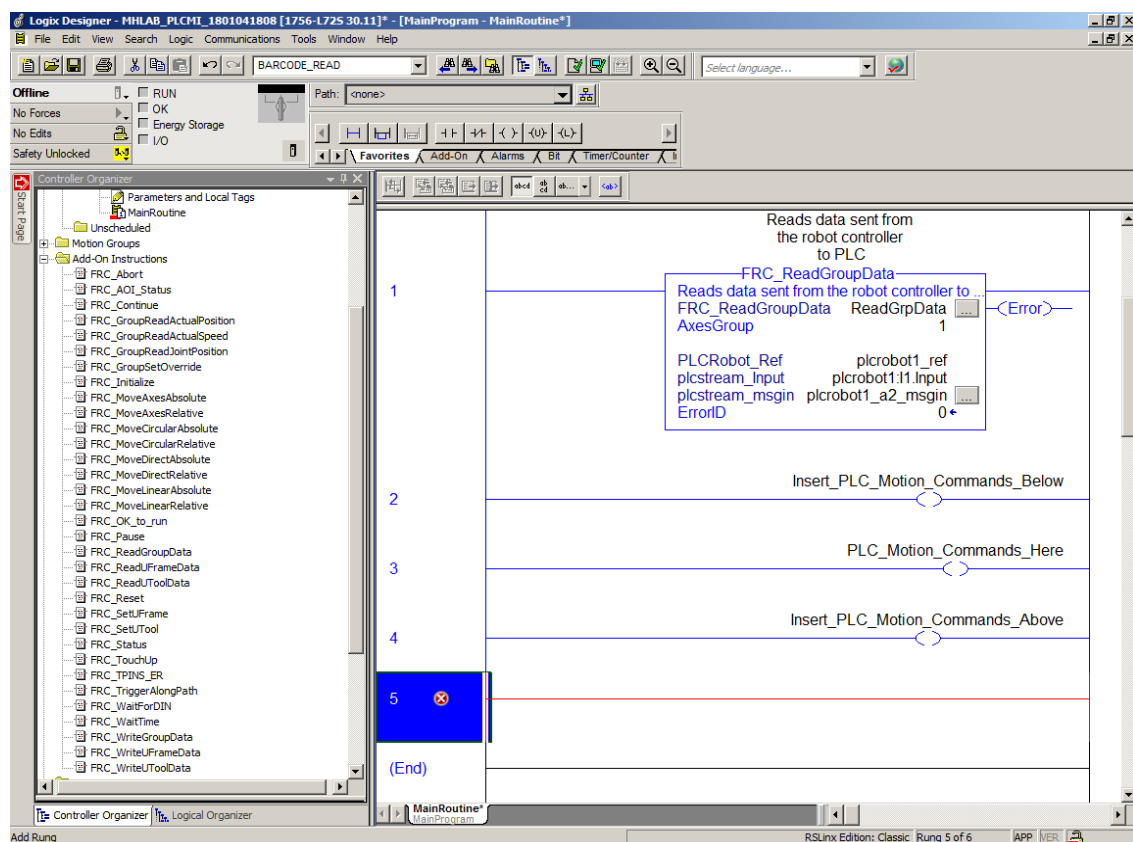
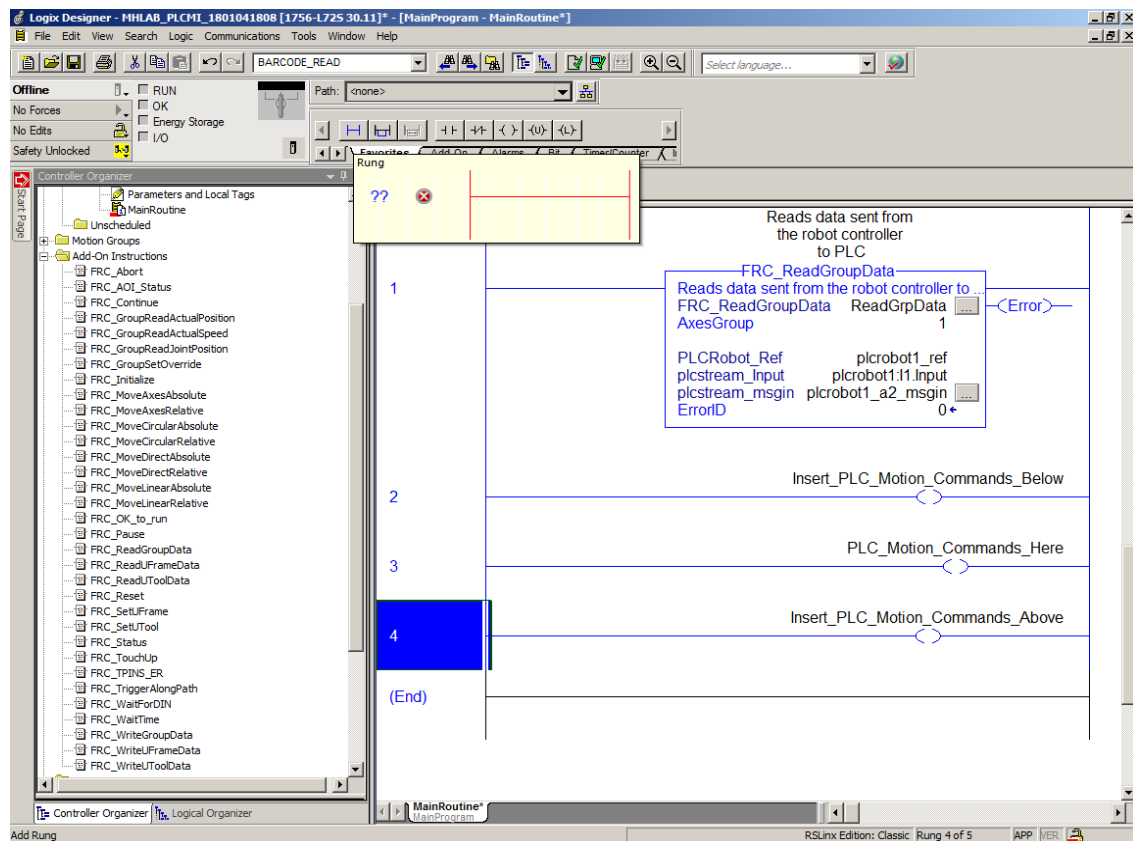


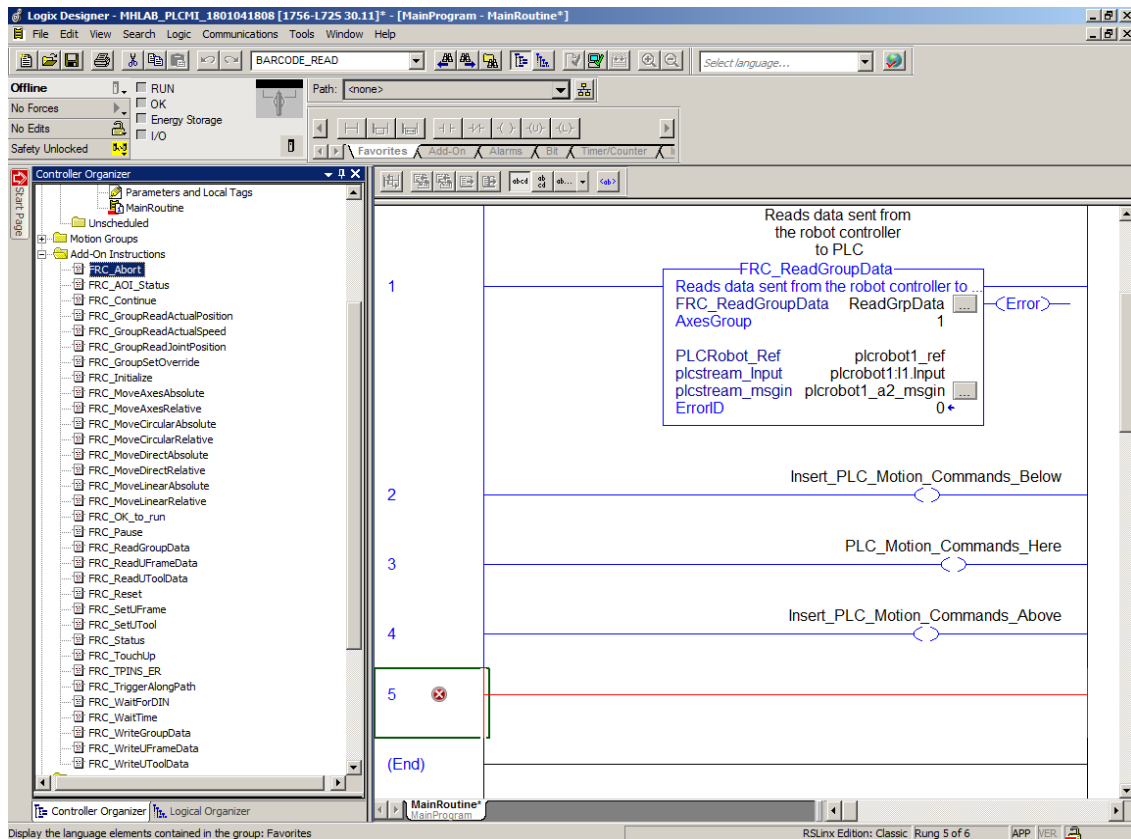
13. Set the input parameter plcstream_Input to plcrobot1:11.Input tag and parameter plcstream_msgin to plcrobot1_a2_msgin.



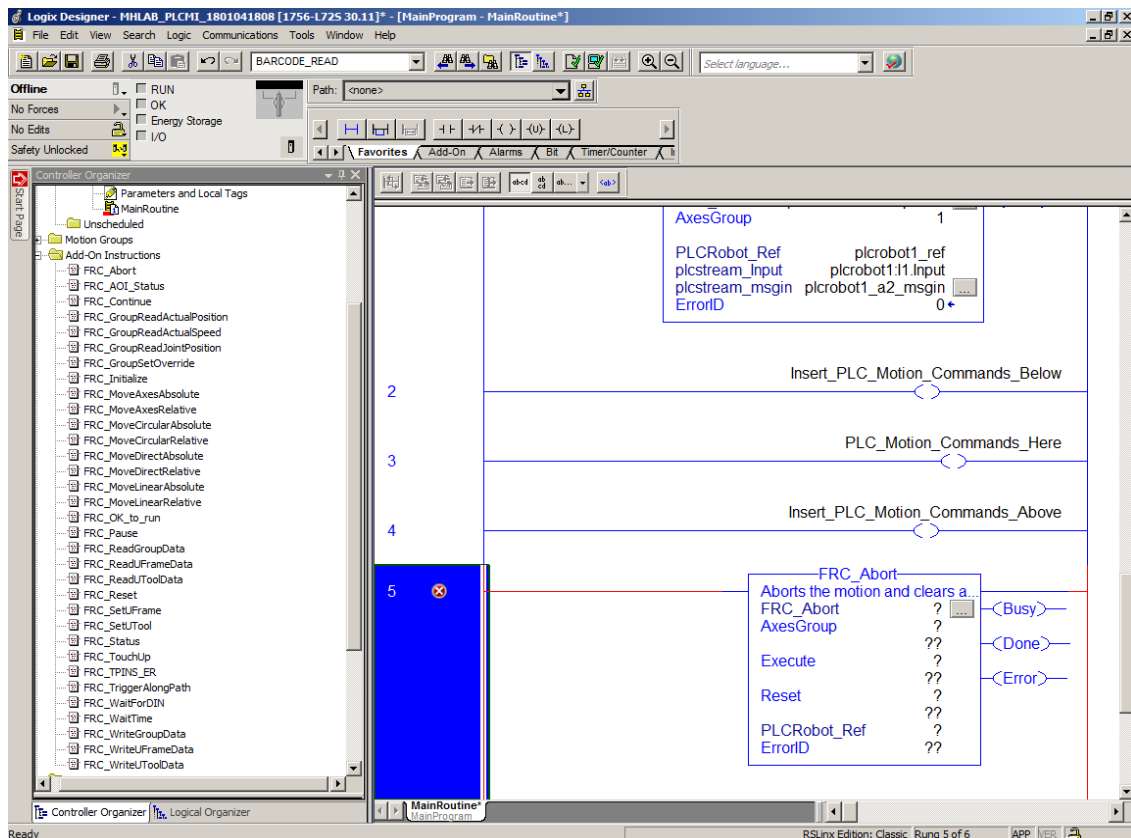


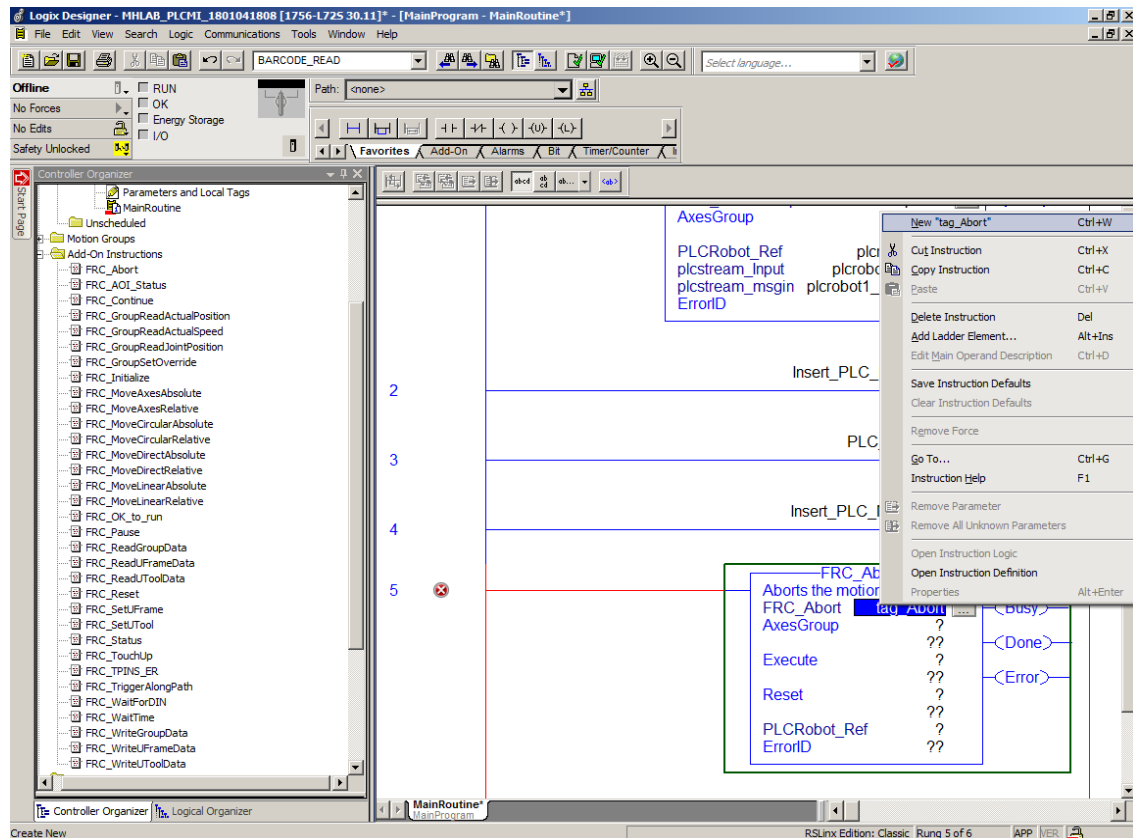
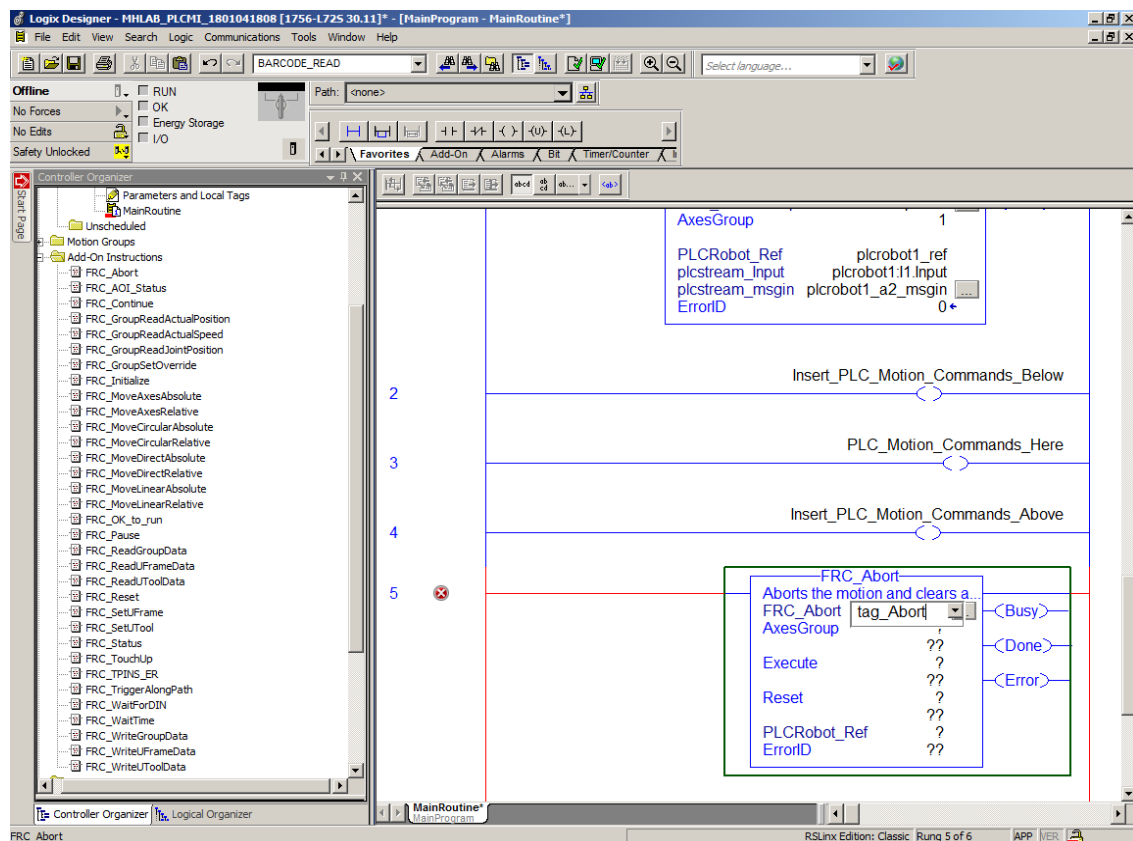


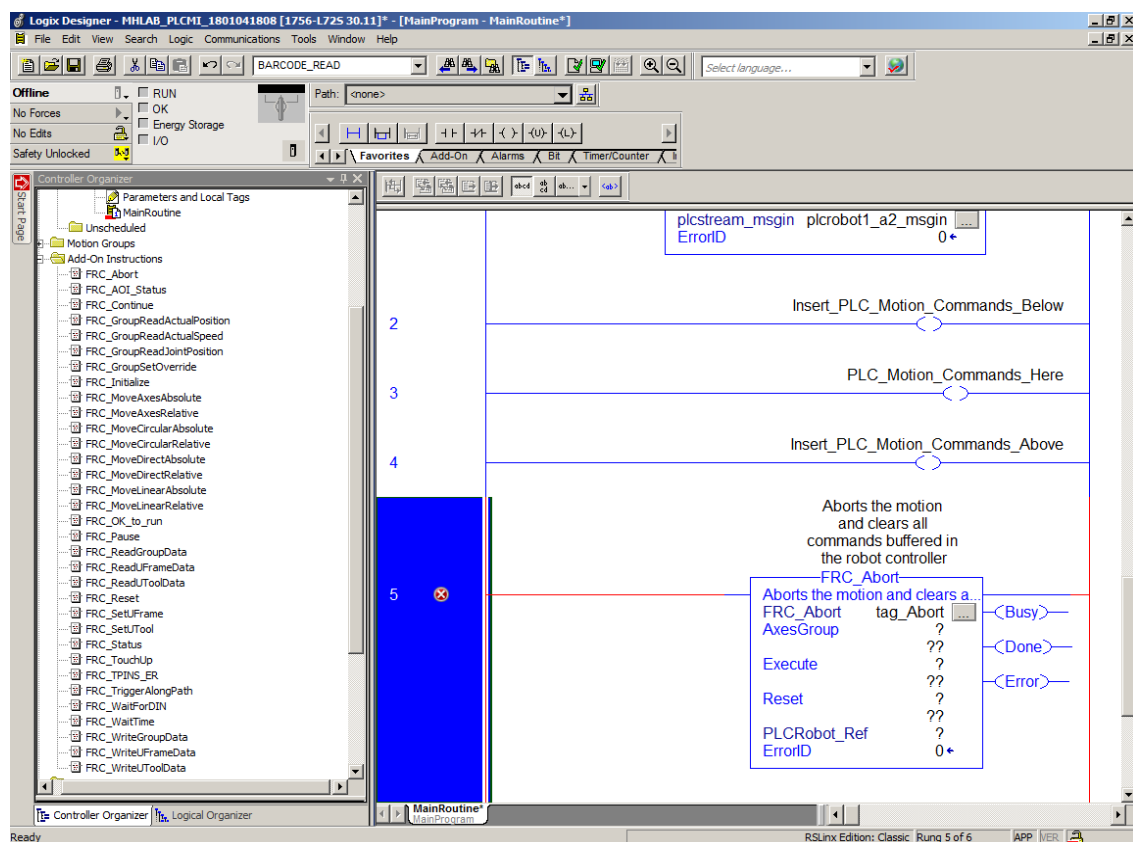
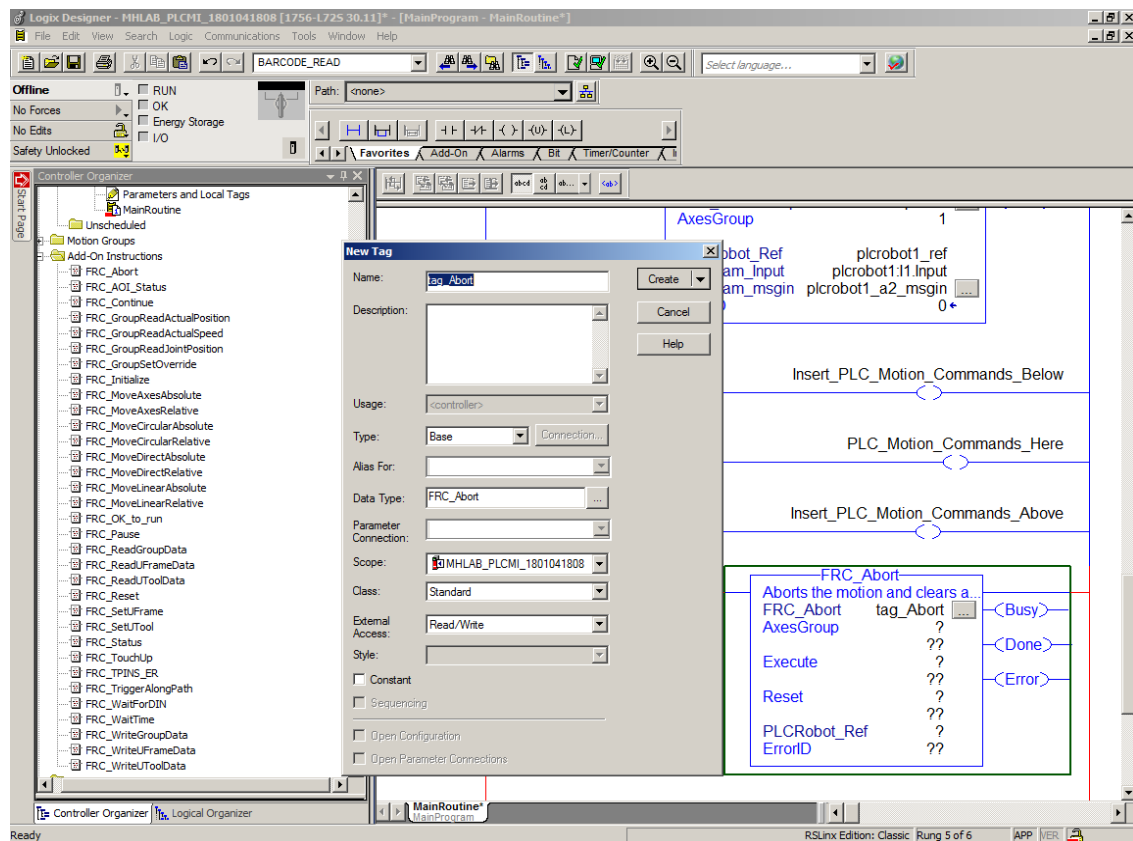


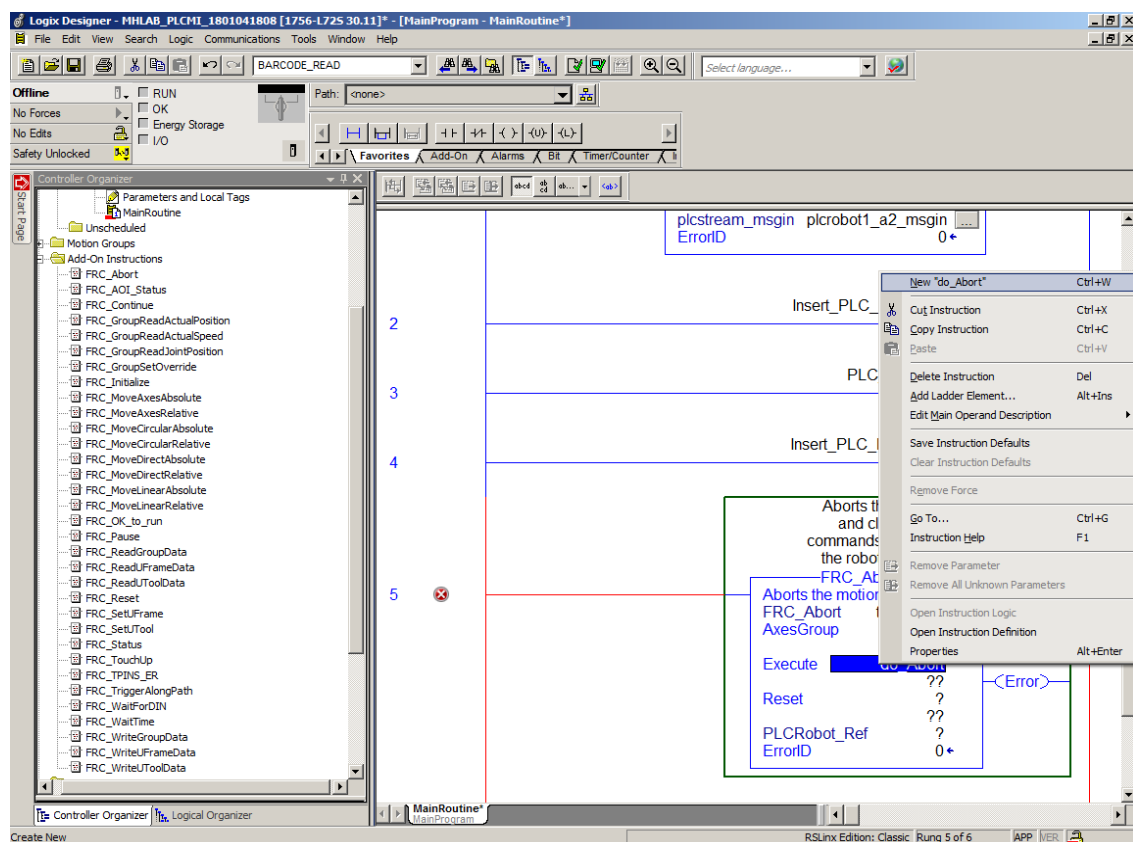
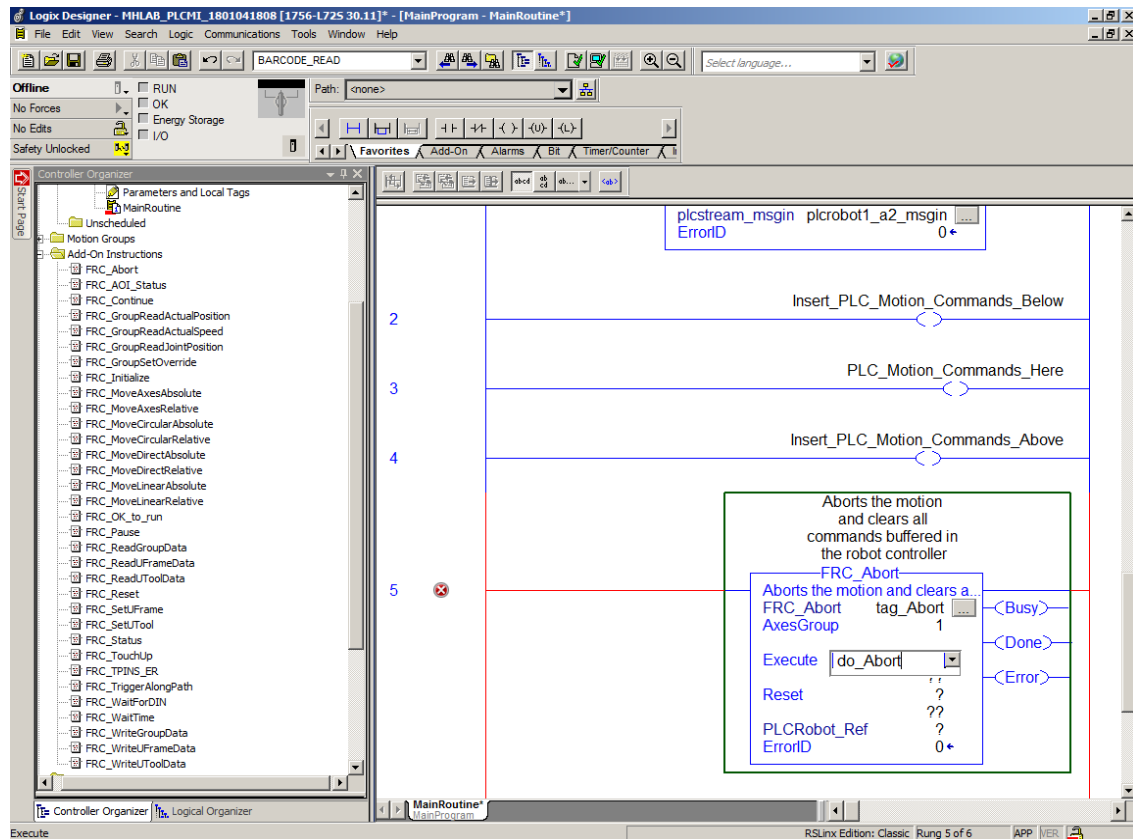


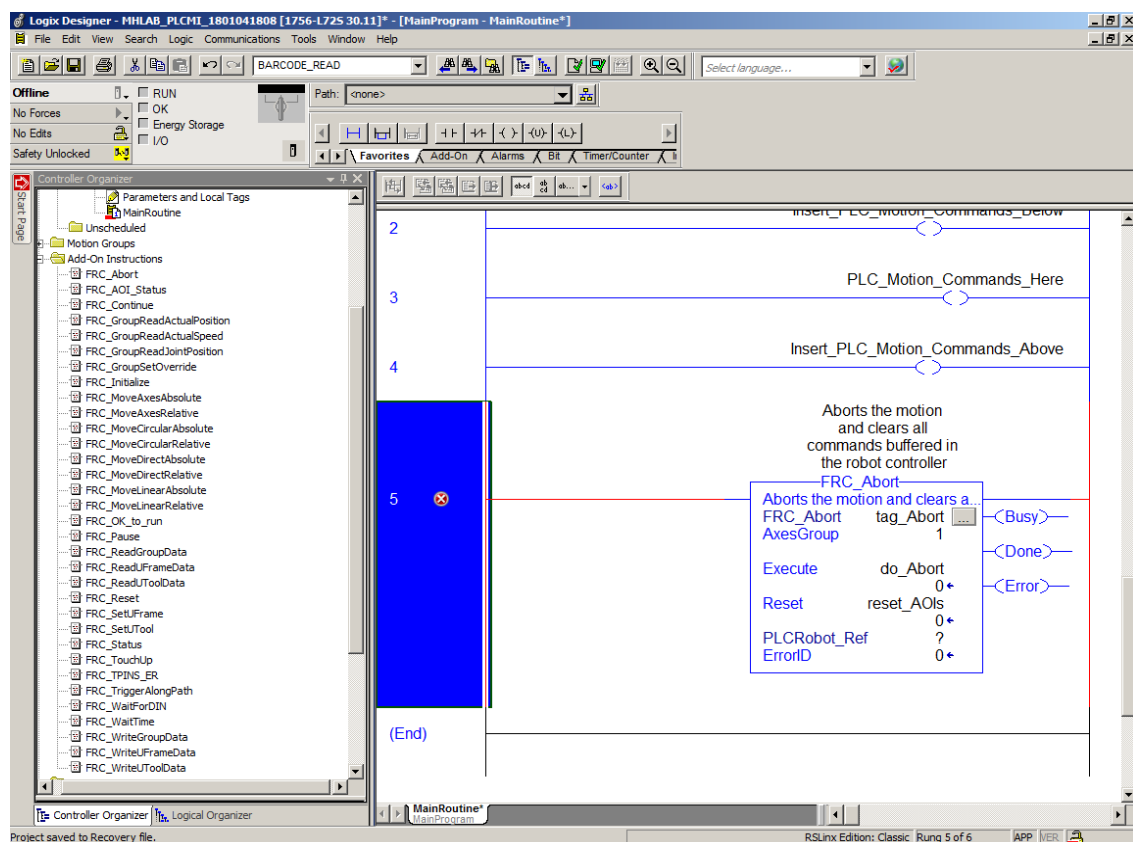
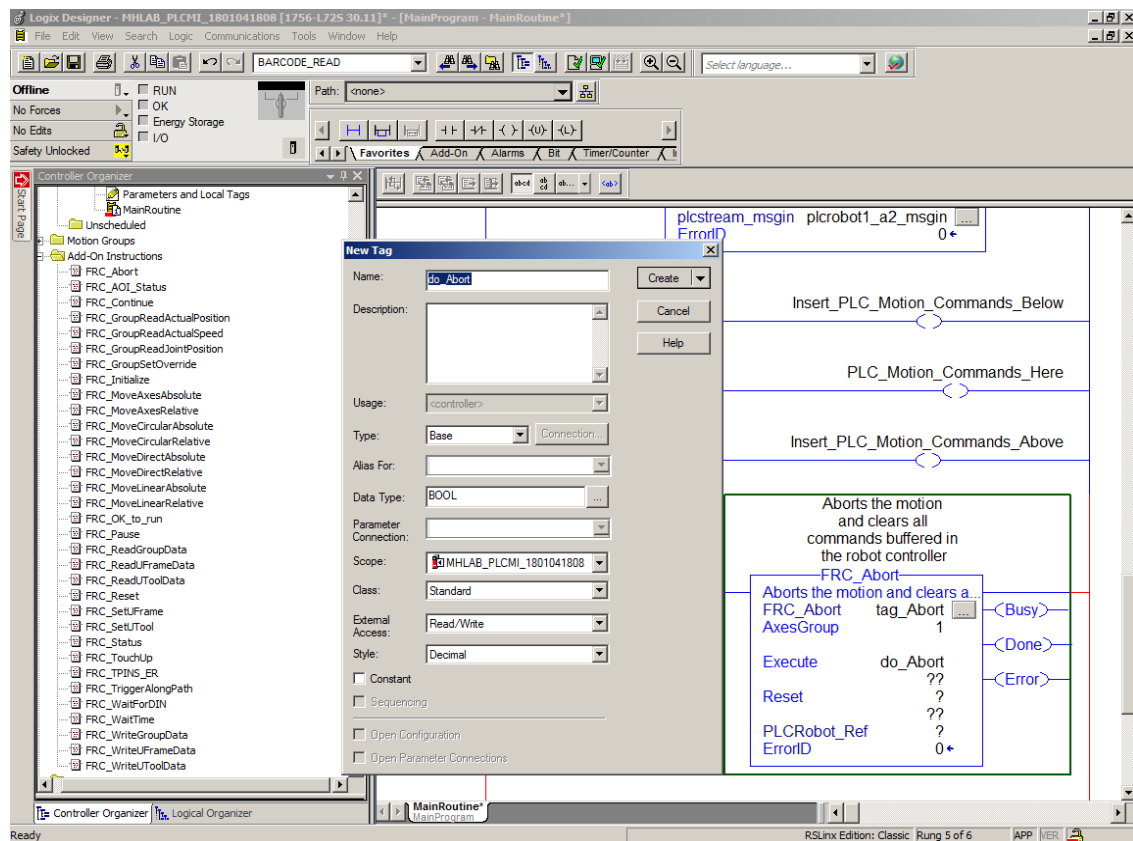
14. Add the FRC_Abort to stop the PLC Motion communication session. The procedure is the same as setting the FRC_Initialize AOI. The only difference is that the AOI tag name and the execute parameter has a different do_abort tag.

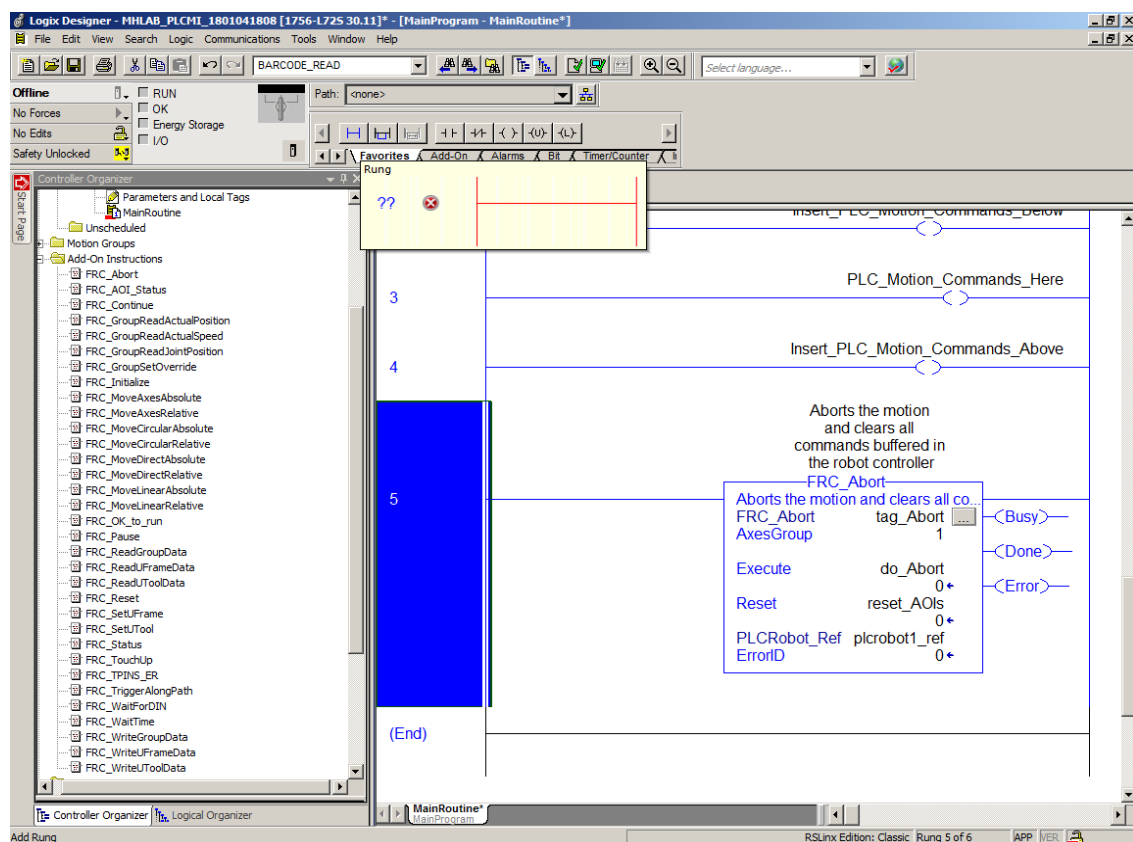
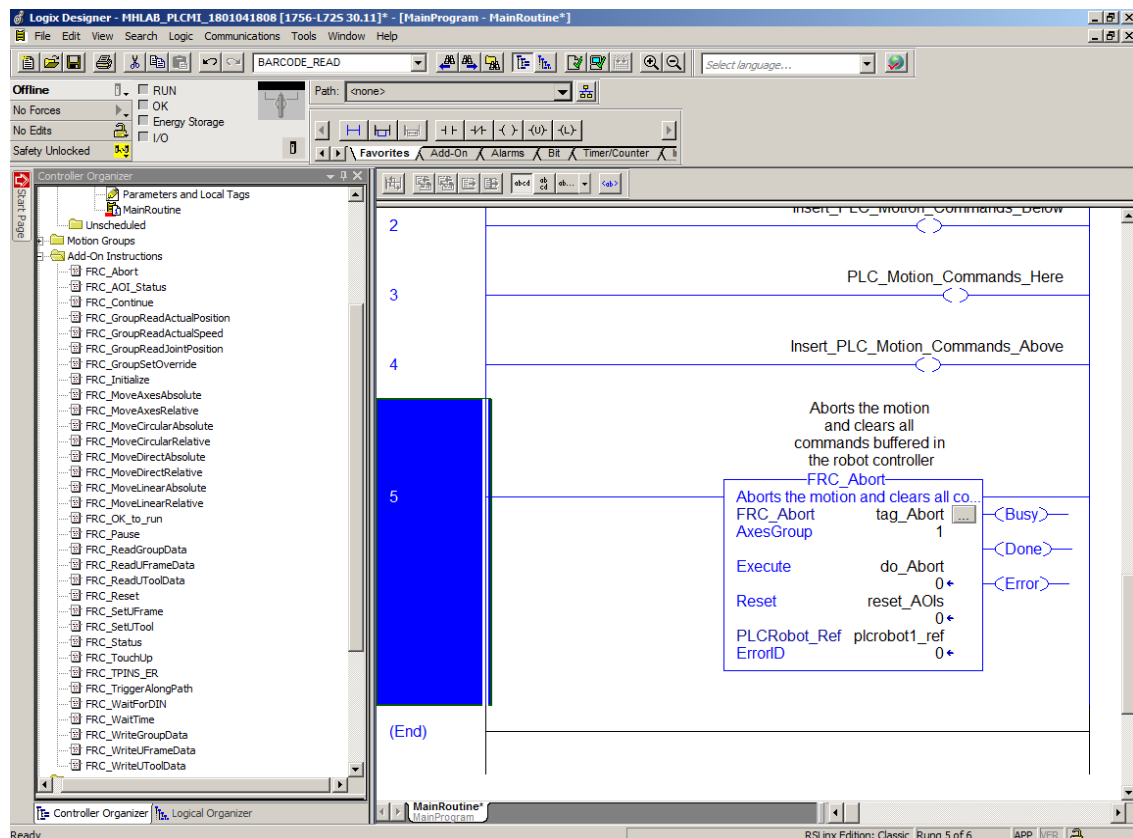




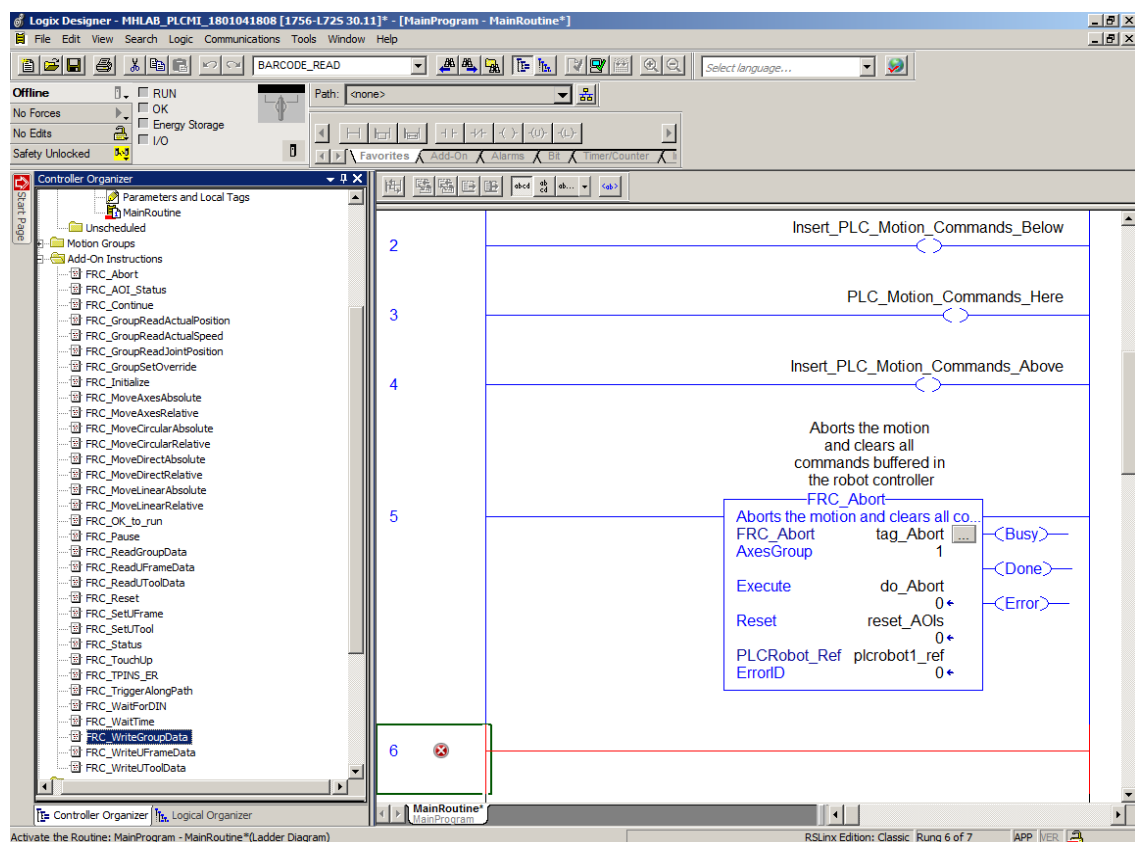
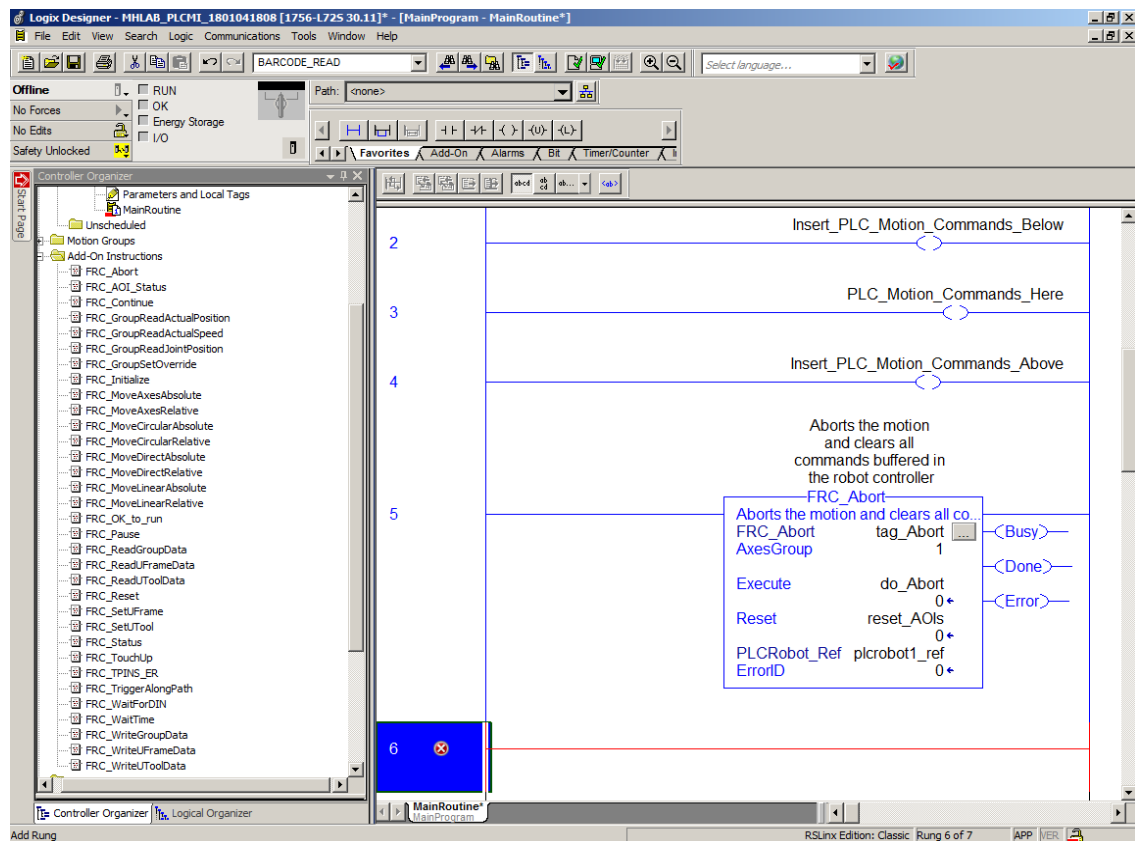






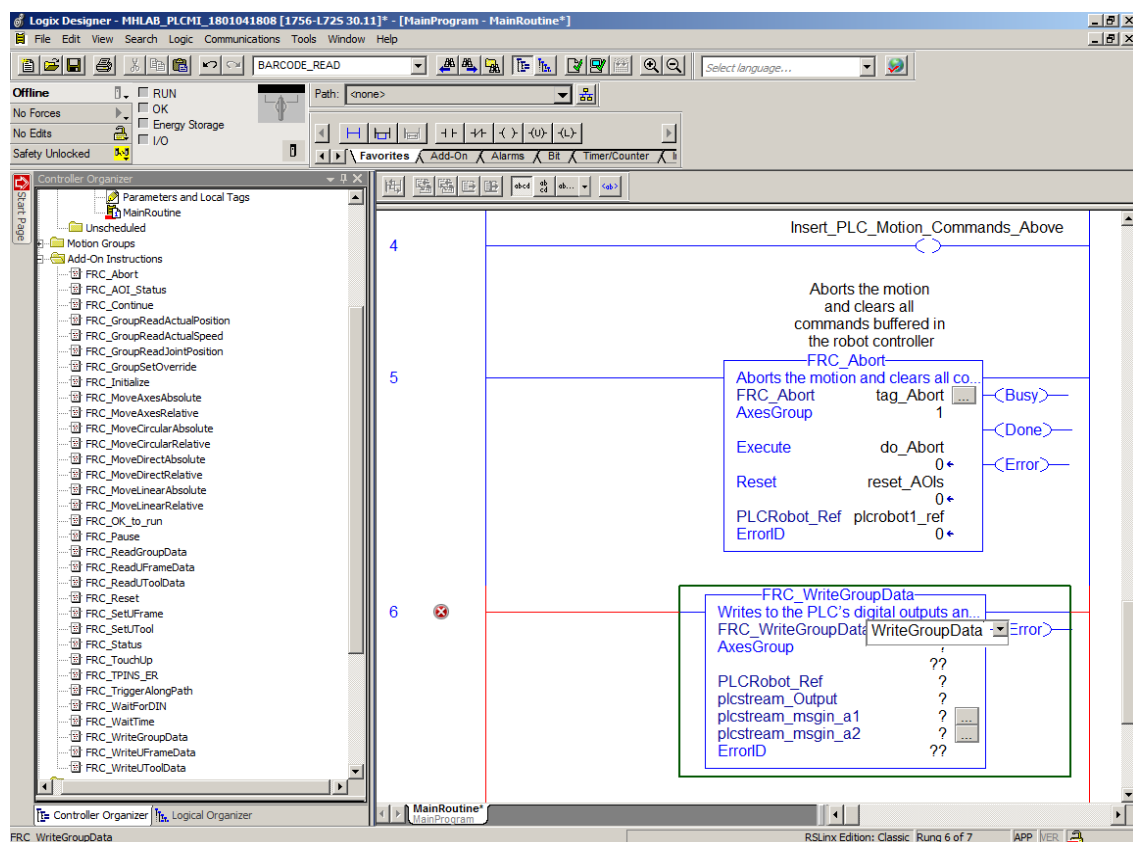
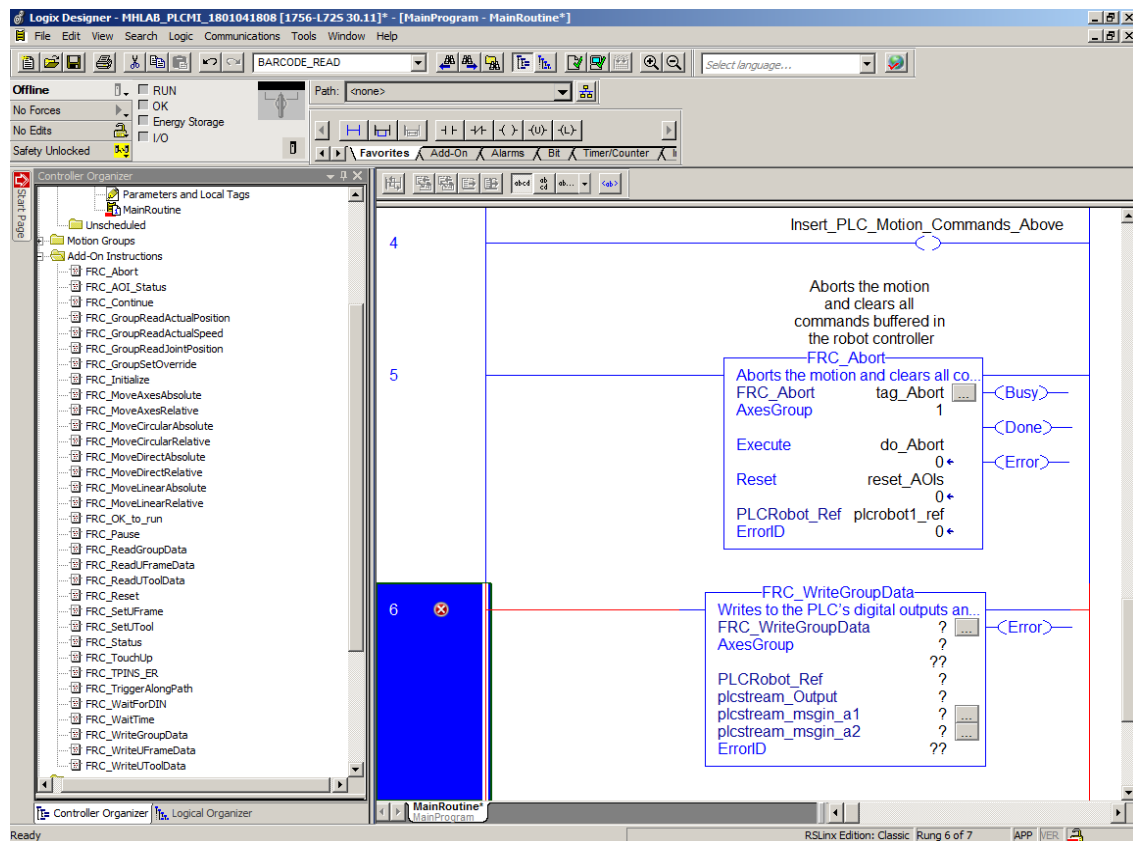


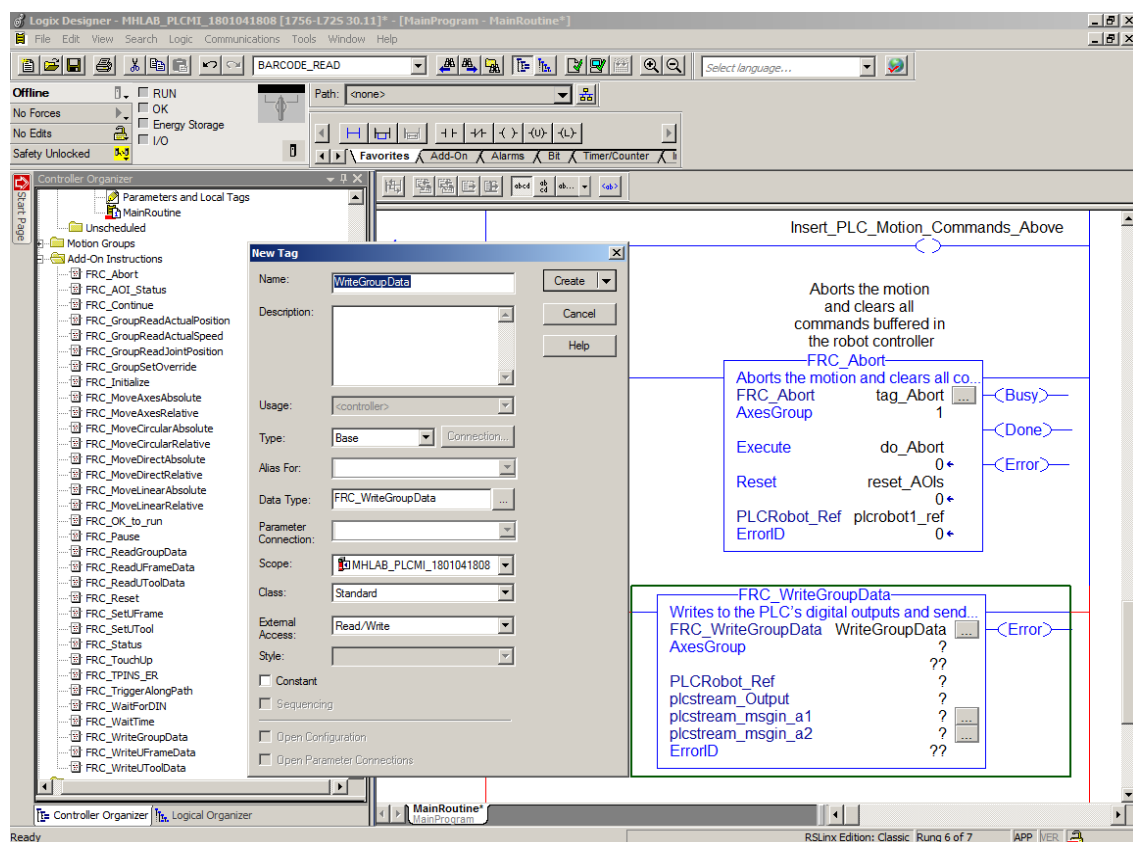
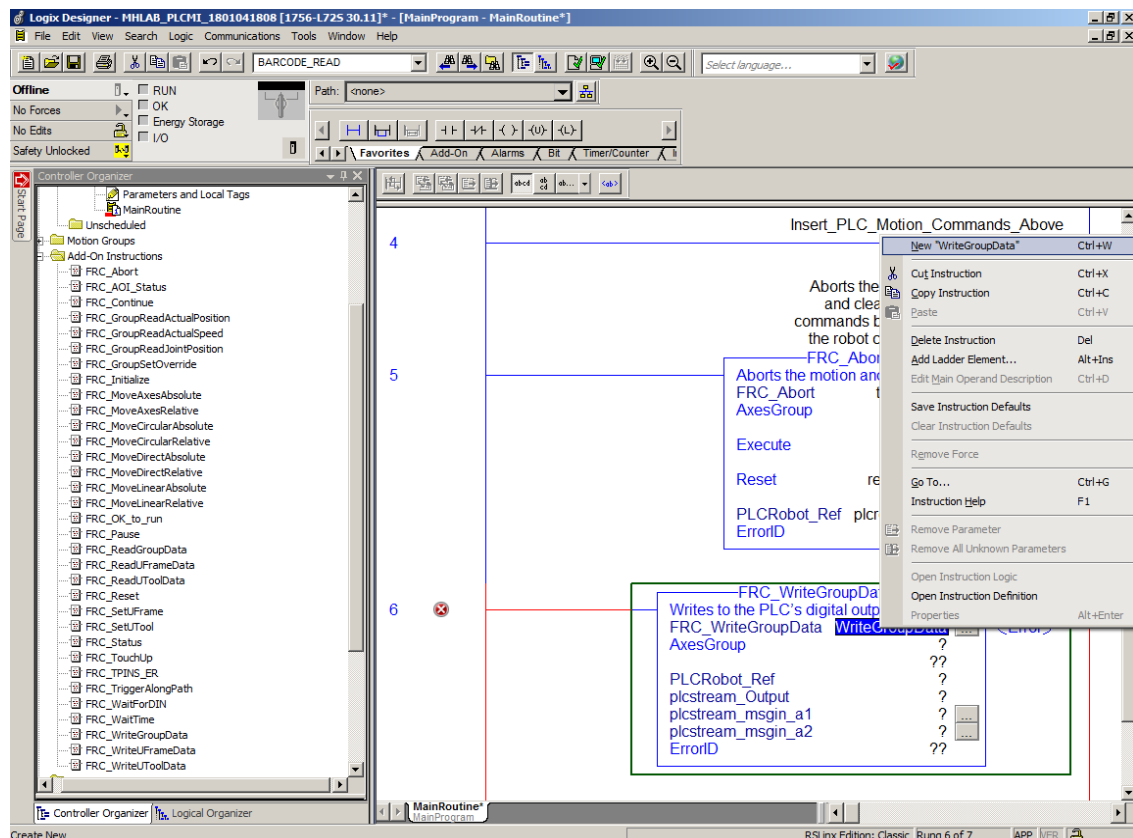
15. Finally, add the FRC_WriteGroupData to the end of the routine. This AOI uses the same input parameter AxesGroup and PLCRobot_Ref as other AOIs, so we will skip showing the steps of the setting of these parameters.

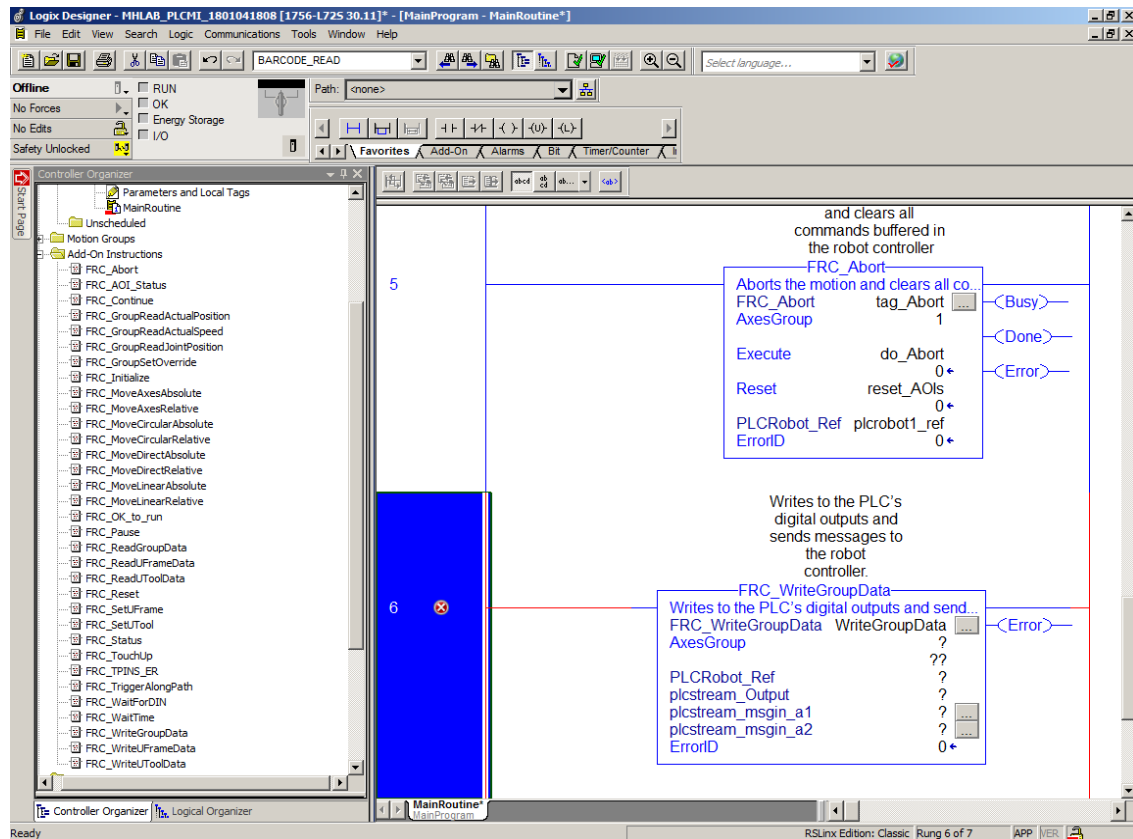


Activate the Routine: MainRoutine - MainRoutine*(Ladder Diagram)

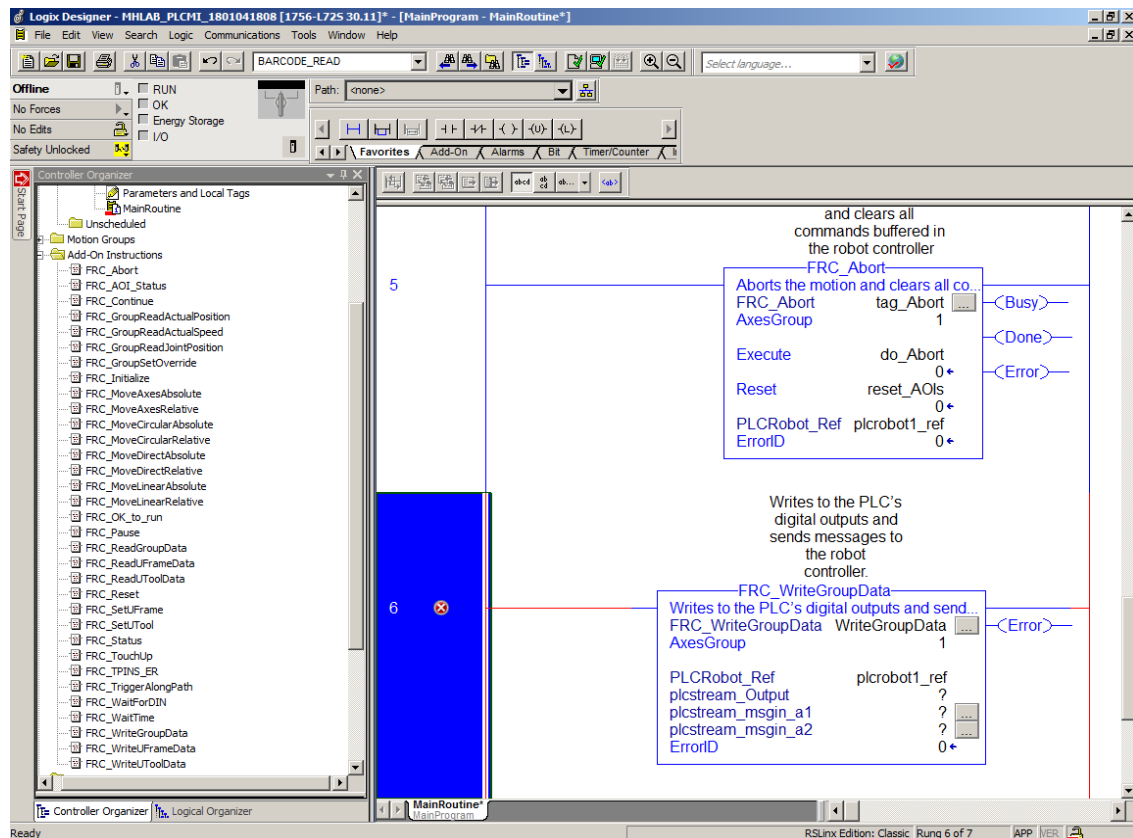
RSLink Edition: Classic Rung 6 of 7 APP VER

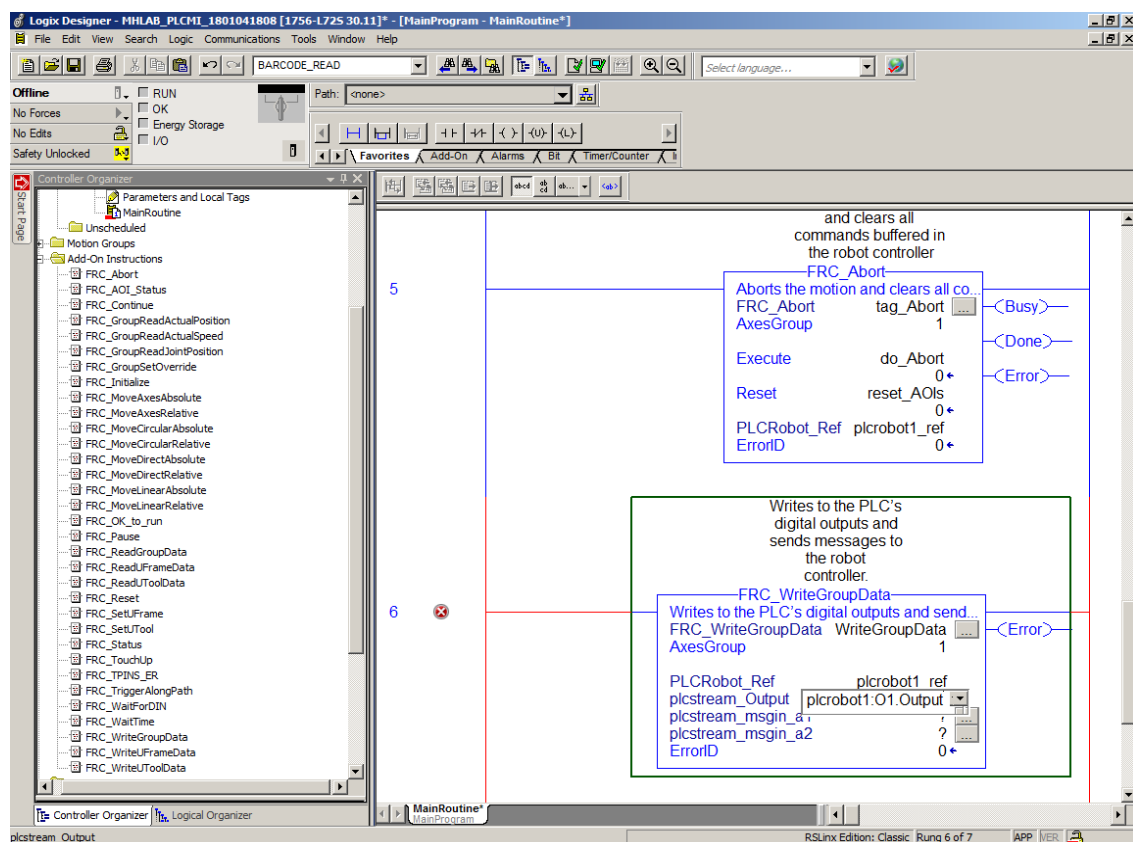
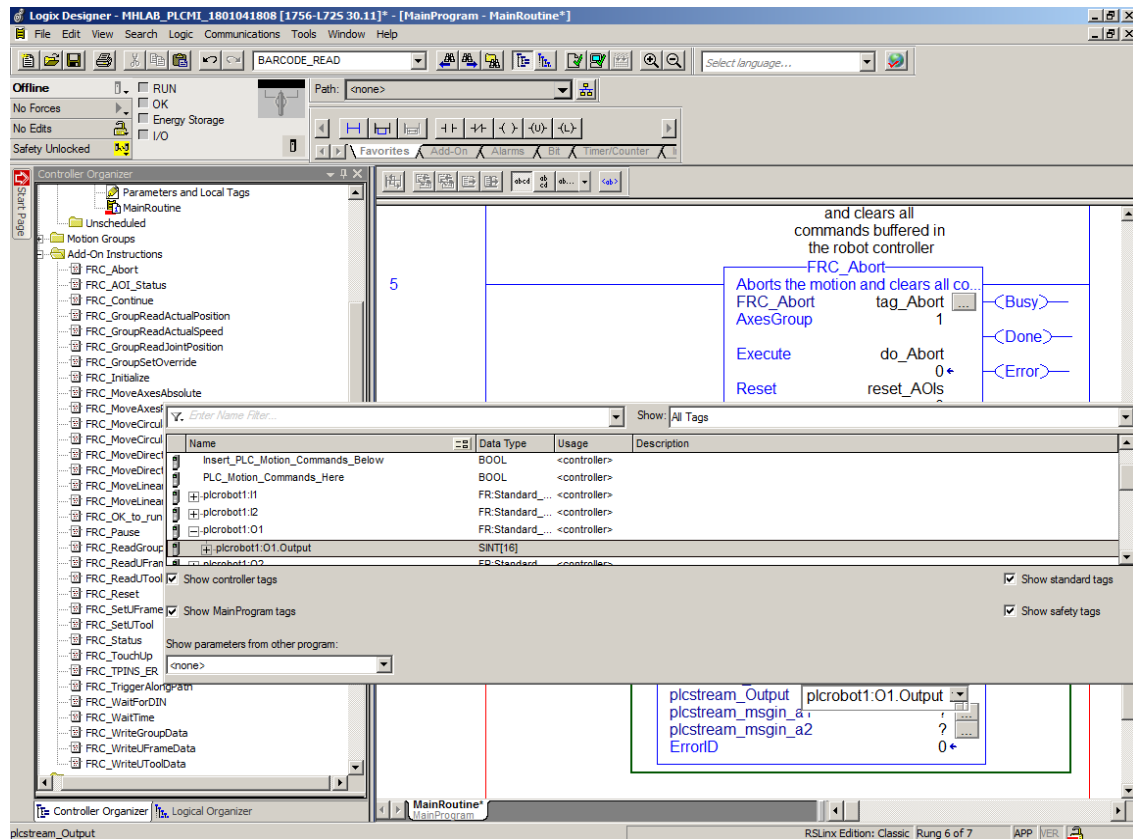




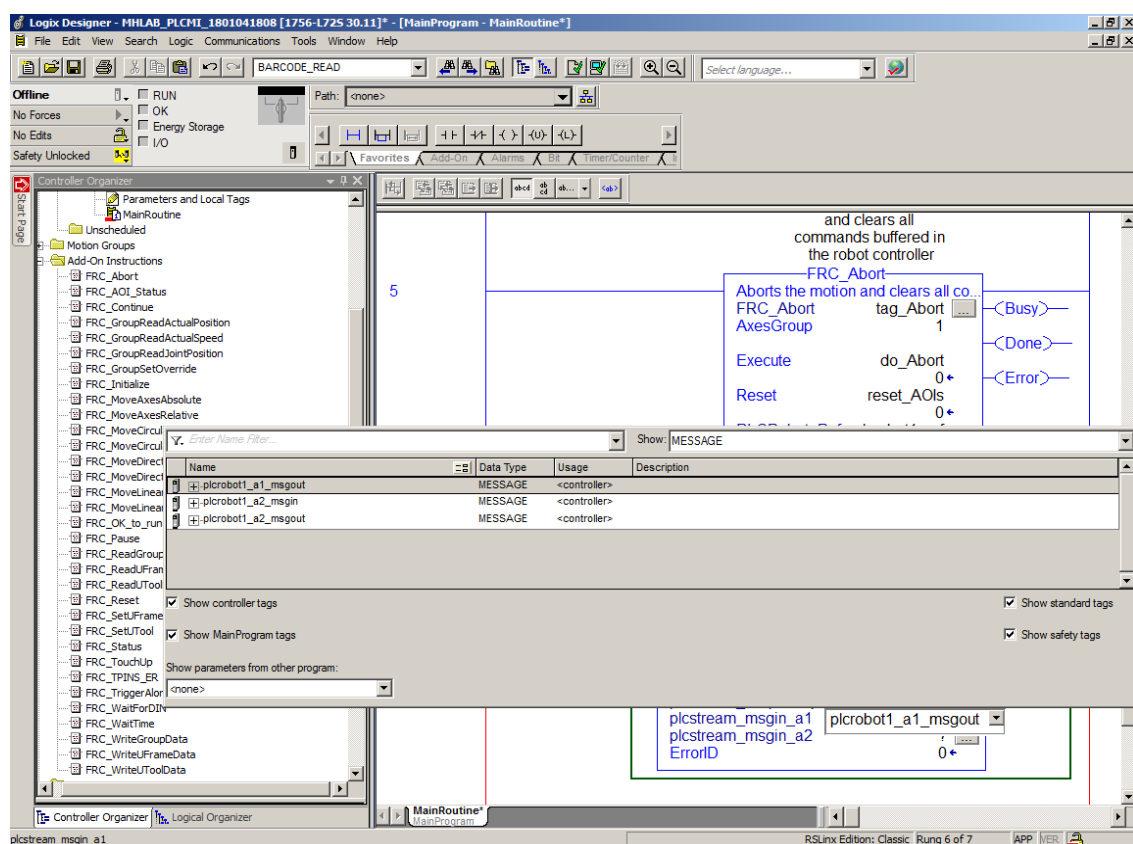
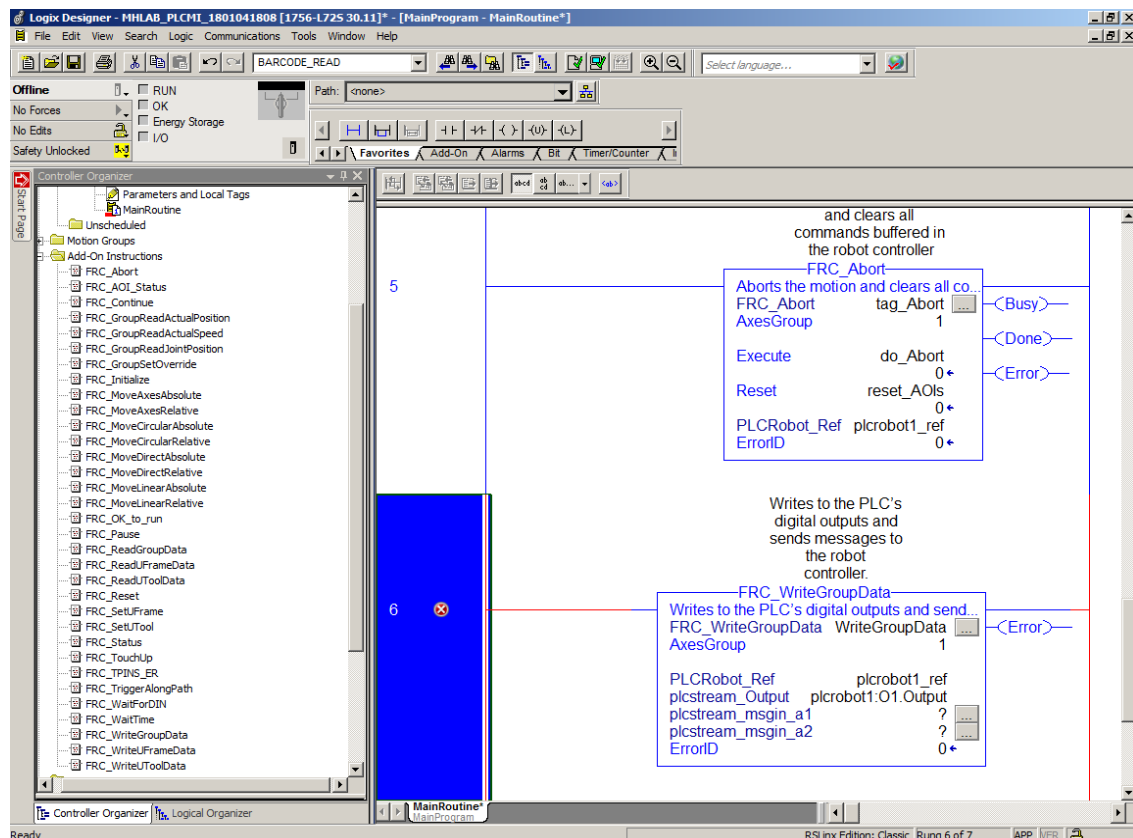


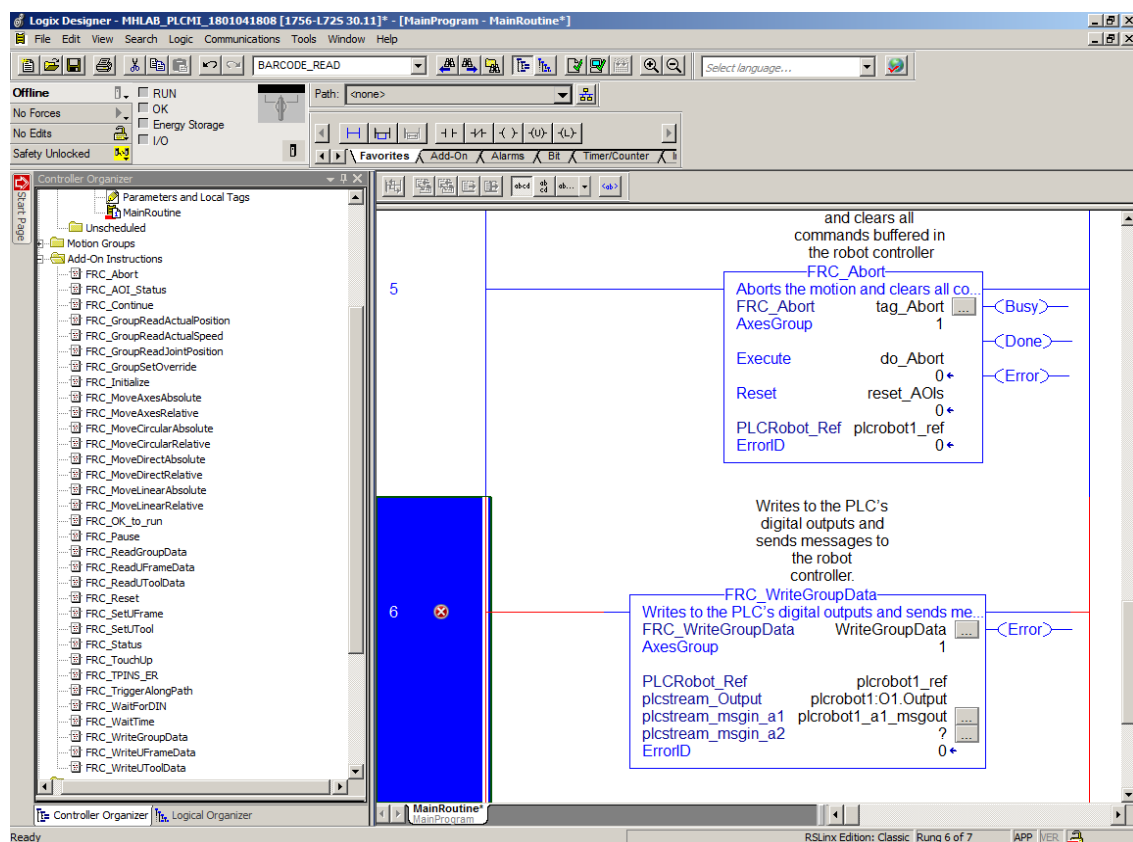
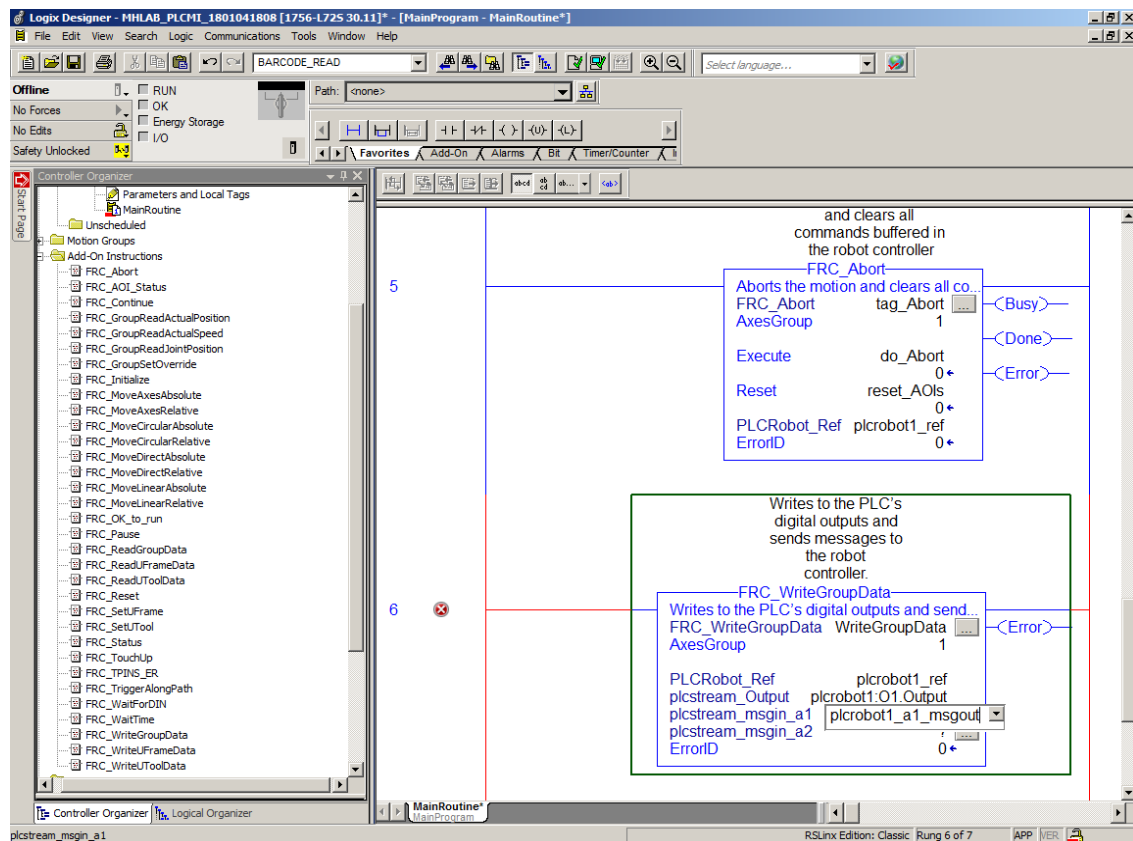
16. Set the plcstream_Output input parameter to the global tag plcrobot1:O1.Output.

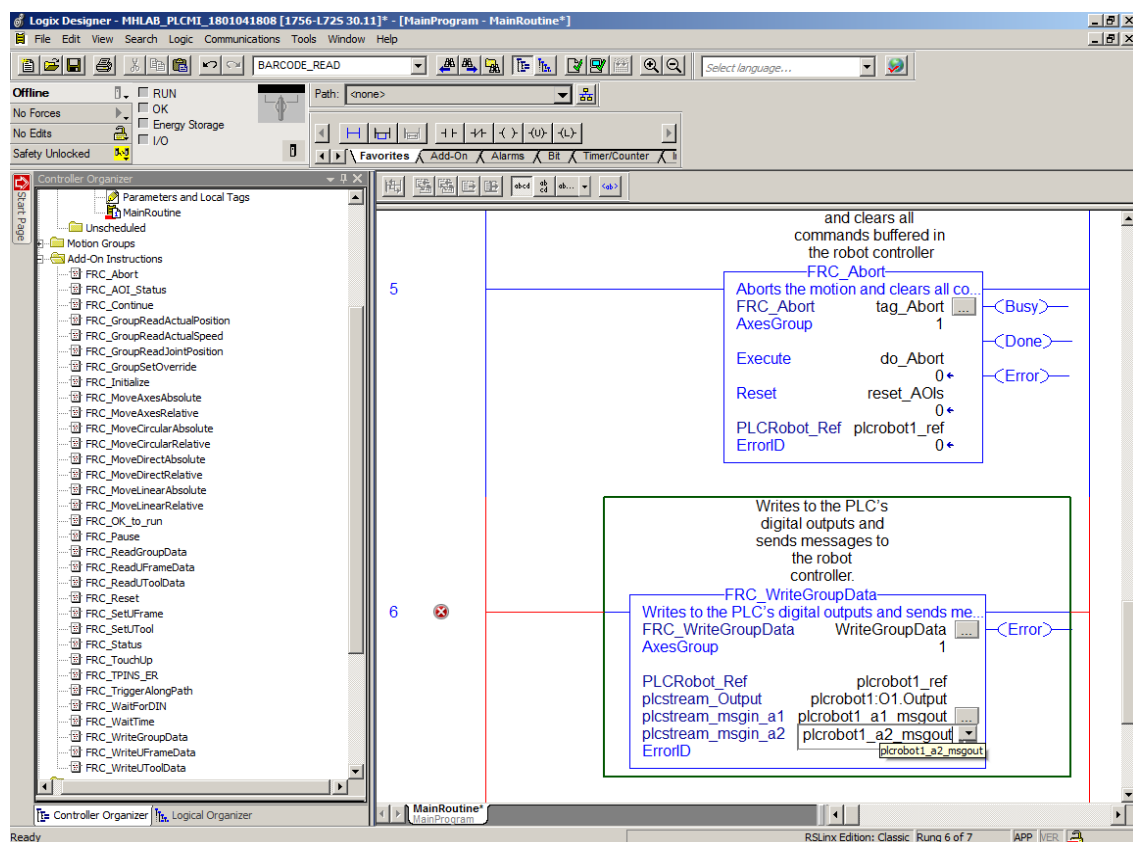
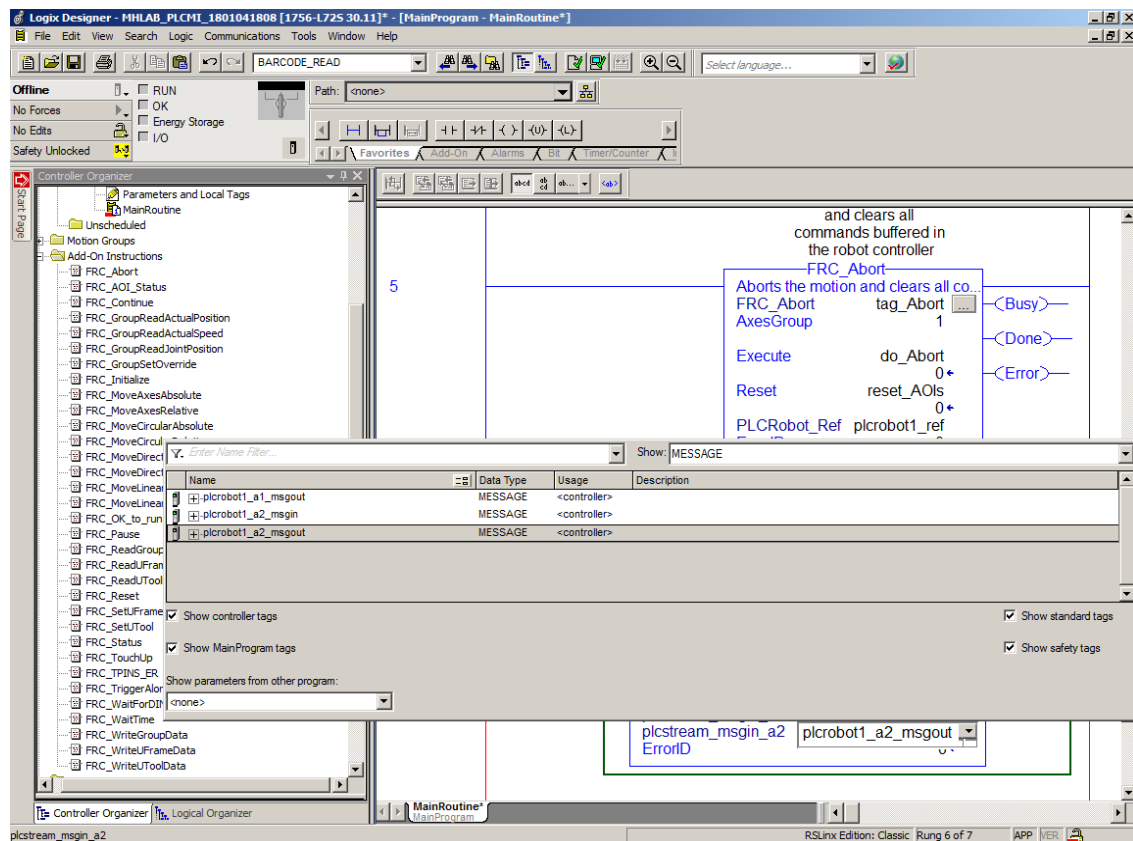


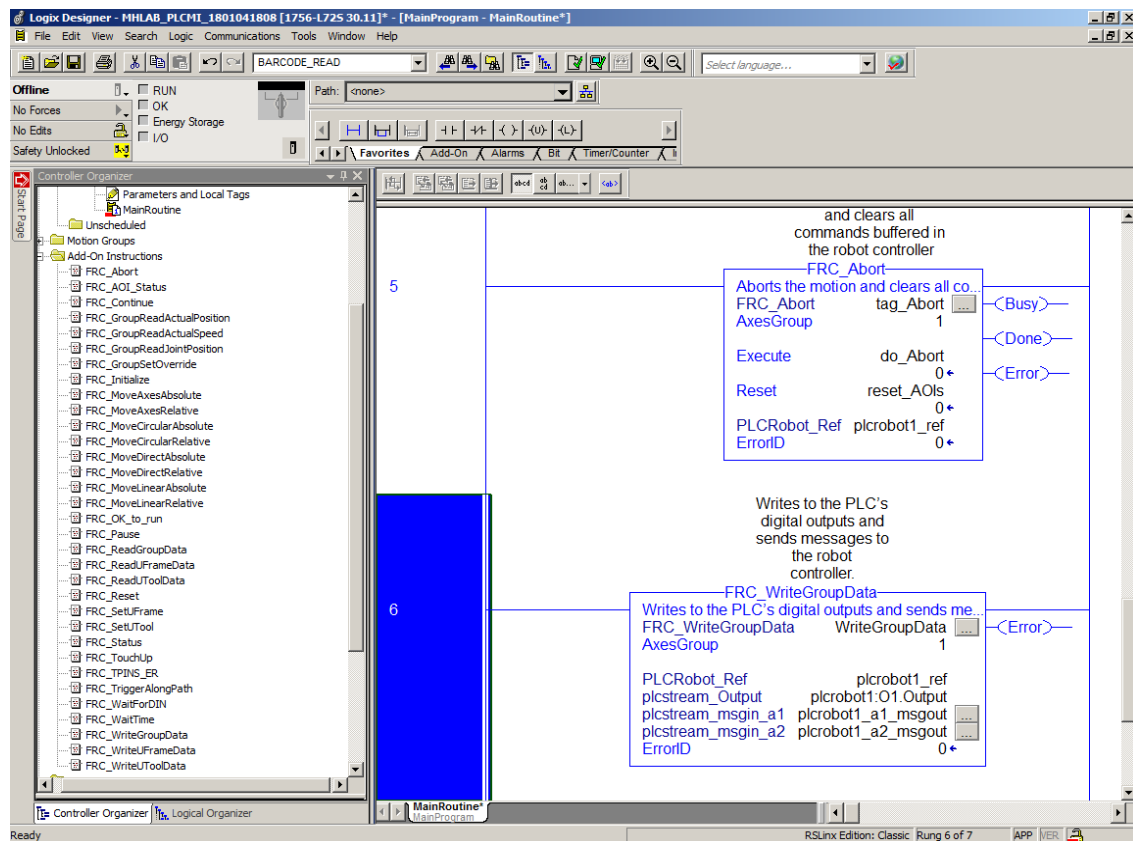


- Set the input parameter plcstream_msgin_a1 to global tag plcrobot1_a1_msgout and parameter plcstream_msgin_a2 to global tag plcrobot1_a2_msgout.





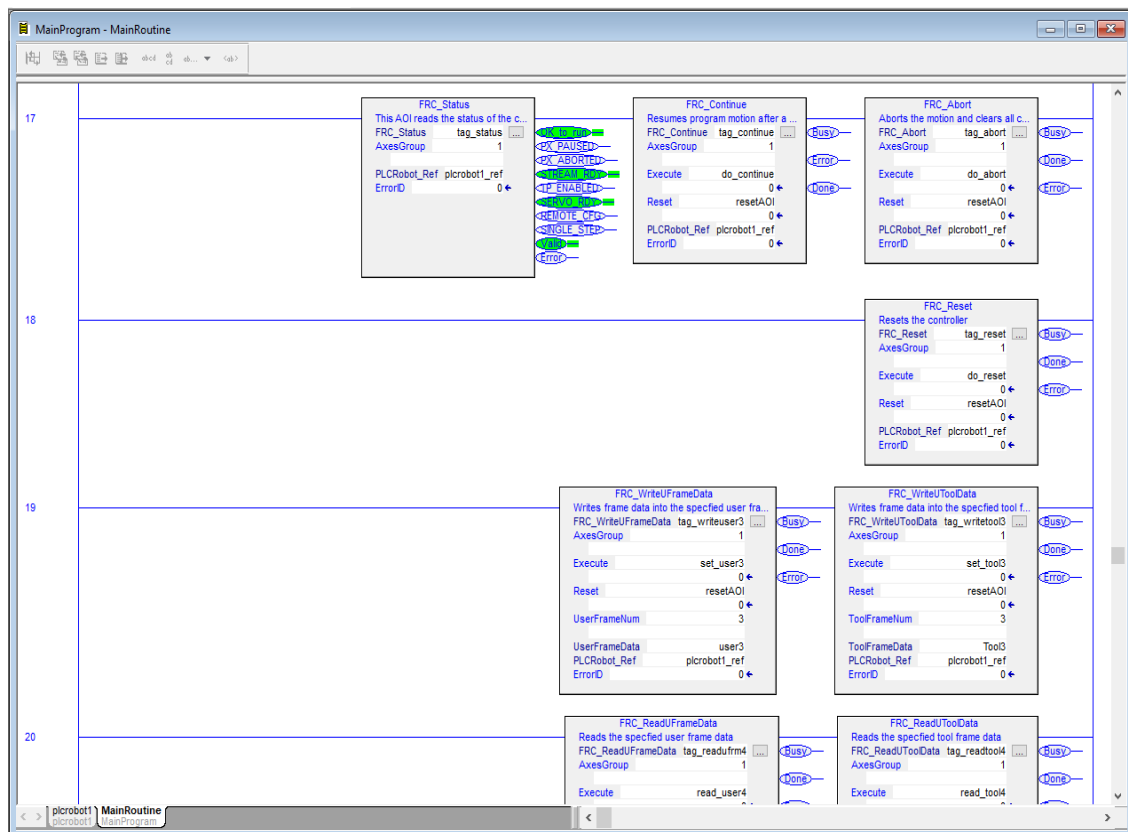




3.3 ROBOT CONTROLLER ERROR RECOVERY

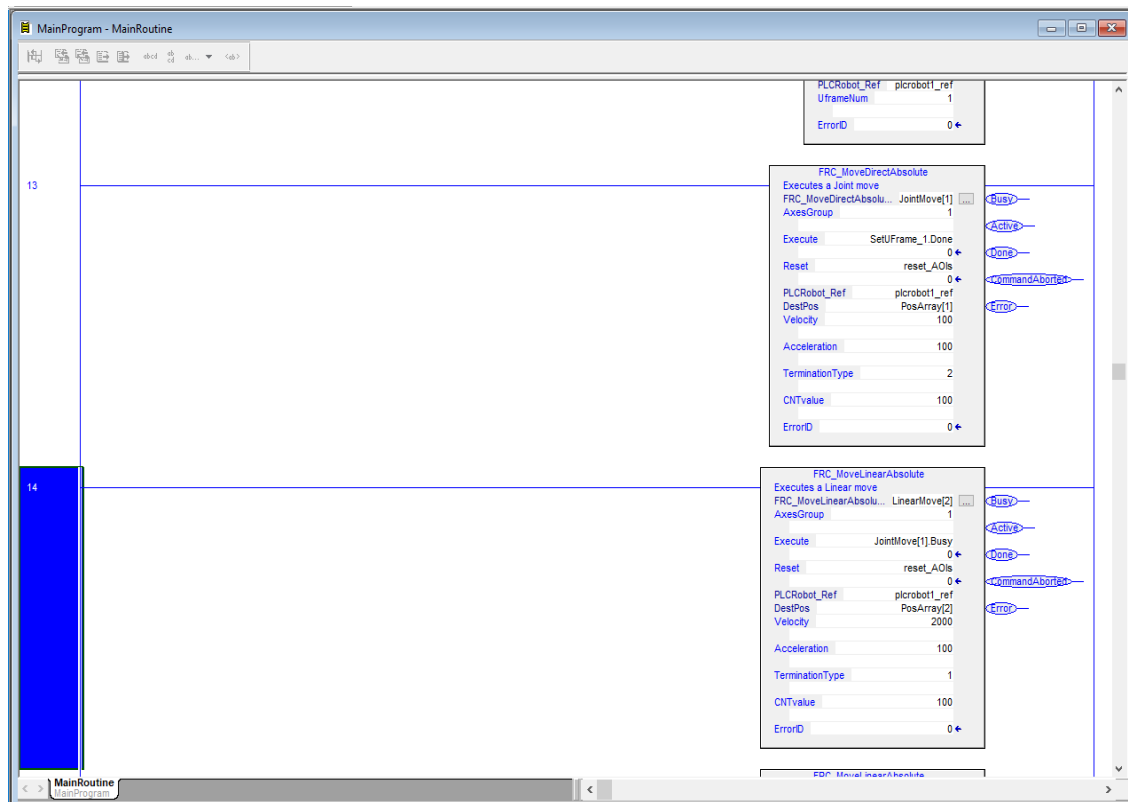
When the robot controller is paused, you can recover by executing FRC_Reset and then FRC_Continue. First, execute the FRC_Reset AOI. When the AOI is done, check the output of FRC_Status to see if OK_To_Run is set to TRUE. If it is, execute the FRC_Continue AOI to continue your program execution.

If the AOI corresponding to the active TP Line has an error, it is not possible to reset and continue. You will need to pick up the teach pendant to see the current robot error and try to clear it. In this case, the program has to be aborted by executing FRC_Abort and then FRC_Initialize needs to be called again to start another PLC Motion Interface session. Note that if you execute FRC_Abort, all of your Active AOIs will reset and you will have to restart these AOIs again.



3.4 MOTION BLENDING

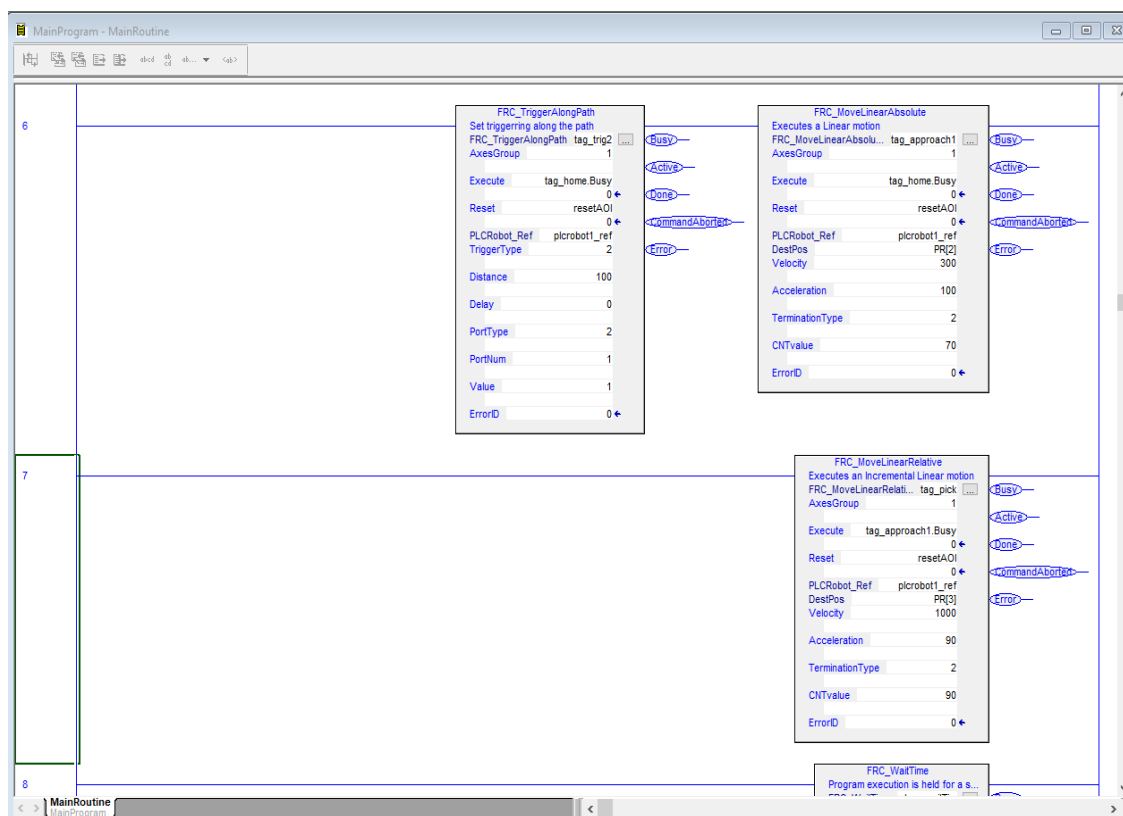
This section shows how to blend two motions together; The JointMove[1] FRC_MoveDirectAbsolute AOI has its input parameter Termination Type set to 2; meaning it is a Continuous termination type. Therefore, the robot controller will not execute this motion until it receives the LinearMove[2] to ensure proper blending. The CNTValue determines how much blending will occur. If this value is set to 100, the LinearMove[2] motion will start as soon as the JointMove[1] starts to decelerate. If the CNTValue is set to 1, the LinearMove[2] motion starts after the JointMove[1] motion almost completes its deceleration.



3.5 TRIGGER ALONG PATH

This section shows how to use a Distance Before/Time Before motion option with a motion AOI. Use FRC_TriggerAlongPath AOI to specify the DB/TB parameters. This should immediately be followed by one of the motion AOIs.

In the example given below, note that both the FRC_TriggerAlongPath and FRC_MoveLinearAbsolute AOIs use the same Execute input parameter tag_home.Busy. This puts the Distance Before motion option on the tag_approach1 motion instruction.

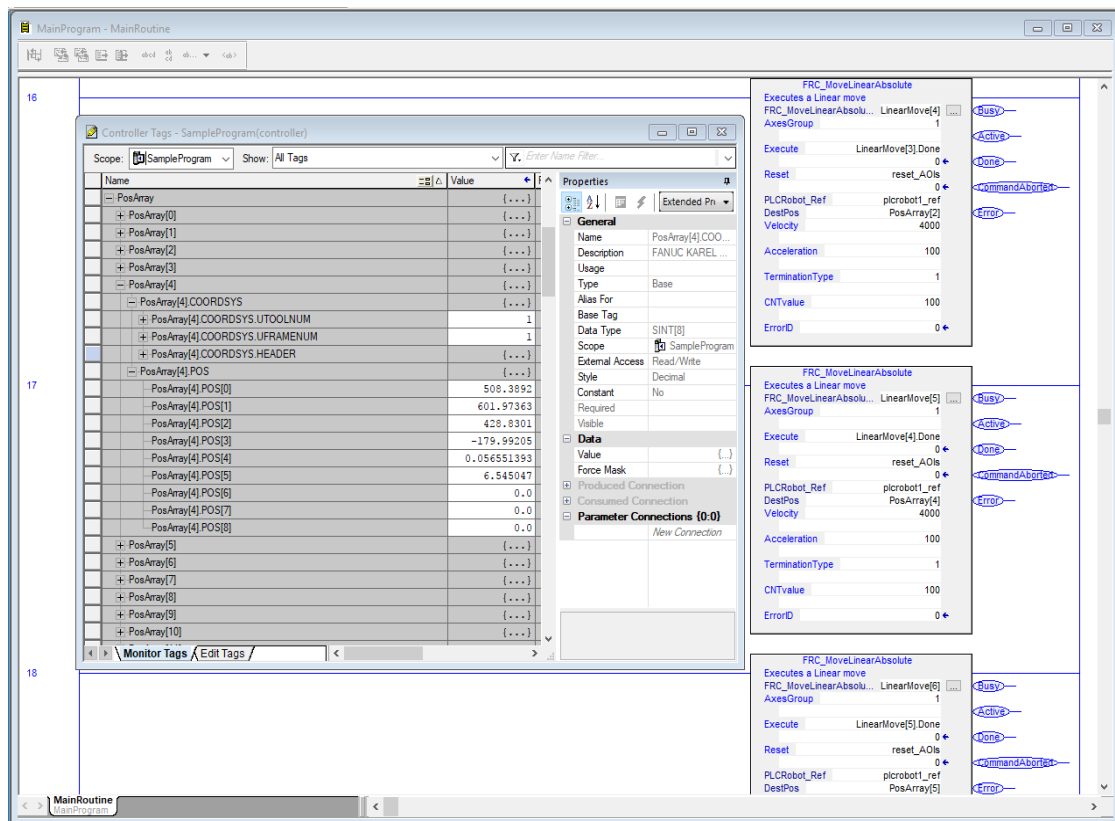


3.6 USER FRAME AND USER TOOL SETTING IN MOVE AOIS

The following AOIs are used:

- FRC_MoveLinearAbsolute
- FRC_MoveLinearRelative
- FRC_MoveDirectAbsolute
- FRC_MoveDirectRelative
- FRC_MoveCircularAbsolute
- FRC_MoveCircularRelative

All have a destination position as its input parameter. When passing in the position tag, you need to set the position's UtoolNum and UframeNum to match the program's user tool and user frame setting. The following screen shows that the LinearMove[5] FRC_MoveLinearAbsolute AOI has PosArray[4] as its input destination position. The PosArray[4] tag shows that the position specified in the motion should use user frame 1 and user tool frame 1 as part of its position data.



3.7 USING THE DIGITAL I/O PORTS DEFINED BY THE PLC Motion INTERFACE

By default, there are 64 input bits and 64 output bits defined by the PLC Motion Interface EDA setting. The corresponding tag for these I/O are the plcrobot1_ref.plcStreamIM.din and plcrobot1_ref.plcStreamIM.dout.

You can use these tags to access the I/O port in the robot controller. For example, in the section 2.2 example, the DIN[145-208] is reserved for PLC Motion Interface, and these DI ports are mapped to the plcrobot1_ref.plcStreamIM.dout.

Name	Value	Force Mask	Style
plcrobot1_ref	{...}	{...}	
plcrobot1_ref.plcStreamIM	{...}	{...}	
plcrobot1_ref.plcStreamIM.out	{...}	{...}	
plcrobot1_ref.plcStreamIM.out.dout	{...}	{...}	
plcrobot1_ref.plcStreamIM.out.dout.dw0	{...}	{...}	
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI0	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI1	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI2	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI3	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI4	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI5	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI6	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI7	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI8	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI9	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI10	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI11	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI12	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI13	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI14	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI15	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI16	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI17	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI18	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI19	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI20	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI21	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI22	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI23	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI24	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI25	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI26	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI27	2#0		Binary
plcrobot1_ref.plcStreamIM.out.dout.dw0.DI28	2#0		Binary

Properties

Extended Properties...

General

Name: plcrobot1_ref.plcStreamIM.out.do...

Description: Mandatory input parameter to all ...

Usage:

Type: Base

Alias For:

Base Tag:

Data Type: PLCSTREAM_DWORDI10_T

Scope: SampleProgram

External Access: Read/Write

Style:

Constant: No

Required:

Visible:

Data

Value: {...}

Force Mask: {...}

Produced Connection

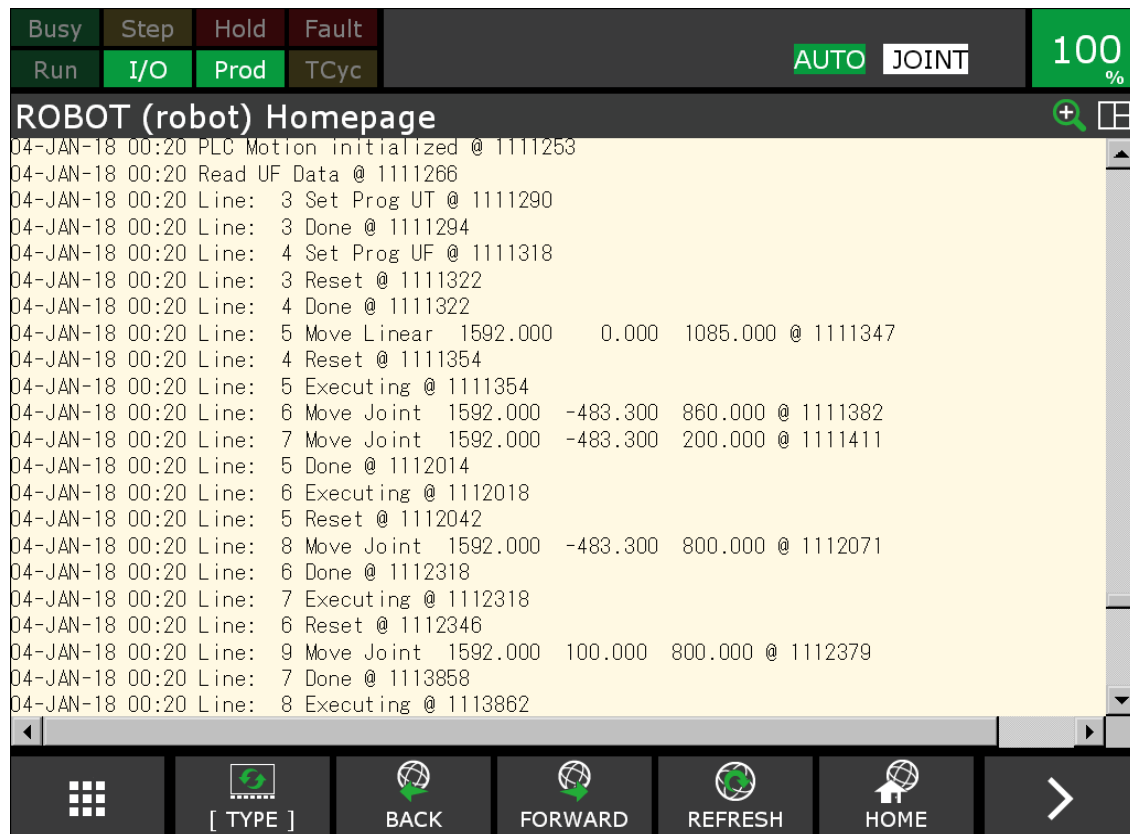
Consumed Connection

Parameter Connections (0:0)

New Connection

4 DATA LOGGING

In order to facilitate debugging and verification interactions between the robot controller and PLC, a data log is created to record all the interactions between the controller and the PLC. You can find the PLC_Log under the Browser menu. A snap shot of the PLC data log is depicted as follows:



Each line in the PLC log has three sections: the first section is the calendar date and time when the robot controller received the PLC command. The second section is the PLC command or the motion execution status. The third section is the controller internal tick count. It starts with a '@' sign and gives a finer resolution in timing.

If the second section starts without a line number, it indicates it is a PLC administrative command. If the section starts with a line number, it can be either a PLC motion command or a TP execution status.

For example, the first line indicates that an FRC_Initialize administrative command was received at 00:20 on January 4, 2018 and the third line shows that an FRC_SetUtool command was received and appended to the TP program as Line 3. The fourth line indicates that the FRC_SetUtool command completed its execution.

The motion instruction is more complicated. For example, the PLC issued an FRC_MoveLinearAbsolute command and the controller received it at 00:20 and writes the motion instruction as line 5 in the TP program at tick count = 1111347. At tick count = 1111354, the motion line was executed by the robot controller. During the execution of Line 5 motion, the robot controller received another three motion instructions and they were appended to the TP program as line 6, 7 and 8. At tick count = 1112014, the first FRC_MoveLinearAbsolute command (Line 5) completed and robot controller informed the PLC about the completion of this AOI. At tick count = 1112042, the PLC sent an acknowledgment that it had

received the FRC_MoveLinearAbsolute completion message which completed the Line 5 AOI execution cycle.

This log does not support dynamic updates. That is, if the PLC log page is opened for viewing, the log is not going to be updated even though the PLC motion interface is active and PLC is sending commands to the robot controller. You have to leave this page and come back again to see new entries to the log.

5 PLC POSITION TOUCH UP USER INTERFACE

A Touchup user interface is available to allow a PLC user to teach a robot position using the robot teach pendant. The taught position is automatically transferred to the PLC so that the PLC program can use this position in the PLC program.

This new screen is found under the Utility menu and it has the following format:

The screenshot shows the 'PLC Position Touchup' screen. At the top, there are status buttons: 'Busy', 'Step', 'Hold', 'Fault', 'Run', 'I/O', 'Prod', and 'TCyc'. To the right of these is 'TEST LINE 0' with 'AUTO' highlighted in green, followed by 'ABORTED' and 'JOINT'. Further right is a green box showing '100 %'. Below the status bar is the title 'PLC Position Touchup' with a magnifying glass icon and a window icon. The main area displays 'Position ID[1]' with '1/1' in the top right. Below this, it shows 'Current UTool Number: 1' and 'Current UFrame: Number: 1'. Then, 'Current Position:' is followed by 'X: 1014.433 Y: 111.782 Z: 890.961' and 'W: -179.995 P: -7.302 R: 6.352'. At the bottom, there is a navigation bar with a grid icon, '[TYPE]', 'TouchUp', and 'JOINT'.

You can input the position ID number (1-100) and then press the F3, TouchUp, key to transfer the current position to the PLC in Cartesian position data format. You will have to use the FRC_TouchUp AOI in your PLC program to capture the touch up position data. Please refer to the FRC_TouchUp AOI section in the Appendix.

APPENDIX

A FANUC AOI

A.1 OVERVIEW

The thirty-one user AOIs can be divided into three categories:

1. Teach Pendant Instruction AOI: These AOIs append a Teach Pendant (TP) instruction to the running PLC TP program. These instructions are
 - FRC_MoveDirectAbsolute: Add joint motion instruction to TP program.
 - FRC_MoveDirectRelative: Add incremental joint motion instruction to TP program.
 - FRC_MoveLineAbsolute: Add linear motion instruction to TP program.
 - FRC_MoveLinearRelative: Add incremental linear motion instruction to TP program.
 - FRC_MoveCircularAbsolute: Add circular motion instruction to TP program.
 - FRC_MoveCircularRelative: Add incremental circular motion instruction to TP program.
 - FRC_MoveAxesAbsolute: Same as FRC_MoveDirectAbsolute except the destination position is in joint representation.
 - FRC_MoveAxesRelative: Same as FRC_MoveDirectRelative except the destination position is in joint representation.
 - FRC_TriggerAlongPath: Add Time Before, Time After or Distance before motion option to an FRC_MoveXXXXXX instruction listed above.
 - FRC_WaitForDIN: Add a wait for DIN instruction to TP program.
 - FRC_WaitTime: Add Wait time instruction.
 - FRC_SetUFrame: Add UFRAME_NUM instruction to TP program.
 - FRC_SetUTool: Add UTOOL_NUM instruction to TP program.
2. Administrative AOI: These AOIs command the robot controller to perform an immediate action, such as pause robot motion or get user frame data, etc.
 - FRC_Initialize: Start the PLC Motion Interface allows the controller to communicate with the PLC.
 - FRC_Abort: Stop the PLC motion Interface
 - FRC_Pause: Pause the TP program execution.
 - FRC_Continue: Continue the TP program execution.
 - FRC_Reset: Same as press the TP's reset button.
 - FRC_GroupSetOverride: Change the controller's speed override.
 - FRC_ReadUFrameData: Read in robot controller's user frame data.
 - FRC_WriteUFrameData: Update the robot controller's user frame data.
 - FRC_ReadUToolData: Read in robot controller's user tool data
 - FRC_WriteUToolData: Update the robot controller's user tool data
 - FRC_GroupReadActualPosition: Read the current robot's Cartesian position
 - FRC_GroupReadActualSpeed: Read the current motion Tool Center Point (TCP) speed.
 - FRC_GroupReadJointPosition: Read the current robot's joint angles.
 - FRC_Status: Get current robot status.
 - FRC_TouchUp: Read the touch up position from robot controller.
3. Communication AOI:
 - FRC_ReadGroupData: Read in FANUC EDA data from robot controller. This AOI should be placed at the beginning of any PLC program that uses FANUC AOIs.
 - FRC_WriteGroupData: Write FANUC EDA data to robot controller. This AOI should be placed at the end of any PLC program that uses FANUC AOIs.
 - FRC_AOI_Status: Get FANUC AOI status.

A.2 AOI STATES

General state transition for all FANUC AOIs, based on the categories defined in section A.1.

Category	AOI Name	Outputs	Description
TP Instruction AOI	FRC_MoveLinearAbsolute FRC_MoveLinearRelative FRC_MoveDirectAbsolute FRC_MoveDirectRelative FRC_MoveCircularAbsolute FRC_MoveCircularRelative FRC_MoveAxesAbsolute FRC_MoveAxesRelative	Busy	TP line has been created
		Active	TP line is currently executing
		Done	TP line execution is complete
		Error	Error occurred during execution of the TP line
		Error ID	Error ID returned by the robot controller
		CommandAborted	Abort command FRC_Abort is called during the execution of the AOI
	FRC_WaitTime FRC_WaitForDIN FRC_SetUFrame FRC_SetUTool	Busy	TP line has been created
		Done	TP line execution is complete
		Error	Error occurred during execution of the TP line
		Error ID	Error ID returned by the robot controller
		CommandAborted	Abort command FRC_Abort is called during the execution of the AOI the AOI
Administrative AOI: Read Robot Information	FRC_TouchUP	Busy	Actively checking to see if a position has been recorded from teach pendant
		Done	Recorded position is copied to the Position array controller tag.
		Error	AOI error (e.g. if position index exceeds position array controller tag size)
		Error ID	AOI error ID
	FRC_GroupReadActualPosition FRC_GroupReadActualSpeed FRC_GroupReadJointPosition FRC_Status	Valid	other AOI outputs are valid when this output is set
		Error	AOI error (e.g. connection is lost)
		ErrorID	AOI error ID
Administrative AOI: Send Robot commands	FRC_Continue FRC_Reset FRC_Pause FRC_Initialize FRC_GroupSetOverride FRC_Abort	Busy	AOI is in the process of sending the administrative command
		Done	Administrative command has been executed
		Error	The administrative command cannot be executed due to this error
	FRC_ReadUFrameData FRC_WriteUFrameData FRC_ReadUToolData FRC_WriteUToolData	Error ID	Error ID returned by the robot controller
Communication AOI	FRC_ReadGroupData FRC_WriteGroupData FRC_AOI_Status	Error	AOI error (e.g. connection is lost)
		ErrorID	AOI error ID

NOTE

- Only one of the outputs; Busy, Done, Error or CommandAborted can be TRUE at one time.
- Done, Error and CommandAborted outputs are set to TRUE for a minimum of one scan time.
- Done, Error and CommandAborted can be reset only after a falling edge is detected in Execute input.

A.3 TP INSTRUCTION AOI

All FANUC motion AOIs (FRC_MoveLinearAbsolute, etc.) only support buffer mode. That is, motion commands sent from the PLC are buffered in the robot controller. FANUC does not support any other mode, such as aborting mode, specified by the PLCopen standard.

NOTE

If a CNT motion is buffered in the robot controller, the CNT motion will not be executed unless the PLC sends another motion. That is, if the last motion sent by the PLC is a CNT motion, the motion will not be executed by the robot. Therefore, the PLC should always send a FINE termination type motion before it calls FRC_ABORT.

In addition, the FRC_WaitForDIN and FRC_WaitTime instructions will not go into DONE state if there is no other TP instruction line added after the wait statement.

A.3.1 FRC_MoveDirectAbsolute

This AOI executes a joint motion to a destination position specified in Cartesian representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position in Cartesian representation
Velocity	DINT	Input	Program speed in %
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.2 FRC_MoveDirectRelative

This AOI executes incremental joint motion to a destination position specified in Cartesian representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position (incremental) in Cartesian representation
Velocity	DINT	Input	Program speed in %
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.3 FRC_MoveLinearAbsolute

This AOI executes linear motion to a destination position specified in Cartesian representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position in Cartesian representation
Velocity	DINT	Input	Program speed in mm/sec
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.4 FRC_MoveLinearRelative

This AOI executes an incremental linear motion to a destination position specified in Cartesian representation.

Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position (Incremental) in Cartesian representation
Velocity	DINT	Input	Program speed in mm/sec
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.5 FRC_MoveCircularAbsolute

This AOI executes a circular motion to a destination position specified in Cartesian representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position in Cartesian representation
ViaPos	FRC_POS_T	InOut	Via position in Cartesian representation
Velocity	DINT	Input	Program speed in mm/sec
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.6 FRC_MoveCircularRelative

This AOI executes an incremental circular motion to a destination position specified in Cartesian representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position(incremental) in Cartesian representation
ViaPos	FRC_POS_T	InOut	Via position (incremental) in Cartesian representation
Velocity	DINT	Input	Program speed in mm/sec
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.7 FRC_MoveAxesAbsolute

This AOI moves the robot in joint motion where the destination position is in joint representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position in Joint representation
Velocity	DINT	Input	Program speed in %
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The Joint motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.8 FRC_MoveAxesRelative

This AOI performs joint incremental motion where the destination position is in joint representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
DestPos	FRC_POS_T	InOut	Destination position in Joint representation
Velocity	DINT	Input	Program speed in %
Acceleration	DINT	Input	ACC value in %
Buffer mode	DINT	Input	Not used in this version
Termination Type	DINT	Input	1: Fine motion 2: CNT motion
CNT Value	DINT	Input	CNT value for CNT termination type. Ignored for FINE termination type.
Done	BOOL	Output	The Joint motion has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.9 FRC_TriggerAlongPath

This AOI adds a Time Before, Time After, or Distance Before motion option to a motion AOI.

NOTE

As triggering is associated with a motion segment, this AOI has to be immediately followed by a motion AOI (FRC_MoveLinearAbsolute, etc.).

The outputs of this AOI (Busy, Active, Done, Error, and Error ID) will match the outputs of the motion AOI with which it is associated.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
TriggerType	DINT	Input	1: Time Before 2: Distance Before 3: Time After
Distance	REAL	Input	Distance before value (0.01 mm)
Delay	REAL	Input	Time before value (ms)
PortType	DINT	Input	Port Type 1 – FANUC Controller Digital Output 2 – FANUC Controller Robot Output
PortNum	DINT	Input	Digital Port Number

Parameter Name	Data Type	Usage	Description
Value	BOOL	Input	Digital Port value
Done	BOOL	Output	The AOI has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
Active	BOOL	Output	Motion corresponding to this AOI is being executing by the robot.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.10 FRC_SetUFrame

This AOI sets the current active uframe number in the TP program.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
UframeNum	DINT	Input	User Frame number
Done	BOOL	Output	The AOI has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.11 FRC_SetUTool

This AOI sets the current active utool number.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
UtoolNum	DINT	Input	Tool Frame number

Parameter Name	Data Type	Usage	Description
Done	BOOL	Output	The AOI has been executed successfully
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.12 FRC_WaitForDIN

This AOI causes program execution to be held until the robot's DIN[PortNum] = Value.

NOTE

If the Wait statement is the last line of the program, the AOI will not go into Done state and the program execution is paused. Add another TP program AOI after the FRC_WaitForDin to make sure the program can resume execution.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
PortNum	DINT	Input	Digital Input port number
Value	BOOL	Input	Digital Input value
Done	BOOL	Output	Robot controller's DIN port is set to the value specified. Program execution resume.
Active	BOOL	Output	The robot controller is waiting for the DIN to be set to the value specified. Program execution is paused
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.3.13 FRC_WaitTime

This AOI causes program execution to be held for a specified amount of time.

NOTE

If the Wait statement is the last line of the program, the AOI will not go into Done state and the program execution is paused. Add another TP program AOI after the FRC_WaitTime to make sure the program can resume execution.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected

Parameter Name	Data Type	Usage	Description
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
WaitTime	REAL	Input	Wait Time (in ms)
Done	BOOL	Output	Wait time expired and the program execution resume.
Active	BOOL	Output	Program execution is paused.
Busy	BOOL	Output	TP line corresponding to the AOI has been created.
CommandAborted	BOOL	Output	Execution of this AOI has been aborted
Error	BOOL	Output	Error occurred during the execution of this AOI
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4 ADMINISTRATIVE AOIS

A.4.1 FRC_Initialize

This AOI initializes the PLC Motion Interface in the robot controller. It starts the TP program that executes commands sent from PLC.

NOTE

When the robot controller starts the PLC Motion Interface, you cannot execute a file backup or a system backup on the robot controller since the PLC Motion TP program is running and cannot be backed up. Use the FRC_Abort command to terminate the PLC Motion Interface session before executing a file backup in the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
ResetAOIs	BOOL	InOut	Tag passed to the "Reset" inputs of all motion and administrative AOIs used in the program. FRC_Initialize AOI uses this input to reset any active AOIs before sending initialization request to the robot controller. Alternatively, user can ensure all active AOIs are reset before calling FRC_Initialize and pass a dummy BOOL tag as input.
Done	BOOL	Output	Initialization has been completed
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Initialization was not successful
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.2 FRC_Abort

This AOI aborts the TP program that executes the PLC commands. It also clears all commands buffered in the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number

Parameter Name	Data Type	Usage	Description
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Done	BOOL	Output	Abort sequence completed
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Error in execution of abort command
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.3 FRC_Continue

This AOI resumes a program after a pause.

This AOI should be called only after the controller has been reset after a fault.

The AOI will not send the command to continue under the following conditions.

- Program Aborted
- Servo not ready
- Teach pendant is enabled

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Done	BOOL	Output	Program execution has been resumed
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Program cannot be resumed
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.4 FRC_Reset

This AOI resets the robot controller. Use this AOI to clear active errors in the robot controller. Alarms that require user action cannot be cleared by this AOI.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Done	BOOL	Output	Robot Controller has been reset
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Cannot reset the active alarms in the robot controller
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.5 FRC_Pause

This AOI pauses program execution. If the active program is already paused or aborted, this AOI will not send the command to the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Done	BOOL	Output	Program execution has been paused
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Error in executing the pause command
ErrorID	DINT	Output	Error ID reported by the controller

A.4.6 FRC_GroupReadActualPosition

This AOI reads the current TCP position of the robot in WORLD frame. The current tool frame number is indicated in the output ToolFrame.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
RobotPos	FRC_POS_T	InOut	Current TCP position of the robot
ToolFrame	INT	Output	Current tool frame that was used when the TCP position was recorded
X	REAL	Output	X of TCP position
Y	REAL	Output	Y of TCP position
Z	REAL	Output	Z of TCP position
W	REAL	Output	W of TCP position
P	REAL	Output	P of TCP position
R	REAL	Output	R of TCP position
E1	REAL	Output	Ext axis 1 position
E2	REAL	Output	Ext axis 2 position
E3	REAL	Output	Ext axis 3 position
Turn4	SINT	Output	Axis 4 turn no.
Turn5	SINT	Output	Axis 5 turn no.
Turn6	SINT	Output	Axis 6 turn no.
Front	SINT	Output	Front/back Config
Up	SINT	Output	Up/down Config
Left	SINT	Output	Left/right Config
Flip	SINT	Output	Flip/non-flip Config

Parameter Name	Data Type	Usage	Description
Valid	BOOL	Output	All outputs of this AOI are valid when this output is TRUE
Error	BOOL	Output	Cannot read the TCP position due to lost connection
ErrorID	DINT	Output	ErrorID 1 – Connection to the robot controller is lost

A.4.7 FRC_GroupSetOverride

This AOI sets the program override.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Override	DINT	Input	Program override (in %) to be set
Done	BOOL	Output	Program override has been set to the new value
Busy	BOOL	Output	AOI is sending the command to the robot controller
Error	BOOL	Output	Error in execution of this command
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.8 FRC_ReadUFrameData

This AOI reads the specified user frame data from the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
UserFrameNum	DINT	Input/Out	User frame number to be read
UserFrameData	FRC_POS_T	Output	User frame data read from the robot controller
Busy	BOOL	Output	AOI is sending the command to the robot controller
Done	BOOL	Output	User frame data has been read
Error	BOOL	Output	AOI execution error
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.9 FRC_ReadUToolData

This AOI reads the specified user tool data from the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
ToolFrameNum	DINT	Input/Out	Tool frame number to be read
ToolFrameData	FRC_POS_T	Output	Tool frame data read from the robot controller
Busy	BOOL	Output	AOI is sending the command to the robot controller
Done	BOOL	Output	Tool frame data has been read
Error	BOOL	Output	AOI execution error
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.10 FRC_WriteUFrameData

This AOI writes user frame data to the specified user frame in robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
UserFrameNum	DINT	Input/Out	User frame number to be written
UserFrameData	FRC_POS_T	Output	User frame value to be set
Busy	BOOL	Output	AOI is sending the command to the robot controller
Done	BOOL	Output	User frame data has been written
Error	BOOL	Output	AOI execution error
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.11 FRC_WriteUToolData

This AOI writes tool frame data to the specified tool frame in the robot controller.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
ToolFrameNum	DINT	Input/Out	Tool frame number to be written
ToolFrameData	FRC_POS_T	Output	Tool frame value to be set
Busy	BOOL	Output	AOI is sending the command to the robot controller
Done	BOOL	Output	Tool frame data has been written
Error	BOOL	Output	AOI execution error
ErrorID	DINT	Output	Error ID reported by the robot controller

A.4.12 FRC_GroupReadActualSpeed

This AOI reads the robot's current TCP speed.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
TCP_Speed	REAL	Output	Current TCP speed
Valid	BOOL	Output	Output of this AOI is valid
Error	BOOL	Output	Cannot read the TCP speed due to lost connection
ErrorID	DINT	Output	ErrorID 1 – Connection to the robot controller is lost

A.4.13 FRC_TouchUp

This AOI reads a position that is recorded using the teach pendant and copies it to a position tag.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number

Parameter Name	Data Type	Usage	Description
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
PR	FRC_POS_T[1]	Input/Out	FANUC Karel position structure
PositionIndex	DINT	Output	Index of the recorded position (1-100)
Busy	BOOL	Output	AOI is actively monitoring to see if a new position was recorded
Done	BOOL	Output	The new position recorded from the teach pendant was successfully copied to the PLC's position tag
Error	BOOL	Output	error in function block
ErrorID	DINT	Output	Error ID 1 – connection to the robot controller is lost 2 –Index of the position recorded exceeds the size of the position array

When a position is copied, Done is set to TRUE and busy is set to FALSE. After completion of the handshake with the robot controller, Done is set to FALSE and Busy is set to TRUE.

When an error occurs, Error is set to TRUE and Busy is set to FALSE. After the error has been cleared, Error is set to FALSE and Busy is set to TRUE.

A.4.14 FRC_GroupReadJointPosition

This AOI reads the current TCP position of the robot in joint representation.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
RobotPos	FRC_POS_T	InOut	Current TCP position in Joint representation
J1	REAL	Output	Axis 1 position
J2	REAL	Output	Axis 2 position
J3	REAL	Output	Axis 3 position
J4	REAL	Output	Axis 4 position
J5	REAL	Output	Axis 5 position
J6	REAL	Output	Axis 6 position
E1	REAL	Output	Ext axis 1 position
E2	REAL	Output	Ext axis 2 position
E3	REAL	Output	Ext axis 3 position
Valid	BOOL	Output	True: position is valid
Error	BOOL	Output	Cannot read the TCP position due to lost connection
ErrorID	DINT	Output	ErrorID 1 – Connection to the robot controller is lost

A.4.15 FRC_Status

This AOI reads the robot controller's program execution status.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Reference Group Number
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
OK_to_run	BOOL	Output	OK to send motion commands to the controller
PX_PAUSED	BOOL	Output	Program execution has been paused
PX_ABORTED	BOOL	Output	Program execution has been aborted
STREAM_RDY	BOOL	Output	Ready to stream commands from PLC
TP_ENABLED	BOOL	Output	Teach pendant enabled
SERVO_RDY	BOOL	Output	Servo is ready
REMOTE_CFG	BOOL	Output	Remote Config is set
SINGLE_STEP	BOOL	Output	Single step is enabled
Valid	BOOL	Output	All outputs of this AOI are valid when this output is TRUE.
Error	BOOL	Output	Cannot read the TCP position due to lost connection
ErrorID	DINT	Output	ErrorID 1 – Connection to the robot controller is lost

A.5 COMMUNICATION AOI

A.5.1 FRC_ReadGroupData

This AOI reads a message sent from the robot controller to the PLC. Use this AOI at the beginning of the program to copy the most recent data from the digital inputs to the PLC's constructs.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
plcstream_Input	SINT[1]	InOut	Input used for messaging
plcstream_msgin	MESSAGE	InOut	Message tag(PLC to robot controller)
Error	BOOL	Output	Connection to the robot controller is lost
ErrorID	DINT	Output	Error ID 1: Connection to the robot controller is lost.

A.5.2 FRC_WriteGroupData

This AOI writes to the PLC's digital outputs and sends messages to the robot controller. Use this AOI at the end of the program.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
AxesGroup	DINT	Input	Robot group number
Execute	BOOL	Input	The AOI is executed when a rising edge of the signal is detected
Reset	BOOL	Input	Input to reset the AOI
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
Plcstream_Output	SINT[1]	InOut	I/O used for messaging
plcstream_msgout_a1	MESSAGE	InOut	Message tag(PLC to robot controller)
plcstream_msgout_a2	MESSAGE	InOut	Message tag(PLC to robot controller)
Error	BOOL	Output	Connection to the robot controller is lost
ErrorID	DINT	Output	Error ID 1: Connection to the robot controller is lost.

A.5.3 FRC_AOI_Status

This AOI checks the connection status and reports internal errors that will cause malfunctioning of the AOIs.

Parameter Name	Data Type	Usage	Description
EnableIn	BOOL	Input	Enabled Input: System defined parameter
EnableOut	BOOL	Output	Enabled Output: System defined parameter
PLCRobot_Ref	FRC_PLC_T	InOut	Mandatory input parameter to all FRC AOIs
RobotConnection	Module	InOut	Connection module to the robot controller
COMM_ERROR	BOOL	Output	Error in the Connection module
AOI_INTERNAL_ERROR	BOOL	Output	Internal error in the structure used by the AOIs
CONNECTION_FAULT	BOOL	Output	PLC is not communicating with robot controller

A.6 PLC AOI ERROR CODES

- 1: Connection to the robot controller has been lost.
- 2: The Index of the position recorded exceeds the size of the position array.

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