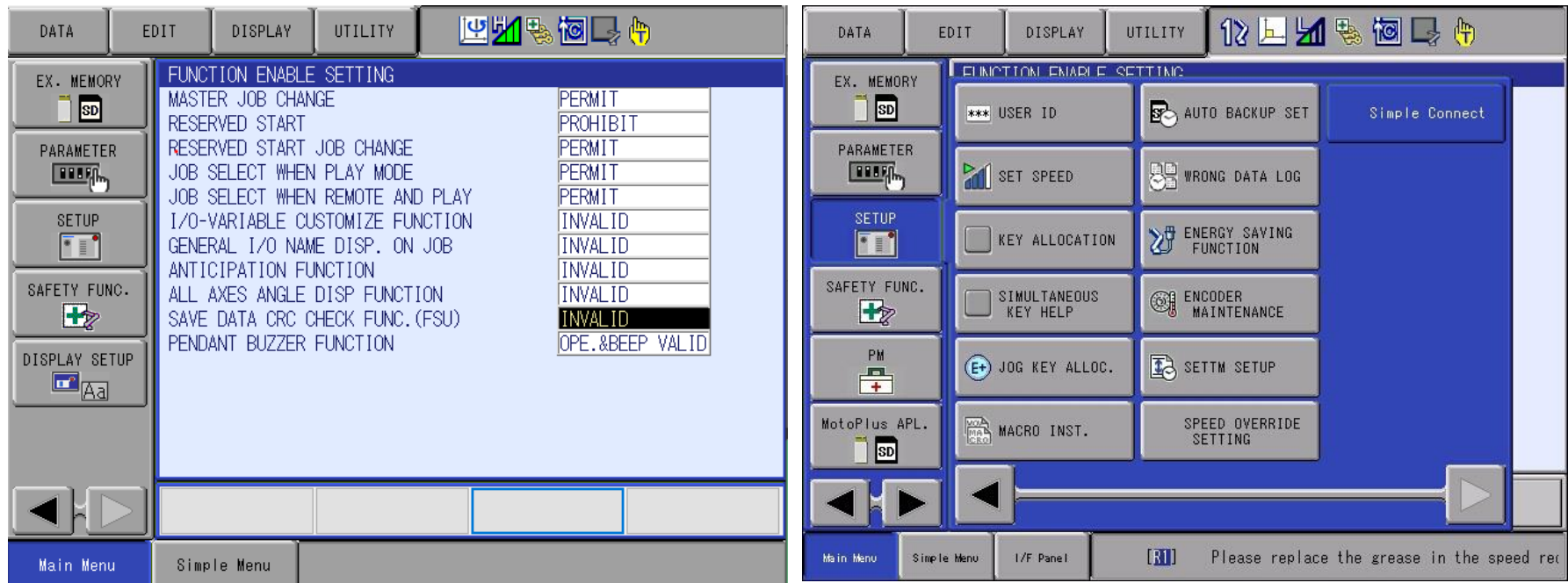


Enabling YAI Standard PLC Map Via Simple Connect

YRC1000 arc welding applications are equipped with a feature known as Simple Connect. Simple Connect is a combination of hardware and software allowing for easy installation and configuration of common robotic devices and accessories with minimal effort and time. This document will guide you through enabling a PLC map VIA the Simple Connect Interface. This option allows for an easy experience configuring a PLC as a master to the Yaskawa YRC1000 Controller acting as the slave. This also will provide standard signaling without the hassle of remapping the Concurrent IO.

1. If the FSU function is enabled ensure you are in-SAFETY mode and the CRC check is set to INVALID. Then navigate to the Simple Connect icon.



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- Once the application has launched, select the robot configuration tab.

The screenshot displays the Yaskawa application interface. The top navigation bar includes icons for 'My Network', 'Add Devices', 'Robot Configuration' (which is highlighted), and 'Return to Pendant'. Below the navigation bar, there are two main panels. The left panel shows a table with columns for 'Status', 'Device Name', 'IP Address', 'Device Tag', and 'MAC'. The table is currently empty, with the text 'There are no devices mapped to this system...' displayed below it. An orange callout box with the text 'NOTE: Use of the PLC map requires Simple Connect version 2.0 or greater.' points to the 'Remove Device' button in the bottom right corner of the table. The right panel is titled 'Additional Controller Configuration' and contains two settings: 'Enable Options' (with a gear icon) and 'Adapter Settings' (with a PLC icon). The bottom of the interface features three buttons: 'Device Details', 'I/O Monitor', and 'Remove Device'. A red box highlights the text 'Simple Connect v2.0.4; Base CIO v1.1.2' located below the 'Remove Device' button.

Status	Device Name	IP Address	Device Tag	MAC
There are no devices mapped to this system...				

NOTE:
Use of the PLC map requires Simple Connect version 2.0 or greater.

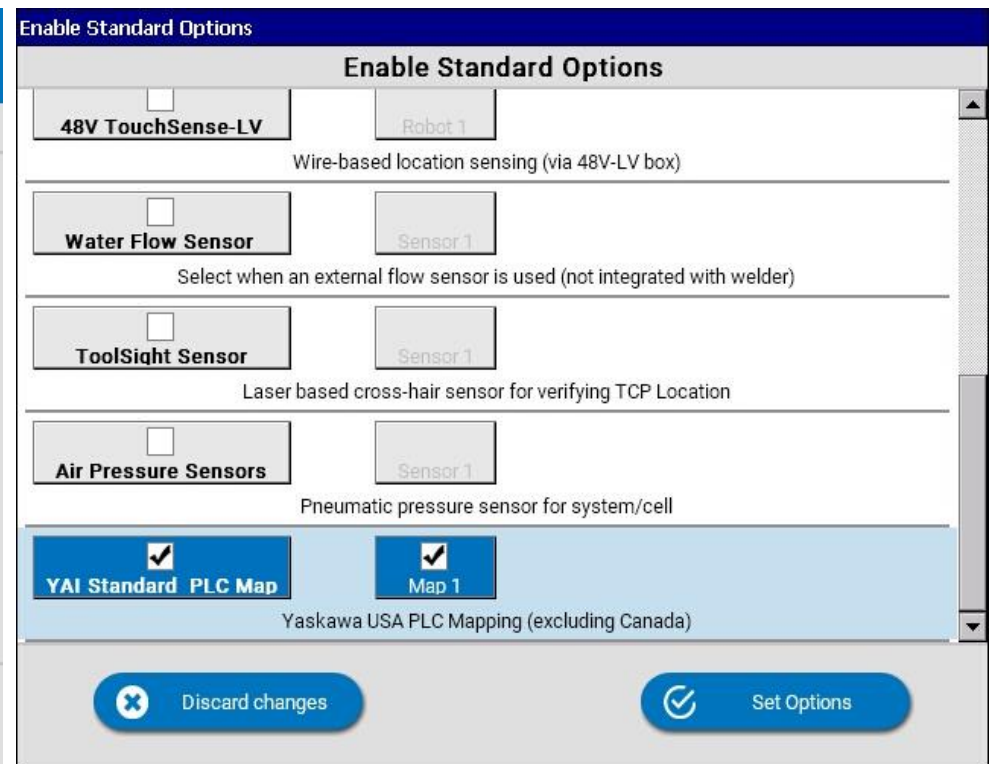
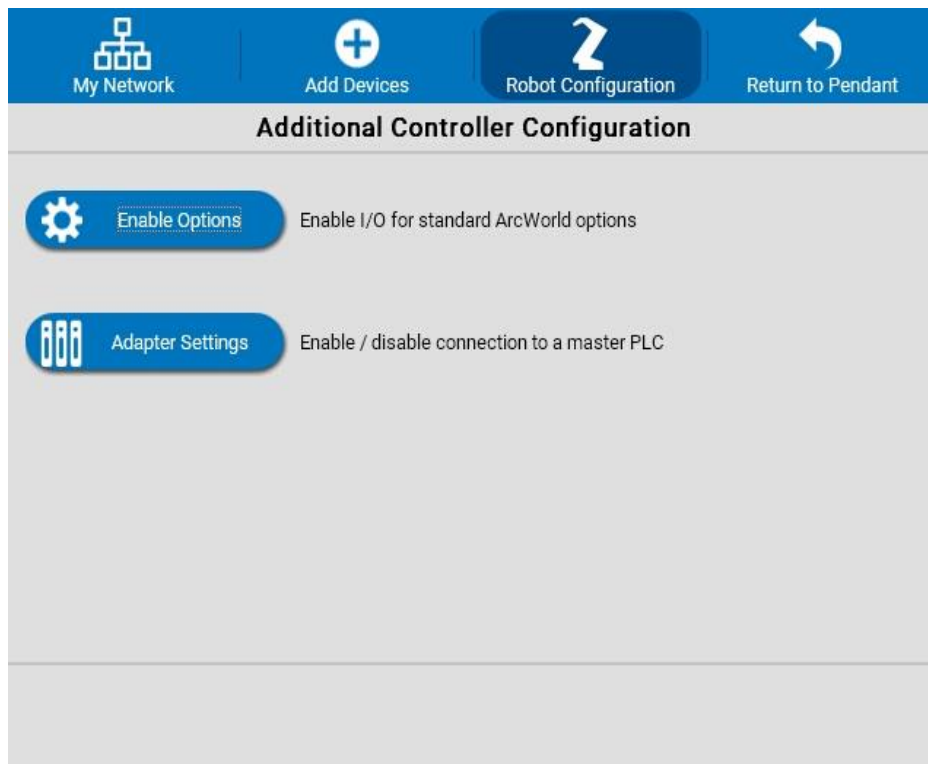
Additional Controller Configuration

- Enable Options: Enable I/O for standard ArcWorld options
- Adapter Settings: Enable / disable connection to a master PLC

Simple Connect v2.0.4; Base CIO v1.1.2

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3. Within the robot configuration tab select enable options and enable the YAI Standard PLC Map and select the set options tab. This sets an activation bit VIA the Concurrent IO.



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4. Select the adapter settings tab. Within the settings tab, the only thing that is configurable is the IO byte size. Your PLC must match the instance configuration. ***Set accordingly: robot's input are the PLC's outputs, robot's outputs are the PLC's Inputs.***

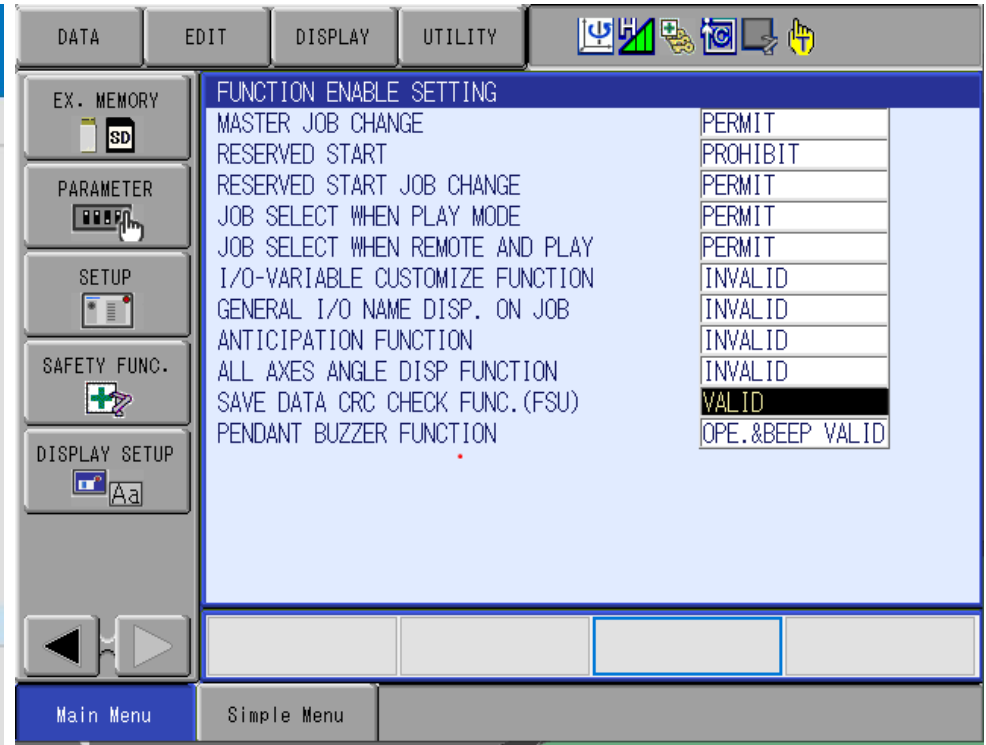
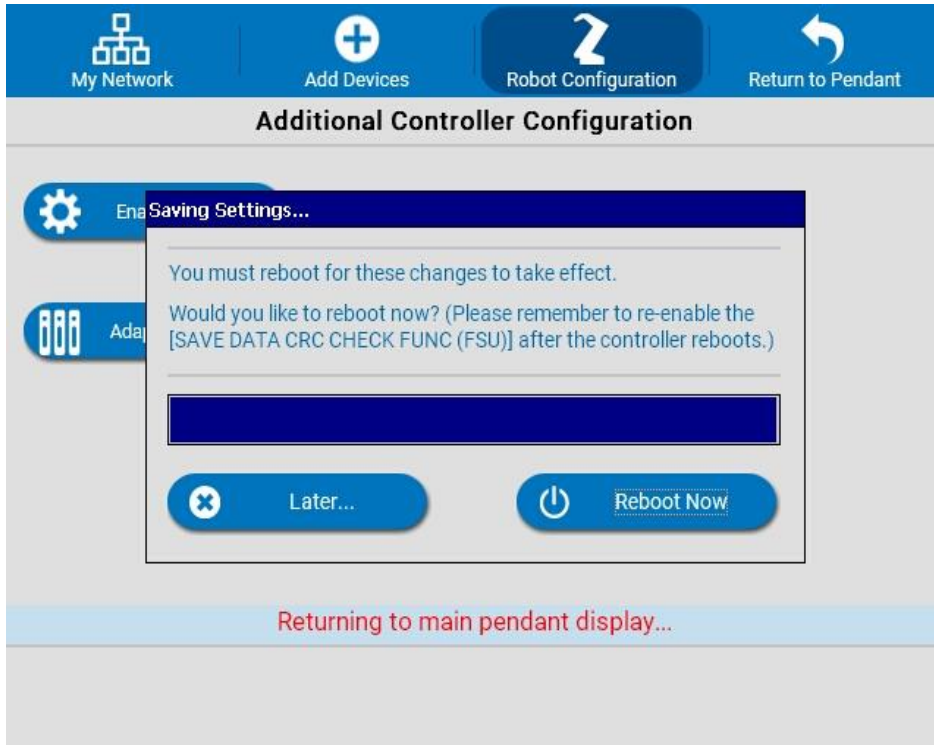
The screenshot shows the 'Additional Controller Configuration' screen with two main options: 'Enable Options' and 'Adapter Settings'. The 'Adapter Settings' option is selected, leading to the 'Ethernet/IP Adapter Settings' dialog box. The dialog box contains a checkbox for 'E/IP Adapter' which is checked, and a table for 'Connection Parameters'.

	Instance	Size in bytes (8 bit SINT)
Input	101	20
Output	100	20
Configuration	150	0

NOTE → Up to 72 bytes could be allocated in the EtherNet/IP adapter setting. This guide will utilize 20 bytes for all examples. The techniques to increase the PLC allocation beyond 20 bytes are left to the user. Change the PLC connection and expanding the UDT would be easy following the examples provided.

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- After accepting the adapter settings, select return to pendant. This will accept and save changes, then prompts for a controller reboot. Also remember to set the CRC check back to valid upon reboot.



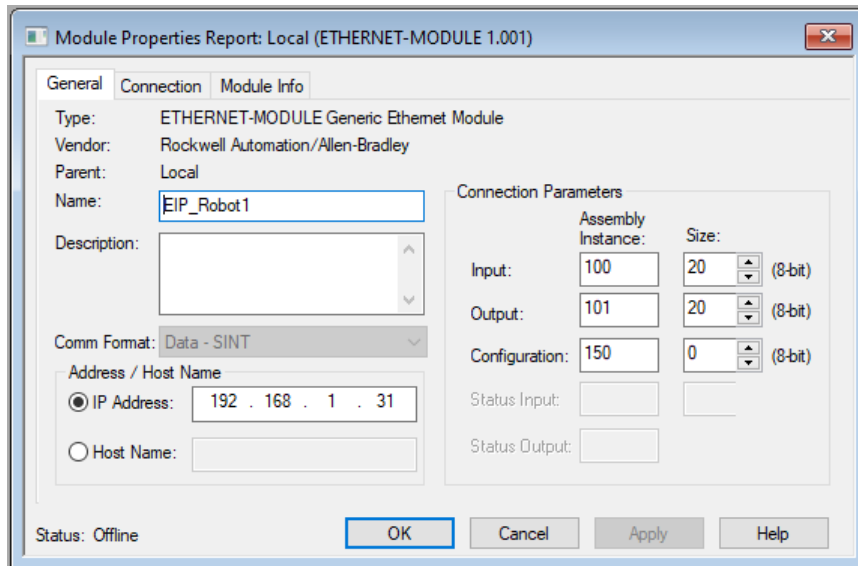
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Settings for Rockwell PLC

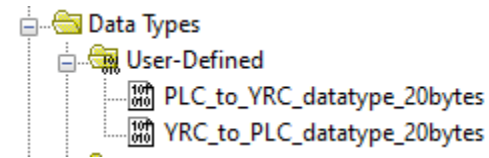
Obtain the file [YRC1000_ArcWorld_PLC_Map_Example_rev0.ACD] from Yaskawa, typically the file will be packaged along with this guide. The file will have the correct settings to match the YRC1000 controller settings established earlier. Additionally, this file will include user defined data types (UDTs) which will provide fully commented data and data with friendly names. The steps below can be skipped if the file was provided. The steps below provide an overview of the functionality in this PLC project.

Verify the Generic Adapter Settings:

Change the IP address if your robot controller is not default →
192.168.1.31



Notice 2 User Defined Data Types are defined:

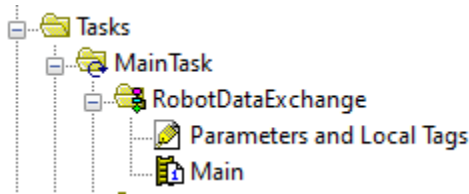


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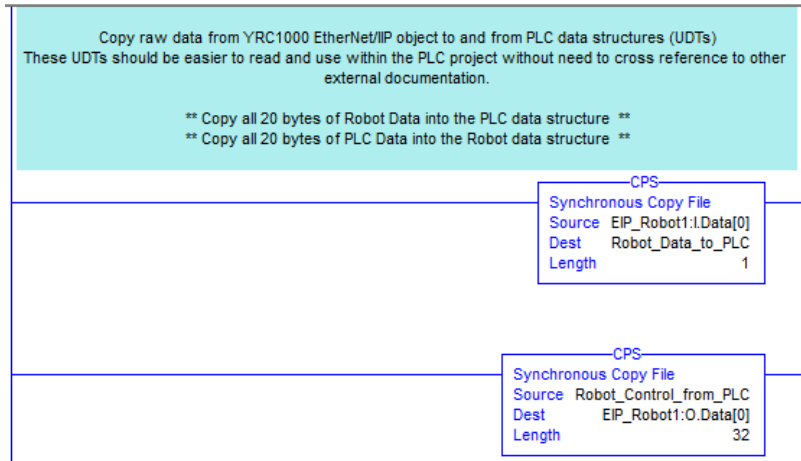
Both data types are used to define Controller scoped Tags (variables):

Name	Alias For	Base Tag	Data Type
+ Robot_Control_from_PLC			PLC_to_YRC_datatype_20bytes
+ Robot_Data_to_PLC			YRC_to_PLC_datatype_20bytes

Next, this solution maps the generic adapter data into these variables by ladder logic.



The ladder logic is simple, two Copy statements. These must be executed all the time or at a rate corresponding to the RPI.



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The UDT structures provide mapping which correspond to the Excel spreadsheet [YRC_Master_resource-2021-03-12-Standard_PLC.xlsm] which is also available with this guide.

Robot_Control_from_PLC
Robot_Control_from_PLC.External_Start
Robot_Control_from_PLC.Ext_Servo_On
Robot_Control_from_PLC.Ext_Servo_Off
Robot_Control_from_PLC.Call_Master_Job
Robot_Control_from_PLC.Alarm_Reset
Robot_Control_from_PLC.avail_byte00_bit5
Robot_Control_from_PLC.avail_byte00_bit6
Robot_Control_from_PLC.avail_byte00_bit7
Robot_Control_from_PLC.Go_Home
Robot_Control_from_PLC.Ext_Hold
Robot_Control_from_PLC.Engage_Safety_Speed
Robot_Control_from_PLC.avail_byte01_bit3
Robot_Control_from_PLC.avail_byte01_bit4
Robot_Control_from_PLC.avail_byte01_bit5
Robot_Control_from_PLC.avail_byte01_bit6
Robot_Control_from_PLC.Check_Mode_Select

Robot_Data_to_PLC
Robot_Data_to_PLC.Operating
Robot_Data_to_PLC.Servos_are_On
Robot_Data_to_PLC.Servos_are_Off
Robot_Data_to_PLC.At_Top_Default_Job
Robot_Data_to_PLC.Alarm_Occured
Robot_Data_to_PLC.In_Remote_Mode
Robot_Data_to_PLC.In_Play_Mode
Robot_Data_to_PLC.In_Teach_Mode
Robot_Data_to_PLC.At_Home_for_Shutdown
Robot_Data_to_PLC.In_Hold
Robot_Data_to_PLC.In_Safety_Speed
Robot_Data_to_PLC.Safety_Circuit_Closed
Robot_Data_to_PLC.External_EStop_OK
Robot_Data_to_PLC.Programming_Pendant_EStop_OK
Robot_Data_to_PLC.Manipulator_was_Jogged
Robot_Data_to_PLC.Check_Mode

uIn#	IG#	IGH#	Contact	EX I/O Name
1001	126	251	21280	PLC: Ext Start
1002	126	251	21281	PLC: Ext Servo On
1003	126	251	21282	PLC:Ext Servo Off
1004	126	251	21283	PLC:Call Mst JBI
1005	126	252	21284	PLC:Ext Alarm Rst
1006	126	252	21285	PLC:
1007	126	252	21286	PLC:
1008	126	252	21287	PLC:
1009	127	253	21290	PLC: Go Home
1010	127	253	21291	PLC:Ext Hold

uOut#	OG#	OGH#	Contact	I/O Name
1001	126	251	11260	EIP STD PLC: Operating
1002	126	251	11261	EIP STD PLC: Servos On
1003	126	251	11262	EIP STD PLC: Servos Off
1004	126	251	11263	EIP STD PLC: At Top of Master Job
1005	126	252	11264	EIP STD PLC: Alarm Occurred
1006	126	252	11265	EIP STD PLC: Remote Mode
1007	126	252	11266	EIP STD PLC: Play Mode
1008	126	252	11267	EIP STD PLC: Teach Mode
1009	127	253	11270	EIP STD PLC: At Home for Shutdown
1010	127	253	11271	EIP STD PLC: Hold

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Testing PLC and YRC1000 Communication

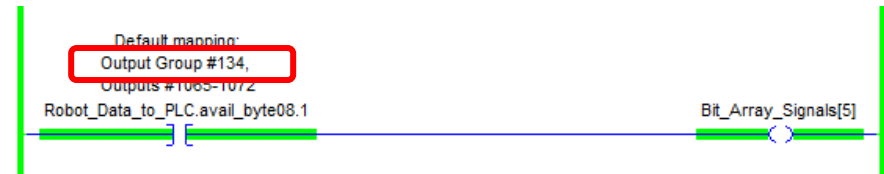
A Task/Ladder is included in the PLC project file [YRC1000_ArcWorld_PLC_Map_Example_rev0.ACD]. The following screenshots use this logic.

- **NOTE: This Task/Ladder should be deactivated when actual cell logic is ready to be written.**

Output from Robot Controller



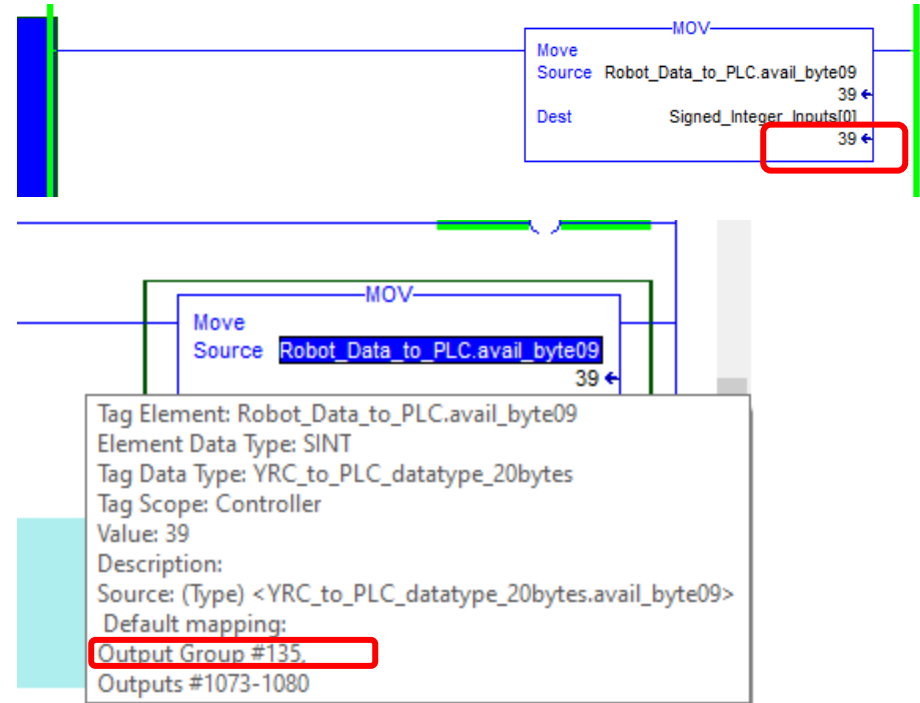
Input to PLC



The comment in the PLC shows that this bit came from Output Group (OG) #134. Looking to the left we can immediately see this correlation. Bit 1 is active. Rockwell PLC starts array counting with 0.

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DATA	EDIT	DISPLAY	UTILITY
GENERAL PURPOSE OUTPUT			
GROUP OG#135 39:DEC. 27:HEX.			
OUT#1073	#11350	●	
OUT#1074	#11351	●	
OUT#1075	#11352	●	
OUT#1076	#11353	○	
OUT#1077	#11354	○	
OUT#1078	#11355	●	
OUT#1079	#11356	○	
OUT#1080	#11357	○	

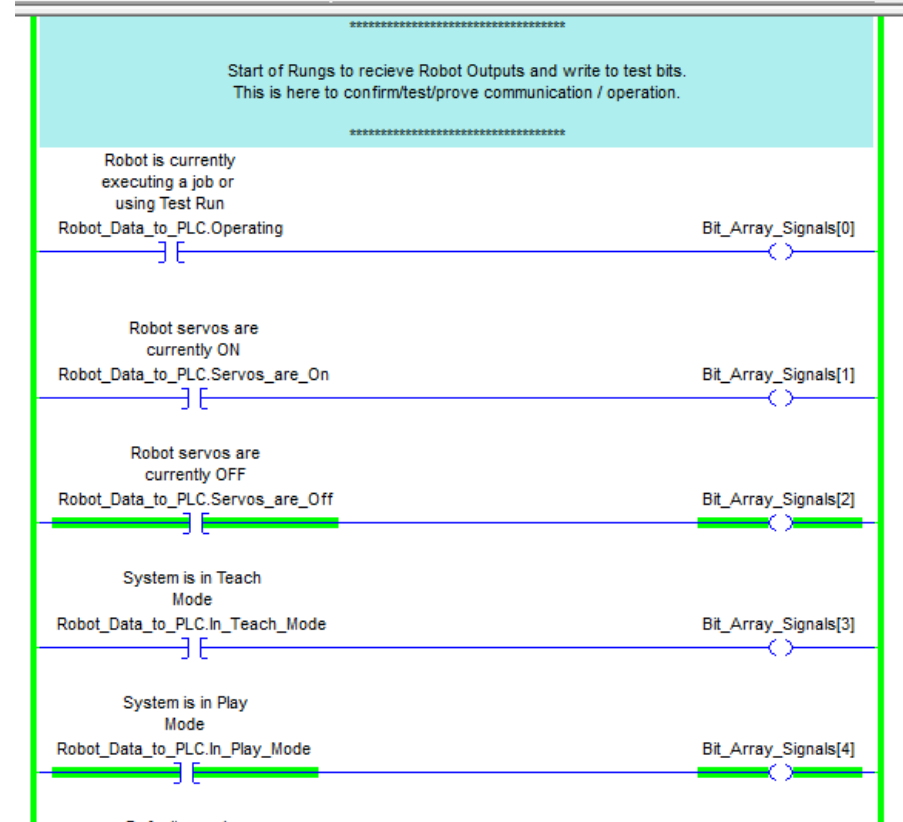


To see the correlation of the robot output to the PLC usage, use the “mouse over” to get the dialog to show up. In this dialog we see the comment displays Output Group (OG) #135.

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DATA	EDIT	DISPLAY	UTILITY
EXTERNAL OUTPUT			
GROUP		132:DEC	84:HEX
JOB	#31280	<input type="radio"/>	Operating
ARC WELDING	#31281	<input type="radio"/>	Servo On
VARIABLE	#31282	<input checked="" type="radio"/>	Servo Off
B001	#31283	<input type="radio"/>	Top Of Master
IN/OUT	#31284	<input type="radio"/>	Alarm Occurred
ROBOT	#31285	<input type="radio"/>	Remote Mode
	#31286	<input type="radio"/>	Play Mode
	#31287	<input checked="" type="radio"/>	Teach Mode

These are specific control signals which are pre-mapped in the concurrent IO ladder. Your system may not have NAME's entered in these fields. Use the Excel data to review the correlation. The intent of this is to show output status from the robot mapped into the PLC. Using the signals at the PLC side is very intuitive due to the UDT structure and naming.



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Output from PLC



Using specific control output signals the PLC can control the YRC1000 robot controller into certain modes. In this example the PLC is requesting the robot to start a job. (Other conditions may be necessary – servo on, play, remote mode, etc.). It will be up to the PLC programmer to check those conditions, which can be done by combining PLC inputs, status signals and other logic.

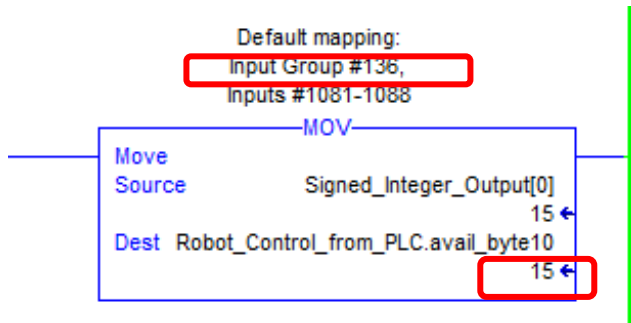
Your system may not have NAME's entered in these fields, use the Excel data to review the correlation.

Input to Robot Controller

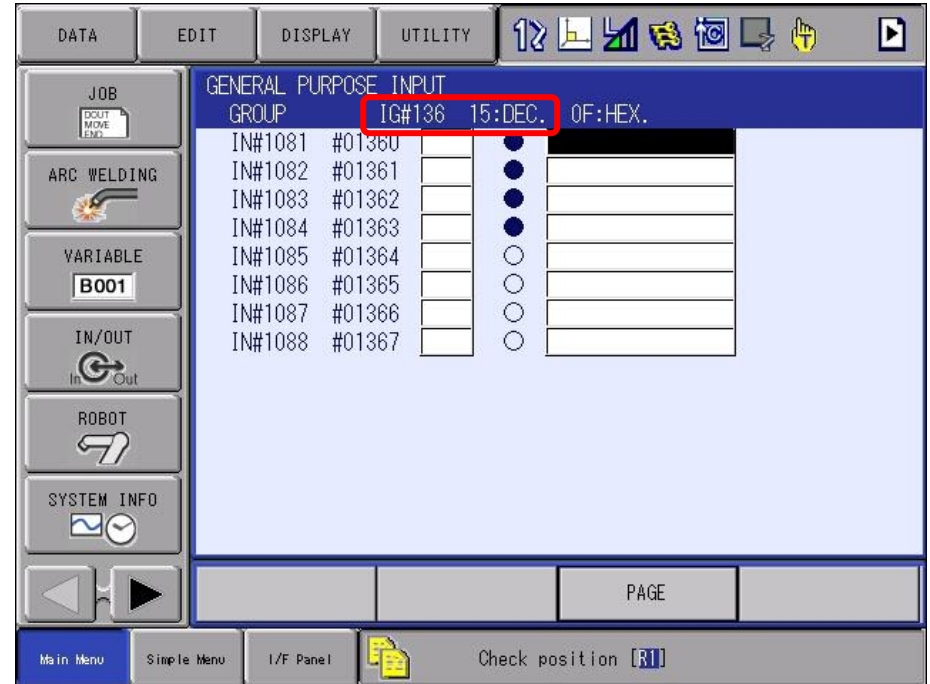
The screenshot shows the 'EXTERNAL INPUT' configuration screen on a robot controller. The screen has a menu on the left with options: JOB, ARC WELDING, VARIABLE (B001), IN/OUT, ROBOT, and SYSTEM INFO. The main area displays a table of external inputs with columns for GROUP, status, and NAME. The status column shows radio buttons, with the first one selected. The bottom of the screen has a status bar with 'Main Menu', 'Simple Menu', 'I/F Panel', and 'Check position [R1]'.

GROUP	1:DEC	01:HEX
#21280	<input checked="" type="radio"/>	Ext Start
#21281	<input type="radio"/>	Ext Servo On
#21282	<input type="radio"/>	Ext Servo off
#21283	<input type="radio"/>	Call Master Job
#21284	<input type="radio"/>	Ext Alarm Reset
#21285	<input type="radio"/>	PLC
#21286	<input type="radio"/>	PLC
#21287	<input type="radio"/>	PLC

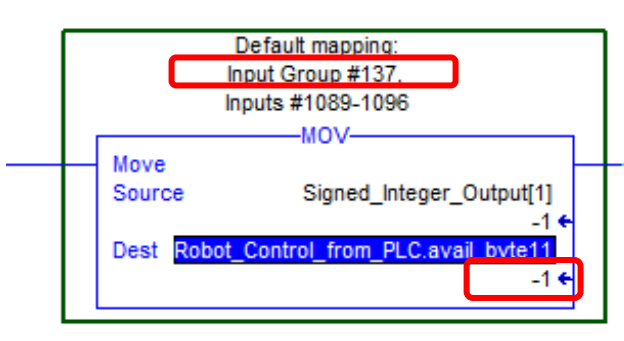
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The comment in the PLC shows that this byte maps to the Input Group (IG) #136. Looking to the left we can immediately see this correlation. The total value is also 15.



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The comment in the PLC shows that this byte maps to the Input Group (IG) #137. Since this is a negative number, we need extra consideration.

The PLC represents the 8-bit number as a SINT – signed integer. However, the YRC1000 represents the 8-bit number as a bit INT (no negative). A negative number uses “2s complement” formatting. Below shows the PLC’s bit-wise representation. This value directly matches the 8 bits in the YRC1000, although the total value is different due to “signing”.

Name	Value
Robot_Control_from_PLC.avail_byte11	-1
Robot_Control_from_PLC.avail_byte11.0	1
Robot_Control_from_PLC.avail_byte11.1	1
Robot_Control_from_PLC.avail_byte11.2	1
Robot_Control_from_PLC.avail_byte11.3	1
Robot_Control_from_PLC.avail_byte11.4	1
Robot_Control_from_PLC.avail_byte11.5	1
Robot_Control_from_PLC.avail_byte11.6	1
Robot_Control_from_PLC.avail_byte11.7	1

DATA EDIT DISPLAY UTILITY

JOB

ARC WELDING

VARIABLE B001

IN/OUT

ROBOT

SYSTEM INFO

GENERAL PURPOSE INPUT

GROUP IG#137 255:DEC. FF:HEX.

IN#1089	#01370		
IN#1090	#01371		
IN#1091	#01372		
IN#1092	#01373		
IN#1093	#01374		
IN#1094	#01375		
IN#1095	#01376		
IN#1096	#01377		

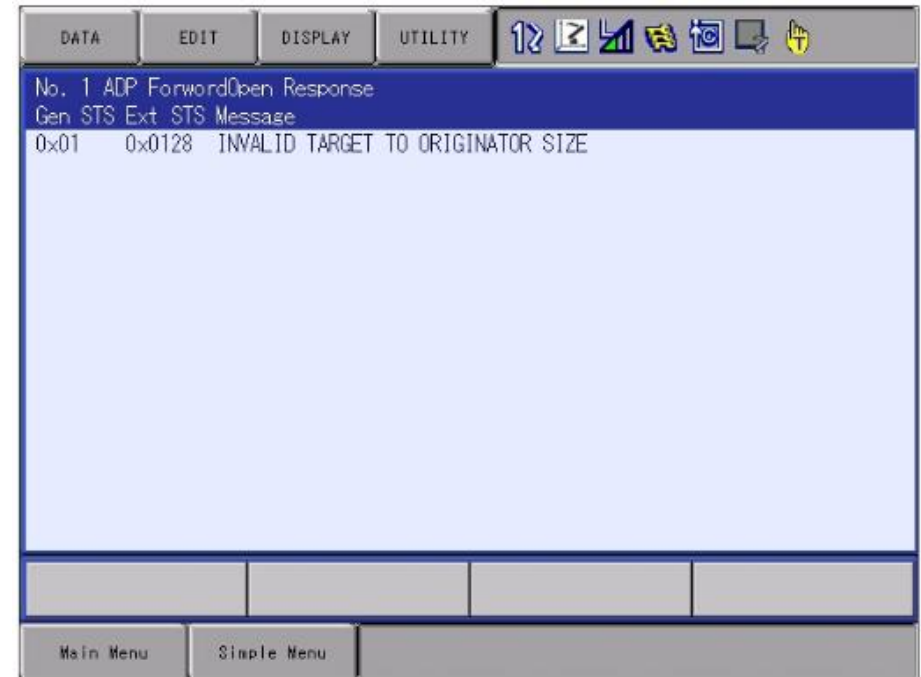
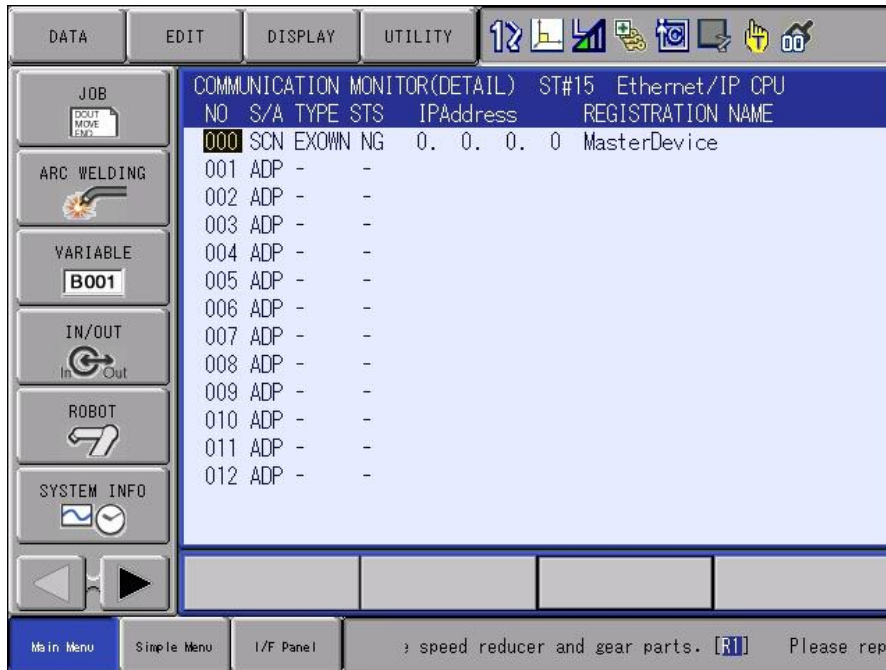
Main Menu Simple Menu I/F Panel Check position [RT]

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Troubleshooting Tips

If establishing communication has failed, please follow troubleshooting tips below.

- Check the communication status of the PLC VIA the Communication Monitor residing under the IN/OUT tab. Note the General Status *STS* column there will be an error code refer to section 4.8.2 of the YRC1000 Ethernet IP manual for the error code explanation.



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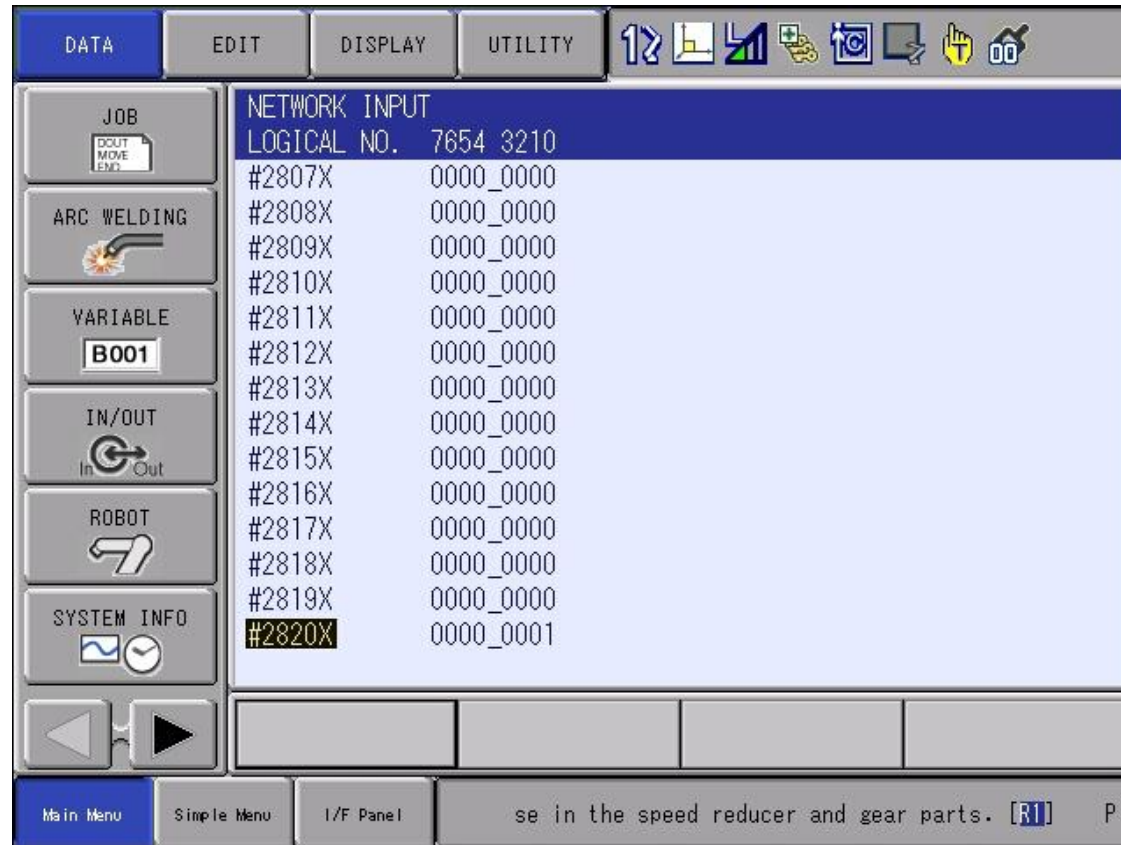
- Try pinging the PLC using the YRC1000 controller ping function. If the ping is unsuccessful verify ethernet cable is properly terminated and PLC ethernet settings are correct.

The image displays two screenshots of the Yaskawa robot control interface, specifically the 'NETWORK UTILITY' screen. The left screenshot shows the main menu with 'NETWORK UTILITY' selected. The right screenshot shows the 'PING' test results for host 192.168.1.55, with all four test attempts resulting in 'TIME OUT'.

TEST TIMES	RESULT
1st	TIME OUT
2nd	TIME OUT
3rd	TIME OUT
4th	TIME OUT

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- If communication status is OK and specific control bits are not properly working. Verify the PLC enable bit is active: Network Bit 28200. Also, the robot will need to reside in Remote mode for the use of the robots control functions like EXT Start, Servos On, Call Master Job Etc.



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Files Referenced in this Document.



YRC1000_ArcWorld_
PLC_Map_Example_r



YRC_Master_resourc
e-2021-03-12-Stand: