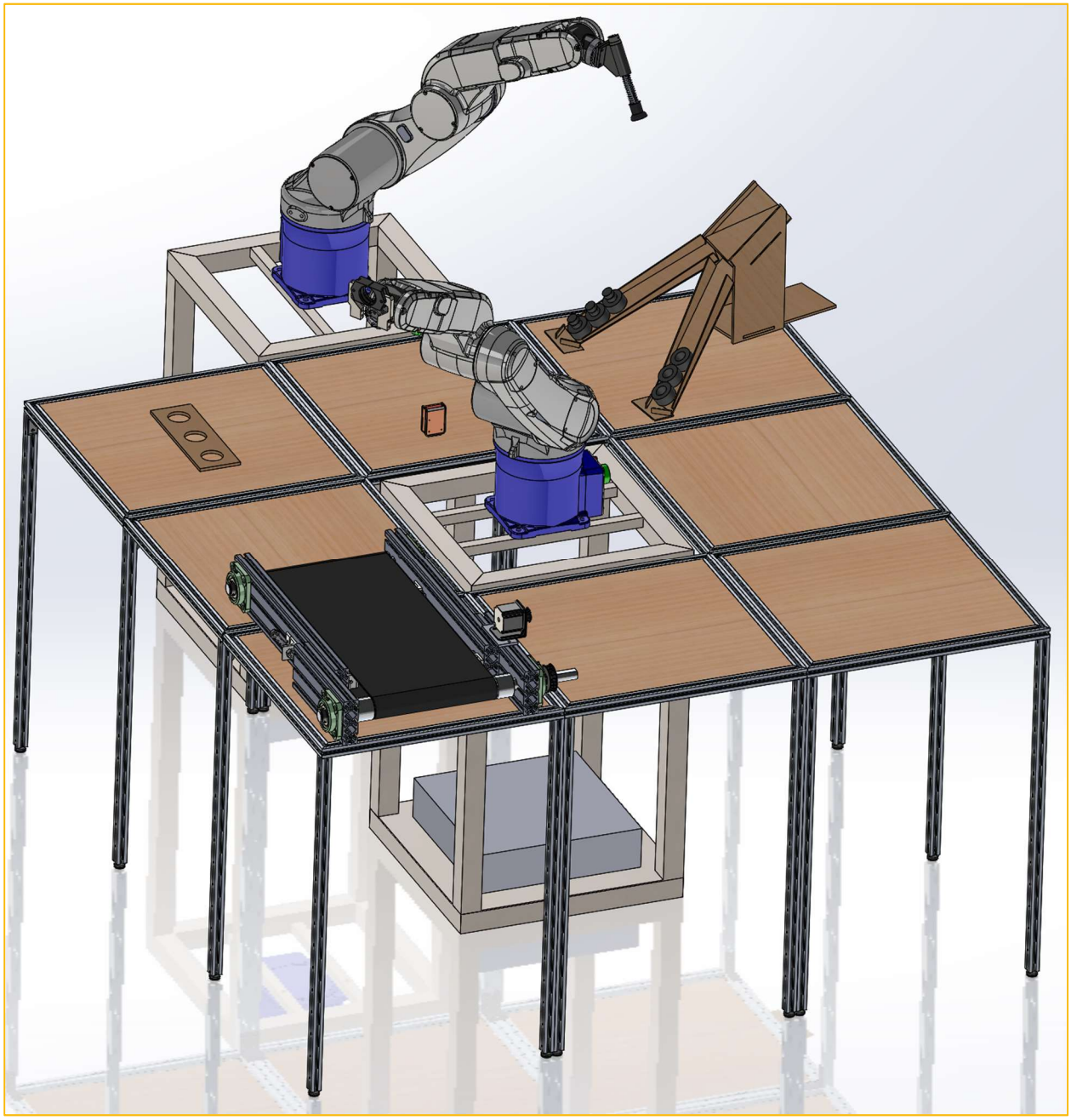
Robotic Manufacturing Cell Guide



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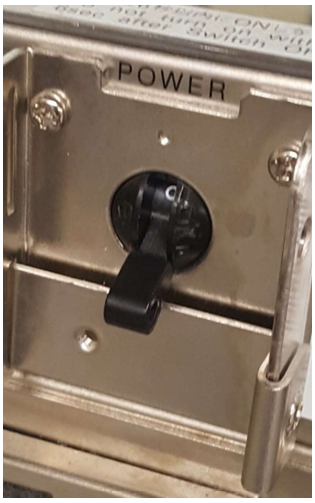
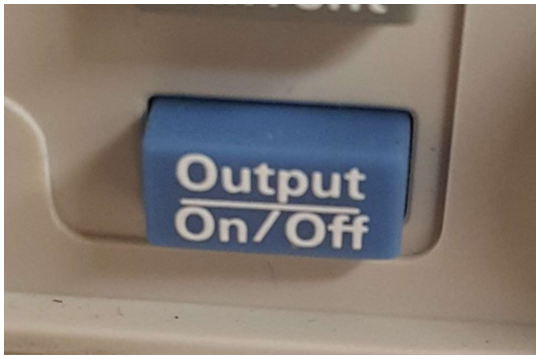
Process

Step 1: Turn on the switches for both controllers. On each controller on the stand, there is a switch on the left side



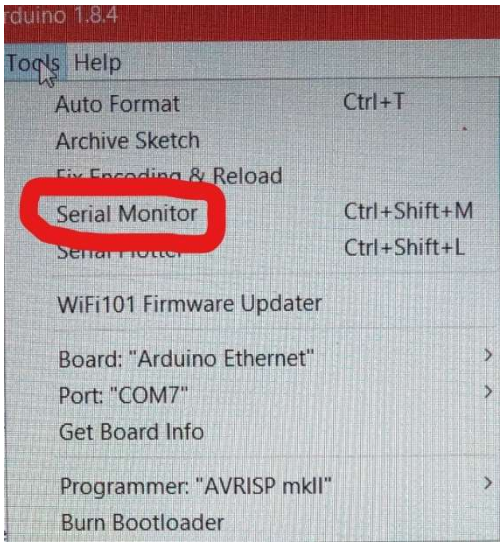
Step 2: Turn on the Power Supply on the top of the stand. This includes both turning on the switch, as well as pressing the “on” button



Step 3: Plug the Ethernet hub into the wall

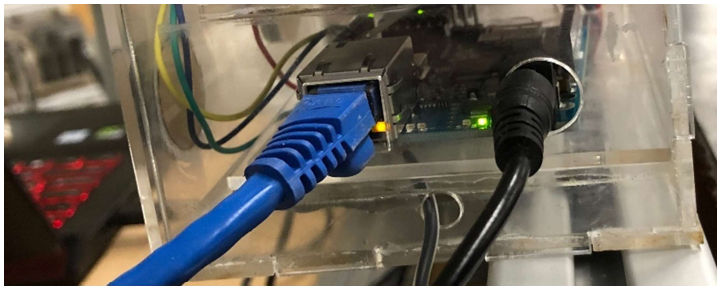
Step 4: Enter the robotic cell and load the ramp

Step 5: Open the Arduino program. Once in, go to the Tools section and open the Serial Monitor

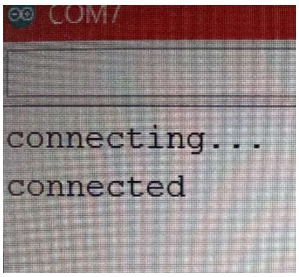


Step 6: Plug in the extension cord, so that the Arduino and controller are both on

Step 7: Plug the blue Ethernet cord into the Arduino, and the USB to mini-USB cord into the computer with the Arduino program

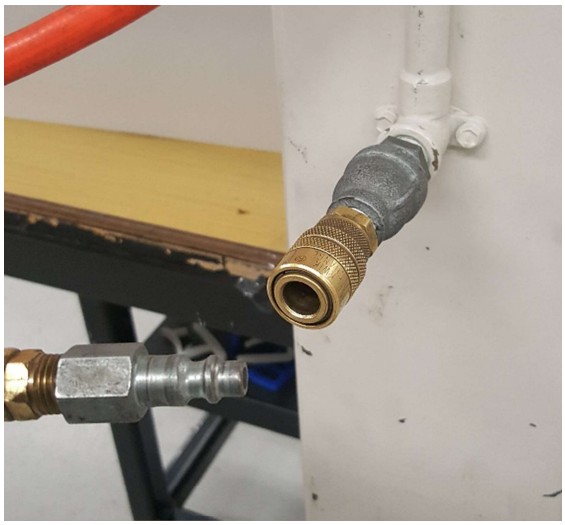


Step 8: Upload the program onto the Arduino, looking at the Serial Monitor. The desired output is shown to the right. If it says it is disconnected, try again. If there is trouble, try scanning something immediately after uploading the program.

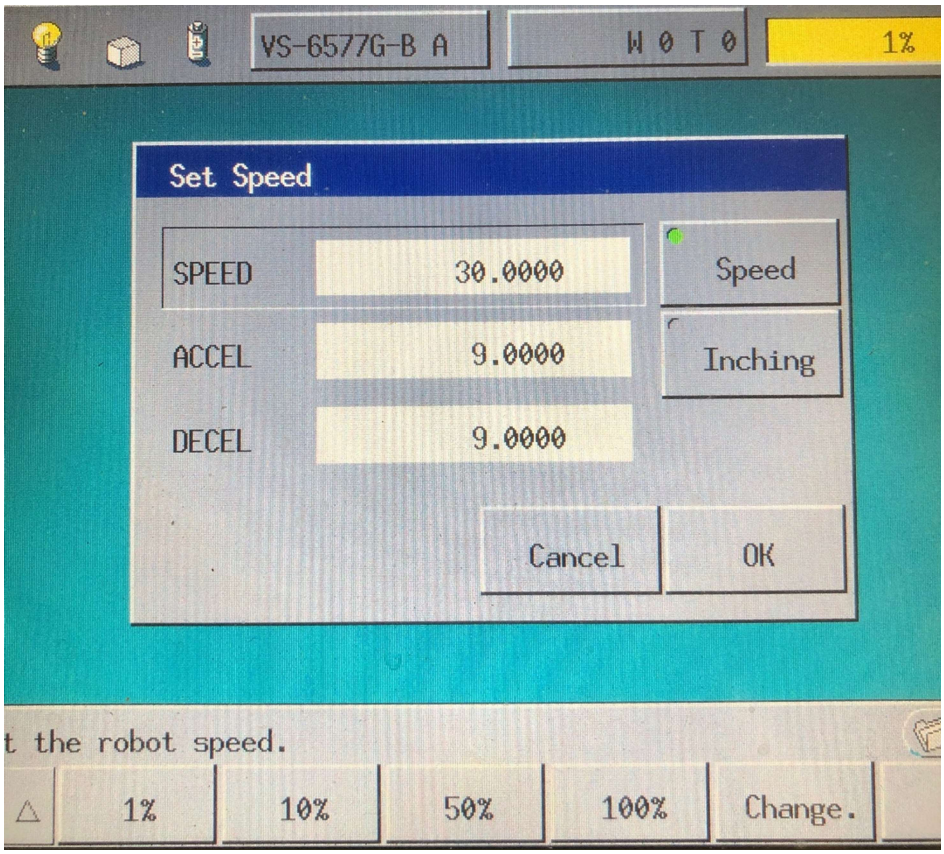


Step 9: Going out of the cell, on the controller stand, ensure the switches are set to Auto

Step 10: Plug the air hose in so the pneumatic grippers work

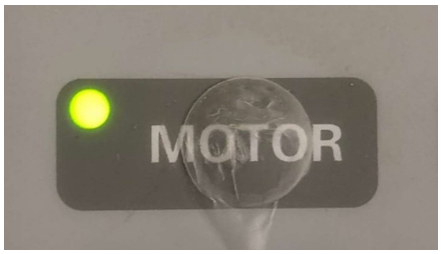


Step 11: Each controller has a speed setting on the top right, clicking this will open a window with a percentage. Set the speed you would like to run the program (less than 40% suggested). To set the speed, you can either click the boxes at the bottom of the screen if one of those speeds is desired, or you can adjust using the scroll wheel on the right side of the controller. Do this for both controllers. Press Cancel to go back to the main screen.

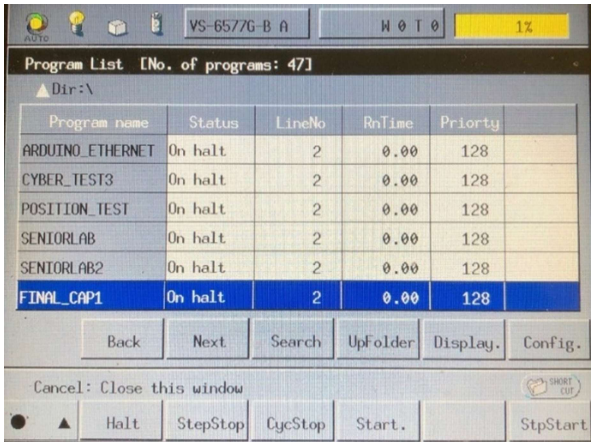


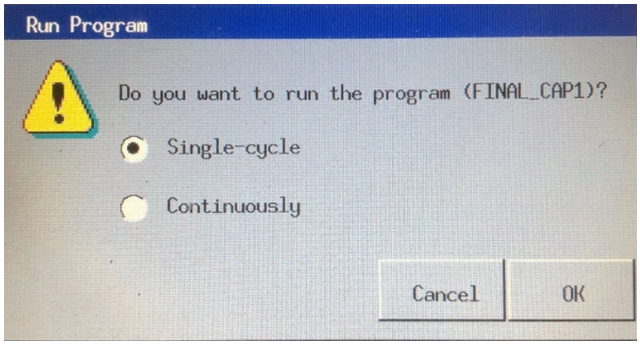
Step 12: On each controller is a button on the bottom left of the screen called Program. Click it, then scroll down almost all the way down the list until you find the programs final_cap1 (Robot 1) and final_cap2 (Robot 2). Make sure the key is turned all the way to the left for AUTO.

Step 13: In order to begin the process, the motor needs to be turned on. This is to the right of the key set to AUTO. To turn the motor on, click the button labeled “Motor”.

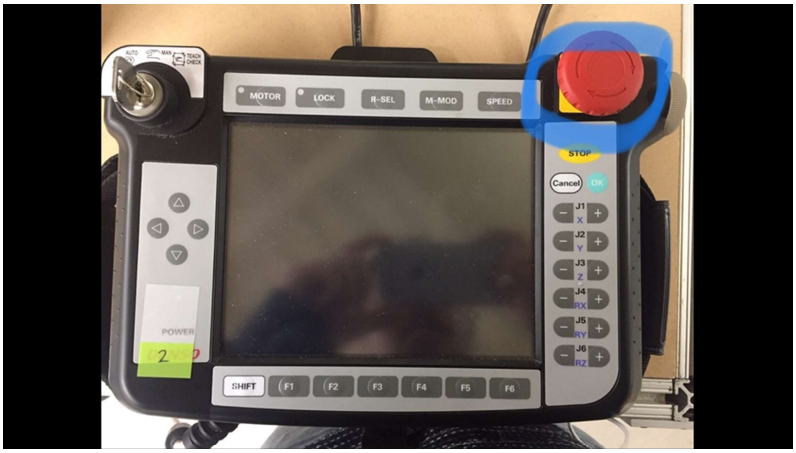


Step 14: While highlighting the programs mentioned, click the Start button on the bottom right part of the screen. A window will pop up asking if the program should run in a single-cycle or if it should be continuous. The single-cycle will already be selected, and this is the desired selection. Clicking OK on the controller will start the program. Start the program at the same time on each controller to ensure the communication between the two happens.





Step 15: After Step 14, users need to keep their hand on the red circle button that is located in the top right corner as shown below in the picture. Users need to watch the robot arms to make certain no collisions take place. The benefit from this red circle button is to stop the robot arms if there are any wrong movements or the arms accidentally crash into anything around the cell. This red circle button is an emergency stop.



If users need to use the Emergency Button, they have to push this button directly down into the controller direction.

(On the back of controller is a button too, which is used for manual mode or manual calibration. The operator must hold it with a normal force in order to move the robot manually.)

After solving the problems and before running the robot arm again, users have to spin the emergency stop in the right direction as shown in the arrows that are on the button's surface, as shown below. The button will automatically jump upward after spinning.

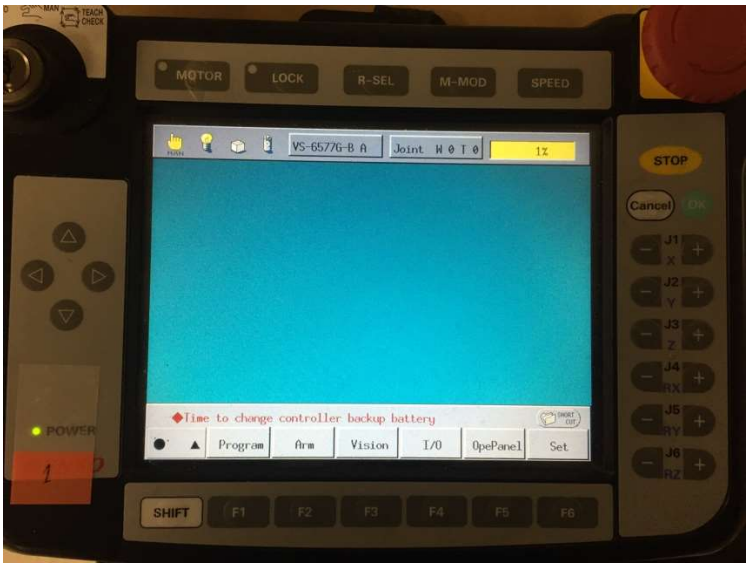
Troubleshooting

For certain reasons, the program does not work properly, so users need to follow the next steps very carefully:

Step 1: Turn the controller in the right direction to be on the Manual Mode as shown below.

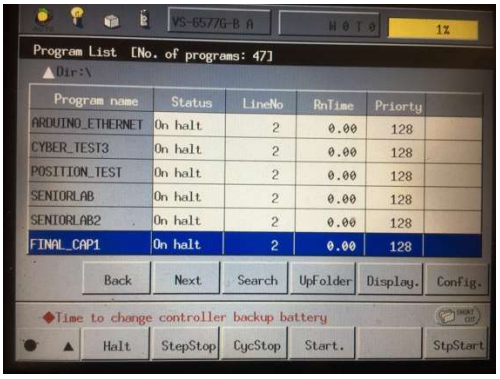
Step 2: Press Cancel until there is a blue screen as shown in Step 3, to make sure the main screen is shown.

Step 3: Press the program button located in the bottom left of the screen as shown.

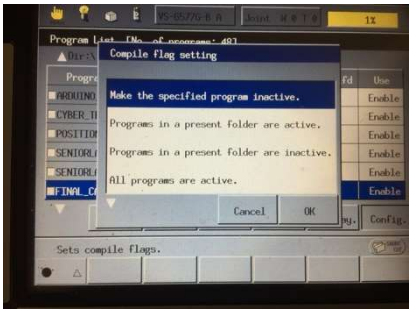


Step 4: After pressing the Program Icon, it will show a list of programs. For example, we use the (Final_ cap1).

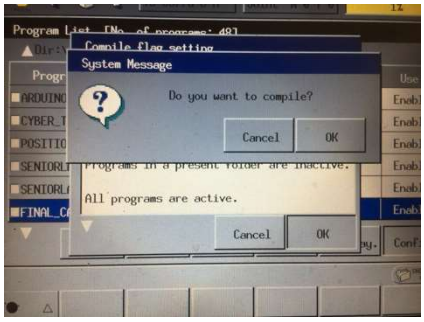
Select the Final_cap1 as shown below and press at (Config) to compile the program file.

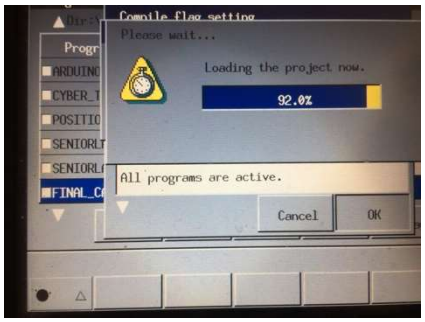


Step 5: A small menu will appear as shown below. Press (OK).

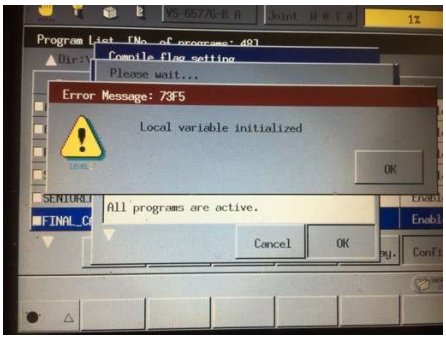


Step 6: Program will ask the users to make sure they want to compile. Pressing (OK) again, it will upload the file as shown down.





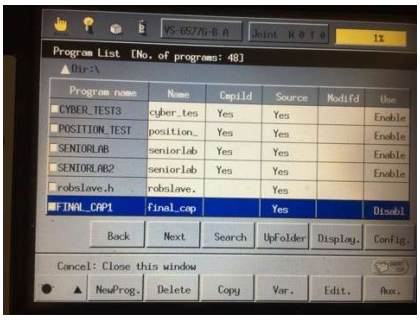
Step 7: After uploading the file, an Error Message will appear. Press (OK) as shown below.



The user will find the Final_cap1 file at the very end of the program menu list with comment (disable), shown below.

Step 8: Redo steps 3 through 6 to activate the Final_cap1 file. It will show the comment (enable) which means the program is now ready to work.

In this moment, users have to follow the steps 12 through 14 in the process part of this user manual.



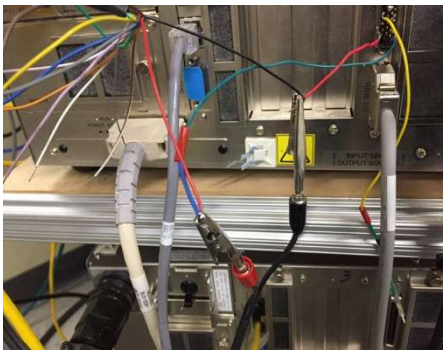
(DISABLE)

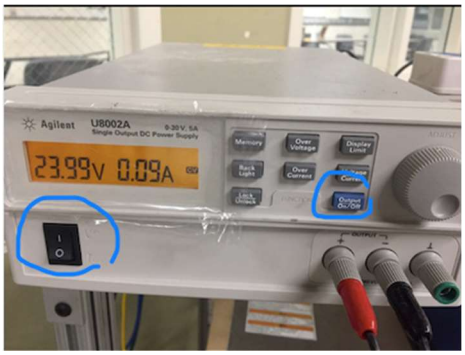
(ENABLE)

NOTE:

1-Using the robots for a long time (more than about 30 min), problems may sometimes occur when they don't communicate with each other. Robot 1 will do its task but unfortunately, the signal does not send to Robot 2. So, users have to power down each device. Turning the devices ON should make the robots run smoothly again.

2- If the Gripper does not work, user have to check the air hoses, or the wire connect that is located in the back of RC7 CONTROLLER and they need to be connected as shown below in the middle picture. The (blue & green) and red wire connect with the positive side of the POWER SUPPLY DEVICE. The red that comes from the controller, and black wire connect directly to the grand wire of the POWER SUPPLY DEVICE. (ALSO, check the on/off switch and blue button on/off) of the power supply.





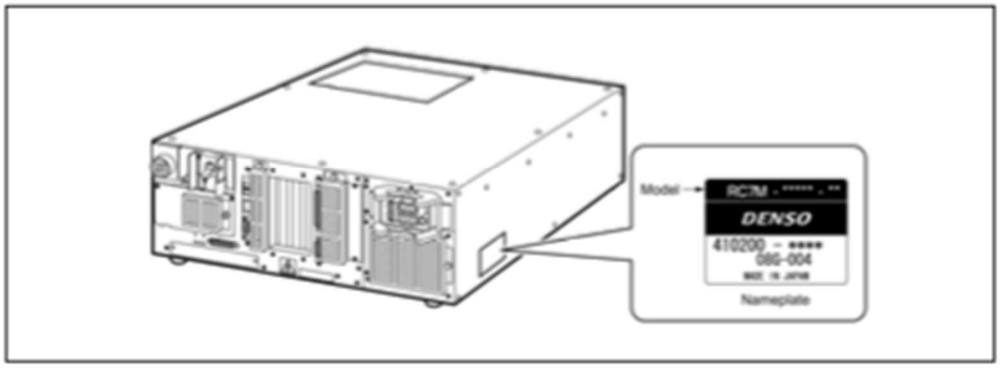
Controller

Chapter 1
General Information about RC7M Controller

The RC7M controller is available in several models which differ in detailed specifications to match robot models.

1.1 Controller Model Name on Nameplate

The model name of the controller is printed on the nameplate attached to the rear side of the controller as shown below. The model name is coded as listed below.



Coding of Controller Model Name

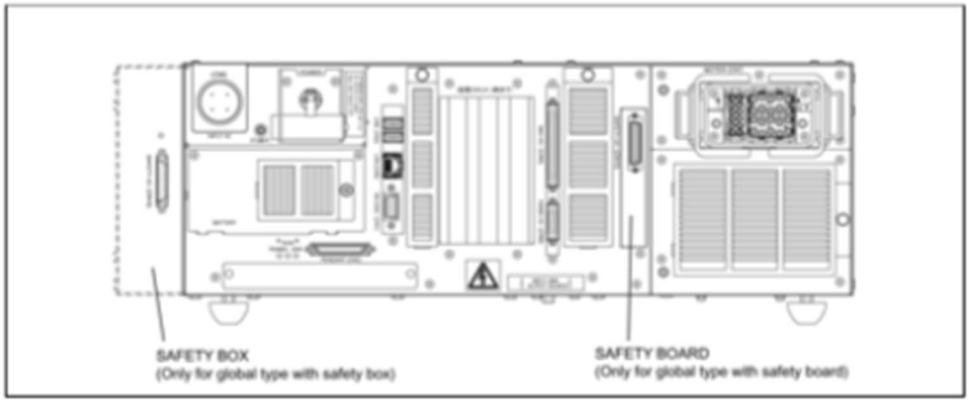
RC7M - VSG 6 B A _ - B P
(a) (b) (c) (d) (e) (f) (g)

Position	Code sample	Denotes:	Coding
(a)	VSG	Robot model name	VMG: VM-G series, VSG: VS-G series, VPG: VP-G series, HMG: HM-G series, HSG: HS-G series, XRG: XR-G series
(b)	6	No. of controllable axes	4: 4 axes, 5/6: 5 or 6 axes, 6: 6 axes
(c)	B	Engineering symbol 1	B: Encoder B C: Encoder C
(d)	A	Engineering symbol 2	A: 24V brake
(e)		Engineering symbol 3	Blank: 200 VAC power A: 100 VAC power
(f)	B	Controller type (Note)	Blank: Standard type B: Global type (with safety board) C: Global type (with safety box) D: UL-Listed（with safety board) E: UL-Listed(with safety box)
(g)	P	I/O type	Blank or N: NPN I/O P: PNP I/O

(Note) For the differences between the global and standard types, see the next page.

Differences between Global and Standard Types of Robot Controllers

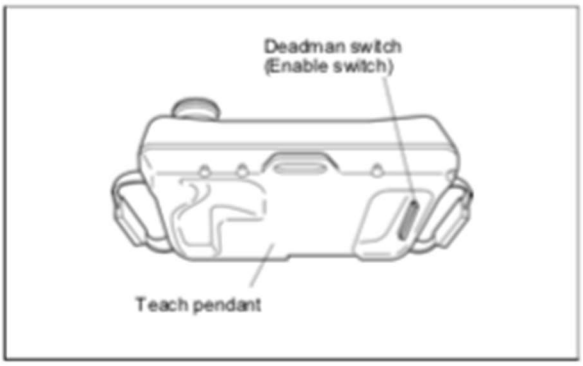
The global type of the robot controller has either a safety board or safety box which the standard type has not. Described below are the functional differences between the global and standard types.



[1] Deadman switch function (Enable switch function)

The global type controls the deadman switch provided on the teach pendant or mini-pendant in a partially different way than the standard type does. When reading the instruction manuals that are prepared for the standard type, be careful with the following differences.

(1) Location of deadman switches (enable switches) on the teach pendant and mini-pendant



(2) Difference in deadman switch operation

The table below lists the functional differences of the teach pendant and mini-pendant between the global and standard types in Manual mode and Teach check mode.

Global type	Standard type (described in the instruction manuals)
(1) Unless the deadman switch is held down, you can neither operate the robot nor turn the motor power ON.	(1) Unless the deadman switch is held down, you cannot operate the robot, but you can turn the motor power ON.
(2) When the robot is in operation, releasing the deadman switch will stop not only the robot but also turn the motor power OFF.	(2) When the robot is in operation, releasing the deadman switch will stop the robot but not turn the motor power OFF (servo lock).

[2] "Single point of control" function

The global type of the robot controller supports the "single point of control" function, while other types do not.

(1) Single point of control

The "single point of control" function, which is one of the robot safety functions, limits the robot control sources (command sources) to only one. This function is specified by the parameter "Single point of control" that limits the control to either "Internal Auto" or "External Auto" limited mode.

■ Internal Auto limited mode

The "Auto mode" is limited to the "Internal Auto" limited mode in which a program start can be triggered from the teach pendant, but cannot from external equipment.

■ External Auto limited mode

The "Auto mode" is limited to the "External Auto" limited mode in which a program start can be triggered from external equipment, but cannot from the teach pendant.

Note: In this mode, the teach pendant operation panel editor "Panel Designer" cannot be used in External Auto.

(2) Setting the Internal/External Auto Limited Mode Parameters

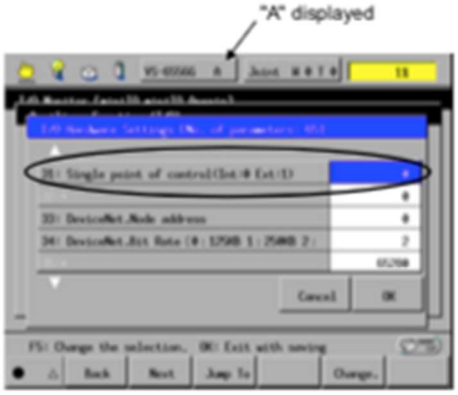
Using the teach pendant, set the parameters with the following access.

Note 1: The "Internal Auto Limited Mode" is the factory default.

Note 2: The global type displays letter "A" following the robot type on the teach pendant screen.

Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F1 Set H/W]—[F3 Jump To]—"31"

In Ver. 2.3 or later:
Access: [Top screen]—[F4 I/O]—[F6 Aux.]—[F4 Int/Ext]



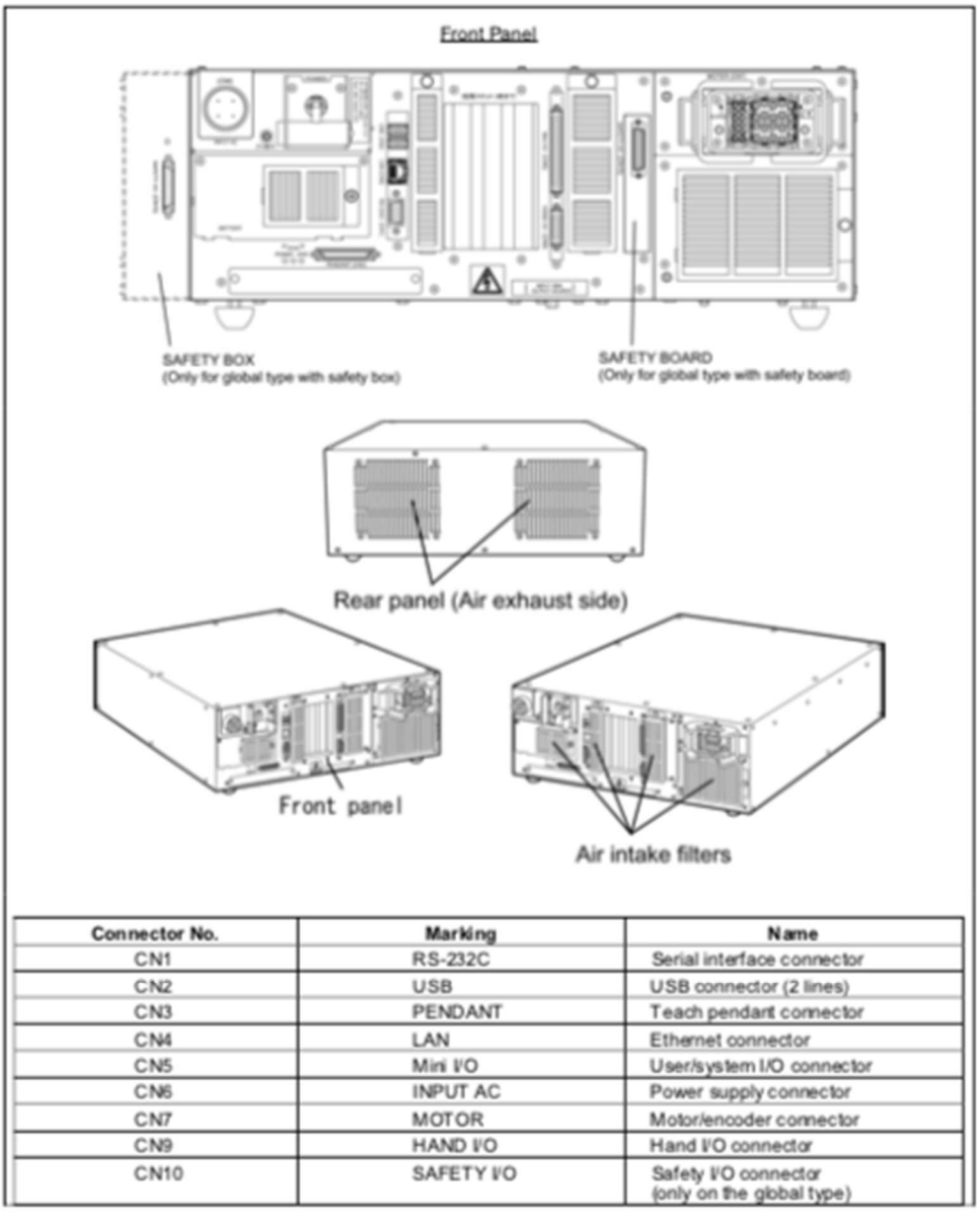
Setting on the "I/O Hardware Settings" window

Setting on the "Single point of control" window (Ver. 2.3 or later)

1.2 Names of the Controller Components

1.2.1 Controller Components

The following figures show the names of the robot controller components.

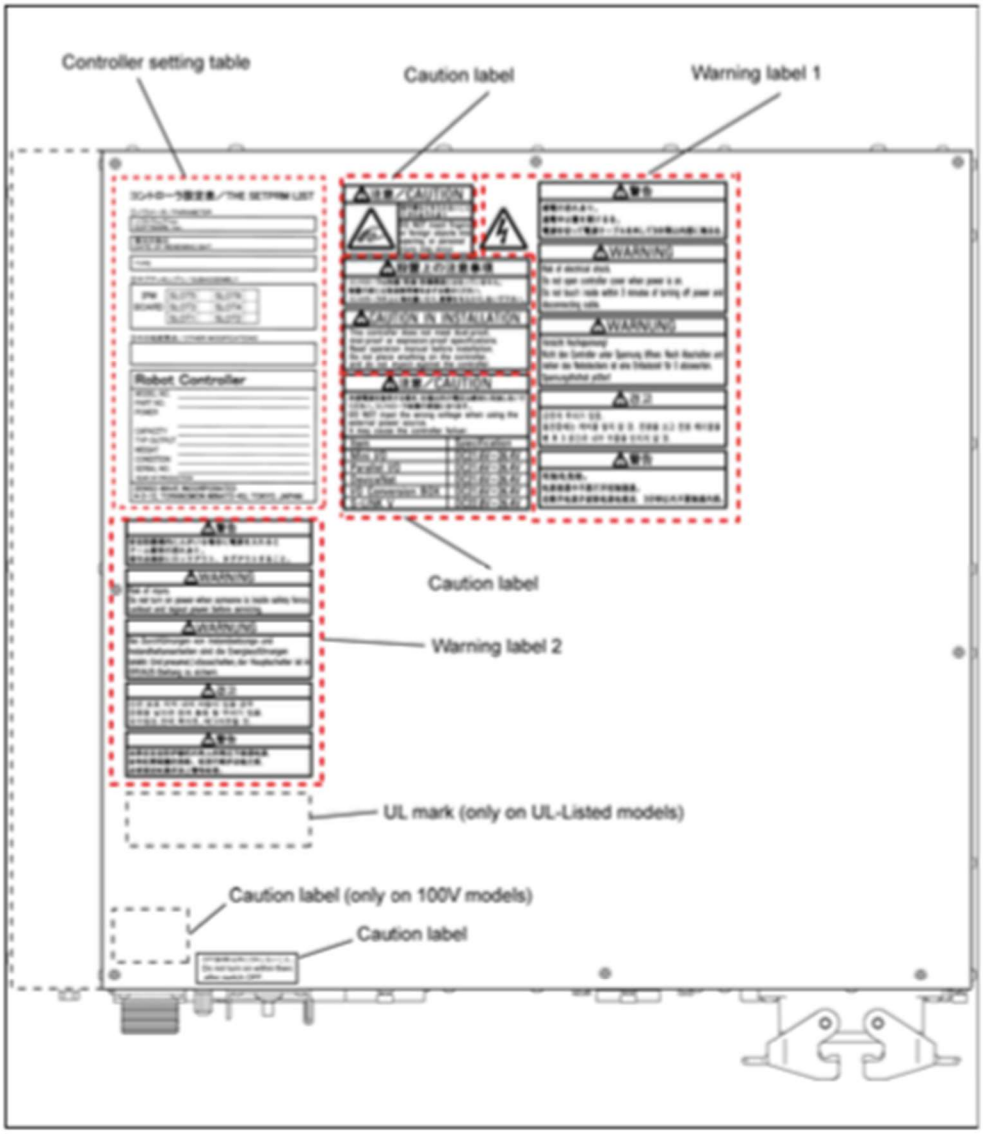


Connector No.	Marking	Name
CN1	RS-232C	Serial interface connector
CN2	USB	USB connector (2 lines)
CN3	PENDANT	Teach pendant connector
CN4	LAN	Ethernet connector
CN5	Mini I/O	User/system I/O connector
CN6	INPUT AC	Power supply connector
CN7	MOTOR	Motor/encoder connector
CN9	HAND I/O	Hand I/O connector
CN10	SAFETY I/O	Safety I/O connector (only on the global type)

Names of RC7M Robot Controller

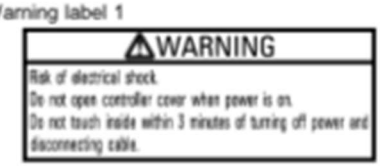
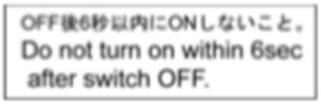
1.2.2 Warning and Caution Labels

The robot unit has warning and caution labels pasted as shown below. They alert the user to the dangers of the areas on which they are pasted. Be sure to observe the instructions printed on those labels.



Location of Labels on the Controller

Warning and Caution Labels on the Robot Controller

Warning and caution labels on the controller	Contents
Warning label 1 	(For maintenance of the controller) Risk of electrical shock. Never open the controller cover when the power is ON. Never touch the inside of the controller for at least 3 minutes even after turning the power OFF and disconnecting the power cable.
Warning label 2 	(For controller power switch) Risk of injury. Be sure to perform lockout/tagout before starting servicing. Turning the power ON may move the arm, causing injuries if a person is inside the safety fence.
Caution label 	(For cooling fans) Risk of injury. Do not insert fingers, sticks or other foreign objects through the openings.
Caution label 	The controller is not designed to be dust-, splash-, or explosion-proof. Before installation, be sure to read the user's manual. Do not put anything on the controller or apply any impact or shock to it.
Caution label 	When using an external power source, never apply the voltage not specified. Doing so can result in a controller failure.
Caution label 	After turning the power switch OFF, do not turn it ON for at least six seconds.

1.3 Controller Specifications

[1] Specifications

The table below lists the robot controller specifications.

RC7M Robot Controller Specifications

Item			Specifications						
Robot series			VM-G series	VS-G series	VP-G series	HM-G series	HS-G series	XYC-4G series	XR-G series
Model (RC7M-)			VMG-6***-**	VSG-6***-**	VPG-5/6***-**	HMG-4***-**	HSG-4***-**	XYCG-4***-**	XR-4J***G*
Controllable axes			6 axes		5 or 6 axes	4 axes			
Control system			PTP, CP 3-dimensional linear, 3-dimensional circular						
Drive system			All axes: Full-digital AC servo						
Language used			DENSO robot language (conforming to SLIM)						
Memory capacity			3.25 MB (equivalent to 10,000 steps, 30,000 points)						
Teaching system			1) Remote teaching 2) Numerical input (MDI)			1) Direct teaching 2) Remote teaching 3) Numerical input (MDI)		1) Remote teaching 2) Numerical input (MDI)	
External signals (I/O)	Standard I/O	Mini I/O	Input: 8 user open points + 11 fixed system points Output: 8 user open points + 14 fixed system points (Note: The global type of the controller cannot use system-fixed emergency stop I/Os.)						
		HAND I/O	Input: 8 user open points Output: 8 fixed system points						
	SAFETY I/O (only on global type)		Input: 6 fixed system points Output: 5 fixed system points						
	Parallel I/O extension boards (option)	2 boards mounted	Input: 80 user open points Output: 96 user open points (addition possible)						
		Single board mounted	Input: 40 user open points Output: 48 user open points (addition possible)						
	DeviceNet board (option)	Master/ Slave	Input: 1024 points (master) + 256 points (slave) Output: 1024 points (master) + 256 points (slave)						
		Master	Input: 1024 points Output: 1024 points						
		Slave	Input: 256 points Output: 256 points						
	CC-Link board (option)	Slave	Input: 128 points Output: 128 points						
External communication			RS-232C: 1 line Ethernet: 1 line USB: 2 lines (Supporting flash memory)						
Extension slots			3 (For optional boards)						
Self-diagnosis function			Overrun, servo error, memory error, input error, etc.						
Timer function			0.02 to 10 sec. (in units of 1/60 sec.)						
Error display			Error codes will be outputted on the external I/O. Error messages will be displayed in English on the teach pendant (option). Error codes will be displayed on the mini-pendant (option).						
Cables	Robot control cable (option)		Standard: 4 m, 6 m, 12 m (Standard type/splash-proof type)		Standard: 4 m, 6 m, 12 m	Standard: 4 m, 6 m, 12 m (Standard type/splash-proof type)		Standard: 4 m, 6 m	Standard: 4 m, 6 m, 12m
	I/O cable (option)		8 m, 15 m (for Mini I/O, HAND I/O, parallel I/O extension boards, safety I/O board)						
	Power cable		5 m						

Item			Specifications	
Environmental conditions (in operation)			Temperature: 0 to 40°C Humidity: 90% RH or less (no condensation allowed) Altitude: 1,000m or less	
Power source	VM-G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 3.3 kVA	
	VS-G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 1.85 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.85 kVA	
	VP-G series	200 VAC type	Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 1 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 1 kVA	
		100 VAC type	Single-phase, 100 VAC -10% to 110 VAC +10%, 50/60 Hz, 1 kVA	
	HM-G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 2.45 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 2.45 kVA	
	HS-G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 1.8 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.8 kVA	
	XYC-4G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 1.15 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.15 kVA	
	XR-G series		Three-phase, 200 VAC -15% to 230 VAC +10%, 50/60 Hz, 1.8 kVA Single-phase, 230 VAC -10% to 230 VAC +10%, 50/60 Hz, 1.8 kVA	
I/O power source	External power source		A 24 VDC ±10% should be supplied from external equipment.	**Note:** Refer to Sections 4.2.1 and 5.2.1 "Setting up Mini I/O Power Supply."
	Internal power source		A 24 VDC ±10% should be supplied internally in the robot controller.	
Rated output current			VM-G series: Approx. 20 A , VS-G series: Approx. 11 A , VP-G series: Approx. 5 A , HM-G series: Approx. 19 A , HS-G series: Approx. 14 A, XR-G series: Approx. 10A	
Safety category			With safety board: Compliant with safety category 3 With safety box: Compliant with safety category 4 (Only the controller with safety box is available to the XYC-4G series of robots.)	
Degree of protection			IP20	
Weight (Mass)			4-axis standard type: Approx. 17 kg 6-axis standard type: Approx. 18 kg 4-axis global type, UL-Listed (w/ safety board): Approx. 18 kg 6-axis global type, UL-Listed (w/ safety board): Approx. 19 kg 4-axis global type, UL-Listed (w/ safety box): Approx. 21 kg 6-axis global type, UL-Listed (w/ safety box): Approx. 22 kg	

Note: When handling the controller, be sure to observe the following.

Controller Handling Notes

⚠WARNING

- **DO NOT touch fins. Their hot surfaces may cause severe burns.**
- **DO NOT insert fingers or foreign objects into openings. Doing so may cause bodily injury.**
- **Before opening the controller cover and accessing the inside of the controller for maintenance, be sure to turn off the power switch, disconnect the power cable, and wait 3 minutes or more. This is for protecting you from electric shock.**
- **DO NOT connect or disconnect connectors to/from the controller when the AC power or the 24 VDC power for I/O is being supplied. Doing so may cause electric shock or controller failure.**

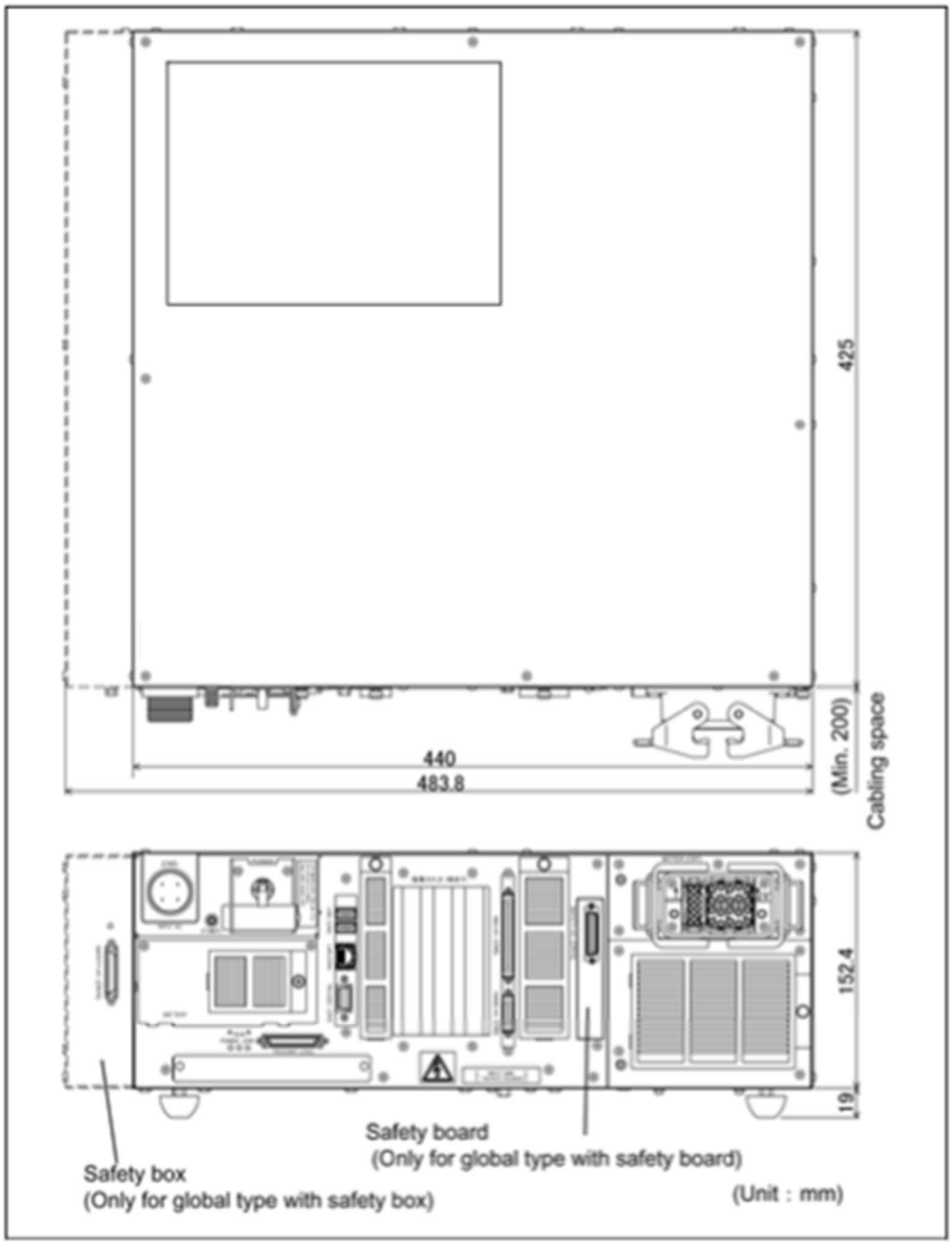
⚠CAUTION IN INSTALLATION

- **This controller is not designed to be dust-, splash-, or explosion-proof.**
- **Read operation manuals before installation.**
- **Do not place anything on the controller or apply an impact or shock to the controller.**
- **Avoid mounting the controller in an environment where excessive vibration is applied to the controller.**

⚠CAUTION: The robot controller connectors are of a screw-lock type or ring-lock type. Lock the connectors securely. If even one of the connectors is not locked, weak contact may result thereby causing an error.
Be sure to turn the robot controller OFF before connecting/ disconnecting the power connector or motor connector. Otherwise, the internal circuits of the robot controller may be damaged.

[2] Outer Dimensions

The outer dimensions of the robot controller are shown below.

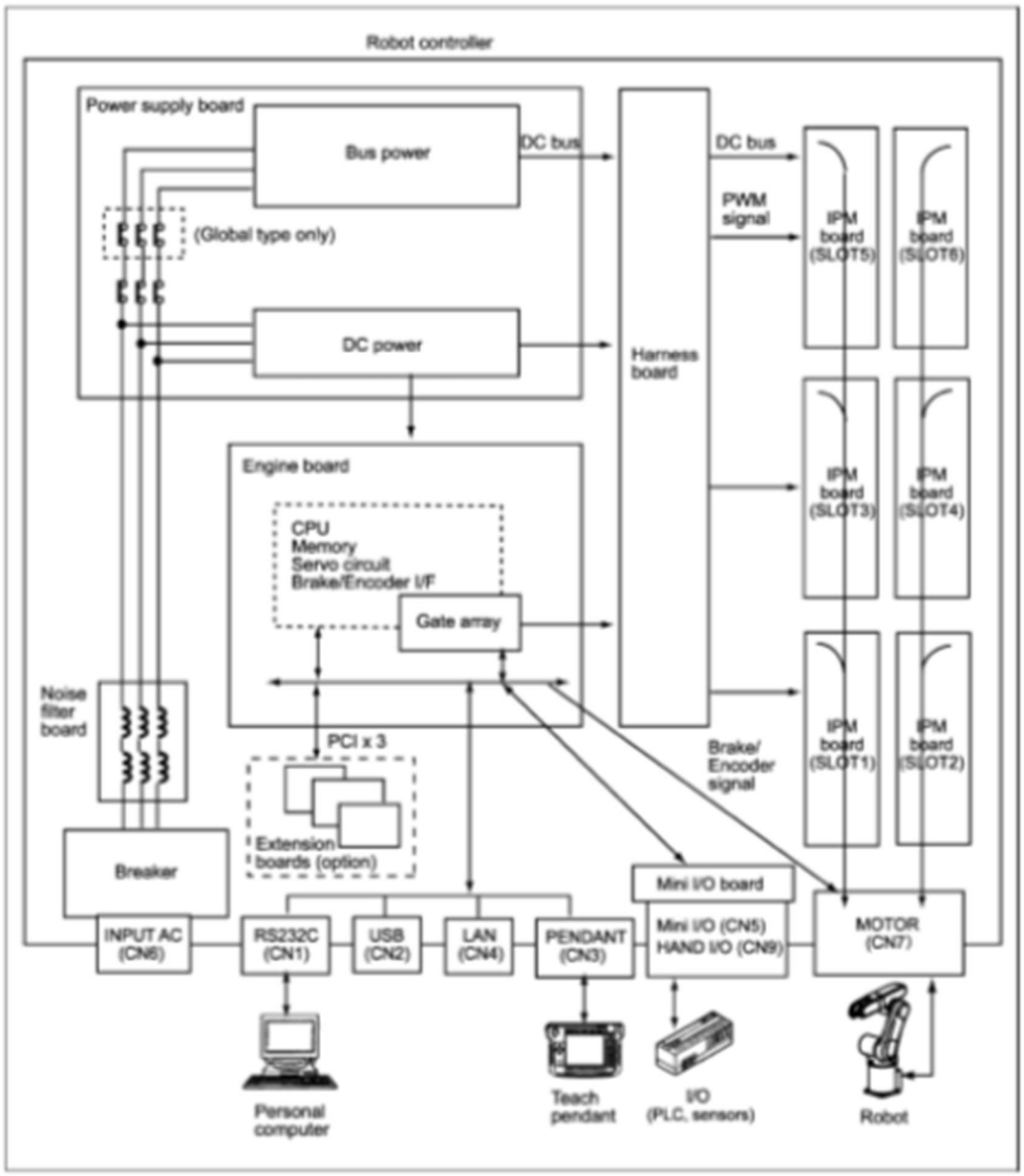


Outer Dimensions of RC7M Robot Controller

1.4 Controller System Configuration

1.4.1 Internal Circuits of the Controller (Typical configuration)

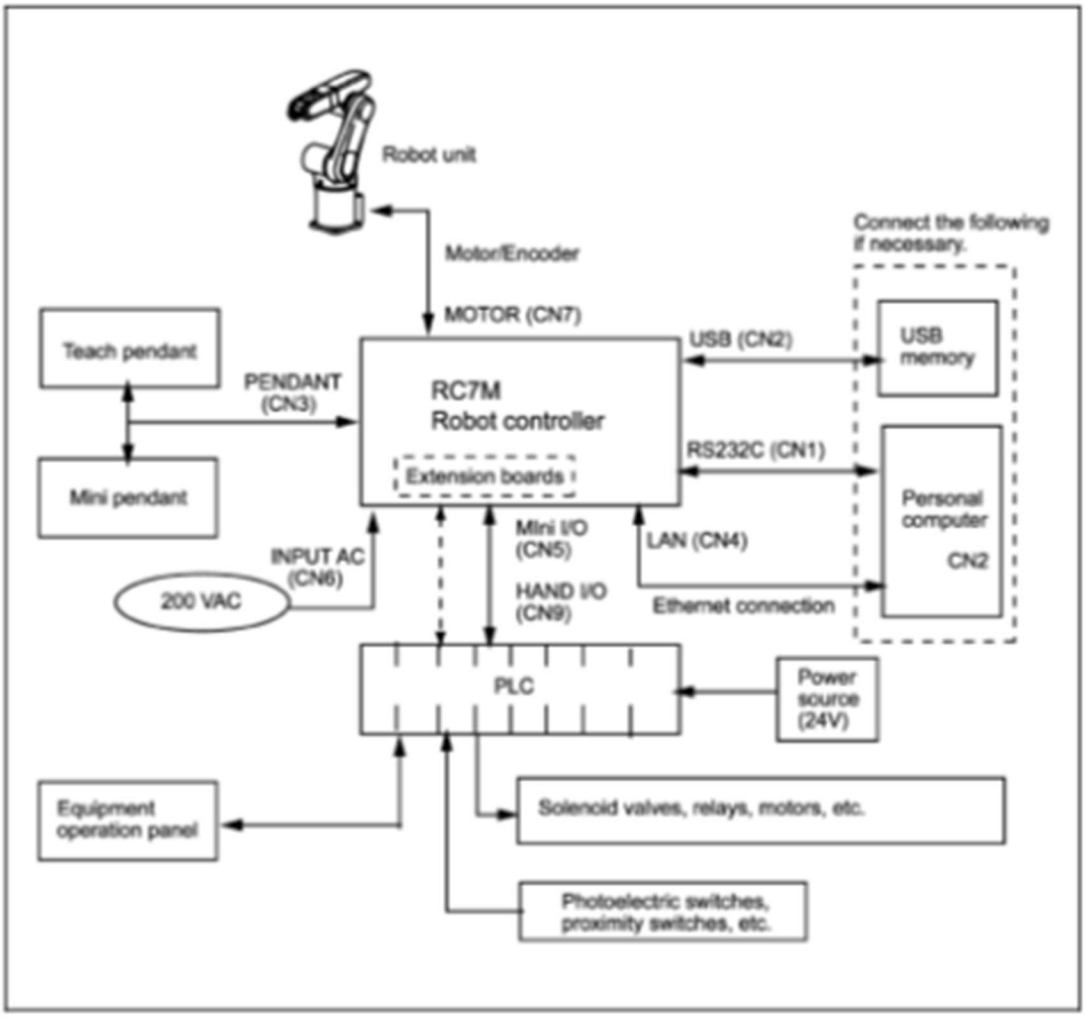
The block diagram below shows the internal circuits of the RC7M controller designed for a 6-joint robot.



Block Diagram of the RC7M Controller

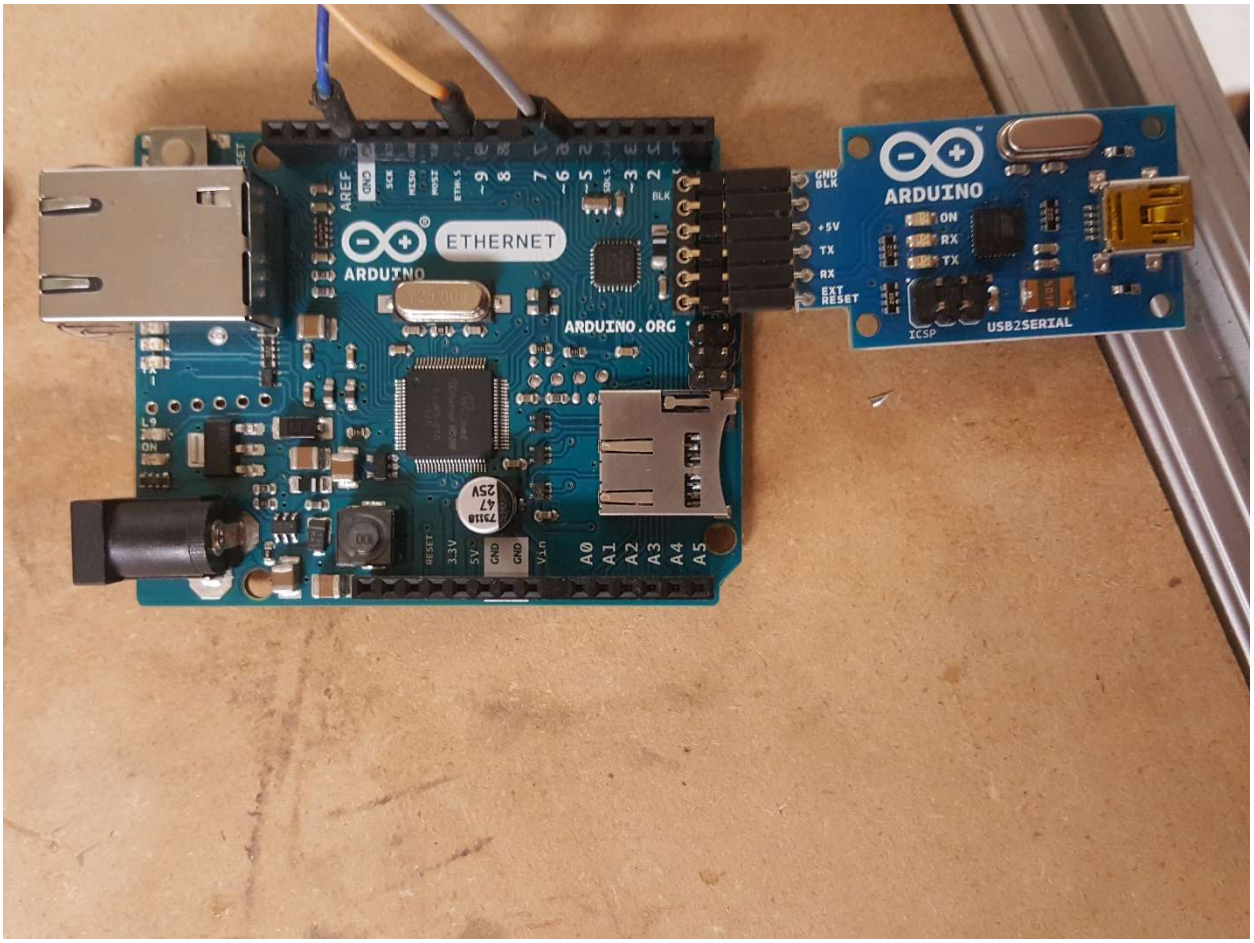
1.4.2 Typical Robot System Configuration

The block diagram below shows a typical robot system configuration.



Robot System Configuration

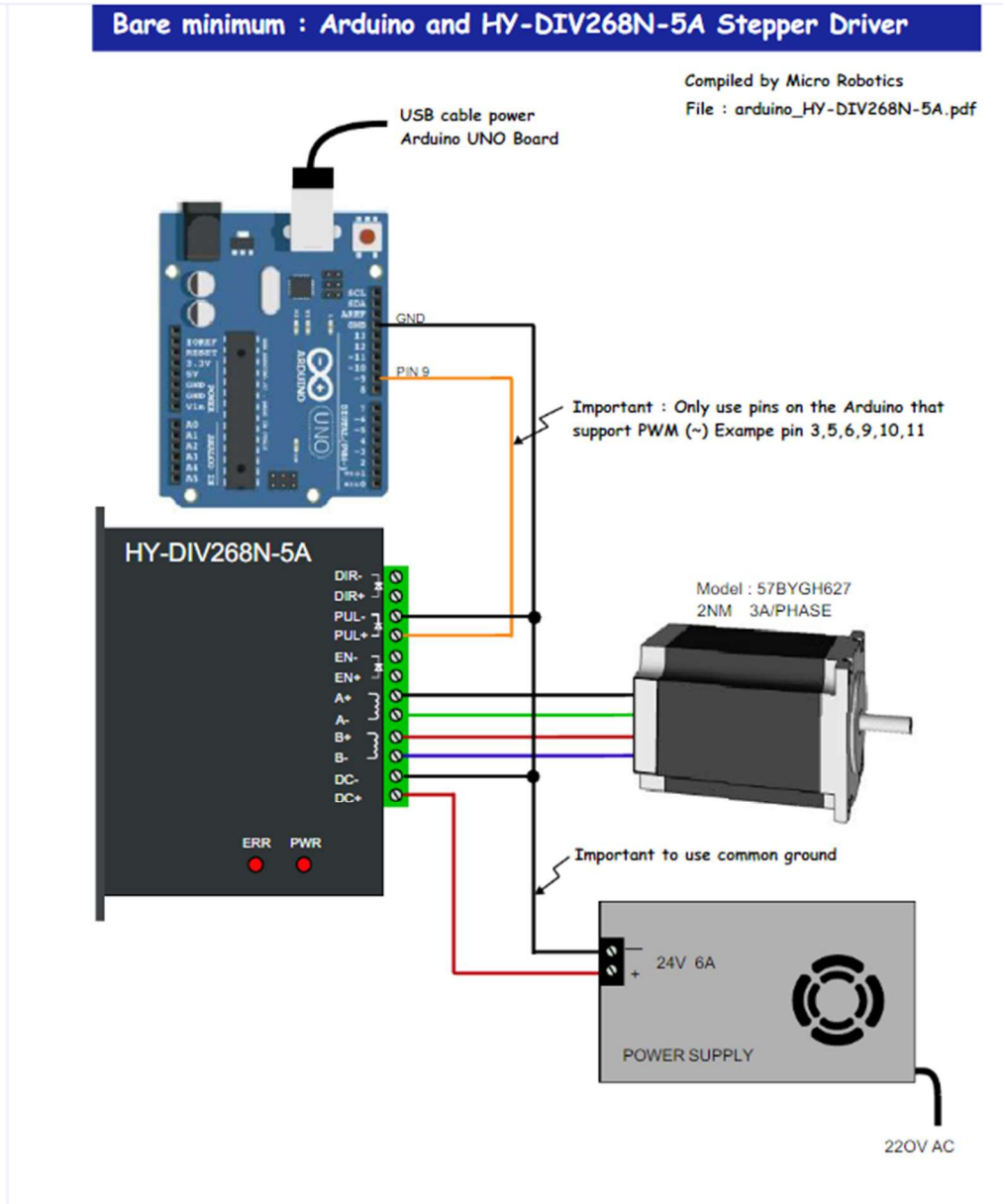
Arduino



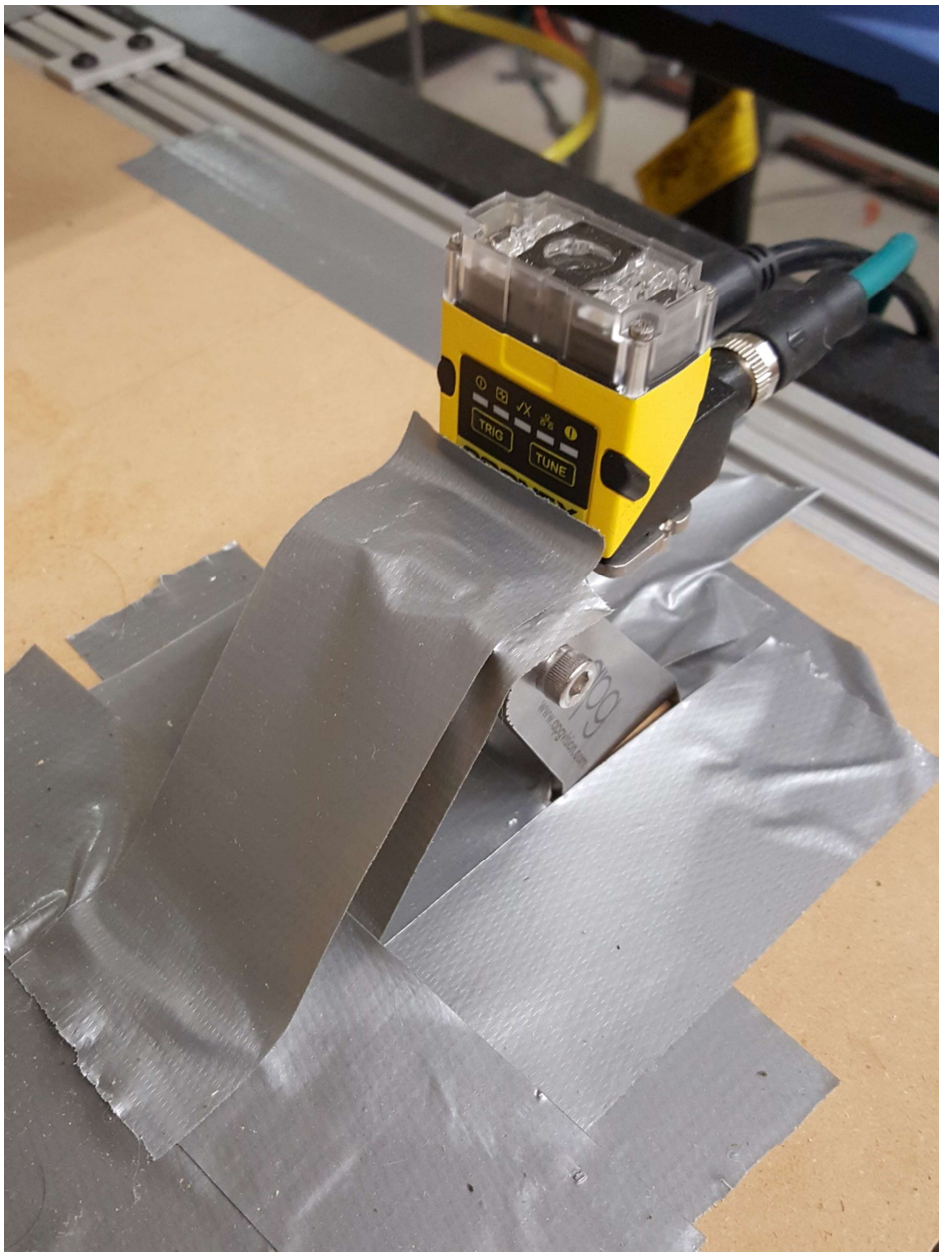
Step 1: See Steps 6 and 7 from the Process section

Step 2: If you want to change the speed of the conveyor, look at the Arduino coding section placed in the portfolio of the project. Every row of the code is commented which gives the possibility to change speed and functions.

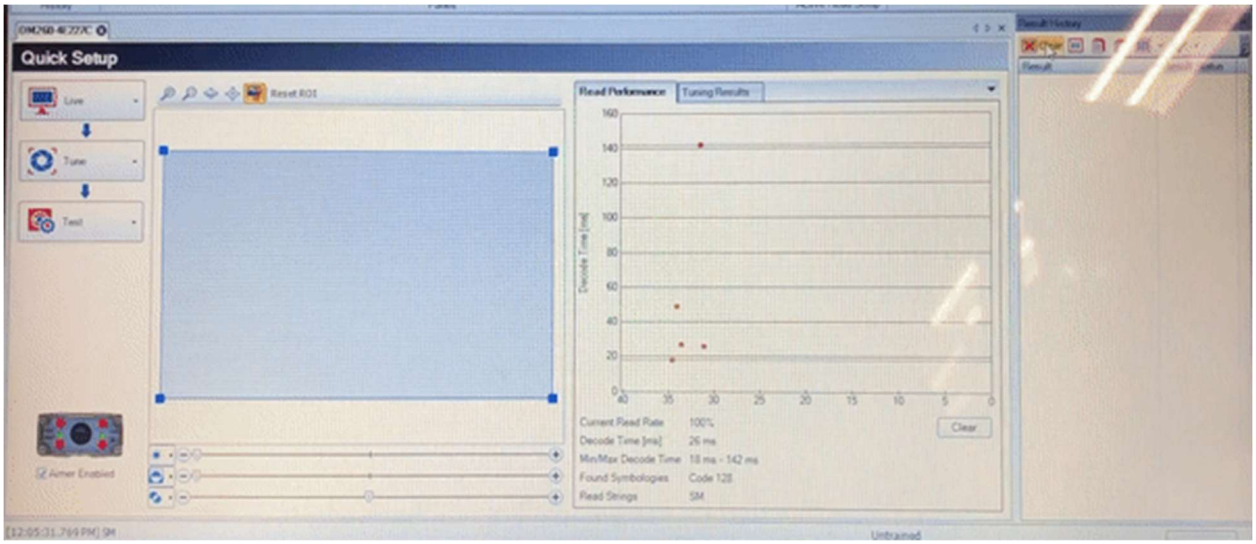
Step 3: In case something happened and the wiring in the conveyor circuit box gets disconnected, a wiring connection diagram is shown below.



Scanner



Step 1: Using the DataMan program, the user is able to see if the barcode is read. This is important due to the small range the barcode scanner can read, as well as the fact it is motion sensing. In the picture below, on the left side (blue screen) is a visual of if the barcode is read. The program knows exactly what type of barcode it is, as well as the string associated with it. This string is shown on the right side of the picture, and will also determine the number of times the barcode is read.



Step 2: For technical specifications see the Scanner technical book COGNEX Dataman 260 series, placed in the Robotic Manufacturing Cell project on the mindworks wikipage, under the barcode scanner section.