ROS

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PUTTY

Installing Putty

```
$ sudo apt-get install putty
$ sudo apt-get install grep
```

Hardware

- 2 USB to serial cable
- 1 cross serial cable. Rx $\rightarrow$ Tx, and Tx $\rightarrow$ Rx

checking the serial device

```
$ dmesg | grep tty
```

This command will display all serial devices. You will see an output something like this

serial device list

```
[    0.000000] console [tty0] enabled
[  138.375094] usb 2-1.5: FTDI USB Serial Device converter now
attached to ttyUSB0
```

serial communication between two computers

- Install putty on two computers (your laptop and CRS computer)
- Connect serial to USB cable with both computers, and connect via cross serial cable.

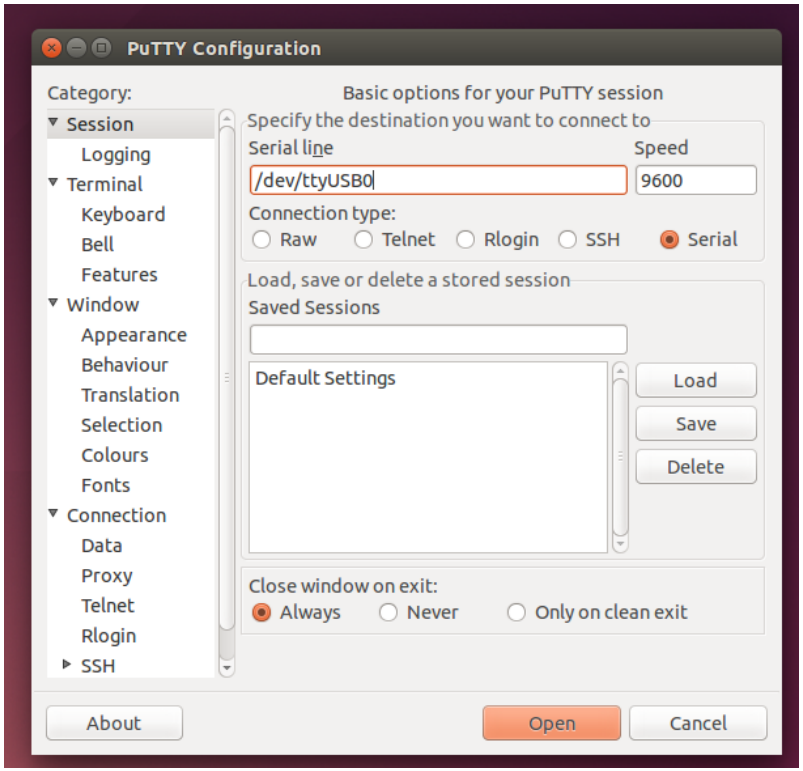
open putty

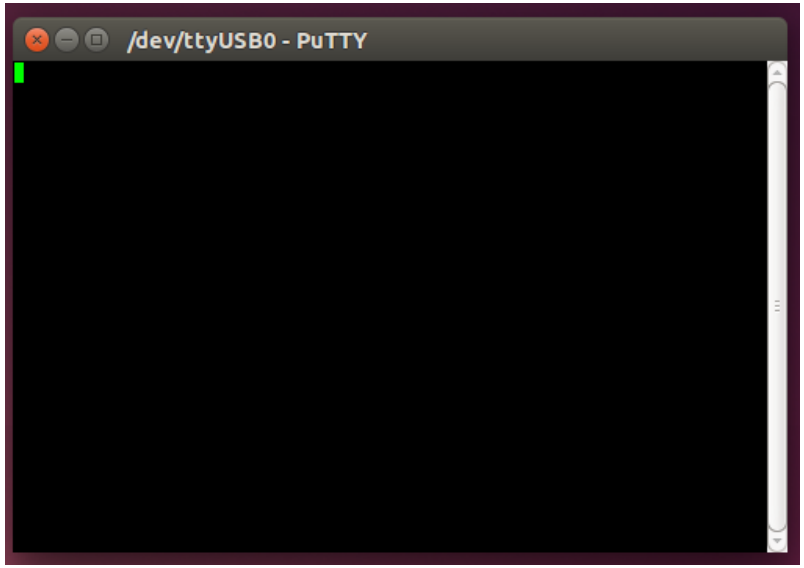
```
$ sudo putty
```

settings

- serial "serial" button
- select the serial line you got on your device. In my case it is "/dev/ttyUSB0".
- select some baud rate, in my case it is 9600.

This should open a new console, as shown in the figures





Open two serial consoles on both computers with matching baudrate setting. By typing characters from one computers you should be able to receive characters at the other computers.

ROS code for serial transmit

transmit.cpp

```
#include <ros/ros.h>
#include <cereal_port/CerealPort.h>
#include <iostream>

#define REPLY_SIZE 8
#define TIMEOUT 1000

// This example opens the serial port and sends a string at 1 Hz
for a reply.
int main(int argc, char** argv)
{

    ros::init(argc, argv, "example_node");
    ros::NodeHandle n;

    cereal::CerealPort device;
    char reply[REPLY_SIZE];
    char str1[] =  "123.45";
    // Change the next line according to your port name and baud rate
    try{ device.open("/dev/ttyUSB0", 9600); }
```

ROS code for serial transmit

transmit.cpp

```
    try{ device.open("/dev/ttyUSB0", 9600); }
    catch(cereal::Exception& e)
    {
        ROS_FATAL("Failed to open the serial port!!!");
        ROS_BREAK();
    }
    ROS_INFO("The serial port is opened.");

    ros::Rate r(1);
    while(ros::ok())
    {
        // writing a string over serial port
        device.write(str1);
ROS_INFO ("Sending: %s", str1);


        ros::spinOnce();
        r.sleep();
    }
}
```

ROS code for serial receive

receive.cpp

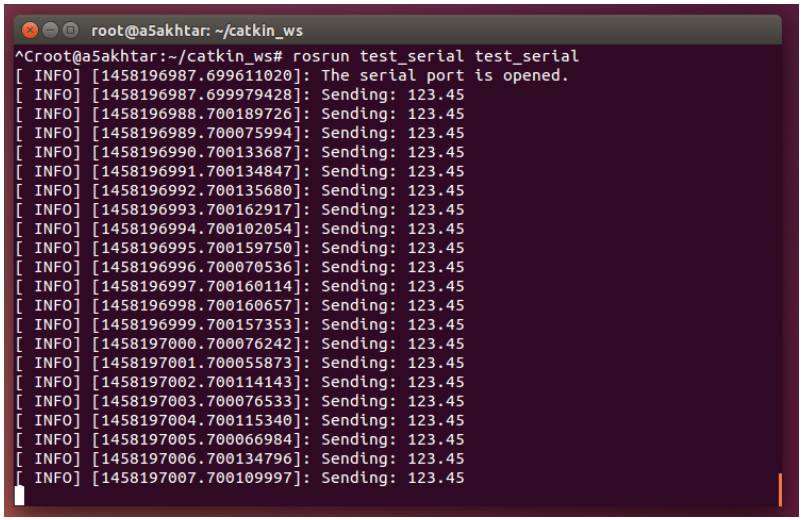
```
#include <ros/ros.h>
#include <cereal_port/CerealPort.h>
#include <iostream>

#define REPLY_SIZE 8
#define TIMEOUT 1000

// This example opens the serial port and receives a string
for a reply.
int main(int argc, char** argv)
{
    ros::init(argc, argv, "example_node");
    ros::NodeHandle n;

    cereal::CerealPort device;
    char reply[REPLY_SIZE];
std::string str1 = "hello";

    // Change the next line according to your port name and baud rate
    try{ device.open("/dev/ttyUSB0", 9600); }
```

ROS code for serial receive

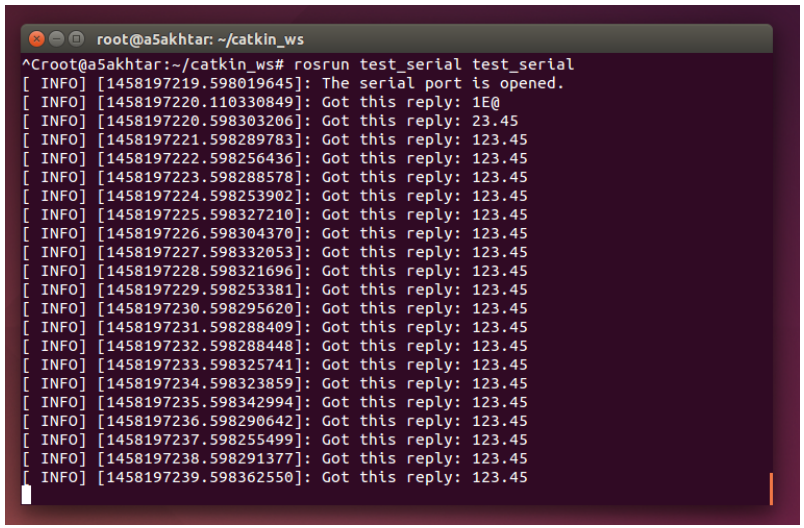
receive.cpp

```
try{ device.open("/dev/ttyUSB0", 9600); }
    catch(cereal::Exception& e)
    {
        ROS_FATAL("Failed to open the serial port!!!");
        ROS_BREAK();
    }
    ROS_INFO("The serial port is opened.");

    ros::Rate r(1);
    while(ros::ok())
    {
        // Get the reply, the last value is the timeout in ms
        try{ device.read(reply, REPLY_SIZE, TIMEOUT); }
        catch(cereal::TimeoutException& e)
        {
            ROS_ERROR("Timeout!");
        }
        ROS_INFO("Got this reply: %s", reply);
        ros::spinOnce();
        r.sleep();
    }
}
```

Serial Transmit and Receive



Serial Transmit



Serial Receive

It should be noted that to run the code we need to install cereal_port package!!

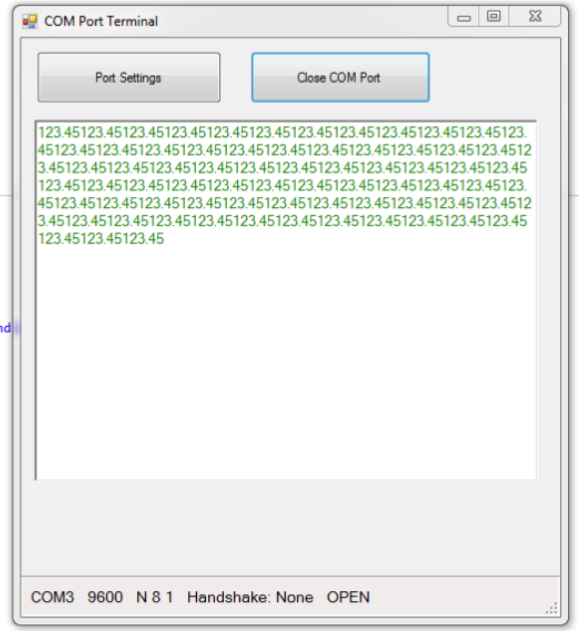
Serial reception in Visual Basic

```
''' Called when data is received on the COM port
''' Reads and displays the data
''' See FindPorts for the AddHandler statement for this routine

Friend Sub DataReceived(ByVal sender As Object, ByVal e As
SerialDataReceivedEventArgs)
Dim newReceivedData As String
Try

' Get data from the COM port.

newReceivedData = selectedPort.ReadExisting

' Save the number of characters received.

receivedDataLength += newReceivedData.Length
      RaiseEvent UserInterfaceData("AppendToMonitorTextBox",newReceivedData,
      Color.Black)
        Catch ex As Exception
            DisplayException(ModuleName, ex)
        End Try
    End Sub
```

Serial reception in Visual Basic

```
System.EventArgs) Handles btnPort.Click
```

```
.PortName)
.BaudRate)
Port.Handshake)
```




```
tem.EventArgs) Handl
```

```
a specific port.
```

```
s(MyPortSettingsDialog.cmbPort.SelectedIndex)
```

OpenCV

- OpenCV is an open source computer vision library
- A large part of vision research is typically done in Matlab. As a result, there is a lot more code available through Matlab than OpenCV.
- However, we like OpenCV because it is easier to integrate vision into robotics through it instead of Matlab-based approaches.
- Additionally, a lot of OpenCV code has been written fairly efficiently

what is OpenCV

- http://opencv.org
- OpenCV (Open Source Computer Vision) is an open source implementation of a number of popular computer vision algorithms
  - RGB to Grey scale
  - Edge detection
  - Face detection
  - Feature detection and correspondence
- OpenCV has a lot of implementations of some really cool algorithms.
- Also some basic filters and image manipulation
  - Threshold
  - Image Derivatives (Sobel) and Edge Detection (Canny)
  - Dilate and Erode
  - Flood Fill

cv _bridge

- http://www.ros.org/doc/api/cv_bridge/html/c++/index.html
- Converts between ROS Image message formats and OpenCV image formats
- ROS → OpenCV
  - toCvCopy()
  - toCvShare()
- OpenCV → ROS
  - toImageMsg()

installing camera drivers

Installing guvcview

```
$ sudo apt-get install guvcview
```

installing camera-umd

```
$ sudo apt-get install ros-indigo-camera-umd
```

Once installed type in the terminal

serial device list

```
$ roscd uvc_Camera
```

if you are now in the "uvc_camera" directory, then the installation was successful

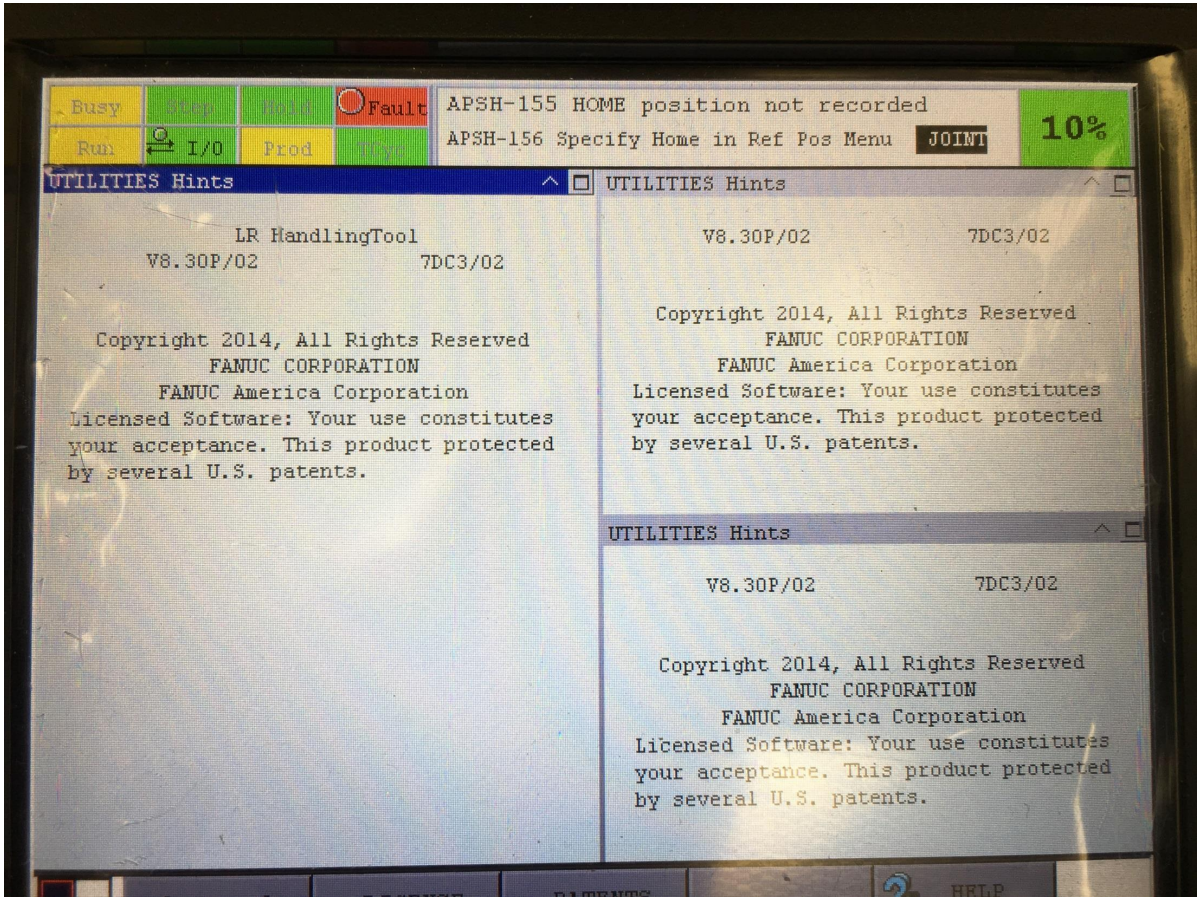
installing Ubuntu and ROS

- Install ubuntu 14.04. You can find tons of tutorials online
- Installing ROS INDIGO.
- Setting up ros environment and catkin workspace
- http://www.ros.org
- https://a5akhtar@bitbucket.org/a5akhtar/me545-codes.git

downloading the code

```
$ git clone https://a5akhtar@bitbucket.org/a5akhtar/me545-codes.git
```

- checkout the code in your ros workspace and do catkin make.


Busy
Run
I/O
Prod
Fault
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
UTILITIES Hints
LR HandlingTool
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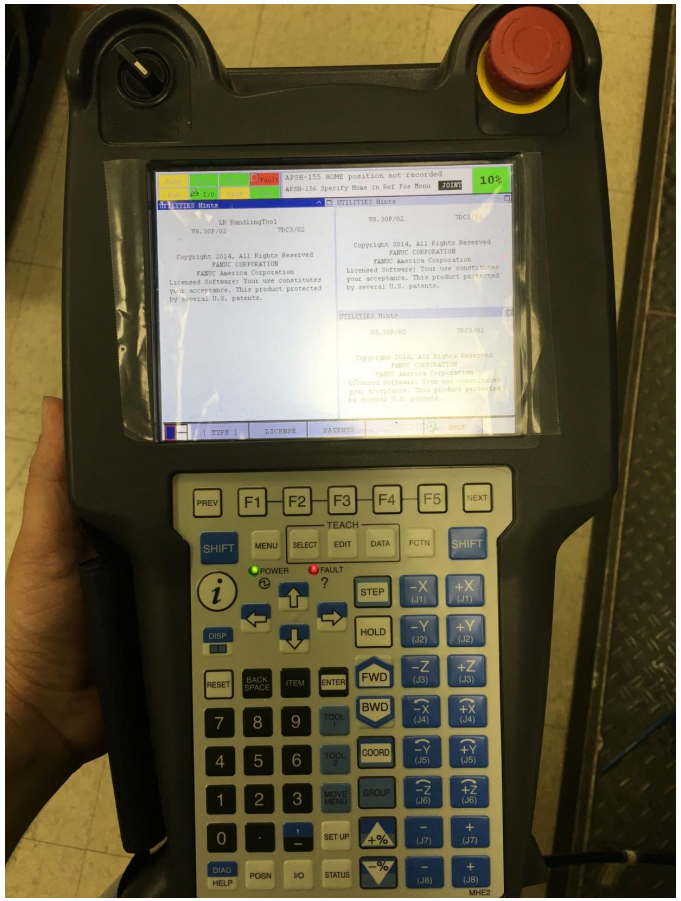
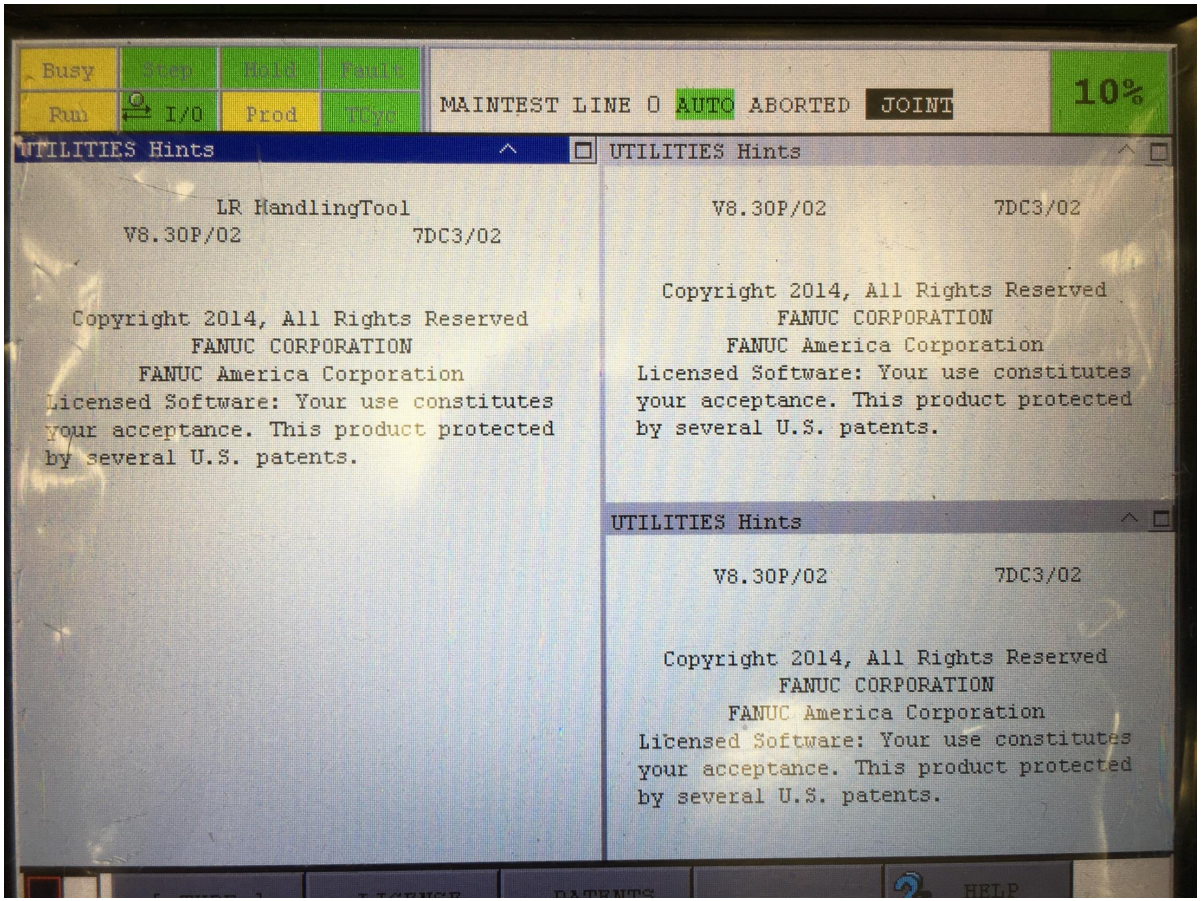
SYSTEM R-30iB
FAULT RESET
CYCLE START
NORMAL
CONNECT/
DISCONNECT
TEACH PENDANT
SHORT CIRCUIT CURRENT RATING
230 VAC 5.000 Arms
WARNING
HIGH VOLTAGE CAPACITOR INSIDE
DISCONNECT SUPPLY AND WAIT
1 MINUTE BEFORE SERVICING
AVERTISSEMENT
CONDENSATEUR HAUT TENSION METTRE
HORS TENSION ET ATTENDRE 1 MINUTE
AVANT D'INTERVENIR
F144121
LR Mate 200iD
FANUC SYSTEM R-30iB Mate
TYPE A05B-2651-B021
SERIAL NO.E14130771 DATE 2014-01
POWER SUPPLY 200-230V PHASE


PREV
F1
F2
F3
F4
F5
NEXT
TEACH
SHIFT
MENU
SELECT
EDIT
DATA
FCTN
SHIFT
POWER
FAULT
STEP
HOLD
FWD
BWD
COORD
GROUP
RESET
BACK SPACE
ENTER
SET UP
DISP
DIAG HELP
POSN
I/O
STATUS


Busy
Step
Hold
Fault
Run
I/O
Prod
T1sys
MAINTEST LINE 0 AUTO ABORTED JOINT
10%
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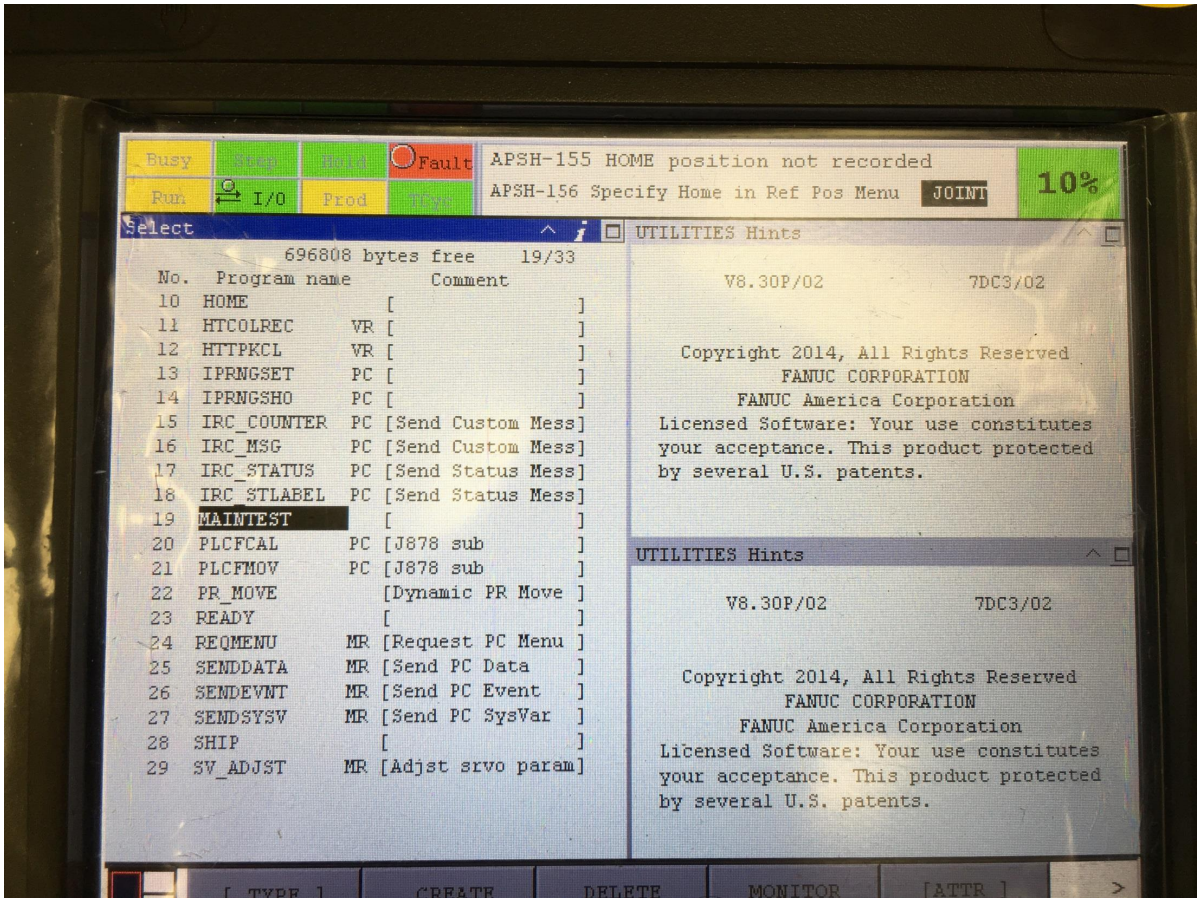
Busy
Step
Hold
Fault
Run
I/O
Prod
T1
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
Select
696808 bytes free 19/33
No. Program name Comment
10 HOME [ ]
11 HTCOLREC VR [ ]
12 HTTPKCL VR [ ]
13 IPRNGSET PC [ ]
14 IPRNGSHO PC [ ]
15 IRC_COUNTER PC [Send Custom Mess]
16 IRC_MSG PC [Send Custom Mess]
17 IRC_STATUS PC [Send Status Mess]
18 IRC_STLABEL PC [Send Status Mess]
19 MAINTEST [ ]
20 PLCFCAL PC [J878 sub]
21 PLCFMOV PC [J878 sub]
22 PR_MOVE [Dynamic PR Move]
23 READY [ ]
24 REQMENU MR [Request PC Menu]
25 SENDDATA MR [Send PC Data]
26 SENDEVNT MR [Send PC Event]
27 SENDSYSV MR [Send PC SysVar]
28 SHIP [ ]
29 SV_ADJST MR [Adjst srvo param]
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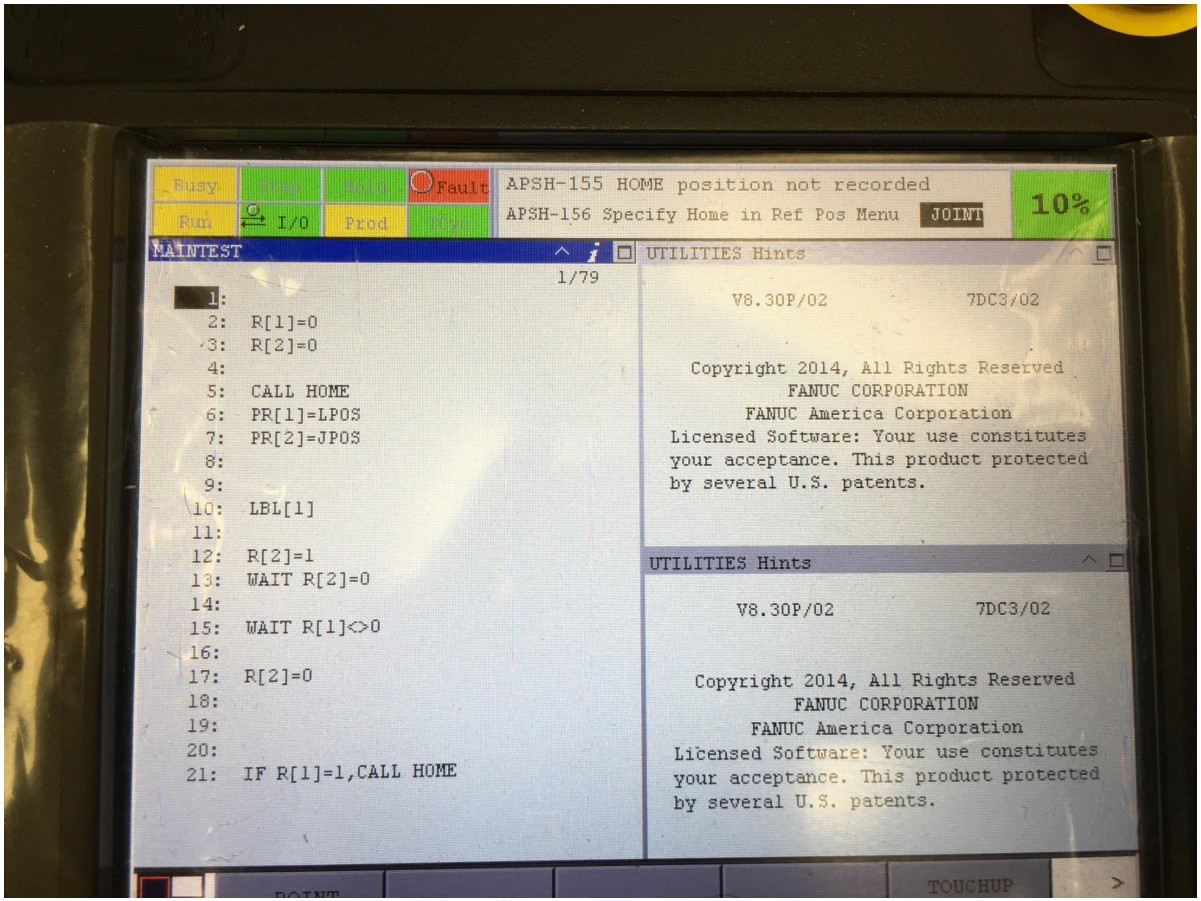
[TYPE]
CREATE
DELETE
MONITOR
[ATTR]


Busy
Run
I/O
Prod
Fault
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
MAINTEST
1/79
1:
2: R[1]=0
3: R[2]=0
4:
5: CALL HOME
6: PR[1]=LPOS
7: PR[2]=JPOS
8:
9:
10: LBL[1]
11:
12: R[2]=1
13: WAIT R[2]=0
14:
15: WAIT R[1]<>0
16:
17: R[2]=0
18:
19:
20:
21: IF R[1]=1,CALL HOME
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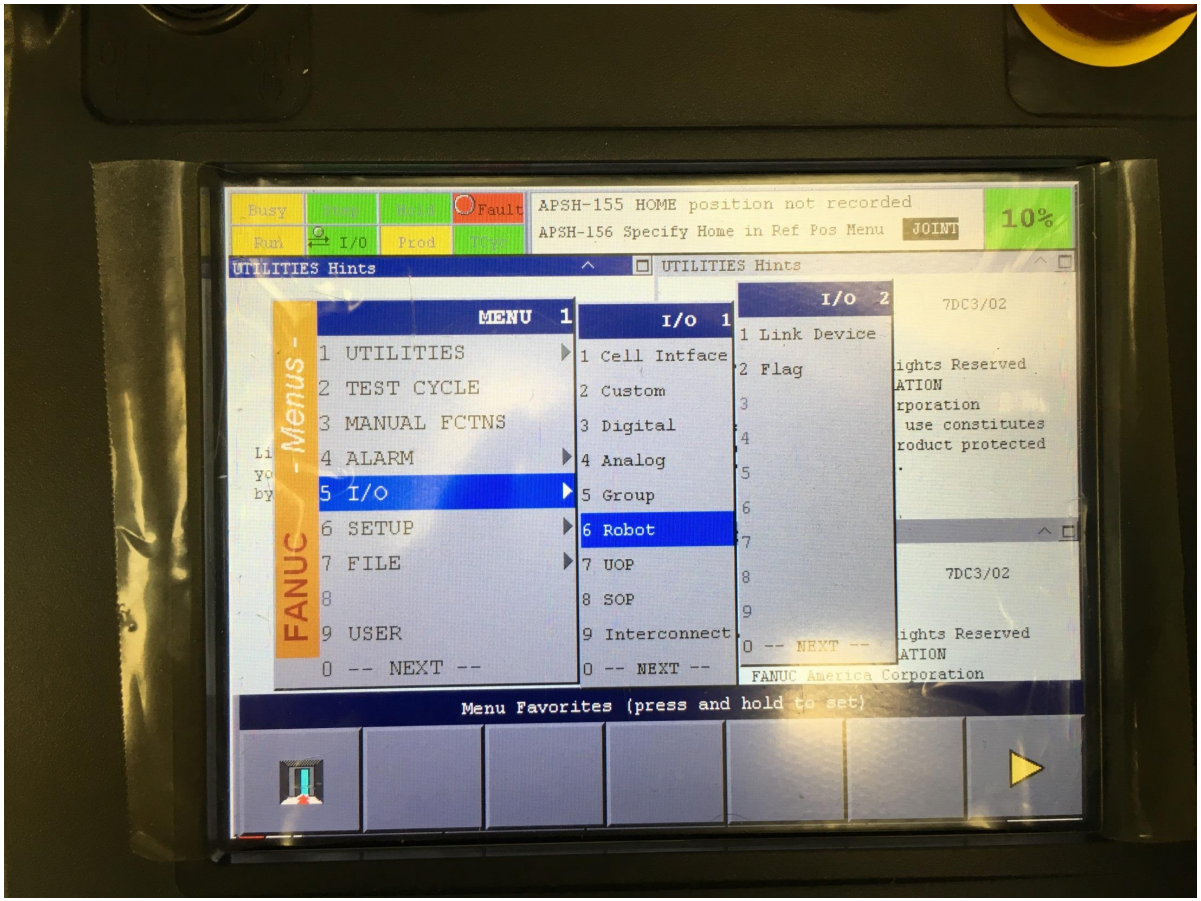
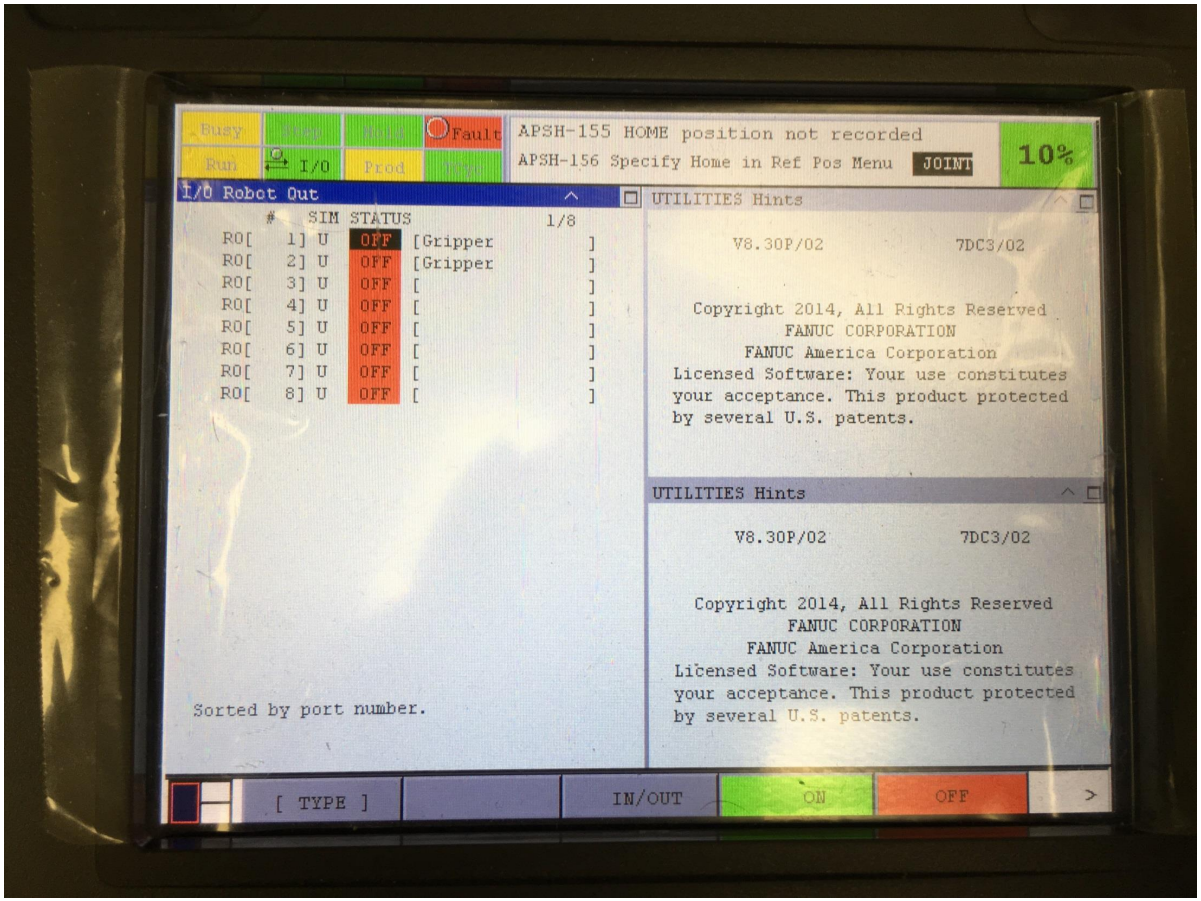
TOUCHUP


Busy
Run
I/O
Prod
Fault
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
UTILITIES Hints
UTILITIES Hints
FANUC -Menus-
MENU 1
1 UTILITIES
2 TEST CYCLE
3 MANUAL FCTNS
4 ALARM
5 I/O
6 SETUP
7 FILE
8
9 USER
0 -- NEXT --
I/O 1
1 Cell Intface
2 Custom
3 Digital
4 Analog
5 Group
6 Robot
7 UOP
8 SOP
9 Interconnect
0 -- NEXT --
I/O 2
1 Link Device
2 Flag
0 -- NEXT --
7DC3/02
ights Reserved
ATION
rporation
use constitutes
roduct protected
FANUC America Corporation
Menu Favorites (press and hold to set)


Busy
Fault
Run
I/O
Prod
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
I/O Robot Out
1/8
SIM STATUS
RO[1] U OFF [Gripper]
RO[2] U OFF [Gripper]
RO[3] U OFF [ ]
RO[4] U OFF [ ]
RO[5] U OFF [ ]
RO[6] U OFF [ ]
RO[7] U OFF [ ]
RO[8] U OFF [ ]
Sorted by port number.
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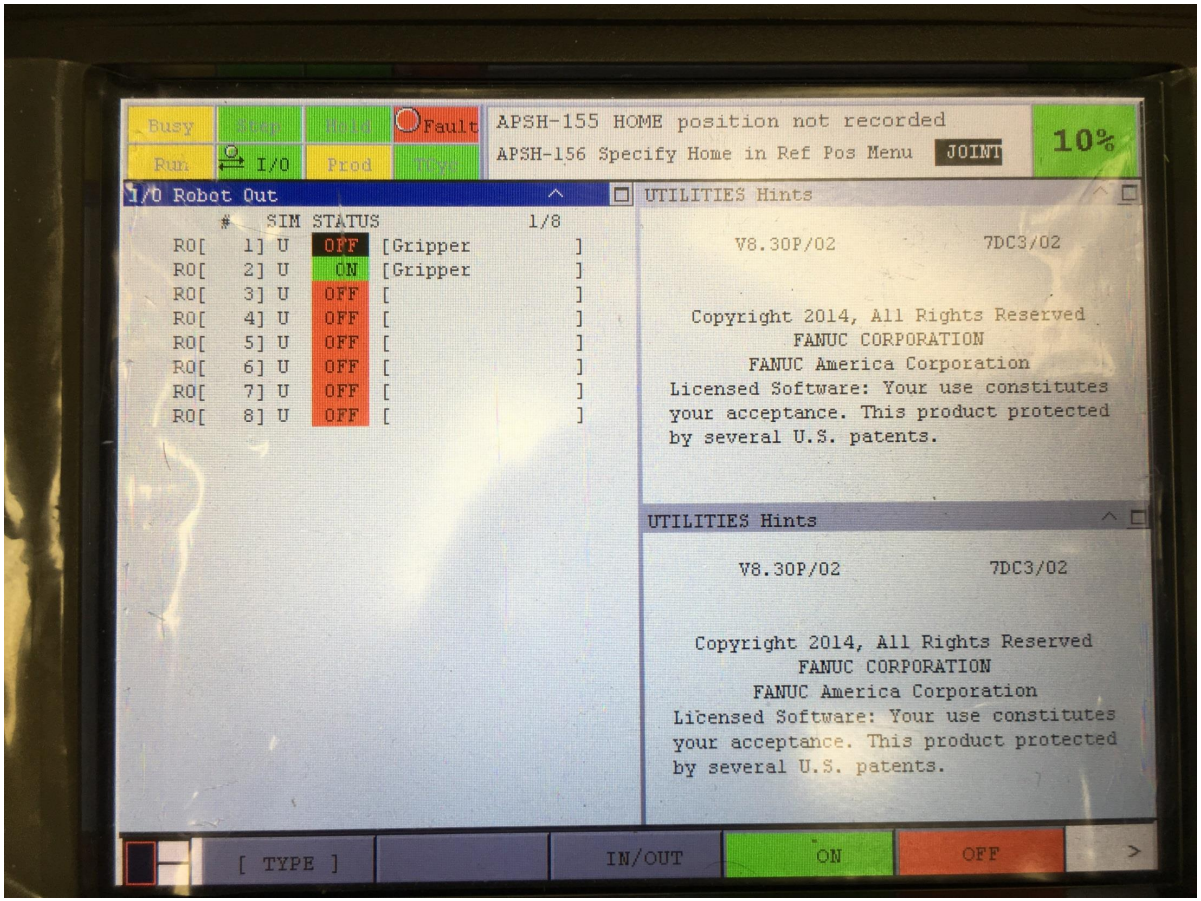
[TYPE]
IN/OUT
ON
OFF
>


Busy
Run
I/O
Hold
Fault
Prod
APSH-155 HOME position not recorded
APSH-156 Specify Home in Ref Pos Menu
JOINT
10%
I/O Robot Out
1/8
SIM STATUS
RO[1] U OFF [Gripper]
RO[2] U ON [Gripper]
RO[3] U OFF [ ]
RO[4] U OFF [ ]
RO[5] U OFF [ ]
RO[6] U OFF [ ]
RO[7] U OFF [ ]
RO[8] U OFF [ ]
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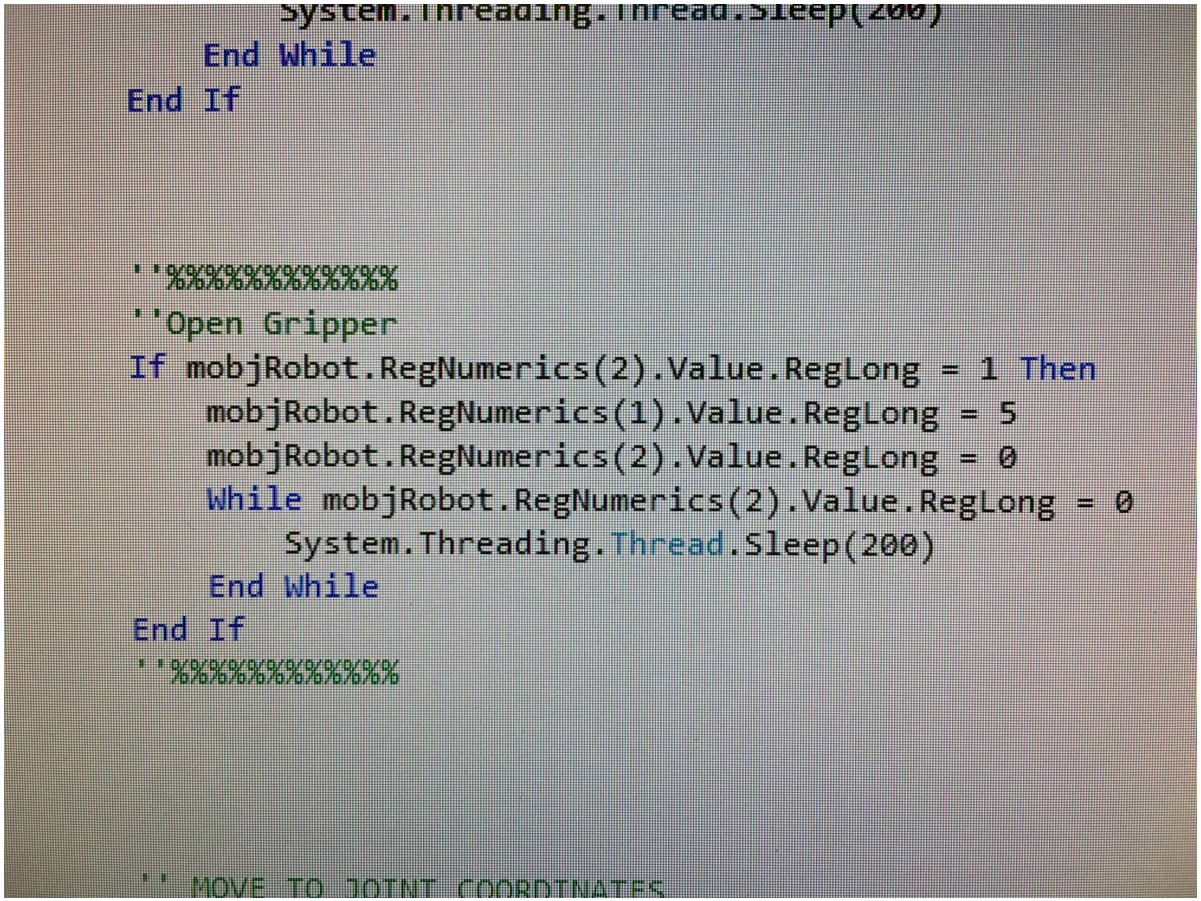
[TYPE]
IN/OUT
ON
OFF

```
End If

'' MOVE TO LINEAR COORDINATES
If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then

    Dim FKxyz(3) As Double
    FKxyz = forwKin(0, 65, -73, 73, -90)
    Console.WriteLine(FKxyz)
    '' x, y, z, W, P, R, speed (mm/sec)
    moveLin(FKxyz(1), FKxyz(2), FKxyz(3), -90, 0, -90, 100)

    mobjRobot.RegNumerics(1).Value.RegLong = 3
    mobjRobot.RegNumerics(2).Value.RegLong = 0
    While mobjRobot.RegNumerics(2).Value.RegLong = 0
        System.Threading.Thread.Sleep(200)
    End While
End If

'' MOVE TO LINEAR COORDINATES
If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then
```

```
End If
''%%%%%%%%%%%%

'' MOVE TO JOINT COORDINATES
If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then

    Dim IKxyz(3) As Double
    IKxyz = invKin(425, -100, -30 + 78, 0)

    '' theta1, theta2, theta3, theta4, theta5, speed (percent)
    moveJnt(IKxyz(1), IKxyz(2), IKxyz(3), IKxyz(4), IKxyz(5), 20)
    ''moveJnt(15, 30, 0, 0, 0, 20)

    mobjRobot.RegNumerics(1).Value.RegLong = 4
    mobjRobot.RegNumerics(2).Value.RegLong = 0
    While mobjRobot.RegNumerics(2).Value.RegLong = 0
        System.Threading.Thread.Sleep(200)
    End While
End If


'' MOVE TO JOINT COORDINATES
If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then
```



```
            System.Threading.Thread.Sleep(200)
        End While
    End If


    ''%%%%%%%%%%%%
    ''Open Gripper
    If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then
        mobjRobot.RegNumerics(1).Value.RegLong = 5
        mobjRobot.RegNumerics(2).Value.RegLong = 0
        While mobjRobot.RegNumerics(2).Value.RegLong = 0
            System.Threading.Thread.Sleep(200)
        End While
    End If
    ''%%%%%%%%%%%%


    '' MOVE TO JOINT COORDINATES
```

```
            System.Threading.Thread.Sleep(200)
        End While
    End If


    ''%%%%%%%%%%%
    ''Close Gripper
    If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then
        mobjRobot.RegNumerics(1).Value.RegLong = 6
        mobjRobot.RegNumerics(2).Value.RegLong = 0
        While mobjRobot.RegNumerics(2).Value.RegLong = 0
            System.Threading.Thread.Sleep(200)
        End While
    End If
    ''%%%%%%%%%%%


    '' MOVE TO JOINT COORDINATES
    If mobjRobot.RegNumerics(2).Value.RegLong = 1 Then

        Dim IKxyz(3) As Double
        IKxyz = invKin(425, -100, -30 + 78, 0)
```

Questions