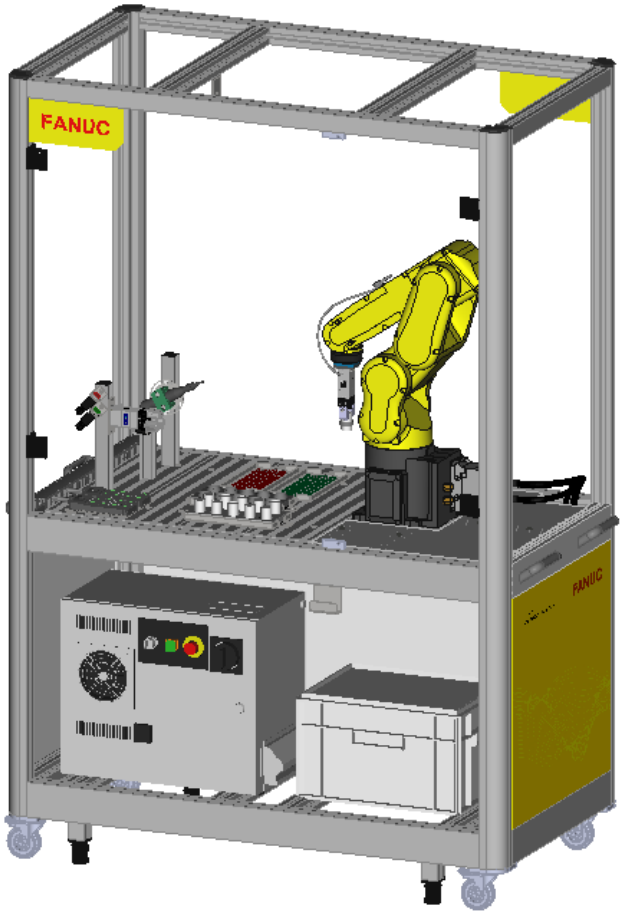
Robot Systems Integration

Example Test Project Technical Documentation V1.0

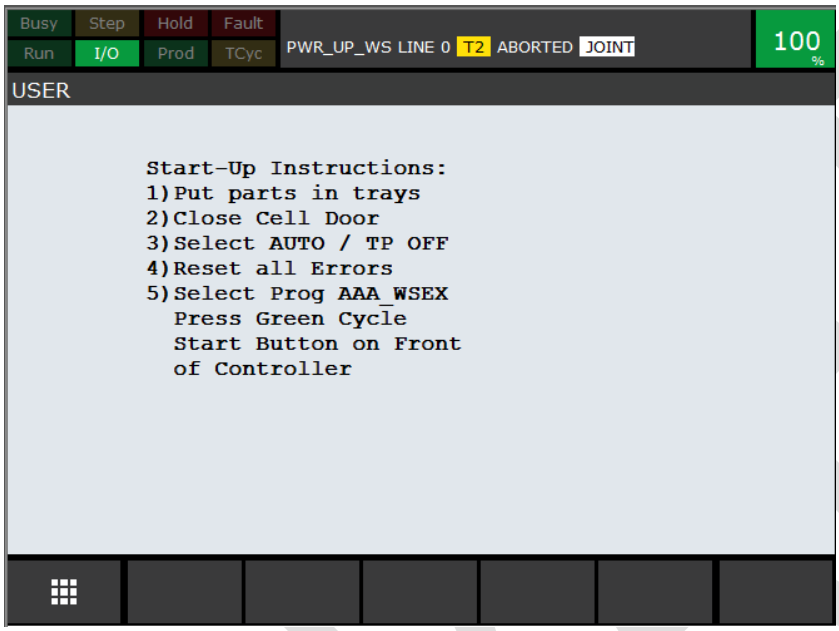


1 Contents

1 Selecting and running the Example Test Project program

1.1 Start Up Screen

When the robot controller is turned on, it displays the following Start-Up Instructions:

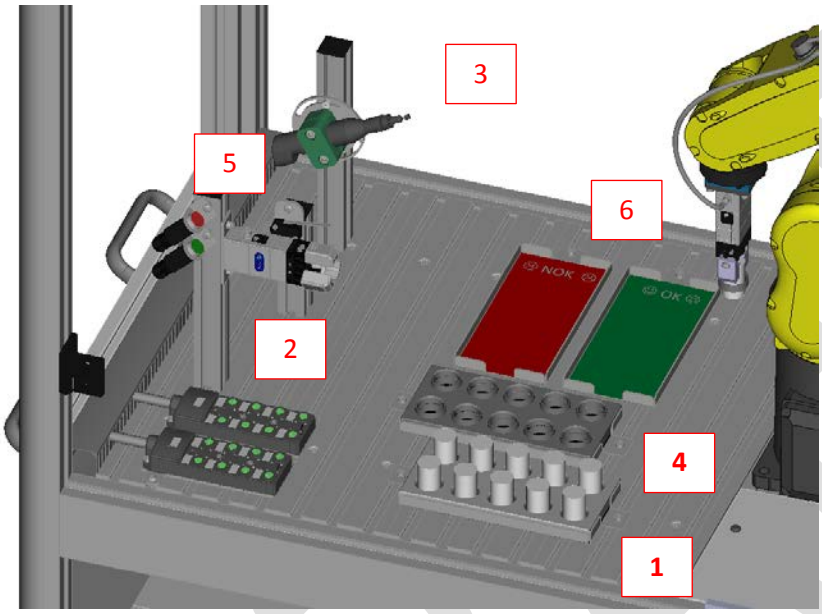


1.2 Example Program "AAA_WSEX and AAA_WSEX_V"

There are 2 main programs for the WS Example Test Project.

- program "AAA_WSEX" is the example program without iRVision
- program "AAA_WSEX_V" is the example program without iRVision

Both programs follow the same basic sequence:



1) Pick the cylinders from the Input Tray
    a. AAA_WSEX uses fixed locations
    b. AAA_WSEX_V uses iRVision
2) Load into the Chuck, and wait for a simulated machining cycle.
3) Take the cylinder to the Deburring Tool
4) Assemble the Ring onto the Cylinder in the Assembly Tray
5) Check for the presence of the Ring:
    a. AAA_WSEX uses the Microswitch
    b. AAA_WSEX_V uses iRVision
6) Place the Assembled Part in the OK or NOK Output Tray

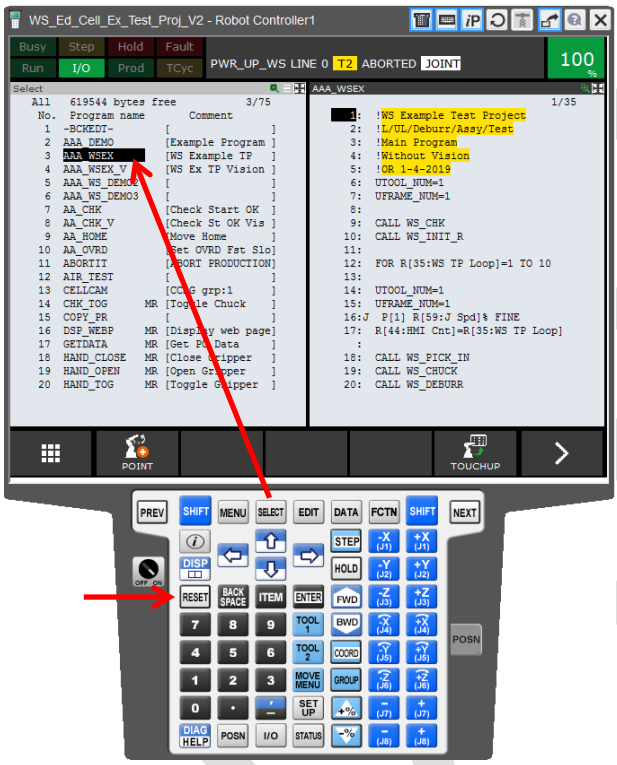
1.3 Starting the Program

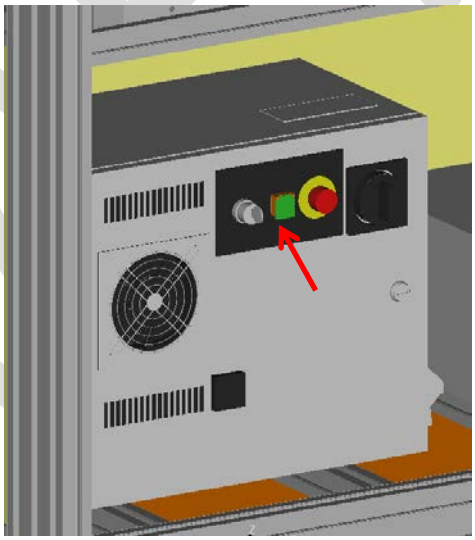
To start the program follow these steps:

a. Robot must be in ‘AUTO’ mode, all E-Stops released, and cell door (‘Fence’) closed

b. Robot should not be in error condition. If robot shows error condition press the “RESET” key on the Teach pendant to try to reset the errors.

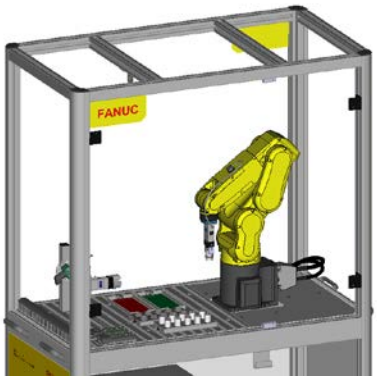
c. Select the program “AAA_WSEX” and Press the ‘Cycle Start’ button on the front of the controller. (Teach pendant enable switch must be OFF and Auto/T1/T2 switch must be in ‘Auto’ position)



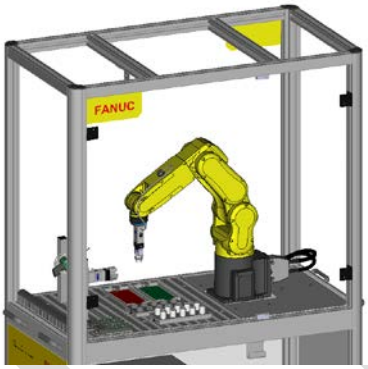


d. The program AAA_DEMO expects to be started from the HOME position:

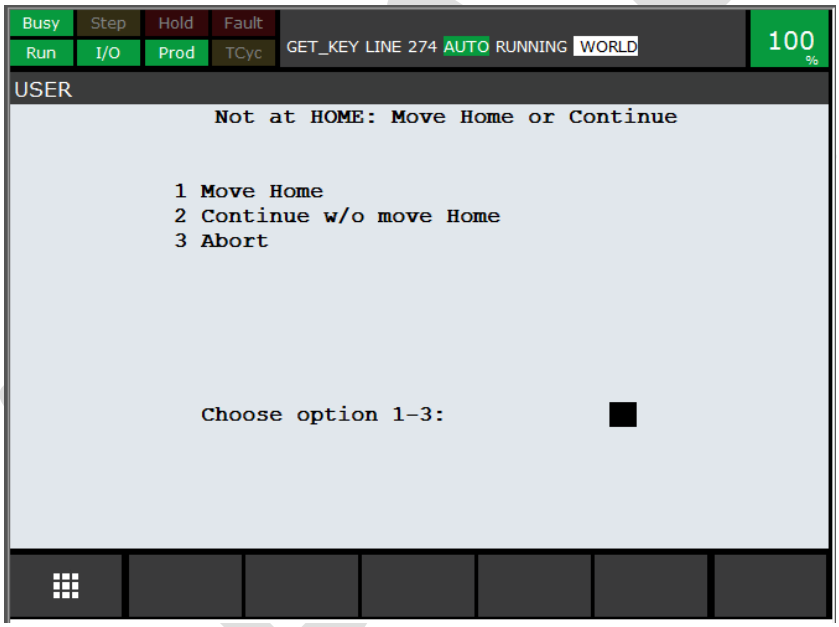
Robot at HOME



Robot not at HOME

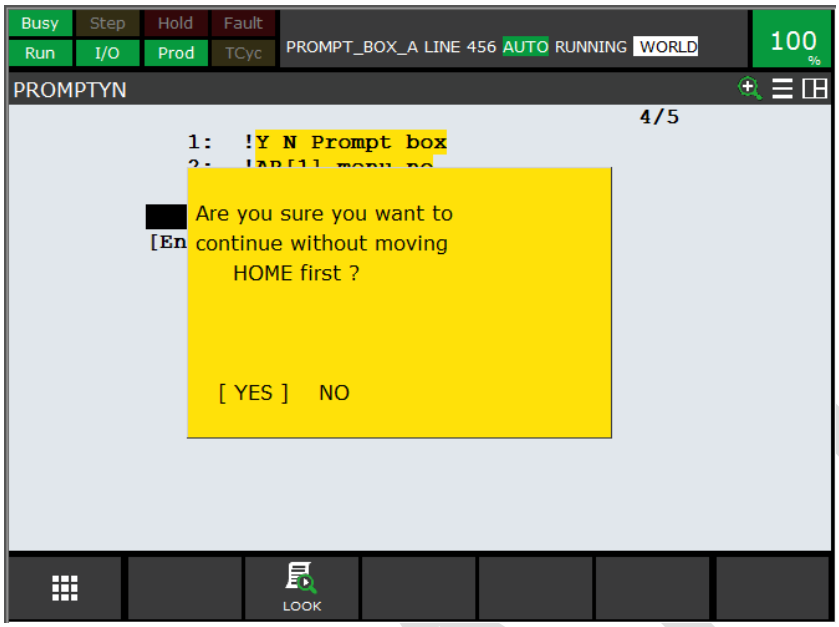


If the Robot is not at the HOME position, the following screen will appear:

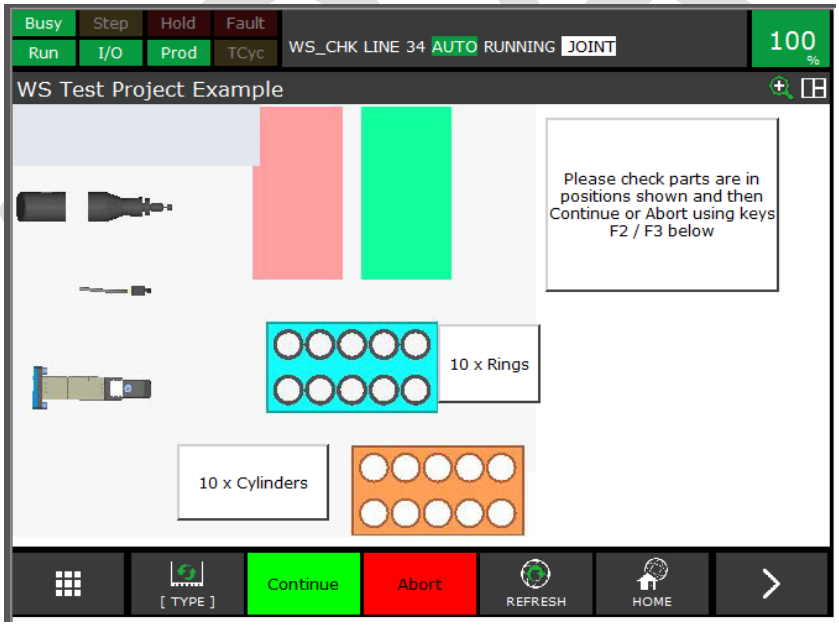


Choose the appropriate action and press 'ENTER'.

If Option 2 " Continue " is chosen , then a confirmation screen will be displayed.

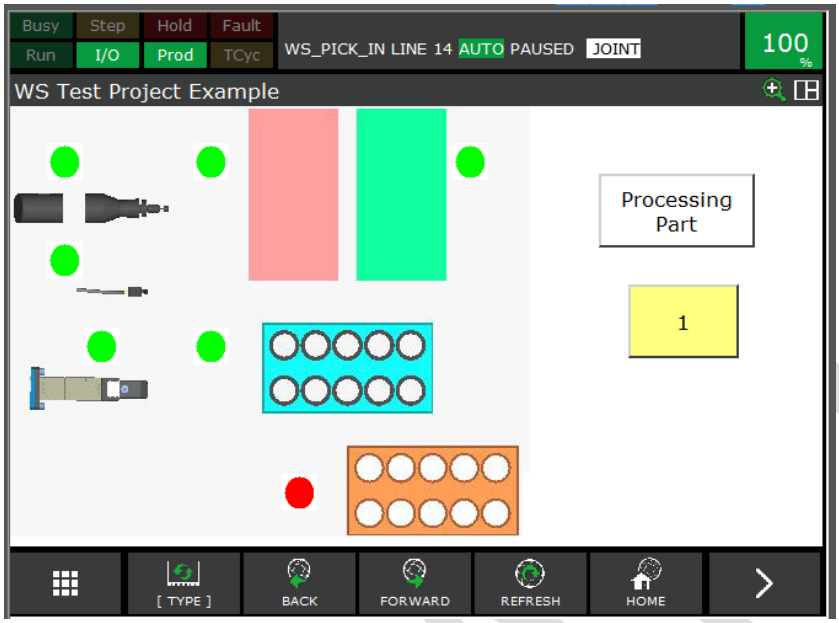


e) Before the program starts, a screen will ask for confirmation that the parts are in the correct starting position:



Make sure that the parts are in the positions shown, then press "Continue".

f) When the program is running, a Status screen is shown:.



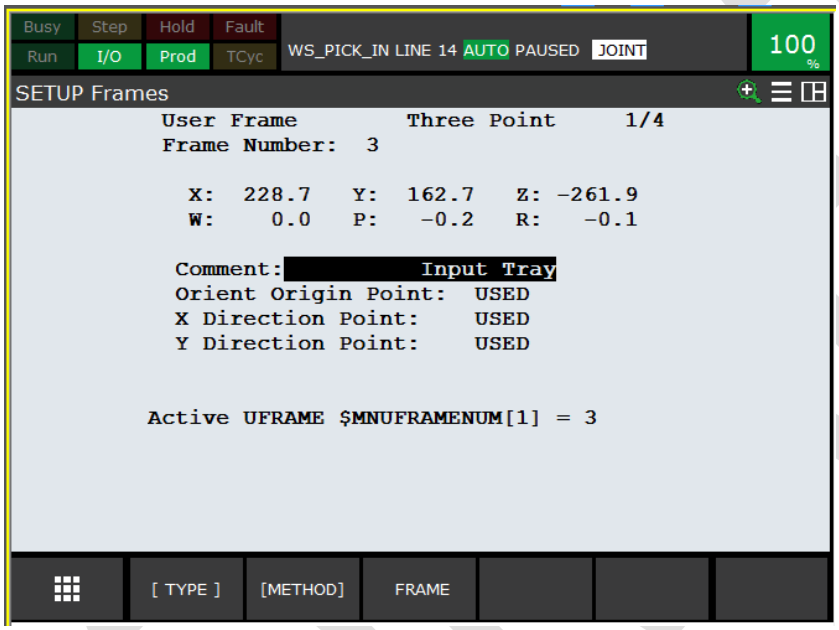
The Red and Green lamps show which station in the cell the robot is currently working on, and the Part Number being processed is also shown.

2 Program Setup / Teaching

The robot motions are all taught relative to “User Frames” so that if the position of the trays changes it is just necessary to re-teach the frame, not the whole program.

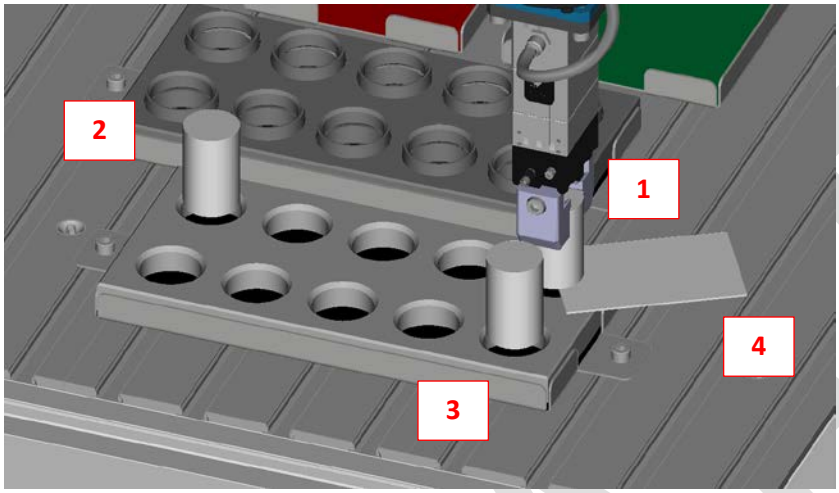
2.1 UFrame Setup - General

The User Frame touchup is done using the Menu>Setup>Frames function:



2.2 Tray Reference Positions

All the frames were taught in the same way, with the cylinder held in the gripper and centred over the holes in the part locator plate:

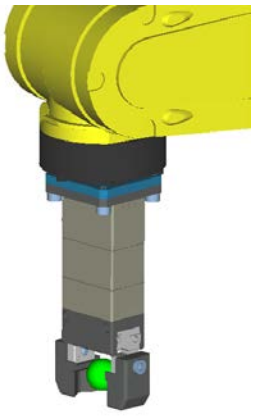


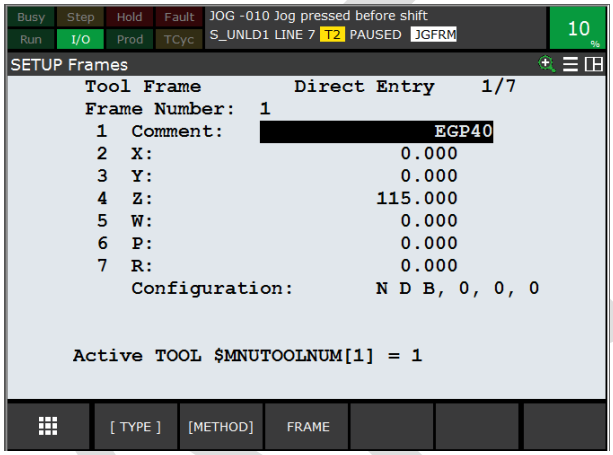
1) Orient Origin Point
2) X Direction Point
3) Y Direction Point
4) Piece of thin card / paper to sense when cylinder is just touching the top surface of the part locator

3 Robot Setup

3.1 UTOOL / TCP Setup

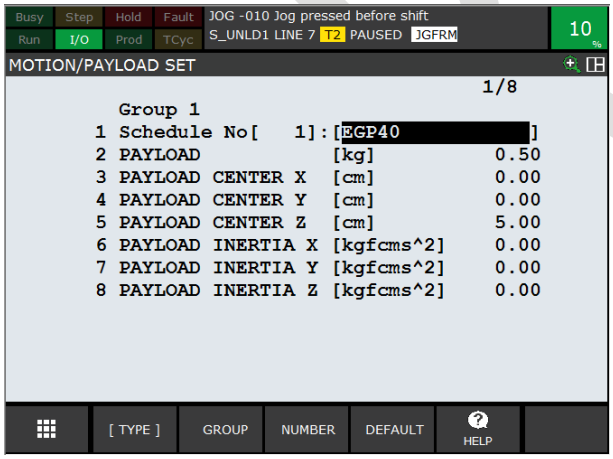
Because of the simple shape and mounting of the Schunk gripper, a simple TCP with an offset of 105mm in Z is sufficient.





3.2 Payload Setup

The payload is quite low for this application – so only one payload of 0.5 kg has been set:



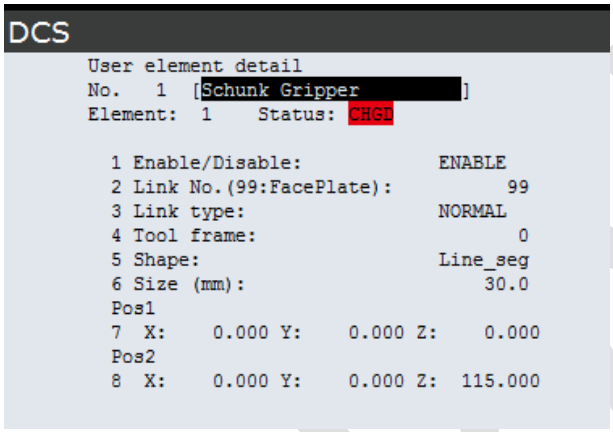
3.3 DCS Setup

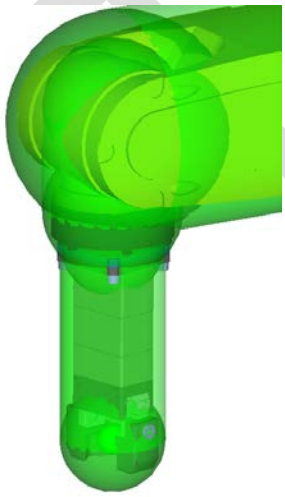
DCS (Dual Check Safety) has been used to ensure that the robot cannot accidentally hit the walls of the cell. This requires setting up a Tool Model and a Safe Zone.

3.3.1 DCS Tool Model.

A simple DCS model using one “Line_seg” type model has been used.

For more details please refer to DCS manuals.



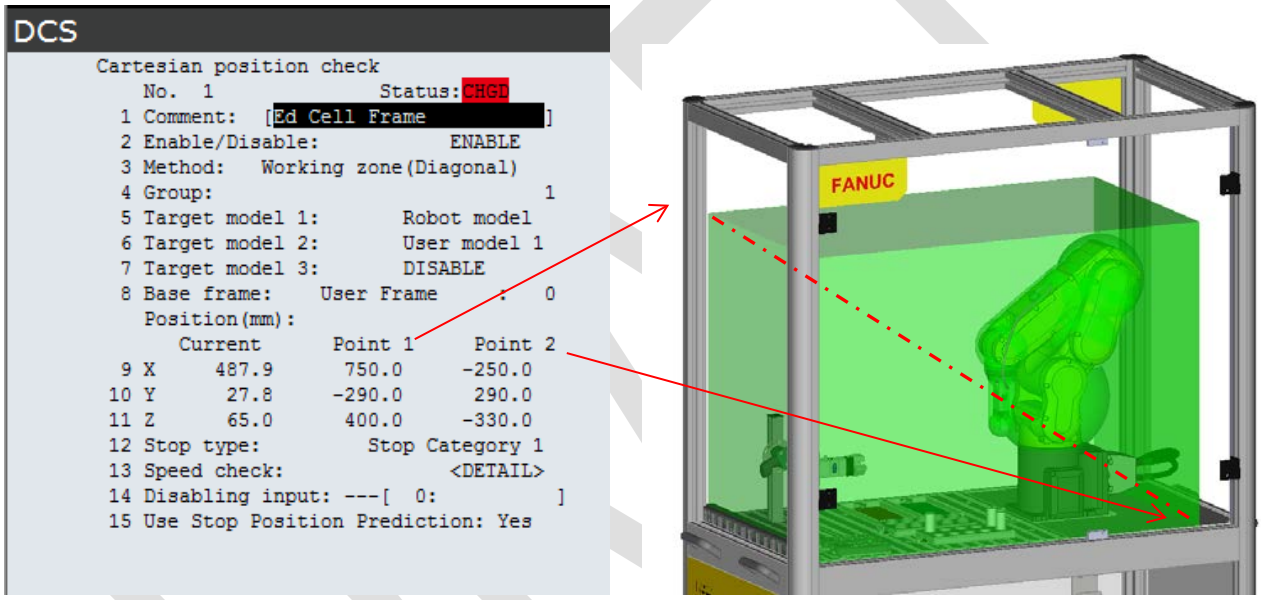


3.3.2 DCS Safe Zone

A simple DCS Cartesian Position Check Zone has been set up using a Diagonal line to define a cuboid zone, running from a point on the " top left " of the cell to the "bottom right " – see screenshot below - where the inside of the cuboid is safe.

If the robot or the tool comes close to the edge of this zone, the robot will stop.

For more details please refer to DCS manuals.



4 List of Registers

4.1 Numeric registers

Registers are used to store settings to control the cell operation, and used by the program internally.

Register	Comment	Description	Default value
35	WS TP Loop	Used to control the main program loop to process all 10 parts	1 to 10
36	Part OK NOK	Used to store the result of the Microswitch or iRVision Ring Check	1 = OK 0 = NOK
37	Vision Check	Used by iRVision Check (copied into R[36])	1 = OK 0 = NOK
40	Input Tray Cnt	Index for PR[] to use for Input Tray	50 > 60
41	Assy Tray Cnt	Index for PR[] to use for Assembly Tray	70 > 80
42	Out OK Tray Cnt	Index for PR[] to use for OK Output Tray	90 > 100
43	Out NOK Tray Cnt	Index for PR[] to use for NOK Output Tray	110 > 120
44	HMI Cnt	Part number to display on HMI	1 to 10
46	Deburr Speed	Speed to use for deburring motion (mm/s)	50
47	Deburr Radius	Radius to use to calculate deburring motion positions (mm)	20
48	Deburr Depth	Depth to use to use to calculate deburring motion positions (mm)	5
50	Grip Delay	Time for Schunk gripper to open / close (sec)	0.5
51	Tmp HMI R[]	Temporary register for HMI setup	-
52	Assy Delay	Time to wait after inserting cylinder in ring during assembly (sec)	0.5

Register	Comment	Description	Default value
54	Chuck Pulse	Time to pulse Red LED on/off during machining simulation (sec)	.5
55	Chuck Cnt	Count	-
56	Chuck Lmt	Number of On/Off cycles for Chuck simulation	2
58	ADL Spd	Linear speed (mm/s) for Approach & Depart movements	200
59	J SPd	Joint speed (%)for Joint Air Cut Motions	25
60	Assy Speed	Speed (mm/s) for Linear assembly motion	100
133 134 135 136 137 138 139	HMI In HMI Assy HMI Chuck HMI Deburr HMI Micro HMI OK HMI NOK	Registers to set to 1/0 to control HMI display via linked iPendant controls	1/0

4.2 Position Registers

Position Registers are used to store positions

Position Register	Comment	Description
45 46 47	Chuck App Chuck Load Chuck Dep	Positions for Approach, Load, Unload, Depart for Chuck
50 - 59 60 61 62	Input Tray 1 - Input Tray 10 Input Tray App Input Tray Pick Input Tray Dep	Positions for Input Tray Cylinder locations Positions for Approach, Pick, Depart relative to above locations
70 - 79 80 81 82	Assy Tray 1 - Assy Tray 10 Assy Tray App Assy Tray Push Assy Tray Dep	Positions for Assembly Tray Cylinder locations Positions for Approach, Push (= assemble), Depart relative to above locations
90 - 99 100 101 102	OK Tray 1 - OK Tray 10 OK Tray App OK Tray Place OK Tray Dep	Positions for Output OK Tray Cylinder locations Positions for Approach, Pick, Depart relative to above locations

110 - 119 120 121 122	NOK Tray 1 - NOK Tray 10 NOK Tray App NOK Tray Place NOK Tray Dep	Positions for Output nOK Tray Cylinder locations Positions for Approach, Pick, Depart relative to above locations
129 130 131 132 133	Deburr App Deburr 1 Deburr 2 Deburr 3 Deburr 4	Positions for Deburring operation

4.3 I/O Listing

RO[]	Comment	Description
7 8	Open Gripper Close Gripper	Gripper control – set up as Complementary

DO[]	Comment	Description
101	Home Signal	Linked to Ref Pos
103 104	Chuck Close Chuck Open	Chuck control – set up as Complementary
105	Red LED	Machine Busy
106	Green LED	Machine Free
107	Deburr ON	Control of deburring tool

DI[]	Comment	Description
101	Microswitch	

5 Program Details

5.1 List of programs

Program	Comment	Description
AAA_WSEX	WS Example TP	Main WS Example Test Project Program – using Microswitch for assembly check
AAA_WSEX	WS Ex TP Vision	Main WS Example Test Project Program – using iRVision for picking and assembly check
AA_HOME	Move Home	This program moves the robot to the home position. Note that it uses Joint definition position – so independent of any UFrame or UTool settings
PWR_UP_WS	Power Up Message	Message for WS Example Project
WS_ASSY	Push Assy Tray	Insert Cylinder into Ring in Assembly Tray
WS_CHK	Check Start OK	Display HMI and check if OK to start
WS_CHUCK	L/UL Chucl	Load / Unload Chuck and simulate machining
WS_COPY_PR	Setup Utility	Utility to copy PR[]s (optional to list this)
WS_DEBURR	Deburr Part	Calculate offsets and move part around deburring tool
WS_INIT_R	Init Display R[]	Initialise registers for HMI display
WS_IRVPICK	Get 1 Part	Find and pick part from Input tray using iRVision
WS_PICK_IN	Pick In Tray	Pick part from Input Tray without iRVision
WS_PL_NOK	Place NOK Tray	Place part in NOK Tray
WS_PL_OK	Place OK Tray	Place part in OK Tray
GETDATA	Get PC Data	Predefined system program – not used by this application
GRP_GRIP	Grip Tote	Program to Grip tote with Schunk Gripper
GRP_RELS	Release Tote	Program to Release tote with Schunk Gripper
GRP_TOG	iRV Calib Start	Toggle between gripper states
IRV_CALSTART	Get Parts Vision	Position to start iRVision Robot Generated Grid Calibration from

Program	Comment	Description
IRV_CHK_CONV	Chk Convyr Tote	Check Orientation of Tote at end of conveyor and return value into register
IRV_CHK_PAL	Chk Pallet Tote	Check position of totes on pallet – note that this uses one vision process per pallet position due to the different heights and the fixed depalletising sequence
LISTMENU	LIST MENU MACRO	Macro installed by the 'Menu Utility' Option. This macro is used to display 3 choices to the user when the robot is not at HOME
OPERMENU	Entry Menu Macro	Macro installed by the 'Menu Utility' Option. This macro is not used in this application
PROMPTOK	Prompt Box OK	Macro installed by the 'Menu Utility' Option. This macro is not used in this application
PROMPTYN	Prompt Box Y N	Macro installed by the 'Menu Utility' Option. This macro is used to confirm the choice by the user when the robot is not at HOME
REQMENU SENDDATA SENDEVNT SENDSYSV STATPAGE	Request PC Menu Send PC Data Send PC Event Send PC Sysvar StatusMenu Macro	Predefined system programs – not used by this application