ST robotics

R17 Tool Changer instructions.
Please read this before proceeding with the R17 manual.

Overview
Some ROBOFORTH 'code' is supplied with the system, see later.

The pneumatic devices comprise a pneumatic gripper and/or a vacuum pickup and/or an electric gripper and a tool changer system. The robot can pick up either the vacuum pickup or the gripper with the tool changer. The tool not in use is parked on a tool stand.

To operate the tool changer compressed air is required to unlock and release the tool. With no air to the changer a spring holds the tool in place but locking pressure is also used to ensure a positive lock against the electrical contacts.

Pneumatics
THIS ITEM IS MOUNTED ON WOODEN BASE AND HAS TEMPORARY CONNECTIONS FOR TESTING ONLY
The pneumatics circuit comprise 4 valves (or switches), a Venturi to produce vacuum, and vacuum sensor. See diagram1 below. Connect to the robot base as indicated in diagram2.
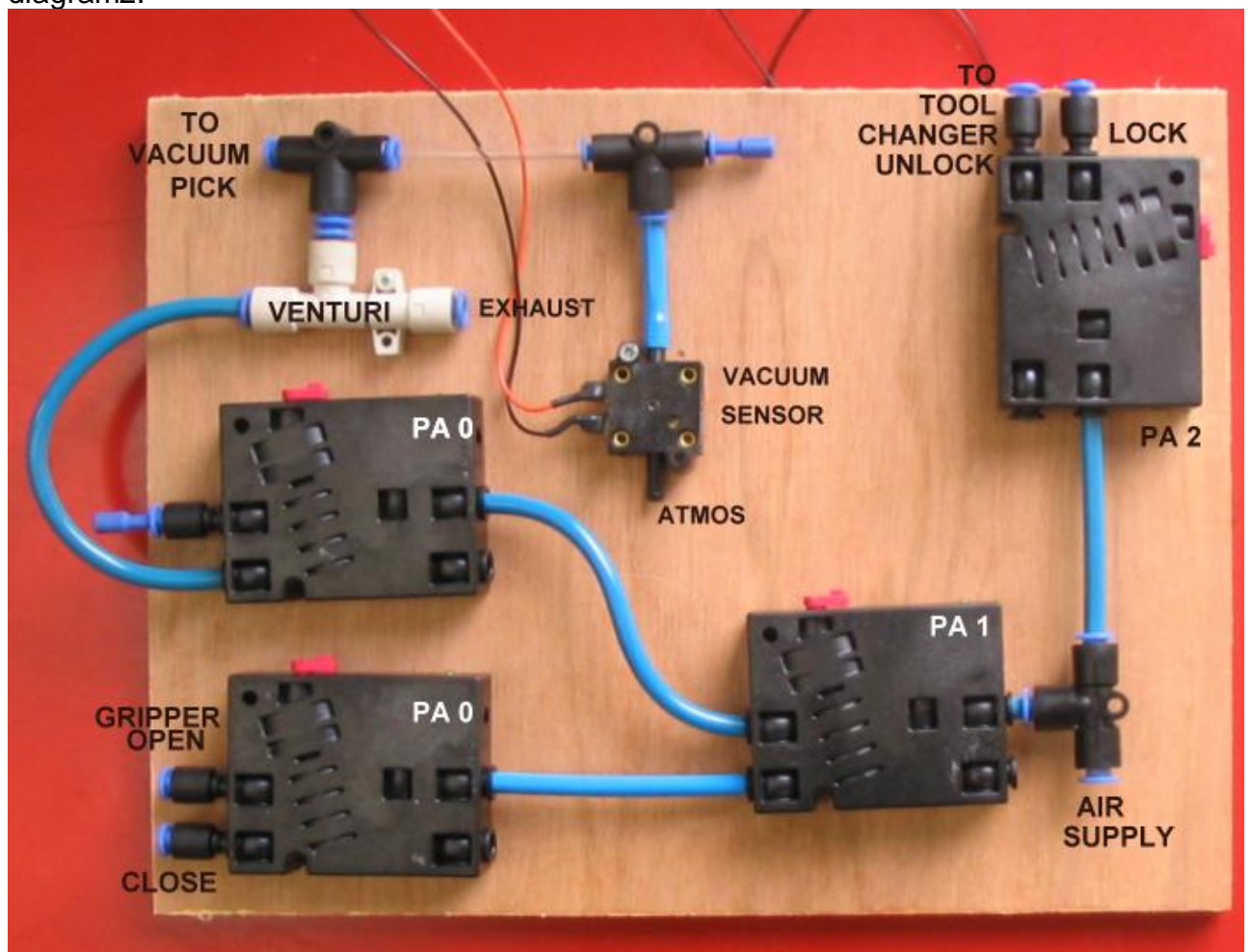
The controller has an output port PA with 8 bits, 3 of which control the pneumatic valves. PA 1 switches air either to the vacuum pickup or the gripper. If air is going to the vacuum pickup then PA 0 switches that on or off. If air is selected to go to the gripper then PA0 switches between open and closed.
To unlock the tool changer operate PA bit 2 with PA 2 ON. To lock again use PA 2 OFF.

To operate the vacuum simply use GRIPPER ON. To release vacuum use GRIPPER OFF. Note that while GRIPped air is continually flowing through the venturi so you will require a decent air supply.

To close the gripper first use PA 1 ON to switch air from vacuum to grip then use GRIP. Use UNGRIP to open the gripper. Note that the gripper must be held by the changer before operating PA 1 or air will escape through the tool changer. All this is handled by the sample code supplied.

Diagram 2

Grip check (if fitted) or Vacuum check
If the vacuum cups are holding something there will be a relatively high vacuum which will operate the vacuum sensor. This connects to the controller via the input port PB bit 6 which can be read with PB 6 BIT? – see sample code.
If you have a gripper sensor this is a small sensor in the side of the gripper which connects back to the controller through the tool changer and the robot to PB bit 5 and can be tested with PB 5 BIT?. The idea is that you slide this sensor along the slot to such a position that you get a true when the gripper is open OR when closed on an object, but you get a false if the gripper closes completely i.e. is gripping nothing.
You can monitor both these sensors with
PP
which reads in the bit pattern from port PB and displays it as a line of 1 and 0s e.g.
11111111
right to left is most significant to least significant. When you operate the gripper sensor
11011111
When you operate the vacuum sensor you will see
10111111
Press escape to exit PP
Adjust the gripper sensor so it will differentiate between the object and no object and lock in place with the small screw. The vacuum sensor is also adjustable using a 1mm metric Allen key.
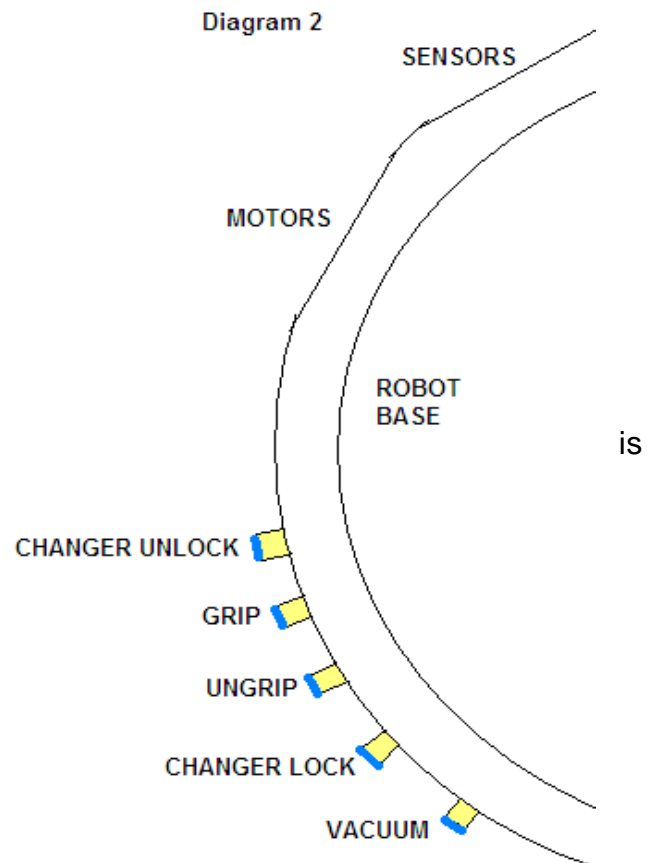
How to program the tool change.
Go to the safe position
READY2
The robot will end up at a position with the hand center level with the shoulder pivot, pointing down and with 500mm between these centers.

Once you have familiarized yourself with the use of projects you can load the project supplied on the CD. In project R17TOOLCHANGE.RUN (see below) the positions where the tools are parked are predefined as positions in 2 routes, GPATH (for the gripper) and VPATH (for the vacuum pickup).

Now enter ALIGN
This will ensure that as you move the robot around the workspace the hand will remain in the same orientation to the axes i.e. 0 degrees.

Starting with the vacuum pickup, in RobWin select and open VPATH.
Next click the J (jog) button and move the robot over the rack and down into the first tool (suggest vacuum pickup) using the teach pad.
Once closed with the tool (a small gap is tolerated) exit the jog mode, click line 4 which is the final lock position in the route. Click 'set to here'.
Now move up by 10-20mm, select line 3 and 'set to here'
Move up another 20mm, select line 2 and 'set to here'
Move up until well clear of the rack, select line 1 and 'set to here'.
GETVAC will get the vacuum pickup.
PUTVAC will put it back.

For the gripper, select and open GPATH
Move the robot across and carefully down into the tool with the Jog function.
Repeat the same procedure as for the vacuum and VPATH but using GPATH.

On RobWin use project, save.

If you want to create these routes from scratch in a new project then what you do is create new routes called GPATH and VPATH. At the pickup position use insert position to learn that. Then progressively move upwards on Z using 'insert position' each time so that the pickup position ends up as line 4 (or more). Then when you RUN the route it starts well clear and finishes at the pickup position.
Open toolchanger.ed2 as a file, copy all the text and insert it into your new ed2 text window. After creating and teaching VPATH and/or GPATH you will need to reload the project to get the definitions of LOCK and UNLOCK, PUTVAC etc.

 Here is a help video: https://www.youtube.com/watch?v=nI9wHfUC-KY

25.02.2015

Sample code for pneumatic gripper
Suggested words:

```
: CHANGER PA 2 ;
: GVALVE PA 1 ; ( OFF = BLOCK AIR
: LOCK CHANGER OFF 200 MSECS GVALVE ON ;
: UNLOCK GVALVE OFF CHANGER ON 200 MSECS ;
: GRIP
CHANGER BIT? 0= IF
   GRIP
THEN
;
GVALVE prevents gripper air open or close being turned on if the
tool is not attached.
```

Sample code for vacuum pickup
Suggested words:

```
: CHANGER PA 2 ;
: LOCK CHANGER OFF 200 MSECS ;
: UNLOCK CHANGER ON 200 MSECS ;
: GRIP
CHANGER BIT? 0= IF
   GRIP
THEN
;
Checking PA 2 prevents vacuum being turned on if the tool is not
attached.
```

When using an electric gripper the blocking air valve is on PA 3 because PA 1 is used by the electric gripper. PA 0 is shared by both grippers.
Then you will need to tell the system which type of GRIP. This is done by changing the value of GTYPE to 0 for pneumatic or 1 for electric:

```
1 GTYPE ! ( SELECTS ELECTRIC GRIPPER
0 GTYPE ! ( SELECTS PNEUMATIC GRIPPER
```
Suggested words:
```
: CHANGER PA 2 ;
: GVALVE PA 3 ; ( OFF = ELEC, ON = PNEU
: LOCK CHANGER OFF 200 MSECS GVALVE ON ;
: UNLOCK GVALVE OFF CHANGER ON 200 MSECS ;
: GRIP
  GVALVE
GTYPE C@ IF ( ELECTRIC GRIPPER
   OFF ( BLOCK THE AIR
ELSE ( PNEUMATIC GRIPPER
   ON ( ENABLE THE AIR
THEN
GRIP
;
```

The starter project on CD is called R17TOOLCHANGER-ELEC
In this project there are 2 routes for the electric gripper. PNEU1 is the route down into the tool or away from the tool once released. PNEU2 is the route to take the gripper sideways out of the tool stand or back into the tool stand after use. The test words are GETP and PUTP for the pneumatic gripper and GETE and PUTE for the electric gripper.

Video of TEST: https://www.youtube.com/watch?v=PXUCqtbAC1I

25.02.2015