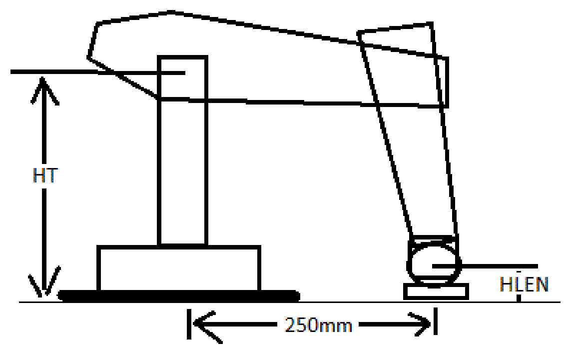
Help sheet 16 Absolute Calibration

Calibrating R12 using known Cartesian position – 5-axis version.

Place graph paper in front of the robot flat on the bench. Identify the position X=0 Y=250.0mm. The size of the base is 220x220 so the front edge of the base (under the plastic cover) is Y=110mm

Load the project AUTOCAL.RUN (If necessary download from our website.)

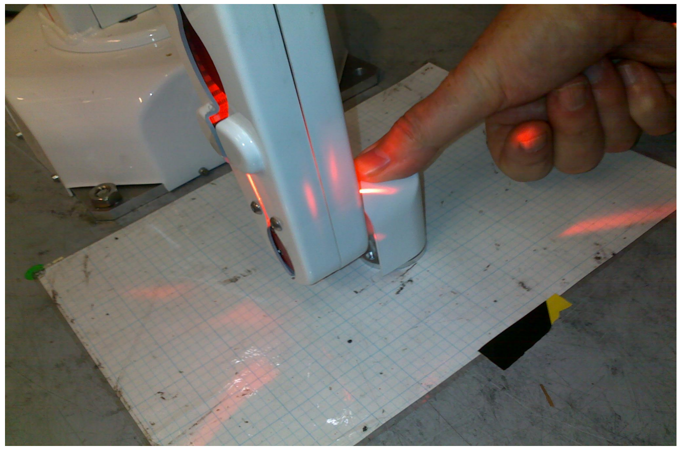


Enter AUTOCAL
Dialog is as follows:
ENTER LENGTH OF HAND TO FLANGE (NORMALLY 410), HLEN in the diagram above.
Measure the distance between the paper and the center of the flange, to the screw center. This is normally 41.0mm but may change depending on assembly tolerances. Enter this distance as a multiple of 0.1mm (for 41.2 enter 412).

ENTER HEIGHT OF ORIGIN FROM BENCH (NORMALLY 3170), HT in the diagram above.
Measure the height from bench to the center of rotation of the shoulder using square and steel rule. The dot in the center of the white disc is close enough. Usually this is 317.0mm but manufacturing tolerances may make this a variable. If in doubt just enter 3170

SET ROBOT AT.... this is the computed coordinates of the target position. Y=250.0mm
The robot will now de-energize.
Place the flange flat on the bench at this position. You may have to judge the space between the edges of the flange and nearest grid lines. Push the flange down flat on the paper as picture below.

Help sheet 16 Absolute Calibration



Enter Y for OK? The robot will then energize. As it does so it may move slightly. Use the teach pad (joint mode) to correct this. Press esc.

OK TO HOME? Answer Y if all is ok otherwise esc.

OK TO CALIBRATE? Answer Y only if the robot looks like it is at home position. The robot will seek out the calibration sensors and change the limits

Enter USAVE to save to flash.
You can make a PC file using file, save binary, 0 A200 200, file name (name).SIG.RAM

Help sheet 13   Absolute Calibration

Calibrating R12-6 using known Cartesian position – 6-axis version.

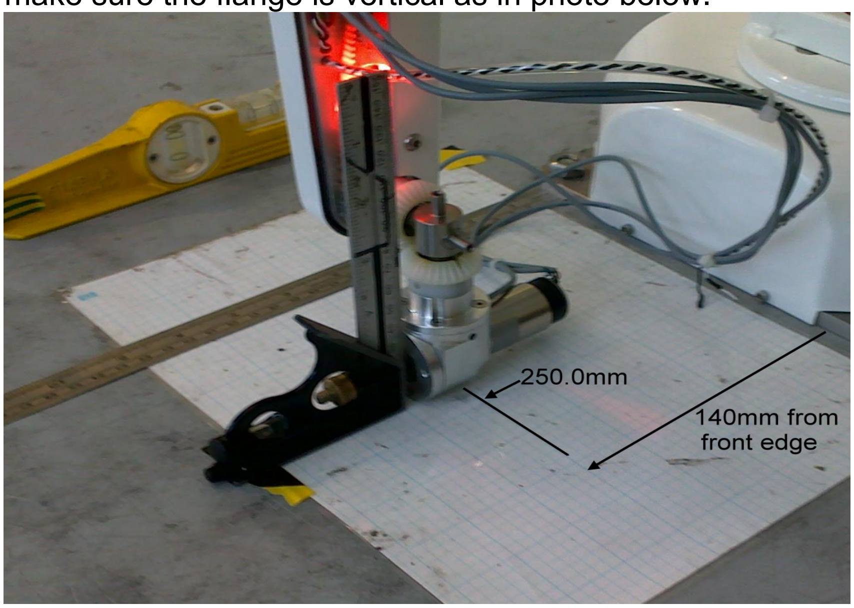
Place graph paper in front of the robot flat on the bench. Identify the position X=0 Y=250.0mm. The size of the base is 220x220 so the front edge of the base (under the plastic cover) is Y=110mm

Load the project AUTOCAL6.RUN
If necessary download from our website.

Enter AUTOCAL
ENTER HEIGHT OF ORIGIN FROM BENCH (NORMALLY 3170)
Measure the height from bench to the center of rotation of the shoulder using square and steel rule. The dot in the center of the white disc is close enough. Usually this is 317.0mm but manufacturing tolerances may make this a variable. If in doubt just enter 3170

SET ROBOT AT.... this is the computed coordinates of the target position.
The robot will now de-energize.

Place the 6th axis module on the bench at this position. You will have to judge the center of the module and space between the nearest grid lines. Note: NOT the flange. Align the module visually along the Y axis. Use a square to make sure the flange is vertical as in photo below.



Enter Y for OK? The robot will then energize. As it does so it may move slightly. Use the teach pad (joint mode) to correct this. Press esc.

OK TO HOME? Answer Y if all is ok otherwise esc.

OK TO CALIBRATE? Answer Y only if the robot looks like it is at home position. The robot will seek out the calibration sensors and change the limits

Enter USAVE to save to flash.
You can make a PC file using file, save binary, 0 A200 200, file name (name).SIG.RAM

Help sheet 13 Absolute Calibration

Absolute Calibration using a sensor

A technique for auto-calibrating the robot to an absolute position in the work space and thus improve on the repeatability of the internal homing sensors.

See this clip
http://www.youtube.com/watch?v=CMdurikIE0U

The clip shows the absolute calibration followed by checking the calibration against an electronic dial-gauge (LVDT). The LVDT will not be described here. You can use a standard dial gauge to check that the calibration is working.

You need a 8mm PNP open collector proximity detector such as may be obtained from Balluff.
Mount this on a bracket as shown in the clip.
Connect the sensor to 9-way D connector PB 7 (see controller manual for pinouts)
Check it works with a piece of steel. Enter PP and offer the steel to the sensor.
11111110
steel on
01111110
steel off
11111110
press esc to exit.

Mount a square of steel (reflector) on the robot hand such that the robot can offer the square to the detector.
The detector should be at X=0 so that any change in Y does not result in any waist motion.

Enter the code below into a new project or into your existing project.

Enter READY for an R12. For an R17 get the robot into CARTESIAN mode and position it so the reflector is flat i.e. level with the X-Y plane.
Use the JOG function to get within 5-10mm of the sensor. Do NOT use X motion.
Enter WHERE and note the Cartesian position. Enter those values for PROX in the code below.
(values shown are for the clip – yours will be different)

```
DECIMAL
: VSLOW 250 SPEED ! 250 ACCEL ! ;
: SLOW 400 SPEED ! 400 ACCEL ! ;
: FAST 10000 SPEED ! 2000 ACCEL ! ;

: PROX
0 X ! 3620 Y ! -1720 Z ! 900 PITCH ! 0 W !
TRANSFORM -GOTO
;
```

Help sheet 13 Absolute Calibration

0SENSE stops motion when the sensor goes to 0, 1SENSE stops motion when the sensor goes to 1

```
: 0SENSE
BEGIN
PB 7 BIT? 0=
?RUN 0=
OR UNTIL
;
: 1SENSE
BEGIN
PB 7 BIT? 0 >
?RUN 0=
OR UNTIL
;
```

ZSENSE moves the robot down slowly until the sensor changes to 0.

```
: ZSENSE
SLOW
-50 Z +!                ( AIM FOR 5MM LOWER
TRANSFORM DSPSMOOTH     ( TELL DSP TO DO IT
DROP                    ( DROP THE UNWANTED TRANSFORM RESULT
0SENSE                  ( MOVE UNTIL PB 7 GOES 0
STOP                    ( STOP THE DSP
DSPASSUME               ( ASK THE DSP WHERE IT GOT TO
COMPUTE                 ( UPDATE THE CARTESIAN POSITION
;
```

YSENSE moves the robot back on Y axis only until the sensor changes to 1

```
: YSENSE
SLOW
-100 Y +!
TRANSFORM DSPSMOOTH DROP
1SENSE
STOP
DSPASSUME
COMPUTE
;
```

XSENSE moves in +X but only the waist is moved. That way the other axes do not move to confuse the calibration or create vibration.

```
: XSENSE
TELL WAIST 200 DSPMOVE
1SENSE
STOP
DSPASSUME
COMPUTE
;
```

Help sheet 13   Absolute Calibration

3SENSE does all 3

```
: 3SENSE
FAST         ( GO FAST TO PROX
PROX
VSLOW
ZSENSE       ( FIND Z FIRST
0 0 -10 MOVE       ( MOVE DOWN A BIT MORE OR THE YSENSE MIGHT BE PREMATURE
500 MSECS    ( SETTLING TIME
YSENSE       ( THEN BACK ON Y - MULTI-AXIS
0 20 0 MOVE
500 MSECS
XSENSE       ( WAIST ONLY
JOINT
;
```

Use 3SENSE one time to find out where it ends up. Enter WHERE and enter the values in NEST

CREATE NEST
142 , 7360 , 4960 , 1181 , 1328 , 0 , 0 , 0 ,

Finally use ABSCAL to restore those values each time.

```
: ABSCAL
FAST
HOME CALIBRATE
READY
PROX
3SENSE
NEST ASSUME ENCSET
FAST
READY
;
```