

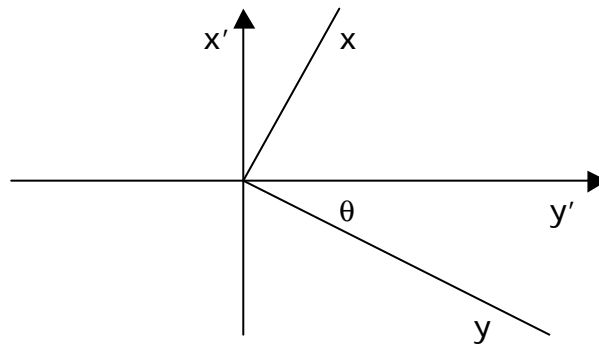
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Subject: Guide to using Frame Transform #5

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Application Note

FRAME Transform #5

This frame is designed to allow axes 0 and 1 to be "turned" through an angle so that command inputs to x, y (along the required plane) are transformed to the fixed axes x' and y'.



The transform is done by way of a 2 x 2 matrix, the coefficients of which can be easily derived from the required rotation angle of the operating plane.

Calculating the Matrix Coefficients.

For the frame to work, 2 sets of matrix coefficients must be entered, one for the forward transform and the second for the inverse. The transform calculates x and y according to the following:

$$(x', y') = (x, y) * \begin{matrix} \text{TABLE}(0), & \text{TABLE}(1) \\ \text{TABLE}(2), & \text{TABLE}(3) \end{matrix}$$

The inverse transform is calculated thus:

$$(x, y) = (x', y') * \begin{matrix} \text{TABLE}(4), & \text{TABLE}(5) \\ \text{TABLE}(6), & \text{TABLE}(7) \end{matrix}$$

For a given angle θ , the table entries are:

TABLE(0, COS(theta))	det = (TABLE(0) * TABLE(3)) - (TABLE(2) * TABLE(1))
TABLE(1, -SIN(theta))	TABLE(4, TABLE(3) / det)
TABLE(2, SIN(theta))	TABLE(5, -TABLE(1) / det)
TABLE(3, COS(theta))	TABLE(6, -TABLE(2) / det)
	TABLE(7, TABLE(0) / det)

Note: TABLE locations 0 to 7 are reserved for this function. User programs MUST NOT write to this area in the TABLE memory.

Example Program

```
RUN "startup"  \ Initialise the axes
WA(1000)

x_axis = 0
y_axis = 1

FRAME = 0
WA(10)
DEFPOS(0, 0)

theta_degrees = 45  \ Set required angle in degrees
theta = theta_degrees * (2*PI/360)  \ Convert to radians
GOSUB calc_matrix
FRAME = 5

BASE(x_axis)
MOVE(xdist, ydist)
WAIT IDLE

STOP

'=====
' Calculate the matrix parameters for FRAME 5
' Transform (x, y) * (TABLE(0), TABLE(1) )
'                   (TABLE(2), TABLE(3) )
'
' Inverse Transform:
'   (x', y') * (TABLE(4), TABLE(5) )
'              (TABLE(6), TABLE(7) )
'=====
calc_matrix:
  ' forward transform
  TABLE(0, COS(theta))
  TABLE(1, -SIN(theta))
  TABLE(2, SIN(theta))
  TABLE(3, COS(theta))

  ' inverse transform
  det = (TABLE(0) * TABLE(3)) - (TABLE(2) * TABLE(1))
  TABLE(4, TABLE(3) / det)
  TABLE(5, -TABLE(1) / det)
  TABLE(6, -TABLE(2) / det)
  TABLE(7, TABLE(0) / det)
RETURN
```

Frame 5 in Operation

The frame applies to axes 0 and 1 only. The axes should be datumed in FRAME=0. Once this is done, then the frame can be set to 5 and move commands directed at either axis or at both axes together in the usual way. However the actual movement of x' and y' (the real axes) will be according to the transform.

While frame 5 is set, DPOS represents the positions of x and y and MPOS shows the positions of the real axes x' and y' . FE shows the following error in the usual way but the output of the transform (i.e. the demand positions of the real axes) is hidden.

If the axes need to be re-positioned according to the real axes, the frame can be turned off simply by setting FRAME=0. When this is done, the DPOS values will change to be the same as the MPOS positions, i.e. they become the positions in the x' / y' plane. The axes can then be moved to a new starting position and the frame set back to 5, perhaps with a new angle set.

Warning: Changing the matrix coefficients while the axes are in motion will result in unpredictable movement and could cause damage to the axes.