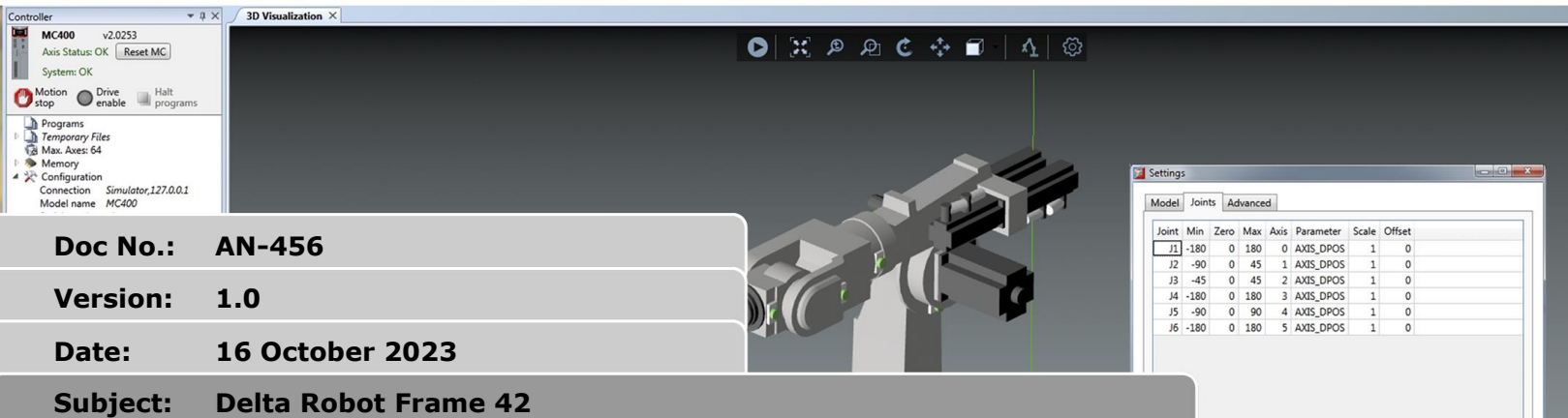


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Doc No.: AN-456

Version: 1.0

Date: 16 October 2023

Subject: Delta Robot Frame 42

APPLICATION NOTE

1. Version

11th October 2023

V1.0

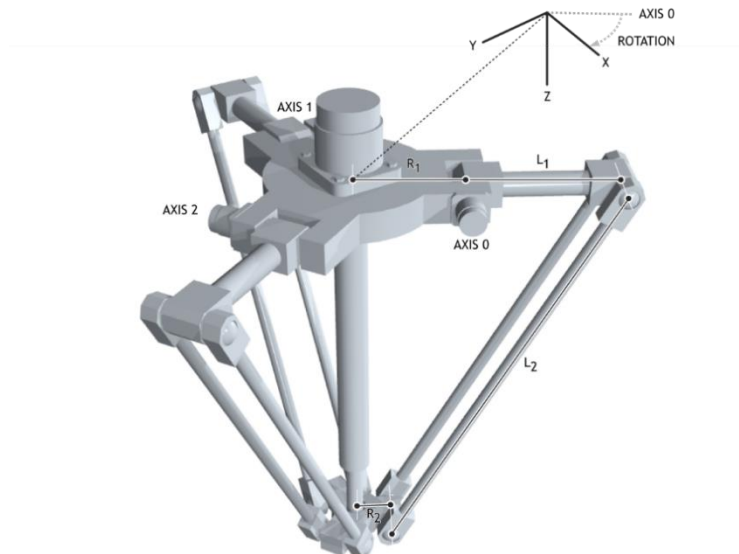
First release

2. Introduction

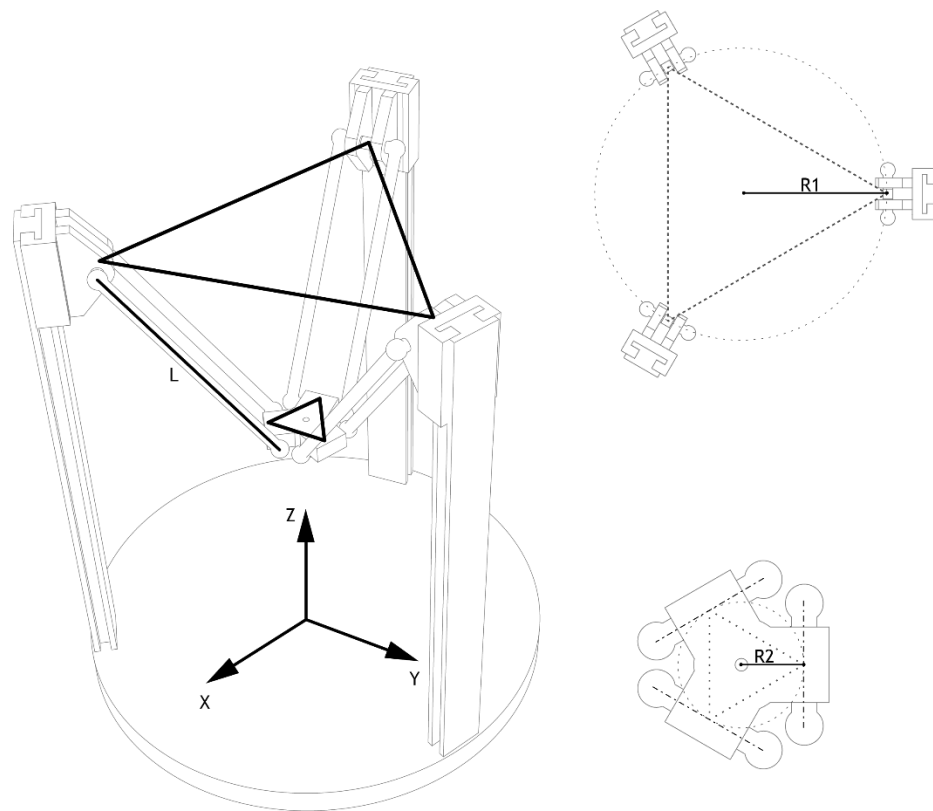
Frame = 42 enables transformation for 3 axis delta robot with 1 / 2 / 3 axis wrist. This is an RPS frame. The frame allows for configuration of two different types of actuation for the first three axes. It also allows for configuration of orientation axes to be attached to the robot end effector.

3. Diagram

The following pictures show the types of machine that can be controlled using this FRAME:



The following picture shows the type of machine:



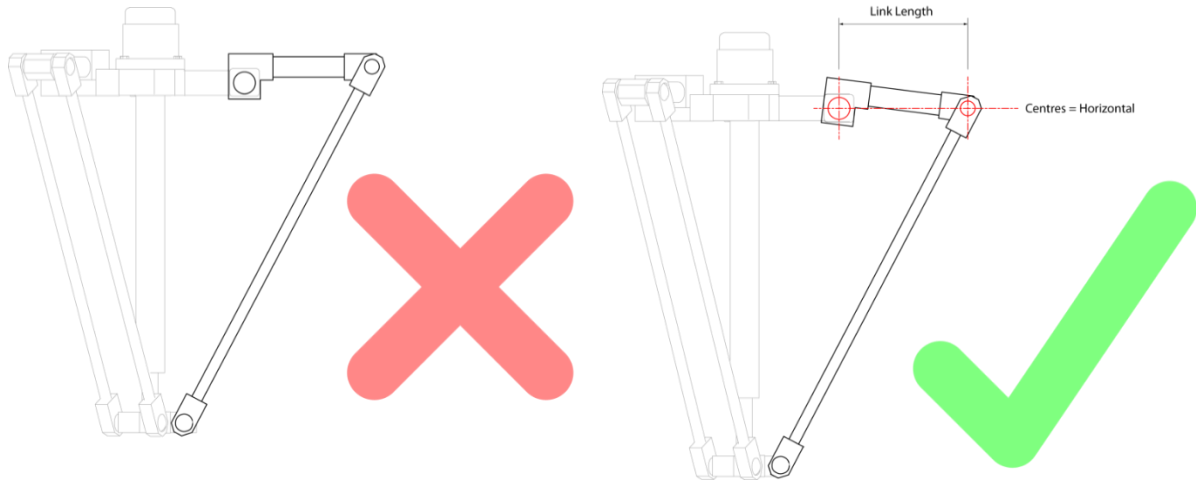
4. Axis order

The axes within the allocated KINEMATIC_GROUP have the following functions:

First Axis	Cartesian X axis
Second Axis	Cartesian Y axis
Third Axis	Cartesian Z axis
Fourth Axis	End effector rotation axis about Z
Fifth Axis	End effector rotation axis about Y
Sixth Axis	End effector rotation axis about X

5. Datuming

When datuming, (homing) it is necessary for each of the arms of the delta robot to be in the horizontal position (i.e. with the joints at either end of the link at the same level with respect to the robot's base).



6. Parameterization

13 parameters needed to be set into a sequence of TABLE values for use by the transformation mathematics. The base TABLE position is set using FRAME_GROUP.

Table data	0	Number of robot axes [3, 4, 5, 6]
	1	Actuation type for first 3 axes 0 = Rotary 1 =Linear
	2	Upper Radius
	3	Lower radius
	4	Upper arm length
	5	Lower arm length
	6	Linkx (optional with 4 axes)
	7	Linky (optional with 5 axes)
	8	Linkz (optional with 6 axes)
	9	Encoder edges/radian (Delta arm 0)
	10	Encoder edges/radian (Delta arm 1)
	11	Encoder edges/radian (Delta arm 2)
	12	Encoder edges/radian (optional with 4 th axis)

	13	Encoder edges/radian (optional with 5 th axis)
	14	Encoder edges/radian (optional with 6 th axis)

7. Example

The following example is of a 3 axis rotary delta robot.

'Start Robots configuration

' IMPORTANT: This file is automatically generated by MotionPerfect
' Any modifications may get overwritten or lost.

' Switch off unused kinematic groups

KINEMATIC_GROUP(1,-1)
KINEMATIC_GROUP(2,-1)
KINEMATIC_GROUP(3,-1)
KINEMATIC_GROUP(4,-1)
KINEMATIC_GROUP(5,-1)
KINEMATIC_GROUP(6,-1)
KINEMATIC_GROUP(7,-1)

'Start Robot 0 configuration

' \$robot0_name="Delta-Robot"

' \$robot0_model_ref="{CCB13DDD-8B4E-4750-B036-16EB855B9ACD}"

TABLE_PROTECT(1000, 1100, 0) 'Protected table range for robot definition

KINEMATIC_GROUP(0,-1)

' Table Mapping

' offset + 0 : Robot axes (3,4,5,6)
' offset + 1 : Actuation type (0 = Rotary, 1 = Linear)
' offset + 2 : Upper Radius
' offset + 3 : lower radius
' offset + 4 : upper arm length
' offset + 5 : lower arm length
' offset + 6 : linkx (optional with 4 axes)
' offset + 7 : linky (optional with 5 axes)
' offset + 8 : linky (optional with 6 axes)

' offset + 9 : encoder edges per radian axis 0 - core arm
' offset + 10 : encoder edges per radian axis 1 - core arm
' offset + 11 : encoder edges per radian axis 2 - core arm
' offset + 12 : encoder edges per radian axis 3 - w Axis
' offset + 13 : encoder edges per radian axis 4 - v Axis
' offset + 14 : encoder edges per radian axis 5 - u Axis

TABLE(1000, 3, 0, 900, 500, 180, 450, 0, 0, 0)

TABLE(1009, (2^23)*(500000/10000)/(2*PI), (2^23)*(500000/10000)/(2*PI),
(2^23)*(500000/10000)/(2*PI), 1, 1, 1)

WORLD_POS_REDUCED_SPEED = 250

WORLD_POS_MAX_SPEED = 4000

```

WORLD_POS_MAX_ACC = 30000
WORLD_POS_MAX_JERK = 300000
WORLD_ORI_REduced_SPEED = 50
WORLD_ORI_MAX_SPEED = 360
WORLD_ORI_MAX_ACC = 3600
WORLD_ORI_MAX_JERK = 36000
WORLD_POS_JOG_SPEED = 250
WORLD_POS_JOG_ACC = 2500
WORLD_ORI_JOG_SPEED = 50
WORLD_ORI_JOG_ACC = 500
JOG_SPEED_FACTOR = 0.2
JOG_ACC_FACTOR = 0.2

```

'Start Axis 0 configuration

BASE(0)

DEFPOS(0)

AXIS_UNITS = (2^23)*(800000/10000)/360

AXIS_MAX_SPEED = 370

AXIS_MAX_ACC = 1500

AXIS_MAX_JERK = 65500

AXIS_MAX_JOG_SPEED = 50

AXIS_MAX_JOG_ACC = 500

AXIS_MAX_TORQUE = 30

AXIS_FS_LIMIT = 132

AXIS_RS_LIMIT = -132

AXIS_MODE.16 = 1

FE_LIMIT = 10

DRIVE_FE_LIMIT = 10

VP_MODE = 5

INVERT_IN(101,ON)

OP(101,OFF)

FWD_JOG=101

INVERT_IN(100,ON)

OP(100,OFF)

REV_JOG=100

AXIS_ENABLE=1

SERVO=1

'Stop Axis 0 configuration

'Start Axis 1 configuration

BASE(1)

DEFPOS(0)

AXIS_UNITS = (2^23)*(800000/10000)/360

AXIS_MAX_SPEED = 580

AXIS_MAX_ACC = 3500

AXIS_MAX_JERK = 237600

AXIS_MAX_JOG_SPEED = 50

AXIS_MAX_JOG_ACC = 500

AXIS_MAX_TORQUE = 30

AXIS_FS_LIMIT = 132

AXIS_RS_LIMIT = -132

AXIS_MODE.16 = 1

FE_LIMIT = 10

DRIVE_FE_LIMIT = 10

VP_MODE = 5

INVERT_IN(103,ON)

OP(103,OFF)

```
FWD_JOG=103
INVERT_IN(102,ON)
OP(102,OFF)
REV_JOG=102
```

```
AXIS_ENABLE=1
SERVO=1
```

```
'Stop Axis 1 configuration
```

```
'Start Axis 2 configuration
```

```
BASE(2)
DEFPOS(0)
AXIS_UNITS = (2^23)*(800000/10000)/360
AXIS_MAX_SPEED = 1000
AXIS_MAX_ACC = 7000
AXIS_MAX_JERK = 235000
AXIS_MAX_JOG_SPEED = 50
AXIS_MAX_JOG_ACC = 500
AXIS_MAX_TORQUE = 30
AXIS_FS_LIMIT = 132
AXIS_RS_LIMIT = -132
AXIS_MODE.16 = 1
FE_LIMIT = 30
DRIVE_FE_LIMIT = 30
VP_MODE = 5
INVERT_IN(105,ON)
OP(105,OFF)
FWD_JOG=105
INVERT_IN(104,ON)
OP(104,OFF)
REV_JOG=104
```

```
AXIS_ENABLE=1
SERVO=1
```

```
'Stop Axis 2 configuration
```

```
'Start Axis 3 configuration
```

```
BASE(3)
DEFPOS(0)
AXIS_UNITS = (2^23)*(800000/10000)/360
AXIS_MAX_SPEED = 1730
AXIS_MAX_ACC = 20000
AXIS_MAX_JERK = 740000
AXIS_MAX_JOG_SPEED = 50
AXIS_MAX_JOG_ACC = 500
AXIS_MAX_TORQUE = 30
AXIS_FS_LIMIT = 360
AXIS_RS_LIMIT = -360
AXIS_MODE.16 = 1
FE_LIMIT = 10
DRIVE_FE_LIMIT = 10
VP_MODE = 5
INVERT_IN(107,ON)
OP(107,OFF)
FWD_JOG=107
INVERT_IN(106,ON)
OP(106,OFF)
REV_JOG=106
```

```

AXIS_ENABLE=1
SERVO=1
'Stop Axis 3 configuration

```

```

'Start Axis 4 configuration
BASE(4)
DEFPOS(0)
AXIS_UNITS = 360000*(1/1)/360
AXIS_MAX_SPEED = 360
AXIS_MAX_ACC = 3600
AXIS_MAX_JERK = 360000
AXIS_MAX_JOG_SPEED = 50
AXIS_MAX_JOG_ACC = 500
AXIS_MAX_TORQUE = 35
AXIS_FS_LIMIT = 180
AXIS_RS_LIMIT = -180
AXIS_MODE.16 = 0
FE_LIMIT = 999
DRIVE_FE_LIMIT = 999
VP_MODE = 5
INVERT_IN(109,ON)
OP(109,OFF)
FWD_JOG=109
INVERT_IN(108,ON)
OP(108,OFF)
REV_JOG=108

```

```

'Stop Axis 4 configuration

```

```

'Start Axis 5 configuration
BASE(5)
DEFPOS(0)
AXIS_UNITS = 360000*(1/1)/360
AXIS_MAX_SPEED = 360
AXIS_MAX_ACC = 3600
AXIS_MAX_JERK = 360000
AXIS_MAX_JOG_SPEED = 50
AXIS_MAX_JOG_ACC = 500
AXIS_MAX_TORQUE = 30
AXIS_FS_LIMIT = 180
AXIS_RS_LIMIT = -180
AXIS_MODE.16 = 0
FE_LIMIT = 999
DRIVE_FE_LIMIT = 999
VP_MODE = 5
INVERT_IN(111,ON)
OP(111,OFF)
FWD_JOG=111
INVERT_IN(110,ON)
OP(110,OFF)
REV_JOG=110

```

```

'Stop Axis 5 configuration

```

```

' Parasitic motion
COMP_RATIO(-1) AXIS(2)
COMP_RATIO(3, AXIS_UNITS AXIS(2) * 20, AXIS_UNITS AXIS(3) * 360) AXIS(2)

```

KINEMATIC_GROUP(0,1000,42,0,1,2,3,4,5)

TABLE_PROTECT(1000, 1100, 1) 'Protected table range for robot definition

'Stop Robot 0 configuration

'Stop Robots configuration