

Membrane Deformable Mirror Manual



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Contents

1	Introduction	3
1.1	History of Membrane Deformable Mirrors	3
1.1.1	Limited Membrane Deformable Mirror References	3
1.2	Device Operation	3
2	Usage.....	4
2.1	Warnings.....	4
2.2	Common Usage in Optical Setups	5
2.3	Mirror Surface Protection	5
2.4	Optical Setup Tips and Suggestions	5
3	Membrane Deformable Mirror Specifications	6
4	Appendix A: One-Inch MDM Actuator Patterns	7
4.1	31 Hexagonal Grid Actuator Pattern	7
4.2	25 Segmented Annular Actuator Pattern.....	9
4.3	32 Square Grid Actuator Pattern	11
4.4	33 Actuator Segmented Annular Grid Actuator Pattern.....	14
4.5	61 Hexagonal Grid Actuator Pattern	17
4.6	59 Segmented Annular Grid Actuator Pattern	20
4.7	61 Square Grid Actuator Pattern	23
5	Appendix B: 2" MDM Actuator Patterns	25
5.1	61 Hexagonal Grid Actuator Pattern	25
5.2	59 Segmented Annular Grid Actuator Pattern	27
5.3	61 Square Grid Actuator Pattern	29
6	Appendix C: Package Specifications.....	31
6.1	Original Package.....	31
6.2	New Package (after Fall 2009).....	32
6.3	Beam Tube Packaging (Fall 2011).....	33
6.3.1	3D CAD Renderings for 1" diameter MDM	33
6.4	Optical Mount – Original Package (before 2008)	34
6.5	Back Panel Drill Map for Original Interface Plate	34
6.6	Original MDM Interface Plate	35

1 Introduction

This manual begins with a brief introduction to membrane deformable mirrors, including a brief history and a summary of the theory of operation. Then there are some instructions on using the membrane deformable mirror, including some important warnings about its usage. It is important to read this manual in its entirety before using the membrane deformable mirror.

1.1 History of Membrane Deformable Mirrors

Membrane deformable mirrors (MDMs) have been in use for many years. Grosso *et al.* demonstrated a large metal membrane deformable mirror in 1977. MEMS community demonstrated several different types of membrane deformable mirrors over the years. Most people cite the work at JPL as the start of this effort, although Vdovin's work at Delft is most commonly known. In parallel with the work at Delft, Mansell at Stanford developed a new kind of membrane deformable mirror for use in high-power lasers that was a more advanced and scalable architecture.

There have been several efforts demonstrating nitrocellulose membrane deformable mirrors, including those by Zamkotsian and for use on the SUBARU telescope, but these have been costly to fabricate due to the choice of electrostatic backplane and the complex design. The membrane deformable mirror product introduced by AOS solves many of these problems.

1.1.1 Limited Membrane Deformable Mirror References

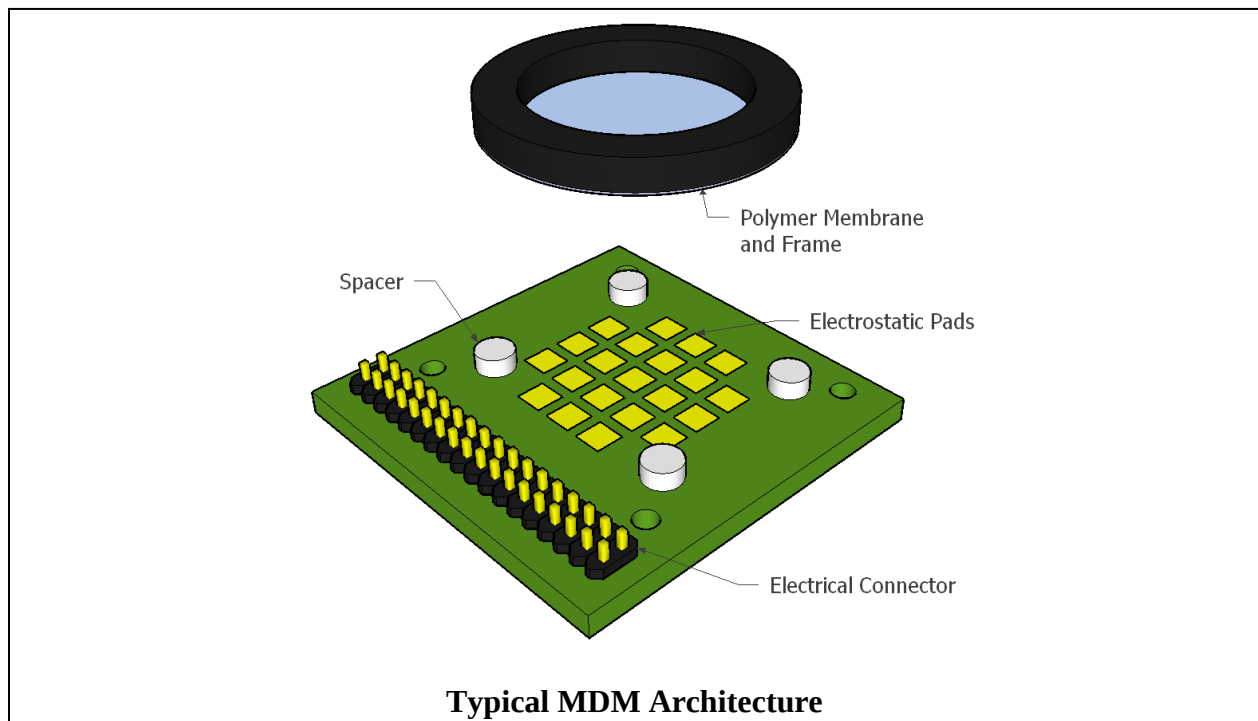
1. J. Mansell et al., "Micromachined silicon deformable mirror", SPIE Proc. 3353, p. 896-901.
2. J. Mansell, "Micromachined deformable mirrors for laser wavefront control", Doctoral Dissertation at Stanford University, February 2002.
3. J. Mansell et al., "Progress toward compact low-cost adaptive optics systems", DEPS Beam Control Meeting, Monterey, CA, March 2006.
4. G. Vdovin et al., "Flexible mirror micromachined in silicon", Applied Optics, 34(16), pp. 2968-2972, 1995.
5. R. Grosso et al., "The membrane mirror as an adaptive optical element", J. Opt. Soc. Am., 67(3), pp. 399-406, 1977.
6. F. Zamkotsian et al., "Polymer-based microdeformable mirror for adaptive optics", SPIE Proc. 5719, (2005).
7. H. Takami et al., "Membrane deformable mirror for SUBARU adaptive optics", SPIE Proc. 2201-78, 762-7 (1994).

1.2 Device Operation

This membrane deformable mirror device consists of a membrane mounted over an electrostatic pad array. The membrane is formed by stretching a thin piece of material over a stiff frame. Spacers are used to keep the membrane from coming in contact with the electrostatic pads and to maintain a proper distance between the mirror and the underlying pads.

This membrane deformable mirror is actuated with electrostatic force by applying a potential difference between the mirror membrane and the underlying surface. The electrostatic force is proportional to the voltage squared, so linear control systems must take this into account. Furthermore, since the voltage response is parabolic and the mechanical restoring force is linear, the mirror can enter an unstable state when the mirror displacement toward the electrostatic pads exceeds $\sim 1/3$ of the static gap between the mirror and the pads. In this state the mirror surface “snaps down” onto the underlying electrostatic pads, often causing damage to the mirror surface. This condition should be avoided at all costs by limiting the range of the mirror being used for adaptive optics.

The shape of the influence functions is different than those produced by a plate-type (Xinetics) deformable mirror because they are not as localized. In fact, the MDM influence functions always extend to the clamped edge. This fact means that the amplitude of high-spatial frequency aberrations is inherently limited with MDMs.



2 Usage

This section starts with important warnings about the proper use of a MDM. Then some important tips on the optical setup are included.

2.1 Warnings

- **Cleaning:** The MDM reflective surface cannot be cleaned. Do not blow off the mirror surface with any type of pressurized air or chemicals. This will probably damage the mirror and will result in voiding of the warranty. It is recommended

that the MDM be protected by a window. This can be accomplished using a SM1L05 or a SM1L03T mount from ThorLabs and a 1" window, such as a WL11050-C11 (for 610-860nm) from ThorLabs.

- **Snap-Down:** The AOS MDMs are designed to be driven up to 300 V without electrostatic snap-down, but there are some conditions that can induce snap-down. For example, if the mirror is driven on resonance, which is about 550Hz for a 1" diameter mirror, then the device can enter snap-down. This condition should be avoided because it often results in damage to the mirror surface. Any and all warranties expressed or implied by AOS will be voided by inducing an electrostatic snap-down event.
- **Laser-Induced Damage:** Standard AOS deformable mirrors are shipped with an aluminum coating for reflectivity. These coatings are not capable of handling high energy laser illumination. AOS is still working to establish these limits, so call AOS to determine limits for any pulsed laser use (Q-switched or mode-locked) or any high average power laser usage (>10mW at 633nm or a spot size on the mirror <1mm in diameter) . Any and all warranties expressed or implied by AOS will be voided by damaging the mirror with laser radiation.
- **Unusual Usage or Disassembly:** To avoid voiding the warranty, please contact AOS before doing anything not outlined as approved usage by AOS. Unapproved usage includes disassembly, use with an unapproved mount, or application of unusual conditions including extreme heat, cold, or vacuum.

2.2 Common Usage in Optical Setups

2.3 Mirror Surface Protection

The 1" diameter MDM is shipped with a cover that screws into the adapter on the front of the device. The adapter can be used to attach other optics to the front of the mirror surface using ThorLabs SM1-type adapters. It is highly recommended that the mirror be covered when not in use because the mirror surface cannot be cleaned. If this is not practical, then it is recommended that a 1" diameter window be used to protect the mirror. The 1" mirror can be adapted to the MDM case using an SM1L03 or SM1L05 from ThorLabs. If the reflections from the window need to be isolated, a SM1L03T can be used instead. It is recommended that the window be AR coated and wedged to help further isolate the Fresnel reflections from the window.

2.4 Optical Setup Tips and Suggestions

There are many different uses for deformable mirrors. Some common uses include:

- Aberration compensation including
 - Atmospheric Aberration Compensation
 - Aero-Optic Aberration Compensation
 - Static or Quasi-Static Optic Aberration Compensation
- Laser beam shaping for
 - Improved gain medium tapping
 - Improved non-linear optics efficiency
- Laser beam clean-up
- Dynamic focus

- Intra-cavity Q-switching
- Temporal pulse shaping

Below are some tips for using the MDM in common optical setups:

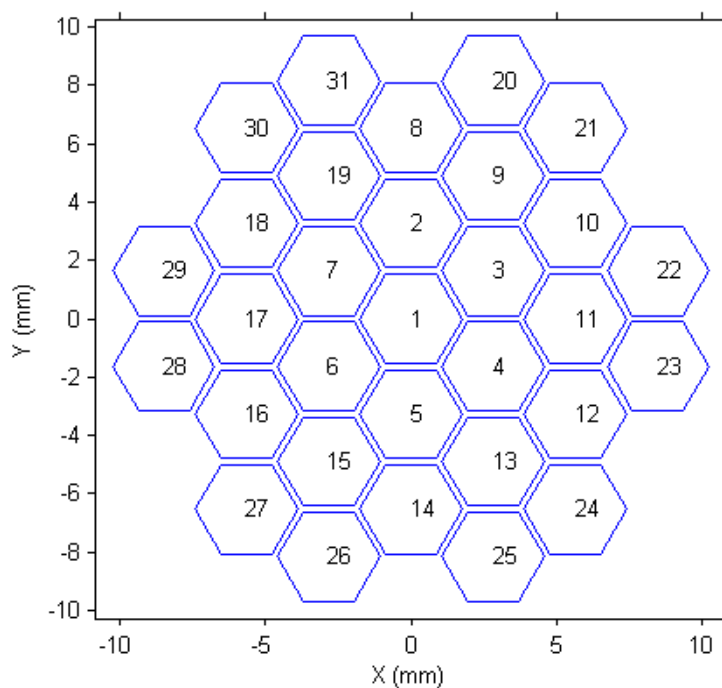
- **Focal Bias Compensation:** The MDM should be operated about a bias at about 70% of the total voltage range. This bias induces a focus on the mirror surface. This focus term can be compensated with a single optic, but is more commonly compensated with a telescope capable of removing the static curvature of the MDM.
- **Low-Power Pre-Compensation:** The MDM can be used to compensate for aberrations in lasers, but it is recommended that the MDM be placed in a low-power part of the laser whenever possible. For example, in a master-oscillator power-amplifier (MOPA) configuration, the MDM should be placed after the master oscillator and before the power-amplifier.
- **Noisy Environments:** The MDM does not perform well in very noisy environments because the sound can couple acoustic energy into the membrane surface. The MDM is designed for use in relatively quiet laboratory or industrial settings. Try to avoid using the MDM in such environments.
- **Voltage Control to the Membrane:** Some of the actuator patterns provide the capability for the user to change the voltage potential on the membrane surface. The MDM is deformed based on potential difference between the actuators and the membrane difference. If the membrane and the MDM actuators are set to the same voltage, the mirror will not deform.

3 Membrane Deformable Mirror Specifications

Specification	Value
Distance from Mirror Surface to Exposed Surface of SM1 Connector	0.8" (21 mm)
Approximate Actuator Capacitance	50 pF

4 Appendix A: One-Inch MDM Actuator Patterns

4.1 31 Hexagonal Grid Actuator Pattern



Mapping to 37-D Connector

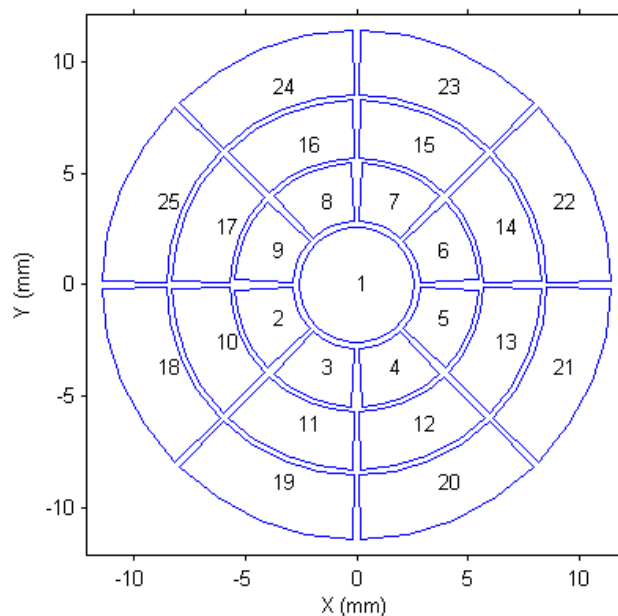
37-D Pin	Actuator
1	8
2	31
3	30
4	18
5	28
6	16
7	27
8	26
9	5
10	25
11	24
12	12
13	23
14	3
15	9
16	20
17	NC
18	NC
19	NC

20	2
21	19
22	7
23	29
24	17
25	6
26	15
27	14
28	1
29	13
30	4
31	11
32	22
33	10
34	21
35	Surface
36	NC
37	NC

Actuator Coordinates – x₁,y₁, x₂,y₂, ... (mm)

1: 0.88,1.52 , -0.88,1.52 , -1.76,0.00 , -0.88,-1.52 , 0.88,-1.52 , 1.76,0.00 , 0.88,1.52
2: 0.88,4.79 , -0.88,4.79 , -1.76,3.27 , -0.88,1.74 , 0.88,1.74 , 1.76,3.27 , 0.88,4.79
3: 3.71,3.16 , 1.95,3.16 , 1.07,1.63 , 1.95,0.11 , 3.71,0.11 , 4.59,1.63 , 3.71,3.16
4: 3.71,-0.11 , 1.95,-0.11 , 1.07,-1.63 , 1.95,-3.16 , 3.71,-3.16 , 4.59,-1.63 , 3.71,-0.11
5: 0.88,-1.74 , -0.88,-1.74 , -1.76,-3.27 , -0.88,-4.79 , 0.88,-4.79 , 1.76,-3.27 , 0.88,-1.74
6: -1.95,-0.11 , -3.71,-0.11 , -4.59,-1.63 , -3.71,-3.16 , -1.95,-3.16 , -1.07,-1.63 , -1.95,-0.11
7: -1.95,3.16 , -3.71,3.16 , -4.59,1.63 , -3.71,0.11 , -1.95,0.11 , -1.07,1.63 , -1.95,3.16
8: 0.88,8.05 , -0.88,8.05 , -1.76,6.53 , -0.88,5.01 , 0.88,5.01 , 1.76,6.53 , 0.88,8.05
9: 3.71,6.42 , 1.95,6.42 , 1.07,4.90 , 1.95,3.38 , 3.71,3.38 , 4.59,4.90 , 3.71,6.42
10: 6.54,4.79 , 4.78,4.79 , 3.90,3.27 , 4.78,1.74 , 6.54,1.74 , 7.42,3.27 , 6.54,4.79
11: 6.54,1.52 , 4.78,1.52 , 3.90,0.00 , 4.78,-1.52 , 6.54,-1.52 , 7.42,0.00 , 6.54,1.52
12: 6.54,-1.74 , 4.78,-1.74 , 3.90,-3.27 , 4.78,-4.79 , 6.54,-4.79 , 7.42,-3.27 , 6.54,-1.74
13: 3.71,-3.38 , 1.95,-3.38 , 1.07,-4.90 , 1.95,-6.42 , 3.71,-6.42 , 4.59,-4.90 , 3.71,-3.38
14: 0.88,-5.01 , -0.88,-5.01 , -1.76,-6.53 , -0.88,-8.05 , 0.88,-8.05 , 1.76,-6.53 , 0.88,-5.01
15: -1.95,-3.38 , -3.71,-3.38 , -4.59,-4.90 , -3.71,-6.42 , -1.95,-6.42 , -1.07,-4.90 , -1.95,-3.38
16: -4.78,-1.74 , -6.54,-1.74 , -7.42,-3.27 , -6.54,-4.79 , -4.78,-4.79 , -3.90,-3.27 , -4.78,-1.74
17: -4.78,1.52 , -6.54,1.52 , -7.42,0.00 , -6.54,-1.52 , -4.78,-1.52 , -3.90,0.00 , -4.78,1.52
18: -4.78,4.79 , -6.54,4.79 , -7.42,3.27 , -6.54,1.74 , -4.78,1.74 , -3.90,3.27 , -4.78,4.79
19: -1.95,6.42 , -3.71,6.42 , -4.59,4.90 , -3.71,3.38 , -1.95,3.38 , -1.07,4.90 , -1.95,6.42
20: 3.71,9.69 , 1.95,9.69 , 1.07,8.16 , 1.95,6.64 , 3.71,6.64 , 4.59,8.16 , 3.71,9.69
21: 6.54,8.05 , 4.78,8.05 , 3.90,6.53 , 4.78,5.01 , 6.54,5.01 , 7.42,6.53 , 6.54,8.05
22: 9.36,3.16 , 7.60,3.16 , 6.73,1.63 , 7.60,0.11 , 9.36,0.11 , 10.24,1.63 , 9.36,3.16
23: 9.36,-0.11 , 7.60,-0.11 , 6.73,-1.63 , 7.60,-3.16 , 9.36,-3.16 , 10.24,-1.63 , 9.36,-0.11
24: 6.54,-5.01 , 4.78,-5.01 , 3.90,-6.53 , 4.78,-8.05 , 6.54,-8.05 , 7.42,-6.53 , 6.54,-5.01
25: 3.71,-6.64 , 1.95,-6.64 , 1.07,-8.16 , 1.95,-9.69 , 3.71,-9.69 , 4.59,-8.16 , 3.71,-6.64
26: -1.95,-6.64 , -3.71,-6.64 , -4.59,-8.16 , -3.71,-9.69 , -1.95,-9.69 , -1.07,-8.16 , -1.95,-6.64
27: -4.78,-5.01 , -6.54,-5.01 , -7.42,-6.53 , -6.54,-8.05 , -4.78,-8.05 , -3.90,-6.53 , -4.78,-5.01
28: -7.60,-0.11 , -9.36,-0.11 , -10.24,-1.63 , -9.36,-3.16 , -7.60,-3.16 , -6.73,-1.63 , -7.60,-0.11
29: -7.60,3.16 , -9.36,3.16 , -10.24,1.63 , -9.36,0.11 , -7.60,0.11 , -6.73,1.63 , -7.60,3.16
30: -4.78,8.05 , -6.54,8.05 , -7.42,6.53 , -6.54,5.01 , -4.78,5.01 , -3.90,6.53 , -4.78,8.05
31: -1.95,9.69 , -3.71,9.69 , -4.59,8.16 , -3.71,6.64 , -1.95,6.64 , -1.07,8.16 , -1.95,9.69

4.2 25 Segmented Annular Actuator Pattern



Mapping to 37-D Connector

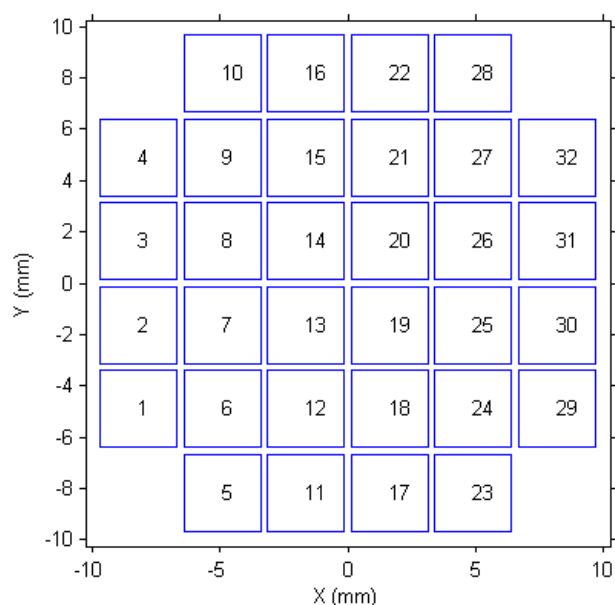
37-D Pin	Actuator
1	NC
2	NC
3	24
4	8
5	17
6	18
7	2
8	3
9	1
10	12
11	5
12	21
13	14
14	7
15	23
16	NC
17	NC
18	NC
19	NC

20	NC
21	NC
22	16
23	25
24	9
25	10
26	19
27	3
28	4
29	20
30	13
31	6
32	22
33	15
34	Surface
35	NC
36	NC
37	NC

Actuator Coordinates – x₁,y₁, x₂,y₂, ... (mm)

1: -2.60,0.03 , -2.55,0.54 , -2.38,1.06 , -2.11,1.53 , -1.74,1.94 , -1.30,2.25 , -0.81,2.48 , -0.27,2.59 , 0.27,2.59 , 0.81,2.48 , 1.30,2.25 , 1.74,1.94 , 2.11,1.53 , 2.38,1.06 , 2.55,0.54 , 2.60,0.00 , 2.55,-0.54 , 2.38,-1.06 , 2.11,-1.53 , 1.74,-1.94 , 1.30,-2.25 , 0.81,-2.48 , 0.27,-2.59 , -0.27,-2.59 , -0.81,-2.48 , -1.30,-2.25 , -1.74,-1.94 , -2.11,-1.53 , -2.38,-1.06 , -2.55,-0.54 , -2.60,0.00
2: -2.86,-0.13 , -2.79,-0.62 , -2.64,-1.09 , -2.41,-1.53 , -2.11,-1.93 , -4.03,-3.69 , -4.61,-2.93 , -5.04,-2.09 , -5.33,-1.18 , -5.46,-0.24 , -2.86,-0.13
3: -1.93,-2.11 , -1.53,-2.41 , -1.09,-2.64 , -0.62,-2.79 , -0.13,-2.86 , -0.24,-5.46 , -1.18,-5.33 , -2.09,-5.04 , -2.93,-4.61 , -3.69,-4.03 , -1.93,-2.11
4: 0.13,-2.86 , 0.62,-2.79 , 1.09,-2.64 , 1.53,-2.41 , 1.93,-2.11 , 3.69,-4.03 , 2.93,-4.61 , 2.09,-5.04 , 1.18,-5.33 , 0.24,-5.46 , 0.13,-2.86
5: 2.11,-1.93 , 2.41,-1.53 , 2.64,-1.09 , 2.79,-0.62 , 2.86,-0.13 , 5.46,-0.24 , 5.33,-1.18 , 5.04,-2.09 , 4.61,-2.93 , 4.03,-3.69 , 2.11,-1.93
6: 2.86,0.13 , 2.79,0.62 , 2.64,1.09 , 2.41,1.53 , 2.11,1.93 , 4.03,3.69 , 4.61,2.93 , 5.04,2.09 , 5.33,1.18 , 5.46,0.24 , 2.86,0.13
7: 1.93,2.11 , 1.53,2.41 , 1.09,2.64 , 0.62,2.79 , 0.13,2.86 , 0.24,5.46 , 1.18,5.33 , 2.09,5.04 , 2.93,4.61 , 3.69,4.03 , 1.93,2.11
8: -0.13,2.86 , -0.62,2.79 , -1.09,2.64 , -1.53,2.41 , -1.93,2.11 , -3.69,4.03 , -2.93,4.61 , -2.09,5.04 , -1.18,5.33 , -0.24,5.46 , -0.13,2.86
9: -2.11,1.93 , -2.41,1.53 , -2.64,1.09 , -2.79,0.62 , -2.86,0.13 , -5.46,0.24 , -5.33,1.18 , -5.04,2.09 , -4.61,2.93 , -4.03,3.69 , -2.11,1.93
10: -5.71,-0.13 , -5.59,-1.18 , -5.28,-2.19 , -4.79,-3.12 , -4.13,-3.95 , -6.01,-5.75 , -6.97,-4.54 , -7.68,-3.18 , -8.14,-1.71 , -8.32,-0.19 , -5.71,-0.13
11: -3.95,-4.13 , -3.12,-4.79 , -2.19,-5.28 , -1.18,-5.59 , -0.13,-5.71 , -0.19,-8.32 , -1.71,-8.14 , -3.18,-7.68 , -4.54,-6.97 , -5.75,-6.01 , -3.95,-4.13
12: 0.13,-5.71 , 1.18,-5.59 , 2.19,-5.28 , 3.12,-4.79 , 3.95,-4.13 , 5.75,-6.01 , 4.54,-6.97 , 3.18,-7.68 , 1.71,-8.14 , 0.19,-8.32 , 0.13,-5.71
13: 4.13,-3.95 , 4.79,-3.12 , 5.28,-2.19 , 5.59,-1.18 , 5.71,-0.13 , 8.32,-0.19 , 8.14,-1.71 , 7.68,-3.18 , 6.97,-4.54 , 6.01,-5.75 , 4.13,-3.95
14: 5.71,0.13 , 5.59,1.18 , 5.28,2.19 , 4.79,3.12 , 4.13,3.95 , 6.01,5.75 , 6.97,4.54 , 7.68,3.18 , 8.14,1.71 , 8.32,0.19 , 5.71,0.13
15: 3.95,4.13 , 3.12,4.79 , 2.19,5.28 , 1.18,5.59 , 0.13,5.71 , 0.19,8.32 , 1.71,8.14 , 3.18,7.68 , 4.54,6.97 , 5.75,6.01 , 3.95,4.13
16: -0.13,5.71 , -1.18,5.59 , -2.19,5.28 , -3.12,4.79 , -3.95,4.13 , -5.75,6.01 , -4.54,6.97 , -3.18,7.68 , -1.71,8.14 , -0.19,8.32 , -0.13,5.71
17: -4.13,3.95 , -4.79,3.12 , -5.28,2.19 , -5.59,1.18 , -5.71,0.13 , -8.32,0.19 , -8.14,1.71 , -7.68,3.18 , -6.97,4.54 , -6.01,5.75 , -4.13,3.95
18: -8.57,-0.13 , -8.39,-1.74 , -7.92,-3.28 , -7.16,-4.71 , -6.15,-5.97 , -8.20,-7.96 , -9.55,-6.28 , -10.56,-4.37 , -11.19,-2.31 , -11.43,-0.17 , -8.57,-0.13
19: -5.97,-6.15 , -4.71,-7.16 , -3.28,-7.92 , -1.74,-8.39 , -0.13,-8.57 , -0.17,-11.43 , -2.31,-11.19 , -4.37,-10.56 , -6.28,-9.55 , -7.96,-8.20 , -5.97,-6.15
20: 0.13,-8.57 , 1.74,-8.39 , 3.28,-7.92 , 4.71,-7.16 , 5.97,-6.15 , 7.96,-8.20 , 6.28,-9.55 , 4.37,-10.56 , 2.31,-11.19 , 0.17,-11.43 , 0.13,-8.57
21: 6.15,-5.97 , 7.16,-4.71 , 7.92,-3.28 , 8.39,-1.74 , 8.57,-0.13 , 11.43,-0.17 , 11.19,-2.31 , 10.56,-4.37 , 9.55,-6.28 , 8.20,-7.96 , 6.15,-5.97
22: 8.57,0.13 , 8.39,1.74 , 7.92,3.28 , 7.16,4.71 , 6.15,5.97 , 8.20,7.96 , 9.55,6.28 , 10.56,4.37 , 11.19,2.31 , 11.43,0.17 , 8.57,0.13
23: 5.97,6.15 , 4.71,7.16 , 3.28,7.92 , 1.74,8.39 , 0.13,8.57 , 0.17,11.43 , 2.31,11.19 , 4.37,10.56 , 6.28,9.55 , 7.96,8.20 , 5.97,6.15
24: -0.13,8.57 , -1.74,8.39 , -3.28,7.92 , -4.71,7.16 , -5.97,6.15 , -7.96,8.20 , -6.28,9.55 , -4.37,10.56 , -2.31,11.19 , -0.17,11.43 , -0.13,8.57
25: -6.15,5.97 , -7.16,4.71 , -7.92,3.28 , -8.39,1.74 , -8.57,0.13 , -11.43,0.17 , -11.19,2.31 , -10.56,4.37 , -9.55,6.28 , -8.20,7.96 , -6.15,5.97

4.3 32 Square Grid Actuator Pattern



Mapping to 37-D Connector – Standard Package

37-D Pin	Actuator
1	14
2	16
3	15
4	4
5	2
6	8
7	6
8	12
9	17
10	23
11	25
12	29
13	31
14	27
15	28
16	20
17	Surf
18	NC
19	NC

20	13
21	10
22	9
23	3
24	1
25	7
26	5
27	11
28	18
29	24
30	26
31	30
32	32
33	21
34	22
35	19
36	NC
37	NC

Mapping to 37-D Connector – Beam Tube Package (-4 part number)

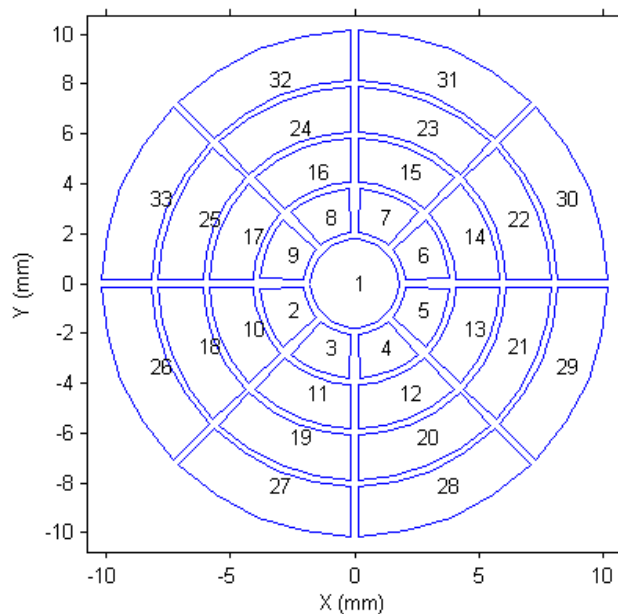
37D Pin	Actuator	37D Pin	Actuator
1	7	20	26
2	1	21	27
3	2	22	28
4	3	23	22
5	4	24	10
6	9	25	16
7	8	26	15
8	14	27	21
9	13	28	20
10	12	29	19
11	18	30	25
12	17	31	24
13	23	32	29
14	11	33	30
15	5	34	31
16	6	35	32

Actuator Coordinates – x₁,y₁, x₂,y₂, ... (mm)

1: -6.66,-3.39 , -6.66,-6.40 , -9.67,-6.40 , -9.67,-3.39 , -6.66,-3.39
 2: -6.66,-0.13 , -6.66,-3.14 , -9.67,-3.14 , -9.67,-0.13 , -6.66,-0.13
 3: -6.66,3.14 , -6.66,0.13 , -9.67,0.13 , -9.67,3.14 , -6.66,3.14
 4: -6.66,6.40 , -6.66,3.39 , -9.67,3.39 , -9.67,6.40 , -6.66,6.40
 5: -3.39,-6.66 , -3.39,-9.67 , -6.40,-9.67 , -6.40,-6.66 , -3.39,-6.66
 6: -3.39,-3.39 , -3.39,-6.40 , -6.40,-6.40 , -6.40,-3.39 , -3.39,-3.39
 7: -3.39,-0.13 , -3.39,-3.14 , -6.40,-3.14 , -6.40,-0.13 , -3.39,-0.13
 8: -3.39,3.14 , -3.39,0.13 , -6.40,0.13 , -6.40,3.14 , -3.39,3.14
 9: -3.39,6.40 , -3.39,3.39 , -6.40,3.39 , -6.40,6.40 , -3.39,6.40
 10: -3.39,9.67 , -3.39,6.66 , -6.40,6.66 , -6.40,9.67 , -3.39,9.67
 11: -0.13,-6.66 , -0.13,-9.67 , -3.14,-9.67 , -3.14,-6.66 , -0.13,-6.66
 12: -0.13,-3.39 , -0.13,-6.40 , -3.14,-6.40 , -3.14,-3.39 , -0.13,-3.39
 13: -0.13,-0.13 , -0.13,-3.14 , -3.14,-3.14 , -3.14,-0.13 , -0.13,-0.13
 14: -0.13,3.14 , -0.13,0.13 , -3.14,0.13 , -3.14,3.14 , -0.13,3.14
 15: -0.13,6.40 , -0.13,3.39 , -3.14,3.39 , -3.14,6.40 , -0.13,6.40
 16: -0.13,9.67 , -0.13,6.66 , -3.14,6.66 , -3.14,9.67 , -0.13,9.67
 17: 3.14,-6.66 , 3.14,-9.67 , 0.13,-9.67 , 0.13,-6.66 , 3.14,-6.66
 18: 3.14,-3.39 , 3.14,-6.40 , 0.13,-6.40 , 0.13,-3.39 , 3.14,-3.39
 19: 3.14,-0.13 , 3.14,-3.14 , 0.13,-3.14 , 0.13,-0.13 , 3.14,-0.13
 20: 3.14,3.14 , 3.14,0.13 , 0.13,0.13 , 0.13,3.14 , 3.14,3.14
 21: 3.14,6.40 , 3.14,3.39 , 0.13,3.39 , 0.13,6.40 , 3.14,6.40
 22: 3.14,9.67 , 3.14,6.66 , 0.13,6.66 , 0.13,9.67 , 3.14,9.67

23: 6.40,-6.66 , 6.40,-9.67 , 3.39,-9.67 , 3.39,-6.66 , 6.40,-6.66
24: 6.40,-3.39 , 6.40,-6.40 , 3.39,-6.40 , 3.39,-3.39 , 6.40,-3.39
25: 6.40,-0.13 , 6.40,-3.14 , 3.39,-3.14 , 3.39,-0.13 , 6.40,-0.13
26: 6.40,3.14 , 6.40,0.13 , 3.39,0.13 , 3.39,3.14 , 6.40,3.14
27: 6.40,6.40 , 6.40,3.39 , 3.39,3.39 , 3.39,6.40 , 6.40,6.40
28: 6.40,9.67 , 6.40,6.66 , 3.39,6.66 , 3.39,9.67 , 6.40,9.67
29: 9.67,-3.39 , 9.67,-6.40 , 6.66,-6.40 , 6.66,-3.39 , 9.67,-3.39
30: 9.67,-0.13 , 9.67,-3.14 , 6.66,-3.14 , 6.66,-0.13 , 9.67,-0.13
31: 9.67,3.14 , 9.67,0.13 , 6.66,0.13 , 6.66,3.14 , 9.67,3.14
32: 9.67,6.40 , 9.67,3.39 , 6.66,3.39 , 6.66,6.40 , 9.67,6.40

4.4 33 Actuator Segmented Annular Grid Actuator Pattern



NOTE: Actuators 1 and 2 are electrically connected to make this compatible with a set of 32-channel drive electronics and still useable in beam shaping applications.

Mapping to 37-D Connector and Software Channel

Act #	Software	Act #	Software
1	13	18	20
2	22	19	16
3	18	20	14
4	12	21	10
5	8	22	6
6	4	23	2
7	0	24	28
8	30	25	24
9	26	26	21
10	23	27	17
11	19	28	9
12	15	29	5
13	11	30	1
14	7	31	17
15	3	32	29
16	31	33	25
17	27		

37D	Act #	37D	Act #
1	32	20	24
2	16	21	8
3	33	22	25
4	17	23	9
5	26	24	18
6	10	25	2
7	27	26	19
8	11	27	3
9	1	28	4
10	12	29	20
11	28	30	5
12	13	31	21
13	29	32	6
14	14	33	22
15	30	34	7
16	15	35	23

Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

1: -1.78,0.03 , -1.74,0.37 , -1.62,0.72 , -1.44,1.04 , -1.19,1.32 , -0.89,1.54 , -0.55,1.69 , -0.19,1.77 ,
0.19,1.77 , 0.55,1.69 , 0.89,1.54 , 1.19,1.32 , 1.44,1.04 , 1.62,0.72 , 1.74,0.37 , 1.78,0.00 ,
1.74,-0.37 , 1.62,-0.72 , 1.44,-1.04 , 1.19,-1.32 , 0.89,-1.54 , 0.55,-1.69 , 0.19,-1.77 , -0.19,-
1.77 , -0.55,-1.69 , -0.89,-1.54 , -1.19,-1.32 , -1.44,-1.04 , -1.62,-0.72 , -1.74,-0.37 , -1.78,-
0.00

2: -2.03,-0.13 , -1.98,-0.46 , -1.88,-0.78 , -1.72,-1.08 , -1.52,-1.35 , -2.86,-2.52 , -3.23,-2.02 , -3.52,-
1.46 , -3.71,-0.86 , -3.80,-0.24 , -2.03,-0.13

3: -1.35,-1.52 , -1.08,-1.72 , -0.78,-1.88 , -0.46,-1.98 , -0.13,-2.03 , -0.24,-3.80 , -0.86,-3.71 , -1.46,-
3.52 , -2.02,-3.23 , -2.52,-2.86 , -1.35,-1.52

4: 0.13,-2.03 , 0.46,-1.98 , 0.78,-1.88 , 1.08,-1.72 , 1.35,-1.52 , 2.52,-2.86 , 2.02,-3.23 , 1.46,-3.52 ,
0.86,-3.71 , 0.24,-3.80 , 0.13,-2.03

5: 1.52,-1.35 , 1.72,-1.08 , 1.88,-0.78 , 1.98,-0.46 , 2.03,-0.13 , 3.80,-0.24 , 3.71,-0.86 , 3.52,-1.46 ,
3.23,-2.02 , 2.86,-2.52 , 1.52,-1.35

6: 2.03,0.13 , 1.98,0.46 , 1.88,0.78 , 1.72,1.08 , 1.52,1.35 , 2.86,2.52 , 3.23,2.02 , 3.52,1.46 ,
3.71,0.86 , 3.80,0.24 , 2.03,0.13

7: 1.35,1.52 , 1.08,1.72 , 0.78,1.88 , 0.46,1.98 , 0.13,2.03 , 0.24,3.80 , 0.86,3.71 , 1.46,3.52 ,
2.02,3.23 , 2.52,2.86 , 1.35,1.52

8: -0.13,2.03 , -0.46,1.98 , -0.78,1.88 , -1.08,1.72 , -1.35,1.52 , -2.52,2.86 , -2.02,3.23 , -1.46,3.52 , -
0.86,3.71 , -0.24,3.80 , -0.13,2.03

9: -1.52,1.35 , -1.72,1.08 , -1.88,0.78 , -1.98,0.46 , -2.03,0.13 , -3.80,0.24 , -3.71,0.86 , -3.52,1.46 , -
3.23,2.02 , -2.86,2.52 , -1.52,1.35

10: -4.06,-0.13 , -3.97,-0.85 , -3.75,-1.55 , -3.41,-2.21 , -2.96,-2.78 , -4.26,-4.00 , -4.91,-3.17 , -5.40,-
2.24 , -5.71,-1.23 , -5.84,-0.18 , -4.06,-0.13

11: -2.78,-2.96 , -2.21,-3.41 , -1.55,-3.75 , -0.85,-3.97 , -0.13,-4.06 , -0.18,-5.84 , -1.23,-5.71 , -2.24,-
5.40 , -3.17,-4.91 , -4.00,-4.26 , -2.78,-2.96

12: 0.13,-4.06 , 0.85,-3.97 , 1.55,-3.75 , 2.21,-3.41 , 2.78,-2.96 , 4.00,-4.26 , 3.17,-4.91 , 2.24,-5.40 ,
1.23,-5.71 , 0.18,-5.84 , 0.13,-4.06

13: 2.96,-2.78 , 3.41,-2.21 , 3.75,-1.55 , 3.97,-0.85 , 4.06,-0.13 , 5.84,-0.18 , 5.71,-1.23 , 5.40,-2.24 ,
4.91,-3.17 , 4.26,-4.00 , 2.96,-2.78

14: 4.06,0.13 , 3.97,0.85 , 3.75,1.55 , 3.41,2.21 , 2.96,2.78 , 4.26,4.00 , 4.91,3.17 , 5.40,2.24 ,
5.71,1.23 , 5.84,0.18 , 4.06,0.13

15: 2.78,2.96 , 2.21,3.41 , 1.55,3.75 , 0.85,3.97 , 0.13,4.06 , 0.18,5.84 , 1.23,5.71 , 2.24,5.40 ,
3.17,4.91 , 4.00,4.26 , 2.78,2.96

16: -0.13,4.06 , -0.85,3.97 , -1.55,3.75 , -2.21,3.41 , -2.78,2.96 , -4.00,4.26 , -3.17,4.91 , -2.24,5.40 ,
-1.23,5.71 , -0.18,5.84 , -0.13,4.06

17: -2.96,2.78 , -3.41,2.21 , -3.75,1.55 , -3.97,0.85 , -4.06,0.13 , -5.84,0.18 , -5.71,1.23 , -5.40,2.24 ,
-4.91,3.17 , -4.26,4.00 , -2.96,2.78

18: -6.09,-0.13 , -5.97,-1.25 , -5.63,-2.33 , -5.10,-3.33 , -4.40,-4.22 , -5.68,-5.45 , -6.59,-4.31 , -7.28,-
3.01 , -7.71,-1.62 , -7.87,-0.16 , -6.09,-0.13

19: -4.22,-4.40 , -3.33,-5.10 , -2.33,-5.63 , -1.25,-5.97 , -0.13,-6.09 , -0.16,-7.87 , -1.62,-7.71 , -3.01,-
7.28 , -4.31,-6.59 , -5.45,-5.68 , -4.22,-4.40

20: 0.13,-6.09 , 1.25,-5.97 , 2.33,-5.63 , 3.33,-5.10 , 4.22,-4.40 , 5.45,-5.68 , 4.31,-6.59 , 3.01,-7.28 ,
1.62,-7.71 , 0.16,-7.87 , 0.13,-6.09

21: 4.40,-4.22 , 5.10,-3.33 , 5.63,-2.33 , 5.97,-1.25 , 6.09,-0.13 , 7.87,-0.16 , 7.71,-1.62 , 7.28,-3.01 ,
6.59,-4.31 , 5.68,-5.45 , 4.40,-4.22

22: 6.09,0.13 , 5.97,1.25 , 5.63,2.33 , 5.10,3.33 , 4.40,4.22 , 5.68,5.45 , 6.59,4.31 , 7.28,3.01 ,
7.71,1.62 , 7.87,0.16 , 6.09,0.13

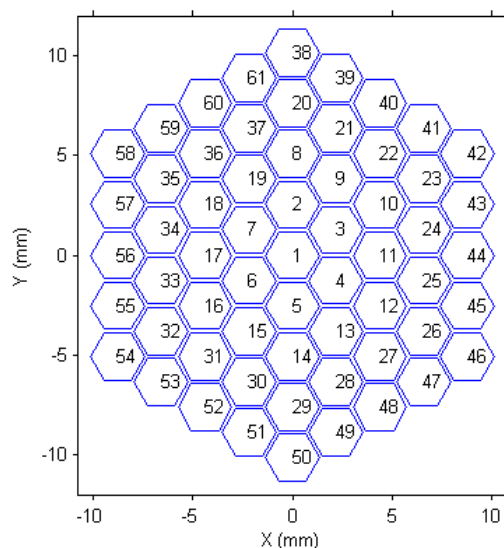
23: 4.22,4.40 , 3.33,5.10 , 2.33,5.63 , 1.25,5.97 , 0.13,6.09 , 0.16,7.87 , 1.62,7.71 , 3.01,7.28 ,
4.31,6.59 , 5.45,5.68 , 4.22,4.40

24: -0.13,6.09 , -1.25,5.97 , -2.33,5.63 , -3.33,5.10 , -4.22,4.40 , -5.45,5.68 , -4.31,6.59 , -3.01,7.28 ,
-1.62,7.71 , -0.16,7.87 , -0.13,6.09

25: -4.40,4.22 , -5.10,3.33 , -5.63,2.33 , -5.97,1.25 , -6.09,0.13 , -7.87,0.16 , -7.71,1.62 , -7.28,3.01 ,
-6.59,4.31 , -5.68,5.45 , -4.40,4.22

26: -8.13,-0.13 , -7.96,-1.65 , -7.51,-3.11 , -6.79,-4.46 , -5.84,-5.66 , -7.30,-7.07 , -8.49,-5.58 , -9.39,-3.89 , -9.95,-2.06 , -10.16,-0.16 , -8.13,-0.13
 27: -5.66,-5.84 , -4.46,-6.79 , -3.11,-7.51 , -1.65,-7.96 , -0.13,-8.13 , -0.16,-10.16 , -2.06,-9.95 , -3.89,-9.39 , -5.58,-8.49 , -7.07,-7.30 , -5.66,-5.84
 28: 0.13,-8.13 , 1.65,-7.96 , 3.11,-7.51 , 4.46,-6.79 , 5.66,-5.84 , 7.07,-7.30 , 5.58,-8.49 , 3.89,-9.39 , 2.06,-9.95 , 0.16,-10.16 , 0.13,-8.13
 29: 5.84,-5.66 , 6.79,-4.46 , 7.51,-3.11 , 7.96,-1.65 , 8.13,-0.13 , 10.16,-0.16 , 9.95,-2.06 , 9.39,-3.89 , 8.49,-5.58 , 7.30,-7.07 , 5.84,-5.66
 30: 8.13,0.13 , 7.96,1.65 , 7.51,3.11 , 6.79,4.46 , 5.84,5.66 , 7.30,7.07 , 8.49,5.58 , 9.39,3.89 , 9.95,2.06 , 10.16,0.16 , 8.13,0.13
 31: 5.66,5.84 , 4.46,6.79 , 3.11,7.51 , 1.65,7.96 , 0.13,8.13 , 0.16,10.16 , 2.06,9.95 , 3.89,9.39 , 5.58,8.49 , 7.07,7.30 , 5.66,5.84
 32: -0.13,8.13 , -1.65,7.96 , -3.11,7.51 , -4.46,6.79 , -5.66,5.84 , -7.07,7.30 , -5.58,8.49 , -3.89,9.39 , -2.06,9.95 , -0.16,10.16 , -0.13,8.13
 33: -5.84,5.66 , -6.79,4.46 , -7.51,3.11 , -7.96,1.65 , -8.13,0.13 , -10.16,0.16 , -9.95,2.06 , -9.39,3.89 , -8.49,5.58 , -7.30,7.07 , -5.84,5.66

4.5 61 Hexagonal Grid Actuator Pattern



Mapping to 37-D Connectors

	37D1	37D2		37D1	37D2
37D pin	Act #	Act #	37D pin	Act #	Act #
1	17	43	20	56	44
2	55	23	21	33	24
3	32	10	22	16	42
4	6	2	23	54	3
5	15	22	24	1	41
6	31	40	25	53	9
7	52	8	26	5	21
8	14	20	27	30	39
9	29	19	28	51	38
10	49	61	29	50	37
11	13	60	30	28	7
12	48	18	31	4	36
13	12	35	32	27	59
14	47	58	33	11	34
15	25	M	34	26	57
16	45	NC	35	46	NC

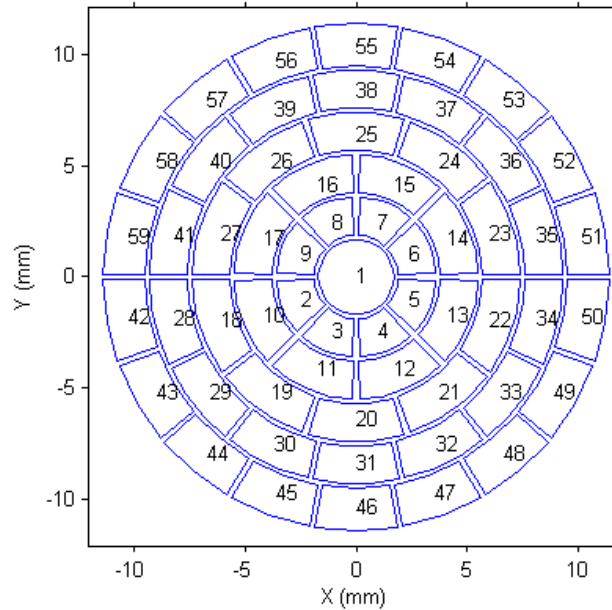
Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

- 0.68,1.18 , -0.68,1.18 , -1.37,0.00 , -0.68,-1.18 , 0.68,-1.18 , 1.37,0.00 , 0.68,1.18
- 0.68,3.72 , -0.68,3.72 , -1.37,2.54 , -0.68,1.36 , 0.68,1.36 , 1.37,2.54 , 0.68,3.72
- 2.88,2.45 , 1.52,2.45 , 0.84,1.27 , 1.52,0.09 , 2.88,0.09 , 3.56,1.27 , 2.88,2.45
- 2.88,-0.09 , 1.52,-0.09 , 0.84,-1.27 , 1.52,-2.45 , 2.88,-2.45 , 3.56,-1.27 , 2.88,-0.09
- 0.68,-1.36 , -0.68,-1.36 , -1.37,-2.54 , -0.68,-3.72 , 0.68,-3.72 , 1.37,-2.54 , 0.68,-1.36
- 1.52,-0.09 , -2.88,-0.09 , -3.56,-1.27 , -2.88,-2.45 , -1.52,-2.45 , -0.84,-1.27 , -1.52,-0.09
- 1.52,2.45 , -2.88,2.45 , -3.56,1.27 , -2.88,0.09 , -1.52,0.09 , -0.84,1.27 , -1.52,2.45
- 0.68,6.26 , -0.68,6.26 , -1.37,5.08 , -0.68,3.90 , 0.68,3.90 , 1.37,5.08 , 0.68,6.26
- 2.88,4.99 , 1.52,4.99 , 0.84,3.81 , 1.52,2.63 , 2.88,2.63 , 3.56,3.81 , 2.88,4.99

10: 5.08,3.72 , 3.72,3.72 , 3.04,2.54 , 3.72,1.36 , 5.08,1.36 , 5.76,2.54 , 5.08,3.72
11: 5.08,1.18 , 3.72,1.18 , 3.04,0.00 , 3.72,-1.18 , 5.08,-1.18 , 5.76,0.00 , 5.08,1.18
12: 5.08,-1.36 , 3.72,-1.36 , 3.04,-2.54 , 3.72,-3.72 , 5.08,-3.72 , 5.76,-2.54 , 5.08,-1.36
13: 2.88,-2.63 , 1.52,-2.63 , 0.84,-3.81 , 1.52,-4.99 , 2.88,-4.99 , 3.56,-3.81 , 2.88,-2.63
14: 0.68,-3.90 , -0.68,-3.90 , -1.37,-5.08 , -0.68,-6.26 , 0.68,-6.26 , 1.37,-5.08 , 0.68,-3.90
15: -1.52,-2.63 , -2.88,-2.63 , -3.56,-3.81 , -2.88,-4.99 , -1.52,-4.99 , -0.84,-3.81 , -1.52,-2.63
16: -3.72,-1.36 , -5.08,-1.36 , -5.76,-2.54 , -5.08,-3.72 , -3.72,-3.72 , -3.04,-2.54 , -3.72,-1.36
17: -3.72,1.18 , -5.08,1.18 , -5.76,0.00 , -5.08,-1.18 , -3.72,-1.18 , -3.04,0.00 , -3.72,1.18
18: -3.72,3.72 , -5.08,3.72 , -5.76,2.54 , -5.08,1.36 , -3.72,1.36 , -3.04,2.54 , -3.72,3.72
19: -1.52,4.99 , -2.88,4.99 , -3.56,3.81 , -2.88,2.63 , -1.52,2.63 , -0.84,3.81 , -1.52,4.99
20: 0.68,8.80 , -0.68,8.80 , -1.37,7.62 , -0.68,6.44 , 0.68,6.44 , 1.37,7.62 , 0.68,8.80
21: 2.88,7.53 , 1.52,7.53 , 0.84,6.35 , 1.52,5.17 , 2.88,5.17 , 3.56,6.35 , 2.88,7.53
22: 5.08,6.26 , 3.72,6.26 , 3.04,5.08 , 3.72,3.90 , 5.08,3.90 , 5.76,5.08 , 5.08,6.26
23: 7.28,4.99 , 5.92,4.99 , 5.23,3.81 , 5.92,2.63 , 7.28,2.63 , 7.96,3.81 , 7.28,4.99
24: 7.28,2.45 , 5.92,2.45 , 5.23,1.27 , 5.92,0.09 , 7.28,0.09 , 7.96,1.27 , 7.28,2.45
25: 7.28,-0.09 , 5.92,-0.09 , 5.23,-1.27 , 5.92,-2.45 , 7.28,-2.45 , 7.96,-1.27 , 7.28,-0.09
26: 7.28,-2.63 , 5.92,-2.63 , 5.23,-3.81 , 5.92,-4.99 , 7.28,-4.99 , 7.96,-3.81 , 7.28,-2.63
27: 5.08,-3.90 , 3.72,-3.90 , 3.04,-5.08 , 3.72,-6.26 , 5.08,-6.26 , 5.76,-5.08 , 5.08,-3.90
28: 2.88,-5.17 , 1.52,-5.17 , 0.84,-6.35 , 1.52,-7.53 , 2.88,-7.53 , 3.56,-6.35 , 2.88,-5.17
29: 0.68,-6.44 , -0.68,-6.44 , -1.37,-7.62 , -0.68,-8.80 , 0.68,-8.80 , 1.37,-7.62 , 0.68,-6.44
30: -1.52,-5.17 , -2.88,-5.17 , -3.56,-6.35 , -2.88,-7.53 , -1.52,-7.53 , -0.84,-6.35 , -1.52,-5.17
31: -3.72,-3.90 , -5.08,-3.90 , -5.76,-5.08 , -5.08,-6.26 , -3.72,-6.26 , -3.04,-5.08 , -3.72,-3.90
32: -5.92,-2.63 , -7.28,-2.63 , -7.96,-3.81 , -7.28,-4.99 , -5.92,-4.99 , -5.23,-3.81 , -5.92,-2.63
33: -5.92,-0.09 , -7.28,-0.09 , -7.96,-1.27 , -7.28,-2.45 , -5.92,-2.45 , -5.23,-1.27 , -5.92,-0.09
34: -5.92,2.45 , -7.28,2.45 , -7.96,1.27 , -7.28,0.09 , -5.92,0.09 , -5.23,1.27 , -5.92,2.45
35: -5.92,4.99 , -7.28,4.99 , -7.96,3.81 , -7.28,2.63 , -5.92,2.63 , -5.23,3.81 , -5.92,4.99
36: -3.72,6.26 , -5.08,6.26 , -5.76,5.08 , -5.08,3.90 , -3.72,3.90 , -3.04,5.08 , -3.72,6.26
37: -1.52,7.53 , -2.88,7.53 , -3.56,6.35 , -2.88,5.17 , -1.52,5.17 , -0.84,6.35 , -1.52,7.53
38: 0.68,11.34 , -0.68,11.34 , -1.37,10.16 , -0.68,8.98 , 0.68,8.98 , 1.37,10.16 , 0.68,11.34
39: 2.88,10.07 , 1.52,10.07 , 0.84,8.89 , 1.52,7.71 , 2.88,7.71 , 3.56,8.89 , 2.88,10.07
40: 5.08,8.80 , 3.72,8.80 , 3.04,7.62 , 3.72,6.44 , 5.08,6.44 , 5.76,7.62 , 5.08,8.80
41: 7.28,7.53 , 5.92,7.53 , 5.23,6.35 , 5.92,5.17 , 7.28,5.17 , 7.96,6.35 , 7.28,7.53
42: 9.48,6.26 , 8.12,6.26 , 7.43,5.08 , 8.12,3.90 , 9.48,3.90 , 10.16,5.08 , 9.48,6.26
43: 9.48,3.72 , 8.12,3.72 , 7.43,2.54 , 8.12,1.36 , 9.48,1.36 , 10.16,2.54 , 9.48,3.72
44: 9.48,1.18 , 8.12,1.18 , 7.43,0.00 , 8.12,-1.18 , 9.48,-1.18 , 10.16,0.00 , 9.48,1.18
45: 9.48,-1.36 , 8.12,-1.36 , 7.43,-2.54 , 8.12,-3.72 , 9.48,-3.72 , 10.16,-2.54 , 9.48,-1.36
46: 9.48,-3.90 , 8.12,-3.90 , 7.43,-5.08 , 8.12,-6.26 , 9.48,-6.26 , 10.16,-5.08 , 9.48,-3.90
47: 7.28,-5.17 , 5.92,-5.17 , 5.23,-6.35 , 5.92,-7.53 , 7.28,-7.53 , 7.96,-6.35 , 7.28,-5.17
48: 5.08,-6.44 , 3.72,-6.44 , 3.04,-7.62 , 3.72,-8.80 , 5.08,-8.80 , 5.76,-7.62 , 5.08,-6.44
49: 2.88,-7.71 , 1.52,-7.71 , 0.84,-8.89 , 1.52,-10.07 , 2.88,-10.07 , 3.56,-8.89 , 2.88,-7.71
50: 0.68,-8.98 , -0.68,-8.98 , -1.37,-10.16 , -0.68,-11.34 , 0.68,-11.34 , 1.37,-10.16 , 0.68,-8.98
51: -1.52,-7.71 , -2.88,-7.71 , -3.56,-8.89 , -2.88,-10.07 , -1.52,-10.07 , -0.84,-8.89 , -1.52,-7.71
52: -3.72,-6.44 , -5.08,-6.44 , -5.76,-7.62 , -5.08,-8.80 , -3.72,-8.80 , -3.04,-7.62 , -3.72,-6.44
53: -5.92,-5.17 , -7.28,-5.17 , -7.96,-6.35 , -7.28,-7.53 , -5.92,-7.53 , -5.23,-6.35 , -5.92,-5.17
54: -8.12,-3.90 , -9.48,-3.90 , -10.16,-5.08 , -9.48,-6.26 , -8.12,-6.26 , -7.43,-5.08 , -8.12,-3.90
55: -8.12,-1.36 , -9.48,-1.36 , -10.16,-2.54 , -9.48,-3.72 , -8.12,-3.72 , -7.43,-2.54 , -8.12,-1.36
56: -8.12,1.18 , -9.48,1.18 , -10.16,0.00 , -9.48,-1.18 , -8.12,-1.18 , -7.43,0.00 , -8.12,1.18

57: -8.12,3.72 , -9.48,3.72 , -10.16,2.54 , -9.48,1.36 , -8.12,1.36 , -7.43,2.54 , -8.12,3.72
58: -8.12,6.26 , -9.48,6.26 , -10.16,5.08 , -9.48,3.90 , -8.12,3.90 , -7.43,5.08 , -8.12,6.26
59: -5.92,7.53 , -7.28,7.53 , -7.96,6.35 , -7.28,5.17 , -5.92,5.17 , -5.23,6.35 , -5.92,7.53
60: -3.72,8.80 , -5.08,8.80 , -5.76,7.62 , -5.08,6.44 , -3.72,6.44 , -3.04,7.62 , -3.72,8.80
61: -1.52,10.07 , -2.88,10.07 , -3.56,8.89 , -2.88,7.71 , -1.52,7.71 , -0.84,8.89 , -1.52,10.07

4.6 59 Segmented Annular Grid Actuator Pattern



Mapping to 37-D Connectors

	37D1	37D2		37D1	37D2
37D pin	Act #	Act #	37D pin	Act #	Act #
1	2	14	20	1	6
2	42	51	21	10	23
3	18	7	22	28	35
4	11	52	23	3	15
5	29	24	24	43	36
6	44	37	25	19	53
7	45	25	26	30	54
8	31	55	27	20	38
9	4	16	28	46	8
10	21	39	29	12	56
11	32	57	30	47	26
12	33	58	31	48	40
13	22	27	32	49	17
14	50	59	33	34	41
15	5	M	34	13	9
16	NC	NC	35	NC	NC

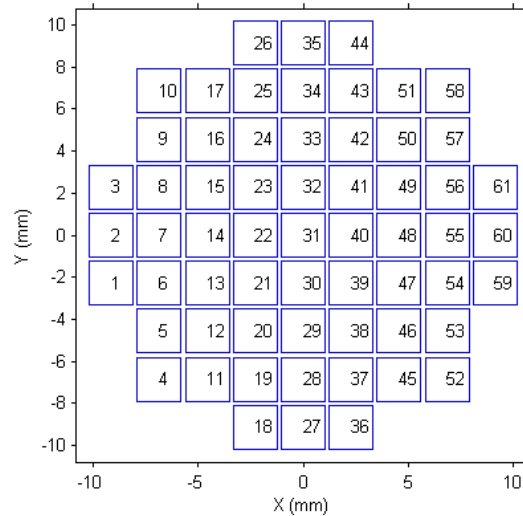
Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

1: -1.70,0.03 , -1.67,0.35 , -1.55,0.69 , -1.38,1.00 , -1.14,1.27 , -0.85,1.47 , -0.53,1.62 , -0.18,1.69 , 0.18,1.69 , 0.53,1.62 , 0.85,1.47 , 1.14,1.27 , 1.38,1.00 , 1.55,0.69 , 1.67,0.35 , 1.70,0.00 , 1.67,-0.35 , 1.55,-0.69 , 1.38,-1.00 , 1.14,-1.27 , 0.85,-1.47 , 0.53,-1.62 , 0.18,-1.69 , -0.18,-1.69 , -0.53,-1.62 , -0.85,-1.47 , -1.14,-1.27 , -1.38,-1.00 , -1.55,-0.69 , -1.67,-0.35 , -1.70,0.00
 2: -1.90,-0.10 , -1.86,-0.42 , -1.76,-0.73 , -1.61,-1.02 , -1.42,-1.27 , -2.68,-2.41 , -3.05,-1.92 , -3.33,-1.38 , -3.52,-0.80 , -3.60,-0.19 , -1.90,-0.10

3: -1.27,-1.42 , -1.02,-1.61 , -0.73,-1.76 , -0.42,-1.86 , -0.10,-1.90 , -0.19,-3.60 , -0.80,-3.52 , -1.38,-3.33 , -1.92,-3.05 , -2.41,-2.68 , -1.27,-1.42
4: 0.10,-1.90 , 0.42,-1.86 , 0.73,-1.76 , 1.02,-1.61 , 1.27,-1.42 , 2.41,-2.68 , 1.92,-3.05 , 1.38,-3.33 , 0.80,-3.52 , 0.19,-3.60 , 0.10,-1.90
5: 1.42,-1.27 , 1.61,-1.02 , 1.76,-0.73 , 1.86,-0.42 , 1.90,-0.10 , 3.60,-0.19 , 3.52,-0.80 , 3.33,-1.38 , 3.05,-1.92 , 2.68,-2.41 , 1.42,-1.27
6: 1.90,0.10 , 1.86,0.42 , 1.76,0.73 , 1.61,1.02 , 1.42,1.27 , 2.68,2.41 , 3.05,1.92 , 3.33,1.38 , 3.52,0.80 , 3.60,0.19 , 1.90,0.10
7: 1.27,1.42 , 1.02,1.61 , 0.73,1.76 , 0.42,1.86 , 0.10,1.90 , 0.19,3.60 , 0.80,3.52 , 1.38,3.33 , 1.92,3.05 , 2.41,2.68 , 1.27,1.42
8: -0.10,1.90 , -0.42,1.86 , -0.73,1.76 , -1.02,1.61 , -1.27,1.42 , -2.41,2.68 , -1.92,3.05 , -1.38,3.33 , -0.80,3.52 , -0.19,3.60 , -0.10,1.90
9: -1.42,1.27 , -1.61,1.02 , -1.76,0.73 , -1.86,0.42 , -1.90,0.10 , -3.60,0.19 , -3.52,0.80 , -3.33,1.38 , -3.05,1.92 , -2.68,2.41 , -1.42,1.27
10: -3.81,-0.10 , -3.73,-0.79 , -3.52,-1.46 , -3.20,-2.07 , -2.77,-2.62 , -4.00,-3.79 , -4.62,-3.00 , -5.09,-2.11 , -5.39,-1.15 , -5.51,-0.15 , -3.81,-0.10
11: -2.62,-2.77 , -2.07,-3.20 , -1.46,-3.52 , -0.79,-3.73 , -0.10,-3.81 , -0.15,-5.51 , -1.15,-5.39 , -2.11,-5.09 , -3.00,-4.62 , -3.79,-4.00 , -2.62,-2.77
12: 0.10,-3.81 , 0.79,-3.73 , 1.46,-3.52 , 2.07,-3.20 , 2.62,-2.77 , 3.79,-4.00 , 3.00,-4.62 , 2.11,-5.09 , 1.15,-5.39 , 0.15,-5.51 , 0.10,-3.81
13: 2.77,-2.62 , 3.20,-2.07 , 3.52,-1.46 , 3.73,-0.79 , 3.81,-0.10 , 5.51,-0.15 , 5.39,-1.15 , 5.09,-2.11 , 4.62,-3.00 , 4.00,-3.79 , 2.77,-2.62
14: 3.81,0.10 , 3.73,0.79 , 3.52,1.46 , 3.20,2.07 , 2.77,2.62 , 4.00,3.79 , 4.62,3.00 , 5.09,2.11 , 5.39,1.15 , 5.51,0.15 , 3.81,0.10
15: 2.62,2.77 , 2.07,3.20 , 1.46,3.52 , 0.79,3.73 , 0.10,3.81 , 0.15,5.51 , 1.15,5.39 , 2.11,5.09 , 3.00,4.62 , 3.79,4.00 , 2.62,2.77
16: -0.10,3.81 , -0.79,3.73 , -1.46,3.52 , -2.07,3.20 , -2.62,2.77 , -3.79,4.00 , -3.00,4.62 , -2.11,5.09 , -1.15,5.39 , -0.15,5.51 , -0.10,3.81
17: -2.77,2.62 , -3.20,2.07 , -3.52,1.46 , -3.73,0.79 , -3.81,0.10 , -5.51,0.15 , -5.39,1.15 , -5.09,2.11 , -4.62,3.00 , -4.00,3.79 , -2.77,2.62
18: -5.71,-0.10 , -5.58,-1.22 , -5.24,-2.29 , -4.68,-3.28 , -6.08,-4.25 , -6.79,-2.98 , -7.25,-1.59 , -7.42,-0.13 , -5.71,-0.10
19: -4.56,-3.44 , -3.80,-4.27 , -2.89,-4.93 , -1.86,-5.40 , -2.42,-7.01 , -3.75,-6.40 , -4.93,-5.54 , -5.92,-4.46 , -4.56,-3.44
20: -1.67,-5.47 , -0.56,-5.69 , 0.56,-5.69 , 1.67,-5.47 , 2.17,-7.09 , 0.73,-7.38 , -0.73,-7.38 , -2.17,-7.09 , -1.67,-5.47
21: 1.86,-5.40 , 2.89,-4.93 , 3.80,-4.27 , 4.56,-3.44 , 5.92,-4.46 , 4.93,-5.54 , 3.75,-6.40 , 2.42,-7.01 , 1.86,-5.40
22: 4.68,-3.28 , 5.24,-2.29 , 5.58,-1.22 , 5.71,-0.10 , 7.42,-0.13 , 7.25,-1.59 , 6.79,-2.98 , 6.08,-4.25 , 4.68,-3.28
23: 5.71,0.10 , 5.58,1.22 , 5.24,2.29 , 4.68,3.28 , 6.08,4.25 , 6.79,2.98 , 7.25,1.59 , 7.42,0.13 , 5.71,0.10
24: 4.56,3.44 , 3.80,4.27 , 2.89,4.93 , 1.86,5.40 , 2.42,7.01 , 3.75,6.40 , 4.93,5.54 , 5.92,4.46 , 4.56,3.44
25: 1.67,5.47 , 0.56,5.69 , -0.56,5.69 , -1.67,5.47 , -2.17,7.09 , -0.73,7.38 , 0.73,7.38 , 2.17,7.09 , 1.67,5.47
26: -1.86,5.40 , -2.89,4.93 , -3.80,4.27 , -4.56,3.44 , -5.92,4.46 , -4.93,5.54 , -3.75,6.40 , -2.42,7.01 , -1.86,5.40
27: -4.68,3.28 , -5.24,2.29 , -5.58,1.22 , -5.71,0.10 , -7.42,0.13 , -7.25,1.59 , -6.79,2.98 , -6.08,4.25 , -4.68,3.28
28: -7.62,-0.10 , -7.53,-1.17 , -7.29,-2.21 , -6.91,-3.21 , -8.45,-3.93 , -8.92,-2.71 , -9.21,-1.43 , -9.32,-0.12 , -7.62,-0.10
29: -6.82,-3.40 , -6.28,-4.32 , -5.61,-5.16 , -4.83,-5.89 , -5.91,-7.21 , -6.86,-6.31 , -7.68,-5.29 , -8.34,-4.16 , -6.82,-3.40
30: -4.67,-6.02 , -3.78,-6.62 , -2.81,-7.08 , -1.79,-7.41 , -2.19,-9.06 , -3.44,-8.66 , -4.63,-8.09 , -5.71,-7.37 , -4.67,-6.02

31: -1.60,-7.45 , -0.54,-7.60 , 0.54,-7.60 , 1.60,-7.45 , 1.95,-9.12 , 0.66,-9.30 , -0.66,-9.30 , -1.95,-9.12 , -1.60,-7.45
 32: 1.79,-7.41 , 2.81,-7.08 , 3.78,-6.62 , 4.67,-6.02 , 5.71,-7.37 , 4.63,-8.09 , 3.44,-8.66 , 2.19,-9.06 , 1.79,-7.41
 33: 4.83,-5.89 , 5.61,-5.16 , 6.28,-4.32 , 6.82,-3.40 , 8.34,-4.16 , 7.68,-5.29 , 6.86,-6.31 , 5.91,-7.21 , 4.83,-5.89
 34: 6.91,-3.21 , 7.29,-2.21 , 7.53,-1.17 , 7.62,-0.10 , 9.32,-0.12 , 9.21,-1.43 , 8.92,-2.71 , 8.45,-3.93 , 6.91,-3.21
 35: 7.62,0.10 , 7.53,1.17 , 7.29,2.21 , 6.91,3.21 , 8.45,3.93 , 8.92,2.71 , 9.21,1.43 , 9.32,0.12 , 7.62,0.10
 36: 6.82,3.40 , 6.28,4.32 , 5.61,5.16 , 4.83,5.89 , 5.91,7.21 , 6.86,6.31 , 7.68,5.29 , 8.34,4.16 , 6.82,3.40
 37: 4.67,6.02 , 3.78,6.62 , 2.81,7.08 , 1.79,7.41 , 2.19,9.06 , 3.44,8.66 , 4.63,8.09 , 5.71,7.37 , 4.67,6.02
 38: 1.60,7.45 , 0.54,7.60 , -0.54,7.60 , -1.60,7.45 , -1.95,9.12 , -0.66,9.30 , 0.66,9.30 , 1.95,9.12 , 1.60,7.45
 39: -1.79,7.41 , -2.81,7.08 , -3.78,6.62 , -4.67,6.02 , -5.71,7.37 , -4.63,8.09 , -3.44,8.66 , -2.19,9.06 , -1.79,7.41
 40: -4.83,5.89 , -5.61,5.16 , -6.28,4.32 , -6.82,3.40 , -8.34,4.16 , -7.68,5.29 , -6.86,6.31 , -5.91,7.21 , -4.83,5.89
 41: -6.91,3.21 , -7.29,2.21 , -7.53,1.17 , -7.62,0.10 , -9.32,0.12 , -9.21,1.43 , -8.92,2.71 , -8.45,3.93 , -6.91,3.21
 42: -9.52,-0.10 , -9.38,-1.65 , -8.98,-3.16 , -10.78,-3.80 , -11.26,-1.98 , -11.43,-0.12 , -9.52,-0.10
 43: -8.91,-3.35 , -8.25,-4.76 , -7.36,-6.04 , -8.83,-7.25 , -9.90,-5.71 , -10.70,-4.02 , -8.91,-3.35
 44: -7.23,-6.20 , -6.12,-7.30 , -4.85,-8.20 , -5.82,-9.84 , -7.35,-8.76 , -8.68,-7.44 , -7.23,-6.20
 45: -4.67,-8.30 , -3.26,-8.95 , -1.75,-9.36 , -2.11,-11.23 , -3.91,-10.74 , -5.61,-9.96 , -4.67,-8.30
 46: -1.55,-9.40 , 0.00,-9.53 , 1.55,-9.40 , 1.87,-11.28 , 0.00,-11.43 , -1.87,-11.28 , -1.55,-9.40
 47: 1.75,-9.36 , 3.26,-8.95 , 4.67,-8.30 , 5.61,-9.96 , 3.91,-10.74 , 2.11,-11.23 , 1.75,-9.36
 48: 4.85,-8.20 , 6.12,-7.30 , 7.23,-6.20 , 8.68,-7.44 , 7.35,-8.76 , 5.82,-9.84 , 4.85,-8.20
 49: 7.36,-6.04 , 8.25,-4.76 , 8.91,-3.35 , 10.70,-4.02 , 9.90,-5.71 , 8.83,-7.25 , 7.36,-6.04
 50: 8.98,-3.16 , 9.38,-1.65 , 9.52,-0.10 , 11.43,-0.12 , 11.26,-1.98 , 10.78,-3.80 , 8.98,-3.16
 51: 9.52,0.10 , 9.38,1.65 , 8.98,3.16 , 10.78,3.80 , 11.26,1.98 , 11.43,0.12 , 9.52,0.10
 52: 8.91,3.35 , 8.25,4.76 , 7.36,6.04 , 8.83,7.25 , 9.90,5.71 , 10.70,4.02 , 8.91,3.35
 53: 7.23,6.20 , 6.12,7.30 , 4.85,8.20 , 5.82,9.84 , 7.35,8.76 , 8.68,7.44 , 7.23,6.20
 54: 4.67,8.30 , 3.26,8.95 , 1.75,9.36 , 2.11,11.23 , 3.91,10.74 , 5.61,9.96 , 4.67,8.30
 55: 1.55,9.40 , 0.00,9.53 , -1.55,9.40 , -1.87,11.28 , 0.00,11.43 , 1.87,11.28 , 1.55,9.40
 56: -1.75,9.36 , -3.26,8.95 , -4.67,8.30 , -5.61,9.96 , -3.91,10.74 , -2.11,11.23 , -1.75,9.36
 57: -4.85,8.20 , -6.12,7.30 , -7.23,6.20 , -8.68,7.44 , -7.35,8.76 , -5.82,9.84 , -4.85,8.20
 58: -7.36,6.04 , -8.25,4.76 , -8.91,3.35 , -10.70,4.02 , -9.90,5.71 , -8.83,7.25 , -7.36,6.04
 59: -8.98,3.16 , -9.38,1.65 , -9.52,0.10 , -11.43,0.12 , -11.26,1.98 , -10.78,3.80 , -8.98,3.16

4.7 61 Square Grid Actuator Pattern



Mapping to 37-D Connectors

	37D1	37D2		37D1	37D2
37D pin	Act #	Act #	37D pin	Act #	Act #
1	1	61	20	2	60
2	6	56	21	7	55
3	4	58	22	5	57
4	13	49	23	14	48
5	11	51	24	12	50
6	21	41	25	22	40
7	18	44	26	20	42
8	30	32	27	19	43
9	27	34	28	29	33
10	31	23	29	28	35
11	36	24	30	37	25
12	39	15	31	38	26
13	46	17	32	45	16
14	52	9	33	47	10
15	54	3	34	53	8
16	NC	NC	35	59	M

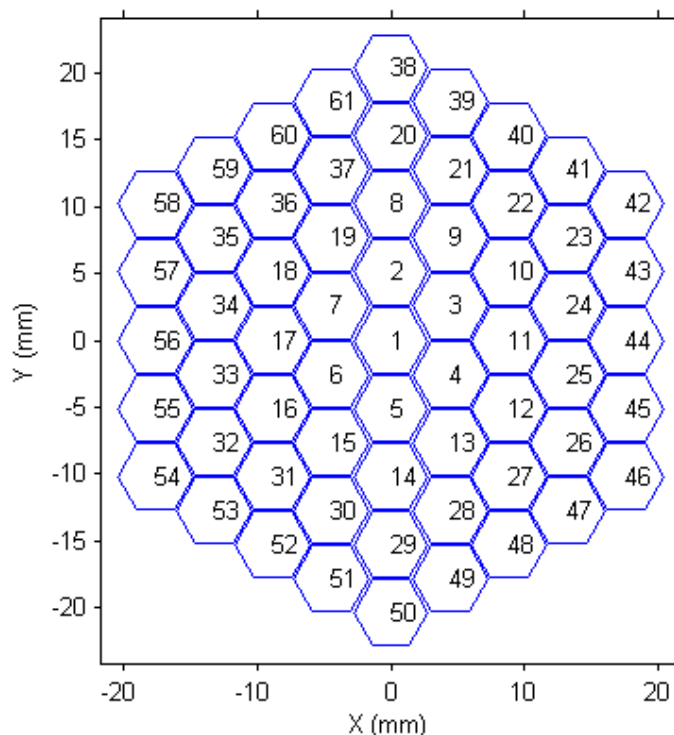
Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

- 1: -17.04,-2.54 , -17.04,-7.12 , -21.62,-7.12 , -21.62,-2.54 , -17.04,-2.54
- 2: -17.04,2.29 , -17.04,-2.29 , -21.62,-2.29 , -21.62,2.29 , -17.04,2.29
- 3: -17.04,7.12 , -17.04,2.54 , -21.62,2.54 , -21.62,7.12 , -17.04,7.12
- 4: -12.21,-12.21 , -12.21,-16.79 , -16.79,-16.79 , -16.79,-12.21 , -12.21,-12.21
- 5: -12.21,-7.38 , -12.21,-11.95 , -16.79,-11.95 , -16.79,-7.38 , -12.21,-7.38
- 6: -12.21,-2.54 , -12.21,-7.12 , -16.79,-7.12 , -16.79,-2.54 , -12.21,-2.54
- 7: -12.21,2.29 , -12.21,-2.29 , -16.79,-2.29 , -16.79,2.29 , -12.21,2.29
- 8: -12.21,7.12 , -12.21,2.54 , -16.79,2.54 , -16.79,7.12 , -12.21,7.12
- 9: -12.21,11.95 , -12.21,7.38 , -16.79,7.38 , -16.79,11.95 , -12.21,11.95
- 10: -12.21,16.79 , -12.21,12.21 , -16.79,12.21 , -16.79,16.79 , -12.21,16.79

11: -7.38,-12.21 , -7.38,-16.79 , -11.95,-16.79 , -11.95,-12.21 , -7.38,-12.21
12: -7.38,-7.38 , -7.38,-11.95 , -11.95,-11.95 , -11.95,-7.38 , -7.38,-7.38
13: -7.38,-2.54 , -7.38,-7.12 , -11.95,-7.12 , -11.95,-2.54 , -7.38,-2.54
14: -7.38,2.29 , -7.38,-2.29 , -11.95,-2.29 , -11.95,2.29 , -7.38,2.29
15: -7.38,7.12 , -7.38,2.54 , -11.95,2.54 , -11.95,7.12 , -7.38,7.12
16: -7.38,11.95 , -7.38,7.38 , -11.95,7.38 , -11.95,11.95 , -7.38,11.95
17: -7.38,16.79 , -7.38,12.21 , -11.95,12.21 , -11.95,16.79 , -7.38,16.79
18: -2.54,-17.04 , -2.54,-21.62 , -7.12,-21.62 , -7.12,-17.04 , -2.54,-17.04
19: -2.54,-12.21 , -2.54,-16.79 , -7.12,-16.79 , -7.12,-12.21 , -2.54,-12.21
20: -2.54,-7.38 , -2.54,-11.95 , -7.12,-11.95 , -7.12,-7.38 , -2.54,-7.38
21: -2.54,-2.54 , -2.54,-7.12 , -7.12,-7.12 , -7.12,-2.54 , -2.54,-2.54
22: -2.54,2.29 , -2.54,-2.29 , -7.12,-2.29 , -7.12,2.29 , -2.54,2.29
23: -2.54,7.12 , -2.54,2.54 , -7.12,2.54 , -7.12,7.12 , -2.54,7.12
24: -2.54,11.95 , -2.54,7.38 , -7.12,7.38 , -7.12,11.95 , -2.54,11.95
25: -2.54,16.79 , -2.54,12.21 , -7.12,12.21 , -7.12,16.79 , -2.54,16.79
26: -2.54,21.62 , -2.54,17.04 , -7.12,17.04 , -7.12,21.62 , -2.54,21.62
27: 2.29,-17.04 , 2.29,-21.62 , -2.29,-21.62 , -2.29,-17.04 , 2.29,-17.04
28: 2.29,-12.21 , 2.29,-16.79 , -2.29,-16.79 , -2.29,-12.21 , 2.29,-12.21
29: 2.29,-7.38 , 2.29,-11.95 , -2.29,-11.95 , -2.29,-7.38 , 2.29,-7.38
30: 2.29,-2.54 , 2.29,-7.12 , -2.29,-7.12 , -2.29,-2.54 , 2.29,-2.54
31: 2.29,2.29 , 2.29,-2.29 , -2.29,-2.29 , -2.29,2.29 , 2.29,2.29
32: 2.29,7.12 , 2.29,2.54 , -2.29,2.54 , -2.29,7.12 , 2.29,7.12
33: 2.29,11.95 , 2.29,7.38 , -2.29,7.38 , -2.29,11.95 , 2.29,11.95
34: 2.29,16.79 , 2.29,12.21 , -2.29,12.21 , -2.29,16.79 , 2.29,16.79
35: 2.29,21.62 , 2.29,17.04 , -2.29,17.04 , -2.29,21.62 , 2.29,21.62
36: 7.12,-17.04 , 7.12,-21.62 , 2.54,-21.62 , 2.54,-17.04 , 7.12,-17.04
37: 7.12,-12.21 , 7.12,-16.79 , 2.54,-16.79 , 2.54,-12.21 , 7.12,-12.21
38: 7.12,-7.38 , 7.12,-11.95 , 2.54,-11.95 , 2.54,-7.38 , 7.12,-7.38
39: 7.12,-2.54 , 7.12,-7.12 , 2.54,-7.12 , 2.54,-2.54 , 7.12,-2.54
40: 7.12,2.29 , 7.12,-2.29 , 2.54,-2.29 , 2.54,2.29 , 7.12,2.29
41: 7.12,7.12 , 7.12,2.54 , 2.54,2.54 , 2.54,7.12 , 7.12,7.12
42: 7.12,11.95 , 7.12,7.38 , 2.54,7.38 , 2.54,11.95 , 7.12,11.95
43: 7.12,16.79 , 7.12,12.21 , 2.54,12.21 , 2.54,16.79 , 7.12,16.79
44: 7.12,21.62 , 7.12,17.04 , 2.54,17.04 , 2.54,21.62 , 7.12,21.62
45: 11.95,-12.21 , 11.95,-16.79 , 7.38,-16.79 , 7.38,-12.21 , 11.95,-12.21
46: 11.95,-7.38 , 11.95,-11.95 , 7.38,-11.95 , 7.38,-7.38 , 11.95,-7.38
47: 11.95,-2.54 , 11.95,-7.12 , 7.38,-7.12 , 7.38,-2.54 , 11.95,-2.54
48: 11.95,2.29 , 11.95,-2.29 , 7.38,-2.29 , 7.38,2.29 , 11.95,2.29
49: 11.95,7.12 , 11.95,2.54 , 7.38,2.54 , 7.38,7.12 , 11.95,7.12
50: 11.95,11.95 , 11.95,7.38 , 7.38,7.38 , 7.38,11.95 , 11.95,11.95
51: 11.95,16.79 , 11.95,12.21 , 7.38,12.21 , 7.38,16.79 , 11.95,16.79
52: 16.79,-12.21 , 16.79,-16.79 , 12.21,-16.79 , 12.21,-12.21 , 16.79,-12.21
53: 16.79,-7.38 , 16.79,-11.95 , 12.21,-11.95 , 12.21,-7.38 , 16.79,-7.38
54: 16.79,-2.54 , 16.79,-7.12 , 12.21,-7.12 , 12.21,-2.54 , 16.79,-2.54
55: 16.79,2.29 , 16.79,-2.29 , 12.21,-2.29 , 12.21,2.29 , 16.79,2.29
56: 16.79,7.12 , 16.79,2.54 , 12.21,2.54 , 12.21,7.12 , 16.79,7.12
57: 16.79,11.95 , 16.79,7.38 , 12.21,7.38 , 12.21,11.95 , 16.79,11.95
58: 16.79,16.79 , 16.79,12.21 , 12.21,12.21 , 12.21,16.79 , 16.79,16.79
59: 21.62,-2.54 , 21.62,-7.12 , 17.04,-7.12 , 17.04,-2.54 , 21.62,-2.54
60: 21.62,2.29 , 21.62,-2.29 , 17.04,-2.29 , 17.04,2.29 , 21.62,2.29
61: 21.62,7.12 , 21.62,2.54 , 17.04,2.54 , 17.04,7.12 , 21.62,7.12

5 Appendix B: 2" MDM Actuator Patterns

5.1 61 Hexagonal Grid Actuator Pattern



Mapping to 37-D Connectors

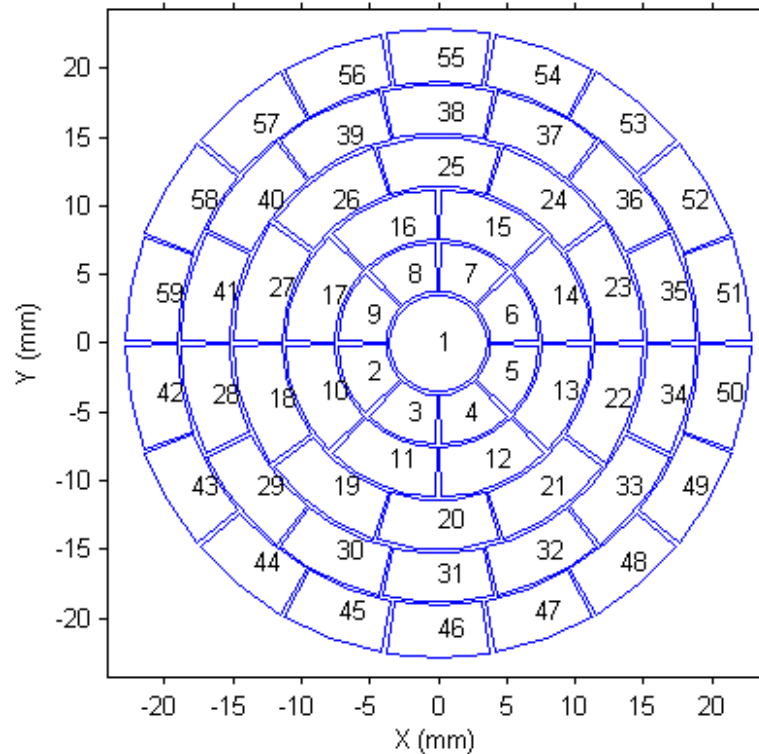
Same as 1" Version

Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

1: 1.41,2.44 , -1.41,2.44 , -2.81,0.00 , -1.41,-2.44 , 1.41,-2.44 , 2.81,0.00 , 1.41,2.44
2: 1.41,7.53 , -1.41,7.53 , -2.81,5.09 , -1.41,2.66 , 1.41,2.66 , 2.81,5.09 , 1.41,7.53
3: 5.82,4.98 , 3.00,4.98 , 1.60,2.55 , 3.00,0.11 , 5.82,0.11 , 7.23,2.55 , 5.82,4.98
4: 5.82,-0.11 , 3.00,-0.11 , 1.60,-2.55 , 3.00,-4.98 , 5.82,-4.98 , 7.23,-2.55 , 5.82,-0.11
5: 1.41,-2.66 , -1.41,-2.66 , -2.81,-5.09 , -1.41,-7.53 , 1.41,-7.53 , 2.81,-5.09 , 1.41,-2.66
6: -3.00,-0.11 , -5.82,-0.11 , -7.23,-2.55 , -5.82,-4.98 , -3.00,-4.98 , -1.60,-2.55 , -3.00,-0.11
7: -3.00,4.98 , -5.82,4.98 , -7.23,2.55 , -5.82,0.11 , -3.00,0.11 , -1.60,2.55 , -3.00,4.98
8: 1.41,12.63 , -1.41,12.63 , -2.81,10.19 , -1.41,7.75 , 1.41,7.75 , 2.81,10.19 , 1.41,12.63
9: 5.82,10.08 , 3.00,10.08 , 1.60,7.64 , 3.00,5.20 , 5.82,5.20 , 7.23,7.64 , 5.82,10.08
10: 10.23,7.53 , 7.42,7.53 , 6.01,5.09 , 7.42,2.66 , 10.23,2.66 , 11.64,5.09 , 10.23,7.53
11: 10.23,2.44 , 7.42,2.44 , 6.01,0.00 , 7.42,-2.44 , 10.23,-2.44 , 11.64,0.00 , 10.23,2.44
12: 10.23,-2.66 , 7.42,-2.66 , 6.01,-5.09 , 7.42,-7.53 , 10.23,-7.53 , 11.64,-5.09 , 10.23,-2.66
13: 5.82,-5.20 , 3.00,-5.20 , 1.60,-7.64 , 3.00,-10.08 , 5.82,-10.08 , 7.23,-7.64 , 5.82,-5.20
14: 1.41,-7.75 , -1.41,-7.75 , -2.81,-10.19 , -1.41,-12.63 , 1.41,-12.63 , 2.81,-10.19 , 1.41,-7.75
15: -3.00,-5.20 , -5.82,-5.20 , -7.23,-7.64 , -5.82,-10.08 , -3.00,-10.08 , -1.60,-7.64 , -3.00,-5.20
16: -7.42,-2.66 , -10.23,-2.66 , -11.64,-5.09 , -10.23,-7.53 , -7.42,-7.53 , -6.01,-5.09 , -7.42,-2.66
17: -7.42,2.44 , -10.23,2.44 , -11.64,0.00 , -10.23,-2.44 , -7.42,-2.44 , -6.01,0.00 , -7.42,2.44
18: -7.42,7.53 , -10.23,7.53 , -11.64,5.09 , -10.23,2.66 , -7.42,2.66 , -6.01,5.09 , -7.42,7.53
19: -3.00,10.08 , -5.82,10.08 , -7.23,7.64 , -5.82,5.20 , -3.00,5.20 , -1.60,7.64 , -3.00,10.08
20: 1.41,17.72 , -1.41,17.72 , -2.81,15.28 , -1.41,12.85 , 1.41,12.85 , 2.81,15.28 , 1.41,17.72
21: 5.82,15.17 , 3.00,15.17 , 1.60,12.73 , 3.00,10.30 , 5.82,10.30 , 7.23,12.73 , 5.82,15.17
22: 10.23,12.63 , 7.42,12.63 , 6.01,10.19 , 7.42,7.75 , 10.23,7.75 , 11.64,10.19 , 10.23,12.63
23: 14.64,10.08 , 11.83,10.08 , 10.42,7.64 , 11.83,5.20 , 14.64,5.20 , 16.05,7.64 , 14.64,10.08
24: 14.64,4.98 , 11.83,4.98 , 10.42,2.55 , 11.83,0.11 , 14.64,0.11 , 16.05,2.55 , 14.64,4.98
25: 14.64,-0.11 , 11.83,-0.11 , 10.42,-2.55 , 11.83,-4.98 , 14.64,-4.98 , 16.05,-2.55 , 14.64,-0.11

26: 14.64,-5.20 , 11.83,-5.20 , 10.42,-7.64 , 11.83,-10.08 , 14.64,-10.08 , 16.05,-7.64 , 14.64,-5.20
 27: 10.23,-7.75 , 7.42,-7.75 , 6.01,-10.19 , 7.42,-12.63 , 10.23,-12.63 , 11.64,-10.19 , 10.23,-7.75
 28: 5.82,-10.30 , 3.00,-10.30 , 1.60,-12.73 , 3.00,-15.17 , 5.82,-15.17 , 7.23,-12.73 , 5.82,-10.30
 29: 1.41,-12.85 , -1.41,-12.85 , -2.81,-15.28 , -1.41,-17.72 , 1.41,-17.72 , 2.81,-15.28 , 1.41,-12.85
 30: -3.00,-10.30 , -5.82,-10.30 , -7.23,-12.73 , -5.82,-15.17 , -3.00,-15.17 , -1.60,-12.73 , -3.00,-10.30
 31: -7.42,-7.75 , -10.23,-7.75 , -11.64,-10.19 , -10.23,-12.63 , -7.42,-12.63 , -6.01,-10.19 , -7.42,-7.75
 32: -11.83,-5.20 , -14.64,-5.20 , -16.05,-7.64 , -14.64,-10.08 , -11.83,-10.08 , -10.42,-7.64 , -11.83,-5.20
 33: -11.83,-0.11 , -14.64,-0.11 , -16.05,-2.55 , -14.64,-4.98 , -11.83,-4.98 , -10.42,-2.55 , -11.83,-0.11
 34: -11.83,4.98 , -14.64,4.98 , -16.05,2.55 , -14.64,0.11 , -11.83,0.11 , -10.42,2.55 , -11.83,4.98
 35: -11.83,10.08 , -14.64,10.08 , -16.05,7.64 , -14.64,5.20 , -11.83,5.20 , -10.42,7.64 , -11.83,10.08
 36: -7.42,12.63 , -10.23,12.63 , -11.64,10.19 , -10.23,7.75 , -7.42,7.75 , -6.01,10.19 , -7.42,12.63
 37: -3.00,15.17 , -5.82,15.17 , -7.23,12.73 , -5.82,10.30 , -3.00,10.30 , -1.60,12.73 , -3.00,15.17
 38: 1.41,22.81 , -1.41,22.81 , -2.81,20.38 , -1.41,17.94 , 1.41,17.94 , 2.81,20.38 , 1.41,22.81
 39: 5.82,20.27 , 3.00,20.27 , 1.60,17.83 , 3.00,15.39 , 5.82,15.39 , 7.23,17.83 , 5.82,20.27
 40: 10.23,17.72 , 7.42,17.72 , 6.01,15.28 , 7.42,12.85 , 10.23,12.85 , 11.64,15.28 , 10.23,17.72
 41: 14.64,15.17 , 11.83,15.17 , 10.42,12.73 , 11.83,10.30 , 14.64,10.30 , 16.05,12.73 , 14.64,15.17
 42: 19.05,12.63 , 16.24,12.63 , 14.83,10.19 , 16.24,7.75 , 19.05,7.75 , 20.46,10.19 , 19.05,12.63
 43: 19.05,7.53 , 16.24,7.53 , 14.83,5.09 , 16.24,2.66 , 19.05,2.66 , 20.46,5.09 , 19.05,7.53
 44: 19.05,2.44 , 16.24,2.44 , 14.83,0.00 , 16.24,-2.44 , 19.05,-2.44 , 20.46,0.00 , 19.05,2.44
 45: 19.05,-2.66 , 16.24,-2.66 , 14.83,-5.09 , 16.24,-7.53 , 19.05,-7.53 , 20.46,-5.09 , 19.05,-2.66
 46: 19.05,-7.75 , 16.24,-7.75 , 14.83,-10.19 , 16.24,-12.63 , 19.05,-12.63 , 20.46,-10.19 , 19.05,-7.75
 47: 14.64,-10.30 , 11.83,-10.30 , 10.42,-12.73 , 11.83,-15.17 , 14.64,-15.17 , 16.05,-12.73 , 14.64,-10.30
 48: 10.23,-12.85 , 7.42,-12.85 , 6.01,-15.28 , 7.42,-17.72 , 10.23,-17.72 , 11.64,-15.28 , 10.23,-12.85
 49: 5.82,-15.39 , 3.00,-15.39 , 1.60,-17.83 , 3.00,-20.27 , 5.82,-20.27 , 7.23,-17.83 , 5.82,-15.39
 50: 1.41,-17.94 , -1.41,-17.94 , -2.81,-20.38 , -1.41,-22.81 , 1.41,-22.81 , 2.81,-20.38 , 1.41,-17.94
 51: -3.00,-15.39 , -5.82,-15.39 , -7.23,-17.83 , -5.82,-20.27 , -3.00,-20.27 , -1.60,-17.83 , -3.00,-15.39
 52: -7.42,-12.85 , -10.23,-12.85 , -11.64,-15.28 , -10.23,-17.72 , -7.42,-17.72 , -6.01,-15.28 , -7.42,-12.85
 53: -11.83,-10.30 , -14.64,-10.30 , -16.05,-12.73 , -14.64,-15.17 , -11.83,-15.17 , -10.42,-12.73 , -11.83,-10.30
 54: -16.24,-7.75 , -19.05,-7.75 , -20.46,-10.19 , -19.05,-12.63 , -16.24,-12.63 , -14.83,-10.19 , -16.24,-7.75
 55: -16.24,-2.66 , -19.05,-2.66 , -20.46,-5.09 , -19.05,-7.53 , -16.24,-7.53 , -14.83,-5.09 , -16.24,-2.66
 56: -16.24,2.44 , -19.05,2.44 , -20.46,0.00 , -19.05,-2.44 , -16.24,-2.44 , -14.83,0.00 , -16.24,2.44
 57: -16.24,7.53 , -19.05,7.53 , -20.46,5.09 , -19.05,2.66 , -16.24,2.66 , -14.83,5.09 , -16.24,7.53
 58: -16.24,12.63 , -19.05,12.63 , -20.46,10.19 , -19.05,7.75 , -16.24,7.75 , -14.83,10.19 , -16.24,12.63
 59: -11.83,15.17 , -14.64,15.17 , -16.05,12.73 , -14.64,10.30 , -11.83,10.30 , -10.42,12.73 , -11.83,15.17
 60: -7.42,17.72 , -10.23,17.72 , -11.64,15.28 , -10.23,12.85 , -7.42,12.85 , -6.01,15.28 , -7.42,17.72
 61: -3.00,20.27 , -5.82,20.27 , -7.23,17.83 , -5.82,15.39 , -3.00,15.39 , -1.60,17.83 , -3.00,20.27

5.2 59 Segmented Annular Grid Actuator Pattern



Mapping to 37-D Connectors
Same as 1" Version

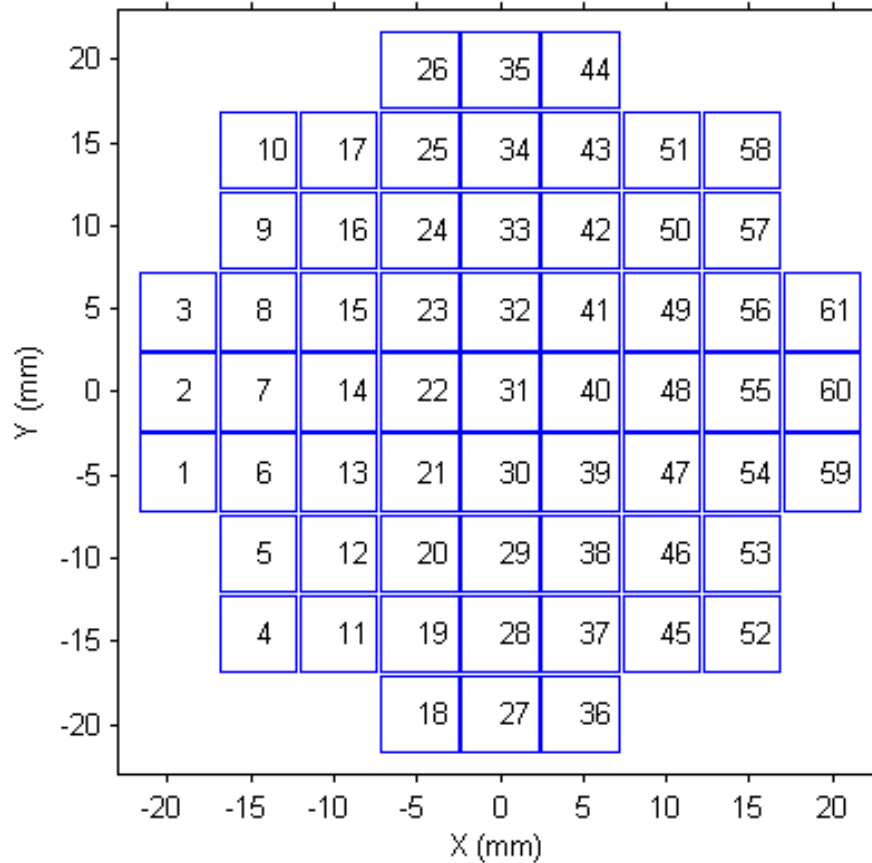
Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

- 1: -3.56,0.03 , -3.48,0.74 , -3.25,1.45 , -2.88,2.09 , -2.38,2.64 , -1.78,3.08 , -1.10,3.38 , -0.37,3.54 ,
0.37,3.54 , 1.10,3.38 , 1.78,3.08 , 2.38,2.64 , 2.88,2.09 , 3.25,1.45 , 3.48,0.74 , 3.56,0.00 , 3.48,-
0.74 , 3.25,-1.45 , 2.88,-2.09 , 2.38,-2.64 , 1.78,-3.08 , 1.10,-3.38 , 0.37,-3.54 , -0.37,-3.54 , -1.10,-
3.38 , -1.78,-3.08 , -2.38,-2.64 , -2.88,-2.09 , -3.25,-1.45 , -3.48,-0.74 , -3.56,0.00
- 2: -3.81,-0.13 , -3.72,-0.81 , -3.52,-1.46 , -3.20,-2.06 , -2.78,-2.60 , -5.38,-5.03 , -6.19,-3.99 , -6.81,-2.82 , -
7.20,-1.56 , -7.36,-0.25 , -3.81,-0.13
- 3: -2.60,-2.78 , -2.06,-3.20 , -1.46,-3.52 , -0.81,-3.72 , -0.13,-3.81 , -0.25,-7.36 , -1.56,-7.20 , -2.82,-6.81 , -
3.99,-6.19 , -5.03,-5.38 , -2.60,-2.78
- 4: 0.13,-3.81 , 0.81,-3.72 , 1.46,-3.52 , 2.06,-3.20 , 2.60,-2.78 , 5.03,-5.38 , 3.99,-6.19 , 2.82,-6.81 , 1.56,-
7.20 , 0.25,-7.36 , 0.13,-3.81
- 5: 2.78,-2.60 , 3.20,-2.06 , 3.52,-1.46 , 3.72,-0.81 , 3.81,-0.13 , 7.36,-0.25 , 7.20,-1.56 , 6.81,-2.82 , 6.19,-
3.99 , 5.38,-5.03 , 2.78,-2.60
- 6: 3.81,0.13 , 3.72,0.81 , 3.52,1.46 , 3.20,2.06 , 2.78,2.60 , 5.38,5.03 , 6.19,3.99 , 6.81,2.82 , 7.20,1.56 ,
7.36,0.25 , 3.81,0.13
- 7: 2.60,2.78 , 2.06,3.20 , 1.46,3.52 , 0.81,3.72 , 0.13,3.81 , 0.25,7.36 , 1.56,7.20 , 2.82,6.81 , 3.99,6.19 ,
5.03,5.38 , 2.60,2.78
- 8: -0.13,3.81 , -0.81,3.72 , -1.46,3.52 , -2.06,3.20 , -2.60,2.78 , -5.03,5.38 , -3.99,6.19 , -2.82,6.81 , -
1.56,7.20 , -0.25,7.36 , -0.13,3.81
- 9: -2.78,2.60 , -3.20,2.06 , -3.52,1.46 , -3.72,0.81 , -3.81,0.13 , -7.36,0.25 , -7.20,1.56 , -6.81,2.82 , -
6.19,3.99 , -5.38,5.03 , -2.78,2.60
- 10: -7.62,-0.13 , -7.46,-1.55 , -7.04,-2.92 , -6.37,-4.18 , -5.48,-5.30 , -8.03,-7.77 , -9.34,-6.13 , -10.33,-4.28 ,
-10.94,-2.27 , -11.17,-0.19 , -7.62,-0.13
- 11: -5.30,-5.48 , -4.18,-6.37 , -2.92,-7.04 , -1.55,-7.46 , -0.13,-7.62 , -0.19,-11.17 , -2.27,-10.94 , -4.28,-10.33
, -6.13,-9.34 , -7.77,-8.03 , -5.30,-5.48
- 12: 0.13,-7.62 , 1.55,-7.46 , 2.92,-7.04 , 4.18,-6.37 , 5.30,-5.48 , 7.77,-8.03 , 6.13,-9.34 , 4.28,-10.33 , 2.27,-
10.94 , 0.19,-11.17 , 0.13,-7.62

13: 5.48,-5.30 , 6.37,-4.18 , 7.04,-2.92 , 7.46,-1.55 , 7.62,-0.13 , 11.17,-0.19 , 10.94,-2.27 , 10.33,-4.28 ,
9.34,-6.13 , 8.03,-7.77 , 5.48,-5.30
14: 7.62,0.13 , 7.46,1.55 , 7.04,2.92 , 6.37,4.18 , 5.48,5.30 , 8.03,7.77 , 9.34,6.13 , 10.33,4.28 , 10.94,2.27 ,
11.17,0.19 , 7.62,0.13
15: 5.30,5.48 , 4.18,6.37 , 2.92,7.04 , 1.55,7.46 , 0.13,7.62 , 0.19,11.17 , 2.27,10.94 , 4.28,10.33 , 6.13,9.34
7.77,8.03 , 5.30,5.48
16: -0.13,7.62 , -1.55,7.46 , -2.92,7.04 , -4.18,6.37 , -5.30,5.48 , -7.77,8.03 , -6.13,9.34 , -4.28,10.33 , -
2.27,10.94 , -0.19,11.17 , -0.13,7.62
17: -5.48,5.30 , -6.37,4.18 , -7.04,2.92 , -7.46,1.55 , -7.62,0.13 , -11.17,0.19 , -10.94,2.27 , -10.33,4.28 , -
9.34,6.13 , -8.03,7.77 , -5.48,5.30
18: -11.43,-0.13 , -11.17,-2.42 , -10.46,-4.61 , -9.32,-6.62 , -12.22,-8.67 , -13.71,-6.04 , -14.65,-3.17 , -14.98,-
0.17 , -11.43,-0.13
19: -9.17,-6.82 , -7.62,-8.52 , -5.75,-9.88 , -3.65,-10.83 , -4.79,-14.20 , -7.54,-12.95 , -9.99,-11.17 , -12.02,-
8.94 , -9.17,-6.82
20: -3.41,-10.91 , -1.15,-11.37 , 1.15,-11.37 , 3.41,-10.91 , 4.47,-14.30 , 1.51,-14.91 , -1.51,-14.91 , -4.47,-
14.30 , -3.41,-10.91
21: 3.65,-10.83 , 5.75,-9.88 , 7.62,-8.52 , 9.17,-6.82 , 12.02,-8.94 , 9.99,-11.17 , 7.54,-12.95 , 4.79,-14.20 ,
3.65,-10.83
22: 9.32,-6.62 , 10.46,-4.61 , 11.17,-2.42 , 11.43,-0.13 , 14.98,-0.17 , 14.65,-3.17 , 13.71,-6.04 , 12.22,-8.67 ,
9.32,-6.62
23: 11.43,0.13 , 11.17,2.42 , 10.46,4.61 , 9.32,6.62 , 12.22,8.67 , 13.71,6.04 , 14.65,3.17 , 14.98,0.17 ,
11.43,0.13
24: 9.17,6.82 , 7.62,8.52 , 5.75,9.88 , 3.65,10.83 , 4.79,14.20 , 7.54,12.95 , 9.99,11.17 , 12.02,8.94 ,
9.17,6.82
25: 3.41,10.91 , 1.15,11.37 , -1.15,11.37 , -3.41,10.91 , -4.47,14.30 , -1.51,14.91 , 1.51,14.91 , 4.47,14.30 ,
3.41,10.91
26: -3.65,10.83 , -5.75,9.88 , -7.62,8.52 , -9.17,6.82 , -12.02,8.94 , -9.99,11.17 , -7.54,12.95 , -4.79,14.20 , -
3.65,10.83
27: -9.32,6.62 , -10.46,4.61 , -11.17,2.42 , -11.43,0.13 , -14.98,0.17 , -14.65,3.17 , -13.71,6.04 , -12.22,8.67 ,
-9.32,6.62
28: -15.24,-0.13 , -15.06,-2.31 , -14.57,-4.45 , -13.79,-6.50 , -17.00,-8.01 , -17.98,-5.49 , -18.58,-2.85 , -
18.79,-0.16 , -15.24,-0.13
29: -13.67,-6.73 , -12.57,-8.62 , -11.20,-10.34 , -9.60,-11.84 , -11.84,-14.60 , -13.81,-12.75 , -15.50,-10.63 , -
16.87,-8.30 , -13.67,-6.73
30: -9.40,-11.99 , -7.58,-13.22 , -5.61,-14.17 , -3.51,-14.83 , -4.34,-18.29 , -6.92,-17.48 , -9.35,-16.30 , -
11.60,-14.79 , -9.40,-11.99
31: -3.27,-14.89 , -1.10,-15.20 , 1.10,-15.20 , 3.27,-14.89 , 4.03,-18.36 , 1.35,-18.75 , -1.35,-18.75 , -4.03,-
18.36 , -3.27,-14.89
32: 3.51,-14.83 , 5.61,-14.17 , 7.58,-13.22 , 9.40,-11.99 , 11.60,-14.79 , 9.35,-16.30 , 6.92,-17.48 , 4.34,-
18.29 , 3.51,-14.83
33: 9.60,-11.84 , 11.20,-10.34 , 12.57,-8.62 , 13.67,-6.73 , 16.87,-8.30 , 15.50,-10.63 , 13.81,-12.75 , 11.84,-
14.60 , 9.60,-11.84
34: 13.79,-6.50 , 14.57,-4.45 , 15.06,-2.31 , 15.24,-0.13 , 18.79,-0.16 , 18.58,-2.85 , 17.98,-5.49 , 17.00,-8.01
13.79,-6.50
35: 15.24,0.13 , 15.06,2.31 , 14.57,4.45 , 13.79,6.50 , 17.00,8.01 , 17.98,5.49 , 18.58,2.85 , 18.79,0.16 ,
15.24,0.13
36: 13.67,6.73 , 12.57,8.62 , 11.20,10.34 , 9.60,11.84 , 11.84,14.60 , 13.81,12.75 , 15.50,10.63 , 16.87,8.30 ,
13.67,6.73
37: 9.40,11.99 , 7.58,13.22 , 5.61,14.17 , 3.51,14.83 , 4.34,18.29 , 6.92,17.48 , 9.35,16.30 , 11.60,14.79 ,
9.40,11.99
38: 3.27,14.89 , 1.10,15.20 , -1.10,15.20 , -3.27,14.89 , -4.03,18.36 , -1.35,18.75 , 1.35,18.75 , 4.03,18.36 ,
3.27,14.89
39: -3.51,14.83 , -5.61,14.17 , -7.58,13.22 , -9.40,11.99 , -11.60,14.79 , -9.35,16.30 , -6.92,17.48 , -
4.34,18.29 , -3.51,14.83
40: -9.60,11.84 , -11.20,10.34 , -12.57,8.62 , -13.67,6.73 , -16.87,8.30 , -15.50,10.63 , -13.81,12.75 , -
11.84,14.60 , -9.60,11.84
41: -13.79,6.50 , -14.57,4.45 , -15.06,2.31 , -15.24,0.13 , -18.79,0.16 , -18.58,2.85 , -17.98,5.49 , -17.00,8.01
13.79,6.50
42: -19.05,-0.13 , -18.76,-3.31 , -17.94,-6.40 , -21.53,-7.68 , -22.51,-3.97 , -22.86,-0.15 , -19.05,-0.13
43: -17.86,-6.64 , -16.50,-9.53 , -14.67,-12.15 , -17.61,-14.58 , -19.80,-11.43 , -21.43,-7.96 , -17.86,-6.64
44: -14.51,-12.34 , -12.25,-14.59 , -9.63,-16.43 , -11.56,-19.72 , -14.69,-17.51 , -17.41,-14.81 , -14.51,-12.34
45: -9.41,-16.56 , -6.51,-17.90 , -3.43,-18.74 , -4.12,-22.49 , -7.82,-21.48 , -11.30,-19.87 , -9.41,-16.56

46: -3.18,-18.78 , 0.00,-19.05 , 3.18,-18.78 , 3.82,-22.54 , 0.00,-22.86 , -3.82,-22.54 , -3.18,-18.78
 47: 3.43,-18.74 , 6.51,-17.90 , 9.41,-16.56 , 11.30,-19.87 , 7.82,-21.48 , 4.12,-22.49 , 3.43,-18.74
 48: 9.63,-16.43 , 12.25,-14.59 , 14.51,-12.34 , 17.41,-14.81 , 14.69,-17.51 , 11.56,-19.72 , 9.63,-16.43
 49: 14.67,-12.15 , 16.50,-9.53 , 17.86,-6.64 , 21.43,-7.96 , 19.80,-11.43 , 17.61,-14.58 , 14.67,-12.15
 50: 17.94,-6.40 , 18.76,-3.31 , 19.05,-0.13 , 22.86,-0.15 , 22.51,-3.97 , 21.53,-7.68 , 17.94,-6.40
 51: 19.05,0.13 , 18.76,3.31 , 17.94,6.40 , 21.53,7.68 , 22.51,3.97 , 22.86,0.15 , 19.05,0.13
 52: 17.86,6.64 , 16.50,9.53 , 14.67,12.15 , 17.61,14.58 , 19.80,11.43 , 21.43,7.96 , 17.86,6.64
 53: 14.51,12.34 , 12.25,14.59 , 9.63,16.43 , 11.56,19.72 , 14.69,17.51 , 17.41,14.81 , 14.51,12.34
 54: 9.41,16.56 , 6.51,17.90 , 3.43,18.74 , 4.12,22.49 , 7.82,21.48 , 11.30,19.87 , 9.41,16.56
 55: 3.18,18.78 , 0.00,19.05 , -3.18,18.78 , -3.82,22.54 , 0.00,22.86 , 3.82,22.54 , 3.18,18.78
 56: -3.43,18.74 , -6.51,17.90 , -9.41,16.56 , -11.30,19.87 , -7.82,21.48 , -4.12,22.49 , -3.43,18.74
 57: -9.63,16.43 , -12.25,14.59 , -14.51,12.34 , -17.41,14.81 , -14.69,17.51 , -11.56,19.72 , -9.63,16.43
 58: -14.67,12.15 , -16.50,9.53 , -17.86,6.64 , -21.43,7.96 , -19.80,11.43 , -17.61,14.58 , -14.67,12.15
 59: -17.94,6.40 , -18.76,3.31 , -19.05,0.13 , -22.86,0.15 , -22.51,3.97 , -21.53,7.68 , -17.94,6.40

5.3 61 Square Grid Actuator Pattern



Mapping to 37-D Connectors

Same as 1" Version

Actuator Coordinates – $x_1, y_1, x_2, y_2, \dots$ (mm)

- 1: -17.04,-2.54 , -17.04,-7.12 , -21.62,-7.12 , -21.62,-2.54 , -17.04,-2.54
- 2: -17.04,2.29 , -17.04,-2.29 , -21.62,-2.29 , -21.62,2.29 , -17.04,2.29
- 3: -17.04,7.12 , -17.04,2.54 , -21.62,2.54 , -21.62,7.12 , -17.04,7.12
- 4: -12.21,-12.21 , -12.21,-16.79 , -16.79,-16.79 , -16.79,-12.21 , -12.21,-12.21
- 5: -12.21,-7.38 , -12.21,-11.95 , -16.79,-11.95 , -16.79,-7.38 , -12.21,-7.38

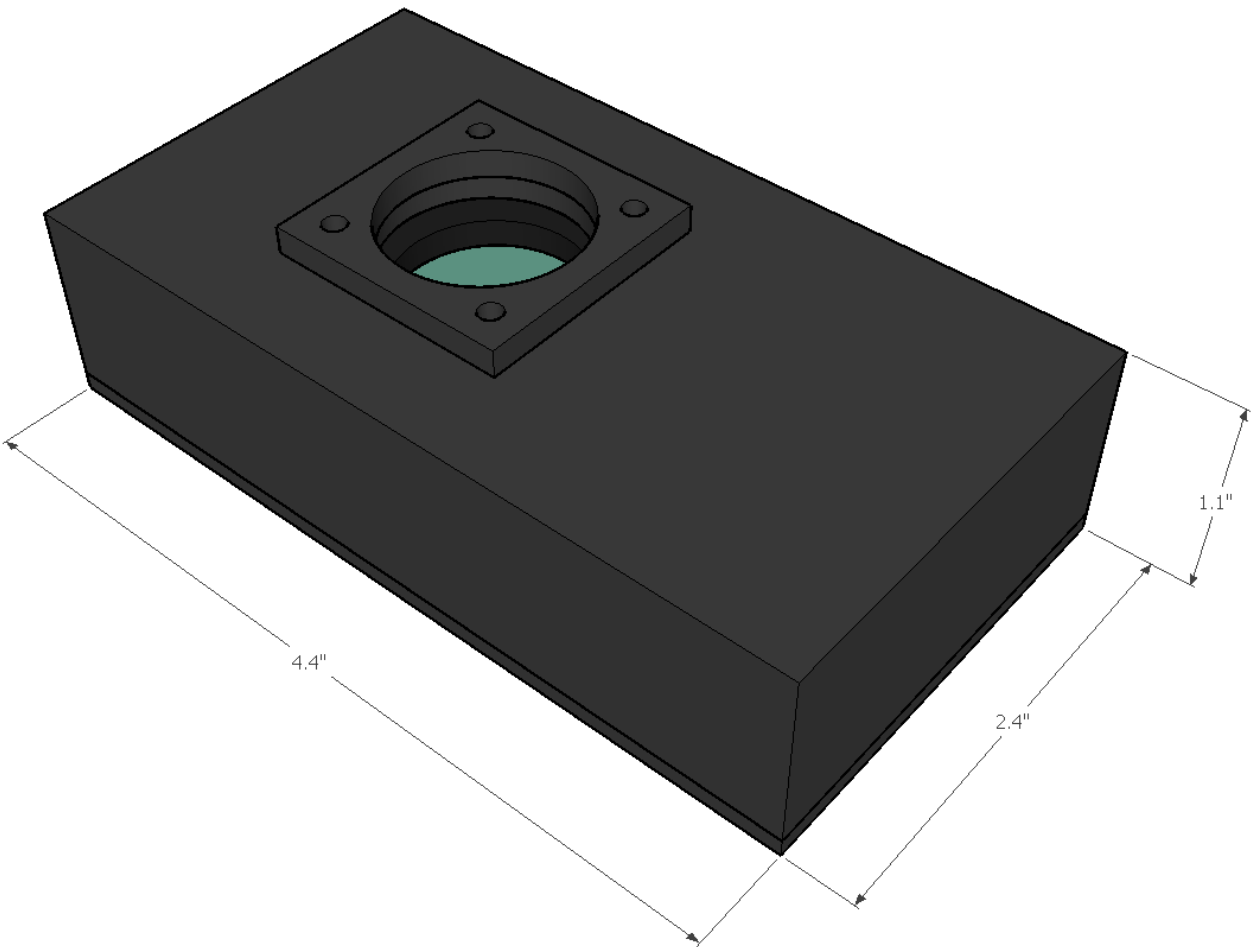
6: -12.21,-2.54 , -12.21,-7.12 , -16.79,-7.12 , -16.79,-2.54 , -12.21,-2.54
7: -12.21,2.29 , -12.21,-2.29 , -16.79,-2.29 , -16.79,2.29 , -12.21,2.29
8: -12.21,7.12 , -12.21,2.54 , -16.79,2.54 , -16.79,7.12 , -12.21,7.12
9: -12.21,11.95 , -12.21,7.38 , -16.79,7.38 , -16.79,11.95 , -12.21,11.95
10: -12.21,16.79 , -12.21,12.21 , -16.79,12.21 , -16.79,16.79 , -12.21,16.79
11: -7.38,-12.21 , -7.38,-16.79 , -11.95,-16.79 , -11.95,-12.21 , -7.38,-12.21
12: -7.38,-7.38 , -7.38,-11.95 , -11.95,-11.95 , -11.95,-7.38 , -7.38,-7.38
13: -7.38,-2.54 , -7.38,-7.12 , -11.95,-7.12 , -11.95,-2.54 , -7.38,-2.54
14: -7.38,2.29 , -7.38,-2.29 , -11.95,-2.29 , -11.95,2.29 , -7.38,2.29
15: -7.38,7.12 , -7.38,2.54 , -11.95,2.54 , -11.95,7.12 , -7.38,7.12
16: -7.38,11.95 , -7.38,7.38 , -11.95,7.38 , -11.95,11.95 , -7.38,11.95
17: -7.38,16.79 , -7.38,12.21 , -11.95,12.21 , -11.95,16.79 , -7.38,16.79
18: -2.54,-17.04 , -2.54,-21.62 , -7.12,-21.62 , -7.12,-17.04 , -2.54,-17.04
19: -2.54,-12.21 , -2.54,-16.79 , -7.12,-16.79 , -7.12,-12.21 , -2.54,-12.21
20: -2.54,-7.38 , -2.54,-11.95 , -7.12,-11.95 , -7.12,-7.38 , -2.54,-7.38
21: -2.54,-2.54 , -2.54,-7.12 , -7.12,-7.12 , -7.12,-2.54 , -2.54,-2.54
22: -2.54,2.29 , -2.54,-2.29 , -7.12,-2.29 , -7.12,2.29 , -2.54,2.29
23: -2.54,7.12 , -2.54,2.54 , -7.12,2.54 , -7.12,7.12 , -2.54,7.12
24: -2.54,11.95 , -2.54,7.38 , -7.12,7.38 , -7.12,11.95 , -2.54,11.95
25: -2.54,16.79 , -2.54,12.21 , -7.12,12.21 , -7.12,16.79 , -2.54,16.79
26: -2.54,21.62 , -2.54,17.04 , -7.12,17.04 , -7.12,21.62 , -2.54,21.62
27: 2.29,-17.04 , 2.29,-21.62 , -2.29,-21.62 , -2.29,-17.04 , 2.29,-17.04
28: 2.29,-12.21 , 2.29,-16.79 , -2.29,-16.79 , -2.29,-12.21 , 2.29,-12.21
29: 2.29,-7.38 , 2.29,-11.95 , -2.29,-11.95 , -2.29,-7.38 , 2.29,-7.38
30: 2.29,-2.54 , 2.29,-7.12 , -2.29,-7.12 , -2.29,-2.54 , 2.29,-2.54
31: 2.29,2.29 , 2.29,-2.29 , -2.29,-2.29 , -2.29,2.29 , 2.29,2.29
32: 2.29,7.12 , 2.29,2.54 , -2.29,2.54 , -2.29,7.12 , 2.29,7.12
33: 2.29,11.95 , 2.29,7.38 , -2.29,7.38 , -2.29,11.95 , 2.29,11.95
34: 2.29,16.79 , 2.29,12.21 , -2.29,12.21 , -2.29,16.79 , 2.29,16.79
35: 2.29,21.62 , 2.29,17.04 , -2.29,17.04 , -2.29,21.62 , 2.29,21.62
36: 7.12,-17.04 , 7.12,-21.62 , 2.54,-21.62 , 2.54,-17.04 , 7.12,-17.04
37: 7.12,-12.21 , 7.12,-16.79 , 2.54,-16.79 , 2.54,-12.21 , 7.12,-12.21
38: 7.12,-7.38 , 7.12,-11.95 , 2.54,-11.95 , 2.54,-7.38 , 7.12,-7.38
39: 7.12,-2.54 , 7.12,-7.12 , 2.54,-7.12 , 2.54,-2.54 , 7.12,-2.54
40: 7.12,2.29 , 7.12,-2.29 , 2.54,-2.29 , 2.54,2.29 , 7.12,2.29
41: 7.12,7.12 , 7.12,2.54 , 2.54,2.54 , 2.54,7.12 , 7.12,7.12
42: 7.12,11.95 , 7.12,7.38 , 2.54,7.38 , 2.54,11.95 , 7.12,11.95
43: 7.12,16.79 , 7.12,12.21 , 2.54,12.21 , 2.54,16.79 , 7.12,16.79
44: 7.12,21.62 , 7.12,17.04 , 2.54,17.04 , 2.54,21.62 , 7.12,21.62
45: 11.95,-12.21 , 11.95,-16.79 , 7.38,-16.79 , 7.38,-12.21 , 11.95,-12.21
46: 11.95,-7.38 , 11.95,-11.95 , 7.38,-11.95 , 7.38,-7.38 , 11.95,-7.38
47: 11.95,-2.54 , 11.95,-7.12 , 7.38,-7.12 , 7.38,-2.54 , 11.95,-2.54
48: 11.95,2.29 , 11.95,-2.29 , 7.38,-2.29 , 7.38,2.29 , 11.95,2.29
49: 11.95,7.12 , 11.95,2.54 , 7.38,2.54 , 7.38,7.12 , 11.95,7.12
50: 11.95,11.95 , 11.95,7.38 , 7.38,7.38 , 7.38,11.95 , 11.95,11.95
51: 11.95,16.79 , 11.95,12.21 , 7.38,12.21 , 7.38,16.79 , 11.95,16.79
52: 16.79,-12.21 , 16.79,-16.79 , 12.21,-16.79 , 12.21,-12.21 , 16.79,-12.21
53: 16.79,-7.38 , 16.79,-11.95 , 12.21,-11.95 , 12.21,-7.38 , 16.79,-7.38
54: 16.79,-2.54 , 16.79,-7.12 , 12.21,-7.12 , 12.21,-2.54 , 16.79,-2.54
55: 16.79,2.29 , 16.79,-2.29 , 12.21,-2.29 , 12.21,2.29 , 16.79,2.29
56: 16.79,7.12 , 16.79,2.54 , 12.21,2.54 , 12.21,7.12 , 16.79,7.12
57: 16.79,11.95 , 16.79,7.38 , 12.21,7.38 , 12.21,11.95 , 16.79,11.95
58: 16.79,16.79 , 16.79,12.21 , 12.21,12.21 , 12.21,16.79 , 16.79,16.79
59: 21.62,-2.54 , 21.62,-7.12 , 17.04,-7.12 , 17.04,-2.54 , 21.62,-2.54
60: 21.62,2.29 , 21.62,-2.29 , 17.04,-2.29 , 17.04,2.29 , 21.62,2.29
61: 21.62,7.12 , 21.62,2.54 , 17.04,2.54 , 17.04,7.12 , 21.62,7.12

6 Appendix C: Package Specifications

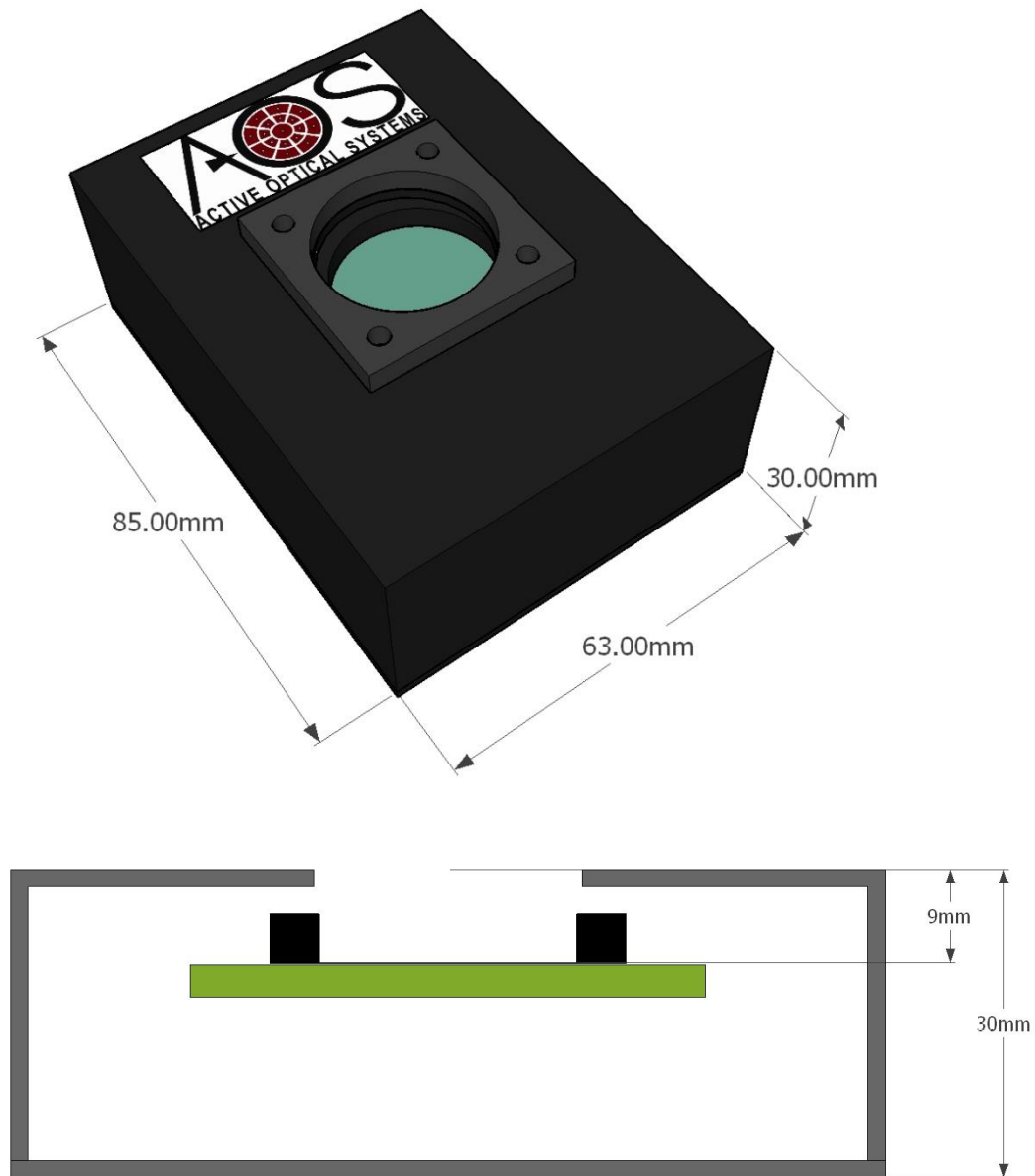
NOTE: All dimensions given here are approximate and subject to change without notice.

6.1 Original Package

Distance from the mirror membrane to the top of the package is approximately 0.7-0.8”.



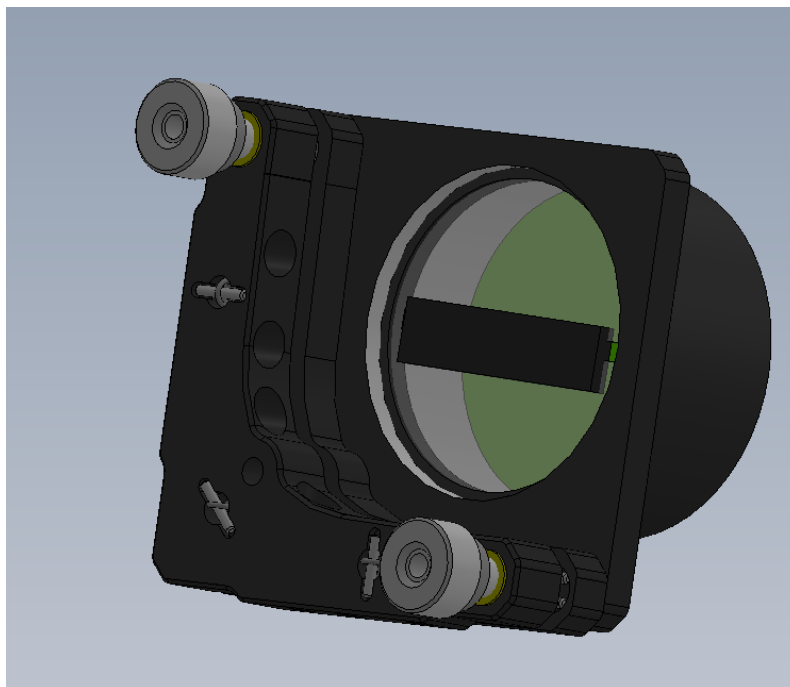
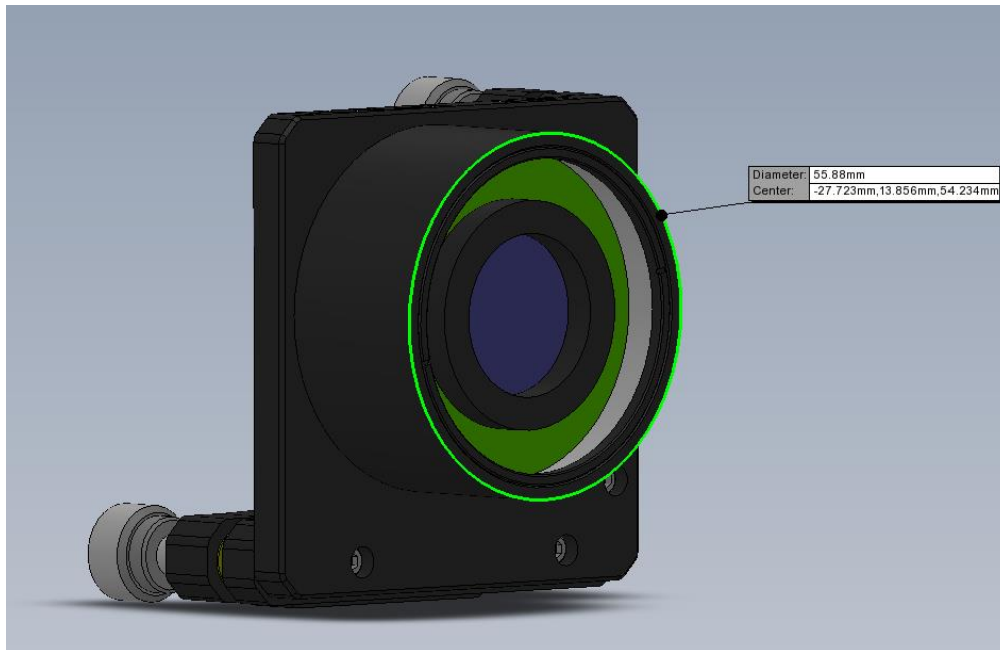
6.2 New Package (after Fall 2009)



6.3 Beam Tube Packaging (Fall 2011)

Based on customer feedback, we have developed a new package based on beam tubes. This package opens up the front of the DM surface more for off-axis incidence. The new beam tube package is designated in the model number with a “-4” suffix.

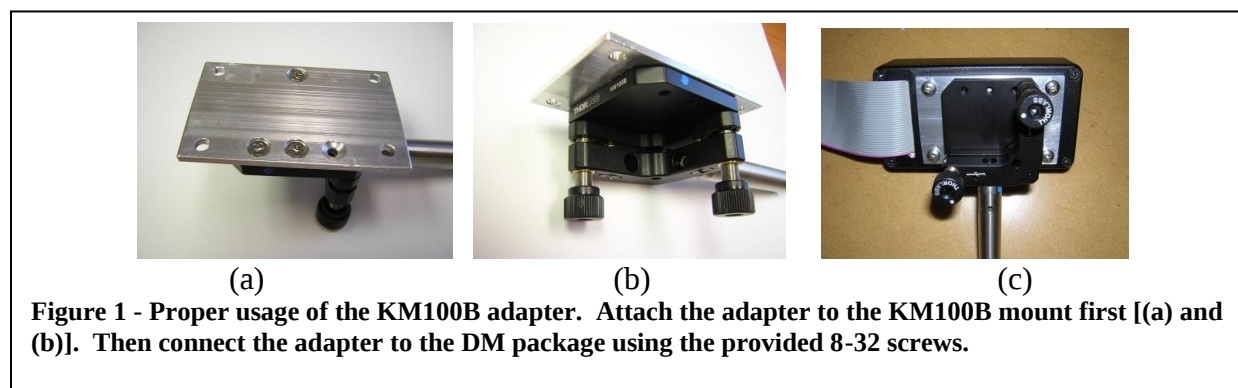
6.3.1 3D CAD Renderings for 1” diameter MDM



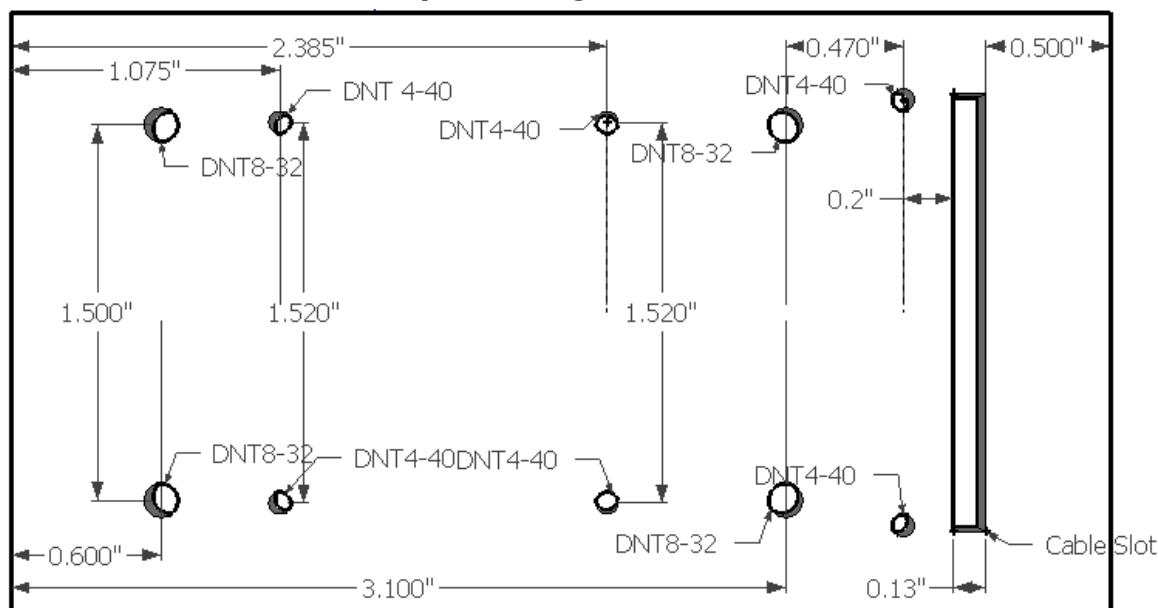
Appendix D: Original MDM Package Interface Plate

6.4 Optical Mount – Original Package (before 2008)

The original one-inch diameter MDM package came with an adapter for a ThorLabs KM100B platform mount to enable alignment of the MDM to a beam of light, but the most recent MDM package is shipped permanently attached to a KM100B mount. Figure 1 shows how that adapter is to be used. First attach the adapter to the KM100B mount using the 6-32 screws provided. Then attach the adapter to the back of the MDM mount using the short 8-32 screws provided. Using anything except the screws provided can result in damage to the mirror.



6.5 Back Panel Drill Map for Original Interface Plate



The only holes available to the user for mounting are the 8-32 holes. Putting anything more than ¼" of threads into the package may result in damage to the device.

