MEMS PACKAGES AND MOUNTS

USER GUIDE

Mirrorcle Technologies, Inc.

Overview

- Mirrorcle Technologies MEMS mirrors are available in the **TINY48.4** standard ceramic-based package, provided in connectorized form on a PCB and a convenient header connector

- All MEMS Mirror actuator **die sizes** fit into the standard TINY48.4 package.

- In special cases of larger quantity orders, other packages may be considered after initial NRE and successful development.
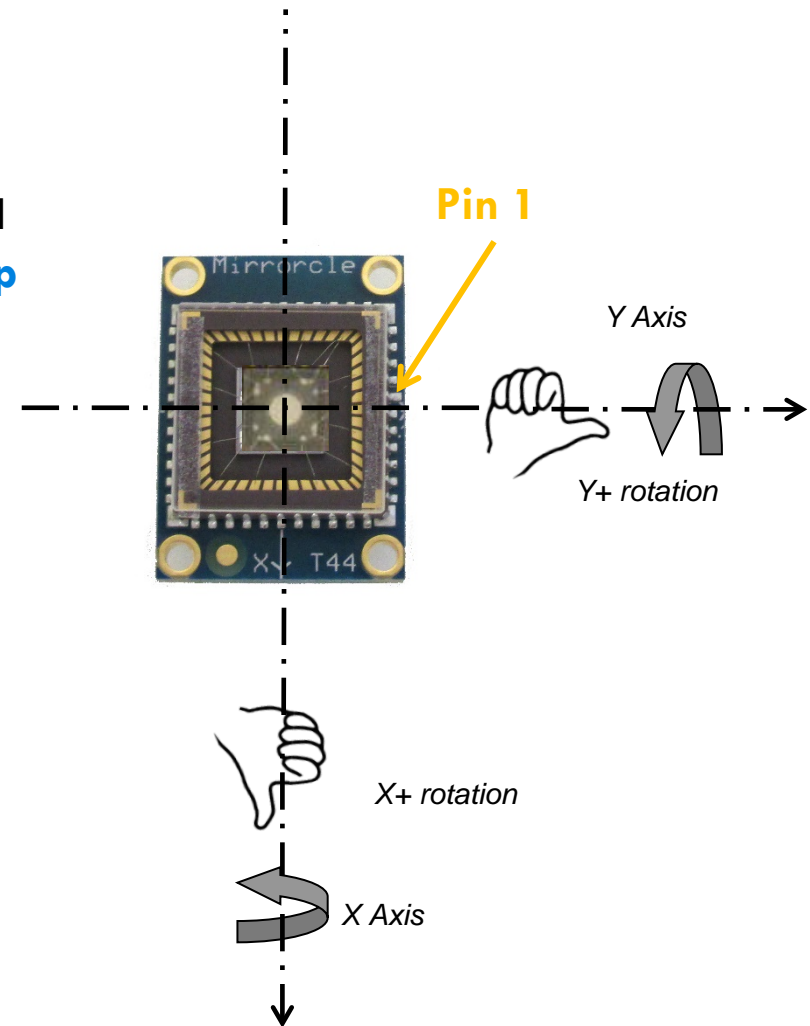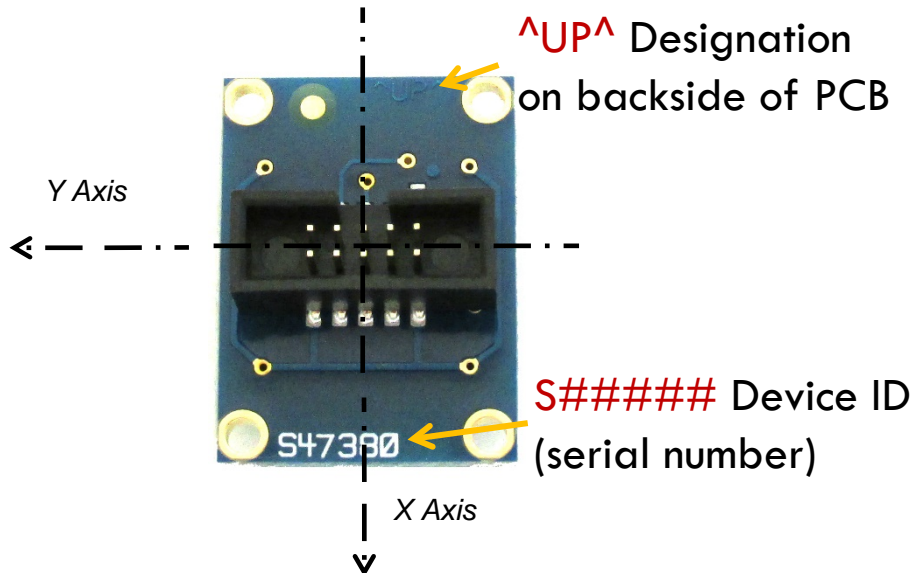
Definitions

Axes, Typical Orientation in Optical Setup, Rotation Directions and Terminal Labels

Orientation of Axes – TINY48.4

- X+ and Y+ mirror rotation are defined by the **rule of (right-hand) thumb**, based on the x and y axes as shown in each diagram. (more on next page)

- Typically, MirrorcleTech MEMS mirrors are mounted so that **X Axis driving provides laser beam sweep in the horizontal plane**.

Pin 1

Y Axis

Y+ rotation

X+ rotation

X Axis

^UP^ Designation on backside of PCB

Y Axis

S##### Device ID (serial number)

S47380

X Axis

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Scan Direction vs. Orientation of Axes

- Mirrorcle documentation defines scanning based on rotation **about** an axis. For example, rotation about the X axis is shown in images below (LEFT), which when mounted in Mirrorcle's standard mounts results in horizontal scanning.
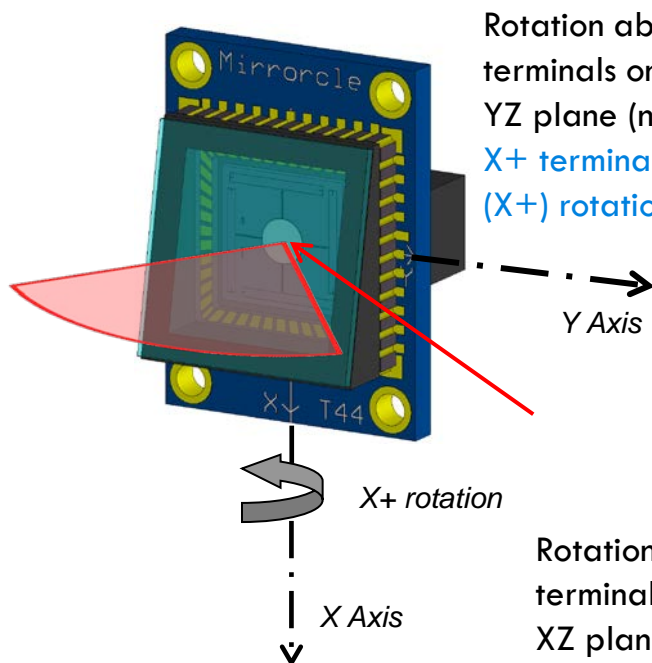
Rotation about the X Axis, as governed by X+ and X- terminals on the device results in beam scanning in the YZ plane (not accounting for optical distortions)
X+ terminals are used to generate torque for positive (X+) rotation about the X Axis, X- for opposite.

Y Axis

X+ rotation
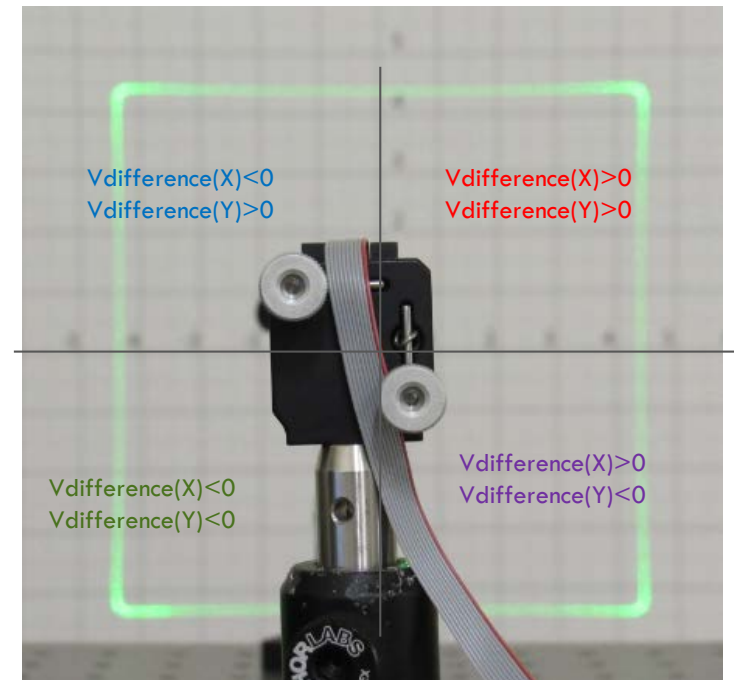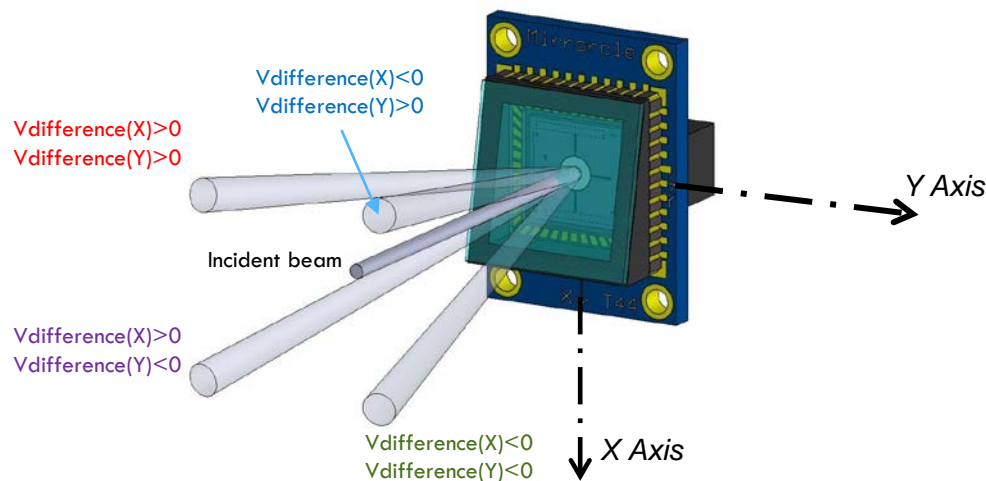
X Axis

Y+ rotation

Y Axis

X Axis
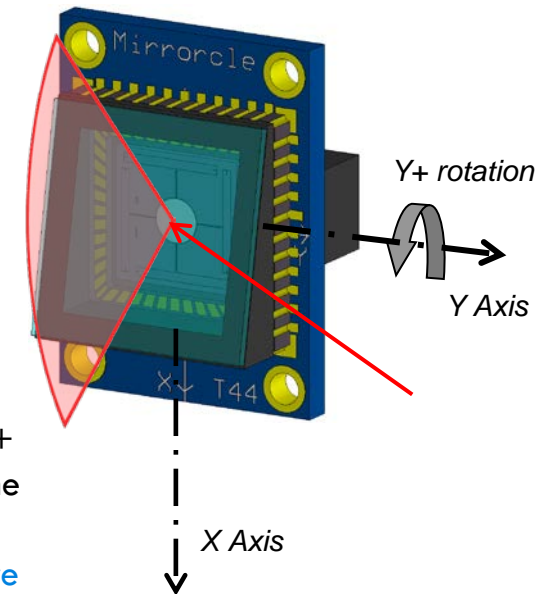
Rotation about the Y Axis, as governed by Y- and Y+ terminals on the device results in beam scanning in the XZ plane (not accounting for optical distortions)
Y+ terminals are used to generate torque for positive (Y+) rotation about the Y Axis, Y- for opposite.

Note: Refer to Application Note **AN004** for additional information on the relationship of optical scan angle and laser's angle of incidence (AOI)

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Breadboard Mounting and Standard Driving Definitions

- The preferred Mirrorcle MEMS Mirrors optical breadboard mounting positions the X-axis arrow so it points into the breadboard (table).

- When used with Mirrorcle's USB MEMS Controllers and MEMS Drivers this orientation results in the following scan definitions based on input Vdifference voltage.

Vdifference(X)<0
Vdifference(Y)>0

Vdifference(X)>0
Vdifference(Y)>0

Incident beam

Y Axis

Vdifference(X)>0
Vdifference(Y)<0

Vdifference(X)<0
Vdifference(Y)<0

X Axis

Vdifference(X)<0
Vdifference(Y)>0

Vdifference(X)>0
Vdifference(Y)>0

Vdifference(X)<0
Vdifference(Y)<0

Vdifference(X)>0
Vdifference(Y)<0

Connectorized Packages Overview

Packages:

TINY48.4

Mounts:

MOUNT-TINY.4-KMS

MOUNT-TINY.4-NM

TINY48.4

4X ⌀1.73
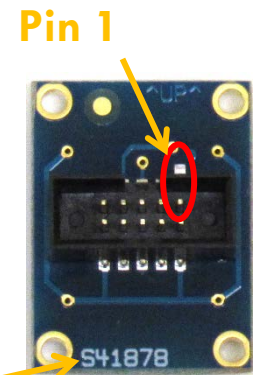
15

12

20   17

1.65

1.57

5.6

All units in mm

Pin 1

View from front

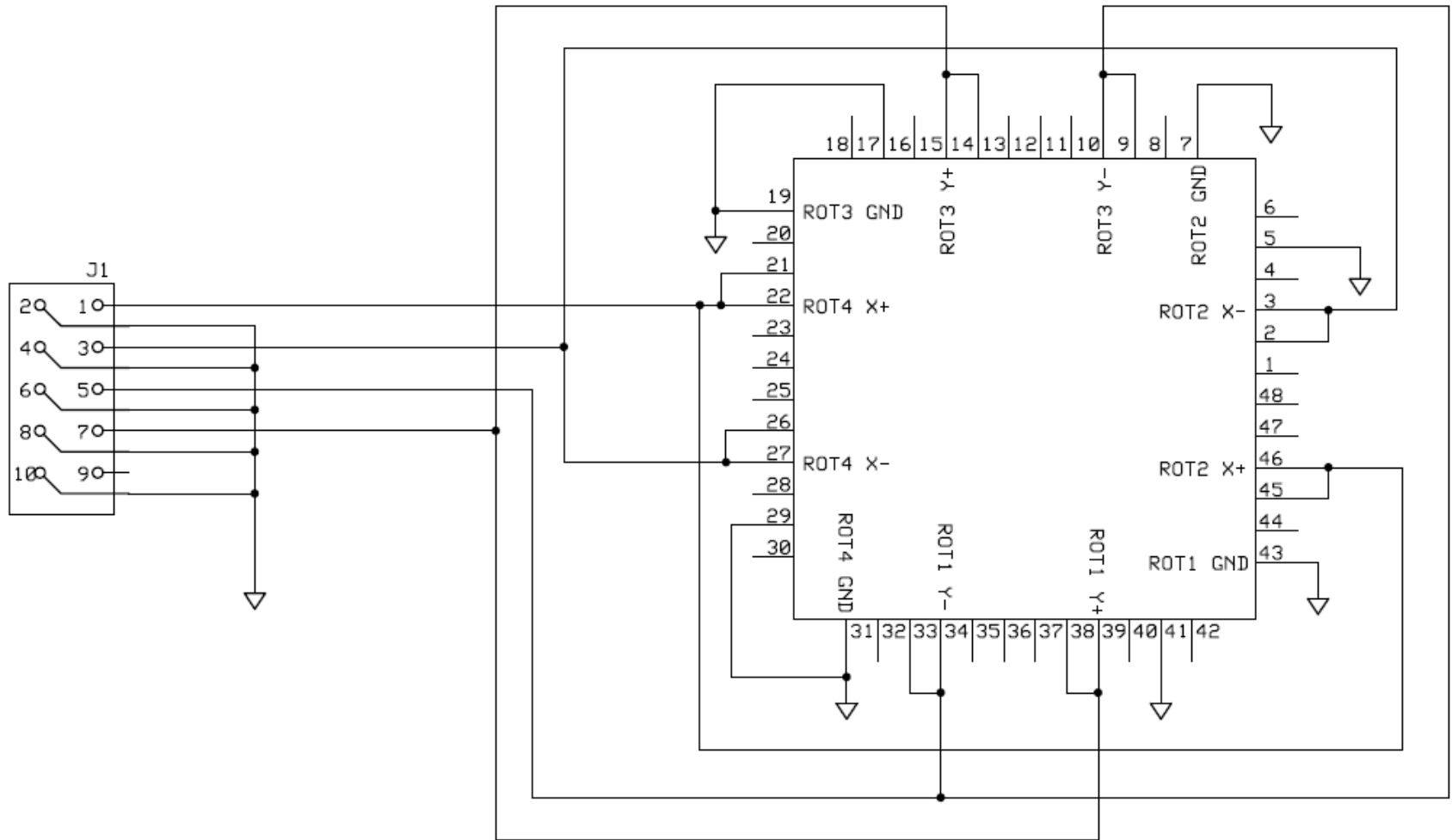**Pin 1**
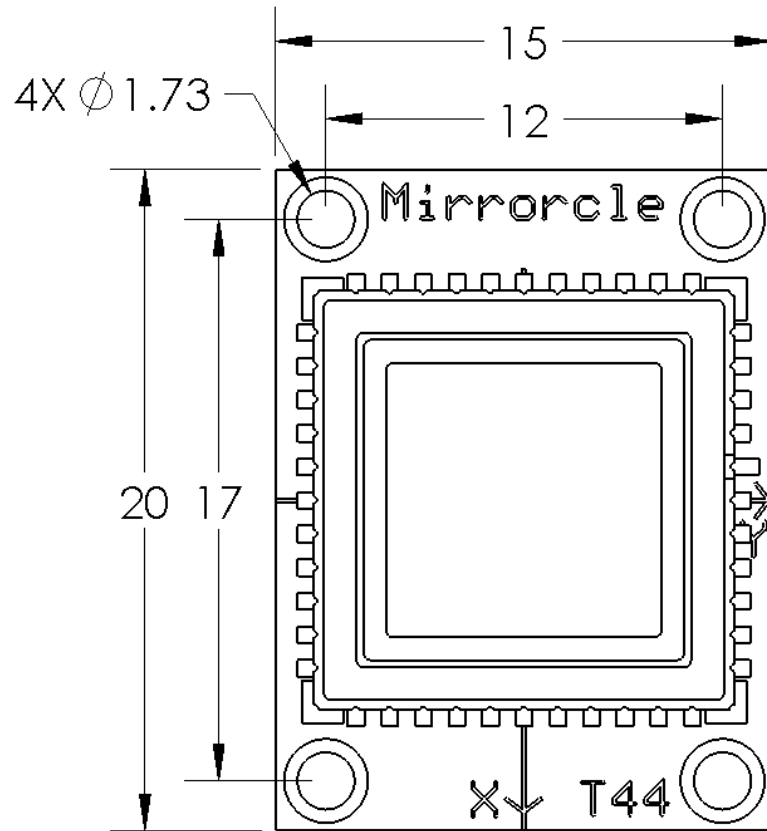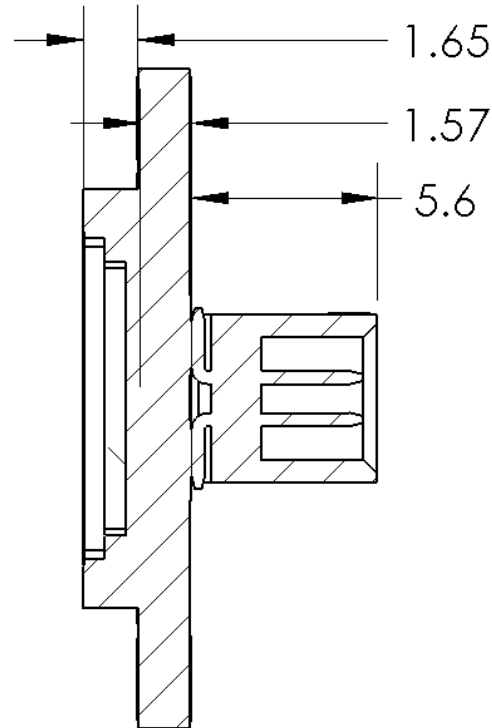
S##### Device ID
(serial number)
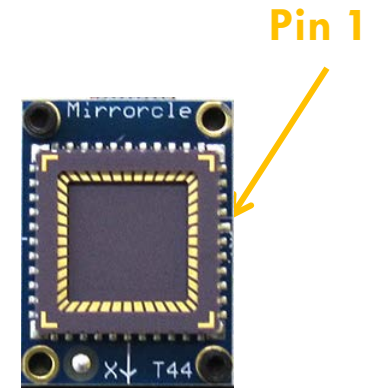
View from back
10-Pin connector
(see page 11)

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TINY48.4 Circuit Schematic

Bill of Materials

Item #	Qty	Ref Des	Digikey Part No.	Description	Package	Type	SMTs
1	1	J1	1175-1629-ND	IDC BOX HEADER 0.050 10 POS	10-pin conn	smt	1
2	1	MEMS Package	LCC Package	LCC48	LCC	smt	1

J1 Connector Pinout

```
9   7   5   3   1
┌─────────────────┐
│ ●   ●   ●   ●   ■ │
│ ●   ●   ●   ●   ● │
└─────────────────┘
10  8   6   4   2
```
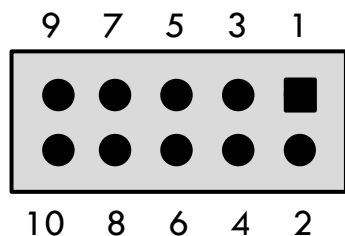
10 - Pin Header – J1		
Pin	**Name**	**Description**
1	HV_A (X+)	MEMS Channel X+
2	GND	Ground
3	HV_B (X-)	MEMS Channel X-
4	GND	Ground
5	HV_C (Y-)	MEMS Channel Y-
6	GND	Ground
7	HV_D (Y+)	MEMS Channel Y+
8	GND	Ground
9	N/C	No Connection
10	GND	Ground

Connector Part No.	Pins	Mating Cables and Sockets
Digikey ID: 1175-1629-ND	10	Cable: SAM8219-ND

Using Connectorized Package MEMS Mirrors

- ☐ Option 1: User's Own Setup

  - ☐ TINY48.4 packages can be used as delivered without any Mirrorcle-provided mounts. Users can utilize one or more of the provided holes or other methods to mount in their optical setups. Electrical connection from the Package connector is made directly to a Mirrorcle MEMS Controller or Driver.

- ☐ Option 2: Mirrorcle's Mount for User's Own Breadboarding

  - ☐ TINY48.4 packages can be mounted on a Mirrorcle-designed machined anodized aluminum mount using 0-80 screws. The mount (P/N: **MOUNT-TINY.4-NM**) can be assembled on top of user's own optical breadboarding posts or kinematic mounts. Electrical connection from the Package connector is made directly to a Mirrorcle MEMS Controller or Driver.

  - ☐ P/N: **MOUNT-TINY.4-NM**

- ☐ Option 3: Mirrorcle's Kinematic Mount with Post for Easiest Breadboarding

  - ☐ TINY48.4 packages mounted as described in Option2 are further assembled on top of a Thorlabs KMS mount with a ½" diameter post for easy integration into optical breadboarding setups. Electrical connection from the Package connector is made directly to a Mirrorcle MEMS Controller or Driver. (**see next page**)

  - ☐ P/N: **MOUNT-TINY.4-KMS**

MOUNT-TINY.4-KMS

Thorlabs KMS

Mirrorcle MOUNT-TINY.4-NM

Y Axis

X Axis

Thorlabs ½" Post
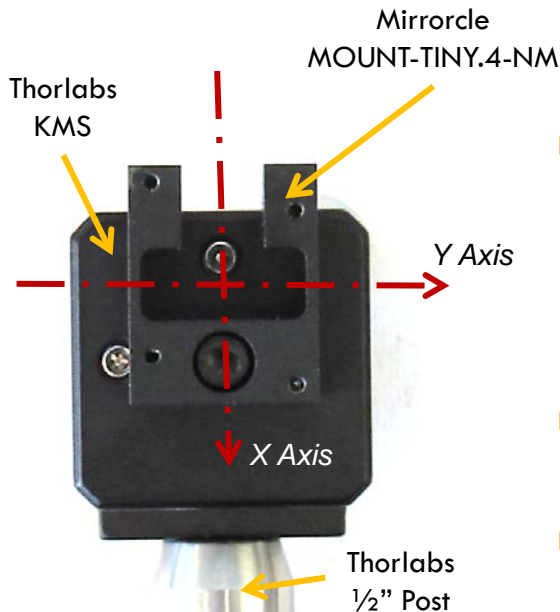
Note: This Mount is not necessary in the optical setup. It is only intended as an optomechanical mount to assist with bread-boarding and may be omitted (see previous page). **Mechanical model of mount available upon request.**

- ☐ The mechanical mount **MOUNT-TINY.4-NM** has threaded holes and is mounted onto a Thorlabs kinematic optical mount (KMS) with a breadboarding ½" diameter post (8-32 thread).

- ☐ Mount has holes for mounting of TINY package with 0-80 thread screws.

- ☐ Carefully place the TINY48.4 packaged MEMS Mirror onto the mechanical mount such that the connector sits in the cavity, allowing for the cable to be connected from behind. Mirrorcle label should be on top as shown.

- ☐ Secure the Package with two diagonally placed 0-80 screws as shown. Tighten the screws to a torque value of 10 cN·m.

Mounting Screws

Cable to Driver

TINY48.4

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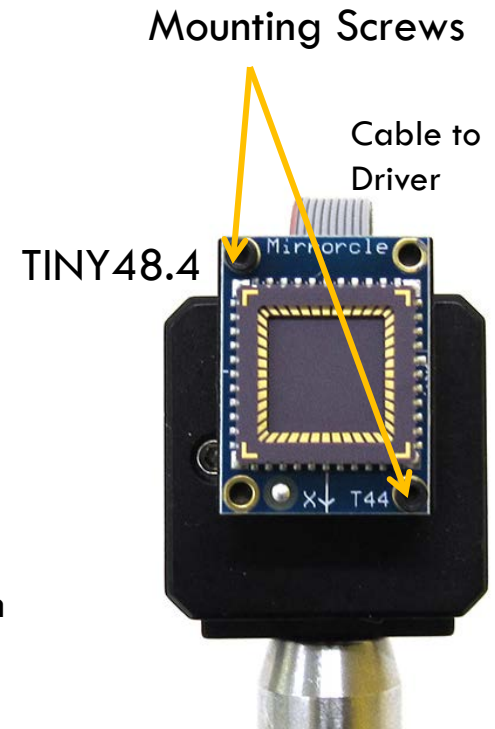
MEMS Mirror Part Number Generation

MEMS Device Part Number Generation

Format: ACTUATOR-MIRROR-PACKAGE-COVER

☐ AAAA.A-BBBBCC-DDDD-EE/FF/GG

- ▣ AAAA.A: MEMS actuator Design ID (e.g.: A8L2.2)

- ▣ BBBB: Mirror diameter in microns (e.g.: 4600)

- ▣ CC: Mirror coating (AL, AU, or SI for uncoated Silicon)

- ▣ DDDD: MEMS carrier package ID (e.g.: TINY48.4)

- ▣ EE: Cover window selection (e.g.: B)

- ▣ FF: Wedge option: 'W' for Wedge, 'F' for Flat

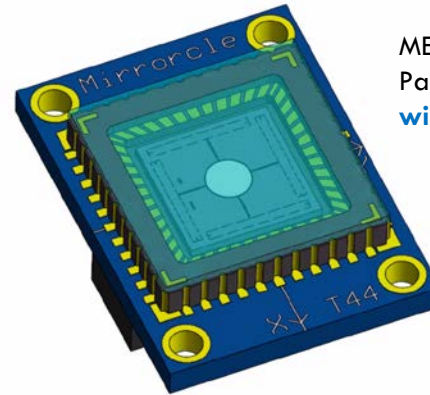- ▣ GG: Cover attachment method (e.g.: EP)

Package Cover

Package Cover Protects MEMS Mirror

MEMS Mirror in TINY48.4
Package with **no protective cover window**
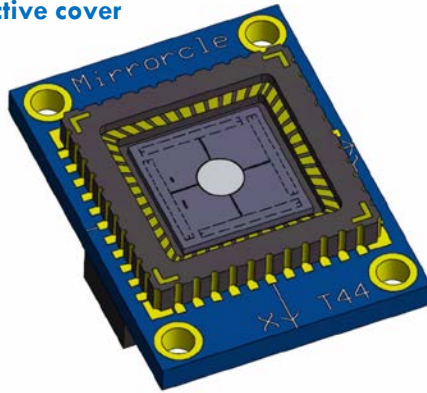
MEMS Mirror in TINY48.4
Package **with protective cover window**

- MEMS Mirrors and the package cavity is **protected by a cover window** with optical properties optimized to reduce reflections and losses. (see next pages)

- In some cases users remove the protective covers (windows) in their assemblies and experiments to increase optical performance. Such removal **voids device warranty** as damage by contact or contamination becomes more probable. Users who take great care in such assemblies in appropriate cleanroom environments can benefit from the removal at their own risk.
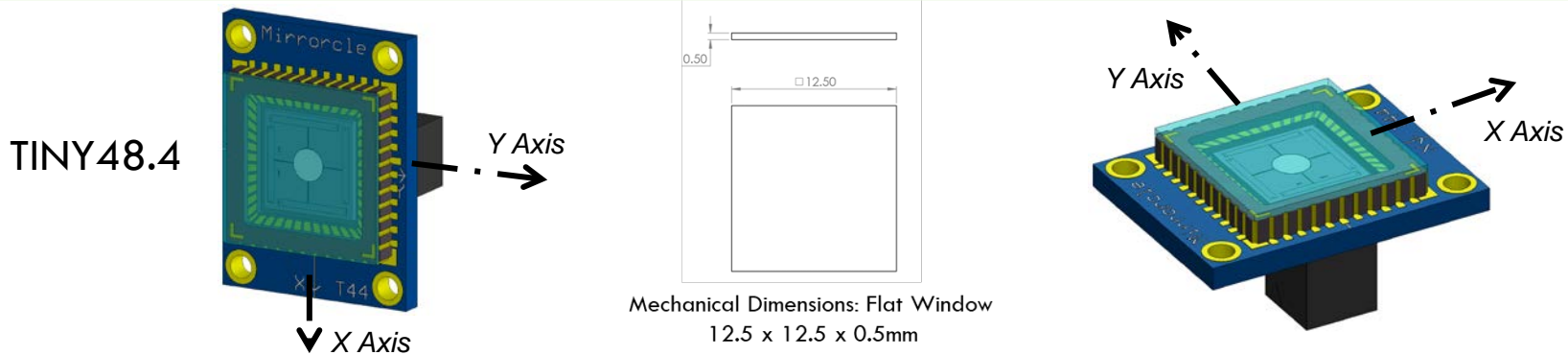
Cover Windows

□ Five standard window options (four with double-sided AR coated and one with no AR coating):

Window Coating	Coating Range [Min]	Coating Range [Max]	AOI [°]	Transmittance [%]	P/N Section E
Type A	400 nm	675 nm	22.5°	>98%	A
Type B	675 nm	1040 nm	22.5°	>98%	B
Type C	1040 nm	1600 nm	22.5°	>98%	C
Type AB	400 nm	980 nm	22.5°	>96%	AB
No coating	400 nm	2000 nm	22.5°	>88%	NC

□ All window types transmittance are specified for +/-10° from AOI (Angle of Incidence) of 22.5°, however, performance is not highly dependent on AOI (see Window Anti-Reflection (AR) Coatings Application Notes).

□ Customer specific wavelengths and AOI can be arranged for orders in quantities from 500 units

Window Mounting - Flat

- The selected window is typically **mounted flat** on the package, over the rim of the ceramic carrier.

- In P/N section F use: **F**

TINY48.4

Y Axis

X Axis

0.50

□12.50

Mechanical Dimensions: Flat Window
12.5 x 12.5 x 0.5mm

Y Axis

X Axis

Example P/N with Flat-mounted window: A7M20.1-2000AL-TINY48.4-A/**F**/EP

Window Mounting - Wedged

☐ The AR-coated window can be **mounted on a wedge** with a tilt to reduce reflections from the window within the MEMS mirror's field-of-regard.

☐ The standard wedge is designed with a -11° tilt about the MEMS Y Axis (negative rotation about the Y Axis, sending the residual reflection UP)

☐ In P/N section F use: **W**

TINY48.4:
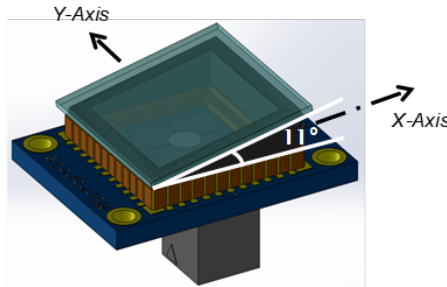
Axes Orientation: Window with Wedge   Mechanical Dimensions: Window with Wedge
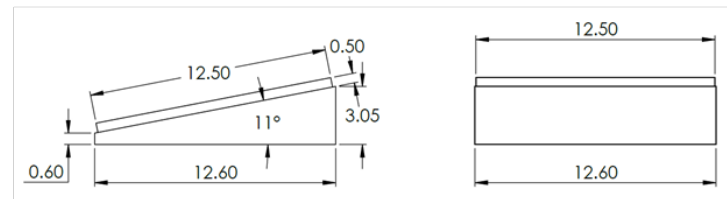
Example P/N with Wedge-mounted window: A7M20.1-2000AL-TINY48.4-A/**W**/EP

Package Cover Attachment Options

There are 3 methods of attaching the cover to the package:

- Cover is **permanently attached** to the package using adhesive.
  - In P/N section G use: **EP**

- Cover is **semi-permanently attached** to the package using double-sided tape on all 4 sides.
  - In P/N section G use: **TP**

- Cover is **lightly attached** to the package using double-sided tape on 2 sides to facilitate easier removal for users who prefer such assembly.
  - In P/N section G use: **2TP**

Examples of Devices with Different Covers

Wedge-Mounted Windows
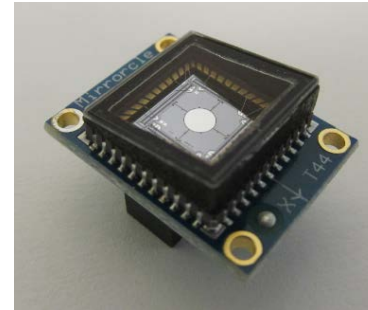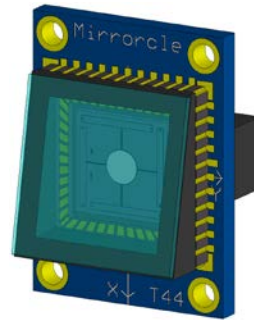
Flat-Mounted Windows
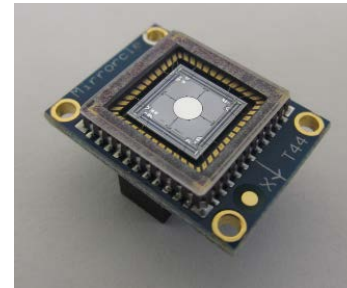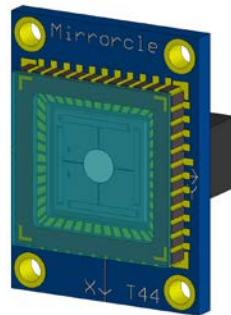
No-Cover or Open-Cavity Packages and Temporary Windows

☐ If a protective cover with a window has overwhelming downsides in optical performance, it may be omitted in customer assemblies. However the protection provided by the cover is still necessary on manufacturing and shipment side for Mirrorcle.

　　☐ Note – **removal of the protective cover voids device warranty** as damage by contact or contamination becomes more probable.

☐ Thus, customers may request **temporary windows for shipping protection only.** The COVER section of the part number simply states "**TW**".

　　☐ With that selection, a window (uncoated or coated, no specified optical performance) is lightly attached (double-sided tape on only 2 edges) for protection of the MEMS Mirror and for easier removal.

　　☐ The temporary window is always provided with flat mounting, dimensions below:

TINY48.4-TW
14 x 14 x 0.5mm window
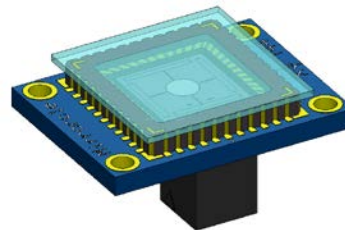
Thank you for Choosing

That's it! Thank you for reading through this guide.

If you have any further questions or suggestions please email us:
support@mirrorcletech.com