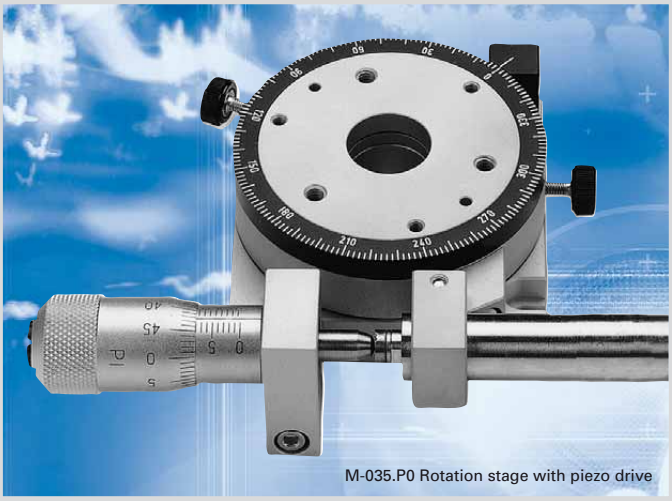
# M-035 Compact Precision Rotation Stage

## Piezo Drive Option for Nanometer Precision


M-035.P0 Rotation stage with piezo drive

- **Sub-Microradian Resolution**
- **360° Coarse Range, up to 19° Fine Range with Resolution <1 µrad**
- **Precision Micrometer or DC Motor Drives**
- **Piezo Option for High-Resolution Scanning and Tracking**
- **Clear Aperture Ø 20 mm**

M-035 series precision rotation stages with tangent-arm drive feature high resolution, excellent repeatability and minimum wobble. The stages are equipped with double-row ball bearings for zero backlash and high load capacity. Both the rotation platform and the scale ring (graduated in 2-degree increments) can be independently coarse positioned over 360° degrees and then locked with screws.

### Drive Options

A total of six different drive types are offered. They include various combinations of piezoelectric fine-positioner (closed-loop or open-loop), manual and motorized micrometer drives.

### Manual Drive

The basic version, the M-035.50, is equipped with a micrometer drive and a zero-backlash magnetic coupling. The micrometer motion, when converted into rotation, provides a positioning range of 19° degrees. The resolution is approximately 23 µrad.

### DC Motor Drive

The motorized version, the M-035.D01 features a high-resolution DC motor drive unit (M-227.10, see p. 1-42 *ff*) and has a range of about 12.6° with resolution of 2 µrad. A set of limit switches on the rotation stage protects against overtravel damage.

### High-Resolution Piezo Option

For applications requiring extremely high angular resolution, models M-035.PS and M-035.P0 (with manual micrometer drive) and M-035.DS1 and M-035.DP1 (motorized) are available. They have an additional piezoelectric fine adjustment, which can also be used for dynamic operation. The piezo drive has a linear travel range of 45 µm with sub-nanometer-resolution, which converts to a rotation range of approx. 1 mrad and sub-µrad resolution.

The piezo drives in the M-035.PS and M-035.DS1 versions is also equipped with a position sensor, making closed-loop operation possible with higher stability, reproducibility and accuracy. For more details on the piezo drives, see the "Piezo Actuators" section.

### Flexibility

M-035 stages without PZT or DC-motor drives can be upgraded at a later date.

### Notes

For adapters, bracket, etc. see p. 4-90 *ff*

### Ordering Information

**M-035.50**
Rotation Stage, Ø 60 mm, Micrometer Drive

**M-035.P0**
Rotation Stage, Ø 60 mm, Micrometer Drive + Piezo Drive

**M-035.PS**
Rotation Stage, Ø 60 mm, Micrometer Drive + Closed-Loop Piezo Drive

**M-035.D01**
Rotation Stage, Ø 60 mm, DC Motor Drive

**M-035.DP1**
Rotation Stage, Ø 60 mm, DC Motor + Piezo Drive

**M-035.DS1**
Rotation Stage, Ø 60 mm, DC Motor + Closed-Loop Piezo Drive

**Upgrade Kits**

**M-035.U0**
Upgrade Kits with Open-Loop Piezo Drive

**M-035.US**
Upgrade Kits with Closed-Loop Piezo Drive

**M-035.UD**
Upgrade Kits with DC Motor Drive (Factory installed)

**Ask about custom designs!**

### Rotation Range Conversion

M-035 and M-036 rotation stages use a tangent-arm which extends beyond the platform. The angular equivalent of the linear actuator displacement can be calculated by the following equation:

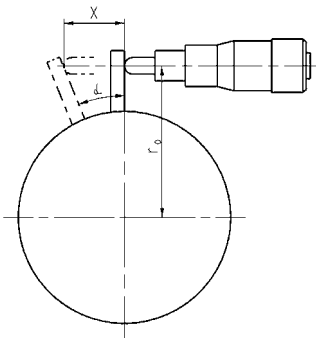
$\alpha \approx \arctan (x/r_0)$

where:
x = displacement of linear actuator [mm]
$\alpha$ = rotation angle [°]
$r_o$ = distance of linear actuator contact point to center of rotation @ 0 degrees [mm]
$r_o$ is 44 mm for the M-035 rotation stages and 66 mm for the M-036 rotation stages.

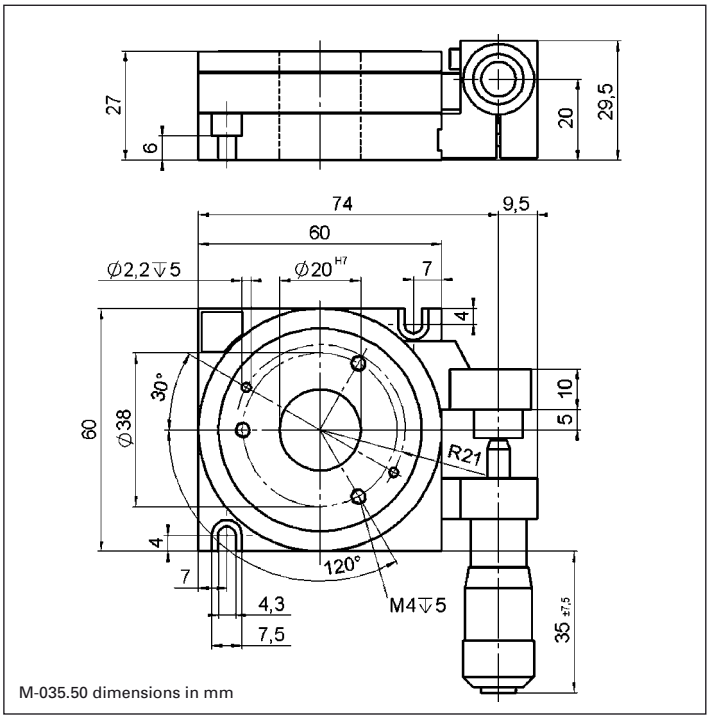
### Example:

The rotation angle of an M-035 for a linear displacement x = 5 mm:

$\alpha \approx \arctan (5/44) \approx 6.48°$.

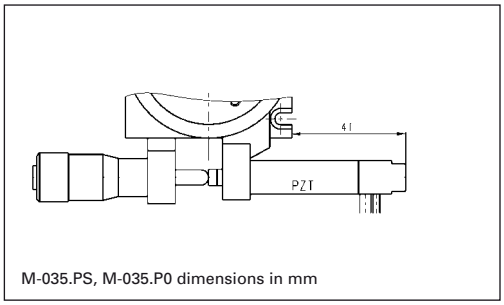


Relation between linear displacement and rotation




M-035.50 dimensions in mm

M-035.50 Rotation stage




M-035.PS, M-035.P0 dimensions in mm

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## Technical Data

| Model | M-035.50 | M-035.P0 | M-035.PS | M-035.D01 | M-035.DP1 | M-035.DS1 | Units |
|---|---|---|---|---|---|---|---|
| Coarse rotation range | 360 | 360 | 360 | 360 | 360 | 360 | ° |
| Rotation range (micrometer drive) | 19 | 19 | 19 | 11 | 11 | 11 | ° |
| Rotation range (piezo drive) | – | 1,040 | 1,040 | – | 1,040 | 1,040 | µrad |
| Min. incremental motion (piezo drive) | – | <1 | <1 | – | <1 | <1 | µrad |
| Repeatability (piezo drive) | – | – | 2 | – | – | 2 | µrad |
| Unidirectional repeatability (motor drive) | – | – | – | 10 | 10 | 10 | µrad |
| Backlash (motor drive) | – | – | – | 50 | 50 | 50 | µrad |
| Design resolution (motor drive) | – | – | – | 0.08 | 0.08 | 0.08 | µrad |
| Min. incremental motion (motor) | – | – | – | 2 | 2 | 2 | µrad |
| Minimum incremental motion (micrometer drive) | 23 | 23 | 23 | – | – | – | µrad |
| Rotation / linear input | 22.7 | 22.7 | 22.7 | 22.7 | 22.7 | 22.7 | µrad/µm |
| Tangent-arm length | 44 | 44 | 44 | 44 | 44 | 44 | mm |
| Wobble | <150 | < 150 | <150 | <150 | <150 | <150 | µrad |
| Max. velocity | – | – | – | 1.2 | 1.2 | 1.2 | °/s |
| Max. axial force | ±300 | ±300 | ±300 | ±300 | ±300 | ±300 | N |
| Max. torque ($\theta_X$, $\theta_Y$) | ±3 | ±3 | ±3 | ±3 | ±3 | ±3 | Nm |
| Max. torque CW* | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | Nm |
| Max. torque CCW* | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | Nm |
| Drive (manual or motor) | M-622 | M-622 | M-622 | M-227.10 | M-227.10 | M-227.10 | |
| Piezo drive | – | P-840.30 | P-841.30 | – | P-840.30 | P-841.30 | |
| Mass | 0.4 | 0.5 | 0.52 | 0.6 | 0.65 | 0.67 | kg |
| Body material | Al, St | Al, St | Al, St | Al, St | Al, St | Al, St | |
| Recommended controller | – | – | – | C-863, single axis, C-843 PCI board for up to 4 axes | C-863, single axis, C-843 PCI board for up to 4 axes | C-863, single axis, (p. 4-114) C-843 PCI board (p. 4-120) for up to 4 axes | |
| Recommended piezo controller | – | E-660, E-610 E-500 System | E-610 E-500 System | – | E-660, E-610 E-500 System | E-610 (p. 2-110) E-500 System (p. 2-142) | |

*CW: clockwise; CCW: counter-clockwise