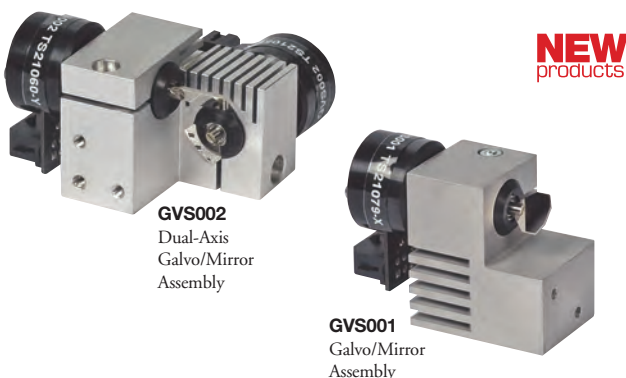


## Galvanometer Mirror Systems (Page 1 of 3)



**NEW**  
products

- **Maximum Beam Diameter:** 5 mm (0.2")
- **Full Scan Range (Mechanical):**  $\pm 12.5^\circ$
- **Max Full Scan Bandwidth:** 350 Hz
- **Max Small Angle Scan Bandwidth:** 1 kHz
- **Mirror:** Protected Silver Coating (400 - 2000 nm)

### Galvanometers Features

- 1D and 2D Systems
- Optically Encoded Mirror Position
- 99.9% Motor and Position Sensor Linearity
- Advanced Analog Control Circuit (Servo Driver) with Current Damping and Error Limiter
- Closed-Loop Mirror Scanning System

Thorlabs' 1D and 2D Scanning Galvanometer Mirror Systems include the mounted mirror or mirror pair, a servo driver for each motor, and all of the cables. Thorlabs also offers a compact linear power supply (GPS011, page 3 of 3) that can be used to power the servo drives. A third-party DC power supply can be used to power the servo drivers if it provides  $\pm 15$  to  $\pm 18$  VDC (1.2 A<sub>rms</sub>, 5 A<sub>peak</sub> each rail).

### Galvanometer Design

Thorlabs' one- and two-axis galvanometer mirror systems use a galvo motor that utilizes a stationary coil and a magnet attached to the rotation shaft. This design was chosen over a stationary magnet and rotating coil design because it allows for the fastest response time and highest resonant frequencies.

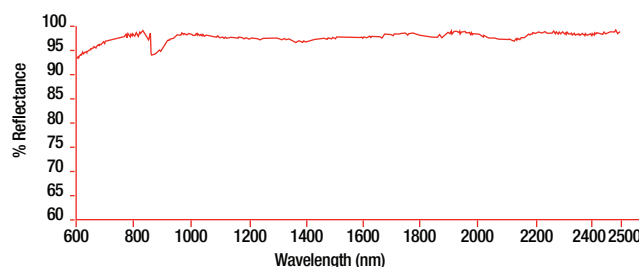
### Mirror

Due to the large angular acceleration of the rotation shaft, the size, shape, and moment of inertia of the mirror become significant factors in the design of Thorlabs' high-performance galvo mirror systems. In addition, the mirror must remain rigid (flat) even when subjected to large accelerations. All of these factors have been precisely balanced in order to match the performance characteristics of the galvo motor, which in turn maximizes the performance of the galvo mirror system.

The mirrors on both the 1- and 2-axis systems can accommodate beam diameters up to 5 mm (0.2") in size. Since the scan mirrors are separated by 10 mm (0.39") in the 2-axis system, the second scan mirror is elongated to accommodate the deflection of the beam from the first mirror. All the mirrors are coated with a protected silver coating that is suitable for applications using light in the 400 - 2000 nm spectral region.

Galvanometer Mirror System Specifications	
Maximum Beam Diameter	5 mm
Wavelength Range	400 -2000 nm
Damage Threshold	150 W/cm <sup>2</sup>
Motor and Position Sensor Linearity	99.9%
Scale Drift (Max)	40 ppm/°C
Zero Drift (Max)	10 $\mu$ rad/°C
Repeatability	15 $\mu$ rad
Typical Resolution	0.0008° (15 $\mu$ rad)
Average Current	1 A
Peak Current	5 A
Coil Resistance	2.2 $\Omega \pm 10\%$
Coil Inductance	150 $\mu$ H $\pm 10\%$
Rotor Inertia	0.02 gm·cm <sup>2</sup>
Maximum Scan Angle (Mechanical Angle)	$\pm 12.5^\circ$
Motor Weight	50 g
Operating Temperature Range	0 to 40 °C
Optical Position Sensor Output Range	40 to 80 $\mu$ A

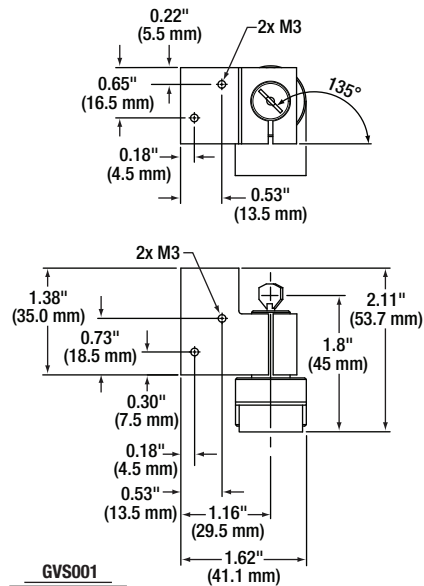
Protected Silver Coating



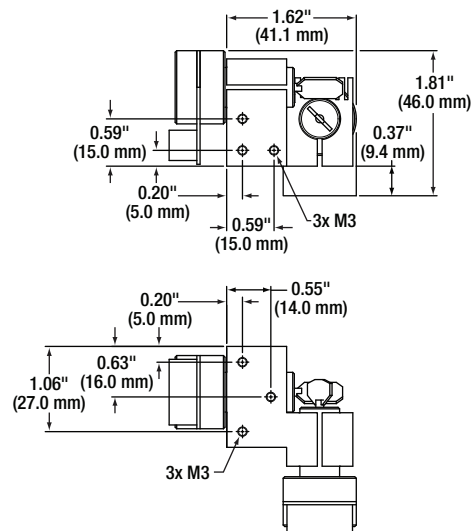
### Mirror Positioning

The angular orientation (position) of the mirror is optically encoded using an array of photocells and a light source, both of which are integrated into the interior of the galvanometer housing. Each mirror orientation corresponds to a unique ratio of signals from the photodiodes, which allows for the closed loop operation of the galvo mirror system.

## Galvanometer Mirror Systems (Page 2 of 3)

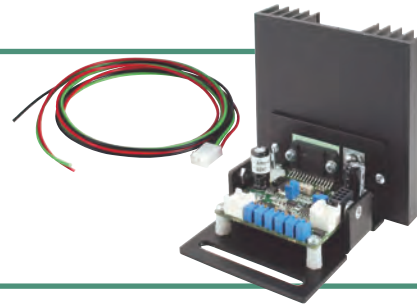


GVS001



GVS002

- Proportional Derivative (PD) Driver Circuit
- Non-Integrating, Class Zero Servo Scanner
  - Ideal for Vector Positioning (Laser Etching)
  - Ideal for Raster Positioning (Printing or Laser Scanning Microscopy)
- Current Damping Feature Enhances Performance
- Error Limiter



### Servo Driver Board with Heatsink

(One Unit Included with a GVS001 1-Axis System,  
Two Units Included with a GVS002 2-Axis System)

### Servo Driver Board

The included proportional derivative (PD) servo circuit with analog control inputs is used to drive the galvo motors in a closed-loop mode using the feedback from the optically encoded mirror position. The driver needs to be powered with a  $\pm 15$  to  $\pm 18$  V ( $1.2 A_{rms}$  each rail) DC power supply (see next page for more information). The circuit board accepts analog control input voltages that are used to determine the position or scan rate of the mirror. For continuous scanning applications, a function generator can be used to control the mirror position while a programmable voltage source can be used for more complicated step and hold applications. The ratio between the input voltage and mirror position is 0.8, which means that the  $\pm 10$  VDC analog input causes the mirror to rotate over a  $\pm 12.5^\circ$  range. The control circuit also provides monitoring outputs that allow the user to track the position of the mirror as well as voltages proportional to the drive current being supplied to the motor and the difference between the command position and the actual position of the mirror (see the manual online at [www.thorlabs.com](http://www.thorlabs.com) for pin out information).

The heat generated by the driver boards must be dissipated in order to prevent tripping of the driver board thermal cut out. The driver boards are supplied with the heatsink shown in the image above. No further heatsinking of the driver is needed under normal operating conditions.

### Drive Electronics Specifications

Full Scale Bandwidth	100 Hz Square Wave, 350 Hz Sine Wave
Small Angle ( $\pm 0.2^\circ$ ) Bandwidth	1 kHz
Small Angle Step Response	300 $\mu$ s
Power Supply	$\pm 15$ to $\pm 18$ VDC ( $1.25 A_{rms}$ , $5 A_{peak}$ Max)
Analog Signal Input Resistance	20 k $\Omega$ $\pm$ 1% (Differential Input)
Position Signal Output Resistance	1 k $\Omega$ $\pm$ 1%
Analog Position Signal Input Range	$\pm 10$ V
Mechanical Position Signal Input Scale Factor	0.8 V/degree
Mechanical Position Signal Output Scale Factor	0.5 V/degree
Operating Temperature Range	0 to 40 $^\circ$ C
Servo Board Size (L x W x H)	3.35" x 2.91" x 1.74" (85.1 mm x 74.0 mm x 44.2 mm)

## Galvanometer Mirror Systems (Page 3 of 3)

### Power Supply Option

The GPS011 is a 3 A<sub>rms</sub>, ±15 VDC, linear two-channel switching power supply designed to power two of the galvo motor drivers. The unit has two outputs and comes with two power cables that are terminated so that they can be plugged directly into both the socket on the driver board and the power supply. The GPS011 can be used with either a 115 VAC or 230 VAC main input. The black power supply enclosure measures 274 mm x 179 mm x 116 mm (10.79" x 7.05" x 4.57"), has a cooling fan, and is protected from power surges with a main input fuse.

### Galvo Mirror System Package Contents

A GVS001 galvo mirror system comes with a single mirror mounted on a galvo motor. The motor is held in a small aluminum mount that can be secured to a larger structure. Also included is the driver (with heatsink) for the galvo motor and four cables. The cable connecting the motor to the driver is connectorized on both ends, while the power cable, analog input cable, and output monitoring cable are only connectorized on the end that attaches to the driver circuit. The GVS002 galvo mirror system comes with two galvo motors, each with a mirror. The mirror on the second galvo motor is elongated so that the full scan range of both mirrors can be used. The mirrors are factory aligned so that the zero position of the two mirrors is orthogonal. Also included are two drivers (with heatsinks) and two of each of the cables included with the GVS001 system above.

### Galvo Mirror System Performance

The mirrors on both the GVS001 and GVS002 can be driven to scan the full mechanical range of ±12.5° at a frequency of 100 Hz when using a square wave control input voltage and at a frequency of 350 Hz when using a sine wave control input voltage. When a mirror is continuously scanned over a small angular range (0.2°), the bandwidth of the system is 1 kHz. For a single small-angle step, it takes the mirror 300 μs to come to rest at the command position. The angular resolution of the system is 0.0008° (15 μrad).

- **Max Beam Diameter:** 5 mm (0.2")
- **Full Scan Range (Mechanical):** 12.5°
- **Mirror:** Protected Silver Coating (400-2000 nm)



**NEW**  
product

ITEM#	\$	£	€	RMB	DESCRIPTION
GVS001	\$ 925.00	£ 641.30	€ 821.30	¥ 7,810.80	1D Galvo System Mirror, Motor, Drivers, and Cables
GVS002	\$ 1,895.00	£ 1,313.50	€ 1,682.50	¥ 16,002.00	2D Galvo System Mirror, Motor, Drivers, and Cables
GPS011	\$ 450.00	£ 312.00	€ 399.60	¥ 3,799.90	Galvo Power Supply, Dual Output

## Galvanometer Mirror System Accessories

### Post Mount

The GHS003 (GHS003/M) post adapter allows the galvo mirror assembly to be mounted on our #8-32 UNC (M4 x 0.7) threaded posts. The adapter also serves as an additional heatsink for the galvo motors. Typically, the galvo motors do not generate enough heat to need the additional heatsink. However, it may be necessary for applications that involve a rapidly changing drive signal waveform.

**NEW**  
product



**GHS003**  
Heat Sink for the Dual-Axis GVS



**GVS002**  
Shown with  
GHS003 and  
Post Assembly

ITEM#	METRIC ITEM#	\$	£	€	RMB	DESCRIPTION
GHS003	GHS003/M	\$ 20.00	£ 13.90	€ 17.80	¥ 168.90	Galvanometer Post Adapter with Heatsink

## Complete 1- and 2-Axis Galvo Mirror System Kits

- 1- or 2-Axis Galvo Mirror
- Galvo Motor Driver with Heatsink and Cover
- Power Supply
- Galvo Mirror Mount with Heatsink

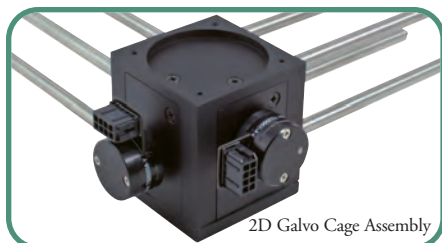
**See Page 1384**



## Galvanometer Mirror Systems Accessories Continued

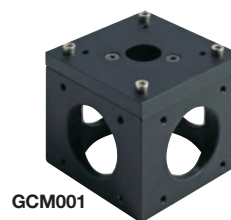
### 30 mm Cage Cube Mounts

The GCM001 and GCM002 30 mm cage cubes are designed to allow the GVS001 and GVS002 Galvo Mirrors, respectively, to be integrated into an optical setup built using Thorlabs' cage construction system (see pages 147-184). The output and input ports on the cube are SM1 (1.035"-40) threaded, which makes them compatible with all of our SM1 lens tubes (see pages 123-135) and other SM1-threaded accessories and components. To mount the motors in the cubes, remove them from the holder they were shipped with, insert them into the cage cube mounting block, and then replace the cage cube covers.



2D Galvo Cage Assembly

The distance between the two mirrors in the GSV002 galvo mirror system is 10 mm (0.39"), which means that the optical axis of the cage system will be displaced vertically (or horizontally depending on system orientation) by the same 10 mm (0.39").



GCM001

**NEW**  
products



GCM002

ITEM#	METRIC ITEM#	\$	£	€	RMB	DESCRIPTION
GCM001	—	\$ 120.00	£ 83.20	€ 106.60	¥ 1,013.30	1D Galvo Cage System Mount
GCM002	GCM002/M	\$ 120.00	£ 83.20	€ 106.60	¥ 1,013.30	2D Galvo Cage System Mount



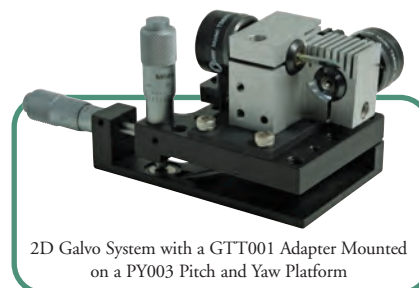
GTT001

**NEW**  
product

 **Mechanical**  
Drawings Available on the  
**WEB**

### Galvo Mirror Adapter for Pitch/Yaw Platform

The GTT001 allows both the GVS001 and the GVS002 Galvo Mirror Systems to be mounted onto the PY003 pitch and yaw platform (see page 235). This platform can greatly simplify the alignment of the galvo mirrors to an incoming beam. The PY003 provides an adjustment range of  $\pm 4^\circ$  with an angular resolution of 10 arcsec.



2D Galvo System with a GTT001 Adapter Mounted on a PY003 Pitch and Yaw Platform

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	\$	£	€	RMB	DESCRIPTION
GTT001	—	\$ 18.00	£ 12.50	€ 16.00	¥ 152.00	Galvo Mount Tip-Tilt Platform Adapter

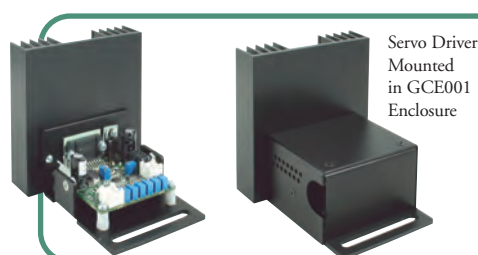


GCE001

**NEW**  
product

### Protective Cover for Servo Driver

The GCE001 is a protective cover designed to fit over the servo driver card supplied with the GVS001 and GVS002 galvo mirror systems.

Servo Driver  
Mounted  
in GCE001  
Enclosure

ITEM#	METRIC ITEM#	\$	£	€	RMB	DESCRIPTION
GCE001	—	\$ 56.00	£ 38.90	€ 49.80	¥ 472.90	Galvo Driver Card Cover

**TOOLS  
OF THE  
TRADE**

## Complete Galvo Mirror System Packages

1D and 2D packages are available that include the mirror, motor, driver, power supply, and some accessories. The power supply included with this package allows the system to operate at its maximum resolution of  $0.0008^\circ$  (15  $\mu$ rad)

**For More Details, See Pages 1384-1385**