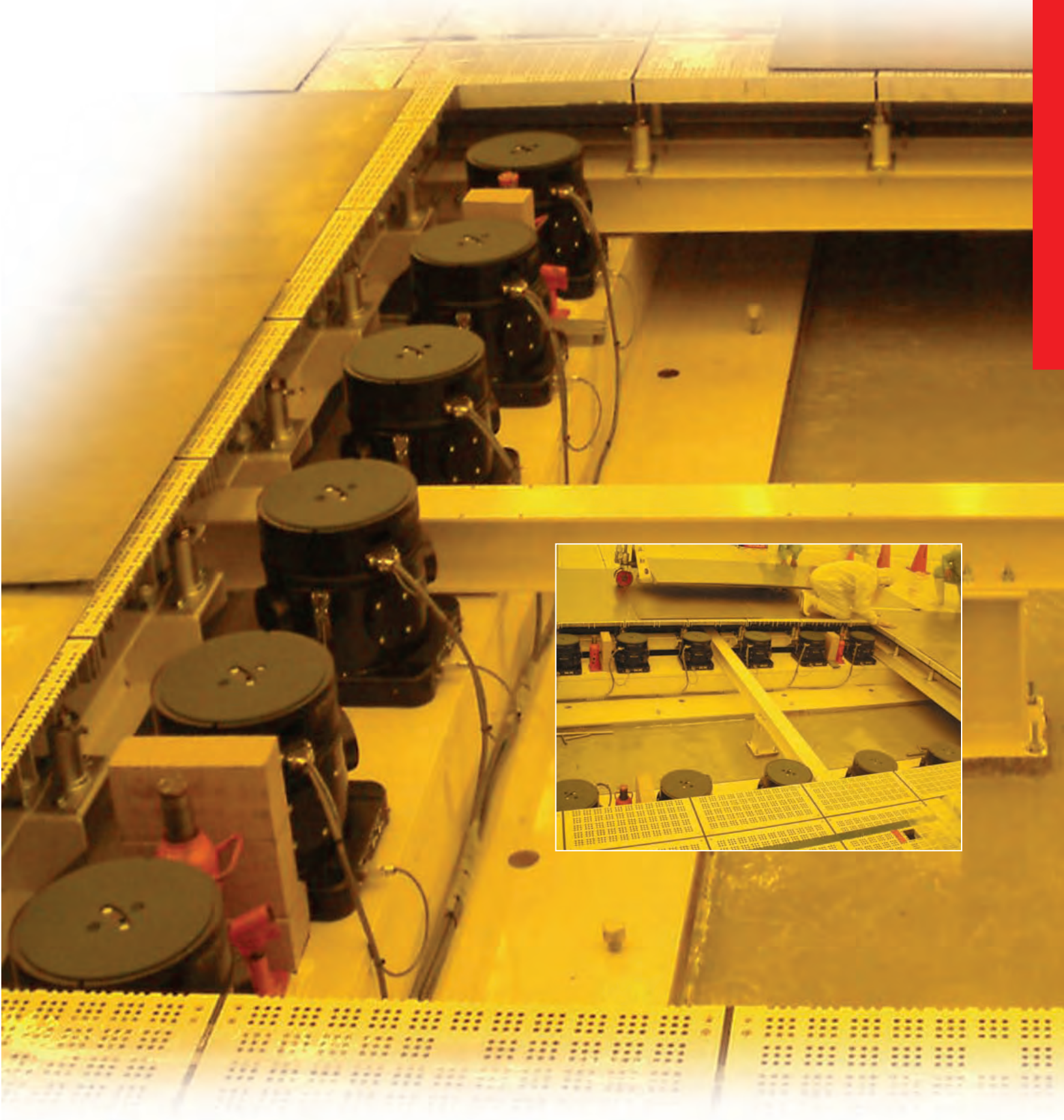


**Active Piezoelectric Vibration Cancellation System**

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## STACIS® 2100

### Active Piezoelectric Vibration Cancellation System



STACIS® is the world's most advanced active vibration cancellation system. Employing advanced inertial vibration sensors and state-of-the-art piezoelectric actuators, Stacis cancels vibration in real time by sensing floor vibration, then expanding and contracting piezoelectric actuators to filter out floor motion. Isolation starts at 0.6 Hz and the active bandwidth is 250 Hz.

Primarily designed to isolate precision microlithography, metrology, and

inspection equipment in advanced semiconductor factories, Stacis is now the industry standard solution for the most sensitive instruments in noisy environments. Hundreds of times stiffer than air isolators, Stacis suffers from none of the limitations of air systems. There is no "soft" suspension and, unlike active air systems, Stacis can be "stacked" (placed beneath a tool with an internal active air isolation system).

In addition to facilitating optimal tool performance and resolution in noisy fabs, Stacis is guaranteed to meet the floor vibration specifications of wafer inspection, metrology and microlithography tools.\*

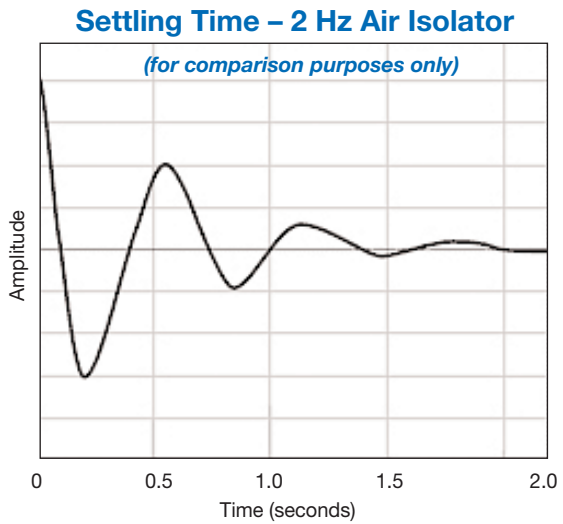
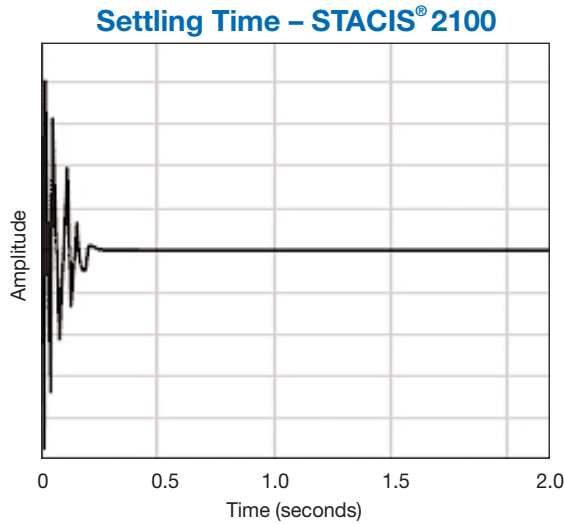
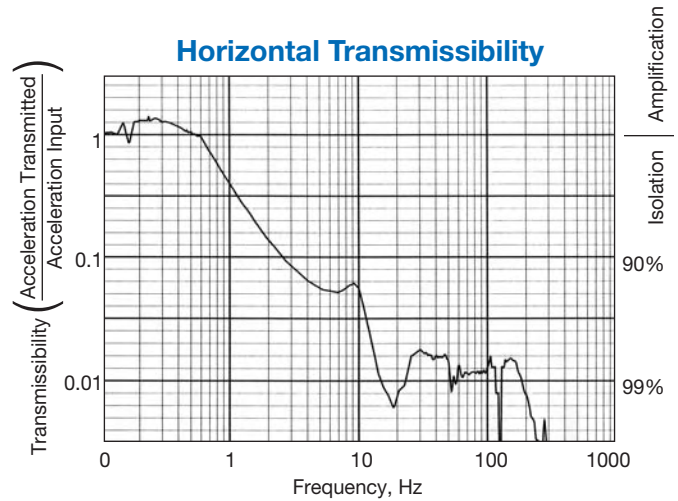
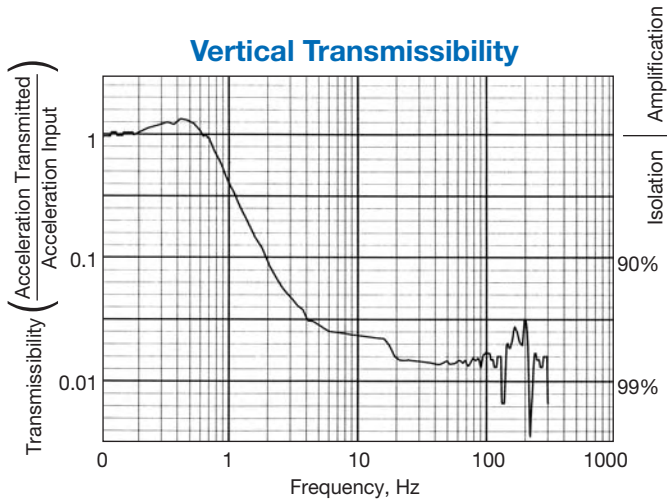
With many hundreds of successful installations worldwide, Stacis is the ideal vibration isolation system for the most vibration-sensitive instruments.



\* Guarantee is contingent on TMC's comparison and review of the site floor vibration data against the tool floor vibration criteria and confirmation that the STACIS® transfer function will provide the required isolation.

*Installation of a TMC high stiffness, highly damped stainless steel platform on STACIS®. (Photo courtesy of Texas Instruments' Kilby Center)*

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**GENERAL SPECIFICATIONS** (may vary depending on configuration)

**DC-2000 Digital Controller**

Analog inputs/outputs	16 channels (16/14 bit)
Digital inputs/outputs	16
Sampling rate	6.5 KHz nominal
Front panel	Two-line LCD with soft menu keys
	BNC input and output for signal monitoring
	Two RS-232 communication ports (second port on rear)
	Tri-color system status lamp
Physical	Single RETMA rack unit height x 15 in. deep
Power	90-240 VAC, 50-60 Hz, 600 watts max.
Other	Power connector for support of external devices

**Performance Specifications**

Active degrees of freedom	6
Active bandwidth	0.6 to 250 Hz
Natural frequency	Passive elastomer: 18 Hz
	Effective active resonant frequency: 0.5 Hz
Transmissibility at resonance	< 1.1
Isolation above 2.0 Hz	> 90 %
Settling time after a 10 lb (4.5 kg) step input (10:1 reduction)	0.3 sec
Internal noise	<0.1 nm RMS
Operating load range per isolator (different passive mounts required)	400 - 4,500 lb (182 - 2,045 kg)
Isolator overload safety factor	> 2:1
Number of isolators	3 or 4
Maximum displacement	590 μ in. (15 μm)
Stiffness (1,000 lb/454 kg mass) (typical middle capacity isolator)	40,000 lb/in. (73 x10 <sup>6</sup> N/m)
Magnetic field emitted	< 0.02 micro-gauss broadband RMS

**Dimensions, Environmental and Utility Requirements**

Isolator size	11.75 in. (w) x 12.5 in. (d) x 10.8 in. (h) (300 x 320 x 275 mm)
Isolator weight	75 lb (34 kg)
Controller size	13 in. (w) x 17 in. (d) x 1.75 in. (h) (330 x 431 x 44 mm)
Temp., operating	50° to +90°F (10 to 32°C)
Temp., storage	-40° to 255°F (-40 to 125°C)
Humidity, operating	68°F dewpoint (maximum)
Power required	100, 120, 230 or 240 volts; 50/60 Hz; < 600 watts, CE compliant
Floor displacement	< 500 μ in. (13 μm) below 15 Hz
Options: TMC laminated, stainless steel platforms, frames, and "risers," leveling devices, and earthquake restraints	

**How to Order**  
**Stacis® Ordering Chart**

Catalog Number	Description	Pricing
21-301-01	Stacis, 3-mount, low capacity	Contact TMC
21-301-02	Stacis, 3-mount, medium capacity	
21-301-03	Stacis, 3-mount, high capacity	
21-401-01	Stacis, 4-mount, low capacity	
21-401-02	Stacis, 4-mount, medium capacity	
21-401-03	Stacis, 4-mount, high capacity	

**Features & Benefits**

- Provides greater than 90% isolation at frequencies greater than 2 Hz, vertical and horizontal
- Reduces fab floor construction costs, allows tools to be installed in higher vibration environments
- Active bandwidth, 0.6 Hz to 250 Hz
- Recommended by many tool manufacturers
- 6 degree-of-freedom active hard mount design, no soft air suspension
- Installs easily, robust control system requires minimal or no on-site compensation
- A point-of-use solution that is compatible with all internal tool vibration isolation systems
- Ensures tool vibration criteria will be met as fab vibration levels increase over time
- Uses TMC's patented STACIS® technology to cancel vibration using piezoelectric actuators
- Enables older and noisier floors to accommodate state-of-the-art tools
- Compatible with various floor heights and sub-floor geometries
- Increases throughput, quality and yield



STACIS® 2100 on a "riser" installed under a TMC platform in a 40" tall raised floor



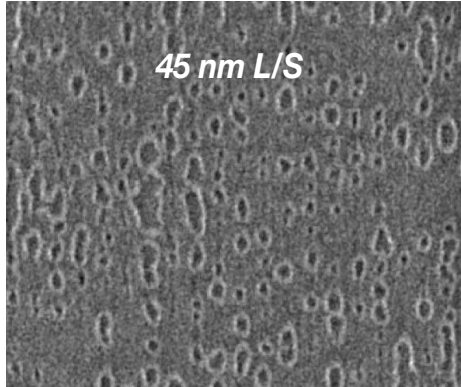
STACIS® isolating a Varian NMR Spectrometer

# APPLICATION NOTE

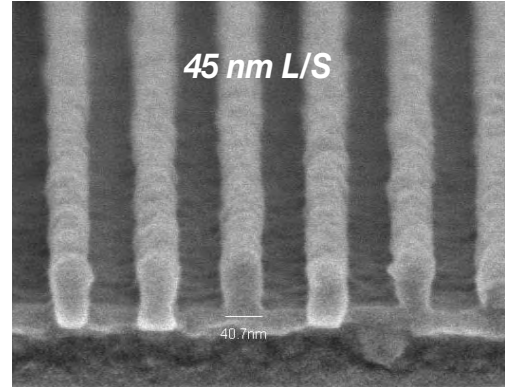
## Impact of Vibration on Advanced Immersion Lithography (actual customer supplied data)



The 45 nanometer line-width test patterns shown were produced with an advanced Immersion Lithography System manufactured by Amphibian Systems and installed at SEMATECH in Austin, Texas. Variation between the images is due to the effect of seismic vibration on the photolithography process. The images shown were obtained using a scanning electron microscope.



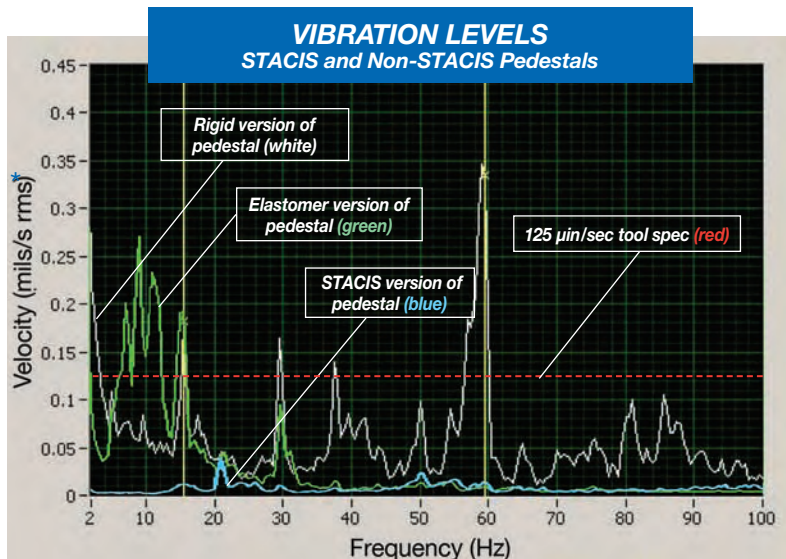
**Without STACIS® ...**  
Best pattern obtained on either the elastomer or rigid version of original pedestal.



**With STACIS® ...**  
Pattern achieved with STACIS active vibration isolation.

The tool was initially installed on a steel and concrete plinth with a steel support structure which incorporated commercial elastomer vibration isolation pads. This pedestal did not achieve the tool's specified vibration criteria and pattern quality was poor.

In an attempt to reduce vibration, the elastomer pads were effectively shorted out with metal shims leading to a more rigid, non-resonant structure but this resulted in little improvement. The vibration criteria were not met with either version of the pedestal and pattern quality remained poor.



\*Vertical Axis Data shown

The plinth support structure was removed and retrofitted with a STACIS® Active Piezoelectric Vibration Cancellation System. The Stacis mounts were placed directly beneath the existing plinth. Supporting the tool on Stacis resulted in a dramatic reduction of overall seismic vibration levels and achievement of the manufacturer's floor vibration specification. More importantly, Stacis provided a dramatic improvement in pattern quality.

Photos, images, and vibration data courtesy of SEMATECH.

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*STACIS® supporting the end chambers of a prototype LIGO interferometer at the California Institute of Technology. These are the most precise instruments ever made – capable of measuring distances of less than  $10^{-16}$  meters.*



*The Nikon FX-21S LCD Stepper incorporates an advanced version of TMC's STACIS® for the ultimate in vibration cancellation. The rigid mounts yield faster settling times in response to motion resulting in higher throughput.*



[www.gmp.ch](http://www.gmp.ch)

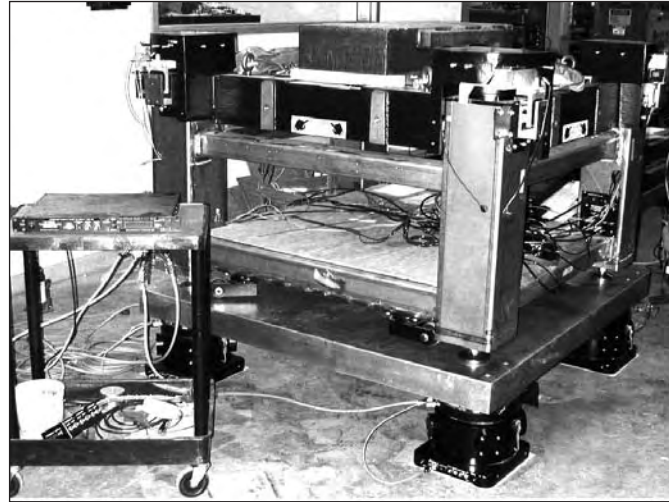
# STACIS® as a Microseismic Shaker

**Equipment manufacturers can use STACIS® to generate micron-level floor vibration simulating real world floor activity to develop tool vibration criteria.**

**Semiconductor equipment makers, electron microscope manufacturers, and other precision tool makers struggle to develop meaningful floor vibration criteria for their instruments. These criteria can be derived either theoretically or empirically. Theoretical calculations are extremely complex and are often impractical or do not reflect actual tool sensitivity because of the many variables that cannot be easily modeled. Floor vibration criteria arrived at empirically are typically based on gathering tool performance information from a wide range of installations represented by various floor vibration levels.**

**These floor vibration levels and the corresponding tool performance are used to create an upper limit of vibration amplitudes over a frequency spectrum that represents floor vibration levels that will result in acceptable tool performance. Both of these approaches are extremely difficult, time consuming, and do not result in a precise vibration specification for the tool.**

STACIS 2100® offers a completely unique and novel way to approach the development of tool vibration criteria. Stacis, which is normally operated as a floor vibration isolation/cancellation system, can also be operated to provide micron-level shaker input. This shaker signal can be white noise, discrete frequency, or a sine-swept wave-form. Stacis can provide independent or combined X, Y and Z axis vibration input. As a shaker, Stacis can be run to simultaneously cancel building floor vibrations providing a quiet foundation while superimposing on this the desired frequency and amplitude vibration spectrum required to test tool performance. No other shaker system can control inputs down to such small amplitudes. No other shaker system can isolate ambient floor vibration while *simultaneously* providing a controlled vibration frequency spectrum. The vibration generated at the Stacis digital controller at extremely low amplitudes is not corrupted by ambient building floor vibrations at the test site.



**STACIS® 2100 is used as an isolation system/micron-level shaker within TMC's own factory to test performance of other TMC vibration isolation products.**



Complete working tools can be mounted on a Stacis isolation/shaker system, and the Stacis vibration amplitudes can be adjusted as overall tool performance is evaluated. The tool can be excited at given

frequencies or given bands of frequencies to determine the exact amplitude/frequency relationship of vibration input that limits overall tool performance. The result is an overall tool vibration criteria level that corresponds to the exact vibration level at which the tool can provide optimal performance. This testing can be completed relatively quickly and easily – without shipping tools to customer sites and waiting for large amounts of field data or relying on questionable modeling information.

Contact TMC or your local sales representative to acquire a STACIS® 2100 system for use as a shaker for testing your sensitive equipment in a controlled vibration environment.

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*A Cameca NanoSIMS 50L on a TMC Floor Platform supported by Stacis® isolators. This tool is a 5,000-pound secondary ion mass spectrometer with a spatial resolution of 50 nanometers. Photo courtesy of the Planetary and Space Sciences Research Institute (PSSRI) at The Open University, Milton Keynes, U.K.*

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Fax. +41 44 825 34 01 so@gmp.ch



*SEM Column on a  
65 Series Floor Platform*



*NMR Spectrometer on a 65 Series Floor Platform.*

*A Canon® Stepper is isolated  
by a STACIS® version of a TMC Quiet  
Island® Floor Platform.*



## Quiet Island®

### Sub-Floor Platforms and Stands



*A version of our Rigid Quiet Island® meets the most stringent wafer scanner floor stiffness specifications.*

TMC Quiet Island® Sub-Floor Platforms are a modular solution to the problem of supporting vibration sensitive and/or large, heavy floor-mounted equipment in a raised-floor cleanroom environment.

Because the primary considerations in designing raised floors are access to electrical cabling and the facilitation of air flow, structural rigidity and damping of vibration are generally secondary design goals. Raised floors routinely amplify the relatively quiet sub-floor vibration levels by a factor of 100 to 1,000. In addition, the high acoustic noise levels generated by sophisticated air handling systems further excite raised floors. The result is a vibration environment that is incompatible with sub-micron wafer manufacturing and inspection equipment.

Conventional solutions to this problem include poured-in-place concrete pedestals and costly, needlessly complex, custom-engineered structures.

Both approaches suffer from a lack of portability, adaptability, and performance.

TMC Quiet Island Sub-Floor Platforms consist of a high-stiffness, high-damping stainless steel floor platform supported by one of our interchangeable support stands. The stand may be our non-resonant rigid tripod or rigid square tube type leveling jack stand, Gimbal Piston™ Air Isolators or patented STACIS® Active Piezoelectric Vibration Cancellation System.

The Rigid-Damped Tripod is a new offering that requires no platform but rather can be placed under individual feet of the tool.

### Platform

The platform is a 2 1/2 in. (60 mm) or 4 in. (100 mm) thick lamination of steel plates sandwiched around a lightweight, incompressible, damped core material. The layering effect of rigid steel plates and core epoxy bonded into a seamless, stainless steel pan provides an extremely high level of structural damping. The large cross-section and steel content yield a very high level of overall rigidity. For a complete discussion of this laminated construction, see pages 4-5.

### Support Stands

The modular design of Quiet Island support stands adapts to changing requirements. The supports may be field upgraded at any time without moving the platform or supported instrument.

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## Rigid Leveling Stands

Instruments with less sensitivity to mechanical vibration or effective internal vibration isolation may be adequately supported on rigid leveling stands. TMC rigid stands are designed to minimize amplification of sub-floor vibration levels, provide a foundation that is much stiffer and less resonant than the raised floor, and allow the option of upgrading to an isolator in the future. The stands consist of square posts with a rigid screw jack



*A number of tripods, quad stands and square post designs exist. Our recommendations will depend on your floor height, sub-floor geometry and application.*

mechanism and jam nut to support the platform. A heavy-duty tripod leveling stand is preferred for taller floors and applications requiring the stiffest support structure. A rigid leveling stand version of our Quiet Island® is ideal for applications where the sub-floor vibration levels meet the tool vibration criteria.

## Gimbal Piston™ Air Isolators

Some vibration sensitive applications will require Gimbal Piston™ Isolators, which offer effective vibration isolation. These isolators have low vertical and horizontal natural frequencies and can achieve excellent isolation above 5-10 Hz. Isolators for raised floors above 30 in. (750 mm) are rigidly connected with tiebars for safety and stability. Shorter posts are independent with oversized baseplates for increased stability. Standard features include rugged aluminum height con-



trol valves, internal piston travel restraints, thin-wall dacron reinforced rubber diaphragms, and non-oil-based pneumatic damping techniques. For a complete discussion of the Gimbal Piston isolator, see pages 2-3. Note that a Gimbal Piston version of Quiet Island may be incompatible with the internal vibration isolation system of the tool being supported.

## STACIS®

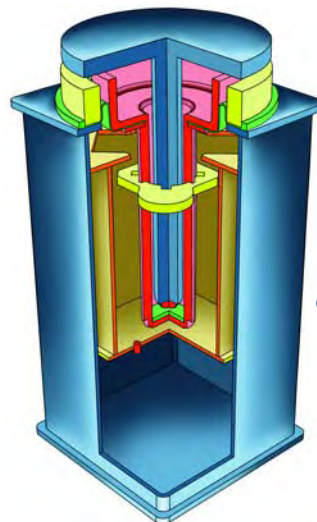
For the ultimate in vibration control beneath a raised floor, the STACIS® Piezoelectric Active Vibration Cancellation System may be combined with our platform laminations. Stacis provides isolation actively from 0.2 Hz to 250 Hz and passively at higher frequencies. The improvement in isolation performance in comparison to an air isolator is two orders-of-magnitude

at 2 Hz. The Stacis system will not only bring a noisy sub-floor back to within spec, but is compatible with all tool internal isolation systems and has been shown to possibly increase stepper yield in quiet environments. For a complete discussion of Stacis, see pages 52-58.

## Counter-Mass

Loaded platforms on air isolators may require a counter-mass to maintain stability. The minimum separation between the isolator centers must meet certain criteria (see Section 10) or self-oscillation may occur. To maintain a low center of mass, a counter-mass is generally required.

Quiet Islands with rigid mounts or Stacis Piezoelectric supports DO NOT require a counter-mass.



Gimbal Piston™ Isolator

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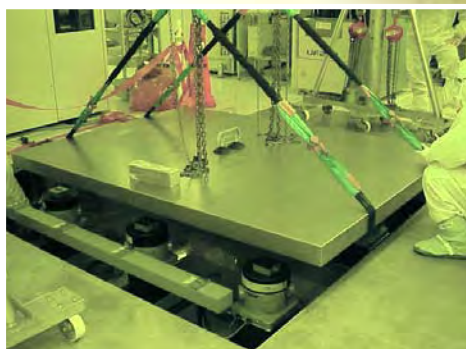
### How to Order

Because of the complexity, sensitivity, and value of the equipment installed on our Quiet Island® Sub-Floor Platforms, we do not maintain standard catalog numbers for ordering. We consider each installation to be a custom-engineered solution. The recommended procedure for ordering is as follows:

- Tell us what equipment or instrument you want to isolate. Because of our installed base, it is likely that we have already engineered a platform design to the requirements of your application. In addition, we maintain close contact with stepper, aligner, SEM, and other tool manufacturers to keep current with size, shape, weight changes, and floor vibration specifications.
- Alternatively, you may want a system to fit within the raised floor grid

system. Specifiers often opt for a 47 x 47 in. (1,190 x 1,190 mm) platform to replace an even number of floor tiles.

- Tell us the height of your raised floor above the solid sub-floor.
- Describe to us or provide an illustration showing any hole pattern in your sub-floor or the steel beam/waffle slab geometry.
- Provide us with floor vibration data or discuss with us how to arrange to have this data measured.
- Consider the vibration sensitivity of the instrument. Many tools are adequately supported by our rigid, non-resonant post design. More sensitive applications will require air or piezo support.



*STACIS® installation at Texas Instrument's KFAB (Kilby Center), TI's most advanced research center. This Stacis platform system will be used to support and isolate an advanced metrology tool. (Pad size is 105 x 65 x 4 in. and tool weight is 6,750 lb.)*



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**NEW From TMC!**  
Patent Pending

# FloorPlatform PZT™

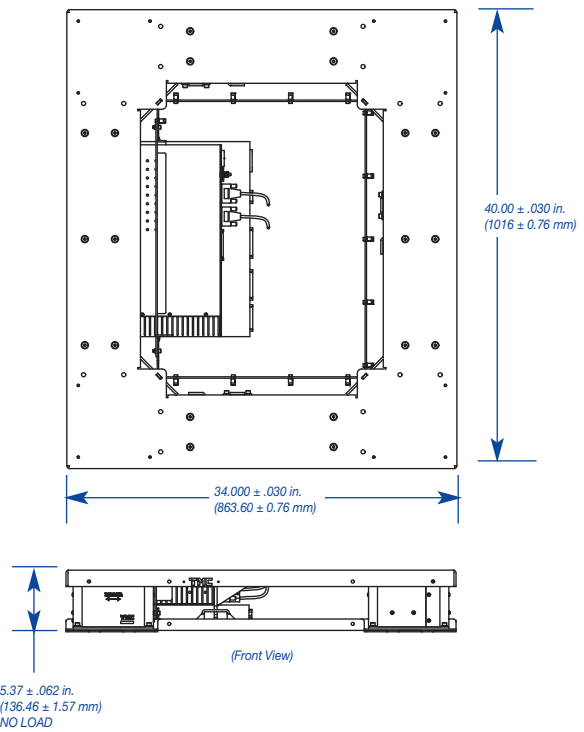
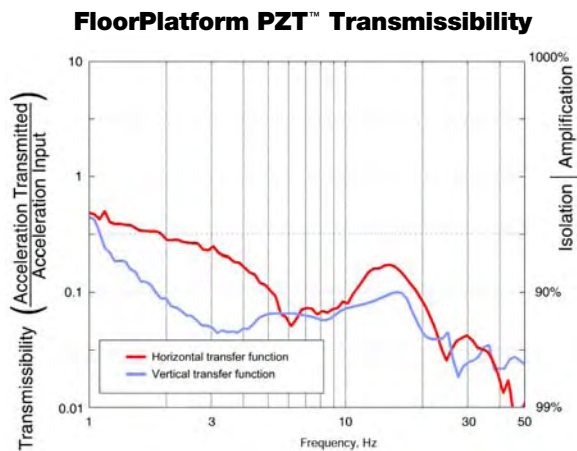
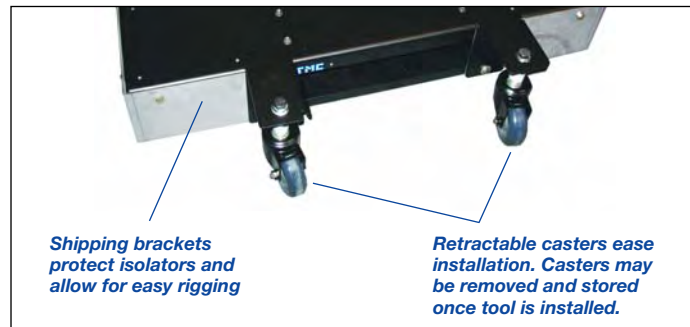
Active Hard-Mount Vibration Cancellation for SEMs



*Sub-Hz Vibration Cancellation in an Active Hard-Mount Floor Platform*

## Features & Benefits

- Incorporates patented Stacis® technology
- Active inertial vibration cancellation system
- 34 x 40 x 5.5 inches, fits most commercial SEMs
- Load capacity: 900 - 1,600 lb.
- Vibration cancellation starts below 1 Hz
- Extended stroke piezoelectric actuators, up to 60µm
- 3 or 6 active degrees-of-freedom
- Installs easily, minimal tuning required
- Compatible with all internal tool vibration isolation systems
- No soft air suspension
- Simple, robust, & cost-effective
- Casters allow easy portability, no lifting required



## Ordering Chart

Catalog No.	Description	Pricing
25-503	FloorPlatform PZT 34 x 40 x 5.5 inches, 3 DOF	Contact TMC
25-506	FloorPlatform PZT 34 x 40 x 5.5 inches, 6 DOF	Contact TMC

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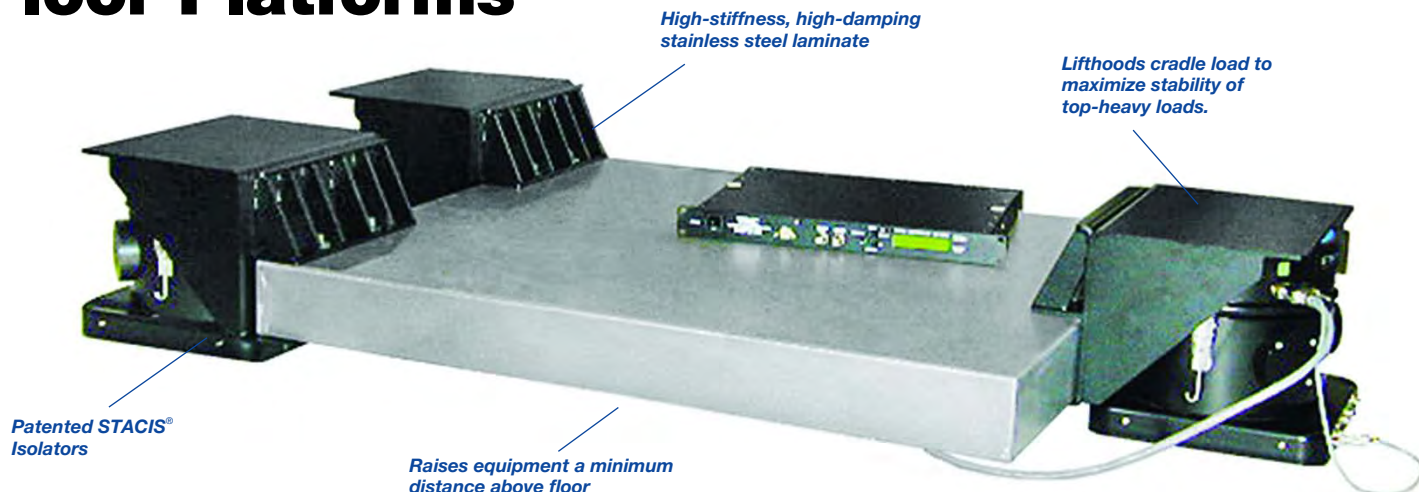
Siège principale: Avenue des Baumettes 17  
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## 65 SERIES

# Floor Platforms



*TMC's low-profile 65 Series Floor Platform Isolation Systems are designed for larger, floor-mounted instruments.*

These platforms effectively isolate instruments weighing a few hundred to tens of thousands of pounds and do so without the compromises in stability normally encountered when isolating instruments with a high center-of-mass.

Historically, we approached the problem of a tall, top-heavy payload by combining our Gimbal Piston™ Air Isolators with “lifhoods” and a massive floor platform. This lowered the effective system center-of-mass and achieved the required stability.

Increasingly, our floor platforms are configured with our Stacis® Active Piezoelectric Isolators in place of our Gimbal Piston Isolators. The advantages of Stacis over pneumatic isolation include:

- Stacis piezoelectric isolators suffer no ill-effects from tall, top-heavy payloads. There is no danger of gravitational instability.
- Instruments mounted on floor platforms (typically electron microscopes) are among the most vibration-sensitive tools made. Stacis provides the best vibration isolation commercially available with no low-frequency amplification.
- Instruments requiring isolation typically incorporate an internal, built-in vibration isolation system. This system is generally a low-frequency air isolator which, in general, should not be supported by another low-frequency air isolation system. Stacis is compatible with being “stacked” beneath any tool’s internal isolation system.

## GENERAL SPECIFICATIONS

**Stacis® Version** (See Page 53)

### Gimbal Piston™ Version

#### Isolator natural frequency:

##### High Input

Vertical = 1.0 Hz

Horizontal = 0.8 Hz

##### Low Input

Vertical = 1.2-1.7 Hz

Horizontal = 1.0-1.5 Hz

#### Isolation efficiency @ 5 Hz:

Vertical = 80-90%

Horizontal = 80-90%

#### Isolation efficiency @ 10 Hz:

Vertical = 90-99%

Horizontal = 90-99%

#### Gross load capacity:

0-15,000 lb (7,000 kg)

#### Net load capacity:

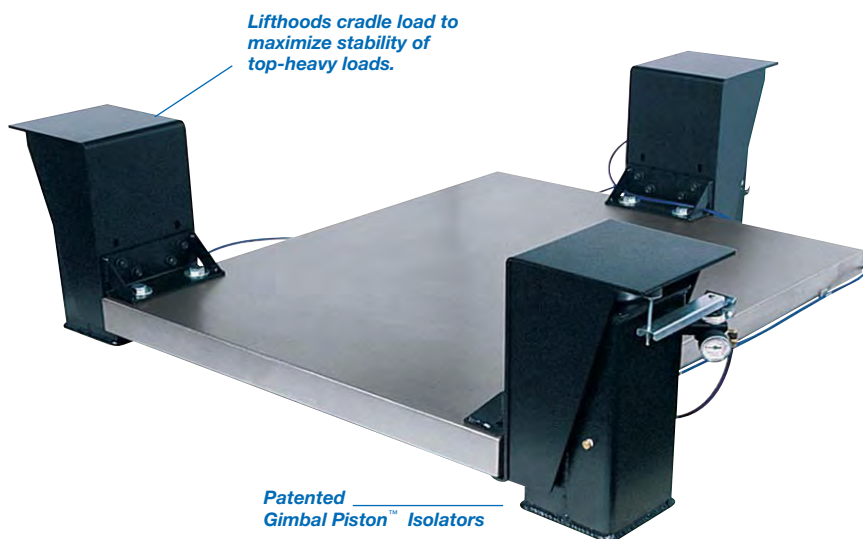
0-20,000 lb (9,000 kg)

**Finish:** Medium texture black powder coat paint isolator and lifhoods, stainless steel platform. (Platforms larger than 40 in. x 40 in., 1 m x 1 m, may include a seam in the stainless steel top skin.)

#### Facilities required:

80 psi nitrogen or air

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Lifthoods cradle load to maximize stability of top-heavy loads.

Patented  
Gimbol Piston™ Isolators

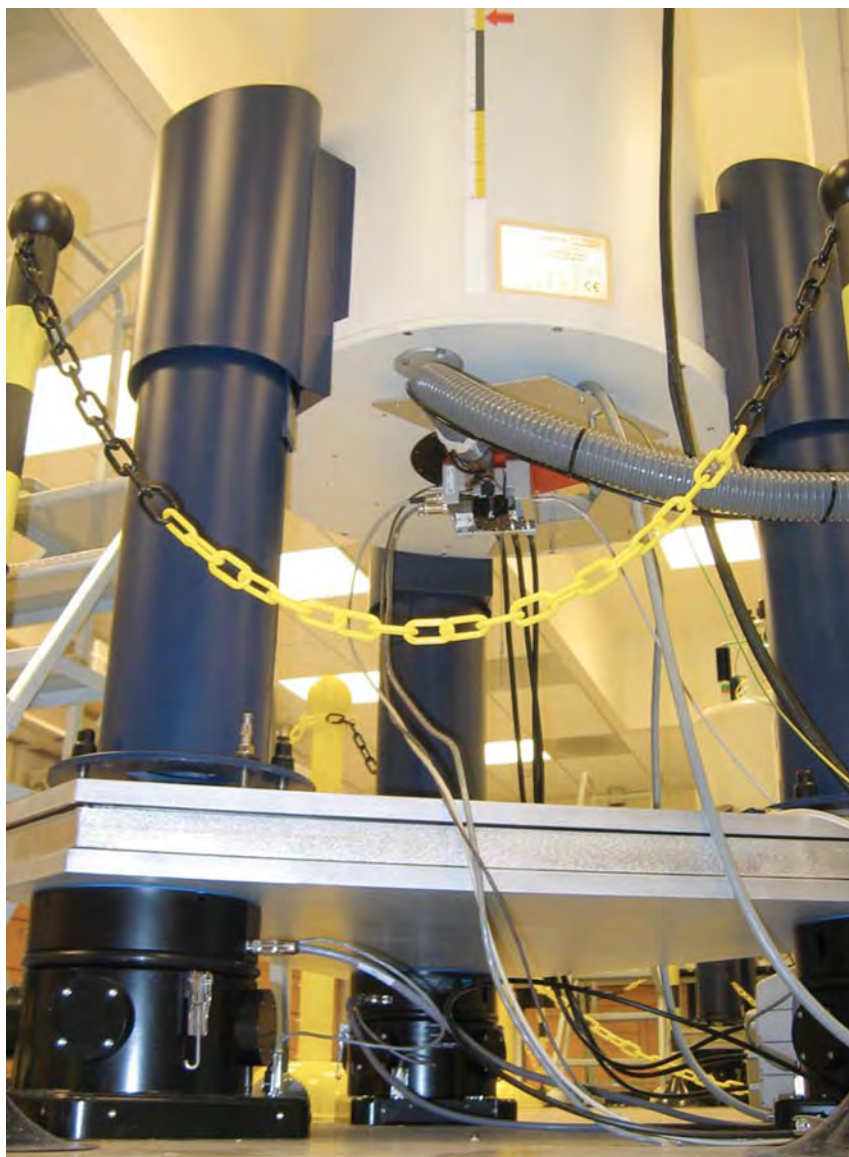
### How to Order:

1. Identify the equipment or instrument model and configuration.
2. Confirm the type of floor you have – conventional tiled lab floor, wooden beam and planks, etc.
3. Tell us if the instrument manufacturer has made a pre-installation site survey of the vibration level. In most cases, a standard floor platform will be recommended. We may recommend taking our own site vibration measurements and look at the special conditions involved.

The Gimbol Piston™ Floor Platform is still available and recommended in many applications. We will help you determine whether a Stacis® or Gimbol Piston Floor Platform is best for you.

TMC works closely with instrument manufacturers to ensure that our platform design meets the instrument's footprint, structural, and utility requirements. We have successfully isolated hundreds of different instruments and are often already familiar with the tool requirements. In most instances, you need only provide the tool manufacturer and model for us to recommend a solution.

*A STACIS® System, incorporating a non-ferromagnetic, highly damped, aluminum platform, provides a second stage of vibration isolation for a Bruker BioSpin 600 MHz NMR Spectrometer. Photo courtesy of Bruker BioSpin and Memorial Sloan Kettering Cancer Center.*



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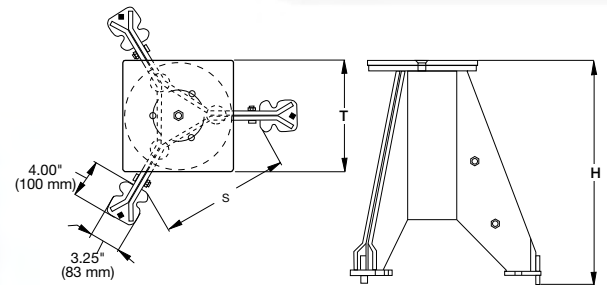
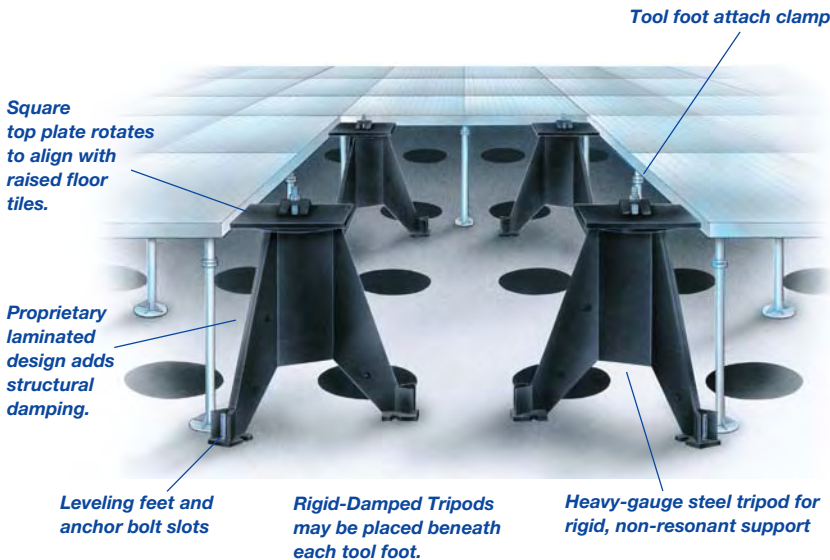
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# Rigid-Damped Tripod

## Semiconductor Equipment Support



### GENERAL SPECIFICATIONS

**Natural frequency (with 2,000 lb load):**

Vertical = 130 Hz  
Horizontal = 120 Hz

**Maximum amplification at resonance:**

Vertical = 10 dB  
Horizontal = 5 dB

**Capacity:** 2,500 lb

The Rigid-Damped Tripod is a true innovation for mounting semiconductor equipment in a raised-floor, cleanroom environment.

Mounting of such equipment has been an ongoing source of difficulty for tool and facility engineers. The combination of tall, lightweight, raised floors, more massive and sensitive equipment, and utility holes or “pop-outs” in the

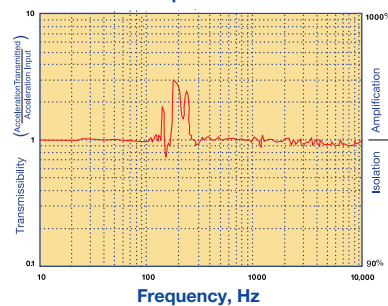
sub-floors have stretched conventional sub-floor pedestals to the limits of their intended performance. Such pedestals are cumbersome, expensive, and require special on-site engineering for each tool at each site. Furthermore, such pedestals are large steel structures prone to resonance with little or no structural damping. Simply designing a stiff structure is not adequate. For sensitive inspection tools, rigidity combined with aggressive structural damping is the only sound approach.

The Rigid-Damped Tripod solves all of these problems at a surprisingly low price, making it the preferred solution for not only vibration-sensitive tools but any tool too massive to be placed on the raised floor.

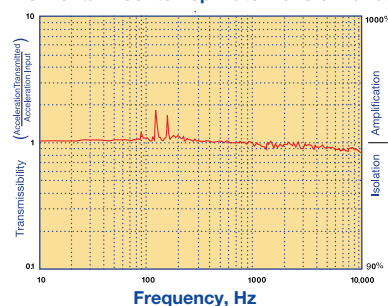
### Features

- Low cost
  - No need to engineer a structure for each tool application
  - Easy rigging – the lightweight tripods can be quickly installed without specialized lifting equipment.
  - Portability – the tripods may be relocated as fab requirements change.
  - Cleanroom-compatible finish
  - Proprietary structural damping facilitates mounting of even vibration-sensitive equipment.
  - Geometry allows clearance of many “pop-out” patterns.
  - 1-in. vertical travel range to ensure mounting is flush with raised floor
  - Meets seismic code requirements (Uniform Building Code).
- Contact TMC for details.

Vertical Floor to Top Plate Transfer Function



Horizontal Floor to Top Plate Transfer Function



### Ordering Chart

Tripod Model	Description	H	S	T	Wt.
83-201-12	Rigid-Damped Tripod for 12 in. (300 mm) high floor	12 in. (300 mm)	10 in. (203 mm)	8 in. (203 mm)	50 lb (22.7 kg)
83-201-18	Rigid-Damped Tripod for 18 in. (450 mm) high floor	18 in. (450 mm)	14 in. (356 mm)	8 in. (203 mm)	85 lb (38.6 kg)
83-201-24	Rigid-Damped Tripod for 24 in. (600 mm) high floor	24 in. (600 mm)	14 in. (356 mm)	12 in. (305 mm)	130 lb (59.0 kg)
Accessory Model	Description				
83-202-01	Rigid-Damped Tripod tool foot attach clamp				

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