

Keysight Technologies

# PXI Programmable Step Attenuator Module

M9168C DC to 26.5 GHz

M9168E DC to 50 GHz

Data Sheet





## Introduction

Keysight Technologies, Inc. has been a leading designer and manufacturer of RF and microwave step attenuators in the global marketplace for more than 60 years. RF and microwave attenuators are used extensively in microwave test systems for signal conditioning between transmitting and receiving of a device under test (DUT). Keysight designs and manufactures a comprehensive range of RF and microwave attenuators to meet your signal attenuation requirements. There is a broad range of fixed, manual, and programmable step attenuators with operating frequencies from DC up to 4/18/26.5/40/50 GHz.

## Product Description

Other than connectorized standalone attenuators, Keysight also offers step attenuator modules that operate across a broad frequency range of DC to 26.5/50 GHz. The M9168C/E is a programmable step attenuator module based on the PXI hybrid platform, with 0.03 dB insertion loss repeatability for each section throughout the 5 million cycles operating life. Its excellent attenuation accuracy across a wide operating temperature range ensures precise measurements. The M9168C/E is a signal conditioning module that enhances the measurement accuracy and flexibility of PXI based RF and microwave test systems.

## Applications

- RF signal path attenuation simulation
- Engineering verification
- RF receiver sensitivity test
- Adjacent channel interference

## Features

- 0.03 dB insertion loss repeatability through-out the operating life of up to 5 million cycles per section
- Broad attenuation range of 0 to 101 dB with 1 dB step
- High attenuation accuracy and flatness of  $\pm 0.4$  dB at 26.5 GHz (M9168C) and  $\pm 0.97$  at 50 GHz (M9168E)
- Soft front panel is available for ease of use

## Customer values

- Peace of mind in technology from Keysight who has a proven track record of providing versatile, quality, RF and microwave step attenuators
- Reduce downtime for recalibration, improve testing efficiency and therefore maximizing throughput
- Maximize measurement accuracy and system flexibility
- Guaranteed precise measurements and stability across a wide temperature range

## Easy Setup...Test...and Maintenance

### Hardware platform

#### Connectors

The M9168C/E comes with 3.5 mm (f) (SMA compatible)/2.4 mm (f) high quality RF coaxial connectors for 50  $\Omega$ .

#### Compliance

The M9168C/E is PXI compliant, using either a PXI-H, PXI-1 or cPCI slot. Designed to benefit from fast data interfaces, the M9168C/E can be integrated with other test and automation modules into PXI, Compact PCI®, and Hybrid chassis. The PXI format offers high performance in a small, rugged package, and it's an ideal platform for many automated test systems. A wide array of complementary PXI products are currently available and include multimeters, waveform generators, local oscillators, digitizers, and switch multiplexers.

### Software platform

#### Drivers

Keysight's M9168C/E comes complete with software drivers for Windows XP, Windows Vista, Windows 7, and LabVIEW. Also included are application code examples for LabVIEW, LabWindows/CVI, Visual Studio, C, C++, MATLAB.

#### Soft Front Panel

The M9168C/E graphical user interface guides developers through the module setup process. Users can quickly configure the module parameters. The interfaces are implemented using the IVI standard supporting both IVI-COM and IVI-C.

Soft front panel of M9168C/E provides an intuitive approach for program simulation and troubleshooting. The soft front panel comes in Uncorrected and Corrected instance.

**Uncorrected** – User sees the nominal value of the attenuation in this instance, regardless of operating frequency.

**Corrected** – Calibration data is burnt in the module EEPROM at factory and is unique to each step attenuator module. The corrected data is the attenuation value by frequency. User could read the actual attenuation value that changes with frequency, and with accuracy up to 2 decimal points.

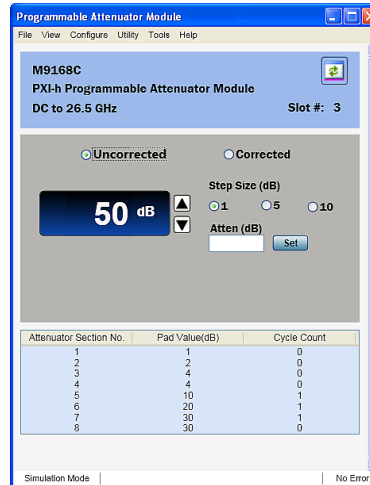


Figure 1a. Uncorrected instance of M9168C/E soft front panel

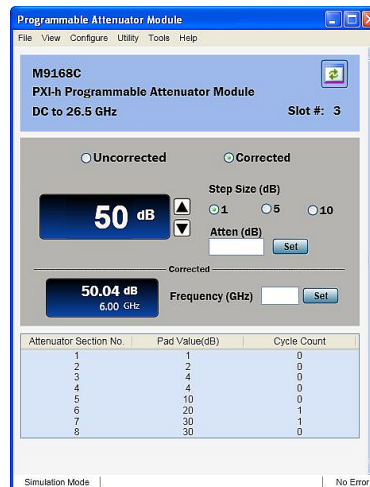


Figure 1b. Corrected instance of M9168C/E soft front panel

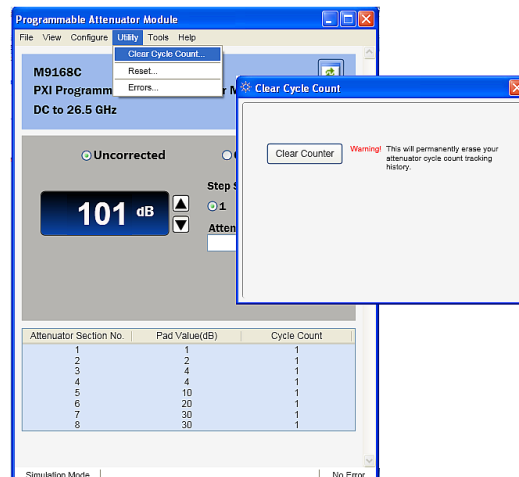


Figure 1c. Onboard cycle count per attenuation section tracking eases maintenance and reduces unexpected system downtime

## Easy Setup...Test...and Maintenance, continued

### Easy software integration

Keysight's M9168C/E comes complete with software drivers for Windows XP, Windows Vista, Windows 7, and LabView. Also included are application code examples for LabView, LabWindows/CVI, Visual Studio, C, C++, C#, Visual Basic, and MATLAB, which provides the M9168C/E with setup and basic switching functionality. The application code examples are easily modified to quickly integrate the module into your measurement system.

### Calibration intervals

The M9168C/E is factory calibrated and shipped with an ISO-9001, NIST-traceable calibration certificate. The recommended calibration interval is 12 months.

## Technical Specifications

### M9168C

#### Specifications

Frequency range	DC to 26.5 GHz
Attenuation resolution	1 dB step
Repeatability	0.03 dB
Lifecycle	5 million life cycles per section
Insertion loss (at 0 dB)	DC to 6 GHz: 2.5 dB 6 GHz to 18 GHz: 4.0 dB 18 GHz to 26.5 GHz: 5.0 dB
Return loss (VSWR)	DC to 6 GHz: 16 dB (1.35) 6 GHz to 18 GHz: 11 dB (1.78) 18 GHz to 26.5 GHz: 7 dB (2.61)
Maximum input power	1 W (+30 dBm) average 50 W peak (10 $\mu$ s max)
Maximum reverse power	1 W (+30 dBm) average 50 W peak (10 $\mu$ s max)
Switching speed	20 ms
RF connector	3.5 mm (f), SMA compatible
Connector compatibility	cPCI, PXI-H, PXI-1

#### Attenuation accuracy

##### Specified across operating frequency of 0 to 50 °C

Attenuation setting for step ranges (dB)	DC to 18 GHz	18 to 26.5 GHz
1 to 2	0.35	0.40
3 to 6	0.55	0.70
7 to 10	0.70	0.80
11 to 20	1.20	1.40
21 to 40	1.40	1.60
41 to 60	1.90	2.50
61 to 80	2.50	2.70
81 to 101	3.70	4.00

#### Power requirements

##### Power consumption from the backplane supply is as follows:

Voltage	+3.3 V	+5.0 V	-12.0 V	+12.0 V
Current	0.5 A (typical 0.2 A)	5.8 A (typical 5.5 A)	0 V	0.37 A (typical 0.34 A)

## Technical Specifications, continued

### M9168E

Specifications	
Frequency range	DC to 50 GHz
Attenuation resolution	1 dB step
Repeatability	0.03 dB
Lifecycle	5 million life cycles per section
Insertion loss (at 0 dB)	DC to 6 GHz: 2.5 dB 6 GHz to 18 GHz: 4.0 dB 18 GHz to 26.5 GHz: 5.0 dB 26.5 to 50 GHz: 6.5 dB
Return loss (VSWR)	DC to 18 GHz: 15.5 dB (1.40) 18 to 26.5 GHz: 9.0 dB (2.10) 26.5 to 40 GHz: 7.0 dB (2.61) 40 to 50 GHz: 4.0 dB (4.42)
Maximum input power	1 W (+30 dBm) average 50 W peak (10 $\mu$ s max)
Maximum reverse power	1 W (+30 dBm) average 50 W peak (10 $\mu$ s max)
Switching speed	20 ms
RF connector	2.4 mm (f), SMA compatible
Connector compatibility	cPCI, PXI-H, PXI-1

Attenuation accuracy				
Specified across operating frequency of 0 to 50 °C				
Attenuation setting for step ranges (dB)	DC to 18 GHz	18 to 26.5 GHz	26.5 to 40 GHz	40 to 50 GHz
1 to 2	0.35	0.40	0.69	0.97
3 to 6	0.55	0.70	0.97	1.23
7 to 10	0.70	0.80	1.21	1.62
11 to 20	1.20	1.40	1.87	2.34
21 to 40	1.40	1.60	2.09	2.58
41 to 60	1.90	2.50	3.36	4.22
61 to 80	2.50	2.70	3.59	4.48
81 to 101	3.70	4.00	4.46	4.91

Power requirements				
Power consumption from the backplane supply is as follows:				
Voltage	+3.3 V	+5.0 V	-12.0 V	+12.0 V
Current	0.5 A (typical 0.2 A)	5.8 A (typical 5.5 A)	0 V	0.37 A (typical 0.34 A)

## Technical Specifications, continued

### Environmental and physical specifications

Temperature range	
Operating	0 to 55 °C
Non-operating	-40 to 70 °C
Relative humidity	
Operating	95% RH at 40 °C, 24 hours cycling, repeated 5 times
Non-operating	95% RH at 40 °C, 5 cycles
Vibration	
Operating random	5–500 Hz, 0.3 g RMS
Vibration	
Survival random vibration	5–500 Hz, 3.41 g RMS
Shock	
End use handling shock	Half sine wave form, 120 in/s, duration < 3 ms
Transportation shock	Trapezoidal, 50 g
Altitude test	
Operating/non-operation	15,000 ft (4600 m)
ESD immunity	
Air discharge	15 kV per IEC61000-4-2
Direct discharge	8 kV per IEC61000-4-2
Safety	This product has input power below the requirements as specified in the Low Voltage Directive (2006/95/EC)
EMC	EMC Standard: IEC 61326-1:2005 / EN 61326-1:2006 Emissions: CISPR 11:2003 / EN55011:2007 Immunity: IEC 61000-4-3:2002 / EN 61000-4-3:2002 Electrostatic Discharge: IEC 61000-4-2:2001 / EN 61000-4-2-:1995+A1:1998+A2:2001 EMC/EMI:CE, C-Tick
CE compliance	EMC Compatibility Directive (EMC): 2004/108/EC
Warm-up time	Refer to PXI Chassis warm-up time

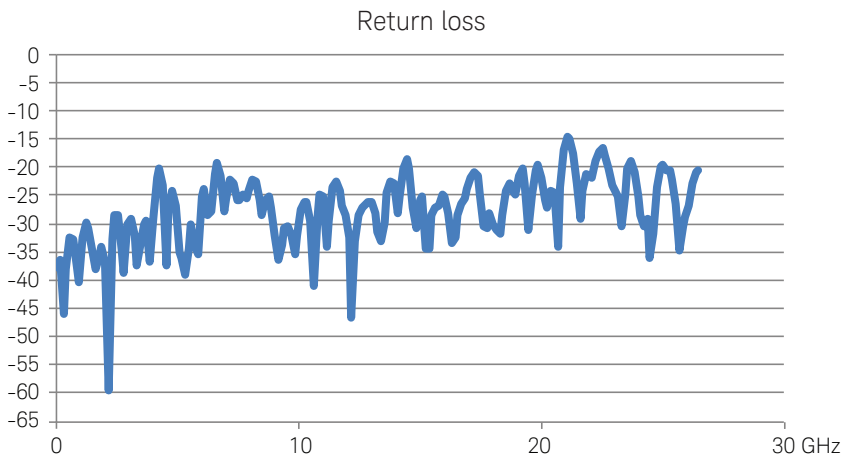
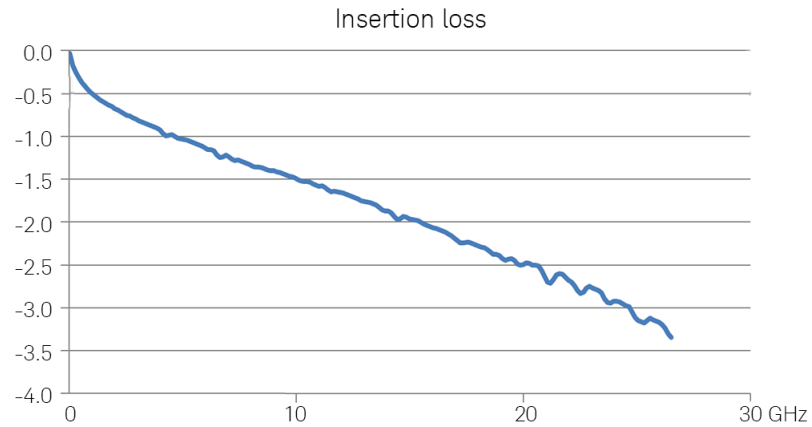
### Dimensions

M9168C/E	3U PXI/Compact PCI standard Front panel complies with IEEE 1101.10 certification and compliance. 174.8 x 128.7 x 40.3 mm
Weight	0.93 kg
Contact material	Beryllium copper, gold plated
Connector compatibility	PXI-H, PXI-1, cPCI

## Supplemental Specifications and Characteristics

Supplemental characteristics are intended to provide useful information. They are typical but non-warranted performance parameters.

### Typical performance graphs

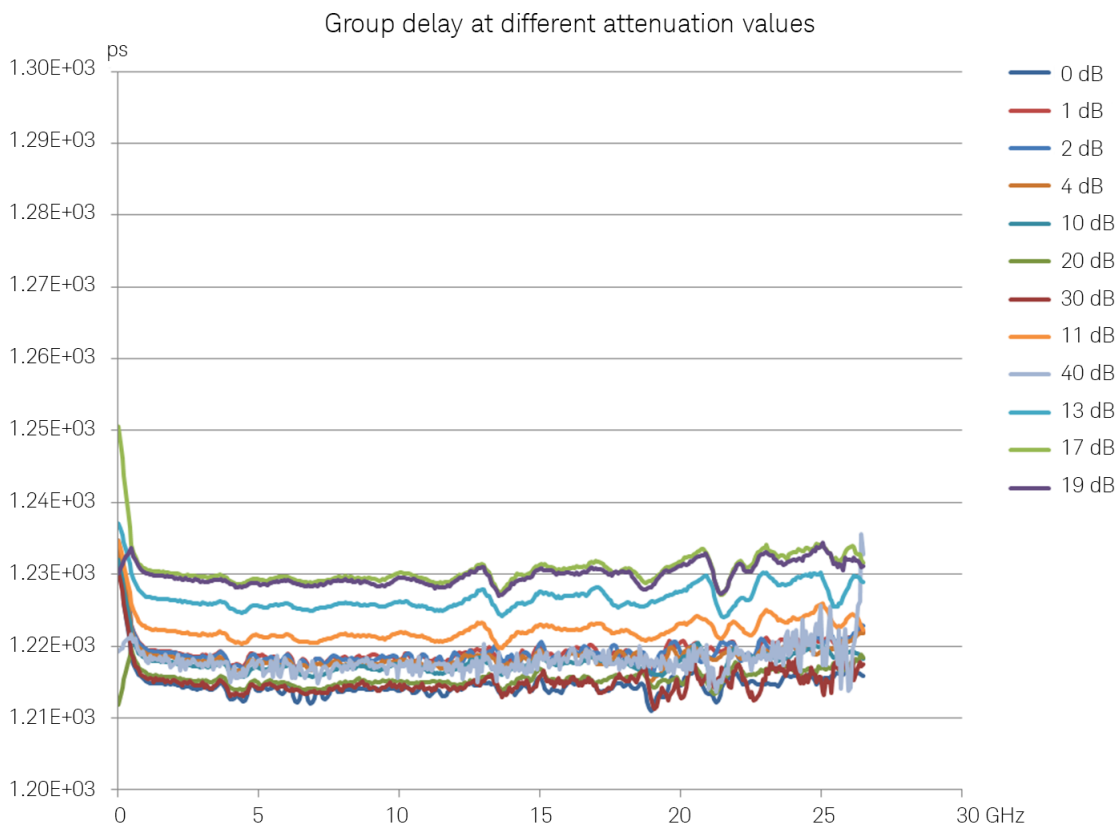
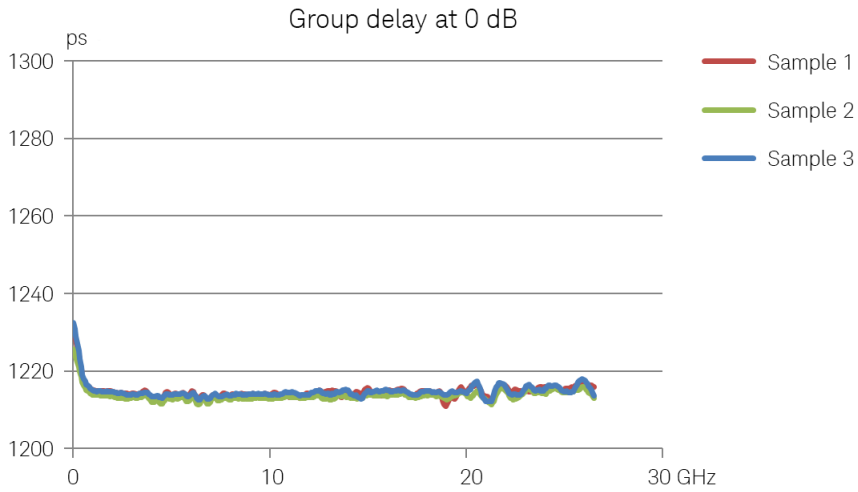




## Supplemental Specifications and Characteristics, continued

Supplemental characteristics are intended to provide useful information. They are typical but non-warranted performance parameters.

### Typical performance graphs



## Configuration and Ordering Information

### Software

Model	Description
Software development platform	Microsoft Visual Studio with C/C++ Microsoft Visual Studio .NET with C# or Visual Basic, National Instruments LabVIEW, National Instruments LabWindows CVI, The MathWorks MATLAB, Keysight VEE
Supported operating systems	Windows XP SP3, 32-bit Windows Vista 32/64-bit Windows 7 32/64-bit
Drivers provided	IVI-COM, IVI-C, LabView, MATLAB
Included GUI	Soft front panel
Application code examples	C, C++, C#, Visual Basic, VEE, MATLAB

### Recommended configuration

Model	Description
M9018A	PXIe Chassis, 18-slots, 3U, 8 GB/s
M9202A	PXIe IF Digitizer: 12-bit, 1 GHz
M9361A	PXI Downconverter: 2.75 to 26.5 GHz
M9168C	PXI-h Programmable Step Attenuator Module, DC to 26.5 GHz
M9168E	PXI-h Programmable Step Attenuator Module, DC to 50 GHz

### Ordering information typical configuration

Model	Description
M9168C	PXI-h Programmable Step Attenuator Module, DC to 26.5 GHz
M9168E	PXI-h Programmable Step Attenuator Module, DC to 50 GHz

### Related products

Model	Description
M9392A	PXI Vector Signal Analyzer
M9351A	PXI Downconverter, 50 MHz to 2.9 GHz
M9360A	PXI Attenuator/Preselector
M9155/6/7C	PXI Switch Modules, DC to 26.5 GHz

### Model and chassis compatibility

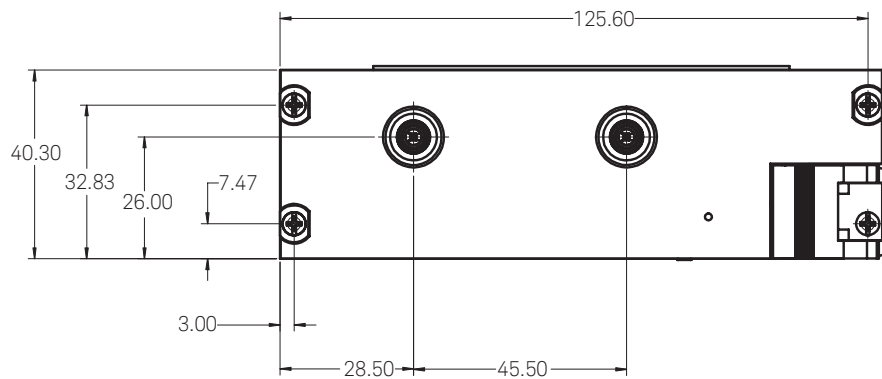
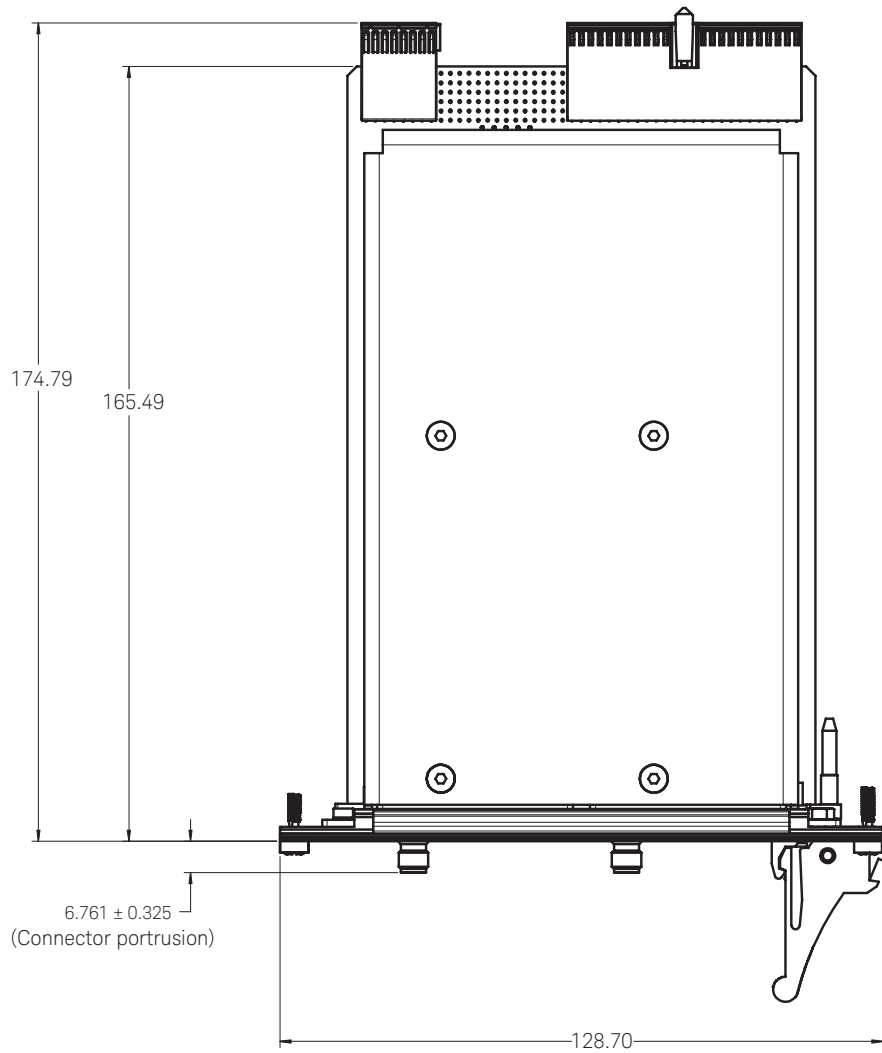
PXI chassis compatibility
Compatible with all chassis conforming to the 3U PXI and 3U cPCI specifications
Compatible with Keysight M9018A PXIe chassis, 18-slots, 3U, 8 GB/s

### Warranty and calibration

Advantage Services: Calibration and warranty
Keysight Advantage Services is committed to your success throughout your equipment's lifetime.
M9168C-UK6      Commercial calibration certificate with test data
R-51B-001-C      1 year Return-to-Keysight warranty

## Mechanical Information

Dimensions are in mm nominal, unless otherwise specified.



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