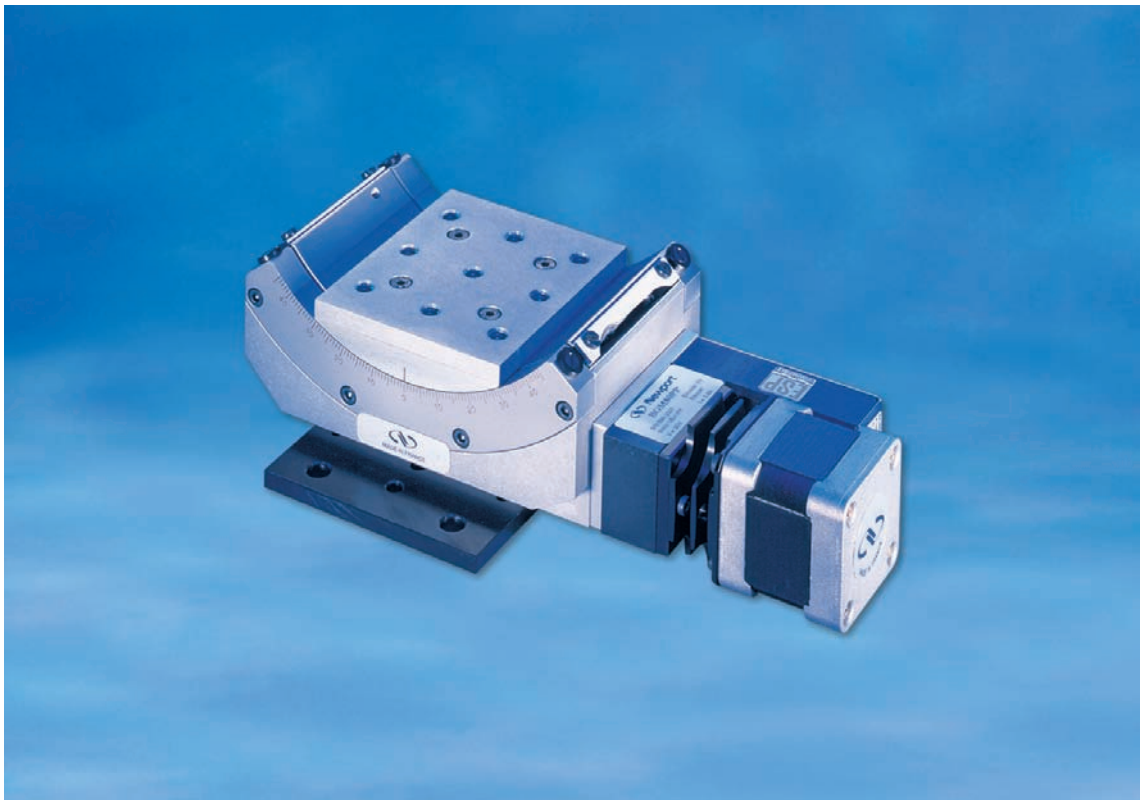
BGM Series

Goniometric Cradles



Newport®
Experience | Solutions

USER'S MANUAL

For Motion, Think Newport

Warranty

Newport Corporation warrants this product to be free from defects in material and workmanship for a period of 1 year from the date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Newport's discretion.

To exercise this warranty, write or call your local Newport representative, or contact Newport headquarters in Irvine, California. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from modification or misuse of any product or part.

CAUTION

Warranty does not apply to damages resulting from:

- **Incorrect usage:**
  - **Load on the stage greater than maximum specified load.**
  - **Carriage speed higher than specified speed.**
  - **Improper grounding.**
    - ¬ **Connectors must be properly secured.**
    - ¬ **When the load on the stage represents an electrical risk, it must be connected to ground.**
  - **Excessive or improper cantilever loads.**
- **Modification of the stage or any part thereof.**

CAUTION

Please return equipment in the original (or equivalent) packing.

You will be responsible for damage incurred from inadequate packaging if the original packaging is not used.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Newport Corporation shall not be liable for any indirect, special, or consequential damages.

This manual has been provided for information only and product specifications are subject to change without notice. Any changes will be reflected in future printings.

Table of Contents

EC Declaration of Conformity

BG Series

EC Declaration of Conformity

following Annex II-1A
of Directive 2006/42/EC on machinery

Newport
Experience | Solutions

The manufacturer:

MICRO-CONTROLE Spectra-Physics,
1 rue Jules Guesde ZI. Bois de l'Epine - BP189
F-91006 Evry FRANCE

Hereby declares that the machinery:

Description: " BG"
Function: High Precision Goniometers
Models: BGS50/80/-CC/-PP ; M-/BGM120/160/200/-CC/-PP/-PE/-PEV6

– the technical file of which was compiled by:

Mr Dominique DEVIDAL, Quality Director,
MICRO-CONTROLE Spectra-Physics, Zone Industrielle - B.P.29
F-45340 Beaune La Rolande France

– complies with all the relevant provisions of the Directive 2006/42/EC on machinery.
– complies with all the relevant provisions of the Directive 2004/108/EC relating to electro-magnetic compatibility.

– was designed and built in accordance with the following harmonised standards:

NF EN 61326-1:2006 « Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements »
NF EN 55011:2007 Class A

– was designed and built in accordance with the following other standards:

NF EN 61000-4-2
NF EN 61000-4-3
NF EN 61000-4-4
NF EN 61000-4-5
NF EN 61000-4-6

ORIGINAL DECLARATION

Done in Beaune La Rolande on 07 June 2011
Dominique DEVIDAL
Quality Director

DC1-EN rev:A

Definitions and Symbols

The following terms and symbols are used in this documentation and also appear on the product where safety-related issues occur.

General Warning or Caution

The exclamation symbol may appear in warning and caution tables in this document. This symbol designates an area where personal injury or damage to the equipment is possible.

European Union CE Mark

The presence of the CE Mark on Newport Corporation equipment means that it has been designed, tested and certified as complying with all applicable European Union (CE) regulations and recommendations.

ATTENTION

This stage is a Class A device. In a residential environment, this device can cause radioelectric interferences. In this case, suitable measurements must be taken by the user of this device.

Warnings and Cautions

The following are definitions of the Warnings, Cautions and Notes that may be used in this manual to call attention to important information regarding personal safety, safety and preservation of the equipment, or important tips.

WARNING

Situation has the potential to cause bodily harm or death.

CAUTION

Situation has the potential to cause damage to property or equipment.

NOTE

Additional information the user or operator should consider.

Warnings

WARNING

The motion of objects of all types carries potential risks for operators. Ensure the protection of operators by prohibiting access to the dangerous area and by informing the personnel of the potential risks involved.

WARNING

Do not use this stage when its motor is emitting smoke or is unusually hot to the touch or is emitting any unusual odor or noise or is in any other abnormal state.

Stop using the stage immediately, switch off the motor power and then disconnect the electronics power supply.

After checking that smoke is no longer being emitted contact your Newport service facility and request repairs. Never attempt to repair the stage yourself as this can be dangerous.

WARNING

Make sure that this stage is not exposed to moisture and that liquid does not get into the stage.

Nevertheless, if any liquid has entered the stage, switch off the motor power and then disconnect the electronics from power supply.

Contact your Newport service facility and request repairs.

WARNING

Do not insert or drop objects into this stage, this may cause an electric shock, or lock the drive.

Do not use this stage if any foreign objects have entered the stage. Switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility for repairs.

WARNING

Do not place this stage in unstable locations such as on a wobbly table or sloping surface, where it may fall or tip over and cause injury.

If this stage has been dropped or the case has been damaged, switch off the motor power and then disconnect the electronics power supply.

Contact your Newport service facility and request repairs.

WARNING

Do not attempt to modify this stage; this may cause an electric shock or downgrade its performance.

WARNING

Do not exceed the usable depth indicated on the mounting holes (see section “Dimensions”). Longer screws can damage the mechanics or cause a short-circuit.

Cautions

CAUTION

Do not place this stage in a hostile environment such as X-Rays, hard UV,… or in any vacuum environment.

CAUTION

Do not place this stage in a location affected by dust, oil fumes, steam or high humidity. This may cause an electric shock.

CAUTION

Do not leave this stage in places subject to extremely high temperatures or low temperatures. This may cause an electric shock.

- **Operating temperature: +10 to +35 °C.**
- **Storage temperature: -10 to +40 °C (in its original packaging).**

CAUTION

Do not move this stage if its motor power is on.

Make sure that the cable to the electronics is disconnected before moving the stage. Failure to do so may damage the cable and cause an electrical shock.

CAUTION

Be careful that the stage is not bumped when it is being carried. This may cause it to malfunction.

CAUTION

When handling this stage, always unplug the equipment from the power source for safety.

CAUTION

When the carriage is in its end-of-run position, it is strongly recommended not to go beyond this point by using the manual knob as this may damage the stage mechanism.

CAUTION

Contact your Newport service facility to request cleaning and specification control every year.

Goniometric Cradles
BGM Series

1.0 Introduction

This manual provides operating instructions for the goniometric cradle that you have purchased in the (M-)BGM Series:

- (M-)BGMPP
- (M-)BGMPEV6 [1]
- (M-)BGMCC
- (M-)BGMMS
- (M-)BGMPE

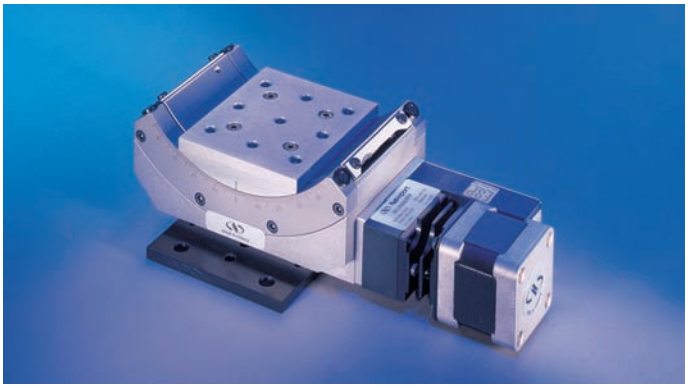
[1] REMARK

Vacuum compatible goniometric cradles to 10^{-6} Torr. In this case, max. speed and load capacity have to be divided by two.

(M-)BGM Series goniometric cradles.

RECOMMENDATION

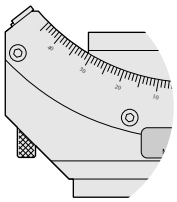
We recommend you read carefully the chapter "Connection to electronics" before using the (M-)BGM goniometric cradle.



2.0 Description

(M-)BGM Series goniometric cradles rotate about a transverse axis above the platform. Compared to 360° rotation stages, they offer maximum free access to the rotating part and allow construction of very compact multi-axis rotation assemblies. BGM cradles are designed so that orthogonal mounting of two adjacent-size cradles (e.g., (M-)BGM50 and (M-)BGM80) provides two perpendicular axes of rotation about the same point in space. Mounting a rotation stage under the assembly adds a third orthogonal rotation axis through the same point.

All (M-)BGM Series stages are equipped with a knurled knob for a manual control when motor power is off.



All (M-)BGM Series cradles feature 0.001° angular resolution and may be configured with manual drives, DC-motors or stepper motors, with mini-step or full-step drive options, and speeds to 20 °/sec. Single-row ball bearings and precision-ground tool-steel races ensure smooth rotation with minimal wobble and eccentricity.

All (M-)BGM stages are equipped with mechanical limit switches at ±45° and a hardware origin allowing the stage to be returned to a reference home position.

For optimal performance, we recommend the use of our ESP or MM series motion controllers.

The (M-)BGM Series goniometric cradles are supplied with a 3-meter cable for connection to our motion controllers.

2.1 Design Details

Base Material	Stainless
Bearings	Ball bearings
Drive Mechanism	Ground worm gear
Worm Gear Ratio	(M-)BGM50 to (M-)BGM120: 1:180 (M-)BGM160 and (M-)BGM200: 1:60
Reduction Gear	1:10 on (M-)BGM120PE to (M-)BGM200PE 3:1 on (M-)BGM160 and (M-)BGM200 (1)
Feedback	2,000 pts/rev. rotary encoder with index pulse
Limit Switches	Mechanical, at ± 45°
Origin	Optical
Cable	3 m long cable included
Vacuum Compatibility	Vacuum compatible versions are available up to 10^{-6} Torr using full-step motor (PE)

1) (M-)BGM160PE and (M-)BGM200PE are equipped with 2 reduction gears.

3.0 Characteristics

3.1 Definitions

Specifications of our products are established in reference to ISO 230 standard part II “Determination of the position, precision and repeatability of the machine tools with CNC”.

This standard gives the definition of position uncertainty which depends on the 3 following quantities:

(Absolute) Accuracy

Difference between ideal position and real position.

On-Axis Accuracy

Difference between ideal position and real position after the compensation of linear error sources.

Linear errors include: cosine errors, inaccuracy of screw or linear scale pitch, angular deviation at the measuring point (Abbe error) and thermal expansion effect. All Newport motion electronics can compensate for linear accuracy errors by step encoder correction.

The relation between absolute accuracy and on-axis accuracy is as follow:

Absolute Accuracy = On-Axis Accuracy + Slope x Travel

Repeatability

Ability of a system to achieve a commanded position over many attempts.

Reversal Value (Hysteresis)

Difference between actual position values obtained for a given target position when approached from opposite directions.

Minimum Incremental Motion (Sensitivity)

Minimum motion that a goniometric cradle can achieve. Our goniometric cradles and our kinematic chain are conceived in such a way that sensitivity is better than the resolution of the encoder.

Resolution

The smallest motion an encoder fixed to the goniometric cradle can measure.

Concentricity

Displacement of the geometric center of a goniometric cradle from the rotation axis in the plane defined by bearings.

Wobble

Tilt of rotation axis during rotation of a stage.

The testing of on-axis accuracy, repeatability, and reversal error are made systematically with our test equipment in an air-conditioned room (20 °C ±1 °C).

Each goniometric cradle is tested with a precision optical encoder.

A linear cycle with 21 measures on the travel and 4 cycles in each direction gives a total of 164 points.

3.2 Mechanical Specifications

Resolution	(°)	0.001
Unidirectional Repeatability	(°)	0.004
Reversal Value (Hysteresis)	(°)	0.02
Origin Repeatability	(°)	0.002
On Axis Accuracy	(°)	0.05
Wobble	(µrad)	200

3.3 Load Specification Definitions

Normal Load Capacity (Cz)

Maximum load a goniometric cradle can move while maintaining specifications.

This value is given with speed and acceleration specified for each goniometric cradle, and with a load perpendicular to bearings.

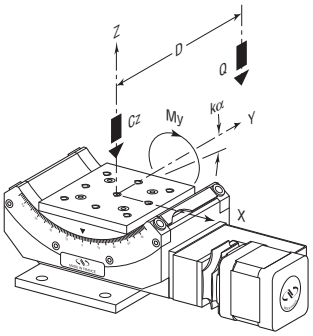
Off-Centered Load (Q)

Maximum cantilever-load a goniometric cradle can move: $Q \leq Cz / (1 + D/a)$

D: Cantilever distance.

a: Construction parameter.

3.4 Load Characteristics and Stiffness



Q: Off-center load, $Q \leq Cz / (1 + D/a)$

Cz: Normal center load capacity on bearings

D: Cantilever distance in mm

a: Construction parameter

kα: Transversal stiffness

My: Maximum forward rotation torque

			Goniometric Cradles: (M-)BGM…				
			50	80	120	160	200
Cz		(N)	40	120	200	300	500
a		(mm)	30	40	70	90	120
kα		(µrad/Nm)	200	20	10	5	2
My	(PE)	(Nm)	1.5	1.7	10	20	29
	(PP)	(Nm)	1.5	1.7	6	16	17
	(CC)	(Nm)	1.5	1.7	9	10	10

3.5 Goniometric Cradle Weights

Weights indicated into the below table are average values for goniometric cradles with a typical drive unit installed.

(M-)BGM50	[lb (kg)]	2.2 (1.0)
(M-)BGM80	[lb (kg)]	4.4 (2.0)
(M-)BGM120	[lb (kg)]	18.7 (8.5)
(M-)BGM160	[lb (kg)]	39.7 (18.0)
(M-)BGM200	[lb (kg)]	83.8 (38.0)

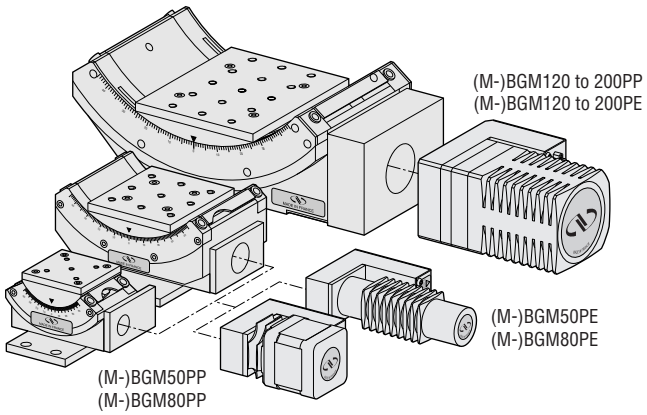
The weight variation between drive units is not very significant.

4.0 Drive

4.1 Stepper Drive Versions

Stepper-motor-driven stages are offered in two variations:

- One mini-step drive version (PP) with 1/10-step per encoder count enabling high angular speed motions up to 20°/sec.
- One full-step version (PE) with motor mounted step-down gear allowing for angular speeds to 2°/sec. This version is primarily designed for applications requiring the direct positioning accuracy to be maintained to within the stage's mechanical resolution when power is switched off, such as operation in a vacuum.



Mini-Step Drive

Is used for stepper motors, when 1 pulse emitted by electronic corresponds to theoretical physical motion of a fraction of a full step of the motor.

For these goniometric cradles a mini-step equals 1/10 of a full step.

Full-Step Drive

Is used for stepper motors, when 1 pulse emitted by electronic corresponds to theoretical physical motion of 1 full step of the motor.

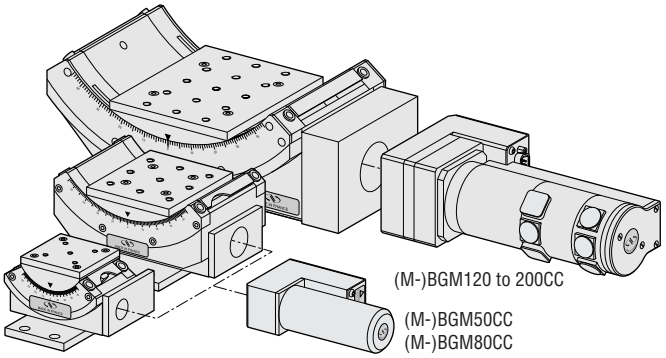
Stepper Motor Performance Specifications

	Resolution (°)	Speed (°/sec)	Motor
M-BGM50PP and M-BGM80PP	0.001	20	UE41PP
M-BGM120PP	0.001	20	UE62PP
M-BGM160PP and M-BGM200PP	0.001	20	UE63PP
M-BGM50PE and M-BGM80PE	0.001	2	UE31PP
M-BGM120PE to M-BGM200PE	0.001	2	UE41PP

4.2 DC-Servo Drive Versions

The DC-motor-driven versions use two different motors depending on the size of the cradle:

- BGM50 and BGM80: These use low-power DC-servo motors enabling speeds to 2.5 °/sec.
- BGM120, BGM160 and BGM200: These use higher torque DC-servo motors, which allow for angular speeds up to 20 °/sec. The motor also features a built-in tachometer to provide superior speed stability.

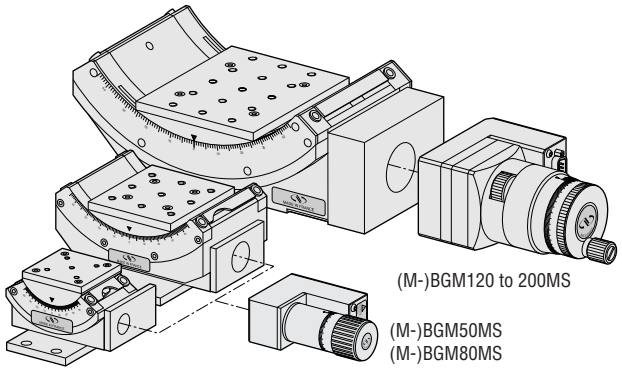


DC-Motor Performance Specifications

	Resolution (µm)	Speed (°/sec)	Motor
(M-)BGM50CC & (M-)BGM80CC	0.001	2.5	UE31CC
(M-)BGM120CC to (M-)BGM200CC	0.001	20	UE511CC

4.3 Manual Drive

The BGM Series goniometric cradles are also available with manual drive (MS). These are offered with angular resolution of 0.001° and 2° rotation per revolution. In addition to the vernier scale on the manual drive, position may be determined using the output from the incremental shaft encoder. A connector for the CV1000 encoder display is provided.



Manual Performance Specifications

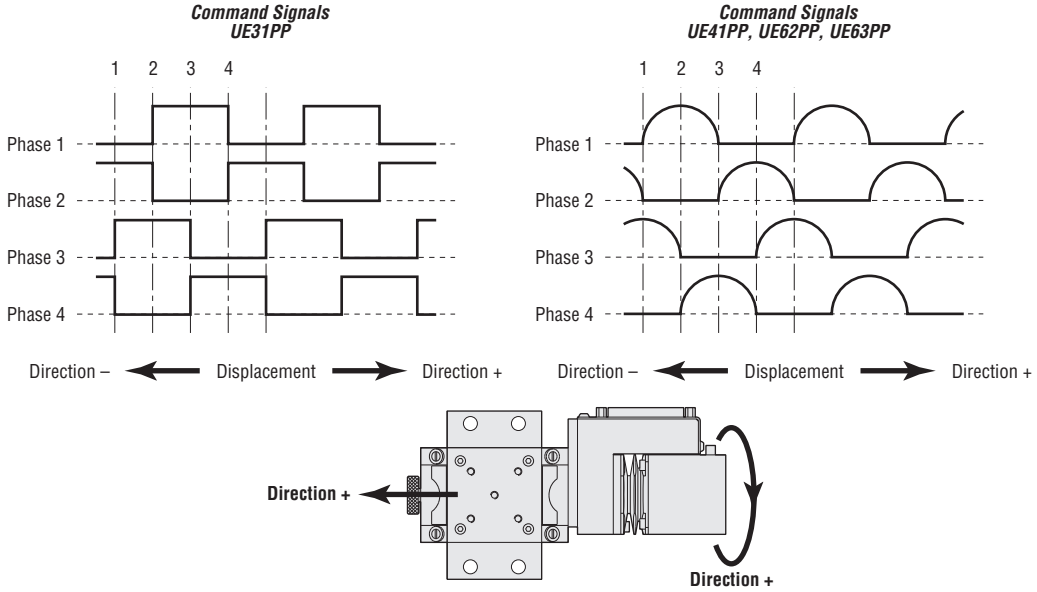
	Resolution (°)	Travel per Revolution (°/rev.)
(M-)BGMMS	0.001	2

5.0 Motor

5.1 Stepper Motor Characteristics

Motor	Angle by Step (°)	Current (A)	Resistance (Ω)	Inductance (mH)	Newport Utilization
UE31PP	3.6	0.56	7.6	8.4	Full-Step
UE41PP	1.8	1.2	3	4.3	Full-Step or Mini-Step
UE62PP	1.8	1.8	2.6	4.9	Mini-Step
UE63PP	1.8	2.9	1.16	2.0	Mini-Step

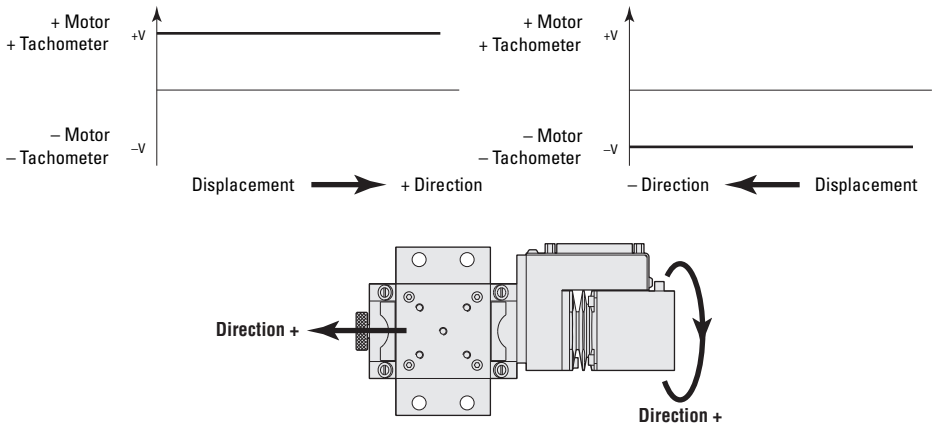
5.2 Command Signals for Stepper Motors



5.3 DC-Motor Characteristics

Motor	Mechanical Power (W)	Nominal Voltage (V)	Armature Resistance (Ω)	Tachometer (V/Krpm)
UE31CC	2.53	24	57	–
UE511CC	110	75	5.1	7 (±10%)

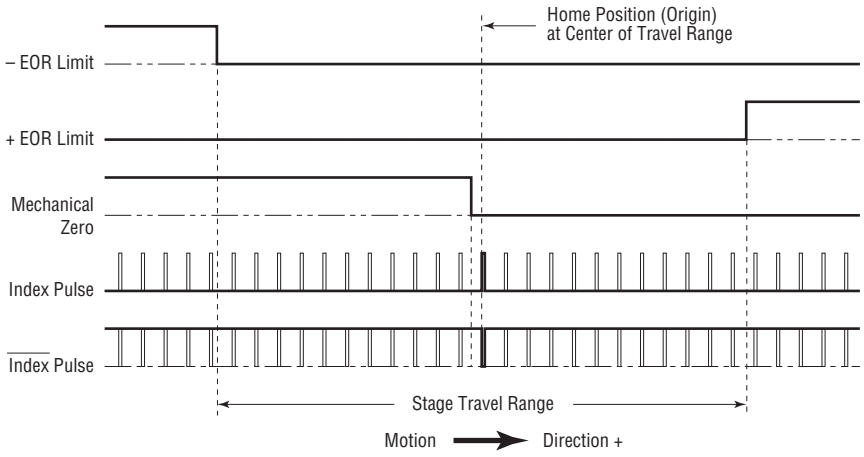
5.4 Command Signals for DC-Motors



In the above drawings, + Motor signal is referred to – Motor signal, + Tacho Generator signal is referred to – Tacho Generator signal.

1. When the stage moves in + Direction, the + Motor voltage is higher than – Motor voltage, and + Tacho Generator voltage is higher than – Tacho Generator voltage.
2. When the stage moves in – Direction, the + Motor voltage is lower than – Motor voltage, and + Tacho Generator voltage is lower than – Tacho Generator voltage.

5.5 Sensor Position



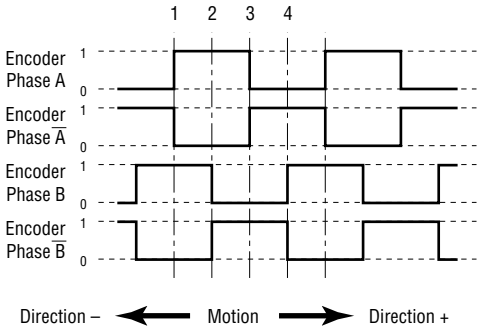
End-of-Run and Mechanical Zero are TTL type: 5 V ±5%, 2 mA max.

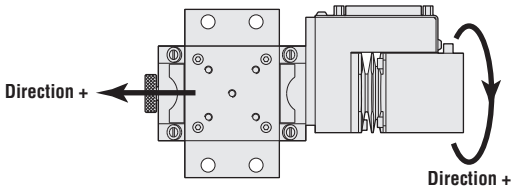
Use of the Index Pulse provides a repeatable Home Position at ±1 step.

CAUTION

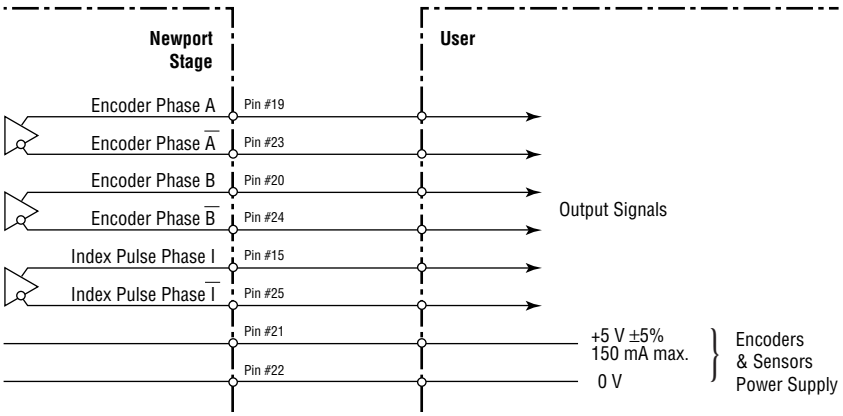
"End-of-Run" and "Mechanical Zero" are active signals and should not be connected to any other source. Use appropriate TTL type receivers.

5.6 Feedback Signal Position



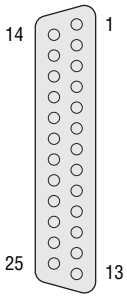


The incremental sensor operates following the photoelectric measurement principle, with a disk including slides. When the sensor shaft turns, the sensor generates square signals in quadrature, sent to pins #19, #20, #23 and #24 of the 25-pin Sub-D connector.



5.7 Pinouts

The 25-pin Sub-D connection for the (M-)BGM goniometric cradles is given in the following table:



UE31PP & UE41PP: **(M-)BGMPE** UE41PP; UE62PP; UE63PP: **(M-)BGMPP**		UE31CC: **(M-)BGM50CC & (M-)BGM80CC**		UE511CC: **(M-)BGM120CC to (M-)BGM200CC**		Manual: **(M-)BGMMS**	
1	Phase 1	**1**	N.C.	**1**	+ Tachometer	**1**	N.C.
2	Phase 1	**2**	N.C.	**2**	+ Tachometer	**2**	N.C.
3	Phase 2	**3**	N.C.	**3**	– Tachometer	**3**	N.C.
4	Phase 2	**4**	N.C.	**4**	– Tachometer	**4**	N.C.
5	Phase 3	**5**	+ Motor	**5**	+ Motor	**5**	N.C.
6	Phase 3	**6**	+ Motor	**6**	+ Motor	**6**	N.C.
7	Phase 4	**7**	– Motor	**7**	– Motor	**7**	N.C.
8	Phase 4	**8**	– Motor	**8**	– Motor	**8**	N.C.
9	Common Phase 3-4	**9**	N.C.	**9**	N.C.	**9**	N.C.
10	N.C.	**10**	N.C.	**10**	N.C.	**10**	N.C.
11	Common Phase 1-2	**11**	N.C.	**11**	N.C.	**11**	N.C.
12	N.C.	**12**	N.C.	**12**	N.C.	**12**	N.C.
13	Mechanical Zero	**13**	Mechanical Zero	**13**	Mechanical Zero	**13**	Mechanical Zero
14	Shield Ground	**14**	Shield Ground	**14**	Shield Ground	**14**	Shield Ground
15	Index Pulse I	**15**	Index Pulse I	**15**	Index Pulse I	**15**	Index Pulse I
16	0 V logic	**16**	0 V logic	**16**	0 V logic	**16**	0 V logic
17	+ End-of-Run	**17**	+ End-of-Run	**17**	+ End-of-Run	**17**	+ End-of-Run
18	– End-of-Run	**18**	– End-of-Run	**18**	– End-of-Run	**18**	– End-of-Run
19	Encoder Phase A	**19**	Encoder Phase A	**19**	Encoder Phase A	**19**	Encoder Phase A
20	Encoder Phase B	**20**	Encoder Phase B	**20**	Encoder Phase B	**20**	Encoder Phase B
21	Encoder Power: +5 V	**21**	Encoder Power: +5 V	**21**	Encoder Power: +5 V	**21**	Encoder Power: +5 V
22	0 V Encoder	**22**	0 V Encoder	**22**	0 V Encoder	**22**	0 V Encoder
23	Encoder Phase /A	**23**	Encoder Phase /A	**23**	Encoder Phase /A	**23**	Encoder Phase /A
24	Encoder Phase /B	**24**	Encoder Phase /B	**24**	Encoder Phase /B	**24**	Encoder Phase /B
25	Index Pulse /I	**25**	Index Pulse /I	**25**	Index Pulse /I	**25**	Index Pulse /I

6.0 Connection to Newport Controllers

6.1 Warnings on Controllers

Controllers are intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possible injury. Read the controller user's manual carefully before operating the instrument and pay attention to all written warnings and cautions.

WARNING

Disconnect the power plug under the following circumstances:

- **If the power cord or any attached cables are frayed or damaged in any way.**
- **If the power plug is damaged in any way.**
- **If the unit is exposed to rain, excessive moisture, or liquids are spilled on the unit.**
- **If the unit has been dropped or the case is damaged.**
- **If you suspect service or repair is required.**
- **Whenever you clean the electronics unit.**

CAUTION

To protect the unit from damage, be sure to:

- **Keep all air vents free of dirt and dust.**
- **Keep all liquids away from the unit.**
- **Do not expose the unit to excessive moisture (>85% humidity).**
- **Read this manual before using the unit for the first time.**

WARNING

All attachment plug receptacles in the vicinity of this unit are to be of the grounding type and properly polarized.

Contact your electrician to check your receptacles.

WARNING

This product is equipped with a 3-wire grounding type plug.

Any interruption of the grounding connection can create an electric shock hazard.

If you are unable to insert the plug into your wall plug receptacle, contact your electrician to perform the necessary alterations to ensure that the green (green-yellow) wire is attached to earth ground.

WARNING

This product operates with voltages that can be lethal.

Pushing objects of any kind into cabinet slots or holes, or spilling any liquid on the product, may touch hazardous voltage points or short out parts.

6.2 Connection

On each goniometric cradle is represented a label which indicates its name, its serial number and the motor it is equipped with (ex.: UE31PP).

M-BGM80PE	S/N#
ENCODER:5V	MOTOR:UE31PP
Stepper Motor	U=30VDC I=1A

WARNING

Always turn the controller's power OFF before connecting to a stage.

Goniometric cradles may be connected to the rear panel motor connectors labeled “Motor…” any time prior to power-up with the supplied cable assemblies.

WARNING

With MM series controllers, damage to goniometric cradle may occur if the goniometric cradle is not the same type as shown on driver label located near the goniometric cradle interface connector.

Check that the option number specified on this label correspond to the number indicated in the driver module options table for your goniometric cradle.

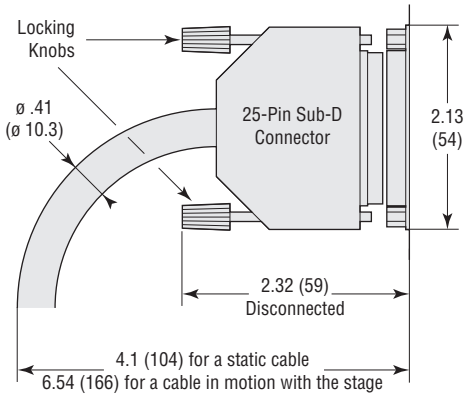
WARNING

Vacuum compatible goniometric cradles have to be configured if running with an ESP series controller.

6.3 Cables

All our (M-)BGM goniometric cradles are delivered equipped with a 3-meter cable with 25-pin Sub-D connectors so they can be directly connected to our controllers/drivers of MM or ESP series.

Dimensions in inches (millimeters)



WARNING

This cable is shielded correctly. For a correct operation, make sure to lock connectors (ground continuity provided by the cable).

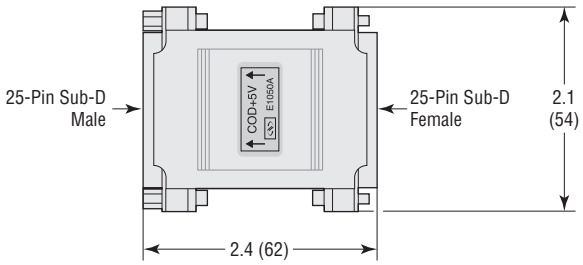
For applications where the standard 3-meter cable (**MMCABLE-3**) included with your goniometric cradle is not adequate, Newport offers longer length cables designed to ensure the integrity of your positioning application.

These cables are specially shielded and terminated with Newport's standard 25-pin sub-D connectors. They are available in 5-m (**MMCABLE-5**), 7-m (**MMCABLE-7**) or 10-m (**MMCABLE-10**) lengths.

WARNING

Keep the motor cables at a safe distance from other electrical cables in your environment to avoid potential cross talk.

For cable lengths in excess of 3 meters, we recommend the **MMCABLE-REG** to ensure a high quality, regulated 5 V supply to the goniometric cradles.



This regulator is available as an option. Please note that for best efficiency, this regulator should be attached to the stage to re-adjust the 5 volts coming from the controller through the long cable.

7.0 Connection to Non-Newport Controllers

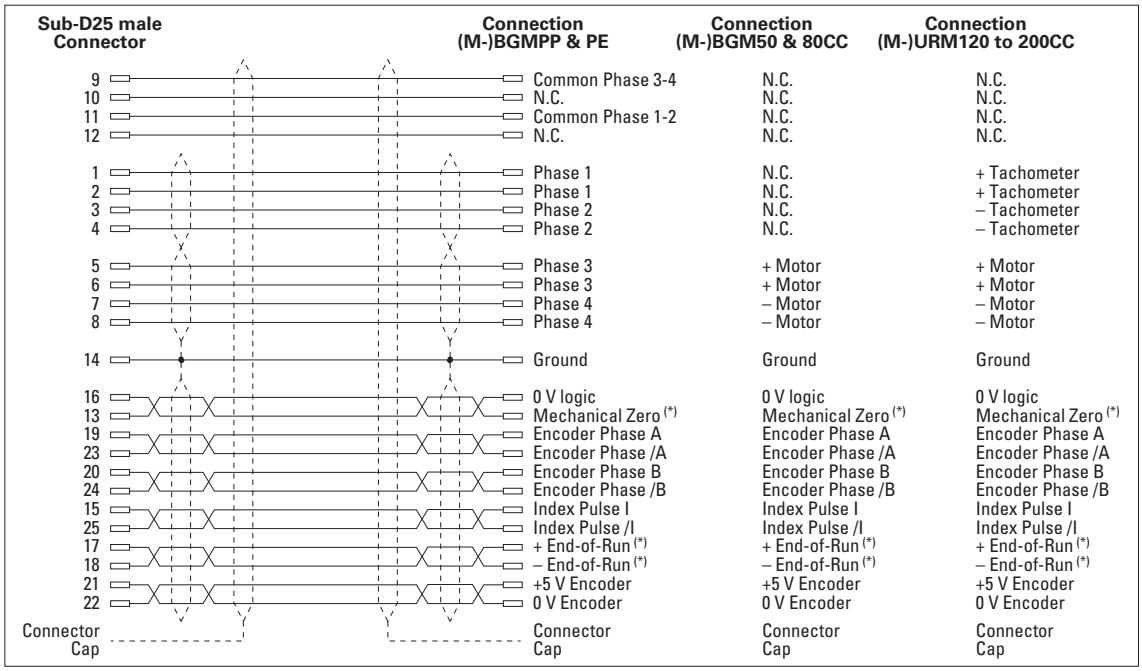
WARNING

Newport takes no responsibility for improper functioning or damage of a goniometric cradle when it is used with any non- Newport controllers.

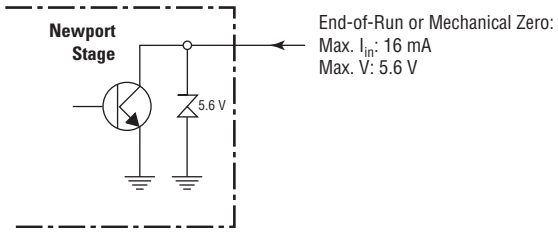
WARNING

Newport guarantees the "CE" compliance of the (M-)BGM goniometric cradles only if they are used with Newport cables and controllers.

Nevertheless, the figure below indicates the recommended wiring when a (M-)BGM goniometric cradle is used with non-Newport controllers.



*** Open collector type with a 5.6 V protective Zener diode.**



If the "Mechanical Zero" output is not used, a 1 kΩ/0.25 W resistor must be connected between pins #13 and #21.

"Encoder" and "Index Pulse" are "differential pair" type output signals. Using these signals permits a high immunity to noise. Emission circuits generally used by Newport are 26LS31 or MC3487. Reception circuits to use are 26LS32 or MC3486.

8.0 Mounting

8.1 Stage Mounting

WARNING

Before to use a (M-)BGM stage, it is imperative to fix it:

- **directly on a rectified working surface, from holes located on the mounting plate,**
- **on another stage, directly or with a mounting interface.**

but in no case, the stage has to remain without fastening.

It is equally necessary to fasten the device to move on the carriage:

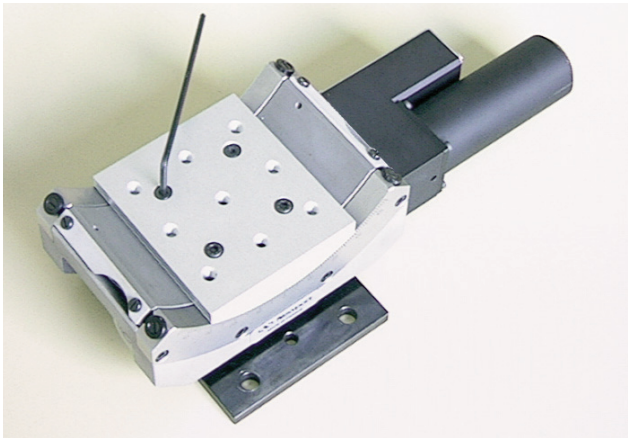
- **directly,**
- **removing the plate on the top of the stage.**

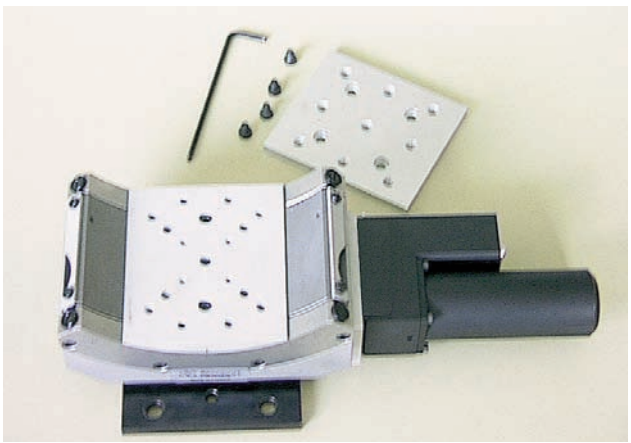
CAUTION

The working surface flatness directly influences stage accuracy and performance.

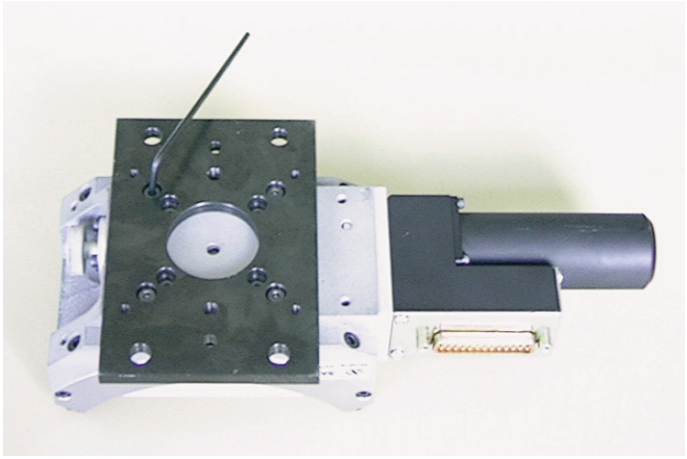
8.2 Interfaces Disassembling

1 Disassemble the top plate of the goniometric cradle, fixed with 4 CHc M4 screws.

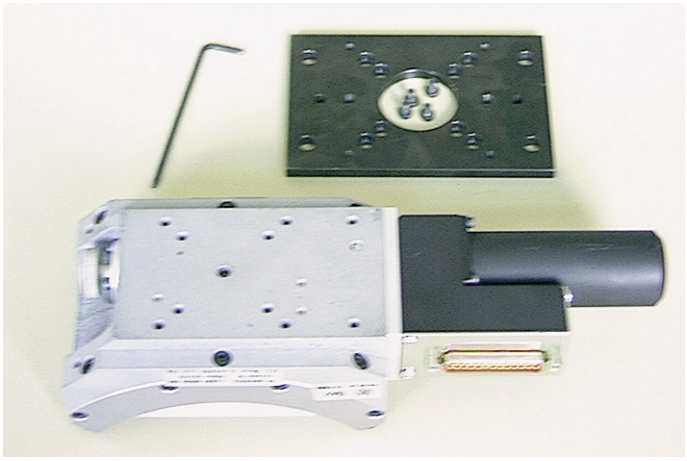




2 Turn the stage upside down.



3 Disassemble the base plate fixed with 4 CHc M4 screws, on the body stage.

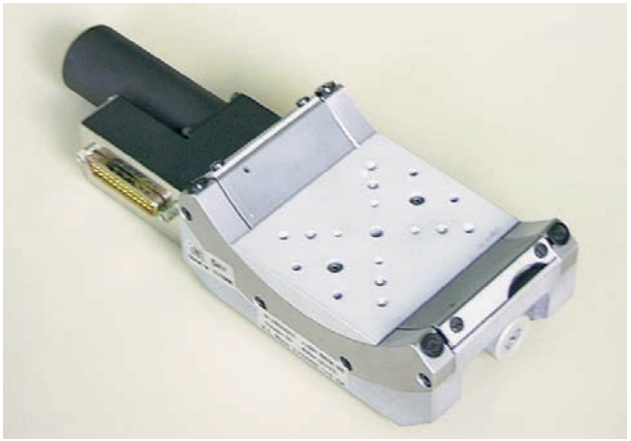


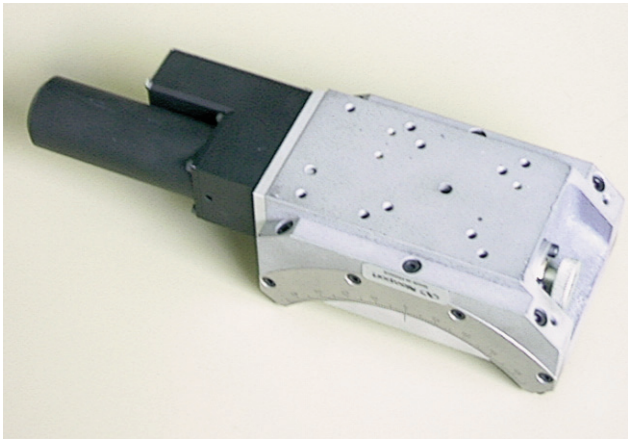
8.3 Interface Plates Mounting

Make steps of “Interfaces Disassembling” chapter in the opposite order.

8.4 Assembly Pattern

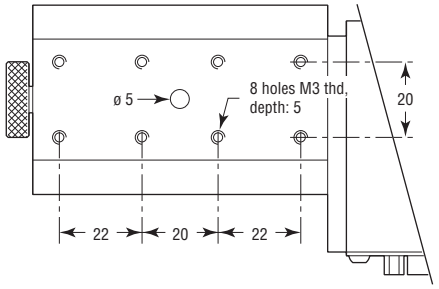
Stacking (M-)BGM Series stages either together or with other Newport stage is easily accomplished. Below are example schematics of the assembly patterns used. These interfaces are accessed by unscrewing and removing the upper and/or lower plates of the stages (see dimension drawing).



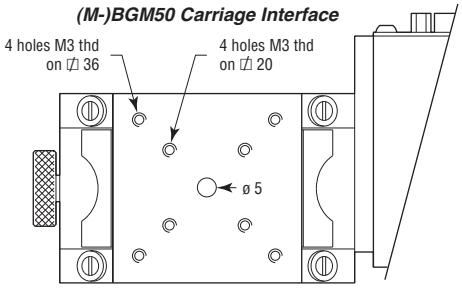


8.5 (M-)BGM50 Interfaces

(M-)BGM50 Body Interface

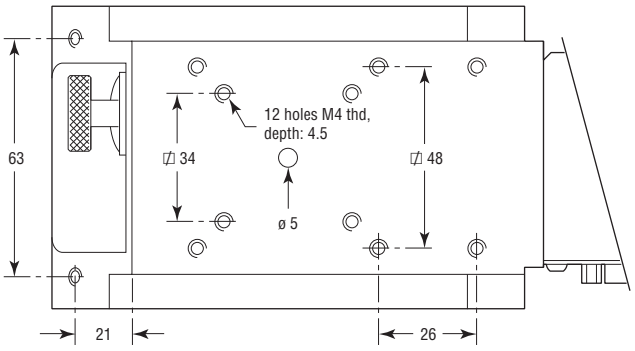


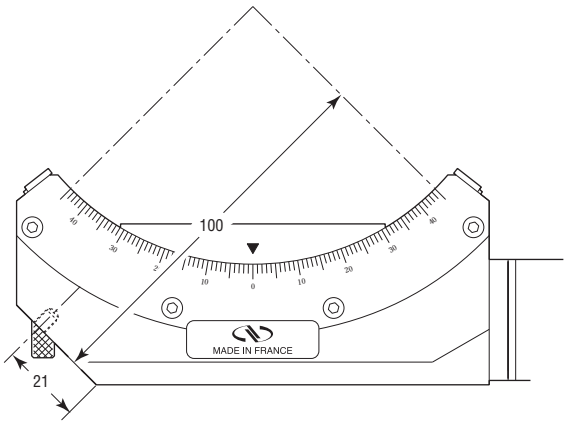
(M-)BGM50 Carriage Interface



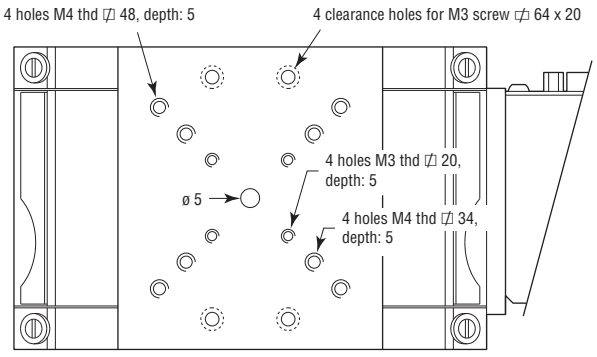
8.6 (M-)BGM80 Interfaces

(M-)BGM80 Body Interface



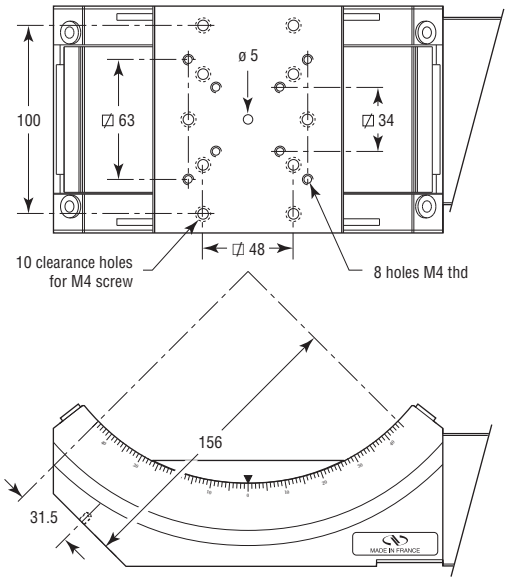


(M-)BGM80 Carriage Interface

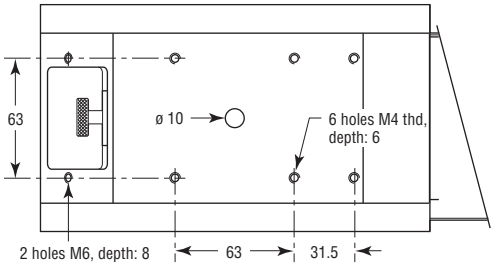


8.7 (M-)BGM120 Interfaces

(M-)BGM120 Carriage Interface

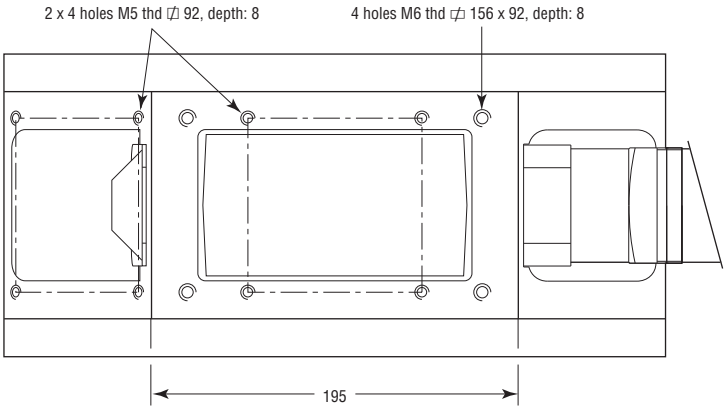


(M-)BGM120 Body Interface

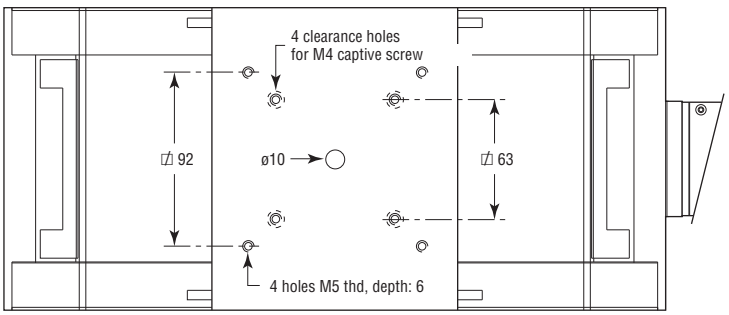


8.8 (M-)BGM160 Interfaces

(M-)BGM160 Body Interface

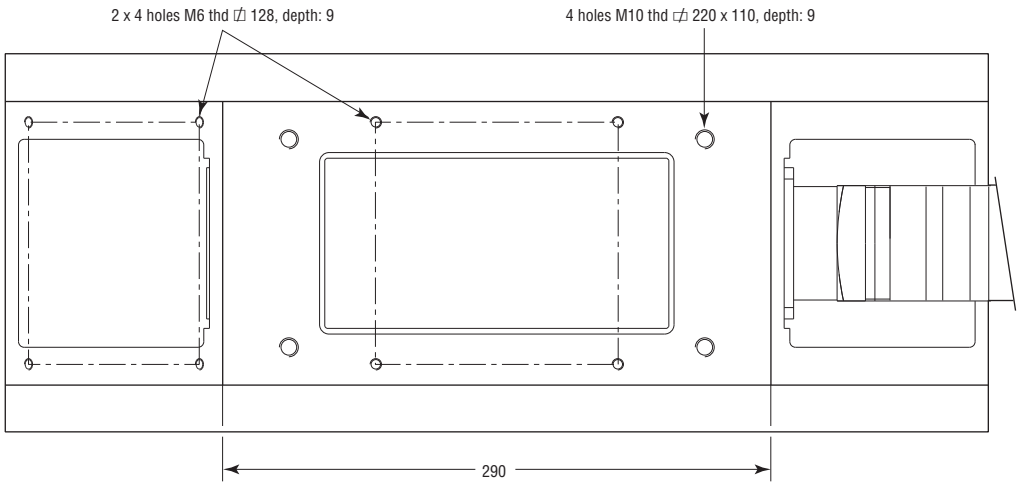


(M-)BGM160 Carriage Interface

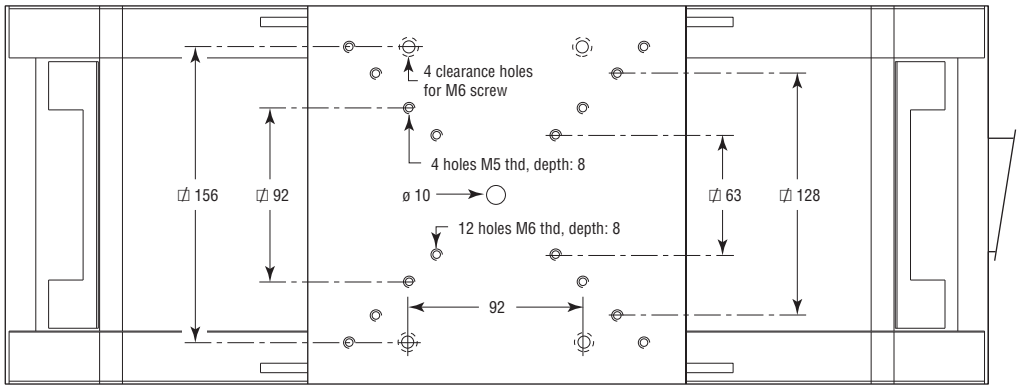


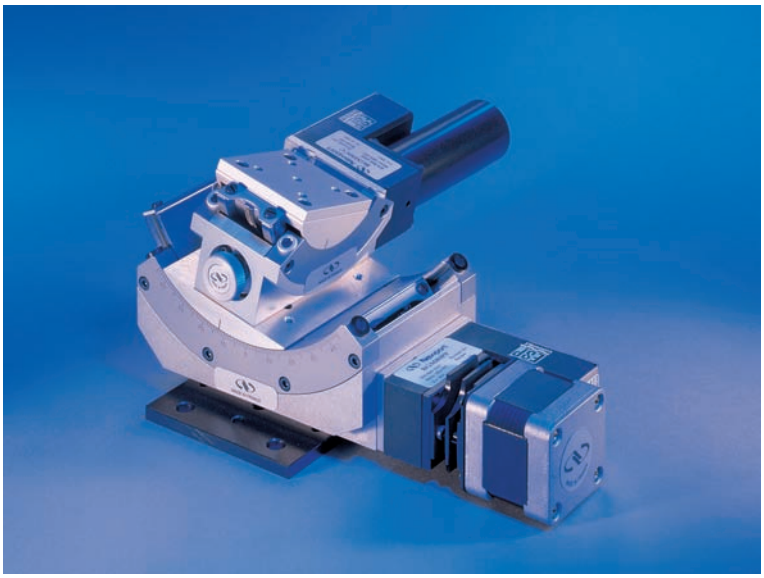
8.9 (M-)BGM200 Interfaces

(M-)BGM200 Body Interface



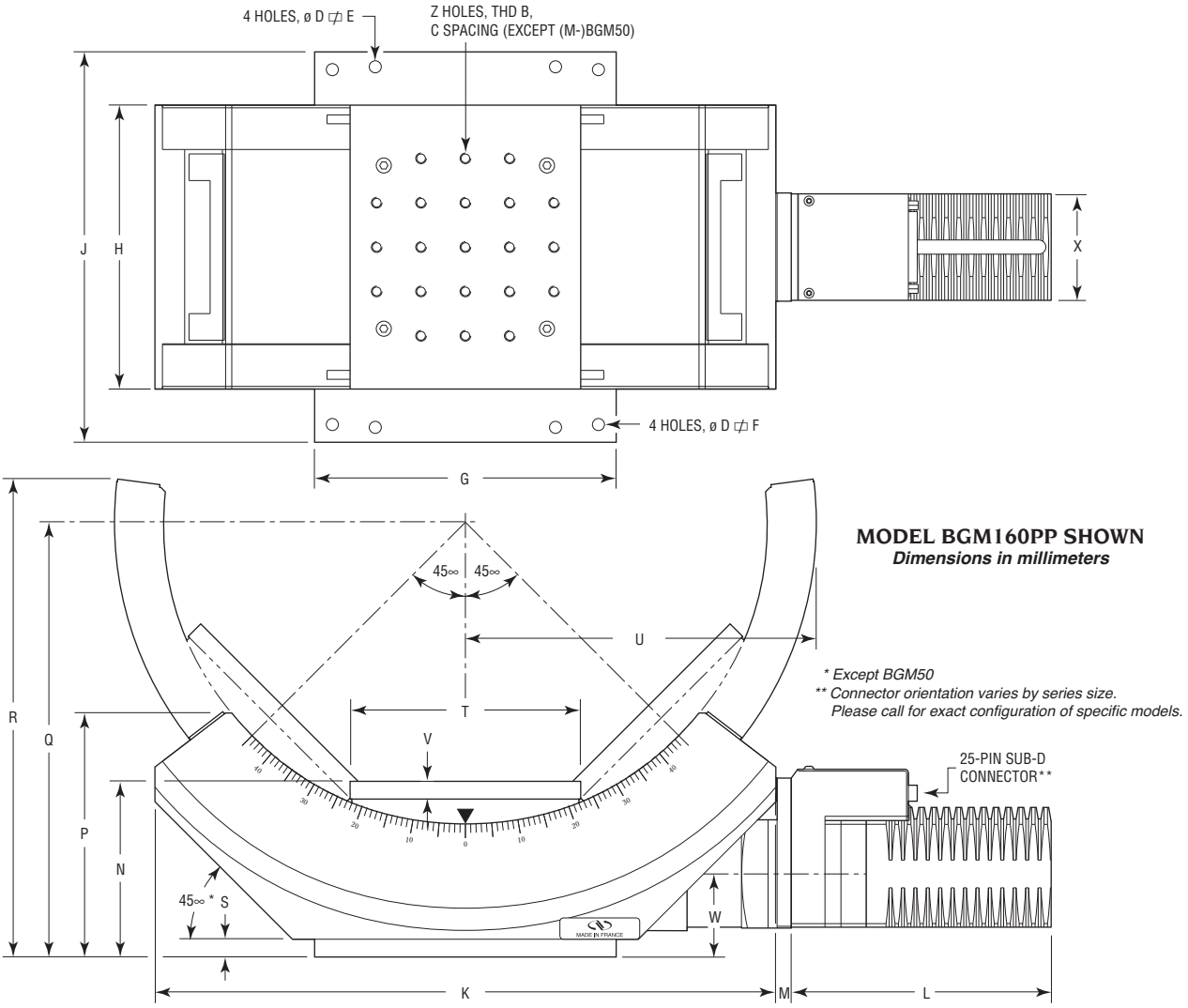
(M-)BGM200 Carriage Interface





These nested (M-)BGM Series cradles can be aligned to provide a 100 micrometer sphere of confusion about the point of rotation.

9.0 Dimensions



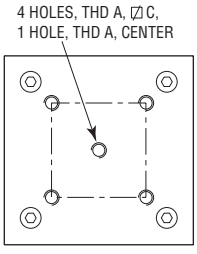
MODEL BGM160PP SHOWN
Dimensions in millimeters

** Except BGM50*
*** Connector orientation varies by series size.*
Please call for exact configuration of specific models.

	Diameter			Dimension (mm)													
Model (Metric)	D	E	F	G	H	J	K	M	N	P	Q	R	S	T	U	V	W
BGM50 (M-BGM50)	7.5	75.4 x 25.4		50	50	89	78	5	53.5		63.5	74.1	6	50		5	22.5
BGM80 (M-BGM80)	7.5	101 x 50.4		80	80	120	125	5	54.5	61.5	106	116	6	70	78.5	6	23.15
BGM120 (M-BGM120)	6.8	152.4 x 50.8	150 x 100	120	120	170	206	31	70	94	164	180	8	99	128	6	43.2
BGM160 (M-BGM160)	6.8	203.2 x 101.6	200 x 150	170	160	220	350	8.7	99	138.2	245	270	10	130	197.5	10	46.8
BGM200 (M-BGM200)	6.8	254 x 203.2	250 x 250	270	200	270	520		135	196	360	398	10	200	300	10	62.5

	Thread		Spacing	
Model (Metric)	A	B	C (mm)	Z (No. Holes)
BGM50 (M-BGM50)	8-32 (M4)		25.4 (25)	
BGM80 (M-BGM80)		1/4-20 (M6)	25.4 (25)	9
BGM120 (M-BGM120)		1/4-20 (M6)	25.4 (25)	15
BGM160 (M-BGM160)		1/4-20 (M6)	25.4 (25)	21
BGM200 (M-BGM200)		1/4-20 (M6)	25.4 (25)	49

	Dimension (mm)			
Model (Metric)	PP	PE	CC	MS
BGM50 (M-BGM50) & BGM80 (M-BGM80)				
L	80.5	129	106.5	90.5
X	42	32	32	32
BGM120 (M-BGM120)				
L	121	129.5	192	143.4
X	60	60	60	60
BGM160 (M-BGM160) & BGM200 (M-BGM200)				
L	146.5	129.5	192	143.4
X	60	60	60	60



(M-)BGM50 TOP PATTERN

10.0 Maintenance

RECOMMENDATION

It is recommended to contact our After Sales Service which will be able to define the appropriate maintenance for your application.

10.1 Maintenance

The (M-)BGM goniometric cradle requires no particular maintenance. Nevertheless, this is a precision mechanical device that must be kept and manipulated with precaution.

PRECAUTIONS

The (M-)BGM goniometric cradle must operate, and be stocked in a clean environment, without dust, humidity, solvents or other substances.

RECOMMENDATION

It is recommended to return your goniometric cradle to our After Sales Service after every 2000 hours of use for lubrication.

If your (M-)BGM goniometric cradle is mounted on a workstation and cannot be easily dismantled, please contact our After Sales Service for further instructions.

10.2 Repairing

CAUTION

Never attempt to disassemble an element of the goniometric cradle that has not been specified in this manual.

Disassembling a non specified element can cause a malfunction of the goniometric cradle.

If you observe a malfunction in your goniometric cradle, please immediately contact us to make arrangements for a repair.

CAUTION

All disassembly attempts or repair of goniometric cradle without authorization will void your warranty.

10.3 Calibration

CAUTION

It is recommended to return your goniometric cradle to Newport once a year for a recalibration to its original specifications.

Service Form

Your Local Representative
Tel.: _____
Fax: _____

Name: _____ Return authorization #: _____
(Please obtain prior to return of item)

Company: _____

Address: _____ Date: _____

Country: _____ Phone Number: _____

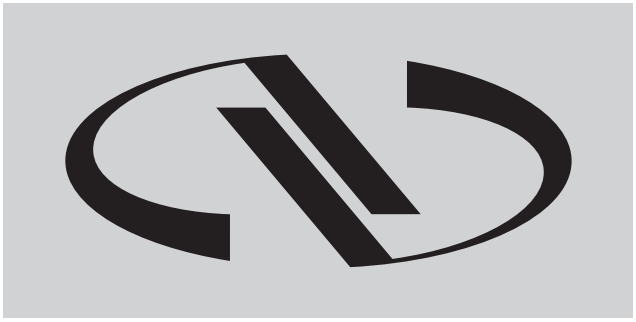
P.O. Number: _____ Fax Number: _____

Item(s) Being Returned:

Model #: _____ Serial #: _____

Description: _____

Reasons of return of goods (please list any specific problems): _____



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