

MM-1

Manual Stages



Constructible into over 16 different configurations (request Basic Contruction Diagrams).

Specifications:				
	Travel	Runout (max)	Return Forc	e (extcomp.) Weight
MM-1	3.175mm	1µm	113 - 312g	3g
MM-1-CR	3.175mm	1µm	113 - 312g	4g
MM-1-EX	5.715mm	1.5µm	170 - 510g	2.5g
MM-1-SPR-090	3.175mm	1µm	227 - 510g	3g
Wobble (max):	10 µrad (2 arc sec) (no	ball bearings)		
Thermal Stability:	15° to 75°C			
Screw Pitch:	80 TPI			
Sensitivity:	0.5 µm			
Backlash:	0			
Load Capacity:				
Direct top or side lo	oad: 0.25 kg			
Push:	0.5 kg			
Retract ext-comp.:	See return for	ce above		
Tilt:	3 in-oz (210 g	g-cm)		
Twist:	1.5 in-oz (105	5 g-cm)		
Dimensions:(L x W x H	I not including lead scr	rew extension)		
	-X Single Stage	-XY (2- axis)		-XYZ (3-axis)
MM-1	26.2 x 11.2 x 5.1 (mm)	26.2 x 26.2 x	10.2 (mm)	26.2 x 26.2 x 36.3 (mm)
MM-1-CR	26.2 x 14.2 x 5.1 (mm)	26.2 x 26.2 x	10.2 (mm)	26.2 x 26.2 x 36.3 (mm)
MM-1-EX	26.2 x 11.2 x 5.1 (mm)	26.2 x 26.2 x	10.2 (mm)	
MM-1-SPR-090	26.2 x 11.2 x 5.1 (mm)	26.2 x 26.2 x	10.2 (mm)	
•-XZ configurati •-CR, -EX, and •Z axis must be	ons available -090 versions may be co a stage with Z connecti	ombined ion enabled		

MM-1 Manual Stage Dimensional Data





Totally Metric/English Compatible



MM-1 Manual MicroMini[™] Stage Accessories



The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc.• 16 Northwestern Dr.• Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810 mail:.key@keystone-intl.co.jp



MM-3



The **larger** of the Manual stages, this unique micropositioner is also a dimensional breakthrough. The MM-3 manual MicroMini[™] Stage is a precision instrument designed for space and weight limitations as well as higher loads and longer travel.

Constructible into over 16 different configurations (request "Basic Contruction Diagrams").

Specification	ons:						
		MM-3		MM-3-CR			
Travel:		0.5 in. (12.7	mm)	0.5 in. (12.7r	nm)		
Runout (max):		1.5µm		1.5µm			
Return Force e	xtcomp.:	6-20oz(170-	567g)	6-20oz (170-5	567g)		
Weight:		16g		20g			
Screw Pitch:		80 TPI					
Sensitivity:		0.5µm					
Backlash:		0 (no ball be	earings)				
Wobble(max):		0.01mrad					
Thermal Stabil	ity:	15° to 75°C					
Load Capacity:							
Direct top	or side load:	0.34 kg					
Push:		1 kg					
Retract ex	t-comp.:	See return f	orce as spe	cified above			
Tilt:		6 in-oz (420	g-cm)				
Twist:		3 in-oz (210	g-cm)				
Dimensions:(L	x W x H, not inclu	iding lead scr	ew extensio	n)			
	-X Single Stage		-XY (2- ax	is)		-XYZ (3-axis)	
MM-3	1.74 x 0.66 x 0.2	9 (inch)	1.74 x 1.74	4 x 0.58 (inch	1)	1.74 x 1.74 x 2	2.32 (inch)
	44.2 x 16.8 x 7.4	(mm)	44.2 x 44.2	$2 \times 14.7 \text{ (mm)}$)	44.2 x 44.2 x 5	58.9 (mm)
MM-3-CR	1.74 x 0.75 x 0.2	9 (inch)	1.74 x 1.74	4 x 0.58 (inch	1)	1.74 x 1.74 x 2	2.32 (inch)
	44.2 x 19.05 x 7.	4 (mm)	44.2 x 44.2	2 x 14.7 (mm))	44.2 x 44.2 x 3	58.9 (mm)
•-XZ configu	rations available						
•Both Styles	•Both Styles of MM-3 may be combined						
•Compatible with all MM-3M motor stages							
•Fully metri	c compatible (all ta	ps and clearan	ice holes)				

MM-3 Manual Stage Dimensional Data







MM-3 Manual MicroMini[™] Stage Accessories



The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc.• 16 Northwestern Dr.• Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810.mail: key@keystone-intl.co.jp



MM-3M-ST

Standard Motorized MicroMini[™] Stage



Specifications:				
*Repeatability:	±0.002 mm			
*Homing Repeatability:	±0.002 mm			
*Accuracy (linearity):	±0.003 mm			
Speed (max.):	4 mm/sec with 64:	1 gearhead		
Slider Backlash:	0 (spring preloaded	1)		
Encoder Conversion(resolution):	0.12406µm per cou	unt with 64:1 gearhead		
	(16:1, 64:1, 256:1,	1024:1 gearheads optional)		
*Encoder resolution must be added based on the	e gearhead: 16:1 add ±0.	.5μm, 64:1 add ±0.12μm		
Wobble (max.):	0.02 mrad (~ 4 arc	-sec)		
Runout (max.):	0.002 mm			
Gearhead Backlash:	$1-2 \ \mu m$ equivalent;	can be compensated in software	e without overshoot	
Motor:	pr: 10 mm dia., 6-12 VDC servo, brush type (see motor specifica		or specifications)	
Vacuum compatiblity:	10 ⁻³ Torr, standard	, higher per request		
Load Capacity:				
*Direct top or side load:	0.34 kg			
*Push:	0.5 kg			
**Retract ext-comp.:	20z-240z (57g - 68	0g)		
*Tilt:	6 in-oz (420 g-cm)			
*Twist:	3 in-oz (210 g-cm)			
*These stages may be run at twice t	he specified ratings with	out damage, but with a loss of accuracy) and <i>speed</i> .	
**Retract is limited by the preload sp	pring.			
Travel Ranges and Dimensions:				
Model No.	Travel Range	Stage Body (L x W x H)	Weight	
MM-3M-ST	0.5 in.	4.48 x 0.75 x 0.36 (inch)	50g	
	12.7mm	113.8 x 19.05 x 9.14 (mm)	50g	
Accesso	ries: See MM-3 man	ual stage accessories		

Standard MM-3M-ST Motorized MicroMini[™] Stage - 0.5 inch (12.7mm) Travel Dimensional Data



Note: Crash resistance is in XY plane only Z axis is not recommended on this version.



MM-3M-F

Folded Motorized MicroMini[™] Stage



On a sifi s sti s n s				
Specifications				
	Standar	d Slider	AB Slider (anti-b	acklash)
*Repeatability:	±2µm		±0.5µm	
*Homing Repeatability:	±2µm		±0.5µm	
*Accuracy (linearity):	±3µm/pe	er inch	±1.5µm/per inch	
Speed (max.):	6mm/sec	2	4mm/sec	
†Slider Backlash:	50µm		3µm	
Encoder Conversion (reso	lution): 0.49609į	ım per count	0.12406µm per cou	nt
(See also: gearheard optio	ms) with 16:1	Igearhead	with 64:1 gearhead	
*Encoder resolution must be add	led based on the gearhead.	$16.1 \text{ add } \pm 0.5 \text{ um}$	54·1 add +0 12 um	
*Slider backlash represents maxi	imum overshoot	10.1 add ± 0.5µm, 0	94.1 aud ±0.12 μm	
· · · ·				
Runout (max.):	3µm/25.	4mm (1 inch)		
Gearhead Backlash:	1-2µm ec	luivalent; can be	compensated in soft	ware without overshoot
Motor:	10 mm d	ia., 6-12 VDC s	ervo, brush type (see	motor specifications)
Vacuum compatiblity:	10 ⁻³ Torr,	standard, high	er per request	
Load Capacity:				
Direct top or side le	oad: 0.5 kg			
Push:	0.5 kg			
Pull:	0.5 kg			
Tilt:	8 in-oz (560 g-cm)			
Twist: 4 in-oz (280 g-cm)				
Note: These stages may	be run at twice the specified	ratings without dam	age, but with a loss of acc	euracy and speed.
Travel Ranges and Dime	nsions:			
Model No.	Travel Range	Stage Body (I	L x W x H)	Weight
MM-3M-F-0.5	0.5 inch (12.7mm)	2.32 x .075 x	(0.64 (inch)	53g
		58.9 x 19.1 x	(16.3 (mm)	53g
MM-3M-F-1	1.0 inch (25.4mm)	2.82 x 0.75 x	0.64 (inch)	58g
		71.6 x 19.1 x	(16.3 (mm)	58g
MM-3M-F-1.5	1.5 inch (38.1mm)	3.32 x 0.75 x	0.64 (inch)	63g
		84.3 x 19.1 x	(mm)	63g
MM-3M-F-2	2.0 inch (50.8mm)	3.82 x 0.75 x	0.64 (inch)	68g
		97.0 x 19.1 x	16.3 (mm)	68g
MM-3M-F-2.5	2.5 inch (63.5mm)	4.32 x 0.75 x	c 0.64 (inch)	73g
		109.7 x 19.1 x	16.3 (mm)	73g
	Specify -A	AB for Anti-Back	lash	<u> </u>

Folded MM-3M-F Motorized MicroMini[™] Stage - 0.5 to 2.5 inch Travel Dimensional Data





MM-4M-F

Folded Motorized MicroMini[™] Stage

(For heavier loads)



Specifications			
*Repeatability:	±0.5 μm		
*Homing Repeatability:	±0.5 μm		
Accuracy:	±1.0 μm per 2	5mm of travel	
Straightness:	±2.0 μm maxin	mum deviation per 50mm of tra	avel
Speed (max):	6mm/sec with	16:1 gearhead (other gearhead	ls available)
†Slider Backlash:	1µm		
Gearhead Backlash:	<2.54µm; can	be compensated in software wi	thout overshoot
Encoder Conversion (resolution):	0.49609µm pe	r count, with 16:1 gearhead	
*Encoder resolution must be added, bas	ed on the gearhed	ıd: 16:1 add ±0.0005mm, 64:1 add	l ±0.00012mm
†Slider backlash represents maximum o	vershoot		
Motor:	10mm dia., 6-	12 VDC servo, brush type	
Slide: Cross roller bearing			
Vacuum Compatibility:	10 ⁻³ Torr, stan	dard, higher per request	
Load Capacity:			
Horizontal:	3.0 kg		
Vertical:	1.0 kg		
Side:	1.5 kc		,
	1.5 kg		
	1.5 kg		
Travel Ranges and Dimensions:	1.5 kg		
Travel Ranges and Dimensions: Model No. Travel	Range	Stage Body (L x W x H)	Weight
Model No. Travel MM-4M-F-25 25mm	Range	Stage Body (L x W x H) 97mm x 31.5mm x 23mm	Weight 165g

MM-4M-F Motor Stage 25mm & 50mm Travel Dimensional Data





MM-3M-EX

Extended Motorized MicroMini[™] Stage

(For extended travel)



Specifications				
	Standard	Slider	AB Slider (anti-	backlash)
*Repeatability:	±2 μm		±0.5 μm	
*Homing Repeatability:	±2 μm		±0.5 μm	
*Accuracy (linearity):	±3 μm		±1.5 μm	
Speed (max.):	6 mm/sec		4 mm/sec	
†Slider Backlash:	50 µm		3 µm	
Encoder Conversion (resolution	ı): 0.49609µm	per count	0.12406µm per ce	ount
(See also: gearheard options)	w/16:1gear	head	w/64:1gearhead	
*Encoder resolution must be added , ba	used on the gearhead: 16:	1 add ± 0.5 µm, 64:1 add	±0.12 μm	
†Slider backlash represents maximum	overshoot			
Load Capacity:				
Direct top or side load:	0.5 kg			
Push:	0.5 kg			
Pull:	0.5 kg			
Tilt:	8 inoz. (56	60 g-cm)		
Twist:	4 inoz. (28	30 g-cm)		
Note: These stages may be rur	at twice the specified rati	ings without damage, but	with a loss of accuracy	and speed.
Runout (max.):	3 μm per 25.4 mm (1 inch)			
Gearhead Backlash:	1-2 μm equi	valent; can be compe	nsated in software	without overshoot
Motor:	10 mm dia.	, 6-12 VDC servo, br	ush type (see moto	or specifications)
Vacuum compatiblity:	10 ⁻³ Torr, st	andard, higher per re	equest	
Wobble (max.):	0.02 mrad (~ 4 arc-sec)		
Travel Ranges and Dimension	s:			
Model No.	Travel Range	Stage Body (I	2 x W x H)	Weight
MM-3M-EX-0.5	0.5 inch	3.90 x 0.75 x	0.36 (inch)	53g
	12.7 mm	99.1 x 19.1 x	9.1 (mm)	53g
MM-3M-EX-1	1.0 inch	4.40 x 0.75 x	0.36 (inch)	58g
	25.4 mm	111.8 x 19.1 x	x 9.1 (mm)	58g
MM-3M-EX-1.5	1.5 inch	4.90 x 0.75 x	0.36 (inch)	63g
	38.1 mm	124.5 x 19.1 x	x 9.1 (mm)	63g
MM-3M-EX-2	2.0 inch	5.40 x 0.75 x	0.36 (inch)	68g
	50.8 mm	137.2 x 19.1 x	x 9.1 (mm)	68g
_				

Specify -AB for Anti-Backlash

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc.• 16 Northwestern Dr. • Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810.mail: key@keystone-intl.co.jp

Folded MM-3M-EX Motorized MicroMini Stage[™] - 0.5 to 2 inch Travel Dimensional Data



BR-3M-X Optional Crash-resistant Slider Brace

Note: Symmetry is applicable wherever implied



MM-4M-EX

Extended Motorized MicroMini[™] Stage

(For heavier loads)



Specifications			
*Repeatability:	±0.5 μm		
*Homing Repeatability:	±0.5 μm		
Accuracy:	±1.0 µm per 25mm o	f travel	
Straightness:	±2.0µm maximum de	eviation per 200mm of travel	
Speed (max):	7 mm/sec with 14:1 g	gearhead (other gearheads available	e)
†Slider Backlash:	1 µm		
Gearhead Backlash:	<2.54 µm; can be con	mpensated in software without ove	rshoot
Encoder Conversion:	0.3595 µm per count	, with 14:1 gearhead	
*Encoder resolution must be added	, based on the gearhead: 1	6:1 add \pm 0.5 µm, 64:1 add \pm 0.12 µm	
+Slider backlash represents maxim	num overshoot		
Motor:	13 mm dia., 6-12 VD	C servo, brush type	
Slide:	Recirculating ball bear	ings with four point contact, hardened	d stainless steel rails
Vacuum Compatibility:	10 ⁻³ Torr, standard, higher per request		
Load Capacity:			
Horizontal:	3.0 kg		
Vertical:	1.0 kg		
Side:	1.0 kg		
Travel Ranges and Dimensi	ions:		
Model No.	Travel Range	Stage Body (L \times W \times H)	Weight
MM-4M-EX-50	48 mm	138.68 x 31.5 x 25.4 (mm)	330g
MM-4M-EX-80	78 mm	168.68 x 31.5 x 25.4 (mm)	345g
MM-4M-EX-110	108 mm	198.68 x 31.5 x 25.4 (mm)	360g
MM-4M-EX-140	138 mm	228.68 x 31.5 x 25.4 (mm)	375g
MM-4M-EX-1701	168 mm	258.68 x 31.5 x 25.4 (mm)	390g
MM-4M-EX-2001	198 mm	288.68 x 31.5 x 25.4 (mm)	405g
MM-4M-EX-230 ¹	228 mm	318.68 x 31.5 x 25.4 (mm)	420g
MM-4M-EX-260 ¹	258 mm	348.68 x 31.5 x 25.4 (mm)	435g
¹ Travel	ranges from 168 mm to 2	260 mm are non-stock items; available o	n request.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

. National Aperture, Inc.• 16 Northwestern Dr. • Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810.mail: key@keystone-intl.co.jp

MM-4M-EX Motor Stage Dimensional Data





MM-3M-R

Miniature Rotary Stage

(For lighter loads)



Specifications

	MM-3M-R		MM-3M-RA	MM-3M-RA+
Repeatability:	15 arc-sec*		same	same
Homing Repeatability:	60 arc-sec*		same	same
Accuracy: (linearity)	80 arc-sec*		same	same
(See diagram on reverse of this sheet for an i	llustration of A.,l	B.,C.,D.)		
A. Axial Wobble (axial angular long range repeatability)	60 arc-sec		2 arc-sec	2 arc-sec
B. Axial angular deviation, total	60 arc-sec		60 arc-sec	2 arc-sec
C. Planar shift, total	1.2 µm		0	0
D. Eccentricity (runout, including bearing mount)	Зµm		3μm	3µm
Direct top load:	2 kg axial		0.5 kg axial	0.5 kg axial
Tilt Load	5 kg-cm (70 in	oz)	1.0 kg-cm (14 inoz)	1.0 kg-cm (14 inoz)
Torque load	850 g-cm (12 in	.oz)	425g-cm (6 inoz)	425g-cm (6 inoz)
Gearhead Ratio:(see "Resolution Data Sheet")	64:1(standard)	16:1	same	same
Speed: (low load)	4 RPM	16 RPM**	same	same
Encoder Conversion: (arc-sec/count)	6.3281	25.3124	same	same
(see gearhead ratios, "Resolution Data Sheet")				
Gearhead Backlash:	~1 mrad†	~4 mrad†	same	same
Rotor Stall Torque:	200 in-oz††	50 in-oz††	same	same
Rotor Backlash: (preloaded)	0		same	same
Weight:	76g		same	same
Vacuum compatiblity:	10 ⁻³ Torr, higher	per request	same	same
Travel Range:	unlimited		same	same
Worm Ratio:	80:1		same	same
Stage Body Dimensions: (L x W x H)	2.86 x 1.43 x 0.5	59 (inch), 72.64 x	x 36.32 x 14.99 (mm)	
Motor:	10 mm dia., 6-1	2 VDC servo, brus	sh type (see motor specifications)	

*Encoder resolution must be added based on the gearhead: 64:1 add ±12 arc-sec 256:1 add ±3 arc-sec, 1024:1 add ±0.75 arc-sec (all approximated)

**A higher gear reduction means a slower speed. Higher speeds (lower ratio) can be used, but at the expense of resolution and load/torque capacity.

[†]Dependent upon gear ratio, and can be compensated in software without overshoot.

*††*Dependent upon gear ratio and worm ratio.

Note: The MM-3M stages are designed for peak performance at low loads: ex; 60g, less than 2 inches (50.8mm) off axis.

Special Features: •Dual class 7 custom bearings for ultra-low axial/angular runout

•Multi-faceted connection interface

•Many other gearhead options, easy-change

•Homing switch

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc.• 16 Northwestern Dr. • Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810 mail: key@keystone-intl.co.jp

MM-3M-R Rotary Stage Dimensional Data





MM-4M-R

Rotary Motorized MiniStage

(For heavier loads)



Specifications				
Repeatability:	±30 arc-sec			
Homing Repeatability:	±30 arc-sec			
Accuracy (linearity):	±2 arc-min, full trave	1		
Max Travel Rate ¹ :	96.63 deg/sec, w/14:1	gearhead		
Encoder Conversion:	16.3091 arc-sec/coun	t, w14:1 gearhead (See also MM-4	M Resolution Sheet)	
¹ Max travel rate calculated with	a maximum motor armat	ure speed of 20,000 RPM		
Load Capacity:	10 lbs (4.5 kg)			
Table Runout:	±2.5µm			
Standard Gearhead:	14:1			
Gearhead Options:	3.71:1, 43:1, 66:1, 13 4,365:1 and 5,647:1	4:1, 159:1, 246:1, 415:1, 592:1, 98	39:1, 1,526:1, 2.608:1,	
Worm Ratio:	90:1			
Motor:	13mm dia., 6-12 VDC servo, brush type			
Bearings:	Pre-loaded duplex angular contact			
Base Material & Finish:	Aluminum, black anodized			
Vacuum Compatibility:	10 ⁻³ Torr. standard, higher per request			
Table Diameter:	2.38 inch (60.45mm)			
Travel Ranges and Dimens	ions:			
Model No.	Travel Range	Stage Body (L $x W x H$)	Weight	
MM-4M-R	Unlimited	5.25 x 2.880 x 1.125 (inch)	1 lb.	
		133.4 x 73.15 x 28.58 (mm)	0.454g	
Special features: •Ultra-low axial/angu •Multi-faceted connec •Anti-backlash worm •Black anodized finis	ilar runout etion interface drive system h			

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.

National Aperture, Inc.• 16 Northwestern Dr. • Salem, N.H. 03079-4810 株式会社キーストンインターナショナル 227-0042千葉県柏市逆井13-27 電話(0471)75-8810 mail: key@keystone-intl.co.jp

MM-4M-R Rotary Stage Dimensional Data





MC-5B Manual Position Controller

Manual Position Control

The MC-5B Micro Positioning Controller from National Aperture, Inc. was designed for ease of use and effortless integration into any application.

The MC-5B is a low-cost, quick-setup solution for those applications requiring precise position control of motorized stages. Incorporated into this all-in-one controller is a keypad/display interface, a 750mA 12V linear DC motor amplifier, single ended (TTL) A/B quadrature encoder inputs, 5 volt limit switch inputs and a serial communication interface.

The MC-5B functions seamlessly as a single axis, stand-alone system or as a multi-axis



networked system, either with or without a PC. The peer to peer network architecture makes it possible for every MC-5B in a multi-axis system to control every axis in the motion system. No software development or complex wiring is required. The controllers themselves may be programmed to store and recall positions and to sequence through stored positions with looping, pausing and user/program interaction. Automation may also be driven serially from a PC or host processor.

Benefits:

- Instant "Out-of-the-Box" Motion Control
- A Low Cost, Integrated Motion Solution
- No Need to write Additional Motion Commands
- Perfect for Rapid Development, Prototyping, Bread Boarding, Proof-of-Concept, Small OEM lots where delivery is Critical

Features:

- Communicate to any node on the system through your PC's Serial Port
- Up to 99 MC-5B controllers can be configured on a single motion system
- Control all nodes from any node on the motion network
- Original Settings are retained
- Configure each unit as a node on the network with a unique node number
- Broadcast Single or Multiple Motion Commands to one node or all nodes at the same time;



MC-4SA Multi-axis Servo Amplifier System

TULTI-AXIS Micro POWER

LVI The MC-4SA is a multi-axis motor drive amplification system designed for use in systems where low power micro motors are required for a particular application.

The MC-4SA was designed for interfaceability to the National Instrument[™] controllers. The MC-4SA interface connectors allow versatile connectivity based on the application and controller being used. All 4 axes may be accessed through a single cable.

Cimple connectivity

All of the difficult interfacing problems have been taken out of the hands of the user. For example, setup is simple; connect one end of the 68 conductor cable to the controller and the other to the MC-4SA; plug in your MicroMini[™] stage and you are ready! No external power supply connections, no multi-wire motor connections.

The MC-4SA also features a number of built-in protective devices and signal enhancement circuits such as;

- Supply Rail Monitoring (SRM)
- System status monitoring
- Kickless Balnced Power Supply
- Encoder conditioning
- Reversible motor polarity



Fully LabVIEWTM by National Instruments compatible.

Features:

- Fully compatible with all MicroMini[™] stages
- 110VAC 60Hz/220VAC 50/60Hz operation
- Built-in limit-sensing logic
- Front panel axis fault lights
- Axis enable switches w/illuminated status lights
- Compact design
- Versatile multiple-controller interface
- On-board encoder conditioning
- Joystick Input
- Linear Encoder Inputs
- Auxiliary I/O connector for ease of wiring
- Easily accessible rear panel mounted fuses
- Rack Mountable or Desktop design

National Aperture, Inc. can provide custom electronic and mechanical design services in order to integrate the MC-4SA into your application.

Specifications:

AC power input (User-selectable):	110/220VAC
Motor control input voltage:	±10VDC across 300 K ohms
Encoder supply voltage:	+5VDC
Max output power (Standard):	6 Watts
Output voltage range:	±12VDC
Slew rate:	8V/μS, max.
Voltage gain (Av):	1.2

Standard cabling:

CA10-10-3	3 ft. motor extension cable
CA10-10-6	5 ft. motor extension cable
CA10-10-9	9 ft. motor extension cable
186381-02	6 ft controller amplifier interface cable

Call for information on additional lengths



MicroMini[®] Controller

General Description

The MicroMini^{\otimes} Controller is a low cost, miniature, single axis "intelligent drive" that provides speed and position control of DC motors with an on-board integrated amplifier. Up to 63 motor axes can be controlled using an RS-485 Multidrop interface or the DeviceNet^{\otimes} protocol.

- •Programmable Current Limit
- •No external amplifier required
- •RS-232, RS-485 Multidrop or DeviceNet $^{\scriptscriptstyle \rm M}$ (CAN) compatible interfaces
- •Linear drive capable of 10 Watts continuous at 22°C ambient
- •Local mode speed range up to 20,000:1
- •Short Circuit Protection
- •Accepts Step/Direction Input /Encoder Tracking (optional)
- •Torque Limiting Capability
- •Flash Based Parameter Storage/ EDS
- •Indexing and Registration Support (Single, Continuous, Count, Absolute and Rel.)
- •Position Capture (2)
- •Macro Programming Support
- •Custom Firmware Support for embedded OEM applications

Modes of Operation

Local/Stand alone (for speed/position control), or Remote via RS-232 or RS-485 , or DeviceNet $^{\! \bowtie}\! .$

Performance(Remote Mode)

Position Range Velocity Range Velocity Accuracy Positional Accuracy Servo Loop Update Time Servo Tuning Acceleration Range ±2,147,483,647 quadrature counts up to 2 million quadrature counts/sec ±0.1% of max. rate 0.18° (with a 500 CPR encoder) 1000μsec Programmable PID filter 32,767 quadrature counts/sec/sec

Power Requirement

Single supply 24 VDC at 300mA, plus current to drive selected motor Input voltage range Linear 18-40 VDC

Communication

RS-232, RS-485, Multidrop, DeviceNet[™]

Controller Inputs

Encoder	Two channel, Single-ended +5VDC TTL compatible
	4 MHz maximum frequency, Optically isolated
Analog	One analog input (0-5 VDC, 10 bit)
General Purpose	Two external event inputs, Two hard limits, One emergency stop. All inputs are optically protected (except analog input)
Opto Coupler Power	Input to supply external Power to Opto Couplers
Controller Outputs	
Sign Bit	One bit digital output (TTL) for external amplifier (direction)
Analog	One 12 bit signed output for external amplifier (± 10 VDC)
Analog	One 12 bit output (± 10 VDC)(Also used for programmable currect limit.)
Drive Amplifier Specificati	ons @ 22°C (72°)F

MicroMiniTM Controller Linear Amplifier

Outputs ±22 Volts DC at 1.0 Amp continuous; 3.5 Amps peak

Environmental

Controller Operating Temperature Ambient Operating Temperature (standard version) Ambient Storage Temperature (standard version) Humidity Tolerance (standard version) 0°C to 70°C (32°F to 158°F) 0°C to 40°C (32°F to 104°F) -20°C to 85°C (-4°F to 185°F) 80% Rh, non-condensing

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



MicroMini[™] Controller

Dimensional Outlines





MM-3M-ST, -EX, -R Resolution Data Sheet

Linear Motion: 80 TPI Lead Screw

	Resolution ¹		Max Trave	Max Travel Rate	
Gearhead Ratio	µInch/count	μm/count	Inch/sec	mm/sec	
16:1	19.5313	0.4960	0.260	6.60	
64:1	4.8828	0.1240	0.064	1.65	
256:1	1.2207	0.0310	0.016	0.41	
1024:1	0.3052	0.0077	0.004	0.10	

Rotary Motion: 80:1 Worm Drive Ratio

		Re	Resolution ¹	
Gearhead Ratio	Final Output	Deg./count	(arc-sec)/count	Deg/sec
16:1	1,280:1	0.00703125	25.3125	93.74
64:1	5,120:1	0.00175781	6.3281	23.44
256:1	20,480:1	0.00043945	1.5820	5.86
1024:1	81,920:1	0.00010986	0.39550	1.46

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.0125 in., 0.3175 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

ation

Conversion:

= 25.4 mm
= 25,400 μ
= 39.37 x 10 ⁻³
= 39.37 x 10 ⁻⁶ in
= 3,600 arc-sec
$= 0.277 \text{ x } 10^{-3} \text{ deg.}$

Notes:

1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Threads per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.

- 2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM.
- 3) The 10 mm motors used with both the rotary and linear stages incorporate dual channel, 10 position, magnetic encoders. The resultant quadrature output is equal to 40 encoder counts per motor armature revolution.



MTR-10-E MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-E Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

Pin #	Name	Pin #
1	Motor+	6
2	Encoder+V	7
3	Encoder Ch A	8
4	Encoder Ch B	9
5	Ground (case)	10

Name Motor Limit ground No connection Reverse limit Forward limit

6

20.1

68

10

17,600

2,854

0.46

0.004

0.15

0.350

0.060

0.48



Electrical Specifications:

Supply Voltage Nom. (Volts) Armature Resistance $(Ohm)\pm 12\%$ Max power output (Watts)⁽²⁾ Max. Efficiency (%)⁽²⁾ No Load Speed (RPM) $\pm 12\%^{(2)}$ Friction Torque (@ no load speed) (oz-in) No Load Current (mA) $\pm 50\%^{(3)}$ Stall Torque(oz-in)⁽²⁾ Velocity Constant (RPM/Volt) Back EMF Constant (mV/RPM) Torque Constant (oz-in/Amp) Armature Inductance (mH)

Mechanical Specifications:

Mechanical Time Constant (ms)^[2] Armature Inertia (x10⁶ oz-in-sec²)^[2] Angular Acceleration (x 10³ Rad/sec²)^[2] Rotor Temperature Range Bearing Play (measured @ bearing) Radial Axial Thermal Resistance (°C/W) Rotor to Caszze Case to Ambient Maximum Shaft Load Radial (@3,000 RPM) 3mm from bearing Axial Weight Encoder Specifications: Supply Voltage

Max Voltage Supply Operating Current Signal Phase Shift Max. Signal Freq. Temperature Range Storage Temp. Range Assymetry Max. Output Signal Type Signal Rise Time Phase Relationship

Pulses per Revolution Quadrature 5 VDC Nom. 15 VDC 5mA Nom. @5VDC 90° 7.2 KHz -20°C to +85° C -40°C to +110°C 10% Square wave Less than 5µs Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 10 (2 channels) 40

9 0.85 193 -30°C to +125°C(-22°F to +257°F)

Less than 0.03mm (0.0012") Less than 0.2mm (0.0079")

10 65

1.8 oz (51 grams) 72 oz(2,041.2 grams) 0.23 oz (6.5 grams)

(1) Ratings are presented independent of each other

(2) Specified at nominal supply voltage

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



16 Northwestern Drive • Salem, NH 03079-4810 • 800-360-4598 • 603-893-7393 • Fax 603-893-7857 * www.nationalaperture.com/www.naimotion.com



MM-3M-F/MM-4M-F Resolution Data Sheet

Linear Motion: 80 TPI Lead Screw

	Resolution ¹		Max Travel Rate	
Gearhead Ratio	µInch/count	µm/count	Inch/sec	mm/sec
16:1	19.5313	0.4960	0.260	6.60
64:1	4.8828	0.1240	0.064	1.65
256:1	1.2207	0.0310	0.016	0.41
1024:1	0.3052	0.0077	0.004	0.10

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.0125 inch, 0.3175 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

Encoder counts per shaft revolution	= 40 encoder counts x Gearhead ratio
Minimum encoder count (inches)	= Lead (0.0125 in.)/Encoder counts per output shaft revolution
Minimum encoder count (millimeters)	= Minimum encoder count (inch)/ 39.37×10^{-3} in.
Minimum encoder count (micrometers)	= Minimum encoder count (inch)/ 39.37×10^{-6}

Conversion:

1 inch (in)	= 25.4 mm
1 inch (in)	= 25,400 µm
1 millimeter (mm)	= 39.37 x 10 ⁻³
1 micrometer (μ)	= 39.37 x 10 ⁻⁶ inch
1 deg (deg)	= 3,600 arc-sec
1 arc-sec	= 0.277 x 10 ⁻³ degree

Notes:

- 1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Threads per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.
- 2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM.
- *3)* The 10 mm motors used with both the rotary and linear stages incorporate dual channel, 10 position, magnetic encoders. The resultant quadrature output is equal to 40 encoder counts per motor armature revolution.



MTR-10-E MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-E Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

Pin #	Name	Pin :
1	Motor+	6
2	Encoder+V	7
3	Encoder Ch A	8
4	Encoder Ch B	9
5	Ground (case)	10

Name Motor Limit ground No connection Reverse limit Forward limit

6

0.15

0.350

0.060

0.48

2,854



Electrical Specifications:

Supply Voltage Nom. (Volts) Armature Resistance $(Ohm)\pm 12\%$ Max power output (Watts)⁽²⁾ Max. Efficiency (%)⁽²⁾ No Load Speed (RPM) $\pm 12\%^{(2)}$ Friction Torque (@ no load speed) (oz-in) No Load Current (mA) $\pm 50\%^{(3)}$ Stall Torque(oz-in)⁽²⁾ Velocity Constant (RPM/Volt) Back EMF Constant (mV/RPM) Torque Constant (oz-in/Amp) Armature Inductance (mH)

Mechanical Specifications:

Mechanical Time Constant (ms)^[2] Armature Inertia (x10⁻⁶ oz-in-sec²)^[2] Angular Acceleration (x 10³ Rad/sec²)^[2] Rotor Temperature Range Bearing Play (measured @ bearing) Radial Axial Thermal Resistance (°C/W) Rotor to Case Case to Ambient Maximum Shaft Load Radial (@3,000 RPM) 3mm from bearing Axial Weight 20.1Max Voltage Supply0.46Operating Current68Signal Phase Shift17,600Max. Signal Freq.0.004Temperature Range10Storage Temp. Range

Temperature Range Storage Temp. Range Assymetry Max. Output Signal Type Signal Rise Time Phase Relationship

Supply Voltage

Encoder Specifications:

Pulses per Revolution Quadrature

5 VDC Nom. 15 VDC 5mA Nom. @5VDC 90° 7.2 KHz -20°C to +85° C -40°C to +110°C 10% Square wave Less than 5µs Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 10 (2 channels) 40

9 0.85 193 -30°C to +125°C(-22°F to +257°F)

Less than 0.03mm (0.0012") Less than 0.2mm (0.0079")

10 65

1.8oz (51.03grams) 72oz (2,041.2grams) 0.23oz (6.5grams)

(1) Ratings are presented independent of each other

(2) Specified at nominal supply voltage

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



16 Northwestern Drive • Salem, NH 03079-4810 • 800-360-4598 • 603-893-7393 • Fax 603-893-7857 * www.nationalaperture.com/www.naimotion.com



MM-3M-F/MM-4M-F Resolution Data Sheet

Linear Motion: 40 TPI Lead Screw

	Resolution ¹		Max Trav	vel Rate
Gearhead Ratio	µInch/count	µm/count	Inch/sec	mm/sec
16:1	39.0625	0.99219	0.5208	13.229

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.025 inch, 0.635 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

Encoder counts per shaft revolution	= 40 encoder counts x Gearhead ratio
Minimum encoder count (inches)	= Lead (0.025 in.)/Encoder counts per output shaft revolution
Minimum encoder count (millimeters)	= Minimum encoder count (inch)/39.37 x 10^{-3} in.
Minimum encoder count (micrometers)	= Minimum encoder count (inch)/39.37 x 10^{-6}

Conversion:

1 inch (in)	= 25.4 mm
1 inch (in)	= 25,400 µm
1 millimeter (mm)	$= 39.37 \text{ x } 10^{-3}$
1 micrometer (μ)	$= 39.37 \text{ x } 10^{-6} \text{ inch}$
1 deg (deg)	= 3,600 arc-sec
1 arc-sec	= 0.277 x 10 ⁻³ degree

Notes:

- 1) The lead values shown above in both travel rate and resolution calculations, are for 40 (1/40) Threads per Inch (TPI) leadscrews. For an 80 TPI leadscrew, substitute 0.0125 inch lead.
- 2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM.
- 3) The 10 mm motors used with both the rotary and linear stages incorporate dual channel, 10 position, magnetic encoders. The resultant quadrature output is equal to 40 encoder counts per motor armature revolution.



MTR-10-E MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-E Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

Pin # Name		Pin #
1	Motor+	6
2	Encoder+V	7
3	Encoder Ch A	8
4	Encoder Ch B	9
5	Ground (case)	10

Name Motor Limit ground No connection Reverse limit Forward limit



Electrical Specifications:

Supply Voltage Nom. (Volts) Armature Resistance $(Ohm)\pm 12\%$ Max power output $(Watts)^{(2)}$ Max. Efficiency $(\%)^{(2)}$ No Load Speed (RPM) $\pm 12\%^{(2)}$ Friction Torque (@ no load speed) (oz-in) No Load Current (mA) $\pm 50\%^{(3)}$ Stall Torque(oz-in)^{(2)} Velocity Constant (RPM/Volt) Back EMF Constant (mV/RPM) Torque Constant (oz-in/Amp) Armature Inductance (mH)

Mechanical Specifications:

Mechanical Time Constant (ms)^[2] Armature Inertia (x10⁻⁶ oz-in-sec²)^[2] Angular Acceleration (x 10³ Rad/sec²)^[2] Rotor Temperature Range Bearing Play (measured @ bearing) Radial Axial Thermal Resistance (°C/W) Rotor to Case Case to Ambient Maximum Shaft Load Radial (@3,000 RPM) 3mm from bearing Axial Weight $20.1 \\ 0.46 \\ 68 \\ 17,600 \\ 0.004 \\ 10 \\ 0.15 \\ 2,854 \\ 0.350 \\ 0.48 \\ 0.060$

6

Encoder Specifications:

Supply Voltage Max Voltage Supply Operating Current Signal Phase Shift Max. Signal Freq. Temperature Range Storage Temp. Range Assymetry Max. Output Signal Type Signal Rise Time Phase Relationship

Pulses per Revolution Quadrature 5 VDC Nom. 15 VDC 5mA Nom. @5VDC 90° 7.2 KHz -20°C to +85° C -40°C to +110°C 10% Square wave Less than 5 μ s Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 10 (2 channels) 40

9 0.85 193 -30°C to +125°C(-22°F to +257°F)

Less than 0.03mm (0.0012") Less than 0.2mm (0.0079")

10 65

1.8oz (51.03grams) 72oz (2,041.2grams) 0.23oz (6.5grams)

(1) Ratings are presented independent of each other

(2) Specified at nominal supply voltage

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



16 Northwestern Drive • Salem, NH 03079-4810 • 800-360-4598 • 603-893-7393 • Fax 603-893-7857 * www.nationalaperture.com/www.nationtion.com



MM-3M-F/MM-4M-F Resolution Data Sheet

Linear Motion: 80 TPI Lead Screw

	Resolution ¹		Max Trav	vel Rate
Gearhead Ratio	µInch/count	µm/count	Inch/sec	mm/sec
16:1	19.5313	0.4960	0.130	3.30
64:1	4.8828	0.1240	0.032	0.83
256:1	1.2207	0.0310	0.008	0.21
1024:1	0.3052	0.0077	0.002	0.05

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.0125 inch, 0.3175 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

Encoder counts per shaft revolution	= 40 encoder counts x Gearhead ratio
Minimum encoder count (inches)	= Lead (0.0125 in.)/Encoder counts per output shaft revolution
Minimum encoder count (millimeters)	= Minimum encoder count (inch)/ 39.37×10^{-3} in.
Minimum encoder count (micrometers)	= Minimum encoder count (inch)/ 39.37×10^{-6}

Conversion:

1 inch (in)	= 25.4 mm
1 inch (in)	= 25,400 µm
1 millimeter (mm)	= 39.37 x 10 ⁻³
1 micrometer (μ)	= 39.37 x 10 ⁻⁶ inch
1 deg (deg)	= 3,600 arc-sec
1 arc-sec	= 0.277 x 10 ⁻³ degree

Notes:

- 1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Threads per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.
- 2) Max travel rate calculated with motor armature running at a maximum speed of 10,000 RPM (no load).
- *3)* The 10 mm motors used with both the rotary and linear stages incorporate dual channel, 10 position, magnetic encoders. The resultant quadrature output is equal to 40 encoder counts per motor armature revolution.



MTR-10-E-12V MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-E-12V Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

Pin #	Name	Pin #
1	Motor+	6
2	Encoder+V	7
3	Encoder Ch A	8
4	Encoder Ch B	9
5	Ground (case)	10

Name Motor Limit ground No connection Reverse limit Forward limit

12

68

4

16,500

1.419

95.0

0.36

0.004

0.116

0.705

0.953

0.310



Electrical Specifications:

Supply Voltage Nom. (Volts) Armature Resistance (Ohm)±12% Max power output (Watts)⁽²⁾ Max. Efficiency (%)⁽²⁾ No Load Speed (RPM) ±12%⁽²⁾ Friction Torque (@ no load speed) (oz-in) No Load Current (mA)±50%⁽³⁾ Stall Torque(oz-in)⁽²⁾ Velocity Constant (mA)/Volt) Back EMF Constant (mV/RPM) Torque Constant (oz-in/Amp) Armature Inductance (mH)

Mechanical Specifications:

Mechanical Time Constant (ms)^[2] Armature Inertia (x10⁻⁶ oz-in-sec²)^[2] Angular Acceleration (x 10³ Rad/sec²)^[2] Rotor Temperature Range Bearing Play (measured @ bearing) Radial Axial Thermal Resistance (°C/W) Rotor to Case Case to Ambient Maximum Shaft Load Radial (@3,000 RPM) 3mm from bearing Axial Weight **Encoder Specifications:** Supply Voltage

Max Voltage Supply Operating Current Signal Phase Shift Max. Signal Freq. Temperature Range Storage Temp. Range Assymetry Max. Output Signal Type Signal Rise Time Phase Relationship

Pulses per Revolution Quadrature 5 VDC Nom. 15 VDC 5mA Nom. @5VDC 90° 7.2 KHz -20°C to +85° C -40°C to +110°C 10% Square wave Less than 5μs Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 10 (2 channels) 40

10 0.7081 165 -30°C to +85°C(-22°F to +185°F)

Less than 0.02mm (0.0008") Less than 0.2mm (0.0079")

26 56

1.8oz (51.03grams) 18oz (2,041.2grams) 0.23oz (6.5grams)

(1) Ratings are presented independent of each other

(2) Specified at nominal supply voltage

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



16 Northwestern Drive • Salem, NH 03079-4810 • 800-360-4598 • 603-893-7393 • Fax 603-893-7857 * www.nationalaperture.com/www.nationi.com



MM-4M-EX and MM-4M-R **Resolution Data Sheet**

Linear Motion: MM-4M-EX, 80 TPI Lead Screw, 13mm mtr, 16 enc. *lines/mtr rev Max Travel Rate² **Resolution**¹ **Gearhead Ratio Actual Gear Ratio** Inch/count mm/count Inch/sec mm/sec 14:1 13.795918367:1 14.1573 x 10⁻⁶ 0.3595 x 10⁻³ 0.30 7.6 43:1 42.920634921:1 4.5506 x 10⁻⁶ 0.1155 x 10⁻³ 0.096 2.466.220408163:1 2.9494 x 10⁻⁶ 0.0749 x 10⁻³ 0.062 66:1 1.5

134:1	133.530864198:1	1.4627 x 10 ⁻⁶	$0.0371 \ge 10^{-3}$	0.030	0.78
159:1	159.419501134:1	1.2251 x 10 ⁻⁶	0.0311 x 10 ⁻³	0.025	0.64
246:1	245.961516035:1	0.7941 x 10 ⁻⁶	0.0201 x 10 ⁻³	0.016	0.41
415:1	415.429355281:1	0.4701 x 10 ⁻⁶	0.0119 x 10 ⁻³	0.010	0.25
592:1	592.129575640:1	0.3298 x 10 ⁻⁶	0.0083 x 10 ⁻³	0.006	0.16
989:1	988.891428571:1	0.1975 x 10 ⁻⁶	0.0050 x 10 ⁻³	0.0036	0.092
1,526:1	1,525.718204082:1	0.1280 x 10 ⁻⁶	0.0032 x 10 ⁻³	0.0027	0.069
2,608:1	2,625.740771277:1	0.0744 x 10 ⁻⁶	0.0018 x 10 ⁻³	0.0015	0.039
4,365:1	4,385.142457309:1	0.0445 x 10 ⁻⁶	0.0011 x 10 ⁻³	0.0009	0.023
5,647:1	5,666.953329446:1	$0.0345 \ge 10^{-6}$	0.0008 x 10 ⁻³	0.0007	0.018

<u>Rotary Motion: MM-4M-R, 90:1 Worm Drive Ratio 13mm mtr, 16 enc. *lines/mtr rev</u>

		Resolution ¹		Max Travel Rate ²
Gearhead Ratio	Actual Gear Ratio	Deg./count	arc-sec/count	Deg./sec
14:1	13.795918367:1	4.53032 x 10 ⁻³	16.3091	96.63
43:1	42.920634921:1	1.45617 x 10 ⁻³	5.2422	31.00
66:1	66.220408163:1	0.94381 x 10 ⁻³	3.3977	20.09
134:1	133.530864198:1	0.46805 x 10 ⁻³	1.6850	9.90
159:1	159.419501134:1	0.39204 x 10 ⁻³	1.4113	8.36
246:1	245.961516035:1	0.25410 x 10 ⁻³	0.9147	5.36
415:1	415.429355281:1	0.15044 x 10 ⁻³	0.5416	3.18
592:1	592.129575640:1	0.10555 x 10 ⁻³	0.3799	2.18
989:1	988.891428571:1	0.06320 x 10 ⁻³	0.2275	1.361
526:1	1,525.718204082:1	0.04096 x 10 ⁻³	0.1474	0.90
2,608:1	2,625.740771277:1	0.02380 x 10 ⁻³	0.0856	0.54
4,365:1	4,385.142457309:1	0.01425 x 10 ⁻³	0.0513	0.27
5.647:1	5,666.953329446:1	$0.01102 \ge 10^{-3}$	0.0397	0.23

Notes:

1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Thread per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.

2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM

*The resultant quadrature output is equal to 64 encoder counts per motor armature revolution. (mtr rev)

Travel rate calculations:

Travel rate calculations:		Conversion :	
Output Shaft RPM	= RPM of motor / Gearhead Ratio	1 inch (in.)	= 25.4 mm
Distance per minute	= Output shaft RPM x Lead	1 inch (in.)	= 25,400µm
	(0.0125 inch, 0.03175mm)	1 millimeter (mm)	$= 39.37 \text{ x } 10^{-3} \text{ in.}$
Distance per second	= Distance per minute/60	1 micrometer (µm)	= 39.37 x 10 ⁻⁶ in.
Distance in millimeters	= inch/39.37 X 10 ⁻³	1 degree (deg)	= 3,600 arc-sec
Distance in micrometers	= inch/39.37 x 10 ⁻⁶	1 arc-sec	$= 0.277 \text{ x } 10^{-3} \text{ deg}$



MTR-13-E MicroMini[™] Motor **Connection Specifications**

Motor Connector Pin Assignments:

Motor Type: **Connector Type:** Mating Part:

MTR-13-E Dual Row IDC Panduit P/N 057-010-115S (male pin socket with mounting flange)

Note: Mating connectors may be purchased from National Aperture, Inc.

Pin #	Name	Pin #	Name
1	Motor +	6	Motor -
2	Encoder+V	7	Limit Ground
3	Encoder Ch. A	8	No Connection*
4	Encoder Ch. B	9	Reverse Limit
5	Ground (case)	10	Forward Limit

*Optional: +5V with Optical Limit Switches

Electrical Specifications:		Encoder Specifications:	
Supply Voltage Nom. (Volts)	6	Supply Voltage	5 VDC Nom.
Armature Resistance (Ohm) $\pm 12\%$	3.6	Max Supply Voltage	15 VDC
Max Power Output (Watts) ¹	2.43	Operating Current	5 mA Nom. @ 5VDC
Max Efficiency (%) ¹	78	Signal Phase Shift	90°
No-Load Speed (rpm) ±12% ¹	10,900	Max Signal Frequency	7.2 Khz
Friction Torque (at no-load speed)(oz-in)	0.018	Operating Temp. Range	-40° C to $+85^{\circ}$ C (-40° F to $+185^{\circ}$ F)
No-Load Current (mA) ±50% ²	25	Storage Temp. Range	-40°C to +110°C (-40°F to +257°C)
Stall Torque (oz-in.) ¹	1.20	Max Asymmetry	10%
Velocity Constant (rpm/Volt)	1,840	Signal Rise Time	Less than 5µs
Back EMF Constant (mV/rpm)	0.542	Phase Relationship	Ch. A leads Ch. B when motor
Torque Constant (oz-in./Amp)	0.734		rotation is clockwise as viewed
Armature Inductance (mH)	0.08		from shaft end.
		Pulses Per Revolution	16 (2 channels)
		Quadrature	64 encoder counts
Mechanical Specifications (Motor):			

Mechanical Time Constant (ms) ¹	9
Armature Inertia (x 10 ⁻⁴ oz-insec ²) ¹	0.095
Angular Acceleration (x 10^3 rad/sec ²) ¹	130
Thermal Resistances (°C/W)	
Rotor to Case	8
Case to Ambient	40
Max Shaft Load	
Radial at 3,000 rpm (3mm from bearing)	4.3 oz (122 grams)
Axial (Static)	72 oz (2,014 grams)
Weight	0.71 oz (20 grams)
Max Operating Temp. Range	-30°C to +85°C (-22°F to +185°F)
Max Rotor Temp.	100°C (212°F)

(1) Specified at nominal supply voltage.

(2) Specified with shaft diameter = 1.5mm at no-load speed.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.





MM-3M-R / MM-4M-F

12 Position Encoder Resolution Data Sheet

Linear Motion: 80 TPI Lead Screw

	Resolution ¹		Max Travel	Rate
Gearhead Ratio	µInch/count	µm/count	Inch/sec	mm/sec
16:1	16.276	0.41341	0.2604	6.6146

Rotary Motion: 80:1 Worm Drive Ratio

		Res	Resolution ¹	
Gearhead Ratio	Final Output	Deg./count	(arc-sec)/count	Deg/sec
16:1	1,280:1	5.859375 x 10 ⁻³	21.1530	93.75

note: for 16:1 gearhead there are 61,440 counts for 360° rotation.

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.0125 inch, 0.3175 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

Encoder counts per shaft revolution	= 48 encoder counts x Gearhead ratio
Minimum encoder count (inches)	= Lead (0.0125 inch)/ Encoder counts per output shaft revolution
Minimum encoder count (millimeters)	= Minimum encoder count (inch)/ 39.37×10^{-3} inch
Minimum encoder count (micrometers)	= Minimum encoder count (inch)/39.37 x 10 ⁻⁶

Conversion:

 $\begin{array}{ll} 1 \mbox{ inch (in.)} &= 25.4 \mbox{ mm} \\ 1 \mbox{ inch (in.)} &= 25,400 \mbox{ \mum} \\ 1 \mbox{ millimeter (mm)} &= 39.37 \mbox{ x } 10^{-3} \\ 1 \mbox{ micrometer (\mum)} &= 39.37 \mbox{ x } 10^{-6} \mbox{ inch} \\ 1 \mbox{ deg (deg)} &= 3,600 \mbox{ arc-sec} \\ 1 \mbox{ arc-sec} &= 0.277 \mbox{ x } 10^{-3} \mbox{ deg.} \end{array}$

Notes:

- 1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Threads per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.
- 2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM.
- 3) The 10 mm motors used with rotary stages incorporate dual channel, 12 position, magnetic encoders. The resultant quadrature output is equal to 48 encoder counts per motor armature revolution.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



MTR-10-12E MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-12E with 16:1 planetary gearhead and magnetic encoder Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

6 7

8

9

10

Pin #	Name	
1	Motor+	
2	Encoder+V	
3	Encoder Ch A	
4	Encoder Ch B	
5	Ground (case)	

Pin # Name Motor Limit ground No connection **Reverse** limit Forward limit

9.09

3.01

4.56

0.08

1.55

1.5



Electrical Specifications:

Supply Voltage Nom. (Volts)	6
Armature Resistance (Ohm)±12%	9
Max. power output (Watts) ⁽²⁾	1
Max. Efficiency (%) ⁽²⁾	76
No Load Speed (RPM) ±12% ⁽²⁾	12,400
No Load Current (mA) ±50% ⁽³⁾	11
Stall Torque (oz-in) ⁽²⁾ mNm	3
Velocity Constant (RPM/Volt)	2,100
Torque Constant (mNm/A)	4
Armature Inductance (mH)	0
Speed/torque gradient (rpm/mNm)	4180
Starting Current (mA)	660
Maximum permissible speed (rpm)	19,000
Maximum continuous current (mA)	339
Maximum continuous torque (mNm)	1
Maximum power output at nominal voltage (mW)	962
Thermal time constant winding(s)	2
Mechanical Specifications:	
Mechanical Time Constant (ms) ⁽²⁾	4

2 Armature Inertia (g - cm²) 0.098 Maximum rotor temperture +85°C Axial Play 0.02 - 0.10mm Thermal Resistance (K/W) Rotor to Case 9 Case to Ambient 38 Maximum Shaft Load (N) Radial 5mm from flange 1 Axial 2 Weight 10 grams

Planetary Gearhead recommended input speed <8000 rpm

(1) Ratings are presented independent of each other (2) Specified at nominal supply voltage

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.

Encoder Specifications:

Supply Voltage Max Voltage Supply **Operating Current** Signal Phase Shift Max. Signal Freq. **Temperature Range Output Signal Type** Phase Relationship Pulses per Revolution **Quadrature** Output signal TTL compatible 5 VDC Nom. 24 VDC 8mA Nom. @5 VDC 90° min. 20 KHz -20°C to +80° C Square wave Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 12 (2 channels) 48



MM-3M-R / MM-4M-F

16 Position Encoder Resolution Data Sheet

Linear Motion: 80 TPI Lead Screw

	Resolution ¹		Max Travel	Rate
Gearhead Ratio	µInch/count	µm/count	Inch/sec	mm/sec
16:1	12.207	0.310	0.2604	6.6146

Rotary Motion: 80:1 Worm Drive Ratio

		Resc	olution ¹	Max Travel Rate ²	
Gearhead Ratio	Final Output	Deg./count	(arc-sec)/count	Deg/sec	
16:1	1,280:1	4.39453125 x 10 ⁻³	15.82031	93.75	

note: for 16:1 gearhead there are 81,920 counts for 360° rotation.

Travel rate calculations:

Output Shaft RPM	=RPM of motor/Gearhead Ratio
Distance per minute	= Output shaft RPM x Lead (0.0125 inch, 0.3175 mm)
Distance per second	= Distance per minute/60
Distance in millimeters	= inch/39.37 x 10 ⁻³
Distance in micrometers	= inch/39.37 x 10 ⁻⁶

Encoder resolution calculations:

Encoder counts per shaft revolution	= 64 encoder counts x Gearhead ratio
Minimum encoder count (inches)	= Lead (0.0125 inch)/ Encoder counts per output shaft revolution
Minimum encoder count (millimeters)	= Minimum encoder count (inch)/39.37 $x10^{-3}$ inch
Minimum encoder count (micrometers)	= Minimum encoder count (inch)/39.37 x 10^{-6}

Conversion:

1 inch (in.)= 25.4 mm1 inch (in.)= 25,400 μ m1 millimeter (mm)= 39.37 x 10⁻³1 micrometer (μ m)= 39.37 x 10⁻⁶ inch1 deg (deg)= 3,600 arc-sec1 arc-sec= 0.277 x 10⁻³ deg.

Notes:

- 1) The lead values shown above in both travel rate and resolution calculations, are for 80 (1/80) Threads per Inch (TPI) leadscrews. For a 40 TPI leadscrew, substitute 0.025 inch lead.
- 2) Max travel rate calculated with motor armature running at a maximum speed of 20,000 RPM.
- 3) The 10 mm motors used with rotary stages incorporate dual channel, 16 position, magnetic encoders. The resultant quadrature output is equal to 64 encoder counts per motor armature revolution.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



MTR-10-16E MicroMini[™] Motor

Connection Specifications

Motor Type: MTR-10-16E with 16:1 planetary gearhead and magnetic encoder Connector type: Dual row IDC *Mate Part# (male pin socket): Panduit part #057-010-115

Pin #	Name	Pin #
1	Motor+	6
2	Encoder+V	7
3	Encoder Ch A	8
4	Encoder Ch B	9
5	Ground (case)	10

Name Motor Limit ground No connection **Reverse** limit Forward limit



Electrical Specifications:

Supply Voltage Nom. (Volts)	6
Armature Resistance (Ohm)±12%	9.
Max. power output (Watts) ⁽²⁾	1.
Max. Efficiency (%) ⁽²⁾	76
No Load Speed (RPM) ±12% ⁽²⁾	12,400
No Load Current (mA) ±50% ⁽³⁾	11
Stall Torque (oz-in) ⁽²⁾ mNm	3
Velocity Constant (RPM/Volt)	2,100
Torque Constant (mNm/A)	4
Armature Inductance (mH)	0.
Speed/torque gradient (rpm/mNm)	4180
Starting Current (mA)	660
Maximum permissible speed (rpm)	19,000
Maximum continuous current (mA)	339
Maximum continuous torque (mNm)	1.
Maximum power output at nominal voltage (mW)	962
Thermal time constant winding(s)	2
Mechanical Specifications:	
Mechanical Time Constant (ms) ⁽²⁾	4
Armature Inertia (g - cm ²)	0.098

4.56 0.08 80 60 00 39 1.5562 2

0.02 - 0.10mm

+85°C

9

1

2

10 grams

38

9.09

3.01

1.5

Supply Voltage Max Voltage Supply

Encoder Specifications:

Operating Current Signal Phase Shift Max. Signal Freq. **Temperature Range Output Signal Type** Phase Relationship Pulses per Revolution **Quadrature** Output signal TTL compatible 5 VDC Nom. 24 VDC 8mA Nom. @5 VDC 90° min. 20 KHz -20°C to +80° C Square wave Ch A leads CH B when motor rotation is clockwise as seen from shaft end. 16 (2 channels) 64

(1) Ratings are presented independent of each other

Planetary Gearhead recommended input speed <8000 rpm

(2) Specified at nominal supply voltage

Radial 5mm from flange

Maximum rotor temperture

Thermal Resistance (K/W) Rotor to Case

Maximum Shaft Load (N)

Axial

Case to Ambient

Axial Play

Weight

(3) Specified with shaft diameter = 0.8mm at no load

*Mating connectors available through National Aperture, Inc.



MicroMini[™] Stage

TO THE MICRO-MOTION USER

National Aperture is the leader in micro-automation. The MicroMini[™] Stages, along with our micro-motion control systems, have become the industry's best selling micro-automation tools.

The patented features of the MicroMini[™] Stage provide **high-precision micropositioning** at "breakthrough" prices.

Our new constraint-free design minimizes inherent error and provides linear and rotary motion in a unique, compact configuration to give you the ultimate in accuracy, linearity, repeatability and speed in the smallest conceivable amount of space. Our miniature servomotor has advantages that far surpass any comparable stepper motor.

Our Controllers:

Now it's easy to integrate your total motion control solution. You can begin with confidence to replace your more critical hand operations in production and laboratory. National Aperture provides "plug in and go" solutions for both PC and Macintosh[™]. Our motion control cards provide real-time, high speed, closed loop control without sacrificing resolution or response time. Standard "C" drivers and support libraries for use with Basic and Windows are included with our controllers. With Windows[™] and the additional support of LabVIEWTM by National Instruments Corp., custom software applications become simple and hardware headaches become a thing of the past!

All of our motion control products are not only user friendly and flexible, but they offer superior compatibility with other major systems.

We are dedicated to bringing you into the world of motion control with the finest state of the art components.

FEATURES OF THE NATIONAL APERTURE MicroMiniI[™] STAGE

- Hard treated surfaces for smooth, wear-resistant motion.
- No ball bearings, for wobble-free slide motion.
- Easy-change screw-on gearheads, for on-site modification.
- Gearhead options; multiple, broad range.
- Ultra low-backlash gearheads, 1µm- 2µm equivalent.
- Low inertia motors for maximum speed-to-resolution ratio
- Ultra-fine lead screw 80 TPI for minimal transmission error.
- Highly specialized limit switches, for error-free response.
- Superior homing repeatability, within 0.5 micrometers
- Easy-construction interfaces, for on-site modification.
- Easily and readily customized.

The information contained in this data sheet is subject to change without notice. Critical dimensions or specifications should be verified with our technical support staff.



GENERAL APPLICATION

The MM stage is designed for loads under 6 ounces (170g) and low moments; below 8 in.-oz.

SLIDE SYSTEM

Hardened precision dowels are preloaded against the four-cornered slider. The low-load requirements of the stage allow a springaction, preloaded, positive slider seating.

RETURN PRELOAD SPRING

The standard manual stages and ST motor stages have a simple return spring and moving lead screw. Although limited in travel, there is the benefit of built in anti-backlash.

FIXED LEAD SCREW THRU SLIDER

The Folded and Extended motor stages have a fixed lead screw passing through a tapped section in the slider.

BACKLASH

Clearance between the tapped hole and the lead screw gives a degree of backlash in slider motion. It also affects linearity of motion (in -F and -EX stages).

ANTI-BACKLASH, HIGH LINEARITY

Option A radially preload-seating tapped lead hole module is provided for more stringent requirements. The effect of this system is; near 0 backlash, along with maximum linearity, repeatability, and homing consistency as demanded by the submicrometer resolution.

LOAD BEARING CONSIDERATION

The amount of preload determines the load bearing capacity. When the preload is overcome by excessive load, the slider-rail seating is disturbed making overload errors easy to detect. Stage damage does not occur at this point. Simple formulae are provided for quick, or detailed load analysis. A larger, MM-4 stage is provided as a base to better carry the weights of additional axes, thus improving the end load capacity by a pyramid effect.

VELOCITY

Slider velocity is determined by the torque and speed of the motor, along with the gearhead ratio. It is limited by the slider drag force, along with the lead screw drag from an anti-backlash module (if used). In order to increase speed without violating accuracy, the "drag" forces may be reduced, but with a consequent decrease in load capacity.

BRACING

A selection of optional braces (BR) offers extra rigidity and crash protection for stages in vulnerable positions, as the slide elements are not designed to withstand pressure or twist. The cushioned "ears" on one side of the slider will begin to yield, then the brace will engage before damage takes place. Braces add some weight and must be counted as load.

MULTI-AXIS VERSATILITY

All similar series (MM-3) manual and motor stages and some dissimilar (MM-, MM-1) series are compatible for quick, multi-axis connection using standard English screws.

ENGLISH - METRIC

All MM- stages possess full compatibility with English and Metric threaded fasteners.



Anti-Backlash Option for MM3M-EX and -F Stages

Date: April 22, 2000 From: George E. Mauro

SUBJECT: Anti-Backlash (A-B) Nut Introduction Flyer

The AB version is not limited to anti-backlash, but <u>contains features which may be equally or more</u> <u>important</u>.

The following seven features are extremely significant:

- •**Reduces backlash** from standard 25-50 micrometers to 2-4 micrometers.
- •**Reservoir of lubrication** for even distribution and long retention.
- •Perfect thread engagement for uniform wear and wear-in.
- •Highest possible linearity; true to lead screw thread accuracy (50µ-inch).
- •**Uniform radial pressure** to eliminate tight spots that may cause servo interference.
- •Self-centering; no lateral stresses to slider resulting from normal lead screw straightness error.
- •Wiper action keeps threads clean and clear of dust and particles.

Regular stages cannot be upgraded to AB versionPrice: \$150 for optionDelivery: 4-6 weeks



National Aperture, Inc.• 16 Northwestern Dr. • Salem, N.H. 03079-4810 Tel. (800) 360-4598 • (603) 893-7393 • FAX (603) 893-7857 • www.nationalaperture.com/www.naimotion.com