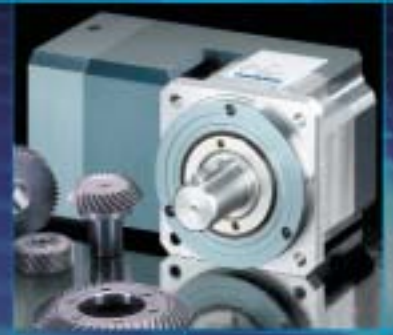




▶ Servo Motors & Drives



▶ Gearmotors & Gearheads



▶ Linear & Rotary Positioning Stages



Ultra Series Product Manual

BAYSIDE
Motion Group
PRECISION IN MOTION



Ultra Series

Product Manual

Rev: 1 / 904

Please check www.baysidemotion.com for latest revisions.

Product Manual

Ultra Series

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1. Introduction

Thank you for your purchase of the Ultra Series of precision linear stages. The Ultra is a high precision stage designed to meet the most demanding of applications. This manual provides installation and maintenance information for the:

Screw Driven Series

Linear Motor Driven Series

If there are any questions regarding the set up of your product, please feel free to contact Bayside Motion Group, Technical Services at (516) 484-5353 for additional support

2. Packaging

The stage is packaged in a wooden crate/carton with high density foam padding to avoid any damage during transportation. The assembly is wrapped in plastic to maintain cleanliness and should be handled with appropriate care.

Uncrating

All appropriate stage documentation (including this manual) will be found on top of the stage. The stage can be easily lifted out of the crate and placed on a secure surface.

Unlocking

Some models may arrive with a locking bracket that restrains the slide plate from moving during transportation. All locking brackets will be identified with an orange tag, and must be removed before operating the stage.

3. Specifications

3.1 General

All Ultra Stages feature a compact, low profile, totally enclosed aluminum alloy construction for high strength in a light weight package. The stages are rugged enough for the toughest requirements, yet accurate enough for precise applications. Ultra stages provide state-of-the-art performance and efficiency at an exceptional value.

Ultra Screw Driven Series

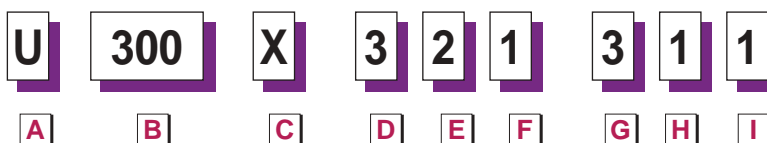
Traditional Ultra Stages are provided with either a ball screw or lead screw mounted alongside the stage. This stage configuration allows easy mounting of any step or servo motor with a flexible coupling. The ball screw version provides high speed and high force for dynamic move-and-settle applications. The lead screw version provides exceptional smoothness for slow speed scanning. Both the lead screw and ball screw models are available with linear encoders, providing high positional accuracy and repeatability.

Ultra Linear Motor Driven Series

Linear Motor Ultra Stages can achieve sub-micron accuracy with position repeatability of ± 1 encoder count. Featuring Bayside's patented AutoFlex Preload, Linear Motor Ultra Stages provide exceptional smoothness of motion for constant velocity requirements in scanning applications. The AutoFlex preload provides a unique thermal compensation method, eliminating any effects of expansion / contraction on bearing performance. The brushless linear motor is mounted inverted, with the ironless coil attached to the stationary base, eliminating moving wires.

3.2 Catalog Configuration Number

Ordering
Numbering
Example:



A	STAGE SERIES	
	U	Ultra Series

B	METRIC WIDTH OF STAGE	
	200	200 mm
	300	300 mm
	400	400 mm
	600	600 mm

C	FRAME				
		U200	U300	U400	U600
	X	Closed	Closed	Closed	Closed
	H	—	Open	Open	Open

D	TRAVEL				
		U200	U300	U400	U600
	1	100 mm	—	—	—
	2	200 mm	200 mm	—	—
	3	300 mm	300 mm	300 mm	—
	4	400 mm	400 mm	400 mm	—
	5	—	500 mm	500 mm	500 mm

E	DRIVE TYPE	
	Lead Screw	Lead
	1	0.1 in
	2	0.2 in
	3	1 mm
	Ball Screw	
	4	3 mm
	5	5 mm
	6	10 mm
	Linear Motor	
	7	Linear Motor Drive

F	LIMITS (1)	
	1	None
	2	End of Travel
	3	End of Travel and Home

G	LINEAR ENCODER (1)	
	1	None
	2	0.1 μm
	3	0.5 μm
	4	1.0 μm
	5	5.0 μm

H	MOTOR MOUNTING	
	1	None
	2	NEMA 23
	3	BM60

I	ROLLER CONF. / ENVIRONMENT	
	1	None (Standard)
	2	PACT
	3	Hollow Roller
	4	Hollow Rollers with PACT
	5	Clean Room (Class 10,000)
	6	Clean Room (Class 10,000) with PACT
	7	Clean Room (Class 10,000) Hollow Roller
	8	Clean Room (Class 10,000) Hollow Roller with PACT
	9	Vacuum (No Finish)
A	Vacuum (No Finish) Hollow Roller	

NOTES:

(1) End-of-Travel and Home Limits integral to linear encoder will be provided, when a linear encoder is selected.

Specifications are subject to change without notice.

How to Order

Ultra Stages are supported by a worldwide network of offices and local distributors. Call **1-800-305-4555** for application engineering assistance or for the name of your local distributor. Information can also be obtained at www.baysidemotion.com.

3.3 Electrical Specifications

3.3.1 Limits (Screw Driven Series)

Two end of travel limits and home switch can be ordered with all Ultra stages. These are optical type switches. (For Linear Motor Driven home & index switch see 3.3.3 Linear Encoder). These switches have the following characteristics:

Supply Power	5-24VDC at 100mA max
Transistor Type	NPN (Current Sinking)
Operation Mode	Normally Closed

3.3.2 Linear Encoder

A linear encoder can be ordered with any Ultra product (standard on the Linear Motor Driven Series). The encoder is a incremental non-contact optical design. It uses a reflective tape scale scanned by a moving read head to produce a digital square wave output. The encoder has been designed to fit inside the stage to protect it from possible damage and give the best possible accuracy results. When a linear encoder option is ordered it automatically comes with limits and a ref mark. The ref mark can be used as a very accurate and repeatable index location. The index pulse can be read from the encoder Z channel (see Section 4 Cabling & Wiring for pin location). The reference mark is always placed near the end of travel limit closest to the stage's connectors. The encoder can be ordered in a range of resolutions (see 3.2 Catalog Configuration for more info) and all have the following characteristics:

Supply Power	5VDC +/- 5% at 150mA max
Output Signal	Square wave differential line driver.
Limit Marks	Hall effect type non adjustable
Reference Mark	Hall effect type synchronized to encoder. Length of engagement equal to resolution of encoder.

Additionally stage velocity and the motion controller/amplifier must be considered when choosing an encoder resolution. Please observe the following chart to ensure proper operation:

Resolution (um)	Maximum speed (m/s)	Minimum recommended controller clock frequency (MHz)
5	10	(Encoder velocity (m/s) / resolution (um)) x 4
1	5	
0.5	3	
0.1	0.7	40

3.3.3 Linear Motor

The linear motor supplied with the Ultra stage is an ironless type that provides smooth cog free motion ideal for scanning and precise positioning applications. The linear motor comes complete with Hall effect sensors for commutation. The linear motor specifications can be found in section 3.4 Performance Specifications

Please observe the following chart for proper Motor/Signal timing. Note that positive travel is in the direction away from the power/signal connector side of the stage.

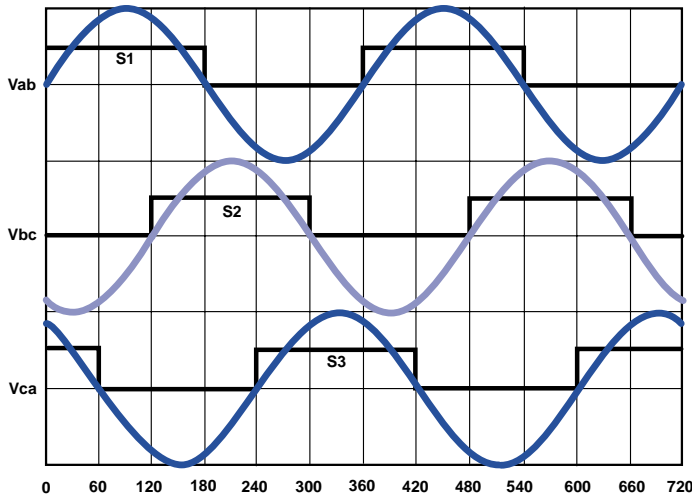
WIRING & OUTPUT

Motor Wire Table <small>SEE TABLE BELOW FOR AWG DIA</small>			Hall Effect Wire Table <small>26 AWG 6.0 DIA (.24")</small>			Thermal Protection Wire Table <small>Thermistor 22 AWG 3.8 (.15")</small>		
Pin Number	Color or Wire No.	Function	Pin Number	Color	Function	Pin	Color	Transition Point
1	Red	∅A	1	Gray	+15 Vdc	1	Black / White	120°C
2	White	∅B	2	Green	S1	2	Black / White	120°C
3	Black	∅C	3	Yellow	S2			
Connector Shell	Grn/Yel	GND	4	Brown	S3		see note 2	
Connector Shell	Violet	Shield	5	White	Return			
			Shell	Shield	Shield			

note 1: Ground connection at shell: first make / last break

note 2: TIC-X extender cable is shielded

Motor Output and Signal Phasing



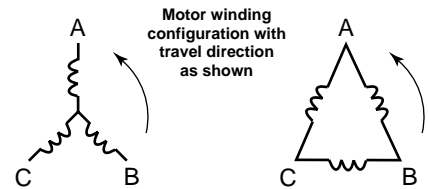
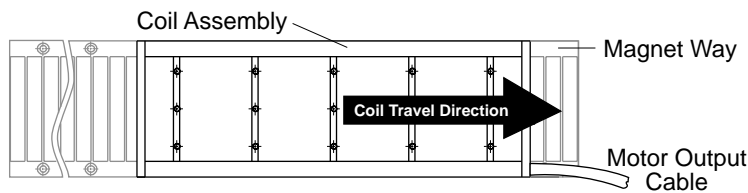
IL WIRE TABLE		
WINDING CODE	AWG	APPROX. CBL. DIA.
ALL (A1,A2,A3,A4)	18	5.6 (.22 IN)

IC WIRE TABLE NON-COOLED		
WINDING CODE	AWG	APPROX. CBL. DIA.
A1	18	5.6mm (.22 IN)
A2	18	5.8mm (.22 IN)
A3	14	8.9mm (.27 IN)
A5	18	5.8mm (.22 IN)
A6	14	6.9mm (.27 IN)
A7	12	7.9mm (.31 IN)

IC WIRE COOLED (AC)		
WINDING CODE	AWG	APPROX. CBL. DIA.
A1	18	5.6mm (.22 IN)
A2	14	8.9mm (.27 IN)
A3	12	7.9mm (.31 IN)
A5	14	8.9mm (.27 IN)
A6	12	7.9mm (.31 IN)
A7 (see note 3)	10	9.7mm (.38 IN)

note 3: (P*) connector not available

- Motor BEMF phases A,B,C relative to Hall effect devices S1,S2,S3 with coil travel direction towards the motor output cable assembly exit as shown below.

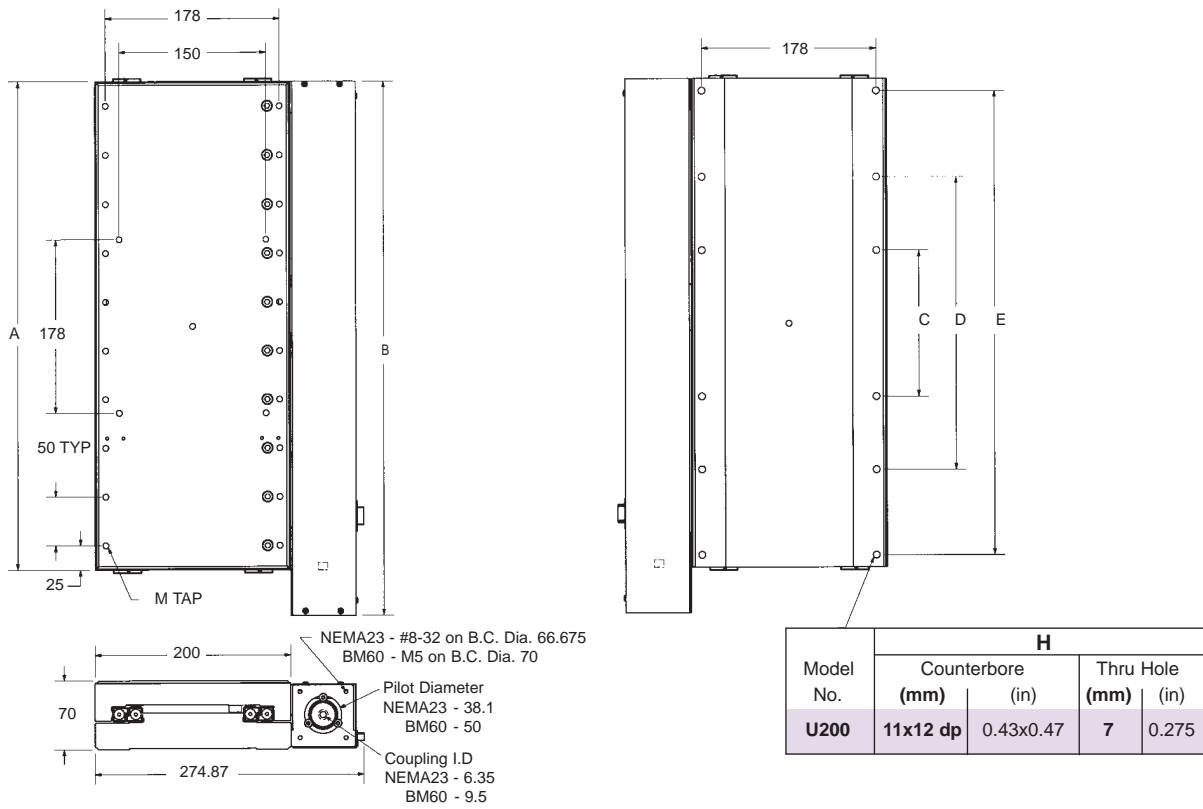


Magnet pole pitch:

Both Ironcore (IC) and Ironless (IL) feature the same pole pitch, which is 32 mm (360 electrical degrees).

The diagrams above refer to both ironless and ironcore motors.

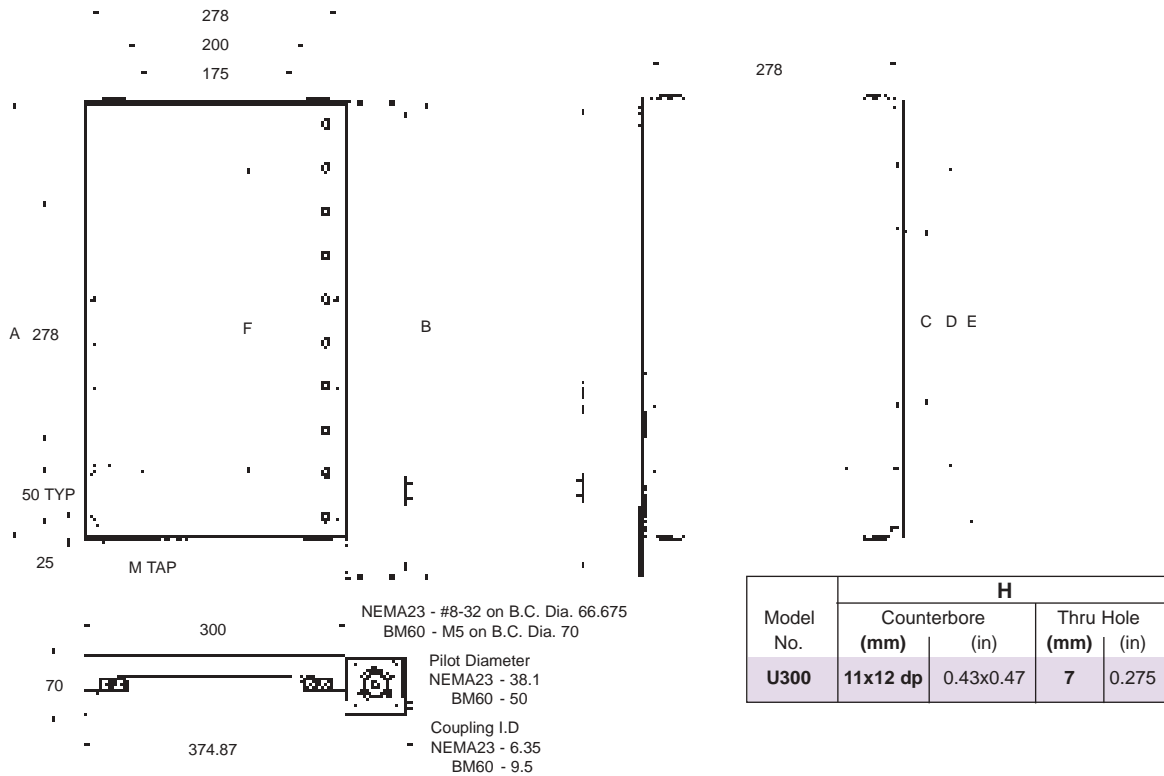
Dimensions



Model No.	Travel		A		B		C		D	
	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
U200-100	100	3.94	200	7.87	246	9.7	150	5.9	—	—
U200-200	200	7.87	300	12.25	346.5	13.64	150	5.9	—	—
U200-300	300	11.81	400	15.75	446.5	17.59	150	5.9	—	—
U200-400	400	15.75	500	19.69	546.5	21.52	150	5.9	300	12.25

Model No.	E		M Tap	Load Capacity		Stage Weight		Moving Slide Weight	
	(mm)	(in)		(kg)	(lb)	(kg)	(lb)	(kg)	(lb)
U200-100	—	—	M6 x 1	875	1,929	9.48	20.9	4.26	9.39
U200-200	275	10.83	M6 x 1	1,203	2,652	13.72	30.25	6.16	13.58
U200-300	375	14.76	M6 x 1	1,531	3,375	18.02	39.73	8.11	17.88
U200-400	475	18.7	M6 x 1	1,859	4,098	22.35	49.27	10.09	22.24

Dimensions

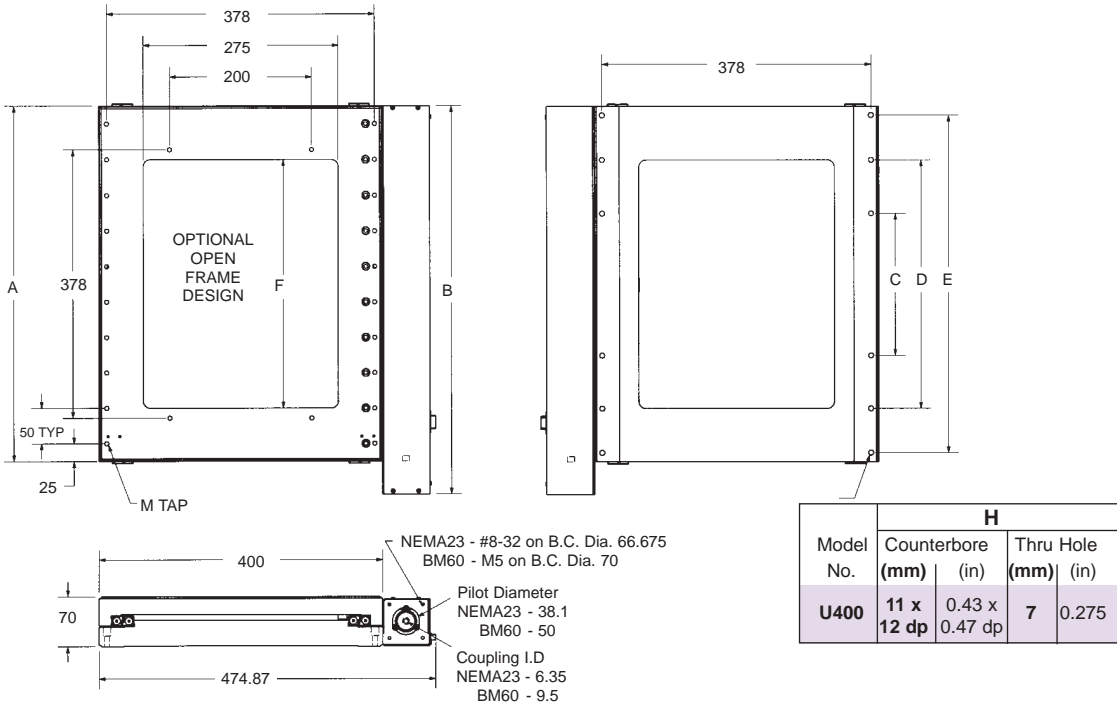


Model No.	Travel		A		B		C		D	
	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
U300-200	200	7.87	300	12.25	346.5	13.6	150	5.9	—	—
U300-300	300	12.25	400	15.75	446.5	17.6	150	5.9	200	7.87
U300-400	400	15.75	500	19.69	546.5	21.5	200	7.9	350	13.78
U300-500	500	19.69	600	23.62	646.5	25.5	200	7.9	400	15.75

Model No.	E		F		M Tap	Load Capacity	
	(mm)	(in)	(mm)	(in)		(kg)	(lb)
U300-200	275	10.83	150	5.9	M6 x 1	1,203	2,652
U300-300	375	14.76	250	9.84	M6 x 1	1,531	3,375
U300-400	475	18.7	350	13.78	M6 x 1	1,859	4,095
U300-500	575	22.64	450	17.72	M6 x 1	2,187	4,821

Model No.	Stage Weight				Moving Slide Weight			
	Open		Closed		Open		Closed	
	(kg)	(lb)	(kg)	(lb)	(kg)	(lb)	(kg)	(lb)
U300-200	9.59	21.1	19.21	42.35	4.27	9.41	8.4	18.5
U300-300	12.48	27.5	25.35	55.89	5.29	11.66	11.11	24.5
U300-400	15.41	33.9	31.46	69.36	6.93	15.28	13.81	30.4
U300-500	18.29	40.3	37.6	82.89	8.25	18.19	16.53	36.4

Dimensions

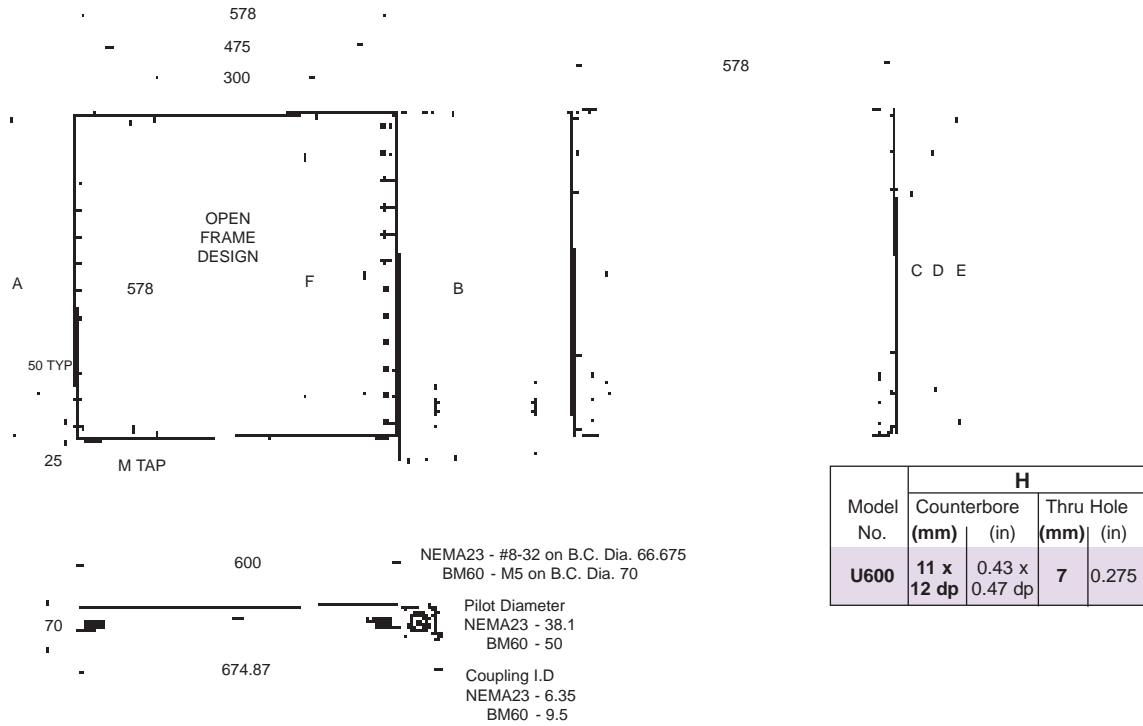


Model No.	Travel		A		B		C		D	
	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
U400-300	300	11.81	400	15.75	446.5	17.58	200	7.87	—	—
U400-400	400	15.75	500	19.69	546.5	21.52	200	7.87	350	13.78
U400-500	500	19.69	60	23.62	646.5	25.45	200	7.87	400	15.75

Model No.	E		F		M Tap	Load Capacity	
	(mm)	(in)	(mm)	(in)		(kg)	(lb)
U400-300	375	14.76	250	9.84	M6 x 1	1,531	3,375
U400-400	475	18.70	350	13.78	M6 x 1	1,859	4,098
U400-500	575	22.64	450	17.72	M6 x 1	2,187	4,822

Model No.	Stage Weight				Moving Slide Weight			
	Open		Closed		Open		Closed	
	(kg)	(lb)	(kg)	(lb)	(kg)	(lb)	(kg)	(lb)
U400-300	15.28	33.69	32.52	71.69	6.87	15.15	14.11	31.11
U400-400	18.90	40.34	40.50	88.29	8.53	18.81	17.60	38.80
U400-500	22.68	50.00	48.88	107.76	10.16	22.40	21.03	46.36

Dimensions



Model No.	Travel		A		B		C		D	
	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
U600-500	500	19.69	600	23.62	646.5	25.45	300	11.81	450	17.72

Model No.	E		F		M Tap	Load Capacity	
	(mm)	(in)	(mm)	(in)		(kg)	(lb)
U600-500	575	22.64	450	17.72	M6 x 1	2,187	4,822

Model No.	Stage Weight		Moving Slide Weight	
	(kg)	(lb)	(kg)	(lb)
U600-500	31.41	69.25	13.99	30.84

Performance and Accuracy Specifications⁽¹⁾

Model No.	Travel Range		Maximum Velocity ⁽¹⁾		Maximum Acceleration ^(1A)
	(mm)	(in)	(mm/sec)	(in/sec)	(g)
U200	100 to 400	3.94 to 15.75	1,500	59.1	2
U300	200 to 500	7.87 to 19.69	1,500	59.1	2
U400	300 to 500	11.81 to 19.69	1,500	59.1	2
U600	500	19.69	1,500	59.1	2

Model No.	Straightness / Flatness (microns/25mm)	Pitch & Yaw (arc sec/25mm)	Accuracy ⁽²⁾ (microns)	Repeatability ⁽²⁾ (microns)
U200	±1.25	±2.0	±2	± 0.5
U300	±1.25	±2.0	±2	± 0.5
U400	±1.25	±3.0	±2	± 0.5
U600	±1.25	±3.0	±2	± 0.5

Linear Motor Specifications

Specification	Symbol	Unit	Motors for U200-100 U200-200 U200-300	Motors for U200-400 All U300 Series	Motors for All U400 Series All U600 Series
Peak Force	F_p	N	120	240	400
		lb	27.0	54.0	90
Continuous Force	F_c	N	38	76	122
		lb	9	17	28
Motor Constant	K_m	N/\sqrt{W}	4.7	6.6	9.5
		lb/\sqrt{W}	1.05	1.48	2.14
Max Continuous Dissipation	P_c	W	65	131	167
Peak Current	I_p	amps RMS	7.1	7.1	7.0
Continuous Current	I_c	amps RMS	2.3	2.3	2.1
Resistance	R_{L-L}	ohms	6.1	12.2	17.2
Inductance	L_{L-L}	mH	1.3	2.6	6.0
Back EMF Constant	K_{EL-L}	$V_{peak}/mm/sec$	13.7	27.5	46.5
		$V_{peak}/in/sec$	0.35	0.70	1.18
Force Constant	K_f	N/amps	16.8	33.7	57
		lb/Arms	3.8	7.6	12.8

(1) Maximum velocity is based on motor size and encoder resolution.

(1A) Maximum acceleration is load and motor size dependent. Actual acceleration may vary.

(2) Accuracy is based on a stage mounted to a flat granite surface and measured at 25mm above the center of the stage. Varies based on encoder length. Repeatability is based on encoder resolution selected and above specification is for 0.1 μ resolution.

Travel

Model No.	Travel Maximum Range	
	(mm)	(in)
U200	100 to 400	3.94 to 15.75
U300	200 to 500	7.87 to 19.69
U400	300 to 500	11.81 to 19.69
U600	500	19.69

Velocity and Thrust

Model No.	Velocity				Maximum Thrust			
	Lead Screw ⁽¹⁾		Ball Screw ⁽²⁾		Lead Screw		Ball Screw	
	(mm / sec)	(in / sec)	(mm / sec)	(in / sec)	(kgf)	(lbf)	(kgf)	(lbf)
U200	100	3.94	300	11.81	11.3	24.9	90	198.4
U300	100	3.94	300	11.81	11.3	24.9	90	198.4
U400	100	3.94	300	11.81	11.3	24.9	90	198.4
U600	100	3.94	300	11.81	11.3	24.9	90	198.4

Accuracy Specifications

Model No.	Straightness/ Flatness		Pitch & Yaw (arc sec / 25mm)
	(microns / 25mm)	(in/in)	
U200	±1.25	±0.00005	±2.0
U300	±1.25	±0.00005	±2.0
U400	±1.25	±0.00005	±3.0
U600	±1.25	±0.00005	±3.0

Model No.	Accuracy ⁽³⁾		Repeatability ⁽⁴⁾	
	(microns / 25mm)	(in)	(microns)	(in)
U200	±2.5	0.0001	±2.0	0.00008
U300	±2.5	0.0001	±2.0	0.00008
U400	±2.5	0.0001	±2.0	0.00008
U600	±2.5	0.0001	±2.0	0.00008

(1) Based on 0.2in Ball Screw

(2) Based on 10mm Lead Screw

(3) Accuracy is based on a stage mounted to a flat granite surface and measured at 25mm above the center of the stage.

(4) Repeatability is based on encoder resolution selected and above specification is for 0.1μ resolution. Lead accuracy of ball screw (open loop without encoder) is ± 6 μm over travel range.

(5) Maximum and moment loads are based on bearing capacity. Loading will effect acceleration and velocity capability.

Specifications are subject to change without notice.

4.0 Cabling & Wiring

4.1 Motor Power Connection

The Ultra linear motor power and commutation connection is flying lead for flexibility to connect to any amplifier

4.2 Sensor Connection

Ultra screw driven stages come with a 9pin Sub D type connector for supplying power and receiving signals from the limit switches when ordered. If a linear encoder option is ordered then the limits connection will be on the linear encoder wire itself.

5.0 Installation

5.1 Home & Limit Adjustment

Home and limit switches for Ultra Stages ordered with linear encoders are non-adjustable. Screw driven series with limits and home are adjustable.

In order to adjust the home and limit switches follow these steps:

1. Remove the side cover
2. Underneath the cover on the side of the base plate are the three limits sensors set on rails. This controls the location of the end of travel limits and home switch. Loosen the appropriate screw and slide the switch forward or backward to adjust the limit location
3. Replace the side cover.

6.0 Maintenance & Lubrication

The only periodic maintenance required is cleaning of the bearings and lubrication of the ball screws. As the frequency of lubrication varies based on the specific application, parameters, and environmental conditions, it is recommended that each axis be analyzed and lubricated after the first 50,000 meters of travel. Based on this evaluation, future lubrication frequency should be developed. It is expected, that a three to six month lubrication frequency will be adequate to assure reliable service life of the bearing and ball screw structure.

6.1 Lubrication Type

For Ball Screw Driven Stages

Lithium soap based grease #2 or equivalent

Acceptable products:

Nye Lubricants: Rheolube 716B

Kluber Lubrication: Isoflex NBU 15

For Lead Screw Driven Stages

PAO based grease #1 or equivalent

Acceptable products:

Nye Lubricants: Nyogel 744

For Cross Roller Rails

Petroleum based lubricant

Acceptable products:

CRC 3-36

6.2 Re-Lubrication Procedure

Lead / Ball screw

1. Remove the side cover of the stage
2. Wipe down the lead / ball screw with a clean lint free cloth.
3. Liberally apply grease to lead / ball screw.
4. Operate the stage at low speeds to allow the grease to work into the lead / ball screw nut.
5. Repeat steps 2 & 3 several times to make sure grease is worked into the component
6. Clean excess grease from lead / ball screw using a clean lint free cloth.
7. Install side cover.

Note: take care not to get grease onto the linear encoder read head or tape scale (if ordered). If the tape scale does become contaminated with grease, clean using a cloth with isopropal alcohol.

Cross Roller Rails

Cross roller rails are extremely low friction devices and require very little lubrication. It is more important to keep them free of dust and debris. During regular maintenance periods travel the stage to its limits and wipe down the exposed rails with a clean lint free cloth. If the environment is humid or the application is very demanding a small amount of lubricant (see above) can be spray on rails.

Note: take care not to get grease onto the linear encoder read head or tape scale (if ordered) or magnet