Detailed Specifications

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

Last Revised: 2010-11-12 09:07:44.0

Stepper Motors and Encoders

Overview

National Instruments offers a complete stepper motion control solution – including stepper motors, drives, controllers, and software – that is easy to se
motors available from NI offer high torque, precision, and easy connectivity to stepper motor drives. Due to their ease of use, simplified control needs
feedback requirements, stepper motors are an excellent solution for applications such as machine control, manufacturing test, semiconductor positior
automation.

Application and Technology

Stepper Motors

- NEMA 17, 23, and 34 frame sizes
- Up to 1710 oz-in. (12.1 N · m) holding torque
- 3000 rpm max speed
- 1.8 deg step angle
- Matched with P7000 drives for high performance

Encoders

- 1000 counts/revolution resolution
- NEMA 23 and 34 motor compatibility
- Low profile 1 in. (25.4 mm) height design and easy mounting
- Industrial construction

Hardware

Stepper motors provide very precise, extremely cost-effective motion control. The 2-phase motors inherently move in small, precise, 1.8 degree incre
brushless and maintenancefree. Stepping action is simple to control and does not require complicated, expensive feedback devices. National Instrum
the motors for applications where position verification is required. Stepper motors are available from NI in three different National Electrical Manufactu
and with either a single or a dual shaft. The motors provide optimum performance and easy connectivity when matched with the P7000 series stepper

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deploym
CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your syste
one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and
to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled.
standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenan
documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibratio
advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. NI offers a nu
maintain the ongoing accuracy of your measurement hardware. These services allow you to be completely confident in your measurements, and help
like ISO 9001, ANSI/NCSL Z540-1 and ISO/IEC 17025. To learn more about NI calibration services or to locate a qualified service center near you, c
ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

Support - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers wh
around the world and speak the local language.

Discussion Forums - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.

Online Community - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services
technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardw
efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

Classroom training in cities worldwide - the most comprehensive hands-on training taught by engineers.

On-site training at your facility - an excellent option to train multiple employees at the same time.

Online instructor-led training - lower-cost, remote training if classroom or on-site courses are not possible.

Course kits - lowest-cost, self-paced training that you can use as reference guides.

Training memberships and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands
the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing
ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Pa
independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Detailed Specifications

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NEMA 17 Motor

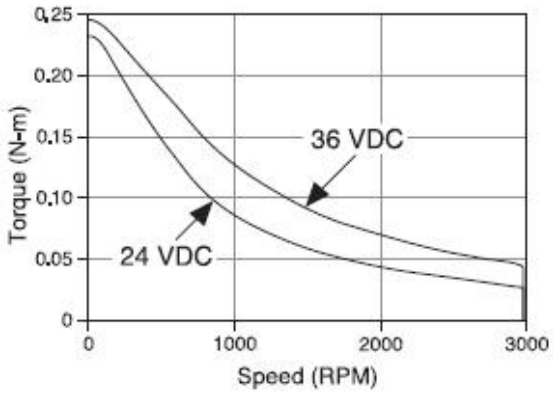
Electrical	
Step angle	1.8 deg
Steps per revolution	200
Angular accuracy	±3%
Phases	2
Industry Standards	
Industrial standards	CE, UR
Sealing standards	IP40
RoHS Compliance	Yes
Physical	
Operating temperature	-20 to 40 °C
Shaft load (20,000 hours at 1,500 rpm)	
Radial	15 lb (6.8 kg) at shaft center
Axial push	6 lb (2.7 kg)
Axial pull	15 lb (6.8 kg)
Recommended heat sink size	10 x 10 x 1/4 in. aluminum plate

					Holding	**Rotor Inertia**	**Phase**	**Phase**	

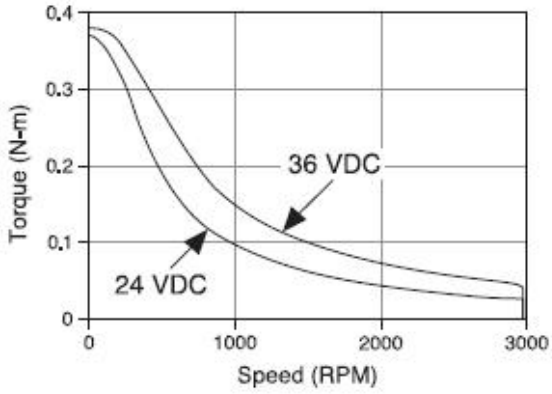
NI Part Number	Manufacturer Part Number	Dual Shaft	Drive	Amps/Phase	Torque oz-in. (N . m)	oz-in.-s^2 (kg-m^2 x 10^{-3})	Inductance mH	Resistance Ω ±10%	Detent Torque oz-in. (N . m)
780067-01	CTP10ELF10MAA00	no	P70530	1.0	43 (0.30)	0.0005 (0.0040)	7.7	5.25	1.98 (0.014)
780068-01	CTP10ELF10MMA00	yes							
780069-01	CTP11ELF11MAA00	no		1.1	63 (0.44)	0.0008 (0.0050)	11	5.19	2.55 (0.018)
780070-01	CTP11ELF11MMA00	yes							
780071-01	CTP12ELF10MAA00	no		1.0	80 (0.56)	0.0011 (0.0070)	12	6.51	2.97 (0.021)
780072-01	CTP12ELF11MAA0	yes							

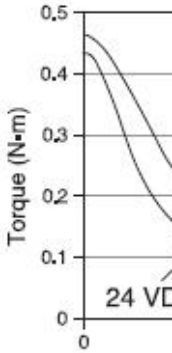
Torque versus Speed

780067-01 and 780068-01
Torque versus Speed at 1.0 A

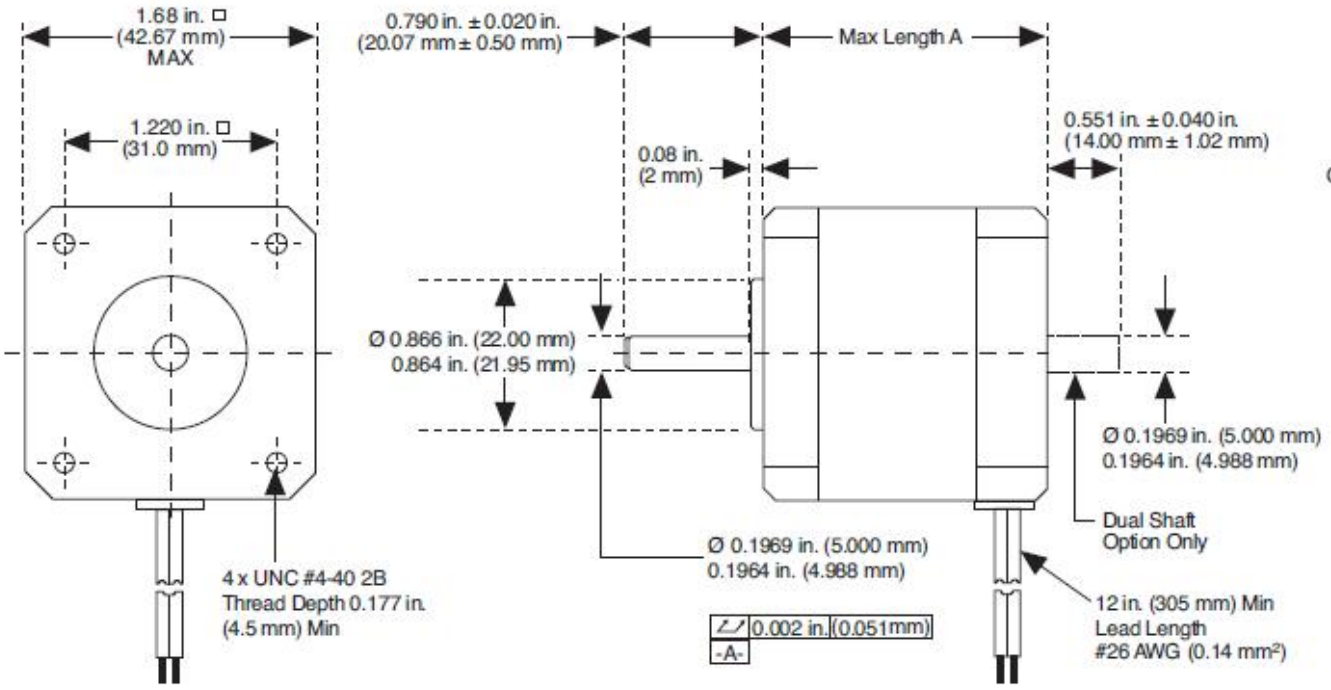


780069-01 and 780070-01
Torque versus Speed at 1.1 A





Dimensions and Wiring



NI Part Number	Manufacturer Part Number	Dual Shaft	Max Length A in. (mm)	Net Weight lb (kg)
780067-01	CTP10ELF10MAA00	no	1.37 (34.7)	0.441 (0.200)
780068-01	CTP10ELF10MMA00	yes		
780069-01	CTP11ELF11MAA00	no	1.61 (40.9)	0.573 (0.260)
780070-01	CTP11ELF11MMA00	yes		
780071-01	CTP12ELF10MAA00	no	1.92 (48.8)	0.750 (0.340)
780072-01	CTP12ELF11MAA0	yes		

NEMA 23 Motor

Back to Detailed Specs

Electrical

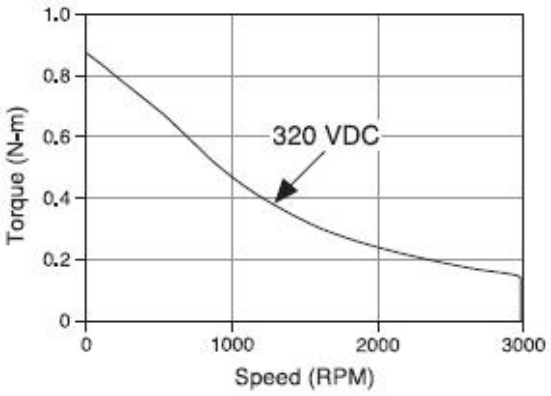
Step angle	1.8 deg
Steps per revolution	200

Angular accuracy	±3%
Phases	2
Industry Standards	
Industrial standards	CE, cUR, UR
RoHS Compliance	Yes
Physical	
Operating temperature	-20 to 40 °C
Rated ambient temperature	40 °C
Shaft load (20,000 hours at 1,500 rpm)	
Radial	20 lb (9.1 kg) at shaft center
Axial push	6 lb (2.7 kg)
Axial pull	50 lb (22.7 kg)
Recommended heat sink size	10 x 10 x 1/4 in. aluminum plate
Recommended encoder	780251-01

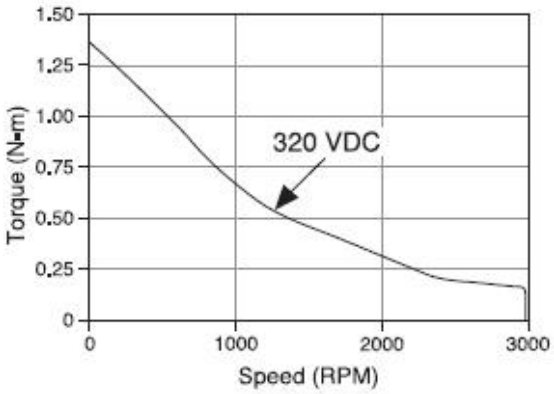
NI Part Number	Manufacturer Part Number	Dual Shaft	Drive	Amps/Phase	Holding Torque oz-in. (N . m)	Rotor Inertia oz-in.-s^2 (kg-m^2 x10^{-3})	Phase Inductance mH	Phase Resistance Ω ±10%	Detent Torque oz-in. (N . m)	R
780073-01	T21NRLC-LNN-NS-00	no	P70360	0.40	180 (1.27)	0.0034 (0.0248)	209	42.9	2.97 (0.021)	
780074-01	T21NRLC-LDN-NS-00	yes								
780075-01	T22NRLC-LNN-NS-00	no		0.46	280 (1.98)	0.0056 (0.0408)	209	41.4	5.95 (0.042)	
780076-01	T22NRLC-LDN-NS-00	yes								
780077-01	T23NRLC-LNN-NS-00	no		0.67	380 (2.68)	0.0084 (0.0612)	136	23.5	6.94 (0.049)	
780078-01	T23NRLC-LDN-NS-00	yes								
780079-01	T21NRLH-LNN-NS-00	no	P70530	2.7	180 (1.27)	0.0034 (0.0248)	4.6	0.85	2.97 (0.021)	
780080-01	T21NRLH-LDN-NS-00	yes								
780081-01	T22NRLG-LNN-NS-00	no		2.5	280 (1.98)	0.0056 (0.0408)	7.1	1.23	5.95 (0.042)	
780082-01	T22NRLG-LDN-NS-00	yes								
780083-01	T23NRLH-LNN-NS-00	no		3.0	380 (2.68)	0.0034 (0.0248)	6.2	1.00	6.94 (0.049)	
780084-01	T23NRLH-LDN-NS-00	yes								

Torque versus Speed

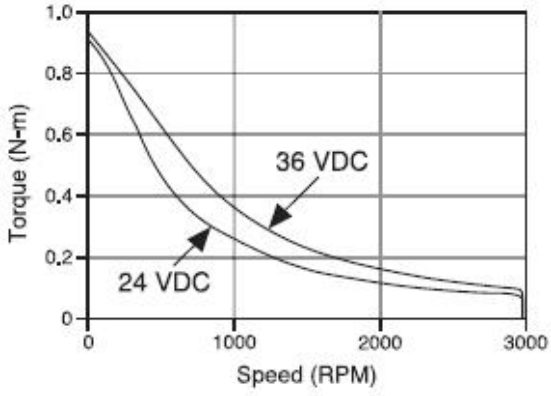
780073-01 and 780074-01
Torque versus Speed at 0.36 A



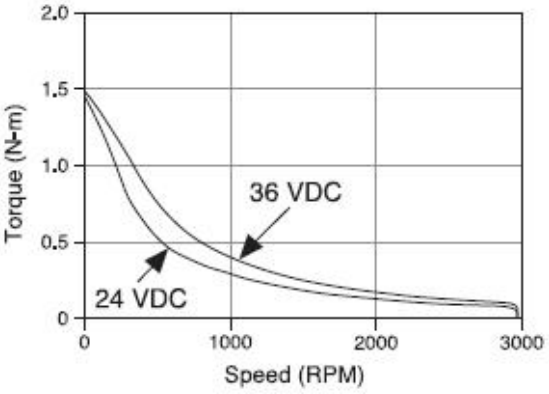
780075-01 and 780076-01
Torque versus Speed at 0.40 A



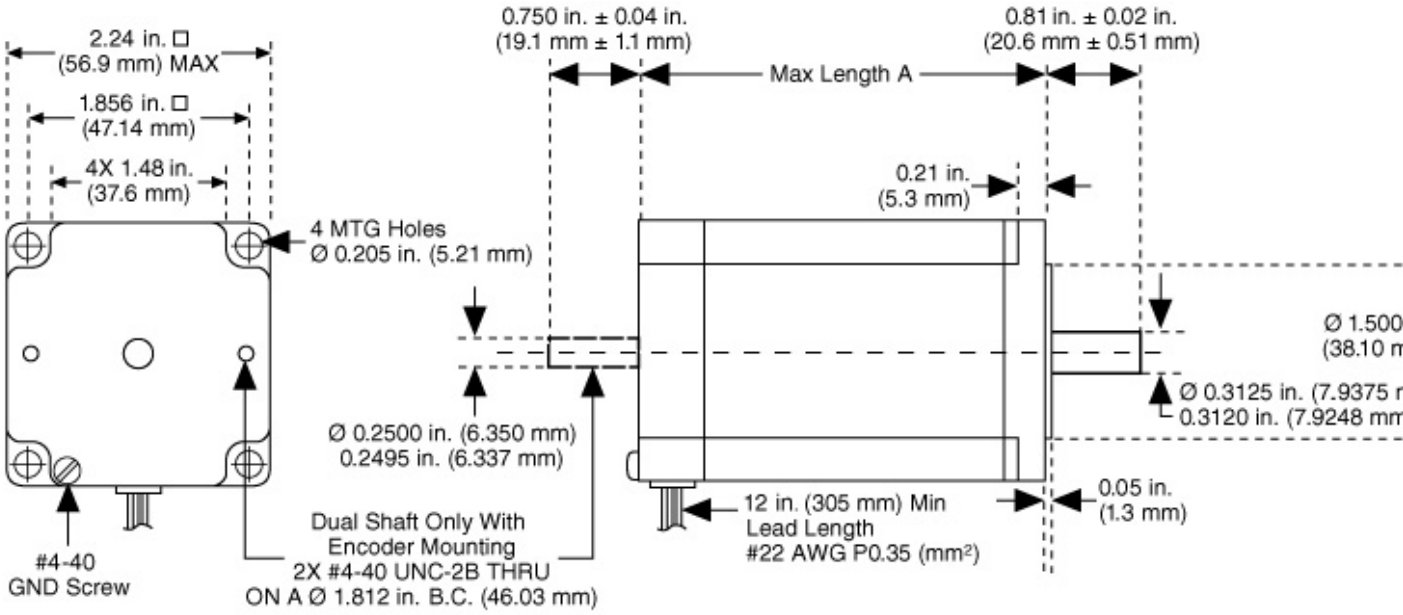
780079-01 and 780080-01
Torque versus Speed at 2.7 A



780081-01 and 780082-01
Torque versus Speed at 2.5 A



Dimensions and Wiring



NI Part Number	Manufacturer Part Number	Dual Shaft	Max Length A in. (mm)	Net Weight lb (kg)
780073-01	T21NRLC-LNN-NS-00	no	2.21 (56.1)	1.6 (0.7)
780074-01	T21NRLC-LDN-NS-00	yes		
780075-01	T22NRLC-LNN-NS-00	no	3.06 (77.7)	2.3 (1.0)
780076-01	T22NRLC-LDN-NS-00	yes		
780077-01	T23NRLC-LNN-NS-00	no	4.06 (103.1)	3.2 (1.5)
780078-01	T23NRLC-LDN-NS-00	yes		
780079-01	T21NRLH-LNN-NS-00	no		

780080-01	T21NRLH-LDN-NS-00	yes	2.21 (56.1)	1.6 (0.7)
780081-01	T22NRLG-LNN-NS-00	no	3.06 (77.7)	2.3 (1.0)
780082-01	T22NRLG-LDN-NS00	yes		
780083-01	T23NRLH-LNN-NS00	no	4.06 (103.1)	3.2 (1.5)
780084-01	T23NRLH-LDN-NS00	yes		

NEMA 34 Motor

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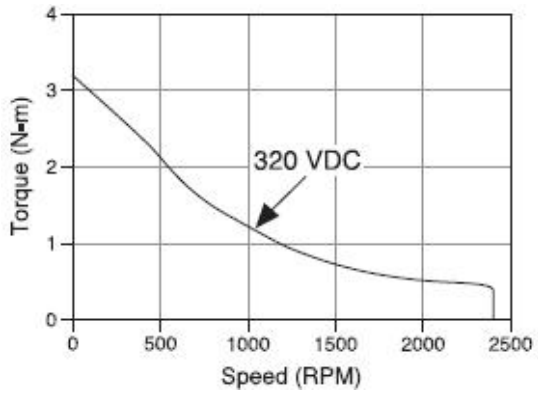
Electrical	
Step angle	1.8 deg
Steps per revolution	200
Angular accuracy	±3%
Phases	2
Industry Standards	
Industrial standards	CE, cUR, UR
RoHS Compliance	Yes
Physical	
Operating temperature	-20 to 40 °C
Rated ambient temperature	40 °C
Shaft load (20,000 hours at 1,500 rpm)	
Radial	
N31, N32	65 lb (29.5 kg)
N33	110 lb (49.9 kg)
Axial	
N31, N32, N33	305 lb (138.3 kg)
Recommended heat sink size	10 x 10 x 1/4 in. aluminum plate
Recommended encoder	780252-01

						Rotor Inertia			

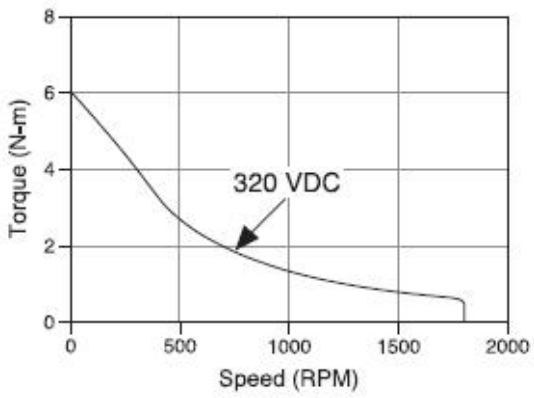
NI Part Number	Manufacturer Part Number	Dual Shaft	Drive	Amps/Phase	Holding Torque oz-in. (N . m)	oz-in.-s^2 (kg-m^2 x 10^{-3})	Phase Inductance mH	Phase Resistance Ω ±10%	Detent Torque oz-in. (N . m)
780085-01	N31HRLG-LNK-NS-00	no	P70360	0.86	641 (4.52)	0.0202 (0.1430)	138	16.2	18.0 (0.127)
780086-01	N31HRLG-LEK-M2-00	yes							
780087-01	N32HRLG-LNK-NS-0	no		0.95	1240 (8.76)	0.0380 (0.2680)	206	17.6	36.0 (0.254)
780088-01	N32HRLG-LEK-M2-00	yes							
780089-01	N33HRLG-LNK-NS-0	no		1.24	1710 (12.08)	0.0567 (0.4000)	144	13.0	54.0 (0.381)
780090-01	N33HRLG-LEK-M2-00	yes							
780091-01	N31HRHJ-LNK-NS-0	no	P70530	5.5	645 (4.55)	0.0202 (0.1430)	3.5	0.42	18.0 (0.127)
780092-01	N31HRHJ-LEK-M2-0	yes							
780093-01	N32HRHJ-LNK-NS-0	no		5.1	1195 (8.43)	0.0380 (0.2700)	6.5	0.63	36.0 (0.254)
780094-01	N32HRHJ-LEK-M2-0	yes							
780095-01	N33HRHJ-LNK-NS-0	no		5.0	1710 (12.07)	0.0567 (0.4000)	9.0	0.83	54.0 (0.381)
780096-01	N33HRHJ-LEK-M2-0	yes							

Torque versus Speed

780085-01 and 780086-01
Torque versus Speed at 0.81 A



780087-01 and 780088-01
Torque versus Speed at 0.88 A



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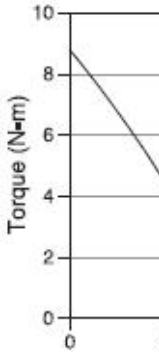

780091-01 and 780092-01

780093-01 and 780094-01

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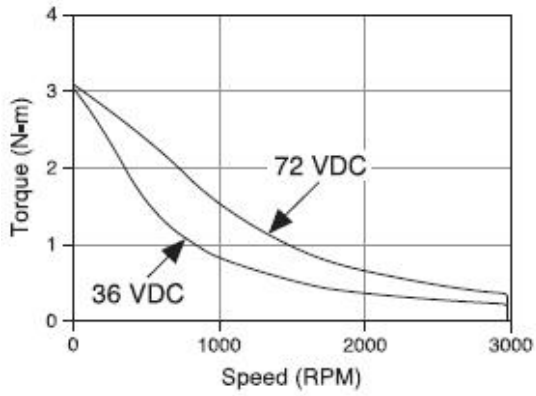
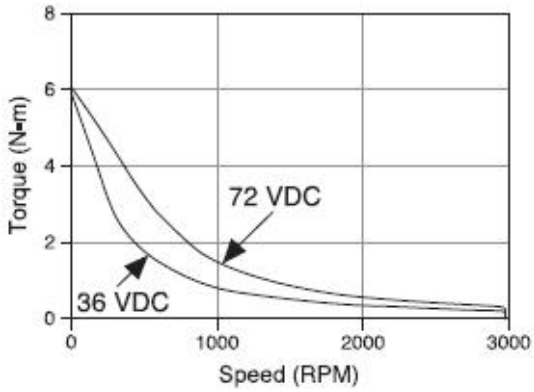
Torque versus Speed at 5 A



Torque versus Speed at 5 A



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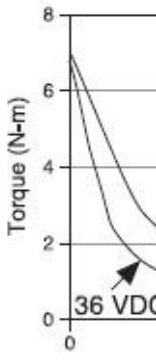
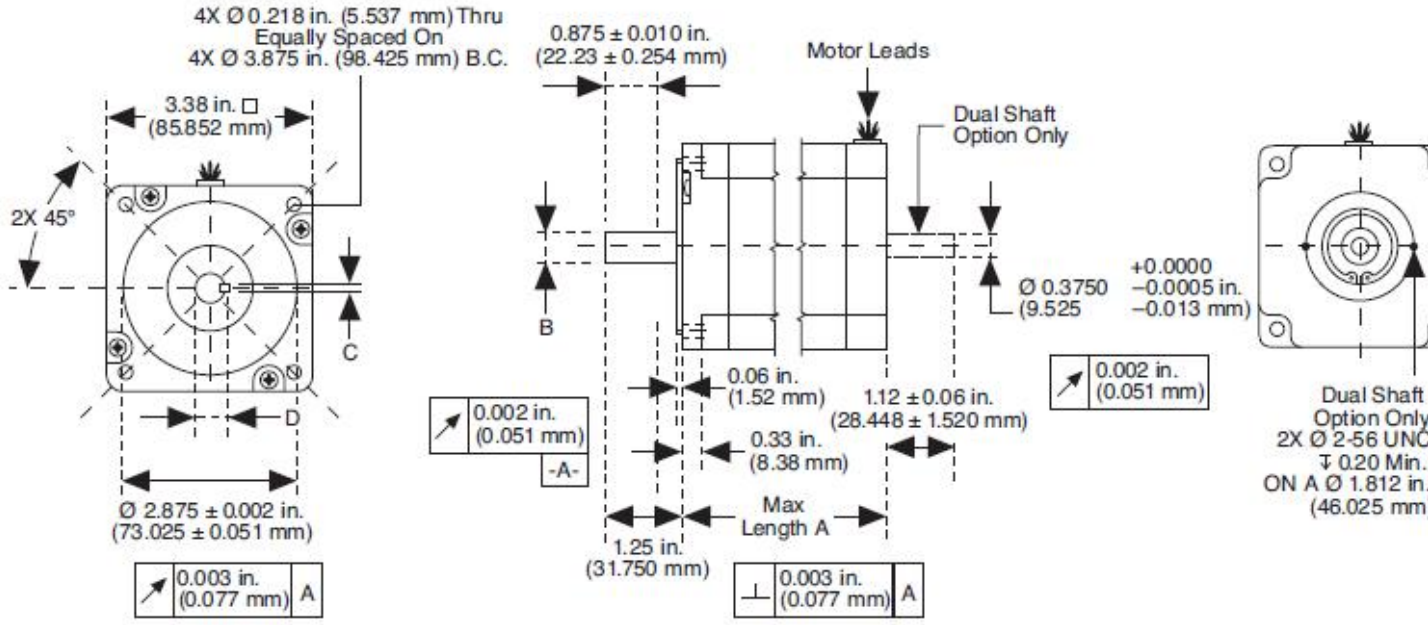


Dimensions and Wiring



Note: Motor leads are 12.0 in. (304.8 mm) minimum.

NI Part Number	Manufacturer Part Number	Dual Shaft	Max Length A in. (mm)	B max and min in. (mm)	C max and min in. (mm)
780085-01	N31HRLG-LNK-NS-00	no	3.13	0.5000 (12.700) 0.4995	0.1250 (3.175) 0.1230

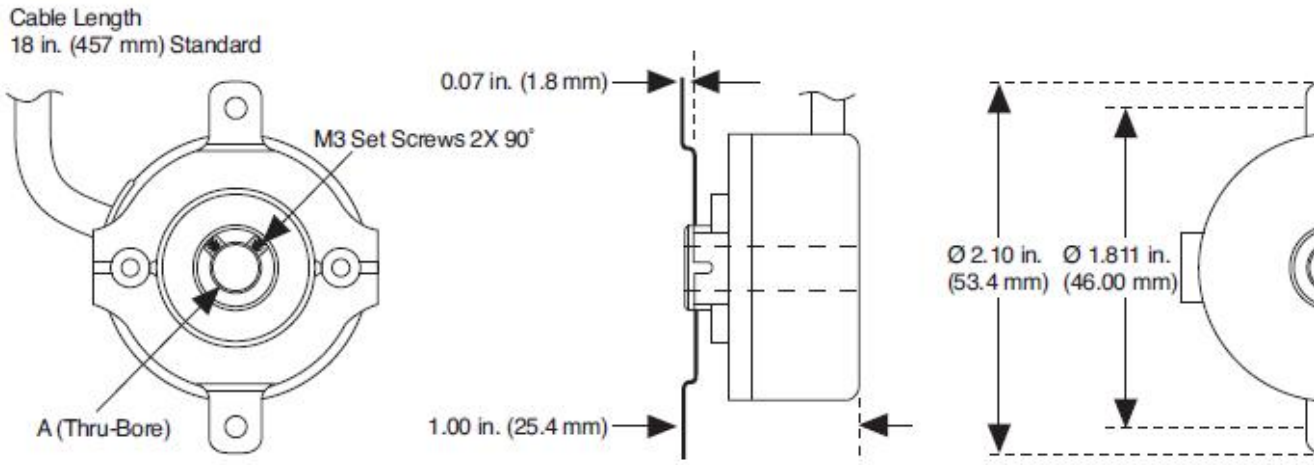
780086-01	N31HRLG-LEK-M2-00	yes	(79.502)	(12.687)	(3.124)	
780087-01	N32HRLG-LNK-NS-00	no	4.65	0.5000 (12.700) 0.4995	0.1250 (3.175) 0.1230	
780088-01	N32HRLG-LEK-M2-00	yes	(118.11)	(12.687)	(3.124)	
780089-01	N33HRLG-LNK-NS-00	no	6.13	0.6250 (15.875) 0.6245	0.1875 (4.763) 0.1855	
780090-01	N33HRLG-LEK-M2-00	yes	(155.70)	(15.862)	(4.712)	
780091-01	N31HRHJ-LNK-NS-00	no	3.13	0.5000 (12.700) 0.4995	0.1250 (3.175) 0.1230	
780092-01	N31HRHJ-LEK-M2-00	yes	(79.502)	(12.687)	(3.124)	
780093-01	N32HRHJ-LNK-NS-00	no	4.65	0.5000 (12.700) 0.4995	0.1250 (3.175) 0.1230	
780094-01	N32HRHJ-LEK-M2-00	yes	(118.11)	(12.687)	(3.124)	
780095-01	N33HRHJ-LNK-NS-00	no	6.13	0.6250 (15.875) 0.6245	0.1875 (4.763) 0.1855	
780096-01	N33HRHJ-LEK-M2-00	yes	(155.70)	(15.862)	(4.712)	

Encoders for NEMA 23 and NEMA 34 Motors

Electrical	
Resolution	1000 counts/revolution
Input voltage	5 V ±10%
Input current	100 mA max (65 mA typical) with no output
Channel configuration	Quadrature A, B, and Index
Output type	Differential line driver
Noise immunity	Tested to BS EN61000-6-2; BS EN50081-02 BS EN61000-4-6; BS EN500811
Symmetry	180 deg (±18 deg) electrical
Quadrature phasing	90 deg (±22.5 deg) electrical
Minimum edge separation	67.5 deg electrical
Accuracy	Within 0.017 deg mechanical or 1 arc-minu
Industry Standards	
Industrial standards	CE
Sealing standards	IP40
RoHS Compliance	Yes
Physical	
Operating temperature	-20 to 85 °C
Model type	Thru-bore
Bore size	1/4 in. (780251-01), 8 mm (780252-01)

Mounting	1.812 in. (46 mm) two-hole flex mount
Maximum frequency	200 kHz
Operating temperature	20 to 85 °C
Max shaft speed	8000 rpm
Bore tolerance	-0.0000 in./+0.0006 in.
User shaft tolerances	
Radial runout	0.008 in. max
Axial endplay	±0.030 in. max
Starting torque	0.300 oz-in. (0.212 N . m)
Moment of inertia	6.7 x 10^{-5} oz-in.-sec^2 (4.8 gm-cm^2)
Max acceleration	1 x 10^5 rad/sec^2
Weight	3 oz typical
Storage temperature	-25 to 85 °C
Humidity	98% RH noncondensing
Vibration	10 g @ 58 to 500 Hz
Shock	80 g @ 11 ms duration

Dimensions, Wiring and Timing Diagrams



Note: All dimensions have a tolerance of ±0.005 in. or ±0.01 in. unless otherwise specified.

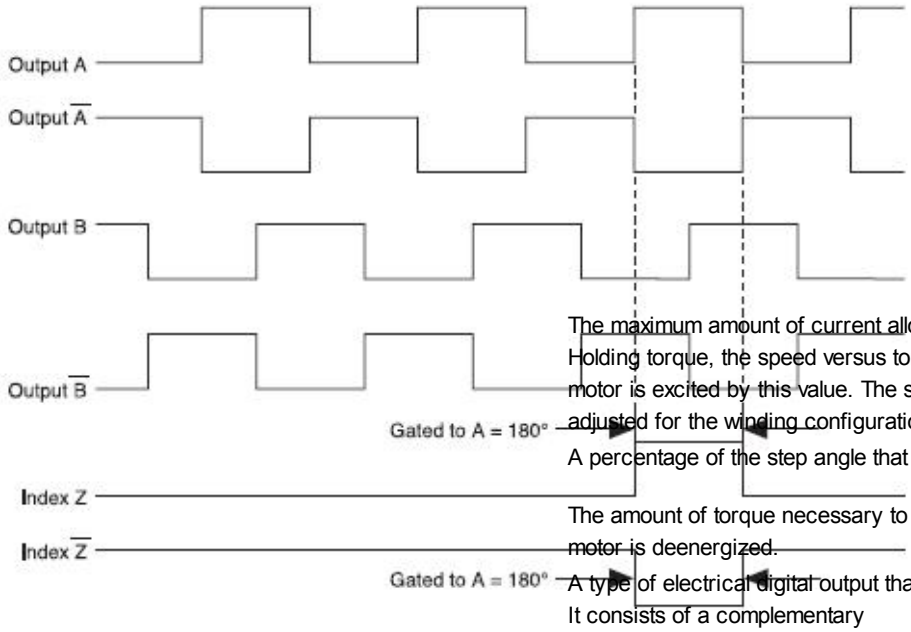
NI Part Number	Manufacturer Part Number	A (Thru-Bore Diameter)
780251-01	15T-01SA-1000-N5RHV-F00-CE	1/4 in., 0.250 in.
780252-02	15T-14SA-1000-N5RHV-F00-CE	8 mm

Wire Description

Pin #	Wire Color	Function
1	Brown	A
2	White	+VDC
3	Yellow	$\overline{A}$
4	Red	B
5	Green	$\overline{B}$
6	Orange	Z
7	Black	COM
8	Blue	$\overline{Z}$

Quadrature Waveform

Glossary



amps/phase	The maximum amount of current allowed thr Holding torque, the speed versus torque cur motor is excited by this value. The specifica adjusted for the winding configuration.
angular accuracy	A percentage of the step angle that defines
detent torque (cogging torque)	The amount of torque necessary to rotate th motor is deenergized.
differential line driver	A type of electrical digital output that can tra It consists of a complementary pair of digital lines.
electrical symmetry	How close each quadrature channel is to a constant speed.
holding torque	The amount of torque necessary to rotate th (microstepping turned off) when the motor is that motor.
minimum edge separation	Defines in degrees how close (electrically) a edge on channel B.
NEMA	National Electrical Manufacturers Associatio association that creates standards for moun defines its shaft size and mounting configur
phase inductance	The inductance of each phase of the steppe this data sheet are already adjusted for the winding configuration.
phases	A wound wire in the stepper motor that is ex electromagnetic force. Two or more phases positively energized, deenergized, and nega stepper motor.
quadrature phasing	The electrical phase shift between channels
step angle	The distance the motor rotates each full step 360 degrees divided by the steps per revolu

