MA4 Features

- 12-bit Analog or PWM output
- Miniature size (0.55 in. diameter)
- -40C to 125C operating temperature range
- Latching Connector
- Three shaft torque options

MA4 Miniature Absolute Encoder Product Description

The MA4 is a magnetic absolute encoder that reports the shaft position over 360° with no stops or gaps. This shafted encoder is available with an analog or a pulse width modulated (PWM) digital output. This is the new generation of the US Digital MA3 absolute encoder, magnetic.

RoHS COMPLIANT

Analog output provides a DC voltage that is proportional to the absolute shaft position with 12-bit resolution.

PWM output provides a pulse duty cycle that is proportional to the absolute shaft position. PWM output has 12-bit resolution with 2 different output frequency options.

Three shaft torque options are available:

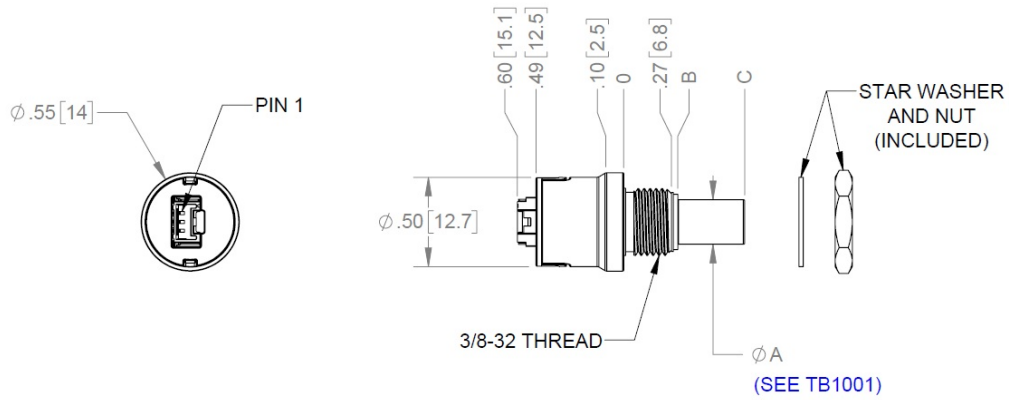
- Default (-D): sleeve bushing with higher damping for human interface applications.
- Ball bearing (-B): miniature precision ball bearings suitable for high-speed applications (1/8" diameter shaft only).
- Light static drag (-N): sleeve bushing with lower damping for low-speed applications.

The MA4 is connected using a 3-pin latching, 1.25mm pitch polarized connector.

Mechanical Drawings

MA4 Miniature Absolute Magnetic Shaft Encoder

RELEASE DATE: 12/19/2024



TORQUE	SHAFT ∅	∅A	∅A TOL	B	C
-D / -N OPTION	1/8" (.125)	.1248 [3.170]	+.0000 [0] -.0003 [-0.008]	.33 [8.3]	.68 [17.2]
	6mm (.236)	.2360 [5.994]	+.0000 [0] -.0003 [-0.008]	.33 [8.3]	.68 [17.2]
	1/4" (.250)	.2498 [6.345]	+.0000 [0] -.0004 [-0.010]	.30 [7.7]	.68 [17.2]
-B OPTION	1/8" (.125)	.1247 [3.167]	+.0000 [0] -.0003 [-0.008]	.31 [8]	.69 [17.5]

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UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

Specifications

ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature	-40 to +125	C
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G
Electrostatic Discharge, IEC 61000-4-2	± 4	kV

MECHANICAL

SPECIFICATION	SLEEVE BUSHING	BALL BEARING
Max. Shaft Speed (1) (mechanical)	100 RPM	15000 RPM
Max. Acceleration	10000 rad/sec²	250000 rad/sec²
Max. Shaft Torque	0.5 in-oz (D-option) 0.3 in-oz (N-option)	0.05 in-oz (B-option)
Max. Shaft Loading	2 lb. dynamic 20 lb. static	1 lb.
Bearing Life (2)	> 1000000 revolutions	$L_{10} = (28.3/F_r)^3$ Where L_{10} = bearing life in millions of revs, and F_r = radial shaft loading in pounds
Weight	0.42 oz.	0.31 oz.
Max. Shaft Runout	0.0015 in. T.I.R.	0.0015 in. T.I.R.

(1) The chip that decodes position uses sampled data. There will be fewer readings per revolution as the speed increases. The formula for number of readings per revolution is given by:

n = 400000 / rpm

(2) only valid with negligible axial shaft loading

MOUNTING

PARAMETER	VALUE	UNITS
Hole Diameter	0.375 +0.005 / -0.0	in.
Panel Thickness	0.125 max.	in.
Panel Nut Max. Torque	20.0	in-lbs

MATERIALS

COMPONENT	MATERIAL	TORQUE OPTION(S)
Shaft	Stainless Brass	Sleeve Bushing (-D and -N options) Ball Bearing (-B option only)
Bushing	Brass	-

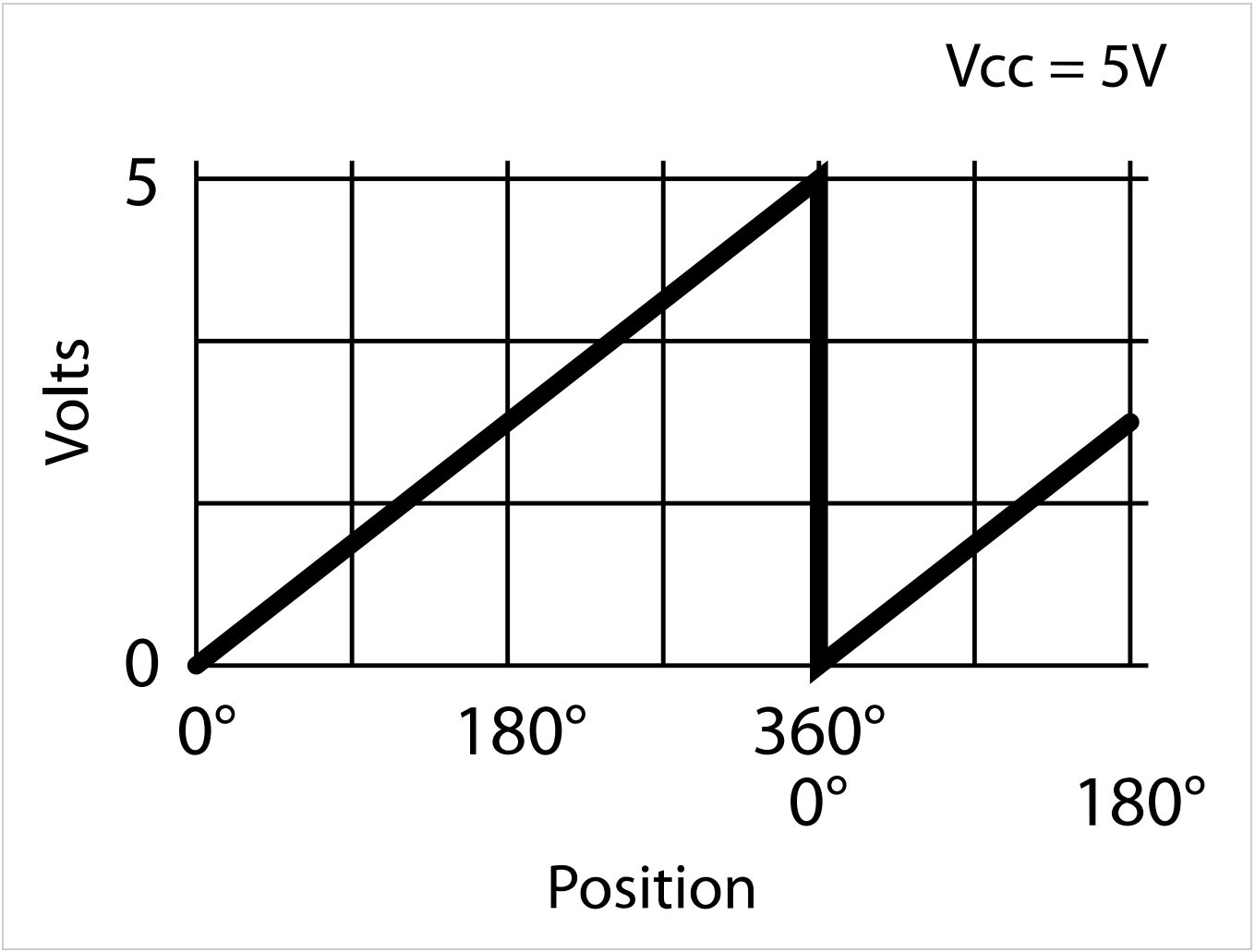
MAGNETIC FIELD CROSSTALK

The MA4 absolute encoder contains a small internal magnet that generates a weak magnetic field extending outside the housing of each encoder. If two MA4 units are mounted closer than 1 inch apart (shaft center to center distance), install a magnetic shield such as a thin steel plate between the two encoders. This prevents magnetic field cross-talk from causing small changes in the reported positions.

ELECTRICAL

PARAMETER	MIN.	TYP.	MAX.	UNITS
Power Supply	4.5	5.0	5.5	Volts
Supply Current		16	20	mA
Power-up Time			50	mS

ANALOG OUTPUT OPERATION



The analog output has 12-bit resolution. The analog output voltage is ratiometric to the power supply voltage, which is typically 5.0V

PARAMETER	MIN.	TYP.	MAX.	UNITS
Position Sampling Rate		6.667		kHz
Propagation Delay		286		µS
Output Noise (1-σ)		0.043		Deg. RMS
Max Output Voltage no load 5k load to GND 2k load to GND		 4.99 4.97 4.92		V
Min Output Voltage no load 5k load to Vcc 2k load to Vcc		 0.010 0.030 0.075		V
Capacitive Load			1000	pF

PWM OUTPUT OPERATION

The PWM duty cycle has 12-bit resolution. To measure the angular position accurately, calculate the position from the duty cycle (t_{on} / (t_{on} + t_{off})) instead of just measuring t_{on} . This will cancel out the effect of the PWM frequency tolerance.

PARAMETER	MIN.	TYP.	MAX.	UNITS
PWM Frequency -L option -H option	 218 874	 230 920	 242 966	Hz
PWM Duty Cycle	2.9		97.1	%
Position Sampling Rate		6.667		kHz
Propagation Delay		286		µS
Output Noise (1-σ)		0.043		Deg. RMS
Output High Voltage 10k load to GND 5k load to GND		 4.72 4.44		V
Output Low Voltage 10k load to Vcc 5k load to Vcc		 0.16 0.36		V
Capacitive Load		1000		pF

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PIN-OUTS

ANALOG OUTPUT (MA4-A):

PIN	NAME	DESCRIPTION
1	5	+5VDC power
2	A	Analog output
3	G	Ground

PWM OUTPUT (MA4-H, MA4-L):

PIN	NAME	DESCRIPTION
1	5	+5VDC power
2	P	PWM output
3	G	Ground

Notes

- Cables and connectors are not included and must be ordered separately.
- US Digital® warrants its products against defects in materials and workmanship for two years. See complete warranty *(https://www.usdigital.com/company/warranty)* for details.

Configuration Options

MA4	-	Output	-	Shaft Diameter	-	Torque
		A (*Analog*)		125 (*1/8"*)		D (*Default Torque*)
		L (*PWM Low*)		236 (*6mm*)		B (*Ball Bearing*)
		H (*PWM High*)		250 (*1/4"*)		N (*Light Static Drag*)

PLEASE NOTE: This chart is for informational use only. Certain product configuration combinations are not available. Visit the MA4 product page *(https://www.usdigital.com/products/MA4)* for pricing and additional information.