Space Micro Kit Encoder

Features

» 1.5 Inch Diameter Kit (Frameless) Encoder

» True Absolute 24-Bit Position Output

» Accurate to <30 arcseconds RMS

» In-Situ Auto-Calibration

» Health and Status Diagnostic Reporting

» Radiation tolerant to 50 krad(Si)

Applications

» Commercial Space Applications

» Low Earth Orbit

» CubeSats

» Miniature DC Motor

» Robotics

Description

The Micro Kit Encoder, or MKE, is Quantic BEI's smallest flight-worthy optical encoder. This true-absolute optical encoder delivers high performance rotary sensing in a package well suited for CubeSats & small satellites. The code disk hub is customizable to fit small shafts <5 mm (3/16"), such as common DC motors. The electronic components are qualified to Level 1 or Level 2 per GSFC EEE-INST-002 and suited for all Earth-orbital applications.

Like other encoders in the nanoSeries family, the MKE employs a long-life LED light source to illuminate our high-accuracy code disk. The code patterns constitute ratiometric tiers of advancing frequencies to create the high-resolution 24-bit contiguous angular position, all while maintaining positional stability over temperature and time.

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MKE 11/2022

	Specification	Units	Min	Max
Performance	Full Revolution Accuracy	arcsec RMS	-	30
	Resolution - Quanta	Bits	24	-
	Resolution - ENOB	Bits	18	-
	Interrogation Rate	Hz	100	1000
	Data Relevancy	µS	43	48
	Speed (operating)	RPM	0	1000
	Reliability, MIL-HDBK-217	FIT, Failures/Billion Hours	114	-
	Direction of Increasing Count	-	CCW	
Electrical	Input Voltage	VDC	4.3	5.5
	Input Current	mA	-	50 (BOL) 90 (EOL)[1]
	ESD Sensitivity	V, HBM	8000	-
Environmental	Vibration, MIL-STD-202 Method 214, Condition I, Profile H	grms	-	29.28
	Shock Response Spectrum	g's	-	Frequency / g's: 30 / 110, 1000 / 1500, 10000 / 1500
	Operating Temperature	°C	-40	+70
	Storage Temperature	°C	-55	+90
	Low-Outgassing Design	-	-	1.0% TML 0.1% CVCM
	Total Ionizing Dose	krad	-	50
	Displacement Damage	n/cm^2 (1 Mev)	-	> 2.4E11

1. End of Life (EOL) maximum current based upon worst case analysis calculations. Consult factory.

Quantic™ BEI

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Connector Pinout

The standard nanoSeries® Micro Kit Encoder output connector is a 9-socket Micro-D Connector [M83513/04-A__N type] with the following pinout:

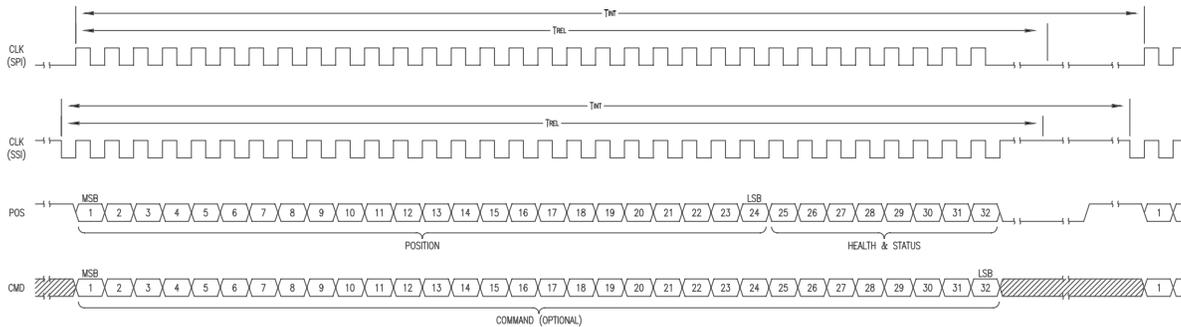| Pin	MNEMONIC	I/O	Description
1	+POS	Out	Position data output
6	–POS	Out	Position data output
3	+CMD	IN	Command word input
8	–CMD	IN	Command word input
2	+CLK	IN	Synchronous clock input
7	–CLK	IN	Synchronous clock input
4	+5 VDC	—	Supply Voltage
9	5V RTN	—	Supply Voltage return
5	CHAS	—	Chassis [case] ground

I/O: LVDS

Output Protocol

Figure 1.
Electrical Interface
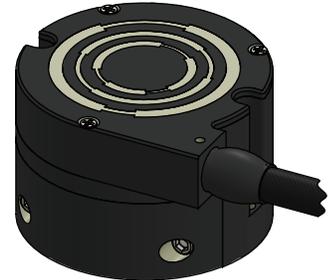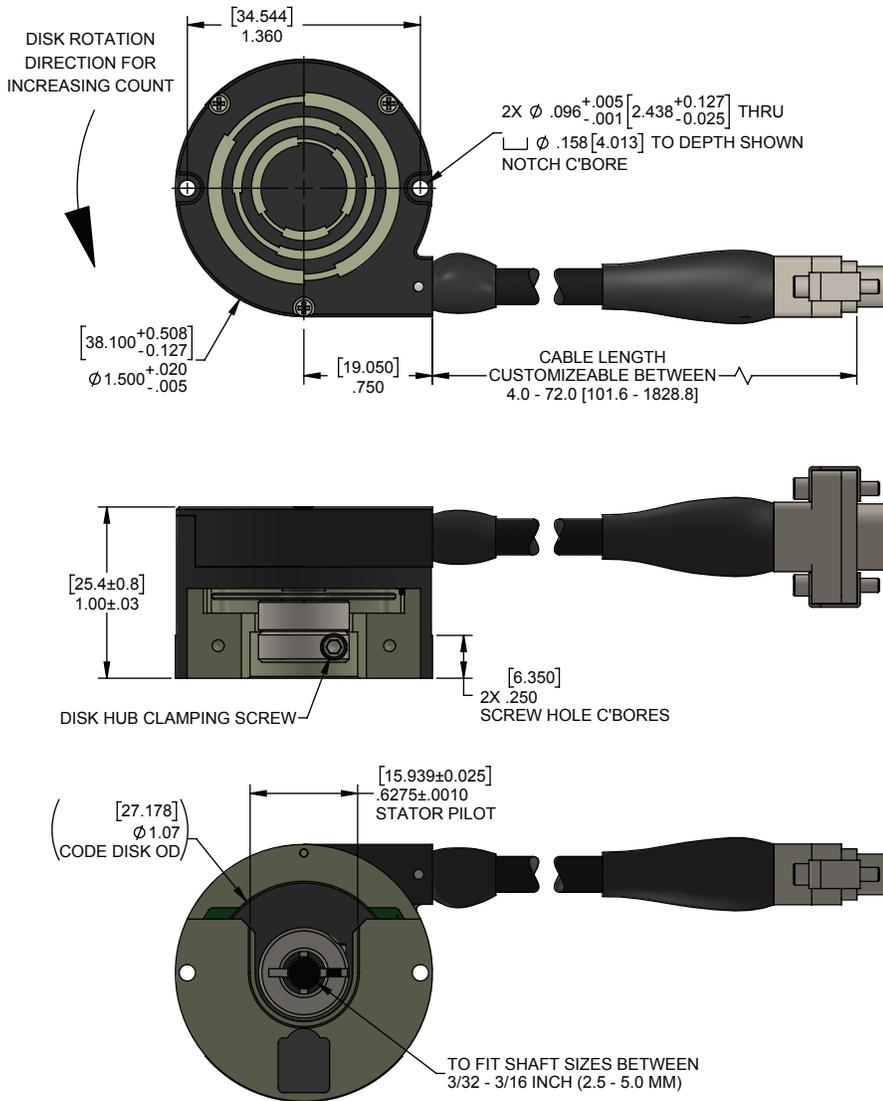Timing Diagram [System]
Timing Values Per Table 1]

Table 1.
Electrical Interface Timing Values [See 190-0323-03 For Details]

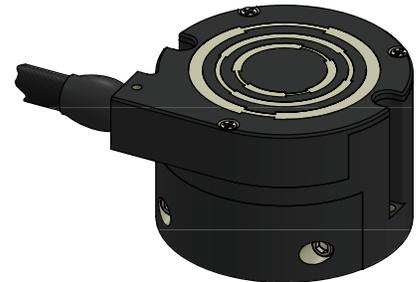| Parameter	Symbol	Min	Typical	Max	Units
Encoder Data Relevancy*	T_{REL}	43	45.5	48	µS
Encoder Interrogation Period	T_{INT}	1000	—	—	µS
Clock Frequency		0.05	2	2.5	MHz

*Although data is sampled witin 45 µS [typ] of the CMD pulses, it is not shifted out until the next cycle

Readhead & Code Disk In Installed State

(Right-exit option, shown with front cover removed)

DISK ROTATION DIRECTION FOR INCREASING COUNT

[34.544]
1.360

2X ϕ .096$^{+.005}_{-.001}$ [2.438$^{+0.127}_{-0.025}$] THRU
$\sqcup$ ϕ .158 [4.013] TO DEPTH SHOWN
NOTCH C'BORE

[38.100$^{+0.508}_{-0.127}$]
ϕ 1.500$^{+.020}_{-.005}$

[19.050]
.750

CABLE LENGTH
CUSTOMIZEABLE BETWEEN
4.0 - 72.0 [101.6 - 1828.8]

[25.4±0.8]
1.00±.03

DISK HUB CLAMPING SCREW

[6.350]
2X .250
SCREW HOLE C'BORES

[27.178]
ϕ 1.07
CODE DISK OD

[15.939±0.025]
.6275±.0010
STATOR PILOT

TO FIT SHAFT SIZES BETWEEN
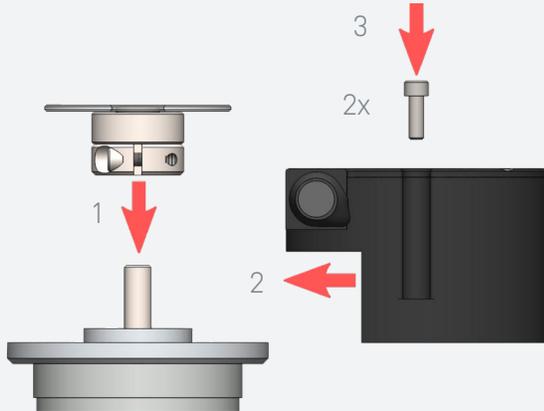3/32 - 3/16 INCH (2.5 - 5.0 MM)

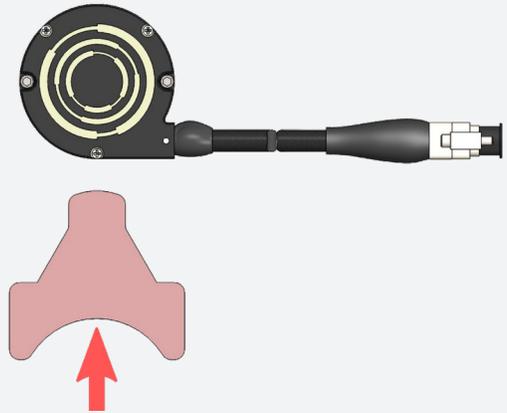RIGHT-EXIT OPTION

LEFT-EXIT OPTION

Notes:
1. See outline drawing 190-0343-01 for complete dimensional specifications and mounting interface recommendations.
2. Unbracketed dimensions are inches and bracketed [x.Xx] dimensions are millimeters.
3. Quantic BEI can provide mounting plates to adapt stator interface to any existing hole pattern. Consult the factory for details.
4. Readhead mass: 50.3 + 1.35(L) grams max, l = cable length
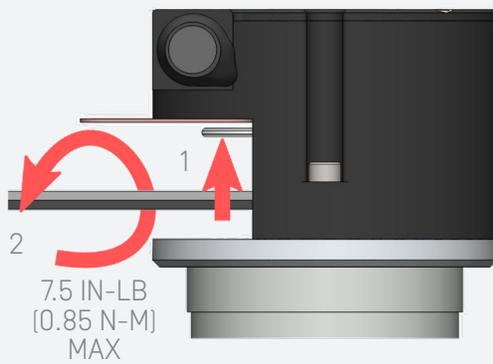Disk hub mass: 10.8 Grams max

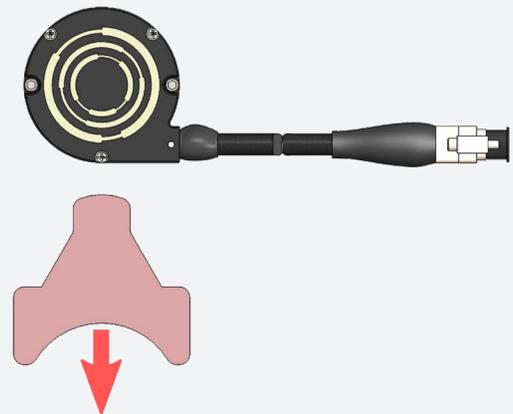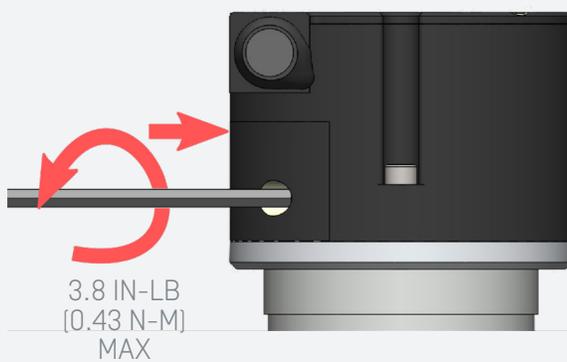# Installation Sequence

1. Mount Hardware

2. Fully Insert Shim

3. Raise Disk to Shim

7.5 IN-LB
[0.85 N-M]
MAX

4. Remove Shim

5 Install Front Cover

3.8 IN-LB
[0.43 N-M]
MAX

Ordering Information

MK	24	/1	88	P1	M1	D1	L7	S1	-	2

Resolution Bits/Turn

Shaft Diameter
188 = 3/16 inch
156 = 5/32 inch
125 = 1/8 inch
094 = 3/32 inch
50M = 5.0 mm
45M = 4.5 mm
40M = 4.0 mm
35M = 3.5 mm
30M = 3.0 mm
25M = 2.5 mm

Input voltage
P1: 5 VDC

Component Materials
M1 = Aluminum readhead, stainless steel disk hub

Serial Output Data Driver
D1 = LVDS
D2 = RS485

Cable Exit
L = Left Exit
R = Right Exit
T = Top exit

Product Assurance Level
(omitted) = Commercial, vacuum-compatible materials
CS = Commercial, Space Assembly, TVAC bakeout

Cable Length
(4-72 inches in 1 inch increments)
72 = 72 inch
36 = 36 inch
24 = 24 inch
12 = 12 inch
4 = 4 inch
etc.