

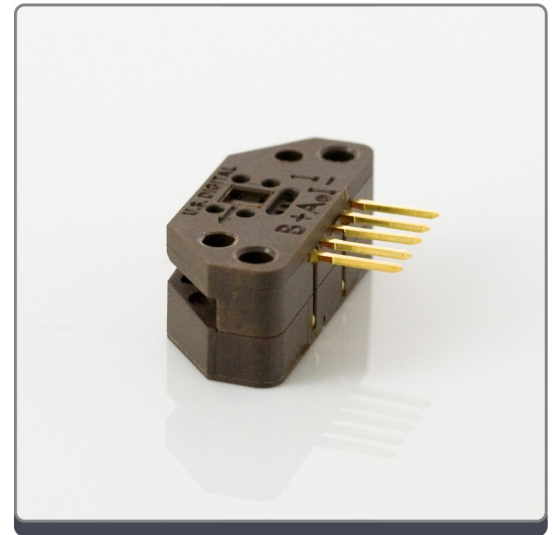
## Description

The **EM1** is a transmissive optical encoder module. This module is designed to detect rotary or linear position when used together with a codewheel or linear strip. The **EM1** consists of a lensed LED source and a monolithic detector IC enclosed in a small polymer package. The **EM1** uses phased array detector technology to provide superior performance and greater tolerances over traditional aperture mask type encoders.

The **EM1** module provides digital quadrature outputs. A third index channel output comes standard on all resolutions. Power is supplied from a single +5Vdc source. The single-ended outputs are capable of sinking or sourcing 8mA each.

The resolution of the modules and encoder disks or linear strips must match. Two mounting holes are provided to accept #4-40 machine screws. Because there is clearance in these mounting holes they should not be relied upon for accurate positioning; instead, mounting assemblies should incorporate two alignment pins (nominal diameter 0.095") just in-board of the mounting holes (see drawing).

For open collector and higher voltage applications, add the PC3 cable driver, or for differential cable driver outputs, add the PC4 cable driver. Encoder disks, linear strips, quadrature decoder chips, counter chips, computer interface boards, mating connectors and cables are also available.



## Features

- Two channel quadrature output with index pulse
- TTL Compatible
- Single +5V supply
- Resolutions up to 2500 CPR (10,000 PPR)
- Internal bypass capacitor
- -55C to 125C operating temperature

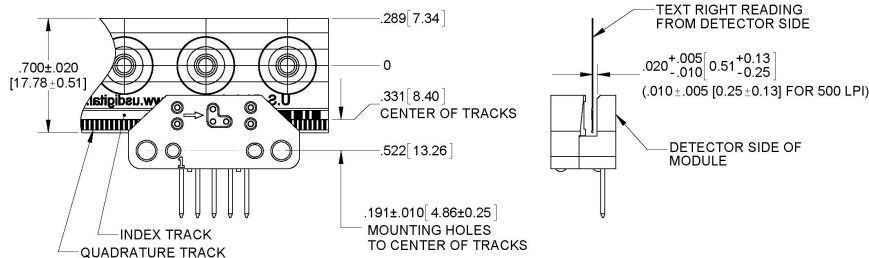
## Related Products & Accessories

- CA-C5-SH-C5 5-Pin Standard / Standard Shielded Cable (Base price \$11.50)
- CA-C5-SH-FC5 5-Pin Standard / Latching Shielded Cable (Base price \$14.13)
- CA-C5-SH-NC 5-Pin Standard / Unterminated Shielded Cable (Base price \$6.25)
- CA-C5-SS-MD6 5-Pin Standard / 6-Pin Modular Unshielded Cable (Base price \$10.48)
- CA-C5-W4-NC 5-Pin Standard / Unterminated 4-Wire Cable (Base price \$5.75)
- CA-C5-W5-NC 5-Pin Standard / Unterminated 5-Wire Discrete Cable (Base price \$5.75)
- CA-FC5-SH-LC5 5-Pin Latching / Locking Shielded Cable (Base price \$16.76)
- CA-LC5-SH-LC5 5-Pin Locking / Locking Shielded Cable (Base price \$16.76)
- CA-LC5-SH-NC 5-Pin Locking / Unterminated Shielded Cable (Base price \$8.88)
- CA-LC5-SS-MD6 5-Pin Locking / 6-Pin Modular Unshielded Cable (Base price \$13.11)
- CA-LC5-W4-NC 5-Pin Locking / Unterminated 4-Wire Discrete Cable (Base price \$8.38)
- CA-LC5-W5-NC 5-Pin Locking / Unterminated 5-Wire Discrete Cable (Base price \$8.38)
- CON-C5 5-Pin Standard Connector (Base price \$1.05)
- CON-LC5 5-Pin Locking Connector (Base price \$3.15)
- DISK-1 1" Transmissive Rotary Disk (Base price \$8.05)
- DISK-2 2" Transmissive Rotary Disk (Base price \$20.80)
- HUBDISK-1 1" Transmissive Rotary Codewheel (Base price \$12.10)
- HUBDISK-2 2" Transmissive Rotary Codewheel (Base price \$18.45)
- LIN Transmissive Linear Strip (Base price \$14.70)

## Linear Strip Alignment

EM1 Transmissive Optical Encoder Module  
Linear Strip Alignment

RELEASE DATE: 11/09/2011



US DIGITAL 1400 NE 136th Avenue  
Vancouver, Washington 98684, USA

info@usdigital.com  
www.usdigital.com

Local: 360.260.2468  
Toll-free: 800.736.0194

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## Disk Alignment

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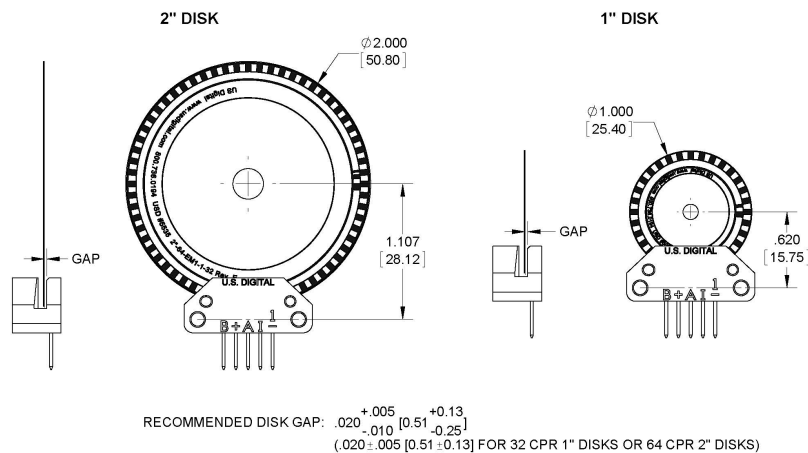
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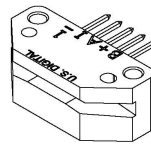
EM1 Transmissive Optical Encoder Module  
Disk Alignment

RELEASE DATE: 11/08/2011

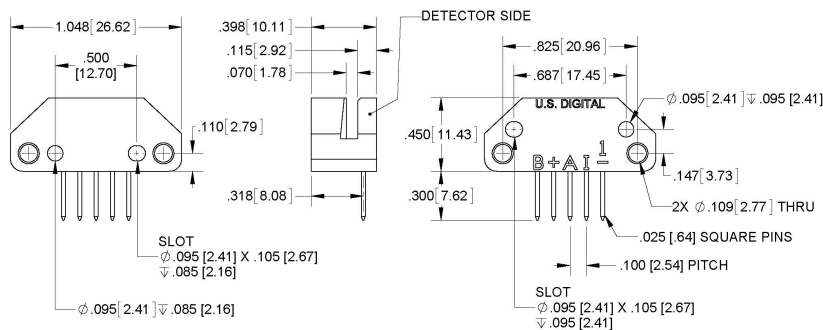


## Mechanical Drawing

EM1 Transmissive Optical Encoder Module



RELEASE DATE: 10/24/2011



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## Available Resolutions

CPI/CPR	1" Disk With Index	2" Disk With Index	Linear Strip With Index
32	EM1-1-32	-	-
64	-	EM1-1-32*	-
120	-	-	EM1-0-120
125	-	-	EM1-0-127*
127	-	-	EM1-0-127
150	-	-	EM1-0-150
200	-	-	EM1-0-200
250	-	-	EM1-0-250
500	-	-	EM1-0-500
720	EM1-1-720	-	-
900	EM1-1-900	-	-
1000	EM1-1-1000	-	-
1024	EM1-1-1024	-	-
1250	EM1-1-1250	-	-
1800	-	EM1-2-1800	-
2500	-	EM1-2-2500	-

\*Some modules can be used with other-than-native OD and/or CPI/CPR while maintaining specified tolerances.

## Recommended Operating Conditions

Parameter	Min.	Max.	Units	Notes
Temperature	-55	125	C	
Supply Voltage	4.5	5.5	Vdc	Ripple (<100mV P-P)
Load Capacitance	-	100	pF	
Count Frequency	-	300	kHz	(rpm/60) x cycles/rev.
Disk Radial Position Tolerance	± .005		inch	with gap set by standard spacer tool

## Electrical Specifications

- Specifications apply over entire operating temperature range.
- Typical values are specified at Vcc = 5.0Vdc and 25 ° C.

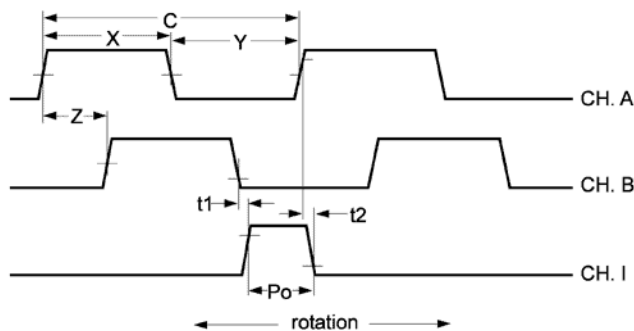
Parameter	Min.	Typ.	Max.	Units	Conditions
Output Voltage	-0.5	-	Vcc	Vdc	
Supply Current (32-250 CPR)	-	27	30	mA	
Supply Current (500-2500 CPR)	-	55	57	mA	
Low-level Output	-	-	0.5	Vdc	IOL = 8mA max.
High-level Output	2.0	-	-	Vdc	IOH = -8mA max.
	4.2	4.8	-	Vdc	Unloaded
Output Current Per Channel	-8	-	8	mA	

## Timing Characteristics

### Encoding Characteristics:

- Specifications apply over entire operating temperature range.
- Values are for the worst error over full rotation.
- Refer to timing diagram below.

Parameter	Symbol	Min.	Typ.	Max.	Units
Cycle Error		-	3.0	5.5	° e
Symmetry		150	180	210	° e
Quadrature		45	90	100	° e
Index Pulse Width	Po	60	90	120	° e
Ch. I Rise After Ch. B or Ch. A Fall	t1	10	100	250	ns
Ch. I Fall After Ch. B or Ch. A Rise	t2	70	150	300	ns

**Timing Diagram:**

**CPR (N):** The number of Cycles Per Revolution.

**One Shaft Rotation:** 360 mechanical degrees, N cycles.

**One Electrical Degree ( ° e):** 1/360th of one cycle.

**One Cycle (C):** 360 electrical degrees ( ° e). Each cycle can be decoded into 1 or 4 codes, referred to as X1 or X4 resolution multiplication.

**Symmetry:** A measure of the relationship between (X) and (Y) in electrical degrees, nominally 180 ° e.

**Quadrature (Z):** The phase lag or lead between channels A and B in electrical degrees, nominally 90 ° e.

**Index (CH I.):** The index output goes high once per revolution, coincident with the low states of channels A and B, nominally 1/4 of one cycle (90 ° e).

**Position Error:** The difference between the actual shaft position and the position indicated by the encoder cycle count.

**Cycle Error:** An indication of cycle uniformity. The difference between an observed shaft angle which gives rise to one electrical cycle, and the nominal angular increment of 1/N of a revolution.



## Installation Torque

Parameter	Torque
Mounting Screws	3.5-4 in-lbs



## EM1 / HEDS Comparison

US Digital is the designer and manufacturer of the **EM1** transmissive optical encoder module. The design of the **EM1** provides electrical and mechanical compatibility with the Agilent **HEDS-9000**, **HEDS-9100**, **HEDS-9200**, **HEDS-9040**, and **HEDS-9140** series modules.

The process of switching from the **HEDS** to the **EM1** module should not require any mechanical or electrical changes. Simply use the **EM1** and matching codewheel in place of the **HEDS** module and codewheel. The **EM1** has a built-in index channel available on all

resolutions, for both rotary disks and linear strips. The **EM1** uses a US Digital designed codewheel with 2 tracks rather than 3 tracks for index versions. Non-index codewheels are interchangeable between the **EM1** and **HEDS** modules. The **EM1** offers improved output drive capability and will source and sink 8mA at TTL levels.

Physically, the **EM1** has no external wire loops which can interfere when mounting. The connector pins are 0.051" shorter than **HEDS** modules, while still providing .30" insertion depth. US Digital's **EM1** offers custom and special resolutions.

### Ordering Information

EM1 -  -

Native OD	Native CPI/CPR
0Linear	32
1 = 1in	120
2 = 2in	127
	150
	200
	250
	500
	720
	900
	1000
	1024
	1250
	1800
	2500

#### Rules

- Native OD must be equal to 1 when Native CPI/CPR is 32, 720, 900, 1000, 1024 or 1250
- Native OD must be equal to 0 when Native CPI/CPR is 120, 127, 150, 200, 250 or 500
- Native OD must be equal to 2 when Native CPI/CPR is 1800 or 2500

#### Notes

- US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

### Base Pricing

Quantity	Price
1	\$32.35
10	\$28.78
50	\$24.53
100	\$21.74

- Add 11% per unit for **Native OD** of 2in
- Add 21% per unit for **Native CPI/CPR** of 500
- Add 11% per unit for **Native CPI/CPR** of 720 , 900 , 1000 , 1024 , 1250