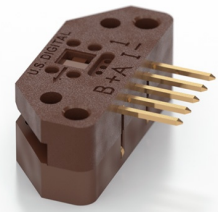




EM1 Features

- Encoder module for measuring linear or rotary movement
- Two-channel quadrature with optional index channel
- 21 Rotary Resolutions from 32 to 2,500 CPR (128 to 10,000 PPR)
- 9 Linear Resolutions from 120 to 500 LPI (x1 quadrature decoding)
- Sink/source 8 mA outputs
- Internal decoupling capacitor for enhanced noise immunity
- Single 5 VDC supply
- Improved replacement for HEDS-9000 Series



EM1 Product Description

The EM1 is a transmissive optical encoder module designed to measure rotary or linear motion when paired together with an encoder disk 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, allowing for a wider gap tolerance and reliable performance even with some disk contamination.



The EM1 encoder module provides digital A & B quadrature outputs with an optional index channel. Each EM1 module is resolution-specific and is matched to the resolution of an encoder disk or linear strip. The EM1 module supports 21 different resolutions. The EM1 operates with a single 5V supply and provides single-ended outputs capable of sinking and sourcing 8mA. An internal 0.1 μ F decoupling capacitor provides enhanced noise immunity.

For open collector and higher voltage applications, add the PC3 (<https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc3/>) cable driver, or for differential cable driver outputs, add the PC4 (<https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc4/>) cable driver.

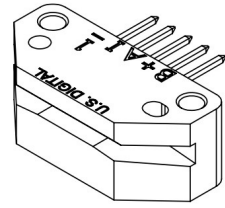
Accessories such as encoder disks, linear strips, mating connectors and cables are also available.

Mechanical Drawings

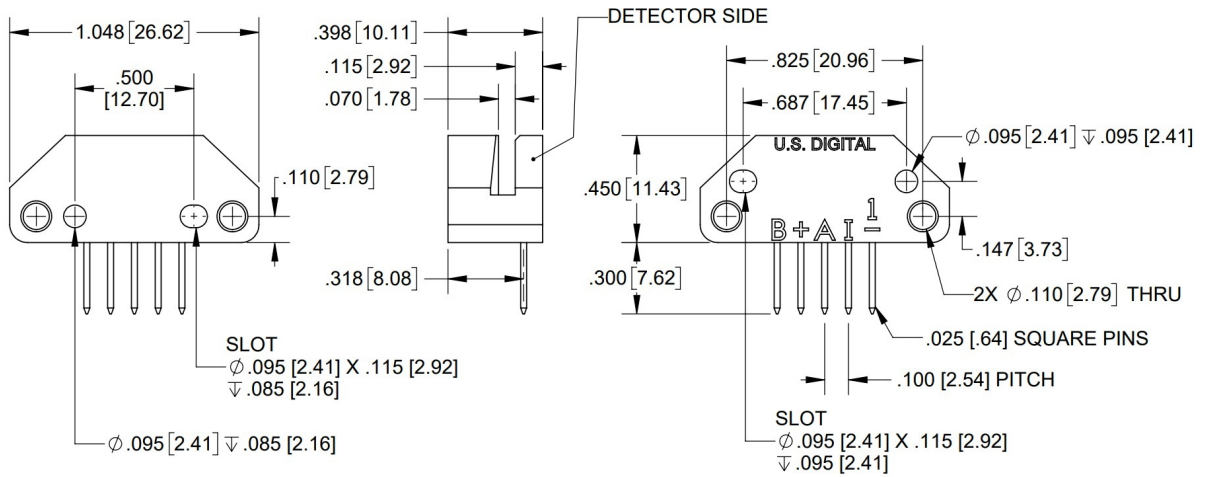


EM1 Transmissive Optical Encoder Module

EM1 Transmissive Optical Encoder Module



RELEASE DATE: 02/07/2022



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

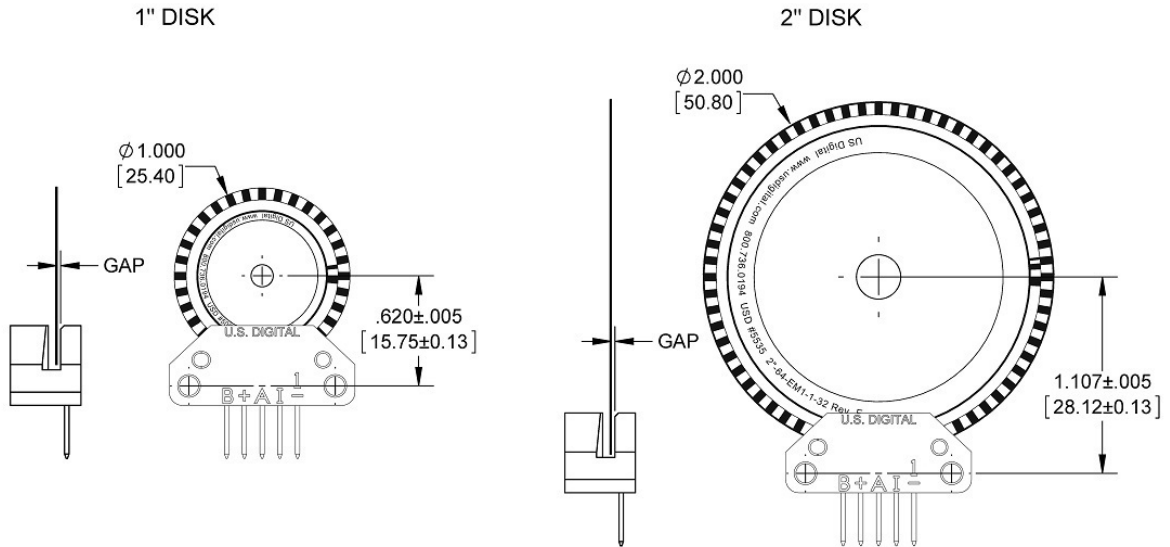
info@usdigital.com
 www.usdigital.com

Local: 360.260.2468
 Toll-free: 800.736.0194

UNITS: INCHES (MM)
 METRIC SHOWN FOR REFERENCE ONLY

EM1 Transmissive Optical Encoder Module Disk Alignment

RELEASE DATE: 04/06/2015



RECOMMENDED DISK GAP: $.020^{+.005}_{-.010}$ [0.51^{+.13}_{-.25}]
 (.020 ± .005 [0.51 ± 0.13] FOR 32 CPR 1" DISKS OR 64 CPR 2" DISKS)

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

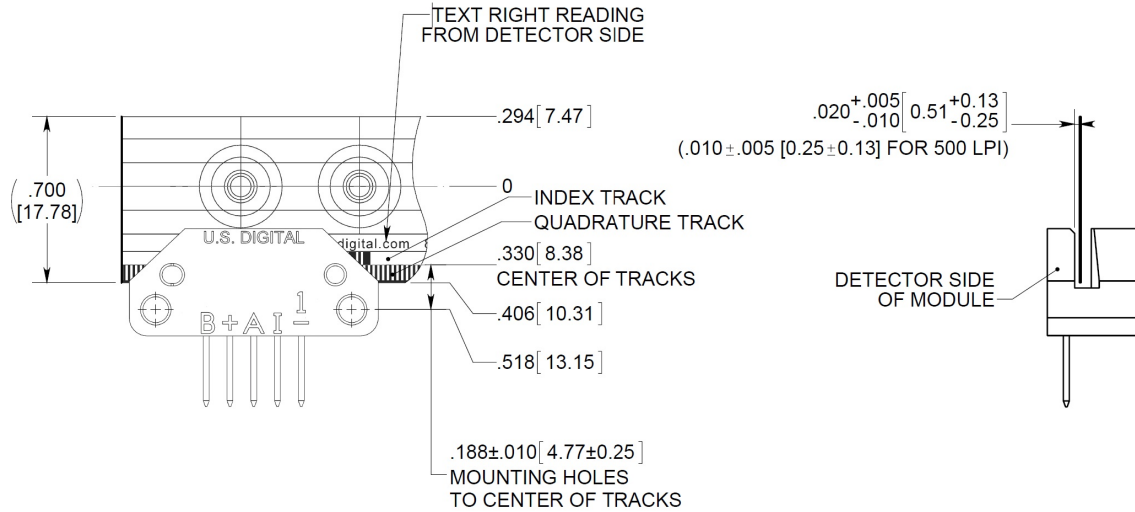
UNITS: INCHES [MM]
 METRIC SHOWN FOR REFERENCE ONLY



EM1 Transmissive Optical Encoder Module

EM1 Transmissive Optical Encoder Module Linear Strip Alignment

RELEASE DATE: 04/07/2015



1400 NE 136th Avenue
Vancouver, Washington 98684, USA

info@usdigital.com
www.usdigital.com

Local: 360.260.2468
Toll-free: 800.736.0194

UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

Specifications

COMPATIBLE 1" & 2" DISKS

1" DISKS				
CPR	MODULE Non-Index	1" DISK Non-Index	MODULE Index	1" DISK Index
32	EM1-1-32-N	DISK-1-32-*-NE		
50	EM1-1-50-N	DISK-1-50-*-NE	EM1-1-50-I	DISK-1-50-*-IE
96	EM1-1-100-N	DISK-1-96-*-NE	EM1-1-100-I	DISK-1-96-*-IE
100	EM1-1-100-N	DISK-1-100-*-NE	EM1-1-100-I	DISK-1-100-*-IE
120	EM1-1-100-N	DISK-1-120-*-NE		
192	EM1-1-200-N	DISK-1-192-*-NE	EM1-1-200-I	DISK-1-192-*-IE



1400 NE 136th Ave.
Vancouver, WA 98684
USA

info@usdigital.com
sales@usdigital.com

Toll Free: 800.736.0194
Worldwide: 360.260.2468
Support: 360.397.9999



EM1 Transmissive Optical Encoder Module

200	EM1-1-200-N	DISK-1-200-*-NE	EM1-1-200-I	DISK-1-200-*-IE
250	EM1-1-250-N	DISK-1-250-*-NE	EM1-1-250-I	DISK-1-250-*-IE
256	EM1-1-250-N	DISK-1-256-*-NE	EM1-1-250-I	DISK-1-256-*-IE
360	EM1-1-360-N	DISK-1-360-*-NE	EM1-1-360-I	DISK-1-360-*-IE
400	EM1-1-400-N	DISK-1-400-*-NE	EM1-1-400-I	DISK-1-400-*-IE
500	EM1-1-500-N	DISK-1-500-*-NE	EM1-1-500-I	DISK-1-500-*-IE
512	EM1-1-512-N	DISK-1-512-*-NE	EM1-1-512-I	DISK-1-512-*-IE
540	EM1-1-540-N	DISK-1-540-*-NE	EM1-1-540-I	DISK-1-540-*-IE
720	EM1-1-720-N	DISK-1-720-*-NE	EM1-1-720-I	DISK-1-720-*-IE
800	EM1-1-800-N	DISK-1-800-*-NE	EM1-1-800-I	DISK-1-800-*-IE
1000	EM1-1-1000-N	DISK-1-1000-*-NE	EM1-1-1000-I	DISK-1-1000-*-IE
1024	EM1-1-1024-N	DISK-1-1024-*-NE	EM1-1-1024-I	DISK-1-1024-*-IE
1250	EM1-1-1250-N	DISK-1-1250-*-NE	EM1-1-1250-I	DISK-1-1250-*-IE
*Represents the bore size				

2" DISKS

CPR	MODULE Non-Index	2" DISK Non-Index	MODULE Index	2" DISK Index
64	EM1-1-32-N	DISK-2-64-*-NE		
100	EM1-1-50-N	DISK-2-100-*-NE	EM1-1-50-I	DISK-2-100-*-IE
200	EM1-1-100-N	DISK-2-200-*-NE	EM1-1-100-I	DISK-2-200-*-IE
400	EM1-1-200-N	DISK-2-400-*-NE	EM1-1-200-I	DISK-2-400-*-IE
500	EM1-2-500-N	DISK-2-500-*-NE	EM1-2-500-I	DISK-2-500-*-IE
512	EM1-2-500-N	DISK-2-512-*-NE	EM1-2-500-I	DISK-2-512-*-IE
800	EM1-1-400-N	DISK-2-800-*-NE	EM1-1-400-I	DISK-2-800-*-IE
1000	EM1-2-1000-N	DISK-2-1000-*-NE	EM1-2-1000-I	DISK-2-1000-*-IE
1024	EM1-2-1024-N	DISK-2-1024-*-NE	EM1-2-1024-I	DISK-2-1024-*-IE
1800	EM1-2-1800-N	DISK-2-1800-*-NE	EM1-2-1800-I	DISK-2-1800-*-IE
2000	EM1-2-2000-N	DISK-2-2000-*-NE	EM1-2-2000-I	DISK-2-2000-*-IE
2048	EM1-2-2048-N	DISK-2-2048-*-NE	EM1-2-2048-I	DISK-2-2048-*-IE
2500	EM1-2-2500-N	DISK-2-2500-*-NE	EM1-2-2500-I	DISK-2-2500-*-IE
*Represents the bore size				



COMPATIBLE 1" & 2" HUBDISKS

1" HUBDISKS				
CPR	MODULE Non-Index	1" HUBDISK Non-Index	MODULE Index	1" HUBDISK Index
32	EM1-1-32-N	HUBDISK-1-32*-NE		
50	EM1-1-50-N	HUBDISK-1-50*-NE	EM1-1-50-I	HUBDISK-1-50*-IE
96	EM1-1-100-N	HUBDISK-1-96*-NE	EM1-1-100-I	HUBDISK-1-96*-IE
100	EM1-1-100-N	HUBDISK-1-100*-NE	EM1-1-100-I	HUBDISK-1-100*-IE
120	EM1-1-100-N	HUBDISK-1-120*-NE		
192	EM1-1-200-N	HUBDISK-1-192*-NE	EM1-1-200-I	HUBDISK-1-192*-IE
200	EM1-1-200-N	HUBDISK-1-200*-NE	EM1-1-200-I	HUBDISK-1-200*-IE
250	EM1-1-250-N	HUBDISK-1-250*-NE	EM1-1-250-I	HUBDISK-1-250*-IE
256	EM1-1-250-N	HUBDISK-1-256*-NE	EM1-1-250-I	HUBDISK-1-256*-IE
360	EM1-1-360-N	HUBDISK-1-360*-NE	EM1-1-360-I	HUBDISK-1-360*-IE
400	EM1-1-400-N	HUBDISK-1-400*-NE	EM1-1-400-I	HUBDISK-1-400*-IE
500	EM1-1-500-N	HUBDISK-1-500*-NE	EM1-1-500-I	HUBDISK-1-500*-IE
512	EM1-1-512-N	HUBDISK-1-512*-NE	EM1-1-512-I	HUBDISK-1-512*-IE
540	EM1-1-540-N	HUBDISK-1-540*-NE	EM1-1-540-I	HUBDISK-1-540*-IE
720	EM1-1-720-N	HUBDISK-1-720*-NE	EM1-1-720-I	HUBDISK-1-720*-IE
800	EM1-1-800-N	HUBDISK-1-800*-NE	EM1-1-800-I	HUBDISK-1-800*-IE
1000	EM1-1-1000-N	HUBDISK-1-1000*-NE	EM1-1-1000-I	HUBDISK-1-1000*-IE
1024	EM1-1-1024-N	HUBDISK-1-1024*-NE	EM1-1-1024-I	HUBDISK-1-1024*-IE
1250	EM1-1-1250-N	HUBDISK-1-1250*-NE	EM1-1-1250-I	HUBDISK-1-1250*-IE
*Represents the bore size				

2" HUBDISKS				
CPR	MODULE Non-Index	2" HUBDISK Non-Index	MODULE Index	2" HUBDISK Index
64	EM1-1-32-N	HUBDISK-2-64*-NE		
100	EM1-1-50-N	HUBDISK-2-100*-NE	EM1-1-50-I	HUBDISK-2-100*-IE
200	EM1-1-100-N	HUBDISK-2-200*-NE	EM1-1-100-I	HUBDISK-2-200*-IE
400	EM1-1-200-N	HUBDISK-2-400*-NE	EM1-1-200-I	HUBDISK-2-400*-IE
500	EM1-2-500-N	HUBDISK-2-500*-NE	EM1-2-500-I	HUBDISK-2-500*-IE



EM1 Transmissive Optical Encoder Module

512	EM1-2-500-N	HUBDISK-2-512*-NE	EM1-2-500-I	HUBDISK-2-512*-IE
800	EM1-1-400-N	HUBDISK-2-800*-NE	EM1-1-400-I	HUBDISK-2-800*-IE
1000	EM1-2-1000-N	HUBDISK-2-1000*-NE	EM1-2-1000-I	HUBDISK-2-1000*-IE
1024	EM1-2-1024-N	HUBDISK-2-1024*-NE	EM1-2-1024-I	HUBDISK-2-1024*-IE
1800	EM1-2-1800-N	HUBDISK-2-1800*-NE	EM1-2-1800-I	HUBDISK-2-1800*-IE
2000	EM1-2-2000-N	HUBDISK-2-2000*-NE	EM1-2-2000-I	HUBDISK-2-2000*-IE
2048	EM1-2-2048-N	HUBDISK-2-2048*-NE	EM1-2-2048-I	HUBDISK-2-2048*-IE
2500	EM1-2-2500-N	HUBDISK-2-2500*-NE	EM1-2-2500-I	HUBDISK-2-2500*-IE
*Represents the bore size				

COMPATIBLE LINEAR STRIPS

LPI	MODULE Non-Index	Linear Strip Non-Index	MODULE Index	Linear Strip Index
120	EM1-0-120-N	LIN-120*-N	EM1-0-120-I	LIN-120*-#
125	EM1-0-127-N	LIN-125*-N	EM1-0-127-I	LIN-125*-#
127	EM1-0-127-N	LIN-127*-N	EM1-0-127-I	LIN-127*-#
150	EM1-0-150-N	LIN-150*-N	EM1-0-150-I	LIN-150*-#
180	EM1-0-180-N	LIN-180*-N	EM1-0-180-I	LIN-180*-#
200	EM1-0-200-N	LIN-200*-N	EM1-0-200-I	LIN-200*-#
250	EM1-0-250-N	LIN-250*-N	EM1-0-250-I	LIN-250*-#
360	EM1-0-360-N	LIN-360*-N	EM1-0-360-I	LIN-360*-#
500	EM1-0-500-N	LIN-500*-N	EM1-0-500-I	LIN-500*-#
* Represents length of Linear Strip			* Represents length of Linear Strip # Represents location of Index	

ENVIRONMENTAL

Parameter	Value	Units
Operating Temperature	-40 to 100	C
Electrostatic Discharge, IEC 61000-4-2	± 4	kV
Vibration (10Hz to 2kHz, sinusoidal)	20	G
Shock (6 milliseconds, half-sine)	75	G



OPERATING CONDITIONS

PARAMETER	MIN.	MAX.	UNITS
A/B Output Frequency	0	300	kHz
Disk RPM	0	(18 x 10 ⁶) / CPR	RPM
Linear Strip Speed	0	(3 x 10 ⁵) / LPI	inches/sec.
Disk/Linear Strip Radial Position Tolerance	±.005		inch

ELECTRICAL SPECIFICATIONS

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

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage	4.5	5.0	5.5	V	Ripple < 100 mVpp
Supply Current, EM1-0- (linear strip)		27	33	mA	LPI < 250, no load
		54	65	mA	LPI ≥ 360, no load
Supply Current, EM1-1- (1" disk)		27	33	mA	CPR < 500, no load
		54	65	mA	CPR ≥ 500, no load
Supply Current, EM1-2- (2" disk)		27	33	mA	CPR < 1000, no load
		54	65	mA	CPR ≥ 1000, no load
Low-level Output		0.05	0.5	V	I _{OL} = 8mA max.
				V	No load
High-level Output	2.0			V	I _{OH} = -8mA max.
		4.8		V	No load
Output Current Per Channel	-8		8	mA	
Load Capacitance			100	pF	
Output Rise Time		110		nS	
Output Fall Time		100		nS	

TIMING CHARACTERISTICS

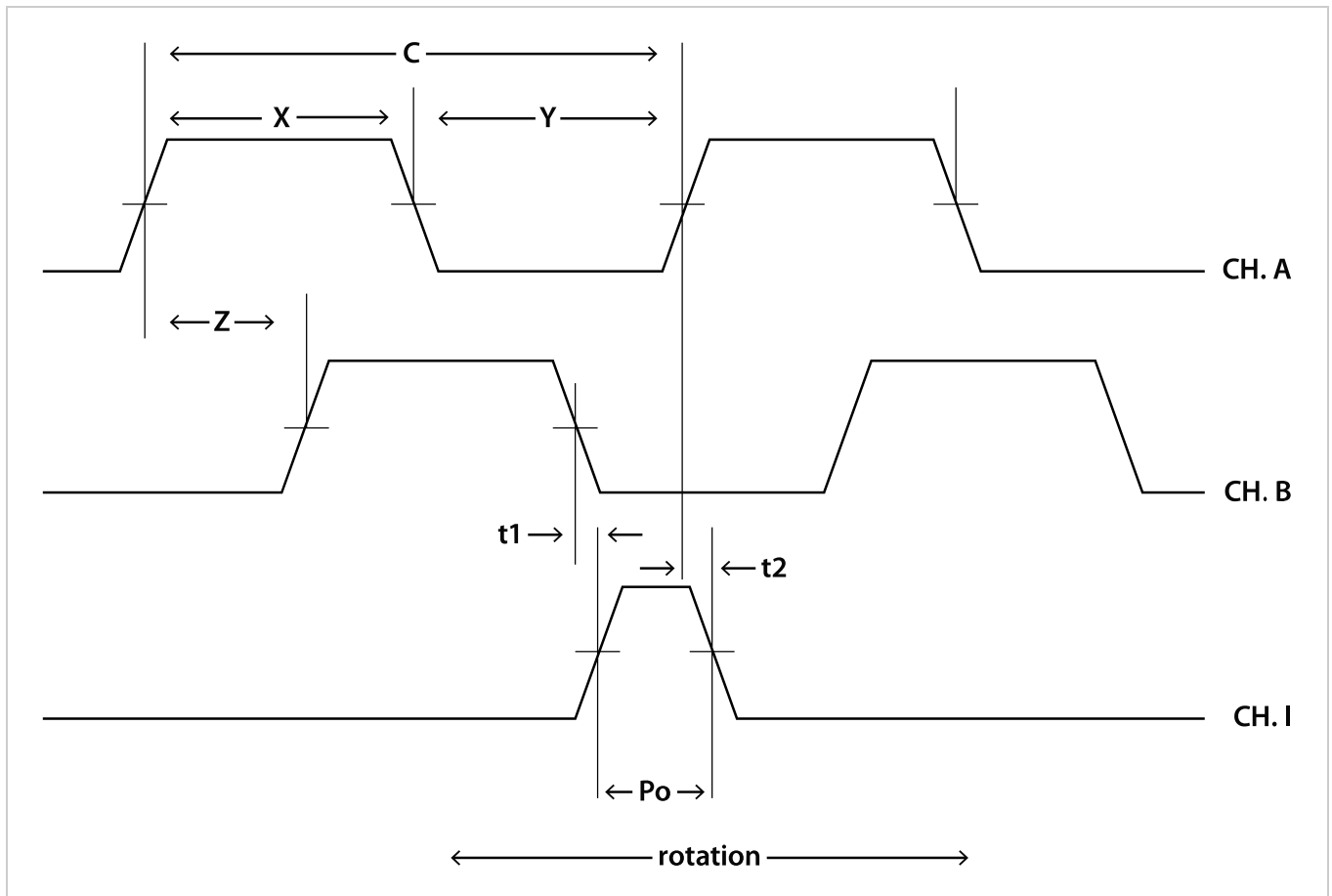
ENCODING CHARACTERISTICS:

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



PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
Symmetry	X, Y	150	180	210	°e (https://www.usdigital.com/support/resources/glossary/electrical-degree/)
Quadrature	Z	60	90	120	°e (https://www.usdigital.com/support/resources/glossary/electrical-degree/)
Index Pulse Width	Po	40	90	120	°e (https://www.usdigital.com/support/resources/glossary/electrical-degree/)
Ch. I Rise After Ch. B or Ch. A Fall	t1	50	100	200	ns
Ch. I Fall After Ch. B or Ch. A Rise	t2	-10	15	25	ns

TIMING DIAGRAM:



CPR: The number of Cycles (C) of the A or B outputs Per Revolution.

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/CPR of a revolution.

Index (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).

LPI: Lines Per Inch. The number of Cycles (C) of the A or B output per inch of linear strip movement.



EM1 Transmissive Optical Encoder Module

One Shaft Rotation: 360 mechanical degrees.

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 states, referred to as X1 or X4 resolution multiplication.

PPR: The number of resolvable Positions Per Revolution of the encoder disk with x4 quadrature decoding.

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

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

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 **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 most 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. 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 resolutions.

PIN-OUTS

Pin	Description
1	Ground
2	Index
3	A channel
4	+5VDC power
5	B channel

Notes

- 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

EM1

PLEASE NOTE: This chart is for informational use only. Certain product configuration combinations are not available. Visit the EM1 product page (<https://www.usdigital.com/products/EM1>) for pricing and additional information.