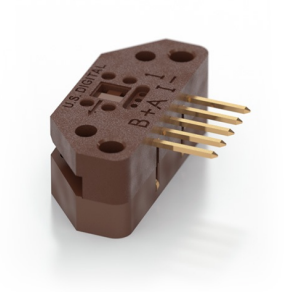
EM1_WEB Features



- Two-channel quadrature with optional index
- Improved replacement for HEDS-9000 Series
- Single 5 VDC supply
- Resolutions from 32 to 2,500 CPR
- Internal decoupling capacitor
- Sink/source 8mA outputs

EM1 Product Description

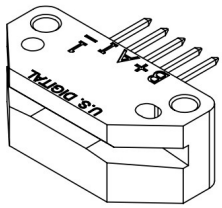
The EM1 is a transmissive optical encoder module designed to detect rotary or linear position when paired together with an encoder disk or linear strip. The EM1 consists of a lensed LED source and a monolithic detector IC enclosed in a small polymer package. The EM1 uses phased array detector technology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

The EM1 provides digital A & B quadrature outputs with an optional third output index channel. Each EM1 module is resolution-specific and is matched to the resolution of an encoder disk or linear strip. The EM1 module now supports all standard resolutions offered by the HEDS-9000 series encoder module and additional resolutions. The EM1 operates with a single 5V supply and provides single-ended outputs capable of sinking and sourcing 8mA. An internal 0.1 µF decoupling capacitor is designed into the EM1 to provide enhanced noise immunity over the HEDS-9000 series encoder modules.

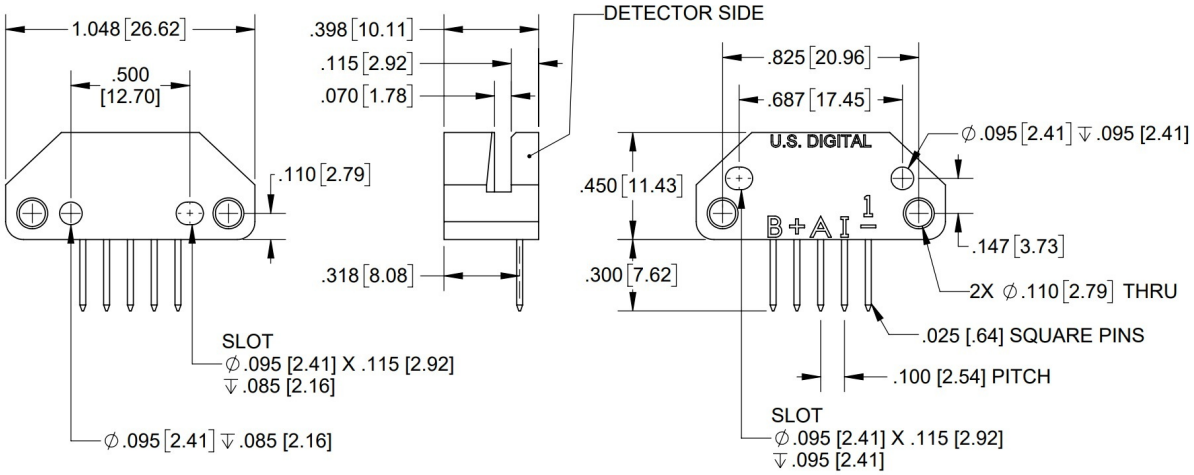
For open collector and higher voltage applications, add the PC3 *(https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc3/)* cable driver, or for differential cable driver outputs, add the PC4 *(https://www.usdigital.com/products/accessories/interfaces/cable-drivers/pc4/)* cable driver. Encoder disks, linear strips, quadrature decoder chips, counter chips, computer interface boards, mating connectors, and cables are also available.

Mechanical Drawings

EM1 Transmissive Optical Encoder Module



RELEASE DATE: 02/07/2022



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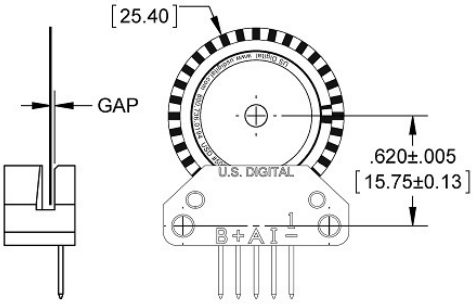
UNITS: INCHES [MM]
METRIC SHOWN FOR REFERENCE ONLY

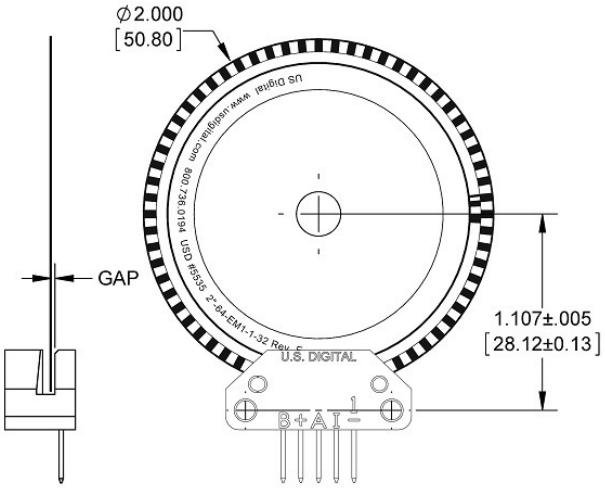
EM1 Transmissive Optical Encoder Module
Disk Alignment

RELEASE DATE: 04/06/2015

1" DISK



2" DISK



RECOMMENDED DISK GAP: $.020^{+.005}_{-.010}$ $[0.51^{+0.13}_{-0.25}]$
(.020±.005 [0.51±0.13] FOR 32 CPR 1" DISKS OR 64 CPR 2" DISKS)

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UNITS: INCHES [MM]
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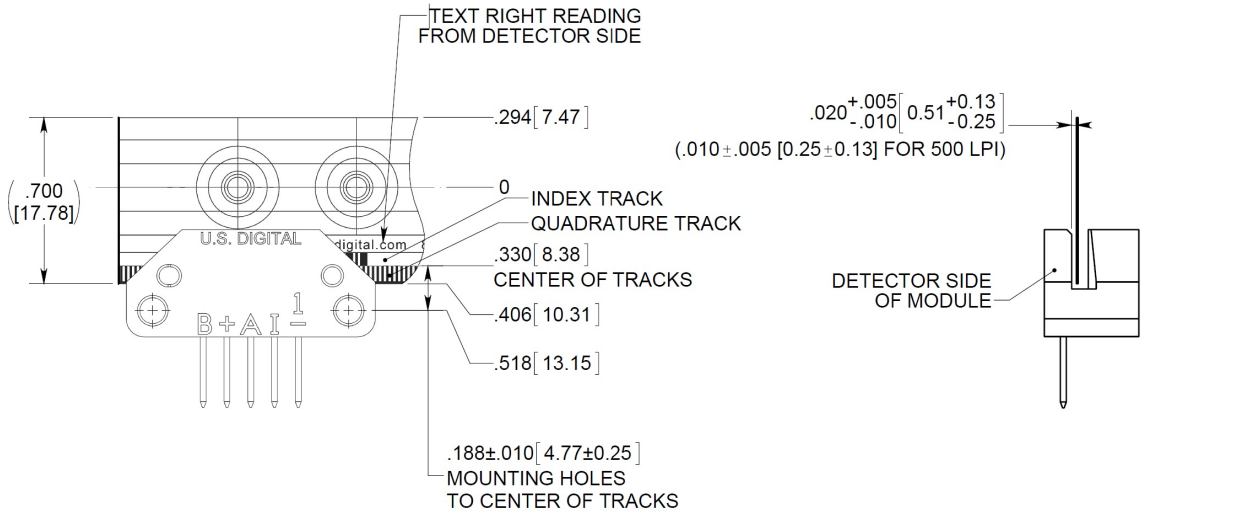
EM1 Transmissive Optical Encoder Module
Linear Strip Alignment

RELEASE DATE: 04/07/2015



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UNITS: INCHES [MM]
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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

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
900	EM1-1-900-N	DISK-1-900-*-NE	EM1-1-900-I	DISK-1-900-*-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
900	EM1-1-900-N	HUBDISK-1-900-*-NE	EM1-1-900-I	HUBDISK-1-900-*-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
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-*-#
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-*-#
300	EM1-0-300-N	LIN-300-*-N	EM1-0-300-I	LIN-300-*-#
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 < 300, no load
		54	65	mA	LPI ≥ 300, 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			0.5	V	I_{OL} = 8mA max.
		0.05		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

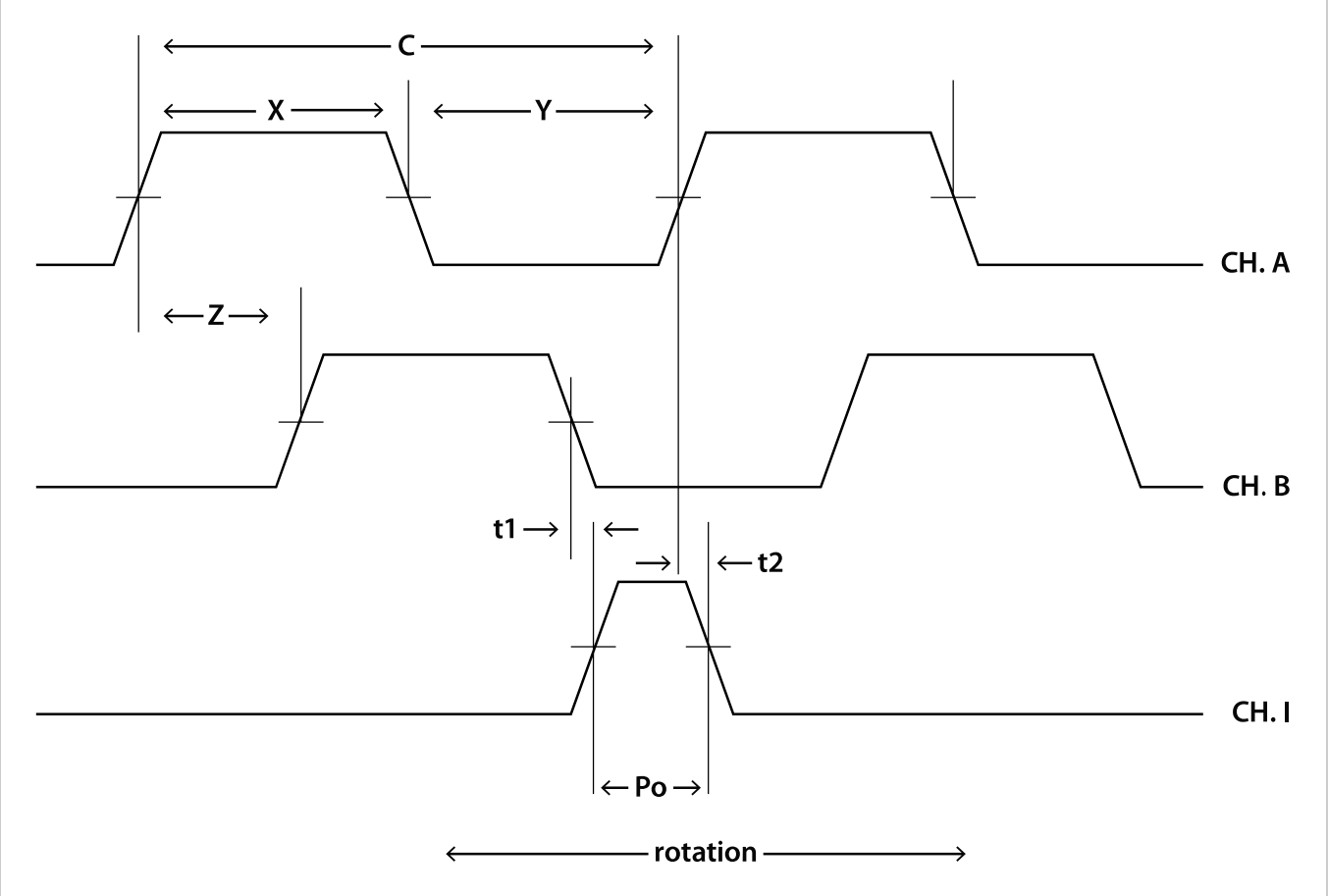
ENCODING CHARACTERISTICS:

- 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/#glossary_e)*
Quadrature	Z	60	90	120	°e *(https://www.usdigital.com/support/resources/glossary/#glossary_e)*
Index Pulse Width	Po	40	90	120	°e *(https://www.usdigital.com/support/resources/glossary/#glossary_e)*
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.

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_WEB	-	Type	-	Resolution	-	Index
		0 (*Linear Strip*)		120 LPI		I (*Index*)
		1 (*1" Disk*)		127 LPI		N (*Non-Index*)
		2 (*2" Disk*)		150 LPI		
				180 LPI		
				200 LPI		
				250 LPI		
				300 LPI		
				360 LPI		
				500 LPI		
				32 CPR		
				50 CPR		
				64 CPR		
				100 CPR		
				100 CPR		
				200 CPR		
				200 CPR		
				250 CPR		
				360 CPR		
				400 CPR		
				400 CPR		
				500 CPR		
				500 CPR		
				512 CPR		
				540 CPR		
				720 CPR		
				800 CPR		
				800 CPR		
				900 CPR		
				1000 CPR		
				1024 CPR		
				1250 CPR		
				1000 CPR		
				1024 CPR		
				1800 CPR		
				2000 CPR		
				2048 CPR		
				2500 CPR		

PLEASE NOTE: This chart is for informational use only. Certain product configuration combinations are not available. Visit the EM1_WEB product page *(https://www.usdigital.com/products/EM1_WEB)* for pricing and additional information.