

## Description

The **EM2** is a transmissive optical encoder module designed to offer 2x or 4x higher resolution than the **EM1** encoder module. This module is designed to detect rotary position when used with a US Digital encoder disk. The **EM2** consists of a lensed LED source and a monolithic detector IC enclosed in a small polymer package that is identical to the **EM1**. The **EM2** uses phased array detector technology to provide superior performance and greater tolerances over traditional aperture mask type encoders.

The **EM2** provides digital A & B quadrature outputs with a third output index channel. Each **EM2** module is resolution specific and is matched to the resolution of a encoder disk. The **EM2** operates with a single 5V supply and provides single ended outputs which are capable of both sinking and sourcing 5mA. An internal 0.1 uF decoupling capacitor is designed into the **EM2** to provide enhanced noise immunity.

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, quadrature decoder chips, counter chips, computer interface boards, mating connectors and cables are also available.

Download the EM2/EM1 comparison chart.



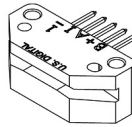
## Features

- Two channel quadrature with index
- High resolution version of EM1
- Single 5V supply
- Rotary versions up to 10000 CPR
- Linear versions up to 2000 CPI
- Internal decoupling capacitor
- Outputs source/sink 5 mA

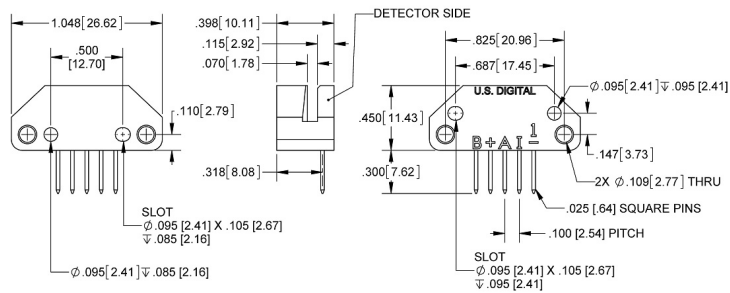
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## Mechanical Drawing

## EM2 Transmissive Optical Encoder Module



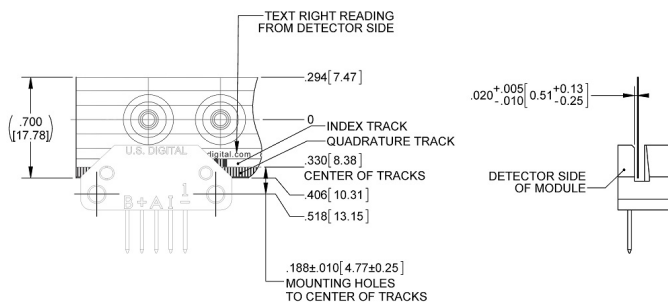
RELEASE DATE: 10/17/2013



## Linear Alignment

## EM2 Transmissive Optical Encoder Module

### Linear Strip Alignment

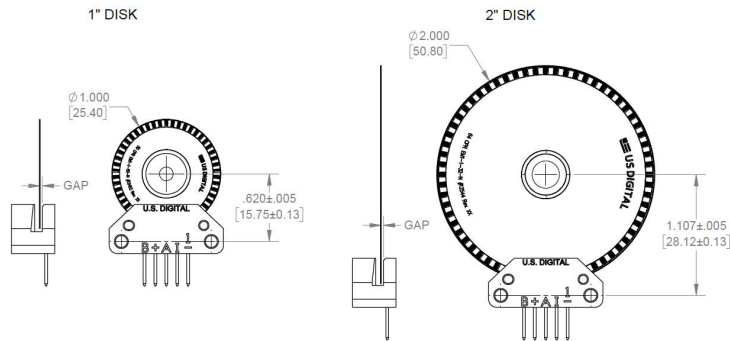


RELEASE DATE: 04/07/2015

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 **EM2 Disk Alignment****EM2 Transmissive Optical Encoder Module**  
Disk Alignment

RELEASE DATE: 12/21/2016

 **Available Resolutions**

| CPR/CPI | EM2                                        | HUBDISK-1           | HUBDISK-2           | LIN          |
|---------|--------------------------------------------|---------------------|---------------------|--------------|
| 1000    | EM2-0-1000-*                               | -                   | -                   | LIN-1000-*.* |
| 2000    | EM2-1-2000-I (1") / EM2-0-2000-<br>* (LIN) | HUBDISK-1-2000-*.IE | -                   | LIN-2000-*.* |
| 2048    | EM2-1-2048-I                               | HUBDISK-1-2048-*.IE | -                   | -            |
| 2500    | EM2-1-2500-I                               | HUBDISK-1-2500-*.IE | -                   | -            |
| 3600    | EM2-2-3600-I                               | -                   | HUBDISK-2-3600-*.IE | -            |
| 4000    | EM2-1-4000-I (1") / EM2-2-4000-I (2")      | HUBDISK-1-4000-*.IE | HUBDISK-2-4000-*.IE | -            |
| 4096    | EM2-1-4096-I (1") / EM2-2-4096-I (2")      | HUBDISK-1-4096-*.IE | HUBDISK-2-4096-*.IE | -            |
| 5000    | EM2-1-5000-I (1") / EM2-2-5000-I (2")      | HUBDISK-1-5000-*.IE | HUBDISK-2-5000-*.IE | -            |

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| CPR/CPI | EM2           | HUBDISK-1 | HUBDISK-2            | LIN |
|---------|---------------|-----------|----------------------|-----|
| 7200    | EM2-2-7200-I  | -         | HUBDISK-2-7200-*-IE  | -   |
| 8000    | EM2-2-8000-I  | -         | HUBDISK-2-8000-*-IE  | -   |
| 8192    | EM2-2-8192-I  | -         | HUBDISK-2-8192-*-IE  | -   |
| 10000   | EM2-2-10000-I | -         | HUBDISK-2-10000-*-IE | -   |

## Operating Conditions

| Parameter                                   | Min.   | Max.                            | Units    | Notes                                                                              |
|---------------------------------------------|--------|---------------------------------|----------|------------------------------------------------------------------------------------|
| Temperature                                 | -25    | 100                             | C        |                                                                                    |
| A/B Output Frequency                        | 0      | 360                             | kHz      | 2000, 2048, 2500 CPR (1")<br>3600, 4000, 4096, 5000 CPR (2")<br>1000 CPI (Linear)  |
|                                             | 0      | 720                             | kHz      | 4000, 4096, 5000 CPR (1")<br>7200, 8000, 8192, 10000 CPR (2")<br>2000 CPI (Linear) |
| Disk RPM                                    | 0      | (21.6 x 10 <sup>6</sup> ) / CPR | RPM      | 2000, 2048, 2500 CPR (1")<br>3600, 4000, 4096, 5000 CPR (2")                       |
|                                             | 0      | (43.2 x 10 <sup>6</sup> ) / CPR | RPM      | 4000, 4096, 5000 CPR (1")<br>7200, 8000, 8192, 10000 CPR (2")                      |
| Linear Strip Speed                          | 0      | 360                             | in./sec. | 1000, 2000 CPI (Linear)                                                            |
| Disk/Linear Strip Radial Position Tolerance | ± .005 |                                 | inch     | with gap set by standard spacer tool                                               |

## Electrical Specifications

- Specifications apply over entire operating temperature/voltage 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    |      | 72   | 85   | mA    | no load           |
| Low-level Output  |      |      | 0.5  | V     | IoL = 5 mA        |
|                   |      | 0.25 |      | V     | no load           |
| High-level Output | 2.0  |      |      | V     | IoH = -5 mA       |
|                   |      | 3.5  |      | V     | no load           |

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| Parameter                  | Min. | Typ. | Max. | Units | Conditions    |
|----------------------------|------|------|------|-------|---------------|
| Output Current Per Channel | -5   |      | 5    | mA    |               |
| Load Capacitance           |      |      | 100  | pF    |               |
| Output Rise Time           |      | 50   |      | nS    | ± 5 mA load   |
| Output Fall Time           |      | 50   |      | nS    | ± 5 mA load   |
| Electrostatic Discharge    |      |      | ± 4  | kV    | IEC 61000-4-2 |



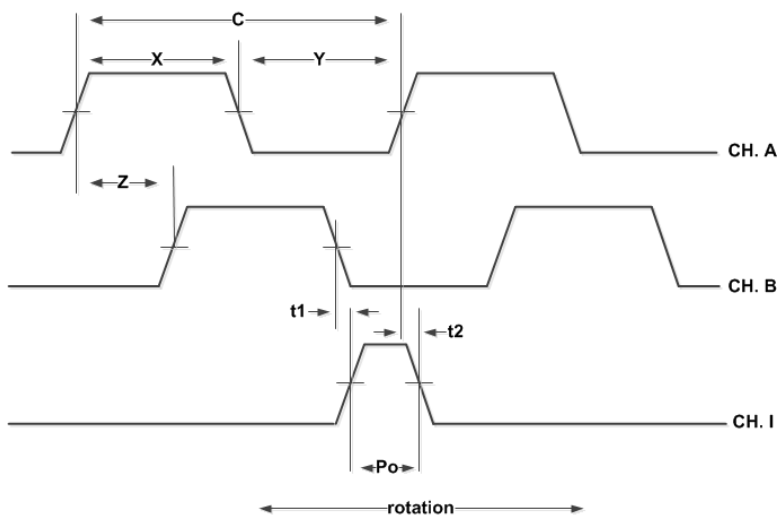
## Timing Characteristics

### Encoding Characteristics:

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

| Parameter                            | Symbol | Min. | Typ. | Max. | Units |
|--------------------------------------|--------|------|------|------|-------|
| Symmetry                             | X, Y   | 108  | 190  | 252  | ° e   |
| Quadrature                           | Z      | 45   | 90   | 135  | ° e   |
| Index Pulse Width                    | Po     | 45   | 90   | 135  | ° e   |
| Ch. I Rise After Ch. B or Ch. A Fall | t1     |      | -40  |      | ns    |
| Ch. I Fall After Ch. B or Ch. A Rise | t2     |      | 25   |      | ns    |

### Timing Diagram:



**CPi:** The number of Cycles (C) of the A or B output Per Inch of linear strip movement.

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**CPR:** The number of Cycles (C) of the A or B outputs Per 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 ( $90^\circ$  e).

**One Shaft Rotation:** 360 mechanical degrees.

**One Electrical Degree ( $^\circ$  e):** 1/360th of one cycle.

**One Cycle:** 360 electrical degrees ( $^\circ$  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  $90^\circ$  e.

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



## Installation Torque

| Parameter       | Torque       |
|-----------------|--------------|
| Mounting Screws | 3.5-4 in-lbs |



## Pin-outs

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

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## Notes

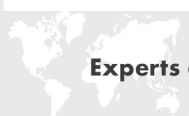
- US Digital® warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

## Ordering Information

EM2 -  -  -

| Native OD | Native CPI/CPR | Index       |
|-----------|----------------|-------------|
| 0Linear   | 1000 =         | I =Index    |
| 1 =1in    | 2000 =         | N =No Index |
| 2 =2in    | 2048 =         |             |
|           | 2500 =         |             |
|           | 3600 =         |             |
|           | 4000 =         |             |
|           | 4096 =         |             |
|           | 5000 =         |             |
|           | 7200 =         |             |
|           | 8000 =         |             |
|           | 8192 =         |             |
|           | 10000 =        |             |

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