

Description:

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

Each module provides digital quadrature and index channel outputs. They use a single supply +5V supply; +12 volt versions will also be available. The **EM1** features internal single ended line drivers that swing from rail to rail while sourcing or sinking up to 8mA of current.

The resolution of the modules and encoder disks and linear strips must match. They can easily be mounted by using 4-40 screws through the mounting holes.

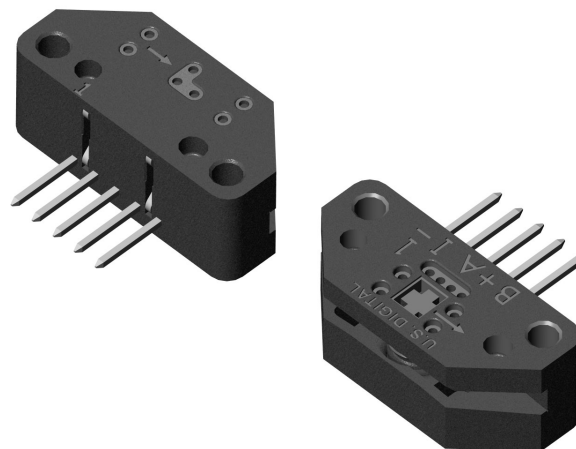
Agilent encoder disks are not compatible with the **EM1**. Only US Digital encoder disks are compatible with the **EM1**. The **EM1** is designed to fit all of US Digital's current and future incremental encoders.

The suggested mating connector is AMPMODU# 103977-4 or AMP# 640442-5. For open collector and higher voltage applications, add the **PC3** device, or for differential cable driver outputs, add the **PC4** device. Encoder disks, linear strips, quadrature decoder chips, counter chips, computer interface boards, mating connectors and mating cables are also available.

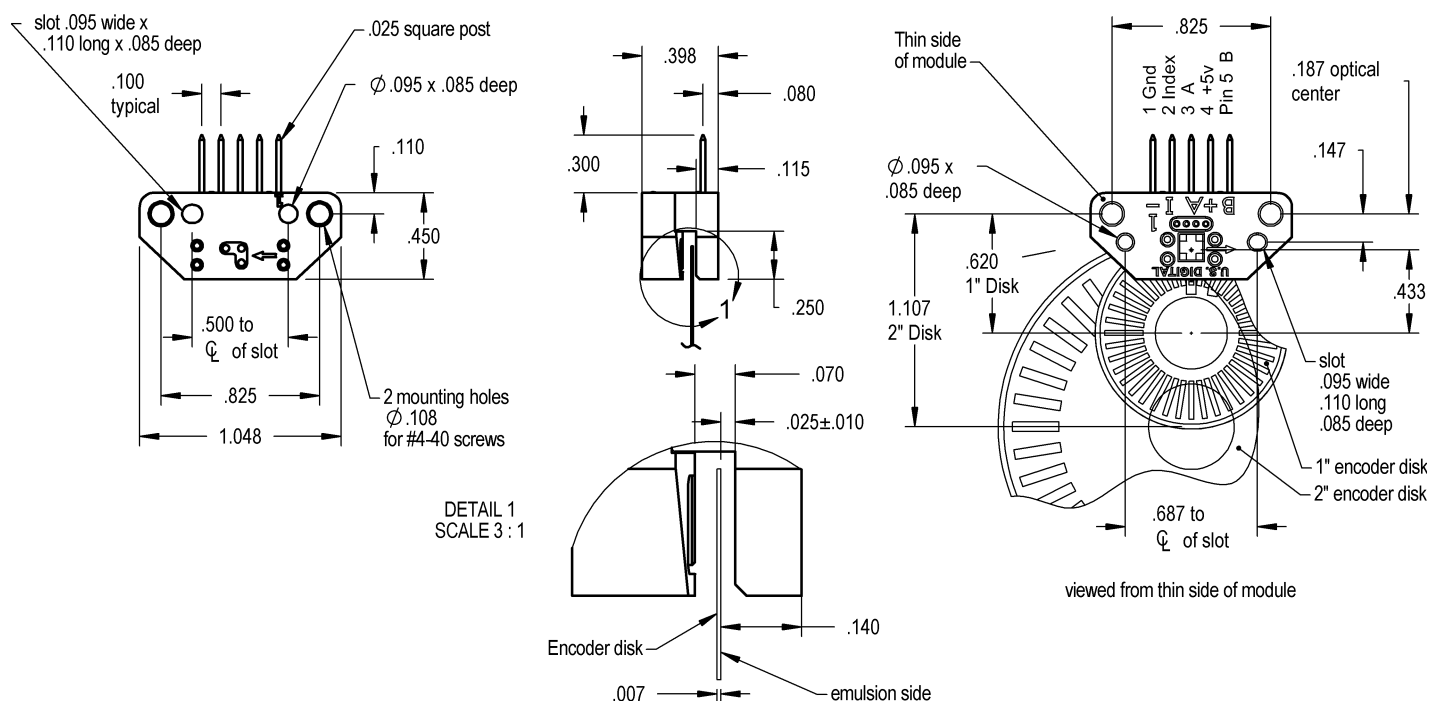
US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

Features:

- Two channel quadrature output with index pulse
- Resolution up to 2500 CPR (10,000 codes/rev)
- Small size
- -55°C to 125°C operating temperature
- TTL compatible
- Single 5V supply



Mechanical Specifications:



Recommended Operating Conditions:

Parameter	Min.	Max.	Units	Notes
Temperature	-55	125	°C	
Supply Voltage	4.5	7.0	Volts	Ripple<100mV _{p-p}
Load Capacitance	-	100	pF	
Count Frequency	-	100	kHz	rpm/60 x cycles/rev.

Encoder Characteristics:

Parameter	Symbol	Min.	Typ.	Max	Units
Cycle Error		3.0	5.5	-	°e
Symmetry		150	180	210	°e
Quadrature		60	90	120	°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. A or CH. B rise	t2	70	150	300	ns
Storage Temperature and Operating		-55	-	125	°C
Supply Voltage	Vcc	-0.5	-	7	Volts
Output Voltage	Vcc	-0.5	-	-	Volts
Current Draw		24	27	30	mA
Output Low (at 8mA current, sink)		-	-	0.5	Volts
Output High (at -8mA current, source)		2.0	-	-	Volts

> Specifications apply over entire operating temperature range. Values are for the worst error over a full rotation.

> Use Timing Diagram below.

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

One Shaft Rotation: 360 mechanical degrees, N cycles.

One Electrical Degree (°e): 1/360 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.

Shaft Rotation for Shaft Encoders:

> View the encoder so the shaft/bushing side is facing up.

H1:

A leads B in a clockwise rotation; B leads A in a counterclockwise rotation.

H3, H5D, H5S, HD25, S1, S2, S5D, S5S and SP-16:

B leads A in a clockwise rotation; A leads B in a counterclockwise rotation.

Shaft Rotation for Kit Encoders:

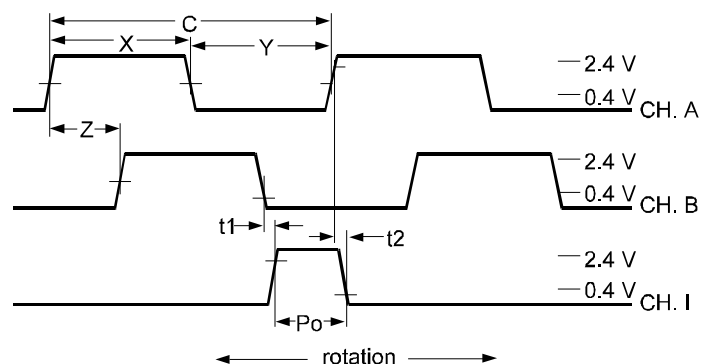
> View the encoder so the cover side is facing up.

E3, E5D, E5M, E5S and E6M:

A leads B in a clockwise rotation; B leads A in a counterclockwise rotation.

E2:

B leads A in a clockwise rotation; A leads B in a counterclockwise rotation.

Timing Diagram:

Compatibility:

Our new encoder module uses a single track with multiple windows to detect index.

At first glance, it may appear that using multiple windows to detect a single ¼ cycle index may not be as accurate as a single window detection method. In reality, this new method yields a stronger signal, excellent positional accuracy, and insures a single index pulse per revolution.

Here's how it works: the index pattern consists of I and I-not photodiodes (sensors). There are two to five times as many I-not sensors as I sensors. Except for the index pattern area, the index track of the disk is transparent allowing light to expose all of the index sensors. Because there are more I-not sensors, the differential index amplifier detects not-index. When the index pattern of the disk exactly lines up with matching detector sensors, only the I sensors receive light. All of the I-not sensors are blocked. The detection pattern is a complex sequence. The number of bits is proportional to the resolution. For example: a 1-inch disk with 1024 CPR uses a 32-bit index sequence. The sequence is arranged so that even through the transition into and out of the correct index phase, only the exact index alignment can bias the index detector into the asserted state. The sequence has similarities to a combination lock. Only the exact code in the correct sequence will work. Nothing else comes close.

This new method yields plenty of index signal and phase accuracy for even the highest resolution modules.

These modules are designed to be closely compatible with Agilent encoder modules. The **EM1** modules and disks have the following differences.

- They provide more line driver current (both sourcing and sinking)
- They consume less power than Agilent index versions
- Standard versions have a wider temperature range
- They use 1 track instead of 2 to generate the index channel
- All versions have index (not an option)
- Additional resolutions are available and more are planned
- Linear versions (not just rotary versions) will also be available with index
- Special resolution modules can be provided with a reasonable lead time
- The connector pins are .300" rather than .350" long
- The wire loops have been recessed into the housing
- Standard versions have an internal 0.1mf bypass capacitor

Why does US Digital use one track rather than two to generate the index channel? A single "combination-lock" type index track provides a stronger internal index signal at higher resolutions and requires less LED current. This enables US Digital to provide the index channel even at the highest resolutions. Can I use Agilent encoder disks with US Digital modules? If you do not use the index channel, the non-index Agilent compatible disks will work just as well. US Digital will continue to manufacture both versions with no cost difference.

What resolutions are planned for the **EM1** module? The resolution is set by a single mask when fabricating the monolithic detector chip. New resolutions are in process and will be added to our datasheets as they become available. Check www.usdigital.com for the most current list of available resolutions. We encourage you to inquire about any resolutions we do not already stock, that may be beneficial to you.

Ordering Information:

EM1 -		—	
Type: 0 = Linear. 1 = 1" Disk.	Linear: 120 125* 127 150 200 250	1" Disk: 32	2" Disk: 64**

Price:

\$28.00 / 1
\$24.64 / 10
\$22.40 / 50
\$20.72 / 100
\$19.60 / 500
\$19.04 / 1K

New resolutions will be released weekly, for information on any new resolutions, please visit our website at www.usdigital.com or call us at 360.260.2468.

Exceptions:

- *125 CPI (linear) uses the EM1-0-127 module, when ordering use part number EM1-0-127.
- **64 CPR (2" disk) uses the EM1-1-32 module, when ordering use part number EM1-1-32.

Technical Data, Rev. 01.20.03, January 2003
All information subject to change without notice.