

A2

Absolute Encoder

Description:

The A2 absolute encoder is a non-contacting optical rotary position sensor which reports the shaft angle within a 360° range. As opposed to incremental encoders, the A2 reports the absolute position rather than the change in position. When powered up, it does not require a home cycle, even if the shaft was rotated while the power was off. In multi-turn mode, it tracks the position in a 32-bit counter as long as the power supply is maintained. The SEI-UPS will retain the multiturn position after a power failure (see the SEI-UPS data sheet). Internally, an infrared LED flashes through a circular bar code onto a linear array sensor. The microcontroller decodes the image into a unique position. All user programmable parameters such as resolution, origin, direction and mode are permanently stored in an internal EEPROM.

The interface of the A2 utilizes our SEI (Serial Encoder Interface) bus. The SEI bus is a simple, quick, convenient network of devices interfacing to an RS232 serial port or USB port. The SEI bus (see the SEI data sheet) supports 1 to 15 devices on a single, 6-wire telephone-type cable up to 1000 feet long (similar to RS-485).

Several versions are available:

- > **Ball Bearing** - For applications that require high speed and low drag.
- > **Hybrid** - For applications that require compatibility with quadrature controllers while the initial position is obtained from the absolute encoder.
- > **Hybrid Kit** - For applications that require compatibility with quadrature controllers while the initial position is obtained from the absolute encoder. For mounting to an existing shaft.
- > **Inclinometer** - For applications that require tilt angle position (see the A2T data sheet).
- > **Kit** - For applications where the absolute encoder needs to mount to an existing shaft.
- > **Sleeve Bushing** - For applications that require low RPM and front panel use (feels like potentiometer).

Analog output (A-option) is available for each of the above versions. It can stand alone (does not need to connect to a PC), providing an analog voltage proportional to the angular position, with 12-bit resolution. The A-option is fully functional with the SEI bus, but is limited to one device instead of 15 devices.

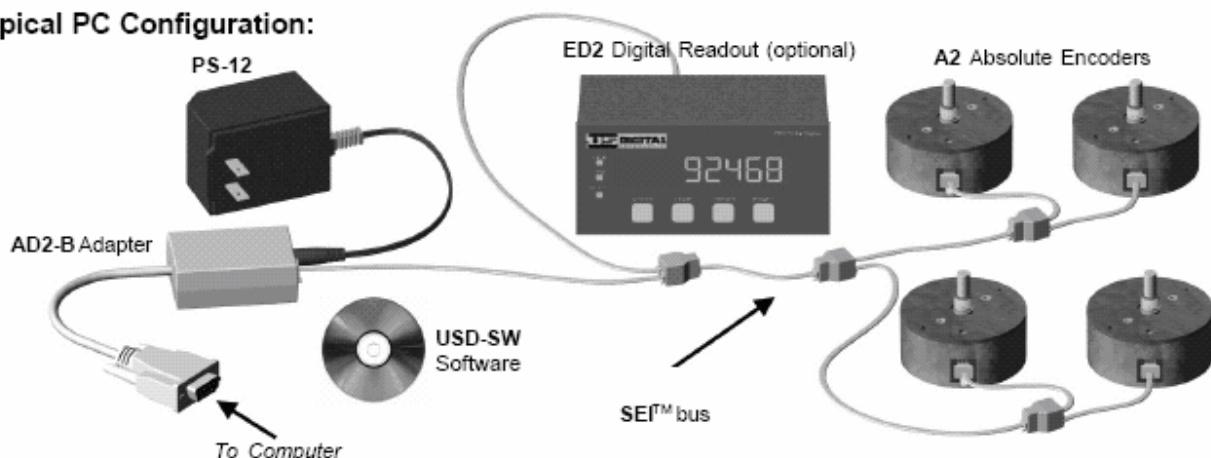
Features:

- > Up to 15 devices on a single 6-pin telephone-type cable
- > 12-bit accuracy
- > Update rate is 4 milliseconds
- > EEPROM stores downloadable parameters
- > Field programmable resolution (2-65536 codes per revolution)
- > Remotely updatable firmware
- > Field programmable zero position
- > Single-turn or multi-turn modes
- > Low power: 18.5mA max
- > 1500 uA sleep mode for battery operation
- > Uses standard PC data rates up to 115 Kbaud
- > -25° to 70°C operating temperature
- > 360° range
- > 12-bit analog output option
- > Sleeve bushing version
- > Ball bearing version
- > Shaft-mount kit version
- > Through-hole kit version
- > Absolute / incremental hybrid version
- > Free software and source code provided
- > Rugged, simple, low cost

Materials:

Housing	Glass filled polycarbonate
Shaft	Brass

Typical PC Configuration:



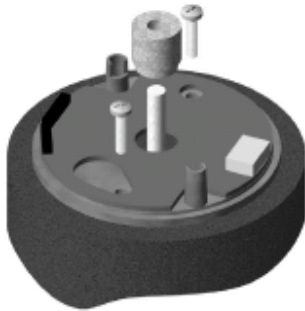
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Kit Assembly Instructions:

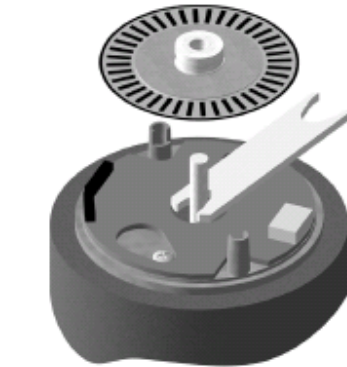
1. Base Mounting:

Secure base by inserting screws through holes on the 1.812" bolt circle. Holes in base are designed for #4 screws. Use centering tool to align base with existing shaft.



2. Spacer Installation:

Place spacer tool on circuit board as shown. Position hub/disk assembly above shaft as shown. Slip over shaft and press down until hub and spacer tool bottom out against base.



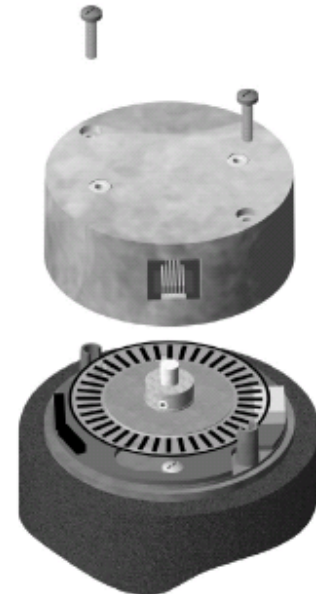
3. Tightening Set Screw:

Press hub disk against spacer tool and tighten set screw with hex wrench provided. Set screw should be snug, but do not overtighten. Remove spacer tool.



4. Cover Installation:

Important: Cover must be oriented as shown. Because cover plugs into base, use caution during installation. Posts on base are two different lengths. Match with proper post. Connector pins can be damaged if not lined up properly. Secure with two 4-40 X 1" pan head screws provided.



Analog Output:

The analog versions of the A2 have a 12-bit DAC on the output which feeds to 2 lines otherwise used for the BUSY handshaking pair. This DAC has a full range of 0 to 4.095V which is 1 milli-volt per bit. The value which the internal microcontroller sends to that DAC is the same as the digital value it sends to the host. Since the resolution (which represents the number of codes per revolution) is field programmable, the range of the DAC will also follow that setup. Our default resolution is 3600 CPR, which yields 1 count per tenth of a degree. This makes the DAC output equal to 1 milli-volt per tenth of a degree, or 0 to 3.599V. When the DAC needs to have the full range to 4.095V, the single turn resolution should be set to 4096. This is easily done with the available software which runs on a PC. See the third page of this data sheet for information on the SEI-ADA absolute encoder analog adapter.

Please Note: The BUSY handshaking lines are replaced by the analog output option. This means that only one device will be able to be connected to the SEI bus when using the analog output option.

Absolute Maximum Ratings:

(Voltage Referenced to Ground)			
Parameter	Min.	Max.	Units
Storage Temperature	-40	100	°C
Operating Temperature	-25	70	°C
Humidity (non-condensing)	0	95	%
Supply Voltage (power)	0	16	Volts
DataH, DataL, Busy+, Busy-	-14	14	Volts
Electrical Tracking (multi-turn mode)	-	1800	RPM
Electrical Tracking (single-turn mode)	-	3600	RPM
Position Update Rate*	-	3.8	mSec

* The internal microcontroller takes a snapshot of the disk every 4 msec. and stores the position in memory. It responds immediately to a "report position request" by sending this value, which is always the most current position.

Electrical Specifications:

> Specifications apply over entire operating temperature range.
> Typical values are specified at Vcc=12V and 25°C.

Parameter	Min.	Typ.	Max.	Units
Supply Voltage (power)	5.5	-	16	Volts
Supply Voltage (above 50°C)	-	-	11	Volts
Supply Current (active)	-	14	18.5	mA
Supply Current (sleep)	-	-	1.5	mA
Analog Output Impedance (analog+)	950	1000	1050	Ohms
Zero Scale Analog Voltage	0	.0005	.003	Volts
Full Scale Analog Voltage	4.079	4.095	4.111	Volts
Differential Nonlinearity	-1.0	-	1.0	LSB

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Accessories:

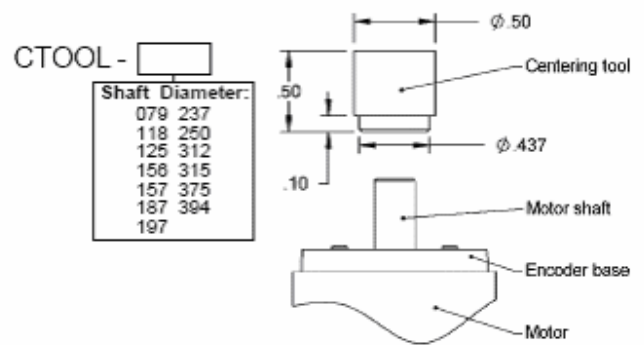
Centering Tool for KIT Version:
This reusable tool provides a simple method for accurately centering the A2 circuit board around the shaft. It is recommended for the following situations:

- When using mounting screws smaller than 4-40.
- When the position of the mounting holes are in question.

Instructions: When mounting encoder base, slide centering tool down shaft until it slips into centering hole of encoder base. Tighten mounting screws, then remove centering tool.

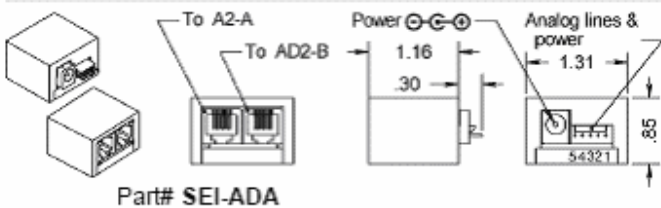
Hex Tools:
HEXD-3404
Hex driver, .050" flat-to-flat for 3-48 set screw.
HEXW-349
Hex wrench, .050" flat-to-flat for 3-48 set screw.

Spacer Tool:
SPACER-13



SEI-ADA:

Absolute Encoder Analog Adapter (for A2-A only):
Connect the A2-A absolute analog encoder to the SEI-ADA to have easy access to the analog output of the absolute encoder. The SEI-ADA will still allow you to connect the A2-A to the AD2-B, which in turn allows complete control of the absolute encoder via your PC. The 5-pin connector on the SEI-ADA has analog output lines of the absolute encoder and power from the SEI bus. The 5-pin connector pin-out is as follows: Pin-1 is Ground, Pin-2 is Analog+, Pin-3 is Analog-, Pin-4 is NC, Pin-5 is Power.



SEI Software:

The software includes a demo/configuration utility which detects encoders on the network and displays their position on the screen. The SEI software recognizes encoders on the bus and automatically assigns them unique addresses. The utility includes diagnostics which display status, assigned address, serial number, model, and version of each encoder, verifying that the SEI bus is operating correctly. It also allows the user to change the resolution, address, mode and zero position of each encoder. The SEI software has the ability to record positions to file. The format is Windows 95/98/ME, Windows NT/2000/XP compatible software on a CD-ROM. A 'readme' file contains additional information.

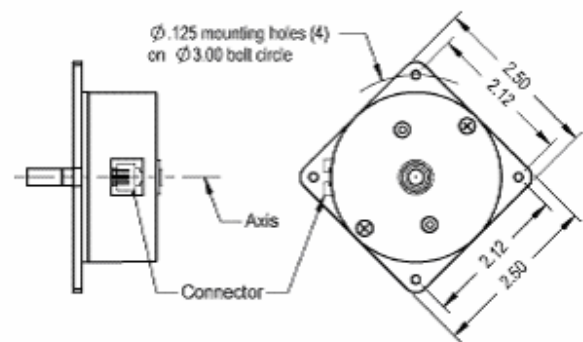
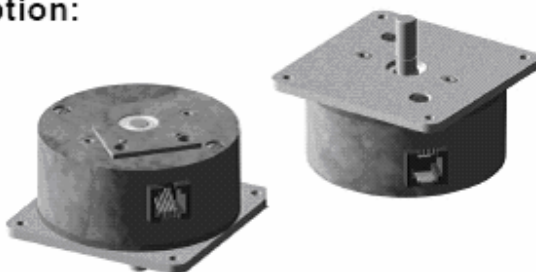


Part# USD-SW (Included with every order.)

Pin-out:

Pin	Description
1	Ground
2	Busy+
3	Busy-
4	Power
5	DataL
6	DataH

M-option:



Mounting:

➤ With the M-option adapter plate the A2 can be mounted using the 4 holes in the plate on a 3" diameter bolt circle.

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Ball Bearing Version:

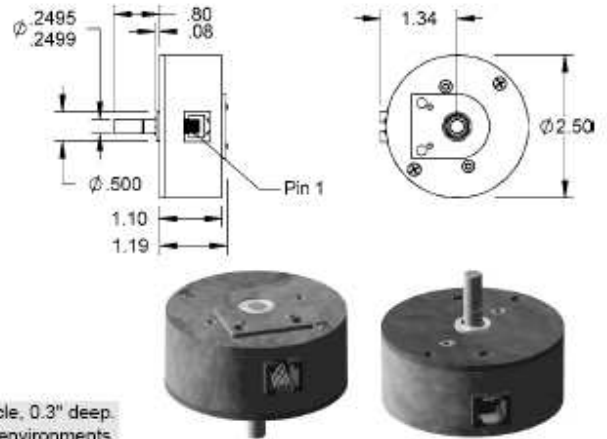
Shaft Speed	10,000 rpm max. continuous
Shaft Rotation	10,000 rad/sec ²
Shaft Torque	0.05 in. oz. max.
Shaft Loading	2 lbs. max.
Bearing Life	(90/P) ³ = life in millions of revs. Where P = radial load in pounds
Weight	3.2 oz.
Shaft Runout	.0008 T.I.R. max.
Moment of Inertia	.0001 oz in s ²

A2 - [] - B - []

Interface:
S = SEI bus.
A = Analog output.

Options:
E = Rear shaft extension.
M = 4-hole adapter plate for 3" diameter bolt circle.
HS = Sealed housing.

- > The A2 can be mounted using the (2) 4-40 threaded holes on the 1.812" bolt circle, 0.3" deep.
- > The HS-option enables the encoder to be reasonably capable of surviving in liquid environments, but this encoder is not waterproof.



Sleeve Bushing Version:

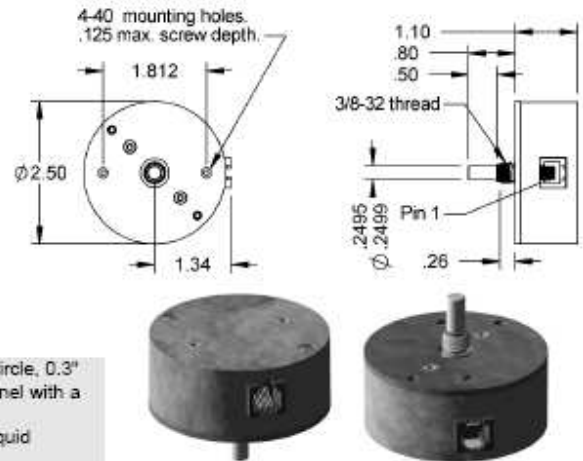
Shaft Speed	180 rpm max. continuous
Shaft Rotation	Continuous and reversible
Shaft Torque	0.5±0.2 in. oz.
Shaft Loading	.390 in. oz. max. (NT-option)
Weight	2.5 oz.
Moment of Inertia	.0001 oz in s ²

A2 - [] - S - []

Interface:
S = SEI bus.
A = Analog output.

Options:
NT= No added torque (feels like a potentiometer).
HS = Sealed housing.

- > The A2 can be mounted using the (2) 4-40 threaded holes on the 1.812" bolt circle, 0.3" deep. The A2 can also be mounted using the supplied nut and washer to a panel with a maximum thickness of .125".
- > The HS-option enables the encoder to be reasonably capable of surviving in liquid environments, but this encoder is not water proof.



Hybrid Version:

Shaft Speed	10,000 rpm max. continuous
Shaft Rotation	10,000 rad/sec ²
Shaft Torque	0.05 in. oz. max.
Shaft Loading	2 lbs. max.
Bearing Life	(90/P) ³ = life in millions of revs. Where P = radial load in pounds
Weight	3.7 oz.
Shaft Runout	.0015 T.I.R. max.
Moment of Inertia	.0001 oz in s ²

A2 - [] - E2 - []

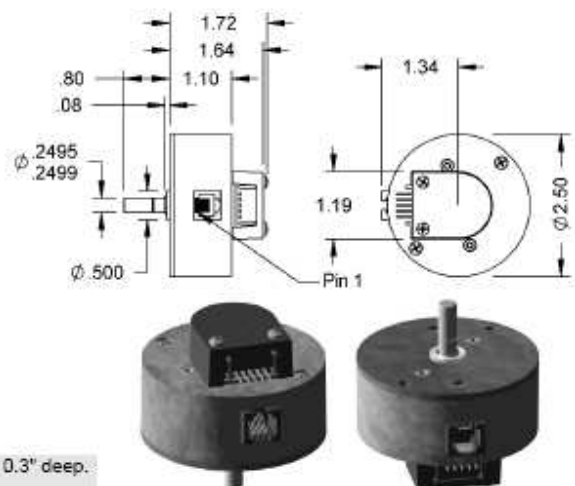
Interface:
S = SEI bus.
A = Analog output.

Incremental	Resolution:
32**	120* 360 720**
50	192 400 1000
98	200 500 1018*
100	250 512 1024
110*	256 540* 1250**

Options:
I = Index.
M = 4-hole mounting adapter plate for 3" diameter bolt circle.

* Index option not available.
** 32, 720, 1250 available only with index.

- > The A2 can be mounted using the (2) 4-40 threaded holes on the 1.812" bolt circle, 0.3" deep.
- > See E2 shaft-mount optical encoder.



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Kit Version:

Shaft Speed	10,000 rpm max. continuous
Acceleration	10,000 rad/sec ²
Weight	2.6 oz.
Moment of Inertia	.0001 oz in s ²
Shaft Length	.60 to .80" from mounting surface.

A2 - - K - -

Interface:
S = SEI bus.
A = Analog output.

Shaft Diameter:

079 - 2mm	237 - 6mm
118 - 3mm	250 - 1/4"
125 - 1/8"	312 - 5/16"
156 - 5/32"	315 - 8mm
157 - 4mm	375 - 3/8"
187 - 3/16"	394 - 10mm
197 - 5mm	

Options:
H = Hole in housing (allows the shaft to pass through the encoder).
M = 4-hole adapter plate for 3" diameter bolt circle.



Notes:

- > The A2 can be mounted using the 2 screws on the 1.812" bolt circle.
- > Includes spacer tool, centering tool and hex wrench.

Hybrid Kit Version:

Shaft Speed	10,000 rpm max. continuous
Acceleration	10,000 rad/sec ²
Weight	2.9 oz.
Moment of Inertia	.0001 oz in s ²
Shaft Length	1.47 to 1.59" in from mounting surface

A2 - - KE2 - - -

Interface:
S = SEI bus.
A = Analog output.

Incremental Resolution:

32	110*	250	512
50	120*	256	540*
96	192	360	1000*
100	200	400	1018*
		500	1024*

* Index option not available.

Shaft Diameter:

079 - 2mm	237 - 6mm
118 - 3mm	250 - 1/4"
125 - 1/8"	312 - 5/16"
156 - 5/32"	315 - 8mm
157 - 4mm	375 - 3/8"
187 - 3/16"	394 - 10mm
197 - 5mm	

Options:
I = Index.
H = Hole in housing (allows the shaft to pass through the E2).
M = 4-hole mounting adapter plate for 3" diameter bolt circle.



Notes:

- > The A2 can be mounted using the 2 screws on the 1.812" bolt circle.
- > Includes spacer tool, centering tool and hex wrench.

In applications where a failure could result in an unacceptable loss, we recommend that your system be designed to include two redundant encoders with the outputs from both continuously compared to make sure that they agree. If there is a discrepancy, the system should be designed to automatically shut down as a fail-safe measure to minimize the risk of damage or danger. This product is not certified for applications where a failure could result in a costly, dangerous, or life-threatening situation.

For more information on the A2 Communications Protocol, please see the A2 Communications Protocol data sheet.
For information on retaining the multi-turn position, please see the SEI-UPS uninterruptable power supply data sheet.