# A2T Absolute Optical Inclinometer



## Description

The A2T is a single axis, digital gravity angle sensor. The A2T serves as a full 360 range absolute tilt sensing programmable level with either digital or analog output. Internally, a rotary bar coded disk is mounted to a weighted gravity driven wheel. A micro-controller strobes an LED to transfer the bar code image onto an optical linear array, then decodes the position every 2 mSec. Magnetic damping provides fast response and settling time while virtually eliminating overshoot and oscillations. An internal EEPROM stores field programmable parameters such as resolution, zero position, direction swap, and mode. This second generation design virtually eliminates the primary accuracy limitation of first generation inclinometers, which is sitation (hysteresis).

The interface of the A2T utilizes our SEI (Serial Encoder Interface) bus (see the SEI page). The SEI bus is a simple, quick, convenient network of devices interfacing to a RS232 serial port. The SEI bus supports from 1 to 15 devices on a single, 6-wire telephone-type cable up to 1000FT long (similar to RS-485).

US Digital offers two SEI interfaces: the AD2B adapter for interface to an RS232 port and the SEI-USB for interface to a USB port. One of these products is required in order to interface the A2T to a PC via our SEI bus. The wall-mount PS-12 power supply furnishes the power for all devices on the SEI bus.

US digital provides software free of charge for all products which require software for operation. The software comes on a CD with each product shipped or can also be down loaded from US Digital's website here. The software can be used as is or it can serve as an example for creating your own custom application. The absolute encoder software utilizes our SEI Explorer software to configure and communicate with the product from a PC platform.

Our absolute encoders may be used in many stand alone applications that do not require a PC interface. For these applications we provide detailed communications protocols for all of our absolute products (see the SEI Absolute Encoder Communications Protocol page).

Typical applications include heavy construction equipment, dredging machinery, mining equipment, solar tracking and warehouse automation.


## Features

- 12-bit accuracy and resolution field programmable from 2 to 4096 codes per revolution (3600 factory default)
- Full 360 degrees range and position update rate is 250 times per second
- Low power drain of 16 mA max., and 0.6 mA in sleep mode
- Field programmable parameters such as setting zero position point (free demo software provided)
- EEPROM stores downloadable parameters
- 9600 baud default data rate adjustable up to 115K baud
- 12-bit analog voltage output option (0 to +3.599 volts factory default setting. Field progammable up to 0 to +4.095 volts)
- Multi-turn mode (note: power must be maintained to prevent reset to zero)
- -25 to 70 degrees C. operating temperature
- Simple, low cost

## Mechanical Drawing

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Vancouver, Washington 98684, USA
info@usdigital.com
www.usdigital.com
Local: 360.260.2468
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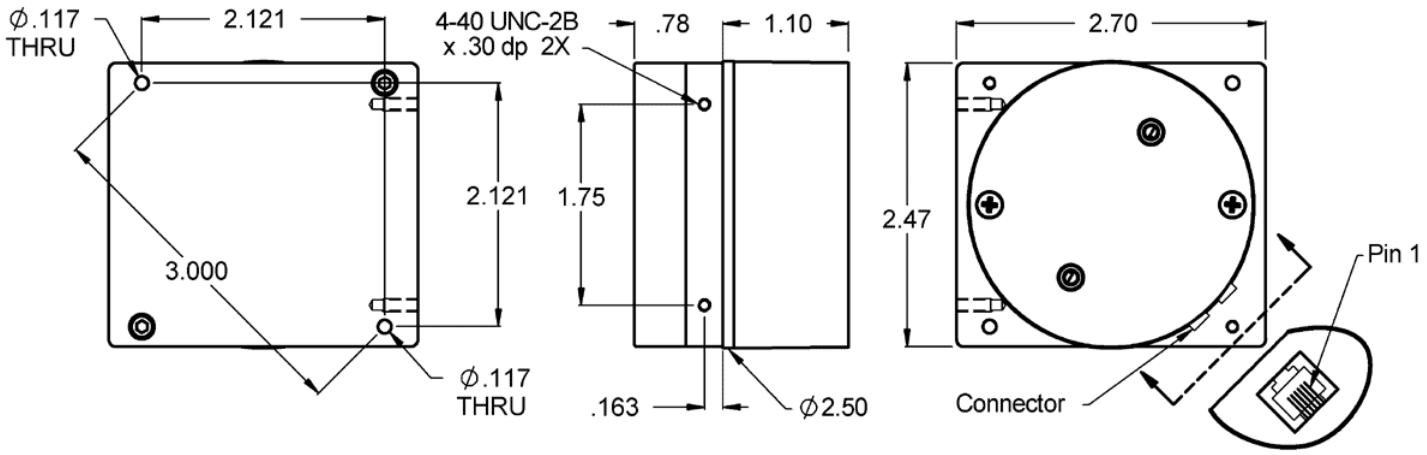


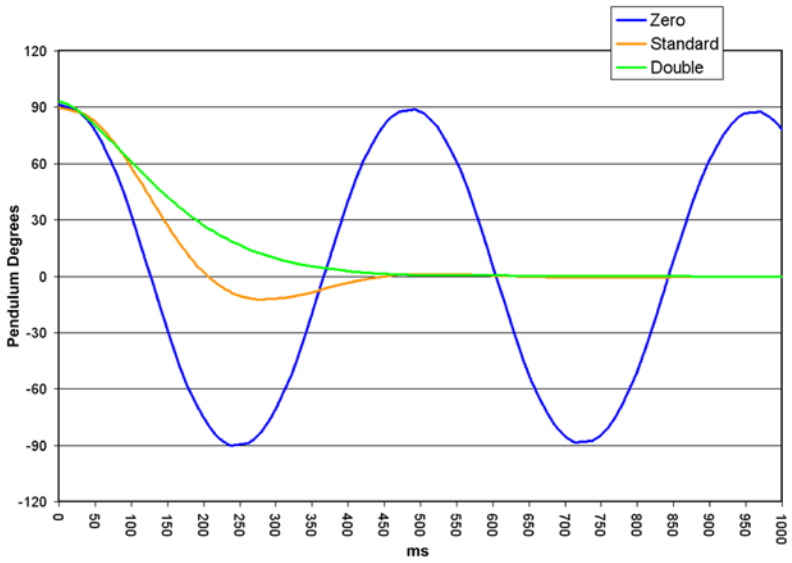

## Environmental

| Parameter | Value | Units |
|---|---|---|
| Operating Temperature | -25 to 70 | C |
| Storage Temperature | -40 to 100 | C |
| Humidity, Non-condensing | 0 to 95 | % |
| Vibration (5Hz to 2kHz) | 20 | G |
| Electrostatic Discharge, Human Body Model | ± 4 | kV |

## Mechanical

| Parameter | Value |
|---|---|
| Settling Time | 0.6 to 1 sec. typ. |
| Pendulum Undamped Natural Frequency | 2 Hz typ. |
| Weight | 9.40oz. |

## Damping




Damping affects settling time and overshoot. Standard damping will fit most applications. Double damping eliminates oscillation but s ettles to the final position more slowly. Some applications may require double damping to average out cyclic motion such as found in m oving vehicles. Damping options can be specified when ordering.

## Electrical

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

| Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|
| Supply Voltage | 5.5 | 12 | 16 | V |
| Supply Current<br>Active<br>Sleep | | 14 | 18.5<br>1.5 | mA |
| Analog Output Impedance | 950 | 1000 | 1050 | Ohms |
| Zero Scale Analog Voltage | 0 | 0.0005 | 0.003 | V |
| Full Scale Analog Voltage | 4.079 | 4.095 | 4.111 | V |
| Output Noise (Analog version) | | 10 | | mVrms |
| Differential Nonlinearity | -1.0 | | 1.0 | LSB |
| Absolute Accuracy (SEI interface version) | | 0.18 | 0.25 | Degrees |
| Angle tracking speed<br>Single-turn mode<br>Multi-turn mode | | | 3600<br>1800 | rpm |
| Position Update Rate (1) | | | 7 | msec. |

(1) The internal microcontroller takes a snapshot of the disk every 7 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.

## Default settings

| Parameter | Default value | Volatile? |
|---|---|---|
| SEI address | 0 | Non-volatile |
| Resolution | 3600 | Non-volatile |
| Origin offset | 0 | Non-volatile |
| Baud rate | 9600 | Volatile |
| Mode | 0 | (1) |

(1) Mode is always restored from non-volatile EEPROM on power-up; however, there are separate SEI commands for setting the RAM copy only, or both the RAM copy and the non-volatile EEPROM copy.

## Analog Output

The analog version of the **A2T** has a 12-bit DAC on the output which feeds to 2 lines that are 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 the internal microcontroller sends to the DAC is the same as the digital value that it sends to the host. Since the resolution (which represents the number of CPR) 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. If you want the DAC to have the full range to 4.095V, set the single turn resolution to 4096. This is easily done with the available software which runs on a PC.

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

**Sealed Housing:**
The sealed housing option enables the encoder to be reasonably capable of surviving in liquid environments, but this encoder is NOT water proof.

**Notice:**
In applications where a failure could result in an unacceptable loss, we recommend that your system be designed to include two redundant inclinometers with the outputs from both continuously compared, making sure 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.

## Pin-out

| Pin | Description |
|---|---|
| 1 | Ground |
| 2 | Busy+<br>Analog+ |
| 3 | Busy-<br>Analog- |

| Pin | Description |
|---|---|
| 4 | Power |
| 5 | DataL |
| 6 | DataH |

## Product Change Notifications

| Title | Date | Description | Download |
|---|---|---|---|
| EOL Sealed Housing Option - PCN 1021 | 4/11/2013 | This PCN is a formal notification that US Digital is discontinuing the Sealed Housing option for the following products:<br>‣ A2 Absolute Optical Encoder<br>‣ A2T Absolute Optical Inclinometer<br>‣ H1 Ball Bearing Optical Shaft Encoder<br>‣ H3 Ball Bearing Optical Shaft Encoder<br>‣ S1 Optical Shaft Encoder<br>‣ S2 Optical Kit Encoder<br><br>The Sealed Housing option provides the encoder with low level capability of surviving in moisture environments, however the encoder is NOT water proof or intended to be used in applications where this is required. | Download |

RoHS COMPLIANT

## Ordering Information

A2T - [ ] - [ ] - [ ]

| Interface | Damping | Housing |
|---|---|---|
| S =*Default - SEI Bus* | S =*Default-Standard damping* | D =*Default-Not sealed* |
| A =*Analog output* | D =*Double damping* | |

**Notes**

- Cables and connectors are not included and must be ordered separately.
- US Digital warrants its products against defects in materials and workmanship for two years. See complete warranty for details.

## Base Pricing

| Quantity | Price |
|---|---|
| 1 | $350.70 |
| 10 | $313.95 |

For volume discounts, please contact us at sales@usdigital.com or 800.736.0194.

- Add $20.00 per unit for **Interface** of Analog output
- Add $10.00 per unit for **Damping** of Double damping

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