T7 Networked Absolute MEMS Inclinometer

Description

The T7 is an absolute inclinometer utilizing MEMS (micro electro-mechanical systems) technology to sense tilt angles over a full 360 ° range in a single axis. A multi-axis version is planned for the future. The T7 is sealed against dust and water (IP-67 rated) for operation in dirty environments. The T7 incorporates a number of breakthroughs to create a new type of inclinometer that is rugged, compact, fast, flexible and easy to use.

The T7 is available with two interface options: RS232 or US Digital's CAN (Controller Area Network) protocol. The RS232 version supports up to fifteen T7s on a single RS232 bus. For users that need longer cable lengths, a US Digital CAN (Controller Area Network) version of the T7 is also available. The USD-CAN protocol to allows a single T7 or a network of up to sixty-four T7s to be easily connected to a single host. Power for each T7 is supplied over the CAN network cable. T7s are networked together as a daisy chain with or without stubs. The host accesses the USD-CAN T7s through US Digital's low cost CANA-232 / CANA-485 adapter module. This module allows the host to access each T7 on the network using simple, easy serial port commands, just like the RS232 version.

The T7 calculates tilt angle (inclination) by sensing the acceleration from MEMS accelerometers integrated into a monolithic chip. Gravity, centrifugal forces, and linear speed changes are all forms of acceleration. The T7 will report the mathematically calculated tilt angle based on all sensed acceleration(s).

The serial port interface provides an efficient way to read and write data to a network of T7s. All configurations and parameters are stored in nonvolatile memory. A Windows demo application is provided for displaying the angles and temperature as well as setting operating modes, orientation, zero position, damping / averaging time, direction, and more for every T7 on the network. In addition, a Windows DLL gives the user a set of simple functions to read and write data to a network of T7s.

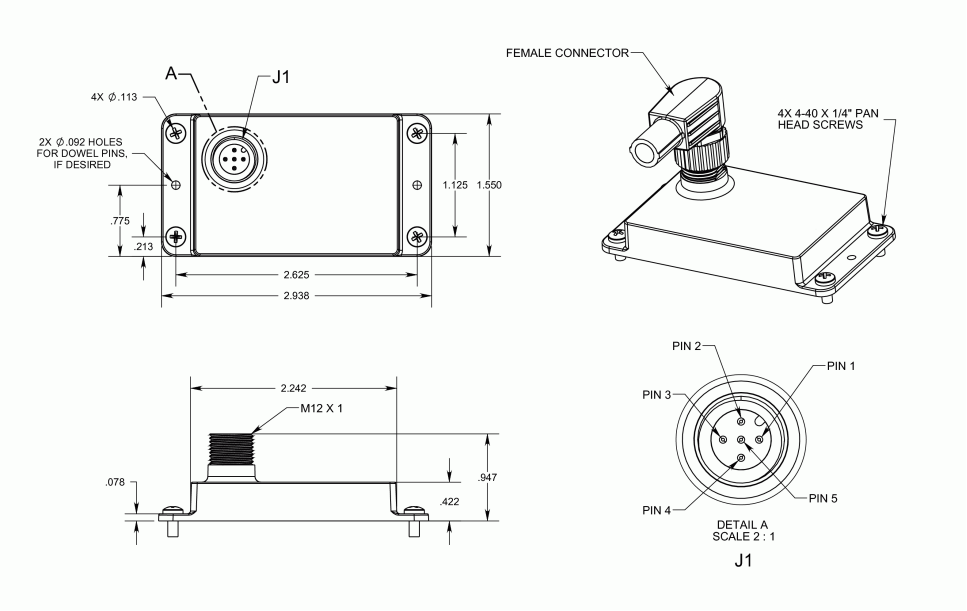
Typical applications include heavy construction equipment, dredging machinery, mining equipment, solar tracking and warehouse automation.

Features

- **ROHS Compliant**
- MEMS technology
- Full 360 ° range, temperature compensated from 0C to 50C
- ±0.1 ° accuracy, 0.01 ° resolution
- US Digital CAN interface allows up to sixty-four T7s to be networked
- USD-CAN version has 700 ft. (213 m) maximum cable length
- Simple serial port interface to CAN bus using USD's CAN-232/CAN-485 adapters
- RS232 version supports up to fifteen T7s with 100 ft. (30 m) maximum cable length
- Field programmable
- Reports temperature
- Rugged, dustproof and waterproof (IP-67 rated) package

Mechanical Drawing

T7 Networked Absolute MEMS Inclinometer



Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Supply Voltage	5.5	24	30	V
Supply Current (Operating, 22C ambient) @ 5.5V @ 12V @ 24V @ 30V		 50 30 20 18		 mA
Operating Temperature	-10	25	70	C
Storage Temperature	-40		125	C
Acceleration (single-axis version)			50000	G
Bandwidth			8	Hz

Note: A lower power variant of the **T7** is available on special order. Contact customer service for more information.

USD-CAN Network Size

Parameter	Max.	Units

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Number of T7s in network	64	
Cable length to furthest T7 in network (excluding stubs)	700	feet
Individual stub length	16	feet
Total length of all stubs	250	feet

RS232 Network Size

Parameter	Max.	Units
Number of T7s in network	15	
Maximum total cable length	100	feet

Note: The T7 can drive 100 ft. of cable. Some PC's have limited drive on the RS232 bus which will limit the maximum cable length to less than 100 ft.

Accuracy

Parameter	Max.	Units	Test Conditions
Axis 2 Angular Error	±0.1	Angular Degrees	0 ° C to 50 ° C, on-axis ±5 °

Mechanical

Parameter	Specification
Case Material	Glass filled polycarbonate
Weight	1.2 oz (34 g) nom.

Axis Orientation

Single Axis Orientation:

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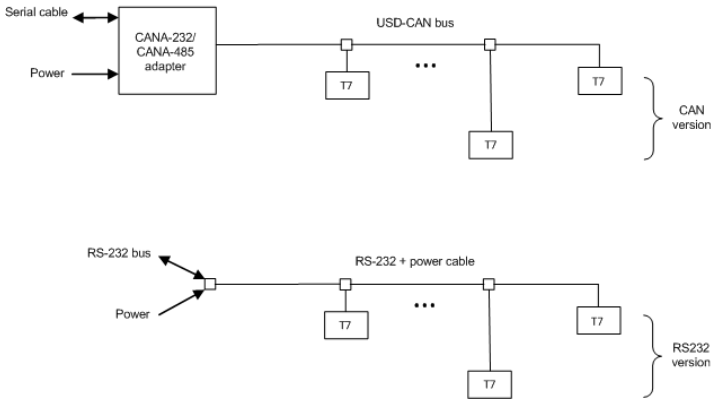
Noise Filtering

The **T7** uses a FIR (Finite Impulse Response) digital filter to provide electronic damping of the angle readings. The digital filter's impulse response has a triangular weighting that decays linearly to zero. The damping time is user programmable from 2 milliseconds to 5000 milliseconds. Since the sensor bandwidth is 8 Hz, damping times below 125 milliseconds do not provide any faster response. Increasing the damping time will average more samples together to form the reported angle. This will reduce noise in the output but increase the response time.

Interfacing with a host computer

An inclinometer network assembled with the USD-CAN version or RS232 version of the **T7** is shown below.



US Digtal sells all the cables and connectors needed to wire a T7 network. The same cable and connectors can be used for both the USD-CAN or RS232 version since the T7 uses the same connector for both interface versions.

Regardless of the interface option, a host PC, PLC or microcontroller communicates with a network of**T7**s by sending/receiving simple serial port commands over the RS232 or RS485 bus. In the case of the USD-CAN version, the CAN adapter serves as a command translator between a standard RS232 or RS485 port and the USD-CAN bus used by the **T7**. The CAN adapter translates serial port command to the USD-CAN protocol and handles all network functions (access, error correction, etc.) to access the T7. Conversely, the

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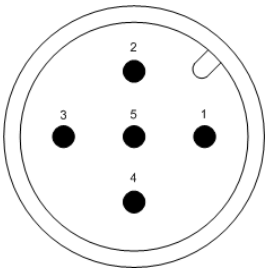
CAN adapter also translates the reply from the T7 and sends the data to the host on the serial port. The CAN adapter frees the user from a complicated network interface on the host side. Note that the CAN adapter is not needed for the RS232 version of the T7. A host can communicate directly to a network of RS232 T7s over the same bus.

For more information on wiring **T7** CAN networks see the **CANA-232/CANA-485 Datasheet**.

Network Address

Each **T7** on the network must be assigned a unique address from 1 to 100 or 127 (decimal). All **T7**s are shipped with a default address of 127. Address 126 is a special broadcast address - all **T7**s will listen and respond to commands sent to this address. To assign an address to a **T7** unit, connect one **T7** to a PC's serial port - either directly if using the RS232 version or through the CAN adapter for the CAN version. The address can be set using the the included PC based "T7 Demo" software . Alternately, a host computer can send the "Set Address" serial port command to the T7. This procedure only needs to be done once for each **T7** since the address is stored in non-volatile flash memory.

J1 Pin-out



Pin	Description
1	Shield
2	Vin
3	GND
4	CANH / TXD
5	CANL / RXD

Default Configuration

All **T7** units ship from US Digital with a default configuration. All configuration parameters are stored in non-volatile flash memory and can be easily changed by the user. The specifications are shown below. However, in larger quantities, special orders may be placed where the units can be preconfigured with any of the available settings noted in the **CAN Adapter Host Serial Communication User Guide**. Please contact customer service for special orders.

Default Configuration:

- Address = 127

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- Single-axis version uses Axis 2
- Angle output range set to +/-180 (-179.99 to 179.99) deg.
- Counting Direction set to "forward"
- Angle Offset set to 0
- Damping time = 1000 milliseconds

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Ordering Information

T7 - [ ] - [ ]

Number of Calibrated Axis	Interface
1	CAN =*CAN*
3	232 =*232*

Part Number Conditions

- Number of Calibrated Axis must be equal to 1 when Number of Calibrated Axis is 1

Notes

- Cables and connectors are not included and must be ordered separately.
- This product is warranted against defects in materials and workmanship for two years.

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