



## Specifications

|                                |   |
|--------------------------------|---|
| Power source                   | 4.1 – 38 VDC  |
| Power consumption              | 20 ± 2 mA (@ 5 V)                                   |
| Measurement range options      | ±5°, ±10°, ±15°, ±30°, ±45°, ±90° (two-dimensional) |
| Resolution                     | < 0.05°   |
| Accuracy                       | 0.25° (Typical), 0.4° (Maximum error in full range) |
| Zero offset error <sup>†</sup> | < ±0.1° (@20°C) <sup>‡</sup>                        |
| Temperature offset drift       | ±0.01°/°C (Typical)                                 |
| Noise density                  | 0.01°/√Hz   |

## Analog Output

|                          |   |
|--------------------------|---|
| Analog voltage output    | 0.25 V to 4.75 <sup>§</sup> V   |
| Sensitivity              | 150 mV/° : range ≤±15°<br>34 mV/° : ±30° ≤ range ≤±60°<br>25 mV/° : ±90° full range |
| Reference voltage output | 2.5 ±0.005 V  |

## Digital Output

|                       |  |
|-----------------------|--|
| Serial interfaces     | 3.3V TTL UART  |
| Baud rate             | 2.4kbps – 921.6kbps selectable, default: 115.2kbps                     |
| Data format           | ASCII, port settings: 1 start bit, 8 data bits, 1 stop bit & no parity |
| Output data rate      | 1, 2, 5, 10, 20, 50, and 100 Hz selectable                             |
| Accelerometer data    | ±2 g/±4 g/±8 g selectable  |
| LED indicators        | Data transmission rate<br>Flashing at current data rate                |
| GUI software          | WinCTi-Tilt®   |
| Temperature sensor    | 1°C resolution   |
| Operating Temperature | -25°C to +80°C (-13°F to +176°F)                                       |

<sup>†</sup> Zero g offset can be easily corrected and saved by user with digital interface command.

<sup>‡</sup> Units can be calibrated between -25°C and 80°C on request.

<sup>§</sup> The maximum analog output voltage 4.75 V (for ±90° full range) needs the power source ≥ 5.25 V.

## Features

- Analog and digital output signals
- Measurement range options, two-dimensional: ±5°, ±10°, ±15°, ±30°, ±45°, ±90° (analog output)
- High accuracy: 0.25° (Typical)
- Three-axis accelerometer (Digital output)
- Low power consumption: 20mA (@ 5 V)
- Analog output: 0.25 V to 4.75 V
- Programmable bandwidth and response time
- Digital interface: 3.3V TTL UART

## Applications

- Platform control, alignment, and stabilization
- Solar panel tracking and control systems
- Tilt sensing and leveling
- Weighting systems
- Telescopic and scissor platform monitoring
- Motion/position measurement
- Navigation and GPS compensation
- Robotic position sensing
- Agricultural and industrial vehicle tilt monitoring

## Accessories

|              |              |
|--------------|--------------|
| GUI Software | WinCTi-Tilt® |
|--------------|--------------|

## Terminal Assignment

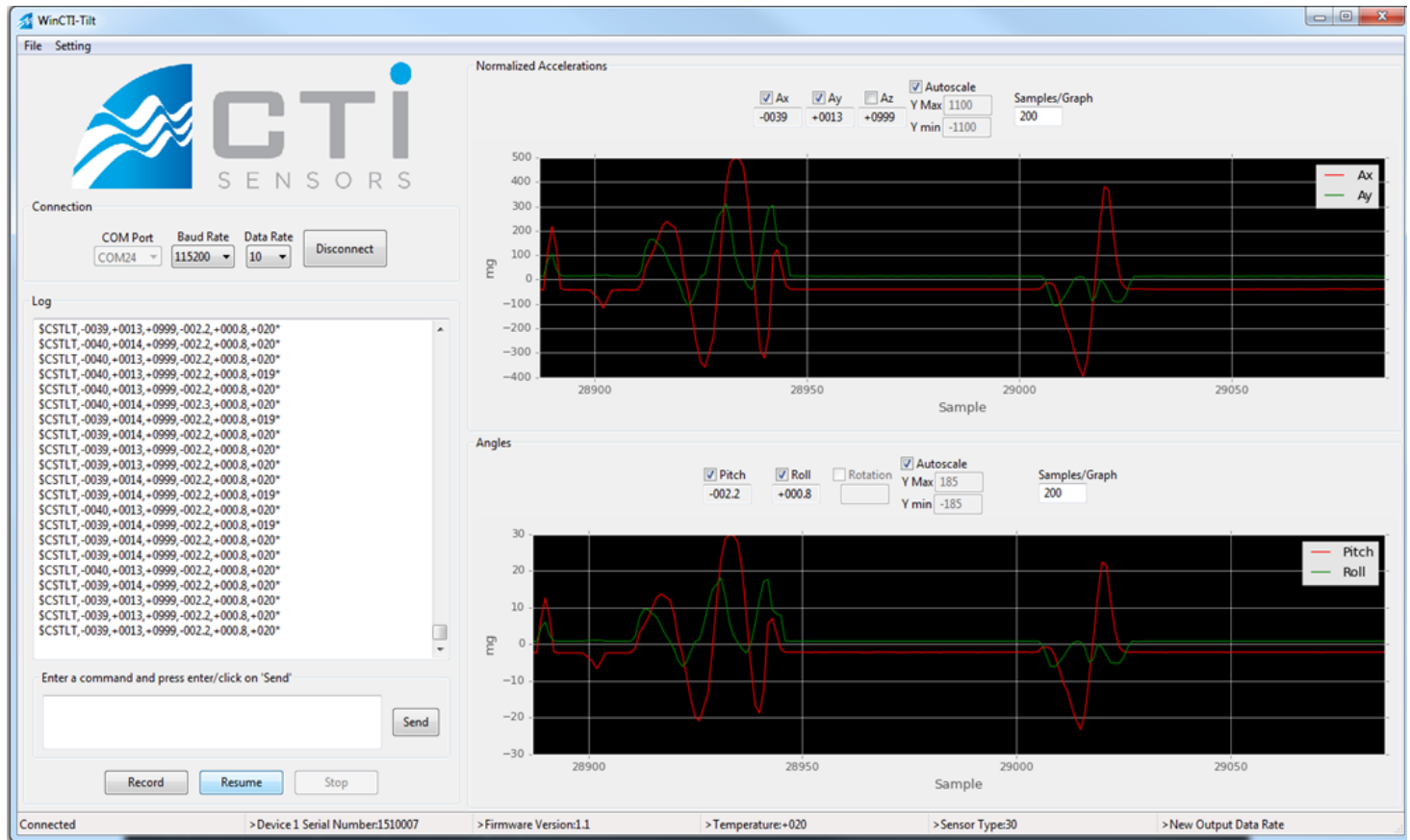
| X1      | Name  | Description                   | Type   |
|---------|-------|-------------------------------|--------|
| Pin 1   | +Vin  | +Vin (4.1 V to 38 V DC)       | Input  |
| Pin 2   | Vref  | Voltage reference (2.5 V)     | Output |
| Pin 3   | GND   | Ground                        | Input  |
| Pin 4   | OUT X | Analog signal, X axis         | Output |
| Pin 5   | OUT Y | Analog signal, Y axis         | Output |
| Pin 6** | OUT T | Analog signal, Temperature    | Output |
| Pin 7   | RX    | Digital signal, receive data  | Input  |
| Pin 8   | TX    | Digital signal, transmit data | Output |

| X2    | Name  | Description                   | Type   |
|-------|-------|-------------------------------|--------|
| Pin 1 | +Vin  | +Vin (4.1 V to 38 V DC)       | Input  |
| Pin 2 | GND   | Ground                        | Input  |
| Pin 3 | TX    | Digital signal, transmit data | Output |
| Pin 4 | OUT X | Analog signal, X axis         | Output |
| Pin 5 | RX    | Digital signal, receive data  | Input  |
| Pin 6 | OUT Y | Analog signal, Y axis         | Output |

\*\* Firmware version 1.20 and higher.

## WinCTi-Tilt Software

WinCTi-Tilt is a graphical user interface (GUI) software provided by CTi Sensors for visualization aide, device configuration, and data logging. WinCTi-Tilt is designed to be user-friendly and intuitive to users. The package can be downloaded from the CTi Sensors website.



## Serial Interface and Data Format

TILT-15-S uses the following ASCII format, very similar to the widely used NMEA 0183 protocol, for data output:

- Default message:  $\$CSTLT, A_{XN}, A_{YN}, A_{ZN}, \alpha_X, \alpha_Y, T * CC <CR> <LF>$
- Optional message:  $\$CSACC, A_X, A_Y, A_Z * CC <CR> <LF>$

Which:

- $A_{XN}, A_{YN}, A_{ZN}$ : Normalized X, Y and Z accelerations in mg
- $A_X, A_Y, A_Z$ : True X, Y and Z accelerations in mg
- $\alpha_X, \alpha_Y$ : Pitch and Roll angles in degrees, horizontal installation
- T: Internal temperature in degrees centigrade
- CC: Checksum (Two ASCII characters)
- <CR> <LF>: Carriage return, and line feed characters

Example:

- $\$CSTLT, -0003.3, -0046.3, +0998.9, -000.19, -002.65, +016*7C <CR> <LF>$  Data rate  $\leq 5$
- $\$CSTLT, -0003, -0046, +0999, -000.1, -002.6, +016*66 <CR> <LF>$  Data rate  $> 5$
- $\$CSACC, -0003.3, -0046.3, +0998.9*48 <CR> <LF>$

## 8-bit Checksum

Checksum is calculated by XORing all characters between \$ and \* (not including the \$ and the \* characters) based on the NMEA standard. It results in two hexadecimal characters which are sent in ASCII format.

## Configuration Commands

TILT-15-S uses a simple command format which allows user to change the device configuration and request specific information or data. All commands start with a '[' character, and end with a carriage return character. All responses end with a carriage return and newline character. Table I shows the list of the interface commands for TILT-15-S. Letter 'n' after '[' character is the unit number which is set to n=1 by default and can be set by user to any number from 1 to 9.

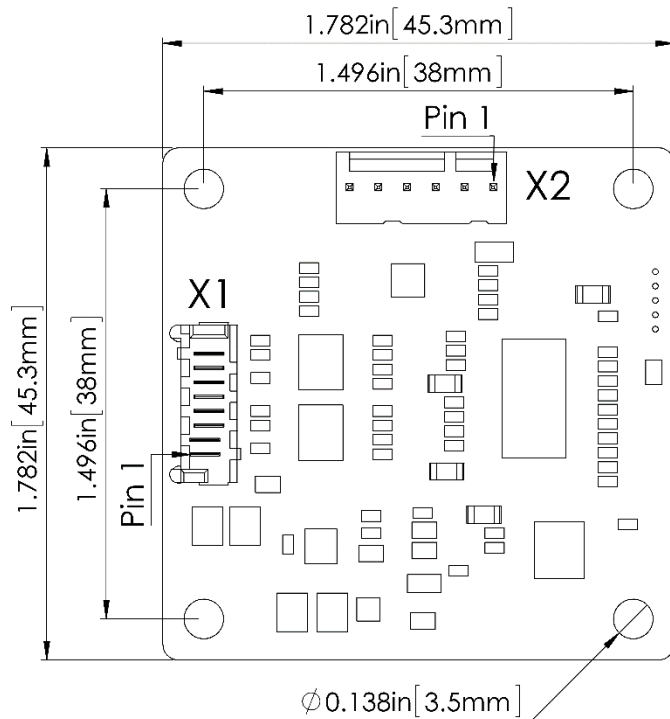
Table I. Interface commands for TILT-15-S

| Command    | Description   | Response   | Description  |
|------------|---|--|--|
| [n<cr>     | Ping unit number n  | >!n<cr><lf>  | Acknowledge ping   |
| [N?<cr>    | Request unit number   | >Unit Number: <u>n</u>   | Returns unit number, default: <u>n</u> =1  |
| [n#m<cr>   | Change unit number <u>n</u> to (non-zero) unit number <u>m</u> , $1 \leq m \leq 9$  | >New Unit Number: <u>m</u>   | <u>n</u> =old unit number, <u>m</u> =new unit number, default: <u>n</u> =1   |
| [n#FW<cr>  | Save unit number into flash memory  | >Current Unit Number, <u>n</u> , was written into flash memory as the default Unit Number for this device! | Unit number will be changed permanently, and current unit number will be saved into the flash memory as the default unit number.                           |
| [nV<cr>    | Firmware Version  | >Firmware Version:d.dd   | Returns firmware version   |
| [nS<cr>    | Serial Number   | >Device n Serial Number: dddddd  | Returns 7-digit serial number  |
| [nBxxx<cr> | Baud rate setting: xxx= 2:2400, 4:4800, 9:9600, 19:19200, 38:38400, 57:57600, 115:115200, 230:230400, 460:460800, 921:921600 (bps)            | >Change to new Baud Rate: dddddd   | Selected baud rate should support current data rate. Otherwise, baud rate will not be changed.   |
| [nBFW<cr>  | Save baud rate into flash memory  | >Current Baud Rate, dddddd, was written into flash memory as the default Baud Rate!                        | Baud rate will be changed permanently, and current baud rate will be saved into the flash memory.  |
| [nDxxx<cr> | Data rate setting: xxx= 1, 2, 5, 10, 20, 25, 40, 50, and 100 Hz   | >New Output Data Rate: xxx   | Default data rate is 2 Hz. New data rate will be saved into the flash memory.  |
| [nARx<cr>  | Selecting accelerometer measurement range: x=±2, ±4, ±8 g   | > New Accelerometer Range is: +/-x g   | New accelerometer range will be saved into the flash memory (the default range is ±2 g).   |
| [nZA<cr>   | Zero g offset correction for X and Y axes   | >Accelerometer Zero Offset Adjusted:<br>X Offset: ddd,<br>Y Offset: ddd                                    | Resolution of the offset registers is 2 mg, with an effective offset adjustment range of -256 mg to +254 mg for each axis.                                 |
| [nMxy<cr>  | Output messages ON/OFF<br>x= I: Inclinometer data<br>A: Accelerometer data<br>Y= S: single message<br>C: Continuous message<br>X: Message Off | Data message will be sent out once, continuously or will be turned off                                     | Example for inclinometer data:<br>[1MIS: Sends out one data message<br>[1MIC: Continuously sends out data message<br>[1MIX: Stops sending out data message |

Continued...

| Command     | Description  | Response  | Description   |
|-------------|--|---|---|
| [nMxCFW<cr> | Save output message ON/OFF status into flash memory<br>x = I: Inclinometer data<br>A: Accelerometer data | >Current ON/OFF message status was written into flash memory as the default status! | Current message ON/OFF status will be saved into flash memory.<br>Example:<br>[1MICFW |

### Dimensional Drawing



### Part Number \*\*

| TILT | - | XX | - | X | - | X | - | XX                                  |
|------|---|----|---|---|---|---|---|-------------------------------------|
|      |   |    |   |   |   |   |   | <b>Design Model</b>                 |
|      |   |    |   |   |   |   |   | <u>A1</u>                           |
|      |   |    |   |   |   |   |   | <b>Interface**</b>                  |
|      |   |    |   |   |   |   |   | 3 RS232                             |
|      |   |    |   |   |   |   |   | 4 RS422                             |
|      |   |    |   |   |   |   |   | 8 RS485                             |
|      |   |    |   |   |   |   |   | A Analog                            |
|      |   |    |   |   |   |   |   | U USB/UART                          |
|      |   |    |   |   |   |   |   | W Wireless                          |
|      |   |    |   |   |   |   |   | <b>Housing Material**</b>           |
|      |   |    |   |   |   |   |   | A Anodized Aluminum                 |
|      |   |    |   |   |   |   |   | P ABS Plastic                       |
|      |   |    |   |   |   |   |   | S Stainless Steel 316L              |
|      |   |    |   |   |   |   |   | O OEM (No Housing)                  |
|      |   |    |   |   |   |   |   | <b>Family Series</b>                |
|      |   |    |   |   |   |   |   | 05 Small Size Series (1"x1")        |
|      |   |    |   |   |   |   |   | 10 Multi Interface Series           |
|      |   |    |   |   |   |   |   | <u>15 Digital and Analog Series</u> |
|      |   |    |   |   |   |   |   | 20 Economical Series                |
|      |   |    |   |   |   |   |   | 3x Static Inclinometer Series       |
|      |   |    |   |   |   |   |   | 5x Dynamic Inclinometer Series      |
|      |   |    |   |   |   |   |   | 70 Harsh Environment Series         |

### Family Series 15 – S Expansion

| Part Number        | Range |
|--------------------|-------|
| TILT – 15 – S – 05 | ±5°   |
| TILT – 15 – S – 10 | ±10°  |
| TILT – 15 – S – 15 | ±15°  |
| TILT – 15 – S – 30 | ±30°  |
| TILT – 15 – S – 45 | ±45°  |
| TILT – 15 – S – 90 | ±90°  |

\*\* Available options for this model are underlined

†† Refer to family series 15-S expansion.

‡‡ Refer to family series 15-S expansion.

## Warranty

This product has 18 months limited warranty:

CTi Sensor, Inc. “CTi” warrants its products against defects in material and workmanship for a period of 18 months from the date of the shipment to the customer provided the products have been stored, handled, installed and used under proper conditions. CTi’s liability under this limited warranty shall extend only to repair or replace the defective product, at CTi’s option. This warranty does not cover misuse or careless handling and it is void if the product has been altered or repaired by personnel not authorized by CTi. CTi disclaims all liability for any affirmation, promise, or consequential damages caused by the product. No warranties, expressed or implied, are created with respect to CTi’s products except those expressly contained herein. The customer acknowledges the disclaimers and limitation contained herein and relies on no other warranties or affirmations.

For more information, please refer to the following link:

[www.CTiSensors.com/warranty](http://www.CTiSensors.com/warranty)

**CTi Sensor, Inc.**

30301 Emerald Valley Parkway, Unit B

Solon, OH 44139

Phone: (440) 264 - 2370

Email: [sales@CTiSensors.com](mailto:sales@CTiSensors.com)

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