CTS : User Configurable Tilt Switch, 2 Relays, SIL1/PLc Rated

Features

- Highly user-adjustable (see list below), with 2 individually programmable relay switch outputs.
- ISO 13849-1 Machine safety rating: Performance Level C / Safety Integrity Level 1 (PLc/SIL1)
- Small size and low power consumption
- No moving parts means no servicing and long life
- High precision switching threshold
- Mercury free and RoHS compliant
- Hardware 'ZERO' button to set zero after installation
- ABS or Aluminium enclosure, sealed to IP65 / IP67
- Manufactured, calibrated and tested in the UK
- UKCA & CE Certified

CTSM - Anodised Aluminium Housing

CTS - ABS Housing

User-Adjustable Settings

The following settings are configurable using the Level Developments simplified PC software (free):

- Single, dual, or omni-directional tilt sensing
- 2 separate switching thresholds can be set ≤60° (dual axis), or ≤180° (single axis), and in selected directions (+ve, -ve, or bidirectional)
- Enable/disable Fail-safe mode (inverts relay function)
- User-configurable axis orientation and 0° position
- Adjustable damping filter from 32Hz to 0.125Hz
- Adjustable delay & hysteresis settings

Description

The CTS is a highly configurable tilt switch that can be user-programmed to activate 2 independently adjustable relays at user-specified angles. It has 3 configurable modes: Single axis, dual-axis, and omni-directional sensing modes. In dual-axis mode, the tilt thresholds can be assigned individually to the X or Y axis, or to both axis simultaneously. In single axis mode, only 1 axis is monitored; and in omni-directional mode, the measurement of both axis is combined to calculate the resultant tilt angle, and the switch will operate if the threshold angle is exceeded in the selected direction(s) of tilt. Once the tilt threshold is reached the relay operates and the switch contacts are closed. This can be used to sound an alarm, switch on a warning light, or interface directly to a machines control system. A unique feature of this product is the optional "fail-safe" mode, where the relay function is inverted (i.e. energised at 0°), this enables the CTS to be used in safety critical applications such cut-off systems for Ariel Work Platforms, cranes, and off-highway machinery. It is also possible to activate both relays in opposite directions on 1 axis, this makes it suitable for automatic levelling. The settings are adjustable using an easy-to-use PC application which is available to download from our website. The device is available with either an ABS, or a robust Anodised Aluminium housing. The devices have a highly accurate and repeatable switching threshold, and built in noise filtering to reduce the effects of vibration.

UKCA SIL1 /PLc

Level Developments Ltd. 97-99 Gloucester Road Croydon, Surrey, CR0 2DN United Kingdom t : +44 (0)20 8684 1400 f : +44 (0)20 8684 1422 sales@leveldevelopments.com www.leveldevelopments.com

Specifications

Parameter	Value	Notes
Number of sensitive axes	Single, Dual, Omni	User selectable via software
Number of sensitive relays	1 or 2	User selectable via software
Relay Switching Range Single/Omni Axis Dual Axis	 ±00.01 to ±180.00° ±00.01 to ± 60.00°	 User selectable via software User selectable via software
Adjustment resolution	0.01°	Minimum adjustment resolution of switching thresholds
Switching Accuracy (20°C)	±0.3°	±0.3° is max error ≤±45° and improves at smaller angles
Hysteresis resolution (%)	0.1 (Default setting 5%)	The software-selectable angle between the switch on/off position. Used to prevent oscillation at the threshold
Adjustable Damping Filter Selectable Range Default setting	 0.125, 0.25, 0.5, 1, 2, 4, 8, 16, or 32Hz 0.5Hz	The user-selectable low-pass filter is adjustable between 0.125Hz & 32Hz via software. This is useful (for example) for reducing the effects of vibration.
Power Supply	9-30Vdc	
Current Consumption 0 Relays energised 1 Relay energised 2 Relays energised	 2.5-5.5mA 10-31mA 18-57mA	 Current varies with supply voltage Current varies with supply voltage Current varies with supply voltage
Relay Switching Capacity	220Vdc, 250Vac, 60W max, 2A max	Maximum capacity per relay. Large switching currents will reduce the relay contact life
Dimensions ABS Version Aluminium Version	 65 x 60 x 40mm 76 x 44 x 20mm	
Operational Temperature	-40 to 85°C	
Storage Temperature	-40 to 85°C	
Sealing ABS Version Aluminium Version	 IP65 IP67	

Cable Details

1. Core wires consisting of bare copper: 8x0.25mm strands per conductor (24 AWG).
2. 8 conductors colours: brown, green, yellow, grey, white, pink, blue and red. PP core insulation.
3. Conductor stranding: Extra fine wire acc. to VDE 0295, class 6 / IEC60228 class 6.
4. Black PUR outer jacket, 5.9mm OD
5. Minimum bend radius: 10xØ (Flexing), 5xØ (Fixed)
6. Approvals: UL AWM Style 20549
7. UL 1581 FT-2 Flame retardant approved
8. Halogen free, VDE 0472-815 compliant
9. RoHs Compliant (EU-Directive 2011/65/EU)

Parameter	Value	Unit
Length	2	m
Approximate Weight	19	kg/km
Operating Temperature Flexing	-25 to 80	°C
Operating Temperature Fixed	-40 to 80	°C
Conductor Resistance	79	Ω/Km
Test Voltage	2	KV DC
Voltage Rating	300	V
Core Current Rating (30°)	4.5	A
Individual Core Diameter	1.2	mm
Overall Diameter	5.9	mm

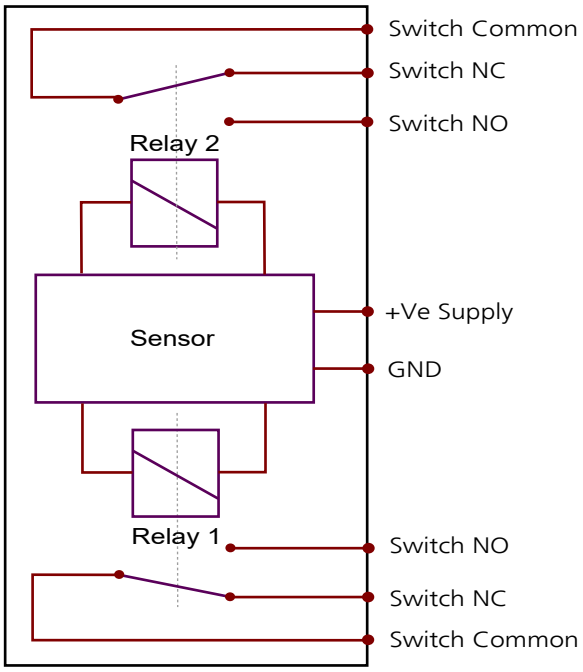
Wiring Information

The Tilt sensor has an eight wire connection. The brown and green wires are used for the power supply and the other wires are connected to the two relay switch contacts.

The unit is not fused internally. On a vehicle system it should be connected to a supply from the fuse box with a 0.25A rating, or connected using an inline 0.25A fuse. Please see the schematic opposite and the table below for connection details.

Wire Colour	Function
White	Relay 1 normally open
Grey	Relay 1 common
Yellow	Relay 1 normally closed
Green	GND
Brown	+Ve Supply
Pink	Relay 2 normally closed
Blue	Relay 2 common
Red	Relay 2 normally open

Wiring Schematic



UKCA & Safety Certification

The products described in this document are type approved in accordance with the following regulations:

- The Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019
- Supply of Machinery (Safety) Regulations 2008 by the application of designated standards BS EN ISO 13849-1:2023 and BS EN ISO 13849-2:2012. The device conforms to PLc, is of category 2 architecture with at least 60% diagnostic coverage and a MTTFD capped at 100 years. (Fail-safe mode is required for Plc).
- Electromagnetic Compatibility Regulations 2016 by the application of designated standards BS EN 61000-6-2:2005 and BS EN 61000-6-4:2007 +A1:2011.
- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 by the application of designated standard BS EN IEC 63000:2018.

CE Certification

The products described in this document are type approved in accordance with the following:

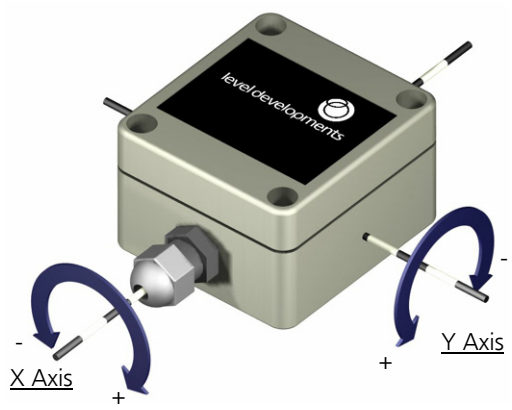
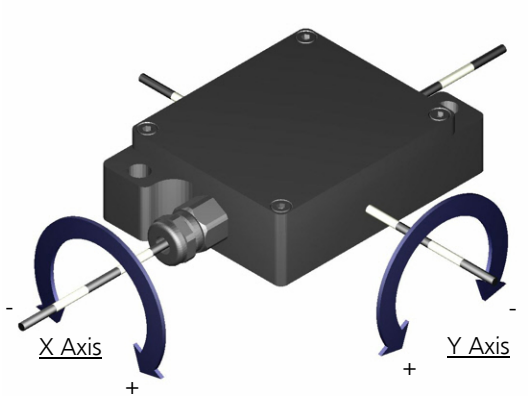
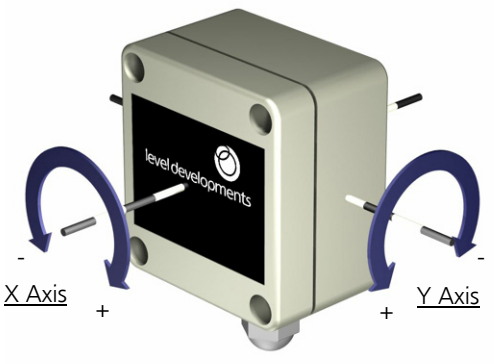
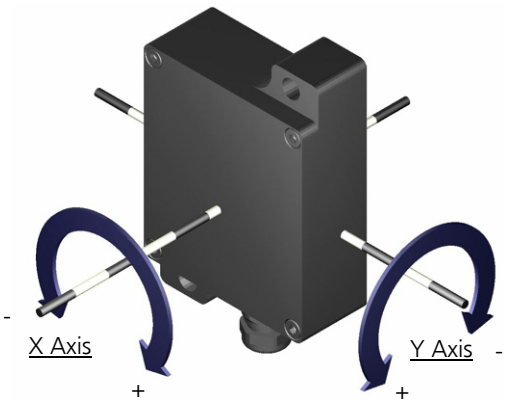
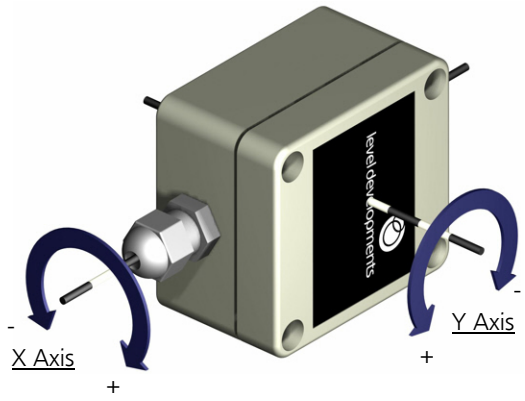
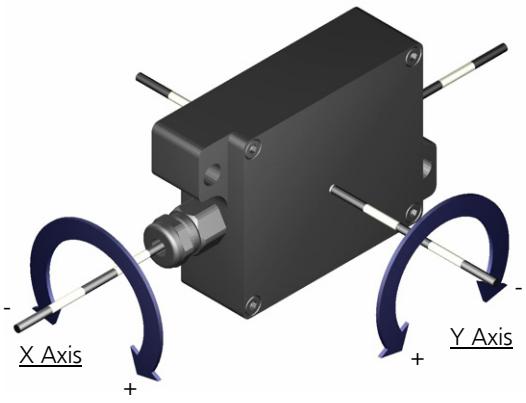
- EMC Directive 2004/108/EC

And it has been designed, manufactured and tested to the following specifications:

- BS EN61326-1:2006 — Electrical equipment for measurement, control and laboratory use - EMC Requirements
- BS EN55011:2007, Group 1, Class B

Axis Direction and Mounting Orientation - Dual Axis Mode

The CTS tilt-switch features a user-selectable mounting orientation which can be configured using our free configuration utility which is described on page 7. The following options are available while "dual axis" mode is selected:

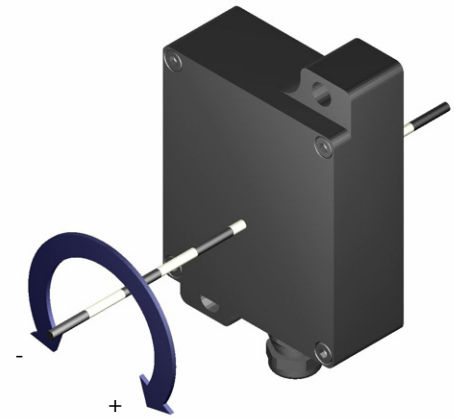
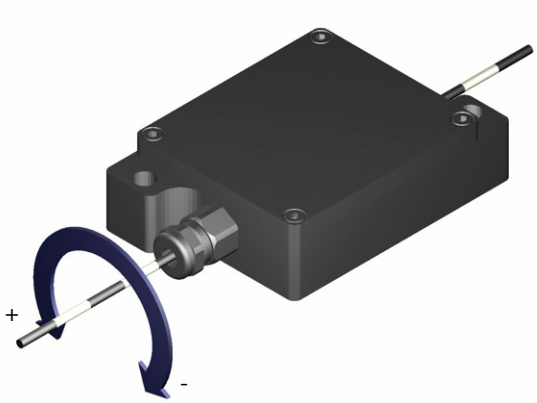
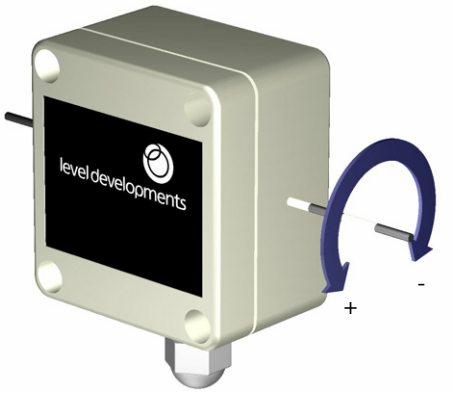
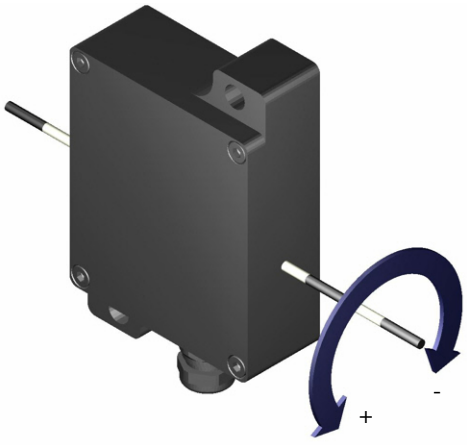
Plane	ABS Type	Metal Type
XY		
XZ		
ZY		

OEM Product Options

For on-going/volume OEM requirements, these devices can be factory pre-configured with any of the adjustable settings mentioned under section "User-Adjustable Settings" (see page 1). They can additionally be supplied with temperature compensation, custom cables/connectors (such as circular M12, or Deutsch DT / DTM series), custom labelling/marking, and there are many other options available. Please ask our sales team for more information.

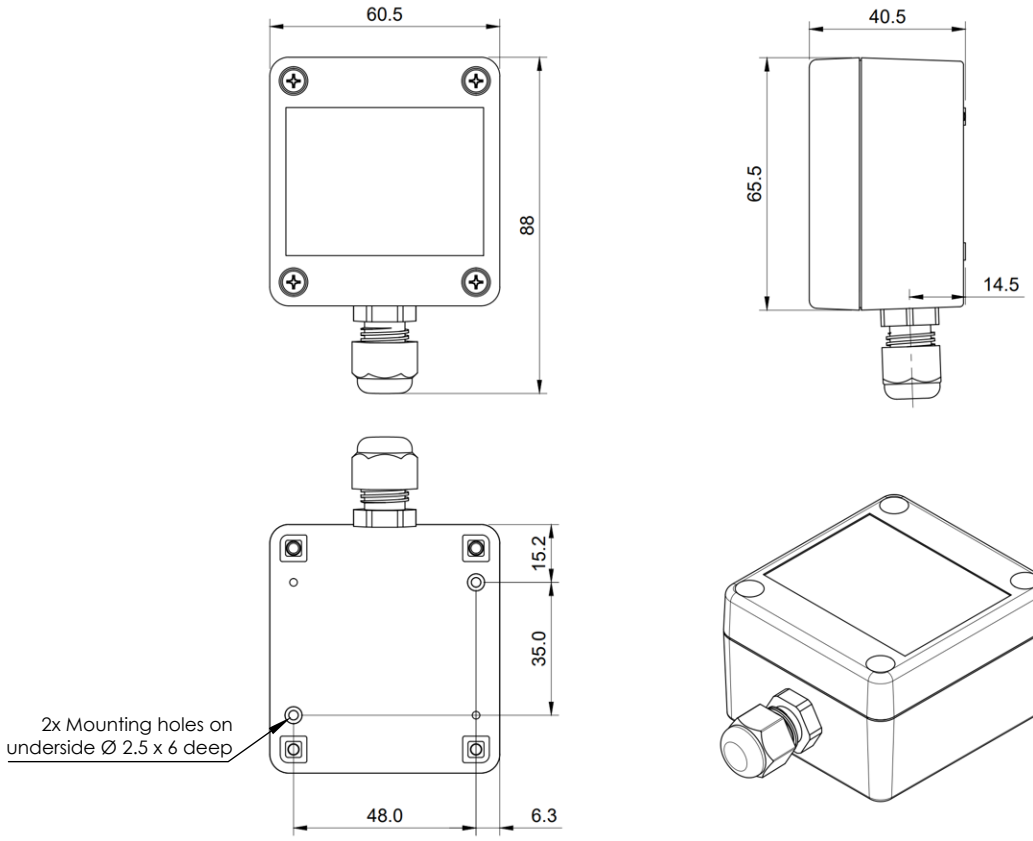
Axis Direction and Mounting Orientation - Single Axis Mode

The CTS tilt-switch features a user-selectable mounting orientation which can be configured using our free configuration utility which is described on page 7. The following options are available while "single axis" mode is selected:

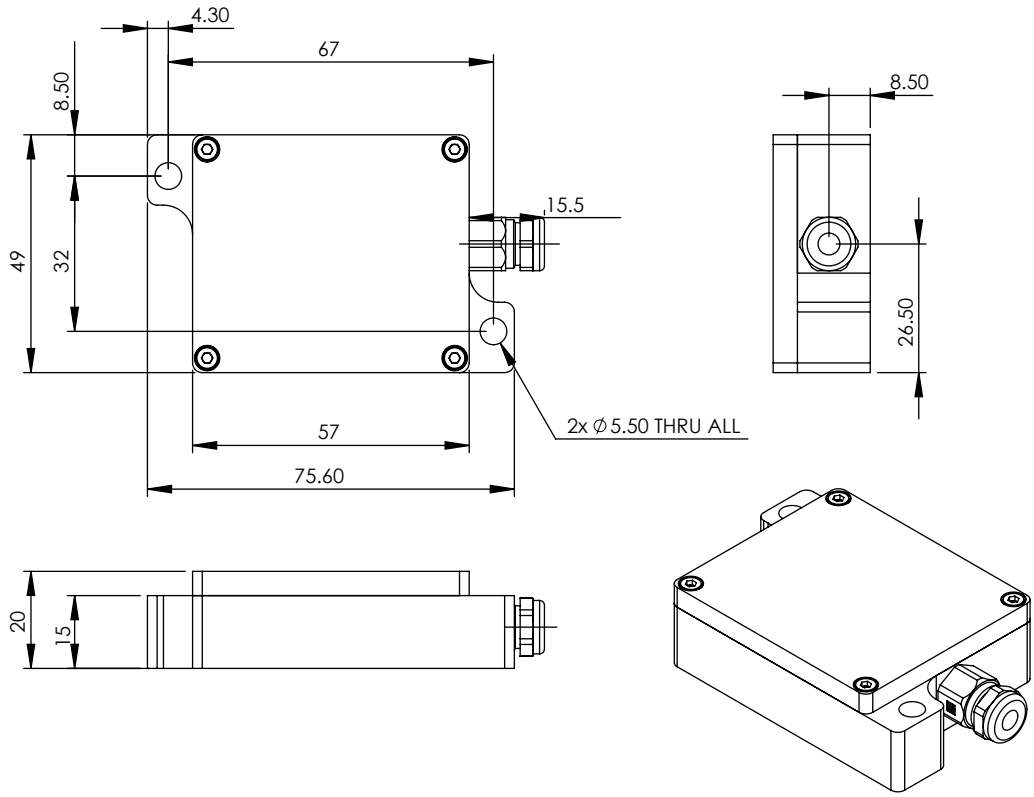
Plane	ABS Type	Metal Type
XY		
XZ		
ZY		

Please Note:
While the CTS is set to "single axis" mode, the measuring range is extended from ±90° to ±180°

Housing Drawing (ABS)



Housing Drawing (Anodised Aluminium)



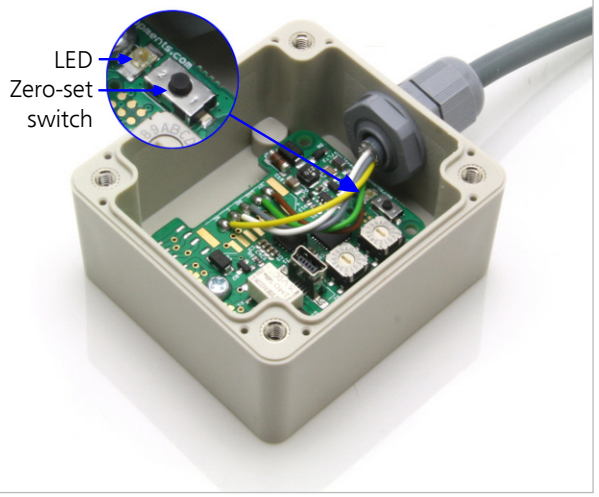
Zero-Set Hardware Switch

The CTS is supplied with a factory pre-set "zero-position" which is calibrated in an absolute level plane. However, the zero position can be re-set using the zero-set switch located on the circuit board. This can be useful for removing an offset after installation, or for taking relative measurements. The zero-position can also be set using the configuration software (see page 6), and/or the zero-set button can optionally be disabled to prevent tampering.

The zero-set switch can be accessed by unscrewing the lid of the housing. The tilt switch must be powered on and stationary for >5 seconds before the zero position is set. The LED will flash once when pressed, & the new zero position is stored in non-volatile memory. It will be remembered even after powering off.

The zero reset function is designed for small offsets. To change the orientation of the tilt switch, see page 4.

Zero-Set Switch location:



Part Numbering

Standard options:
CTS - ABS Housing
CTSM - Aluminium Housing

CTS(M) - XX

Customer specific options (optional)

Mounting Bracket (sold separately)

An optional aluminium right angle bracket for mounting the CTS tilt switches is available from our website at the following link:

https://www.leveldevelopments.com/products/inclinometers/inclinometer-accessories/ets-rab-right-angle-bracket-for-ets-tilt-switch/

Properties:

Parameter	Parameter	Value
Length	60	mm
Width	63.5	mm
Height	25.4	mm
Weight	84	grams

Configuration Cable (sold separately)

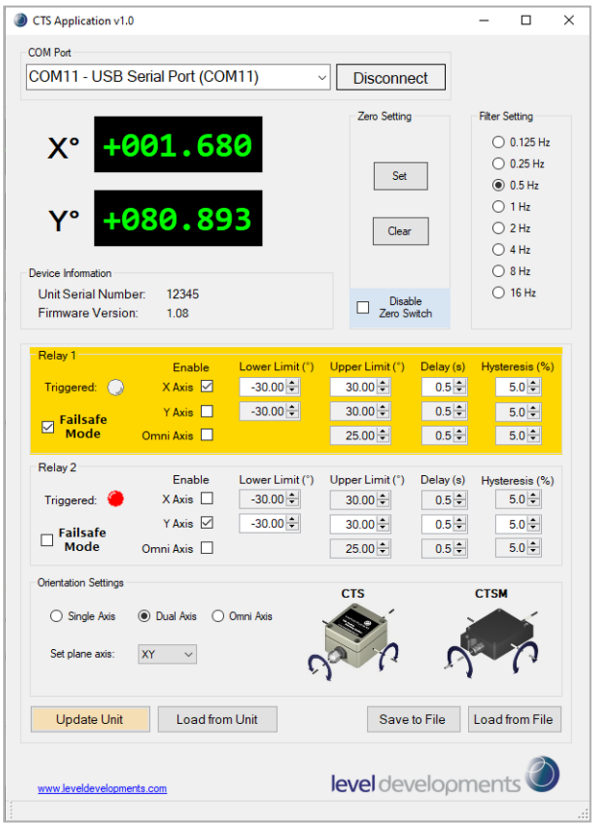
An programming cable "EL-CAB-ETS-UART" must be purchased and used to modify the settings of the CTS tilt switches. **Standard USB cables cannot be used**. The cable can be purchased from our website using this link: [EL-CAB-ETS-UART product page.]

Free Configuration Software for Windows

A free Windows PC application enables user-customisation of the settings available to the tilt switch. It is compatible with Windows 10 and works with 32 or 64 bit systems. It requires .NET framework V4.8 or higher and will prompt you to download this from Microsoft if this isn't already installed. The PC application is available to download using following link: https://www.leveldevelopments.com/wp/wp-content/uploads/software/CTS_App_Setup.zip

To use the software, remove the Lid from the tilt switch by releasing the 4 top screws. Connect the EL-CAB-ETS-UART cable to the CTS's circuit board (see image above) and the other end to the PC/Laptop.

Open the CTS configuration App, choose the correct COM port & click "connect". The serial no. (& existing settings) will display to indicate a successful connection.



Using this application it is possible to:

- Enable or disable the physical zero switch
- Adjust X and Y axis tilt switch delay*
- Adjust the filter** setting and baud rate
- Set (and cancel) the relative zero position
- Enable/disable "failsafe" mode (inverts the operation of the relays so they are active at 0°)
- Assign relay 1 and/or relay 2 to X , Y, (or X and Y), or Omni directional axis.
- Adjust the tilt switch threshold for relay 1 or relay 2
- Adjust hysteresis % for relay 1 or relay 2
- Switch between single, dual, or omni directional axis mode.
- Change the "zero position" orientation (e.g. To switch to "upside down", or "vertically" etc.).

Important Notices: The settings can only be transferred using the "EL-CAB-ETS-UART" cable from Level Developments, the CTS tilt switch does not feature a USB interface. This software is provided 'as-is', without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.