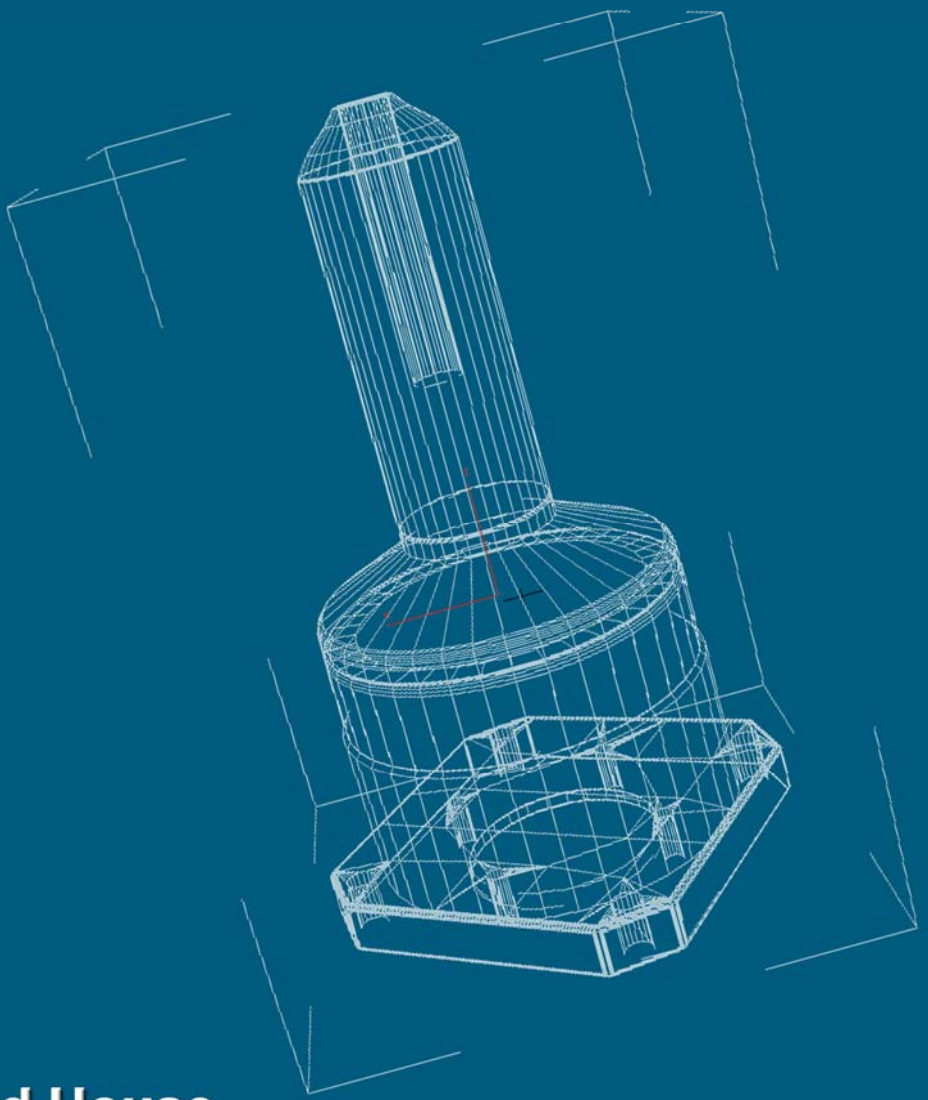
MicroTilt

Technical Manual



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Document Rev H

Table of Content

Table of Figures

Table of Tables

REVISION HISTORY

1.0. DOCUMENT REVISIONS

Rev A Manual for MicroTilts up to and including serial number 33.
Rev B Updated for new revision of MicroTilt SN > 33
Rev C New MicroTilt boards have designed this manual reflects those changes. Boards now have RS232 and RS422
Rev D Error in specification of sample rate corrected
Rev E Updated wiring for the surface versions
Rev F Changed manual to reflect changes in new PCB and Firmware SN >74
Rev G Changed manual to new format

1.1. FIRMWARE REVISIONS

V3.0b Firmware re-write to implement changes and update calibration routine. V3.2 complete releases version
V3.2 Completed with the zero offset changed
V3.3 Firmware version for new boards. Allows RS232 to RS422 change to happen in firmware. Works with RevB and greater boards
V4.06 Updated firmware for Rev D PCBs and new sensor

This manual is only for MicroTilts with a serial number greater or equal to MCT075

2.0. WARNINGS AND NOTES

Throughout the manual the following symbols are used:

Indicates a warning. Failure to follow these instructions will result in serious injury, damage to equipment or incorrect operation of equipment.

Indicates a note. This indicates important information that should be followed to ensure correct operation of the unit.

2.0. GENERAL DESCRIPTION

Figure 2.1: The MicroTilt Sub Sea Unit

This manual is only for MicroTilts with a serial number greater or equal to MCT075

The CDL MicroTilt is a surface or sub sea Pitch and Roll sensor for use in the offshore survey industry. It is based on a MEMS accelerometer which provides fast reliable acceleration readings. These are then used to compute the devices attitude. The MicroTilt provides an accuracy of 0.2 degrees in both axes over a range of ±30°. The unit can be provided in a surface or sub sea (3000m rated) package or can be supplied in an accurately machined mounting frame for OEM applications.

The product has the following features:

- High Accuracy (0.2 degrees)
- Low cost
- 3000m depth rated
- Surface and OEM versions
- ±90° range (quoted accuracies within ±30°)
- Software selectable sampling rate

The MicroTilt is highly compatible with existing Pitch and Roll sensors. Previously, installation problems have occurred where pitch and roll sensors do not agree on polarity selection.

The optional deep-rated MicroTilt sub sea housing is machined from solid stainless steel to provide a high quality and extremely rugged case.

2.1. OEM VERSION

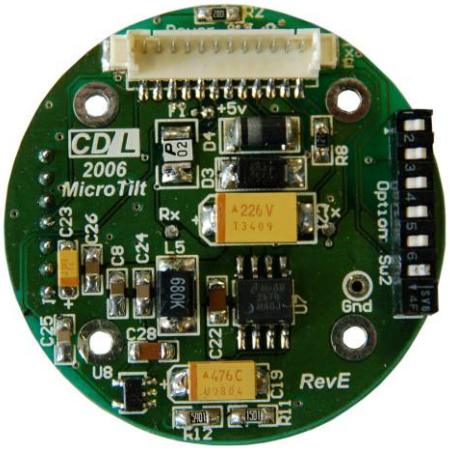

Figure 2.2: The MicroTilt OEM Unit

The OEM version of MicroTilt contains all the functionality of the full product but is supplied without external packaging of any kind.

Connection to the OEM MicroTilt is by way of a 1.25mm pitch 12 way Molex connector (RS part no. 615-146) and matching leads (RS part no. 279-9516).

The option switches are easily accessible to the operator.

2.2. SURFACE VERSION

The surface version of MicroTilt contains a complete OEM unit inside an anodized aluminium housing. The housing has 4 mounting holes machined into the base that can be used to attach the MicroTilt to any flat surface.

2.3. SUBSEA VERSION (3000M)

The sub sea version of MicroTilt contains a complete OEM unit inside an aluminium housing depth rated to 3000m in seawater. The housing is sealed with a single piston 'O'-ring that should be cleaned and re-greased whenever the housing is opened.

2.4. DEEPWATER VERSION (6000M)

The deepwater version of MicroTilt is identical to the sub sea version in every way except that the housing is machined from Titanium rather than aluminium in order to achieve the superior depth rating.

The 'O'-ring seal should be cleaned and fitted with particular care for any operations beyond 3,000m water depth as any scratches or residue can cause failure.

Figure 2.3: Titanium MicroTilt

2.5. CHECK-OUT AND CALIBRATION

The MicroTilt system should be given a full factory calibration every 12 months.

Between factory calibration checks, the MicroTilt can be checked after each job using the following procedure.

2.6. MICROTILT CHECKOUT PROCEDURE

1. Inspect housing frame for signs of mechanical damage
2. Inspect connector for bent pins, damage or dirt. Clean and grease if necessary.
3. Use test cable wired as shown in section 4 (into computer and 12V PSU):
4. Switch on test cable at power supply and check that MicroTilt draws less than 15mA.
5. Run terminal program on PC and set to 9600,8,1,N. Check that data is displayed on screen.

2.7. SELF TEST

The Rev D units incorporate a self test function that checks the functionality of the MEMS sensor and critical electronics. When the unit is turned on the self test routine is entered. If all checks are passed then "Self Test OK" will be displayed below the start-up message and attitude data will subsequently be displayed.

If the self check routine reports errors then "Self Check Failed" will be displayed below the start up message, output will pause for approximately five seconds and then attitude data will be displayed. The user should check the status of the self check whenever possible to ensure the unit is functioning properly. If a "Self Check Failed" message is seen then CDL should be contacted.

"Self Check Failed" does not necessarily indicate a faulty unit; however, the unit should be checked for correct operation. "Self Check OK" does not necessarily indicate the unit is functioning correctly.

Extreme Vibration during power up of the unit can cause a "Self Check Failed" message

3.0. MICROTILT SPECIFICATIONS

Range	±90°
Resolution	0.1°
Accuracy	±0.2° in the range ±30°, 8 samples/reading ±0.5° in the range ±64°, 8 samples/reading
Rate	~60Hz at 115200bps, 1 sample/reading ~8Hz at 9600bps, 8 samples/reading
Angle calculation	4000 point sine look-up table
Power Input	7-24 Vdc
Current consumption	<30mA (@12Vdc typical)
Power consumption	0.36W
Data Output	RS232 or RS422 (selectable on order)
Baud Rate (bps)	9600 19200 38400 57600 115200
Data Bits	8
Stop bits	1
Parity	None
Measurement Range	±1.7g
0° offset vs temp	0.34'arc/°C

3.1. ABSOLUTE MAXIMUM RATINGS

Acceleration (Any axis un-powered)	3,500g
Acceleration (Any axis powered)	3,500g
Drop Test (Concrete Surface)	1.2m
Voltage	30v
Operating Temperature	0°C to +75°C
Storage Temperature	0°C to +80°C

CONNECTIONS

4.0. OEM VERSION CONNECTOR

Connection to the OEM version is by way of a 1.25mm pitch 12 way Molex connector (RS part no. 615-146) and matching leads (RS part no. 279-9516).

Pin	Function	
	RS232	RS422
1	N/C	RxB
2	N/C	TxZ
3	Data Ground	N/C
4	Rx Data (to unit)	RxA
5	Tx Data (from unit)	TxY
6	N/C	
7	+Vin	
8	N/C	
9	Ground	
10	N/C	
11	N/C	
12	N/C	

Table 4.1: OEM Connections

4.1. SURFACE VERSION CONNECTOR

Connection to the surface version is by way of an un-terminated tail.

4.1.1. Connections in Surface Connector

Colour	Function		PC 9-way D-type (RS232 Only)
	RS232	RS422	
Blue	RS232 Tx (Data from MicroTilt)	TxY	2
Orange	RS232 Rx (Data to MicroTilt)	RxA	3
White	Data Ground	N/C	5
Pink	N/C	TxZ	
Yellow	N/C	RxB	
Red	+12v DC		
Green	0v DC		

Table 4.2: Surface Version Connections

4.2. SUBSEA VERSION CONNECTOR

Connection to the sub sea version is by way of an integrally moulded un-terminated tail.

4.2.1. Connections in Sub-sea Connector

Colour	Function		PC 9-way D-type (RS232 Only)
	RS232	RS422	
Blue	RS232 Tx (Data from MicroTilt)	TxY	2
Orange	RS232 Rx (Data to MicroTilt)	RxA	3
White	Data Ground	N/C	5
Clear	N/C	TxZ	
Yellow	N/C	RxB	
Red	+12v DC		
Green	0v DC		

5.0 MAIN DISPLAY

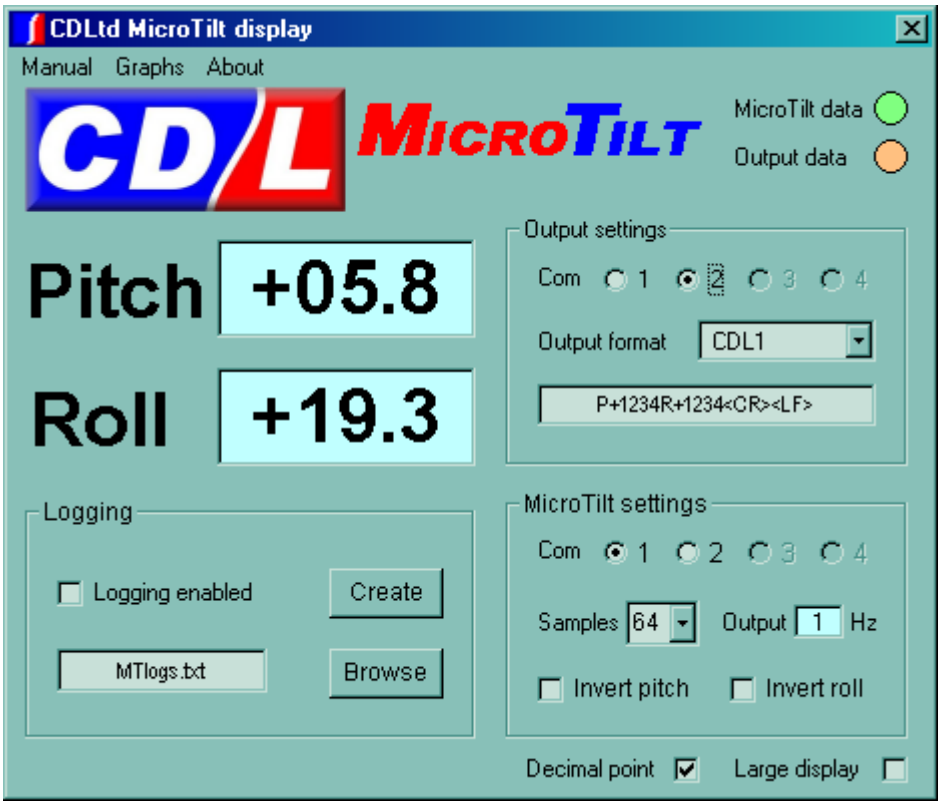

Figure 5.1: MicroTilt Software

The main display page shown above contains various areas used for the display of MicroTilt data and setup parameters.

Com ports are selected automatically at start up, the software will attempt to place the lowest numbered valid com port for the MicroTilt and the next highest will be used for data output. If only one com port can be found the software will disable data output and the 'Output settings' frame will be greyed out.

Data output formats can be selected from the pull down box, a wide variety of formats allow for easy interfacing with other sensors and computer packages. Customers can have new formats added simply by contacting CDL on:

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In the 'MicroTilt settings' frame, two checkboxes allow the user to invert the polarity of the two axes of the MicroTilt. Note that this function actually inverts the polarity on the device, i.e. the MicroTilt will actually generate inverted data even if the display software is not being used.

A pull down box also selects the number of samples taken by the device before each data telegram is sent. The available options are:

No. of samples	Approx Output rate (Hz) @ 115200bps
1	60
2	32
3	22
4	17
5	14
6	12
7	10
8	9

Table 5.1: Relation between samples and output rate

At the bottom of the display are checkboxes for removing the decimal point from the data (on the display only) and for placing the screen into 'Large display' mode as shown below.

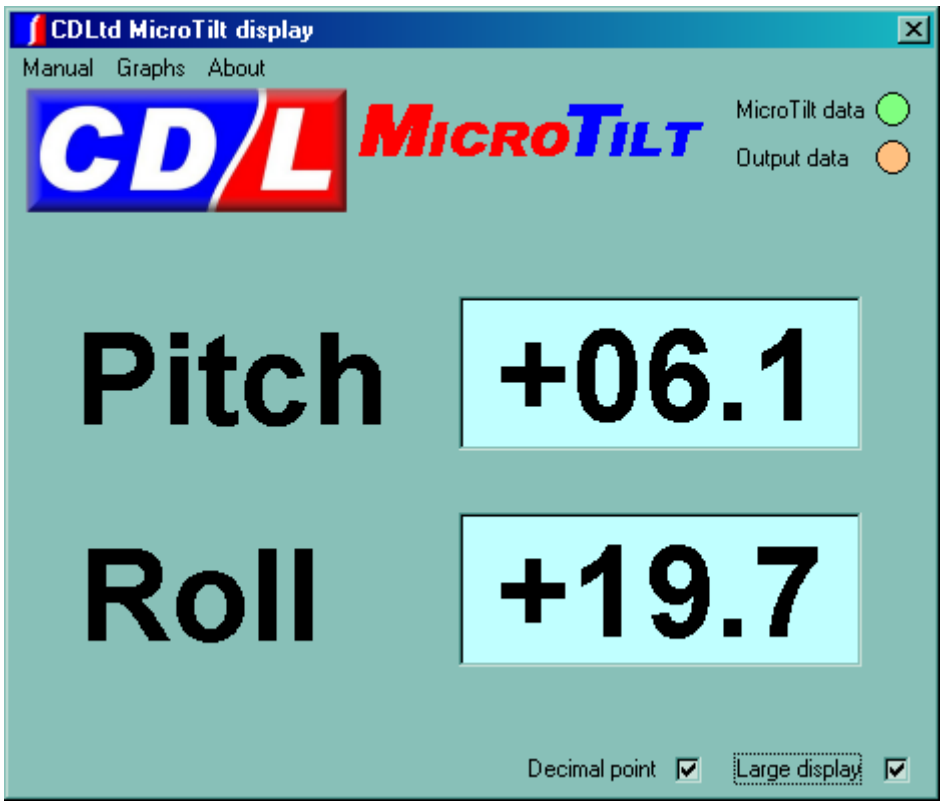


Figure 5.2: Large display in software

The system has a logging facility. A 'browse' button allows the selection of the correct file location. The 'create' button will create a log file using the name in the text box. Logging will be made continuously to this file if the checkbox is selected.

The log is made up of a simple data header followed by pitch and roll information and a time stamp. Date info is contained in the header only.

An example log file is shown below:

CDL MicroTilt Log File
Created 16/08/2002 09:04:23

Pitch	+00.20	Roll	+01.30	09:04:25
Pitch	+00.20	Roll	+00.90	09:04:25
Pitch	+00.20	Roll	+01.00	09:04:25
Pitch	+00.00	Roll	+01.00	09:04:25
Pitch	+00.40	Roll	+01.00	09:04:25
Pitch	+00.40	Roll	+00.90	09:04:25
Pitch	+00.20	Roll	+00.90	09:04:25
Pitch	+00.20	Roll	+00.90	09:04:25
Pitch	+00.40	Roll	+01.00	09:04:25
Pitch	+00.20	Roll	+00.90	09:04:25
Pitch	+00.20	Roll	+00.90	09:04:25
Pitch	+00.40	Roll	+01.00	09:04:25
Pitch	+00.40	Roll	+01.30	09:04:25

Figure 5.3: An Example log file

5.1. PITCH AND ROLL GRAPHS

By selecting 'Graphs' from the main display menu, the display below can be toggled on or off.

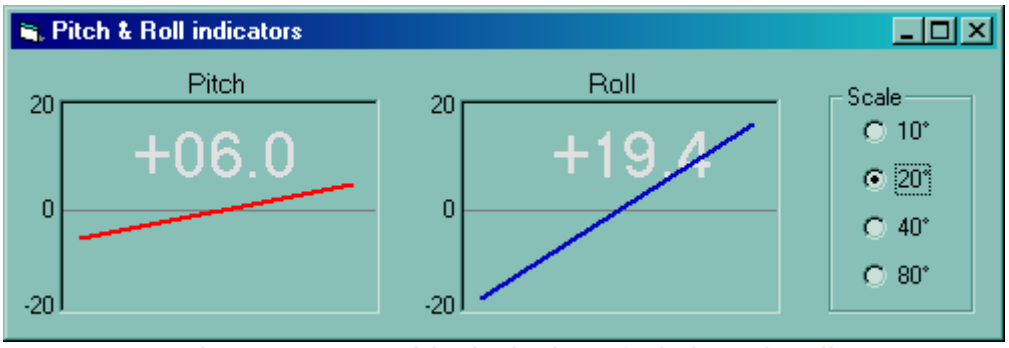


Figure 5.4: Graphical Display of Pitch and Roll

The two boxes provide a visual representation of the current pitch and roll angles to allow better visualization of the data outputs from the MicroTilt. The

centreline is marked in a light grey with the pitch and roll readings overlaid in red and blue respectively.

The ‘Scale’ frame allows more accurate monitoring of the artificial horizons for applications ranging from +/-10 ° to +/- 80 °.

The pitch and roll readings are directly overlaid in a light font colour.

COMMAND LIST

6.0. DATA OUTPUT FORMAT

By default the MicroTilt outputs a string formatted as:

P±12.30R±12.30

This string is the required output string for interface to the CDL MicroTilt Software

The output string can also include the T1 and T2 data from the accelerometer. This data is the raw pulse count from the accelerometer. If this is included the string is as follows.

T1x12345T1y12345T212345P±12.34R±12.34

It is also possible to include acceleration data in the output string. This gives the acceleration the unit is being subject to in the x and y axis. In this case the string output is:

AccX1234AccY1234P±12.34R±12.34

Finally it is possible to include all outputs giving a string:

AccX1234AccY1234T1x12345T1y12345T212345P±12.34R±12.34

Acceleration is in mg

6.1. SIL SWITCH SETTINGS

The MicroTilt has a set of 6 SIL switches on the PCB. These are at time of manufacture set to the off position (opposite way to arrow) as shown in figure 6.1.

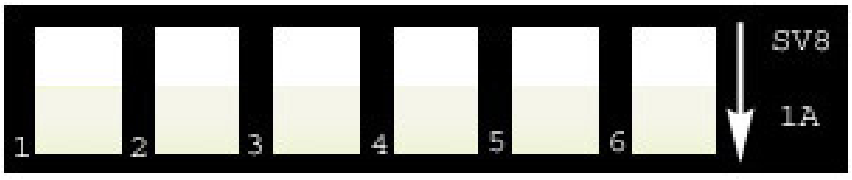


Figure 6.1: SIL switches

These SIL switches have the following functions:

Switch	Function
1	Swap Pitch and Roll axis
2	Swap Pitch ± sign convention
3	Swap Roll ± sign convention
4	Adds acceleration data to the output string (max 2g)
5	Adds T1 and T2 data to the output string
6	NA

Table 6.1: SIL switch Functions

Under no circumstances is switch 6 to be used. Use of this switch will invalidate calibration and warranty.

6.2. KEYBOARD COMMANDS

With the unit connected to a PC serial port it is possible to change settings by sending characters via a Terminal application. The characters sent are **not** case sensitive and characters sent are echoed back to the terminal application. To be able to change settings a “>” character must be sent initially at this point data output will stop and a “>” will be displayed. To exit this mode without making changes simply press the escape key. To confirm changes made press the enter key.

6.2.1. Baud Rate Selection

By sending the “b” character followed by a number between 1 and 5 it is possible to select different output baud rates. The settings shown in Table 6.2.

Number	Baud Rate (bps)
1	9600
2	19200
3	38400
4	57600
5	115200

Table 6.2: Baud Rate Options

6.2.2. Number of Samples

It is possible to increase the accuracy of the output by averaging a number of samples. By default the unit is setup so that it does not average samples however this can be altered by sending an “s” character followed by a number between 1 and 8. If 1 is sent then no averaging occurs, if 2 is sent then the output will be the average of 2 samples from the accelerometer etc.

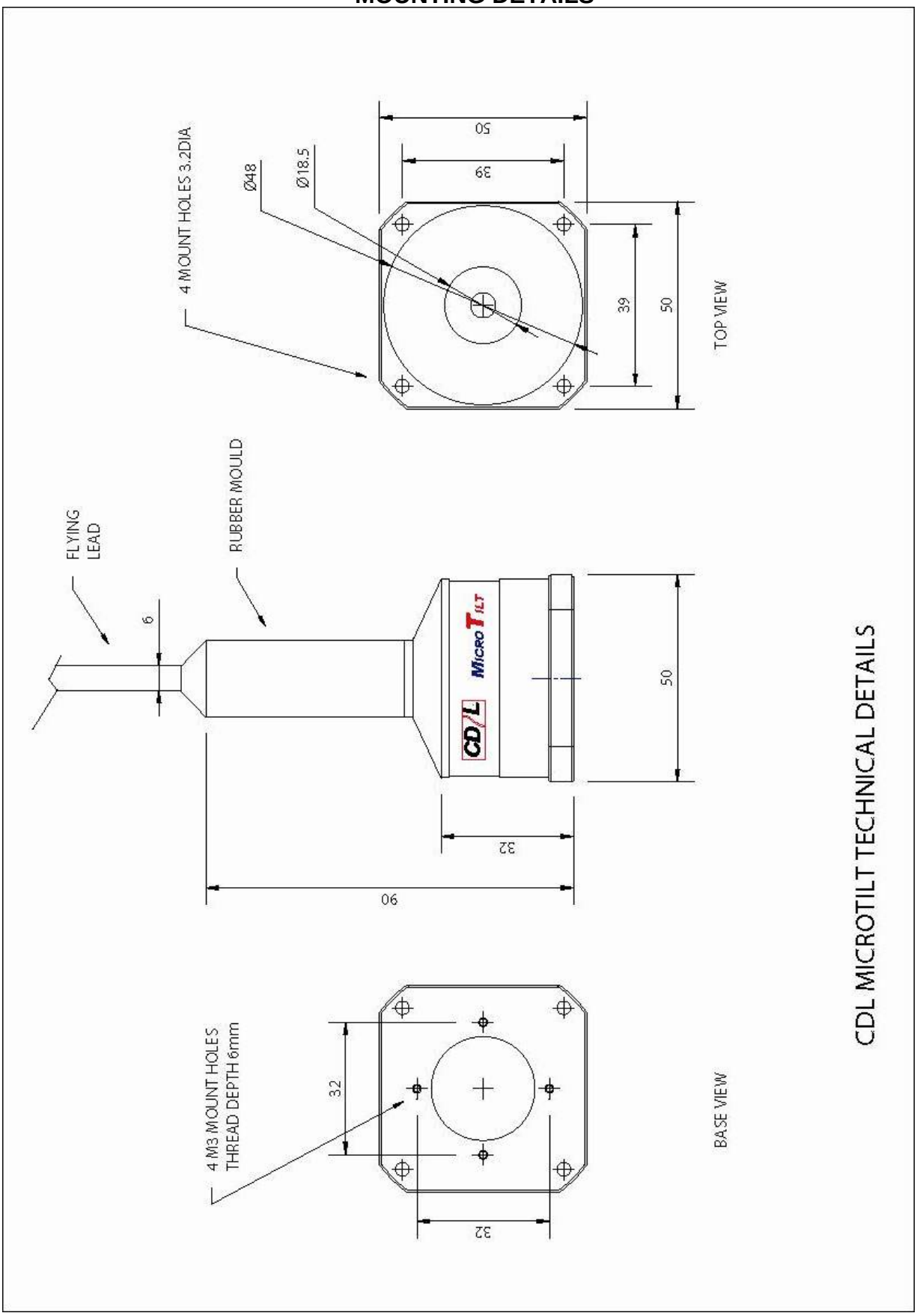
6.2.3. Removing Decimal Point

For some application it is advantageous not have a decimal point in the output string. This can be toggled on and off by sending “.” to the unit.

6.2.4. Removing Second Decimal Place

For some applications it is advantageous not to display the second decimal place in the output string. This can be toggled on and off by sending “o” to the unit.

MOUNTING DETAILS



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