Augmented Sensing Object for Handle - Manual

The Can Sensing Object

Table of Contents

1 Introduction

This document covers the operation and instructions of use of an augmented sensing object. Designed to mimic a standard 330ml cola can. It has 40 independent tactile sensing regions and 10 x 3-axis accelerometers, one mounted on each face. It is completely wireless running on 4xAAA batteries and communicating with the host via Bluetooth.
In the following document we will go through step by step some of the things which you may want to do in the course of using this product. From changing the batteries to writing simple code to displaying the data in the way you wish.

The average observed battery time is approximately **90mins**. It is advisable to have one set of batteries on charge the whole time.

All example programs and datasheet documentation can be downloaded from the Shadow website at the following address:

http://shadowrobot.dnsalias.org/sensingcan/...

2 Setting up the Can

The Can will be supplied with batteries already installed. Remove it from the packaging and stand it in front of you.

2.1 Relevant Information needed for setup

The pairing code for the Bluetooth device is 1234
The baud rate is 112500

2.2 Setting up the Can for Unix (including use of example code)

On a Linux computer with Bluetooth drivers installed, the following steps can be taken to get data from the device:

1. Turn on the Sensing Can

2. Bind the Bluetooth module to rfcomm with "`sudo rfcomm bind 0 <ID> 1`"
   (to check the ID of the blutooth module, enter "GB" in command mode).
   E.g. <ID> = 00:06:66:03:9C:4F.

3. Run a program to send ascii characters to the device to get data back.
   The "bluetooth_serial.c" program sends a space character to the device and then receives and displays the data.

   The following script does the same in a terminal window:

   ```
   ( sleep 1 ; while true ; do echo -n ' ' >/dev/fd/3 ; sudo head -c 18 <
   /dev/fd/3 | od -t x2 -w18 -v ; done ) 3<>/dev/rfcomm0
   ```


2.3 Setting up for Windows (basic setup)

Next you will have to install the Bluetooth program on your computer. If you are using a windows PC you can download it from here:

http://www.lm-technologies.com/home/product_support/3833

It is important that you do not connect the USB Bluetooth adaptor until the installation is complete.

When the installation is complete plug in the USB Bluetooth adaptor and turn the can on using the switch on the top. Clicking on 'find device' will start a search for the adaptor. Once connected to your PC you can use a terminal program to read the streaming data e.g. realterm or hyperterminal.

2.4 Bluetooth Module Settings

See the "Roving Networks Bluetooth Product User Manual" for instructions for the RN-41 Bluetooth module.

Here are some useful commands from the manual:

$$$	Enter command mode (must be done within 60s of power up).
---<cr>	Exit command mode (---<enter>).
I	Performs an inquiry scan (10 sec.) and returns addresses of any devices in range. This remote address can be used to bond the module to a specific Bluetooth dongle.
SR,<number>	Store remote address. E.g. SR,001986002C16
SX,<0,1>	If set, the device will only accept connections from the device that matches the stored remote address. It is a good idea to set this if more Bluetooth devices are in range.
SU,<rate>	Set the baud rate. SU,11 sets the rate to 115.2K.
D	Display basic settings.

3 Breakdown of the Internal Workings of the Can

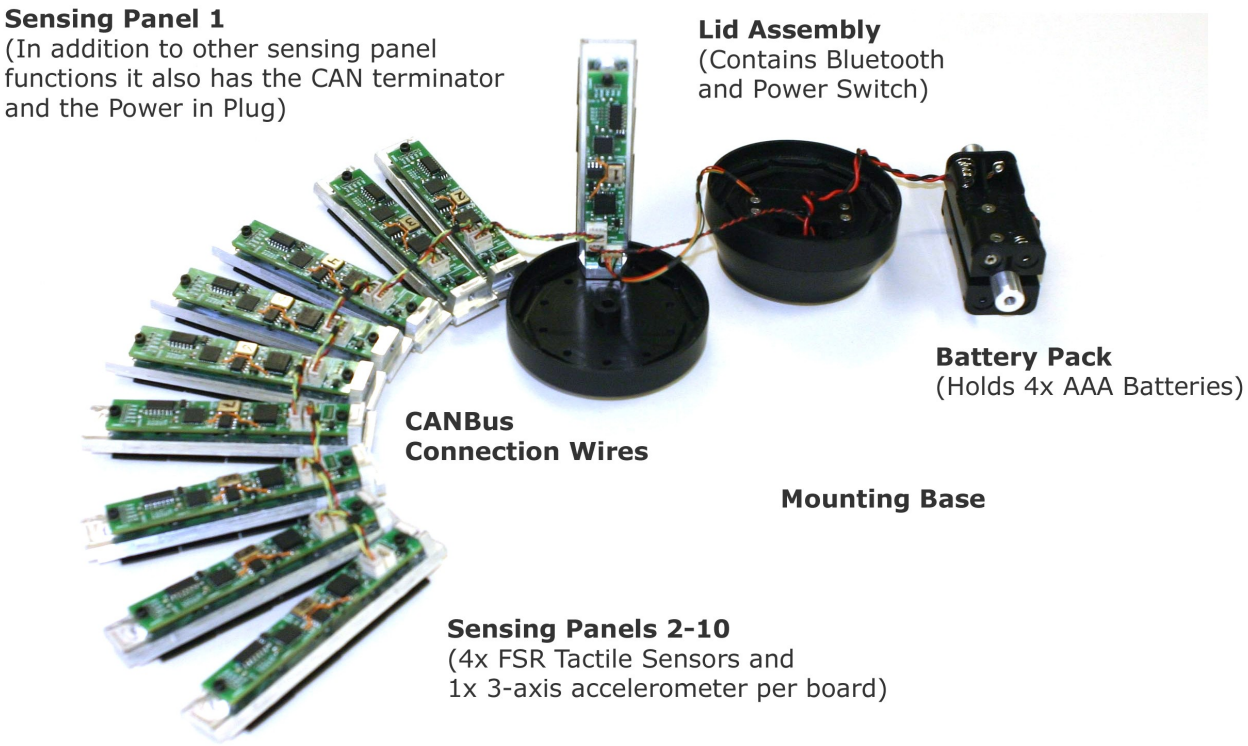
The Can is broken down into 10 identical 'slices'. Each one of these slices has 4x FSR sensors and 1x 3-axis accelerometer. Each PCB is connected to the next by a CANBus interface.

The board no 1 includes the CAN terminator as well as connecting to the Bluetooth module in the lid.

Each PCB forms a CAN node and is controlled by a PIC 16F2580. The data streaming protocol is explained in sections 9 and 10.

The Switch on the top disconnects the batteries from the rest of the electronics. The 4x AAA batteries provide 6v to the CANBus. For the instructions on how to replace them please refer to Section 12.

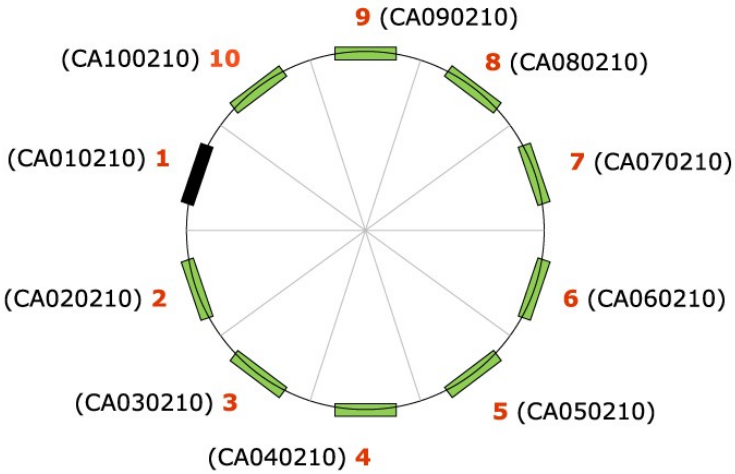
4 Sensing Can Components



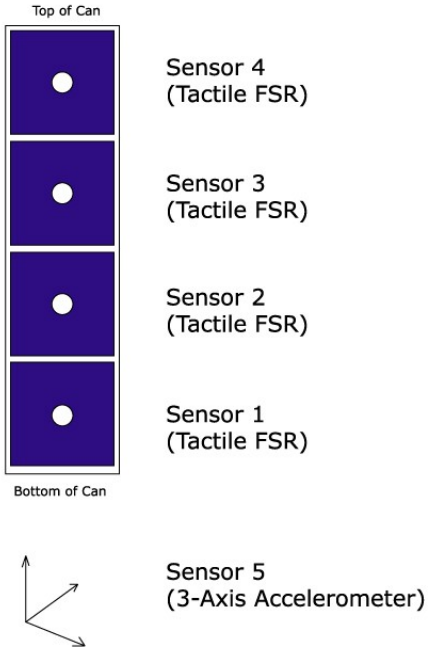
Bluetooth USB adaptor for the PC (LM-Technologies LM505)

5 Sensor and Node Numbering

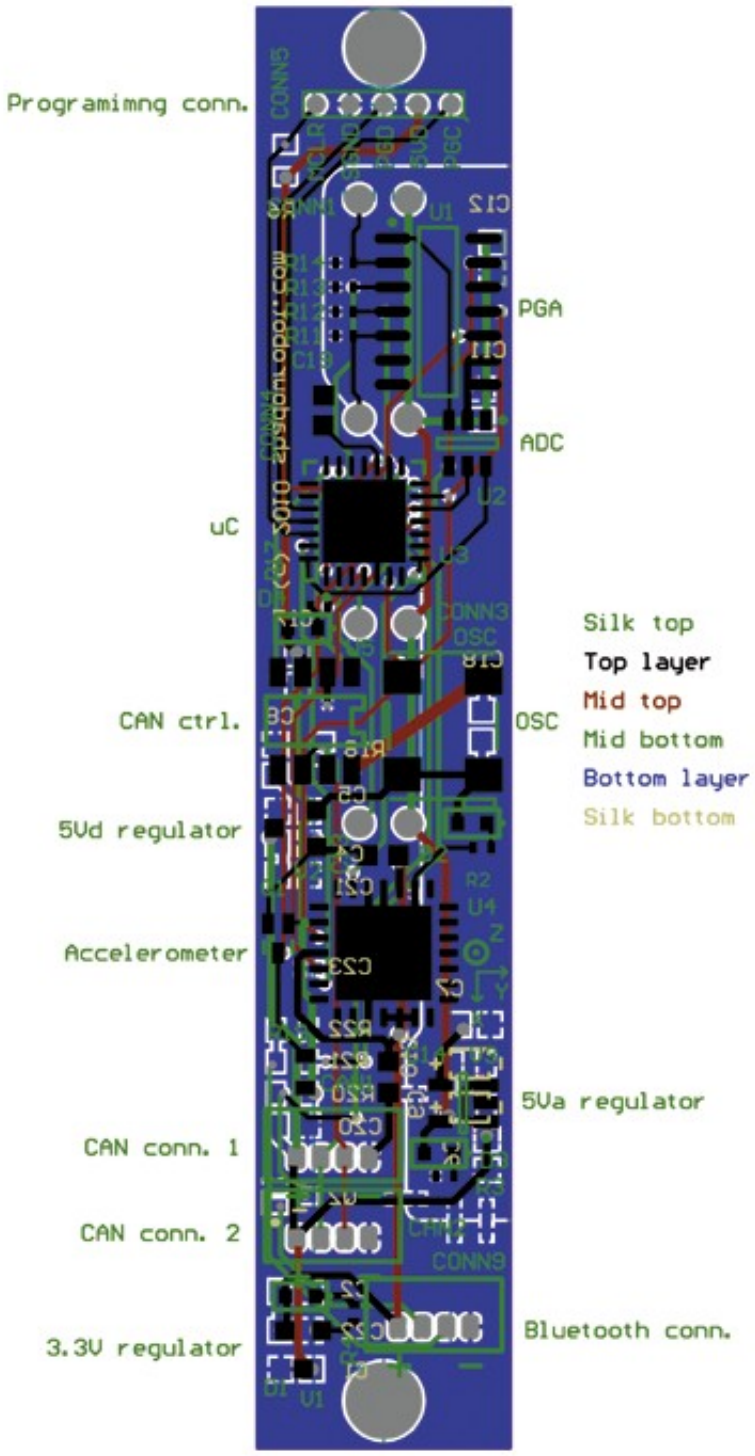
Board Numbers (Node ID) Plan View of Can



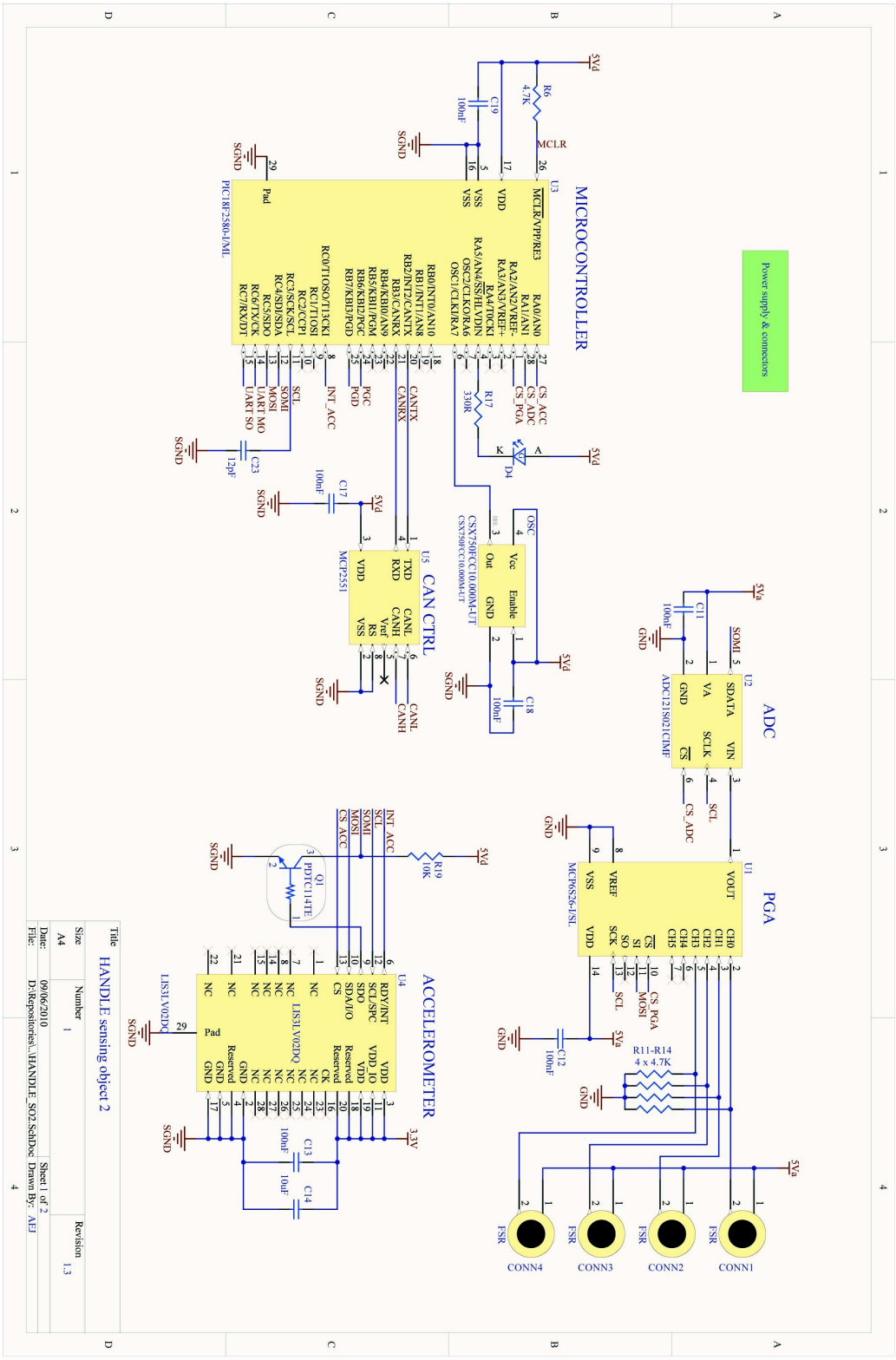
Sensor Numbering per Sensing Panel

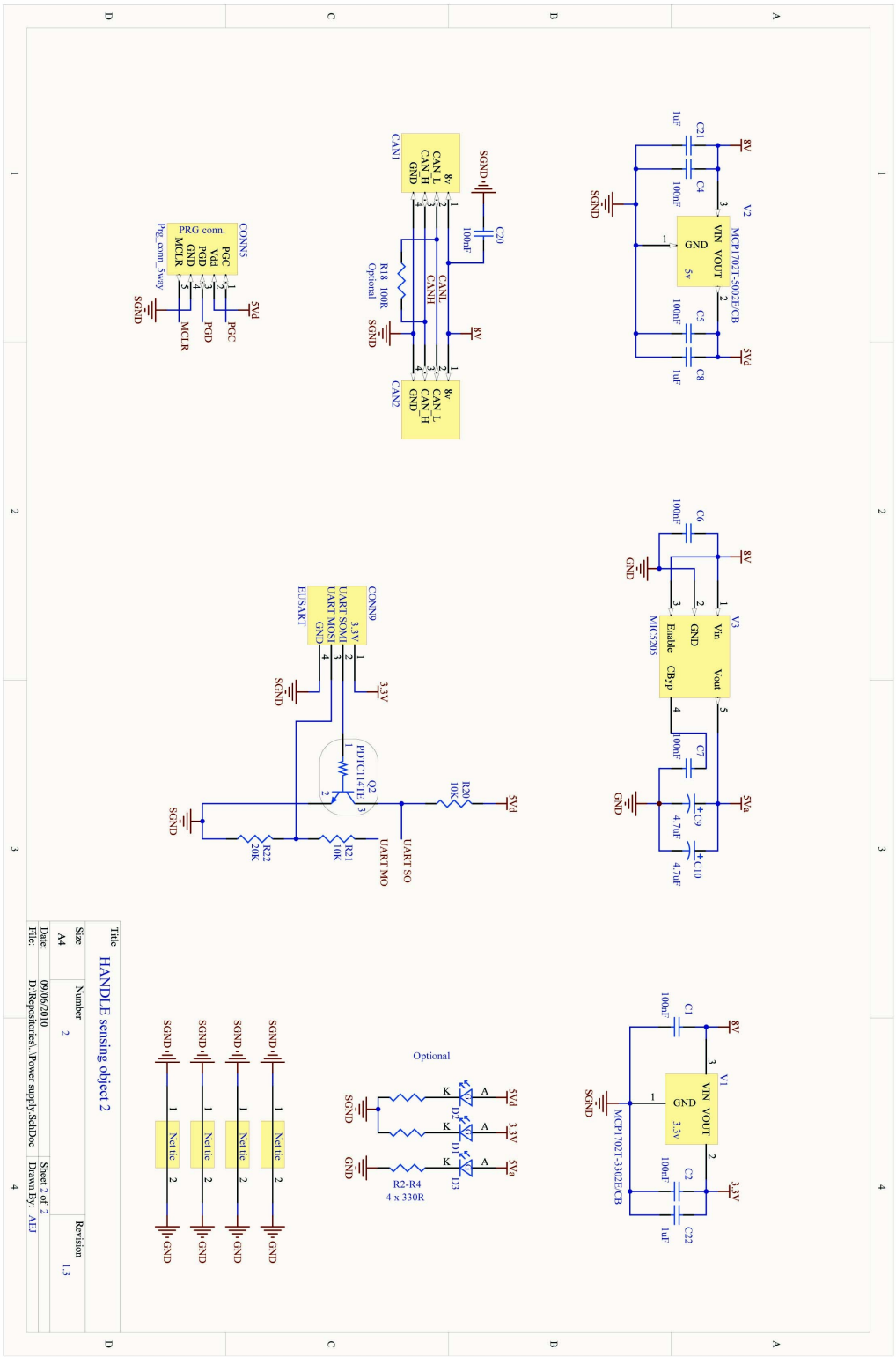


6 PCB Layout

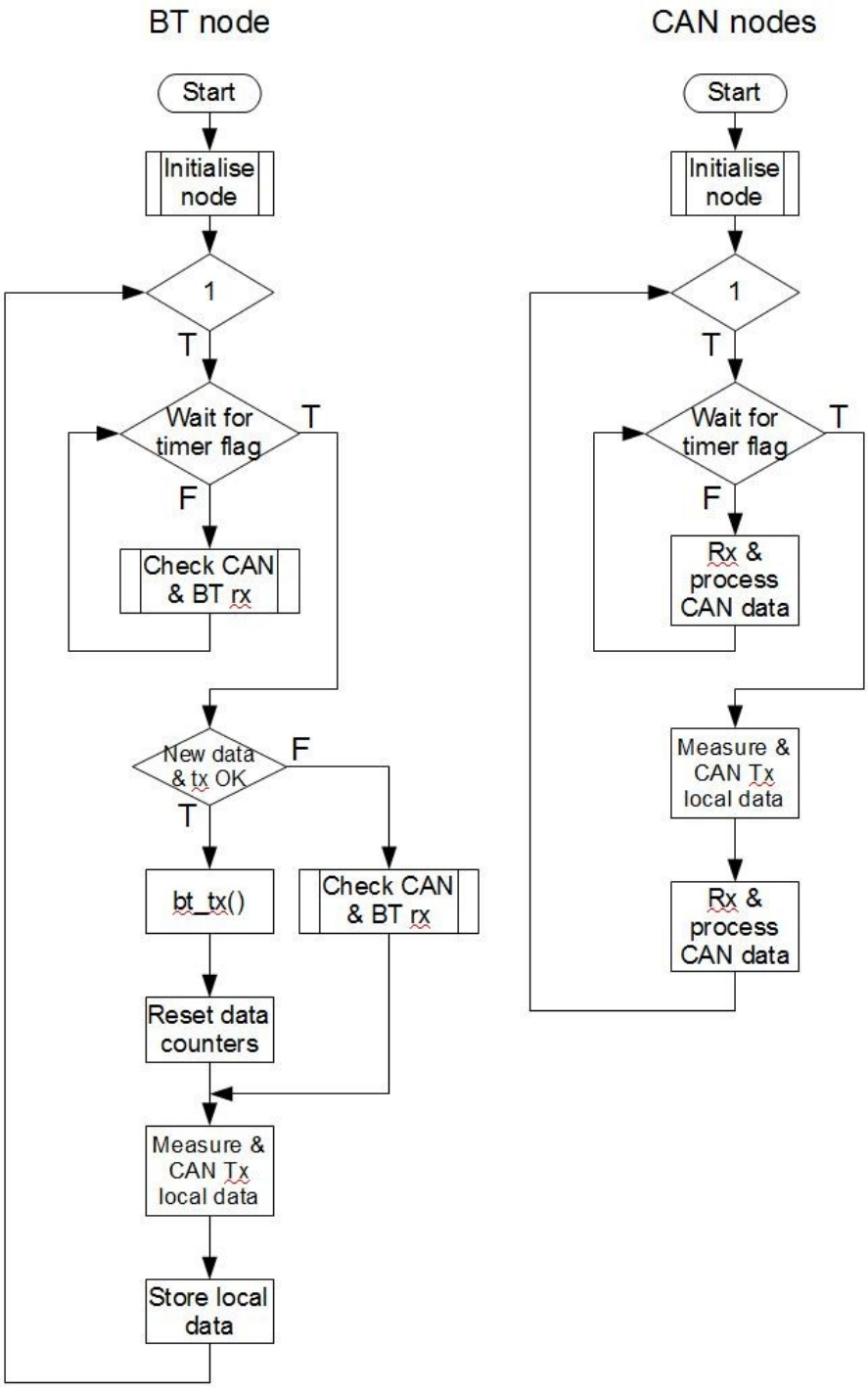


7 PCB Schematic





8 Program/Node Information Flow Diagram



BT node:

In “Initialise node” the node's configuration is restored and its devices set up. The rest of the code consists of two loops: asynchronous(“wait for timer flag”) and synchronous. The timer flag is set every millisecond. In the asynchronous loop, the CAN-bus is checked (for data from the other nodes) along with the Bluetooth module (for transmission requests or node configuration).

In the synchronous loop the program first checks if there is a transmission request (tx OK) and new data for the node that data is requested for. If the answer is yes to both, the data is sent to the Bluetooth module and the flags for transmission request and new data are reset. If the answer is no to either (or both), the CAN-bus and Bluetooth are checked for data.

Finally measurements are taken from the local FSR sensors and the accelerometer and the data stored for later transmission.

CAN nodes:

The “Initialise node” block is the same as in BT node, as is the basic structure (with the asynchronous and synchronous loops). In the asynchronous loop the CAN bus is checked for configuration messages.

In the synchronous loop, measurements are taken from the local FSR sensors and the accelerometer and the data sent on the CAN bus. Finally the CAN bus is checked again for configuration messages.

9 Sending Data to the Can

To change the settings for the FSR sensors or the accelerometers, send 4 ASCII characters to the BT module with the following formatting:

gXYZ

where:

The 'g' (not case sensitive) is there to indicate that settings data follows.

X is node, (The node number can be '0-9' ('0' is for node 10).)

Y is sensor (Sensor number '1-4' selects FSR sensor 1-4 on the node selected and '5' selects the accelerometer.)

Z is setting. (Node dependent, see below)

The settings number options for the FSRs are as follows:

Gain settings:
0: +1 (default)
1: +2
2: +4
3: +5
4: +8
5: +10
6: +16
7: +32

example:
g625 : set the gain on FSR sensor 2 on node 6 to +10.

The Accelerometer settings are on the next page.

The Setting Number options for the Accelerometer are as follows:

Accelerometer settings:
0: off
1: on (default)
2: 6g
3: 2g (default)
4: self test off (default)
5: self test on

ex.
g052 : select the 6g range on the accelerometer on node 10

10 Data Format Received From the Can & Transmission IDs

The Data returned from the can will be in the following format:

ID-FSR1-FSR2-FSR3-FSR4-ACCX-ACCY-ACCZ-0000

Each section will be a 16bit number.

For location and orientation of the FSR's and the accelerometers please read on to the section entitled "Sensor Orientations and Locations"

The Transmission Ids are as follows:

Sensing Board Number	Transmission ID
1	0610
2	0720
3	0630
4	0740
5	0650
6	0760
7	0670
8	0780
9	0690
10	07A0

When set on "1g" setting the expected range of the accelerometer data will be:

-1g > 0 > 1g

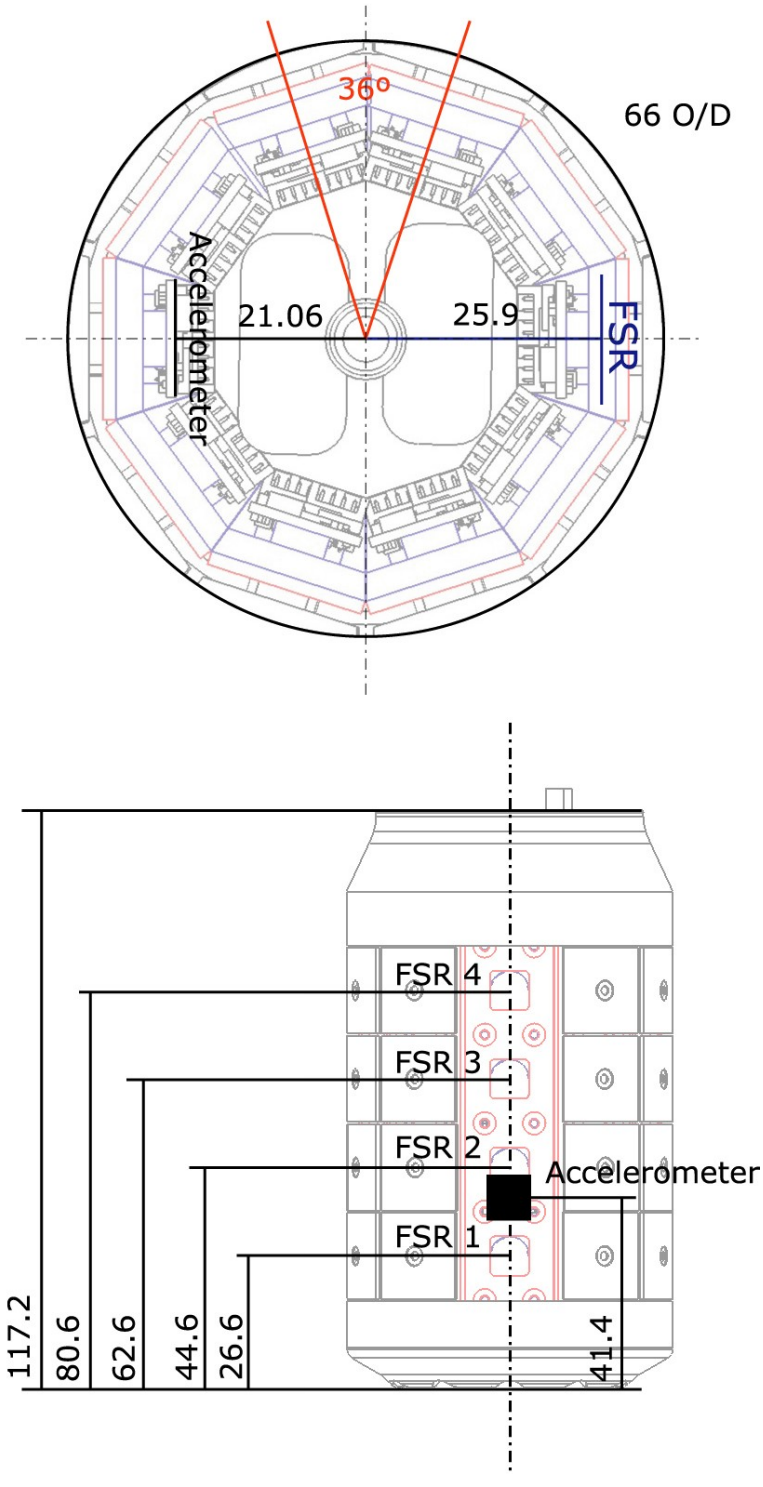
0400 > 0800 > 0c00

An example data stream would look like the following (Without the spaces...):

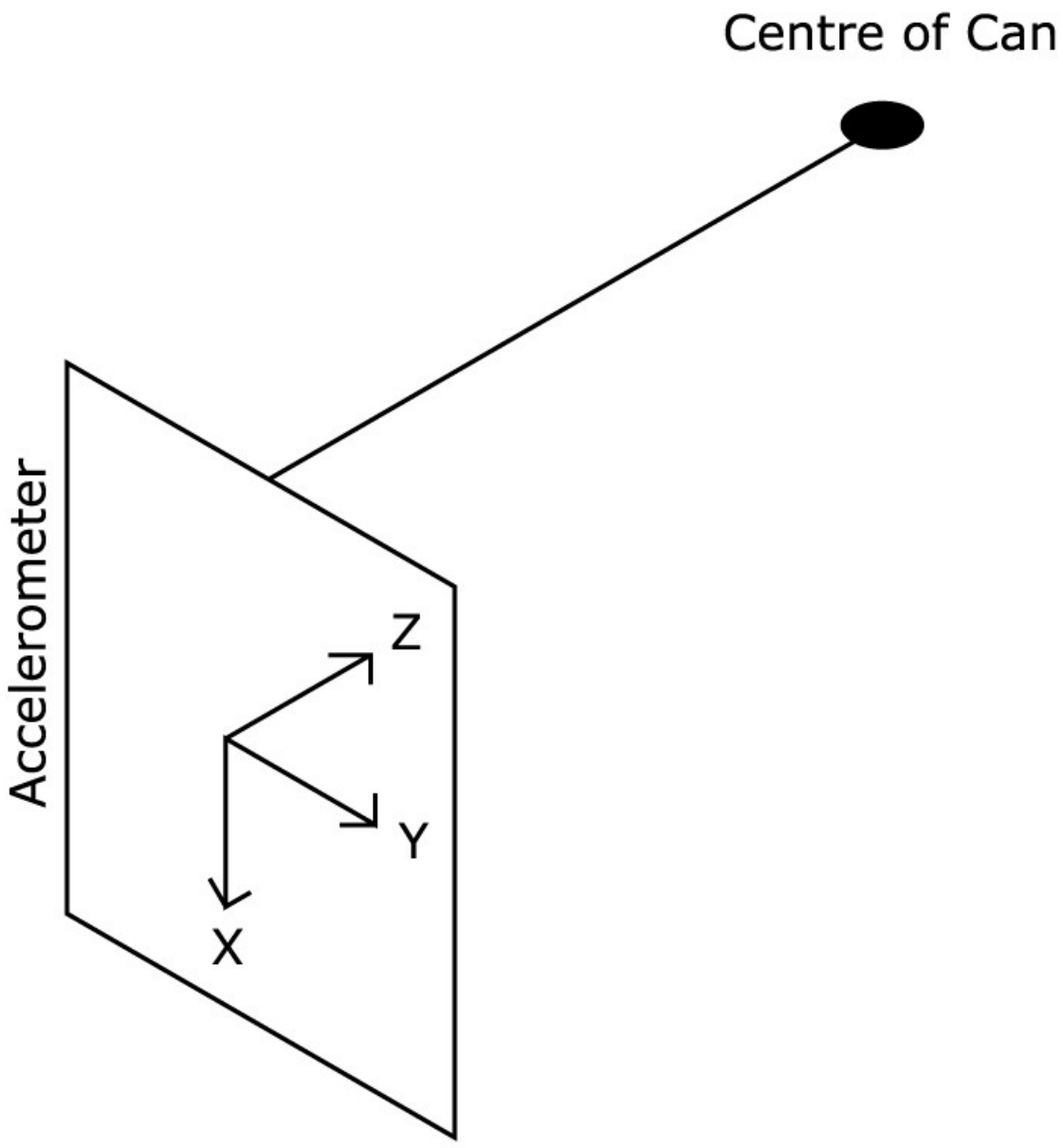
0610 0003 0A40 0638 1789 0005 03cd 07cb 0838 0000

11 Sensor Orientation and Location

11.1 Accelerometer and FSR Locations



11.2 Accelerometer Orientation



12 General Repairs and Maintenance

12.1 Replacing the Batteries

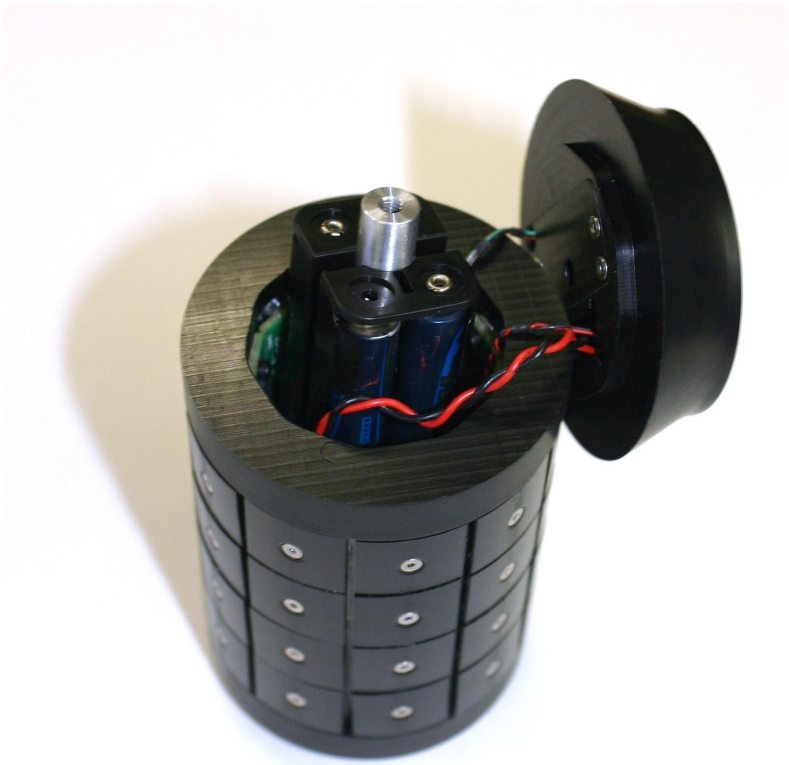
1. Remove the top bolt using a 3mm hex driver

2. Remove the top lid, leaving the collar in place. If the collar is removed as well it is OK but a little harder to reassemble.

3. Holding the collar in place with one hand tip the can upside down. Used the 3mm Hex driver to remove the other bolt in the base.

4. Whilst continuing to hold the collar carefully slide the battery block out of the centre of the can.

5. Replace the batteries and slide the battery block back inside the can. Be careful not to pinch any of the internal wires.



6. Screw the lid and base bolts back in. (The long one goes in the lid) and you're done.

12.2 What to do if the collar becomes detached during battery replace.

If at any stage the collar slips off the top of the side panels don't panic. By applying a gentle pressure on the collar towards the base and wriggling slightly they should located back into the slots. With the lid off it sometimes helps to put your finger inside and push the side panels out slightly. See pictures below:

Illustration 1: Underside View of the collar

Illustration 2: Replacing the Collar