CAN bus LCD Display
User's Manual

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1 INTRODUCTION

This document details the interface, installation, and usage requirements for the Tritium CAN bus LCD display product. It also provides information on programming the device to implement custom functionality.

The LCD display provides an easy way to show telemetry and control information for a Tritium WaveSculptor motor controller. The LCD display comes programmed from the factory configured with sensible default values that will work in a plug-and-play manner with a motor controller.

The microcontroller firmware for the device (in 'C') is available on the Tritium website under an open-source license, as are the hardware schematics and component overlays.

2 DEVICE OVERVIEW

The LCD display provides a 3.5 digit 7-segment liquid-crystal interface to show numbers from -1999 to 1999, with selectable decimal point position. Up to four different variables can be chosen to be displayed, one at a time.

The display receives data and power via a CAN bus running at up to 1 Mbit/second, with the factory default at 500kbit/sec. Alteration of either the bit rate or the addresses for various data types currently requires reprogramming the microcontroller, although hardware support does exist to allow remote configuration in the future.

Four LEDs are provided on the front panel of the device to indicate which variable is currently being displayed.

With appropriate modification of the firmware, the display is capable of reading and displaying any variable on the CAN bus. It is not only restricted to Tritium devices.

3 HARDWARE

3.1 FRONT PANEL

An adhesive decal protects the front of the LCD and provides a single pushbutton switch to select between display variables. It is backed by a 0.8mm thickness stainless steel plate to provide a mechanically strong mounting surface.

3.2 LABELS

Four transparent windows are present in the decal to allow placement of a paper label behind the decal. This label is inserted at the factory to match the four variables chosen for display, and once in place cannot be removed.

If you will be programming the display with your own firmware, please specify that your display be delivered unassembled, so that you can insert your own labels once you have finalised your firmware modifications.

3.3 POWER INPUT

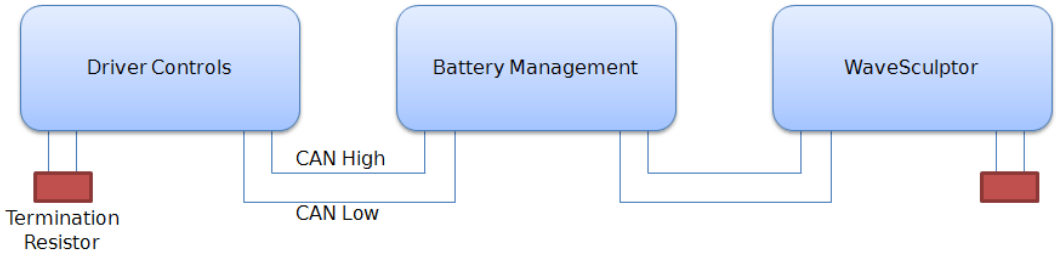
Power for the display needs to be supplied along the CAN bus cable. The display contains an internal regulated power supply and will operate successfully with a supply of between 9V and 15V DC. The display uses less than 20mA when operational.

4 CAN BUS

4.1 CAN NETWORK TOPOLOGY

The CAN bus is structured as a linear network, with short stubs branching from 'T' connectors on the main bus backbone to each device. The CAN bus data lines must be terminated at each end of the main bus with 120 ohm resistors between the CAN-H and CAN-L signals.

In the range of Tritium EV products, including the WaveSculptor 200, EV Driver Controls, and LCD display, the CAN connections are implemented with an 'in' and an 'out' connector, therefore placing the 'T' on the device, resulting in a very short fixed-length stub on the circuit board of each device. This is ideal from a signal integrity and network performance point of view.



4.2 CAN WIRING

The CAN data lines (CAN-H and CAN-L) must be implemented with twisted-pair wire for proper data integrity. The wire should have a characteristic impedance of 120 ohms.

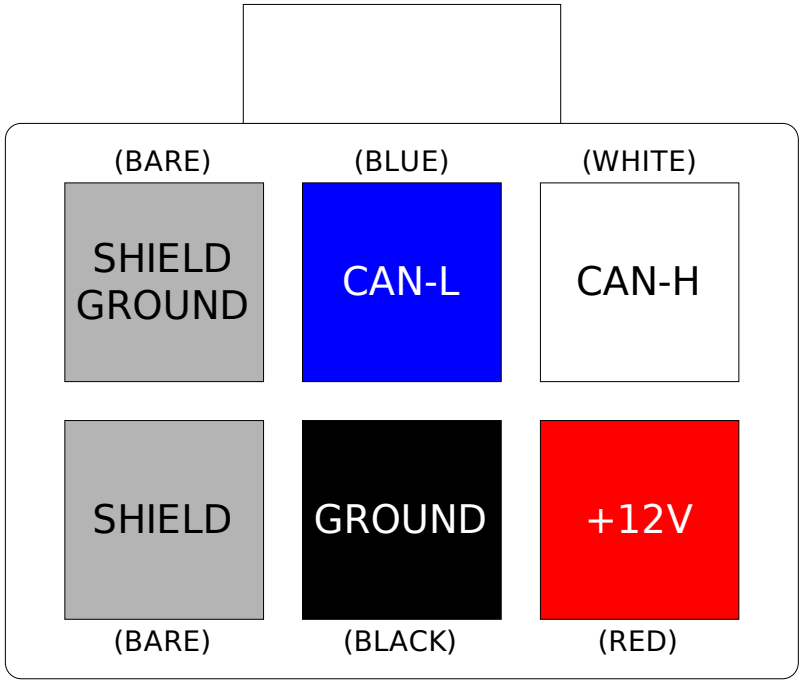
Power should also be provided along the CAN cable, ideally with another twisted pair to minimise noise pickup. An overall shield can also be advantageous.

From a performance perspective, the optimal choice of cable is 7mm Devicenet CANbus 'thin' cable, with 24AWG (data) + 22AWG (power) twisted pairs and a braided shield. Using this cable will result in a robust installation. However, it is not cheap, and using it for a large network with many devices will quickly add up to a significant cost. It also presents a significant mechanical load on the lightweight LCD display, and should be strain relieved close to the display.

For those on a budget, standard CAT5 network cabling (which has an impedance of 100 ohms) can be used, but may become unreliable in longer networks or in the presence of electrical noise from DC/DC converters and other electrical devices in the system – use this type of cable at your own risk.

4.3 CAN CONNECTOR

The connector used on the LCD display, EV Driver Controls and other Tritium devices is a 6-way 3mm pitch Molex MicroFit connector. The pinout is shown below, as viewed from the wire side – as you would look at it while inserting crimps. The colours shown match those in the standard DeviceNet CAN cabling pairs.



4.4 CAN SHIELDING

If the recommended braided shield is used in the cable, then terminate it to the SHIELD pin (lower-left corner on the connector) on both CAN IN and CAN OUT connectors on each device.

On **one device only** in the network, instead of using the SHIELD pin, terminate the shield to the SHIELD GROUND pin (upper-left corner on the connector) on both CAN IN and CAN OUT connectors, to ground the shield for the entire network at this single point. The usual place to do this is where power is fed into the network, typically at Tritium's **EV Driver Controls** product.

4.5 CAN TERMINATION

To implement the required 120 Ohm termination resistor at each end of the CAN bus, plug a connector into the unused CAN connector on the last device at each end of the network with a resistor crimped into the appropriate locations.

4.6 COMMUNICATIONS

The CAN standard does not specify high-level message protocols. Tritium devices use a custom protocol, outlined in the communication specification document for each device.

By default, each device operates at 500 kbits/second, one step below the maximum possible data rate of 1 Mbit/second, and comes programmed from the factory with a CAN base address that will allow it to work without problems with other Tritium devices. Currently, modifying the data rate or CAN base address requires reprogramming the microcontroller, although hardware support is provided to allow updates over the CAN bus in the future.

5 MOUNTING

The LCD display can be mounted using double-sided adhesive tape to hold it into position in a cutout in a flat panel. The display itself is lightweight, although the CAN cable may present some load and may require strain relief elsewhere on the panel.

The display requires a rectangular mounting hole cutout of 60 x 40mm, with panel thicknesses of up to 1.5mm.

6 PROGRAMMING

6.1 OVERVIEW

The LCD display is based around a Texas Instruments (TI) MSP430 16-bit embedded low-power microcontroller, operating from a clock derived from a multiplied 32.768kHz watch crystal as default. CAN bus support is provided via a Microchip MCP2515 CAN controller and TI SN65HVD234 CAN transceiver. The display is not isolated from the CAN network.

6.2 SCHEMATICS & SOURCE CODE

Schematics and PCB component position overlays in PDF format are available for download on the Tritium website. A zip file is also provided containing the default source code for the microcontroller, written in 'C' and available under a BSD open-source license.

Please refer to these references if developing custom firmware for the display.

6.3 TOOLCHAIN

The example default code provided is configured to work with the freely-available open-source MSP430 GCC toolchain, which provides a command-line driven compiler, binutils, download, and real-time debug capability through a JTAG header present on the back of the display PCB. Please refer to the README file with the source code for download and installation instructions.

An adapter is provided with every display product that converts the TI standard 14-pin JTAG debug header to the smaller 8-pin flexible printed circuit (FPC) header used on Tritium devices. Tritium recommends the use of the USB programmer part number MSP-FET430 UIF available from TI or their distributors, although lower cost and slower performance parallel-port devices are also useable.

6.4 CODE DOWNLOAD

Connect the 8-pin FPC ribbon to the header on the display PCB, with the Pin 1 indication arrows matching on both the display and the adapter board.

Follow the instructions in the README file to compile your 'C' source, produce an object file for loading into the microcontroller, and download the new firmware to flash memory in the microcontroller. Please feel free to email any questions or comments to James Kennedy, james@tritium.com.au.

7 REVISION RECORD

REV	*DATE*	*CHANGE*
1	14 May 2007	Document creation (JMK)
2	10 April 2011	Modified CAN bus connector description (JMK)