1 Introduction

The Battery Cell Monitor & Balancer includes a CAN interface that allows control and monitoring features to be accessed across a CAN network. Configuration is performed using the USB interface and provided software.

There is no requirement to connect anything to the CAN interface – the Battery Balancer will operate quite normally with no CAN connections.

The CAN interface on the Battery Balancer is isolated (floating) from battery potentials, so that multiple Battery Balancers can be stacked to monitor series-connected batteries. Two CAN connectors (wired identically) are provided to assist in stacked implementations.

This document describes the default CAN communications interface and protocol. Custom CAN protocols can also be developed to suit existing CAN ID structures; please contact us to discuss your requirements.

2 Overview of CAN

CAN is a multi-master broadcast serial bus, originally developed for automotive applications but now used extensively across a wide range of industries. CAN provides more robust communications than is possible with RS232, and includes automatic arbitration-free transmission, message prioritisation, automatic retries, CRC data protection, fault confinement and more.

Physically CAN is usually implemented as a 2-wire differential serial bus, although a third ground wire is always recommended. The bus must be terminated at each end. This can be a simple 120 Ohm resistor connected across the two signal lines, or it can be a pair of 60 Ohm resistors connecting each signal line to a rail biased midway between the minimum and maximum signal voltages. The second arrangement is superior as it provides far greater immunity from electrical noise. The Battery Cell Monitor & Balancer does not terminate the bus.

The baud rate of this CAN implementation is 1Mbit/sec.

The CAN specification defines four frame types (data, remote, error and overload), but only the data frame can actually transmit any payload data. Like many CAN implementations, only the data frame is used here. Data frames can have 0 to 8 bytes of payload data.

This protocol is based on CAN 2.0B; i.e. CAN frames have a 29-bit message identifier associated with them. The message ID is divided into 3 parts as described in the next section.

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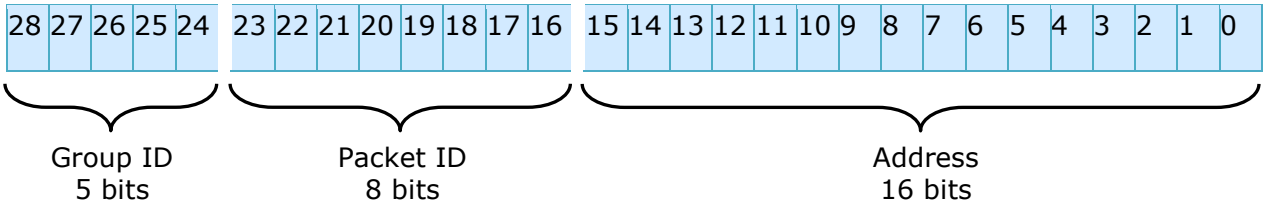
3 Contents

4 CAN Message ID

Each CAN message is preceded by the 29-bit CAN message ID, which specifies the type of hardware (group ID), the type of content (packet ID), and the address of the device associated with the message:



4.1 Packet ID

Specifies the contents of a packet. The following packet types are defined for the Battery Cell Monitor & Balancer:

Packet ID	Name	Direction (with respect to Battery Balancer)	Length (number of data bytes)	Description
0x00	Voltages	Out	12	Contains measured cell voltages
0x03	Temperatures	Out	2	Contains measured temperatures
0x04	Miscellaneous	Out	4	Contains status flags
0x0F	Measurement request	In	1 -> 0 to 4 packets	Request a set of measurement values
0x21	Enable balancing	In	0	Turn battery balancing on
0x22	Disable balancing	In	0	Turn battery balancing off
0x26	Reset	In	0	Restart the Battery Balancer

Table 1 – Blue: Measured/calculated values; Red: Commands.

For packets with IDs up to 0x20 inclusive, if sent to the Battery Balancer with zero data bytes the Battery Balancer will return a packet (or pair of packets) containing the current values.

4.2 Address

Each Battery Balancer within any given network must have a unique address between 0 and 65534 inclusive. 65535 (0xFFFF) is reserved to form a broadcast message ID to which all Battery Balancers will respond. Battery Balancers are shipped with a default address of 2.

5 CAN Packet Types

Please note that all 2-byte quantities are transmitted and received in big-endian format; i.e. high byte first, followed by the low byte.

5.1 Packet ID 0x00 – Voltages

This pair of packets contain measured cell voltages. The Battery Balancer can be configured to stream these packets at regular intervals, or they can be requested by sending this packet ID to the Battery Balancer (with zero data bytes).

Byte	Name	Description
0, 1	Cell 1 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.
2, 3	Cell 2 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.
4, 5	Cell 3 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.
6, 7	Cell 4 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.

Table 2 – Voltages (packet 1 of 2)

Byte	Name	Description
0, 1	Cell 5 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.
2, 3	Cell 6 voltage	An unsigned integer equal to the measured cell voltage in millivolts. Value ranges from 0 to 5000mV.

Table 3 – Voltages (packet 2 of 2)

5.2 Packet ID 0x03 – Temperatures

This packet contains measured temperatures. The Battery Balancer can be configured to stream this packet at regular intervals, or it can be requested by sending this packet ID to the Battery Balancer (with zero data bytes).

Byte	Name	Description
0	Internal Battery Balancer temperature	A signed byte with value equal to the temperature inside the Battery Balancer in degrees Celsius. Value ranges from −128 to +127.
1	Battery temperature	A signed byte with value equal to the battery temperature in degrees Celsius. Value ranges from −128 to +127 (< −20 = no sensor).

Table 4

5.3 Packet ID 0x04 – Miscellaneous

This packet contains status flags. The Battery Balancer can be configured to stream this packet at regular intervals, or it can be requested by sending this packet ID to the Battery Balancer (with zero data bytes).

Byte	Name	Description
0	Flag register 0	The following bits are defined: Bit 0: Battery present flag
1	Flag register 1	The following bits are defined: Bit 0: Balancing enabled by external comms request Bit 1: Balancing enabled by configuration software Bit 2: Balancing enabled by battery voltage Bit 3: Balancing enabled by analog voltage Bit 4: Balancing enabled by charging device via CAN
2	Flag register 2	The following bits are defined: Bits 0 to 5: Cell balancing flags (1 = balancing)
3	Flag register 3	The following bits are defined: Bit 0: Undervoltage, one or more cells Bit 1: Undervoltage, all cells Bit 2: Overvoltage, one or more cells Bit 3: Overvoltage, all cells Bit 4: Unbalanced

Table 5

5.4 Packet ID 0x0F – Measurement request

This packet requests a set of measurements from the Battery Balancer. The measurements that are required may be specified in the data byte. If this packet ID is sent to the Battery Balancer with zero data bytes all measurements will be returned.

Use of this packet allows the supervising entity to poll the Battery Balancer, as an alternative to having the Battery Balancer push values onto the CAN bus at regular intervals using the Battery Balancer's packet streaming feature.

Byte	Name	Description
0	MR	Measurements requested. This byte indicates the measurements that are to be returned. Bits have the following significance: Bit 0: Packet ID 0x00 (Voltages) Bit 3: Packet ID 0x03 (Temperatures) Bit 4: Packet ID 0x04 (Miscellaneous) Bits 1, 2, 5–7: X (don't care)

Table 6

5.5 Packet ID 0x21 – Enable balancing

For this command to work successfully, balancing must be set to "Off" using the configuration software. After receiving this command, bit 0 of flag register 1 will be set.

5.6 Packet ID 0x22 – Disable balancing

For this command to work successfully, balancing must be set to "Off" using the configuration software. After receiving this command, bit 0 of flag register 1 will be cleared.

5.7 Packet ID 0x26 – Reset

Restarts the Battery Balancer.

6 Document version history

6.1 0.9

- Initial draft.