Xtrema Balancer I2C Command Protocol

Provided by

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Last edit March 6, 2008

Introduction

This document describes the message semantics used to communicate over an I2C bus to control and read the Xtrema Balancer. It does not describe the timing and bit level protocol o f the physical I2C bus. If you are not familiar with the I2C protocol a good central source of information may be found in the Wikipedia article located at http://en.wikipedia.org/wiki/I2c

This specification is provided by TME Inc. to engineers and serious hobbyists that want to integrate the balancer(s) into custom applications requiring the monitoring and balancing of lithium cells used in a battery. Please report any errors or omissions to http://www.tmenet.com/contact.htm Care must be taken when connecting an experimental I2C bus to the balancer and a lithium battery. The user assumes all risk of damage to the balancer, and surrounding property.

Connecting to the I2C bus

The Xtrema Balancer is configured as a slave on the I2C bus running at up to 100khz. The slave address is determined by the balancers physical position when connected to the BIM (Balancer Interface Module) and the state of jumper pin #2.

Address	**BIM SLOT**	**Jumper #2**
0x10	BAL1	OFF
0x12	BAL2	OFF
0x14	BAL1	ON
0x16	BAL2	ON

EXPANSION PORT PINOUT

The Balancer and the Balancer Interface Module use a 0.1" header connector with standard pin assignments. The pinout for I2C data is described in the table below. All other pins are reserved for proprietary uses.

If multiple balancers are used or balancer isolation is required the BIM must be used. Your connections to the BIM will be made on either the XTREMA or COMPUTER connector (they are both wired the same)

Pin	Description
1	+5V - Needed to power opto isolator circuitry
2	GND
5	SDA Data – terminated by pullup
7	SCL Clock – terminated by pullup
8	Address Select – BIM Pulls pin to GND in BAL1 SLOT and to +5 in BAL2 SLOT
9	GND

Command Protocol

The I2C Master must first clock out the desired balancers slave address followed by a command byte (similar to a register address). Some commands have additional bytes following the initial command byte. Depending on the command, the addressed slave balancer performs a function and may return a string of values if there is a read byte length > 0.

NOTE: Commands that return a value need to have the balancer re-addressed with the R/W bit set to 1. You must allow a minimum of 100 ms from the time the master finishes clocking out the command to the time the master re-addresses the slave and starts clocking out the read data. The "Read Byte Length" in the table below tells you how many bytes to expect during the read.

Command (register address)				Balancer Action	
ASC	HEX	DEC	Write Byte Length		Read Byte Length
NULL	0x00	00	1	Returns Most Significant Digit of Firmware Version # 0x00w {100ms delay) 0x00r 0x01 returns versions 1	1
STX	0x02	02	1	Force Status LED ON	0
ETX	0x03	03	1	Force Status LED OFF	0
A	0x41	65	1	Abort Command - Forces balancer to idle state	0
B	0x42	66	3	Balance Command - Forces the balancer into a balance state with the next two bytes representing a 16 bit value sent high byte first. This 16 bit number is the desired balance voltage in millivolts. If 16 bit value is 0 then balancer simply balances to the lowest voltage cell. Similar to "X" command however	0

				discharge voltage is forgotten when powered down VALID range is 3000 to 4200 Ex: 0x42, 0x10, 0x68 = balance to 4.20 volts	
D	0x44	68	3	Sets the minimum voltage delta (spread) that the pack is balanced to. voltage is forgotten on next pack VALID range is 10 to 200 Ex: d 20 if the lowest cell is 3.500 volts then other cells need to be below 3.500 + .020 = 3.520 to stop	0
N	0x4E	78	3	set miN The second and third bytes represent a 16 bit value sent high byte first. This 16 bit number is the minimum voltage that the pack is permitted to discharge, argument is stored in EEPROM until changed again or via jumper and is represented in millivolts. VALID range is 2800 to 3100. Ex: 0x4E, 0x0B, 0xB8 sets up balancer min voltage to be 3.000	0
P	0x50	80	3	Power down command Sets the time after balance ends and there is no activity before a power saving power down occurs. Remember this time is after balance completes. Caution putting short values of time. The altered time is forgotten on the next power up. VALID range is 0 to 7200 seconds (2 hours) (entering 0 disables powerdown) (default is 1800 seconds or 30 minutes) Ex 0x52, 0x0E, 0x10 sets the power down timer to 3600 seconds or 1 hour	0
S	0x53	83	1	Status command	6

				Returns balancer status summary .Voltages returned are represented in millivolts. i.e. 4.2 volts is represented as 4200 Byte 1: "Idle" = 0 or "Balancing" = 1 Byte 2: ”cell count” 2-6 Byte 3: MSB Byte 4: LSB <maximum cell voltag measured> "max" Byte 5: MSB Byte 6: LSB <difference between max and min cell voltage> "delta" Ex: 0x53w {100ms delay) 0x53r, 0x00, 0x03, 0x0F, 0x61, 0x00, 0x46 Reports Status: Idle,03 cells, 3.937max, .070delta	
T	0x54	84	1	Returns balancer input voltages without initiating a balancing state. Voltages returned are represented in millivolts. i.e. 4.2 volts is represented as 4200 Byte 1: MSB Cell 1 Byte 2: LSB Cell 1 Byte 3: MSB Cell 2 Byte 4: LSB Cell 2 Byte 5: MSB Cell 3 Byte 6: LSB Cell 3 Byte 7: MSB Cell 4 Byte 8: LSB Cell 4 Byte 9: MSB Cell 5 Byte 10: LSB Cell 5 Byte 11: MSB Cell 6 Byte 12: LSB Cell 6 Ex: 0x54w {100ms delay) 0x54r, 0x10, 0x36, 0x10, 0x37, 0x10, 0x38 , 0x10, 0x39, 0x10, 0x3A, 0x10, 0x3B Represents cell voltages as follows:	12

				Cell1 = 4.150 volts Cell2 = 4.151 volts Cell3 = 4.152 volts Cell4 = 4.153 volts Cell5 = 4.154 volts Cell6 = 4.155 volts	
X	0x58	88	3	set maX The second and third bytes represent a 16 bit value sent high byte first. This 16 bit number is the maximum voltage that the pack is permitted to be argument is stored in EEPROM until changed again or via jumper VALID range is 3000 to 4200 Ex: 0x58 , 0x0E ,0x10 sets up balancer max voltage to be 3.600	0