Battery Programmer I/O Board Theory Of Operation

1 Overview

1.1 The I/O board is designed as a wing for an Adafruit Feather M4 Express board. It provides the electrical interface to the various batteries

1.2 It also provides other functions as detailed below

2 Connectors

2.1 Feather headers - A1

2.1.1 These connectors provide the interface to the Arduino Mega 2560

2.1.2 For a detailed pin out please see the Adafruit documentation

2.2 Battery connector – J1

2.2.1 J1 connects the 5 battery wires to the board, these are Batt+, Gnd, SDA, SCL, Therm

3 Input protection

3.1 The diode pack U7 is used to clamp input signals to the rails

3.2 Relays K1 – K3

3.2.1 Used to isolate the unit from the battery connector until it is powered up and configured

3.2.2 Controlled by GPIOs from the Mega board thru FETs

4 I2C interface

4.1 The I2C interface is handled by the M4 Express board hardware

4.1.1 The Mega board interface is 3.3V, a level shifter made with Q2 & Q3 is used to support higher bus voltages.

4.2 Pull up voltage

4.2.1 The I2C pull up voltage is controlled by an M4 Express GPIO using the 2 to 1 analog mux at U4.

4.2.2 Voltages of 3.3V, or the battery voltage are supported.

4.2.3 Battery voltages up to ~9.5V are supported

4.3 Pull up resistors

4.3.1 The I/O board can provide pull up resistor values from 2K to 6.7K

4.3.2 The resistor value is controlled by GPIOs using the quad analog switches at U1 and U2

4.3.3 By combining the 5.1K, 6.8K, and 10K resistors in various combinations the following pull up resistor values are available: 2.0K, 2.5K, 2.9K, 3.4K, 4.1K, 5.1K, and 6.7K

4.4 Active clock drive

4.4.1 To support batteries that need an active clock drive the left over analog switches in U1 and U2 are used to select between the selected pull up resistance or the output of the level shifter at U3

4.4.2 Only a 3.3V active drive is supported

5 On board Auth Chip

5.1 U6 is an Atmel/Microchip ATECC608A authentication chip like the ones in our batteries.

5.1.1 It’s main use is to perform the math associated with authenticating our batteries

5.1.2 It stores the serial number and of the battery programmer unit

5.1.3 It also stores the hardware rev of the I/O board

6 Battery voltage measurement

6.1 The battery voltage is measured by an analog input on the M4 Express board

6.2 Resistors R11 and R10 divide the voltage down to a level that allows inputs of up to ~9.5V to be measured

6.3 The on-board regulator on the M4 Express provides a 3.3V 1% reference voltage to the M4 Express AREF pin.

7 Config storage

7.1 The unit serial number is stored in the first two bytes of slot 0, LSB first.

7.1.1 SN values < 1000 are for Zebra internal use only devices

7.1.2 SN values >= 1000 are for JDM devices

7.1.3 Slot 0 will be locked after being programmed

7.2 The hardware revision of the unit will be stored in the first two bytes of slot 1.

7.2.1 Byte 0 will be the major rev value and byte 1 will be the minor rev value.

7.2.2 Slot 1 will be left unlocked after being programmed.