Battery Programmer I/O Board Theory Of Operation

1 Overview

1.1 The I/O board is designed as a shield for an Arduino Mega 2560 board. It provides the electrical interface to the various batteries

1.2 It also provides other functions as detailed below

2 Connectors

2.1 Arduino headers - P1-P7

2.1.1 These connectors provide the interface to the Arduino Mega 2560

2.1.2 For a detailed pin out please see the Arduino documentation

2.2 Battery connector – J1

2.2.1 J1 connects the 4 battery wires to the board, these are Batt+, Gnd, SDA, SCL

2.2.2 It also has connections to a set of normally open relay contacts for future use

2.3 SD Card socket – J2

2.3.1 Socket for an SD card that can be used to load/store battery hex files

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 Mega board hardware

4.1.1 The Mega board interface is 5V but is compatible with 3.3V signals.

4.2 Pull up voltage

4.2.1 The I2C pull up voltage is controlled by the Mega GPIOs using the dual 4 to 1 analog mux at U4.

4.2.2 Voltages of 5V, 3.3V, or the battery voltage are supported.

4.2.3 The extra input is tied to ground thru R11 and could be used for another input in the future.

4.3 Pull up resistors

4.3.1 The I/O board can provide pull up resistor values from 2.3K to 10K

4.3.2 The resistor value is controlled by GPIOs using the two 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: 2.3K, 2.9K, 3.4K, 4K, 5.1K, 6.8K and 10K

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 SD Card interface

5.1 The SD card interface only supports a 3.3V SPI interface

5.2 The level shifters at U3 and U5 are used to shift from the 5V mega pins to the 3.3V SD interface

5.3 Both card detect and write protect detection are supported

6 On board Auth Chip

6.1 U6 is an Atmel/Microchip ATECC508A authentication chip like the ones in our batteries.

6.1.1 It's main use is to perform the math associated with authenticating our batteries

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

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

7 Battery voltage measurement

7.1 The battery voltage is measured by an analog input on the Mega board

7.2 Resistors R17 and R22 divide the voltage down to a level that allows inputs of about 5V to be measured

7.3 The regulator at U8 provides a 3.3V reference voltage to the Mega AREF pin.

8 Future Expansion

8.1 An extra relay K4 was added for possible future uses

8.1.1 Load resistor connection

8.1.2 Charger connection

8.1.3 Device under test connection