MAXREFDES1277 Reference design HARDWARE User manual

The MAXREFDES1277 reference design enables quick evaluation of MAX17853/52 for battery management in 48 V system. It can be used to test IC capabilities such as measurements, Cell balancing and alerts using UART and SPI communications.

The MAXREFDES1277 consists of

- MAX17852 BMS IC
- 2 x MAX17841 for Dual UART
- MAXREFDES1277 Battery test Jig
- General purpose Micro controller (Arduino Mega) for configuring and communication
- Various Communication cables (Cable #1, #2, #3A, #3B, #3C, #3D, #3E) and Arduino Mega to REFDES SPI connections.

The MAXREFDES1277 manual gives details on following:

- Hardware setting up
- GUI interface
- Voltage measurements
- Current measurement
- Temperature measurements
- Cell Balancing
- UART communications types
    - Single UART
    - Dual UART
    - Dual UART redundancy check

1. Hardware Setting Up in Reference design MAXREFDES1277

The hardware connections for MAXREFDES1277 (MAX17852) with MAXREFDES1287 (MAX17841-2), Battery test jig and connection cables as shown in image below.

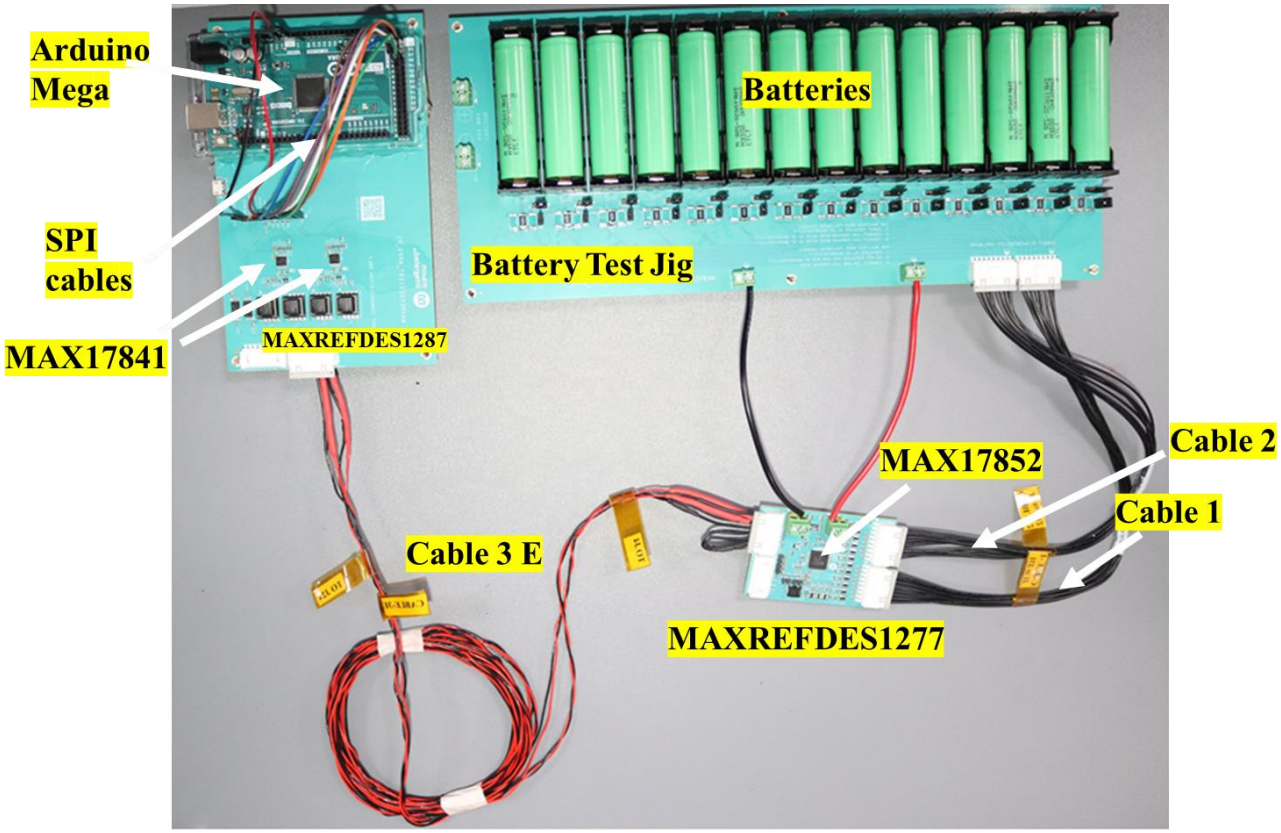


Fig 1.1 MAXREFDES1277 Hardware image

The setting up of MAXREFDES1277 involves placing Battery cells in Battery test jig holders. Connecting cables Cable1(J1 to J31), cable 2 (J2 to J32) for the voltage measurements and Cable 3 (J4 to J24) for UART communication *(section 1.1 for more details)*. The Arduino mega microcontroller can be connected to the computer using USB AB (printer) cable for interfacing with Computer.

Other steps and connections are as follows.

1. Connect the pins 1-2 of all the jumpers from **J12 to J28** *(in Battery test jig)* for the voltage measurements. (for enabling the ADC measurements to MAX17852).
2. Disconnect the jumpers **J41 to J54** if already connected in Battery test jig**.** *(It is for discharging of the battery)*
3. Connect the microcontroller Arduino mega to the MAXREFDES1287 for SPI communications. The connection details for Arduino Mega to reference design is as follows:

Table 1.1MAXREFDES1287 Board to Arduino Wire connections

MAXREFDES1287 J23 connector	Arduino Mega 2560 Pin Number	Wire color
CSB_1	53	Orange
SHDN_1	48	Brown
SHDN_2	46	Green
CSB_2	49	White
SCLK	52	Grey
DIN	51	Purple
DOUT	50	Blue
+5V_MICRO	5V (in Arduino)	Red
SHDNL_MICRO	NC	
ALERTOUT_PIN_MICRO	NC	
ALERTIN_MICRO	NC	
AGND_MICRO	GND (in Arduino)	Black

These connections are specific to Arduino Mega 2560 microcontroller. Wire coloring are given for the easy reference.

For current measurements,

- Connect **J33** (battery test jig) through wire with **J6** (MAXREFDES1277).
- Connect **J34** (battery test jig) through wire with **J5** (MAXREFDES1277).

(For the reverse direction of the current flow, connections can be interchanged.)

Also refer section 2.2.2 current measurement for the block diagram and hardware images.

- The UART cables are connected between **J4**(MAXREFDES1277) **to J24** (MAXREFDES1287)**.** There are different UART cable configurations as follows. *(refer section 1.3.3 for more details)*
  - Single UART with external loop back- Cable 3A:
  - Dual UART- Cable 3B
  - Reconfigurable cable -Cable 3 C
  - EVKIT to MAXREFDES1277 cable- Cable 3 D
  - Single UART with external loop back for 2 meters – Cable 3E

1.1.1 Voltage measurement:

Voltage measurements of cell and pack are directly from battery pack. The Oversampling setting is 128 in scan control register for accurate measurement. Refer to datasheet for more details

1.1.2 Current measurements:

Current measurement is made using the current sense resistor. The value of the current sense resistor is **3 milli ohms.** The Board is intended for demo purpose, and it does not support full range charging and discharging currents of the battery pack. Thus, full range current is measured across **J5 and J6** externally to showcase the current measurement.

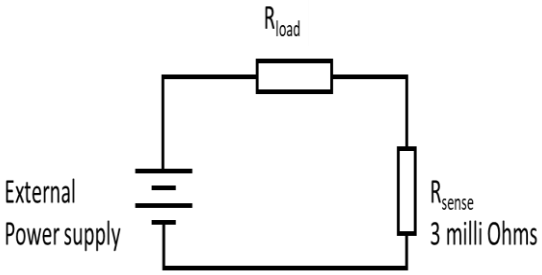


Fig1.7 Basic Current measurement circuit with sense resistors.

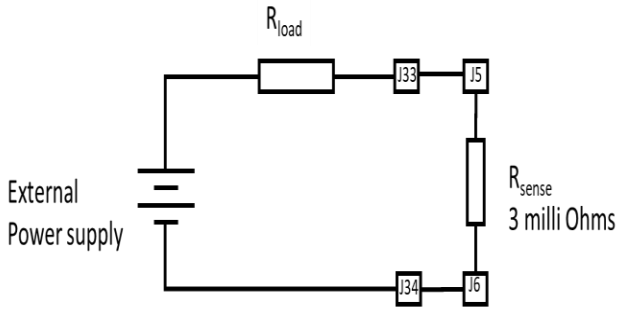


Fig 1.8 Block diagram of Current measurement with Connector numbers

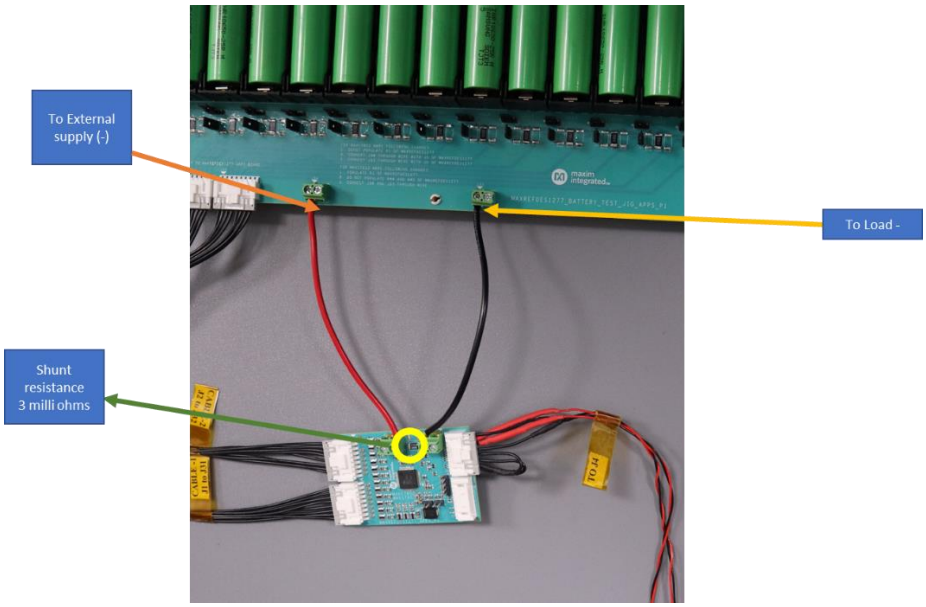


Fig 1.9 Hardware connection for current measurement in MAXREFDES1277

1.1.3 Temperature measurements:

Temperature measurements are measured using thermistor which can be connected in the jumper connections measurement. The resistance value of the **thermistor is 10K** ohms and the **beta value is 3984 K.**

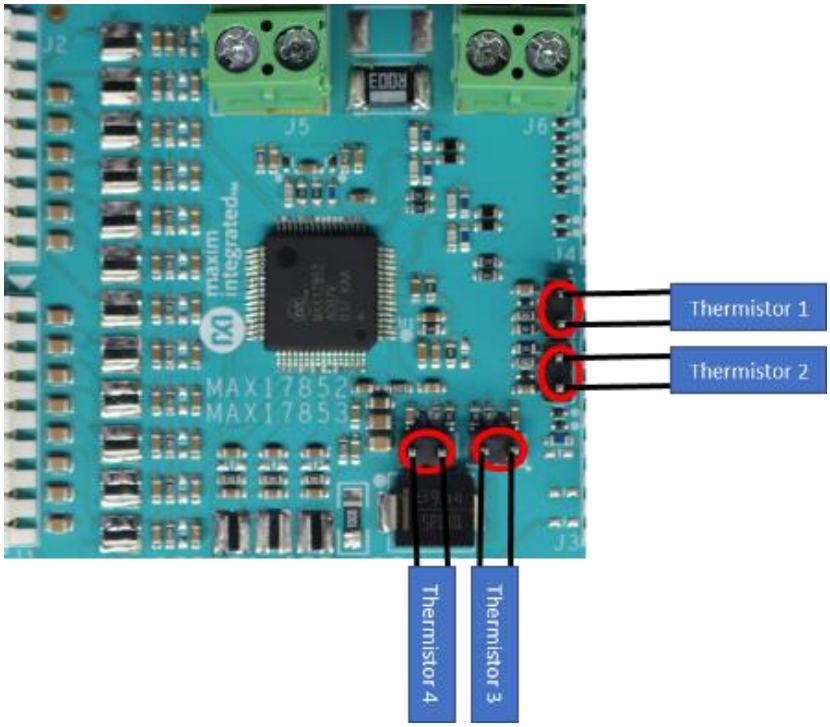


Fig 1.10 Hardware connections for temperature measurments

1.1.4 Cell Balancing:

To demonstrate the cell balancing feature of the MAX17852/3, basic cell balancing algorithm is implemented. This works on principle of charge removal from the highest charged cell. Whenever there is over charge in a cell, it is discharged by the balancing switch via the balance resistors.

The cell balancing takes place with this simple logic, the cell with the maximum voltage is found and if it is greater than the Average cell voltages of other cells and hysteresis of 50 mV, the cell balancing takes place in that cell.

The balance resistor = **7.5 ohms**

Maximum cell balance current =**300 milli amps** *(for maximum cell voltage of 4.5 V)*.

There is option to measure the balancing current in a balancing cell, the jumper wire can be placed between pins 1,2 of jumper *(say J21 for cell 5 balance current measurement)* and the balancing current in the loop can be measured using a current probe. Fig 1.14 shows the hardware setup for balance current measurements in cell 5.

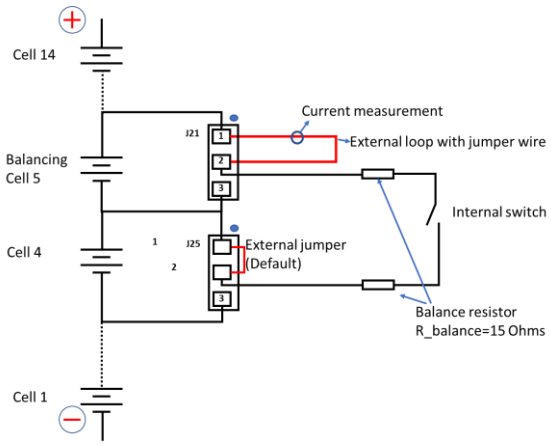


Fig 1.13 Cell Balancing Block diagram

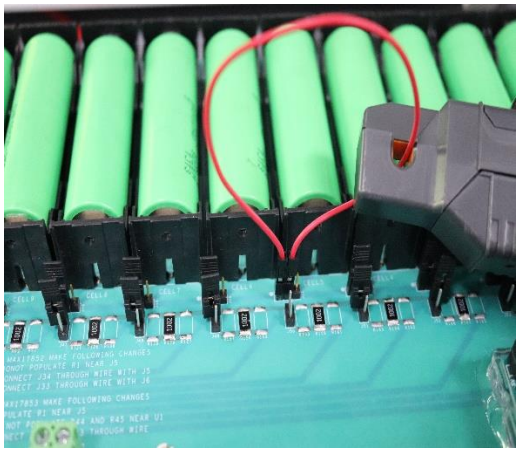


Fig 1.14 Hardware image for current measurement during cell balancing

1.1.5 UART Communication:

The UART communication has two host masters mainly UPHOST and DOWNHOST masters. MAX17853 can communicate through any of the host for monitoring.

This reference design has unique feature to validate various UART configurations such as single, dual UART with redundancy. The images of the UART communication cables 3A, 3B, 3 C, 3D, 3E are given below

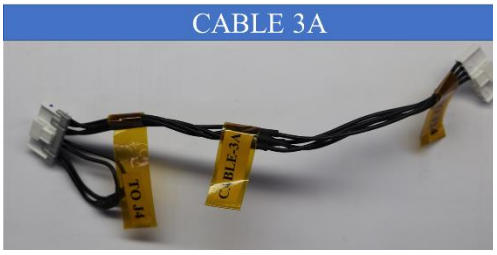


Fig1.17 Single UART Cable 3A with external loop-back

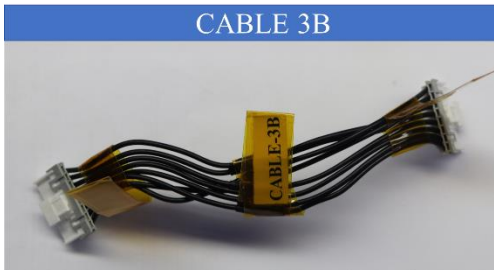
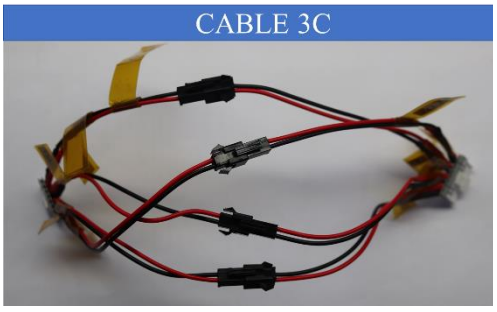


Fig1.18 Dual UART Cable 3 B



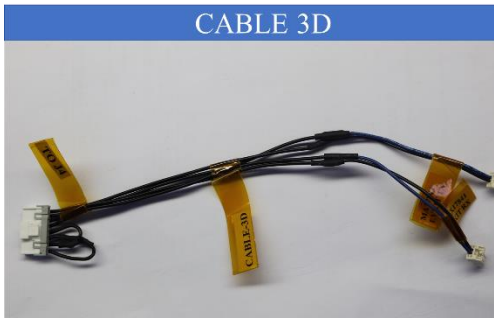


Fig1.19 Dual UART cable 3C pluggable

Fig1.20 EVKIT to MAXREFDES1285 cable 3 D

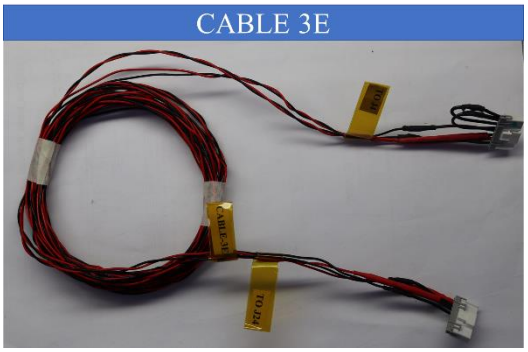


Fig1.21 Single UART with external loop back for 2 meters Cable 3E

3.1.1 Single UART

To demonstrate the Single UART Cables 3A and 3 E (with extra length to validate the UART communication for longer distances) are used. The external loop back need for the single UART cable is made directly in the cable. Single UART cable is connected between **J4**(MAXREFDES1277) to J24 (MAXREFDES1287)**.**

3.1.2 DUAL UARTS

To demonstrate the redundancy property of dual UART, Cables 3B and 3C are used. The Cable 3B has fixed dual UART connections. In Cable 3 C, tests for redundancy are made with pluggable clips. Whenever UPHOST communication is removed, there is automatic switch over to DOWNHOST. This can be tested with Dual UART pluggable cable 3 C as shown in Fig 1.22

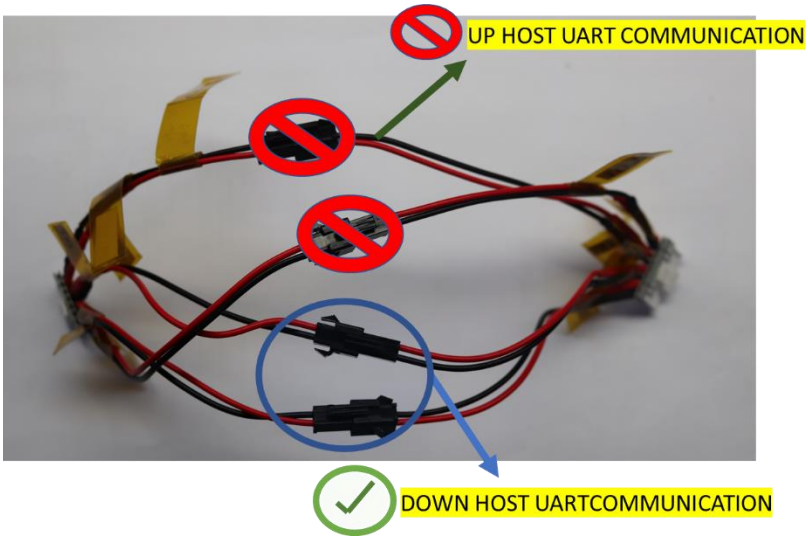


Fig1.22 Dual UART cable 3C pluggable demonstration

1.1.6 Others

1.1.6.1 Setting up tests

Following are the general setting up test to make sure that the MAX17852/3 is power on from the sleep state.

- Check the jumpers, cables are intact and connected properly as per section 1.
- Check for logic high **(usually around 8-10 V or above)** between **SHDNL to AGND** in connector **J3** (in MAXREFDES1277) using multimeter. Check **VDDL_2_3** to **AGND** for **3.3 V** in connector **J3** as this is internal LDO which outputs 3.3V after power up. These two checks ensure the IC MAX17853/52 is awake.