



PROGRAMMABLE LI-ION PCM

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INTRODUCTION

The PCM, as shown in Figure 1, is a protection device for a multi-cell Li-ion battery which isolates the battery if it is misused or if a cell fails.

The acronym PCM stands for "Protection Circuit Module", and in operation, the PCM monitors the voltage across each cell individually to prevent cells becoming unbalanced over a period of time.

Failure to employ a PCM can result in battery damage and possible risk of explosion.



Figure 1 – PCM PCB

A PCM is fully configurable and can be applied to battery packs with different numbers of cells, capacities and cell chemistries. Certain limits can apply, dependant on the nature of the battery pack.

The PCM described in this brochure was designed to protect a Li-ion Phosphate battery made up of 4 or 6 cells each having a capacity of 4950 mAh capacity.

The PCM's patent-pending circuit can be supplied in one of two forms:

- pre-configured to customer requirements
- re-configurable in the field, by using the 'Configurator' tool, in tandem with a PC and the 'Configurator' software.

Typically a PCM should be built into the battery pack, as a permanent fixture.

PCM SPECIFICATION

The following is a brief specification of the PCM:

- Overall dimensions 68mm x 29.5mm x 5mm
- Weight 9.5 gram (no terminations)
- Output terminations: 2 solder pads with 2mm diameter holes
- Battery terminations: 2 pads 1.5mm diameter + 6 pads 1mm diameter
- Measures each of up to 7 cell voltages independently
- Disables charging if any cell voltage exceeds an upper threshold voltage
- Charging resumes when all cells are below the threshold voltage
- Disables discharging if any cell voltage is less than a lower threshold voltage
- Disables discharging if the discharge current exceeds the threshold *I_{OVERDISCHARGE}*.
- Discharging resumes when the fault and load are removed and the load re-connected
- Discharging and/or charging are disabled when the ambient temperature is outside limits
- Voltage thresholds and other parameters re-programmable using the *Configurator* tool
- Voltage measurement accuracy better than 1%
- Voltage measurement frequency once per second
- Hardware current measurement accuracy better than 20% at room temperature
- Hardware current trip threshold typically 7A (can be specified at time of order, see note)
- Hardware current trip response typically 3ms (can be specified at time of order, see note)
- Temperature measurement using on-board thermistor to 5 deg accuracy
- Total quiescent current typically 60µA (normal charge level, with battery voltage < 22V)
- Insertion resistance normally 30mΩ (except when cells over or under charged)
- Maximum recommended battery voltage 24V
- Absolute maximum battery voltage 32V
- Optional passive cell balancing network

Note: the current trip is executed in hardware if that hardware option was ordered. The hardware current trip can act within milliseconds, whereas the firmware current trip may take as long as one second to act. If a firmware current trip value is set lower than the fixed hardware current trip value, it will operate before the latter on a steady state current with value between the two settings.

THE CONFIGURATOR TOOL

The *Configurator* tool, shown in Figure 2, consists of a programming station, into which the PCM board plugs.

The programming station is connected to a PC via a standard USB cable.

The tool and the PCM inserted into it, are powered from the PC.

The PCM may optionally be connected to its battery, however it must not be in electrical contact with any other device – the output terminals should be open-circuit.

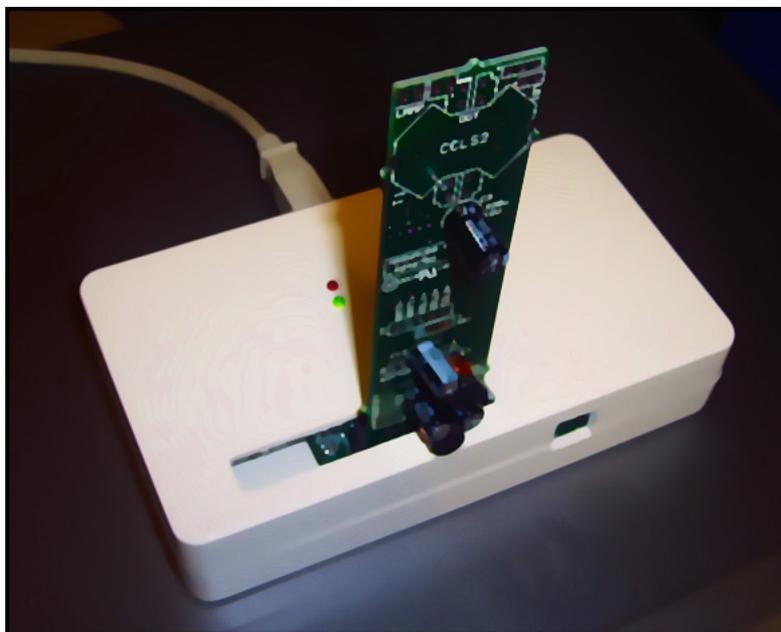


Figure 2 – The Configurator Tool

The following section demonstrates the *Configurator* tool and its software.

CONFIGURATOR SOFTWARE

The *Configurator* software is installed by inserting the distribution CD into the PC and following the on-screen instructions.

The main screen is shown in Figure 3 below.

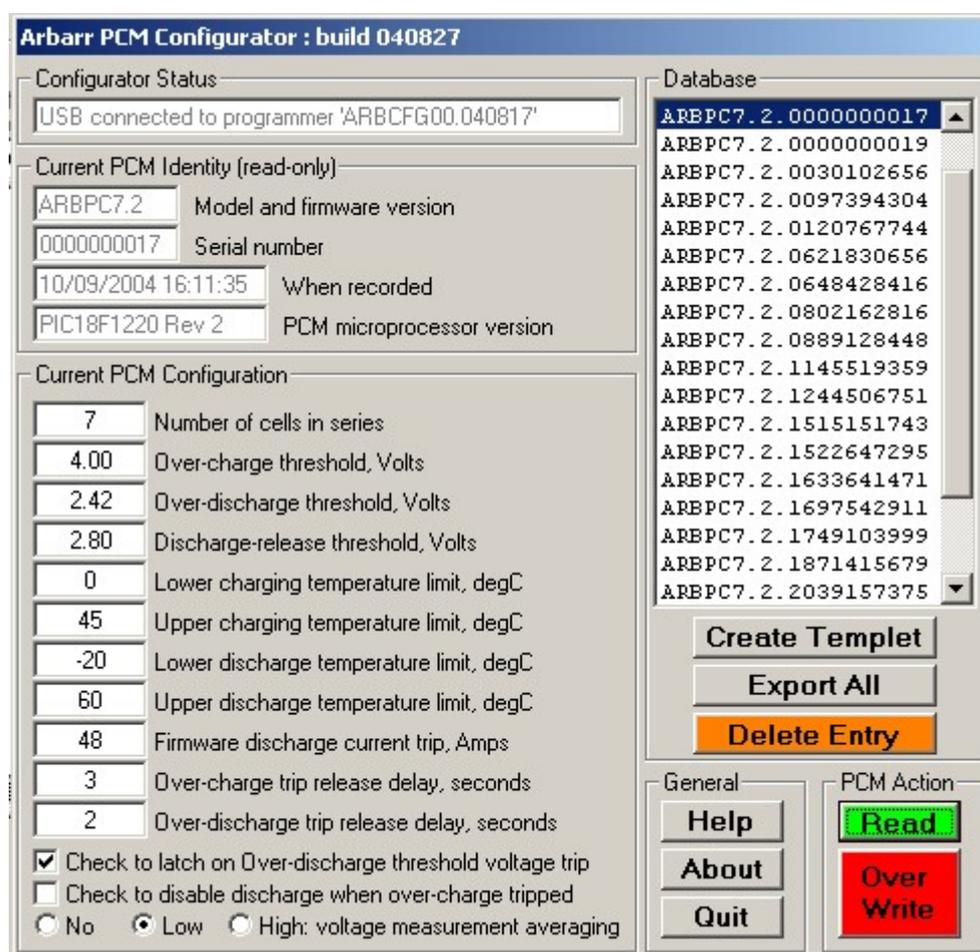


Figure 3 – The Configurator Software Main Screen

Overleaf is a demonstration guide to programming a PCM using the software. The guide refers to Figure 3 throughout.

Software Demonstration

- Clicking on the *Configurator* icon will start the software.

The software will display the version number of the connected *Configurator* tool, and will report it's status in the 'Configurator Status' box at top left.

- To interrogate a target PCM, insert its edge connector carefully into the programming slot, taking care that the arrow on the target PCM board points in the same direction as the arrow beside the slot.

Inserting the target PCM incorrectly could result in damage to either PCM or Configurator hardware.

- Once inserted, you may press the green "Read" button to read the target PCM configuration parameters, which will then be decoded and displayed in the boxes on the right.

The software will search through its database of previous entries, and unless a model and serial number match is found it will automatically add the read data to the database. If a match is found, a warning box will invite the user to either overwrite the existing entry with the new data, or to "Cancel".

- To change the configuration parameters of a target PCM board, you may either edit the parameter boxes manually, or more typically you will search for and select a database entry with the required parameters.
- Having updated the displayed parameters by one of the methods mentioned, you simply press the "Over-Write" button to program the PCM.

This "one button programming" allows you to re-program target PCM's quickly and efficiently, and if, by chance, you re-program the wrong data by mistake the software offers you a single chance to "Undo" after pressing "Over Write".

- To update the displayed parameters from a database entry, simply select the entry from the list by scrolling up or down.

The model and serial numbers are listed in ascending order, however, special entries, known as "templets", are always at the end of the list for ease of retrieval.

- The "Create Templet" button can be used to create a profile for a PCM type that is frequently used.

For example, you may want to frequently re-program target PCM boards for 4-cell operation with voltages that pertain to Li-ion Cobalt. So, having first defined the new parameters manually and having written them to the first PCM, a database entry will be made. You should now press "Create Templet" and type in an appropriate name for example "4-cell Li-ion Cobalt". The entry data will now be duplicated and the new entry will have the specified name and be displayed near the end of the list, to ensure programming is as efficient and effective as possible.

TERMINAL CONNECTIONS

The battery consists of a number of cells wired in series.

In this context, each "cell" may in fact be several cells wired in parallel.

Connections must be made from the positive and negative terminals of the battery and from each cell tap terminal, to the PCM, as indicated on the reverse side of the PCB.

If less than 7 cells in series are to be connected, say for example, 5 cells, the most positive battery terminal must be connected to both "BATT POSITIVE" and to, in this case, "CELL5".

In this case the terminal "CELL6" may either be left open circuit or strapped to "CELL5".

The two (larger) terminals marked "LOAD" are the battery pack's output terminals, which connect to the battery charger and/or the battery load.

ENVIRONMENTAL SPECIFICATIONS

Figure 4, below, shows the environmental specifications of the system.

Factor	Value	Notes
Operating temperature	-40 to +70 °C	[1]
Humidity	0% to 96% (not condensing)	[2]
MTBF	10 ⁵ hours	[1]
Maximum altitude	15,000 m	N/A
Shock capacity	500 G (operating or non-operating)	[3]
Vibration capacity	±10G (operating or non-operating)	[3]

Figure 4 – Environmental Specifications

Notes

- [1] Upper temperature subject to limited use in condition where only one power mosfet is switched on thus when discharging at during over-charge condition, or charging during over-discharge condition: such use will automatically be limited by the battery characteristics so long as the battery is not totally faulty (e.g. a short circuit battery).
- [2] The limitation on condensation could be ameliorated by coating or potting the product.
- [3] For guidance only: these parameters are very dependent on the way the product is packaged / embedded with its host battery pack.



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