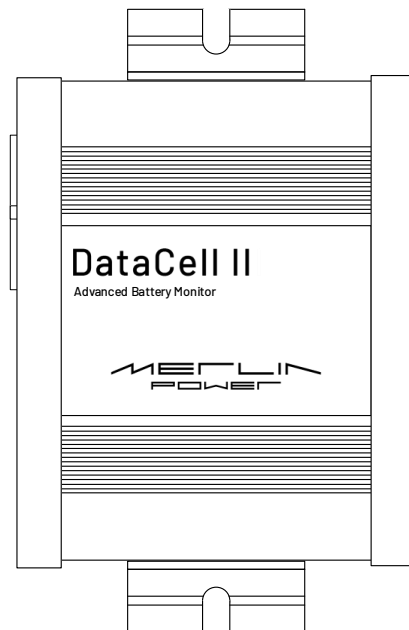




# DATACELL II

## PROGRAMMING GUIDE

Revision: A



Merlin Equipment Ltd  
Clyst Court  
Hill Barton Industrial Estate  
Exeter, Devon, EX5 1SA  
United Kingdom  
T: +44 (0) 1202 697979

Merlin Power Systems  
332-4 West Montauk Highway  
Hampton Bays  
New York NY11946  
United States of America  
T: +1 (631) 594 5102

[www.merlin-power.com](http://www.merlin-power.com)

## VERSION HISTORY

| Revision | Implemented By | Revision Date | Approved By | Approval Date | Status          |
|----------|----------------|---------------|-------------|---------------|-----------------|
| 1.0      | J. Hortop      | 08/10/2013    | J. Hortop   | 08/10/2013    | Initial Release |
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|          |                |               |             |               |                 |

Please ensure that the version of this document you are using is current. Merlin Equipment reserves the right at any time, whether documented within this guide or elsewhere to change, modify or withdraw features and specifications.

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## INTRODUCTION

DataCell II is a complete battery monitoring system. The system provides high levels of monitoring of batteries and electrical systems and is designed with minimum power consumption in mind.

DataCell II has been designed for use within mobile platforms, (e.g. vehicles, boats, trailers) but equally could be used for monitoring of batteries within static locations.

DataCell II has been extensively independently tested by EnerSys (the World's largest battery manufacturer), the UK and US ministries of defence and many other leading bodies. Their results prove that DataCell II is often more accurate than a Bitrode and other laboratory test equipment that costs tens of thousands of pounds.

DataCell II provides the following information for 1, 2, 3 or 4 independent battery banks (number of batteries monitored dependent on model):

- Battery Voltage
- Current (Net in/out)
- Battery Temperature
- Battery SoC% (State of Charge %)
- Battery Amp Hours
- Time Remaining Until Battery Flat
- Battery SoH% (State of Health %)

The DataCell II has the following additional outputs:

- 1) RS232 data output. This output is used for:
  - Programming the unit from a PC
  - Outputting battery information to Merlin Software
  - Running data logging using Merlin Software
  - Interfacing with 3<sup>rd</sup> party equipment
- 2) MerlinNet data output. This output is used for:
  - Connection to a Battery Management Display Panel

DataCell II can be used in various different ways, the most popular include:

- As a 'conventional' battery monitor in conjunction with the Display Panel.
- As a PC interfaced battery monitor (displaying data on the M-Power software or on Merlin Dashboard Software).
- As a discrete module where no user interaction is required.

**Please take the time to read and understand this manual before commencing configuration.**

## HOW DATACELL II WORKS

*Caution: DataCell II is designed for 12 and 24V DC common negative ground systems. Do not use on positive ground systems. For installations with multiple battery banks, each must share a common ground. Multiple individual batteries can be monitored but with independent DataCell II units.*

DataCell II uses a very different method of calculating battery state of charge compared to a conventional battery monitor. It is important that you understand how it works so that you are able to make the most of your DataCell II. The product uses two separate methods to determine true battery State of Charge (SoC) %:

**Model Based Calculation:** DataCell II uses the proven Merlin SmartGauge technology of advanced battery modelling and monitoring techniques to determine the state of charge (SoC) of your battery bank as a percentage of its true, currently available, capacity.

**Amp Hour Counting Calculation:** Like a conventional battery monitor, DataCell II also counts amp hours in and out of the battery.

**Combining the advantages of Amp Hour Counting & Model Based Calculation:** Conventional amp hour counting actually provides the most finite accuracy possible when determining battery SoC. However, the amp hour counter must be in synchronisation with the batteries (this is the single biggest problem with conventional amp hour counters which run out of synch within a couple of battery cycles – resulting in very poor accuracy).

Model based calculation provides the most repeatable results (with an accuracy of around +10/-5%). However, it never runs out of synchronisation.

DataCell II automatically switches between Model Based and Amp Hour Counting (or uses a combination of the two). This method provides not only finite accuracy, but never runs out of synch so returns repeatable, dependable results.

DataCell II will indicate when it is 'in sync' with the batteries (and using amp hour calculation (and possibly model based calculations at the same time). When DataCell II is not 'in sync' it relies solely on the model-based calculations. This is a fully automatic operation.

**State of Health Calculations:** Because DataCell II can provide highly accurate SoC results, it can compare the real capacity of the battery at any given time against the manufacturer's declared Amp Hour (C20) capacity of the battery.

This comparison generates the State of Health (SoH) reading. Again, because this is dependent on accurate SoC readings, DataCell II's SoH accuracy is usually better than 1%. Note that battery SoH can go down as well as up (dependent on how it is being used, temperature etc).

Note that as part of the modelling process, DataCell II needs to learn about the health and condition of your battery. Therefore, it requires 2-3 battery cycles to achieve maximum accuracy.

**Battery Models:** DataCell II is designed for lead/acid batteries including:

Conventional wet lead/acid  
Semi Sealed Lead/Calcium Batteries  
Sealed Lead/Acid Batteries  
AGM (Absorbed Glass Matt)  
Gel  
Spiral (Optima, Cyclon etc.)

DataCell II needs certain parameters to be set to function correctly. These are set within the Merlin software.

DataCell II can also be used with Lithium-Ion batteries by using the 'Amp Hour' counter mode only to provide a SoC reading.

## BEFORE YOU BEGIN

### COMPUTER / SOFTWARE COMPATIBILITY

Merlin 'DataCell and Monitor' software is designed to operate on a PC running Windows XP or later. . It should not be used on other devices such as Mac or partitioned systems as this may cause configuration issues.

### FTDI CONVERTER

DataCell II uses an RS232 Serial Link to connect to your laptop or personal computer. This must be used in conjunction with the supplied FTDI USB/Serial Connector. Do not connect the DataCell II directly to a serial port on your PC.

*NOTE: Due to the significant variances in quality and configuration of USB converters, DataCell II will only operate with an approved FTDI Converter. This is supplied with the unit. If additional converters are required, they may be sourced directly from your Dealer, Merlin or FTDI directly.*

DataCell/PowerBank/PowerBank Combi Programming Kit: Merlin Part Number 19-5004

## PROGRAMMING CABLE CONNECTION

To carry out programming, connect the DataCell II to a USB socket on your PC via the programming cable and FTDI adapter cable.



Fig 1: Programming Cable & FTDI Converter

The FTDI converter connects to a USB socket on your PC. The 4-pin RJ11 connector connects to RS232 socket on the DataCell II.

## PROGRAMMING

DataCell II is factory shipped pre-configured for the number of battery banks as ordered. However the unit must be configured for battery voltage, type, capacity etc. The remainder of the set-up procedure is completed through software as detailed below:

Ensure that the Merlin 'DataCell and Monitor' software is installed upon your PC or laptop. This is either supplied with the device or available for download from the Merlin Power website.

Before connection of the programming cable, ensure that the applicable FTDI device driver is installed on the PC. This is available either direct from the Merlin Power or FTDI websites.

Once the FTDI driver is installed, please carry out the following:

- Plug the FTDI USB/Serial Converter into a free USB port in your PC.
- Wait for up to one minute for your PC to recognise the new device.
- Windows may find the saved driver automatically. If asked for a location of the driver, point windows to the saved Driver file.
- Once completed, windows will provide a "This device is ready for use" message. Click start and type in "Device Manager". Device Manager can also be found in your Windows Control Panel. When open, look for "Ports", click on this - the COM ports that the PC is using will be displayed. Against one of these USB Serial Converter will be displayed. Note down the COM port number assigned.
- You are now ready to connect the DataCell II to your PC.

*NOTE: These instructions are for first time use. The PC should automatically recognise the FTDI converter and the driver etc. It will also remember the COM port assigned. Therefore, if you power down your PC and repower it later, DataCell II should automatically be found by the PC (provided that the converter remains plugged into the same USB socket).*

*If the FTDI converter has been unplugged from the computer and plugged back in again, windows may assign a different COM port number. You may need to click "Refresh Comm Ports" under the "Settings" tab in the software.*

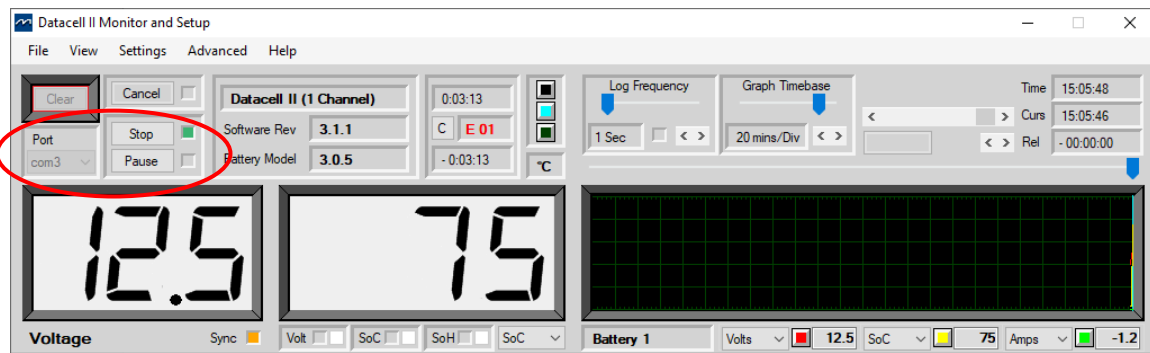
If, when reconnecting the USB converter (perhaps because in normal use you will use the DataCell remote panel), the PC doesn't seem to 'find' the converter ensure that:

1. You have plugged in the converter without the DataCell II connected.
2. You have waited up to 1 minute for the PC to find the converter and load the driver.
3. Go to Device Manger, check under Ports to see which COM port has been assigned to the USB Converter.

Once installed, connect the programming cable to the DataCell II ECU via the RS232 connection. Open the Merlin DataCell Monitoring software.

## Establishing Communication

Click the "Stop" button and choose the COM port you noted down previously in the upper left corner of the window.



Click the 'Start' button, ensure that communication has been established (data will be displayed).

If a COM port is not displayed the software will not be able to communicate with the DataCell II.

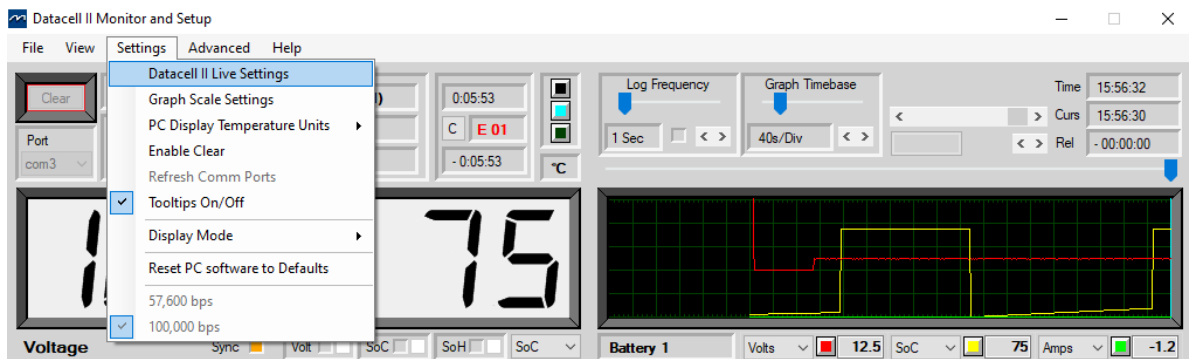
If no data is not displayed, click 'Stop', 'Settings', 'Refresh Comm Ports', choose Comm Port and click 'Start'. You may have to do this more than once.

## DataCell Live Settings – Master Functions

DataCell II must be properly configured to provide accurate and meaningful battery data. Configuration tells DataCell II what type of batteries are being monitored and allows you to set alarms and, alarm thresholds.

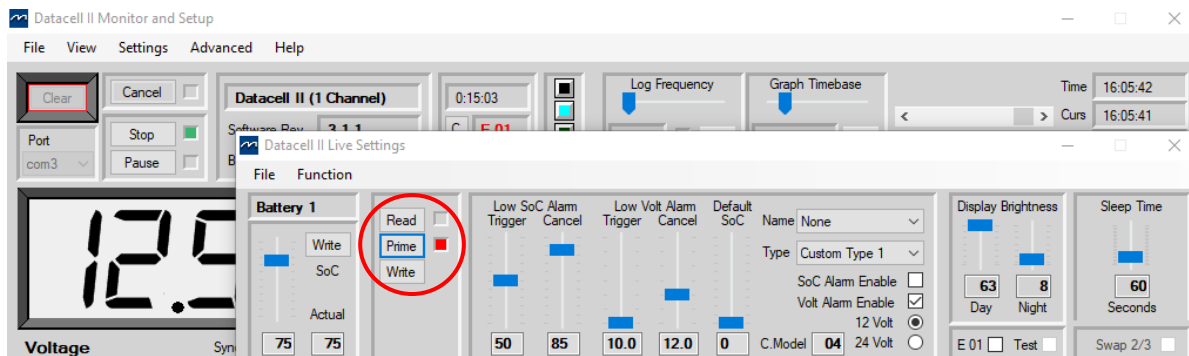
DataCell II is configured "On the Fly". This means that your PC talks directly to the microprocessor within the ECU.

- Click "DataCell Live Settings" box under the "Settings" tab.



The DataCell Live Settings box will appear. To prevent accidentally changing settings, three buttons are provided labelled:

- a) Read: This reads and displays the current settings from DataCell II.
- b) Prime: Unlocks the settings in the window. Once prime is selected, you can adjust settings.
- c) Write: Writes the settings that you have changed back to the DataCell II internal memory.



Click the 'Prime' button, and configure the following settings:

1. Battery Name: Batteries can be named using preselected names from the drop-down box (e.g. Engine, Auxiliary etc).

*Note that this is the name that will be transmitted to any connected devices (e.g. a DataCell LED or LCD Panel).*

2. Battery Type: Those available as in standard shipped product are:
  - Deep cycle: Wet cell, antimony lead acid.
  - Gel: Cell lead acid (a type of VRLA – Valve Regulated Lead Acid).
  - AGM: Absorbed Glass Matt (another type of VRLA).
  - Hybrid: Calcium/antimony (usually marked as dual purpose or “leisure”) lead acid.
  - Carbon Fibre: Lead acid.
  - Maintenance Free: (wet cells but no way to top up the electrolyte) lead acid.
  - Custom Type.



*Note: Genuine AGM's have the electrolyte held in a glass mat but with additional chemicals in the battery. They require higher charge voltages and the off-load terminal voltages will be similar to gel cells. Only this type requires DataCell II to be set to AGM Type 1.*

*There are other Glass Mat type batteries without the additional chemicals. This type usually has charge voltages very similar to flooded wet cell batteries.*

*The off-load terminal voltages will also be very similar to flooded wet cell batteries. If your AGM batteries are of this type, then DataCell II should be set to AGM Type 2*

*Custom Battery Models: Certain customers may have requested custom battery models for specific makes and models of batteries. If this is the case, Merlin Power will have provided the custom battery model. See Loading Custom Battery Types on page 16.*

3. Battery Voltage: 12 or 24V depending on battery bank voltage.

*Note: Maximum displayed for 12V setting is 19.3V.*

4. Default SoC (State of Charge):

The "Default SoC" slider sets the State of Charge value that the DataCell II would assume if power is lost or reset. We normally recommend that this is set at 75%. However, for safety critical applications, it should always be set to zero.

5. Low Voltage Alarm:

Trigger and cancel alarm levels are set and enabled from this page.

*Note: Volt Alarm Enable box must be checked for this alarm to function.*

6. Low SoC (State of Charge) Alarm:

Trigger and cancel alarm levels are set and enabled from this page.

*Note: SoC Alarm Enable box must be checked for this alarm to function.*

7. Display Brightness: Set the display illumination levels for Day and Night.

*Note: Default setting is 63 Day / 8 Night respectively.*

8. Sleep Time: Time (seconds) that the display will remain illuminated for after last button press.

9. E01 Check Box: Used to enable / disable 'E01' alarm. E01 alarm indicates when battery power has been disconnected to the DataCell II.

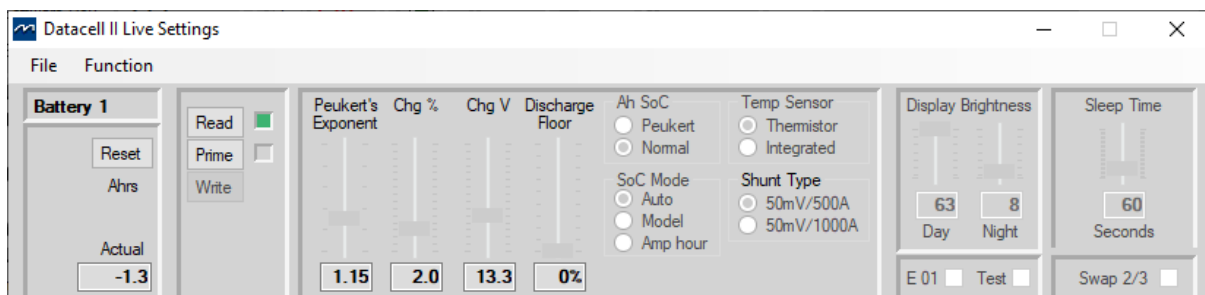
Configuration for your first battery bank is now complete. Select the “Write” button to write the new settings to the DataCell ECU. Repeat these steps for battery banks 2 to 4 (as applicable).

## DataCell Live Settings – DataCell II Functions

In the DataCell Live Settings window, click ‘Function’ and select ‘DataCell II Functions’.

These settings relate to the settings specific to the DataCell II product, including unit ‘Sync’. For more information on this, please read unit description on page 7 of this document.

The DataCell II Live Settings box will now again display the ‘Read’, ‘Prime’ and ‘Write’ boxes which can be used to change the settings:



From here the following settings can be adjusted:

1. Peukerts Exponent:

Peukerts Exponent expresses approximately the change in capacity of rechargeable lead–acid batteries at different rates of discharge. This information should be available from your battery manufacturer.

The default DataCell II setting is 1.15.

2. Charge Percentage:

This is the amount of current (Amps) entering the battery during charge, as a percentage of the stated battery capacity. For the DataCell II to sync the charge current MUST be below this setting for a period of 4 minutes.

To clarify further, if a battery has a stated capacity of 100Ah and the Charged Percentage is set to 2.0%, the current consumed by the battery during charging would have to be less than 2.0 Amps for the DataCell II to sync.

This setting is configurable between 0.5 and 8, however Merlin recommends a setting between 2% (more accurate, longer sync) and 4% (less accurate but quicker sync).

### 3. Charge Voltage:

Charged Voltage setting – This is the voltage that the battery MUST be above for a period of 4 minutes to enable the DCII to sync.

The setting is configurable between 12.8 to 14.3V DC (double for 24V operation).

Merlin typically recommends setting the charge voltage (Chg V) to 0.2 volts (12V) or 0.4 volts (24V) below the acceptance voltage of the charge source.

*Note: For the unit to 'sync', both the Charge Voltage AND Charge Percentage criteria needs to be met continuously for a period of 4 minutes.*

### 4. Discharge Floor:

Set the discharge floor to the level you want the "Time Remaining" feature to reference to.

Typically for cyclic battery use, Merlin recommends between 50 and 30% remaining. For engine start use, Merlin recommends around 65% remaining.

### 5. Ah SoC: Normal or Peukerts can be selected.

Merlin recommends 'Peukert' setting. More information available upon request.

### 6. SoC Mode: Auto, Model or Amp Hour can be selected.

Merlin recommended setting is 'Auto', in the exception where Li-Ion battery technology is being used. In this application the SoC Mode must be set to 'Amp Hour'.

### 7. Shunt Type: 50mV/500A or 50mV/1000A selectable.

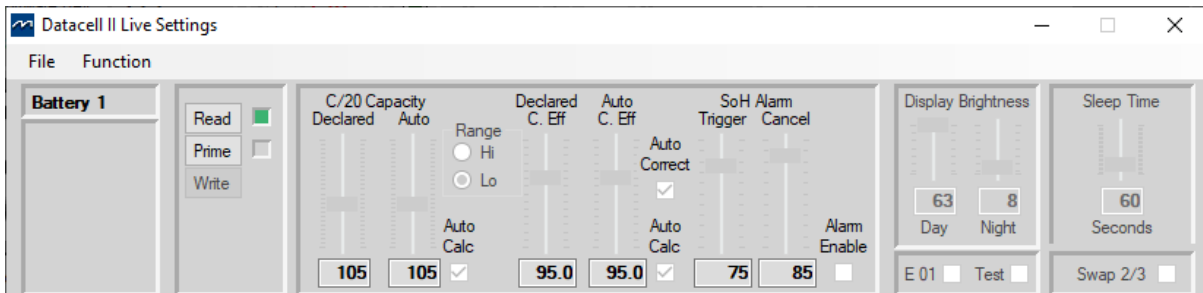
DataCell II is supplied with 500A shunts as standard, however 1000A rated shunts are available if required.

Configuration for your first battery bank is now complete. Select the "Write" button to write the new settings to the DataCell II ECU. Repeat these steps for battery banks 2 to 4 (as applicable).

## DataCell Live Settings – Battery Capacity, Charge Efficiency and SoH

In the DataCell Live Settings window, click 'Function' and select 'Battery Capacity, Charge Efficiency and SoH'.

These relate to the settings specific to the battery. The DataCell Live Settings box will now again display the 'Read', 'Prime' and 'Write' boxes which can be used to change the settings.



From here the following settings can be adjusted:

1. C/20 Capacity: From here the battery capacity in Amp hours (Ahrs) can be set.

In the 'Lo' range, battery capacity from 10 to 250 Ahrs can be set. For larger battery banks (e.g. Domestic) select the 'Hi' range, battery bank capacity from 100 to 2500Ahrs are selectable.

Ensure that the 'Auto Calc' box is ticked to enable actual battery capacity and hence State of Health (SoH) of the battery to be calculated.

2. Charge Efficiency:

The "Charge Efficiency" compensates for the capacity (Ah) losses during charging. This information should be available from your battery manufacturer.

Default setting for this with the DataCell II is 95%. Assuming the 'Auto Calc' box is ticked DataCell II will calculate and correct this figure during battery cycling.

3. Low SoH (State of Health) Alarm:

Trigger and cancel alarm levels are set and enabled from this page.

Please note that most battery manufacturers regard a battery with a health of 80% or less as "end of life". Alarm levels should therefore be set above this value.

*Note: SoH Alarm Enable box must be checked for this alarm to function.*

Configuration for your first battery bank is now complete. Select the "Write" button to write the new settings to the DataCell II ECU. Repeat these steps for battery banks 2 to 4 (as applicable).

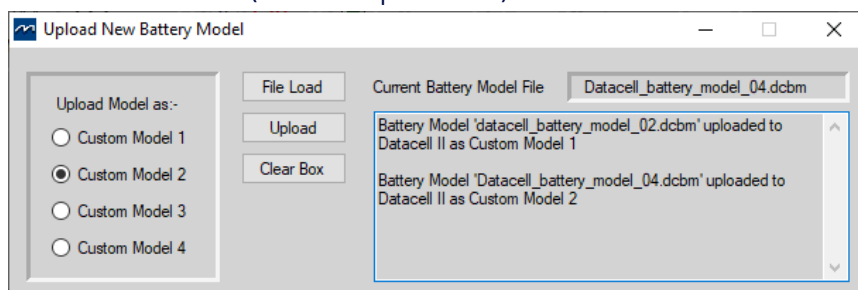
## Loading Custom Battery Models

Where applicable, Merlin may be able to provide custom battery models for specific battery types which have been laboratory tested. Specific battery models are available for download from the Merlin Power Website.

DataCell II uses a battery model to calculate battery SoC (For model-based calculation). Where standard models are not being used (as selected within the DataCell software), each battery channel will require its own custom model to use.

This means that for a two channel DataCell II you will need to upload the battery model in twice (one for each channel), for a four channel DataCell II you will need to upload the battery model in four times (assuming each channel is using this custom battery type).

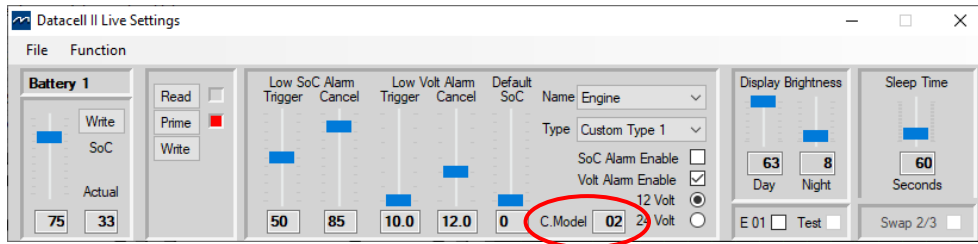
1. Download the battery model and save the file (.dcbm) in a known location on your PC.
2. Under the 'Advanced' menu, click on 'Upload Battery Models'.
3. A new window will open. You now have the ability to upload up to 4 separate battery models to the 4 battery channels. You will be able to assign a different custom model to each channel if applicable.
4. Click on 'File Load' and select the battery model from your saved location.
5. Select the relevant battery channel (you wish to upload the battery model to) from the left-hand side window. To clarify, 'Custom Model 1' is for battery channel 1, Custom Model 2' is for battery channel 2.
6. Click on 'Upload' . The right-hand window will now show which Battery Model has been loaded into which channel (see example below):



Battery Model 02 loaded into Custom Model 1 (Battery Channel 1), Battery Model 04 loaded into Custom Model 2 (Battery Channel 2).

7. Repeat until you have loaded in all battery models for each channel you wish to use a custom model for. For example: if you have a 4 channel DataCell II and wish to use a custom model type in two of the channels (and the standard battery types for the others), you will need to upload the battery model twice.
8. Close the window, click on 'Settings' and select 'DataCell Live Settings'. The Live Settings Window will open. For each applicable battery channel, click 'Prime', under Type, select Custom Type (numbered 1 for channel 1, etc) . Repeat for each battery which you wish to use custom models for.

Battery custom model number will now be displayed in the 'C.Model' window:



## Zeroing the Shunts

Before DataCell II can be used, it is imperative that current shunts are correctly zeroed. If the current shunts are not correctly zeroed, the battery monitoring data will be inaccurate.

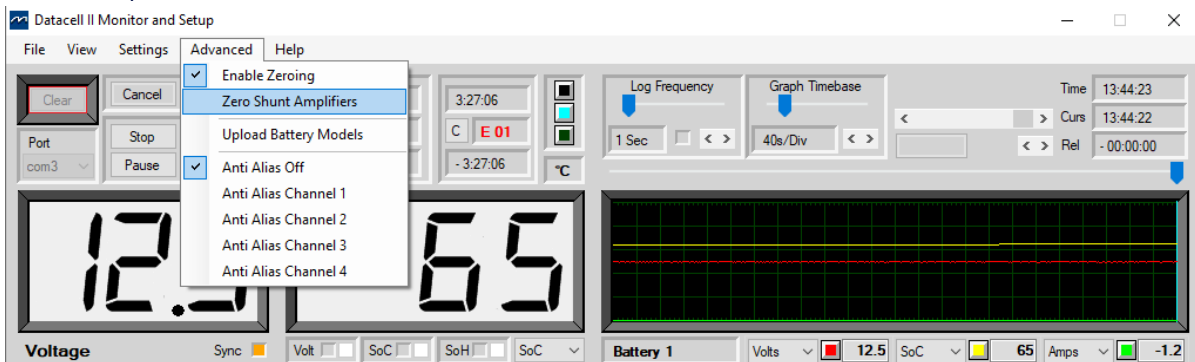
Before zeroing the shunts ensure that ALL battery loads are switched off and / or isolated.

For chassis batteries, this would include ensuring the ignition is turned off and all chassis loads are switched off (e.g. interior & exterior lights). For auxiliary batteries, all connected loads should be isolated (e.g. inverter, charger, fridge etc.)

Methods of isolating loads includes switching off and removing fuses where standby loads are still present.

With all loads switched off / isolated, current reading on each battery bank should be 0.0A +/- 0.2A (Amps). If the current reading is outside of this specification, then the shunts should be zeroed.

Zero the shunts by selecting "Enable Zeroing" under the "Advanced" tab, and then choose "Zero Shunt Amplifiers".

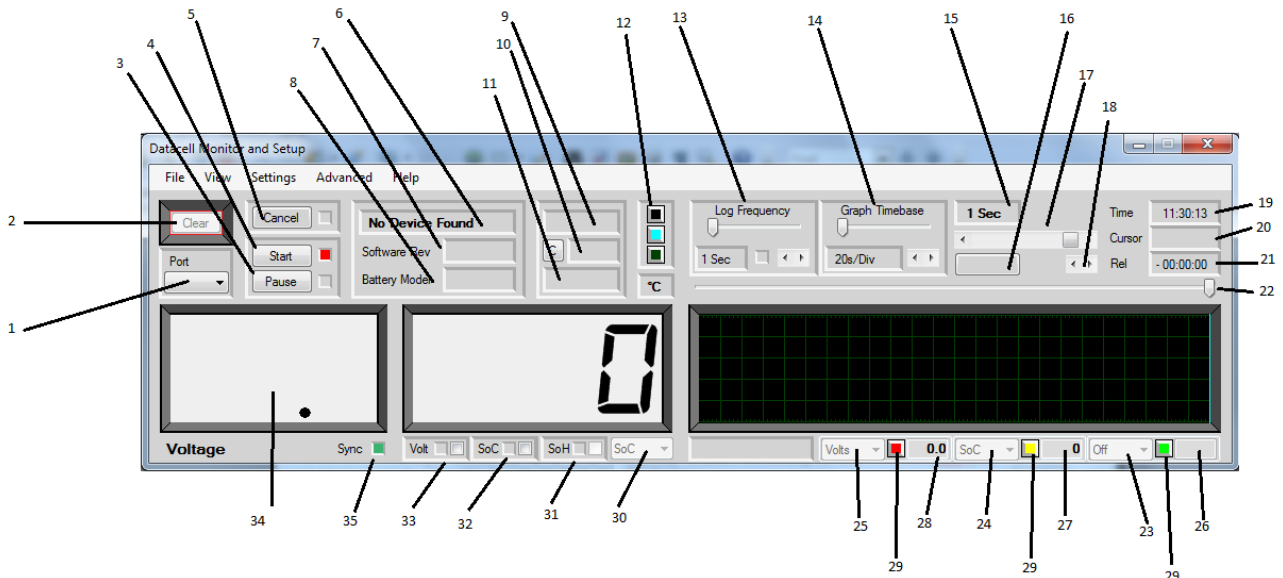


*Caution: Ensure that there is absolutely no load or charge during this process!*

DataCell II is now fully configured and ready to operate.

## SOFTWARE USE

The following screenshots from DataCell II software show how the software can be used for diagnostics & data logging.



### Main Screen Key:

1. COM port selector.
2. Clears the main graph display. This button has to be enabled under 'Settings' 'Enable Clear' to prevent accidental erasure.
3. Pause simply pauses the graph display. Pressing "Resume" will immediately update the graph and continue with no gaps.
4. Stop/Start. Stops and starts data reception from DataCell.
5. Cancel. If communication with DataCell fails (comms lead pulled out etc) the software will sound an alarm and this button will flash red. Clicking it mutes the audible alarm.
6. Displays the device currently connected (i.e. DataCell II 4 Channel, or DataCell I 3 channel etc).
7. Displays the software revision of the attached device (not the PC software revision).
8. Displays the battery model of the attached device.
9. Total operation time. Displays the time DataCell has been operating since power up.
10. Either "Normal" or "E 01". E 01 means power has been lost at some point since it was last cleared. This error can only be cleared by clicking the "C" to its left.
11. Total time since E 01 error was generated.
12. Colour buttons. Allows the graph colours (graph background, cursor and graticule) to be changed.
13. Log frequency: How often data is written to file when the software is data logging.
14. Graph Timebase: Time per graph division.
15. No Longer Available.
16. If the cursor and graph are not at the home position (i.e. the cursor at far right and the graph is positioned so that the far right is "Now") this button will flash and display "Home". Clicking the button will force the graph to the home position.
17. Adjusts the position of the graph window over the graph. This can also be done by clicking in the graph and dragging the graph to the required position.
18. Cursor fine adjustment.
19. Current time according to the PC system clock. If the PC clock is wrong, so too will this be. This time clock is used to time stamp logged data.
20. The time at the current cursor position. This was the time according to the system clock when that data was received.
21. The time of the cursor relative to the right-hand side of the graph.
22. Cursor adjustment.
23. Assign measurement reading to green graph line (e.g. Volts, Amps Temp etc).
24. Assign measurement reading to yellow graph line (e.g. Volts, Amps Temp etc).
25. Assign measurement reading to red graph line (e.g. Volts, Amps Temp etc).

26. Green graph data reading at cursor line.
27. Yellow graph data at cursor line.
28. Red graph data at cursor line.
29. Sets the graph colour for this function.
30. Selects the function of this "LCD" (e.g. SoC).
31. If a SoH alarm has been set in DataCell, and that alarm has triggered, this LED will light up. An audible alarm will also sound. Clicking in the checkbox will cancel the audio. The alarm will remain triggered.
32. As above (31) for SoC alarm.
33. As above but for a Low Volt alarm.
34. Voltage "LCD"
35. Sync indicator.

## DataCell II Datalogging Functions:

Whilst the DataCell II is connected to a PC, you are able to Datalog all measured and calculated data to an Excel spreadsheet file. This is particularly useful for diagnosing electrical issues on your platform. The following logging features are available under the 'File' Menu:

### Log as Spreadsheet File

Log all incoming / calculated data to a CSV (Comma Separated Values) spreadsheet file. You will be asked to select file location for the saved document.

Note that if the 'Log Frequency' is set to a very short duration (e.g. 1 Second) you will receive a file size warning. Depending on datalogging requirement a longer duration may be suitable. Note that battery information generally only changes over longer periods of time, so a log frequency of 1-5 minutes is normally perfectly acceptable in some instances.

Logging will continue until you stop it. This can go on for as long as you like (or until the spreadsheet file is filled up). Whilst logging is active, the 'LED' in the 'Log Frequency' box will illuminate. To stop logging uncheck the box in the same menu.

Note that the PC must be powered and 'on' for the logging to continue. Power save options may need to be disabled to stop computer going to sleep.

### Save as Spreadsheet File

This is almost identical to "Log as Spreadsheet File" except in this case all the data currently in the PC (which will be displayed on the graph) will be saved as a spreadsheet file. Once saved the file is closed. Note: The graphs will only show the last 24 hours of activity.

This option will also save data that has been loaded in as a "DataCell Session" (see below)

### Save as DataCell Session

This is similar to "Save as Spreadsheet File" except this doesn't save the file as a spreadsheet file. It saves it in a simple proprietary format which can be loaded back into the DataCell PC software for later analysis. This option saves what is already there then closes the file.



## Load DataCell Session

This loads in a previously saved DataCell Session. Notice that it is “greyed out”. In order to activate it you need to stop reception from DataCell. This is to prevent you accidentally overwriting your current reception data with a saved file.

## Save Screenshot

This saves a picture of the main screen as a bitmap image.

## Error Codes & Product Help:

The ‘Help’ menu provides information on displayed Error Codes and DataCell Software information. For more information on the DataCell II Product (including product manuals) please visit our website: [www.merlin-power.com](http://www.merlin-power.com)



If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Merlin directly at: Merlin Equipment Ltd, Clyst Court, Hill Barton Industrial Estate, Exeter, Devon, EX5 1SA, United Kingdom. Tel: +44 (0)1202 697979.