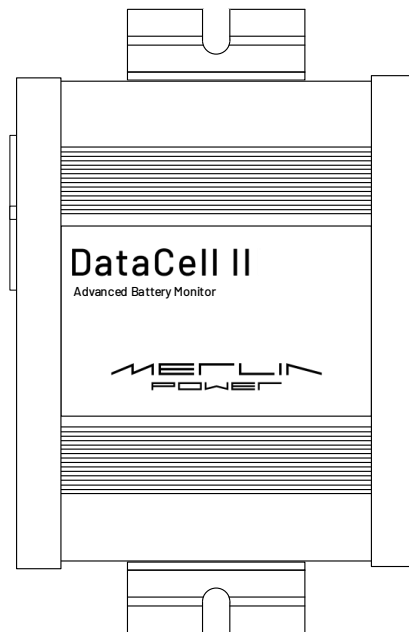




# DATACELL II

## USER & INSTALLATION GUIDE

Revision: A



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## WARNING

Your attention is drawn to "Caution!" and "Warning!" statements throughout this manual.

"Caution!" refers to practices that may cause damage to the Merlin Product or your electrical system.

"Warning!" identifies practices that may cause injury or death.

**DataCell II is designed for installation by qualified and competent electrical engineers.**

Qualified and competent engineers will be familiar with safe working practices, local health & safety legislation and the proper and safe use of tools and equipment.

Therefore not all obvious practices that may lead to system damage, injury or death are detailed within this manual.

If you are in anyway unsure about any aspect of the installation or use of DataCell II, contact your Dealer or Merlin Power Systems for advice.

## PRECAUTIONS

- This product is designed for use in 12 and 24 Volt DC vehicular systems depending on model. Use in other than its designed application may result in fire, electric shock or other injury.
- DO NOT disassemble, modify or alter. Doing so may result in an accident, fire or electric shock.
- USE ONLY in vehicles with a NEGATIVE GROUND. Failure to do so may result in fire, electric shock, damage or other injury.
- FUSES: Use the correct ampere rating when replacing fuses. Failure to do so may result in fire, injury, electric shock or damage.
- DO NOT install or operate the CPU in an explosive atmosphere.
- DO NOT install or expose the CPU to excessive temperatures or humidity.
- If in any doubt consult a suitably qualified and competent engineer or the supplier.
- MAINTENANCE. If you have problems or suspect device failures DO NOT attempt to repair the unit yourself. Return it to your Dealer or Merlin for servicing.

# APPROVALS AND CONFORMITY

## CERTIFICATE OF CONFORMITY



Declaration of Conformity

Merlin Equipment Limited, hereby declares that the product marketed as DataCell II is in compliance with the requirements of EU Electromagnetic Compatibility (EMC) Directive 2014/30/EU.



DataCell II complies with RoHS (Reduction of Hazardous Substances) Directive 2011/65/EC. At the end of life, DataCell II should be disposed of as normal electrical waste.

DataCell II has been tested to and surpasses ISO-7637-2 for use Vehicles.

Signed:

A handwritten signature in blue ink, appearing to read 'James Hortop', with a stylized flourish at the end.

James Hortop  
Managing Director  
Merlin Equipment Limited

## INTRODUCTION

Thank you for choosing Merlin DataCell II!

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 installation and use.**

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## 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 synch' with the batteries (and using amp hour calculation (and possibly model based calculations at the same time). When DataCell II is not 'in synch' 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.

## IDENTIFICATION OF SYSTEM COMPONENTS

DataCell II comprises a number of components. DataCell II may be configured for up to 4 battery bank installations, at 12 or 24 Volt DC. A number of additional components may also be used in the system.

### DataCell II Control Unit (ECU):

Contains main CPU and battery monitoring circuitry.



DataCell II ECU

### Current Shunts:

DataCell II is supplied with Current Shunts for battery monitoring. Up to 4 may be required for the DataCell II system (1 per battery bank).

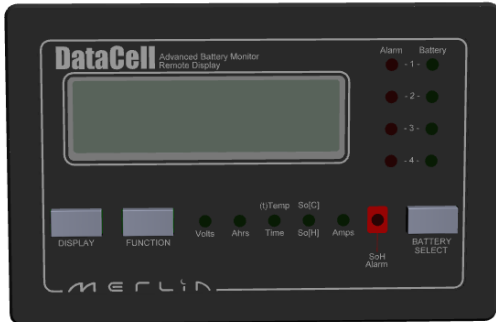


Current Shunt



## Battery Monitoring Display Panel:

The DataCell Display Panel is used to view information relative to the DataCell II Battery Monitor. It is used to display real time battery data being monitored or data calculated by the DataCell II. It can be supplied with LED or LCD Screens depending on application.



Control Panel

The panel contains 3 buttons, which provide the following functions:

1. Select battery bank: 1 to 4 depending on configuration.
2. Scroll through battery data to include: Voltage, Current (Amps), Temperature, State of Charge, Time Remaining, Amp Hours and Battery State of Health.
3. Illumination: Day/Night-time mode.

DataCell II status can be communicated to the user via the LEDs contained within the panel.

## System Cabling:

DataCell II will be supplied with two mating wiring looms for connecting to external components.



Connector 1 Loom  
Note: Black Sleeving



Connector 2 Loom  
Note: Grey Sleeving with coloured idents

DataCell II will also be supplied with a programming cable to connect between the device and a personal computer. This is supplied with an appropriate serial to USB adapter.



DataCell Programming Lead  
(Inc USB to Serial Converter)

The programming cable can also be used whereby the DataCell II is used as a PC interfaced battery monitor where the control panel is not required.

*Caution! Please ensure familiarity with the wiring of cable connectors, switches etc. It is highly recommended only personnel that have undertaken correct training attempt these tasks.*

*Warning! Incorrectly connected cables may damage DataCell II or vehicle electrics and will invalidate the Warranty.*

## INSTALLATION

*Warning! Isolate power supply before starting installation.*

### POSITIONING OF PARTS

DataCell II main components (ECU & Shunts) do not need to be easily accessible from a user's perspective. Only the control panel needs to be readily accessible to the user.

The following should be observed as parts of the DataCell II are designed for wet/dirty environments, but others are not.

#### DataCell II ECU:

The ECU is designed for location in a dry / clean environment. The ECU is **NOT** suitable for installation or operation in atmospheres where there is a risk of ignition or explosion. The ECU is **NOT** suitable for installation outside, under bonnet or in wet / damp cupboards.

*Caution! Damage will occur if the ECU is allowed to get wet.*

*Warning! Do not install the ECU in a petrol/gas engine room environment.*

### **Current Shunts:**

These are designed for location in a dry environment. It is suitable for installation in drier engine compartments. However, it is not sealed against moisture ingress.

Shunts must be installed as close as possible to the negative of the respective battery bank that they will be connected to.

### **Control Panel:**

The control panel is designed for location in a dry environment. It should be mounted on the dashboard or within easy view/access for the driver.

## **FIRST FIX INSTALLATION**

### **Pre-Installation Preparation:**

- Disconnect the main positive and negative from each battery bank to ensure no power is on the vehicle (up to 4 battery banks).
- Remove items (e.g. seats, access panels etc) to ensure easy installation.
- Survey the sites where you wish to locate components.

### **Mount Components:**

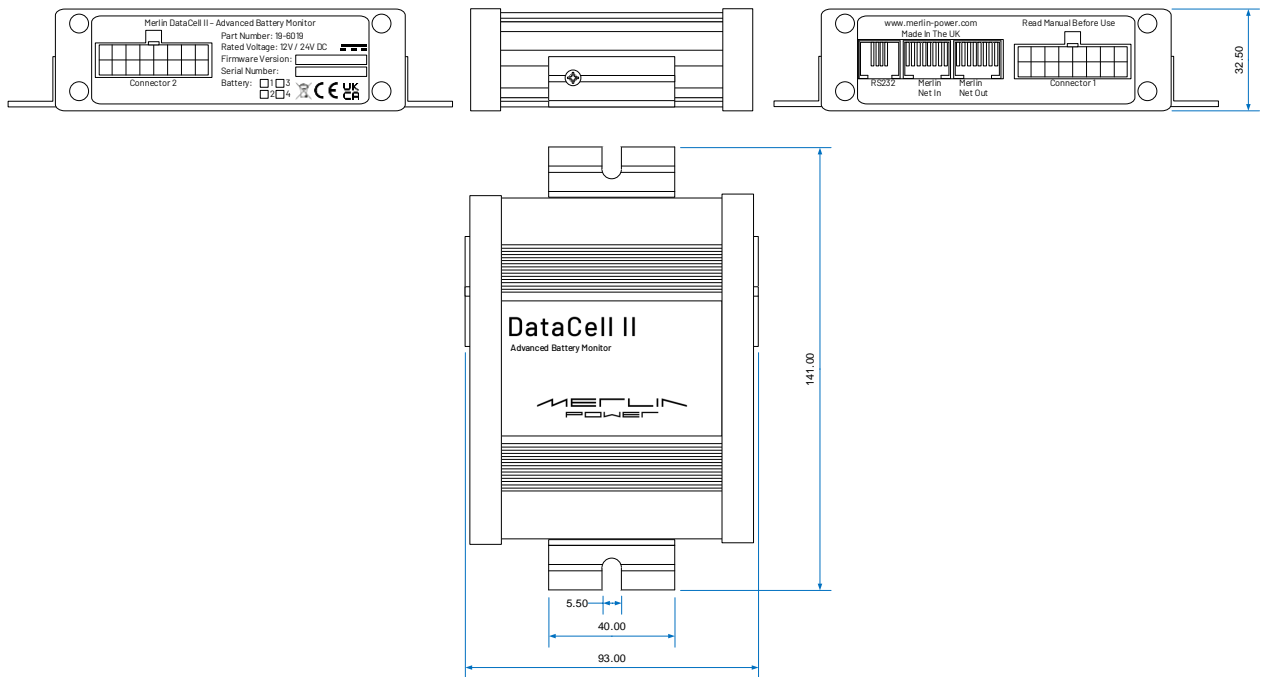
Mount the components in the agreed locations with the specifying Engineer. We recommend installing directly to bulkheads using stainless steel bolts. All nuts should be either of the Nyloc type or protected with a shake proof washer. Appropriately sized washers should be used to mount components to distribute component weight and loadings.

### **Plan and lay in cables:**

Lay in the cables / wiring to the various components as per the system diagram supplied by the specifying / design Engineer. Ensure all cables are routed away from vehicle control devices and are suitably fixed and secured. Cables and wiring should not be installed above vehicle access points.

## **ECU INSTALLATION**

The DataCell II ECU is supplied with 2 Mounting Flanges. Each flange has a mounting slot to enable fitment of M5 bolts. Ensure that the unit is securely mounted to the vehicle using suitable bolts, washers and nuts. Unit dimensions are as detailed overleaf:



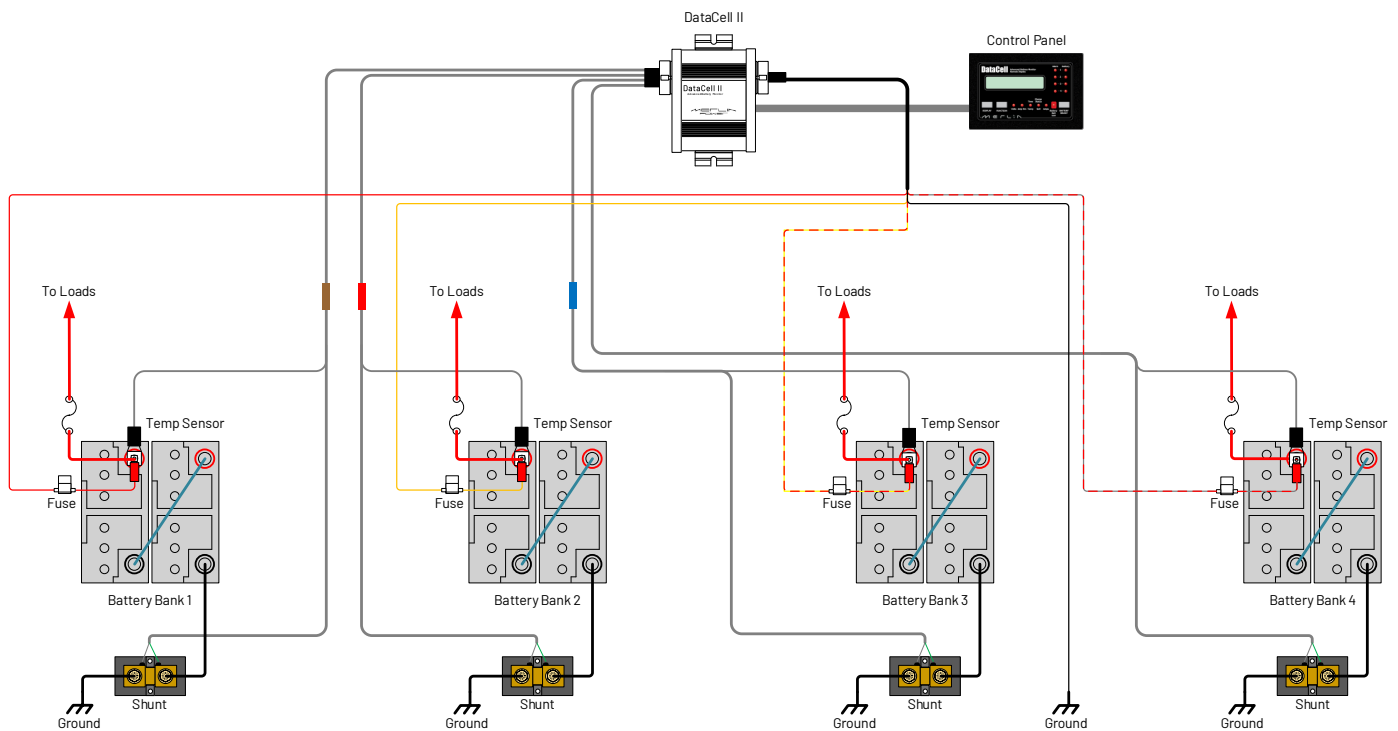
The DataCell II wiring connections are as detailed within the Interface Control Document.

## WIRING SCHEMATICS

### TYPICAL SYSTEM LAYOUT:

This section is for information only. Please check with the specifying / design engineer. However, these diagrams show a typical layout which will give you an understanding of how the systems install and the component parts required.

The following 4 Battery Bank Example is based upon a typical installation:

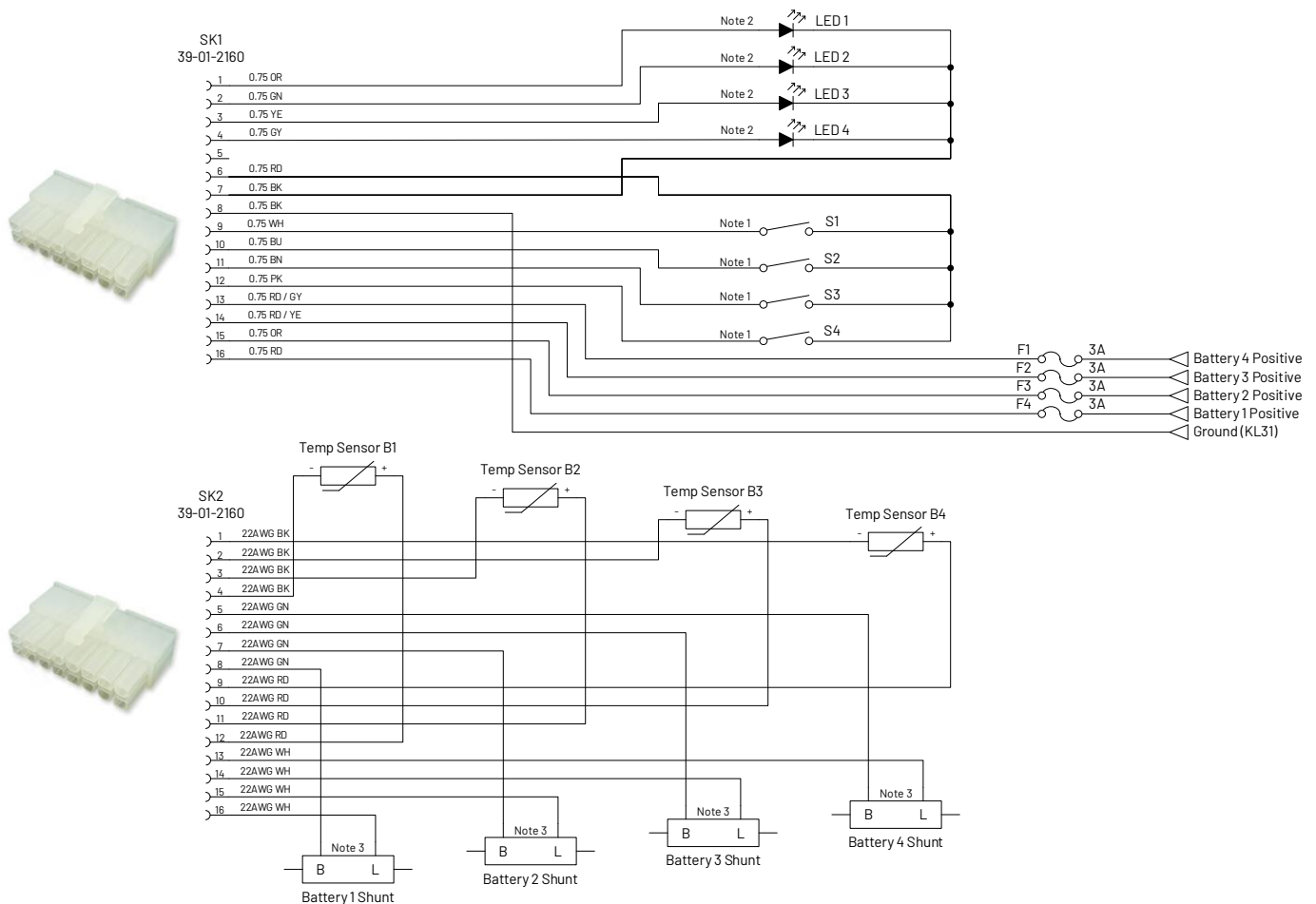


**Notes:**

1. Drawing details 4 battery bank installation. DataCell II is available in 1 to 4 battery variants.
2. Drawing details 24V battery banks. DataCell II is suitable for fitment to 12 or 24V batteries.
3. Drawing details optional control panel. DataCell II can be supplied without and connected to a personal computer to provide battery monitoring information.

- *Caution & Warning! We recommend that appropriately rated fuses or circuit breakers are inserted between batteries and existing loads to protect against short circuits. These should be located as close as possible to the battery positive terminal of each battery bank.*
- *Caution & Warning! DataCell II Battery Sense Cables must be protected with small inline fuses. These should be rated at 3A DC and used in every installation.*
- *Caution! Shunts MUST be placed in the negative of each battery bank. No other cables must be connected to the negative of the battery (or between the negative of the battery and shunt). Any connection that bypasses the shunt will render the DataCell II battery monitor inaccurate.*

## CONTROL & SENSE CABLING:



### Notes:

Note 1: Switches SW1 to SW4 should be momentary (On) Off.

Note 2: LED Supply 5 Volt DC source with a 1K series limiting resistor.

Note 3: Current shunt connections must be correctly orientated Battery Side (B) and Load Side (L).

### Cable Loom 1 (voltage sense, input/output wiring):

The wiring loom is split into two sections. The first section can be identified by having 2-5 wires. This first section contains the battery sensing wires.

Black	Battery Negative/Ground
Red	Battery 1 Positive
Orange	Battery 2 Positive
Red/Yellow	Battery 3 Positive
Red/Grey	Battery 4 Positive

Your DataCell II will include a wiring loom that is specific to the number of batteries that the unit is configured for. For example, a 2-battery bank DataCell II cable loom would not include wires for Battery 3 & 4 Positive.

The second section can be identified by having 4-10 wires and contains the input/output connections for switches and LEDs.

Orange	LED Output 1
Green	LED Output 2
Yellow	LED Output 3
Grey	LED Output 4
Red	Switch Power Feed
Black	LED Ground
White	Switch Input 1
Blue	Switch Input 2
Brown	Switch Input 3
Pink	Switch Input 4

Again, your DataCell II will include a wiring loom that is specific to the number of batteries that the unit is configured for. For example, a 2-battery bank DataCell II cable loom would not include wires relative to LEDs 3 & 4 and Switches 3 & 4.

The input / outputs are configurable within the Merlin software and will be discussed within the programming section of the manual.

The LED outputs may be used to drive other items (e.g. a relay to operate a generator auto-start system). However, to do this, electronic amplification is required. Please consult Merlin Power for further information and advice.

- *Caution & Warning! Do not attempt to drive a relay or any other equipment directly from a DataCell II LED Output.*

The switch inputs are used to cancel an active alarm LED.

#### **Cable Loom 2 (shunt sense & temperature sense):**

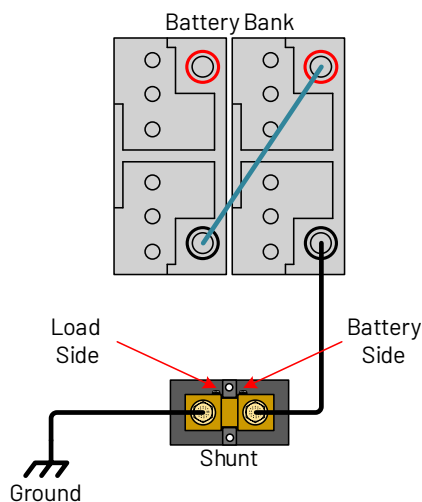
This cable loom is split into colour coded sections. Again the loom supplied will reflect the model of DataCell II purchased:

Battery Bank 1: Brown Heatshrink  
Battery Bank 2: Red Heatshrink  
Battery Bank 3: Blue Heatshrink  
Battery Bank 4: No Heatshrink

Each cable is made up from 2x twisted pair wire. The wires are colour coded Black, Red, Green & White and are connected as follows:

Black: Temperature Sensor Negative  
Red: Temperature Sensor Positive  
Green: Shunt Sense Battery Side  
White: Shunt Sense Load Side

The definition of “Load Side & Battery Side” of the shunt is as follows:



- *Caution! No other cables must be connected to the negative of the battery (or between the negative of the battery and shunt). Any connection that bypasses the shunt will render the DataCell II battery monitor inaccurate.*

The DataCell II is supplied with wiring looms of 1.5 metres length. Where possible, use the supplied wiring, however, wires may be extended if necessary.

Connections to battery terminals, fuses etc should be made using a good quality crimp connectors. For external and connections to open lead/acid batteries, we recommend heatshrink style terminals to provide a corrosion (and thus resistance) free connection.

If cables are to be extended, either use a good quality double crimp butt connector (preferably of heatshrink type) or soldered connections with adhesive lined heatshrink. Use only 0.75 – 1.0mm (18-16AWG) multi-stranded cable. Do not use bell wire or telephone wire.

- *Caution! Low resistance connection is essential to correct DataCell II operation. Always use high quality connections and wiring.*

DataCell II should always be left powered up. It consumes a tiny amount of electrical power and does not significantly contribute to parasitic draw. Do not install switches in the sense wires.

## NOTES

### FINAL CHECKS:

Once cabling is complete. We highly recommend following the checklist below before reconnecting the main battery cables.

- *CAUTION! Incorrect and reverse polarity may damage the system.*
- *WARNING! Reverse polarity connections to batteries may cause them to explode. Check all cabling before powering up the system.*

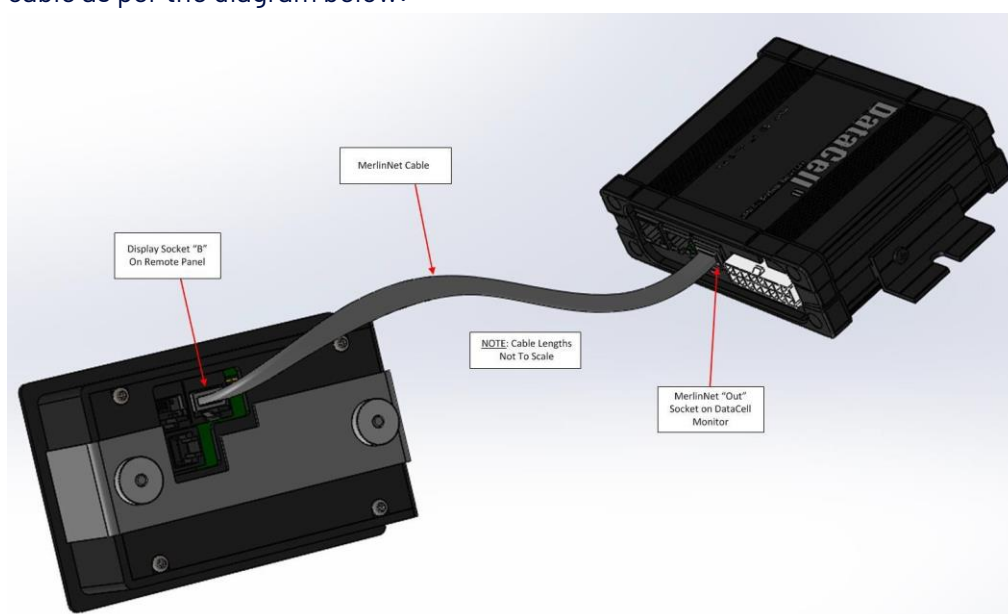


## PRE POWERUP-CHECKS:

- Check security of each component.
- Check main battery cables against system diagrams.
- Check main battery cables are correctly sized based upon rated loads.
- Check tightness of all connections.
- Ensure all live terminals are covered with rubber insulating boots.
- Ensure all positive wires are fused.
- Check all negative connections are secure.

## CONTROL PANEL CONNECTION

The Display Panel (if required) must be connected to the DataCell II ECU via the 8-way MerlinNet cable as per the diagram below:



*Note: Cable connects to DataCell II 'MerlinNet Out' connection and Display Panel socket 'B'.*

## POWER UP

Plug connectors 1 & 2 of the DataCell II wiring looms into the unit, ensure fuses are fitted in-line to battery connections.

Display panel (If fitted) should illuminate, and it should be possible to scroll through the data. This includes switching between battery banks (1 to 4 depending on model) and battery data (e.g. Volts, Amps, Temperature, SoC, SoH, Ahrs & Time Remaining).

*Note: DataCell II still requires configuration at this stage. Displayed data may therefore be incorrect.*

*Caution: Display panel will not operate correctly if the MerlinNet cable is plugged into the wrong connections.*

## 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 Merlin supplied software.

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.

The software is designed to work on Microsoft Windows PCs only. It should not be used on other devices such as Apple Mac or partitioned systems as this may cause configuration issues.

To ensure all programming requirements are captured the following information will need to be considered:

- Number of Battery Banks.
- Battery Bank Voltages (12 or 24V).
- Battery Size (Ah) & Type (e.g. Lead Acid / AGM / GEL / Li-Ion)
- Alarm Levels (e.g. Voltage, SoC)
- Vehicle Alternator Rating
- Maximum Battery Bank Loads

Programming instructions are provided within our DataCell II programming guide which is available from the Merlin Power website: [www.merlin-power.com](http://www.merlin-power.com)

*Note: 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.*

*Caution: 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.*

## AFTER INSTALLATION

If you are unsure about any aspect please consult a suitably qualified engineer, your Dealer or Merlin Equipment Ltd before commissioning the unit.

## PRODUCT SPECIFICATIONS

DataCell II ECU	
Part Number(s)	19-6019 (ECU Only) 19-6021 (12 / 24V 1 Battery) 19-6022 (12 / 24V 2 Batteries) 19-6023 (12 / 24V 3 Batteries) 19-6024 (12 / 24V 4 Batteries)
ECU Dimensions (Excluding Cables)	141 x 93 x 33mm (W x L x H)
ECU Weight excluding cabling	0.25Kg
Operational Voltage Range	12 or 24V DC
Operational Input Voltage Range	5.5 to 36V DC
Current Consumption	Battery Monitor Only Mode <10mA* *at 12V DC, Not including connected Battery Monitor Display or RS232 Communications
Operation Temperature Range (°C)	-25 to +105°
Battery Management / Monitoring	
Maximum number of Battery Banks	4
Platform Voltage Rating	12 / 24V DC Systems
Voltage Reading Range	0 to 19.3V or 38.6V (Dependant on 12 / 24V Setting)
Voltage Reading Accuracy	+/- 0.1V DC on 12V setting +/- 0.2V DC on 24V setting
Current Reading Range	+/- 500 amps or +/-1000A (Shunt Type Dependent)
Current Reading Accuracy	+/- 5% +/- 2 least significant digits
LED Output	5V DC Source with 1K series limiting resistor
PC Communications	RJ11 - RS232 Communications

## PRODUCT ACCESSORIES

Merlin Part Number	Description
19-5004	DataCell/PowerBank/PowerBank Combi Programming Kit
19-6029	DataCell II 500A Exposed Shunt
19-6039	DataCell II 1000A Exposed Shunt
19-6100	DataCell Remote Panel LCD
19-6101	DataCell Remote Panel LED
19-5018	Input Switch (On)-Off Momentary with Red LED
19-5019	Input Switch (On)-Off Momentary with Green LED
10-4012	Cable Cap Insulation Boot 2 - 2/0 AWG Red
10-4013	Cable Cap Insulation Boot 2 - 2/0 AWG Black
08-1060	Mega Fuse Holder
08-1054	200A Mega Fuse
08-1013	ATO Single Blade Fuse Holder
08-1003	3 Amp Blade Fuse

## WARRANTY

For details of our market-leading warranty policy, please refer to the FAQs section of the Merlin Power website: [www.merlin-power.com](http://www.merlin-power.com)



All details of the warranty policy are detailed here, to include duration, scope, claims procedure, limitations & governing law.

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.