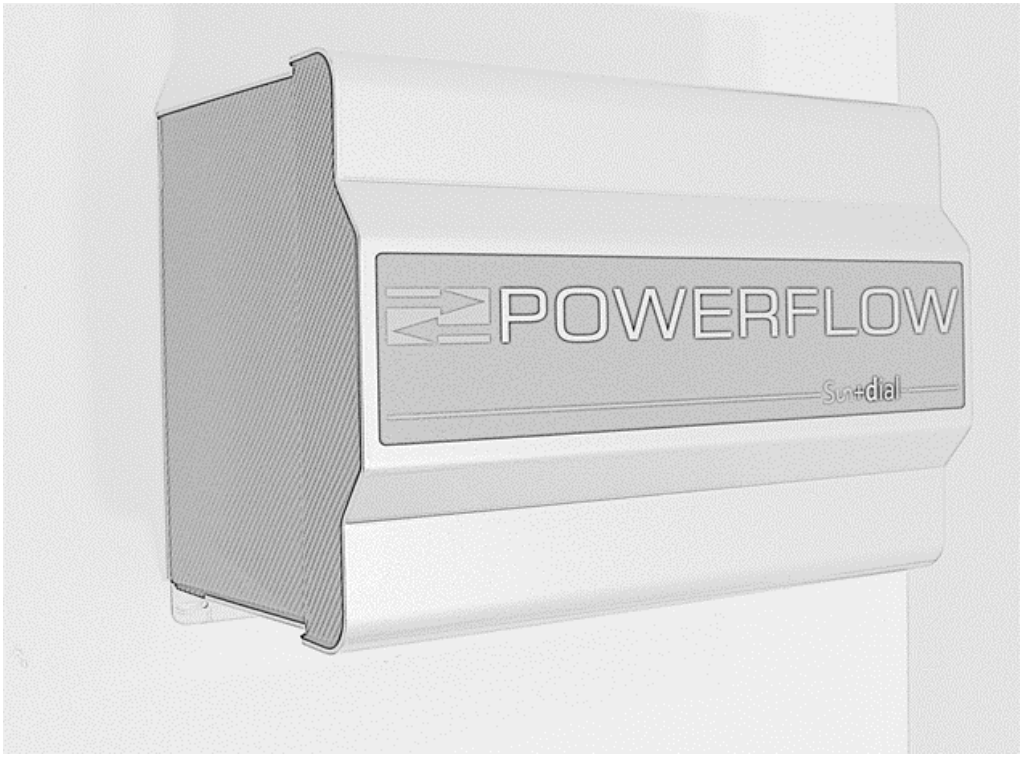
Sundial®

Important Information for your PowerFlow:
Sundial M: (SDM-2.0-500-10)
Sundial S: (SDS-2.0-500-10)

- **Installation and User Manual**

IMPORTANT SAFETY INFORMATION:
PLEASE READ AND UNDERSTAND THIS MANUAL BEFORE COMMENCING WORK



POWERFLOW

Thank you for choosing PowerFlow

PowerFlow's Mission is to continually develop efficient energy storage technologies in order to increase the availability of low carbon generated power. This will contribute to CO2 reduction and help to protect our planet for future generations, something all of us at PowerFlow are very passionate about.

Over five decades of combined experience has been deeply integrated into your Sundial product. From its class leading efficiency, to the highest of safety standards, every component has been carefully considered to ensure long lasting reliable operation. All of our products are fully designed and 100% manufactured in the UK at our factory in Herefordshire, helping to support Great British manufacturing. By purchasing Sundial, you are supporting the development of this important technology so future generations can benefit and prosper from cleaner, greener more sustainable energy.

Thankyou for supporting our mission

Ian Murray
Managing Director, PowerFlow Energy Ltd

Register Your Product.

Don't forget to register your product on the PowerFlow website. This will extend your 2 year standard warranty for an additional 3 years absolutely free.

Visit: www.powerflowenergy.com/warrantyregistration

Contact Us

If you have any questions about our products, our website is designed to provide support. Should you not find what you are looking for, you can contact us using the details below.

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Section A: Introduction

1.0 Introductory Information

1.1 Validity

Read fully and understand this manual before commencing work

This manual is for electrically skilled persons. The tasks described in this manual may be performed by electrically skilled persons only. It describes the installation, commissioning, maintenance and warranty procedures for the following battery storage systems.

- Sundial M (SDM-1.5-500-10)
- Sundial MT (SDMT-1.5-500-10)
- Sundial S (SDS-1.5-500-10)

1.2 Visual Inspection

Following installation, visually check the device and cables for any signs of external damage. Contact your supplier if you find any damage. DO NOT perform any repair work yourself.

1.3 Glossary of terms

The following terms are used within this manual.

AC: Abbreviation for 'Alternating Current' a term used for grid supply electricity.

DC: Abbreviation for 'Direct Current' a term used for electricity stored within a battery.

Energy, or kWh: Energy is measured in Wh (watt hours), kWh (kilowatt hours) or MWh (megawatt hours). The energy is the power calculated over time. If, for example your Sundial system operates at a constant power of 500W for 2 hours then the system has delivered 1kWh of energy into the building.

Power: Power is measured in W (watts), kW (kilowatts) or MW (megawatts). Power is an instantaneous value. Sundial displays the power currently charging (input power) or discharging (output power) from the battery.

PV or Solar: Abbreviation of photovoltaic. This may also be called the solar PV system or generator.

National Grid or grid: A term to refer to the national electricity supply network

Import: A term used to reference energy imported or used from the national grid by the house

Export: A term used to reference solar energy being fed onto the national grid from the house

RCD: Abbreviation for 'Residual Current Device' a term used for an electrical safety disconnection device.

MCB: Abbreviation for 'Miniature Circuit Breaker' a term used for an electrical safety disconnection device.

1.4 Maintenance and Cleaning

If the Sundial enclosure is dirty and the visibility of the LCD display is limited, clean with a damp cloth. Sundial has an automotive finish, therefore for stubborn stains and light scratches, an automotive granular cleaner and automotive polish can be used for improved results.
Do not use corrosive substances or abrasive cloths for cleaning as they may damage the paint work.

1.5 Additional Information

You can find additional information on the design of the complete Sundial system by using Sundial Design. Sundial Design can be used to determine the number of Sundial units required for a given installation.
More information on Sundial Design can be found at www.powerflowenergy.com.
For electrical design information such as MCB, RCD and cable sizing, please reference BS7671.

1.6 Country Regulatory Network Parameters

Note: Under local grid disconnection parameters, Sundial M and Sundial S are NOT able to provide backup power during a power cut and have been designed solely for grid connection energy storage applications only.

Using Sundial in the UK

Sundial is pre set by default with the G83/2 regulatory standard to enable parallel connection with the UK public electricity network. These parameters ensure that during a power cut, electricity from the battery cannot be distributed onto the public grid. The pre installed country set can be seen on the boot screen

Using Sundial outside the UK

The default shipping parameters during manufacture are G83/2 for use within the UK electricity network. The country set cannot be changed after shipping by either the installer or the user.

The country set can be changed during manufacture for use in other counties. In addition to the appropriate country set being ordered, it is recommended that any local connection permission required is also sought prior to ordering. A list of available country sets is listed below. Please contact PowerFlow Energy if a particular country set is required prior to ordering.

Supported country sets:

G83/2: UK.
VDE4105 (VDE0126): Germany, Austria, Switzerland, Poland.
CEI-021: Italy.
EN-50438: Slovenia, Ireland, Estonia.

2.0 Safety Information

2.1 Appropriate Usage

PowerFlow Sundial is a grid connected battery storage system designed solely to be used together with any grid connected solar PV or wind generation system. It is not designed as a battery back up system or to be operated in off grid situations.

Do not use Sundial for any other purpose other than described in this manual. Alternative uses or modifications to Sundial are expressly NOT recommended. Any other use will void any warranty claims and operation permission.

2.2 Safety Instructions

The following terms will be used throughout this manual. Please observe the safety instructions.

DANGER: **Danger to life due to high voltages.**

- All work detailed by this instruction MUST be carried out by an electrical professional.
- Children may not play with or have access to Sundial.

WARNING: **Risk of injury or damage to property.**

- All work detailed by this instruction should be carefully considered.
- Children may not play with or have access to Sundial.

CAUTION: **Adhere to all recommendations during installation**.

2.3 Safety Notices

WARNING: Risk of injury due to heavy lifting

PowerFlow Sundial is designed to be as light weight as possible and is suitable for wall mounting. However, even lithium battery technology is inherently heavy in home storage applications due to the large capacity required.

CAUTION: Sundial weighs more than 25kg and should NOT be lifted by a single person. The carton has carry handles at either end and should be carried by two persons at all times.

During installation care should be taken when selecting a mounting location, fixing the wall bracket and lifting Sundial into place. Two persons should be present at all times during this operation. Please take note of all mounting instructions on pages 8 to 10 before commencing work.

DANGER: Risk of electric shock
DO NOT remove cover, exposed conductive parts inside

PowerFlow Sundial is designed to be full integrated and simple to install. It is recommended however, that all electrical work is carried out by a competent electrical professional and all local electrical standards, such as BS7671 and other local regulations are observed prior to installation.

DANGER: Sundial has an aluminium enclosure and is considered to be a conductive part. There must be an earth connection terminated to Sundial at all times. Please take note of all electrical connection instructions on pages 11 to 15 before commencing work.

3.0 Product Description

PowerFlow Sundial is a grid connected battery storage system which converts surplus AC electrical energy, or export, from any grid connected solar or wind generator into DC electrical energy for energy storage. When there is no longer surplus energy from the generator Sundial re-converts the stored DC energy back to AC energy to use distributed within the building.

By performing this function, surplus energy generation, which is unable to be used, can be stored and used at a later time when demand is greater than generation. This results in less energy consumption and in turn leads to cost savings.

Sundial is completely independent from the solar or wind generator other than it uses a current measurement device or CT to calculate in which direction energy is flowing and how much energy is available for storage.
Sundial performs energy capture and release purely based on this measurement.
This enables Sundial to work during any time of the day or night and, together with the solar or wind generator, to ensure that maximum energy capture is possible.

During times when export occurs, the amount of energy available continually changes due to changes in generation and changes in building demand. Sundial automatically adjusts it's charging input every 200 milliseconds to match export levels ensuring that only surplus energy is used to charge the battery.

During times when demand is greater than generation, i.e. at night or on cloudy days, the amount of imported power continually changes due to changes in electrical load and changes in network supply voltage. Sundial automatically adjusts it's power output every 200 milliseconds to match import levels ensuring that storage energy being released is only used within the building and does not get exported.

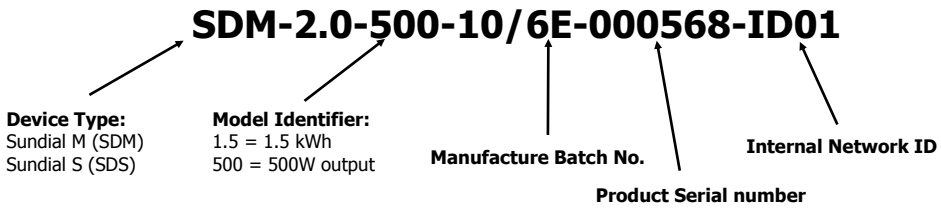
This method of fast accurate power measurement, combined with fast reacting automated self adjusting charge and discharge power, makes Sundial unique. By utilising these control techniques, the maximum possible self consumption can be achieved through the system.

3.1 Product Identification

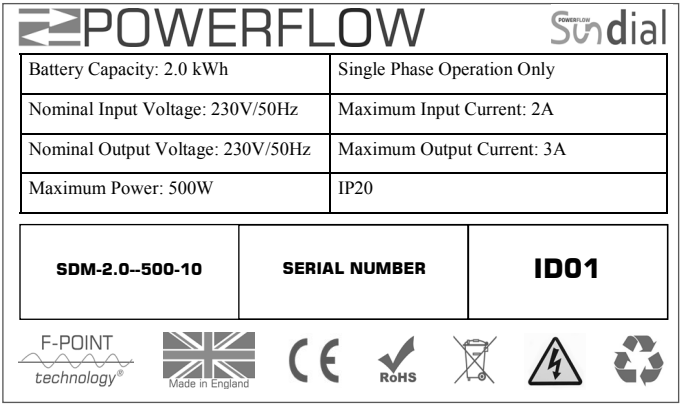
Sundial M and Sundial S communicate with each other via a CAT5e cable which transmits the RS485 communication protocol. Sundial M acts as the controller for the entire system, giving instructions to additional Sundial S units on when to charge and discharge power. In order for Sundial M to communicate, each Sundial device is factory set with an internal ID.
When multiple Sundial S devices are connected in the same system, each device ID MUST be different in order for Sundial M to communicate with all devices. If two of the same ID numbers are connected in the same network, Sundial M will not be able to identify two separate devices and the system will not function correctly.

IMPORTANT: Please ensure that different ID numbers for each sundial S device exist in the same network.

Each Sundial device is assigned a unique identifier, which incorporates a unique product reference, part code and network ID number. The network ID for Sundial M is always ID01. The Network ID's for Sundial S range from ID02—ID16. In three phase installations, each phase is treated separately meaning there is no connection between phases. Therefore the network ID numbers can be repeated in each phase separately. The following example describes how the serial number is derived:



The type verification label below is a copy of that on the product, note the ID number. Each serial number is also registered at the time of shipping against the supplier it was supplied through and is displayed on the back page of this manual.



Section B: Installation

4.0 Unpacking

4.1 Scope of Delivery

Please check the delivery for completeness and for any visible external damage. Contact your supplier if anything is damaged or missing.
Ensure that the Product Identification Documentation is retained.

The following components should be included:

A

B

C

D

E

F

G

H

Object	Quantity	Description
A	1	Sundial M or Sundial S
B	1	Wall mounting bracket
C	1	Main 5 pin power IN connector
D	1	Main 5 pin power OUT connector (Sundial S only)
E	1	Current clamp and current clamp connector (Sundial M only)
F	1	RJ45 CAT5e 3M RS485 communications cable (Sundial S only)
G	2	M4 x 10mm bolt and plain washer
H	1	Installation and User Manual

5.0 Mounting

WARNING: Risk of injury due to heavy lifting

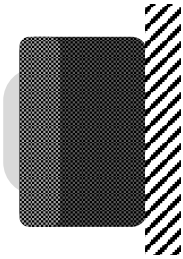
During installation care should be taken when selecting a mounting location, fixing the wall bracket and lifting Sundial into place. Two persons should be present at all times during this operation.

CAUTION: Sundial weighs more than 25kg and should NOT be lifted by a single person. The carton has carry handles at either end and should be carried by two persons at all times.

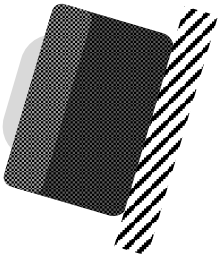
5.1 Selecting a Suitable Mounting Location

IMPORTANT: Sundial is rated to IP20. It is only suitable for indoor installations.
Also consider heat. Do not mount sundial in direct sunlight or in uninsulated loft spaces.
It is designed to be wall mounted and is supplied with a wall mounting bracket. Consider Sundial's weight of 35kg and adhere to the following requirements when selecting the mounting location.

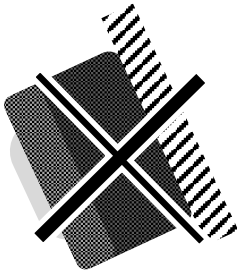
- The mounting method and location must be suitable for Sundial's weight and dimensions.
- Only mount on a solid surface. DO NOT mount onto a stud wall unless it can be reinforced with timber suitable for the weight. In this instance ensure that all bracket fixings have penetrated fully into timber work.
- The mounting location must at all times be clear and safely accessible without the use of additional equipment such as scaffolding or lifting platforms. Non-compliance with this recommendation may restrict servicing.



Vertical Mounting



Titled backwards no more than 15°



Never mount Sundial with a forward tilt

Never mount Sundial Horizontally

Extended Mounting Criteria

- The connection panel must always point downwards, DO NOT MOUNT UPSIDE DOWN!
- Never mount Sundial with a sideways tilt
- Install Sundial at eye level due to the accessibility of the consumer display.
  If future service is required, this will facilitate service work.

IMPORTANT
Temperature Considerations
Do not expose Sundial to direct sun light, as this can cause excessive internal heating

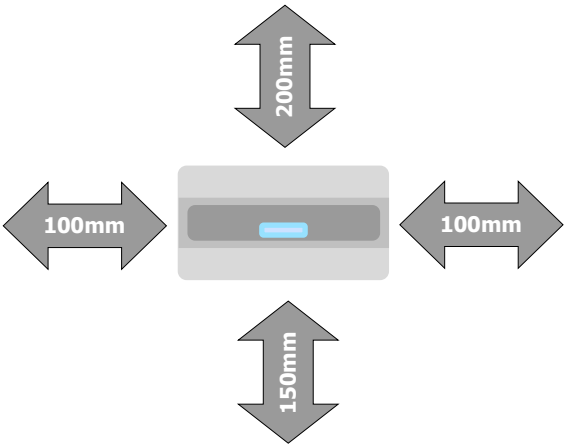
It is strongly recommended NOT to install Sundial into loft spaces due to increased heat during Summer months. Installations in locations which can exceed 40°C will reduce Sundial's ability to operate and could reduce the life span of the battery pack.

5.2 Mounting Clearances

CAUTION: Observe the minimum clearance to walls and other Sundial devices.

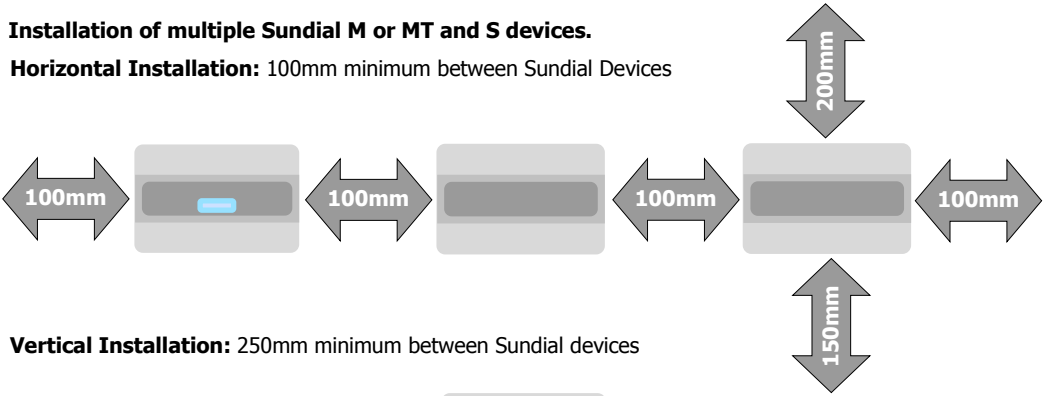
When installing multiple Sundial devices, the minimum distances must be observed.
This is to ensure that there is sufficient and suitable space for heat dissipation

Installation of a single Sundial M or MT device.

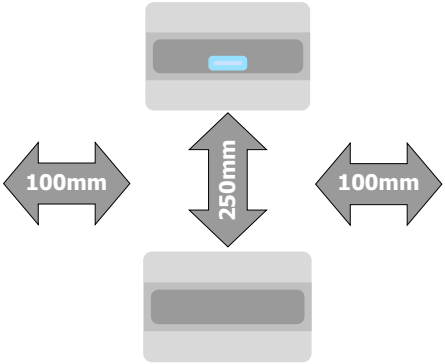


Installation of multiple Sundial M or MT and S devices.

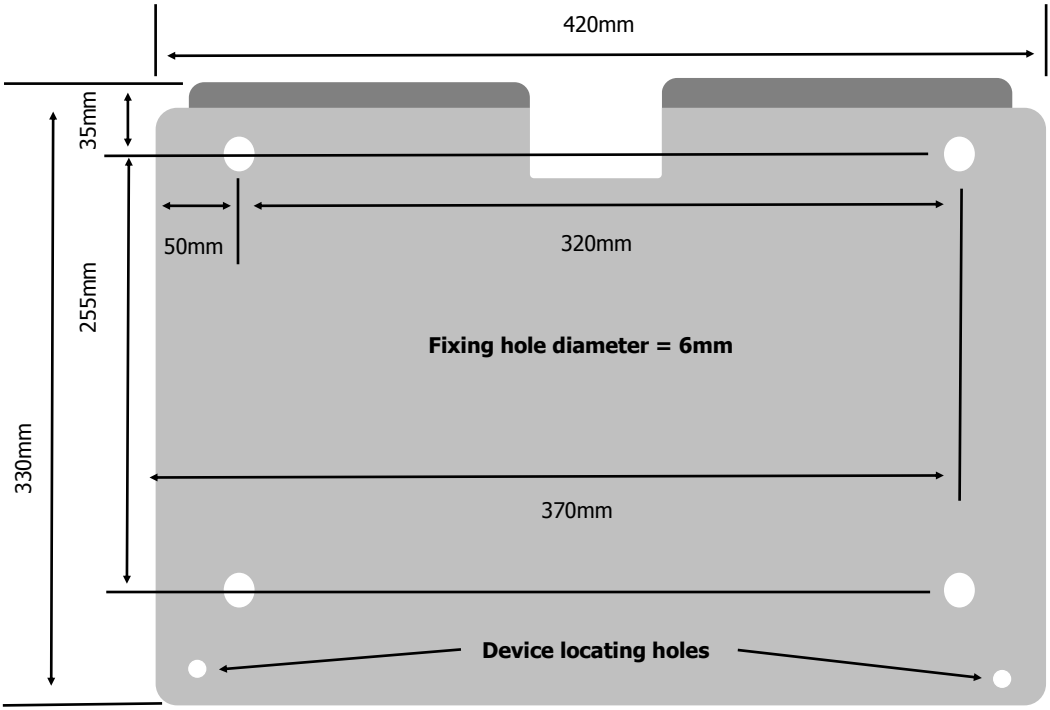
Horizontal Installation: 100mm minimum between Sundial Devices



Vertical Installation: 250mm minimum between Sundial devices



5.3 Mounting Bracket Dimensions



5.4 Fixing the Mounting Bracket

Use the mounting bracket as a drilling template by marking the positions of the holes on the wall.
It is recommended to mark and drill the upper centre fixing first. Drill the wall and mount the bracket with one fixing. As this fixing is centred in the bracket, you can adjust the bracket to ensure it is level. Then mark the position of the four corner holes, remove the bracket and drill. Re fixing the bracket to the wall using suitable fixings for the substrate.

CAUTION: Please Note: Wall fixings and wall plugs are not included in shipping. This is because PowerFlow cannot determine which type of substrate Sundial will be secured to. It is the responsibility of the installer to select suitable fixings for a given installation and to ensure that Sundial is securely fixed to the wall. The warranty conditions do not cover unsuitable wall fixing.

5.5 Attaching Sundial to the Mounting Bracket

Once the wall bracket has been securely fitted, two persons should lift Sundial into place. There is a recess on the back of Sundial which will fit over the top edge of the wall bracket. Lift Sundial and tilt the top edge towards the wall. Lower the device onto the top edge of the bracket, once the top edge is located, rotate the lower edge down towards the wall to allow Sundial to hang vertically.

There are two locating holes below the connection panel, these will line up with the locating holes on the bracket. Use the two M4x10mm screws and washers to secure the lower edge of Sundial in place.
This will ensure that Sundial cannot be pushed upwards and fall off the bracket.

6.0 Electrical Connection

It is important to take note of the following notices. Failure to do so may result in danger to persons, damage to property, or invalidation of the device warranty. All electrical work referenced in this section should be carried out by an electrical professional.

Take note of the following warnings:

DANGER: Risk of electric shock

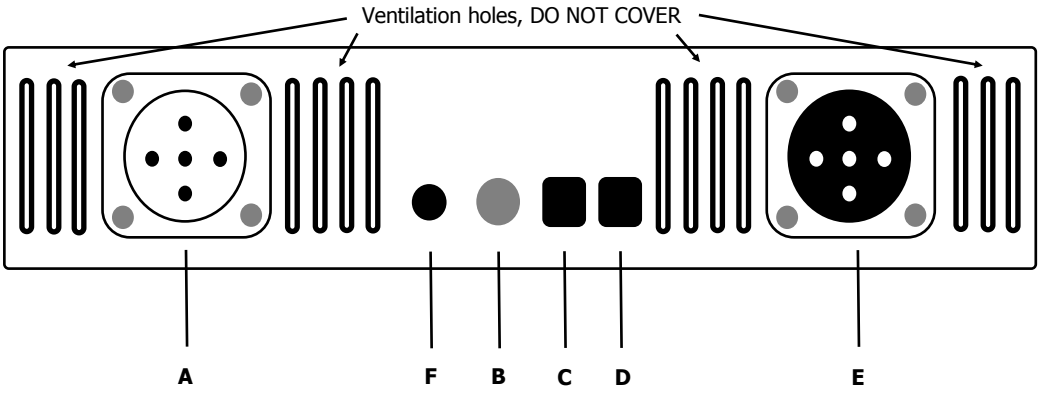
PowerFlow Sundial is designed to be fully integrated and simple to install. It is recommended however, that all electrical work is carried out by a competent electrical professional and all local electrical standards are observed prior to installation.

DANGER: Sundial has an aluminium enclosure and is considered to be an exposed conductive part. There MUST be an earth connection terminated to Sundial at all times.
Ensure an earth continuity check between the PE supply and the case has been carried out.

WARNING: Risk of damage to the Sundial Device

Sundial **MUST NOT** be installed in conjunction with Voltage Optimization or power factor correction equipment. Doing so may damage the Sundial device. Failure to ensure that no voltage or power factor correction devices of any type are installed on the premises prior to installation will result in the warranty being void. For further information, please refer to the warranty section in the user manual.

6.1 Overview of Connection Panel



Object	Description
A	230V 50Hz AC Power IN Connection
B	Current Clamp Connection (only on Sundial M)
C	RS485 Communication Port INPUT (only on Sundial S)
D	RS485 Communication Port OUTPUT
E	230V 50Hz AC Power OUT (To Sundial S Power IN Connection ONLY)
F	Night Rate timer, ON/OFF switch (only on Sundial MT)

6.2 AC Design

Sundial M, Sundial MT and Sundial S are all grid connected storage devices only and cannot be used in a off grid application. All Sundial devices MUST be connected to a 230V 50Hz AC supply only. Electricity networks outside this criteria are not supported.
Sundial uses the same AC IN (A) supply cable to charge and discharge the internal battery pack. Depending on the number of Sundial devices in the system, differing installation methods may be required.

DANGER: Risk of Electric Shock

In all circumstances, adhere to the following installation guidance.
Failure to follow the installation guidance will void the warranty and may result in danger to persons or property.

- No More than 4 Sundial devices may be connected together in one series connected string. When connecting more devices, see section 6.3 on configuration of multiple strings.

- For systems which incorporate a single Sundial M device, a 13A double pole fused connection outlet plate with neon may be used provided it is located within 1 meter of the device for local isolation. It is also necessary for the supply circuit to be protected by a 30mA RCD. Care should be taken to ensure the addition of any Sundial device on to an existing RCD protected circuit does not cause nuisance tripping of the RCD device.

- For systems which incorporate 2 or more Sundial devices, the addition of a final circuit will be necessary with a local double pole AC isolator located within 1 meter of the device.
  The size of the over current protective device (MCB) must be calculated using the example below, but **MUST NOT** exceed 16A with a maximum string of 4 devices maximum. The circuit must also include independent 30mA RCD Protection to reduce the risk of nuisance tripping. A suitably rated RCBO device is permitted.

AC Design Criteria

Each Sundial device is capable of outputting a maximum power of 500W. The maximum number of sundial devices allowed on one string is 4. A maximum value of a 16A type B MCB should be observed for overcurrent or short circuit protection.

The total system output current can be calculated by multiplying the number of Sundial units by 500 to give a maximum system output power.

Example: System Size: 1 x Sundial M + 3 x Sundial S (total of 4 Sundial devices)

- 4 x 500W = 2000W
- 2000W / 230V = 8.7 amps.

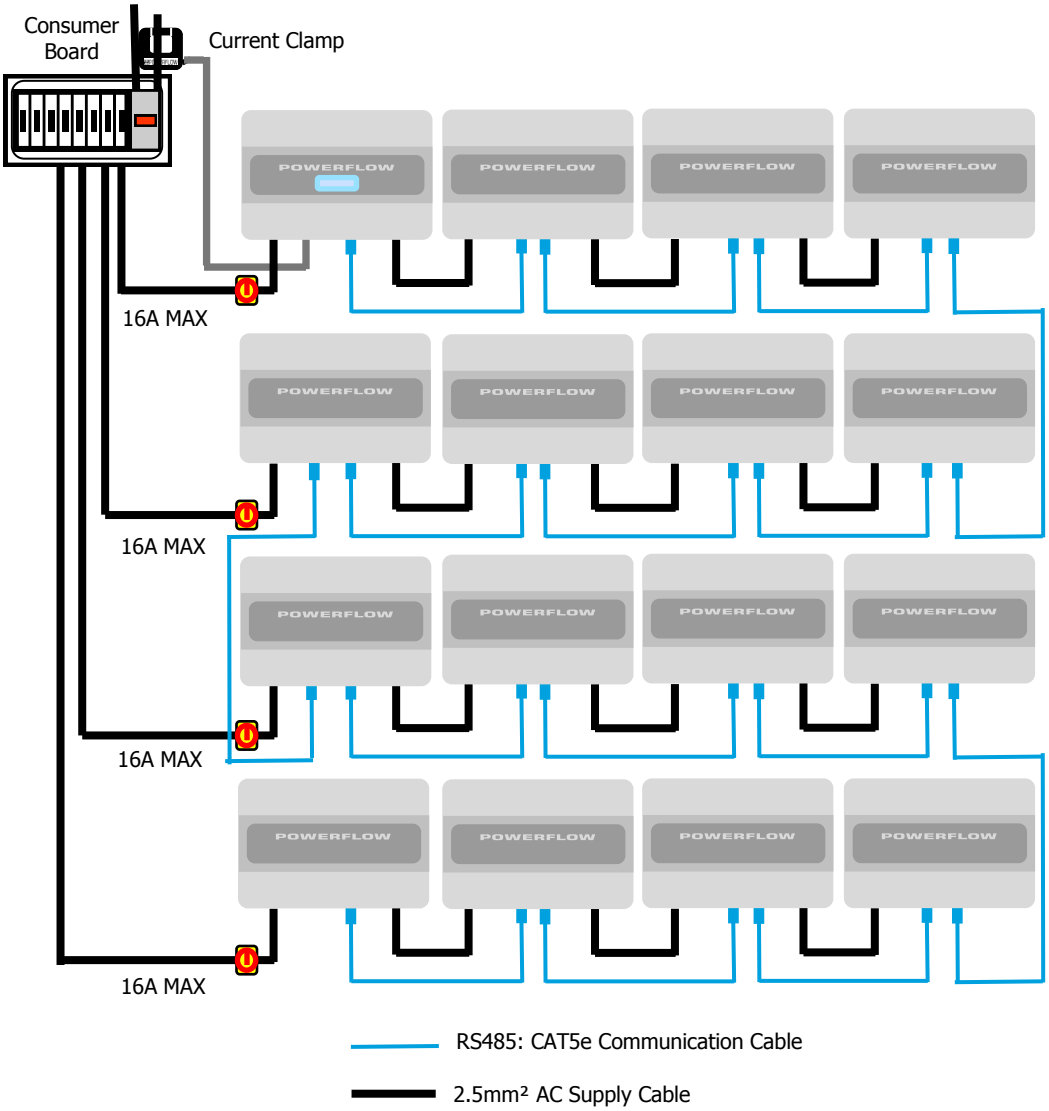
Conclusions from this example:

Connection method: A New Final Circuit with DP AC isolator
Cable Size: 2.5mm²
Protection and isolation method: 30mA RCD protection with 10A type B MCB.

6.3 Connecting Multiple Sundial Devices

When connecting multiple Sundial S devices, no more than 4 devices may be connected together in 1 AC string on a single AC circuit. This is due to the maximum current carrying capacity of the AC IN and AC OUT connectors. Each circuit should be protected by an MCB of no greater than 16A. For the connection of more than 4 devices, a separate AC circuit must be installed for each additional 4 Sundial S devices as per the example below. The RS485 communication cable can then simply be connected in series to each device, highlighted as the grey cable in the example below. See section 6.4 for more information on RS485 communication.

Connection Example: 16 x Sundial Devices



6.4 RS485 Communications Connection

When installing multiple Sundial units, Sundial M has to communicate with additional Sundial S devices. To do this, Sundial uses an RS485 communication bus which uses standard CAT5e twisted pair networking cable. A 3M RJ45 CAT5e cable is included at the time of shipping. Should you require a longer connection, a standard CAT5e cable with RJ45 connector can be used up to a maximum of 100 meters.

Connect to OUTPUT D on the Sundial M device and run the communication cable to the Sundial S device. Connect the communication cable in INPUT C. If further Sundial S devices have been installed, repeat the connection process using OUTPUT D to INPUT C for as many devices as there are in the system.

Currently there is a maximum of 1 x Sundial M Plus 15 x Sundial S devices allowed on a single phase network. This can be repeated on each phase in a 3 phase system.

6.5 Connector Assemblies: Assemble each connector following the guide below:

5 PIN Power Connector Assembly: PF-PC-07-FM

Pin connections for main power connector (Recommended cable: 2.5mm² 3 core flex)

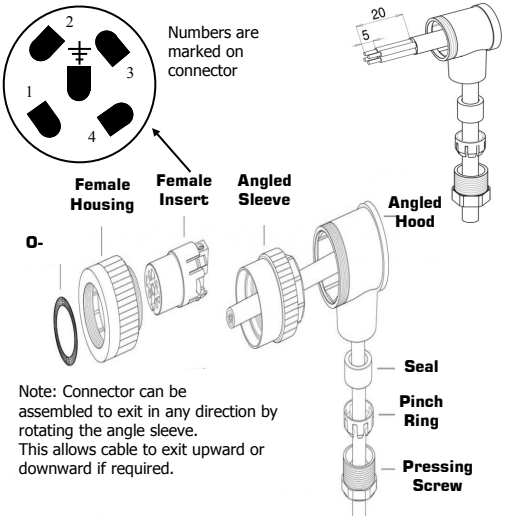
PIN 1: Live In (from supply) (**Brown**)

PIN 2: Neutral (From Supply) (**Blue)**

PIN 3: Spare

PIN 4: Spare

CENTRE PIN: Protective Earth (**Green/ Yellow)**



5 PIN Current Clamp Connector: PF-CC-05-ML

Pin connections for current clamp connector

PIN 1: Spare

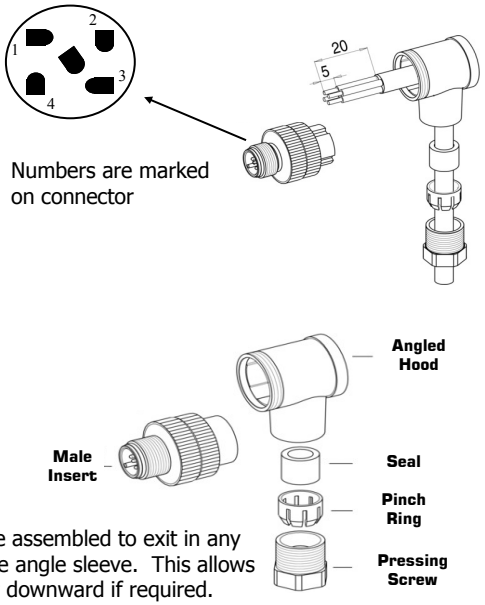
PIN 2: Spare

PIN 3: Live (Black)

PIN 4: Ground (White)

CENTRE PIN: Spare

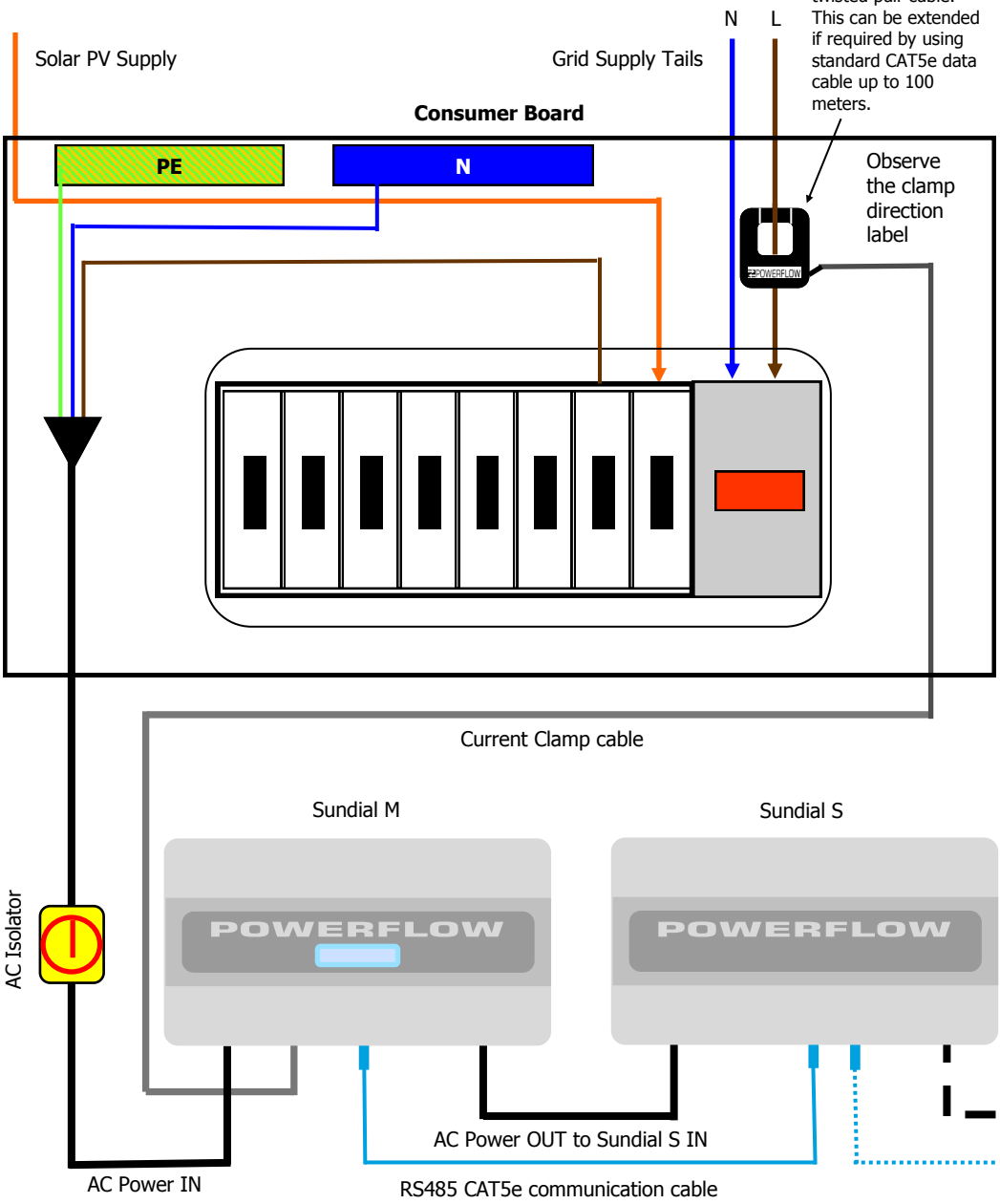
The current clamp cable may be extended by up to 100 meters by using CAT5e cabling. Only a single twisted pair is required for this application.



6.6 AC Connection Diagram (Additional Circuit Connection)

Observe the following diagram for the AC connection of Sundial using an additional circuit. Ensure RCD protection is present on all final circuits supplying Sundial Devices and that MCB protection of no greater than 16A is used.

Current Clamp PF-0750-005.
Note: the current clamp is pre wired with 3 meters of twisted pair cable. This can be extended if required by using standard CAT5e data cable up to 100 meters.



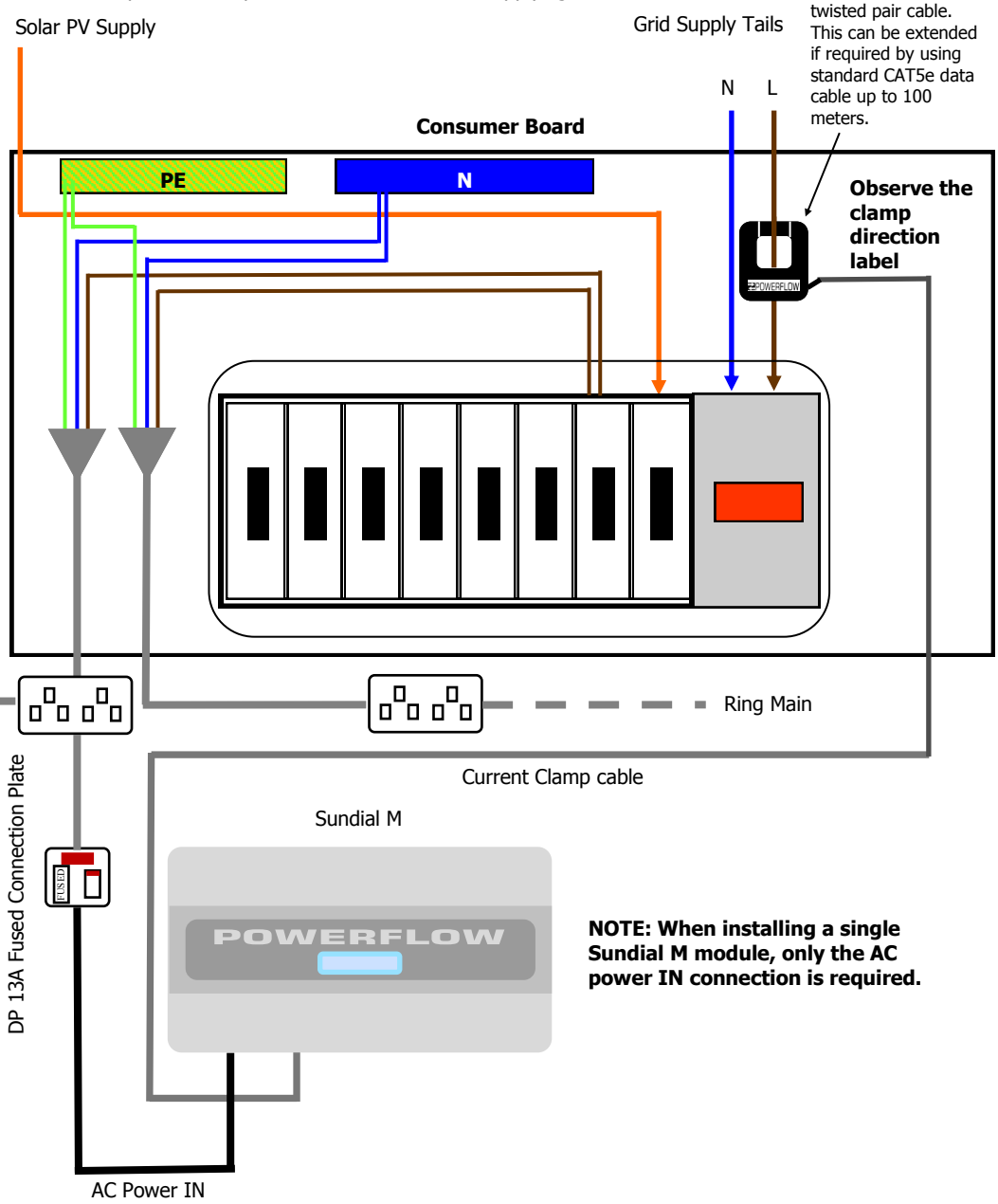
NOTE: When installing a single Sundial M module, only the AC power IN is required.

Electrical Connection : WARNING: ENSURE RCD PROTECTION IS PROVIDED

6.7 AC Connection Diagram (Fused Spur Connection)

Observe the following diagram for the AC connection of Sundial using a fused spur connection from an existing circuit. **(Max. 1 Sundial M device only)**
Ensure RCD protection is present on all final circuits supplying Sundial devices.

Current Clamp PF-0750-005.
Note: the current clamp is pre wired with 3 meters of twisted pair cable. This can be extended if required by using standard CAT5e data cable up to 100 meters.



NOTE: When installing a single Sundial M module, only the AC power IN connection is required.

7. Commissioning

7.1 Commissioning Sundial

Before switching on for the first time, check that the following has been completed.

1. Sundial has been mounted vertically to a secure surface, the correct way up and with adequate Ventilation.
2. All cable runs are correctly fixed and supported.
3. The main power cable has been terminated observing the correct pin numbers.
4. Ensure all the terminations inside the consumer unit are correct and the terminals have been tightened.
5. Ensure earth continuity between the earthing bar inside the consumer unit and one of the cover fixing screws on the underside of the device.
6. Carry out all circuit tests in accordance with BS7671.
7. Ensure the current clamp connector has been terminated observing the correct pin numbers and is securely clamped around the incoming live supply conductor in the correct location.
8. Check the orientation of the current clamp to ensure the label faces the incoming supply and that it is installed between the main meter position and the main consumer board.
9. Ensure all safety labelling for battery storage systems have been securely fitted in the correct locations. (see section 7.3 for further information)
10. Ensure the customer has been issued the USER MANUAL from the sundial packaging.

Once all of the above are completed, switch on at the installed isolation point.

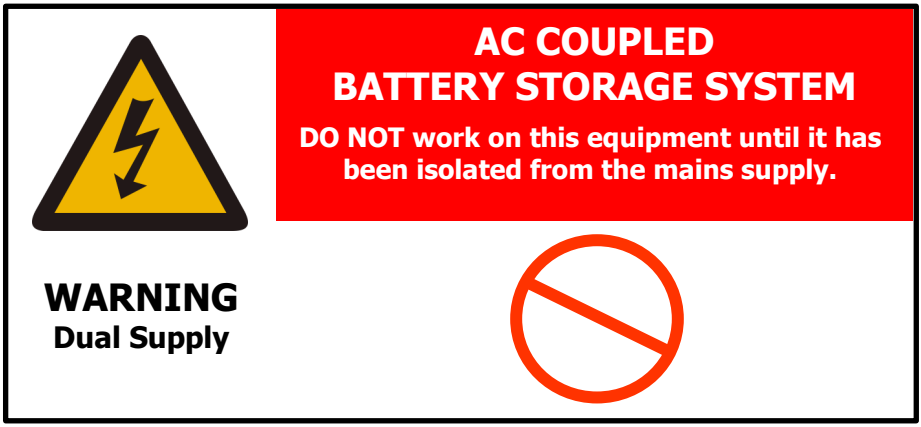
7.2 Sundial Automated Setup

Sundial is an intelligent device with no initial setup required. It automatically detects and self calibrates its own internal communications network, the import/export reading and the voltage and frequency of the electricity network.

The green power LED will be ON and the boot screen on Sundial M will be observed. During this time

7.3 System Labelling

When installing battery storage systems in domestic or commercial environments, an appropriate warning label should be fixed at the meter position and to each distribution board warning of the presence of an AC coupled battery storage generator on site. The following example may be used.



Section C: Operation

8.0 Display and Control Elements

8.1 External Control Overview

Sundial contains the following control and display elements.

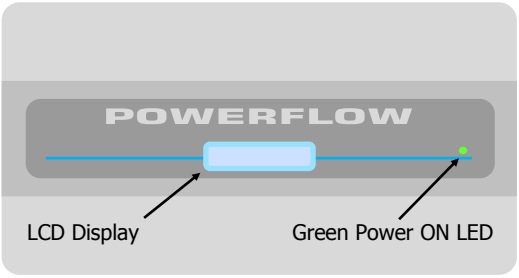
- **Green power LED indicator on the front right hand side of the device**

  The green power LED indicator on the front left hand side of both Sundial M and Sundial S indicates there is a mains power supply to the device. If there is no LED, check the AC supply is correctly connected and switched ON. Check any fuses that may be in the system between the main distribution board and Sundial.

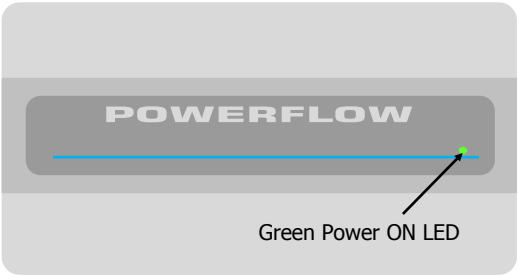
- **LCD display for the communication of basic information (Sundial M, MT only)**

  Sundial M and MT houses an LCD display with backlight. The backlight automatically dims when Sundial is in standby mode. This occurs when neither charging or discharging is possible, i.e when the battery is empty, or the battery is full, or the building is in a state of energy balance.
  When operation continues the backlight becomes brighter to indicate operation.

Sundial M



Sundial S



8.2 LCD Display Overview

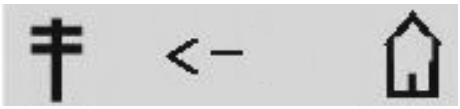
Sundial M and Sundial MT house an LCD display designed to give live operational information to the user. The LCD display contains two lines which are both used on the home screen.

- The top line is dedicated to displaying the live power measurement of the building.
- The bottom line is dedicated to displaying operational and status information of the battery.

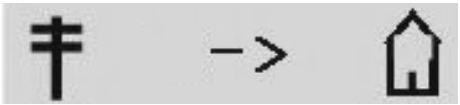
8.3 LCD Display Icons The following icons are used on the home screen.

Grid Icon
Represents the electricity grid.

House Icon
Represents the house or building.



Energy Flow Arrow
If the arrow points from the house icon to the grid icon, this indicates power is being exported to the grid.



Energy Flow Arrow
If the arrow points from the grid icon to the house icon, this indicates power is being imported from the grid.

Battery Icon 1
Indicates the battery is empty.

Battery Icon 2
Indicates the battery is part charged.

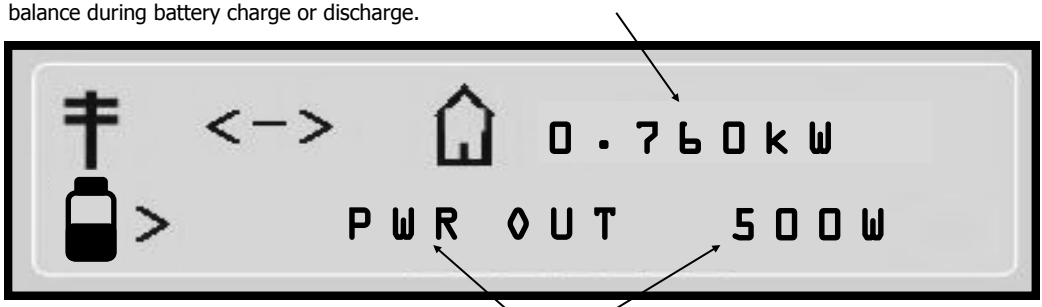
Battery Icon 3
Indicates the battery is fully charged.

Battery Charge Icon
Indicates the battery is being discharged.

Battery Charge Icon
Indicates the battery is being charged.

8.4 Home Screen The home screen displays system data and is updated every 2 seconds.

AC Power Value
Displays the amount of power being measured by the current clamp. This value is either import power or export power depending on the direction of the Energy Flow Arrow.
The DC power value is subtracted from the AC power value to give a true reading of the building energy balance during battery charge or discharge.



DC Power Value
Displays the amount of power being charged or discharged from the battery. PWR OUT indicates the battery is being discharged, PWR IN indicates the battery is being charged.

8.5 LCD Display Messages

In addition to the display icons, the following messages can be seen during operation.

Messages seen on Sundial M and MT:

Display Message	Description
PWR IN	The battery is charging from export solar power
PWR OUT	The battery is discharging stored power into the house or building
BATTERY EMPTY WAITING EXPORT	The battery has been fully discharged and the house continues to import power. With no solar export available to charge the battery, Sundial will remain in standby mode (display dimmed) until PWR IN is possible.
BATTERY FULL WAITING IMPORT	The battery has been fully charged and the house continues to export solar power. Sundial will remain in standby mode (display dimmed) until PWR OUT is possible.
BALANCED	The house is in a state where solar generation is equal to the house consumption or below the activation threshold for Sundial. In this situation, Sundial can neither charge or discharge the battery and will wait in standby until the energy balance changes.
COOLING	The battery has been charging or discharging at a high rate for a sustained period of time in a warm environment. The charging or discharging circuits have been disconnected to protect the battery and Sundial enters standby mode. Once the temperature has reduced sufficiently, PWR IN or PWR OUT will continue automatically.
NIGHT RATE TIMER ACTIVATED	The night rate timer has been switched ON using switch F on the connection panel (Sundial MT only)
NIGHT RATE TIMER DEACTIVATED	The night rate timer has been switched OFF using switch F on the connection panel (Sundial MT only)
TIMER ON	The night rate timer has been activated and has turned Sundial to charge mode during the timed period.

Section D: Support

9.0 Warranty Information

9.1 PowerFlow Factory Warranty

Applies solely to the following products: **Sundial M, Sundial MT, Sundial S**
The statutory warranty obligation of the seller of your device is not affected by this warranty and remains fully valid for 24 months from the date of purchase from PowerFlow. For the above mentioned products, you receive a POWERFLOW extended factory warranty above the statutory 24 months period valid only if the warranty conditions are met:

If the device is registered on the POWERFLOW website at: www.powerflowenergy.com/warrantyregistration it will benefit from a five year warranty period from the date of manufacture. This is inclusive of, but does not affect, the statutory warranty obligation of 24 months.

The POWERFLOW factory warranty covers any costs for repair or spare parts during the agreed period beginning on the date of manufacture of the device, subject to the following warranty conditions. This is not associated with a durability warranty.

9.2 Warranty Conditions

Sundial is a non serviceable device. All internal workings are maintenance free. The removal of the cover is prohibited unless during service under express permission from PowerFlow. Any unauthorised removal of the cover will void any warranty.

Due to the nature of the battery technology used in the Sundial device, each battery pack holds a shelf life of 12 months. If the device remains in storage for longer than this period without use, this may reduce the expected life of the battery. In such circumstances, PowerFlow Energy Ltd cannot warranty the battery performance specified in the technical specification and as a result cannot honour any extended warranty period detailed above.

If a device becomes defective during the first six months of operation from date of purchase, the device will be replaced with a new equivalent product. Defects arising after the first six months will be covered under the POWERFLOW manufacturer warranty period and, unless this should be impossible or disproportionate, one of the following options will be selected at the discretion of POWERFLOW:

- Device repair at POWERFLOW, or
- Device repair on-site, or
- Exchange for a replacement device of equivalent value with regard to model and age.

In the latter case, the remainder of the warranty entitlement will be transferred to the replacement device and your entitlement will be documented at POWERFLOW. The term "disproportionate" as referred to above applies in particular if, as a result of the envisaged measures, POWERFLOW were to incur costs deemed unreasonable according to the following criteria:

- In view of the value that the device would have without the defect,
- Taking into account the significance of the defect, and
- After consideration of alternative workaround possibilities that POWERFLOW customers could revert to without significant inconvenience.

The factory warranty includes the costs of POWERFLOW for work and material for the restoration of faultless functioning in POWERFLOW's factory or for on-site repair work by POWERFLOW service personnel. All other costs, particularly shipping costs, travel and accommodation costs of POWERFLOW's personnel for on-site repairs as well as costs of the customer's own employees are NOT included in the factory warranty.

To determine the warranty entitlement, it will be necessary to either complete and submit the device replacement form at www.powerflowenergy.com/devicereplacement or email POWERFLOW at info@powerflowenergy.co.uk.
If the defective device was installed by a PowerFlow accredited installer, it will be necessary to contact them in the first instance. The type label on the device must be completely legible. Otherwise, POWERFLOW is entitled to refuse warranty services.

Defective devices, with a detailed error description and proof of purchase, will need to be sent to the POWERFLOW factory for fault diagnosis. If no error is found with the device, you will NOT be charged and the device will be returned to the sender. Shipping costs may be charged at the discretion of POWERFLOW.
If we agree to a replacement, we generally send an equivalent replacement device, packaged appropriately for transport, within ten working days. this time frame is not guaranteed.

9.3 Scope of Factory Warranty

The factory warranty does not cover damage that has occurred due to any of the following reasons:

- Transport damage
- Incorrect installation or commissioning.
- Failure to observe the user manual and/or the installation and technical manuals
- Removal of cover without prior service permission from PowerFlow
- Modifications, changes or attempted repairs
- Incorrect use or inappropriate operation
- Insufficient ventilation of the device
- Failure to observe the applicable safety regulations and appropriate standards. (e.g: BS7671, etc.)
- Public or private network supply problems outside of tolerance limits of the statutory guidelines
- Force Majeure (e.g: lightning strikes, storms, fire, flooding or water damage, etc.)

Neither does it cover cosmetic defects which do not influence the energy recovery.

Claims that go beyond the rights cited in the warranty conditions, in particular claims for compensation for direct or indirect damages arising from the defective device, for compensation for costs arising from disassembly and installation, or loss of profits are not covered by the manufacturer warranty, insofar PowerFlow Energy Ltd is not subject to statutory liability. In such cases, please contact the company that sold you the device. Possible claims in accordance with the law on product liability remain unaffected. POWERFLOW reserve the right to change the warranty conditions without notice. All claims arising from or in connection with this warranty are subject to UK law.

For further information, visit **www.powerflowenergy.com** under the section "Service".

9.4 EN Declaration of Conformity

POWERFLOW

EN Declaration of Conformity

The devices listed below have been developed, manufactured and/or tested according to the below mentioned EN directives.

- Electromagnetic Compatibility
- Generation Connection Requirements
- Low Voltage Directive and General Electrical Safety Requirements

PRODUCT(s)	**Sundial M,MT**	**Sundial S**
Electromagnetic Compatibility –3 (EMC) *	SDM-1.5/500-10	SDMS1.5/500-10
BS EN 61000-2-3-6: 2006: Limitation for harmonic current emissions in public low-voltage supply systems. Limitation of voltage fluctuations and flicker in public low-voltage supply	X	X
BS EN 61000-6-1: 2007: Generic standards. Immunity for residential commercial and light-industrial environments.	X	X
Electromagnetic Compatibility –4 (EMC)		
BS EN 61000-4-5:2011: Surge immunity tests.	X	X
BS EN 61000-4-11: 2004: Voltage dips, short interruptions and voltage variations immunity tests.	X	X
Generation Connection Requirements		
BS EN 50438: Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks	X	X
VDE 4105: Technical requirements for the connection to and parallel operation with low-voltage distribution networks	X	X
G83/2: Connection of small scale embedded generators up to 16A per phase	X	X
Low Voltage Directive and General Electrical Safety Requirements		
BS EN 60335-1:2012+A11:2014: Household similar electrical appliances. Safety, General Requirements.	X	X
BS EN 62109-1-2: 2010: Safety of power converters for use in photovoltaic power systems. General requirements.	X	X
BS EN 50438: Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks	X	X
EU Directives: 2006/95/EC, 2004/108/EC, CE, RoHs compliant	X	X
Device Operation		
F-POINT *technology ®:* Measurement and reaction time of control system	400ms	400ms

Information
Without written confirmation by Power Flow Energy, this declaration of conformity is no longer valid if:

- The product is modified, supplemented or changed in any other way.
- Components, which are not part of the Power Flow accessories list are integrated into the product.
- The product has not been used for its intended use laid out by the product specifications.

Signature:

Ian Murray .BSc Managing Director
PowerFlow Energy Ltd

PowerFlow Energy Ltd, Barrs Court, Netherwood Road, Rotherwas, Hereford, HR2 6JU
Tel: 01452 857701, email: info@powerflowenergy.co.uk, www.powerflowenergy.com

Document Ref: PF-ECCONFDOC/SDM/SDS-V1.1

10.0 Trouble shooting

Why does Sundial not switch ON?

Check all AC connections are terminated correctly.
Check that all MCB's, fuses are in place
Check all isolators are in the ON position.
Check the AC power connection plug has been terminated correctly and is seated correctly into the connector on Sundial's power connection plate.

If all of the above have been verified, please contact your supplier for further support in the first instance.

I don't understand the display?

Refer to section 8 of this manual for further details on the display.

How do I connect an additional Sundial device to my system?

If you already own a Sundial M battery storage module and would like to expand the system to a greater capacity, Sundial S can be integrated at a later date. A Sundial S module can easily be integrated into a new or existing system by connecting the main power cable and communications cable from Sundial M to Sundial S. See the electrical connections section of this guide for further information or contact your local supplier.

Please refer to page 5 of this guide for more information on product identification. The serial numbers and product codes identify internal network ID's. If you are adding a Sundial S device, the internal network ID must be different from one you already have. More information can also be found on the Product Identification Document supplied with your Sundial device.

What do the WI-FI network ID numbers mean?

Sundial is already embedded with WI-FI communication. PowerFlow are currently working on an internet gateway product that will allow information from the Sundial system to be viewed on your own portal via your PC or tablet. The ID numbers will be required for the connection of the gateway to your Sundial device. Please keep this information in a safe place for future reference. The gateway device will be available Summer 2016. For further information please visit www.powerflowenergy.com

I can't find what I'm looking for here?

If you can't find the answers to your questions in this manual, then for further information please visit **www.powerflowenergy.com**

You can also send us an email via our website at **www.powerflowenergy.com/contact-us**

11.0 Technical Data

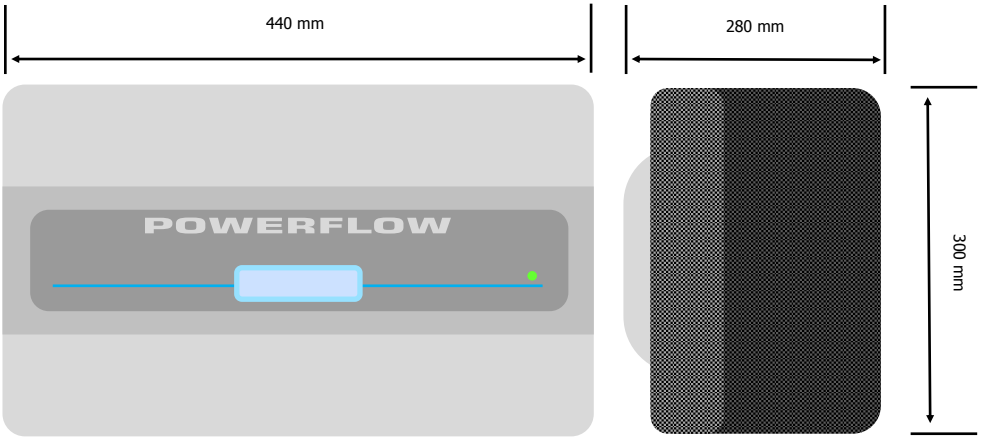
TECHNICAL DATA Product Code	**Sundial M** (PF-SDM-2.0-500-10)	**Sundial S** (PF-SDS-2.0-500-10)
Battery	Lithium Iron Phosphate (LiFePO4)	Lithium Iron Phosphate (LiFePO4)
Battery Capcity	2.0kWh	2.0kWh
Nominal Usable Storage Capacity (80% DoD)	1.6 kWh	1.6 kWh
Number of Cycles (80% DOD)	> 6000	> 6000
Life Expectancy	15 Years	15 Years
Under/Over Voltage Protection	Yes	Yes
Under/Over Charge Current Protection	Yes	Yes
Under/Over Discharge Current Protection	Yes	Yes
Cell Balancing / Anti-Aging Protection	Yes / Yes	Yes / Yes
AC Input / Output		
Input / Output Voltage: Nominal / Range	230V / 180-270V	230V / 180-270V
Input / Output Voltage: Nominal / Range	50Hz / 47.5-55Hz	50Hz / 47.5-55Hz
Nominal Input Power	300W (6 x 50W adaptive steps)	300W (6 x 50W adaptive steps)
Nominal Real Output Power	500W (4 x 125W adaptive steps)	500W (4 x 125W adaptive steps)
Max Apparent Output Power	580VA	580VA
Dynamic Reactive Power Control on output	YES / 1 (Unity) 0.8cap, 0.8ind	YES / 1 (Unity) 0.8cap, 0.8ind
Power Factor Correction control on input	YES	YES
Inverter Topology	Galvanically isolated	Galvanically isolated
Start up power: Export / Import	120w / 200w	120w / 200w
Total Harmonic Distortion (odd)	<3%	<3%
Operational Data		
Max Number of Devices (per phase)	1	15
Max Number of Devices (per string)	1	7
Max Storage Capacity (per phase)	2.0 kWh	30.0 kWh
Max Nominal Output Power (per phase)	500W	7500W
Input / Output Power Connection	Plug and Play (PowerFlow Speed-Fit)	Plug and Play (PowerFlow Speed-Fit)
Measurement and Power Control Method	F-POINT *technology* ®	F-POINT *technology* ®
Communication Bus / Connection	RS485-PFLIN / RJ45	RS485-PFLIN / RJ45
WiFi, Ethernet Access with web server	(available 2016)	(available 2016)
Ambient Temperature Range	-20ºC to +60ºC	-20ºC to +60ºC
Optimum Battery Temperature Range	+5ºC to +40ºC	+5ºC to +40ºC
Battery Charge Temperature Range	0ºC to +45ºC	0ºC to +45ºC
Full Battery Discharge Temperature Range	-20ºC to +60ºC	-20ºC to +60ºC
Cooling Concept	Convective (fan less)	Convective (fan less)

11.0 Technical Data

TECHNICAL DATA	Sundial M,MT (PF-SDM-1.5-500-10)	Sundial S (PF-SDS-1.5-500-10)
General Data		
Dimensions (L /H /D)	440 / 300 / 280 mm	440 / 300 / 280 mm
Enclosure Weight (Kg)	35	32
Mounting Type	Wall Hung	Wall Hung
Compatible with PowerFlow ERS immersion heating	Yes	Yes
Battery Enclosure Ingress Protection	IP56	IP56
Cooling Architecture Ingress Protection	IP20	IP20
Crystal Clear LCD Display / LED status indicators	Yes / Yes	No / Yes
Compliant Certification Standards	EN 50438, VDE 4105, CEI 0-21, G83/2, EN 62109-1, EN 62109-2, EN 61000-2-3-6, EN 61000-6-1, RoHS, CE	EN 50438, VDE 4105, CEI 0-21, G83/2, EN 62109-1, EN 62109-2, EN 61000-2-3-6, EN 61000-6-1, RoHS, CE
Anti-Islanding Protection	Yes	Yes
Backup Power Availability	N/A	(available 2016)
Export Limitation Control (compliance with DNO)	(available 2016)	(available 2016)
Night Rate (economy 7) charge timer	Sundial MT only	N/A
Country of Manufacture	England	England
Enclosure	Custom Aluminium Designed (sealed)	Custom Aluminium Designed (sealed)
Colour	Metallic Silver / Carbon Fibre	Metallic Silver / Carbon Fibre
External Touch Screen Display	(available 2016)	(available 2016)
Warranty*	5 Years / 6000 cycles	5 Years / 6000 cycles

*See the warranty document for further details on Sundial extended limited warranty conditions. (65% battery retention after 6000 cycles).
Product specification is subject to change without notice.

11.1 Product Dimensions



POWERFLOW

Made in England

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12.0 Product Identification and Serial No.