



## **SIRIUS CAPACITOR MODULE**

### User Manual

Model number: 3550-48-A-1.7C-M-SD-G  
Version 2.1; Release Date: October, 2018

## **Introduction**

The Sirius Capacitor Module (“Sirius”) is supercapacitor-based storage that uses supercapacitors as storage cells instead of chemical cells. Kilowatt Labs’ proprietary balancing, control and charge retention algorithms control the operation of the supercapacitor-based modules, making Sirius a safe, efficient and effective alternative to chemical batteries wherever chemical batteries are deployed.

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## **Safety**

This Manual contains instructions for unpacking, mounting, installation and operation of a Sirius module. Please read this manual carefully before operating the system and follow all warnings and safety instructions. Please follow the instructions in this Manual carefully to prevent accidents. The Sirius module must be installed by trained personnel.

## **Warning**

Selling and installation of this product is only through the Company’s Resellers who are trained on installation, operation and maintenance of the Sirius modules.

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## Unpacking and Handling

### Unpacking

Inspect the shipping carton for damage prior to unpacking the module. Document (photograph) any damage and report this to the Company or the Company's authorized representative and to the shipping agent immediately. Remove the module from the shipping carton and retain the shipping materials until the unit has been inspected and is determined to be operational.



**The module must be removed from the carton by lifting the module body.  
Do not remove the module by the terminal posts.**

The following items are included in the package:

- Sirius Capacitor Module: 3.55kWh48VDC
- Compact Disc with the monitoring software manual and application software.

**NOTE:** The original shipping materials are approved for both air and ground shipment.

### Handling

The Sirius Capacitor modules are designed to provide years of trouble-free operation. Proper handling is required to avoid damage to the module. In particular, the following handling precautions should be observed:

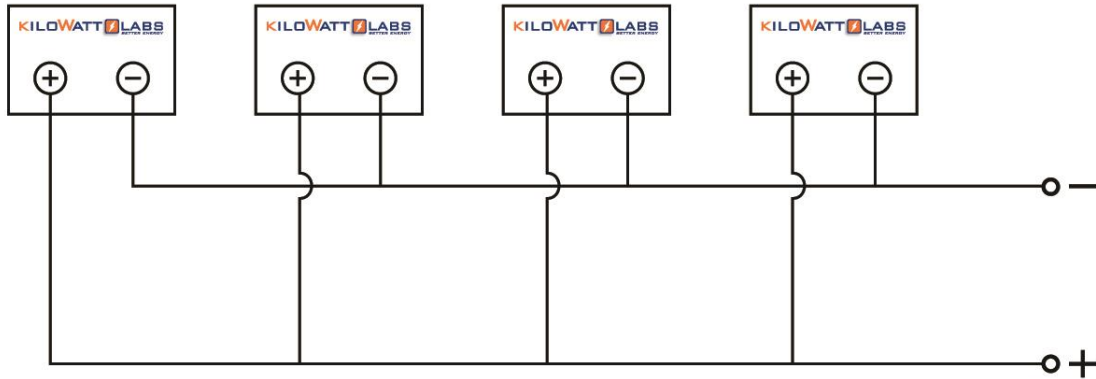
- Do not lift the module by the terminal posts.
- Do not stack modules once they have been removed from the packaging, instead the module should be placed on shelving.
- Do not drop the module. Internal damage may occur that will not be visible from the exterior.
- Only mount the module horizontally
- Do not step on the module.
- Protect the module from impact.

### Installation

Installation must strictly follow the national safety regulations in compliance with the enclosure, installation, creep age, clearance, casualty, markings, and segregation requirements of the end-use application. Installation must be performed by professional installers only. Switch off the system and check for hazardous voltages before altering any connection! Sirius modules must be handled only by qualified and trained personnel. Installation should not exert bending or twisting torque to the module enclosure.

**Parallel Connection of Sirius Modules**

The parallel combination of the Sirius modules is as shown below. Any number of modules can be connected in parallel.



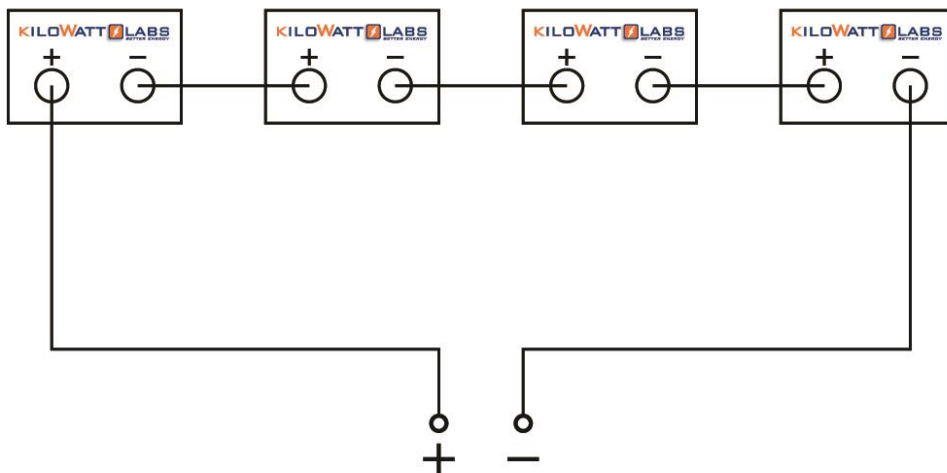
To do the parallel connection, the positive terminals of all the modules should be connected together and negative terminals of all the modules should be connected together and the output positive and output negative should be taken from the respective common point.

**Caution:** Charge all the modules to 100% SOC or same voltage level before connecting them to parallel.

**Series Connection of Sirius Modules**

The series combination of the Sirius modules is as shown below.

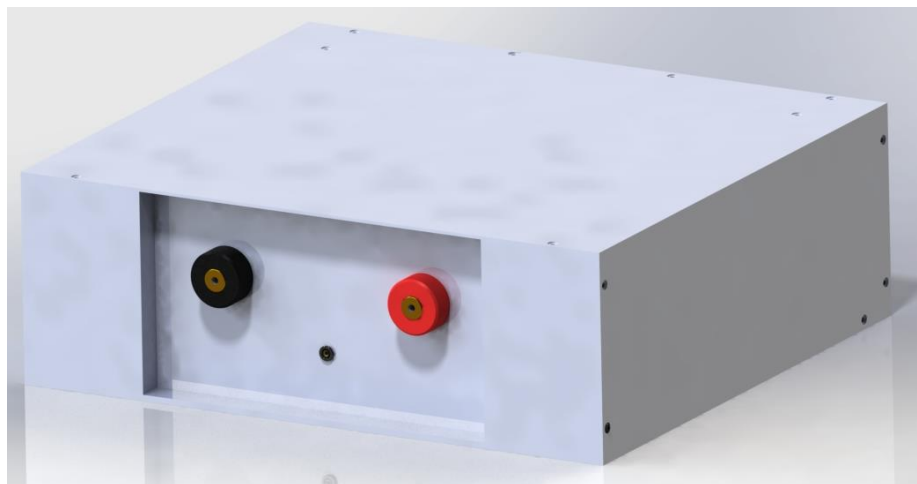
Only 8 modules can be connected in series with module combiner and please make sure that all the modules are balanced and charged to same SOC level. The advised way is to charge them to 100% SOC level and then put them in series.



To do the series connection, for eg: if you want to connect two modules in series, the negative of the first module should be connected with the positive of the second module and the output negative should be taken from the second module and the output positive should be taken from the first module.

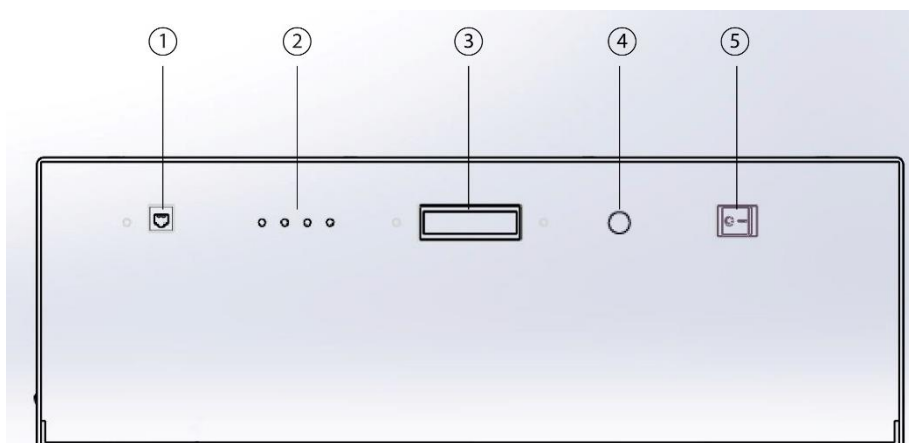
**Product Overview**

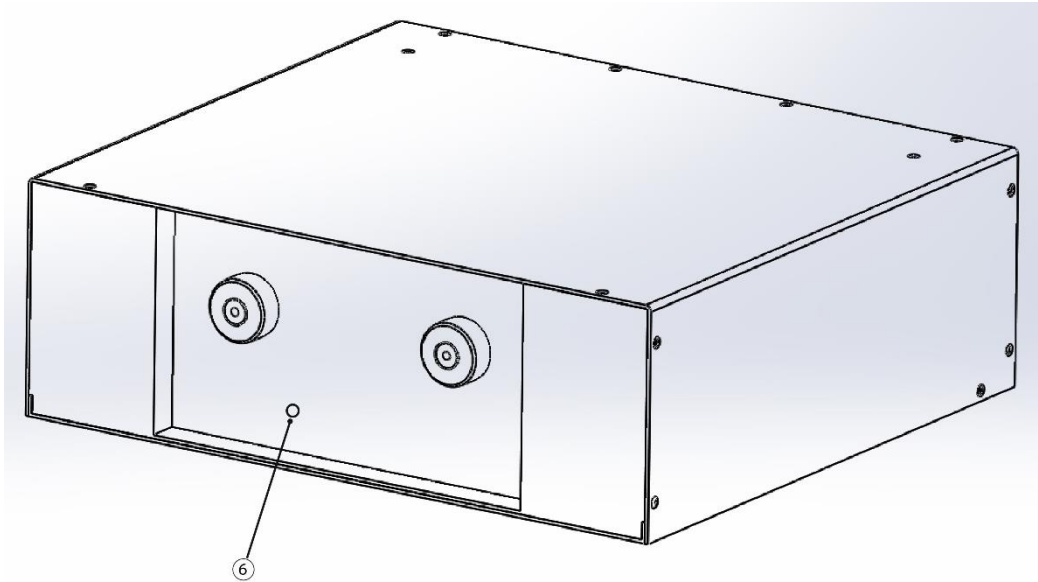
The appearance of the Sirius Capacitor Module is shown in the figure below:



**Panel Description**

The figure below describes the front panel components of the module:

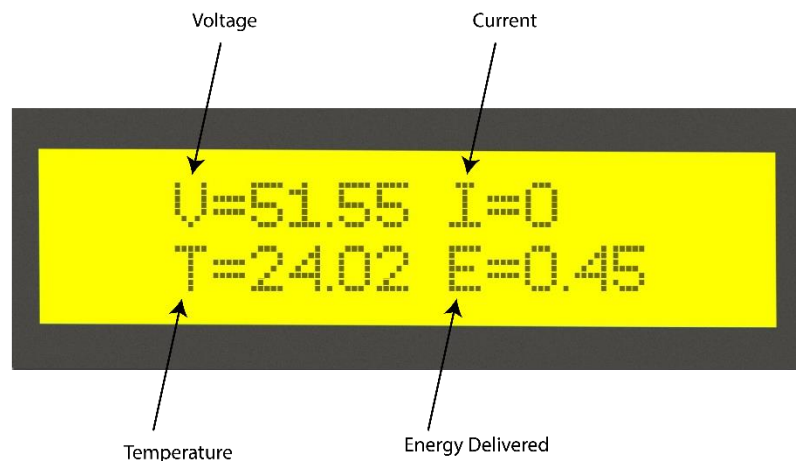




1	COMM Connector	2	COMM LEDs
3	LCD	4	Fault Reset
5	Power Switch	6	Recovery Jack

### LCD

Once the power is switched ON from the Power Switch, the module gets power and the LCD shows the following message under normal operation:



### COMM LEDs

COMM LEDs are the LEDs which show the status of communication of the control module with the application software. There are 4 LEDs for the four control modules in the Sirius Capacitor Module.

Each LED has the following status:

- **OFF:** The control module is not powered and hence not communicating with the application software.
- **ON (Green):** The control module is powered ON but no communication with the application software.
- **Blinking Red:** The control module is communicating with the application software.

### COMM Connector

This is a RJ45 connector to monitor the module using the application software.

### Power Switch

When the power is switched ON using the ON/OFF switch on the front panel, the module electronics are powered up. The module is now functional and can be operated.

### Recovery Jack

When the module voltage goes too low, recovery jack can be used to energize the internal components to activate the module.

### Fault Reset

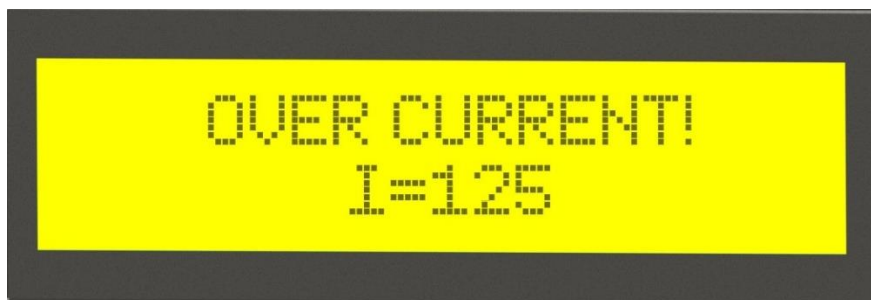
Fault Reset is a push button which is used to turn on the DC contactor manually after the contactor turns off due to any error.

### Safety Features

Sirius Capacitor Module has the following safety features:

#### Overcurrent (OCD)

When the module has an **overcurrent** fault (OCD), the buzzer alarms and the LCD shows the following warning message:

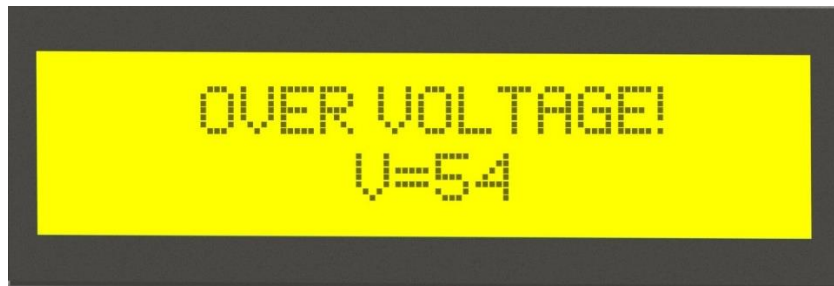


This means the current has reached the cut-off current of 125A (in the illustration, the LCD shows that the module current has reached the cut-off 125A).

#### Overvoltage (OV)

When the module has an **overvoltage** fault (OV), the buzzer alarms and the LCD shows the following warning message:

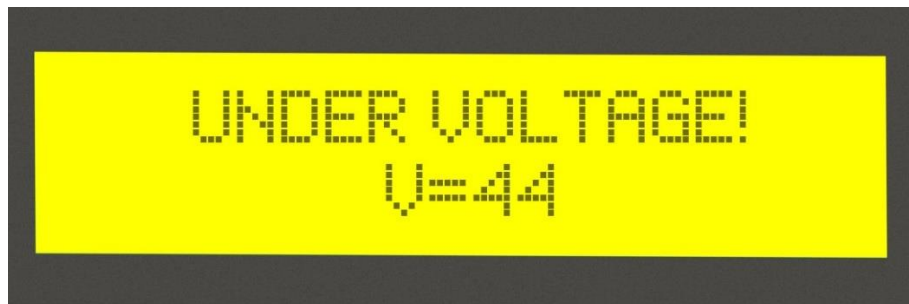




This means the module voltage has reached the cut off limit of 54V. The LCD shows the voltage at that time as well (in the illustration, the LCD shows that the module voltage has reached to 54V).

### **Undervoltage (UV)**

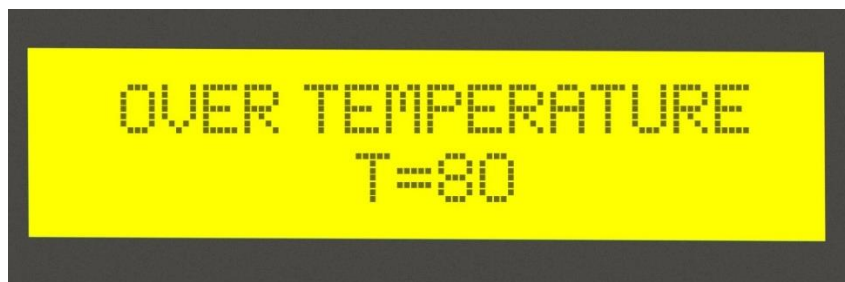
When the module has an **undervoltage** fault (UV), the buzzer alarms and the LCD shows the following warning message:



This means the module voltage has reached the cut off value of 44V. The LCD shows the voltage at that time as well (in the illustration, the LCD shows that the module voltage has reached to 44V).

### **Overtemperature (OT)**

When the module has an **overtemperature** fault (OT), the buzzer alarms and the LCD shows the followig warning message:



This means that the temperature of the module has reached the cut-off value of 80°C. The LCD shows the temperature at that time as well (in the illustration, the LCD shows that the module temperature has reached to 80°C).

## Operation Procedures



**The module should only be operated within the specified voltage and temperature ratings.**

**Observe polarity indicated on module.**

**Do not reverse polarity.**

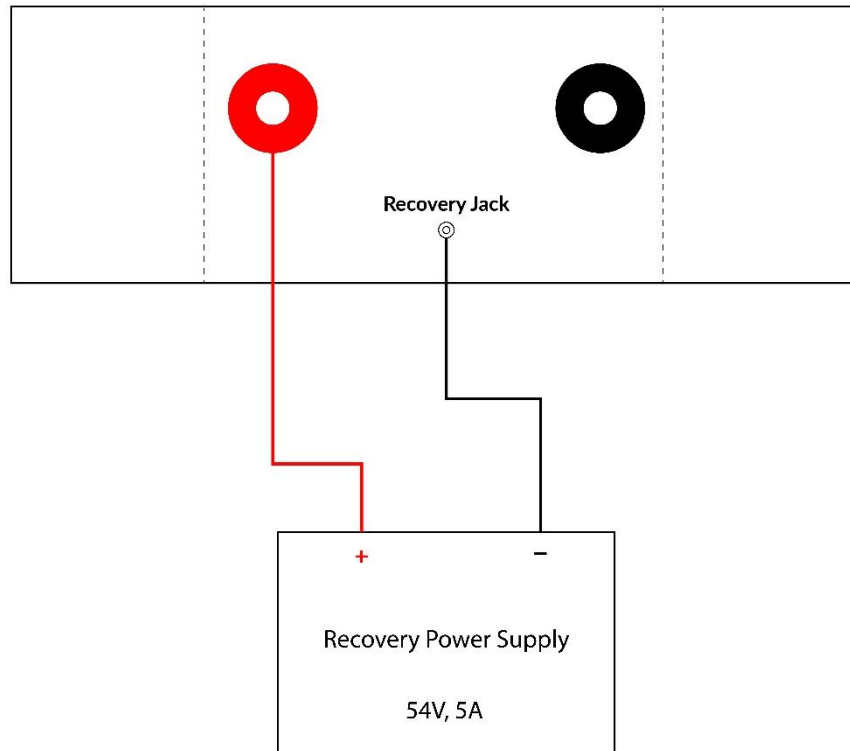
Follow the steps below (in sequence) to operate the module:

- Connect the RJ45 cables to the COMM connector slot to start communication and monitoring.
- Turn on the power switch – the LCD will start to display data.
- Check the IP address displayed on the LCD screen of the module and configure the IP address of the PC in regarding to the module IP address displayed on the LCD screen. The module and monitoring device should be in the same network (Ref to the Sirius View monitoring software manual)
- Install the monitoring software application in the monitoring device from the CD/USB provided with the module.
- The module will continue to function even when the RJ45 connector is removed (monitoring OFF).
- The module can be shutdown either by the ON/OFF switch

**NOTE:** Switch OFF the module when not in use as the module is self-powered or else, it can result in faster self-discharge of the module.

### Recovery Procedure

When the module voltage goes down too low that the LCD and contactor turns off, use the Recovery Jack to turn it on. For this process, a 48VDC to 54VDC, 1A to 5A power supply is required to recover the unit. The positive terminal of the supply should be connected to the positive terminal of the module and negative terminal of the supply should be connected to the recovery Jack using the lead provided. Once the connection is done, the unit can recharge and recover to a voltage where the LCD and contactor can be turned ON. This may take several minutes depending on the power supply used. At this stage, the recovery power supply can be removed, and the module can recharge normally.



## Trouble shooting: Faults and Solutions

### Over-voltage (OV)

The OV cut-off is at 54V. Set the charger's limit below 54V to prevent an OV event. If the voltage exceeds 54V, the DC contactor turns off

The DC contactor turns on when the module's surface charge is cleared, and the voltage drops below 53V. The event can be repeated if the charger is still ON and operating in the same condition.

**Troubleshooting: Check the charger's upper cut off limit and ensure it is set below 54V.**

### Under-voltage (UV)

The UV cut-off is 44V. If the voltage goes below 44V, the DC contactor turns off.

The DC contactor turns on when the voltage goes above 45V. The event can be repeated if the load is still ON and operating in the same condition.

**Troubleshooting: Check for the operating load lower cut off limit and ensure it is above the lower threshold limit of 44V.**

### Over-Current (OC)

OC occurs when the current goes above 125A or when the module is short-circuited. In this event, the module will start the count down and if the count down falls to zero, DC contactor will turn off.

**Troubleshooting:** Switch off the module and check the voltage across the module terminals to find whether there is a short circuit. In case of a short circuit, check the operating circuitry and clear the short circuit. The DC contactor turns on after the current goes below 125A.

**Over-Temperature (OT)**

OT occurs when the module temperature goes above 80°C. In this event, the DC contactor turns off

**Troubleshooting:** Shut down the module and check the room temperature and ensure the cooling units are operating properly. Leave the module to cool till the module temperature comes below 60°C. Now, turn ON the module.

**Multiple Errors**

The above-mentioned errors can occur simultaneously and will be shown on the LCD. To clear these, follow the steps explained in the above sections.

**Maintenance**

The Sirius Capacitor Module does not require periodic maintenance.

Safety
<b>Strictly observe the safety instructions listed below to ensure safe handling, injury prevention and trouble-free operation of the module.</b>
<ul style="list-style-type: none"> <li>• Never touch the positive (+) or negative (–) terminals as the module can be charged and cause fatal electrical shocks. Always verify that the module is fully discharged before handling the module.</li> <li>• Ensure precautions to prevent short-circuit under all circumstances.</li> <li>• Do not operate the module above the specified voltage.</li> <li>• Do not operate the module above the specified temperature rating.</li> <li>• Do not touch the terminals with conductors while the module is charged. Serious burns, shock, or material fusing may occur.</li> <li>• Wear protective equipment when handling the modules including gloves, eyewear and hardhat.</li> <li>• Protect surrounding electrical components from incidental contact.</li> <li>• Do not use the module in an open environment, in rain or in a place exposed to water and other liquids.</li> <li>• In case the module is physically damaged due to any event, do not install and energize the module under any circumstances and contact your Reseller.</li> <li>• When connecting to external devices ensure that galvanic isolation does not exceed 1000V.</li> <li>• Under no circumstances must the charge / discharge current exceed 125A.</li> <li>• Under no circumstances must the charging voltage exceed 54VDC for more than 60 seconds.</li> <li>• During charge cycle ensure never to exceed constant voltage of 54VDC and constant current of 125A.</li> <li>• All modules must be at 100% SOC before connecting in series or parallel.</li> <li>• The maximum number of modules that can be connected in series is 8 with a Module Combiner. Under no circumstances should you connect more than 3 modules in series.</li> </ul>

- If you want to connect more than 8 modules in series, please contact your Reseller.
- Modules cannot be connected in a series – parallel combination under any circumstances.

### **Storage**

The Sirius modules can be stored at any SOC (State of Charge) without affecting the projected supercap cell cycle life of 1,000,000 cycles.

Projected supercap cell calendar life (the projected life of the supercap cells (in years) from the date the module is first operated) is 45 years.

Shelf life (the life of the module (in years) from the date it is manufactured to the time it is first operated) is 10 years.

### **Disposal**

Dispose according to local regulations.

## Technical Specifications

Nominal Voltage	48VDC
Voltage Range	44VDC – 54VDC
Capacity	3550Wh
Maximum Charge Rate (0% -100% SOC)	125A
Maximum Discharge Rate (100% - 0% SOC)	125A
Maximum Charging Voltage	54VDC
Recovery jack	(5A, 52VDC) max
Internal Resistance	≤4mΩ
Supercap cell DC to DC Roundtrip efficiency (@125A)	99.1%
Supercap cell Operating Temperature <sup>1</sup>	-30°C to 85°C, non -condensing
Galvanic Isolation	1000V
Projected Cycle Life <sup>2,3</sup>	1,000,000
Projected Calendar Life <sup>3,4</sup>	45 years
Shelf Life <sup>5</sup>	10 years
Warehousing	Can be stored at any SOC without affecting cycle life
Communication Port	TCP/IP RJ45 Ethernet
Monitoring Data	Temperature, Voltage, Current, Energy, Supercap Balancing
Remote Control Input	Battery Self-Check
Safety	Shutdown on - Over-Charge, Over-Discharge, Over-Current, Over-Temperature, Reverse Polarity, Cell Imbalance
Terminal Type	F12
Module Casing Material	Aluminium
Dimensions module/packed (w x d x h)	600mm x 534mm x 200mm/680mm x 615mm x 280mm
Weight module/packed	69kg/73kg
Supercap Cell Self-discharge <sup>6</sup>	2% per month
Alarm	Audible alarm in the event of Over -Charge, Over -Discharge, Over -Temperature, Over- Current
CE Certification <sup>7</sup>	EN55032:2015, EN55024:2010, EN61000-4-2:2009, EN61000-4-3:2006+A1:2008+A2:2010
<b>Precautions</b>	
Alarm	In case of alarm, immediately rectify/attend to the cause of the alarm
Physical Damage	In case the module is physically damaged due to any event, do not install and energize the module under any circumstances and contact an authorized technician
Short Circuit	Ensure precautions to prevent short-circuit under all circumstances
Galvanic isolation	When connecting to external devices ensure that galvanic isolation does not exceed 1000V
Charge / Discharge Current	Under no circumstances must the charge / discharge current exceed 125A
Charging Voltage	Under no circumstances must the charging voltage exceed 54VDC for more than 60 seconds.
Charge Cycle	During charge cycle ensure never to exceed constant voltage of 54VDC and constant current of 125A

Series Connection	All modules must be at 100% SOC before connecting in series
Maximum number of modules that can be connected in series <sup>8</sup>	8 with Module Combiner Please consult with Kilowatt Labs or its Reseller when connecting the modules in series. Under no circumstances should more than 3 modules be connected in series without the Module Combiner
Maximum number of modules that can be connected in parallel	No limit
Series – Parallel Connection	Modules cannot be connected in a series – parallel combination under any circumstances
<b>Sirius View – Monitoring Software</b>	
Individual Cell	Monitoring of voltage
Module	Monitoring of current, max. & min. voltage, temperature, DOD, SOC, rate of charge, rate of discharge, time to discharge, balance energy, total energy delivered over lifetime, graphs
System	Monitoring of all modules connected together

<sup>1</sup>Cycle life may vary if the module is to be operated continuously outside a temperature range of -10°C to 55°C, and/or at C-rates higher than the maximum charge/discharge rate specified in this spec sheet. Please consult Kilowatt Labs or its Reseller prior to deploying the module in such applications.

<sup>2</sup>Projected Cycle life of supercap cells.

<sup>3</sup>Additional terms and conditions, including a limited warranty, will apply at the time of purchase.

<sup>4</sup>Projected Calendar life of supercap cells from the date of first operation

<sup>5</sup>Shelf life is the life of the module (in years) from the date it is manufactured to the time it is first operated

<sup>6</sup>Self-discharge for the module is 2% per month if idle (not charging or discharging) AND in Sleep Mode (switched off). If the module is not in sleep mode, then self-discharge may vary depending on ambient temperature.

<sup>7</sup>CE certification is completed for supercap cells

<sup>8</sup>Consult Kilowatt labs or its Reseller for information on connecting modules in series.

Product dimensions are for reference only unless otherwise identified and may change without notice.

For critical applications, please contact Kilowatt Labs, Inc., or its Reseller.