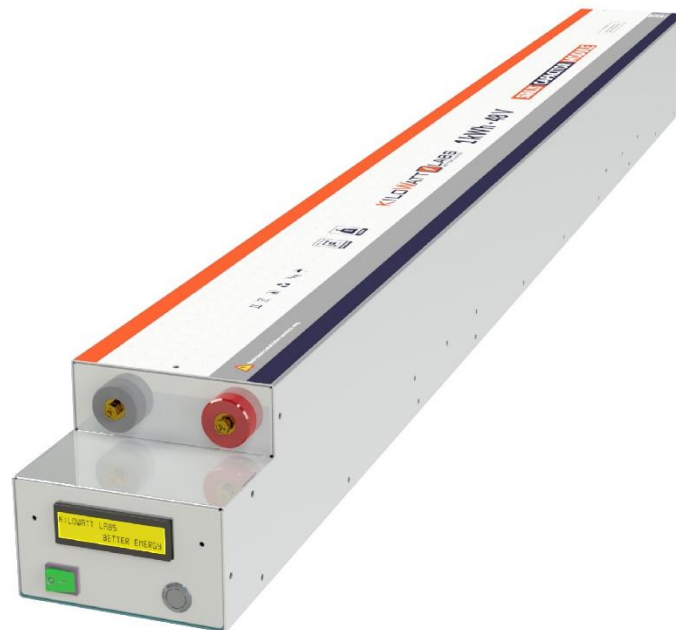# SIRIUS CAPACITOR MODULE
User Manual

Model number: 1000-48-B-1C-TM-X-A-X-X-SL

Version 1.1; Release Date: September 2020

Author:

Mamoona Khalid

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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1. Safety Instructions:

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 to prevent accidents. The Sirius Module must be installed by trained personnel.

1.1 Symbols Convention:

Safety instructions and general information that appear in this manual are described.

⚠️	**Caution!** 'Caution" indicates hazardous situation which, if not avoided could result in minor or moderate injury.

⚠️	**Warning!** 'Warning" indicates hazardous situation which, if not avoided could result in major injury or death.

⚡	**Danger!** 'Danger" indicates hazardous situation which, if not avoided could result in serious injury or death.

⚠️	**Note!** 'Note" provides tip that are valuable for optimal operation of your product.

1.2 Safety Precautions:

The Sirius Modules are designed to provide years of trouble-free operation. Proper handling is required to avoid damage to the Module. In particular the following precautions should be observed.

- **Personal Safety:**

→ Always wear proper personal protective equipment (eyes protection, gloves and safety shoes).

→ Always make sure the charger is set as recommended.

→ Always make sure the chargers are disconnected while working on the Modules.

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- **Module Safety:**

→ Do not subject the Module to strong impact.

→ Do not crush or puncture the Module.

→ Do not dispose the Module in a fire.

→ Do not charge the Module when the temperature is below -30°C.

→ Do not charge the Module when the temperature is above 80°C.

→ Do not operate the Module above the specified voltage.

→ Under no circumstance charge/discharge the Module at more than 20A.

→ Under no circumstance must the charging voltage exceed 54 V_{dc} for more than 60 seconds.

→ Do not expose the Module to temperature in excess of 80°C.

→ Do not place the Module near a heat source, such as a fireplace.

→ Do not disassemble the Module under any circumstances.

→ Do not lift the Module by the terminal posts.

→ Do not touch the Module with wet hands.

→ Do not expose the Module to moisture or liquids.

→ Keep the Module away from children and animals.

→ Ensure precautions to prevent short-circuit under all circumstances.

→ Do not connect or disconnect terminals from the Module without first disconnecting the load.

→ Do not touch the terminals with conductors while the Module is charged. Serious burns, shock, or material fusing may occur.

→ Protect surrounding electrical components from incidental contact.

→ When connecting to external devices ensure that galvanic isolation does not exceed 1500V.

→ Do not use the Module in open-environment, in rain or in a place exposed to water and other liquids.

→ Do not subject the Module to high pressure.

→ Do not place any objects on top of the Module.

→ Do not step on the Module.

→ Mount the Modules only in horizontal direction.

→ Do not drop the Module. Internal damage may occur that will not be visible.

→ Do not stack Modules once they have been removed from the packaging, instead the Modules should be placed on shelving.

→ In case the Module is physically damaged due to any event, do not install and energize the Module under any circumstances and immediately contact your Reseller.

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⚠	**Note!** **Do not stack more than 2 Modules.**

1.3 Modules Connection Safety Precautions:

→ All Modules must be at 100% SOC before connecting in series or in parallel.

→ The maximum number of Modules that can be connected in series is 4.

→ Do not connect more than 4 Modules in Series.

→ There is no limit on the Modules while connecting in parallel.

→ Modules cannot be connected in series-parallel combination under any circumstance.

⚠	**Note!** **If you want to connect more than 4 Modules in series, please contact your Reseller.**

1.4 Shipping:

Sirius Modules are shipped out via Air and Sea.

- If you receive the Modules shipped by Air, please follow the instructions given below:

  - Carefully remove the nails from all the four sides of the wooden box and open it.

  - Remove the foam and cling wrap and open the carton box and lift the Module manually.

- If you receive the Modules shipped by Sea, please follow the instructions below:

  - Carefully remove the Module from the pallets after cutting the packing strip holding the Modules to the shipping pallets.

  - Open the carton box and lift the Module manually.

⚠	**Danger!** **The Module must be removed from the carton by lifting the it from base. Do not remove the Module by the terminal posts.**

1.5 Qualified Installer:

Selling and installation of this Module is only through the Company's Resellers who are trained on installation, operation and maintenance of the Sirius Modules.

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2. Product Introduction:
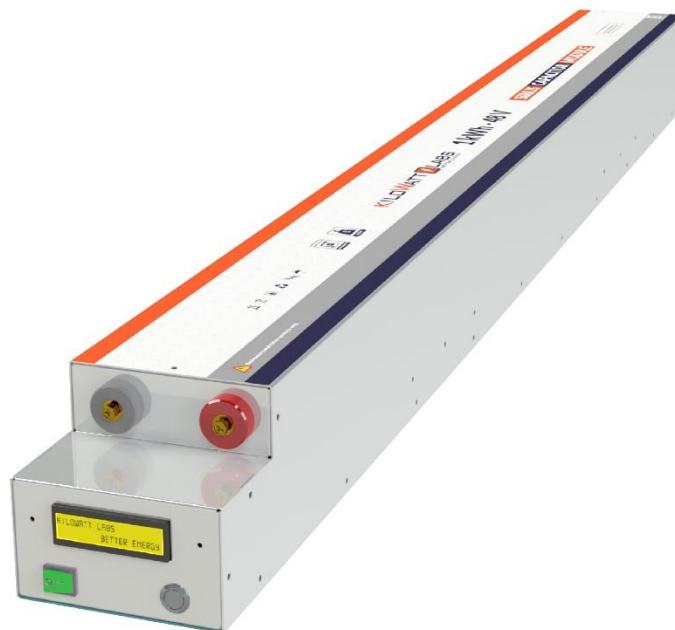
2.1 Product Part Number:

1000-48-B-1C-TM-X-A-X-X-G

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

1) Capacity of Module in Wh
2) Nominal Voltage of the Module
3) Terminals are on the Front Side
4) Maximum Charge Rate of the Module
5) Total Monitoring
6) Not Available
7) With Alarm
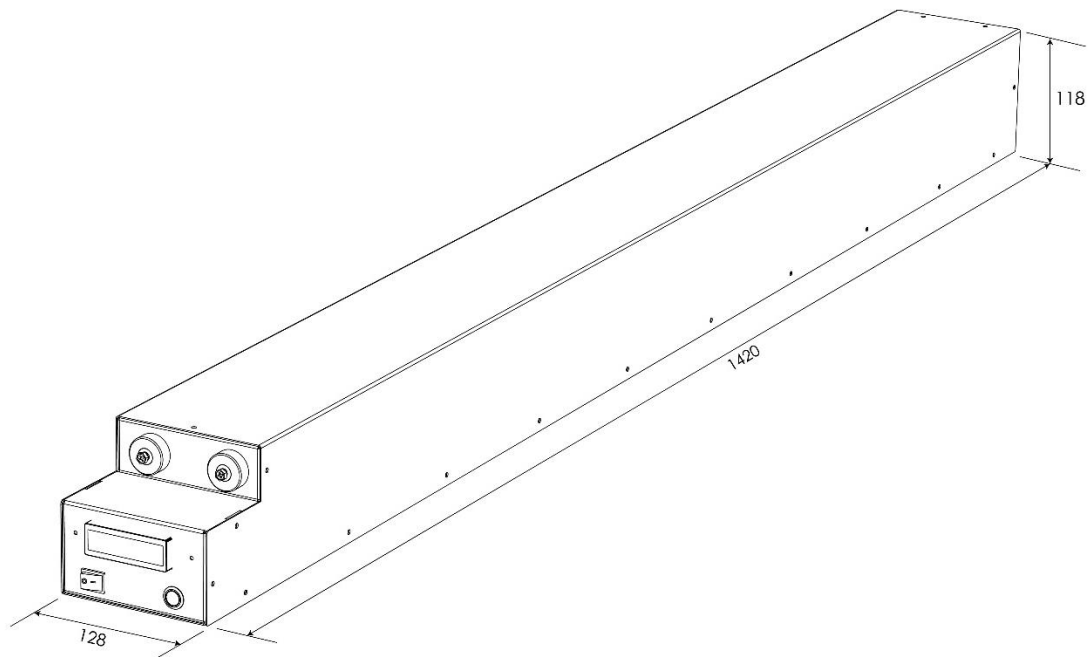8) Not Available
9) Not Available
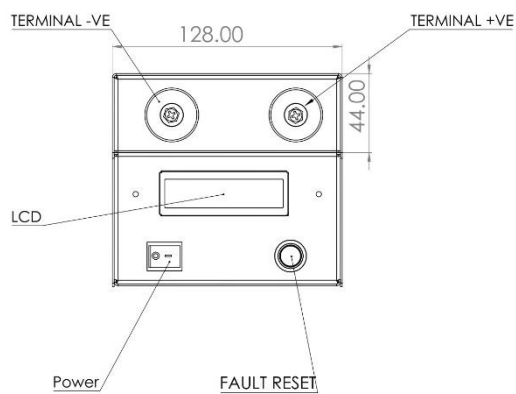10) General Module

2.2 Product Overview:

2.2.1 Appearance:

The appearance of the Sirius Capacitor Module is shown below:

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2.2.2 Mechanical Drawings:

Isometric View

Front View

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Side View

2.2.3 Dimensions and Weight:

Width	128 mm
Depth	1420 mm
Height	118 mm
weight	23 Kg

2.3 Product Description:
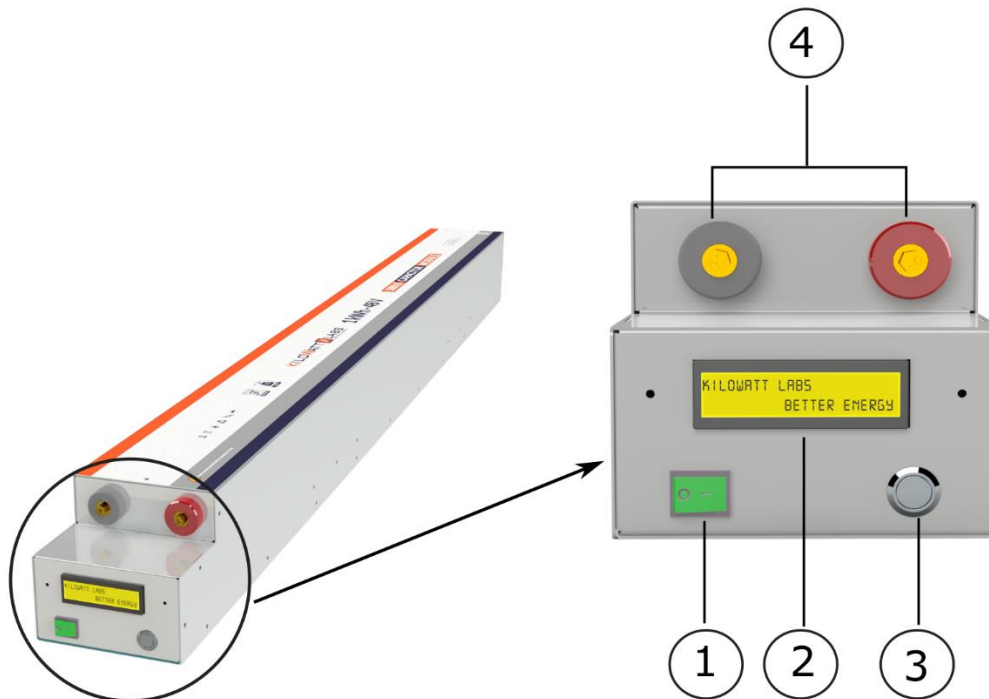
1. Power Switch
2. LCD
3. Fault Reset
4. Terminals

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1. Power Switch:

When the power button is switched ON, the Module electronics are powered up and it will raise alarm during overvoltage, undervoltage, overcurrent and overtemperature. If the switch is OFF then there will be no alarm.

2. LCD Description:

Once the power is switched ON from the circuit breaker, the Module gets power and the LCD shows the following message after 3 seconds under normal operation:
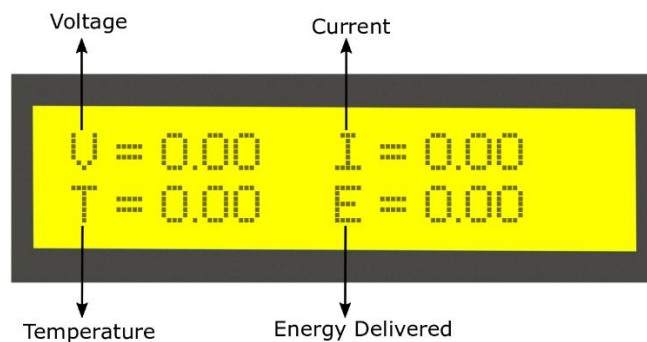
→ After 1 second, the following two LCD screens get switched with each other.
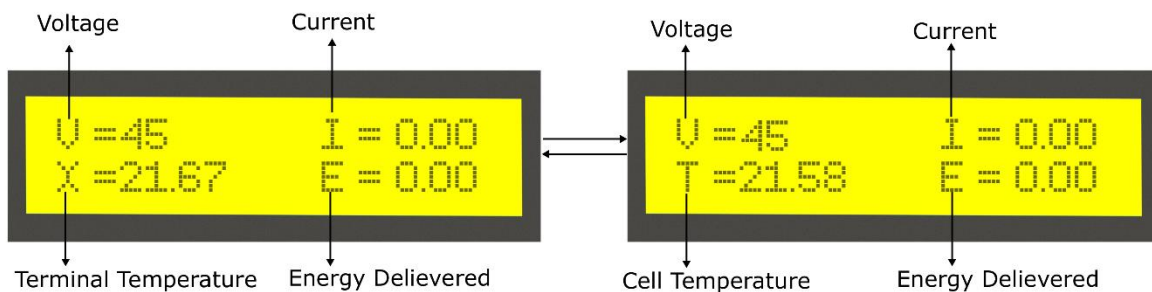
3. Fault Reset:

Fault Reset is a push button which is used to reset alarm raised during overvoltage, undervoltage, overcurrent and overtemperature faults. It is also used to make the offset current to zero.

4. Terminals:

F12 terminals are used to connect the load or charger to the Module. The red one is positive (+), the black one is negative (-).

> ⚠ **Note!**
>
> **Never connect the red cable to the negative terminal of Module.**

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3. Module Installation:

3.1 Inspection:

Inspect the shipping carton for visible damage including cracks, dents, deformation and other visible abnormalities prior to unpacking the Module. Document (photograph) any damage and report this to your Reseller as well as 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.
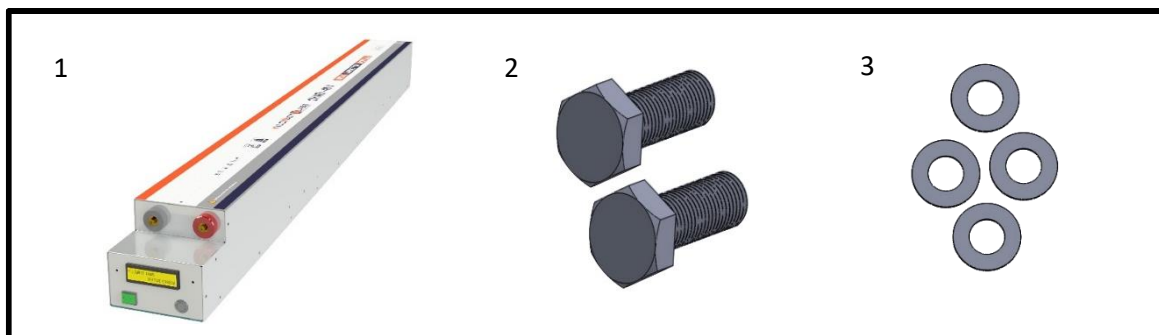
3.2 Safety Gear:

Installation must strictly follow the national safety regulations in compliance with the enclosure, installation, creepage, 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.

> ⚠ **Note!**
> **Read the safety Instruction sheet before installation.**

3.3 Unpacking and Contents Check:

Check the contents of the package. Only two items are included in the package.

1) Sirius Capacitor Module: 1KWh48VDC

2) Bolts × 2

3) Washers × 4

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4. Operation Procedures:

4.1 Module Configuration:

Follow the steps below to switch ON the Module.

Step 1: Module Start-Up:

1. Connect the F08 terminals of the Module to the load.

2. Turn ON the power switch button in order to give alarm during overvoltage, undervoltage, overcurrent and overtemperature faults.

> ⚠️ **Note!**
> **The Module should only be operated within the specified voltage and temperature ratings.**

> ⚠️ **Note!**
> **Observe polarity indicated on Module. Do not reverse polarity.**

Step 2: Module Shut-Down:

1. The Module can be shut down by disconnecting the load.

> ⚠️ **Note!**
> **Always turn OFF the Module when not in use because the Module is self-powered. It can result in faster self-discharge of the Module.**

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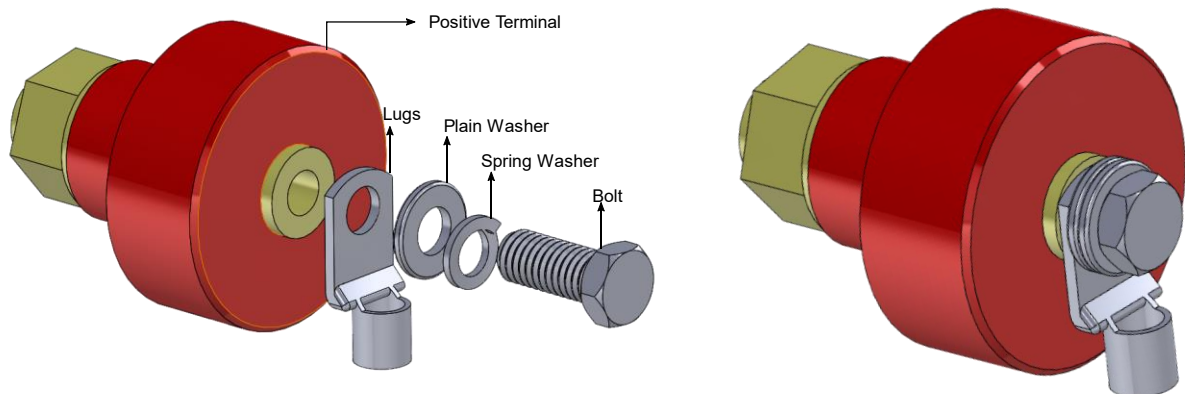# 5. Electrical Installation:

5.1 Cable Size:

We recommend a cable size of 35mm^2 thick and 1m length to hold current up to 150A. Please use thick cable size for lengths longer than 1m.

5.2 Connecting Cable Lugs, Washers and Bolts to Module Terminals:

Follow the sequence below to connect the washers, lugs and bolts to the positive and negative terminals of the Sirius Module. Make sure connection is not loose.
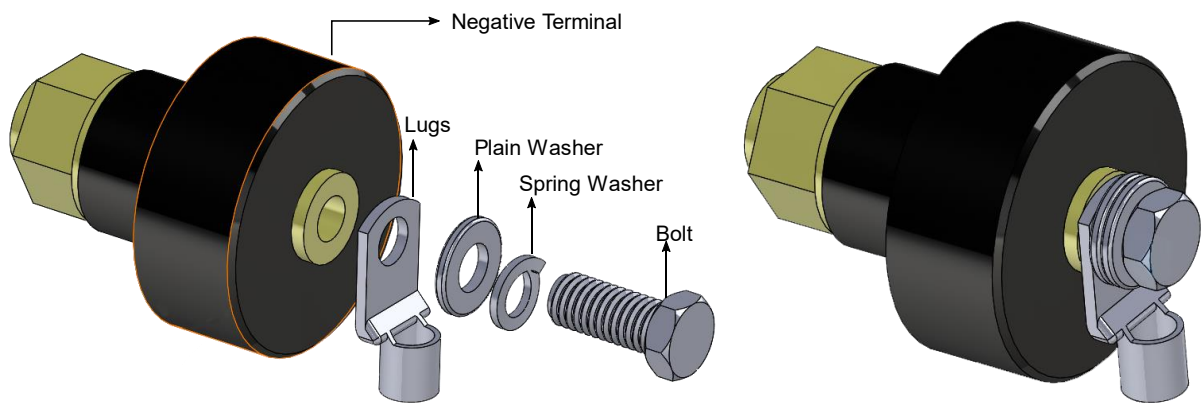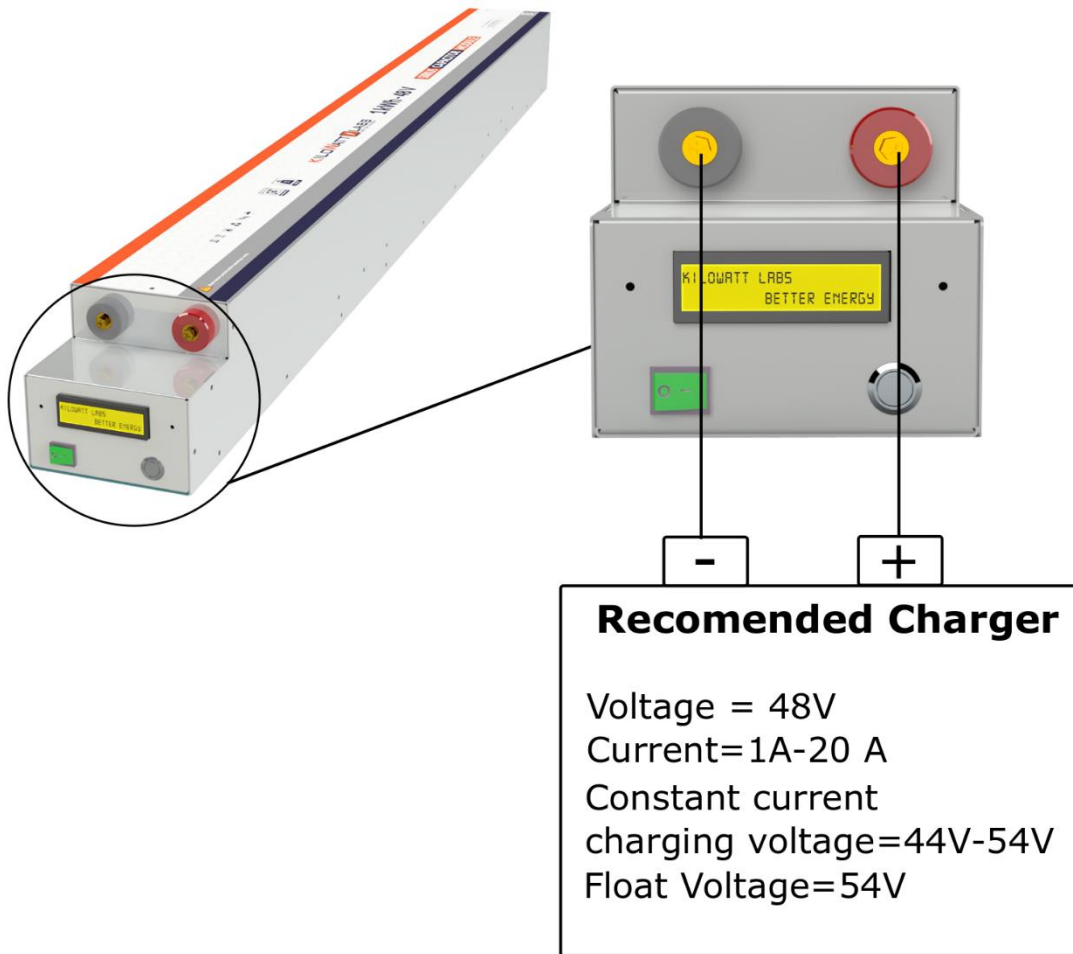

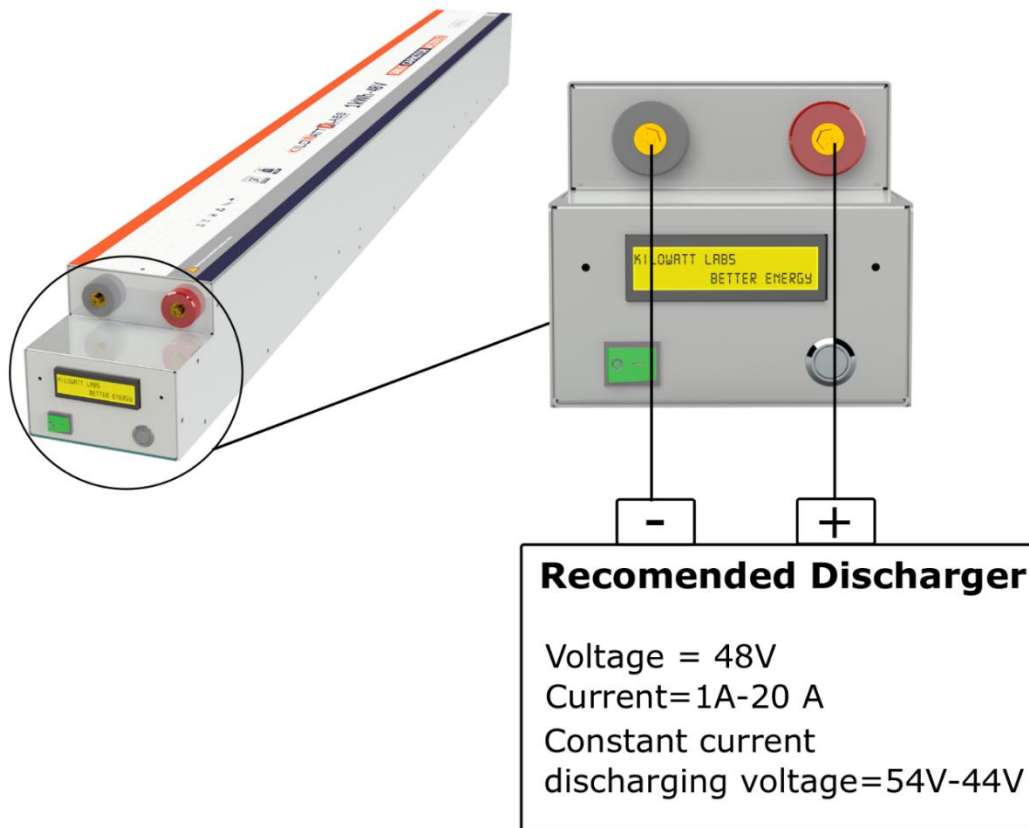*Connecting washers, lugs and bolts to negative terminal of Module*

Connecting washers, lugs and bolts to positive terminal of Module

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5.3 Connecting Module to Power Supply:

Recomended Charger

Voltage = 48V
Current=1A-20 A
Constant current
charging voltage=44V-54V
Float Voltage=54V

- Connect positive and negative terminals of charger to the positive and negative terminals of the Sirius Module respectively.

- Make sure to activate the Module by turning ON the power switch to get the output from the terminal.

- Turn ON the charger.

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5.4 Connecting Module to Load:

Recomended Discharger

Voltage = 48V
Current=1A-20 A
Constant current
discharging voltage=54V-44V

- Connect positive and negative terminals of discharger to the positive and negative terminals of the Sirius Module respectively.

- Make sure to activate the Module by turning ON the power switch to get the output from the terminal.

- Turn ON the discharger.

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5.5 Connecting Modules in Parallel:

Any number of Modules can be connected in parallel.

- **Steps to Connect Modules in Parallel:**

Refer to the parallel combination of the Sirius Modules as shown below and make your connection accordingly.
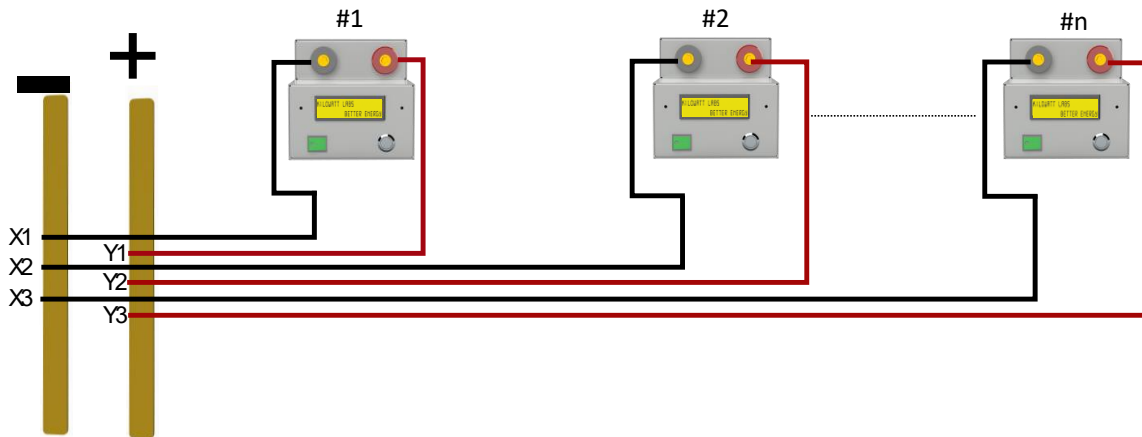
- Connect the positive (+) terminal of all Modules.

- Connect the negative (-) terminal of all Modules.

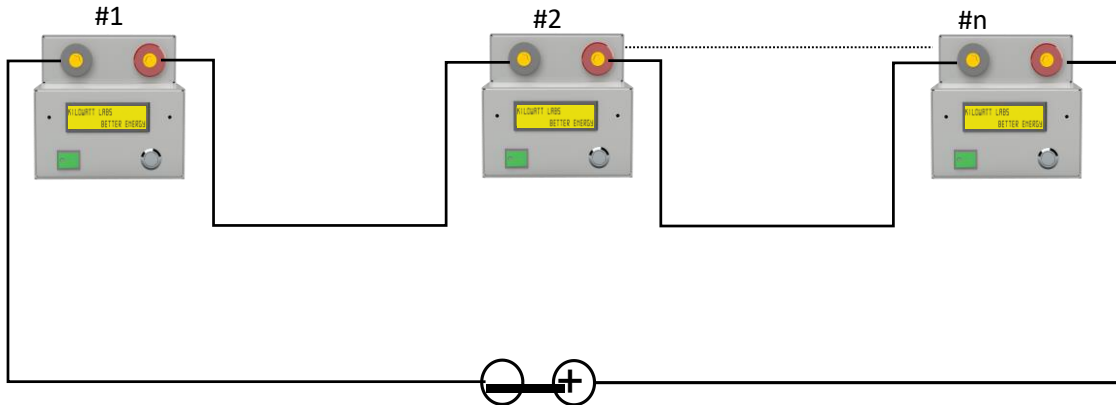- Take out the output positive terminal and output negative terminal from the respective common point.

> ⚠️ **Caution!**
> **Charge all the Modules to 100% SOC or same voltage level before connecting them in Parallel.**

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5.6 Connecting Modules in Series:

A maximum of 4 Modules can be connected in series.

- **Steps to Connect Modules in Series:**

Refer to the series combination of the Sirius Modules as shown below and make your connection accordingly.

- Connect the positive (+) terminal of the first Module with the negative (-) terminal of the next Module.

- Take the Output Negative from first Module and Output Positive from the last Module.

> ⚠️ **Caution!**
>
> **Charge all the Modules to 100% SOC or same voltage level before connecting them in Series.**

> ⚠️ **Note!**
>
> **Modules cannot be connected in series-parallel combination under any circumstance.**

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6. Recovery Procedure:

Use the steps below to recover the Module.

1. A power supply having voltage range of $44V_{dc}$ to $54V_{dc}$ and current range of 1A to 10A will be required.

2. Connect the positive terminal of the power supply to the positive terminal of the F05 terminal and negative terminal of the power supply to the negative terminal of the F05 terminal.

3. Once the connection is done, turn ON the Charger.

4. The event may take several minutes depending on the power supply used.

5. At this stage, remove the power supply and leave the Module for normal recharge.

Recommended Power Supply

Voltage = 48V
Current=1A-10A
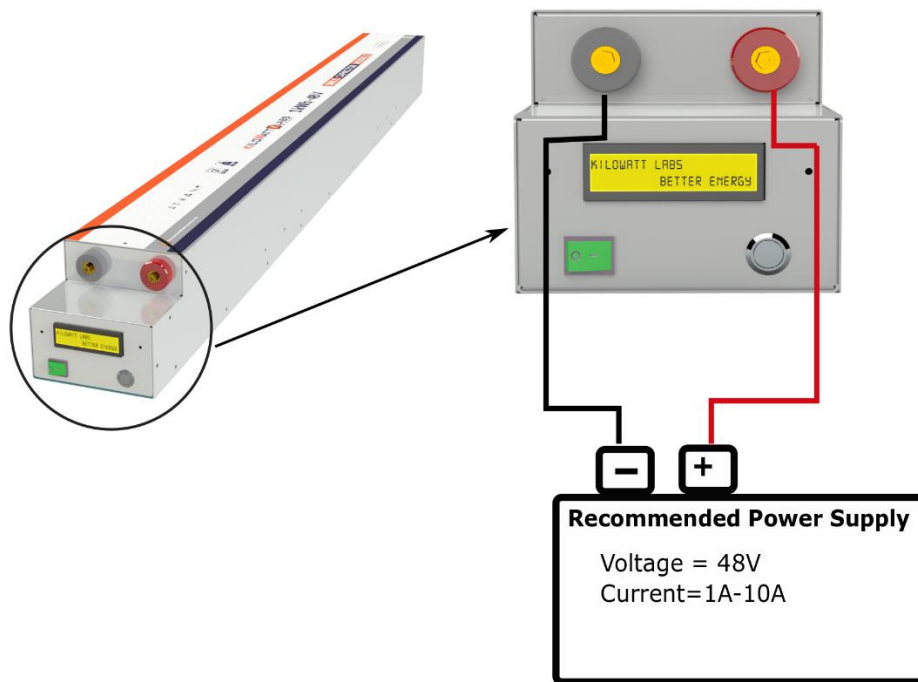
- **Recommended Charger for Recovery:**

Maximum Current	10 A
Recommended Voltage	44V-54V

⚠️ **Caution!**
Do not use more than 10A to recover the Module.

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7. Automatic Safety Alarm:

The Module will automatically raise alarm under any excessive use conditions in order to prevent damage to itself and the connected equipment. Specified limits for excessive current, high voltage and low voltage are provided in Module's technical data sheet.

Alarm	LCD warning	Description
OVER-VOLTAGE	ALARM CODE 01	When the Module has an Over-Voltage fault, it means the voltage has increased beyond the cut-off limit of 54V. The Module will raise alarm which can be reset by the fault reset button.
UNDER-VOLTAGE	ALARM CODE 02	When the Module has an Under-Voltage fault, it means the voltage has reached beyond the cut-off limit of 44V. The Module will give alarm which can be reset by the fault reset button.
OVER-TEMPERATURE (TERMINAL)	ALARM CODE 04	When the Module has an Over-Temperature fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (TERMINAL) & OVER-VOLTAGE	ALARM CODE 05	When the Module has an Over-Temperature and Over-Voltage fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEPMERATURE (TERMINAL) & UNDER-VOLTAGE	ALARM CODE 06	When the Module has an Over-Temperature and Under-Voltage fault, the buzzer alarms, which can be reset by the fault reset button.

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OVER-TEMPERATURE (CELLS)	ALARM CODE 08	When the cells have an Over-Temperature fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (CELLS) & OVER-VOLTAGE	ALARM CODE 09	When the Module has an Over-Voltage and cells Over-Temperature fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (CELLS) & UNDER-VOLTAGE	ALARM CODE 10	When the Module has an Under-Voltage and cells Over-Temperature fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL)	ALARM CODE 12	When the Module has an Over-Temperature and cells Over-Temperature fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL) & OVER-VOLTAGE	ALARM CODE 13	When the Module has an Over-Temperature, cells Over-Temperature and Over-Voltage fault, the buzzer alarms, which can be reset by the fault reset button.
OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL) & UNDER-VOLTAGE	ALARM CODE 14	When the Module has an Over-Temperature, cells Over-Temperature and Under-Voltage fault, the buzzer alarms, which can be reset by the fault reset button.

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OVER-CURRENT	ALARM CODE 16	When the Module has an Over-Current fault, it means the current has increased beyond the cut-off limit of 20A. The Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-VOLTAGE	ALARM CODE 17	When the Module has an Over-Current and Over-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & UNDER-VOLTAGE	ALARM CODE 18	When the Module has an Over-Current and Under-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (TERMINAL)	ALARM CODE 20	When the Module has an Over-Current and Over-Temperature fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (TERMINAL) & OVER-VOLTAGE	ALARM CODE 21	When the Module has an Over-Current, Over-Temperature and Over-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (TERMINAL) & UNDER-VOLTAGE	ALARM CODE 22	When the Module has an Over-Current, Over-Temperature and Under-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.

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OVER-CURRENT & OVER-TEMPERATURE (CELLS)	ALARM CODE 24	When the Module has an Over-Current and cells Over-Temperature fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (CELLS) & OVER-VOLTAGE	ALARM CODE 25	When the Module has an Over-Current, cells Over-Temperature and Over-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (CELLS) & UNDER-VOLTAGE	ALARM CODE 26	When the Module has an Over-Current, cells Over-Temperature and Under-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL)	ALARM CODE 28	When the Module has an Over-Current, Over-Temperature and cells Over-Temperature fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL) & OVER-VOLTAGE	ALARM CODE 29	When the Module has an Over-Current, Over-Temperature, cells Over-Temperature and Over-Voltage fault, the Module will raise alarm which can be reset by the fault reset button.
OVER-CURRENT & OVER-TEMPERATURE (CELLS) & OVER-TEMPERATURE (TERMINAL) & UNDER-VOLTAGE	ALARM CODE 30	When the Module has an Over-Current, Over-Temperature, cells Over-Temperature and under-Voltage fault, the Module will raise

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		alarm which can be reset by the fault reset button.
Module Low Charge (Without Load)	LOW CHARGE MODULE	When the Module is in standby mode and it reaches the minimum voltage, the LCD will display this message every 10 seconds.

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8. Trouble Shooting:

Switch ON the power switch button on the front panel to determine the state of the Module. A warning state is triggered when a condition, such as voltage, current or temperature, is beyond design limitations. When the Module falls outside prescribed limits, it enters a warning state. When a warning is reported, the buzzer alarms.

The possible warning alarms are as follows:

Warning Messages	Description	Trouble Shooting
Over-Current (OC)	OC occurs when the current goes above 20A or when the Module is short-circuited. In this event, the buzzer alarms which can be reset by fault reset button.	Switch OFF the Module and check the continuity 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.
Over-Temperature (OT)	OT occurs when the Module temperature goes above 80°C. In this event, the buzzer alarms which can be reset by fault reset button.	Shut down the Module and check the surrounding temperature and ensure the ambient temperature is less than 80°C. If not leave the Module to cool till the temperature comes below 80°C.
Over-voltage (OV)	OV occurs when the Module voltage has increased the cut-off limit of 54V. In this event, the buzzer alarms which can be reset by fault reset button.	Check the charger's upper cut-off limit and ensure it is set below 54V. The Module becomes operational when the module's surface charge is cleared, and the voltage drops below 54V.
Under-voltage (UV)	UV occurs when the Module voltage goes beyond cut-off limit of 44V. In this event, the buzzer alarms which can be reset by fault reset button.	Check for the operating load lower cut-off limit and ensure it is above the lower threshold limit of 44V. The Module becomes operational when the voltage goes above 44V.

9. Features:

9.1 Key Features:

- Low power consumption.

- Detection of circuit board errors.

- Long service life.

9.2 Physical features:

1. Sirius Module has efficient relay that buzzer alarm in case of:

- High Voltage

- Low Voltage

- High Current

- High Module Temperature

10. Shelf Life:

Shelf life is the life of the Module in years from the date it is manufactured to the time it is first operated. The shelf life of supercapacitor cell is 10 years.

11. Maintenance:

The Sirius Capacitor Module does not require periodic maintenance.

12. Disposal:

Dispose according to local regulation.

Sirius Capacitor Module – User Manual   Model Number -1000-48-B-1C-TM-X-A-X-X-SL
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