# User Manual

## LSUM 129R6C 0062F EA FI

LS Materials

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LS ULTRACAPACITOR LSUCF

## History

| Version | Date | Change Description | Author |
|---|---|---|---|
| V00 | 20 . May . 2020 | First version | SH Kim |
| V01 | 26 . Nov . 2021 | New format | SH Kim |
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## 1. Overview

The LS 129.6V / 62F Ultracapacitor Module has high energy and low ESR to meet energy storage and power delivery requirements.

The cells used in the module have 2.7 V maximum voltage rating and are connected in series to get higher operating voltage of modules. To meet the long cycle life requirements, the cells operate under 2.7V. In addition, all the cells are balanced by balancing circuit connected parallel to each cell.


<Fig. 1> Product Image

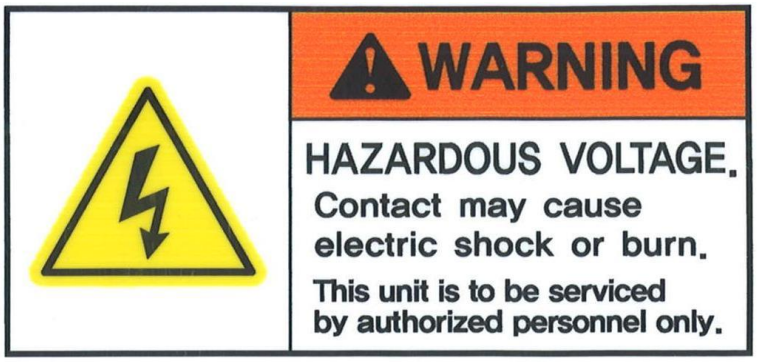
## 2. Unpacking

Inspect the shipping carton for signs of damage prior to unpacking the module. Damage to the shipping carton or module should be reported to the carrier 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.

**NOTE**: The original shipping materials are approved for both air and ground shipment. The module should be removed from the shipping carton by lifting the body of the module.

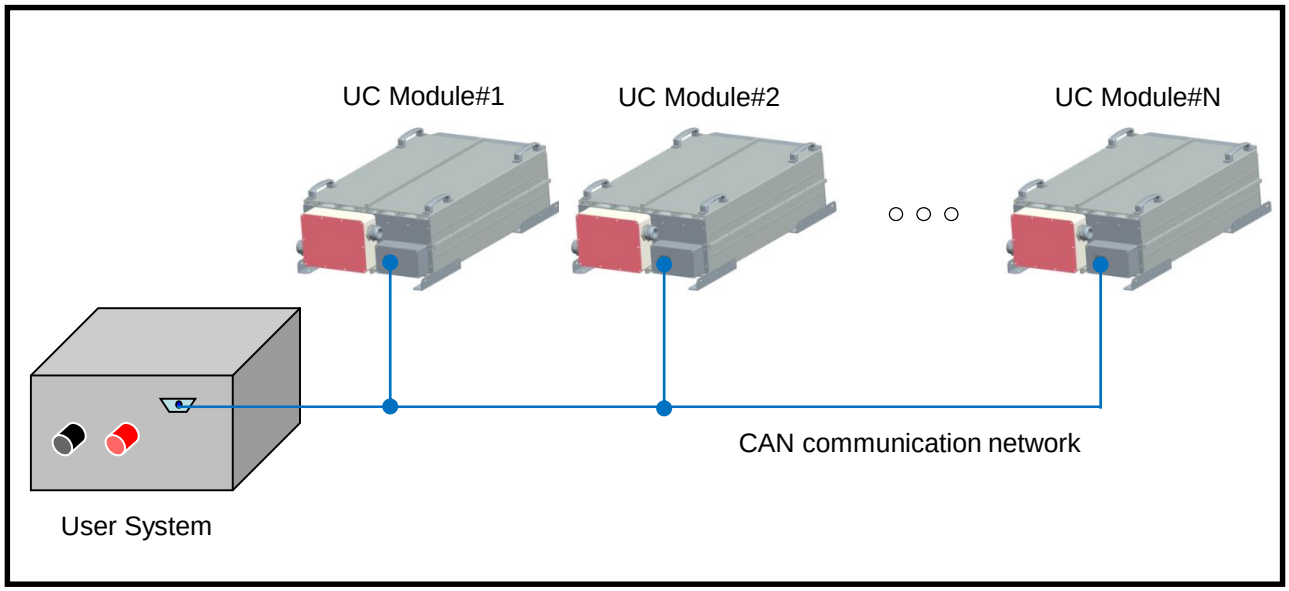
## 3. Safety




- Do not operate above specified voltage.
- Do not operate above specified temperature rating.
- Do not touch terminals with conductors while charged. Serious burns, shock, or material fusing may occur.
- Protect surrounding electrical components from incidental contact.
- Provide sufficient electrical isolation when working above rated voltage.
- Prior to installation and removal from the equipment, it is mandatory to fully discharge the module.

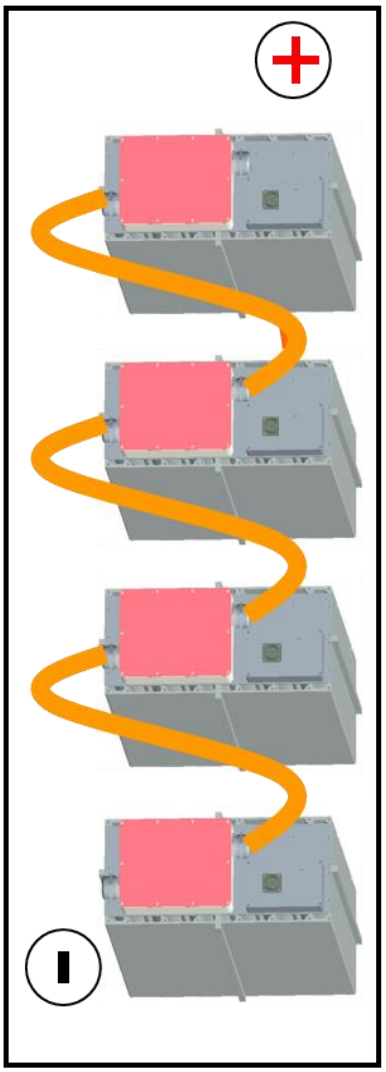
## 4. Module to module connection

- <Fig. 2> specifies how ultra-capacitor modules are interconnected. Detailed circuit diagram is referred to the Chapter Monitoring system - CAN communication.

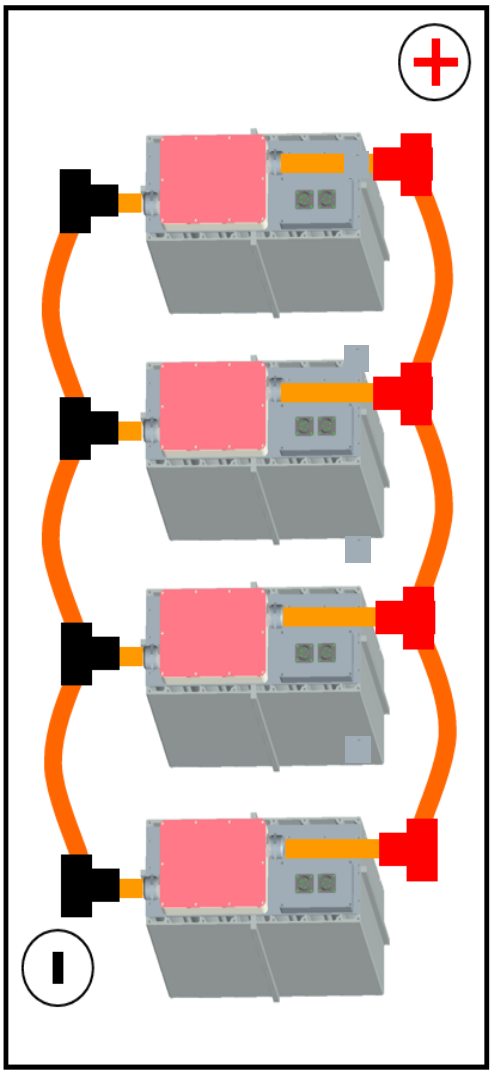



<Fig. 2> CAN communication network

- There are series and parallel connection for High power



<Fig. 3> Series Connection of Modules



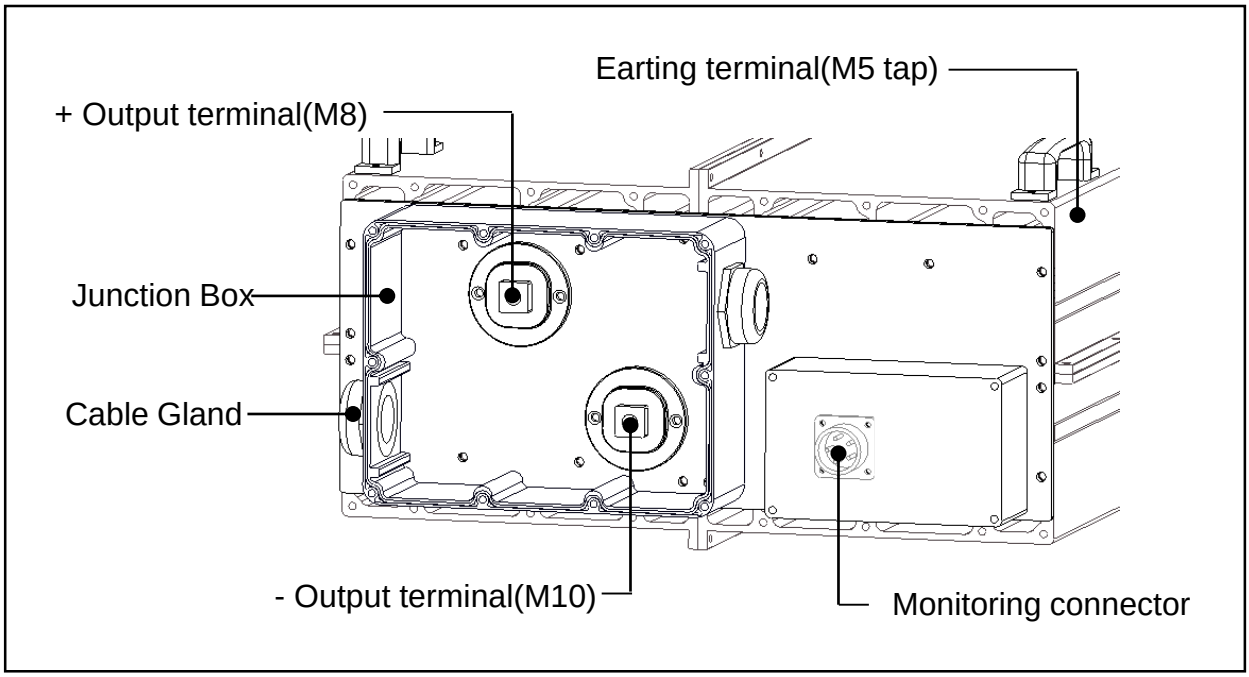
<Fig. 4> Parallel Connection of Modules.

## 5. Output terminal connection

- The output terminals are located inside the Junction Box which is in the front part of the module. They are designed to connect directly to a ring lugs. The positive and negative terminals have each hole for the screw. The threaded size is M8.(negative terminal is M10)

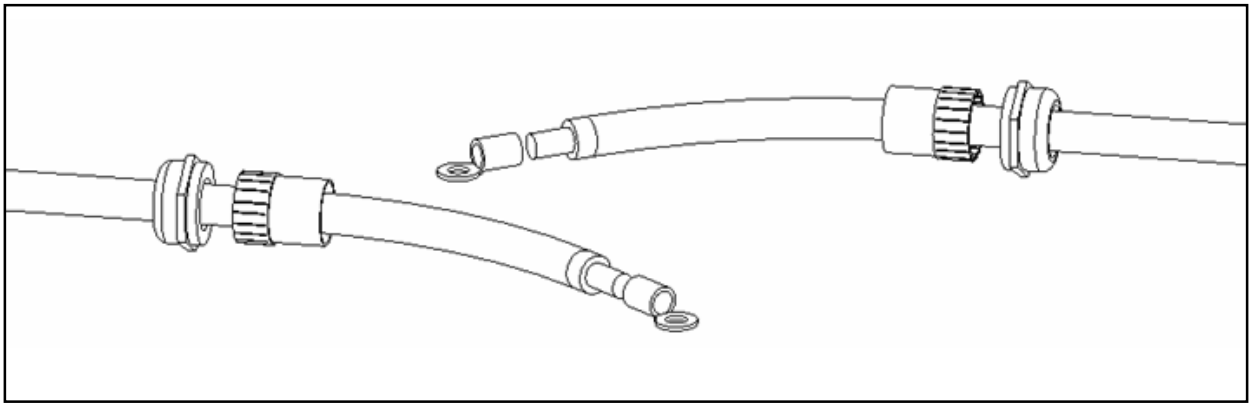
Wave washers are required to ensure reliable connections in long term. When implementing torque to the terminals, it is suggested to apply a torque of 20N-m for the M8 (30N-m for the M10) bolt and screw hole. Because the module itself has a very low ESR, total ESR can be affected by a ring lug torque. Therefore, it needs more attention to assemble the modules.

1) Open the Junction Box located in the front of the module.



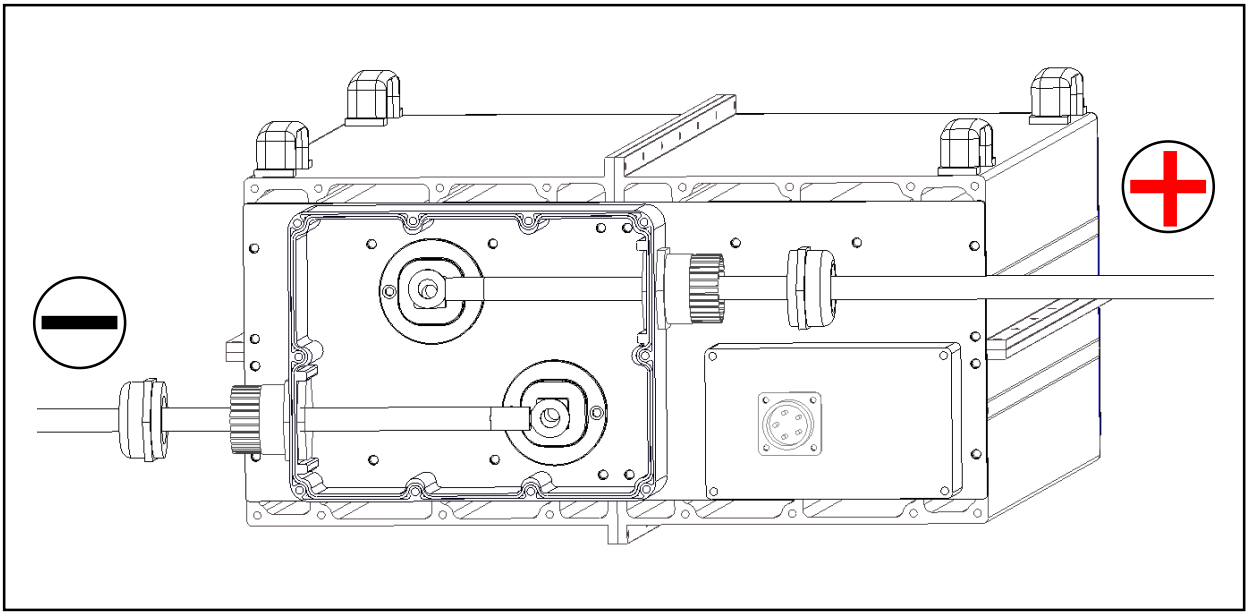

<Fig. 5> Internal Junction Box

2) Disassemble male Cable-grand off female Cable-gland attached to the side of Junction Box. Connect cable into male Cable-gland, and then clamp Ring lug at the end of cable.



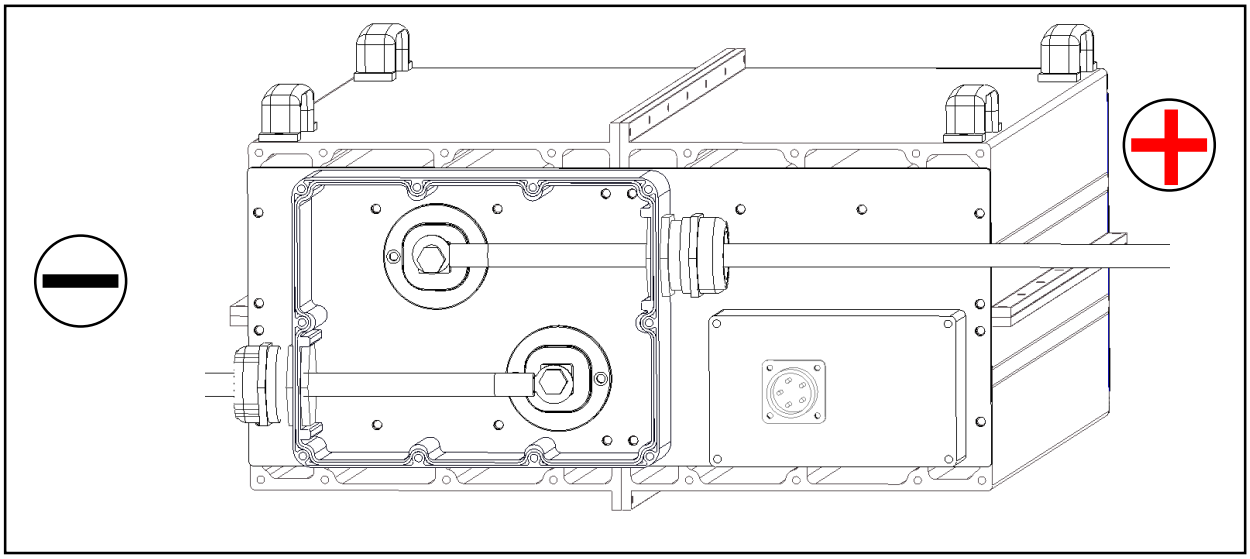
<Fig. 6> Clamping Ring lug

3) Push the Ring lug clamped with cable into the Female Cable-gland on the side of Junction -Box. Fix Ring lug with washer and M8 bolt into + terminal( M10 bolt into – terminal).
* Attention to Polarity



< Fig. 7 > Fixing Cable

4) After fixing cables into + / - output terminals, tighten Cable-gland on the side of Junction- Box. (place extra attention because it is related with water proof)



<Fig. 8> Tightening Cable-gland

## 6. Monitoring System

### 6.1. Monitoring connector

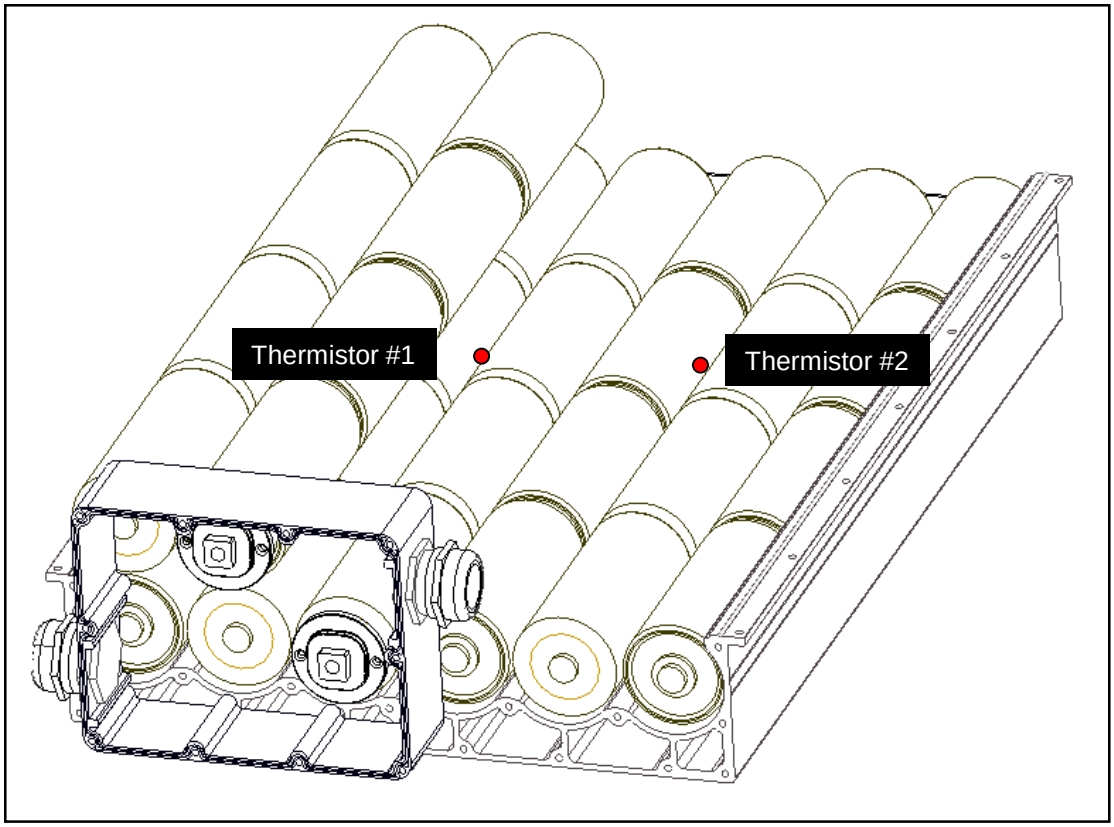
- The output of connector is tabulated below.

| | LS UC Module Side | | Customer System Side | | Pin Out |
|---|---|---|---|---|---|
| | Image | Part's No. (pin) | Image | Part's No. (pin) | |
| Monitoring Connector 2 |  | KD3102A 16s-8P (5-pin) |  | KD3106A 16s-8S (5-pin) | A - +24<br>B - GND<br>C - CAN_GND<br>D - CAN_h<br>E - CAN_l |

* Connector images are used just for reference only. 5 pin type is actually used.

## 6.2. Temperature monitoring

- The NTC thermistors are used for module temperature monitoring. The temperature output is also available via CAN communication. <Fig. 9> shows the location of thermistors.

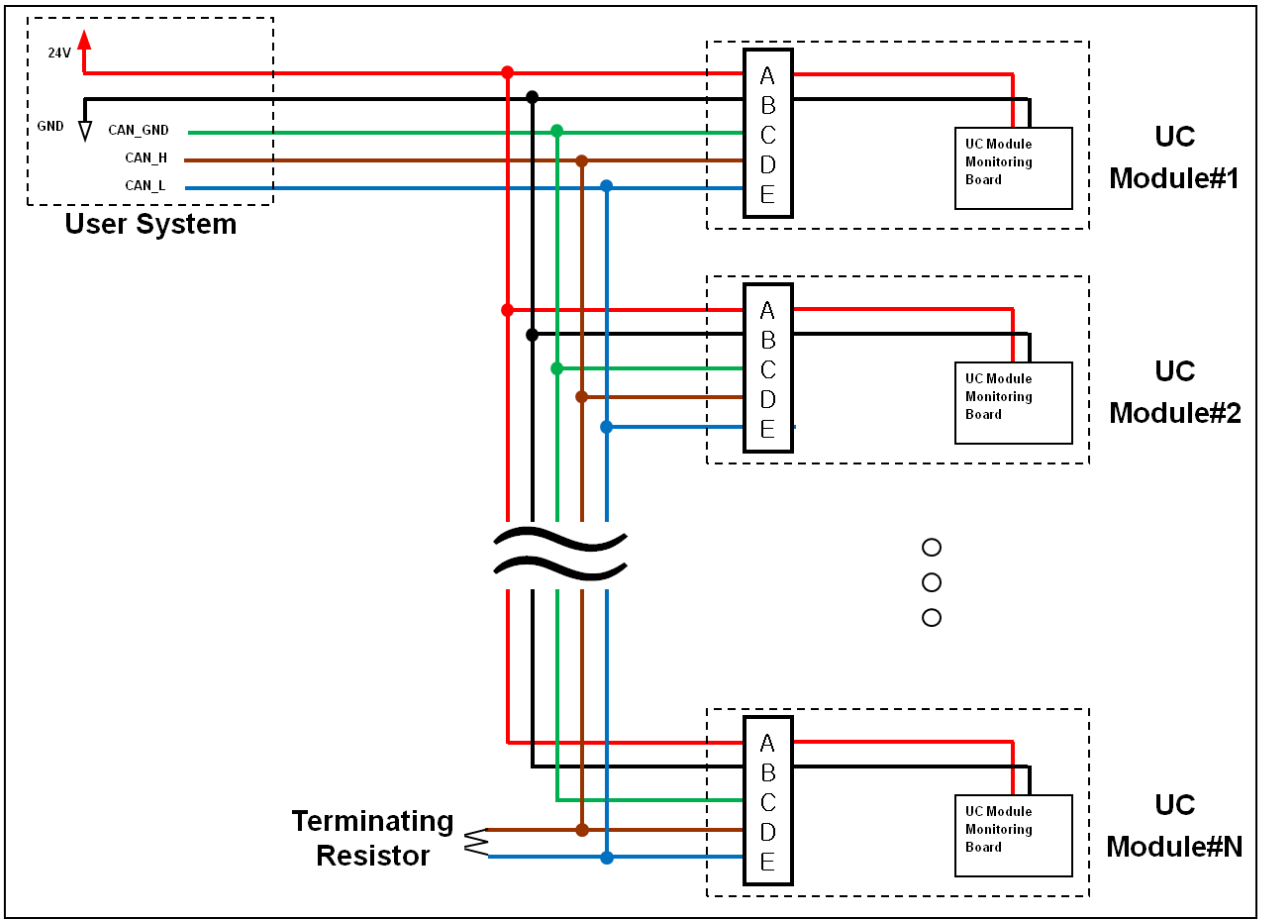



<Fig. 9> Location of the NTC thermistors

## 6.3. CAN communication

### 6.3.1. Circuit Diagram & Terminating Resistor

<Fig. 10> shows the schematic of User system - LS UC Modules

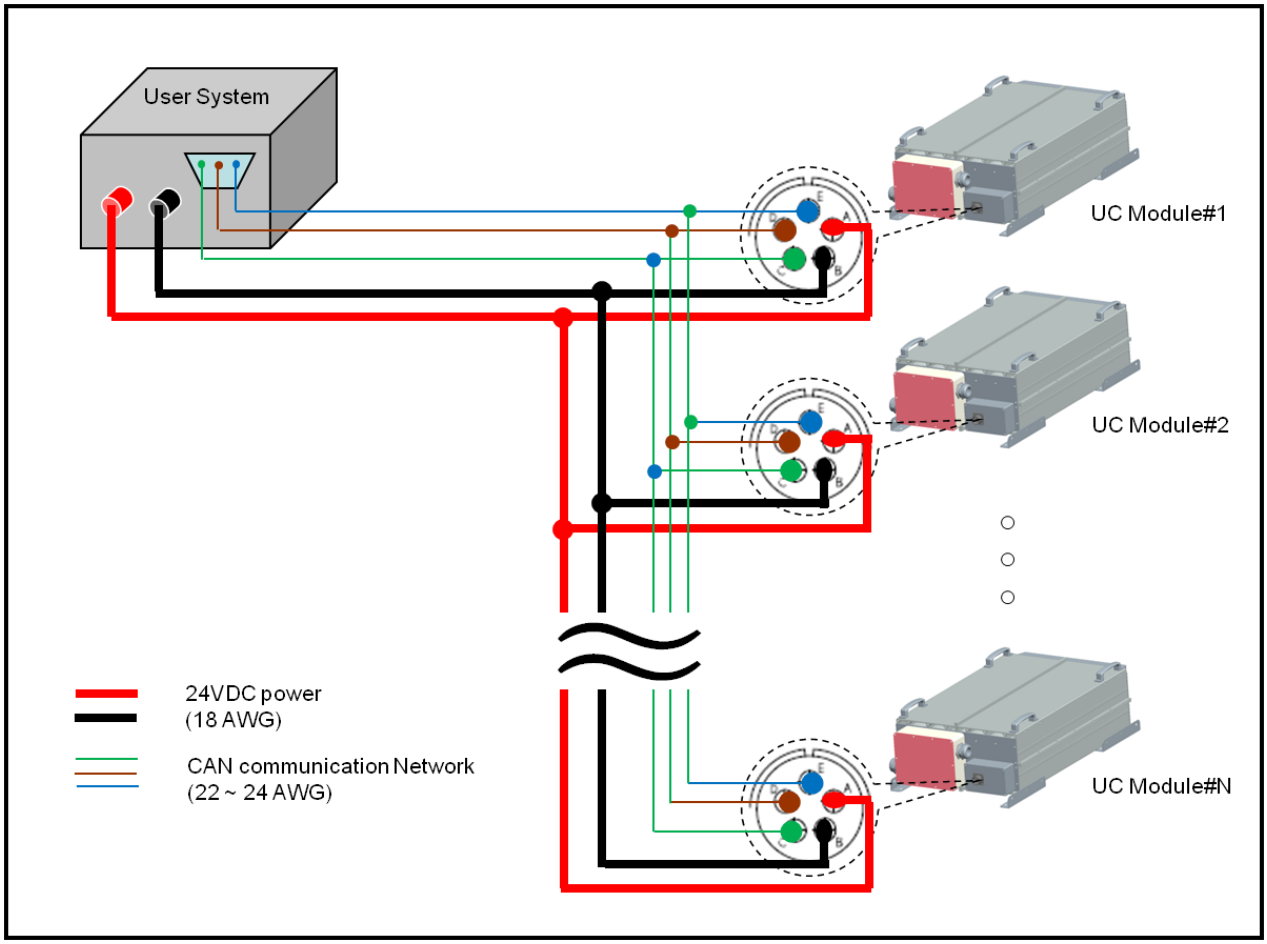



<Fig. 10> Circuit Diagram

Terminating Resistor is not installed when customer receive modules. Terminating resistor should be connected to the last module from CAN Communication network.(The far end module from the user system. 120Ω in parallel will be suitable.)

For example, if modules are connected as diagram above, terminal resistor is to be located between D-E terminal of 5pin connector in the Module #N

### 6.3.2. CAN communication  line and DC power line connection




<Fig. 11> CAN communication & DC power line

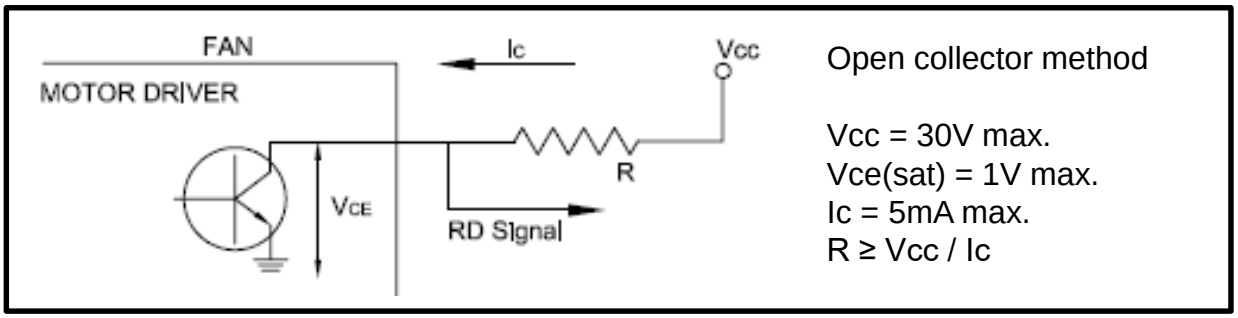
Solder CAN communication lines and DC power lines with wires in reference with <Fig. 11>.
Applying heat shrinkable tube (13ϕ, 110mm: enclosed with 5pin connector) is recommended. If UC module is installed to expose direct sunlight - Please refer to the appendix III

## 7. FAN

- LSUM 129R6C 0062F EA module has two cooling kit. Cables connected to Fan comply with UL1007 24AWG. Each wire is to be connected as below.

| |
|---|
| Red : (+)<br>Black : (-)<br>Yellow : Rotation detect |

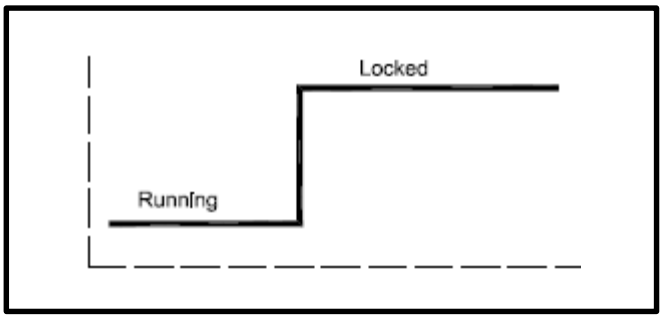
- Rotation of FAN can be checked with yellow wire with following instruction
  Caution : The lead wire of rotation detect signal cannot short the lead wire of (+) or (-)




Open collector method

Vcc = 30V max.
Vce(sat) = 1V max.
Ic = 5mA max.
R ≥ Vcc / Ic

- Alarm signal waveform

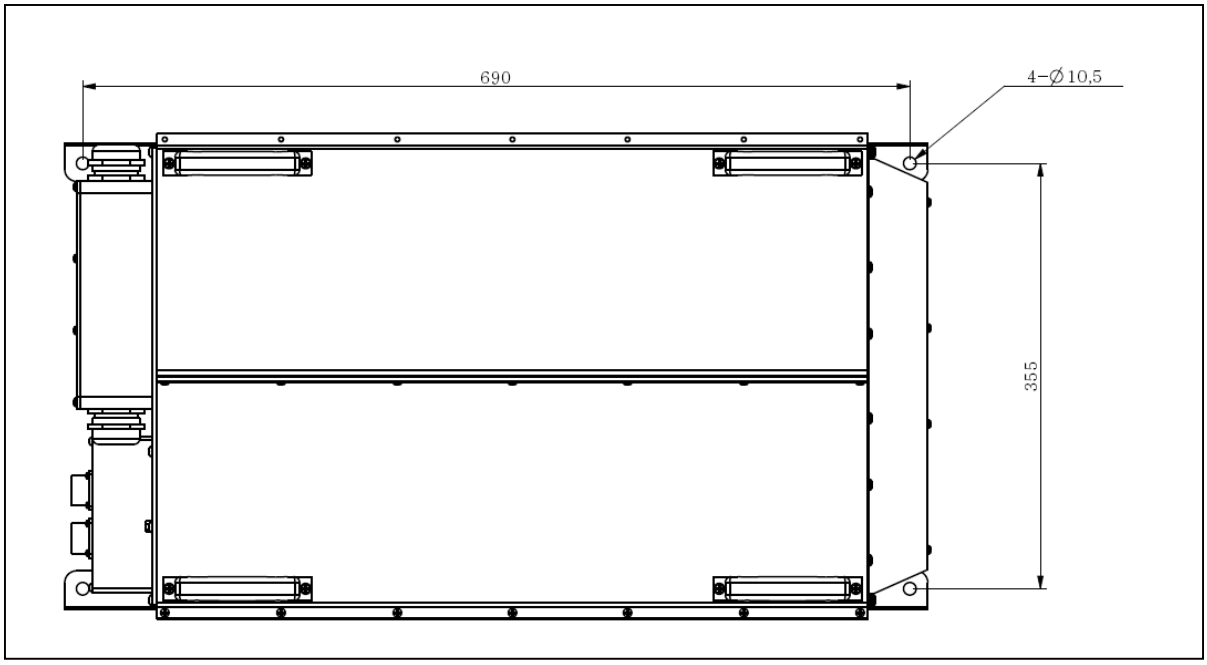


- FAN specification (Each fan)

| Items | Description |
|---|---|
| Rated Voltage | 24VDC |
| Operating Voltage | 12 ~ 27.6VDC |
| Start up Voltage | 12VDC |
| Current | 1.05A |
| Power | 25.2W |
| Speed | 6,000±10%rpm<br>(at 25℃ To record speed after FAN running normal, this time about 3~5 minutes) |
| Protection Rating | IP 68 |

## 8. Mounting

- <Fig. 12> shows the mounting positions of the module.




<Fig. 12. Mounting Positions>

## 9. Maintenance

**Power Rating**

If the applied voltage is over rated voltage, charging the module should be stopped. And the allowable low voltage level of the module depends on the user's requirements, but full discharging to 0V does not affect the module performance.

**Temperature**

The module has its optimal operating temperature range of -40 to 65. Over 70℃, charging and discharging should be stopped to preserve its performance and life cycle.

**Do not expose to direct sunlight**

For installation do not make the module expose to direct sunlight due to temperature increase inside the module.

**Maintenance**

The module has its projected life over 10years at rated voltage and +25℃. However the life cycle of the module may be decreased in high temperature condition or over voltage charging.

If following abnormal module performances are detected, operation should be stopped and checking the electrical & mechanical connections is recommended.

- Detection of high temperature in normal operating conditions

- Internal resistance increase or initial voltage drop increase

- Deformation of the module case

## 10. Reconditioning

### Voltage monitoring via the CAN network

The LS Materials 129.6V / 62F Ultracapacitor Module has 4 internal voltage groups and each group`s voltage data can be delivered to customer`s CAN network.
1 group consists of 8 series cells as below.

$V_1$ : 1st 8 Series cell group voltage
$V_2$ : 2nd 8 Series cell group voltage
$V_3$ : 3rd 8 Series cell group voltage
$V_4$ : 4th 8 Series cell group voltage
$V_5$ : 5th 8 Series cell group voltage
$V_6$ : 6th 8 Series cell group voltage

Therefore, using voltage data, $V_1$~$V_4$ can be calculated as below

$V_1$ = 1/6 voltage
$V_2$ = 2/6 voltage – 1/6 voltage
$V_3$ = 3/6 voltage – 2/6 voltage
$V_4$ = 4/6 voltage – 3/6 voltage
$V_5$ = 5/6 voltage – 4/6 voltage
$V_6$ = 6/6 voltage – 5/6 voltage

When multiple modules(N) are connected directly, the number of voltage data is 6*N. This 6*N data may have voltage deviation. $V_{max\text{-}min}$ is the difference between the highest voltage data and lowest voltage data . If $V_{max\text{-}min}$ is higher than 3V, conducting the reconditioning cycle can narrow down the difference.

### Reconditioning cycle

Step1. Maintain 129.6V*N (Number of module connected) for 5 minutes.

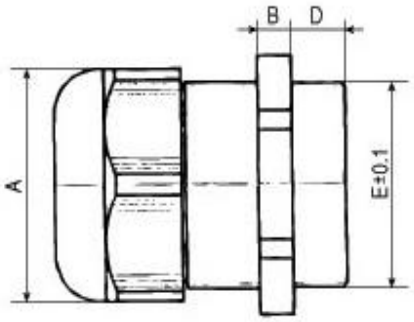
Step2. Disconnect modules from the charging device and conduct voltage monitoring through CAN network.
Connected modules in series connection continues discharging by the balancing circuit inside modules.

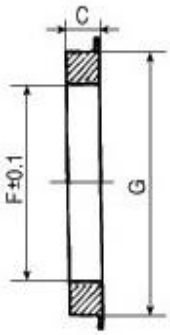
Step3. Check $V_{max\text{-}min}$ value when the each of module voltage goes under 125V.
(It takes about 10minitues to be discharged to under 125V)
If $V_{max\text{-}min}$ value is higher than 1, conduct 1 more cycle from step.1

## Appendix I

- Cable Glands Specification

- Material : Nylon
- Silver-grey or weather resistant UV Black
- Seal insert : Neoprene
- Temperature : -30℃ to+80℃
- Protection class : IP 68
- Flame-retardant : Good Reinforced Nylon. Sealing Nut Weather resistant

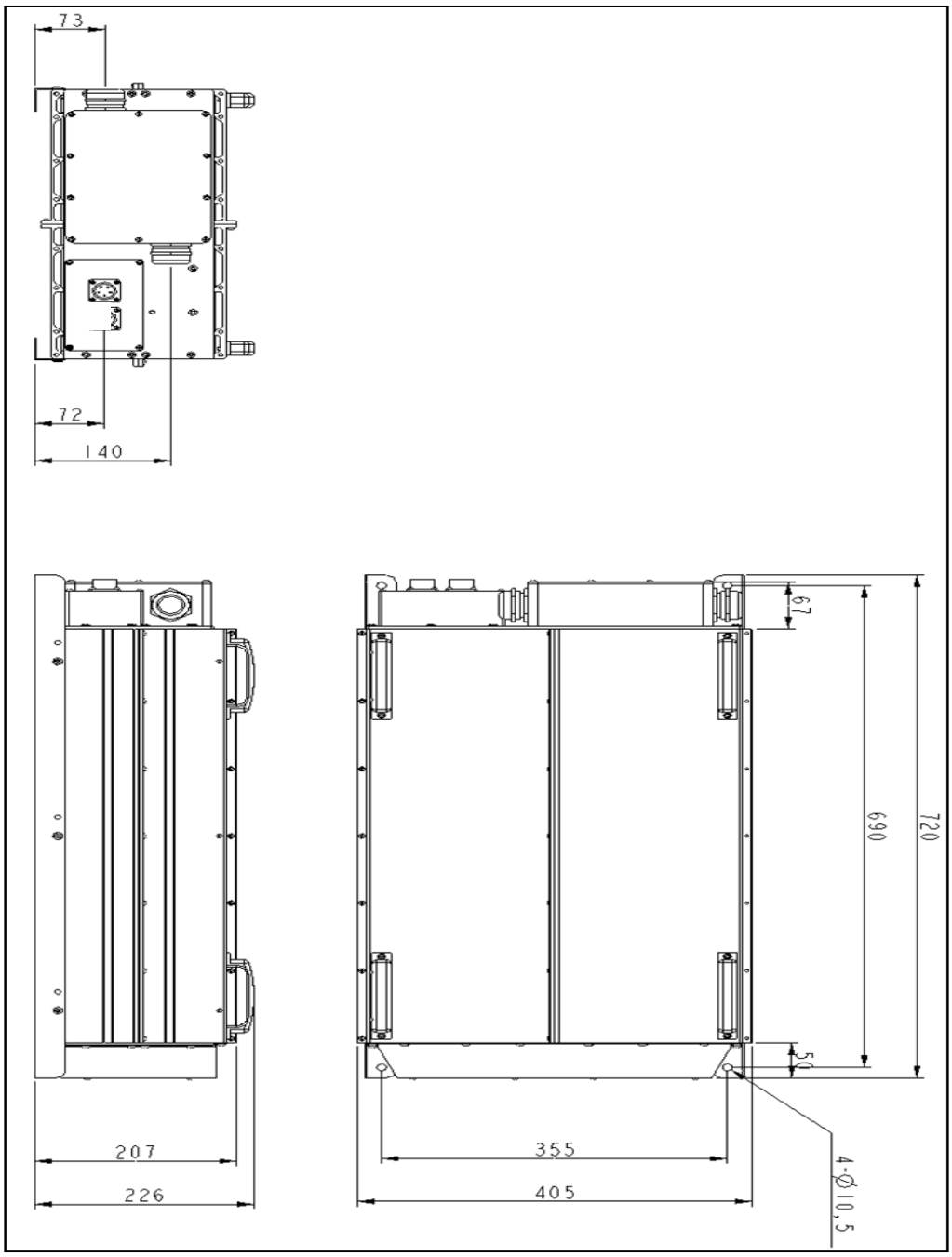



Unint : mm

| PART NO | To suit cable dia between mm | A | B | C | D | E | F | G | PITCH |
|---|---|---|---|---|---|---|---|---|---|
| PG 7 | 3-6.5 | 15.0 | 5.0 | 5.0 | 8.0 | 12.3 | 11.6 | 21.0 | 1.0 |
| PG 9 | 4-8 | 19.0 | | | | 14.8 | 14.0 | 23.7 | 1.25 |
| PG 11 | 5-10 | 22.0 | | | | 18.2 | 17.2 | 26.0 | 1.25 |
| PG 13.5 | 6-12 | 24.0 | | 6.0 | 9.0 | 19.9 | 19.0 | 29.0 | 18G |
| PG 13.5-L | | | | | 12.5 | | | | |
| PG 16 | 10-14 | 27.0 | 6.0 | | 10.0 | 22.0 | 21.2 | 33.0 | 1.5 |
| PG 21 | 13-18 | 32.60 | | 7.0 | 11.0 | 27.6 | 28.8 | 38.4 | 16G |
| PG 29 | 18-25 | 42.0 | 7.0 | | | 36.5 | 35.6 | 50.0 | 1.5 |
| PG 36 | 24-32 | 53.0 | 8.0 | 8.0 | 13.0 | 46.0 | 45.2 | 66.0 | 16G |
| PG 42 | 32-38 | 60.0 | 9.0 | 9.0 | | 53.0 | 52.2 | 72.0 | 16G |
| PG 48 | 37-44 | 65.0 | | | 14.0 | 58.5 | 57.6 | 76.0 | 16G |

## Appendix II



## Appendix III


1. Assemble the heat shrinkable tube on the rubber tube


2. Fasten +bolt(2points) after assembling the cramp


3. After assembling connector, apply heat on the heat shrinkable tube until the tube shrinks properly(Please refer to the picture above) and fasten a cable tie on the tube