



# User Manual

LSUM 129R6C 0062F EA



# User Manual

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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.

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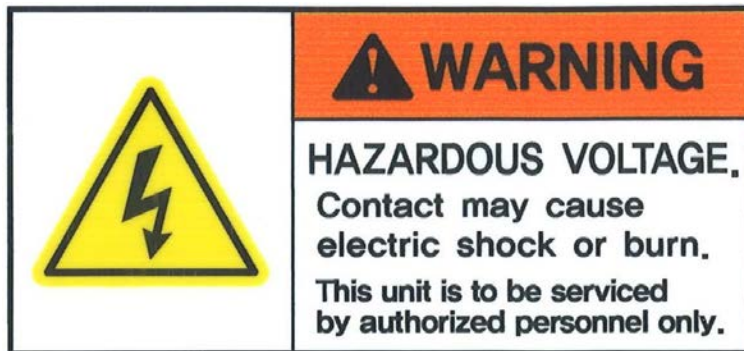
## 2. Unpacking

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 129.6V DC.

Prior to installation and removal from the equipment, it is mandatory to fully discharge the module.

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## 4. Identification of features

### - Product Image

Detailed identification is referred to the Chapter Output terminal connection.



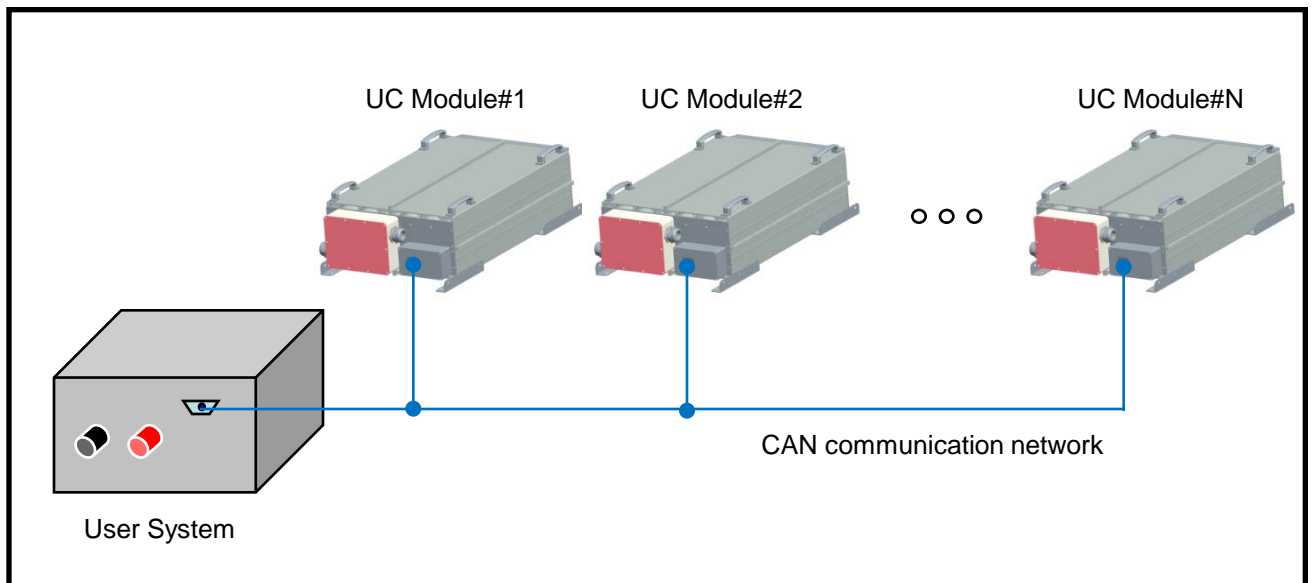
<Fig. 1> Product Image

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## 5. 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.

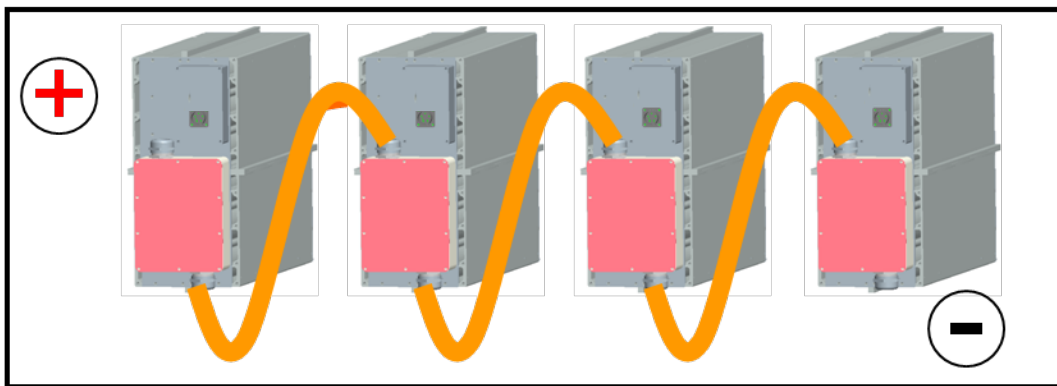


<Fig. 2> CAN communication network

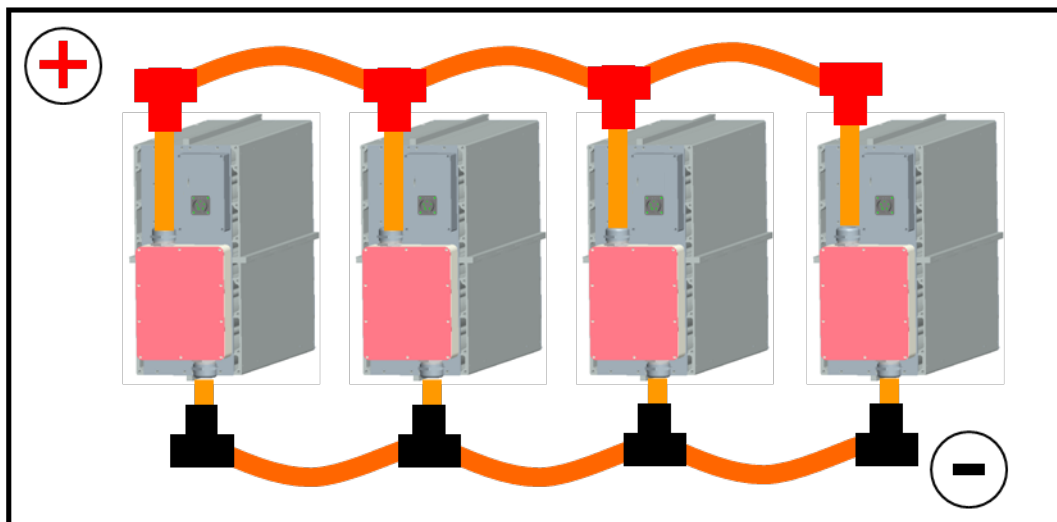
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- There are series and parallel connection for High power



<Fig. 3> Series Connection of Modules



<Fig. 4> Parallel Connection of Modules.

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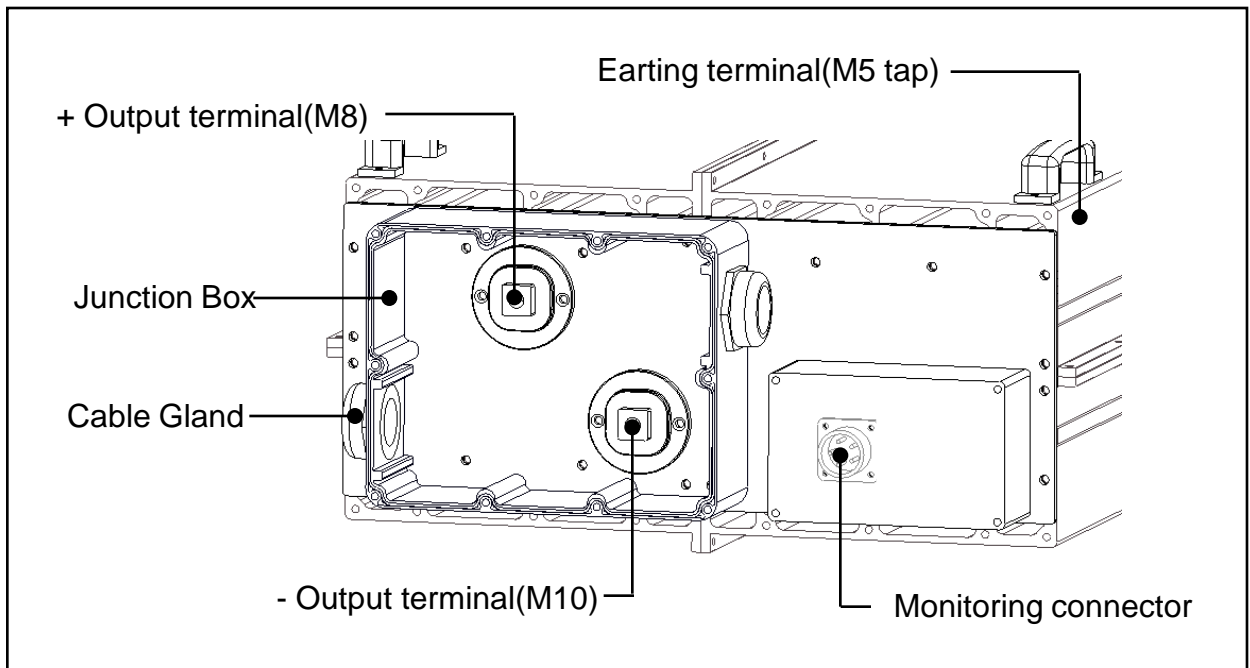
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## 6. Output terminal connection

- 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.



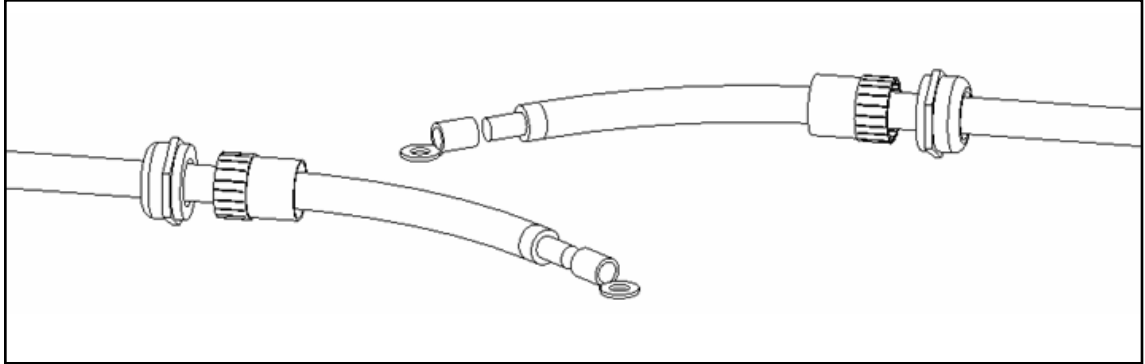
<Fig. 5> Internal Junction Box



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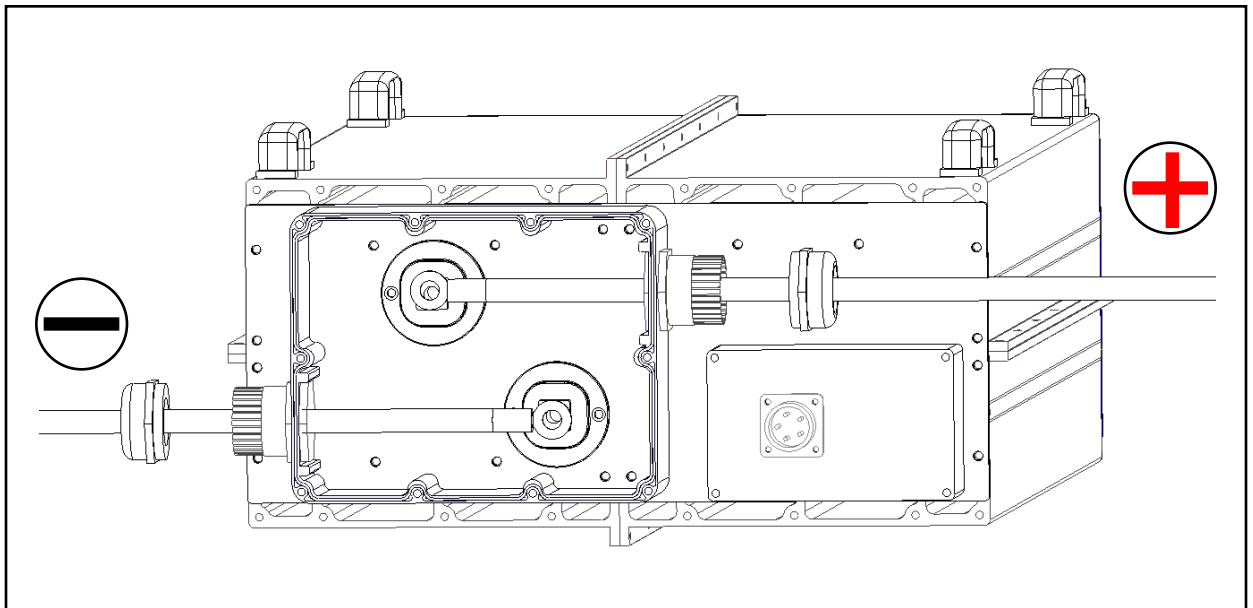
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- 2) Disassemble male Cable-gland off female Cable-gland attached to the side of Junction Box. Connect cable into male Cable-gland, and then clamp Ring lug at the end of cable.



<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)

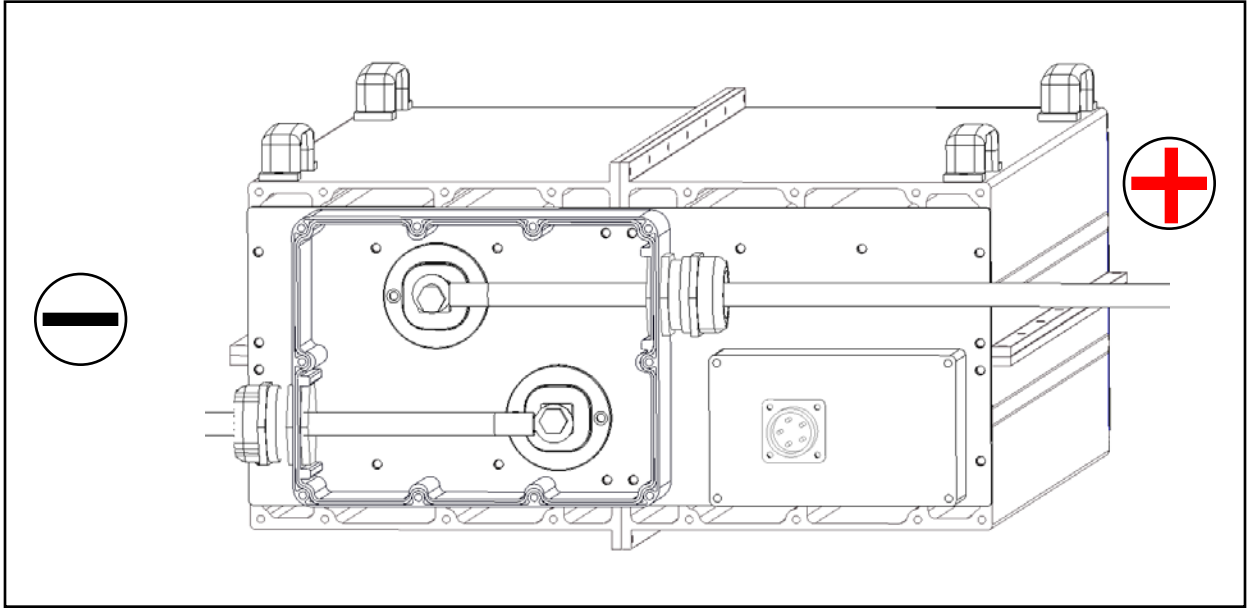


< Fig. 7 > Fixing Cable

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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

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## 7. Monitoring System

### 7-1. 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 B - GND C - CAN_GND D - CAN_h E - CAN_l

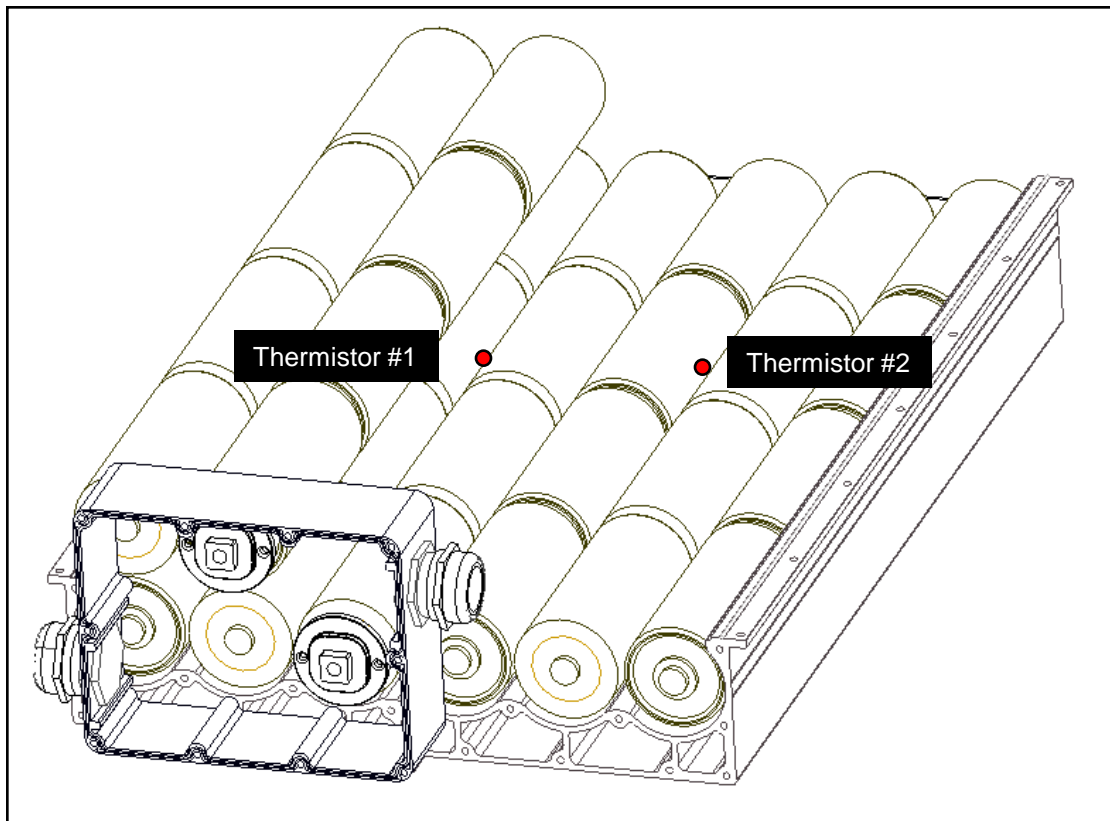
\* Connector images are used just for reference only. 5 pin type is actually used.

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## 7-2. 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

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### 7-3. CAN communication

#### 7.3.1. CAN Protocol

1) Baud rate : 125, 250, 500kbps (The default baud rate is 250kbps)

2) CAN identifier : 29-bit extended CAN identifier

LS UC Master Module Default ID - Receive : 0x18EF0100

LS UC Master Module Default ID - Send : 0x18FF4601

2-1) 24V DC power comes on and for initial 5sec, ID / Baud rate can be on changing mode.

2-2) Message table for ID / Baud rate changing mode

Message	Sender	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	L
Enter ID/Baud rate Changing Mode	User system	0x80	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Changing UC Module ID-Receive	User system	0x81	*ID_LL	ID_LH	ID_HL	ID_HH	0xff	0xff	0:11bit ID 1:29bit ID	8
Changing Baud rate	User system	0x82	0:125kbit/s 1:250kbit/s 2:500kbit/s	0xff	0xff	0xff	0xff	0xff	0xff	8
Read ID-Receive / Baud rate	User system	0x83	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Return message	UC Module	0x83	Baud rate	ID_LL	ID_LH	ID_HL	ID_HH	0xff	0:11bit ID 1:29bit ID	8
Exit ID/Baud rate Changing Mode	User system	0x84	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Changing UC Module ID-Send	User system	0x85	ID_LL	ID_LH	ID_HL	ID_HH	0xff	0xff	0:11bit ID 1:29bit ID	8
Read ID-Send	User system	0x86	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Return message	UC Module	0x86	ID_LL	ID_LH	ID_HL	ID_HH	0xff	0xff	0:11bit ID 1:29bit ID	8

\* <ex1> If the UC Module ID-Receive is set to 0x12345678 29bit  
ID 0x18EF0100 0x81 78 56 34 12 ff ff 01

<ex2> If the UC Module ID-Receive is set to 101(=65\_hex) 11bit  
ID 0x18EF0100 0x81 65 00 00 00 ff ff 00

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### 3) User System → UC Modules

Messages	DB 1	DB 2	DB 3	DB 4	DB 5	DB 6	DB 7	DB 8	Data length
Set Cyclic Transmission Interval	0x02	bit 0 : 4 Voltage data bit 1 : only 4/4 Voltage data bit 2 : Temp.#1 bit 3 : Temp.#2	*Interval(ms)_L	Interval(ms)_H	0xff	0xff	0xff	0xff	8
Set Time Between Messages	0x03	Time(ms)_L	Time(ms)_H	0xff	0xff	0xff	0xff	0xff	8
Ask 1/4 2/4 Voltage data	0x11	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Ask 3/4 4/4 Voltage, temp data	0x12	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Condition Check	Ask Version	0x21	0xff	0xff	0xff	0xff	0xff	0xff	8

\* Default condition 0x02 0f e8 03 ff ff ff ff

All UC modules send message of voltage & temperature automatically to User's system through CAN network in every 1000ms

\*\* <ex 1>. If customer wants to receive voltage data only in every 500ms(=01f4\_hex),  
User's system should give command message to UC module as below;  
ID 0x18EF0100 0x02 01 f4 01 ff ff ff ff

<ex 2>. If customer wants to receive 2 temperature data only in every 5.6sec(=15e0\_hex),  
User's system should give command message to UC module as below;  
ID 0x18EF0100 0x02 0c e0 15 ff ff ff ff

<ex 3>. If customer does not want to receive data cyclically,  
User's system should give command message to UC module as below;  
ID 0x18EF0100 0x02 00 00 00 ff ff ff ff

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### 4) User System ← UC Modules

Messages	DB 1	DB 2	DB 3	DB 4	DB 5	DB 6	DB 7	DB 8	Data length
Cyclic Transmission Interval Acknowledge	0x02	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Time Between Messages Acknowledge	0x03	0xff	0xff	0xff	0xff	0xff	0xff	0xff	8
Voltage & Temperature Acknowledge	0x11	1/4 Voltage_L	1/4 Voltage_H	2/4 Voltage_L	2/4 Voltage_H	*SOC	0x00	0xff	8
		Value = DATA/100		Value = DATA/100					
	0x12	3/4 Voltage_L	3/4 Voltage_H	4/4 Voltage_L	4/4 Voltage_H	Temp. #1	Temp. #2	0xff	8
		Value = DATA/100		Value = DATA/100					
Condition Check	Version Acknowledge	0x21	Main Version	Sub Version	0xff	0xff	0xff	0xff	8

\* SOC : State of Charge

### 5) Messages

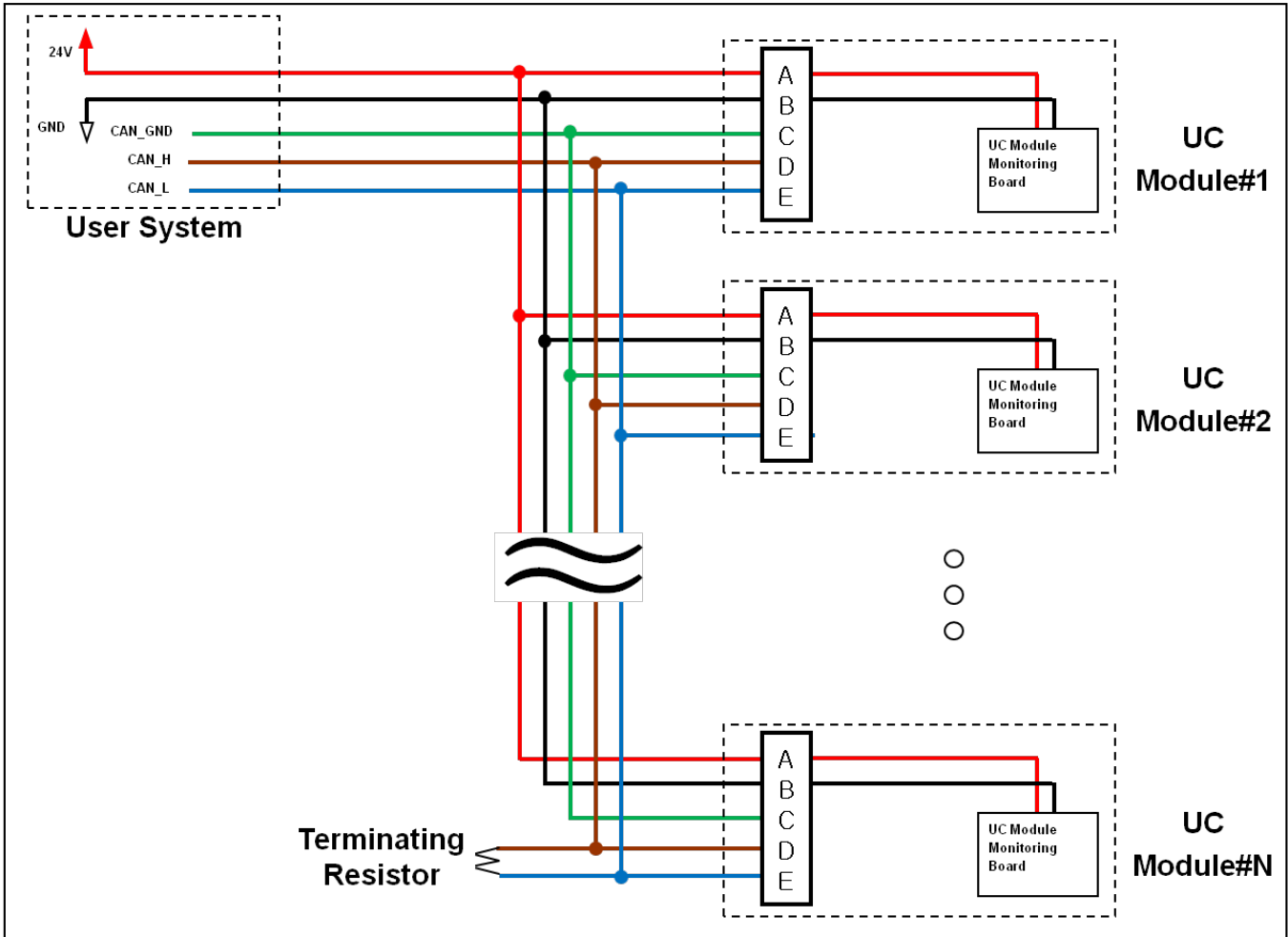
	Offset	Min	Max	Units
Voltage	0	0.12	499.87	Volts
Temperature	0	0.00	120.00	°C

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### 7.3.2. 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. in parallel will be suitable)

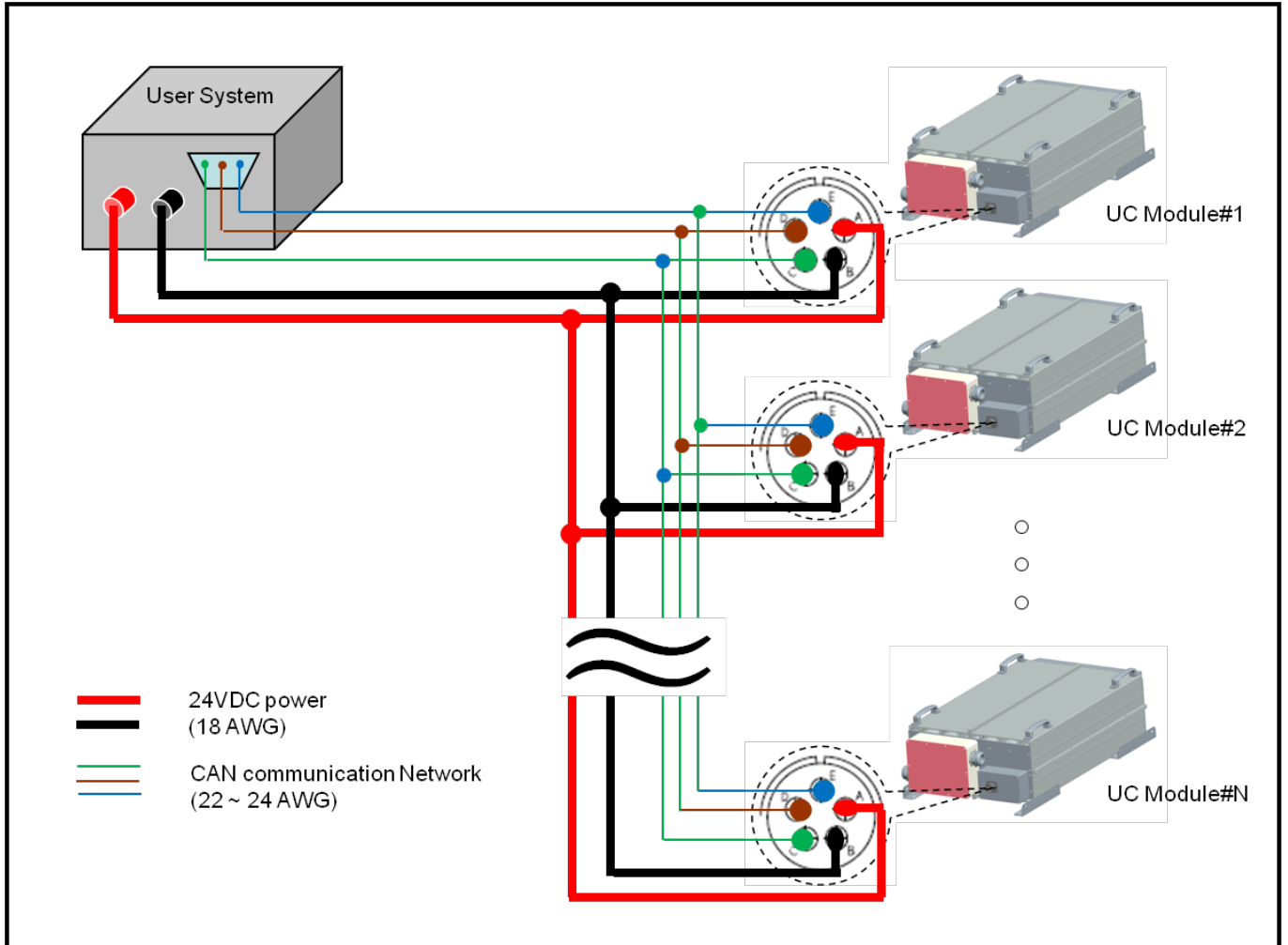
For example, if modules are connected as diagram above, terminal resistor is to be located between D-E terminal of 5pin connector in the Module #N



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### 7.3.3. 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

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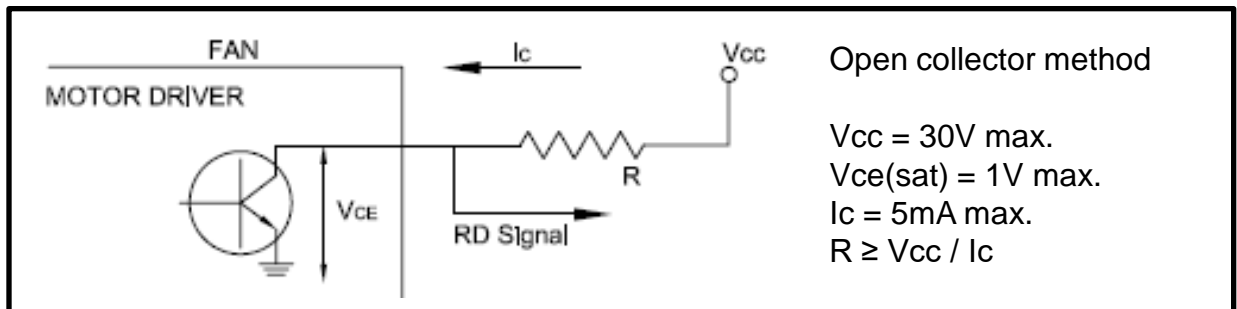
## LSUM 129R6C 0062F EA

### 8. FAN

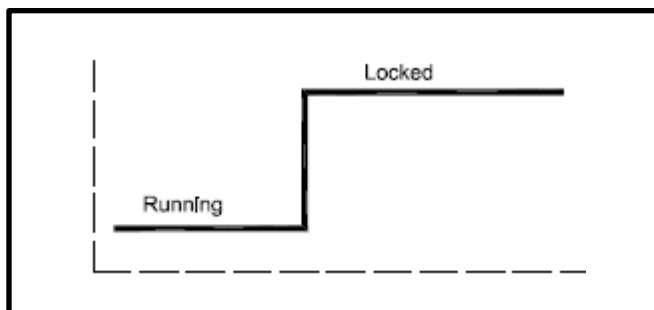
- LSUM 129R6C 0062F EA module has two cooling kit. Cables connected to Fan comply with ULUL1007 24AWG. Each wire is to be connected as below.

Red : (+)  
Black : (-)  
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 (-)



- Alarm signal waveform



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- FAN specification (each fan)

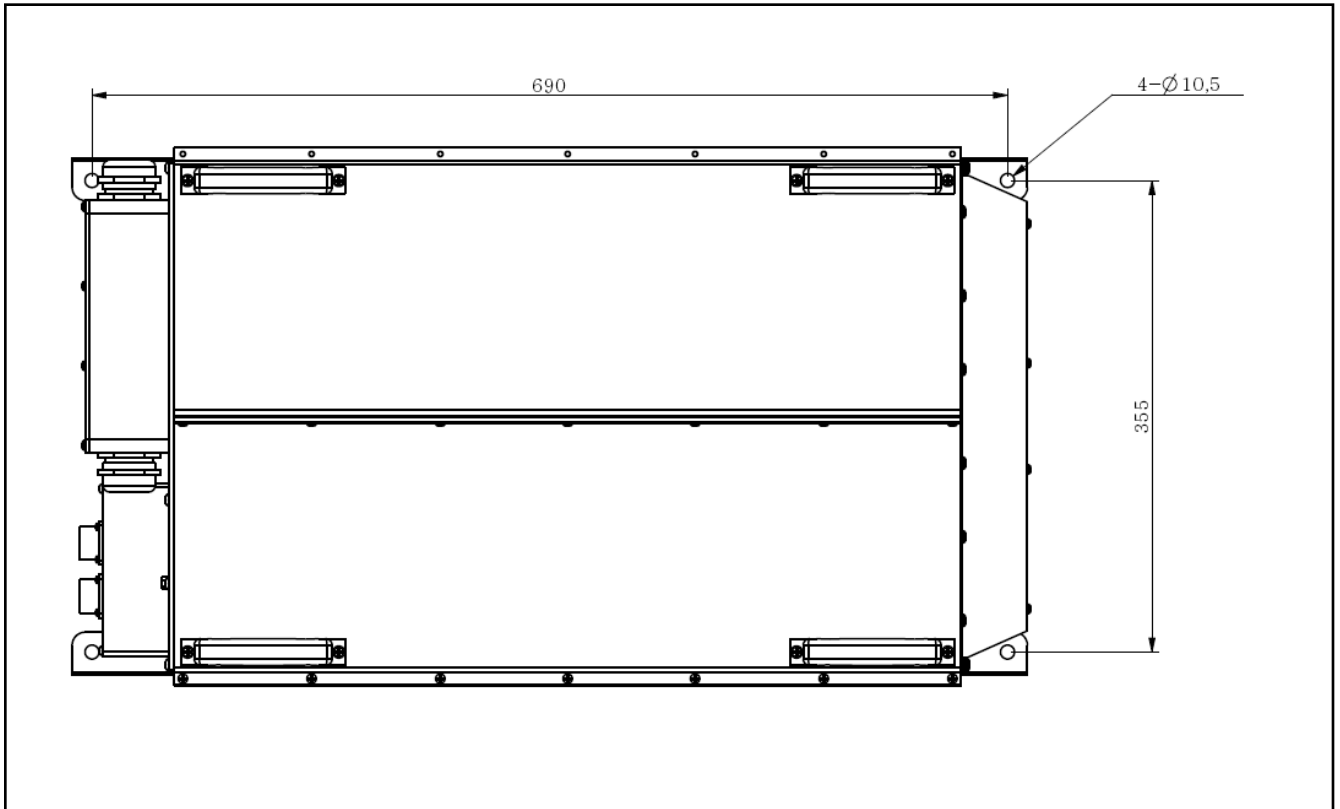
Items	Description
Rated Voltage	24VDC
Operating Voltage	12 ~ 27.6VDC
Start up Voltage	12VDC
Current	1.05A
Power	25.2W
Speed	6,000±10%rpm (at 25℃ To record speed after FAN running normal, this time about 3~5 minutes)
Protection Rating	IP 68

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## 9. Mounting

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



<Fig. 12. Mounting Positions>

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## 10. Maintenance

### Power Rating

The rated voltage of the module is max 129.6V. If the applied voltage is over 129.6V, 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°C, charging and discharging should be stopped to expect 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 expected life cycle over 10years at rated voltage and +25°C. 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.

- Monitoring high temperature in normal operating conditions
- Internal resistance increase or initial voltage drop increase
- Deformation of the module case

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## 11. Reconditioning

### Voltage monitoring via the CAN network

The LS Mtron`s 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 12 series cells as below.

$V_1$  : 1<sup>st</sup> 12 Series cell group voltage

$V_2$  : 2<sup>nd</sup> 12 Series cell group voltage

$V_3$  : 3<sup>rd</sup> 12 Series cell group voltage

$V_4$  : 4<sup>th</sup> 12 Series cell group voltage

The below is the composition of the 4 group voltage data(16page) and  $V_1\sim V_4$

DB1	DB2	DB3	DB4	DB5
0x11	1/4 voltage = $V_1$		2/4 voltage = $V_1+V_2$	
0x12	3/4 voltage = $V_1+V_2+V_3$		4/4 voltage = $V_1+V_2+V_3+V_4$	

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

$$V_1 = 1/4 \text{ voltage}$$

$$V_2 = 2/4 \text{ voltage} - 1/4 \text{ voltage}$$

$$V_3 = 3/4 \text{ voltage} - 2/4 \text{ voltage}$$

$$V_4 = 4/4 \text{ voltage} - 3/4 \text{ voltage}$$

When multiple modules(N) are connected directly, the number of voltage data is  $4*N$ . This  $4*N$  data may have voltage deviation.  $V_{\max-\min}$  is the difference between the highest voltage data and lowest voltage data . If  $V_{\max-\min}$  is higher than 4V, conducting the reconditioning cycle can narrow down the difference.

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## Reconditioning cycle

Step1. Maintain  $129.6V \cdot N$  (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  $V_{\max-\min}$  value when the each of module voltage goes under 125V.  
(It takes about 10 minutes to be discharged to under 125V)

If  $V_{\max-\min}$  value is higher than 1, conduct 1 more cycle from step.1

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## 12. Contact Information

LS Ultracapacitor

LS Mtron

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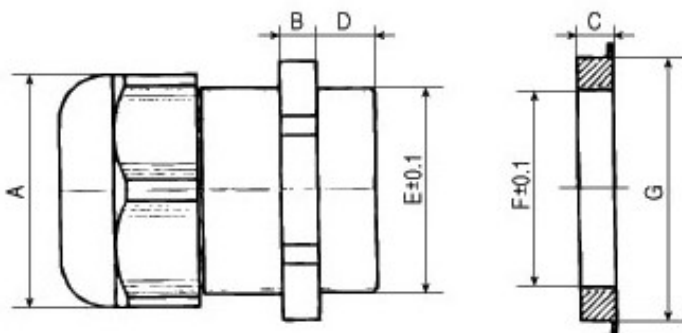
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## Appendix I

### - Cable Glands Specification

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



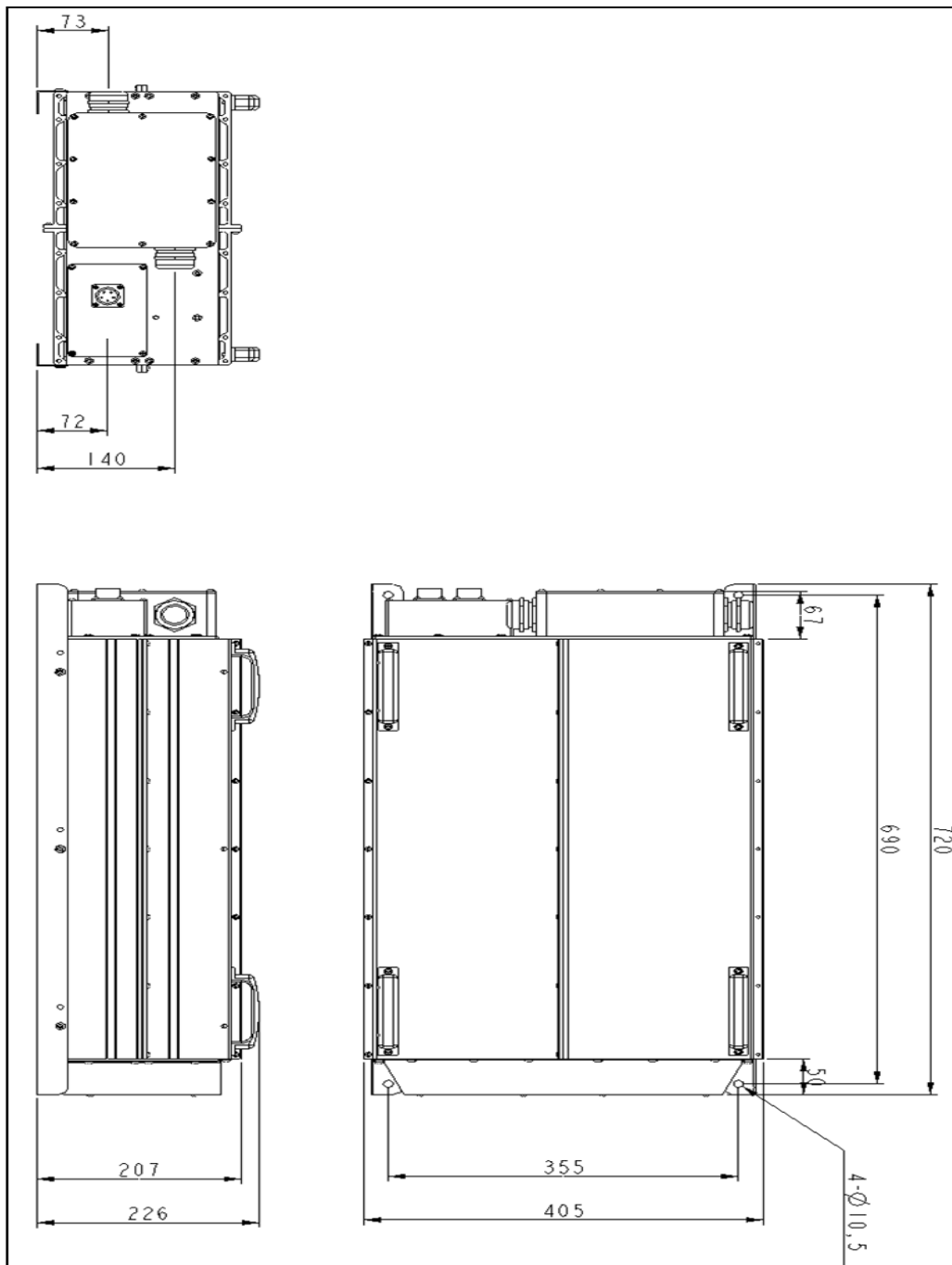
Unit : mm

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	6.0	9.0	19.9	19.0	29.0	18G
PG 13.5-L					12.5				
PG 16	10-14	27.0			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	11.0	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	14.0	53.0	52.2	72.0	16G
PG 48	37-44	65.0				58.5	57.6	76.0	16G

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## Appendix II



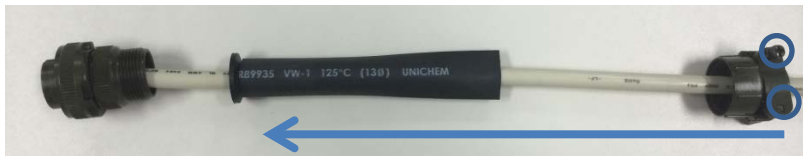
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## Appendix III



1. Assemble the heat shrinkable tube on the rubber tube



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



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