



# User Manual

LSUM 168R0L 0005F EA



# User Manual

## CONTENT

1. Overview .....	04
2. Unpacking .....	05
3. Safety .....	05
4. Identification of features .....	06
5. Module to module connection .....	07
6. Output terminal connection .....	08
7. Mounting .....	10
8. Maintenance .....	11
9. Contact Information .....	12
Appendix I .....	13
Appendix II .....	16

# User Manual

LSUM 168R0L 0005F EA

## 1. Overview

The LS 168V / 5.8F Ultracapacitor Module has high energy and low ESR to meet energy storage and power delivery requirements.

The cells used in the module have 2.8 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 2.8V. In addition, all the cells are balanced by balancing circuit connected parallel to each cell.

# User Manual

LSUM 168R0L 0005F EA

## 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 168V DC.

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

# User Manual

LSUM 168R0L 0005F EA

## 4. Identification of features

- Product Image



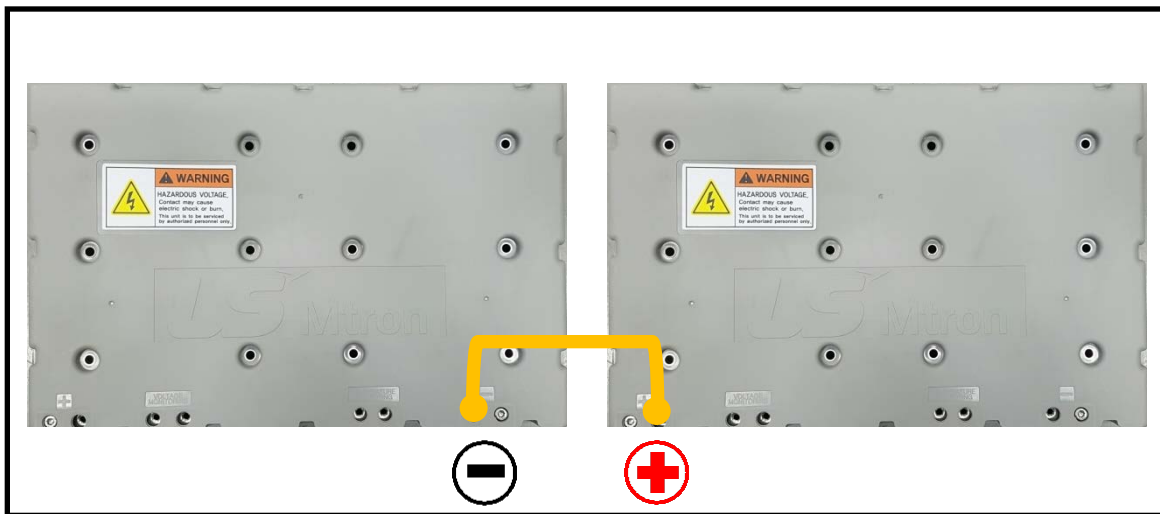
<Fig. 1> Product Image

# User Manual

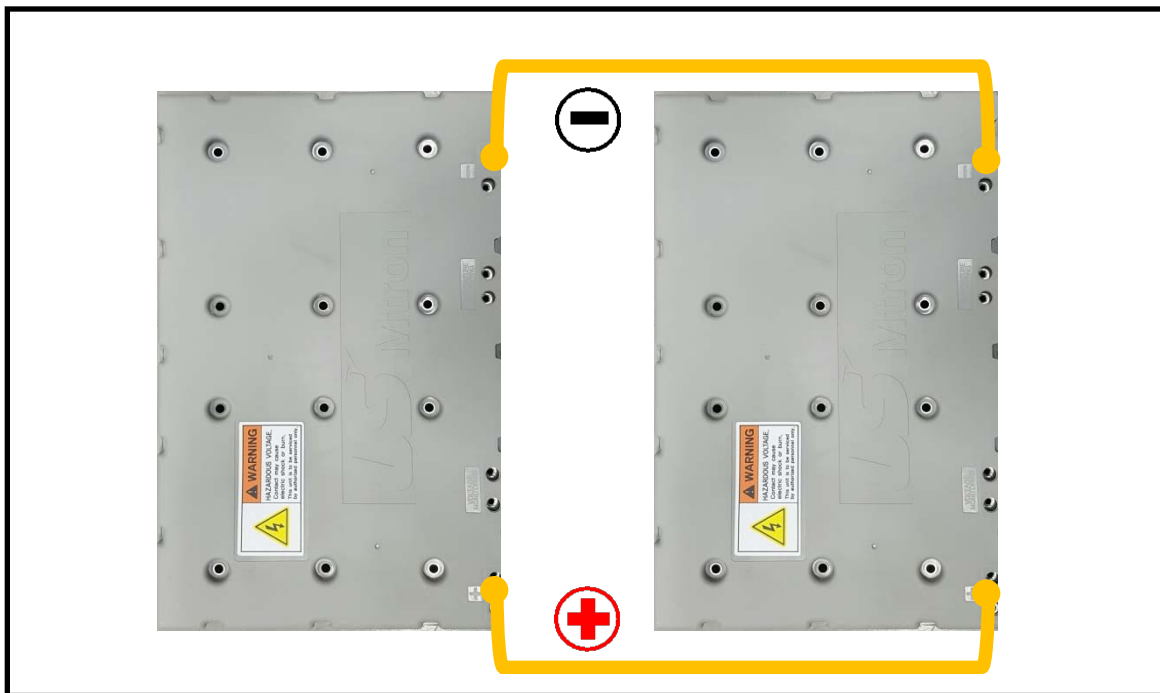
LSUM 168R0L 0005F EA

## 5. Module to module connection

- There are series and parallel connection for High power



<Fig. 2> Series Connection of Modules



<Fig. 3> Parallel Connection of Modules.

# User Manual

LSUM 168R0L 0005F EA

## 6. Output terminal connection



<Fig. 4> Monitoring connector

Pin no.	Pin out	Comment
①	(+) terminal	Power terminal
②	(+) terminal	
③	1/2 Voltage	Voltage monitoring (Do not use power terminal)
④	(-) terminal	
⑤	Thermistor pin 1or2	Temperature monitoring
⑥	Thermistor pin 2or1	
⑦	(-) terminal	Power terminal
⑧	(-) terminal	

# User Manual

## LSUM 168R0L 0005F EA

### Power terminals

- The LS 168V / 5.8F Ultracapacitor Modules are designed to connect directly to a ring or a bus bar. Power terminal threaded size is M5. When tightening the terminal bolt, a torque of 4 Nm for the M5 bolt should be used. Because the modules have a very low ESR, total ESR will be affected by a ring lug, bus bar or torque. Therefore, it needs more attention to assemble the modules. And appropriate protection and sealing should be used on both module terminals to avoid shock hazards and corrosion.

### Half voltage monitoring

-The LS 168V / 5.8F Ultracapacitor Module has a center-tap terminal that can be used to compare the voltage of the upper half of the ultracapacitor array with that of the lower half as a diagnostic for imbalance. This mid-point voltage is accessible through the M5 monitoring terminals . The current drawn from the center tap should not exceed 10  $\mu$ A. Drawing currents in excess of this amount can create imbalance within the module. The maximum torque for this M5 terminal is 4 Nm.

### Temperature monitoring

-Temperature monitoring terminals are connected with a NTC thermistor for temperature monitoring.

According to temperature variation in the module, the resistance of the thermistor is determined. The resistance measured through the thermistor relates to temperature according to the SMD chip thermistor 10K@ 25 $^{\circ}$ C resistance to temperature chart for the appendix I.



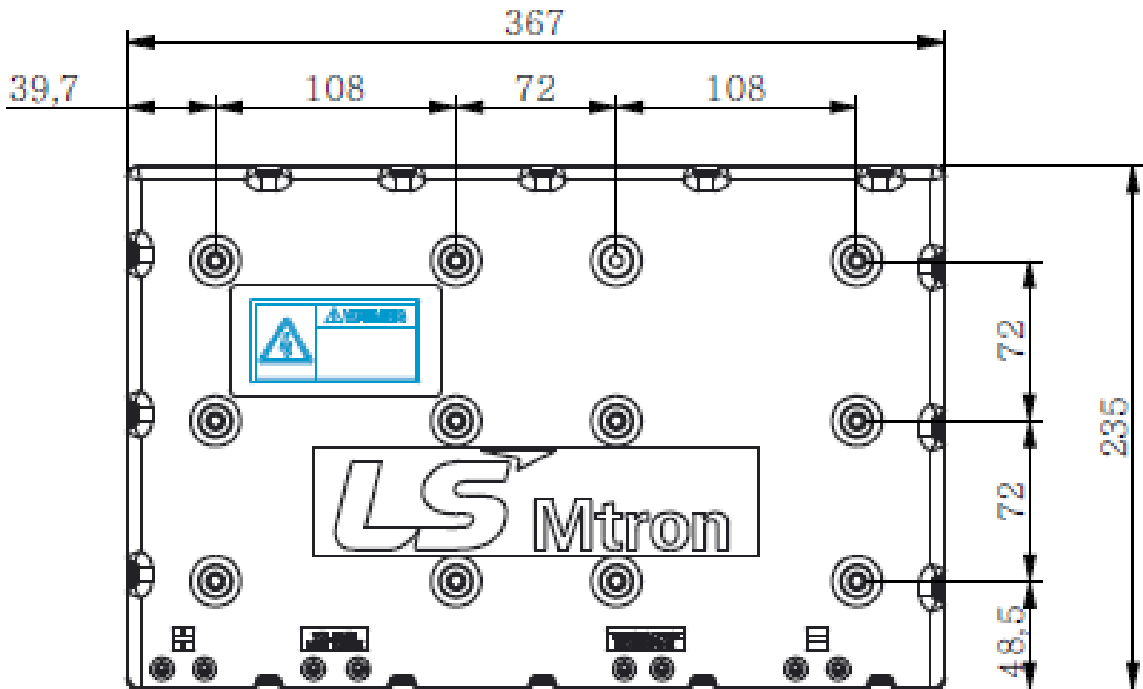
# User Manual

LSUM 168R0L 0005F EA

## 7. Mounting

The modules should not be mounted in locations where they are directly exposed to the environment.

<Fig. 5> shows the mounting positions of the module



<Fig. 5> Mounting Positions

# User Manual

LSUM 168R0L 0005F EA

## 8. Maintenance

### Power Rating

The rated voltage of the module is max 168V. If the applied voltage is over 168V, 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

# User Manual

LSUM 168R0L 0005F EA

## 9. Contact Information

LS Ultracapacitor

LS Mtron

6F, LS Mtron Hi-Tech Center, 39, LS-Ro, 116beon-gil, Dongan-gu, Anyang-si,  
Gyeonggi-do 431-831, Korea

Tel. +82-31-8045-9579

Fax. +82-31-8045-9544

E-mail. [ultracapacitor@lsmtron.com](mailto:ultracapacitor@lsmtron.com)

# User Manual

## LSUM 168R0L 0005F EA

### Appendix I

T(°C)	Rmin(kΩ)	Rcent(kΩ)	Rmax(kΩ)	DR(%)	DT(°C)
-40	332.8	348.4	364.6	4.65%	0.67
-39	311.2	325.5	340.4	4.58%	0.66
-38	291.2	304.3	318.0	4.51%	0.66
-37	272.5	284.7	297.3	4.44%	0.65
-36	255.2	266.4	278.0	4.37%	0.65
-35	239.1	249.4	260.2	4.30%	0.64
-34	224.2	233.7	243.6	4.23%	0.64
-33	210.2	219.0	228.1	4.17%	0.63
-32	197.3	205.4	213.8	4.10%	0.63
-31	185.2	192.7	200.4	4.03%	0.62
-30	173.9	180.8	188.0	3.97%	0.61
-29	163.4	169.8	176.4	3.90%	0.61
-28	153.6	159.5	165.6	3.84%	0.60
-27	144.5	149.9	155.6	3.77%	0.60
-26	135.9	141.0	146.2	3.71%	0.59
-25	127.9	132.6	137.5	3.64%	0.59
-24	120.5	124.8	129.3	3.58%	0.58
-23	113.5	117.5	121.6	3.52%	0.58
-22	107.0	110.7	114.5	3.46%	0.57
-21	100.9	104.3	107.8	3.40%	0.56
-20	95.15	98.33	101.6	3.34%	0.56
-19	89.79	92.74	95.77	3.27%	0.55
-18	84.76	87.50	90.31	3.21%	0.55
-17	80.05	82.59	85.19	3.16%	0.54
-16	75.63	77.98	80.40	3.10%	0.53
-15	71.49	73.66	75.90	3.04%	0.53
-14	67.59	69.61	71.69	2.98%	0.52
-13	63.94	65.81	67.73	2.92%	0.51
-12	60.50	62.24	64.02	2.86%	0.51
-11	57.27	58.88	60.53	2.81%	0.50
-10	54.23	55.73	57.26	2.75%	0.49
-9	51.37	52.76	54.18	2.69%	0.49
-8	48.68	49.97	51.29	2.64%	0.48
-7	46.15	47.35	48.57	2.58%	0.47
-6	43.77	44.88	46.01	2.53%	0.47
-5	41.52	42.55	43.60	2.47%	0.46
-4	39.40	40.36	41.34	2.42%	0.45
-3	37.41	38.29	39.20	2.37%	0.45
-2	35.52	36.35	37.19	2.31%	0.44

# User Manual

## LSUM 168R0L 0005F EA

T(℃)	Rmin(kΩ)	Rcent(kΩ)	Rmax(kΩ)	DR(%)	DT(℃)
-1	33.74	34.51	35.29	2.26%	0.43
0	32.07	32.78	33.50	2.21%	0.43
1	30.48	31.14	31.81	2.15%	0.42
2	28.99	29.60	30.22	2.10%	0.41
3	27.57	28.14	28.72	2.05%	0.40
4	26.24	26.78	27.30	2.00%	0.40
5	24.97	25.48	25.98	1.95%	0.39
6	23.78	24.23	24.69	1.90%	0.38
7	22.64	23.07	23.49	1.85%	0.37
8	21.57	21.96	22.36	1.80%	0.37
9	20.56	20.92	21.29	1.75%	0.36
10	19.60	19.94	20.27	1.70%	0.35
11	18.69	19.00	19.31	1.65%	0.34
12	17.83	18.12	18.41	1.60%	0.34
13	17.01	17.28	17.54	1.55%	0.33
14	16.24	16.48	16.73	1.51%	0.32
15	15.50	15.73	15.98	1.46%	0.31
16	14.80	15.01	15.22	1.41%	0.30
17	14.14	14.33	14.53	1.36%	0.30
18	13.51	13.69	13.87	1.32%	0.29
19	12.91	13.08	13.24	1.27%	0.28
20	12.35	12.50	12.65	1.23%	0.27
21	11.81	11.95	12.09	1.18%	0.26
22	11.29	11.42	11.55	1.13%	0.25
23	10.81	10.92	11.04	1.09%	0.24
24	10.34	10.45	10.56	1.04%	0.24
25	9.900	10.00	10.10	1.00%	0.23
26	9.472	9.572	9.671	1.04%	0.24
27	9.064	9.164	9.264	1.09%	0.25
28	8.677	8.776	8.875	1.13%	0.26
29	8.308	8.408	8.505	1.18%	0.27
30	7.957	8.054	8.153	1.22%	0.29
31	7.622	7.719	7.817	1.26%	0.30
32	7.304	7.400	7.496	1.30%	0.31
33	7.000	7.095	7.191	1.35%	0.32
34	6.711	6.805	6.900	1.39%	0.33
35	6.436	6.528	6.622	1.43%	0.35
36	6.173	6.265	6.357	1.47%	0.36
37	5.922	6.013	6.104	1.52%	0.37
38	5.683	5.772	5.862	1.56%	0.38
39	5.455	5.543	5.631	1.60%	0.40
40	5.237	5.324	5.411	1.64%	0.41
41	5.030	5.114	5.200	1.68%	0.42
42	4.831	4.915	4.999	1.72%	0.44
43	4.641	4.724	4.807	1.76%	0.45
44	4.460	4.541	4.623	1.80%	0.46

# User Manual

## LSUM 168R0L 0005F EA

T(°C)	Rmin(kΩ)	Rcent(kΩ)	Rmax(kΩ)	DR(%)	DT(°C)
45	4.287	4.367	4.447	1.84%	0.47
46	4.122	4.200	4.279	1.88%	0.49
47	3.964	4.040	4.118	1.92%	0.50
48	3.812	3.887	3.964	1.96%	0.51
49	3.668	3.741	3.816	2.00%	0.53
50	3.529	3.601	3.675	2.04%	0.54
51	3.397	3.468	3.540	2.08%	0.55
52	3.270	3.339	3.410	2.11%	0.57
53	3.149	3.217	3.286	2.15%	0.58
54	3.032	3.099	3.167	2.19%	0.59
55	2.921	2.986	3.053	2.23%	0.61
56	2.814	2.878	2.944	2.27%	0.62
57	2.712	2.775	2.839	2.30%	0.64
58	2.614	2.675	2.738	2.34%	0.65
59	2.520	2.580	2.642	2.38%	0.66
60	2.430	2.489	2.549	2.41%	0.68
61	2.344	2.401	2.460	2.45%	0.69
62	2.261	2.317	2.375	2.49%	0.71
63	2.181	2.237	2.293	2.52%	0.72
64	2.105	2.159	2.214	2.56%	0.74
65	2.032	2.085	2.139	2.60%	0.75
66	1.962	2.013	2.066	2.63%	0.77
67	1.894	1.945	1.997	2.67%	0.78
68	1.829	1.879	1.930	2.70%	0.80
69	1.767	1.815	1.865	2.74%	0.81
70	1.707	1.755	1.803	2.77%	0.83
71	1.650	1.696	1.744	2.81%	0.84
72	1.594	1.640	1.686	2.84%	0.86
73	1.541	1.586	1.631	2.88%	0.87
74	1.490	1.534	1.578	2.91%	0.89
75	1.441	1.483	1.527	2.95%	0.90
76	1.394	1.435	1.478	2.98%	0.92
77	1.348	1.389	1.431	3.01%	0.93
78	1.304	1.344	1.385	3.05%	0.95
79	1.262	1.301	1.341	3.08%	0.96
80	1.222	1.260	1.299	3.11%	0.98
81	1.183	1.220	1.258	3.15%	1.00
82	1.145	1.181	1.219	3.18%	1.01
83	1.109	1.144	1.181	3.21%	1.03
84	1.074	1.109	1.145	3.25%	1.04
85	1.040	1.074	1.110	3.28%	1.06
86	1.008	1.041	1.076	3.31%	1.08
87	0.9785	1.009	1.043	3.34%	1.09
88	0.9464	0.9785	1.011	3.38%	1.11
89	0.9174	0.9488	0.9811	3.41%	1.12
90	0.8894	0.9201	0.9517	3.44%	1.14

# User Manual

LSUM 168R0L 0005F EA

## Appendix II

### Drawing

