LS

User Manual

LSUM 086R4C 0093F EA

LS ULTRACAPACITOR
LSUC

User Manual

CONTENT

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1. Overview

The LS 86.4V / 93F 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

⚠ WARNING

HAZARDOUS VOLTAGE.
Contact may cause electric shock or burn.
This unit is to be serviced by authorized personnel only.

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.

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4. Identification of features

- Product Image

<Fig. 1> Product Image

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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.

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6. Output terminal connection

The LS 86.4V / 93F Ultracapacitor Modules are designed to connect directly to a ring or a bus bar. The positive and negative terminals have each hole for the screw. The positive terminal threaded size is M8 and negative terminal is M10. Wave washers are required to ensure long term, reliable connections.

When tightening the terminal bolt, a torque of 20 N-m for the M8 bolt should be used.(30N-m for the M10 bolt) 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.
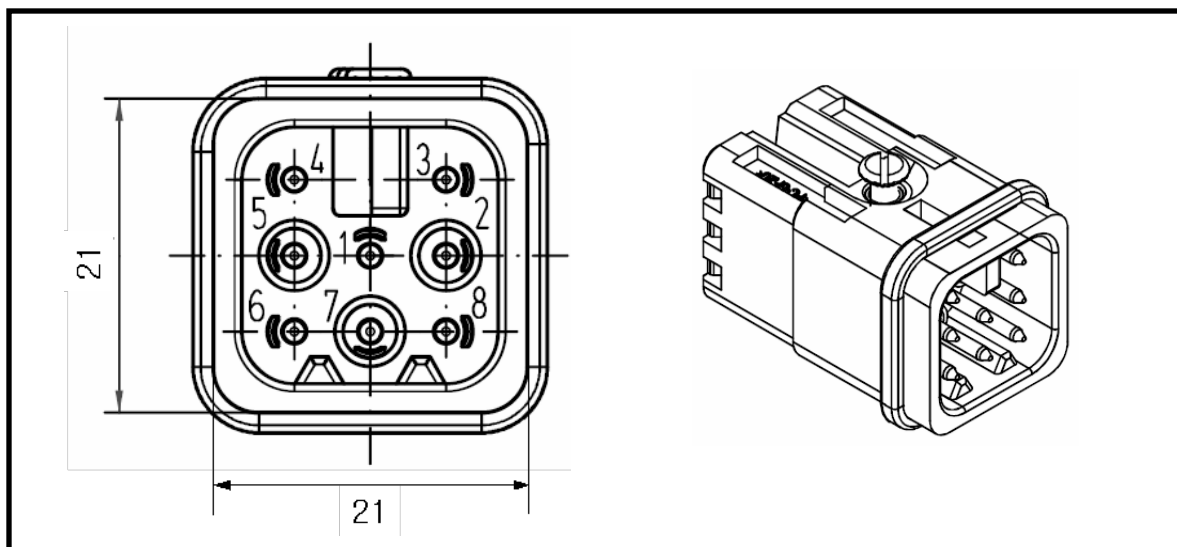
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7. Output connector

- The output of connector is tabulated below.

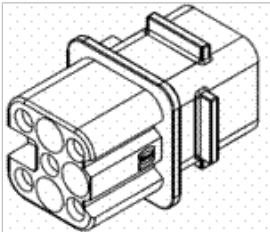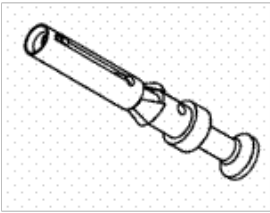| Pin #	Pin out	Pin #	Pin out
1	Not used	5	Not used
2	Not used	6	Not used
3	Thermistor pin1	7	Not used
4	Thermistor pin2	8	Not used
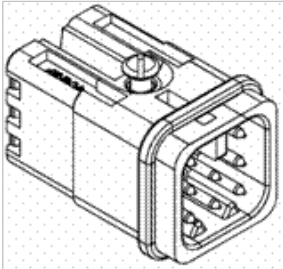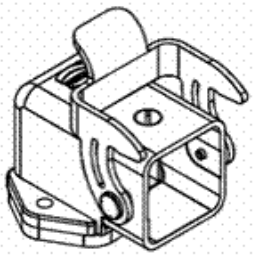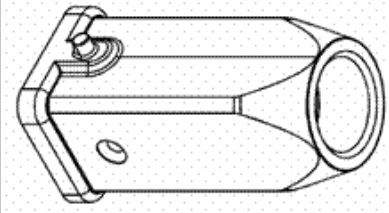
<Fig. 4> Monitoring connector

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- Pin 3-4 is connected with a NTC thermistor for temperature monitoring. According to temperature variation in the module, the resistance of the thermistor is determined. The resistance is 10KΩ with one-percent error, when the internal temperature in the module is 25 ℃.

- The mating monitoring connector is not supplied by LS. For recommendation, please refer to following table below, and the web page.. www.harting.de. (Connector manufacturer)

	LS Module	Customer System
Insert	09 36 008 2632	09 36 008 3101
Pin		09 15 000 622x
Housing	09 37 003 0801	09 37 003 1440

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8. Mounting

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

(1) Fixing the module with mechanical pressure.
   - Impose mechanical pressure on the top, bottom and each side into designated space to fix the module.

(2) Connecting with thread bolts
   - Step 1 : Unscrew four bots (M6) on the top cover of the module. (remove four nuts on the bottom
   - Step 2 : Insert 4 thread bolts (over 200mm) into the 4 holes on the top cover with spring washers and flat washers, then make connection

Bolt (M6 L180)

Spring Washer

Flat Washer

Nut

<Fig. 5> Step 1

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Bolt(M6 length over 200mm)
This picture is for reference only and
the bolt is not included.

Spring Washer

Flat Washer
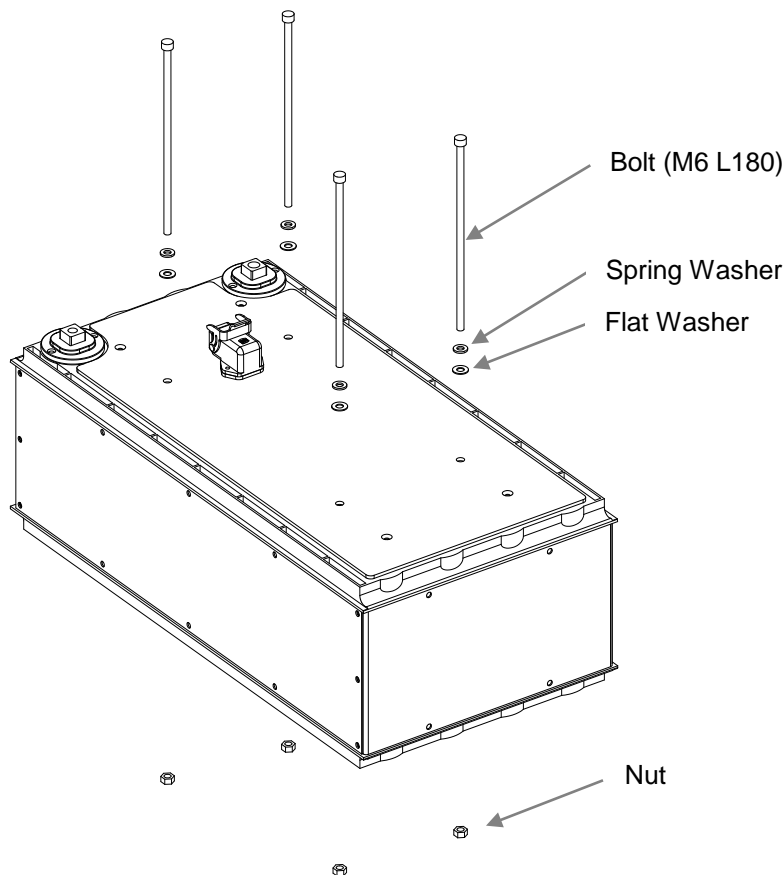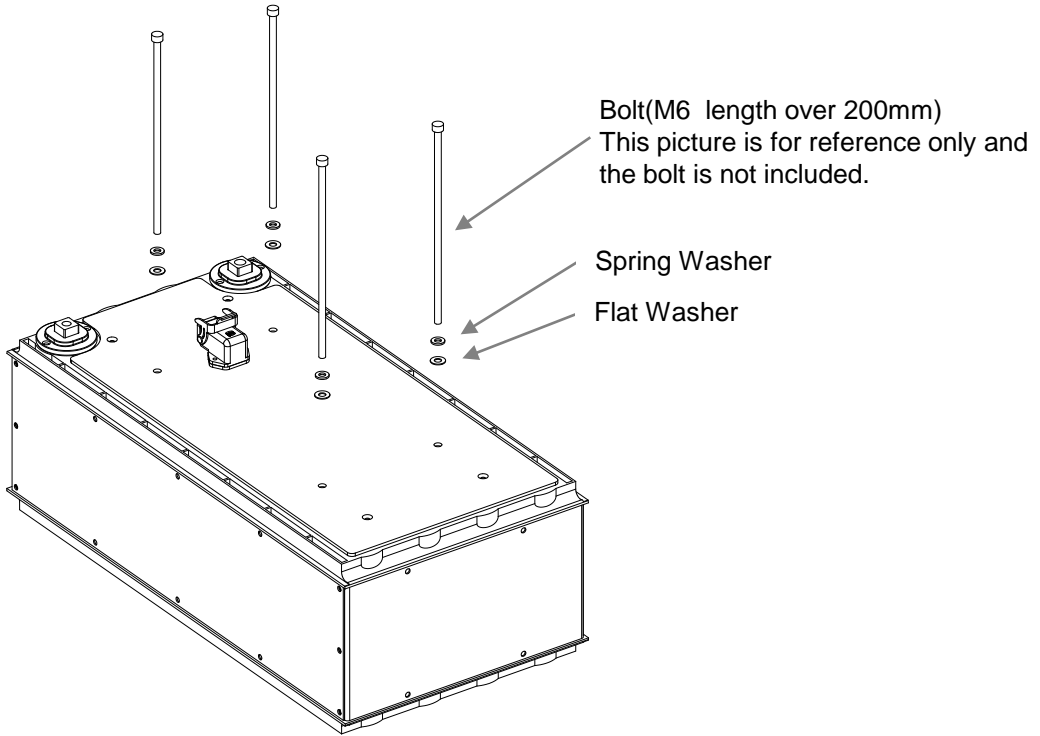
<Fig. 6> Step 2
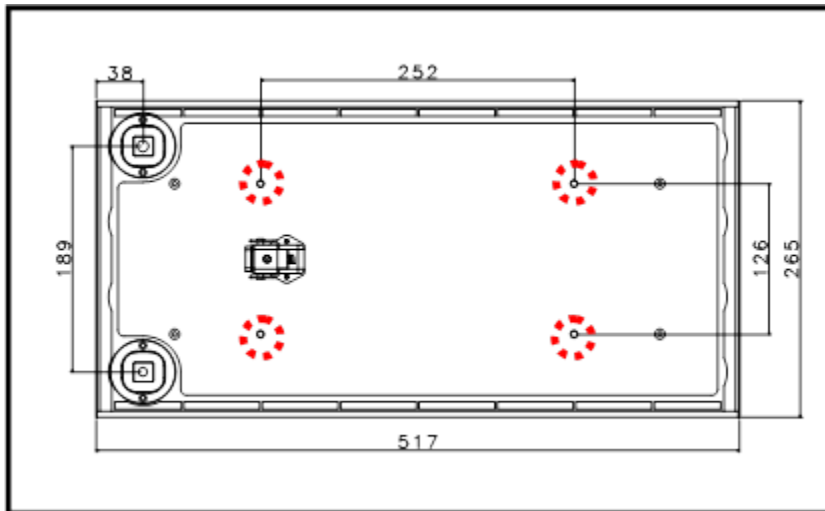
<Fig. 7> Mounting Positions

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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 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℃. 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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10. Contact Information

LS Ultracapacitor

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Appendix I

T(℃)	Rmin(kΩ)	Rcent(kΩ)	Rmax(kΩ)	DR(%)	DT(℃)
−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

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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	26.76	27.30	2.00%	0.40
5	24.97	25.46	25.96	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	15.96	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	8.406	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

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T(℃)	Rmin(kΩ)	Rcent(kΩ)	Rmax(kΩ)	DR(%)	DT(℃)
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	0.9765	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

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Appendix II

Drawing