



Descriptive Report and Test Results

MASTER CONTRACT: 300254

REPORT: 80117111

PROJECT: 80139278

Edition 1: Sep 2, 2022; Project 80117111 - Kunshan
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Edition 2: Feb 02, 2023; Project 80139278 - Kunshan
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PRODUCTS

CLASS C370182 - Battery System for use in Stationary Applications – Certified to US Standards

Battery pack B051100P02, B051100P03, and Battery system for Use in Stationary Electrical Energy Storage Application, Lithium-ion, Stack Up Mounting, models **SunESS-5, SunESS-10, SunESS-15, SunESS-20**; and Rack Mounting models Atrix-5, Atrix-10, Atrix-15 and Atrix-20.

Refer to the following table for the product electrical ratings

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Battery System Model No.	Battery Pack Ratings				Battery Pack No.
	Normal Voltage, Vdc	Normal Capacity, Ah/Wh	Battery Pack Configuration*	Enclosure IP Rating	
Atrix-5	51.2	5kWh	(16S1P)*1	IP20	B051100P02
Atrix-10	51.2	10kWh	(16S1P)*2	IP20	B051100P02
Atrix-15	51.2	15kWh	(16S1P)*3	IP20	B051100P02
Atrix-20	51.2	20kWh	(16S1P)*4	IP20	B051100P02
SunESS-5, RES0505BS-51LFP, SBESS5	51.2	5kWh	(16S1P)*1	IP55	B051100P03
SunESS-10, RES1009BS-51LFP, SBESS10	51.2	10kWh	(16S1P)*2	IP55	B051100P03
SunESS-15, RES1510BS-51LFP, SBESS15	51.2	15kWh	(16S1P)*3	IP55	B051100P03
SunESS-20, RES2010BS-51LFP, SBESS20	51.2	20kWh	(16S1P)*4	IP55	B051100P03

Manufacturer's Specified Charging/Discharging Parameters for Battery System

Battery System Model No.	Working Temperature Range, °C		Rated Charging/Discharging Current, A	Maximum Charging/Discharging Current, A
	Charge	Discharge		
Atrix-5	-10~50	-20~50	50	100
Atrix-10	-10~50	-20~50	100	180
Atrix-15	-10~50	-20~50	150	200
Atrix-20	-10~50	-20~50	200	200
SunESS-5, RES0505BS-51LFP, SBESS5	-10~50	-20~50	50	100
SunESS-10, RES1009BS-51LFP, SBESS10	-10~50	-20~50	100	180
SunESS-15, RES1510BS-51LFP, SBESS15	-10~50	-20~50	150	200
SunESS-20, RES2010BS-51LFP, SBESS20	-10~50	-20~50	200	200

Manufacturer's Specified Charging Parameters for Battery Pack

Battery Pack Model	Temperature Range, °C	Normal Charging Voltage, Vdc	Normal Charging Current, A	Maximum Charging Voltage, Vdc	Maximum Charging Current, A
B051100P02, SB51V100Ah-R	-10~50	51.2	50	55.2	100
B051100P03, RES0505BT-51LFP, SB51V100Ah	-10~50	51.2	50	55.2	100

Manufacturer's Specified Discharging Parameters for Battery Pack:

Battery Pack Model	Temperature Range, °C	Normal Discharging Current, A	Discharging Cut-off Voltage, Vdc	Maximum Discharging Current, A
B051100P02, SB51V100Ah-R	-20~50	50	44.8	100
B051100P03, RES0505BT-51LFP, SB51V100Ah	-20~50	50	44.8	100

Notes:

1. Refer to the following table for the model identification and differences:

Model Name	Alternate Model Name	Difference
SunESS-5	RES0505BS-51LFP	Identical except for model name from different customer
SunESS-10	RES1009BS-51LFP	
SunESS-15	RES1510BS-51LFP	
SunESS-20	RES2010BS-51LFP	
B051100P02	RES0505BT-51LFP, SB51V100Ah	Identical except for model name from different customer
B051100P03	SB51V100Ah-R	Identical except for model name from different customer

2. The battery system including its battery management system has been tested according to the functional-safety requirements of ANSI/CAN/UL-1973:2018, Second Edition.
3. The enclosure for each battery system was evaluated only to establish an IP rating of its own enclosure rating in accordance with the Standard for Degrees of Protection Provided by Enclosure (IP Code) IEC 60529.

Condition of Acceptability

1. Solid state circuits and software controls relied upon as the primary safety protection, have been evaluated to the Standard for Safety: Automatic Electrical Controls – Part 1, UL 60730-1. Any change to the software and electronic controls of the BMS may require additional testing.
2. Product is evaluated for indoor use for battery system models Atrix-5, Atrix-10, Atrix-15 and Atrix-20, indoor and outdoor use for models SunESS-5, SunESS-10, SunESS-15 and SunESS-20, additional enclosure shall be provided for Atrix series battery system to be used in moisture environment. Further evaluation shall be considered for both Atrix and SunESS series models when being used near sea environments.
3. Further evaluation for Resistance of Moisture and Salt Fog may be required for the battery pack intended to be used in the end product where moisture and salt fog condition were applied.
4. Corrosion due to electrochemical action is to be determined for conductive parts in contact with terminals when subjecting to the installation of the end products.
5. Bluetooth and Wi-Fi with its function was not evaluated, further consideration may be required on the end product.
6. Equipment Application Location: Stationary
7. Access Location: Operator Accessible.
8. The installation was not evaluated. The battery system shall be installed in accordance with NFPA 70 or other applicable installation code.
9. Overvoltage Category(OVC): 2
10. Pollution Degree(PD): 2
11. Altitude for Operation: Up to 2000 m.

APPLICABLE REQUIREMENTS

ANSI/CAN/UL-1973:2018, Second Edition - Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications.

MARKINGS

The manufacturer is required to apply the following markings:

- Products shall be marked with the markings specified by the particular product standard.

Additional bilingual markings not covered by the product standard(s) may be required by the Authorities Having Jurisdiction. It is the responsibility of the manufacturer to provide and apply these additional markings, where applicable, in accordance with the requirements of those authorities.

The products listed are eligible to bear the CSA Mark shown with adjacent indicators 'US' for US only (indicating that products have been manufactured to the requirements of U.S. Standards).

The markings shall be legibly and permanently marked with:

- a) The products listed are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US, or with adjacent indicator 'US' for US only, or without either indicator for Canada only:



- b) Batteries shall be marked with the manufacturer's name, trade name, trademark, CSA master contract number "300254" or other descriptive marking which may identify the organization responsible for the product.
- c) Part number or Model number; as specified in product section above.
- d) Electrical ratings in volts dc and capacity in Ampere-hours or Watt-hours and chemistry; as specified in product section above.
- e) The electric energy storage system terminals shall be marked to indicate whether they are positive (+) or negative (-).
- f) IP Code rating; as specified in product section above.
- g) Battery system shall be marked with the maximum short circuit current and duration (at maximum short circuit current) at the system output terminals.
- h) Electric energy storage systems shall also be marked with the date of manufacture, which may be in the form of a code that does not repeat within 20 years.
- i) Systems shall be marked with a cautionary marking indicating to read all instructions before installation, operation and maintenance of the system. This marking may be in the form of the symbol(s) for example: the Standard for Graphical Symbols for Use on Equipment – Index and Synopsis, ISO 7000, "caution" Symbol No. 434 (exclamation point inside triangle) followed by the "read instruction manual" Symbol No. 790 (open book). If using symbols, their meaning shall be explained in the instruction manual.
- j) Systems that must be operated in a certain orientation for safe operation, shall be provided with markings indicating the correction orientation of the system.
- k) Systems shall be marked with a warning marking indicating risk of electrocution near hazardous voltage battery terminals.
- l) The main ground terminal of the protective grounding system shall be identified by one of the following:
- A green-colored, not readily removable terminal screw with a hexagonal head;
 - A green-colored, hexagonal, not readily removable terminal nut;
 - A green colored pressure wire connector; or
 - The word "Ground" or the letters "G" or "GR" or the grounding symbol (IEC 60417, No. 5019) or otherwise identified by a distinctive green color.
- m) Additional warning markings for battery systems located in restricted access locations such as warnings regarding hazardous moving or electrical parts, hot surfaces, etc., to alert service or other trained personnel and prevent hazards, shall be provided on the battery systems in locations where they will be visible those persons having access to the location.

Nameplate adhesive label material approval information:

Label (INT*): UL 969 approved adhesive material.

Manufacturer: FLEXCON CO INC (UL File No.: MH10170)

Model: DPM-FW, DPM-FW-RTS, FLEXmark V-400-FW T/C-348 L-344

Applicable Surface: Aluminum

Temperature range: -40~80°C, indoor and outdoor use.

Refer to Att. 2, ILL. 1~3 for marking of Atrix series, Refert to Att.6, ILL.1~3 for marking of SunESS series.

ALTERATIONS

Marking is as noted above.

FACTORY TESTS

Manufacturers of battery systems shall have documented production process controls in place that continually monitor the following key elements of the manufacturing process that can affect safety, and shall include corrective/preventative action to address defects found affecting these key elements:

- a) Supply chain control; and
- b) Assembly processes.

1. Active Controls Utilized Function Check.

Battery systems shall be subjected to 100% production screening to determine that any active controls utilized for safety are functioning.

Exception: This check of the safety controls can be conducted on subassemblies or components of the system before final assembly.

2. Continuity Check

A continuity check of the grounding system using a milliohm meter or other method, shall be conducted on 100% production employing protective grounding. The continuity check shall determine that measurements made on any two points of the grounding system do not exceed 0.1 Ω .

Warning: The factory test(s) specified may present a hazard of injury to personnel and/or property and should only be performed by persons knowledgeable of such hazards and under conditions designed to minimize the possibility of injury.

SPECIAL INSTRUCTIONS FOR FIELD SERVICES

1. Component descriptions marked with either the "(INT)" or "(INT*)" identifiers may be substituted with other components providing the requirements specified under the notes in the "Description" are complied with.
2. The software version noted on the label affixed to the product's internal electronics controller (See MARKINGS for location details) shall be verified to be the same as that recorded in the functional safety report that is referenced in the 'Contents' section. (In cases where 2 software versions are noted, both need to be verified.)

COMPONENT SPECIAL PICKUP

1. Component descriptions marked with the identifier "(CT)" are subject to annual pickup and Conformity Testing.

DESCRIPTION

Notes:

1. Component Substitution
 - a) Critical components (those identified by mfr name, cat no), which are NOT identified with either "INT" or "INT*" are not eligible for substitution without evaluation and report updating
 - b) The term "INT" means a "Certified" and/or "Listed" (or a "Recognized" and/or "Accepted") component may be replaced by one "Certified" and/or "Listed" by another certification organization accredited by the appropriate accreditation body or scheme requirements to the correct standard, for the same application; providing the applicable country identifiers are included and requirements in item "d" below are complied with.
 - c) The Term "(INT*)" means a "Recognized" and/or "Accepted" component may be replaced by a component that is CSA Certified. The applicable country identifiers shall be included, the requirements in item "d" below as well as any "conditions of suitability" for the component (as recorded in this descriptive report) shall be complied with;
 - d) Components which have been substituted, must be of an equivalent rating, configuration (size, orientation, mounting) and the applicable minimum creepage and clearance distances are to be maintained from live parts to bonded metal parts and secondary parts.
 - e) Substitution of a "Certified" and/or "Listed" component with a component that is "Recognized" or "Accepted" is not permitted without evaluation and report updating.
 - f) Substitution of a "Recognized" and/or "Accepted" component by one that is not CSA Certified is not permitted without a proper evaluation as well as a report update because the Conditions of Acceptance of the original component may be different than the Conditions of Acceptance of the substitute component.

General: Battery system models **SunESS-5, SunESS-10, SunESS-15, SunESS-20**; Atrix-5, Atrix-10, Atrix-15 and Atrix-20 are used for energy storage system for stationary applications and will be installed in accordance with the applicable installation codes.

Battery system Atrix series consists of up to 4 battery packs connected in parallel using pack model B051100P02 for rack mounting; Battery system SunESS series consists of up to 4 battery packs connected in parallel using pack model B051100P03 for stack-up mounting.

The construction parts were separated into two parts, part A indicated the construction of models Atrix-5, Atrix-10, Atrix-15 and Atrix-20; while part B indicated the construction of models **SunESS-5, SunESS-10, SunESS-15, SunESS-20**.

Part A: Construction for Atrix series battery system models.

Battery System Model No.	Battery Pack		Mounting Method	ILIs.
	Model No.	Quantity		
Atrix-5	B051100P02	1	Indoor Rack Mounting	Att.1, Figure 1~3
Atrix-10	B051100P02	2	Indoor Rack Mounting	Att.1, Figure 4~6
Atrix-15	B051100P02	3	Indoor Rack Mounting	Att.1, Figure 7~9
Atrix-20	B051100P02	4	Indoor Rack Mounting	Att.1, Figure 10~12

The following description for battery module B051100P02 was considered suitable for all battery system models Atrix-5, Atrix-10, Atrix-15 and Atrix-20.

Construction for Battery Module: B051100P021. Battery Module Enclosure:

Enclosure Parts	Overall Length, mm	Overall Width, mm	Overall Height, mm	Material Designation	Illustration
Enclosure Base	440	407	131.5	SGCC or SPCC	Att.2, Ill.4
Enclosure Cover	440	407.5	15	SGCC or SPCC	Att.2, Ill.5
Front Enclosure	440	19	135	SGCC or SPCC	Att.2, Ill.6

2. Start Up Switch: TUV approved for US and Canada.(CU 72214142 01)

Manufacturer: D-SWITCH ELECTRONICS CO., LTD

Model No. PBM-19

Ratings: rated 5A, 250Vac, -20°C~80°C

Alternate Start Up Switch: UL recognized for US and Canada.(WOYR2/8.E187490)

Manufacturer: DAILYWELL ELECTRONICS CO LTD

Model No. MPS19-A02FN-0-JR-0V

Ratings: 2A 36Vdc -20°C~70°C

3. Wire for Start-up Button(INT): UL recognized for US and Canada.(ECBT2/8. E330488)

Manufacturer: DONGGUAN ZELONGKANG WIRE CO., LTD

Model No. UL 1569

Rating: wire size 24AWG , rated 300V, VW-1, 105°C

4. Terminal Connector (Batt+/-): 4 provided, UL recognized for US. (ECBT2.E521169)

Manufacturer: Sanco Intelligent Connector Technology Co.,Ltd

Model No. ES090-01M6-1SYK-01 for negative; ES090-01M6-2SYK-01 for positive

Rating: rated 1000Vdc, 200A.

5. Connector (INT): UL recognized for US and Canada. (E503104)

Manufacturer: STLC TERMINALS TECHNOLOGY LIMITE

Model No. RNB22-6S

Rating: 600V, 75°C

6. Cell Holder (INT): UL recognized for US and Canada. (QMFZ2/8. E121562)

Material Manufacturer: SABIC INNOVATIVE PLASTICS US L L C

Model No. NX05467(GG)

Rating: at minimum thickness1.5 mm, rating V-0, RTI :75 °C.

7. Cell: UL recognized. Refer to following table for detailed model No. and electrical ratings.

Table 1: Cell Chemistry and Rating per Cell

Cell Model	Cell Manufacturer	Cell Chemistry / type	Rate Voltage, Vdc	Nominal Capacity, Ah
SBP-01-1000	Sunwoda Electronic Vehicle Battery Co.,Ltd(BBGA2/8.MH65547)	lithium-ion/ Prismatic	3.2	102
IFP50160116A-102Ah*	Hefei Gotion High-tech Power Energy Co Ltd (BBCV2.MH62514)	lithium-ion/ Prismatic	3.2	102

*Remark: additional requirements were considered according to clause 7.11.2.

Table 2: Manufacturer Specified Cell Normal Operating Region:

Cell Model	Charging Temperature Range, °C	Operating Temperature Range, °C	Upper Limit for Charging Voltage, Vdc	Max Charging Current, A	Max Discharge Current, A	Discharge Cutoff Voltage, Vdc	Upper Limit for Cell Surface Temperature, °C
SBP-01-1000	0~65	-30~65	3.65	102	255	2.5 Vdc T>0°C 2.0 Vdc T≤0°C	70
IFP50160116A-102Ah	0~60	-30~65	3.65	102	255	2.0Vdc T>0°C 1.8 Vdc T≤0°C	70

8. Heat Pad: UL recognized for US.(QMFZ2/8. E332023)

Material Manufacturer: MICA ELECTRICAL MATERIAL (LUHE) CO., LTD

Model No. Goode Shield T 28

Ratings: At a minimum thickness 0.5 mm, rated V-0, RTI 200 °C

Application: Adhere to the surface of battery module.

Cells are interconnected via aluminum sheet by spot welding. The thickness of interconnection aluminum sheet was indicated in below table:

Cat. No.	Material	Dimension, mm	Ills.
Interconnection Plate 1	Aluminum	80*28*1.5	Att.2, ILL.7
Interconnection Plate 2	Aluminum	94.5*31*5.5	Att.2, ILL.8
Positive and Negative	Aluminum	43.5*70.5*10.6	Att.2, ILL.9
Busbar (Positive)	Copper	76*50*27	Att.2, ILL.10
Busbar (Negative)	Copper	89.8*28.5*34	Att.2, ILL.11
BMS Busbar Terminal	Copper	82*90*38	Att.2, ILL.12

9. Silicon Pad (INT): UL recognized for US and Canada. (QMFZ2/8. E346848)
Material Manufacturer: DONGGUAN NANJU POLYMER MATERIAL CO LTD
Model No. NJ-352H/N-40 or NJ-352H/N-80
Ratings: at a minimum thickness 1.5mm, rated V-0, RTI 150°C.
Application: employed at the side of the module.
10. Insulation Sheet 1: UL recognized for US and Canada. (QMFZ2.E329660)
Material Manufacturer: SHENZHEN TEESUN TECHNOLOGY CO LTD
Model No. TS-FR1383-13
Rating. At minimum thickness 0.175mm, rated VTM-0, RTI 80°C.
Application: 1pcs provided between inner surface of enclosure and heater assembly, 1pcs provided between BMS supporting and heater assembly.
11. Insulation Sheet 2: UL recognized for US and Canada. (QMFZ2.E329660)
Material Manufacturer: SHENZHEN TEESUN TECHNOLOGY CO LTD
Model No. TS-FR370F
Rating. At minimum thickness 0.43mm, rated V-0, RTI 80°C.
Application: employed between the inner surface of enclosure and busbar.
12. Heater Assembly: Accepted
Manufacturer: SHIN-ETSU SILICONE INTERNATIONAL TRADING (SHANGHAI) CO LTD
Rating. 80W 51.2V 32.768Ω
Application: employed to heating cells when charged in low temperature.
- a. Insulating Film: UL recognized for US and Canada. (QMFZ2/8.E54153)
Manufacturer: Arlon LLC dba Rogers Corporation
Model No. (GG)98(C)(Co)
Rating: at minimum thickness 1.0 mm, rated V-0, RTI 200°C
Mounting: employed on the heater elements .
- b. Connector for Heater (INT): UL recognized for US and Canada.(ECBT2/8.E179987)
Manufacturer: JOINT TECH ELECTRONIC INDUSTRIAL CO LTD
Model No. A2501HB-02P
Rating: rated 30Vdc max, 5A.
- c. Heater Wire (INT): UL recognized for US and Canada.(AVLV2/8.E305164)
Manufacturer: DONGGUAN BOLI ELECTRONIC CO LTD
Model No. style 3135
Rating: 22AWG, rated 600Vac, RTI 200°C.
13. Power Leads (INT): UL recognized for US and Canada.(AVL V2/8.E231903)
Manufacturer: WUXI HUAHAO ELECTRIC CO LTD
Model No. style 10269
Ratings: rated 3AWG, 1250Vdc, 105°C.

Alternate Power Leads: UL recognized for US and Canada.(AVL V2/8.E231903)
Manufacturer: SHANGHAI JIUKAI WIRE & CABLE CO LTD
Model No. style 10269
Ratings: rated 3AWG, 1250Vdc, 105°C.

14. Power Wire Connector (INT): UL recognized for US and Canada. (ZMVB2/8.E503104)

Manufacturer: TLC TERMINALS TECHNOLOGY LIMITED

Model No. RNB22-6S

Ratings: rated 600V, 75°C.

Application: Employed to crimp the power leads for module connection.

Alternate Power Wire Connector: UL recognized for US and Canada.(ZMVB2/8.E471409)

Manufacturer: Yueqing Guosai Technology Development Co Ltd

Model No. RNB22-6S

Ratings: rated 600V, 75°C.

15. Power leads for BMS(INT): UL recognized for US and Canada.

Ratings: 16AWG, 600V, 105°C

16. NTC: UL recognized for US and Canada.(XGPU2/8.E356449)

Manufacturer: SHENZHENSHI KEMIN SENSOR CO LTD

Model No. MF5210K

Rating: R25 10 Ω , Tmoa:120°C, Class C4

For NTC layout, see Att. 2 ILL. 10 for details.

17. Heater Driven Board: Provided with UL recognized PWB board for US and Canada. (ZMPV2/8. E234156)

Manufacturer: SHEN ZHEN SUN & LYNN CIRCUITS CO LTD

Model No. SL-D

Rating: Single Layer, rated V-0, RTI 130°C

Note: Manufacturer and model number of the PWB board except for ratings can be interchangeable.

The main electronic devices assembled on the heater driven board were indicated as below:

Type of Protective Component	Identifier of Component	Component Manufacturer	Component File No.	Component Part No.	Component Ratings
Optocoupler	U1, U2	EVERLIGHT ELECTRONICS CO LTD	-	EL817	VCE:35V, IF=60mA Isolation Votlage:5000VAC Operating Temperature: -55°C to 110°C
Zener diode	D4	BRIGHTKING (SHENZHEN) CO LTD	-	SMAJ	Maximum Clamping Voltage:113V Peak Pulse Current:3.5A Operating Temperature: -65°C to 150°C

Fuse	F1	AEM COMPONENTS (SUZHOU) CO LTD	-	AF2	125V, 8A, Nominal I _{2t} :20.3 Operating Temperature: -55°C to 125°C"
N-MOSFET	Q1	Samwin	-	SW062R08E8T (TO-252)	VDS:80V, VGS:±20V, ID:110A (TC=25°C), TJ, TSTG:-55°C to 150°C
P-MOSFET	Q2	NCE	-	ID:110A (TC=25°C),	VDS: -100V, VGS: ±20V, ID:-30A (TC=25°C), TJ, TSTG:-55°C to 150°C"

18. BMS board(INT): Provided with UL recognized PWB board for US and Canada. (ZMPV2/8. E234156)

Manufacturer: SHEN ZHEN SUN & LYNN CIRCUITS CO LTD

Model No. SL-M

Rating: Multilayer, rated V-0, RTI 130°C

Note: Manufacturer and model number of the PWB board except for ratings can be interchangeable.

The main electronic devices assembled on the heater driven board were indicated as below:

Type of Protective Component	Identifier of Component	Component Manufacturer	Component File No.	Component Part No.	Component Ratings
Fuse for CHG/DSG	F2, F3, F5, F7	DEXERIALS CORP	JDYX2/8.E16 7588	SFK-5045A	rate 80V, 45A, interrupt current 120A
Alternate Fuse for CHG/DSG	F2, F3, F5, F7	POLYTRONICS TECHNOLOGY CORP	JDYX2/8.E33 1807	CLM3820P 5045	rated 62V, 45A, interrupt current 120A
MOSFET	Q46,Q47,Q48,Q 49,Q60,Q61,Q6 2,Q64,Q71,Q77(CHG) ; Q51,Q52,Q53,Q 54,Q55,Q56,Q5 7,Q75,Q76,Q78(DSG)	CRMICRO	-	CRSS028N 10N	VDS:100V ID:180A@25°C VGS:±20V TJ, Tstg:-55°C to 150°C
TVS Diode	Z30, Z31,Z32,Z3,Z8, Z9	BRIGHTKING (SHENZHEN) CO LTD	QVGQ2.E244 458	5.0SMDJ	Maximum Clamping Voltage:38.9V,

					Peak Pulse Current:129A, Operating Temperature: - 55°C to 150°C
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Type of Protective Component	Identifier of Component	Component Manufacturer	Component File No.	Component Part No.	Component Ratings
Optical Isolators	U1,U3,U4,U7,U11,U12,U13,U14,U21,U28	EVERLIGHT ELECTRONICS CO LTD	FPQU2/8.E214129	EL817	VCE:35V,IF=60mA, Isolation Votlage:5000VAC, Operating Temperature: -55°C to 110°C
MCU	U16	NATION	-	N32G455V EL7	VCC Range: 1.8V to 3.6V Operating Temperature:-40°C to 105°C
AFE	U15	Sinowealth	-	SH367309	Operating Temperature:-40°C to 85°C
Sampling resistor	R215, R345,R339, R331,R344, R340,R347,	-	-	-	
IC for Communication	U30	SIT	-	SIT1050T	Operating Voltage:4.5V to 5.5V Operating Temperature:-40°C to 125°C
Alternate IC for Communication	U30	PHILIPS	-	TJA1050T	Operating Voltage:4.75V to 5.25V Operating Temperature:-40°C to 125°C
Isolation IC for Communication	U18, U29	NOVOSENSE	-	NSi8222N1-DSPR	Operating Voltage:2.5V to 5.5V Isolation Votlage:3750VAC

					Operating Temperature:- 40°C to 125°C
Alternate IC for Communication	U18, U29	CHIPANALOG	-	CA-IS3721HS	Operating Voltage:2.5V to 5.5V Isolation Votlage:3750VAC Operating Temperature:- 40°C to 125°C
Communication IC for 485	U22	3PEAK		TP8485E	Operating Voltage:3V to 5.5V Operating Temperature:- 40°C to 125°C
Alternate Communication IC for 485	U22	GATEMODE		GM485E	Operating Voltage:3V to 5.5V Date Rate:500kbps Operating Temperature:- 40°C to 125°C
Alternate Communication IC for 485	U22	ADI		ADM483E	Operating Voltage:3V to 5.5V Date Rate:250kbps Operating Temperature:- 40°C to 85°C

Part B - Construction for SunESS series battery system models.

Battery System Model No.	Battery Pack		Control Module	Mounting Method	ILLs.
	Model No.	Quantity			
SunESS-5	B051100P03	1	H0K1200P03	Indoor/outdoor stack-up mounting	Att.6, ILL.4
SunESS-10	B051100P03	2	H0K1200P03	Indoor/outdoor stack-up mounting	Att.6, ILL.4
SunESS-15	B051100P03	3	H0K1200P03	Indoor/outdoor stack-up mounting	Att.6, ILL.5
SunESS-20	B051100P03	4	H0K1200P03	Indoor/outdoor stack-up mounting	Att.6, ILL.6

SunESS series battery system models consist of control module and multiple battery packs for stack-up mounting and the mounting base. The following description for battery module B051100P03 and Control Module were suitable for all battery system models SunESS-5, SunESS-10, SunESS-15 and SunESS-20.

Construction for Battery Modul: B051100P031. Battery Module Enclosure:

Enclosure Parts	Overall Length, mm	Overall Width, mm	Overall Height, mm	Material Designation	Illustration
Enclosure Base	572.8	347	164	Coated Aluminum	Att.6, ILL.7
Enclosure Cover	572.5	327	27	Coated Aluminum	Att.6, ILL.8

2 handles were provided on the side of module enclosure base for lift,

2. Module Valve: UL recognized for US and Canada.(QMFZ2/8.E171666)

Manufacturer: KINGFA SCI & TECH CO LTD

Model No. PA66-R11G20 (##)

Rating: at minimum thickness 1.5mm, rated 5VA, 130°C

Mounting: located on the side of the module enclosure base for pressure and off gases release in abnormal condition.

3. Battery Input/Output Connector: UL recognized for US. (ECBT2/8. E28476)

Manufacturer: TYCO Electronics Corp

Application: Provide for Power, earthing and communications.

Mounting: Located on the top of each battery module, see below table for details.

Model No.	Function	Ratings
HMN-001-MC, HMN-001-FC	Power Connector	600V, 200A
HMN-003-M, HMN-003-F	Earthing	600V, 40A
HMN-003-M, HMN-003-F	Communication	600V, 20A

4. Gasket (INT): UL recognized for US. (JMLU2.MH45126)
 Manufacturer: GUANGDONG RUIFU SEALING TECHNOLOGY CO LTD
 Model No. NBR220

Alternate Gasket: UL recognized for US (JMLU2.MH60816)
 Manufacturer: ASIA LANNERET SCIENCE & TECHNOLOGY CO LTD
 Model No. EPDM-2015

5. Cell: UL recognized. Refer to following table for detailed model No. and electrical ratings.

Table 1: Cell Chemistry and Rating per Cell

Cell Model	Cell Manufacturer	Cell Chemistry / type	Rate Voltage, Vdc	Nominal Capacity, Ah
SBP-01-1000	Sunwoda Electronic Vehicle Battery Co.,Ltd(BBGA2/8.MH65547)	lithium-ion/ Prismatic	3.2	102
IFP50160116A-102Ah	Hefei Gotion High-tech Power Energy Co Ltd (BBCV2.MH62514)	lithium-ion/ Prismatic	3.2	102

Table 2: Manufacturer Specified Cell Normal Operating Region:

Cell Model	Charging Temperature Range, °C	Operating Temperature Range, °C	Upper Limit for Charging Voltage, Vdc	Max Charging Current, A	Max Discharge Current, A	Discharge Cutoff Voltage, Vdc	Upper Limit for Cell Surface Temperature, °C
SBP-01-1000	0~65	-30~65	3.65	102	255	2.5 Vdc T>0°C 2.0 Vdc T≤0°C	70
IFP50160116A-102Ah	0~60	-30~65	3.65	102	255	2.0Vdc T>0°C 1.8 Vdc T≤0°C	70

6. Cell Holder (INT): UL recognized for US (QMFZ2 E121562)
 Material Manufacturer: SABIC INNOVATIVE PLASTICS US L L C
 Model No. 954(GG)
 Rating: at minimum thickness 1.2mm, rated V-0, 120°C

Cells were interconnected via aluminum sheet by spot welding. The thickness of interconnection aluminum sheet w indicated in below table:

Cat. No.	Material	Dimension, mm
Busbar(BMS Output -)	Copper	Att.6, ILL.9
Busbar(Battery Module Output -)	Copper	Att.6, ILL.10
Busbar(Battery +)	Copper	Att.6, ILL.11
Busbar(Battery Output -)	Copper	Att.6, ILL.12
Module Interconnection Aluminum Busbar	Aluminum	Att.6, ILL.13

7. Cover for Battery Pack +/- Terminal (INT): UL recognized for US (QMFZ2 E121562)
Materials: Same as Cell Holder
Rating: at minimum thickness 1.2mm, rated V-0, 120°C
8. Insulation Sheet 1: UL recognized for US and Canada.(QMFZ2/8.E329660)
Manufacturer: SHENZHEN TEESUN TECHNOLOGY CO LTD
Model No. TS-FR370F
Rating: at minimum thickness 0.5mm, rated VTM-0, RTI 80°C.
Mounting: Located at the bottom of inside of the module enclosure base.
9. Insulation Sheet 2: UL recognized for US and Canada.(QMFZ2/8.E315185)
Manufacturer: CHENGDU KANGLONGXIN PLASTICS CO LTD
Model No. KLX FRPC-1860B
Rating: at 0.5mm thick, rated V-0, RTI 80°C.
Mounting: Located at the top of inside of the module enclosure cover.
10. Aerogel: UL recognized for US and Canada (QMFZ2/8. E332023)
Manufacturer: MICA ELECTRICAL MATERIAL (LUHE) CO., LTD
Model No. Goode Shield T 28
Rating: at minimum 1mm, rated V-0, RTI 200°C.
Application: employed between each cell for heat insulation.
11. Heater Assembly: Accepted
Manufacturer: SHIN-ETSU SILICONE INTERNATIONAL TRADING (SHANGHAI) CO LTD
Rating. 80W 51.2V 32.768Ω
Application: adhered to to the module surface to heat cells when charged in low temperature.
- d. Insulating Film: UL recognized for US and Canada.(QMFZ2/8.E54153)
Manufacturer: Arlon LLC dba Rogers Corporation
Model No. (GG)98(C)(Co)
Rating: at minimum thickness 1.0 mm, rated V-0, RTI 200°C
Mounting: To pack the heating elements.
- e. Connector for Heater (INT): UL recognized for US and Canada.(ECBT2/8.E179987)
Manufacturer: JOINT TECH ELECTRONIC INDUSTRIAL CO LTD
Model No. A2501HB-02P
Rating: rated 30Vdc max, 5A.
- f. Wire(INT): UL recognized for US and Canada.(AVLV2/8.E305164)
Manufacturer: DONGGUAN BOLI ELECTRONIC CO LTD

Model No. style 3135

Rating: 22AWG, rated 600Vac, RTI 200°C.

12. Silicon Rubber Pad: UL recognized for US and Canada.(QMFZ2/8.E346848)
Manufacturer: DONGGUAN NANJU POLYMER MATERIAL CO LTD
Model No. NJ-352H/N-40 or NJ-352H/N-80
Rating: at a minimum thick 3.0mm, rated V-0, RTI 150°C.
13. Terminal Insulator: UL recognized for US and Canada. (QMFZ2/8.E315185)
Manufacturer: CHENGDU KANGLONGXIN PLASTICS CO LTD
Model No. KLX FRPC-1860B
Rating: at minimum thickness 0.5mm, rated V-0, 80°C.
14. Power Wire (Input)(INT): UL recognized for US and Canada. (AVL V2.E156525)
Manufacturer: ZHONGLI SCIENCE & TECHNOLOGY GROUP CO LTD
Model No. style 10269
Rating: wire size 2/0 AWG, rated 1250Vdc, 105°C.
15. Grounding Wire (INT): UL recognized for US and Canada. (AVL V2.E156525)
Manufacturer: ZHONGLI SCIENCE & TECHNOLOGY GROUP CO LTD
Model No. style 1015
Rating: wire size 8 AWG, rated 750Vdc, 105°C.
16. Signal Wire: (INT): UL recognized for US and Canada. (AVL V2.E214500)
Manufacturer: DONGGUAN WENCHANG ELECTRONIC CO LTD
Model No. Style 1569
Rating: wire size 24AWG, rated 300Vac, 105°C.
17. Battery Output Wire (Positive): UL recognized for US and Canada. (AVLV2/8.E323711)
Manufacturer: GUANGDONG OMG TRANSMITTING TECHNOLOGY CO LTD
Model No. Style 1015
Rating: 3AWG, rated 750Vdc, 105 °C.
18. Wire Connector: UL recognized for US and (ZMVV/7.E503104)
Manufacturer: TLC TERMINALS TECHNOLOGY LIMITED
Model No. RNB22-6S
Rating: rated 300V, 75 °C
19. NTC: UL recognized for US and Canada.(XGPU2/8.E356449)
Manufacturer: SHENZHENSHI KEMIN SENSOR CO LTD
Model No. MF5210K
Rating: R25 10 Ω , Tmoa:120°C, Class C4

For NTC layout, see Att. 2 ILL. 10 for details.

20. BMS Board: Same as BMS in Atrix ESS series noted in item 18, page 11.

Construction for Control Module

Model No. H0K1200P03

Location: Located on top of the battery system.

Consist of the following components:

1. Control Module Enclosure

Enclosure Parts	Overall Length, mm	Overall Width, mm	Overall Height, mm	Material Designation	Illustration
Enclosure Base	572.4	202.3	164	Coated Aluminum	Att.6, ILL.17
Enclosure Cover	572.5	201.5	27	Coated Aluminum	Att.6, ILL.18

A LED display provided on the front of the module enclosure to indicate the battery information.

2. Receptacle: UL recognized for US.(BBTH2.E525073)

Manufacturer: Sanco Intelligent Connector Technology Co.,Ltd

Model No. ES103-01M8-1SYW-07, ES103-03C120-1SYW-06(for DC-); ES103-01M8-2SYX-07, ES103-03C120-2SYX-06(for DC+),

Rating: rated 1500Vdc, 350A.

3. Water Proof Cover: UL recognized for US and Canada.(QMFZ2/8.E56070)

Manufacturer: CHI MEI CORPORATION

Model No. PC-6600(Y)(f1)(a) or EC-8100(Y)(f1)(a) or

Ratings: at minimum 1.5mm, rated V-0, RTI 120°C

Application: Employed to protect the

Model No. PC-110U(f1)(a)

Ratings: at minimum 0.75mm, rated V-2, RTI 105°C

4. Gasket (INT): UL recognized for US.(JMLU2.MH45126)

Manufacturer: GUANGDONG RUIFU SEALING TECHNOLOGY CO LTD

Model No. NBR220

Application: Employed to encapsulate the water proof cover and the rear control unit enclosure.

Alternate Gasket: UL recognized for US.(JMST2.MH49297)

Manufacturer: SAND PROFILE (SUZHOU) CO LTD

Model No. W6035 or S6051,or GM-S6010NB2

Application: Employed to encapsulate the module rear enclosure.

5. Circuit Breaker: UL listed for US and Canada.(DITT.E310211)
Manufacturer: SHANGHAI LIANGXIN ELECTRICAL CO LTD
Model No. NDB3-100
Ratings: 3P, 80V, 200A

Alternate Circuit Breaker: UL recognized for US and Canada.(QVNU2.E357198)
Manufacturer: ZHEJIANG DONGYA ELECTRONIC CO LTD
Model No. BCPS3DM250MU210-T
Ratings: rated 80V, 250A, 3P, SC5000A.

6. Start Up Switch: TUV approved for US and Canada.(CU 72214142 01)
Manufacturer: D-SWITCH ELECTRONICS CO., LTD
Model No. PBM-19
Ratings: rated 5A, 250Vac, -20°C~80°C

Alternate Start Up Switch: UL recognized for US and Canada.(WOYR2/8.E187490)
Manufacturer: DAILYWELL ELECTRONICS CO LTD
Model No. MPS19-A02FN-0-JR-0V
Ratings: 2A 36Vdc -20°C~70°C

7. Busbar: Accepted

Refer to below table for details.

Cat No.	Material	Dimension, mm
Busbar for Circuit Breaker Output	Copper with Ni coating	Att.6, ILL.12
Busbar for Output(Negative)	Copper with Ni coating	Att.6, ILL.13

8. Insulation Tube(INT): UL recognized for US and Canada.(YDPU2/8.E180908)
Manufacturer: CHANGYUAN ELECTRONICS GROUP CO LTD
Model: CB-HFT
Rating:600V, 125°C, VW-1
9. DC-DC Power Supply: UL recognized for US and Canada.(QGGQ2/8.E235235)
Manufacturer: MORNSUN GUANGZHOU SCIENCE & TECHNOLOGY CO., LTD.
Model No. URB4805YMD-10WR3
Ratings: Input:18VDC~75VDC ,0.258A max. ,output:5VDC ,2A max. 10W, -40~85°C
10. Wi-Fi & Bluetooth Internet of Things Module
Manufacturer: ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD
Model No. ESP32-WROVER-E; ESP32-WROVER-IE
Ratings: rated 3.3V ,0.1A
11. PWB Board(INT): Provided with UL recognized PWB board for US and Canada. (ZMPV2/8. E234156)
Manufacturer: SHEN ZHEN SUN & LYNN CIRCUITS CO LTD
Model No. SL-D
Rating: Single Layer, rated V-0, RTI 130°C

12. Power Wire (Input)(INT): UL recognized for US and Canada. (AVLV2.E156525)
Manufacturer: ZHONGLI SCIENCE & TECHNOLOGY GROUP CO LTD
Model No. style 10269
Rating: wire size 2/0 AWG, rated 1250Vdc, 105°C.
13. Grounding Wire(INT): UL recognized for US and Canada. (AVLV2.E156525)
Manufacturer: ZHONGLI SCIENCE & TECHNOLOGY GROUP CO LTD
Model No. style 1015
Rating: wire size 8 AWG, rated 750Vdc, 105°C.
14. Signal Wire: (INT): UL recognized for US and Canada. (AVLV2.E214500)
Manufacturer: DONGGUAN WENCHANG ELECTRONIC CO LTD
Model No. Style 1569
Rating: wire size 24AWG, rated 300Vac, 105°C.
15. Battery Output Wire (Positive)(INT): UL recognized for US and Canada. (AVLV2/8.E323711)
Manufacturer: GUANGDONG OMG TRANSMITTING TECHNOLOGY CO LTD
Model No. Style 1015
Rating: 3AWG, rated 750Vdc, 105 °C.

Safety Functions

The solid state circuits and software controls, relied upon as the primary safety protection of the battery pack, models B051100P02 and B051100P03 have been evaluated to the Standard for Safety: Automatic Electrical Controls – Part 1, UL 60730-1. And the functional safety evaluation for software was recorded in the project 80117112, refer to Att.8 BMS functional safety report for details.

The applicable model and the approved software versions for the battery management system were noted as below.

BMS Unit Name	Description	Hardware version	software version
BMS: H48100BP-BMS-P01	Maximum of 16 battery cells protection functions, include overvoltage, undervoltage, high temperature, low temperature, overcurrent protections.	PCB version: V1.04 Part Number: SL-M	Software version: V1.0 Date : 2022-07-27 CRC: 3CAF9369

A description of the product characteristics and modification changes of safety function covered under this project is provided.

BMS Protection for battery pack, models B051100P02 and B051100P03:

- a) Cell Overvoltage Protection (OVP): Max cell voltage $\geq 3.6V \pm 0.01V$
- c) Cell Under-voltage Protection (UVP): Min cell voltage $\leq 2.8 V \pm 0.01V$
- c) Cell Over-temperature Protection for charge condition (OTP-C): Max cell temperature $\geq 55 \pm 2^{\circ}C$
- d) Cell Under-temperature Protection for charge condition (UTP-C): Max cell temperature $\geq 2 \pm 2^{\circ}C$
- c) Cell Over-temperature Protection for discharge condition (OTP): Max cell temperature $\geq 60 \pm 2^{\circ}C$
- d) Cell Under-temperature Protection for discharge condition (UTP): Max cell temperature $\leq -20 \pm 2^{\circ}C$
- e) Battery Overcurrent for discharge condition (OCP-D): $\geq 102 \pm 1A$.
- h) Battery Overcurrent for charge condition (OCP-C): $\geq 101 \pm 1A$

TEST HISTORY**Edition 1: Project 80117111**

Original certification for battery pack B051100P02, B051100P03, and battery system for use in Stationary Electrical Energy Storage Application, Lithium-ion, Stack Up Mounting, models SunESS-5, SunESS-10, SunESS-15, SunESS-20; and Rack Mounting models Atrix-5, Atrix-10, Atrix-15 and Atrix-20. in accordance with ANSI/CAN/UL 1973 2nd edition.

Based on the battery pack and system design, and the electrical rating declared, battery system with 1 and 4 packs the selected for testing purpose and were considered to representative of battery system with other pack numbers.

Considering the similarity for the two battery pack constructions, Overcharge, Short circuit, Overdischarge and Imbalanced Charging test conducted on battery pack B051100P03 and battery system SunESS20 were considered to representative of battery pack B051100P02 and battery system of Atrix series.

Considering the module construction and installation configuration difference for rack mounting and stacked-up battery system, Failure of Cooling/Thermal Stability System and Resistance of Moisture were additionally considered on the stack-up mounting battery pack. The detailed test item and test models were indicated in below table.

The following tests were conducted in the following test facilities under CSA APT program with an acceptable test results.

Test Lab: Shenzhen Precise Testing Technology Co., Ltd.

Address: No.9, Shuiku Road, Tangwei, Guangming District, Shenzhen City, China

List the applicable tests for the battery module.

TEST No.	SECTION	TEST NAME:	[P], [F] or [N/A]	Test Model	COMMENTS / REMARKS
1	15	Overcharge Test	P	B051100P03	---
2	16	Short Circuit Test	P	B051100P03	---
3	17	Over discharge Protection Test	P	B051100P03, SunESS-20	---
4	18	Temperature and Operating Limits Check Test	P	B051100P02, B051100P03, SunESS-20	---
5	19	Imbalanced Charging Test	P	B051100P03	---
6	20	Dielectric Voltage Withstand Test	N/A	---	No hazardous voltage applied for the battery system
7	21	Continuity Test	P	Atrix-20, SunESS-20	---
8	22	Failure of Cooling/Thermal Stability System	P	B051100P02, B051100P03	---
9	23	Working Voltage Measurements	N/A	---	Client declared max charging voltage was used for evaluating the spacing.

10	24.1	Locked-rotor test for low voltage dc fans/motors in secondary circuits	N/A	---	No low voltage dc fans/motors in secondary circuits.
	24.2	Input	N/A	---	No AC main supplied control or accessory control for the battery system
	24.3	Leakage Current	N/A	---	No cord connected separate control or accessories supplied by AC mains
	24.4	Strain Relief	N/A	---	Permanently connected for the battery system, no strain relief means applied for the accessible cords.
	24.5	Push-Back Relief	N/A	---	Permanently connected for the battery system, no strain relief means applied for the accessible cords.
11	25	Vibration Test	N/A	---	Battery system was intended for stationary use
12	26	Shock Test	N/A	---	Battery system was intended for stationary use
13	27	Crush Test	N/A	---	Battery system was intended for stationary use
14	28	Static Force Test	P	B051100P02, B051100P03	---
15	29	Impact Test	P	B051100P02, B051100P03	---
16	30	Drop Impact Test	P	B051100P02, B051100P03	Test considered on the cell stack
17	31	Wall Mount Fixture/Handle Test	P	B051100P03	Ground mounting, no handles provided for the product
18	32	Mold Stress Test	N/A	---	Not applied for metal enclosure
19	33	Pressure Release Test	N/A	---	Not applied for Li-ion batteries
20	34	Start-To-Discharge Test	N/A	---	Not applied for Li-ion batteries
21	35	Thermal Cycling Test	N/A	---	Battery system was intended for stationary use
22	36	Resistance to Moisture Test	N/A	---	The battery system was intended for indoor use
23	37	Salt Fog Test	N/A	---	The battery system was intended for indoor use
24	39	Single Cell Failure Design Tolerance	P	B051100P02, B051100P03	---
38	7.7,7.8	Protective circuits and safety Analysis	P	---	Refer to function safety test report 80117112, Applicable test performed as per UL60730-1 and CAN/CSA-E60730-1 Annex H.

Construction Review:

Construction review performed with satisfactory results.

Edition 2: Project 80139278

Update report 80117111 to include cell model IFP50160116A-102Ah for battery pack, models B051100P02, B051100P03 and battery system models SunESS-5, SunESS-10, SunESS-15, SunESS-20; Atrix-5, Atrix-10, Atrix-15 and Atrix-20.

Correct the model names from SunESS5, SunESS10, SunESS15, SunESS20 to SunESS-5, SunESS-10, SunESS-15, SunESS-20 due to typo.

Based on the previous investigation recorded in 80117111 on Sep. 2nd, 2022, and the components alternated, the following tests were conducted in the following test facilities under CSA APT program with acceptable test results.

Test Lab: Shenzhen Precise Testing Technology Co., Ltd.

Address: No.9, Shuiku Road, Tangwei, Guangming District, Shenzhen City, China

List the applicable tests for the battery module.

TEST No.	SECTION	TEST NAME:	[P], [F] or [N/A]	Test Model	COMMENTS / REMARKS
1	7.11.2	Short circuit test	P	IFP50160116A-102Ah	Additional requirements for cell
2	7.11.2	Crush	P	IFP50160116A-102Ah	
3	7.11.2	Heating	P	IFP50160116A-102Ah	
4	15	Overcharge Test	P	B051100P03	---
5	16	Short Circuit Test	P	B051100P03	---
6	17	Over discharge Protection Test	P	B051100P03	---
7	18	Temperature and Operating Limits Check Test	P	B051100P02, B051100P03, SunESS-20, Atrix-20	---
8	19	Imbalanced Charging Test	P	B051100P03	---
9	39	Single Cell Failure Design Tolerance	P	B051100P02, B051100P03	---

Construction Review:

Construction review performed with satisfactory results.

---End of Report---