



CSA GROUP
Laboratory Test Data - UL 9540A

Master Contract: 302680

Report: 80263071

Project: 80263071

November 04, 2025

Mr. Yang

Certification Engineer

FOXESS CO., LTD.

No.939, Jinhai Third Road,

New Airport Industry Area,

Longwan District

Wenzhou, Zhejiang 325025

China

Subject: Rechargeable Li-ion battery unit, model CQ 241.05 (UL 9540A Test Report)

Dear Mr. Yang:

We are pleased to inform you that testing of your product per UL 9540A has been completed. Applicable test was performed at ChuWeiNeng Testing Technology (Shanghai) Co.Ltd, and witnessed by CSA Group – Kunshan. Unit level of test was conducted on the sample you provided and the results are enclosed in the test report.

Note: This Test Report is not an Authorization to apply the CSA Mark to the product. The results contained in the report(s) provided are contingent upon the characteristics of the actual sample(s) used in the investigation. In the absence of a continuing inspection service, CSA provides no assurance, expressed or implied, that the contents of the report are applicable to reproductions of the sample(s). Use or reproduction of the CSA name, logo, or trademark is not permitted without the prior written consent of CSA. No references can be made to this report when using the results of this investigation for the purposes of advertising, promotion or litigation, without the prior written consent of CSA.

Please examine the enclosed documents and contact me if you have any questions or would like us to make any changes.

On behalf of CSA, I would like to thank you for your business and offer our services for your future needs.

Yours truly,

Alex Li

CSA –CCIC-CSA International Certification Co., Ltd. Kunshan Branch

2F-1, Building C12, No 555 Dujuan Road, Kunshan Economic & Technical Development Zone, Kunshan, Jiangsu, China 215331



- Encl. [UL 9540A Test Report]
- Att.1 - Unit charge/discharge conditioning graphs*
 - Att.2 - Photos*
 - Att.3 - Diagram and dimension of test setup*
 - Att.4 - Temperature/voltage graph during testing*
 - Att.5 - Heat Release Rate graph*
 - Att.6 - Gas generation graph*
 - Att.7 - Smoke release graph*
 - Att.8 - Heat flux graph*
 - Att.9 - Notable observation during test*
 - Att.10 - Critical components information*
 - Att.11 - Video (separate file)*



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Laboratory Test Data - UL 9540A Checklist and Test Result (Unit Level)

ORIGINAL TEST DATA

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Master Contract:	302680	Model:	CQ 241.05	Page number 1 of 59
Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Standard(s): ANSI/CAN/UL 9540A:2025 Fifth Edition, Dated March 12, 2025 - Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

CSA Laboratory Name: CCIC-CSA International Certification Co.,Ltd. Kunshan Branch
Address: 2F-1, Building C12, No 555 Dujuan Road, Kunshan Economic & Technical Development Zone, Kunshan, Jiangsu, China 215331

If tests were performed at another facility, then described below:

Testing Laboratory Name: ChuWeiNeng Testing Technology (Shanghai) Co.Ltd
Address: Building 3, No.1065 Beihe Road, Jiading District, Shanghai
Facility Qualification Program: ☐ TMPC, ☐ WMTC, ☐ SMTCC, ☐ CPC, ☐ APD, ☒ APT, ☐ Subcontract
Witness By: Alex Li(T)/Michael Sw Wang, Certifier
Name, Title
Alex Li(T)/Michael Sw Wang 2025-09-03 to 2025-09-05
Signature *Date (YYYY-MM-DD)*

Customer: FOXESS CO., LTD.
Address: No.939, Jinhai Third Road,
New Airport Industry Area,
Longwan District
Wenzhou, Zhejiang 325025
China

Prepared By:(PSDP) Alex Li(T)/Michael Sw Wang, Certifier
Name, Title
Alex Li(T)/Michael Sw Wang 2025-10-20
Signature *Date (YYYY-MM-DD)*
Reviewed By:(Technical reviewer) Joseph Zhou, Team Lead
Name, Title
Joseph Zhou 2025-11-04
Signature *Date (YYYY-MM-DD)*
--
Address (If different then CSA Test Lab above)



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Cell Level Test Summary

Name of test laboratory perform cell level testing:	UL(Changzhou) Quality Technical Service Co., LTD
Unique identification of test report:	Project No. 4790919769
Standard and its edition used for testing:	UL 9540A, 4 th Edition
Manufacturer:	Guangzhou Great Power Energy Storage Technology Co., Ltd.
Brand name / Trademark:	N/A
Model number:	GSP71173204F
Nominal cell voltage, (V)	3.2
Cell capacity, (Ah)	314
Cell chemistry:	LFP
Physical format of cell:	Prismatic
Approximate dimension, (mm)	L*W*T: (207.3±0.5)* (173.9±0.5)* (71.7±0.8)
Mass, (kg)	≤5.90
Method used to initiate thermal runaway:	Film Heater
Average temperature at which cell first vented excluding gas collection sample, (°C)	166
Average temperature prior to thermal runaway excluding gas collection sample, (°C)	185
Flammable gas generation, (Liter)	--
Total gas generation, (Liter)	177.8
Lower flammability limit (LFL) at ambient temperature (25 ± 5°C), (%)	7.54
Lower flammability limit (LFL) at average gas vent temperature, (%)	6.44
Burning velocity, (Cm/Sec)	74.18
Maximum pressure P _{max} , (psig)	99.97
Gas composition:	See Table below



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Gas		Measured %
Carbon Monoxide	CO	9.576
Carbon Dioxide	CO ₂	24.949
Hydrogen	H ₂	49.706
Methane	CH ₄	6.631
Acetylene	C ₂ H ₂	0.230
Ethylene	C ₂ H ₄	5.046
Ethane	C ₂ H ₆	1.331
Propene	C ₃ H ₆	0.562
Propane	C ₃ H ₈	0.220
-	C4 (Total)	0.709
-	C5 (Total)	0.277
-	C6 (Total)	0.149
1-Heptene	C ₇ H ₁₄	0.024
Benzene	C ₆ H ₆	0.051
Toluene	C ₇ H ₈	0.007
Dimethyl Carbonate	C ₃ H ₆ O ₃	0.011
Ethyl Methyl Carbonate	C ₄ H ₈ O ₃	0.521
Total	-	100

Module Level Test Summary

Name of test laboratory perform module level testing:	CCIC-CSA International Certification Co., Ltd. Kunshan Branch
Unique identification of test report:	CSA, Test report No. 80263070
Standard and its edition used for testing:	UL 9540A:2025 5 th Edition
Manufacturer:	FOXESS CO., LTD.
Brand name / Trademark:	N/A
Model number:	CQ16
Nominal voltage rating, (V)	51.2
Nominal capacity rating, (Ah)	314
Approximate dimension, (mm)	W*D*H: 390*810*235
Method used to initiate thermal runaway:	Film Heater
Number of cells used for initiating thermal runaway:	1
Number of cells exhibited thermal runaway within module:	6
Cell to cell propagation condition:	Yes, 6 of 16 cells in the module went to thermal runaway.



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Peak chemical heat release rate, (kW)	5.89
Flammable gas generation, (Liter)	1733.03
Total gas generation, (Liter)	2415.37
Weight loss, (%)	5.21
Gas composition:	CO (3.685%), CO ₂ (28.250%), H ₂ (11.529%), THC (56.536%)
Additional Information:	The cell level test was based on the requirements in UL 9540A 5 th edition. The cell vent temperature and thermal runaway temperature were based on cell large surface uncovered by heater.

Unit Level Test Summary	
Manufacturer:	FOXESS CO., LTD.
Brand name / Trademark:	N/A
Model number:	CQ 241.05
Nominal voltage rating, (V)	768.0
Nominal capacity rating, (Ah)	314
Approximate dimension, (mm)	W*D*H: 1,710*810*1,010
BESS test configuration/intended installation:	Indoor floor mounted non-residential use BESS/ Indoor floor mounted non-residential use BESS
Unit certification available?	No, refer to Attachment 10 for the critical components.
Standard(s) used to certify product:	N/A
Certification organization name and its certificate number:	N/A
Electrical configuration of module in BESS:	15S-1P
Number of modules in BESS:	15
Fire detection and suppression system integral part of BESS: (Yes/No)	Yes. Only fire suppression system was integral part of BESS.



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Unit Level Test Summary

Test conducted with fire detection and suppression system: (Yes/No/Not Applicable)	No
Method used to initiate thermal runaway:	Film Heater
Number of cells used for initiating thermal runaway:	1
Number of cells exhibited thermal runaway within initiating module:	6
Number of modules exhibited thermal runaway within initiating BESS:	1
Cell to cell propagation condition:	Yes. 6 of 16 cells were thermal runaway inside of the initiating module.
Peak chemical heat release rate, (kW)	7.82
Peak convective heat release Rate, (kw)	0
Flammable gas generation, (Liter)	1,131.3
Total gas generation, (Liter)	1,494.5
Gas composition:	CO (4.7%), CO ₂ (24.3%), THC (53.6%), H ₂ (17.4%)
Maximum wall surface temperature, (°C)	45.1
Maximum target BESS temperature, (°C)	33.4
Maximum incident heat flux on target wall surfaces, (kw/m ²)	0.088
Maximum incident heat flux on target BESS, (kw/m ²)	0.031
Maximum incident heat flux of egress path, (kw/m ²)	0.082
Total smoke release, (m ²)	2.4394
Peak smoke release rate, (m ² /s)	764.28
Additional Information:	N/A



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Performance Unit Level Test (Non – Residential Indoor Floor Mounted)

Requirement	Comments	Verdict
Flaming outside the initiating BESS unit is not observed	No fire outside of the initiating BESS observed during test.	P
Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10;	Maximum module surface temperature inside of target BESS was 33.4 °C and less than cell venting temperature of 166 °C.	P
Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient;	Maximum wall surface temperature rise above ambient was 12.9 °C and less than 97 °C.	P
Explosion hazards are not observed, including deflagration or detonation.	No explosion hazards were observed.	P

Summary of Result:

No further testing is required based on the above performance condition indicated in Section 9.8 of UL 9540A 5th Edition.

Possible test case verdicts:

- Test object does not apply to the test object: N/A
- Test object does meet the requirement: P (Pass)
- Test object does not meet the requirement: F (Fail)
- Test object waived based construction detail: W (Waived)

Decision Rules: “Pass” when the measured value is within the prescribed limits for the test; and “Fail” when the measured value is not within the prescribed limits for the test. When the measured value falls on a prescribed limit for the test, CSA Group will refer to the written standard (or other applicable requirement) to determine the results of the test.



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Project / Network:	80263071	Description:	Rechargeable Li-ion Battery Unit	

Clause	Requirement + Test	Result - Remark	Verdict
Construction			
5	General	---	---
5.3	Battery energy storage system unit	---	---
5.3.1	BESS/Battery system certification available? (Yes/No)	No, refer to Attachment 10 for the critical components.	---
	Standard(s) used to certify product:	N/A	---
5.3.2	BESS/Battery system component documentation	☐ BESS/Battery system certification was available – Component detail not documented. ☒ BESS/Battery system certification was not available – See list of critical components in attachment section. ☐ Other(explain): --	---
	BESS/Battery system enclosure approximate dimension, (mm)	W*D*H: 1710*810*1010	---
	BESS/Battery system enclosure material:	Metallic	---
	Based on configuration of BESS, test conducted on:	☐ BESS ☒ Battery system	---
5.3.3	Fire detection system	☐ Integral part of DUT, test conducted with fire detection system. ☐ Integral part of DUT, test conducted without fire detection system. ☒ Not integral part of DUT	---
	Fire suppression system	☐ Integral part of DUT, test conducted with fire suppression system. ☒ Integral part of DUT, test conducted without fire suppression system. ☐ Not integral part of DUT	---
5.3.4	Unit level test report	See below	---
Performance			
9	Unit level	---	---
9.1	Sample and test configuration	---	---
9.1.1	The unit level test was conducted with BESS units installed as described in the manufacturer's instructions and this section.	Confirmed	P
	BESS test configuration:	Indoor floor mounted non-residential use BESS	---
9.1.2	Unit level test was conducted in which thermal runaway condition resulting in	Confirmed, refer to module level test report, Project No. 80263070	P



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Clause	Requirement + Test	Result - Remark	Verdict
	cell-to-cell thermal runaway propagation in accordance with module level test.		
	Test setup include initiating BESS unit and target BESS unit representative of an installation.	See Attachment 3 for details	P
	Additional representative test configuration based on test configuration.	N/A	---
	Separation distances between initiating and target units were representative of the installation.	Confirmed	P
	Testing conducted outdoor for BESS intended for outdoor installation only.	Testing was conducted under indoor condition	N/A
	Following controls and environmental conditions were in place.		
	a) Wind screens were utilized with a maximum wind speed maintained at ≤ 12 mph	See above	N/A
	b) Temperature range was within 10°C to 40°C	See above	N/A
	c) The humidity was < 90% RH	See above	N/A
	d) There was sufficient light to observe the testing;	See above	N/A
	e) There was no precipitation during the testing;	See above	N/A
	f) There was control of vegetation and combustibles in the test area to prevent any impact on the testing and to prevent inadvertent fire spread from the test area; and	See above	N/A
	g) There were protection mechanisms in place to prevent inadvertent access by unauthorized persons in the test area and to prevent exposure of persons to any hazards as a result of testing.	See above	N/A
9.1.3	Outdoor non-residential use High Temperature Batteries	Li-ion battery	N/A
9.1.4	High temperature battery module was considered the test unit for the test	Li-ion battery	N/A
9.1.5	Based on configuration and design of BESS, test conducted on:	☐ BESS ☒ Battery system	---
9.1.6	Where the manufacturer's instructions indicate that the BESS can be installed	Not applicable	N/A



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Clause	Requirement + Test	Result - Remark	Verdict
	outdoors and in open parking garages less than 3 m (10 feet) from the means of egress or other exposures, testing was conducted as described in this Section.		
9.1.7	Initiating BESS unit contain components representative of a BESS unit in a complete installation.	See Attachment 2 for details. The Initiating BESS comprised four columns connected in series, with a spacing of 50 mm between each. The second column was designated as the Initiating column and was fully populated. Modules positioned at the highest anticipated temperatures in the remaining columns were also populated. In total, the Initiating BESS contained 8 live modules and 7 dummy modules, providing a configuration considered sufficiently representative of a full BESS unit.	P
	Combustible components that interconnect the initiating and target BESS units were included.	Copper busbar connectors were used.	P
9.1.8	Target BESS units include the outer cabinet (if part of the design), racking, module enclosures, and components that retain cells components.	Use wall as target BESS for representative.	N/A
	The target BESS unit include one live module. Populated module was located at highest anticipated temperature in the enclosure.	See above. Maximum wall surface temperature was recorded as representative of maximum target BESS temperature.	N/A
	The remaining target BESS unit module enclosure do not need to contain cells.	See above	N/A
9.1.9	Initiating BESS unit was at the maximum operating state of charge (MOSOC).	Confirmed, see Table 2 for details.	P
	After charging and prior to testing, the initiating BESS was rested for a minimum period of 1 h at room ambient before start of the test.	Confirmed, see Table 2 for details.	P
9.1.10	Prior to initiating the test, the voltage of the initiating module was measured and recorded.	Confirmed, see Attachment 4 for details.	P
	the voltage drop was greater than 0.1 % of the fully charged voltage of the module, then the initiating BESS was be charged	Confirmed	P



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Clause	Requirement + Test	Result - Remark	Verdict
	again as noted and the voltage of the initiating BESS was be recorded		
9.1.11	BESS unit test conducted as per following condition.	See below	P
	a) Integral fire suppression system provided with the DUT.	See below	N/A
	b) Without Integral fire suppression system.	Confirmed. Integral fire suppression system was removed before the test	P
9.1.12	Electronic and software control were not relied upon for this testing.	Confirmed	P
	BESS unit test conducted with Integral fire suppression system meet UL 864 and considered reliable for this testing.	Testing was conducted without integral fire suppression system.	N/A
9.2	Test method – Indoor floor mounted BESS units	---	---
9.2.1	The test room environment was controlled to prevent drafts that may affect test results.	Confirmed	P
	At the start of the test, the room ambient temperature was not less than 10°C (50°F) nor more than 32°C (90°F).	Confirmed	P
	Ambient temperature range during test, °C	See Table 3 for details	P
9.2.2	Any access door(s) or panels were closed, latched and locked at the beginning and duration of the test.	Confirmed, refer to Figure 2.9 in Attachment 2 for details	P
9.2.3	The initiating BESS unit was positioned adjacent to two instrumented wall sections.	See Attachment 3 for details. Instrumented walls were used as target BESS for represent.	P
9.2.4	Instrumented wall sections were extended not less than 0.49 m (1.6 ft) horizontally beyond the exterior of the target BESS units.	Confirmed	P
9.2.5	Instrumented wall sections were at least 0.61-m (2-ft) taller than the BESS unit height, but not less than 2.13 m (7 ft) in height above the floor.	Confirmed	P
9.2.6	The surface of the instrumented wall sections was covered with gypsum wall board and painted flat black.	Confirmed	P
	An incremental visual reference was provided on the instrumented wall sections for scale so that flame extension can be accurately measured if applicable.	Confirmed	P



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Clause	Requirement + Test	Result - Remark	Verdict
	The gypsum wall board was 13-mm (1/2-inch) thick at minimum.	Confirmed	P
9.2.7	The initiating BESS unit was centered underneath an appropriately sized smoke collection hood of an oxygen consumption calorimeter.	Confirmed, 5MW calorimeter was used for testing.	P
9.2.8	The light transmission in the calorimeter's exhaust duct was measured.	Confirmed	P
	White light source and photo detector was used for the duration of the test.	Confirmed	P
	The smoke release rate was calculated as per following formula. $SRR = 2.303 \left(\frac{V}{D} \right) \log_{10} \left(\frac{I_o}{I} \right)$	Confirmed	P
9.2.9	The chemical and convective heat release rates were measured for the duration of the test.	See Attachment 5 for details	P
	Chemical heat release rate was calculated as per following formula. $HRR_1 = \left[E \times \phi - (E_{co} - E) \times \frac{1 - \phi}{2} \times \frac{X_{co}}{X_{O_2}} \right] \times \frac{\dot{m}_e}{1 + \phi \times (a - 1)} \times \frac{M_{O_2}}{M_a} \times (1 - X_{H_2O}^a) \times X_{O_2}^a$	Confirmed	P
9.2.10	The heat release rate measurement system shall be calibrated using an atomized heptane diffusion burner.	Confirmed	P
	Ther calibration was performed using appropriate flow rate of heptane.	Confirmed	P
9.2.11	The convective heat release rate was measured during test.	See Attachment 5 for details	P
	Thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust system of the exhaust duct were used for measurement.	Confirmed	P
9.2.12	The convective heat release rate was calculated as per following formula. $HRR_c = V_c A \frac{353.22}{T_c} \int_{T_o}^T C_p dT$	Confirmed	P
9.2.13	Physical spacing between BESS units (both initiating and target) and adjacent	See Attachment 3 for details	P



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Clause	Requirement + Test	Result - Remark	Verdict
	walls were representative of the intended installation.		
9.2.14	Separation distances was specified by the manufacturer for distance between:	See Attachment 3 for details	P
	a) The BESS units and the instrumented wall sections.	See above	P
	b) Adjacent BESS units.	See above	P
9.2.15	Wall surface temperatures was measured in vertical array(s) at 152-mm (6-in) intervals for the full height of the instrumented wall sections.	Confirmed	P
	No. 24-gauge or smaller, Type-K exposed junction thermocouples were used for measurement.	Confirmed, 24 AWG thermocouples were used in the test.	P
	The thermocouples were placed horizontally positioned in the wall locations anticipated to receive the greatest thermal exposure.	Confirmed	P
	Temperatures was measured continuously, averaging over every 60 second interval.	Confirmed	P
	The maximum of these averages was documented for each thermocouple location.	Confirmed	P
9.2.16	Thermocouples were secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires.	Confirmed	P
	The thermocouple tip was depressed into the gypsum so as to be flush with the gypsum surface at the point of measurement and held in thermal contact with the surface at that point by the use of pressure-sensitive paper tape.	Confirmed	P
9.2.17	Heat flux was measured with the sensing element of at least two water-cooled Schmidt- Boelter or Gardon gauges at the surface of each instrumented wall.	See Attachment 3 for details	P
	Heat flux was measured continuously, averaging over every 60-second interval.	Confirmed	P
	The maximum of these averages was documented for each gauge location.	Confirmed	P
	a) Both were collinear with the vertical thermocouple array.	Confirmed	P



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Clause	Requirement + Test	Result - Remark	Verdict
	b) One was positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module	Confirmed	P
	c) One was positioned at the elevation estimated to receive the greatest heat flux during potential propagation of thermal runaway within the initiating BESS unit.	Confirmed	P
9.2.18	Heat flux was measured with the sensing element of at least two water-cooled Schmidt- Boelter or Gardon gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit:	See Attachment 3 for details	P
	Heat flux was measured continuously, averaging over every 60-second interval.	Confirmed	P
	The maximum of these averages was documented for each gauge location.	Confirmed	P
	a) One was positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module within the initiating BESS	Confirmed	P
	b) One was positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.	Confirmed	P
9.2.19	For BESS intended for installation outdoors or in open parking garages, heat flux was be measured with the sensing element of at least one water-cooled Schmidt-Boelter or Gardon gauge positioned at the mid height of the initiating unit at the minimum horizontal distance from the BESS specified by the manufacturer or the point where the majority of off-gas venting is expected from the initiating unit.	Not applicable	N/A
	Heat flux was measured continuously, averaging over every 60-second interval.	Not applicable	N/A
9.2.20	No. 24-gauge or smaller, Type-K exposed junction thermocouples was installed to measure the temperature of the surface proximate to the cells and between the cells and exposed face of the	Confirmed.24 AWG thermocouples were used in the test.	P



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Clause	Requirement + Test	Result - Remark	Verdict
	initiating module.		
	Each non-initiating module enclosure within the initiating BESS unit was instrumented with at least one No. 24-gauge or smaller Type-K thermocouple(s) to provide data to monitor the thermal conditions within non-initiating modules.	Confirmed	P
	Additional thermocouples shall be placed to account for convoluted enclosure interior geometries.	Confirmed	P
	Temperatures was measured continuously, averaging over every 60 second interval.	Confirmed	P
	The maximum of these averages was documented for each thermocouple location.	Confirmed	P
9.2.21	For residential use BESS, the DUT was covered with a single layer of cheese cloth ignition indicator.	Non-residential use BESS	N/A
	The cheesecloth was untreated cotton cloth running 26 – 28 m ² /kg with a count of 28 – 32 threads in either direction within a 6.45 cm ² (1 in ²) area.	Non-residential use BESS	N/A
9.2.22	Cell to cell thermal runaway propagation in accordance with the module level test was established within a single module in the initiating BESS unit:	Confirmed, refer to module level test report project No. 80263070.	P
	a) The position of the module was selected to present the greatest thermal exposure to adjacent modules (e.g. above, below, laterally), based on the results from the module level test;	Confirmed, see Attachment 2 Figure 2.19 for details.	P
	b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module was the same as that used to initiate and propagate thermal runaway within the module level test.	Confirmed	P
9.2.23	The composition, velocity and temperature of the initiating BESS unit vent gases was measured within the calorimeter's exhaust duct.	Confirmed	P



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Clause	Requirement + Test	Result - Remark	Verdict
	The hydrocarbon content of the vent gas was measured using flame ionization detection.	Confirmed	P
	Hydrogen gas was measured with a palladium-nickel thin-film solid state sensor.	Confirmed	P
	Composition, velocity and temperature instrumentation were collocated with heat release rate calorimetry instrumentation.	Confirmed	P
9.2.24	The hydrocarbon content of the vent gas was additionally measured by a Fourier-Transform Infrared Spectrometer with a minimum resolution of 1 cm ⁻¹ and a path length of at least 2.0 m (6.6 ft), or equivalent gas analyzer.	FTIR was used during test for reference only.	P
9.2.25	The test was terminated at:	See below	P
	a) There were three consecutive temperature readings measured inside each module within the initiating BESS unit that were determined to be falling over 15-minute intervals;	Confirmed	P
	b) The modules return to a temperature less than 60 °C (140 °F);	Confirmed	P
	c) The fire propagates to adjacent units or to adjacent walls;	No flame observed	N/A
	d) A condition hazardous to test staff or the test facility requires mitigation; or	No hazardous condition	N/A
	e) Flaming outside the test room is observed.	No flame observed	N/A
9.2.26	For residential use systems, the gas collection data gathered was compared to the smallest room installation specified by the manufacturer to determine if the flammable gas collected exceeds 25% LFL in air.	Non-residential use BESS	N/A
9.3	Test method – Outdoor ground mounted units	Indoor floor mounted non-residential use BESS	N/A
9.4	Test Method – Indoor wall mounted units	Indoor floor mounted non-residential use BESS	N/A
9.5	Test Method – Outdoor wall mounted units	Indoor floor mounted non-residential use BESS	N/A
9.6	Rooftop and open garage installations	Indoor floor mounted non-residential use BESS	N/A



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Clause	Requirement + Test	Result - Remark	Verdict
9.7	Unit level test report	See below	P
9.7.1	Type of installation considered during unit level testing:	Indoor floor mounted non-residential use BESS	P
9.7.2	Additional installation represented by the type of installation considered during unit level testing:	No	N/A
9.7.3	The unit level report include the following information.	See below	P
	a) Unit manufacturer name and model number (and whether UL 9540 compliant);	Unit manufacturer name: FOXESS CO., LTD. Model number: CQ 241.05 without UL 9540 certified. See Attachment 10 for the critical component list.	P
	b) Number of modules in the initiating BESS unit;	15	P
	c) The construction of the initiating BESS unit per 5.3;	See Attachment 2 for details	P
	d) Fire protection features / detection / suppression systems within unit;	Test was conducted without fire protection, detection and suppression systems within unit.	N/A
	e) Module voltage(s) corresponding to the tested SOC;	See Attachment 1 for details	P
	f) The thermal runaway initiation method used;	Film Heater	P
	g) Location of the initiating module within the BESS unit;	See Attachment 3 for details	P
	h) Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, and soffits;	See Attachment 3 for details	P
	i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension;	No flame observed	N/A
	j) Chemical and convective heat release rate versus time data;	See Attachment 5 for details	P
	k) Separation distances from the initiating BESS unit to target walls;	See Attachment 3 for details	P
	l) Separation distances from the initiating BESS unit to target BESS units;	See Attachment 3 for details	P
	m) The maximum wall surface and target BESS temperatures achieved during the	Confirmed	P



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Clause	Requirement + Test	Result - Remark	Verdict
	test and the location of the measuring thermocouple;		
	n) The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple;	Not applicable	N/A
	o) The maximum incident heat flux on target wall surfaces and target BESS units;	See Attachment 8 for details	P
	p) The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test;	Not applicable	N/A
	q) Gas generation and composition data;	See Attachment 6 for details	P
	r) Peak smoke release rate and total smoke release data;	See Attachment 7 for details	P
	s) Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred;	Test conducted without fire protection and detection system	N/A
	t) Observation of flying debris or explosive discharge of gases unless mitigated by an engineered deflagration protection system;	Not observed	N/A
	u) Observation of re-ignition(s) from thermal runaway events;	Not observed	N/A
	v) Observation(s) of sparks, electrical arcs, or other electrical events;	Not observed	N/A
	w) Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; 3) Adjacent walls, ceilings, or soffits	See Table 5 for details	P
	x) Photos and video of the test.	See Attachment 2 and Attachment 11 for details	P
	y) If the test is terminated in accordance with 9.2.25, the circumstances of the termination;	The modules return to a temperature of less than 60 °C. See Attachment 4 for details	P
	z) Module level test report summary and cell level test report summary.	Confirmed	P



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Table 1 – Unit charge/discharge specification

Charging method	CC-CV	Discharging method	CC
Charge current, (Adc)	240	Discharge current, (Adc)	240
Charge voltage, (Vdc)	58.4 V for module/3.65V for cell	---	---
Charge end current, (Adc)	16	Discharge end voltage, (Vdc)	46.4 V for module/2.50V for cell
Manufacturer recommended charge temperature, (°C)	0 to 55	Manufacturer recommended discharge temperature, (°C)	-10 to 55

Table 2 – Unit rest duration

Sample Number	Final charge end time		Test start time	
	Date (YYYY-MM-DD)	Time (HH:MM AM/PM)	Date (YYYY-MM-DD)	Time (HH:MM AM/PM)
CWN250902XF01BR	2025-09-04	10:20 AM	2025-09-04	17:29 PM
Ambient temperature during unit conditioning				
Ambient Lab Temperature, (°C)		Relative Humidity, (%RH)		
26.3 to 28.3		54.0 to 70.0		

Table 3 – Unit level test

Sample Number:	CWN250902XF01BR
Ambient temperature at start of test, (°C)	27.9
Ambient temperature range during test, (°C)	25.6 to 32.2
Relative humidity, (%RH)	63.0
Number of cells used for initiating thermal runaway:	1
Open circuit voltage before test, (Vdc)	54.35
External film heater ramp rate, (°C/min)	4.5
Other method used to initiate thermal runaway:	N/A
Location of cell and module for initiating thermal runaway:	See Attachment 2 for details
Number of cells exhibited thermal runaway within initiating module:	6 of 16 cells were thermal runaway inside of the initiating module
Number of modules exhibited thermal runaway within initiating BESS:	1 of 8 live modules was thermal runaway inside the initiating BESS (only the initiating module, no module to module propagation observed)
Location of cell and module exhibited thermal runaway within initiating BESS:	See Attachment 2 for details



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Table 3 – Unit level test

Cell to cell propagation condition:	Yes
Peak chemical heat release rate, (kW)	7.82
Peak convective heat release rate, (kW)	0
Flammable gas generation, (Liter)	1,131.3
Total gas generation, (Liter)	1,494.5
Peak smoke release rate, (m ² /sec)	2.4394
Total smoke release rate, (m ²)	764.28

Table 4 – Gas composition

Gas Component		Volume Released (Before Flaming) (Liter)	Volume Released (After Flaming) (Liter)
Carbon Monoxide	CO	70	--
Carbon Dioxide	CO ₂	363.2	--
Hydrogen (palladium-nickel thin-film solid state sensor)	H ₂	260.7	--
Total Hydrocarbons (equivalent to CH ₄)	THC	800.6	--

Table 5 – Critical observation

Condition	Comment
Any flaming outside the initiating BESS enclosure and the maximum flame extension:	Not observed
Flying debris	Not observed
Explosive discharge of gases	Not observed
Re-ignition(s) from thermal runaway events	Not observed
Sparks	Not observed
Electrical arcs	Not observed
Other electrical events	N/A
Damage to the initiating BESS unit	See Attachment 2 for details
Damage to target BESS units;	Not observed
Damage to adjacent walls	Not observed
Damage to ceilings	N/A
Damage to soffits	N/A



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Attachments

Index of Attachments		
No.	Name	Page
1	Unit charge/discharge conditioning graphs	21-22
2	Photos	23-33
3	Diagram and dimension of test setup	34
4	Temperature/voltage graph during testing	35-43
5	Heat release rate graph	44
6	Gas generation graph	45
7	Smoke release graph	46
8	Heat flux graph	47
9	Notable observation during test	48
10	Critical components information	49-59
11	Video (separated file)	Mp4

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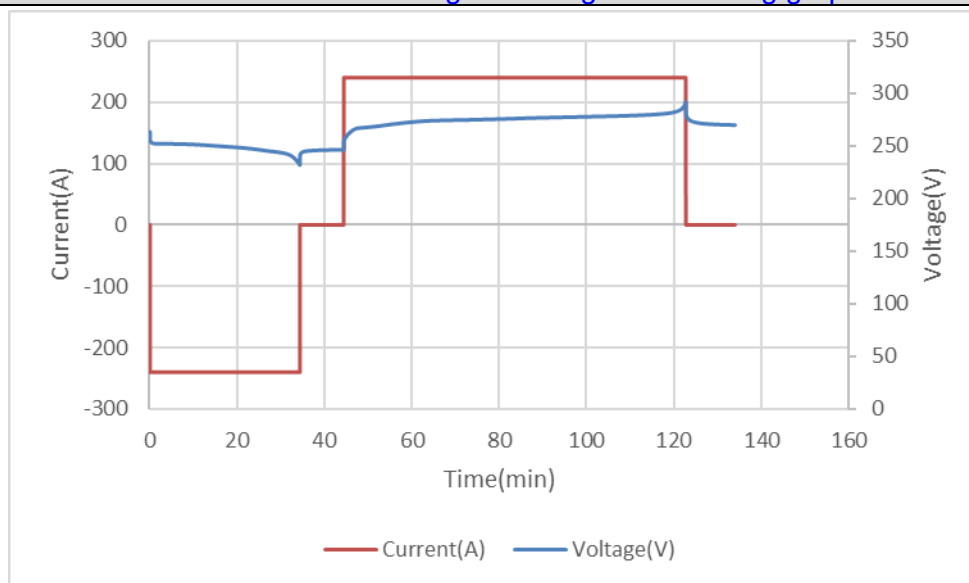
Attachment 1 - Unit charge/discharge conditioning graphs


Figure 1.1: Charge/discharge conditioning of 5 modules in series (initiating column)

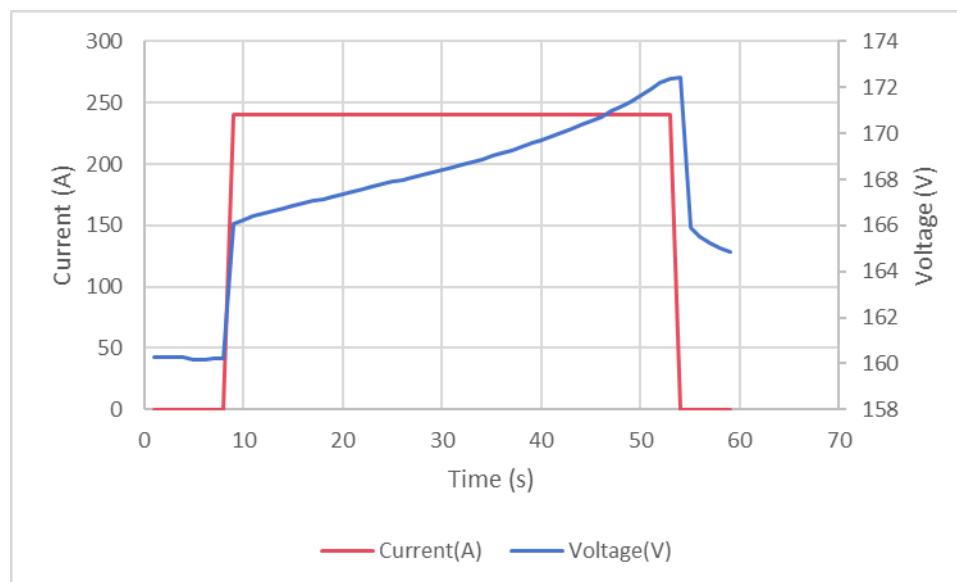


Figure 1.2: Recharging conditioning of 5 modules in series (initiating column)



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Attachment 1 - Unit charge/discharge conditioning graphs

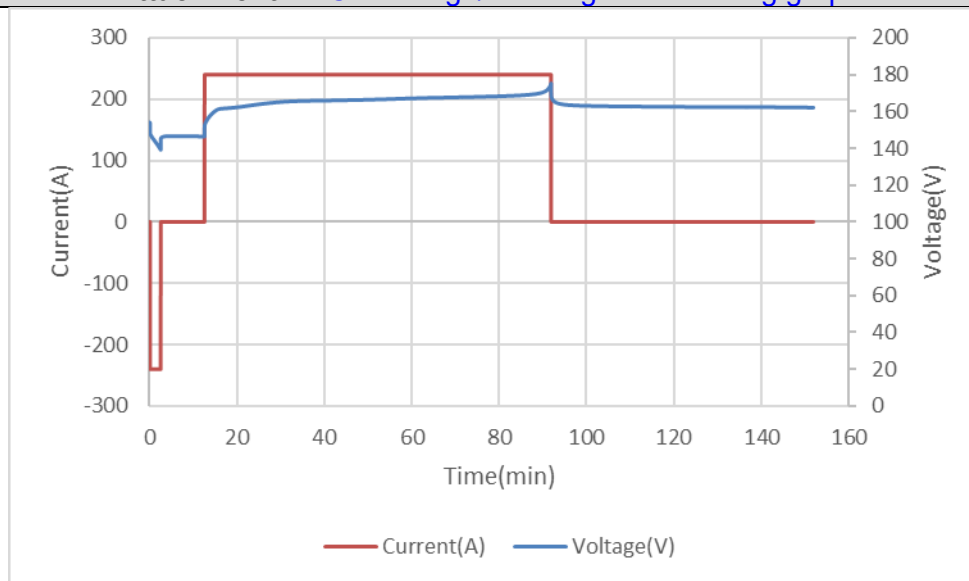


Figure 1.3: Charge/discharge conditioning of 3 modules in series

Note: There were 8 live modules populated in the Initiating unit, all of them were fully charged. Besides, the initiating module was submitted to additional charging. The final capacity of initiating module was 315.994Ah.

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Attachment 2 – Photos
General sample photos


Figure 2.1: [Front view of initiating module](#)



Figure 2.2: [Back view of initiating module](#)



Figure 2.3: [Left view of initiating module](#)

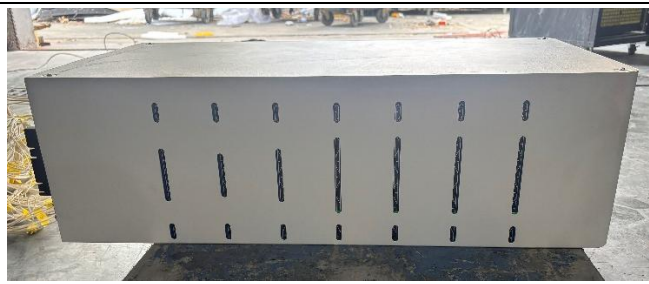


Figure 2.4: [Right view of initiating module](#)



Figure 2.5: [Top view of initiating module](#)

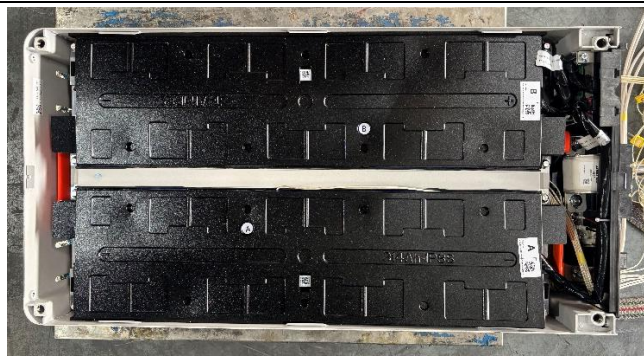


Figure 2.6: [Internal view of initiating module-1](#)

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Attachment 2 – Photos


Figure 2.7: [Internal view of initiating module-2](#)



Figure 2.8: [Front view of Test Unit without front covering](#)

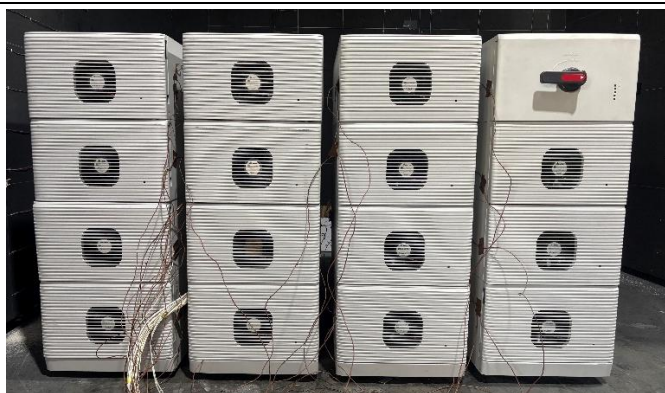


Figure 2.9: [Front view of Test Unit](#)



Figure 2.10: [Back view of Test Unit](#)



Figure 2.11: [Right view of Test Unit](#)



Figure 2.12: [Left view of Test Unit](#)

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Attachment 2 – Photos
Photos with heater and thermocouple installation


Figure 2.13: [Thermocouples on Column D](#)



Figure 2.14: [Thermocouples on Column C](#)



Figure 2.15: [Thermocouples on Column B](#)



Figure 2.16: [Thermocouples on Column A](#)

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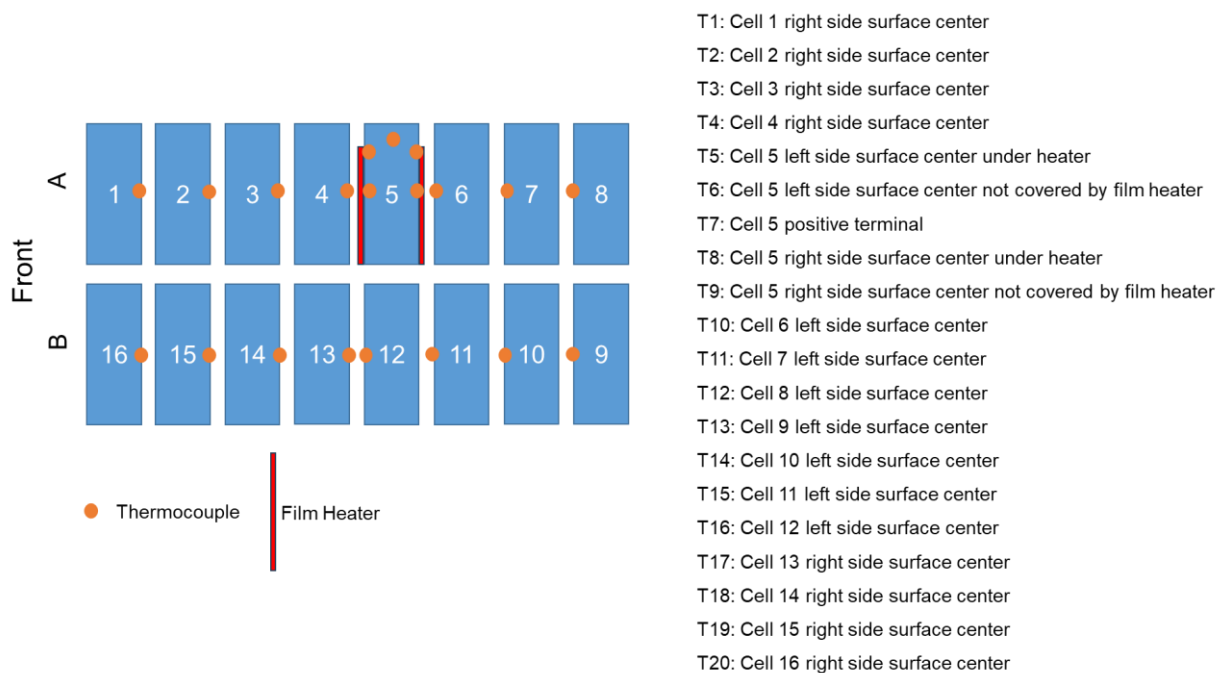
Attachment 2 – Photos


Figure 2.17: Thermocouple Map inside of initiating module

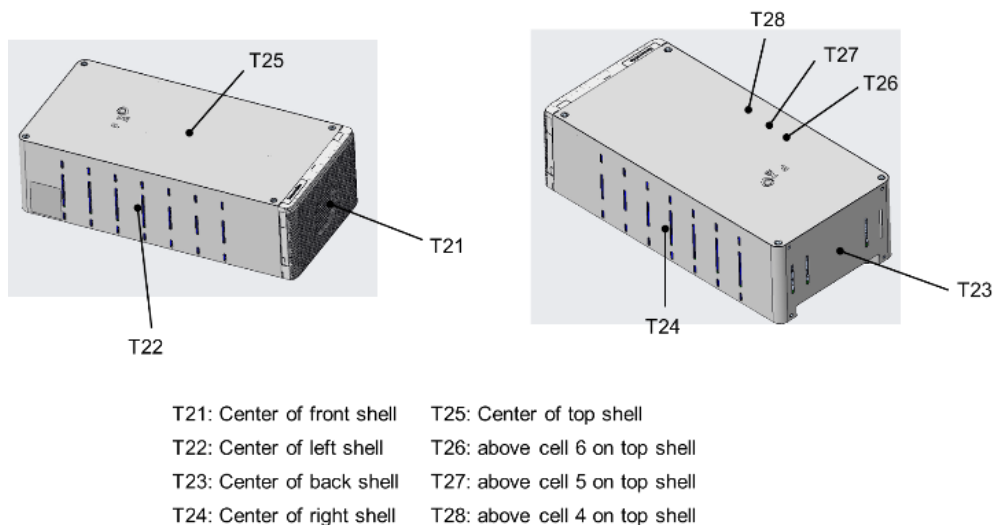


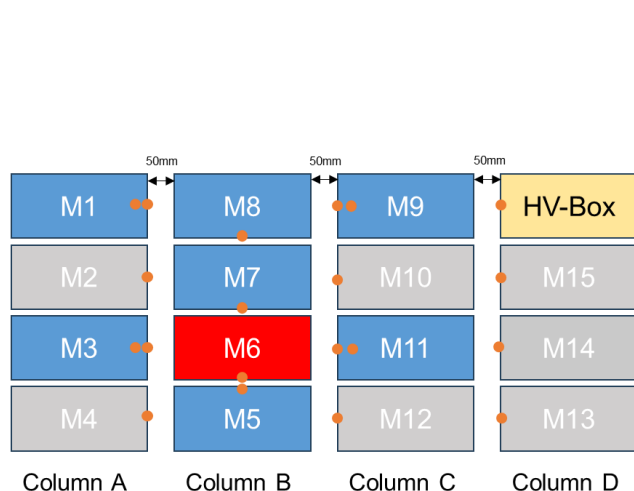
Figure 2.18: Thermocouple Map on the enclosure of initiating module

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Attachment 2 – Photos


- Thermocouple
- Initiating module
- Real module
- Dummy module

- TM1: Right shell of Module 1
- TM1-1: Center of right cell pack surface in Module 1
- TM2: Right shell of Module 2
- TM3: Right shell of Module 3
- TM3-1: Center of right cell pack surface in Module 3
- TM4: Right shell of Module 4
- TM5: Top shell of Module 5
- TM6: Bottom shell of Module 6
- TM7: Bottom shell of Module 7
- TM8: Bottom shell of Module 8
- TM9: Left shell of Module 9
- TM9-1: Center of left cell pack surface in Module 9
- TM10: Left shell of Module 10
- TM11: Left shell of Module 11
- TM11-1: Center of left cell pack surface in Module 11
- TM12: Left shell of Module 12
- TM13: Left shell of Module 13
- TM14: Left shell of Module 14
- TM15: Left shell of Module 15
- THV: Left shell of HV-Box
- V1: Voltage of M6

Figure 2.19: Thermocouple Map on the test unit

Photos during test in progress


Figure 2.20: At test start (Local Time in 17:29, 2025-09-04)



Figure 2.21: During 1st cell (cell 5) venting (Local Time in 18:10)

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Attachment 2 – Photos


Figure 2.22: During 1st cell (cell 5) thermal runaway (Local Time in 18:23)



Figure 2.23: During 2nd cell (cell 4) venting (Local Time in 18:24)



Figure 2.24: During 3rd cell (cell 6) venting (Local Time in 18:25)



Figure 2.25: During 2nd cell (cell 4) thermal runaway (Local Time in 18:28)



Figure 2.26: During 3rd cell (cell 6) thermal runaway (Local Time in 18:29)



Figure 2.27: During 4th cell (cell 3) venting (Local Time in 18:40)

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Attachment 2 – Photos


Figure 2.28: During 4th cell (cell 3) thermal runaway (Local Time in 18:40)



Figure 2.29: During 5th cell (cell 7) venting (Local Time in 19:27)



Figure 2.30: During 5th cell (cell 7) thermal runaway (Local Time in 19:27)



Figure 2.31: During cell 14 venting (Local Time in 19:28)



Figure 2.32: During 6th cell (cell 8) thermal runaway (Local Time in 19:38)



Figure 2.33: During 6th cell (cell 8) thermal runaway (Local Time in 19:57)

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Attachment 2 – Photos


Figure 2.34: [During cell 10 venting \(Local Time in 21:18\)](#)



Figure 2.35: [During test unit cooling down naturally \(Local Time in 23:24\)](#)



Figure 2.36: [End of test \(Local Time in 07:55, 2025-09-05\)](#)

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Photos after test


Figure 2.37: [Front view of Test Unit after test](#)



Figure 2.38: [Back view of Test Unit after test](#)

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Attachment 2 – Photos


Figure 2.39: [Right view of Test Unit after test](#)



Figure 2.40: [Top view of Test Unit after test](#)



Figure 2.41: [Left view of Test Unit after test](#)



Figure 2.42: [Left view of Column D after test](#)

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Attachment 2 – Photos


Figure 2.43: [Right view of Column C after test](#)



Figure 2.44: [Left view of initiating Column B after test](#)



Figure 2.45: [Right view of Column A after test](#)



Figure 2.46: [Front view of Column B after test](#)

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Attachment 2 – Photos


Figure 2.47: Front view of Initiating module after test



Figure 2.48: Back view of Initiating module after test



Figure 2.49: Right view of Initiating module after test



Figure 2.50: Left view of Initiating module after test



Figure 2.51: Top view of Initiating module after test



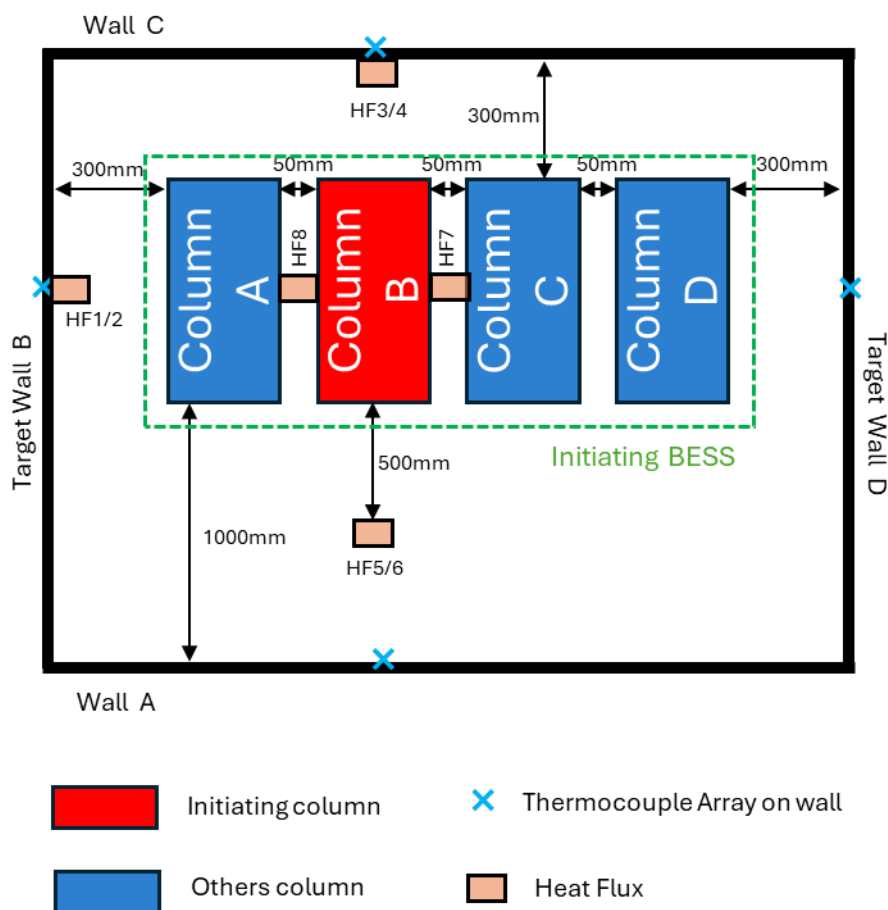
Figure 2.52: Thermal runaway cells

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Attachment 3 - Diagram and dimension of test setup


Note: Target Wall B & Target Wall D were instrumented to represent the target BESS

Separation distance and other critical dimension detail		
Location	Required by manufacturer (mm)	Measured (mm)
Distance between test unit and wall A	1000	1000
Distance between test unit and Target wall B	300	300
Distance between test unit and wall C	300	300
Distance between test unit and Target wall D	300	300
Distance between Column A and Column B	50	50
Distance between Column B and Column C	50	50
Distance between Column C and Column D	50	50

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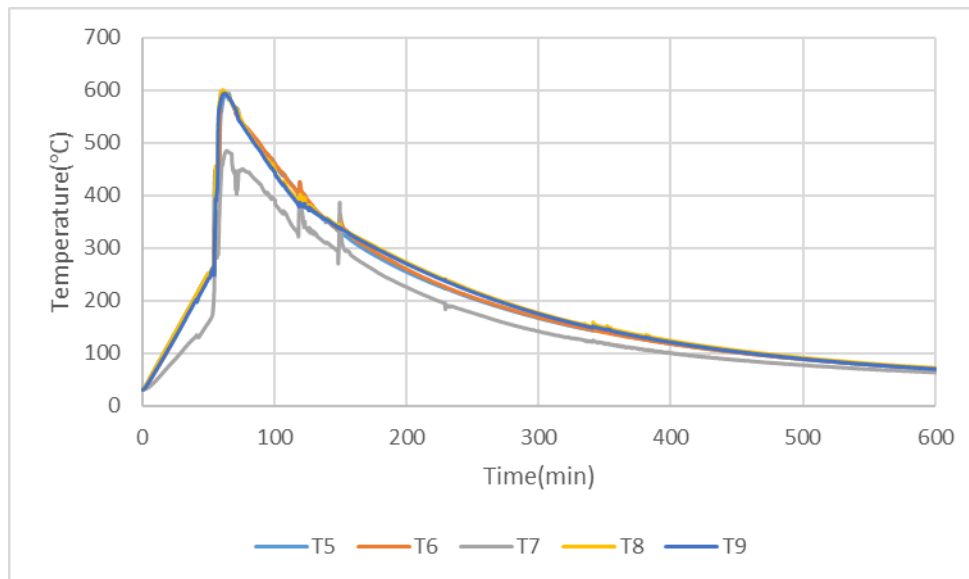
Attachment 4 - Temperature/voltage graph during testing


Figure 4.1: Temperatures of initiating cell inside of initiating module

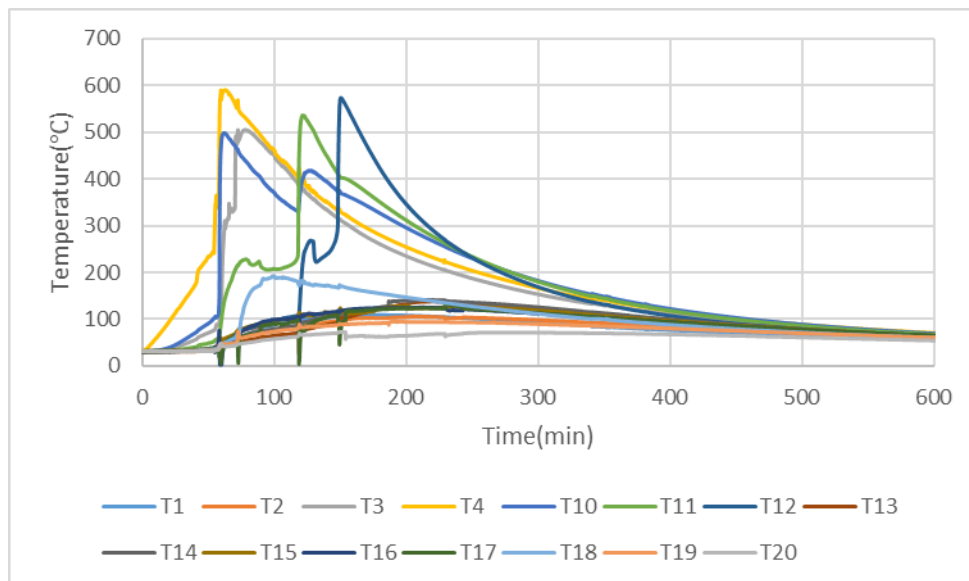


Figure 4.2: Temperatures of adjacent cells inside of initiating module

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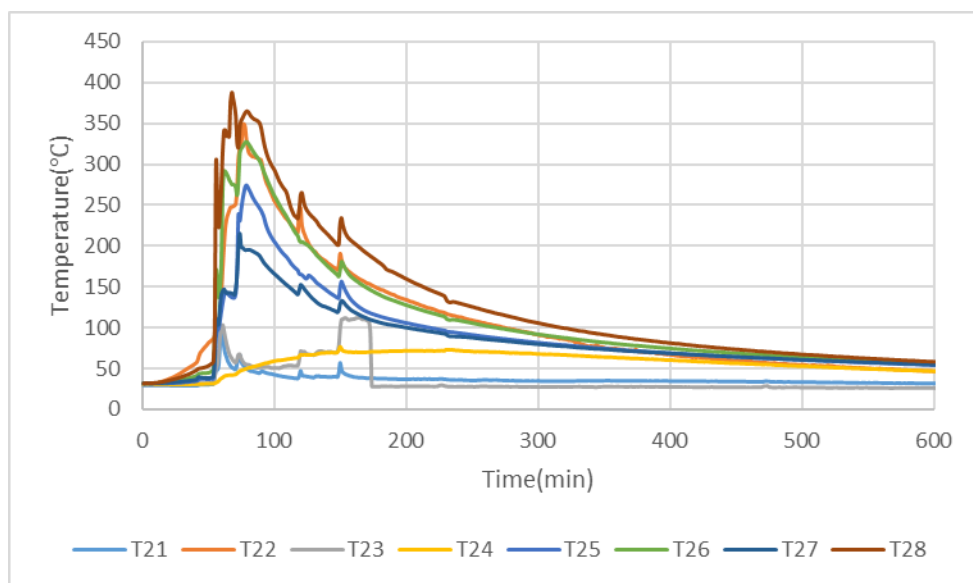
Attachment 4 - Temperature/voltage graph during testing


Figure 4.3: Surface temperatures of initiating module enclosure

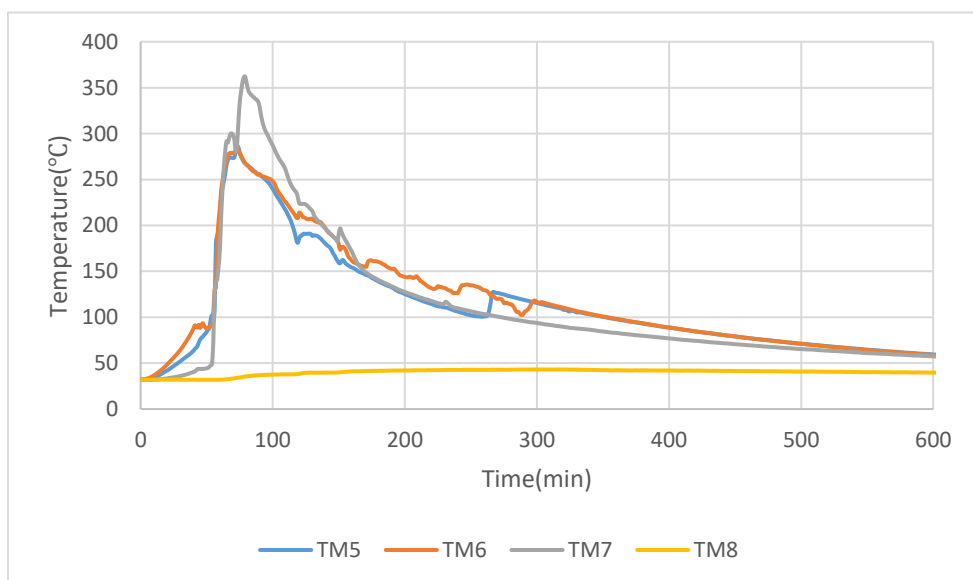


Figure 4.4: Surface temperatures of adjacent modules in initiating Column B

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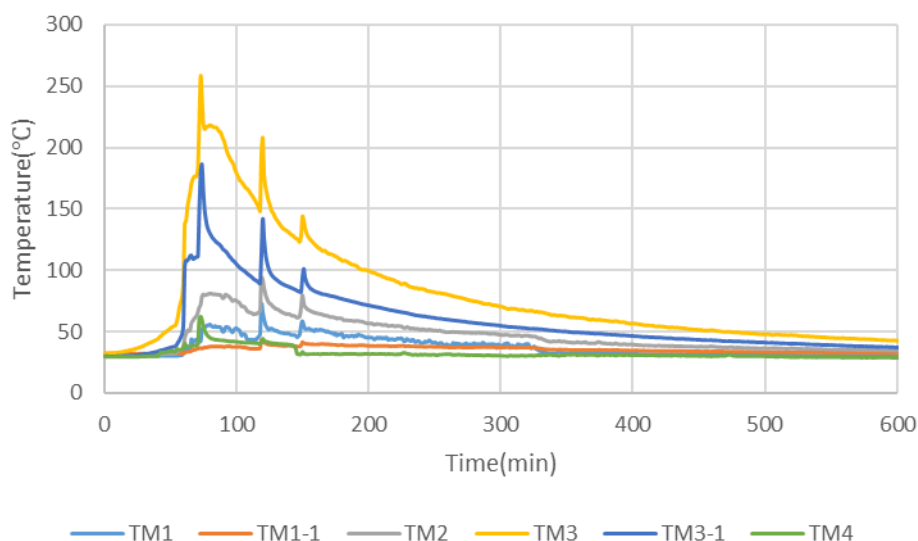
Attachment 4 - Temperature/voltage graph during testing


Figure 4.5: Temperatures of Column A

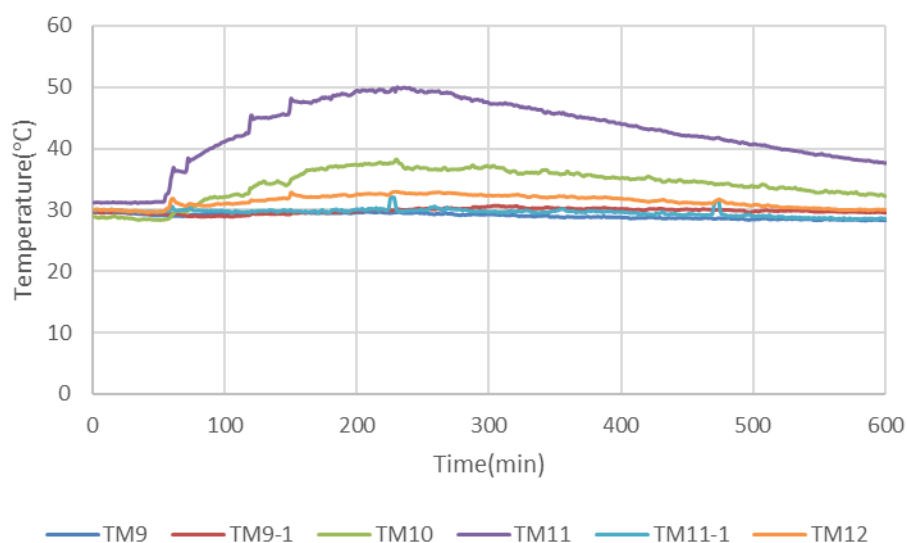


Figure 4.6: Temperatures of Column C

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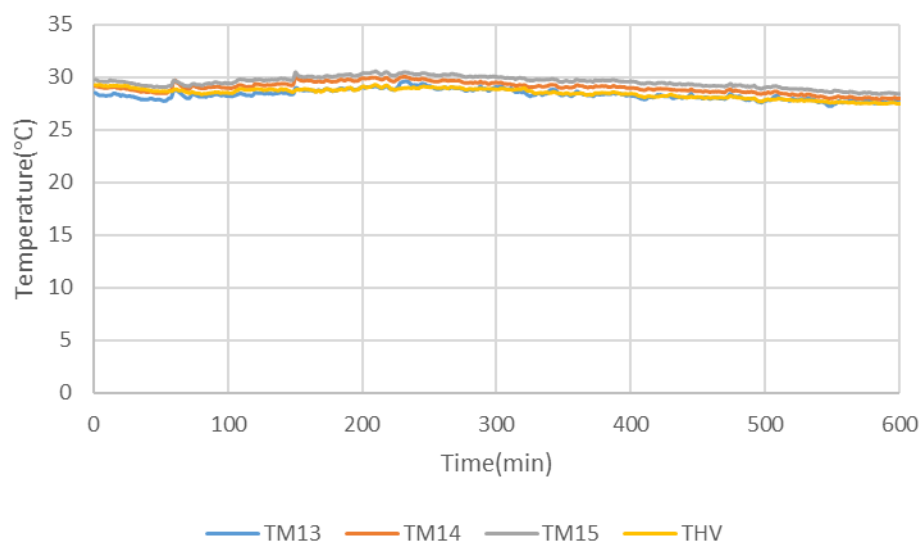
Attachment 4 - Temperature/voltage graph during testing


Figure 4.7: Temperatures of Column D

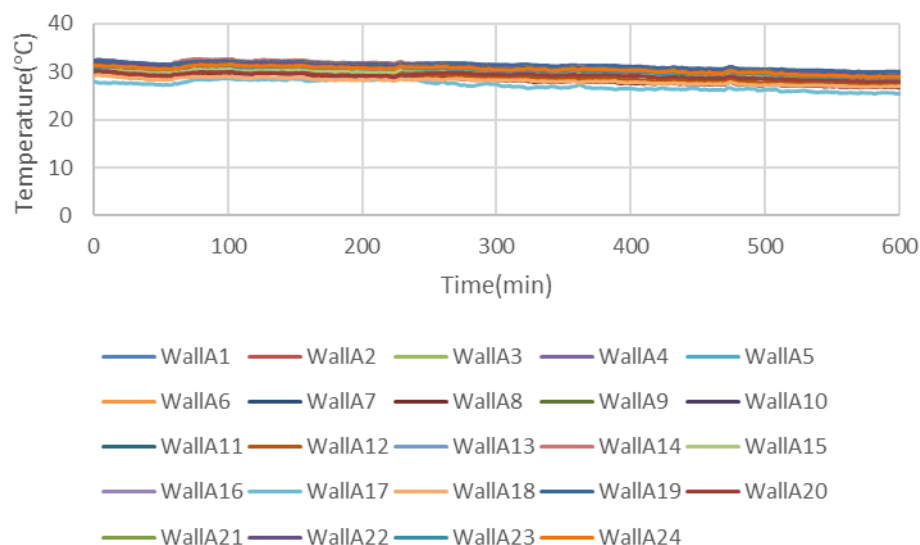


Figure 4.8: Temperatures on Wall A, temperature points are spaced every 6 inches, starting with WallA1 at the bottom and ending with WallA24 at the top.

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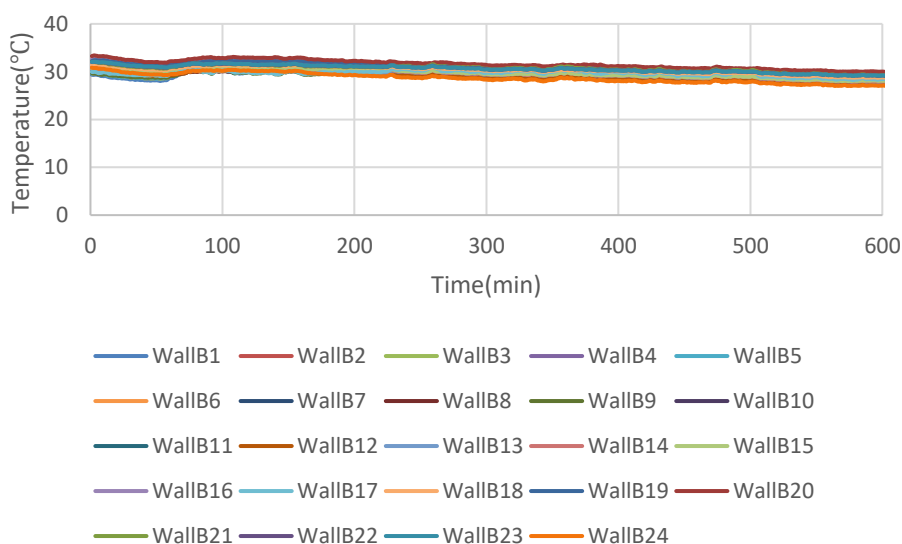
Attachment 4 - Temperature/voltage graph during testing


Figure 4.9: Temperatures on Target Wall B, temperature points are spaced every 6 inches, starting with WallB1 at the bottom and ending with WallB24 at the top.

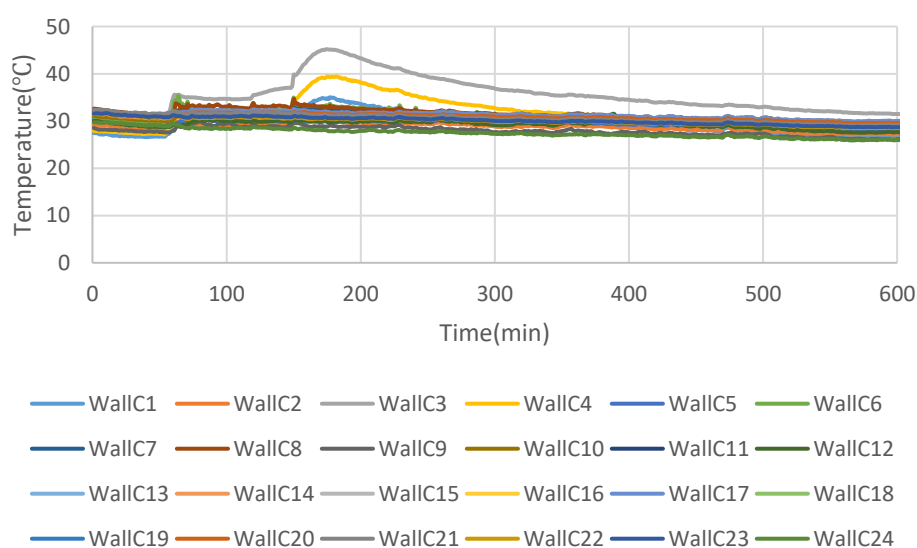


Figure 4.10: Temperatures on Wall C, temperature points are spaced every 6 inches, starting with WallC1 at the bottom and ending with WallC24 at the top.

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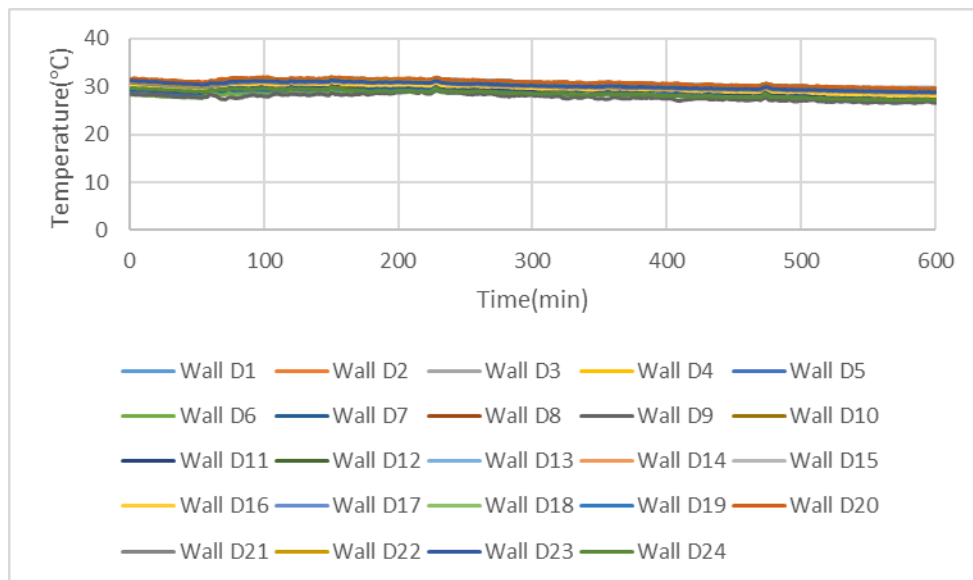
Attachment 4 - Temperature/voltage graph during testing


Figure 4.11: Temperatures on Target Wall D, temperature points are spaced every 6 inches, starting with WallD1 at the bottom and ending with WallD24 at the top.

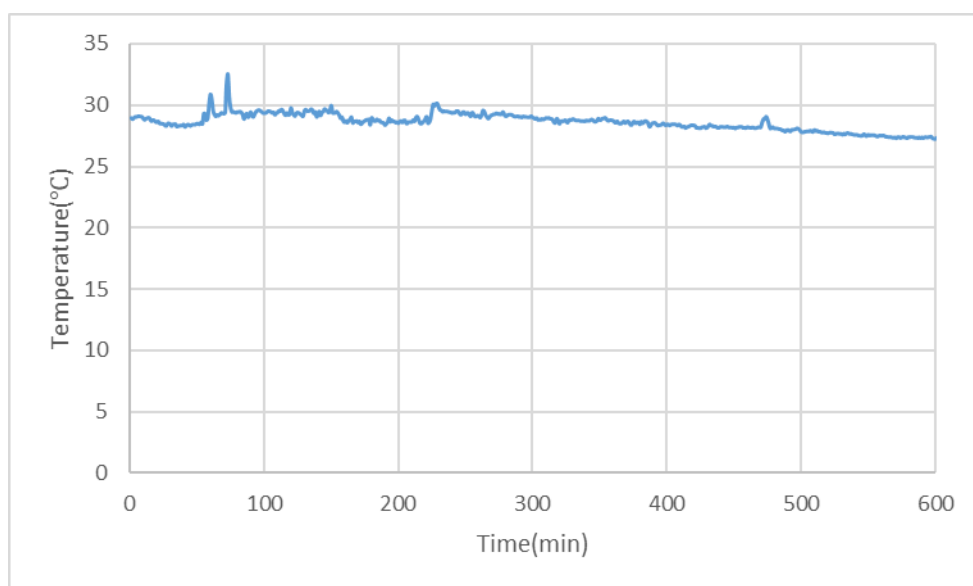


Figure 4.12: Ambient temperature during test



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Attachment 4 - Temperature/voltage graph during testing

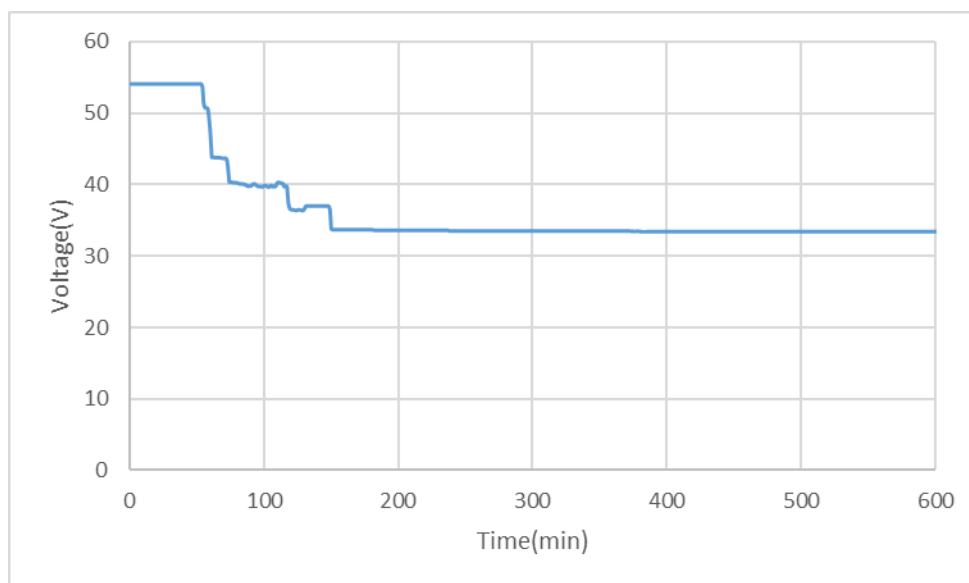


Figure 4.13: Voltage of initiating module

Maximum temperature measurement		
Location	Temperature limit (°C)	Measured maximum temperature (°C)
T1, Initiating module cell surface - Cell 1 right side surface center	N/A	109.0
T2, Initiating module cell surface - Cell 2 right side surface center	N/A	105.5
T3, Initiating module cell surface - Cell 4 right side surface center	N/A	505.1
T4, Initiating module cell surface - Cell 4 right side surface center	N/A	590.6
T5, Initiating module cell surface - Cell 5 left side surface center under heater	N/A	593.9
T6, Initiating module cell surface - Cell 5 left side surface center not covered by film heater	N/A	597.4
T7, Initiating module cell surface - Cell 5 right side surface center under heater	N/A	485.3
T8, Initiating module cell surface - Cell 5 right side surface center under heater	N/A	600.9
T9, Initiating module cell surface - Cell 5 positive terminal	N/A	594.1
T10, Initiating module cell surface - Cell 6 left side surface center	N/A	498.6
T11, Initiating module cell surface - Cell 7 left side surface center	N/A	536.6
T12, Initiating module cell surface - Cell 8 left side surface center	N/A	573.8
T13, Initiating module cell surface - Cell 9 left side surface center	N/A	137.8



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Attachment 4 - Temperature/voltage graph during testing

T14, Initiating module cell surface - Cell 10 left side surface center	N/A	141.3
T15, Initiating module cell surface - Cell 11 left side surface center	N/A	128.2
T16, Initiating module cell surface - Cell 12 left side surface center	N/A	125.3
T17, Initiating module cell surface - Cell 13 right side surface center	N/A	133.6
T18, Initiating module cell surface - Cell 14 right side surface center	N/A	192.3
T19, Initiating module cell surface - Cell 15 right side surface center	N/A	94.5
T20, Initiating module cell surface - Cell 16 right side surface center	N/A	73.4
T21, Initiating module enclosure - Center of front shell	N/A	99.8
T22, Initiating module enclosure - Center of left shell	N/A	349.4
T23, Initiating module enclosure - Center of back shell	N/A	112.5
T24, Initiating module enclosure - Center of right shell	N/A	76.5
T25, Initiating module enclosure - Center of top shell	N/A	274.3
T26, Initiating module enclosure - above cell 6 on top shell	N/A	327.5
T27, Initiating module enclosure - above cell 5 on top shell	N/A	215.1
T28, Initiating module enclosure - above cell 4 on top shell	N/A	387.9
TM1, modules in Column A - Right shell of Module 1	N/A	73.2
TM1-1, modules in Column A - Center of right cell pack surface in Module 1	N/A	50.7
TM2, modules in Column A - Right shell of dummy Module 2	N/A	97.7
TM3, modules in Column A - Right shell of Module 3	N/A	262.1
TM3-1, modules in Column A - Center of right cell pack surface in Module 3	N/A	193.6
TM4, modules in Column A - Right shell of dummy Module 4	N/A	63.1
TM5, modules in Initiating Column B - Top shell of Module 5	N/A	287.0
TM6, modules in Initiating Column B - Bottom shell of Module 6	N/A	285.9
TM7, modules in Initiating Column B - Bottom shell of Module 7	N/A	362.6
TM8, modules in Initiating Column B - Bottom shell of Module 8	N/A	43.2
TM9, modules in Column C - Left shell of Module 9	N/A	29.8
TM9-1, modules in Column C - Center of left cell pack surface in Module 9	N/A	30.8
TM10, modules in Column C - Left shell of dummy Module 10	N/A	38.3
TM11, modules in Column C - Left shell of Module 11	N/A	50.1
TM11-1, modules in Column C - Center of left cell pack surface in Module 11	N/A	32.1
TM12, modules in Column C - Left shell of dummy Module 12	N/A	33.0



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Attachment 4 - Temperature/voltage graph during testing

TM13, modules in Column D - Left shell of dummy Module 13	N/A	29.6
TM14, modules in Column D - Left shell of dummy Module 14	N/A	30.2
TM15, modules in Column D - Left shell of dummy Module 15	N/A	30.6
THV, HV-Box in Column D - Left shell of HV-Box	N/A	29.3
Wall A (WallA1-WallA24)	129.5	32.7
Target Wall B (WallB1-WallB24)	166.0	33.4
Wall C (WallC1-WallC24)	129.5	45.1
Target Wall (WallD1-WallD24)	166.0	32.0
Ambient	N/A	32.5

Open circuit voltage measurement

Location	Before testing (Vdc)	After testing (Vdc)
M1	53.48	53.47
M3	53.52	53.50
M5	54.03	53.97
M6(Initiating Module)	54.29	33.43
M7	54.44	54.33
M8	53.81	53.81
M9	53.54	53.54
M11	53.41	53.40



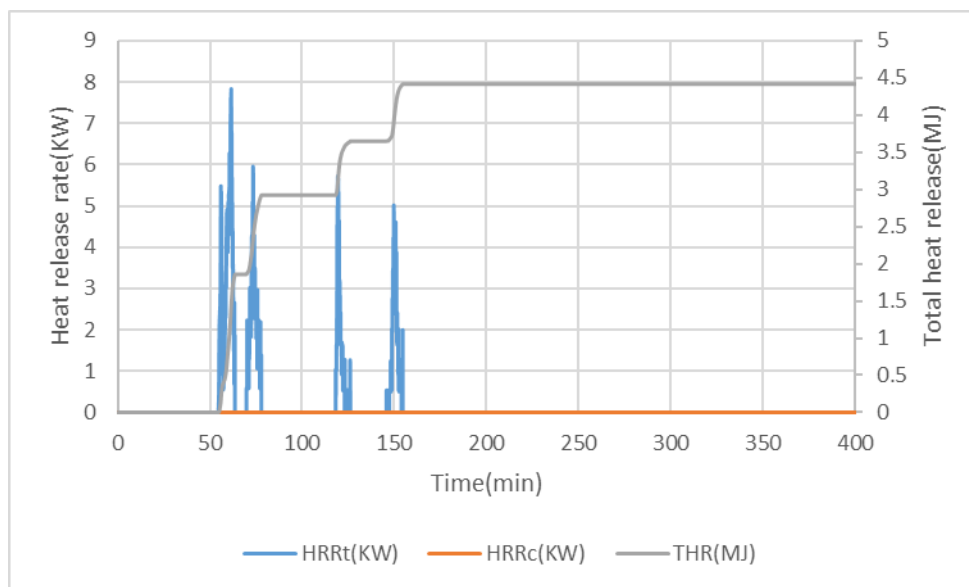
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Attachment 5 - Heat release rate graphs





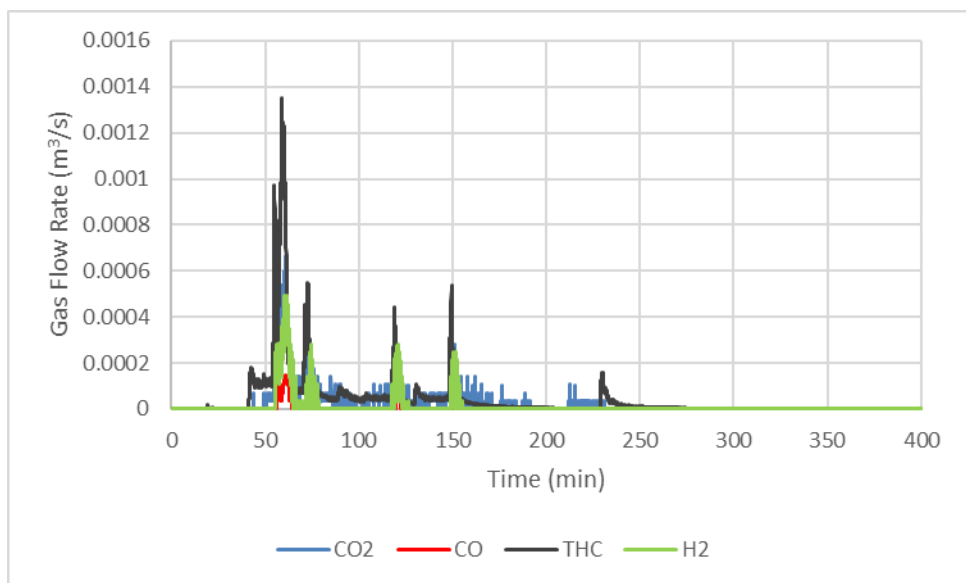
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Attachment 6 - Gas generation graphs





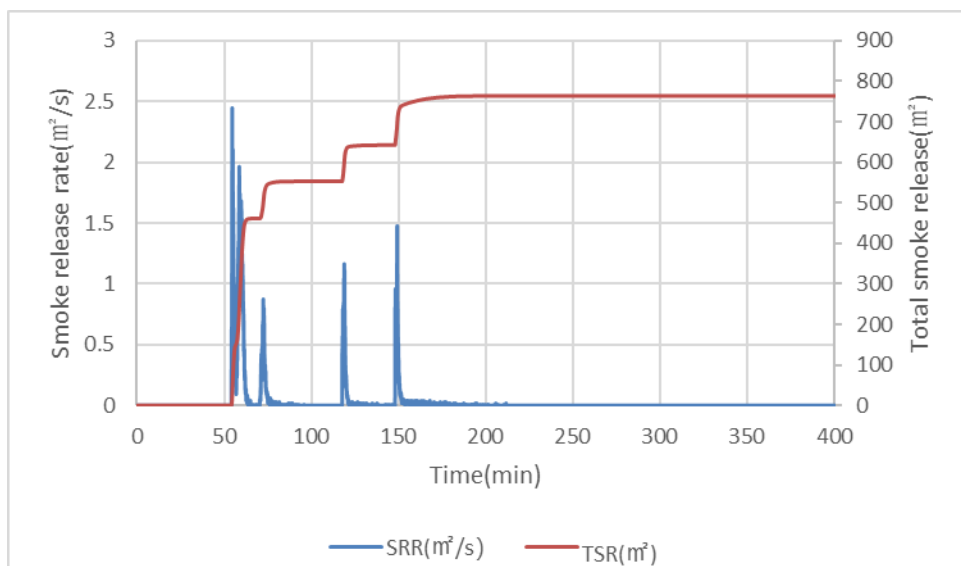
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Attachment 7 - Smoke release graph

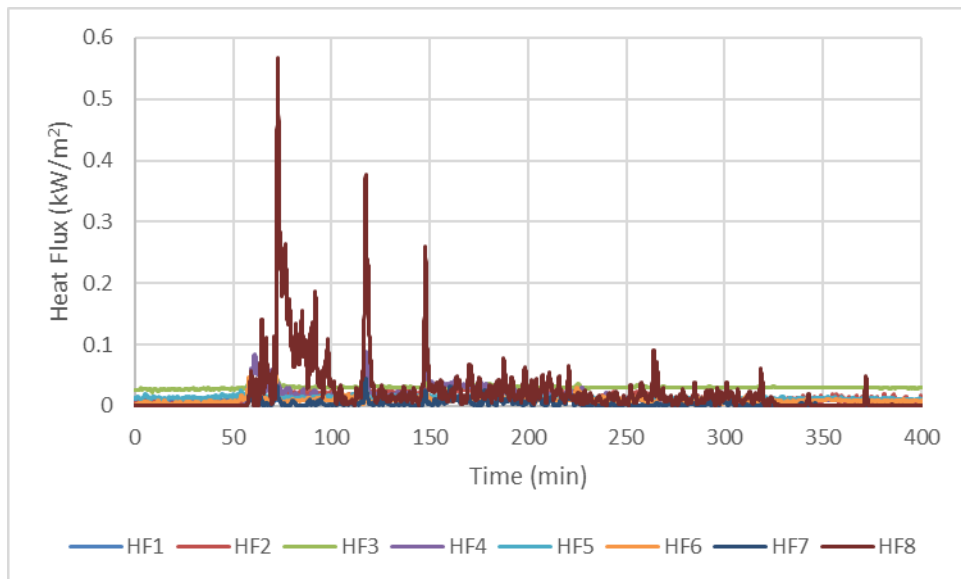


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Attachment 8 - Heat flux graph

Table 6 – Maximum Heatflux measurement

Location	Heatflux limit (kW/m²)	Measured maximum Heatflux (kW/m²)
HF1 (Location on Target Wall B with sample height, 1010 mm)	N/A	0.010
HF2 (Location on Target Wall B with initiating module height, 422 mm)	N/A	0.031
HF3 (Location on Wall C with sample height, 1010 mm)	N/A	0.043
HF4 (Location on Wall C with initiating module height, 422 mm)	N/A	0.088
HF5 (500mm in front of initiating Column B with sample height, 1010 mm)	1.3	0.055
HF6 (500mm in front of initiating Column B with initiating module height, 422 mm)	1.3	0.082
HF7 (between column B and C with sample height, 1010 mm)	N/A	0.046
HF8 (between column A and B with sample height, 1010 mm)	N/A	0.567



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Attachment 9 - Notable observation during test

Observation	Local time (HH:MM:SS)	Comment
Test start (Date: 2025-09-04)	17:29:12	Heater films on cell 5 with a heating ramp of 4.5 °C/minute.
Venting	18:10:38	Cell 5 (1 st cell) venting with pop sounds and smoke
Thermal runaway	18:23:38	Cell 5 (1 st cell) thermal runaway with smoke and rapid Temperature rise was observed, heater films on cell 5 were de-energized immediately.
Venting	18:24:56	Cell 4 (2 nd cell) venting with pop sounds
Venting	18:25:35	Cell 6 (3 rd cell) venting with pop sounds
Thermal runaway	18:28:25	Cell 4 (2 nd cell) thermal runaway with smoke released
Thermal runaway	18:29:16	Cell 6 (3 rd cell) thermal runaway with smoke released
Venting	18:40:08	Cell 3 (4 th cell) venting with pop sounds
Thermal runaway	18:40:23	Cell 3 (4 th cell) thermal runaway with smoke released
Venting	19:27:23	Cell 7 (5 th cell) venting with pop sounds
Thermal runaway	19:27:30	Cell 7 (5 th cell) thermal runaway with smoke released
Venting	19:28:35	Cell 14 venting with pop sounds
Venting	19:38:09	Cell 8 (6 th cell) venting with pop sounds
Thermal runaway	19:57:45	Cell 8 (6 th cell) thermal runaway with smoke released
Venting	21:18:39	Cell 10 venting with pop sounds
Natural Cooling	23:24:13	All the temperatures were dropping naturally; no other events were observed.
Test end (Date: 2025-09-05)	07:55:30	Data acquisition stopped



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Attachment 10 - Critical components information

Object / part No.	Manufacturer / trademark	Type / Model	Technical Data	Standard	Mark(s) of Conformity
Rechargeable Li-ion Battery System	FOXESS CO., LTD.	CQ 48.21, CQ 64.28, CQ 80.35, CQ 96.42, CQ 112.49, CQ 128.56, CQ 144.63, CQ 160.70, CQ 176.77, CQ 192.84, CQ 208.91, CQ 224.98, CQ 241.05	CQ 48.21: 153.6 Vd.c. CQ 64.28: 204.8 Vd.c. CQ 80.35: 256.0 Vd.c. CQ 96.42: 307.2 Vd.c. CQ 112.49: 358.4 Vd.c. CQ 128.56: 409.6 Vd.c. CQ 144.63: 460.8 Vd.c. CQ 160.70: 512.0 Vd.c. CQ 176.77: 563.2 Vd.c. CQ 192.84: 614.4 Vd.c. CQ 208.91: 665.6 Vd.c. CQ 224.98: 716.8 Vd.c. CQ 241.05: 768.0 Vd.c.	IEC 62619: 2022 IEC 63056: 2020	085-28256026 1-000 085-28256047 7-000

Below list is the critical components of main control box



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Attachment 10 - Critical components information

1. BCU	FOXESS CO., LTD.	BMS model: CQ-BCU (include BCU board, DC-DC board and BMU board) BCU board: 99-080-20297-01 V1.1 (Software version: V1.1 Hardware version: R1.001_V1.0 .15) DC-DC Board, model no.: 99-080-20303-01 V1.1 (Software version: EA DCDC V1.0.0 Hardware version: EA DCDC V1.1) BMU board: EA_BMU 99-080-20302-01 (Software version: R.0.4 V1.0.8 Hardware version: V1.1)	Overcharge detection voltage for each cell: 3.64 V Overdischarge detection voltage for each cell: 2.9 V Charge overcurrent detection current: 283.2 A Discharge overcurrent detection current: 283.2 A High temperature charging protection: 56 °C High temperature discharging protection: 56 °C Low temperature charging protection: 0 °C Low temperature discharging protection: -10 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- Below list is the critical components of BCU board, model: 99-080-20297-01 V1.1					
- PCB material	NAN YA PLASTICS CORP CCL DEPT ELECTRONIC MATERIAL DIV	FR-4-11PYR	Flame Class: UL94-V0 Max. temperature: 130 °C	UL796	UL E98983
- IC for Watch Dog (U38)	SGMICRO	SGM706B-SXS8G/TR SOIC-8	Supply voltage: 2.93 V, T _{opr.} : -40 °C to 125 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- DC-DC (U1)	TI	LM5164DDAR	6 V- 100 Vd.c., T _{opr.} : -40 °C to 150 °C	EN 62477-1:2012/A12:2021	Tested with appliance



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- IC for MCU (U39)	GigaDevice Semiconductor Inc.	GD32F527ZST7	Supply voltage: 3 V-5.5 V, T _{opr.} -40 °C to 85 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- DC-DC (U1)	TI	LM5164DDAR	6 V- 100 Vd.c., T _{opr.} -40 °C to 150 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- IC for AFE (U19) Hardware alarm signal detection	TI	SN65HVD82DR	U-Trans TI , SOIC-8 , -40°Cto+85°C RS 485 transceiver, Supply voltage: 4.5 V-5.5 V	EN 62477-1:2012/A12:2021	Tested with appliance
- IC for ADC (U32) Sampling analog-to-digital conversion (voltage, current, insulation detection)	SG Micro Corp	SGM58031XMS10G/TR	U-TRAS SGMICRO , MSOP, -40 °C ~125 °C A D Analog chips Supply voltage: 3 V-5.5 V	EN 62477-1:2012/A12:2021	Tested with appliance
-IC for Isolated operational amplifier (U30)	NOVOSENSE	NSI1300D25-DSWWAR	Supply voltage: 3 V-5.5 V, T _{opr.} -40°C to 85°C	UL1577	UL E500602
-IC for Isolator (U33)	NOVOSENSE	NSI8200-DSWWAR	Supply voltage: 3 V-5.5 V, T _{opr.} -40 °C to 85 °C	UL1577	UL E500602
-IC Isolated CAN transceiver (U18, U24)	Texas Instruments	ISO1050DUBR	Supply voltage: 3 V-5.5 V, T _{opr.} -40 °C to 85 °C	UL 1577	UL E181974
- Optcoupler for flyback power supply feedback signal (U9)	Everlight Electronics., Ltd.	CNY65(B)-V	T _{opr.} -55 °C to 110 °C.	UL1577	UL E214129
- Transformer for high voltage side (TX16, TX2)	PULSE ELECTRONIC CO., LIMITED	PGG6457.034NL	4200 Vrms, T _{opr.} -40 °C to 125 °C.	EN 62477-1:2012/A12:2021	Tested with appliance
- Transformer for high voltage side (TX3, TX4)	PULSE ELECTRONIC CO., LIMITED	PGG6457.012NL	4200 Vrms, T _{opr.} -40 °C to 125 °C.	EN 62477-1:2012/A12:2021	Tested with appliance



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Attachment 10 - Critical components information

- Transformer for CAN (T30,T53)	PULSE ELECTRONIC CO., LIMITED	PH9384.034NLT	4000 Vrms, T _{opr} : -40 °C to 150 °C.	EN 62477-1:2012/A12:2021	Tested with appliance
- Transformer for low voltage side (TX1)	HANGZHOU YOZEA ELECTRONIC CO.,LTD.	YZ4328-PQ32	Input: 35 V~60 V, Output: 24 V	EN 62477-1:2012/A12:2021	Tested with appliance
-- Bobbin	CHANG CHUN PLASTICS CO..LTD	T375HF	V-0,150 °C	UL 94	UL E59481
-- Wire	SUZHOU YUSHENG ELECTRONIC CO..LTD	TIW-B	130 °C	UL 1446	UL E332529
-- Insulation Tape	JINGJIANG JINGYIADHESIVE PRODUCTCO..LTD	J16	180 °C	UL 510	UL E246950
-- VARNISH	ZHEJIANG RONGTAI TECHNICALINSUSTRY CO..LTD	EIS R-155-1	155 °C	UL 1446	UL E242776
-- TUBE	CHANGYUAN ELECTRONIC GROUP CO..LTD	CB-TT-L	150 V, 200°C	UL 224	UL E180908
- MOS for control (Q23)	STMicroelectronics N.V.	SCT1000N170	V _{DS} : -1700 V, V _{GS} : -10-22 V, I _D (T _c =25 °C): 7 A, T _{J, stg} : -55 °C to 200 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- Y Capacitor (CY2, CY3, CY4, CY5)	TDK CORPORATION	CD45-B2GA471K-NKA	470pF ±10% /400VAC - T _{opr} : -25 °C to 125 °C	UL 60384-14	UL E37861
- Alternative	Xiamen SINO Faith Electronic Technology Co., Ltd.	HCY95B1Y471KN10 K	0.47 nF ±10% /400 Vac, Y1, T _{opr} : -25 °C to 125 °C	UL 60384-14	UL E328673
- Y Capacitor (C247, CY7)	Xiamen SINO Faith Electronic Technology Co., Ltd.	HCY12E1Y222MN19 K	2.2 nF±20% /400 Vac, Y1, T _{opr} : -25 °C to 125 °C	UL 60384-14	UL 328673
- Fuse	ADVANCED SURGETECH MATERIALS LTD	HV110.PV3.5A-TH	1000 Vdc, 3.5 A, T _{opr} : -40 °C to 90 °C	UL 248-1, UL 248-13	UL E364962
- Relay for insulation testing (RAY1, RAY2, RAY3)	XIAMEN HONGFA ELECTRIC POWER CONTROLS CO.,LTD	HFD3-V/5	Rating: 125 VAC, 0.5 A, coil voltage: 5 Vdc, T _{opr} : -40 °C to 85 °C	UL 60947-1 UL 60947-4-1	UL E133481
- IC for (U6, U9)	Everlight Electronics., Ltd.	CNY65(B)-V	50mA CTR100~200 -55~+110°C	UL1577	UL E214129



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Attachment 10 - Critical components information

-High impedance resistance (R258)	Yageo Corporation	RC0603FR-073K3L	3.3kΩ ±1%, 75V, 1/10W, 0603, -55°C to +155°C	EN 62477-1:2012/A12:2021	Tested with appliance
-Quick connector (J3)	Guangdong Hongru Technology Co.,LTD.	M34381-1X6-A-B	1000V, AC/DC, 15A, 0.81mm 6, 180°C, -40°C to +105°C	UL1977	UL E304945
-Quick connector (J5)	Guangdong Hongru Technology Co.,LTD.	M25010-5-W-D	1000V AC/DC 3A AC/DC 2.5mm, 5pin, 180°C, -40°C to 105°C	UL1977	UL E304945
-Quick connector (J4)	Guangdong Hongru Technology Co.,LTD.	M25010-10-W-D	1000V AC/DC 3A AC/DC 2.5mm, 10pin, 180°C - 40~105°C	UL1977	UL E304945
2. RELAY for pre-charge	XIAMEN HONGFA ELECTRIC POWER CONTROLS CO.,LTD	HFE82P-20/1000-24-H-Q2M-1	1000 V, 2 0A, 24 Vd.c., T _{opr} : -40 °C to 85 °C	UL 60947-1 and 60947-4-1	UL E133481
Alternative	Weifa Electronic Technology (Changzhou) Co., Ltd	VVC20-24SN-20B	1500 V, 20A, 24Vd.c., T _{opr} : -40 °C to 85 °C	IEC EN 60947-4-1:2019	N8A 118067 0002 REV.00
3. Contactor for Main circuit (2pcs)	XIAMEN HONGFA ELECTRIC POWER CONTROLS CO.,LTD	HFZ21-300/1000-24-H-B5	Rating: 1000 VDC, 300 A (1000 Breaks Only), coil voltage: 24 Vd.c., T _{opr} : -40 °C to 85 °C	IEC EN 60947-4-1:2019	TUV Rheinland R 50596357
Alternative	Weifa Electronic Technology (Changzhou) Co., Ltd	VVE300-24SN-01A	Rating: 1000 VDC, 250 A (1000 Breaks Only), coil voltage: 24 Vd.c., T _{opr} : -40 °C to 85 °C	IEC EN 60947-4-1:2019	N8A 118067 0003 REV.01
4. Fuse for Main Circuit	Advanced Surge Tech Materials Ltd.	A4305-350F 350A	1000 Vd.c., 350 A, T _{opr} : -40 °C to 125 °C	IEC 60269-1:2006+A1+A2, IEC 60269-7:2021	TUV Rheinland R 50593884



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Attachment 10 - Critical components information

Alternative	Xi'an Sinofuse Electric Co., Ltd	RS0ER-L2Q N 350A	1000Vdc, 350A, T _{opr} : -40 °C to 125 °C	IEC 60269-1:2006+A1+A2, IEC 60269-7:2021	TUV Rheinland R 50653137
5. Circuit Breaker	Shanghai Liangxin Electrical Co., Ltd.	NDM3Z-630VZ/2300 500A (CS2-A)	Rated Voltage: 1500 VDC, 2P. Rated Current: 500 A (1000 Breaks Only), 1000 cycle. - 40 °C to 70 °C	IEC EN 60947-2:2017/A:2020	N8A 083574 0458 REV.01
6. Hall	SINOMAGS TECHNOLOGY CO., LTD	STK-200BS/S1	Measuring range: 600 A, T _{opr} : -40 °C to 105 °C	UL 508	UL E507664
7. Shunt	Shenzhen Yingfa Electronics Co., Ltd	FL-300A -21mV-D	21 mV, 300 A, 0.07 mΩ ±0.5%, T _{opr} : -50 °C to 275 °C	EN 62477-1:2012/A12:2021	Tested with appliance
8. Pre-charge resistance	Shenzhen Yingfa Electronics Co., Ltd	RXLG-200W-100RJ-B	200 W, 100 Ω	EN 62477-1:2012/A12:2021	Tested with appliance
Alternative	Futaba, Shuangyu Electronics (Suzhou) Co., Ltd	RAMC201J1000S500	200 W, 100 Ω	EN 62477-1:2012/A12:2021	Tested with appliance
9. Insulated column	ZHEJIANG YUEQING RESIN FACTORY	DMC-1	1.6mm, V-0, 105 °C	UL 94	UL E25211
10. Connector for PCS (P1+, P2+, P3+, P1-, P2-, P3-)	AMPHENOL CORP	C10-730187-011	1000 Vd.c., 120 A(1P), - T _{opr} : - 40 °C to 125 °C, 3P	UL1977	UL E115497
11. Wiring for Sampling	Suzhou Wanxu Electronic Components Co., Ltd	10183	1000 V, 24 AWG, 105 °C	UL 758	UL E248566
12. Wiring for Communication	Suzhou Wanxu Electronic Components Co., Ltd	1569	300 V, 24 AWG, 105 °C	UL 758	UL E77981
13. Switch button	Yijia Industrial Electric Co.,Ltd	YJ-GQ22A	1000 V, 0.1 A, T _{opr} : -20 °C to 75°C	EN 60947-5-1:2017	TÜV SÜD B 121522 0004 REV.00
14. Copper busbar	SUZHOU SHOUFAN ELECTRONIC TECHNOLOGY CO., LTD	T2	Copper, cross section: 75 mm²	EN 62477-1:2012/A12:2021	Tested with appliance



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Attachment 10 - Critical components information

15. Terminal connection Support	Shanghai Yuemin Electronic Technology Co, Ltd.	99-110-00491-02	17 kV/mm	EN 62477-1:2012/A12:2021	Tested with appliance
- Material of Terminal connection Support	Guangdong Xingshengdi Technology Co Ltd	XD933G(X)(f1)	1.5 mm, V-0, 125 °C	UL 94	UL E342846
16. Terminal connection Cover	Shanghai Yuemin Electronic Technology Co, Ltd.	99-110-00491-02	17 kV/mm	EN 62477-1:2012/A12:2021	Tested with appliance
- Material of Terminal connection Cover	Guangdong Xingshengdi Technology Co Ltd	XD933G(X)(f1)	1.5 mm, V-0, 125 °C	UL 94	UL E342846
17. FAN	Ningbo Shengjiu Technology Co., Ltd.	SA120515BSCNR019	12 Vd.c., 0.25 A, -10 °C to 70°C	UL 508	UL E471112
18. Enclouse	FOXESS CO., LTD.	sheet metal parts	SGCC, T=1.5 mm	EN 62477-1:2012/A12:2021	Tested with appliance
19. Plastic cover	FOXESS CO., LTD.	10-110-00230-00	ABS, UL94-V0, T=2.0mm	EN 62477-1:2012/A12:2021	Tested with appliance
- Material of cover	CGN JUNER NEW MATERIALS CO.,LTD.	ABS-301FR	V-0	UL 94	UL E204321
20. Insulation sheet	CHENGDU KANGLONGXIN PLASTICS CO LTD	KLX PP WT/BK-10	UL 94-V0, T=0.35mm, 110° C	UL 94	UL E315185
For battery module, model no.: CQ16					
1. Cell (16 pcs)	Guangzhou Great Power Energy &Technology Co.,Ltd.	GSP71173204F	3.2 Vd.c., 314 Ah	IEC 62619:2022	Report No.: 085-28236063 0-000 Certif. No. SG PSB-BT-04272
2. BMU, board no.: EA_BMU 99-080-20302-01					
- PCB material	EXPRESS ELECTRONICS LTD	13MV0	V-0, 130 °C	UL 796	UL E157925
- IC for MCU (U7)	Gigadevice Semiconductor Inc.	GD32F425RGT6	Supply voltage: 2.6 V-3.6 V T _{opr.} -40 °C to 85 °C	EN 62477-1:2012/A12:2021	Tested with appliance



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- IC for Power supply step-down chip for MCU (U2)	SGMICRO	SGM2212-3.3XKC3G/TR	Supply voltage: 3.3 V T _{opr.} : -40 °C to 125 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- IC for Watch Dog (U8)	SGMICRO	SGM706B-SXS8G/TR SOIC-8	Supply voltage: 2.7 V-5.5 V T _{opr.} : -40 °C to 125 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- AFE (U15)	ADI	ADBMS1818ASWZ-R7	Supply voltage: V+ to V-, 112.5 V, T _{opr.} : -40 °C to 125 °C	EN 62477-1:2012/A12:2021	Tested with appliance
- IC for alarm signal (U12)	Suzhou Novosense Microelectronics Co.,Ltd	NSi83085A-DSWR	Supply voltage: 3 V- 5.5 V, T _{opr.} : -40 °C - 105 °C	UL 1577	UL E500602
- IC for isolated CAN communication (U11)	Shanghai Chipanalog Microelectronics Co Ltd	CA-IS3050U	Supply voltage: 3 V- 5.5 V, T _{opr.} : -40 °C to 125 °C	UL 1577	UL E511334
- Alternative	Suzhou Novosense Microelectronics Co.,Ltd	NSI1050-DDBR	Supply voltage: 3 V- 5.5 V, T _{opr.} : -40 °C to 125 °C	UL 1577	UL E500602
- IC for isolation alarm signal(U5)	NOVOSENSE Microelectronics Co., Ltd.	NSi8241W1-DSWWR	Supply voltage: 2.5V- 5.5V, T _{opr.} : -40 °C to 125 °C	UL 1577	UL E500602
- Alternative	Shanghai Chipanalog Microelectronics Co Ltd	CA-IS3841HWW	Supply voltage: 2.5 V- 5.5 V, T _{opr.} : -40 °C to 125 °C	UL 1577	UL E511334
- IC for isolated SPI communication (U6)	Shanghai Chipanalog Microelectronics Co Ltd	CA-IS3831LWW	Supply voltage: 2.5 V- 5.5 V, T _{opr.} : -40 °C to 125 °C	UL 1577	UL E511334
- Alternative	Suzhou Novosense Microelectronics Co.,Ltd	NSi8231W0-DSWWR	Supply voltage: 2.5 V- 5.5 V, T _{opr.} : -55 °C to 125 °C	UL 1577	UL E511334
-Transformer (TX1)	PULSE ELECTRONIC CO., LIMITED	PGG6457.034NL	4200 Vrms, T _{opr.} : -40 °C to 125 °C.	EN 62477-1:2012/A12:2021	Tested with appliance
-Transformer (T49)	PULSE ELECTRONIC CO., LIMITED	PH9384.034NL	4200 Vrms, T _{opr.} : -40 °C to 150 °C.	EN 62477-1:2012/A12:2021	Tested with appliance



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-Opto (OP3, OP4, OP5)	LITE-ON Technology Corp./Optoelectronics	LTV816S2TPC-V-G	CTR200% ~ 400% , 30°C to +100°C	UL 1577	UL E113898
-Quick connector (J1,J2)	Guangdong Hongru Technology Co.,Ltd	M20094R-2x9/10-S-B	250V, 3A, P2mm, -55°C to 105°C	UL1977	UL E304945
-Quick connector (J4)	Guangdong Hongru Technology Co.,Ltd	M3045-SL-1X4-B-K	250V, 5A, P2, -40°C to 105°C	UL1977	UL E304945
3. DC-DC Board: Model no.: 99-080-20303-01 V1.1					
- PCB material	Wan An YuWei Electronics Co.,Ltd	Y-D	V-0, 130 °C	UL 796	UL E511912
- IC for Power (U1)	Mornsun Guangzhou Science&Technology Ltd.	UWTH1D24QB-50WR3S	Input Votage: 14~160 V, 4.475 A (for 50 W models); Output: 24 V, 2.08 A, 50 W, T _{opr.} : -40 °C to 105 °C	IEC 62368-1:2014	CSA CB 267770-80094632
- Relay (RY1)for controlling swith	Hongfa (Xiamen) Co., Ltd.	HF158F-V/24-HS2T	10 A, 24 Vd.c., T _{opr.} : -40 °C to 85 °C.	UL 60947-4-1:2019	UL E134517
- Fuse (F1)	Advanced Surge Tech Materials Ltd.	12 100.4	24 Vd.c., 4 A, T _{opr.} : -50 °C to 150 °C.	UL 248-1, UL 248-13	UL E355868
-Y Capacitor (CY2, CY20, CY19, CY18)	TDK CORPORATION	CD45-B2GA471K-NKA	470 pF± 10% /400 Vac, Y1, T _{opr.} : -25 °C to 125 °C	IEC 60384-14	VDE 40015248
4. Fuse	Advanced Surge Tech Materials Ltd.	A43003-450A	250 Vd.c., 450 A, T _{opr.} : -40 °C to 105 °C	IEC 60269-1:2006+A1+A2, IEC 60269-7:2021	TUV Rheinland R 50612295
Alternative	HOLLYLAND CO LTD	H00P5aBat-L	500 Vd.c., 450 A, T _{opr.} : -40 °C to 90 °C	IEC 60269-1:2006+A1+A2, IEC 60269-7:2021	TUV Rheinland R 50616523
5. DC-FAN	DELTA ELECTRONICS, INC.	QFR1224GHEV3R	24 Vd.c., 1.41 A, -10 °C to 80 °C	UL 507	UL E132003
Alternative	PROTECHNIC ELECTRIC (WUJIANG) CO LTD	MGT12024ZB-W38	24 Vd.c., 1.62 A, -10 °C to 80 °C	UL 507	UL E338217



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6. Plastic rack for cell	CHENGDU KANGLONGXIN PLASTICS CO LTD	KLX PP WT/BK-10	V-0, 110 °C, Min Thickness: 0.5 mm	UL 94	UL E315185
7. Terminal connection bracket	Guangdong Xingshengdi Technology Co Ltd	XD2002LV(#)GF(X)(f 1)	V-0, 130 °C, Min Thickness: 1 mm	UL 94	UL E342846
8. External plastic bracket	Guangdong Xingshengdi Technology Co Ltd	PC+10%GF 381*205*	V-0, 125 °C, Min Thickness: 1.5mm	UL 94	UL E342846
9. NTC (8 pcs)	Suzhou Huaidian Jingchuang Electronic Technology Co., Ltd	HD-RD-24323-02	R ₂₅ =10 kΩ±1%, B _{25/85} =3435 K±1%, T _{opr} : -40 °C to 120 °C	UL 1434	UL E342846
10. Enclouse	FOXESS CO., LTD.	sheet metal parts	SGCC, T=1.5 mm	EN 62477-1:2012/A12:20 21	Tested with appliance
11. Plastic cover	FOXESS CO., LTD.	10-110-00230-00	ABS, UL94-V0, T=2.0mm	EN 62477-1:2012/A12:20 21	Tested with appliance
- Material of cover	CGN JUNER NEW MATERIALS CO.,LTD.	ABS-301FR	V-0	UL 94	UL E204321
12. Balanced resistance	SHENZHEN YINGFA ELECTRONICS CO.,LTD	RXLG-40W-75R-J	75R, 40W, - 55°C to 275°C	EN 62477-1:2012/A12:20 21	Tested with appliance
13. Wire for fan	REI HSING WIRE CO LTD	1430	300V, 105°C, VW-1	UL758	UL E108485
14. Sample wire of cell	WONDERFUL HI-TECH CO LTD	1569	300V, 105°C, VW-1	UL758	UL E77981
For Connecting					
1. Copper busbar between racks	Suzhou Juxian Electric Technology Co., Ltd.	43*14*3	SUS304, 43 mm ²	EN 62477-1:2012/A12:20 21	Tested with appliance
2. Tubing for Copper busbar between racks	CHANGYUAN ELECTRONICS GROUP CO LTD	CBHFT CBHFT(XY) CYG-MT	125 °C, VW-1	UL 224	UL E180908
3. Power Wire between racks	Suzhou Wanxu Electronic Components Co., Ltd	10269	2/0 AWG, 105 °C	UL 758	UL E248566



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Laboratory Test Data - UL 9540A Checklist and Test Result (Unit Level)

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4. Communication Power Wire between racks	Suzhou Wanxu Electronic Components Co., Ltd	1569	300 V, 24 AWG, 105 °C, VW-1	UL 758	UL E77981
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