STATERA ENERGY, EAST CLAYDON BATTERY ENERGY STORAGE SYSTEM (BESS)
FIRE SAFETY AT PLANNING STAGE & NFCC GUIDANCE COMPLIANCE NOTE

This note sets out the project approach to fire safety at planning stage and is structured to provide a summary of engagement with the Buckinghamshire Fire and Rescue Services (BFRS) and project compliance with National Fire Chiefs Council (NFCC) Guidance[1].

In support of this note, the following is also provided:

Annex A (NFCC Guidance Summary of Compliance)
- **Appendix 1** (BYD Safety Manual)
- **Appendix 2** (MC Cube ESS Fire Control Technology Plan)
- **Appendix 3** (UL9540A Unit Level Report)
- **Appendix 4** (Fire Detection Datasheets)

Annex B (Battery Fire Safety Waterfall)

General

BFRS were originally contacted in March 2023 and a Fire Liaison Framework (FLF) was agreed with Area Manager Simon Tuffley as the Head of Prevention, Response and Resilience for BFRS.

The FLF acknowledged that although BFRS are not a statutory consultee in relation to the East Claydon project, one of Statera's underlying principles is *'early and full engagement with the local fire and rescue service associated with the site in question at the pre-planning, planning, commissioning and day to day operational management of the site'*. To achieve this Statera have deployed and agreed with BFRS a three staged stepped approach to their FLF. In conjunction with Greston Associates Ltd, Statera have developed a long-term approach whereby fire and rescue liaison takes place throughout the complete cycle associated with the BESS planning, implementation, and operational phases. This would include liaison and support at pre-planning, planning submission and multi-agency liaison, commissioning, and operational delivery (business as usual) of the BESS.

Therefore, the FLF approach and methodology consists of three strategic areas.

Pre-planning
Site Commissioning (post planning approval)
Operational Delivery

A breakdown of inputs, outputs and outcomes associated with the Pre-planning phase is detailed below:

Pre-planning

Pre-planning includes:

a) Working with NFCC to establish latest thinking and best practice in relation to planning, protection, monitoring and operational emergency response
b) Liaison with BFRS to exchange early information at the planning and design stage and to enhance professional understanding
c) Gathering information and intelligence from the wider FRS sector including the Fire Industry Association
d) Working with Fire Industry Association concerning latest technology, passive and active fire systems to ensure Statera remains at the forefront of innovation
e) Reviewing and refreshing recommendations/changes to Fire Safety and Fire Response Strategies

[1] https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf

f) Help support fire and firefighting related information as part of any environmental impact survey or assessment

Pre-application discussions have taken place between BFRS and Statera to explore potential for positive changes which could be made to the project whilst allowing BFRS to ask questions of the Statera project team. These discussions made direct reference to the NFCC Guidance and compliance with the guidance, alongside the context of elements being included within the project design and relevant planning policies at a national level. At the conclusion of the meeting with Piers Vallance, Station Commander Protection Central, BFRS were requested to provide any final suggestions and areas requiring further design amendment with no further correspondence or contact was received.

Following a direct invitation from Statera, additional pre-planning discussion also took place with Senior Officers from BFRS who attended one of the East Claydon Public Exhibitions. The Senior Officers had previously visited other sites which were operational and, due to the quality of the engineering design, comprehensive battery safety management and rural locations, considered BESS sites (including the proposed site at East Claydon) to be low risk. With reference to the East Claydon proposal, the officers were also taken through the Battery Safety Management Systems including thermal monitoring, off gas detection, heat and smoke detection as well as the pressure release and venting mechanisms plus fire suppression systems. No adverse comments or suggested improvements were verbally received by the attended officers at the public exhibition. Again, through attendance of the Officers BFRS were requested to provide any final suggestions and areas requiring further design amendment. No further correspondence or contact was received.

In terms of ongoing engagement with BFRS, Statera will maintain the Fire Liaison Framework (FLF) and keep this in place with BFRS for the lifetime of the BESS. The FLF will be updated and reviewed where technology or other considerations may require this.

For the planning application, Statera propose that a planning condition is attached to any future grant of planning consent which would require that an Emergency Response Plan (ERP) is provided in line with NFCC Guidance and in advance of BESS operation. This ERP will be subject to the prior agreement of BFRS and will set out how, tactically, any fire event on site would be approached. An example form of words for such a planning condition is provided below:

> *Prior to the commencement of development, an Emergency Response Plan shall be submitted to and approved in writing by the Local Planning Authority in consultation with Buckinghamshire Fire and Rescue Service. The Emergency Response Plan should demonstrate how any fire event on site would be approached, including details on site familiarisation and exercising of emergency plans with the fire service.*

Following any future grant of planning consent, a detailed Integrated Fire Risk Management Strategy (IFRMS) will be published. Through the FLF, the fire service will be able to engage on the IFRMS and, if necessary, suggest improvements. Through the development of the FLF and ERP, early contact with BFRS for site familiarisation and exercising of emergency plans will also be put in place.

In summary, discussions between BFRS and Statera have included direct reference to the NFCC Guidance. In particular this has been on demonstrating compliance with the NFCC Guidance in the context of project design. BFRS have also been consulted by Buckinghamshire planning department following submission of the planning application and they have responded with no objection; within their response BFRS request that a risk reduction and mitigation strategy and Emergency Response Plan be put in place, BFRS also reference the NFCC Guidance.

Project compliance with the NFCC Guidance is set out at Annex A to this note. The multiple layers of safety in place to prevent a fire event occurring and to protect life in the unlikely event of a fire, are set out within the detailed appendices to Annex A. The Battery Fire Safety Waterfall at Annex B also provides a summary account of the safety layers in place.

Annex A: NFCC Guidance Summary of Compliance

The below information is structured under the same headings as the NFCC Guidance[2].

Principles

The NFCC Guidance provides a series of principles which should be considered by FRS when liaising on battery projects. Each of the principles listed are covered within subsequent parts of that document and are discussed in turn below.

Information Requirements

This part of the NFCC Guidance advises that site specific risk information should be made available to the FRS in the form of an ERP. Through Statera's discussions with multiple fire and rescue services, the majority consider the creation of an ERP to be only necessary following approvals at planning stage, with ERP being prepared prior to / during site operation. Statera propose to provide an ERP which would be secured by way of a planning condition attached to any future planning consent. The ERP will cover site specific information as advised under the NFCC Guidance.

System design, construction, testing and decommissioning

The NFCC Guidance lists information to be provided to the FRS on a number of matters. Some of which are relevant to planning and others are specific to the type of battery used and chosen manufacturer specifications. Specific information requested:

System design and construction

A number of specific system design and construction elements are identified within the NFCC Guidance, please see Table 1.1 which deals with each of these in-turn.

Testing

Statera can confirm that battery cabinets will be UL9540A Certified to the unit level as a minimum. UL9540A certification to unit level involves forcing one battery cell into thermal runaway by attaching heating elements to the battery cell and heating the cell until thermal runaway occurs. In order to pass the UL9540A certification, thermal runaway cannot propagate into neighbouring battery modules, even when thermal runaway is artificially induced.

Design

The rack layout and setup is provided by the information appended to this Annex (appendix 1-4), the information will inform the future ERP and IFRMS. Clearances between batteries will be 3m or above, in accordance with NFPA855, which is the de facto industry standard for battery container clearances.

Detection and Monitoring

An effective and appropriate method of early fault detection will be put in place through each battery cabinet having its own independent heat detection, smoke detection and flammable gas detection, pressure relief valve and fire suppression. The detection outputs will report to the battery management system which is responsible for the management of each battery cabinet. These battery cabinet controllers will report to either a battery container controller or an overall site controller. Further detail on chain of communication with the FRS, and in which

[2] https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf

circumstances the fire service will be called, will be included within the ERP and IFRMS which will be developed in consultation with the FRS following grant of any future planning permission.

It can be confirmed that the chosen technology will be tested to UL9540A at rack level. Modern Lithium Iron Phosphate chemistry does not exhibit thermal runaway until temperatures are in the region of 150-200 degrees celcius, which is well above all thermal cut outs, and almost certainly never to be seen in operation. The batteries themselves also have overtemperature protection and fire suppression initiation, which operates well below thermal runaway temperatures:

Suppression systems

It can be confirmed that each battery storage system will include a fire suppression system. The battery energy storage will be made up of battery containers, each consisting of a number of battery cabinets (typically 10). Each battery cabinet will be supplied with its own independent fire suppression system, which is typically a pulsed aerosol system, supplied by a vendor such as Stat-X. This system has been proven effective on lithium battery thermal runaway fires (https://www.youtube.com/watch?v=Kj2BP8aJhsM).

From an operational response perspective, discussions have taken place concerning the likely response of BFRS to an incident involving a BESS. It is recommended operational practice that due to the potential electrical hazard, no firefighting operations would be undertaken until a member of the Statera Operations Team is in attendance to advise as appropriate. This procedure is also advocated in the Fire and Rescue National Operational Guidance which states that as part of their strategic actions, Fire and rescue services should 'develop arrangements and procedures with identified sources of specialist advice or assistance for dealing with utility incidents'.

The likely design of the containers will ensure that any fire will be contained and self-combust within the individual BESS unit. Such a 'burn policy' is now becoming widespread within the industry particularly on the next generation of containers. Therefore, the only likely use of water on the site would be to boundary cool. However, due to the fire protection, suppression and construction of the containers, even with a worst-case scenario of fire spreading between all battery cabinets despite the features listed previously, there is insufficient thermal energy to spread to any neighbouring structure reducing possibility of horizontal fire spread. As advised by the NFCC Guidance water run-off and potential impact on the environment, along with mitigation measures, will be considered and detailed within the ERP.

Deflagration Prevention and Venting

Each BESS cabinet will be equipped with deflagration venting and explosion protection including:

Ventilation for air conditioning system
Passive pressure relief valve to NFPA68
Active exhaust vents, activated to vent gas from the battery cabinet when gas detectors identify a buildup of flammable gas, well below lower explosivity limits, designed to NFPA69

The ERP and the IFRMS, developed with the FRS, will provide information on the approach to be taken by first responders to their explosion / deflagration strategies.

Access

Site Access

Suitable facilities for safe BFRS access and egress will be provided. The NFCC Guidance states that designs should be developed in close liaison with fire and rescue services, this approach has been followed for the project to ensure that FRS operational requirements are provided for. Site access measures incorporated include:

Two separate access points to allow for FRS access to the site
Access routes which are capable of accommodating FRS vehicles in all weather conditions

Circulatory accesses around battery rows with passing places to allow FRS vehicles ease of access across the site and turning areas at the end of each battery row
Once onsite, unobstructed access to all areas of the facility

Access between BESS units and unit spacing

Design features and mitigations included within the BESS units reduce potential for fire spread. Statera adopts a minimum 3m spacing between BESS containers, in line with NFPA855, and between BESS containers and other plant with mitigating measures in place to prevent fire spread between containers. Such mitigating measures include:

1. Cooling systems to keep battery temperatures below 40 degrees Celsius at all times.
2. Controls to stop charging of batteries should a temperature of 60 degrees ever be reached.
3. Heat and smoke detectors to initiate a fire suppression system should temperature of 65 degrees ever be reached.
4. A fire suppression system, typically a pulsed aerosol system, per battery rack, initiated on sensing heat and smoke.
5. BESS tested to UL9540A at a unit level. The UL9540A test forces a battery cell into thermal runaway by heating it to several hundred degrees C. The results of these tests for the technology Statera would expect to use show:
    a. Thermal runaway does not occur until 200+ degrees C
    b. In the event that thermal runaway occurs in one cell, it does not spread to neighbouring battery modules
6. If all of the above mitigation measures fail and if all battery racks on one side of a battery container are on fire, then the heat flux generated on containers 3m away are not sufficient to heat the neighbouring container to a level that might initiate thermal runaway.
7. The above fire suppression measures would be provided independently for each individual battery cabinet, allowing fire suppression to act within each compartment separately, thus further reducing the possibility that thermal runaway could occur.

Distance from BESS units to occupied buildings & site boundaries

The BESS units exceed the minimum NFCC Guidance advised distance of 25m from nearest occupied buildings or residential property boundaries. The distance of each BESS unit from the application site boundary varies but adjacent land is not occupied by residential properties and is rural.

Site Conditions

Statera take great care to ensure that it's BESS sites are well maintained, clear of combustible materials and that any overgrowing vegetation is cut back. The need to maintain sites is also often required and controlled by planning conditions attached to any grant of consent.

On site design, the proposed layout include:

- Proposed trees, hedges and scrub are set, and maintained to, a minimum 10m away from nearest battery units.
- An Emergency Service Information Point (Premises Information Box) will be installed, this will provide detail on emergency contact information, emergency isolation points and of any specific hazards on site. All FRS's have a master key which can open the Premises Information Boxes so they will be able to gain access to site information prior to the attendance of a Statera competent person as defined under the Health and Safety at Work Act.

Water Supplies

An Emergency Water Supply (EWS) will be provided by water tanks onsite which are of a capacity that will exceed supply of 1,900 l/m for at least 120 minutes as advised by the NFCC Guidance. An elevation drawing showing these water tanks has been included within the planning application documentation, the location of the water tanks is shown on the masterplan document included with the planning application. The water tanks will be sited at least 10m from any BESS container/cabinet as advised by the NFCC Guidance and will be connected and pumped to perimeter piping across the site, with hydrants at locations for access by BFRS. These hydrants will be to standard specification and will be tested and maintained in-line with the FLF and ERP. Consideration has been given within site design to the management of water run-off during any fire event, this includes a series of swales and interceptor channels which are discussed in more details under the 'Environmental Impacts' section below.

Signage

An Emergency Service Information Point (Premises Information Box) will be installed, this will provide detail on emergency contact information, emergency isolation points, technology associated with the BESS (including inbuilt suppression fitted) and of any specific hazards on site.

The specific nature, size and location of signage will be a matter for detailed design and following any future grant of planning permission. The specific signage to support the operational needs for the FRS will be discussed through the FLF.

Emergency Plans

A Risk Management Plan

As confirmed above, following any future grant of planning consent a detailed IFRMS will be published. Through the FLF, the fire service will be able to engage on the IFRMS and, if necessary, suggest improvements. The IFRMS will provide for the requirements of the NFCC Guidance on a risk management plan.

An Emergency Response Plan

As confirmed above, an ERP is proposed to be provided and Statera have suggested that this is secured by way of planning condition. The ERP will meet the requirements of the NFCC Guidance.

Environmental Impacts

An onsite fire containment strategy will be incorporated into the overall site drainage design. It is proposed that in the unlikely event of a fire the unit on fire will be left to burn out, water will be focussed on the adjacent battery units to ensure the fire is contained. As a consequence the runoff generated is less likely to pose a contamination risk. Runoff used to cool the units will be initially intercepted by the gravel surfacing from where it will be conveyed by gravity to interceptor swales/channels and held for inspections via a penstock or similar for testing prior to release or tanking off site for treatment as appropriate. Battery storage compounds at the site will also be lined, preventing discharge of any potentially polluted water during a fire event to groundwater receptors.

Recovery

A post-incident recovery plan will be developed as a component part of the ERP and will cover potential for reignition, de-energising the system and removal and disposal of any damaged equipment.

Summary

The approach taken by the project has been, where able at planning stage, to address the relevant points contained within the NFCC Guidance, and to discuss matters with the FRS to ensure that their operational requirements are reflected within scheme design. This being the case, detailed matters will still form the content of the ERP and IFRMS which will be developed in discussion with the FRS once any future planning consent has been granted.

A full account of how the project complies with the NFCC guidelines is provided at Table 1 (Compliance with NFCC Guidance).

Chris Palmer BSc(Hons) MSc MRTPI
Planning Lead
Statera Energy Ltd

July 2024

Table 1.1: Compliance with NFCC Guidance

NFCC Section	Item / Detail	Compliance Detail / Information	NFCC Compliant
System design and construction	Battery Chemistry	LFP	Yes
	Battery form factor	Blade. A blade battery is a form of prismatic cell.	Yes
	Type of BESS	The selected BESS type will be containerised units	Yes
	Number of BESS containers / cabinets	The number of BESS containers are described in the application	Yes
	Size/capacity of each BESS unit	The size/capacity of each EBESS unit is described in the application	Yes
	How the BESS units will be laid out relative to one another	The layout of the BESS units is shown in the application	Yes
	A diagram/plan of the site	A layout diagram of the site is provided with the application	Yes
	Evidence that site geography has been taken into account (e.g. prevailing winds)	The DNV analysis for fire spread has considered wind conditions	Yes
	Access to, and within, the site for FRS assets	Fire service response consultation has taken place, and access routes given around the site	Yes
	Details of any fire-resisting design features	Containers are separated by steel enclosure walls. These are not formally fire rated. Efficacy is proven by successful UL9540A test (see Appendix 3 – UL9540A Unit Level Report) to unit level that shows fire does not spread between enclosures in the event of thermal runaway.	Yes
	Fire suppression systems	See Appendix 1 (BYD Safety Manual) for details of operation. See Appendix 2 (MC Cube ESS Fire Control Technology Plan) for the strategy, and Appendix 4 (Fire detection datasheets) for the datasheets of the equipment.	Yes
	On-site water supplies	On-site water tanks providing at least 1900 l/m for at least 120 minutes. Water tanks located at least 10m from the BESS units.	Yes
	Smoke or fire detection systems	See 5.4 of BYD Safety Manual for details of operation. See attached "MC Cube ESS Fire Control Technology Plan" for the strategy, and "Fire detection datasheets" for the datasheets of the equipment.	Yes

	Temperature management systems	See BYD Safety Manual for details of operation. See attached "MC Cube ESS Fire Control Technology Plan" for the strategy, and "Fire detection datasheets" for the datasheets of the equipment.	Yes
	Ventilation systems	See MC Cube ESS Fire Control Technology Plan	Yes
	Exhaust systems	See MC Cube ESS Fire Control Technology Plan	Yes
	Deflagration venting systems	See MC Cube ESS Fire Control Technology Plan	Yes
	Identification of any surrounding communities, sites and infrastructure that may be impacted.	There are no residential properties or infrastructure which would be impacted by a fire event onsite.	Yes
Testing	Results of tests (e.g. UL9540A)	See "UL9540A Unit level report"	Yes
Design	Rack layout and setup	See BYD Safety Manual for details of rack setup, layout and operation. Alongside MC Cube ESS Fire Control Technology Plan.	Yes
	Thermal barriers and insulation	Containers are separated by steel enclosure walls. These are not formally fire rated. Efficacy is proven by successful UL9540A test to unit level that shows fire does not spread between enclosures in the event of thermal runaway. Also see BYD Safety Manual for details on setup, layout and operation. Alongside MC Cube ESS Fire Control Technology Plan.	Yes
	Container layout and access arrangements	The application details contain layout and access arrangements.	Yes
Detection and Monitoring	Detection provision within units	See BYD Safety Manual for details of operation. See attached "MC Cube ESS Fire Control Technology Plan" for the strategy, and "Fire detection datasheets" for the datasheets of the equipment.	Yes
Suppression Systems	Choice of suppression system	System is Stat-X pulsed aerosol fire suppression system. See https://www.statx.com/demos-and-videos/.	Yes
Deflagration Prevention and Venting	Analysis of required deflagration protection	See MC Cube ESS Fire Control Technology Plan	Yes
Access	Site access	There is a perimeter road around the BESS area, with two points of access. The application includes liaison framework with BFRS to ensure operational access requirements.	Yes
	Spacing between units	3m in line with NFPA855 and NFCC guidance which provides for spacing below six meters where suitable design features are introduced.	Yes

	Distance to boundary	Context setting is rural and the NFCC Guidance notes that in this context it may be appropriate for distances to site boundaries less than 25m. The DNV report determines that likelihood of fire spread beyond site boundary is low.	Yes
	Site conditions	There will be no vegetation planted within 10m of the BESS units and maintenance will be undertaken to ensure that this 10m buffer is maintained. We suggest that a planning condition will be attached to any future grant of planning consent to secure this.	Yes
Water Supplies	Sufficient water supply	On-site water tanks providing at least 1900 l/m for at least 120 minutes.	Yes
	Water tank location	Water tanks located at least 10m from the BESS units. Shown on site layout.	Yes
Signage	Sufficient signage	Compliant signage will be provided as part of the detailed design of the project and will be specified within the Emergency Response Plan (ERP) which will be required by planning condition.	Yes
Emergency Plans	Risk Management Plan	A future integrated fire risk management strategy (IFRMS) will be based on detailed design. Statera have suggested that this is secured by way of planning condition to be provided before operation of the proposed development. Through the FLF, the fire service will be able to engage on the IFRMS and, if necessary, suggest improvements. The IFRMS will meet the requirements of the NFCC Guidance on a risk management plan.	Yes
	Emergency Response Plan	An Emergency Response Plan (ERP) is proposed to be provided and Statera have suggested that this is secured by way of planning condition to be provided before commencement of development. The ERP will meet the requirements of the NFCC Guidance.	Yes
	Environmental Impacts	The Environmental Response Plan is a component part of the ERP which is proposed to be secured by way of planning condition to be provided before commencement of development. The ERP will meet the requirements of the NFCC Guidance.	Yes
	Recovery	The Recovery Plan is a component part of the ERP which is proposed to be secured by way of planning condition to be provided before commencement of development. The ERP will meet the requirements of the NFCC Guidance.	Yes

Appendix 1 (BYD Safety Manual)

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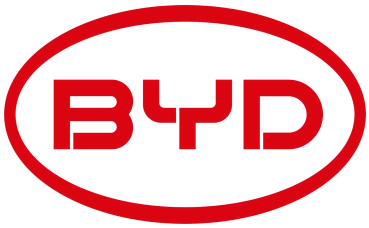


MC Cube ESS Safety Manual

May 29th, 2023

Electric Power Research Institute

MC10C-B4659-E-R2M01

This manual is verified to be accurate at the date of publication identified within Section 1.4. BYD reserves the right to make product and documentation modifications at any time to achieve the goal of "Technological innovations for a better life".

The images provided in this manual are for demonstration purposes only. Details vary slightly according to product version and market region. BYD has the final interpretation right for all detailed designs of the product.

The information and recommendations set forth are made in good faith and believed to be accurate as of the date of preparation. BYD makes no warranty, expressed or implied, with respect to this information.

Please contact the BYD Technical Team at EPRIsupport_Europe@fdbatt.com for further information or to report inaccuracies or omissions in this manual.

Made in China

1 Preface

1.1Document Purpose and Scope

The purpose of this document is to provide an overview of the electrical, chemical, and fire hazards that exist within the MC Cube Energy Storage System (ESS). The scope of this document is limited only to equipment contained within the MC Cube ESS and does not include an analysis of all hazards existing at an ESS site. Topics covered include an overview of comprehensive site safety planning processes, MC Cube ESS safety systems and features, MC Cube ESS hazards, emergency response options, and other important system safety precautions.

This document should be made available to all field personnel participating in the design, installation, operation, and maintenance of the MC Cube ESS in addition to project safety personnel and local emergency first responders.

This manual is to be considered supplemental to a project specific Environmental Health and Safety (EH&S) plan, Failure Mode Effects Analysis (FMEA), and Emergency Response Plan (ERP). Please read and understand all aspects of this document prior to initiating MC Cube ESS installation, commissioning, and operation.

Should any questions arise, please contact BYD support:

- By After Sales Management System at http://asms.byd.com/asapp/login
- By email at EPRIsupport_Europe@fdbatt.com

1.2Applicable Models

This manual covers the following model only:

- MC10C-B4659-E-R2M01

1.3Reference Documents

The MC Cube ESS Safety Manual exists as part of library of product specific documents. Please consult the following documents to ensure a comprehensive understanding of MC Cube ESS attributes.

- MC Cube ESS Installation Manual
- MC Cube ESS User Manual
- MC Cube ESS Safety Manual
- MC Cube ESS Maintenance Manual

1.4Version Control

This is the initial release of the MC Cube ESS Safety Manual. As part of BYD's continuous improvement process, BYD reserves the right to make technology and document changes. Please contact BYD support to verify this manual reflects the most recent release or to report omissions or inaccuracies.

Version	Description	Date of Issuance
MC Cube ESS Safety Manual_V01	Initial publication	05-29-2023

1.5Document Safety Notices

Throughout this manual the below indicated Danger, Warning, and Caution labels are used to convey hazards associated with specific tasks, procedures, and equipment. These safety notices do not represent all hazards present. All personnel should adhere to industry safety best practices; the project specific EH&S plan, ERP, and FMEA; and local safety requirements and regulations. Only properly trained and qualified personnel should be permitted install, operate, and maintain the MC Cube ESS. All emergency first responders shall receive training regarding the hazards of the MC Cube ESS.

"DANGER" indicates a hazardous situation which, if not avoided, will result in death or serious injury. The signal word "DANGER" is limited to the most extreme situations. DANGER indicators are not used for property damage hazards unless personal injury risk appropriate to these levels is also involved.

"WARNING" indicates a hazardous situation which, if not avoided, could result in death or serious injury. WARNING indicators are not used for property damage hazards unless personal injury risk appropriate to this level is also involved.

"CAUTION" indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION indicators without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only.

1.6 MC Cube ESS Primary Hazards

This section summarizes the primary hazards associated with the MC Cube ESS. These hazards are discussed in detail within this guide, in addition to other notable hazards. For further guidance, please refer to the remainder of this manual, the documents identified in Section 1.3, and a project/site specific EH&S plan, Hazard Analysis, and Emergency Response Plan.

1.6.1 Electrocution Hazard

Personnel will be exposed to voltages in excess of 1500 VDC from the MC Cube ESS's battery strings, and *cal/cm^2 available incident energy. Battery strings cannot be de-energized. Low and medium voltage AC is also present – exposure levels will depend on site specific conditions. Risk of arc flash and electrocution is omnipresent at an ESS site. BYD encourages full compliance with the practices and procedures indicated in NFPA 70E including use of Personal Protective Equipment (PPE) sufficient to mitigate any hazards identified in a site-specific arc flash study. Emergency Response Personnel should rely on Standard Operating Procedures (SOP) for responding to incidents at electrical generating facilities.

1.6.2 Fire and Explosion Hazard

The MC Cube ESS contains combustible fuels, ignition sources, and sufficient oxygen to result in propagation of fire. Fire and other sources of extreme heat, if not properly mitigated, can lead to battery cascading thermal runaway and the release of combustible gases. These combustible gases, if present in sufficient density, pose a risk of explosion. If a fire, or other indications of thermal runaway are present within the MC Cube or at the ESS site, first responders are advised to maintain a safe perimeter until it can be verified that entry into the ESS site is safe per the ERP and SOP.

1.6.3 Chemical Exposure Hazard

The MC Cube ESS contains the following hazardous chemicals: LFP battery electrolyte, lead acid battery electrolyte, and R410a/R134a refrigerant. These chemicals can be hazardous to both health and environment. Please refer to the Safety Data Sheets (SDS) contained within Attachment A of this document for hazards and precautions specific to each chemical.

1.7Product Certification and Compliance

The MC Cube ESS is compliant with the standards, regulations, and requirements identified in Table 1.

Table 1: MC Cube ESS Standards Compliance

Standards	
System	NFPA 70® – National Electrical Code® IEC 60529 – Degrees of Protection Provided by Enclosure UL 508 – Standard for Industrial Control Equipment UL 991 – Standard for Tests for Safety-Related Controls Employing Solid-State Devices UL 1998 – Standard for Software in Programmable Components IEEE C84.1 – Standard Preferred Voltage Ratings for Alternating-Current Electrical Systems IEEE 693 – Recommended Practice for Seismic Design of Substations IEEE 1584-2018 – Guide for Performing Arc-Flash Hazard Calculations Modular Energy Storage Architecture – Energy Storage System (MESA-ESS) Standard IEC 62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications
Fire Protection and Safety	CEC – California Electric Code CFC – California Fire Code (2019, Section 1206) NFPA 1 – Fire Code NFPA 855 – Installation of Energy Storage Systems NFPA 70E® – Standard for Electrical Safety in the Workplace®

2 Contents

3 Acronyms and Abbreviations

AC – Alternating Current
AHJ – Authority Having Jurisdiction
BMS – Battery Management System
BOL – Beginning of Life
DMC – Distribution Management Cabinet
DC – Direct Current
EMCU – Energy Management Control Unit
EMS – Energy Management System
ERP – Emergency Response Plan
ESS – Energy Storage System
FMEA – Failure Mode and Effects Analysis
HVAC – Heating Ventilation Air Conditioning
IEC – International Electrotechnical Commission
LFP – Lithium Iron Phosphate
LPC - Local Plant Controller
NFPA – National Fire Protection Association
NMC - Nickel Manganese Cobalt
OCPD - Over-current Protection Device
PCS – Power Conversion System
PPE – Personnel Protective Equipment
SOC – State of Charge
SOP – Standard Operating Procedures
UPS – Uninterruptible Power Supply

4 Introduction

4.1Comprehensive Site Safety and Emergency Response

Development of effective and comprehensive safety procedures and emergency response guidelines requires, among other things, i) analysis of project specific ESS architecture and all components within, ii) site specific risks and hazards, iii) engagement with project stakeholders, iv) and a clear understanding of both customer and fire department Standard Operating Procedures (SOP). BYD has provided this Safety Manual as an input to these processes and the development of the below recommended project specific documents.

- Environmental, Health, and Safety (EH&S) Plan: A living project safety plan which serves as an instructional tool for personnel working on a project, notifying them of hazards as well as procedures required to ensure personnel safety and environmental protections in consideration of such hazards.
- Failure Modes and Effects Analysis (FMEA): A bottom-up analysis which identifies the worst-case effect of component (software and hardware) failure on system performance and safety. An FMEA is similar to a Hazard Analysis. Reference International Electrotechnical Commission (IEC) 60812 for guidelines on how to perform an FMEA.
- Emergency Response Plan (ERP): An ERP leverages the FMEA, EH&S Plan, SOPs, and other inputs to develop a project specific plan which dictates the actions to be taken by key project stakeholders in response to an emergency at an ESS site. A copy of the ERP should be kept at the ESS site, at a location accessible to emergency first responders.

4.2System Overview

The MC Cube ESS integrates all power electronics, controls, and safety features required to support the DC side of a battery energy storage system. An overview of the MC Cube ESS layout and key features is shown in Figure 1 and further described in Table 2.

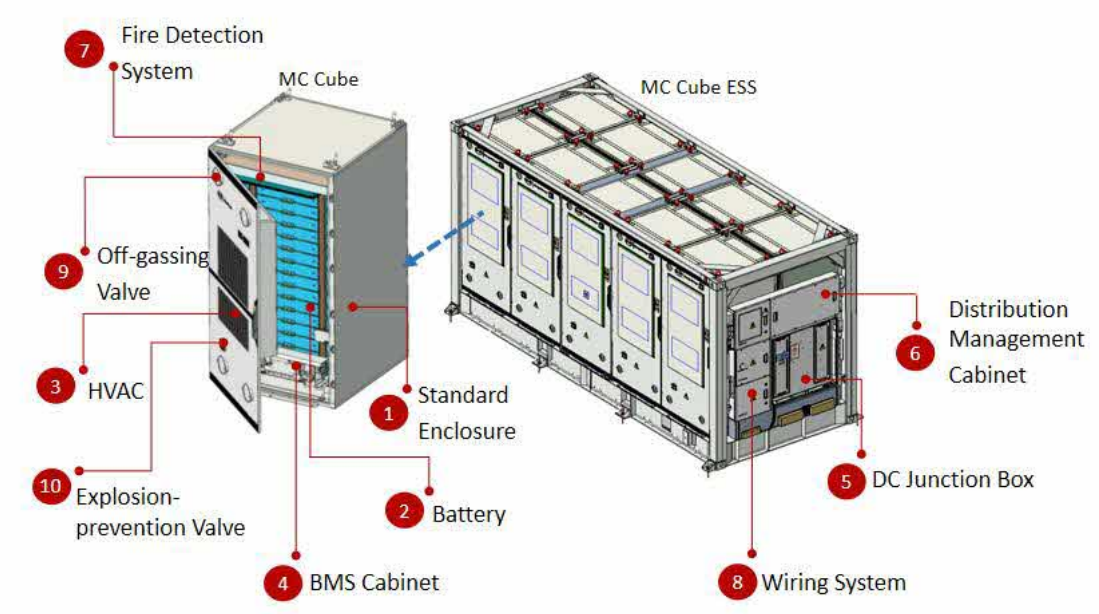


Figure 1. Layout and Features of the MC Cube ESS

Table 2: Description of MC Cube ESS Safety Equipment and Features

No.	Name		Remarks
①	Standard Enclosure		All models of the MC Cube utilize a standard IP-55 rated container.
②	1P416S Battery		The MC Cube ESS contains 10 MC Cubes, each consisting of 416 Lithium Iron Phosphate (LFP) cells, providing a maximum string voltage of 1497.6VDC (1500 VDC during charging). Each cells contains roughly 1.4kg (3.2lbs) of electrolyte. Each MC Cube contains roughly 589.8kg (1300.3lbs) of electrolyte. This battery greatly improves overall system energy density via the reduction of peripheral battery integration cabling and buswork.
③	HVAC		Install One HVAC per MC Cube to adjust the internal temperature of battery cabinet automatically. During charge and discharge, cell temperature is maintained between 20°C and 35°C. The MC Cube's HVAC system contains refrigerant of R410a: (Tongfei 1.3kg; Black Shield 1.2kg; SONGZ 1.4kg; Sanhua 1.9kg) or R134a: (Haier 1.8kg; Shengling 2.0kg).
④	Battery Management System		The MC Cube ESS houses 10 Battery Management Systems (BMS) (one for each MC Cube). BMS integrates battery management and safety management.
⑤	MCC Cube	DC Junction Box	The MC Cube ESS's DC Junction Box contains all primary DC buswork, disconnects, and power monitoring required to safely exchange power between the MC Cube and plant Power Conversion System (PCS).
⑥		Distribution Management	The Distribution Management Cabinet (DMC) houses all auxiliary power distribution equipment including backup UPS; auxiliary

		Cabinet	system Over-current Protection Devices (OCPDs); communication, control, and monitoring hardware including network switch, and Energy Management Control Unit (EMCU); and all required customer communication, signal, and auxiliary power interfaces.
⑦	Fire Detection System		The MC Cube ESS incorporates heat and smoke detections system.
⑧	Wiring System		The MC Cube ESS arrives on site with all power, communication, and signal wiring internal to the MC Cube ESS fully installed. Note: Some terminations have been removed to facilitate safe transport.
⑨	Off-gassing Valve		MC Cube has a flammable gas detection function, and four off-gassing valves set on the front. The flammable gas detector is calibrated to 25% LEL. If the flammable gas detector is triggered, both alarms will be activated and the off-gassing valve will be open for exhaust.
⑩	Explosion-prevention Valve		MC Cube has an explosion-prevention valve set on the front.

5 MC Cube ESS Safety Systems and Features

5.1Battery String Chemistry and Design

The MC Cube ESS contains 10 MC Cubes, and each MC Cube contains 416 LFP cells. LFP cells have high heat resistance relative to traditional ones such as Nickel Manganese Cobalt (NMC), and thus have a greater resistance to thermal runaway conditions. Furthermore, in a thermal runaway state, LFP cells generate a very small amount of energy as compared to other technologies, thereby slowing the progression of fault conditions, and reducing the chances of propagation to adjacent cells.

Battery string voltage can be dramatically reduced during transportation and maintenance via the 7 removable quick-disconnect connector cables within each MC Cube battery string. When the removable quick-disconnect connector cables are removed, string voltage can be reduced from 1497.6VDC to 187.2VDC (fully charged), greatly reducing the risk of fatal electrocution. Removing these quick-disconnect connector cables effectively breaks the internal string of 416 series wired cells into 8 groups of 52 cells. Note, during normal operation, and when fully installed, a battery string has a voltage exceeding 1500 VDC.

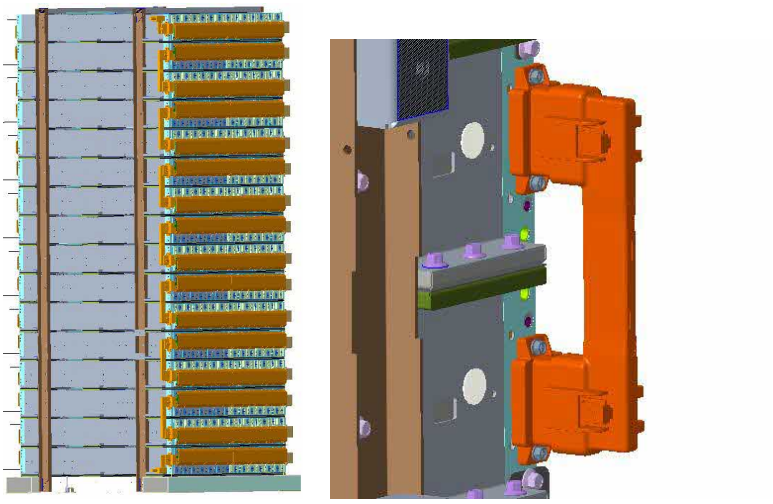


Figure 2. MC Cube CBFAE Battery String.

5.2Battery Management System

The MC Cube ESS contains 10 MC Cubes, and each MC Cube's CBFAE battery string are wired with 416 LFP cells, as shown in Figure 3. Each string is controlled and monitored by a dedicated Battery Management System (BMS). The BMS constantly monitors cell level voltage, temperature, State of Charge (SOC), and other parameters to ensure early detection of pre fault conditions, and immediate detection of fault events. Should any parameter exceed a permissible value, the BMS will disconnect the affected string and surface an alarm to the site EMS.

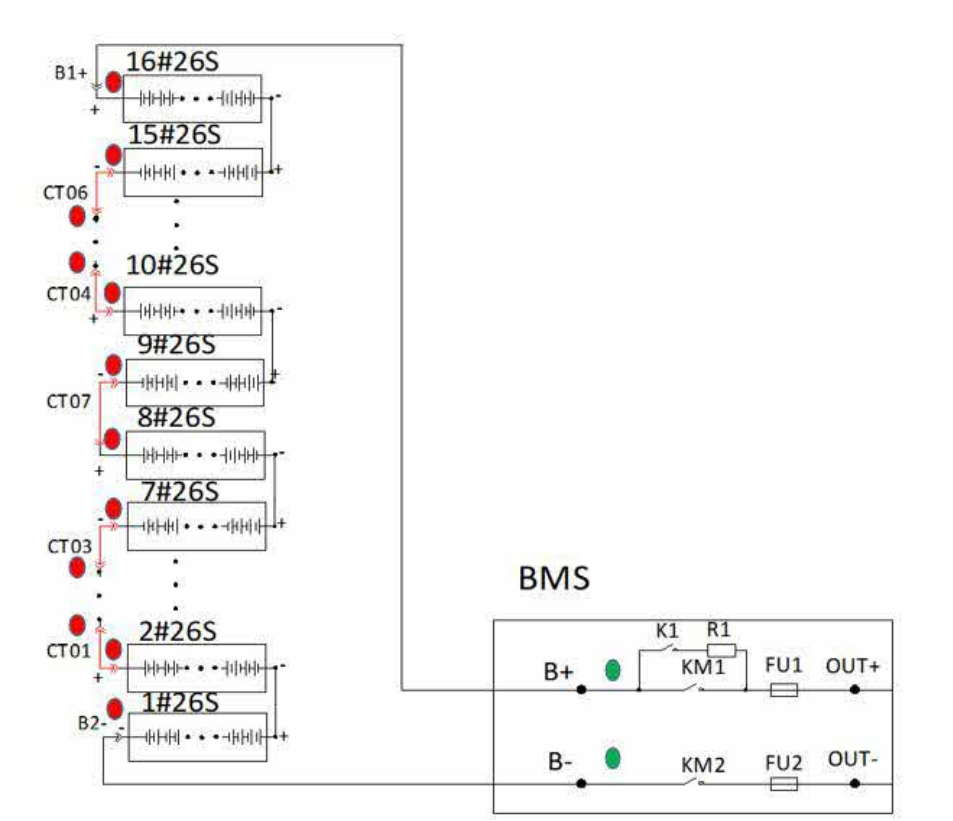


Figure 3. MC Cube String Wiring (Each string consists of 416 cells and a single BMS)

5.3E-stop

The MC Cube ESS contains one E-stop button on the front of the MC Cube ESS. When the button is pushed, the MC Cube ESS will immediately commence shutdown, and all BMS will isolate their battery strings from the main system bus. See Figure 6 and Section 7.1.1 for additional details.

5.4Fire Detection and Alarming

The MC Cube ESS contains 10 MC Cubes, and each MC Cube is equipped with humidity, water, smoke and heat detectors calibrated to detect early signs of fire within the MC Cube. The locations of these detectors are shown in Figure 6.

The MC Cube ESS contains both an audible fire alarm and visual fire strobe. If an alarm is triggered, both alarms will be activated.

The fire alarm logic is shown in the Figure 4.

The MC Cube is equipped with flammable gas detector and off-gassing valve. The flammable gas detector is calibrated to 25% LEL. If the flammable gas detector is triggered, bell alarm will be activated and the off-gassing valve will be open for exhaust. Corresponding alarms will be sent to the ESS EMS.

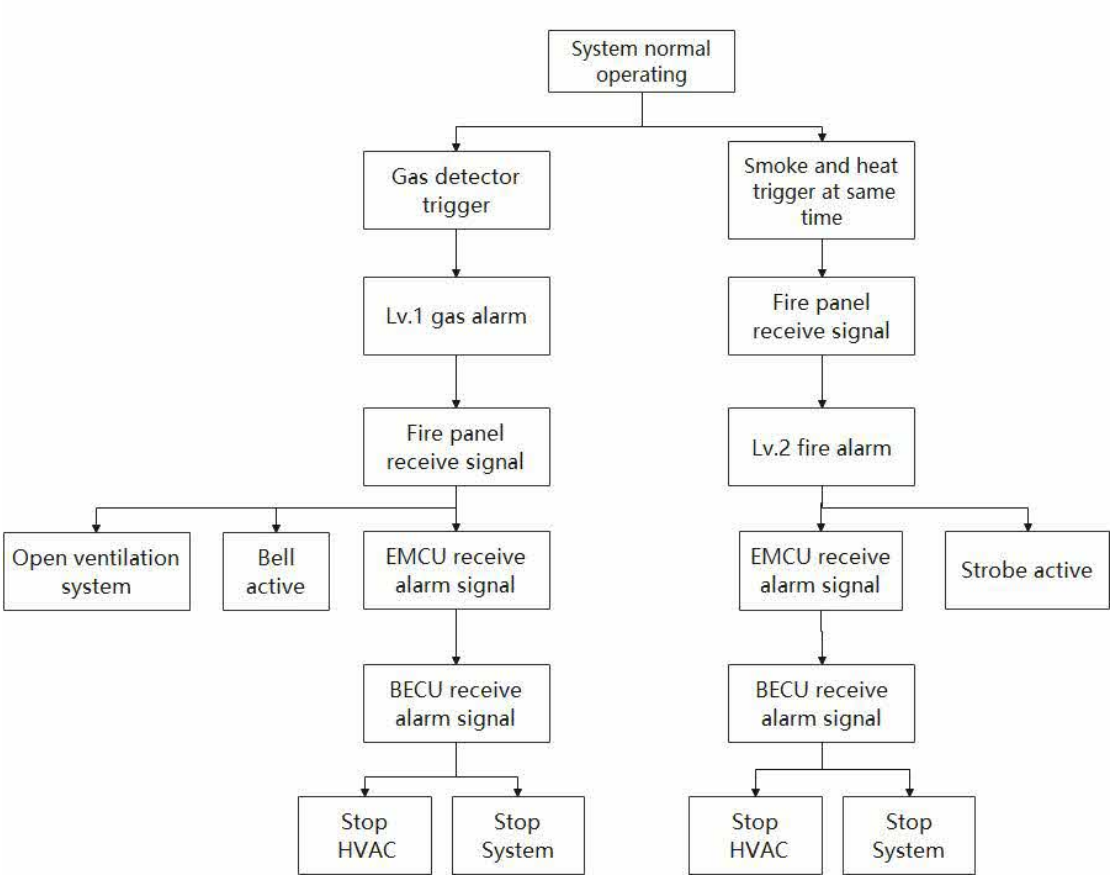


Figure 4. Fire Alarm and Response Logic

6 MC Cube ESS Hazards

The primary hazards associated with installation and operation of the MC Cube ESS are indicated in Table 3 and discussed in the following sections.

Table 3: MC Cube Primary Hazards

Classification	Hazard	Description	Quantity	Risk
Electrical Hazards	DC voltage	Primary voltage of storage system	1500VDC	Electrocution
	AC voltage	Primary voltage of auxiliary power supply	400VAC	Electrocution
Chemical Hazards	R410a refrigerant or R134a refrigerant	Refrigerant used in HVAC system	R410a: (Tongfei 1.3kg; Black Shield 1.2kg; SONGZ 1.4kg; Sanhua 1.9kg) or R134a: (Haier 1.8kg; Shengling 2.0kg)	See Attachment A: MSDS Library
	Li-ion electrolyte	Battery electrolyte used in LFP cells	5898kg (13003lbs)	See Attachment A: MSDS Library
	Lead acid electrolyte	Battery electrolyte used in UPS	0.77L(0.2gal)	See Attachment A: MSDS Library
Fire & Explosion Hazards	Electrical fire	Fire caused by cable fault or component failure	--	Fire
	Thermal runaway	Thermal runaway from battery fault or heat	--	Fire, off-gassing
	Battery off-gassing	Off-gassing resulting from thermal runaway	--	Explosion

6.1Electrical Hazards

6.1.1 DC Voltage

Hazard: Exposure to 1500VDC

As shown in Figure 3, the MC Cube's CBFAE battery string are wired with 416 LFP cells, and each MC Cube CBFAE cell has a maximum DC voltage of 3.6VDC. When a series string of 416 cells is wired,, the total voltage increases to 1497.6VDC. Charging voltage can be as high as 1500VDC. Risk of

electrocution exists.

Location: When system is shut down, high DC voltage is present at the terminals of each battery and BMS. When the system is started or on-line, each BMS will close the string disconnect, and energize the main DC bus of the MC Cube ESS. If the system primary disconnect is closed, the conductors between the MC Cube ESS and DC terminals of the PCS will also be energized.

6.1.2 AC Voltage

Hazard: Exposure to 400VAC

The MC Cube ESS's auxiliary power system, which includes HVAC systems, control systems, and other system support equipment, operates under 400VAC. Risk of electrocution exists.

Location: 400VAC aux power feed is routed into the bottom of the MC Cube ESS Distribution Management Cabinet as shown in Figure 1. 400VAC supplies HVAC loads.

6.2Chemical Hazards

6.2.1 R410a or R134a Refrigerant

Hazard: Exposure to hazardous chemicals

The MC Cube ESS contains 10 MC Cubes, and the MC Cube's air conditioning system circulates R410a or R134a refrigerant to the entire HVAC system. R410a or R134a can be flammable under certain circumstances and does pose a health risk when exposed to personnel in sufficient quantity. See the safety data sheet (SDS) contained in Attachment A for further details.

Location: R410a (Tongfei 1.3kg; Black Shield 1.2kg; SONGZ 1.4kg; Sanhua 1.9kg) or R134a (Haier 1.8kg; Shengling 2.0kg) circulates throughout the HVAC system, as shown in Figure 5.

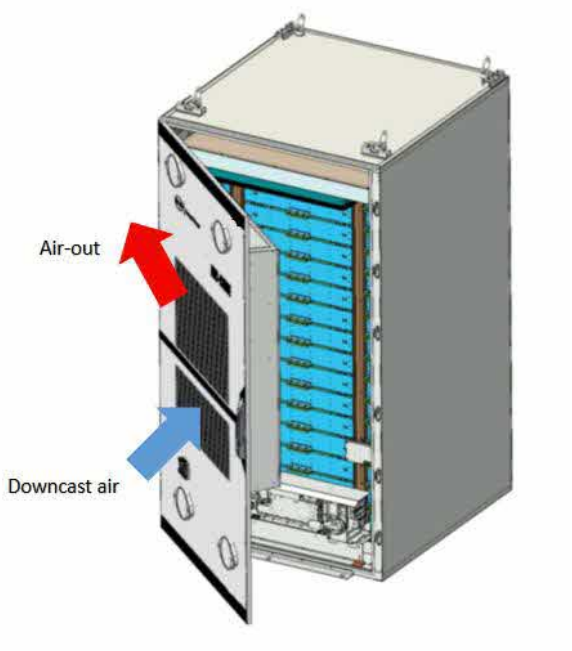


Figure 5. MC Cube's HVAC System

6.2.2 Lithium Ion Electrolyte

Hazard: Exposure to hazardous chemicals

The electrolyte contained within the CBFAE cells consists of a volatile hydrocarbon-based liquid and a dissolved lithium salt such as lithium hexafluorophosphate. The electrolyte solution can be flammable under certain circumstances and does pose a health risk when exposed to personnel. See the safety data sheet (SDS) contained in Attachment A for further details. Additional materials used in the construction of the CBFAE LFP cell are indicated in Table 4.

Location: 1.4kg (3.1lbs) of electrolyte is contained within each of the MC Cube ESS's 4160 cells. The battery strings are located within the steel racks shown in Figure 1.

Table 4: Non-electrolyte Materials in MC Cube ESS Cells

No.	Materials/Ingredients	Approx. % by wt.
1	Carbon	20.17-26.12%
2	Polypropylene	2.36-3.05%
3	Aluminum	8.51-11.03%
4	Copper	6.43-8.32%

6.2.3 Lead Acid Electrolyte

Hazard: Exposure to hazardous chemicals

The electrolyte contained within the MC Cube ESS's UPS consists of a sulfuric acid electrolyte. The electrolyte solution does not combust easily but does pose a health risk when exposed to personnel. See the safety data sheet (SDS) contained in Attachment A for further details.

Location: The Lead Acid Electrolyte is contained within the MC Cube ESS's UPS which is in the Distribution Management Cabinet.

6.3Fire & Explosion Hazards

6.3.1 Electrical Fire

As a result of short circuit, failed OCPD (over-current protection device), or other electrical component failure, electrical fires are possible within the MC Cube ESS.

6.3.2 Thermal Runaway and Battery Fire

Due to excessive heat build-up from external sources (i.e. electrical fire), or internal cell failure, it is possible that one, or many of the MC Cube's LFP cells may be pushed into a state of thermal runaway. Should this occur, the CBFAE cells are designed to reduce the chances of propagation of thermal runaway to adjacent cells, a process called "cascading thermal runaway."

6.3.3 Explosion of Battery Off Gas

When Li-ion batteries go into thermal runaway, toxic and flammable gases are released in a process called off-gassing. During cascading thermal runaway events, when many cells are consumed,

sufficient gas can build up within a confined space to create conditions sufficient for explosion.

7 Emergency Response

7.1Emergency System Shutdown

In the event of an emergency on site, the MC Cube ESS can be shut down locally, or remotely. A system shutdown will result in electrical isolation of the battery strings and cessation of battery charging or discharging. A system shutdown will not de-energize the battery bank, nor will it guarantee that a fault or thermal runaway event has been stopped. Do not open the MC Cube ESS until deemed safe to do so by an individual qualified to direct such decision.
Procedures for shutdown of the site and isolation from the grid should be dictated within the ERP.

7.1.1 Local Emergency Shutdown

If it is safe to approach the MC Cube ESS, as defined by the project ERP, SOPs, Emergency Incident Commander, or other qualified on-site personnel, the E-stop button located on front of the MC Cube ESS can be pushed. See Figure 6 for the location of the E-Stop button. When the E-stop is pushed, the MC Cube BMSs will disconnect all battery strings from the main system bus, thereby stopping all charging and discharging. Simultaneously, the plant PCS will shut down if properly configured to do so. When multiple MC Cube ESSs exist on a single site, their E-stop circuits can be interconnected, resulting in total system shutdown when one E-stop button is triggered.
If the temperature reaches the activation threshold of the hot aerosol (optional) fire suppression system(190 ± 20℃), the hot aerosol will be sprayed.

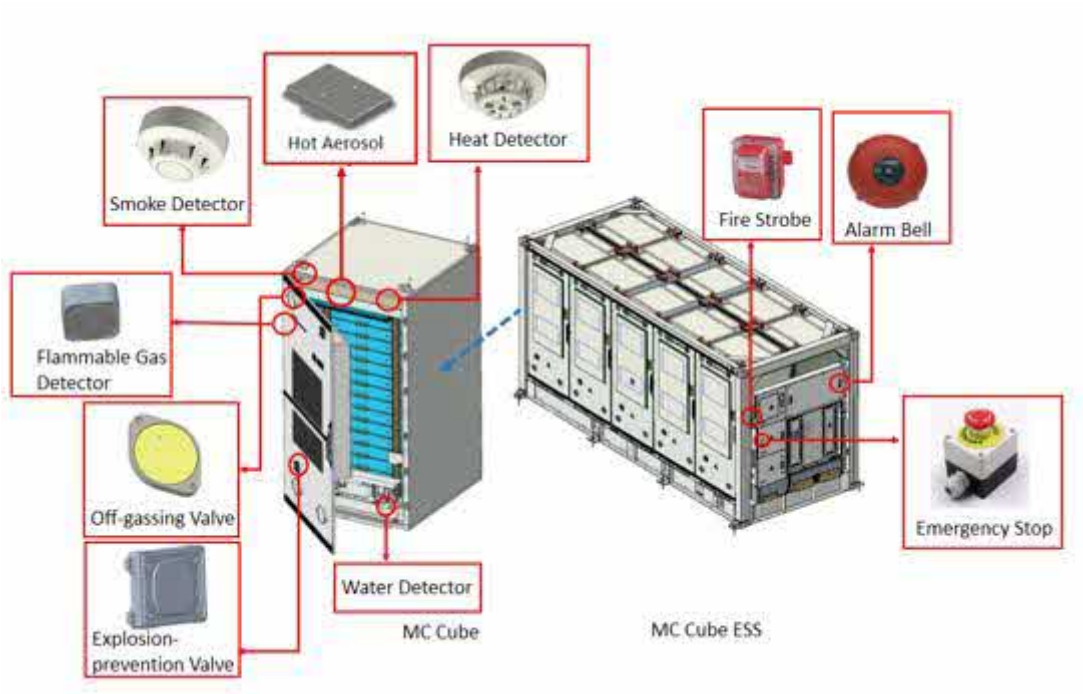


Figure 6. Location of E-stop, Fire Detectors, and Alarms

Pressing the E-stop while charging and discharging places considerable stress on the system. Only use the E-stop to stop the system during an emergency. Before restarting the system, the E-stop must be pulled out to its original position.

If indications of a fire within the MC Cube ESS exists, such as smoke emanating from the MC Cube ESS, or activation of the fire alarm strobe, it is recommended to immediately evacuate the area and maintain a safe perimeter. System shutdown should be attempted remotely as described in Section 7.1.2. Do not open the MC Cube ESS access doors.

7.1.2 Remote System Shutdown

During normal operation, the MC Cube ESS will be under the control of a site Energy Management System (EMS) or Local Plant Controller (LPC). The EMS or LPC in turn will communicate with, and be controlled by, an offsite fleet controller, SCADA operations center, or other third-party dispatch and monitoring entity. MC Cube ESS alarms will be forwarded to such remote operations, and in turn, remote operations personnel can shut down the MC Cube ESS as necessary.

On-site personnel witnessing an emergency should not however assume automated alarms have reached the LPC or EMS or that they have been passed onto remote operations. Such personnel are advised to first call the local fire department, and then contact remote operations directly in addition to other key stakeholders identified in the ERP.

7.2Fire Alarm Response

7.2.1 Initial Indications of Fire

If any of the below is observed, personnel should immediately evacuate the area, contact the local fire department, and notify all stakeholders as defined within the ERP. Do not open the MC Cube ESS access doors under any circumstance.

- Acrid burning smell
- Excessively hot access door handles or outer surfaces
- Unusual sounds indicating electrical arcing or combusting materials
- Triggered audible or visual fire alarm, or site EMS has received fire alarm messages
- Smoke emanating from the MC Cube ESS

7.2.2 Establish Secure Perimeter and Monitor

In the event of a fire, or indication of a fire within the MC Cube ESS, BYD recommends that first responders establish a secure perimeter, monitor, and approach only when determined safe to do so by an incident commander or other qualified authority. No direct suppression tactics are advised by BYD.

7.2.2.1 Establish a Perimeter

The circumference of such perimeter should be calculated as part of a project specific ERP. Variables analyzed should include potential plume size (a product of system size), prevailing winds, proximity to

other buildings and sensitive areas (schools, etc), and the potential blast radius should a cascading thermal runaway result in accumulation and ignition of explosive gases.

7.2.2.2 Monitor

In the absence of a justified reason to enter the site (i.e. entrapment of personnel), it is advised that emergency first responders not take direct action to suppress the fire. A communication link should be established with the remote system operator to obtain data regarding system status if available. Battery/cell status, temperature, and voltage trends should be observed to quantify scope of event and conditions within the MC Cube ESS. IR cameras can also be used to evaluate hot spots and decreasing/increasing temperatures. Note, a battery fire may continue for 24 hours or longer and can re-ignite due to the exothermic reaction of constituent materials from broken or damaged cells.

If deemed appropriate and safe to do so by the incident commander, water can be applied to the MC Cube ESS and adjacent structures to prevent fire spread. Such processes should be clearly indicated in the ERP and incorporated into fire department and customer SOPs.

7.2.2.3 Direct Suppression

It is outside the scope of this manual to advise on means and methods for direct suppression of Li-ion fires. Again, BYD does not advise direct firefighting tactics. BYD does however offer the following general information for consideration should it be necessary to take a direct suppression approach:

- If the hot aerosol fire suppression system does not effectively suppress the fire or re-ignition occurs, it can only be safely stopped by cooling with large quantities of water.
- Foam and other chemical agents will not be effective. Foam suppressants may trap heat and increase rate of propagation.
- Ventilation of internal areas of the MC Cube ESS is essential to ensuring the absence of accumulated explosive gases. Firefighters are advised to not open access doors until flammable gas has been reduced to a safe value and the exhaust valve has been opened.
- Approaching the MC Cube ESS from the sides without access doors may minimize injury in the event of explosion.

8 Other System Precautions

8.1 Storage Precautions

Should the MC Cube ESS or CBFAE cells require storage for extended periods of time, the following is advised:

1. Storage temperature shall be between -20°C and 50°C. Elevated temperatures can result in increased capacity degradation and/or fire danger. Contact BYD if short duration storage is anticipated to exceed the above limits for reasons outside the installer/owner's control.
2. Batteries should be stored at a humidity <85% and protected from moisture, condensation, and flooding.

3. Batteries should be stored between 25%-60% SOC to prevent accelerated capacity degradation.
4. Battery system, and sub-assemblies should be stored in approved packaging.
5. Storage facility should be compliant with the appropriate local fire code requirements.
6. Acceptable storage density of cells and storage height of cells shall be defined by the local authority having jurisdiction (AHJ). Requirements and limits will be based upon a number of factors including the structural and fire protection characteristics of the storage area and recommendations for fire protection promulgated by the National Fire Protection Association (NFPA) and similar organizations.
7. At the time of this writing, no Commodity Classification has been defined for lithium-ion cells or battery strings. Until a Commodity Classification has been defined based on testing by NFPA or a similar organization, BYD recommends treating lithium-ion cells and batteries in packaging as equivalent to a Group a Plastic Commodity.

8.2Installation, Operation, and Maintenance Precautions

Numerous safety hazards exist during the installation, operation, and maintenance of the MC Cube ESS. Please refer to the relevant manuals identified in Section 1.3 for further details.

8.3Handling, Storage, and Transportation of Damaged Goods

If a cell has been damaged (battery enclosure has been dented or broken), it is possible that heating is occurring that may eventually lead to a fire. Damaged cells/batteries can result in the release of flammable vapors, and propagation of thermal runaway reactions to neighboring cells.

Before handling or transporting a damaged cell, wait at least one hour. Smoke in the vicinity of a cell may be an indication that a thermal reaction is in progress. If no smoke, flame, leakage of electrolyte, or signs of heat has been observed for one hour, the MC Cube ESS may be disconnected and moved into a safe location. To obtain specific instructions for evaluating and preparing damaged batteries for transport, please visit http://asms.byd.com/asapp/login and contact the BYD Service team.

A damaged cell should be monitored during storage for evidence of smoke, flame, leakage of electrolyte or signs of heat. If full-time monitoring of the damaged product is not possible (for example during extended storage), the damaged product should be moved to a safe storage location.
A safe storage location for a damaged cell will be free of flammable materials, accessible only by trained professionals. Do not store a damaged cell adjacent to undamaged products.

8.4Disposal Procedures

Batteries at the end of their service life should be disposed of or recycled in accordance with local, state, and federal regulations. Note that regulations regarding disposal of batteries vary by jurisdiction. In the United States, batteries are classified as “Universal Waste”, and in addition, many individual states have specific regulations regarding disposal of cells. For example, in California, all batteries must

be taken to a Universal Waste handler or authorized recycling facility.

BYD Lithium-ion Batteries contain recyclable materials. BYD lithium-ion batteries do not contain heavy metals such as lead, cadmium, or mercury. BYD strongly encourages recycling. Please consult with local, state and/or federal authorities on the appropriate methods for disposal and recycling.

8.5Transportation Information

Lithium-ion batteries are regulated as Class 9 Miscellaneous dangerous goods (also known as “hazardous materials”) pursuant to the International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air, International Air Transport Association (IATA) Dangerous Goods Regulations, the International Maritime Dangerous Goods (IMDG) Code, European Agreements concerning the International Carriage of Dangerous Goods by Rail (RID) and Road (ADR), and applicable national regulations such as the USA’s hazardous materials regulations. These regulations contain very specific packaging, labeling, marking, and documentation requirements. The regulations also require that individuals involved in the preparation of dangerous goods for transport be trained on how to properly package, label, mark and prepare shipping documents.

Table 5: Transportation of Lithium Ion Cells

UN Number	3480
Proper Shipping Name	Lithium-ion Batteries
Hazard Classification	Class 9 Miscellaneous
Packing Group	N/A

9 Attachment A

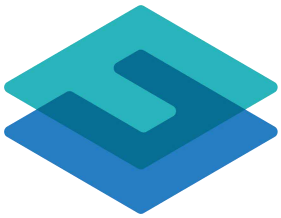
"Attachment A: MC Cube ESS Safety Data Sheet Library" includes the following documents. Attachment A is provided separately.

- R410a Refrigerant MSDS or R134a Refrigerant MSDS
- Antifreeze Coolant MSDS
- Li-ion Electrolyte CBFAE MSDS
- UPS (lead acid electrolyte) MSDS
- Other project specific MSDS as required

Appendix 2 (MC Cube ESS Fire Control Technology Plan)

4th Floor, 80 Victoria Street, London SW1E 5JL
Registered in England and Wales No: 09840486
VAT number: 234 9362 96

Subject	Fire Control Technology Plan	Rev.	1
Doc. No.	INS-022	Proj. No.	R209



FinDreams Battery

MC CUBE ESS
Fire Control Technology Plan

November 15th, 2022

Electric Power Research Institute

MC10C-B5365-U-R4M01

Subject	Fire Control Technology Plan	Rev.	1
Doc. No.	INS-022	Proj. No.	R209

Issue/Revision History

Rev.	Date	Revision Content	Revise/created by	Checked by	Approved by
1	2022.11.13	Establish	Liu Lukuan	Li Shanpeng	Cao Hu
2	2022.11.15	Version Update	Liu Lukuan	Li Shanpeng	Cao Hu

Subject	Fire Control Technology Plan	Rev.	1
Doc. No.	INS-022	Proj. No.	R209

Contents

1 Introduction

This paper describes the technology plan of the U.S. fire technology scheme of BYD MC Cube.In order to meet the code NFPA72/NFPA69, this fire protection scheme adopts fire control devices which meet the certification standard requirements. BYD evaluates and optimizes the overall strategy and layout to realize the fire alarm and protection of the whole lithium battery storage machine cabinet.

2 Reference Standard

The reference criteria for this fire plan are as follows:

NFPA72《National Fire Alarm and Signaling Code》2022

NFPA70《National Electrical Code》2020

NFPA69《Standard on Explosion Prevention Systems》2019

NFPA855《Standard for the Installation of Stationary Energy Storage Systems》2022

NFPA111 《 Standard on Stored Electrical Energy Emergency and Standby Power Systems》2022

UL268《Standard for Smoke Detectors for Fire Alarm Systems》2021

UL521《Standard for Heat Detectors for Fire Protective Signaling Systems》2022

UL864《Standard for Control Units and Accessories for Fire Alarm Systems》2020

UL1638《Standard for Heat Detectors for Fire Protective Signaling Systems》2016

UL2075《Standard for Gas and Vapor Detectors and Sensors》2021

UL9540A《Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems》

3 Fire Protection Introduction

The MC Cube fire system design has the following functions:：

❖ Fire Alarm Function

Fire alarm is launched when the system fire panel detects the temperature/smoke detector.

❖ Fault Alarm Function

Fault alarm is started launched when the system controller detects the device failure.

❖ Combustible Gas Detection Alarm Function

The system is equipped with detector,which can detect combustible gas and give an alarm when combustible gas appears in the system.

❖ Explosion Proof Exhaust Function

The system is equipped with exhaust valves and exhaust fans. The exhaust function can be activated when the combustible gas detector is triggered.

❖ System Emergency Control Function

When the system EMCU receives fire alarm information, it can control the entire system to stop working to implement emergency control.

❖ System Alarm Control Priority

Fire Alarm > Combustible Gas Detection Alarm > Fault Alarm

4 Control Strategy Description

❖ **NFPA72**

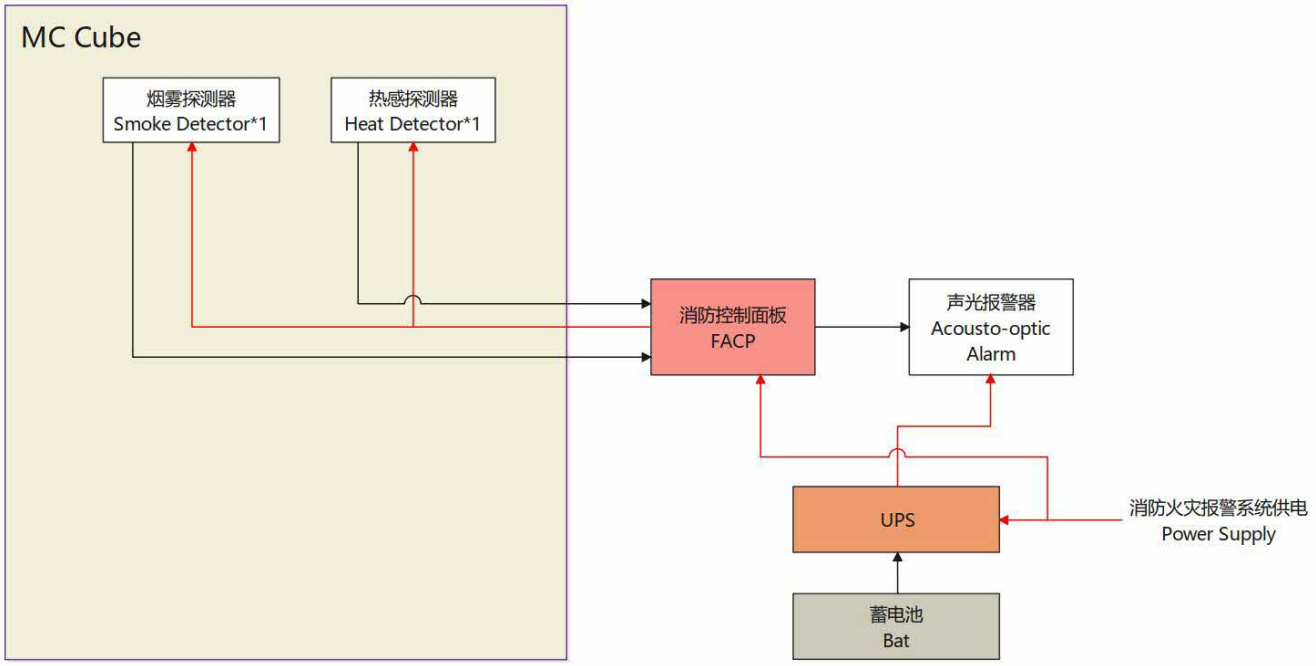


Figure 1：NFPA72

Design Standard Conformity	
Smoke Detector	UL268
Temperature Detector	UL521
Fire Control Panel	UL864
Sound and Light Alarm	UL1638
UPS/Battery	NFPA111

Control policy specification:

All fire protection devices(Smoke Detector、Temperature Detector、Fire Control Panel、Sound and Light Alarm) are powered by a single UPS；

One temperature detector and one smoke detector are fitted in a single cell battery. When the sensor detects the temperature and smoke anomalies in the cupboard, it will transfer the signal to the fire controller. Fire control controller starts sound and light alarm;

The MC Cube project system is equipped with 10 battery cabinets.The fire alarm system puts 10 battery cabinets as a whole to fire the alarm.

❖ **NFPA69**

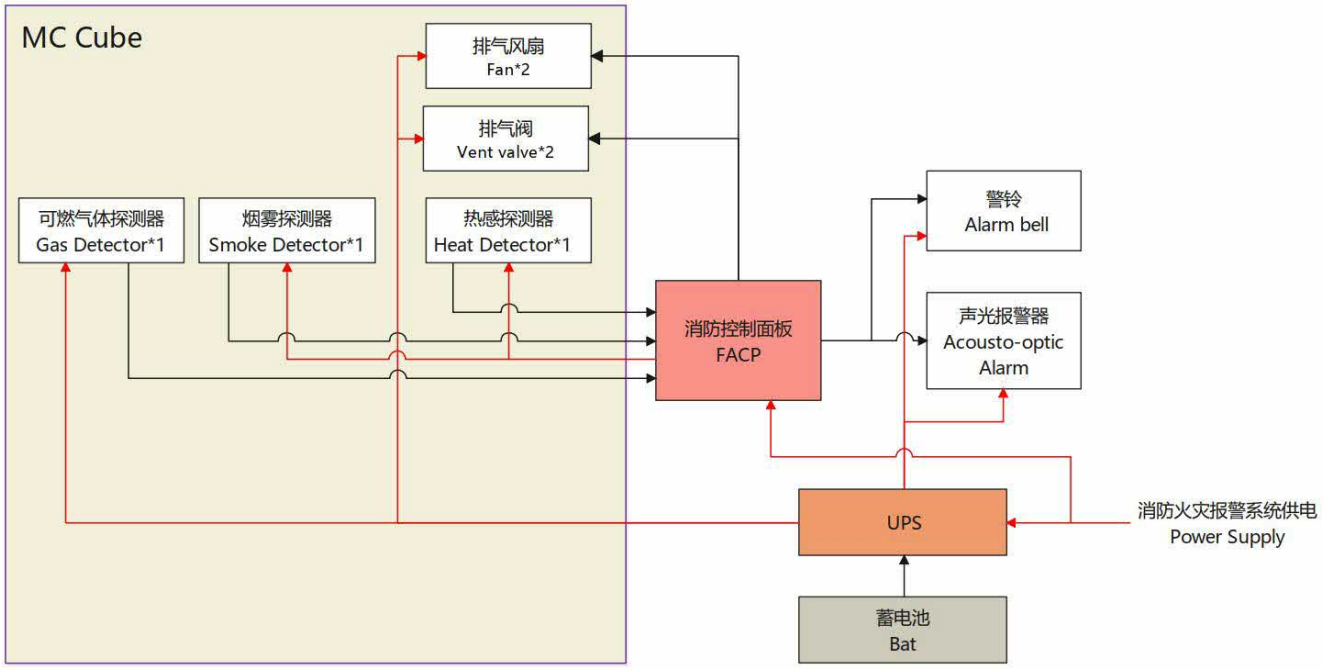


Figure2：NFPA69

Design Standard Conformity

Combustible Gas Sensor UL2075

Control Strategy Description:

When a combustible gas detector detects a combustible gas in the battery cabinet, the signal is transmitted to the fire controller. The fire panel will identify the cabinet number and open the exhaust valve and fan of the battery tank. Meanwhile, the gas alarm is carried out.

When the system also has a fire, stopping the gas alarm, starting the fire alarm.

❖ System Emergency Control

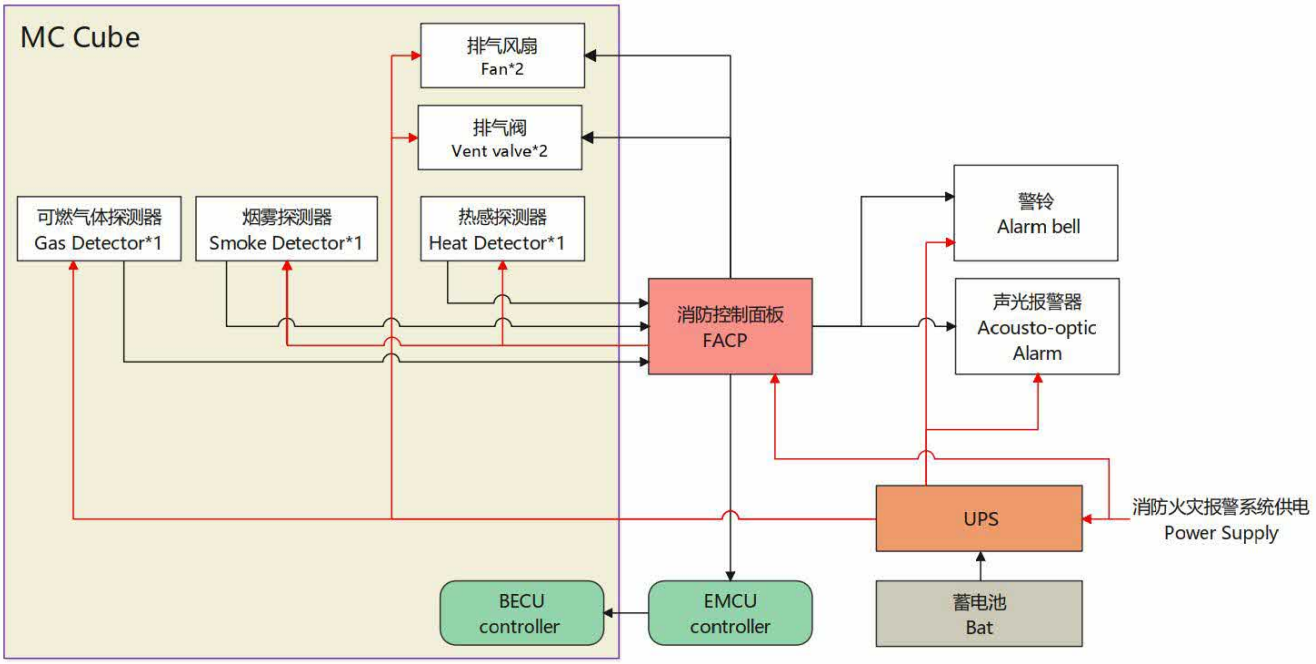


Figure3：System Emergency Control

Control Strategy Description:

When the system starts to alarm, the fire panel will control the sound light alarm to start working;

EMCU collects the dry contact information in the control sound alarm of FACU. System will stop.

5 System Fire Exhaust Design

Refer to UL9540A Figure A.3

❖ **First we confirm whether the system needs exhaust:**

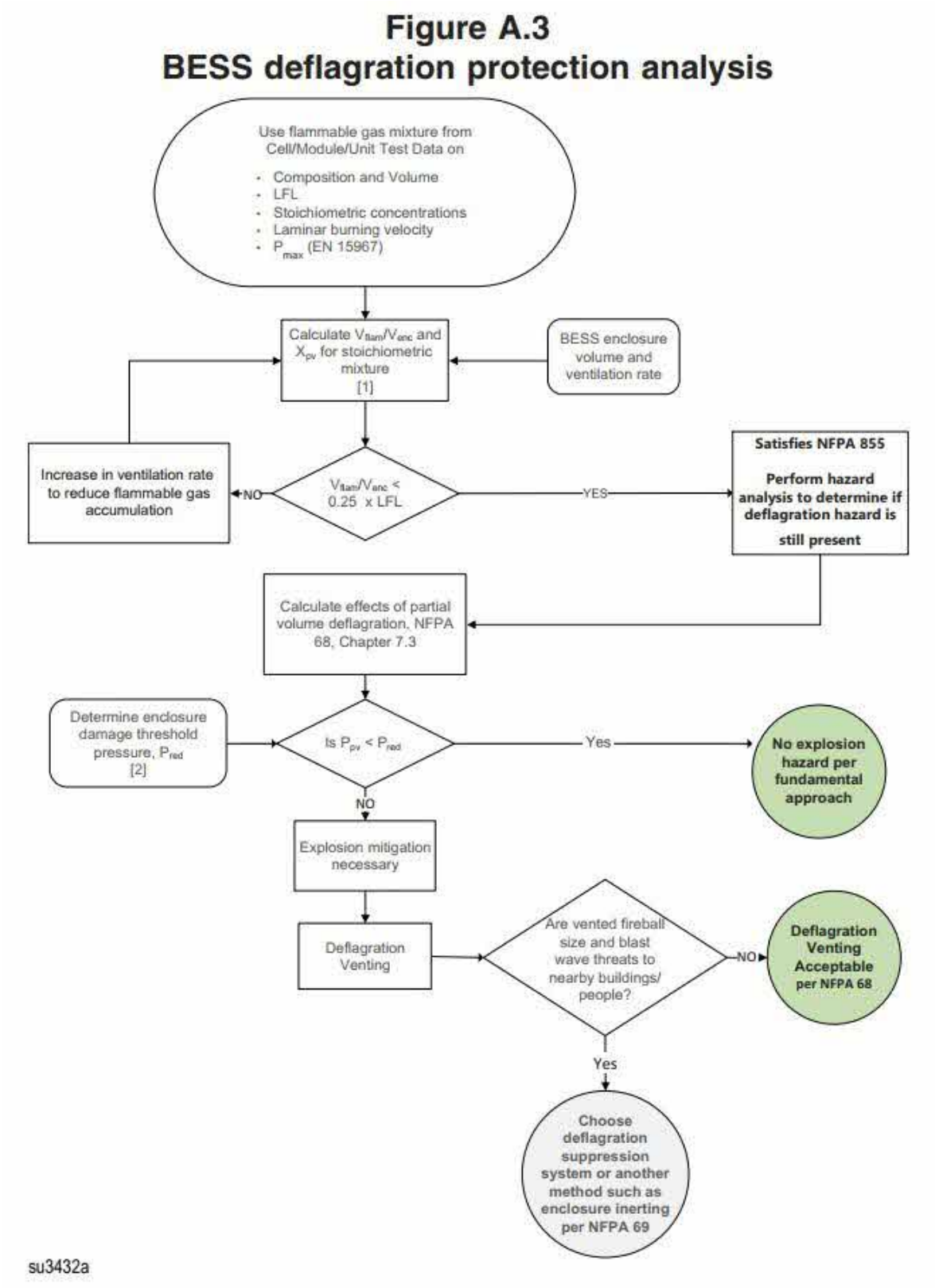


Figure4：BESS deflagration protection analysis

Where:

V_{flam} – Volume or volume flow rate of flammable gas.

V_{enc} – Volume of enclosure or ventilation rate of enclosure.

X_{pv} – Flammable mix partial volume fraction.

LFL – Lower flammability limit.

P_{pv} – Partial volume pressure.

P_{max} – Maximum pressure from cell vent gas composition (EN 15967).

P_{red} – Maximum pressure developed in a vented enclosure during vented deflagration.

Figure5：Introduction to terms

According to the actual data of the core heat, the ratio of gas emissions after the power of the core heat is as follows:

Gas	Chemical formula	% by Vol
Methane	CH_4	5.70
Ethane	C_2H_6	1.03
Ethylene	C_2H_4	5.17
Propane	C_3H_8	0.26
Propylene	C_3H_6	1.78
i-Butane	i-C_4H_{10}	0.19
n-Butane	n-C_4H_{10}	0.30
n-Butene	n-C_4H_8	0.72
n-Pentane	n-C_5H_{12}	0.30
n-Pentene	n-C_5H_{10}	0.19
Carbon Monoxide	CO	6.83
Carbon Dioxide	CO_2	23.71
Hydrogen	H_2	53.82
Total	---	100

The total displacement of the single core heat is about 90L

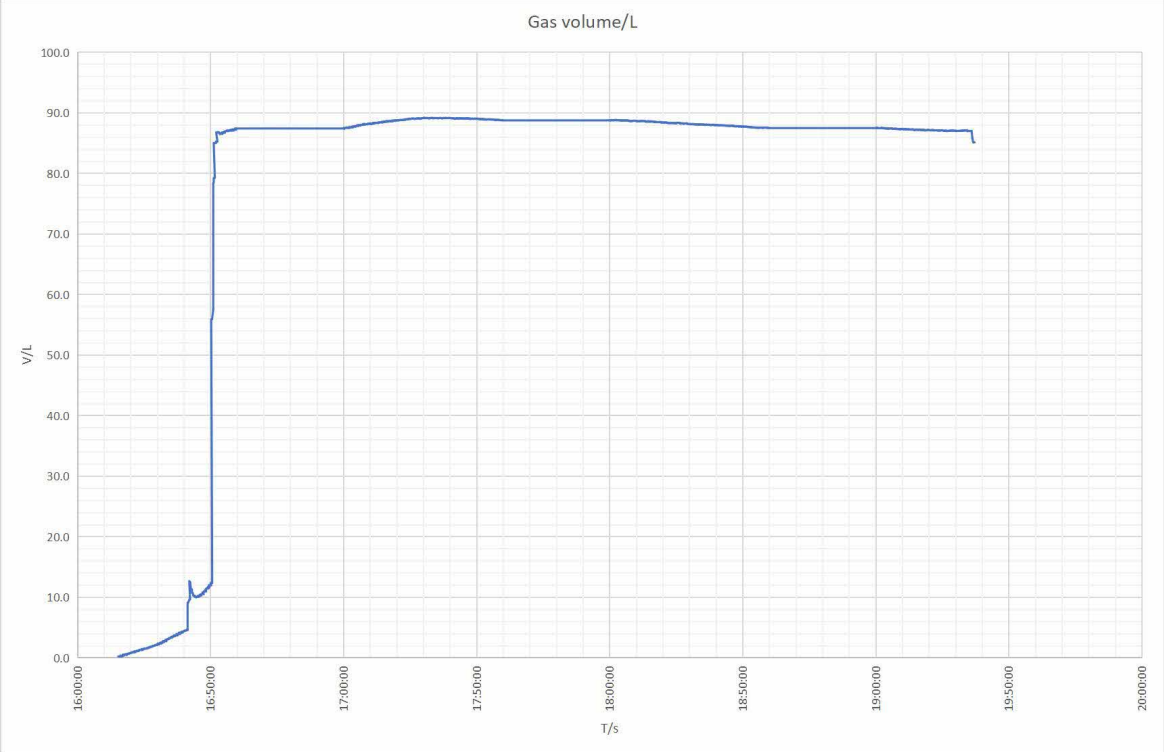


Figure6：Gas release volume

The exhaust volume of the system heat out of control is calculated by four electrical cells.

Flammable Volume Vflam=90*4*(1-23.71%)≈275L

The remaining volume of the cabinet is 0.95m³=950L

Vflam/Venc=29%

Refer to the test result of the core level of UL9540A. The LFL value of the hybrid gas body is 5.8%@35℃, 5%@154℃ after the battery out of control, The lowest of 0.25LFL is 1.25%@154℃＜29%, the system needs active exhaust.

NO.	Name of Test	Clause of Standard	Test Result	Remark
1	Flammable (explosion) limits of gas and vapours - LFL	ASTM E918-19	LFL=5.8% at 35(±2)℃ and101(±3)kPa.	See Attached Table 3 and 4.
2	Flammable (explosion) limits of gas and vapours - LFL	ASTM E918-19	LFL=5% at 154(±5)℃ and101(±2)kPa.	See Attached Table 5 and 6.

❖ **System Exhaust Rate Requirement**

According to the results of the strain of UL9540A heat loss, the volume flow of combustible gas in the process of heat loss is shown below. Vflam, Venc are showed with Volume Flow. Refer to requirement , Vflam/Venc ＜ 0.25LFL, Vflam takes the peak of the entire process(47L/min). Four electric cells are out of control at the same time. The peak of the exhaust is approximately 3.13L/s(Combustible gas ratio76.29%), 0.25LFL is 1.25%, We can get a gas ratio＞191L/s, We consider a certain amount of margin, It is estimated that when the system's exhaust rate is greater than 200L/s, it can meet the requirements.

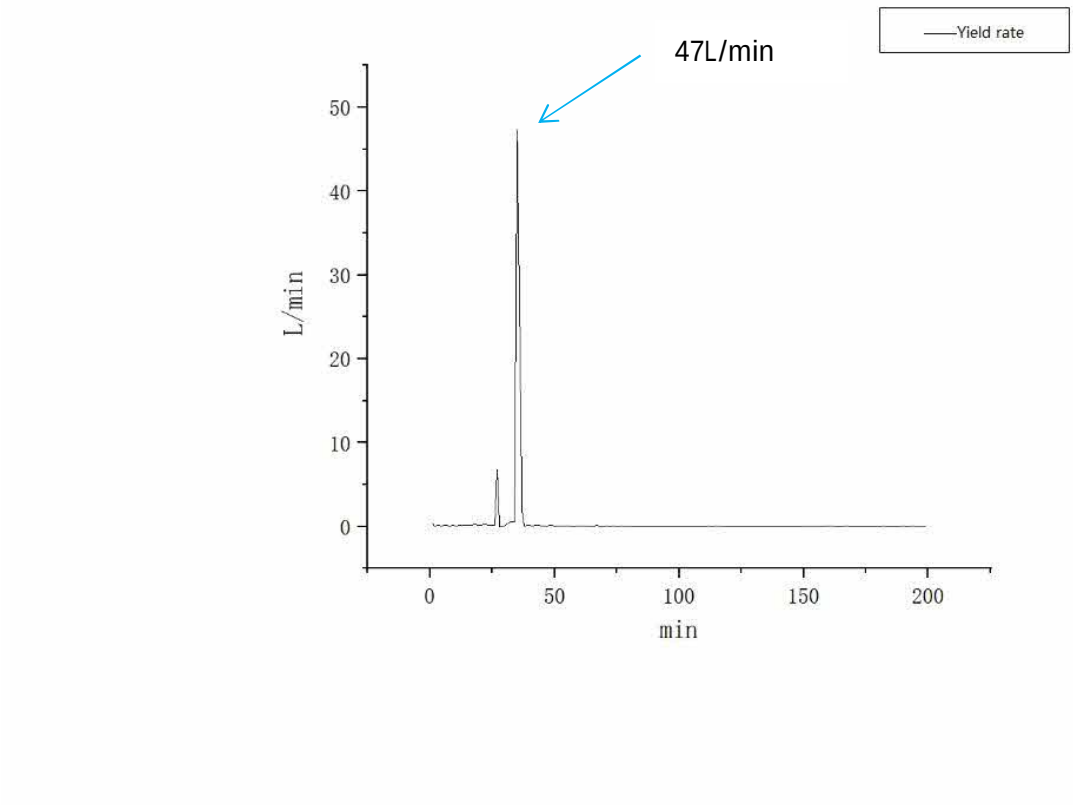


Figure7：Gas release rate

Appendix 3 (UL9540A Unit Level Report)

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CSA GROUP
Laboratory Test Data - UL 9540A

Master Contract: *260091*
Report*: 80147747*
Project: *80147747*

Jul. 11, 2023

Mr Xiaofeng Liu,
Project Manager
BYD Auto Industry Company Limited
No.3001&3007, Hengping Road, Pingshan New District,
Shenzhen, Guangdong 518118
China

Subject: *Li-ion battery system for stationary application, model MC-B466-U-R2M01 (UL 9540A Test Report)*

Dear Mr *Xiaofeng Liu,*

We are pleased to inform you that testing of your product per UL 9540A has been completed. Applicable test(s) was witnessed at CSA partner lab Shanghai Huahui Testing Co.,Ltd, witnessed by CSA GROUP – Kunshan and reviewed by CSA GROUP - Cleveland. Unit level of test(s) 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,

Michael Sw Wang
CSA –*CCIC-CSA International Certification Co., Ltd. Kunshan Branch*
Building 8, Tsinghua Science Park, No. 1666 Zu chongzhi Rd (S) , Kunshan, Jiangsu (215347)

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 - Test Video (Separated file)

CSA GROUP

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

ORIGINAL TEST DATA

The results relate only to the items tested.
This report shall not be reproduced, except in full, without the approval of CSA Group Testing & Certification Inc.

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 1 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Standard(s): ANSI/CAN/UL 9540A:2019 Fourth Edition, Dated November 12, 2019 - Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Testing Laboratory Name:	CCIC-CSA International Certification Co., Ltd. Kunshan Branch
Address:	Building 8, Tsinghua Science Park, No. 1666 Zu chongzhi Rd (S) , Kunshan, Jiangsu (215347)
Testing Program:	**Custom Test** : Cover Latter ☐, Testing Only ☒

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

Testing Laboratory Name:	Shanghai Huahui Testing Co.,Ltd
Address:	No. 158, Changbangcun Road, Fengxian District, Shanghai, China
Facility Qualification Number:	N/A

	As above / or describe otherwise
Customer:	BYD Auto Industry Company Limited
Address:	No.3001&3007, Hengping Road, Pingshan New District, Shenzhen, Guangdong 518118 China

Tested By: Jiaming Huang
Name, Title

Jiaming Huang — 2023-05-24~2023-05-26
Signature — *Date (YYYY-MM-DD)*

☒ **Reviewed by:** Michael Sw Wang(T)/Joseph Zhou
☒ **Witnessed by:**
Name, Title

[redacted] — 2023-05-24~2023-05-26
Signature — *Date (YYYY-MM-DD)*

Version6 : 2022-08-02

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 2 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Cell Level Test Summary	
Name of test laboratory perform cell level testing:	CSA
Unique identification of test report:	CSA Report No. 80147745
Standard and its edition used for testing:	UL 9540A 4th Edition
Manufacturer:	BYD Auto Industry Company Limited
Brand name / Trademark:	BYD
Model number:	CBFAE
Nominal cell voltage, (V)	3.2
Cell capacity, (Ah)	350
Cell chemistry:	LFP
Physical format of cell:	Prismatic
Approximate dimension, (mm)	L*W*T: (961.6±1.0)*(122 ± 0.5)*(27.4±0.5)
Mass, (g)	6.9±0.2Kg
Method used to initiate thermal runaway:	Mica Film Heater
Average temperature at which cell first vented excluding gas collection sample, (°C)	190.275
Average temperature prior to thermal runaway excluding gas collection sample, (°C)	252.375
Flammable gas generation, (Liter)	128.4
Total gas generation, (Liter)	176.2
Lower flammability limit (LFL) at ambient temperature (25 ± 5°C), (%)	5.6
Lower flammability limit (LFL) at average gas vent temperature, (%)	4.8
Burning velocity, (Cm/Sec)	67.3
Maximum pressure P_{max}, (psig)	0.79MPa
Gas composition:	See below

Gas Component	Gas Type	Gas Volume in percentage (%)
Hydrogen	H_2	47.022
Carbon Dioxide	CO_2	27.13
Carbon Monoxide	CO	6.74

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 3 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Cell Level Test Summary		
n-Pentene	$n\text{-}C_5H_{10}$	0.247
n-Pentane	$n\text{-}C_5H_{12}$	0.367
i-Pentane	$i\text{-}C_5H_{12}$	0.026
n-Butene	$n\text{-}C_4H_8$	0.301
n-Butane	$n\text{-}C_4H_{10}$	0.143
i-Butane	$i\text{-}C_4H_{10}$	0.072
Propylene	C_3H_6	2.954
Propane	C_3H_8	0.41
Ethylene	C_2H_4	6.577
Ethane	C_2H_6	1.638
Methane	CH_4	6.373
Total	-	100

Module Level Test Summary	
Name of test laboratory perform module level testing:	CSA Partner Lab
Unique identification of test report:	CSA Project No. 80147742
Standard and its edition used for testing:	UL 1973 3rd Edition
Manufacturer:	BYD Auto Industry Company Limited
Brand name / Trademark:	BYD
Model number:	26S1P battery module
Nominal voltage rating, (V)	83.2
Nominal capacity rating, (Ah)	350
Approximate dimension, (mm)	-
Method used to initiate thermal runaway:	Mica Film Heater
Number of cells used for initiating thermal runaway:	1
Number of cells exhibited thermal runaway within module:	4
Cell to cell propagation condition: (Note: Indicate cell to cell propagation occurred during testing or not)	4

Peak chemical heat release rate, (kW)	-
Flammable gas generation, (Liter)	-
Total gas generation, (Liter)	-
Weight loss, (%)	-
Gas composition:	-
Additional Information:	Considered the special design of the BESS cabinet, module level test was conducted in order to finalize the heater instrument and heating method, no off-gases, HRR and SRR measured all over the test.

Unit Level Test Summary	
Manufacturer:	BYD Auto Industry Company Limited
Brand name / Trademark:	BYD
Model number:	MC-B466-U-R2M01
Nominal voltage rating, (V)	1331
Nominal capacity rating, (Ah)	466kWh
Approximate dimension, (mm)	Same dimension as 20 ft standard container, contains 10 battery cabinet. W*D*H: 1130mm*1203mm*2521mm for each battery cabinet
BESS test configuration/intended installation:	Outdoor ground mounted non-residential BESS
Unit certification available?, (Yes/No)	Yes, CSA Project No. 80147742
Standard(s) used to certify product:	UL 1973 3rd Edition
Certification organization name and its certificate number:	CSA Project No. 80147742
Electrical configuration of module in BESS:	1P16S

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 5 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Unit Level Test Summary	
Number of modules in BESS:	16
Fire detection and suppression system integral part of BESS: (Yes/No)	Yes, smoke detector, heat detector and combustible gases detector equipped in the battery cabinet.
Test conducted with fire detection and suppression system: (Yes/No/Not Applicable)	Yes, test conducted with fire detection.
Method used to initiate thermal runaway:	Mica Film Heater
Number of cells used for initiating thermal runaway:	1
Number of cells exhibited thermal runaway within initiating module:	5
Number of modules exhibited thermal runaway within initiating BESS:	1
Cell to cell propagation condition:	Yes
Peak chemical heat release rate, (kW)	N/A
Peak convective heat release Rate, (kw)	N/A
Flammable gas generation, (Liter)	N/A
Total gas generation, (Liter)	N/A
Gas composition: (e.g., CO (10%), Co_2 (15%), H_2 (15%))	N/A
Maximum wall surface temperature, (°C)	27.9
Maximum target BESS temperature, (°C)	35.4
(If applicable) Maximum ceiling or soffit surface temperatures, (°C)	N/A
Maximum incident heat flux on target wall surfaces, (kw/m^2)	0
Maximum incident heat flux on target BESS, (kw/m^2)	0
Maximum incident heat flux of egress path, (kw/m^2)	0
(If applicable) Maximum incident heat flux on target ceiling or soffit surfaces, (kw/m^2)	N/A
Total smoke release, (m^2)	N/A
Peak smoke release rate, (m^2/s)	N/A
Additional Information:	N/A

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 6 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Performance Unit Level Test (Non – Residential Outdoor Ground Mounted)		
Requirement	**Comments**	**Verdict**
If flaming outside of the unit is observed, separation distances to exposures shall be determined by greatest flame extension observed during test.	No flaming observed	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	Module surface temperature within target BESS did not exceed the cell venting temperature.	P
For BESS units intended for installation in locations with combustible constructions, surface temperature measurements on wall surfaces do not exceed 97°C (175°F) of temperature rise above ambient	Max wall surface temperature measured: 27.9°C	P
Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases	Explosion hazards including deflagration, detonation or accumulation were not observed.	P
Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m^2	Max measured heat flux in the center of the accessible means of egress: 0 kW/m^2	P
Summary of Result: A unit level test met the applicable performance criteria noted above from section 9.8 of UL 9540A 4th Edition is considered compliant.		

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)

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 7 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

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)	Yes, CSA Project No. 80147742	---
	Standard(s) used to certify product:	UL 1973, 3rd Edition	---
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: 1130*1203*2521mm for each battery cabinet(unit)	---
	BESS/Battery system enclosure material:	Metal enclosure	---
	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.	See Attachment 3 for details	
	BESS test configuration:	Outdoor ground mounted non-residential BESS	---

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 8 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Clause	Requirement + Test	Result - Remark	Verdict
9.1.2	Unit level test was conducted in which internal fire condition created as per module level test.	Module rehearsal result was provided for testing.	P
	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.	Outdoor ground mounted non-residential BESS	---
	Separation distances between initiating and target units were representative of the installation.	See Attachment 3 for details	P
	Testing conducted outdoor for BESS intended for outdoor installation only. Following controls and environmental conditions were in place.	See below	P
	a) Wind screens were utilized with a maximum wind speed maintained at ≤ 12 mph	2.46 mph	P
	b) Temperature range was within 10°C to 40°C	See Table 3 for details	P
	c) The humidity was < 90% RH	See Table 3 for details	P
	d) There was sufficient light to observe the testing;	Confirmed	P
	e) There was no precipitation during the testing;	Confirmed	P
	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	Confirmed, refer to Figure 11 for details	P
	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.	Test conducted under smoke duct indoor with the room door closed to prevent inadvertent access.	P
9.1.2.1	For a container system BESS including those intended for outdoor installation only, the unit level test performed in accordance with the indoor floor mounted unit level test using the battery system racks as the test units and with the test installation set up in accordance with the installation layout within the container.	Not a container system BESS	N/A

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 9 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Clause	Requirement + Test	Result - Remark	Verdict
9.1.3	Based on configuration and design of BESS, test conducted on:	☐ BESS ☒ Battery system	---
9.1.4	Initiating BESS unit contain components representative of a BESS unit in a complete installation.	See Attachment 3 for details	P
	Combustible components that interconnect the initiating and target BESS units were included.	Confirmed, intended interconnection between initiating BESS and target BESS unit were considered when testing.	P
9.1.5	Target BESS units include the outer cabinet (if part of the design), racking, module enclosures, and components that retain cells components.	Target BESS unit includes only empty cabinet enclosure.	P
	The target BESS unit module enclosures did not contain cells.	Module designed without enclosure.	N/A
9.1.6	Initiating BESS unit was at the maximum operating state of charge (MOSOC).	See Table 2 for details	P
	After charging and prior to testing, the initiating BESS was rested for a maximum period of 8 h at room ambient.	Confirmed	P
9.1.7	BESS unit test conducted as per following condition.	No fire suppression system designed integrated inside the BESS cabinet(unit)	N/A
	a) Integral fire suppression system provided with the DUT.	See above	N/A
	b) Without Integral fire suppression system.	See above	N/A
9.1.8	Electronic and software control were not relied upon for this testing.	Smoke detection system was remained when conducting the test	P
	BESS unit test conducted with Integral fire suppression system meet UL 840 and considered reliable for this testing.	No fire suppression system for the DUT	N/A
9.2	**Test method – Indoor floor mounted BESS units**	---	---
9.2.1	Test room environment was controlled to prevent drafts that may affect test results.	Outdoor grounded mounted non-residential BESS	N/A
	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).	See above	N/A
	Ambient temperature range during test, °C	See above	N/A
9.2.2	Any access door(s) or panels were closed, latched and locked at the beginning and duration of the test.	Confirmed	P

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 10 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Clause	Requirement + Test	Result - Remark	Verdict
9.2.3	The initiating BESS unit was positioned adjacent to two instrumented wall sections.	See Attachment 3 for details	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 3.66 m (12 ft) in height above the bottom surface of the unit.	Confirmed	P
9.2.6	The surface of the instrumented wall sections was covered with 16-mm (5/8-in) gypsum wall board and painted flat black.	Confirmed	P
9.2.7	The initiating BESS unit was centered underneath an appropriately sized smoke collection hood of an oxygen consumption calorimeter.	Confirmed	P
9.2.8	The light transmission in the calorimeter's exhaust duct was measured.	Not apply for outdoor only installation	N/A
	White light source and photo detector was used for the duration of the test.	See above	N/A
	Smoke release rate was calculated as per following formula. $SRR = 2.303\left(\frac{V}{D}\right)Log_{10}\left(\frac{I_o}{I}\right)$	See above	N/A
9.2.9	The chemical and convective heat release rates were measured for the duration of the test.	Not apply for outdoor only installation	N/A
	Chemical heat release rate was calculated as per following formula. $HRR_1 = \left[E \times \varphi - (E_{co} - E) \times \frac{1-\varphi}{2} \times \frac{X_{co}}{X_{O_2}}\right] \times \frac{\dot{m}_e}{1+\varphi \times (\alpha - 1)} \times \frac{M_{O_2}}{M_a} \times (1 - X^o_{H_2O}) \times X^o_{O_2}$	See above	N/A
9.2.10	The heat release rate measurement system shall be calibrated using an atomized heptane diffusion burner.	Not apply for outdoor only installation	N/A
9.2.11	The convective heat release rate was measured during test.	Not apply for outdoor only installation	N/A
	Thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust	See above	N/A

Clause	Requirement + Test	Result - Remark	Verdict
	system of the exhaust duct were used for measurement.		
9.2.12	Convective heat release rate was calculated as per following formula. $HRR_c = V_e A \frac{353.22}{T_e} \int_{T_o}^{T} C_p dT$	See above	N/A
9.2.13	Physical spacing between BESS units (both initiating and target) and adjacent walls were representative of the intended installation.	See Attachment 3 for details	P
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 Attachment 3 for details	P
	b) Adjacent BESS units.	See Attachment 3 for details	P
9.2.15	Wall surface temperature measurements was collected for BESS intended for installation in locations with combustible construction.	Outdoor ground mounted, no combustible materials near the BESS, wall surface temperature measured for reference only.	N/A
9.2.16	Wall surface temperatures was measured in vertical array(s) at 152-mm (6-in) intervals for the full height of the instrumented wall sections.	See above	N/A
	No. 24-gauge or smaller, Type-K exposed junction thermocouples were used for measurement.	See above	N/A
	The thermocouples were placed horizontally positioned in the wall locations anticipated to receive the greatest thermal exposure.	See above	N/A
	Temperatures was measured continuously, averaging over every 60 second interval.	See above	N/A
	The maximum of these averages was documented for each thermocouple location.	See above	N/A
9.2.17	Thermocouples were secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires.	Outdoor ground mounted, no combustible materials near the BESS, wall surface temperature measured for reference only.	N/A
	The thermocouple tip was depressed into the gypsum so as to be flush with the gypsum surface at the point of	See above	N/A

Master Contract:	260091	Model:	MC-B466-U-R2M01	Page number 12 of 52
Project / Network:	80147747	Description:	Li-ion battery system for stationary application	

Clause	Requirement + Test	Result - Remark	Verdict
	measurement and held in thermal contact with the surface at that point by the use of pressure-sensitive paper tape.		
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 instrumented wall.	See Figure 35 in Attachment 3.	P
	a) Both were collinear with the vertical thermocouple array.	Refer to HFG3 and HFG4 measured for reference only.	P
	b) One was positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module	See above	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.	See above	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
9.2.18.1	Heat flux measurements on walls were waived for residential units that are tested with the cheesecloth indicator.	Non-residential BESS	N/A
9.2.18.2	With reference to 9.2.18, if b) and c) were deemed to be at the same location, only one gauge was installed on the wall for the measurement.	Refer to HFG3 and HFG4 measured for reference only	P
9.2.19	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:	Refer to Figure 35 and 37 in Attachment 3 for details.	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	See HFG5 in Figure 35 and 37.	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.	See HFG6 in Figure 35 and 37.	P
	Heat flux was measured continuously, averaging over every 60 second interval.	Confirmed	P

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Clause	Requirement + Test	Result - Remark	Verdict
	The maximum of these averages was documented for each gauge location.	Confirmed	P
9.2.19.1	Heat flux measurements on target units were waived for residential units that are tested with the cheesecloth indicator.	Non-residential BESS	N/A
9.2.19.2	With reference to 9.2.19, if a) and b) were deemed to be at the same location, only one gauge was installed on the target unit for the measurement.	Refer to HFG5 and HFG6 measured for reference only.	P
9.2.20	For non-residential use BESS, heat flux was measured with the sensing element of at least one water-cooled Schmidt-Boelter or Gardon gauge positioned at one for the following location.	Confirmed	P
	a. At the mid height of the initiating unit in the center of the accessible means of egress.	See Figure 35 in Attachment 3 for details.	P
	b. At the point where the majority of off-gas venting was expected from the initiating unit in the center of the accessible means of egress.	See Figure 35 in Attachment 3 for details.	P
9.2.21	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 initiating module.	Confirmed	P
	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.	Module designed without enclosure. Temperature on the cell surface of non-initiating module were monitored as instead.	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
9.2.22	For residential use BESS, the DUT was covered with a single layer of cheese cloth ignition indicator.	Non-residential application	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	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 application	N/A
9.2.23	An internal fire condition in accordance with the module level test was created within a single module in the initiating BESS unit.	Test conducted follow the module level rehearsal results.	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;	Test conducted follow the module level rehearsal results. See Figure 34, module 7 from the bottom of the unit was used as initiating module.	P
	b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module was same as that used to initiate and propagate thermal runaway within the module level test.	Confirmed, test conducted follow the module level rehearsal results. See Figure 38 for the heater and TC location inside the module.	P
9.2.24	The composition, velocity and temperature of the initiating BESS unit vent gases was measured within the calorimeter's exhaust duct.	Outdoor ground mounted BESS.	N/A
	The hydrocarbon content of the vent gas was measured using flame ionization detection.	See above	N/A
	Hydrogen gas was measured with a palladium-nickel thin-film solid state sensor.	See above	N/A
	Composition, velocity and temperature instrumentation were collocated with heat release rate calorimetry instrumentation.	See above	N/A
9.2.25	The hydrocarbon content of the vent gas was additionally measured 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.	Outdoor ground mounted BESS.	N/A
9.2.26	The test was terminated at:	See below	P
	a) Temperatures measured inside each module within the initiating BESS unit return to ambient temperature;	Test terminated with temperature measured return to ambient.	P
	b) The fire propagates to adjacent units or to adjacent walls; or	See above	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	c) A condition hazardous to test staff or the test facility requires mitigation.	See above	N/A
9.2.27	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 BESS.	N/A
9.3	**Test method – Outdoor ground mounted units**	See below	P
9.3.1	Test method described in Section 9.2 was used for non-residential use BESS testing.	Confirmed	P
	Smoke release rate, convective and chemical heat release rate and content, velocity and temperature of the released vent gases were not measured for outdoor ground mounted installation only.	Confirmed	P
9.3.2	Test method described in Section 9.2 except noted in 9.3.3 and 9.3.4 was used for residential use BESS testing.	Non-residential BESS.	N/A
	Heat flux measurements for the accessible means of egress was measured in accordance with 9.2.20.	See Figure 35 for details.	P
	The heat flux measurement for the accessible means of egress was waived for outdoor ground mounted residential use BESS because the BESS was draped with cheesecloth.	Non-residential BESS.	N/A
	Smoke release rate, convective and chemical heat release rate and content, velocity and temperature of the released vent gases were not measured for outdoor ground mounted installation only.	Confirmed	P
9.3.3	Test samples was installed in proximity to an instrumented wall section that was 3.66-m (12-ft) tall with a 0.3-m (1-ft) wide horizontal soffit.	Outdoor ground mounted non-residential BESS.	N/A
	The sample was mounted on a support substrate and spaced from the wall in accordance with the minimum separation distances specified by the manufacturer.	See above	N/A
	The wall and soffit were constructed	See above	N/A

Clause	Requirement + Test	Result - Remark	Verdict
	with 19.05-mm (3/4-in) plywood installed on wood studs and painted flat black.		
	The instrumented wall was extended not less than 0.49-m (1.6-ft) horizontally beyond the exterior of the target BESS units.	See above	N/A
	The No. 24-gauge or smaller, Type-K exposed junction thermocouple array on the walls were extended to the surface of the soffit	See above	N/A
	Manufacturer requires installation against non-flammable material, the test setup included with manufacturer recommended backing material between the unit and plywood wall.	See above	N/A
9.3.4	Target BESS were installed on each side of the initiating BESS in accordance with the manufacturer's installation specifications.	See Figure 35 for details.	P
	The physical spacing between BESS units (both initiating and target) were the minimum separation distances specified by the manufacturer.	See Figure 35 for details.	P
9.4	**Test Method – Indoor wall mounted units**	Outdoor ground mounted non-residential BESS.	N/A
9.4.1	Test method described in Section 9.2 except as modified in this section was used for indoor wall mounted BESS.	See above	N/A
9.4.2	The test was conducted in a standard NFPA 286 fire test room, 3.66 × 2.44 × 2.44-m (12 × 8 × 8-ft) high, with a 0.76 × 2.13-m (2-1/2 × 7-ft) high opening.	See above	N/A
	The room was constructed with 16-mm (5/8-in) gypsum wall board installed on wood studs and painted flat black.	See above	N/A
9.4.2.1	BESS intended for residential installations only was tested using, instrumented wall sections not less than 2.44 m (8 ft) in height and width instead of the test room of 9.4.2.	See above	N/A
9.4.3	The initiating BESS unit was positioned on the wall opposite of the door opening, with the center located 1.22-m (4-ft) above the floor, and halfway between adjacent walls.	See above	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.4.3.1	When residential BESS was tested in accordance with 9.4.2.1, the initiating BESS unit was positioned with the center located 1.22-m (4-ft) above the floor, and halfway between adjacent walls.	See above	N/A
9.4.4	Target BESS was installed on the wall on each side of the initiating BESS, at the same height above the floor as the initiating BESS.	See above	N/A
	The physical spacing between BESS units (both initiating and target) was the minimum separation distances specified by the manufacturer.	See above	N/A
9.4.5	The wall on which the initiating and target BESS units are mounted were instrumented.	See above	N/A
9.4.6	The gas collection methods was in accordance with 9.2	See above	N/A
	For residential use systems, the gas collection data gathered were compared to the smallest room installation specified by the manufacturer to determine if the flammable gas collected exceeds 25% LFL in air.	See above	N/A
9.4.7	For residential use BESS, the DUT was covered with a single layer of cheese cloth ignition indicator.	See above	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.	See above	N/A
9.4.8	BESS for residential only installations, the criteria in 9.2.9. 9.2.18 and 9.2.19 were waived.	See above	N/A
9.5	**Test Method – Outdoor wall mounted units**	Outdoor ground mounted non-residential BESS.	N/A
9.5.1	Test method described in Section 9.2 except as modified in this section was used for outdoor wall mounted BESS.	See above	N/A
	Smoke release rate, convective and chemical heat release rate and content, velocity and temperature of the released vent gases were not measured for outdoor wall mounted installation only.	See above	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.5.2	Test samples was mounted on an instrumented wall section that is 3.66-m (12-ft) tall with a 0.3-m (1-ft) wide horizontal soffit.	See above	N/A
	The wall and soffit were constructed with 19.05-mm (3/4-in) plywood installed on wood studs and painted flat black	See above	N/A
	The No. 24-gauge or smaller, Type-K exposed junction thermocouple array on the walls were extended to the surface of the soffit.	See above	N/A
9.5.3	The initiating BESS unit was positioned on the instrumented wall, with its center located 1.22-m (4-ft) above the floor, and halfway between wall edges.	See above	N/A
9.5.4	Target BESS was installed on the wall on each side of the initiating BESS, at the same height above the floor as the initiating BESS.	See above	N/A
	The physical spacing between BESS units (both initiating and target) were the minimum separation distances specified by the manufacturer.	See above	N/A
9.5.5	The wall on which the initiating and target BESS units are mounted were instrument.	See above	N/A
9.5.6	For residential use BESS, the DUT was covered with a single layer of cheese cloth ignition indicator.	See above	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.	See above	N/A
9.6	**Rooftop and open garage installations**	Outdoor ground mounted non-residential BESS.	N/A
9.6.1	Test method described in Section 9.2 was used for non-residential use rooftop or open garage installations.	See above	N/A
9.6.2	Smoke release rate, convective and chemical heat release rate and content, velocity and temperature of the released vent gases were not measured for rooftop and open garage use only.	See above	N/A
9.7	**Unit level test report**	See below	P

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Clause	Requirement + Test	Result - Remark	Verdict
9.7.1	Type of installation considered during unit level testing:	Outdoor ground mounted non-residential BESS.	P
9.7.2	Additional installation represented by type of installation considered during unit level testing:	-	N/A
9.7.3	Unit level report include following information.	See below	P
	a) Unit manufacturer name and model number (and whether UL 9540 compliant);	BYD Auto Industry Company Limited Battery System (Cabinet) model MC-B466-U-R2M01	P
	b) Number of modules in the initiating BESS unit;	16	P
	c) The construction of the initiating BESS unit per 5.3;	The BESS unit consists of 16 battery modules,1 BMS control box, and one liquid cooled air conditioning system (HVAC model: LCI-80CR-05C4NZ3-3407CU; piping material: AL3003 H112, Size: 911*906.1*117.2mm, liquor condensate: 50% glycol solution) near the cell. Battery modules were connected in series, each battery module was designed with a cell configuration 26S1P, total 416 battery cells. - Electrical configuration of the module in BESS unit: 16S-1P -Physical layout of the modules in BESS: see Figure 34 in Attachment 3 -Battery management system(BMS): Model BMS-C240-U-R2M01 -Other major components of BESS unit: -Fire Detection System: see components in item d. -Suction fan: model JE12038B24-(0.3)46 Unit level test was conducted with the setup indicated in Figure 35, attachment 3. One battery system unit(cabinet) fully populated with battery modules for	P

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Clause	Requirement + Test	Result - Remark	Verdict
		initiating BESS unit, 5 additional BESS cabinets without battery cell and BMS control box were used as target BESS units.	
	d) Fire protection features / detection / suppression systems within unit;	Fire detection system integrated inside the BESS unit was used when testing: Butterfly Valve: 1 provided, located on the door of the cabinet at the bottom for air inlet. Anti-explosion Valve: model VE-P480-00-KS1 Anti-explosion window: model 305*610mm, material: SST 304L. Smoke Detector: 1 provided at the top of inner cabinet enclosure, model JTY-GM-SIGA-OSD. Heat Detector:1 provided, model JTW-ZOM-SIGA-HRD Combustible gas detector:1 provided, model Sensepoint XCL	P
	e) Module voltage(s) corresponding to the tested SOC;	See Table 1 and Attachment 1	P
	f) The thermal runaway initiation method used;	Mica film heater, see Figure 35 in Attachment 3	P
	g) Location of the initiating module within the BESS unit;	See Figure 34 in Attachment 3.	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 Figure 35 in Attachment 3.	P
	i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension;	Not observed.	P
	j) Chemical and convective heat release rate versus time data;	Not applicable for outdoor ground mounted non-residential use BESS.	N/A
	k) Separation distances from the initiating BESS unit to target walls;	See Figure 35 in Attachment 3.	P
	l) Separation distances from the initiating BESS unit to target BESS units;	See Figure 35 in Attachment 3.	P
	m) The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple;	See Attachment 4 for details.	P
	n) The maximum ceiling or soffit surface temperatures achieved during the indoor	Not applicable for outdoor ground mounted non-residential use BESS.	N/A

Clause	Requirement + Test	Result - Remark	Verdict
	or outdoor wall mounted test and the location of the measuring thermocouple;		
	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 for outdoor ground mounted non-residential use BESS.	N/A
	q) Gas generation and composition data;	Not applicable for outdoor ground mounted non-residential use BESS.	N/A
	r) Peak smoke release rate and total smoke release data;	Not applicable for outdoor ground mounted non-residential use BESS.	N/A
	s) Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred;	Fire detection system was integrated and activated during testing.	P
	t) Observation of flying debris or explosive discharge of gases;	See Table 5 for details.	P
	u) Observation of re-ignition(s) from thermal runaway events;	See Table 5 for details.	P
	v) Observation(s) of sparks, electrical arcs, or other electrical events;	See Table 5 for details.	P
	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 10 for details.	P

Table 1 – Unit charge/discharge specification			
Charging method	CP	Discharging method	CP
Charge current, (Adc)	224kW	Discharge current, (Adc)	224kW
Charge voltage, (Vdc)	1497.6	---	---
Charge end current, (Adc)	-	Discharge end voltage, (Vdc)	1081.6
Manufacturer recommended charge temperature, (°C)	N/A	Manufacturer recommended discharge temperature, (°C)	N/A

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)
MC-B466-U-R2M01	2023-05-25	9:16 AM	2023-05-25	16:50 PM
Ambient temperature during unit conditioning				
Ambient Lab Temperature, (°C)		Relative Humidity, (%RH)		
23 to 25		27 to 50		

Table 3 – Unit level test	
Sample Number:	MC-B466-U-R2M01
Ambient temperature at start of test, (°C)	24.4
Ambient temperature range during test, (°C)	23 to 25
Relative humidity, (%RH)	29
Number of cells used for initiating thermal runaway:	1
Open circuit voltage before test, (Vdc)	173.6 (Module 7&8)
External film heater ramp rate, (°C/min)	5.5
Other method used to initiate thermal runaway:	N/A
Location of cell and module for initiating thermal runaway:	See Figure 34 and Figure 38 in Attachment 3.
Number of cells exhibited thermal runaway within initiating module:	5
Number of modules exhibited thermal runaway within initiating BESS:	1
Location of cell and module exhibited thermal runaway within initiating BESS:	Cell 10~14 in initiating module(module #7). See Figure 14~23 in Attachment 2 and Figure 38 in Attachment 3.
Cell to cell propagation condition:	Yes, cell to cell propagation occurred. See Figure 14~23 in Attachment 2
Peak chemical heat release rate, (kW)	Not applicable for outdoor ground mounted non-residential BESS application.

Table 3 – Unit level test	
Peak convective heat release rate, (kW)	Not applicable for outdoor ground mounted non-residential BESS application.
Flammable gas generation, (Liter)	Not applicable for outdoor ground mounted non-residential BESS application.
Total gas generation, (Liter)	Not applicable for outdoor ground mounted non-residential BESS application.
Peak smoke release rate, (m^2/sec)	Not applicable for outdoor ground mounted non-residential BESS application.
Total smoke release rate, (m^2)	Not applicable for outdoor ground mounted non-residential BESS application.

Table 4 – Gas composition			
Gas Component		**Volume Released (Before Flaming) (Liter)**	**Volume Released (After Flaming) (Liter)**
N/A	N/A	N/A	N/A

Table 5 – Critical observation	
Condition	**Comment**
Any flaming outside the initiating BESS enclosure and the maximum flame extension:	No flaming 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 (specify event)	Not observed
Damage to the initiating BESS unit	Not observed
Damage to target BESS units;	Not observed
Damage to adjacent walls	Not observed
Damage to ceilings	Outdoor ground mounted application, N/A
Damage to soffits	Outdoor ground mounted application, N/A

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Attachments

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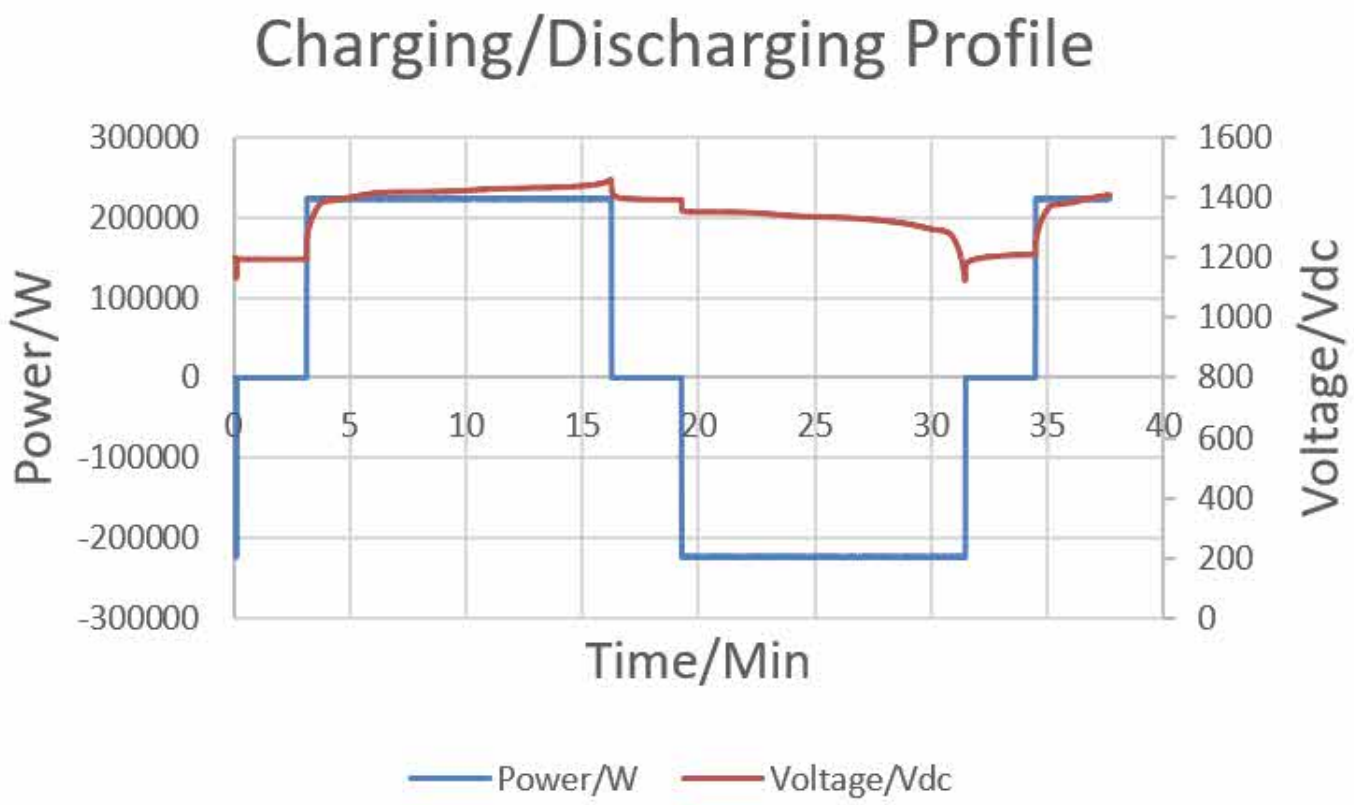
Attachment 1 - Unit charge/discharge conditioning graphs



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Attachment 2 – Photos

General sample photos

Figure 1: BESS unit front view

Figure 2: BESS unit cabinet internal view

Figure 3: BESS unit internal view(Front)

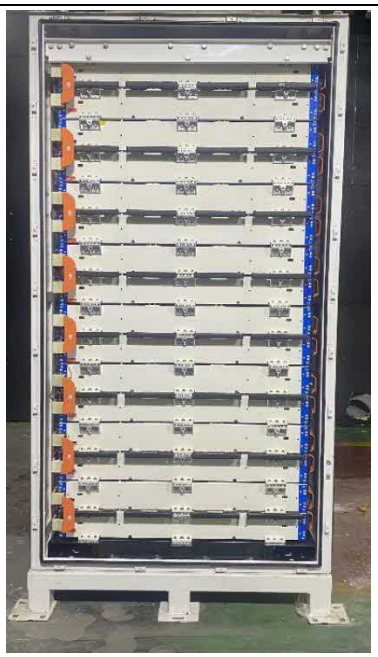

Figure 4: BESS unit internal view(Back)

Attachment 2 – Photos

Photos with heater and thermocouple installation

Figure 5: Unit Level Test Setup(Front)

Figure 6: Unit Level Test Setup(Back)

Figure 7: Initiating BESS Internal Instrument

Figure 8: Initiating BESS Cabinet Instrument

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Attachment 2 – Photos

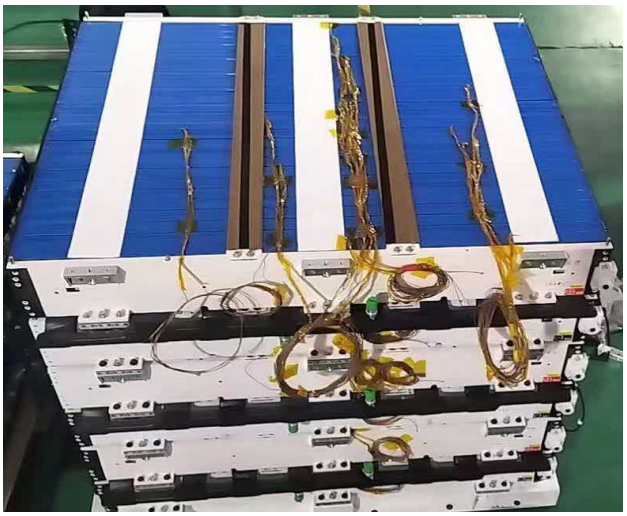

Figure 9: Initiating Module Instrument

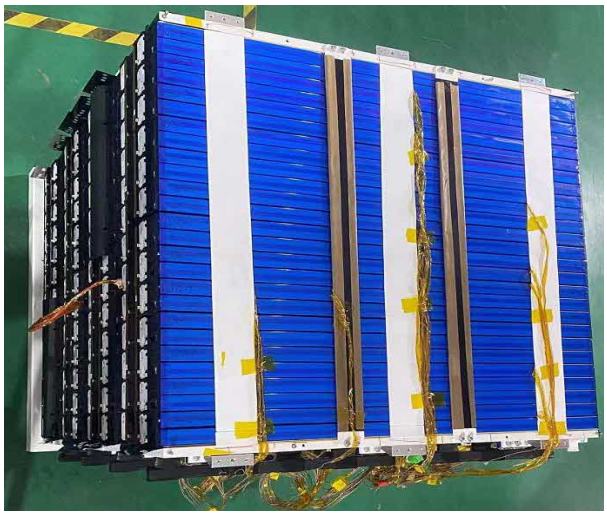

Figure 10: Adjacent Module Instrument

Photos during test in progress

Figure 11: At test start (Time at 16:50)

Figure 12: During cell venting (Time at 17:20)

Figure 13: Ventilation valve (inlet) and window unfolded (Time at 17:39)

Figure 14: During thermal runaway (Time at 17:41)

Attachment 2 – Photos

Figure 15: 2nd cell venting (Time at 17:47)

Figure 16: 3rd cell venting (Time at 17:49)

Figure 17: Heating restart (Time at 17:53)

Figure 18: 2nd cell thermal runaway (Time at 18:17)

Figure 19: 3rd thermal runaway (Time at 18:25)

Figure 20: 4th cell venting (Time at 18:31)

Attachment 2 – Photos

Figure 21: 5th cell venting (Time at 18:32)

Figure 22: 4th thermal runaway (Time at 19:10)

Figure 23: 5th thermal runaway (Time at 19:18)

Figure 24: Test end (Time at 20:59)

Photos after test

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Attachment 2 – Photos

Figure 25: BESS unit after test(Front)

Figure 26: BESS unit after test(Front)

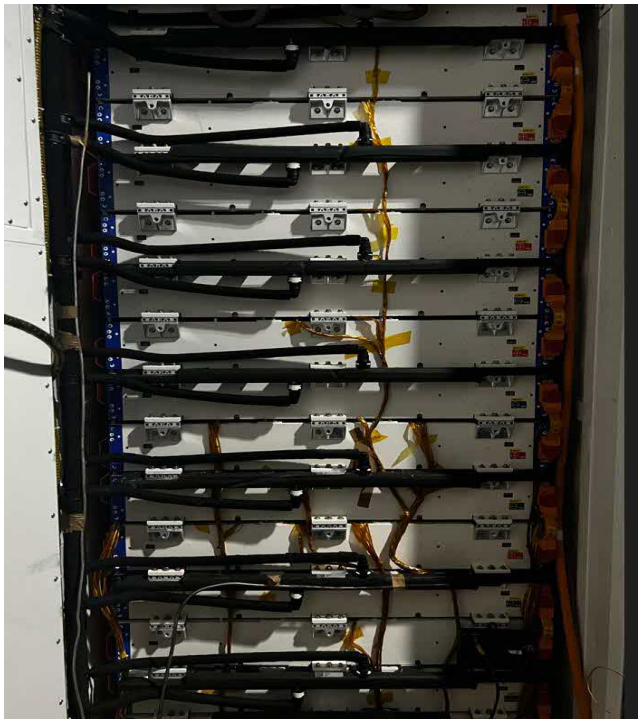

Figure 27: Internal view of initiating BESS unit

Figure 28: Internal view of initiating BESS unit

Attachment 2 – Photos

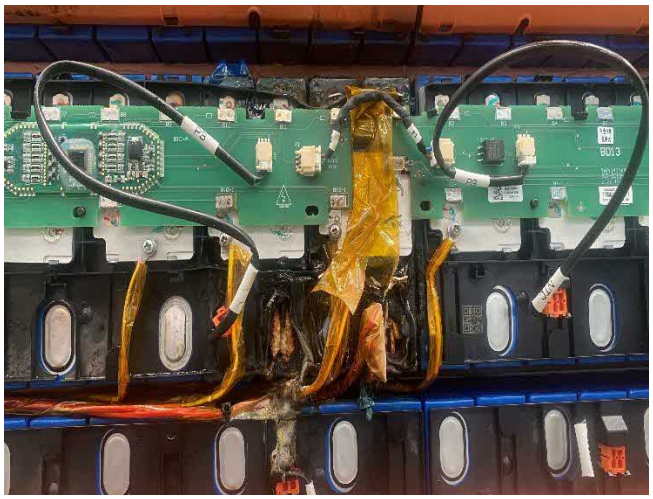

Figure 29: Internal view of initiating BESS unit

Figure 30: Internal view of initiating BESS unit

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Attachment 3 - Diagram and dimension of test setup

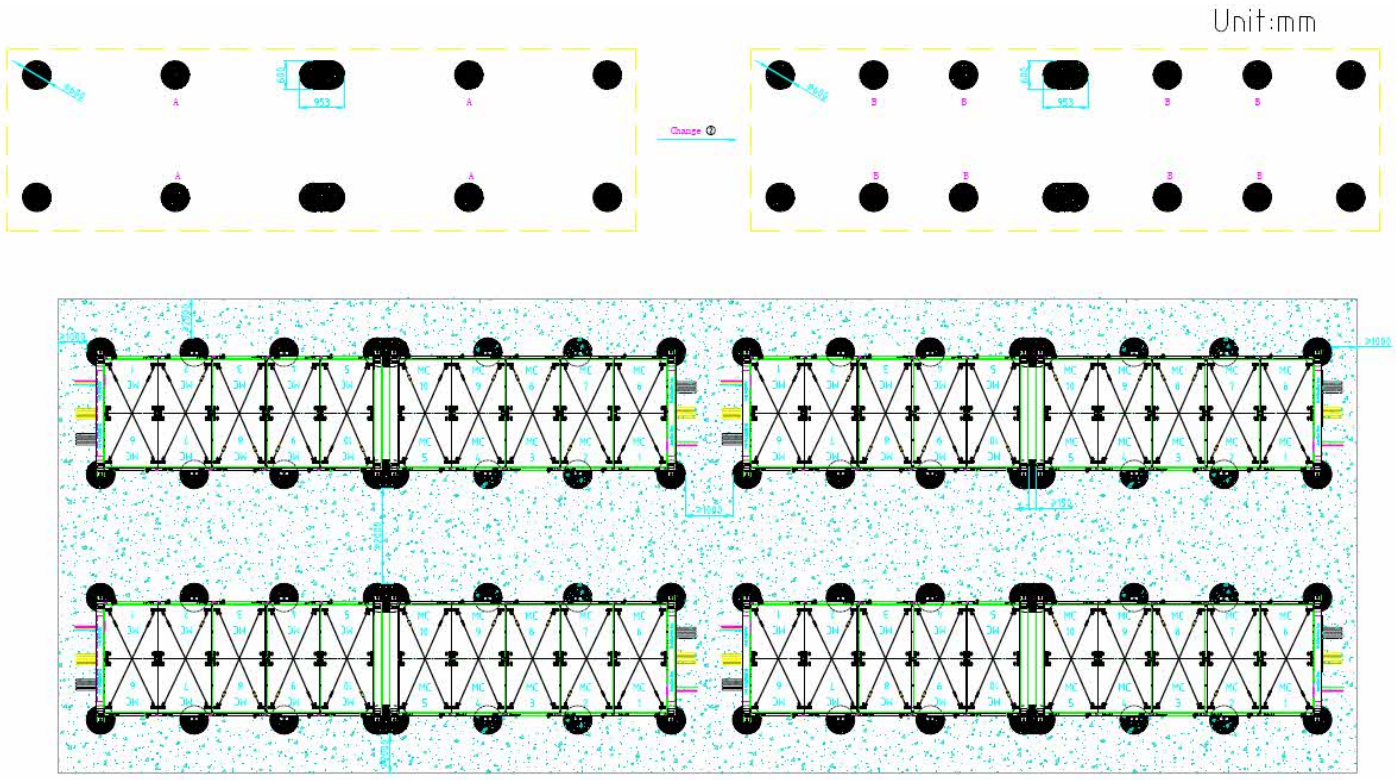

Figure 31. Overall Installation Layout for MC10C-B4659-U-R2M01

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Attachment 3 - Diagram and dimension of test setup

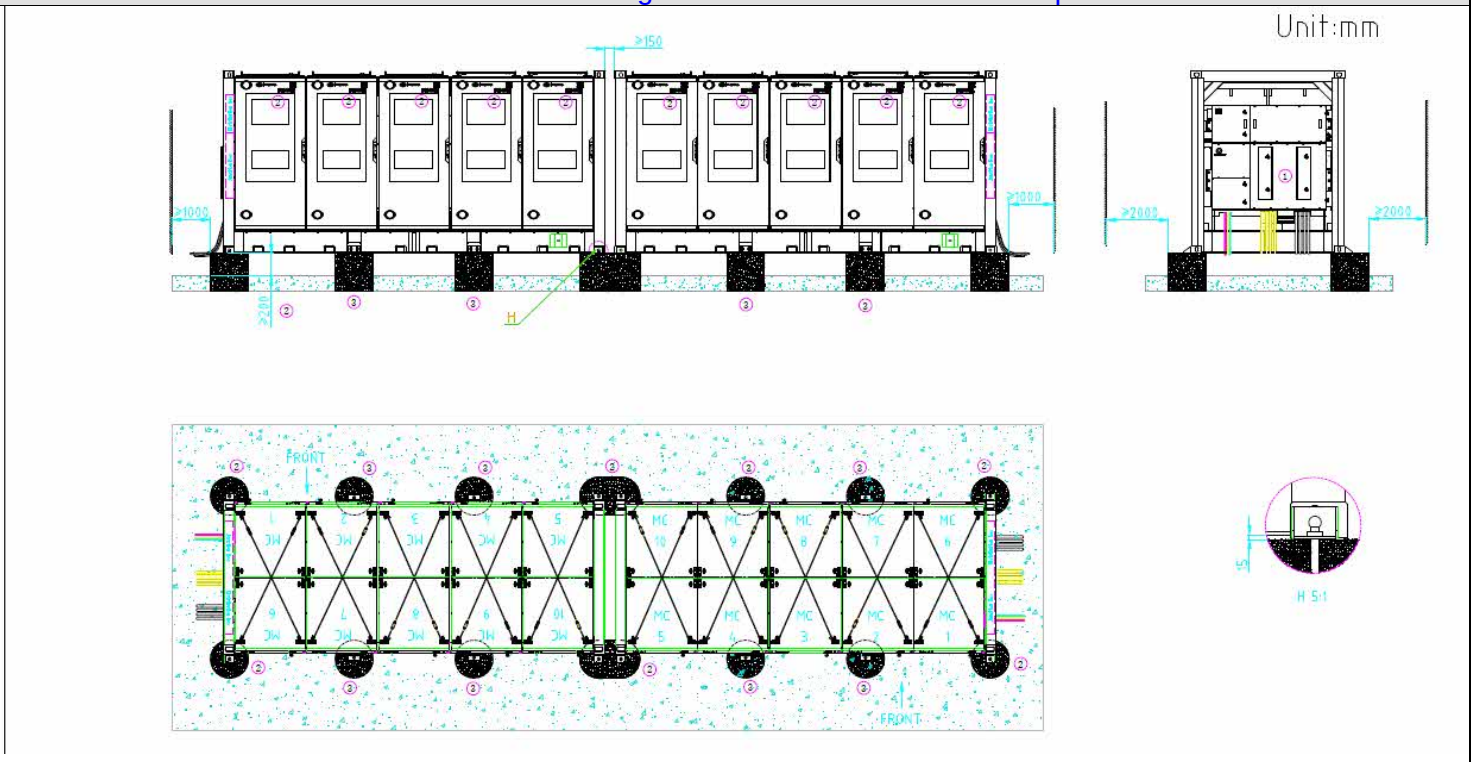

Figure 32. BESS Enclosure Clearance

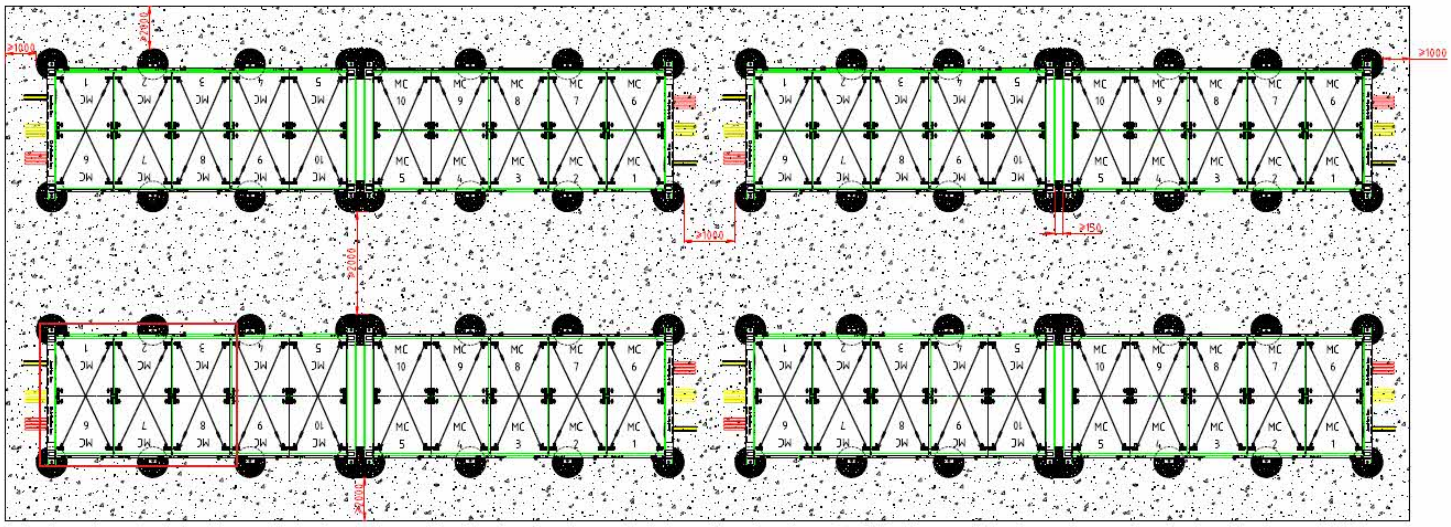

Figure 33. Portion Selected for Testing(Red Area)

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Attachment 3 - Diagram and dimension of test setup

Figure 34. Initiating module location inside MC Cube

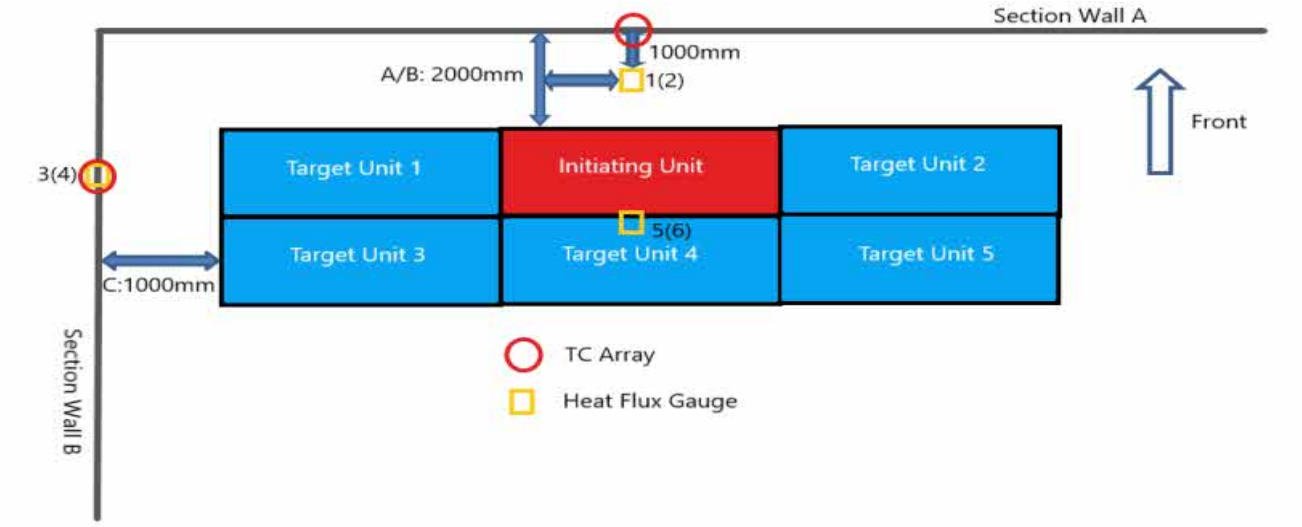

Figure 35. Unit Level Test Setup

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Attachment 3 - Diagram and dimension of test setup

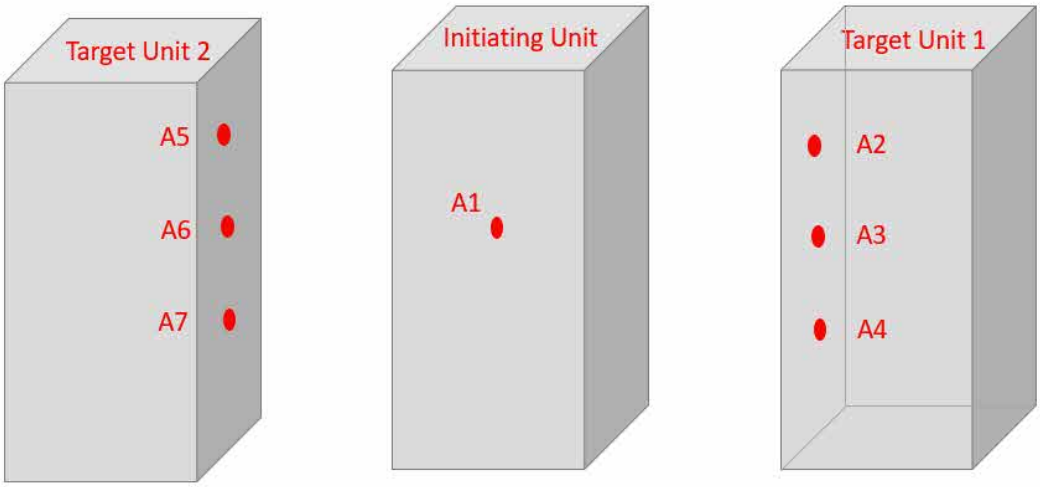

Figure 36. Thermal Couple Location for BESS unit(Front View)

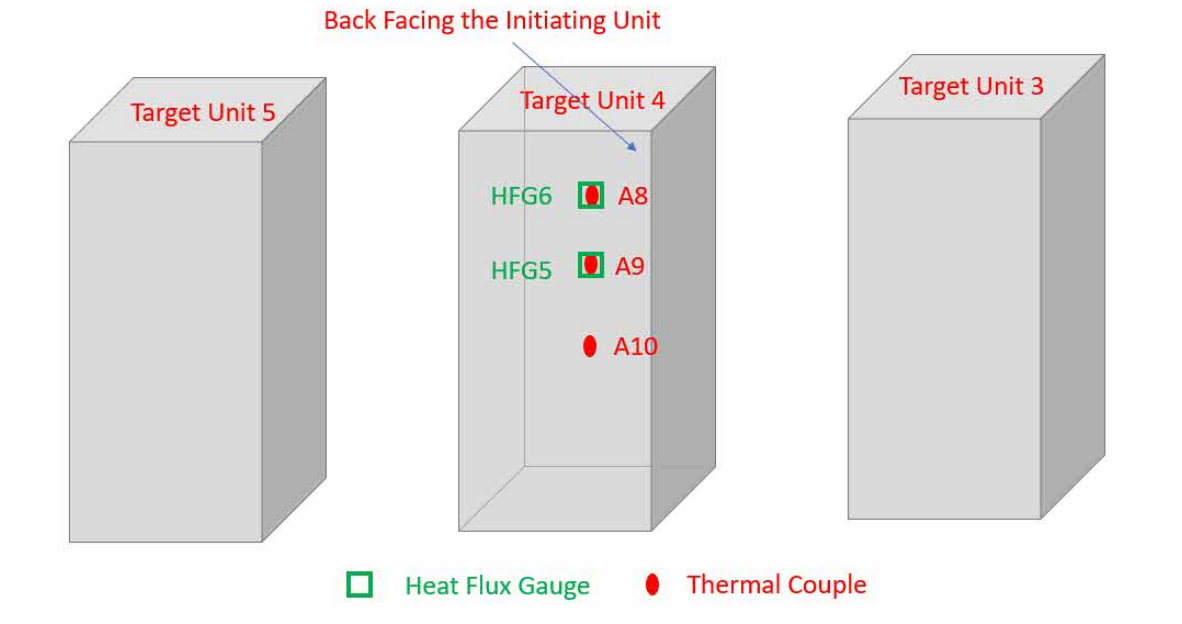

Figure 37. Thermal Couple Location for Target BESS unit(Back View)

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Attachment 3 - Diagram and dimension of test setup

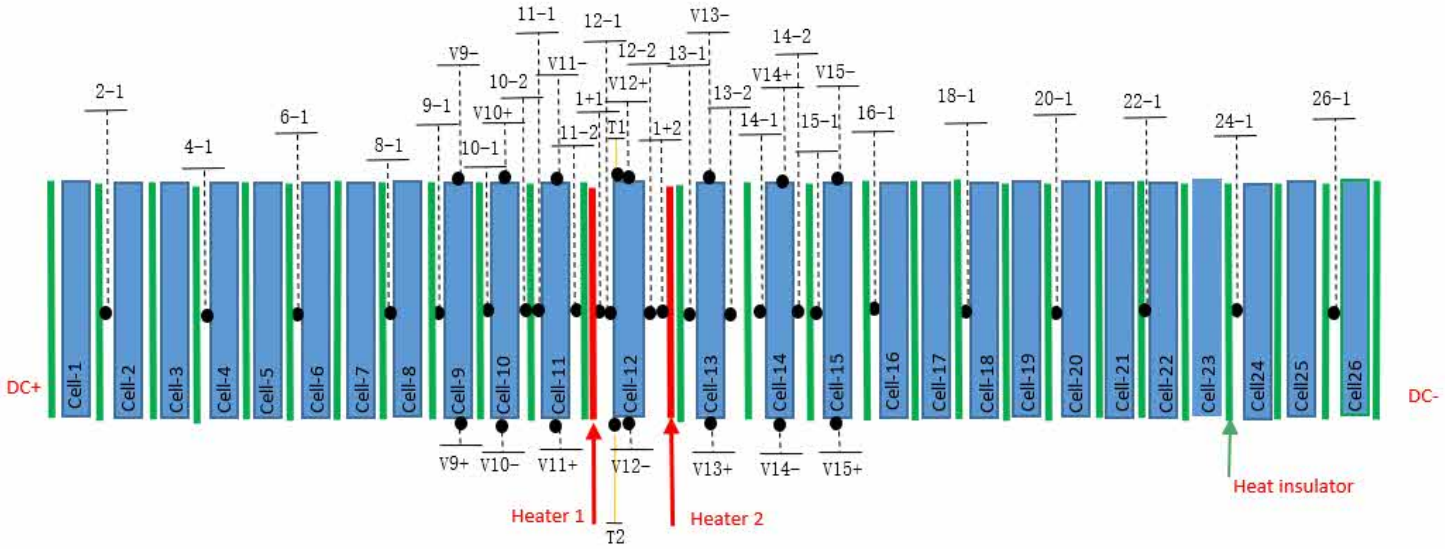

Figure 38 Heater and TC wire instrument inside the initiating battery module(module 7)

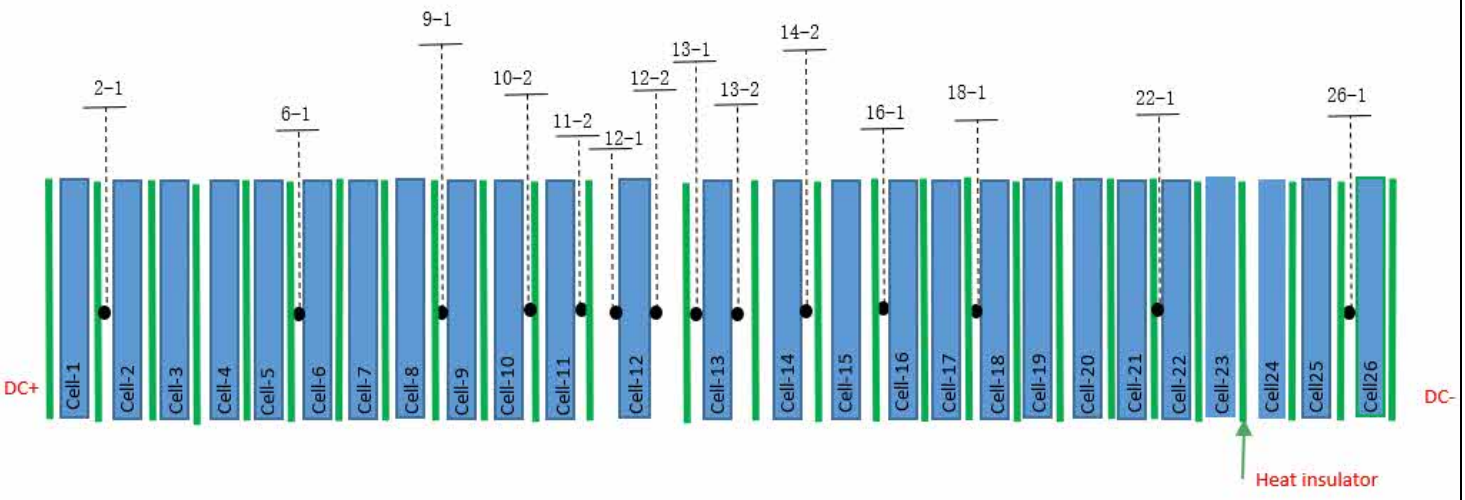

Figure 39 TC wire location for adjacent module(module 6&8)

Attachment 3 - Diagram and dimension of test setup

Separation distance and other critical dimension detail

Location	Required by manufacturer (mm)	Measured (mm)
Between initiating BESS unit and instrument wall behind initiating BESS unit(A/B)	2000	2000
Between target BESS unit and side instrument wall (C)	1000	1000
Between initiating BESS unit and target BESS unit1 at the same line	0	0
Between target BESS unit 1 and target BESS unit 3 at the same line	0	0

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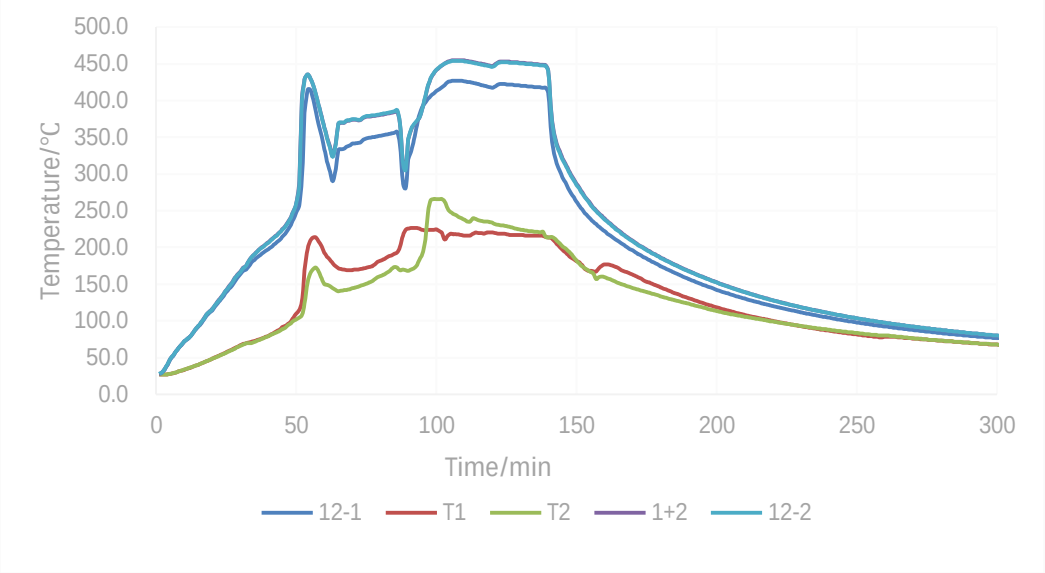
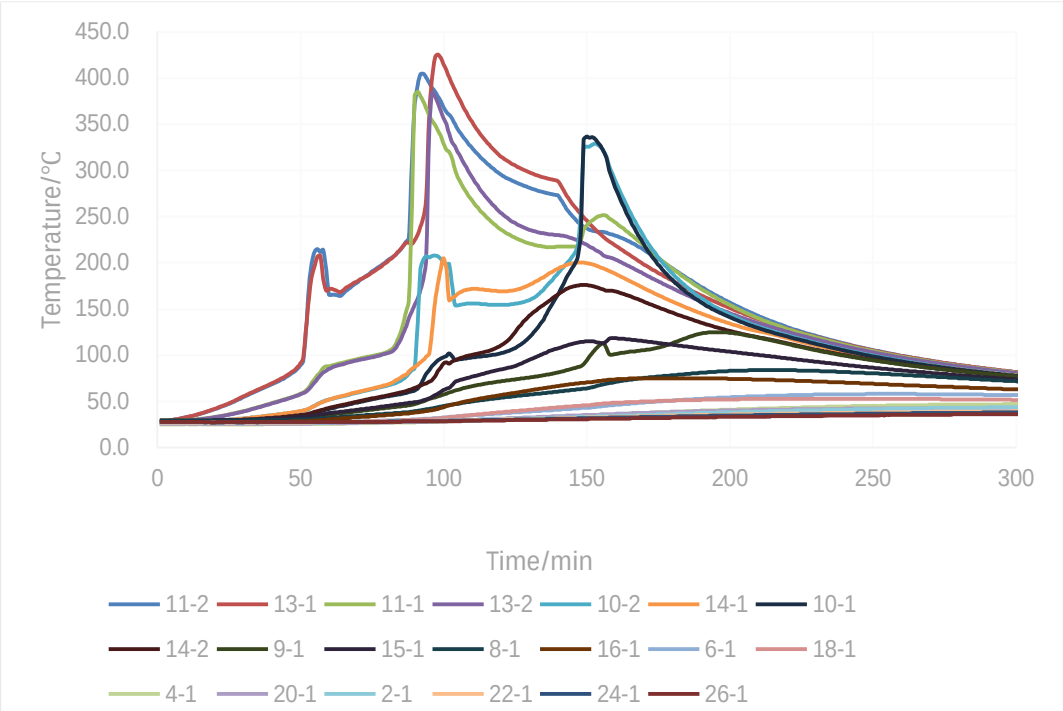
Attachment 4 - Temperature/voltage graph during testing



Plot 1. Temperature measurement on initiating cell(cell12 in Module 7)



Plot 2. Temperature measurement on adjacent cell in initiating module

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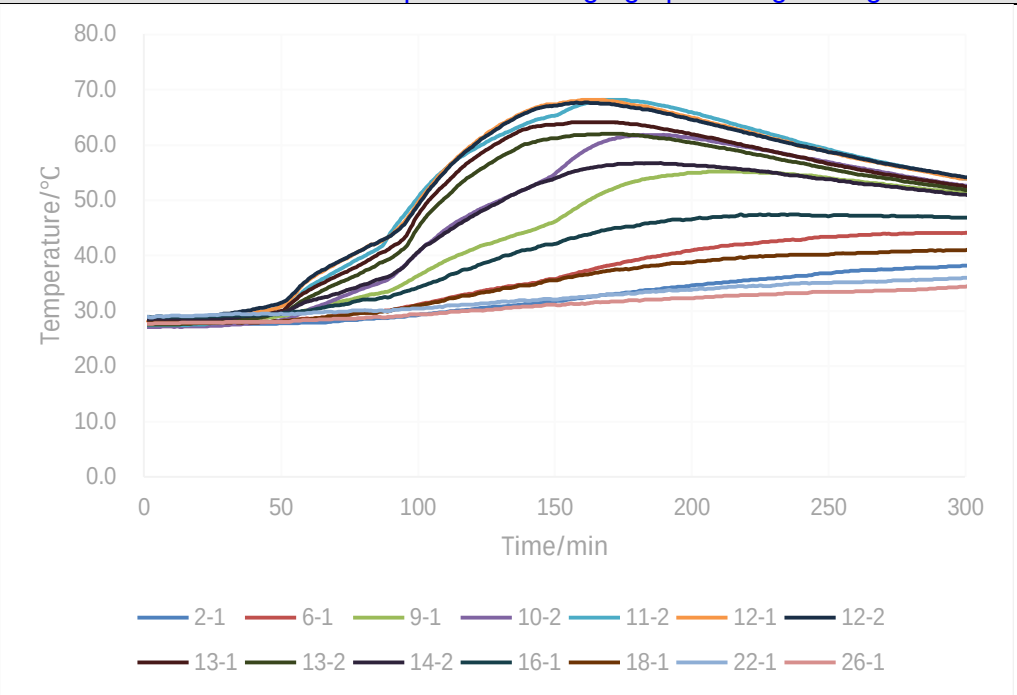
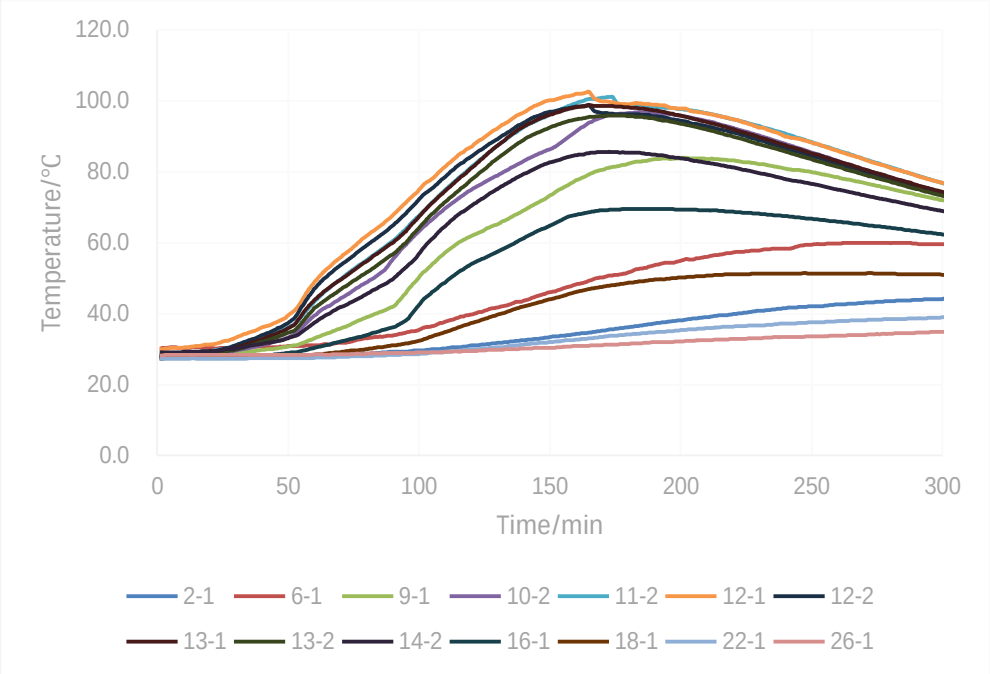
Attachment 4 - Temperature/voltage graph during testing



Plot 3. Temperature measurement on the adjacent module(Module 6)



Plot 4. Temperature measurement on the adjacent module(Module 8)

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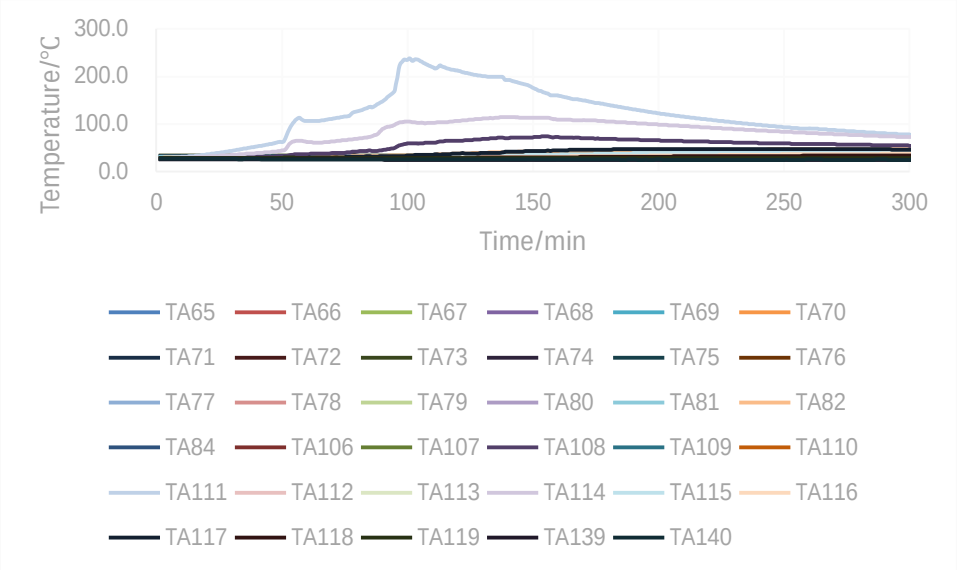
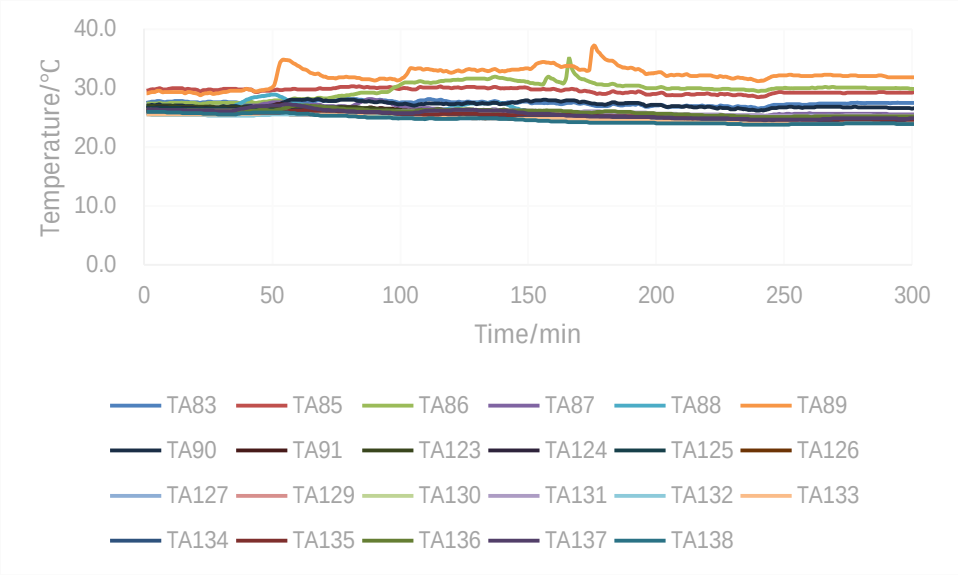
Attachment 4 - Temperature/voltage graph during testing



Plot 5. Temperature measurement on the other adjacent module in the initiating BESS-1



Plot 6. Temperature measurement on the other adjacent module in the initiating BESS-2

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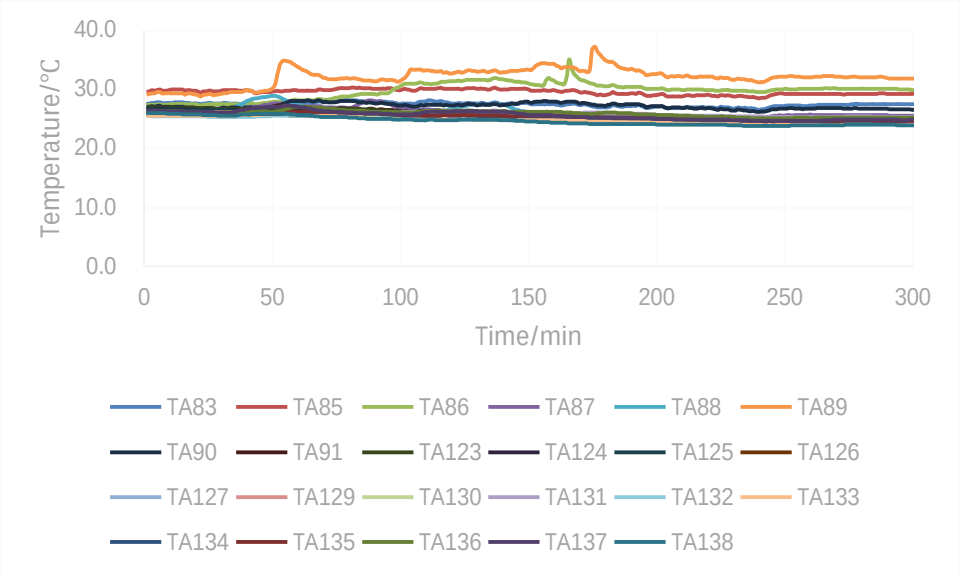
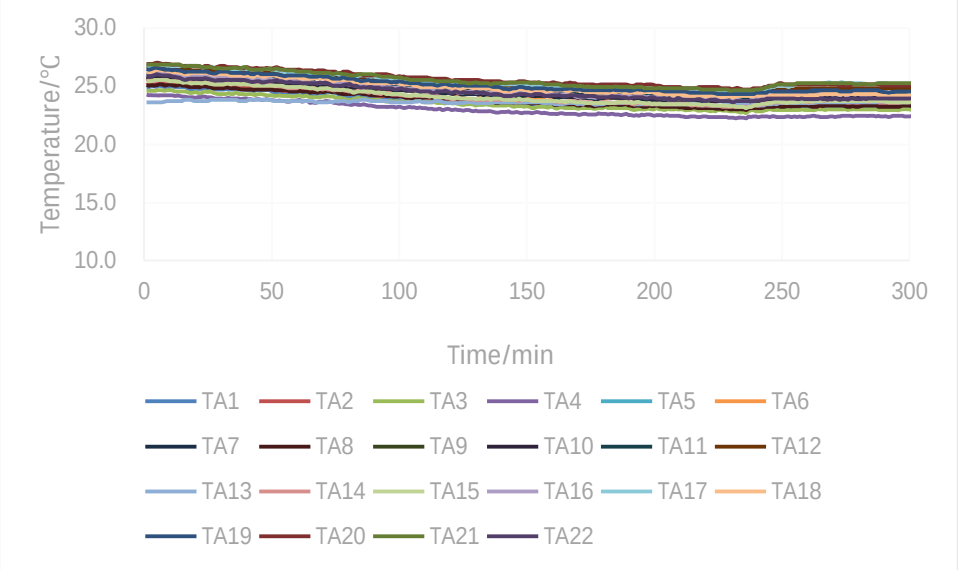
Attachment 4 - Temperature/voltage graph during testing



Plot 7. Temperature measurement on the other target BESS



Plot 8. Temperature measurement on Wall-A

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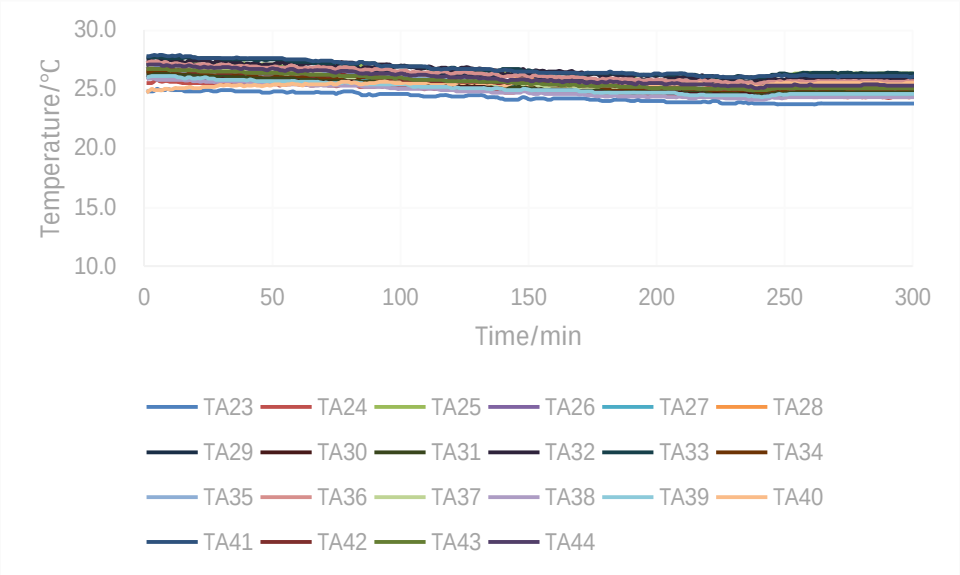
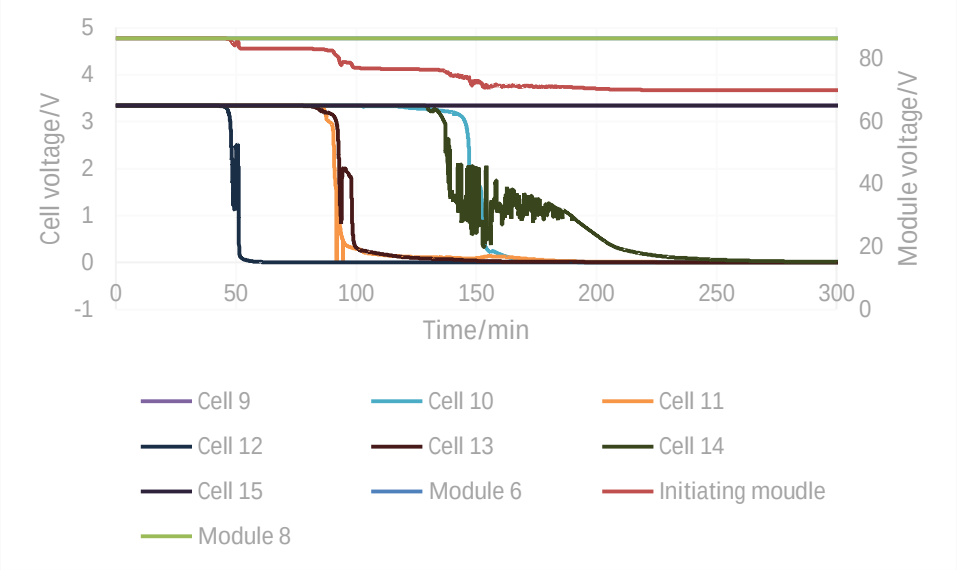
Attachment 4 - Temperature/voltage graph during testing



Plot 9. Temperature measurement on Wall-B



Plot. 10 Voltage measurement

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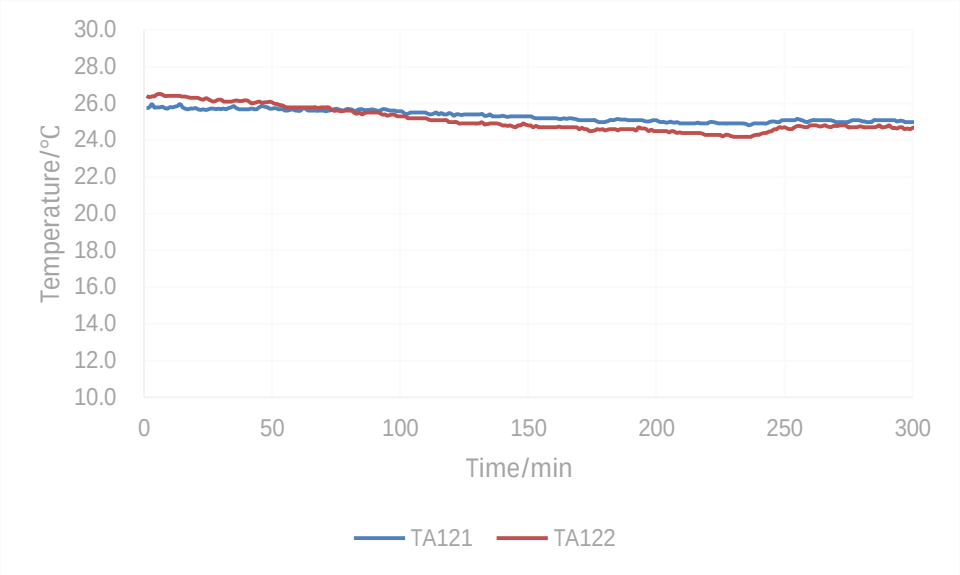
Attachment 4 - Temperature/voltage graph during testing



Plot. 11 Ambient temperature

Maximum temperature measurement		
Location	**Temperature limit (°C)**	**Measured maximum temperature (°C)**
Maximum temperature measurement on the initiating cell 12 in module 7		
Cell 12 surface center (left)	12-1	427.2
Cell 12 terminal surface near B+	T1	227.0
Cell 12 terminal surface near B-	T2	271.5
Cell 12 surface center(right) To controller	1+2	455.3
Cell 12 surface center(right)	12-2	454.5
Maximum temperature measurement on the adjacent cell in module 7		
Cell 11 surface center(right)	11-2	404.8
Cell 13 surface center (left)	13-1	425.7
Cell 11 surface center (left)	11-1	385.5
Cell 13 surface center(right)	13-2	384.0
Cell 10 surface center(right)	10-2	328.9
Cell 14 surface center (left)	14-1	212.0
Cell 10 surface center (left)	10-1	337.9
Cell 14 surface center(right)	14-2	175.7
Cell 9 surface center(left)	9-1	124.7
Cell 15 surface center (left)	15-1	118.1
Cell 8 surface center(left)	8-1	83.5
Cell 16 surface center (left)	16-1	74.8
Cell 6 surface center(left)	6-1	57.7
Cell 18 surface center (left)	18-1	52.7

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Attachment 4 - Temperature/voltage graph during testing

Cell 4 surface center(left)	4-1	46.8
Cell 20 surface center (left)	20-1	42.8
Cell 2 surface center(left)	2-1	44.0
Cell 22 surface center (left)	22-1	40.0
Cell 24 surface center (left)	24-1	39.4
Cell 26 surface center(left)	26-1	38.1
Maximum temperature measurement in the adjacent module 6		
Cell 2 surface center(left) (Module 6)	2-1	39.2
Cell 6 surface center(left) (Module 6)	6-1	44.1
Cell 9 surface center(left) (Module 6)	9-1	55.1
Cell 10 surface center(right) (Module 6)	10-2	61.8
Cell 11 surface center(right) (Module 6)	11-2	68.1
Cell 12 surface center(left) (Module 6)	12-1	68.1
Cell 12 surface center(right) (Module 6)	12-2	67.6
Cell 13 surface center(left) (Module 6)	13-1	64.1
Cell 13 surface center(right) (Module 6)	13-2	62.0
Cell 14 surface center(right) (Module 6)	14-2	56.7
Cell 16 surface center(left) (Module 6)	16-1	47.4
Cell 18 surface center(left) (Module 6)	18-1	41.3
Cell 22 surface center(left) (Module 6)	22-1	37.9
Cell 26 surface center(left) (Module 6)	26-1	38.6
Maximum temperature measurement on the adjacent module 8		
Cell 2 surface center(left) (Module 8)	2-1	45.2
Cell 6 surface center(left) (Module 8)	6-1	59.9
Cell 9 surface center(left) (Module 8)	9-1	83.8
Cell 10 surface center(right) (Module 8)	10-2	96.6
Cell 11 surface center(right) (Module 8)	11-2	101.1
Cell 12 surface center(left) (Module 8)	12-1	102.6
Cell 12 surface center(right) (Module 8)	12-2	98.8
Cell 13 surface center(left) (Module 8)	13-1	98.6
Cell 13 surface center(right) (Module 8)	13-2	95.9
Cell 14 surface center(right) (Module 8)	14-2	85.6
Cell 16 surface center(left) (Module 8)	16-1	69.5
Cell 18 surface center(left) (Module 8)	18-1	51.4
Cell 22 surface center(left) (Module 8)	22-1	40.0
Cell 26 surface center(left) (Module 8)	26-1	37.6
Maximum temperature measurement on the other adjacent module		
On top side of the middle cell (Module 1)	TA65	33.4
On top side of the middle cell (Module 2)	TA66	34.2
On top side of the middle cell (Module 3)	TA67	37.1
On top side of the middle cell (Module 4)	TA68	34.1
On top side of the 1st cell (Module 4)	TA69	34.3
On top side of the 26th the cell (Module 4)	TA70	33.6

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Attachment 4 - Temperature/voltage graph during testing

On top side of the middle cell (Module 10)	TA71	39.1
On top side of the 1st cell (Module 10)	TA72	35.3
On top side of the 26th the cell (Module 10)	TA73	40.0
On bottom side of 1st cell (Module 11)	TA74	36.8
On bottom side of middle cell (Module 11)	TA75	36.4
On bottom side of 26th cell (Module 11)	TA76	32.8
On bottom side of middle cell (Module 12)	TA77	34.8
On bottom side of middle cell (Module 13)	TA78	31.8
On bottom side of middle cell (Module 14)	TA79	31.0
On bottom side of middle cell (Module 15)	TA80	29.7
On bottom side of middle cell (Module 16)	TA81	40.1
On top side of the middle cell (module 5)	TA82	47.2
On top side of the 1st cell (Module 5)	TA106	33.5
On top side of the 26th the cell (Module 5)	TA107	34.0
On top side of the middle cell (Module 6)	TA108	73.9
On top side of the 1st cell (Module 6)	TA109	39.7
On top side of the 26th the cell (Module 6)	TA110	44.5
On top side of the middle cell (Module 7)	TA111	242.3
On top side of the 1st cell (Module 7)	TA112	37.4
On top side of the 26th the cell (Module 7)	TA113	38.1
On bottom side of the middle cell (Module 8)	TA114	115.0
On bottom side of the 1st cell (Module 8)	TA115	44.5
On bottom side of the 26th the cell (Module 8)	TA116	39.7
On bottom side of the middle cell (Module 9)	TA117	47.7
On bottom side of the 1st cell (Module 9)	TA118	36.9
On bottom side of the 26th the cell (Module 9)	TA119	30.8
Maximum temperature measurement on the target BESS		
Initiating BESS Cabinet Enclosure (front)	TA84	27.1
Target BESS Cabinet 1 Enclosure right side at the height of initiating module	TA85	30.3
Target BESS Cabinet 1 Enclosure right side at the middle height	TA86	35.4
Target BESS Cabinet 1 Enclosure right side at the top	TA87	28.1
Target BESS Cabinet 2 Enclosure left side at the height of initiating module	TA88	28.9
Target BESS Cabinet 2 Enclosure left side at the middle height	TA89	37.5
Target BESS Cabinet 2 Enclosure left side at the top	TA90	28.1
Target BESS Cabinet 4 Enclosure back side at the height of initiating module	TA91	27.2
Target BESS Cabinet 4 Enclosure back side at the middle height	TA83	28.2
Target BESS Cabinet 4 Enclosure back side at the top	TA123	26.9

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Attachment 4 - Temperature/voltage graph during testing

Target BESS Cabinet 1 Enclosure (front)	TA140	26.6
Target BESS Cabinet 2 Enclosure (front)	TA139	25.6
Target BESS Cabinet 4(BESS Internal surface from top to bottom TA124~TA128)	TA124~TA127	27.3
Target BESS Cabinet 1(BESS Internal surface from top to bottom TA129~TA133)	TA134~TA138	27.2
Target BESS Cabinet 2(BESS Internal surface from top to bottom TA134~TA138)	TA129~TA133	26.4
Maximum temperature measurement on wall		
Maximum temperature measurement on wall-A	-	27.0
Maximum temperature measurement on wall-B	-	27.9
Maximum ambient temperature		
Maximum ambient temperature	-	26.6

Open circuit voltage measurement

Location	Before testing (Vdc)	After testing (Vdc)
Module 1 and 2	173.6	173.5
Module 3 and 4	173.6	173.6
Module 5 and 6	173.6	173.6
Module 7 and 8(Module 7 was the initiating module)	173.6	156.8
Module 9 and 10	173.7	173.6
Module 11 and 12	173.6	173.5
Module 13 and 14	173.6	173.6
Module 15 and 16	173.6	173.6

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Attachment 5 - Heat release rate graphs

Heat release rate over the duration of the test was not measured per testing requirement noted in section 9.3 for outdoor ground mounted units.

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Attachment 6 - Gas generation graphs

The content, velocity and temperature of the released vented gases were not measured over the duration of the test per testing requirement noted in section 9.3 for outdoor ground mounted BESS units.

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Attachment 7 - Smoke release graph

The smoke release rate was not measured over the duration of the test per testing requirement noted in section 9.3 for outdoor ground mounted BESS units.

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Attachment 8 - Heat flux graph

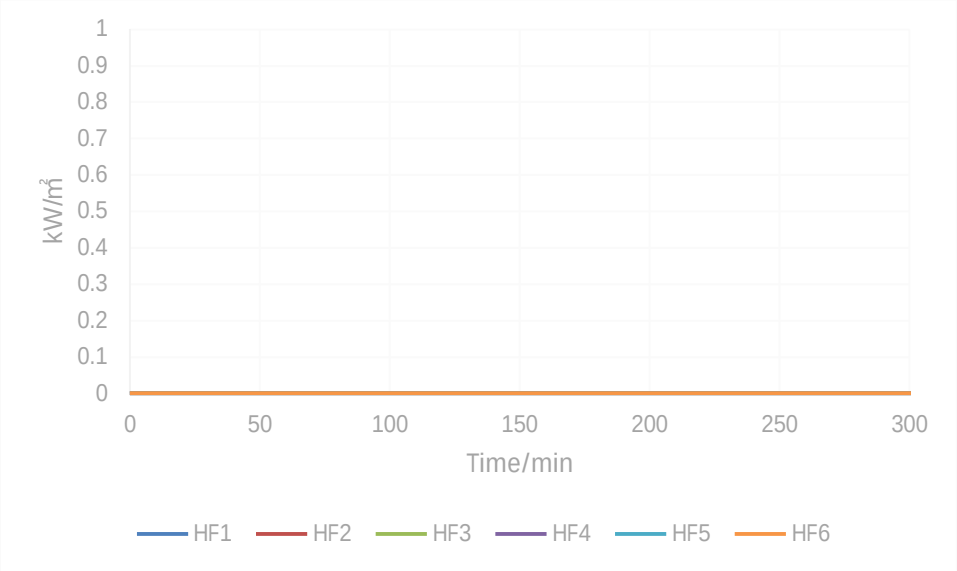

Table 6 – Maximum Heatflux measurement

Location	Heatflux limit (kW/m^2)	Measured maximum Heatflux (kW/m^2)
HFG1 positioned at the mid height of the initiating unit in the center of the accessible means of egress	1.3	0
HFG2 positioned at the top of the initiating unit in the center of the accessible means of egress	1.3	0
HFG3 positioned at the elevation of initiating module on posterior section wall	1.3	0
HFG4 positioned at the elevation of the top of initiating unit on posterior section wall	1.3	0
HFG5 positioned at the mid height of the target unit 4 facing the initiating unit	1.3	0
HFG6 positioned at the top of the target unit 4 facing the initiating unit	1.3	0

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Attachment 9 - Notable observation during test

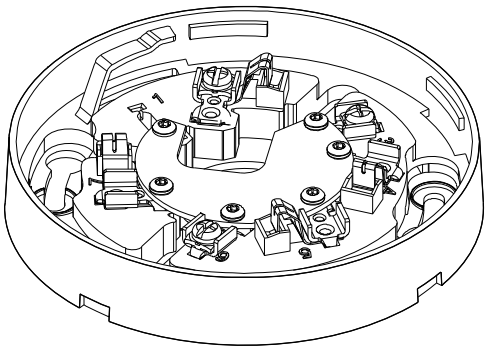
Observation	Time from test start (HH:MM:SS)	Comment
Test start	16:50:50	Heating started on the cell 12# (Module 7) with a ramp 5.5℃/min using automatic temperature regulator.
Visible	17:20:15	Cell vented with a slight decrease of the surface temperature observed.(Cell 12#).
Visible	17:39:42	Ventilation valve (inlet and outlet) and window unfolded, smoke released observed with 1min.
Visible	17:41:10	Thermal runaway initiated on cell 12# (Module 7) occurred, heater deenergized immediately.
Visible	17:47:54	Cell vented with sound(Cell 13#).
Visible	17:49:07	Cell vented with sound(Cell 11#).
Visible	17:53:56	Heating started again on the cell 12# (Module 7) with a ramp 5.5℃/min using automatic temperature regulator.
Visible	18:17:23	Thermal runaway triggered on cell 11# (Module 7) occurred.
Visible	18:25:01	Thermal runaway triggered on cell 13# (Module 7) occurred.
Visible	18:31:00	Cell vented with sound(Cell 14#).
Visible	18:32:59	Cell vented with sound(Cell 10#).
Visible	19:10:30	Thermal runaway triggered on cell 14# (Module 7) occurred, heater deenergized immediately.
Visible	19:18:33	Thermal runaway triggered on cell 10# (Module 7) occurred.
Test End	20:59:54	Test terminated with video recording stopped.

End of Report….

Appendix 4 (Fire Detection Datasheets)

4th Floor, 80 Victoria Street, London SW1E 5JL
Registered in England and Wales No: 09840486
VAT number: 234 9362 96

SIGA-IB Detector Base Installation Sheet



Description

The SIGA-IB is a Signature Series detector base with a built-in line fault isolator for use on a Class A signaling line circuit (SLC). It does not operate without a detector and does not support the SIGA-LED.

The isolator operates as follows: A short on the line causes all isolators to open within 23 ms; at 10 ms intervals, beginning on the side of the Class A circuit nearest the loop controller, the isolators close to provide the next isolator down the line with power; when the isolator next to the short closes, it reopens within 10 ms. The process repeats beginning on the other side of the loop controller.

Installation

Caution: Risk of equipment damage. To prevent damage to the base, do not overtighten the base mounting screws or wire terminal screws. Refer to “Specifications” for torque values.

Refer to Technical Bulletin P/N 270145-EN for location and spacing requirements.

To install the SIGA-IB:

1. Mount the SIGA-IB on a compatible electrical box using the screws provided with the electrical box.
2. Wire the base as shown in the “Wiring” section.
3. Write the address assigned to the detector on the label provided and apply the label to the inside rim of the base.
4. Use a SIGA-TS trim skirt to finish the installation as needed.

Wiring

Caution: Risk of system failure. Electrical supervision requires that the wire run be broken at each terminal. Do not loop the field wires around the terminals.

Notes

- Shielded wire is required only in environments with very high electrical noise.
- Shields, if used, must be continuous and insulated from ground.

To wire the SIGA-IB:

1. Wire the detector base as shown in Figure 1.

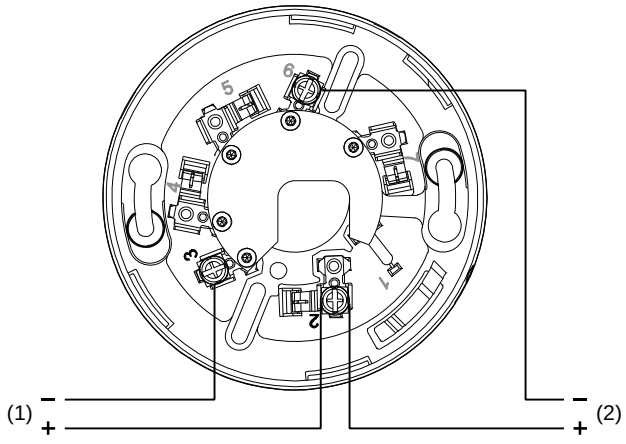
   Break the wire run at each terminal. Do not loop the signaling line circuit field wires around the terminals.
2. Insulate the shield with electrical tape.

SIGA-IB

7 93016 01974 5

P/N P-047550-1887-EN • REV 07 • ISS 13JAN17

Figure 1: Wiring the SIGA-IB



(1) SLC IN from previous device
(2) SLC OUT to next device

Table 1: Base terminals

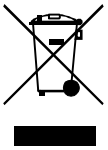
Number	Description	Number	Description
1	Not used	5	Not used
2	SLC IN / OUT +	6	SLC OUT −
3	SLC IN −	7	Not used
4	Not used		

Specifications

Circuit resistance between isolators	6 Ω max.
Wire size	12 to 18 AWG (1.0 to 4.0 mm²) Sizes 16 and 18 AWG are preferred
Screw torque	
Base mounting	18 lbf-in (2.0 N·m) max.
Terminal	12 lbf-in (1.4 N·m) max.
Housing	High impact engineering polymer, white
Compatible detectors	Signature Series detectors
Accessories	SIGA-TS Four-Inch Box Trim Skirt/Ring
Compatible electrical boxes	North American single-gang box Octagon box 3-1/2 in. (89 mm) by 1-1/2 in. (38 mm) deep Octagon box 4 in. (102 mm) by 1-1/2 in. (38 mm) deep European single-gang box 75 mm with 60.3 mm fixing centers BESA box with 60.3 mm fixing centers
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93% noncondensing
Technical bulletin	P/N 270145-EN

Regulatory information

EU compliance	CE		
CPD certificates	0832-CPD-1313		
EN 54-17 ratings			
V max	19.95 VDC	Vsc min	17.59 VDC
V nom	19.0 VDC	IC max	0.147 A to 0.149 A
V min	15.2 VDC	IL max	0.1 mA
Vso max	17.64 VDC	IS max	0.75 A
Vso min	17.57 VDC	ZC max	400 mΩ
Vsc max	17.70 VDC		

European Union directives	1999/5/EC (R&TTE directive): Hereby, UTC Fire & Security declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
	2002/96/EC (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Contact information

For contact information see our website: www.edwardsfiresafety.com.

P/N P-047550-1887-EN • REV 07 • ISS 13JAN17

Signature Driver Controller Modules

3-SSDC1-E

EN54-2:1997+A1: 2006
and EN54-4:1997+2002
+A2 : 2006

Overview

The 3-SSDC1-E Signature Driver Controller modules provide an intelligent interface between the 3-CPU3-E module and Signature Series devices. Each module contains its own micro-processor used to coordinate, process and interpret information received from and sent to Signature devices. Power and commu-nications is received directly from the control panel rail assembly.The 3-SSDC1-E Single Signature Driver Controller module supports one Signature Data circuit, while the 3-SDDC1- Signature Dual Driver Controller module supports two Signature circuits. Both modules occupy one rail space in the fire alarm control cabinetand provide removable field wiring terminals to aid installation.

Innovative design gives the 3-SSDC1-E and Signature devices truly “distributed intelligence”. Signature detectors and modules have their own on-board microprocessor communicating with the loop controller in a fully digital communication format. This increases the accuracy of the information coming to and from the loop controller by reducing the effects of capacitance and noise.

With decentralized intelligence much of the decision making moves from the loop controller to the devices. Advanced fire detection algorithms processed within the Signature devices effectively end unwanted alarms. Environmental compensation and multiple sens-ing element decision making operations are resident in the devices. Intelligent devices allow the Signature Controllers to execute commu-nication and system functions with greater speed and low baud rates, increasing the accuracy of information transmitted between the loop controller and devices.

Standard Features

- One or two circuit versions
- Dedicated microprocessor control
- Full digital communication
- Specialized communication protocol
  –Less sensitive to cable characteristics
  –Utilize existing wiring in most applications
- Loop alarm in under 750 milliseconds
- Device location supervision
  –Unexpected additional device addresses
  –Missing device addresses
  –Switched device locations
  –Programmed device parameters
- Automatic nonvolatile as-built mapping
  –Stores “actual” and “expected” device data
  –Stores physical connection sequence including “T” taps
- Automatic day/night sensitivity
- Supports up to 250 intelligent Signature detectors and 250 Intelligent Signature Modules
- Up to five 3-SDDC1-Es per node
  –Total of 10 Signature circuits
- Removable field wiring terminal blocks
- Multiple survival modes —stand alone
- Fully backward compatible with 3-SSDC-E
- Supports the full line of Signature II devices, including carbon monixide detection

Application

Up to 125 detectors and 125 modules are supported over a single pair of wires by the 3-SDC1-E Signature Cards that plug into the Signature controller modules. Both Class A wiring (style 6 or style 7) and Class B (style 4) wiring are supported. Loop distances over 11,000 feet (3300m) are possible.

The 3-SSDC1-E use advanced communication for-mats that provide exceptional response. Using a "BROADCAST POLL" the loop controller checks the entire device circuit for any changes of state. Should one or more devices report a change the 3-SSDC1-E uses "DIRECT ADDRESS SEARCH" to find reporting device(s). Devices that have entered the alarm state or become active are located nearly instantaneously.

The unique use of "BROADCAST POLLING" combined with "DI-RECT ADDRESS SEARCH" ensures that only new information is transmitted allowing a reduced baud rate with fast response time. The low baud rate is ideal for retrofit applications since in most applications existing wiring can be used.

To enhance survivability of the system the 3-SSDC1-E supports a standalone mode for Signature devices. Two cata-strophic failure modes are supported. If the 3-CPU(1/3) fails,the loop controller will continue to poll its devices. If an alarmis detected it will be sent on the local rail communication busand received by other local rail modules. A common alarm condition throughout the panel will result. If the local rail mod-ule (3-SSDC1-E) fails, and a device (smoke or module)detects an alarm, specialized circuitry will make the node aware of the alarm condition. The 3-CPU(1/3) will communicate the alarm condition to the rest of the network. Having multiple redundant modes is paramount in a life safety system.

Every time the 3-SSDC1-E communicates with a detector a green LED on the detector flashes. Normal green LED activity is not disturbing to building occupants, but can be quickly spottedby a maintenance technician. A red LED on the detector turns on only in the alarm condition.

The 3-SSDC1-E also supervises the device wiring, physi-cal location of each device and the programmed device charac-teristics. This Edwards/Signature Series unique characteristic is accomplished by "MAPPING" the Signature circuit and committing the map to memory. Upon power up the loop controller will scan device serial numbers and map their physical location sequence on the loop, including "T" taps. After mapping is complete the controller automatically addresses each detector and module through downloading over the loop. There are no switches or dials to set. Each device is assigned a unique soft address generatedby the site specific program.

The 3-SSDC1-E then compares the "Actual" physical device data to the "Expected" site specific program data. If any correlations are different, the loop controller issues a trouble to the CPU identifying the devices which do not match and posting a map fault. Through the 3-CPU3's RS-232 port a graphical map of the loop can be uploaded depicting each device's location on the loop, including branches (T-Taps) and all of the physical attributes associated with the device. This diagnostic information is unparal-leled in the fire detection industry and vital for keeping accurate records on how the system was installed.

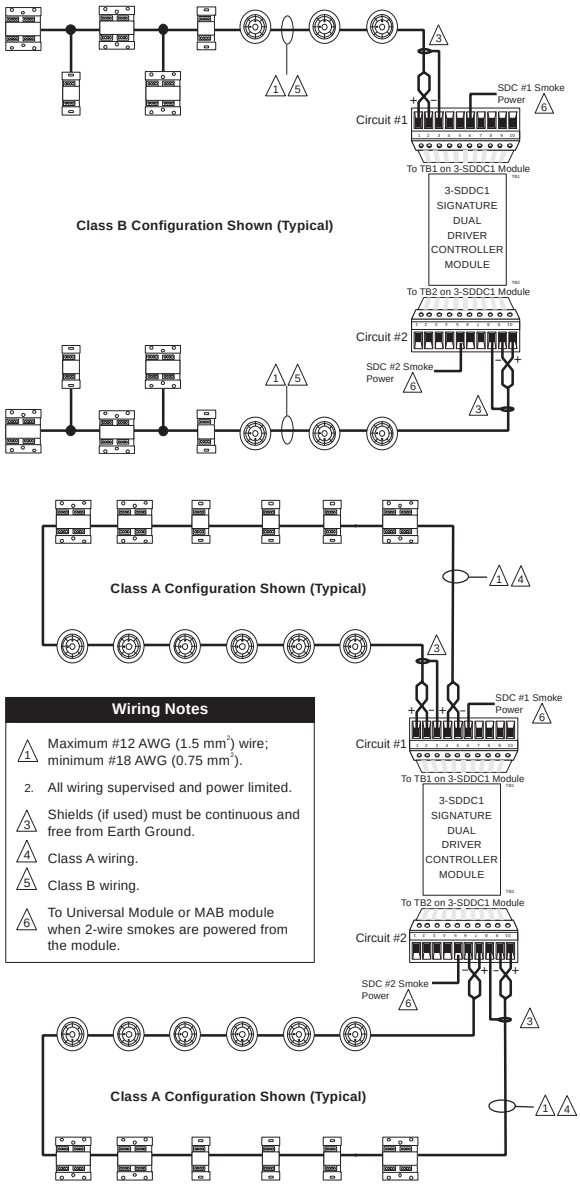
During installation a common problem with analog/ addressable systems is locating ground faults. The 3-SSDC1-E controllers have the ability to locate ground faults by specific mod-ule, speeding up the troubleshooting process. Another significant advantage of the 3-SSDC1-E controllers during com-missioning is electronic addressing and mapping. This eliminates duplicate addresses, which are also very difficult for most systems to locate.

During maintenance, should groups of detector heads be removed for service and returned into the wrong smoke detector base (location), the 3-SSDC1-E will automatically detect the problem. If the attributes of the switched devices are the same,the system will automatically download the correct soft addresses and algorithms to the devices (maintaining location supervision).

If the attributes are not the same the 3-SSDC1-E will send a map fault indication to the 3-CPU3 and post a trouble indicating the specific devices in fault.

The 3-SSDC1-E also monitors the Signature Series devices for maintenance and trouble conditions. Each smoke de-tector contains intelligence to adjust with environmental changes.This expands the amount of time required between cleaning while maintaining a constant alarm threshold. As the detector begins to exhaust the environmental compensation, and reaches the 80% level, the 3-SSDC1-E will indicate a maintenance alertor dirty condition to the 3-CPU and indicate the specific device requiring cleaning. If cleaning is not performed the detector will continue to operate until all of its environmental compensation is

Typical Wiring



utilized. At this point the 3-SSDC1-E sends a dirty trouble indication to the 3-CPU and posts a trouble condition. If maintenance is still not performed the Signature detector will automatically remove itself from service once the programmed threshold window has been breached (preventing a false alarm).

When a detector includes carbon monoxide (CO) detection, the detector monitors its CO life remaining for the CO sensor element and provides this information automatically to the panel. For maintenance of the system the CO life remaining is also available by simply running a maintenance report at the panel or through the FireWorks graphical interface. A unique CO maintenance signal is automatically generated by the panel when there is 8% (several months) of CO element life remaining. Should the CO sensor element not be replaced after the maintenance signal is reported, an "End of Life" trouble automatically posts on the panel when the CO sensor detection capability is exhausted.

Remote test capability permits devices to be put in alarm, pre-alarm, supervisory, monitor, or security alarm, or trouble from the panel menu or controls. This facilitates testing of smoke and heat detectors as well as monitor and security devices. Fast test is also provided for CO detectors allowing these devices to be tested quickly in the field.

The 3-SSDC1-E local rail modules modules are fully backwards compatible with the 3-SSDC and 3-SDDC local rail modules. 3-SSDC1-E modules provide additional onboard memory to facilitate future Synergy functions. To upgrade a 3-SSDC/3-SDDC to a 3-SSDC1-E respectively, replace the 3-SSDC/3-SDDC Local Rail Module with a 3-SDDC1-MB Local Rail Module and reuse the 3-SDC Signature Device Cards and filters.

Specifications (Signature Circuits)

Charts assume wire and devices are evenly distributed over length of circuit

Non-twisted, non shielded wire

Device type	# of Detectors	# of Module Addresses	#14 AWG (20pf/foot) (2.53 Ohm/1000ft)	#16 AWG (20pf/foot) (4.02 Ohm/1000ft)	#18 AWG (20pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	14,752 feet (4,497 meters)	9,275 feet (2,827 meters)	5,839 feet (1,780 meters)
Modules only	0	125	12,599 feet (3,840 meters)	7,921 feet (2,414 meters)	4,986 feet (1,520 meters)
Detectors and Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and Modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Twisted pair non shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (38pf/foot) (2.53 Ohm/1000ft)	1.5mm² (36pf/foot) (3.75 Ohm/1000ft)	#16 AWG (36pf/foot) (4.02 Ohm/1000ft)	1.0mm² (25pf/foot) (5.51 Ohm/1000ft)	#18 AWG (25pf/foot) (6.38 Ohm/1000ft)
Detectors only	125	0	13,157 feet (4,010 m)	9,933 feet (3,028 m)	9,275 feet (2,827 m)	6,760 feet (2,061 m)	5,839 feet (1,780 m)
Modules Only	0	125	12,599 feet (3,840 m)	8,483 feet (2,586 m)	7,921 feet (2,414 m)	5,774 feet (1,760 m)	4,986 feet (1,520 m)
Detectors & Modules	125	125	5,738 feet (1,749 m)	3,864 feet (1,178 m)	3,608 feet (1,100 m)	2,630 feet (802 m)	2,271 feet (692 m)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	7,623 feet (2,324 m)	5,133 feet (1,565 m)	4,793 feet (1,461 m)	3,494 feet (1,065 m)	3,017 feet (920 m)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	3,798 feet (1,158 m)	2,558 feet (780 m)	2,388 feet (728 m)	1,741 feet (531 m)	1,503 feet (458 m)

Twisted pair shielded wire

Device Type	# of Detectors	# of Module Addresses	#14 AWG (84pf/foot) (2.53 Ohm/1,000ft)	#16 AWG (82pf/foot) (4.02 Ohm/1,000ft)	#18 AWG (58pf/foot) (6.38 Ohm/1,000ft)
Detectors only	125	0	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	5,839 feet (1,780 meters)
Modules Only	0	125	5,952 feet (1,814 meters)	6,098 feet (1,859 meters)	4,986 feet (1,520 meters)
Detectors & Modules	125	125	5,738 feet (1,749 meters)	3,608 feet (1,100 meters)	2,271 feet (692 meters)
Detectors and modules with 2-wire smokes	63	55 + 9 SIGA-UM	5,952 feet (1,814 meters)	4,793 feet (1,461 meters)	3,017 feet (920 meters)
Modules with 2-wire smokes	0	107 + 9 SIGA-UM	2,558 feet (780 meters)	2,388 feet (728 meters)	1,503 feet (458 meters)

Banshee Excel Lite™ CHX/CHL Sounder Beacons

The Banshee Excel Lite™ combines the aesthetics and performance of the Excel Sounder with either a very bright and efficient Xenon Beacon (CHX model) or a low-current LED Beacon (CHL model).

The sounder is fitted with a professional capsule driven horn and comes with 32 user-selectable tones incorporating low frequencies, high frequencies, European, American and Australian norms and all industry-standard frequency patterns.

Manufactured in flame retardant polymer, the units are available in a choice of base colours and up to 5 different lens colours, making it suitable for a range of fire and security dual notification applications as well as DDA-compliant installations. All models use the push and twist bayonet fitting BansheeMT base.

Tested and approved to EN 54 Part 3, the Banshee Excel Lite™ boasts leading acoustics, aesthetically pleasing design and low power consumption. The units are designed for ease of installation and are complemented by a wide selection of accessories to suit all applications.

CE 0786

Choice of lens colour:

Features

- Available with either Xenon or LED Beacon with a red or white body
- Choice of lens colours (CHX: Red, Clear, Amber, Blue, Green / CHL: Red, Clear)
- Sounder has 32 user-selectable tones - industry standard compatible
- Very low current consumption
- EN 54-3 tested and fully approved in accordance with CPR
- VdS approved
- Easy to install with side and rear cable entry
- Robust 'two in two out' 2.5 mm2 terminals
- Choice of three volume levels
- Rated to IP66 or IP45
- Uses same bases as BansheeMT - simple push and twist bayonet
- mounting with locking screw
- Extensive family of accessories for a wide range of applications
- Recyclable

Specification

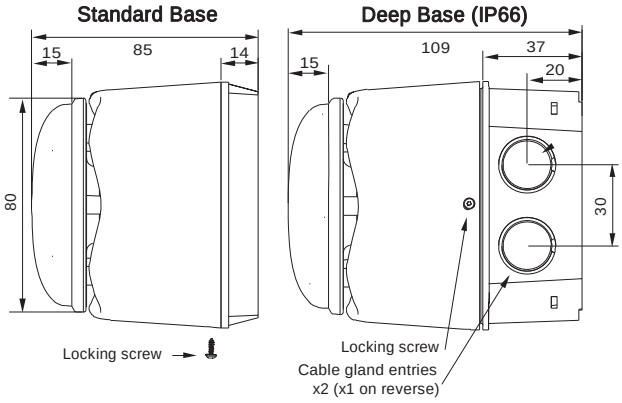
Operating Voltage (Vdc):	9-30
Operating Voltage EN 54-3 (Vdc):	24 (20 -28)
Tone Current Consumption (mA):	See Sound Output Table#
Sound Output (dBA Typ @1m):	See Sound Output Table#
Tones Available:	See Sound Output Table#
Flash Current Consumption (mA):‡	
- @24 Vdc	40 (CHX), 16 (CHL)
- @12 Vdc	90 (CHX), 12 (CHL)
Light Output Rating (Cd):	TBC
Flash Rate (Per Second):	1
Body Colours:	Red or White
Temperature Range (Deg C):	-15 to +40 (CHX) -20 to +70 (CHL)
Volume Control:	High, Medium (-10 dBA) Low (-20 dBA)
Environment Category / IP Rating:	Type A/IP45 Std Base Type B/IP66 Deep Base

‡Flash current consumption is additional to sounder tone current
All units meet minimum requirements of IP21C Shallow Base and IP33C Deep Base in accordance with EN 54-3

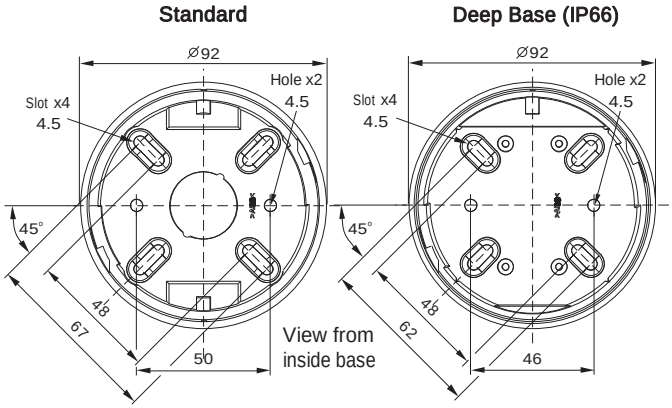
VIMPEX
Shaping Alarm Technology

Installation

Banshee Excel Lite™ CHX/CHL Sounder Beacon



Banshee Excel™ Common Base



#Sound Output Table & Tone Specification

No.	DIL SW 1 2 3 4 5	Description	Frequency and timing	2nd Ton	(12V) dBA		(24V) dBA	
1	OOOOO	BansheeBuzzLF	800Hzto950Hzsweptat120Hz	4	94	6	100	12
2	**1OOOO**	**BansheeFastSweepLF***	**800Hzto950Hzsweptat9Hz**	4	94	6	100	12
3	0 1 0 0 0	Banshee Slow Sweep LF	800Hz to 950Hz swept at 3Hz	4	94	6	100	12
4	1 1 0 0 0	Banshee Continuous LF	Continuous at 900Hz	4	94	6	100	12
5	0 0 1 0 0	Banshee Fast Sweep LF (New)	830Hz to 970Hz swept at 9Hz	4	93	6	100	12
6	1 0 1 0 0	**Medium SweepLF***	**800Hzto970Hzsweptat1Hz**	7	94	6	100	12
7	0 1 1 0 0	Continuous LF	Continuous at 950Hz	7	94	6	99	13
8	1 1 1 0 0	Back Up Alarm LF	Intermittent at 950Hz 1 sec on, 1 sec off	4	93	6	99	14
9	0 0 0 1 0	Alternate LF	Alternating 800Hz/1000Hz at 1Hz	4	94	6	100	13
10	1 0 0 1 0	Medium Sweep LF	800Hz to 1000Hz swept at 0.5 secs	4	94	6	100	12
11	0 1 0 1 0	Alternate LF	Alternating Tones 800/950 at 3Hz	4	94	6	101	12
12	1 1 0 1 0	Banshee Buzz HF	2400Hz to 2900Hz at 120Hz	15	102	16	109	35
13	0 0 1 1 0	Banshee Fast Sweep HF	2400Hz to 2900Hz at 9Hz	15	103	17	110	35
14	1 0 1 1 0	Banshee Slow Sweep HF	2400Hz to 2900Hz at 3Hz	15	103	17	110	35
15	0 1 1 1 0	Banshee Continuous HF	Continuous 2900Hz*	15	103	19	109	39
16	1 1 1 1 0	Banshee Fast Sweep HF (New)	2450Hz to 3100Hz swept at 9Hz	15	103	18	109	36
17	0 0 0 0 1	Back Up Alarm HF	Intermittent at 2900Hz 1 sec on, 1 sec off*	15	103	18	109	37
18	1 0 0 0 1	Alternate HF	Alternating Tones 2400/2900 at 3Hz	15	104	17	110	36
19	**O1OO1**	**Slow Whoop***	**500hz rising to 1200hz over 3.5 secs, silence 0.5 sec**	4	95	6	101	12
20	**11OO1**	**Din Tone (DK)***	**1200Hz falling to 500Hz over 1 sec, silence 10mS, repeat**	4	93	5	100	10
21	**OO1O1**	**French Fire Sound***	**554Hz for 100mS and 440Hz for 400mS**	4	90	4	96	7
22	1O1O1	AustralianAlertSignal	420Hzrepeating0.625secon,0.625secoff	4	89	3	94	6
23	O1 1O1	AustralianEvacuationSignal	500Hzto1200Hzsweeping,3.75secson,0.25secsoff	4	95	6	101	12
24	11 1O1	USTemporalToneLF	950HzforO.5secon.0.5secofff or3phases,silencefor1.5secsandrepeat	4	93	5	99	10
25	OO11	USTemporalToneHF	2900HzforO.5secon.0.5secofff or3phases,silencefor1.5secsandrepeat	15	103	13	109	27
26	1OO11	SwedishTone(Fire)	Intermittent660Hz150mSon,150mSoff	26	90	3	96	6
27	O1O11	SwedishTone(AllClear)	Continuous660Hz	27	91	5	97	9
28	11O11	ISO8201LF	Intermittent970Hz500mSon,500mSoff	28	90	5	96	10
29	OO111	ISO8201HF	Intermittent2900Hz500mSon,500mSoff*	29	103	13	109	27
30	1O111	BT Banshee(FP1063.1)	Yodel800Hz/1000Hz,0.25seceachfrequency	31	94	6	100	12
31	O1111	BT Banshee(FP1063.1)	Continuous1000Hz	31	88	6	94	14
32	11111	BellTone	BellTone	32	94	12	99	25

Notes: *Tones highlighted in bold are approved under the Construction Product Directive; Sound output (dBA) and current (mA) values are typical.

Part Numbers - Spares & Accessories

8502700: Mains Pack - 110 Vac/230 Vac input 24 Vdc output
8502800: Cable Spacing Ring for Surface Wiring of sounder
8502900: Flush Mounting Ring - for Banshee Excel, Excel Lite
8503000: Combination bracket - for Sounders and Strobes
8503100: External Fixing Clip for Deep Base (avoids drilling base thus retaining IP66 rating)
BA87331/P:Deep Base - White, complete with 'O' Ring
BA87341/P:Deep Base - Red, complete with 'O' Ring
BA87351/P:Deep Base - Grey, complete with 'O' Ring

Part Numbers

(Model-Body Col/Lens Col/ Base)

958CHL1000: CHL-Red/Red/Std
958CHL1001: CHL-Red/Red/Deep
958CHL1100: CHL-Red/Clear/Std
958CHL1101: CHL-Red/Clear/Deep
958CHL1500: CHL-White/Red/Std
958CHL1501: CHL-White/Red/Deep
958CHL1600: CHL-White/Clear/Std
958CHL1601: CHL-White/Clear/Deep
958CHX1000: CHX-Red/Red/Std
958CHX1001: CHX-Red/Red/Deep
958CHX1100: CHX-Red/White/Std
958CHX1101: CHX-Red/White/Deep
958CHX1200: CHX-Red/Amber/Std
958CHX1201: CHX-Red/Amber/Deep
958CHX1300: CHX-Red/Blue/Std
958CHX1301: CHX-Red/Blue/Deep
958CHX1400: CHX-Red/Green/Std
958CHX1401: CHX-Red/Green/Deep
958CHX1500: CHX-White/Red/Std
958CHX1501: CHX-White/Red/Deep
958CHX1600: CHX-White/Clear/Std
958CHX1601: CHX-White/Clear/Deep
958CHX1700: CHX-White/Amber/Std
958CHX1701: CHX-White/Amber/Deep
958CHX1800: CHX-White/Blue/Std
958CHX1801: CHX-White/Blue/Deep
958CHX1900: CHX-White/Green/Std
958CHX1901: CHX-White/Green/Deep

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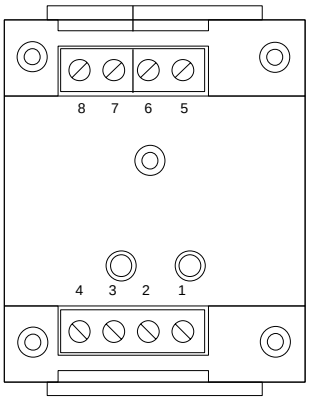
Assessed to ISO 9001
Cert/LPCB ref. 456

VIMPEX
Shaping Alarm Technology

DS/EXLITE-TD/ISS 2

SIGA-IOI Input/Output Module Installation Sheet



Description

The SIGA-IOI Input/Output Module is an addressable device that provides a control relay output and an initiating device input in a single package. Depending on the module's personality code, the two circuits operate independently or together.

The module requires one address on the signaling line circuit (SLC). Addresses are assigned electronically. There are no address switches.

Diagnostic LEDs provide visible indication of the status of the module:

- Normal: Green LED flashes
- Alarm/active: Red LED flashes

Personality codes

The module requires the loop controller to download the personality code that determines how the module operates. Use the personality codes described below to configure the SIGA-IOI.

Personality code 31: Monitor - NO input/output NO: Factory default. Configures the module as a normally open output relay contact that requires a maintained dry contact input activation. The activation must take place within a time period defined by the user (15 second default, 5 to 120 second selectable) after the output circuit activation. If the fire alarm control panel does not receive a monitor input within the specified time, it generates a trouble condition.

Personality code 32: Monitor - NO input/output NC: Personality code 32 operates the same as personality code 31, except that the output is configured as a normally closed, dry contact relay.

Personality code 33: Alarm - NO latching input/output NO: Configures the module as a normally open, dry contact relay and an alarm latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an alarm signal to the Signature loop controller and the alarm condition is latched at the module. The output must be programmed to be activated by the panel.

Personality code 34: Alarm - NO latching input/output NC: Personality code 34 operates the same as personality code 33, except that the output is configured as a normally closed, dry contact relay.

Personality code 35: Alarm - NO delayed latching input/output NO: Configures the module as a normally-open dry contact relay and a delayed latching alarm input circuit. The module generates an alarm event after a short is placed across the input circuit and maintained for at least 16 seconds. The output must be programmed to be activated by the panel.

Personality code 36: Alarm - NO delayed latching input/output NC: Personality code 36 operates the same as personality code 35, except that the output is configured as a normally closed, dry contact relay.

Personality code 37: Active - NO nonlatching input/output NO: Configures the module as a normally open, dry contact relay and an active latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an active signal to the Signature loop controller. The active signal does not latch, and restores when the input device returns to its normal state. The output must be programmed to be activated by the panel.

Personality code 38: Active - NO nonlatching input/output NC: Personality code 38 operates the same as personality code 37, except that the output is configured as a normally closed, dry contact relay.

Personality code 39: Active - NO latching input/output NO: Configures the module as a normally open, dry contact relay and an active latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an active signal to the Signature loop controller and the active condition is latched at the module. The output must be programmed to be activated by the panel.

Personality code 40: Active - NO latching input/output NC: Personality code 40 operates the same as personality code 39, except that the output is configured as a normally closed, dry contact relay.

Installation

WARNING: Connecting a device that exceeds this module's pilot duty contact ratings may cause activation failure. This module does not support capacitive loads. See "Specifications" on page 4 for contact ratings.

P/N 3102404-EN • REV 002 • ISS 18APR22

Notes

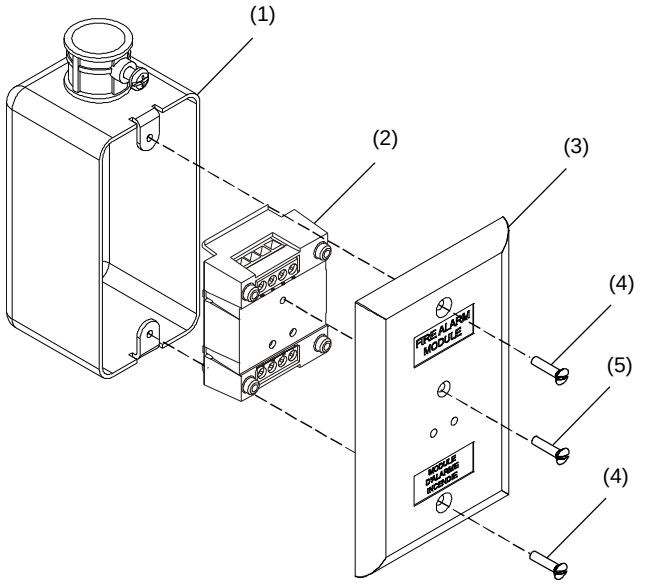
- The module is shipped from the factory as an assembled unit; it contains no user-serviceable parts and should not be disassembled.
- This module does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- The module does not support conventional smoke detectors.

Install in accordance with all applicable local codes and standards and the local authority having jurisdiction.

To install the module:

1. Wire in accordance with “Wiring” below.
2. Write the address assigned to the module on the label provided, and then apply the label to the module. Remove the serial number label from the detector, and then attach it to the project documentation.
3. Using the screw provided, mount the wall plate on the module. See Figure 1 for mounting details.
4. Using the screws provided, mount the wall plate (with the module attached) on one of the compatible electrical boxes listed in “Specifications” on page 4.

Figure 1: Mounting the IO module



(1) Compatible electrical box
(2) Module
(3) Wall plate, white (single-gang)
(4) #6-32 × 5/8 machine screw
(5) #4 × 1/2 self-tapping screw

Wiring

Wire in accordance with applicable requirements of the latest editions of the local codes and standards and the local authority having jurisdiction.

Note: When stripping wire ends, exposing more wire may cause a ground fault or circuit malfunction on unsupervised wiring; exposing less wire may result in a faulty connection.

Strip 1/4 in. (about 6 mm) from the ends of all wires that connect to the terminal block of the module.

Notes

- Refer to the Signature loop controller installation sheet for SLC wiring specifications.
- Each terminal on the module is limited to a single conductor.

To wire the module:

1. Verify that all field wiring is free of opens, shorts, and ground faults.
2. Make all wiring connections as shown in Figure 2.

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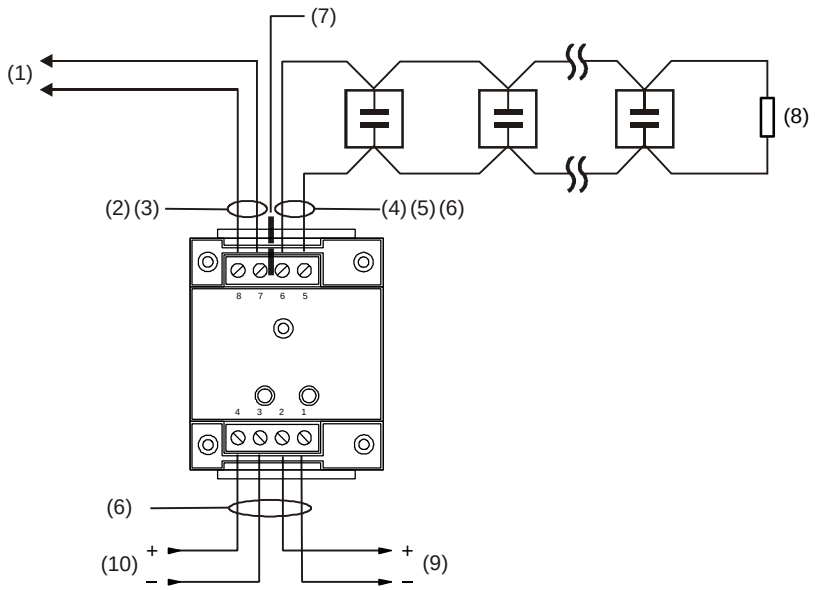
Figure 2: Wiring diagram



(1) Normally open (NO) or normally closed (NC) relay contacts (user configurable)

(2) Not supervised. Power-limited unless connected to a nonpower-limited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 *National Electrical Code* for more details.

(3) The relay function is programmable

(4) 25 Ω max per wire

(5) 10 VDC at 350 µA, max

(6) Power-limited and supervised

(7) The Nomex isolation barrier separates power-limited and nonpower-limited wiring.

(8) 47 kΩ EOL resistor (PN EOL-47) used for Class B only

(9) Signaling line circuit (SLC) to next device

(10) Signaling line circuit (SLC) from previous device

Specifications

Operating voltage	15.20 to 19.95 VDC
Current	
Standby	310 µA
Activated	450 µA
Ground fault impedance	10 kΩ
Initiating device circuit (IDC)	
Circuit resistance	50 Ω max. per channel, (25 Ω per wire)
Circuit capacitance	0.1 µF max. per channel
Circuit designation	
Signaling line circuits	Class A, Style 6 or Class B, Style 4
Contact ratings (pilot duty)	24 VDC at 2 A 120 VAC at 0.5 A
Relay type	Form A or B, programmable
Compatible electrical boxes	2-1/2 in. (64 mm) deep single-gang box; Standard 4 in. square,1-1/2 in. (38 mm) deep box
Wire size	12 to 18 AWG (0.75 to 2.5 mm²)
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93%, noncondensing
Storage temperature range	−4 to 140°F (−20 to 60°C)

Regulatory information

EU compliance	CE
EU certificate	2831-CPR-F1389
UK compliance	UKCA 0832
EN 54	EN 54-18:2005
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information, see www.recyelethis.info..

Contact information

For contact information, see www.edwardsfiresafety.com.

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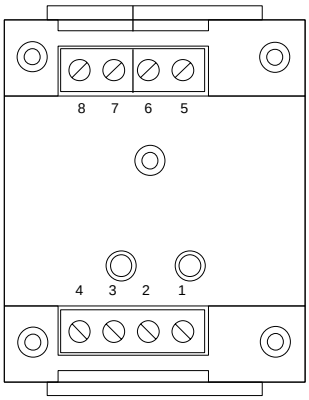
SIGA-IOI Input/Output Module Installation Sheet



Description

The SIGA-IOI Input/Output Module is an addressable device that provides a control relay output and an initiating device input in a single package. Depending on the module's personality code, the two circuits operate independently or together.

The module requires one address on the signaling line circuit (SLC). Addresses are assigned electronically. There are no address switches.

Diagnostic LEDs provide visible indication of the status of the module:

- Normal: Green LED flashes
- Alarm/active: Red LED flashes

Personality codes

The module requires the loop controller to download the personality code that determines how the module operates. Use the personality codes described below to configure the SIGA-IOI.

Personality code 31: Monitor - NO input/output NO: Factory default. Configures the module as a normally open output relay contact that requires a maintained dry contact input activation. The activation must take place within a time period defined by the user (15 second default, 5 to 120 second selectable) after the output circuit activation. If the fire alarm control panel does not receive a monitor input within the specified time, it generates a trouble condition.

Personality code 32: Monitor - NO input/output NC: Personality code 32 operates the same as personality code 31, except that the output is configured as a normally closed, dry contact relay.

Personality code 33: Alarm - NO latching input/output NO: Configures the module as a normally open, dry contact relay and an alarm latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an alarm signal to the Signature loop controller and the alarm condition is latched at the module. The output must be programmed to be activated by the panel.

Personality code 34: Alarm - NO latching input/output NC: Personality code 34 operates the same as personality code 33, except that the output is configured as a normally closed, dry contact relay.

Personality code 35: Alarm - NO delayed latching input/output NO: Configures the module as a normally-open dry contact relay and a delayed latching alarm input circuit. The module generates an alarm event after a short is placed across the input circuit and maintained for at least 16 seconds. The output must be programmed to be activated by the panel.

Personality code 36: Alarm - NO delayed latching input/output NC: Personality code 36 operates the same as personality code 35, except that the output is configured as a normally closed, dry contact relay.

Personality code 37: Active - NO nonlatching input/output NO: Configures the module as a normally open, dry contact relay and an active latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an active signal to the Signature loop controller. The active signal does not latch, and restores when the input device returns to its normal state. The output must be programmed to be activated by the panel.

Personality code 38: Active - NO nonlatching input/output NC: Personality code 38 operates the same as personality code 37, except that the output is configured as a normally closed, dry contact relay.

Personality code 39: Active - NO latching input/output NO: Configures the module as a normally open, dry contact relay and an active latching input for Class B contact initiating devices. When the input contact of the initiating device changes state, the module sends an active signal to the Signature loop controller and the active condition is latched at the module. The output must be programmed to be activated by the panel.

Personality code 40: Active - NO latching input/output NC: Personality code 40 operates the same as personality code 39, except that the output is configured as a normally closed, dry contact relay.

Installation

WARNING: Connecting a device that exceeds this module's pilot duty contact ratings may cause activation failure. This module does not support capacitive loads. See "Specifications" on page 4 for contact ratings.

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Notes

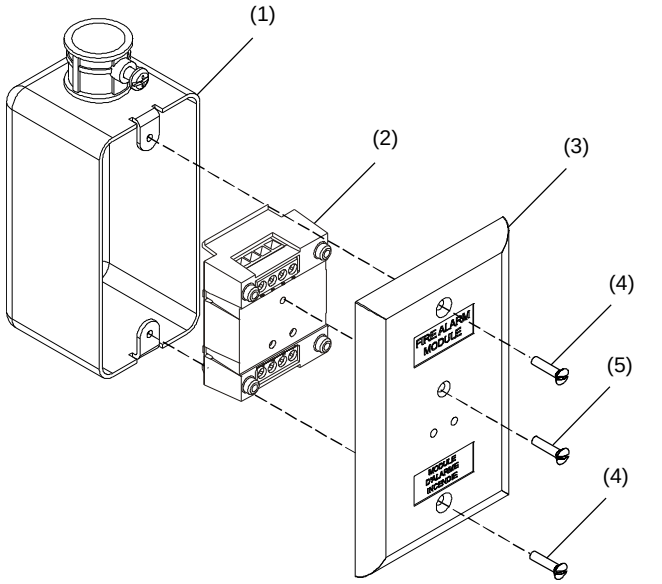
- The module is shipped from the factory as an assembled unit; it contains no user-serviceable parts and should not be disassembled.
- This module does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- The module does not support conventional smoke detectors.

Install in accordance with all applicable local codes and standards and the local authority having jurisdiction.

To install the module:

1. Wire in accordance with “Wiring” below.
2. Write the address assigned to the module on the label provided, and then apply the label to the module. Remove the serial number label from the detector, and then attach it to the project documentation.
3. Using the screw provided, mount the wall plate on the module. See Figure 1 for mounting details.
4. Using the screws provided, mount the wall plate (with the module attached) on one of the compatible electrical boxes listed in “Specifications” on page 4.

Figure 1: Mounting the IO module



(1) Compatible electrical box
(2) Module
(3) Wall plate, white (single-gang)
(4) #6-32 × 5/8 machine screw
(5) #4 × 1/2 self-tapping screw

Wiring

Wire in accordance with applicable requirements of the latest editions of the local codes and standards and the local authority having jurisdiction.

Note: When stripping wire ends, exposing more wire may cause a ground fault or circuit malfunction on unsupervised wiring; exposing less wire may result in a faulty connection.

Strip 1/4 in. (about 6 mm) from the ends of all wires that connect to the terminal block of the module.

Notes

- Refer to the Signature loop controller installation sheet for SLC wiring specifications.
- Each terminal on the module is limited to a single conductor.

To wire the module:

1. Verify that all field wiring is free of opens, shorts, and ground faults.
2. Make all wiring connections as shown in Figure 2.

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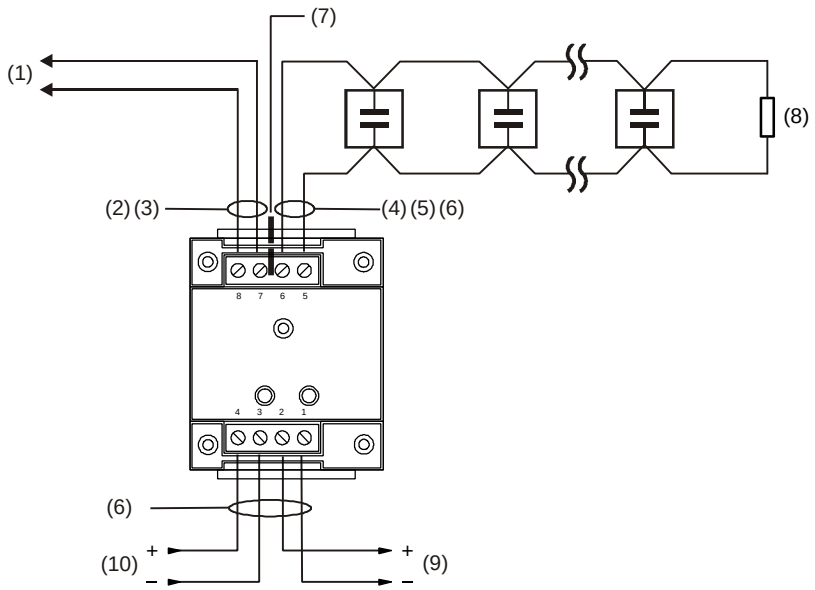
Figure 2: Wiring diagram



(1) Normally open (NO) or normally closed (NC) relay contacts (user configurable)

(2) Not supervised. Power-limited unless connected to a nonpower-limited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 *National Electrical Code* for more details.

(3) The relay function is programmable

(4) 25 Ω max per wire

(5) 10 VDC at 350 µA, max

(6) Power-limited and supervised

(7) The Nomex isolation barrier separates power-limited and nonpower-limited wiring.

(8) 47 kΩ EOL resistor (PN EOL-47) used for Class B only

(9) Signaling line circuit (SLC) to next device

(10) Signaling line circuit (SLC) from previous device

Specifications

Operating voltage	15.20 to 19.95 VDC
Current	
Standby	310 µA
Activated	450 µA
Ground fault impedance	10 kΩ
Initiating device circuit (IDC)	
Circuit resistance	50 Ω max. per channel, (25 Ω per wire)
Circuit capacitance	0.1 µF max. per channel
Circuit designation	
Signaling line circuits	Class A, Style 6 or Class B, Style 4
Contact ratings (pilot duty)	24 VDC at 2 A 120 VAC at 0.5 A
Relay type	Form A or B, programmable
Compatible electrical boxes	2-1/2 in. (64 mm) deep single-gang box; Standard 4 in. square,1-1/2 in. (38 mm) deep box
Wire size	12 to 18 AWG (0.75 to 2.5 mm²)
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93%, noncondensing
Storage temperature range	−4 to 140°F (−20 to 60°C)

Regulatory information

EU compliance	CE
EU certificate	2831-CPR-F1389
UK compliance	UKCA 0832
EN 54	EN 54-18:2005
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information, see www.recyelethis.info..

Contact information

For contact information, see www.edwardsfiresafety.com.

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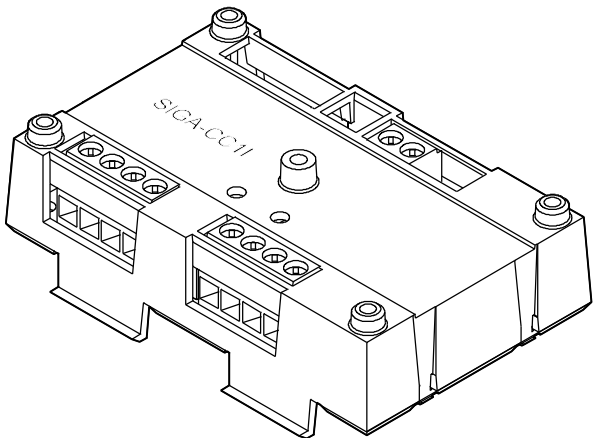
SIGA-CC1I Single Input Signal Module Installation Sheet



Description

The SIGA-CC1I Single Input Signal Module is an addressable module that is used to connect the following circuits:

- Audible and visible notification appliance circuits (synchronized or unsynchronized)
- Speaker circuits
- Two-way telephone communication circuits (three-state or four-state)

Upon command from the loop controller, the module connects supervised Class B signal or telephone circuits to the respective riser input. The riser input can be 24 VDC (to operate polarized audible and visible signal notification appliances), 25 or 70 VRMS (to operate audio evacuation speakers), or firefighter telephones.

This module does not provide signal synchronization.

The SIGA-CC1I module requires one address on the signaling line circuit (SLC). Addresses are assigned electronically. There are no address switches.

Diagnostic LEDs provide visible indication of the state of the module through the cover plate:

- Normal: Green LED flashes
- Alarm/active: Red LED flashes

Personality codes

Use the personality codes described below to configure the SIGA-CC1I module.

Personality code 5: Signal - supervised output (Class B). Configures the SIGA-CC1I module as a riser selector for audible and visible notification appliance circuits or for single-channel audio circuits. The output circuit is monitored for open or shorted wiring. If a short exists, the module will not activate in order to prevent shorting the riser. The module will activate once the short is cleared.

Personality code 6: Telephone - three-state (Class B) Configures the module as a riser selector for a three-state firefighter telephone. When a telephone handset is plugged into its jack or lifted from its hook, the module generates its own ring-tone signal, making a separate ring-tone riser unnecessary. The module sends this signal to the control panel to indicate the presence of an off-hook condition, and waits for the system operator to respond to the call. When the system operator responds, the ring-tone signal is disabled.

Personality code 26: Telephone - four-state (Class B). Configures the module as a riser selector for a four-state firefighter telephone. Operation is the same as Personality code 6 except that the module can distinguish when a telephone is off-hook and when the circuit is shorted, which causes a trouble condition.

Installation

Install in accordance with all applicable local codes and standards and the local authority having jurisdiction.

Notes

- This module is shipped from the factory as an assembled unit; it contains no user-serviceable parts and should not be disassembled.
- This module does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with your local fire protection specialist.

To install the module:

1. Connect the field wires. See “Wiring” on page 2.
2. Write the address assigned to the module on the label provided, and then apply the label to the module. Remove the serial number label from the module and, and then attach it to the project documentation.

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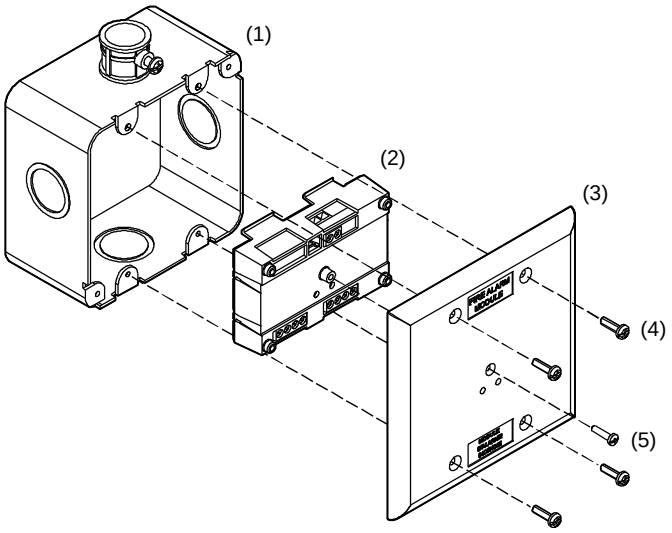
3. Using the self-tapping screw, attach the wall plate to the module. See Figure 1.
4. Using the four machine screws, attach the wall plate (with the module) to the electrical box.

Figure 1: Installing the SIGA-CC1I module



(1) Compatible electrical box
(2) SIGA-CC1I module
(3) Wall plate
(4) #6-32 × 5/8 machine screw (4X)
(5) #4 × 1/2 self-tapping screw

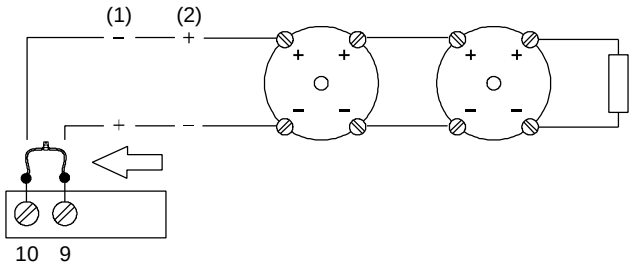
Protection from transient spikes

For installations in which the output circuit connects to electromechanical bells or horns, install a bipolar transient protector (P/N 235196P) to protect the module from transient spikes caused by switching inductive loads. Locate bells and horns at least 6 ft. (1.8 m) from the module.

To install a bipolar transient protector:

1. Install the transient protector across the output circuit inside the electrical box with the module. See Figure 2.

Figure 2: Bell circuit showing bipolar transient protector placement



(1) Normal state
(2) Active state

Wiring

Wire this device in accordance with applicable national and local codes, ordinances, and regulations.

General wiring notes

- Refer to the Signature loop controller installation sheet for SLC wiring specifications. Refer to the firefighter phone installation sheet for additional details.
- Each terminal on the module is limited to a single conductor.
- Test resistors are supplied with the SIGA-CC1I to prevent trouble signals on unused circuits during installation. When connecting field wires, remove the test resistors and install a 47 kΩ EOLR at the end of the circuit.
- This module does not support conventional smoke detectors.

Riser wiring notes

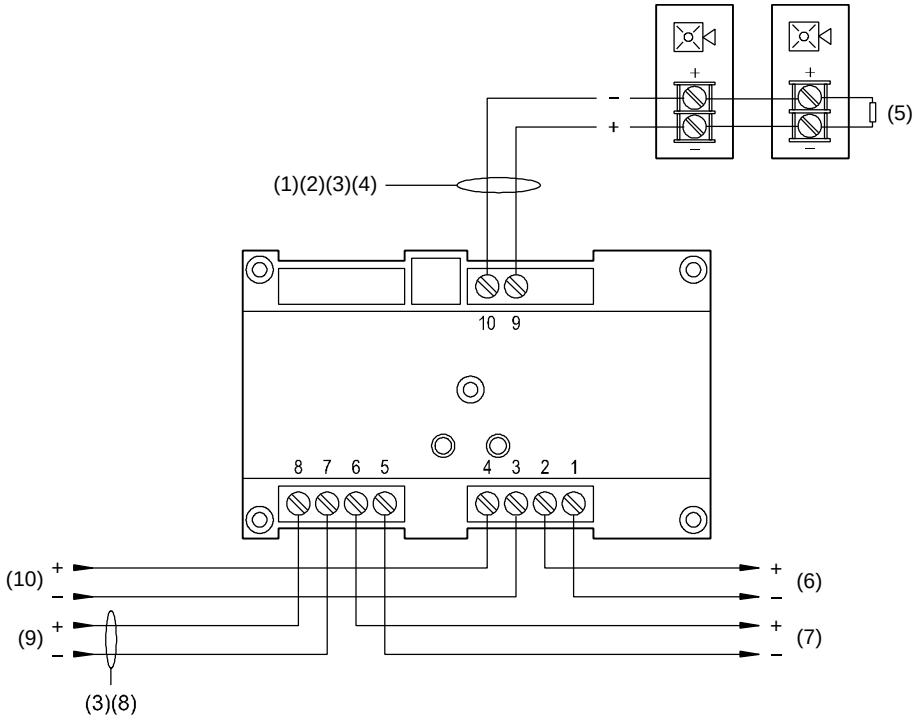
- For maximum line impedance, refer to the installation manual for the fire alarm panel. Maximum circuit capacitance is 0.1 µF.
- If the riser is used for more than one notification zone, install in accordance with the survivability from attack by fire requirements in NFPA 72 *National Fire Alarm and Signaling Code.*
- Circuit and riser wiring is different when four-state firefighter telephones are installed on three-state circuits. Before replacing a SIGA-CC1I module, tag the wires to ensure correct reconnection.
- The SIGA-CC1I module does not supervise the riser; the fire alarm control panel provides this function.

To wire the module:

1. Verify that all field wiring is free of opens, shorts, and ground faults.
2. Strip 1/4 in. (about 6 mm) from the ends of all wires that connect to the terminal block of the module.

   When stripping wire ends, exposing more wire may cause a ground fault; exposing less wire may result in a faulty connection.
3. Connect the field wires. See Figure 3 to Figure 5.

Figure 3: Wiring diagram for NAC (personality code 5)



(1) Signal polarity is shown when the circuit is in supervisory state. Polarity reverses when the circuit is active.

(2) Supervised.

(3) Power-limited unless connected to a nonpower-limited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 *National Electrical Code* for more details.

(4) If using a G1-P Genesis series horn while connected to a compatible fire alarm control panel, a CDR-3 Bell Coder must be used to comply with ANSI S3.41.

(5) 47 kΩ EOLR (P/N EOL-47).

(6) Signaling line circuit (SLC) to next device.

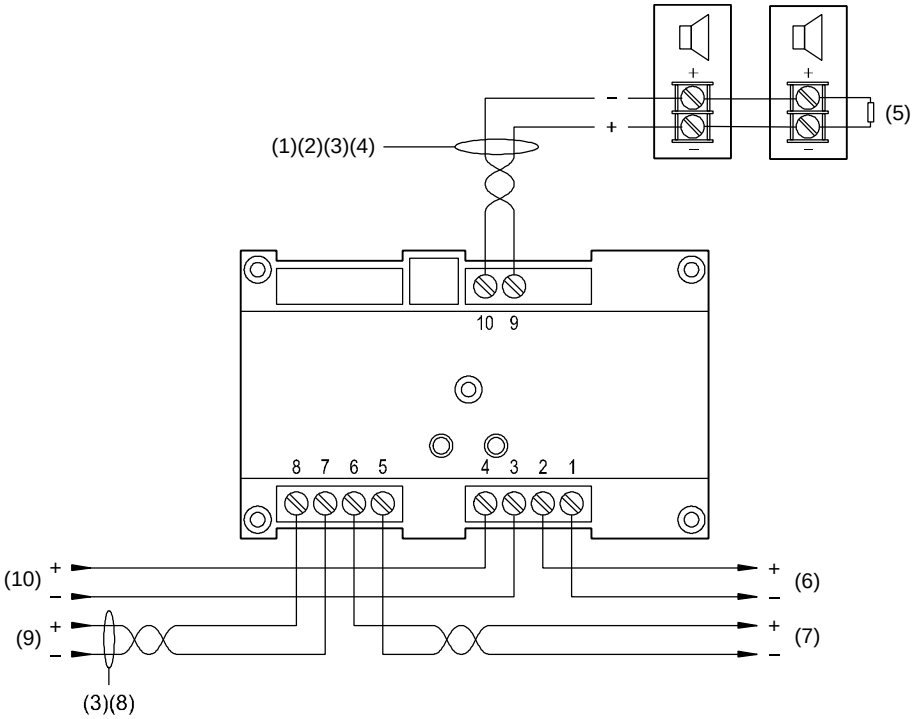
(7) AUX riser (to next module or riser supervisory device).

(8) Power-limited regulated, 24 VDC power supply that is approved for fire protective signaling service.

(9) AUX riser (from previous device).

(10) Signaling line circuit (SLC) from previous device. Supervised and power-limited.

Figure 4: Wiring diagram for audio (personality code 5)



(1) Signal polarity shown when the circuit is in supervisory state. Polarity reverses when the circuit is active.

(2) Supervised.

(3) Power-limited unless connected to a nonpower-limited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 *National Electrical Code* for more details.

(4) Unshielded twisted pair.

(5) 47 kΩ EOLR (P/N EOL-47).

(6) Signaling line circuit (SLC) to next device.

(7) Audio riser (to next module or supervisory end of line device).

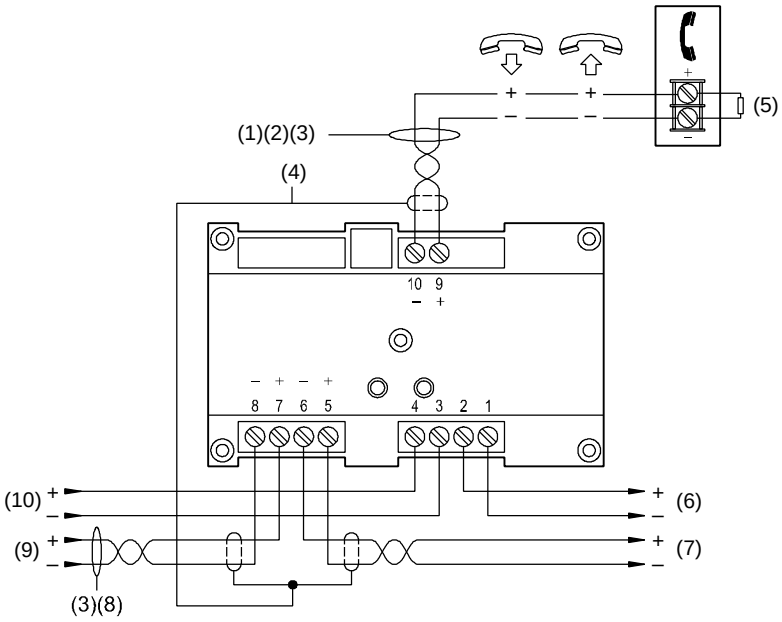
(8) Unshielded twisted pair. Use shielded twisted pair when installed in the same conduit as with a telephone riser.

(9) Audio riser (from previous device).

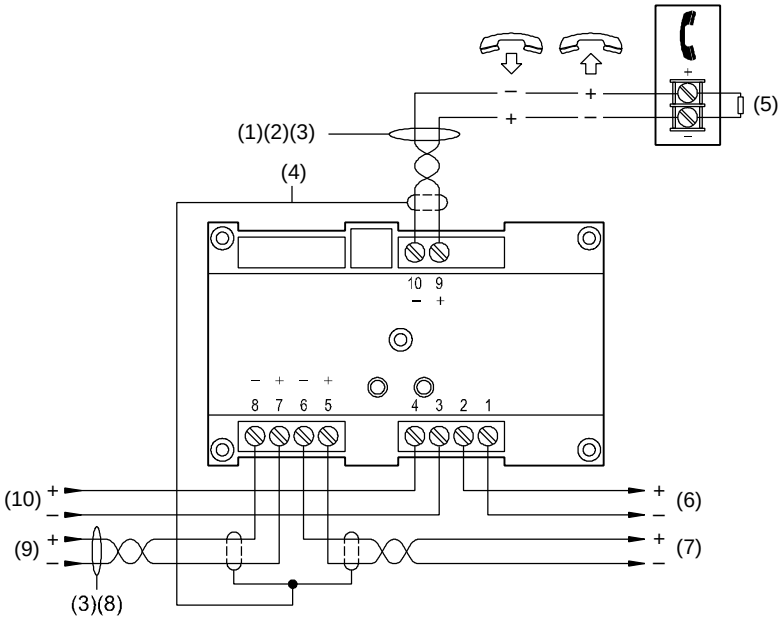
(10) Signaling line circuit (SLC) from previous device. Supervised and power-limited.

Figure 5: Class B telephone (personality codes 6 and 26)

Three-state telephone circuit (personality code 6)



Four-state telephone circuit (personality code 26)



(1) Telephone circuit. The plus and minus symbols indicate signal polarity.

(2) Supervised.

(3) Power-limited unless connected to a nonpower-limited source. If the source is nonpower-limited, eliminate the power-limited mark and maintain a minimum of 0.25 in. (6.4 mm) space from power-limited wiring. For other mounting methods, see enclosure and bracket installation sheets to maintain separation of power-limited and nonpower-limited wiring. The wire size must be capable of handling fault current from nonpower-limited source.

— or —

Use type FPL, FPLR, FPLP, or permitted substitute cables, provided these power-limited cable conductors extending beyond the jacket are separated by a minimum of 0.25 in. (6.4 mm) space or by a nonconductive sleeve or nonconductive barrier from all other conductors. Refer to the NFPA 70 *National Electrical Code* for more details.

(4) Required if the distance from the SIGA-CC1I to the phone is greater than 5 ft. Shield must be continuous, insulated, and isolated from ground, except for the connection to chassis ground in the control panel.

(5) 47 kΩ EOLR (P/N EOL-47).

(6) Signaling line circuit (SLC) to next device.

(7) Telephone riser (to next module or end-of-line supervisory device).

(8) Use shielded twisted pair. Shields must be continuous and grounded at the panel end.

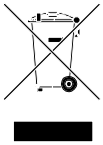
(9) Telephone riser (from previous device).

(10) Signaling line circuit (SLC) from previous device. Supervised and power-limited.

Specifications

Operating voltage range	15.20 to 19.95 VDC
Current	
Standby	310 µA
Activated	135 µA
Maximum line impedance	Refer to the control panel installation manual
Ground fault impedance	10 kΩ
Output ratings (special applications)	
24 VDC	2 A
25 VRMS audio	50 W
70 VRMS audio	35 W
EOL resistor value	47 kΩ
Circuit resistance	Refer to the control panel installation manual
Circuit capacitance	0.1 µF max.
EOLR	47 kΩ (P/N EOL-47)
Circuit designation	
Signaling line circuits	Class A, Style 6 or Class B, Style 4
Telephone riser circuits	Class B, Style 4
Notification line circuits	Class B, Style Y
LPCB/CPR electrical box	
Requirements	Plastic box with cover plate, no gaps or unused holes
Minimum size W × H × D	3.5 × 3.5 × 1.5 in. (85 × 85 × 38 mm)
Compatible electrical boxes	2-1/2 in. (64 mm) deep dual-gang box; 4 in. square box 1-1/2 in. (38 mm) deep box with a dual-gang cover
Wire sizes	12 to 18 AWG (1.0 to 4.0 mm²)
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93%, noncondensing
Storage temperature range	−4 to 140°F (−20 to 60°C)

Regulatory information

EU compliance	CE
EU certificate	2831-CPR-F0840
UK compliance	UKCA 0832
EN 54	EN 54-18:2005
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Contact information

For contact information, see www.edwardsfiresafety.com.

P/N 3102184-EN • REV 005 • ISS 18APR22

Li-ion Tamer Interface Module Specification

Product Description

This module is Li-ion Tamer supporting interface product (LT-SEN-IM), which can help customers use it independently and directly. Li-ion Tamer detector products, no additional controller purchase. It is suitable for miniaturized energy storage applications such as outdoor energy storage cabinets and independent lithium-ion battery racks. It is convenient for the system integration before the manufacturer leaves the factory, eliminating the interconnection between the cabinets and other engineering.

• This product is a sensor signal conversion module, this module is used to receive Li-ion Tamer lithium battery mixed gas leak detection sensor signals, at the same time can supply power to Li-ion Tamer sensor.
• The module converts the received signal to the relay output.
• The module has a status indicator to indicate different operating states of the Li-ion Tamer sensor.
• The module has RS485 Modbus and CAN-bus communication interfaces, through which the Li-ion Tamer sensor status CAN be reported.

本模块为 Li-ion Tamer 配套接口产品（LT-SEN-IM），可以帮助客户独立直接使用；Li-ion Tamer 探测器产品，无需额外控制器采购。适用于户外储能柜、独立锂离子电池机架等小型化储能应用场景。便于制造商出厂前的系统集成，省去现场机柜间互联等工程。

- 本产品是一种传感器信号转接模块，此模块用于接收 Li-ion Tamer 锂电池混合气体泄露检测传感器信号，同时可以向 Li-ion Tamer 传感器供电。
- 模块将接收到的信号转化为继电器干节点输出。
- 模块具有状态指示灯，可以指示 Li-ion Tamer 传感器不同的工作状态。
- 模块具有 RS485-Modbus 和 CAN-Bus 通信接口，可以通过这两个通信接口上报 Li-ion Tamer 传感器的状态。

参考标准
UL61010-1
EN50581-2002
EN55011-2010
EN61326-1-2013

Table of Contents

Revision History

Date	Document	Revision	Changed By	Comment
2022-10-18	S00-0088-000A	A	CXT	

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Device Specifications

Table 1 – Environmental Specifications

Specification	Value
Non-Condensing Humidity	10% to 95% RH
Operating Temperature	-30°C to 80°C

Table 2 – Mechanical Specifications

Specification	Value
Height	140mm
Width	85mm
Thickness	32.8mm
Shipping Weight	365g

Table 3 – Terminal Connections

		RJ45	Connect the Li-ion Tamer
DC+	Power input cable – Positive	Alert1 NO	Relay interface – Alert1 state
DC-	Power input cable – Negative	Alert1 COM	
RS485A	RS485 – Port A	Alert2 COM	Relay interface – Alert2 state
RS485B	RS485 – Port B	Alert2 NO	
CAN_L	CAN Bus – Port L	Fault NO	Relay interface – Fault state
CAN_H	CAN Bus – Port H	Fault COM	

Table 4 – Electrical Specifications

Specifications	Min	Nor	Max	Units	Comments
Supply Voltage	15	24	32	V_{DC}	Input DC voltage
Supply Current	15	20	40	mA	Input DC current with Li-Tamer detector load
Power	0.4	0.5	0.8	W	Input power with Li-Tamer detector load
Relay load Voltage			30/125	V_{DC}/V_{AC}	Relay capacity
Relay load Current			2/0.5	A_{DC}/A_{AC}	Relay capacity
Output Voltage (RJ45)		5		V_{DC}	Power supply for Li-ion Tamer
Output Current (RJ45)		53	100	mA	

Table 4 – Communication Specifications

Specifications	Min	Nor	Max	Units	Comments
Number of nodes			12		Max 12 nodes can be connected
communication distance			12	m	Distance between two nodes
Status reading frequency	1			s	The upper computer reads module status command sending frequency

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Application method

- o 接口模块左侧上方是 RJ45 接口，用于与 Li-ion Tamer 探测器连接；
  The RJ45 port on the upper left of the interface module is used to connect to the Li-ion Tamer detector.
- o 左下方具有 DC 电源输入接口、RS485 和 CAN 总线接口；
  DC power input interface, RS485 and CAN bus interface are provided in the lower left corner.
- o 右侧是继电器输出端子，可以将 Li-ion Tamer 探测器状态输出。
  On the right is the relay output terminal, which can output the Li-ion Tamer detector status.
- o 模块也可以通过正面 3 个 LED 灯指示 Li-ion Tamer 探测器状态。
  The module can also indicate the Li-ion Tamer detector status through three LED lights on the front.
- o 模块具有外壳接地，以提高模块抗干扰能力。
  module has shell grounding to improve the anti-jamming ability of the module.

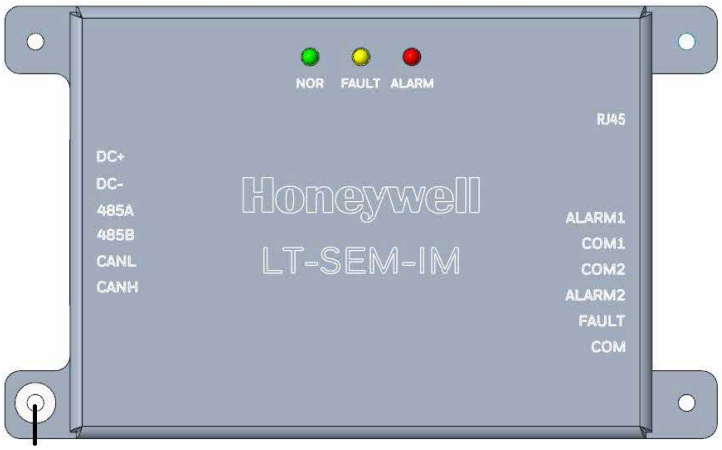

Table 5 – Status indicator description

Li-ion Tamer State	Relay Output	LED
Normal	/	LED NOR, Green, Steady
Alarm	Alert1 & Alert2	LED Alarm Red, Steady
Fault	Fault	LED FAULT, Yellow, Steady
Initialization	/	LED NOR, Green, Blink
Unconnected	/	LED FAULT, Yellow, Steady
Other	/	LED FAULT, Yellow, Blink

Li-ion Tamer State	RS485&CAN data	Sensor state voltage 传感器状态电压	ADC 判定范围 （12bit ADC）
Normal	0x01	0.5V ± 0.05V	0.25~2.5V
Alarm	0x02	3V ± 0.3V	2.7~3.3V
Fault	0x03	0.1V ± 0.05V	0~0.15V
Initialization	0x04	0.25V ± 0.05V	0.15~0.25V
Other	0x05	Other	Other

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Communication Specifications

Table 3 – RS485-Modbus Commands

Baud: 9600 bit/s;Parity: None;Data Bites: 8bits;Stop Bits: 1bit;

➢ 读 **LT-SEM-IM** 状态命令：**(Read LT-SEM-IM status command)**

主机发送：Host Send

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 状态寄存器地址	16bit 寄存器数量	16bit CRC
0x02	0x03	0x4001	0x0001	先低后高

主机地址为 0x01；从机模块默认地址为 0x02；

从机响应回复：Slave Reply

1	2	3	4	5
8bit 地址	8bit 功能码	8bit 字节总数	16bit 寄存器数据	16bit CRC
0x02	0x03	0x02	0x0001：正常状态 0x0002：报警状态 0x0003：故障状态 0x0004：预热状态 0x0005：异常状态	先低后高

➢ 读取 **LT-SEM-IM** 地址：**(Read the address of the slave command)**

主机发送：Host Send

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 地址寄存器地址	16bit 寄存器数据	16bit CRC
0x00	0x03	0x4002	0x0000	先低后高

主机地址为 0x01；从机模块默认地址为 0x02；

从机响应回复：Slave Reply

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 地址寄存器地址	16bit 寄存器数据	16bit CRC
0x02	0x03	0x4002	0x0002	先低后高

➢ 修改 **LT-SEM-IM** 地址：**(Change the address of the slave command)**

主机发送：Host Send

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 地址寄存器地址	16bit 寄存器数据	16bit CRC
0x02	0x06	0x4002	0x0003	先低后高

主机发送命令，将从机模块地址由默认值 0x0002 改为 0x0003；
从机模块地址设置范围 0x0002 ~ 0x003F （即 2~63）

从机响应回复：Slave Reply

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 地址寄存器地址	16bit 寄存器数据	16bit CRC
0x03	0x06	0x4002	0x0003	先低后高

➢ 自检功能：主机发送命令使模块所有 **LED** 灯和继电器同时动作，持续 **5s**，并读取模块当前 **ADC** 采样值；

主机发送：Host Send

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 状态寄存器地址	16bit 寄存器数量	16bit CRC

0x02	0x06	0x4004	0x0001	先低后高

主机地址为 0x01；从机模块默认地址为 0x02；

从机响应回复：Slave Reply

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 状态寄存器地址	16bit ADC 采样值	16bit CRC
0x02	0x06	0x4004	0x0000 ~ 0xFF0F （12bitADC 先低后高）	先低后高

➢ 读 **LT-SEM-IM** 固件版本命令：（**Read Firmware vision command**）

主机发送：Host Send

1	2	3	4	5
8bit 地址	8bit 功能码	16bit 状态寄存器地址	16bit 寄存器数量	16bit CRC
0x02	0x03	0x4005	0x0001	先低后高

主机地址为 0x01；从机模块默认地址为 0x02；

从机响应回复：Slave Reply

1	2	3	4	5
8bit 地址	8bit 功能码	8bit 字节总数	16bit 寄存器数据	16bit CRC
0x02	0x03	0x02	0x0100：即 V1.0 版本	先低后高

Table 4 – CAN-BUS Commands

本模块采样标准数据帧结构；Baud Rate：500K bit/s

标识符 Identify（ID）定义

1bit（方向）	**4bit**（功能码）	**6bit**（节点地址）
0 主机向从机 1 从机向主机	0001 代表主机获取从机状态命令 0010 代表主机获取从机地址命令 0011 代表点对点消息	出厂默认地址 00 0010

从机模块出厂默认地址 00 0010 即 2；

主机地址建议设置为 00 0001 即 1；

➢ **0001** 功能码定义：主机获取从机状态命令 **Host Send**

Idntifier			DLC	Data
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit
0	0001	00 0010	0001	0000 0000
0x042			0x1	0x00

主机地址为 00 0001；从机模块默认地址为 00 0010；

LT-SEM-IM 响应 0001 功能码 Slave Reply

Idntifier			DLC	Data
1bti 方向	4bit 功能码	地址 6bit	4bit	8bit
1	0001	00 0010 （LT-SEM-IM 出厂默认地址）	0001	0x01：正常状态 0x02：报警状态 0x03：故障状态 0x04：预热状态 0x05：异常状态
0x442			0x1	

➢ **0010** 功能码定义：主机获取节点地址命令 **Host Send**

Idntifier			DLC	Data
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit
0	0010	00 0000	0x1	0x00

0x080		

主机地址为 00 0001；从机模块默认地址为 00 0010；

LT-SEM-IM 响应 0010 功能码 Slave Reply

Idntifier			DLC	Data
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit
1	0010	00 0010	0x1	0x02 当前节点地址
0x442				

➢ **0011** 功能码定义：主机发送点对点消息（设置节点地址命令）**Host Send**

Idntifier			DLC	Data	
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit	8bit
0	0011	00 0010 （LT-SEM-IM 出厂默认地址）	0x2	0x01 （设置节点地址命令）	0x03 （将节点地址修改为 3）
0xC2				先低后高	

主机地址为 00 0001；从机模块默认地址为 00 0010；
主机发送命令，将从机地址由默认值 00 0010 改为 00 0011；
从机地址设置范围 0x02 ~ 0x3F （即 2~63）；

LT-SEM-IM 响应点对点消息（设置节点地址命令）Slave Reply

Idntifier			DLC	Data	
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit	8bit
1	0011	00 0011	0x2	0x01 （设置节点地址命令）	0x03 （将节点地址修改为 3）
0x4C3				先低后高	

➢ **0100** 功能码定义：自检功能，主机发送命令，使从机所有 **LED** 灯及继电器动作，持续 **5s**

Idntifier			DLC	Data
1bit 方向	4bit 功能码	6bit 节点地址	4bit	8bit
0	0100	00 0010	0x1	0x00
0x102				

主机地址为 00 0001；从机模块默认地址为 00 0010；

LT-SEM-IM 响应 0001 功能码 Slave Reply

Idntifier			DLC	Data
1bti 方向	4bit 功能码	地址 6bit	4bit	16bit
1	0100	00 0010 （LT-SEM-IM 出厂默认地址）	0x2	0x0000 ~ 0xFF0F （12bitADC 先低后高）
0x102				

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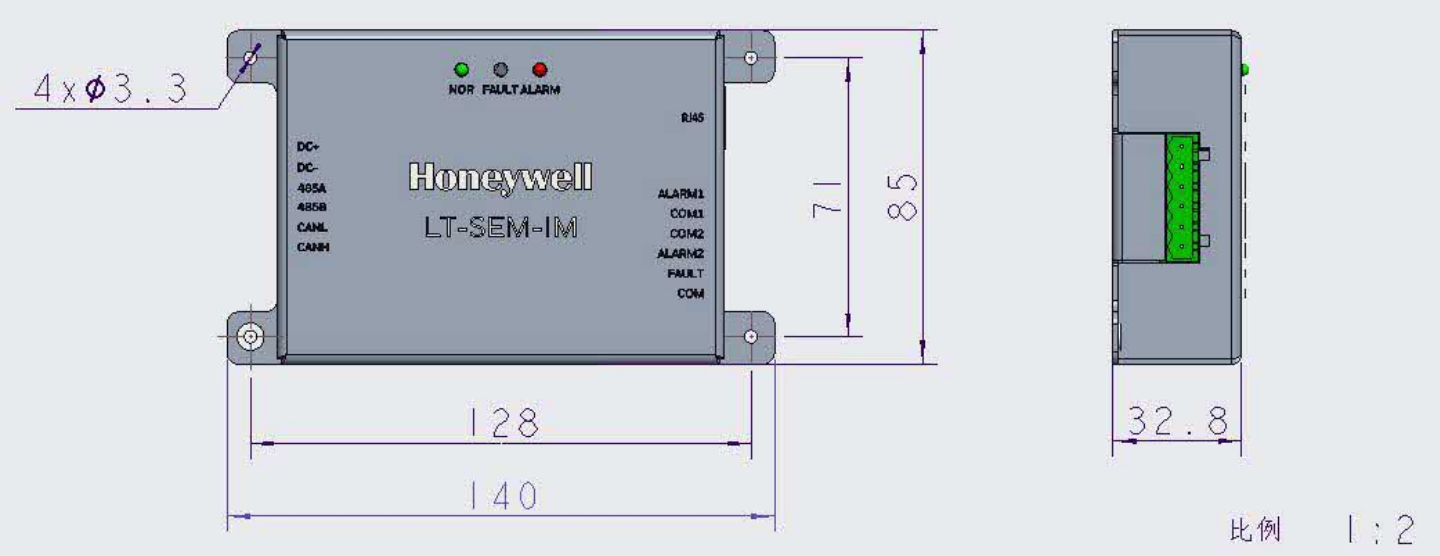
Structure Specifications



unit: mm

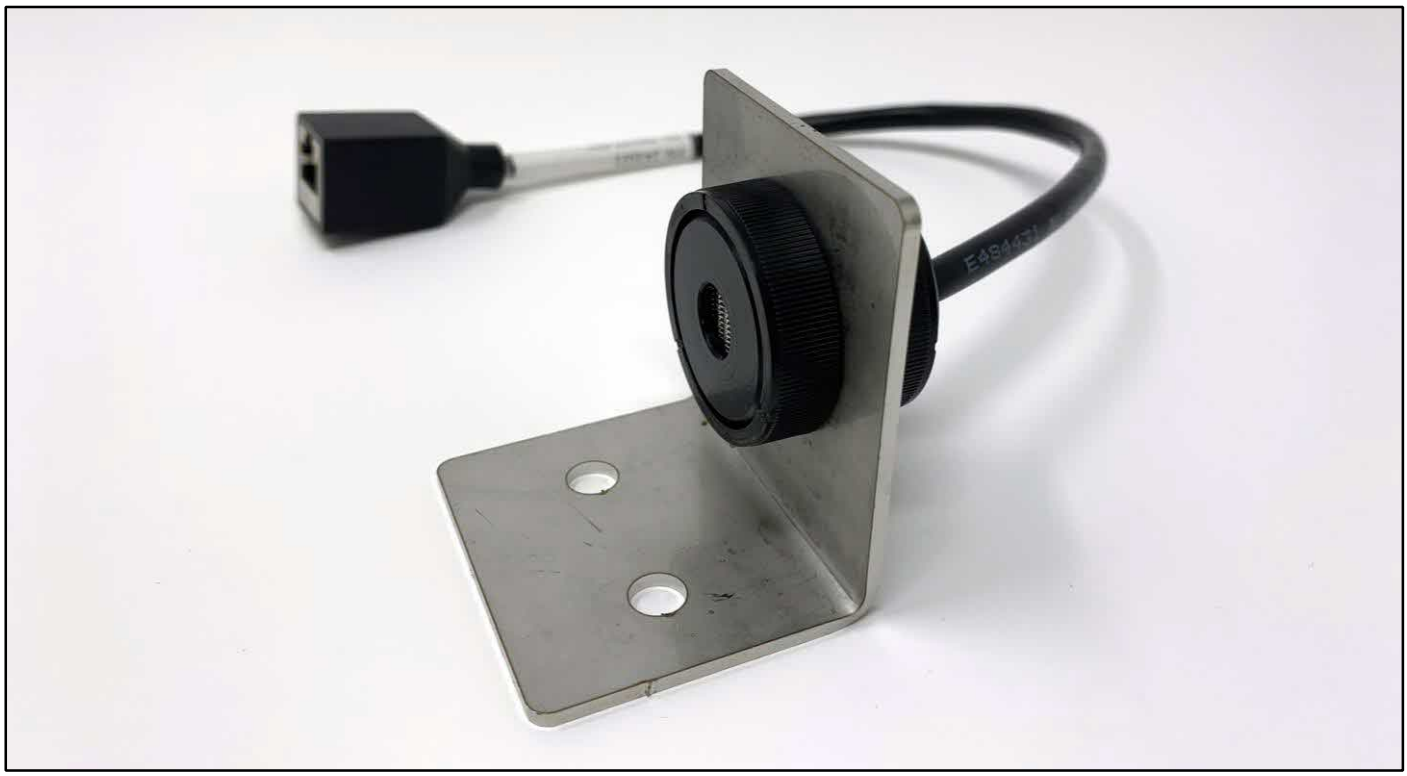
2022-10-18	**See Revision History**	**CXT**	**A**
DATE	DESCRIPTION OF CHANGE	CHANGED BY	REV
THIS PRINT AND INFORMATION THEREIN ARE PROPRIETARY TO SYSTEM SENSOR AND SHALL NOT BE USED IN WHOLE OR IN PART WITHOUT THEIR EXPRESSED CONSENT.		**Honeywell**	High-tech Branch. 40 Zhangba 2nd Road, High-tech Zone, Xi 'an
TITLE **Product Spec, Li-ion Tamer Interface Module**		DRAWING NUMBER **S00-0088-000A**	SHEET **8 : 8**

LI-ION TAMER®

Li-ion Tamer Fault Detector – Module

Lithium Ion Battery Monitoring System – PN 241022

Technical Datasheet



Product Description:

The Fault Detector – Module Level product is a low-power and compact device that monitors lithium-ion batteries for increased safety. The monitor is integrated into lithium-ion battery systems and provides a signal that indicates whether a single cell within the module has experienced an off-gassing event.

Our products provide value through gas sensing that is acutely sensitive to battery electrolyte solvent vapors. This sensing ability is paired with proprietary algorithms and creates a product that can detect a single cell failure without electrical interrogation or mechanical contact of the cells. At times, the Fault Detector can detect battery failures prior to traditional monitoring methods such as temperature and voltage monitoring. By delivering warning well ahead of thermal runaway the Fault Detector enables battery failure prevention.

The utilization of off-gas monitoring creates a completely independent perspective of battery health that can be used to provide an extra layer of safety for your lithium-ion battery systems.

Key Features:

- Compatible with all lithium-ion battery form factors and chemistries
- Parts-per-million level detection threshold
- Calibration-free product
- Distributed sensing network provides localized gas detection
- Provides early warning of lithium-ion battery failures
- Long product lifetime
- Fast response time to off-gassing events
- Highly reliable output signal
- Low power consumption
- Several mounting options
- Unobtrusive sensor with easy installation
- Independent and redundant perspective on battery health

LI-ION TAMER®

Li-ion Tamer Fault Detector – Module

Lithium Ion Battery Monitoring System – PN 241022

Physical description:

The Fault Detector Module Level product consists of an off-gas monitor with several mounting options, intended to be placed within a battery module. The product then offers sensing capability of gas space around the battery module and will have the capability to provide early warning of battery failures.

*Custom cable lengths are available. Adapter available for bare wire usage.

Physical specifications

Part	Dimensions
Sensor	Ø 28.6 x 25.4 [mm]
Monitor cable	165 [mm]*
Connector type	Female RJ45
Wire type	Brown (POWER +) Green/White (GND) Brown/White (SIGNAL +)

Environmental description:

The Fault Detector product is intended to be integrated into spaces with lithium-ion batteries and, therefore, has very similar specifications to that of a standard lithium-ion battery system.

Environmental specifications

Condition	Specification
Temperature (Operate)	-10 to +60°C
Temperature (Store)	-10 to +70°C
Humidity	5 to 95% RH
Max temperature change	8.6°C/min

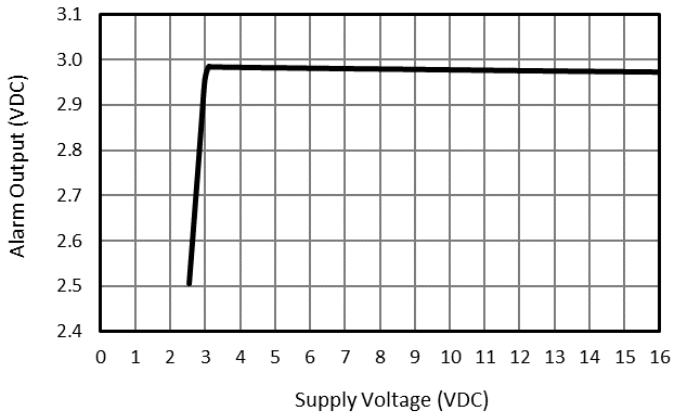
Electrical description:

The Fault Detector product provides signals specific to the battery module where it is installed. With this localized signal, you will be able to know not only when your battery module is experiencing a problem, but also you will have early warning of a fully developed lithium-ion battery failure. Signal outputs from the Fault Detector can be tied into a BMS or other controller.

Electrical specifications

Detail	Specification
Controller power input	3 - 16 VDC
Power consumption	275 mW (@ 5VDC and 25°C)
Output signal (error state)	0.10 VDC
Output signal (warm up)	0.25 VDC
Output signal (OK)	0.50 VDC
Output signal (alarm)	3.0 VDC (see graph below)

ALARM OUTPUT vs SUPPLY VOLTAGE



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LI-ION TAMER®

Li-ion Tamer Fault Detector – Module

Lithium Ion Battery Monitoring System – PN 241022

Gas detection description:

The Fault Detector is equipped with a sensing element that is acutely sensitive to lithium-ion battery electrolyte solvent vapors. This acute sensitivity is how this product is able to provide indication of a single cell battery failure without electrical or mechanical contact of battery cells.

Gas detection specifications	
Detail	**Specification**
Target gases	Lithium ion battery electrolyte solvent vapors
Min. detection threshold	<1 ppm/sec
Response time	5 seconds
Fault detection	Single cell failure

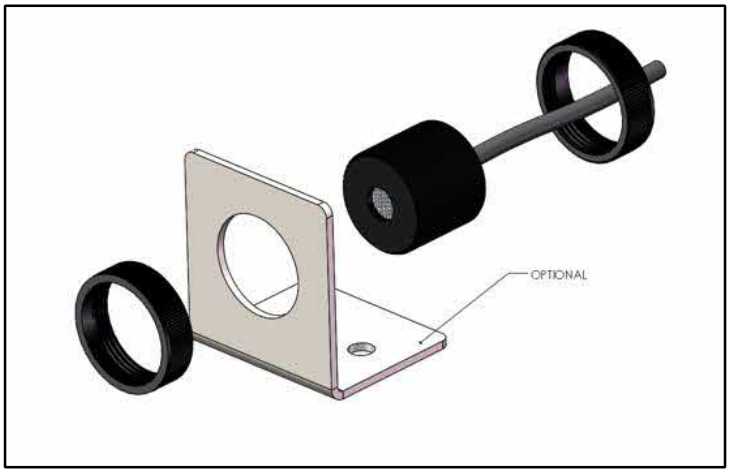
Product life description:

The associated algorithms provided an extended lifetime product that does not require calibration. The product is intended to have comparable lifetime to lithium-ion battery systems.

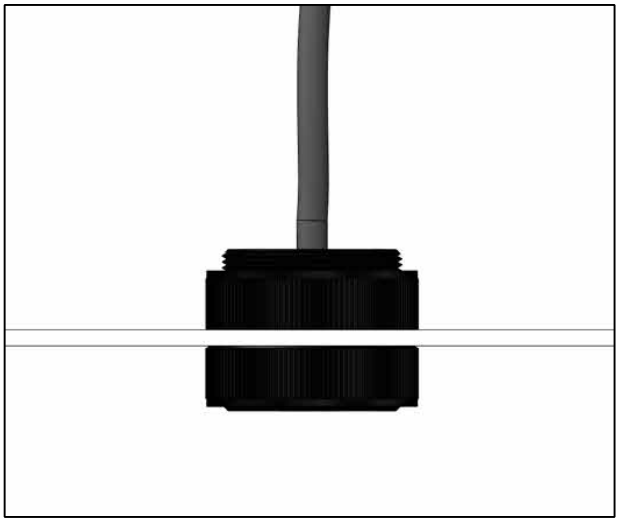
Product life specifications	
Detail	**Specification**
Target lifetime	10 years
Warranty	1 year

Product certifications	
Detail	Standard/Directive
Product Safety	UL/IEC 61010
EMC	EN 60326-1 for EU Directive (2014/30/EU)
RoHS	RoHS 3 EU 2015/863

Mounting bracket



Through-wall mount



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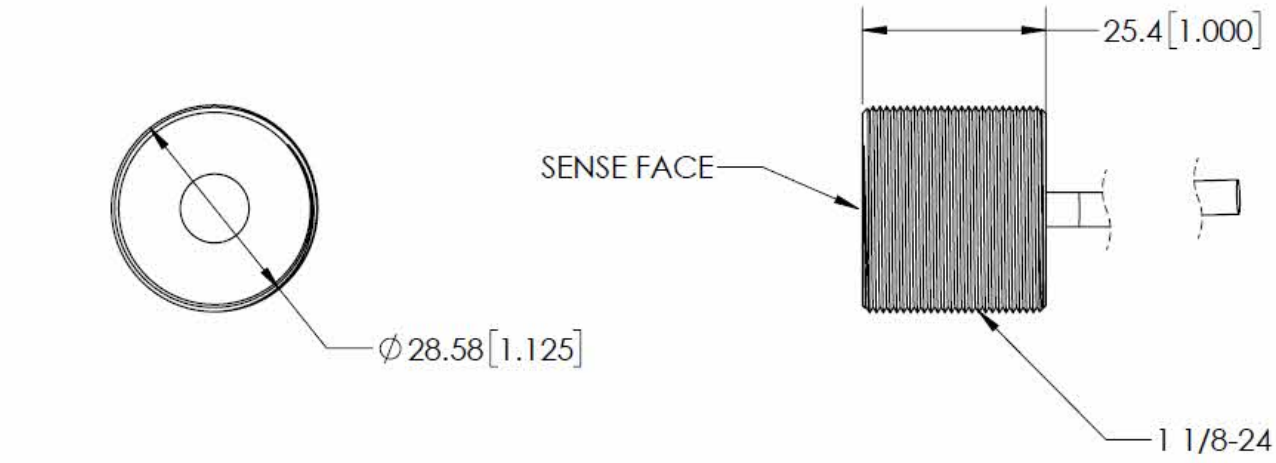
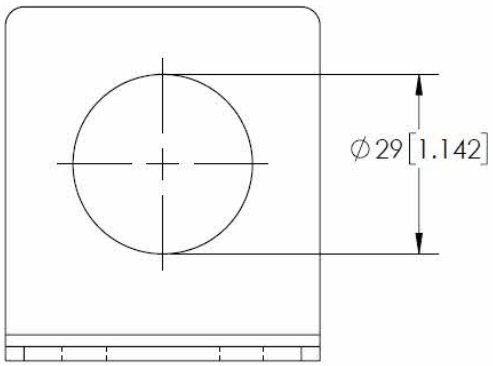
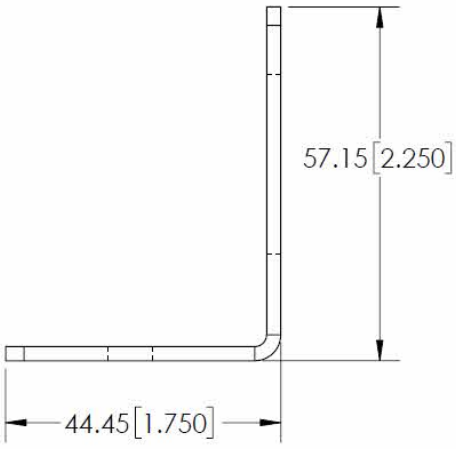
LI-ION TAMER®

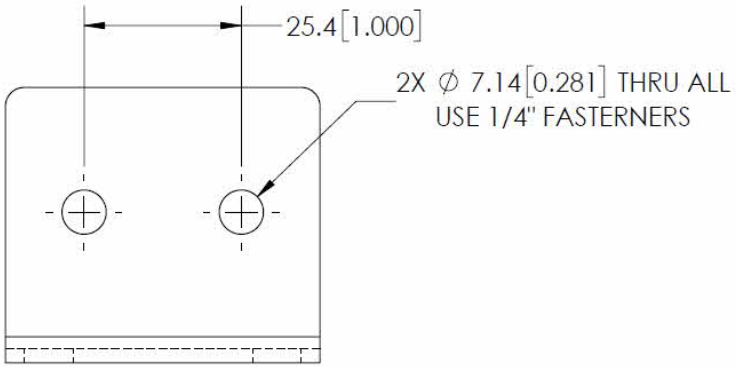
Li-ion Tamer Fault Detector – Module

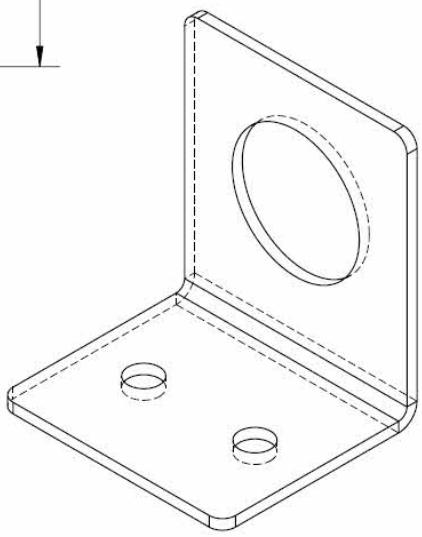
Lithium Ion Battery Monitoring System – PN 241022











NOTICE *This device detects off-gas from lithium-ion batteries. It does not prevent fires or thermal runaway. This device is not a stand alone safety device and should be incorporated into a proper safety system. If device responds, there is a risk of battery fault which could lead to thermal runaway. To avoid injury, leave area immediately.*

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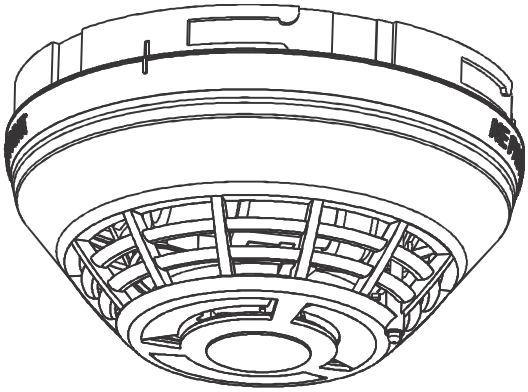
SIGA-HRDI Intelligent Heat Detector Installation Sheet



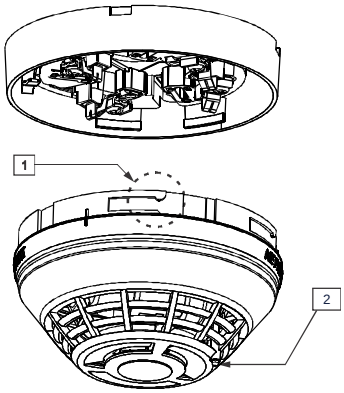
Description

The Signature Series model SIGA-HRDI Intelligent Heat Detector is an intelligent device that uses a heat sensor to detect fire. The heat sensor monitors the temperature of the surrounding air and the detector analyzes the data from the sensor to determine whether to initiate an alarm. The fixed-temperature heat function detects fire when the air temperature near the detector exceeds the alarm point.

LED indicator. The LED indicator (see Figure 1) displays the following states:

- Normal: Green LED indicator flashes. No action.
- Alarm/active: Red LED indicator flashes. Evacuate the area.

Figure 1: SIGA-HRDI features



(1) Self-locking tab
(2) LED indicator

Installation

Notes

- This detector does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- This detector does not sense fires in areas where heat cannot reach the detector. Heat from fires in walls, roofs, or on the opposite side of closed doors may not reach the detector.
- This heat detector by itself does not provide life safety protection. Use this detector in conjunction with ionization or photoelectric smoke detectors, or both for life safety situations.
- This detector does not detect oxygen levels, smoke, toxic gases, or flames. Use this device as part of a broad-based life safety program which includes a variety of information sources pertaining to heat and smoke levels, extinguishment systems, visual and audible devices, and other safety measures.
- Independent studies indicate that heat detectors should only be used when property protection alone is involved. Never rely on heat detectors as the sole means of fire protection.
- To ensure proper operation, store the detector within the recommended ranges. Allow the detector to stabilize to room temperature before applying power.
- The dust cover (supplied) must remain on the detector during installation and be removed prior to commissioning and service. The dust cover is not a substitute for removing the detector during new construction or heavy remodeling.

To install the detector:

1. Install and wire the base, as described on the installation sheet supplied with the base.
2. Remove the serial number label from the detector and attach it to the project documentation.
3. Attach the detector to the base by rotating the detector clockwise until it snaps into the locked position.

Testing

Before testing, notify the proper authorities that the fire alarm system is undergoing maintenance and will be temporarily out of service.

Caution: Heat damage. Excessive heat may damage the detector outer cover. Do not apply excessive heat when using a hair dryer. When using a Testifire detector tester, you must install a SIGA2 Testifire Adapter Assembly.

Make sure the SIGA2 Testifire Adapter Assembly (model SIGA2-TSTSPACER) is installed in the Testifire detector tester before testing. Refer to the *SIGA2-TSTSPACER Testifire Adapter Assembly Installation Sheet* (P/N 3101942-ML) for further details.

To perform an initial installation test:

1. Visually inspect each detector and verify that it is installed in the correct location. Make sure it is not adversely affected by factors not apparent on the plans.
2. Remove the detector from its base and verify that the proper detector address, trouble signals, and messages are reported.
3. If wired for Class A operation, verify that the detector continues to operate first with the SLC_IN disconnected, and then with the SLC_OUT disconnected. (Refer to the installation sheet for the base.)
4. Place a momentary ground fault on the SLC circuit to verify operation of the ground fault detection circuitry.

P/N 3102510-EN • REV 001 • ISS 15SEP17

5. Perform a sensor function test, as described below.

To perform a function test:

1. If desired, use the fire alarm control panel to put the detector or zone into a service group for testing. (Refer to the panel technical reference manual for instructions.)
2. Activate the heat sensor using a hair dryer (maintaining a distance of three inches) or using a Testifire detector tester per the manufacturer's instructions.

Maintenance

To ensure proper operation, plan maintenance (regular or selected) of the detector in accordance with the AHJ and all applicable governing laws, codes, or standards.

Specifications

Operating voltage	15.20 to 19.95 VDC
Current	
Normal operating	51 µA
Alarm	68 µA
Vibration level	10 to 35 Hz, with an amplitude of 0.01 in.
Rate-of-rise	8°C/min
Maximum spacing [1]	15.2 m centers
Compatible bases	
Standard	SIGA-SB, SIGA-SB4
Relay	SIGA-RB, SIGA-RB4
Isolator	SIGA-IB, SIGA-IB4, SIGI-IBS
Audible	SIGA-AB4GI
Compatible detector testers [2]	Testifire 1000, Testifire 2000
Operating environment	
Temperature	0 to 38°C
Relative humidity	0 to 93% noncondensing
Storage temperature	−20 to 60°C

[1] When replacing SIGA-HRSI detectors with the SIGA-HRDI, ensure that the spacing is 15.2 m or less.

[2] Requires the SIGA2-TSTSPACER Testifire adapter assembly.

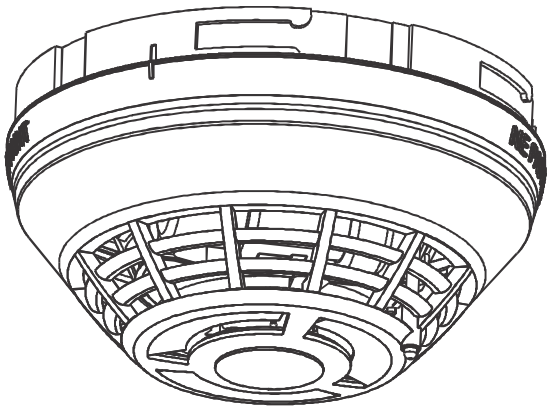
Regulatory information

European standards	EN 54-5 (Class A1/A2R) certified
EU compliance	CE
CPR certificate	0832-CPR-F2101
European Union directives	1999/5/EC (R&TTE directive): Hereby, UTC Fire & Security declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Contact information

For contact information, see www.edwardsfiresafety.com

SIGA-PDI Intelligent Photoelectric Smoke Detector Installation Sheet



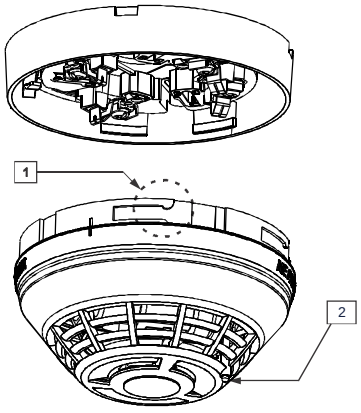
Description

The Signature Series model SIGA-PDI Intelligent Photoelectric Smoke Detector is an intelligent device that uses an optical sensing chamber to detect smoke. The detector analyzes data from the sensing chamber to determine whether to initiate an alarm.

LED indicator. The LED indicator (see Figure 1 below) displays the following states:

- Normal: Green LED indicator flashes, no action.
- Alarm/active: Red LED indicator flashes, evacuate the area.

Figure 1: SIGA-PDI features



(1) Self-locking tab
(2) LED indicator

Installation

Notes

- This detector does not operate without electrical power. As fires frequently cause power interruption, discuss further safeguards with the local fire protection specialist.
- This detector does not sense fires in areas where smoke cannot reach the detector. Smoke from fires in walls, roofs, or on the opposite side of closed doors may not reach the detector.
- Photoelectric detectors have a wide range of fire-sensing capabilities and are best suited for detecting slow, smoldering fires.
- To ensure proper operation, store the detector within the recommended ranges. Allow the detector to stabilize to room temperature before applying power.
- The dust cover (supplied) must remain on the detector during installation and be removed prior to commissioning and service. The dust cover is not a substitute for removing the detector during new construction or heavy remodeling.
- Upon completion of the original installation and following any modifications or additions to the system, perform a calibrated sensitivity test. The Signature Series devices can perform this test and the panel can generate a system sensitivity report.

To install the detector:

1. Install and wire the base, as described on the installation sheet supplied with the base.
2. Remove the serial number label from the detector and attach it to the project documentation.
3. Attach the detector to the base by rotating the detector clockwise until it snaps into the locked position.

Testing

Before testing, notify the proper authorities that the fire alarm system is undergoing maintenance and will be temporarily out of service.

To perform an initial installation test:

1. Remove the detector from its base and verify that the proper detector address, trouble signals, and messages are reported.
2. For SIGA-PDI detectors placed in the air ducts, verify that the airflow is within specifications. See “Specifications” on page 2.
3. If wired for Class A operation, verify that the detector continues to operate first with SLC_IN disconnected, and then with SLC_OUT disconnected. (Refer to the installation sheet for the base.)
4. Place a momentary ground fault on the SLC circuit to verify operation of ground fault detection circuitry.
5. Run a system detector sensitivity report on all detectors and verify that the readings fall within acceptable limits.
6. Perform a sensor function test, as described below.

To perform a sensor function test:

1. If desired, use the fire alarm control panel to put the detector or zone into a service group for testing. (Refer to the panel technical reference manual for instructions.)

P/N 3102508-EN • REV 002 • ISS 02OCT19

2. Activate the smoke sensor using No Climb Products model Smoke Centurion/M8, FireTech Smoke or Smoke Sabre smoke aerosol spray, a smoke generator, or the Testifire detector tester per the manufacturer's instructions.

Maintenance

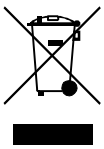
To ensure proper operation, plan maintenance (regular or selected) of the detector in accordance with the AHJ and all applicable governing laws, codes, or standards.

Refer to application bulletin P/N 3102403-EN for additional information and cleaning instructions.

Specifications

Operating voltage	15.20 to 19.95 VDC
Current	
Normal operating	51 µA
Alarm	68 µA
Vibration level	10 to 35 Hz, with an amplitude of 0.01 in.
Air velocity [1]	0 to 20.32 m/s
Wall mounting: distance from ceiling	305 mm max.
Compatible bases	
Standard	SIGA-SB, SIGA-SB4
Relay	SIGA-RB, SIGA-RB4
Isolator	SIGA-IB, SIGA-IB4
Audible	SIGA-AB4GI, SIGI-IBS
Compatible detector testers	Testifire 1000, Testifire 2000
Operating environment	
Temperature	-10 to 55°C
Relative humidity	0 to 93% noncondensing
Storage temperature	−20 to 60°C
Environmental compensation	Automatic

Regulatory Information

Manufacturer	Edwards, A Division of UTC Fire & Security Americas Corporation, Inc. 8985 Town Center Parkway, Bradenton, FL 34202, USA
European standards	EN 54-7 certified
EU compliance	CE
CPR certificates	2831-CPR-F2099
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Contact information

For contact information, see www.edwardsfiresafety.com

TECHNICAL DATASHEET

CLAMBELL®
FIRE ALARM BELLS

Manufactured by Vimpex in the UK, the ClamBell® EN54-3 approved fire bell incorporates traditional and innovative design.

The hinged design of ClamBell® means installers benefit from reduced installation time. Once fitted to the wall and wired to the circuit, ClamBell® clicks shut.

Low power consumption and good sonorous tone result from use of an aluminium gong which also significantly reduces weight.

Three mounting versions are available - shallow base, deep base and purpose designed weatherproof option.

APPROVALS

LPCB 456d/01

CE 2831

FEATURES

- Permanently fitted gong
- Specifically designed weatherproof back box
- Mounting options for European, Asian and US style installations
- Slick and modern looking
- Fully customised pad printed branding
- Strobell EN-23 VAD option which integrates ClamBell and VAD for unique combined unit will be available soon

STROBELL VARIANT AVAILABLE SOON

*Please contact us for more information on the StroBell product.

PART NUMBERS - BELLS

ClamBell 24 V 6” Fire Alarm Bell

- CBE6-RD-024-EN ClamBell 24 V 6” Fire Alarm Bell - Deep Base*1
- CBE6-RS-024-EN ClamBell 24 V 6” Fire Alarm Bell - Shallow Base*1
- CBE6-RW-024-EN ClamBell 24 V 6”Fire Alarm Bell - Weatherproof*1

ClamBell 12 V 6” Fire Alarm Bell

- CBE6-XS-012-EN ClamBell 12 V 6” Fire Alarm Bell - Shallow Base
- CBE6-XA-012-EN ClamBell 12 V 6” Fire Alarm Bell - Shallow Base/US Install Plate
- CBE6-XD-012-EN ClamBell 12 V 6” Fire Alarm Bell - Deep Base
- CBE6-XW-012-EN ClamBell 12 V 6” Fire Alarm Bell - Weatherproof

ClamBell 230 V 6” Fire Alarm Bell

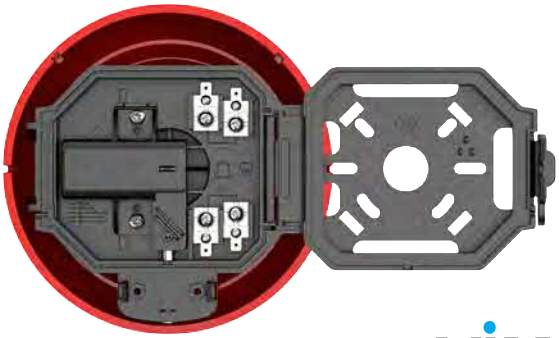
- CBE6-XD-230-EN ClamBell 230 V 6” Fire Alarm Bell - Deep Base
- CBE6-XW-230-EN ClamBell 230 V 6” Fire Alarm Bell - Weatherproof

ClamBell 120 V 6” Fire Alarm Bell

- CBE6-XD-120-EN ClamBell 110 V 6” Fire Alarm Bell - Deep Base
- CBE6-XW-120-EN ClamBell 110 V 6” Fire Alarm Bell - Weatherproof

*X= Colour. Standard colours are R=Red, White=White and G=Grey

*1 Tested and Approved by LPCB



VIMPEX

TECHNICAL DATASHEET

CLAMBELL®
FIRE ALARM BELLS

SPECIFICATION

	6” (150 mm) Internal - 24 V dc			6” (150 mm) Internal - 12 V dc			6” (150 mm) Internal - 230 V ac		6” (150 mm) Internal - 120 V ac	
	Shallow Base	Deep Base	W/P Base	Shallow Base	Deep Base	W/P Base	Deep Base	W/P Base	Deep Base	W/P Base
Rated Voltage (V):	20.4 - 27.6			9.6 - 13.2			207 - 253		114 - 126	
Rated Current @24 V (mA):	12			12			TBC			
Starting Voltage (V):	11			5.5			TBC			
Sound Output dB(A) @1 m (max):	96.0			TBC			96.0			
Temperature Range (C°):	-10 - +50	-25 - + 70		-10 - +50	-25 - + 70		-25 - + 70		-25 - + 70	
Humidity Range (%):	≤96 %									
Weight (g):	378 g	497 g	499 g	378 g	497 g	499 g	497 g	499 g	497 g	499 g
Gong Colour:	Red/ White/ Grey									
Gong Construction:	Aluminium									
IP Rating:	IP21C	IP33C	IP56 Cat2*2	IP21C	IP33C	IP56 Cat2*2	IP33C	IP56 Cat2*2	IP33C	IP56 Cat2*2

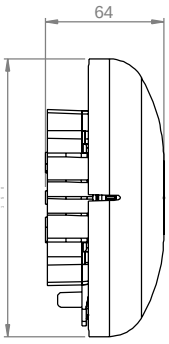
*2 Weatherproofing not approved by LPCB, tested by Intertek

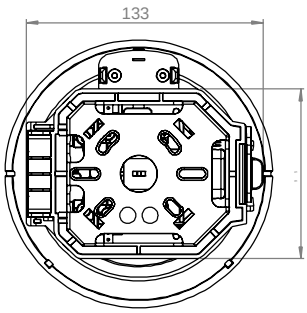
*Note: Other gong colours available subject to minimum order quantity. Please contact us for a full list of colours. Customers must specify R= Red, W= White or G= Grey when placing an order.

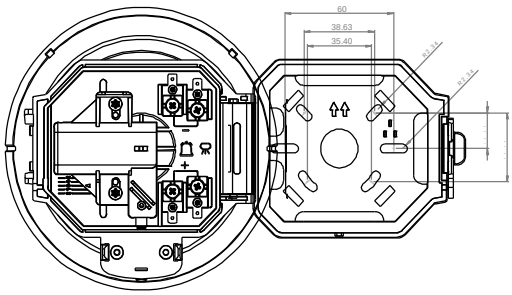
INSTALLATION

Shallow Base

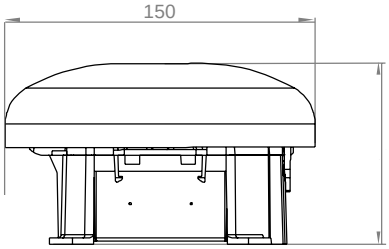
Dimensions (mm)

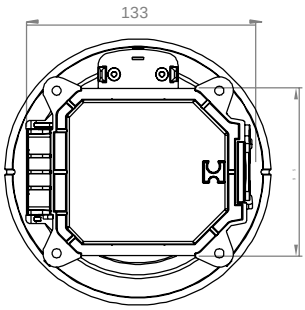


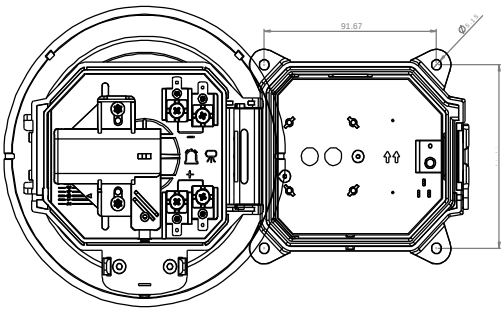




Deep Base







MADE IN THE UK BY VIMPEX

Vimpex Ltd, Star Lane, Great Wakering, Essex SS3 0PJ, UK
Vimpex Europe BV / Vimpex Sweden AB / Vimpex Fire & Security (Ireland) Ltd
T: +44 (0) 1702 216999 / E: sales@vimpex.co.uk / W: vimpex.co.uk

Cabinets and Chassis

3-CAB7B-E series,

Overview

EST3 has a wide selection of cabinet arrangements allowing the greatest use of EST3's flexible modular design. Lobby enclosure wallboxes are manufactured from #14 AWG cold rolled steel with a gray baked enamel finish. Lobby enclosure doors are manufactured from #14 AWG cold rolled steel and have a modern contoured door design with integral viewing window. The exception is the small lobby enclosure 3-CAB5. The 3-CAB5 wallbox and non-contoured door are #16 AWG cold rolled steel. Lobby enclosure doors come with gray baked enamel or optional red baked enamel finishes. The EST3 lobby enclosures back boxes, doors and chassis units are ordered and shipped separately. The 3-CAB5 lobby enclosure comes complete with door and back box providing space to mount five local rail modules.

The EST3 remote closet cabinet design allows the installation of control panel electronics in electrical closets. The remote closet cabinets have left hand hinged doors and are available with red finish only. Optional display modules used for system diagnostics display, mount behind the closet cabinet door and are not visible with the door closed.

Standard Features

- Right or left hand hinging of doors
- Lag and Keyway holes for quick mounting
- Attack rated door for security applications
- Knockouts for 3/4 inch conduit
- Attractive contour door design on lobby enclosures
- Combination flush or surface mounting lobby enclosure design
- Remote closet cabinets for electrical closet mounting support up to 65 AMP hour batteries
- Optional earthquake hardening: OSHPD seismic pre-approval for component Importance Factor 1.5

Application

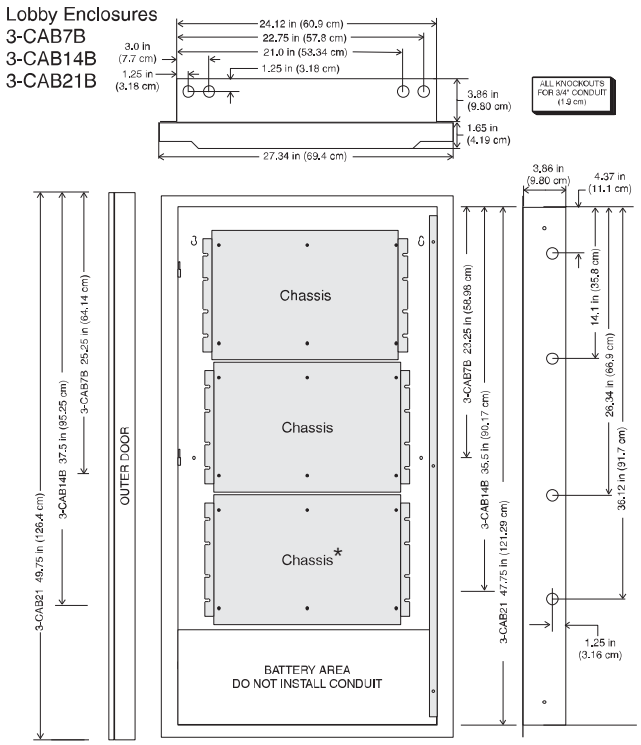
Lobby Enclosures

EST3 lobby enclosures provide space for control, monitoring and display modules where they remain visible even with the door closed and secure. Ideal for mounting in lobby's where appearance is important, maximum mounting flexibility is provided with doors that will mount for right or left hand opening. Lobby enclosures come in several sizes to match individual project requirements.

The **3-CAB7** semi-flush or surface mounts and has a contoured front door with viewing window. Space is provided for two 17 AH batteries and one chassis assembly providing seven local rail module spaces.

Remote Closet Cabinets

Remote closet cabinets provide an economical way of installing equipment in locations where esthetics are not paramount, like electrical closets. You can have optional display modules used for system diagnostics display mounted behind the front door. These display modules will not be visible with the door closed. Remote closet cabinets are surface mounting and come in sizes providing space for one to three chassis with room for standby batteries. A UL Listed attack rated door having a 2-minute rating is available for the 3-RCC7R cabinet. This door is required for security applications.



Installation and Mounting

Ordering Information

Catalog Number	Description	Equipment Mounting Space	Battery Space	Ship Wt. lb. (Kg)
Lobby Enclosures — Outer doors with viewing window				
3-CAB7B	Wallbox only	One Chassis	Four - 6V8A Two - 12V10A Two - 12V17A	30 (13.6)
3-CAB7B-E	Wallbox only, EN54* certified CE	1 Chassis		30 (13.6)
3-CAB7D(R)	Inner and outer doors for 3-CAB7B	N/A		10 (4.5)
3-CAB7D(R)-E	Inner & outer doors for 3-CAB7B, EN54*, CE			10 (4.5)

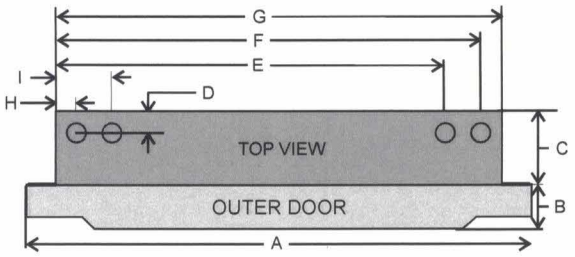
Notes:

1. All lobby enclosures, wallboxes and doors have a textured gray enamel finish; outer doors are available in red by adding the suffix "R" to the catalog number, i.e. 3-CAB7DR.
2. Remote closet cabinets will support 65 AH batteries with the use of the 3-BATS Battery Shelf, which reduces the enclosure's chassis capacity by one chassis.
3. The EST3 is modularly listed under the following standards:
   UL 864 categories: UOJZ, UOXX, UUKL and SYZV, UL 2572, UL 294 category ALVY, UL 609 category AOTX, UL 636 category ANET, UL 1076 category APOU, UL 365 category APAW, UL 1610 category AMCX, UL 1635 category AMCX ULC-S527, ULC-S301, ULC-S302, ULC-S303, ULC-S306, ULC/ORD-C1076, ULC/ORD-C693
   Please refer to EST3 Installation and Service Manual for complete system requirements.

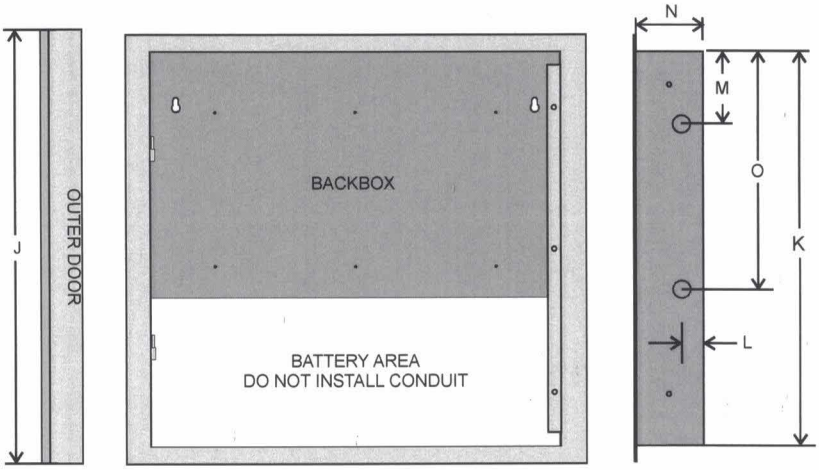
** EN54-2:1997+A1 and EN54-4:1997+A1:2002+A2 pending*

*** Add "-CC" for City of Chicago.*

CABINET INSTALLATION DIMENSIONS



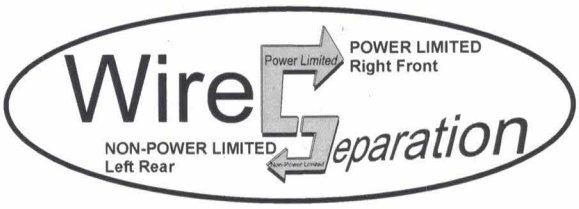
ALL KNOCKOUTS
FOR 3/4-INCH CONDUIT
(1.9 cm)

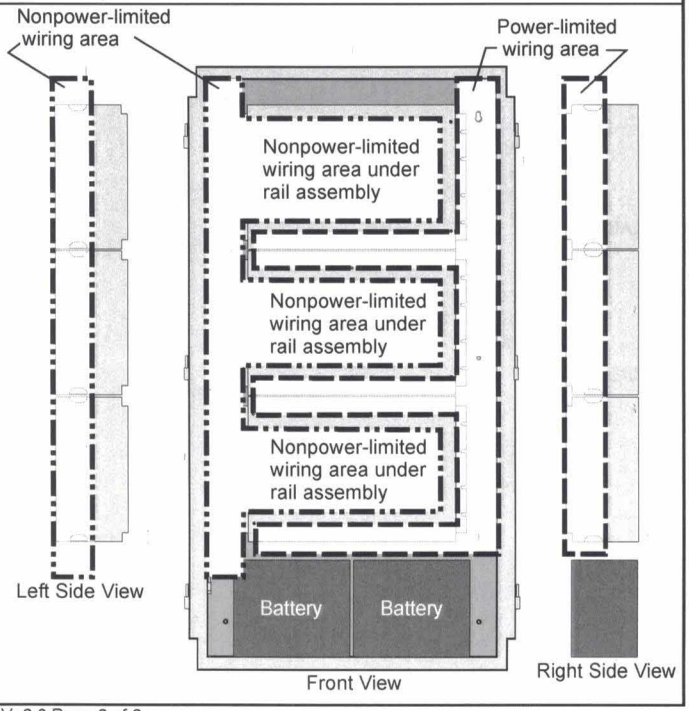


	3-CAB7B	3-CAB14B	3-CAB21B
A	27.34 in (69.40 cm)	27.34 in (69.40 cm)	27.34 in (69.40 cm)
B	1.65 in (4.19 cm)	1.65 in (4.19 cm)	1.65 in (4.19 cm)
C	3.86 in (9.80 cm)	3.86 in (9.80 cm)	3.86 in (9.80 cm)
D	1.25 in (3.18 cm)	1.25 in (3.18 cm)	1.25 in (3.18 cm)
E	21.0 in (53.34 cm)	21.0 in (53.34 cm)	21.0 in (53.34 cm)
F	22.75 in (57.8 cm)	22.75 in (57.8 cm)	22.75 in (57.8 cm)
G	24.0 in (60.9 cm)	24.0 in (60.9 cm)	24.0 in (60.9 cm)
H	1.25 in (3.18 cm)	1.25 in (3.18 cm)	1.25 in (3.18 cm)
I	3.0 in (7.7 cm)	3.0 in (7.7 cm)	3.0 in (7.7 cm)
J	25.5 in (64.77 cm)	37.75 in (95.89 cm)	50.0 in (127.0 cm)
K	23.2 in (58.98 cm)	35.5 in (90.17 cm)	47.75 in (121.3 cm)
L	1.25 in (3.16 cm)	1.25 in (3.16 cm)	1.25 in (3.16 cm)
M	4.37 in (11.1 cm)	4.37 in (11.1 cm)	4.37 in (11.1 cm)
N	3.86 in (9.80 cm)	3.86 in (9.80 cm)	3.86 in (9.80 cm)
O	14.1 in (35.8 cm)	14.1 in (35.8 cm)	14.1 in (35.8 cm)

POWER-LIMITED AND NONPOWER-LIMITED WIRING REQUIREMENTS

Fire Alarm System wiring is classified as either power-limited or nonpower-limited per NEC Article 760. All power-limited wiring must be separated from all nonpower-limited wiring by a minimum distance of 1/4 in (6 mm). The system enclosures and chassis assemblies are designed such that nonpower-limited wiring is at the left rear of the cabinet and the power-limited wiring is at the front of the cabinet. When installing nonpower-limited wiring, use the feed through notches at the left rear of the chassis. When installing power-limited wiring, use the feed through notches at the right front of the chassis.





PRODUCT DESCRIPTION

The 3-CAB series of equipment enclosure backboxes are made of 14-gauge steel and finished with a textured baked grey enamel. The backboxes are designed for semi-flush or surface mounting. Conduit and nail knockouts, keyhole style mounting holes, and wide wiring troughs facilitate quick installation.

Chassis assembly design facilitates separation of power-limited and nonpower-limited circuits inside the backbox by locating power-limited wiring towards the front of the cabinet and nonpower-limited wiring towards the rear.

SPECIFICATIONS

3-CAB7B Dimensions (H x W x D)

Rough-In (See note 1)	23.2 in x 24.0 in x 3.86 in (58.98 cm x 60.9 cm x 9.8 cm)
Finished	
Surface Mounted	25.5 in x 27.34 in x 5.5 in (64.77 cm x 69.4 cm x 14.0 cm)
Semi-Flush Mounted	25.5 in x 27.34 in x1.65 in (64.77 cm x 69.4 cm x 4.19 cm)

3-CAB14B Dimensions (H x W x D)

Rough-In (See note 1)	35.5 in x 24.0 in x 3.86 in (90.17 cm x 60.9 cm x 9.8 cm)
Finished	
Surface Mounted	37.75 in x 27.34 in x 5.5 in (95.89 cm x 69.4 cm x 14.0 cm)
Semi-Flush Mounted	37.75 in x 27.34 in x 1.65 in (95.89 cm x 69.4 cm x 4.19 cm)

3-CAB21B Dimensions (H x W x D)

Rough-In (See note 1)	47.75 in x 24.0 in x 3.86 in (121.29 cm x 60.9 cm x 9.80 cm)
Finished	
Surface Mounted	50.0 in x 27.34 in x 5.5 in (127.0 cm x 69.4 cm x 14.0 cm)
Semi-Flush Mounted	50.0 in x 27.34 in x 1.65 in (127.0 cm x 69.4 cm x 4.19 cm)

Note:

1) Add 1/4" to height and width to allow for knockouts when framing in backbox for semi-flush mounting.

Equipment Capacity

3-CAB7B

Chassis	1 chassis assembly
Batteries	
Model 6V8A	4 max.
Model 12V10A	2 max.
Model 12V17A	2 max.

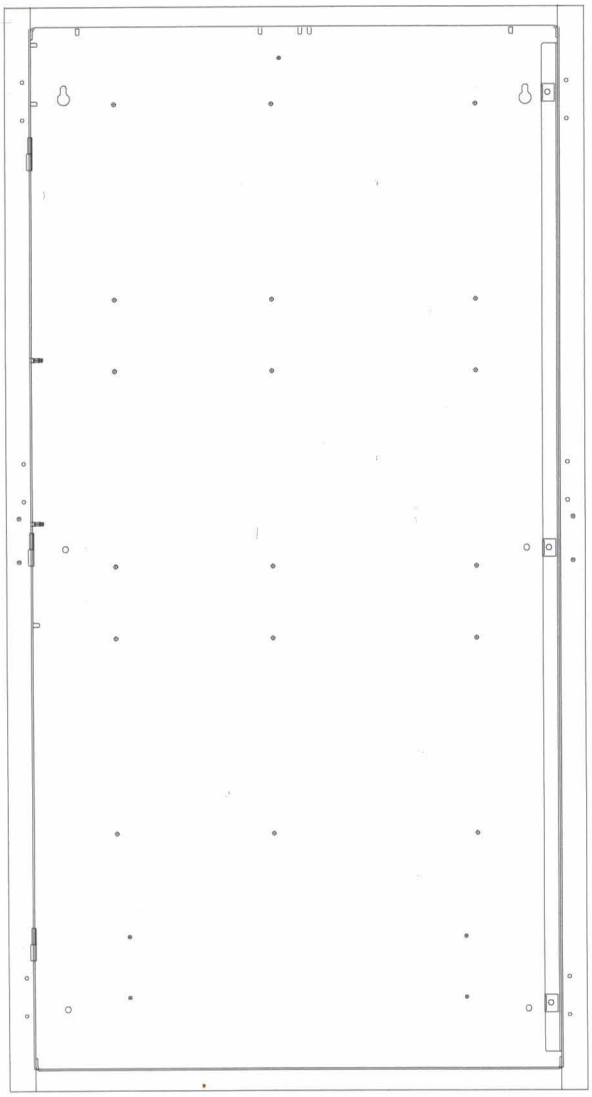
3-CAB14B

Chassis	2 chassis assemblies
Batteries	
Model 6V8A	4 max.
Model 12V10A	2 max.
Model 12V17A	2 max.

3-CAB21B

Chassis	3 chassis assemblies
Batteries	
Model 6V8A	4 max.
Model 12V10A	2 max.
Model 12V17A	2 max.

PRODUCT DIAGRAM



3-CAB21B shown

INSTALLATION SHEET:

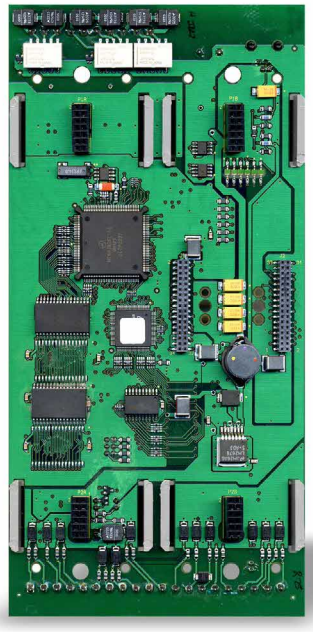
3-CAB Series Equipment Enclosure Backboxes

INSTALLATION SHEET P/N: 387557	FILE NAME: 387557.CDR
REVISION LEVEL: 2.0	
DATE: 15AUG06	

LIFE SAFETY & INCIDENT MANAGEMENT

Central Processor Unit

3-CPU3-E, 3-RS485A, 3-RS485B,3-RS232



FM APPROVED
CE
UL
ULC
S3000
7165-1657: 0186
FDNY APPROVED
LPCB

EN 54-2: 1997 + A1: 2006
EN 54-4: 1997 + A1: 2002 + A2: 2006
EN 54-16: 2008

Overview

The 3-CPU3 is the Central Processing Unit Module monitoring the status of all modules and providing the link for network communications. Although each local rail card contains their own microprocessor, the 3-CPU3 provides all inter-module communication and has the ability to download rail module operating parameters. Upon power up the 3-CPU3 automatically learns all local rail module attributes and locations. Site specific software is loaded into the 3-CPU3 which then downloads data to each local rail module. Firmware upgrades are also done from the 3-CPU3 eliminating the need to unplug chips on rail modules.

Mounting must be in the first two local rail spaces of the upper 3-CHAS7 (module chassis). Options for the 3-CPU3 include the addition of an LCD display and User Interface, RS-232 Communication Card, and RS-485 Series Network Communication Cards.

The 3-CPU3 is fully compatible on the same network with the 3-CPU and 3-CPU1 modules.

Standard Features

- Up to 1,000 history events
- RS-485 local rail communications
- Multiplexed audio channels
- Network communication media can consist of twisted copper RS485, short-haul modems and/or single or multimode fiber optic cables
- RS-232 communication card
- Form ‘C’ contacts for: Alarm, Supervisory and Trouble
- Low voltage memory write protection
- Non-volatile memory

DATA SHEET E85010-0133
Not to be used for installation purposes. Issue 1.2

Application

The 3-CPU3 helps make EST3 an extremely powerful and flexible system. As a single node, stand alone system a single 3-CPU3 controls 1 to 19 additional local rail modules. For larger systems, up to 64 nodes interconnect on a peer-to-peer multi-priority token ring protocol network.

The 3-CPU3 controls all local panel responses to automatic, user initiated, or network reported events. As a network node, it is an equal among peers, there is no master on the network. This gives exceptional response times over the network, less than three seconds.

Each 3-CPU3 provides slots at the back for mounting Network, and RS-232, cards. Removable terminal blocks on the 3-CPU3 support connection of network and audio data wiring. On board common relays also terminate at the 3-CPU3 terminals. To aid in trouble shooting and service, status LEDs monitor local rail, network, RS232 and audio data communications.

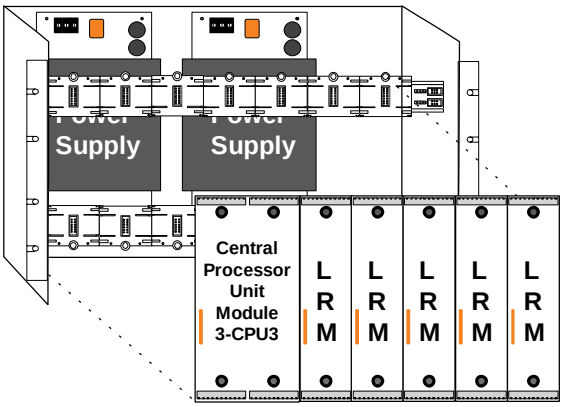
The **Network Communications** card mounts to the back of the Central Processor Unit. The 3-RS485A card provides a Class A, Class X or Class B circuit for network communications signals and support for a Class B, Class A or Class X circuit for the digitized audio signals. The 3-RS485B card provides a Class B, Class A or Class X circuit for network communications signals and a second Class B circuit for the digitized audio signals. The 3-RS485B card provides a Class B or Class A circuit for network communications signals and a second Class B circuit for the digitized audio signals. Network messages received by the Network Communications card are re-transmitted to the next network node. Re-transmission maximizes the wire run lengths between nodes. With 64 nodes miles of network length is possible. Fail safe mechanisms built into the card direct connect the data input and output ports should the network card or its related Central Processor fail. Network communications may be configured via copper or fiber media using the 3-FIBMB.

The **3-RS232 Communication Card** mounts to the back of the 3-CPU3. The 3-RS232 has two optically isolated RS-232 ports. The ports support connection of a printer and/or an external command center. Entire network downloading from one location (to all 64 nodes) is available through the RS-232 card.

Engineering Specification

It must be possible to support a single stand alone node or up to 64 nodes communicating on a peer-to-peer token ring protocol network. Network and digitized audio wiring shall be run in a [choose one: Class A, Class X or Class B] configuration. Network alarm response from alarm input to signal activation must be under 3 seconds. All field wiring must be to removable terminal blocks. Status LEDs must be provided for communications of network and internal rail communications. Inter-node communication speed must be programmable. Internal rail communications speed must be programmable.

Installation and Mounting



Data

Maximum resistance between any 3 panels	90 Ohms
Maximum capacitance between any 3 panels	0.3 µF
Maximum distance between any 3 panels via RS485	5,000 ft. (1,524 m)

Capacitance, entire network

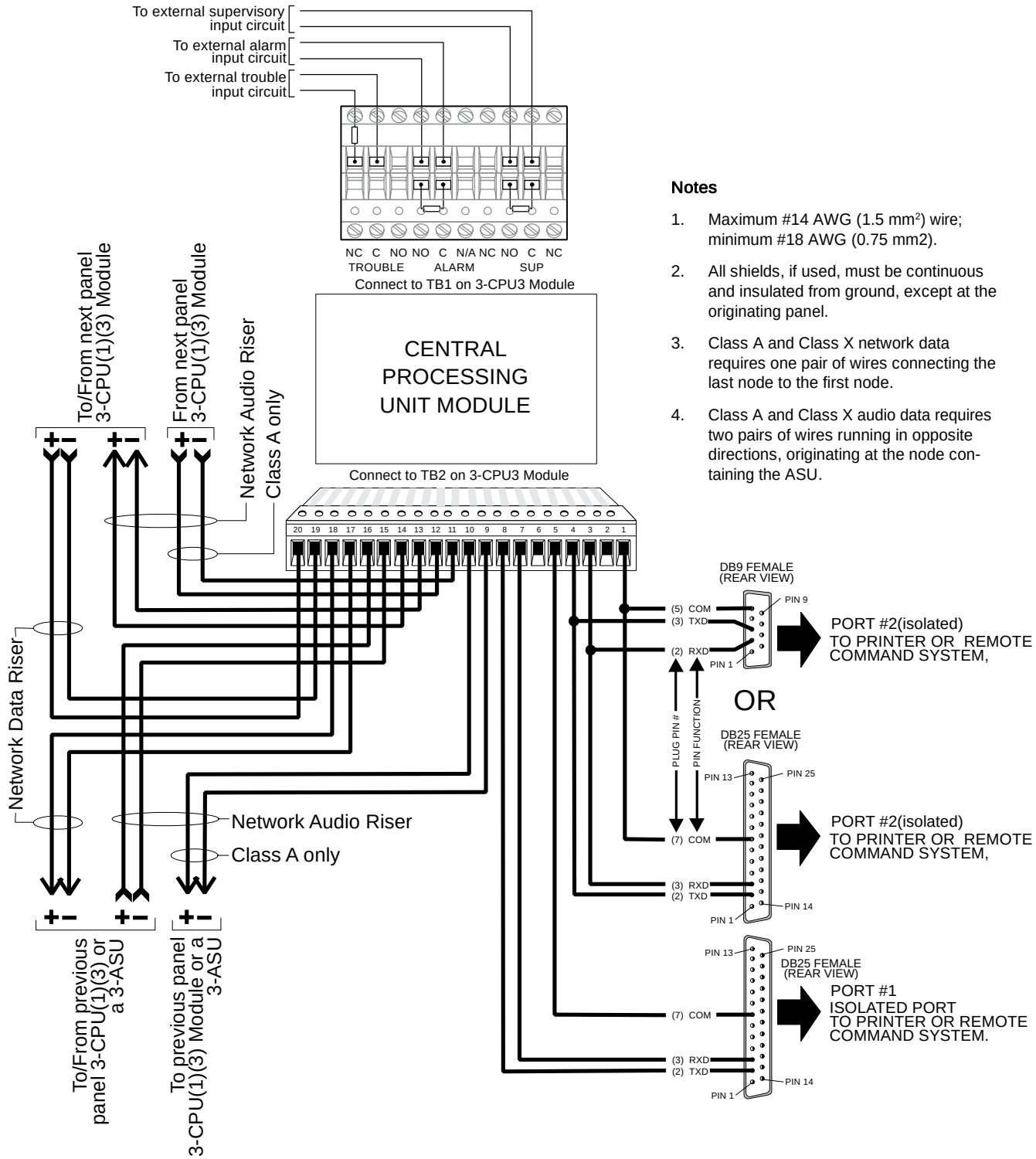
Maximum Accumulative Capacitance

Wire Size	38.4K Baud	19.2K Baud
18 AWG	1.4 µF	2.8 µF
16 AWG	1.8 µF	3.6 µF
14 AWG	2.1 µF	4.2 µF

Audio

Maximum resistance between any 3 panels	90 Ohms
Maximum capacitance between any 3 panels	0.09 µF
Maximum distance between any 3 panels via copper RS485	5,000 ft. (1,524 m)

Typical Wiring



Notes

1. Maximum #14 AWG (1.5 mm^2) wire; minimum #18 AWG (0.75 mm2).
2. All shields, if used, must be continuous and insulated from ground, except at the originating panel.
3. Class A and Class X network data requires one pair of wires connecting the last node to the first node.
4. Class A and Class X audio data requires two pairs of wires running in opposite directions, originating at the node containing the ASU.

LIFE SAFETY & INCIDENT MANAGEMENT

Contact us

Phone: 800-655-4497 (Option 4)
Email: edwards.fire@carrier.com
Website: edwardsfiresafety.com

8985 Town Center Pkwy
Bradenton, FL 34202

Specifications

3-CPU3

Agency Listings	UL, ULC, CSFM, CE, LPCB EN54*.
Mounting	2 - Left most local rail spaces
Terminal Size	18-12 AWG (1.0mm² to 2.5mm²)
Standby Current	155 mA
Alarm Current	165 mA
Contact Ratings	Nonbypassable Alarm, Supervisory and Trouble Form 'C' 1A at 30 Vdc
Data Down Loading	RJ14 Jack
Operating Environment	0°C - 49°C (32° F - 120° F); 93% at 40° C Non-Condensing

**For EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and EN 54-16: 2008 compliant product add suffix -E to model eg. 3-CPU3-E.*

Note: CPU current includes the main power supply, since the CPU and PPS cannot be measured separately.

Option Cards

Catalog number	3-RS232	3-RS485A	3-RS485B
Standby Current	58 mA	98 mA	98 mA
Alarm Current	58 mA	98 mA	98 mA
Communication Ports	Two optically isolated RS-232	Three RS-485 Class A or Class X	One Class A or Class X network data circuit and one Class B audio data circuit
Agency Listings	UL, ULC. CSFM, CE, LPCB. EN54*.		
Mounting	Back of 3-CPU3		
Operating Environment	0° C - 49° C (32° F - 120° F); 93% at 40° C Non-Condensing		

**For EN 54-2: 1997 + A1: 2006, EN 54-4: 1997 + A1: 2002 + A2: 2006, and EN 54-16: 2008 compliant product add suffix -E to model eg. 3-RS485A-E*

Ordering Information

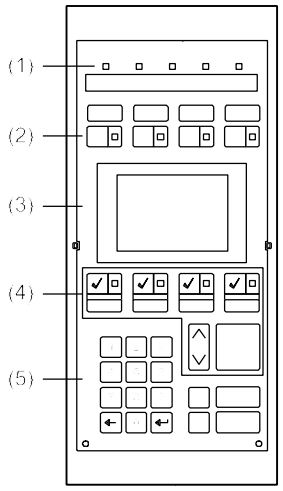
Catalog Number	Description	Ship Wt. lb (kg)
3-CPU3	Central Processor Unit Module. Add suffix "-E" for EN54 compliant versions.	0.7lb (0.32kg)
3-RS485A	Network Communications Card, Class A or Class X . Add suffix "-E" for EN54 compliant versions .	0.33lb (0.15kg)
3-RS485B	One Class A,X/B network data circuit and one Class B audio data circuit. Add suffix "-E" for EN54 compliant versions.	0.33lb (0.15kg)
3-RS232	RS-232 Communication Card. Add suffix "-E" for EN54 compliant versions.	0.33lb (0.15kg)
3-CPUDR	CPU doors with filler plates. Order separately, one required per CPU where no LCD display is installed.	0.25lb (0.11kg)

3-LCD-E Main LCD Display Module Installation Sheet

Description

The 3-LCD-E Main LCD Display Module provides the controls and indicators that make up the system user interface. Figure 1 shows the principal features of the module.

Figure 1: 3-LCD-E Main LCD Display Module



(1) System status indicators
(2) Common controls
(3) Display
(4) Event message controls
(5) Keypad

At least one LCD display module is required to provide a point of control for an entire network. Additional LCD display modules can be installed to provide multiple points of control at other locations throughout the protected premises.

The 3-LCD-E module mounts on a 3-CPU3-E module or on a 3-ANNCPU3-E module and occupies two LRM spaces on the panel's operator layer.

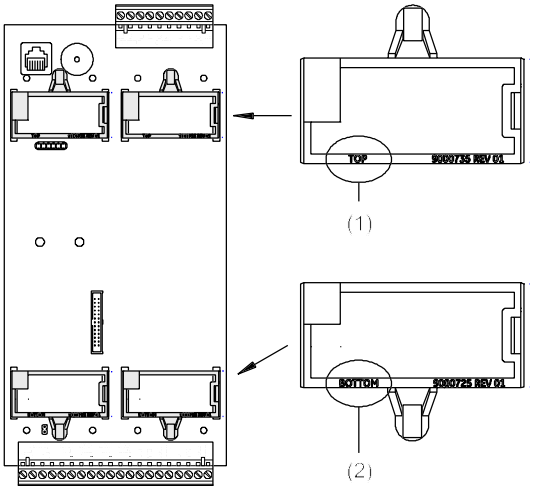
Installation

The instructions below are for new installations on a 3-CPU3-E module. Instructions for installing a 3-LCD-E module on a 3-ANNCPU3-E module are similar.

To install the 3-LCD-E module:

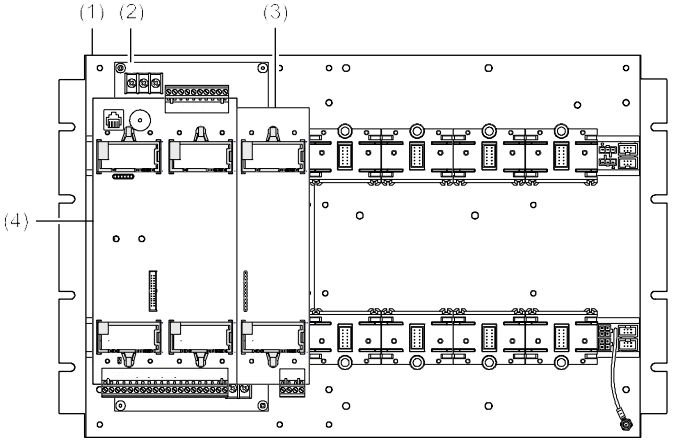
1. Insert the display mounting brackets into the 3-CPU3-E module. See Figure 2.
2. Plug the 3-CPU3-E module into the rail, and then push the plungers to lock the module into place. See Figure 3.
3. Position the 3-LCD-E module in its fully open position, align the hinge pins with the hinges on the left display mounting brackets on the 3-CPU3-E, and then gently slide the 3-LCD-E into the brackets.
4. Connect the ribbon cable on the 3-LCD-E module to J1 on the 3-CPU3-E module. See Figure 4.
5. Connect the ground cable on the 3-LCD-E module to the two-pin header on the 3-CPU3-E module. The two-pin header is located just above the Network B terminals on TB2.
6. Make sure that the 3-LCD-E module can open and shut without interference.

Figure 2: Display mounting bracket installation



(1) Top
(2) Bottom

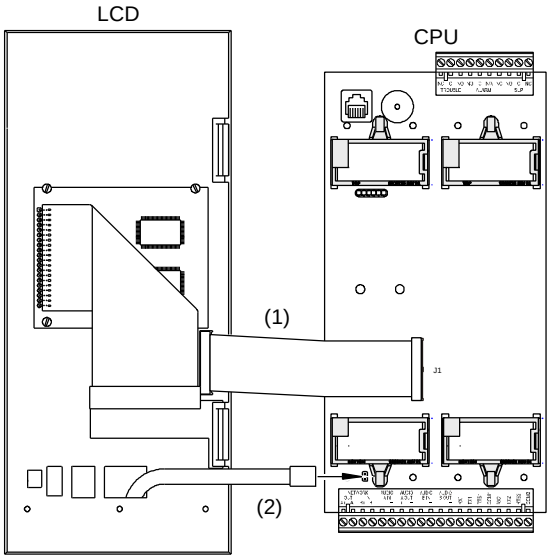
Figure 3: Mounting diagram



(1) 3-CHAS7-E
(2) Primary power supply
(3) Primary power supply monitor card
(4) 3-CPU3-E

P/N 3102182-EN • REV 002 • ISS 15APR21

Figure 4: 3-LCD-E cable connections

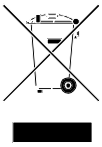


(1) Ribbon cable
(2) Ground cable

Specifications

Voltage	24 VDC
Current	
Standby	43 mA
Alarm	43 mA
Mounting	Two LRM mounting spaces on the operator layer
LCD display	64 × 128 pixels, backlit liquid crystal
Indicators	Power: Green LED Test: Yellow LED CPU Fault: Yellow LED Sounder: Yellow LED Disable: Yellow LED Reset: Yellow LED, integrated with Reset switch Sounder Off/On: Yellow LED, integrated with Sounder Off/On switch Panel Silence: Yellow LED, integrated with Panel Silence switch Drill: Yellow LED, integrated with Drill switch Fire: Red LED Fault: Yellow LED Disable: Yellow LED Monitor: Yellow LED
Operator controls	Reset switch Sounder Off/On switch Panel Silence switch Drill switch Fire queue switch Fault queue switch Disable queue switch Monitor queue switch Message scroll switches Ten-digit keypad with Enter and Delete keys Details switch Command Menus switch
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93% noncondensing

Regulatory information

EU compliance	CE
EU certificates	2831-CPR-F1080
UK compliance	UK CA 0832
EN 54	EN 54-2:1997/A1:2006 EN 54-4:1997/A1:2002/A2:2006 EN 54-16:2008
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Contact information

For contact information, see www.edwardsfiresafety.com.

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European Power Supplies Installation Sheet

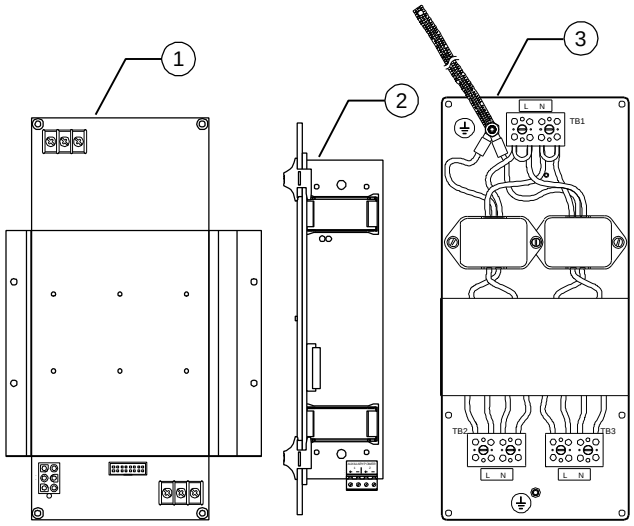
Description

This installation sheet applies to primary and booster power supplies and chargers. See Table 1 for applicable model numbers and descriptions.

Table 1: Power supply models

Number	Name
3-PPS/M-230-E	Primary Power Supply
3-BPS/M-230-E	Booster Power Supply
3-BBC/M-230-E	Booster Charger Supply

Figure 1: Power supply components



1. Heat sink assembly
2. Monitor Module
3. Power distribution assembly

Packaged with the 3-PPS/M-230-E are the following:

- The EFM-2 filter board to protect two initiating device circuits, 4-wire smoke detector power, communication circuits or output circuits rated less than 1/2 amp
- A 15-ferrite kit, PN 7300173 to clamp around each cable entering or leaving the cabinet
- A sheet of Kapton labels to place over each local rail module's rail communication LEDs

3-PPS/M-230-E Primary Power Supply

The 3-PPS/M-230-E Primary Power Supply provides the required power and related supervision functions for the control panel. The 3-PPS/M-230-E comprises a heat sink assembly, a monitor module, and a power distribution assembly. The monitor module plugs into the rail, and the heat sink and power distribution assemblies mount onto the rail chassis.

The 3-PPS/M-230-E provides filtered, regulated power to the rail chassis modules as well as 24 VDC for operating ancillary equipment. AC power and battery connections are made to fixed terminals on the heat sink assembly, away from the panel's power limited wiring.

The 3-PPS/M-230-E provides a dual rate constant current battery charger circuit with automatic temperature compensation. To prevent memory problems and total battery discharge, a battery monitor circuit supervises the standby batteries and disconnects them when they reach the low battery threshold.

The 3-PPS/M-230-E checks the AC input source and automatically switches to battery power in the event of a brownout or loss of AC power. In the event of a failure of one or more booster power supplies, the 3-PPS/M-230-E determines its ability, along with the surviving booster supplies, to supply the load. If the load exceeds the ability of the primary and surviving booster supplies to meet the demand, the 3-PPS/M-230-E automatically switches in the standby batteries. The 3-PPS/M-230-E also switches in the standby batteries if an overload causes the heat sink temperature to reach a high level.

The power supply monitor module provides the interface between the 3-PPS/M-230-E and the panel, making the required data and power connections to and from the rail chassis. The monitor module requires one rail space and is secured to the assembly using snap rivet fasteners. The monitor module has a hinged front panel for mounting displays or a blank protective faceplate.

3-BPS/M-230-E Booster Power Supply and 3-BBC/M-230-E Booster/Charger Supply

The 3-BPS/M-230-E and 3-BBC/M-230-E booster power supplies are used to provide additional power over and above that of the 3-PPS/M-230-E. Each model is composed of a heat sink assembly and a monitor module. The monitor module plugs into the rail and the heat sink assembly mounts on the rail chassis.

Depending on the size of the cabinet, up to three booster power supplies can be added to make a total of 28 amperes available for both internal and external applications. Each booster supply provides filtered, regulated power to the rail chassis modules as well as 24 VDC for operating ancillary equipment.

A 3-BPS/M-230-E supply can share a common set of standby batteries with the 3-PPS/M-230-E or 3-BBC/M-230-E. Each 3-BPS/M-230-E supervises its own battery connection but does not have any battery charging capability. The 3-BBC/M-230-E is capable of charging standby batteries.

Each booster supply shares the panel's 24 VDC electrical load with the 3-PPS/M-230-E. In the event of a booster power supply failure, a trouble is annunciated, and the panel load is distributed among the remaining operational power sources. Should the load ever exceed the ability of the operable power sources to supply the power, as in the event of an alarm, the system automatically switches to standby batteries.

The booster supply monitor module provides the interface between the booster power supply and the panel, making the required data and power connections to and from the rail chassis. The monitor module requires one rail space and is secured to the assembly using snap rivet fasteners. The monitor module has a hinged front panel for mounting displays or a blank protective faceplate.

P/N 387555 • REV 006 • ISS 12JAN23

Installation

Install heat sink assemblies on the rail chassis behind the rail module connectors. See Figure 2.

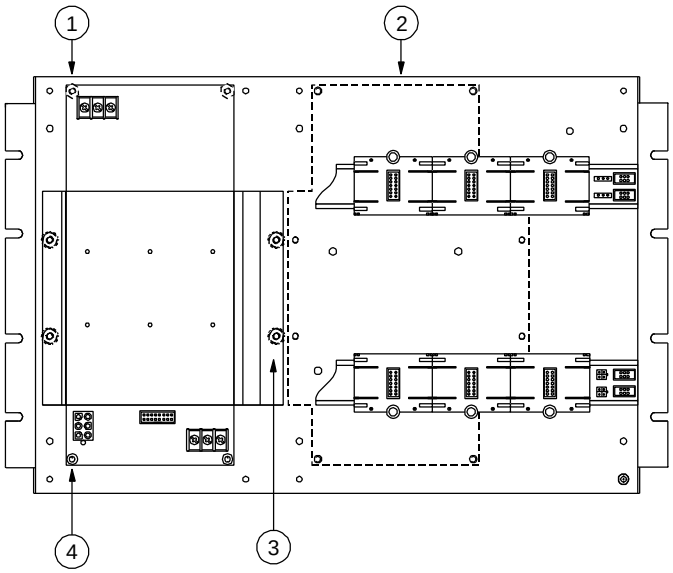
Step 1: Install the heat sink assembly

1. Attach the heat sink assembly to the four threaded mounting studs on the rail chassis using lock nuts provided in the hardware kit.
2. Secure the bottom edge of the heat sink assembly to the threaded standoffs on the rail chassis using screws provided in the hardware kit.
3. Secure the top edge of the heat sink assembly to the rail chassis using the two threaded standoffs provided in the hardware kit.
4. Attach the TB1 terminal block cover to the threaded standoffs using two #6-32 pan head screws.

Notes

- Mount the 3-PPS/M-230-E heat sink assembly on the left side of the top rail chassis. Mount the power distribution assembly on the right side of the top rail chassis.
- Mount booster supplies on any rail chassis other than the top. Do not install more than three booster supplies in the same enclosure.

Figure 2: Heat sink assembly installation

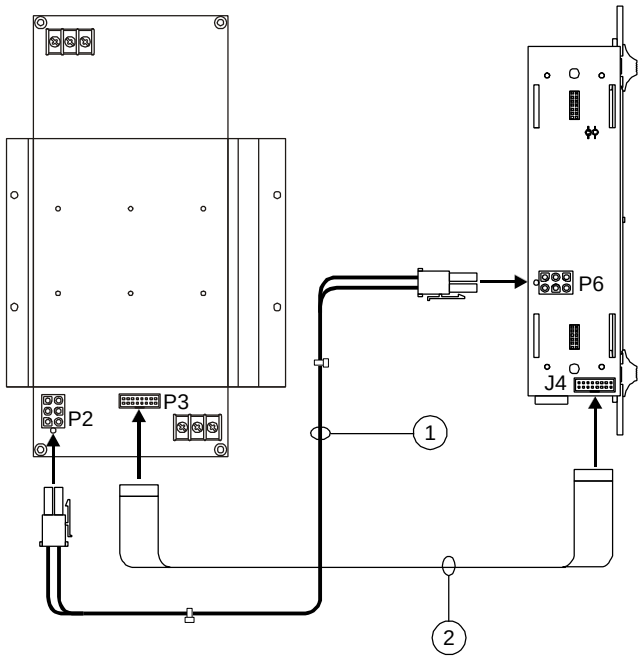


1. 6-32 x 1.6875 threaded standoff (2 places)
2. Space for power distribution assembly
3. #8-32 lock nut (4 places)
4. 6-32 x 1/2 pan head screw, #6 lock washer, #6 flat washer (2 places)

Step 2: Install the power distribution assembly

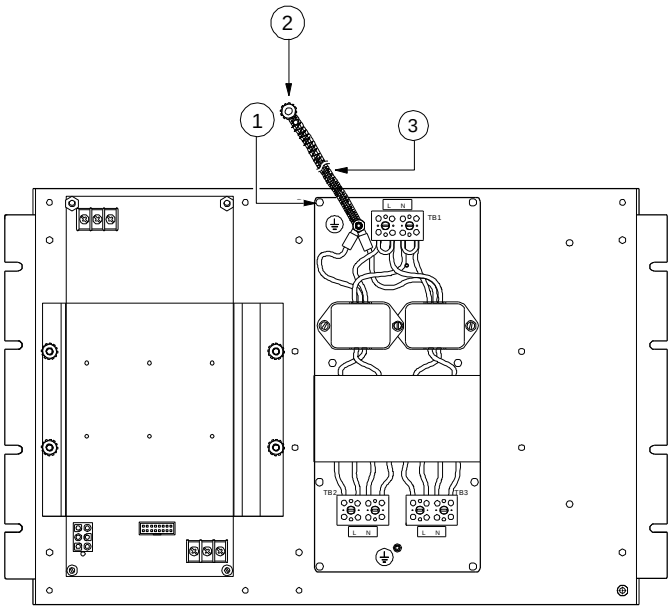
1. Attach the power distribution assembly to the six threaded standoffs on the rail chassis, behind the rail module connectors and to the right of the primary power supply heat sink assembly. See Figure 4.
2. Attach the earth ground braid to the backbox ground stud located just above the power distribution assembly. See Figure 5.
3. Plug the cable harness and ribbon cable into the monitor module as shown in Figure 3. Ensure the cable connections are secure.
4. For a primary supply monitor module, align the module to the guideposts on slot 3 of the rail chassis.
5. For a booster supply monitor module, align the module to the guideposts on slot 3 or slot 5 of the rail chassis, whichever is closer to the heat sink assembly.
6. Route the cable harness over and behind the bottom rail and connect it to P2 on the heat sink assembly. Push in until the connector clicks.
7. Route the ribbon cable under the bottom rail and connect it to P3 on the heat sink assembly.
8. Plug the module into the rail connectors and lock it into place using the snap rivet fasteners.
9. Apply a Kapton label over the rail communication LEDs. Kapton labels are included in the cabinet hardware kit and are required on every rail module installed in the cabinet.

Figure 3: Power supply to monitor module cable connections



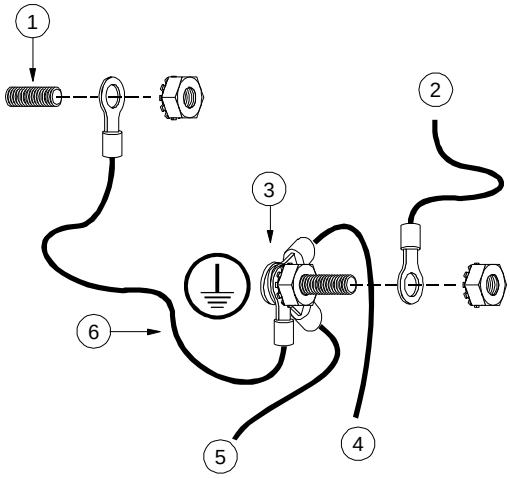
1. Cable harness (P/N 250187)
2. Ribbon cable
   - P/N 250189 (primary monitor module)
   - P/N 250188 (booster monitor module)

Figure 4: Power distribution assembly installation (rails removed for clarity)



1. 6-32 pan head screw, #6 lock washer, #6 flat washer (6 places)
2. Earth ground stud on enclosure backbox
3. Earth ground braid

Figure 5: Earth to chassis ground connection



1. Earth ground stud on enclosure back box
2. Mains earth conductor
3. Stud next to TB1 on the power distribution assembly
4. To filter 2
5. To filter 1
6. Earth ground braid

Step 3: Install a monitor module

Note: To make installation easier, wire the power distribution assembly to the heat sink assemblies before installing the monitor modules.

Step 4: Install the EFM-2 filter board

To install the EFM-2 filter board, follow the instructions on its installation sheet.

Wiring

Make all wiring in accordance with national electrical codes and all other local requirements.

Step 1: Wire the standby batteries

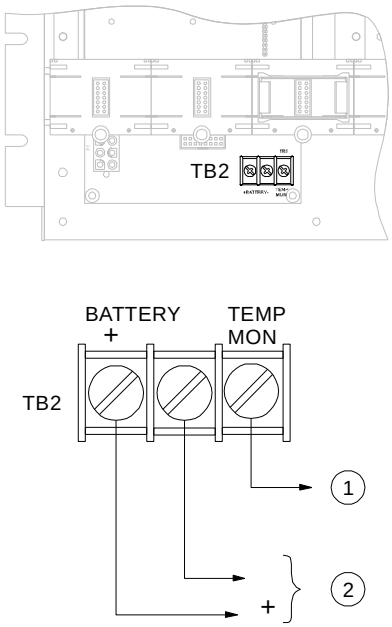
Connect the standby batteries to TB2 on the heat sink assembly as shown in Figure 6 and according to the following requirements:

- Connect each set (pair) of batteries to a separate battery charging circuit, either on a 3-PPS/M-230-E or on a 3-BBC/M-230-E.
- Connect each power supply to only one set of batteries per Figure 6.
- Do not connect a 3-PPS/M-230-E with a 3-BBC/M-230-E on the same set of batteries.
- Each power supply must have its own separate pair of wires connecting it to a set of standby batteries. Do not daisy-chain battery connections from power supply to power supply.
- All battery wiring must be the same length and wire gauge.
- All batteries connected to the same control panel must have the same ampere-hour rating, be from the same manufacturer, and have the same manufacturing date code.
- An external battery cabinet used to house standby batteries must be installed within one meter and in the same room as the control panel. The 3-PPS/M-230-E must be connected to the temperature-sensing circuit on a 3-BTSEN-E.

Table 2: Typical battery and power supply combinations

Total current	Power supplies required	Battery sets required
7 A	1 (3-PPS/M-230-E)	1 set, 65 Ah max.
14 A	1 (3-PPS/M-230-E) 1 (3-BPS/M-230-E)	1 set, 65 Ah max.
	1 (3-PPS/M-230-E) 1 (3-BBC/M-230-E)	2 sets, 65 Ah max
21 A	1 (3-PPS/M-230-E) 2 (3-BPS/M-230-E)	1 set, 65 Ah max.
	1 (3-PPS/M-230-E) 2 (3-BBC/M-230-E)	3 sets, 65 Ah max
28 A	1 (3-PPS/M-230-E) 3 (3-BPS/M-230-E)	1 set, 65 Ah max.
	1 (3-PPS/M-230-E) 3 (3-BBC/M-230-E)	4 sets, 65 Ah max

Figure 6: TB1 standby battery wire connections



1. To TEMP_MON connection on 3-BTSEN-E (3-PPS/M-230E only)
2. To plus and minus terminals on cabinet battery or to plus and minus terminals on power distribution bus in remote cabinet

Note: Removing batteries

These power supplies are connected to one or more sealed, rechargeable, lead-acid batteries located in the control panel or in an external battery cabinet. Removing the battery compromises the life safety function of the system and will trigger a fault alarm. Only a qualified installation or service technician should remove the battery. Refer to the Installation and Service manual for your system. For proper recycling, dispose of all batteries as required by local ordinances or regulations.

Step 2: Install the ferrite clamp

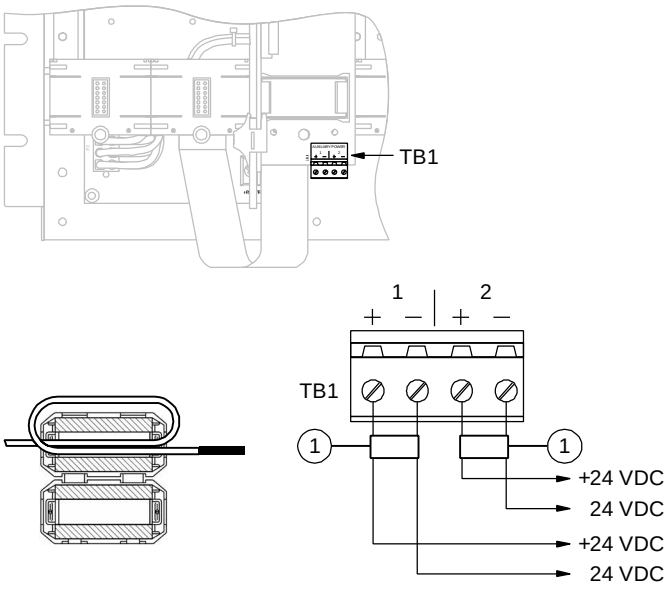
1. Loop the wires once around a ferrite clamp. See Figure 7.
2. Except for the mains AC conductors, install a ferrite clamp on each pair of field wires entering or leaving the cabinet.

Step 3: Wire the auxiliary 24 VDC riser

Connect the 24 VDC auxiliary power riser conductors to TB1 on the monitor module as shown in Figure 7.

Note: Evenly distribute current loads across all power supplies.

Figure 7: TB1 auxiliary power connections



1. Install a ferrite clamp around each pair of wires

Step 4: Wire mains power

Connect the mains power wiring after installing all power. Do not connect more than one primary power supply and three booster supplies to a single mains AC circuit. All mains power wiring must be double insulated.

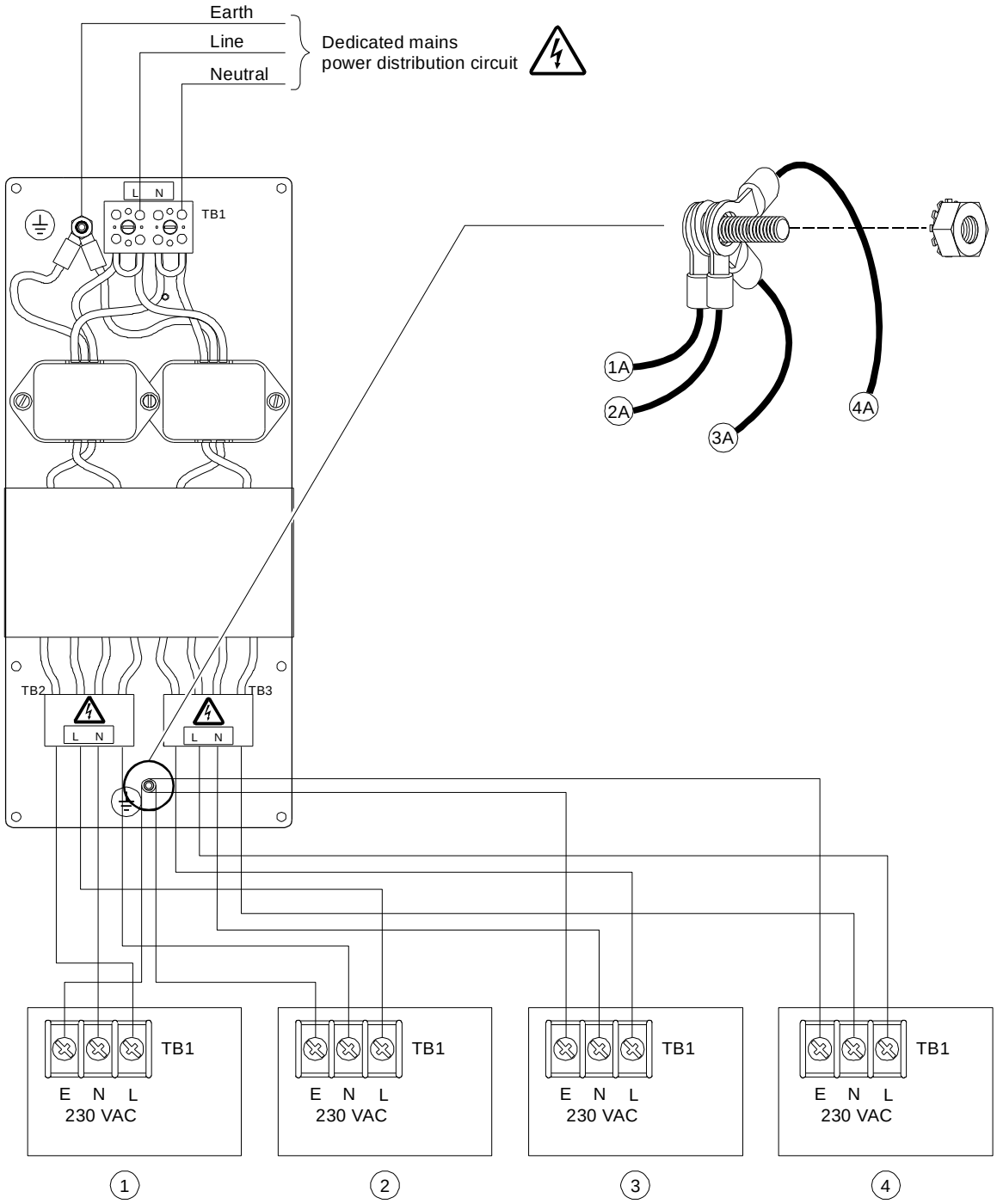
WARNING: Electrocution hazard. High voltage levels capable of causing injury or death may be present. Ensure that the mains power is de-energized and cannot be inadvertently switched on.

1. Connect the filtered Line, Neutral, and Earth conductors from the power distribution assembly to TB1 as shown in Figure 8. Ensure a secure mechanical connection to earth ground.
2. Reattach the terminal block cover over TB1 using the two standoffs and two 6-32 × 3/4 pan head screws.

   WARNING: Electrocution hazard. To avoid personal injury or death from electrocution, ensure that the terminal block cover is installed prior to turning on the mains power.

3. Connect the mains AC conductors from the dedicated mains distribution circuit to TB1 on the power distribution assembly.

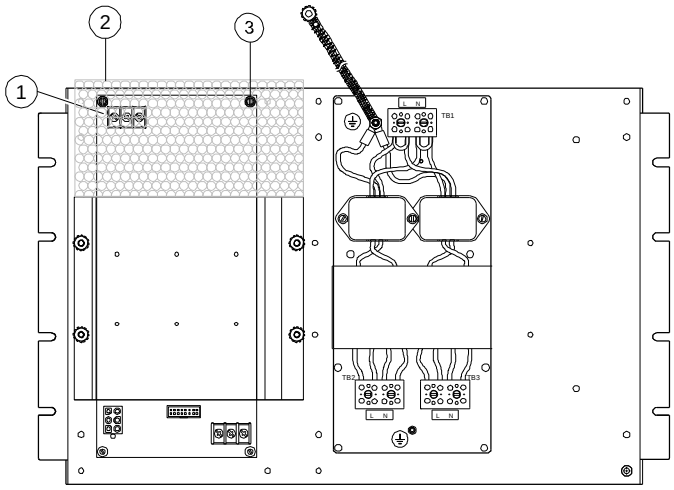
Figure 8: Mains power wiring



1. 3-PPS/M-230-E
2. Optional: 3-BPS/M-230-E or 3-BBC/M-230-E
3. Optional: 3-BPS/M-230-E or 3-BBC/M-230-E
4. Optional: 3-BPS/M-230-E or 3-BBC/M-230-E

1A. 3-PPS/M-230-E TB1-E
2A. Optional: 3-BPS/M-230-E TB1-E or 3-BBC/M-230-E TB1-E
3A. Optional: 3-BPS/M-230-E TB1-E or 3-BBC/M-230-E TB1-E
4A. Optional: 3-BPS/M-230-E TB1-E or 3-BBC/M-230-E TB1-E

Figure 9: Installing the terminal block cover



1. TB1 mains power connector
2. Terminal block cover
3. Standoff

Specifications

3-PPS/M-230-E, 3-BPS/M-230-E, and 3-BBC/M-230-E

Power Input	230 VAC, +10%, −15%, 50 Hz, 2.0 A,
Output	
Total	24 VDC at 7.0 A (internal and auxiliary outputs)
Internal DC	24 VDC at 7.0 A, max.
Auxiliary DC	Two 24 VDC at 3.5 A max. Power-limited and supervised for ground faults and shorts.
Brownout level:	< 188 VAC
Current	3-PPS/M-230-E: included with CPU current requirements
Alarm	3-BPS/M-230-E: 50 mA 3-BBC/M-230-E: 70 mA
Standby	3-BPS/M-230-E: 50 mA 3-BBC/M-230-E: 70 mA
Installation	
Heat sink assembly	Mounts onto the rail chassis
Monitor module	Mounts in one rail space
Dimensions (W × H × D)	205 × 120 × 64 mm
Termination	
AC Input	Terminals on heat sink assembly
Batteries	Terminals on heat sink assembly
Internal DC output	LRM chassis rails via monitor module
Auxiliary DC output	Removable plug-in terminal strips on monitor module
Operating environment	
Temperature	0 to 49°C
Humidity	0 to 93% RH, noncondensing at 32°C

Regulatory information

Note: For other regulatory information, refer to *EST3 European Marketplace Manual* (P/N 270925) or *EST4 European Marketplace Manual* (P/N 3102838).

Environmental class	UL/ULC: Indoor dry IEC: 3K5

Contact information

For contact information, see www.edwardsfiresafety.com.

P/N 387555 • REV 006 • ISS 12JAN23

Control-Display Module Installation Sheet

Description

Control-display modules provide additional operator interface capability for the life safety system. They can be mounted on any local rail module, except the 3-CPU3-E and ANNCPU3-E. Inserts are provided for labeling switches and LEDs.

This document provides installation instructions for the control-display modules listed below.

Model	Description
3-24R-E	Twenty-four red LEDs
3-24Y-E	Twenty-four yellow LEDs
3-24G-E	Twenty-four green LEDs
3-12RY-E	Twelve red-over-yellow pairs of LEDs
3-12SG-E	Twelve LED-switches with green LEDs
3-12SR-E	Twelve LED-switches with red LEDs
3-12SY-E	Twelve LED-switches with yellow LEDs
3-12/S1GY-E	Twelve LED-switches with green-over-yellow LEDs
3-12/S1RY-E	Twelve LED-switches with red-over-yellow LEDs
3-6/3S1G2Y-E	Six groups of three LED-switches with green LEDs (top switch), and yellow LEDs (middle and bottom switch)
3-6/3S1GYR-E	Six groups of three LED-switches with green LEDs (top switch), yellow LEDs (middle switch), and red LEDs (bottom switch)

Installation

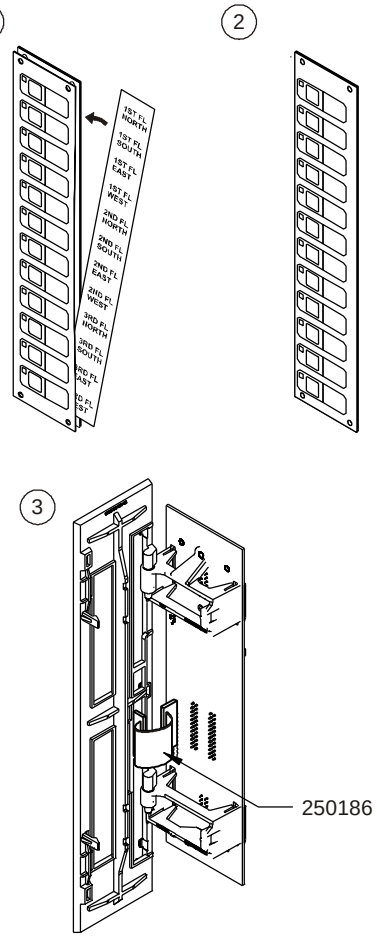
Cautions

- Risk of equipment damage. This product contains components that are sensitive to electrostatic discharge (ESD). Handle with care.
- Risk of equipment damage. Installing this product with power applied will damage the equipment. Power down the panel before installing.

To install a control-display module:

1. Fill out the label insert. Slip it between the overlay and the circuit board. See Figure 1.
2. Insert the left side of the control-display module into the door frame then push in on the right side until it snaps into place.
3. Connect the ribbon cable (P/N 250186) to the rail module with the red edge of the cable pointed up.

Figure 1: Installation



Specifications

Voltage	24 VDC
Current	
Standby	2.0 mA plus 1.5 mA for each active LED
Alarm	2.0 mA plus 1.5 mA for each active LED
Operating environment	
Temperature	32 to 120°F (0 to 49°C)
Relative humidity	0 to 93% noncondensing

Regulatory information

Note: For other regulatory information, refer to *EST3 European Marketplace Manual* (P/N 270925) or *EST4 European Marketplace Manual* (P/N 3102838).

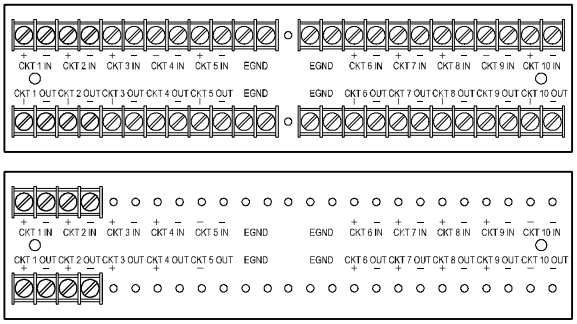
Environmental class	UL/ULC: Indoor dry IEC: 3K5

Contact information

For contact information, see www.edwardsfiresafety.com.

P/N 3102171-EN • REV 003 • ISS 12JAN23

EFM-10 and EFM-2 Filter Board Installation Sheet



EFM-10

EFM-2

Description

The EFM-10 and EFM-2 filter boards provide noise immunity as required in accordance with CE requirements. The EFM-10 Filter Board protects ten individual circuits; the EFM-2 protects two circuits.

Installation

Install and wire this device in accordance with applicable national and local codes, ordinances, and regulations.

To install an EFM filter board:

1. Mount the EFM on the PEM studs on the right side of the cabinet backbox, nearest to the CPU (see Figure 1). Refer to the cabinet documentation for mounting locations.

Wiring

Connect EFM field wiring as shown in Figure 2, observing polarity.

Specifications

Wire size	0.75 to 3.0 mm²
Operating environment	
Temperature	0 to 49°C
Relative humidity	0 to 93% noncondensing

Regulatory information

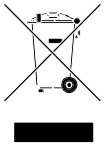
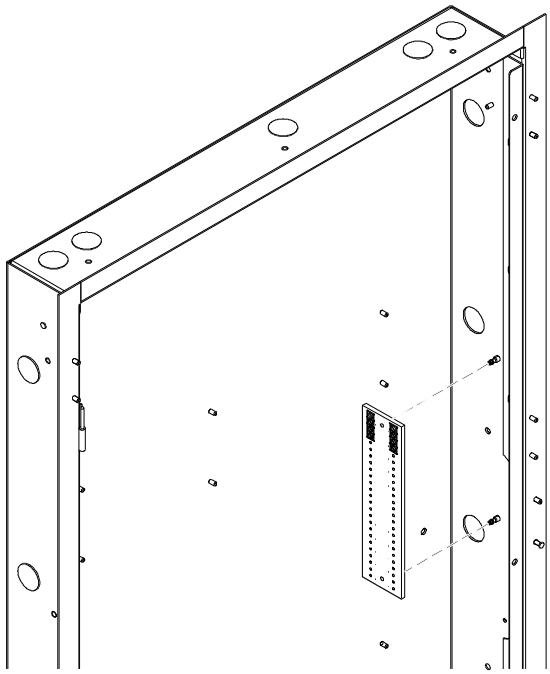
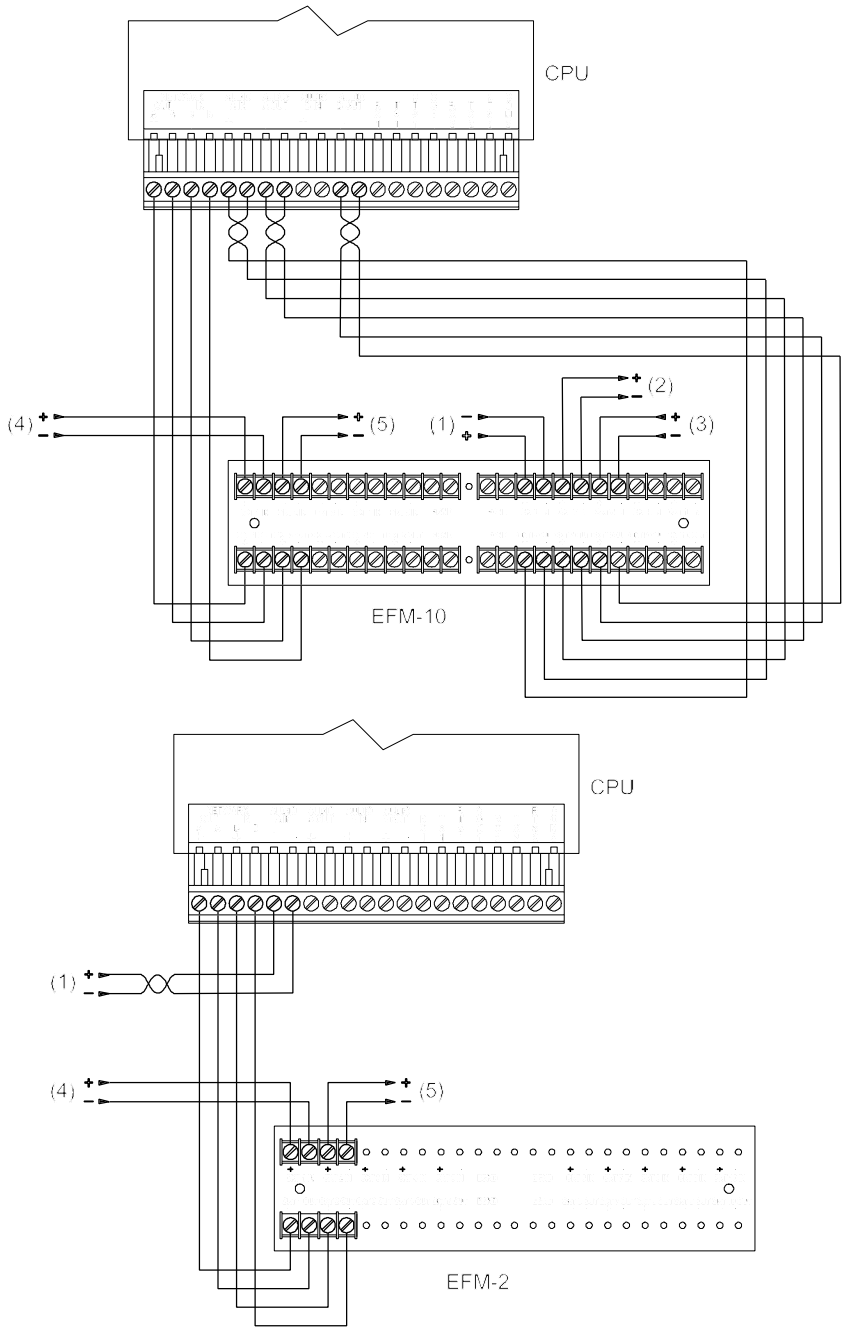
EU compliance	CE
EU certificate	2831-CPR-F1080
UK compliance	UK CA 0832
EN 54	EN 54-2:1997 / A1:2006 EN 54-4:1997 / A1:2002 / A2:2006 EN 54-16:2008
Emissions	CISPR Class B
European Union directives	2014/53/EU (RED directive): Hereby, Carrier declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.
	2012/19/EU (WEEE directive): Products marked with this symbol cannot be disposed of as unsorted municipal waste in the European Union. For proper recycling, return this product to your local supplier upon the purchase of equivalent new equipment, or dispose of it at designated collection points. For more information see: www.recyclethis.info.

Figure 1: Installing the EFM filter board



P/N 387214-EN • REV 005 • ISS 20MAY21

Figure 2: EFM network data riser wiring in an EST3 application



(1) AUDIO A IN from 3-ASU-E (audio data primary)
(2) AUDIO A OUT to next CPU in the network
(3) AUDIO B OUT from last CPU in the network
(4) Network Data Riser In
(5) Network Data Riser Out

Contact information

For contact information, see www.edwardsfiresafety.com.

P/N 387214-EN • REV 005 • ISS 20MAY21

Annex B: Battery Fire Safety Waterfall

4th Floor, 80 Victoria Street, London SW1E 5JL
Registered in England and Wales No: 09840486
VAT number: 234 9362 96

Annex B

Battery Fire Safety Waterfall

STATERA
BALANCING THE GRID

Multiple layers of safety are in place to prevent a fire occurring and to protect life in the unlikely event of a fire

Fire Safety