ESPIRE 280 SYSTEM

INSTALLATION MANUAL

Contents

1. Introduction

This document provides the necessary details to design a site for eSpire 280 system. The **eSpire 280** system is modular, fully integrated, AC coupled Energy Storage System (ESS)

This document should be used for the design, installation, and maintenance of the system. Only qualified personnel can install, maintain, and troubleshoot the eSpire System.

Unauthorized persons should not operate the procession and should be away from the eSpire system to avoid potential hazards.

This document applies to the following configurations:

I. eSpire 125 KW / 280 KWH
II. eSpire 125 KW / 560 KWH
III. eSPire 125 KW / 840 KWH

The installation consists of five major components:

- Keystone Micro Grid Control Panel
- Power Conditioning System (PCS)
- Liquid Cooling Lithium Battery Cabinet
- System Islanding and Feeder Protection System
- Energy Meters

2. Product Models & Layout

2.1 eSpire 125 KW / 280 KWH

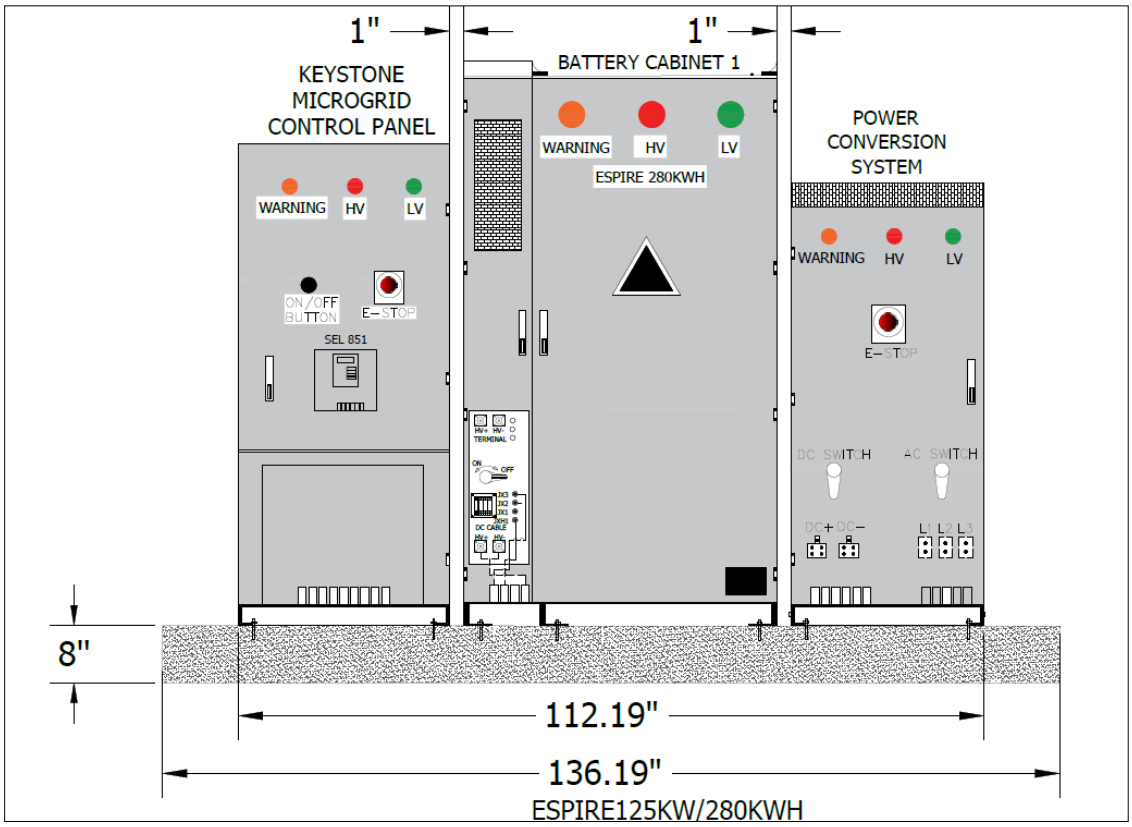


Figure 1. Front view layout of eSpire 125KW/280KWH

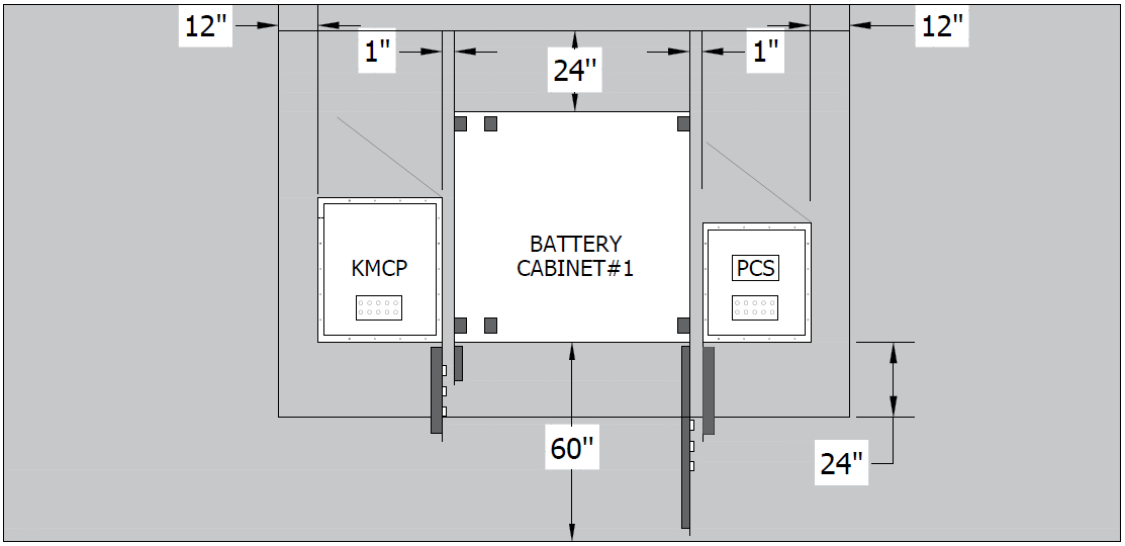


Figure 2. Spacing Layout of eSpire 125KW/280KWh

2.2 eSpire 125 KW / 560 KWH

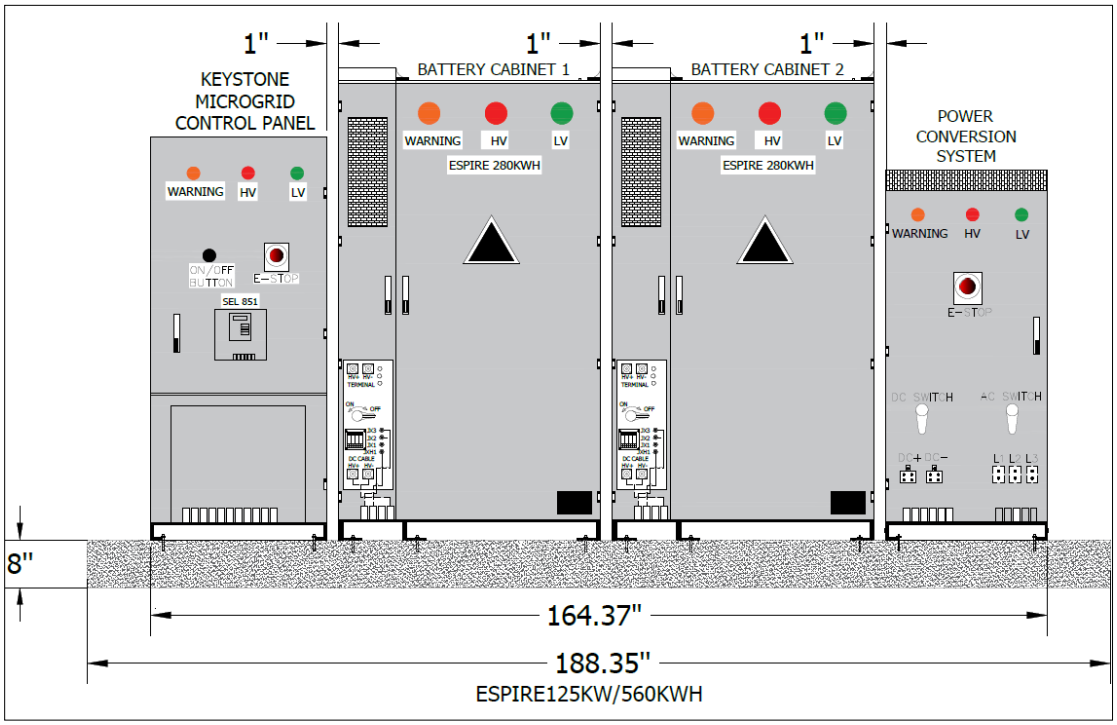


Figure 3. Front view layout of eSpire 125KW/560KWH

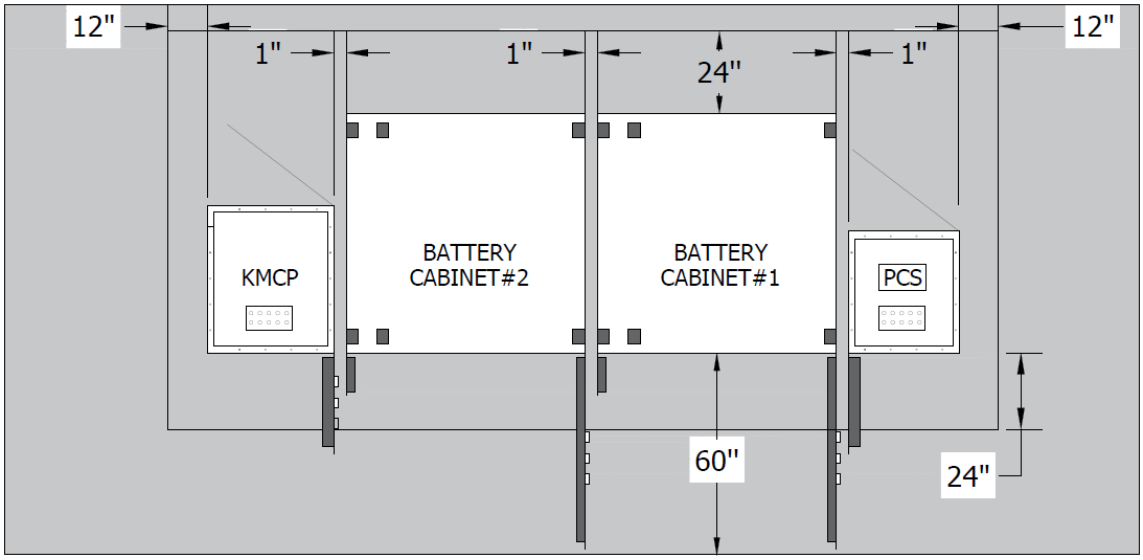


Figure 4. Spacing Layout of eSpire 125KW/560KWh

3. Overview of Site Components

3.1 Battery System

The battery serves as a fundamental and essential unit within an energy storage system, playing a pivotal role in the storage and management of electricity. Comprising batteries, a Battery Management System (BMS), and relevant structural installation devices, the battery cabinet acts as the central hub for energy storage, ensuring a reliable and efficient operation of the entire system.

Specifications

Battery Specification	
Fortress Power Battery Module	eSpire 280
Chemistry	Lithium Iron Phosphate
Cell Type	Prismatic
Configuration	1P6S
Number of Modules	6
Nominal Capacity	280 Ah
Nominal Energy	279.5 kWh
Nominal Voltage	998.4 Vdc
Operating Voltage Range	873.7 – 1123.2 VDC
Maximum Continuous Charging / Discharging Current	140 Amps
Communication	Modbus TCP, CAN, Modbus RTU
Cycle Life @ 25C @ 70% Retention	8000 Cycles
DC-DC Round Trip Efficiency	92% @ 0.5C, 25°C, 1 Cycle Per Day
Operating Temperature Range	Charging: 0-55°C & Discharging -20-55°C
Thermal Management System	Integrated Liquid Cooling System (HVAC)
Fire Suppression System	Fire Detector, Smoke Detector & Fire Extinguisher
IP Class	Type IP66, NEMA 3R
Battery Bank Scalability	Up to 10 (2.8 MWH)
Weight	3005 kgs / 6625 lbs
Dimensions	92.13 x 51.18 x 51.18 in (2340 x 1300 x 1300 mm)

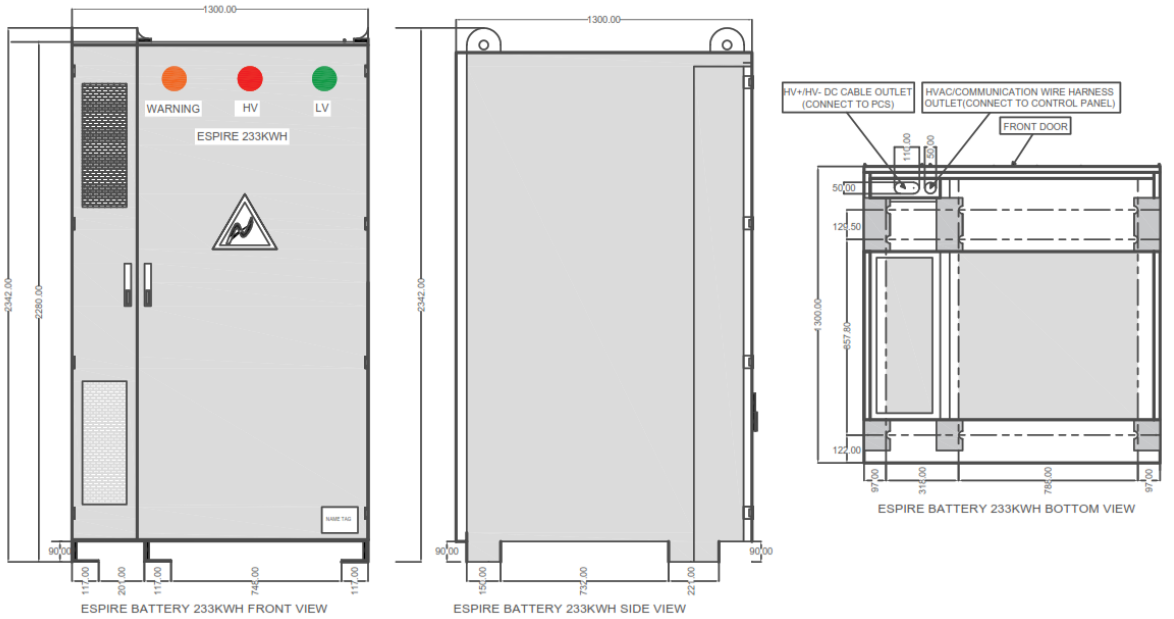


Figure 7. Battery Cabinet Dimensions and layout

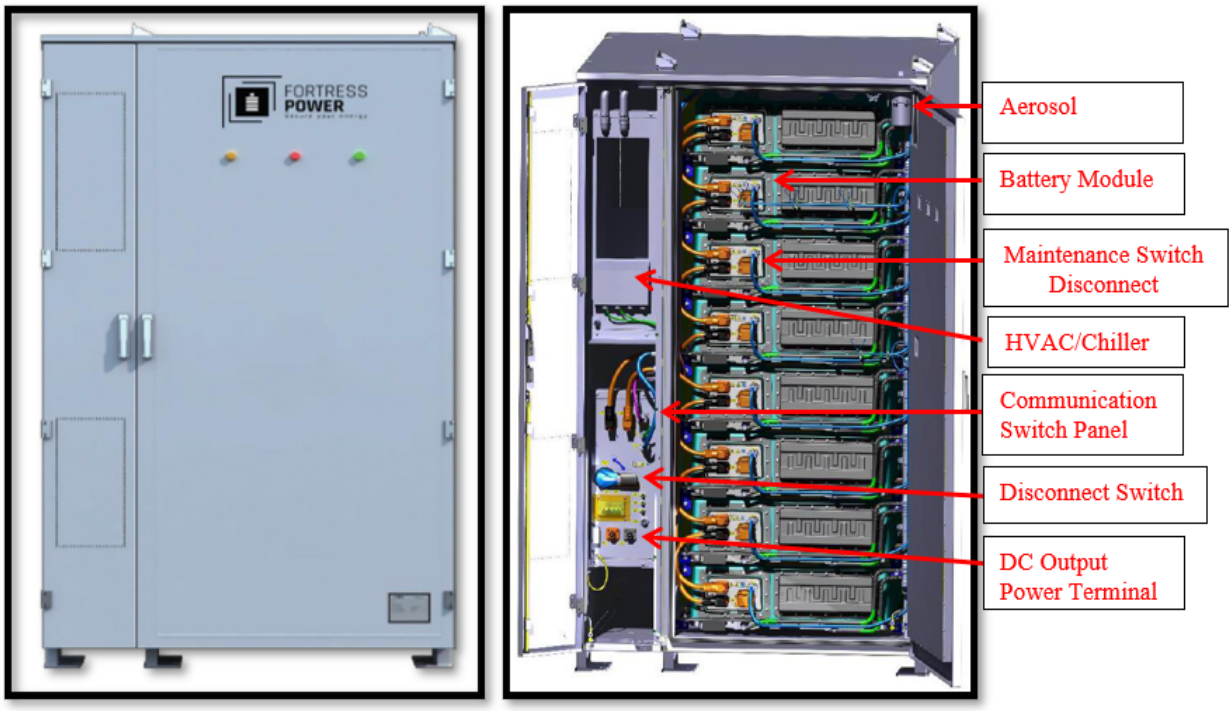
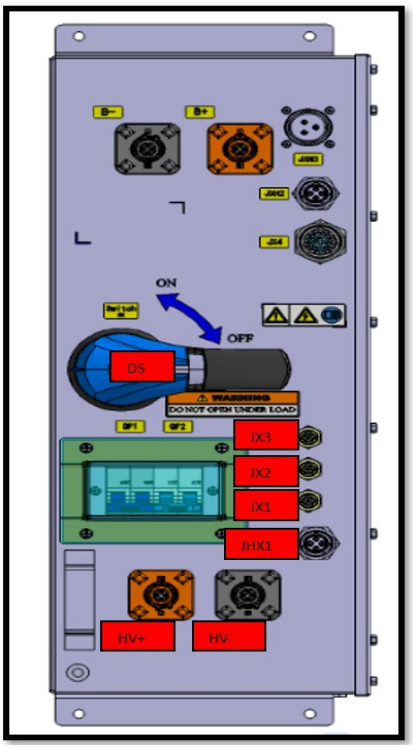


Figure 8. Battery internal components



Communication and Electrical Interface Panel

The interface panel below allows for a plug-and-play connection between Battery, PCS, and the Fortress Control panel. Below are the usable terminals of the interface panel.

Tag #	Terminal Description
DS	Disconnect Switch
JX3	Fire Alarm Signal
JX2	Terminal Resistor
JX1	N/A
JHX1	HVAC and Power Supply Signal
HV + & HV-	High Voltage DC Positive Terminal & High Voltage DC Negative Terminal

Figure 9. Communication and Electrical Interface Panel

HVAC/Chiller Specifications

No	Parts Description	Operating Specification
1	Auxiliary Power	1Ph 187 -253 VAC 50/60Hz
2	Compressor rated power	3.5KW
3	Compressor rated speed	4500 RPM
4	Compressor RLA	15.8Amp
5	Total Load	25A
6	Maximum over current protection device	40A

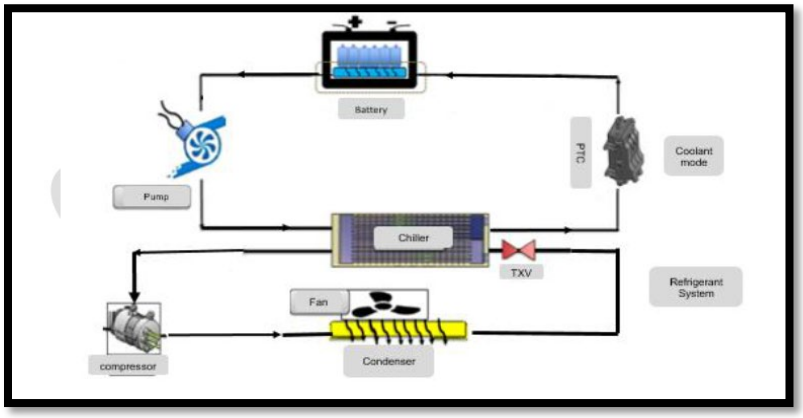


Figure 10. Battery chiller schematic diagram

3.2 Keystone Micro Grid Control Panel

The Control Panel serves as the main control unit for the energy storage system, providing monitoring, control functionalities, and Feeder Protection Relay. The panel houses a collection of electronics and communications devices for monitoring and controlling the energy storage system, including the battery cabinet, PCS, and other controllable Distributed Energy Resources. The Keystone Microgrid Control Panel also includes an SEL device for protection.

It is a user interface between the customer, energy storage system, and cloud-based monitoring system, and it's equipped with the following buttons in front of the panel:

I. ON/OFF Push Button
II. Emergency Stop Button
III. Status Indicators such as Low voltage LV, High voltage HV & Alarm indicator (Warning).

Customers can initiate start-up or shutdown commands to the energy storage system through the push buttons/activate the emergency stop button. All the components in the panel and external islanding panel are backed up through online UPS, allowing the control system and Islanding logic to remain online during grid failure.

Specification

ITEM	UNIT	SPECIFICATION
Input Voltage	VAC	180-260
Input Frequency	HZ	60Hz
DC Control Voltage	VDC	24
Integrated Microgrid Controller	-	Cloud Based Controller
Support Protocol	-	Modbus TCP/RTU
High Voltage DC Sensing	VDC	750-1000
Enclosure Rating	-	NEMA 3R / IP54
Altitude	m	≤ 3000
Humidity	%	0 ~ 95%, no condensation
Operating Temperature	C / F	0 – 40 / 32 - 104
Weight	kg / lbs	313 / 690
Dimension (H x W x D)	mm/inch	1990 x 900 x 916 / 78.34 x 35.43 x 36.00

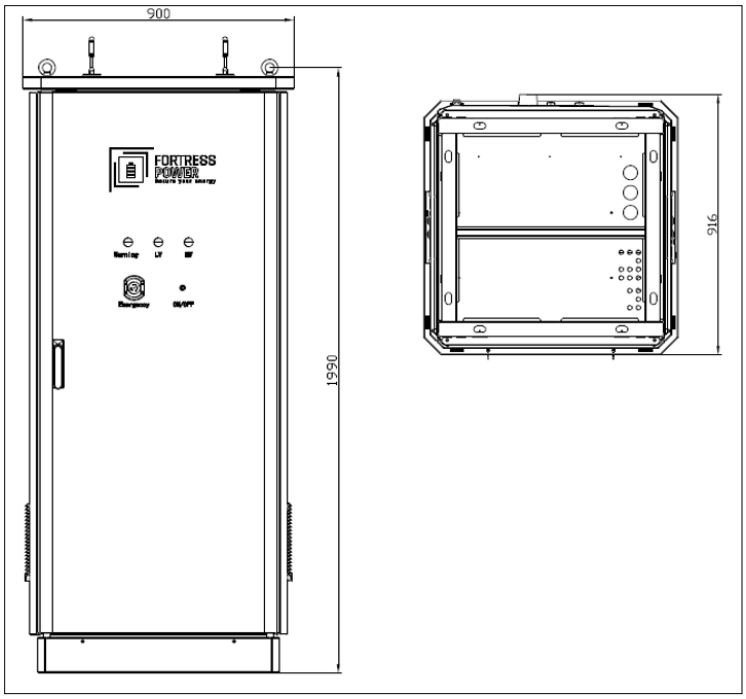
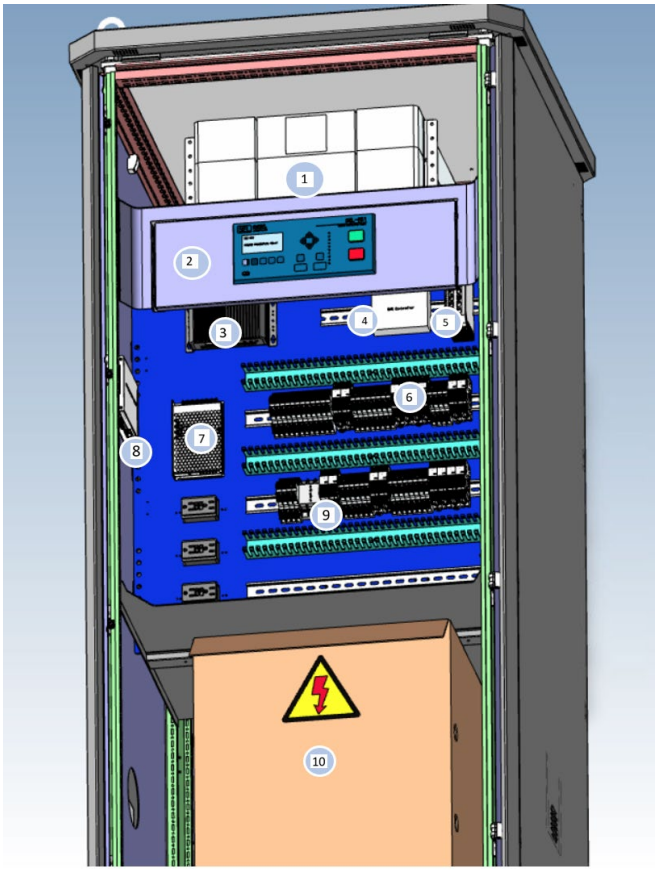


Figure 11. Dimensions and layout of Control Panel



No	Description
1	UPS
2	SEL 851 (Optional)
3	IMM
4	MBMU
5	Ethernet Switch
6	HVAC 1 Circuit Breaker QF1
7	ETH
8	Modem
9	HVAC 1 Circuit Breaker QF2
10	15KVA Transformer (1Ph 480/240 V)

Figure 12. Components of Keystone Microgrid Control Panel

3.3 Power Conditioning System (PCS)

The eSpire 233 system facilitates power conversion in both directions, converting AC to DC and DC to AC. It utilizes this bi-directional power conversion capability to charge the liquid cooling lithium phosphate battery from the available power source (Grid) and discharge it to the grid or the load as determined by the keystone control strategy.

The modular design of the eSpire system allows for scalability, meaning the system capacity can be adjusted or expanded to accommodate different power requirements.

The turnkey solution works can be used in both grid tie and off grid applications.

- For grid-tie applications, up to 10 PCS can be connected in parallel configuration.
- For off grid application, up to 5 PCS can be connected in a parallel configuration.

Specifications

Description	eSpire 125kw
Rated Grid Voltage	3 Phase 480VAC
Grid Voltage Range	423 to 528VAC (-12% +10%)
Rated Grid Frequency	60Hz
Frequency Range	59.3 to 60.5Hz, adjustable
Rated AC Power	125kva
Rated AC Current	151A
Maximum Continuous AC Current	167Arms
Current THD	IEEE 1547 Compliant, < 5% at rated power
DC Voltage Range	750 to 1350VDC
Rated DC Voltage	900VDC
Rated Discharge Power	128kW
Rated Charge Power	122 kW
Max Discharge DC Current	157A
Max Charge DC Current	151A
Rated Output Voltage	480VAC (3P3W / 3P3W)
Rated Output Power	125KVA/125KW with Linear Load 100KVA with RCD load (Ipk≦240A)
Rated Output Current	151A
Rated Output Frequency	60Hz ±1%
Power Factor	>0.99 (-1 leading to 1 lagging, adjustable)
Output Voltage Accuracy	1%
Output Voltage THD	<3% @ linear load
Output Voltage Regulation	<10% at dynamin, Recovering within tolerance in 100ms
Weight (kg/lbs)	230 / 506
Dimension (H x W x D) (mm / inch)	2000 x 600 x 500 / 78.74 x 23.62 x 19.68

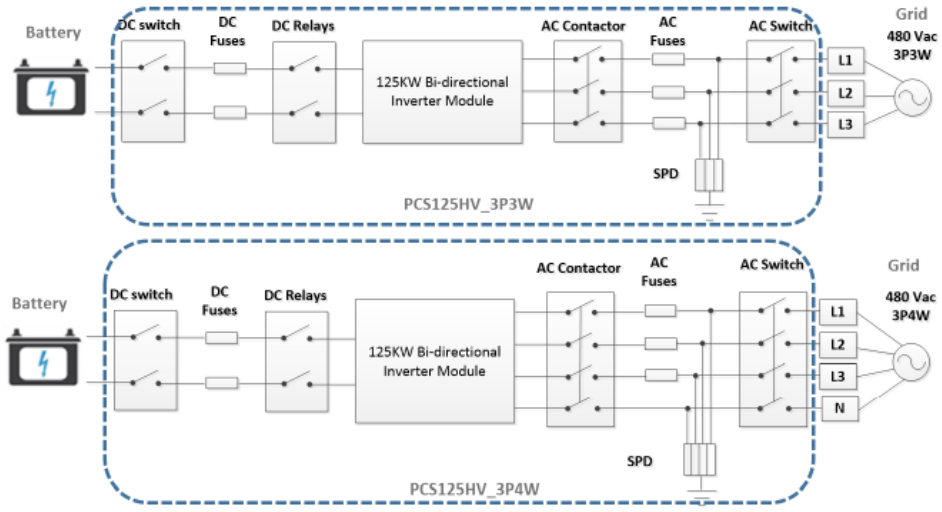


Figure 13. Schematic layout of PCS with Battery

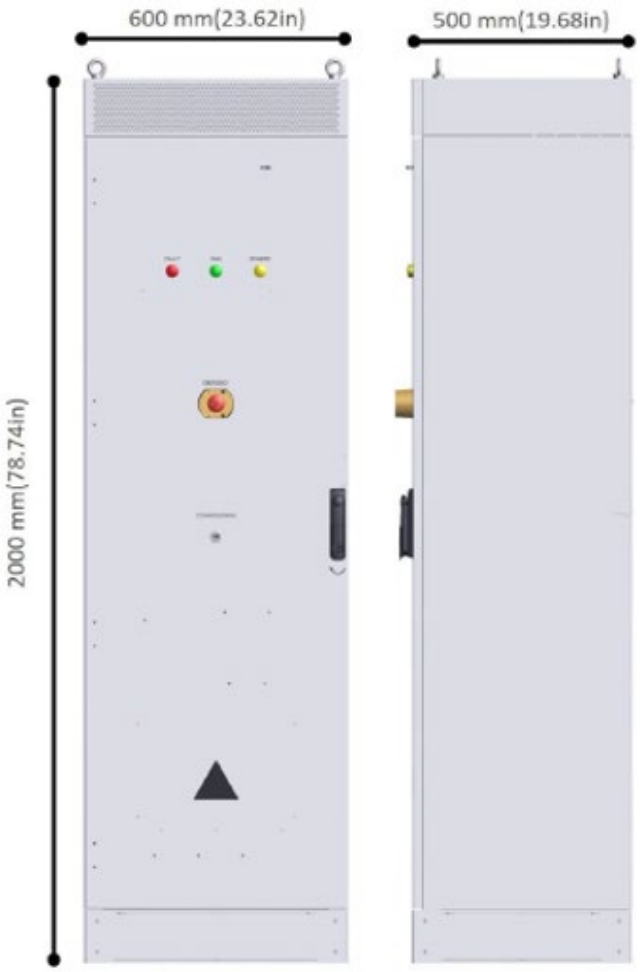


Figure 14. Dimensions of PCS

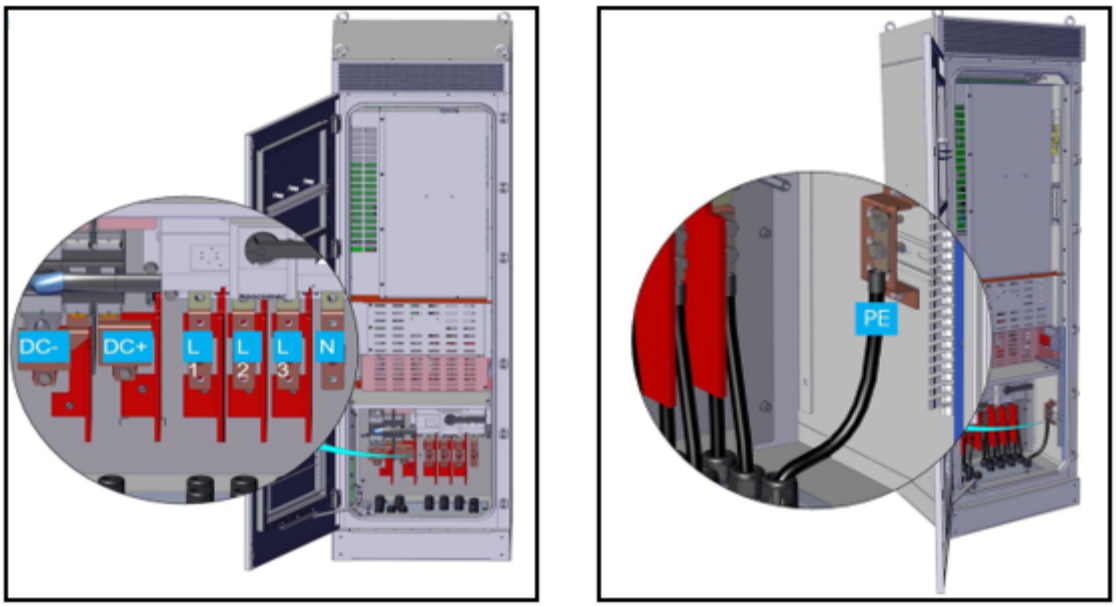


Figure 15. Terminals for DC and AC Connections

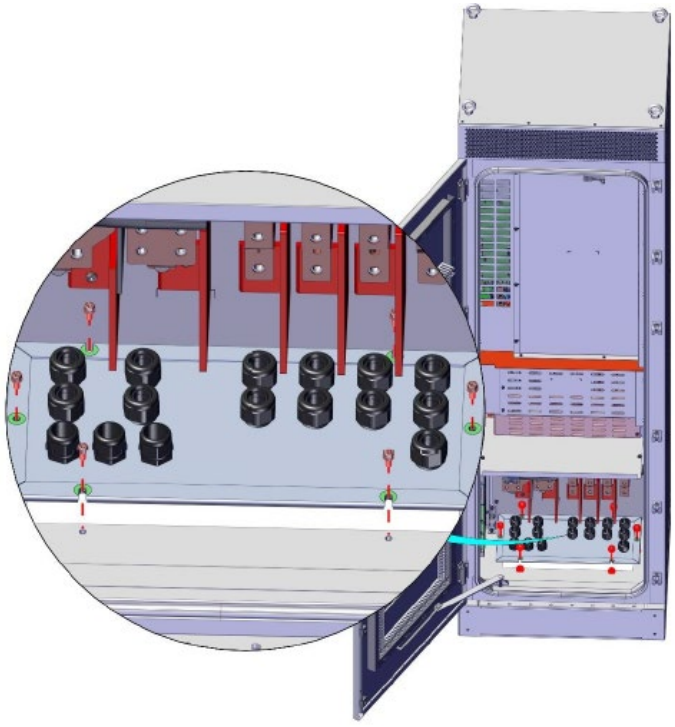


Figure 16. Cable glands for AC. DC, and Communication wiring

4. Installation

4.1 Mechanical

WARNING:
Adhere to all national, state, and local codes required to install the energy storage system (eSpire system).

Transportation

Transporting the eSpire system is possible, and provision should be made for the system to be moved on a low-bed truck or truck. Ensuring that the forklift used to transport the eSpire system has a sufficient load capacity is essential.

After a freight forwarding company delivers the eSpire system to the site, the plant staff will transport the eSpire system to the designated location on site. It is important to note that the plant staff should have the necessary knowledge and experience to transport the equipment safely.

Transporting the eSpire system piece by piece is also an option. However, it is necessary to ensure that each piece of equipment is appropriately packaged and labeled for transport. This will help to prevent any damage that may occur during transportation.

In either case, taking necessary precautions during transportation is crucial to avoid damaging the equipment. Proper handling, packaging, and labeling of the equipment are essential to ensure it arrives at the installation site in optimal condition.

WARNING:

Follow all local and national electric codes during loading & unloading of the eSpire system. Observe safety instructions as required by law.

- All the accessories required for transportation should be maintained beforehand.
- The eSpire system must be transported by qualified personnel. Qualified means the operators must have relevant training experience, especially those related safety.

NOTICE:

Always keep in mind the dimensions and weight of battery

- Battery H x W x D: 2340 x 1300 x 1300
- Weight: approx. 3005 kg

NOTICE:

Always keep in mind the dimensions and weight of control panel

- Keystone Microgrid Control panel H x W x D: 1990 x 900 x 916 mm
- Weight: approx. 313 kg

Ensure that the following requirements are met:

- All the doors are locked.
- Choose the appropriate crane or hoist or forklift to transport each piece of equipment.
- The forklift or crane or hoist must be sufficient to bear the weight of each piece of equipment.
- Battery should be only transported after its being discharged to <25% SOC.
- Anything that may hinder transportation, like trees, cables (or similar), should be removed.
- If possible, choose fine weather days to transport the eSpire system.
- Warning signs or barriers must be posted near the transport areas to avoid accidental injuries.

Additionally, the following should be met when the eSpire system is placed on the ground:

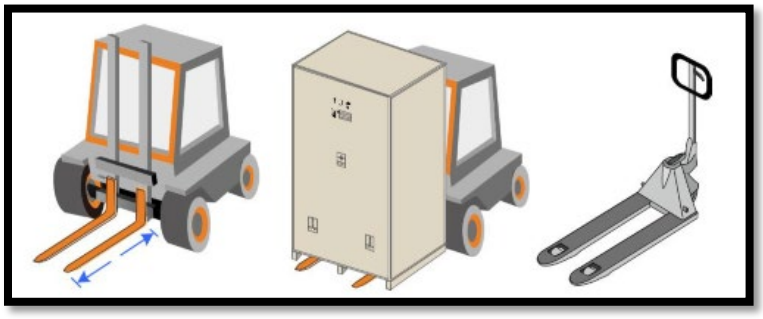
- Place each piece of equipment carefully and gently.
- Do not pull or push each panel on any surface.

The ground should be firm and flat with a good drainage system and have no obstacles or outshoots. Each piece of equipment should be placed and supported by four feet.

4.1.1 Forklift Transportation

When using a forklift to transport each piece of equipment (Battery Cabinet, PCS, and Fortress Control panel), it is important to ensure the following:

- The forklift has a sufficient carrying capacity. (At least a minimum of tons)
- That the box's center of gravity falls between the two forks of the forklift during transportation.
- That the forklift prong is at least 1500mm long and inserted into the pockets at the bottom of the container.
- Handle the eSpire system slowly and steadily and perform trial handling first to ensure safe transportation.
- The place where the forklift will operate should be firm and flat, with good drainage and no obstacles or humps.
- During the transportation process, it is important to observe the safety operation rules of forklifts strictly.
- The large battery cabinet may block the driver's view, it is recommended to coordinate with auxiliary personnel to ensure safe transportation.



4.1.2 Pre-Installation Requirements

4.1.2.1 Location Consideration

Item	Description
Proximity	Proximity to the structure and convenient proximity to the AC power disconnect will be major factors in locating the system.
Clearance	It is recommended that the system be located a minimum of 5 feet from any doors or windows. Ensure that there is sufficient clearance for any maintenance required. Do not locate the system where bushes, trees, or other vegetation may grow up and obstruct access. Do not locate the system under any decks or other structures. Ensure there is adequate overhead clearance from any structure, overhang, or projections from the wall. Ensure the concrete pad will not interfere with any easements or any underground services such as phone, water, sewage, fuel, or irrigation.
Drainage and Flooding	Do not locate the system where excessive water may accumulate or in locations subject to flooding. Ensure that gutter downspouts, roof runoff, landscape irrigation, water sprinklers, or sump pump.
Security	It is recommended that the system be located such that it will not be easily accessible to unauthorized individuals.

4.1.2.2 Concrete Pad Preparation

Improper foundation construction may affect an operator's ability to open and close the door of the eSpire system. Therefore, the foundation must be designed and constructed according to related standards. The dimensions, weight of the eSpire system, cable routes, and maintenance access should always be considered.

The following conditions must be fulfilled according to the local and national codes.

- The bottom of the foundation should be firm enough.
- The foundation should be at least 300mm/11.8 inches higher than the ground level on the site to avoid rain or flood from entering inside the eSpire system.
- Sufficient cross-sectional area and depth of the foundation should be maintained. The depth is designed according to local site conditions.
- Cable routes through electric conduit should be considered.
- The ground pit with proper grounding conductors should be designed early and finished with foundation construction.

4.1.3 Foundation Construction Method

This section describes a method for the construction of the foundation. For specific on-site design, please refer to each piece of equipment manual.

- If each piece of equipment will be installed side by side, design the concrete pad with the following (Length ×Width): 11.4 ft x 8.6 ft for 1 PCS, 1 battery cabinet and 1 keystone microgrid control panel.
  *Note: Refer the recommended spacing layout in the Product Models and layout section in this manual.
- Provision must be made for electrical conduits to connect the system to the disconnect AC panel.
- Provision must be made for electrical conduit interconnect wiring between each piece of Equipment (PCS, battery cabinet & control panel).
- The concrete pad or other installation such as skid installation on existing pad shall have a minimum strength of 4000 psi and a minimum slab thickness of 8". The reinforcement for the concrete pad shall be in accordance with all local building codes and regulations.
- According to the position and size of the cable, inlets/outlets at the bottom of the eSpire system, cables must thread through the bottom of each piece of equipment. Reserve the trough for AC/DC cables and electric conduit during the concrete pad construction.
- A licensed electrician or engineer should determine the size and quantity of electrical conduits after reviewing the Scope of Supply.
- The foundation and anchoring design must be performed by a civil or structural engineer registered in the state where the system is being installed in accordance with local building codes. Consult the site geotechnical report for the geotechnical design requirements.
- The concrete pad or base shall slop a minimum of 1% and a maximum of 2% to allow positive drainage from the pad/ base or toward a drain or catch pit.
- Catch pits should be designed at the bottom of the foundation, and drainpipes should be provided.
- The two ends of all-electrical conduit pipes must be sealed temporarily to prevent entry of foreign objects to facilitate future wire implementation.
- After making electrical connections, cable outlet/inlet and gaps in between should be sealed with fireproof mud to prevent entry of rodents.
- Concrete finishing or other mounting equipment is required to produce smooth, even surfaces of uniform texture and appearance, free from bulges, depressions, and other imperfections that would impact equipment anchorage or foundation/ base drainage.

4.2 Electrical

DANGER:
High voltage! Electrical hazard

- Do not touch the live components of the device.
- Make sure the AC and DC sides are voltage-free before installation.
- Never put flammable materials in the vicinity of the eSpire system.

DANGER:

Electrical hazard!

- If a ground fault occurs, some parts that were voltage-free before may contain lethal voltage.
- Accidental touch may cause serious damage. Make sure there is no system ground fault before operation and take proper protection measures.

WARNING:

- Observe all the country-specific national, state & local standards and regulations.
- Connect the PCS to public grid only after receiving authorization from the local network operator.

WARNING:

Only professional or licensed electricians can perform electrical connections.

- Follow all wiring instructions in accordance with NEC when performing electrical action.
- Fortress Power LLC will not be held liable for any personal injury or property loss due to negligence of the safety instructions.

WARNING

- Disconnect all AC and DC switches /circuit breakers before performing any electrical connection.

WARNING:

- Sand and moisture penetration inside any piece of equipment may affect the performance of electric components in the panel.
- Do not perform electrical tasks in sandy season or when the ambient relative humidity is above 95%.
- Do not locate the system where excessive water may accumulate or in locations subject to flooding. Ensure that gutter downspouts, roof runoff, landscape irrigation, water sprinklers, or sump pump discharge will not cause water to accumulate near the system.

WARNING:

- Improper torque may cause fire to the connection point!
- Fix the bolts by strictly following the torque requirements in this manual during electrical connection.

WARNING:

- Too small bending radius or excessive intertwining may damage the fiber!
- Follow the recommended bend radius from the cable manufacturer.
- Communication cable wire shield must be grounded at both ends of the device

WARNING:

- Ensure the electrical insulation is satisfied before laying the cables. Follow the EMC regulation and lay the power cable and communication cable in different layers.
- Provide support and protection to the cables to reduce the stress of the cables when necessary.

Five Safety Rules

During electrical connections and other operations on the eSpire system, observe the following Five Safety Rules:

- Always wear the correct personal protective equipment when performing operation or electrical wiring.
- Disconnect all the external connections and disconnect the container internal power supply.
- Avoid any accidental re-connections.
- Verify that no voltage or current is present with appropriate testing devices.
- Ground and short-circuit whenever necessary.

Cover possible live parts to avoid accidental Contact.

WARNING:

Incorrect power or control cable connection may result in short circuit, follow the wiring sequence when connecting the power and control cables.

The selected cable must have sufficient current carry capacity, the current carry capacity of the conductor must at least account for environmental conditions, insulation material, conductor material and cross-sectional area.

- The wire diameter or size of all cables must be selected according to maximum.
- Charging and discharging current of the system cabinet and for service factor per NEC code.
- Cable of the same size and specification must be used in two or three battery cabinet applications.
- Please select flame retardant cable and ensure to use properly sized cable.
- Cable overload is strictly prohibited.

4.2.1 Schematic Diagram and Wire Routing

4.2.1.1 eSpire 125 KW / 280 KWH

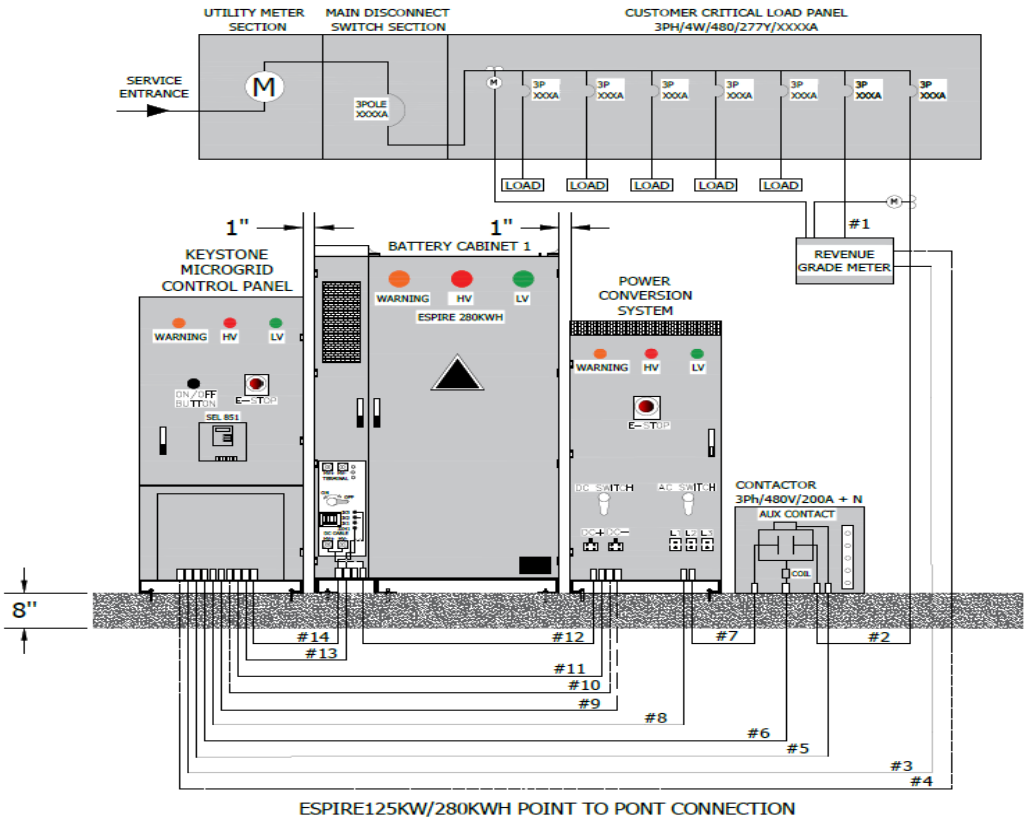


Figure 17. Schematic point to point diagram of 1 Battery System

CABLE MANAGEMENT						
Tag	**Tag Type**	**Description**	**From**	**To**	**Responsible Party**	**Minimum Recommended Cable Size**
1	Revenue Grade Meter Voltage Sensing Cable	3 Phase 480Vac + Neutral Voltage Sensing Cable	Revenue Grade Meter Panel	Critical Load Panel 3P/4W	Customer	(3) #12 AWG-THWN-2 + N
2	AC Man Input/Output Power Supply Cable	3phase 480Vac Man Input/Output + N Power Supply Cable	Contactor	Customer Man Distribution Panel	Customer	####
3	Revenue Grade Meter Power Supply Cable	Revenue Grade Meter DC Cable	Keystone Microgrid Control Panel	Revenue Grade Meter Panel	Customer	(2) #12 AWG-THWN-2
4	Revenue Grade Meter Communication Cable	Revenue Grade Meter Communication Cable (Ethernet Cable)	Keystone Microgrid Control Panel	Revenue Grade Meter Panel	Customer	Cat 6 Ethernet Cable
5	Contactor Dry Contact	Contactor Dry Contact Cable	Contactor Panel	Keystone Microgrid Control Panel	Customer	(2) #12 AWG-THWN-2

6	Contactor Control Voltage Cable	Contactor Coil Control Voltage Cable 1 Ph/120Vac	Keystone Microgrid Control Panel	Contactor Panel	Customer	(2) #12 AWG-THWN-2
7	AC Main Input/Output Power Supply Cable	3 Phase 480V Man Input/Output + N Power Supply Cable	Power Conversion System (Ac Side)	Contactor Panel (Load Side)	Customer	(3) # 1/0 AWG-THWN-2 + N
8	AC Input Power Supply Cable	1 Phase 480Vac Input Power Supply Cable	Power Conversion System (AC Side)	Keystone Microgrid Control Panel	Customer	(2) #10 AWG-THWN-2
9	Power Conversion System Input/Output Signal Cables	3 Inputs & 2 Outputs Dry Contact Cable	Power Conversion System (J-Board)	Keystone Microgrid Control Panel	Customer	(10) #12 AWG-THWN-2
10	Communication Cable	Cable (Communication Cable)	Power Conversion System (J-Board)	Keystone Microgrid Control Panel	Customer	Cat 6 Ethernet Cable
11	High Dc Voltage Sensing Cable	High DC Voltage Sensing Cable (1500Vdc)	Power Conversion System (DC Side)	Keystone Microgrid Control Panel	Customer	(2) 12 AWG-THWN-2 + N
12	Battery #1 High DC Voltage Power Supply Cable	Battery #2 High DC Voltage Power Supply Cable (1500Vdc)	Power Conversion System (DC Side)	Battery Cabinet #1	Fortress	(2) #1/0 AWG-THWN-2
13	HVAC & Control Panel Power Supply Cable for Battery #1	Battery #1 HVAC & Control Panel Power Supply Wire Harness (220Vac)	Keystone Microgrid Control Panel	Battery Cabinet #1 (JXH1)	Fortress	(4) #12 AWG-THWN-2
14	BMS And Fire Control Panel Signal Cable	BMS And Fire Control Wire Harness	Keystone Microgrid Control Panel (Fire Control Panel)	Battery Cabinet #1	Fortress	(6) #0.22mm Size

4.2.1.2 eSpire 125 KW / 560 KWH

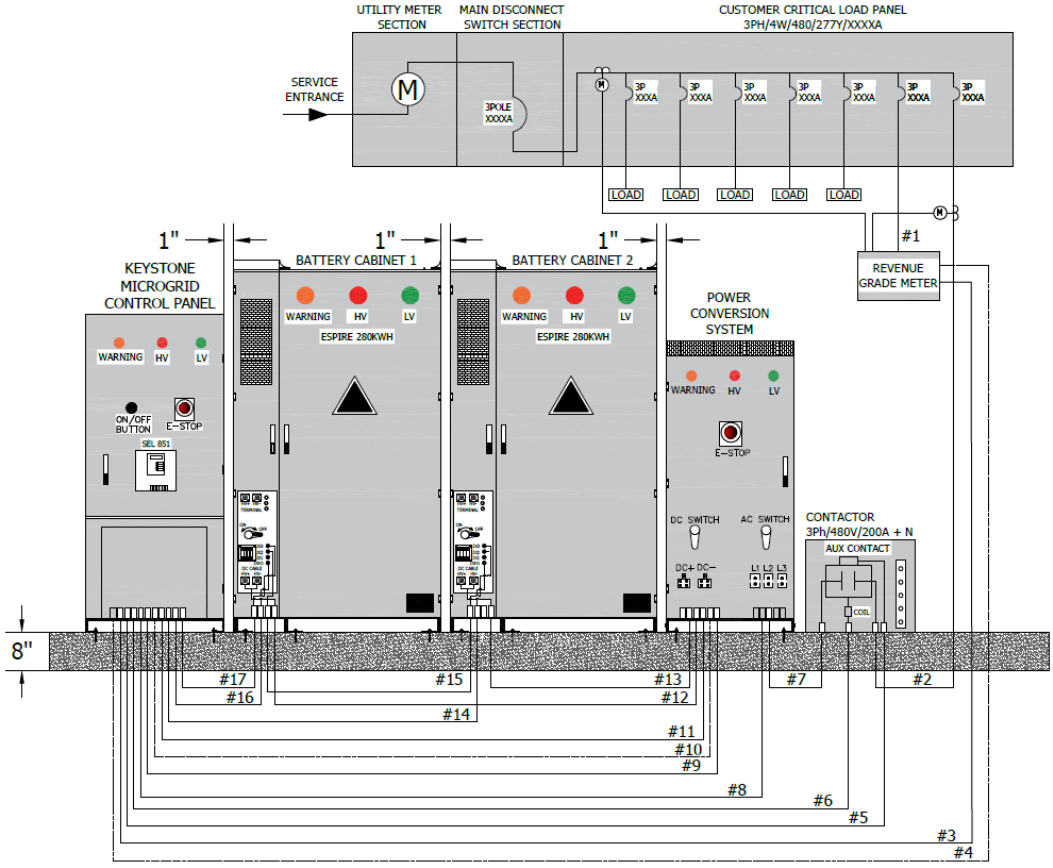


Figure 18. Schematic point to point diagram of 2 Battery System

Cable Management						
Tag	**Tag Type**	**Description**	**From**	**To**	**Responsible Party**	**Minimum Recommended Cable Size**
1	Revenue Grade Meter Voltage Sensing Cable	3 Phase 480Vac + Neutral Voltage Sensing Cable	Revenue Grade Meter Panel	Critical Load Panel 3P/4W	Customer	(3) #12AWG-THWN-2
2	AC Main Input/Output Power Supply Cable	3 Phase 480Vac Main Input/Output + N Power Supply Cable	Contactor	Customer Main Distribution Panel	Customer	####
3	Revenue Grade Meter Power Supply Cable	Revenue Grade Meter DC Cable	Keystone Microgrid Control Panel	Revenue Grade Meter Panel	Customer	(2) #12 AWG-THWN-2
4	Revenue Grade Meter Communication Cable	Revenue Grade Meter Communication Cable (Ethernet Cable)	Keystone Microgrid Control Panel	Revenue Grade Meter Panel	Customer	Cat 6 Ethernet Cable
5	Contactor Dry Contact	Contactor Dry Contact Cable	Contactor Panel	Keystone Microgrid Control Panel	Customer	(2) #12 AWG-THWN-2

6	Contactor Control Voltage Cable	Contactor Coil Control Voltage Cable 1Phase 120Vac	Keystone Microgrid Control Panel	Contactor Panel	Customer	(2) #12 AWG-THWN-2
7	AC Main Input/Output Power Supply Cable	3 Phase 480V Main Input/Output + N Power Supply Cable	Power Conversion System (AC Side)	Contactor Panel (Load Side)	Customer	(3) # 1/ AWG-THWN-2 N
8	AC Input Power Supply Cable	1Phase 480Vac Input Power Supply Cable	Power Conversion System (AC Side)	Keystone Microgrid Control Panel	Customer	(2) #10AWG-THWN-2
9	Power Conversion System Input/Output Signal Cables	3 Inputs & 2 Outputs Dry Contact Cable	Power Conversion System (J-Board)	Keystone Microgrid Control Panel	Customer	(10) #12AWG-THWN-2
10	Communication Cable	Ethernet Cable (Communication Cable)	Power Conversion System (J-Board)	Keystone Microgrid Control Panel	Customer	Cat 6 Ethernet Cable
11	High DC Voltage Sensing Cable	High DC Voltage Sensing Cable (1500Vdc)	Power Conversion System (DC Side)	Keystone Microgrid Control Panel	Customer	(2) 12AWG-THWN-2
12	Battery#1 High DC Voltage Power Supply Cable	Battery#1 High DC Voltage Power Supply Cable (1500Vdc)	Power Conversion System (DC Side)	Battery Cabinet#1	Fortress	(2) #1/0AWG-THWN-2
13	Battery#2 High DC Voltage Power Supply Cable	Battery#2 High DC Voltage Power Supply Cable (1500vdc)	Power Conversion System (DC Side)	Battery Cabinet#2	Fortress	(2) #1/0AWG-THWN-2
14	HVAC & Control Panel Power Supply Cable for Battery#2	Battery#2 HVAC & Control Panel Power Supply Wire Harness (220Vac)	Keystone Microgrid Control Panel	Battery Cabinet#2 (Jxh1)	Fortress	(4) #12AWG-THWN-2
15	BMS Control Signal Cable	BMS Control Panel Wire Harness	Battery Cabinet#1 (Jx2)	Battery Cabinet#2 (Jx3)	Fortress	(6) #0.22mm Size
16	HVAC & Control Panel Power Supply Cable for Battery#1	Battery#1 HVAC & Control Panel Power Supply Wire Harness (220vac)	Keystone Microgrid Control Panel	Battery Cabinet#1 (Jxh1)	Fortress	(4) #12AWG-THWN-2
17	BMS and Fire Control Panel Signal Cable	BMS And Fire Control Wire Harness	Keystone Microgrid Control Panel (Fire Control Panel)	Battery Cabinent#1	Fortress	(6) #0.22mm Size

4.2.2 Recommended CT's Placement

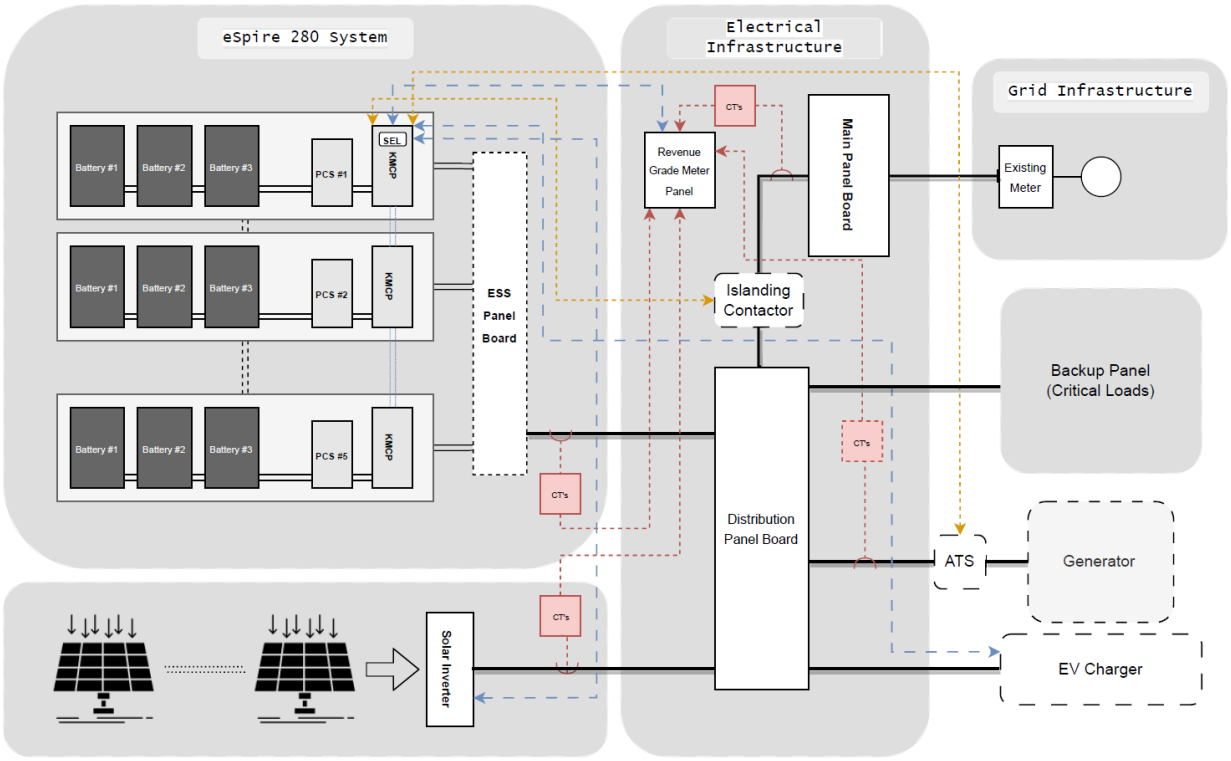


Figure 19. Signal Wiring and CT's recommendations

4.2.3 Recommended installation steps for eSpire System

1. Ensure electrical conduit pipes between each piece of equipment have been laid during concrete pad construction. Each piece of equipment has cable holes on the bottom of the panel.
2. Mount the PCS, battery cabinet, and Keystone Control Microgrid Control panel on the constructed concrete pad and ensure each piece of equipment is laid out side by side according to the drawing.
3. Anchor each piece of equipment on the concrete pad *(as per individual equipment manual).
4. Use Fisher and run wire harnesses and power cables through the conduit pipes.
5. Connect all interconnection cables before connecting the external power source.
6. Seal all conduit pipes and holes in each piece of equipment.

4.2.4 Connections

Electrical site preparation for the eSpire system must be performed by licensed electrical contractors, and all the interconnection cables must be wired to the correct terminals.

4.2.4.1 Keystone Micro Grid Control Panel Schematics

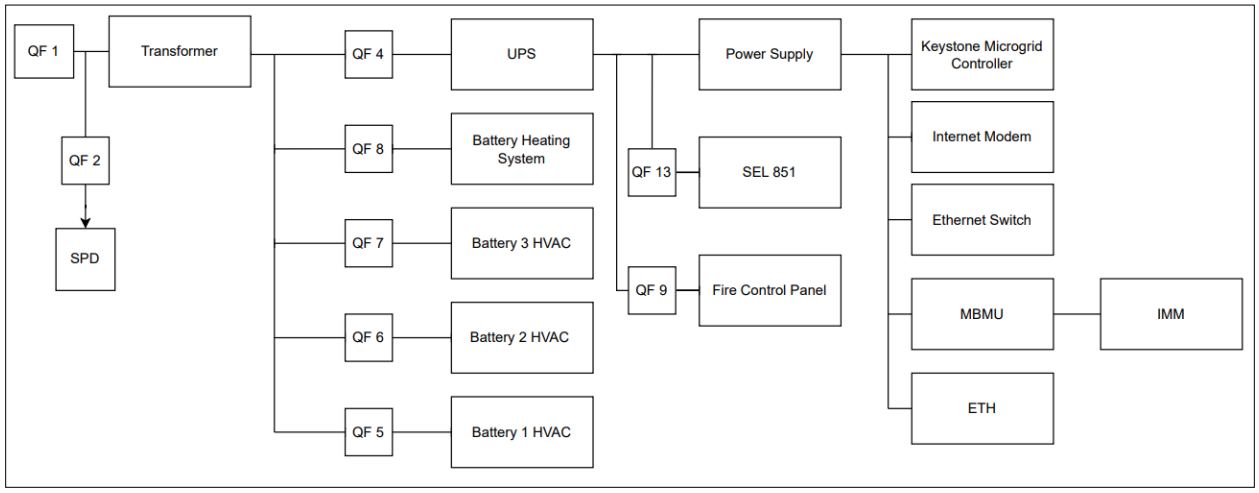


Figure 20. Functional Block Diagram of Control Panel

*Note: Please refer the Appendix for the internal schematics of the Keystone Microgrid Control Panel

Note: Each piece of Equipment must be powered off when performing electrical work. Ensure to follow all national, state, and local codes when performing electrical work.

4.2.4.2 3 Phase AC Connections Between Customer Mains Circuit Breaker and PCS

AC Input power to PCS Connection (3Phase 480VAC to PCS)

Ensure the customer's upstream circuit breaker or disconnect switch is properly sized.

***Note: PCS Rated Current is 151A @ 480Vac. For 480Vac connections, we recommended using a minimum of 1/0 AWG.**

i. *Run the 3-phase AC input Power cable through the electrical conduit pipe between the customer's upstream circuit breaker to the AC side of the disconnect.*
ii. *Connect one end to the upstream circuit breaker (load side) and the other end of the power cable to the AC input power of the PCS.*
iii. *Run the ground cable through the same conduit along with the power cables and connect one end of the cable to PCS and the other to the service entrance ground system.*

***Note that the system must be grounded as required by NEC.**
***For more details, refer to the PCS user manual.**

4.2.4.3 3 Phase AC Connections between PCS and Keystone Microgrid Control Panel

AC Input power to Control Panel Connection (1 Phase 480VAC to Fortress control panel)

i. *Run 1 phase AC output cable from PCS through the electrical conduit pipe to the Keystone Microgrid Control Panel Transformer primary side.*
ii. *Refer to the schematic wiring for the internal wiring of the Keystone Microgrid Control Panel*

**Note that the Fortress Control panel must be grounded to the Service Entrance system as required by the NEC.*

4.2.4.4 Connections Battery Cabinet to PCS Connection: (Max Length 15ft)

High voltage DC power cable connection between PCS and battery cabinet.

The positive high-voltage dc power cable is denoted as orange in color, while the Negative high-voltage dc power cable is denoted as black.

***Note: High-voltage DC power cable requires a high-voltage (HV) connector at one end of the cable and a cable lug at the other.**

i. *Hydraulic clamp is required to clamp the HV connector on each end of the high-voltage dc power cable. (orange + & black -)*
ii. *Run the high voltage dc power cable through the electrical conduit pipe between the battery cabinet and PCS.*
iii. *Plug the high-voltage dc power cable with orange connector (+) into the high-voltage terminal in the battery cabinet while the other end should be connected to the DC side of the PCS (+ terminal)*
iv. *Plug the high voltage dc power cable with black connector (-) to the high voltage terminal in the battery cabinet while the other end should be connected to the DC side of the PCS (-terminal)*

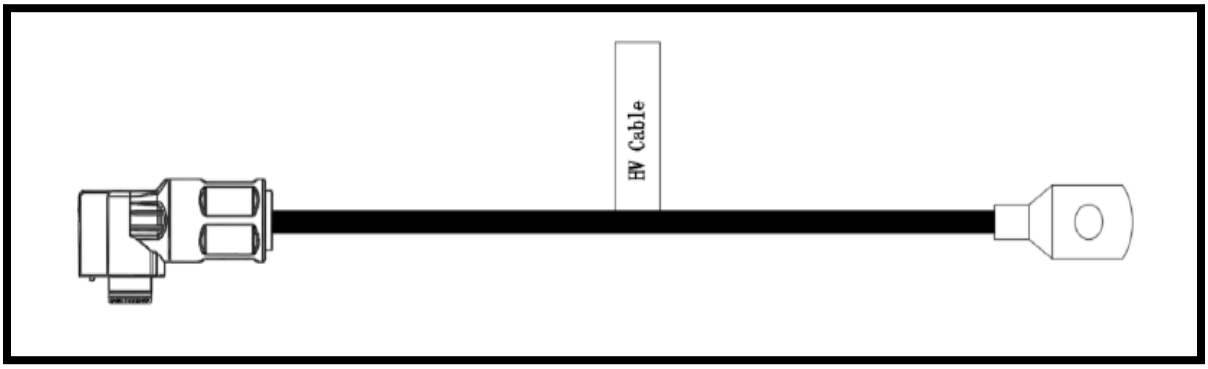


Figure 21. High Voltage DC Power Cable Schematics

PCS	Type of cable	Battery Cabinet
HV + Terminal HV – Terminal	HV DC Connection cable Red (2/0AWG) HV DC Connection cable Black (2/0AWG)	HV + Terminal HV - Terminal

4.2.4.5 Connections between Battery Cabinet to Control Panel

a. **HVAC and Control panel power supply (Wire harness JXH1) (Max Length 12ft)**

***Note:** The HVAC and power supply wire harness are terminated on a round female connector socket on one end of the wire harness, while the other end of the wire harness is required to be connected to the terminal block in the control panel.

i. Run the HVAC (230Vac L-N) and power supply (230Vac L-N) wire harness through the electrical conduit pipe between the battery cabinet and control panel.
ii. Plug the round female connector socket into the male terminal JXH1 on the battery cabinet.
iii. Connect the HVAC (230Vac L- N) power cable to the load side of the QF2 circuit breaker in the control panel.
iv. Connect the power supply(230Vac-L-N) cable for the control panel to terminal XT3 and XT4

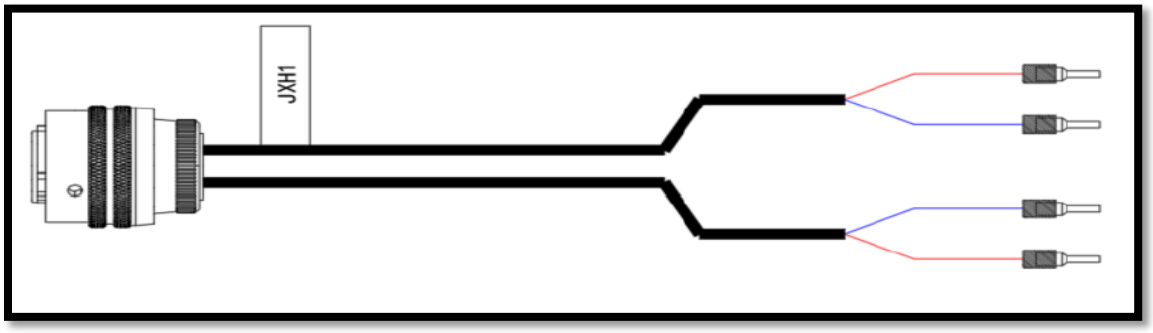


Figure 22. HVAC and Control Panel Cable Schematics

Battery Cabinet	Type of cable	Fortress Control Panel (Fire Alarm system)	Terminal
Plug JXH1 Power Cable to the JXH1 terminal on the battery cabinet	HVAC control panel 12AWG 15Ft	HVAC power cable L to QF2 L terminal	Circuit Breaker
		HVAC power cable N to QF2 N terminal	
	Control panel cable 12AWG 15Ft	Control power cable L to terminal block XT3	Terminal Block
		Control power cable N to terminal block XT4	

b. **BMS Fire-Alarm Wire Harness (Wire harness JX3) (Max Length 12ft)**

i. Run the BMS-Fire alarm wire harness through the electrical conduit pipe between Battery Cabinet 1 and the Fortress Control panel.
ii. The BMS fire alarm wire harness is terminated on a round female connector socket on one end of the wire harness, while the other end of the wire harness is required to be connected to the terminal block in the Fortress control panel.

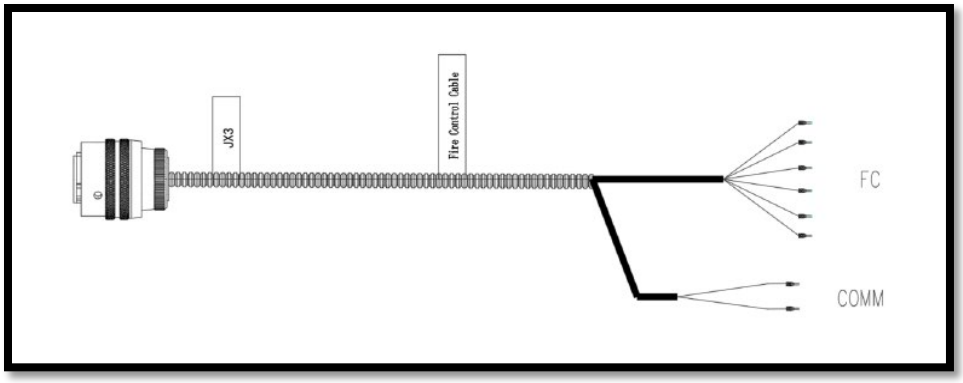


Figure 23. Fire Alarm Wire Harness Schematics

Battery Cabinet	Type of cable/signal	Control Panel (Fire Alarm system)	Terminal
JX3 Terminal	Fire alarm wire harness (18 AWG 15 Ft)	Wire signal 1 to Zone 2 +	Fire Alarm Terminal
		Wire signal 2 to Zone 2 -	
		Wire signal 3 to Zone 1 +	
		Wire signal 4 to Zone 1 -	
		Wire signal 5 to Exiting +	
		Wire signal 6 to Exiting -	
		Wire signal JX- 1 to JX2 left terminal	Connector JX2
		Wire signal JX-2 to JX2 right terminal	

4.2.4.6 Connections Between PCS and Fortress Control Panel

a. **High voltage dc sensing cable between PCS and control panel.**

Recommendation (12AWG 1500VDC insulation)

i. *Run the high voltage dc sensing cables through the electrical conduit pipe between the PCS and control panel.*

ii. *Connect one end of the high voltage dc sensing cable (Red) to the positive DC terminal of the PCS and the other end to the terminal block (XT-19) in the control panel.*

iii. *Connect one end of the high-voltage dc sensing cable (Black) to the negative DC terminal of the PCS and the other end to the terminal block (XT-20) in the control panel.*

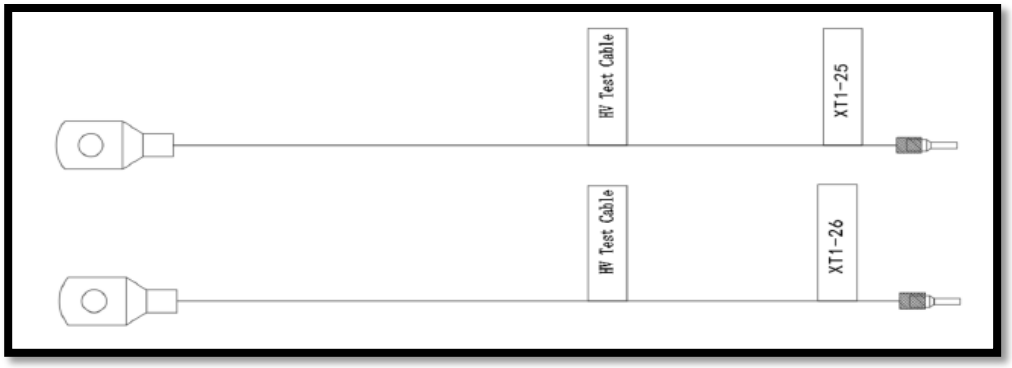


Figure 24. High Voltage DC sensing cable Schematic

PCS	Type of cable	Fortress Control Panel
HV + Terminal	DC Voltage Sensing cable XT2-26 (12AWG)	Terminal block XT-19
HV – Terminal	DC Voltage Sensing cable XT2-25 (12AWG)	Terminal block XT-20

b. **Communications cable between the PCS ad Control Panel**

i. Run the CAT5e or CAT 6 Ethernet Cable through the electrical conduit pipe between the control panel and PCS.

ii. Connect one end of the communication cable to the Ethernet Switch in the control panel and the other end to the RJ45 port terminal in the PCS.

PCS	Type of cable	Fortress Control Panel
RJ45 Port Terminal	Cat 5e or Cat 6 Ethernet	Ethernet Switch

4.2.4.7 Termination cable between Battery and Battery Cabinet

Terminal resistor cable (Double layer insulated)

100 Ohms x 1

i. Plug the terminal resistor cable into the battery cabinet (terminal JX2)

Figure 25. Terminal Resistor

Battery Cabinet	Type of cable/signal	Control panel (Fire Alarm system)	Terminal
JX2 Terminal	Terminating Resistor	N/A	N/A