ZBB EnerStore® 50V3.1(C) Flow Battery Module

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1.0 Introduction

ZBB Energy Corporation designs and manufactures advanced Electrical Energy Storage Flow Batteries, and Intelligent, modular power conversion electronics equipment to address today's ever growing conventional and renewable energy needs.

The ZBB EnerSystem™, which includes the Patented ZBB EnerSection® and the ZBB EnerStore®, is a modular, expandable, and flexible power electronics architecture that provides the complete integration of various types of renewable energy generating sources, conventional energy generating sources and various types of energy storage; automatically manages the generating assets along with the energy storage assets and provides single or multiple outputs for the required customer application needs. Being completely modular and built on a standard industrial MCC (Motor control Center) platform, the ZBB EnerSection® can easily and readily be expanded upon to accommodate future needs of additional generation and/or additional energy storage with minimal installation and startup effort, referred to as "Plug-n-Play".

Whether it is AC Voltage or DC Voltage, this unique ZBB proprietary topology and control concept eliminates the need for complex software algorithms typically used in hybrid systems with multiple generating sources, including the capability of multiple outputs to customer loads through a single device, and utilization in On-Grid and/or Off-Grid applications. Furthermore, the ZBB EnerSection® can provide the active power (kVa) required for applications, in addition to the reactive power (kVar) for power factor correction, regulation, and voltage stability. When utilizing the ZBB EnerSection® platform, the customer truly has a modular, expandable "plug-n-play" energy and power routing device that optimizes the use of the connected generation resources in an intelligent way.

The ZBB EnerStore® 50V3.1(C) Zinc Bromide Flow Battery technology provides the energy storage needed in many applications; from support to Micro-grids, to smoothing and shifting renewable energy generation, to providing the necessary energy storage for Off-Grid or On-Grid controllable power plants utilizing renewable energy. The ZBB EnerStore® 50V3.1(C) provides a modular approach utilizing the ZnBr chemistry technology that provides redundancy, high availability, 100% depth of discharge capability, high energy density, small foot print and long life; all being performed as a "controllable" battery as it has the ability of being turned on and off at any State of charge while maintaining a true "green" concept thru utilizing recyclable plastics and an environmentally friendly electrolyte.

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The power electronics and energy storage products ZBB produces are targeted at advancing energy efficiency, energy independence and renewable energy, by providing integrated factory tested systems for direct use by customers and system integrators for On- and Off-Grid applications with and without renewable energy generation.

This solution reduces the installed cost when considering the installation, integration, and commissioning of multi-faceted systems and completely manages the various generation sources and loads through the use of the ZBB EnerSystem™, EnerStore®, and EnerSection® products via the customer communications and control through the ZBB ECM.

One single intelligent, modular, expandable and flexible factory integrated solution developed and deployed for any application.

This Operations and Maintenance Manual provides the user with setup, installation, operations and basic trouble shooting guidelines for the ZBB EnerStore® 50V3.1(C) Flow Battery Module as well as Factory assistance contacts and recommendations.

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2.0 EnerStore® 50V3.1(C) Module Drawings

2.1 Mechanical Drawings

Refer to the following **Drawing # 20-000063** for the **Mechanical Details and Layout** for the ZBB EnerStore® 50V3.1(C) Flow Battery Module.

Refer to the following **Drawing # 30-000256** for the **Mounting and Enclosure Details** for the ZBB EnerStore® 50V3.1(C) Flow Battery Module.

Refer to the following **Drawing # 30-000266** for the **Center of Gravity Details** for the ZBB EnerStore® 50V3.1(C) Flow Battery Module.

Torque Settings for the ZBB EnerStore® 50V3.1(C) Flow Battery Bus connections are based on standard industry recommendations for the specified mechanical sizing.

Screw Torque in lb-in			
	Steel	Steel Class 8.8	Stainless
M3	5.0 - 6.6		8.5 - 11.3
M4	11.6 - 15.5		19.7 - 26.4
M5	23.5 - 31.2		40.0 - 53.4
M6	49.9 - 66.6	76.4 - 101.8	68.1 - 90.7
M8	72.9 - 97.2	185.4 - 246.9	165.5 - 220.4
M10	239.9 - 320.1	367.4 - 489.9	327.5 - 436.6
M12	418.6 - 558.5	740.8 - 854.5	571.3 - 761.7
	Steel	Steel Gr5	Stainless
#4	3.7 - 5.0		6.3 - 8.4
#6	6.9 - 9.2		11.8 - 15.7
#8	12.6 - 16.8		21.5 - 28.7
#10	18.3 - 24.4		31.2 - 41.6
1/4	54.7 - 72.9	84.5 - 112.7	74.5 - 99.4
5/16	112.6 - 150.2	174.1 - 232.1	153.6 - 204.8
3/8	199.8 - 266.4	308.8 - 411.7	272.4 - 363.2
1/2	487.8 - 650.4	753.8 - 1005.1	665.2 - 886.9

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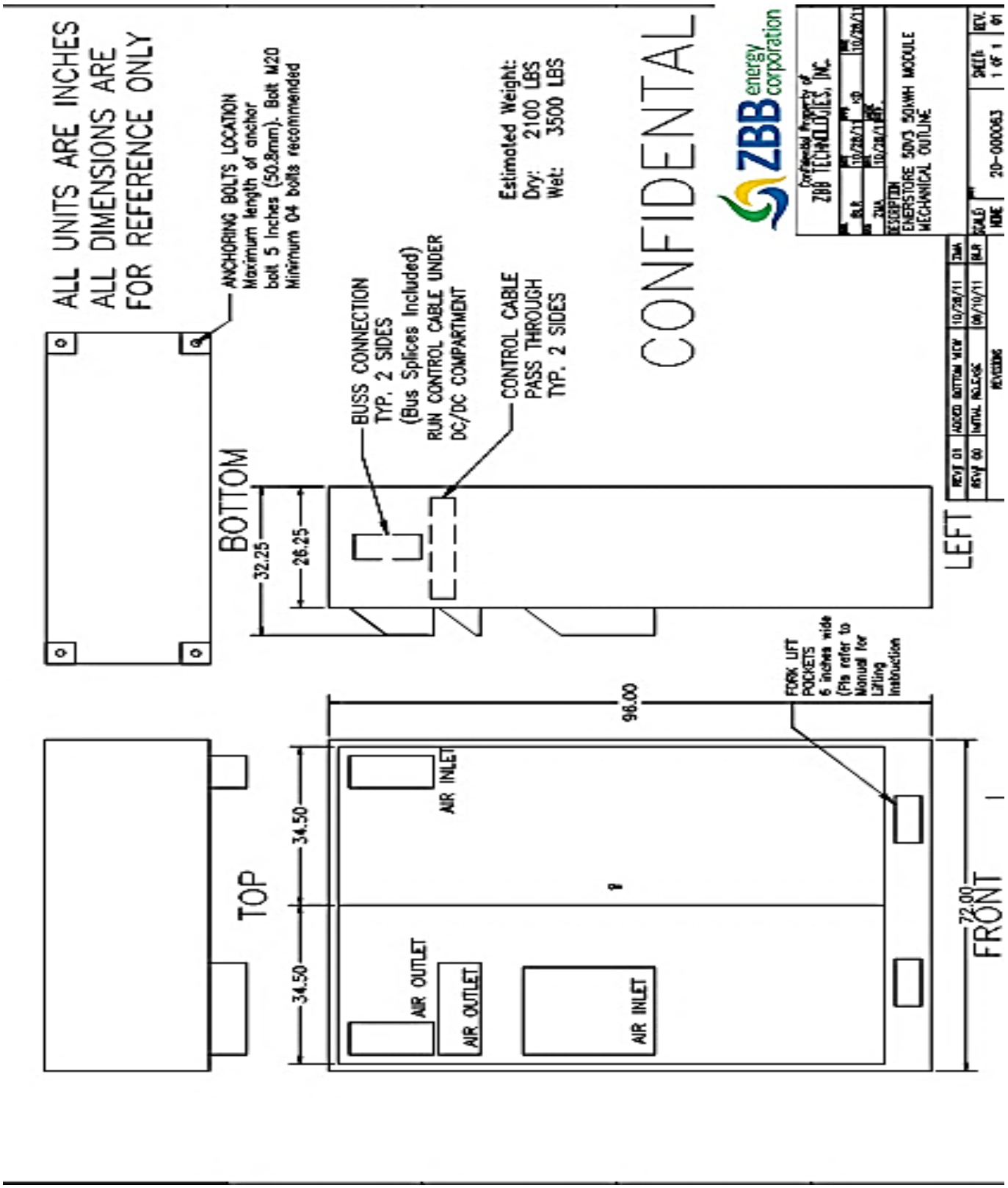

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Drawing # 30-000256

Mounting and Enclosure Details for the ZBB EnerStore® 50V3.1(C) Flow Battery Module.

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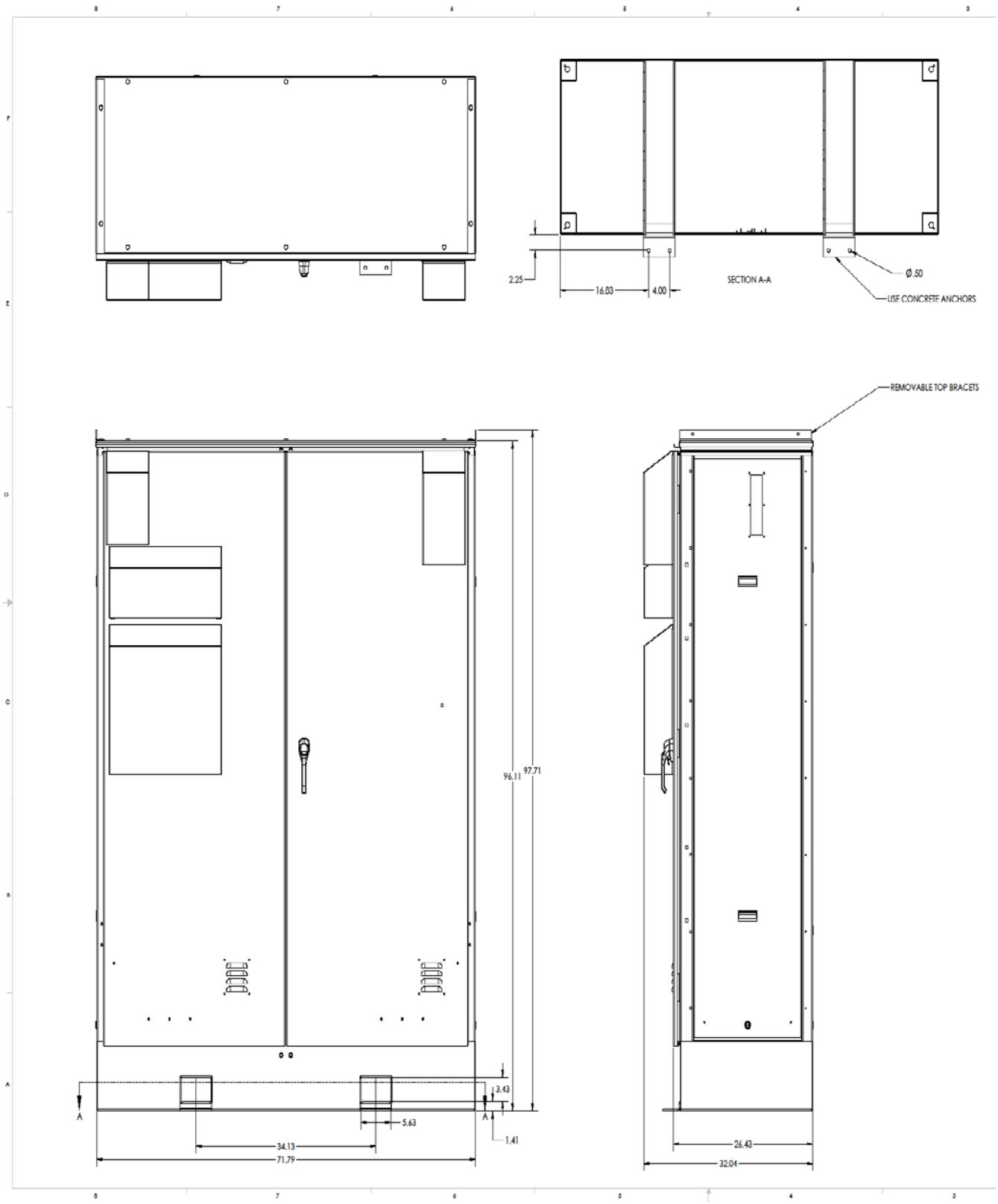

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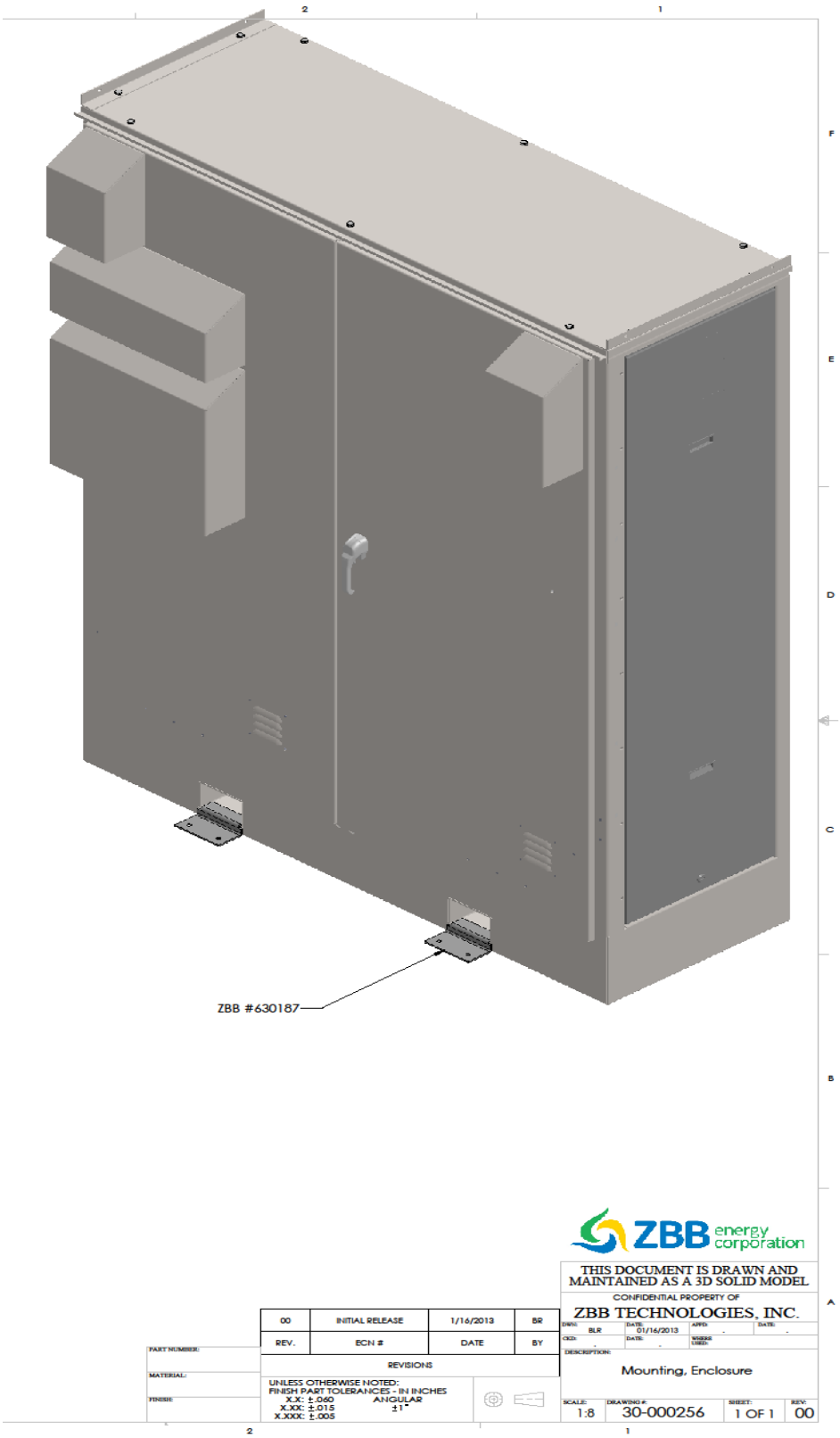

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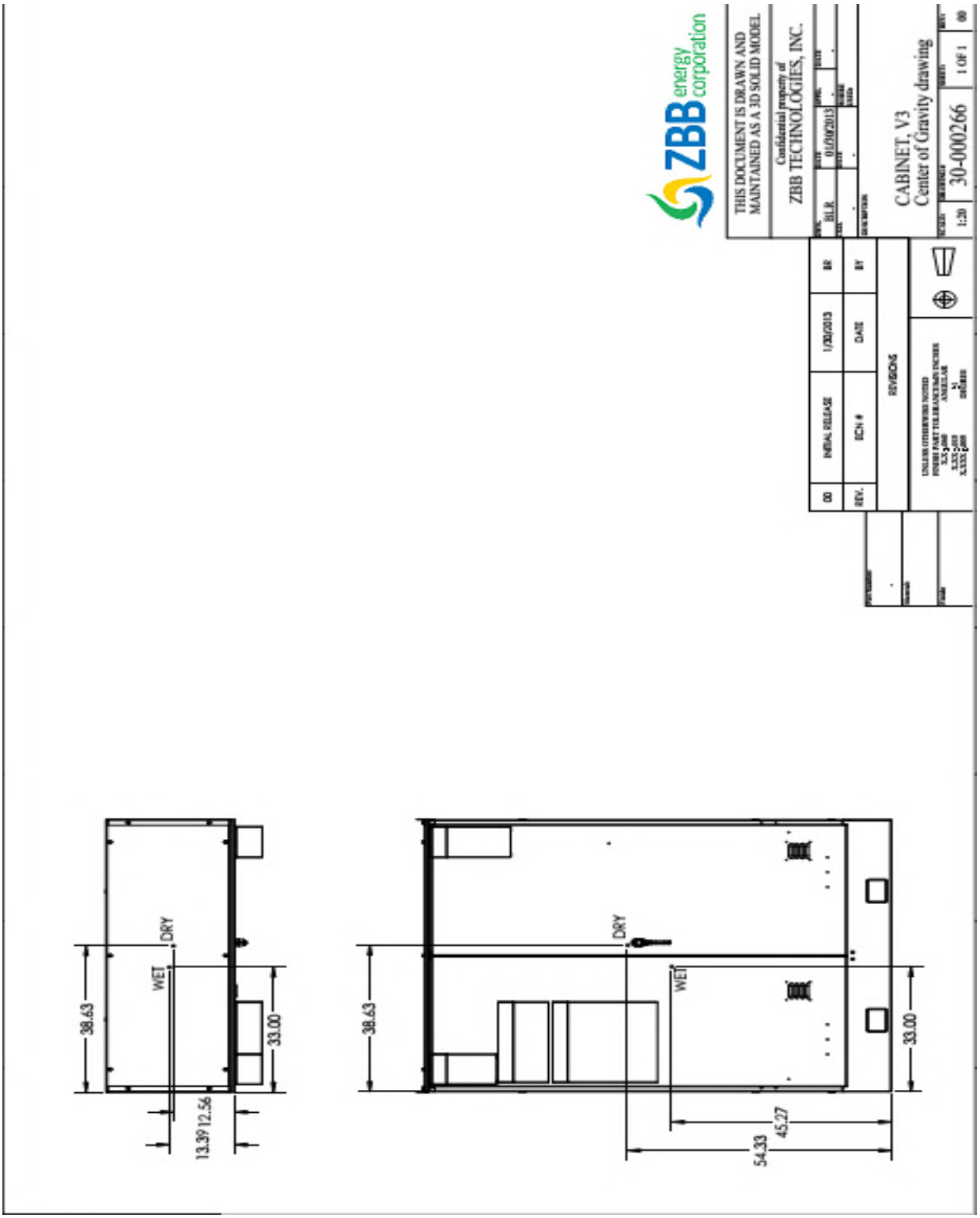

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2.2 Electrical Schematic

Refer to the following **Drawing # 20-000198** for the **Electrical Three Line Diagram** for the ZBB EnerStore® 50V3.1(C) Flow Battery Module.

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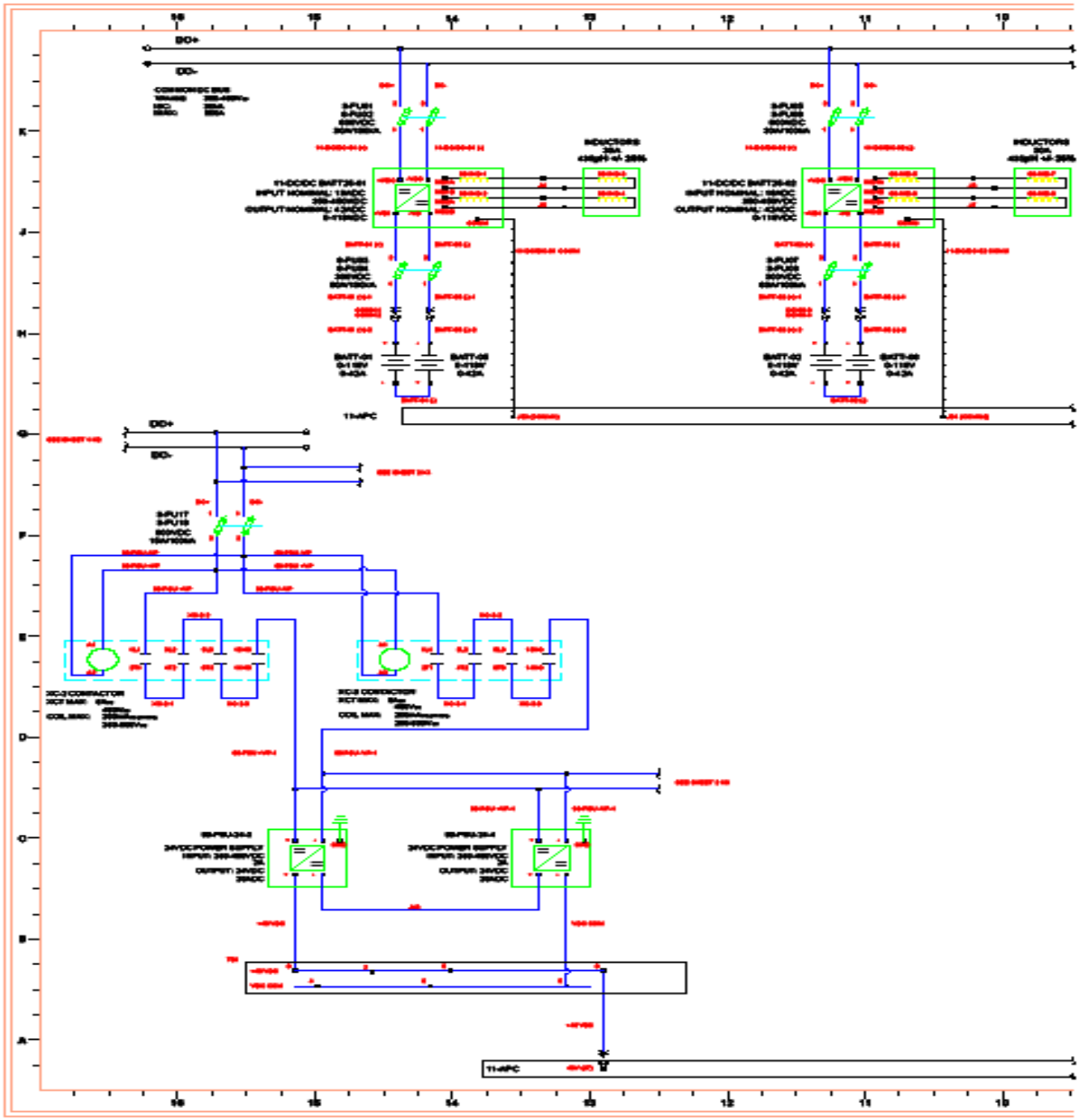

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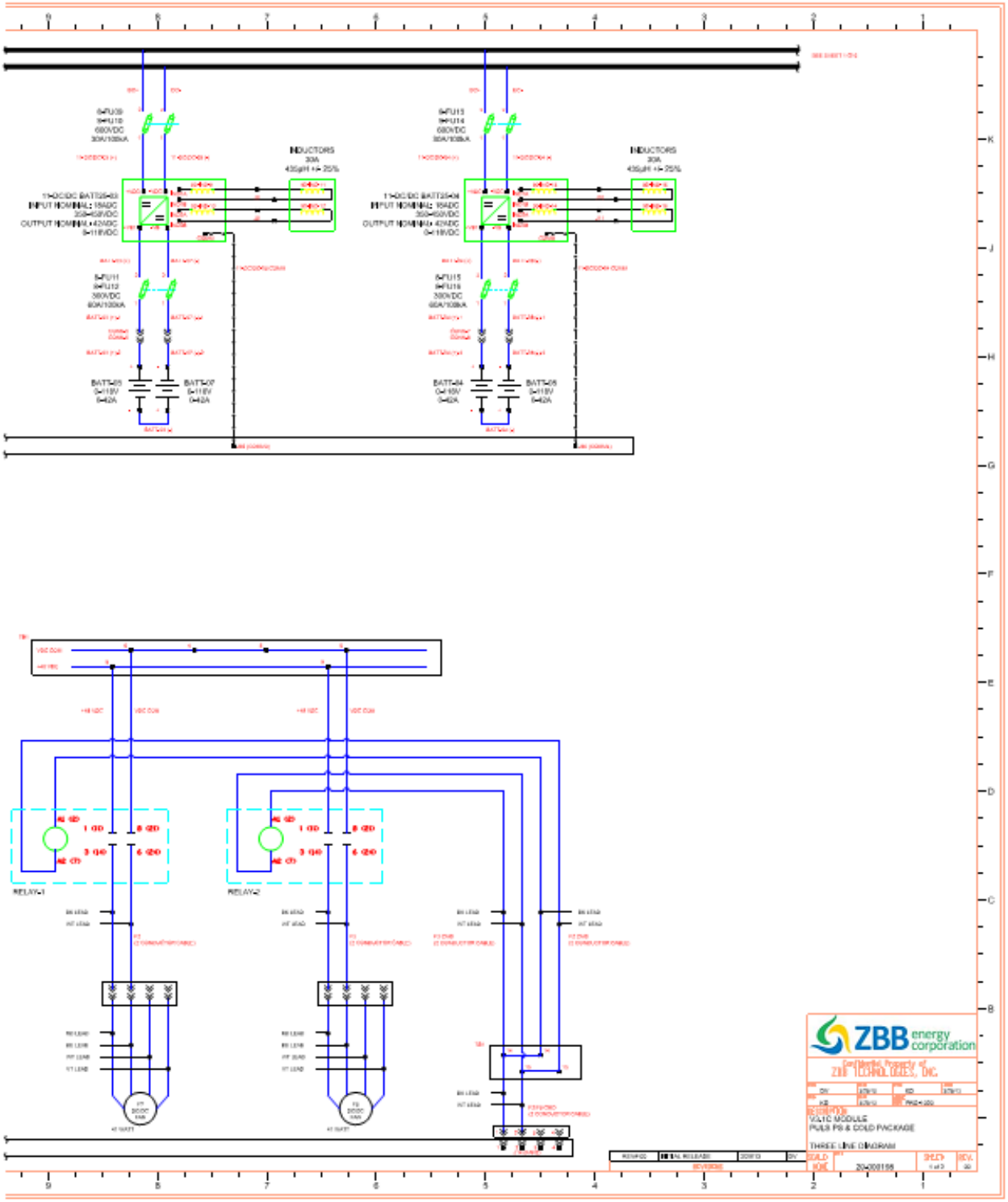

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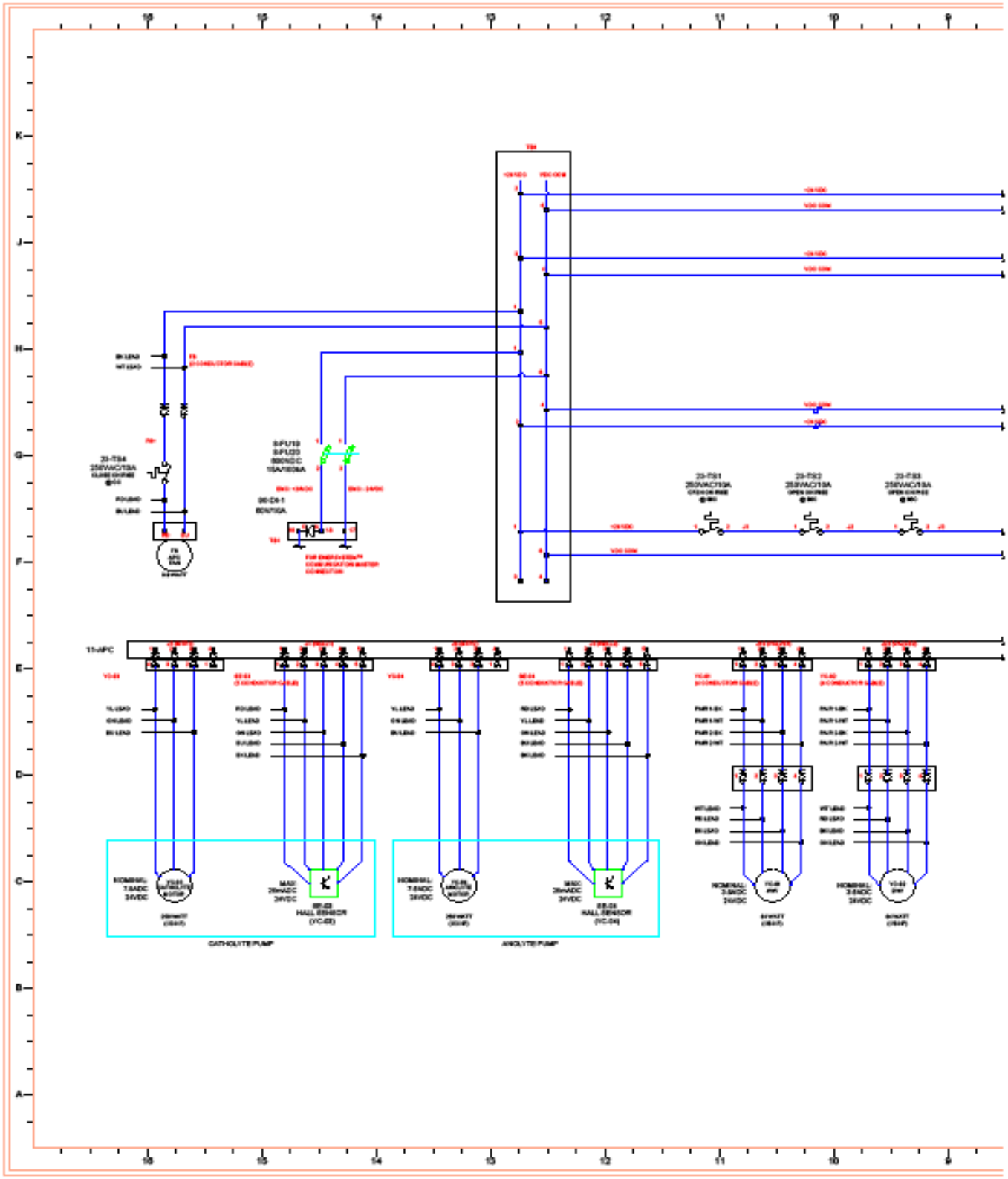

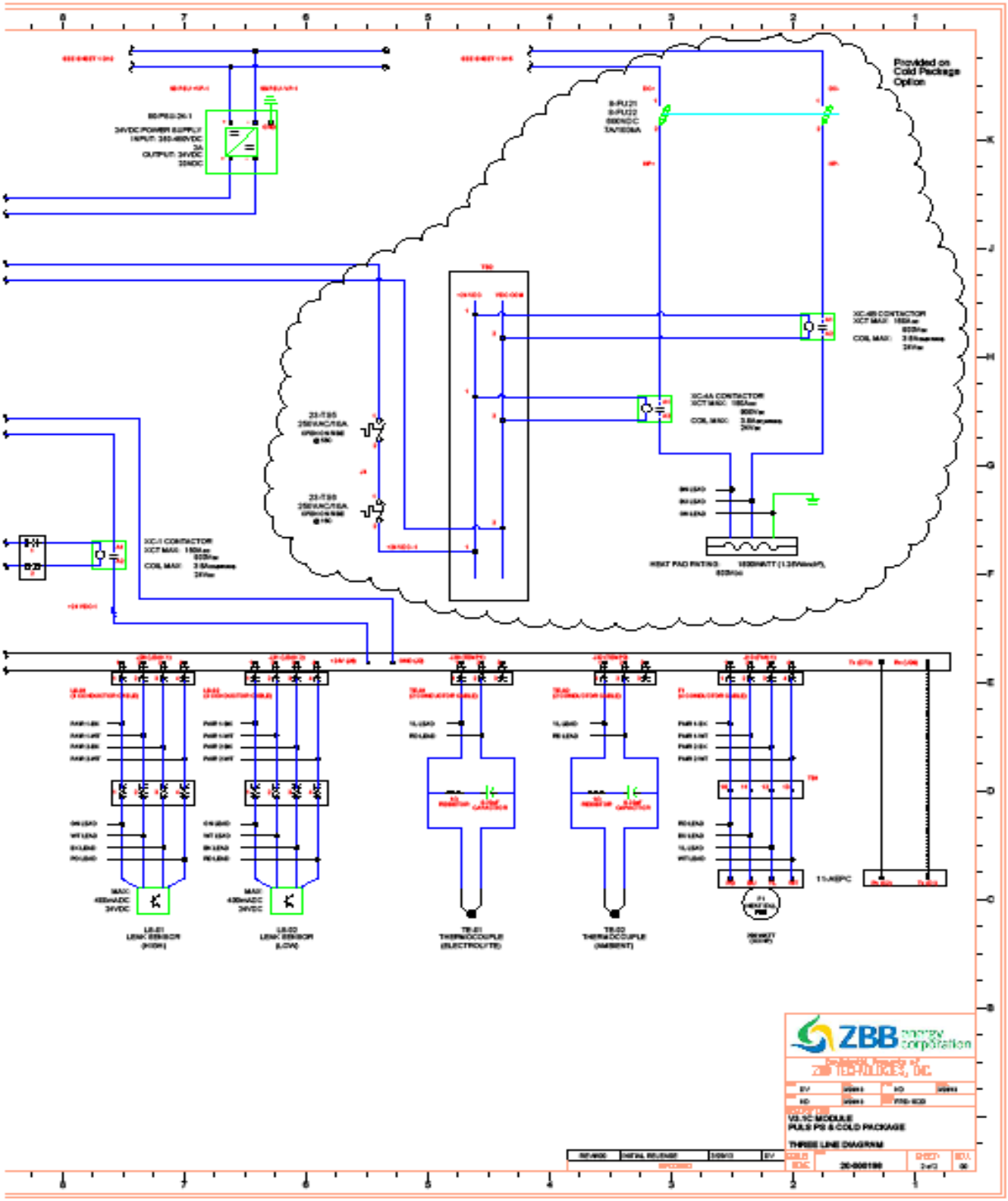

3.0 General Safety

3.1 General Safety - Electrical

[WARNING]

Energizing control voltages (24VDC or less) & low voltages (600V or less) shall be conducted in a manner that prevents damage to personnel & equipment.

Table 1- ZBB Battery Stack Electrical Ratings

VDC	ADC
120	40

Table 2- ZBB Battery Enclosure Electrical Ratings

VDC	ADC
450	800

[CAUTION]

Work shall only be done by qualified personnel only.

If work is involved in connecting additional equipment to existing equipment, ensure that incoming power is disconnected before work is begun. Disconnecting means should be locked out and/or tagged out. Where it is not feasible to de-energize the system (charged battery) the following precautions should be taken:

i. Person(s) working near exposed parts that are or maybe energized should be instructed and should use practices (appropriate apparel, equipment and tools) in accordance to NEC safety codes or governing bodies.

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ii. Person(s) working on exposed parts that are or may be energized should in addition, be qualified personnel who have been trained to work on energized circuits.

Each section will additionally list appropriate steps & safety precautions when energizing or handling energized equipment. Personnel conducting commissioning SHALL READ THROUGH EACH SECTION PRIOR TO PROCEEDING.

All work should be done in accordance with local safety laws and codes.

3.2 General Safety – Chemical

[WARNING]

Electrolyte is **caustic** and considered a **toxic chemical**! Wear rubber gloves when working with it. Use baking soda or a baking soda – water solution to neutralize any spills. Isopropanol (isopropyl alcohol) can also be used on minor splashes or spills. Electrolyte left on the skin will burn. Electrolyte left on untreated or unpainted metallic surfaces will accelerate corrosion/rust.

Refer to MSDS for specifics on Electrolyte.

4.0 Setup and Installation Guide Lines

4.1 ZBB EnerStore® 50V3.1(C) Setup Procedure

At time of receipt, the EnerStore 50V3 Flow Battery module should be inspected for any physical damage by the customer. All physical damage shall be recorded and described; and if possible, photographs of the damage should be taken and reported to the party responsible for shipping for further coordination with the transport company.

Inspection – A battery system will normally consist of the following major components:

- EnerStore 50V3 Enclosure cabinet
- Qty 8 Battery Stacks
- Qty 4 DC/DC Converters
- Qty 1 Heat Exchanger

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- Qty 2 Pumps for electrolyte
- APC control Board
- Electrolyte Barrels
- Other equipment as ordered per customer request

Examine equipment to ensure all doors open as designed; no electrical component has sustained "breaking force," or water damage. Where possible, check plumbing fixtures – looking for signs of obvious trauma, abuse and / or damage.

Lifting & Handling

- The ZBB EnerStore® 50V3 system cabinet includes the battery module. As shipped, the ZBB EnerStore® 50V3 will weigh approximately 2096 pounds (953 kilograms) with no electrolyte in the module tanks. As designed, the entire cabinet can be lifted with a fork truck having a lift capacity of 5000 pounds (2300 kilograms) or greater.

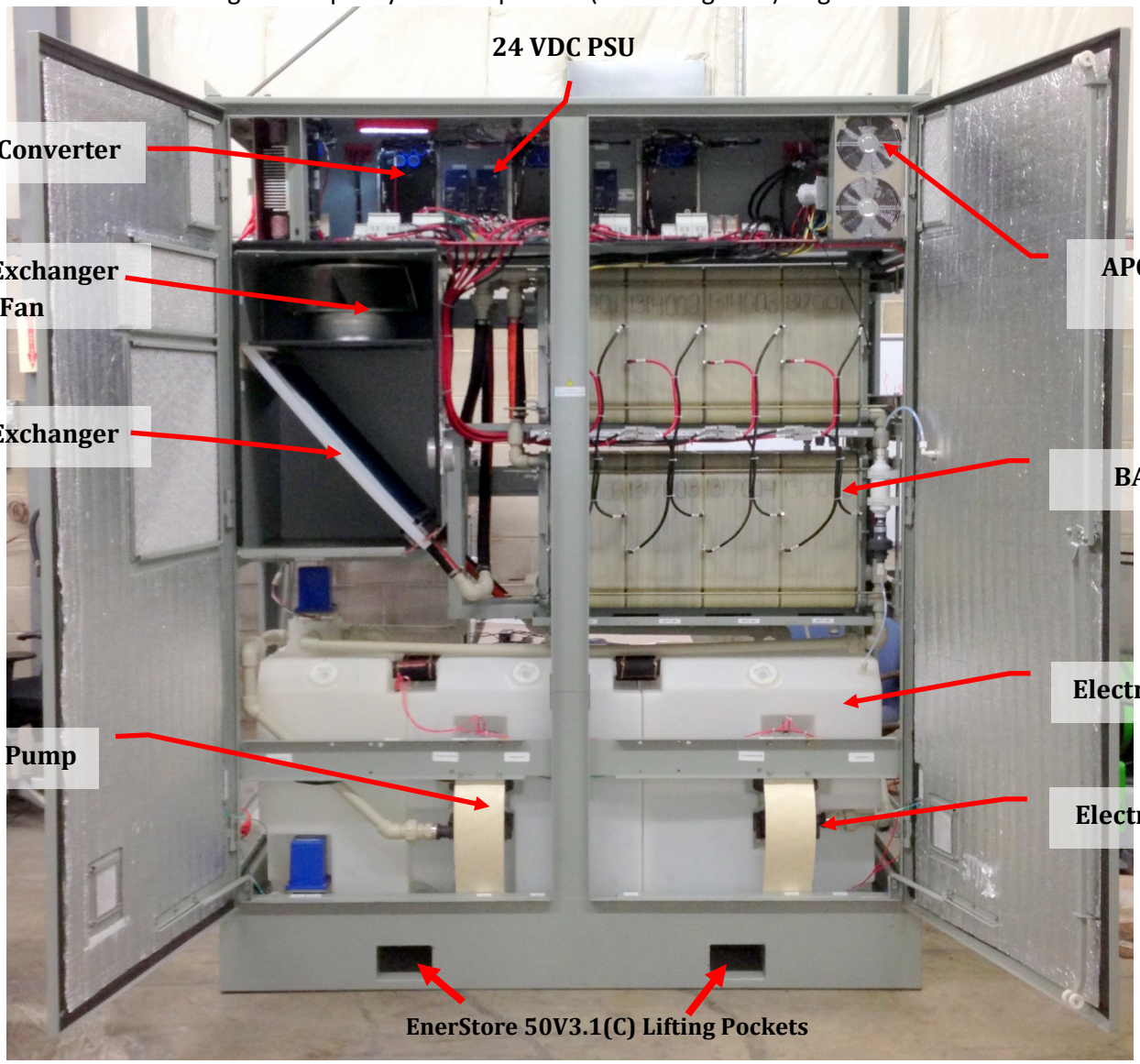

FIGURE: 01

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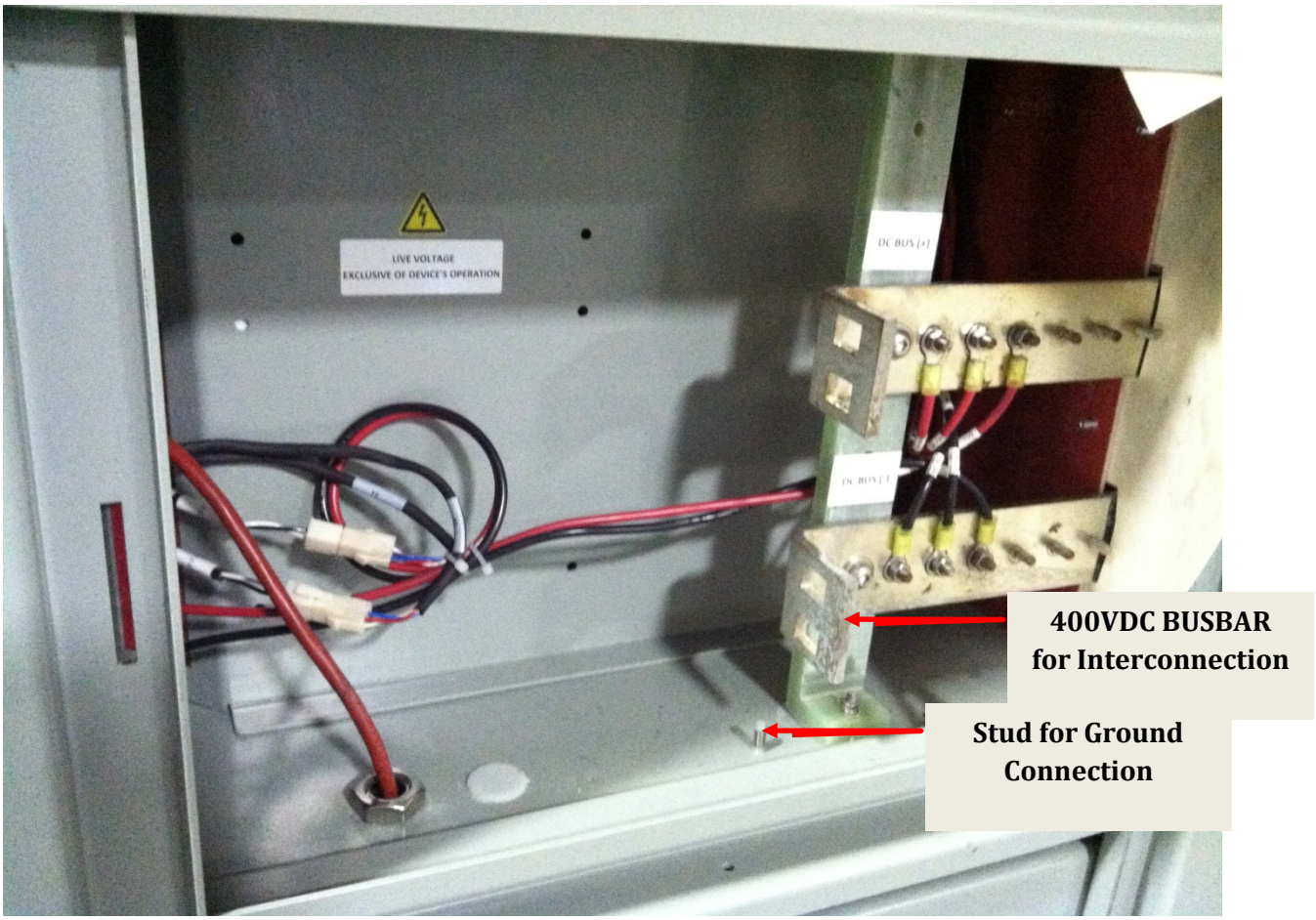
Figure-1 shows the lift points of a 50V3.1(C) cabinet and where the components are physically mounted within the cabinet.

4.2 INSTALLATION

Wire, cable, fiber optic cable, and conduit shall be provided by customer. Bus connections are made using DC BUSBAR interconnect kit provided by ZBB to connect to ZBB EnerSections. Please refer to drawing 20-000063 in Section 2.0 for more details.

System schematics, system interconnection wiring and grounding requirements are provided in section 2.0 of O&M Manual.



Chemical

Only ZBB technical services personnel are to fill the electrolyte and brominated electrolyte before 1st start up.

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Use baking soda or a baking soda – water solution to neutralize any spills. Isopropanol (isopropyl alcohol) can also be used on minor splashes or spills. Electrolyte left on the skin will burn. Electrolyte left on untreated or unpainted metallic surfaces will accelerate corrosion/rust.

4.3 ENERSTORE 50V3.1(C) TYPICAL OPERATION

DISCHARGE:

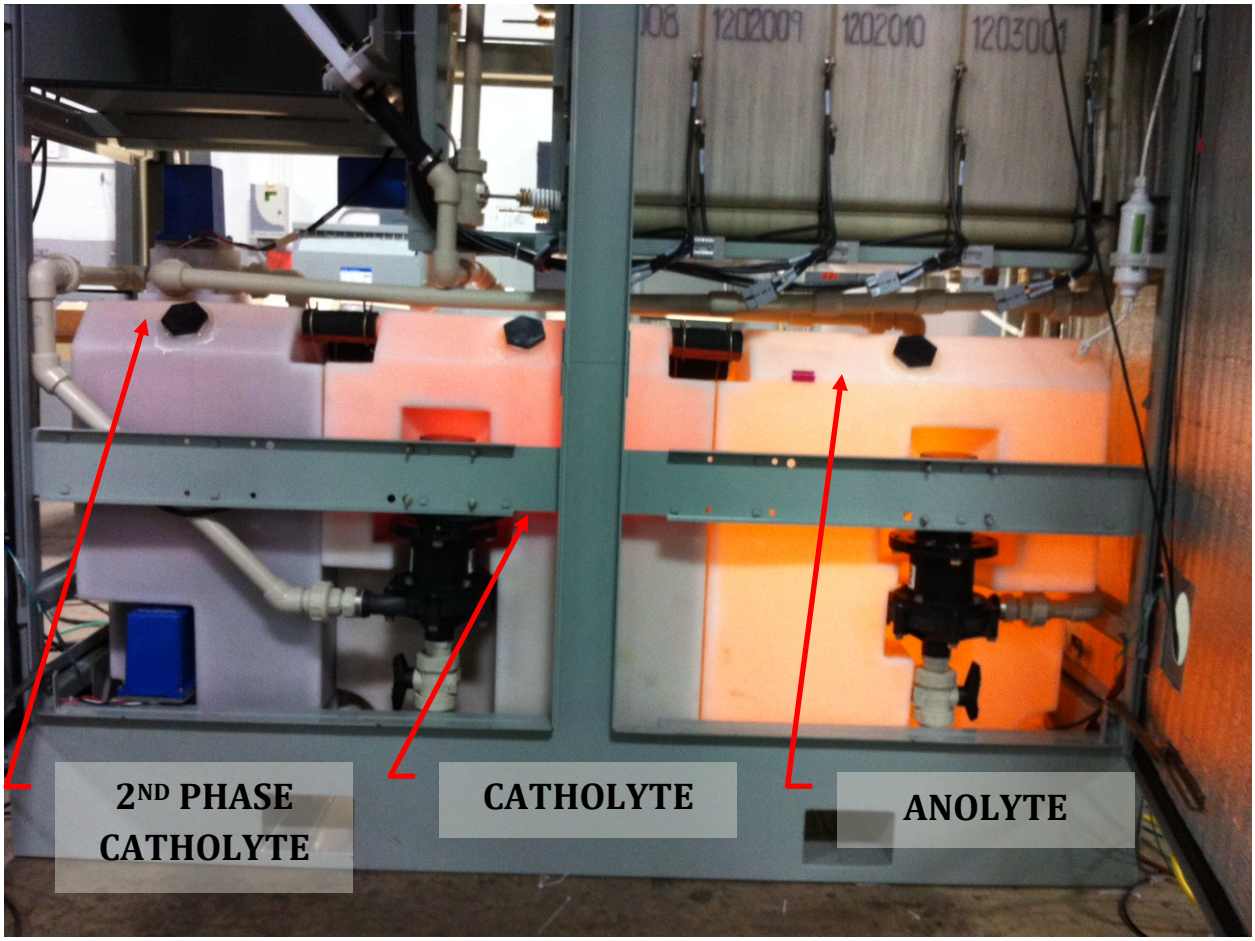
- When the battery is fully discharged, the ANOLYTE and CATHOLYTE tanks should be approximately even

CHARGE

- As the battery is charged, the CATHOLYTE should decrease because of the increased density and viscosity as it charges

PARTIALLY CHARGE

- When partially charged, the ANOLYTE should be slightly above the CATHOLYTE level.



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4.4 ZBB ENERSTORE® 50V3.1(C) ELECTROLYTE: PROCEDURE FOR FILLING AND REMOVAL

CAUTION: Electrolyte is corrosive; and is an inhalation hazardous. Wear rubber gloves, Respirator and safety glasses when working with it. Refer to MSDS sheet.

Electrolyte left on the skin will cause skin irritation. Electrolyte left on untreated or unpainted metallic surfaces will accelerate corrosion/rust.

Use dry Sodium Bicarbonate [baking soda] to neutralize fluid spills. Keep a solution of sodium bicarbonate and water handy for general clean-up. Isopropanol (isopropyl alcohol) can be used on minor splashes or spills.
Oil dry or similar absorbant material can also be used to assist in fluid clean-ups, after neutralization.

Equipment:

1. Drum pump; [e.g. Standard Pump – SP-PVDF-39 or Sethco P-80; Finish Thompson Model S-1]. The pumps are Kynar tubing and piping. Tube length is 39 inches; motor voltage 120VAC or 240VAC [F**igure-1**].
2. Sodium Bicarbonate (baking soda) or Sodium Carbonate (soda ash).
3. Cloth rags or heavy duty paper towels.
4. Squirt bottle of Isopropyl alcohol (Isopropanol).
5. Clean water

The following hose and fittings are used to make the necessary connections between the pump and tank fittings.

6. 10 feet of 4879 Viton Chemical hose; 1 inch ID diameter.
7. 1 – Kynar Elbow fittings, 1 inch barb to 1 inch male pipe thread; **Ryan Herco Flow Solutions**.
8. 1 - BANJO female coupler –to- female thread (**polypropylene**), 1.25 inch ID.
9. 1 – BANJO 1.5 inch plug for female coupler (**polypropylene**); drum pump hose end.
10. 1 – Kynar 1 inch male pipe thread by 1 inch barb hose adapter.
11. 2 – Oetiker 1 inch step-less, stainless steel, spring clamps.

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NOTE: The fittings and hose type currently used are based on their history of reliability and compatibility with the zinc-bromine electrolyte; the fittings called out are specific to the Sethco pump. No fittings are currently used with the Finish Thompson pump because the hose is much more flexible, therefore easier to maneuver into the tanks and drum.

Figure-1 (**Sethco drum pump**)

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Figure-2 (Finish Thompson drum pump)

Figure-3 (left) shows an example of a drum wrench used to open electrolyte barrels.

Figure-3

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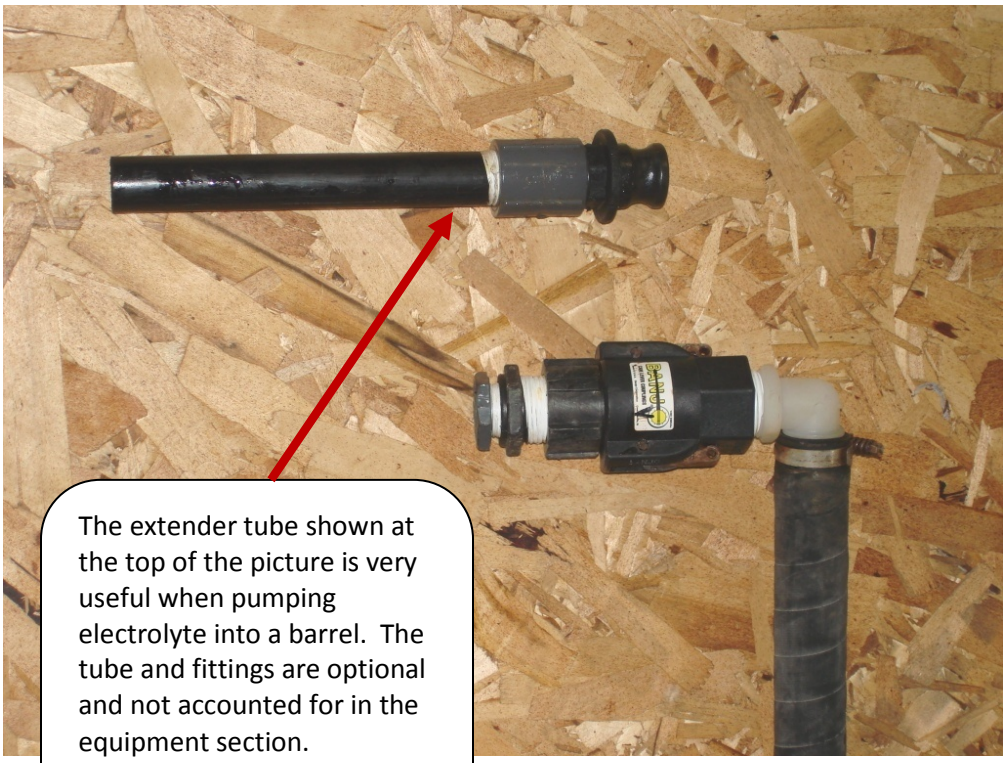

Figure-4

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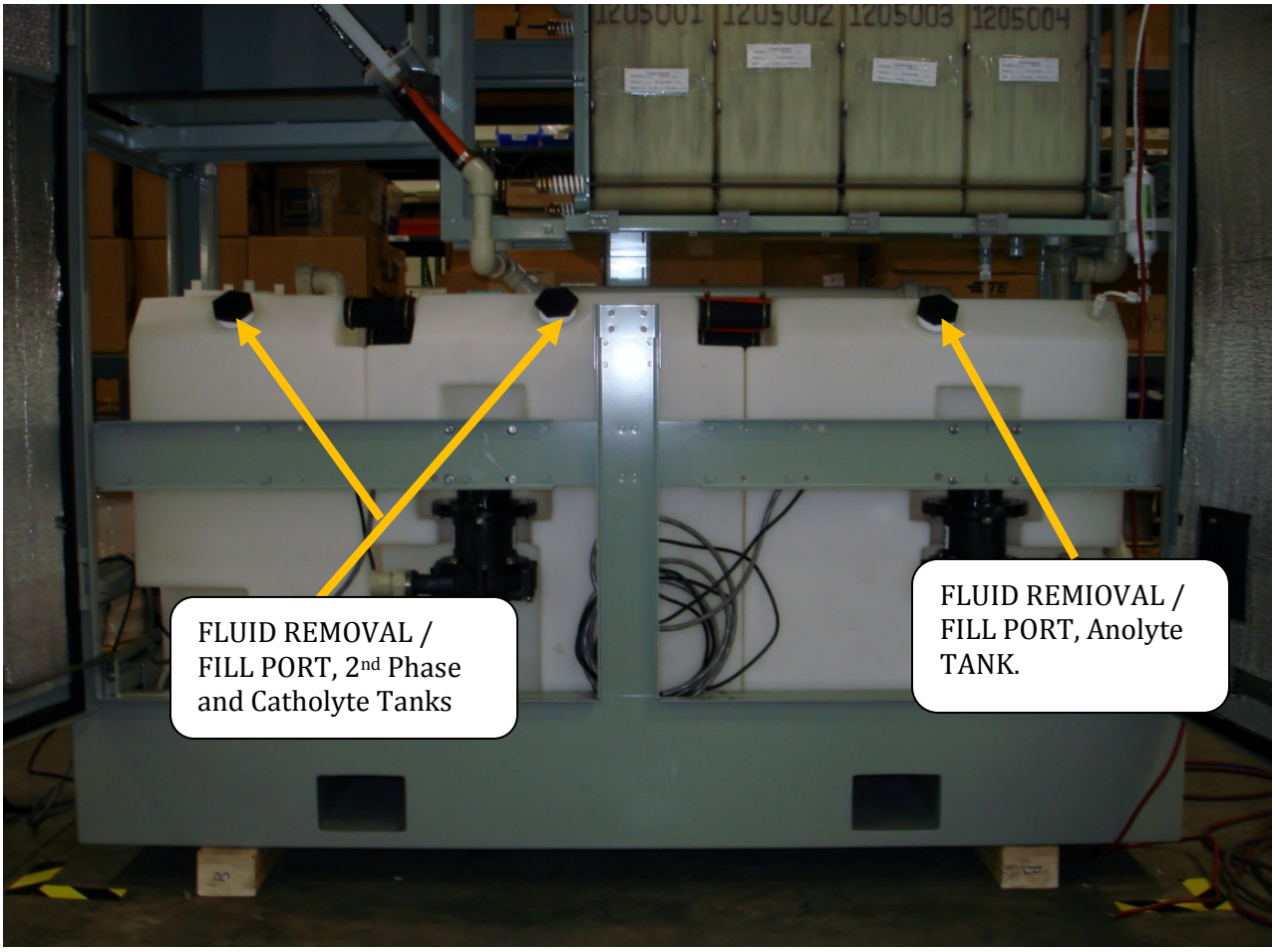

Figure-5

SAFETY

The zinc-bromine electrolyte is corrosive. It will irritate and/or burn bare skin if left untreated. Always wear some type of rubber gloves (e.g. disposable nitrile gloves) when working with electrolyte. Safety glasses are highly recommended as is an apron, smock or coveralls.

It is recommended that when working with electrolyte some sort of respirator designed for chemicals should be worn.

Electrolyte Filling

The V-3 module has a total electrolyte capacity of 130 gallons, distributed across three plastic tanks. From left to right looking at the front of the module: 2nd phase tank, catholyte tank, anolyte tank; Figure-5.

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There is no specified order to which the tanks get filled. The anolyte and catholyte tanks hold approximately 50 gallons apiece, the 2nd phase tank 30 gallons.

Open a barrel of electrolyte and put the Kynar Tube of the drum pump into the barrel; depending on the model of drum pump used – either the hose end or the plastic tube fits into the quick fill port of the tank. Fill each tank to the point where the vertical face of the tank breaks at a 30 degree angle just below the fill port opening.

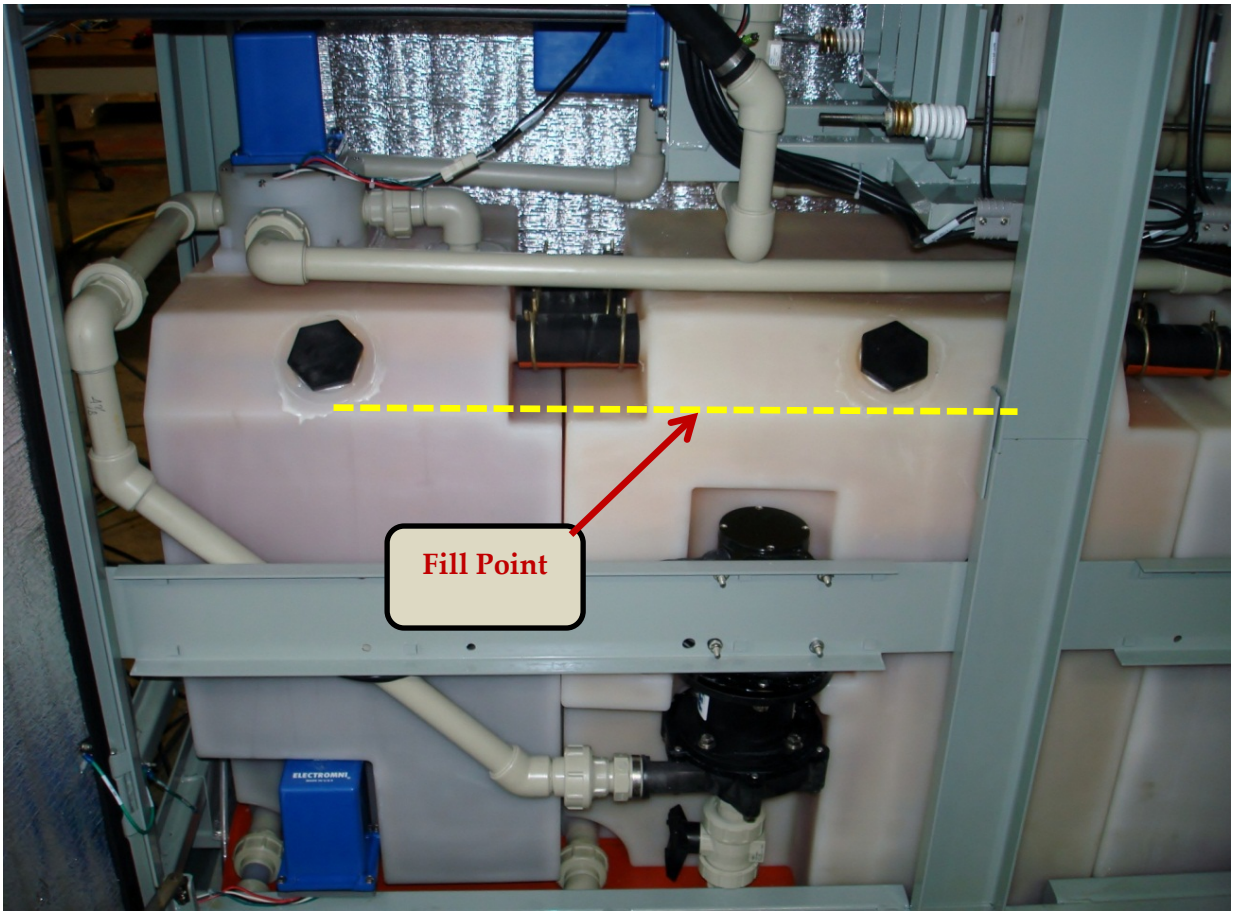

Figure-6

NOTE: With tank filling completed ensure the fill port plugs have 8 to 9 wraps ofTeflon tape on the treads. There is no specific torque spec used for tightening the plugs; turn each one in all the way. Replace and tighten the barrel cap. Clean up any spilled electrolyte with a sodium bicarbonate/water solution.

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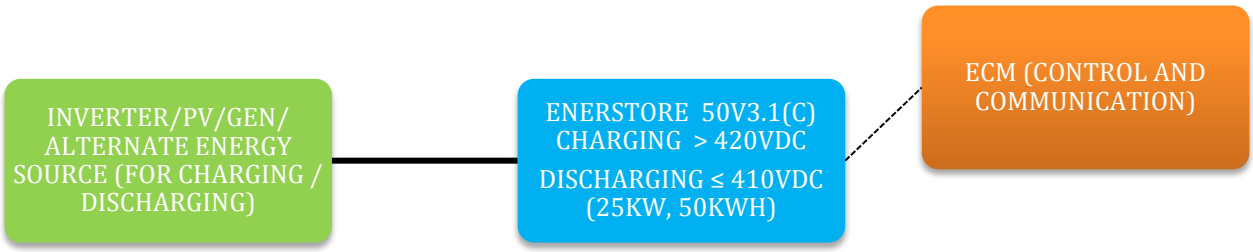
Electrolyte Emptying

Removing electrolyte from the tanks is the reverse of the filling process. The drum pump Kynar tube goes directly into the tank and the Viton hose with fitting(s) goes into the drum. There is one caveat to removing fluid from the electrolyte tank(s): **Ensure the fluid in the tank is not higher than the fill port cap!!!** As can be expected – if that is the case and the cap is opened there will be a sizable electrolyte spill.

5.0 Operations Instructions

Enable/Disable the EnerStore® 50V3.1(C) Flow Battery Module(s) via the ZBB ECM (EnerSystem™ Communications Module). The customer provided communications controller will provide the necessary commands to operate the system based on application specific parameters.

EnerStore 50V3.1(C) operation:



The 50V3.1(C) is Enabled and Disabled locally by the ZBB supplied ECM, and remotely through a ModBus TCP/IP protocol via customer supplied controls. To enable a V3, the DC bus voltage needs to be at 350 VDC or more for the unit to come online. At the ECM, the 50V3.1(C) (V3) is enabled, when the operator selects the V3 they wish to bring online, and presses the "Enable" button on the HMI. When the V3 receives the "Enable" command, the V3 will power up and come online within a variable start time (7secs to 15 min). Start time will depend on what state the V3 module was in before the enable was issued. During the start time, the status of the V3 will show "Wake Up". Once the enable command is received to a 50V3.1(C) control board (APC), it will perform a hardware check. After the hardware check is completed, the APC will turn on both the Anolyte and Catholyte pumps and start pumping electrolyte throughout the

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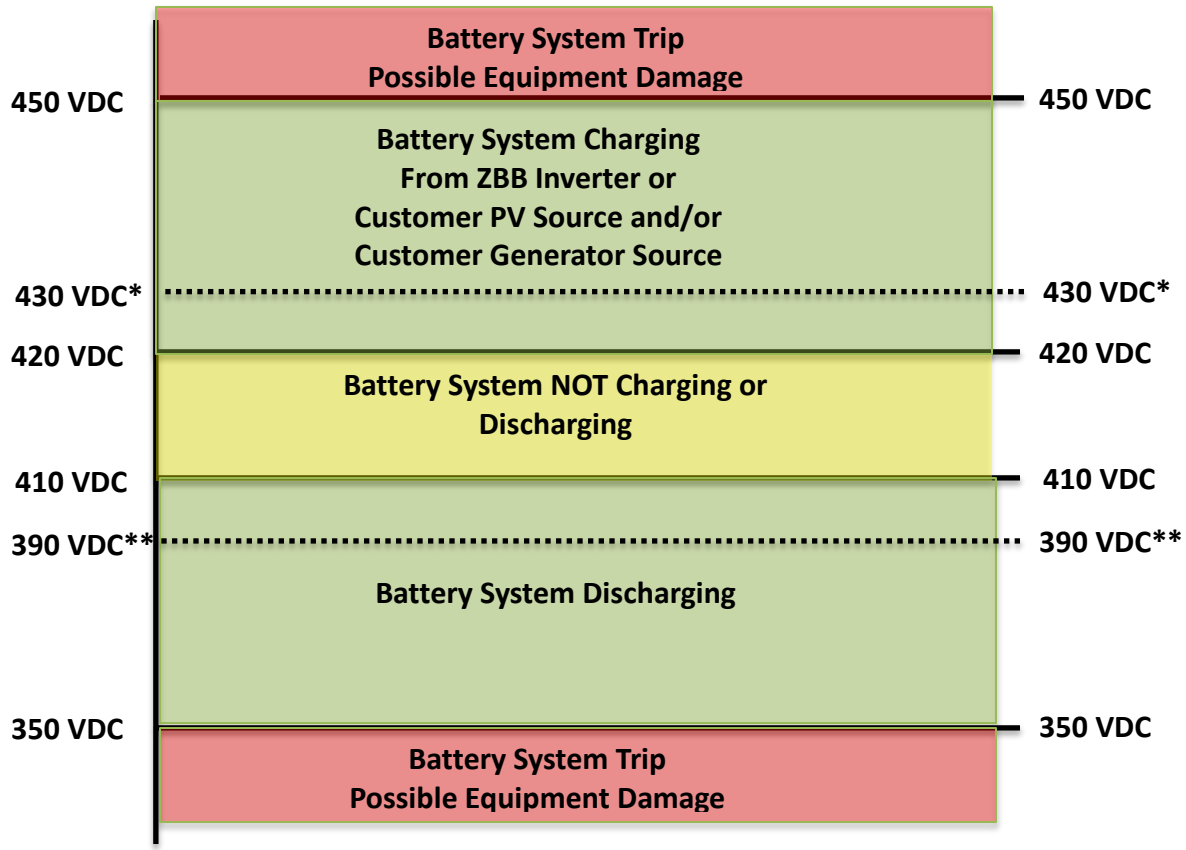
cell stacks. The 50V3.1(C) controller will initialize all valves to confirm their status and report any faults. Then, the 50V3.1(C) controller sends an enable command to all DC - DC Converters. All DC - DC Converters will initialize a start-up, and come online. Once the V3 completes the initialization process and comes online, the V3 status will change to "Online", and depending on its State (STRIP, CHARGE/DISCHARGE, TRIP, ALERT) it will react to the DC BUS voltage to CHARGE or DISCHARGE. If the BUS voltage is over 420VDC, it will start to charge. Once all stacks reach 100% SoC (State of Charge), the DC-DC Converters will stop charging the stacks until SoC < 95%. Once the SoC reaches 95%, the DC-DC converters will start charging the stacks until they reach 100% SoC.



The DC voltage level is controlled by ZBB inverter or customer supplied inverters or Generator under license agreement from ZBB Energy. Voltage levels above are factory default settings.

* Between 420 to 430VDC the battery will allow between 0-100% full amperage of charge, respectively

** Between 410 to 390VDC the battery will allow between 0-100% full amperage of discharge, respectively, provided SOC minimum is not reached.

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When the DC BUS is below or equal to 410VDC, the V3 goes into Discharge mode. The discharge kW amount will depend on the level of kW requested from the system, up to a maximum limit of 25KW per V3. The V3 will discharge until the bus voltage can no longer be maintained, or its SoC is at 0%. Should the DC BUS voltage fall below 350VDC, the V3 will not guaranty export of power.

While the V3 is operational, a Disable command, received from the Client by remote or local control, will initiate a shutdown process and report its status as "Shutdown". The V3, will then disable the DC - DC converters, will cease to import or export power. After a predetermined amount of time, the pumps inside the V3 will also shutdown. Once the shutdown process is complete, the V3 will report its status as "OFFLINE"

After approximately 36 hours of charging and discharging, the V3 module will begin a deep discharge cycle, known as a strip cycle. The V3 will go into a discharge mode, and bring the SoC of its cell stacks to 0%. After the strip process, if the bus voltage is > 350 VDC, the V3 will stay in an idle mode until the bus voltage is raised to 420 VDC. The duration of the Strip cycle varies depending upon; the SoC of the V3 in Strip, the SoC of other V3s if connected, if the system is charging or discharging, and what kW levels the system is charging or discharging. Through local or remote commands, the strip cycle can be expedited by up to 34 hours.

Below is a typical V3's sequence of Operation.

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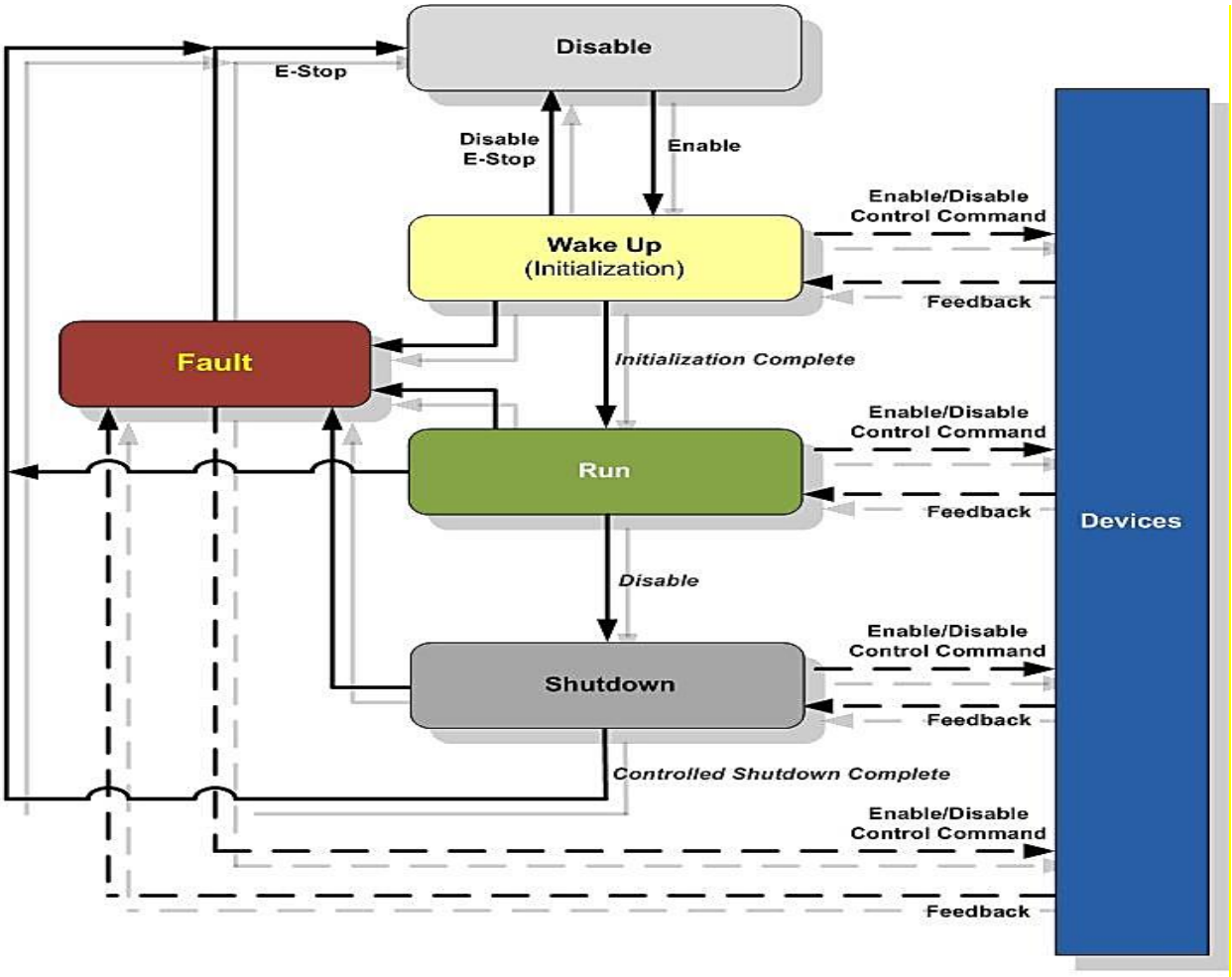

Operator Parameters	
Inputs	**Outputs**
Enable	DC Bus Voltage
Disable	SoC
E-Stop	kW
	Event Code

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6.0 General Maintenance

The ZBB EnerStore® 50V3.1(C) Flow Battery Module should be checked on a regular basis, monthly to twice per year depending upon site conditions. Ensure that there is no debris, no unwanted rodents/insects/etc. nesting inside the unit, and check the air filters on the doors. If the filters on the doors appear to be congested with debris, remove and replace. Contact ZBB if there is a need to purchase more filters.

The electrolyte within the module is reusable between the stack replacements at the set intervals provided it has been operated within its designed specification characteristics.

Maintenance Checklist included in the back of this Manual.

- *Automatic* – A Pre-programmed equalization cycle will occur approximately every 36 hours during operation to reset the EnerStore® battery stacks. This function can be forced, or intentionally reached, upon the full discharge of the module allowing each stack to reach "0" DCV. Depending on the SoC prior to the discharge, it can take from four to six hours for the full cycle.
- *End User* – A Monthly visual check should be performed by the End User to ensure that there is no damage or abnormalities.
- *ZBB Technician* – Monthly Monitoring/Reporting can be performed provided there is customer- established remote internet accessibility. This allows the capability of continuous system recording through analyzed key parameters, updates, and alarm conditions to allow proper operation. **
- *ZBB Technician* – Standard Annual Inspection of the operating system. Address any items regarding maintenance of the system to assure continued operation. Including System connections, electrical inspections and torque settings will be reviewed under this procedure. *(This includes verification of Monthly Maintenance Records, Recording of operation parameters and measurements, and addressing any identified concerns)***
- *ZBB Technician* – 3-year System Operations Inspection and Performance Evaluation. Verification of Annual Maintenance records, operation of full range system cycles and performance measurement, energy storage capacity evaluation. **

** These tasks are optional and inclusive to a customer purchased extended warranty and ZBB maintenance program.

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Frequency	*Description*	*Action By*	*Date*	*Comments*
Alternate Days	Perform Cell Equalization Cycle* ✓ Occurs automatically every 36 hours ✓ Approximately 4 – 12 hours per ZBB EnerStore® Module depending on module SoC	N/A		
Monthly	External Visual Observation for Damage, abnormalities, etc. ✓ Inspection/Operations ✓ Approximately 1 hour per ZBB EnerStore® Module	End User		
Monthly	Remote Monitoring and Reporting Using Customer Supplied Internet Connection ✓ System continuously monitored for operations, key parameters, analyzed data, and alarm conditions ✓ Approximately 2 -4 hours per ZBB EnerStore® Module	ZBB Tech (Remote)		
Annual	System Inspection ✓ Inspection of each module and individual component operations ✓ Mechanical connections, torque settings, standard operations ✓ Electrical connections, standard operations ✓ Internal module cabinet basic cleaning ✓ Verification of monthly maintenance and records ✓ Record operating parameters and internal measurements ✓ Address any noted, or recorded concerns ✓ Approximately 1 – 2 days per Module	ZBB Tech (Onsite)		

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Frequency	*Description*	*Action By*	*Date*	*Comments*
3-Year	System Inspection and Performance Evaluation ✓ Verify annual maintenance and system operations records ✓ Perform full range of system operations and measure performance factors and standard parameter comparison ✓ Extended Measurements and operations modes to determine state of energy storage capacity of each module ✓ Address any identifiable items or concerns ✓ Approximately 1 -2 days per ZBB EnerStore® Module			

**See Description and details in Section 6 of Manual*

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7.0 Fault Codes / Tech Support

WARNING! Do not attempt any measurement, parts replacement or other service procedure not described in this manual. Such action will void the warranty, may endanger correct operation and increase downtime and expense.

WARNING! All electrical installation and maintenance work described in this chapter should only be undertaken by qualified service personnel. The safety instructions in section *General Safety* must be followed.

EnerStore® 50V3.1(C) Fault Code – Lookup Table

The ZBB EnerStore® 50V3.1(C) generates fault code(s) as defined by the Excel spreadsheet 30-000332 – V3 X sw 3 44 APC EVENT Code – Ring Decoder.xlsx . It is possible to get multiple faults depending on the decimal value. For instance, should you get a decimal value of 3, you will have both a temperature ambient over and a temperature anolyte over fault.

To use the spreadsheet, enter the hexadecimal number for Fault, Fault 2, Alert, or Alert 2 area from the ECM into the Enter Hex number cell. Below the cell, you will get a decimal value. Place that decimal value either into the EVENT Code 1 Parameter for Alert or Fault code, or into EVENT Code 2 Parameter for Alert 2 or Fault 2 code. The spreadsheet will highlight what faults are associated with the value that is entered.

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Step 1. Enter HEX value into the Highlighted Field, result below (Note: for HMI USE ONLY, If not applicable skip to step 2.)

Enter HEX # from 0 to FFFFFFFF >>>	
DEC Result >>>	0

Step 2. Enter DEC value from Step 1 or from interface into Event Code 1 or 2 into the Highlighted Field. The appropiate faults will be highlighted dar

Enter DEC # from 0 to 2^32 >>>>		< Enter EVENT Code 1 Parameter 9000, 900			
Enter DEC # from 0 to 2^32 >>>>		< Enter EVENT Code 2 Parameter 9002, 900			
				Flag	BIT #
Temperature Ambient Over	0	0	0	0	0
Temperature Anolyte out Over	0	0	0	0	1
Bus Under Voltage	0	0	0	0	2
Batt Over Current	0	0	0	0	3
	0	0	0	0	4
Batt 1 Over Voltage Failure	0	0	0	0	5
Batt 2 Over Voltage Failure	0	0	0	0	6
Batt 3 Over Voltage Failure	0	0	0	0	7
Batt 4 Over Voltage Failure	0	0	0	0	8
Converter 1 No Comm	0	0	0	0	9
Converter 2 No Comm	0	0	0	0	10
Converter 3 No Comm	0	0	0	0	11
Converter 4 No Comm	0	0	0	0	12
Batt 1 Under Voltage Failure	0	0	0	0	13
5 or more of 8 total converters faulted or no comm OR 3 or more of 4 total converters faulted or no comm	0	0	0	0	14
Valve 2W Over Current	0	0	0	0	15
Valve 2W Time Out	0	0	0	0	16
Valve 2W Under Current	0	0	0	0	17
Valve 4W Over Current	0	0	0	0	18
Valve 4W Time Out	0	0	0	0	19
Valve 4W Under Current	0	0	0	0	20
Leak Low	0	0	0	0	21
Leak High Failure	0	0	0	0	22
Batt 2 Under Voltage Failure	0	0	0	0	23
Batt 3 Under Voltage Failure	0	0	0	0	24
Converter 1 Faulted	0	0	0	0	25
Converter 2 Faulted	0	0	0	0	26
Converter 3 Faulted	0	0	0	0	27
Converter 4 Faulted	0	0	0	0	28
Temperature Ambient Under	0	0	0	0	29
Temperature Anolyte Under	0	0	0	0	30
Batt 4 Under Voltage Failure	0	0	0	0	31

				Flag	BIT #
Converter 5 No Comm	0	0	0	0	0
Converter 6 No Comm	0	0	0	0	1
Converter 7 No Comm	0	0	0	0	2
Converter 8 No Comm	0	0	0	0	3
Converter 5 Faulted	0	0	0	0	4
Converter 6 Faulted	0	0	0	0	5
Converter 7 Faulted	0	0	0	0	6
Converter 8 Faulted	0	0	0	0	7
Batt 5 Over Voltage Failure	0	0	0	0	8
Batt 6 Over Voltage Failure	0	0	0	0	9
Batt 7 Over Voltage Failure	0	0	0	0	10
Batt 8 Over Voltage Failure	0	0	0	0	11
Pump Anolyte Over RPM	0	0	0	0	12
Pump Anolyte Under RPM	0	0	0	0	13
Pump Anolyte Over Current	0	0	0	0	14
Pump Anolyte Under Current	0	0	0	0	15
Pump Catholyte Over RPM	0	0	0	0	16
Pump Catholyte Under RPM	0	0	0	0	17
Pump Catholyte Over Current	0	0	0	0	18
Pump Catholyte Under Current	0	0	0	0	19
Batt 5 Under Voltage Failure	0	0	0	0	20
Batt 6 Under Voltage Failure	0	0	0	0	21
Batt 7 Under Voltage Failure	0	0	0	0	22
Batt 8 Under Voltage Failure	0	0	0	0	23
	0	0	0	0	24

HISTORY:

REV	DATE:	ISSUER	DESCRIPTION
0.0	09/05/13	HCB	INITIAL RELEASE
1.0	10/17/13	HCB	ADDED BATT UNDERVOLTAGE & PUMP FAULTS PER EC-0344.

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Table 1 Alarm or Fault

Fault Code (Bit)	Name	Cause	What to do
1 (0)	Temperature Ambient Over	Temperature inside V3.1 is too high	Check ambient temperature inside enclosure by heat exchanger Open doors to allow additional cooling Restart unit once temperature gets below 50 degrees C Contact ZBB should fault continue
2 (1)	Temperature Anolyte Over	Anolyte temperature is too high	Stop charging / discharging Keep unit enabled to allow pumps to run Put unit into strip by adjusting strip cycle counter Contact ZBB should fault continue
4 (2)	Bus Under Voltage	Main DC bus is less than 325 VDC	Verify ZBB EnerSection is enabled If V3.1 is connected to other sources, verify the DC bus is above 325 VDC. Contact ZBB should fault continue
8 (3)	Battery Over Current	Controller instability	Check DC Load Wiring, cycle power Contact ZBB
32 (5)	Battery 1 Over Voltage Failure	Cell stack voltage is over 240 VDC (V3.1), 120 VDC (V3)	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
64 (6)	Battery 2 Over Voltage Failure	Cell stack voltage is over 240 VDC (V3.1), 120 VDC (V3)	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
128 (7)	Battery 3 Over Voltage Failure	Cell stack voltage is over 240 VDC (V3.1), 120 VDC (V3)	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
256 (8)	Battery 4 Over Voltage Failure	Cell stack voltage is over 240 VDC (V3.1), 120 VDC (V3)	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue

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Fault Code	Name	Cause	What to do
512 (9)	Converter 1 No Comm	DC-DC Converter has stopped communicating to the V3.1 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU01, FU02 Contact ZBB
1024 (10)	Converter 2 No Comm	DC-DC Converter has stopped communicating to the V3.1 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU05, FU06 (V3.1), FU03, FU04 (V3) Contact ZBB
2048 (11)	Converter 3 No Comm	DC-DC Converter has stopped communicating to the V3.1 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU09, FU10 (V3.1), FU05, FU06 (V3) Contact ZBB
4096 (12)	Converter 4 No Comm	DC-DC Converter has stopped communicating to the V3.1 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU13, FU14 (V3.1), FU07, FU08 (V3) Contact ZBB
8192 (13)	Battery 1 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Verify fuses are not blown to Cell Stacks FU03, FU04 Put unit into strip cycle by adjusting strip cycle counter Contact ZBB
16384 (14)	5 or more of 8 total converters faulted or no comm OR 3 or more of 4 total converters faulted or no comm	DC-DC Converter has stopped communicating to the V3.1 controller or it has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
32768 (15)	Valve 2W Over Current	Valve is drawing more current than rated, possibly caused by the valve binding in the piping	Disable and enable V3.1 to clear fault Contact ZBB should fault continue
65536 (16)	Valve 2W Time Out	Valve has not opened or closed within the allotted time	Disable and enable V3.1 to clear fault Contact ZBB should fault continue

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Fault Code	Name	Cause	What to do
131072 (17)	Valve 2W Under Current	Valve is drawing less current than rated, possibly caused by actuator decoupling from valve	Disable and enable V3.1 to clear fault Contact ZBB should fault continue
262144 (18)	Valve 4W Over Current	Valve is drawing more current than rated, possibly caused by the valve binding in the piping	Disable and enable V3.1 to clear fault Contact ZBB should fault continue
524288 (19)	Valve 4W Time Out	Valve has not opened or closed within the allotted time	Disable and enable V3.1 to clear fault Contact ZBB should fault continue
1048576 (20)	Valve 4W Under Current	Valve is drawing less current than rated, possibly caused by actuator decoupling from valve	Disable and enable V3.1 to clear fault Contact ZBB should fault continue
2097152 (21)	Leak Low	Fluid has reached the low level sensor in the containment area	Check the V3.1 for leaks Check wiring and contacts of leak sensor LS-2 Contact ZBB
4194304 (22)	Leak High Failure	Fluid has reached the high level sensor in the containment area	Check the V3.1 for leaks Check wiring and contacts of leak sensor LS-1 Contact ZBB
8388608 (23)	Battery 2 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Verify fuses are not blown to Cell Stacks FU03, FU04 Put unit into strip cycle by adjusting strip cycle counter Contact ZBB
16777216 (24)	Battery 3 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Verify fuses are not blown to Cell Stacks FU03, FU04 Put unit into strip cycle by adjusting strip cycle counter Contact ZBB

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Fault Code	Name	Cause	What to do
33554432 (25)	Converter 1 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
67108864 (26)	Converter 2 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
134217728 (27)	Converter 3 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
268435456 (28)	Converter 4 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
536870912 (29)	Temperature Ambient Under	Temperature is not above V3.1 Minimum Operating Point	Verify temperature where the V3.1 is located Increase temperature in area where V3.1 is located Contact ZBB should temperature be above minimum operating point
1073741824 (30)	Temperature Anolyte Under	Electrolyte temperature is not above V3.1 Minimum Operating Point	Verify temperature where the V3.1 is located Increase temperature in area where V3.1 is located For V3.1C, verify heat blanket is operating Contact ZBB should temperature be above minimum operating point
2147483648 (31)	Battery 4 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Verify fuses are not blown to Cell Stacks FU03, FU04 Put unit into strip cycle by adjusting strip cycle counter Contact ZBB

Table 2 Alarm 1 or Fault 1

Fault Code	Name	Cause	What to do

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Fault Code	Name	Cause	What to do
1 (0)	Converter 5 No Comm	DC-DC Converter has stopped communicating to the V3 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU09, FU10 Contact ZBB
2 (1)	Converter 6 No Comm	DC-DC Converter has stopped communicating to the V3 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU11, FU12 Contact ZBB
4 (2)	Converter 7 No Comm	DC-DC Converter has stopped communicating to the V3 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU13, FU14 Contact ZBB
8 (3)	Converter 8 No Comm	DC-DC Converter has stopped communicating to the V3 controller	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter FU15, FU16 Contact ZBB
16 (4)	Converter 5 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
32 (5)	Converter 6 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
64 (6)	Converter 7 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB
128 (7)	Converter 8 Faulted	DC-DC Converter has faulted	Verify lights are on DC-DC converter red/green LEDs Verify fuses are not blown to DC-DC converter Contact ZBB

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Fault Code	Name	Cause	What to do
256 (8)	Battery 5 Over Voltage Failure	Cell stack voltage is over 120 VDC	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
512 (9)	Battery 6 Over Voltage Failure	Cell stack voltage is over 120 VDC	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
1024 (10)	Battery 7 Over Voltage Failure	Cell stack voltage is over 120 VDC	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
2048 (11)	Battery 8 Over Voltage Failure	Cell stack voltage is over 120 VDC	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB should fault continue
4096 (12)	Pump Anolyte Over RPM	Motor has decoupled from the pump	Contact ZBB
8192 (13)	Pump Anolyte Under RPM	Pump or motor has seized or electrolyte liquid is too cold	Verify temperature is above minimum specification for model of V3(.1). Heat area if temperature is too low. Contact ZBB
16384 (14)	Pump Anolyte Over Current	Pump or motor has seized or electrolyte liquid is too cold	Verify temperature is above minimum specification for model of V3(.1). Heat area if temperature is too low. Contact ZBB
32768 (15)	Pump Anolyte Under Current	Motor has decoupled from the pump	Contact ZBB

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Fault Code	Name	Cause	What to do
65536 (16)	Pump Catholyte Over RPM	Motor has decoupled from the pump	Contact ZBB
131072 (17)	Pump Catholyte Under RPM	Pump or motor has seized or electrolyte liquid is too cold	Verify temperature is above minimum specification for model of V3(.1). Heat area if temperature is too low. Contact ZBB
262144 (18)	Pump Catholyte Over Current	Pump or motor has seized or electrolyte liquid is too cold	Verify temperature is above minimum specification for model of V3(.1). Heat area if temperature is too low. Contact ZBB
524288 (19)	Pump Catholyte Under Current	Motor has decoupled from the pump	Contact ZBB
1048576 (20)	Battery 5 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB
2097152 (21)	Battery 6 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB
4194304 (22)	Battery 7 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB
8388608 (23)	Battery 8 Under Voltage Failure	Cell stack has not reached a minimum voltage while charging	Put unit into strip cycle by adjusting strip cycle counter Contact ZBB

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ZBB SERVICE NUMBERS

SERVICE & TECHNICAL SUPPORT

Address:
ZBB Energy Corporation
N93 W14475 Whittaker Way
Menomonee Falls, Wisconsin 53051

Business hours: United States Central Time Zone – 0700 to 1700
Telephone: 1-262-253-9800 ext 135

Emergency Mobile/Cell Number: + 1 262 442 1216

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8.0 Recommended Spare Parts

ZBB Energy Corporation 50V3.1C Recommended Spare Parts			
EnerStore™ 50V3.1C Module/s Project Total:			
Item Description	**ZBB Part Number**	**Quantity per Module**	**Recommended No. of Spares**
Valve, Ball 32mm, Soc.,Pump shut-off, 2nd Phase discharge	110041	3	1
Actuator, 24 VDC, 90 degree rotation PLUS 2104750 24VDC	120325	2	1
Valve, 4 way, V3.1	610029	1	1
Heat Exchanger	610008	1	1
Pump, DB6H Anolyte 24VDC,250W, 3.63" Impeller	110175	1	1
Pump, DB6H Catholyte 24VDC,250W, 3.63" Impeller	110176	1	1
Sensor,spill,liquid level,24v	120148	2	2
Heat Pad, 66.5 x 22", 1.25 Watts per/in.,1800 Wats@ 600VDC	120356	1	1
Fan, 404 mm, 48 VDC, 1600 CFM	130123	1	1
Fan, 48V DC, 4A 414W, CFM	130441	2	1
V3 Stack (Complete and Tested)	308001	8	2
DC/DC Converter	327346	4	1
Power Supply, In: DC250-500V, Out: DC 24-48V; 20A, PULS	120855	3	1
Auxiliary Power & Control -APC	620005	1	1
Contactor #EV200HAANA	120120	3	1
Fuse, 10A, fast acting, 600VAC/VDC 100kAIR	120872	2	2
Fuse, 15A Fast Acting, 600V, 100kAIR, Midget	120856	4	2
Fuse, 30A Fast Acting, 600V, 100kAIR, Midget	120857	8	4
Fuse, 60A Fast Acting, 600VAC, 200kAIR/300VDC 100kAIR	120858	8	4
Thermosnap, NC, open on rise 15C, QD Terminal	120789	1	1
Thermosnap, NC, open on rise 60C, QD Terminal	120790	1	1
Thermosnap, NC, open on rise 65C, QD Terminal	120788	1	1
Thermosnap, NC, open on rise 80C, QD Terminal	120787	2	1
Thermosnap , OC NC, Temp Range	120381	1	1
Thermocouple, Omega, Self-Adhesive, K-type	120526	2	1
Fan, Axial, 11.8cfm, 24vdc, 5000rpm,-20-70C	130154	1	1
PCB, RJ-45 to Fiber Optic, Interface w/Sync	327307	1	1
EnerStore™ Special Tools			
Drum pump/fittings kit (fill and empty)	314701	0	1
Peristaltic Pump	155000	0	1

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9.0 Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

Product Name: **ZBB ELECTROLYTE**
Revision Date: 12/05/12 Revision: 6
Supersedes: 07/07/10

1. Identification Of The Substance And The Company

Chemical name Mixture

Chemical formula Not applicable

Type of product Solution used in batteries

Company ZBB Energy Corp.
N93 W14475 Whittaker Way
Menomonee Falls, WI 53051
(8am-5pm ET) (262) 253-9800

Emergency Contact ZBB Energy Corp. (262) 253-9800
INFOTRAC 1-800-535-5053 (24 hours)

NFPA Profile: **Health = 3 Flammability = 0 Reactivity = 0**
Personal Protection = Oxidizer

2. Composition / Information on Ingredients

Componenets	CAS	Weight %	ACGIH-TLV Data	OSHA (PEL) Data
Zinc Bromide	7699-45-8	30-35	Not determined	Not determined
N-ethyl-N-methylpyrrolidinium Bromide	69227-51-6	7-12	Not determined	Not determined
Zinc Chloride	7646-85-7	3-7	1 mg/m^3 (as fume)	1 mg/m^3 (as fume)
Water	7732-18-5	45-55	Not determined	Not determined
Bromine	7726-95-6	< 1%	0.1 ppm (0.66 mg/m^3) TWA 0.2 ppm (1.3 mg/m^3) STEL	0.1 ppm (0.7 mg/m^3)

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3. Hazards Identification / Health Information

Emergency overview	Corrosive to eyes, skin and mucous membranes. May cause skin sensitization. Bromine vapors are highly irritating and painful to the respiratory tract.
Eye Contact	May cause eye irritation.
Skin Contact	May cause dermatitis.
Inhalation	May cause irritation to the respiratory tract.
Ingestion	May cause severe burns to the mucous membranes of the mouth, esophagus, and stomach, abdominal pain, nausea and vomiting. May cause falling asleep, muscular incoordination and respiratory depression.

4. First Aid Procedures

Eye Contact	Holding the eyelids apart, flush eyes promptly with copious flowing water for at least 20 minutes. Get medical attention immediately.
Skin Contact	Remove contaminated clothing. Wash skin thoroughly with mild soap and plenty of water for 15 minutes. Wash clothes before re-use. Get medical attention immediately.
Inhalation	In case of inhalation, remove person to fresh air. Keep him quiet and warm. Apply artificial respiration if necessary and get medical attention immediately.
Swallowing	If swallowed, wash mouth thoroughly with plenty of water and give water or milk to drink. Get medical attention immediately. ********** Note: Never give an unconscious person anything to drink. **********
Notes to physician:	Corrosive In case of ingestion DO NOT induce vomiting No specific antidote. Treat symptomatically and supportively.

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5. Fire and explosion hazards

Flash point	None
Auto-ignition Temperature	Not applicable
Flammable limits in air	Not flammable
Extinguishing media	Material is not combustible. Use extinguishing media appropriate to surrounding fire conditions.
Fire fighting procedures	Stay upwind. Avoid any bodily contact. Wear self-contained breathing apparatus in a positive pressure mode and appropriate protective clothing. Use water from side and from safe distance to keep fire exposed containers cool.

Unusual fire & explosion hazards

When heated to decomposition, may release poisonous and corrosive fumes of hydrobromic acid (HBr) and Bromine (Br_2). Although not combustible itself, the fuming liquid will react with combustible materials and may cause them to ignite. Hydrogen, many organic compounds and some metals will burn in a bromine atmosphere.

6. Accidental Release Measures

Personal precautions	Evacuate area. Full protective clothing, including self-contained breathing apparatus or power air purifying respirator, must be used.
Methods for cleaning up	Neutralize, then absorb on sand or vermiculite and place in closed container for disposal. Ventilate area and wash spill site after material pickup is complete. Avoid access to streams, lakes or ponds.

The following neutralizing agents for bromine are listed in order of neutralizing efficiency:

1. 10-50% potassium carbonate solution
2. 10-30% sodium carbonate solution
3. 5-10% sodium bicarbonate solution
4. Sodium thiosulfate solution (prepared by dissolving 4 kg of technical grade sodium thiosulfate in 9 liters of water and adding 100 gr of soda ash). Please note that there is a high heat of reaction released in this procedure.
5. 5% magnesium hydroxide slurry (very slow neutralizing action).
6. 5% slaked lime
7. 5% sodium hydroxide solution

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7. Handling and Storage

Handling Avoid breathing vapors and any other bodily contact. Keep containers tightly closed.

Storage Store in a dry, well-ventilated area away from incompatible materials (see “materials to avoid”).

8. Exposure control / personal protection

PEL/TWA (OSHA Permissible Exposure Limit/Time Weighted Average):
For Bromine: 0.1 ppm, Not established for other components.

TLV/TWA (ACGIH Threshold Limit Value/Time Weighted Average):
For Bromine: 0.1 ppm, Not established for other components.

Ventilation requirements Provide adequate ventilation.
Use local exhaust as necessary, especially under misting conditions.

Personal protective equipment:

- Respiratory protection Respirator with cartridge providing protection against bromine (up to 5 ppm) or self-contained breathing apparatus (above 5 ppm).
For short term exposure to low concentrations, an approved combination acid gas-organic vapor gas mask is suitable.
The wearer should be warned to get out of the area at the first sign of bromine gas odor coming through the mask.
NIOSH recommendation for respirator selection includes any chemical cartridge respirator with a full face piece and cartridge.

- Hand protection Neoprene or rubber gloves, (tucked under sleeves.

- Eye protection Chemical safety goggles or face shield with safety glasses.

- Skin and body protection Protective impervious clothing, hard hat and neoprene or rubber boots.

Hygiene measures Avoid bodily contact.
Safety shower and eye bath should be provided. Do not eat, drink or smoke until after-work showering and changing clothes.

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9. Physical And Chemical Properties

Appearance and Odor:	Yellow to slightly orange liquid with a slightly irritating odor.
Boiling Point/Range:	136°C
Melting Point/Range:	ca. -8°C
Vapor Pressure:	5.2 mm Hg at 25°C
Specific Gravity:	1.4 - 1.6
Vapor Density (Air = 1)	Not available
Evaporation (ether = 1)	Of water
Solubility in Water:	Soluble
Thermal Decomposition	Not available

10. Stability and Reactivity

Stability	Stable under normal conditions
Materials to avoid	Strong oxidants
Conditions to avoid	Not available
Hazardous decomposition products	Hydrogen bromide and bromine
Hazardous polymerization	Will not occur

11. Toxicological Information

Toxicity:

- Rat oral LD50	For zinc bromide 100% (1047 mg/kg)
- Rat inhalation LC50	For bromine 2700 mg/m^3
- Mouse inhalation LC50	for bromine 750 ppm/9 min.

Effects of overexposure

- Ocular	Corrosive Symptoms include redness, pain and blurred vision. Lachrimation occurs at less than 1 ppm.
- Dermal	Corrosive. Mild irritant to intact skin
- Inhalation	Corrosive to mucous membranes and upper respiratory tract. Symptoms include sore throat, dizziness, headache, nosebleed, coughing, abdominal pain, and sometimes rash. Concentrated bromine vapors may cause severe burns that ulcerate and are slow to heal.
- Ingestion	Corrosive by ingestion. Symptoms of inhalation.

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-Chronic toxicity	Prolonged exposure may cause chronic bronchitis, contact and allergic dermatitis. Repeated oral intake of bromides (.9 mg/kg of body weight/day) may affect the central nervous system. Warning symptoms include mental dullness, slurred speech, weakened memory, apathy, anorexia, constipation, drowsiness and loss of sensitivity to touch and pain.
Mutagenicity	Not mutagenic by the Ames Test. MEP is positive in in vivo somatic cell mutagenicity assay, the bone marrow micronucleous test.
Carcinogenicity	Not known to be a carcinogen. Not classified by IARC. Not included in NPT 10th Annual Report on carcinogens.

12. Ecological Information

Ecological Effects	Zinc bromide is classified by IMO as a marine pollutant. Bromine is not biodegradable. Because of its high vapor density, bromine id not transferred to the high atmospheric levels.
Note:	The following data refer to zinc bromide ($ZnBr_2$)
Aquatic toxicity:	
- 96 Hour-LC50, Fish	115.9 mg/l (Juvenile turbot)
- 72 Hour-EC50, Marine alga	6.6 mg/l (Skeletenoma costatum)
- 48 Hour-EC50, Marine invertebrate	2.4 mg/l (Acatia tonsa)
- 48 Hour-EC50, Daphnia magna	8.8 mg/l

13. Disposal Considerations

Waste disposal	May be disposed of by absorption on vermiculite or other equivalent absorbent. Dispose of waste in suitable containers covered with sodium carbonate or bicarbonate. Remove to approved incinerator or landfill. Observe all federal, state and local environmental regulations when disposing of this material.

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14. Transportation Information

UN No.	1760
DOT	Proper shipping name: Corrosive Liquid, n.o.s. (contains zinc bromide and bromine) Class: 8 – Corrosives Label: CORROSIVE (8) Marking: MARINE POLLUTANT Packing Group: II
IMO	Proper shipping name: Corrosive Liquid, n.o.s. (contains zinc bromide and bromine) Class: 8 – Corrosives Label: CORROSIVE (8) Marking: MARINE POLLUTANT Packing Group: II
ICAO / IATA	Class: 8 Hazard Label (s): Corrosive Packing Group: II

15. Regulatory Information

USA	Reported in the EPA TSCA Inventory
EPCRA (SARA title III)	Zinc compounds and Bromine (CAS #7726-95-6) are subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR 372. Section 311/312 Categorization (40CFR 370): Zinc bromide & zinc chloride are categorized as an immediate and delayed health hazard. Under the provisions of Section 311 of the Clean Water Act, zinc compounds are designated a hazardous substance if discharged in navigable waters. The Reportable Quantity (RQ) for notification is 1,000 lb/454 kg.
EEC	Not all ingredients in the preparation are reported in EINECS
Japan	Listed in MITI
Australia	Listed in AICS

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16. Other information

The information presented herein is believed to be factual as it has been derived from the works and opinions of persons believed to be qualified experts; however, nothing contained in this information is to be taken as a warranty or representation for which ZBB Technologies, Inc., bears legal responsibility. The user should review any recommendations in the specific context of the intended use to determine whether they are appropriate.

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