

# Maintenance & Operation Manual

## NESPACE 48/3K Rectifier Module

220V (1Phase 3Wire) AC Input  
-54VDC @ 55.56A DC Output  
3KW Rectifier Module



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**SAFETY FIRST... at ALL TIMES !**

- Before starting installation, operation, test. or repair work, carefully read and follow all directions specified in this manual for safe operation of the system and to minimize risk to the operator.
- This product has been manufactured under strict quality management. If any potentially hazardous procedure cannot be performed safely with regard to life or connected equipment, contact Dongah Elecomm immediately.
- Pay special attention to sections throughout this manual that are highlighted with the following **WARNING** or **CAUTION** symbols:

	<p>This <b>WARNING</b> symbol indicates a high risk that may cause death or critical injury to the operator if proper procedures and safety precautions are not used.</p>
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	<p>This <b>CAUTION</b> symbol indicates a serious risk that may cause injury to the operator or damage to connected equipment if proper procedures and safety precautions are not used. .</p>
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《Check of Contained Materials》

	<ul style="list-style-type: none"> <li>• Ensure that the product type and quantity received is the product type and quantity that you ordered. Use the enclosed shipping documents to verify all contents.</li> <li>• Ensure that all parts and hardware are accounted for and with no deformation, damage, peeling or scratched paints, or cable damage.</li> </ul>
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《Directions in Storage》



- Secure and store this product package away from water, rain, direct sunlight, and any potentially harmful gas or liquid.
- Store this product within the specified temperature (-40°C to +85°C) and humidity (5% to 95%, non-condensing) conditions.

《Test & Repair》

Electric Shock, Fire



- Trained and qualified personnel should perform test and repair work periodically with designated methods. (Violating this directive is a risk to life and limb and may cause an electric shock or fire.)
- Only qualified labor with due knowledge and experience should repair this product. (Violating this directive is a risk to life and limb and may cause an electric shock or fire.)
- Whenever the AC input, DC output, and/or Battery voltage(s) are applied or present, use precautions to avoid electric shock or short circuit when the system is tested or repaired.



- Even when the system is turned on while commercial power has failed, AC input may be fed to the system. Take particular attention of the live AC input voltages present during test and repair work.

《Disposal》



- This product should be disposed under the ordinary industrial wastes disposition procedure. Be aware that there may be industrial waste management policies that need to be followed at the local, state, and national levels.

《Directions in Operation》

Injury, Electric Shock, Fire

- Do not run this system in a place with flammable or corrosive gases, dew or humidity. (It may cause an electric shock or fire.)
- Do not try to modify this product. (It may cause an electric shock, burn, or fire.)



- Operate this system under the environmental conditions specified in this manual.  
Take particular attention to voltage, frequency, temperature, humidity and vibrations. (Violating the environmental requirements may cause an electric shock or fire.)
- Before connecting the battery connections, load and grounding wires, pay attention not to reverse the polarity of them. (Polarity reversal may cause fire.)
- While the system is connected, do not touch any battery wire, load or grounding wire ports. It may cause an electric shock or death.
- Pay attention not to reverse the polarity of signaling cables and detection cables when connected. (It may cause a fire.)
- Do not leave excess or foreign materials (such as sheathes of electric wires or hardware) on top of or inside the product. It may cause an electric shock or fire.
- The DC outputs are connected to the battery before the system starts to be driven. Pay close attention not to cause an electric shock or short circuit.
- When the rectifier units are inserted into the shelf, be aware that the live AC input voltage is fed to the Connector in the rack side. (It may cause an electric shock.)
- When you insert or remove a rectifier unit from or into the shelf, be aware of the unit may be hot enough to cause a burn injury.
- Do not insert an object or finger into the rectifier unit fan. (It may cause an injury.)
- When handling rectifier units, pay close attention not to touch any open connector pins. (It may cause an electric shock.)



- When cables are connected, battery should be separated from the rectifier system except one point of the conductor at each cell.
- Start operation after all connections (battery, load, and grounding wires/cables) are made but Circuit Breakers are OFF.
- Connect the battery wire, load and grounding wire while the load side has been unloaded and Circuit Breakers are OFF.
- External transmission signal should be  $\leq 60V$  level and  $\leq 0.5A$ .
- Rectifier unit should be inserted and removed using the guide rail of the rectifier system, to engage connectors without damage.

- • Use caution during an AC failure event as the AC power may be restored at any time. Use special care to lockout/tagout the AC whenever necessary, check the presence of, and maintain the AC input to the power shelf, as needed.

# 1 - Rectifier Module Specifications

## 1.1 Electrical Characteristics

### 1.1.1 Input Characteristics

- 1) UL Rated input voltage : 1P3W AC: 99Vac ~ 264Vac  
(Derates 18.68W/V below 176 Vac)
- 2) Max Input voltage operating range: 85Vac~ 285Vac  
(Designed for nominal:176VAC ~ 285VAC)
- 3) Max Input current: 18.5A
- 4) Leakage current: 3.5A @ 264Vac
- 5) Input frequency: 47 ~ 63 Hz
- 6) Efficiency: typical 96% (at 40% ~ 60% load)
- 7) Power factor:  $\geq 0.99$  (at  $\geq 50\%$  load)
- 8) Protection: MAINS fuse on both Line 1 and Line 2; TVS for Transients
- 9) UVP: 77Vac (Auto-Recovery: 85Vac); OVP: 297Vac (Auto-Recovery: 285Vac)

### 1.1.2 Output Characteristics

- 1) Rated output voltage:  $-54.0V \pm 0.27V$  (at 50% load)
- 2) Operating voltage:  $-43.5V \sim -58.0V$
- 3) Output current: 55.5A (at 240Vac Input)
- 4) Output connector: designed for backplane insertion
- 5) Line Regulation:  $\pm 0.5\%$  ( $\pm 0.27V$ ) across full input range
- 6) Load Regulation:  $\pm 0.5\%$  ( $\pm 0.27V$ ) across full load range
- 7) Over-Current Limit: power-limited to 3KW down to 48Vout; (limited to 62.5A Between 48V~38Vout, then folds back (see datasheet Output Power curve)
- 8) Over- Voltage Protection:  $-58.5V \sim -59.5V$  (Recycle AC input to reset)
- 9) Output Ripple & Noise:  $\leq 300mVp-p$  (max);  $\leq 20mVrms$  (20MHz BW)

## 1.2 Emissions

### 1.2.1 Electro Magnetic Interference (EMI)

CE Mark, including:

- ✓ EN 55022:2010 +AC:2011 (Class A)
- ✓ /EN61204-3:2000



### 1.2.2 Input Surge Voltage

- ✓ Voltage: 6kV (1.2 x 50  $\mu$ s); Current: 3kA (8 x 20  $\mu$ s)

### 1.2.3 Withstand Voltage

- 1) Input to Output: 3.0kVac (1 minute) or 4242Vdc (1 minute)
- 2) Input to Chassis: 1.5kVac (1 minute) or 2121Vdc (1 minute)

## 1.3 Environmental Characteristics

- ✓ Pollution Degree 2
- ✓ Altitude tested to < 2000 meters
- ✓ 3KW Max Power Range: -35°C ~ +45°C
- ✓ Full Power to -40°C (Cold Shutdown/Auto-recovery -35°C)
- ✓ Derated Power to +75°C (Hot Shutdown/Auto-recovery +65°C)

### 1.3.1 Cooling

- ✓ Intelligent Fan control
- ✓ Front-to-back airflow

## 1.4 Operating Humidity: 10% ~95%. non-condensing

## 1.5 Acoustic Noise:

- ✓ < 60dBA (220Vac, full load, Ta > +40°C)

## 1.6 Physical Specifications

### 1.6.1 Dimensions (W x D x H):

- ✓ 108.2mm x 321.7mm x 41.0mm (4.26in. x 12.67in. x 1.61in.)

### 1.6.2 Weight:

- ✓ 2.30 kg (5.07 lbs)

## 1.7 Safety Reports:

- ✓ UL Report # E166582-A62-UL
- ✓ (UL-60950-1, 2<sup>nd</sup> Edition (UL Recognized))
- ✓ CAN/CSA C22.2 No. 60950-1-07, 2<sup>nd</sup> Edition
- ✓ EN60950-1:2006/A11:2009/A1:2010/A12:2011/A2:2013
- ✓ Tests conducted under CB Scheme, issued by UL International Demko A/S, CB Certificate Number DK-56640-UL (Test Report Ref. No. C16O043-A0C0 issue date 7-25-2016).

## 2 – NESPACE Shelf- Typical Installation & Cabling



Example of NESPACE48/3K Rectifier Modules installed into a CSPS-6K Shelf

Figure 2-1. Shelf with NESPACE rectifier modules installed

### 2.1 Preparation for Rack Installation

The rectifier modules should be installed into a shelf using an indoor cabinet/rack in a clean, dry location, with at least 50cm spacing front and rear of the shelf to allow for unrestricted air flow.

### 2.2 Cabling to a shelf containing NESPACE48/3K Modules



- Focus on and follow safety procedures while installing rectifiers.
- Before cable installation, use a DVM to verify AC and DC voltages are not present. Use tagout/lockout, as needed.
- Before starting any operation, carefully read the following directions.

Inputs and outputs of the NESPACE rectifier is typically connected through a shelf backplane, PCB traces, filter networks, bus bars, terminals, connectors, and cables.

Pay attention to AC input Line/Load/GND and DC output connection polarities.

#### 2.2.1 AC Input Connection

The AC input includes a lightning surge arrestor (10kA) within the backplane in a typical shelf. AC input cables to the Rectifier Shelf should be physically separated from DC output cables as much as possible to minimize EMI.

The AC 1Ø3W input cable may be connected after AC voltage is verified to be OFF and LOCKED-OUT. A typical 1U Rectifier Shelf configured with NESPACE48/3K rectifier modules is shown in Figure 2.2, which shows the the Shelf's rear-side power cable connections.

- \* INPUT & FG cables should be as sized properly, at a minimum of:
  - AC Line (ACL) and AC Neutral (CAN) terminal: min. 6SQ (10AWG)
  - AC Ground (PE) : min. 8SQ (8AWG)
  - Frame Ground (FG) : min. 8SQ (8AWG) / 1 or 2 HOLE LUG (5Øx15mm)

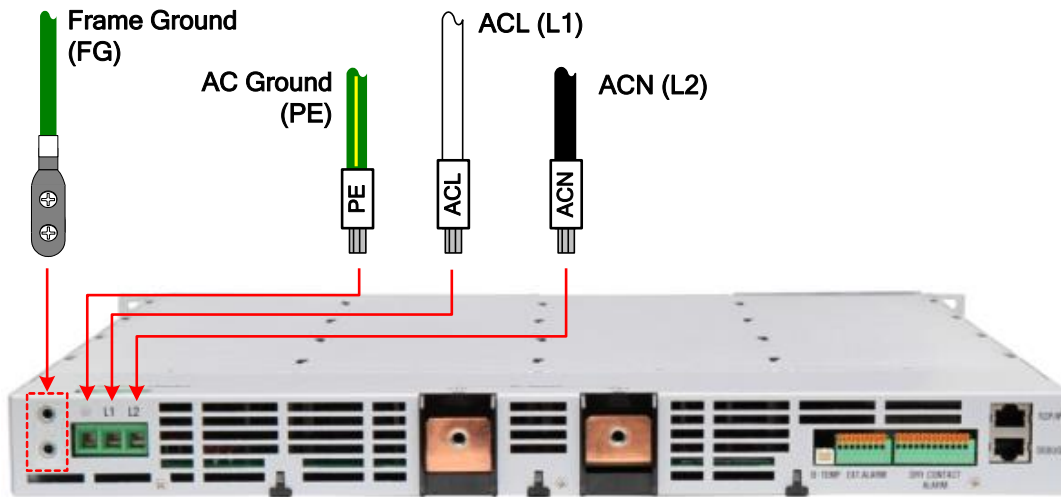


Figure 2-2. AC Input & FG Cable Connection

2.2.2 DC Output Connection

DC output cables should be connected referring to Table 2-1 and Figure 2-3. Connect each of the output cables to corresponding terminal.

Table 2-1 Output Cable & LUG

LOAD (-48V)	RTN (RETURN GROUND)
55A: 1HOLE LUG → 25SQ or greater	55A: 1HOLE LUG → 25SQ or greater
110A: 1HOLE LUG → 50SQ or greater	110A: 1HOLE LUG → 50SQ or greater

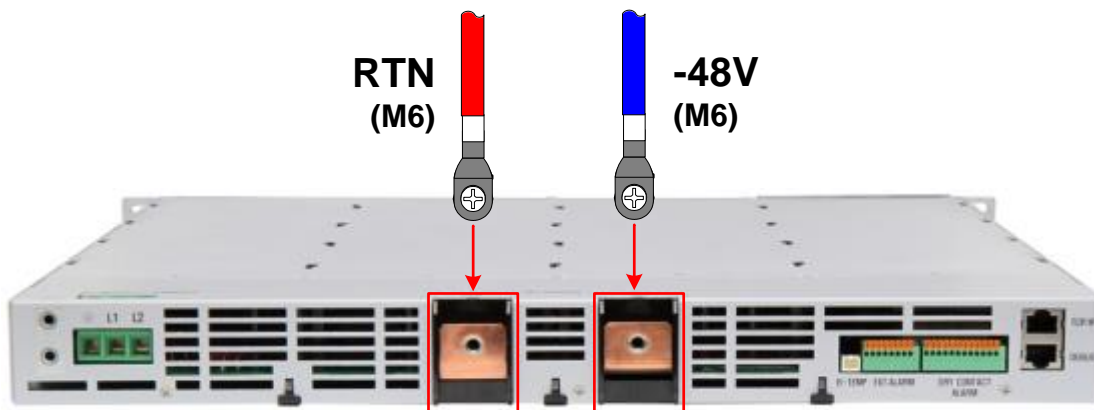


Figure 2-3 Output Cable Connection

2.2.3 Communication Cable Connection

Rectifier alarm and operation status are sent out over Debug and Ethernet ports.

Pins are assigned as follows:

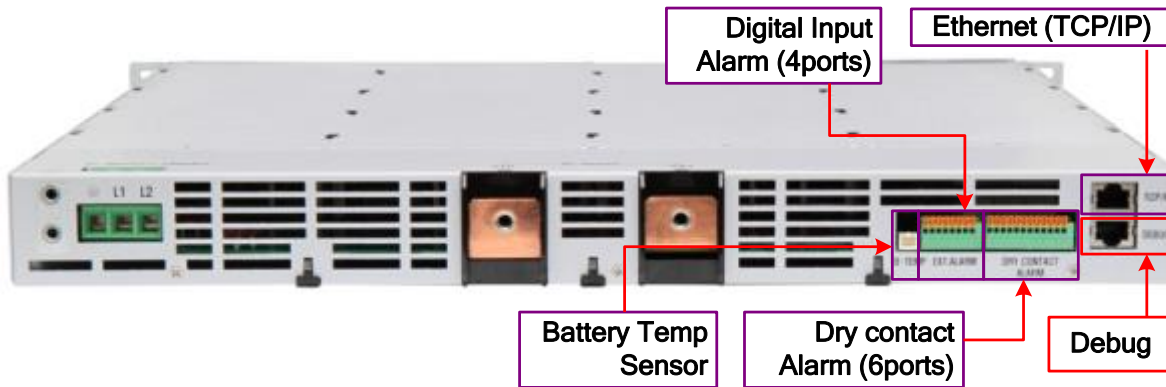


Figure 2-4. Communication Connection Ports

Table 2-2. Communication Pinout Table

> Ethernet (TCP/IP)

Pin NO	Name	Description	Comments
1	TX+	Transmit Data+	CONNECTOR: RJ45
2	TX-	Transmit Data-	
3	RX+	Receive Data+	
4	Not Used		
5	Not Used		
6	RX-	Receive Data-	
7	Not Used		
8	Not Used		

### 3 – Shelf Initialization & Check Points with NESPACE modules

*When installation procedures are finished, initialize the Rectifier Shelf and perform the following functional test to check for any failures or alarms..*

- 1) Check that all circuit breakers and/or power switches have been turned off, and check polarity and cable connection status using DVM.
- 2) Use a DVM to ensure that the AC input power is correctly connected to the Shelf.
- 3) Check that the DC Output cables have been correctly connected, and check polarity.
- 4) Turn on the AC main Circuit Breaker.
- 5) Check that each installed NESPACE48/3K Rectifier Module front panel LED is green, and verify that the DC output voltage is correct.

### 3.1 Installation Check List

To check installation of the Rectifier shelf, use the following procedure:

- 1) Check that the equipment rack has been properly and firmly mounted to the floor.
- 2) Check that the dry contact alarms cable (optional) of the Control Unit is connected.
- 3) Ensure that the AC Input Circuit Breaker has been installed in the distribution frame of the system.
- 4) Verify that the rack Frame Ground has been connected to the main ground busbar.
- 5) Check if the I/O cable has been correctly connected.
- 6) Verify that all installed NESPACE Rectifier Modules have been fully inserted.

### 3.2 Rectifier Module Insertion & Removal

#### 3.2.1 Rectifier Module Installation

Each NESPACE48/3K Rectifier Module is hot-swappable so may be inserted with or without the power applied to the shelf. The rectifier module should be inserted into the shelf from the front. Insert each module until it reaches the mating connector then push in the ejector to fully seat the connectors. The ejector will easily lock into place when inserted and properly seated.



**Figure 3-1. NESPACE Rectifier Unit Front View****3.2.2 Rectifier Module Removal**

Remove the Rectifier Module by pushing in on the top front portion of the ejector then pull the ejector handle to slide the module out from the shelf assembly.

**3.3 Normal Operation**

Status data is displayed on the LCD window of the Control unit. Use the push button switches on the Control Unit front panel to edit or display setup values.

**3.3.1 Initial Operation Status Check****1) Rectifier Module (NESPACE48/3K)**

- ➔ Check that the ON LED is illuminated.
- ➔ Check that ALARM LED is turned off.

If the FAIL LED is ON, the Rectifier Module is not operating normally. In that case, check the unit status on the LCD window of the Control unit.

- ➔ Check that the Rectifier Module fan operates normally (pulls air in from front to rear).

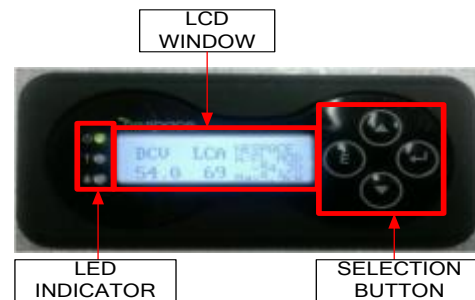
**2) Controller (NESPACE-KA)**

- ➔ Check that the status indicator "FAIL" LED (red) is off.
- ➔ Check that the audible alarm is not activated (it should remain quiet).
- ➔ Check that alarms are not shown (as activated) on the LCD display and that the LCD displays the present status correctly.

**Note:** For additional details, see the *NESPACE-KA Rectifier Control Unit Operating Manual*

### 3.4 Corrective Measures

If the FAIL LED (red) is on while the Rectifier Shelf is powered ON, the alarm status will be displayed on the Control Unit LCD window and the audible alarm will sound. Check the alarm status and take corrective measures, if needed.



**Table 3-1 Corrective Actions per Alarm (optional, user defined)**

No	ALARM*	CORRECTIVE MEASURES	Default (List)
Port1	AC input	AC High & Low voltage Measure actual input voltage using the digital volt meter. Verify input voltage UV, OV alarm settings.	AC UV : Under 174Vac AC OV : Over 276Vac
Port2	Output voltage	Verify default setting of output voltage. Verify output voltage UV,OV alarm settings. Verify individual current of unit and check if load sharing is working correctly (only for the case of Under voltage fail).	DC OV : Over 58Vdc DC UV : Under 47.5Vdc
Port3	Rectifier module	If an inserted NESPACE rectifier module inserted has any problem, remove and reinsert it. If it fails again, replace the NESPACE rectifier module.	UNIT FAIL (Default.#1~#2, Max #3)
Port4	Environment (Etc)	Check details using a PC and the Debug port to check the actual status of the alarm.	Rack. High Temp (80°C) Rack. Sensor fail (open)
Port5	Ext Alarm	Check details using a PC and the Debug port to check the actual status of the alarm. Check the Digital input (Ext) Alarm cable	Digital input Alarm fail (Default: Normally open)
Port6	Control	If Control Unit has any problems, power the AC off to the Shelf then remove and reinsert it. If it fails again, replace the Control Unit.	

\* Alarm contact.type can be set arbitrarily to NO or NC(Normally Open or Normally Closed)

## 4 - NESPACE48/3K Rectifier Module Configuration

### 4.1 ON LED (GREEN)

The ON LED is lit (GREEN) when the Rectifier Module is in normal operation.

If internal communication with the Control Unit fails, the ON LED slowly blinks.

#### 4.2 FAIL LED (RED)

The FAIL LED is lit (RED) under one of the following conditions:

- \* When system is shut down due to the DC OV (OverVoltage) protection circuit.
- \* When system is shut down due to the OT (OverTemperature) protection circuit.
- \* When system is in a DC UV (UnderVoltage) due to an over-current limit condition.
- \* When the internal FAN has failed – FanFail (FF).
- \* When system shuts down due to the AC OV or AC UV exceeding rated spec limit.
- \* When output is not functioning or voltage falls below DC UV limit (for any reason).

#### 4.3 NESPACE48/3K Rectifier Module Connector Pinout

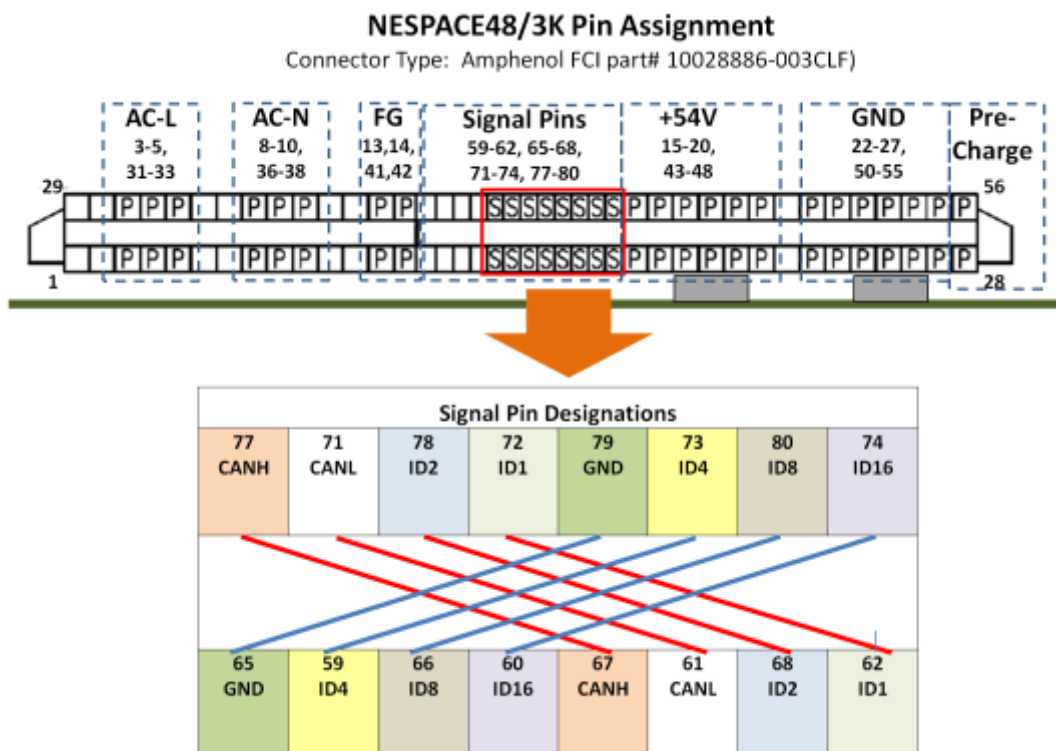


Figure 2-1. Rectifier Module Connector Pin Assignment

## 5 - Rectifier Module Operation



#### 4.4 Rectifier System Operation

- ① Check that each RM ON LED is illuminated (GREEN) for normal operation.  
If the RM FAIL LED is on (RED), check module error status then remove and reinsert the RM to check the status again.
- ② Verify that the RM ON LED is illuminated (GREEN) for normal operation.  
If the FAIL LED is still on (RED), check the alarm displayed on the Control Unit LCD.  
*If any error on the rectifier system is not solved under the direction of above Table 3-1, contact a Sales Representative or the headquarters of Dongah Elecomm.*

#### 4.5 Rectifier Removal / Replacement

- ① The Rectifier Modules are hot-swappable so can be replaced with AC power applied.  
(Note that if any external battery has been connected, the Control Unit still operates.)
- ② The Control Unit is not hot-swappable so replacement requires that the AC input voltage be turned off and all external batteries be disconnected (BATT circuit breakers OFF). Then the Control Unit can be replaced and the system power restored.

#### 4.6 Rectifier Module Restart

If a Rectifier Module output voltage is suspended due to a DC OverVoltage (OV), manually turn off the main AC Circuit Breaker. Then, when the module is fully discharged (LED off), turn on the AC Circuit Breaker to see if the event was isolated or recurring. If the OV condition is not recovered, replace the Rectifier Module and repeat this restart process to check that the replacement module clears the alarm.

## 5 - Rectifier Maintenance

### 5.1 Overview

The purpose of this document is to provide guidelines to test the rectifier and setup measures to restore the rectifier to normal operation within a shortest possible time when any fault occurs to the system. Enough field-replaceable spare parts must be maintained on-hand to prepare for replacement of units or components that may fail in the field. Even though the fault location and reason are detected under the guidelines of this Manual, if field repair work is not possible, or a long period of time is needed for repair, the faulty units should be replaced with a spare one held in reserve. This allows the system alarm to be cleared quickly and efficiently to minimize technician time and maximize system up-time.

Note: As this rectifier is powered by AC voltage, it naturally may cause electric shock. If external battery banks are also used, this battery voltage is fed to the system even during an AC failure event. Because of the AC and/or DC presence, safety measures should be taken during rectifier shelf repair and maintainance.

### 5.2 Periodic Inspection of Rectifier Shelf, Modules, and System

To guarantee effective operation of the system, periodic inspection is required.

Periodic inspection should be carried out once every 6 months.

- 1) Take care not to block the air ventilation holes with dust, dirt, or other debris.
- 2) Check the cable connections and tighten as necessary.
- 3) Check if internal temperature of the site is maintained at the rated levels.
- 4) Visually check all rectifier operation states and alarm states.
- 5) Check the equipment rack floor mount is maintained and ensure there is not any water leakage at or near the installation site for the rectifier system.

### 5.3 Adding Rectifier Module

To expand the system capacity, rectifier modules are hot-swappable so may be inserted into vacant slots while the Rectifier Shelf is powered up normally.

- 1) Insert a rectifier module to the vacant slot until it reaches the mating connector then push in the ejector to fully seat the connectors. The ejector will easily lock into place when inserted and seated.
- 2) Confirm the Rectifier Module ON LED is illuminated GREEN.
- 3) On the Control Unit, check operation status of the newly inserted module for no active alarms.

## **6– Problem Solving & Fault Fixing**

***Repairing or troubleshooting Rectifier Shelves and Rectifier Modules should only be performed by experienced workers observing all safety precautions.***

- \* Jobs should be carried out in due order.
- \* Workers should not wear rings, watches or metallic accessories.
- \* If non-insulated conductors are used, always use a DVM to verify if any voltage is present before attempting to perform any work in or around the Shelf or Rectifier.

***- Circuits and boards should be protected from EMI.***

### 6.1 Problem Solving

This rectifier has been designed for users to solve problems easily. The Control Unit LCD window displays details of faults.

### 6.2 Replacing Parts within a Shelf

If a fault is suspected on a particular point, the field-replaceable unit (circuit board or module) at that point should be replaced. Replacing individual components on a circuit board or module should not be performed in the field.

### 6.3 Order of Replacement

#### 6.3.1 Replacement of Rectifier Module

- 1) When a rectifier module is replaced, an alarm will be activated. Turn off the rectifier module alarm from the control panel, or notify this fact to the person in charge.
- 2) To remove the faulty rectifier module, push in on the ejector on the Rectifier Module, and then pull the ejector handle to remove the module from the shelf.
- 3) Slide in a new Rectifier Module along the mechanical guides until it reaches the

backplane connector.

- 4) Carefully push in the ejector handle to lock the mating connectors. The ejector handle should easily snap into place and lock into the Rectifier Module front panel.
- 5) Check that the module operates normally and that no alarms are activated.

## Definitions

<p> <b>C/B</b> : Circuit Breaker  <b>S/W</b> : SWitch  <b>RMS</b> : Root Mean Square  <b>LVD</b> : Low Voltage Disconnect  <b>ACF</b> : AC Fail(power failure)  <b>ACV</b> : AC Voltage  <b>ALM</b> : ALarM  <b>AMP</b> : AMPere  <b>AUTO-FL MODE</b> : AUTO-FLoating charging <b>MODE</b>  <b>AUTO-EQ MODE</b> : AUTO-EQualize charging <b>MODE</b>  <b>DCV</b> : DC Voltage  <b>Comm. Fail</b> : Communication Fail  <b>Comp.</b> : Compensation  <b>Curr.</b> : Current  <b>DC</b> : Direct Current  <b>DCF</b> : DC Fail  <b>DCOV</b> : DC Over Voltage  <b>DCUV</b> : DC Under Voltage                 </p>	<p> <b>DCH</b> : DisCHarge  <b>FF</b> : Fan Fail  <b>LCD</b> : Liquid Crystal Display  <b>LED</b> : Light Emitting Diode  <b>LDA</b> : output LoaD Ampere  <b>MF</b> : Module Fail  <b>OV</b> : Over Voltage  <b>OCA</b> : Over Current Ampere  <b>OT</b> : Over Temperature  <b>REC</b> : RECTifier  <b>RX</b> : Receipt channel  <b>TX</b> : Transmit channel  <b>Temp</b> : Temperature  <b>UV</b> : Under Voltage  <b>V1.0</b> : Version 1.0  <b>ERR</b> : ERRor  <b>ENT</b> : ENTer  <b>LCA</b> : Load Current Ampere                 </p>
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## **NESPAC48/3K RECTIFIER MODULE MAINTENANCE & OPERATION MANUAL**

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