



**VRLA**  
**(VALVE REGULATED LEAD ACID) BATTERY**

**Installation, Operation and Maintenance  
Manual 12V & 2V**

**HIGH RATE (HRL)  
RESERVE POWER  
(FM, GFM, NDT, NDF, CPL, EOS)  
PURE LEAD (NPL, UDS)  
HIGH TEMP (HTB)  
CXL4 Reserve Power**

Version: V2.3











### Important Safety Instructions

Please read this installation, operation and maintenance (IO&M) manual carefully. All VRLA cells and batteries from Narada are safe when handled and operated in accordance with the precautions and recommendations outlined in this document. **ONLY PERSONNEL TRAINED IN THE SAFE HANDLING OF BATTERIES AND OTHER LIVE ELECTRICAL EQUIPMENT SHOULD BE ALLOWED TO WORK ON ANY BATTERY SYSTEM.**

- **DO NOT** attempt to remove any component or part of the battery. VRLA batteries are not repairable.
- VRLA batteries are fully recyclable. Contact your nearest Narada service center to safely dispose of your spent battery
- **DO NOT SMOKE**, have a naked flame or cause a spark near a battery
- **DO NOT** use any organic solvent to clean the battery
- **ALWAYS** use insulated tools when working on or near a battery since using an uninsulated tool could

- cause a battery short circuit that can lead to serious bodily injury
- **ALWAYS** wear eye protection when working on a battery
- **DO NOT** wear a watch or metallic jewelry when working on a battery as they can cause a short circuit
- **DO NOT** charge batteries in a sealed (airtight) container or enclosure
- In the unlikely event of eye or skin exposure to acid clean the affected area with plenty of clean water, then seek medical help

**California Proposition 65 warning:** Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm, and during charging, strong inorganic acid mists containing sulfuric acid are evolved, a chemical known to the State of California to cause cancer. Wash hands after handling.

 Danger	 Electricity Danger	 Wear eye protection	 Do not short circuit	 Keep children away
 Read the manual	 No smoking, no naked flame, no sparks	 Pb Recycle	 Do not put battery in the trash can	 Recognized by UL as a component

### 1. Receipt of shipment

Examine the batteries received for any signs of physical damage and that the contents of the shipment agree with the packing slip. Report any damage or discrepancy immediately to Narada. Since VRLA batteries contain acid in fiberglass separators, use rubber gloves when handling a physically damaged battery.

### 2. Storage

All VRLA batteries should be stored in a cool, dry place and away from exposure to sunlight or other sources of heat. Since batteries lose charge over time they need to be given a freshening charge at regular intervals. These intervals are determined by the storage temperature; batteries lose charge faster at warmer temperatures – storage time is cut by 50% for every 10°C (18°F) rise in temperature. The maximum storage times between freshening charges are given below. **Failure to follow our freshening charge recommendations will void the warranty of the battery.**

**Note that batteries must always be fully charged before they are stored.**

VRLA series	Storage Temperature Range	Recharge criteria <sup>1</sup>	
		Months	OCV
HRL / GFM / FM	0°C to 35°C (32°F to 95°F)	6	2.10 VPC
NDT / NDF / AT	-20°C to 40°C (-4°F to 104°F)	6	2.10 VPC
EOS	-20°C to 40°C (-4°F to 104°F)	12	2.10 VPC
NPL / UDS / HTBF / CPL	-20°C to 40°C (-4°F to 104°F)	12	2.05 VPC
HTB	-20°C to 40°C (-4°F to 104°F)	24	2.05 VPC

Table 1: Freshening charge and storage criteria

VRLA series	Freshening Voltage	Maximum Current
HRL / GFM / FM	2.40 VPC	0.20C <sub>20</sub> amp
NDT / NDF / AT	14.4V	0.20C <sub>10</sub> amp
EOS	2.35 VPC	0.20C <sub>10</sub> amp
NPL / UDS / HTBF /CPL	14.4V	0.25C <sub>10</sub> amp
HTB	14.4V	0.25C <sub>10</sub> amp

Table 2: Recharge voltage and current parameters

<sup>1</sup> Recharge whichever occurs first; OCV threshold or Months of Storage

### 3. Installation

- Ambient temperature**

VRLA batteries must be installed in clean, dry areas and away from direct exposure to heat sources such as sunlight. The optimal operating temperature range for VRLA batteries is between 68°F (20°C) and 77°F (25°C). The actual operating temperature range can be as wide as -40°F (-40°C) to 140°F (60°C). Please consult the battery's data sheet for its specific operating temperature range.

- Ventilation**

Although VRLA batteries release minute quantities of gas during normal operations (the recombination efficiency is >99%) they must not be installed in airtight enclosures. The battery enclosure is acceptable as long as it affords normal ventilation that is sufficient to keep the batteries cool and prevent the accumulation of hydrogen gas in case the charger inadvertently overcharges the batteries. Finally, all batteries must be installed in accordance with not only the manufacturer's recommendations but must also comply with all relevant local, state and federal regulations.

- Torque**

It is extremely important to make sure all inter-battery or inter-cell connectors are torqued to the manufacturer's recommended setting, as shown in Table 1. A loose connection can cause problems such as incorrect charge voltage at the battery terminals, cable overheating and unnecessary voltage drops due to higher connection resistance.

Terminal	Torque	
	N-m	In-lb
M5-F	6±1	53.4±8.9
M6-F / M6-M	8±1	71.2±8.9
M8-F	10±1	89.0±8.9

Table 3: Recommended torque values

### 4. Charging

- Float voltage**

The float charge voltages for the various VRLA battery families at 77°F (25°C) are shown below, along with the maximum recommended charge currents and the temperature compensation coefficients. Note that the compensation coefficient is inversely related to the temperature – charge voltage must be lowered when the temperature rises and raised when the temperature drops. Table 4 below shows the recommended float charging parameters.

- Equalizing charge voltage**

The equalize charge voltages for the various VRLA battery families at 77°F (25°C) are shown in the following table. Equalize charging should be used when batteries have been on open circuit for an extended period of time and need freshening. (2-3 months or longer, less than 2.13VPC and/or have a battery to battery voltage differential of 0.05VPC or greater). The equalizing charge voltages listed in Table 4 should be limited to 16 hours.

**The charge current for both float and equalizing charge must be limited to its C<sub>5</sub> (in amps) to 1.75 VPC.**

Models	Volts per cell (VPC) at 77°F (25°C)		Temperature Compensation
	Float	Equalize	
FM / GFM / TT / NDT	2.25–2.27	2.35–2.40	±3mV/cell/°C (±1.7mV/cell/°F)
HRL	2.25–2.27	2.35–2.40	±3.6mV/cell/°C (±2mV/cell/°F)
<b>HTB</b>	<b>2.24 VPC at 95°F (35°C)</b>	<b>2.30 VPC at 95°F (35°C)</b>	<b>±3mV/cell/°C variation from 35°C</b>
NPL / HTBF / UDS / CLP	2.25–2.27	2.35–2.40	±3mV/cell/°C (±1.7mV/cell/°F)
EOS	2.25–2.27	2.35–2.40	±3.6mV/cell/°C (±2mV/cell/°F)

Table 4: Voltage, current and temperature compensation

- Ripple current**

Since ripple currents are damaging to batteries and shorten their life we recommend limiting the ripple content of the charger to 0.5% RMS and 1.5% peak-to-peak of the float charge voltage.

### 5. State of charge (SOC)

The SOC of a battery can be determined by measuring its open circuit voltage (OCV) using a high quality digital voltmeter. The battery must have been at rest preferably for 24 hours (but for no less than 8 hours) before an OCV reading is taken. Table 5 shows the relationship between SOC and OCV. **Batteries must be recharged once every 6 months during cooler months and every 3 months during warmer months, or when the OCV drops to 2.10 VPC, whichever occurs earlier.** See Section 2 above for more details.

Volts per cell (VPC)	State of charge (SOC)
2.12V or higher	100%
2.09 – 2.10V	80%
2.05 – 2.08V	60%
2.01 – 2.04V	40%
1.97 – 2.00V	20%

Table 5: Relationship between SOC and OCV

### 6. Battery discharge

Batteries should not be overdischarged as it is detrimental to its life expectancy. To prevent an overdischarge the end of discharge voltage (EODV) must be limited to a value based on the discharge rate. A low voltage cutoff should also be included in the load circuit to prevent an accidental overdischarge. MPINarada data sheets are formatted to show only acceptable discharge rate – EODV combinations. Narada does not recommend discharging cells to under 1.60 VPC and no longer than 15 min.

Two other factors are relevant when discussing battery discharges. First, batteries must not be left in a discharged state, and must be charged immediately after a discharge. Second,

MPINarada battery discharge rates are given for a reference temperature of 77°F (25°C). At temperatures above the reference the capacity increases at the expense of life, while at temperatures below the reference capacity diminishes and extends battery life. Please refer to industry standard IEEE 1188 for more information on the effect of temperature on battery capacity.

### 7. Maintenance and record keeping

MPINarada VRLA batteries do not require periodic watering. However, for optimum life and performance they must be kept clean; cleaning should be done with only a damp cloth, avoiding the use of any organic solvents. Below are the recommended maintenance procedures.

- **Monthly maintenance (Recommended)**

- ✓ Keep battery room /site clean.
- ✓ Check each battery for cleanliness and look for signs of damage due to overheating, particularly at and around the terminals and on the cables.
- ✓ Record battery room /cabinet ambient temperature.
- ✓ Measure and record the total string float voltage and float charge current at the closest point to the battery or battery string termination. The string voltage should read ( $N \times \text{Recommended float voltage}$ ), where  $N$  is the number of cells in the series string.

- **Quarterly maintenance (Recommended)**

- ✓ Perform monthly maintenance procedures
- ✓ Measure and record voltage of each individual on-line battery/cell of the string. If more than two cells or batteries vary by more than 0.10 VPC (13V and 6.5V for a 12V and 6V battery, respectively) equalize the string as noted in the Section 4 on equalizing charge. If the problem exists the batteries may be given the yearly maintenance noted below.

- **Annual maintenance (Required)**

- ✓ Perform quarterly maintenance procedures
- ✓ Check all connections for looseness and retorque them as necessary.
- ✓ Conduct a load test to 30-40% depth of discharge (DOD), or perform an impedance /conductance /resistance test to verify battery change from Baseline or Reference.

- **3-year maintenance (Recommended)**

- ✓ Perform quarterly maintenance procedures
- ✓ Check all connections for looseness and retorque them as necessary.
- ✓ Conduct a load test to 80% DOD or perform an impedance/conductance /resistance test to verify battery system capacity.

All of the records should be carefully kept in a logbook as MPINarada will require all maintenance records in the event of a warranty claim. The logbook should also record any unusual activity such as power outages, rectifier/UPS alarms, etc.

### After sales service

North America:  
MPINarada  
44 Oak Street, Newton, MA 02464  
Tel: 800-982-4339  
www.mpinarada.com  
sales@mpinarada.com

China:  
NARADA POWER SOURCE CO.,LTD.  
No.459 Wensan Road, Hangzhou, Zhejiang, P.R.China  
Tel: +86-571-28827013 Fax: +86-571-85126942  
www.en.naradapower.com  
intl@narada.biz