

Integrating KiloVault LiFeP04 batteries with Conext XW+ Systems

Overview:

This case study will provide information about configuring Conext XW+/Conext MPPT80 settings. Also covered will be the setup and use of Conext Battery Monitor to provide basic information regarding battery voltage, current, temperature (not at cell level) and SOC%.

Note: The Conext Battery Monitor will not act as a BMS, as this function is built into each battery.

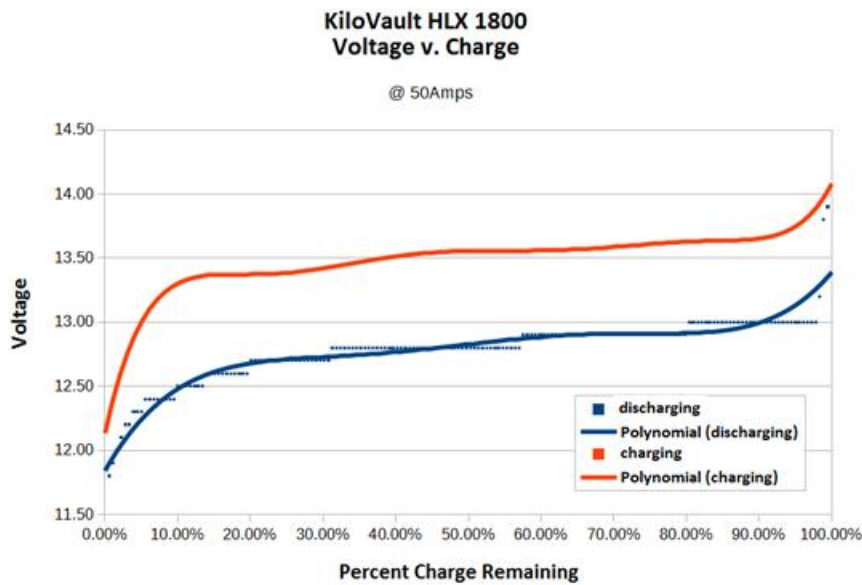
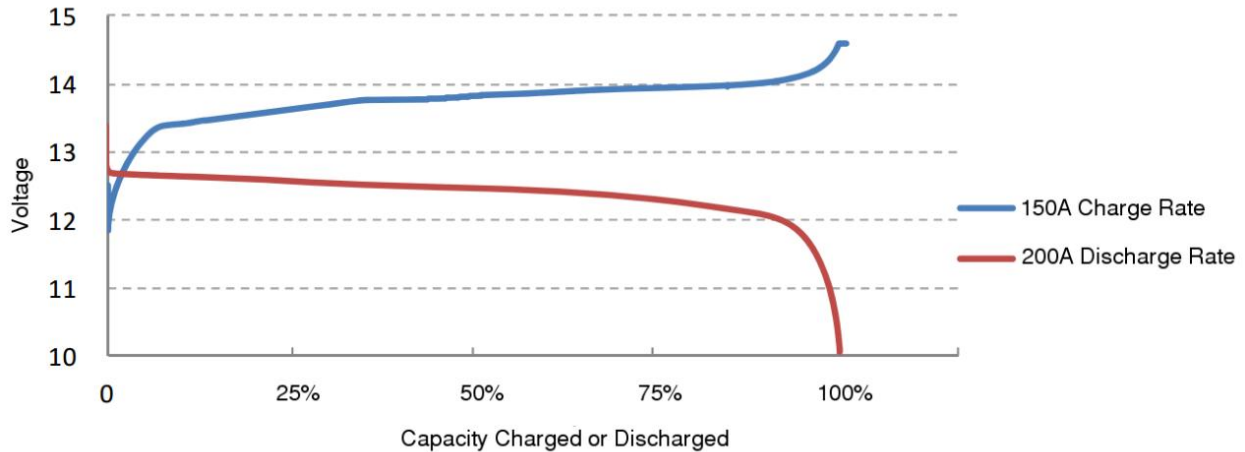
Definition of Drop-in Replacement for Lead-Acid:

When Li-ion or advanced batteries are designed to operate as a drop-in replacement for lead-acid batteries, the cell configuration and packaging is designed such that the charge setting for the inverter/charger or MPPT charger connected to it needs to be configured only once at installation. Such battery packs are designed with a margin and consideration that aging, state-of-charge and temperature variations will not necessitate any change in charge voltage and maximum charge rate. Often the charging characteristics are configured conservatively, thus simplifying the installation.

KiloVault specifications and characteristics:

HLX Series	1800 HLX	3600 HLX
Rated Capacity	1800Wh	3600Wh
Rated Voltage	12.8V DC	
Nominal Amp-Hour Capacity	150Ah	300Ah
Optimal Charger/Inverter Settings		
Bulk/Absorption Voltage	14.1V recommended (14.0 - 14.2V acceptable)	
Float Voltage	13.8V recommended (13.4 - 14.0V acceptable)	
Low Voltage Inverter Cut-off	12.0V	
Equalization	Disable. Do not use. Battery will shut down into protection mode.	
Maximum Cut-Off Voltage	14.6 ±0.2V	
Minimum Cut-Off Voltage	11.5V	
Continuous Discharge Current	150A	
Maximum Discharge Current	150A (continuous)	200A for 30 mins, 150A (continuous)
Peak Discharge Current (<3 secs)	500A	
Standard Charge Current	100A	
Maximum Charge Current	150A	
Dimensions	19.1in x 6.7in x 9.4in (485mm x 170mm x 240mm)	20.5in x 10.6in x 8.7in (520mm x 269mm x 220mm)
Battery Weight	41.7 lbs (18.9kg)	84.4 lbs (38.3 kg)
Shipping Weight	45.2 lbs (20.5kg)	103.4 lbs (46.9 kg)
Terminals	Stainless Steel M8-1.25 x 12 mm Bolts	
Operating Temperature Range	Charging: 32 - 113°F (0 - 45°C) Discharging: -4 - 140°F (-20 - 60°C)	
Optimal Temperature Range	59 - 95°F (15 - 35°C)	
Temperature Protection		
Low Temp. Charge Protection	32°F (0°C) with protection release at 39°F (4°C)	
Low Temp. Discharge Protection	-4°F (-20°C) with protection release at 14°F (4°C)	
High Temp. Charge Protection	149°F (65°C) with protection release at 122°F (50°C)	
High Temp. Discharge Protection	149°F (65°C) with protection release at 122°F (50°C)	
Over Current Protection		
Delay until cutoff @255A	4-6 minutes	
Delay until cutoff @400A	5-6 seconds	
Time until protection is released	8 seconds after load is disconnected	
Self-Discharge Rate	≤2% per month	
Normal Self-Discharge Current	≤20mA	
Estimated # of Cycles Until 80% of Rated Watt-Hour Capacity Remains	2000 cycles @ 100% Depth of Discharge 5000 cycles @ 80% Depth of Discharge	
Voltage Configurations	12, 24, 36 or 48V	
Maximum Configuration	Up to 4 parallel strings of 4 series batteries (16)	
Battery Management System	Monitors and optimizes charge & discharge for each cell, provides overcharge, over discharge, temperature and short circuit protection	
Maximum Time Between Charges	6 months	
Warranty	3 Year Manufacturer Defect Free	
Monitoring	Wireless on-site battery status monitoring (optional)	

For the following graphs, multiply voltage times 2 for a 24V bank and times 4 for a 48V bank.



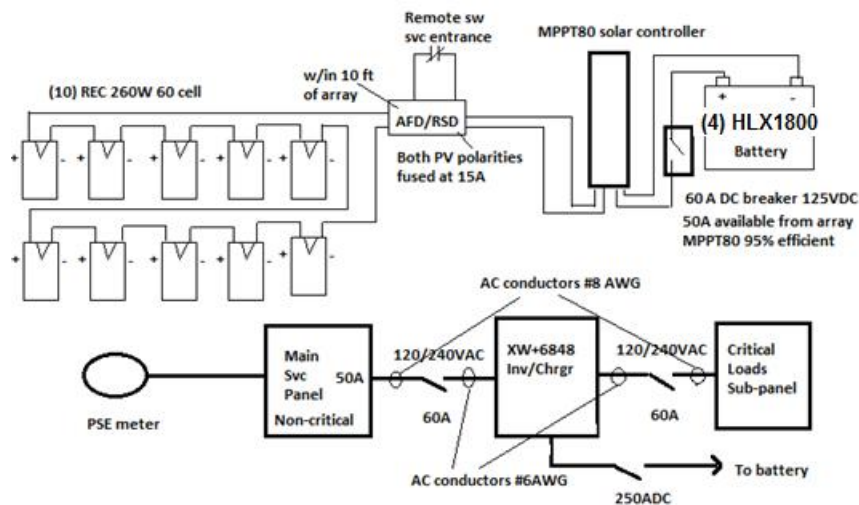
As can be seen, the battery voltage remains somewhat flat throughout most of the SOC% range. Also, charge/discharge voltage hysteresis is less than that of lead acid chemistries, which may require different settings adjustments according to desired system behavior. These settings may include but are not limited to Grid Support Voltage, LBCO, HBCO, Recharge Volts and Max Sell Amps.

Case Study

System consists of:

- (1) XW+6848
- (1) MPPT80
- (1) SCP
- (1) Conext Battery Monitor
- (1) Combox
- (1) AGS
- (4) HLX1800 batteries were configured in series for a 48V nominal battery bank.

1-line diagram



Observations

Batteries received were 78% SOC, a result of self-discharge. A 12V battery charger was used to bring each battery to 100% SOC before connecting in series.

It is recommended to energize XW+ with battery power before energizing the MPPT80 to avoid nuisance-tripping the internal BMS in the HLX1800 battery. Even if the BMS trips, it should reset within 1 minute.

XW+ system is set up for net metering and Load Shave is set between 6P to 10A. The XW+ will “look” for a dip in battery voltage when selling so it knows the maximum PV supply has been reached. Since LFP voltage is stiff throughout most of the range of SOC, the XW+ may sell beyond what the PV can supply unless Max Sell Amps is limited to maximum PV watts divided by 240V. For example, the maximum expected PV for this system is 2400W, so Max Sell Amps is limited to 10A. For this reason, Enhanced Grid mode is not recommended for LFP.

Settings used for this system:

XW+ Settings

Inverter	Enabled
Search Mode	Disabled
Grid Support	Enabled
Charger	Enabled
Low Batt Cut Out	48 v
LBCO Delay	2 s
LBCO Hysteresis	5 v
High Batt Cut Out	59 v
Search Watts	n/a
Search Delay	n/a
Batt Type	Custom
Eqz Support	Disabled
Eqz Voltage	n/a
Bulk Voltage	56.4 v
Absorb Voltage	56.4 v
Float Voltage	n/a
Batt Temp	1 mV/C

Comp	
Batt Capacity	150 Ah
Max Chg Rate	35%
Charge Cycle	2-Stage
Default Batt Temp	n/a
ReCharge Volts	50 v
Absorb Time	10 Min
ChgBlockStart	12:00am
ChgBlockStop	12:00am
Grid Support Volts	54.5 v
Sell	Enabled
Max Sell Amps	10 a
Load Shave	Enabled
Load Shave Amps	0 a
LoadShaveStart	6:00pm-10:00am
LoadShaveStop	6:00pm-10:00am
SellBlockStart	6:00pm-10:00am
SellBlockStop	6:00pm-10:00am

MPPT80 Settings

Batt Type	Custom
Eqlz Support	Disabled
Eqlz Voltage	n/a
Bulk Voltage	56.4 v
Absorb Voltage	56.4 v
Float Voltage	54 v
Batt Temp Comp	1 mV/C
Batt Capacity	150 Ah
Max Chg Rate	100%
Charge Cycle	3-Stage
ReCharge Volts	54 v

Absorb Time	10 Min
Default Batt Temp	n/a
Batt Voltage	48 v

Battery Monitor settings

Capacity	150 Ah
Discharge Rate	1 Hour
Nominal Temp	22 C
Shunt Amps	500 Amps
Shunt mV	50 mV
Self Disch	3% / Month
Discharge Floor	0.00%
Float Volt	55 v
Float Amps	1%
Auto Sync Time	120 Sec
Temp Unit	Celsius
Peukert Expo	1
Charge Eff	Auto
Temp Coeff	0.01%
Sync Sensitivity	5%
Time Rem Filter	Faster

Graphs:



After one week of testing at the above settings, battery SOC maintained within 3% as accessed thru mobile device with highest SOC at 99%, lowest at 96%.

Combox graphs were consistent within 2-3% of individual battery SOC. Setting a higher Grid Support voltage (55.5V) to obtain a higher SOC only resulted in a greater discrepancy between SOC with highest battery voltage above the recommended value.

Individual batteries reported SOC/voltage as follows:

056 = 99% at 13.6V
044 = 100% at 13.6V
067 = 96% at 13.8V
105 = 100% at 14.4V

At partially discharged state (no load), battery voltage is constant however this is to be expected in the middle of SOC range. SOC/voltage as reported by each battery is:

056 = 58% at 13.2V
044 = 58% at 13.2V
067 = 54% at 13.2V
105 = 58% at 13.2V