

Multi RS Solar 48/6000 with a single MPPT tracker Smart LiFePO4 48V 2 x 25.6V 200Ah-a Lynx Smart BMS Lynx Distributor Cerbo GX Touch 70.

What is this drawing about ?

This drawing can be used as a basic plan and as an example to setup off-grid solar applications where AC power is required for 230V/50Hz AC.

This Victron system works as follows:

This system has been built around the Multi RS Solar 48/6000 with 2 x 200Ah 24 Volt series connected Li batteries resulting to 48V 200Ah total battery capacity. Protection of the Li batteries from a charge and discharge point of view is in good hands with use of the Lynx Smart BMS. The Multi RS Solar is able to charge the batteries from 3 Power sources: AC Grid power, the built in MPPT tracker, and by using the AC output from a separate connected PV inverter.

There are two charge possibilities available in this drawing:

1. AC Grid Power that will enable the 6kVA Multi RS Solar to charge with about 88 Amps towards the Li batteries.
2. DC Solar Power that will enable the built in MPPT tracker to charge with about 80A towards the Li batteries. The total Charge capacity depends on the size of the installed Solar array.

Charge combinations of the two above mentioned possibilities also are possible with a maximum combined total of 100A (DC).

There are no DC Loads or users like lights, pumps, and so on connected in this drawing, but that can also be made possible as there are main fuses free in the Lynx Distributor for this.

AC Power will be available from the 6kVA Multi RS Solar Inverter/Charger the moment it has been switched on. This means that without any AC power on the input, the Multi RS will give you 6kVA of inverter power on AC OUT-1. The moment AC Power is available on input AC IN of the Multi RS, AC Power will be used to charge the batteries and also is available for loads connected to AC OUT-1 and AC OUT-2. The second AC output AC OUT-2 is live only when AC power is available on AC IN of the Multi RS.

With use of the Cerbo GX one can adjust the available AC Grid power to the maximum AC current the Multi RS will use and this is where the Power Assist function comes into play.

Power Assist supplements AC inverter power to (for instance) a limited Grid power connection when needed.

All information about the system and its connected Victron devices are clearly visible on the GX Touch 70 Screen that is connected to the Cerbo GX. All AC Input power and AC Loads are clearly visible as well. Here you can monitor the state of charge (SoC) from your Li batteries.

You can also exactly see what discharge current runs away and what charge current comes into the batteries from the AC charger of the Multi RS and the MPPT of the Multi RS.

You can then rest assured that you are in control of your AC and DC power availability.

More info about the system and its individual Victron parts used in this installation are explained in more details down below.

This is how the system has been setup: Around the Victron Lithium Batteries 25.6V Smart, Battery Main fuse and Main switch and the Lynx Distributor (Dip switch Pos-A)

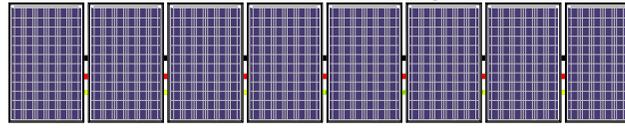
Both 200Ah 24 Volt Li batteries are series connected resulting to 48V 200Ah total battery capacity. Positive power from the Lowest visible Li battery runs to a Mega Main fuse holder with a 250A fuse inside. From the main fuse holder positive power runs further to a Victron Main switch and

Multi RS Solar Array

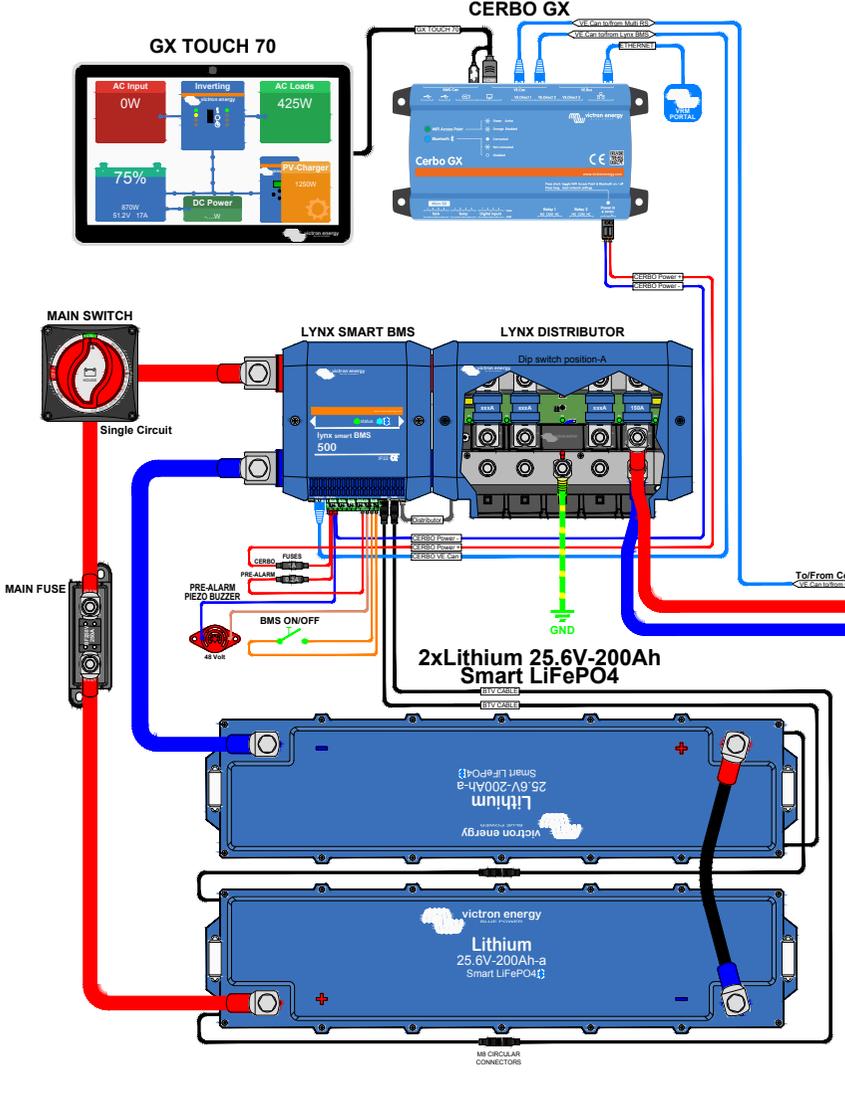
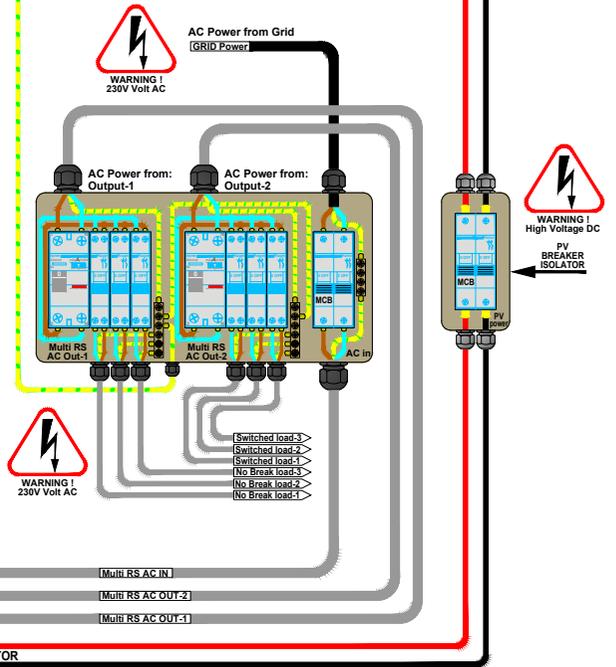
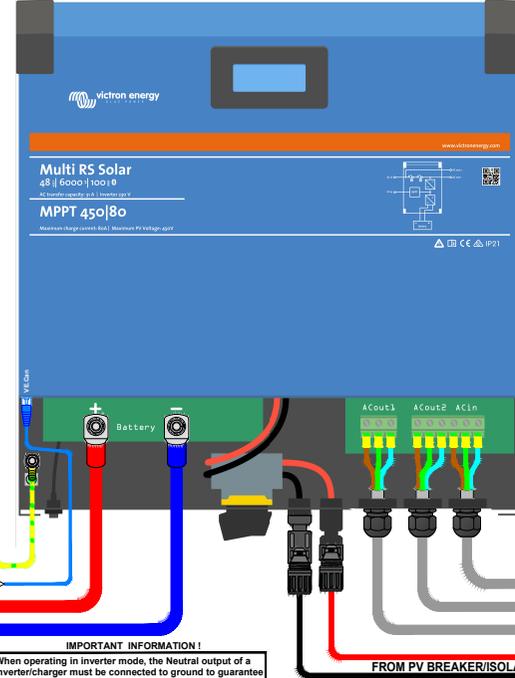
IMPORTANT INFORMATION !
Solar array configuration setup info-1
When the RS MPPT switches to float stage it reduces the battery charge current by increasing the PV Power Point voltage. The maximum open circuit voltage of the PV array must be less than 5 times the minimum battery voltage when at float. For example, where a battery has a float voltage of 54.0 volts as with the batteries used in this drawing, the maximum open circuit voltage of the connected array cannot exceed 432 volts. Where the array voltage exceeds this parameter the system will give a "Over-charge Protection" error and shuts down. To correct this, simply reduce the PV voltage by removing a panel from the Array string.

Solar array configuration setup info-2
The Multi RS Solar contains multiple PV input connectors. However these are internally connected to one single Maximum Power Point Tracker. It is recommended that the connected strings are made with the same number and type of panels. The max operational input current for the MPPT is 15A.

IMPORTANT INFORMATION !
Solar array configuration setup info-3
The Multi RS Solar has a built in AC PV inverter detection system. When feedback is detected of AC PV power on the AC-output side, frequency shift will automatically be enabled. While no further configuration is required, it is important that the AC PV inverter is configured correctly to respond to a rising frequency adjustment by reducing its output. Be aware of the 1:1 rule of any AC PV inverter size to the Multi RS size, and minimum battery sizing applies. More information about these limitations are available in the Victron AC Coupling manual, and this document is required reading if using any AC PV inverter. More info is available in the Multi RS manual and on the website.

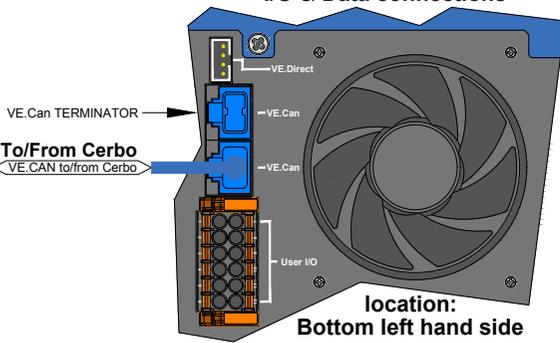


Multi RS Solar 48/6000

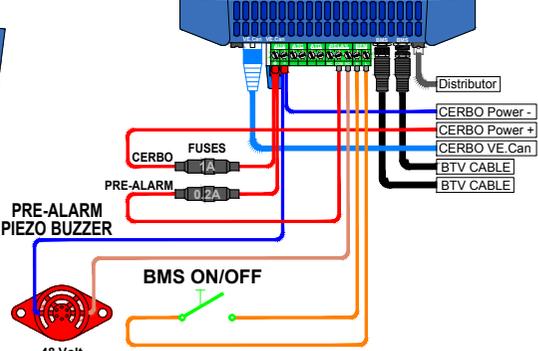


IMPORTANT INFORMATION !
When operating in inverter mode, the Neutral output of an inverter/charger must be connected to ground to guarantee proper functioning of a GFCI or RCD device. In case of a split phase supply the Neutral also must be grounded.

Multi RS Solar enlarged I/O & Data connections



Lynx Smart BMS Enlarged connections



IMPORTANT INFORMATION !
Recommended AC Out-1 cable/breaker size Multi RS
With Power assist the Multi RS Solar can add 6kVA to the output load when needed. Together with the adjustable 30A input this all adds up to the max sum of input and output current of 30+25=55A. An Earth leakage device with breaker or a combination MCB/RCD must be installed on the output. Cable size must be adjusted accordingly.

IMPORTANT INFORMATION !
Recommended AC Out-2 cable/breaker size Multi RS
AC Out-2 only is available when power is present on AC IN and AC Out-2 supports up to 32A similar to the maximum connected AC IN power source as they are internally connected. An Earth leakage device with breaker or a combination MCB/RCD must be installed on the output. Cable size must be adjusted accordingly.

IMPORTANT INFORMATION !
Recommended DC cable/fuse size Multi RS Solar
0-2 m cable length: 35S0mm, 2-5 m cable length: 79S0mm. When used in closed conduits, cable size should double. Cable length stands for the distance between the batteries and the Multi RS connections !!! Recommendations are without other loads in the system and these also should be taken into account for proper main battery, main fuse & main switch cables !!! Fuse size should be 125-150A.

IMPORTANT INFORMATION !
Recommended AC IN cable/breaker size Multi RS Solar
AC IN must be protected by a circuit breaker rated at 30A max or less. This depends heavily on the size of the connected power source. The input current must be adjusted to fit the size of the connected power source. The breaker and cable size for AC IN should be adjusted accordingly.

User I/O functions Multi RS

I/O Number	Connection	Description
1	RELAY_N0	Programmable relay Normally Open connection
2	AUX_N0	Common negative for programmable auxiliary outputs
3	AUX_N1+	Programmable auxiliary output 1 positive connection
4	AUX_N2+	Programmable auxiliary output 2 positive connection
5	RELAY_C0	Remote On/Off connector Low or ATC connection with SmartBMS
6	RELAY_C1	Remote On/Off connector High or ATD connection with SmartBMS
7	RELAY_C0M	Programmable relay Normally Closed connection
8	RELAY_C0M	Programmable relay Common negative
9	TSENSE+	Temperature sensor positive
10	TSENSE-	Temperature sensor negative
11	VSENSE+	Voltage sensor positive
12	VSENSE-	Voltage sensor negative

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from the Main switch Positive power continues to the Positive battery power connection of the Lynx Smart BMS. Negative power from the top visible Li battery runs to the Negative battery power connection of the Lynx Smart BMS.

A Lynx Distributor is an easy to use and connect DC distribution system. It can hold 4 Mega fuses and one of them is in use here. It is important to always start with connecting the negative cable first before connecting the positive for each distribution position. Read the manual for additional information.

1. The first fuse position at the left hand side of the Distributor holds a spare fuse together with its lower positioned negative spare connection.
2. The second fuse position of the Distributor holds a spare fuse together with its lower positioned negative spare connection.
3. The third fuse position of the Distributor holds a spare fuse together with its lower positioned negative spare connection.
4. The fourth fuse position of the Distributor holds a 150A fuse together with its lower positioned negative connection for the Multi RS. Keep the distance between Distributor Fuse-4 for the Multi RS, and the negative Multi RS connection as short as possible. Read the Multi RS manual carefully to proceed further.

Lynx Smart BMS:

The Lynx Smart BMS is connected directly to the left hand side of the Lynx Distributor. The BMS is the controlling safety heart of the system as this device protects the LiFePO4 batteries against over Voltage, under Voltage and high temperature. The Victron Lithium Batteries 25.6V Smart have an integrated Balancing, Temperature and Voltage control (acronym: BTV) and connect to the BMS with two M8 circular connector cable sets. The BTV's of several batteries can be daisy-chained like in this drawing with 2 series connected batteries. When cables are not long enough, extensions cables are available in several lengths from your Victron dealer which will suit your purpose. A shunt has been built inside this BMS in the negative connection bus. This shunt is needed to measure what the charge/discharge current is for all connected batteries. The protective part of the BMS for the Li batteries is called ATC (Allow To Charge) and ATD (Allow To Discharge) and this happens through two potential free contacts called ATC and ATD. You can see all these connections clearly in the enlarged part of the Lynx Smart BMS at the bottom left of the drawing next to the batteries. Power for these contacts to control external equipment can be taken from the Aux positive and Negative power connections through a fuse. No ATC or ATD wiring is needed in this drawing.

Power for the Cerbo has to be connected as follows: from the BMS Aux + contact towards a 1A fuse. From the fuse to the positive power connection of the Cerbo and from the BMS Aux - contact to the negative power connection of the Cerbo.

The BMS can generate a Pre-Alarm signal to warn of an imminent Cell under-Voltage with use of the Relays contacts. By using a Pre-Alarm Piezo Buzzer as shown in the drawing, the buzzer will sound and this will give you about 30 seconds to start a charge or to switch off devices preventing a load disconnect.

Power for the Buzzer comes from the Aux + and Aux - connections and positive power has to be connected through a 0,2 A fuse towards the relays COM Connection. From the relay NO connection Positive power (brown wire) should be connected to the positive connection of the Buzzer. The negative connection of the Buzzer comes from the Aux-.

Instead of a wire bridge you can install a small BMS ON/OFF switch connected to the BMS Remote-H and Remote-L connections as shown in the drawing. You can decide whether or not to use this switch. If you decide to use the BMS ON/OFF switch, make sure to mount it away/out of sight from little kid's hands otherwise you might be in the dark quite suddenly !

The BMS-Distributor RJ11 cable on the right hand side of the BMS has to be connected to the Distributor. This provides power to the LED PCB for a Distributor and can be daisy-chained from one Distributor to another (if available). These cables transfer data between the Distributor and the BMS about each main fuse status. Dip switches in each distributor need to be set properly to make this work. See settings behind each Distributor header.

Data at Can bus level between the BMS, the Cerbo and the Multi RS has to be connected to a VE.Can port on each device. The VE.Can cable between the BMS, Cerbo and the RS Solar all are normal RJ45 cables. Do not forget to use a terminator at each open VE.Can port at the BMS and the Multi RS. Use the by Victron supplied terminators for this.

The ATC contacts of the BMS will stop connected devices from charging to prevent Cell over-Voltage or a Cell temperature that runs too high. This is not used in this drawing.

The ATD contacts of the BMS will stop connected devices from discharging when the Battery Voltage has decreased below a preset value. This is not used in this drawing.

Other connected Victron devices in this system also need to be controlled from a charge and discharge point of view and this can be achieved through the connected GX device:

- The Multi RS Solar 48/6000 Inverter/Charger will be controlled digitally through the GX device DVCC feature.

Acronym: DVCC stands for: Distributed Voltage and Current Control.

Cerbo GX with GX Touch 70 Display:

The Cerbo GX with its GX Touch 70 Display is visible above the BMS and its Distributor. The Cerbo together with the GX Touch 70 Display is the monitoring heart of your installation showing you what is going on with all connected devices. Monitoring of your installation can be done either with the Cerbo in front of you or from anywhere in the world using an internet connection as shown in the drawing with the Victron VRM portal either using the VictronConnect app or website. The Cerbo also provides Remote Firmware updates and allows settings to be changed Remotely. Whatever you connect to a Cerbo can be made visible on the GX Touch 70 display or with: Remote Console, VRM Dashboard, Advanced VRM Widgets, VRM App Widgets, and VE.Can/NMEA 2000. This all has been clearly explained in the Cerbo manual.

The positive power for the Cerbo comes through a 1A fuse connected to the Lynx Smart BMS AUX connections including its negative as explained with the BMS. The GX Touch 70 Display HDMI connector with attached USB power cable obviously has to go into the HDMI port of the Cerbo and the USB cable directly next to it.

The VE.Can bus cables coming from the Multi RS Solar and from the Lynx Smart BMS both connect to a VE.Can port of the Cerbo. Don't forget that both open VE.Can ports at the Multi RS and the BMS need a terminator in each open Can bus port.

The Ethernet cable and its connector, to connect to the VRM Portal (if available), will go into the Network port of the Cerbo. No VE.Direct cable or VE.Bus cable are necessary in this drawing. These are all the connections you have to make for the Cerbo. There is plenty more you can connect and do with a Cerbo and that all is very well explained in its manual.

Multi RS Solar 48/6000 Inverter/Charger with a MPPT tracker of 450V 80A max:

Below the Solar array with 8 series connected panels you will find the Multi RS 48/6000.

The Multi RS should be mounted in such a way that it can cool itself down properly and the space where it is in should be dry and well ventilated. Free space above and below the device should be at least 30cm. Don't box the device in as this will certainly have a bad effect on its functioning and service life.

Most connections to and from the Multi RS already have been discussed except for the built in MPPT PV connections. It might be a good idea to have them all together here:

DC power to and from the Multi RS connects to the forth fuse position at the right hand side of the Distributor holding a 150A fuse together with its lower positioned negative connection.

Incoming AC Grid power passes through an incoming AC breaker panel towards the Multi RS AC IN connections. AC OUT-1 of the Multi RS is connected to an AC breaker panel and from the breaker panel onward these are NO Break AC outputs and as the name suggests are constantly powered by the Multi RS Inverter.

AC OUT-2 of the Multi RS is also connected to an AC breaker panel and from the breaker panel onward these are switched AC outputs and as the name here suggest are switched off when there

is no incoming AC power available. AC OUT-2 is live only when AC power is available on the input of the Multi RS with a 2 minute connect delay.

The AC breaker panels like AC OUT-1, AC-OUT-2 and AC IN need to be seen as an example. It is however very important that combination MCB/RCD or GFCI breakers are installed on each output of the Multi RS before connecting to a row of specific sized breakers for users. Also check the local requirements for this !

The Multi RS Solar in this drawing is a single tracker model that contains multiple PV input connectors. However these are internally connected to one single Maximum Power Point Tracker. It is strongly recommended that the connected strings are made with the same number and type of panels. The maximum total operational input current is 18 A.

DC power from the solar array first passes through a PV breaker/Isolator and then connects to the MC4 PV input connections of the Multi RS PV+ and PV-. The size of the PV breaker/Isolator depends on the total size of the solar array. The PV breaker/Isolator will also help to connect the Multi RS MPPT PV inputs in a safe and responsible way.

WARNING: Do not underestimate the power coming from a solar array. These DC Voltages can easily go up to 450V and are absolutely lethal !!!

The Multi RS MPPT PV inputs are protected against reverse polarity, to a maximum short circuit current of 20 A. *Connecting PV arrays with a higher short circuit current is possible, up to an absolute maximum of 30A, as long as connected with correct polarity. This outside of specification potential allows for system designers to connect larger arrays, and can be useful to understand in case a certain panel configuration results in a short circuit current just slightly above the maximum of the reverse polarity protection circuit.*

When the Multi RS MPPT switches to float stage it reduces the battery charge current by increasing the PV Power Point voltage. The maximum open circuit voltage of the PV array must be less than 8 times the minimum battery voltage when at float.

For example, where a battery has a float voltage of 54.0 volts, the maximum open circuit voltage of the connected array cannot exceed 432 volts. Where the array voltage exceeds this parameter the system will give a "Over-charge Protection" error and shut down. To correct this, either increase the battery float voltage, or reduce PV voltage by removing PV panels from the string to bring the voltage back within specification.

The Multi RS has two VE.Can connections:

One is used for the Cerbo and the other open port needs a terminator.

The VE.Direct port and the User IO ports are not in use here.

In a fixed installation like in this drawing, an uninterruptible grounding can be secured with the grounding wire of the AC input. It will however be good practice to ground the casing of the Multi RS to the PE/Ground Busbar in the AC Distribution panel as well, as is visible in this drawing. The Case Ground cable should be able to carry the full combined ground current of the AC input (30A) plus the inverter (25A)=55 A.

This is the maximum throughput current towards the loads the Multi RS can handle.

Be aware that local rules may require alternative AC ground configurations.

The Multi RS itself will test for sufficient resistive isolation between PV+ and GND, and PV- and GND. In the event of a resistance below the threshold (indicating an earth fault), the unit will stop charging and display the error.

Ground the Frame of the PV array to local requirements.

When in doubt about how to continue with the ground connections, consult your Victron dealer. Read the Multi RS manual carefully to proceed further.

Software settings for all shown Victron devices in this drawing:

- When setting up a new system, it will be good practice to update all Victron devices to the latest available Software/Firmware.
- The two Victron LiFePO4 25,6V 200Ah Smart batteries can be set, monitored and updated with use of the VictronConnect App.
- The Victron Cerbo GX Device can be updated to the latest Firmware in two different ways:
 - 1 - Update it via the internet, either manually or let it check for new updates every day.
 - 2 - Update it from a microSD-card or USB-stick. Check the Cerbo manual for this.
- The Victron Lynx Smart BMS can be set, monitored and updated with use of the VictronConnect App.
- The Victron Multi RS Solar 48/6000 can be set, monitored and updated with use of the VictronConnect App (Multi Platform).

Wiring Calculations:

There are no wire sizes visible in this drawing and there is a good reason why this is not available in any drawing on the Victron website. We at Victron do not know what the physical size of your project is and it therefore will be impossible to give you specific wire sizes that will fit your setup. But there is a very handy tool available from Victron called Victron Toolkit for Android and iPhone users. In this app you will find Cable Calc that will help you size any cable for AC and DC. This will help you find all the right cable sizes for your project.

Wiring Unlimited:

This is a book freely available for downloading from the Victron Website. This book is all about electrical wiring for systems containing batteries, inverters, charger, inverter/chargers and so on. With this book Victron aims to explain wiring basics of electrical systems. This book helps to explain the importance of ‘getting it right’ and the issues that might happen when a system has inferior wiring. It also assists electrical installers or users to troubleshoot issues that have arisen from bad wiring. This book will certainly help to get it right and to make sure proper conclusions can be drawn for the electrical systems its readers are involved with.

Using the Victron-Remote-Monitoring / VRM app or website:

Monitoring of your installation can be done either with the Cerbo in front of you or from anywhere in the world using an internet connection as shown in the drawing with the Victron VRM portal either using the VictronConnect app or website. Just login to your VRM account or setup a new one and tap on your account to view your installation. You can for instance set alarm status information for the state of charge or SoC and this will automatically warn you when a certain level has been reached. This is extremely useful during periods of absence and..... it is free of charge ! For more info read the latest available VRM manual. The VRM app is available for Android and iPhone users.

To keep communication of your system going with use of the VRM app or website, you do need an Internet connection to make this work and Victron also has a solution for this with for instance the GX LTE 4G cellular modem. Check it out on the Victron website.

In this drawing you will find the following Victron equipment with some additional material:

Victron Part description	Part No.	Amount	Remark
Battery switch on/off 275A	VBS127010010	1	
BMS Piezo buzzer and on/off switch if needed		Order from your Victron dealer
Breaker box Multi RS PV with DC breaker isolator for solar Array	1	Order from your Victron dealer
Breaker box Multi RS with breakers for AC IN, AC OUT-1 & AC OUT-2	1	Order from your Victron dealer
Cables with M8 circular connector (for Li-ion batteries) Male to Female 3 pole 2 m (bag of 2)	ASS030560200	1	Bag of 2

Victron Part description	Part No.	Amount	Remark
Cerbo GX	BPP900450100	1	
Fuse holder for Mega-fuse between batteries and Lynx Smart BMS	CIP000100001	1	Order fuses from your Victron dealer
Fuse holder 2AG or 5x20mm by Little Fuse including fuses for the Cerbo and the Pre-Alarm	150 series	2	Order on line or from your Victron dealer
GX Touch 70 Display	BPP900455070	1	
LiFePO4 Battery 25,6V/200Ah - Smart-a	BAT524120610	2	
Lynx Smart BMS 500	LYN034160200	1	
Lynx Distributor	LYN060102000	1	
MEGA-fuse 150A/32V (package of 5 pcs)	CIP136150010	1	
MEGA-fuse 250A/32V (package of 5 pcs)	CIP136250010	1	
Multi RS Solar 48/6000-100-450/80	PMR482602000	1	
VE.Can cable: from BMS to Cerbo and from Cerbo to Multi RS Solar 48/6000-100-450/80	2	RJ45 Cable length not known

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