

Multi RS Solar 48/6000 with Dual MPPT trackers in 3 Phase setup with Smart LiFePO4 48V 600Ah-a batteries, a Lynx Smart BMS, Class-T Power In, Distributor and Ekran GX.

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 3 x 230V/50Hz AC single phase and 400V/50Hz 3 Phase.

Differences between Single phase and 3 Phase power usage:

The most important difference between single and 3-phase power is the consistency of the delivery of power. A three-phase power supply can support three times as much power compared to a single-phase power supply, while only needing three or four wires instead of two.

A single-phase power supply will show peaks and dips in voltage and especially when bigger loads are switched on and off where a three-phase power supply delivers power with efficient constant stability. This obviously only counts for 3 phase powered users.

This Victron system works as follows:

This system has been built around 3 x Multi RS Solar 48/6000 connected in 3 Phase configuration with 3 x 200Ah 24 Volt series connected Li batteries resulting to 48V 600Ah total battery capacity. There is room to extend the 600Ah to 800Ah total capacity if needed. Protection of the Li batteries from a charge and discharge point of view is in good hands with use of the Lynx Smart BMS.

Each Multi RS Solar unit is able to charge the batteries from 3 Power sources:

230V AC Grid power per unit, the built in dual MPPT trackers of each unit, and by using the AC output from a separate connected PV inverter per unit (not available in this drawing).

There are two charge possibilities available in this drawing:

1. AC Grid Power that will enable each 6kVA Multi RS Solar to charge with about 88 Amps towards the Li batteries. This can add up to a total charge current of 3x88A or 264A in total.
2. DC Solar Power that will enable the built in MPPT trackers to charge with about 80A towards the Li batteries. The total Charge capacity depends on the size of the installed Solar array, but this can add up to a total charge current of 3x80A or 240A in total.

Charge combinations of the two above mentioned possibilities also are possible with a maximum combined total of 100A (DC) per phase or 300A in total.

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 is a main fuse free in Lynx Distributor-1 for this. If needed an extra Distributor can be installed to Distributor-1 to connect more loads to the system.

Three phase AC Power will be available from all three phase connected 6 kVA Multi RS Solar Inverter/Chargers the moment they all are switched on. This means that without any 3 phase power on the AC inputs, the 3 phase connected Multi RS devices will give you 18kVA of inverter power on the AC OUT-1 connections. The moment 3 phase AC Power is available on the AC IN inputs, AC power will be used to charge the batteries with each Multi RS device and also is available for loads connected to AC OUT-1 and AC OUT-2 in 3 phase connection and individual single phase connection per device. The second AC outputs AC OUT-2 will be live only when AC power is available on AC IN of each Multi RS.

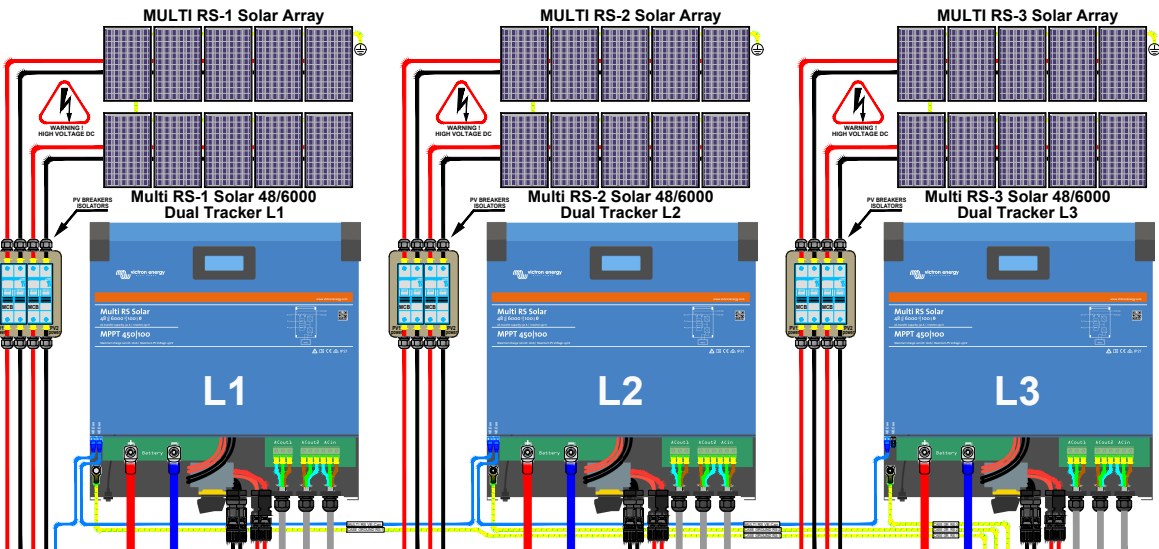
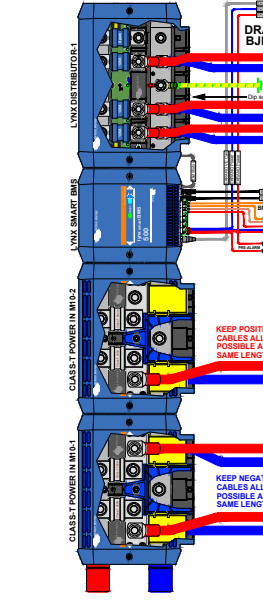
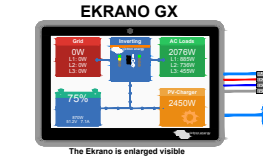
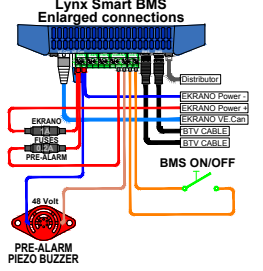
With use of the Ekran GX one can adjust the available AC Grid power to the maximum AC current the 3-phase connected Multi RS units will use and this is where the Power Assist function comes into play. Power Assist supplements AC inverter power to (for instance) a limited Grid power connection when needed.

IMPORTANT INFORMATION!

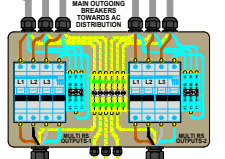
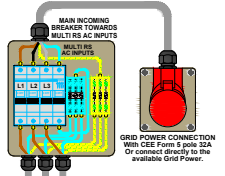
Solar array configuration safety note:
The Multi RS Solar Dual Tracker contains multiple PV input connectors. These are wired to two individual Maximum Power Point Trackers. It is possible to use different panel configurations with the same system for each PV input connector. You should NOT connect the PV array to any other system or to any other PV input connector. The maximum input current per PV input is 15A.

Solar array configuration safety note:
When the RS MPPT switches to float stage it reduces the battery charge current by increasing the PV Power Point voltage. This implies the total current of the PV array must be less than 4 times the maximum battery voltage when at float. For example, when a battery has a float voltage of 54.8V with the batteries used in this drawing, the maximum float current should be less than 14.2A. When the array voltage exceeds this parameter the system will give a "Low Voltage Protection" error and shut down. To correct this, simply reduce the PV voltage by removing a panel from the array string.

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 will be discontinued. While no further configuration is required, it is important that the AC PV inverter is configured correctly as required in a separate document regarding the inverter. Be aware of the 1:1 ratio of any AC PV inverter size to the Multi RS size. Any inverter that is not 1:1 will cause the system to shut down. More information about these limitations are available in the Multi RS User Manual. For more information on the correct wiring of the AC PV inverter, more info is available in the Multi RS manual and on the Victron website.



IMPORTANT INFORMATION!
3 PHASE PROGRAMMING CONFIGURATION SETUP
In order to configure a 3 phase system the Multi RS Solar will need to be correctly configured. The correct configuration is as follows:
1. Set the system to 3 phase in the VictronConnect app.
2. Configure a system for 3 phases in the VictronConnect app.
3. Connect the system to the VictronConnect app.
CAUTION!
The AC output power will be discontinued for a few seconds when switching the system between configurations. Make sure the system is configured BEFORE connecting the inverter AC outputs to the loads.
To set up a 3 phase system, connect to the first unit on VictronConnect, change the system setting to 3 phase, and then select the correct phase for that unit (L1, L2, L3). Further information is available in the Multi RS Solar product manual.



IMPORTANT INFORMATION!
AC Output cable length:
With power applied the Multi RS can use 50VA for 50A in AC Out 1 for peak electrical cable length. The Multi RS can throughput 50A from the AC input directly to the output loads. An Earthing system with a breaker size of 20kVA or more is recommended. The breaker size must be installed on the output of AC Out-1. Cable size should be adjusted accordingly.

IMPORTANT INFORMATION!
AC Out-2 only is available when power is applied on AC In 1 or AC In 2.
AC Out-2 is only available when power is applied on AC In 1 or AC In 2. It supports up to 50A. The Multi RS can throughput 50A from the AC input directly to the output loads. An Earthing system with a breaker size of 20kVA or more is recommended. The breaker size must be installed on the output of AC Out-2. Cable size should be adjusted accordingly.

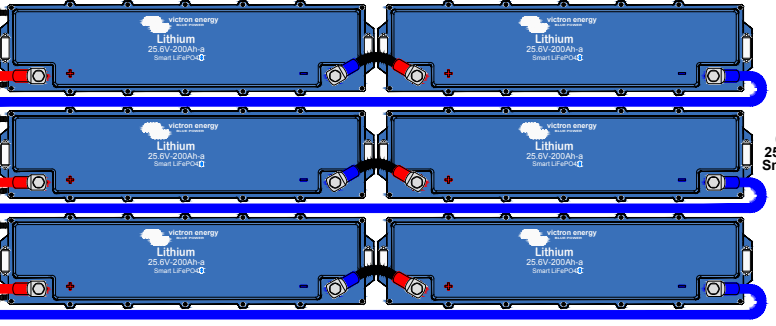
IMPORTANT INFORMATION!
AC In 1 and AC In 2:
The Multi RS can use 50VA for 50A in AC In 1 for peak electrical cable length. The Multi RS can throughput 50A from the AC input directly to the output loads. An Earthing system with a breaker size of 20kVA or more is recommended. The breaker size must be installed on the output of AC In 1. Cable size should be adjusted accordingly.

IMPORTANT INFORMATION!
AC In 2 and AC In 3:
The Multi RS can use 50VA for 50A in AC In 2 for peak electrical cable length. The Multi RS can throughput 50A from the AC input directly to the output loads. An Earthing system with a breaker size of 20kVA or more is recommended. The breaker size must be installed on the output of AC In 2. Cable size should be adjusted accordingly.

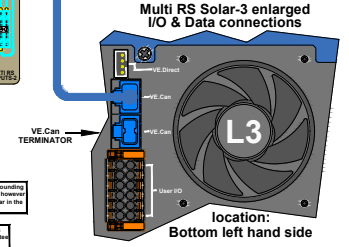
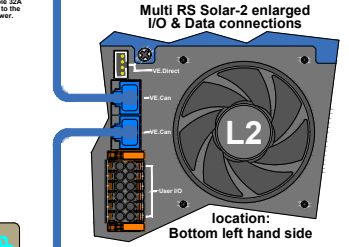
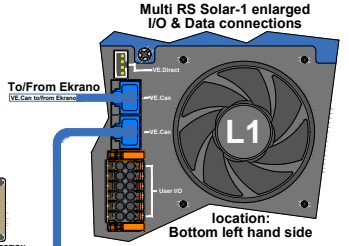
IMPORTANT INFORMATION!
AC In 3 and AC In 4:
The Multi RS can use 50VA for 50A in AC In 3 for peak electrical cable length. The Multi RS can throughput 50A from the AC input directly to the output loads. An Earthing system with a breaker size of 20kVA or more is recommended. The breaker size must be installed on the output of AC In 3. Cable size should be adjusted accordingly.

When adding these 2 extra batteries and when extra loads are connected to the Distributor, update the Lynx Smart BMS to the 1000A model.

Optional 2 x Lithium 25.6V-200Ah-a Smart LiFePO4



6 x Lithium 25.6V-200Ah-a Smart LiFePO4



User I/O functions Multi RS

| ID Number | Connection | Application |
|-----------|-------------------|--------------------|
| 1 | EVANG | Emergency Voltage |
| 2 | PRE-ALARM | Pre-alarm signal |
| 3 | BMS ON/OFF | BMS control signal |
| 4 | VE.Can | Vehicle CAN bus |
| 5 | VE.Can TERMINATOR | VE.Can termination |
| 6 | User I/O | User defined I/O |

All information about the system and its connected Victron devices are clearly visible on the Ekran GX Touch Screen. 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 see exactly how much charge or discharge current is flowing into or out of the batteries from all 3 Multi RS devices including its MPPT's. You can also individually check detailed information from each Multi RS in the Ekran device list.

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 3 x 2 series connected Victron Lithium Batteries 25.6V Smart, and the Class-T power in M10 units 1 and 2.

There are 3 series connected 200Ah 24 Volt Li batteries resulting to 48V 600Ah total battery capacity with room for another series connected row of batteries when needed.

The optional set of batteries is dashed visible.

A Class-T Power In unit is an easy to use and connect DC battery safety system.

Per unit it can hold 2 Class-T fuses and three fuses are in use here. It is important to always start with connecting the negative cable first before connecting the positive for each battery string position. Read the manual for additional information.

1. The first fuse position of the Class-T Power In-1 holds a 225-250A fuse for battery string-1 together with its lower positioned negative connection.
2. The second fuse position of the Class-T Power In-1 holds a 225-250A fuse for battery string-2 together with its lower positioned negative connection.
3. The first fuse position of the Class-T Power In-2 holds a 225-250A fuse for battery string-3 together with its lower positioned negative connection.
4. The second fuse position of the Class-T Power In-2 holds a Spare fuse for battery string-4 together with its lower positioned negative Spare connection.

Lynx Smart BMS:

The Lynx Smart BMS is connected directly to the right hand side of the second Lynx Class-T Power In unit. The BMS is the controlling safety heart of the system as this device protects the LiFePO4 batteries against over Voltage, under Voltage and high or low 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 3 x 2 series connected batteries. When cables are not long enough, extension 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 right above the Ekran. 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 Ekran 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 Ekran and from the BMS Aux - contact to the negative power connection of the Ekran.

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 Distributor-1. 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 or look in the manual.

Data at Can bus level between the BMS, the Ekran and the 3 x Multi RS has to be connected to a VE.Can port on each device. The VE.Can cable between the BMS, Ekran and the 3 x Multi RS Solar all are normal RJ45 cables. Do not forget to use a terminator at each open VE.Can port at the BMS and Multi RS Solar L3. Use the terminators supplied by Victron 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:

- All 3 Multi RS Solar 48/6000 Inverter/Chargers will be controlled digitally through the GX device DVCC feature.

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

Important:

The Lynx Smart BMS 500 can handle 500 Amps. When the optional dashed visible batteries in this drawing are going to be used including a load connected to the Spare fuse of Distributor-1, or a distributor extension, it will be best to use the Lynx Smart BMS 1000 instead of the 500 model.

Lynx Distributor-1 (dip-switch setting-A):

Lynx Distributor-1 is connected directly to the right hand side 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 three of them are 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 of Distributor-1 holds a 125-150A fuse together with its lower positioned negative connection for Multi RS Solar L1.
2. The second fuse position of Distributor-1 holds a 125-150A fuse together with its lower positioned negative connection for Multi RS Solar L2.
3. The third fuse position of Distributor-1 holds a 125-150A fuse together with its lower positioned negative connection for Multi RS Solar L3.
4. The fourth fuse position of Distributor-1 holds a Spare fuse together with its lower positioned negative spare connection.

Keep the positive cables between the fuses and all 3 Multi RS Solar devices at the same length and as short as possible. Keep the negative cables between the negative Lynx Distributor connections and all 3 Multi RS Solar Devices at the same length and as short as possible. Read the Multi RS Solar manual carefully to proceed further.

Ekran GX:

The Ekran GX is visible above the BMS and Distributor-1.

The Ekran 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 Ekran 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 Ekran also provides Remote Firmware updates and allows settings to be changed Remotely.

Whatever you connect to a Ekran can be made visible on its 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 Ekran manual.

The positive power for the Ekran comes through a 1A fuse connected to the Lynx Smart BMS AUX connections including its negative as explained with the BMS.

The VE.Can bus cables coming from the 3 x Multi RS Solar and from the Lynx Smart BMS both connect to a VE.Can port of the Ekran. Don't forget that both open VE.Can ports at Multi RS Solar L3 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 Ekran. No VE.Direct cables or VE.Bus cables are necessary in this drawing. These are all the connections you have to make for the Ekran. There is plenty more you can connect and do with a Ekran and that all is very well explained in its manual.

Multi RS Solar 48/6000 Inverter/Charger with a Dual MPPT tracker of 450V 100A max:

Below the Solar arrays each with 2 rows of 5 series connected panels you will find Multi RS 48/6000 L1, Multi RS 48/6000 L2 and Multi RS 48/6000 L3.

Each Multi RS Solar 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 each device should be at least 30cm. Don't box the devices in as this will certainly have a bad effect on its functioning and service life.

Each Multi RS has a built-in battery monitor. This monitor is needed to measure what the charge/discharge current is per device and this monitor can also be used to program the functionality of the built-in programmable relay (as explained in the manual).

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

The negative connection for each Multi RS L1-L2-L3 should be connected first and in the same following order under Fuse-1 Fuse-2 and Fuse-3 of Distributor-1.

Positive DC power for each Multi RS L1-L2-L3 comes from the Distributor-1 fuses in the same following order Fuse-1 Fuse-2 and Fuse-3 and should be connected last.

3 phase Incoming AC Grid power passes through a 3 phase incoming AC breaker panel towards each Multi RS AC IN connections L1-L2-L3. AC OUT-1 of each Multi RS is connected to a 3 phase AC breaker panel and from the breaker panel onward these are NO Break AC outputs and as the name suggests are constantly powered by all 3 Multi RS Inverters L1-L2-L3.

AC OUT-2 of each Multi RS is also connected to a 3 phase 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 L1-L2-L3 are live only when AC power is available on the input of each Multi RS with a 2 minute connect delay.

The 3 phase AC breaker panels AC OUT-1, AC-OUT-2 and AC IN need to be seen as examples. It is very important that combination MCB/RCD or GFCI breakers are being used on the outputs of each Multi RS before connecting to a row of specific sized breakers for users. Also check the local requirements as this can be setup directly for 3 phase or for single phase usage or a combination of both.

Each Multi RS Solar in this drawing is a Dual tracker model with dedicated PV input connectors for each tracker. This means one PV array per input and these should be completely isolated from each other and can not be mixed. It is possible to use different panel configurations within the specifications for each PV input. The maximum total operational input current per tracker is 13A. The tracker inputs are protected against reverse polarity to a max. short circuit current of 16A.

DC power from each solar array first passes through a PV breaker/Isolator before connecting to the MC4 PV input connections of each Multi RS PV+ and PV-. The size in Amps of the PV breakers/Isolators depends on the total size of each solar array. The PV breakers/Isolators 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 !!!

When a 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 VE.Can connection coming from the Ekrano should be connected to Multi RS Solar L1
The VE.Can connections should be looped through from Multi RS Solar L1 to L2 and to L3.
Don't forget that Multi RS Solar L3 needs a terminator in the open Can bus port.
The VE.Direct ports are not in use here.

Each 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 and send the error signal to the GX device for audible and/or email notification.

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/Firmware 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 6 Victron LiFePO4 25,6V 200Ah Smart batteries can be set, monitored and updated with use of the VictronConnect App. Detailed instructions in the VictronConnect manual.
- The Victron Ekrano GX Device can be updated to the latest Firmware in two different ways:
 - 1 - Update it via the on board WiFi or internet connection, either manually or let it check for new updates every day. Detailed instructions in the VictronConnect manual.
 - 2 - Update it from a microSD-card or USB-stick. Check the Ekrano manual for this.
- The Victron Lynx Smart BMS can be set, monitored and updated with use of the VictronConnect App. Detailed instructions in the VictronConnect manual.
- The Victron Multi RS Solar 48/6000 DT can be set, monitored and updated with use of the VictronConnect App (Multi Platform). 3 phase Configuration of all 3 Multi RS Solar 48/6000 DT's can also be setup with use of the VictronConnect App. Detailed instructions in the VictronConnect manual.

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 Ekran 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 | 3 | |
| BMS Piezo buzzer and on/off switch if needed | | 1 | Order from your Victron dealer |
| Class-T fuse 250A | | 3 | Order on line or from your Victron dealer |
| DC Breaker box Multi RS PV with 2 x DP breaker isolator for solar Arrays | | 3 | Order from your Victron dealer |
| 3 phase AC Breaker box Multi RS with breakers for AC IN | | 1 | Order from your Victron dealer |
| 3 phase AC Breaker box Multi RS with breakers for 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 |
| Ekran GX | BPP900480100 | 1 | |
| Fuse holder 2AG or 5x20mm by Little Fuse including fuses for the Ekran and the Pre-Alarm | 150 series | 2 | Order on line or from your Victron dealer |
| LiFePO4 Battery 25,6V/200Ah - Smart-a | BAT524120610 | 6 | |
| Lynx Smart BMS 500 | LYN034160200 | 1 | Drill out M8 to M10 for Class-T Power In |
| Class-T Power IN M10 | LYN060404010 | 2 | |
| Lynx Distributor | LYN060102000 | 1 | |
| MEGA-fuse 125A/58V (package of 5 pcs) | CIP137125010 | 1 | |
| Multi RS Solar 48/6000-100-450/100 | PMR482602000 | 3 | |
| VE.Can cable: from BMS to Ekran and from Ekran to Multi RS Solar 48/6000-100-450/80 | | 4 | RJ45 Cable length not known |