AC (coupled)-Powerwall System Manual

Edit 2

System developer, designer and owner of the Powerwall: Roland Wukovits

Location: The Hillside Pranburi Resort, Pak Nam Pran, Thailand

Project type: DIY (Do it yourself), Powerwall with AC coupled charging and No-Export-Limited discharge

Warning! To build a system like this, requires to work on household AC with a voltage of up to 250V. You should know what to do and how to protect yourself from electricution! AC-grids vary by country. Be aware, that some components used in my system might not be the right in your situation. If you are not sure, please consult an electrician for verification.

Main Objective: Excessive energy from grid-tied solar, shall be captured stored into a battery bank and used during night time. Power bill shall be reduced through increase of "Behind the meter" consumption.

Secondary Objective: System can as well operate without solar through time based operation

The main functions are provided by a DIY controller, which is on one hand gathering required "Power available" data from a meter via Mod-bus connection, measuring sensor data, calculating variables and switching connected devices to achieve the objectives.

The controller is providing "Home power monitoring" of all phases as a secondary function. Data is stored on the SD-card in 6 minute intervals.

The controller can be as well used with "Zero-Export" limited PV-Systems.

Note:

In this setup, the Powerwall does not provide backup power during a grid-down situation. But it could easily be added to the battery system by simply adding 3 components:

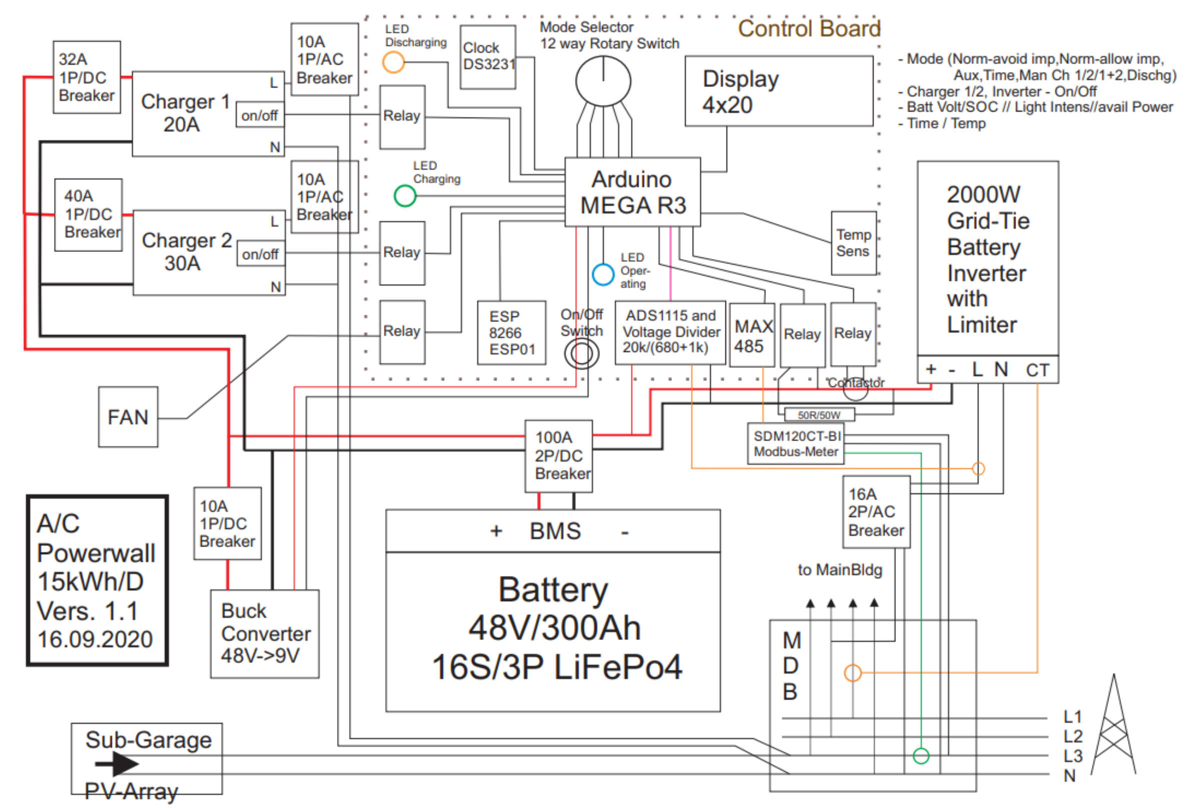
1. a simple off grid inverter connected to the battery bus, covering the essential loads you designate

2. a independent breaker box/ load centre to connect your essential circuits

3. an automatic/manuell transfer switch, feeding the essential loads box either from the grid or the off-grid inverter

System overview:

Schematics:



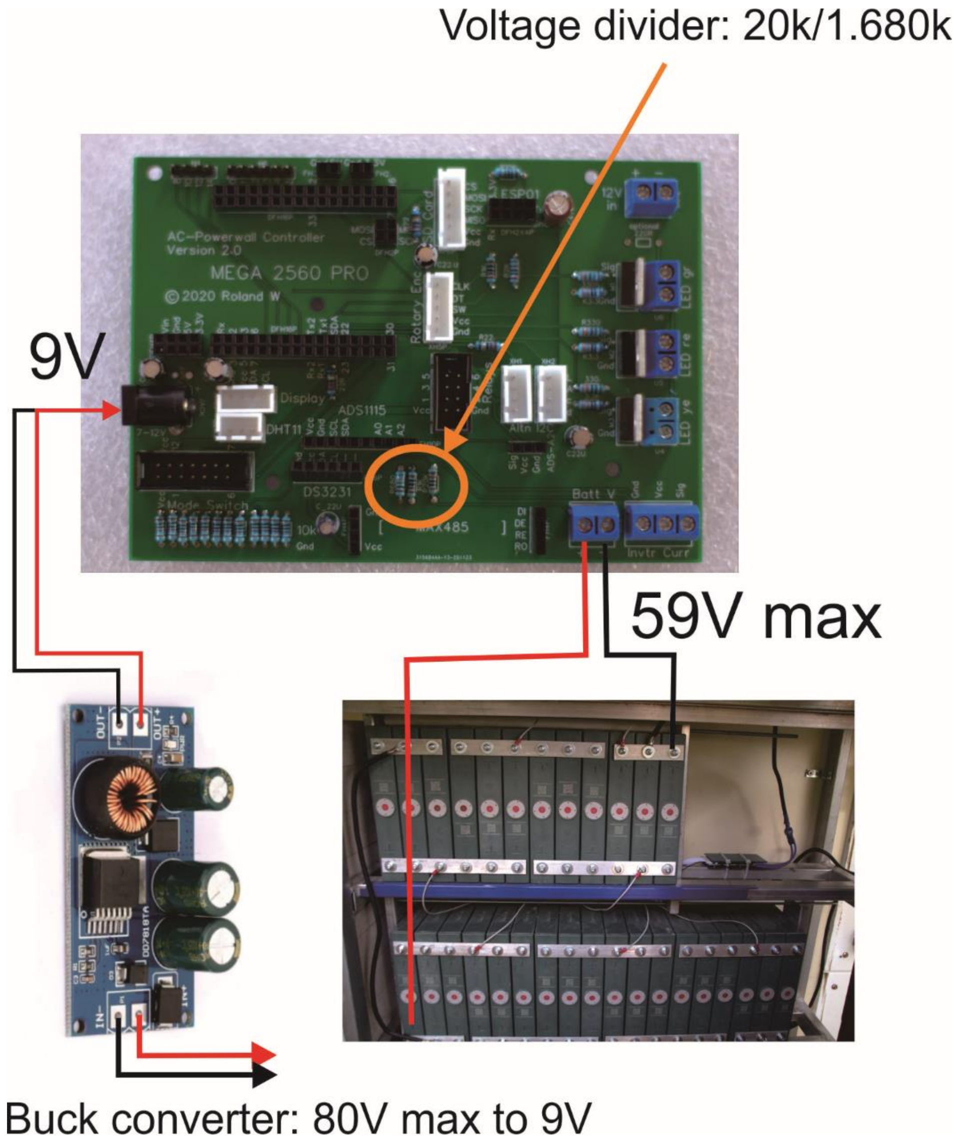
Battery bank:

48 LFP 100Ah cells (used cells in this case, with a remaining DOD of 85%), original capacity 15kWh connected as 16 strings, each 3 cells in parallel, for a nominal 48V system voltage. The system is designed as low current application. Max. current at discharge is 40A or 0.13C, max. current at charge in this setup is 45A or 0.15C.

In my case I am using 25/2mm aluminium bus bars to connect cells. It is recommended to use copper bus bars when high current is expected!Interconnecting wires between cell groups are 16mm2 copper, until the main DC bus.

The cells are slightly compressed by a fixture to optimize longevity of the pack.

Connection to controller:



Chargers:

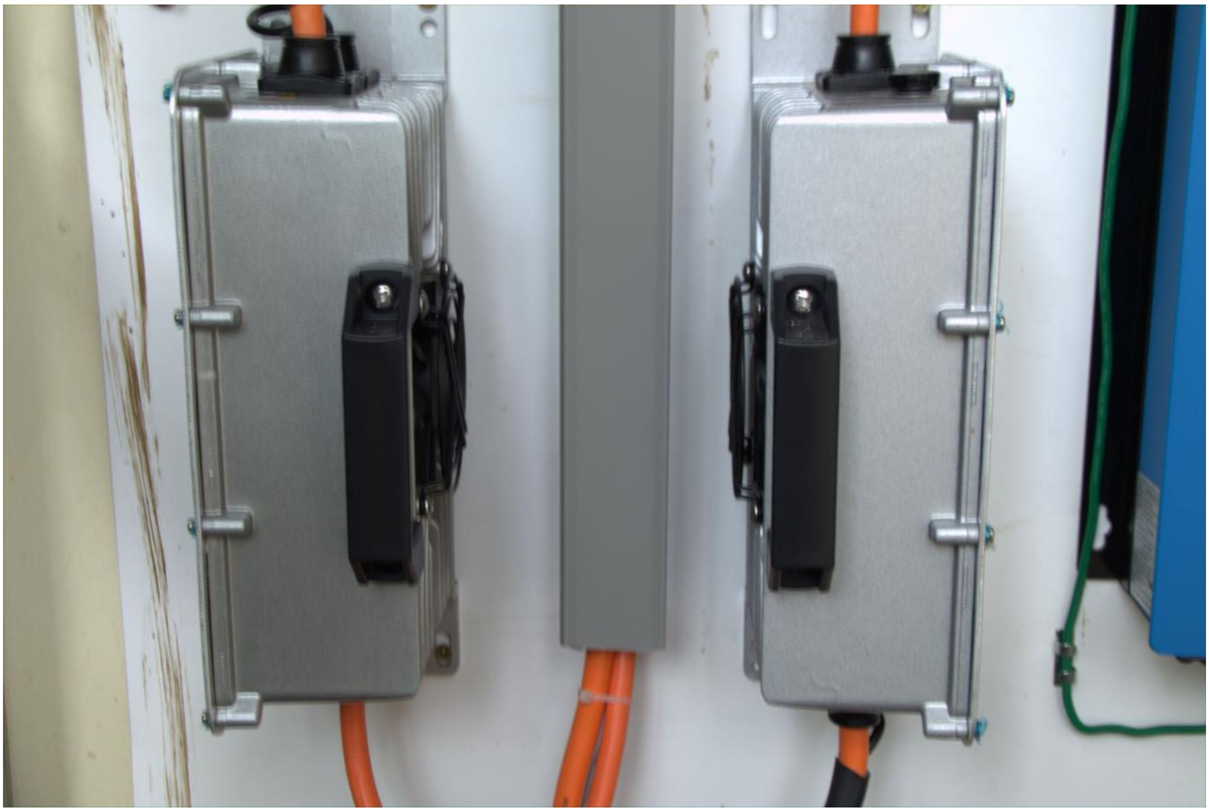
Two (or 3) small vehicle chargers, while the first charger should ideally have half of output as second charger. If three chargers are used, charger 2 and 3 are creating a single virtual charger trough the controller.

Example for setups:

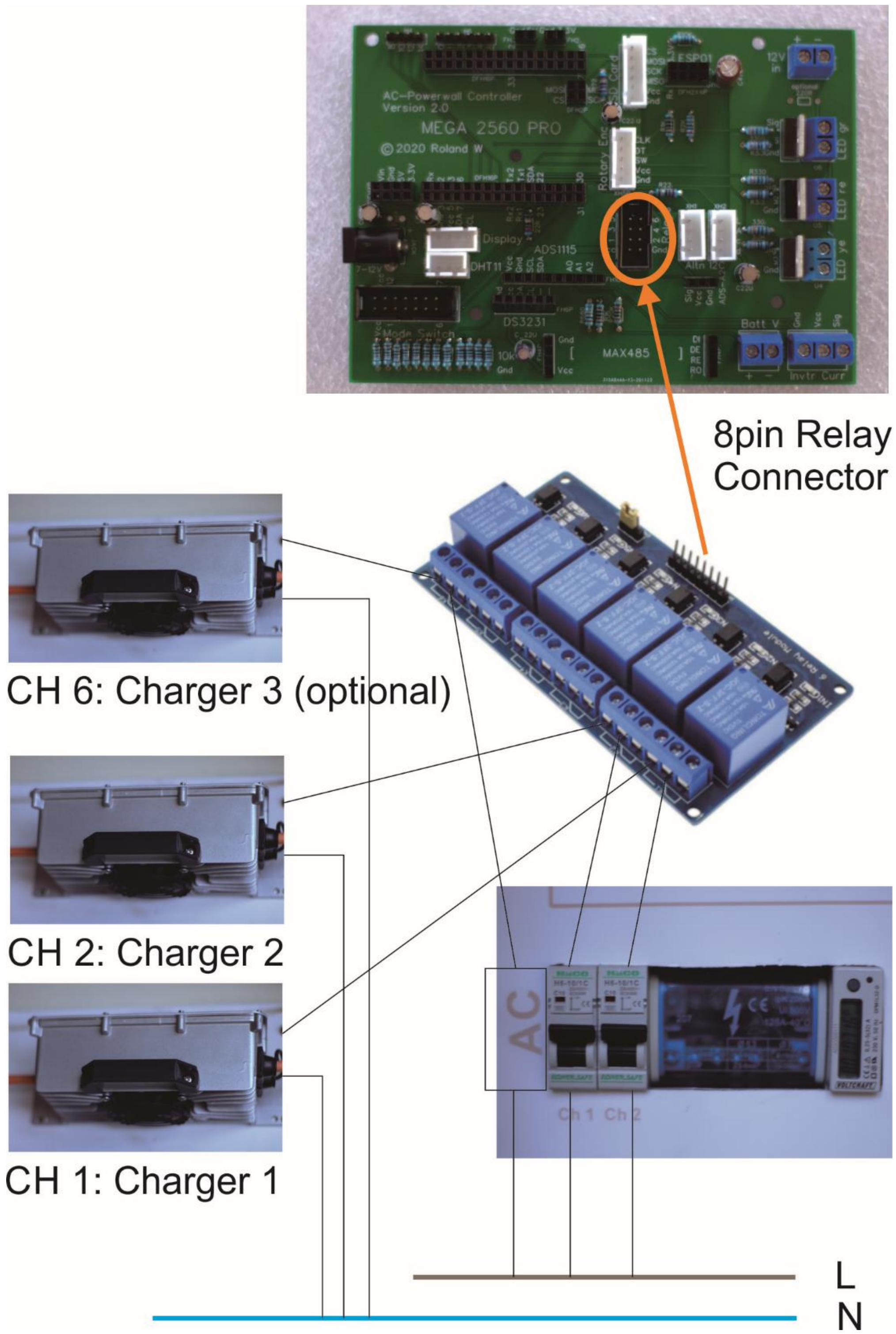
Chg 1: 15A, Chg 2: 30A --> 45A total

Chg 1 20A, Chg 2: 20A, Chg 3: 20A --> virtual setup Chg1: 20A, Chg 2: 40A --> 60A total

Max. AC current directly connected to controller relais is 10A. That would equal a 2000W charger or 40A on DC side with 48V equipment. So the theoretical max. setup for chargers directly connected to the controller relais, is 3x40A or 120A total (48V system). If you require higher currents, you would need to connect the chargers via extra high current relais, which by itself are switched trough the controller relais.



Connection to controller:



All devices are connected to the “Common” and “Normally Open” (NO) pins

Inverter:

The inverter is a grid-tied battery inverter with export limiter. In this case a SUN 2000 GTIL.

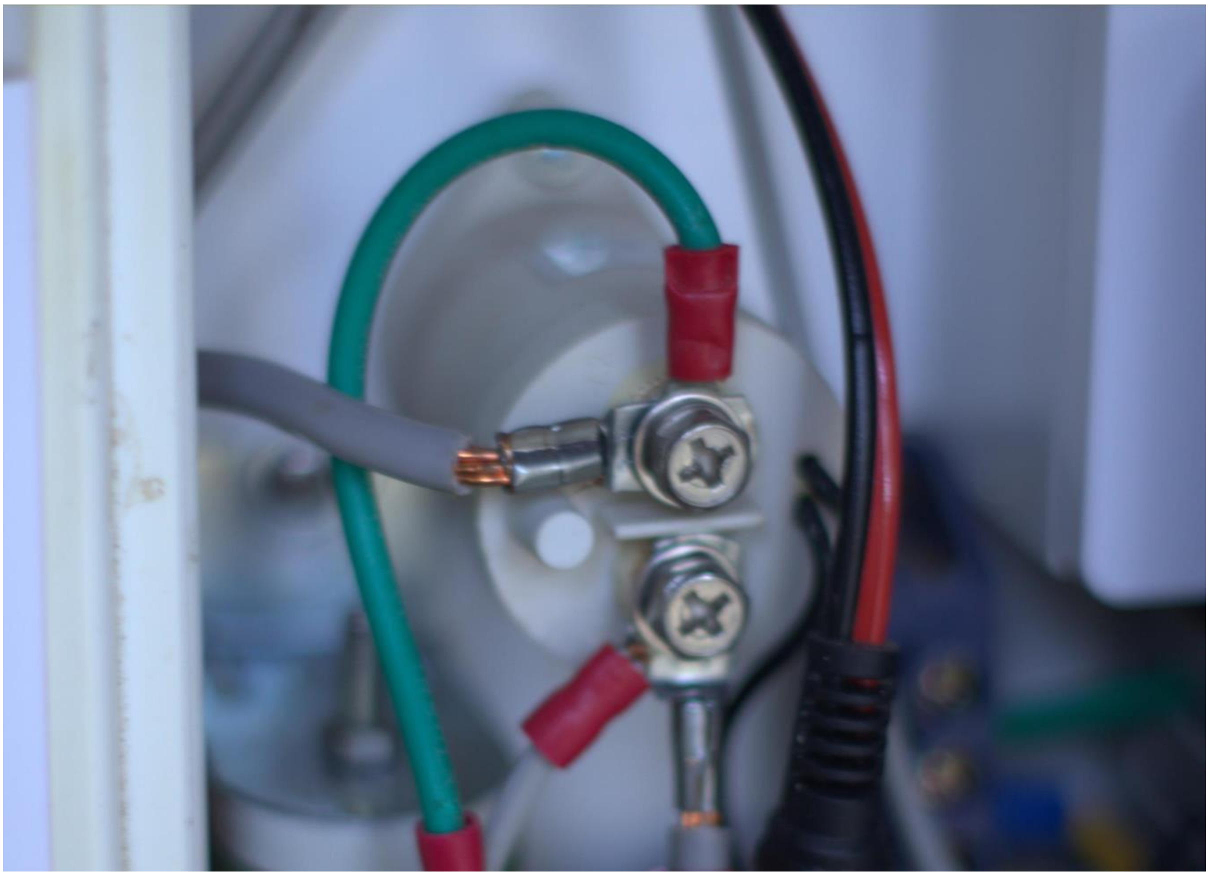
The limiting feature is assuring, that our precious captured energy is not escaping back to the grid. Multiple inverters, on same or different phases are optional. Each of this inverters will draw a maximum of around 40A from the battery bank.

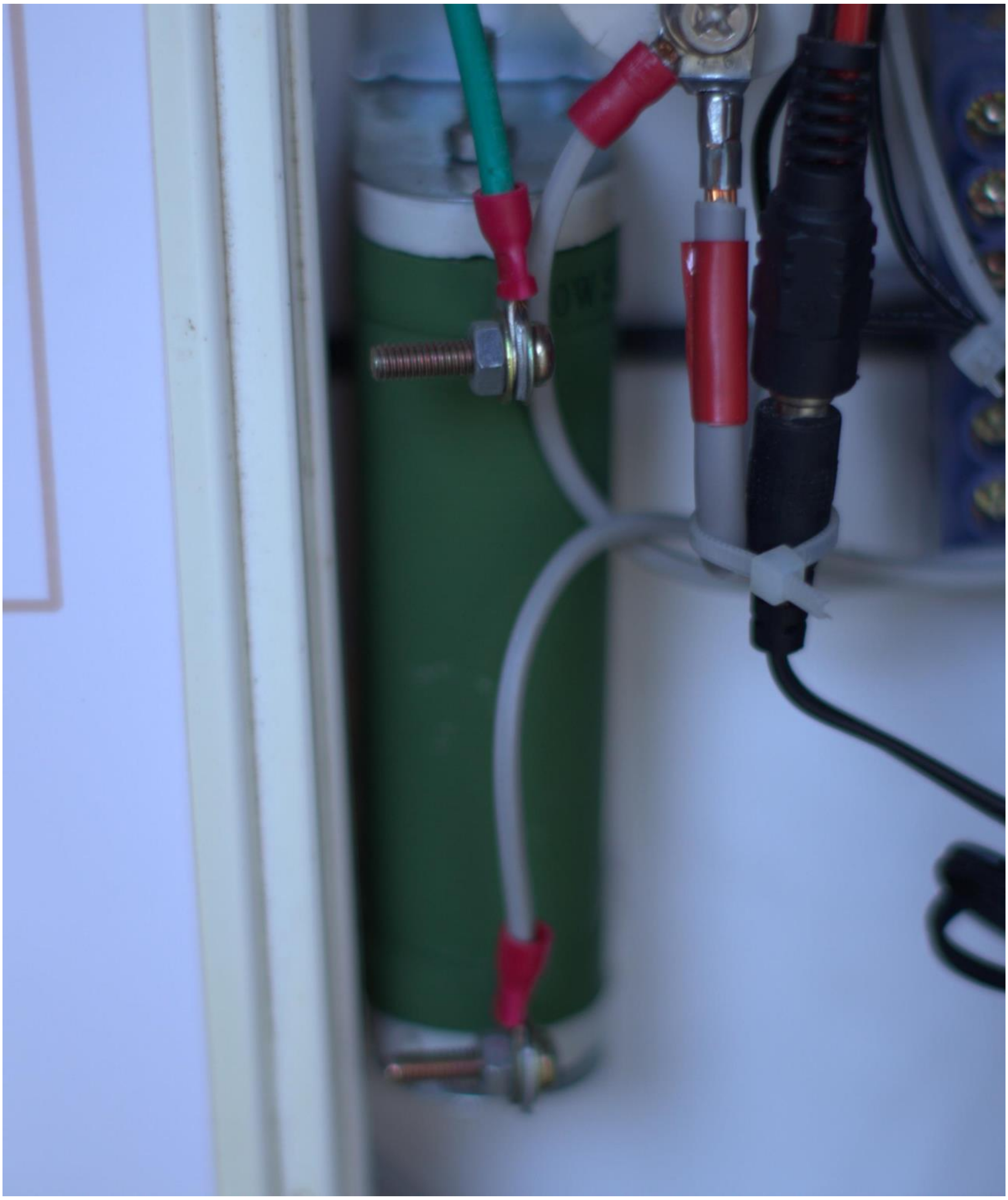
DC connection: copper 6mm2

Limiter on “Internal” socket

As the SUN GTIL inverter is switched on the DC side, controller is providing “Inrush current protection” for the inverter.

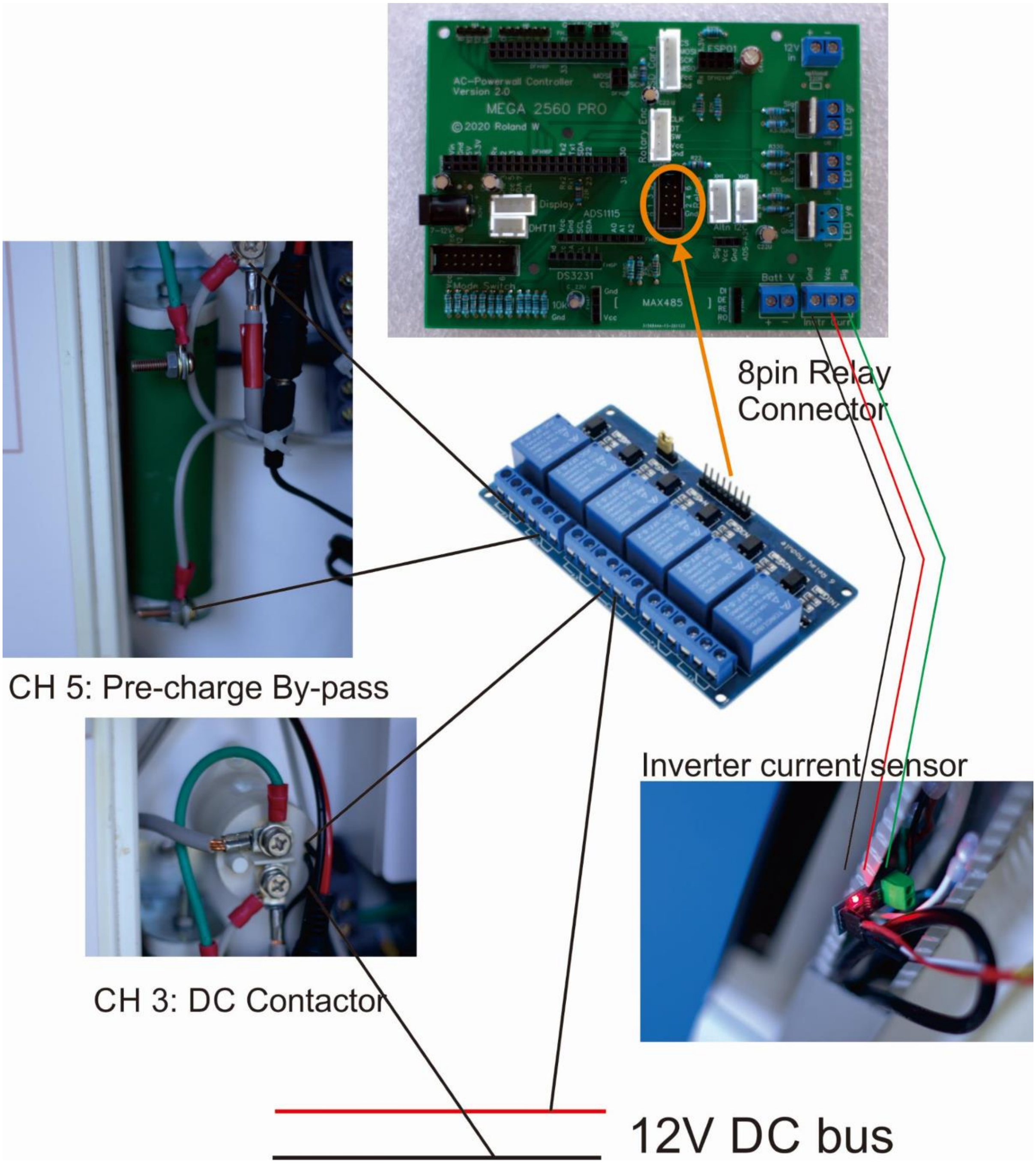
The contactor is a high voltage DC contactor (400V/50A), the resistor a 50Ohms/50W type.





The by-pass relay will be activated 2,5 seconds prior the main contactor, and released again shortly after to prevent it drawing current in case of a contactor coil failure.

Connection to controller:



All devices are connected to the "Common" and "Normally Open" (NO) pins

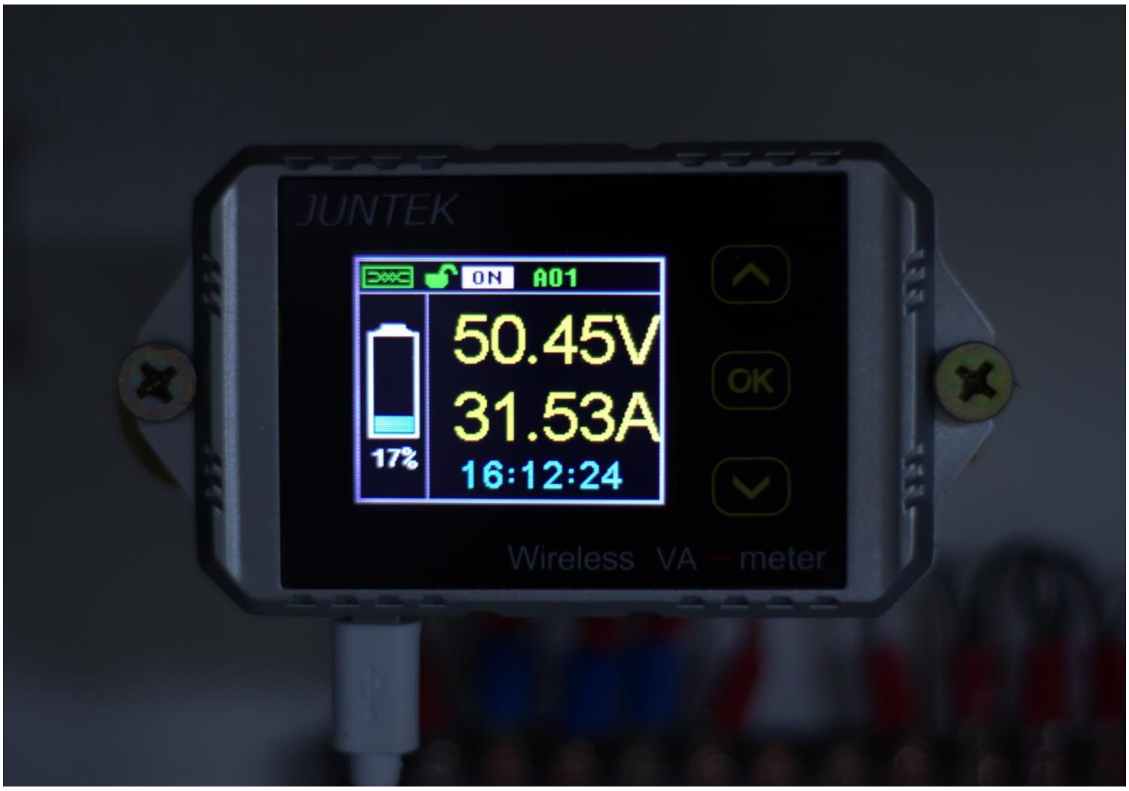
Battery protection and monitoring:

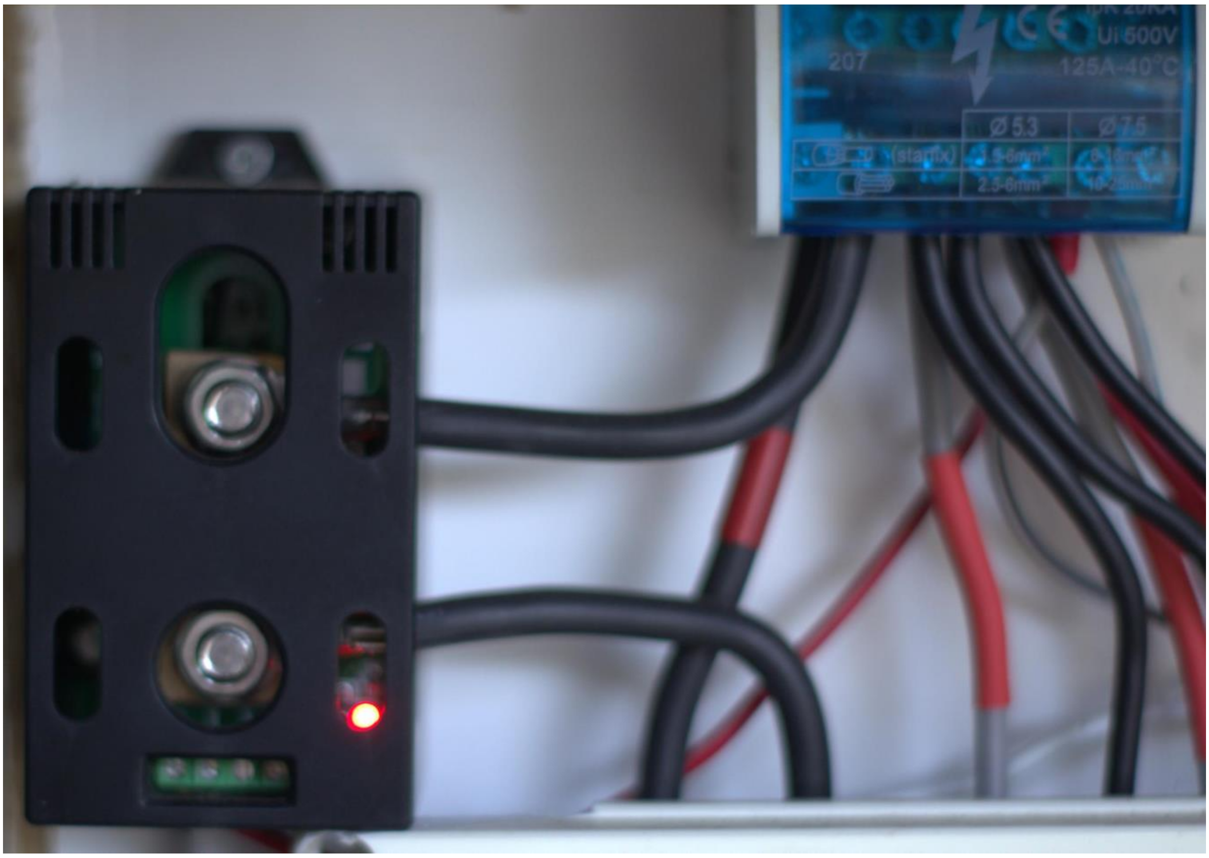
The BMS is a simple LIFEPO4 hardware type. I am only interested in Low and High voltage cell protection and disconnect as a last line of defense when all other protections fail.

This BMS is rated for max continuous current of 70A.

Feel free to use any more advanced type of BMS you like!

Monitoring is primarily done by the controller. But the controller uses a voltage based prediction of SOC only, so I do alternatively as well monitor with a Coulomb meter.





As Coulomb meters will drift by time, it can be manually reset to the value of the controller indication, best when SOC is low (<10%), as the voltage based reading of the controller is most accurate there, due to the nature of discharge curves (especially with LFP cells)!

Breakers:

DC Main battery breaker: 100A

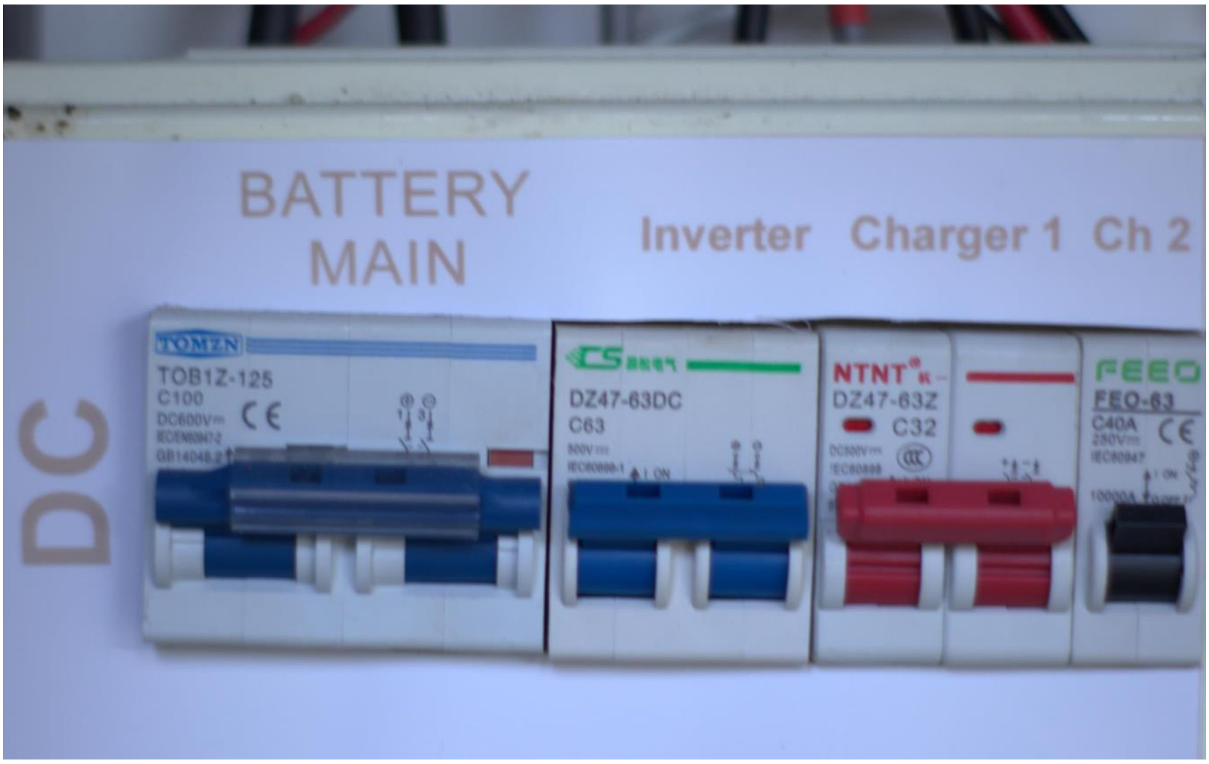
Inverter: DC 63A

Charger 1: DC 32A for a 20A charger

Charger 2: DC 40A for a 25A, 30A charger

AC breakers for chargers are 10A, as that is the max. rated for the controller relays

I am using a meter to log energy used up by the chargers.


BATTERY
MAIN
Inverter
Charger 1
Ch 2
DC
TOMZN
TOB1Z-125
C100
DZ47-63DC
C63
NTNT
DZ47-63Z
C32
FEEO
FEO-63
C40A


AC
H6-10/1C
C10
H6-10/1C
C10
POWER SAFE
POWER SAFE
IpK 20kA
Ui 500V
125A-40°C
VOLTCRAFT
Ch 1
Ch 2

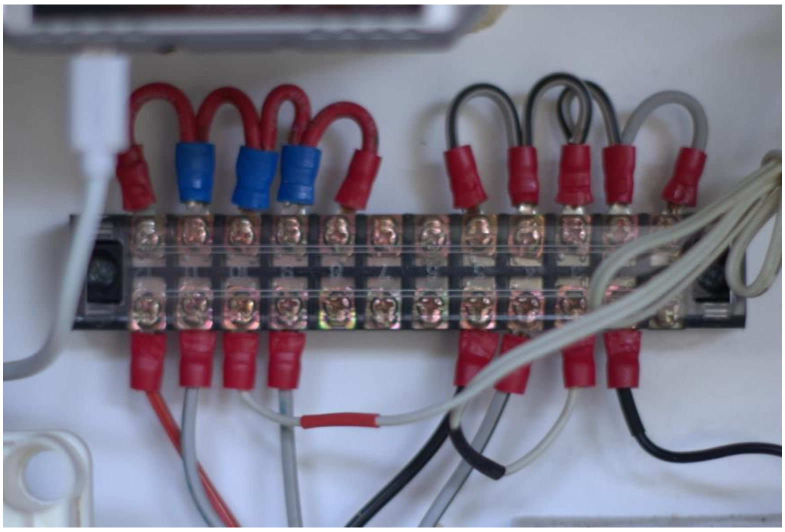
12V Bus and AC outlet:

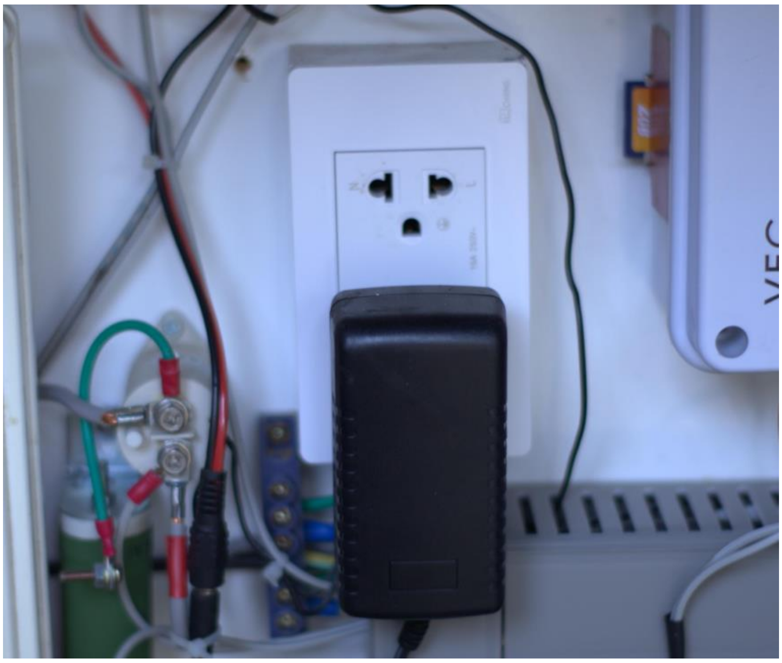
The Powerwall uses a 12V bus to power several DC components. They are powered via an AC outlet and power supply:

- Part of the controller internal

- External fans inside enclosure

- DC contactor coil

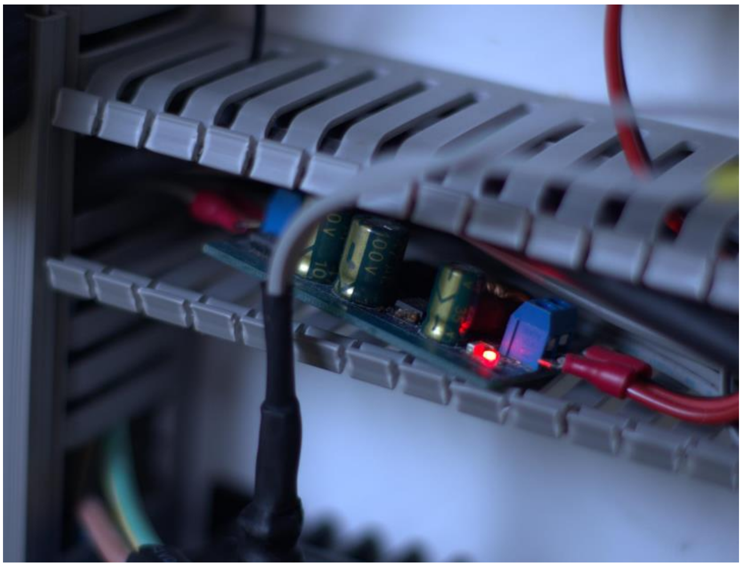




Fans:

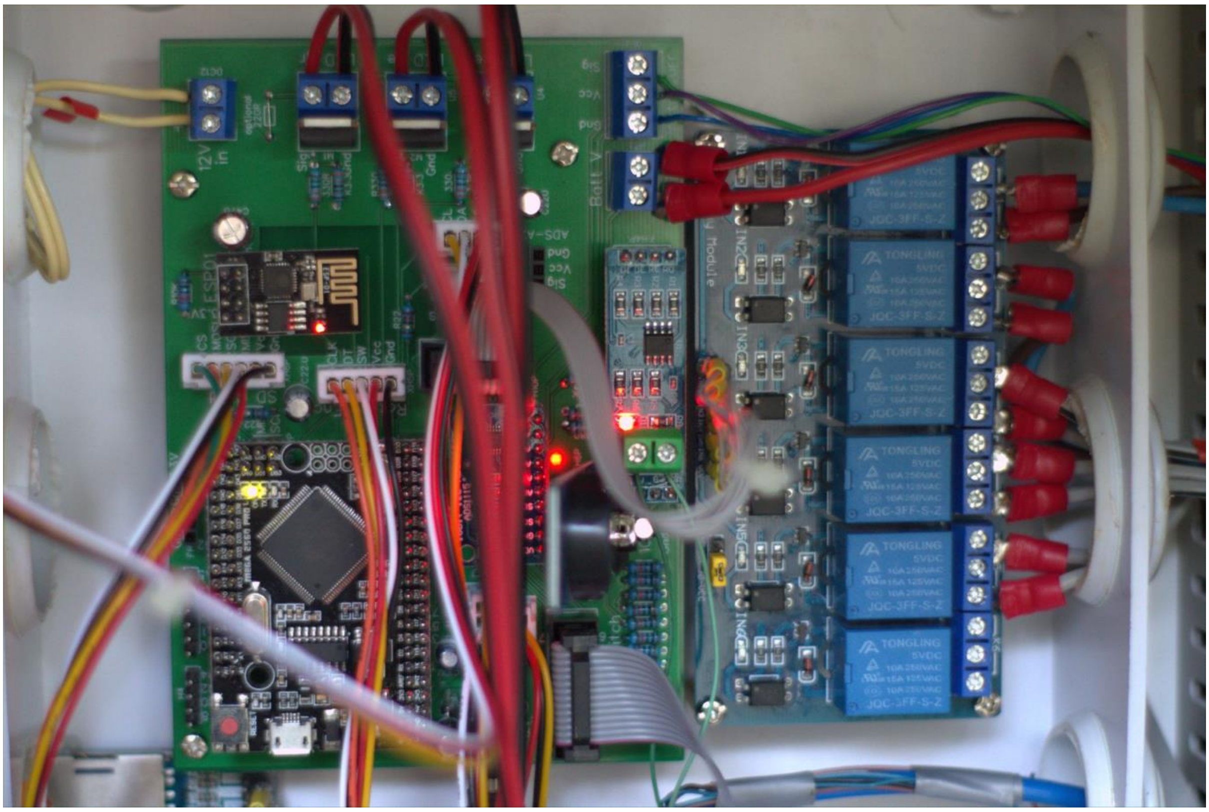
Air-flow is provided by a bank of 12cm PC fans, powered from the 12V DC bus bar and switched on Relay channel 4. The temperature can be set in setting Mode 10 - Limits.

The main Controller power supply, comes via a High voltage Buck Converter, which is converting battery voltage directly to 9V.

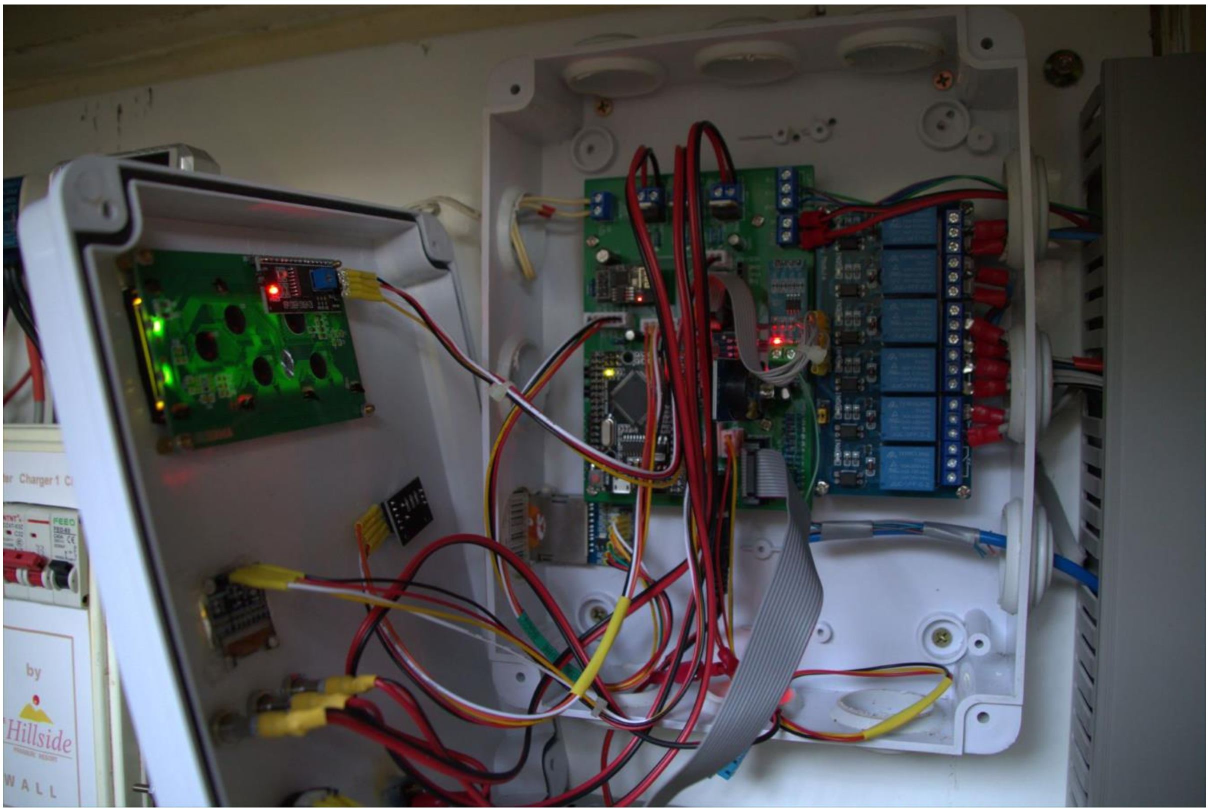


Controller:

The controller is DIY and build from groud up to serve its functions in controlling the Powerwall.



Sig
Vcc
Gnd
Batt V
TONGLING
5VDC
JQC-3FF-S-Z



Charger 1
by
Hillside
WALL

Items/Modules/Devices the controller (Board Version 1 and 2) is using are:

- Arduino Mega or compatible 2560 board (Mega 2560 Pro board is used in the controller)
- DS3231 Real Time Clock
- Max485 Modbus Module
- DHT11 Temperature and Humidity sensor
- 2004 LED Screen with I2C Serial Board
- 0,96 inch OLED Display I2C
- ADS1115 16-bit Analog to Digital Converter
- 6-way Relay Module (5V, activate on LOW)
- Rotary Encoder Switch
- 3 12V LED-Indicators (red, yellow, green)
- SD-Card Module
- 20A AC-current sensor module to be connected on the inverter AC connection
- ESP01 Module (ESP8266)
- 12 way Rotary Switch as Mode selector
- diverse 1/4W resistors and electrolytic capacitors
- diverse male, female headers and sockets

The controller is switching:

- 2 or 3 battery chargers (AC small vehicle chargers (max 10A on AC side), use 2 different power outputs (optimal is, if Charger 1 power has half output of Charger 2), Charger 3 is optional, and is creating a virtual Charger together with Charger 2)
- 1 inverter via DC-contactor, including a precharge bypass

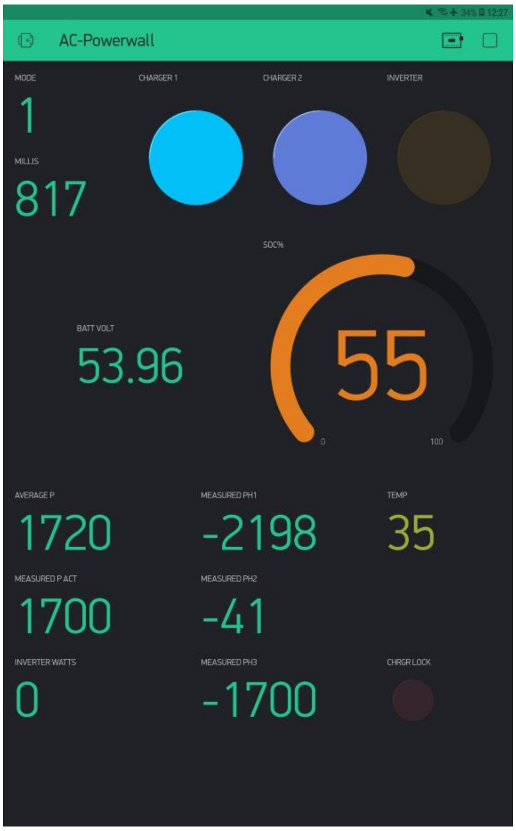
- Fans

Logic:

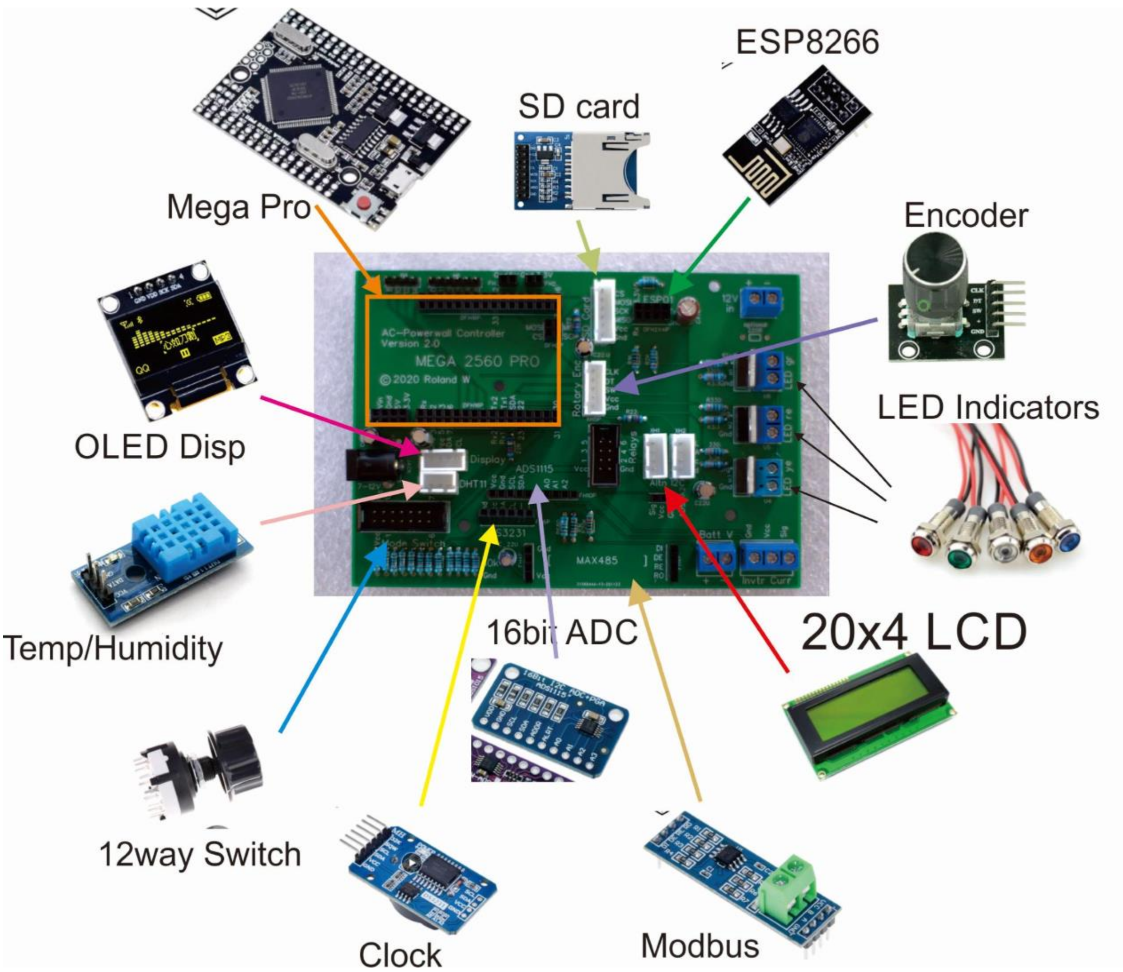
- 2 metered modes, by reading out a SDM meter via Modbus (SDM120, SDM630, X835, etc)
- 1 Timer mode using 2 programmable timers (this Mode can be used with PV-systems which are “Zero-Export” limited by using additional controller features)
- 1 Mixed metered/timer mode (M1/T1)
- 4 manual modes (3 for chargers, 1 for discharge)
- 4 setting modes (limits, parameters, timers, clock)
- Battery logic to be customized. You will have to enter your particular voltage curve of your battery. SOC can be calculated with enough precision even for LIFEPO chemistry but requires some effort :) You would still have to use a Coulomb-meter for more exact monitoring, but you can reset it from information you get from the controller.

Monitoring:

- The controller is connecting to the IoT platform Blynk

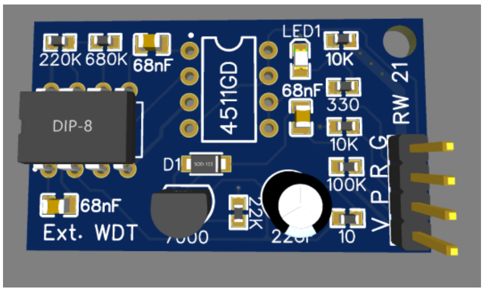


On -board modules:



A **Version 3** Board is already in final stage of design. It will additionally feature Ethernet, an external (long interval) Hardware Watchdog Timer (20 sec watch interval) and 3 connectors for a variable resistor (temperature probes).

The Watchdog Timer is a breakout board, designed for universal use on any micro controller device

Due to additional PCB changes, V3 board will internally not be pin-compatible to V1,V2 boards. A different software version is required. Connected hardware stays fully compatible!

System startup sequence:

Contact e-mail and version number/date of release is shown

The display sequence will show about actual step of startup if successful or failed

Modes:

Modes are shown on the small OLED display. “ab” after the mode number is indicating, that there is a second page available for display on the main LCD display.

The first page will typically always show status of Chargers and Inverter, Battery voltage and SOC, available power or temperature&humidity, date and time.

Second pages will give additional information according the respective modes.

Manuell-Modes, do not have a second page.

All data is presented on the main LCD display, varying by mode. Setup modes can have up to 5 pages, or maybe even more in future.

LED indicators are additionally showing operation of the controller. Any Run-Mode, does at least need to show a green LED illuminated. Yellow LED is showing active charging. Short blinking interval means Charger one only, Long blinking interval means Charger two only, steady light means both Chargers On. Red blinking LED is showing active inverting/discharge. If you enter a Setting-Mode, all LED Indicators should be Off!

Mode 1, avoid import:

Mode 1 will try to avoid using grid power to charge batteries by setting a trigger which is above output power of chargers. The trigger is set in Mode 10 - Limits. An additionally activated dynamic trigger, will rise the buffer during very dynamic load scenarios.

The trigger is based on average power. Small changes might have big effects!

Page A:

Charger state, Inverter state

Battery Voltage and SOC

Average or measured power available during this cycle (V or ^ is indicating trend of power from this cycle to last one)(d or D is indicating if dynamic trigger is in use)

Date and Time

Page B:

Charger Lock On or Off (near full battery condition)

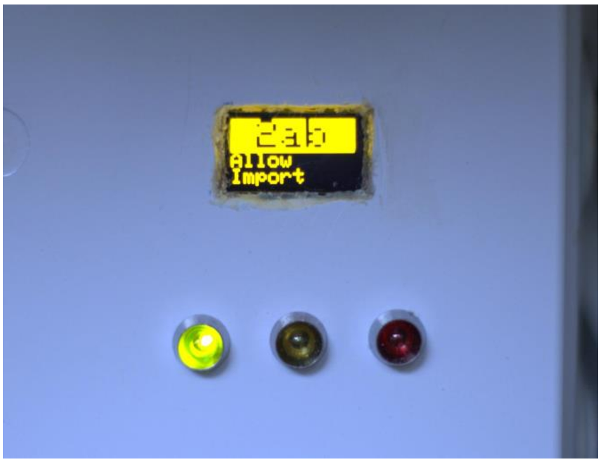
10.000th of Millis(econds past)-timer since last start of controller

Actual power Phase 1/2/3

Temp and humidity inside cabinet

Type of battery, Blynk connected, type of meter, power readout inverted, SOC corrections debug code

Mode 2, allow import:



Mode 2 will as well mostly avoid using grid power to charge batteries by using a trigger which is set just slightly below power of chargers. The trigger is set in Mode 10 - Limitss. An additionally activated dynamic trigger, will rise the buffer during very dynamic load scenarios.

The trigger is based on average power. Small changes might have big effects!

Page A:

Charger state, Inverter state

Battery Voltage and SOC

Average or measured power available during this cycle (V or ^ is indicating trend of power from this cycle to last one)(d or D is indicating if dynamic trigger is in use)

Date and Time

Page B:

Charger Lock On or Off (near full Battery condition)

10.000th of Millis since last start of controller

Actual power Phase 1/2/3

Temp and humidity inside cabinet

Type of battery, Blynk connected, type of meter, power readout inverted, SOC corrections debug

Mode 3, Timer based:

Mode 3 will operate the Powerwall just by using timers, regardless of power metering. This mode can be used to charge the battery based on energy tariff. There is no need to own a solar system at all.

You charge your battery when price for energy is cheap, and discharge when it is most expensive!

But be aware, that storing energy comes with losses. The round-trip efficiency of this system is about 85%, which means 15% of energy will be lost!

Timer -Mode has two times for each charger and the inverter, which you can set seperately.

The timers are set in Mode 9.

Page A:

Charger state, Inverter state

Battery Voltage and SOC

Temperature inside cabinet

Actual measured Power at the active Phase, A "L" after the number is indicating that "Limiter" feature is activated

Date and Time

Page B:

This page will show, which timer is active at the present time. If there is no timer match, it will just show "waiting", while if there is a match, it will show the time frame of the active timer too.

“Loss Limiting” or “Limiter” function:

This function is only available in Mode 3, and can be activated under item “Export Limiter” on Page 11e in “Parameter Setup”.

It has two meanings:

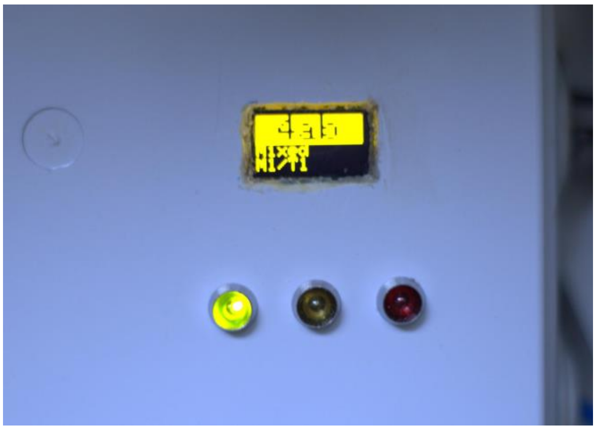
1. Your PV-system is using an “Zero-Export” Limiter, but you still want to store power from your grid-tied system into batteries

The feature, will probe the Active Line, regardless of Power measurement, if the requested timer setting for charging can be sustained without substantially going into Import. So it will wait, if or how a maybe power limited Inverter is compensating for the extra load.

2. You are using a Timer Mode during “Solar hours” and want to avoid extensive Import in case of cloudy conditions, while you have programed the Chargers to run

To avoid excessive amount of switching chargers, Timers should be set positively to times, where it can be very much expected, that there will enough power available to keep chargers going!

Mode 4, Mixed M1/T1:



This mode will, as long there is now timer match according to settings of Timer 1, try to charge from excess power by metering.

So during daytime, it can source power from your PV system, and during nighttime, it could top up the battery on cheap off-peak electricity. With two available timers for discharge, you can then use energy during shoulder peak times.

Page A:

Charger state, Inverter state

Battery Voltage and SOC

Temperature and humidity inside cabinet

Date and Time

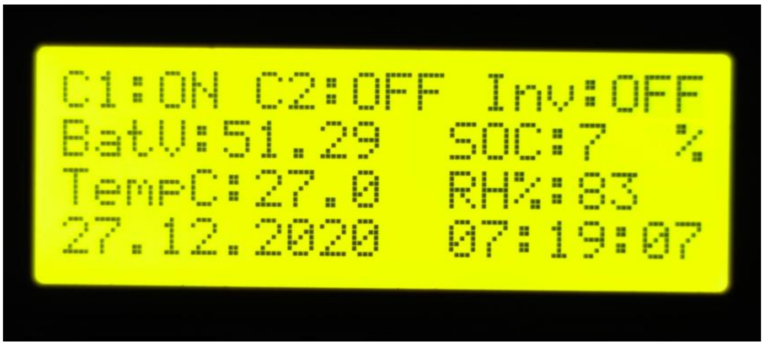
Page B will show either power related data if currently metering, or timer related if there is a timer match.

The next 4 modes are all manual modes.

Mode 5: Charger One ON:

In this mode, you can switch on the charger one manually. This mode will allow you to fully charge the battery pack to 100%, regardless of the maximum SOC setting in Mode 10 - Limits.

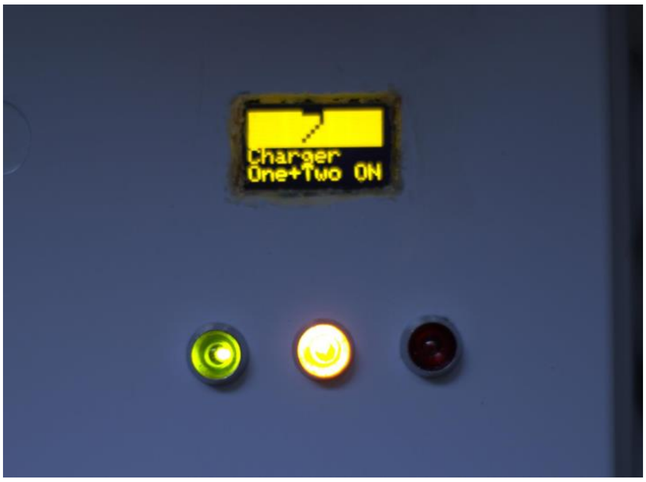
But still, the controller will stop charging when 99-100% is reached!



Mode 6: Charger Two ON:

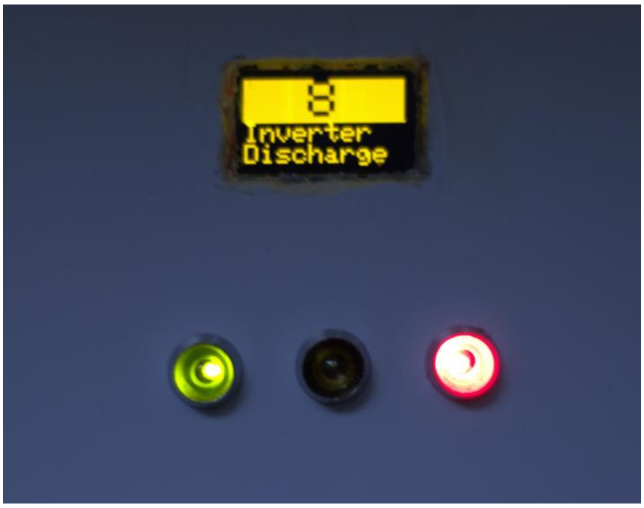
In this mode, you can switch on the charger two manually. This mode will respect maximum SOC setting in Mode 10 - Limits.

Mode 7: Charger One+Two ON:



In this mode, you can switch on both/all chargers manually. This mode will respect the maximum SOC setting in Mode 10 - Limits.

Mode 8: Inverter Discharge



This mode will start inverting manuelly. It will allow you to fully discharge the Pack, regardless the limit which is set for minimum SOC in Mode 10 - Limit!

Nevertheless, the controller will end discharging inside its save frame for SOC!

The next 4 Modes are Setup-Modes. Before you operate the powerwall first time, you need to go through all setting menues, to enter the actual values of your system.

Please set the controller in following order:

1. Mode 12 - Setup Clock

2. Mode 11 - Setup Parameters

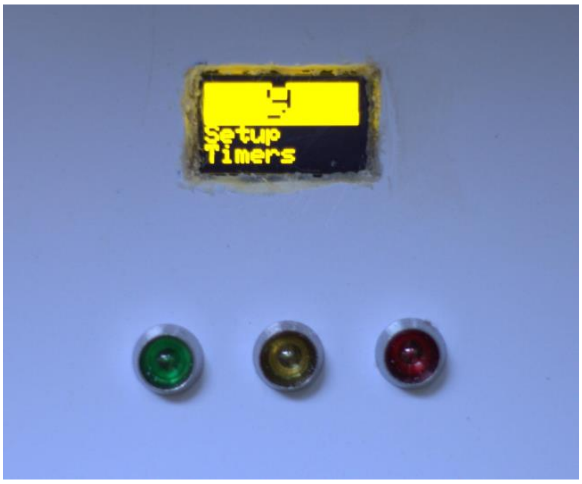
Before you start with next mode, please switch to any mode which is showing actual battery voltage, and note the difference of controller indicated voltage and your reference voltage

3. Mode 10 - Setup Limits

4. Mode 9 - Setup Timers

After finishing each Setup-Mode, the values will be saved into the Micro controllers EEPROM. Some Setup-Modes (10 and 11) will reset the controller after they are done. You may just switch to the next mode then.

Mode 9: Setup Timers



There are two Timers to set for each charger and the inverter. Times for normal Timers are in Hours only, time for the inverter discharge in metered modes is in Hours and Minutes.

Three rules need to be considered when setting times for Timers:

1. Only On times are counted as a set time

2. Timer 1 has priority over Timer 2

3. Discharge has priority over charge

Setting-Modes always start with the push on the Rotary Encoder Knob!

A "<" symbol is marking the field which is selected. Then you can change the value by turning the knob clockwise to increase, and counterclockwise to decrease.

When value is set to required number or state, press the knob again to jump to next field.

Page A: Timer 1

Charger 1 On and Off -time

Charger 2 On and Off -time

Inverter On and Off -time

Page B: Timer 2

Charger 1 On and Off -time

Charger 2 On and Off -time

Inverter On and Off -time

Page C: Inverter time in metered modes (Mode 1, 2, 4)

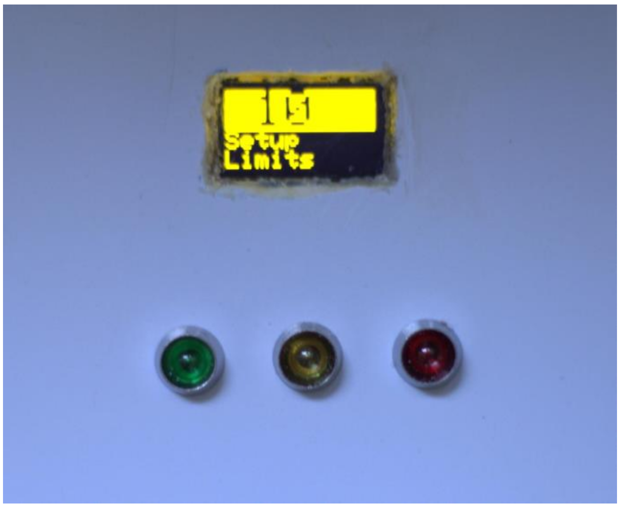
Inverter On -time hours and minutes

Inverter Off -time hours and minutes

Page D:

You may set a time, where the controller will reset on daily basis if you wish to do so. Choose YES/NO as of requirement. If YES, select a time when controller shall reset

Mode 10: Setup Limits



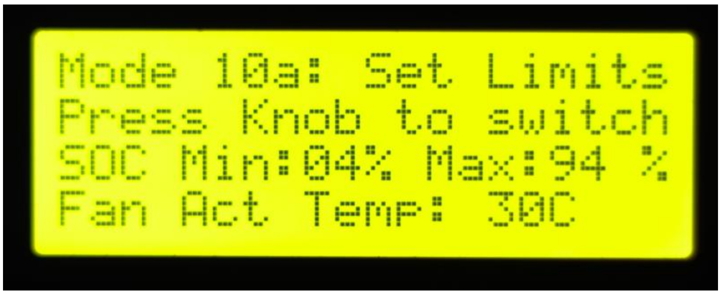
In this mode, you can set the limits for your system. Press the knob to start selection.

Page A:

Set the minimum SOC at which discharging shall stop. The controller is ending a discharge session, once the set value is maintained for at least 90 seconds continously.

Set the maximum SOC at which charging shall stop. The controller will finish a cycle if the limit is not overshot further then by 2%. In cases of abruptly reaching 100%, or >2% then set maximum, the controller will immediately stop chargers.

Set the temperature inside the cabinet, above which the fans shall be running



Page B:

Set the Trigger for Mode 1, which tells, how much in average more power must be available, then the next charger in line would consume if activated. This is reducing peak overshots. A small change can have big effect on general behavior.

Set the Trigger for Mode 2, which tells, how much in average less power is allowed, then the next charger in line would consume if activated. This is enabling a certain overshoot. A small change can have big effect on general behavior.

Voltage readout calibration: as every voltage divider after building the controller is unique, you need to calibrate the controller voltage readout with a multi meter or coulomb meter before its first operation. One unit will change the readout by around 0.03V. If the controller is showing more then your reference meter, then correct to "-" (minus). If it shows to little, correct to plus. Please calibrate the meters only when the battery is resting. If the closest unit of correction is not resulting in a equal value, use the unit, which is correcting the controller readout a bit higher then your reference.

After you finish setting Limits, the controller will reset automatically

Mode 11: Setup Parameters

In this mode, you can set the parameters for your system. The controller will then understand what is hiding behind its terminals and sensors. Press the knob to start selection.

Page A:

Charger One DC Current in Amps

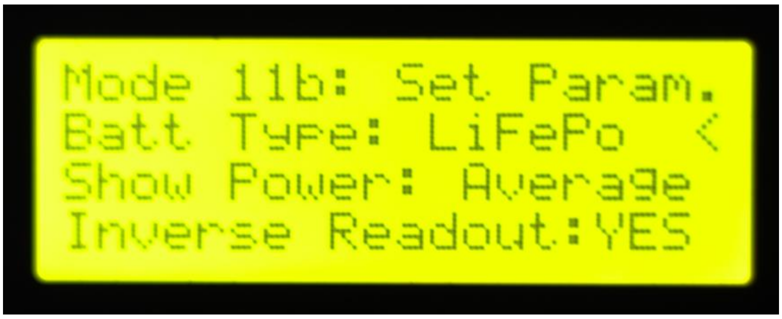
Charger Two DC Current in Amps

Page B:

Select the type of battery. Choose from LiPO (Lithium Polymer), LiFePo (Lithium Iron Phosphate) or NMC (Nickel, Manganese,Cobalt). This selection will set your charge/discharge curve

Select if your Power readout in metered modes on Page A shall show average or real measured values

Select if your power readout needs to be inverted. In general, power meters are showing a "-" for export and "+" for import. If your Power meter is set like that, you need to invert the readout for the controller. The controller must show "+" for power available, and "-" for no power available



Page C:

Please select, which type of ACS721 current sensor your inverter is connected to (they come in 5,20,30A versions)

Select if you are using Wifi/Blynk monitoring or not

Select if you want to use a dynamic trigger. A dynamic Trigger will help the controller not to overshoot its targets in case of a very dynamic load situation. If during a cycle the power difference from your phase is very high, a dynamic trigger will automatically increase the buffer to avoid import from the grid. Recommended setting: YES

Page D:

Select the type of meter you are using. Options are SDM120 (1-phase), SDM630 (3-phase), X835 (3-phase)

Select which Phase is your reference phase on which the chargers are connected to draw energy.

Select the battery size in Ah

Page E:

Select if you are using a third charger on relay 6. If YES, that charger will create a virtual charger together with Charger Two and be seen as one by the controller. So the Amps of Charger 2 and 3 will be added.

Select how much DC current in Amps charger 3 has

Select if "Loss Limiting" or "Limiter" function shall be used

After finishing Mode 11, the controller will reset automatically.

Mode 12: Setup clock

In this mode, you can set the clock of the controller.

Please enter date and time

Data logging on SD-card:

The controller is saving data to SD-card once every 6 minutes.

Stored data are:

Time, Date

Battery Voltage, SOC

Measured Power (active Phase), Phase 1, Phase 2, Phase 3

Charging power of individual chargers and accumulated

Inverter discharge power

Temerature, Humidity inside Cabinet

Peak difference of power (dynamic trigger)

Millis timer

The data is stored as a .txt file on the card, and can be imported in most Excel programs for analysis.

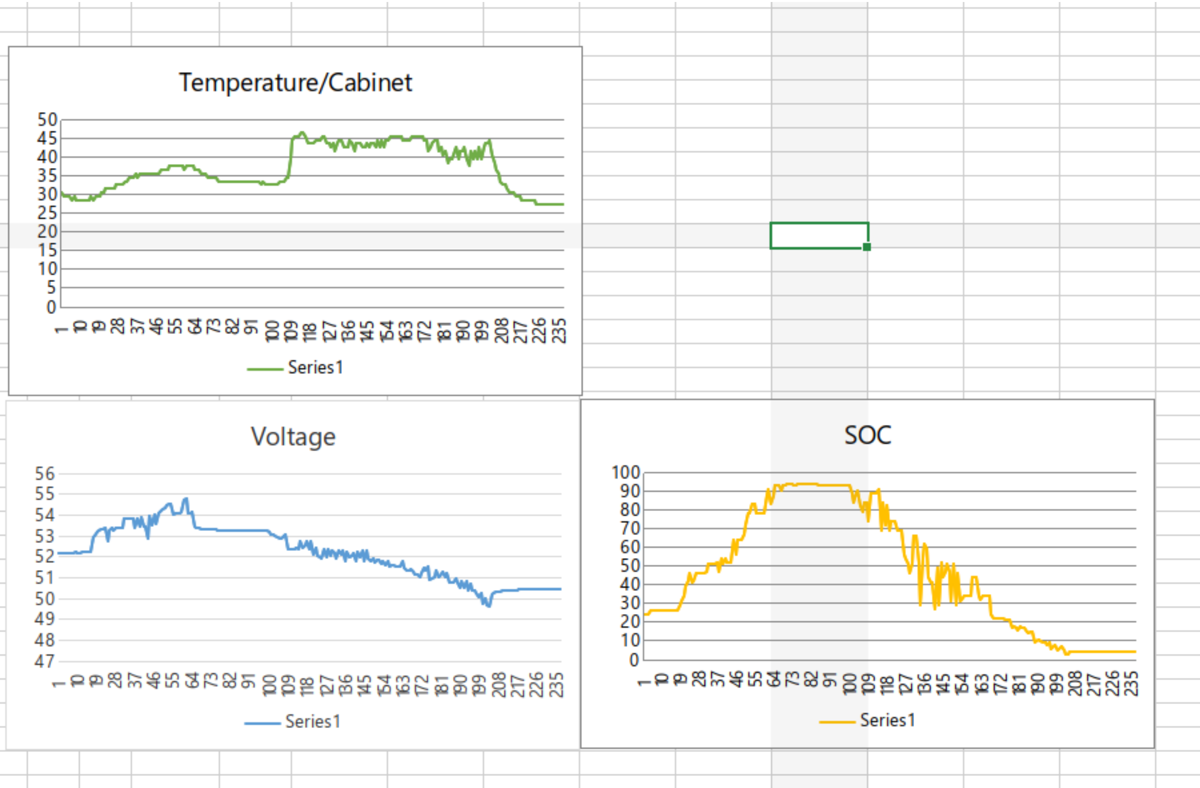
You can create graphs there to visualize the data.

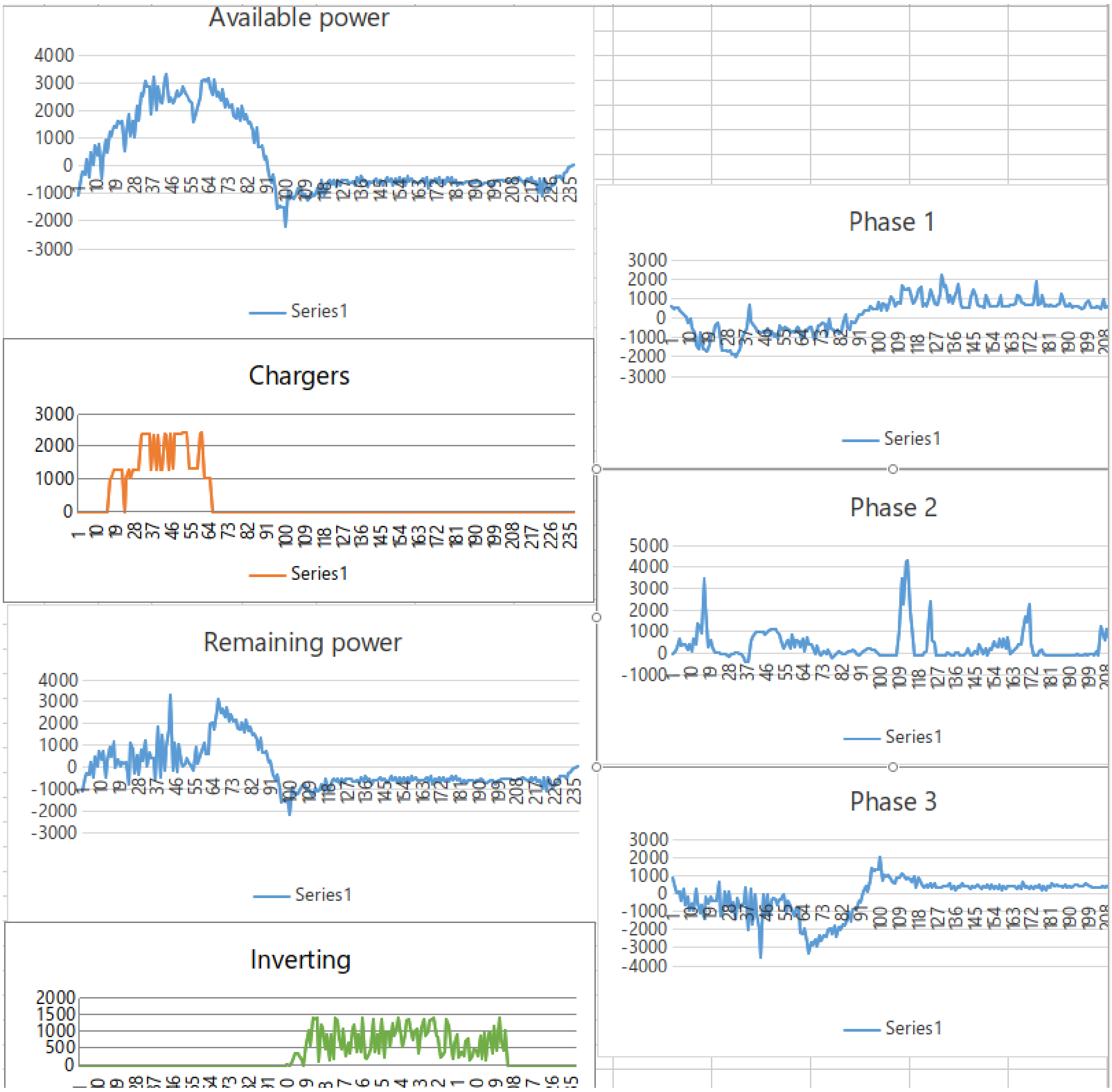
This way, the Powerwall controller becomes a fully fetched home power monitor.

Example:

3863	50.54	5	-879.44	-879.44	575.97	531.74	879.44	0	0	0	0	28	68	722	2855
3864	50.54	5	-696.47	-696.47	633.87	1413.9	696.47	0	0	0	0	28	69	631	2891
3865	50.54	5	-661.84	-661.84	991.74	550.55	661.84	0	0	0	0	28	70	1292	2927
3866	50.54	5	-590.11	-590.11	476.5	691.44	590.11	0	0	0	0	28	70	1440	2963
3867	50.55	5	-311.77	-311.77	417.89	395.64	311.77	0	0	0	0	28	70	872	2999
3868	50.55	5	-336.71	-336.71	358.35	478.91	336.71	0	0	0	0	28	71	833	3035
3869	50.55	5	-298.31	-298.31	257.17	1413.96	298.31	0	0	0	0	28	72	893	3071
3870	50.55	5	-434.63	-434.63	214.88	560.42	434.63	0	0	0	0	28	72	1461	3107
3871	50.55	5	-211.51	-211.51	219.98	1303.93	211.51	0	0	0	0	28	73	491	3144
3872	50.55	5	-142.62	-142.62	185.3	444.16	142.62	0	0	0	0	28	73	413	3180
3873	50.56	5	2.36	2.36	552.84	645.19	-2.36	0	0	0	0	28	73	399	3216
3874	50.56	5	60.15	60.15	50.88	688.98	-60.15	0	0	0	0	28	74	419	3252
3875	50.56	5	111.15	111.15	759.59	991.11	-111.15	0	0	0	0	28	73	367	3288
3876	50.56	5	-35.92	-35.92	1225.66	579.32	35.92	0	0	0	0	28	74	1276	3324
3877	50.56	5	74.69	74.69	1151.31	335.89	-74.69	0	0	0	0	28	73	1196	3360
3878	50.56	5	159.35	159.35	1399.98	1194.23	-159.35	0	0	0	0	29	74	1149	3396
3879	50.57	5	318.15	318.15	775.57	830.38	-318.15	0	0	0	0	29	74	867	3432
3880	50.57	5	388.39	388.39	887.61	676.04	-388.39	0	0	0	0	29	73	881	3468
3881	50.57	5	-11.53	-11.53	671.94	469.9	11.53	0	0	0	0	29	72	1930	3504
3882	50.57	5	-1347.69	-1347.69	900.03	1704.24	1347.69	0	0	0	0	29	72	3078.47	3540
3883	50.57	5	-155.64	-155.64	-228.16	1563.75	155.64	0	0	0	0	29	72	2757	3576
3884	50.57	5	828.36	828.36	95.69	379.8	-828.36	0	0	0	0	29	72	1331.64	3612
3885	50.57	5	1063.85	1063.85	-75.55	2578.57	-1063.85	1011.35	0	1011.35	0	29	72	921	3648
3886	51.54	7	-435.24	-1466	173.73	3485.85	1466	0	0	0	0	29	73	4359.85	3684
3887	51	6	384.56	384.56	-247.04	2322.51	-384.56	0	0	0	0	29	71	2868	3721
3888	50.96	6	996.94	996.94	1945.67	2384.43	-996.94	0	0	0	0	29	70	1096	3757
3889	50.94	6	801.43	801.43	79.75	2889.58	-801.43	0	0	0	0	29	71	2002	3793
3890	50.93	6	413.72	413.72	677.18	2478.58	-413.72	0	0	0	0	29	70	2500	3829
3891	50.92	7	1570.67	1570.67	-625.24	1044.97	-1570.67	0	1273.11	1273.11	0	29	70	1614.28	3865
3892	51.92	9	1760.72	462.71	-420.61	-46.68	-462.71	0	1298.16	1298.16	0	30	71	3035	3901
3893	52.07	11	1439.21	137.44	-560.56	182.84	-137.44	0	1301.84	1301.84	0	30	69	1214.71	3937
3894	52.12	12	1148.22	-154.75	280.48	1107.47	154.75	1042.57	0	1042.57	0	30	67	1949	3973
3895	52.03	12	22.17	-1018.4	293.49	-142.16	1018.4	0	0	0	0	31	65	2046	4009
3896	51.53	11	-349.53	-349.53	-1004	-53.01	349.53	0	0	0	0	31	65	1426	4046
3897	51.49	11	479.07	479.07	-405.5	151.28	-479.07	0	0	0	0	31	66	3360	4082
3898	51.47	11	1880.13	1880.13	-513.11	212.94	-1880.13	0	1286.91	1286.91	0	31	66	2668	4118
3899	52.15	13	489.55	-814.18	570.7	1113.31	814.18	0	0	0	0	31	65	3296.13	4154
3900	51.54	11	2029.18	2029.18	-1255.58	2286.18	-2029.18	0	1288.4	1288.4	0	31	64	3562.18	4190
3901	52.18	13	2713.17	1408.55	-1688.95	2188.85	-1408.55	1043.86	1304.82	2348.67	0	31	65	2505	4226
3902	52.71	18	2807.13	435.14	-2086.69	3359.39	-435.14	1054.18	1317.73	2371.91	0	32	60	2446	4262
3903	52.82	20	2906.66	529.59	-1905.85	5248.79	-529.59	1056.56	1320.7	2377.26	0	33	58	1495	4298
3904	52.95	22	2141.42	-241.13	-1310.03	3419.32	241.13	0	1323.74	1323.74	0	33	56	1736.59	4334
3905	52.59	19	2599.71	1284.98	-1642.41	2949.31	-1284.98	1051.95	1314.93	2366.88	0	34	55	1963.13	4370

As the controller uses SOC prediction based on Voltage only, SOC indication can be a bit rough during times of discharge due to its continuos load changes.




Available power
Series1
Chargers
Series1
Remaining power
Series1
Inverting
Phase 1
Series1
Phase 2
Series1
Phase 3
Series1