

User Description: MPPT Wind Power Charge Controller

windMax500, windMax1000, windMax1500, windMax2000, windMax2500

Version: WMR-MS_171210_EN

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Attention:

The positive pole of solar and battery are connected through.

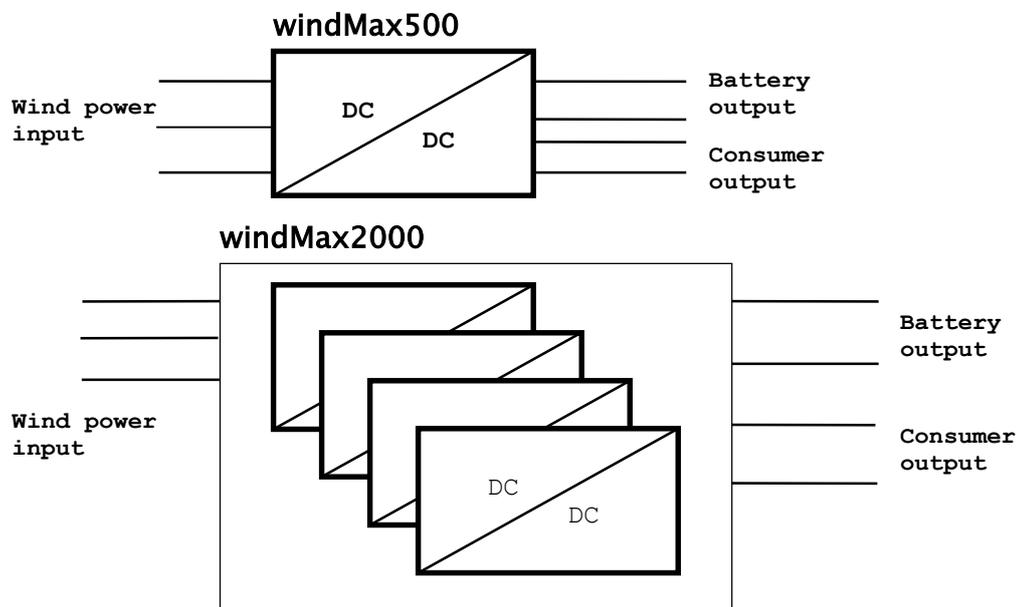
GND side is switched. Solar minus and battery minus are not on the same level and are not allowed to be connected to each other.

A. Function

The MPP (Maximum Power Point) – wind power charge controller show a very high degree of efficiency and higher charge currents (up to 200%) as compared to standard charge controllers.

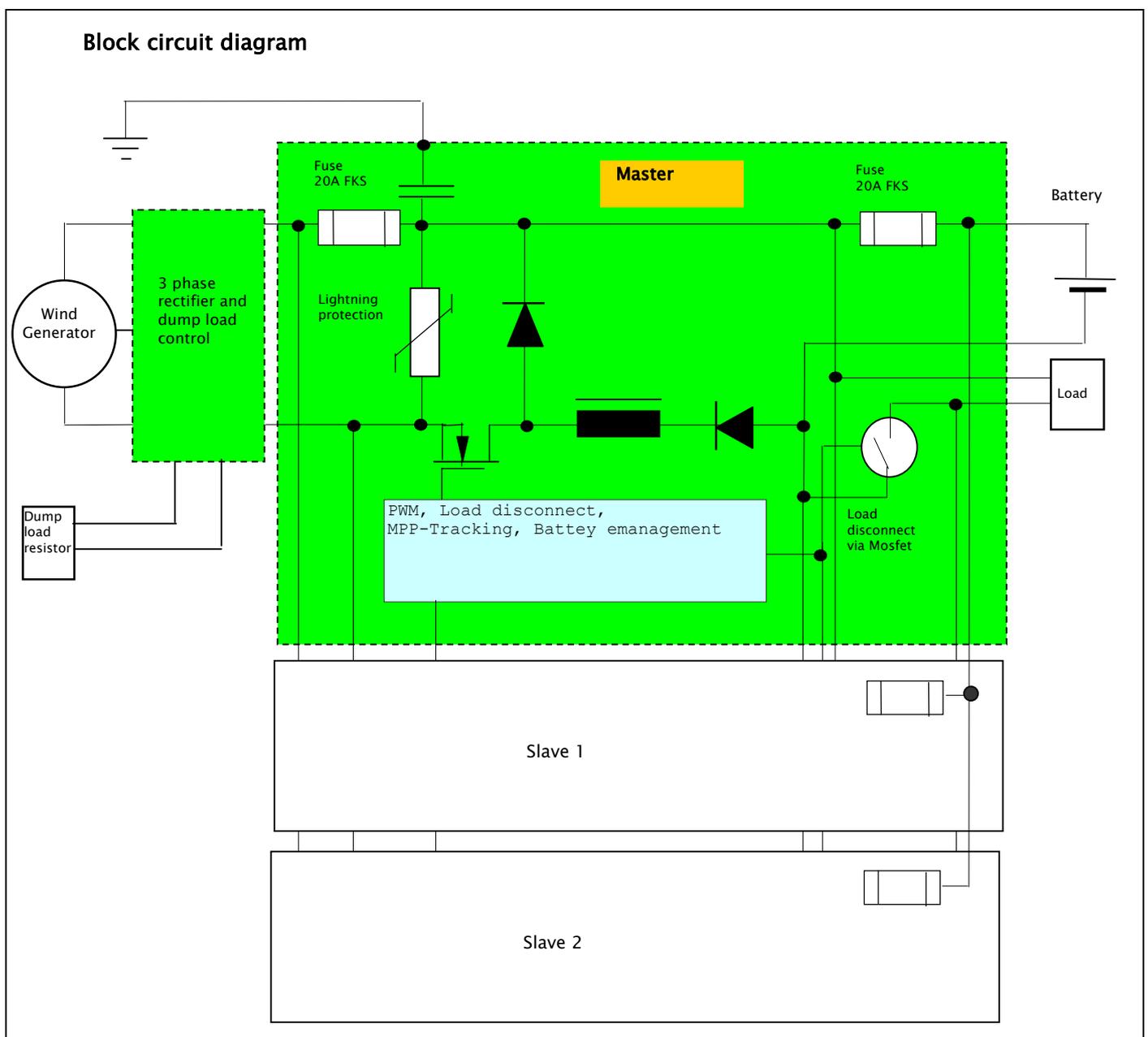
The modular concept consists of 12V, 24V or 48/20A units which are switched in parallel.

The *windMax500* consists of only one module; however the *windMax2000* consists of 4 modules. Each controller has a 3-phase rectifier at the input for a three-phase wind turbine.



- ⇒ The micro controller system consists of step-down-converters being regulated to maintain the nominal voltage of the wind power generator, as a function of the wind speed (power tracking) and to transform the total input to the battery level. This results in an increase of the charging current.
- ⇒ At the achievement of a maximum generator voltage of 160V dc, a load resistor will be switched on, at the output (RL+, RL-).
- ⇒ On the basis of power tracking an ideal power extraction is always guaranteed. This is shown for example through the increased charge current at a decreasing battery voltage.
- ⇒ At a lower wind speed (generator current smaller than 0.05% of the maximum charge current) the power tracker switches off and the controller works similarly like an ordinary controller.

- ⇒ To protect the battery from overcharge, at achieving the charge end voltage, the maintenance charge controlling sets in. The maintenance charge controlling moves the generator voltage towards off-load voltage and activates the dumpload circuite, until the charging current is off. With a temperature sensor, the end charging voltage can be changed. The higher the temperature is, the lower the end charging voltage will be. A breakresistor must be connected, in order to remove energy and reduce generator rotation.
- ⇒ To protect the battery from total discharge, a MOSFET throws off the load at the minus output.
- ⇒ The fine lightning protection consists of a varistor at the generator input
- ⇒ The device has a transistor inverse-polarity protection.



B. Operation

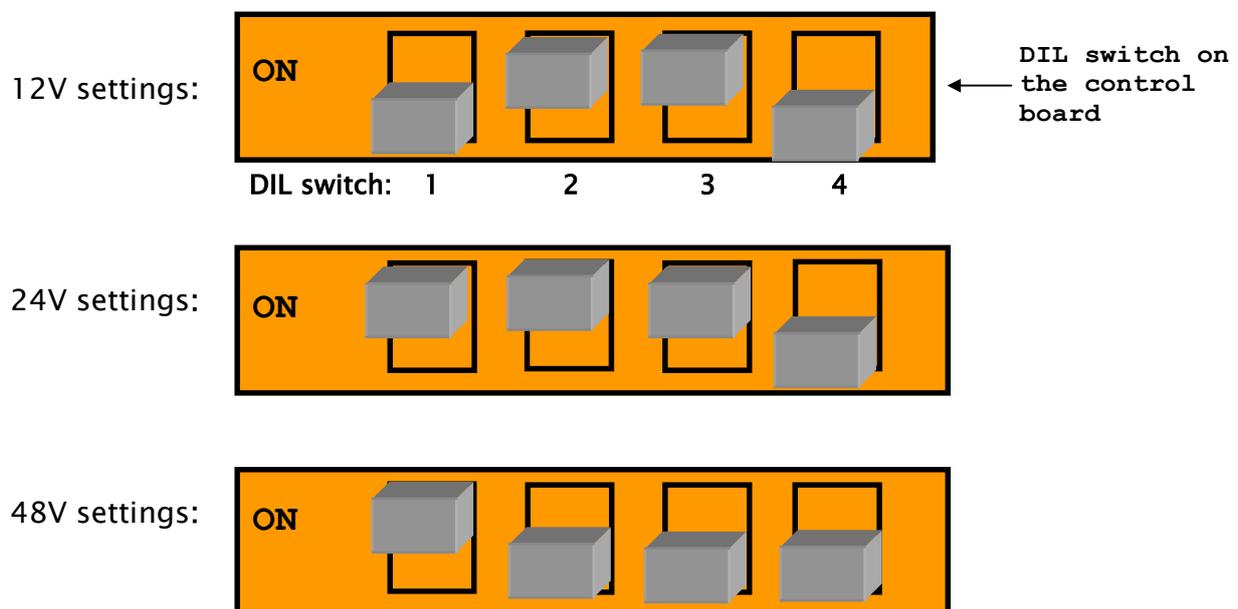
A 12V, 24V or a 48V lead battery can be used. For this the DIL switch on the controller board has to be switched. Fault battery setting is recognized by the software. The red and green leds are blinking and charge current is disrupted.

B.1 12V/24V/48V Change Over Switch

DIL switch 1 "OFF", 2 u. 3 "ON": 12V Battery voltage

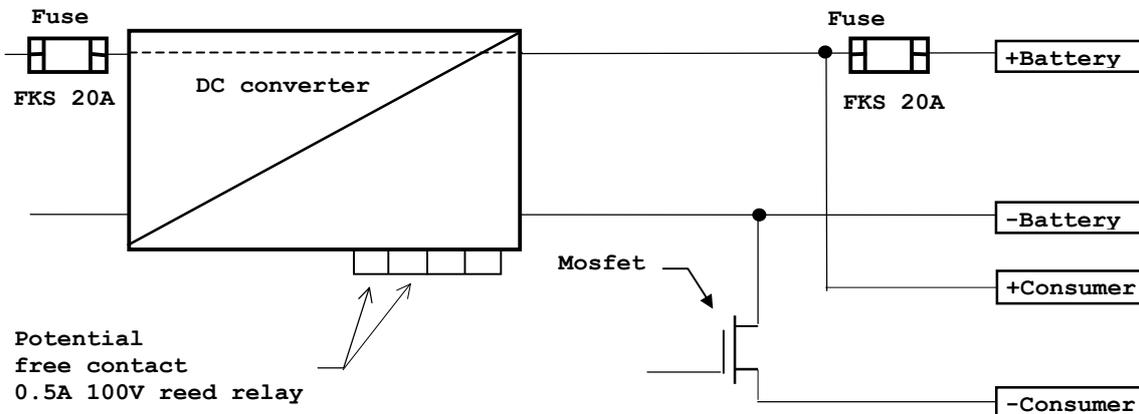
DIL switch 1, 2 u. 3 "ON": 24V Battery voltage

DIL switch 1 "ON", 2 u. 3 "OFF": 48V Battery voltage



B.2 Total Discharge Protection

The consumer will be charged directly by the battery voltage via a MOSFET. At high consumer currents, a minor drop in voltage at the MOSFET occurs (ca 0.2–0.3V).



If the battery voltage will be smaller than 10.8V/21.6V (at 20° C) for about 60 secs, the MOSFET disconnects the consumer from the battery (load control)

This is indicated through the red LED in the middle of the controll board.

Only if the battery voltage has reached 12.5V/25V, or through pressing the "reset" button, the load will be reconnected.

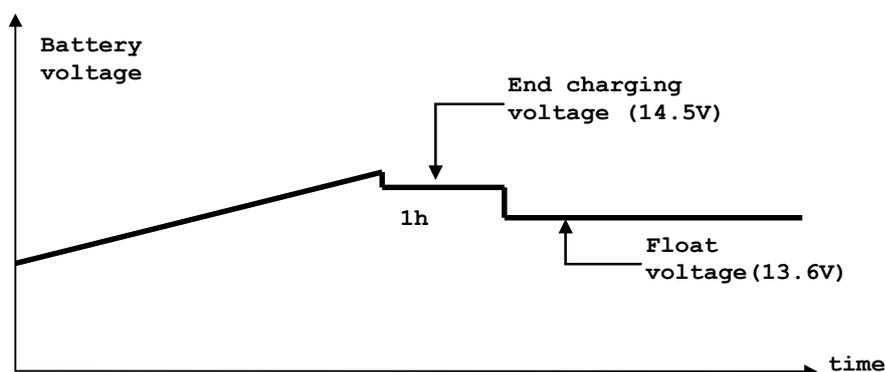
The load control is temperature controlled. That means, the battery temperature, as reported by the battery temperature sensor, determines the interrupting voltage of the load control as well as the reconnection voltage. The effect is -4mV/battery cell. (See section B.6 Temperature sensor KTY10-5).

At shortcut, the mosfet switches off immediately (Shortcut proof output). Further operation is only possible, if the charge controller is disconnected from battery and solar generator for a short time.

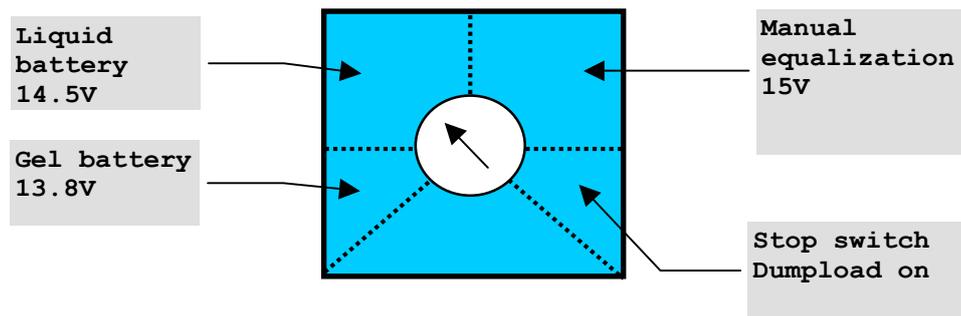
At overload (current > 18A/powermodul) the consumer output switches off and on in millisecond period.

B.3 Charging characteristics

The charging of the batteries proceeds according to an IU characteristics. At first, the battery is charged by a maximum current. As soon as the charging voltage exceeds 14.5V/28.2V, the micro controller switches to end charge voltage controlling, the yellow LED flashes. After 1 hour, the end charging voltage will be limited to 13.6V/27.2V maintenance charging. Only if the voltage drops below 13.5V/27.0V the controlling will be deactivated. This charging characteristic always guarantees a maximum charging current, until the end charging voltage is reached.



B.4 Function switch



The switch is located at the control device.

Gel Batteries

If the pointer of the potentiometer is at the left arrester, the device adjusts at 13.8V/27.6V battery voltage

Liquid batteries

If the pointer of the potentiometer is located in the 2nd quarter, the device adjusts at 14.5V/29V end charging voltage.

Manual equalization

If the pointer of the potentiometer is located in the 3rd quarter, the manual equalization is activated and the yellow LED display flashes. The equalization voltage is limited to 15V.

Stop switch

If the pointer of the potentiometer is located in the 4th quarter, the dump load resistor will be switched on within max. 5 seconds. **To deactivate the dump load, turn the poti back to its former position.**

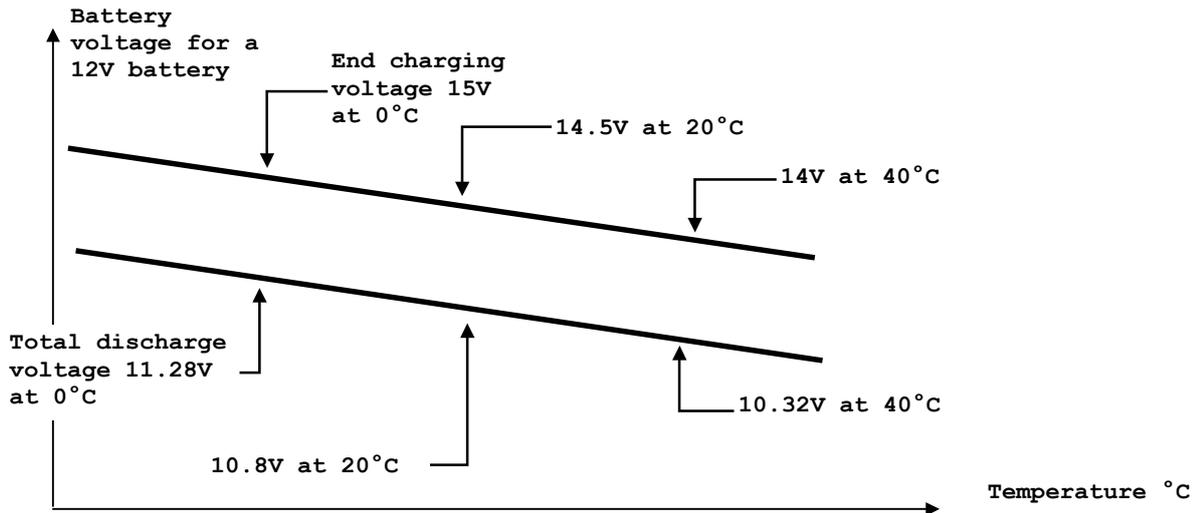
B.5 Reset

Pressing the "reset" button at the control device has the following effect:

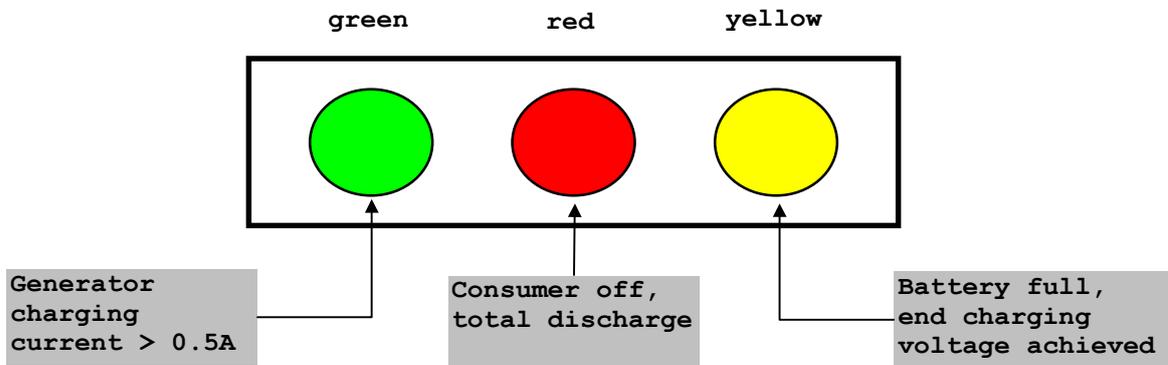
- ⇒ Reset of the total discharge protection at a voltage below 12.5V/25V/50V.
- ⇒ Continuously pressing: the green LED is on with reduced light, the operating point (rectified wind generator voltage, U_{gen}) decreases for about 0.5V per second. **The dilswitch 4 should be in "On" Position.**
- ⇒ After release of pressing and pressing again: the green LED is blinking 1x per second and the operating point increases for about 0.5V per second.

B.6 Temperature sensor *KTY10-5*

The temperature sensor controls the end charging voltage of the battery and therefore it has to be mounted on the battery. It will be 14.5V at 20°C. If the temperature sensor is waived, the sensor entrance has to be replaced by a fixed resistor of 1.9kOhm. This resembles to a battery temperature of 20°C. The effect on the end charging voltage is -4mV/°C/battery cell. At a battery temperature of 45°C, the controller disconnects the consumer—and charging current in order to protect the battery.



B.7 LEDs on control pcb



- | | |
|--------------------------------------------------------------|---------------------------------------------------------------|
| Continuously yellow: | end charging voltage achieved |
| Blinking yellow discontinuously: | dumpload on, while battery is full. |
| Blinking yellow: | manual equalization on, autom. equalization |
| Continuously red: | load throw-off (consumer output) |
| Short blinking green, 4x per sec.: | charge current lower than 0.2A/MPPT-Modul, no MPPT. |
| blinking green, 1.5x per sec.: | Charge current higher than 0.25A per MPPT-Modul), MPPT is on. |
| Continuously green: | charge current, while battery is full |
| Continuously green, reduced light, while Reset pressed: | Operating point goes down. |
| 1s blinking green, while Reset pressed 2 nd time: | Operating point goes up with 0.5V/sec. |

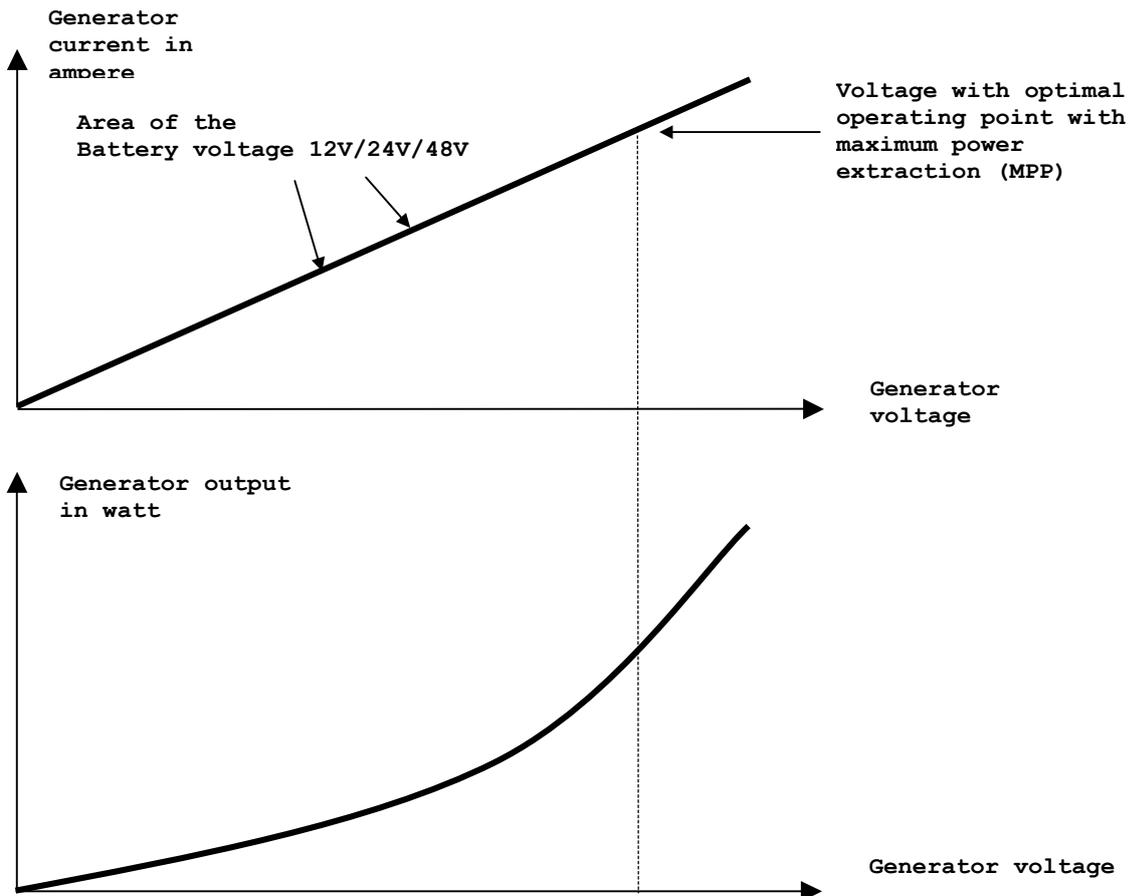
B.8 Safety installations

- ⇒ A fks fuse at the +accu exit protects the device from significant mechanical damage at excessive currents at the consumer output. The fuse disconnects the accu from the consumer and wind generator.
- ⇒ A fks fuse at the +generator entry disconnects the charge controller from the wind generator at excessive currents.
- ⇒ The accu output is protected from inverse-polarity. A transistor separates the accu from the chargecontroller, in case of inverse-polarity. **Inverse polarity protection is not functioning in case, when electrical power is generated by a connected wind turbine!!!**
- ⇒ Overheat switchoff is achieved within the electronic unit, as soon as the inside temperature of the box reaches 70°C.
- ⇒ In connection with the use of a KTY10-5 accu temperatur sensor, the controller is switched off at 45°C accu temperature.
- ⇒ At start up, the green and yellow LED is blinking for a few seconds. If this blinking does not stop, the battery setting is not properly done. Please check the dil switches.
- ⇒ A lightning protection is placed at the Generator input, right after the fuse (Varistor+Capacitor).
- ⇒ Earth connection has to be done to the enclosure inside. There is no galvanic connection to the electronic circuit.

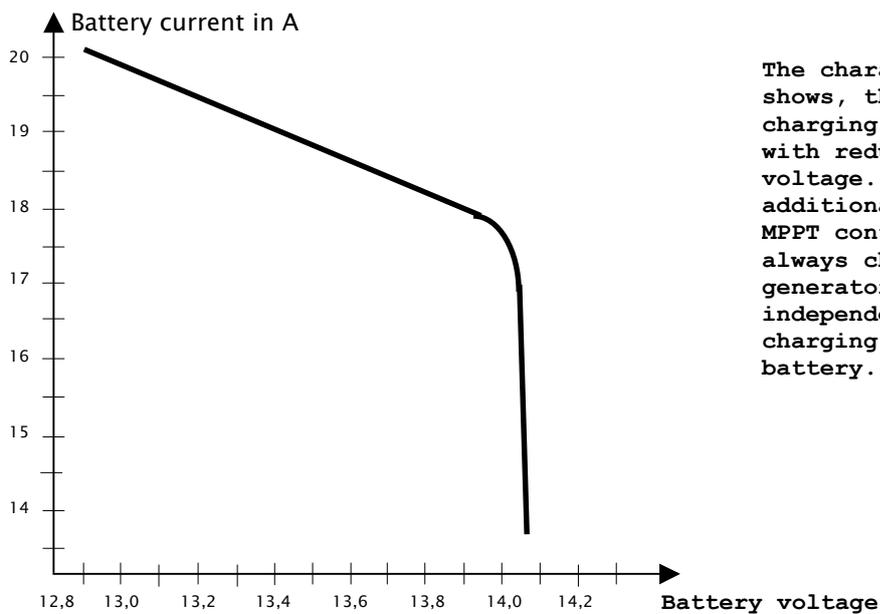
B.9 MPP tracking

The voltage of a connected wind turbine should not exceed 220Vdc in any case. At 160Vdc the dumpload is activated and breaks the turbine, if a resistor is connected to the dumpload output. The MPP tracking works in intervals of 0.5 sec for about 0.5-2sec. It automatically searches for the ideal operating point between 15Vdc and 170Vdc generator voltage.

Below 0.05% of the maximum allowed charging current of the device, the controlling switches to the battery level.



The curves of a windpower generator above show, that the power increases nonlinear with rising voltage. The MPPT-charger transforms the electrical power from the point of highest voltage down to the battery level.



B.10 Potential-free Contact

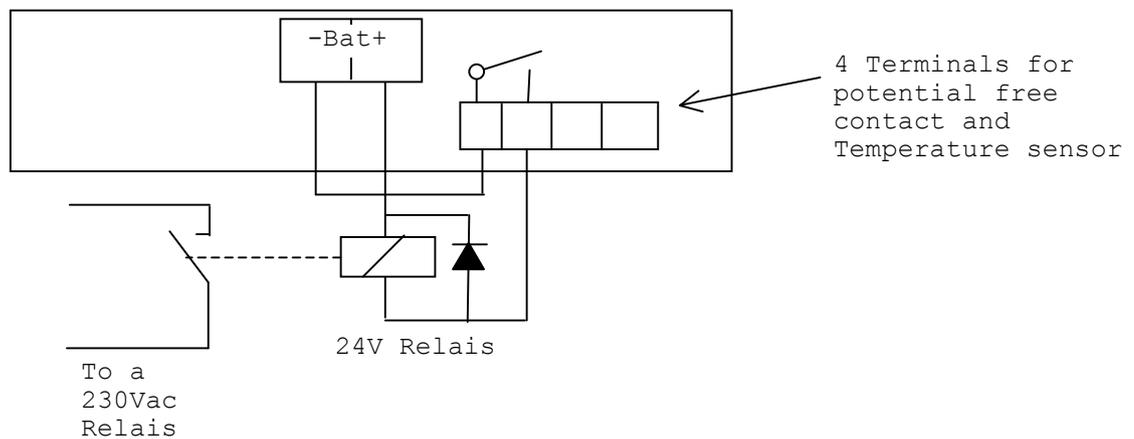
A potential-free contact (100V) is closed via a relais (0.5A, 12V), as soon as the battery voltage goes below

- 11.3V at 12V battery,
- 22.6V at 24V battery,
- 45.2V at 48V battery

Please refer to section D. Connection diagram.

This contact is available via to terminals on the power pcb, leftside of the temperature sensor terminals. The maximum allowed voltage on the relais contacts is 100Vdc

How to switch a 230V relais with the potential-free contact:
This could be important for controlling a diesel generator.



B.11 Dump Load Resistor

The dump load resistor is connected at the output of the 3 phase rectifier. It's a diversion load control. The resistance should be such, that the windMax loads the wind generator sufficiently at high wind speeds in order to avoid an increase of the generator voltage. With a rectified generator voltage of $U_{\text{gendc}}=160\text{V}$, the dump load resistor will be connected. At $U_{\text{gendc}}=125\text{V}$, the dump load resistor will be disconnected.

Additionally the dump load resistor can be switched on, by turning the blue potentiometer to the 4th section or right marking. (see B4, functional switch).

Recommended dimensions:

Value of resistance:
 $R=160\text{V}\times 160\text{V}/(2*\text{P}_{\text{nom}})$

Output at resistor:
 $\text{DUMPLoad}=165\text{V}\times 165\text{V}/R$

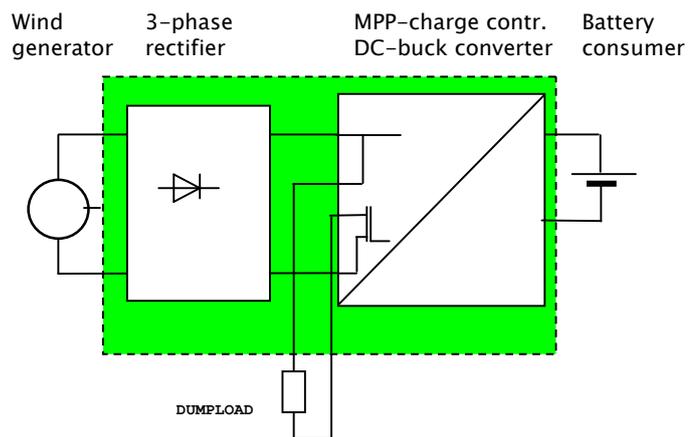
Example: $\text{P}_{\text{nom}}=620\text{W}$

$R=160\times 160/(2*620)=20.650\text{ohm} \Rightarrow 200\text{ohm}$
 $R_{\text{min}} \geq 100\text{ohm}$

$P=165\times 165/20=1361\text{W}$

Since the dumpload control switches on at P_{nom} , the power of the dumpload Resistor can be P_{nom} , which means:

$\text{P}_{\text{dump_real}}=\text{P}_{\text{nom}}=620\text{W}$



B.12 Efficiency

The diagrams below, show efficiencies of to 2 different battery voltages 28V/56V and generator-DC-voltages of 33V to 99V. The higher the battery voltage is, the better the efficiency is. However, they also show that with a higher difference in generator-dc-voltage to battery voltage, the efficiency decreases slightly. The optimal efficiency would be at 56V battery voltage and at 66V generator-DC-voltage (see diagram 2).

Diagram 1: Efficiency at 28V battery voltage and 33V to 82V generator-dc-voltage

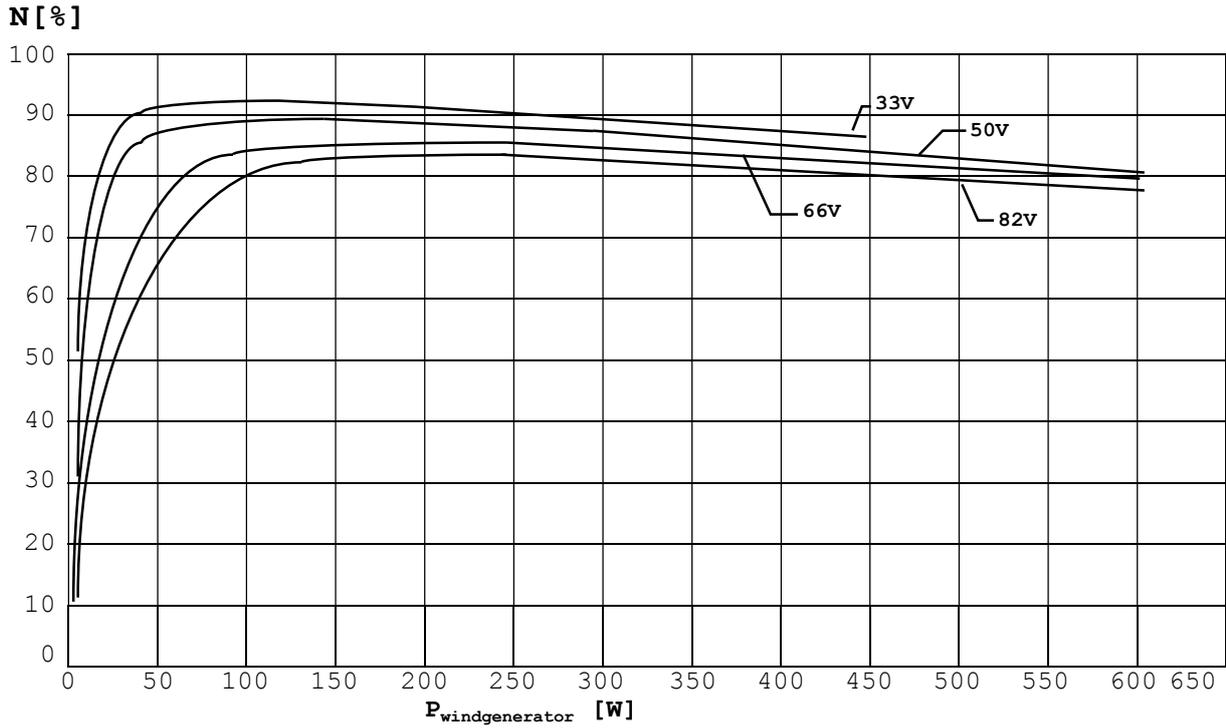
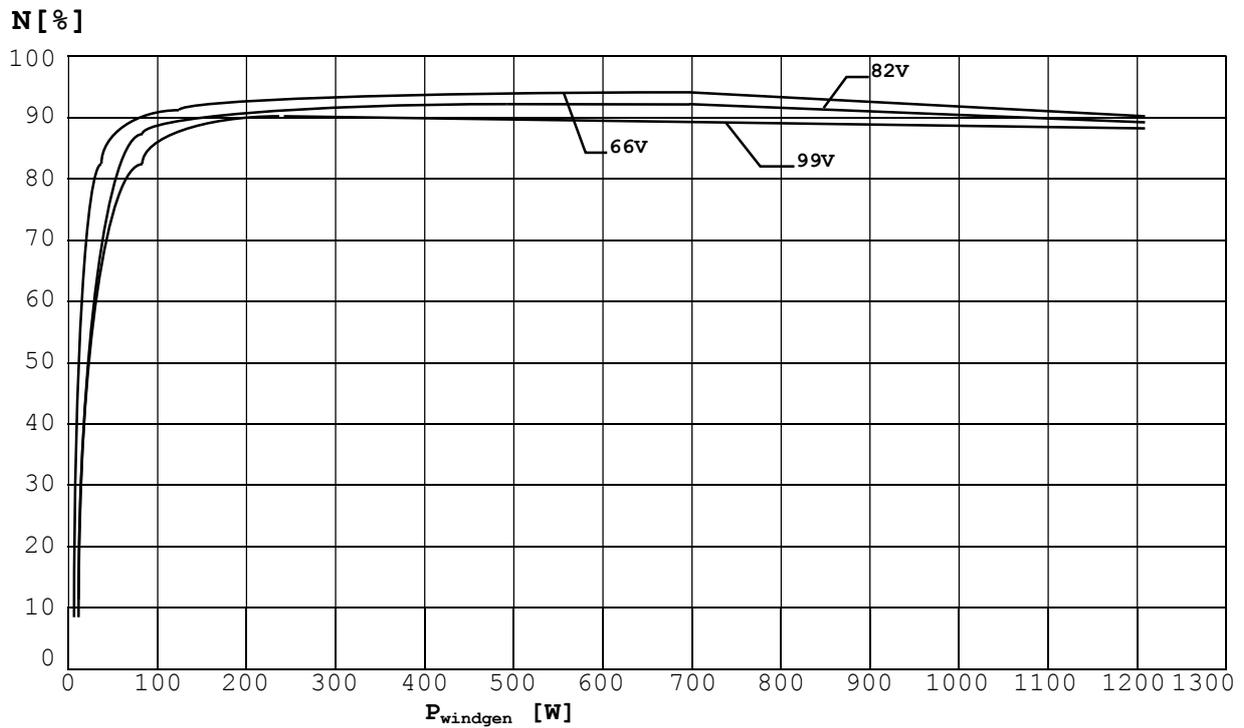


Diagram 2: Efficiency at 56V battery voltage and 66V to 99V generator-dc-voltage



C. Technical Data

C.1 48V Configuration

Typ	windMax 500	windMax 1000	wndMax 1500	windMax 2000	windMax 2500
Number of MPP-Modules	1	2	3	4	5
Ventilation	no	no	yes	yes	yes
Max. wind generator output	771W	1543W	2314W	3085W	3856W
Max. charging current	12.5A	25A	37.5A	50A	62.5A
Max. generator-DC-voltage	200Vdc				
AC-voltage (3phase)	140Vac				
Dump load resistor Re- / Deconnection at Udc or Uac (3phase)	160Vdc/150Vdc 118Vac/111Vac				
Max. generator AC current	8A	16A	16A	24A	24A
Max. battery voltage at 20°C	58.0V				
Max. float voltage	54.0V				
Max. Consumer current	12.5A	25A	37.5A	50A	62.5A
Deep discharge protection	Switch off voltage., Uta	43.2V at 20°C			
	Switch off delay	60 seconds			
	Switch on voltage, Ute	50.0V at 20°C			
	Volt.drop at Mosfet at Imax	0.24V			
Temperature sensor	Input	Connection of a 1.9kOhm resistor or temperature sensor KTY 10-5			
	Switch off temperature	45°C			
	Effect on end charging voltage and deep discharge voltage	-96mV/°C			
Self consumption	7mA	10mA	13mA	16mA	19mA
Efficiency at half load and at 80V generator voltage inclusive 3-phase recitifier	91%	91%	91%	91%	91%
Fuses	2x20A FKS	4x20A FKS	6x20A FKS	8x20A FKS	10x20A FKS
LED displays: Left, green Middle, red Right, yellow	Charging current, MPP controlling activated Load discharge Battery fully charged, flashing when equalization control activated				
Housing: material	Alu casting	Sheetsteel	Sheetsteel	Sheetsteel	Sheetsteel
Housing: measures in mm wxhxd	220x80x120	300x300x150	300x400x150	300x500x210	300x500x210
Weight ca	2kg	11kg	12.5kg	17kg	17.5kg
Protection category	IP65	IP65	IP65	IP54	IP54
Certification	CE	CE	CE	CE	CE
Admissible operating temperature	-20°C to +50°C				
Admissible relative humidity	90%				
Connecting terminals	Lizz 10sq.mm, single wire 16sq.mm			Lizz 25sqmm, one wire 35sqmm	
Cable glands	3xPG16, 2xPG7, 1xPG11				

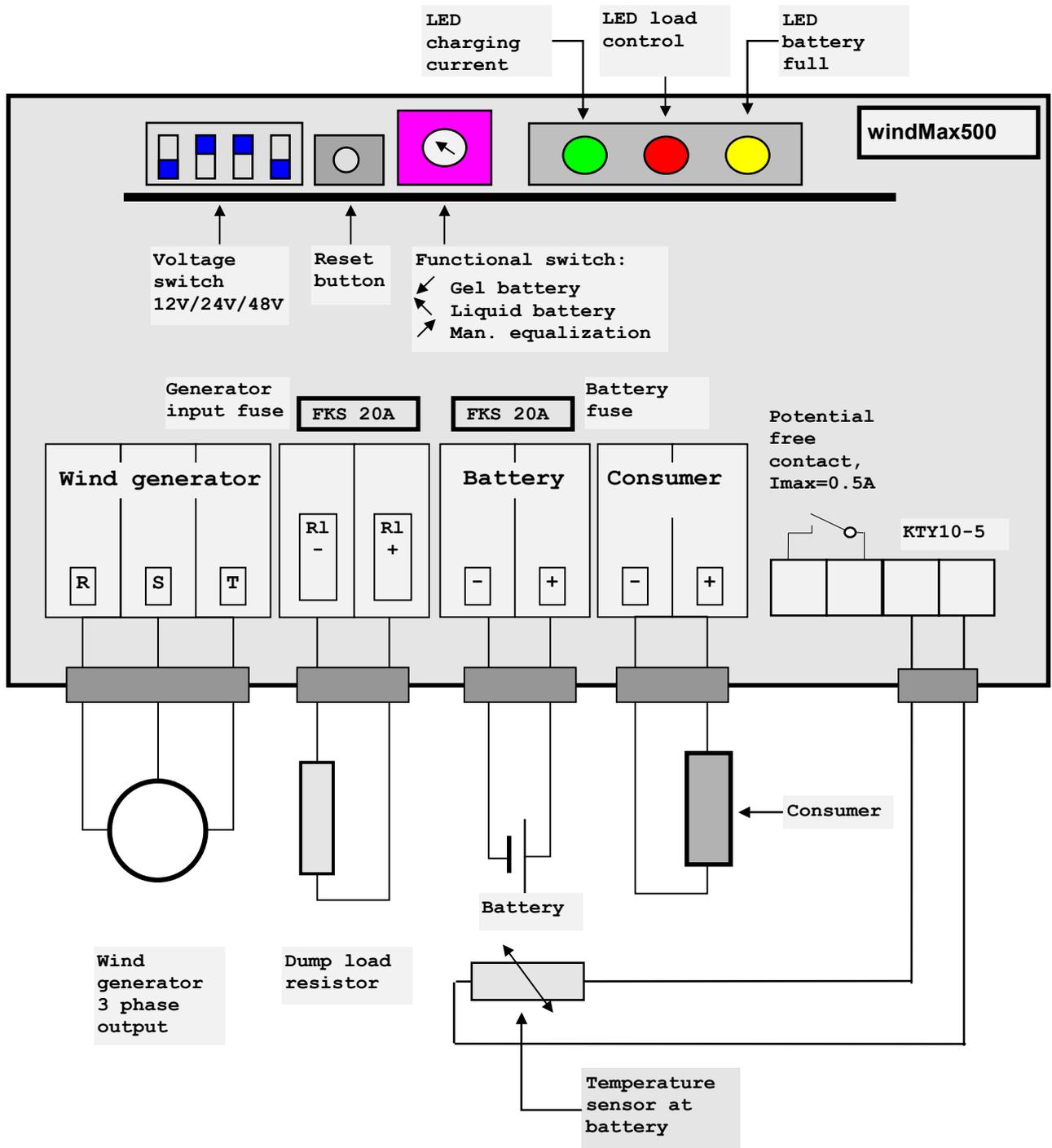
C.2 24V Konfiguration

Typ	windMax 500	windMax 1000	windMax 1500	wndMax 2000	windMax 2500
Number of MPP-Modules	1	2	3	4	5
Ventilation	no	no	yes	yes	yes
Max. wind generator output	617W	1234W	1851W	2468W	3085W
Max. charging current	20A	40A	60A	80A	100A
Max. generator-DC-voltage	200Vdc				
AC-voltage (3phase)	140Vac				
Dump load resistor Re- / Deconnection at Udc or Uac (3phase)	160Vdc/150Vdc 118Vac/111Vac				
Max. generator AC current	8A	16A	16A	24A	24A
Max. battery voltage at 20°C	29.0V				
Max. float voltage	27.0V				
Max. Consumer current	12.5A	25A	37.5A	50A	62.5A
Deep discharge protection	Switch off voltage., Uta	21.6V at 20°C			
	Switch off delay	60 seconds			
	Switch on voltage, Ute	25.0V at 20°C			
	Volt.drop at Mosfet at I _{max}	0.24V			
Temperature sensor	Input	Connection of a 1.9kOhm resistor or temperature sensor KTY 10-5			
	Switch off temperature	45°C			
	Effect on end charging voltage and deep discharge voltage	-48mV/°C			
Self consumption	7mA	10mA	13mA	16mA	19mA
Efficiency at half load and at 80V generator voltage inclusive 3-phase rectifier	89%	89%	89%	89%	89%
Fuses	2x20A FKS	4x20A FKS	6x20A FKS	8x20A FKS	10x20A FKS
LED displays: Left, green Middle, red Right, yellow	Charging current, MPP controlling activated Load discharge Battery fully charged, flashing when equalization control activated				
Housing: material	Alu casting	Sheetsteel	Sheetsteel	Sheetsteel	Sheetsteel
Housing: measures in mm wxhxd	220x80x120	300x300x150	300x400x150	300x500x210	300x500x210
Weight ca	2kg	11kg	12.5kg	17kg	17.5kg
Protection category	IP65	IP65	IP65	IP54	IP54
Certification	CE	CE	CE	CE	CE
Operating temperature	-20°C to +50°C				
Admissible relative humidity	90%				
Connecting terminals	Lizz 10sq.mm, single wire 16sq.mm			Lizz 25sqmm, one wire 35sqmm	
Cable glands	3xPG16, 2xPG7, 1xPG11				

C.3 12V Konfiguration

Typ	windMax 500	windMax 1000	windMax 1500	windMax 2000	windMax 2500
Number of MPP-Modules	1	2	3	4	5
Ventilation	no	no	yes	yes	yes
Max. wind generator output	322W	644W	967W	1289W	1611W
Max. charging current	20A	40A	60A	80A	100A
Max. generator-DC-voltage	200Vdc				
AC-voltage (3phase)	140Vac				
Dump load resistor Re- / Deconnection at Udc or Uac (3phase)	160Vdc/150Vdc 118Vac/111Vac				
Max. generator AC current	8A	16A	16A	24A	24A
Max. battery voltage at 20°C	14.5V				
Max. float voltage	13.5V				
Max. Consumer current	12.5A	25A	37.5A	50A	62.5A
Deep discharge protection	Switch off voltage., Uta	10.8V at 20°C			
	Switch off delay	60 seconds			
	Switch on voltage, Ute	12.5V at 20°C			
	Volt.drop at Mosfet at Imax	0.24V			
Temperature sensor	Input	Connection of a 1.9kOhm resistor or temperature sensor KTY 10-5			
	Switch off temperature	45°C			
	Effect on end charging voltage and deep discharge voltage	-24mV/°C			
Self consumption	7mA	10mA	13mA	16mA	19mA
Efficiency at half load and at 80V generator voltage inclusive 3-phase rectifier	90%	90%	90%	90%	90%
Fuses	2x20A FKS	4x20A FKS	6x20A FKS	8x20A FKS	10x20A FKS
<u>LED displays:</u> Left, green Middle, red Right, yellow	Charging current, MPP controlling activated Load discharge Battery fully charged, flashing when equalization control activated				
Housing: material	Alu casting	Sheetsteel	Sheetsteel	Sheetsteel	Sheetsteel
Housing: measures in mm wxhxd	220x80x120	300x300x150	300x400x150	300x500x210	300x500x210
Weight ca	2kg	11kg	12.5kg	17kg	17.5kg
Protection category	IP65	IP65	IP65	IP54	IP54
Certification	CE	CE	CE	CE	CE
Admissible operating temperature	-20°C to +50°C				
Admissible relative humidity	90%				
Connecting terminals	Lizz 10sq.mm, single wire 16sq.mm			Lizz 25sqmm, one wire 35sqmm	
Cable glands	3xPG16, 2xPG7, 1xPG11				

D. Connection diagram



Fittings

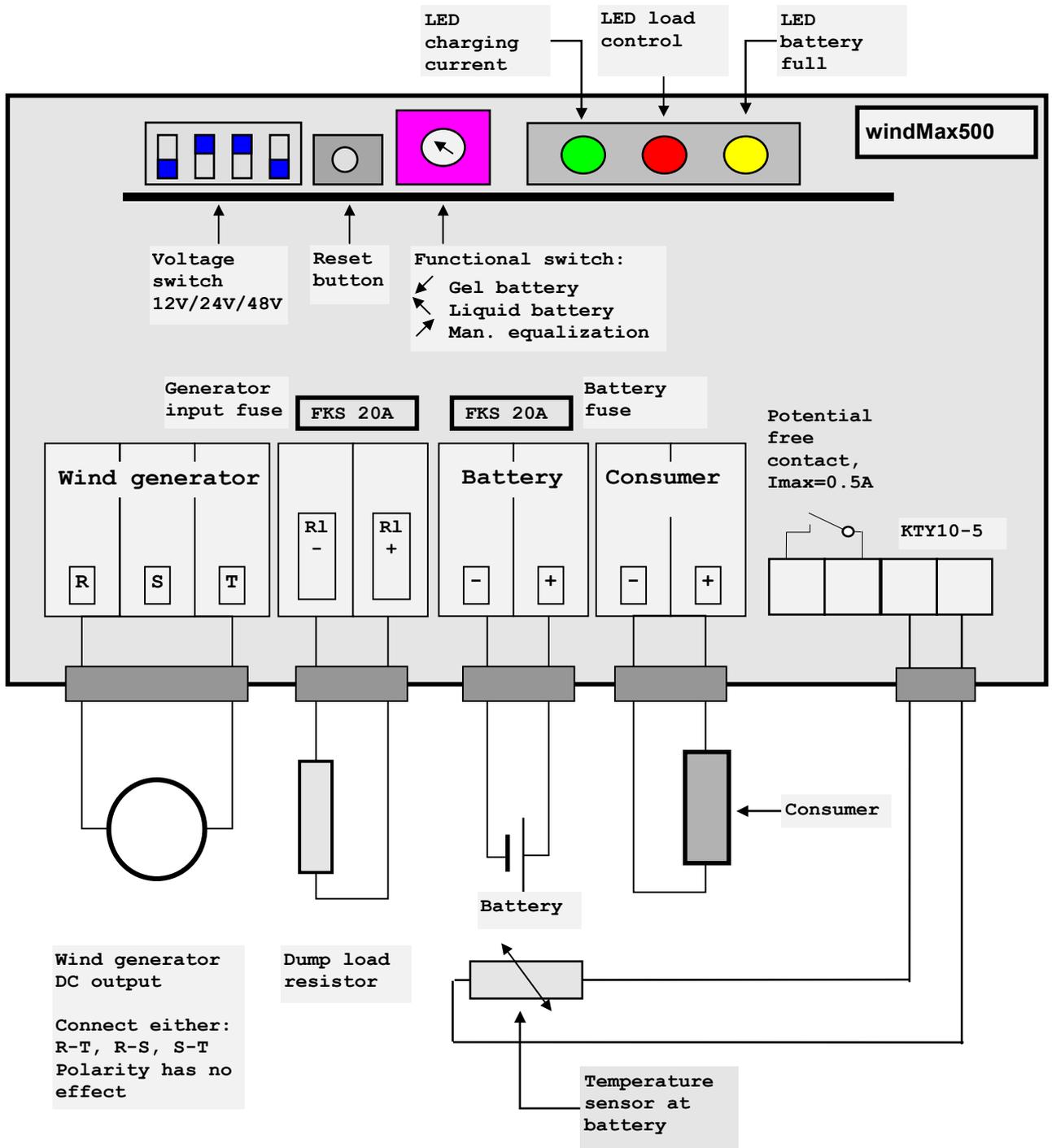
Wind generator, battery, consumer: PG16

Dump load resistor: PG9-PG11

Temperature sensor: PG7

Earth \perp : PG7

Connection to a DC output windgenerator:



E. Installation Guidelines

For the *windMax500*, the wind power generator, consumer and battery cables have to be connected through the PG fittings inside at the terminals. For that purpose, the cover of the enclosure needs to be taken off.

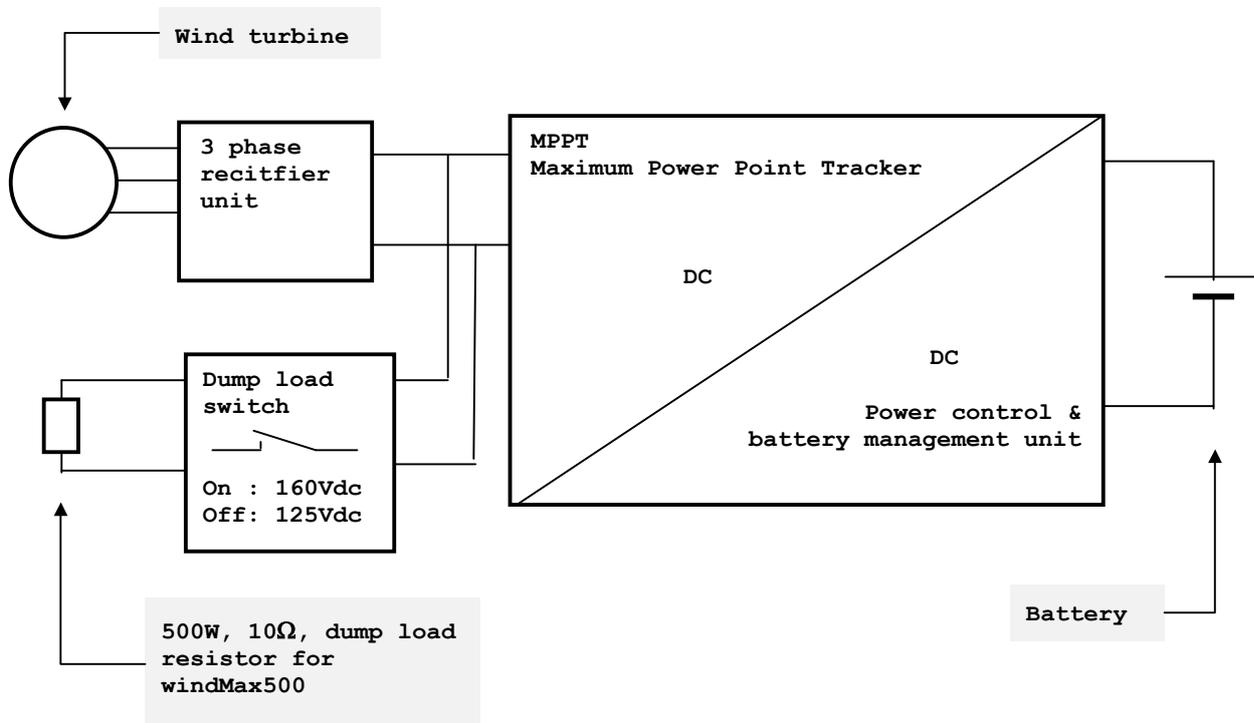
In order to connect the devices *windMax1000* to *windMax2500*, the device has to be opened with a switchboard key. The terminals for the three-phase current input of the wind power generator as well as the terminals for the battery and the consumer are located inside. (See D. Connection diagram.)

1. Connect the battery cable
The minus cable to the terminal "-battery", the plus cable to the terminal "+battery". Battery is switched off.
Attention: Reverse polarity should not destroy the device!
2. Now connect the consumer.
The minus cable to "-consumer", the plus cable to "+consumer".
3. Turn the blue poti up to right marking. Dumpload is now on.
4. Now connect the wind generator cables.
5. Connect the battery to the battery cable.
Normally the LED display indicates "battery empty", (red). The battery voltage is still below 12.5V/25V. Only if the wind generator starts charging current, the voltage increases above 12.5V/25V and the red LED goes off.
6. Now connect the wind power generator to the cable. Turn the blue poti into its battery select position. See section B4
The left LED (green) indicates that charging current flows. After a short period the red LED switches off and the consumer is connected.
7. Approximately every 0.5 second, the green LED is pulsing, indicating tracking procedure.

The PG fittings serve as a pull relief for the cables at the same time. In order to achieve this, the cable has to be strong enough so that the gasket inside the PG fittings presses on the cable while tightening the fittings.

Please check this by trying to move the cable after tightening the fittings. It should not move anymore.

F. Security Concept



If battery is full and wind generator voltage rises above 106Vac the charge controller needs to be protected from overvoltage, since electrical power is not consumed from the battery. In this case the dump load switch turns on and causes the turbine to slow down its rotation and saving it from overload and mechanical stress due to excessive rotational speed of the blades.

G. Warranty

The manufacturer will remove all construction and material faults that occur during the warranty time of two years and that do not impair the proper functioning of the device. Guarantee is effected by either rectification or replacement. This does not include the costs involved in exchanging, dispatching or re-installing. Any further claims against the manufacturer arising from this obligation, particularly compensation claims due to losses in sales, reimbursement payments as well as indirect damages are excluded if not forced by law.

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