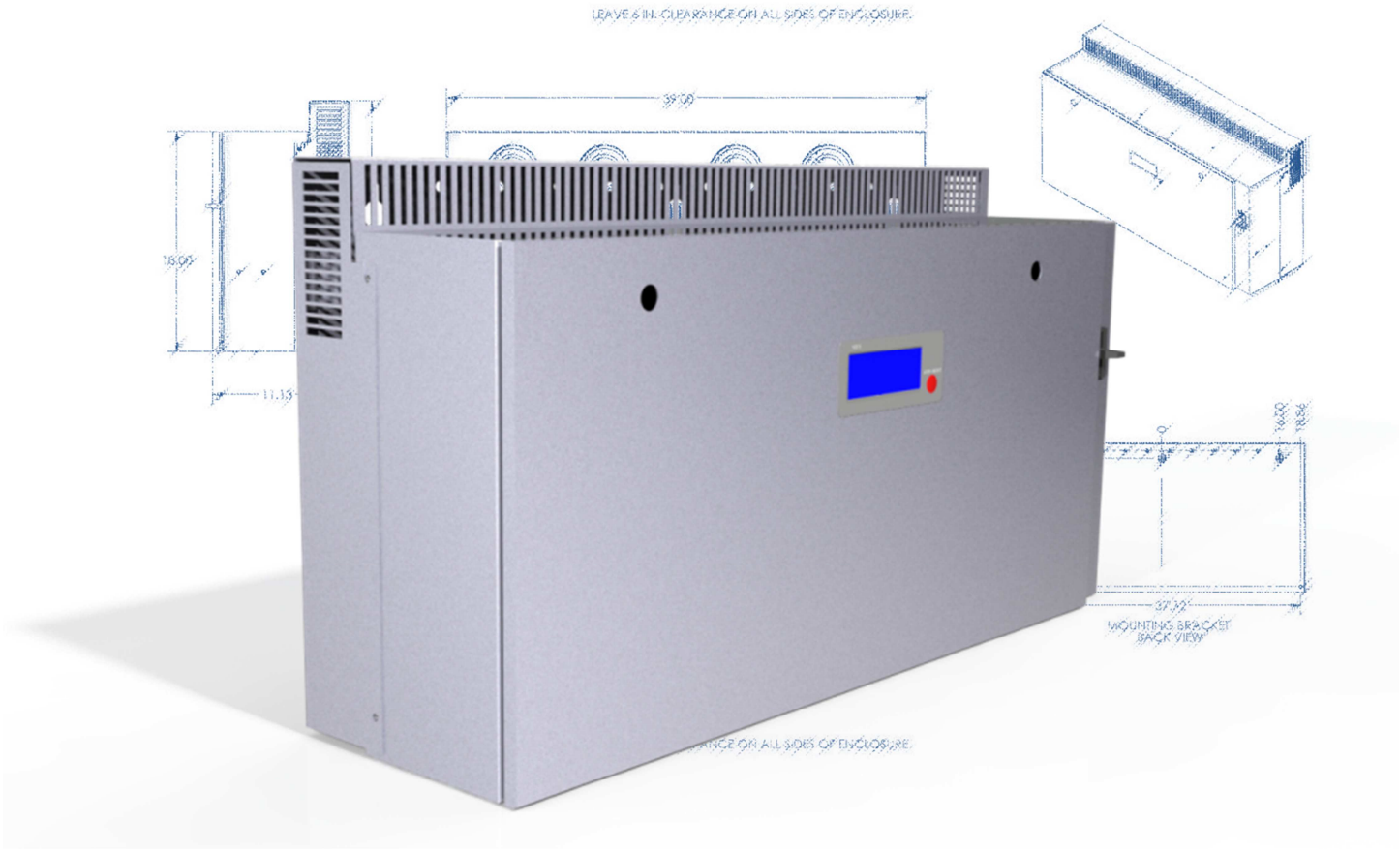


VCSII – Battery Charger

Bergey WindPower Co.

Owner's Manual

Rev: 1

June 17, 2016

Table of Contents

Important Safety Instructions

This manual contains important information concerning the installation of your VCSII. We strongly recommend that you read and familiarize yourself with its contents.

At several points in this manual, items of special interest or significant impact are highlighted by one of the following symbols:


DANGER: Hazard or unsafe practice that could cause personal injury or death.

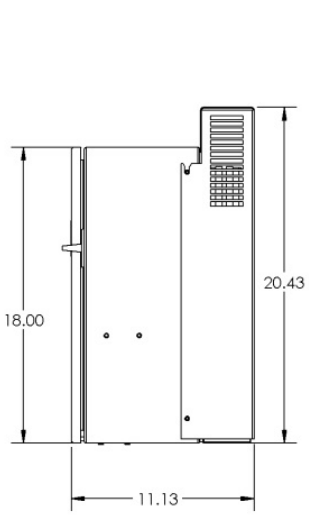

WARNING: Hazard or unsafe practice which could cause product damage.

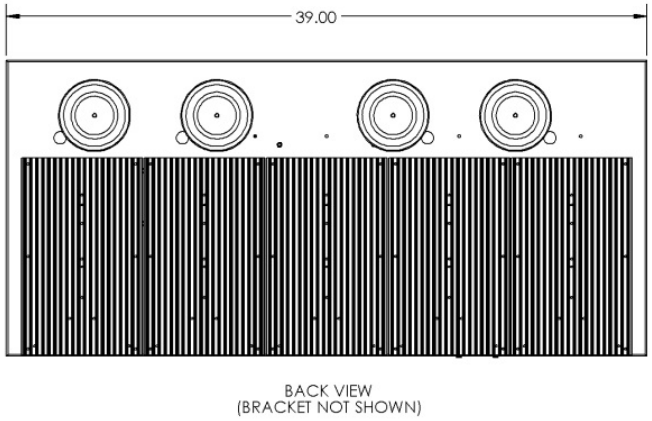
SAVE THESE INSTRUCTIONS This manual contains important instructions for the VCSII that shall be followed during installation and maintenance of the converter.
The output field wiring terminal (Battery) can be used for connection of a maximum of: One 350MCM wire per terminal (1 wire for each line)
The input field wiring terminal (Turbine) can be used for connection of a maximum of: One 2 AWG wire per terminal (1 wire per phase per terminal provided).
The field-wiring terminals shall be connected using the following wire types: Copper Conductors Only (Input Turbine connection) Use No. 8 - 2 AWG, 75°C copper wire only Copper Conductors Only (Output Battery connection) Use No. 6 – 350MCM, 75°C copper wire only
The following symbols are used as markings on this product with the following meanings: Equipment grounding conductor – 
This converter is intended for operation in an indoor NEMA 1 compatible environment having a maximum ambient temperature of 40°C (104° F).
CAUTION To reduce the risk of fire, connect only to a circuit provided with 200 amperes maximum branch-circuit over-current protection in accordance with the National Electrical Code, ANSI/NFPA 70.
 Hot surfaces – To reduce the risk of burns – Do not touch The enclosure and the rear heatsink can exceed 70°C (150°F).
Note that the input and output circuits are isolated from the enclosure. In accordance with Clause 15.2.1.1 of CAN/CSA-C22.2 No. 107.1, system grounding, when required by the *Canadian Electrical Code, Part I,* is the responsibility of the installer.

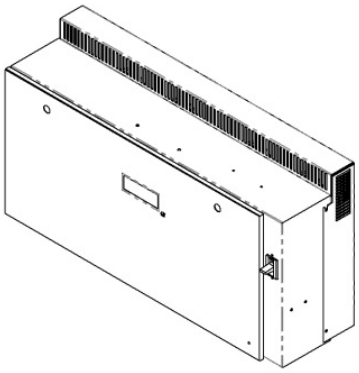
VCS II Mounting

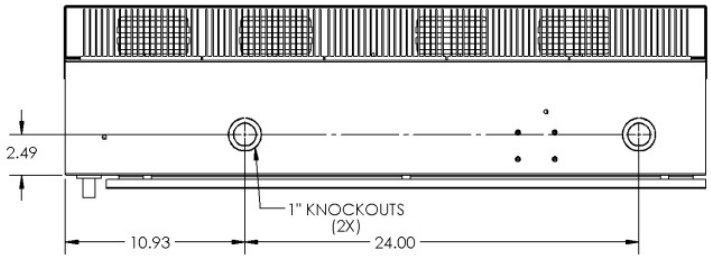
WARNING: **Confirm factory default settings are appropriate for you battery bank prior to commissioning to avoid potential battery damage. See the "VCS II User Configuration" section.**

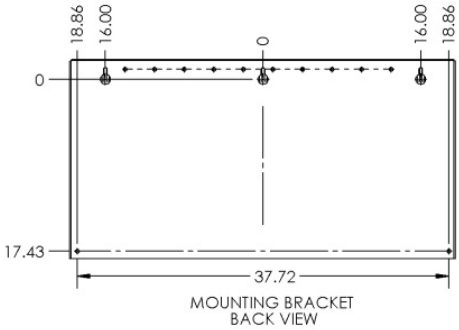
The internal portion of the enclosure is sealed with no need for ventilation. The heatsinks, breaker and external inductors are re not sealed to the enclosure and results in a NEMA 1 rating. The bottom and top of the enclosure needs at least 12" of clearance to allow for natural convection through the rear heatsinks and inductors. Mount the enclosure indoors away from excess heat, vibration and moisture, and as close to the battery bank as possible.











The mounting bracket must be secured to the wall before mounting the enclosure. The hardware to mount the bracket is not included. There are three main mounting holes at the top of the bracket on 16" centers and two holes at the bottom of the bracket. There are also 10 additional mounting holes at the top that can be used if necessary. Make certain that the combined mounting screws used are capable of holding the weight of 110 lb. (50 kg).

 **DANGER:** The unit is heavy. Use appropriate lifting methods.

 **WARNING:** Care must be used when lifting the enclosure to the mounting bracket to avoid any contact with the inductors to prevent their damage.

To install the VCSII enclosure on the bracket, partially put the two top screws (M6x20) on both sides of the enclosure. They will be used to hang the unit on the bracket. Carefully lift the enclosure placing close attention to the rear magnetics so they are not damaged. Once the enclosure is hung, the bottom two mounting bolts can be installed and all tightened (Torque to 4.5N-m, 40in-lb).

Conduit enters the bottom of the enclosure through provided knockouts. Drilling extra holes into the enclosure is not recommended. The turbine leads enter on the left side of the enclosure, while the battery connections are on the right side.

 **WARNING:** Clearance is required all sides of the enclosure for proper cooling.

Clearance is required on all sides of the VCSII to ensure proper cooling by natural convection. Each side of the enclosure requires at least 6 inches (150mm) of clearance and the top and bottom of the enclosure requires a minimum of 12inches (300mm) to ensure a free flow of air through the rear mounted heatsinks. The VCS II does not use nor require fans for cooling for normal operation. The door is hinged on the bottom - ensure that there are no obstructions to the door opening.

VCS II User Interface

The charge controller user/operator control input interface consists of a single push button on the front panel of the charge controller. The single push button performs different functions depending on the controller system state and operating mode and the length of time that the button is pressed.

The user push button functions are defined as follows:

1) No press of the user push button:

    a) If the charge controller is powered up and there are no faults, the charge controller will automatically go to the Charging Mode. The charge controller will charge the batteries, and then maintain the battery voltage at a specified float voltage.

2) Press and hold the user push button for more than 0.5 seconds and less than 5 seconds:

    a) If the charge controller is powered up and in the Charging Mode with no faults, the charge controller will go to the Manual Idle Mode.

    b) If the charge controller is powered up and in the Manual Idle Mode with no faults, the charge controller will go to the Charging Mode.

    c) If the charge controller is powered up and in a Fault State, the charge controller will clear the faults and go to the Charging Mode.

    d) If the charge controller is powered up and in the Equalize Mode with no faults, the charge controller will exit Equalize Mode and go to the Charging Mode.

3) Press and hold the user push button for more than 5 seconds:

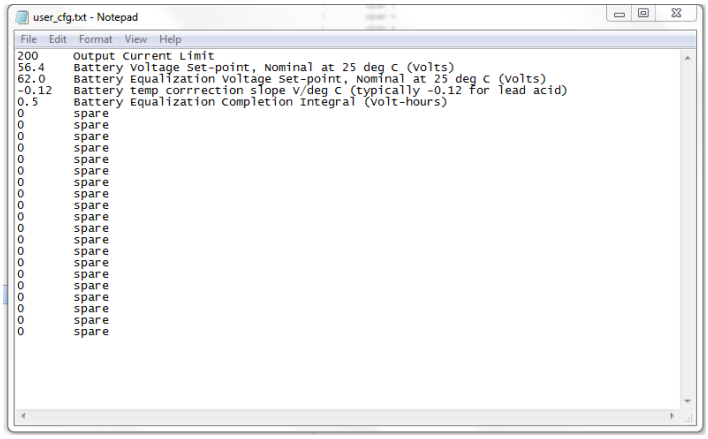
    a) If the charge controller is powered up and in the Charging Mode with no faults, the charge controller will go to the Equalize Mode for a predetermined time period. After Equalization, the charge controller will go to normal charging mode, and will maintain the battery voltage at a specified float voltage.

VCS II User Configuration

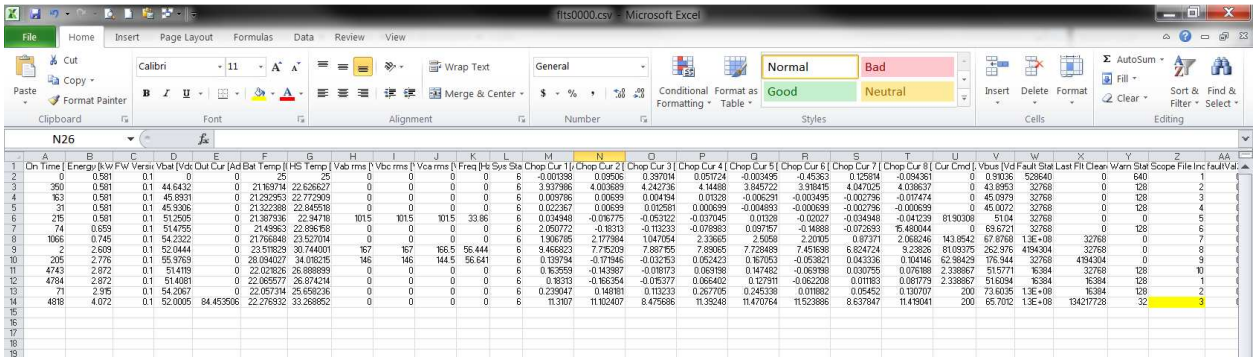
WARNING: **Confirm factory default settings are appropriate for you battery bank prior to commissioning to avoid potential battery damage.**

The VCS II user configurable parameters are stored on the SD card along with other files which should not be altered without consultation of Bergey WindPower Co. The file user_cfg.txt ***is tab delimited*** and allows setting all of the configuration settings. The file may be easily configured with any text file editor.

- ***"Output Current Limit":*** [Adc], Factory default is "200". This setting should not exceed 200 amps, but may be reduced to allow use with smaller battery banks.
- ***"Battery Voltage Set-point":*** [Vdc], Factory default is "56.4", for open celled lead acid batteries. The voltage regulation is a constant voltage scheme, there are no bulk or float settings.
- ***"Battery Equalization Voltage Set-point":*** [Vdc], Factory default is "62.0". The equalization Voltage is settable, and if a battery temperature sensor is present, the equalization voltage is temperature compensated. Equalization time is dependant on the "*Battery Equalization Completion Integral".*
- ***"Battery temp correction slope":*** [Vdc/degC], Factory default is "-0.12", for lead acid batteries. Battery temperature compensation operates if an optional 10kΩ battery temperature sensor is installed. There is only a slope correction vs temperature.
- ***"Battery Equalization Completion Integral":*** [V*hrs], Factory default is "0.5", essentially deactivating the equalization feature until the installer changes this value. Consult your battery manufacturer. This value is defined as Volt*hours. For example at a setting of "4.0", once equalization is engaged, the batteries will be held above the nominal voltage either 1 volt for 4 hours, or 2 volts for 2 hours, etc. This allows for the intermittent nature of the wind, and as soon as the totalized Volt*Hours are completed the controller will return to its normal Battery Voltage Set-point.

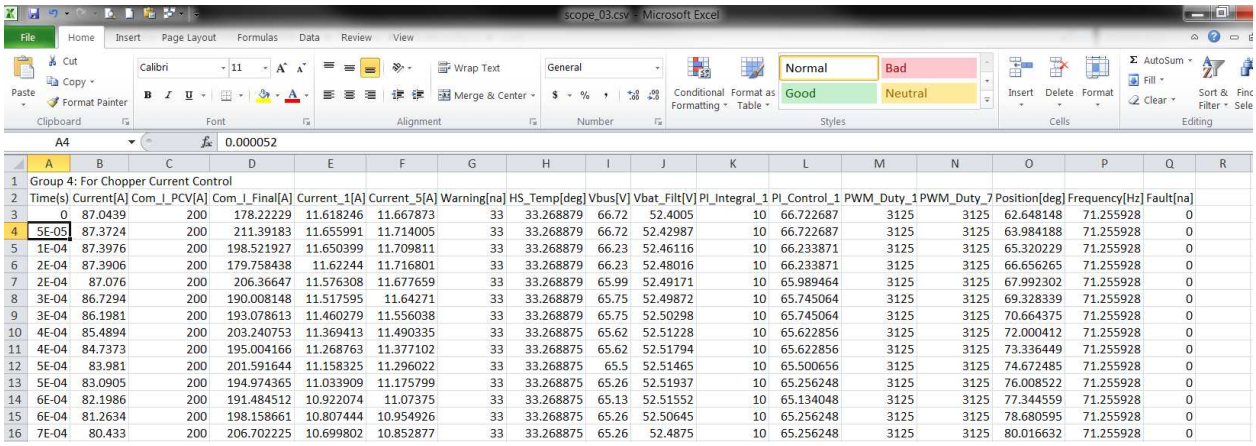


There is a fault log stored on the SD card for all faults encountered- fltsxxxx.csv. The highest number xxxx is the latest fault log. Basic data surrounding the fault are stored. Additionally there is high resolution scope data files created during each fault. To avoid filling the SD card with too much data there are only 10 detailed fault scope files stored. The files are overwritten in numerical order. To find the last fault log file look in column Z for the scope file index (shown in yellow below).



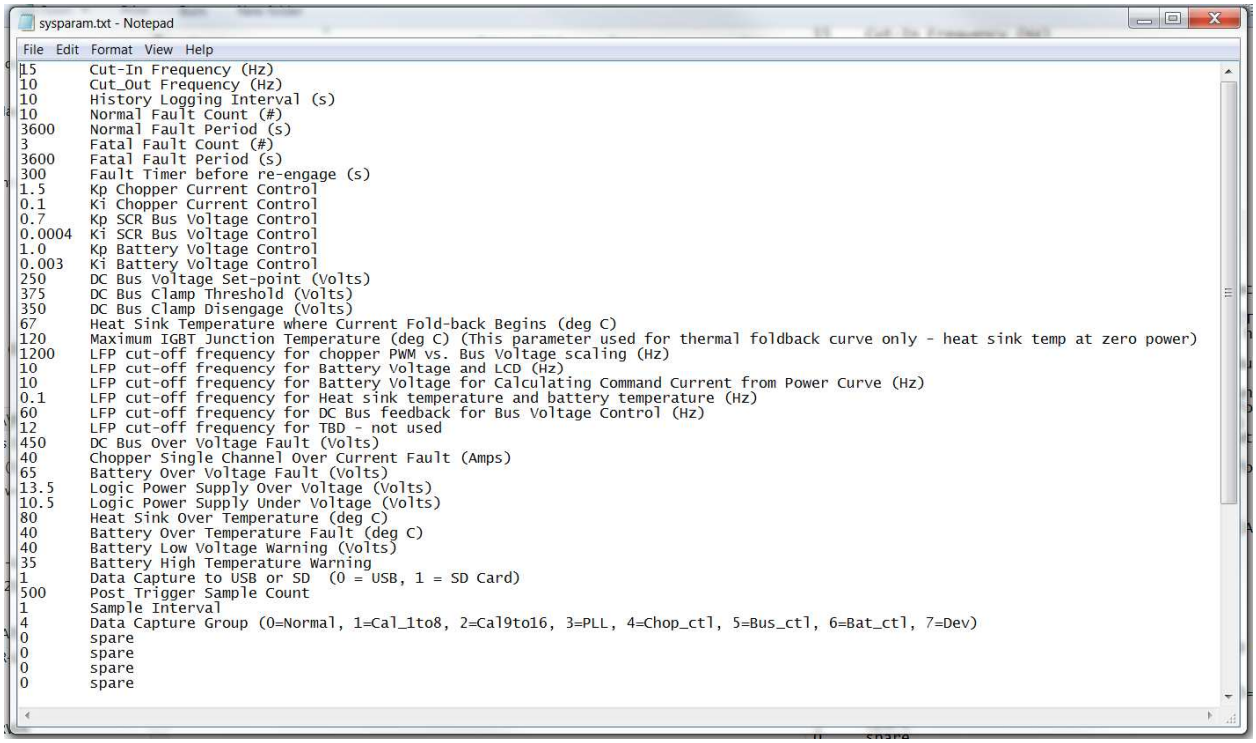
Then find the scope_xx.csv that corresponds to that fault, in this case scope_03.csv. Keep in mind that only scope logs for the last 10 faults are stored.

The scope fault logs show 16 channels of data surrounding the faults, with a 52 µs resolution. There are 2000 samples saved in each scope file. The channels which will be saved are selected from several groups of data, which data group is saved is set in the last line in sysparam.txt (see below)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Group 4: For Chopper Current Control																	
2	Time(s)	Current[A]	Com_I_PCV[A]	Com_I_Final[A]	Current_1[A]	Current_5[A]	Warning[na]	HS_Temp[deg]	Vbus[V]	Vbat_Filt[V]	PI_Integral_1	PI_Control_1	PWM_Duty_1	PWM_Duty_7	Position[deg]	Frequency[Hz]	Fault[na]	
3	0	87.0439	200	178.22229	11.618246	11.667873	33	33.268879	66.72	52.4005	10	66.722687	3125	3125	62.648148	71.255928	0	
4	5E-05	87.3724	200	211.39183	11.655991	11.714005	33	33.268879	66.72	52.42987	10	66.722687	3125	3125	63.984188	71.255928	0	
5	1E-04	87.3976	200	198.521927	11.650399	11.709811	33	33.268879	66.23	52.46116	10	66.233871	3125	3125	65.320229	71.255928	0	
6	2E-04	87.3906	200	179.758438	11.62244	11.716801	33	33.268879	66.23	52.48016	10	66.233871	3125	3125	66.656265	71.255928	0	
7	2E-04	87.076	200	206.36647	11.576308	11.677659	33	33.268879	65.99	52.49171	10	65.989464	3125	3125	67.992302	71.255928	0	
8	3E-04	86.7294	200	190.008148	11.517595	11.64271	33	33.268879	65.75	52.49872	10	65.745064	3125	3125	69.328339	71.255928	0	
9	3E-04	86.1981	200	193.078613	11.460279	11.556038	33	33.268879	65.75	52.50298	10	65.745064	3125	3125	70.664375	71.255928	0	
10	4E-04	85.4894	200	203.240753	11.369413	11.490335	33	33.268875	65.62	52.51228	10	65.622856	3125	3125	72.000412	71.255928	0	
11	4E-04	84.7373	200	195.004166	11.268763	11.377102	33	33.268875	65.62	52.51794	10	65.622856	3125	3125	73.336449	71.255928	0	
12	5E-04	83.981	200	201.591644	11.158325	11.296022	33	33.268875	65.5	52.51465	10	65.500656	3125	3125	74.672485	71.255928	0	
13	5E-04	83.0905	200	194.974365	11.033909	11.175799	33	33.268875	65.26	52.51937	10	65.256248	3125	3125	76.008522	71.255928	0	
14	6E-04	82.1986	200	191.484512	10.922074	11.07375	33	33.268875	65.13	52.51552	10	65.134048	3125	3125	77.344559	71.255928	0	
15	6E-04	81.2634	200	198.158661	10.807444	10.954926	33	33.268875	65.26	52.50645	10	65.256248	3125	3125	78.680595	71.255928	0	
16	7E-04	80.433	200	206.702225	10.699802	10.852877	33	33.268875	65.26	52.4875	10	65.256248	3125	3125	80.016632	71.255928	0	

Sysparam.txt contains most of the tuning calibrations; do not change any values except History Logging Interval or Data Capture Group. The history files are long term performance type data that are saved to the SD Card. They are saved at 10 minute increments by default (not the 10 seconds shown below). The Data Capture Group can be changed to help with fault diagnosis in case there are faults that require different high resolution data to diagnose.

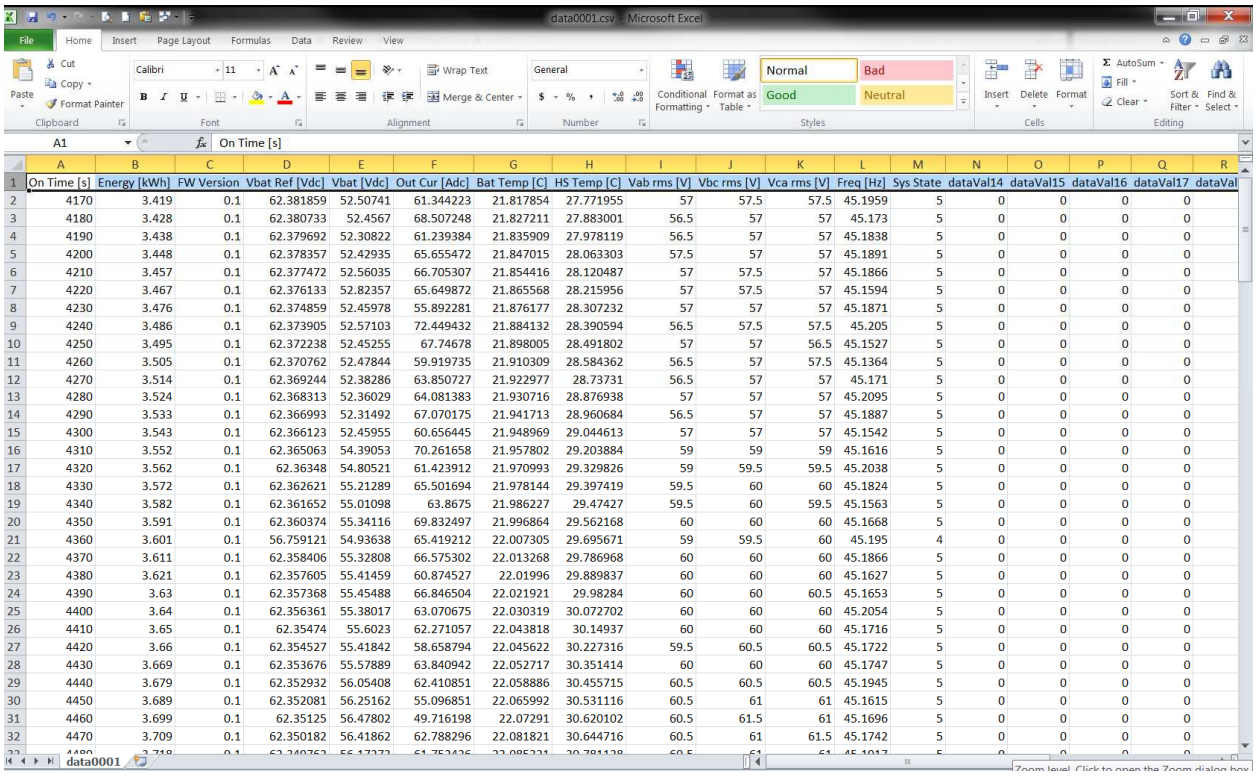


sysparam.txt - Notepad

File Edit Format View Help

```
15      Cut-In Frequency (Hz)
10      Cut_Out Frequency (Hz)
10      History Logging Interval (s)
10      Normal Fault Count (#)
3600    Normal Fault Period (s)
3       Fatal Fault Count (#)
3600    Fatal Fault Period (s)
300     Fault Timer before re-engage (s)
1.5     Kp Chopper Current Control
0.1     Ki Chopper Current Control
0.7     Kp SCR Bus Voltage Control
0.0004  Ki SCR Bus Voltage Control
1.0     Kp Battery Voltage Control
0.003   Ki Battery Voltage Control
250     DC Bus Voltage Set-point (Volts)
375     DC Bus Clamp Threshold (Volts)
350     DC Bus Clamp Disengage (Volts)
67      Heat Sink Temperature where Current Fold-back Begins (deg C)
120     Maximum IGBT Junction Temperature (deg C) (This parameter used for thermal foldback curve only - heat sink temp at zero power)
1200    LFP cut-off frequency for chopper PWM vs. Bus Voltage scaling (Hz)
10      LFP cut-off frequency for Battery Voltage and LCD (Hz)
10      LFP cut-off frequency for Battery Voltage for Calculating Command Current from Power Curve (Hz)
0.1     LFP cut-off frequency for Heat sink temperature and battery temperature (Hz)
60      LFP cut-off frequency for DC Bus feedback for Bus Voltage Control (Hz)
12      LFP cut-off frequency for TBD - not used
450     DC Bus Over Voltage Fault (Volts)
40      Chopper Single Channel Over Current Fault (Amps)
65      Battery Over Voltage Fault (Volts)
13.5    Logic Power Supply Over Voltage (Volts)
10.5    Logic Power Supply Under Voltage (Volts)
80      Heat Sink Over Temperature (deg C)
40      Battery Over Temperature Fault (deg C)
40      Battery Low Voltage Warning (Volts)
35      Battery High Temperature Warning
1       Data Capture to USB or SD  (0 = USB, 1 = SD Card)
500     Post Trigger Sample Count
1       Sample Interval
4       Data Capture Group (0=Normal, 1=Cal_1to8, 2=Cal9to16, 3=PLL, 4=Chop_ctl, 5=Bus_ctl, 6=Bat_ctl, 7=Dev)
0       spare
0       spare
0       spare
0       spare
```

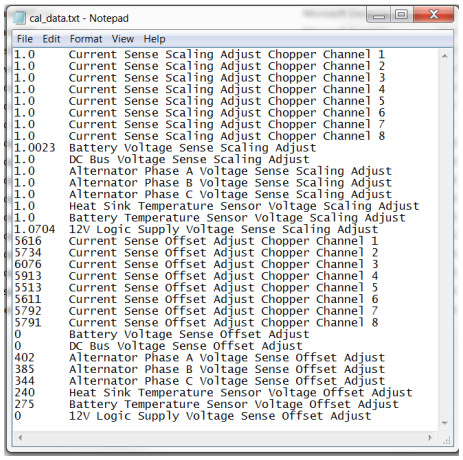
The long term data files are stored by default at 10 minute intervals; there is no real time clock in the VCS II so the on time is stored in the first column, with the cumulative energy in kWh stored in the second column. Snapshot data are also stored regarding battery voltage, current, and temperature. To help with turbine and wiring diagnosis all 3 phase voltages, as well as the turbine frequency are stored. The dataxxxx.csv files are the only place that cumulative kWh and run time are stored, so if the files are deleted or modified an incorrect kWh or run time will be displayed.



data0001.csv - Microsoft Excel

On Time [s]	Energy [kWh]	FW Version	Vbat Ref [Vdc]	Vbat [Vdc]	Out Cur [Adc]	Bat Temp [C]	HS Temp [C]	Vab rms [V]	Vbc rms [V]	Vca rms [V]	Freq [Hz]	Sys State	dataVal14	dataVal15	dataVal16	dataVal17	dataVal
4170	3.419	0.1	62.381859	52.50741	61.344223	21.817854	27.771955	57	57.5	57.5	45.1959	5	0	0	0	0	
4180	3.428	0.1	62.380733	52.4567	68.507248	21.827211	27.883001	56.5	57	57	45.173	5	0	0	0	0	
4190	3.438	0.1	62.379692	52.30822	61.239384	21.835909	27.978119	56.5	57	57	45.1838	5	0	0	0	0	
4200	3.448	0.1	62.378357	52.42935	65.655472	21.847015	28.063303	57.5	57	57	45.1891	5	0	0	0	0	
4210	3.457	0.1	62.377472	52.56035	66.705307	21.854416	28.120487	57	57.5	57	45.1866	5	0	0	0	0	
4220	3.467	0.1	62.376133	52.82357	65.649872	21.865568	28.215956	57	57.5	57	45.1594	5	0	0	0	0	
4230	3.476	0.1	62.374859	52.45978	55.892281	21.876177	28.307232	57	57	57	45.1871	5	0	0	0	0	
4240	3.486	0.1	62.373905	52.57103	72.449432	21.884132	28.390594	56.5	57.5	57.5	45.205	5	0	0	0	0	
4250	3.495	0.1	62.372238	52.45255	67.74678	21.898005	28.491802	57	57	56.5	45.1527	5	0	0	0	0	
4260	3.505	0.1	62.370762	52.47844	59.919735	21.910309	28.584362	56.5	57	57.5	45.1364	5	0	0	0	0	
4270	3.514	0.1	62.369244	52.38286	63.850727	21.922977	28.73731	56.5	57	57	45.171	5	0	0	0	0	
4280	3.524	0.1	62.368313	52.36029	64.081383	21.930716	28.876938	57	57	57	45.2095	5	0	0	0	0	
4290	3.533	0.1	62.366993	52.31492	67.070175	21.941713	28.960684	56.5	57	57	45.1887	5	0	0	0	0	
4300	3.543	0.1	62.366123	52.45955	60.656445	21.948969	29.044613	57	57	57	45.1542	5	0	0	0	0	
4310	3.552	0.1	62.365063	54.39053	70.261658	21.957802	29.203884	59	59	59	45.1616	5	0	0	0	0	
4320	3.562	0.1	62.36348	54.80521	61.423912	21.970993	29.329826	59	59.5	59.5	45.2038	5	0	0	0	0	
4330	3.572	0.1	62.362621	55.21289	65.501694	21.978144	29.397419	59.5	60	60	45.1824	5	0	0	0	0	
4340	3.582	0.1	62.361652	55.01098	63.8675	21.986227	29.47427	59.5	60	59.5	45.1563	5	0	0	0	0	
4350	3.591	0.1	62.360374	55.34116	69.832497	21.996864	29.562168	60	60	60	45.1668	5	0	0	0	0	
4360	3.601	0.1	56.759121	54.93638	65.419212	22.007305	29.695671	59	59.5	60	45.195	4	0	0	0	0	
4370	3.611	0.1	62.358406	55.32808	66.575302	22.013268	29.786968	60	60	60	45.1866	5	0	0	0	0	
4380	3.621	0.1	62.357605	55.41459	60.874527	22.01996	29.889837	60	60	60	45.1627	5	0	0	0	0	
4390	3.63	0.1	62.357368	55.45488	66.846504	22.021921	29.98284	60	60	60.5	45.1653	5	0	0	0	0	
4400	3.64	0.1	62.356361	55.38017	63.070675	22.030319	30.072702	60	60	60	45.2054	5	0	0	0	0	
4410	3.65	0.1	62.35474	55.6023	62.271057	22.043818	30.14937	60	60	60	45.1716	5	0	0	0	0	
4420	3.66	0.1	62.354527	55.41842	58.658794	22.045622	30.227316	59.5	60.5	60.5	45.1722	5	0	0	0	0	
4430	3.669	0.1	62.353676	55.57889	63.840942	22.052717	30.351414	60	60	60	45.1747	5	0	0	0	0	
4440	3.679	0.1	62.352932	56.05408	62.410851	22.058886	30.455715	60.5	60.5	60.5	45.1945	5	0	0	0	0	
4450	3.689	0.1	62.352081	56.25162	55.096851	22.065992	30.531116	60.5	61	61	45.1615	5	0	0	0	0	
4460	3.699	0.1	62.35125	56.47802	49.716198	22.07291	30.620102	60.5	61.5	61	45.1696	5	0	0	0	0	
4470	3.709	0.1	62.350182	56.41862	62.788296	22.081821	30.644716	60.5	61	61.5	45.1742	5	0	0	0	0	

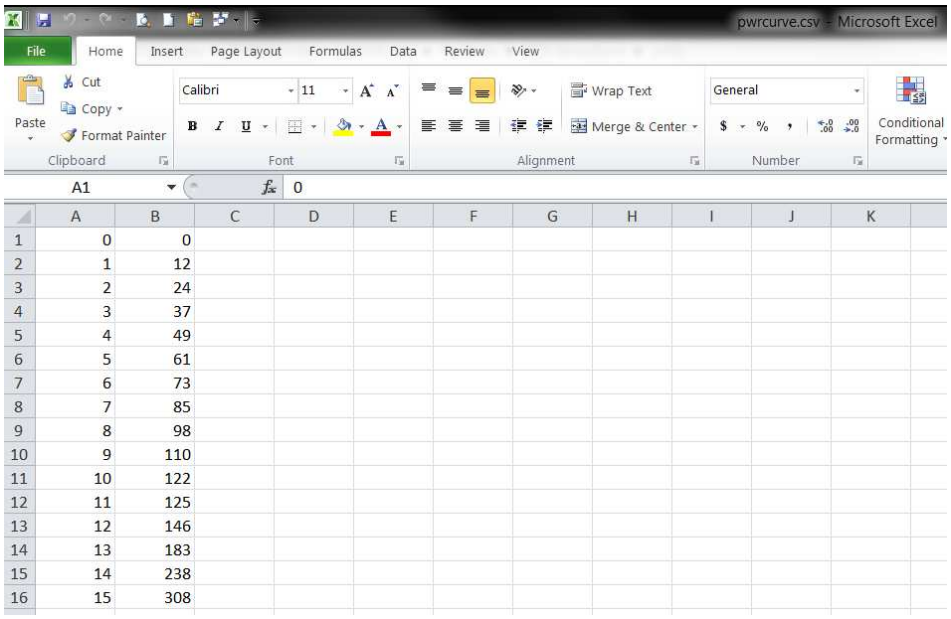
All calibration data are stored in cal_data.txt, these values are determined for each unit during initial testing. They should not need to be altered after initial calibration.



cal_data.txt - Notepad

```
1.0     Current Sense Scaling Adjust Chopper Channel 1
1.0     Current Sense Scaling Adjust Chopper Channel 2
1.0     Current Sense Scaling Adjust Chopper Channel 3
1.0     Current Sense Scaling Adjust Chopper Channel 4
1.0     Current Sense Scaling Adjust Chopper Channel 5
1.0     Current Sense Scaling Adjust Chopper Channel 6
1.0     Current Sense Scaling Adjust Chopper Channel 7
1.0     Current Sense Scaling Adjust Chopper Channel 8
1.0023  Battery Voltage Sense Scaling Adjust
1.0     DC Bus Voltage Sense Scaling Adjust
1.0     Alternator Phase A Voltage Sense Scaling Adjust
1.0     Alternator Phase B Voltage Sense Scaling Adjust
1.0     Alternator Phase C Voltage Sense Scaling Adjust
1.0     Heat Sink Temperature Sensor Voltage Scaling Adjust
1.0     Battery Temperature Sensor Voltage Scaling Adjust
1.0704  12V Logic Supply Voltage Sense Scaling Adjust
5616    Current Sense Offset Adjust Chopper Channel 1
5734    Current Sense Offset Adjust Chopper Channel 2
6076    Current Sense Offset Adjust Chopper Channel 3
5913    Current Sense Offset Adjust Chopper Channel 4
5513    Current Sense Offset Adjust Chopper Channel 5
5611    Current Sense Offset Adjust Chopper Channel 6
5792    Current Sense Offset Adjust Chopper Channel 7
5791    Current Sense Offset Adjust Chopper Channel 8
0       Battery Voltage Sense Offset Adjust
0       DC Bus Voltage Sense Offset Adjust
402     Alternator Phase A Voltage Sense Offset Adjust
385     Alternator Phase B Voltage Sense Offset Adjust
344     Alternator Phase C Voltage Sense Offset Adjust
240     Heat Sink Temperature Sensor Voltage Offset Adjust
275     Battery Temperature Sensor Voltage Offset Adjust
0       12V Logic Supply Voltage Sense Offset Adjust
```

The power curve is stored as pwrcrv.csv, the format is frequency in column A and power in watts in column B. The frequency must be given in 1 Hz increments up to 150 Hz. Changes to the power curve should not be made without Bergey WindPower Co approval, as damage to the controller or the alternator can occur if improper values are used.

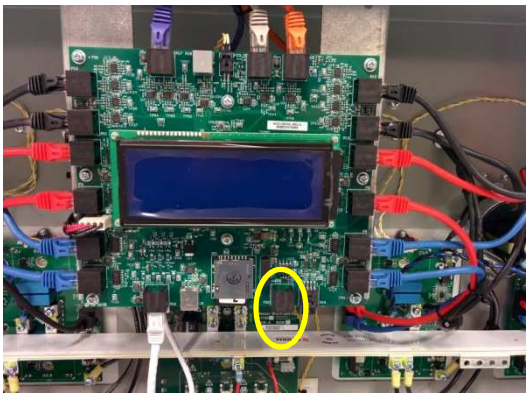


	A	B	C	D	E	F	G	H	I	J	K
1	0	0									
2	1	12									
3	2	24									
4	3	37									
5	4	49									
6	5	61									
7	6	73									
8	7	85									
9	8	98									
10	9	110									
11	10	122									
12	11	125									
13	12	146									
14	13	183									
15	14	238									
16	15	308									

VCS II Can Bus Interface

The CAN Bus utilizes an isolated input to provide a galvanic isolation rating of 2500 V_{RMS}. An RJ45 connection (CN20) is provided on the controller with a pinout of:

Pin 1 – NC
Pin 2 – NC
Pin 3 – V+
Pin 4 – CANH
Pin 5 – CANL
Pin 6 – GND
Pin 7 – NC
Pin 8 - NC



VCS II CAN Bus Message Specification

1. The baud rate is fixed to 250k.
2. "Little endian" is used for CAN transmission — least significant byte is transmitted/received first.
3. Only standard identifier (11bit) is supported.
4. Message ID Specifications:

Message ID	Request	Response	Comment
1	DLC: 1 Mailbox 0 is reserved to receive this message.	DLC: 1 Mailbox 16 is reserved to echo back the original message	This message is for command: 1 = Start (Reset), 0 = Stop. • If the system is in regular charge or equalizer mode, the "Stop" command will stop the system operation. • If the system is in stop mode, the "Start" command will start the system. • If the system is in fault state, the "Start(Reset" command will clear the fault and prepare the system to go to run state.
2	DLC: 4 Mailbox 1 is reserved to receive this message. Data format: single precision float.	DLC: 4 Mailbox 17 is reserved to echo back the original message. Data format: single precision float.	This message sets the battery regulation voltage for normal operation.

Message ID	Request	Response	Comment
3	DLC: 4 Mailbox 2 is reserved to receive this message. Data format: Uint32	DLC: 8 Mailbox 18 is reserved to send the parameter to external controller. Data format: The first 4 bytes are Uint32. The last 4 bytes are float32 or Uint32, depending on the data item.	• The external controller sends this message to DSP to request certain parameter. The parameter ID (PID) is included in the requested message. • The DSP responds with the parameter filled in the last 4 bytes of the CAN message. The first 4 bytes still holds the PID.

5. Parameter ID Specifications:

Parameter ID (PID)	Description	Data Type
0	High Limit battery voltage target allowed [Vdc]	Float32
1	Lo Limit battery voltage target allowed [Vdc]	Float32
2	Max output current limit allowed [Adc]	Float32
3	Maximum Output Power (W)	Float32
4	Hot Start Ramp Timer (s)	Float32
5	Firmware revision [na]	Float32
6	Equalize voltage reference [Vdc]	Float32
7	Battery temperature compensation [V/deg C]	Float32
8	VoltTime limit for Equalize mode [Vhr]	Float32
9	Regulation voltage reference [Vdc]	Float32
10	Energy(kWh)	Float32
11	Average battery voltage measured [Vdc]	Float32
12	Average output current measured [Adc]	Float32
13	Average battery temp measured [deg C]	Float32
14	Average heatsink temp measured [deg C]	Float32
15	L1-L2 voltage [Vac,rms]	Float32
16	L2-L3 voltage [Vac,rms]	Float32
17	L3-L1 voltage [Vac,rms]	Float32
18	Turbine frequency measured [Hz]	Float32
19	System state [na]	Uint32
20	Average current measured, chopper 1 [Adc]	Float32
21	Average current measured, chopper 2 [Adc]	Float32
22	Average current measured, chopper 3 [Adc]	Float32
23	Average current measured, chopper 4 [Adc]	Float32
24	Average current measured, chopper 5 [Adc]	Float32
25	Average current measured, chopper 6 [Adc]	Float32
26	Average current measured, chopper 7 [Adc]	Float32
27	Average current measured, chopper 8 [Adc]	Float32
28	Software current reference [Adc]	Float32
29	Bus voltage measured [Vdc]	Float32
30	Present fault state[na]	Uint32
31	Last fault state cleared	Uint32
32	Warnings [na]	Uint32
33	Reserved	
34	Reserved	
35	Reserved	
36	Reserved	
37	Reserved	
38	Reserved	

VCS II Status, Faults, & Warnings

The faults and warning messages are basically coded as binary bits, such that multiple faults and warnings can be transmitted. There will be an integer value returned for fault and warning queries. This can be converted to hex and looked up in the tables on the following pages, or if converted to binary then each individual bit indicates a separate fault.

Status:

Low Wind Speed = Turbine is spinning too slow to generate power.

VCS II Fault List

Fault (PID 30 & 31)	Hex Code
Fault, over current chopper 1 [na]	0x00000001
Fault, over current chopper 2 [na]	0x00000002
Fault, over current chopper 3 [na]	0x00000004
Fault, over current chopper 4 [na]	0x00000008
Fault, over current chopper 5 [na]	0x00000010
Fault, over current chopper 6 [na]	0x00000020
Fault, over current chopper 7 [na]	0x00000040
Fault, over current chopper 8 [na]	0x00000080
Fault, De-saturation chopper 1 [na]	0x00000100
Fault, De-saturation chopper 2 [na]	0x00000200
Fault, De-saturation chopper 3 [na]	0x00000400
Fault, De-saturation chopper 4 [na]	0x00000800
Fault, De-saturation chopper 5 [na]	0x00001000
Fault, De-saturation chopper 6 [na]	0x00002000
Fault, De-saturation chopper 7 [na]	0x00004000
Fault, De-saturation chopper 8 [na]	0x00008000
Fault, Battery Over Voltage Fault (Volts)	0x00010000
Fault, DC bus over voltage [na]	0x00020000
Fault, Logic Power Supply Over Voltage (Volts)	0x00040000
Fault, Logic Power Supply Under Voltage (Volts)	0x00080000
Fault, battery over temp [na]	0x00100000
Fault, Heat sink over temp [na]	0x00200000
Fault, battery disconnect	0x00400000
Fault, Interrupt overrun [na]	0x00800000
Fault, alternator phase loss [na]	0x01000000
Fault, non-maskable interrupt [na]	0x02000000
Fault, D5V [na] - No parameter for this. Uses GPIO	0x04000000
Fault, PLL Sync	0x08000000
Fault, [EXCESS BUS CLAMPING]	0x10000000
Fault, Watchdog [na]	0x40000000

VCS II Warning List

Warning (PID 32)	Hex Code
MS_OUTPUT_POWER	0x00000001
MS_BAT_FULL_CHARGED	0x00000002
MS_SD_MISSING	0x00000004
MS_THERMAL_ACTIVE	0x00000008
MS_CAN_COMM_ERROR	0x00000010
MS_EQUALIZE_MODE	0x00000020
MS_SD_PROTECTED	0x00000040
MS_LOW_SPEED	0x00000080
MS_MANUAL_MODE	0x00000100
MS_BAT_VOL_LOW	0x00000200
MS_BAT_TEMP_HIGH	0x00000400
MS_PHASE_ROTATION	0x00000800
MS_EXT_RAM_FAILED	0x00001000

VCS II Specifications

Turbine Input

Input current (max)	43 Amps
Input voltage (max)	480 Vrms
Input start voltage minimum (at low battery condition)	30 Vrms
Input normal operating voltage range	35 Vrms – 480 Vrms
Input frequency range	0 – 150 Hz
Cut-in frequency	15 Hz
Cut-out frequency	10 Hz

Battery Output

Rated output current (max)	200 Amps
Rated output voltage (max)	65 Vdc
Output start voltage minimum (at low battery condition)	36 Vdc
Output normal operating voltage range	40 – 63 Vdc
Control method	Constant Voltage
Output overcurrent protection (DC Breaker)	250 Amps

Environmental

Enclosure type	NEMA 1 / IP60 Overall NEMA 3R / IP66 for internal controls
Operating temperature range	-20 to 40 °C
Max altitude	1000 m
Thermal derating (approximate ambient temperature)	45 °C
Thermal shutdown	80 °C
Weight	106 lb / 48kg

Performance

Rated power (11 m/s)	8 kW
Rated RPM	170
Rated windspeed	11 m/s
Start-up windspeed	4 m/s
Cut-in windspeed	1.8 m/s
Cut-out windspeed	none
Furling windspeed	16-18 m/s
Max design windspeed	60 m/s