



# AURORA<sup>®</sup>

## Wind Interface

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### INSTALLATION AND OPERATOR'S MANUAL

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*Model numbers: PVI-7200-WIND-INTERFACE*

*PVI-4000-WIND-INTERFACE*

*PVI-2500-WIND-INTERFACE*

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*Rev 2.3*



### REVISION TABLE

Document Revision	Author	Date	Change Description
1.0	T. Melzl	5/9/2006	First release of the document
2.2	T. Melzl	6/23/06	Additional Model revision
2.3	T. Melzl	6/30/06	Updated Input Current rating ,fuse characteristics and diversion load sizing



**SAVE THESE INSTRUCTIONS!**



**IMPORTANT SAFETY INSTRUCTIONS**

**PVI-7200-WIND-INTERFACE**  
**PVI-4000-WIND-INTERFACE**  
**PVI-2500-WIND-INTERFACE**

This document applies only to the above-mentioned models.

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## IMPORTANT SAFETY INSTRUCTIONS

This manual contains important safety and operational instructions that must be accurately understood and followed during the installation and maintenance of the equipment.

To reduce the risk of electrical shock hazards, and to make sure the equipment is safely installed and commissioned, special safety symbols are used in this manual to highlight potential safety risks and important safety information. The symbols are:



**WARNING:** the paragraphs highlighted by this symbol contain processes and instructions that must be absolutely understood and followed to avoid potential danger to people.



**NOTE:** the paragraphs highlighted by this symbol contain processes and instructions that must be rigorously understood and followed to avoid potential damage to the equipment and negative results.

The equipment is provided with several labels, some of them with a yellow background, which are related to safety issues.

Make sure to read the labels and fully understand them before installing the equipment.

The labels utilize the following symbols:

	Equipment grounding conductor (Main grounding protective earth, PE)
	Alternate Current (Ac) value
	Direct Current (Dc) value
	Phase
	Grounding (Earth)

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## **USEFUL INFORMATION AND SAFETY STANDARD**

### **FOREWORD**

- The installation of AURORA must be performed in full compliance with national and local standards and regulations
- AURORA has no internal user serviceable parts other than fuses.  
For any maintenance or repair please contact the nearest authorized repair center. Please contact your reseller if you need to know the nearest authorized repair center.
- Read and understand all the instructions contained in this manual and become familiar with the safety symbols in the relevant paragraphs before you install and commission the equipment
- The connection to the distribution grid must be done only after receiving approval from the distribution utility as required by national and state interconnection regulations, and can be done only by qualified personnel.
- Safety Brake the wind turbine to prevent any possibility of high voltages appearing at the connecting cable terminations.
- The AC disconnecting means must be opened before working on the Aurora Wind inverters.

### **GENERAL**

During inverter operation, some parts can be powered, some not properly insulated and, in some cases, some parts can move or rotate, or some surfaces can be hot.

Unauthorized removal of the necessary protections, improper use, incorrect installation or incorrect operation may lead to serious damage to people and objects.

All transport, installation and start-up, as well as maintenance operations, shall be carried out by skilled and trained personnel (all national regulations on accidents prevention shall be complied with ! ! !).

According to these basic safety rules, qualified and trained people have skills for the assembling, start-up and operation of the product, as well as the necessary requirements and qualifications to perform such operations.

### **ASSEMBLY**

Devices shall be assembled and cooled according to the specifications mentioned in the corresponding documents.

In particular, during transport and handling, parts shall not be bent and/or the insulation distances shall not be changed. There should be no contact between electronic parts and connection terminals.

Electrical parts must not be mechanically damaged or destroyed (potential health risk).

### **ELECTRICAL CONNECTION**

With the inverter powered, comply with all prevailing national regulations on accidents prevention.

Electrical connections shall be carried out in accordance with the applicable regulations, such as conductor sections, fuses, PE connection.

### **OPERATION**

Systems equipped with inverters shall be provided with further control and protective devices in compliance with the corresponding prevailing safety rules, such as those relating to the compliance with technical equipment, accident-preventing regulations, etc. Any calibration change shall be made using the operational software. Once the inverter has been disconnected from the power grid, powered parts and electrical connections shall not be touched as some capacitors could be charged.

Comply with all corresponding marks and symbols present on each device. During operation, make sure that all covers and doors are closed.

### **MAINTENANCE AND SERVICE**

Comply with manufacturer's recommendations.

**SAVE ALL DOCUMENTS IN A SAFE PLACE !**



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# 1 Wind Interface Description

The AURORA WIND Interface box is an integral part of the wind energy system.

The Wind Interface box serves three purposes.

- Rectifies the “Wild AC” from wind turbine generator into DC input for the inverter.
- Diversion Load Control. The diversion load limits the turbine voltage when the DC voltage exceeds 530 Vdc. The diversion load is activated during high winds, severe gusts and when the utility grid fails.
- Wind Speed feed-back: The Wind speed feed-back is based on the frequency of the “Wild AC” input from the wind turbine generator.

## 1.1 Operating Parameters

Description	Value Aurora Wind Interface
Input voltage range (no damaging)	0 Vac to 400 Vac
Input voltage range (MPPT operating range)	40 Vac to 400 Vac
Max. operating input current	16.6 A
Input over current (fuse protected)	20 A
Max. output power (@400Vac, PFC≥0.7)	7200 W
Efficiency (@400Vac, PFC≥0.7)	99.4%
Output Voltage range	0-600 Vdc
Output Voltage range (Inverter active)	50-600 Vdc
Output Voltage range (@ full output power)	360-600Vdc
Output Power Current Rating	20 A
Max current in the brake resistor	30A
Operating ambient temperature	-25°C to +55°C (-13°F to 140°F)
Enclosure type	Nema 4X
Relative Humidity	0 – 100 % condensing
Audible Noise	< 40dBA
Size (height x width x depth):	29 x 26 x 9.5 mm

Table 1: Operating Parameters:PVI-7200-WIND-INTERFACE



<b>Description</b>	<b>Value Aurora Wind Interface</b>
Input voltage range (no damaging)	0 Vac to 400 Vac
Input voltage range (MPPT operating range)	40 Vac to 400 Vac
Max. operating input current	16.6 A
Input over current (fuse protected)	20 A*
Max. output power (@400Vac, PFC≥0.7)	4000 W
Efficiency (@400Vac, PFC≥0.7)	99.4%
Output Voltage range	0-600 Vdc
Output Voltage range (Inverter active)	50-600 Vdc
Output Voltage range (@ full output power)	360-600Vdc
Output Power Current Rating	12Adc*
Max current in the brake resistor	30A
Operating ambient temperature	-25°C to +55°C (-13°F to 140°F)
Enclosure type	Nema 4X
Relative Humidity	0 – 100 % condensing
Audible Noise	< 40dBA
Size (height x width x depth):	29 x 26 x 9.5 mm

\*The over current protection may be sized smaller depending on the generator/alternator short circuit current, this value will be determine by the generator/Alternator supplier.

Table 2: Operating Parameters: PVI-4000-WIND-INTERFACE

<b>Description</b>	<b>Value Aurora Wind Interface</b>
Input voltage range (no damaging)	0 Vac to 400 Vac
Input voltage range (MPPT operating range)	40 Vac to 400 Vac
Max. operating input current	16.6 A
Input over current (fuse protected)	20 A*
Max. output power (@400Vac, PFC≥0.7)	2500 W

Efficiency (@400Vac, PFC≥0.7)	99.4%
Output Voltage range	0-600 Vdc
Output Voltage range (Inverter active)	50-600 Vdc
Output Voltage range (@ full output power)	360-600Vdc
Output Power Current Rating	9Adc*
Max current in the brake resistor	30A
Operating ambient temperature	-25°C to +55°C (-13°F to 140°F)
Enclosure type	Nema 4X
Relative Humidity	0 – 100 % condensing
Audible Noise	< 40dBA
Size (height x width x depth):	29 x 26 x 9.5 mm

\*The over current protection may be sized smaller depending on the generator/alternator short circuit current, this value will be determine by the generator/Alternator supplier.

Table 3: Operating Parameters: PVI-2500-WIND-INTERFACE

## 1.2 Input Fuse Rating

The input fuse rating will be 20Amperes or less on all models. A specific input fuse rating can be reduced by the wind turbine generator/alternator supplier based on the short circuit current rating of the specific generator/alternator model. The input fuses F4, F5 and F6 are intended to protect the AURORA Wind Interface box.

Fuse Characteristics:

+Fuses (F4, F5, F6) : CSA\*, NRTL Recognized (US)

Manufacturer : Cooper Bussmann or equivalent recognized Manufacturer

Manufacturer's P/N : Type KLM-20 (Max. Rating)

Rating : 20 A or less, 500 Vac, Fast Acting fuse.

Interrupt Rating: IR 10,000 Amps AC

Mounting : Secured brass-plated clip type fuseholders with integral end stops.

## 1.3 Diversion Load Resistor Sizing:

The diversion load resistor is intended to limit the wind interface box output voltage during gusts and high wind speed conditions. The wind turbine must have a primary safety means of limiting the wind turbine speed, this typically is a some type of furling method, blade stalling or self limiting airfoil design.



Most wind turbines designs require the use of a diversion load resistor with the AURORA WIND Interface Box in order to limit the generator/alternator input voltage peaks during gusts or high wind speed conditions.

The diversion load resistor is needs to be sized based on the following guidelines:

Minimum Ohm value: 16 ohms

Minimum Watt rating: 1.5 times the generator/alternator/turbine rating

Voltage rating: 600 V

The diversion load circuit starts operating when internal buss reaches 530 Vdc. The diversion load circuit is disconnected from the internal buss at 430 Vdc.

The diversion load resistor is not intended for continuous duty cycle. The momentary peak current rating of circuit is 30A and only intended for quick surges. The maximum continuous rating of the circuit is 16.6 A.

## 1.4 Wind Interface Block Diagram

The AURORA Wind Interface box is designed to be used the Aurora Wind Inverter.

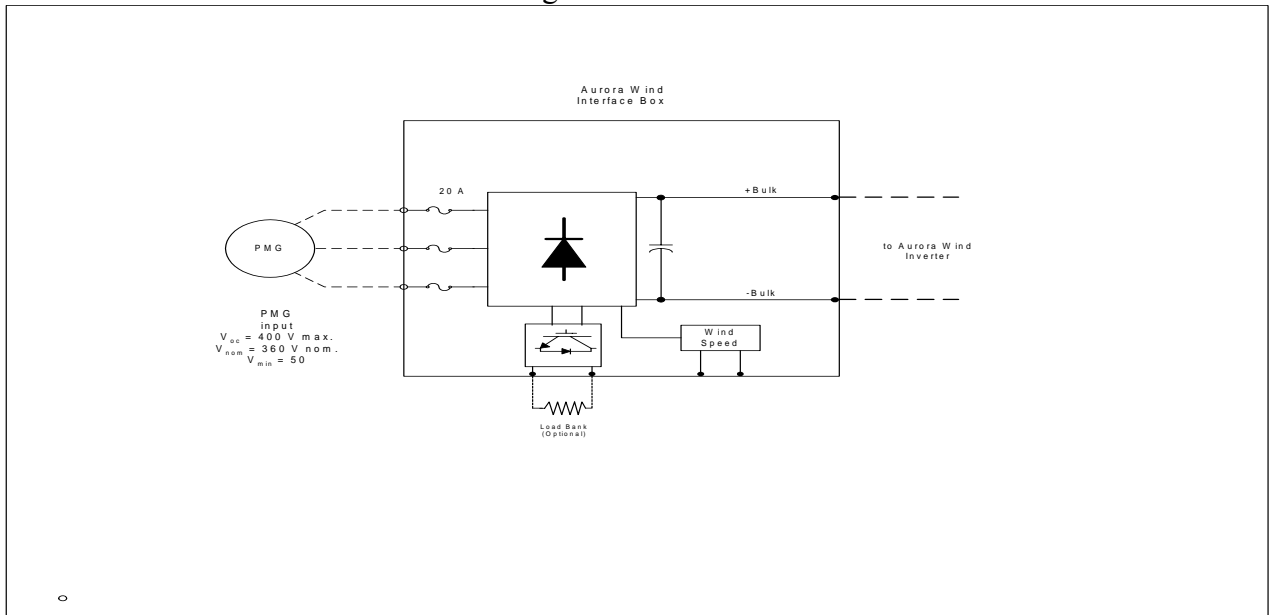


Figure 1: Wind Interface Block Diagram

## 1.5 System Block Diagram

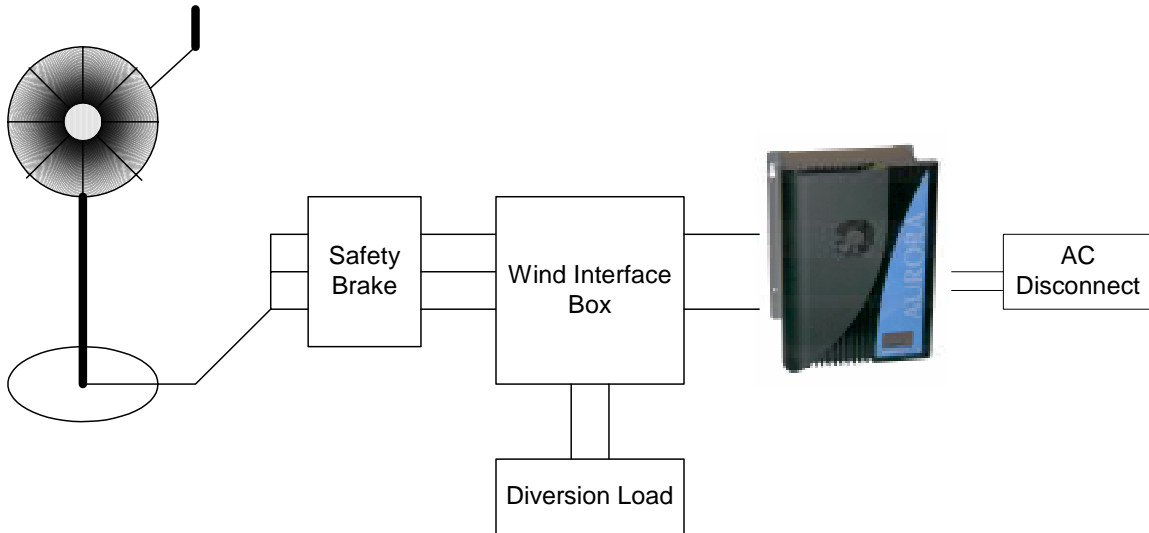


Figure 2: Wind system block diagram

## 1.6 Operating Modes:

Mode	Bulk Out Voltage (Vdc)	Interface Box	Diversion Load	Inverter
Off	$< 50$ Vdc	OFF	OFF	OFF
Grid Check	$50 < Vdc < 530$	Control Power	OFF	Control Power
Export	$50 < Vdc < 530$	ON	OFF	Exporting to Grid
Export w/ Diversion	$Vdc > 530$	ON	ON	Exporting to Grid
Grid Fail	$Vdc > 530$	ON	ON	Control Power or OFF

Table 4: Operating Modes

### 1.6.1 Off Mode

There is insufficient energy from the wind turbine to allow operation of the system

### 1.6.2 Grid Check Mode

There is sufficient energy to power the Wind interface box control and provide control power to the Aurora Inverter.

### **1.6.3 Export Mode**

The Aurora Wind inverter has completed the utility interconnection checks and connected to the utility grid. The inverter is exporting power to the utility grid and Wind maximum power point tracking algorithm is actively following the model specific Wind power curve of the wind generator.

### **1.6.4 Export w/ Diversion**

The Aurora Wind is in the Export mode and the Bulk voltage is greater than 530 Vdc. When the Bulk voltage exceeds 530 Vdc the Diversion load is switched on and remains on until the Bulk voltage reaches approximately 430 Vdc. This mode is entered during excess wind conditions and gusts.

### **1.6.5 Grid Fail**

The Aurora Wind inverter has disconnected from the utility grid and the Bulk voltage exceeds 530 Vdc. In this condition the Diversion load is switched on and remains on until the Bulk voltage reaches approximately 430 Vdc.

## 2 Wind Interface Connections



**WARNING:** Always safety brake the wind turbine before opening the n the AC disconnecting means.

### 2.1 Required System Connections

Connection	Required	Knock-out Trade Size
Wind Speed	Optional	PG 9 = 3/8"
Wind Input	Yes	PG 16 = 3/4 "
Diversion Load	Optional*	PG 16 = 1/2 "
Bulk Out	Yes	PG 21 = 3/4 "

Table 3: Required Connections and Knock-out Size

\*This connection is optional with engineering documentation that the wind turbine will self-limit and prevent the Wind turbine input voltage from exceeding 600V under any condition.

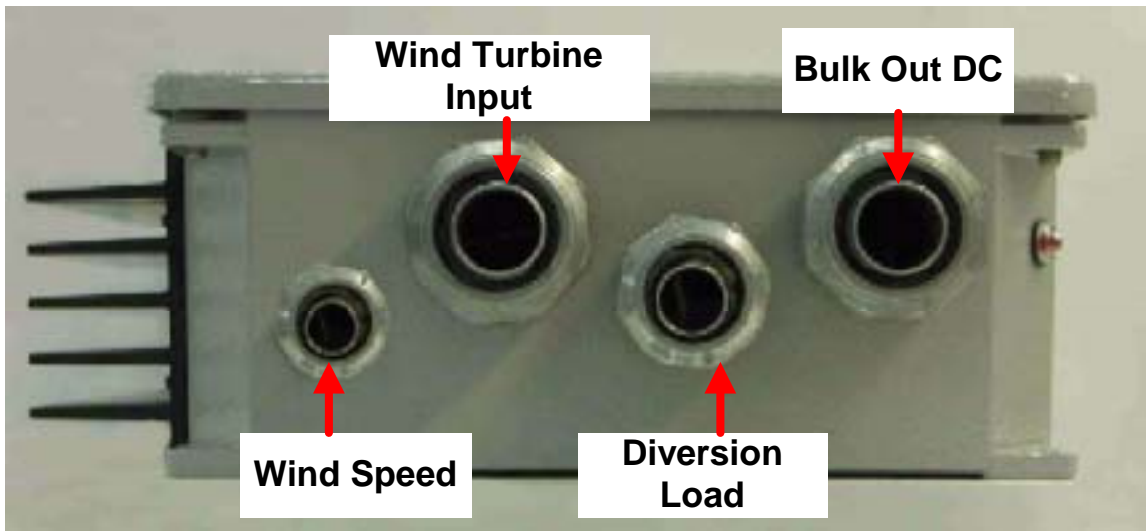
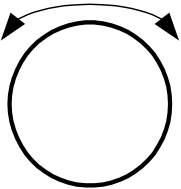
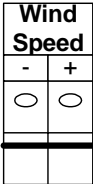
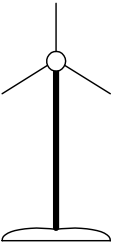
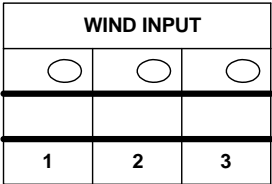

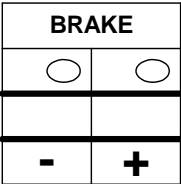
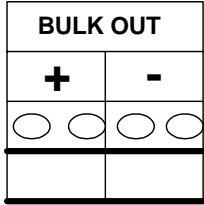


Figure 3: Knockout Designations: Shown with example fittings that are not supplied with the unit.

## Wind Interface Connection Table

See Section 1.1 for Over current Protection sizing

Connection	Wind Speed		Wind Input	Brake	Bulk Out
Terminals	  		  	<p>Diversion Load</p>   	<p>Aurora Wind Inverter</p> 
Electric Ratings	Voltage	5 Vdc, Open Collector	0-600 Vac, 600 Hz	0-600Vdc	0-600Vdc
Max. Current		1mA	20 A	30 A	20 A
Wire Gage	Minimum	28 AWG	12 AWG	10 AWG	10 AWG
	Maximum	12 AWG	6 AWG	6 AWG	10 AWG

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## 2.2 Wind Speed Feed back

The wind speed feed back is an open collector source. The pulse training is the generator frequency. Full scale = 5V, Zero = 1.4 V, max current = 1mA, max voltage = 24 Vdc. The pulse train is generated from two of the wind turbine input phases.

## 3 Wind Interface Box Installation and Commissioning

The Wind Interface Box must be wired in accordance to the National Electric Code (NEC) ANSI/NFPA 70.

All energy sources need to be de-energized and locked out before starting to work on the wind energy system.

**CAUTION:** Risk of fire and shock, connect Output (DC) terminals prior to the connection of Input (AC) terminals.

Disconnect devices shall be provided in the end use installation, both on the AC and on the DC side.

Input source and output circuit conductors shall have a disconnect device complying with the National Electrical Code ANSI/NFPA 70.

Input source and output circuit conductors shall be provided with over current protection complying with the National Electrical Code ANSI/NFPA 70

The Wind Interface box must be installed using watertight wiring methods. This requires the use of UL listed watertight components and locknuts with the applicable wiring method: refer to Table 2.1 for required system connections. The optional Wind speed and Diversion load connections are sealed with hole covers, Cembre, type PG9 (3/8") (model 1052009N) and type PG16 (model 1052016N) or the equivalent UL listed watertight hole covers. See figure 2 for further details.

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## **3.1 Assembly and Mounting Instructions**

The unit shall be installed in a location so that it is not expected to be casually contacted by person with the external heat sink.

### **3.1.1 Mounting Height**

The Wind Interface box must be mounted at least 3 feet above grade or floor level on a vertical surface.

### **3.1.2 Minimum clearances**

The Wind Interface box needs to be mounted with the following minimum clearance around the interface box.

Top: 20 cm

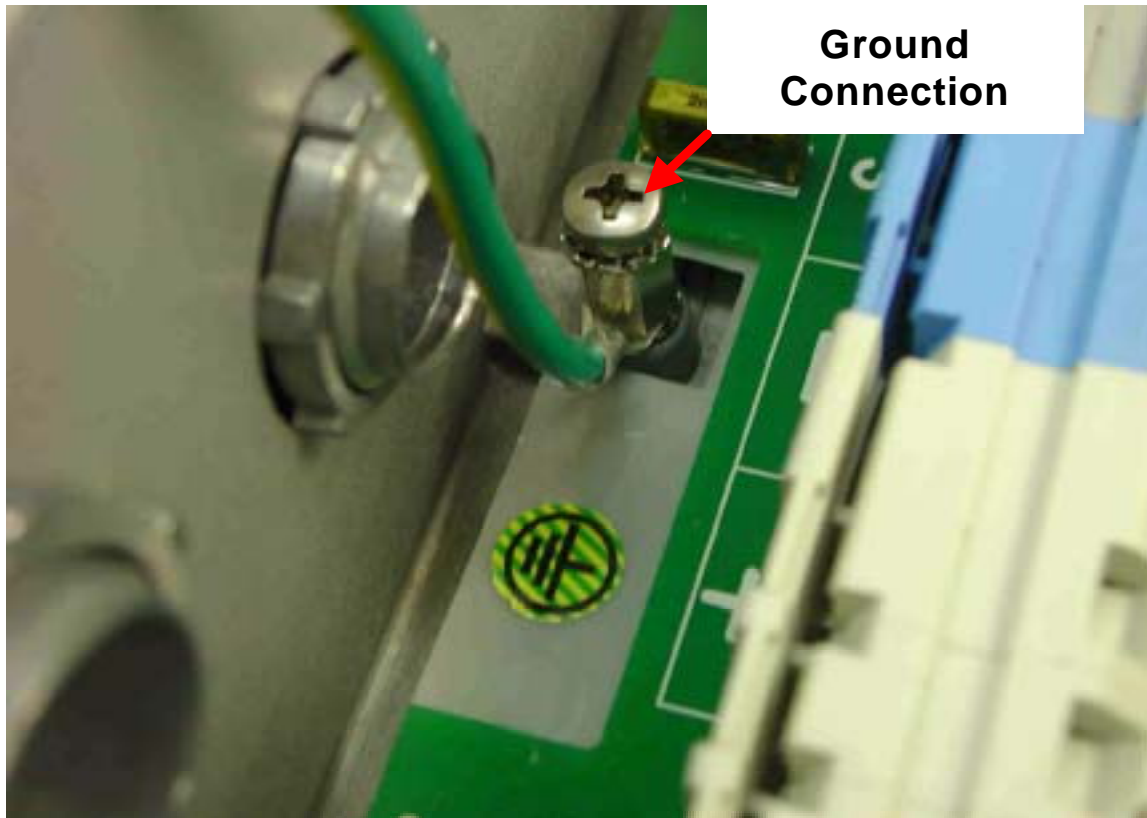
Bottom 20 cm

Right Side: 20 cm

Left Side (Heat Sink): 20 cm

## 3.2 Equipment Ground Connection

The equipment ground connection to wind interface box is shown below.



## 3.3 Diversion Load Connection

The value of the Diversion Load resistor is determined by the wind system manufacturer using wind generator characteristics.

- Connect the Brake – terminal to the corresponding terminal properly sized diversion load.
- Connect the Brake + terminal to the corresponding terminal of the properly sized diversion load.
- Measure the resistance between the Brake – terminal and the Brake + terminal. The resistance value should be equivalent to the diversion load resistance value.

## 3.4 Bulk Out DC Connections

The Bulk Out DC connections provide the input to the Aurora Wind Inverter. The polarity of these connections is critical for proper operation and to prevent damage to the Aurora Wind Inverter.

- Connect the Bulk Out + terminal to the IN+1 terminal in the Aurora wind inverter



- 
- Connect the Bulk Out- terminal to the IN-1 terminal in the Aurora wind inverter
  - Verify that the polarity of the wiring is correct.

### **3.5 Wind Input Connections**

The wind turbine needs to safety braked to a zero energy state before terminating the wind input wiring in the Wind Interface box. Verify that no voltage is present before terminating the wiring.

- Wind Input 1 connect a single wire (Phase A) to the terminal
- Wind Input 2 connect a single wire (Phase B) to the terminal
- Wind Input 3 connect a single wire (Phase C) to the terminal

### **3.6 Commissioning Sequence:**

The commissioning of the wind energy system must be performed by trained and qualified wind energy professional due to the potential hazards involved.

#### **3.6.1 Wiring Verification**

- Verify Diversion Load connections.
- Verify Wind turbine input connections.
- Verify Aurora Wind Inverter is correctly and fully installed.

#### **3.6.2 Wind input power-up**

- Monitor wind speed and at a safe wind speed release the Safety brake on the wind turbine. (Consult our wind turbine manufacturer for the safe wind speed release)
- At approximately 40 Vac on Wind Input terminal blocks the Wind interface will be able to supply enough energy to power up the Aurora Wind Inverter controls. The green LED on the Aurora Wind Inverter will be blinking.
- Verify the Diversion Load status LED is off.

#### **3.6.3 Aurora Wind Inverter**

The Aurora Wind Inverter is a grid connected only inverter. A connection to a grid is required for operation. The Aurora Wind Inverter will connect to the grid and export power when the utility interactive protection determines that the utility is within range and a maintained wind input is above 40 Vac.

- Verify that the utility interconnection agreement has been approved.
- Verify that the Green Power LED is blinking on the front of the Aurora Wind Inverter.



- 
- Connect the Aurora Wind inverter to the AC grid by closing the AC disconnecting means.
  - The Aurora Wind inverter will connect to the grid and export power, when the utility checks are completed and the wind input is maintained above 40 Vac.

## 4 Trouble-shooting

Trouble-shooting should only be done by trained and qualified personnel. Trouble-shooting involves hazardous voltages and energies.

Symptom	Measurement	Possible Cause
Aurora Wind Inverter, Blinking Green LED	Bulk Out Vdc > 50 Vdc Grid Voltage at Aurora Wind Inverter.	<ul style="list-style-type: none"> <li>• Low wind speed</li> <li>• Grid connection out of range, check Inverter output voltage setting</li> <li>• Grid is not present</li> </ul>
Wind turbine stalls	Wind Input Vac > 40 Vac	<ul style="list-style-type: none"> <li>• Low wind speed</li> <li>• Intermittent wind</li> <li>• Diversion Load active</li> </ul>
Wind turbine cyclically accelerates and slows down	Bulk Out Vdc Diversion LED status	<ul style="list-style-type: none"> <li>• High wind speeds, diversion load is activating.</li> </ul>
Wind turbine furling	Bulk Out Vdc Diversion LED status Check Diversion load for heat production	<ul style="list-style-type: none"> <li>• Diversion load is not connected.</li> <li>• Extremely high wind speeds.</li> <li>• Bulk Out Vdc is not exceeding 530 Vdc.</li> </ul>
No Green LED blinking when, wind turbine is above cut-in speed	<ul style="list-style-type: none"> <li>• Wind Input Vac &gt; 40 Vac at terminals</li> <li>• Vac between F7, F8 and F9</li> </ul>	<ul style="list-style-type: none"> <li>• Generator damaged</li> <li>• F1, F2, or F3 fuse(s) are open.</li> <li>• Over voltage condition.</li> <li>• Wiring issue between PM generator and wind Interface box</li> </ul>
Wind turbine won't turn	Wind Input Vac Bulk Out Vdc	<ul style="list-style-type: none"> <li>• Generator leads shorted together</li> </ul>

Table 6: Trouble shooting guide.

## 4.1 Diversion Load Status LED



Figure 4: Diversion Load Status LED