

Hybrid XT Vane & Anemometer | WRA

USER'S MANUAL



NRGSystems®

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Customer Support

NRG Systems offers a variety of support options to help you get the most from your NRG Systems product. If you have questions about your NRG Systems product, first look in the product documentation and Knowledge Base contained in the Tech Support section of the NRG Systems web site. If you cannot find the answer, contact your salesperson or NRG Systems Technical Support for assistance using the information below. Customer support is available 8:30 AM to 5:00 PM EST, Monday through Friday.

NRG Systems T | **802-482-2255**
110 Riggs Road E | **support@nrgsystems.com**
Hinesburg, Vermont,
05461
USA

When you call or email, you should have the appropriate product documentation at hand and be prepared to give the following information:

- Customer name
- Item number or description
- Serial number
- When equipment was purchased
- Where equipment is installed - terrain conditions
- Description of the problem with some detail
- What events took place leading up to the problem?
- What you have tried while attempting to solve the problem

NRG Systems maintains an extensive website which includes an in-depth customer support area for NRG Systems customers. If you need assistance at times other than our regular business hours, we suggest visiting our website, www.nrgsystems.com.

All instruments, sensors, software, and towers manufactured by NRG Systems are designed to be reliable and easy to use. We welcome your comments and appreciate your help in making NRG Systems products the best available.



Introduction

The Hybrid XT anemometer and wind direction vane are proven and reliable heated sensors ideal for maximizing wind measurement data availability on meteorological towers in climates that experience frequent icing. The Hybrid XT anemometer and vane can be used with all NRG Systems data loggers.

Because the heaters and sensor signal require more power than typical meteorological sensors, careful planning is necessary to ensure optimal performance.

The following document has been created to assist in the planning and installation of Hybrid XT sensors on meteorological towers.

Transport and Handling

This sensor is a precision instrument. Please use care in its handling to protect the bearings and shaft. It is recommended that the sensor be carefully placed on its side instead of standing up.



Use care when handling sensors. If a sensor tips over onto a hard surface, bearing or shaft damage may occur.

Sensor Identification

Serial Number | The serial number is located on the name plate just under the bar code.

Electrostatic Discharge (ESD) & Circuit Protection

- Do not apply greater than 30V to the outputs at any time.
- Do not mount the sensor until proper grounding has been completed. When installing the sensor, protect the signal wires and connect the ground wire first.
- There are internal TVS diodes on the output. If the output voltage is pulled above 30V, or below ground, the diode will clamp the output to the ground.
- Do not apply constant reverse voltages to the outputs. The sensors are not designed to protect against this type of voltage.



*Failure to adequately ground the sensor may result in ESD damage and/or impaired sensor function.
ESD damage is not covered by warranty.*



Using This Manual

Read this manual completely before installing and operating the Hybrid XT anemometer. Follow all instructions and recommendations closely.

This document and the sensor may use the following symbols:



Earth (Ground)



Chassis Ground



AC Voltage



AC or DC Voltage



DC Voltage



Hot Surface



WARNING

NOTICE

This typeface within the body of the manual is used for general descriptions and instructions to the user.

This typeface is used to warn users of a potential danger, either to themselves or to the sensor.



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Hybrid XT Anemometer

Kit #18015 | FG #4718

Square wave Output | 10m Cable

Operation

The Hybrid XT anemometer provides a high-level square wave output where the frequency (Hz) is proportional to the wind speed. The square wave amplitude is determined by the power supply voltage.

A typical logger/controller input stage may consist of overvoltage protection, low pass filter (corner frequency of 100 Hz), limiter, and comparator. If unsure of your input circuit design, please consult with NRG.

Calibration

If the Hybrid XT sensor has been calibrated, an individual calibration report has been shipped with the sensor. If the calibration report should get lost, you may contact NRG with the sensor serial number for a copy.

Hybrid XT Vane

Kit # 18016 | FG # 5762

4-20mA | 10m Cable

Operation

The Hybrid XT 4-20 mA Vane provides an industry-standard 4-20 mA output signal sourced by the sensor. The output range of 4-20 mA corresponds to 0-359 degrees.

South Mark

The Hybrid XT vane uses the mounting bolt hole and “Toward Rotor label as the South mark (180°).



Sensor Heater



Sensor surfaces (particularly the head and the upper body) can become quite hot and may burn you, especially in warm ambient conditions. Use caution when the heater power is on.

Operation

The heat source for the Hybrid XT is a self-regulating constant-temperature heater. Constant heating prevents condensation and corrosion and maintains proper bearing temperature for consistent performance and transfer function. In severe wind and icing conditions, the HXT draws more power to help remain clear of ice. As conditions improve, the HXT draws less power. The HXT's self-regulating feature increases reliability, ensuring that the head does not reach excessive temperatures. This prevents excessive stress on bearing lubricants and wiring.

The Hybrid XT heater is powered by 24 volt power, AC or DC, making it compatible with a wide range of remote site equipment. An optional 120/240V - 24 VAC transformer and AC switching power converters are also available.

Power Considerations

- Hybrid XT sensors require 24V AC or DC power for the heater (+/- 3V).
- Upon initial startup, there is an in-rush current of approximately 9A with a duration of roughly 3 seconds.
- After 1 minute, the current settles under 3A constant (1A typical). This operating current can range from 0.8A (~ 20W) up to 3A (~70W).
- The heater is self-regulating at a constant internal temperature of 170°C and will draw the appropriate current to maintain the right temperature.
- When possible, use grid power. Connecting the 120/240 VAC to 24 VAC Transformer to the grid is simple and dependable.
- If necessary, a remote power supply can be built and used to provide 24 VDC to the heaters.
- Following a brief inrush current, the heater quickly settles into its temperature-controlled mode.
- It is recommended that a 15 Amp slow-blow fuse or 10A circuit breaker be placed in line with the heater.

Heater Power Supply Requirements

When designing a remote power supply to provide power to the heater, enough capacity is needed to provide the maximum power (3A per sensor) for a predetermined amount of time.

Roughly, 3A for 24 hours is 72 Ah (or 144 Ah for a pair of sensors). If you expect to have 3 days of worst-case conditions in a row, then your battery bank should be rated for 216 Ah (or 432 Ah



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for a pair of sensors). Ultimately, power supply sizing is dependent on multiple factors and is a judgment call.

NOTICE

Always power the heater on your HXT sensor! Failure to maintain constant heating may lead to corrosion or inferior sensor performance. Constant heating prevents condensation from forming on the bearings, increasing accuracy, and enabling the sensor to achieve a 10-year service cycle. **If the sensor is used without the heater, the warranty will be void.**

Sensor Power Supply Requirements



Hybrid XT sensors require power, in addition to the heaters, for the signal measurements to be read by the logger. Each sensor draws a maximum of 40mA constantly, so constant power of 80mA at 12V is required to power an anemometer and vane. In wattage: A total of 1 watt is required for the pair of sensors. $80\text{mA} \times 24 \text{ hours} = 2 \text{ Amp-hours per day or } 24 \text{ watt-hours per day.}$

Once the power requirement has been determined, grid power or a power supply will need to be created. Combinations of deep cycle 24V batteries, PV panels and/or a small wind turbine (1kW) have been used successfully in the past.

WARNING

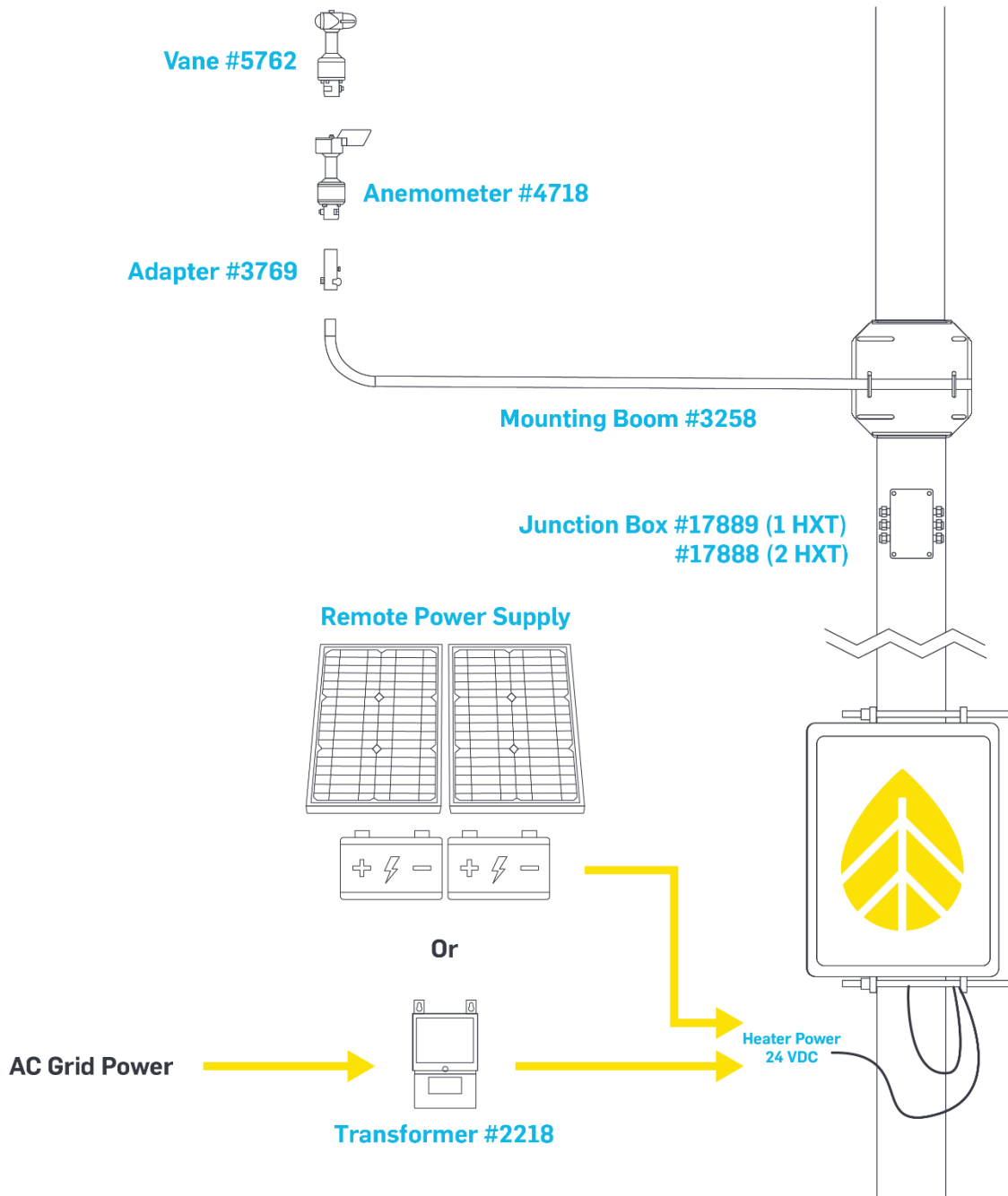
Always power Hybrid XT sensors with external power. Utilizing the iPack battery to power your Hybrid XT sensors will result in power failing to the logger and loss of measurement data.



Sensor Installation

Parts Required

The diagram & table in this section show the part numbers required for installing Hybrid XT sensors onto a tubular tower (8-10" diameter).





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Hybrid XT Sensor Kit Numbers and Components:

Hybrid XT Anemometer Kit Number	Hybrid XT Vane Kit Number	Hybrid XT Sensor	125 Ohm Resistor	Adapter Assembly	Hybrid XT Cable(10m) from sensor to Junction box
18015		4718		3769	9234
	18016	5762	17884	3769	9234

Sensor cable and Junction Box Kit Numbers and Components:

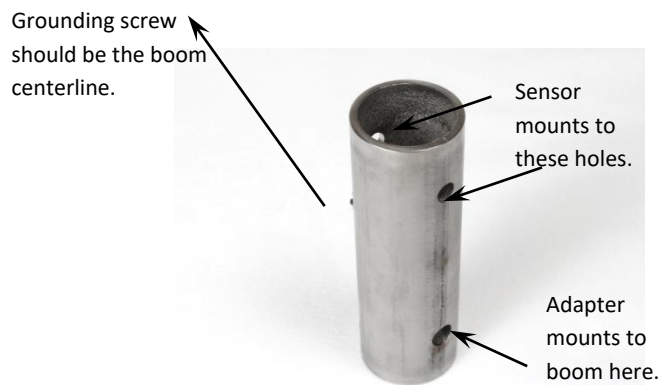
Cable Length (m)	Kit numbers 1Sensor 2 Sensors	Junction Box part numbers in Kits 1Sensor 2 Sensors	3C cable in kits (Anemometer & Vane) Junction box to logger & Power supply	Heater cable in kits (Anemometer & Vane) Junction box to power supply
30m	18017 18022	17889 17888	1863	2455
40m	18018 18023	17889 17888	1864	2456
50m	18019 18024	17889 17888	1865	2457
60m	18020 18025	17889 17888	2406	2735
90m	18021 18026	17889 17888	2410	2726



HXT Sensor Installation

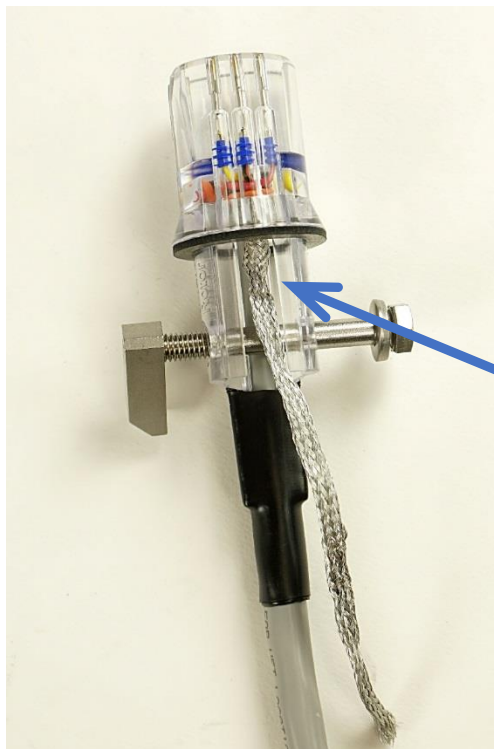
Mounting Mast Orientation

Refer to the technical drawing for details on mounting mast design. Orient the cross-holes in the top of the mounting mast such that they are lined up parallel to the sensor boom centerline.



Prepare Shield

Based on your decision about the cable shield connection scheme, cut off or attach the shield to the mounting mast. If you choose to cut the shield wire, make sure to cut it off short enough to avoid touching the mounting mast or bolt.



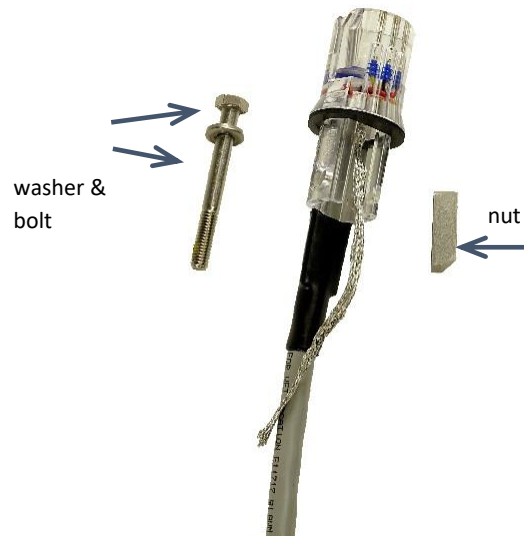
If cutting shield wire, cut close to connector base as shown.



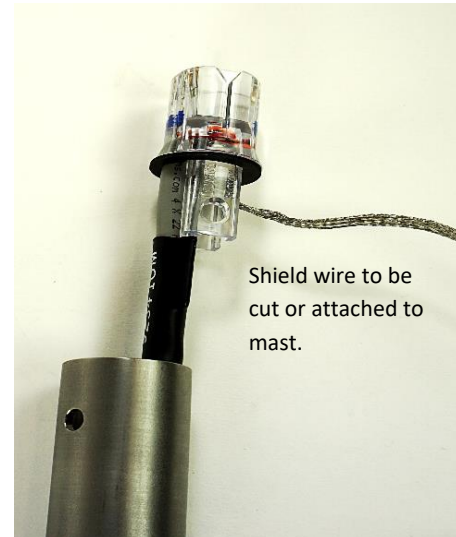
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Mount Connector

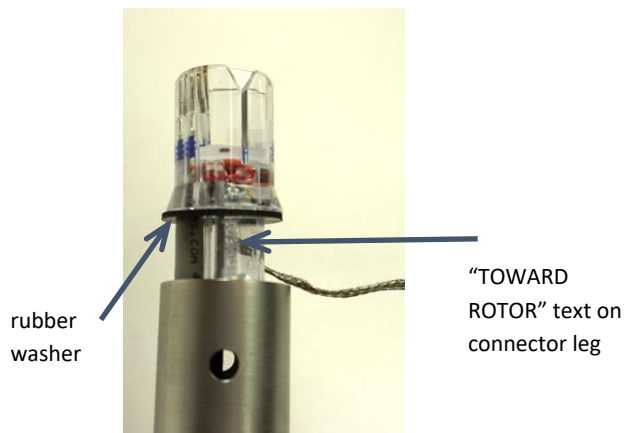
Remove the nut, washer, and bolt from the connector. Feed the cable through the mounting mast until the connector reaches the mast. Align the bolt hole in the connector with the holes in the mounting mast such that the “TOWARD ROTOR” text molded onto the connector leg is oriented toward the South. If you are connecting the shield to the mounting mast, do so now.



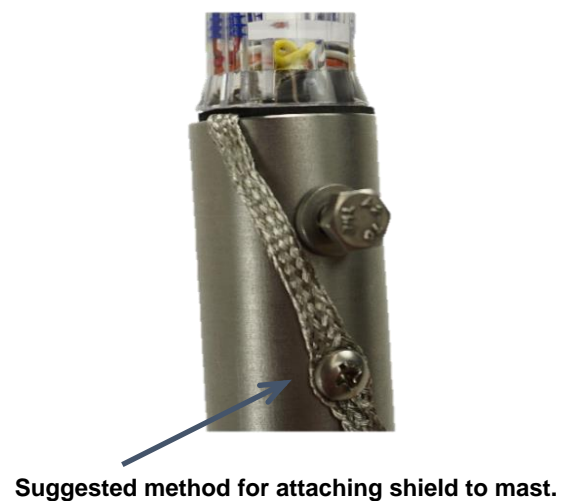
Remove the nut, washer, & bolt.



Feed cable through mast.



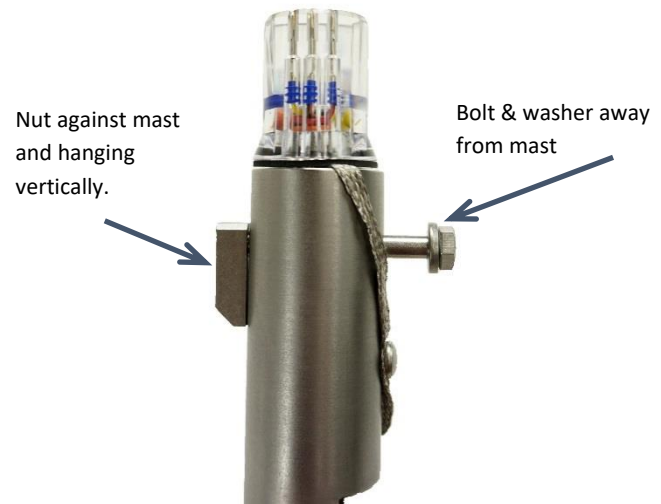
Install connector with “TOWARD ROTOR” text pointing to the South.





Mount Sensor

To attach the sensor to the mounting mast, slide the clamp bolt and washer away from the mounting adapter until the nut is against the mounting adapter and is hanging vertically.



Rotate the HXT sensor body so that the “THIS SIDE TOWARD ROTOR” label is facing the vertical nut. This aligns the internal key with the alignment slot in the connector. Now, slide the sensor down over the boom carefully making sure that the key drops into the slot. Continue to slide the sensor down until it is firmly seated on the nut. There will be some drag as the O-ring seal and the connector pins engage. Tighten the bolt using a 10 mm wrench to 7 N-m (5 ft-lbs).



Slide sensor down over mast.

Replacement washers, nuts and bolts can be ordered from NRG Systems (part #4422).



Sensor Wiring:

1. Connect the sensor and heater wires from the mast to the terminals in the junction box shown on page 17.
2. Connect the sensor and heater cables running down the tower to the junction box terminals shown on page 17.
3. Connect the sensor signal and ground wires to the logger's wiring panel.
4. Using the notations on the individual wires, connect the ground (common) lead first. Connect the signal leads second. Connect power last, especially if power is on during connection. Confirm input on data logger.
5. Connect the sensor(s) excitation wire plus the heater power cable to your power source, then check to be sure that the sensor head is heating. You do not need to wait until the body gets hot to be sure the heaters are working. Any warmth at the top of the stem (near the head) means that the heaters are working. The lower housing will take longer to warm up and will not get as hot.



To protect the wiring, a 15A slow blow fuse can be placed in line with the heater.



Hybrid XT sensors **must be heated year-round** to maintain constant bearing temperatures and to prevent moisture or condensation internally. Disconnecting the heater circuit for any meaningful amount of time may shorten the lifespan of the sensor and will void the warranty.

Logger Programming

Anemometer:

Use Channels 1-12 for wiring the anemometer Signal and Shield wires. Program as shown below.

The screenshot shows the configuration page for an Anemometer channel in the NRG Hybrid XT logger software. The top status bar displays: 6 Statistics Anemometer NRG Hybrid XT 4718000000 60.00m 0.0° (N) .5 -0.5 m/s.

Data Logging Mode: Statistics (selected)

Channel Type: Anemometer (selected)

Description: NRG Hybrid XT

Serial Number: 4718000000

Height: 60 Meters

Boom Bearing: 0 Degrees

Sensor Transfer Function:

- Scale Factor: 0.5 m/s per Hz
- Offset: -0.5 m/s
- Units: m/s (meters per second)

Signal Type:

- Coil: (selected)
- Pulsed:

Enable Internal Pull-up:

Data Logging Mode Legend:

- Average
- Standard Deviation
- Min
- Max
- 3-Second Gust



Vane:

Note: This configuration requires the external sense resistor NRG # 17884 (RES 125 OHM 1-2W 0.1% Axial)

Boom bearing should be entered as actual, based on the site. Vane Mounting Angle is always 270 based on the bolt hole alignment, if "toward rotor" is away from the tower. Vane Mounting Angle would be 90 if "toward rotor" is towards the tower.

Use Channels 16-19 for wiring the vane Signal and Shield wires. Program your channel as shown below.

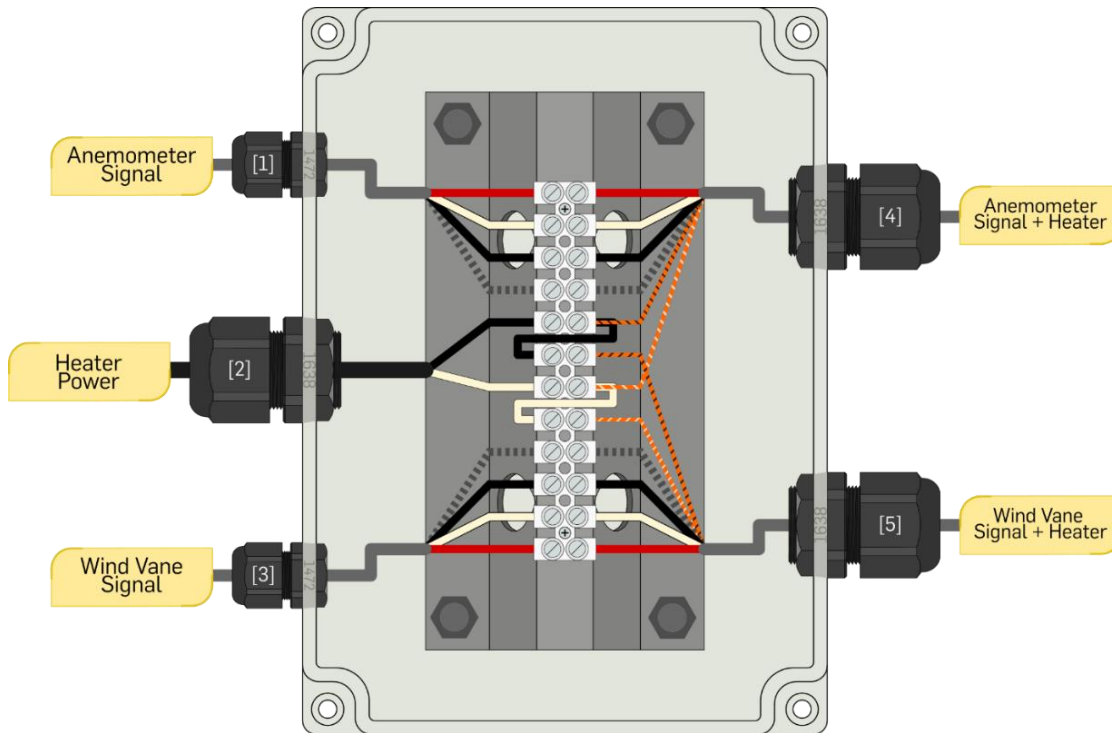
The screenshot shows the configuration interface for a Wind Vane channel. The top bar indicates channel 16, Statistics mode, Wind Vane sensor type, NRG Hybrid XT description, and various sensor parameters like 5762 serial number, 50m height, 90 degrees boom bearing, 270 degrees vane mounting angle, 180 degrees per V scale factor, and -90 degrees offset. The main configuration area is divided into three panels:

- Left Panel:**
 - Data Logging Mode:
 - Channel Type:
 - Description:
 - Serial Number:
 - Height: Meters
 - Boom Bearing: Degrees
 - Vane Mounting Angle: Degrees
 - Sensor Transfer Function:
 - Scale Factor: Degrees per V
 - Offset: Degrees
 - Total Direction Offset: 270.0 Degrees
- Right Panel:**
 - Excitation Mode:
 - Excitation Voltage:
 - Dead Band Compensation:
 - North East: Degrees
 - North West: Degrees
 - Analog Mode:
 - Reference Voltage:



Junction Box Wiring

The diagram below shows the correct wiring for (1) anemometer & (1) vane using a “2C + 3C” Hybrid XT wiring kit.



Sensor Wiring

	Power Supply	Data Logger	Function	Hybrid XT
Anemometer	RED	N/A	DC Sensor EXC	RED
	N/A	WHITE	Signal	WHITE
	BLACK	N/A	DC Sensor GND	BLACK
	N/A	BARE	Cable Shield	BRAID
Heater Power	BLACK	N/A	Heater EXC	Org & Blk
	BLACK	N/A		Org & Blk
	WHITE	N/A	Heater GND	Org & Wht
	WHITE	N/A		Org & Wht
Wind Vane	N/A	BARE	Cable Shield	BRAID
	BLACK	N/A	DC Sensor GND	BLACK
	N/A	WHITE	Signal	WHITE
	RED	N/A	DC Sensor EXC	RED



Transformer Wiring

When using grid power for the Hybrid XT sensor heater(s), refer to the wiring diagrams below.

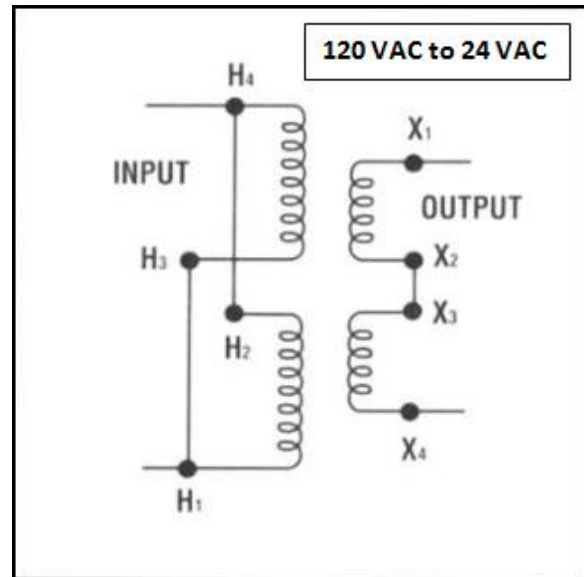
120 VAC Grid Power

Grid-to-Transformer input:

- H4 & H2 tied together w/ wire nuts
- H3 & H1 tied together w/ wire nuts

Transformer-to-Junction Box output:

- X1 out
- X4 out
- X2 & X3 tied together w/ wire nuts



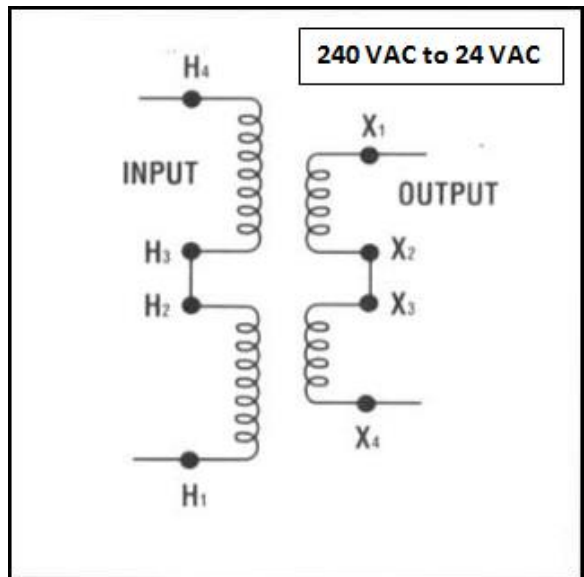
240 VAC Grid Power

Grid-to-Transformer input:

- H4
- H1
- H2 & H3 tied together w/ wire nuts

Transformer-to-Junction Box output:

- X1 out
- X4 out
- X2 & X3 tied together w/ wire nuts





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Sensor Maintenance

The sensors' readings in the data files should be checked on a regular basis. During winter months the data files should be checked more regularly to make sure the heaters are working properly. Site visits should be performed on a semi-annual basis to make sure booms, wiring and power sources are in good working condition.

Sensor Diagrams | Wind Vane #5762

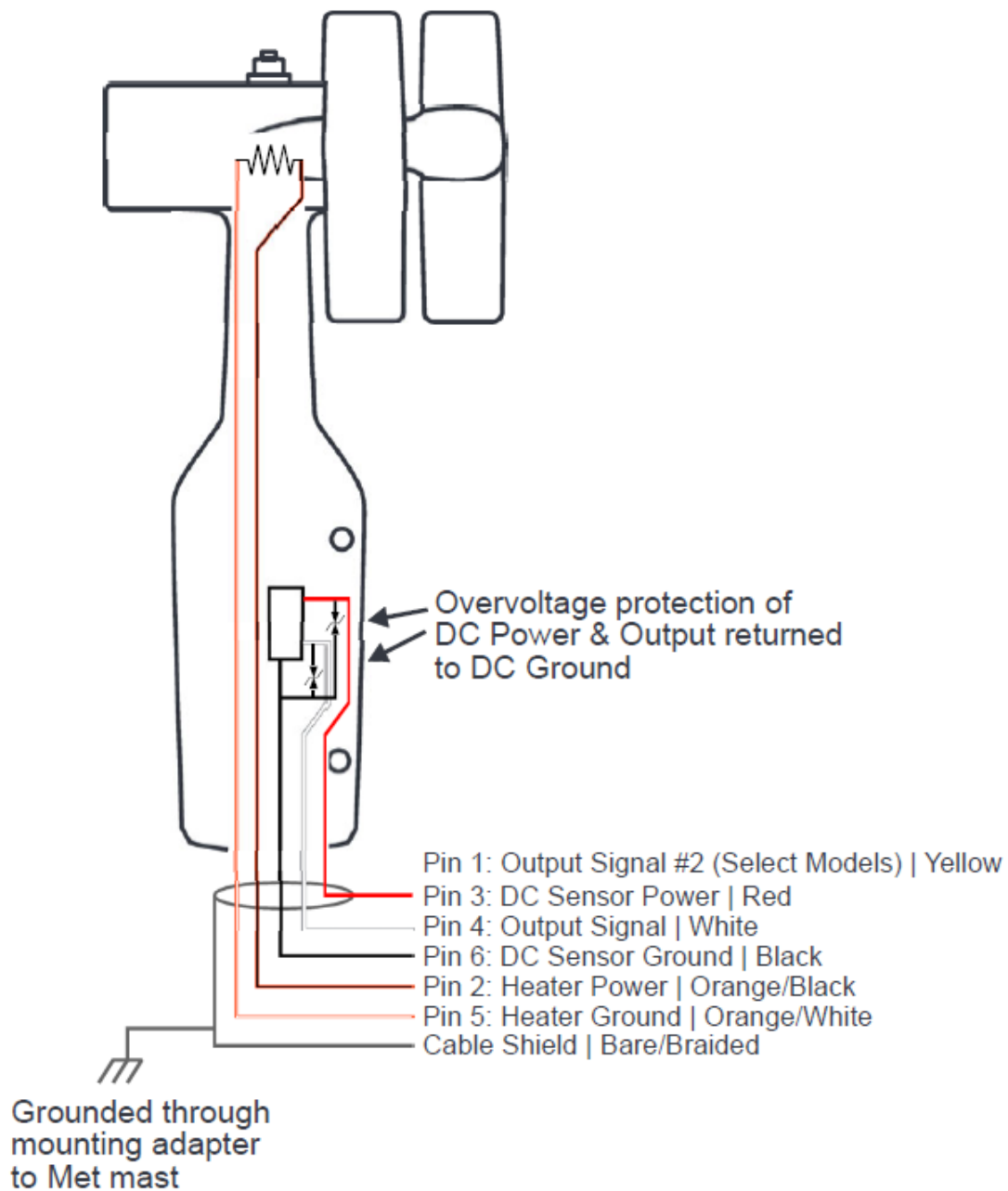




Table of Specifications | Wind Vane #5762

5762	Hybrid XT Vane 4-20mA Output CW	
Description	Sensor type	Heated Wind Turbine Yaw Control Vane
	Sensor range	0° to 360°, free rotation
		Guaranteed survivability to 90 m/s (200 mph)
Certifications	CE Marked	
Output signal	Signal type	Current loop, 4 to 20mA, sourced by the sensor
	Output signal range	4 to 20 mA
< 4 mA indicates fault		
Accuracy	Transfer function	4 to 20 mA corresponds to 0° to 360° in clockwise (CW) direction
	Accuracy	+/- 1.8° (0.5%)
		Factory calibrated at 180° (on the wind)
	Dead band	None
Resolution	0.4 degrees, guaranteed monotonic	
Response characteristics	Threshold	<2.4 m/s (<5.4 mph)
Power requirements	Supply voltage	11 to 24 V DC
	Supply current	20 mA typical, plus output signal current.
	Heater supply voltage	24V, AC or DC
	Heater supply current	Self regulating
		1 to 4 A, thermal load dependent
Cold start inrush current: 9 A peak		
Inrush drops below 4 A within 30 secs.		
Installation	Mounting	Quick disconnect allows for easy mounting or dismounting
		captive M6 clamp bolt, nut, and connector
	Tools required	10 mm wrench



	Accessories	Pre-wired cable assembly	
	Wiring	Sensor plugs onto captive connector	
Environmental	Operating temperature range	-40 ° C to 60 ° C (-40 ° F to 140 ° F)	
	Operating humidity range	0 to 100% RH	
	Other		IP55 per IEC 60529 and DIN40050-9 (Ingress Protection)
			MIL-STD-810F Method 509.4 (96 Hour Salt Fog Corrosion)
			IEC 60068-2-52, Severity 1 (28 Day Salt Fog Corrosion)
			IEC60068-2-38 Z/AD (Cyclic Humidity & Temperature)
			IEC 60068-2-78 (Constant Humidity)
			IEC 60068-2-6, Test Fc (Sinusoidal Vibration)
			IEC 60068-2-64, Test Fh (Random Vibration)
	Packaging meets ISTA 1A (Drop Test)		
Physical	Weight	1.68 kg (3.71 lbs)	
	Dimensions	Overall height 247 mm (9.72 inches)	
		Swept diameter: 150 mm (5.92")	
	Body diameter: 58 mm (2.3")		
Materials	Wing	Anodized Aluminum	
	Body	Zinc	
	Shaft	Stainless steel	
	Bearing	Double-shielded stainless steel ball bearings in a protective cartridge	

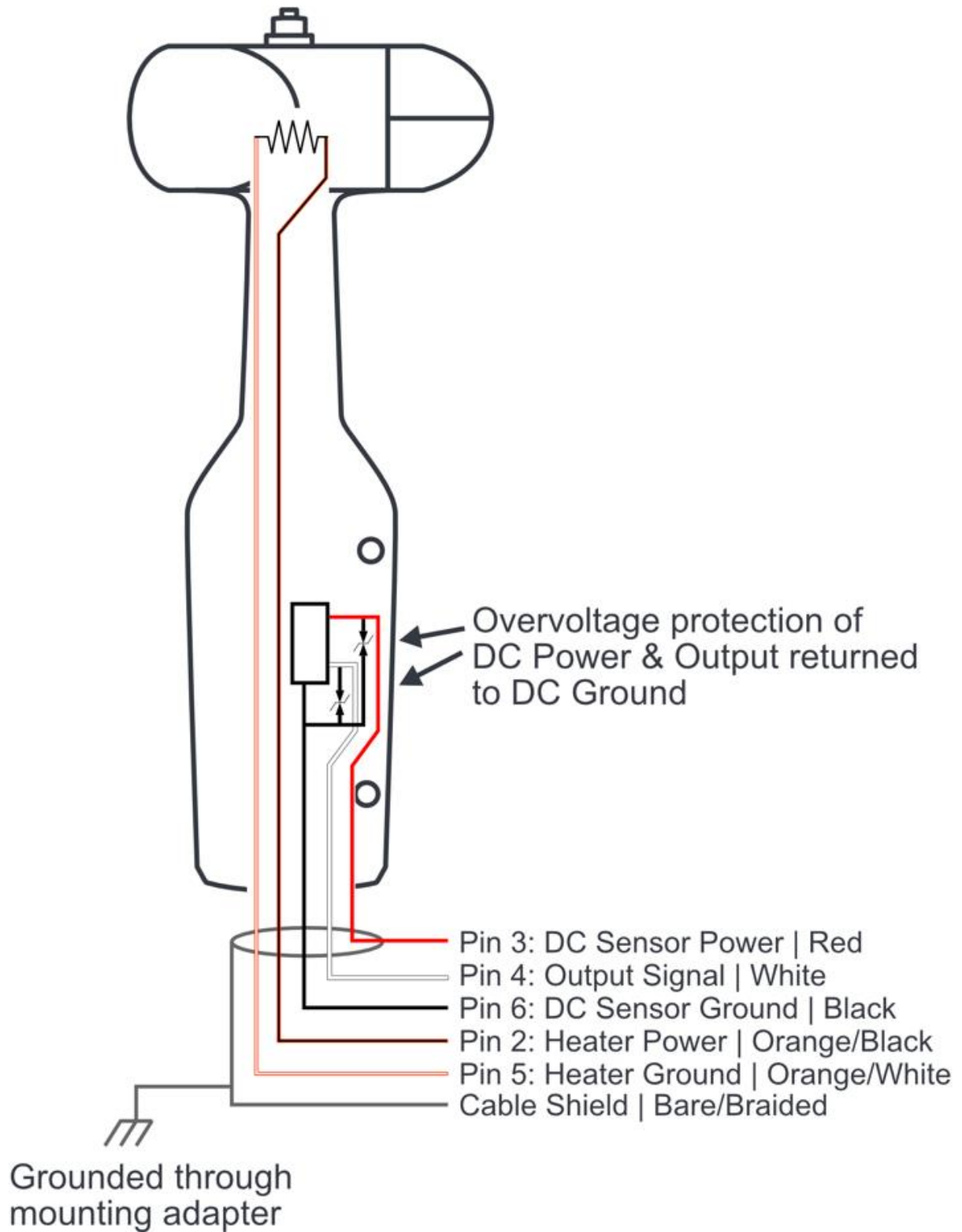




Table of Specifications | Anemometer #4718

4718	Hybrid XT Anemometer	
Specifications		
Description	Sensor type	3 Cup Heated Anemometer
	Sensor range	Measuring range 0 to 50 m/s (112 mph)
		Guaranteed survivability to 90 m/s (200 mph)
	Certifications	Conforms to UL Std 61010-1
		Conforms to CSA STD C22.2 NO. 61010-1
		CE
Output signal	Signal type	High level square wave frequency
		Amplitude equals supply voltage
	Output signal range	1 to 101 Hz
		0 Hz output indicates fault
Accuracy	Anemometer Transfer Function	0.5 m/s per Hz - 0.5 m/s
	Accuracy	+/- (0.3 m/s + 2% of measured value)
	Sensor to Sensor Variation	99.7% of sensors fall within 2% of the specified slope
	Calibration	Available upon request
Response characteristics	Threshold	1.58 m/s (3.52 mph)
	Distance constant (63% recovery)	16 m
Power requirements	Supply voltage	8 to 24 V DC
	Supply current	40 mA typical
		51 mA max. (not including heater)
	Heater supply voltage	24 V, AC or DC
	Heater supply current	Self regulating
		1 to 4 A, thermal load dependent
Cold start inrush current: 9 A peak		



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		Inrush drops below 4 A within 30 secs.	
Installation	Mounting	Quick disconnect allows for easy mounting or dismounting	
		captive M6 clamp bolt, nut, and connector	
	Tools required	10 mm wrench	
	Accessories	Pre-wired cable assembly	
	Wiring	Sensor plugs onto captive connector	
Environmental	Operating temperature range	-40 ° C to 60 ° C (-40 ° F to 140 ° F)	
	Operating humidity range	0 to 100% RH	
	Other		IP55 per IEC 60529 and DIN40050-9 (Ingress Protection)
			MIL-STD-810F Method 509.4 (96 Hour Salt Fog Corrosion)
			IEC 60068-2-52, Severity 1 (28 Day Salt Fog Corrosion)
			IEC60068-2-38 Z/AD (Cyclic Humidity & Temperature)
			IEC 60068-2-78 (Constant Humidity)
			IEC 60068-2-6, Test Fc (Sinusoidal Vibration)
			IEC 60068-2-64, Test Fh (Random Vibration)
	packaging meets ISTA 1A (Drop Test)		
Physical	Weight	1.45 kg (3.2 lbs)	
	Dimensions	Overall height: 237.6 mm (9.35 inches)	
		Swept diameter of rotor: 127 mm (5 inches)	
		Body diameter: 58 mm (2.3 inches)	
Materials	Cups	Black Anodized Aluminum	
	Body	Zinc	
	Shaft	Stainless Steel	
	Bearing	Double-shielded stainless steel ball bearings in a protective cartridge	



Power Requirements:

Power and Energy budgets for Heated Anemometry using Hybrid XT sensors.					
Vane	5762				
Anemometer	4718				
	Supply [Volts]	Max Current [Amps]	Running Current (typical) [Amps]	Running Power (typical) [Watts]	Energy (per day) [Watt-hours]
Heater, Ano	24	4	1.5	36	864
Heater, Vane	24	4	1.5	36	864
Sensor, Ano	12	0.051	0.04	0.48	11.52
Sensor, Vane	12		0.02	0.24	5.76
Signal, Ano			0		0
Signal, Vane	12	0.02		0.24	5.76
Ano Total				0.48	11.52
Vane Total				0.48	11.52



Two Year Limited Warranty

NRG Systems (NRG) warrants its products for a period of two years from the date of original purchase solely for the benefit of the original consumer purchaser. If this NRG product is determined to be defective in materials or workmanship, NRG will, at NRG's option, repair or replace this product without charge. This warranty does not cover damage due to improper installation or use, accident or misuse, damage due to lightning or any unauthorized service. This warranty also will not apply if any seal on any instrument or sensor is broken, if any cable has been severed, or the equipment was not adequately grounded.

To return a defective product, call NRG Systems at the telephone number listed below for an RMA (return merchandise authorization) number. When you call you must also have available the serial number of the item as well as the date of purchase. No products will be accepted for warranty work without an RMA number. The product must be returned, postage prepaid, to NRG with a brief description of the problem, RMA number and a return address with phone number.

The foregoing limited warranty is given in lieu of all other warranties, express or implied. NRG specifically disclaims all implied warranties including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose.

The above limited warranty expressly excludes, and NRG shall not be liable for, any incidental or consequential damage caused by or related to the selection, use of, inability to use or malfunction of this product.

NRG will make a good faith effort to repair or replace promptly any product which proves to be defective within the warranty period. First, contact NRG or the representative from whom the product was purchased and ask for an RMA number.

Tel: 802-482-2255

Fax: 802-482-2272

Email: support@nrgsystems.com