



# **NRG IceFree3™ Wind Resource Assessment Vane and Anemometer**

## ***User Manual***



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Specifications are subject to change without notice.

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# Customer Support

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

**NRG Systems, Inc.**  
**110 Riggs Road**  
**Hinesburg, Vermont**  
**05461 U.S.A.**

**Telephone: 802-482-2255**  
**Toll Free (USA only): 800-448-WIND (800-448-9463)**  
**FAX: 802-482-2272**  
**Email: [support@nrgsystems.com](mailto:support@nrgsystems.com)**

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

- Customer name
- Who purchased equipment
- 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 customers. If you need assistance at times other than our regular business hours, we suggest visiting our website, **[www.nrgsystems.com](http://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 products the best available.

# Introduction

## **NRG IceFree3™ Vane with Potentiometer (Heated)**

The NRG IceFree3™ vane is an electrically-heated potentiometer wind direction sensor designed for wind resource assessment at ice-prone sites. The IceFree3™ is reliable in heavy and light winds. It is rugged enough to accurately measure winds in excess of 90 meters per second (200 miles per hour), yet its low moment of inertia allows it to respond to winds as low as 2.0 m/s. The NRG IceFree3™ vane can be used with all NRG Systems data loggers.

## **NRG IceFree3™ Anemometer (Heated)**

The NRG IceFree3™ anemometer is an electrically-heated wind speed sensor, designed for resource assessment at ice-prone sites. The sensor provides an electrical output signal with frequency directly proportional to windspeed.

The IceFree3™ is reliable in heavy and light winds. It is rugged enough to accurately measure winds in excess of 90 meters per second (200 miles per hour), yet its relatively low moment of inertia permits it to respond rapidly to gusts and lulls.

The NRG IceFree3™ anemometer can be used with all NRG Systems data loggers.

# Sensor Identification

## Serial Number

The serial number is etched into the base of the sensor.



## Finished Good (FG) vs. Kit Numbers

Finished Good (FG) numbers are used to refer to the sensor itself. A Kit number always includes the FG number, but may include item accessories as well. Always use the Kit # when placing an order.

### Quick ID: NRG IceFree3™ Vanes (Heated)

Product	Kit#	FG#	Description	See Page
NRG IceFree3™ Wind Vane 10k Pot, 8 m	#2450	#2442	<ul style="list-style-type: none"><li>For wind resource assessment only</li><li>Continuous rotation potentiometric heated wind direction vane</li><li>Analog DC voltage</li><li>10K Ohms</li><li>8.0m cable</li></ul>	8

### Quick ID: NRG IceFree3™ Anemometers (Heated)

Product	Kit#	FG#	Description	See Page
NRG IceFree3™ Anemometer AC Sine, 8.0 m	#2651	#2649	<ul style="list-style-type: none"><li>3 cup heated anemometer</li><li>AC sine wave output signal.</li><li>8.0m cable</li></ul>	12

# General Sensor Information

## ESD, Circuit Protection, and Cautions

- Do not apply greater than 30 Volts to the outputs at any time.
- We suggest that you not mount the sensor until the proper grounding is available. When you mount the sensor, protect the signal wires and connect the ground first. After connecting to ground, attach the signal wires from the sensor.
- There are internal TVS diodes on the output. If the output voltage is pulled above 30 V, or below ground, the diode will clamp the output to ground.
- Do not apply constant reverse voltages to the outputs. The internal diode is intended only to protect the sensor output from transient reverse voltages, for example, the inductive turn-off spike caused by driving reed-relay coils directly from the output.

## Heater Operation

The heat source for the IceFree3 is a self-regulating constant-temperature heater. In severe wind and icing conditions, the IceFree3 draws full power and remains clear of ice. As weather conditions improve, the IceFree3 draws less power. The IceFree3's self-regulating feature increases its reliability, insuring that the head does not reach excessive temperatures. The IceFree3 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 is also available.

- Following a brief inrush current, the heater quickly settles into its temperature-controlled mode.
- It is recommended that a 15 A slow-blow fuse be placed in line with the heater.

## Vane Installation

1. Tape the ends of the cable to prepare for feeding the cable through the mounting boom. Feed the cable through the mounting boom until the sensor base meets the boom. Check that the IceFree3 sensor is secure against the top of the boom. Insert the bolt into the slot side of the base and tighten.
2. The bolt hole (not the slot) and nut should be pointing towards the tower.
3. Using the notations on the individual wires, connect the signal leads to your logger. Confirm that the correct wind direction is being read by the data logger.
4. Connect the heater power cable to your power source and check to be sure that the sensor head is heating. Any warmth at the top of the stem (near the head) means that the heater is working (the lower housing will take longer to warm up and will not get as hot). It is recommended that a 15 A slow-blow fuse be placed in line with the heater.

***The IceFree3 should be heated year-round to maintain constant bearing temperatures and to prevent moisture or condensation internally. We do not recommend turning off the heaters, even in warm weather.***

## Anemometer Installation

1. Tape the ends of the cables to prepare them for feeding through the mounting boom. Maintain the isolation of the signal leads from the boom. Remove the nut and bolt from the base of the unit. Feed the cables through the mounting boom until the sensor is on the boom. Align the bolt hole in the base (not the slot) with the hole in the boom such that the hole in the base points towards the tower.
2. Check to be sure that the sensor is secure against the top of the boom. Insert the bolt into the slot side of the base. Place the nut on the end of the bolt and tighten.

3. Using the notations on the individual wires, connect the ground (common) lead to your controller first. Then connect the signal leads. Connect power last, especially if power is on during connection. Confirm input on controller.

4. Connect the heater power cable to your power source and 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.

***IceFree sensors should be heated year-round to maintain constant bearing temperatures and to prevent moisture or condensation internally. We do not recommend turning off the heaters, even in warm weather.***

### **\*Calibration**

If the IceFree sensor has been calibrated, a sensor specific calibration report has been shipped with the sensor. If the calibration report should get lost, you may contact NRG for a copy. Please note that you will need the sensor serial number when you contact NRG.

## **NRG IceFree3™ Wind Vane**



# 10k Pot, 8 m

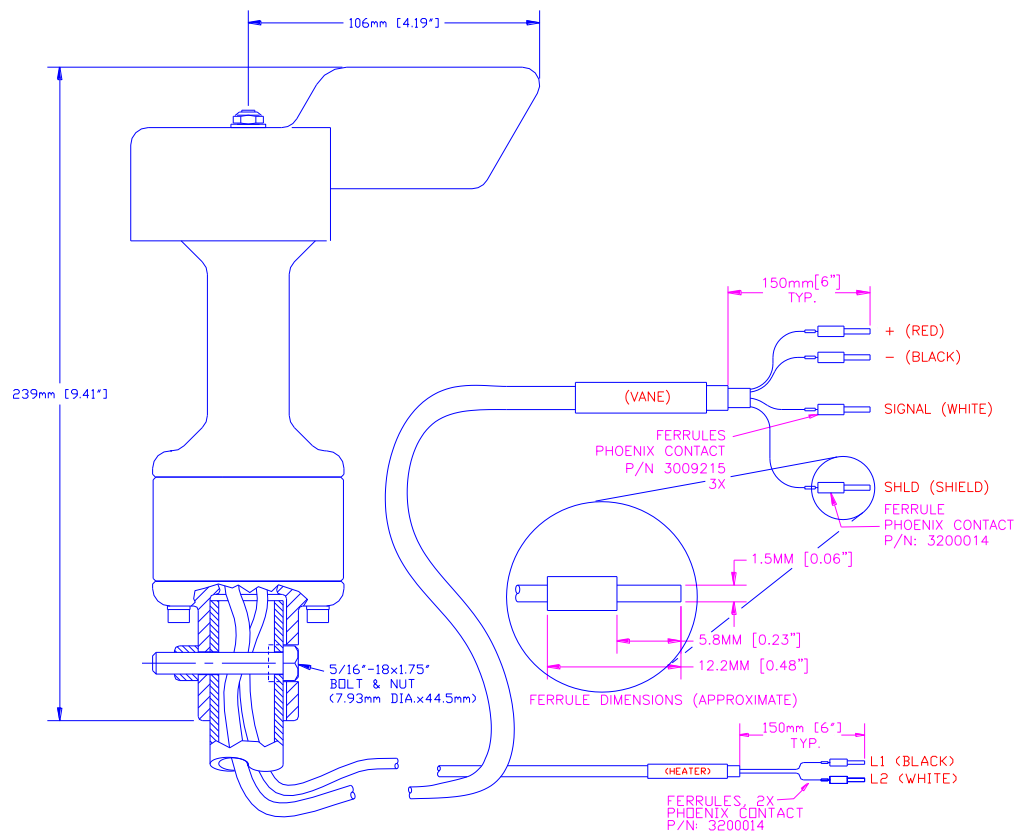
**Kit# 2450**

**FG# 2442**

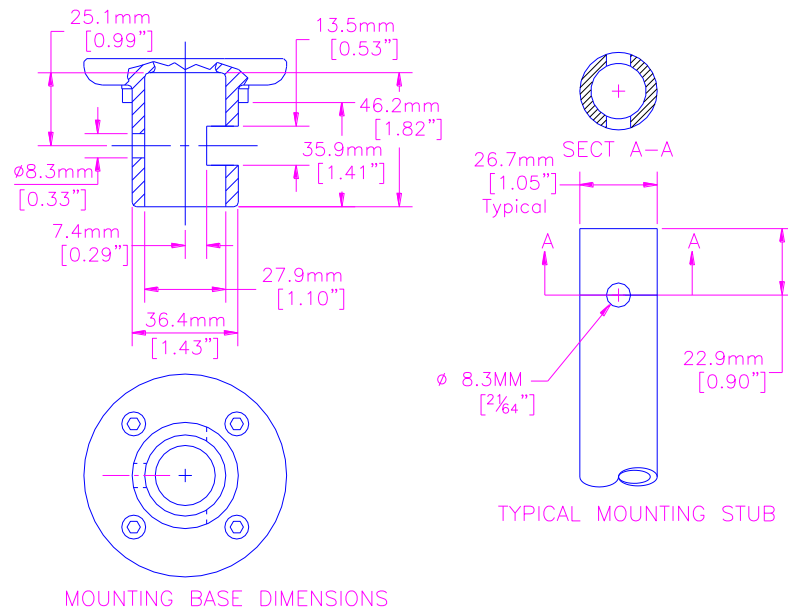
## Operation

Rotation of the vane head moves a potentiometer. With an applied excitation voltage, a ratiometric DC voltage output is produced. The signal range is 352 degrees (8 degrees open), and the "deadband" is centered around North.

## [ Kit# 2450, FG#2442 ] Sensor and Mounting Outline



**[Kit# 2450, FG#2442 ] Sensor and Mounting Outline Cont.**



## [ Kit# 2450, FG#2442 ] Specifications

Description	Sensor type	continuous rotation potentiometric heated wind direction vane
	Applications	<ul style="list-style-type: none"> <li>• wind resource assessment</li> <li>• meteorological studies</li> <li>• environmental monitoring</li> </ul>
	Sensor range	360° mechanical, continuous rotation
	Instrument compatibility	all NRG loggers
Output signal	Signal type	analog DC voltage from conductive plastic potentiometer, 10K ohms
	Transfer function	output signal is a ratiometric voltage
	Accuracy	potentiometer linearity within 1%
	Dead band	8° Maximum, 4° Typical
Power requirements	Supply voltage	regulated potentiometer excitation of 1 V to 15 V DC
	Heater supply voltage	<ul style="list-style-type: none"> <li>• 24 V AC/DC</li> <li>• optional transformer available</li> </ul>
	Heater supply current	<ul style="list-style-type: none"> <li>• Inrush: 8 A maximum</li> <li>• Steady state: 1 A at 20 °C (68 °F), 4 A under maximum thermal load (head frozen in clear ice then powered on)</li> </ul>
Installation	Mounting	mounts to a 27 mm (1.05 inch) diameter (3/4 inch IPS) pipe with a 3/8 inch lock bolt; cabling exits into mounting pipe
	Tools required	13 mm (0.5 inch) nut driver
Environmental	Operating temperature range	-40 °C to 80 °C (-40 °F to 176 °F)
	Operating humidity range	0 to 100% RH
Physical	Connections	Signal Cable <ul style="list-style-type: none"> <li>• red: excitation</li> <li>• black: common</li> <li>• white: signal</li> </ul> Heater Cable <ul style="list-style-type: none"> <li>• black/white: heater power (AC or DC)</li> </ul>
	Cable length	8 m (26 feet) signal and heater cables
	Weight	1.58 kg (3.49 pounds)
	Dimensions	<ul style="list-style-type: none"> <li>• overall assembly height: 239 mm (9.41 inches)</li> <li>• body diameter: 70 mm (2.75 inches)</li> <li>• swept diameter: 212 mm (8.38 inches)</li> <li>• center to tail radius: 106 mm (4.19 inches)</li> </ul>
Materials	Body	cast aluminum with black anodized finish and heat-resistant black paint

	Shaft	centerless ground, stainless steel
	Bearing	<ul style="list-style-type: none"> <li>• upper: sealed, stainless steel, ball bearing with application specific lubrication</li> <li>• lower: stainless steel bearing</li> </ul>
	Wing	precision balanced aluminum with black anodized finish and heat-resistant black paint
	Cable	<ul style="list-style-type: none"> <li>• Signal: 3 conductor 20 AWG, chrome PVC jacket with overall foil shield and drain</li> <li>• Heater: 2 conductor 20 AWG, Teflon jacket with overall foil shield and drain</li> </ul>
	Enclosure	<ul style="list-style-type: none"> <li>• sealed to IP55</li> <li>• heater is epoxy encapsulated to IP65</li> </ul>
	Signal generator	glass reinforced thermoplastic shell
	Heater	fully encapsulated, self-regulating
	Base	cast aluminum with black anodized finish and heat-resistant black paint

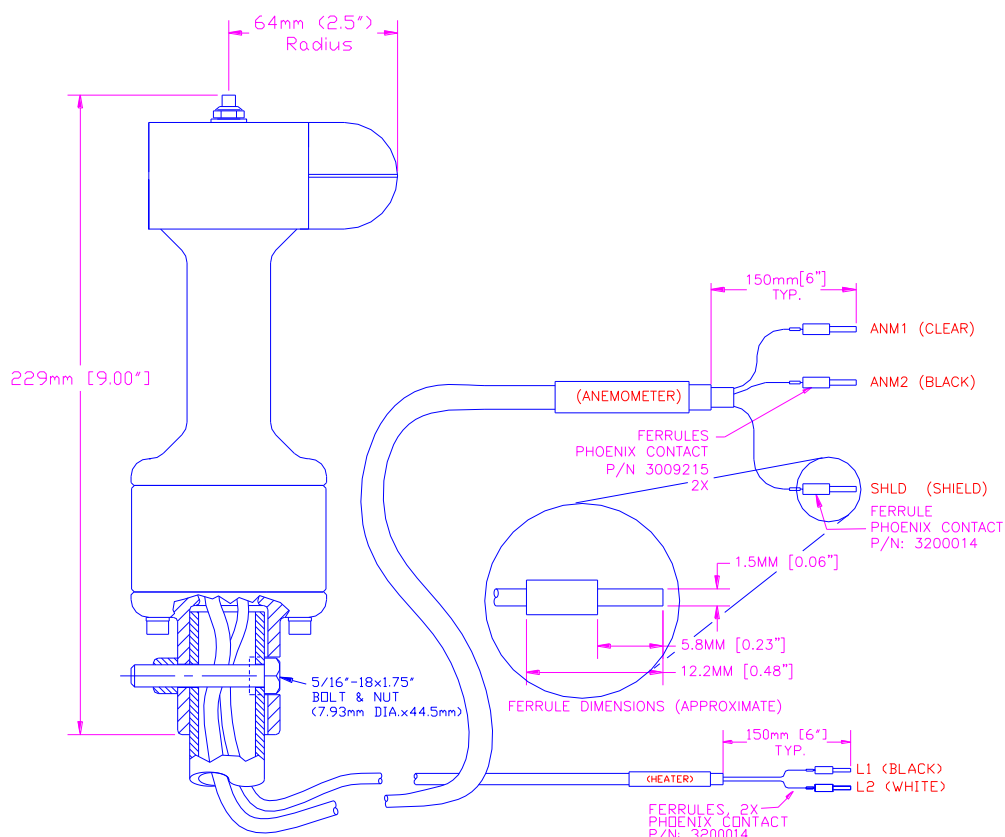
## NRG IceFree3™ Anemometer AC Sine

**Kit# 2651**  
**FG# 2649**

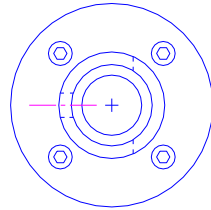
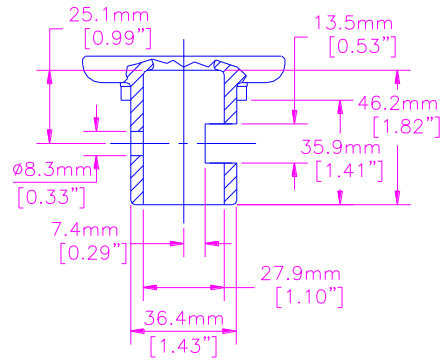
## AC Output Circuit Operation

The IceFree3 anemometer provides an AC sine wave output signal. Rotation of the anemometer head rotates the four pole magnet past a low impedance generator coil inducing a current in the coil. The coil electrical output is a sine wave with frequency directly proportional to the wind speed. Amplitude of the sine wave varies from about 50 mV at threshold to several volts at full speed. 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 or refer to application note **an40C-if3\_interface**.

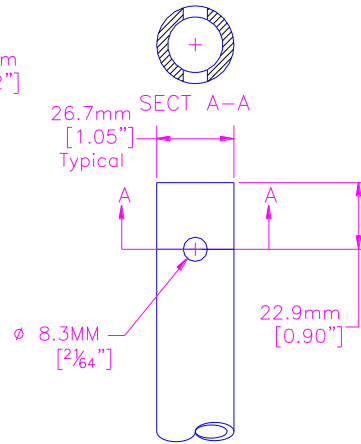
## [ Kit# 2651, FG# 2649 ] Sensor and Mounting Outline



## [ Kit# 2651, FG# 2649 ] Sensor and Mounting Outline Cont.



MOUNTING BASE DIMENSIONS



TYPICAL MOUNTING STUB

[ Kit# 2651, FG# 2649 ]

**Specifications**

Description	Sensor type	3 cup heated anemometer
	Applications	<ul style="list-style-type: none"> <li>• wind resource assessment</li> <li>• wind turbine control</li> <li>• meteorological studies</li> <li>• ski area maintenance</li> <li>• environmental monitoring</li> </ul>
	Sensor range	maximum rated wind speed is 90 m/s (200 miles per hour)
	Instrument compatibility	all NRG loggers
Output signal	Signal type	variable amplitude sine wave, frequency proportional to wind speed
	Anemometer Transfer function	$m/s = (Hz \times 0.572) + 1.00$ $[miles\ per\ hour = (Hz \times 1.28) + 2.24]$
	Sensor to Sensor Variation	99.7% of sensors fall within 4.3% of stated transfer function (based on over 800 samples)
	Calibration	available upon request - contact NRG for more information.
	Output signal range	0 Hz to 155 Hz
Response characteristics	Distance constant (63% recovery)	7.6 m (25 feet)
Power requirements	Heater supply voltage	<ul style="list-style-type: none"> <li>• 24 V AC/DC</li> <li>• optional transformer available</li> </ul>
	Heater supply current	<ul style="list-style-type: none"> <li>• Inrush: 8 A maximum</li> <li>• Steady state: 1 A at 20 °C (68 °F), 4 A under maximum thermal load (head frozen in clear ice then powered on)</li> </ul>
Installation	Mounting	mounts to a 27 mm (1.05 inch) diameter (3/4 inch IPS) pipe with a 5/16 inch nut and bolt; cabling exits into mounting pipe
	Tools required	13 mm (0.5 inch) nut driver
Environmental	Operating temperature range	-40 °C to 60 °C (-40 °F to 140 °F)
	Operating humidity range	0 to 100% RH
Physical	Connections	Signal Cable <ul style="list-style-type: none"> <li>• clear: signal</li> <li>• black: ground</li> <li>• shield drain</li> </ul> Heater Cable <ul style="list-style-type: none"> <li>• black / white: heater power (AC/DC)</li> </ul>
	Cable length	<ul style="list-style-type: none"> <li>• Signal &amp; Power cables: 8m</li> <li>• extension kits available</li> </ul>
	Weight	1.45 kg (3.2 pounds)
	Dimensions	<ul style="list-style-type: none"> <li>• overall assembly height : 224 mm (8.82 inches)</li> <li>• body diameter: 70 mm (2.75 inches)</li> <li>• swept diameter of rotor: 127 mm (5 inches)</li> </ul>

Materials	Cups	precision balanced aluminum with black anodized finish and heat-resistant black paint
	Body	cast aluminum with black anodized finish and heat-resistant black paint
	Shaft	centerless ground, stainless steel
	Bearing	stainless steel ball bearings with application specific lubrication
	Magnet	4 pole ceramic
	Coil	single coil, shielded for ESD protection
	Cable	<ul style="list-style-type: none"> <li>• Signal: 2 conductor 20 AWG, chrome PVC jacket with overall foil shield and drain</li> <li>• Heater: 2 conductor 20 AWG, Teflon jacket with braid shield and drain</li> </ul>
	Enclosure	<ul style="list-style-type: none"> <li>• sealed to IP55</li> <li>• heater is epoxy encapsulated to IP65</li> </ul>
	Heater	fully encapsulated, self-regulating
	Base	cast aluminum with black anodized finish and heat-resistant black paint



# Warranty & Repair

## Two Year Limited Warranty

NRG Systems, Inc. (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, lightning or damages due to any unauthorized service. This warranty also will not apply if any seal on any instrument or sensor is broken or the equipment is not grounded.

To return a defective product, call NRG Systems at the telephone number listed below for an RMA number. You must have available when you call the serial number of the item as well as the date purchased. *No products will be accepted for warranty work without an RMA number.* The product must be returned, postage prepaid, to NRG. Include 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 damages caused or related to the use of, inability to use or malfunction of this product.***

Prompt disposition: NRG will make a good faith effort for prompt correction or other adjustment with respect to any product which proves to be defective within warranty. First contact NRG or representative from whom product was purchased and ask for an RMA number.

NRG will also make a good faith effort for prompt service after the warranty period. Contact NRG with the nature of the problem and obtain an RMA number.

Inspect your shipments for damaged or missing packages immediately upon receipt. Record any such exceptions on the freight receipt of the delivery agent. If any contents are damaged or missing, report this in writing to the freight carrier and send NRG a copy of the damage report. If you insured the shipment yourself, report any damages to your insurance carrier.

TEL: 802-482-2255      FAX: 802-482-2272 EMAIL: [sales@nrgsystems.com](mailto:sales@nrgsystems.com)

# Return Instructions (Repairs)

If you wish to return an item to NRG Systems for repair or any other reason, please **before shipping contact NRG's Service Department by phone (802) 482-2255 or fax (802) 482-2272** to obtain a Return Material Authorization (RMA) Number. The RMA Number allows us to track and route your shipment or repair. Note the RMA Number on all boxes shipped to us and refer to it in your correspondence or phone calls to us. Please fill out a copy of this sheet and send it with your shipment to NRG Systems.

Date: \_\_\_\_\_ Your Name: \_\_\_\_\_ RMA No: \_\_\_\_\_

Items being returned: \_\_\_\_\_ Serial Number: \_\_\_\_\_

Reason for return: \_\_\_\_\_

Warranty: Yes No Not Sure Purchase Date / Invoice No: \_\_\_\_\_

Estimate for repair charges requested? Yes No Repair not to exceed US\$: \_\_\_\_\_

Person to be contacted with estimate: \_\_\_\_\_ Phone: \_\_\_\_\_

Person to issue Purchase Order for repair: \_\_\_\_\_ Phone: \_\_\_\_\_

Billing Address: \_\_\_\_\_ Shipping Address: \_\_\_\_\_

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Send your shipment **FREIGHT PREPAID and INSURED** against loss or damage in transit to:

NRG Systems, Inc.  
Attn: Receiving Dept., RMA No. R-\_\_\_\_\_  
110 Riggs Road  
Hinesburg, VT 05461, USA

SHIPMENTS SENT FREIGHT COLLECT WILL NOT BE ACCEPTED BY NRG SYSTEMS.

International Customers please state the following in your shipping documents:

"THESE ITEMS ARE BEING RETURNED TO THEIR U.S. MANUFACTURER.  
COUNTRY OF MANUFACTURE AND ORIGIN IS U.S.A. HS CODE 9801.00.1025"



Global leaders in wind assessment technology

[www.nrgsystems.com](http://www.nrgsystems.com)

## Declaration of Conformity

(in accordance with ISO/IEC 17050-1:2004)

NRG Systems Document Number: N3440, Rev C

**Supplier:** NRG Systems  
**Supplier Address:** 110 Riggs Road, Hinesburg, VT 05461, USA  
Telephone: 802 482 2255, Fax: 802 482 2272  
Email: [sales@nrgsystems.com](mailto:sales@nrgsystems.com)

**Declares that the Products:** IceFree 3 Anemometers and Wind Vanes  
**Including Model Numbers:**

IceFree 3 Anemometer	Models 2377, 2448, 2549, 2578, 2651, 2750, 2777, 2781, 2849, 2847, 3058, 3290, 3445, 3447, 3537, 4107, 4108
IceFree 3 Wind Vane	Models 2378, 2450, 2451, 2652, 2808, 2850, 3059, 3292, 3450, 3482

are in conformity with the requirements of the following standards:

**Safety:** IEC 61010-1 Ed. 2.0 b:2001, "Safety requirements for electrical equipment for measurement, control, and laboratory use"  
**EMC:** 2004/108/EC "Council Directive of 15 December 2004, on the approximation of the Laws of Member States relating to electromagnetic compatibility"  
EN61326-1 Class A "Electrical Equipment for Measurement, Control, and Laboratory Use—EMC Requirements"

### Additional Information:

All circuits are extra low voltage (ELV), therefore standard 2006/95/EC (the low-voltage directive) does not apply.

The technical files and other documentation are on file with Mr. David Blittersdorf, Engineering.

Issued at Hinesburg, VT, USA

08 October 2007

  
Owen Clay  
Engineering Manager

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110 Riggs Road, PO Box 509, Hinesburg, Vermont 05461 USA • Tel 802-482-2255 • Fax 802-482-2272 • [info@nrgsystems.com](mailto:info@nrgsystems.com)