

NRG User Manual

IceFree3 Heated Vane & Anemometer | WRA

For Wind Resource Assessment Applications

Authors:
Technical Services



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Introduction

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

Because the heaters 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 IceFree3 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 etched into the base of the sensor.

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.*



IceFree3 Anemometer

Kit #2651 | FG #2649

AC Sine Output | 8m Cable

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.

Calibration

If the IceFree3 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.

IceFree3 Vane

Kit #2450 | FG #2442

10k Pot | 8m Cable

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 from 4-356 degrees, spanning 352 degrees total. The “dead band” is centered around the north mark, at 0 degrees.

North Mark

The IceFree3 vane uses the mounting bolt hole as the north mark.



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 IceFree3 is a self-regulating constant-temperature heater. The current draw increases in severe weather conditions in order to maintain adequate temperature and sensor performance.

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.

Power Considerations

- IceFree3 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.

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

Once the power requirement has been determined, a power supply will need to be created.

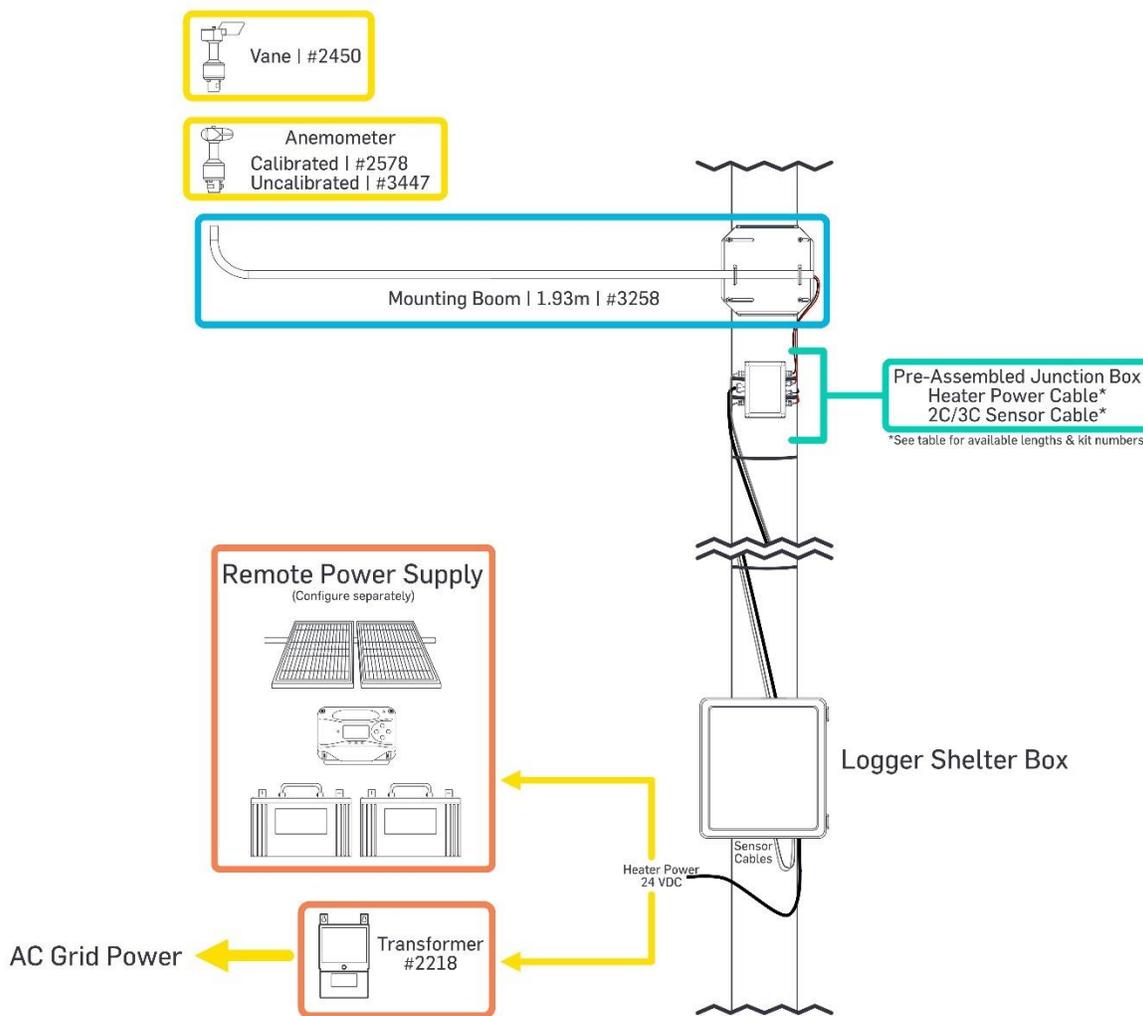
Combinations of deep cycle 24V batteries, PV panels and/or a small wind turbine (1kW) have been used successfully in the past.



Sensor Installation

Parts Required

The diagram & table in this section show the part numbers required for installing IceFree3 sensors onto a tubular tower (8-10" diameter). Note: *Boom kit #9327 for lattice towers has been discontinued.*



Cable Length (m)	2C (Ano)	3C (Vane)	2C + 3C	Cable Length (m)	2C (Ano)	3C (Vane)	2C + 3C
5	2481	2487	-	50	2486	2492	2948
10	2482	2488	2786	67	2588	2747	2589
20	2483	2489	-	70	2736	-	2738
30	2484	2490	2715	80	2956	-	2898
40	2485	2491	2667	90	2725	4272	3605



Installation Procedure

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 sensor.
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.



On the wind vane, the bolt hole represents the north mark on the sensor and should be pointed towards the tower.

2. Connect the sensor wires to the data logger wiring panel or to the appropriate terminals in the junction box (see **Junction Box Wiring** for diagram).
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.
3. Connect the heater power cable to your power source or to the appropriate terminals in the junction box, 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 heater circuit, a 15A slow blow fuse can be placed in line with the heater.



*IceFree3 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.*

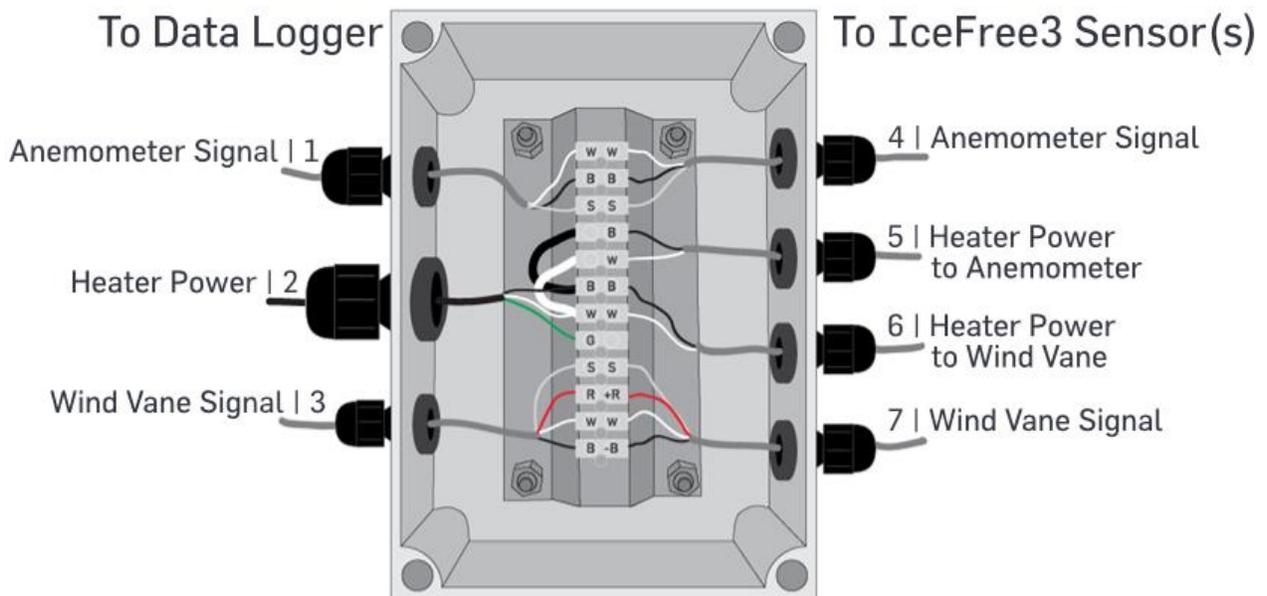
4. Check to be sure that the sensor is secure against the top of the boom. Insert the bolt into the slot side of the base. Place the nut on the end of the bolt and tighten.



Junction Box Wiring

The diagram below shows the correct wiring for (1) anemometer & (1) vane using a “2C + 3C” IceFree3 wiring kit.

- When using just (1) Icefree3 anemometer, 3C cables #3 & #7 can be ignored.
- When using just (1) Icefree3 vane, 2C cables #1 & #4 can be ignored.
- When using (2) Icefree3 anemometers, cables #3 & #7 would be 2C cables identical to #1 & #4.





Transformer Wiring

When using grid power for the IceFree3 sensor heater(s), refer to the wiring diagrams below.

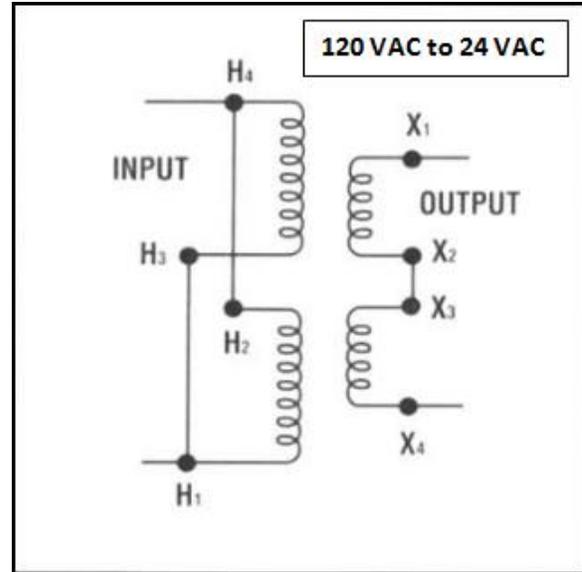
120 VAC Grid Power

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



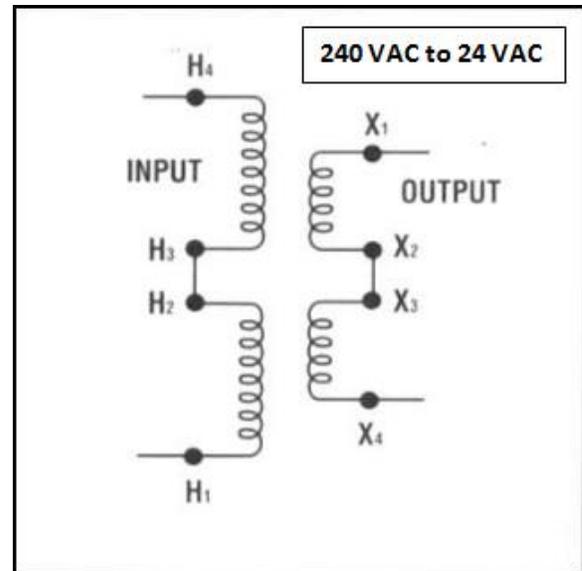
240 VAC Grid Power

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



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 #2442

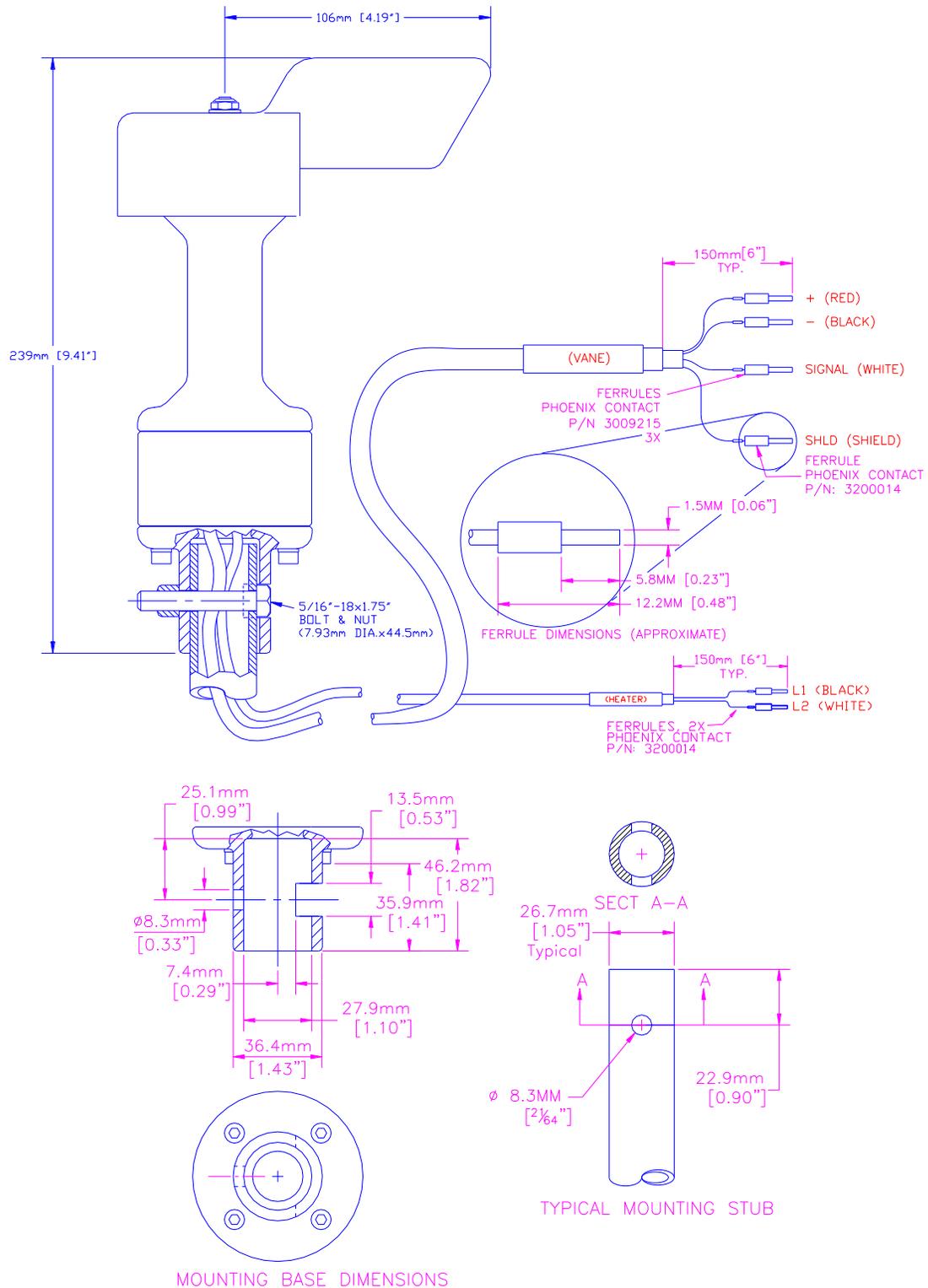




Table of Specifications | Wind Vane #2442

Description	Sensor type	Continuous rotation potentiometric heated wind direction vane
	Applications	<ul style="list-style-type: none"> – Wind resource assessment – Meteorological studies – Environmental monitoring
	Sensor range	360° Mechanical, continuous rotation
	Instrument compatibility	<ul style="list-style-type: none"> – All NRG loggers – Data loggers with potentiometer vane compatibility
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"> – 24 V AC/DC – Optional transformer available
	Heater supply current	<ul style="list-style-type: none"> – Inrush: 8 A maximum – Steady state: 1 A at 20 °C (68 °F), 4 A under maximum thermal load (head frozen in clear ice then powered on)
Installation	Mounting	Mounts to a 27 mm (1.05 inch) diameter (3/4 inch IPS) pipe with a 5/16"-18 x 1.75" bolt & locknut; 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"> – Red: excitation – Black: common – White: signal Heater Cable <ul style="list-style-type: none"> – Black/white: heater power (AC or DC)
	Cable length	8 m (26 feet) signal and heater cables
	Weight	1.58 kg (3.49 pounds)
	Dimensions	<ul style="list-style-type: none"> – Overall assembly height: 239 mm (9.41 inches) – Body diameter: 70 mm (2.75 inches) – Swept diameter: 212 mm (8.38 inches) – Center to tail radius: 106 mm (4.19 inches)



Materials	Body & Base	Cast aluminum with black anodized finish and heat-resistant black paint
	Shaft	Centerless ground, stainless steel
	Bearing	<ul style="list-style-type: none"> – Upper: sealed, stainless steel, ball bearing with application specific lubrication – Lower: stainless steel bearing
	Wing	Precision balanced aluminum with black anodized finish and heat-resistant black paint
	Cable	Signal 3 conductor 20 AWG, chrome PVC jacket with overall foil shield and drain Heater 2 conductor 20 AWG, Teflon jacket with overall foil shield and drain
	Enclosure	<ul style="list-style-type: none"> – Sealed to IP55 – Heater is epoxy encapsulated to IP65
	Signal generator	Glass reinforced thermoplastic shell
	Heater	Fully-encapsulated, self-regulating



Sensor Diagrams | Anemometer #2649

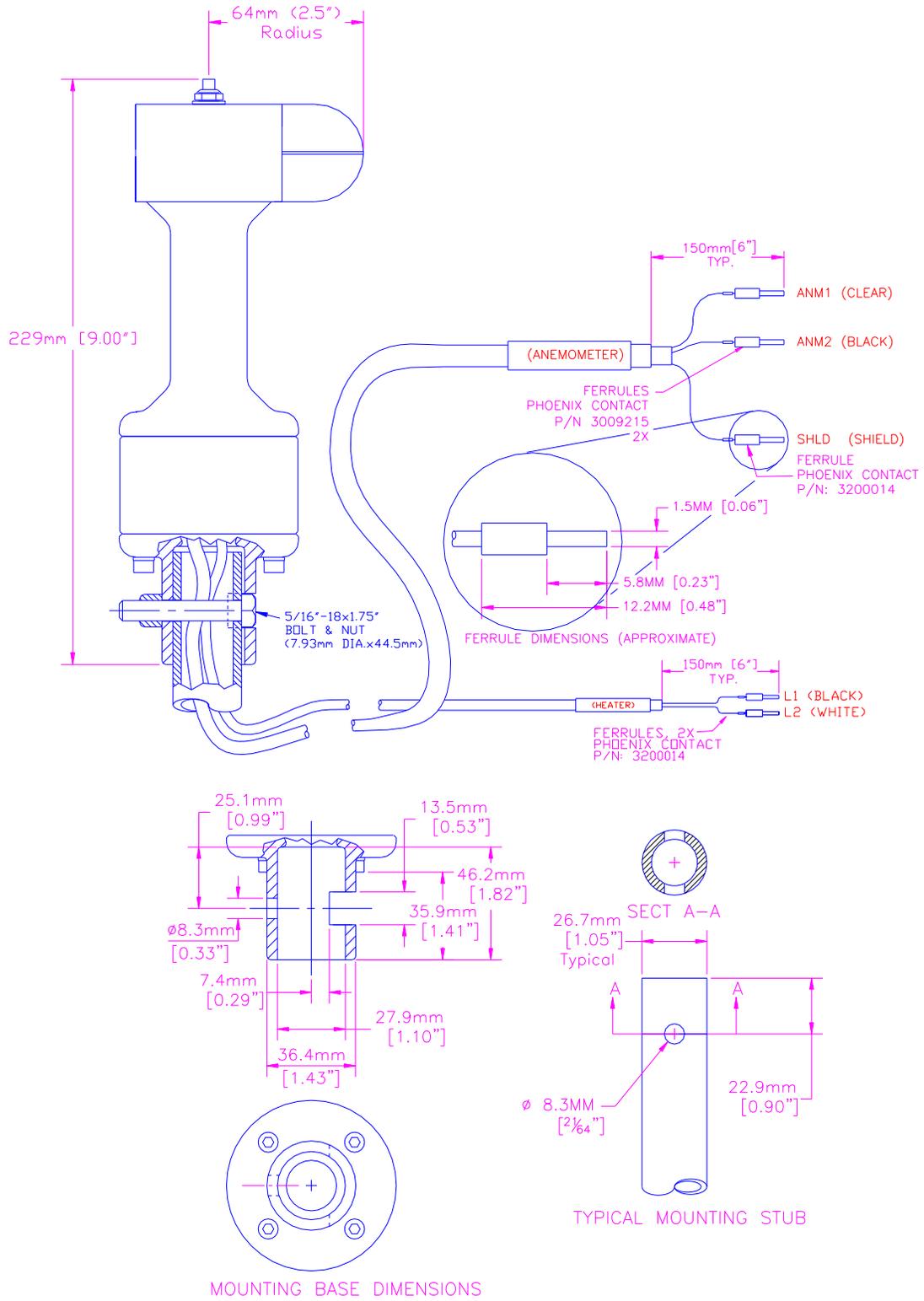




Table of Specifications | Anemometer #2649

Description	Sensor type	Continuous rotation potentiometric heated wind direction vane
	Applications	<ul style="list-style-type: none"> – Wind resource assessment – Meteorological studies – Environmental monitoring – Ski area maintenance
	Sensor range	Maximum rated wind speed is 90 m/s (200 miles per hour)
	Instrument compatibility	<ul style="list-style-type: none"> – All NRG loggers – Data loggers with frequency input compatibility
Output signal	Signal type	Variable amplitude sine wave, frequency proportional to wind speed
	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)
	Output signal range	0-155 Hz
	Calibration	Available upon request
Response characteristics	Distance constant (63% recovery)	7.6 m (25 feet)
Power requirements	Heater supply voltage	<ul style="list-style-type: none"> – 24 V AC/DC – Optional transformer available
	Heater supply current	<ul style="list-style-type: none"> – Inrush: 8 A maximum – Steady state: 1 A at 20 °C (68 °F), 4 A under maximum thermal load (head frozen in clear ice then powered on)
Installation	Mounting	Mounts to a 27 mm (1.05 inch) diameter (3/4 inch IPS) pipe with a 5/16"-18 x 1.75" bolt & locknut; 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"> – Black: ground – Clear: signal – Shield drain Heater Cable <ul style="list-style-type: none"> – Black/white: heater power (AC or DC)
	Cable length	8 m (26 feet) signal and heater cables



	Weight	1.45 kg (3.2 pounds)
	Dimensions	<ul style="list-style-type: none"> – Overall assembly height: 224 mm (8.82 inches) – Body diameter: 70 mm (2.75 inches) – Swept diameter: 127 mm (5.00 inches)
Materials	Body & Base	Cast aluminum with black anodized finish and heat-resistant black paint
	Shaft	Centerless ground, stainless steel
	Bearing	<ul style="list-style-type: none"> – Upper: sealed, stainless steel, ball bearing with application specific lubrication – Lower: stainless steel bearing
	Cups	Precision balanced aluminum with black anodized finish and heat-resistant black paint
	Cable	Signal 2 conductor 20 AWG, chrome PVC jacket with overall foil shield and drain Heater 2 conductor 20 AWG, Teflon jacket with overall foil shield and drain
	Enclosure	<ul style="list-style-type: none"> – Sealed to IP55 – Heater is epoxy encapsulated to IP65
	Signal generator	Glass reinforced thermoplastic shell
	Heater	Fully-encapsulated, self-regulating



Two Year Limited Warranty

NRG Systems (NRG) warrants its products for a period of two years from 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, damages 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 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 damages 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



Declaration of Conformity



Global leaders in wind assessment technology

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

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"

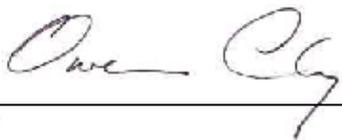
Additional Information:

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

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