



# NRG IceFree3™ Anemometer AC Sine, 2.8 m

## *User Manual*



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## Introduction

The NRG IceFree3™ anemometer is an electrically-heated wind speed sensor, designed for wind resource assessment and wind turbine control at ice prone sites. The sensor is mounted to the meteorological tower or turbine nacelle, and 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.

## 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.

The IceFree3 linear frequency output makes the IceFree3 ideal for use with wind turbine controllers.

## 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 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. Excessive temperatures can stress bearing lubricants, wiring and present a hazard in the presence of combustible materials. 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.

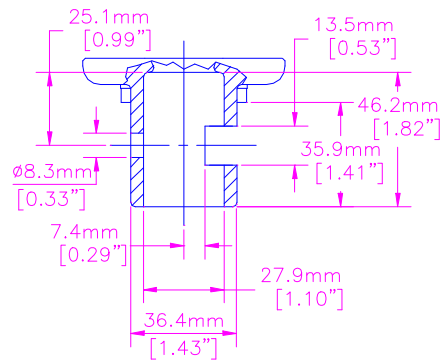
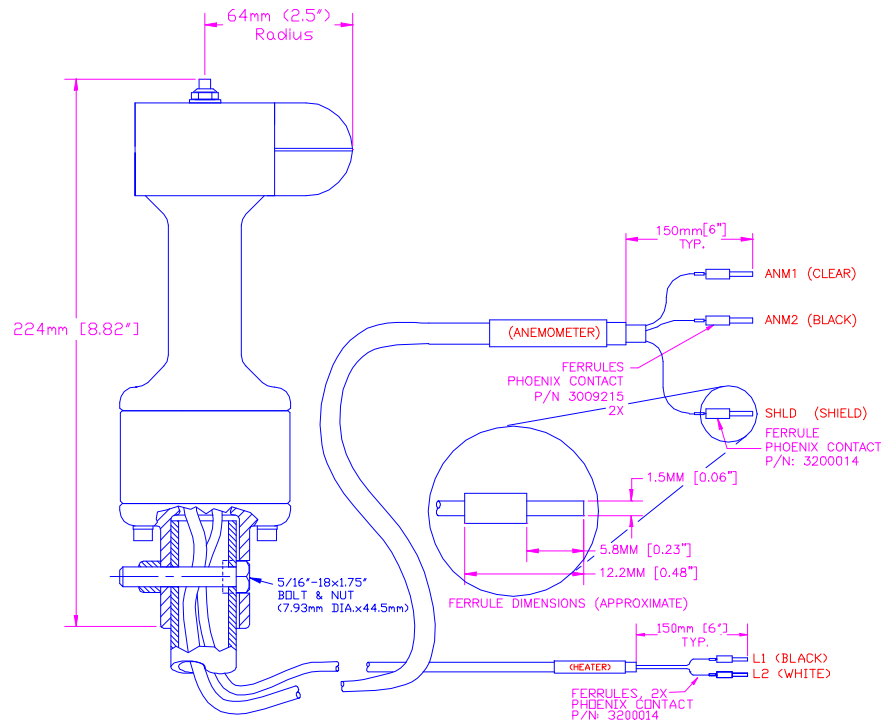
- Following a brief inrush current, the heater quickly settles into its temperature-controlled mode.
- It is recommended that a 15 A slow-blow fuse be placed in line with the heater.

## Installation

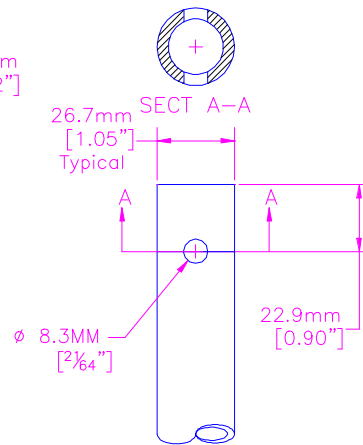
1. Tape the ends of the cables to prepare them for feeding through the mounting boom. Maintain the isolation of the signal leads from the boom. Remove the nut and bolt from the base of the unit. Feed the cables through the mounting boom until the sensor is on the boom. Align the bolt hole in the base (not the slot) with the hole in the boom such that the hole in the base points forward toward the rotor blades.
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.***

# Sensor and Mounting Outline



MOUNTING BASE DIMENSIONS



TYPICAL MOUNTING STUB

## 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
	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
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>
Response characteristics	Distance constant (63% recovery)	7.6 m (25 feet)
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: 2.8 m (9.2 feet)</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