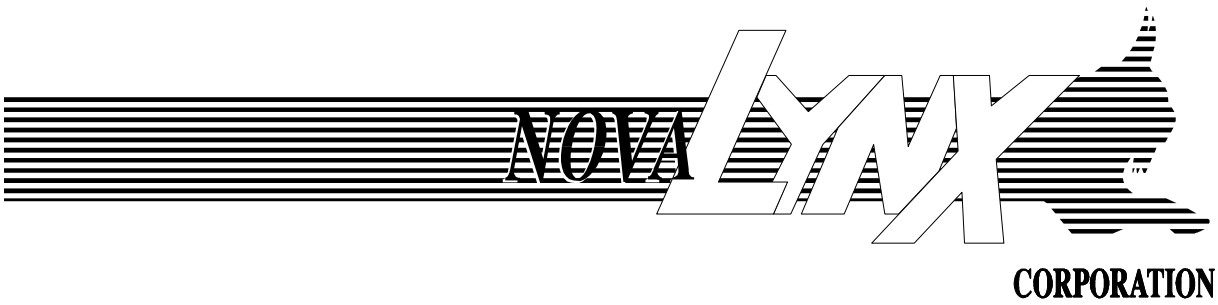
# NovaLynx Corporation

## MODEL 200-2201
## NOVA-VANE WIND SENSOR

INSTRUCTION MANUAL



## Receiving and Unpacking

Carefully unpack all components and compare to packing list. Notify NovaLynx Corporation immediately concerning any discrepancy. Inspect equipment to detect any damage that may have occurred during shipment. In the event of damage, any claim for loss must be filed immediately with the carrier by the consignee. Damages to equipment sent via Parcel Post or UPS require the consignee to contact NovaLynx Corporation for instructions.

## Returns

If equipment is to be returned to the factory for any reason, call NovaLynx between 8:00 A.M. and 4:00 P.M. Pacific Time and request a Return Authorization Number (RA#). Carefully pack the equipment to prevent damage or additional damage in the return shipment. Call NovaLynx for packing instructions in the case of delicate or sensitive items. If packing facilities are not available take the equipment to the nearest Parcel Post, UPS, or freight service and obtain assistance with the packaging. Write the RA# on the outside of the box. Fill out a copy of the NovaLynx Repair Order form, if available, and return it with the equipment.

## Warranty

NovaLynx Corporation warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment from the factory. NovaLynx Corporation's obligations under this warranty are limited to, at NovaLynx's option: (i) replacing; or (ii) repairing; any product determined to be defective. In no case shall NovaLynx Corporation's liability exceed product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by NovaLynx Corporation, or that has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

## Address

**NovaLynx Corporation**
**4055 Grass Valley Highway, Suite 102**
**Auburn, CA 95603**
**(916) 823-7185**
**FAX (916) 477-8339**



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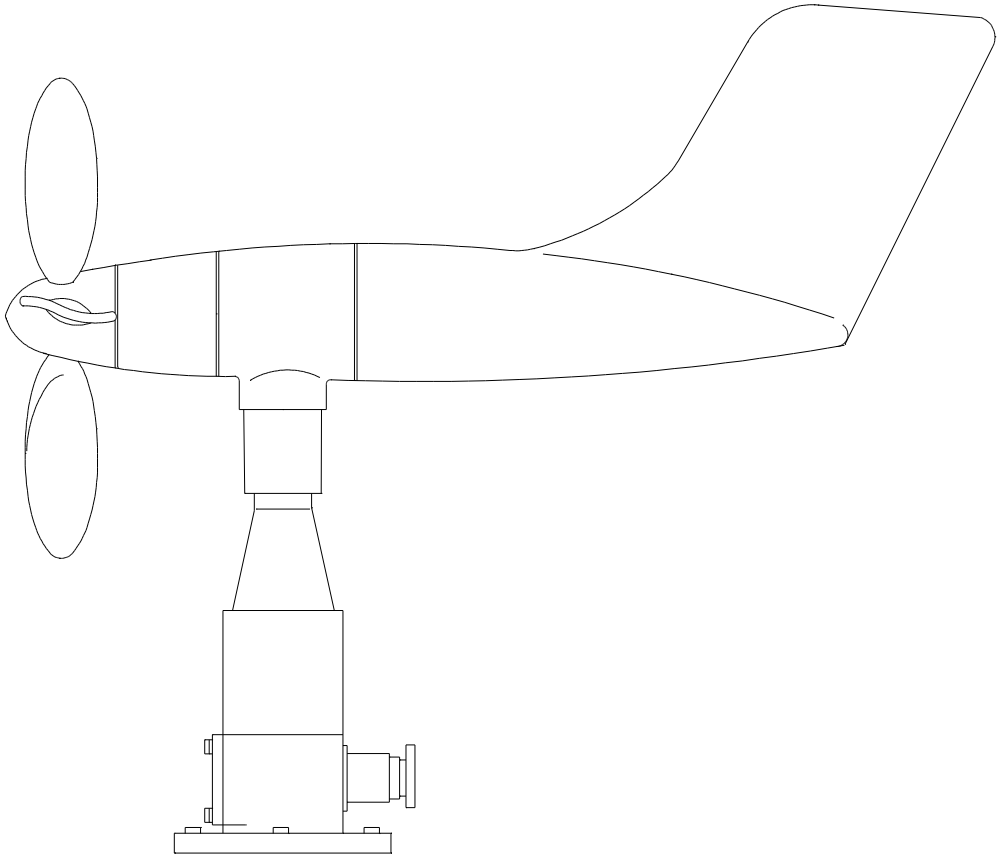


# NOVA-VANE WIND SENSOR
# MODEL 200-2201

## 1.0 INTRODUCTION

### 1.1 GENERAL DESCRIPTION

The NovaLynx Nova-Vane is a combination wind speed and wind direction sensor designed for use in high wind and marine environments. The Nova-Vane features a sensitive, four-blade propeller made of high impact plastic to withstand gale force winds. The body of the sensor is constructed of a combination of aluminum and high impact plastic. The base of the sensor is aluminum with a mounting hole pattern that matches other marine style sensors. The materials used in the construction of the body along with the aerodynamic design contribute to the durability and to the responsiveness of the Nova-Vane.

The Nova-Vane produces accurate wind speed and wind direction data using a precision built, four pole, AC generator for the speed transducer, and a precision, wire wound potentiometer for sensing direction. Wind speed is measured by the response of the propeller to the wind. The propeller is coupled directly into the AC generator to produce the analog output signal that is proportional to the wind speed. Wind direction is sensed by the motion of the Nova-Vane aerodynamic body. As the body rotates, the motion is transferred to the direction transducer. The potentiometric direction transducer is used with analog signal conditioning circuits to produce a linear signal to operate with indicators, data loggers, and recorders.

Signal transmission for the Nova-Vane is provided through the use of a multiple conductor cable. The cable attaches onto a terminal block located inside the base of the Nova-Vane. Access to the terminal block is available through a removable cover located on one side of the base housing. The cable enters the Nova-Vane through a cable gland.

The Nova-Vane can be mounted onto flat surfaces using the mounting flange that is built into the sensor base, or the sensor can be mounted onto a pipe or pole using a mast adapter. The mast adapter is suitable for use with masts having an outside dimension of 1-1/2 inches.

## 1.2 SPECIFICATIONS

### WIND SPEED

| | |
|---|---|
| Sensor: | 4-Blade Propeller, 13.78" (350 mm) Dia. |
| Transducer: | AC Generator, 4-pole |
| Range: | 0-200 mph (0-90 m/s) |
| Output Signal: | 20 VAC, 84 Hz, typical at 100 mph |
| Accuracy: | ±0.3 m/s for winds less than 10 m/s<br>±3% for winds greater than 10 m/s<br>(with 1.1 k ohm load) |
| Starting Speed Threshold: | ≤ 1.5 mph ( 0.7 m/s ) |
| Distance Constant: | 9.9 ft. ( 3 m ) |

### WIND DIRECTION

| | |
|---|---|
| Sensor: | Aerodynamic, Counter-Balanced Body |
| Transducer: | 5000 ohm potentiometer |
| Range: | 0-360° Azimuth |
| Resolution: | 1° ( depends upon monitoring device ) |
| Output Signal: | 0 to 5 VDC typical |
| Linearity: | ±0.3% |
| Threshold: | ≤ 1.5 mph ( 0.7 m/s ) |
| Damping Ratio: | 0.36 |
| Deadband: | Approximately 3° |

### POWER CONSUMPTION

| | |
|---|---|
| Wind Speed: | None, Self Generating |
| Wind Direction: | 1 mADC Max. |

### SIZE

| | |
|---|---|
| Height: | 26.4" (670 mm) |
| Body Length: | 27.2" (690 mm) |
| Base Diameter: | 5.9" (150 mm) |

### WEIGHT

11.5 lbs (5.2 kg)

### 1.3 MANUAL CONTENTS

This manual contains the following items:

| | |
|---|---|
| TABLE OF CONTENTS | 1 PAGE |
| TEXT | 10 PAGES |
| OUTLINE DRAWING | NO. 950107 |
| MAST ADAPTER DRAWING | NO. 950903 |
| TRANSDUCER SCHEMATIC | NO. 950902 |

## 2.0 INSTALLATION

### 2.1 UNPACKING

Refer to the directions given below for removing the wind sensor from the shipping carton. Carefully unpack all of the components of the instrument and inspect them for damage that may have occurred during shipment. In the event of damage, all claims for loss must be filed against the carrier by the consignee. This does not apply to shipments via Parcel Post or UPS, in which case you should contact us for instructions on handling the claim.

#### 2.1.1 REMOVING SENSOR FROM SHIPPING CARTON

Save all of the packing materials for use later in case the sensor needs to be returned to NovaLynx for maintenance or for repairs.

The shipping carton will be taped and may also have strapping around the outside. Cut off any strapping and carefully cut the tape along the ends and the center of the top flaps. Do not cut deeply into the carton. Remove the top piece of plywood from the carton, exposing the sensor and the interior of the carton. Notice that there is an interior section of cardboard surrounding the sensor. The interior cardboard has a styrofoam block taped to the top of the cardboard section. Carefully lift out the interior cardboard section and the styrofoam block. There will be a piece of fiberboard or plywood between the interior cardboard and the outer carton. Lift this piece of board out of the carton. The next step is to lift out the sensor. Do not attempt to lift the sensor out by the tail section. Grasp the center section of the upper sensor body or use the main stem extending up from the base to lift out the sensor. Notice that the sensor is bolted onto a piece of plywood. It may be necessary to tilt the sensor and the wood slightly in order to facilitate the removal of the assembled pieces from the carton. Upon removing the sensor and the wood from the carton, place the sensor onto a table or flat surface. Two bolts attach the sensor onto the

plywood shipping base. A small adjustable wrench can be used to loosen the hex nuts. Loosen and remove the two hex nuts on the sensor flange in order to separate the sensor from the wood. Lift the sensor up and away from the plywood base.

### 2.1.2 UNPACKING THE PROPELLER

The propeller may be shipped attached to the sensor. For most shipments from NovaLynx, however, the propeller will be detached and located inside the carton. If the propeller is on the sensor, carefully cut the tape along one side of the cardboard box covering the propeller. Open the flap and slide the cardboard off the propeller. For propellers shipped separately, cut the tape, open the flap and pull the propeller out of the box. Handle the propeller carefully. Even though it is constructed of durable, high impact plastic, the propeller can be damaged through mishandling and a damaged propeller greatly affects the sensor's performance.

Remove any plastic wrapping from both the sensor and the propeller. Attach the propeller to the sensor using the Allen head screw and the nose cone supplied with the sensor. Notice that the propeller and the wind speed generator shaft are both keyed. Make certain that the pins on the shaft fit into the notches in the propeller. Do not over-tighten the propeller mounting screw.

The plywood base may be used as a sensor mount for bench top work to help stabilize the sensor during testing, maintenance and repairs in order to help prevent the sensor from falling over.

Upon completion of the unpacking process, place all of the packing materials back into the shipping carton for storage to be used later if necessary.

## 2.2 SITE SELECTION

Careful consideration must be taken when deciding upon a site for installing the Nova-Vane. Unless there are severe limitations on available space, the Nova-Vane should be located at an elevation of 33 feet above open terrain. Open terrain is defined as an area where the distance from the sensor to the nearest obstruction is at least ten times the height of the obstruction above the ground with respect to the sensor location. This type of installation provides standard exposure for a wind sensor as defined by the National Weather Service and other Meteorological organizations.

Avoid mounting the sensor onto the roof of a building if at all possible. Turbulence generated by the edges of the roof prevent reliable measurements. If a roof-top installation must be used try to locate the sensor onto the upwind side of the building where prevailing winds occur. The rule for roof mounted wind sensors is that the sensor should be located above the roof at an elevation that is one and one-half times the height of the building. If the building is an extremely tall structure then this rule becomes impossible. For tall buildings the sensor should be at least 33 feet above the roof, if

possible. In addition, roof mounted sensors should be placed as far away as possible from ventilation systems, smoke stacks, and exhaust vents.

## 2.3 MOUNTING

The Nova-Vane is designed for installation onto either flat surfaces or pipe masts. A mounting flange with five evenly spaced bolt holes is built into the sensor base. The flange may be bolted directly onto a flat plate or platform of an existing structure. If a flat surface is not available, the Nova-Vane can be installed onto a mast using the mast adapter available as an option from NovaLynx. For customers choosing to mount the sensor onto an existing flat surface, the sensor alignment to True North must be performed before drilling any mounting holes since the sensor base is rotated to set the alignment. Slotted mounting holes would assist in making the alignment process easier on an unmovable flat surface.

The mast adapter is clamped onto a pipe using set screws built into the body of the adapter. The adapter body will fit a mast with a diameter as large as 1-1/2 inches. The plate of the adapter matches the flange of the Nova-Vane. Mounting hardware for bolting the sensor onto the adapter is provided with the mast adapter. A ground lug is provided on the sensor flange for attaching the sensor to a ground cable.

After the Nova-Vane has been set onto its mounting surface and before permanently securing the bolts, check to ensure that the sensor is level with regards to its vertical orientation. Try to obtain the best vertical level possible to prevent the direction sensor from stopping at the same spot during calm or low wind conditions.

## 2.4 ORIENTATION

The direction portion of the Nova-Vane must be properly set to give readings that can be correlated to either true or magnetic North, depending upon the user's requirements. For most systems, the direction is aligned to True North. The magnetic declination must be known for the sensor location in order to correctly align the sensor to True North. Magnetic North is first located using a compass and the reading is then adjusted using the magnetic deviation for the location. Generally, magnetic declination can be obtained from a nearby airport or weather service office.

Locate True North and locate a visual reference in line with the sensor and True North. Upon obtaining the North reference point, rotate the base or mast adapter of the Nova-Vane until the N mark on the flange faces North and the S mark faces South. A vertical line below the N can be used to accurately align the sensor. For most customers, an alignment that is within five to ten degrees is acceptable.

A more precise sensor alignment may be obtained by using a precision surveyor's style compass mounted onto a tripod, or by using a transit. The compass or transit should be set up at some distance ( approx. 100 feet) and on the South side of the sensor mounting

location in order to obtain an accurate alignment to North. Looking back toward the sensor, find the visual reference point and set the reticule of the compass onto the reference. At this point, the compass should read True North. If it does not read True North, move the compass until the True North reading is obtained. Try to keep the visual reference point, the sensor body, and the compass in line. This is a difficult procedure and may require several attempts before good results are obtained. An assistant may be required to hold the sensor body in line with the North-South marks of the flange in order for the alignment process to be easily performed. A correctly aligned sensor will have the horizontal axis of the sensor body in line with the True North visual reference point and the reticules of the compass ( or transit). Additionally, the compass should read True North within the accuracy desired by the user whether it is one degree or ten degrees.

The mast adapter set screws or the sensor flange bolts may be fastened securely after the alignment has been completed. A recommendation for customers that use the mast adapter is to leave the mast adapter in place and only remove the sensor during maintenance or servicing. This will allow quick replacement of the sensor without the need to do the True North alignment each time the sensor is taken down for repairs. Should the mast adapter become loose for any reason, the alignment will need to be checked and corrected.

## 2.5 CABLE

Prior to installing the Nova-Vane onto its mast, it will be easier to connect the signal cable into the terminal strip located inside the base of the instrument with the sensor sitting on the test bench. Remove the front cover plate that is opposite the cable port strain relief to expose the terminal strip. Remove the cover plate on the bottom of the sensor base to enable and to ease the placement of the cable and to obtain additional access to the terminal strip. The individual wires are inserted into the terminals from below the terminal strip. The fastening screws face forward and are reached through the front cover port. The terminals are numbered left to right with the corresponding numbers indicated in the system wiring diagrams provided by NovaLynx. After the cable has been inserted into the sensor, the sensor may be permanently installed onto the mast.

As soon as the Nova-Vane has been securely mounted, the signal cable can be routed from the sensor down the mast. If possible, measure the length of cable needed prior to ordering the sensor. Allow extra length to accommodate drip loops and strain relief loops. For tower mounted sensors allow enough cable to reach to the ground and then back up the tower at least five feet in case a junction box is to be mounted at the tower base. Also allow extra cable for horizontal mounting arms if any are to be used. Cable ordered from NovaLynx will be attached to the sensor and used as part of the final system calibration test. This cable may be shipped attached to the sensor in some special cases.

Cable requirements for the Nova-Vane, Model 200-2201, can be satisfied by using a four

or five conductor cable. The cable wire should be 18 or 20 gauge stranded copper with individually jacketed conductors. Whenever possible, an overall foil shield should be used to help protect against induced electrical noise from nearby equipment.

Standard NovaLynx cable wire colors and sensor connections are presented in the table below. Cables furnished by others may vary in color. Make note of any cable differences during installation to help aid in future servicing and trouble shooting problems.

**SENSOR OUTPUT SIGNAL CONNECTIONS**

| TERMINAL# | SIGNAL | LEVEL | 5 WIRE COLOR/ 4 WIRE COLOR | |
|---|---|---|---|---|
| [1] | AC SPEED + | 0-40 VAC | WHITE | WHITE |
| [2] | AC SPEED - | GROUND | BLACK | BLACK |
| [3] | DIRECTION +V | 5 VDC | RED | RED |
| [4] | DIRECTION Signal | 0-5 VDC | GREEN | GREEN |
| [5] | DIRECTION 0V | GROUND | BROWN | NOT USED |

## 3.0 THEORY OF OPERATION

The purpose of the Nova-Vane is to provide a single sensor design to measure wind speed and wind direction and to operate under high winds and harsh environments. The design of the housing and the materials used in the fabrication of the instrument contribute to the durability and to the response of the sensor. The use of internal wiring and slip rings enable speed and direction transducers to operate inside the same housing.

### 3.1 WIND SPEED

Wind velocities are sensed as the propeller rotates about its axis. A shaft attached to the propeller transfers the rotation to the magnet of the AC generator. The rotating magnet produces an alternating current (AC) with a voltage that is proportional to the wind velocity. The electrical signal is transmitted down through the sensor body through the use of slip rings, terminating at the terminal block. Since the signal is an AC voltage there is no polarity and the output signal can be connected into either terminal of the monitoring device provided that it will accept an AC signal. For reference purposes and for circuits that convert the AC signal into a DC signal, NovaLynx refers to terminal 1 as the signal + and to terminal 2 as ground.

Typical output values for the wind speed portion of the sensor are shown in the table below. Note that the addition of a 1.1 k ohm resistor produces an AC voltage output that is directly compatible with sensors manufactured by other companies. Whenever the resistor is to be used, it will be soldered between terminals 1 and 2 and on the back side of the terminal strip.

**PROPELLER SHAFT SPEED vs. WIND SPEED**

| RPM | MPH | KNOTS | M/S |
|---|---|---|---|
| 245 | 11.2 | 9.7 | 5 |
| 548 | 22.4 | 19.4 | 10 |
| 1120 | 44.7 | 38.8 | 20 |
| 1693 | 67.1 | 58.3 | 30 |
| 1800 | 71.6 | 62.1 | 32 |
| 2265 | 89.5 | 77.7 | 40 |
| 2838 | 111.8 | 97.2 | 50 |
| 3410 | 134.2 | 116.6 | 60 |

## 3.2 WIND DIRECTION

Wind direction is measured as a result of the response of the aerodynamic body of the Nova-Vane to the fluctuations of the horizontal wind. The sensor body attempts to keep itself aligned with the direction of the wind and rotates upon its main shaft as the wind direction changes around it. The sensor shaft is attached directly to the wind direction transducer. As the transducer shaft is rotated, the transducer output signal varies in proportion to the horizontal angle of the wind. The zero point of the transducer output signal is set to be equal to zero degrees, or North.

With regard to the potentiometer style transducer, the output signal is seen as a varying voltage with a magnitude that is proportional to the excitation voltage. The output signal is connected to an analog interface circuit or a signal conditioning circuit for amplification and scaling. A change in the potentiometer shaft position causes a voltage change at the potentiometer wiper. The wiper signal is used with the signal conditioning to drive indicator dials, panel meters and recorders. Indicators are normally set to present a 0 to 360 degree reading of the horizontal wind direction.

The typical excitation voltage used with the potentiometer is +5 VDC. Current limiting series resistors are often used to prevent the current into the potentiometer from exceeding 1 milliampere.

# 4.0 MAINTENANCE

## 4.1 GENERAL

Maintenance of the Nova-Vane should be limited to a visual inspection of the instrument and a manual operation test. If possible during the inspection perform a functional test of the sensor to determine if the electronic portions of the sensor have changed electrically.

The visual inspection should be performed to detect damage to the housing, to detect damage to the cable, to detect loose or missing parts, and to detect effects of corrosion.

**4.1.1** Any signs of visible damage must be corrected immediately to prevent further damage from occurring. Corrosion, dust and surface contaminants should be removed using a soft cloth and clean water. Do not immerse the sensor into water and disconnect any power to the sensor prior to performing any maintenance work on the sensor. Discoloration of the exterior surfaces may occur with aging of the sensor. The sensor may be returned to NovaLynx for repainting.

**4.1.2** Look for loose or missing hardware. The propeller screw must be securely tightened to prevent it from loosening due to mast vibrations from high winds. Check the base flange mounting bolts and tighten any loose nuts. On tall masts the mounting bolts are usually inserted from the bottom side. In case any of the bolts become loose and fall out, the open hole can be spotted easily from ground level. Loose, missing, and corroded hardware must be replaced immediately. Some of the hardware used on the sensor has metric threads. If local sources are not available please contact NovaLynx.

**4.1.3** Check the signal/power cable for wear wherever the cable contacts any structure. Strong winds can whip the loose sections of cable causing outer jacket abrasions wherever contact is made. Avoid loose cables by fastening the cable using plastic wire ties every two or three feet along the mast if possible.

**4.1.4** Inspect the mounting structure as well, periodically, to prevent loose hardware or damage from occurring that might affect the life and operation of the sensor.

**4.1.5** Manually turn the propeller and rotate the sensor body to detect worn bearings. Worn bearings are typically noisy and cause abrupt stops as opposed to smooth stops. Suspected bearings should be replaced immediately. NovaLynx strongly recommends that bearings be replaced annually in areas that experience continuous or high levels of wind throughout the year.

**4.1.6** Check the blades of the propeller for damage. Objects can impact the propeller during severe storms. If there is any damage at all to the blades, replace the propeller. A damaged propeller will produce uneven wind speed readings and will over a period of time damage the wind speed transducer and bearings.

## 4.2 FUNCTIONAL TEST

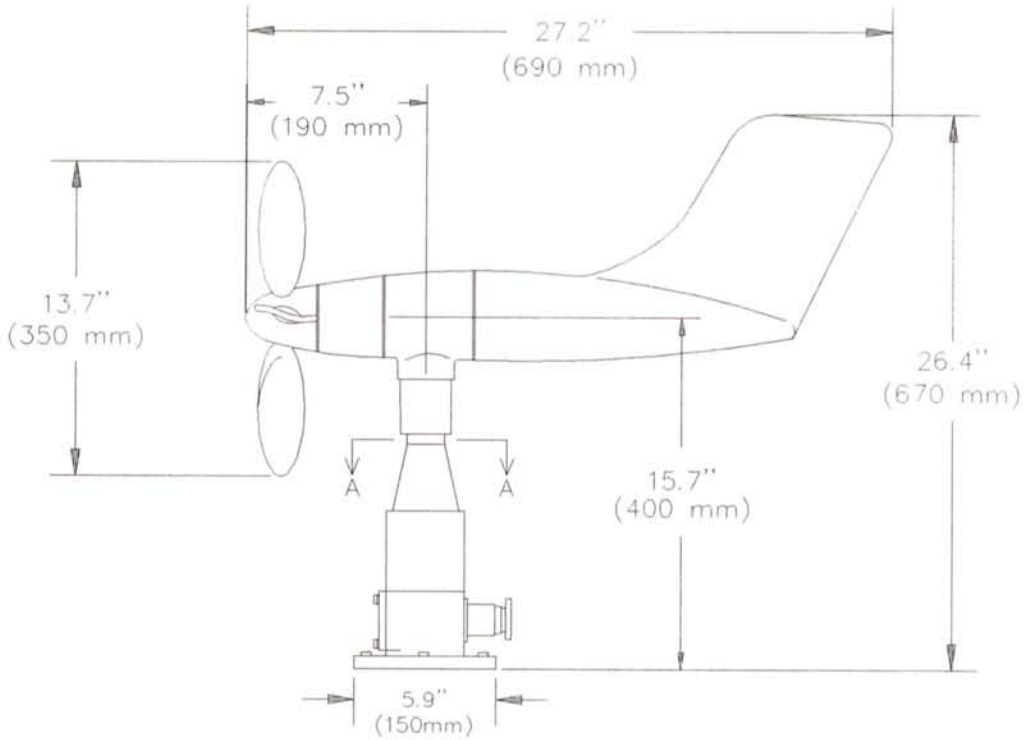
A functional test involves rotating the propeller at a specific speed and either measuring the transducer output or looking at an indicator and rotating the sensor body to specific angles and looking at the indicator. The indicator readings should agree with the expected results within the specified accuracies of the system.

**4.2.1** Wind speed is tested by removing the propeller and attaching a spin-up motor to the sensor AC generator shaft. The speed of rotation of the motor must be known and the value of the rotation compared to those shown on the calibration data sheet for the wind speed transducer. The most commonly used motor speed is 1800 rpm. For this sensor 1800 rpm represents a wind speed of 71.6 mph ( 32 m/s ). As the motor turns the wind sensor shaft, measure the unloaded AC voltage output of the transducer or measure the frequency (typically 13.75 VAC at 60 Hz) and compare the reading to the original calibration value provided by NovaLynx. If an indicating dial is used with the sensor, take a reading from the dial and compare that reading to the expected results. Remove the calibration motor and replace the propeller at the end of the test.

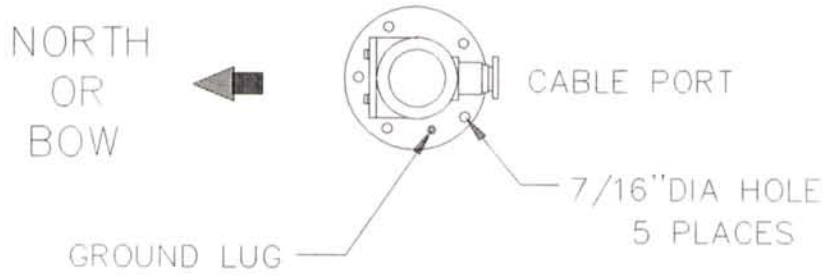
**4.2.2** Wind direction is tested by rotating the sensor body and observing the indicator dial for agreement in the indication as well as in the direction of the rotation. Looking down on top of the sensor, a clockwise rotation of the sensor body will produce an increasing reading on the indicator dial. If possible set the sensor to the cardinal points, N,E,S,W one at a time and check the indicator for agreement.

**4.2.3** For systems using an electronic translator with the wind sensor, monitor the translator outputs while performing the functional tests. The electronic output signals should agree with the tests being performed.

Should any portion of the sensor appear to be faulty during the test, please contact NovaLynx for assistance. If the fault is not repairable, the sensor should be returned for repair or for replacement. Replacement of either of the two transducers will require a calibration test of the sensor. Any electronic indicator or translator being used with the sensor must also be recalibrated to match the new transducer in order to provide accurate data.




VIEW A–A




NOVALYNX SYSTEMS INC

C

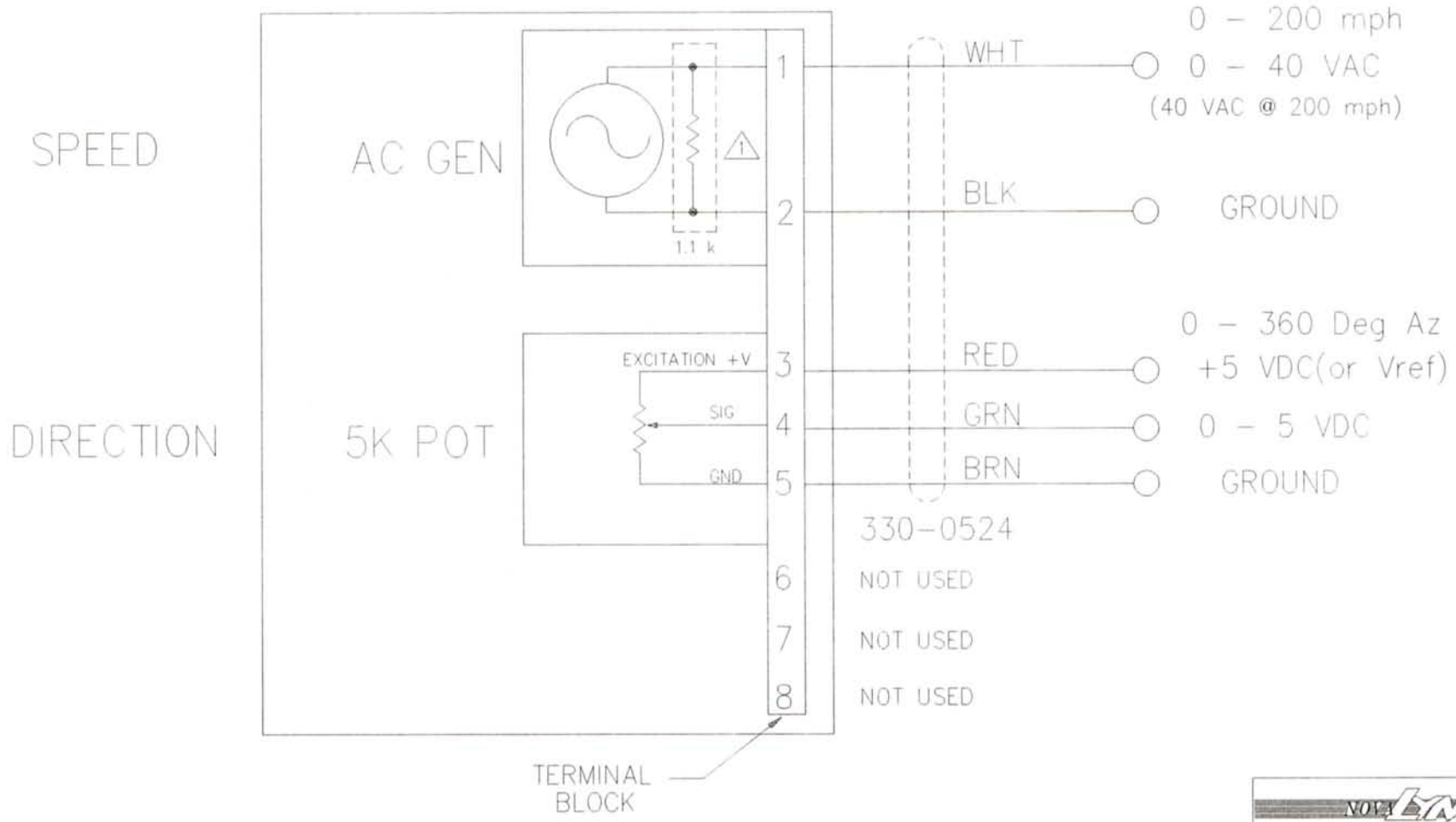
TITLE: WIND SPEED & DIRECTION SENSOR, MODEL 200-2206

MODEL USAGE | SHEET 1 OF 1

BY RGN | SCALE NONE | DWG. NO. 950107

DATE 1-11-95

# NOVA-VANE
# MODEL
# 200-2201
# SENSOR TRANSDUCERS




NOTES:

1. OPTIONAL LOAD RESISTOR.

| | | |
|---|---|---|
| NOVALYNX SYSTEMS INC | | C |
| TITLE: SCHEMATIC, SENSOR MODEL 200-2201 | | |
| MODEL USAGE 200-2201 | | SHEET 1 OF 1 |
| BY RN | DEG. NO. | 950902 |
| DATE 9-18-95 | | |

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|---|---|---|---|
| NOVALYNX CORPORATION | C | | |
| TITLE: ASSEMBLY, MAST ADAPTER FOR NOVA-VANE WIND SENSOR | | | |
| MODEL USAGE 200-2201 | | SHEET 1 OF 1 | |
| BY RGN | SCALE NONE | DWG. NO 950903 | |
| DATE 9-18-95 | | | |