OPERATING INSTRUCTIONS

Incorporating

CALIBRATION DATA, SAFETY & SERVICING INFORMATION

For

Switching Anemometer

type

A100R

(mercury-free/dry-reed A100R-01 revision)

Including Option A100R/K

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Please read through <u>all</u> of this Operating Instructions booklet carefully.
Failure to follow all instructions, guidance and warnings may result in injuries, or damage to the anemometer and may invalidate any guarantee.

WARNINGS: This product is:

- <u>not</u> ATEX certified
- <u>not</u> explosion proof
- <u>not</u> intrinsically safe
- <u>not</u> fail-safe

NOTICES

It is important to note that cup anemometers (whether manufactured by Vector Instruments or anyone else) are not "fail-safe". Should the anemometer become disconnected, or should the rotor be damaged/jammed or come off, or the shaft/bearings seize, it is possible for the wind-speed sensor to falsely indicate zero or a lower wind-speed than it should. In applications related to safety, this would mean that warnings/alarms would fail to be activated when they should. It is therefore recommended that a single system/anemometer should <u>not</u> be relied upon when incorrect readings (or alarms derived from it) could be life-threatening or could result in injury to persons or property.

WARNING: ELECTRIC SHOCK HAZARD

This product is for connection to a low-voltage power supply <u>only</u> (72V DC Absolute Max), and <u>must not</u> be connected directly to "AC MAINS" supplies under any circumstances. The zero current consumption makes this product suitable for battery operation, however should a "mains adaptor" or "DC power supply" of some sort be used, then it must be appropriately insulated, safety-rated and earthed. Recommended operating voltage range is 1..5V DC.

PRECAUTIONS AGAINST STATIC (ESD)

These products are generally insensitive to ESD (Electro-Static Discharge) damage once installed and when handled/installed under the majority of "normal" environmental conditions. When handling/installing in dry environments (RH < 40%) however, there is an increased risk of static build-up and a consequent increased risk of damage to instruments containing electronic components due to discharging of that static (ESD). In these circumstances, it is advisable that care be taken to ensure that there is no build-up of static between the instrument/cable, the mast, the equipment to which it is to be connected, and "ground/earth", or that any such static build-up be dissipated before handling/installing any instruments. Persons handling/installing instruments should be careful <u>not</u> to wear nylon or acrylic clothing (or other artificial fibres) wherever possible. Such materials are prone to gathering static charges as they rub together as the wearer moves around. Some shoes also have soles which can cause the wearer to become "charged up" as they walk (especially over nylon/acrylic carpeting). Personnel should eliminate/dissipate any static charge build-up by touching the system "earth/ground" point before handling/mounting any instruments. The screen/shield of the cable is <u>not</u> connected at the anemometer end of the cable and is normally connected to a suitable "system ground", "earth point" or "0V" point at the datalogger.

EMC (ELECTRO-MAGNETIC COMPATIBILITY)

- Ensure that the cable and shield/braid are properly connected, and instrument is properly grounded/earthed.
- Do not install close to radio/TV/radar antennae or RF transmitters and cables.
- Do not operate mobile phones or other radio equipment in close proximity to the anemometer/cable.
- Maintain adequate separation between sensor/signal cables and power cables.
- Never run signal and power wires in the same conduit/tray.
- Install Ferrite Beads/Sleeves on signal wires close to the measuring equipment if EMC problems persist.

OVERVIEW AND PRINCIPLE OF OPERATION

- These anemometers uses the same body-shell and 3-cup rotor as the rest of the A100 Series Anemometer range. A magnetic actuator inside the anemometer causes a reed switch to make and break contact once per revolution of the rotor.
- No power is required apart from that necessary to detect contact closure, making it ideal for battery/solar operated remote installations. The rotor is tested by comparison with a standard /reference rotor (traceable to international standards) and an individual calibration figure is provided for each individual rotor.
- Because regulations/legislation no longer permit the use of mercury in the reed switch of the A100R product, the original mercury-wetted reed version (A100R, or A100R-00) is now superseded by this **A100R-01 model revision which contains no mercury and will continue to be referred to as A100R**.

INTENDED PRODUCT APPLICATIONS/USE

This instrument is intended for use in various meteorological wind measurement applications, mounted on a mast or pole in a vertical position with the rotor at the top and connected to a data-logger, meter, signal conditioner or similar measuring equipment.

LIMITATIONS TO USE

Overall cable length (instrument cable plus any extension cables) is limited to 115m in total.

Warning: Anemometers must ONLY be installed/operated upright, with the rotor/cups at the top. If installed in any other orientation the rotor may become detached and water ingress will damage the instrument. Anemometers must not be left in a horizontal or inverted position during precipitation as water ingress into the anemometer body will cause damage to the bearings and internal components.

UNPACKING THE A100R ANEMOMETER

- Remove the Advice/Delivery Note (Packing List) from the outer carton/packaging and verify that all the cartons in the consignment have been received, and all the equipment listed on the Advice/Delivery Note.
- If there are any questions about the shipment, contact Windspeed Ltd (see contact details on the back cover).
- Upon receipt of shipment, inspect the outer packing and equipment for any signs of damage.
- Note any evidence of rough handling or damage in transit. Immediately report any damage to the delivery company.
- Notify Windspeed Ltd of any shipping damage, or missing items.
- Retain the anemometer and rotor boxes to allow future shipment for recalibration/servicing etc.
- These cardboard boxes (and "inserts") can be unfolded and stored flat to save space if required.

- Note that the carrier may not honour any claims for missing/damaged goods unless all shipping materials are saved for their examination.
- It is recommended to save the packing material and carton in the event reshipment is necessary.
- If discarding the packing materials, please reuse or recycle where possible.

BOX CONTENTS

Each A100R Anemometer is packed in a box containing the following items:

- A100R anemometer and cable (with any options ordered)
- R30 Series 3-cup Rotor in a triangular protective box
- Anemometer mount, 405 or 405/27P (this item is optional, and may be packed separately in some circumstances)
- These operating instructions, plus the individual Rotor Calibration Data Sheet (Test Certificate).
  - Depending upon the country and the order, there may be additional documentation/accessories in the anemometer box.

Take great care when handling the rotor
(or an anemometer with the rotor fitted) as any knocks/bends to the arms/cups will invalidate its calibration

Keep the rotor and anemometer in their respective boxes
(with the spindle protector tube fitted)
until it is time to fix them to the mast to protect against accidental physical damage.

Check that the rotor is the correct one for the anemometer
Each anemometer is supplied with a rotor having a calibration "matched" to the individual anemometer.
Refer to the labels on the anemometer and rotor boxes to determine which serial numbers
are to be used together to get correct readings.

Do not allow the rotor/cups to rest on the ground (or other surface) when the rotor is fitted to the anemometer
If it is necessary to put the anemometer down for any reason
the rotor should be removed and replaced by the spindle protector tube.

SEVERE ENVIRONMENT VERSION (/SE option, for marine/offshore, desert/dusty, and cold/icing sites)

Anemometers ordered with the /SE option include an improved top-seal and additional protection to reduce water/sand/dust entering the top bearing and a HE-4 internal anti-icing heater to ensure that the bearings/rotor continue to rotate in low-temperature/icing conditions. This is combined with a special black-cup rotor which retains the external features & First Class performance of the standard R30 rotor but includes a close tolerance hub for improved sealing and side clamping screw for use in environments where shock and vibration occur. The improved fixing catch of the /SE rotor also permits fitting the rotor in a horizontal position before raising on a tower. The black rotor cups help with natural (solar) cup de-icing but the internal heater must be used in cold/icy conditions to prevent the "close fitting" parts freezing up.

*The **/SE** option supersedes the less effective older/obsolete "/WR "option which included a "touching" seal to provide a tight seal against the anemometer spindle to keep water and sand/dust out of the anemometer bearings in arduous conditions. Because the /WR seal actually touched the spindle, friction varied during the seal's life and was enough to affect the accuracy and calibration/performance of the anemometer to an extent that could be significant in high-accuracy applications, therefore the /WR seal was not fitted or suitable for, applications requiring high-accuracy.*

PREPARING FOR INSTALLATION:

TOOLS, EQUIPMENT AND ACCESSORIES REQUIRED:

- Cable ties/tape, Screwdriver (+ 1/4" Whit/UNC box-spanner/socket if using a 405 mounting adaptor)
- Anemometer mounting adaptor/arm/boom and fasteners/bolts for it (optional extras)

ROTOR GRAVITY CATCH

ROTOR

The standard R30 series 3-cup rotor assemblies which are used with the A100 Series Anemometers are all fixed to the main part (body) of the anemometer using a patented gravity-sensitive catch/fastener. Severe environment /SE rotors have a clamping-screw in the side of the rotor hub in addition to the gravity-catch (tighten after fitting, loosen before removal).

It is recommended that the rotor is fitted/removed a few times before installing the anemometer in order to become familiar with the operation of this gravity-catch to ensure that the rotor is securely fitted when finally installing the anemometer.
IMPORTANT: Do not adjust/loosen the screws holding the cups onto the rotor arms at any time.

To assemble the rotor to the anemometer:

To fit standard rotors: Hold the anemometer in one hand with the spindle at the top. Remove the spindle protection tube.

- Grip the rotor in the other hand at the top of the rotor hub (metal central part of the rotor). Be careful not to bend/knock the cups or arms as this will invalidate the calibration.
- With the anemometer held upright, slide the rotor onto the anemometer spindle, release the hold on the rotor, then press the hub (middle part of the rotor assembly) down lightly to activate the gravity catch (approx 2KgF is required).
- Check that the rotor is securely located (press the hub again if not). The rotor can also be fitted to an anemometer when the body is horizontal (e.g. when on a boom on a lowered mast/tower provided that the rotor is locked on when the pip/mark on the rotor hub is facing down (i.e. nearest to the ground) *Older rotors do not have this pip/mark and can only be fitted to an anemometer in the upright position.*
- **/SE option rotors:** The Severe Environment rotor can be fitted to an anemometer when the body is upright, but also when horizontal (e.g. when on a boom on a lowered mast/tower provided that the rotor is locked on when the rotor hub side clamping screw is facing down (i.e. nearest to the ground) *Orientation of the side screw is not important when fitting to an upright anemometer.*
- *To fit the /SE rotor:* Tighten the hub side clamping screw until it just touches the internal rubber seal (when slight resistance can be felt), then unscrew it approximately 2 turns. With the anemometer body upright (spindle at top), the rotor should slide-on to the anemometer spindle easily. Press the rotor hub towards the anemometer body twice to activate the gravity catch and lock the rotor to the spindle. Finally, tighten the hub side clamping screw until slight resistance is felt when it just touches the internal rubber seal, then tighten no more than three quarters of a turn more to clamp against the spindle. *Do not over tighten as this will damage the spindle/screw and may prevent future rotor removal.*

To remove the rotor from the anemometer:

- Remove the anemometer from any mounting-arm to which it may be fixed.
- Hold the anemometer upside-down (spindle/rotor at the bottom), grip the end of the rotor hub (metal central part of the rotor) and press towards the anemometer body lightly (approx 2Kgf force) - the gravity catch should release and the rotor will slide off. Rotors can also be removed when the anemometer body is horizontal (e.g. when still fixed to a lowered mast/boom) if the rotor is turned until the pip/mark on the hub is uppermost before pressing the hub to release. *Older rotors do not have this pip/mark and cannot be removed in this manner.*
- **/SE option rotors only:** *Before trying to remove the rotor:* Unscrew the hub side clamping screw a maximum of 2 turns to un-clamp the spindle. Invert the anemometer and press the rotor hub towards the anemometer body, to allow the rotor to slide-off. /SE rotors can also be removed when the anemometer body is horizontal (e.g. when still fixed to a lowered mast/boom) if the rotor is turned until the side screw is uppermost before pressing the hub to release. After removal, tighten the side-screw until slight resistance is felt to prevent the screw dropping out. *Be careful not to drop/lose the screw .*

Warning: If an anemometer is to be left without a rotor fitted for any reason (e.g. for shipping, or if left on a mast) the spindle should be protected using the plastic spindle protection tube which is provided with each anemometer.

PRE-INSTALLATION CHECKS

Before taking the anemometer/rotor to the installation site, it is advisable to check that they operate properly. Check that:

- The rotor is the correct serial number for the anemometer and that it is undamaged
- The rotor fits the anemometer securely (and that it can be removed).
- The anemometer/rotor calibration is valid.
- The anemometer spindle turns freely and that the bearings are not worn or "noisy".
- With the anemometer connected to a suitable ohm-meter, verify that the reed-switch operates as the spindle rotates.

ANEMOMETER BEARINGS

The bearings fitted to this anemometer are high-quality, high-precision types. It has been shown that the performance/friction of new bearings does not change nor affect the calibration of the anemometer measurably due to any "running-in" effects. It is therefore <u>not</u> necessary to "run-in" new bearings before using or calibrating the anemometer. These bearings are "lubricated for life" - <u>do not</u> attempt to oil/lubricate these bearings as doing so will degrade performance/accuracy/calibration.

ON-SITE ANEMOMETER INSTALLATION

It is advisable that the spindle protector-tube be left on the anemometer while it is fitted to the mast/pole/boom and that the rotor be fitted to the anemometer after the latter has been fitted to the mast/pole/boom in order to minimize the chance of accidentally damaging the spindle or rotor. However, if the anemometer is being installed onto a mast which is laid horizontally along the ground (and which will be raised into an upright position afterwards), the rotor must be fitted to the anemometer as described above. *Older rotors without a pip/mark on the hub can only be fitted with the anemometer upright.*

SELECTING THE BEST MOUNTING METHOD FOR HIGH-ACCURACY/WIND ASSESSMENT APPLICATIONS:

Selection of an appropriate, suitable and safe mounting arrangement is key in obtaining the best wind measurement results in any instance. Advice differs according to the particular wind measurement application:

OBTAINING THE BEST ACCURACY

In order to obtain the highest accuracy wind speed measurements, the following is recommended:

1. Use an anemometer which has been classified to IEC 61400-121, and operate within the parameters stated in the report (turbulence intensity, slope of terrain, and allowance for low temperatures), as well as a suitable design of mast, boom and mounting.
2. Obtain a wind tunnel calibration (for each anemometer/rotor pair) according to IEA 11 by a MEASNET certified laboratory for the windspeed range of interest for the application. The 4-16m/s speed range is normally specified for applications in the windpower industry. The A100R/A100R/K anemometer comes with a calibration certificate for a test at a single wind speed (nominally 9m/s) in the Windspeed Ltd wind tunnel - these wind tunnel calibrations are periodically compared/checked against other reputable wind tunnels, however obtaining an independent MEASNET calibration should be considered for most high-accuracy applications. The anemometer may have a MEASNET calibration certificate if such a calibration was ordered with the anemometer (or a MEASNET calibration can be arranged if required – see price list).
3. Use of the correct type of mounting adaptor, pole-diameter and boom is critical in ensuring that First Class Performance and highest accuracy measurements are achieved from an A100R/A100R/K Anemometer. For quoted/highest accuracy and "First Class" performance (and for MEASNET calibrations) A100R/A100R/K anemometers must be mounted using 405 or 405/27P mounts. If mounting both sensors at the same height, there will be some interference to the airflow which will reduce accuracy of reading, depending on the mast top diameters and separation distance.
4. For best accuracy in all applications, it is preferable to mount the anemometer in such a way that the mast/structure (and/or other anemometers/windvanes/instruments) do not interfere with the airflow "seen" by the anemometer. Typical recommendations in the IEA-11 and IEC61400-12-1 standards include mounting the top-most anemometer on an upright thin round pole at least 0.8m above the main structure of the mast. In the case of instruments mounted part-way up the mast, guidance is to mount on side booms (with an upright pole at the end having a round cross-section) such that the instruments are 15 to 25 diameters away from the mast structure while also taking into account the prevailing wind direction - the upright round pole should be thin and typically around 0.75m long and approximately 1 inch outside diameter (i.e. in the range 23.0mm to 27.4mm outside diameter) with a circular/round cross-section, and our 405 or 405/27P mounts must be used to fix the anemometer to the end.

CABLE INSTALLATION, HANDLING, & ROUTING

5. The anemometer cable should be handled carefully to avoid kinks or damage to the outer covering which may allow ingress of water. It should be secured tightly/neatly with ties or tape to the mast/boom/pole at a maximum of 0.5 metre intervals, as loose cable, or loops of cable, close to the anemometer can flap around and disturb the airflow, affecting the accuracy and scuffing or damaging the cable. Refer to the paragraph concerning EMC on page 2. The anemometer cable should pass through the slot/groove in the 405 or 405/27P mount and then be tightly secured to the pole for at least the first 150mm/6ins below the anemometer (preferably recessed into a groove/slot in the pole over that 150mm/6ins length, and/or tightly secured down the "mast side" of the pole in the case of mounting on a boom). In the case of tall masts, consideration also needs to be given to the positioning of guy-wires relative to the instrument positions as the guy wires can also affect the airflow.
6. Boom designs using horizontal arms with either circular or rectangular tubular cross-sections have both been used successfully in many installations, however the boom must be strong enough to support the anemometer weight (roughly 0.5Kg) and stiff enough to avoid causing errors due to excessive vibration (or resonances) in the boom. Consult a specialist or the standards mentioned above for full details, many mast manufacturers can offer suitable booms and advice for this application.
7. The use of booms with 0.5 inch diameter ends (or 0.75 inch diameter tubes/poles) as used by some other anemometer manufacturers is not recommended. The use of these smaller diameter poles/booms will compromise the anemometer classification as the pole/mount size/shape can noticeably affect the airflow around the anemometer/rotor itself and affect response/calibration of the instrument. Many of these small-diameter booms are not strong/stiff enough to support the A100R/A100R/K Anemometers (as they are larger/heavier than the anemometers originally intended for those booms). Using upright mounting poles which are "off centre" with respect to the centre axis of the anemometer (when the anemometer is fitted to the pole) is not recommended either. Note that the calibration data supplied with an anemometer/rotor assumes the use of a 405 or 405/27P mount and a pole in the range 23.0 to 27.4mm outside diameter - use of a different mount/pole can alter the calibration slightly and can reduce the accuracy of the measurement results

obtained. MEASNET calibrations are also normally carried out using a 25 to 27mm diameter pole and 405 or 405/27P mount - using a different mount/pole to that stated on the MEASNET calibration certificate when installing the anemometer will render the MEASNET calibration invalid for that installation.

8. If fixing the anemometer using a ¼ inch BSW/UNC screw (standard tripod thread size) directly into the base of the anemometer, then that screw/bolt should not enter the anemometer by more than 0.25 inches. Use of an excessively long screw may damage the anemometer internally.

SELECTING THE BEST SITE AND MOUNTING FOR GENERAL METEOROLOGY:

In order to obtain the best measurements of wind speed and direction, the sensors should be supported in such a way that neither the supporting poles nor the other sensor, obstruct the air flow to the sensor. The instrument cables should also be routed/fixed securely to the mast/boom/pole so as to avoid affecting the airflow. Due to increased wind speed with height and the increase of turbulence close to the ground, a standard height of 10 metres is used. The site should be level and have no large obstructions, buildings etc, within a radius of 300 metres.

Application: Turbine Power Performance Testing and/or Wind Farm Site Assessment

The A100R/K variant is strongly advised for this type of application. Typical recommendations include mounting the top-most anemometer on a thin round pole at least 10 mast diameters (or min 0.75m) above the main structure of the mast, and in the case of instruments mounted part-way up the mast, mount on side booms (with a round cross-section, and 0.75m min. upright end section) such that the instruments are at least 10 mast-diameters (or min 0.75m) away from the mast structure while also taking into account the prevailing wind direction. In the case of tall masts, consideration also needs to be given to the positioning of guy-wires relative to the instrument positions as the guy wires can also affect the airflow. Consult a specialist or the standards mentioned for full details, many mast manufacturers can offer suitable booms for this application.

AN URBAN SITE

The average urban site will contain many obstacles to wind flow, which will generally have the affect of reducing the average wind speeds and increasing localised turbulence levels. Therefore, a compromise has to be reached, taking into account as many as possible of the following points.

- Seek an area where all the buildings are of a similar height and place the sensors on the roof of the highest.
- Position sensors on the prevailing wind side of the site i.e. on the west or south-west side.
- The sensors should be mounted on the top of the mast (a minimum of 500 mm apart when mounting multiple instruments on the same boom/arm).
- Theoretically the sensors should be mounted at a height of at least 1.5 times the height of the building. However, on tall buildings, satisfactory results can usually be obtained using a 3 to 5 metre mast, mounted on the prevailing wind side of the building.
- On very large buildings, additional sensors mounted on the other side(s) may also be required.
- If the sensors are to be mounted on a boom, part way up a tower or mast, then the boom should be at least twice as long as the minimum diameter or diagonal of the tower. The boom should be positioned on the prevailing wind side of the tower.

INSTALLATION/SITING-ALL APPLICATIONS:

On occasions the localised wind speed and direction is required rather than the general wind conditions. In these cases the sensors should be mounted as near as possible to this localised position. For example :-

- If there is concern that people may be blown over by strong winds, due to the tunnel effect between two buildings, then the sensors should be mounted between the buildings, preferably at the height of a human being.
- If there is concern about the possible effect of an emission on an area of population to the north of a factory, then the sensors should be placed (for example) on the south side of the factory, to ensure the best possible results during southerly winds.
- Do not cut the sensor cables to the exact length when initially installing the system, as sometimes, moving the sensors by only one metre, can make the difference between accurate and inaccurate readings.
- Ensure that the sensors are positioned as far away as possible from any heat output, vents or air turbulence caused by extractor fans or obstructions.
- Ensure that the sensors are in a secure position, where they can not be easily vandalised.
- Refer to the EMC and ESD guidelines/advice earlier in this booklet.
- Mount vertically for accurate results.
- The anemometer cable should be secured tightly/neatly with ties or tape to the pole (as loose cable, or loops of cable, close to the anemometer can disturb the airflow and affect the accuracy) - route the cable along/through any slot in the mounting adaptor where applicable.
- The anemometer cable should not be run close to conductors carrying heavy currents which may be frequently switched.

CABLE CONNECTIONS

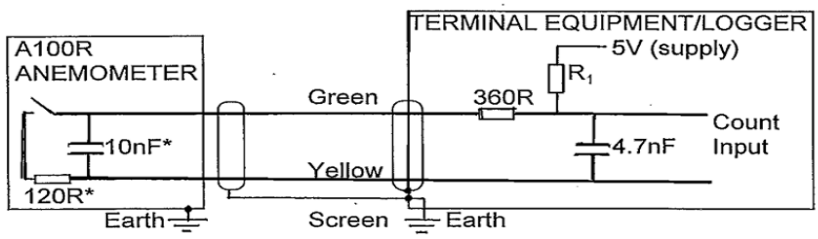
Each instrument is fitted with a cable which must be routed to, then terminated at the equipment. The cable length varies according to what was specified at the time of ordering. There is no connector fitted to the cable as standard (various connectors may be fitted as options, or by resellers – see additional/separate documents for connection details in this case). Vector Instruments anemometers do not have connectors fitted into their bases (as is the case with some other anemometers.) For this anemometer, the cable connections/colours are summarised in the following table, with details below:

WIRE COLOUR	WIRE FUNCTION	
RED	NOT USED (INSULATED)	*NOTE: THE RED AND BLUE WIRES ARE UNUSED EXCEPT FOR ANEMOMETERS FITTED WITH THE OPTIONAL INTERNAL ANTI-ICING HEATER WHEN THESE WIRES BECOME THE POWER SUPPLY CONNECTIONS TO THE HEATER ELEMENT.*
BLUE	NOT USED (INSULATED)	
GREEN	TERMINAL 1 (REED SWITCH)	
YELLOW	TERMINAL 2 (REED SWITCH)	
SCREEN/BRAID	CABLE SCREEN (INSULATED AT INSTRUMENT END). CONNECT TO SYSTEM EARTH/GROUND	

Warning: Extreme care must be taken while connecting the anemometer wires to the datalogger, equipment or junction-box terminals as any inadvertent contact between the anemometer reed switch wires and supply voltages from the equipment may cause damage to the anemometer's reed switch.

Warning: Ensure any static charge is dissipated before handling the instrument/wires.

Connect the green and yellow wires to the pulse counting equipment e.g. data-logger. *Note:* The dry-reed switch may exhibit "contact bounce" (older mercury-wetted reed switches did not). The internal resistor/capacitor filter (and the cable resistance/capacitance) filter-out most of the contact-bounce, it is necessary to ensure that the datalogger is configured for a "switching/contact-closure" type input, or a low-frequency range/input. Note that in many cases this equipment will include suitable filtering/noise immunity ('switch closure' / 'de-bounced input') and no additional components will be necessary - refer to your datalogger manual. If this is not the case, a recommended input circuit is shown below.



*These components are built into the A100R

Cable Length (m)	Resistance R_1 (KΩ)
0-25	9
26-50	8
51-115	6

Switched output: (YELLOW WIRE +, GREEN WIRE -)

Switching Voltage: The A100R can be operated from a DC voltage of 72Vdc Max, the recommended operating voltage is 1–5V dc.

Switching Current: The max rated reed switch current is 40mA, the recommended current is 1mA

Switch Life: Rated 25,000,000,000 operations minimum (>20 years)

Min Current: Zero (life not reduced by use in dry circuits)

Duty Cycle: 50% ±25%

Impedance: 120Ω series resistor plus 10nF capacitor across line for interference suppression

Filtering: It is recommended that measuring equipment should incorporate low-pass filtering with a max. cut-off frequency of 10KHz for this pulse/frequency signal. Also refer to the EMC guidance in this booklet.

Non-Linearity: The R30 rotor has a slightly non-linear response, most noticeable at very high wind speeds. The pulse-output will directly reflect this non-linearity and correction data can be found on the back of the rotor calibration sheet supplied with the rotor. For best accuracy you should always obtain an individual calibration and use that data.

Grounding/Earthing the Instrument: (SCREEN)

Grounding/Earthing: Appropriate earthing/grounding is required to reduce the risk of damage due to ESD (static build-up/discharge). Ensure that the data logger/equipment and mast/metalwork "earth's" are suitably grounded/earthed and bonded together to a "system ground point".

Cable Screen: The cable screen is not connected at the instrument. Connect the screen to the system ground/0V point for maximum interference screening effect.

Unused: The unused red & blue wires should be insulated (or connected to spare/unused/isolated terminals). Do not connect to any other voltage, nor allowed to short to 0V, ground/earth, screen or any other potential.

Anti-Icing Heaters (optional):

HE-4: If an anti-icing heater is necessary, use an internal heater type (such as the/HE-4 heater option) which does not affect the outer shape/profile of the instrument. With this 24V/6W anti-icing heater, power is connected to the heating element by means of the two cores, red and blue. The other 2 cores in the cable and the screen are connected/used in exactly the same way as for non-heated instruments. As the heater power runs inside the same cable as the rest of the anemometer signals, the heater power supply voltage used should be a stable, regulated noise-free DC. Refer to the HE-4 spec for full details.

HE-1 and HE-2: If it is absolutely necessary to fit an external anti-icing heater (e.g. type /HE-1 or /HE-2), the calibration should be done with the heater fitted/oriented for the wind direction expected; this is because asymmetry of the external heater causes wind speed calibration to vary by approx. 1% according to wind direction. These external 12V/6W (HE-1) and 24V/6W (HE-2) anti-icing heaters use a separate heavier cable with two 16/0.2mm stranded cores and a braided screen. The screen is not connected at the instrument/heater end. The two cores connect to the heater element.

Heater Control: There is no thermostat or control device in the anemometer to control these heaters. Some dataloggers may be configurable to switch the power to the heaters based on air temperature measurements.

Extending the cable(s):

General: The preferred option is to order the instrument with the required length of cable from the factory because there will be no connectors/junction-boxes where problems with connections can occur. If it is essential to extend the cable, then a CJK1 cable extending kit can be ordered from the factory . In situations where interference/pickup may be a problem, it may be desirable to extend a short instrument cable using a cable type with similar conductor cross-section but constructed as "twisted-pairs" with a foil/braid shield (the standard cable is not). The braided shield/screen in the standard cable provides both electrical screening as well as good physical cable strength.

Standard 4 core: The standard cable type/specification for the A100R/A100R/K anemometer is 7-2-4C to DEF-STAN 61-12 Part 4. This cable has 4 PVC insulated cores which are 7/0.2mm stranded. There is also an overall braided screen and a PVC outer sheath. Core resistance is approximately 92 Ohms/Km, capacitance is approx. 100pF/m or less.

Heater Cable: Anemometers with external/retrofit heaters use a second heavyweight cable for the heater supply with lower resistance 16/0.2mm stranded cores, designated 16-2-2C also to the same DEF-STAN 61-12 Part 4 standard.

HE-4 Heaters Because the wires are light gauge it will be necessary to use a separate heavy gauge cable to power the heater when extending the cable length beyond the 12M max limit for 12V HE4 or 50M for 24V HE-4 (connected through a junction box or CYJK1 jointing kit).

DATA LOGGER CONNECTIONS

Scaling the Data logger/Measuring Equipment:

Manufacturer	Model	A100R Connections			Pull-up resistor connections	Additional Information
		Green	Yellow	Screen		
Campbell Scientific	CR1000	Pulse count channel P1 or P2	⏚	⏚	VX1 to green	- Refer to logger manual (Other CS Loggers are similar). *Campbell Logger software can auto-generate a suitable program if A100R is selected*
Secondwind	Nomad 2	Signal C1...C12) CNTR#	0V GND	0V GND	+12V to CNTR#	- Refer to logger manual.
Ammonit	Meteo 32/32X Wicom 32	A, B, or C	M	M	H to A, B, or C	- Refer to logger manual.
Symmetron	Stylitis 100/101	2, 4 or 6	1	3, 5 or 7	Green to 3,5 or 7	A 20K resistor is required between green and 3, 5 or 7 - Refer to logger manual.
NRG	Symphonie, Symphonie Plus	Counter Inputs 13, 14, 15,		Shields	Provided by SCM	- Refer to logger manual. A Signal Conditioner Module (SCM) type 3151 is required for each channel. Connect 20K pull-up between +12V/EXC and green if required.
		SPD +	SPD-			
NRG	Symphonie Plus 3	Counter Inputs 1-3, 13-15		SHD	Provided in logger/SCM	- Refer to logger manual. A100R connects directly to counter channels 1-3/13-15. A Signal Conditioner Module (SCM) type 3151 is ONLY necessary for channels 4, 5 and 6. Connect 20K pull-up between +12V/EXC and green if required.
		SIG	GND			

General: Always refer to your data logger/measuring equipment manual for full information specific to that item. It is usually necessary to select the appropriate measurement mode/range for the channel in question, as well as select the sampling/logging intervals and any processing (max/min/average/SD etc) required. Some data loggers allow "A100R" to be selected as the sensor for the channel which automatically configures all scaling & logging etc. Other data loggers require a "program" to be written to control all these factors – examples are usually available in the data logger manual. Examples of connections for some dataloggers are shown above.

LOGGERS

Scaling: Details of the A100R calibration and scaling (and individual calculation thereof) are explained below:

Slope and Offset Cal. Some calibration tests/certificates, including MEASNET/NIST calibrations, are done over a specific range of wind speeds (e.g. 4 to 16m/s) and the test certificate will normally provide "slope" and "offset" figures which are calculated by fitting a straight line to the test results. The slope/offset values are normally scaled such that the resulting wind speed readings will be in metres/sec (m/s), however they can be further scaled if other units are required. If the data logger supports direct entry of slope/offset figures (or other gain/offset scaling facility) then these 2 figures are all that it is necessary to enter. It is not necessary to apply any further non-linearity corrections. If your data logger supports "2-point calibration" scaling, then the slope/offset figures can be used to calculate 2 "points" at either end of the windspeed range of interest.

Linearisation: Rotor non-linearity information is given in the table on the back of the rotor calibration data sheet. If individual calibration test data is available for the anemometer/rotor then that data should be used instead of the table. Some data loggers will allow these corrections to be applied by linear-interpolation (using a table of points read from the charts), some require a polynomial derived from the charts, others can apply the correction in a program.

A100R CALIBRATION DATA

Note: Each R30 series 3-cup rotor supplied with an A100R or A100R/K anemometer will have an individual "Rotor Calibration Data Sheet" (Test Certificate) provided in the box. This provides the individual test results for the rotor from a test performed in the Windspeed Ltd wind tunnel at a single windspeed of 9m/s (nominal).

Anemometer Type:	A100R anemometer	Serial No:		
Wind speed range:	0 to 75 m/s			
Contact closures over wind speed range:	0 to 60,	0.8 revolutions per metre nominal,	1 contact closure per 1.25m	
Number of contact closures per rotor revolution:	1			
Rotor type :	R30S	Rotor Serial No		
Rotor Calibration:	R30S			r.p.m. per m/s
Rotors in Band 'S' have 'R' within 48.0±1%, i.e. 47.52 to 48.48 r.p.m. per m/s				

Anemometer Type:	A100R/K anemometer	Serial No		
Wind speed range:	0 to 75 m/s			
Contact closures over wind speed range:	0 to 60,	0.777 revolutions per metre nominal,	1 contact closure per 1.285m	
Number of contact closures per rotor revolution	1			
Rotor type :	R30K	Rotor Serial No.		
Rotor Calibration:	R30K			r.p.m. per m/s
Rotors in Band 'K' have 'R' within 46.6 ± 1% i.e. 46.13 to 47.07 r.p.m. per m/s				

Notes: Calibration figure is for rotor speed of 425 rpm which corresponds to a wind speed near to 9m/s.
Refer to the rear of the rotor test certificate for the small corrections/non-linearities applicable at speeds up to 3700 rpm.

Consensus/Nominal Transfer Functions (slope/offset figures):

Analysis of a large number of individual independent calibrations of **A100R** anemometers by a third party has arrived at a "nominal" or "consensus" transfer function for the switching output of the A100R anemometer covering the 4-16m/s range as follows:

A100R: slope = 1.2146 m/s per Hz offset = 0.2170 m/s (uncertainty = 0.13m/s).

These figures correspond closely with those calculated by Windspeed Ltd and may be suitable for many applications where an individual calibration is unavailable. Always use data from an individual calibration if the highest accuracy is required.Calculations to obtain nominal slope/offset figures for the A100R/K variant product for the 4-16m/s range yield the following figures:

A100R/K: slope = 1.250 m/s per Hz offset = 0.253 m/s

It is recommended that the slope/offset figures obtained from an individual multi-point calibration in a high-quality wind tunnel are used to ensure the highest accuracy, however these "nominal" or "consensus" figures might be sufficiently accurate to be used in some applications, or where no other calibration data is available.

TROUBLESHOOTING:

If there appears to be an incorrect switching operation, check that:

TROUBLESHOOTING

- The rotor is properly locked onto the anemometer spindle (see rotor fitting/removal instructions).
- The rotor is not damaged. Cups/arms should not be twisted/bent, cracked, scratched or dented.
- The rotor is the correct one for the anemometer, and that its calibration is still valid
- The anemometer bearings are not noisy/worn and that the spindle is not bent
- The mounting/cables are secure and that cables are undamaged
- There has been no water ingress into the anemometer or cable
- The cable connections are correct
- The datalogger/measuring equipment is properly configured and correct channel type/processing and scaling selected

If a fault persists, please contact the sales desk for further assistance or to arrange for repair/refurbishment/recalibration

Further Checks:

Use a multimeter/scope to check reed operation:

- Connect a multimeter on the ohms range across the yellow and white wires. Rotating the spindle slowly should produce a reading of approximately 120Ω when the reed is closed, and infinity when it is open. To check operation with a scope, it will be necessary to connect a pull-up resistor of not less than 5KΩ in series with the green wire and connect the other end of the resistor to the + side of a DC power supply of 10v for example. The - end of the supply should be connected to the yellow wire and the scope connected across the yellow and green wires. Check that the voltage on the scope varies between approx. 0.25v and 10v (for example) when the spindle is rotated slowly. Spin the spindle quickly and observe the waveform. It should be a square wave, varying in frequency as the spindle speed is varied and have a mark/space ratio of approximately 50%

Notes:

- It is difficult to directly compare readings against another nearby anemometer to check they are "correct" because windspeed generally varies with height and turbulence/distortion of the airflow caused by mountings and nearby obstacles will affect the windspeed "seen" by any particular anemometer.

Lightning Protection

In order to obtain the best conditions for measurement of wind speed and direction, it is necessary to site anemometers and windvanes in positions suitably exposed to the elements usually on a mast or pole of some kind which may be free standing, guyed, fitted to the roof or side of a building etc. These sites by their nature are also susceptible to lightning damage. As 50% of lightning strikes involve currents of more than 28000 amps it is obvious that a strike (or flashover from an adjacent structure) directly onto an anemometer or windvane will cause physical damage to the instrument as well as destroying any electronics within. Cups can be blown off rotors, pieces melted out of fins, moving parts welded together etc. Instruments damaged in this way are usually irreparable with few parts being recoverable necessitating a replacement instrument.

Damage can be reduced by using a lightning rod, heavy duty copper tape and earth rods to divert the main portion of any strike away from the instruments.

To summarise:

1) Divert the strike to a good low-resistance earth
2) Use a lightning rod to attract any strikes away from the instruments
3) If using a metal/conductive mast, ensure it is bonded adequately to a good low-resistance earth
4) Use low resistance cabling/tape between the rod and earth
5) Use surge protection measures on the instruments and other equipment

Obviously, using a lightning rod can provide and "umbrella of protection" to the anemometer, but will have to be mounted reasonably close to the anemometer. Such close proximity to the anemometer can interfere with the airflow and affect the accuracy of the readings. In the case of high-accuracy applications, it may be necessary to use multiple anemometers (on either side of the lightning rod) and use wind direction measurement data to select measurements from whichever anemometer is not in the wake of the lightning rod at any given time.

F.A.Q.s

(1) **Q: "**What is the A100R/K variant and why/when should it be used?"

(1) **A:** The A00R/K uses the same rotor as the A100L2, A100LK, A100LM instruments which have been verified for "first class" applications and will offer the "best cosine response" when opto-electronic instruments cannot be used.

(2) **Q:** "What is the "K" in A100R/K for?"

(2) **A:** The "/K" in A100R/K simply means that the product is shipped with an R30/K rotor instead of the R30/S rotor shipped with the "standard" A100R. In this case, the "K" does not refer to the "scaling" of the output signal "being in knots", although the different rotor means that the nominal calibration of the A100R/K is slightly different to that of the "standard" A100R. (approx 0.777Hz per m/s rather than 0.8Hz per m/s).

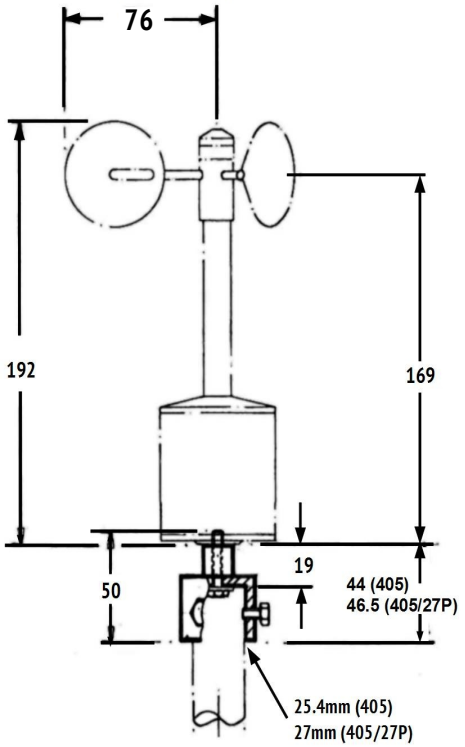
SPECIFICATION SUMMARY:

Specifications for the A100R anemometer, taken from the Specification sheet, (ref. 050-115-01) are reproduced below for reference and are correct at the time of writing. Windspeed Ltd reserve the right to change the specification at any time in line with the policy of continued product improvement – please contact the sales desk for a copy of the latest issue of the specification sheet if required.

Specification Summary:

- Threshold: 0.2m/s (/WR version: 0.6m/s)
- Maximum Windspeed: over 75m/s (146Kts)
- Temperature Range:-30 to +70 °C operating (-50 to +70 °C
- Accuracy: 1% of reading between 10 and 55m/s, 2% above 55m/s. 0.1m/s for 0.3..10m/s (or 0.7..10m/s for /WR version)
- Distance Constant:2.3m +/-10% (R30 rotor)
- Switching Voltage: Rated 72V dc maximum, recommended operation: between 1V and 5V.
- Switching Current: Rated 40mA maximum, recommended operation: 1mA or less. Note: switch life is not reduced by operation in dry (0mA) circuits.
- Switch Life: Rated 25 x 10^9 operations minimum, equivalent to at least 20 years use.
- Duty Cycle: 50% +/- 25%
- Impedance: 120 Ohm resistance in series with the switch, plus 10nF capacitor across line for interference suppression.
- Calibration: 0.8 rotor revolutions per metre, one contact closure per revolution = 1 contact closure per 1.25m of wind (or 0..60Hz = 0..75 m/s approx.)

DIMENSIONS IN MM (Shown with optional 405 & 405/27P mount)



REGULAR MAINTENANCE/CALIBRATION

- The standard anemometer/rotor calibration normally remains valid for at least 2 years. It is recommended that the bearings are replaced every 2 – 3 years. This interval may need to be reduced in dirty/dusty or marine applications.
- MEASNET calibrations (where supplied) are valid for 12 months from the date of installation (provided that the anemometer is installed within 6 months of the calibration test). Replacing bearings or rotor (cups) will invalidate the calibration.
- In high-accuracy applications, it is recommended that the instrument/rotor be checked/tested and bearings changed before each deployment (or at least annually). Recalibration should also be carried out annually. An additional calibration at the end of the deployment may give added confidence, especially for "extended deployments" (e.g. 2-3 years in the field.) Post-deployment calibration can be followed by maintenance/refurbishment at the factory and subsequent calibration preparing the instrument for a new deployment.
- Please note that opening the A100R/A100R/K anemometer will render any Warranty/Guarantee invalid. It is advisable to have maintenance carried out by the Windspeed Ltd factory to ensure optimum reliability, accuracy and performance.

FACTORY SERVICING, REFURBISHMENT AND RECALIBRATION

The A100R/A100R/K Anemometer is a precision, high-performance instrument and most servicing/repair operations require a properly equipped workshop and special tools. Repair/maintenance operations may invalidate instrument calibration and can cause a reduction in the performance of the instrument if not carried out correctly. Regular maintenance is required to maintain optimum reliability, performance and accuracy. It is therefore recommended that the Windspeed Ltd repair /refurbishment, and maintenance services are used to ensure that the instrument continues to perform optimally. For customers with suitable maintenance and recalibration facilities, various spares/kits are now available. (Note that the Guarantee is void if the instrument is opened to fit spare parts) Please contact the sales office before shipping anything. (see contact details and "Returning to the factory" below)

CLEANING THE ANEMOMETER/ROTOR

Use mild soap/water to remove dirt/contamination from the outside of the anemometer body. Do not use abrasives or corrosive cleaning agents. Any rubbing, scraping, bending or polishing of the rotor cups is likely to invalidate any calibrations and cause accuracy/performance to deteriorate. Do not allow cleaning agents to enter bearings. Do not oil/lubricate bearings.

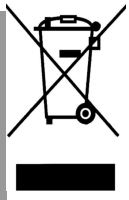
Do not insert anything into the instrument spindle hole to clean it as damage could be caused to the gravity catch.

RETURNING TO THE FACTORY

Windspeed Ltd Anemometers/Rotors can be returned (carriage/duty paid) for repair/refurbishment for which a fee will be charged. Notification is necessary in advance of an intention to return any goods, and consent obtained with a "Return Material Authorisation Number (RMA)" reference.

REGULATORY INFORMATION:

END OF LIFE DISPOSAL (WEEE)



You must comply with the legislation in effect in your country regarding End-of-Life goods, and dispose of or recycle the anemometer responsibly. The "Waste Electronic and Electrical Equipment" (crossed-out wheelie-bin) WEEE symbol on the anemometer means that it should not be disposed of in domestic waste, but should be taken to a suitable disposal/recycling facility. Appropriate precautions should be taken to protect health and environment to comply with local regulations/legislation upon disposal/recycling. If the purchaser of the product is a "business", then under the EU WEEE regulations, the purchaser is responsible for disposal costs at end of life. If the purchaser is a "consumer" then the company who supplied the anemometer should be contacted regarding disposal at the end of its life. Also refer to the Windspeed Ltd Terms and Conditions of Sale concerning disposal.

CE This instrument complies with the European CE Marking Directive (which includes Electro-Magnetic Compatibility – ' EMC' and CE marking) when within the recommended operating conditions, and used in accordance with the operating/installation instructions, 'warnings', 'Intended use' and 'Limitations to use' sections in this document.
When used in this way, and when connected to other CE marked equipment intended to be used with this instrument, it should result in a system which also complies with the regulations (although this is not guaranteed). The instrument cable may be extended (see page 8). EC Declaration of Conformity and Application circuits are available on request. OEM users and Value Added Resellers may need to make their own CE conformity declarations.

GUARANTEE

This product is covered for two years by a Standard Guarantee (ref. G-5 at the time of writing, available on request) at the time the anemometer was purchased from Windspeed Ltd, unless otherwise agreed in writing. Opening the anemometer or disassembly of the rotor will render the guarantee invalid. Contact the sales office before shipping anything (see contact details below and "Returning to the factory" above).

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Document revision summary for 061-037

Issue	Date	Description
-00	2015	Initial Draft
-01	2018	Corrected typos before first issue

All dimensions are approximate.
Specification and Prices subject to change at any time without notice, contact our sales office for latest pricing and availability details.
E&OE. All information herein is believed to be correct at time of writing but may change without notice.
Contact us to confirm latest information.
All information is provided in Good Faith and Windspeed Limited (and its employees) ***shall NOT be responsible for any errors, omissions, injury, loss or damages of any kind howsoever caused.***