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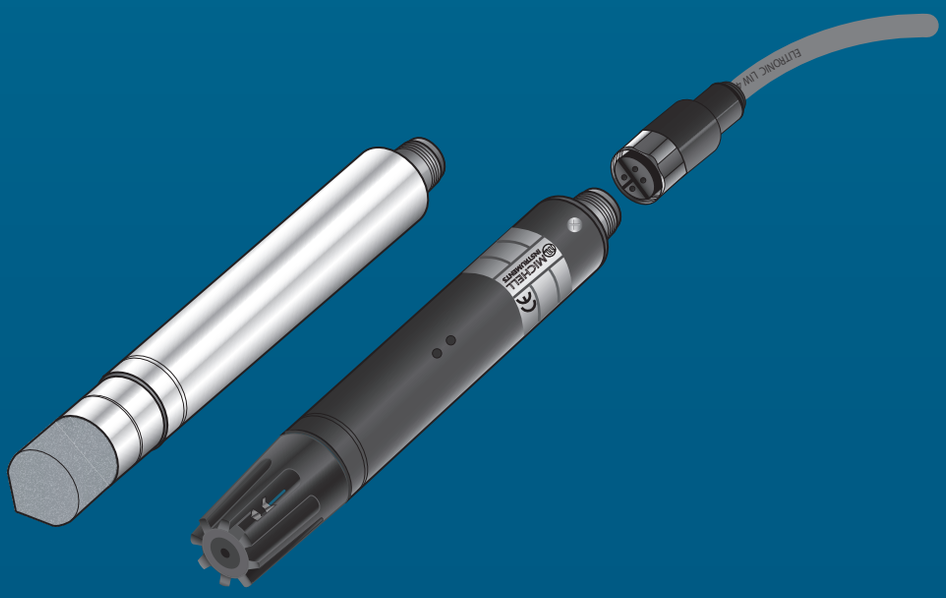
MICHELL Instruments

PC33 & 52
RH & Temperature Probes
User's Manual



97238 Issue 3.2
June 2020

Please fill out the form(s) below for each instrument that has been purchased.

Use this information when contacting Michell Instruments for service purposes.

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Invoice Date	
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PC33 and 52

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Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use competent personnel using good engineering practice for all procedures in this manual.

Electrical Safety

The instruments are designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument.

Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

Repair and Maintenance

The instruments must be maintained either by the manufacturer or an accredited service agent. Refer to www.michell.com for details of Michell Instruments' worldwide offices contact information.

Calibration

Michell Instruments recommends an annual calibration for an accuracy requirement of ±2% RH under ambient conditions where temperature is 0 to +50°C (+32 to +122°F) and relative humidity is 0 to 70% RH. For environments with airborne chemicals or for high humidity and high temperature conditions, Michell recommends more frequent calibration.

Safety Conformity

This product meets the essential protection requirements of the relevant EU directives. Further details of applied standards may be found in the product specification.

EMC Compatibility

The PC33 & 52 relative humidity probes are designed to meet the following European standards:

- EN 61326 (1997) + A1 (1998) + A2 (2001)
- EN 61000-3-2 (1995) +A1 (1998) + A2 (1998) & EN 61000-3-3 (1995)
- Emission: Class B, Immunity: Industrial

Abbreviations

The following abbreviations are used in this manual:

°C	degrees Celsius
°F	degrees Fahrenheit
DC	direct current
mA	milliampere
mm	millimeters
oz	ounce(s)
RH	relative humidity
T	temperature
V	Volts
Ω	Ohms
"	inch(es)
%	percentage

Warnings

The following general warning listed below is applicable to this instrument. It is repeated in the text in the appropriate locations.

Where this hazard warning symbol appears in the following sections it is used to indicate areas where potentially hazardous operations need to be carried out.

1 INTRODUCTION

The PC series offers a comprehensive range of relative humidity probes for accurate, stable and repeatable measurements. Available with analog output signals, the PC series can be installed in a wide variety of applications.

Figure 1 *PC33 & 52*

1.1 Highlights

- Low cost PC33 with analog output is designed for HVAC applications
- PC52 with analog output is designed for accurate measurement in controlled environments
- Analog zero and span adjustment

1.2 Features

- % RH and temperature outputs
- 4-20 mA, 0 to 1, 0 to 5 and 0 to 10 V analog output signals
- Excellent sensor protection
- Long term stability ±1% RH over 12 months
- Stainless steel housing (optional)
- Connectors are available with various cable lengths

2 INSTALLATION

Voltage output		
Cable	**Connector**	
White	Pin 1	Power Supply V +
Yellow	Pin 2	Output temperature +
Brown	Pin 3	Common ground
Green	Pin 4	Output RH +

4-20 mA output 2-wire		
Cable	**Connector**	
White	Pin 1	Output RH +
Yellow	Pin 2	Output temperature -
Brown	Pin 3	Output RH -
Green	Pin 4	Output temperature +

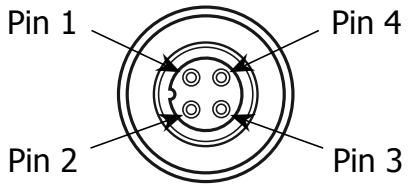


Figure 2 *Cable Connections*

3 CALIBRATION AND ADJUSTMENT PROCEDURE

- **Calibration certifications**: In addition to the normal calibration procedure, each transmitter can be supplied with its own traceable calibration certificate. Please ask Michell Instruments or your local distributor for more information.
- **Calibration interval time**: Under normal ambient conditions (0 to 50°C, 20 to 70% RH) and for accuracy of ±2% RH, an annual calibration is recommended. For accuracy of ±5% RH a calibration is recommended every five years. For environments with airborne chemicals or of high humidity and high temperature conditions more frequent calibration is recommended.

If re-adjustment is necessary, refer to Sections 3.1 and 3.2 and also see the drawings of the circuit boards for the location of the potentiometers (*Figures 5 and 6) .*

If a humidity generator is being used, an adjustment tube should be used to protect the PCB and sensor (see *Figure 4*). For more information on these adjustment tubes please contact Michell Instruments or your local distributor.

A humidity generator, (Michell Instruments S503, S904 or Optical), used in combination with a general reference handheld hygrometer, is ideal for a quick and accurate calibration. For more information on the S503, S904 or Optical humidity generators please contact Michell Instruments (see contact details at www.michell.com).

Figure 3 *Adjustment Tube*

3.1 Calibration & Adjustment for 3% Accuracy (1pt Adjustment)

PC33

1. Remove the screw at the side of the connector.
2. Carefully unscrew the sensor protection cap from the head.

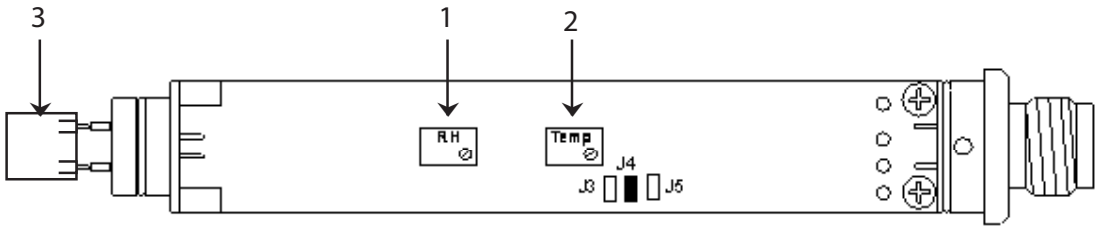
DO NOT TOUCH THE SENSOR ELEMENT (see 3 below)

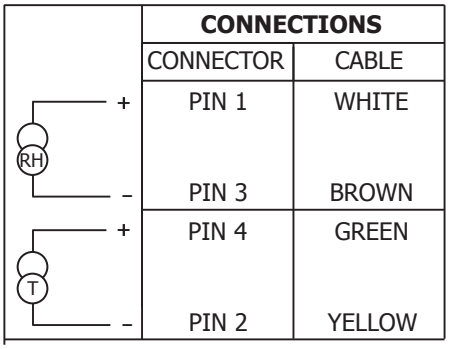
3. Carefully remove the circuit board from the body by pulling on the threaded end while holding the tube.

- The transmitter should be calibrated at one point, for example 50% RH.
- Once this value is reached and the reading of the reference has stabilized, adjust the transmitter with the RH potentiometer (see 1 below).
- For versions with a T output the temperature should be calibrated at ambient temperature.
- After stabilizing, adjust with the temperature potentiometer (see 2 below).

See *Figure 5* for 2-wire V DC power supply voltage, output 4-20 mA and *Figure 6* for 3/4-wire V DC power supply voltage, output 0 to 1, 0 to 5 or 0 to 10 V.

2-wire (mA)





CONNECTIONS	
CONNECTOR	CABLE
PIN 1	WHITE
PIN 3	BROWN
PIN 4	GREEN
PIN 2	YELLOW

TEMPERATURE RANGE			
INPUT	J3	J4	J5
0 to +50°C (+32 to +122°F)	●	●	●
0 to +100°C (+32 to +212°F)	●		
-20 to +80°C (-4 to +176°F)		●	

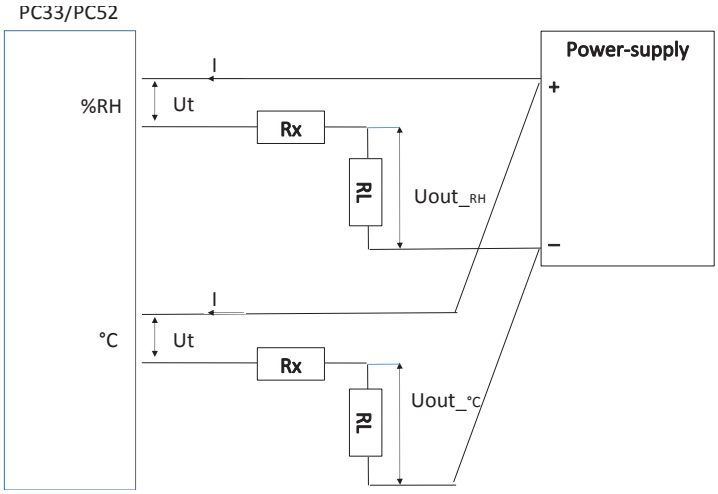
● Soldered joint

Figure 4 *PC33 - 2-wire Connection*

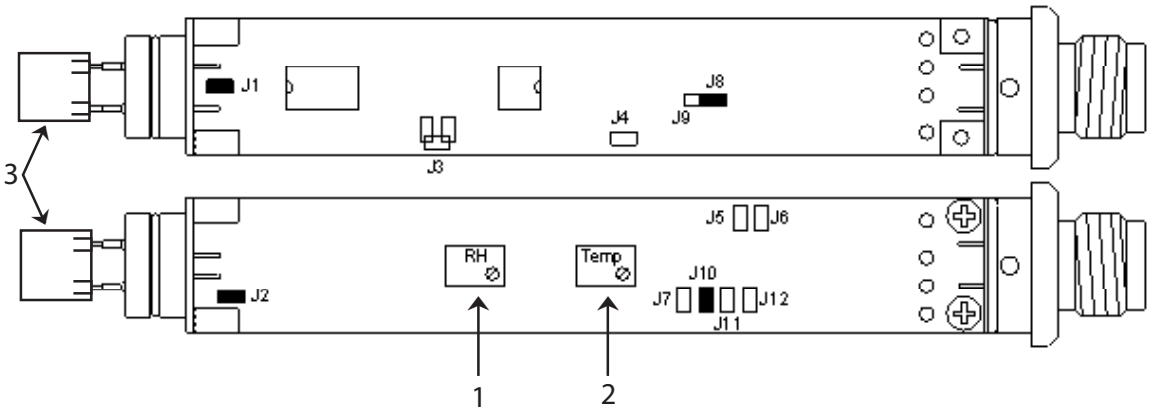
Supply voltage

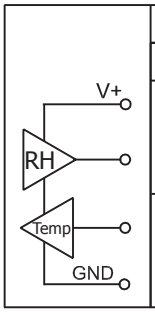
The specified supply voltage of this transmitter is 4,5..35 Vdc. To prevent a self heating effect which will influence the measurement, it is necessary to keep the voltage across the transmitter as low as possible. We advise a supply voltage of approx. 10 volt across the transmitter at 20 mA current. If not possible, place a resistor in series with the supply, so that the voltage across the transmitter will be 10 Volt at 20 mA.

Example
See drawing: U_t is the supply voltage. R_x is the load resistance
U_I is the voltage across the transmitter and I is the current.
U_p = 24V and R_L = 50Ω and I = 20mA
$Rx = (U_p - U_1)/I - R_L$ => Rx = (24V - 10V) / 0.02 - 50Ω =>
Rx = 14 /0.02 - 50=> Rx + 650Ω
A good choice is a resistance from 620 Ω.
(Do not place this resistor in the transmitter housing)



3/4-wire (Volt)





CONNECTIONS	
CONNECTOR	CABLE
PIN 1	WHITE
PIN 4	GREEN
PIN 2	YELLOW
PIN 3	BROWN

REL HUMIDITY OUTPUT		
	J5	J6
0 to 1 V DC	●	
0 to 5 V DC		●
0 to 10 V DC		

● Soldered joint

TEMPERATURE RANGE / OUTPUT																		
	0 to +50°C (+32 to +122°F)						0 to +100°C (+32 to +212°F)						-20 to +80°C (-4 to +176°F)					
Output	J7	J8	J9	J10	J11	J12	J7	J8	J9	J10	J11	J12	J7	J8	J9	J10	J11	J12
0 to 1 V DC	●		●			●	●		●	●			●	●		●		
0 to 5 V DC			●	●					●					●				
0 to 10 V DC			●		●				●	●				●		●		

● Soldered joint

Figure 5 *PC33 - 3/4-wire Connection*

3.2 Calibration & Adjustment for 2% Accuracy (2 pt Adjustment)

PC52

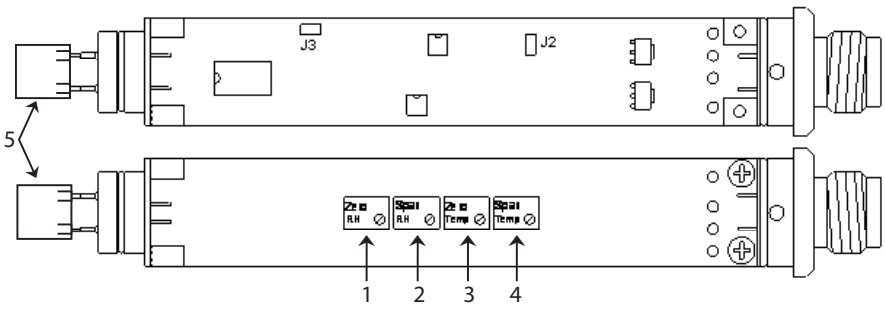
1. Remove the screw at the side of the connector.
2. Carefully unscrew the sensor protection cap from the head.

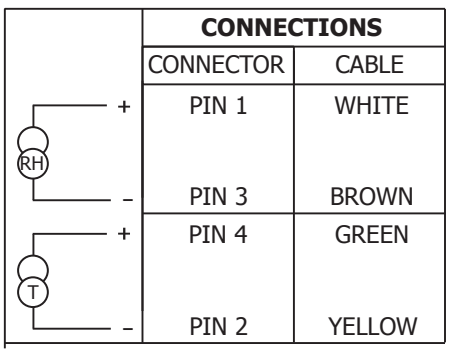
DO NOT TOUCH THE SENSOR ELEMENT (see 5 below)

3. Carefully remove the circuit board from the body by pulling on the threaded end while holding the tube.
   - The transmitter should be calibrated at two points, one low (Zero) and one high (Span) point.
   - Once the first low value is reached and the reading of the reference is stabilized, adjust the transmitter with the Zero RH potentiometer (see 1 below). Compare with the reference.
   - After the second high value is reached and stabilized, adjust with the Span RH potentiometer (see 2 below).
   - For versions with a T output this procedure should be repeated with a temperature potentiometer (see 3 and 4 below) only use the "Zero temp" potentiometer to adjust the temperature readings.

See *Figure 7* for 2-wire V DC power supply, output 4-20 mA and *Figure 8* for 3/4-wire V DC power supply voltage, output 0 to 1, 0 to 5 or 0 to 10 V.

2-wire (mA)





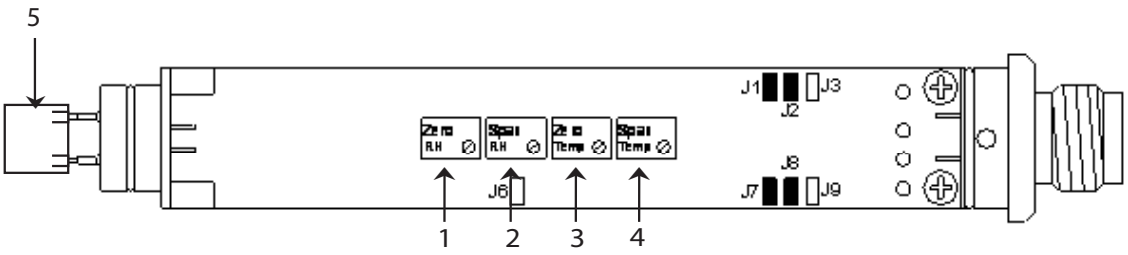
	CONNECTIONS	
	CONNECTOR	CABLE
+	PIN 1	WHITE
–	PIN 3	BROWN
+	PIN 4	GREEN
–	PIN 2	YELLOW

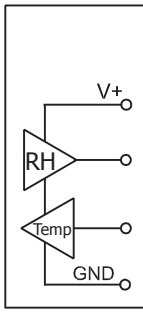
TEMPERATURE RANGE		
INPUT	J2	J3
0 to +50°C (+32 to +122°F)	●	
0 to +100°C (+32 to +212°F)		
-20 to +80°C (-4 to +176°F)		●

● Soldered joint

Figure 6 *PC52 - 2-wire Connection*

3/4-wire (Volt)





CONNECTIONS	
CONNECTOR	CABLE
PIN 1	WHITE
PIN 4	GREEN
PIN 2	YELLOW
PIN 3	BROWN

REL HUMIDITY OUTPUT			
	J1	J2	J3
0 to 1 V DC	●		
0 to 5 V DC			●
0 to 10 V DC	●	●	

● Soldered joint

SETTINGS TEMPERATURE OUTPUT AND RANGE WITH SOLDER JUMPERS												
	0 to +50°C (+32 to +122°F)				0 to +100°C (+32 to +212°F)				-20 to +80°C (-4 to +176°F)			
Output	J6	J7	J8	J9	J6	J7	J8	J9	J6	J7	J8	J9
0 to 1 V DC						●			●	●		
0 to 5 V DC		●	●					●	●			●
0 to 10 V DC			●			●	●		●	●	●	

● Soldered joint

Figure 7 *PC52 - 3/4-wire Connection*

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance	
Measurement Range (RH)	0-100% RH
Measurement Range (T)	-20 to +80°C (-4 to +176°F)
Accuracy at 23°C (73°F) Humidity	PC52: <±2% RH (10-90% RH) PC33: <±3% RH (30-80% RH)
Accuracy at 23°C (73°F) Temperature	PC52: ±0.2°C (±0.36°F) PC33: ±0.3°C (±0.54°F)
Stability – RH Sensor	±1% RH/year
Response Time – RH Sensor	<10 sec typical (for 90% of the step change)
Electrical Specifications	
Output Signal Options	4-20 mA, 0 to 1, 0 to 5, 0 to 10 V
Supply Voltage	14 to 30 V DC (for 0 to 5 / 0 to 10 V output), 5 to 30 V DC (0 to 1 V & mA output)
Operating Specifications	
Operating Temperature Probe, Housing Storage	 -30 to +85°C (-22 to +185°F) -40 to +85°C (-40 to +185°F)
Mechanical Specifications	
Ingress Protection	IP65 (NEMA 4 level)
Housing Material	Molded polymer or stainless steel (ordering option)
Dimensions	L=130mm, ø19mm (L=5.11", ø0.74")
Weight	30g (1.06oz) without cable (molded polymer version)
Electrical connections	M12

A.1 Dimensions

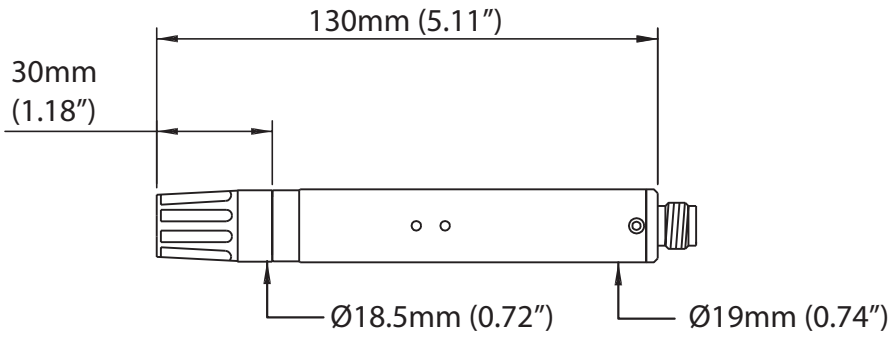


Figure 8 *Dimensions*

Appendix B

Quality, Recycling & Warranty Information

Appendix B Quality, Recycling & Warranty Information

Michell Instruments is dedicated to complying to all relevant legislation and directives. Full information can be found on our website at:

www.michell.com/compliance

This page contains information on the following directives:

- ATEX Directive
- Calibration Facilities
- Conflict Minerals
- FCC Statement
- Manufacturing Quality
- Modern Slavery Statement
- Pressure Equipment Directive
- REACH
- RoHS2
- WEEE2
- Recycling Policy
- Warranty and Returns

This information is also available in PDF format.

Appendix C

Recommended Practices in Humidity Measurement

Appendix C Recommended Practices in Humidity Measurements

The following text is reproduced with kind permission from the National Physical Laboratory. It is originally published in the booklet, *A Guide to the Measurement of Humidity.*

Definition of Relative Humidity

Relative Humidity – The ratio of the actual vapor pressure to the saturation vapor pressure over a plane liquid water surface at the same temperature, expressed as a percentage. This is commonly understood when the term 'X percent relative humidity' is used.

For actual vapor pressure, e, and saturation vapor pressure, e_s

$$\text{relative humidity (in \%)} = \frac{e}{e_s} \times 100$$

USAGE: The phrase 'relative humidity' is commonly abbreviated RH although this is not a recognized abbreviation. Values of relative humidity are commonly expressed in units of percent relative humidity (% RH).

Recommended practices in humidity measurements

General practical recommendations

- Where relative humidity is of interest, a direct measurement of relative humidity is usually best. Where an absolute measure of humidity is needed, choose dew point, vapor pressure or similar measurements.
- Establish the measurement requirements at the purchasing stage in order to have the right instrument for the job.
- Allow hygrometers to equilibrate in any new environment. This is particularly necessary after changes in temperature due to transportation or storage. Depending on the instrument and on how great the change in conditions, this may require from only a few minutes to many hours.
- Follow Michell Instruments' care instructions for the instrument. Some instruments need routine cleaning or other maintenance. Before using any solvent cleaner, check with Michell Instruments that this will not harm the sensor or other materials of construction.
- Wherever possible, ensure that hygrometers are calibrated under the conditions of use, i.e. at similar values of humidity and temperature, and (if relevant) in similar conditions of pressure, airflow, etc.
- Keep a record of calibrations and any adjustments to the hygrometer. This will show the long-term stability of the instrument and allow the associated uncertainty to be assessed.
- Check instruments, if possible, at intervals between calibrations, by comparison with another (stable) instrument, to monitor for long-term drift. Routine checks are also useful before and after subjecting an instrument to transportation or other stress, which might lead to a shift in its performance. Where the check is against two (or more) instruments this is even better: not only does this add confidence, but in the event of one instrument drifting among a set of three, it can be seen which reading is most suspect.

- Cleanliness of the environment will affect different hygrometers in different ways. Dust and airborne droplets should be avoided or filtered out if possible. Contaminants can come from the most surprising sources, ordinary urban pollution, for example.
- The readings given by some types of hygrometer are sensitive to gas type. For any Instrument which reads in terms of mass per unit volume, e.g. in grams per cubic metre, it must be confirmed whether the calibration is valid for the gas in use.
- Avoid using instruments in direct sunlight or near any other source of heat, unless they are suitably shielded to prevent measurement errors.

Sampling in general

- Relative humidity measurements should be carried out at a representative temperature. Failure to allow temperature equilibration will lead to a false indication of the relative humidity.
- Variations in vapor pressure from place to place can occur where an environment is subject to any addition or removal of water. If so, care must be taken over where to make a measurement in order to obtain a representative result.
- Sources and sinks of water vapor should be avoided in any sampling system. Invasion of stray water can be minimised by attention to leaks, hygroscopic materials, droplets and condensation. The lower the humidity, the more critical these precautions are.
- Hygroscopic materials should be avoided. Many materials contain moisture as part of their structure, particularly organic materials (whether natural or synthetic), salts (or anything which contains them), and anything which has small pores. Temperature changes can increase the tendency of these materials to affect the humidity of the surrounding air.
- Condensation in a sampling process can invalidate humidity measurements by reducing the water content of the gas being measured. What is more, condensed liquid may alter the humidity elsewhere by dripping or running to other locations and evaporating there. In these circumstances, measurement results may be misleading if hygrometer location is not considered carefully.
- Water droplets or mist must be avoided. These can result in overestimates of the humidity of the air between the droplets. Such results may exceed 100% RH, or may be impossible to interpret meaningfully. Droplets of liquid also damage some electrical types of humidity sensor. Filtering the air sample can eliminate droplets.
- If pumps are used for sampling gas, these should be located after the hygrometer, to avoid contaminating the measurement environment. Where possible, oil free pumps should be used, or filters employed. Oscillations in pressure due to pumping can sometimes be reduced or buffered using a needle valve or a reservoir of large volume.
- Special treatments such as filtration can change the amount of moisture in a gas. Some drying agents take out other gases too.
- When sealing any sensor or probe into a port or manifold in a duct or chamber, leaks through the probe or electrical cable should be considered. These are not always sealed against passage of ambient air.
- Where sampling involves a step change in temperature, pressure or gas flow rate, relative to the process being sampled, results may need to be converted or interpreted. For example 'pressure dew point' will differ from the value found after expanding the gas sample to atmospheric pressure. Care should be taken to distinguish between 'gauge' and absolute values of pressure.

Dew point in general

- The measuring environment and all parts of the sampling pathway must be kept above the dew point if condensation is to be avoided. Electrical trace heating or other heating methods should be used if necessary. An excess temperature of 10°C above the dew point is usually a safe margin.
- For measurements in the region below 0°C it must be clear whether the condensate is dew or frost. Failure to distinguish between these can result in errors of about 1°C for every 10°C below zero.

Relative humidity in general

- Due care must be taken of temperature. The effect of temperature on humidity is highly significant. Failure to take this into account can sometimes lead to errors so large that the measurement is meaningless. In many situations, the largest single source of uncertainty in a humidity measurement is the effect of temperature differences from place to place in the process, room or chamber. The importance of considering the temperature effects carefully cannot be overstated when relative humidity is the parameter of interest.
- Care must be taken when expressing uncertainties, changes or fractional differences in relative humidity. For example, the difference between 50% RH and 52% RH is 2% RH. This can also be expressed as a difference of 4% of value. It is important to distinguish clearly between these two kinds of statement.

Recommendations specific to ranges of measurements

- Ambient humidity - Avoid using hygrometers near the body, which is a source of heat and moisture. Do not breathe close to the measurement.
- High humidity, above the ambient range - Sample lines should be maintained above the dew point of the gas being measured, to avoid condensation. Electrical trace heating is often the most practical method.
- Low humidity, and very dry gases - If possible, prepare for measurements by flushing sample lines and hygrometers with dry gas, or by evacuating to low pressure. Drive off stray residual water by baking assemblies if possible (but not instruments – unless designed for this!). The lower the moisture content to be measured, the more dramatically the required drying time multiplies.
- Avoid hygroscopic materials. At low humidity (anything much below a dew point of 0°C) the amounts of water given off by organic and porous materials can dramatically affect the value of humidity. The lower the level of moisture, the more significant the effects.
- Choose impermeable materials, to avoid inward diffusion of moisture through sampling tubes and enclosures. Steel and other metals are practically impermeable. PTFE ('Teflon') is only slightly permeable and will usually be satisfactory for dew points above -20°C, and sometimes below this level. Materials such as PVC and rubber are relatively permeable and so totally unsuitable at low humidity, and not really satisfactory in any humidity range.
- Surface finish of pipework is important for very dry gases. Even the tiny quantities of water adsorbed on the surfaces of non-hygroscopic materials can have significant effect. Polished or electropolished steel is recommended for the best results.

- Clean environments are always best for humidity measurements, but this is especially critical at very low humidity. Even fingerprints harbour water. High purity cleaning agents are recommended: Analytical Reagent (AR) quality solvents for oil-based contaminants, and purified water (distilled or de-ionised) for salts. Cleaning should be followed by thorough drying by a clean method.
- Sample tubing should be as short in length as possible. The surface area should be minimised by using the narrowest tubing that the flow conditions will permit.
- Avoid leaks. Minimising the number of connections (elbows, tees, valves, etc.) helps with this.
- Adequate flow of the gas sample should be ensured, to minimise the influence of sources of stray water in the flow path.
- 'Dead ends' should be avoided, as they cannot easily be flushed.
- Back-diffusion of moisture should be minimised, e.g. by fast flow rates of gas, long exhaust tubes after the sensor, or by valves which isolate the low-humidity region from ambient air.

Practical recommendations for specific types of hygrometer

Relative humidity capacitive sensor

- Care should be taken to avoid mechanical shock (impact) or thermal shock (sudden temperature changes). Sensors should be protected from steam or water sprays, and from direct sunlight.
- Where a sensor is at risk of exposure to dust, droplets, or the occasional knock during handling, the appropriate guard or filters for the sensor head should be used.
- Any temptation to breathe on the sensor, or to wave it over cups of tea, etc. should be resisted. Filters and saturation guarding may protect the sensor, but these actions carry a risk of damage by condensation or other contamination.
- Protective filters can slow the response time of sensors. This can be avoided by removing any filter, but the benefit must be weighed against the risk of damage to the sensor.
- Sensors should not normally be submerged in liquids. In the case of a resistive (electrolytic) sensor, water or other liquids would certainly damage the sensor beyond repair.
- Salt solutions are especially commonly used for calibration of electrical sensors, and should be provided with traceability directly or via a calibrated hygrometer. Protection of sensors from direct contact with salt or solution is most important as contamination would destroy or seriously impair the sensing element.

EU Declaration of Conformity

Manufacturer: **Michell Instruments B.V.**
Krombraak 11
4906 CR Oosterhout
The Netherlands

We declare under our sole responsibility that the product:

PC52 RH & Temperature Transmitter

complies with all the essential requirements of the EU directives listed below.

2014/30/EU	**EMC Directive**
2011/65/EU	**Restriction of Hazardous Substances Directive (RoHS2)**

Using the standards:

EN61326-1:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity**.**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Robert-Jan Pouw RH Business Manager.
Michell Instruments Benelux B.V. Oosterhout The Netherlands
Date of Issue 6 December 2017

on behalf of
Peter Haakma Managing Director Michell Instruments Benelux B.V.

EUD PC52 Issue 05

EU Declaration of Conformity

Manufacturer: **Michell Instruments Benelux B.V.**
Krombraak 11
4906 CR Oosterhout
The Netherlands.

CE

We declare under our sole responsibility that the product:

PC33 RH & Temperature Transmitter

complies with all the essential requirements of the EU directives listed below.

2014/30/EU	**EMC Directive**
2011/65/EU	**Restriction of Hazardous Substances Directive (RoHS2)**

Using the standards:

EN61326-1:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity**.**

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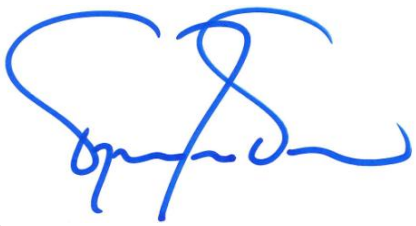

Robert-Jan Pouw RH Business Manager.
Michell Instruments Benelux B.V. Oosterhout The Netherlands
Date of Issue 6 December 2017

on behalf of
Peter Haakma Managing Director Michell Instruments Benelux B.V.

EUD PC33 Issue 05

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