MICHELL Instruments

WM281/291
Premium Wall Mount
RH & Temperature Transmitters'
User's Manual

97463 Issue 1
July 2014

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

Use this information when contacting Michell Instruments for service purposes.

Transmitter	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Transmitter	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

Transmitter	
Code	
Serial Number	
Invoice Date	
Location of Instrument	
Tag No	

WM281/291 Transmitters

For Michell Instruments' contact information please go to
www.michell.com

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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 instrument is 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 instrument must be maintained either by the manufacturer or an accredited service agent. For Michell Instruments' contact information please go to www.michell.com.

Calibration

Refer to details in Section 3.1.2 regarding recalibration of transmitters in order to adjust their calibration in accordance with reference samples or an external reference device. This can be undertaken via the keypad on the display versions or by using the RS485 Modbus interface on all versions.

Safety Conformity

This product meets the essential protection requirements of the relevant EU standards and directives.

Abbreviations

The following abbreviations are used in this manual:

A	ampere
°C	degrees Celsius
°F	degrees Fahrenheit
g/m^3	grams per cubic meter
g/kg	grams per kilogram
kJ/kg	kilojoules per kilogram
km	kilometer
mA	milliampere
mm	millimeter
m/sec	meters per second
RH	relative humidity
s	second
T	temperature
V	volt

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.

Where this symbol appears in the following sections it is used to indicate areas of potential risk of electric shock.

1 INTRODUCTION

The 280/290 Series Transmitters are microprocessor-based instruments used to measure relative humidity and air temperature.

These products are available in four different model types:

- WM281/WM291 Premium Wall Mount Transmitter range
- DT282/DT292 and DT284/DT294 Premium Duct Mount Transmitter range
- WR283/WR293 Premium Wall Mount Remote Transmitter range
- PR285 Premium Pressurized Remote Transmitter range

This manual is for the WM281/291 versions only.

The 280/290 Series Transmitters have two analog outputs for temperature and relative humidity respectively providing 4-20 mA, 0-20 mA, 0-10 V, 0-1 V and 0-5 V. There is a third analog output which is calculated providing 4-20 mA, 0-20 mA, 0-10 V, 0-1 V and 0-5 V.

The 290 Series Transmitters are equipped with an LCD display mounted in the cover of the housing, making it possible to display the temperature, relative humidity and a value set at the third calculated output.

The key features are:

- Dual voltage or dual 4-20 mA outputs
- Digital RS485 Modbus output
- Traceable calibration certificates
- Interchangeable sensor module
- Optional LCD display

The third analog output is configurable by the user through the Comms Kit or display version and indicates one of the following calculated values:

Dew point

The temperature at which a mixture of gas and water vapor must be cooled (at constant pressure) for condensation to begin to form in the liquid phase, i.e. the temperature at which a gas becomes saturated in equilibrium on a flat surface of water. The unit of measure is degrees Celsius (°C), or can be set to degrees Fahrenheit (°F).

Frost point

The temperature at which a mixture of gas and water vapor must be cooled (at constant pressure) so that condensation begins in the solid phase, i.e. the temperature at which a gas becomes saturated in equilibrium on a flat surface of ice. The unit of measure is degrees Celsius (°C), or can be set to degrees Fahrenheit (°F).

Absolute humidity

The mass of vapor present in the unit of volume of humid gas at defined temperature and pressure levels. The unit of measure is 1g of water/cubic meter (g/m^3).

Mixing ratio (or title)

The ratio between the mass of water vapor and the mass of dry gas contained in the sample of gas. The unit of measure is 1g of water/kilogram of dry air (g/kg).

Specific enthalpy (heat content)

The heat required to bring 1kg of dry air (and the vapor contained in it) to a constant pressure from the state of 0°C (air + liquid water) to the state of a gaseous mixture at temperature 't'.

2 INSTALLATION

2.1 Unpacking the Instrument

On delivery please check that all the following components are present in the packing box:

- WM281 or WM291 Premium Wall Mount Transmitter
- Certificate of calibration
- User's manual
- Digicor2 280/290 configuration software and communication kit (optional)

2.2 Choice of the Site of Installation

The installation site choice for the transmitter must be made bearing in mind the effectiveness of air circulation. The point at which the sensor is installed must be typical of the surrounding environment where the measurements of relative humidity are to be taken.

The following should be avoided in keeping with good instrumentation practice:

- Installation location not representative of measuring conditions
- Installation location adjacent to high power sources

The operating envelope of the measurement probe is detailed in the following operating graph:

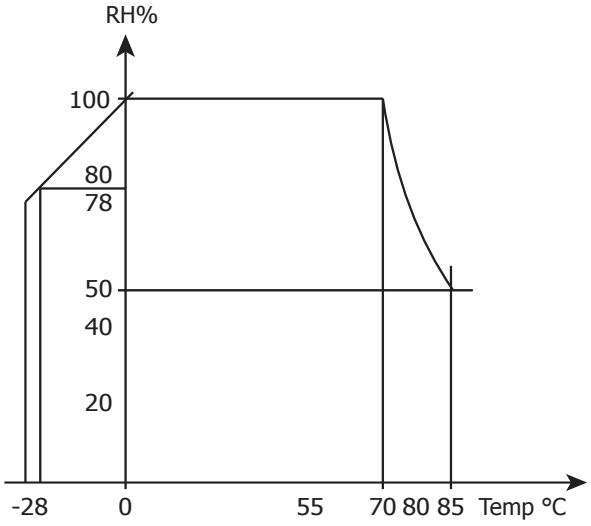


Figure 1 *Operating Graph*

2.3 Element Filter Assembly

The filter is a fundamental element for a relative humidity transmitter, ensuring excellent protection against dust pollution and high-speed air flow, and a good level of resistance against chemical pollutants which are harmful for the sensor.

The filter allows the sensor to 'breathe' the humidity contained in the environment to be measured and it is therefore very important to keep it clean.

The WM281/291 Transmitters can be equipped with the following filter models:

K7	Standard - Delrin cap with steel mesh filter for use in environments which are relatively clean and where there is poor ventilation.
H2	Sintered steel filter for use in dusty environments.
J2	Sintered steel filter with PTFE coating for use in environments where there is a risk of saturation and/or where aggressive chemical substances (solvents and acids) are present.
Z7	Delrin cap with PTFE filter.

2.4 Wall Mounting

It is recommended that the WM281/291 Transmitters are installed with the measurement probe facing downwards so as to minimize the propagation of heat between the transmitter housing and the measuring element.

Figure 2 *WM291*

2.5 Connections

2.5.1 Electrical Connection

Applicable for the following products: **WM281/291**	
Pin	
1	Power supply +
2	Power supply -
3	RS485 system 0v
4	Ground
5	Output Channel 1 Temperature +
6	Output Channel 1 Temperature -
7	Output Channel 2 RH +
8	Output Channel 2 RH -
9	RS485 Data +
10	RS485 Data -
13	Output Channel 3 Calculated +
14	Output Channel 3 Calculated -
Do not connect Pin 2 (V-) to Pin 4 (Ground)	

15 - 27 V AC and 18 - 38 V DC

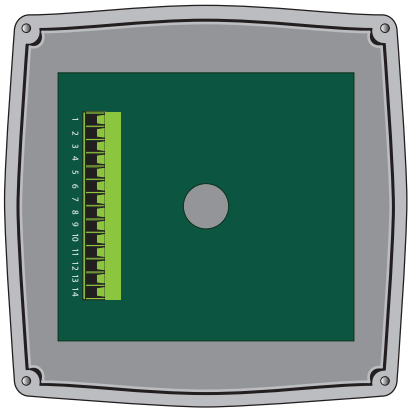


Figure 3 *Electrical Connections*

The electrical connection box is located in the main body of the WM281/291 Transmitters. Undo the four screws on the face of the transmitter and carefully lift up the top panel. The connector is located on the circuit board.

2.5.2 Earth Connection

A suitable shielded conductor cable with a diameter between 5 and 10mm should be used for entry and exiting the transmitter housing via the 2 x PG11 metal glands.

The shielded cable must be suitably grounded to ensure electromagnetic protection.

2.5.3 Power Supply

The power supply required to power the system is:

- 18 V to 38 V DC
- 15 to 27 V AC

The DC and AC power supply enter via the same pcb connection pins.

2.5.4 Digital Serial Interface

The WM281/291 Transmitters are equipped with an RS485 communication port which provides users with the following features:

- RS485 Modbus output for use as a control signal within a single or multidrop system
- All transmitter variables and diagnostics can be accessed and modified using the Digicor2 Communications Kit, available from Michell.
- With use of suitable calibration equipment and trained personnel, unit re-calibration can be performed

2.5.4.1 Modbus Register Holding Map

Please refer to Appendix B.

2.6 Analog Output Configuration

On the WM281/291 Transmitters, configuration of the three analog outputs can be achieved automatically via the RS485 Modbus interface with the Digicor2 Configuration Software (see Section 4) or on the WM291 manually via the LCD display keypad.

Output Channel 1

- The output signal is equal to the range -30 to +70°C (-22 to +158°F) (unless another output scale is ordered)

Output Channel 2

- The output signal is equal to the range 0 to 100% RH

Output Channel 3

- Dew point range -99.9 to +212 (includes both °F and °C)
- Frost point range -99.9 to +212 (includes both °F and °C)
- Mixing ratio range (g/kg) 0 to 500 g/kg
- Absolute humidity range (g/m^3) 0 to 600 g/m^3
- Enthalpy range -40 to +1500 kJ/kg

These are the electronic minimum/maximum limits which the transmitter is capable of calculating.

2.7 Interchangeable Sensor Module

The WM281/291 Transmitters are equipped with the interchangeable, Hygrosmart I7000 sensor module. The 'plug-in' type connection allows for a rapid, low-cost replacement operation, and significantly reduces maintenance costs.

The labels of all I7000 sensor modules include:

- the serial number
- the date of calibration

2.8 Calibration Reference Equipment

The following calilbrators are available for the WM281/291 Transmitters:

- 503 - Humidity calibrator - for calibration checking purposes
- S904 - Humidity calibrator - for calibration purposes
- Optical cooled mirror calibrator - for laboratory calibration purposes

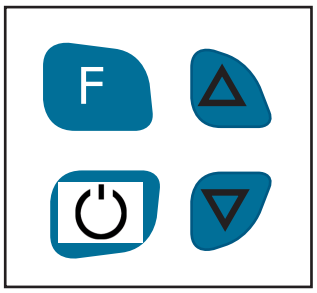
2.9 Certificate of Conformity

The WM281/291 Transmitters are delivered with a Certificate of Conformity and a calibration report for each individual transmitter.

3 OPERATION

3.1 Digital Display and Operation Keys

Applicable to WM291 Transmitter only



The WM291 Transmitter can be configured manually through the following 8 sub-menus.

Press and hold the **F** (Function) key and then single press the ▲ (up) key to allow selection of any of the required sub-menus below:

Once the required sub-menu is reached, edit by pressing the ⏻ key, then choose the value by pressing the ▲ (up) and ▼ (down) keys and confirm by pressing the ⏻ key. To exit the sub-menu press the **F** (Function) key then press the ▲ (up) key and scroll to the normal measurement screen.

3.1.1 Open Sub-Menus

These are open menus which can be accessed and amended with no password protection.

1. Information

- Model type
- Password

2. Configuration

- LCD contrast
- LCD back light
- Temperature Filter from 0 - 20 s
- Humidity Filter from 0 - 20 s
- Temperature unit

3.1.2 Protected Sub-Menus

These are password protected menus and should only be accessed by trained personnel by pressing the ⏻ key, entering a password of **99** and then pressing the ⏻ key again. This gives access to the sub-menus 3 to 8 below. Once the required protected sub-menu changes are made, the unit is reset into protected mode by changing the password from 99 to any other value or by power supply disconnection.

3. Out Temperature

- Out type: 4-20 mA, 0-20 mA, 0-10 V, 0-1 V, 0-5 V
- Low scale *
- High scale *

*** refer to Section 2.6.1 for setting range**

4. Out RH

- Out type: 4-20 mA, 0-20 mA, 0-10 V, 0-1 V, 0-5 V
- Low scale*
- High scale*

*** refer to Section 2.6.1 for setting range**

5. Out Value Calculate

- Out type: 4-20 mA, 0-20 mA, 0-10 V, 0-1 V, 0-5 V
- Low scale*
- High scale*

*** refer to Section 2.6.1 for setting range**

6. Serial

- Code 1 (address)
- Protocol (MODBUS)
- Rate
- Parity

7. Temperature Calibration

- Set temperature
- Restore factory settings

NOTE: Changes to some of these settings may lead to the loss of calibration data and should only be changed by qualified personnel when absolutely necessary.

8. RH Calibration

- Set RH
- Restore factory settings

NOTE: Changes to some of these settings may lead to the loss of calibration data and should only be changed by qualified personnel when absolutely necessary.

4 DIGICOR2 280/290 CONFIGURATION SOFTWARE AND COMMUNICATIONS KIT

For more details refer to Appendix C.

4.1 Hardware RS485 Installation

To reconfigure the set-up of the WM281/291 Transmitters, Communications Kit Digicor2 must have been ordered and this is supplied with the following components:

- Configuration Software CD
- RS485 to USB convertor
- RS485 to USB connection instructions

4.1.1 Connections

Connect the 2 RS485 flying lead wires into the green pcb connector as per Section 2.5.1.

Insert the USB connector into the PC and follow the instructions as in Section 4.2 below.

4.2 Software Installation

To install the Digicor2 software, make sure all running Windows applications are closed before inserting the CD into the CD-ROM drive and installing the Product Application software. Follow the instructions below to install the software:

1. Run the **'Digicorapplication.exe'** file
2. To install the software click **'Next'**
3. For final installation click **'Install'**
4. Once installation of the Digicor2 software has been completed, click on the **'Finish'** button. The Digicor2 program is now ready to use.

Instructions of how to use the software are available on the help menu within the software.

5 MAINTENANCE

5.1 Replacing the Interchangeable I7000 Module

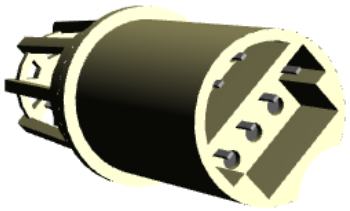


Figure 4 *I7000 Sensor Pin Connector*

The following steps should be taken to carry out the replacement of the I7000 module:

1. Switch off the power supply to the transmitter.
2. Unscrew the protection filter mounted on the measurement probe body. **NOTE: Be careful not to apply any force to the filter protection cage.**
3. Taking care not to bend the male pins on the sensor electrical connector, remove the I7000 to be replaced and insert the new component.
4. Ensure that the appropriate adhesive label (with the date of calibration) is attached to the transmitter housing.
5. Carefully screw the protection filter back on.

Michell Instruments delivers each interchangeable module with an identification label which must be attached to the transmitter housing over the previous label.

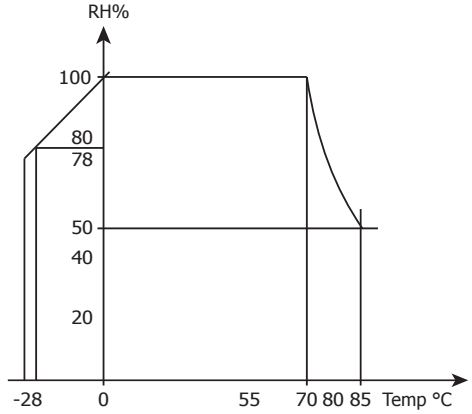
If a transmitter is returned to the factory for repair or maintenance without the appropriate label of the corresponding interchangeable module, the warranty shall be considered as invalid.

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance Specifications	
Measurement Range (RH)	0 to 100% RH
Measurement Range (T)	-30 to +70°C (-22 to +158°F)
Accuracy at 23°C (73°F) Humidity	<±2% RH (5–95% RH)
Accuracy at 23°C (73°F) Temperature	±0.4°C (±0.72°F)
Stability – RH Sensor	<±1% RH/year
Response Time – RH Sensor	<10 sec typical (for 90% of the step change)
Electrical Output/Input Specifications	
Output Signal	0–1, 0–5, 0–10 V 0–20 mA, 4–20 mA, RS485
Supply Voltage	15 - 27 V AC and 18 - 38 V DC
Load Resistance	Current output: R ≤ 500 Ω
Power Consumption	1.7 W maximum
CE Conformity	2004/108/EC
Operating Specifications	
Operating Temperature Probe Housing Storage	 -30 to +85°C (-22 to +185°F) -20 to +70°C (-4 to +158°F) -30 to +70°C (-22 to +158°F)
Mechanical Specifications	
Ingress Protection	IP65 (NEMA 4 level)
Material Housing Probe	 Aluminum die casting Delrin
Dimensions Housing Probe	 120 x 120 x 49.5mm (4.72 x 4.72 x 1.94") L=100mm ø19mm (L=3.93" ø0.74")
Weight	450g (15.87oz)
Electrical Connections	Screw terminals via PG11 metal glands
Display Resolution	LCD, 2 lines x 16 characters



Operating conditions

Appendix B

Modbus Holding Register Map

Appendix B Modbus Holding Register Map

B.1 Current Mapping of Modbus Holding Registers

Address	Parameter	Access Type	Min Value	Max Value	Default	Decimal Points	Unit	Description
0	Temperature Reading	R	-	-	-	2	°C/°F	Returns present value of temperature channel
1	Humidity Reading	R	0.0	100.0	-	1	%	Returns present value of humidity channel
2	RESERVED	R	-	-	0	0	-	-
3	Model Type	R	-	-	-	0	-	Returns device model type value
4	RESERVED	R	-	-	0	0	-	-
5	Calculated Variable Reading	R	-	-	-	1	-	Returns present value of calculated channel
6-7	Current input Reading	R	96	480	-	2	mV	Returns the voltage measured across the main connector pin which corresponds to the current input supplied
8– 9	RESERVED	R	-	-	0	0	-	-
10	Actual Low Temperature Scale	R	-	-	-30.0	1	°C	Returns fixed value -30°C
11	Actual High Temperature Scale	R	-	-	140.0	1	°C	Returns fixed value 140°C
14	Board Type	R	-	-	0x0430 or 0x0C08	0	-	Returns board type identifier Read 0x0430 on MS430 board & Read 0x0C08 on HC08 board
15 – 22	RESERVED	R	-	-	0	0	-	-
23	Temperature Offset Correction (Single Point Calibration)	R/W	-999	999	0	2	°C	Get/Set Single Point Calibration offset for Temperature input
24	Digital Temperature Filter	R/W	0.0	20.0	0.8	1	Seconds	Get/Set Digital Filter value for Temperature input
40 – 44	RESERVED	R	-	-	0	0	-	-
45	Baud rate	R/W	0	4	4	0	-	Get/Set COM Baud rate setting 0 = 1200, 1 = 2400, 2 = 4800, 3 = 9600, 4 = 19200
46	ModBus Slave ID	R	0	247	-	0	-	Returns ModBus Slave ID of device
47	Parity	R/W	0	2	0	0	-	Get/Set COM Parity setting 0 = None, 1 = Odd, 2 = Even
48 – 49	RESERVED	R	-	-	0	0	-	-
50	Temperature Open/ Under range Counter value	R	0	65535	0	0	-	Returns count value for number of times the device has gone below Temperature under limit
51	Temperature Saturate/Over range Counter value	R	0	65535	0	0	-	Returns count value for number of times the device has gone above Temperature over limit
52	Humidity Open/ Under range Counter value	R	0	65535	0	0	-	Returns count value for number of times the device has gone below Humidity under limit
53	Humidity Saturate/ Over range Counter value	R	0	65535	0	0	-	Returns count value for number of times the device has gone above Humidity over limit
57 – 59	RESERVED	R	-	-	0	0	-	-
64	RESERVED	R	-	-	0	0	-	-
69 – 119	RESERVED	R	-	-	0	0	-	-
120	Trademark	R	-	-	5000	0	-	Reads Michell identifier in ModBus
121	Device Type identifier	R	-	-	129	0	-	Reads type of device

122	Software Release	R	-	-	6.00	2	-	Reads Software release number in format X.XX
123 – 124	RESERVED	R	-	-	0	0	-	-
125	Type of Analog output for Temperature	R/W	0	130	1	0	-	Get/Set Analog output type for Temperature 0 = 0 – 20mA 1 = 4 – 20mA 128 = 0 – 1V 129 = 0 – 5V 130 = 0 – 10V
126 - 139	RESERVED	R	-	-	0	0	-	-
140	Type of Analog output for Humidity	R/W	0	130	1	0	-	Get/Set Analog output type for Humidity 0 = 0 – 20mA 1 = 4 – 20mA 128 = 0 – 1V 129 = 0 – 5V 130 = 0 – 10V
141 – 154	RESERVED	R	-	-	0	0	-	-
155	Low Limit of Analog output for Temperature	R/W	-30.0	140.0	-30.0	1	°C/°F	Get/Set Minimum value of Analog output for Temperature
156	High Limit of Analog output for Temperature	R/W	-30.0	140.0	140.0	1	°C/°F	Get/Set Maximum value of Analog output for Temperature
157	Low Limit of Analog output for Humidity	R/W	0.0	100.0	0.0	1	%	Get/Set Minimum value of Analog output for Humidity
158	High Limit of Analog output for Humidity	R/W	0.0	100.0	100.0	1	%	Get/Set Maximum value of Analog output for Humidity
159	RESERVED	R	-	-	0	0	-	-
160	Type of Analog output for Calculated Variable	R/W	0	130	1	0	-	Get/Set Analog output type for Calculated Variable 0 = 0 – 20mA 1 = 4 – 20mA 128 = 0 – 1V 129 = 0 – 5V 130 = 0 – 10V
161 – 174	RESERVED	R	-	-	0	0	-	-
175	Low Limit of Analog output for Dew Point	R/W	-	-	-	0	-	Get/Set Minimum value of Dew Point output
176	High Limit of Analog output for Dew Point	R/W	-	-	-	0	-	Get/Set Maximum value of Dew Point output
177 – 179	RESERVED	R	-	-	0	0	-	-
180	Low Limit of Analog output for Mixing Ratio	R/W	-	-	-	0	-	Get/Set Minimum value of Mixing Ratio output
181	High Limit of Analog output for Mixing Ratio	R/W	-	-	-	0	-	Get/Set Maximum value of Mixing Ratio output
182	Low Limit of Analog output for Absolute Humidity	R/W	-	-	-	0	-	Get/Set Minimum value of Absolute Humidity output
183	High Limit of Analog output for Absolute Humidity	R/W	-	-	-	0	-	Get/Set Maximum value of Absolute Humidity output
184	Low Limit of Analog output for Enthalpy	R/W	-	-	-	0	-	Get/Set Minimum value of Enthalpy output
185	High Limit of Analog output for Enthalpy	R/W	-	-	-	0	-	Get/Set Maximum value of Enthalpy output
186	Low Limit of Analog output for Frost Point	R/W	-	-	-	0	-	Get/Set Minimum value of Frost Point output

187	High Limit of Analog output for Frost Point	R/W	-	-	-	0	-	Get/Set Maximum value of Frost Point output
190 – 218	RESERVED	R	-	-	0	0	-	-
219	Digital Humidity Filter	R/W	0.0	20.0	0.5	1	Seconds	Get/Set Digital Filter value for Humidity input
220	Humidity Offset Correction (Single Point Calibration)	R/W	-999.0	999.0	0.0	1	%	Get/Set Single Point Calibration offset for Humidity input
221 – 399	RESERVED	R	-	-	0	0	-	-
400	Temperature Unit	R/W	30	31	30	0	-	Get/Set Temperature Unit 30 = °C 31 = °F
401 – 403	RESERVED	R	-	-	0	0	-	-
406 – 419	RESERVED	R	-	-	0	0	-	-
420	Calculated Variable Type	R/W	0	5	0	0	-	Get/Set Calculation Type 0 = Dew Point 1 = Mixing Ratio 2 = Absolute Humidity 3 = Enthalpy 4 = Frost Point
421	LCD Contrast and Backlight	R/W	0	128	5	0	-	Get/Set LCD Contrast and Backlight Settings Bit 0 – 6 are used for LCD Contrast Level (0 to 9) Bit 7 is used for LCD Backlight control (1 = ON, 0 = OFF)
422	Michell Identifier String	R	-	-	"DI"	0	-	Returns constant string "DI"
423	Michell Identifier String	R	-	-	"GI"	0	-	Returns constant string "GI"
424	Michell Identifier String	R	-	-	"CO"	0	-	Returns constant string "CO"
425	Michell Identifier String	R	-	-	"RT"	0	-	Returns constant string "RT"
426	Michell Identifier String	R	-	-	"29"	0	-	Returns constant string "29"

Appendix C

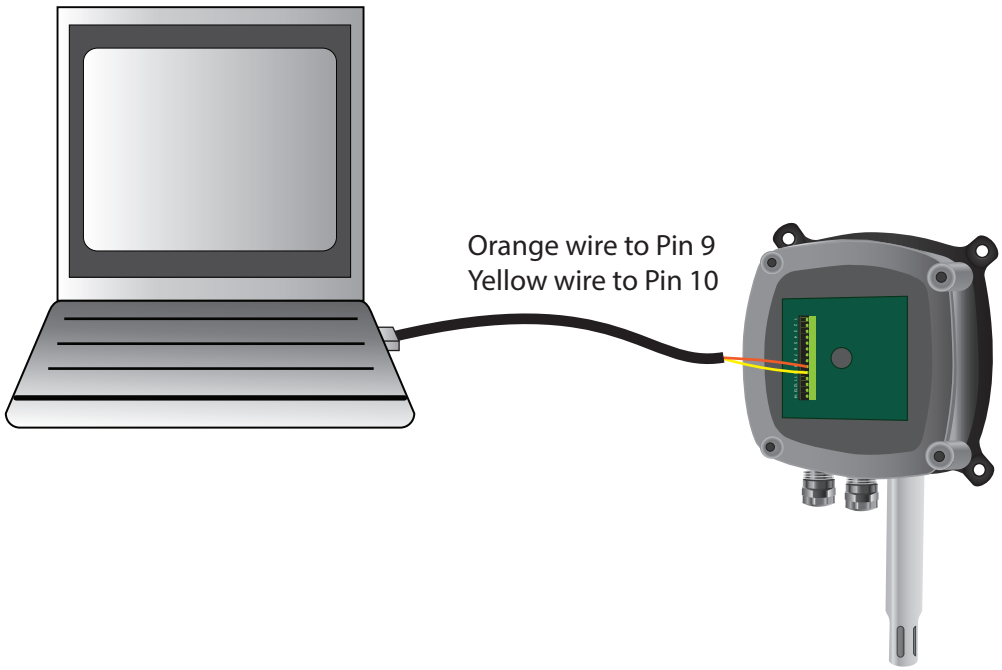
Digicor2 280/290 Communications Kit (optional)

Appendix C Digicor2 280/290 Communications Kit (Optional)

This communications kit consists of the following items:

- Configuration Software CD, which is loaded with the following files:
  - Digicor2 280/290 configuration software
  - USB to RS485 convertor drivers
- USB to RS485 convertor hardware
- USB to RS485 convertor hardware connection instructions

The connection details are shown in the connection diagram below:



Updates on all Digicor2 280/290 software are available on www.michell.com through the WM281/291 product page.

Appendix D

EC Declaration of Conformity

Appendix D EC Declaration of Conformity

Manufacturer: Michell Instruments SAS
2-4 Rue Jean Desparmet
69008, Lyon. France.

CE

We declare under our sole responsibility that the product:

WM/DT/WR/PR 280-290 Series
Premium RH & Temperature Transmitter

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

2004/108/EC **EMC Directive**

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

EN61326-1:2006 **Electrical equipment for measurement, control and laboratory use – EMC requirements – Group 1, Class B (emissions) and immunity.**

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

Andrew M.V. Stokes, Technical Director

Date of Issue: May 2014

Appendix E

Quality, Recycling & Warranty Information

Appendix E Quality, Recycling & Warranty Information

E.1 Pressure Equipment Directive (PED) 97/23/EC

The above Directive has been implemented in United Kingdom Law by the Pressure Equipment Regulations 1999.

The Regulations require that all pressure equipment and assemblies within the scope of the Pressure Equipment Directive must be safe when placed on the market or put into service.

Michell Instruments' products have been assessed and, as referenced against the Classification Charts detailed in Annex II of the Directive, do not fall into the requirements for CE marking compliance with the Pressure Equipment Directive.

Article 3, paragraph 3 states that any product containing a pressurized fluid that does not qualify for compliance should, nevertheless, be constructed with Sound Engineering Practice (SEP).

Michell Instruments attests here that its products have been designed, manufactured & tested to assure safe operation, and in accordance with Sound Engineering Practices.

E.2 Recycling Policy

Michell Instruments is concerned with the protection of the environment. It is our commitment to reduce and eliminate from our operations, wherever possible, the use of substances which may be harmful to the environment. Similarly, we are increasingly using recyclable and/or recycled material in our business and products wherever it is practical to do so.

To protect natural resources and to promote material reuse, please separate batteries from other types of waste and recycle responsibly. If batteries are not properly disposed of, these substances can cause harm to human health and the environment.

The product that you have purchased may contain recyclable and/or recycled parts and we will be happy to provide you with information on these components if required. For further information please see the following sections.

E.3 WEEE Compliance

Directive 2012/19/EU 4 July 2012 on Waste Electronic and Electrical Equipment (WEEE)

The Waste Electronic and Electrical Equipment (WEEE) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

Michell Instruments is in full compliance with the WEEE Directive and is registered with an approved recycler (Registration No. WEE/JB0235YW) and treats the requirement of the directive and the protection of the environment with the utmost importance. All Michell Instruments' products are appropriately marked indicating their requirement for recycling.

It may be required to return certain instruments for treatment at the end of their working life.

Feb 2013

E.4 RoHS2 Compliance

Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011

The Restriction of Hazardous Substances (RoHS) Directive places rules upon European manufacturers of electrical and electronic equipment. The directives' aim is to reduce the impact that electronic devices have on the environment.

According to the EC Directive 2002/95/EC, Michell Instruments' products qualify as Category 9, Control and Monitoring Equipment. Under the 2002/95/EC Directive, Category 9 products are exempt from compliance with the Directive.

However, the careful design of all Michell Instruments' products takes into consideration the requirements of the Directive and, wherever possible, compliance is achieved. All future products will be developed entirely using compliant materials. Furthermore, Michell Instruments is taking active steps to remove non-compliant materials and components from existing products wherever these may occur. Presently, none of the non-compliant materials are known to occur in Michell Instruments' products.

The new Directive 2011/65/EU (RoHS2) entered into force on 21 July 2011 and required all Member States to transpose the provisions into their respective national laws by 2 January 2013.

Under the provisions of the RoHS2 EU Directive 2011/65/EU (Article 3, [24]) defines 'Control and Monitoring Equipment' specifically as 'monitoring and control instruments designed exclusively for industrial or professional use'.

RoHS2 EU Directive 2011/65/EU states the closing date for compliance of any Control and Monitoring Equipment product sold into the EU market place as 22nd July 2017.

However, the careful design policy of all Michell Instruments' products continues to attain compliance in the shortest practical timescales and strives to ensure that less than 0.1% of total mass per product, of all non-compliant materials, appear within them. Michell Instruments continues to monitor suppliers and material sources to ensure that compliance of goods provided is maintained.

January 2013

E.5 Warranty

Unless otherwise agreed, the Supplier warrants that, as from the date of delivery for a period of 12 months, the goods and all their component parts, where applicable, are free from any defects in design, workmanship, construction or materials.

The Supplier warrants that the services undertaken shall be performed using reasonable skill and care, and be of a quality conforming to generally accepted industry standards and practices.

Except as expressly stated, all warranties whether express or implied, by operation of law or otherwise, are hereby excluded in relation to the goods and services to be provided by the Supplier.

All warranty services are provided on a return to base basis. Any transportation costs for the return of a warranty claim shall reside with the Customer.

E.6 REACH Compliance

Regulation (EC) No. 1907/2006
Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Michell Instruments is a manufacturer of moisture measurement and gas analysis instrumentation and is a 'downstream' user of chemicals, as described by the EU Council Directive 76/769/EEC. The products we supply are not raw chemical products (goods).

Under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not contain or release any prohibited chemicals. No listed SVHC (Substances of Very High Concern) appear within products manufactured by Michell Instruments. Therefore the 0.1% mass per product, or total usage of 1 tonne/year, will never be exceeded. For these reasons we are neither required by obligation for registration nor for the creation of material safety data sheets (MSDS) for our products.

Our continued review of the SVHC Candidate List and latest additions is to ensure we remain compliant.

Michell Instruments maintains a hazardous material register in which MSDS data sheets are collated, and we will check that our suppliers will comply to REACH requirements for all materials and substances we use in the processes of our manufacturing.

In the unlikely event that any chemicals of concern appear in our products in quantities greater than 0.1% of total mass per product we will immediately inform you by correspondence according to the REACH Article 33 requirements. Our current appraisal is, however, that we do not expect or foresee such an incidence.

January 2013

E.7 Calibration Facilities

Michell Instruments' calibration facilities are among the most sophisticated in the world and have been recognized for their excellence.

Traceability to the National Physical Laboratory (NPL) UK is achieved through our UKAS Accreditation (Number 0179). This covers dew point over the range -90 to +90°C (-130 to +194°F) and also Relative Humidity.

Dew-point calibrations are also traceable to the National Institute for Standards & Technology (NIST) USA over the range -75 to +20°C (-103 to +68°F).

NOTE: Standard traceable calibration certificates for instruments and sensors are not issued under our UKAS accreditation. UKAS certificates are usually to special order and are clearly identified.

E.8 Return Policy

If a Michell Instruments' product malfunctions within the warranty period, the following procedure must be completed:

1. Notify a Michell Instruments' distributor, giving full details of the problem, the model variant and the serial number of the product.
2. If the nature of the problem indicates the need for factory service then the instrument should be returned to Michell Instruments, carriage prepaid, preferably in the original packaging, with a full description of the fault and the customer contact information.
3. Upon receipt, Michell Instruments will evaluate the product to determine the cause of the malfunction. Then, one of the following courses of action will be taken:
   - If the fault is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
   - If Michell Instruments determines that the fault is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs, at standard rates, will be provided. Upon receipt of the owner's approval to proceed, the product will be repaired and returned.

E.9 Manufacturing Quality

Michell Instruments is registered with the British Standards Institute for Quality Assurance to:

BS EN ISO 9001: 2008

Rigorous procedures are performed at every stage of production to ensure that the materials of construction, manufacturing, calibration and final test procedures meet the requirements laid down by our BSI approved Quality System.

Please contact Michell Instruments (www.michell.com) if the product does not arrive in perfect working order.

Appendix F

Recommended Practices in Humidity Measurements

Appendix F 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 - Ample 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.

Appendix G

Return Document & Decontamination Declaration

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Decontamination Certificate

IMPORTANT NOTE: Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #			E-mail address	
Reason for Return /Description of Fault:				
Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below				
Biohazards		YES	NO	
Biological agents		YES	NO	
Hazardous chemicals		YES	NO	
Radioactive substances		YES	NO	
Other hazards		YES	NO	
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)				
Your method of cleaning/decontamination				
Has the equipment been cleaned and decontaminated?		YES	NOT NECESSARY	
Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return. **Work will not be carried out on any unit that does not have a completed decontamination declaration.**				
Decontamination Declaration				
I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.				
Name (Print)		Position		
Signature		Date		

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