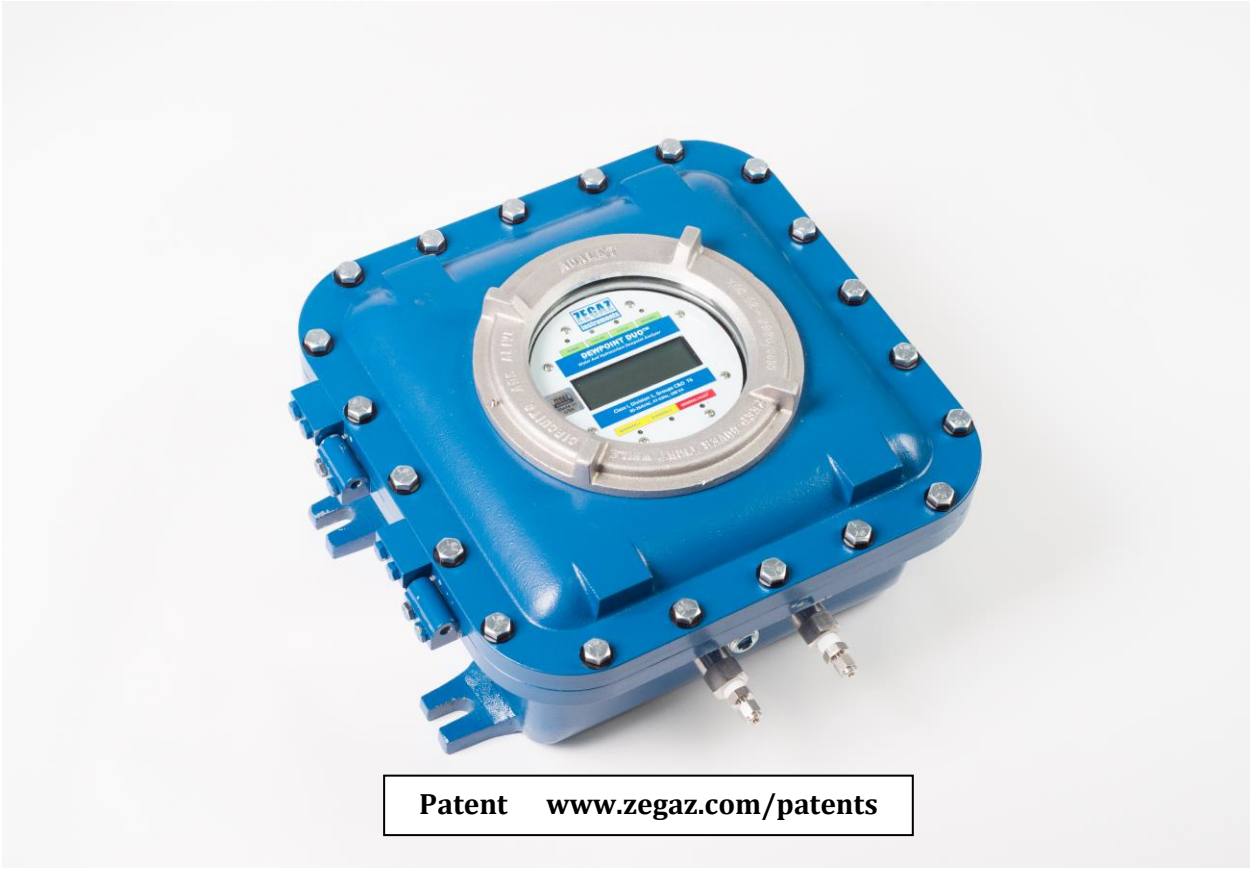
DP5000™ SERIES

(DEWPOINT DUO™, HCD5000™, WDP5000)

HYDROCARBON AND WATER DEWPOINT ANALYZERS



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OPERATOR'S MANUAL

DP5000™ SERIES

(DEWPOINT DUO™, HCD5000™, WDP5000™)

HYDROCARBON AND WATER DEWPOINT ANALYZERS

OPERATOR'S MANUAL

DOC# M-5000D-0021

VERSION 3.2

PRODUCT OF

7340 Executive Way, Suite-M

Frederick, MD 21704

TEL: 877-ZEGAZ-10

(877-934-2910)

WWW.ZEGAZ.COM

DP5000™ SERIES

(DEWPOINT DUO™ / HCD5000™/ WDP5000™)

OPERATOR'S MANUAL

CONGRATULATIONS

*You have purchased a ZEGAZ Instruments DP5000™ series analyzer (either Dewpoint Duo™, HCD5000™ or WDP5000™) the most advanced Water and Hydrocarbon Dew Point Analysis systems available in the world. They are based on breakthrough CEIRS™ infrared technology to accurately and unambiguously determine the dew points of hydrocarbon g*as streams at pressures up to 2000*psi. DP5000™ series analyzers can distinguish between hydrocarbon dewpoints and water/glycol condensation.*

The DP5000™ analyzers do not need field calibration and will retain their factory calibration under normal operating conditions. It also does not need any field adjustments as the measurements are done based on a very accurate detection of the condensation process and the nature of the condensate.

Please take the time to read this manual in its entirety. It will provide necessary and useful information about how you can optimize your use of this product.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

A	Amperes (unit of electrical current
AC	Alternating Current
AO	Analog output (typically 4-20 mA)
Bar	Unit of pressure
CEIRS™	Chilled-Mirror Evanescent Infra Red Spectroscopy
°C	Degree Celsius (unit of temperature)
DC	Direct Current
DO	Digital output
DP	Dew Point
°F	Degree Fahrenheit (unit of temperature)
HCDP	Hydrocarbon Dew Point
Hz	Hertz (unit of frequency)
IR	Infra-Red
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	milli-Amperes (unit of electrical current typically used in reference to analog outputs
psi	Pounds per Square Inch (unit of pressure)
psig	Pounds per Square Inch, gauge pressure
RMA	Return Material Authorization
RS-232	Recommended Standard 232 (a standard for serial communications)
RS-485	Recommended Standard 485 (a standard for serial communications)
SLM	Standard Liters per Minute (unit of flow)
TB	Terminal Block
V	Volt (unit of electrical potential)
VAC	Volts AC
VDC	Volts DC
WDP	Water Dew Point

1- INTRODUCTION

DP5000™ analyzers are automated Water and/or Hydrocarbon Dew Point Measurement System. DP5000™ analyzer series include:

1. HCD5000™ : Hydrocarbon Dew Point Analyzer
2. WDP5000™: Moisture (water) Dew Point Analyzer
3. DewPoint Duo™: Hydrocarbon **and** Moisture Dew Point Analyzer

All three products use state-of-the-art infrared technology coupled with the chilled-mirror principle to accurately determine the dew points of hydrocarbon gas streams as well as characterizing the nature of the condensate.

In order to ensure that the analyzer performs as specified, it is important to pay close attention to the details of the installation and operation. This manual contains a comprehensive overview of the DP5000™ series of analyzers, as well as step-by-step instructions on:

- Connecting necessary power and signal cables.
- Powering the analyzer
- Operating the analyzer
- Using the Serial, Digital, and 4-20 mA communication ports
- Troubleshooting

A- WHO SHOULD READ THIS MANUAL

This manual should be read and referenced by anyone installing, operating, or having contact with the analyzer. Take a moment to familiarize yourself with this Operator's Manual by reading the Table of Contents.

This manual has been written to address the most common options and accessories. Read each section in the manual carefully so you can quickly and easily install and operate the analyzer. The manual includes images, tables, and charts that provide a visual understanding of the analyzer and its functions. Special symbols are also used to make you aware of potential hazards, important information, and valuable tips. Pay close attention to this information.

B- SPECIAL SYMBOLS USED IN THIS MANUAL

This manual uses the following symbols to represent potential hazards, caution alerts, and important information associated with the analyzer. Every symbol has significant meaning that should be heeded.

This icon denotes a warning statement. It indicates a potentially hazardous situation which, if not avoided, may result in serious injury or death.

Failure to follow the directions marked by this icon may result in damage or malfunction of the analyzer.

This icon denotes important information concerning installation and operation of the analyzer.

This icon represents the presence of a fuse. The rating of the fuse is 2.5A, 250V, for the AC version and 8A, 250V for the DC version.

C- ABOUT ZEGAZ INSTRUMENTS

ZEGAZ Instruments, Inc. is an innovative technology company focusing on the development of next-generation diagnostics for the natural gas industry. We are located in Frederick, Maryland, United States of America.

ZEGAZ Instruments' products are sold worldwide through authorized representatives and distributors.

2-DP5000™ OVERVIEW

This analyzer combined advanced infrared absorption spectroscopy with the chilled-mirror principle to accurately and unambiguously determine the dew point of water and/or hydrocarbon in natural gas streams at pressures up to 2000 psig. Each analyzer includes of a state-of-the-art core analyzer cell which encompasses multiple infrared sources and detectors. The analyzer core, including all electrical components, is housed in a certified explosion proof box, making the system suitable for installation in hazardous locations.

An appropriate sample conditioning system may also be included with the system that has been specifically designed to deliver an optimum sample stream that is representative of the process stream at the time of sampling. DP5000™ analyzer systems are configured for use at extractive natural gas sampling stations without dropping the pressure for the analysis. Therefore, DP5000™ reports the dew point at the actual pressure at the sampling point.

Before proceeding make sure you know which analyzer (DewPoint Duo™, HCD5000™, or WDP5000™ you have purchased. However, this manual applies to all three.

It is very important that the sample introduced into the system to be all vapor and devoid of any liquids. Appropriate sampling tools and membranes should be used to make sure that no liquids are introduced into the system. The gas probe used to sample the gas from the pipeline should be equipped with a membrane separator.

Heat tracing of the probes and sample lines is necessary to ensure that the sampled gas remain completely in the vapor phase.

3-SPECIFICATIONS (Analyzer Only)

A- PERFORMANCE

Dewpoint Measurement Range:	Up to 70 °C (126 °F) below ambient *Cooling range can be impacted by several factors such as ambient temperature, flow rate, etc.*
Lowest Detectable Dewpoint	-40 °C (-40 °F)
Dewpoint Accuracy	±0.5 °C (±0.9 °F)
Measurement Time	2-15 minutes (depending on dewpoint)

B- APPLICATION CONDITION

Operating Temperature	-20 °C to +60 °C (-4 °F to 140 °F)
Humidity:	Non-condensing
Input Pressure	0-2000 psig (0-135 bar)
Output Pressure	~20 psi (with standard sample system)
Storage Temperature	-30 °C to +60 °C (-22 °F to 140 °F). Non-Condensing
Flow Rate	~0.5-0.75 slm (Standard Liters Per Minute)

C- ELECTRICAL

Input Voltage	100-264 VAC, (Optional 24 VDC available)
Power Usage	Average<30W (150W peak)
Communication	4x 4-20mA, 3x DO, RS-232, RS-485, Ethernet
Protocol:	MODBUS Gould RTU, Daniel RTU

D- PHYSICAL

Size (without sample system)	14" x 14" x 6" (355 mm x 355 mm x 150 mm)
Weight (without sample system)	40 lbs (18 kg)

E- PHYSICAL

Certification	Compatible with Class I, Division 1, Groups B, C, and D ATEX II 2 G Ex d IIB+H2 Gb (Cert: ITS16ATEX101262X) IECEX Ex d IIB+H2 T6 (Cert: IECEx ETL 16.0037X)

4- INSTALLATION

DP5000™ analyzers are housed in an explosion proof box.

Do not operate the unit without gas flow. Turn on power only when gas connections are made and flow established.

The unit weighs 40lbs (~18Kg), without the sample conditioning system. Extreme care should be taken in handling, lifting, and installing the unit to prevent risk of injury or death. The unit should be mounted to a fixture capable of bearing the weight of the analyzer.

There is a smaller box inside the analyzer unit. This box does not contain any user serviceable items. It should never be opened by a user. Opening of this box will void the warranty on the system.

All appropriate safety conditions and schedule of limitations have to be followed, when installing and operating this unit

There is no intention for any adjustments or repair to be made on the flamepath joints.

Do not operate the unit without any gas flow. When the unit is not turned on, make sure the input and output ports are closed to avoid ingress of outside atmosphere into the unit.

Your unit may be housed in ZEGAZ Instruments' Z-TCE-500™ temperature controlled enclosure or similar. If so, make sure you refer to Z-TCE-500™ manual, as the electrical and gas connections will be different.

The unit should not be installed in direct sunlight. If it is installed outdoors, it should be installed under a canopy or other structures protecting it from direct sunlight.

The unit should not be installed in environments where the ambient temperature is not at least 10°C (18°F) above the highest expected dewpoint. In such cases, a heated enclosure will be necessary. Please consult the factory for details.

The analyzer box is usually installed in conjunction with a sample system. The sample system should be mounted directly under the analyzer. ZEGAZ Instruments recommends installation of Z-SCS-300™ sample system manufactured by ZEGAZ Instruments. Installation of any other sample systems may void the warranty on the unit. Please refer to the Z-SCS-300™ manual for complete details.

The analyzer box can be mounted using the mounting brackets on the analyzer. Make sure that it is mounted on a wall in upright direction. The wall should be capable of bearing the weight of the analyzer as well as the sample system.

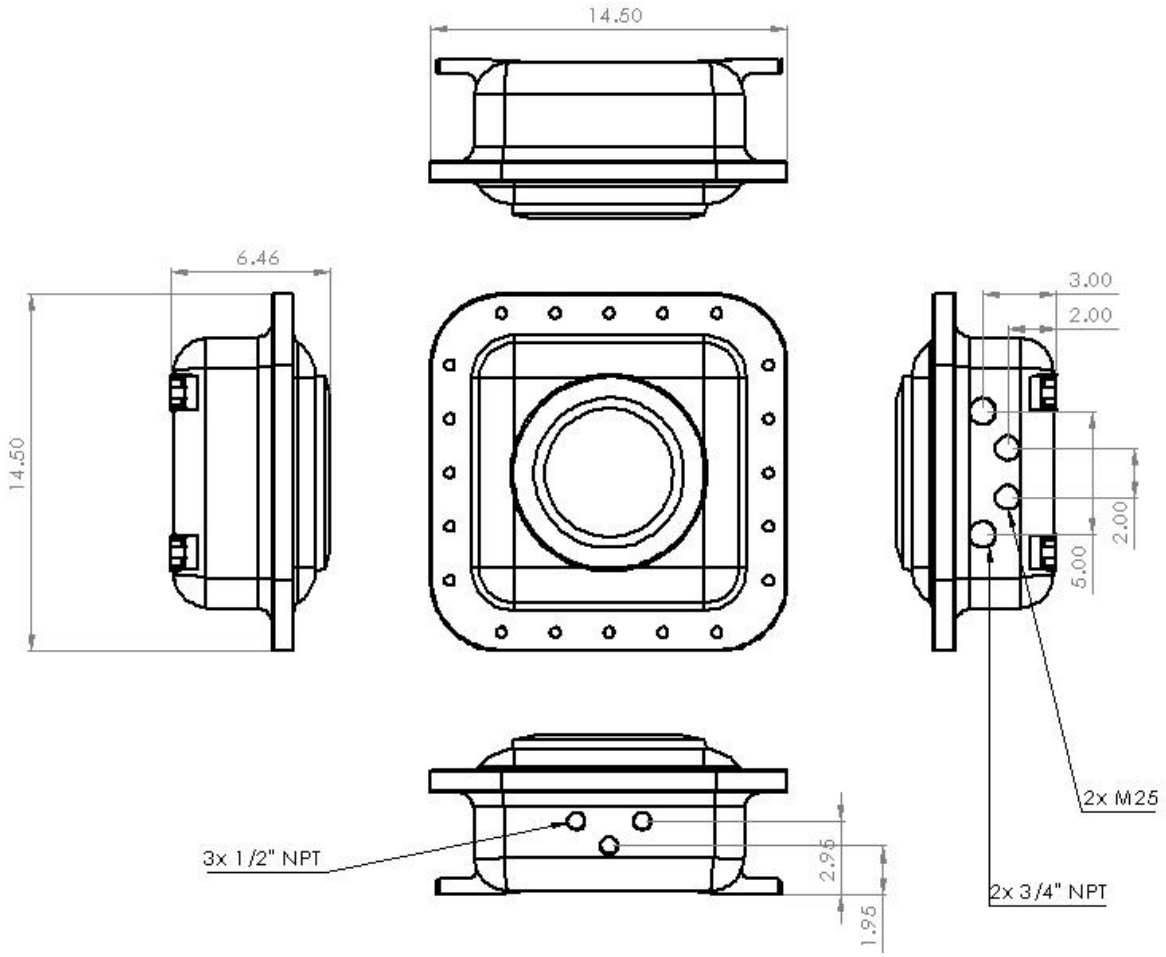


Figure (4.A.1)- The analyzer box drawing (dimensions in inches)

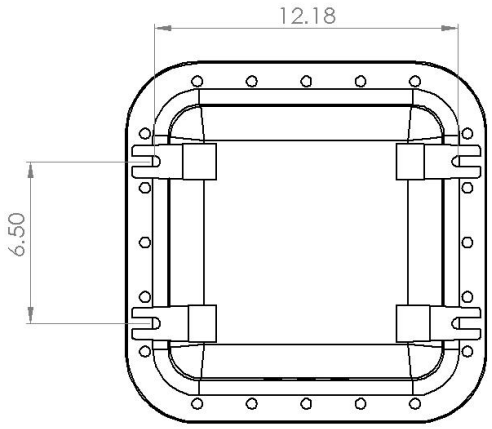


Figure (4.A.2)- The analyzer box Mounting

A- GAS SAMPLING POINT

DP5000™ analyzers are designed to work at any pressure up to 2000 psi (135 Bar). ***However, it is important that the sample introduced into the system to be all vapor and devoid of any liquids. Appropriate sampling tools and membranes should be used to make sure that no liquids are introduced into the system. The gas probe used to sample the gas from the pipeline should be equipped with a membrane separator.***

It is also recommended that a membrane separator with a liquid block be installed close to the system to block the introduction of liquids into the system. Heat-tracing the sample line is also needed.

The process lines introducing sample to the system should also be configured so that there is no possibility of mixing air, or any oxygen containing gas into the process lines.

B- CONNECTING THE GAS INPUT AND OUTPUT

Do not operate the unit without gas flow. Turn on power only when gas connections are made and flow established.

It is very important to close off the gas output of the system before introducing pressure. This is important because if there is a significant pressure drop upstream of the analyzer, the gas under analysis may turn into liquid due to JT effects and may damage the analyzer. After the system is pressurized the output valve can be opened to create flow within the specified guidelines.

B.1- the standard sample system

Your analyzer may have a standard sample system or one customized for your specific application. The standard sample system is shown in Figure (4.B.1). Your sample system may look different, but will have comparable components to the standard sample system. *In any case, the sample flow rate into the system must be limited to a maximum of 1 SLM.*

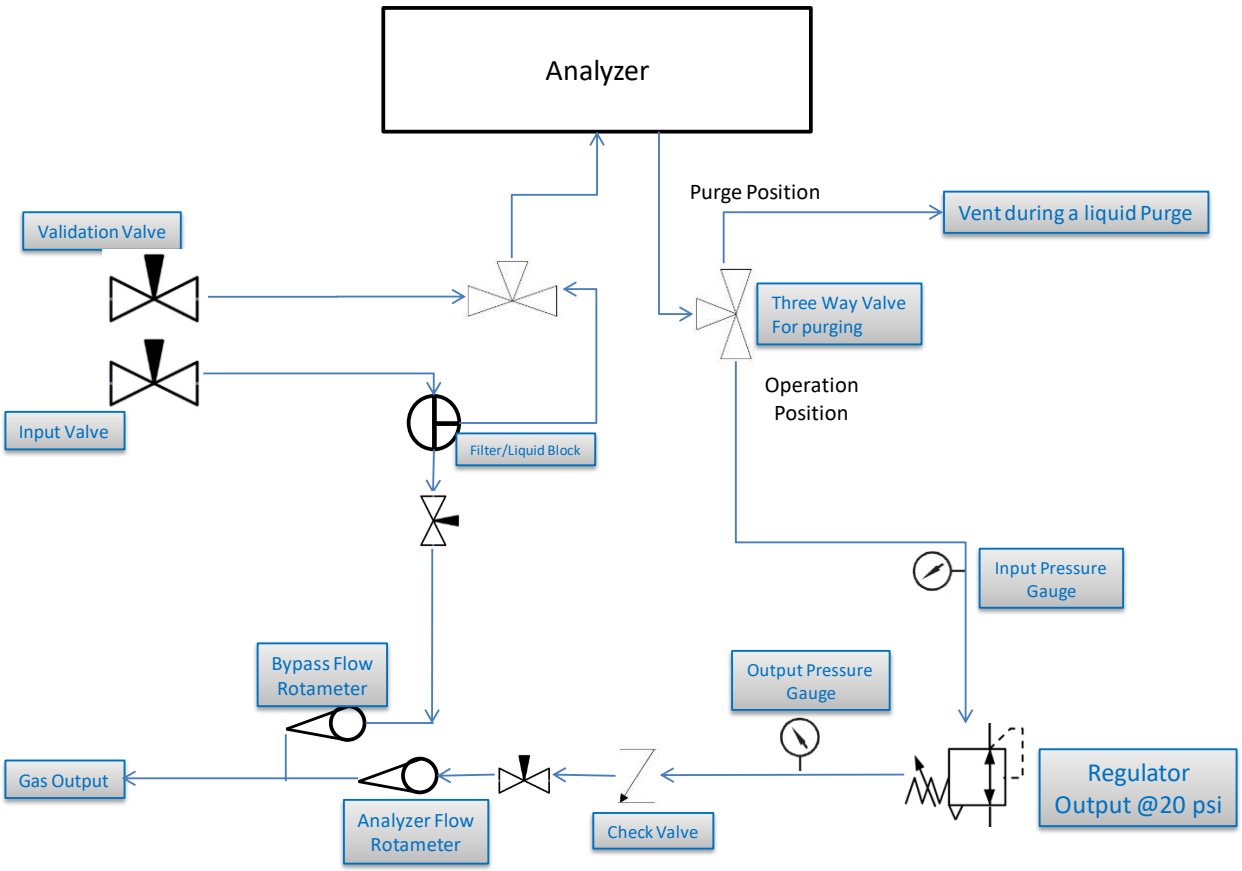


Figure (4.B.1)- The Standard Sample System Process Diagram

B.2- Connecting the gas lines from the sample system to the analyzer box

The sample system gas lines should be connected to the analyzer should be connected to the input/output ports on the analyzer main box. See figure (4.B.2) for the analyzer box gas input/output ports.

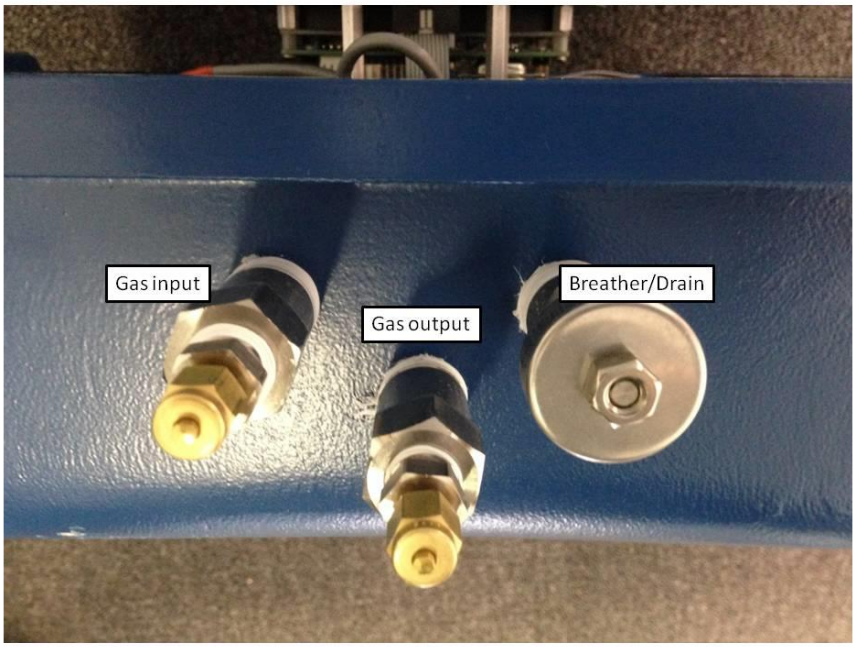


Figure (4.B.2)- Connecting the Sample System to the Analyzer Box

Gas connections should be made to the input and output of the standard sample system. (If you are using a different sample system, please consult your authorized factory representative or the factory for guidance). The output of the sample system should be regulated down to 20 psi and can be vented or used for other appropriate purposes.

Make sure that the outputs of the system as well as the filter bypass are vented to a safe location according to applicable local and industry standards and regulations.

All the gas connections should be checked for leaks before proceeding any further.

Sample flow rate is controlled by the flow meter valve in the sample system. This flow is set at the factory and does not need to be adjusted under normal operating conditions. The flow is usually set for ~0.5-0.75 SLM at 20 psig output pressure.

C- CONNECTING THE ELECTRICAL AND SIGNAL CABLES

There are 4 entry points for the power and signal cables to the analyzer. These are located on the right-side of the analyzer (Figure 4.A.1). Two of these are ¾" NPT connections, while the other two are M25 connections. Make sure that you plug any entry points that are not used with approved plugs.

DP5000™ analyzers are operated on AC (DC option available) power input. You can use either the ¾" NPT port or the M25 port. Make sure you use the lower entry point that lines

up closer to the internal power connection terminal blocks. Appropriate cable sealing glands, or approved conduits need to be used in all cases to seal the cable entry points.

Do not use the same entry point for both power and signal connections.

AC Option

Please verify that you have the AC or the DC version.

*It is **strongly recommended** that you use an uninterruptable Power Supply (UPS) to power the system. Doing so, will ensure that your analyzer will receive clean, consistent power. Power glitches/surges may temporarily or permanently damage the unit. Damage caused by power surges is not covered under factory warranty.*

All field wiring should be in accordance with local and international codes. Make sure the instrument enclosure is properly grounded according to national and international standards.

AC current usage is peak of <2A at 110VAC and <1A at 220VAC. DC current usage is <8A at 24VDC. Appropriate gauge wiring should be used to power the analyzer

Input for AC power should be 100-264 VAC 50/60 Hz. The input connections need to be made at the terminal blocks (see figure 4.C.1). The ground wire should be connected to the green terminal block (TB). The ground wire should also be connected to the internal grounding nut inside the box. Please see the picture below for the location of the grounding nut inside the box.

The neutral connection needs to be connected to the white TB.

The line connection should be connected to the black, fused TB. The line TB contains a fuse (2.5A, 250V, fast-blow) that can be accessed by opening the flap on the side of the TB.

Figure (4.C.1)- power Terminal Blocks, AC Version

DC Option

Please verify that you have the AC or the DC version.

If your unit uses a DC option, the terminal blocks have a different color. The DC input should be 18-28 VDC. Connect the (+) wire to the red terminal block. Connect the (-) wire to the Black terminal block. Please see Diagram (4.C.2) below. The red TB contains a fuse (10A, 250V, fast-blow) that can be accessed by opening the flap on the side of the terminal block.

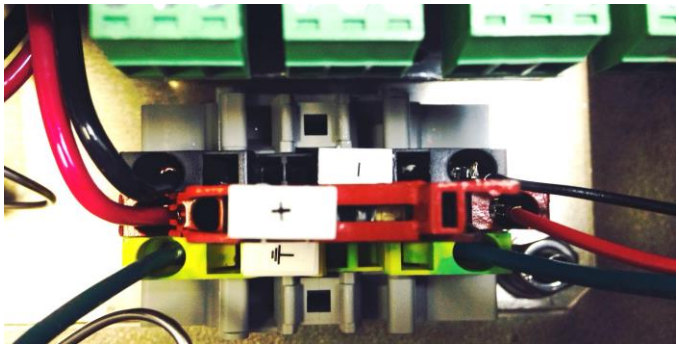


Figure (4.C.2)- Power Terminal Blocks, DC Version

C.1- external switch or circuit-breaker over-current protection

- A switch or circuit-breaker shall be included in the building installation.
- It shall be in close proximity to the equipment and within easy reach of the OPERATOR.
- It shall be marked as the disconnecting device for the equipment.

C.2- Location of Analog (4-20Ma) Digital Outputs

Make sure that all the signal cables/wires (AOs, DOs and digital outputs) are routed through the top of the

unit in such a way that they would not make contact with power TBs if they are disconnected.

Figure (4.C.3) shows the location of the analog and digital out puts.

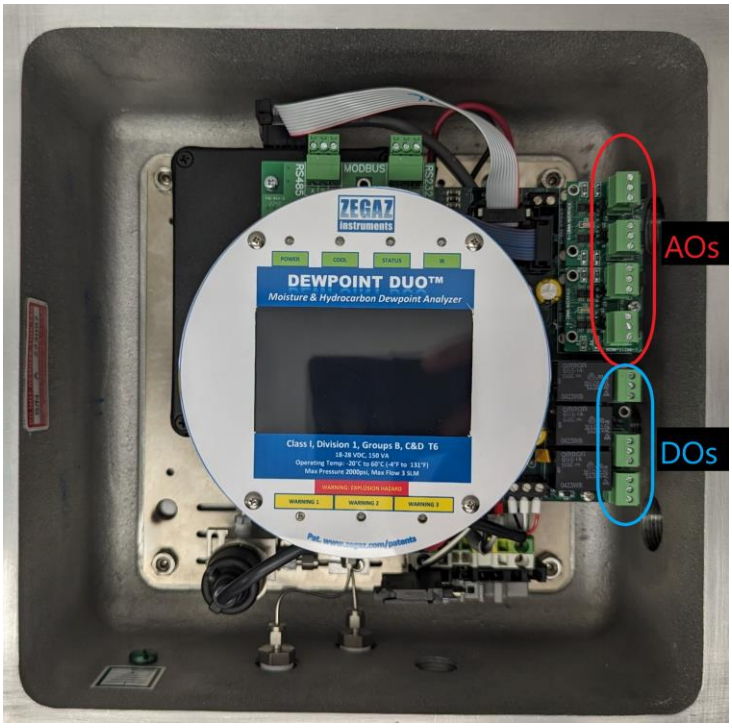


Figure (4.C.3)- Location of Analog Outputs (AO) and Digital Outputs (DO)

C.3- Connection of Analog (4-20Ma) outputs

There are 4 analog outputs (see figure 4.C.4). They are programmable so that each can provide the value of a specific operation parameter (dew point, pressure, etc.) from a list of available parameters. Each 4-20 mA output can also be calibrated.

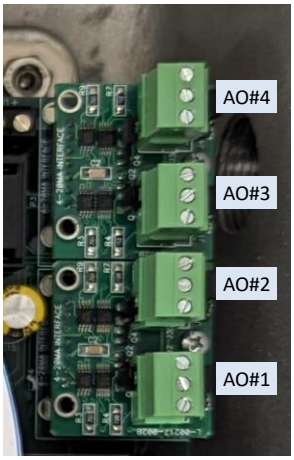


Figure (4.C.4)- Location and numbering of Analog Outputs

C.4- Connection of Analog (4-20Ma) outputs

The 4-20 mA current loops can be sourced internally or externally. There is a jumper to the right of every AO that will allow the user to choose between external and internal sourcing. Please check this jumper to make sure that it is placed appropriately. The location of the jumpers are shown in Figure (4.C.5).

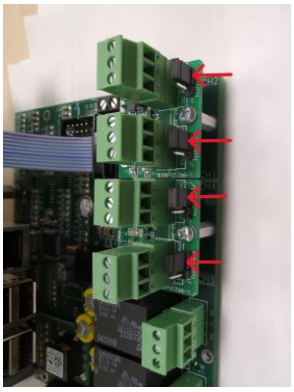


FIGURE (4.C.5)- Choosing internal or external powering of AOs

Internal Powering of Analog Outputs

If you choose internal sourcing (factory default) the jumper has to be between the upper two pins. For each AO, connect the ground wire to the terminal marked GN and the signal wire to the terminal marked S*(where * is 1, 2, 3, or 4). If choosing the internal powered option, the output is 12-12.5 VDC between 4-20 mA.

Loop-powering of the 4-20 mA outputs

First of all, move the jumper to the lower two pins.

When you want to loop power the 4-20 mA outputs, you should have a pair of wires from your SCADA system labeled (+) and (-). Connect your (+) wire to the terminal labeled (E) and the (-) wire to the terminal labeled (S).

External Powering of Analog Outputs

This procedure applies to when you have an external source of power to power the 4-20 mA. This is not for loop-powering of the 4-20 mA.

Make sure the jumper is between the lower two pins. You should use a power source voltage between 9-28 VDC.

The (+) pole of external power should be connected to the middle pin marked “E”. The ground pole should be connected to the top pin marked (GN). The output will be on the lower pin marked “S” (where * is 1, 2, 3, or 4) and the right pin marked (GN).

C.5- connection of digital outputs (alarms)

The system provides 3 Digital Outputs (DO) to be used as alarms. Please see figure (C.6).

The digital outputs should be powered with 9-24 VDC . The current rating for the contact should be 2A.

The three DOs can be passive (not powered) or active (powered). Exceeding these rating will result in permanent damage to the analyzer electronics.

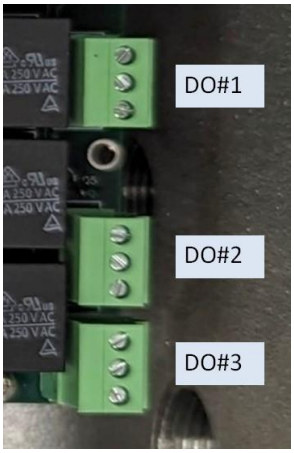


FIGURE (C.6)- Connecting the digital outputs

C.6- RS-232 wiring connection to the analyzer

Point-to-Point Serial Connection

The RS-232 and RS-485 connections are located near the top of the instrument as shown in figure (C.7). The DP5000™ controller has one RS-232 serial port which is labeled GN, TD, RD. It also has an RS-485. Both ports are MODBUS ports and can be connected to a MODBUS host.

To connect using the RS-485 cable, follow the same protocol for the terminal labeled RS485 on the board. The RS-485 terminals are labeled A(+), B(-), and GN.

Figure (C.7)- Making the Serial Connections

MODBUS over Ethernet

Connect the Ethernet cable to the Ethernet port on the unit. The MODBUS map is the same whether communicating over Ethernet or the serial connections.

Please note that the Ethernet connection can also be used for communications with the analyzer through the ZCS™ software. For details, please refer to the ZCS™ manual.

If the unit is connected to a network, it needs an IP address. If the network connected to is a DHPC (Dynamic Host Configuration Protocol) network, the network will assign an IP address to the analyzer. The assigned IP address can be found in the "Logs" page (see section 7.C.1)

The analyzers are shipped based on a default of being used in a DHPC netwrok.If the unit is used in a "static" network, a change needs to be made to the initial

D- SEALING THE POWER AND SIGNAL PORTS

To maintain the safety designation of the system, appropriately certified sealing glands should be used to seal the power input and signal output ports on the explosion proof box. To prevent ignition of hazardous atmospheres, the conduit seals must be within 3 inches of enclosure. Please refer to the gland manufacturer's instructions on installing sealing glands.

E- CLOSING THE LID

After all connections are made, the system door should be closed and bolted. Before closing the lid, check to make sure that all surfaces of the flange joint are clean and free of debris. When closing the door, make sure no wires are snagged between the door and the system.

Make sure any unused openings to the system are appropriately plugged with approved plugs.

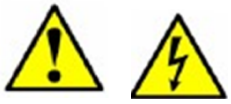
Please ensure atmosphere is non-hazardous before opening enclosure. When closing the enclosure, a torque rating of 35 lbf.ft (47.6 N.m) should be applied to the bolt lids. The bottom of the Hex bolts should be flush against the washer on the lid when fully tightened.

5- POWERING THE SYSTEM

At this point, the system is ready for use. The operation of the system is completely automated.

There are no power switches on the DP5000™ systems. As soon as the external power switch or circuit breaker is turned on, the system will turn on and will go through an initialization sequence. The initialization process with take approximately 3-5 minutes. Do not disrupt power during this process.

The use of an uninterruptible power supply or a surge protector is highly recommended. Damage resulting from electrical surges is not covered by the warranty.



Only use approved power sources based on the specifications of the system. Connect the power input of the system to an approved AC (or DC for the systems with DC option) source. The display should turn on and indicate the system is going through initialization. Make sure the wiring used to power the system is capable of handling the required current and the voltage. See specifications.

There are no consumable materials in the use of this system. There is an electrical fuse, 2.5A, 250V, fast-blow (8A, 250V for DC versions) which may require replacement occasionally. Except the gas under analysis, there are no other gases involved in the operation of this system.

6- SENSOR SELF-DIAGNOSTICS

DP5000™ analyzers are equipped with state-of-the-art self-diagnostics system. Before a measurement cycle is initiated, the sensor will go through a set of self-diagnostics. A cycle will not start before the successful completion of the self-diagnostics routine.

Because of the technology used in DP 5000™ series, the unit can sense if the sensor element is clean before start of a cycle.

7- EXPLANATION OF THE ANALYZER DISPLAY SCREENS

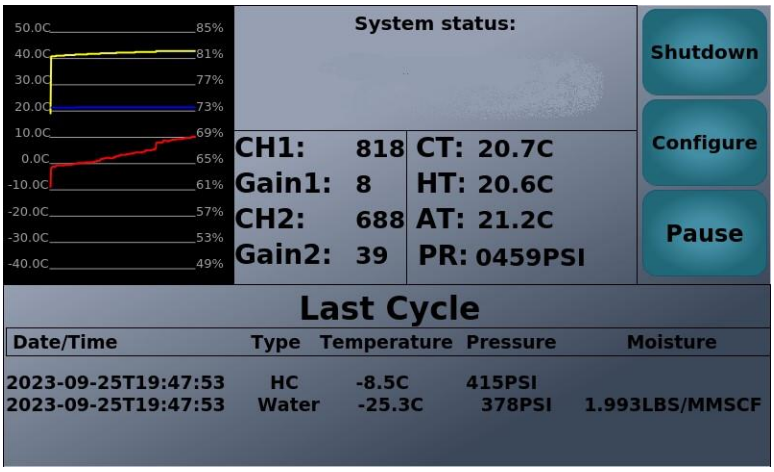
The graphical display can display all information related to the operation of the analyzer. It is also a touchscreen that can be used to change user-settings as needed. The following is a brief description of information displayed at each stage of the analyzer's operation as well as instructions on changing user-settings.

A- SYSTEM POWER UP

When the system is first turned on, the LCD display will momentarily display the ZEGAZ Instruments logo. Afterwards, the unit will immediately start operating.

B- SYSTEM INITIALIZATION AND SELF-DIAGNOSTICS

After system Power Up, the analyzer will immediately enter into an initialization phase. In this phase, the analyzer undergoes a self-diagnostic process where the integrity of each component is verified. Upon successful initialization the following screen will be displayed. This is the main status screen that displays the current status of the analyzer.



In this screen, the results of the last operation are displayed at the bottom of the page. Other parameters shown are:

CT: This is the current temperature of the chilled-mirror crystal.

HT: This is the current temperature of the analyzer box.

AT: This is the current temperature of the electronics inside the analyzer.

PR: This is current pressure of the gas under analysis.

CH1, **CH2**, **Gain1** and **Gain2** pertain to the IR spectrometer inside the analyzer. This information will be only useful during diagnostics if needed.

There is also a graph on the left side when CH1, CH2, and CT are displayed live.

On the right-hand side, there are three touch-buttons: “Shutdown”, “Configure”, and “Pause”.

The “Shutdown” button should be used when shutting down the unit. This will allow the internal computer to close all the necessary files to shut down. It is essential that it be used when shutting down the unit. When this button is used, the screen will indicate it and power can be cut to the unit.

The “Pause” button will put the unit in a paused state. Operation is stopped, but the unit’s computer is still operating. The unit will exit the paused phase and will start operating again after 30 minutes.

The “Configure” button allows the user to configure the system. Please see below for details.

C- CONFIGURING THE ANALYZER

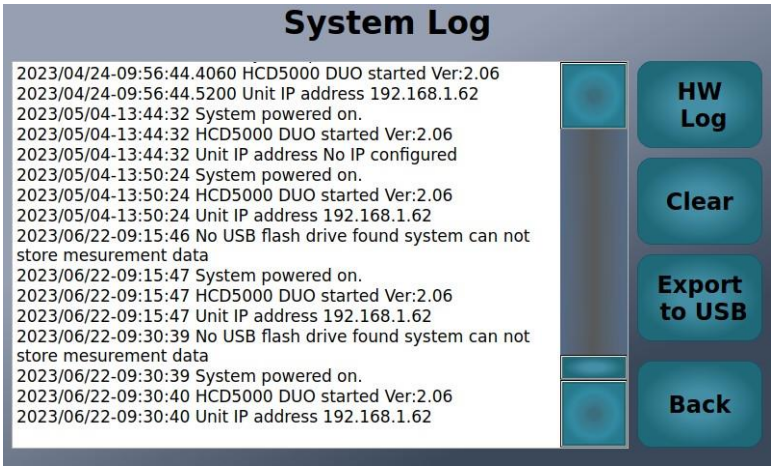
The analyzer can be configured by using the touchscreen or by using ZCS™ (ZEGAZ Communication System; the browser-based software interface). In this section we will only discuss configuring using the touchscreen. For information on using ZCS™ please consult the ZCS™ manual.

When in the System Status screen, press the configure button. The following screen will show:

This is the main screen to configure the instrument with specific settings. Each button will take you to a screen that will allow you to configure a group of user settings.

C.1- Logs Page

Pressing on the Logs screen will take you here.



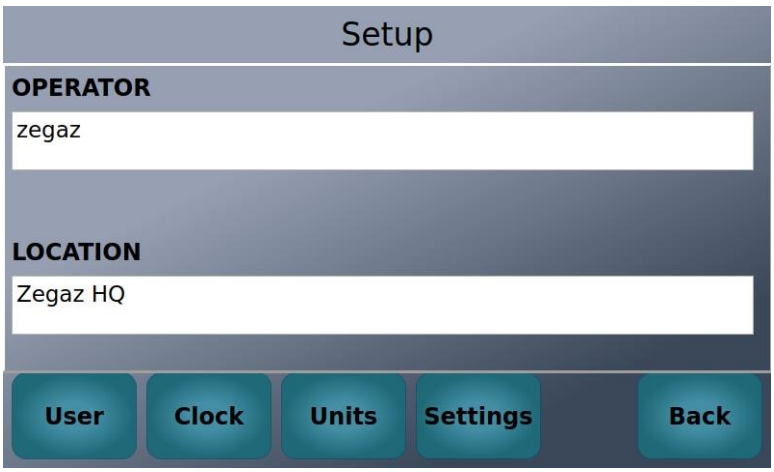
There are two different screens. The "Software" logs and the hardware logs. The above screen is an example of the software logs.

The software logs page is a log of all the operations and changes that are made to the analyzer. If connected to a network, this is also the location where the assigned IP address is found.

By pressing on the "HW Log" button will display some information about the hardware events. Such information is only useful for troubleshooting and can be disregarded during normal operation.

C.2- Setup Menu: User

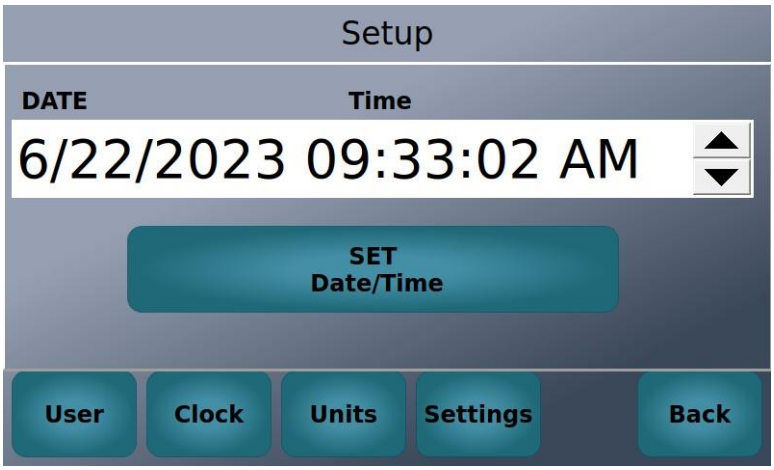
This is the screen where all the user settings can be specified. Initially, when it is pressed, the following screen will be displayed:



You can enter the operator's name as well as the location here. This information will have no bearing on the operation of the analyzer.

Clock Setup

Now press the “Clock” button, the following screen appears:

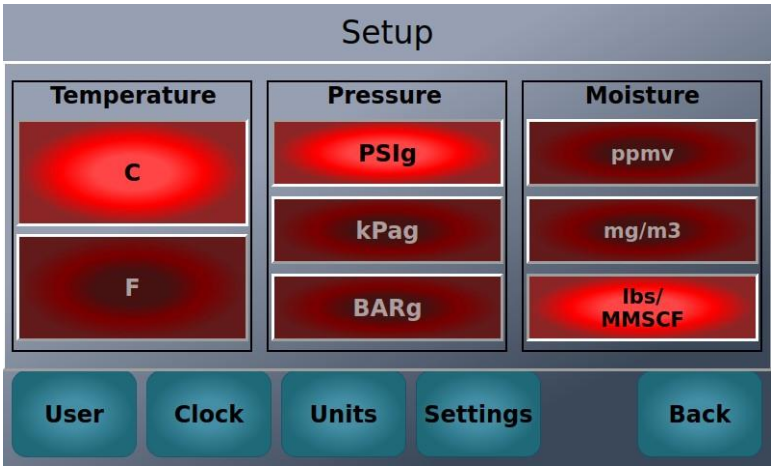


Here you can set the current date and time. Note that the format for date is mm/dd/yyyy. To set the month, click on the month and then use the arrows to increase or decrease the value. Follow the same procedure for day, year, and time. The unit does not change time based on the daylight savings time.

After setting the correct time, make sure you press the “SET Date/Time” button to make the change permanent.

Units Setup

If you press on the “Units” button, you will see the following screen:

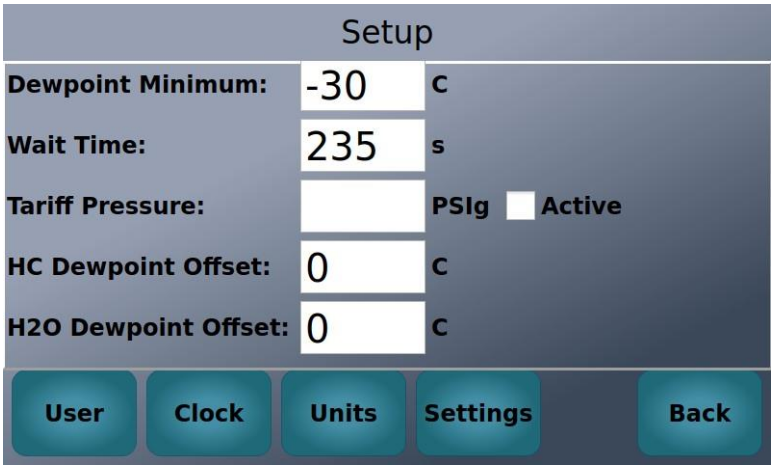


In this screen you can choose the units of operation. For temperature the choices are °C and °F. You can choose either by simply clicking on it.

You can similarly choose the units for pressure and moisture content.

Settings Setup

If you press on the "Settings" button, you will see the following screen:



There several important parameters here to set.

Dewpoint minimum

This is the value that the analyzer will cool down to before stopping. We recommend setting this value to a value that has operational significance. For example, if you are only trying to establish that the dew points are below -5 C, then that is the value to enter here. In such a case, the analyzer will cool down the mirror down to -5 before stopping and starting over.

Wait Time

This is the number of seconds between each cooling cycle. We recommend a minimum of 300-500 s. However, if you are interested in less frequency, you can set a higher number up to 999.

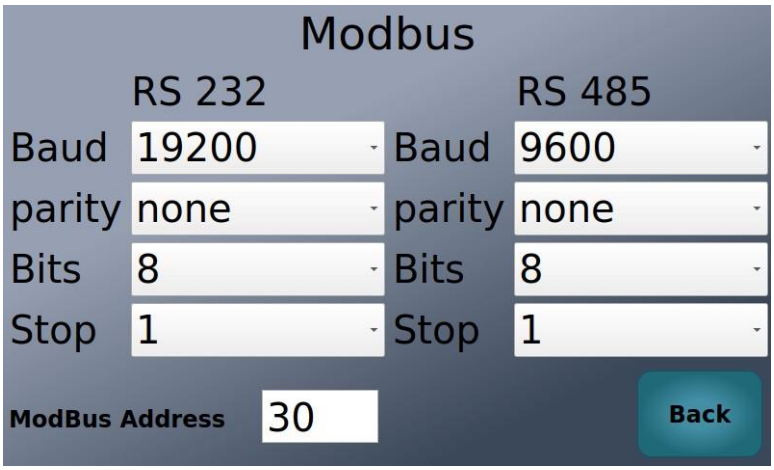
Tariff Pressure

This is a very useful feature of the WDP5000™ and the DewPoint Duo™ units. Both analyzers can measure water dew point and calculate the water content accurately from the dew point. However, they can also calculate the dew point at another pressure and report it.

This is useful, when the process pressure is different than the tariff pressure used for contractual obligations. For example, assume that your process pressure is 100 Bar, but the tariff (reporting pressure) for moisture is only 50 Bar. The unit will measure the dew point at 100 Bar. If you input the number 50 in the Tarriff Pressure box, and activate the checkbox next to it, then the analyzer will also calculate the moisture dew point at 50 Bar. It can report this value using the serial outputs (MODBUS) or 4-20mA outputs.

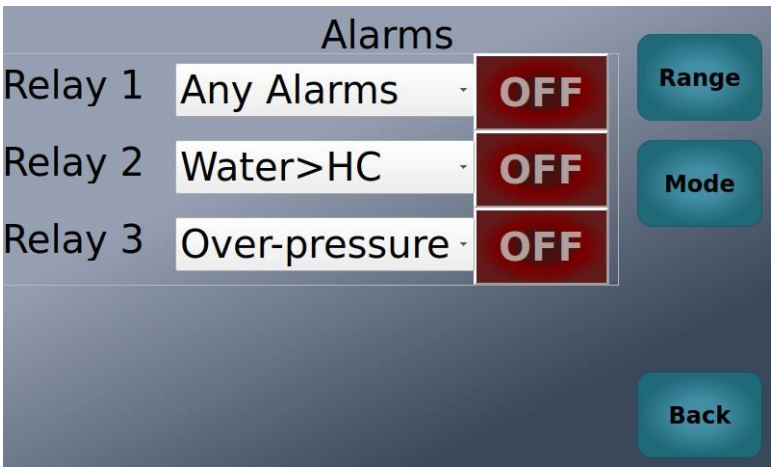
C.3- MODBUS (RS-232 and RS-485)

If you press MODBUS button, the following screen will appear. This is where you can configure the settings for the RS-232 and RS-485 serial connections.



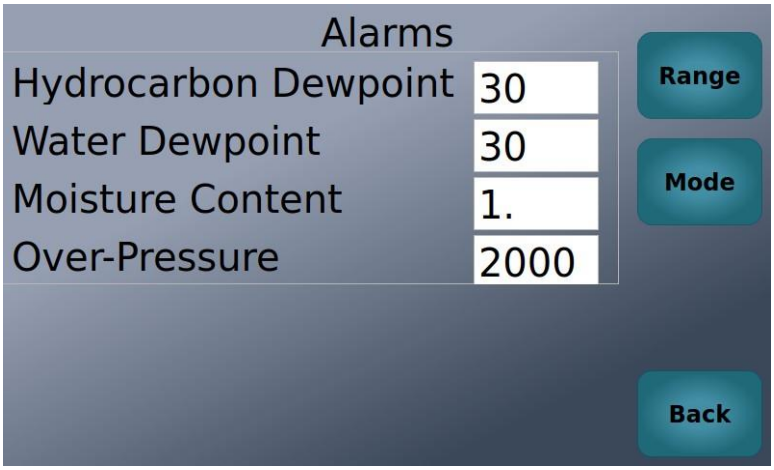
C.4- Alarms (Digital Output Setup)

When you press on the "Alarms" button, the following screen appears. This is where you can configure the 3 digital alarms on the unit.



Each of the three alarms can be either turned OFF or set to specific conditions. The specific alarm conditions "mode" can be chosen from the drop-down menus.

If you press the "Range" button in this screen, the following screen appears. It will allow you to define some of the alarms that have a numerical definition.

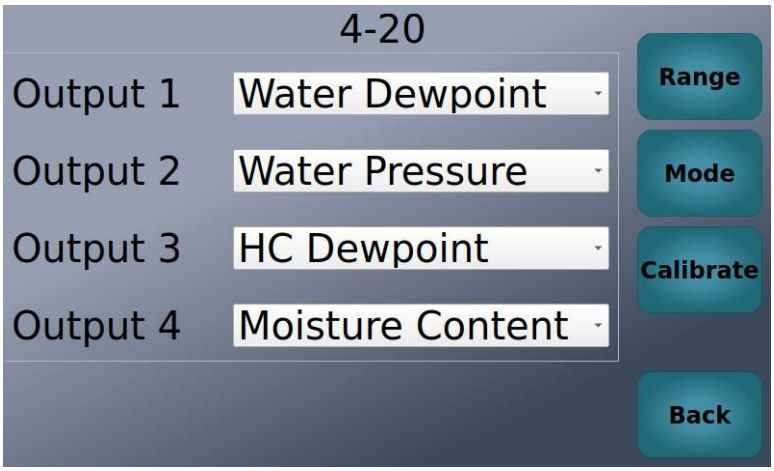


For example, you can define a hydrocarbon dewpoint alarm. In the above picture, if you enter the value of 30 into this field, the hydrocarbon dewpoint alarm condition is defined as when it is above 30 (in whatever temperature unit you have chosen), You can similarly define a water dewpoint alarm, as well as a moisture content and over-pressure alarm conditions.

As an example, if you define hydrocarbon dewpoint alarm at 30, and then choose Relay 1 to be defined as hydrocarbon dew point, then Relay 1 (or digital output #1) will be turned on, whenever the measured hydrocarbon dewpoint is > 30.

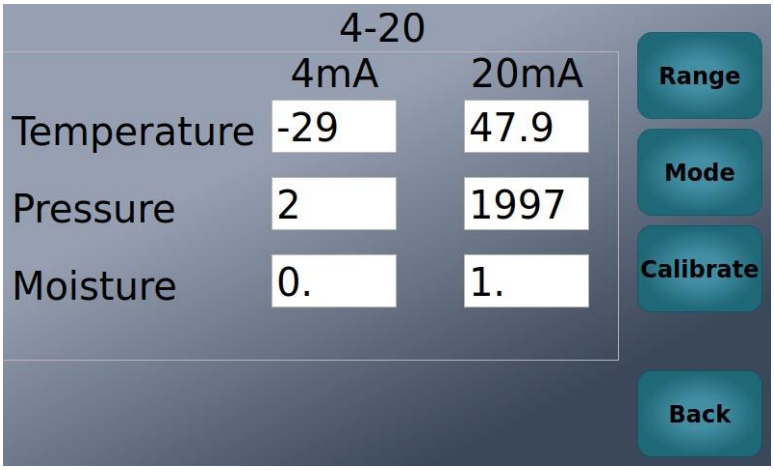
C.5- 4-20mA (Analog Outputs Setup)

If you press the "4-20" button, the following screen appears. This is where you can program the analog outputs (4-20mA) for their definition and their range.



In this screen, you can define what parameter will be populated in each analog output. There is a drop-down menu next to each that allows you to choose the desired parameter.

Once you have chosen a parameter for each of the outputs, you can press “Range” to choose the range of each output (minimum corresponding to 4mA and maximum corresponding to 20mA). The screen below is the “Range” screen.



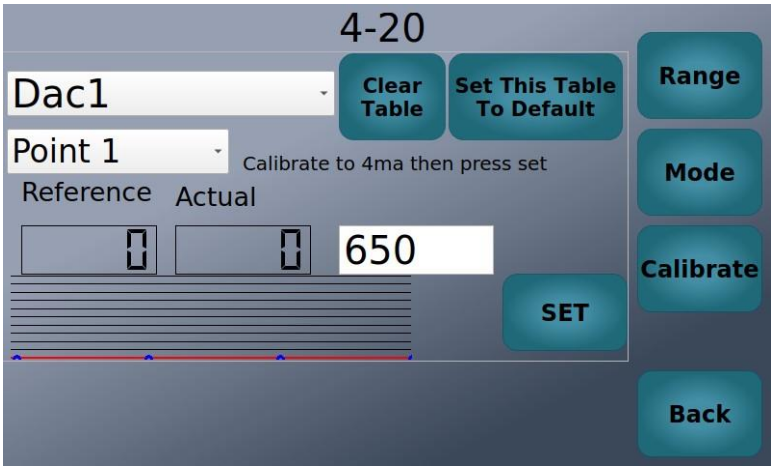
Note that the Temperature parameter corresponds to the dew point range for both the hydrocarbon and/or water dew points.

The Pressure parameter corresponds to the pressure of the gas applied to the system. It is good practice to set the minimum pressure to “0” and maximum to 2000 psi (or 138 Bar) since that is the range of the internal pressure sensor.

The moisture parameter corresponds to moisture content of the gas. It is good to set the minimum to “0”.

<u>Calibrating the 4-20mA outputs</u>
The 4-20mA outputs can also be calibrated. Please note that the analyzers are shipped calibrated against our “golden” multimeter. However, they can be calibrated against your multimeter in with this procedure.

Press the “Calibrate” button. The following screen appears.



Please note that system will not pause operations when you enter this screen. It is recommended that you pause test cycles by pressing the "pause" button from the main "Operations" screen. After completion of the calibration, you can go back to the main "Operations" screen and hit "Run" to resume test cycles.

To calibrate the first 4-20mA output, choose "Dac1" from the dropdown menu. Then select "Point 1". In the white box, there will be a number. Using your reference multimeter, measure what the output of the first 4-20mA is. It should be close to 4mA. Increase or decrease the number in the white box to get exactly 4.00 mA on your meter. When you have done that, press the "SET" button.

Now select "Point 2" from the menu. Measure the output. It should be close to 10 mA. Adjust the number in the white box until you get exactly 10.00 mA. Repeat for points 3 and 4 which sould correspond to outputs of 15 and 20 mA.

Now you can select "Dac 2" for calibrating the second 4-20mA output. Repeat the above steps. Then calibrate "Dac 3" and "Dac 4".

DO NOT PRESS THE SET THIS TABLE TO DEFAULT. This action will restore all the calibration table to the standard numbers.

The system configuration is now complete.

Press the "Back" button until you get back to the main operation screen (the one with the graph).

8- DEFAULT PROGRAMMING OF ANALOG AND DIGITAL OUTPUTS

The AOs (4-20mA) and DOs are programmable. However, the analyzers are shipped with a default programming for these outputs. These defaults are listed in this section.

A- ANALOG OUTPUTS

The default settings are for the Analog Outputs (4-20mA) are:

For DewPoint Duo™

- AO # 1 is programmed to carry the latest hydrocarbon dew point.
- AO #2 is programmed to carry the pressure at which the hydrocarbon dew point was measured at.
- AO # 3 is programmed to carry the latest moisture dew point.
- AO # 4 is programmed to carry the water content.

For HCD5000™

- AO # 1 is programmed to carry the latest hydrocarbon dew point.
- AO #2 is programmed to carry the pressure at which the hydrocarbon dew point was measured at.
- AO # 3 is not programmed.
- AO # 4 is not programmed.

For WDP5000™

- AO # 1 is programmed to carry the latest moisture dew point.
- AO #2 is programmed to carry the pressure at which the moisture dew point was measured at.
- AO # 3 is programmed to carry the moisture content.
- AO # 4 is not programmed.

B- DIGITAL OUTPUTS (ALARMS)

The default settings are for the Digital Outputs (Relays) are:

For DewPoint Duo™

- DO # 1 is programmed as a Dew Point maximum reached alarm.
- DO #2 is programmed as an overpressure alarm.
- DO # 3 is programmed as a moisture content maximum reached alarm.

For HCD5000™

- DO # 1 is programmed as a Dew Point maximum reached alarm.
- DO #2 is programmed as an overpressure alarm.

- DO # 3 is programmed as an internal fault alarm.

For WDP5000™

- DO # 1 is programmed as a Dew Point maximum reached alarm.
- DO #2 is programmed as an overpressure alarm.
- DO # 3 is programmed as a moisture content maximum reached alarm.

Digital Outputs (Alarms) Assignment modes:

0 = OFF

(not active)

1 = ANY ALARMS (NO, normally open)

Internal fault conditions apply (see below)

- ex. detector values drop below 300
- ex. heatsink temp too high
- ex. sensor cable not plugged in.
- unit is unable to perform test cycles due to these conditions and relay will latch

2 = DEWPOINT ALARM

HC dewpoint exceeds threshold set by user (default 30C)

3 = WATER > HC

Water dewpoint detected at higher temperature than HC dewpoint

4 = OVER-PRESSURE

Pressure exceeds threshold set by user (default 2000psi)

5 = MOISTURE ALARM

Moisture content exceeds threshold set by user (default 30lbs)

6 = OPERATIONAL ALARM (NC, normally closed)

Inverse alarm. Internal fault conditions apply (see below)

- ex. detector values drop below 300
- ex. heatsink temp too higher
- ex. sensor cable not plugged in.
- ex. POWER LOSS
- unit is unable to perform test cycles due to these conditions and relay will unlatch

7 = NO ALARMS (NC, normally closed)

Inverse alarm

- internal fault conditions DO NOT APPLY
- relay closed while unit is operational and no user settable alarms nor internal faults are active
- ex. unit is able to run but over-pressure alarm threshold is exceeded. Over-pressure alarm will latch and NO ALARMS relay will unlatch

8 = UNMEASUREABLE

No dewpoint detected during cycle

Internal fault conditions are:

- CH1 value is below threshold of 300.
- CH2 value is below threshold of 300.
- Mirror temperature below operating threshold.
- Mirror temperature above operating threshold.
- Heatsink temperature below operating threshold.
- Heatsink temperature above operating threshold.
- Intermittent or sustained Power Loss

9- TROUBLESHOOTING

This section covers possible problems if the system does not turn on or does not operate properly.

A- CONDITION: THE DISPLAY DOES NOT TURN ON

1- Check the SYSTEM, INFRARED, and STATUS LEDs above the LCD and see if they are turned on:

   a. The STATUS and INFRARED LEDs should be flashing. If these LEDs are working, then the system has power and the problem is with the LCD itself. In this case open the analyzer door. There is a cable with three wires (red, yellow, and black) that connect the main circuit board to the display. Make sure this cable has not come loose. If it has, you need to reconnect it. However, make sure that the system power is turned off before doing so.

   b. If the LEDs are not working, then the system is not getting power. Make sure you disconnect power and check the fuse. If the fuse is burnt, make sure that you replace with a factory supplied fuse. Do not use any other fuse.

   c. If the system is plugged into a live power connection and the LED lights are still out, then consult the factory.

2- If replacing the fuse does not correct the problem, consult your factory authorized dealer.

B- CONDITION: 4-20MA SIGNALS ARE NOT WORKING

1- Open the system door.

   a. Make sure that the 4-20mA cable is properly inserted in the proper place.

2- If the readings are incorrect, see the section on connecting and calibrating the 4-20 mA outputs.

3- If this step does not resolve the problem, consult the factory.

C- CONDITION: THE PRESSURE SENSOR DOES NOT DISPLAY KNOWN PRESSURE

The pressure transducer used in this system is a durable high-quality component that should perform accurately for many years. However, under certain conditions it may cease to function. These conditions are:

1- When it is exposed to pressures above its proof pressure (2x of the maximum specified pressure). If the transducer is exposed to such pressures, it will be

irreparably damaged and will need to be replaced by the factory, or a factory trained technician. Please consult the factory.

2- If the wires connecting the transducer to the circuit board gets disconnected. This should not happen during normal operation with the system door closed. When opening the system door for any reason, care should be taken so that the signal and power cables do not get damaged.

D- CONDITION: THE DATA ON THE DISPLAY DOES NOT CHANGE

The sensor data on the display changes with time and system conditions. If the quantities CH1 and CH2 do not change at all and always show the same value, then there is an internal communication problem. This could be to a power glitch which may have disrupted the operation of the on-board computer. In most cases, the unit is capable of self-diagnosis of this condition and re-booting the computer. This will take 5-10 minutes. If this condition persists, the system should be reset by turning it off for 30 seconds, and turning it back on.

If the system does not re-boot and the condition remains, or if it does re-boot and runs into the same condition, the problem should be reported to the factory and service requested.

E- CONDITION: THE SYSTEM DOES NOT KEEP CORRECT TIME

Once the time is set on the system, it will keep the time accurately. There is a button cell battery on the on-board computer which ensures correct time-keeping even if the system is turned off. If this battery is exhausted, the system will lose the correct time after a power interruption.

If this happens, the button cell battery needs to be replaced. Disconnect the power to the system. Make sure the atmosphere is non-hazardous. Open the system door. Locate the on-board computer which is on the upper section of the system. Locate the battery on the system. Replace this battery by one obtained from the factory. Reset to the correct time.

Battery Replacement Instructions:

Battery Orientation: Make sure the positive pole of the battery is up. Remove the clip holding the battery in. Remove the old battery. Place the new battery in, making sure that the positive pole (+) is up. Refer to below picture.

F- ALL OTHER SYSTEM PROBLEMS

All other system problems should be referred to the factory.

10- SPARE PARTS

The **DP5000™** analyzers are designed for maintenance free operation. It has very few user replaceable spare parts. Please contact your authorized representative for replacement parts. If using the standard sample system Z-SCS-300, the filters in the sample system should be inspected and replaced as necessary.

11- MAINTENANCE

The DP5000™ analyzers do not require routine maintenance if operated properly and within the guidelines of this manual. If the system is equipped with the standard sample system, then the filter in the sample system should be inspected at least every 30 days and replaced as necessary. Please consult the manual for your sample system.

12- SERVICE CONTACT

If the troubleshooting solutions do not resolve the problem, contact your sales representative. If returning the unit is required, obtain a Return Materials Authorization (RMA) Number from your sales representative before returning the analyzer to the factory. Your sales representative can determine whether the analyzer can be serviced on-site or should be returned to the factory.

13- DISCLAIMER

ZEGAZ Instruments accepts no responsibility for consequential damages arising from the use of this equipment. Liability is limited to replacement and/or repair of defective components.

14- WARRANTY

The manufacturer warrants the items delivered shall be free from defects (latent and patent) in material and workmanship for a period of one year after delivery to the Buyer. The Buyer's sole and exclusive remedy under this warranty shall be limited to repair or replacement. Defective goods must be returned to the manufacturer and/or its distributor for valid warranty claims.

This warranty shall become inapplicable in instances where the items have been misused or otherwise subjected to negligence by the Buyer.

Notwithstanding any other provision of this contract, no other warranties, whether statutory or arising by operation of law, expressed or implied, including but not limited to those of merchantability or fitness for particular purpose, shall apply to the goods or services hereunder, other than the repair and replacement warranty above. Seller shall in no event be liable to Buyer or any third party for any damage, injury or loss, including loss of use or any direct or indirect incidental or consequential damages of any kind.

15- APPENDIX I: SETTING A STATIC OR DYNAMIC IP

The analyzer can be incorporated into a dynamic (DHPC) or static IP network. The analyzers are shipped condigured to be in a DHPC network. So if your network is a DHPC network, no changes are needed.

If you need to incorporate the analyzer into a "Static IP" network, follow this procedure:

Setting a Static IP

1. Receive a file called **NetworkInterface.txt** from the factory**.**
2. Use the notepad software (included with MS Windows) to open the file **NetworkInterface.txt .** Do not use a word processing program like Microsoft Word.
3. The file will have the following 3 lines in it:

static ip_address=192.168.0.10/24
static routers=192.168.0.1

static domain_name_servers=192.168.0.1

4. Edit the first line and put the desired static IP in place of **192.168.0.10**. Keep the /24 at the end.
5. Edit the second line and input the router (Gateway) IP address in place of **192.168.0.1**
6. Edit the third line and enter the DNS IP address in place of **192.168.0.1**
7. Save this file after making the changes.
8. Put this file on a clean USB flash drive.
9. Remove the original USB flash card from the unit. Put the new USB with the file **NetworkInterface.txt** into the same slot. Wait 30 seconds.
10. Check the "Logs" screen. A message will say "Network Settings Changed".
11. Shut down the unit properly from the screen using the "Shutdown" button.
12. Remove the USB flash.
13. Re-insert the original USB (the one that came with the unit) flash drive back into the unit.
14. Wait at least 30 seconds. Turn the unit back on.
15. The unit should display the desired IP address in the Logs screen.

Setting back to a DHCP (Dynamic) network

1. Take the **Networkinterface.txt** file and erase all lines from it.
2. Put this file on a clean USB flash drive.
3. Remove the original USB flash card from the unit. Put the new USB with the blank **NetworkInterface.txt** into the same slot. Wait 30 seconds.
4. Check the "Logs" screen. A message will indicate "Network Settings Changed".
5. Shut down the unit properly from the screen using the "Shutdown" button.
6. Remove the USB flash.
7. Re-insert the original USB (the one that came with the unit) flash drive back into the unit.
8. Wait at least 30 seconds. Turn the unit back on.
9. The unit should display the desired IP address in the Logs screen.

16- APPENDIX II: MODBUS REGISTER MAP

ZEGAZ Instruments DP5000™ series analyzers MODBUS Interface Specification

(14 November 2015)

Introduction

The ZEGAZ Instruments' 5000 series analyzers (DewPoint Duo™, HCD5000™, WDP5000™) can act as a slave in a Master-Slave(s) Serial network. It can receive queries from a MODBUS Host Master and send responses back using MODBUS RTU or ASCII protocols.

MODBUS Function Codes

The System supports MODBUS function codes:

3 (read holding registers)

MODBUS RTU Addressing

The series 5000 instruments respond to two MODBUS addresses:

1. Configurable slave/unit address: 30

2. Hard-wired slave/unit address: 251

The default MODBUS slave address for normal communications is 30. This will need to be reconfigured to use multiple instruments on a shared RS485 network.

The instrument always responds to address 251, so this address can be used to interrogate a single unit when its address is unknown. Of course using 251 on an RS485 network with multiple analyzers will result in comedy, as all of them will respond at once.

Data Format

Register numbers are 16-bits, standard big-endian byte ordering.

[15...8][7....0]

Floating point values follow the IEEE Standard 754 format.

0 [15...8][7....0]

1 [31..24][23..16]

Time values are expressed as four byte-wide fields.

0 [Day][Month]

1 [Minute][Hour]

5000 Series MODBUS Holding Register Map

This table contains register definitions for the Gould MODBUS RTU protocol. The table follows the Gould MODBUS convention of identifying holding registers with an offset of 40001. For example, the address of register 47001, as sent on the wire, is 7000.

Register	Format	Description
47403	[15..8][7..0]	hydrocarbon dewpoint time [minute][hour]
47404	[15..8][7..0]	hydrocarbon dewpoint time [day][month]
47405	[float 15..0]	hydrocarbon dewpoint temperature lo
47406	[float 31..16]	hydrocarbon dewpoint temperature hi
47407	[float 15..0]	hydrocarbon dewpoint pressure lo
47408	[float 31..16]	hydrocarbon dewpoint pressure hi
47409	[15..8][7..0]	water dewpoint time [minute][hour]
47410	[15..8][7..0]	water dewpoint time [day][month]
47411	[float 15..0]	water dewpoint temperature lo (5)
47412	[float 31..16]	water dewpoint temperature hi
47413	[float 15..0]	water dewpoint pressure lo (5)
47414	[float 31..16]	water dewpoint pressure hi
47415	[float 15..0]	moisture content lo (5)
47416	[float 31..16]	moisture content hi
47417	[15..8][7..0]	[HC dewpoint found (1)][water dewpoint found (2)]
47418	[15..8][7..0]	[temp limited (3)][system limited (4)]
47419	[15..8][7..0]	end of measurement time [minute][hour]
47420	[15..8][7..0]	end of measurement time [day][month]
47421	[float 15..0]	end of measurement temperature lo

47422 [float 31..16] end of measurement temperature hi

47423 [float 15..0] end of measurement pressure lo

47424 [float 31..16] end of measurement pressure hi

48979 [15..0] Alarms (see Alarm Flags)

(1) This octet is 01 if the instrument successfully measured a hydrocarbon dewpoint during the last measurement cycle. Otherwise 00 if the dewpoint was either below the lowest measurable temperature or some alarm situation prevented the normal completion of the test.

(2) This octet is 01 if the instrument successfully measured a water dewpoint during the last measurement cycle. Otherwise 00 if the dewpoint was either below the lowest measurable temperature or some alarm situation prevented the normal completion of the test.

(3) This octet is 01 if the instrument reached its configured minimum temperature during the last measurement. Otherwise 00 if the system did not reach the normal minimum temperature. A 00 is expected if both hydrocarbon and water dewpoints were detected.

(4) This octet is 01 if the instrument was unable to measure both the hydrocarbon and water dewpoints and was also unable to drive the temperature down to the minimum temperature limit. The lowest temperature reached is recorded in register 47413 and 47414. This octet is 00 if the instrument was successfully able to drive the temperature low enough to either measure both hydrocarbon and the water dewpoints, or the configured minimum temperature was reached.

(5) Will report a value of 0.0 if the instrument does not measure the value. An instrument that can only measure hydrocarbon dewpoints will report 0.0 for water and moisture levels.

Alarm Flags

Each 1 bit in holding register 48979 indicates the presence an alarm.

Bit	Hex Value	Description
0	0001	General fault condition
1	0002	Moisture level too high
2	0004	Hydrocarbon dewpoint too high
3	0008	Water dewpoint too high

4	0010	Dewpoint below minimum temperature
5	0020	Unable to reach minimum temperature
6	0040	Reserved
7	0080	Ambient temperature too high
8	0100	Ambient temperature too low
9	0200	Test chamber pressure out of range
10	0400	Liquid in test chamber
11	0800	Internal communications failure
12	1000	Reserved
13	2000	Reserved
14	4000	Reserved
15	8000	Reserved