MICHELL Instruments
A PST BRAND

CD603
Condumax Dew-Point Analyzer
User Manual

99997 Issue 1
January 2025

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

Use this information when contacting Michell Instruments for service purposes.

Product Name	
Order Code	
Serial Number	
Invoice Date	
Installation Location	
Tag Number	

Product Name	
Order Code	
Serial Number	
Invoice Date	
Installation Location	
Tag Number	

Product Name	
Order Code	
Serial Number	
Invoice Date	
Installation Location	
Tag Number	

CD603

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

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Safety

The analyzer is designed to be completely safe when installed and operated correctly in accordance with the information provided in this manual.

This manual contains all the required information to install, operate and maintain this product. Prior to installation and use of this product, this entire manual should be read and understood. Installation and operation of this product should be carried out by suitably competent personnel only. The installation and operation of this product must be in accordance with the instructions provided and according to the terms of any associated safety certificates. Incorrect installation and use of this product other than those described in this manual and other than its intended purpose will render all warranties void.

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

Electricity and pressurized gas can be dangerous. This product must be installed and operated only by suitable trained personnel.

Warnings

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 and where particular attention to personal and personnel safety must be observed.

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

Electrical Safety

Ensure electrical safety is complied with by following the directions provided here and observing all local operation & installation requirements at the intended location of use.

This product is completely safe when using any options and accessories supplied by the manufacturer of this product for use with it. Refer to Section 2 (Installation) of this manual for further details.

Pressure Safety

For this product to operate satisfactorily, pressurized gas must be connected to it. Observe all the information contained within this manual and all local operation & installation requirements at the intended location of use. Refer to Section 2 (Installation) of this manual for further details.

Hazardous Materials (WEEE, RoHS & REACH)

This product does not contain or release any prohibited chemicals listed on the SVHC (Substances of Very High Concern) Candidate List. During the intended normal operation of this product it is not possible for the user to come into contact with any hazardous materials. This product is designed to be recyclable except where indicated; see relevant sections in this manual for further details.

Calibration (Factory Validation)

Prior to shipment, the analyzer undergoes stringent factory calibration to traceable standards. Due to the inherent stability of the analyzer, regular factory calibration is not required under normal operating conditions. The analyzer should perform reliably for many years with just basic maintenance, housekeeping and regular field calibrations from the internal reference (moisture generator) or a known external reference.

Michell Instruments can provide a fully traceable factory calibration service for the analyzer and it is recommended that this is considered annually for the lifetime of the product. Please contact your local Michell Instruments office or representative for further details – visit www.ProcessSensing.com.

Safe Handling

Appropriate lifting and handling techniques should be used when moving and installing the CD603.

- The total weight of the product is 23 kg (51 lb).
- Before commencing any lifting or handling, ensure that the intended location is suitable and is appropriately prepared.
- A clear path to the intended location should be made and appropriate lifting aids used (e.g. a suitably rated trolley).
- Due to the bulky nature and weight of the product, it is recommended that two people perform all handling operations.

Repair and Maintenance

Apart from user-replaceable components required for routine operational maintenance described above, the analyzer must only be maintained either by the manufacturer or an accredited service agent. Refer to www.ProcessSensing.com for details of Michell Instruments' worldwide offices' contact information.

Abbreviations

The following abbreviations are used in this manual:

AC	alternating current
atm	pressure unit (atmosphere)
barg	pressure unit (=100 kP or 0.987 atm) gauge
°C	degrees Celsius
°F	degrees Fahrenheit
EU	European Union
Hz	Hertz
IEC	International Electrotechnical Commission
kg	kilogram
lb	pound
lbs/MMscf	pounds per million standard cubic foot
mA	milliampere
mV	millivolt(s)
mbar	millibar
ml/min	milliliters per minute
ppm_w	parts per million (by weight)
ppm_v	parts per million (by volume)
psig	pound(s) per square inch (gauge)
RH	relative humidity
RTU	Remote Terminal Unit
V	Volts
W	Watts
"	Inch

1 INTRODUCTION

1.1 General

The CD603 Analyzer is designed for continuous, automatic measurement of the hydrocarbon dew point and water dew point of processed natural gas. It is the result of more than 50 years' experience in the supply of analyzers to the worldwide oil, gas and petrochemical industry.

The system consists of a hydrocarbon and water dew-point measurement sensor cell and control electronics housed in an Exd enclosure. A sample gas handling panel to prepare the gas sample prior to entry into the CD603 can also be supplied. The analyzer is designed to be positioned close to the process sample point. It is ATEX, UKEX and IECEx approved and is also approved for use in North America in accordance with the requirements of the NEC and CEC. These and additional international approvals are listed in the Certification section of this manual. Certificates are available on the Process Sensing Technologies website. A marking label located on the analyzer will identify appropriate approvals.

The high-contrast capacitive button operated LC display presents all measured data to the user in a clear and understandable format. The main display incorporates a real-time trend graph and alarm indicators. A powerful and intuitive HMI makes control, logging and configuration of analyzer parameters easy.

The analyzer provides three user-configurable analog outputs, and Modbus RTU/TCP communications, allowing it to interface with a SCADA DCS system, or by a computer using the dedicated application software. A set of 4 adjustable volt free alarm contacts allow the CD603 to be used for direct process control.

Optional Dedicated Wdp Measurement

The use of an optional Exd ceramic metal-oxide transmitter means continuous real-time Wdp measurement operating at full pipeline pressure is also possible. It enables the cooled-mirror sensor to operate in parallel, at intermediate pressure, to measure HCdp on continuous 10-minute cycles at the circondentherm condition or any analysis pressure stipulated in the gas supply specification.

Use your Preferred Communication Media

For greater flexibility, the CD603 offers:

- Modbus RTU/TCP
- 3 user-configurable analog outputs
- Status and Process Alarms

Minimal & Straightforward Maintenance

Sophisticated analyzers are often complicated and require experience and special care in use, increasing cost of ownership. The CD603 differs through its very uncomplicated approach to field serviceand has been designed with ease of access and serviceability in mind.

Full Hazardous Area Certification

The analyzer is ATEX, UKEX, IECEx and cQPSus certified. The main unit (electronics and sensing) and associated sampling system may be mounted at a convenient location next to the pipeline or process, with gas sample and vent connections. The product serial number label will identify the required operating power supply.

Purpose-Designed Sample Systems

Sample extraction, handling and conditioning techniques are of critical importance to assure optimal performance and reliability of all gas analyzers which accurately quantify specific components within a process gas composition. Michell Instruments' recommendations and requirements in relation to the CD603 are outlined below. Michell Instruments offers a range of sample conditioning systems which are designed to exceed these minimum requirements. For further information and advice, contact your local Michell Instruments office or representative – go to www.ProcessSensing.com for contact details.

Sample Extraction and Impulse Tubing

An insertion probe, with tip positioned within the central third of the cross sectional area of the pipe, should be used to derive a sample composition that is representative of the majority of gas flowing within the pipeline.

Attention should be given to the installation of impulse tubing connecting from sample probe to the analyzer sample conditioning system. Analytical-grade acid-etched stainless-steel tubing should be used, which has a low moisture sorption capacity. Tube size should not be larger than ¼" or 6 mm outside diameter to ensure that sample transportation delay time is kept to a minimum. Likewise, to ensure best dynamic response of the complete installed analyzer system, the positioning of the analyzer with sample conditioning system should be as close as possible to the sample extraction probe.

To avoid any risk of condensation forming during transportation to the analyzer, and so ensure the integrity of the sample gas is maintained, the temperature of the sample impulse tubing must be maintained at a temperature above the highest envisaged water dew point. It is recommended that the sample tubing temperature is maintained at least 5 °C (10 °F) above the maximum water dew point at the prevailing pressure, as a suitable 'safety margin'. Self-limiting heating cable should be applied to the complete length of the impulse tube enclosed within suitable insulation. The power rating of heating cable should be selected to achieve the required maintained temperature given the minimum climatic temperature at the installation location. For convenience during installation, a number of leading process electric heating companies offer tube 'bundles' comprising instrumentation tubing, self-limiting heating cable, insulation and protective outer sheath. Trace-heated tube bundle is a factory-fitted option for Michell-produced sample conditioning systems.

Sample Conditioning

The sample conditioning system must address the needs for filtration, pressure reduction and sample flow control.

To maintain cleanliness of the analyzer's optical detection system, the process sample flow must be filtered to eliminate entrained liquids and particles. To provide protection against HC condensates and compressor oils that may be present in process natural gas, it is recommended to use micro-porous membrane filtration with an oleo-phobic element specifically intended to reject such low-surface tension liquids.

Pressure reduction and sample flow control is required to achieve the desired analysis pressures and the stated sample flow requirements of the analyzer – see Appendix A, Technical Specification. Care should be taken to counteract, through directly applied heating, the Joule-Thomson cooling effect of sample expansion to reduced pressure. Established business practice at custody transfer is to measure water dew point at full line whilst HC dew point is determined at intermediate pressure, commonly 27 barg (400 psig), the cricondentherm condition at which HC dew-point temperature will be highest on the retrograde phase envelope – see figure below:

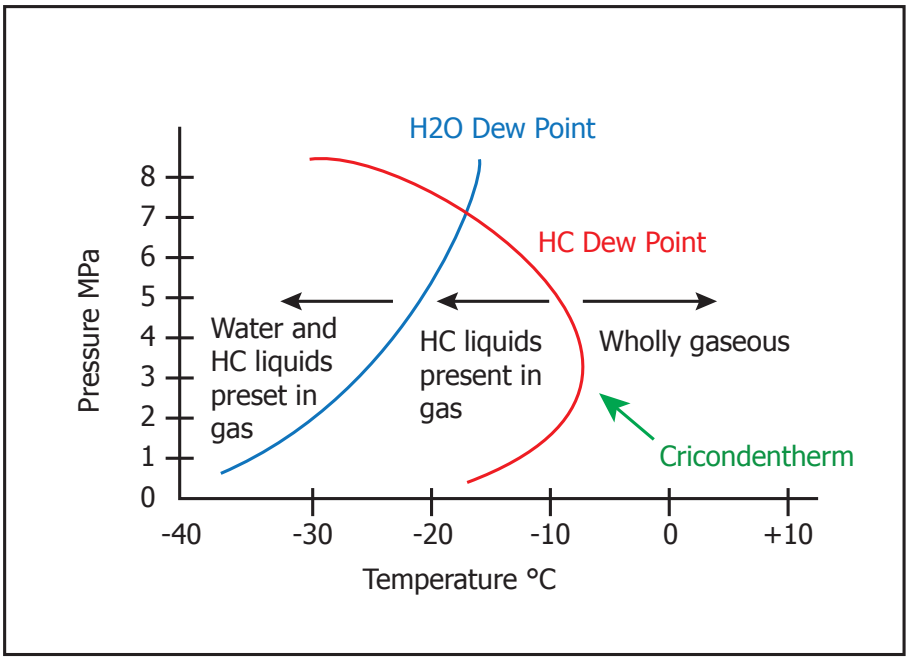


Figure 1 *Typical Phase Envelope for Northern Europe Natural Gas*

As with the sample impulse tubing, the sample conditioning system (SCS) must be maintained at a temperature above the highest expected water and HC dew point at the prevailing process sample pressure and the analysis pressure for HC dew point, either by housing the SCS together with the analyzer within a heated and thermostatic -controlled insulated enclosure, or by positioning in a suitable indoor environment. The enclosure for outdoor installed systems must be located within 100% shade from direct sun, if necessary, by the addition of an effective sun canopy with walls on three sides.

As with all precision analytical equipment, it is desirable to maintain a moderate operating temperature. In the specific case of a HC dew-point analyzer, care should be taken not to elevate the analyzer operating temperature higher than is necessary to maintain sample integrity. Given the principle of cooled-mirror dew-point measurement, the measurement range of HC dew point is limited by a cooling depression range capability.

In the case of the CD603, the lower-range capability is ≥65 °C from the prevailing analyzer operating temperature. When the analyzer system is installed outside in hotter climate installation locations, or where the application requires measurement near or below the measurement cooling depression limit, it may be necessary to provide auxiliary cooling within the system enclosure. Such cooling can be achieved using a compressed air-driven vortex tube controlled by an adjustable thermostat.

1.2 Sample Gas Path

The CD603 measurement system must be supplied with gas at the required pressure and flow via a sample gas handling panel. Sample gas entry and exit ports pass the gas through flame arrestors. All sample wetted metallic parts are manufactured in AISI 316L stainless steel with Viton soft parts that comply with the NACE standard MR-0175 and MR-0103 (latest edition). Tube fittings are twin ferrule Swagelok© compression type.

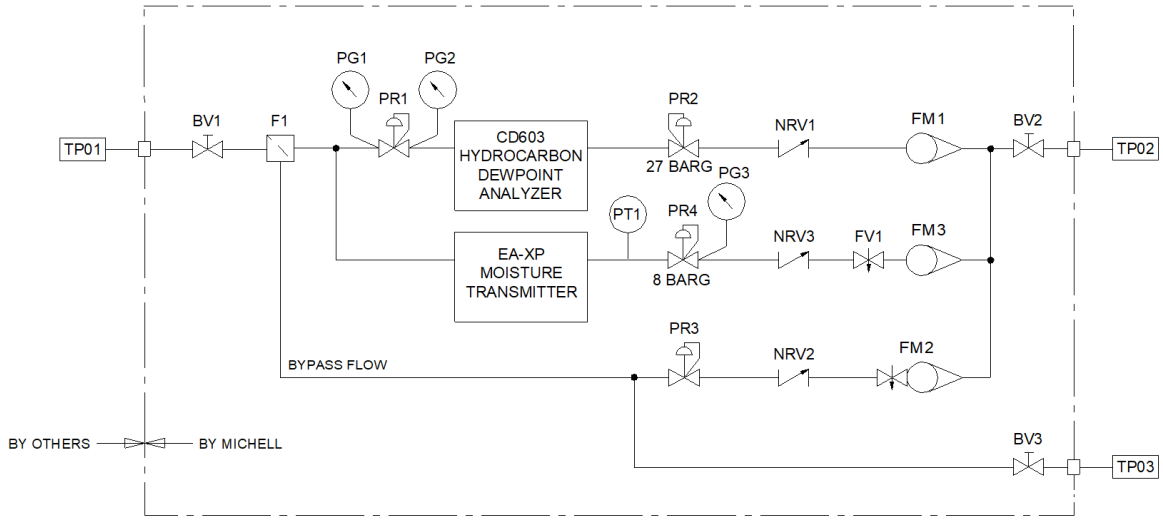


Figure 2 *Example Flow Diagram for a CD603 Sampling System*

2 INSTALLATION

2.1 Analyzer Storage Instructions

In order for this product to be functional upon installation it should be stored in accordance with the guidelines below:

- The product must be housed in a sheltered area, out of direct sunlight and rain.
- The product should be stored to minimize the possibility of sitting in ground water.
- The temperature within the storage environment should be maintained between -20 and +55°C (-4 and +131°F).
- The humidity within the storage environment must be non-condensing.
- The storage environment must not expose the analyzer to any corrosive elements.
- The product should stay assembled with its sample conditioning system (if supplied).
- All electrical and process connections should remain disconnected and capped.
- All protective coatings should remain in place until installation.
- For prolonged periods of storage, the lid of the packaging crate should be removed to allow air to circulate.
- Any documentation supplied with the product should be removed from the packaging crate and stored elsewhere to protect its integrity.

For the period from installation of the product to commissioning start-up, the following precautions should be followed:

- The product and associated sampling system (if supplied) must remain isolated from the process gas, and the enclosure should remain closed to ensure ingress protection is maintained.
- If supplied, the sampling system enclosure heating/thermostat circuit should be operated if the climatic temperature might fall below +5°C (+41°F).
- At time of start-up the procedures contained in the user manuals for both analyzer and sampling system must be followed.

If the product was previously in service/operation then the following precautions should be followed before storage:

- Upon isolation from the gas sample the entire system should be purged with a dry nitrogen gas before powering down of the analyzer.
- All connections and ports (gas and electrical) to the analyzer or sample system (if provided) should be capped.
- If the product is not removed from its location, the electrical grounding of the analyzer should remain in place.

2.2 Unpacking the Analyzer

Open the crate and carefully unpack the analyzer.

WARNING:

The analyzer weighs 23 kg (51 lbs) alone, or 38 kg (84 lbs) in the crate

The package also contains a traceable calibration certificate.

If there are any shortages, please notify the supplier immediately.

NOTE: Retain the packaging in case the analyzer is returned for factory calibration or service.

2.3 Lifting and Handling

WARNING:

Personnel must observe suitable lifting and handling precautions.

The CD603 is not designed as portable or transportable equipment. The product should be rigidly fixed in position as per the full installation instructions.

The weight of the analyzer is 23 kg (51 lbs). Therefore, appropriate lifting and handling techniques should be used during the installation process. Before commencing any lifting or handling ensure that its intended location is suitable and appropriately prepared. Make sure that mounting point design considerations have employed locally approved safety factors.

When handling and installing this analyzer (particularly after removal from its packaging) ensure that it is not dropped, impacted or subjected to high levels of vibration or environmental conditions that may impair its operation.

2.4 Mounting the Analyzer

The analyzer is housed in an aluminum Ex d enclosure suitable for wall or panel mounting. Four mounting points are available with M10 clearance holes on fixing centres of X = 308 mm and Y = 312 mm.

The enclosure provides environmental ingress protection IP66/UL Type 4X and should be mounted vertically (as shown in the TOP VIEW below) in a location free of any appreciable vibration. It should be placed in a shaded position to prevent heating effects through sun radiation. The weight of the analyzer is 23 kg (51 lbs).

Conduit entries are intended for connection to threaded rigid metal conduit or other wiring methods in accordance with the prevailing regulations at the point of use.

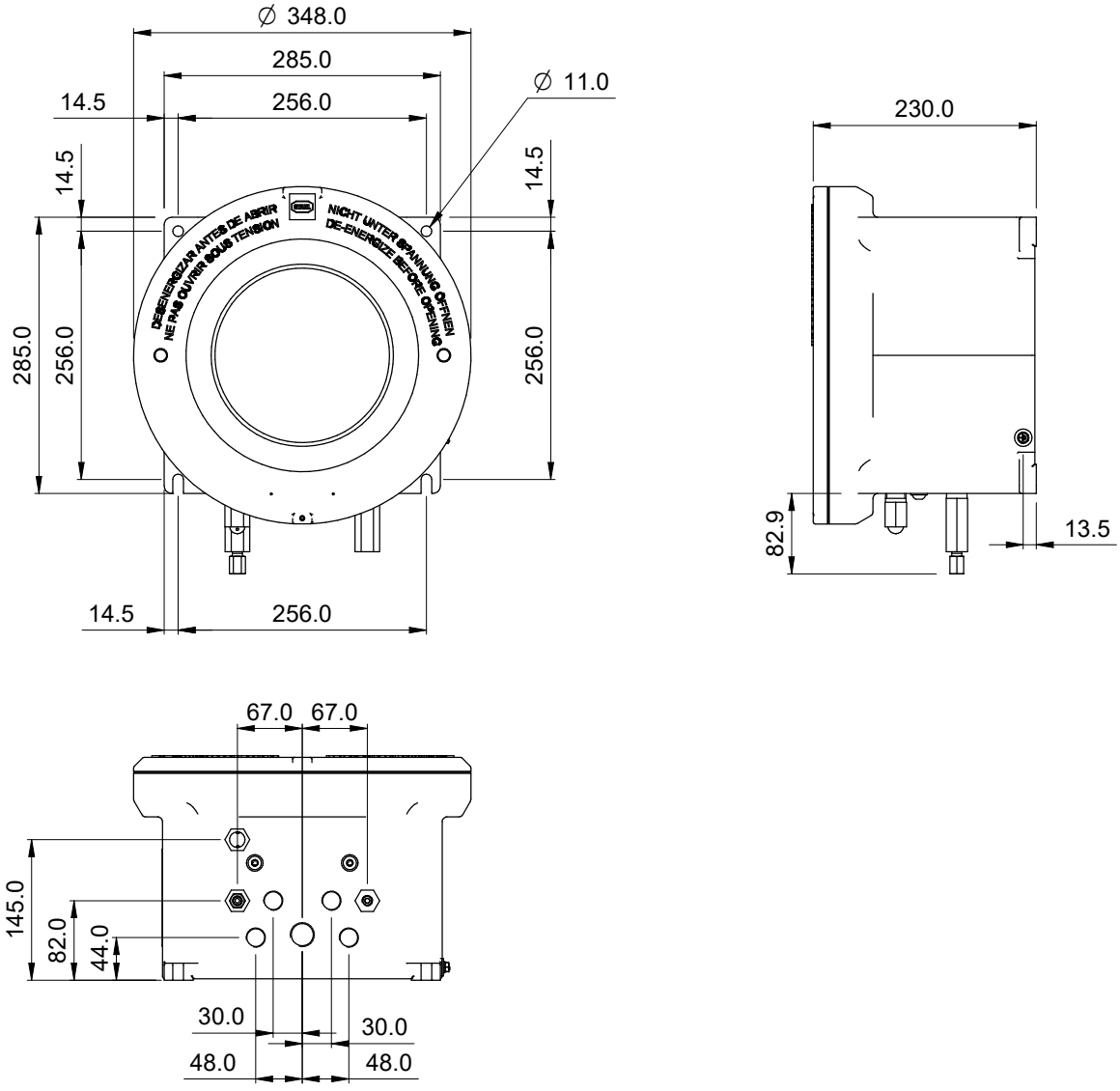


Figure 3 *Mounting Dimensions*

2.5 Hazardous Area/Location Safety

This product is compliant for installation and use in a Hazardous Area/Location. All certificates awarded to this product should be fully examined prior to installation and use.

WARNING:
This product is certified safe for use in an ATEX Zone 1 and Zone 2 / Class I, Division 1 area only. This product must not be installed or used within a Zone 0 area.

WARNING:
This product must not be operated within an explosive atmosphere greater than 1.1 bara (16 psia).

WARNING:
This product must not be operated with enriched oxygen atmospheres (more than 21 % oxygen content).

WARNING:
This product must not be operated outside of the temperature range of +5...+45 °C (+41...+113 °F)

Refer to Appendix B for the Hazardous Area/Location certification details of this product.

Hazardous Area/Location certificates for this product may be downloaded from www.ProcessSensing.com

This product is fitted with a marking label that contains Hazardous Area/Location information pertinent to the suitable location and installation.

During all installation and operation activities, local regulations and permitted working routines must be observed. Installation should only be performed by competent personnel and, where applicable, in accordance with IEC/EN 60079-14 (latest version) or local equivalents.

Cable glands/barrier glands/conduit seals shall be installed in accordance with the manufacturer's instructions.

Repair and servicing of this equipment must only be carried out by the manufacturer. An Installation and Maintenance Information Sheet is supplied separately to the manual.

2.6 Electrical Safety

WARNING:
During the installation of this product ensure that all applicable national and local electrical safety regulations are observed.

WARNING:
Isolate the power prior to installation.

WARNING:
Always ensure that power is switched off prior to accessing the product for any purpose other than normal operation, or prior to disconnecting any cables.

Fuse

This product is provided with an internally mounted fuse located beneath the power connector.

The fuses are rated at 5 x 20mm anti-surge to IEC60127-2:

Mains 240 V AC 3 A

A replacement fuse can be obtained by contacting Michell Instruments' technical support.

2.6.1 Equipment Ratings and Installation Details

This equipment and all power isolation devices must be installed in a location and position that allows safe and easy access to their operation and is able to rigidly support the equipment.

For location and mounting arrangements refer to the relevant sections of this manual.

Do not install this equipment in a location that would expose it to impact or high levels of vibration. Installation of this equipment must include the provision of a suitable and locally positioned power isolation switch or circuit breaker. Indication of the purpose of the switch or circuit breaker is strongly recommended. An over-current protection device should be rated to a maximum of 10 A. Ensure that the power supply is sufficient to satisfy the instrument's power consumption requirements.

Any power supply terminals and voltages must be suitably separated from the other input/output requirements of this product.

The product enclosure is supplied with an external protective earthing/grounding terminal at the lower right-hand side as shown in the figure below. As the first step of the electrical installation, connect this earthing/grounding terminal to plant earth/ground by a minimum 4mm^2 earth/ground bond strap. The earthing/grounding terminal comprises of an earth bolt, 2 x plain washers and 1 x spring washer, which are all nickel plated.

Figure 4 *Earth Bolt and Nut Washer Assembly*

Mains Powered Units

As a minimum, the power connection cable should be 3 core over sleeved, with minimum 0.5mm insulation and rated at 300 V. Cables should have Live (L), Neutral (N) and Earth [Ground] (E) conductors.

Ensure suitably rated power supply cables and glands are used to ensure that electrical safety is maintained. Connect each of the Live (L), Neutral (N) and Earth [Ground] (E) conductors to the similarly marked terminals (L, N, E) on the Power In connector shown above.

This product is designed, where applicable and possible, to follow IEC 61010-1 safety requirements of electrical equipment for measurement, control, and laboratory use.

This product is designed to be safe at least under the following conditions:

- between a temperature range of -20...+55 °C (-4...+131 °F)
- in maximum 95 %rh.
- Supply voltages of ±10% and transient over voltages up to Overvoltage Category II.
- Pollution Degree 2.
- Altitudes up to 2000 m.
- Outdoor mounting is permitted using suitably rated glands equivalent to NEMA 4/IP66.

Before applying power, perform a continuity test to ensure that the power supply cable and product are effectively connected to the protective earth. A protective earth terminal is mounted internally, and the Earth wire connected to it should never be disconnected.

Do not remove or exchange any of the cables, electrical components or any other parts supplied with this product. Doing so will invalidate all warranties.

If installing rigid conduit, a stopping fitting must be installed within 46 cm (18") of the enclosure.

There are no additional or special electrical safety requirements other than those referred to in this manual.

See Appendix A, Technical Specification, for full operating parameters.

2.6.2 Power Connection

The product is provided with 1 x M25, 2 x M16 and 4 x M20 threaded cable gland entries for customer connection. Only these gland entry points may be used. The end user/installer is not permitted to machine additional entries into the enclosure.

This equipment must be supplied with a voltage in the range of 85...264 V AC, 47/63 Hz (18 W 50/60 Hz) or 18...36 V DC (18 W) to function correctly. Cable entry into the measurement system is made through the bottom of the enclosure.

For an 85/264 V AC powered unit the terminals are marked:

L Live (= IEC Brown)
N Neutral (= IEC Blue)
E Earth/Ground (= IEC Green/Yellow)

All power connections are made via a removable screw terminal connector mounted on the mains connection PCB shown in *Figure 5.*

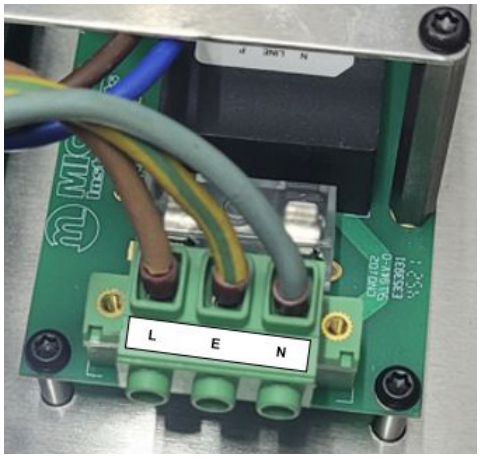


Figure 5 *240 V AC Power Unit Connectors*

All input and output connectors are 2-part PCB mounted type rated @ 300 V 10 A. The detachable, screw terminal half of each connector is designed to accept 0.5...2.5 mm^2 (24...12 AWG) stranded or solid conductors.

2.6.3 Other Electrical Connections

PL6 Analog Outputs

1	4-20 mA OUTPUT 1 +
2	4-20 mA OUTPUT 1 – (GROUND)
3	4-20 mA OUTPUT 2 +
4	4-20 mA OUTPUT 2 – (GROUND)
5	4-20 mA OUTPUT 3 +
6	4-20 mA OUTPUT 3 – (GROUND)

PL3 External Pressure

1	EXT LINE PRESSURE SENSOR SIGNAL
2	EXT LINE PRESSURE SENSOR +12V

PL16 Alarms 3-4

1	ALARM3 NORMALLY CLOSED (NC)
2	ALARM3 NORMALLY OPEN (NO)
3	ALARM3 COMMON (C)
4	ALARM4 NORMALLY CLOSED (NC)
5	ALARM4 NORMALLY OPEN (NO)
6	ALARM4 COMMON (C)

PL18 Alarms 1-2

1	ALARM1 NORMALLY CLOSED (NC)
2	ALARM1 NORMALLY OPEN (NO)
3	ALARM1 COMMON (C)
4	ALARM2 NORMALLY CLOSED (NC)
5	ALARM2 NORMALLY OPEN (NO)
6	ALARM2 COMMON (C)

Alarm relays: SPDT Form C suitable for signal circuits 24 V DC 1A

PL10 RS485

1	MODBUS RS485 A
2	MODBUS RS485 B
3	MOSBUS RS485 0V (GROUND)

PL5

1	EXT EASIDEW SENSOR SIGNAL
2	EXT EASIDEW SENSOR +12V
3	EXT EASIDEW GND

Figure 6 *Other Electrical Connections*

2.7 Pressure Safety

WARNING:
This product is used in conjunction with pressurized gases.
Observe pressurized gas handling precautions.

WARNING:
Pressurized gas is dangerous and should only be handled by suitably trained personnel.

DO NOT permit pressures greater than the specified safe working pressure to be applied directly to the analyzer.

2.8 Additional Detail

The analyzer is constructed such that the main inlet and outlet access are in the bottom face when correctly installed. Also in the bottom face are located two button-headed fasteners. These fasteners are part of the construction and are not intended to be accessed by the end user. They are locked into position and must not be adjusted or tampered with in any way. To do so would cause loss of correct function and any warranty claims would be invalidated.

Figure 7 *Analyzer Bottom Face View*

2.9 Gas Sample Connections

The following points should be considered when installing the sample gas supply line:

- PTFE tape is recommended for pipe connections.
- Solvent-based pipe thread sealant should not be used, as condensable components or contaminates can be leached during the curing period.

Care and attention to the position and installation of the tubing will minimize problems caused by avoidable contamination. The most common issue with sample flow is the accumulation of liquid in impulse lines during a shutdown period. If the measurement system has not been isolated, condensate can be displaced, on re-start, into components and associated tubework.

WARNING:
Exd enclosure breather must remain open to atmosphere at all times, without any obstruction.

Michell Instruments' recommendations are:

- The sampling point from the process line should be taken from the top of the process line. If a radial probe is used, the orience should face downstream.
- It is recommended that Viton is used for all O-rings.
- The internal volume of the impulse tubing connecting between the process line and this product should be as small as possible to minimize response lag time to changing process conditions.
- Piping should be lagged and/or trace heated if ambient temperatures could cause the sample gas to fall below its dew-point temperature.
- A drain valve should be placed at the lowest point in the system.
- It should be standard procedure to isolate this product during shutdowns or when plant problems are being experienced and to adequately purge the supply lines before restarting.
- The relatively large area of surfaces and internal volume of inline components can be particularly troublesome if contamination is experienced.

  Prolonged purging, or stripping and cleaning, followed by re-purging with gas may be necessary to remove the contamination.
- Avoid sample gas streams that are already very close to the dew point or which have dispersed liquid within them. In such cases, sampling from fast loops and/or from downstream of existing catch pot/coalesce systems is always preferred.

Failure to observe these recommendations will potentially cause problems of contamination as well as causing consequential inaccurate, unreliable and inconsistent monitoring. If a top-entry sample point is not available, extra attention should be given to the design of the sample line installation to avoid unwanted contamination.

3 OPERATION

This section describes both the general operation of the analyzer and the method of setting up and changing the default parameters should this become necessary.

NOTE: Before operating the analyzer, read Sections 1 to 3 which explain the analyzer's functionality, installation, controls, display functions and screens.

Prior to operation, the analyzer must have been connected to the correct electrical power supply and the relevant analog and alarm outputs connected to external systems as required and as described in Section 2.6.2. The analyzer must also have been installed as detailed in Section 2.4 and connected to a sample gas supply that is representative of the monitored process.

3.1 General Operational Information

Operation of the CD603 is completely automated and, once set up, requires little or no operator intervention.

A miniature mirror is positioned in a high-pressure gas sensor cell. The gas to be measured flows through the sensor cell and across the surface of the mirror at a set pressure and flow rate. The mirror is mounted on top of a thermoelectric cooler (TEC). Embedded in the mirror is a PT1000 temperature sensor to measure the mirror surface temperature.

The temperature of the mirror at the trigger signal points is related to the dew point of the gas.

There are two types of optical measurement of the same gas: a hydrocarbon dew-point measurement and a water dew-point measurement. When a dew point is detected during a measurement cycle, the detection algorithm will decide whether it has detected a water or hydrocarbon dew point.

As the mirror temperature goes up during the recovery phase, the hydrocarbon and water droplets will evaporate from the surface of the mirror. The signals at the recovery temperature phase (~clean mirror) will be used to 'zero' the signal so that contamination on the mirror (or any other optical drift) are zeroed out.

The cycles of heating and cooling will repeat every few minutes to enable continuous measurement of the gas at discrete intervals.

3.1.1 Keypad

The HMI is accessed via 4 main keypad buttons: **Up, Down, Enter, Escape**. These multifunction buttons are capacitive touch switches which work through the glass of the enclosure lid.

ESC button

- Cycles through front pages
- Cycles out of menu pages
- **LONG ESC** will navigate from the front page to the config menu passcode page

UP and DOWN buttons

- Cycle through menu items
- Adjust variables
- Navigate through Log data

ENTER button

- Selects and deselects menu items and variables to adjust
- **LONG ENTER** will save any adjusted configuration values in the configuration pages

3.1.2 First Time Operation

To commence operation, proceed as follows:

1. Switch on the power supply to the analyzer. The Initializing Screen will appear.

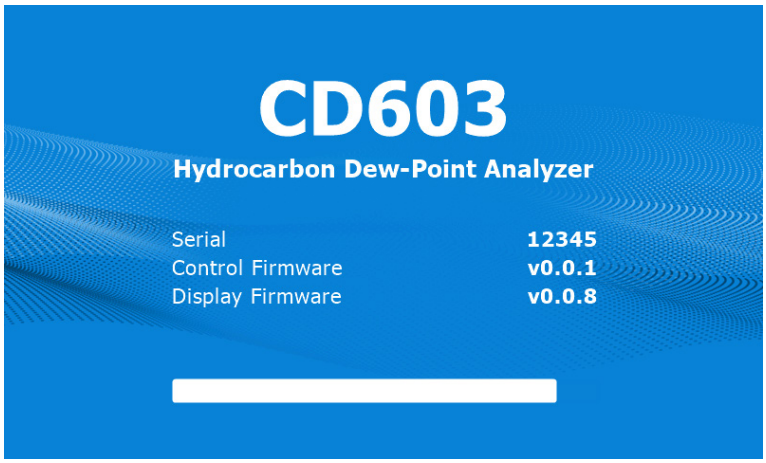


Figure 8 *Initializing Screen*

3.1.3 Analyzer Set-Up

The first pane shows the current mode, phase and countdown to the beginning of the next measurement cycle.

The second pane shows the HCdp or Wdp and the cell pressure. The dew point shown will be last successful measurement, whether HCdp or Wdp.

The third pane shows the optional External Easidew Wdp reading with selected hygrometric unit, and the external pressure reading from the external pressure sensor.

The fourth pane shows the status of the Alarm Relays and any status symbols.

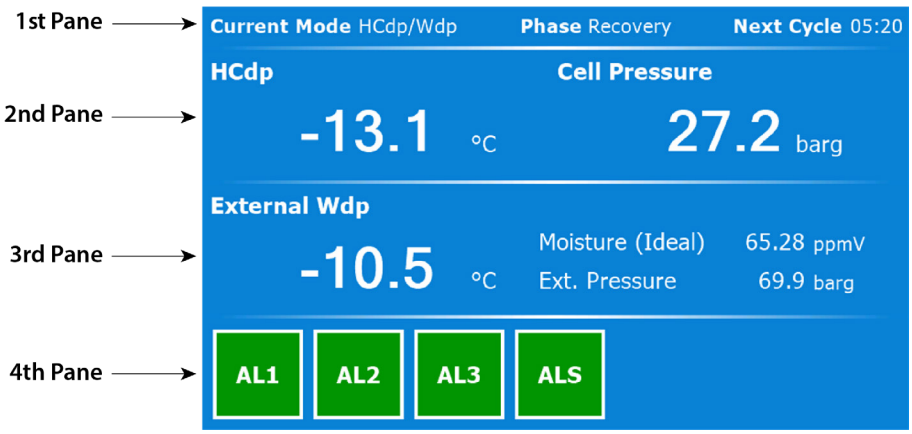


Figure 9 *Front Page A – Main Page*

3.1.4 Operating Mode Selection

The available operating modes are:

- HCdp/Wdp
- Line Wdp only (if enabled)

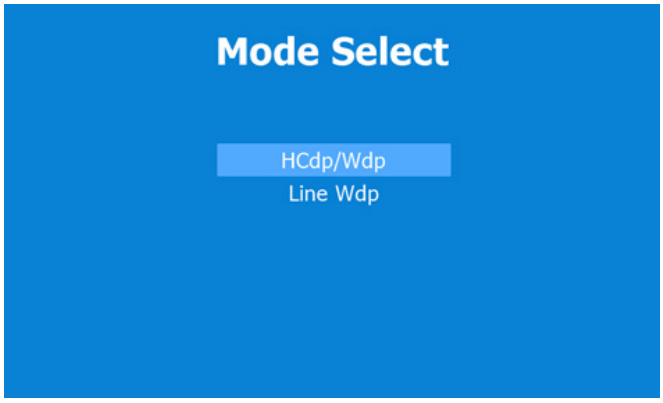


Figure 10 *Front Page A – Main Page*

3.1.5 Operating Mode – External Easidew Wdp Transmitter Fitted

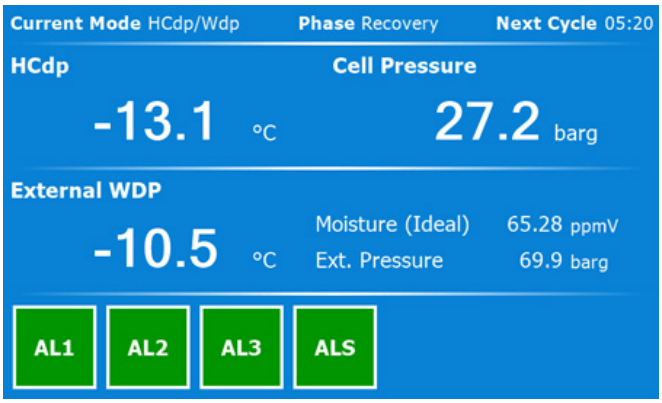


Figure 11 *FRONT PAGE A with External Easidew Wdp Transmitter Fitted*

Warning messages will be flagged by an exclamation symbol on the front page. The messages can then be viewed by pressing the ESC button from this page. This will reveal the Status page, which contains any warning messages.

3.1.6 Front Page A without External Easidew fitted

The second pane shows the HCdp or Wdp. The dew point shown will be the last successful measurement, whether HCdp or Wdp.

The third pane shows the cell pressure reading.

The fourth pane shows the status of the Alarm Relays and status symbols.

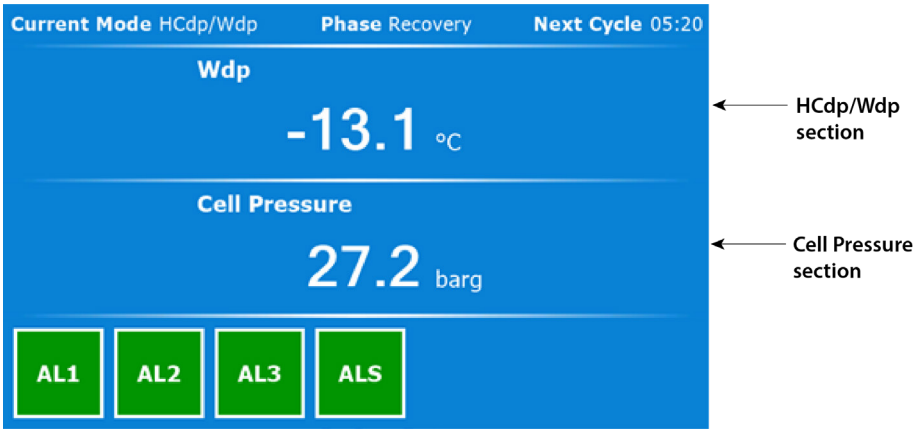


Figure 12 *FRONT PAGE A without External Easidew Fitted*

The Operating Mode selection dialog box can be accessed via a Long **ENTER** press on Front Page A (Only available if Line Wdp is enabled).

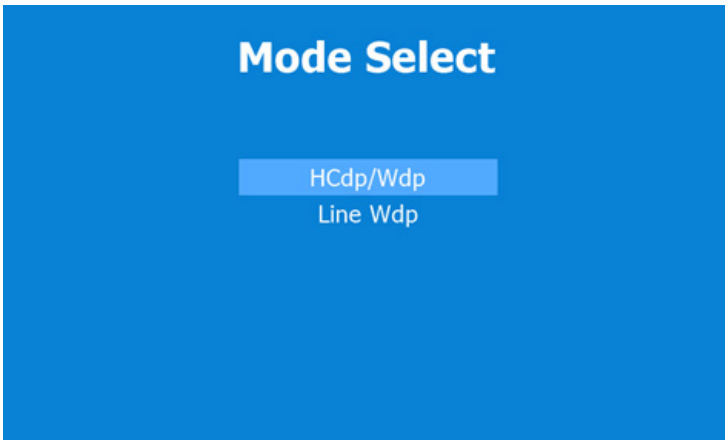


Figure 13 *Operating Mode Selection Page*

3.1.7 Front Page Status Symbols

A Water symbol will appear when water is detected

A warning symbol will appear when there are any Status Alarm messages

Status Relay Alarm condition (red when alarmed)

Process Relay Alarm condition (red when alarmed)

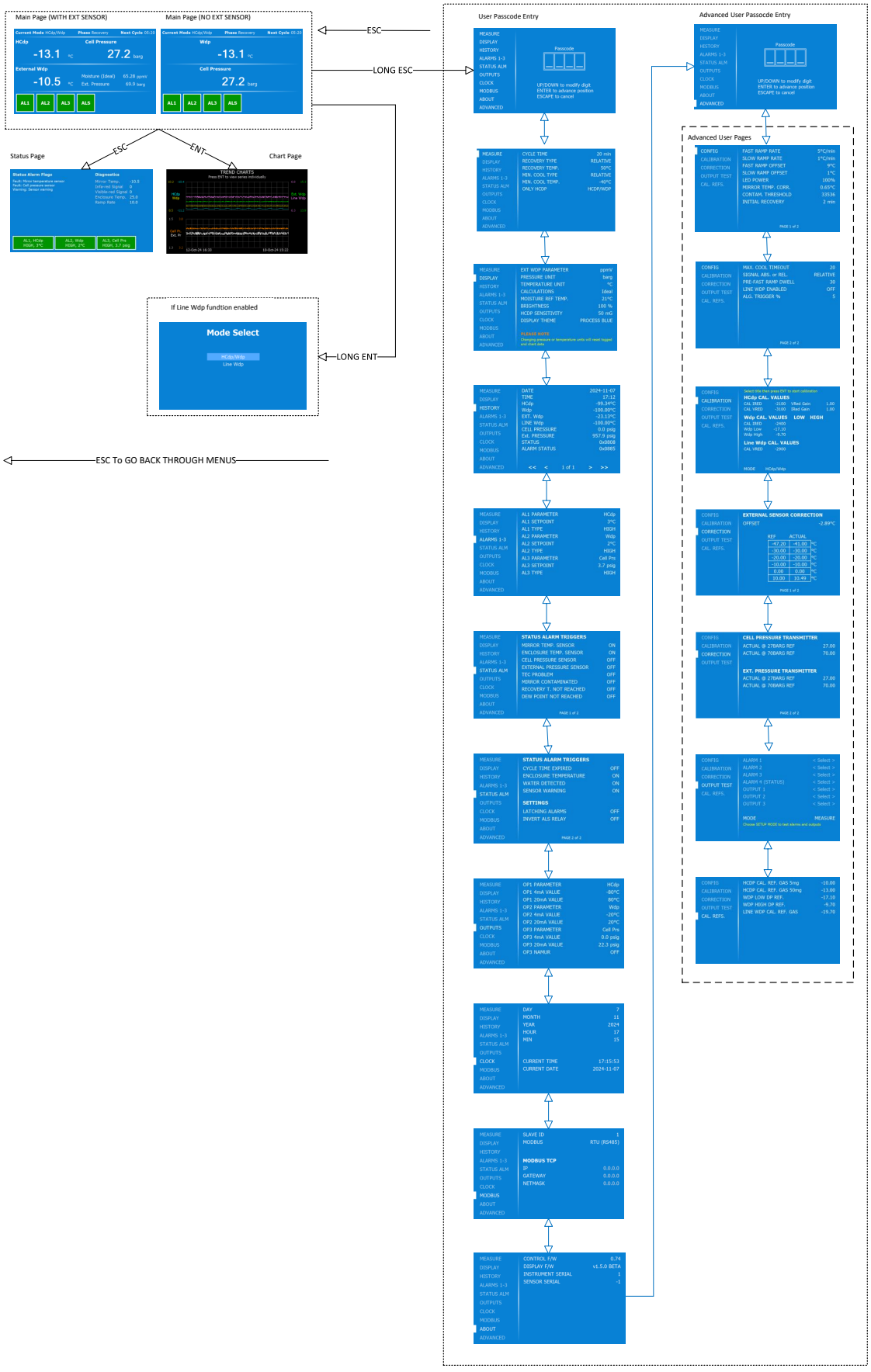
Menu Name/ Location	Item Name	Display Range/ Precision	Description/Notes
Front Page – 1st pane	Current Mode	"HCdp/Wdp" "Line Wdp" "HCdp Cal" "Line Wdp Cal" "Setup" "Wdp Cal" "Ethane Cal"	Indicates current mode of the instrument. *Cal and Setup modes are in italic and will not normally be seen by the customer.*
	Phase	"RECOVERY" "MEASURE"	Indicates the current phase within the measurement cycle. Recovery is when the mirror is at (or going to) an elevated temperature. Measure is the measurement phase of the cycle.
	Next Cycle	Minutes and Seconds in format MM:SS	The time left until the next measurement cycle.
Front Page – 2nd pane	Last successful measurement type	"HCdp" "Wdp" "Line Wdp"	
Front Page with Easidew – 2nd pane Front Page without Easidew – 3rd pane	"Cell pressure"	0.0 to 100.00 barg or equivalent in psig and MPag	Sensor cell pressure. Pressure unit displayed according to user pressure setting.
Front Page with Easidew – 3rd pane	"External Wdp"	-100...+20 °C or equivalent in °F	External Wdp. Unit displayed according to user setting.

	"Moisture (IGT)" "Moisture (ISO)" "Moisture (Ideal)"	"ppmv" "lb/MMscf" "mg/m^3"	Unit displayed is user selectable
	External Pressure	0.0...100.00 barg or equivalent in psig and MPag	The External pressure. Pressure unit displayed according to user pressure setting.
Front Page – 4th pane	AL1 to ALS	Alarm relay status, alarmed or not alarmed, displayed using color	The not alarmed condition will display in a green background and the alarmed condition will be in a red background.
	Water symbol	Not displayed; Displayed	The last measurement was a water dew point.
	Warning symbol	Not displayed; Displayed	Not displayed = Status alarms are all clear. Displayed = one or more status alarms are on.
Front Page – long ENTER button press	Select Mode:	"HCdp/Wdp" "Line Wdp"	Selects the desired measurement mode (only if Line Wdp is enabled).

3.2 User Interface

The CD603 features a 7” color display.

3.2.1 Menu Map



3.2.2 Status Page

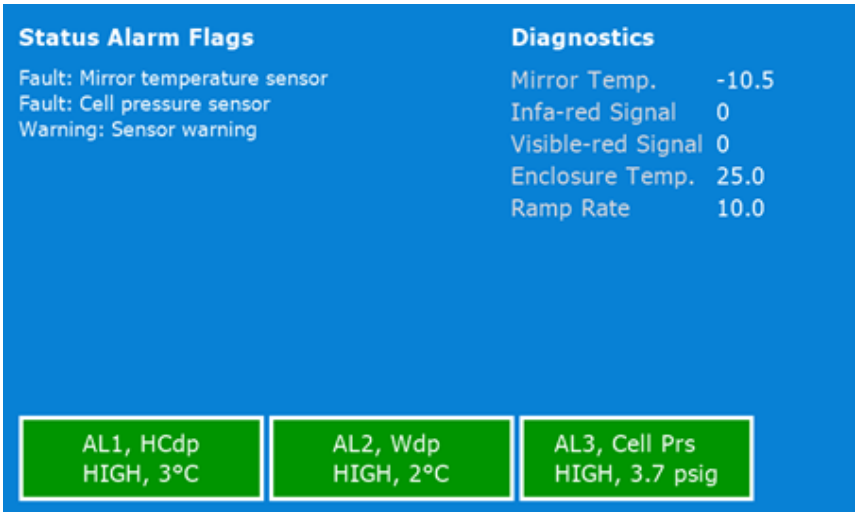


Figure 14 *Status/Alarm Flags Page*

To access this page, press the ESC button from the Front Page.

The Status page has 3 sections:

Status Alarm Flags – This will list any functional warnings or faults detected by the analyzer, as detailed in Appendix A. If **LATCHING ALARMS** (in STATUS ALARM menu) is ON, then these warnings or faults will remain on the screen until the latch is cleared. To clear the latch, long press the **ENTER** button while on this page. Then select **YES**.

Diagnostics – This shows the live readings of Mirror Temperature, Infra-red Signal, Visible-red Signal, Enclosure Temperature and Ramp Rate. This is useful for diagnostics purposes.

Alarm Relay Status – Each box contains the current settings for the relevant alarm relays. The data displayed is:

- Parameter that drives the relay
- Whether it is activated when the parameter is higher or lower than the setpoint
- The setpoint
- The background color reflects the current status.

3.2.3 TREND CHARTS PAGE

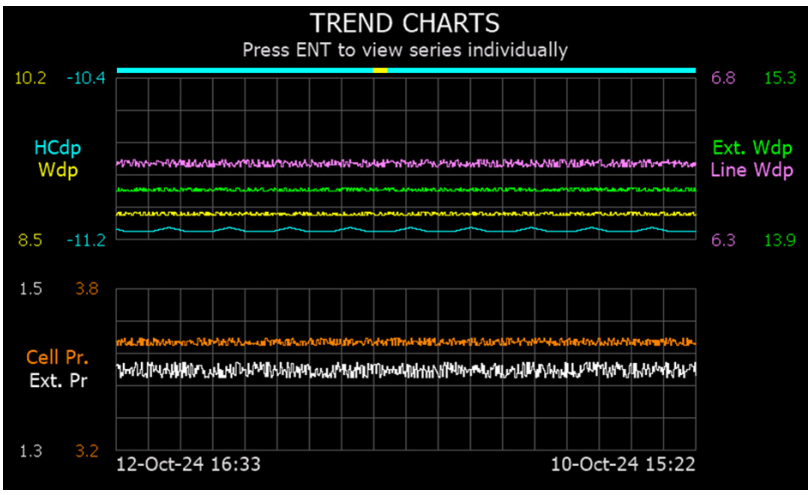


Figure 15 *Trend Charts Page*

To access this page, press the **ENTER** button from the Front Page.

There are two auto-ranging and auto-scrolling charts. The top charts display the dew points (HCdp, Wdp, Ext Wdp and Line Wdp), and the bottom chart displays the pressure (Cell Pressure and External pressure).

The bar at the top of the graph indicates the dew-point type at the time of measurement, whereby light blue = HCdp and yellow = WDp.

Subsequently pressing the **ENTER** button will cycle through displaying individual plots only or all plots.

3.2.4 User Configuration or Advanced Configuration Menu – Passcode Entry

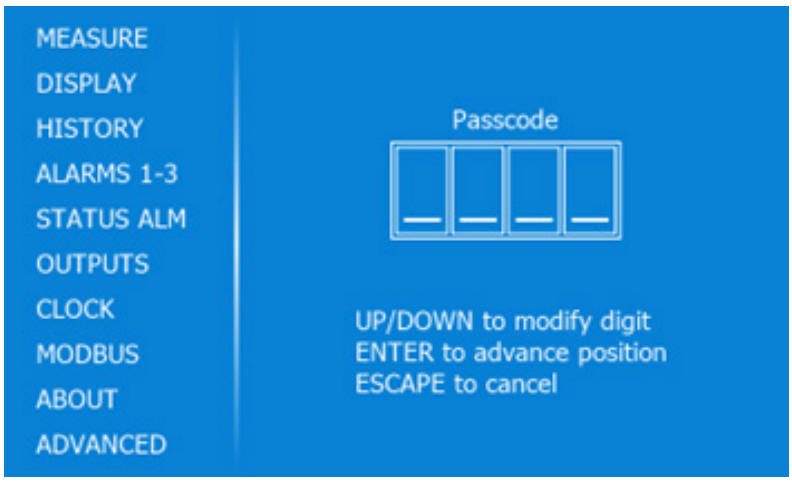


Figure 16 *User Configuration page*

To access the Configuration menu pages, long press the **ESC** button from the Front Page.

UP/**DOWN** keys = Adjust digit

ENTER = Cycle to next digit (previous digit then hidden with a *)

ESC = Return to Configuration page

Passcode = 7316 for user and 5491 for advanced

Once the passcode has been entered, it should allow re-access to the menu for 5 minutes without the need to enter the passcode again.

3.2.5 User Configuration Menu – Measurement Page

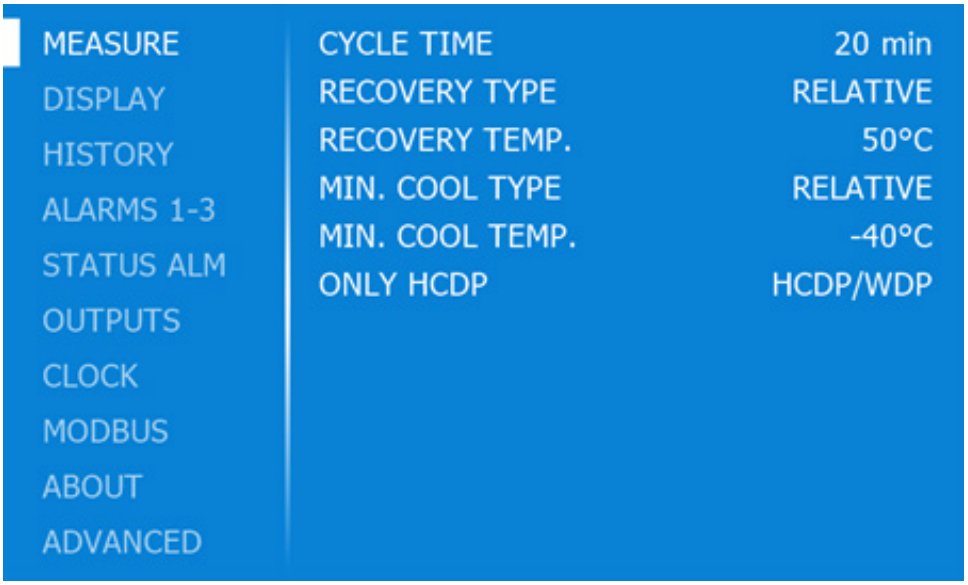


Figure 17 *Measurement Settings Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
MEASUREMENT	CYCLE TIME	10...60 minutes in 10-minute steps	The measurement interval and the maximum time for one cycle. Note: The first cycle after switching on will have an initial heating period – normally 3 minutes.
	RECOVERY TYPE	ABSOLUTE or RELATIVE	Select absolute if the RECOVERY TEMP is a fixed temperature or select REL if the RECOVERY TEMP is an offset from the enclosure temperature.
	RECOVERY TEMP	10...60 °C (50...140 °F) in 1° steps	The absolute recovery temperature or the offset value from the enclosure temperature.
	MIN COOL TYPE	ABSOLUTE or RELATIVE	ABS indicates the MIN COOL TEMP is a fixed value. REL indicates that the MIN COOL TEMP is an offset from the enclosure temperature.
	MIN COOL TEMP	-80...0 °C (-112...32 °F) in 1° steps	The absolute min cooling limit or the offset value from the enclosure temperature.
	ONLY HCDP	HCDP/WDP, HCDP only	Select between HCDP/WDP mode (default) and ONLY HCDP mode.

3.2.6 User Configuration Menu – Display Page

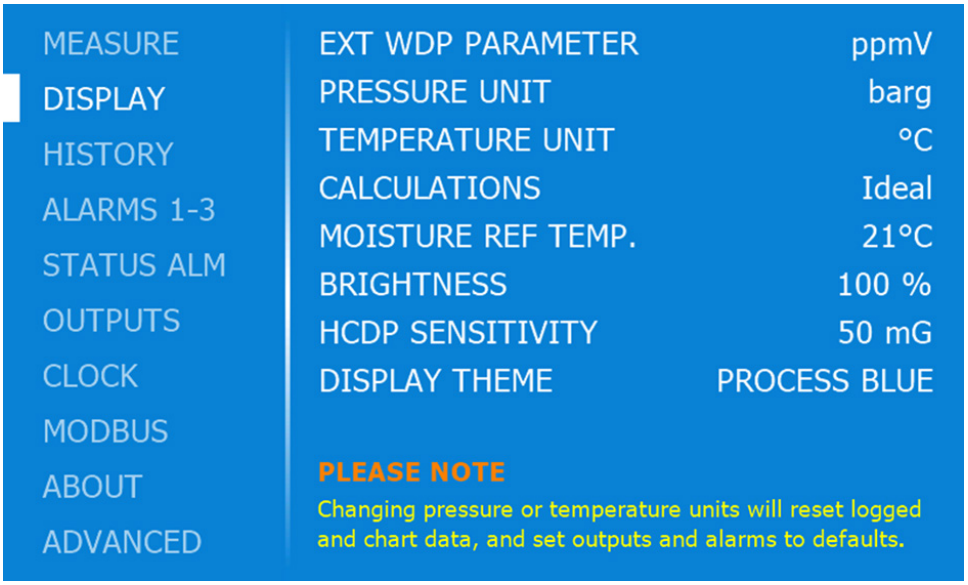


Figure 18 *Display Settings Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
DISPLAY	EXT WDP PARAMETER	ppm_v, lb/MMscf, mg/m³	The displayed parameter in front page for the moisture content from the external sensor (Easidew)
	PRESSURE UNIT	barg, psig, MPag	The global unit for pressure values
	TEMPERATURE UNIT	°C or °F	The global unit for dew point and temperature values
	CALCULATIONS	IGT#8, ISO18453, Ideal	The calculation standard to apply for deriving lb/MMscf
	MOISTURE REF TEMP	0, 15 or 21 °C	Reference temperature used for mg/m³ calculations
	BRIGHTNESS	25...100% in 25% steps	The brightness of the TFT display
	HCDP SENSITIVITY	5 mG, 50 mG	The measurement sensitivity for HCdp measurements
	DISPLAY THEME	BLACK, PROCESS BLUE, PURPLE	Adjust the display color scheme

3.2.7 User Configuration Menu – History Page

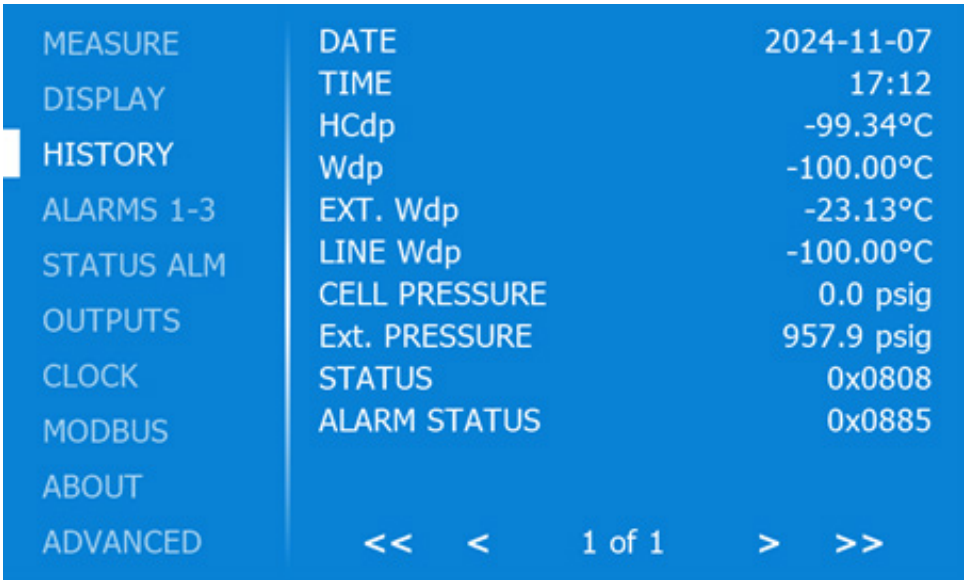


Figure 19 *Measurement History Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
HISTORY		Scroll through 288 logs of data < previous log > next log << first log >> last log	Rolling buffer of up to 288 data samples, logged at end of each measurement cycle. This equates to 48 hours of data on a typical 10-minute measurement cycle. The chart is plotted from this data. Note: This data will be lost on a power cycle.

3.2.8 User Configuration Menu – Alarms 1–3 Page

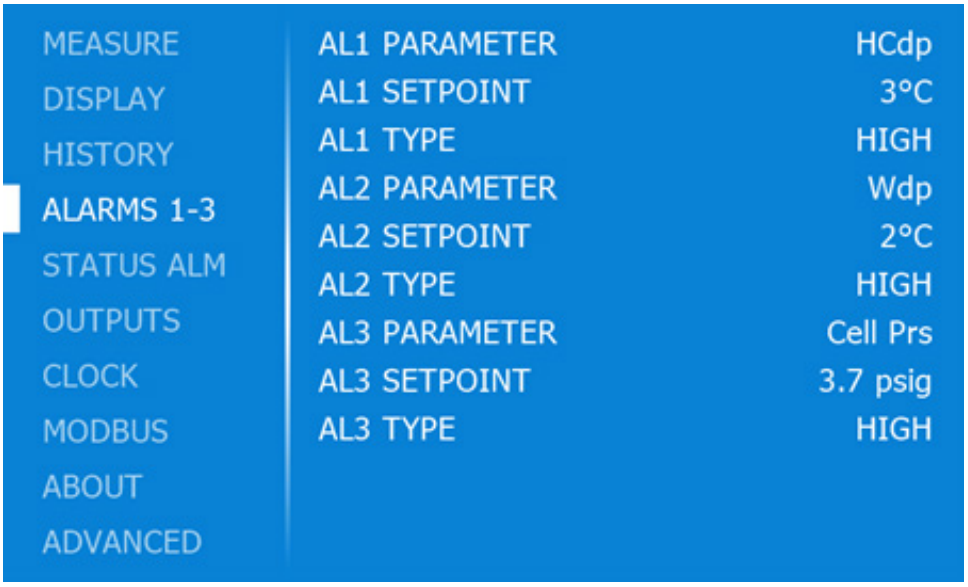


Figure 20 *Alarms 1–3 Settings Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
ALARMS 1–3	ALx PARAMETER	HCdp, Wdp, Cell Pressure, Enclosure Temp., Ext. Wdp, ppm_v, lb/MMscf, mg/m^3, Ext. Pressure, Line Wdp (if enabled)	The alarm will activate on this selected parameter. **Note:** Parameters marked in blue are only available if External sensor is fitted; line Wdp is only available if it is enabled.
	ALx SETPOINT	See Section 3.3 for the range, depending on the selected parameter/unit.	The setpoint at which point the alarm will activate.
	ALx TYPE	High or Low	High – The alarm will activate when the selected parameter goes above the setpoint. Low – The alarm will activate when the selected parameter goes below the setpoint.

3.2.9 User Configuration Menu – Status Alarms Page

Select the status alarm conditions that will trigger the status relay alarm (Alarm 4) and configure other behavior.

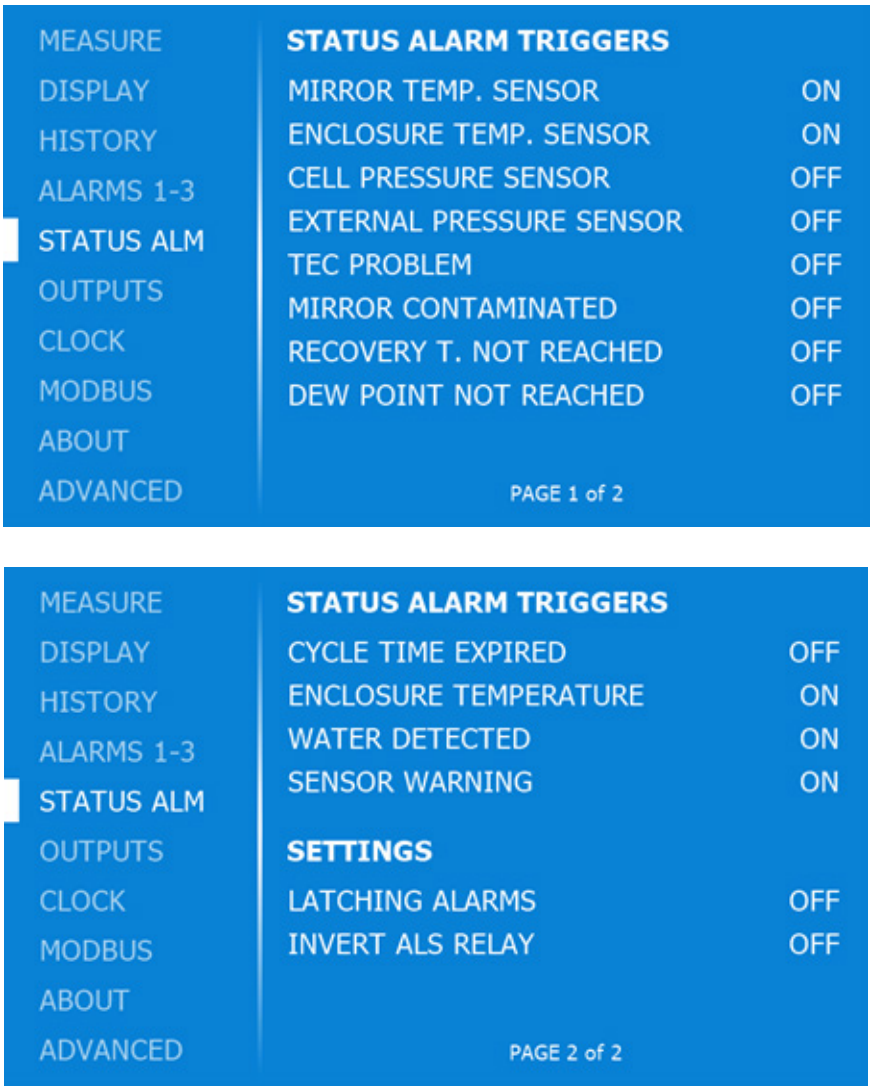


Figure 21 *Status Alarm (Alarm 4) Settings Page*

Menu Name	Item Name	Adjustments/ Options	Description/Notes
STATUS ALARM	STATUS ALARM TRIGGERS See Appendix B for all available options	OFF, ON	Select which alarm condition(s) sets the status alarm (ALS) relay and the NAMUR error condition at OP3.
	LATCHING ALARMS	OFF, ON	Latch all status alarm messages and therefore the OP3 Namur state (if on) and AL4 relay state (if the latched are message(s) selected via settings above).
	SETTINGS – INVERT ALS RELAY	OFF, ON	Invert the behavior of status relay alarm ALS. OFF = Energise relay on alarm condition ON = De-energize relay on alarm condition

3.2.10 User Configuration Menu – Outputs Page

Figure 22 *Analog Output Settings Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
OUTPUTS	OPx PARAMETER	HCdp, Wdp, Cell Pressure, Enclosure Temp., Ext. Wdp, ppm_v, lb/MMscf, mg/m^3, Ext. Pressure, Line Wdp	The output will reflect this selected parameter. **Note:** Parameters marked in blue are only available if External sensor is fitted.
	OPx 4 mA VALUE	See Section 3.3 for the range, depending on the selected parameter/unit	The parameter value that will give a 4.0 mA output.
	OPx 20 mA VALUE	See Section 3.3 for the range, depending on the selected parameter/unit	The parameter value that will give a 20.0 mA output.
	OP3 NAMUR	OFF, 3.2 mA, 21.4 mA	OFF = No error signalling. Normal operation where OP3 mA output will follow the selected parameter. 3.2 mA = OP3 Low error signalling on selected status alarm. mA output will go to 3.2 mA during selected alarm condition(s), otherwise it will follow the selected parameter. 21.4 mA = OP3 High error signalling on selected status alarm. mA output will go to 21.4 mA during selected alarm condition(s), otherwise it will follow the selected parameter. See diagram in Section 3.4.

3.2.11 User Configuration Menu – Real Time Clock Page

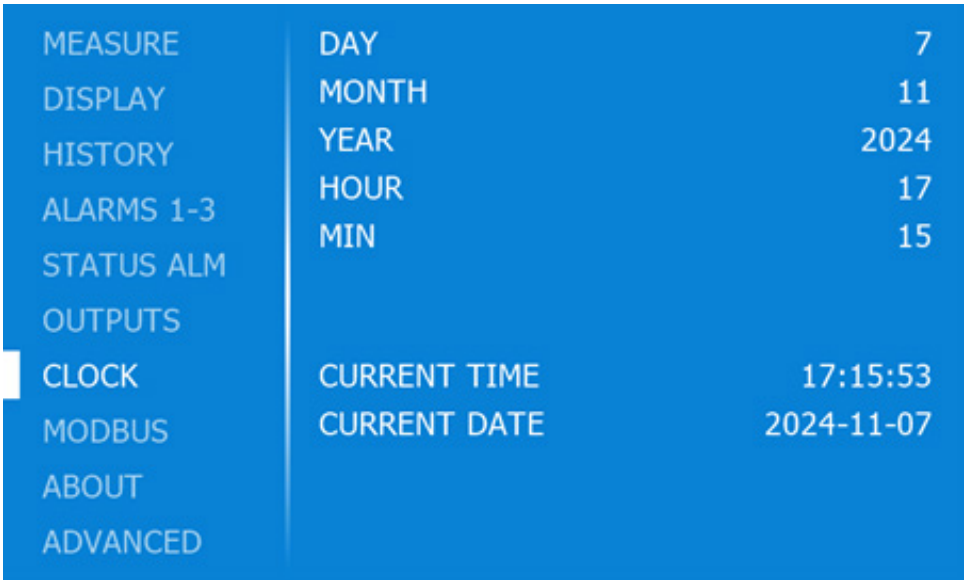


Figure 23 *RTC Settings Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
CLOCK	DAY	01...31	Date – day
	MONTH	01...12	Date – month
	YEAR	00...99	Date – year
	HOUR	00...23	Time – hour
	MIN	00...59	Time – minutes
	CURRENT TIME		Display the current time
	CURRENT DATE		Display the current date

3.2.12 User Configuration Menu – Modbus Set-Up Page

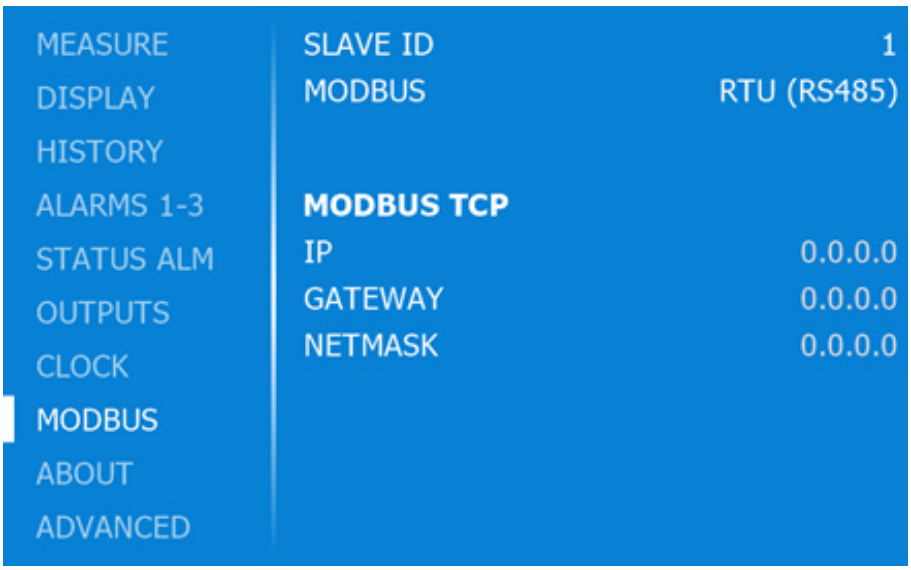


Figure 24 *Modbus / TCP/IP Settings Page*

Menu Name	Item Name	Adjustments/ Options	Description/Notes
MODBUS	SLAVE ID	1...31	Modbus address of analyzer
	MODBUS	RTU (RS485), TCP (Ethernet)	Active Modbus comms interface
	IP ADDRESS	0...255 for each octet	IP Address for TCP connection
	DEFAULT GATEWAY	0...255 for each octet	Default Gateway for TCP connection
	SUBNET MASK	0...255 for each octet	Subnet Mask for TCP connection
	SAVE TCP SETTINGS		This option appears if the TCP settings have been adjusted. Highlight this and select to save the TCP settings into the analyzer. **Note:** This may take a few seconds to complete.

3.2.13 User Configuration Menu – About Page

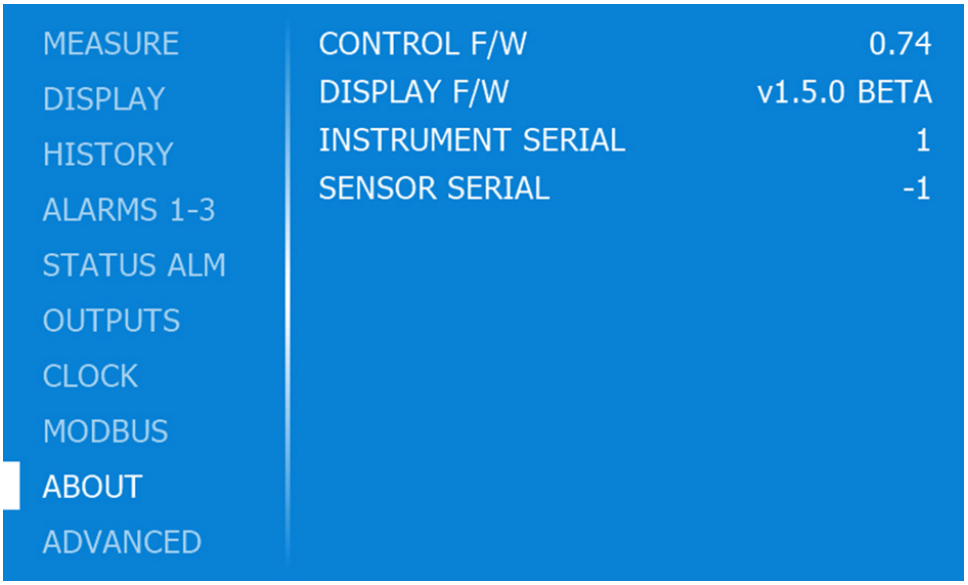


Figure 25 *Version/Serial Number Information Page*

Menu Name	Item Name	Adjustments/options	Description/Notes
ABOUT		CONTROL F/W DISPLAY F/W INSTRUMENT SERIAL SENSOR SERIAL	Contains the firmware revision numbers and instrument serial numbers. Also contains a QR code linking to the PST website.

3.2.14 User Configuration Menu – Advanced Pages Passcode Entry

UP/**DOWN** keys = Adjust digit

ENTER = Cycle to next digit (previous digit then hidden with a *)

ESC = Return to configuration menu

Passcode = 5491

Once entered, re-access to the configuration menu is allowed for 5 minutes after exiting, without requiring the passcode again.

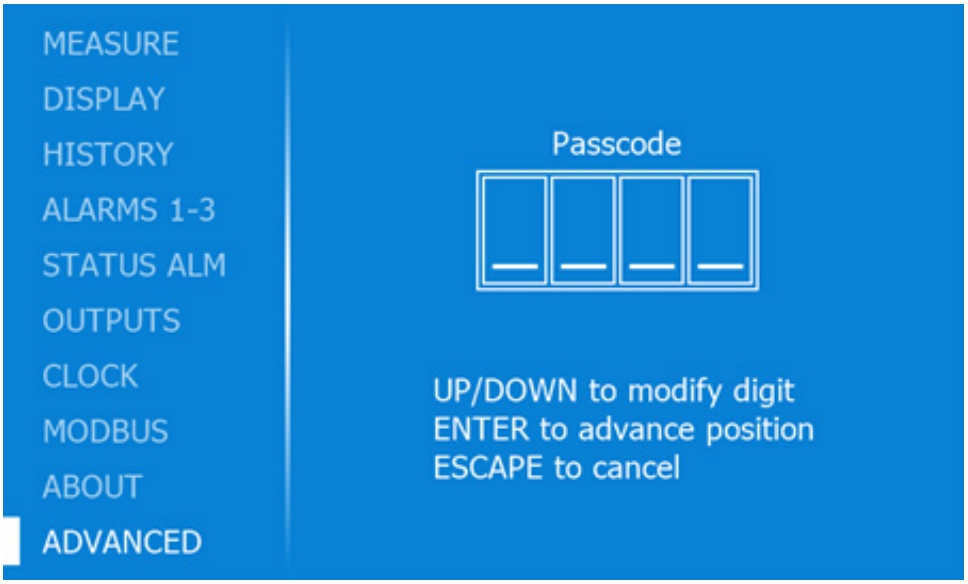


Figure 26 *Advanced Configuration Access Page*

Menu Name	Item Name	Adjustments/options	Description/Notes
ADVANCED		5491 passcode	

3.2.15 User Configuration Menu – Advanced Menu – Configuration Page

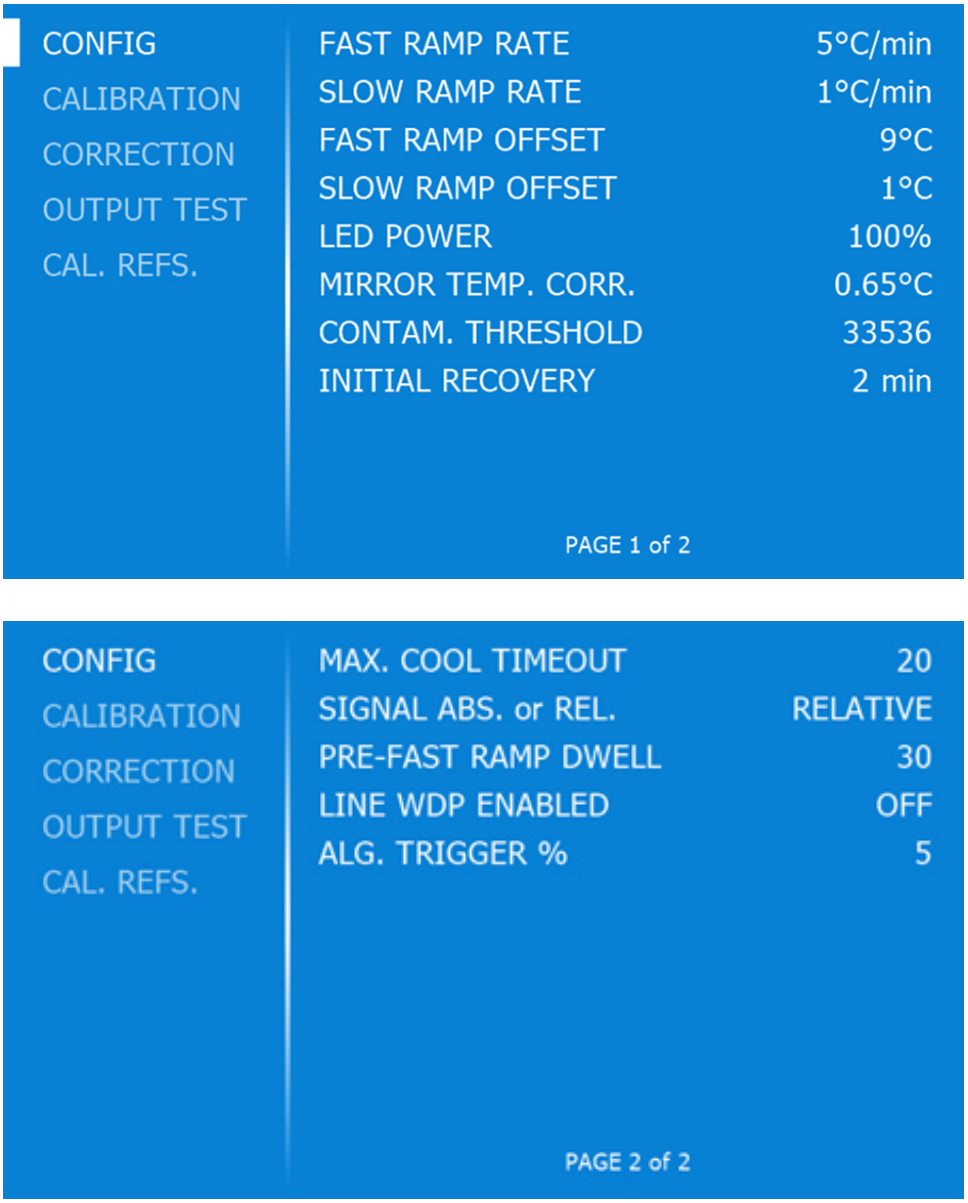


Figure 27 *Advanced Configuration Settings Page*

Menu Name	Item Name	Adjustments/ Options	Description/Notes
CONFIG	FAST RAMP RATE	1...15 °C /min in 1° steps	Ramp rate from start of fastdown to slow-down temperature
	SLOW RAMP RATE	1...15 °C /MIN IN 1° STEPS	Ramp rate from start of slowdown to target temperature
	FAST RAMP OFFSET	3...20 in 1° steps	Difference between target and start of fast-down temperature
	SLOW RAMP OFFSET	1...20 in 1° steps	Difference between target and start of slow-down temperature
	LED POWER	5...100 %	Sensor LED intensity
	MIRROR TEMP CORR.	-10.0...10.0 ° in 0.1° steps	A positive or negative offset to correct errors in the mirror temperature reading
	CONTAMINATION TH.	0...65000	The signal threshold for excessive mirror contamination
	INITIAL RECOVERY	1...60 m	Recovery period after power on or after switching measurement modes.
	MAX COOL TIMEOUT	10...150 s	Maximum time allowed for the TEC drive to be at maximum cooling power
	SIGNAL ABS or REL	ABSOLUTE, RELATIVE	Optical signals relative to recovery temperature, or absolute
	PRE FAST RAMP DWELL	0...63 s	Pause time at start temperature of the fast ramp of the mirror temperature
	LINE WDP	OFF, ON	Enable or disable the Line Wdp function.
	ALG TRIGGER %	5...100	Wdp detection signal range in %

3.2.16 Advanced Menu – Calibration Page

Figure 28 *Calibration Values Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
CALIBRATION	HCdp CAL VALUES	Click **ENTER** while cursor is on the title text to start the calibration.	The calibration values for measuring hydrocarbon dew point.
	Wdp CAL VALUES LOW HIGH	Click **ENTER** while cursor is on LOW or HIGH to start the relevant calibration.	The calibration values for measuring water dew point.
	Line Wdp CAL VALUES	Click **ENTER** while cursor is on the title text to start the calibration.	The calibration values for measuring Line Water dew point.

3.2.17 User Configuration Menu – Advanced Menu – Corrections Page

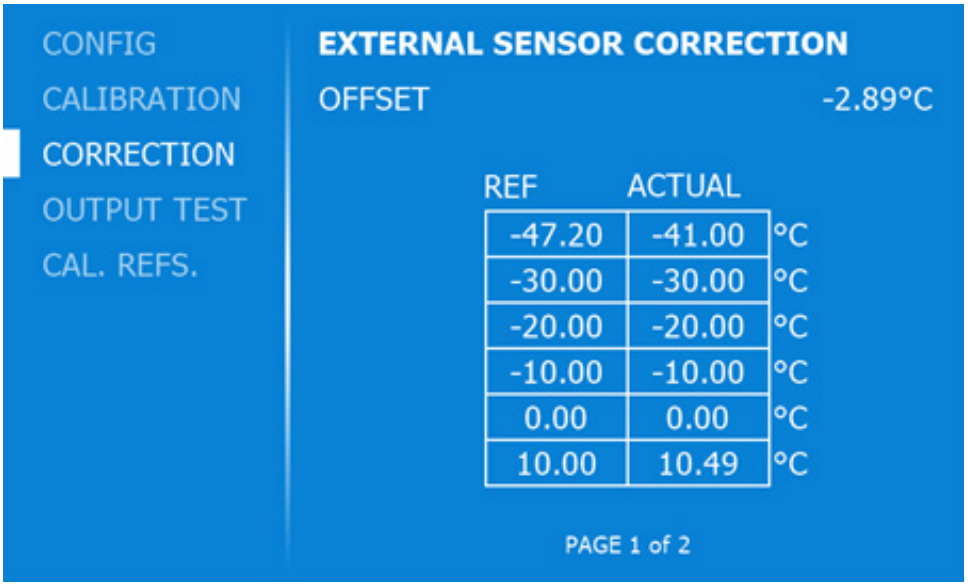


Figure 29 *Sensor Corrections Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
CORRECTION	OFFSET	-10.0...+10.0 °C	Single point correction of the external sensor reading
	REF values	-100.0...+100.0 °C	External sensor correction – reference gas
	ACTUAL values	-100.0...+100.0 °C	External sensor correction – actual reading
	CELL PRESSURE ACTUAL @27BARG REF	0...100 barg	Pressure sensor correction – Sensor cell pressure value at 27.0 barg
	CELL PRESSURE ACTUAL @70BARG REF	0...100 barg	Pressure sensor correction – Sensor cell pressure value at 70.0 barg
	EXT PRESSURE ACTUAL @27BARG REF	0...100 barg	Pressure sensor correction – External cell pressure value at 27.0 barg
	EXT PRESSURE ACTUAL @70BARG REF	0...100 barg	Pressure sensor correction – External cell pressure value at 70.0 barg

UP/**DOWN** keys = Cycle to next item

ENTER = Make adjustments to selected item

ESC = Return to **Advanced** menu

3.2.18 User Configuration Menu – Advanced Menu – Output Test Page

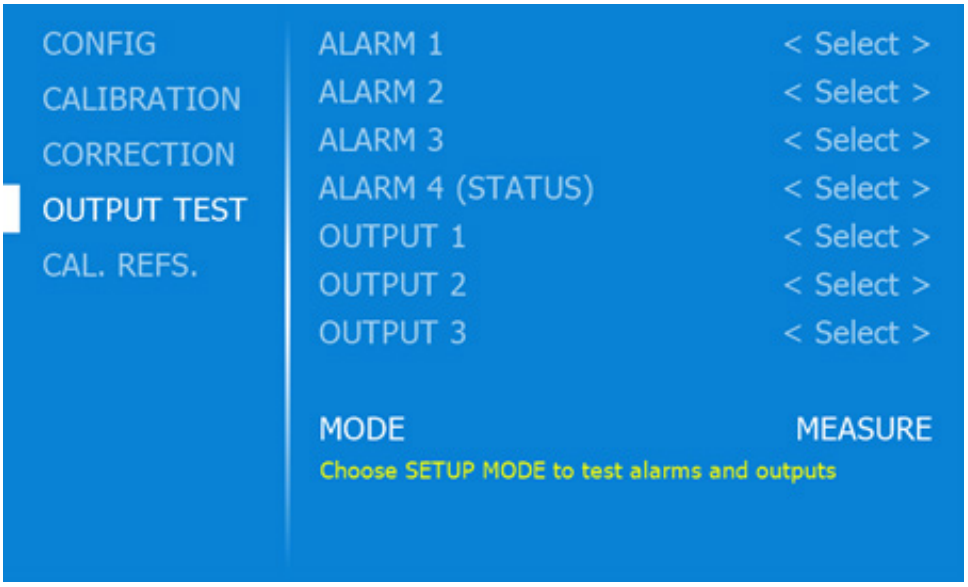


Figure 30 *Analog Outputs Test Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
OUPTPUT TEST	ALARM X	OFF, ON	First ensure instrument is in SETUP mode. De-energises or energises the alarm relays for test purposes.
	OUTPUT X	4 mA, 12 mA, 20 mA	First ensure instrument is in SETUP mode. Sets the analog output to the selected values for test purposes.
	MODE	Current Instrument mode	To check instrument is in setup mode before operating the above tests.

3.2.19 User Configuration Menu – Advanced Menu – Cal. Refs

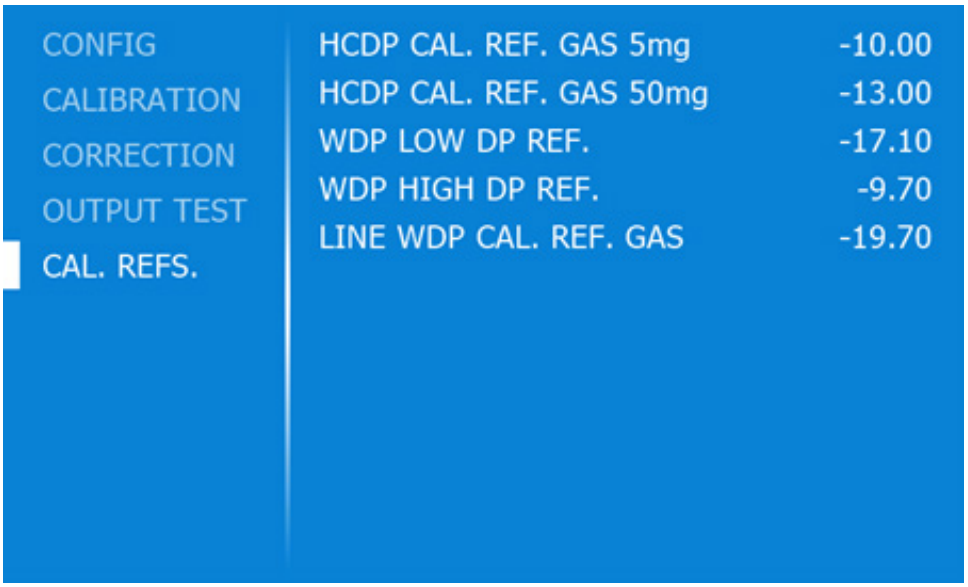


Figure 31 *Calibration Reference Page*

Menu Name	Item Name	Adjustments/Options	Description/Notes
CAL. REFS.	HCDP 5 mg HCDP 50 mg WDP LOW WDP HIGH LINE WDP	-50...+50 °C	The reference gas dew-point values for calibration of the analyzer.

3.3 Analog Outputs Range and Alarm Setpoints

Unit	Adjustment Range/Res.
Dew point in °C	-100...100
Dew point in °F	-148...212
ppm_v	0...3000
lb/MMscf	0.0...1500.0
mg/m³	0...25000
Pressure, psig	0...1470
Pressure, barg	0.0...100.0
Pressure, MPag	0.0...10.1
Enclosure T °C	-50...+100
Enclosure T °F	-58...+212

3.3.1 Alarm Hysteresis

The alarms are equipped to clear on 0.2 % of setpoint hysteresis. This is to ensure that the clear value is not the same as the set value as to avoid the alarm chattering on/off when the value is close to the alarm set point.

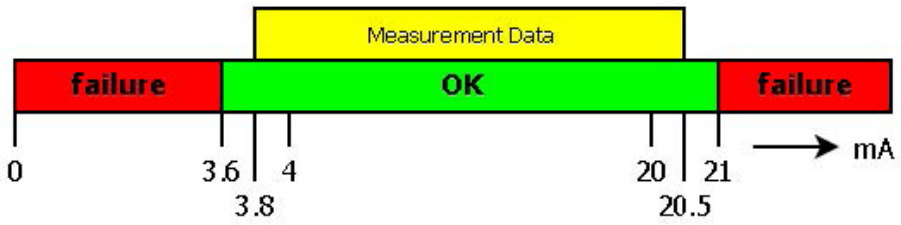
For example, if a Hi alarm is set to trigger at 41.00 barG external pressure input, it will come on at 41.00 and go off at 41.00-(41.00*0.2%) = 40.92 barg.

For example, if a Lo alarm is set to trigger at 39.00 barG external pressure input, it will come on at 39.00 and go off at 39.00+(39.00*0.2%) = 39.08 barg.

3.4 Possible Status Alarm Conditions

Bit	HEX	Warning Message	Meaning	Type
0	0001	"Fault: Mirror temperature sensor"	Open or short circuit sensor	Fault
1	0002	"Fault: Enclosure temperature sensor"	Open or short circuit sensor	Fault
2	0004	"Fault: Cell pressure sensor"	Sensor malfunction or pressure out of range	Fault
3	0008	"Fault: External pressure sensor"	Sensor malfunction or pressure out of range (only when Easidew connected)	Fault
4	0010	"Fault: TEC problem"	Short circuit on TEC output	Fault
5	0020	"Warning: Mirror contamination"	Mirror may require cleaning	Warning
6	0040	"Warning: Failed to reach recovery temperature"	TEC heating issue	Warning
7	0080	"Warning: Failed to reach the dew-point temperature"	Minimum HCdp cooling temperature reached, or TEC has reached maximum cooling capability	Warning
8	0100	"Warning: Cycle time expired"	Measurement unable to be made within the cycle time	Warning
9	0200	"Warning: Enclosure temperature out of range"	Beyond -20 and +70 °C	Warning
10	0400	"Warning: Water formation detected"	Water may be present	Warning
11	0800	"Warning: Sensor warning"	Possible sensor problem	Warning

NAMUR Analog ouput OP3 error signalling diagram:



3.5 Description of Measured Parameters

Moisture content ppm_V	parts per million of H_2O by volume
Moisture content ppm_W	parts per million of H_2O by weight
Moisture content mg/m^3	milligrams of H_2O per cubic meter gas
Water Vapor Pressure Pa	water vapor pressure in pascals
lbs/MMscf	pounds of H_2O per million standard cubic feet
Dew point	dew-point temperature of either ideal or natural gas depending on options set on measurement screen
Flow	Gas flow rate
Cell Pressure	Pressure measured by the internal pressure transducer
Ext. Pressure	Pressure measured by an external pressure transducer (if fitted)

3.6 Sampling Guidelines

The CD603 measurement system must be supplied with gas at the required pressure via a sample gas handling panel. The hydrocarbon dew-point stream is always included as part of the system and, as an additional option, the water dew-point stream can be fitted. Sample gas entry and exit ports pass the gas through flame arrestors which provide the explosion-proof protection.

The measurement system components are housed within a cast aluminium EExd rated enclosure. The enclosure has a screw cover incorporating a sealed window. It is chromate primed, polyester coated in black, and provides environmental protection to IP66/NEMA 4. An enclosure breather is fitted in the form of an additional flame arrestor. It is important that no pipe connection is made to this breather and that no restriction is allowed to occur.

All sample-wetted metallic parts are manufactured in AISI 316L stainless steel with Viton soft parts that comply with the NACE standard MR-01-75 (latest edition). Tube fittings are twin ferrule compression type. All electrical and gas connections are made through the base of the enclosure. Refer to the Mounting Drawing in Figure 3.

General guidelines to be followed when setting up a sampling system are as follows:

- **Ensure that the sample is representative of the gas under test**

To ensure that the sample is representative of the process being monitored, the sample point should be as close to the critical measurement point as possible. Also, never sample from the bottom of a pipe where entrained liquids may be drawn into the analyzer's sample input line.

- **Minimize the 'dead space' in sample lines**

Dead space in sample lines causes moisture entrapment points, increased system response times or measurement errors as the trapped moisture is released into passing sample gas, producing an increase in partial vapor pressure.
Avoid the use of too many T-pieces, in-line couplings or other unnecessary tubework. Sample tubework should, ideally, be specially designed for each application rather than adapted from that previously installed for another application. Dead space in sample lines increases response time by holding water molecules which are more slowly released to the passing gas sample.

- **Remove any particulate matter or oil from the gas sample**

Particulate matter can damage the sensors. If particulate matter, such as degraded desiccant, scale or rust, is likely to be present in the sample gas use a particulate in-line filter. Michell Instruments can be contacted for advice.

- **Use high-quality sample tube fittings**

The sample tubework must be capable of withstanding the operating pressure of the sample line. Wherever possible, always use stainless-steel tubework and fittings. This is particularly important at low dew points since other materials, e.g. nylon, have hygroscopic characteristics and adsorb moisture on the tube walls, giving rise to slower measurement response and, under certain circumstances, false readings.

In order to maximize response time, always use the shortest run of tubework and the smallest bore possible, taking care not to induce pressure differentials by aiming for too high a flow rate through too small a bore. Michell Instruments supplies a range of precision pressure fittings suitable for use with the CD603. Contact Michell Instruments for details of the items available.

- **Gas samples**

Generally, if the sample gas (in conjunction with water vapor) is not corrosive to base metals, it will be suitable for measurement by the CD603 Analyzer. Gases containing entrained solids should be filtered before application to the analyzer.

Care should be taken with gas mixtures containing potentially condensable components in addition to water vapor, e.g. oil, to ensure that only water vapor is present in the sample. Once present on the surface of the sensors, oil will not dry out and will contaminate and damage them.

- **Material of construction**

All materials are permeable to water vapor, as the water molecule is extremely small compared to the structure of solids, even when compared to the crystalline structure of metals.

Many materials contain moisture as part of their structure, particularly organic materials, salts and anything which has small pores. It is important to ensure that the materials used are suitable for the application.

If the partial water vapor pressure exerted on the outside of a compressed air line is higher than on the inside, the atmospheric water vapor will naturally push through the porous medium against a dry air water vapor pressure. Water will migrate into the pressurized air line; this effect is called transpiration.
Over a long tube run, water will inevitably migrate into any line even through the most resistant materials. Moisture on the outlet of the line will be different than on the inlet. The best material to resist transpiration is 316L stainless steel.

It is also important to note that temperature changes can increase the tendency of these materials to affect the humidity of the surrounding air. With a given surface and gas composition, increases of line pressure and decreases in temperature increase surface adsorption.

- **Internal material surface finish**

Components with a smooth surface finish are always preferred. If a choice of surface finish is available for the materials dictated by the process or sample system, select the smoothest for fastest response.

- **Tube diameter**

The larger the sampling tube diameter, the more exposed the gas will be to the tube wall. Therefore, it is recommended to use the smallest possible tube diameter to minimize the previously mentioned effects. This must be balanced with the desired response speed. Depending on the configuration, 1/8” tube diameter is recommended. Please contact Michell Instruments if further recommendations are needed.

- **Ambient temperature variation**

Fluctuations in ambient temperature conditions can cause detectable changes in the moisture content of the sample gas, due to heating/cooling of the sample system. Small molecules such as water will migrate through the wall until the entire system reaches a new equilibrium. It is possible to minimize this effect on a sampling system by heat tracing sample lines and insulating/heating the sampling system enclosure to a stable temperature above the maximal ambient temperature.

It is important to control the temperature of all components of the sampling system, including regulators and sample lines. For this reason, it is strongly advised to use heat-traced lines to eliminate this temperature change effect and measure moisture content solely related to the gas under test.

4 MAINTENANCE

The power to the enclosure must be turned off before any work is carried out in the measurement system enclosure.

Before commencement of the start-up procedure, ensure that all power and signal connections to the CD603 are fully isolated and, if necessary, observe the stipulated de-energization period of 45 minutes.

Gas line connections to the measurement system must be isolated and de-pressurized before any work commences.

Any loose or disturbed tubework or couplings must be leak tested.

The design of the CD603 and measurement system is such that no specific routine maintenance is required. However, if a fault that is not covered within this manual does occur with the system, please contact Michell Instruments or your local representative – visit www.ProcessSensing.com for contact details.

The CD603 is a certificated product for use in Zone 1 Hazardous Areas. Any maintenance of this product should only be conducted by suitably trained personnel and in accordance with locally applying regulations. Any unauthorized maintenance of this product could invalidate the product warranty.

4.1 Safety

This equipment operates from power supply voltages that can be lethal.

Ensure that any installation meets the standards described in Section 2 of this handbook.

Under NO circumstances should the analyzer's covers be removed while the analyzer is in operation or the air vents covered or in any way restricted.

Maintenance and repair must only be carried out by competent personnel or, alternatively, returned to the manufacturer for this purpose.

4.2 Removal and Replacement of the Power Supply Fuse

This product is provided with an internally mounted fuse located beneath the power connector.

The fuses are rated at:

Mains 240 V AC 3 A

NOTE: Only these types of fuses must be used.

Replacement fuses can be obtained by contacting Michell Instruments' technical support.

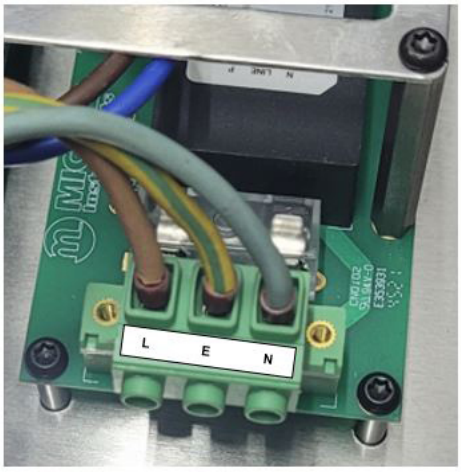


Figure 32 *Power Unit Connection and Fuse Location*

4.3 Field Verification of HC Dew-Point Measurement

If desired by the user, periodic verification of the HC dew-point measurement can be carried out at the field installation location using ethane gas. This gas has a well-defined phase relationship, as shown in the table below.

Test Gas

Ethane ≥99.9% purity recommended (99.5% purity is also satisfactory but with increased uncertainty).

A cylinder containing liquified ethane is most convenient for site handling and effective use in delivering the required gas pressure. 1 kg of liquid provides 780 litres of gas supplied at 30...40 barg vapor pressure (assuming moderate ambient temperature). This supply pressure is sufficient to achieve the desired analysis pressure and sample flow for the CD603 with flow restrictor fitted in accordance with Ex standards current at the time of manufacture of this analyzer.

Pressure measurement

The internal pressure measurement within the HCdp sensor of the CD603 Analyzer offers an appropriate measurement range and accuracy to carry out this procedure.

Pressure regulation and sample flow control

The Michell Instruments CD603 sampling system can be operated as normal during the field verification procedure, whilst flowing ethane gas in place of process natural gas. The ethane cylinder can be connected directly to the sample gas inlet of the CD603 sampling system.

Accuracy expectation

The measurement readings of the CD603 are expected to agree with the theoretical HCdp temperatures shown in the table below, within the following accuracy tolerances:

+/-0.5 °C when using ≥99.9% purity grade ethane
+/-1.0 °C when using 99.5% purity grade ethane

Ethane	mol	100	100	100	100	100	100	100
Pressure	Barg	15	16	17	18	19	20	21
Temp	°C	-16.2	-14.0	-11.8	-9.7	-7.7	-5.8	-3.9
Ethane	mol	100	100	100	100	100	100	100
Pressure	Barg	22	23	24	25	26	27	28
Temp	°C	-2.1	-0.4	1.3	3.0	4.6	6.1	7.7
Ethane	mol	100	100	100	100	100	100	100
Pressure	Barg	29	30	31	32	33	34	35
Temp	°C	9.2	10.6	12.0	13.4	14.8	16.1	17.4

Table of expected HC dew point at the analysis pressure within the CD603 sensor cell

5 CALIBRATION

5.1 Traceability

The original factory calibration of this analyzer is traceable to national standards.

A calibration certificate bearing the calibration data points is issued with each analyzer.

6 SHIPPING

6.1 Preparation for Shipping and Packing if not Supplied as a Sample System

For shipping purposes, the analyzer should be packed into its original crate as this will provide the recommended degree of protection during transit.

To prepare the analyzer for shipping, proceed as follows:

1. Isolate the incoming sample line and depressurize the system. Remove the connections to the GAS IN and GAS OUT ports. Purge the gas lines with dry nitrogen to remove potentially corrosive gases.
2. Switch off the analyzer, isolate the power supply and remove the power supply cable.
3. Remove the analog connector and alarm output connectors.
4. Pack the analyzer in its original crate by first fitting the end packing, and lowering the analyzer into the crate. Place any accessories being returned in the accessories box and place in the crate last.
5. Create a packing list detailing all equipment contained in the crate, place it inside and seal the crate.

7 APPLICATION SOFTWARE OVERVIEW

Software is available on request.

Appendix A

Technical Specifications

Appendix A Technical Specification

Hydrocarbon & Water Dew-Point Measurement	
Measurement Technique	Chilled Mirror
Sensor Cooling	Automated cooling rate control
Maximum Range	Maximum cooling = >65 °C (117 °F) ΔT from analyzer operating temperature
HCdp Accuracy	± 0.5 °C (0.9 °F)
Wdp Accuracy	± 0.8 °C (1.4 °F)
Resolution	0.1 °C, 0.1 °F
Sample Flow	Nominally 0.1 Nl/min (0.0035 scfm)
Pressure Measurements HCdp & Wdp	
Units	MPag, barg, psig
Resolution	0.1 MPag, 0.1 barg, 1 psig
Accuracy	± 0.25 barg (3.6 psig)
Hydrocarbon Dew-Point Analyzer	
Operating Pressure	Up to 100 barg (1450 psig) – Ex db IIB+H2 T3 Gb Up to 60 barg (870 psig) – Ex db IIB+H2 T6 Gb *
Enclosure	Cast LM25 Alloy IP66/UL Type 4X Coating: Epoxy primer, powder coat polyester suitable for marine applications
Gas Connections	1/8" NPT
Operating Environment	-30 °C...+50 °C (-22 °F...+122 °F) max 95 %rh
Weight	23 kg (51 lb)
Display & User Interface	High-definition 5” color display, operated by 4 capacitive touch pads
Logging & Charting	Up to 288 log samples (equivalent to 48 hrs of data in 10-min measurement cycles)
Hazardous Area Certification	See Appendix B
Interfaces	
Analog Outputs	Three 4...20 mA linear (non-isolated) outputs, user-configurable for any combination of dew-point or pressure parameters. Max shunt resistance 400 ohms.
Digital Outputs	1 x system alarm, 3 x process alarms, selectable for all warnings and measurement parameters, all volt-free changeover. Modbus RS485 or TCP/IP
Optional Continuous Water Dew-Point Measurement	
Range	-100 °C...+20 °C (-148 °F...+68 °F) dew point
Accuracy	± 1...2 °C Wdp
Parameters and Units	°C and °F Wdp , moisture content lb/ MMscf , ppm_V , mg/m^3 (15 °C/ 59 °F), analysis pressure barg, psig, MPa
Analysis Pressure	Up to 100 barg (option dependant)
Power Supply	
AC Version (Ex1)	85...264 V AC, 50/60 Hz, 18 W 36 VA
DC Version (Ex2)	18...36 V DC, 18 W

* To order T6 rated units, please contact your local sales team.

A.1 Dimensions

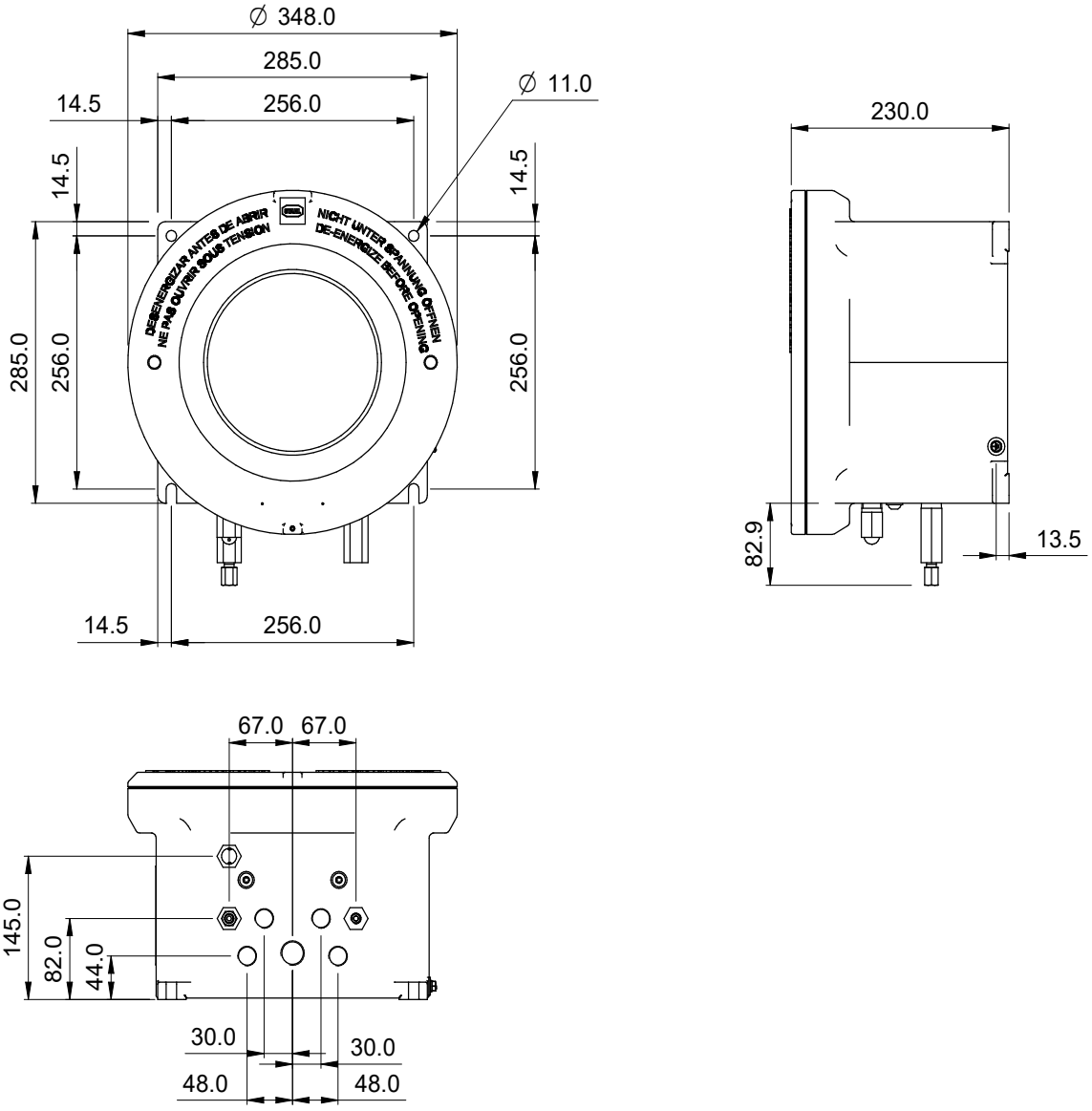


Figure 33 *Dimensional Drawings*

Appendix B

Hazardous Area Certification

Appendix B Hazardous Area Certification

The CD603 Condumax Dew-point Analyzer is certified compliant to the ATEX Directive (2014/34/EU), the IECEx scheme and SI 2016 No. 1107 UKEX product marking scheme for use within Zone 1 & 2 Hazardous Areas and has been assessed as being so by CML BV Netherlands (Notified Body 2776) and EUROFINS CML UK (Approved Body 2503).

The CD603 Condumax Dew-point Analyzer is certified compliant to the applicable North American Standards (USA and Canada) for use within Class I, Division 1 and Class I, Zone 1 Hazardous Locations and has been assessed as being so by QPS Evaluation Services Inc.

B.1 ATEX/UKEX

Certificate: CML 21ATEX1326X / CML 21UKEX1377X

Certification: II 2 G Ex db IIB+H2 T3 Gb – 100 barg max.
II 2 G Ex db IIB+H2 T6 Gb – 60 barg max.
Tamb -20 °C...+55 °C

Standards: EN IEC 60079-0:2018, EN 60079-1:2014

B.2 IECEx

Certificate: IECEx CML 21.0039X

Certification: Ex db IIB+H2 T3 Gb – 100 barg max.
Ex db IIB+H2 T6 Gb – 60 barg max.
Tamb -20 °C...+55 °C

Standards: IEC 60079-0:2017, IEC 60079-1:2014

B.3 North American (cQPSus)

Certificate: LR1507-9

Certification: Class I, Division 1, Groups B, C & D T3 – 100 barg max.
Class I, Division 1, Groups B, C & D T6 – 60 barg max.
Tamb -25 °C...+55 °C

Class I, Zone 1
AEx db IIB+H2 T3 Gb / Ex db IIB+H2 T3 Gb – 100 barg max.
AEx db IIB+H2 T6 Gb / Ex db IIB+H2 T6 Gb – 60 barg max.
Tamb -20 °C...+55 °C

Standards: UL 60079-0-7th ed. / CSA C22.2 No. 60079-0:19
UL 60079-1-7th ed. / CSA C22.2 No. 60079-1:16
UL 61010-1-3rd ed. / C22.2 No. 61010-1:12
FM 3600-2018
FM 3615-2018
CSA C22.2 No. 30:20

B.4 Special Conditions of Use

The following conditions relate to safe installation and/or use of the equipment:

1. Only suitably certified cable glands and blanking elements are to be used with the equipment.
2. The flameproof joints must not be repaired.
3. The equipment uses a non-metallic coating that under extreme circumstances may present a risk of electrostatic discharge. Clean only with a damp cloth and refer to the manufacturer's instructions for details.

B.5 Maintenance and Installation

The CD603 must only be installed by suitably qualified personnel and in accordance with the instructions provided and the terms of the applicable product certificates.

Maintenance and servicing of the product must only be carried out by suitably trained personnel or returned to an approved Michell Instruments Service Center.

Flame paths are not intended to be repaired.

The certificates can be viewed or downloaded from our website at: www.ProcessSensing.com.

Appendix C

Modbus Register Map

Appendix C Modbus Register Map

Address	Function Description	Read/ Write	Register Config.	Notes
0	Modbus Configuration	R/W	C	
1	Configuration 1	R/W	D	
2	Configuration 2	R/W	F	
3	Configuration 3	R/W	G	
4	Configuration 4	R/W	H	
5	Ramp Offsets	R/W	I	
6	Configuration 5 (Not in HMI)	R/W	J	
7	Alarms Configuration	R/W	K	
8	Analog Output Configuration	R/W	L	
9				
10	Mirror Temperature Correction offset	R/W	B3	
11	Easidew Correction Offset	R/W	B3	
12	Alarm1 Set point	R/W	W	
13	Alarm2 Set point	R/W	W	
14	Alarm3 Set point	R/W	W	
15	Status alarm relay (ALS) selection mask	R/W	T	
16	Analog Out 1 – Low Set point	R/W	W	
17	Analog Out 1 – High Set point	R/W	W	
18	Analog Out 2 – Low Set point	R/W	W	
19	Analog Out 2 – High Set point	R/W	W	
20	Analog Out 3 – Low Set point	R/W	W	
21	Analog Out 3 – High Set point	R/W	W	
22	Wdp and HCDp Pressure Sensor Span (barg)	R/W	2 bytes	High Byte = WDp
23	Instrument Serial Number HI WORD (32bit)	R/W	HI Word	1...4294967296
24	Instrument Serial Number LO WORD (32 bit)	R/W	LO word	"
25				
26				
27	Easidew Correction REF -40	R/W	B3	
28	Easidew Correction REF -30	R/W	B3	
29	Easidew Correction REF -20	R/W	B3	
30	Easidew Correction REF -10	R/W	B3	
31	Easidew Correction REF 0	R/W	B3	
32	Easidew Correction REF +10	R/W	B3	

Address	Function Description	Read/ Write	Register Config.	Notes
33	Easidew Correction ACT -40	R/W	B3	
34	Easidew Correction ACT -30	R/W	B3	
35	Easidew Correction ACT -20	R/W	B3	
36	Easidew Correction ACT -10	R/W	B3	
37	Easidew Correction ACT 0	R/W	B3	
38	Easidew Correction ACT +10	R/W	B3	
39	Mirror Contamination Threshold	R/W	A1	
40				
41	Analog Output 3 - DAC 4 mA Value	R/W	A1	
42	Analog Output 3 - DAC 20 mA Value	R/W	A1	
43	Analog Output 1 - DAC 4 mA Value	R/W	A1	
44	Analog Output 1 - DAC 20 mA Value	R/W	A1	
45	Analog Output 2 - DAC 4 mA Value	R/W	A1	
46	Analog Output 2 - DAC 20 mA Value	R/W	A1	
47	Cell Pressure channel Cal Val at 27barg	R/W	B3	
48	Cell Pressure channel Cal Val at 70barg	R/W	B3	
49	External Pressure channel Cal Val at 27barg	R/W	B3	
50	External Pressure channel Cal Val at 70barg	R/W	B3	
51	Easidew channel Cal Val at -100C	R/W	B3	
52	Easidew channel Cal Val at +20C	R/W	B3	
53	Ethane Cal – Target temperature degC	R/W	B3	
54	Ethane Cal – Target Signal Trigger	R/W	B1	
55	PT1000 Cal Val at -35C	R/W	B3	**Sensor Flash – START**
56	PT1000 Cal Val at -20C	R/W	B3	
57	PT1000 Cal Val at -10C	R/W	B3	
58	PT1000 Cal Val at 0	R/W	B3	
59	PT1000 Cal Val at +10C	R/W	B3	
60				
61				
62	Trip HC VRED 5mG Hi Word	R/W	Int32	
63	Trip HC VRED 5mG Lo Word	R/W	Int32	
64	Trip HC IRED 5mG Hi Word	R/W	Int32	
65	Trip HC IRED 5mG Lo Word	R/W	Int32	
66				

Address	Function Description	Read/ Write	Register Config.	Notes
67				
68	Trip WD IRED 5mG Hi Word (from HIGH DP)	R/W	Int32	
69	Trip WD IRED 5mG Lo Word (from HIGH DP)	R/W	Int32	
70	WD 5mg LOW DP ACTUAL Value	R/W	B3	
71	WD 5mg HIGH DP ACTUAL Value	R/W	B3	
72				
73				
74				
75				
76	Trip HC VRED 50mG Hi Word	R/W	Int32	
77	Trip HC VRED 50mG Lo Word	R/W	Int32	
78	Trip HC IRED 50mG Hi Word	R/W	Int32	
79	Trip HC IRED 50mG Lo Word	R/W	Int32	
80				
81				
82	Trip WD IRED 50mG Hi Word (from HIGH DP)	R/W	Int32	
83	Trip WD IRED 50mG Lo Word (from HIGH DP)	R/W	Int32	
84	WD 50mg LOW DP ACTUAL Value	R/W	B3	
85	WD 50mg HIGH DP ACTUAL Value	R/W	B3	
86				
87				
88				
89	Trip LINE WD VRED Hi Word	R/W	Int32	
90	Trip LINE WD VRED Lo Word	R/W	Int32	
91				
92				
93				
94		R/W	B3	
95		R/W	B3	
96		R/W	B3	
97		R/W	B3	
98		R/W	B3	
99				
100				

Address	Function Description	Read/ Write	Register Config.	Notes
101				
102	LED Intensity 0-100% = 0-5 mA	R/W	A1	
103	Algorithm Trigger Range %	R/W	A1	
104	Optics Gain VRED	R/W	A3	
105	Optics Gain IRED	R/W	A3	
106				
107	Sensor Serial Number HI WORD (32 bit)	R/W		
108	Sensor Serial Number LO WORD (32 bit)	R/W		
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				**Sensor Flash – END**
120	Ethernet Settings – IP Address – Upper 2 Bytes	R/W	U	Ethernet Module
121	Ethernet Settings – IP Address – Lower 2 Bytes	R/W	U	Ethernet Module
122	Ethernet Settings – Def Gateway – Upper 2 Bytes	R/W	U	Ethernet Module
123	Ethernet Settings – Def Gateway – Lower 2 Bytes	R/W	U	Ethernet Module
124	Ethernet Settings – Subnet Mask – Upper 2 Bytes	R/W	U	Ethernet Module
125	Ethernet Settings – Subnet Mask – Lower 2 Bytes	R/W	U	Ethernet Module
126	Instrument ID	R	A1	Set to 42262 for CD603
127	RTC set hours/mins	W	O	
128	RTC set day/month/year	W	P	

Address	Function Description	Read/ Write	Register Config.	Notes
129	Command/control register	W	S	
130	Passcode to unlock orange registers	R/W	A1	Unlock code = 7316
131	HCdp in user unit	R	B3	Updates cycle time
132	Wdp in user unit	R	B3	Updates cycle time
133	Moisture Content - ppmv High Word	R	IEEE754	See Appendix A
134	Moisture Content - ppmv Low Word	R	IEEE754	See Appendix A
135	Absolute Humidity – lb/MMscf High Word	R	IEEE754	See Appendix A
136	Absolute Humidity - lb/MMscf Low Word	R	IEEE754	See Appendix A
137	Absolute Humidity – mg/m³ High Word	R	IEEE754	See Appendix A
138	Absolute Humidity - mg/m³ Low word	R	IEEE754	See Appendix A
139	Cell Pressure in user unit	R	M	
140	External Pressure in user unit	R	M	
141	Enclosure temperature in user unit	R	B3	
142	Mirror temperature setpoint in user unit	R	B3	
143	Mirror temperature in user unit	R	B3	
144	Current ramp rate in user unit	R	B3	
145	TEC Drive %	R	B2	
146	RTC Hours/Minutes	R	O	
147	RTC Seconds	R	A1	
148	RTC Day/Month/Year	R	P	
149	Cycle count-down	R	Q	
150	Instrument Status register	R	N	
151	System Status Alarms	R	T	
152	Control Board Firmware Version	R	A3	
153	External (Easidew) Wdp Reading in user unit	R	B3	
154	Uncalibrated Mirror temperature, degC	R	B3	For factory Cal use
155	Uncalibrated Cell pressure, barg	R	B3	For factory Cal use
156	Uncalibrated External pressure, barg	R	B3	For factory Cal use
157	Uncalibrated Easidew Value degC	R	B3	For factory Cal use
158	Line Wdp in User unit	R	B3	
159	INFRARED SIG HI WORD	R	32bit Int	
160	INFRARED SIG LOW WORD	R	"	

Address	Function Description	Read/ Write	Register Config.	Notes
161	VISRED SIG HI WORD	R	32bit Int	
162	VISRED SIG LOW WORD	R	"	
163				
164				
165				
166				
167	Ethane Cal - Un-Cal Mirror temperature degC	R	B3	
168	Ethane Cal - Cell Pressure in Barg	R	B3	
169				
170				
171				
172				
173				
174				
175				
176				
177				
178				
179	Number of logs taken (up to 288)	R	A1	
180	**Log 1 – Hours/Mins**	R	O	LATEST LOG
181	Log 1 – Day/Month/Year	R	P	
182	Log 1 – HCdp	R	B3	
183	Log 1 – Wdp	R	B3	
184	Log 1 – External Wdp	R	B3	
185	Log 1– Line Wdp	R	B3	
186	Log 1 – Cell Pressure	R	M	
187	Log 1– External Pressure	R	M	
188	Log 1 – Status Register	R	N	
189	Log 1 – Status Alarms Register	R	T	
190	Log 1 – Config Register 1	R	D	
191	**Log 2 – Hours/Mins**	R	O	
192	Log 2 – Day/Month/Year	R	P	
193	Log 2 – HCdp	R	B3	
194	Log 2 – Wdp	R	B3	

195	Log 2 – External Wdp	R	B3	
196	Log 2 – Line Wdp	R	B3	
197	Log 2 – Cell Pressure	R	M	
198	Log 2– External Pressure	R	M	
199	Log 2 – Status Register	R	N	
200	Log 2 – Status Alarms Register	R	T	
201	Log 2 – Config Register 1	R	D	
>>>	>>> To log 288 (48hrs @10mins cycle time)			
3347				Last Register

Register Configuration A

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

A1: Unsigned Short. Range = 0...65535
A2: Unsigned Short /10. Range = 0...6553.5
A3: Unsigned Short /100. Range = 0...655.35

Conversion: float*x = unsigned integer
Unsigned integer/x = float

Or cast:

float value to read= ((float) (value))/x;
unsigned short value to write= (unsigned short) (value*x)

Register Configuration B

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

B1: Signed Short. Range -32768...+32767
B2: Signed Short /10. Range -3276.8...+3276.7
B3: Signed Short /100. Range -327.68...+327.67

Most languages will cast from one type to another

Values to write into register manually:

if value is a negative number: (value*x) +65536
if value is 0 or a positive number: value*x

e.g. for type B3

(-5.39*100) + 65536 = 64997
(2.01*100) = 201

Or Cast:

(unsigned short) (value*x)

Reading values from register manually:

If value in register is greater than 32767: (value-65536)/x
If value in register is less than or equal to 32767: value/x

e.g. for type B3

(64997-65536)/100 = -5.39
201/100 = 2.01

Or Cast:
((float) ((signed short)value))/x;

Register Configuration C – System Configuration

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
						PT	PT	IA	IA	IA	IA	IA	IA	IA	IA

Instrument Address (IA)	Protocol Type (PT)
1...31	00=RS485 01= Ethernet

Register Configuration D – Configuration 1 (Reg 1)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
				SL	LA	DC	DC	MR	MR	MC	MC	MC	PU	PU	TU

Moisture Calculation Standard (DC) 0000 = IGT #8 01 = ISO18453 10 = IDEAL	Moisture Ref Temperature (MR) 00 = 0 °C 01 = 15 °C 10 = 21 °C
External Wdp Parameter (MC) 000 = ppm_V 001 = lb/MMscf 010 = mg/m^3	Pressure Units (PU) 00 = barg 01 = psig 10 = MPag
Temperature Unit (TU) 0 = °C 1 = °F	Latch Status Alarm messages (LA) 0 = NO 1 = YES
Sensitivity Level (SL) 0 = 50 mG 1 = 5 mG	

Register Configuration F – Configuration 2 (Reg 2)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		IR	IR	IR	IR	IR	IR	RT	RT	RT	RT	RT	RT	RT	RT

Initial Recovery Time (IR) 1...60 mins	Recovery temperature (RT) 20...140 °(C or F)

Register Configuration G – Configuration 3 (Reg 3)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SR	SR	SR	SR	FR	FR	FR	FR	CT	CT	CT	CT	CT	CT	CT	CT

Slow Ramp Rate (SR) 1...15 °/min	Fast Ramp Rate (FR) 1...15 °/min
Min-Cooling temperature (CT) -127 °...+128 ° (signed char)	

Register Configuration H – Configuration 4 (Reg 4)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCT	RTT	SAR		CT	CT	CT	CT	LW	OH						

Min Cooling temperature type (MCT) 0 = Absolute 1 = Relative	Recovery temperature type (RTT) 0 = Absolute 1 = Relative
Signal Absolute or Relative (SAR) 0 = Relative to ref Signal Values 1 = Absolute values	Line Wdp Enabled (LW) 0 = Not enabled 1 = Enabled
Cycle Time (CT) 1 = 10min 2 = 20min 3 = 30min 4 = 40min 5 = 50mins 6 = 60mins	
Line Wdp Enabled (LW) 0 = Not enabled 1 = Enabled	Only HCdp in HCdp/Wdp mode (OH) 0 = Normal HCDp/Wdp 1 = Only HCdp

Register Configuration I – Ramp Offsets (Reg 5)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SO	SO	SO	SO	SO	SO	SO	SO	FO	FO	FO	FO	FO	FO	FO	FO

Fast Ramp Start Offset (FO) 3...20 °	Slow Ramp Start Offset (SO) 0...20 °

Register Configuration J – Configuration 5 (Reg 6)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MT	MT	MT	MT				SM	SM	SM	DT	DT	DT	DT	DT	DT

Max Cool Timeout (MT) 1...15 x 10 = 10...150 seconds 0 = No timeout	Seek Cycles Fast Rate Multiplier (SM) 1...7
Pre-Fast Ramp Dwell Time (DT) 0...63 seconds Dwell time at start temperature (just before fast ramp)	

Register Configuration K – Alarm Configuration (Reg 7)

Note: Alarm 4 is a system status alarm and is configured in Reg 15.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AI	C3	C2	C1	A3	A3	A3	A3	A2	A2	A2	A2	A1	A1	A1	A1

Alarm1 Parameter (A1) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppmV 0110 = lb/MMscf 0111 = mg/m³ 1000 = External Pressure 1001 = Line Wdp	Alarm2 Parameter (A2) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppmV 0110 = lb/MMscf 0111 = mg/m³ 1000 = External Pressure 1001 = Line Wdp
Alarm3 Parameter (A3) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppmV 0110 = lb/MMscf 0111 = mg/m³ 1000 = External Pressure 1001 = Line Wdp	Alarm LOW or HIGH configuration (C1 to C3) C1 = 0 = Alarm1 LOW Alarm C2 = 0 = Alarm2 LOW Alarm C3 = 0 = Alarm3 LOW Alarm C1 = 1 = Alarm1 HIGH Alarm C2 = 1 = Alarm2 HIGH Alarm C3 = 1 = Alarm3 HIGH Alarm
Alarm 4 Inverse Operation (AI) 0 = No Not Alarmed: NO = Open, NC = closed Alarmed: NO = Closed, NC = Open 1 = Yes Not Alarmed: NO = Closed, NC = Open Alarmed: NO = Open, NC = closed	

Register Configuration L – Analog Output Configuration (Reg 8)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		NM	NM	O3	O3	O3	O3	O2	O2	O2	O2	O1	O1	O1	O1

Output 1 Parameter (O1) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppm_v 0110 = lb/MMscf 0111 = mg/m^3 1000 = External Pressure 1001 = Line Wdp	Output 2 Parameter (O2) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppm_v 0110 = lb/MMscf 0111 = mg/m^3 1000 = External Pressure 1001 = Line Wdp
Output 3 Parameter (O3) 0000 = HCdp 0001= Wdp (or Line Wdp if selected) 0010 = Cell Pressure 0011 = Enclsr. Temperature 0100 = External Wdp 0101 = ppm_v 0110 = lb/MMscf 0111 = mg/m^3 1000 = External Pressure 1001 = Line Wdp	NAMUR signalling for OP3 (NM) 00 = OFF (OP3 is process output) 01 = LOW (OP3 is NAMUR 3.2 mA) 10 = HIGH (OP3 is NAMUR 21.4 mA)

Register Configuration M – Pressure reading (Reg 139, 140, and logged pressure registers)

The pressure register format depends on the pressure unit.

Unit	Range	Register Range	Register Type
psig	0.0...3000.0	0...30000	B2 (unsigned short/10)
barg	0.00...200.00	0...20000	B3 (unsigned short/100)
MPag	0.00...20.00	0...2000	B3 (unsigned short/100)

Register Configuration N – Instrument Status (Reg 150)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RS	LM	LM		A4	A3	A2	A1	WC	CP	CP	CP	EA	CM	CM	CM

Russian Mode(RS) 1 = Instrument is set for Russian mode (Rus ver. number)	Last successful Measurement(LM) Or What to display? 0 = HCdp 1 = Wdp 2 = Mixed 3 = Line Wdp
Relay Alarm Status flags (A1, A2, A3, A4) 0 = NOT ALARMED 1 = ALARMED	Current Phase (CP) 0 = Recovery 1 = Measurement – Seek 2 = Measurement – Fast Ramp Down 3 = Measurement – Slow Ramp Down 4 = Measurement – Slow Ramp Up
Current Mode/Cycle (CM) 0 = HCdp/Wdp Measure 1 = Line Wdp 2 = HCdp Cal 3 = Line Wdp Cal 4 = Setup 5 = Wdp Cal 6 = Ethane Cal	External Wdp (Easidew) Connected (EA) 0 = No 1 =YES
WDp Cal Type (WC) 0 = Wdp Low PPM Gas Cal 1 = Wdp High PPM Gas Cal	

Register Configuration O – Time (hours/minutes or minutes/seconds)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HS	HS	HS	HS	HS	HS	HS	HS	MM	MM	MM	MM	MM	MM	MM	MM

Hours or Seconds Value (HS) 00...23 for hours 00...59 for seconds	Minutes Value (MM) 00...59

Register Configuration P – Date

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DD	DD	DD	DD	DD	MM	MM	MM	MM	YY	YY	YY	YY	YY	YY	YY

Date Number (DD) 1...31	Month Number (MM) 1...12
Year Number (YY) 00...99	

Register Configuration Q – Cycle Countdown (Reg 149)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MM	MM	MM	MM	MM	MM	MM	MM	SS	SS	SS	SS	SS	SS	SS	SS

Seconds Number (SS) 0...59	Minutes Number (MM) 0...69

Register Configuration S – Instrument Command Register (S)

Writing relevant number to this register initiates associated setting, calibration, or test function.

** Put in setup mode first (command 36) and then, after test, put back into measurement mode (command 37).

3 = Clear Log Buffer

8 = Force to max cool**
9 = Force to recovery temperature **

10 = Force Analog Output 1 to 4 mA**
11 = Force Analog Output 1 to 12 mA**
12 = Force Analog Output 1 to 20 mA**
13 = Force Analog Output 2 to 4 mA*
14 = Force Analog Output 2 to 12 mA**
15 = Force Analog Output 2 to 20 mA**

16 = Force Sensor LEDs ON **
17 = Force Sensor LEDs OFF **

19 = All Alarm Relays de-energised**
20 = Energise Alarm Relay1**
21 = Energise Alarm Relay2**
22 = Energise Alarm Relay3**
23 = Energise Alarm Relay4 (ALS)**
24 = Clear latched status messages (and AL4, OP3 Namur)

25 = Set Int Solenoid (uses 100% power to solenoid)**
26 = Set Ext Solenoid (uses 100% power to solenoid)**
27 = All Solenoids Off**

28 = All digital outputs ON **
29 = All digital outputs OFF **

31 = Enter Setup Mode (Normal measurement cycle and output/alarm updates are stopped, all Analog outputs, relays and solenoids set to Setup Start settings)
32 = Enter Normal HCDP/WDP Measure Mode
33 = Enter Line WDP Measurement Mode
34 = Start Auto HCDP Cal (must be followed by Auto WDP Cal).
35 = Start Auto Line WDP Cal
36 = Start Auto WDP Cal (must be after Auto HCDP Cal) LOW DP 50PPM
37 = Start Ethane Mirror Tempr Cal
38 = Start Auto WDP Cal (must be after Auto HCDP Cal) HIGH DP 100PPM

40 = Set Default Ethernet Settings (to default values to Registers 67...72) – (Command not allowed via Modbus) – See below
41 = Set Ethernet Settings (to user values in Registers 67...72) – (Command not allowed via Modbus)
42 = Set Defaults of the Control Board reg map values and flash
43 = Reset RTC to default Time and Date
45 = Set Defaults of the Sensor Board reg map values and flash

67 = Set Mirror temperature setpoint DOWN by 10°**
68 = Set Mirror temperature setpoint DOWN by 5°**
69 = Set Mirror temperature setpoint DOWN by 1°**
70 = Set Mirror temperature setpoint DOWN by 0.1°**
71 = Set Mirror temperature setpoint UP by 10°**
72 = Set Mirror temperature setpoint UP by 5°**
73 = Set Mirror temperature setpoint UP by 1°**
74 = Set Mirror temperature setpoint UP by 0.1°**

75 = Auto Ramp DOWN**
76 = Auto Ramp UP**
77 = Stop Auto Ramp**

78 = Force Analog Output 3 to 4 mA**
79 = Force Analog Output 3 to 12 mA**
80 = Force Analog Output 3 to 20 mA**

Ethernet Default Settings (Reg 67-72) for command 40 and SW1-1 default.

IP: 192.168.1.3,
Def Gate: 192.168.1.254,
Sub Mask: 255.255.255.0

Reg 67 = 49320,
Reg 68 = 259,
Reg 69 = 49320,
Reg 70 = 510,
Reg 71 = 65535,
Reg 72 = 65280,

Register Configuration T – Status Alarm Messages (Reg 151)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
8000	4000	2000	1000	0800	0400	0200	0100	0080	0040	0020	0010	0008	0004	0002	0001

Bit	HEX	Warning Message	Meaning	Type
0	**0001**	"Fault: Mirror temperature sensor"	Open or short circuit sensor	Fault
1	**0002**	"Fault: Enclosure temperature sensor"	Open or short circuit sensor	Fault
2	**0004**	"Fault: Cell pressure sensor"	Sensor malfunction or pressure out of range	Fault
3	**0008**	"Fault: External pressure sensor"	Sensor malfunction or pressure out of range (only when Ext sensor connected)	Fault
4	**0010**	"Fault: TEC fault"	Short circuit on TEC output	Fault
5	**0020**	"Warning: Mirror contamination"	Mirror may require cleaning – NOT IMPLEMENTED	Warning
6	**0040**	"Warning: Failed to reach recovery temperature"	TEC heating issue	Warning
7	**0080**	"Warning: Failed to reach the dew-point temperature"	Minimum HCdp cooling temperature reached, or TEC has reached maximum cooling capability.	Warning
8	**0100**	"Warning: Cycle time expired"	Measurement unable to be made within the cycle time	Warning
9	**0200**	"Warning: Enclosure temperature out of range"	Beyond -20 and +70 °C	Warning
10	**0400**	"Warning: Water formation detected"	Water may be present	Warning
11	**0800**	"Warning: Sensor warning"	Connection error or virgin sensor board	Warning

Note: Status Alarm relay selection mask (in Register 15) allows user to set which condition(s) trigger the status alarm relay (ALS) and the NAMUR error conditions at OP3.

Register Configuration U – Ethernet Address

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
HB	HB	HB	HB	HB	HB	HB	HB	LB	LB	LB	LB	LB	LB	LB	LB

Hi Byte (HB)	Lo Byte (LB)
0-255	0-255

Register Configuration W – Analog Outputs and Alarm Setpoints

Analog outputs range and Alarm setpoints – ranges, precision and register configuration.

Unit	Adjustment Range/Res.	Max Range of Register	Register Type
Dew point in °C	-100...100	-32767...32768	B1 (signed short)
Dew point in °F	-148...212	-32767...32768	B1 (signed short)
ppm_v	0...3000	-32767...32768	B1 (signed short)
lb/MMscf	0.0...1500.0	-3276.7...3276.8	B2 (signed short/10)
mg/m³	0...25000	-32767...32768	B1 (signed short)
Pressure, psig	0...1470	-3276.7...3276.8	B2 (signed short/10)
Pressure, barg	0.0...100.0	-3276.7...3276.8	B2 (signed short/10)
Pressure, MPag	0.0...10.1	-3276.7...3276.8	B2 (signed short/10)
Enclosure T °C	-50...+100	-32767...32768	B1 (signed short)
Enclosure T °F	-58...+212	-32767...32768	B1 (signed short)

Note: Changing temperature or pressure units will set temperature- and pressure-based configurations to default values.

HMI Notes:

Display/HMI auto-precision for Main Pages for ppm_v, lb/MMscf, mg/m³:

0.00...999.99 (2 dp)
1000.0...9999.9 (1 dp)
10000...99999 (0 dp)

Appendix D

Quality, Recycling, Compliance & Warranty Information

Appendix D Quality, Recycling, Compliance & Warranty Information

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

www.ProcessSensing.com/en-us/compliance

This page contains information on the following directives:

- Anti-Facilitation of Tax Evasion Policy
- ATEX Directive
- Calibration Facilities
- Conflict Minerals
- FCC Statement
- Manufacturing Quality
- Modern Slavery Statement
- Pressure Equipment Directive
- REACH
- RoHS
- WEEE
- Recycling Policy
- Warranty and Returns

This information is also available in PDF format.

Appendix E

Return Document & Decontamination Declaration

Appendix E Return Document & Decontamination Declaration

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	

MICHELL Instruments

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