



XPM601 Paramagnetic Oxygen Analyzer User Manual



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XPM601

This manual relates to products with firmware version V1.0

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Safety

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

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

Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument. The input power supply voltage is 24 V DC, 1.5 A (max). Refer to labels on the instrument or calibration certificate.

Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified safe maximum working pressure for this instrument is 0.33 barg (4.78 psig) max.

Temperature Safety

During operation, some parts of the instrument may be at high temperature.

Toxic Materials

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

Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. For the contact details for Michell Instruments' offices worldwide, go to www.ProcessSensing.com.

Calibration

The recommended calibration interval for the analyzer is 3 months. Depending on the application in which the instrument is used, the calibration interval may be reduced. Please consult the factory for the specific calibration interval.

Safety Conformity

This product carries the CE/UKCA mark and meets the requirements of the relevant European/UK safety directives.

Equipment Ratings

This equipment must be supplied with a voltage of 24 V DC, 1 A (22 W).

The power is connected via PL9 on the mother board (see Section 4.5).

All input and output connectors are 2-part PCB-mounted type.

The detachable, screw terminal half of each connector is designed to accept 24 -12 AWG stranded or solid conductors.

Abbreviations

The following abbreviations are used in this manual:

A	Ampere
AC	alternating current
bara	pressure in bar (absolute)
barg	pressure in bar (gauge)
°C	degrees Celsius
°F	degrees Fahrenheit
DC	direct current
kg	kilogram
kPa	Kilopascal
lb	pound
LCD	Liquid Crystal Display
max	maximum
mA	milliampere
mbar	millibar pressure unit
ml/min	milliliters per minute
mm	millimeters
PCB	Printed Circuit Board
ppm	parts per million
psig	pounds per square inch
RTC	Real-Time Clock
scfh	standard cubic feet per hour
SPCO	Single Pole Changeover
V	Volt
"	inches
Ω	ohm

Warnings

The following general warnings listed below are applicable to this instrument. They are repeated in the text in the appropriate locations.



Where this symbol appears in the following sections it is used to indicate areas where potentially hazardous operations need to be carried out. THESE TASKS SHOULD BE UNDERTAKEN BY QUALIFIED PERSONNEL ONLY.



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

NOTE: Warnings and important notifications are marked with bold text.

1 INTRODUCTION

This manual will show how to measure oxygen easily using the XPM601 Paramagnetic Oxygen Analyzer. The following sections contain information about:

- Analyzer components
- Operating instructions
- Calibration and maintenance of the Analyzer
- Installation

Please read this manual carefully and pay special attention to the safety warnings and notifications.

NOTE: Warnings and important notifications are marked with bold text.

The XPM601 Paramagnetic Oxygen Analyzer is based on advanced Paramagnetic technology. It measures the percentage of oxygen in hydrogen gas and is designed for use in potentially explosive atmospheres (hazardous areas).

1.1 Features

- The XPM601 can be supplied meeting the requirements of IEC 61508 (SIL2 Capability), allowing the user to integrate the analyzer into their functional safety system.
- The XPM601 is calibrated to achieve maximum performance in electrolyzer generation applications.
- The XPM601 provides 2 off 4...20 mA analog output signals that are proportional to the oxygen concentration. The primary 4...20 mA output is fixed the same as the calibrated range of the instrument. The secondary output is user-selectable within the calibrated range.
- Modbus RTU over RS485 serial communications are provided as standard.
- Accuracy of <math><0.1\%</math> of O_2 .
- The robust and weather-proof enclosure (IP66 rated) allows the XPM601 to be installed on site, at the point of measurement. It is ATEX, IECEx and UKCA certified to II 2 G D Ex db IIB+H2 T6 Gb, Ex tb IIIC T85 °C Db IP66 Tamb -15 °C...+60 °C and is approved for use in North America in Class I/II Division 1 and Class I Zone 1/21 hazardous locations.
- Low cost of ownership due to minimal maintenance. For installation and commissioning, the casing unscrews to allow for easy access to the electrical connections.
- 2 x single pole change-over relay alarms for oxygen concentration, supplied as standard. Can be configured as OFF, LOW or HIGH.

1.2 Applications

The XPM601 uses a highly sensitive and stable paramagnetic sensor that has been factory calibrated to achieve maximum performance in electrolyzer generation applications.

Together with a purpose-designed sampling system, the XPM601 is able to work under various process and environmental conditions. Examples of applications include:

- Accurate measurement of O₂ in H₂ in process conditions
- Safe operation of electrolyzer
- Monitor electrolyzer generation performance
- Determine hydrogen purity

2 OPERATION



The XPM601 analyzer is not certified for use with ambient oxygen levels that are enriched (i.e. over 21 % O₂)

This analyzer has been manufactured within our quality procedures and is configured according to the purchase order. When it is installed and used as per the manufacturer's guidelines, it will operate within the stated specification.

Before operating the unit, it is recommended that the user becomes familiar with this manual in which all the equipment controls, indicators, the elements of the display and the overall menu structure are described.

2.1 Preparation



Before applying power and beginning the flow of gas, please ensure that the system has been properly installed following the instructions in Section 4.

Check that the wiring has been completed correctly.

Zero and Span gas cylinders with correct regulation and flow control should be in place before installing and powering up the analyzer. Commissioning should include a check with both gases and, if necessary, a field calibration performed.

The factory calibration is performed at nominally 100 ml/min with an atmospheric vent (50...100 mbar back-pressure). The calibration gas applied to the analyzer should be at the same temperature, pressure and flow rate as the process gas being sampled.

Sample Pressure: 0...0.33 barg (0...4.78 psig)

Sample Flow Rate: 100 ml/min (0.25 scfh)

2.2 Powering up the Analyzer



After all the preparation work is done and the installation and wiring have been checked, turn on the analyzer and wait for at least 30 minutes (or until **Cell T Not Stable** message disappears). This will allow the analyzer to reach its operating temperature.

There is no power switch on the XPM601 Paramagnetic Oxygen Analyzer. It is operational once a 24 V DC power source is applied. After the analyzer is powered up, the display will be illuminated. The analyzer takes up to 5 seconds to initialize, and during this period will display the product type and firmware version number.

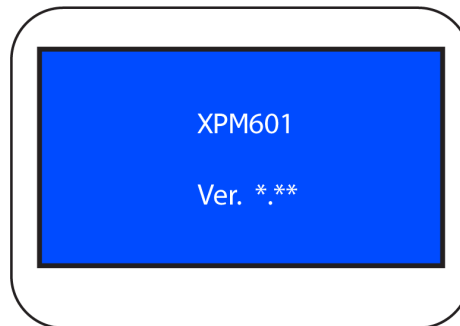


Figure 1 *Initializing Screen*

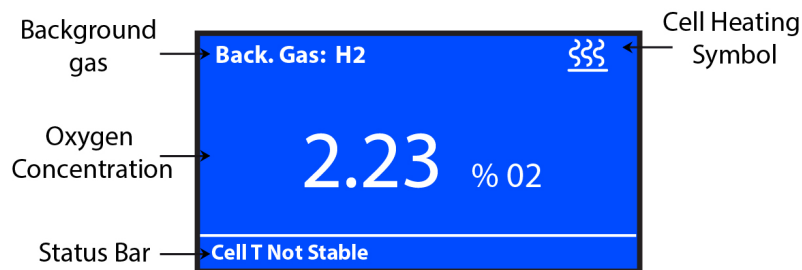


Figure 2 *Main Page*

Once initialized, the analyzer will show the Main Page which displays the O₂ concentration.

During warm-up (less than 25 minutes) a heating symbol will flash in the top right-hand corner of the page. This symbol will remain until the temperature has stabilized for a minimum of 5 minutes. The analyzer will be ready for use within 30 minutes from power-up.

2.3 User Interface

2.3.1 Interface Controls

The user interface consists of a backlit liquid crystal display and four touch-sensitive pads that facilitate user interaction through the glass of the enclosure.

All versions have application software to monitor or adjust parameters. Application software will require a PC or laptop with comm port connection. If using the RS232 serial port, ensure that an isolated RS232-to-RS485 converter is used.

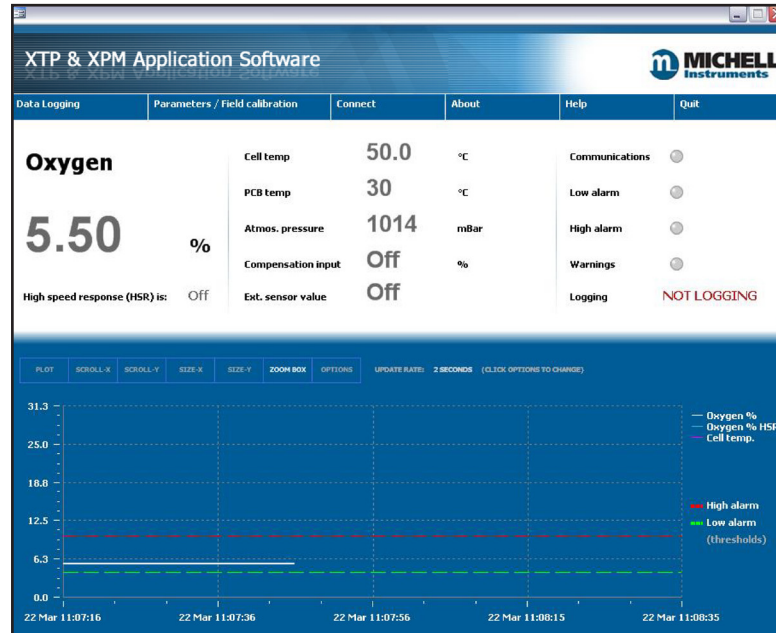


Figure 3 XTP and XPM Series Application Software

2.3.2 'ESC' Button



Figure 4 *ESC Button*

The **ESC** button is used to exit the current menu and to return to the previous menu. From the Main Page, pressing **ESC** will access the Info Page.

2.3.3 'Up/Down Arrow' Buttons

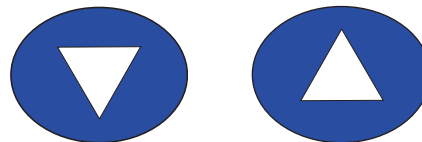


Figure 5 *Up/Down Arrow Buttons*

The **Down** (▼) and **Up** (▲) buttons are used to change pages, scroll through lists and adjust values. In the Reset and Field Calibration Menus, pressing the **Up** (▲) button 3 times will confirm a selection.

2.3.4 'ENTER' Button



Figure 6 *ENTER Button*

The **ENTER** button is used to select or de-select the highlighted item in a menu and to confirm a value. From the Main Page, pressing **ENTER** will access the Passcode Page.

2.4 Menu Structure

The XPM601 has a front page that does not require a passcode but allows the user to scroll through and view oxygen concentration, recent trend, internal parameters, minimum & maximum oxygen concentration and alarm history.

In order to change any settings on the User Menu pages, the user must enter a passcode. There is also a separate passcode for service engineers to allow factory setting changes.

To access the User Menu, press the **ENTER** button from the Main Page to call up a passcode prompt. Use the **Up (▲)** and **Down (▼)** buttons and press **ENTER** after each value.

The User Passcode is: 1919

From the Main Page, the user can press the **ESC** button to view the Info Page. This page shows the firmware version, hours used, last calibration date, calibration pressure and the received Modbus code.

The passcode is stored for one minute to allow access back into the User Menu, if necessary.

2.4.1 Changing the Passcode

To meet the requirements of IEC 61508 (SIL Capability), the user must change the passcode after the unit is set up and before bringing it on-line in a functional safety system. This new passcode must be kept secure and must only be made available to authorized personnel.

Press **Enter** from the Front Page and arrive at the Passcode Screen.

Enter the activation code: 6182 and the unit will be ready to accept the new passcode.

Warning: The passcode can only be changed once, so care must be taken from this point onwards.

Now enter the new passcode and, once activated, the analyzer will bring you straight into the user menu. If you change your mind, or you make a mistake at any point before you hit the enter button the final time, just press and hold the **ESC** button to return to the front screen and start again.

The passcode will be active for 5 minutes, so make a note of what was actually entered by going back to the passcode screen. Store this new passcode in a secure place.

If you forget/lose the passcode, contact Michell Instruments for help.

2.4.2 Menu Map

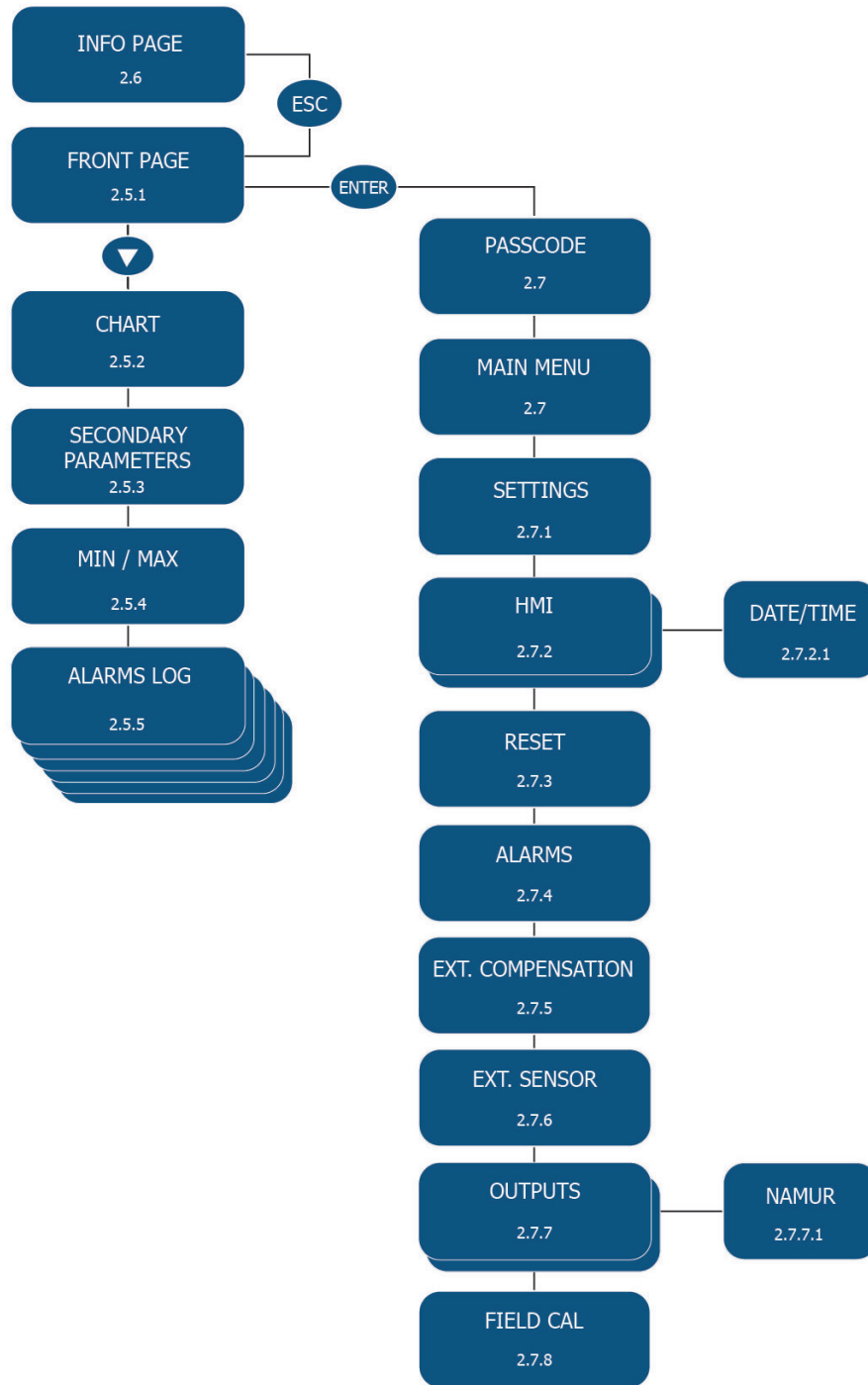


Figure 7 Menu Map

2.5 Front Pages (No passcode required)

The user has the ability to toggle between 5 different home screens without the need for a passcode. **NOTE: These are for display of information only and there is no way of adjusting any settings on these pages.**

From the Main Page (O₂ concentration), the rest of the front pages can be accessed using the Down (▼) button. To return to the Main Page, either press the Up (▲) button the required number of times or press the ESC button.

2.5.1 Front Page

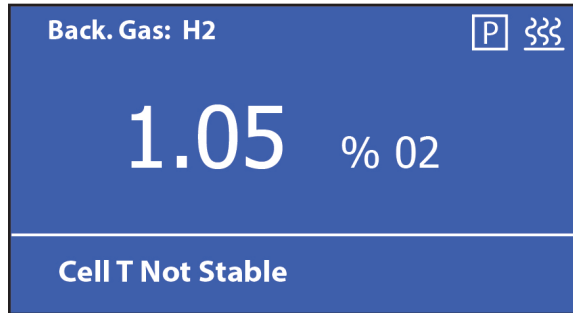


Figure 8 Front Page

Parameter	Description
Background Gas	Displays the background gas that the unit was calibrated in
% O ₂ (if HSR=OFF)	Real oxygen reading in % Display resolution = 0.01 (Display resolution 0.1 % when min value is >=20 %)
% O _{2p} (if HSR = ON)	HSR oxygen reading (extrapolated quick response value of real oxygen reading) Real oxygen value is displayed in status bar
Flashing "Heating" Symbol	This flashes until cell temperature is stable at set point ±0.5 °C for minimum of 5 minutes
Pressure Compensation	If 'P' is visible this indicates that the pressure compensation is turned on
Status Bar	Flashes any system warnings and error messages (see below)

Status Message Table	
Message (Trigger Condition)	Light Guide (if fitted)
% O ₂ out of range (beyond calibration range, e.g. 0...5 %)	N/A
AL1 ON	ORANGE1 ON (app s/w only)
AL2 ON	ORANGE2 ON (app s/w only)
Comp i/p signal error (input < 3.6 mA or > 21 mA)	RED FLASH (priority2)
Ext sens signal error (input < 3.6 mA or > 21 mA)	RED FLASH (priority2)
Cell T not stable (not within ±0.5 °C of set point for continuous period of 5 minutes)	RED ON (priority1)
Cell T sensor error (cell temp measures <-50 or >+80 °C)	RED ON (priority1)
Press sensor error (pressure sensor < 850 or >1100 mbar)	RED ON (priority1)
O ₂ sensor error (Vcomp <1 or >8191)	RED ON (priority1)
PCB temp too high (PCB temp > cell temp set point)	RED ON (priority1)

2.5.2 Chart Page

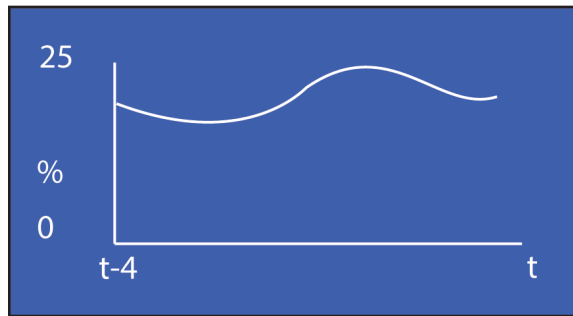


Figure 9 *Chart Page*

NOTE: This data is not available via the Modbus

- This indicative chart is continuously running at the set chart interval (2...60 seconds).
- Chart duration in seconds = (chart interval * 60).
- It is auto ranging with an auto range resolution of 1 % O₂.
- It is reset if the chart interval is changed, the Display is changed between % O₂ and % O₂ HSR or the instrument power is cycled.
- The chart will record either % O₂ (Non HSR) or % O₂ HSR if this is set to **ON** in the setup pages.
- Chart buffer size is 60 values and therefore the chart duration changes according to interval chosen.
- Chart data is only stored in volatile memory and therefore is not saved. Chart interval is saved and available in a Modbus register.
- Chart data is not available via serial comms as the Application Software is able to perform more sophisticated charting functions.

2.5.3 Secondary Parameters Page

CELL T, °C	50.0
PCB TEMP, C	28
COMP I/P	OFF
EXT I/P	OFF

Figure 10 Secondary Parameters Page

Parameter	Description
CELL T	Sensor cell temperature display in set unit (°C, °F or Kelvin) Display Resolution = 0.1
PCB TEMP	Temperature display of Microcontroller in selected temperature unit This gives an indication of the internal enclosure temperature Display Resolution = 1 unit Accuracy = ±2 °C
COMP I/P	The value of compensation input (mA i/p channel 1) as a % (4 mA=0 % and 20 mA=100 %) OFF displayed instead of value if external compensation is turned off
EXT I/P	Value of the external input in the selected parameter and unit (DEWP, TEMPR, PRESS or NONE) OFF displayed instead of value if external compensation parameter is set to NONE

2.5.4 O₂ Min/Max Page

MINIMUM	0.00	%O ₂
D12/01	T	19:29:44
MAXIMUM	0.00	%O ₂
D12/01	T	19:29:44

Figure 11 O₂ Min/Max Page

This indicates the minimum and maximum O₂ values measured, along with date/ time of occurrence. The value is reset manually via the Reset Page in the User Menu.
NOTE: This data is not saved in NV memory and is not available via serial communications.

2.5.5 Alarms Log Pages

ALARM	DATE	TIME	P1
AL1	02/01	12:50:40	
AL1	02/01	11:10:32	
AL1	02/01	11:00:29	
AL2	02/01	10:20:00	

Figure 12 Alarms Log Page

A maximum of 40 High/Low alarms, along with date and time of occurrence, are recorded in a ring buffer in NV memory. The most recent alarm will overwrite the oldest alarm when more than 40 alarms are recorded. The data is displayed over a maximum of 10 pages (with 4 alarms on each page). The latest alarm record is displayed in line 1 of page 1. This data is not available via serial communications. The data is reset manually via the Reset Page in the User Menu. The data is saved and restored when the instrument is restarted. P1 = Page 1.

2.6 Info Page

Firmware Ver	1.0
Hours Used	125
Last Cal Date	04:08:11
Cal Press. mB	1000.0
Atm Press. mB	1000.0
ModBus Rx Code	---

Figure 13 Info Page

From the Main Page it is possible to get to the Info Page by pressing the **ESC** button.

The information available is displayed below:

Parameter	Description
Firmware Ver	Indicates the firmware version installed in the instrument
Hours used	Indicates the number of hours that the instrument has been powered up
Last Cal Date	The date of the last field or Michell Calibration Character indicates F for Field and M for Michell
Cal Press, mB	The atmospheric pressure recorded during the last calibration (used as null reference point for pressure compensation)
Atm Press, mB	Current atmospheric pressure being read within the analyzer
ModBus Rx Code	The received Modbus function code is flashed here as soon as a function code is received – this is useful to check the Modbus communications to ensure that good data is coming through. If no code is received then '---' is displayed

2.7 Main Menu (Passcode Required)

In order to change any settings on the User Menu pages, the user must enter a passcode. There is also a separate passcode for service engineers to allow factory setting changes.

To access the User Menu, press the **ENTER** button from the Main Page to call up a passcode prompt. Use the **Up (▲)** and **Down (▼)** buttons and press **ENTER** after each value.

The User Passcode is: 1919

SETTINGS	EXT COMP.
HMI	EXT SENS.
RESET	OUTPUTS
ALARMS	FIELD CAL

Figure 14 *User Set-Up Variables Page*

Use the **Up (▲)** and **Down (▼)** buttons to select the sub-menu required. Then press the **ENTER** button. This will give access to one of the following pages.

2.7.1 Settings Page

FIELD CAL	ON/OFF
PRESS COMP	ON/OFF
EXT COMP	ON/OFF
HSR	ON/OFF
LIMIT 0-100%	ON/OFF
MODBUS ID	1-127

Figure 15 Settings Page

Select the parameter required. The options will be highlighted and can be toggled between by pressing the **ENTER** button. These are all **ON/OFF** except for Modbus ID which, if only one analyzer is connected to your system, should be set to '1'.

Setting	Description/Operation	Options
FIELD CAL	Turns use of field calibration on or off	ON/OFF
PRESS COMP	Turns pressure compensation on or off When pressure compensation is on a P symbol will appear on the main screen	ON/OFF
EXT COMP	Turn external sensor compensation on or off	ON/OFF
HSR	Turns high speed response on or off It is automatically turned off when Michell or field calibration is being performed When HSR is ON then these values are derived from the % O ₂ HSR value: <ul style="list-style-type: none"> • mA outputs (both channels) • alarm trigger points • chart values • min/max The Main Page displayed value is also HSR value (designated % O _{2p}) The NON HSR value will also appear in the status bar	ON/OFF
LIMIT 0-100 %	Limits the % O ₂ and % O _{2p} to 0.00 and 100.00 % so that any drift below 0.00 and above 100.00 (for suppressed zero) is not visible mA outputs also limited accordingly	ON/OFF
Modbus ID	Unit's network address for Modbus communications	1-127

2.7.2 Human Machine Interface (HMI) Page

CONTRAST	O-100%
BRIGHTNESS	O-100%
TEMPR UNIT	C/F/K
EXT PRESS UNIT	psia, bara, kpa
CHART INTVAL	2-60s
DATE	DD/MM/YY

Figure 16 HMI Page

It is possible to change parameters within the HMI, as shown below:

Setting	Description/Operation	Options
CONTRAST	LCD contrast setting	0-100 % in 10 % steps
BRIGHTNESS	LCD backlit setting	0-100 % in 10 % steps
TEMPR UNIT	Global temperature unit selection	°C, °F, K
EXT PRESS UNIT	Pressure unit selection (for external sensor only)	psia, bara, kPa
CHART INTVAL	Chart interval	2-60 s in 2 sec steps
DATE	Date on the LCD can be either format	DD/MM/YY or MM/DD/YY

2.7.2.1 Date and Time Page

HOURS	00-23
MINS	00-59
DAY	1-31
MONTH	1-12
YEAR	00-99
LIVE CLOCK	**.**.**

Figure 17 Date and Time Page

The real-time clock and calendar is used to store date/time information for log data, min/max data and date of calibration. On entering this page all fields are initialized with the current values. These can also be set through the application software.

Setting	Description/Operation	Options
HOURS	Hours	00-23
MINS	Minutes	00-59
DAY	Day	1-31
MONTH	Month	1-12
YEAR	Year	00-99
LIVE CLOCK	Current Time	**.**.**

2.7.3 Reset Page

O ₂ MIN/MAX	RESET?
ALARM LOGS	DELETE?
FIELD CAL	DELETE?

Figure 18 *Reset Page*

O₂ Min/Max and Alarm Logs can be cleared from this menu. See Sections 2.5.4 and 2.5.5 respectively for more information.

This menu can also be used to restore the original calibration settings. For more information, see Section 3.3.

To reset/delete highlight the item using the **Down (▼)** button. Press **ENTER** to select the item, then press the **Up (▲)** button 3 times to confirm the change. Press **ENTER** to deselect the item.

2.7.4 Alarms Page

AL1 SETPOINT	0.00	%
AL1 CONFIG	OFF	
AL1 TEST	TOGGLE	
AL2 SETPOINT	5.00	%
AL2 CONFIG	OFF	
AL2 TEST	TOGGLE	

Figure 19 Alarms Page

The analyzer has 2 user-configurable alarms which are freely assignable within the calibrated range. The alarm relays are Single Pole Change-Over (SPCO) and are rated to 250 V, 5 A maximum. Both alarms can be set as high, low or off.

Setting	Description/Operation	Options
AL1 SETPOINT	% O ₂ set point for lo alarm relay	0...100 % O ₂
AL2 SETPOINT	% O ₂ set point for hi alarm relay	0...100 % O ₂
CH2 OUT ZERO	% O ₂ point for 4 mA	0...100 % O ₂
CH2 OUT SPAN	% O ₂ point for 20 mA	0...100 % O ₂
AL1 CONFIG	Turn on/off and set alarm 1	OFF, LOW OR HIGH
AL2 CONFIG	Turn on/off and set alarm 2	OFF, LOW OR HIGH

2.7.5 External Compensation Page

COMP 20%	0.50-2.00
COMP 40%	0.50-2.00
COMP 60%	0.50-2.00
COMP 80%	0.50-2.00
COMP 100%	0.50-2.00

Figure 20 External Compensation Page

A 4...20 mA sensor may be used to compensate the % O₂ reading for the effects of process variables such as line pressure, flow, etc. The table of compensation factors may be edited for 5 points along the compensation sensor range. The values would be determined by applying the process variable at each point and noting the effect on the % O₂.

For example: a compensation is needed for line pressure. A 4...20 mA line pressure sensor would be ranged over the compensation range. While the instrument reads a fixed % O₂ value, a table is created (see example below) while varying the pressure at 20 % of range intervals:

Pressure (mbarg)	% of Pressure span	O₂ reading	Effect = (affected value / non affected value)	Compensation factor = 1 / effect
0	0 %	2.00	2.00/2.00=1.00	1.00
66	20 %	2.16	2.16/2.00=1.08	0.93
133	40 %	2.28	2.28/2.00=1.14	0.88
200	60 %	2.40	1.20	0.83
266	80 %	2.52	1.26	0.79
333	100 %	2.66	1.33	0.75

The compensation factor values are then entered into the External Compensation table (excluding the 0 % point as this will always be assumed to be 1 = no effect).

Below 0 % (< 4 mA), the compensation factor is fixed to 1. Above 100 % the compensation factor is extrapolated beyond the last factor.

2.7.6 External Sensor Page

EXT.SENS PV	temp
EXT.SENS MIN	-50.0
EXT.SENS MAX	100.0
UNIT	°C

Figure 21 External Sensor Page

This page sets up the type and range of the 4...20 mA external sensor signal that may be connected to the XPM601 for viewing in the Main Page. The range is adjustable between the MIN and MAX values but is not adjustable for **Other** setting (fixed at 0 % and 100 %).

Setting	Description/Operation	Options
EXT.SENS PV	The process variable that is being measured by the external sensor Select None to turn the feature off Other represents a user-defined variable	None, Dewpoint, temp, Pressure, Other
EXT.SENS MIN	Depends on parameter and unit settings: Dew point: -100 °C, -148 °F, 173.0 K Temperature: -50 °C, -58 °F, 223.0 K Pressure: 0.0 psia, 0.0 bara, 0.0 kpa Other: 0 % (non-adjustable)	minimum to EXT.SENS MAX
EX.SENS MAX	Depends on parameter and unit settings: Dew point: 20 °C, 68 °F, 293.0 K Temperature: 100 °C, 212 °F, 373.0 K Pressure: 44.1 psia, 3.0 bara, 304.0 kpa Other: 100 % (non-adjustable)	EXT.SENS MIN to maximum
UNIT	These are related to the type of sensor selected If Other is selected, then the unit will be a % of the overall range	°C, °F, K, psia, kPa, bara, %

2.7.7 Outputs Page

CH1 TRIM Z	655	
CH1 TRIM S	3289	
CH2 TRIM Z	649	
CH2 TRIM S	3276	
CH2 ZERO	0.00	%
CH2 SPAN	5.00	%

Figure 22 OUTPUTS Page

The analyzer has two 4...20 mA outputs and two concentration alarm relays. The primary 4...20 mA is fixed to the calibrated range of the unit, the second is freely selectable from 0 to 100 %. The analyzer has the ability to output 4 mA and 20 mA to aid with installation and commissioning. The user is able to trim these outputs via the HMI by highlighting the appropriate channel and using the up and down arrows to adjust the output.

Setting	Description/ Operation	Options
CH1 TRIM Z	Trim 4 mA output on Channel 1	+/- 660
CH1 TRIM S	Trim 20 mA output on Channel 1	+/- 3300
CH2 TRIM Z	Trim 4 mA output on Channel 2	+/- 660
CH2 TRIM S	Trim 20 mA output on Channel 2	+/- 3300
CH2 ZERO	Set 4 mA point for Channel 2	0.00...100 %
CH2 SPAN	Set 20 mA point for Channel 2	0.00...100 %

Scroll down past OUTPUTS Page to enter this menu.

2.7.7.1 NAMUR Output Set-Up

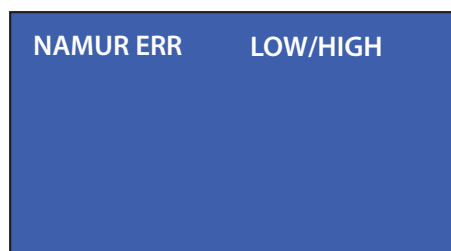


Figure 23 NAMUR ERR Page

During initial warm up, or in the event of a sudden change of cell temperature beyond 0.5 °C from the set point, the mA output will be driven to an alarm state of either 3.5 mA or 21.5 mA. This is to comply with the NAMUR convention (NE43) and the user can choose either high or low.

Setting	Description/Operation	Options
NAMUR ERR	Will drive mA output high or low if cell temperature is out of tolerance.	Low/High

2.7.8 Field Cal Page

CAL TYPE	1/2 POINT
REF GAS 1	0.00-100.00
ACTUAL 1	0.00-100.00
REF GAS 2	0.00-100.00
ACTUAL 2	0.00-100.00
Adjusted ~	**.**

Figure 24 Field Cal Page

Setting	Description/Operation
CAL TYPE	1 POINT or 2 POINT
REF GAS 1	Cal reference gas for 1 point cal, lower cal reference gas for 2 point cal
ACTUAL 1	Actual measured O ₂ for REF GAS 1 See Section 3.1
REF GAS 2	Upper cal reference gas for 2 point cal Disabled if 1 point cal selected
ACTUAL 2	Actual measured O ₂ for REF GAS 2 See Section 3.2 Disabled if 1-point cal selected
ADJUSTED ~	O ₂ reading before and after change ~ symbol will be visible until reading is stable

See Section 3 for field calibration procedure.

3 CALIBRATION

Factory Calibration:

The unit is factory calibrated at 5 points for the range 0...4.5 %, to achieve maximum performance accuracy. Factory calibration will retain performance specification up to 4.5 % O₂. Concentrations between 4.5 % and 5 % O₂ are extrapolated values.

NOTE: Analyzers are calibrated in a hydrogen background gas. Customers' calibration gases must match the process gas. Please refer to Test Result Sheet or a Michell Instruments representative.

For range 0...5 %, the analyzer will have calibration points between 0 and 4.5 % and will retain specification up to 4.5 % O₂. Concentrations between 4.5 % and 5 % O₂ are extrapolated values.

Field Calibration:

Like all process analyzers, the XPM601 will require periodic calibration. The frequency entirely depends on the location, application and accuracy requirements of the user. The typical calibration period is expected to be between 1 and 3 months; however, it is recommended to calibrate the unit at least every 6 months. The user should establish a calibration frequency to ensure that the reading is within the specifications required for the process.

NOTE: It is possible to switch off the Field Calibration and revert to the Factory Calibration. This can be useful for diagnostic purposes if the reading is not what is expected. The unit is delivered with a factory calibration and, as such, would not have any field calibration data.

When the user enters the FIELD CAL page, the FIELD CAL setting is automatically switched ON; however, when the user exits the FIELD CAL page, the FIELD CAL setting is restored to its previous state.

Preparation:



Hydrogen Safety Note

When applying or removing calibration gases from the XPM601, care should be taken to avoid generating gas mixtures within explosive limits. This can occur when transitioning directly between air and hydrogen, such as during initial commissioning. If local rules and regulations exist governing the safe use of hydrogen, these should be followed.

It is recommended that a third, non-flammable gas (such as nitrogen or carbon dioxide) is used as a middle transition step. The application of the third gas is recommended for at least 5 minutes. This avoids the creation of gas mixtures within explosive limits. An example transition would be:

Air ↔ Nitrogen ↔ Hydrogen

Zero and Span gas cylinders with correct pressure regulation and flow control should be in place before installing and powering up the analyzer. Commissioning should include a check with both gases and, if necessary, a field calibration performed.

The calibration gas applied to the analyzer should be at the same temperature, pressure and flow rate as the process gas being sampled.

Sample Pressure: 0...0.33 barg (0...4.78 psig)

Sample Flow Rate: 100 ml/min (0.25 scfh)

Surrogate Nitrogen Field Calibration

If a suitable hydrogen background calibration gas is not available, a surrogate calibration gas with nitrogen background may be used. The nitrogen surrogate calibration gas will require an offset to be added to its oxygen value, based on the calibration certificate results. The oxygen content of the nitrogen surrogate gas should fall within the normal oxygen measurement range of the XPM601.

For nitrogen surrogate gases that are different to those on the calibration certificate, a linear fit between the certificate data points should be used when calculating a suitable offset.

The Table below gives an example of surrogate gas field calibration adjustments.

Original Calibration Reference Value (% O2)	Adjusted Calibration Reference Value (% O2)
0.00	0.20
0.50	0.73
1.50	1.79
2.50	2.85
4.50	5.00

3.1 1-Point Calibration

This is a single-point offset overlaid on top of the factory calibration. It is designed to correct minor drift and minor changes during transit. This calibration makes the unit very accurate at the calibration point and improves accuracy throughout the range.

The calibration gas should be of a value that is within the main area of interest: i.e., if main points of interest for a 0...5 % range instrument are around the 2 % area, then apply a calibration gas as close as possible – in the example below, we used 2.5 % O₂.

1. Apply the calibration gas and purge the unit for at least 5 minutes. View the chart until a flat line shows for 1...2 minutes.

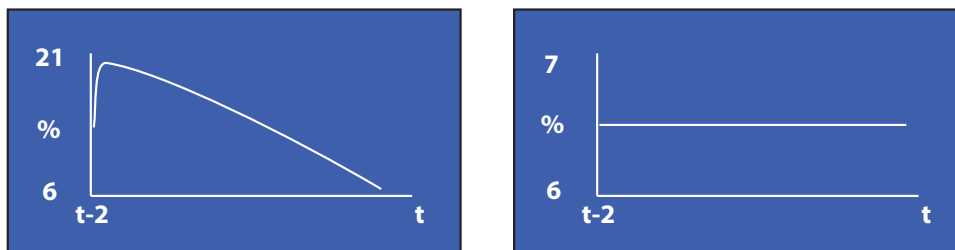


Figure 25 1-Point Calibration Page

2. Press **ENTER** to open the Passcode Page – 1919 Passcode. Navigate to the Field Cal page using the **Up (▲)** button. Press **ENTER** to highlight CAL TYPE and set to 1 POINT. Press **ENTER** to de-select.
3. Press **ENTER** to highlight REF GAS 1 and use the **Up (▲)** and **Down (▼)** buttons to match the value of the concentration of the calibration gas. **NOTE: This value only needs to be set when using a new gas cylinder.** Press **ENTER** to de-select.
4. Ensure the Adjusted value at the bottom of the page has stabilized **NOTE: There will be a ~ symbol next to 'Adjusted' while the reading is stabilizing. When the ~ symbol disappears, the reading will be stable and the next change can be made.**
5. Press **ENTER** to highlight ACTUAL 1 value and press the **Up (▲)** button 3 times. Ensure that the Adjusted value equals the REF Gas 1 value (± 0.01 %). Press **ENTER** to de-select. Press **ESC** to return to the Main Menu.
6. The Adjusted reading will now be the same as that displayed on the Main Page and be equal to the calibration gas.
7. The calibration process is complete. Return to sampling the process gas.

3.2 2-Point Calibration

This is a 2-point adjustment that is overlaid on top of the factory calibration. It is designed to correct minor drift and minor changes during transit. This calibration makes the unit more accurate throughout the range than the single point calibration.

1. Apply the lower calibration gas and purge the unit for at least 5 minutes. View the chart until a flat line shows for 1...2 minutes.

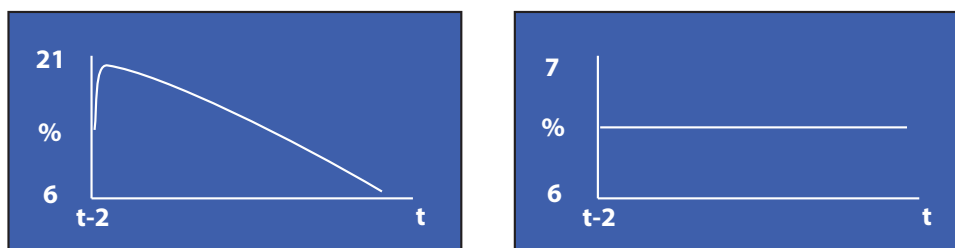


Figure 26 2-Point Calibration Page

2. Press **ENTER** to highlight CAL TYPE and set to 2 POINTS. Press **ENTER** to de-select.
3. Press **ENTER** to highlight REF GAS 1 and use the **Up** (**▲**) and **Down** (**▼**) buttons to match the value of the concentration of the lower calibration gas. **NOTE: This value only needs to be set when using a new gas cylinder.** Press **ENTER** to de-select.
4. Ensure the Adjusted value at the bottom of the page has stabilized **NOTE: There will be a ~ symbol next to 'Adjusted' while the reading is stabilizing. When the ~ symbol disappears, the reading will be stable and the next change can be made.**
5. Press **ENTER** to highlight ACTUAL 1 value and press the **Up** (**▲**) button 3 times. Ensure that the Adjusted value equals the REF Gas 1 value (± 0.01 %). Press **ENTER** to de-select.
6. Apply the upper calibration gas and purge the unit for at least 5 minutes. View the chart until a flat line shows for 1...2 minutes (see above).
7. Press **ENTER** to highlight REF GAS 2 and use the **Up** (**▲**) and **Down** (**▼**) buttons to match the value of the concentration of the upper calibration gas. **NOTE: This value only needs to be set when using a new gas cylinder.** Press **ENTER** to de-select.
8. Ensure that the Adjusted value at the bottom of the page has stabilized.
9. Press **ENTER** to highlight ACTUAL 2 value and press the **Up** (**▲**) button 3 times. Ensure that the Adjusted value now equals REF Gas 2 value (± 0.01 %). Press **ENTER** to de-select. Press **ESC** to return to the Main Menu.

10. The Adjusted reading will now be the same as that displayed on the Main Page and be equal to the upper calibration gas.
11. The calibration process is complete. Return to sampling the process gas.

NOTE: The analyzers leave the factory with the field calibration function turned off. When first calibrating the analyzer go to the settings page and turn Field Calibration on. This can be done either just before or just after the field calibration procedure.

3.3 Field Calibration Reset

The Field Calibration can simply be turned ON or OFF in the settings page. But if the user would like to start again, the Field Cal (including saved data) can be deleted in this menu.

This feature is accessed by selecting the Reset Page (see below).

O2 MIN/MAX	RESET?
ALARM LOGS	DELETE?
FIELD CAL	DELETE?

Figure 27 *Field Calibration Reset Page*

Select Field Calibration and highlight **DELETE?**, then press the **Up (▲)** button 3 times and then press **ENTER** to accept the change.

4 INSTALLATION

Before installing the analyzer, read through this manual carefully and take note of all warnings.



The XPM601 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.



Before the cover is refitted, the flamepath/threaded joint between the cover and body must be thoroughly wiped clean of dirt, grit or other foreign substances and then a thin coating of an approved form of non-setting grease applied to joint/threads. Ensure gasket is free from damage.

Threaded covers must be screwed on to a minimum of 7 full threads and then locked in position with the hex key provided.



The terms of the Hazardous Area Certification do not permit oxygen measurement in ambient areas with enriched oxygen.

4.1 Unpacking

If sold separately (not part of a sampling system), the XPM601 will be supplied in a custom box which should be retained for future use (such as service return). The box contains a small carton containing 2 lid keys and 1 hex key (for the grub screw). Any cable glands supplied will also be in the smaller carton.

Contents:

- XPM601
- Test result sheet
- Carton (containing: 2 x lid keys, 1 x hex key and 1 x main PCB fuse)
- Cable glands (if ordered)
- 97634 – Hazardous Area Installation and Maintenance sheet

4.2 System Components

The XPM601 Paramagnetic Oxygen Analyzer benefits from a modular construction, with the major parts of the analyzer shown below:

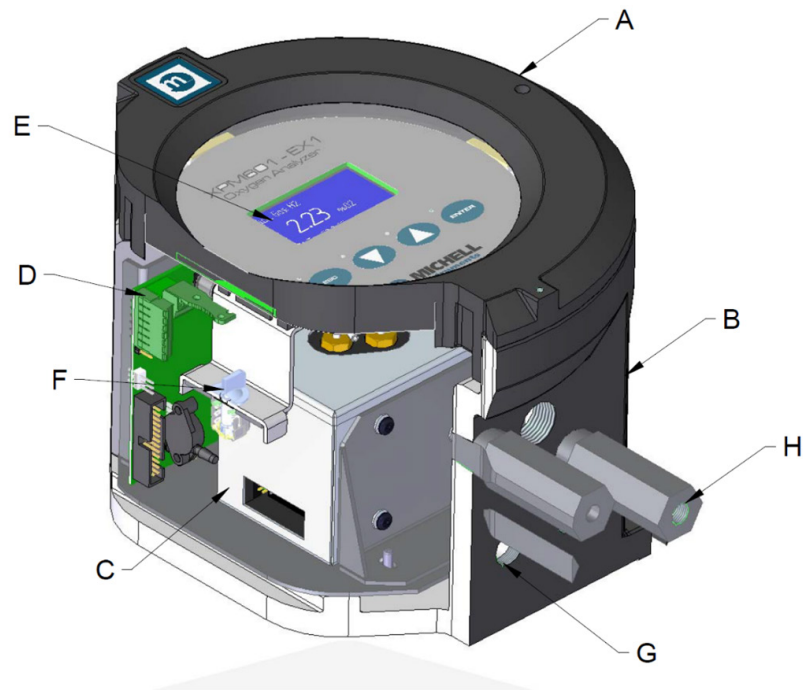


Figure 28 XPM601 Cutaway Showing Major Components

- A Lid with display and touch screen
- B Instrument case
- C Measuring cell
- D Motherboard
- E Display PCB
- F Quick release mechanism for display PCB
- G Cable/Conduit entries (3 available)
- H Gas Inlet (left-hand side) / Outlet (right-hand side)

4.3 Set-Up

- The XPM601 is designed to be panel or wall mounted. There are 2 bolt holes and 2 lugs (1 per corner) – see Figure 30. Dimensional drawings can be found in Appendix A.1. Mount the analyzer before attempting to remove the lid.



WARNING: This unit is 24 V DC powered only! Do not attempt to loop-power this instrument via the 4...20 mA output as this will irreversibly damage the main PCB.

- The EX d enclosure thread is greased and, therefore, it may be advisable to wear latex gloves.
- Ensure that the grub screw is loose, using the hex key (supplied), to prevent scoring on the casing.
- Connect the earthing strap to the earth point on the right-hand side of the case.
- Remove the lid, using the lid keys (supplied). The lid will require a firm grip to loosen.

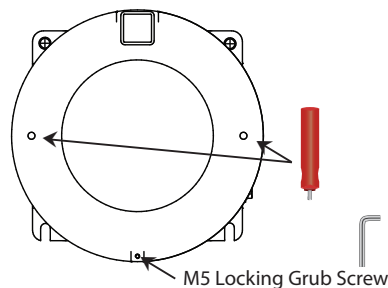


Figure 29 XPM601 Lid Removal

- If fitted, remove the display / status PCB via the two ¼ turn quick-connect fittings.
- Disconnect the ribbon / interconnecting cable from the loose PCB.



WARNING: Prior to connecting power, ensure the unit is correctly earthed via the earth point on the right-hand side of the case.

- Connect to the power and outputs (see Section 4.5).
- After making all necessary connections, reconnect the PCB via the ribbon/ interconnecting cable and quick-connect fittings and replace the lid, ensuring at least 7 full turns on the thread to complete the gas path.
- Use the hex key (supplied) to tighten the grub screw. **NOTE: This is necessary in order to adhere to the hazardous area certification requirements.**

4.4 Mechanical Installation

There are 3 cable entries on the bottom surface, towards the rear, that can be utilized by the customer in a variety of manners. The following standard options are available: Cable Gland, Conduit Entry, Blanking Plug or Light Guide.

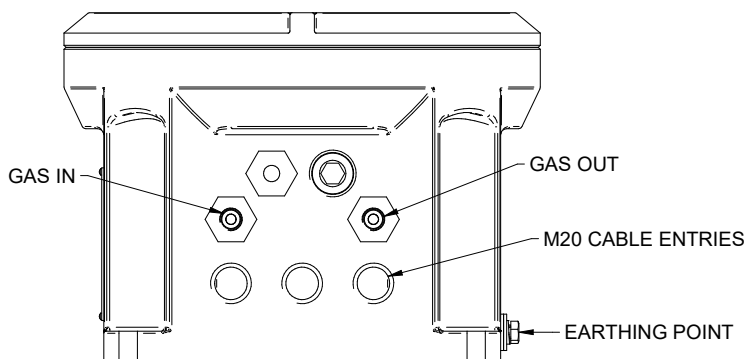


Figure 30 XPM601 Cable Entries

4.4.1 Gas Connection

The 1/8" NPT female gas connections are on the bottom surface towards the front of the unit. The gas inlet is the left-hand connection when viewing the unit from the front.

Unsintered PTFE tape is available as an accessory from Michell Instruments (PTFE-TAPE-02).

4.4.2 Sample Gas Requirements

This analyzer must have a constant sample temperature, pressure and flow rate to remain within its stated specification. Furthermore, the calibration gas (ideally certified gas) should be introduced to the analyzer in a manner matching the process conditions.

Samples must have a dew point at least 10 °C less than the cell temperature (so as not to condense), be free from oil-mist and with particle size < 3µm. **NOTE: There is NO filtration inside the analyzer.**

Sample Pressure: 0...0.33 barg (0...4.78 psig)

Sample Flow Rate: 100 ml/min (0.25 scfh)

Ideally, a flowmeter and needle valve would be placed in front of the analyzer and the vent would be open to the atmosphere.

4.4.3 Calibration Gases

Cylinders of the appropriate Zero and Span gases should be available for installation and commissioning. Dependent on the specific duty of the analyzer, these gases may have a lead time of several weeks. See Section 3, Calibration, for more information.

4.5 Electrical Installation

4.5.1 Power Supply and Input/Output Signal

The XPM601 requires 24 V DC power input at a maximum start-up current of 1.5 A.

All versions will use a braid screened multi-core cable. Ideally, one cable for signals (PL4, PL5) and another cable for power (PL9) / relay contacts (PL1). Braid of cables must be well terminated at the cable glands. Wire sizes should be between 28 and 16 AWG.

The terminal blocks for the power supply, input signal and output signal are located underneath the lower PCB. **NOTE: The terminal blocks are color co-ordinated to match the connectors – make sure this color coding is adhered to.**

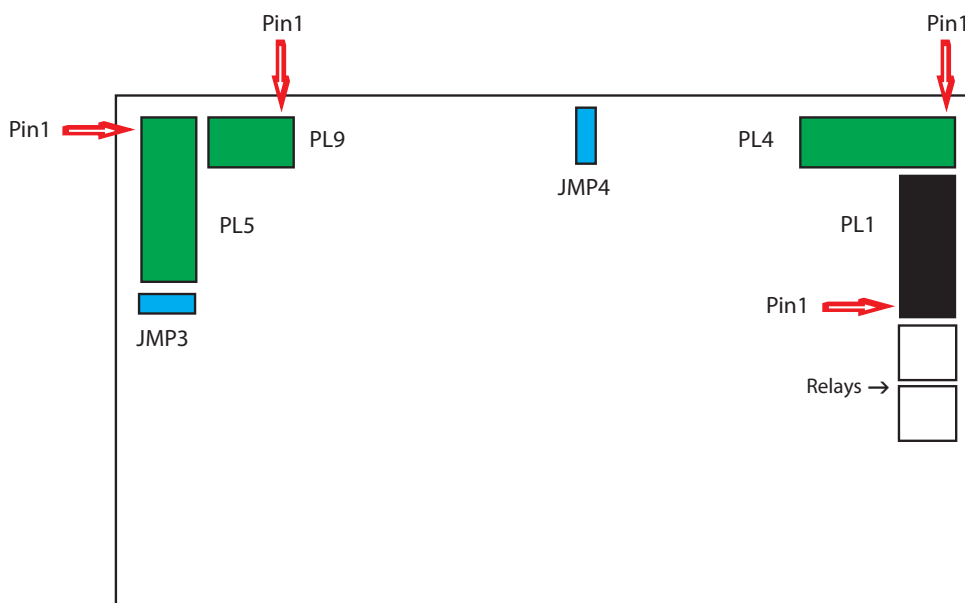


Figure 31 Terminal Block Locations

4.5.2 Power Supply (PL9 – Green)

PIN 3	PIN 2	PIN 1
0 V	N/C	24 V ±4 V

4.5.3 Signal Output

There are two 4...20mA linear signal output channels. Both are for oxygen concentration. One is fixed on the calibrated range of the unit and the second can be configured in the menu. **NOTE: When the instrument is warming up (cell temperature not stabilized) these outputs are set to 3.2 mA (if set to NAMUR ERR LOW) or 21.4 mA (if set to NAMUR ERR HIGH) to indicate that the instrument is not ready.**

- The maximum mA output is approximately 20.5 mA
- The minimum mA output is approximately 3.8 mA
- The user can select the fault condition to drive the mA output Low (3.2 mA) or Hi (21.4 mA).

4.5.4 Serial Output

The analyzer has Modbus RTU communications over RS485.

- Type: Modbus RTU over RS485
- RS485: 2-wire (plus ground), half duplex
- Baud Rate: 9600
- Parity: None
- Data bits: 8
- Stop bits: 1

4.5.5 Analog (4...20 mA) Outputs and Communications (PL5 – Green)



Warning: Do not attempt to loop-power this instrument via the 4...20 mA output as this will irreversibly damage the main PCB.

PIN 7	PIN 6	PIN 5	PIN 4	PIN 3	PIN 2	PIN 1
RS485 GND	RS485 B	RS485 A	Ch2 O/P -	Ch2 O/P +	Ch1 O/P -	Ch1 O/P +

NOTE 1: Channel 1 is fixed range output over instrument range and Channel 2 is adjustable between 0 and 100 %.

NOTE 2: For long cable lengths, a termination resistor of 120Ω is provided to aid in impedance matching of the communications cable. This is selectable via JMP3. A terminating resistor is simply a resistor placed at the extreme end or ends of a cable on an RS485 network to reduce effects of impedance mismatch. Impedance mismatch can cause reflections of data as it passes down the cable and the reflections could be large enough to cause data errors.

NOTE 3: The maximum loop load resistance for mA outputs is 550Ω

4.5.6 Alarm Relay Contacts (PL1 – Black)

AL2			AL1		
PIN 6	PIN 5	PIN 4	PIN 3	PIN 2	PIN 1
Alarm 2 C	Alarm 2 NO	Alarm 2 NC	Alarm 1 C	Alarm 1 NO	Alarm 1 NC

- Type: SPCO (NO, NC and C)
- Contact Rating, Max: 2 A, 250 V AC
- Hysteresis is 0.03 % O₂
- AL1 and AL2 can be configured as OFF, LOW or HIGH
- A low alarm switches on when % O₂ is below the set point and switches off when % O₂ is above the set point + Hysteresis
- A high alarm switches on when % O₂ is above the set point and switches off when % O₂ is below the set point – Hysteresis
- When the instrument is warming up (cell temperature not stabilized) both relays are OFF

4.5.7 Analog (4...20 mA) Inputs and Sensor Excitation Voltage (PL4 – Green)

PIN 6	PIN 5	PIN 4	PIN 3	PIN 2	PIN 1
Ch2 I/P -	Ch2 I/P +	Ch2 Exc.V	Ch1 I/P -	Ch1 I/P +	Ch1 Exc.V

The XPM601 features 2 input channels for 4...20 mA signal from external instruments such as pressure transmitters or other devices to compensate for pressure or background gas influence.

The input configured as **EXT SENS** (External Sensor) can be viewed on the Secondary Parameters Page under the heading **EXT I/P** (External Input).

NOTE 1: Channel 1 is External Compensation input and Channel 2 is External Sensor input.

NOTE 2: Excitation voltage = Same as power supply ±1 V if JMP4 connected across top 2 pins and 15 ±0.5 V (max 100 mA per channel) if JMP4 connected across bottom 2 pins.

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance	
Measurement Technology	Paramagnetic oxygen analyzer
Gas	Non-condensing sample with particles <5 µm
Measurement Range	Up to 5 % O ₂
Display Resolution	0.01 %
Display Type	Backlit LCD
Accuracy	< ±0.1 % O ₂
Response Time (T90)	< 15 seconds
Repeatability	< ±0.012 % O ₂
Linearity	< ±0.1 % O ₂
Zero Stability	±0.25 % of range per month
Range Stability	±0.25 % of range per month
Sample Flow Rate *	100 ml/min (0.25 scfh)
Sample Pressure *	0...0.33 barg (0...4.78 psig)
Sample Temperature *	A constant temperature of +5...+55 °C (+41...+131 °F)
Sample Cell Temperature	+60 °C (+140 °F)
Background Gas	Analyzer is calibrated in the background gas of H ₂
Electrical Input/Output	
Analog Inputs	1 off mA input for an external sensor (can be displayed on the screen) 1 off mA input to act as an active compensation for the process conditions
Analog Outputs	2 off 4...20 mA outputs (powered with 24 V excitation voltage)
Output Ranges	Primary range is set to the calibrated range of the instrument The second is user configurable between 0 and 5 %
Alarms	2 off single pole changeover (SPCO) relays for O ₂ concentration (250 V, 5 A max)
Datalogging	The user can use the digital communications to log the output from the analyzer The unit will store 40 alarm points and the min/max O ₂ concentrations with date and time stamp
Digital Communications	Modbus RTU over RS485
Power Supply	24 V DC; 1.5 A max
Cable Entries	Analyzer is supplied with 3 x M20 cable entries. Cable glands, conduit entries and blanking plugs are available as accessories.
Operating Conditions	
Ambient Temperature	+5...+60 °C (+41...+140 °F) +5...+50 °C (+41...+122 °F) cQPSus
Atmospheric Pressure	750 mbar...1250 mbar

Mechanical Specifications	
Warm-Up Time	< 25 minutes
Stabilization Time	5 minutes
Dimensions	234 x 234 x 172 mm (9.2 x 9.2 x 6.7") (w x d x h)
Weight	9.7 kg (21.4 lbs)
Wetted Materials	316 stainless steel, Viton 'O' ring, borosilicate glass, Electroless Nickel, platinum, platinum/iridium alloy
O-Ring Materials	Viton
Gas Connection	1/8" NPT (female)
Ingress Protection	IP66, NEMA 4X
Enclosure Material	Aluminum, copper free
Hazardous Area Certification (see Appendix C)	

The XPM601 meets or exceeds all relevant clauses in BS EN 50104:2019 "Electrical apparatus for the detection and measurement of oxygen".

* This analyzer must have a constant sample temperature, pressure and flow rate to remain within its stated specification. Furthermore, the calibration gas (ideally certified gas) should be introduced to the the analyzer in a manner matching the process conditions.

A.1 Dimensions

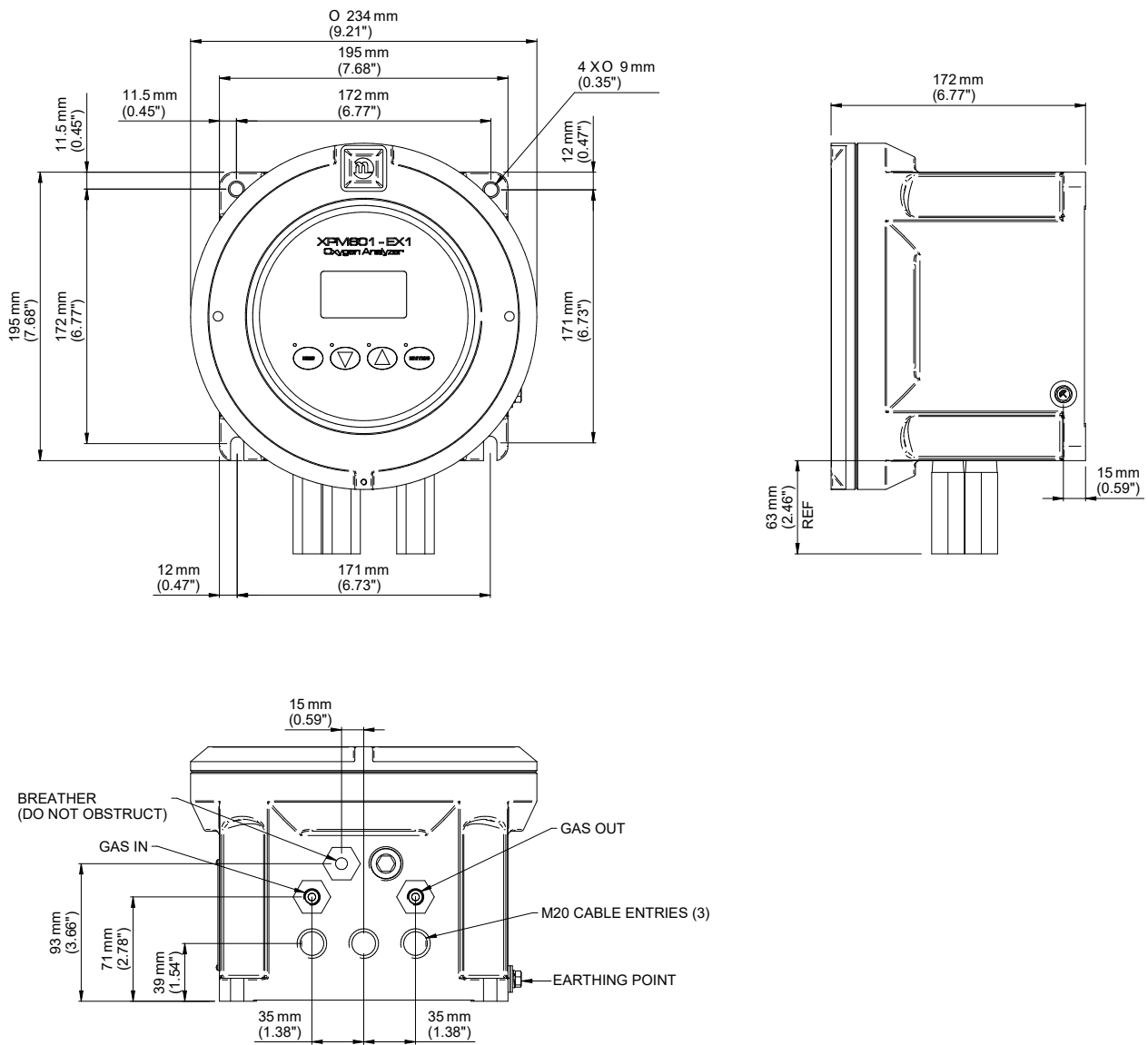


Figure 32 XPM601 Dimensional Drawings

NOTE: Fixing mounts are NOT symmetrical. This is to ensure correct orientation.

Appendix B

Modbus Register Map

Appendix B Modbus Register Map

Compatible with XPM601 Firmware Version: V1.0

Addr	Function	Access	Ranges/Resolution	Type
0	Modbus Instrument Address (ID)	R/W	1...127	A
1	Settings Register	R/W	0...65535	B
2	Display Contrast / Brightness	R/W	0...100 % / 0...100 %, 10 % steps	C
3	Units Register(Tempr, Pressure, Ext Sens Param etc)	R/W	See Reg details	D
4	Chart Interval	R/W	2...60 Sec, in 2 sec intervals	A
5	N/A	R/W	N/A	N/A
6	Alarm 1 (Lo alarm) Set point	R/W	Instrum range min Instrum range max, 0.01	G
7	Alarm 2 (Hi alarm) Set point	R/W	Instrum range min Instrum range max, 0.01	G
8	O ₂ Range Zero (Ch1 output zero)	R	0.00 to O ₂ Range Span	G
9	O ₂ Range Span (Ch1 output span)	R	O ₂ Range Zero to 100.00	G
10	CH1 comp coefficient 20 %	R/W	0.50...2.00	G
11	CH1 comp coefficient 40 %	R/W	0.50...2.00	G
12	CH1 comp coefficient 60 %	R/W	0.50...2.00	G
13	CH1 comp coefficient 80 %	R/W	0.50...2.00	G
14	CH1 comp coefficient 100 %	R/W	0.50...2.00	G
20	CH2 Input (Ext Sensor) zero	R/W	See Reg Details	F
21	CH2 Input (Ext Sensor) span	R/W	See Reg Details	F
22	Alarm / NAMUR Configuration	R/W	See Reg Details	L
23	Cell Tempr Set point	R	40...70 C	A
29	O ₂ Field Cal Reference 1	R/W	0.00 % or (min -20 % for suppressed Zero) to max + 20 % of Instrument Range, 0.01	G
30	O ₂ Filed Cal Actual 1	R/W	-199.99...199.99	G
31	O ₂ Field Cal Reference 2	R/W	Instrument Range min to (max + 20 % of range), 0.01	G
32	Pressure at calibration	R	800.0...1200.0 mBar	F
37	O ₂ Field Cal Actual 2	R/W	-199.99...199.99	G
56	CH2 output zero	R/W	Instrument range min to CH2 output span, 0.01	G
57	CH2 output span	R/W	CH2 output zero to instrument range max, 0.01	G
63	Hours Of Operation	R	0...65535	A
65	Set Clock HRS	W	00...23	J
66	Set Clock MIN	W	00...59	J
67	Set Clock DAY	W	01...31	J
68	Set Clock MONTH	W	01...12	J
69	Set Clock YEAR	W	00...99	J
70	%O ₂ without HSR	R	-199.00...199.99 %	G
71	%O ₂ with HSR	R	-199.00...199.99 %	G
72	Cell Temperature	R	-99.9...99.9 or equiv in F or K	F
73	PCB temperature (from MSP)	R	-99 to 99 C or equiv in F or K	K
74	Atmos pressure	R	0...1500 mBar	A

Addr	Function	Access	Ranges/Resolution	Type
75	mA1 Input in % (comp signal)	R	0.0...100.0 %	F
76	mA2 Input (ext sensor signal)	R	See Reg Details	F
77	Status Flags register	R	0...65535	I
78	Clock HOURS/MIN	R	00...23 / 00...59	J
79	Clock SEC/DAY	R	00...59 / 01...31	J
80	Clock MONTH/YEAR	R	01...12 / 00...99	J
81	%O ₂ MINIMUM (stats)	R	-199.00...199.99 %	G
82	%O ₂ MAXIMUM (stats)	R	-199.00...199.99 %	G
84	Firmware Version	R	0.00...200.00	G
91	%O ₂ without field cal correction	R	-199.00...199.99 %	G

Register Type A: Unsigned Integer

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

Unsigned integer. Range = 0 to 65535

Register Type B: Settings

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

Bit	HEX	Meaning
0	0001	Field Cal On
1	0002	Pressure Compensation On
2	0004	External Compensation On
3	0008	Background Gas Compensation On
4	0010	HSR On
5	0020	Display Limit 0...100 % On

Register Type C: Display Parameters

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Display Brightness								Display Contrast							
r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w	r/w
0...100 in 10% steps								0...100 in 10% steps							

Register Type D: Units

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

Bits	HEX	Meaning (binary)
0, 1	0003	00=°C, 01=°F, 10=K
2, 3	000C	Ext press unit, 00 = psia, 01=bara, 10=kPa
4	0010	Field cal type, 0=1 gas (offset), 1=2 gas
5	0020	Date format 0=Non US, 1=US
11,12,13	3800	Ext Sensor Parameter (000=none, 001=dewp, 010=tempr, 011=press, 100=other)

Register Type F: -2000.0 to +2000.0

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

Range = 0 to 40000 represents -2000.0 to +2000.0

Conversion: $(\text{RegValue} - 20000)/10.0$

For external sensor values

Dew point: -100/+20 °C, -148.0/+68.0 °C, 173.0/293.0 K

Tempr: -50.0/+100.0 °C, -58.0/+212.0 °F, 223.0/373.0 K

Pressure: 0.0/44.1 psia, 0.0/3.0 barA, 0.0/304.0 kpa

Register Type G: -200.00 to +200.00

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

Range = 0...40000 represents -200.00...+200.00

Conversion: $(\text{RegValue} - 20000)/100.00$

Register Type I – Status/Error

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

Bit	HEX	Meaning
0	0001	Displays O ₂ HSR or O ₂ depending on setting (system)
1	0002	%O ₂ out of range (beyond calibration range, e.g. 0...25 %)
2	0004	Low alarm ON
3	0008	High alarm ON
4	0010	Ext Comp i/p signal error (input < 3.6mA or > 21mA)
5	0020	Ext sens. signal error (input < 3.6mA or > 21mA)
6	0040	Cell T not stable (not within +/- 0.15 °C of setpoint for continuous period of 15 minutes)
7	0080	Cell T sensor error (cell tempr measures <-50 or >80 °C)
8	0100	Press sensor error (Press sensor < 700 or >1300 mbar)
9	0200	O ₂ sensor error (Vcomp <=1 or >=8191)
10	0400	PCB tempr too high (PCB tempr > Cell tempr setpoint)

Register Type J

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

←────────────────── eg Day ───────────────────▶ ←────────────────── eg Month ───────────────────▶

For reading each 8 bits represents a RTC value. For setting only the Lower 8 bits are used for each RTC value.

Register Type K: -32767 to +32767

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

Range = 0...65535 represents values

Conversion: (RegValue – 32767)

Register Type L: Alarm/NAMUR Configuration

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

Bits	Meaning
1, 0	00 = Alarm1 is Inactive (off) 01 = Alarm1 is a Low Alarm 10 = Alarm1 is a High Alarm
3, 2	00 = Alarm2 is Inactive (off) 01 = Alarm2 is a Low Alarm 10 = Alarm2 is a High Alarm
4	0 = Namur Error Level Low (3.2mA) 1 = Namur Error Level High (21.4mA)

Appendix C

Hazardous Area Certification

Appendix C Hazardous Area Certification

The XPM601 is certified compliant to the ATEX Directive (2014/34/EU), the IECEx scheme and SI 2016 No. 1107 UKCA 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 XPM601 is certified compliant to the applicable North American Standards (USA and Canada) for use within Class I & II, Division 1 and Class I, Zone 1 & Zone 21 Hazardous Locations and has been assessed as being so by QPS Evaluation Services Inc.

C.1 ATEX/UKCA

Certificate: CML 20ATEX1038X / CML 21UKEX1048X

Certification: II 2 G D
Ex db IIB+H2 T6 Gb
Ex tb IIIC T85 °C Db IP66
Tamb -15 °C...+60 °C

Standards: EN IEC 60079-0:2018, EN 60079-1:2014, EN 60079-31:2014

C.2 IECEx

Certificate: IECEx CML 20.0018X

Certification: Ex db IIB+H2 T6 Gb
Ex tb IIIC T85 °C Db IP66
Tamb -15 °C...+60 °C

Standards: IEC 60079-0:2017, IEC 60079-1:2014, IEC 60079-31:2013

C.3 North American (cQPSus)

Certificate: LR1507-6R1

Certification: Class I, Division 1, Groups B, C & D T6
Class II, Division 1 Groups E, F & G
Class I, Zone 1
AEx db IIB+H2 T6 Gb / Ex db IIB+H2 T6 Gb
Zone 21
AEx tb IIIC T85 °C Db / Ex tb IIIC T85 °C Db
Tamb -15 °C...+60 °C

Standards: ANSI/UL 60079-0-7th ed. / CSA C22.2 No. 60079-0:19
ANSI/UL 60079-1-7th ed. / CSA C22.2 No. 60079-1:16
ANSI/UL 61010-1-3rd ed. / C22.2 No. 61010-1:12 (guides)
ANSI/UL 60079-31-2nd ed. / CSA C22.2 No. 60079-31:15
FM 3600-2018, FM 3615-2018, FM 3810-2018
CSA C22.2 No. 30:1986

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

C.4 Special Conditions

1. Cable entry holes shall be fitted with either an appropriately certified cable gland or appropriate certified blanking element. These shall provide and maintain a minimum enclosure ingress protection of IP66.
2. The maximum pressure associated with the process medium in the internal pipes shall be limited to 0.33 bar (4.78 psig).
3. The maximum temperature associated with the process medium shall be limited to 60 °C.
4. The flameproof joints of the flame arrestors & breather are not intended to be repaired.

C.5 Maintenance and Installation

The XPM601 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.

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

Analyzer Return Document & Decontamination Declaration

Appendix E Analyzer 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	



NOTES



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