DORGEAN
Beijing Dorgean Electronic Technology Co.,Ltd
Instrument Expert
Original factory packaging
www.dorgean.com

MICHELL Instruments
A PST BRAND

XTP501 Oxygen Analyzer & XTC501 Binary Gas Analyzer User Manual

99976 Issue 1.3
November 2021

Please fill out the form(s) below for each instrument 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	

XTP501 or XTC501 Analyzer

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

© 2021 Michell Instruments
This document is the property of Michell Instruments Ltd and may not be copied or otherwise reproduced, communicated in any way to third parties, nor stored in any Data Processing System without the express written authorization of Michell Instruments Ltd.

Contents

Appendices

Figures

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 working pressure for this instrument is 1.5 barg (20 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 Michell Instruments' worldwide offices contact information go to www.michell.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 relevant European safety directives.

Equipment Ratings

This equipment must be supplied with a voltage of 24 V DC, 1.5 A (32.1W). 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
max	maximum
mA	milliampere
ml/min	milliliters per minute
mm	millimeters
ppm	parts per million
psig	pounds per square inch
scfh	standard cubic feet per hour
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 or binary gas mixtures easily using the 501 Analyzer.

The following sections contain information about:

- 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 2 versions of the 501 available are shown below:

GP1
Analyzer

GP2
Transmitter

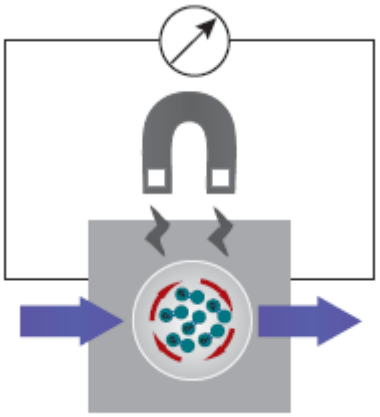
Figure 1 *501 Analyzer and Transmitter*

The XTP501 Analyzer is based on Michell Instruments' advanced proprietary Thermo-Paramagnetic technology. It measures the percentage of oxygen in a wide range of gases, including nitrogen, hydrogen, carbon dioxide, methane and biogas. The XTC501 Analyzer uses our thermal conductivity sensor to measure a target gas such as hydrogen in a background gas such as nitrogen. In both Analyzers the sensor is housed in a splash-proof casing – IP55 rated.

1.1 Sensor Technologies

1.1.1 Thermo-paramagnetic

Michell's thermo-paramagnetic sensor uses a combination of paramagnetic and thermal conductivity techniques to accurately measure the oxygen content within a process gas. Oxygen is a paramagnetic gas, which means that it is attracted to a magnetic field. It is this property that can be exploited to help determine the level of oxygen in many background gases. The magnetic susceptibility of oxygen changes with its temperature, so Michell's thermo-paramagnetic analyzer uses a temperature-controlled measuring chamber. The sensing element is in a diffusion chamber out of the direct flow of gas to ensure a stable measurement that also offers mechanical protection to the sensor.

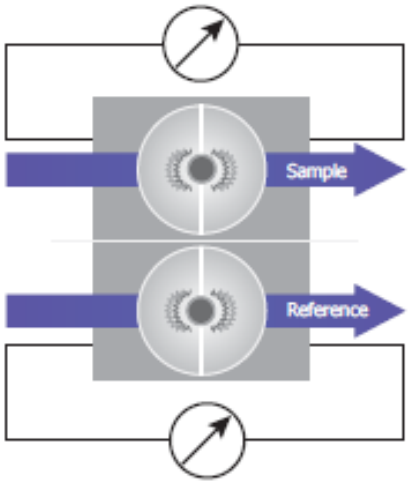


Advantages of Thermo-Paramagnetic:

- The thermo-paramagnetic sensor has no consumable or moving parts which means lower cost of ownership
- Units are calibrated specifically to maximize the accuracy at the required measurement range
- Stable measurements
- Good balance of price and performance

1.1.2 Thermal Conductivity

Thermal conductivity (TC) is a property of all gases. This can be exploited as each gas has a different TC value and is used to determine the level of one gas in a binary or pseudo-binary mix. Air is a good example of a pseudo binary mix as it has a fixed proportion of oxygen and nitrogen (both with very similar thermal conductivities). A pair of matched thermistors (glass coated) are placed in symmetrical a sensor body with one in the measuring side and one in the reference side. These thermistors accurately measure the difference in the thermal conductivity of the measured gas and the reference gas. The reference chamber is sealed and does not require a flowing reference gas.



Advantages of Thermal Conductivity:

- Zero point stability of 0.5 % of span per month means less frequent calibrations
- No moving parts or consumable items
- Stable and accurate measurement from symmetrical cell design
- Cost-effective measurement
- Flexible technology allows many target gas measurements

1.2 Features

- There are 2 versions of the 501 available:

  Analyzer with display and keypad
  Transmitter (base model)

- The 501 is calibrated in a specific background gas to match customer's requirements. This is displayed on the front screen of the analyzer or via the Application Software.
- The 501 provides 2 off 4...20 mA analog output signals that are proportional to the oxygen/target gas concentration. The primary 4...20 mA output is locked on the calibrated range of the instrument. The secondary output is user-configurable.
- Modbus RTU over RS485 serial communications are provided as standard.
- The innovative designs of both sensors have no moving parts. This makes them less sensitive to vibration and highly resistant to drift over a long period of time, compared to other sensing technologies.
- The splash-proof enclosure (IP55 rated) allows the 501 to be installed on-site, at the measurement point in most indoor applications, without the need for an additional enclosure.
- All the analyzer functions can be accessed through the built-in or remote HMI or via the Application Software.
- 2 x single pole change-over relay alarms for concentration, supplied as standard. Can be configured as OFF, LOW or HIGH.
- If the sensor temperature is outside of the allowed tolerance, the mA output can be configured to be driven LOW or HIGH.

2 OPERATION

The 501 is not suitable for use with ambient oxygen levels that are enriched (i.e. over 21 % O_2).

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 starting operation, 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.

All analyzers will be factory calibrated with a nominally atmospheric vent and flow rate of 300 ml/min (0.63 scfh). The calibration gas applied to the analyzer should be at the same pressure and flow rate as the process gas being sampled.

Sample Inlet Pressure:

0.75...1.5 Bar A (10...20 psi A)

Sample Flow Rate:

100...500 ml/min (0.2...1.06 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 of +50 °C and protect it from any condensation forming in the sensor.

There is no power switch on the 501 Analyzer. It is turned on automatically 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. The transmitter version (XTP501-GP2) has a power interrupt button for use when connecting the optional remote display, approximately 10 minutes will be required for stabilization after powering back on.

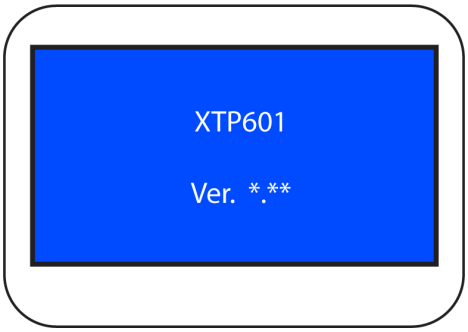


Figure 2 *Initializing Screen*

Figure 3 *Main Page*

Once initialized, the analyzer will show the Main Page which displays the O_2 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

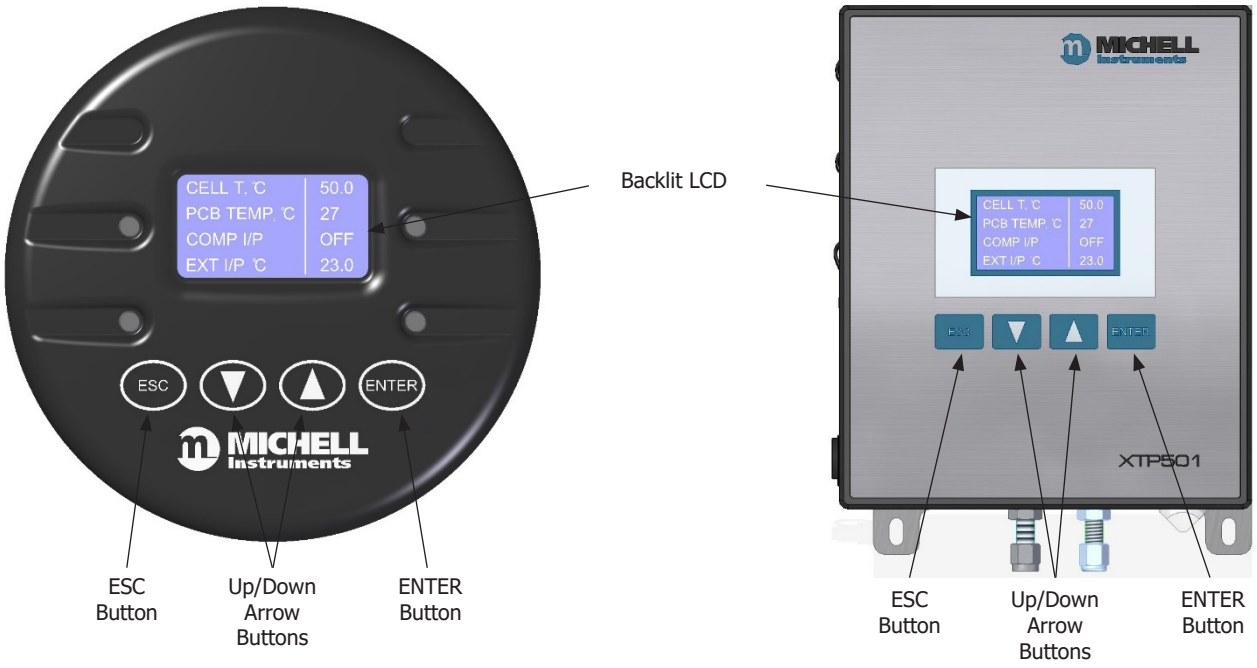


Figure 4 *User Interface*

The images above illustrate the user-interface options, which consist of a backlit Liquid Crystal Display and 4 touch-sensitive pads that facilitate user interaction.

Application Software is available to monitor or adjust parameters. Application software will require a PC or laptop with comm port connection. If using RS232 serial port, ensure that an isolated RS232 to RS485 converter is used.

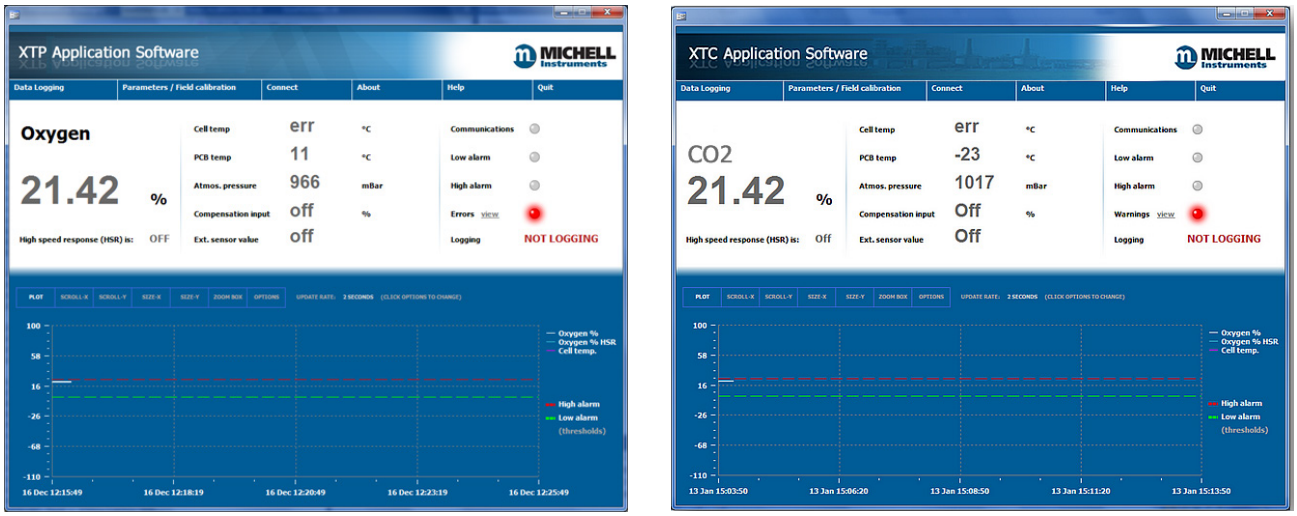


Figure 5 *Application Software example images*

2.3.2 'ESC' Button

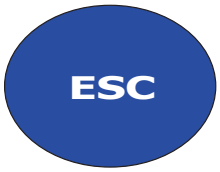


Figure 6 *ESC Button*

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

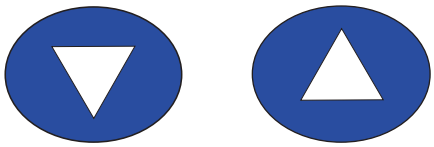


Figure 7 *Up/Down Arrow Buttons*

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

2.3.4 'ENTER' Button

Figure 8 *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.

NOTE: The buttons require the user to press and hold for 1 second to activate. This inhibits accidental operation.

2.4 Menu Structure

The analyzer has a front page that does not require a passcode but allows the user to scroll through and view oxygen/target gas concentration, recent trend, internal parameters, minimum & maximum 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 user will be able to set up and access all functions of the transmitter versions via the Application Software.

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

2.4.1 Changing the Passcode

As part of the SIL compliance 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 want to 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

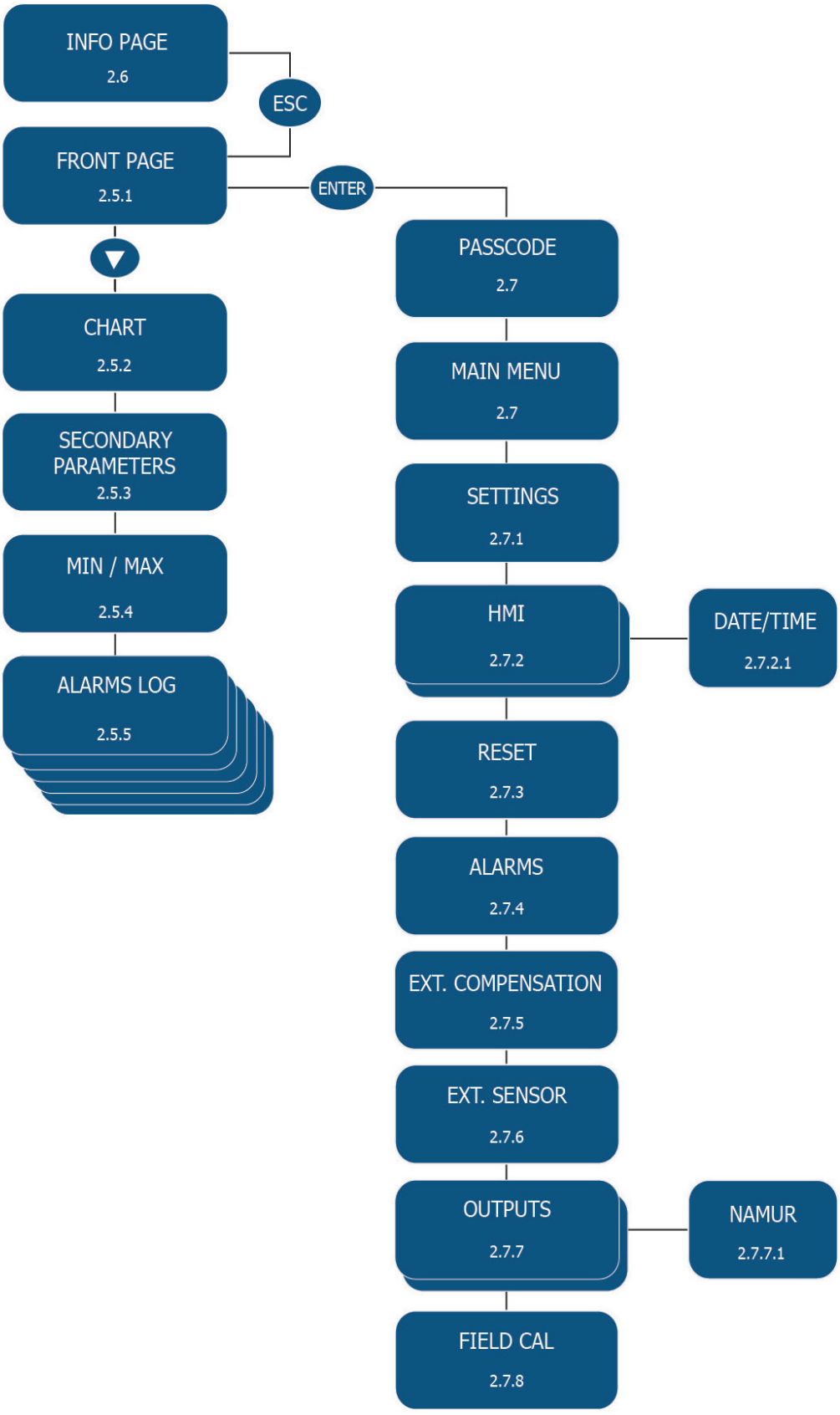


Figure 9 *Menu map*

2.5 Front Pages (No Passcode Required)

2.5.1 Front Page

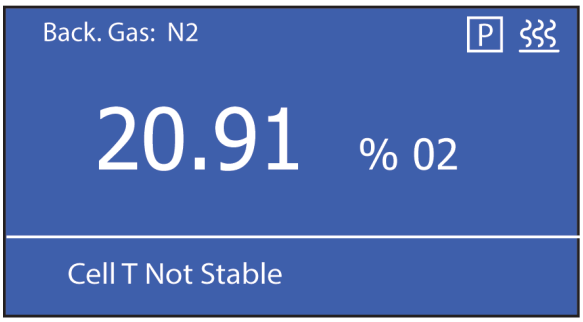


Figure 10 *Front Page*

XTP501

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 % for suppressed zero ranges)
% 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
Status Bar	Flashes any system warnings and error messages (see below)
P	When the symbol is visible, it denotes that the pressure compensation is active.

XTC501

Parameter	Description
Background Gas	Displays the background gas that the unit was calibrated in
Target gas %	Real target gas reading in % Display resolution = 0.01 (Display resolution 0.1 % when range is >10 %)
Flashing "Heating" Symbol	This flashes until cell temperature is stable at set point ±0.5 °C for minimum of 5 minutes
Status Bar	Flashes any system warnings and error messages (see below)

Status Message Table	
Message (Trigger Condition)	**Light Guide**
% O_2 (or target gas) out of range	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 ±0.5ºC of set point)	RED ON (priority1)
Cell T sensor error (cell temp measures <-50 or >+80ºC)	RED ON (priority1)
Press sensor error (pressure sensor < 750 or >1250 mbar)	RED ON (priority1)
PCB temp too high (PCB temp > cell temp set point)	RED ON (priority1)

2.5.2 Chart Page

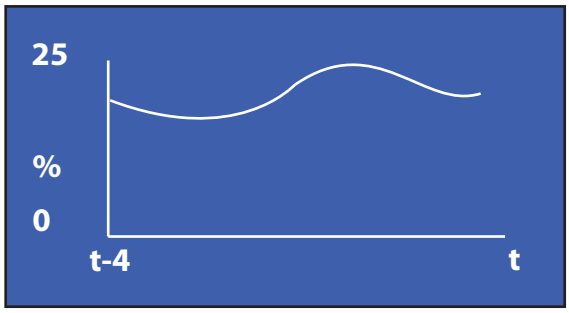


Figure 11 *Chart Page*

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 %.
- It is reset if the chart interval is changed or the instrument power is cycled.
- 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

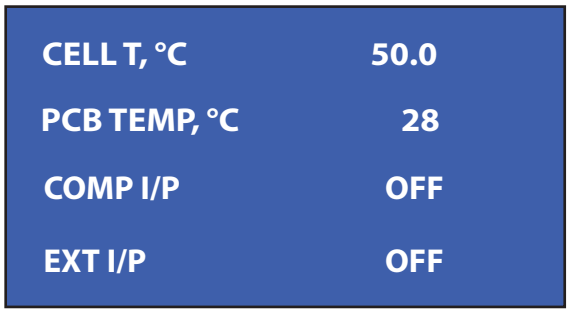


Figure 12 *Secondary Parameters Page*

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 temperature Display Resolution = 1 unit Accuracy = ±2ºC
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 Min/Max Page

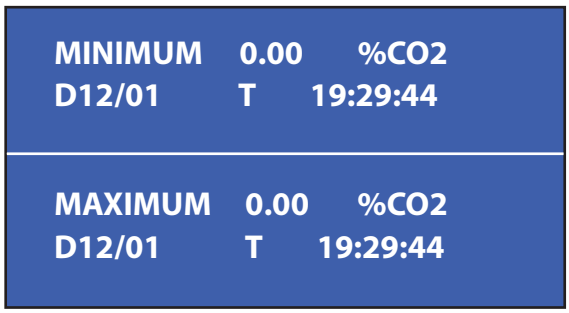


Figure 13 *Min/Max Page*

This indicates the minimum and maximum 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 non-volatile (NV) memory and is not available via serial communications.

2.5.5 Alarms Log Pages

Figure 14 *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 or in the blind unit. 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

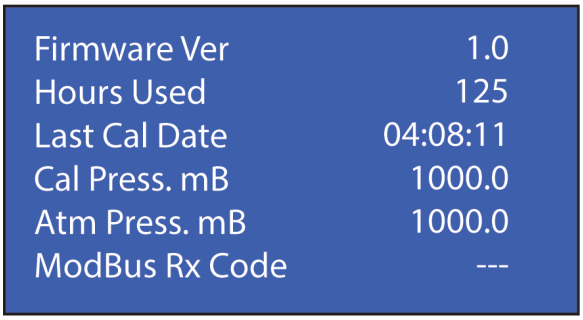


Figure 15 *Info Page*

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) (XTP only)
Atm Press, mB	Current atmospheric pressure being read within the analyser (XTP only)
Code ModBus Rx	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 16 *Main Menu 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

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

Figure 17 *Settings Pages for XTP (left) and XTC (right)*

The analyzer is microprocessor-based and, as such, has settings and features accessible to the user.

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 It is automatically turned off when Michell or field calibration is being performed	**ON/OFF**
PRESS COMP (XTP only)	Turns pressure compensation on or off It is automatically turned off when Michell or field calibration is being performed	**ON/OFF**
EXT COMP	Turn externals sensor compensation on or off It is automatically turned off when Michell or field calibration is being performed	**ON/OFF**
HSR (XTP only)	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 HSR value: • mA outputs (both channels) • alarm trigger points • chart values • min/max The Main Page displayed value is also HSR value (designated **% O_2p**)	**ON/OFF**
LIMIT 0-100 %	Limits the % O_2 and % O p 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	0-100%
BRIGHTNESS	0-100%
TEMPR UNIT	C/F/K
EXT PRESS UNIT	psia, bara, kpa
CHART INTVAL	2-60s
DATE	DD/MM/YY

Figure 18 *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**

Scroll down past the DATE field to access the date and time page.

2.7.2.1 Date and Time Page

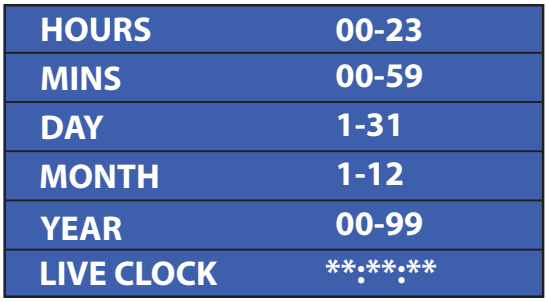


Figure 19 *Date and Time Page*

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 be 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

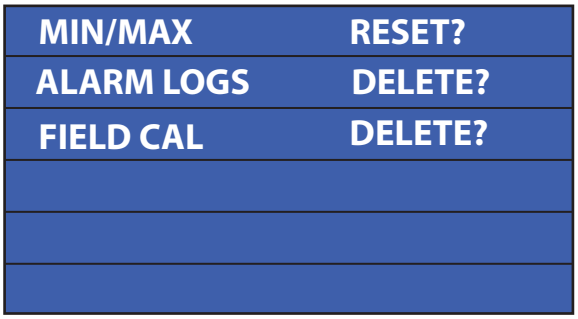


Figure 20 *Reset Page*

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

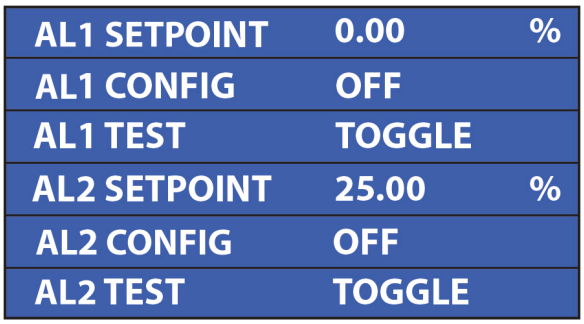


Figure 21 *Page Alarmes*

The analyser 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. Both alarms can be activated to test their operation by highlighting the Toggle option and pressing either up or down arrow.

Setting	Description/Operation	Options
AL1 SETPOINT	% set point for alarm relay 1	0...100 %
AL1 CONFIG	Turn on/off and set to HIGH or LOW	OFF, LOW OR HIGH
AL1 TEST	Toggle alarm by pressing up or down arrow	N/A
AL2 SETPOINT	% set point for alarm relay 2	0...100 %
AL2 CONFIG	Turn on/off and set to HIGH or LOW	OFF, LOW OR HIGH
AL2 TEST	Toggle alarm by pressing up or down arrow	N/A

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 22 *External Compensation Page*

A 4–20 mA sensor may be used to compensate the % 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 %.

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 % O_2 value, a table is created (see example below) while varying the pressure at 20 % of range intervals:

Pressure	% of Pressure span	O_2 reading	Effect = (affected value / non-affected value)	Compensation factor = 1 / effect
0	0 %	20.91	20.91/20.91=1.00	1.00
1	20 %	21.65	21.65/20.91=1.04	0.96
2	40 %	23.56	1.13	0.88
3	60 %	25.99	1.24	0.81
4	80 %	29.66	1.42	0.70
5	100 %	38.85	1.86	0.54

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

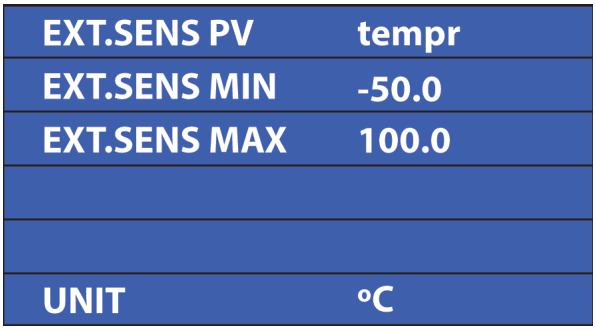


Figure 23 *External Sensor Page*

This page sets up the type and range of the 4–20 mA external sensor signal that may be connected to the XTP601 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 %).

Parameter	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, tempr, 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

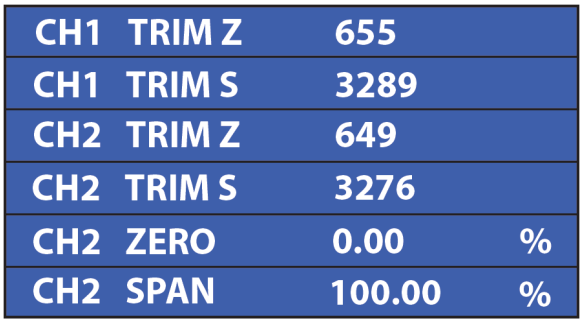


Figure 24 *Outputs Page*

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 sub-menu NAMUR Output Set-Up.

2.7.7.1 NAMUR Output Set-Up

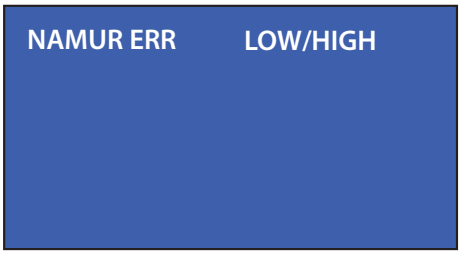


Figure 25 *NAMUR ERR Page*

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 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% ~	**0.00-100.00**

Figure 26 *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 value 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 value for REF GAS 2 See Section 3.2 Disabled if 1-point cal selected
ADJUSTED ~	Displayed concentration before and after change ~ symbol will be visible until reading is stable

See Section 3 for field calibration procedure.

2.7.9 Light Guide

The light guide is fitted to the right-hand side of the lower surface and has a red and green LED to display the current status.

- Green On – indicates instrument power is on.
- Red LED flashing – indicates when external compensation input or external sensor is out of range (if either is selected to **ON**). Out of range is <3.6 mA or >21 mA (see Status Message Table in Section 2.5.1).
- Red LED on – indicates an internal sensor error or instrument cell temperature not yet stabilized (see Status Message Table in Section 2.5.1)

These have been designed to follow the NAMUR NE44 standard.

3 CALIBRATION

Factory Calibration:

The unit is factory calibrated at 5 points to maximize the accuracy over the desired range. The calibration generally includes Zero & Span points as well as 3 intermediate points. In the case of suppressed zero ranges then the lowest concentration will replace the Zero Point.

NOTE: Analyzers are calibrated in background gas suitable for the specific application. Customer's calibration gases must match the process gas. Please refer to Test Result Sheet or a Michell Instruments' representative.

For range 0...25 % the analyzer will have calibration points between 0 and 21 % and will retain specification up to 23 % O_2. Concentrations between 23 % and 25 % O_2 are extrapolated values, unless the operator Field Calibrates (adjusts) the unit with a calibration gas of 25 %.

Field Calibration:

This analyzer 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. As soon as the first field calibration is performed, the field calibration setting is automatically switched on.

Preparation:

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

Sample Inlet Pressure: 0.75...1.5 BarA (10...20 psiA)

Sample Flow Rate:

100...500 ml/min (0.2...1.06 scfh)

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 0-25 % range instrument are around the 6 % area then apply a calibration gas as close as possible, in the example below we used 6.5 % O_2.

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.

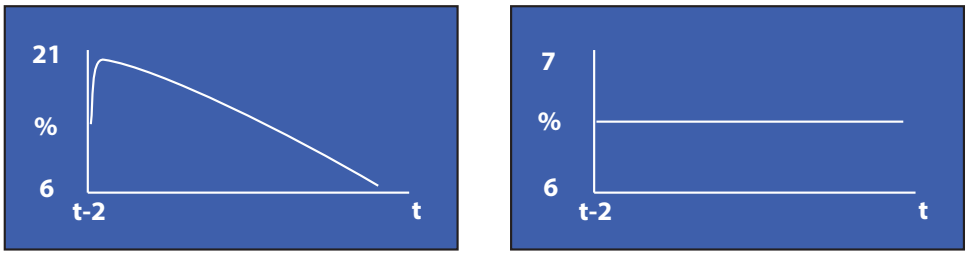


Figure 27 *1-Point Calibration Page*

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.

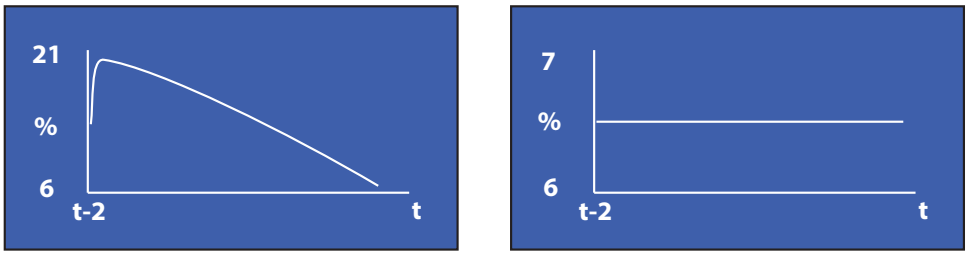


Figure 28 *2-Point Calibration Page*

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.

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).

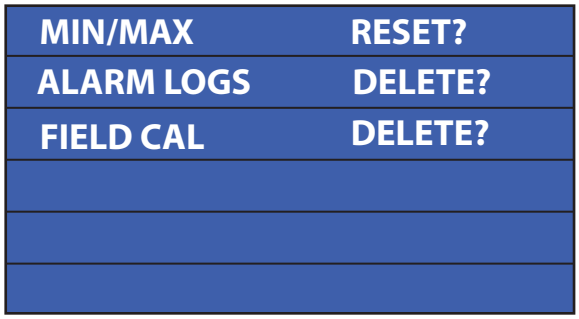


Figure 29 *Field Calibration Reset Page*

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.

4.1 Unpacking

If sold separately (not part of a sampling system), the 501 will be supplied in a custom box which should be retained for future use (such as service return).

Contents :

- XTP501 or XTC501 Analyzer
- Test result sheet
- Leak test report
- Power supply mating connector (part number XTX501-MCP)
- Signals OUT mating connector (part number XTX501-MCS)
- Signals IN mating connector (part number XTX501-MCSI)
- Alarms mating connector (part number XTX501-MCA)

NOTE : All mating connectors can be supplied with cables fitted, the part number will be the same as the core connector with the addition of a number at the end, which corresponds to the length of the cable in metres.

Example :
XTX501-MCS-05 = a Signals OUT mating connector with 5 metres of cable connected.

Please see order code sheet for available options.

4.2 System Components

The 501 Analyzer benefits from a modular construction, with the major parts of the analyzer shown below:

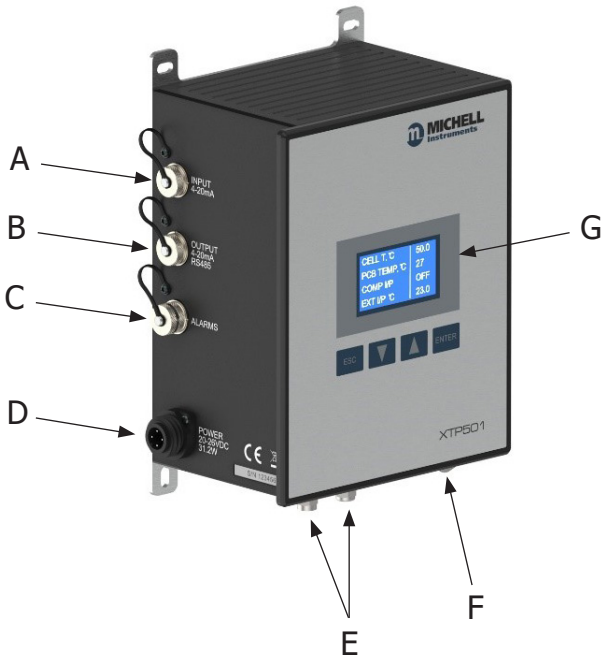


Figure 30 *XTP501 and XTC501 Showing Major Components*

A	Inputs (2 x 4...20 mA)
B	Outputs (2 x 4...20 mA + RS485)
C	Alarms (2 x concentration alarms)
D	24v Power connection
E	Gas Inlet and Outlet
F	Light Guide
G	HMI

4.3 Set-Up

- The 501 is designed to be wall mounted via 4 bolt holes. Dimensional drawings can be found in Appendix A.

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

- Connect to the power and outputs (see Section 4.5).
- For operating instructions refer to Section 2.

4.4 Mechanical Installation

The gas ports are located on the bottom surface, as is the light guide.

The transmitter version also has a connector for an optional remote display connector and a power interrupt (service reset) button.

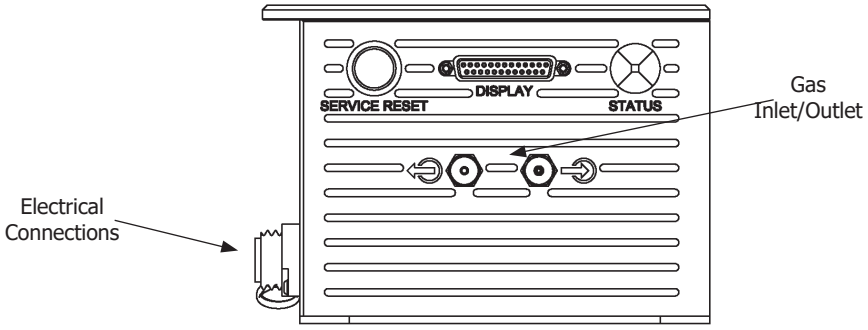


Figure 31 *501 Connections*

4.4.1 Gas Connection

The gas connections are on the bottom surface in the centre of the unit. The gas inlet is the right-hand connection when viewing the unit from the front. 501 models have 1/8" Swagelok gas connections.

4.4.2 Sample Gas Requirements

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 Inlet Pressure:

0.75...1.5 Bar A (10...20 psi A)

Sample Flow Rate:

100...500 ml/min (0.2...1.06 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 for more information.

If you are having difficulty in finding a local gas supplier, please contact your local Michell representative for assistance.

4.5 Electrical Installation

4.5.1 Power Supply and Input/Output Signal

The 501 requires 24 V DC power input at a maximum start-up current of 1.5 A.

NOTE : Loose connectors are supplied with the analyser for Power, Inputs, Outputs and Alarms.

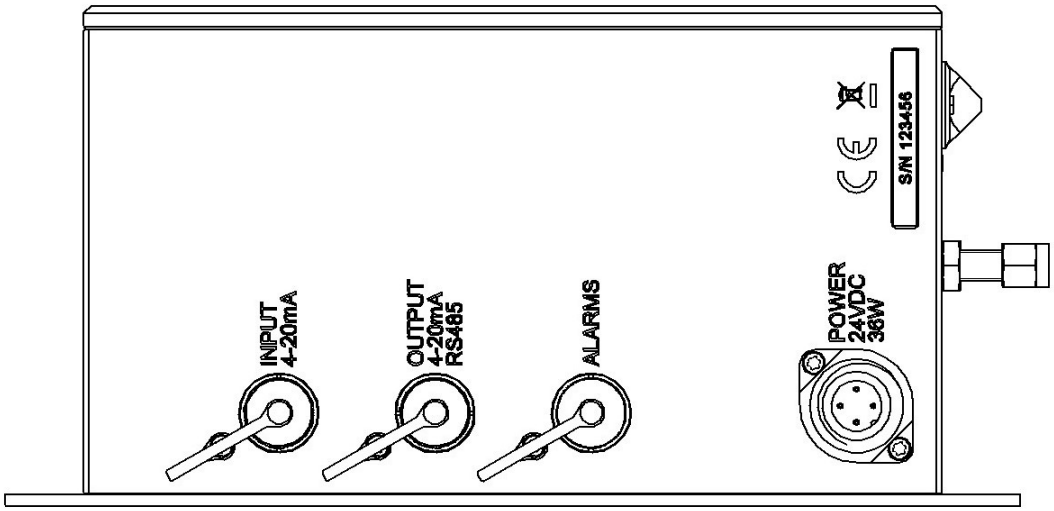
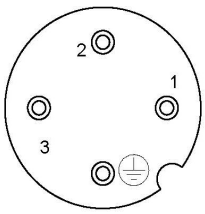
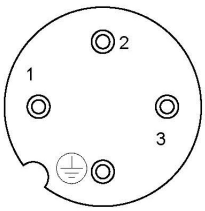


Figure 32 *Connections*

4.5.2 Power Supply



POWER FEED	
Power	Pin Number
NC	1
24 V ±4 V	2
NC	3
0 V	4



NOTE: The above view of the electrical connections is shown from the mating side.

Here are the connections as viewed from the back of the connector and this should be used for wiring purposes.

4.5.3 Signal Output

There are two 4...20mA linear signal output channels for target gas 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 driven to 3.2 or 21.4 mA.**

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

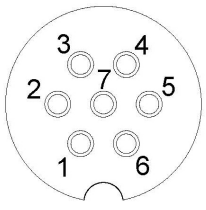
4.5.4 Serial Output

The analyzer has Modbus RTU communications over RS485; please see Application Software CD for more details.

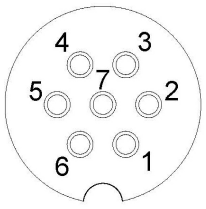
- Type: Modbus RTU over RS485
- RS485: 2 wire (plus ground), half duplex
- Baud Rate: 9600
- Parity: None
- Data bits: 8
- Stop bits: 1

4.5.5 Analog (4...20 mA) Outputs and Communications

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



Pin Number	Description	Color
1	Channel 2 -VE	Red
2	RS485 B	Blue
3	Channel 1 -VE	Green
4	Channel 1 +VE	Yellow
5	RS485 A	White
6	Channel 2 +VE	Black
7	RS485 GND	Brown



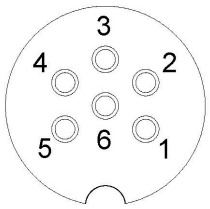
NOTE: The above view of the electrical connections is shown from the mating side.

Here are the connections as viewed from the back of the connector and this should be used for wiring purposes.

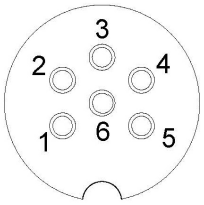
NOTE 1: Channel 1 is fixed range output over instrument range and Channel 2 is adjustable between 0...100 %.

NOTE 2: The maximum loop load resistance for mA outputs is 550Ω.

4.5.6 Alarm Relay Contacts



Pin Number	Description	Color
1	Alarm 2 NO	Red
2	Alarm 1 NO	Blue
3	Alarm 1 Common	Green
4	Alarm 1 NC	Yellow
5	Alarm 2 NC	White
6	Alarm 2 Common	Black

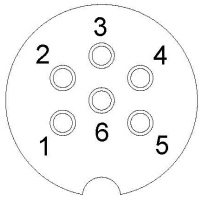


NOTE: The above view of the electrical connections is shown from the mating side.

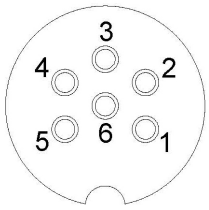
Here are the connections as viewed from the back of the connector and this should be used for wiring purposes.

- Type : SPCO (NO, NC and C)
- Contact Rating, Max: 2 A, 250 V AC
- Hysteresis is 0,03 %
- AL1 and AL2 can be configured as OFF, LOW or HIGH
- A low alarm switches on when % is below the set point and switches off when % is above the set point + Hysteresis
- A high alarm switches on when % is above the set point and switches off when % 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



Pin Number	Description	Color
1	Channel 2 -VE	White
2	Channel 2 +VE	Yellow
3	Channel 1 Feed	Green
4	Channel 1 +VE	Blue
5	Channel 1 -VE	Red
6	Channel 2 Feed	Black



NOTE: The above view of the electrical connections is shown from the mating side.

Here are the connections as viewed from the back of the connector and this should be used for wiring purposes.

The 501 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).

Channel 1 is the External Compensation input.

Channel 2 is the External Sensor input.

NOTE: The excitation voltage is the same as the power supply ±1 (max 100 mA per channel).

Appendix A

Technical Specifications

Appendix A Technical Specifications

Performance (XTP501)	
Measurement Technology	Thermo-paramagnetic oxygen sensor
Gas	Process and non-condensing sample with particles <3µm
Measurement Range	Select from 0...5 % up to 0...50 % and 20...100 % up to 90...100 %
Accuracy (excluding suppressed zero ranges)	< ±1 % of range or ±0.02 % O_2, whichever is greater
Accuracy (for suppressed zero ranges 20/80/90...100 %)	< ±1 % of range or 0.2 % O_2, whichever is greater
Response Time (T90) with HSR enabled	< 15 seconds
Repeatability	±0.2 % of range or 0.01 % O_2, whichever is greater
Linearity	±0.5 % of range or 0.05 % O_2, whichever is greater
Zero Stability	±0.25 % of range per month
Span Stability	±0.25 % of range per month
Sample Flow Rate	100...500 ml/min (0.2...1.06 scfh)
Sample Pressure	0.75...1.5 Bar A (10...20 psi A)
Sample Temperature	5...45 °C (+41...+113 °F)
Sample Cell Temperature	Standard +50 °C (+113 °F)
Background Gas	Analyzer is calibrated in the background gas of the process.

The XTP501 process oxygen analyzer meets or exceeds all relevant clauses in BS EN 50104: 2010 "Electrical apparatus for the detection and measurement of oxygen".

Performance (XTC501)	
Measurement Technology	Thermal Conductivity Sensor
Gas	Process and non-condensing sample with particles <3µm
Measurement Range	Select from 0...5 % up to 0...100 % and 50...100 % up to 90...100 %
Accuracy (H_2 or He)	< ±1 % of range or ±0.05 %, whichever is greater
Accuracy (other gases)	< ±2 % of range or ±0.1 %, whichever is greater
Response Time (T90)	< 50 seconds for most gas combinations
Repeatability	±0.2 % of range
Linearity	±1 % of range
Zero Stability	±0.5 % of range per month
Span Stability	±0.5 % of range per month
Sample Flow Rate	100...500 ml/min (0.2...1.06 scfh)
Sample Pressure	0.75...1.5 Bar A (10...20 psi A)
Sample Temperature	5...45 °C (+41...+113 °F)
Sample Cell Temperature	Standard +50 °C (+113 °F)
Background Gas	Analyzer is calibrated in the background gas of the process.

Common Features and Specifications

Electrical Specifications	
Display Type	Backlit LCD (GP1 model only)
Display Resolution	0.01 % 0.1 % for XTP with suppressed zero ranges or XTC ranges > 10 %
Analog Inputs	2 off 4...20 mA inputs One for an external sensor that can be displayed on the screen One to act as an active compensation for the process conditions
Analog Outputs	2 off 4...20 mA outputs (powered with 24V excitation voltage)
Output Ranges	Primary range is set to the calibrated range of the instrument The second is user selectable 0...100 %
Alarms	2 off single pole changeover (SPCO) relays for O_2 concentration (250 V, 5 A max)
Digital Communications	Modbus RTU over RS485
Power Supply	24 V DC; 1.5 A max – Mating connector supplied
Electrical connections	Analyzer is supplied with required mating connectors.
Operating Conditions	
Ambient Temperature	5...+45 °C (+41...+113 °F)
Atmospheric Pressure	750 mbar...1250 mbar
Ambient Relative Humidity	0...95 % rh (non-condensing)
Mechanical Specification	
Warm-Up Time	< 25 minutes
Stabilization Time	5 minutes
Dimensions	260 x 180 x 128mm (10.24 x 7.09 x 5.04”) (h x w x d)
Weight	Approx. 3kg (6.6lbs)
Wetted Materials	316 & 430F stainless steel, borosilicate glass, platinum, 3M 2216 plus O-ring
O-Ring Materials	Viton
Gas Connection	1/8" Swagelok
Ingress Protection	IP55

A.1 Dimensions

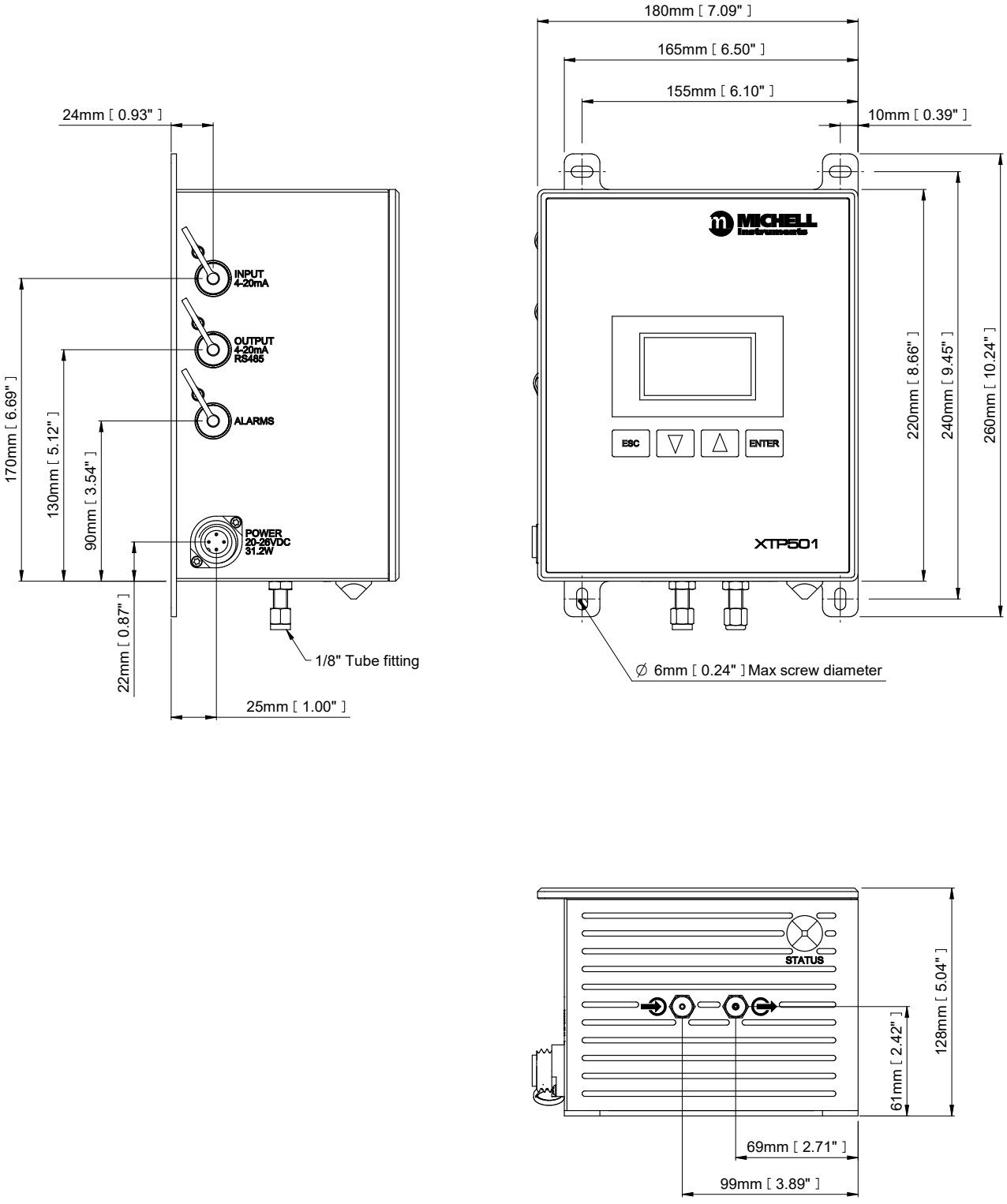


Figure 33 *501 Dimensional Drawings – GP1*

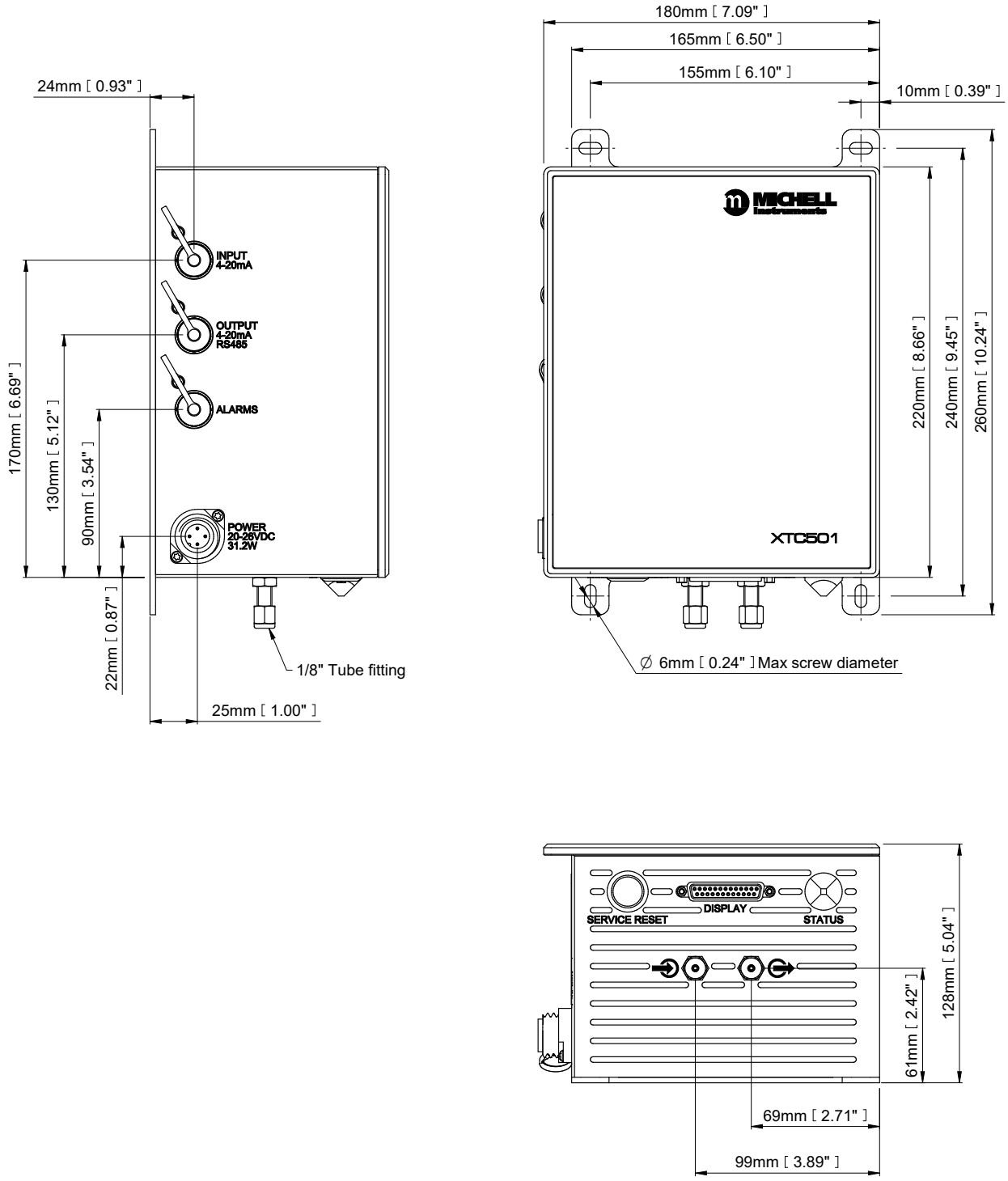


Figure 34 *501 Dimensional Drawings – GP2*

Appendix B

Modbus Register Map (XTP501)

Appendix B Modbus Register Map (XTP501)

Compatible with XTP501 Firmware Version: V1:11

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	Background Gas Index	R/W	0–23	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	O2 Range Zero (Ch1 output zero)	R	0.00 to O2 Range Span	G
9	O2 Range Span (Ch1 output span)	R	O2 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
15	N2 VCOMP ADC (for ratio comp)	R	0–8191	A
16	BACKG VCOMP ADC (for ratio comp)	R	0–8191	A
17	BACKG ZERO (for zero offset value)	R	-10.00–10.00 %	G
18	BACKG SPAN (for ratio gas value)	R	0.00–100.00 %	G
19	BACKG CAL VALUE (for ratio gas value)	R	0.00–100.00 %	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
24	PID Proportional Term	R	1–20000	A
25	PID Integral Term	R	1–500	A
26	PID Derivative Term	R	1–100	A
27	HSR Var A (gain or multiplier)	R	2–200	A
28	HSR Var B (rate of gain reduction)	R	0–40	A
29	O2 Field Cal Reference 1	R/W	Instrum range min to Instrum range max + 20 % of range, 0.01	G
30	O2 Filed Cal Actual 1	R/W	-199.99–199.99	G
31	O2 Field Cal Reference 2	R/W	Instrum range min to Instrum range max + 20 % of range, 0.01	G
32	Pressure at calibration	R	800.0–1200.0 mBar	F
33	Atmos Press Offset	R	-100/+100mBar	K
34	Spare			
35	Bridge Pot Wiper Code	R	0–1023	A
36	Gain Pot Wiper Code	R	0–1023	A
37	O2 Field Cal Actual 2	R/W	-199.99–199.99	G
38	Cal 02 Ref1	R	0.00–100.00	G
39	Cal 02 Ref2	R	0.00–100.00	G

Addr	Function	Access	Ranges/Resolution	Type
40	Cal 02 Ref3	R	0.00–100.00	G
41	Cal 02 Ref4	R	0.00–100.00	G
42	Cal 02 Ref5	R	0.00–100.00	G
43	Cal 02 ADC1	R	0–8191	A
44	Cal 02 ADC2	R	0–8191	A
45	Cal 02 ADC3	R	0–8191	A
46	Cal 02 ADC4	R	0–8191	A
47	Cal 02 ADC5	R	0–8191	A
48	mAINPUT1 4mA Cal point	R	0–8191	A
49	mAINPUT1 20mA Cal point	R	0–8191	A
50	mAINPUT2 4mA Cal point	R	0–8191	A
51	mAINPUT2 20mA Cal point	R	0–8191	A
52	mAOUTPUT1 4mA Cal point	R	0–8191	A
53	mAOUTPUT1 20mA Cal point	R	0–8191	A
54	mAOUTPUT2 4mA Cal point	R	0–8191	A
55	mAOUTPUT2 20mA Cal point	R	0–8191	A
56	CH2 output zero	R/W	O_2 range min to 0–100 %, 0.01	G
57	CH2 output span	R/W	CH2 output zero to instrum range max, 0.01	G
58	Last Cal Date DATE/MONTH	R	1–31/1–12	J
59	Last Cal Date: Field or Factory (bit 15) / YEAR (bits0–3)	R	0=Factory, 1=Field / 0–99	J
60	PCB Tempr Offset (for MSP430 Int Tempr only) – NOT USED in latest f/w	R	-100/+100 C	K
61	Spare			
62	Spare			
63	Hours Of Operation	R	0–65535	A
64	Restore Factory Settings / Cal data (write 5491 to this reg)	W	5491	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	%O2 without HSR	R	-199.00–199.99 %	G
71	%O2 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	0–1500mBar	A
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	%O2 MINIMUM (stats)	R	-199.00–199.99 %	G
82	%O2 MAXIMUM (stats)	R	-199.00–199.99 %	G

Addr	Function	Access	Ranges/Resolution	Type
83	VCOMP	R	0–8191	A
84	Firmware Version	R	0.00–200.00	G
85	Live ADC 02	R	0–8191	A
86	Live ADC mAINPUT1	R	0–8191	A
87	Live ADC mAINPUT2	R	0–8191	A
88	Live ADC CellTempr	R	0–8191	A
89	Live ADC Pressure	R	0–8191	A
90	Live ADC PCB Tempr	R	0–8191	A
91	%O2 without field cal correction	R	-199.00–199.99 %	G
92	Spare			
93	Spare			
94	Spare			
95	Spare			
96	Spare			
97	Spare			
98	Spare			
99	Spare			

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
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
6	0040	SPARE
7,8,9,10	0780	SPARE
11,12,13	3800	Ext Sensor Parameter (000=none, 001=dewp, 010=tempr, 011=press, 100=other)
14,15	C000	SPARE

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: (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 to 40000 represents -200.00 to +200.00
Conversion: (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	Namur LED
0	0001	Displays O_2HSR or O_2 depending on setting (system)	N/A
1	0002	%O_2 out of range (beyond calibration range, e.g. 0–25 %)	N/A
2	0004	Low alarm ON	YELLOW 1 ON
3	0008	High alarm ON	YELLOW 2 ON
4	0010	Ext Comp i/p signal error (input < 3.6mA or > 21mA)	RED FLASH (priority2)
5	0020	Ext sens. signal error (input < 3.6mA or > 21mA)	RED FLASH (priority2)
6	0040	Cell T not stable (not within +/- 0.15 °C of setpoint for continuous period of 15 minutes)	RED ON (priority1)
7	0080	Cell T sensor error (cell tempr measures <-50 or >80 °C)	RED ON (priority1)
8	0100	Press sensor error (Press sensor < 700 or >1300 mbar)	RED ON (priority1)
9	0200	O2 sensor error (Vcomp <=1 or >=8191)	RED ON (priority1)
10	0400	PCB tempr too high (PCB tempr > Cell tempr setpoint)	RED ON (priority1)
11	0800	NA	NA
12	1000	NA	NA
13	2000	NA	NA
14	4000	Instrument is BLIND version (system)	N/A
15	8000	NA	N/A

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

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 to 65535 represents values
Conversion: (RegValue – 32767)

Register Type L: Alarm 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

Modbus Register Map (XTC501)

Appendix C Modbus Register Map (XTC501)

Compatible with XTC501 Firmware Version: V1:08

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
5	Background gas in application	R/W	0–23	A
4	Chart Interval	R/W	2–60 sec, in 2 sec intervals	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	Range Zero (Ch1 output zero)	R	0.00 to Range Span	G
9	Range Span (Ch1 output span)	R	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
15	N2 VCOMP ADC (for ratio comp)	R	0–8191	A
16	BACKG VCOMP ADC (for ratio comp)	R	0–8191	A
17	BACKG ZERO (for zero offset value)	R	-10.00–10.00 %	G
18	BACKG SPAN (for ratio gas value)	R	0.00–100.00 %	G
19	BACKG CAL VALUE (for ratio gas value)	R	0.00–100.00 %	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	Main gas in application	R/W	0–23	A
23	Cell Tempr Set point	R	40–70 C	A
27	Alarm / NAMUR Configuration	R/W	See reg details	L
24	PID Proportional Term	R	1–20000	A
25	PID Integral Term	R	1–500	A
26	PID Derivative Term	R	1–100	A
27	Alarm / NAMUR Configuration	R/W	See Reg Details	L
29	Field Cal Reference 1	R/W	Instrum range min to Instrum range max + 20 % of range, 0.01	G
30	Field Cal Actual 1	R/W	-199.99–199.99	G
31	Field Cal Reference 2	R/W	Instrum range min to Instrum range max + 20 % of range, 0.01	G
34	Language	R/W	0–15	A
35	Bridge Pot Wiper Code	R	0–1023	A
36	Gain Pot Wiper Code	R	0–1023	A
37	Field Cal Actual 2	R/W	-199.99–199.99	G
38	Cal Ref1	R	0.00–100.00	G
39	Cal Ref2	R	0.00–100.00	G
40	Cal Ref3	R	0.00–100.00	G
41	Cal Ref4	R	0.00–100.00	G

Addr	Function	Access	Ranges/Resolution	Type
42	Cal Ref5	R	0.00–100.00	G
43	Cal ADC1	R	0–8191	A
44	Cal ADC2	R	0–8191	A
45	Cal ADC3	R	0–8191	A
46	Cal ADC4	R	0–8191	A
47	Cal ADC5	R	0–8191	A
48	mAINPUT1 4mA Cal point	R	0–8191	A
49	mAINPUT1 20mA Cal point	R	0–8191	A
50	mAINPUT2 4mA Cal point	R	0–8191	A
51	mAINPUT2 20mA Cal point	R	0–8191	A
52	mAOUTPUT1 4mA Cal point	R	0–8191	A
53	mAOUTPUT1 20mA Cal point	R	0–8191	A
54	mAOUTPUT2 4mA Cal point	R	0–8191	A
55	mAOUTPUT2 20mA Cal point	R	0–8191	A
56	CH2 output zero	R/W	Instrum range min to CH2 output span, 0.01	G
57	CH2 output span	R/W	CH2 output zero to instrum range max, 0.01	G
58	Last Cal Date DATE/MONTH	R	1–31/1–12	J
59	Last Cal Date: Field or Factory (bit 15) / YEAR (bits0–3)	R	0=Factory, 1=Field / 0–99	J
60	PCB Tempr Offset (for MSP430 Int Tempr only) – NOT USED in latest f/w	R	-100/+100 C	K
63	Hours Of Operation	R	0–65535	A
64	Restore Factory Settings / Cal data (write 5491 to this reg)	W	5491	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	% Reading of Gas	R	-199.00–199.99 %	G
72	Cell Temperature	R	-99.9–99.9 or equiv in F or K	F
73	PCB temperature	R	-99–99 C or equiv in F or K	K
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	% MINIMUM (stats)	R	-199.00–199.99 %	G
82	% MAXIMUM (stats)	R	-199.00–199.99 %	G
84	Firmware Version	R	0.00–200.00	G
85	Live ADC	R	0–8191	A
86	Live ADC mAINPUT1	R	0–8191	A
87	Live ADC mAINPUT2	R	0–8191	A
88	Live ADC CellTempr	R	0–8191	A
90	Live ADC PCB Tempr	R	0–8191	A
91	% 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	
2	0004	External Compensation On
3	0008	Background Gas Compensation On
4	0010	
5	0020	Display Limit 0–100 % On
6	0040	
7	0080	
8	0100	
9	0200	
10	0400	
11	0800	
12	1000	
13	2000	
14	4000	
15	8000	

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
6	0040	SPARE
7, 8, 9, 10	0780	SPARE
11, 12, 13	3800	Ext Sensor Parameter (000=none, 001=dewp, 010=tempr, 011=press, 100=other)
14, 15	C000	SPARE

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: (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 to 40000 represents -200.00 to +200.00
Conversion: (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	Namur LED
0	0001	Displays O_2HSR or O_2 depending on setting (system)	N/A
1	0002	%Gas out of range (beyond calibration range, e.g. 0–25 %)	N/A
2	0004	Low alarm ON	YELLOW 1 ON
3	0008	High alarm ON	YELLOW 2 ON
4	0010	Ext Comp i/p signal error (input < 3.6mA or > 21mA)	RED FLASH (priority2)
5	0020	Ext sens. signal error (input < 3.6mA or > 21mA)	RED FLASH (priority2)
6	0040	Cell T not stable (not within ± 0.15 °C of setpoint for continuous period of 15 minutes)	RED ON (priority1)
7	0080	Cell T sensor error (cell tempr measures <-50 or >80 °C)	RED ON (priority1)
8	0100	NA	NA
9	0200	Thermal Conductivity sensor error (Vcomp <=1 or >=8191)	RED ON (priority1)
10	0400	PCB tempr too high (PCB tempr > Cell tempr setpoint)	RED ON (priority1)
11	0800	N/A	N/A
12	1000	N/A	N/A
13	2000	N/A	N/A
14	4000	Instrument is BLIND version (system)	N/A
15	8000	N/A	N/A

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

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 to 65535 represents values
Conversion: (RegValue – 32767)

Register Type L: Alarm 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 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.michell.com/compliance

This page contains information on the following directives:

- ATEX Directive
- Calibration Facilities
- Conflict Minerals
- FCC Statement
- Manufacturing Quality
- Modern Slavery Statement
- Pressure Equipment Directive
- REACH
- RoHS3
- WEEE2
- 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	

MICHELL Instruments

F0121, Issue 2, December 2011

DORGEAN
Beijing Dorgean Electronic Technology Co.,Ltd
Instrument Expert
Original factory
packaging
www.dorgean.com

www.ProcessSensing.com

MICHELL
Instruments
A PST BRAND

http://www.michell.com