# XTP501 Oxygen Analyzer & XTC501 Binary Gas Analyzer User's Manual


99976 Issue 1

January 2020

Please fill out the form(s) below for each instrument that has been purchased. Use this information when contacting Michell Instruments for service purposes.

| | |
|---|---|
| Analyzer | |
| Code | |
| Serial Number | |
| Invoice Date | |
| Location of Instrument | |
| Tag Number | |

| | |
|---|---|
| Analyzer | |
| Code | |
| Serial Number | |
| Invoice Date | |
| Location of Instrument | |
| Tag Number | |

| | |
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| Analyzer | |
| Code | |
| Serial Number | |
| Invoice Date | |
| Location of Instrument | |
| Tag Number | |


# XTP501 or XTC501 Analyzer

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

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## Safety

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

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

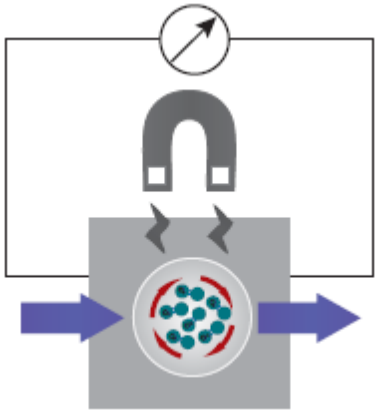

***Figure 1*** *501 Analyzer and Transmitter*

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.

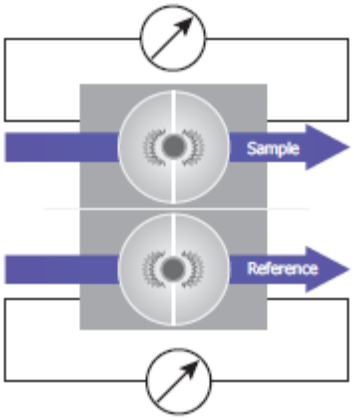


**Advantages of Thermo-Paramagnetic:**

- 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.




**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 protocol 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 to 1.5 Bar A (10 to 20 psi A)

**Sample Flow Rate:**

100 to 500 ml/min (0.2 to 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.

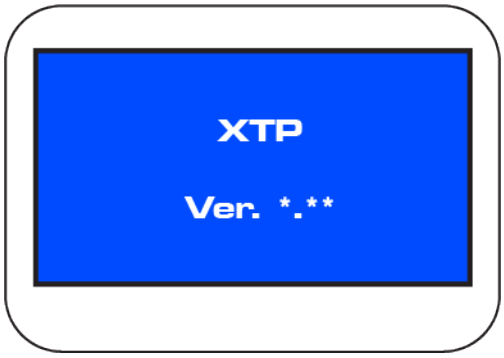



***Figure 2*** *Initializing screen*

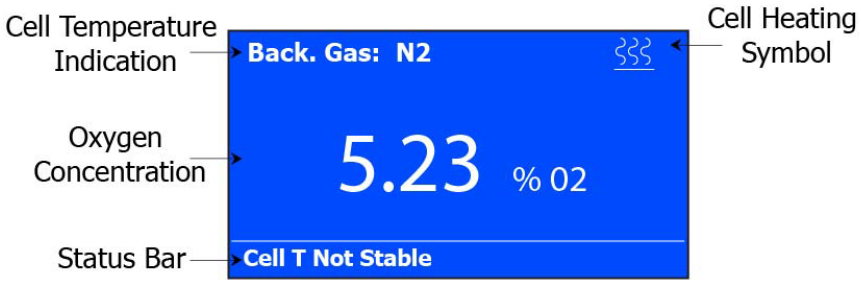



***Figure 3*** *Main page*

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

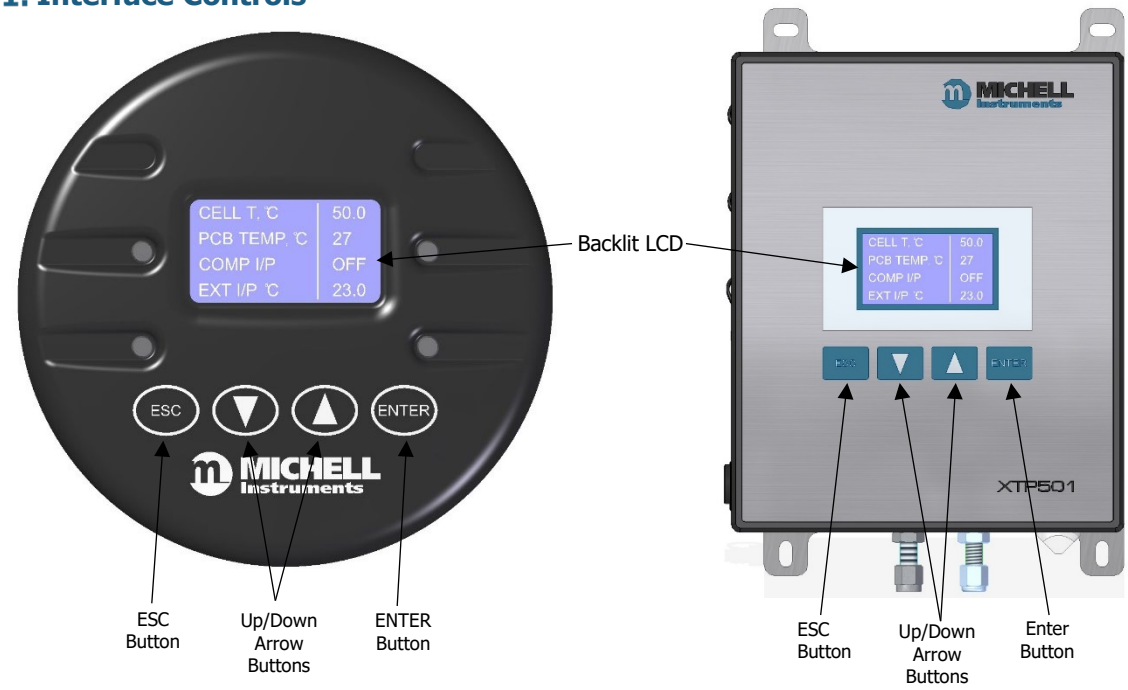



***Figure 4*** *User Interface*

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.

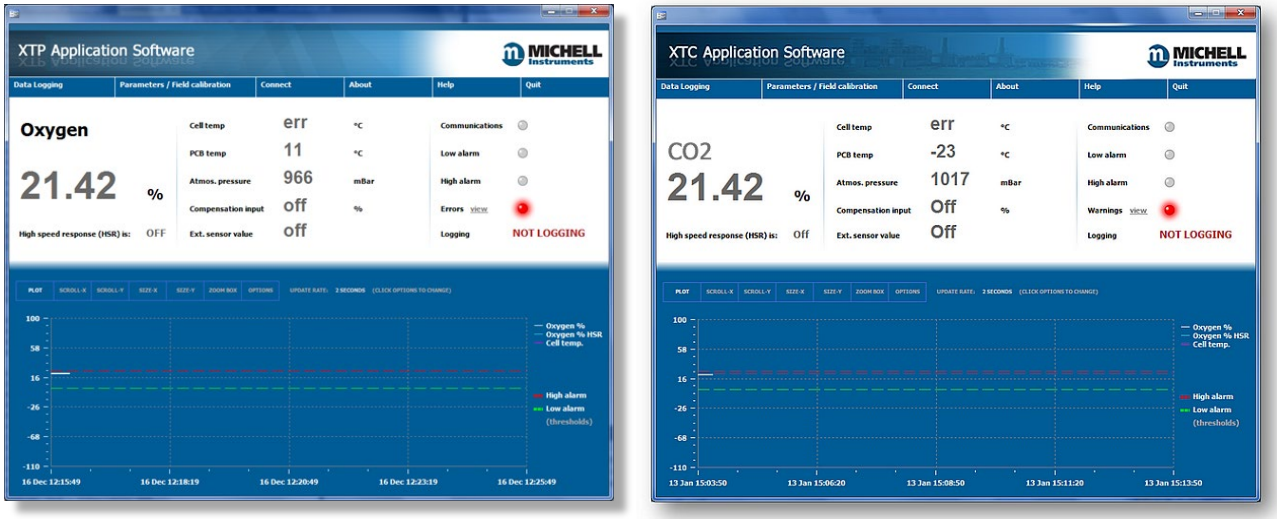



***Figure 5*** *Application Software example images*

### 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

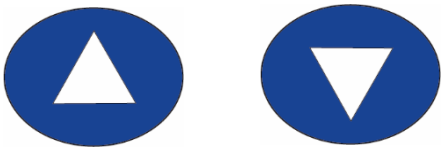


***Figure 7*** *Up/Down Arrow Buttons*

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

## 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. Menu Map

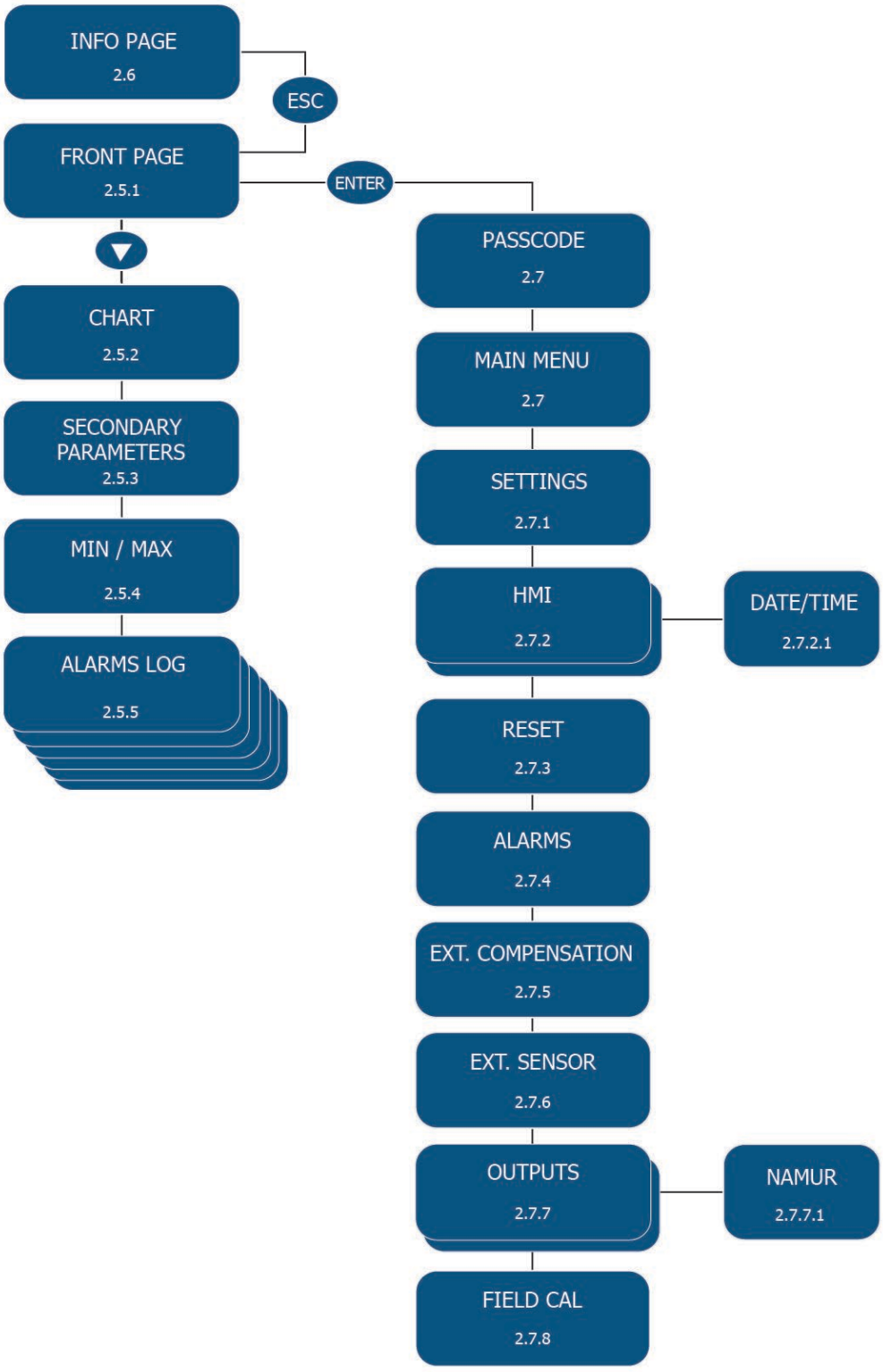



*Figure 9* Menu Map

## 2.5. Front Pages (No Passcode Required)

### 2.5.1. Front Page

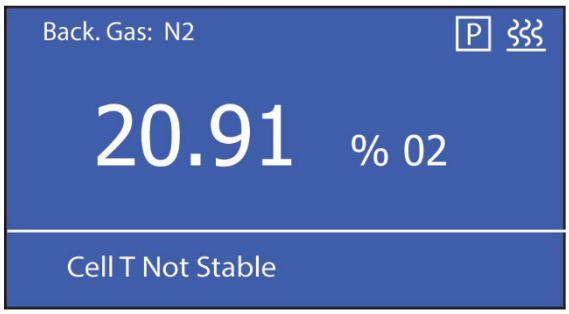



***Figure 10*** *Front Page*

**XTP501**

| Parameter | Description |
|---|---|
| **Background Gas** | Displays the background gas that the unit was calibrated in |
| **% $O_2$**<br>(if HSR=OFF) | Real oxygen reading in %<br>Display resolution = 0.01<br>(Display resolution 0.1% for suppressed zero ranges) |
| **% $O_2$p**<br>(if HSR = ON) | HSR oxygen reading (extrapolated quick response value of real oxygen reading)<br>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 %<br>Display resolution = 0.01<br>(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**<br>(input <3.6 mA or >21 mA) | RED FLASH<br>(priority2) |
| **Ext sens signal error**<br>(input <3.6 mA or >21 mA) | RED FLASH<br>(priority2) |
| **Cell T not stable**<br>(Not within ±0.5ºC of set point) | RED ON<br>(priority1) |
| **Cell T sensor error**<br>(cell temp measures <-50 or >+80ºC) | RED ON<br>(priority1) |
| **Press sensor error (XTP only)**<br>(pressure sensor <750 or >1250 mbar) | RED ON<br>(priority1) |
| **PCB temp too high**<br>(PCB temp > cell temp set point) | RED ON<br>(priority1) |

### 2.5.2. Chart Page

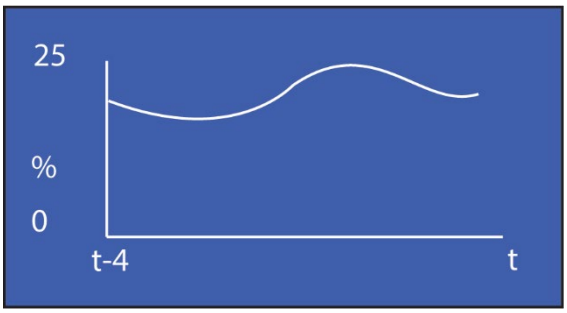



*Figure 11 Chart Page*

**NOTE: This data is not available via the Modbus**

- This indicative chart is continuously running at the set chart interval (2 to 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

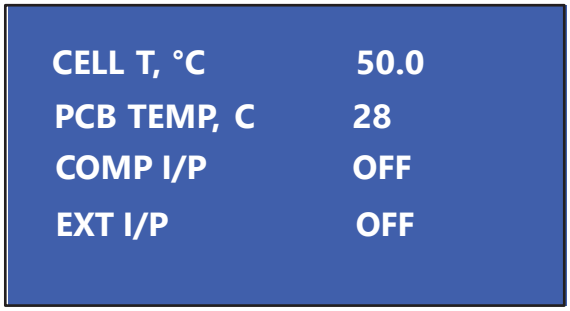



*Figure 12 Secondary Parameters Page*

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

### 2.5.4. Min/Max Page

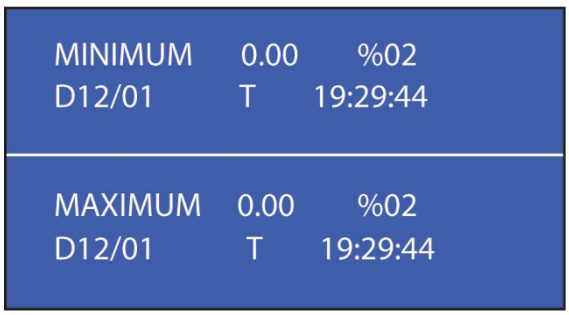



*Figure 13 Min/Max Page*

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

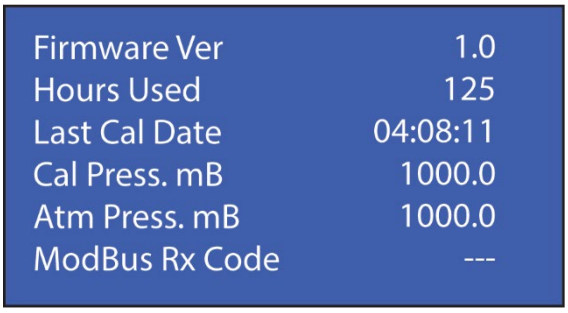



***Figure 15*** *Info Page*

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<br>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) |
| **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.<br>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

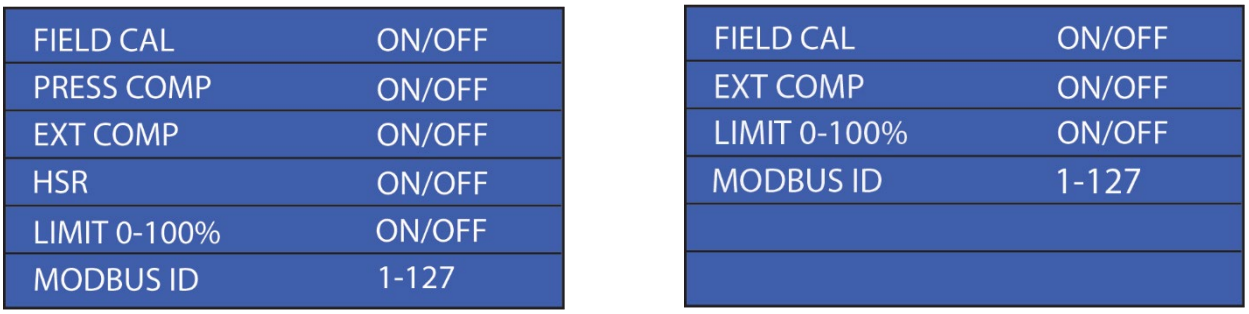



***Figure 17*** *Settings Pages for XTP (left) and XTC (right)*

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<br>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<br>It is automatically turned off when Michell or field calibration is being performed | **ON/OFF** |
| **EXT COMP** | Turn externals sensor compensation on or off<br>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<br>It is automatically turned off when Michell or field calibration is being performed<br>When HSR is ON then these values are derived from the % O<br>HSR value:<br>• mA outputs (both channels)<br>• alarm trigger points<br>• chart values<br>• min/max<br>The Main Page displayed value is also HSR value (designated % $O_2$p) | **ON/OFF** |
| **LIMIT 0-100%** | Limits the % O2 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<br>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


*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

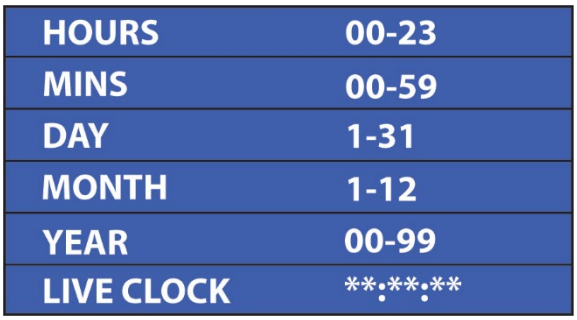



***Figure 19*** *Date and Time Page*

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

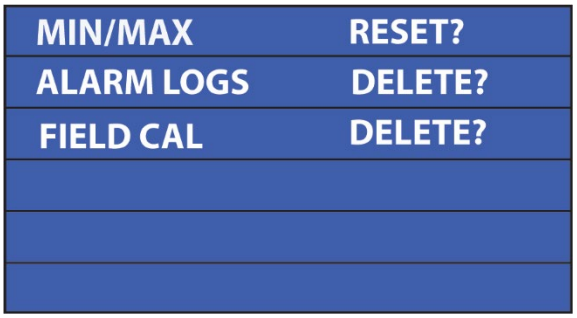



*Figure 20 Reset Page*

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

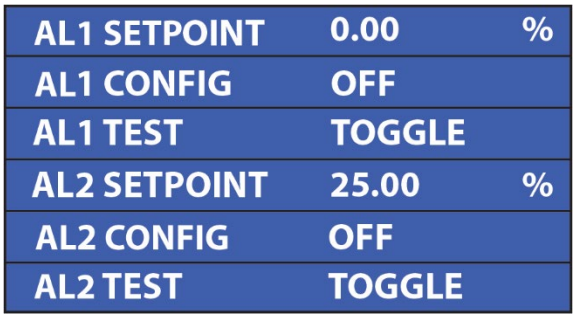



***Figure 21*** *Alarms Page*

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 to 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 to 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

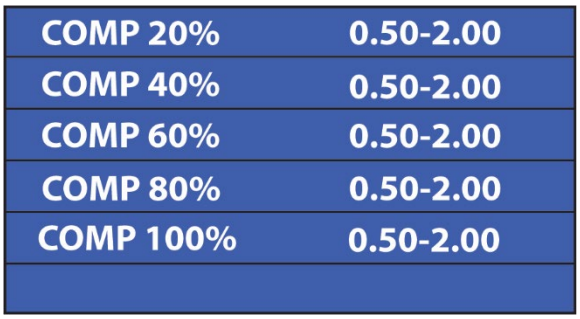



***Figure 22*** *External Compensation Page*

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

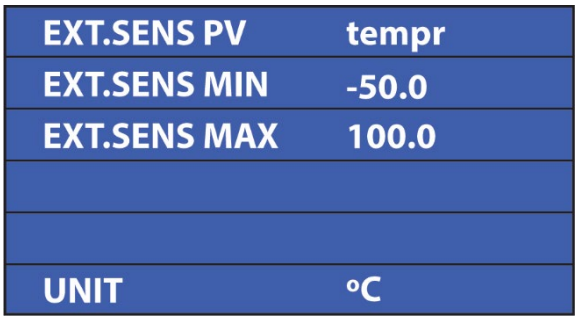



*Figure 23 External Sensor Page*

This page sets up the type and range of the 4-20 mA external sensor signal that may be connected to the 501 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<br>Select **None** to turn the feature off<br>**Other** represents a user-defined variable | **None, Dew point, tempr, Pressure, Other** |
| **EXT.SENS MIN** | Depends on parameter and unit settings:<br>Dew point: -100°C, -148°F, 173.0 K<br>Temperature: -50°C, -58°F, 223.0 K<br>Pressure: 0.0 psia, 0.0 bara, 0.0 kpa<br>Other: 0% (nonadjustable) | minimum to<br>EXT.SENS MAX |
| **EX.SENS MAX** | Depends on parameter and unit settings:<br>Dew point: 20°C, 68°F, 293.0 K<br>Temperature: 100°C, 212°F, 373.0 K<br>Pressure: 44.1 psia, 3.0 bara, 304.0 kpa<br>Other: 100% (nonadjustable) | EXT.SENS MIN<br>à maximum |
| **UNIT** | These are related to the type of sensor selected<br>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

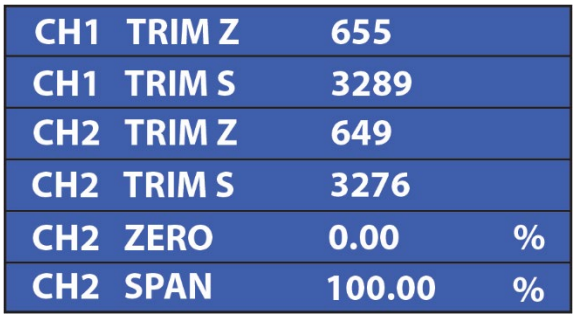



***Figure 24*** *Outputs Page*

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 to 100.00% |
| **CH2 SPAN** | Set 20 mA point for Channel 2 | 0.00 to 100.00% |

Scroll down past OUTPUTS Page to sub-menu NAMUR Output Set-Up.

### 2.7.7.1. NAMUR Output Set-Up

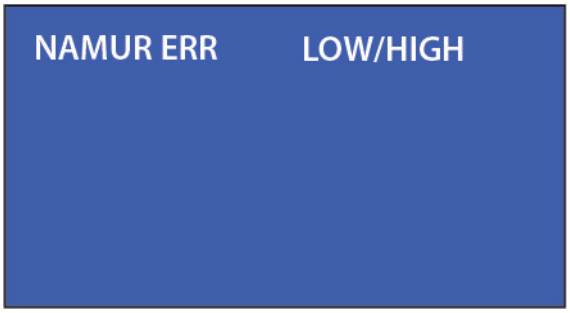



***Figure 25*** *NAMUR ERR Page*

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

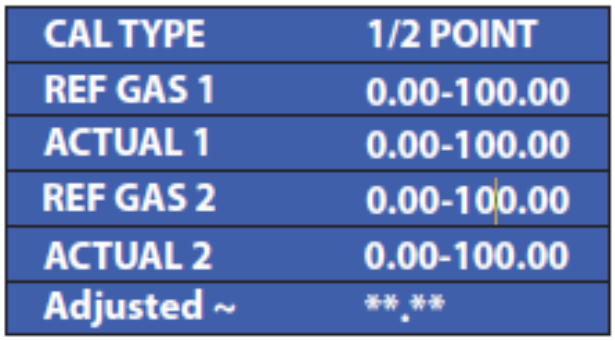



***Figure 26*** *Field Cal Page*

| 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<br>See Section 3.1 |
| **REF GAS 2** | Upper cal reference gas for 2-point cal<br>Disabled if 1-point cal selected |
| **ACTUAL 2** | Actual measured value for REF GAS 2<br>See Section 3.2<br>Disabled if 1-point cal selected |
| **ADJUSTED ~** | Displayed concentration before and after change<br>~ 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 to 25% the analyzer will have calibration points between 0 to 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 to 1.5 Bar A (10 to 20 psi A)

**Sample Flow Rate:**

100 to 500 ml/min (0.2 to 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.

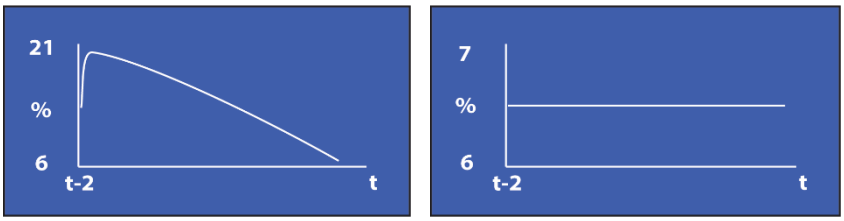



*Figure 27 1-Point Calibration Page*

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.

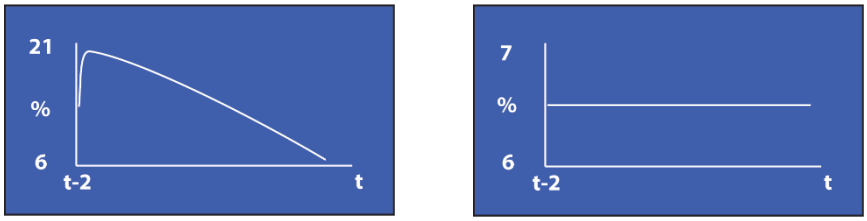



*Figure 28 2-Point Calibration Page*

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).

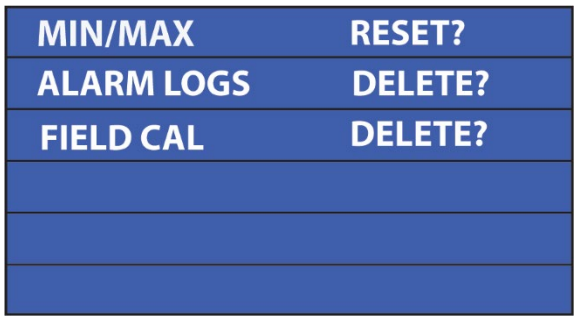



***Figure 29*** *Field Calibration Reset Page*

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
- User's manual (part number 99976)
- 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:

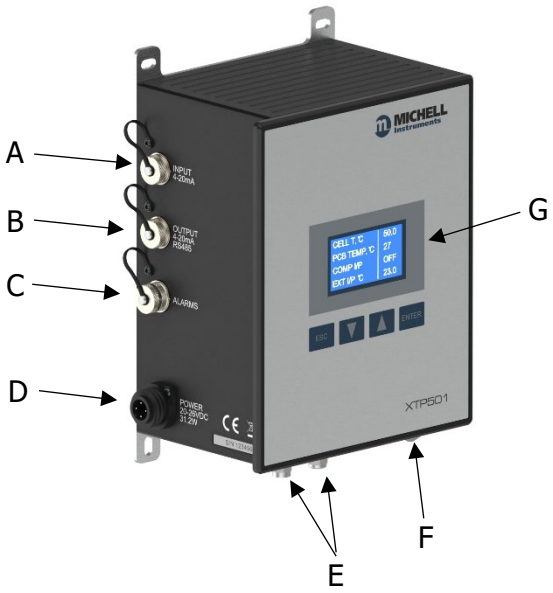



***Figure 30*** *XTP501 and XTC501 Showing Major Components*

| | |
|---|---|
| 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.

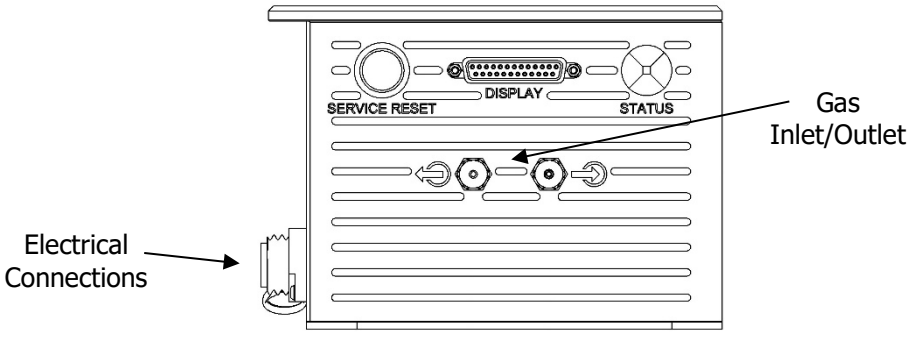



*Figure 31 501 Connections*

### 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. XP501 models have 1/8" bulkhead gas connections – conversion to ¼" or 6 mm can be achieved using an adaptor.

### 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 to 1.5 Bar A (10 to 20 psi A)

**Sample Flow Rate:**

100 to 500 ml/min (0.2 to 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.**

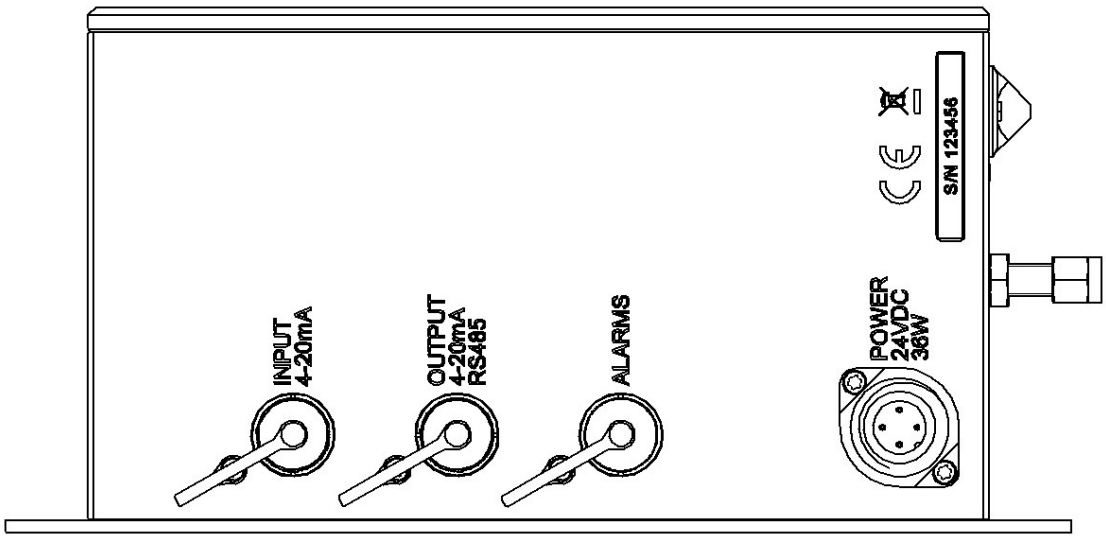
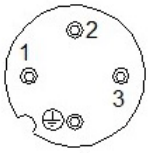



*Figure 32 Connections*

### 4.5.2. Power Supply




| PIN 1 | PIN 2 | PIN 3 | PIN GND |
|---|---|---|---|
| N/C | 24 V ±4 V | N/C | 0 V |

### 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).

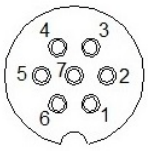
### 4.5.4. Serial Output

The analyzer has Modbus RTU communications over RS485 protocol; 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.**



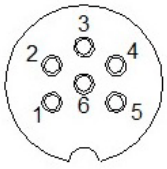

| PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PIN 6 | PIN 7 |
|---|---|---|---|---|---|---|
| Ch2 O/P - | RS485 B | Ch1 O/P - | Ch1 O/P + | RS485 A | Ch2 O/P + | RS485 GND |

**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.**

**NOTE 3: The mA outputs are powered with a 24V excitation voltage.**

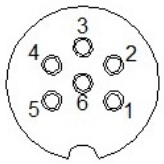
### 4.5.6. Alarm Relay Contacts




| PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PIN 6 |
|---|---|---|---|---|---|
| Alarm 2 NO | Alarm 2 NO | Alarm 1 C | Alarm 1 NC | Alarm 2 NC | Alarm 2 C |

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

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 span or ±0.02% $O_2$, whichever is greater |
| Accuracy (for suppressed zero ranges 20/80/90-100%) | < ±1% of span or 0.2% $O_2$, whichever is greater |
| Response Time (T90) with HSR enabled | < 15 seconds |
| Repeatability | ±0.2% of span or 0.01% $O_2$, whichever is greater |
| Linearity | ±0.5% of span or 0.05% $O_2$, whichever is greater |
| Zero Stability | ±0.25% of span per month |
| Span Stability | ±0.25% of span per month |
| Sample Flow Rate | 100 to 500 ml/min (0.2 to 1.06 scfh) |
| Sample Pressure | 0.75 to 1.5 Bar A (10 to 20 psi A) |
| Sample Temperature | 5 to 45°C (+41 to +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 to 5% up to 0 to 100% and 50 to 100% up to 90-100% |
| Accuracy (excluding suppressed zero ranges) | < ±1% of span or ±0.02% $H_2$, whichever is greater |
| Accuracy (for suppressed zero ranges 20/80/90-100%) | < ±1% of span or 0.05% $H_2$, whichever is greater |
| Response Time (T90) | < 50 seconds for most gas combinations<br>< 20 seconds H2 or He |
| Repeatability | ±0.2% of span or 0.02% $H_2$, whichever is greater |
| Linearity | ±1% of span or 0.05% $O_2$, whichever is greater |
| Zero Stability | ±0.5% of span per month |
| Span Stability | ±0.5% of span per month |
| Sample Flow Rate | 100 to 500 ml/min (0.2 to 1.06 scfh) |
| Sample Pressure | 0.75 to 1.5 Bar A (10 to 20 psi A) |
| Sample Temperature | 5 to 45°C (+41 to +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%<br>0.1% for XTP with suppressed zero ranges or XTC ranges > 10% |
| Analog Inputs | 2 off 4-20 mA inputs<br>One for an external sensor that can be displayed on the screen<br>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<br>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 Protocol |
| 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 to +45 °C (+41 to +113°F) |
| Atmospheric Pressure | 750 mbar to 1250 mbar |
| Ambient Relative Humidity | 0 to 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" bulkhead standard |
| **Ingress Protection** | IP55 |

## A.1 Dimensions

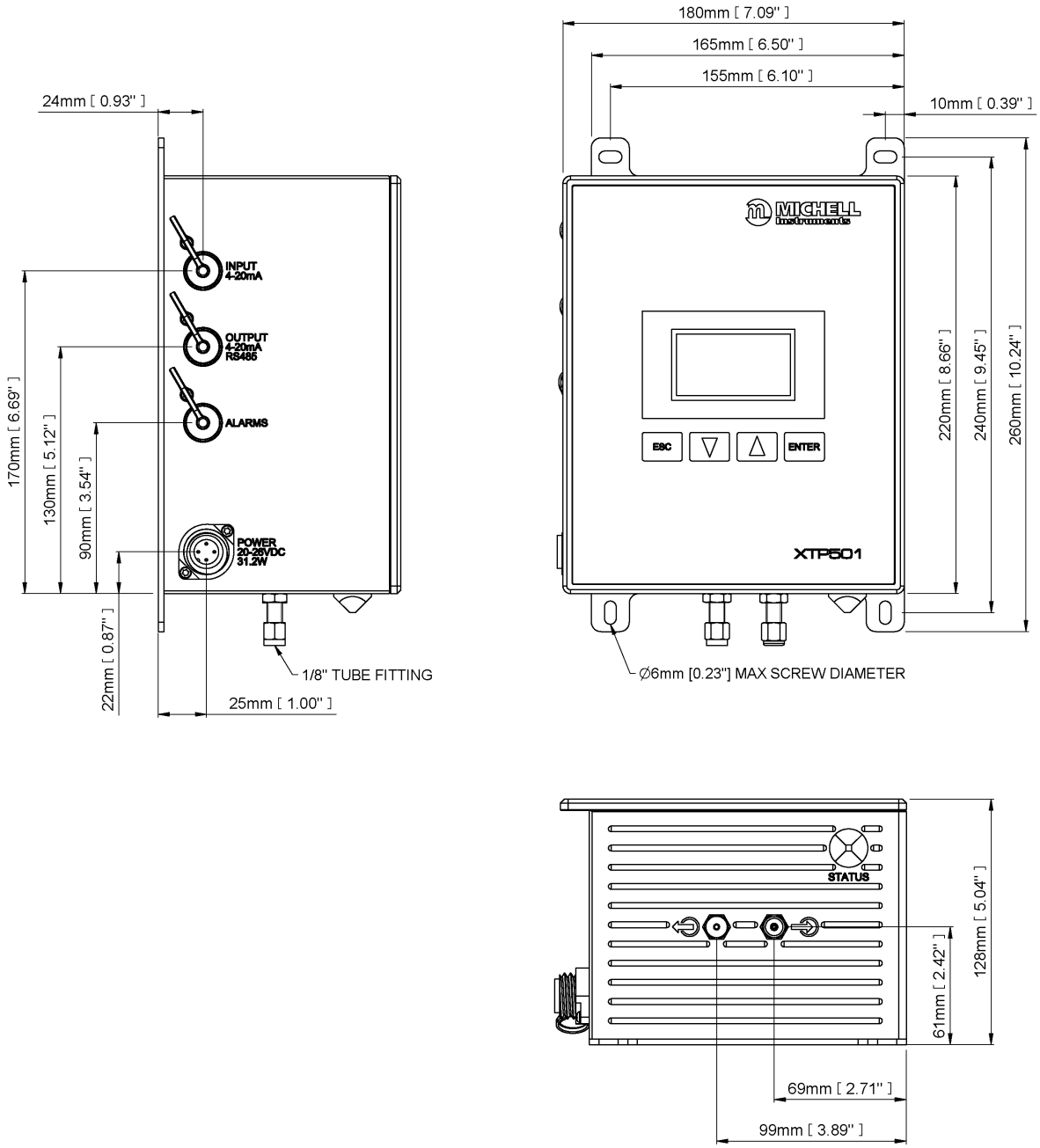



***Figure 33*** *501 Dimensional Drawings – GP1*

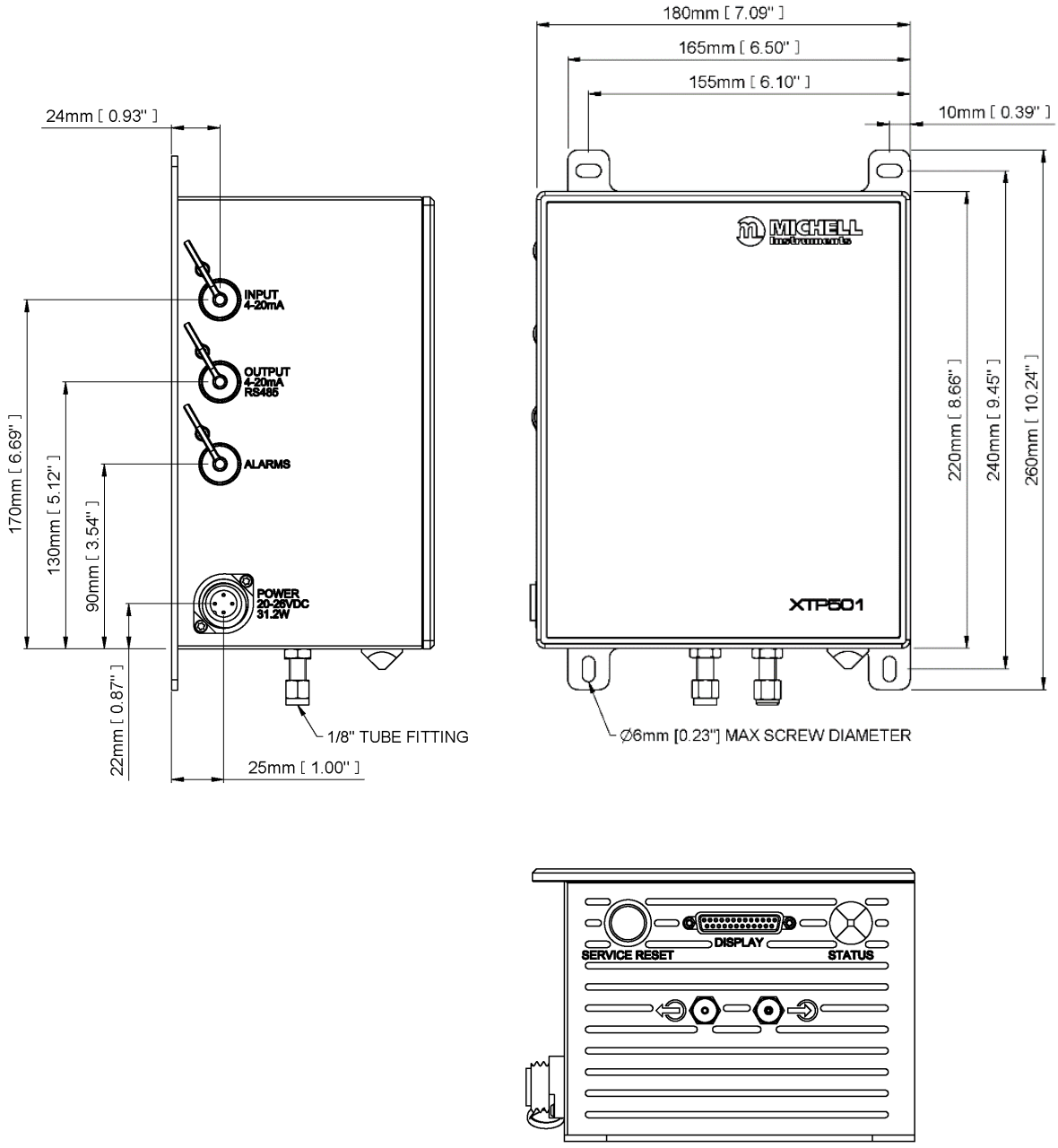



***Figure 34*** *501 Dimensional Drawings – GP2*

# APPENDIX B

# Quality, Recycling, Compliance & Warranty Information

## APPENDIX B 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:

- 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 C

# Analyzer Return Document and Decontamination Declaration

## Appendix C Analyzer Return Document & Decontamination Declaration

**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<br><br>**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

## NOTES


http://www.michell.com