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# 2416
# Pressure Scanner

**INSTALLATION**
**AND**
**OPERATING MANUAL**

**e-mail:- info@chell.co.uk**

Visit the Chell website at:

**http://www.chell.co.uk**

900266-1.0

Please read this manual carefully before using the instrument.

**Use of this equipment in a manner not specified in this manual may impair the user's protection.**

Chell Document No. : 900266 Issue 1.0

ECO : - Date: 28th April 2025

Chell's policy of continuously updating and improving products means that this manual may contain minor differences in specification, components and software design from the actual instrument supplied.

CONTENTS

# 1 Description

## 1.1 Introduction

The 2416 pressure scanning module can acquire 16 high accuracy pressure channels. The scanner utilises individual Pressure Sensor Modules (PSM) that each contain at least one 24bit ADC. The absolute pressure transducers can be configured to provide measurement of absolute or differential pressures. PSM ranges and configured modes can be individual selected on a per channel basis.

The 2416 contains a three-position shuttle valve. The shuttle valve facilitates in-line purging of the measurement lines, also controlling purge gas isolation. On-line calibration is also possible whilst in the CAL position.

An embedded Linux operating system allows the support of several differing protocols; those being the Chell native protocol (TCP/IP or UDP), ModbusTCP, IENA, iDDS and TE™ emulation. Product configuration can be effected using the on-board webserver (over http), via the native command set or using XidML. To maintain the deterministic acquisition of the pressure values, a separate acquisition microcontroller is utilised to cover data acquisition and the output from this is passed to the operating system processor using a dedicated internal bus.

External measurement connectors are made via the 5/16-24 SAE ‘O’ ring bosses. This gives the user the flexibility to specify 1/8” double ferrule compression fittings or AS205 quick disconnects. The optional 8 channel quick disconnect plate can accommodate these fitting types with the additional capability of bulged tubulation in 1.0mm or 1.6mm sizes.


*Figure 1 A single PSM (Pressure Sensor Module)*

Protocol documents are defined in separate documents:

900204 – DAQ Systems Native TCP/UDP Protocol

900257 – TE Netscanner® Emulation Protocol

EM0179 – DAQ MODBUS TCP Register mapping

# 2 Specification

## 2.1 Power Supply:

| | |
|---|---|
| DC Supply | 18 to 32VDC |
| Maximum current consumption: | Maximum current = 0.25A at 28VDC |
| Minimum cold start temp | -20°C |
| PoE : | See section 3.1.1 |

## 2.2 Package:

| | |
|---|---|
| Dimensions | 241.2 x 89 x 103.7mm |
| Weight | 3.5 Kg |

## 2.3 Ethernet Specifications:

| | |
|---|---|
| TCP/IP<br>(inc. Modbus TCP) | 10/100/1000BASE-T via Auto Negotiation<br>TCP and UDP protocols supported |

## 2.4 Operating conditions:

| | |
|---|---|
| Operating temperature range: | 0°C to +90°C |
| Storage temperature range: | 0°C to +90°C |
| Maximum Relative humidity: | 80%@31°C<br>(IP67 subject to port & connector sealing) |

## 2.5 Maximum Pressure Considerations:

A maximum purge gas pressure of 7barg is recommended to prevent sensor damage. Maximum channel (inc. reference) pressures are as follows:

| PSM Range (kPa) | Max Measurement Limit | Case Proof Limit |
|---|---|---|
| 1kPa to 300kPa | 400kPa absolute | 689kPa gauge |
| 300kPa to 1000kPa | 1340kPa absolute | 1380kPa gauge |
| 3000kPa | 4000kPa absolute | 5000kPa gauge |
| 7000kPa | 7500kPa absolute | 9100kPa gauge |

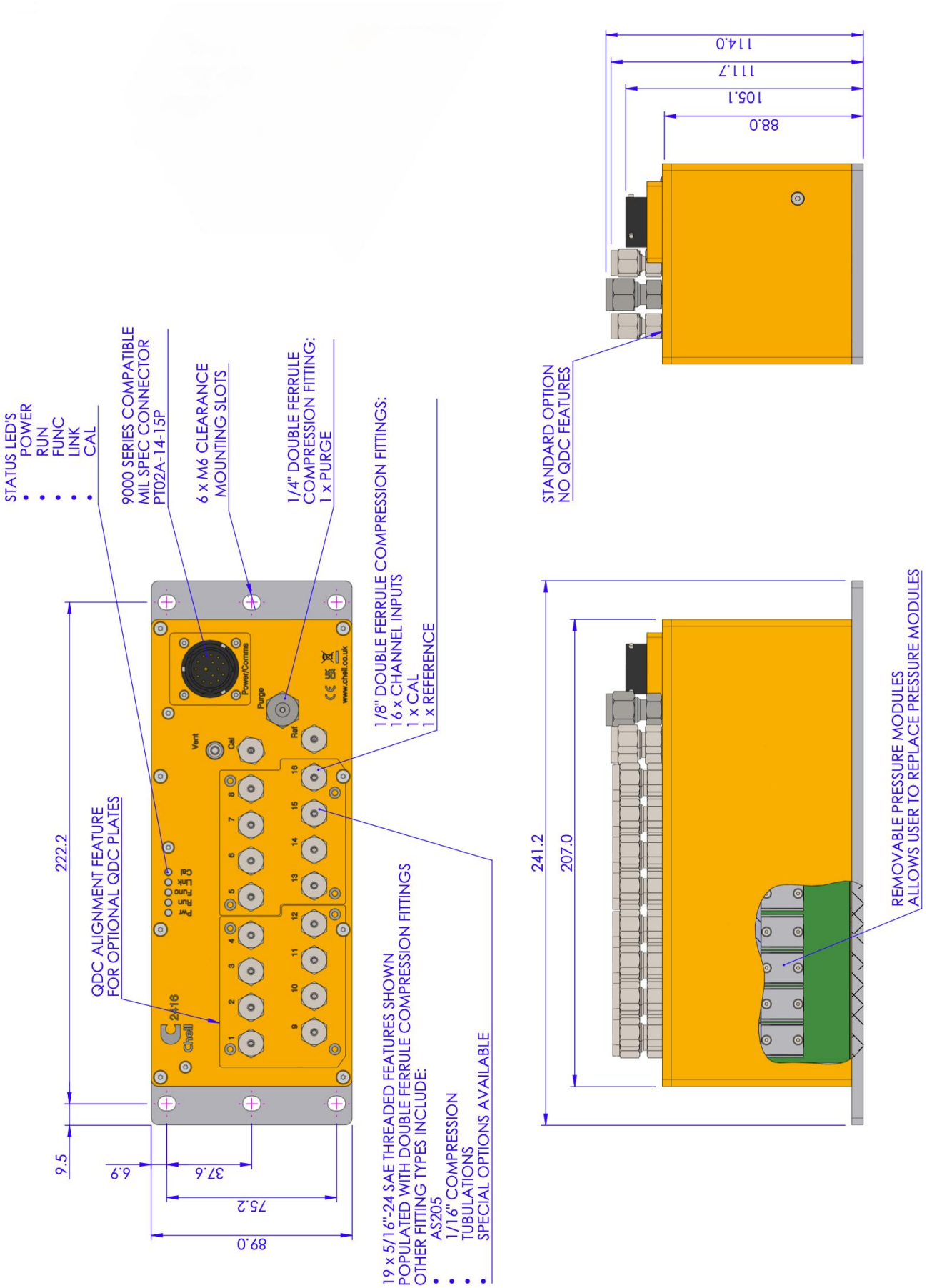
*Table 1 PSM Sensor Limits*

Caution!

**The pressure table above lists current typical PSM sensor options. Always consult the pressure rating for the sensor in use as PSM sensors are considered interchangeable and the sensor fitted at time of use may differ from the above table. Where doubt exists use:**

**Proof Pressure=1.3 x Range**

## 2.6 Dimensions



# 3 Installation and Interconnections

## 3.1 Wiring – Power & comms

### 3.1.1 2416 Power Supply

The 2416 is equipped with a DC power supply and a Power-over-Ethernet supply. Either power method may be used, no adverse reaction will occur if both power supplies exist simultaneously.

### 3.1.2 09-49-15KPT Mating Connector

(Souriau 851-36-G-14-15S-51-38)

| Pin Number | Designation |
|---|---|
| A | Ethernet DB+ (RX+) |
| B | Ethernet DA+ (TX+) |
| C | Ethernet DA- (TX-) |
| D | Trigger Input (TTL) |
| E | Trigger Return |
| F | Ethernet DC+ |
| G | Chassis Common |
| K | Ethernet DC- |
| L | Ethernet DD+ |
| M | Ethernet DD- |
| N | DB- (RX-) |
| P | DC Power Return |
| R | DC Power Supply |

Undeclared pins are reserved and must not be connected.

### 3.2 Pneumatic & Measurement Connection

The body of the 2416 is fitted with 5/16-24 SAE threaded o ring bosses for all pneumatic connections. This permits many types of connection, the following options are available as standard supply:

#### 3.2.1 Measurement connectors

00 = No mating Connectors (female 5/16-24 SAE)

01 = 1/8” double ferrule compression fittings

02 = AS205 single quick-connects

03 = Two quick disconnect plates with 1/8” double ferrule compression fittings

04 = AS205 on 2 x quick disconnect plates

05 = 1.0mm (0.040”) bulged tubulations on 2 x quick disconnect plates

06 = 1.6mm (0.063”) bulged tubulations on 2 x quick disconnect plates

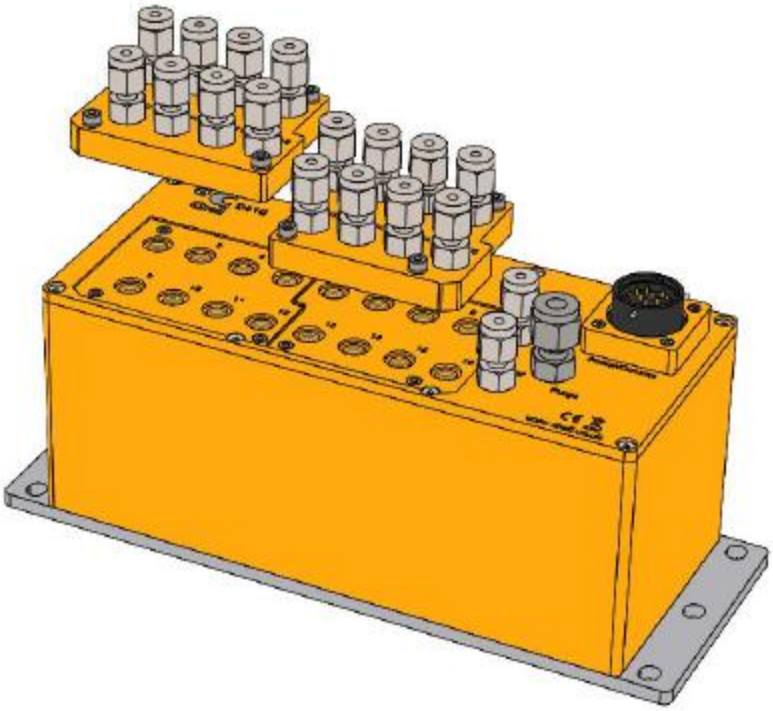


*Figure 2 Option 03 Removable Quick-Connect Plates*

*Figure 3 Option 02 AS205 Single Quick-Connect*

### 3.2.2 Service connectors

The service ports consist of the following (and are all optional):

| Port | Description | |
|---|---|---|
| Purge | Purge supply pressure | Clean, dry gas with max pressure 7 bar gauge. Care must be taken if the purge pressure exceeds the pressure range of the scanner. |
| Calibration | Calibration source for calibrating the 2416 | Clean, dry gas with a maximum pressure not exceeding the scanner capacity. Caution! This applies gas to all sensors simultaneously, use care with mixed-range devices. |
| Reference | Reference for pressure measurement | Reference pressure (usually left open to atmosphere). Maximum positive or negative gauge pressure applied to the reference must not exceed the limits of the reference sensor fitted. |
| Supply | N/A | No pneumatic supply is required |

The following options are available as standard supply:

01 = 5/16” - SAE O-ring boss

02 = 1/8” double ferrule compression fittings (Purge port is ¼”)

03 = AS205 quick disconnect

04 = 1.6mm (0.063”) bulged tubulations

### 3.2.3 Double ferrule installation instructions

When terminating to the double ferrule fittings it is important to properly follow installation instructions. Note that these fittings are ‘gaugeable’ using a tool purchased from the fitting manufacturer.

The 2416 will be supplied with either Swagelok® tube fittings or Hoke® Gyrolok® tube fittings.

Swagelok® and Hoke® both offer a comprehensive guide which details best practices, it is available to download from their website:

Swagelok®

https://www.swagelok.com/en/toolbox/tube-fitting-manual

Hoke® Gyrolok®

https://hoke.com//wp-content/uploads/2020/05/77100_GyrolokFittings_Manual_Catalog.pdf

**It should be noted that double ferrule compression fittings require different installation depending on size:**

**1/8” should be tightened 3/4 of a turn from finger tight.**

**1/4” should be tightened 1 & 1/4 turn from finger tight.**

## 3.3 Mounting Holes.

The 2416 has 6 mounting holes suitable for a M6 bolt or stub. It is advisable that at least the four outer most holes are used in service.

## 3.4 Earthing

Any of the 6 mounting holes can be used to provide a suitable ground connection (the coating used on the base plate is conductive). It is always recommended that the 2416 is connected to a good ground. Use caution during system design and installation to avoid creating a ‘ground loop’ as this may compromise performance.

# 4 Internal Valving

The 2416 contains the necessary valving to purge the measurement lines of the 2416 and to perform a re-zero – even when the measurement lines are subject to pressures.

The schematics below illustrates the function of the internal valves. There are three states of the scanner shuttle valve – run mode, calibrate mode and purge mode. The shuttle valve is shifted by electric motor and does not require pneumatic pressure.

In run mode, the measurement ports are connected to each measurement port on the scanner. The reference port is connected to the internal barometric sensor. In this mode normal differential or absolute pressure measurements can be performed. Note that connection to the Reference port is not mandatory if only Absolute measurements are to be made.

In cal mode the pressure transducers are all connected to the cal port and the measurement ports are isolated. The reference measurement port is still live. As all the transducers are connected to the calibration port in this mode, it is possible to re-zero the scanner and remove any zero offset – even when the system is subjected to pressures. This is simply achieved by externally connecting the calibrate and reference port together (as shown in the cal mode schematic) which will ensure that the differential transducers have no pressure differential across them. For best performance (and for Absolute mode tare) the reference line should still be connected to the correct source, such as tunnel static or barometric pressure.

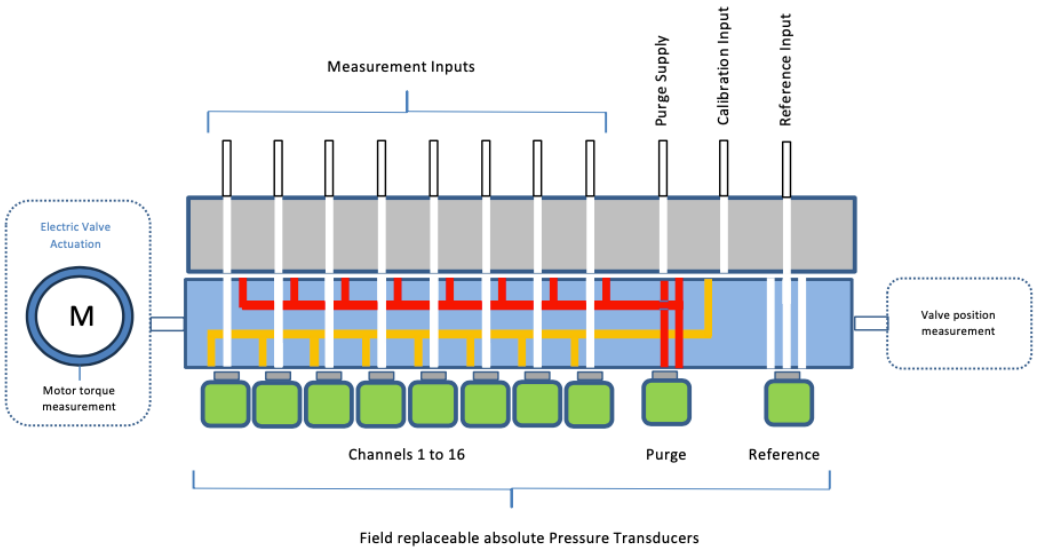
In Purge mode the measurement lines are connected to the purge supply gas fed into the purge port on the top of the 2416 to purge the measurement lines of contaminants and moisture. Where the option is taken, the purge gas pressure may be monitored. The Purge supply will be isolated in the CAL and RUN modes.

 Please see note in section 5.5 on purge methods for on-ground and in-flight situations.

The internal valves are controlled via the embedded web server or over the communications protocol used. In addition to manually actuating each valve, we offer a re-zero and purge routine that will actuate all the necessary valves in the appropriate sequence returning to Run mode once completed.

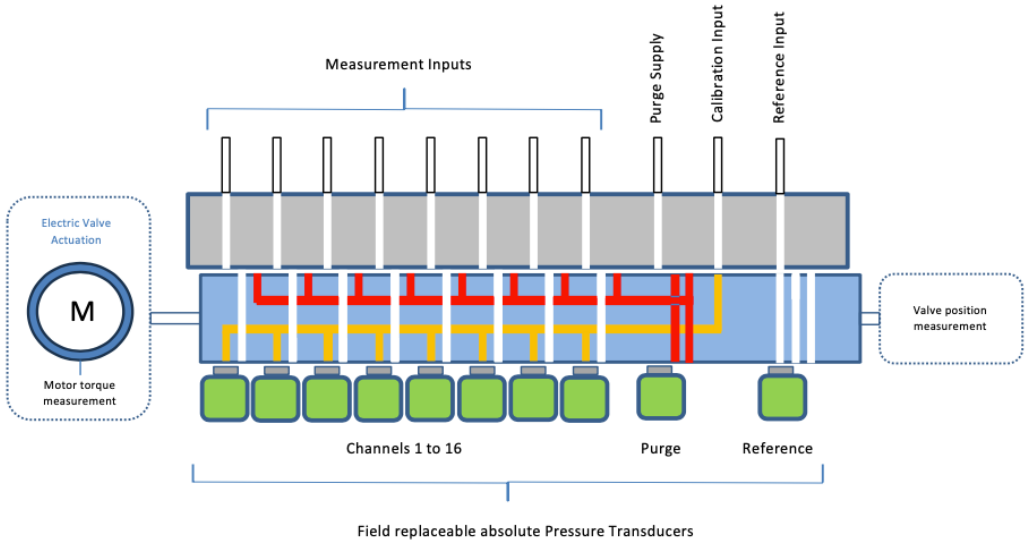
## 4.1 Scanner in Run mode.

Here each measurement input is connected to its transducer. The purge supply and calibration input are positively shut-off.



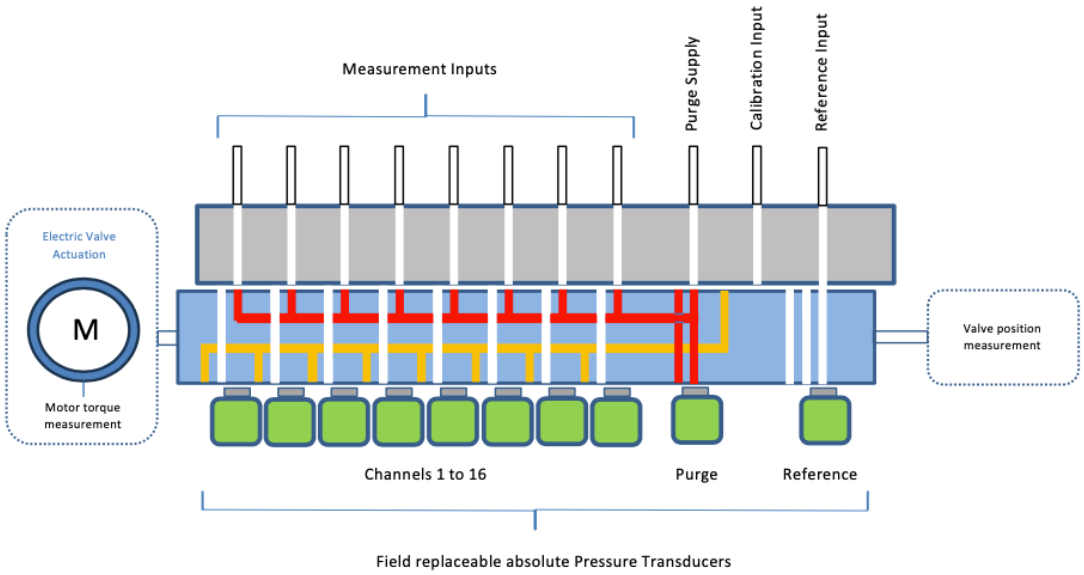

## 4.2 Scanner in Calibrate mode.

In cal mode, all the transducers are connected to the calibration input. The measurement lines are isolated and the purge supply is positively shut-off.



### 4.3 Scanner in Purge mode.

In purge mode, all the measurement lines are connected to the purge supply. The purge pressure can also be measured by the purge transducer. The transducers are isolated and the calibration input is shut-off.



# 5 2416 Configuration Webserver

## 5.1 Introduction.

The 2416 webserver configuration provides the means of setting up, calibrating and demonstrating the 2416 unit from a standard PC with an ethernet port and browser.
The software is divided by tabs into five areas of functionality, namely 'Setup', 'Live data', 'Channel Configuration', 'Advanced', and 'Factory Tools'

## 5.2 Common Controls Sidebar

Figure 5 (in Section 5.3 below) shows the first page viewed when navigating to the webserver. The menu at the top allows the user to choose what is visible in the central window, and the sidebar (shown left) shows information and has a select few commands that are useful regardless of the central page the user is on. The function of the controls on the sidebar is detailed in the subsequent table.

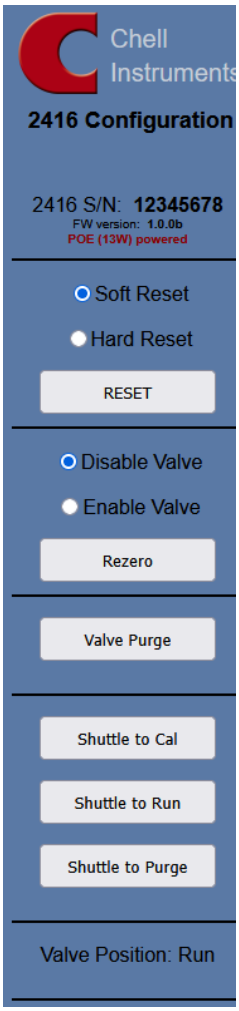



*Figure 4 Sidebar*

| Control | Function |
|---|---|
| **'RESET' button** | Resets the 2416. Use to activate new settings and/or rebuild calibration tables. The option exists for a hard reset and a soft reset. A hard reset will re-start the operating system within the 2416 and is required when low-level changes are made such as the IP address. A soft reset will restart with modified settings and is suitable for changed to channel configuration etc. A soft reset will take around 12 seconds but a hard reset will take around 60 seconds. |
| **'Rezero' button** | Starts a 2416 rezero operation, tares the applied pressure. Select if the valve should shuttle to Cal for the tare. |
| **'Valve Purge' button** | Runs the Valve Purge routine. Set the duration in Function Length.<br><br>This will interrupt normal measurement to direct purge gas down the measurement ports to remove contaminates or condensation. Normal measurement will resume automatically after the set time. ⚠**See following Caution**. |
| **'Shuttle to Cal' button** | Move the Valve to the Cal position. |
| **'Shuttle to Run' button** | Move the Valve to the Run position. |
| **'Shuttle to Purge' button** | Move the Valve to the Purge position. |
| **'Valve Position' declaration** | Advises the position of the Valve. This will show:<br><br>Run, Cal, Purge or Indeterminate where between positions. |

*Table 2 Sidebar Controls*

**Purge Operations.**

Caution!

The user should be aware that performing a purge whilst high pressure exists on the measurement port may result in back-flow creating dirt or moisture ingress and product damage. Therefore, the measurement port pressure vs purging pressure must be considered. Given the purge pressure is vented briefly before the shuttle valve is returned a failed or incomplete purge may permit dirt or moisture ingress. Due to this risk the Valve control Function timer should not be set to a value of short duration. The default duration is 10 seconds, this can be extended where longer tubing is used.

The user is additionally advised that where a failed purge occurs it is possible for a purge gas pressure to be transferred to the measurement sensors causing over-pressure related failure. Ensure the purge gas pressure used does not exceed the over-pressure limits of the measurement sensors. The 2416 may be used with user installed sensors so reference must be made to the individual sensor datasheet (PSM). Pressure limit data is given in Section 2.5.

## 5.3 ‘Setup’ tab.

Here it is possible to configure the following parameters:

- Protocol
- Additional stream fields
- Boot-up Data Rate
- Ethernet IP address, subnet mask and port
- UDP destination and remote port
- IENA Key and End Word
- Netscanner Emulation settings

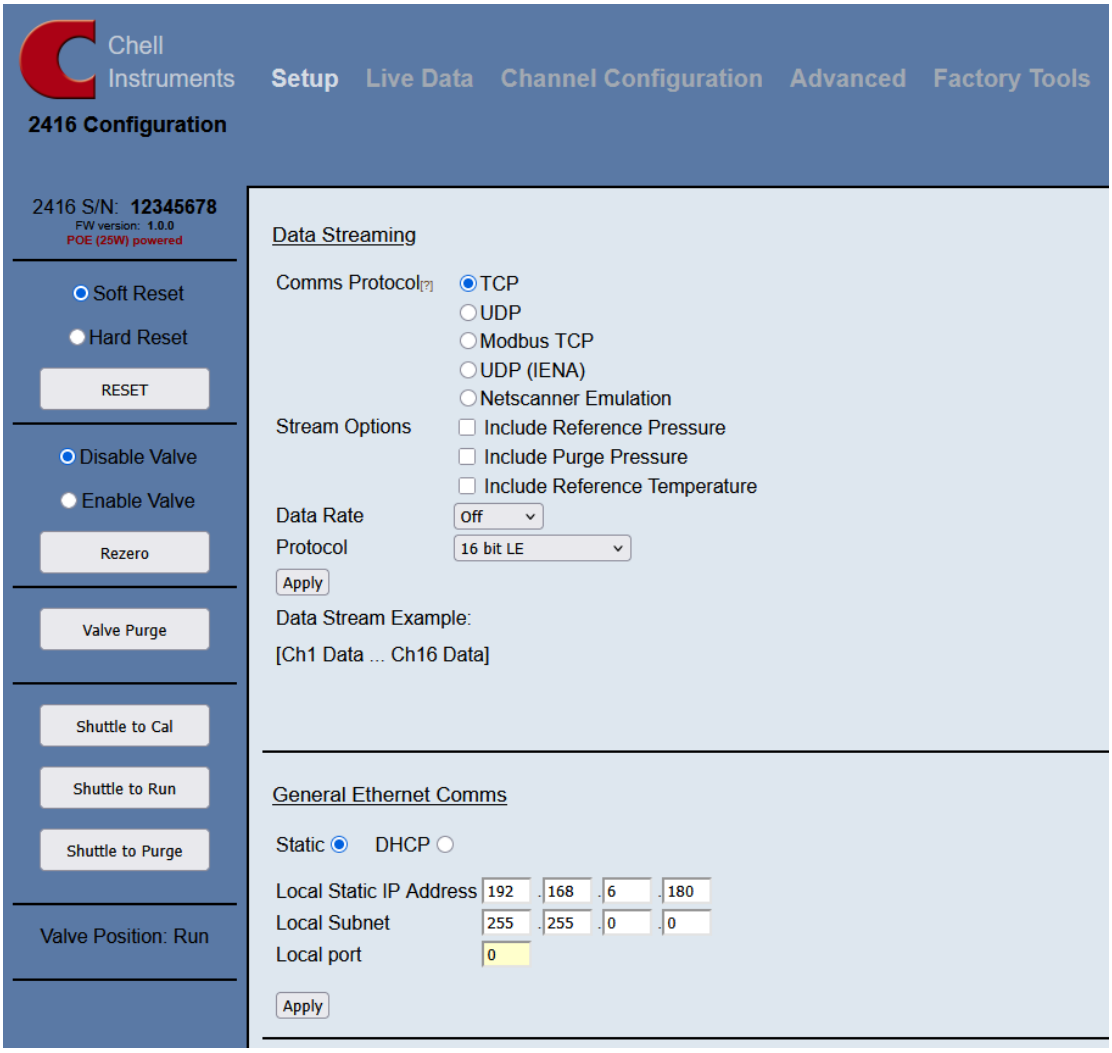



*Figure 5 Webserver Setup Page*

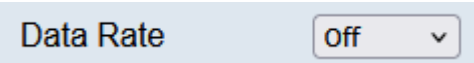
### 5.3.1 General Notes for configuration changes

- It is always important to stop a running data stream operation before it is reconfigured
- Always Press ‘Apply’ to change a setting, followed by a soft reset.

- Always be certain a configuration change will leave the product in a reachable state. i.e. Never set an IP address beyond the reach of the configuring PC, Never set DHCP if you do not have the tools to discover the address granted.
- Be aware that the live data page consumes system resources and should not be left open if it is not required, especially if high data rates are demanded.

### 5.3.2 Data Rate

The Setup Page has the following Data Rate setting:




This sets the power-up data rate. It is possible to set this so the product will automatically volunteer data on the protocol specified (Not MODBUS).

This setting may be left ‘Off’ and the data rate requested via the selected protocol. Either method is valid.

Note that some rates are only possible via this menu, e.g. 33Hz and that the Sensor Response setting may limit the actual rate achieved.

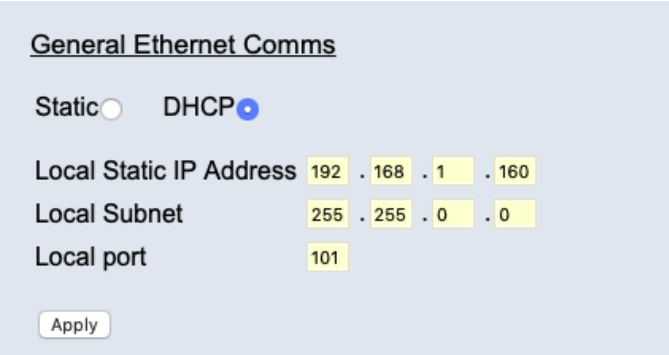
### 5.3.3 Comms Protocol

The 2416 will support several protocol options, they are detailed as follows:

#### 5.3.3.1 TCP/UDP

TCP is the factory default option and is often described as the ‘Native’ protocol. This protocol is covered in detail in the ‘900204 - DAQ protocol guide’ document.

The IP address must be set in the General Ethernet Comms section. Static addressing is strongly advised. The Local port is 101 by default.

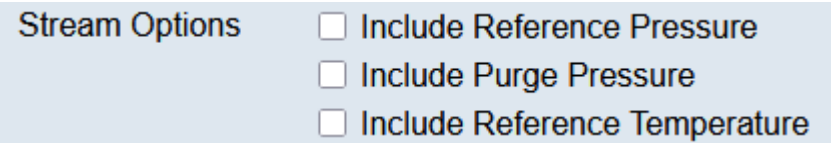



Be sure to select the data endianness. 16 bit Little endian is a historical default for DAQ products and is compatible with the free to download microDAQX.

Little Endian, Big Endian and EU 32bit IEEE754 Float (BE) are valid selections.

**Stream Options**

Select the required additional stream options:




The stream build up is given below to indicate the selected items and the order they would appear in the stream.

**UDP Specific Options**

Setting the Remote UDP IP address is optional. A Setting of 0.0.0.0 will cause the product to direct packets to the address that requested the transmission. Where an IP address is entered the product will direct packets to that address. Be sure to set a remote port. There is no default remote port but this should typically be within the 'private' port range (49152 onwards) as the device is generally intended for use on a private network.

Ensure the 'Apply' button is pressed and the product reset after any protocol changes.

Each acquisition cycle (of 'x' number of channels) is packed as a separate UDP packet with a four-byte representation of the 2416 serial number at the start of the packet followed by a four byte packet number. These are attempted to be sent out at the required rate but with no checking for reception or validity of data.

### 5.3.3.2 Modbus

If selecting ModbusTCP ensure the data rate is set to 'Off'. Press 'Apply' and 'Reset'. The product will be available at the IP Address specified. Port 502 is default. The register listings are specified in detail in document

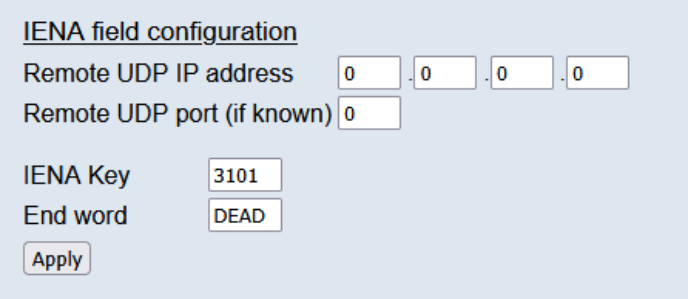
'EM0179 – ModbusTCP register mapping'

As well as reading the 3xxxxx registers to obtain data it is possible to perform some service functions (such as rezero) by writing to 4xxxxx registers.

In ModbusTCP the stream option controls have no effect, this data is available in the stated registers regardless of this setting.

### 5.3.3.3 UDP (IENA)

The product will support a predefined UDP IENA stream. This will issue timestamped data in EU format. When selected some IENA specific settings appear:




IENA Key of ‘0x3101’ and End Word of ‘0xDEAD’ are Default hex values.

The Endianess is typically Big Endian for this protocol.

Be certain to press ‘Apply’ and ‘Reset’ after making changes.

#### 5.3.3.4 Netscanner Emulation

This configures the product to use the TE™ Netscanner™ protocol.

When selected a new menu appears where the emulation type can be selected. A choice of ‘9216’ would be appropriate, but others may be selected.

The supported commands are detailed in document:

‘90025716 - NetScanner emulation support for flightDAQ & 24-series’

**Limitations**

When configuring a stream, it is only possible to select stream rates supported by the product (see the Setup page ‘Rate’ drop-down). So, for example 100ms (10Hz) is valid but 15ms (66Hz) is not.

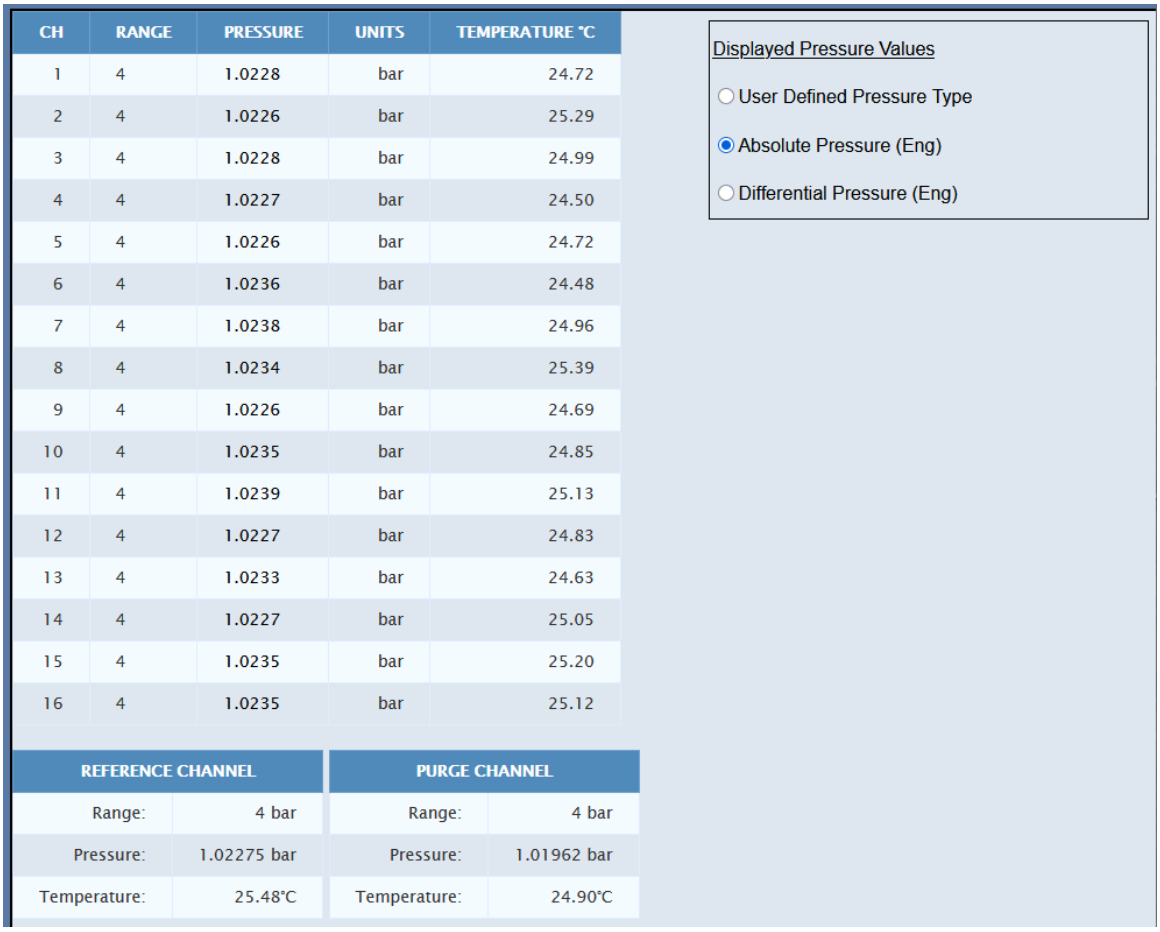
The 2416 supports two configurable streams. The Tertiary stream is not supported.

**Enable Command Logging**

Selecting this tick box will cause the product to log any commands received that it cannot process. This can be useful during evaluation or commissioning. Where commands are not supported it is possible to submit a command compliance request to the factory and the command integration will be considered for inclusion.

## 5.4 Live Data Tab

Figure 6 Live Data tab below shows the 'Live Data' page of the webserver.



| CH | RANGE | PRESSURE | UNITS | TEMPERATURE °C |
|---|---|---|---|---|
| 1 | 4 | 1.0228 | bar | 24.72 |
| 2 | 4 | 1.0226 | bar | 25.29 |
| 3 | 4 | 1.0228 | bar | 24.99 |
| 4 | 4 | 1.0227 | bar | 24.50 |
| 5 | 4 | 1.0226 | bar | 24.72 |
| 6 | 4 | 1.0236 | bar | 24.48 |
| 7 | 4 | 1.0238 | bar | 24.96 |
| 8 | 4 | 1.0234 | bar | 25.39 |
| 9 | 4 | 1.0226 | bar | 24.69 |
| 10 | 4 | 1.0235 | bar | 24.85 |
| 11 | 4 | 1.0239 | bar | 25.13 |
| 12 | 4 | 1.0227 | bar | 24.83 |
| 13 | 4 | 1.0233 | bar | 24.63 |
| 14 | 4 | 1.0227 | bar | 25.05 |
| 15 | 4 | 1.0235 | bar | 25.20 |
| 16 | 4 | 1.0235 | bar | 25.12 |



| REFERENCE CHANNEL | | PURGE CHANNEL | |
|---|---|---|---|
| Range: | 4 bar | Range: | 4 bar |
| Pressure: | 1.02275 bar | Pressure: | 1.01962 bar |
| Temperature: | 25.48°C | Temperature: | 24.90°C |

*Figure 6 Live Data tab*

The live data page is a diagnostic page permitting the user to view the current (calibrated) sensor values. Using the radio button to the right the user can select the format that the data viewed. Note that changing this view does NOT change the streamed data, only this view.

| Selected Data | Description |
|---|---|
| User defined | In this mode the user may view channels as configured in the ‘Channel Configuration’ tab. Mixed absolute and differential is possible. |
| Differential pressure (Eng) | This is the compensated engineering unit output of the 2416 in differential mode – relative to the reference port. The display units can be changed in the ‘Channel Configuration’ tab. |
| Absolute pressure (Eng) | This is the compensated engineering unit output of the 2416 in absolute mode – The display units can be changed in the ‘Channel Configuration’ tab. |

| | |
|---|---|
| Temperature (ºC) | This is the temperature measurement for each channel. |
| Reference Channel | The absolute pressure and temperature of the reference channel is displayed here in the configured units. |
| Purge Channel (optional) | The absolute pressure and temperature of the Purge channel is displayed here in the configured units. |

## 5.5 'Channel Configuration' tab

This tab shows the configuration information for each of the sensors, note that it is possible to set the absolute/differential mode and units for each sensor independently.

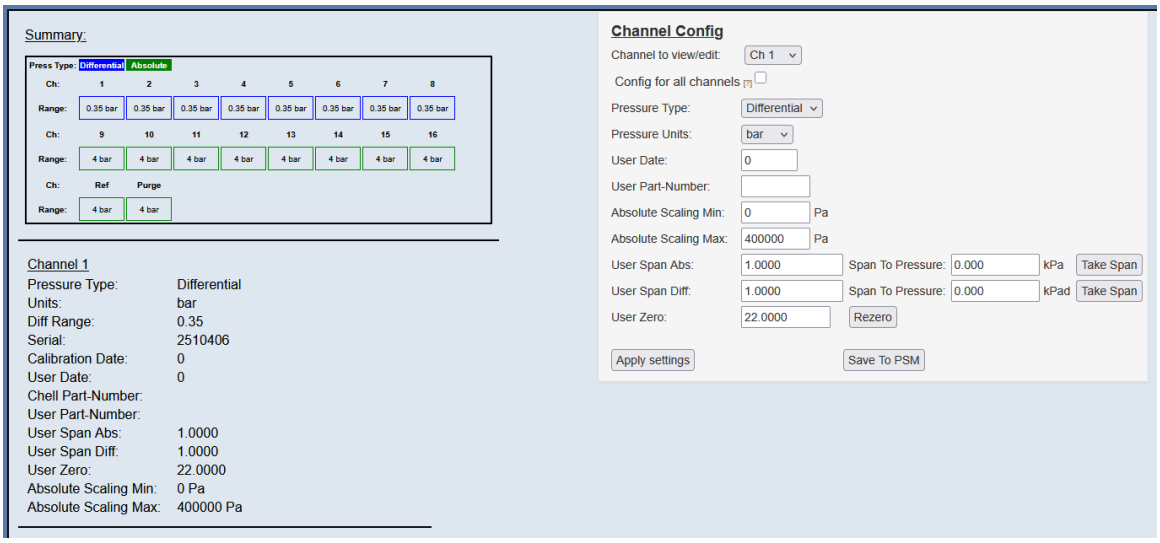



*Figure 7 Overview of the Channel Configuration tab*

### 5.5.1 Summary

The summary table gives a quick overview of the sensor information. The information given includes:

- Range – It is possible for each sensor (PSM) to have a different range
- Mode
    - Differential – Shown with a blue outline
    - Absolute – Shown with a green outline

  Note that Purge and Reference are always set for absolute.

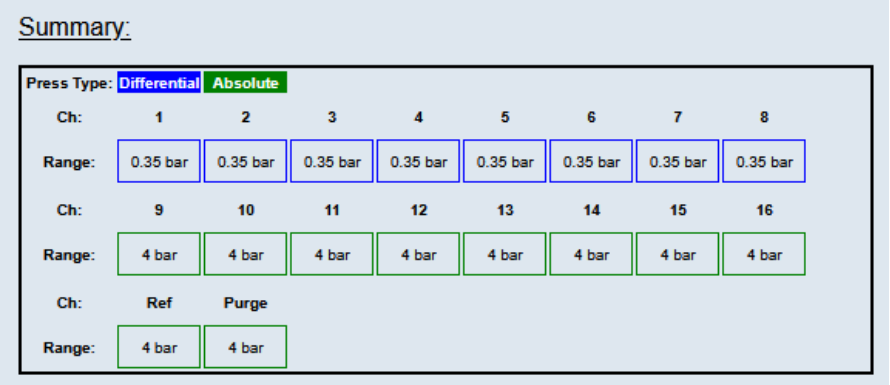



*Figure 8 Configuration Summary Table*

Below the table there is full details for each channel configuration. These settings are changed in the 'Channel Config' setting to the right of the page.

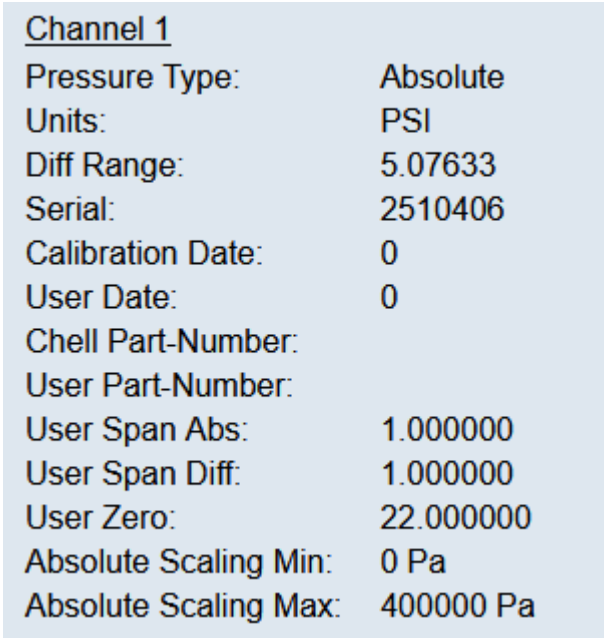
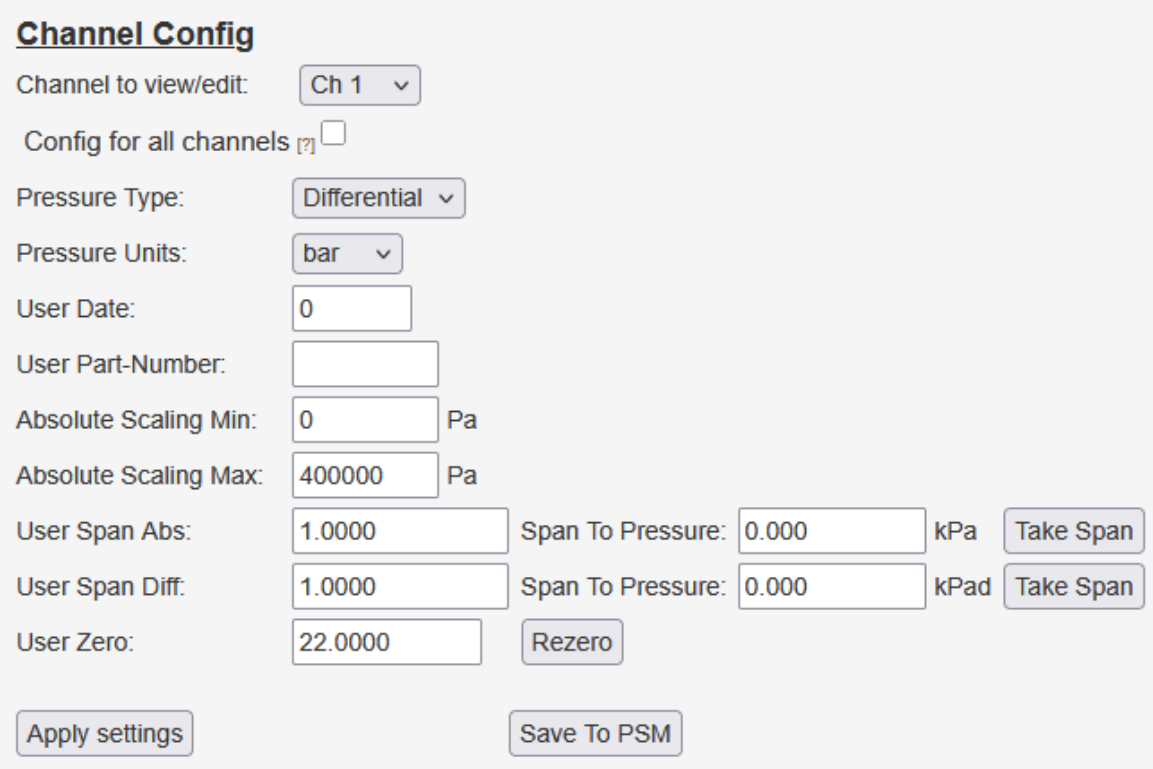



*Figure 9 Channel Specific Summary Information*

### 5.5.2 Channel Config




The Channel Config section permits the modification of the channel setup. Note that each channel is a separate PSM (Pressure Sensor Module) and may be configured (or exchanged) on a channel-by-channel basis. PSM configuration and calibration data is saved within the PSM internal memory so would travel with the PSM should it be moved to another 2416 device or channel location.

**Channel to view/edit**
A pull-down to select the channel to be edited. On selection of Ch1 a tick box is present allowing the setting to be saved into all 16 channels, this copies the following fields:

**Pressure Type**
**Pressure Units**
**User Date**
**User Part Number**
**Absolute Scaling Min**
**Absolute Scaling Max**

**Pressure Type**
A pull-down to select Absolute or Differential mode. This sets the mode used for streaming.

**Pressure Units**
A pull-down to select units. These units are used for the Live Data tab and also the EU streaming. Select from: Pa, PSI, bar, mbar or kPa.

**User Date**
A free-form field to accept a numerical date entry of maximum length 6. This field is unused by the product and is for user use only. The data is stored in the PSM memory. An example format could be ddmmyy (e.g. 010525)

**User Part-Number**
A free-form field to accept an alpha-numerical date entry of maximum length 8. This field is unused by the product and is for user use only. The data is stored in the PSM memory. An example format could be 12345678. Special characters are not permitted.

**Absolute Scaling Min**
This field sets the minimum channel reading in Pascal that can be transmitted using the binary scale in absolute mode. This defines the pressure reading for a 16 bit binary value of ‘0’.

**Absolute Scaling Max**
This field sets the maximum channel reading in Pascal that can be transmitted using the binary scale in absolute mode. This defines the pressure reading for a 16 bit binary value of ‘65535’.

**User Span functions**
These fields permit the user to adjust the calibration of the product. The values pertain only to the selected channel. The Span value is the ‘m’ component of y=mx+c. Default is ‘1’, returning the device to the factory calibration.

The value may be entered in the box or the coefficient may be derived by applying a pressure to the channel, entering the pressure value, and then selecting ‘Take Span’.

**User Zero functions**
These fields permit the user to adjust the calibration of the product. The values pertain only to the selected channel. The Zero value is the ‘c’ component of y=mx+c and is in units of Pascal. Default is ‘0’, returning the device to the factory calibration.

The value may be entered in the box or the coefficient may be derived by applying zero differential pressure to the channel and then selecting ‘Rezero’.

**Note that it is a requirement to press the ‘Apply settings’ and ‘Save TO PSM’**

## 5.6 'Advanced' Page

The advanced page contains functions that will change the how the 2416 acts and how it applies various calculations to its data, this page should only be used by users who fully understand what they are changing.

### 5.6.1 Filtering

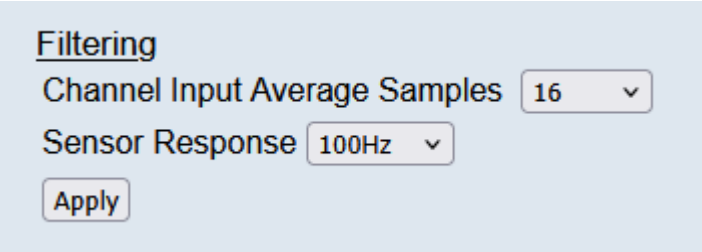



*Figure 10 Filter Controls*

The 2416 has settings to allow the user flexible control over the data throughput of the device.

**Channel Input Average Samples**

The 'Channel Input Average Samples' algorithm is a 'infinite response average' so increasing this value will reduce the apparent noise but reduce the response of the measurement. The function is based on a power of '2'. As such a filter of 16, meaning that the new data contributes only one $1/16^{th}$ of the derived data. In contrast with a filter of 2 meaning the new data contributes ½ of the derived data. Clearly, where a filter of 'Off' is selected only the current data is used to build the output.

**Sensor Response**

This setting configures the sensor for best performance up to the maximum acquisition speed of the selected setting, as such the output rate will be limited by this setting. For optimum accuracy this setting should be set to be only just greater than the acquired data rate. This setting does require a 'reset' so careful selection is important where the acquisition rate may change.

Where hardware trigger or timestamping is in use this setting should be set to the maximum (1kHz) to achieve best synchronisation or timestamp accuracy.

**Note that it is a requirement to press the 'Apply settings' and 'RESET' after making changes in this section.**

### 5.6.2 Valve Control

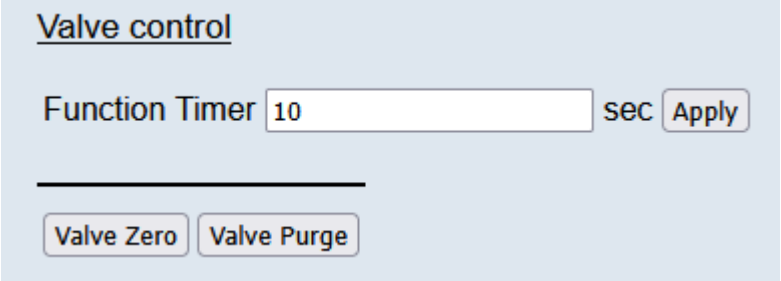



*Figure 11 Valve Control (Function Length)*

The function timer sets the duration of a Rezero using the valve or the purge duration. The default of 10 seconds is an appropriate minimum. Select a longer duration where long tubing is installed. This value can be over-ridden by remote commands if specified.

The Valve Zero or Valve Purge operations can be initiated from here by selecting the appropriate button.

### 5.6.3 Time Stamping

This section allows the user to edit the timestamp settings of the 2416. This timestamp will allow the user to get timestamps to nanosecond resolution on the data packets. Time stamps are in Epoch time and are based on seconds since 00:00 1 January 1970. Note that IENA uses a different standard.

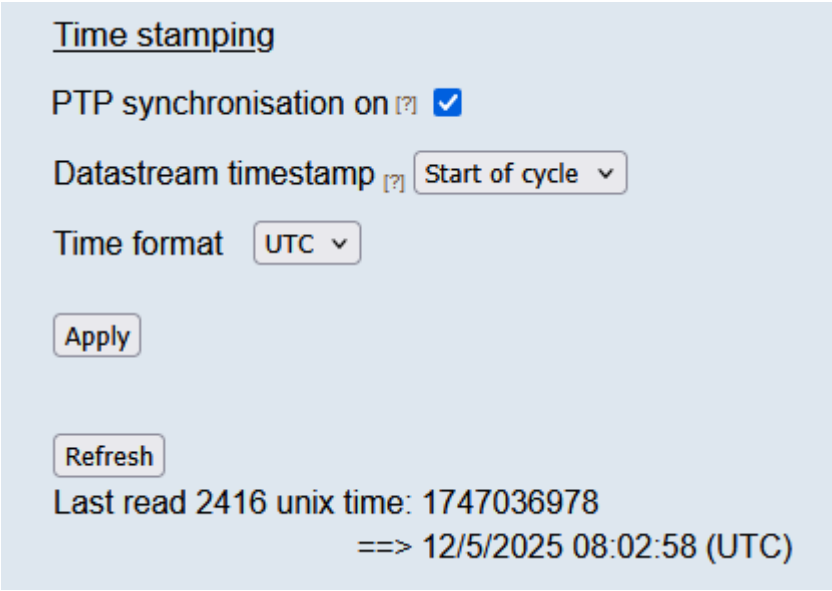



*Figure 12 Timestamp Controls*

**'PTP synchronisation on' checkbox**

Checking this box directs the 2416 to apply a timestamp synchronised with a PTP1588 Grand master clock. Where this is not checked the time applied to a timestamp is an unmanaged system time.

**‘Data stream timestamp’ drop box**

To set if the timestamp is positioned in the data stream, select either ‘none’ which will turn the timestamp off or ‘start of cycle’ which will place a timestamp at the beginning of all the channels.

**Time Format**

Selects if the timestamp is aligned to UTC or TAI time. Note that UTC is 37 seconds behind TAI.

**Refresh**

Permits the user to ask the 2416 for the current Epoch time.

**Note that it is a requirement to press the ‘Apply settings’ after changing any elements in this section.**

### 5.6.4 Miscellaneous

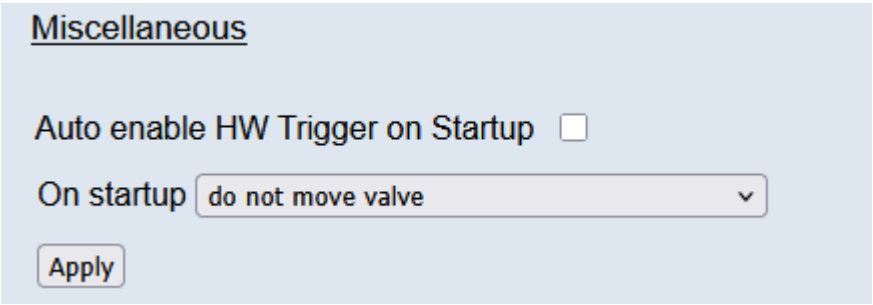



*Figure 13 Miscellaneous Controls*

**Auto enable HW Trigger on Startup**

Check to switch on Hardware Trigger by default. Subsequent Hard or Soft Reset operations will NOT clear this flag.

**On Startup drop-down**

The following options are possible:

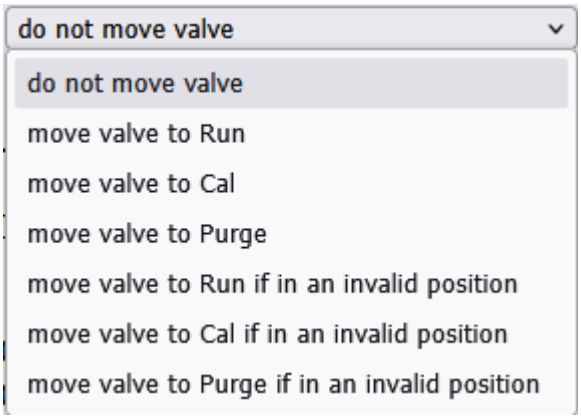



*Figure 14 Start-up valve operations*

### 5.6.5 Live Health Check

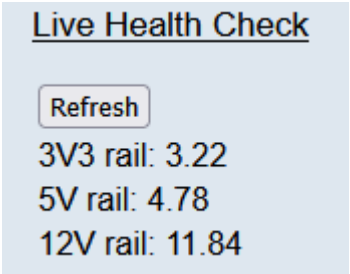



*Figure 15 Health Check Data*

The 2416 is able to monitor its internal power supplies for diagnostic purposes. These values are obtained from the acquisition processor. The 5V rail is shared with the main microcomputer. These values are nominal. Click ‘Refresh’ to obtain current values.

### 5.6.6 Zero Offset Data

This section displays the last read user zero data. This is displayed in the selected user units.

It is possible to ‘Select All’, or select only a limited number of sensors to Rezero.

Where a Rezero is performed and the results favourable the values may be saved to non-volatile PSM memory, or alternatively if desired the values cleared using the ‘Reset Selected’ option. Note that cleared data must be saved if this is desired to be non-volatile.

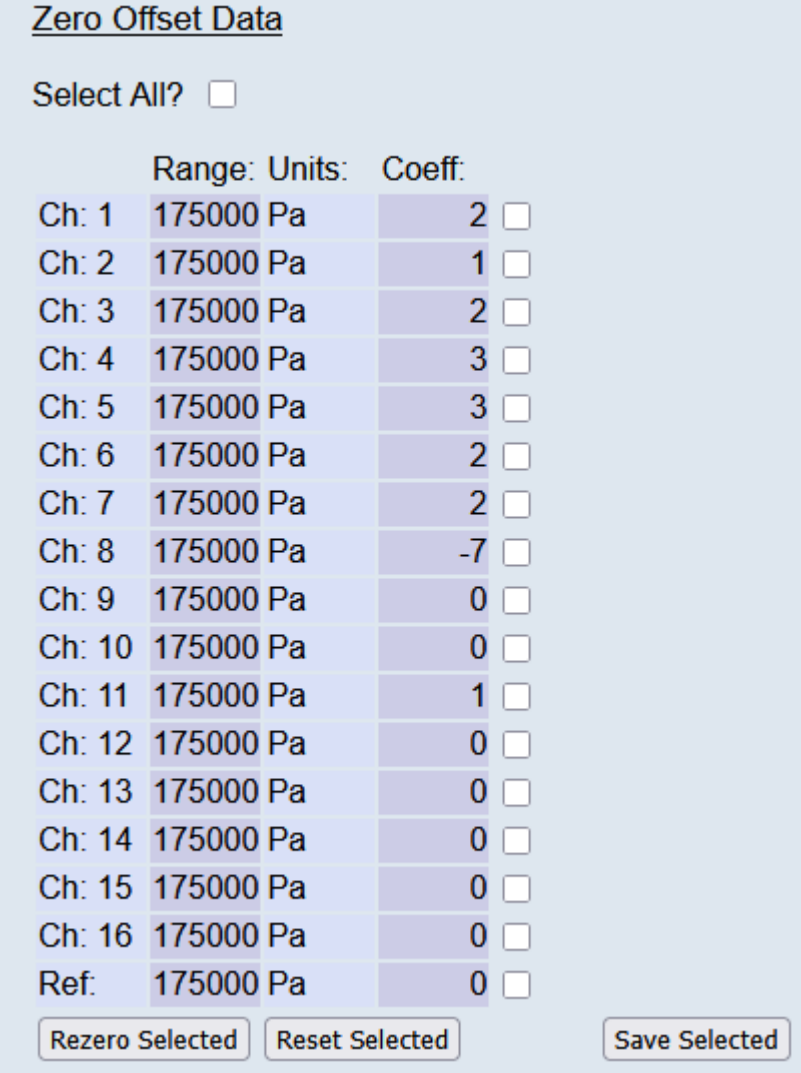



*Figure 16 Zero Offset Data*

### 5.6.7 Absolute and Differential Span Coefficients

It is possible to apply a user level Span calibration to the 2416 data channels. Note that there are separate coefficients for absolute and differential, there are no differential coefficients for the Reference and Purge sensors as these operate only in absolute mode.

Span Coefficients are given as a %, as such a default is 100% to use the factory calibration.

To make an adjustment first ‘Reset’ The span to 100%, save and reset the 2416, ensure the channel to be changed declares a coefficient of 100%. Apply a pressure to the channels to be adjusted, ensure the channel to be adjusted is selected and the presented pressure is entered into the ‘Applied Pressure’ in kPa. Select ‘Take Span’ assuming the coefficients achieved are desired select ‘Save Span’ to store the new coefficients into the PSM memory.

**Where absolute and differential adjustments are to be made, adjust absolute first.**

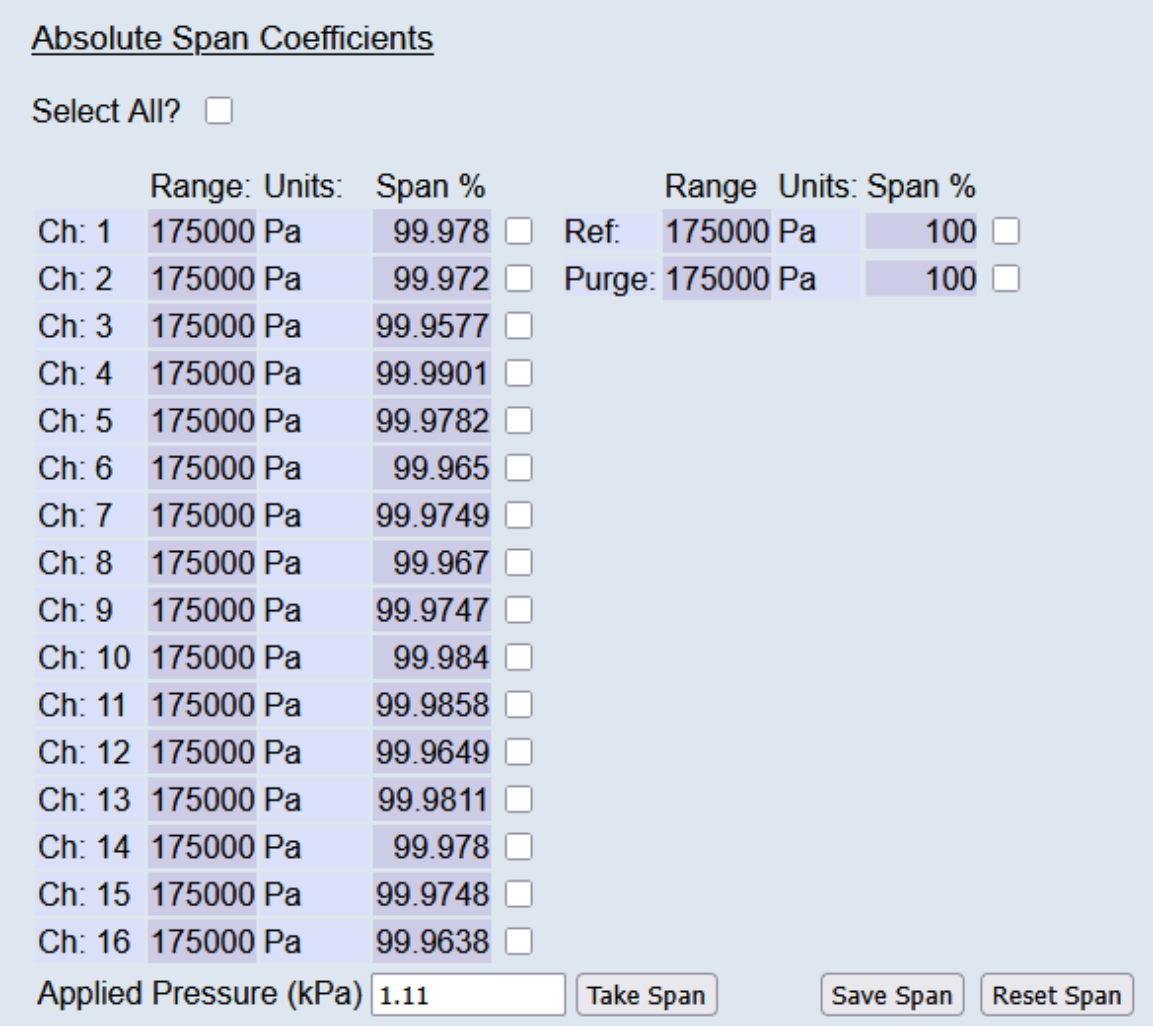



*Figure 17 Absolute Span Coefficient Table*

### 5.6.8 Live Data Precision

This table permits the precision of the displayed data on the 'Live Data' tab to be set. The number correlates to the number of digits given after the decimal point. This settings in no way affects the product accuracy.

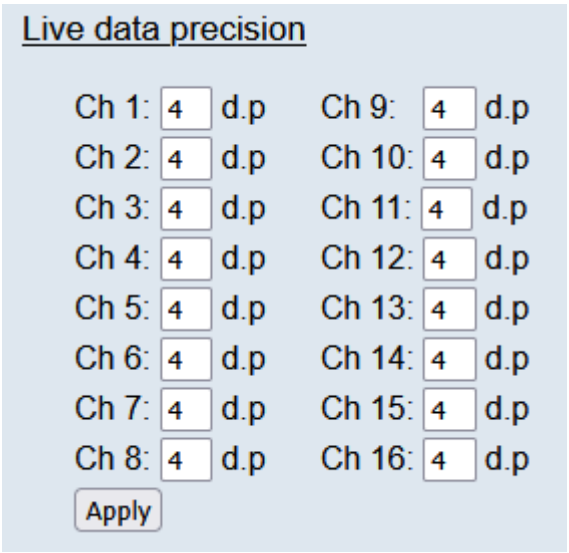



*Figure 18 Live Data Precision setting*

# 6 Sensor Replacement

## 6.1 Sensor Removal / Replacement

Caution!

**HIGH PRESSURE GAS HAZARD**

The following Information must only be attempted by competent persons. Improper actions may result in **hazardous release on high pressure gas** resulting in personal injury. Where competency is uncertain return the product to an authorised representative to complete the work.

**ELECTRICAL POWER HAZARD**

The following procedure requires disconnection from the power source. **Once opened the case no longer offers protection to the user**. Ethernet and power lines can present a risk of injury through electrical shock or burns. **There is a risk of personal injury or product damage**.

**MECHANICAL HAZARD**

NEVER attempt to operate the 2416 when not installed in the casing, this is a hazardous operation as body parts may be crushed in the mechanism.

NEVER attempt to override the interlock mechanism

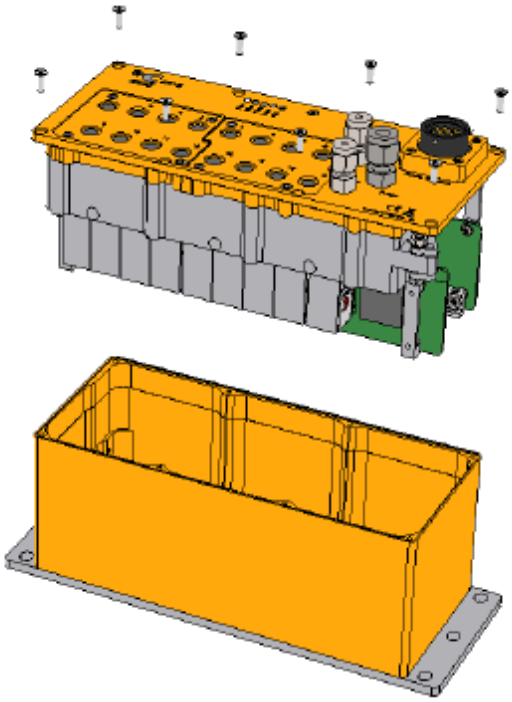
NEVER apply gas to the product when removed from the casing as expelled parts are unlikely to be contained.

NEVER attempt to disassemble any part of the product not explicitly advised as this may compromise the users safety.

a. Prepare a clean and dry work area.

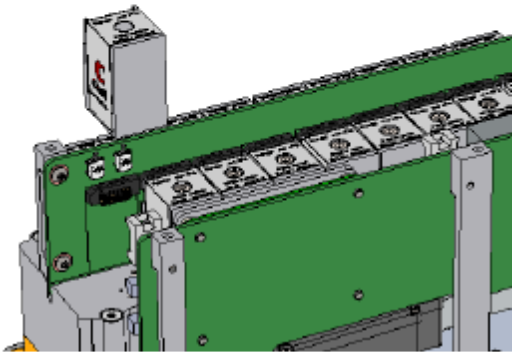
b. Ensure the Power and pneumatic lines are disconnected.

c. Remove the top Screws and withdraw the product from the main body. The 2416 may now be inverted and replaced on top of the case again, add a couple of screws to hold the top panel over the empty case. This helps to provide a stable platform.



d. Locate the sensor to be removed, retract the securing screw. Remove the screw fully.

e. Slightly tilt the PSM away from the PCA contacts and carefully withdraw it from the unit. Be careful not to damage the electrical contacts.



f. To replace a sensor first inspect the seal face and o-ring ensuring no dirt or damage is present on either the new sensor or the 2416 body.

g. Ensure the PSM has the screw removed. Lower the PSM into place with the electrical contacts orientated to make connection with the 2416 electrical contacts.

h. Once in place, tilt the PSM away from the 2416 PCA to release tension on the electrical contacts to ensure these have not been bent or misaligned during insertion.

i. Now hold the PSM in place, firm against the pneumatic manifold and insert the screw, maintaining PSM location. Tighten the securing screw.

j. Repeat as required.

k. Replace the 2416 into the case ensuring the location pins in the bottom of the case locate with the pillars securing the PCAs. DO NOT USE FORCE. There is only one correct orientation, if the assembly does not drop into place the orientation is likely incorrect.

l. Replace the top panel screws, securing with Loctite 222.

m. Power the device and review the new sensor configuration on the webserver.

n. The 2416 must now be leak tested to ensure safe and accurate operation, leak testing should be conducted at a minimum of the full-scale range of the sensor, where this pressure is in excess of 7 bar leak testing should be conducted in a secured environment ensuring persons are protected should parts or pipework be expelled.

# 7 Service and Calibration

## 7.1 Service

There are no user serviceable parts inside the instruments. User Service is limited to replacement of sensor to facilitate re-range or replacement of a faulty sensor, this is covered in Section 6. Should any difficulties be encountered in the use of the 2416, it is recommended that you contact Chell Instruments Ltd for advice and instructions.

## 7.2 Calibration

Calibration is recommended on an annual basis and Chell Instruments Ltd. provides a fully traceable facility for this purpose.

## 7.3 Adjustment

There are no user adjustments in the instrument. Adjustments are possible by reviewing section 5.6.7 Absolute and Differential Span Coefficients.

## 7.4 Cleaning

A dirty instrument may be wiped clean with a soft cloth that has been sprayed with a proprietary ‘foaming cleaner’, then wiped dry immediately.

Caution

Under no circumstances should the instrument be wetted directly or left damp.