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microDAQ3
Pressure Scanner Acquisition System

INSTALLATION AND OPERATING MANUAL

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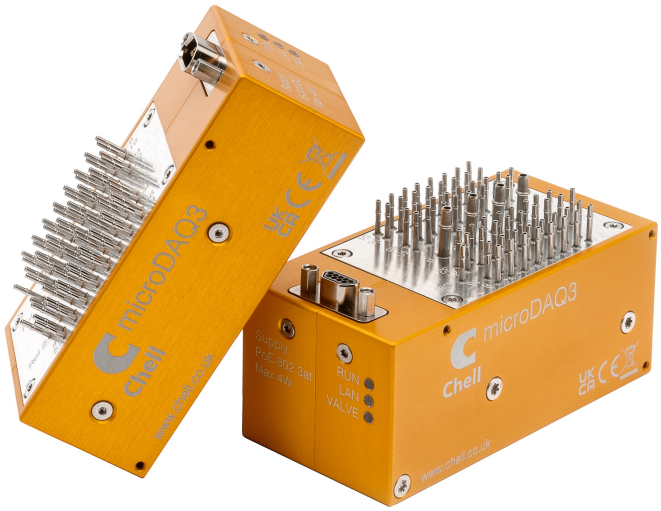
Visit the Chell website at:
http://www.chell.co.uk

900252-2.2

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.



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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.

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1 Description

1.1 General

The microDAQ3 is a self-contained pressure scanner that acquires and transmits pressure data to a host via Ethernet or a CAN bus. The microDAQ3 fits into the Chell pressure scanner range alongside the established microDAQ, microCAT and nanoDAQ-LT range.

The combination of high-precision digital transducers and Chell's calibration technology have resulted in the most accurate and flexible pressure scanners available on the market.

The device has the ability to output absolute pressures or differential pressures by using additional reference sensors, the 65th and 66th reference channels for the 64 channel variant and 17th channel for the 16 channel variant.

The microDAQ3s are configured using their embedded web-servers. The output stream can be configured in a number of ways including averaging, transmission speed, absolute or differential and also the ability to add a time stamp to the data. Compliance with IEEE1588 PTP V2 and a hardware trigger facility give a good level of time determination for the acquired data.

This manual revision covers microDAQ3-64 firmware version 1.0.16 as well as version 2.0.2 and microDAQ3-16 firmware version 1.0.15.

2 Specifications

2.1 Ranges

The microDAQ3 is available in the following ranges:

Differential Range		microDAQX Range Code (PSI)	Absolute Range		microDAQX Range Code
4” water	1 kPa	0.144509	2.2 to 16.8 psia	15 to 115 kPa	2(a)
10” water	2.5 kPa	0.362173			
20” water	5 kPa	0.722541			
1 psi	7 kPa	1			
1.5 psi	10 KPa	1.5			
2.5 psi	17 kPa	2.5			
5 psi	35 kPa	5			
8 psi	55 kPa	8	1.885 to 23.2 psia	13 to 160 kPa	8(a)
15 psi	103 kPa	15	2.2 to 29.9 psia	15 to 206 kPa	15(a)
30 psi	207 kPa	30	2.2 to 58.01 psia	0 to 400 kPa	
45 psi	310 kPa	45			

2.2 Power Supply:

2.2.1 DC Powered Version

Line voltage:	8-30 Vdc
Absolute Max. Line voltage	30Vdc
Consumption:	Max 1W (non-valved), 4W (valved version)

2.2.2 PoE Version

PoE Standard:	802.3at Type 1 (Previously 802.3af)

2.3 CAN specifications:

CAN type	2.0B
CAN baudrate	Configurable from 1M, 500K, 125K and 100K.
Programmable variables:	
Address 0x?nn	Most significant programmable device ID
Address 0xn?n	Next most significant programmable device ID
BRP	CAN bus timing
TSEG1	CAN bus timing
TSEG2	CAN bus timing
SJW	CAN bus timing

2.4 Ethernet Specifications:

TCP/IP	10Mb/s & 100Mb/s via Auto Negotiation TCP & UDP protocols supported

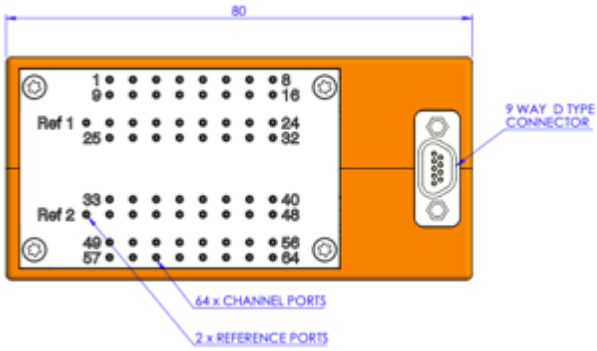
2.5 Environmental specification:

Operating temperature range:	-40°C to +90°C
Storage temperature range:	-40°C to +90°C
Maximum Relative humidity:	95% at 50°C (non condensing)
Ambient altitude	100 mbar abs or nominally 52000 ft
Vibration	Engine standard vibration test to DO160E category S, curve W with duration of 1 hr/axis. Fan blade out case to DO160E category S, curve P. Fan blade out to DO160F section 7 (40g 11m/s) Engine load to +/- 40g per axis
Radiated emissions	MIL standard 461-E: RE102
Conducted emissions	MIL standard 461-E/MIL standard 461-C

3 Installation and Interconnections

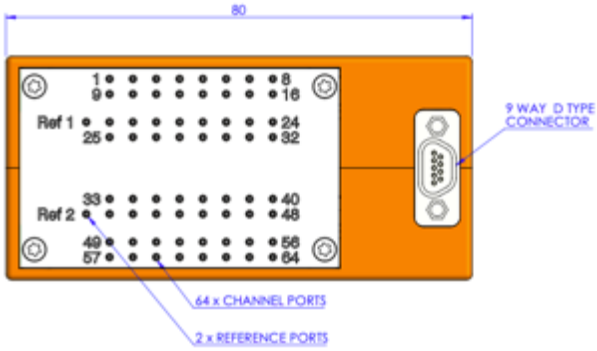
3.1 Electrical Connections

3.1.1 64 channel DC powered versions - 9-way micro-miniature ‘D’ type (suggested mate : Glenair MWDM2L-9PS - solder cup version)



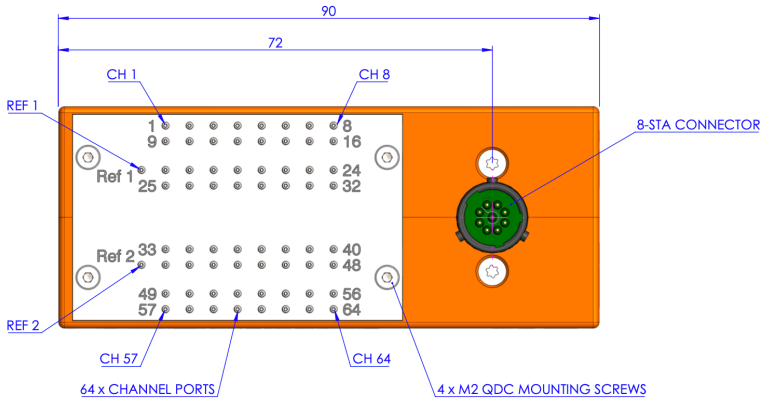
Pin 1	0v
Pin 2	Ethernet Rx+
Pin 3	CAN Low
Pin 4	Ethernet Tx+
Pin 5	+ Supply (8-25 VDC)
Pin 6	Trigger in (TTL)
Pin 7	Ethernet Rx-
Pin 8	Ethernet Tx-
Pin 9	CAN high

3.1.2 64 channel PoE powered versions - 9-way micro-miniature ‘D’ type (suggested mate : Glenair MWDM2L-9SS - solder cup version)



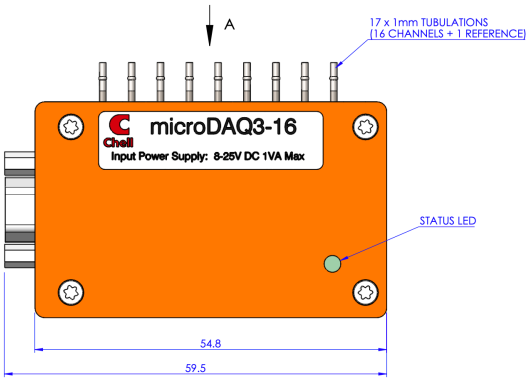
Pin 1	ETH BI_DD+
Pin 2	ETH BI_DA+ (TX+)
Pin 3	n/c
Pin 4	ETH BI_DB+ (RX+)
Pin 5	ETH BI_DC-
Pin 6	ETH BI_DD-
Pin 7	ETH BI_DA- (TX-)
Pin 8	ETH BI_DB- (RX-)
Pin 9	ETH BI_DC+

3.1.3 64 channel DC powered versions - Souriau 8STA0-06-9PN (suggested mate : Souriau 8STA6-06-9SN)



Pin 1	Ethernet Tx+
Pin 2	Ethernet Rx+
Pin 3	Trigger in (TTL)
Pin 4	+ Supply (8-25 VDC)
Pin 5	0v
Pin 6	CAN high
Pin 7	CAN Low
Pin 8	Ethernet Tx-
Pin 9	Ethernet Rx-

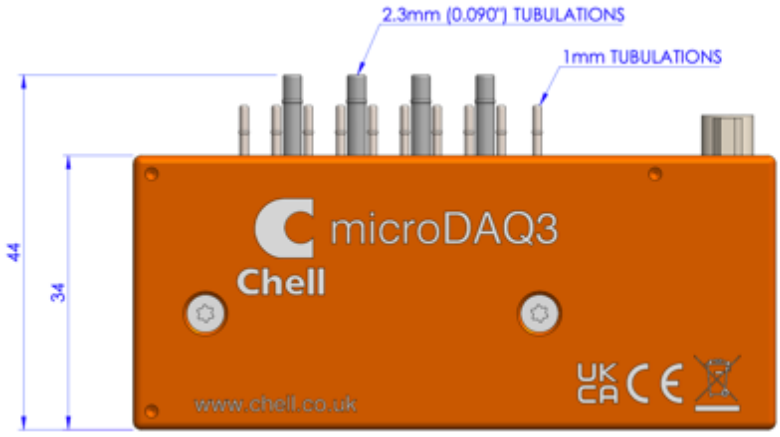
3.1.4 16 channel DC powered versions - 9-way micro-miniature ‘D’ type (suggested mate : Glenair MWDM2L-9PS - solder cup version)



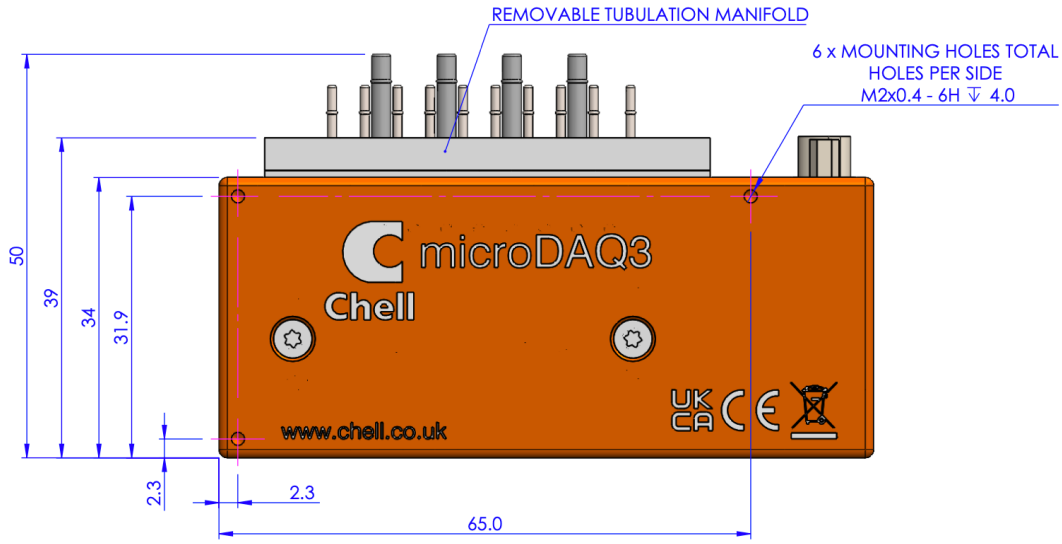
Pin 1	0v
Pin 2	Ethernet Rx+
Pin 3	CAN Low
Pin 4	Ethernet Tx+
Pin 5	+ Supply (8-25 VDC)
Pin 6	Trigger in (TTL)
Pin 7	Ethernet Rx-
Pin 8	Ethernet Tx-
Pin 9	CAN high

3.2 Pneumatic Connections

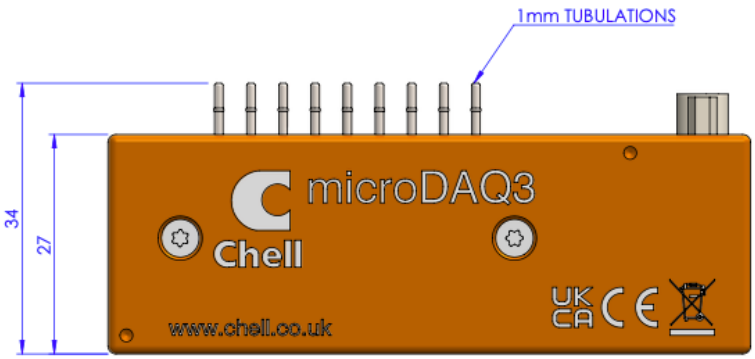
3.2.1 64 channel valved version



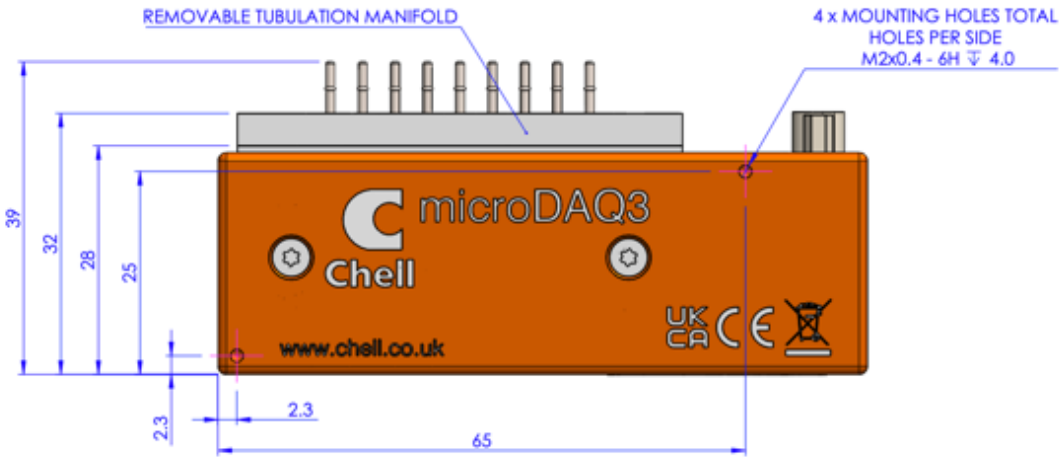
3.2.2 64 channel valved version with quick disconnect plate



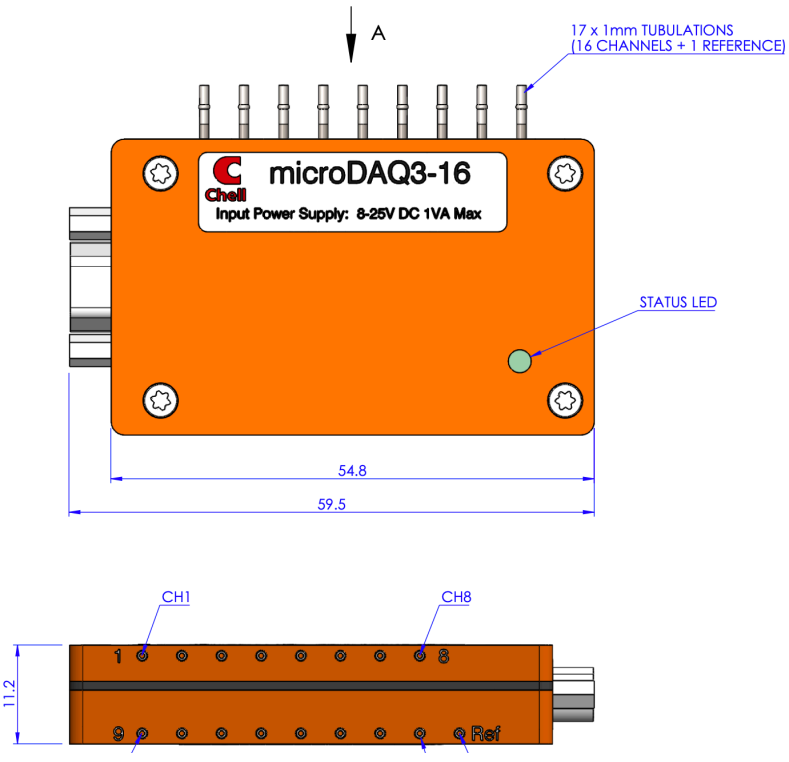
3.2.3 64 channel non-valved version



3.2.4 64 channel non-valved version with quick disconnect plate



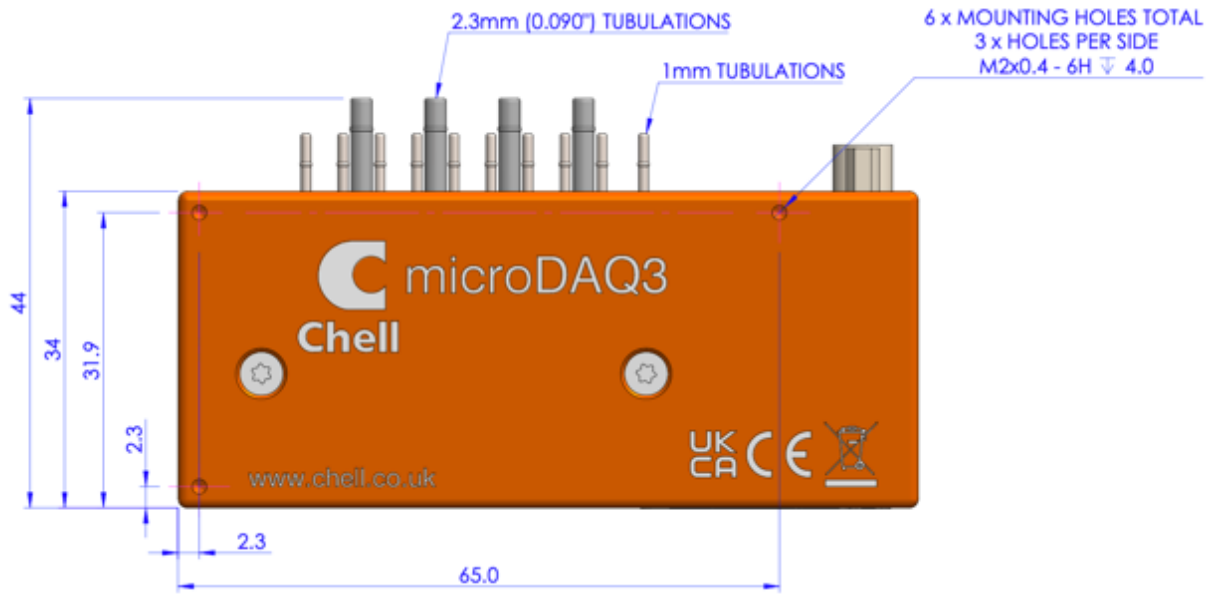
3.2.5 16 channel version



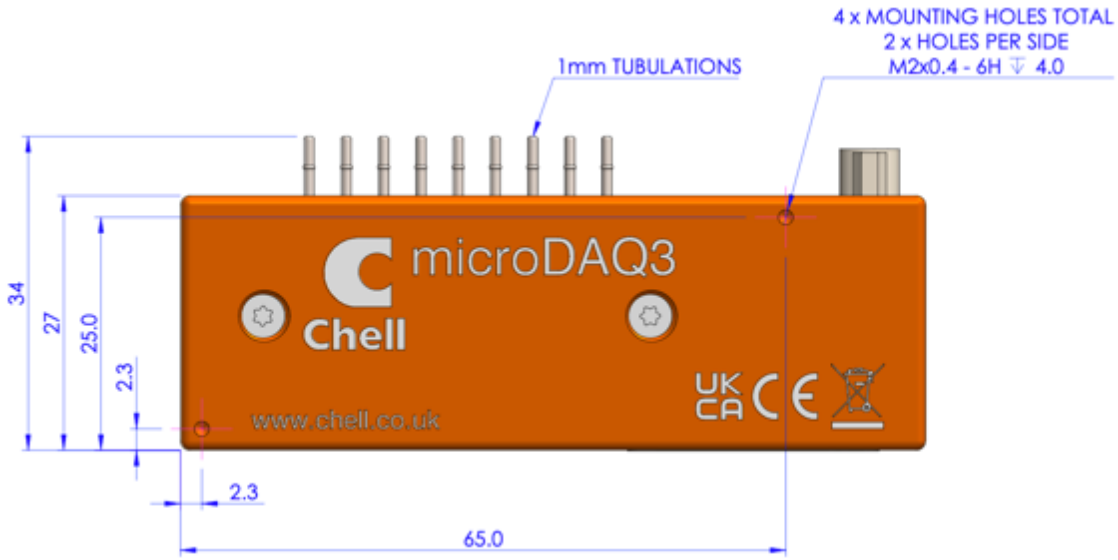
	Hot plugging the power to the microDAQ3 at the connector can cause permanent damage to the unit. Always switch the power at the power supply source.

3.3 Mounting Features

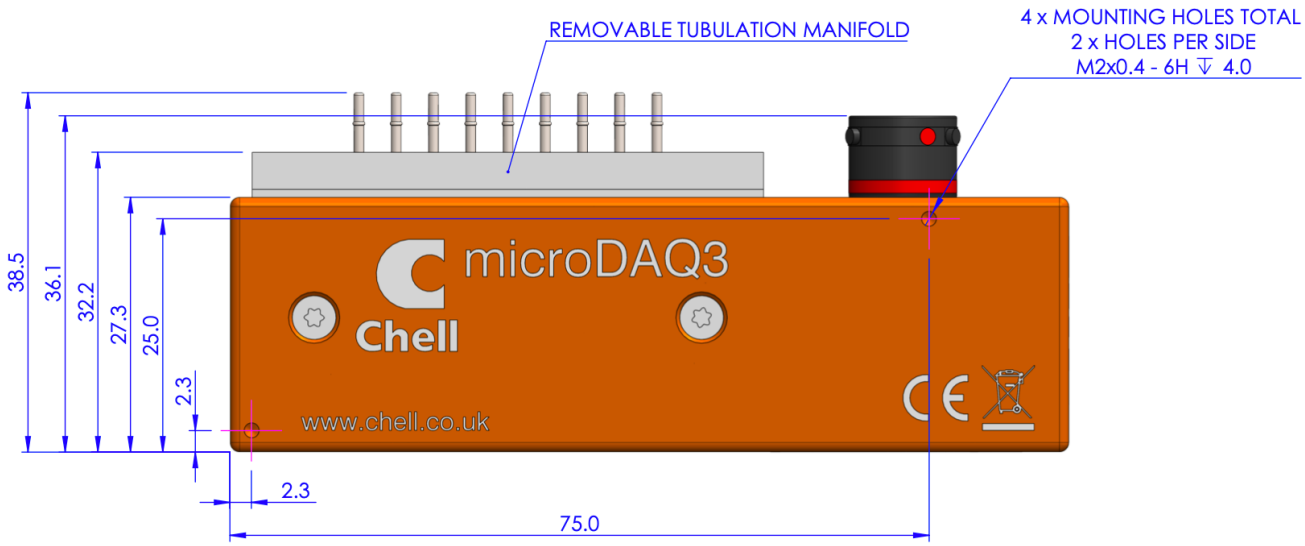
3.3.1 64 channel valved version



3.3.2 64 channel non-valved version

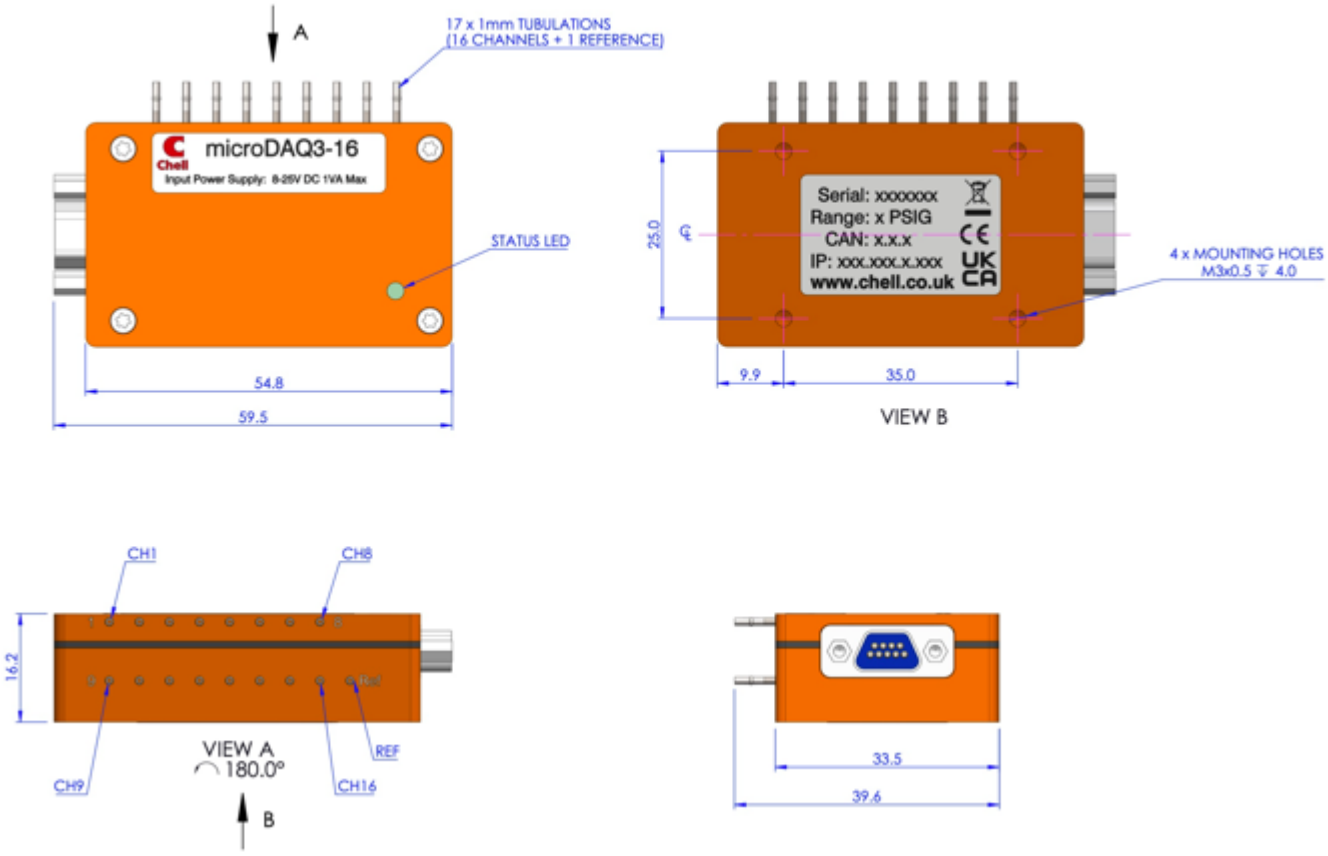


3.3.3 64 channel non-valved 8STA Connector version



3.3.4 16 channel Version

There are no mounting features on the standard microDAQ3-16. There is however an option to purchase the unit with mounting facilities (16MD3-AABB02) as below:



4 Operation of the instrument

4.1 Connecting the microDAQ3

The microDAQ3-64 can be supplied in DC powered versions complete with CAN and hardware trigger or power-over-ethernet (PoE) versions for units that incorporate the valve option. Currently the microDAQ3-16 is only available as a DC version, which includes CAN and hardware trigger.

4.1.1 DC Powered Versions

The microDAQ3 has a single connector, the cable which supplies the unit with power also provides CAN and Ethernet comms. Ensure all the connections are made before powering up the microDAQ3.

The microDAQ3 can be supplied with a cable and interface (microDAQ-INT and microDAQ-INT-4) to make connection to the units straight forward. In this case, connect the cable to the microDAQ3 and interface and then power the unit with the plug-in DC supply (12 Vdc) that is supplied with the interface or via PoE with the RJ45 connector in the case of the microDAQ-INT-4. The Ethernet connection can be made directly from a PC or hub / switch to the RJ45 incorporated in the microDAQ-INT or microDAQ-INT-4.

Alternatively, a user can make their own cable that brings out the Ethernet and DC supply to their own power supply. Care should be taken that the connection are correct or the unit may be damaged.

Upon power up, the blue LED will light constantly while the microDAQ3 boots up. This will typically take around 2 seconds. When the microDAQ3 has finished booting, the blue LED will flash at a constant rate to show that the system is running (unless auto hardware trigger enable has been set – see later).

4.2 Connecting to the microDAQ3

Once the blue LED is flashing, the microDAQ3 can be connected to by any one of the following methods.

[1] By using Ethernet and the embedded web server
[2] By using Ethernet and the Chell microDAQX software
[3] By using Ethernet and custom software
[4] By using CAN and custom software

4.2.1 Connecting to the Webserver

To connect to the internal web server, simply connect the microDAQ3 to a suitable PC and simply type the IP address of the microDAQ3 (found on the label) into a web browser. The web server will allow you to read data (both absolute and differential) as well as view all the configuration options available on the microDAQ3.

We have found that the best results are achieved with the Firefox web browser but it will also work with Edge, Chrome and Safari. We do not recommend using Internet Explorer as we have come across settings options errors with this web browser.

For a PC to successfully connect over Ethernet, the first three parts of the IP address must be the same on the microDAQ3 and the PC that is making the connection. For example, if the IP address of the microDAQ3 is 192.168.1.190, the PC must have an IP of 192.168.1.XXX. Once connection has been made, the IP address can be changed to suit the user's network.

NOTE. If the IP or subnet mask of the microDAQ3 is changed, it must be recorded (we recommend that it is written on a new label) as it will not be possible to connect to the microDAQ3 if these details are not known. In this instance, the microDAQ3 will need to be returned to the factory so the IP address can be reset.

4.2.2 Connecting using the microDAQ-X Software.

Chell supply the microDAQX software free of charge which can be used to view data and save it to disk. It also allows many of the run time configuration settings to be adjusted (such as re-zero and hardware trigger control). See the microDAQX manual for further information (900170-X.X).

When using high data rates, Windows® may require some registry modifications to enable the higher speeds. Please refer to section 4.1.4 in the microDAQ-MK2 and flightDAQ2 user programming guide (900204-X.X) for further details.

4.2.3 Connecting to Custom Software (Ethernet and CAN)

The full command structure for both the Ethernet (TCP and UDP) and CAN may be found in the microDAQ3 user programmers guide (900253-X.X).

4.3 Configuring the microDAQ3

The microDAQ3 is designed to be configured via the embedded web server. Here all the product variables may be changed including IP address, CAN ID, averaging, transmission speed etc. Once these setting are configured, they can be permanently saved by clicking on 'BURN TO EEPROM'. Once the unit is reset, the microDAQ3 will run using these setting.

The microDAQ3 can be configured to output data over CAN or Ethernet (TCP/IP or UDP) and, if configured to do so, it will output this data immediately upon power up. The microDAQ3 can also accept commands over the Ethernet or CAN networks to configure the majority of the internal setting (with the exception of CAN ID, IP address and some lower level functions). Please refer to document 900253 – microDAQ3 user programming guide for available CAN and Ethernet commands and the format of the data output stream.

4.4 Re-zeroing the microDAQ3.

It is possible to re-zero the output of the microDAQ3 for either absolute or differential measurements. This may be necessary if the unit is not sufficiently warmed up or has been subjected to a severe thermal gradient.

The microDAQ3 is re-zeroed by sending the appropriate command over the CAN or Ethernet link via the Chell software or via the embedded webserver. The system will then average a number of zero readings and perform a re-zero. Naturally, there should be no pressure applied to the ports of the scanner when a re-zero is being performed.

When a re-zero is being performed, the red LED will light momentarily. The re-zero value is not stored in volatile memory and will be lost upon reset. By default, the re-zero values are volatile and lost with a power cycle - see section 5.7.3 for permanently saving the zero values if necessary.

5 microDAQ3 Configuration Webserver

5.1 Introduction.

The microDAQ3 web Configuration provides the means of setting up and demonstrating the microDAQ3 unit from a standard PC with an Ethernet port and browser.

The webserver is divided by tabs into five areas of functionality, namely 'Setup', 'Live Data', 'Advanced', 'Timestamp' and 'Factory Tools'.

'Setup Parameters' provides the means to set microDAQ3's main operating parameters such as data streaming rates and Device addresses.

The unit's function may be checked and demonstrated using **'Live Data'** to show the microDAQ3's calibrated output.

'Advanced' provides setup for all other more advance parameters that may require setting on a per application basis.

'Timestamp' provides some options for configuring the timestamping feature of the microDAQ3.

'**Factory Tools'** provides some functionality to change the MAC address of the Ethernet hardware. This tab is password protected and therefore not readily available to everyone and further detail is beyond the scope of this document.

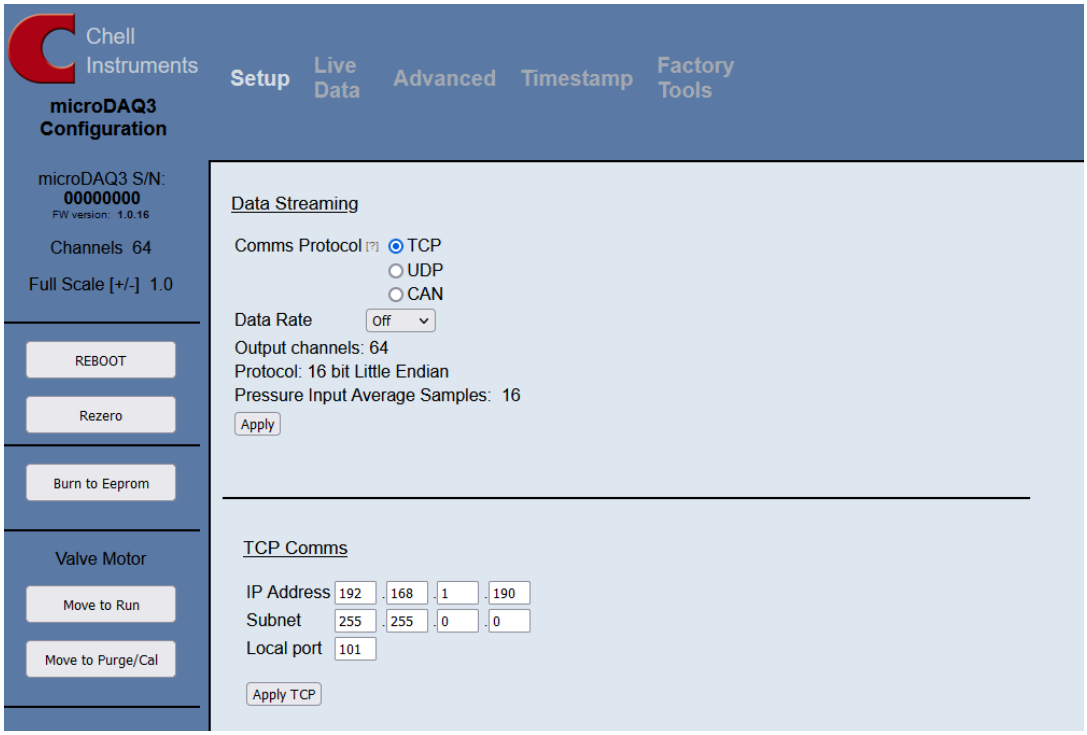


Figure 5.1: Main setup page of valve variant unit

5.2 Common Controls Sidebar

5.3 Controls for all variants

Figure 5.1 shows the first page viewed when navigating to the webserver. It includes the common controls sidebar, shown in Figure 5.2, and the main group of setup parameters. The sidebar provides information on the microDAQ3 unit including serial numbers and current firmware revision along with the configured scanner full scales and total channels. The function of the common controls is detailed in Table 5.1.

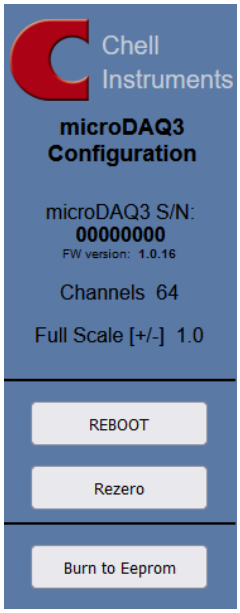


Figure 5.2: Sidebar

Control	Function
'RESET' button	Resets the microDAQ3, similar to power cycling the device. Use to activate new settings and/or rebuild calibration tables.
'Rezero' button	Starts a microDAQ3 rezero operation.
'Burn to eeprom" button	Burns all changes made to the local settings into the eeprom so they can be retrieved upon restart.

Table 5.1: Common sidebar control functions

5.4 Controls for valved variant

Figure 5.3 shows the sidebar panel of a valved microDAQ3 unit, it contains the same standard controls as described in the previous section with the addition of two additional controls for placing the device into its calibration mode and into standard operating mode.

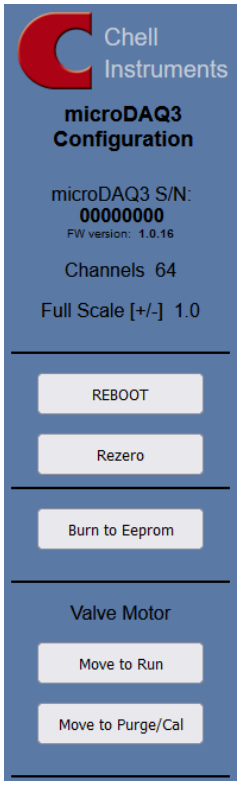


Figure 5.3: Valved variant sidebar

Control	Function
'Run Position' button	Moves the internal shuttle valve so that all measurement ports are connected to each transducer.
'Purge/Cal Position' button	Moves the internal shuttle valve so that all transducers are connected to the 'cal' port and all measurement ports are connected to the purge ports.

Table 5.2: Valved variant specific sidebar control functions

5.4.1 The 'Setup Parameters' Page

5.4.2 Introduction

The 'Setup Parameters' page shows all of the microDAQ3's main operating parameters. Setup Parameters is divided into different categories by function, and each category is detailed separately in the following.

5.4.3 Data Streaming

The 'Data Streaming' section allows the user to change settings that affect all three communication protocols, and allows the user to choose the protocol that is to be used, along with the data transfer rate.

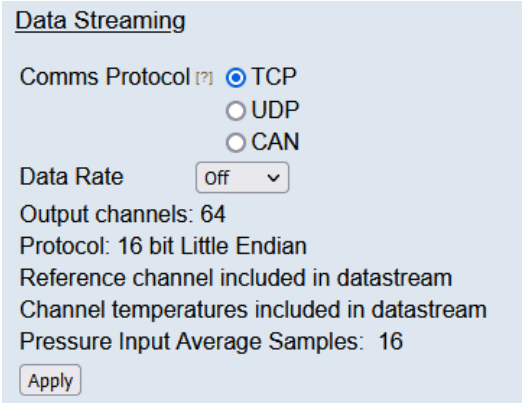


Figure 5.4: Data streaming group

Control	Function
'Comms Protocol' radio button	Chooses the communication protocol that is to be used. This button changes what options are available below it.
'Data Rate' option list	Selects the rate at which the microDAQ3 will automatically transmit data after reset. The maximum data rate available will be dependent on the sensor response setting is selected on the Advanced settings tab.
'Apply' button	Applies the changes made to the local settings memory.

Table 5.3: Data streaming settings

For convince, below the selectable options the current state of the output stream is detailed. This includes: the number of channels output, protocol, whether the reference pressure is output, whether temperatures are also output, and the current number of samples being averaged. These setting may all be changed as required in the 'advanced' tab.

It should also be noted that when changing the data rate specifically from this selector the Pressure input averaging samples are set to the optimum settings based on the requested data rate, the averaging can then be set manually from the advanced page if required.

The maximum measurements per sensor is determined by the sensor response setting that is used, data rates up to and including the selected sensor response frequency may be used.

5.4.4 TCP Parameters

The TCP communication protocol parameters are shown in Figure 5.5. This only shows if the TCP radio button is selected in the data streaming section. The options in this section control the microDAQ3's IP address, subnet mask and Local port.

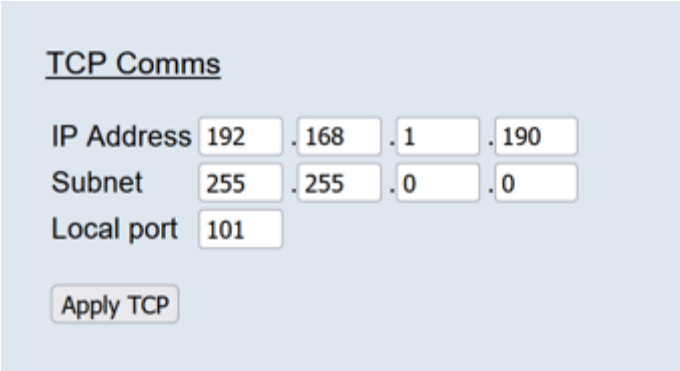


Figure 5.5: TCP comms group

'IP Address'	IP address allocated to microDAQ3 on the user's network.
'Subnet'	Subnet mask as set on the user's network.
'Local port'	Local port of the device.
'Apply TCP'	Applies the settings to the local memory

Table 5.4: TCP comms group settings

5.4.1 UDP Parameters

The UDP section (shown in Figure 5.6) holds all the settings specific to UDP. In UDP mode each acquisition cycle (of 'x' number of channels) is packed as a separate UDP packet with a four-byte representation of the microDAQ3 serial number at the start of the packet. These are attempted to be sent out at the required rate but with no checking for reception or validity of data.
It is also possible to change the output data packet format to IENA specification format by using the check box.
The format of these packets are described more in the user programming guide.

NOTE: The microDAQ3's local UDP IP address is shared with TCP Comms group.

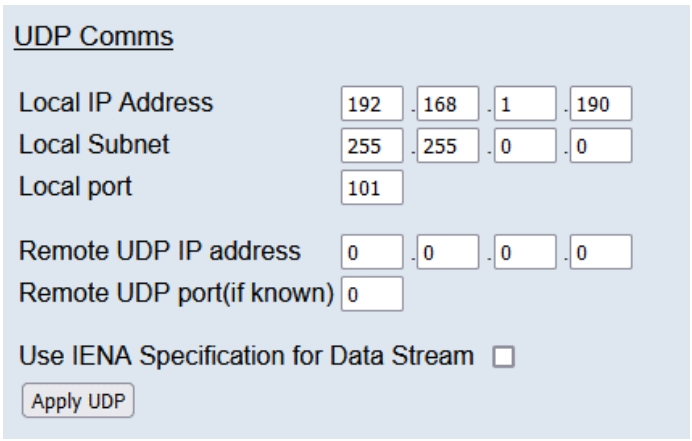


Figure 5.6: UDP comms group

‘Local IP address and subnet’	This displays the IP address of the microDAQ3, this is the same as in the TCP comms section.
‘Local port’	Local port of the device.
‘Remote UDP IP address’.	Address of remote connection to microDAQ3. If set then the microDAQ3 can be set to auto stream data to that remote host on boot up (after initialisation)
‘Remote UDP port.’	Port of remote connection to microDAQ3. If set then the microDAQ3 can be set to auto stream data to that remote host on boot up (after initialisation)
‘Use IENA Specification for data stream’	Changes the format of data output packets to IENA specification.
‘Apply’	Applies the settings to the local settings memory

Table 5.5: UDP Comms group settings

5.4.2 CAN Parameters

The CAN communication settings are shown in Figure 5.7. Options are available to set the base message ID number may be selected, and the offset from this base number for the reception of user commands over CAN, and whether an acknowledgement of these user commands is sent on the next higher message number. Data may be transmitted on either multiple messages, or alternatively on a single message ID, with a selectable delay between messages.

Figure 5.7: CAN comms group

‘CAN First TX Message ID’	microDAQ3 uses standard CAN message arbitration id’s, and the unit is assigned the most significant 2 digits of the Hex base address. For the digits 0x1A0 for example, data for the first 4 channels will be sent on 0x1A0, the next 4 on 0x1A1, etc.
Message scheme/delay	Select ‘Multiple Messages’ for the 4 channels per message, multiple message scheme. Alternatively, data may be packed 3 channels per message + identifier byte, with a selectable delay between messages.
‘CAN RX ID Offset’	Selects the hex offset from the base message ID where microDAQ3 will receive incoming user commands (see user command document). If ‘Ack. Enabled’ is selected, the unit will acknowledge the reception of a correctly formatted command on the message ID calculated as Base ID + RX Offset + 1
‘Apply’	Applies the settings to the local settings memory

Table 5.6: CAM comms group settings

5.5 Live Data Page

Figure 5.8 shows the 'Live Data' page of the webserver when data is selected to be shown as absolute pressures, Figure 5.9 shows the same data displayed as absolute pressures.

Pressure								Temperature							
1	-0.0002	17	-0.0002	33	-0.0002	49	-0.0002	1	37.74	17	37.87	33	37.76	49	37.25
2	-0.0002	18	-0.0002	34	-0.0002	50	-0.0002	2	38.13	18	37.92	34	37.29	50	36.83
3	-0.0002	19	0.0000	35	-0.0002	51	0.0000	3	38.04	19	38.15	35	37.84	51	37.07
4	-0.0002	20	-0.0002	36	-0.0002	52	0.0000	4	38.28	20	37.85	36	37.84	52	37.18
5	-0.0002	21	-0.0002	37	-0.0002	53	-0.0002	5	38.33	21	37.65	37	38.21	53	37.19
6	-0.0002	22	-0.0002	38	0.0000	54	-0.0002	6	37.63	22	37.96	38	37.35	54	36.49
7	-0.0002	23	-0.0002	39	-0.0002	55	-0.0002	7	37.96	23	37.62	39	37.47	55	36.60
8	-0.0002	24	-0.0002	40	-0.0002	56	-0.0002	8	37.77	24	37.47	40	37.11	56	36.67
9	-0.0002	25	-0.0002	41	-0.0002	57	-0.0002	9	37.28	25	37.69	41	36.72	57	37.20
10	-0.0002	26	-0.0002	42	-0.0002	58	-0.0002	10	37.82	26	38.34	42	37.11	58	37.45
11	0.0000	27	-0.0002	43	-0.0002	59	-0.0002	11	37.58	27	38.02	43	37.57	59	37.40
12	0.0000	28	-0.0002	44	-0.0002	60	-0.0002	12	37.84	28	37.91	44	37.22	60	37.13
13	-0.0002	29	-0.0002	45	-0.0002	61	-0.0002	13	37.87	29	38.46	45	37.43	61	37.55
14	-0.0002	30	-0.0004	46	-0.0002	62	-0.0002	14	37.75	30	38.10	46	36.76	62	36.96
15	0.0000	31	-0.0002	47	-0.0002	63	-0.0002	15	37.33	31	38.30	47	37.23	63	37.64
16	-0.0002	32	-0.0002	48	-0.0002	64	-0.0002	16	37.13	32	37.93	48	36.45	64	36.88

Pressure data displayed in **PSI**

(•) Differential Pressure (Eng)

( ) Absolute Pressure (Eng)

Reference Pressure 1	14.5009
Reference Pressure 2	14.5010
Reference Temperature 1 (C)	37.81
Reference Temperature 2 (C)	36.86

Figure 5.8: 64 channel Live Data Page – differential measurements

Pressure								Temperature							
1	14.5007	17	14.5007	33	14.5007	49	14.5007	1	37.90	17	37.96	33	37.74	49	37.22
2	14.5007	18	14.5009	34	14.5009	50	14.5007	2	38.25	18	37.98	34	37.27	50	36.80
3	14.5007	19	14.5009	35	14.5007	51	14.5009	3	38.15	19	38.18	35	37.81	51	37.04
4	14.5007	20	14.5007	36	14.5007	52	14.5007	4	38.36	20	37.85	36	37.79	52	37.15
5	14.5007	21	14.5007	37	14.5009	53	14.5009	5	38.39	21	37.63	37	38.15	53	37.17
6	14.5009	22	14.5007	38	14.5009	54	14.5007	6	37.66	22	37.92	38	37.28	54	36.45
7	14.5007	23	14.5007	39	14.5009	55	14.5009	7	37.98	23	37.54	39	37.38	55	36.55
8	14.5007	24	14.5009	40	14.5007	56	14.5007	8	37.76	24	37.34	40	37.01	56	36.59
9	14.5009	25	14.5009	41	14.5007	57	14.5007	9	37.40	25	37.80	41	36.71	57	37.15
10	14.5009	26	14.5007	42	14.5009	58	14.5009	10	37.92	26	38.41	42	37.08	58	37.41
11	14.5009	27	14.5009	43	14.5009	59	14.5009	11	37.64	27	38.07	43	37.54	59	37.37
12	14.5009	28	14.5007	44	14.5009	60	14.5007	12	37.88	28	37.93	44	37.18	60	37.11
13	14.5009	29	14.5009	45	14.5009	61	14.5009	13	37.90	29	38.45	45	37.38	61	37.52
14	14.5007	30	14.5009	46	14.5009	62	14.5009	14	37.76	30	38.06	46	36.70	62	36.92
15	14.5007	31	14.5009	47	14.5009	63	14.5007	15	37.33	31	38.22	47	37.16	63	37.57
16	14.5009	32	14.5007	48	14.5007	64	14.5007	16	37.11	32	37.79	48	36.37	64	36.78

Pressure data displayed in **PSI**

( ) Differential Pressure (Eng)

(•) Absolute Pressure (Eng)

Reference Pressure 1	14.5010
Reference Pressure 2	14.5011
Reference Temperature 1 (C)	37.96
Reference Temperature 2 (C)	36.87

Figure 5.9: 64 channel Live Data Page – absolute measurements

The live data page is a means to demonstrating the correct operation of microDAQ3 and testing the unit's calibration. A value label is shown for each channel with 1-64 (1-16 for the 16 channel variant) for both the temperature and the pressure data.
There is also both of the reference channels pressure and temperature value at the bottom of the page (a single reference for the 16 channel variant).

The pressure data can be in either BAR, PSI or Pa (Pascals), this is decided on the advanced page, but is displayed on the top right of the live data page for convenience.
The type of value shown in the labels may be selected by means of the option buttons in the righthand frame. These are as follows:

- Differential Pressure (Eng) — Calibrated engineering units pressure value scaled to known full scale and relative to the reference port or ports depending on the setting from the advanced page.
- Absolute Pressure (Eng) — As above, except represented as an absolute.

Values are updated automatically, once every 500ms, with the default view being Differential Pressure (Eng).

NOTE: The selection of differential or absolute pressures on this page or for diagnostics only. This setting does not affect the main output stream configuration (see “Advanced Data Stream Settings” section).

5.5.1 ‘Live Data’ Page Valve Position Descriptor

For valved variants of the microDAQ3 the current position of the valve is described below the reference channels. This will indicate whether the valve is in the position that each channel is fed by its individual tubulation (Run) or the position in which all channels are fed from a common tubulation (Purge/Cal).

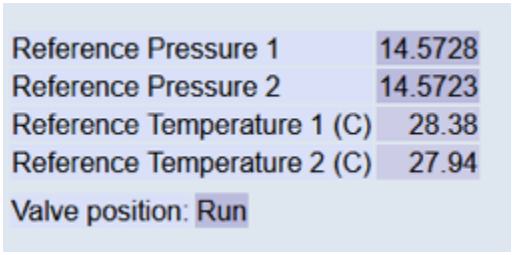


Figure 5.10: Current valve position display on 'Live Data' page

5.6 ‘Advanced’ Page

The advanced tab contains extra options that users may find useful for more exact configuration but are not compulsory.

5.6.1 Advanced Data Stream Settings

The advanced data stream settings section contains options for modifying the data format of the output stream.

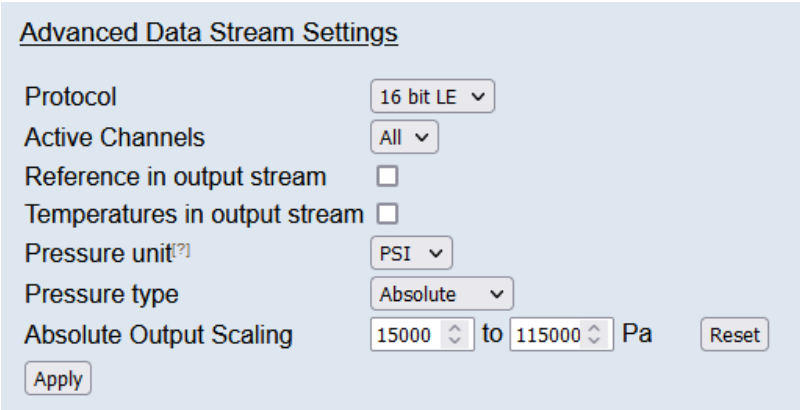


Figure 5.11: Advanced data steam settings group

Control	Function
Protocol	Selects the network byte order in which the data stream will be transmitted, options are 16 bit LE, and 16 bit BE which will apply to all protocols except IENA.
Active Channels	Sets the number of channels transmitted in data stream (excluded on 16 channel variant). The first X channels are used (e.g. when selecting 16 on a 64 channel unit, channels 1 to 16 are transmitted)
Reference in output stream	If checked, the reference pressure in the current absolute output format will be appended after each of the active channels.
Temperatures in output stream	If checked, after all transmitted pressures, active and reference (if enabled), the temperature of each of those channels are sent. (Does not apply to CAN)
Pressure unit	Selects the unit for pressures output in the IENA packet format as well as the units displayed on the 'Live Data' webserver page.
Pressure type	Sets the pressure type (Absolute or Differential) of non-reference channel data in the output stream.
Absolute Output Scaling	Sets the minimum and maximum values (in Pascals) for the scaled 16bit output representation of Absolute data (Not relevant for engineering unit float outputs such as IENA protocol) Example: When set to 15000 to 115000 Pa, a channel with a 16bit value of 0 represents a pressure less than 15000Pa, a 16bit value of 65535 represents a pressure greater 115000 Pa, values in between are linearly scaled between the two values.

Table 5.7: Advanced data stream settings

5.6.2 Advanced communication settings

The microDAQ3 has extra communication variables that may help get a more precise connection between the microDAQ3 and the PC.

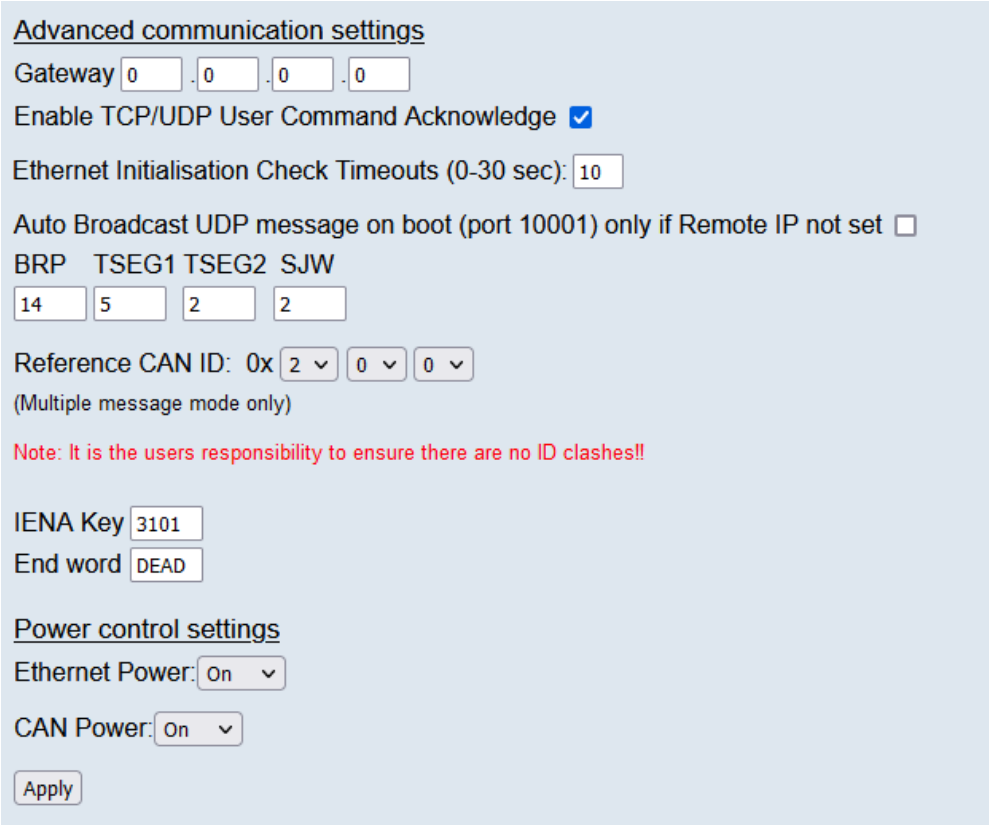


Figure 5.12: Advanced comms group

Control	Function
Gateway	Allows the microDAQ3 gateway address to be changed.
Enable TCP/UDP User Command Acknowledge	Turns on or off acknowledge bytes from commands sent via TCP or UDP.
Auto Broadcast UDP message on boot	If checked, auto broadcasts a UDP message on port 10001 on start-up which details the microDAQ3's serial number, IP address, etc. in an ASCII, comma separated list. (should not be used if remote UDP address/port has been configured and auto streaming has been set – via TCP rate on Standard tab)
BRP, TSEG1, TSEG2, SJW	Register values for the CAN module within the microDAQ3's microcontroller.
Reference CAN ID	Sets the CAN message ID used for reference channel output
IENA key	This changes the key word at the start of an IENA data packet.
End Word	This changes the IENA END word at the end of an IENA packet.
Ethernet power	Turns the Ethernet power Phy to 'Off', 'On' or 'Auto'. This setting can be used to save power and reduce device temperature.
CAN power	Turns the CAN transceiver to 'Off', 'On' or 'Auto'. This setting can be used to save power and to reduce device temperature.

Table 5.8: Advanced comms settings

5.6.3 Miscellaneous

The remaining parameters are edited via the Miscellaneous group shown in Figure 5.13. The microDAQ3 allows the user to change the pressure unit and type output in the data stream

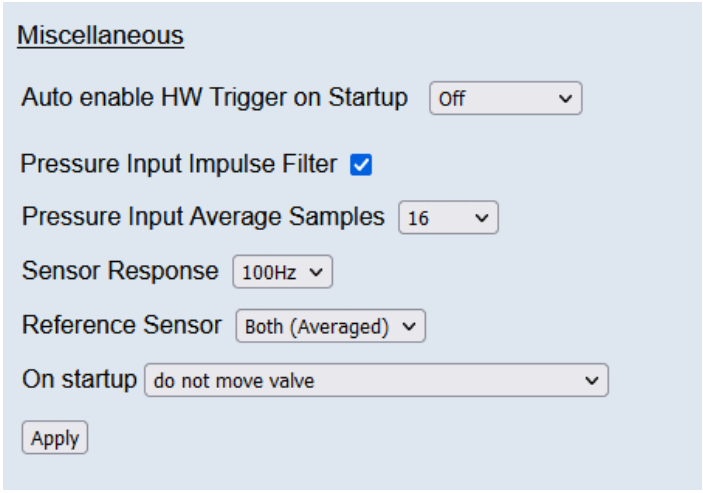


Figure 5.13: Miscellaneous group

'Auto enable HW trigger on start-up' dropdown	If set to anything other than Off, the microDAQ3 will immediately switch to hardware trigger mode, waiting for the first trigger pulse, after initialisation. The dropdown indicates the comms protocol used to send acquired data during triggering.
'Pressure input impulse filter'	Applies median filter to pre-calibration data – will remove single impulse noise events in the pressure data.
'Pressure input average samples'	Selects the number of samples for a moving average of pre-calibration data.
'Sensor Response'	Select the internal filtering and oversampling of the transducer. This will determine the maximum data output rate.
'Reference Sensor' (64 channel variants only)	Select which of the reference channels will be use, if both is selected the two channels will be averaged and used instead.
'Apply'	Applies the settings to the local settings memory
'Valve power on action' (valved variants only)	Valve action to take upon power up: 'do not move valve', the valve will stay put. 'move valve to Run', the valve will be shuttled into the 'Run' position. 'move valve to Purge/Cal, the valve will be shuttled into the 'Purge/Cal position. 'move valve to Run in invalid', the valve will be shuttled into the 'Run' position if not already in 'Run' or 'Purge/Cal'. 'move valve to Purge/Cal if invalid', the valve will be shuttled into the 'Purge/Cal' position if not already in 'Run' or 'Purge/Cal'.

Table 5.9: Miscellaneous group settings

5.6.4 Zero Coefficients

The Zero coefficients for the linear cal. are displayed as a separate group at the bottom of this page. These values are the current zero offsets generated when the device is re-zeroed. The units of the displayed zero offsets are internal scanner bits.

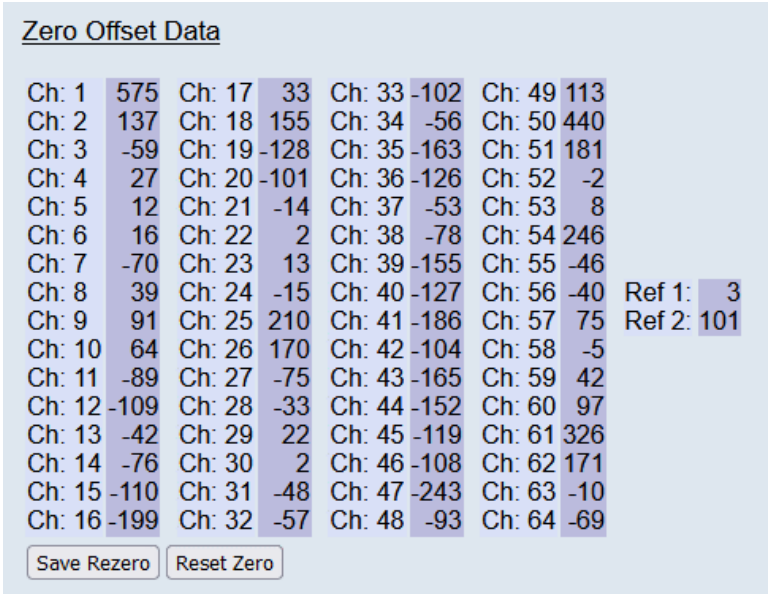


Figure 5.14: 64 channel zero coefficients group

'Save Rezero'	Saves the Rezero values to the eeprom
'Reset Zero'	Clears the current zero offsets to 0 and saves them to eeprom

Table 5.10: Zero offset controls

5.6.5 Span Coefficients (microDAQ3-64 variant only)

Currently the Span Coefficients are only available on the 64 channel variant of the microDAQ3.

To perform a user span calibration, first apply the displayed pressure to all channels including reference channels, then click "Take Span" to capture coefficients. Once the values are displayed, they will be applied to the output pressures.

In order to store these values to eeprom so they can be retrieved on subsequent power on cycles, press the "Save Span" button, once successfully burnt into memory red text will appear below the buttons stating "Span offsets saved to eeprom".

To clear any existing coefficients and return them to 100%, simply press the "Reset Span" button, this will also burn them to eeprom automatically.

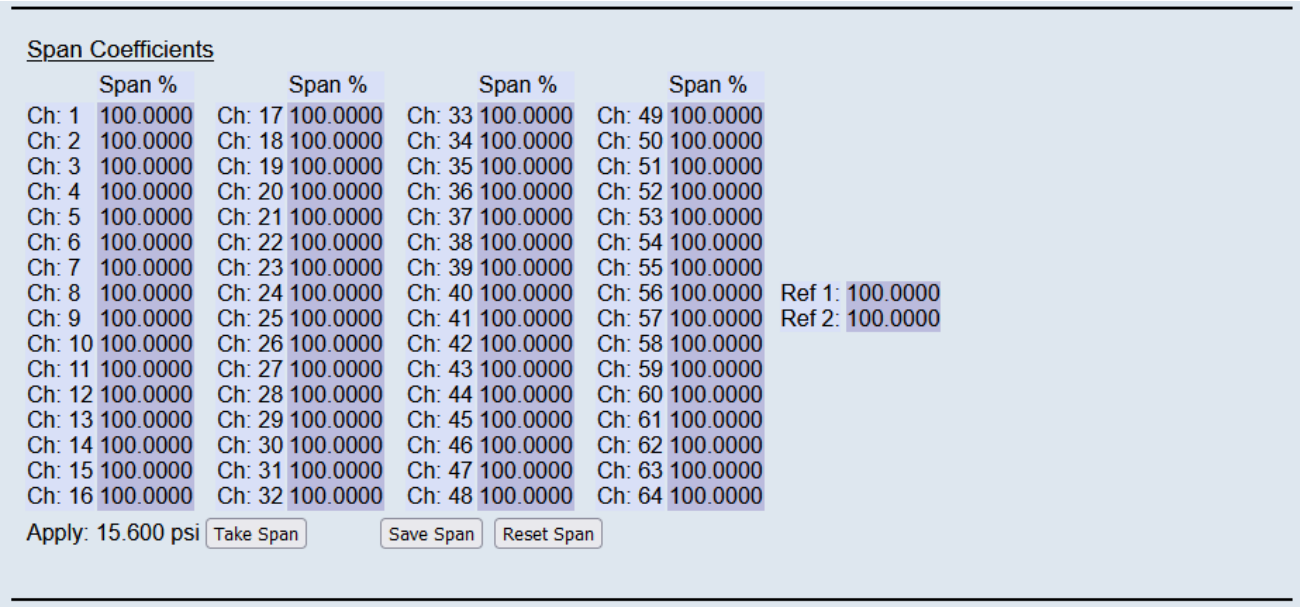


Figure 5.15: 64 channel span coefficients group

'Save Rezero'	Saves the Rezero values to the eeprom
'Reset Zero'	Clears the current zero offsets to 0 and saves them to eeprom

Table 5.11: Zero offset controls

5.6.6 Valve Shuttle Count (valve variant only)

The Valve shuttle count indicates the number of times that the valve has moved from the Run position to Purge/Cal then back to Run.

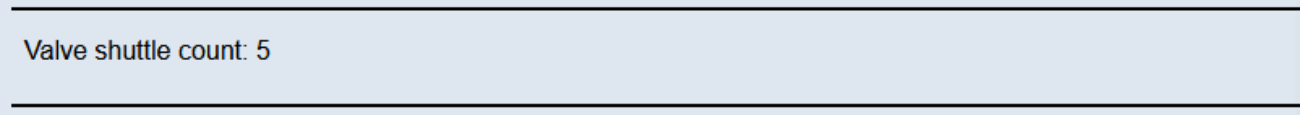


Figure 5.16: Valved unit shuttle counter

5.6.7 Flash over Ethernet

The flash over ethernet feature allows a user to update their device with firmware provided by Chell using a software application.
The user should not interact with this section unless they are already in possession of a new firmware file and understand how the update is to be deployed.

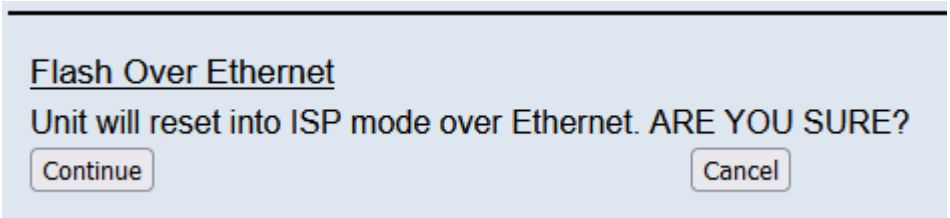


Figure 5.17: Flash over Ethernet mode entry confirmation

5.7 Timestamp

This page allows the user to edit the timestamp settings of the microDAQ3. This timestamp will allow the user to get up to nanosecond level accurate timestamps on the data packets. If the timestamp is enabled it may have an effect on the maximum transmission rate.

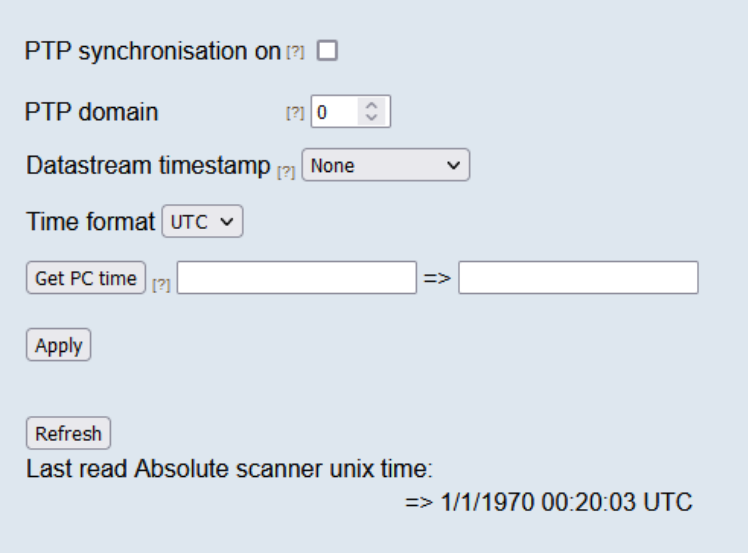


Figure 5.18: Timestamp options

"PTP synchronisation on" checkbox	This allows the user to select whether any timestamps that may be added to the data stream are PTP synchronised or not. Please note this will only work if there is a PTP grandmaster clock on the same network as the microDAQ3.
"PTP domain"	This allows the user to select the domain used by PTP, configuring a domain value allows multiple clock distributions on the same network. The default PTP domain is 0. (Currently available on 16 channel variants only)
"Data stream timestamp"	The user can use this to select where the timestamp is positioned in the data stream, either none which will turn the timestamp off, start of cycle which will place a timestamp at the beginning of all the channels and every channel which will read the timestamp for every channel. It should be noted that the latter 2 options will reduce the maximum transmission speed due to the increased bandwidth required. This has no effect when using the IENA protocol
"Timestamp subsecond units"	The user may specify the units used for the subsecond part of data timestamps that are output. This has no effect when using the IENA protocol (Currently available on 64 channel variants only)
"Time format"	Selects the time format of output time, currently selecting UTC will offset timestamps from TAI by 37 microseconds. This does not affect timestamps when using the IENA protocol, as these are always microseconds from 1st January of the current year
"Get PC time"	This button allows the user to get the timestamp from the PC time of the PC they are using. This can be used as a base time for the timestamps if the user is not using PTP. In the first box it will show the timestamp and in the second box it displays the timestamp converted date/time to make it easier to understand. NOTE the user must click apply to send the timestamp to the microDAQ3
"Apply"	This button will apply the settings chosen on this page.
"Refresh"	This allows the user to refresh the displayed value of the last read timestamp from the microDAQ3.
"Last read UNIX time"	The top line shows the current time in the microDAQ3

Table 5.12: Timestamp options

6 Timing and The Acquisition Cycle

6.1 The microDAQ3 Acquisition Cycle

All the high resolution transducers within the microDAQ3 are read, calibrated and compensated within 2.5 ms on a 37.8 μs interval. The channels are read successively from 1 to 64, Reference 1 and then Reference 2 (1 to 16 then reference on the 16 channel variant). If the start of cycle time stamp option is selected then the time of channel 1's acquisition is transmitted with the data (as shown in blue below). If 'every channel' is selected as the time stamp and the times transmitted with the data will be 37.8 μs apart as shown in orange below.

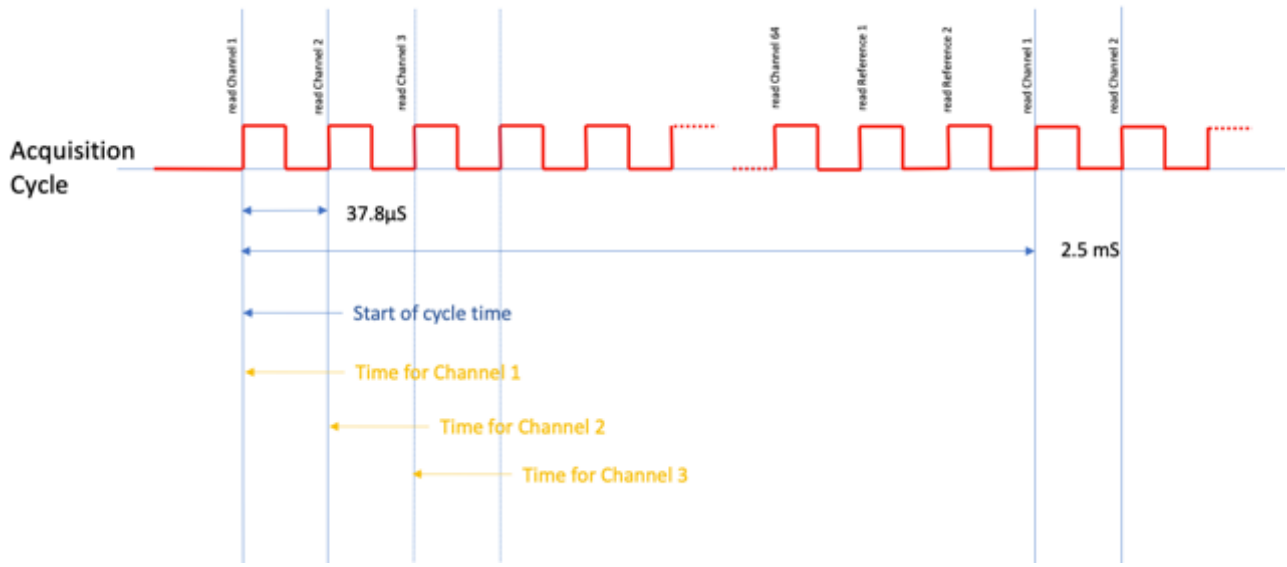


Figure 6.1: microDAQ3 acquisition cycle

6.1 Sensor Response Modes

The microDAQ3 offers a range of oversampling options that will reduce noise at the expense of reducing the maximum acquisition frequency. These sensor modes are:

400 Hz
200 Hz
100 Hz
50 Hz

In order not to compromise bandwidth, it is important to select a mode that is as fast or faster than the maximum speed you wish to acquire at. The signal to noise of the data can be further enhanced by adding a running average.

6.2 The microDAQ3 Data Output Cycle

The output data rate of the microDAQ3 can be configured separately and is disconnected from the acquisition cycle. The user can select the data rate they require and the microDAQ3 will output at this data rate upon power-up.

The example below shows a microDAQ3 configured in 400 Hz mode but with a 100 Hz data rate. Here, every 4th set of channel data will be selected from the acquisition buffer and transmitted over Ethernet or CAN.

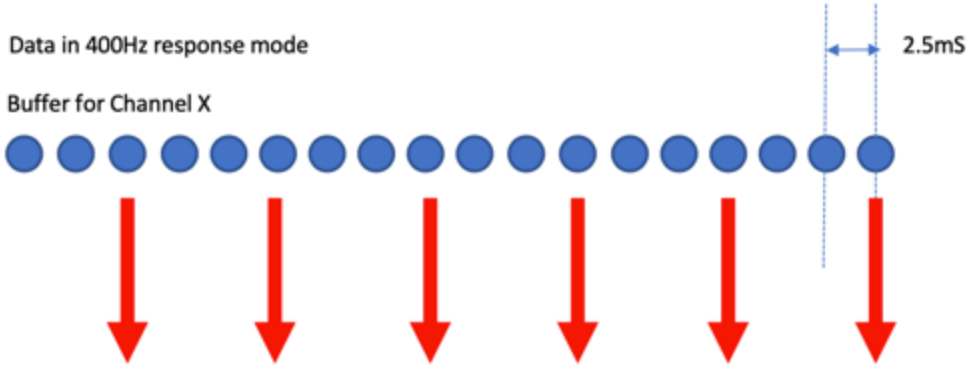


Figure 6.2: microDAQ3 output data cycle at 100Hz

6.3 Averaging

The microDAQ3 provides the option to add a running average to the output data cycle to further improve the signal. This allows the microDAQ3 to acquire at high speed and have the data internally average to improve the signal to noise and the result transmitted at a lower speed (and therefore consuming less network bandwidth).

The example below shows a microDAQ3 configured in 400Hz mode but with a 100Hz data rate. Here, the last channel measurements will be averaged together and then output at 100 Hz over Ethernet or CAN.

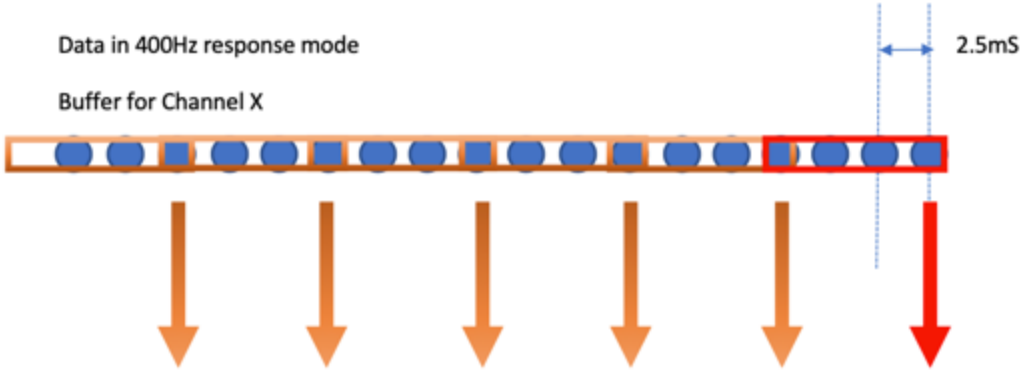


Figure 6.3: microDAQ3 output data cycle at 100Hz with 4 sample average

6.4 Averaging and Time Stamping

When a running average is selected, it should be noted that the time stamp for that data set is that of the last measurement that is added to the averaging buffer.

7 Hardware Trigger

The microDAQ3 features a hardware trigger to enable the user to synchronise multiple microDAQ3's and to calculate the timing of the measurements made. The hardware trigger takes the form of a pulse train. Each time the microDAQ3 receives a positive edge, it will generate a set of measurements for all the channels configured in the system.

7.1 Hardware Trigger Input.

The hardware trigger input is a 5 V TTL square wave pulse train. Minimum frequency 2Hz and maximum frequency 400 Hz.

7.2 Timing Information

The hardware trigger allows the user to calculate the time of each measurement. For example, if the hardware trigger were running at 100Hz then the user would receive 100 measurements per channel per second. The first pulse would generate the first set of measurements and 10 ms later the second pulse would generate the second set and so on. When the hardware trigger is activated, the microDAQ3 will wait for the first pulse. The time that this first pulse is generated can be measured by the user and therefore the time of the first set of data and all subsequent sets can be determined.

7.3 Web server control

Section 5.7.2 includes the 'enable H/W trigger on start up function'. With this enabled and saved to EEPROM, every time the microDAQ3 boots up, it will not acquire data but instead wait for a valid hardware trigger. In this instance, the blue LED will NOT flash when the microDAQ3 boot up.

7.4 Software Control

The hardware trigger mode is activated by the T command over the CAN or Ethernet interfaces. The T command can be used to enable the hardware trigger that will cause the microDAQ3 to stop free-running and wait for the first pulse. The disable command will return the microDAQ3 to free-running. The command structure is as follows:

Command	Interface	On / Off
T01	CAN	Off
T11	CAN	On
T02	Ethernet	Off
T12	Ethernet	On

Table 7.1: Hardware trigger commands

The hardware trigger can also be set to auto enable on power up which means that the microDAQ3 will not go into free-running mode after initialisation and will instead wait for the first hardware trigger pulse. In this instance the blue LED will not flash at a constant rate after initialisation and will remain off instead. This feature can be enabled/disabled from the embedded webserver configuration.

7.5 The Hardware Trigger and System Timing

When the microDAQ3 hardware trigger is enabled, the microDAQ3 will pause and wait for a hardware trigger. When it is received, the microDAQ3 will acquire data from channel 1 and then continue the acquisition cycle as normal. When all 64 (16 for the 16 channel variant) channels and the reference(s) are acquired, the microDAQ3 will then wait again for the next hardware trigger. Please note the minimum and maximum speeds associated with the hardware trigger.

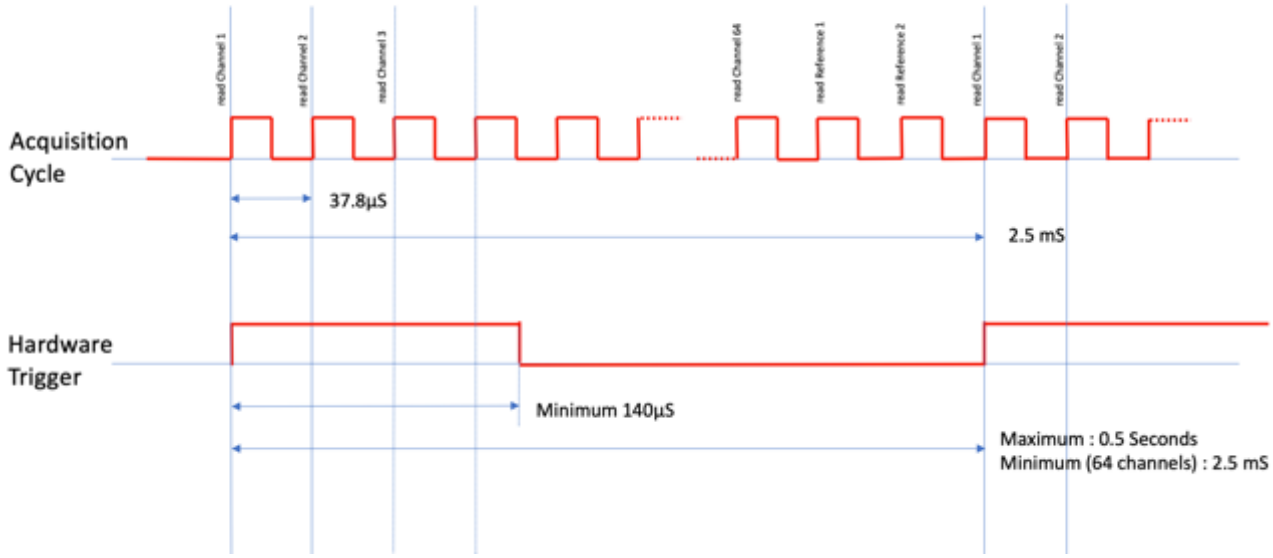


Figure 7.1: microDAQ3 hardware triggered acquisition

8 Service and Calibration

8.1 Service

There are no user serviceable parts inside the instruments. Should any difficulties be encountered in the use of the microDAQ3, it is recommended that you contact Chell Instruments Ltd for advice and instructions.

8.2 Calibration

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

8.3 Adjustment

There are no user adjustments in the instrument. The user is strictly forbidden from removing the covers without invalidating Chell's obligations under warranty.

8.4 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.

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