Q-Daq
Pressure Scanner
Acquisition System

INSTALLATION
AND
OPERATING MANUAL

Cover models : Q-Daq PoE and
Q-Daq DC

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

900223-1.0

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.**

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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.

CONTENTS

1 Description

1.1 General

The Q-Daq is a self-contained pressure scanner that acquires and transmits pressure data to a host via Ethernet or a CAN bus. The Q-Daq is mechanically based on the Chell SQDC range giving the user the ability to connect it to an existing SQDC loom or, with the appropriate mating half, connect the Q-Daq to flexible or solid tubing.

The Q-Daq range consists of two of models which are covered by this manual. These are the Q-Daq PoE with is powered by Power over Ethernet (PoE) and features an M12 connector. This variant of the Q-Daq does not have the facility for CAN communications or hardware trigger. The DC powered version (D-Daq DC) does have the CAN and hardware trigger facility and is powered by a DC voltage of 8 to 25 VDC.

Both devices have the ability to output absolute pressures or differential pressures. When differential pressures are required, one of the 16 transducers is selected as the reference and subtracted from the other 15 measurements.

Both Q-Daq models have a built-in heater which can be controlled via the web interface. The heater is capable of maintaining a temperature of around 30°C above ambient and it can be set to control any given temperature from -55°C to 70°C.

The Q-Daq is configured by using its embedded web-server. The output 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 (compliant with IEEE1588 PTP v2).

This manual revision covers firmware version 1.0.0 PoE.

2 Specifications

2.1 PoE Specification

802.3af/bt Class 3 10W maximum

2.2 Power Supply (Q-Daq DC Only):

Line voltage:	8-25 VDC
Absolute Max. Line voltage	25 VDC
Consumption:	Max 1VA

2.3 CAN specifications (Q-Daq DC only):

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 (provisional)	100 mbar abs or nominally 52000 ft
Vibration (provisional)	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

2.6 Mechanical specifications.
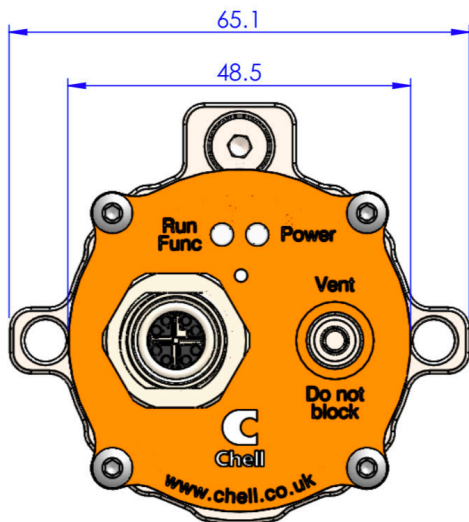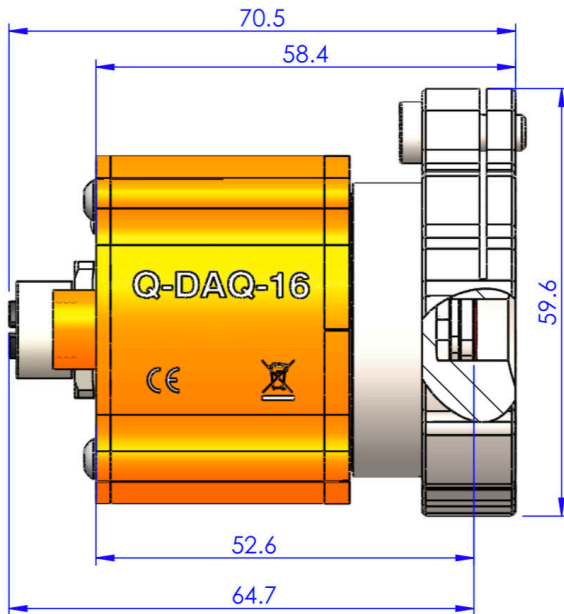
Pneumatic interface:	16 way SQDC male – will interface with:
	SQDC-R-16-01 to SQDC-R-16-07
Weight :	340g
Environmental sealing:	IP67

2.7 Heater Specifications

Controlable between -55 and 70°C (via Webserver). 7.5 watts power.

2.6 Dimensions

2.6.1 Q-Daq-PoE

3 Installation and Interconnections

3.1 Electrical connections

3.1.1 Q-Daq PoE Electrical connections (M12 connector)
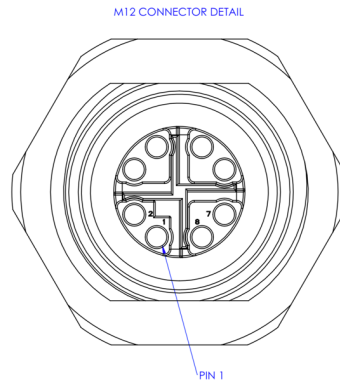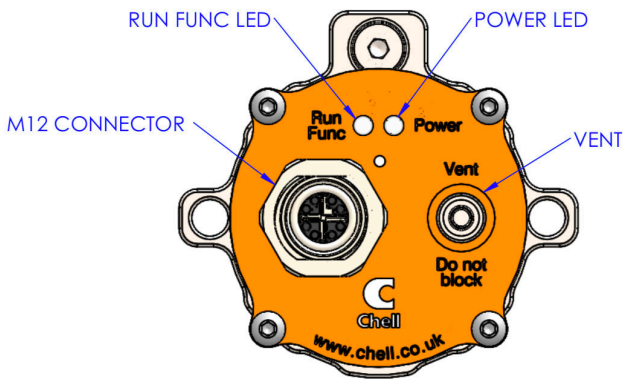
Pin	Function
1	MDX0+
2	MDX0-
3	MDX1+
4	MDX1-
5	MDX3+
6	MDX3-
7	MDX2+
8	MDX2-

> ⚠ **Hot plugging the power to the Q-Daq at the connector can cause permanent damage to the unit. Always switch the power at the power supply source.**

3.2 Q-Daq Pneumatic Connections
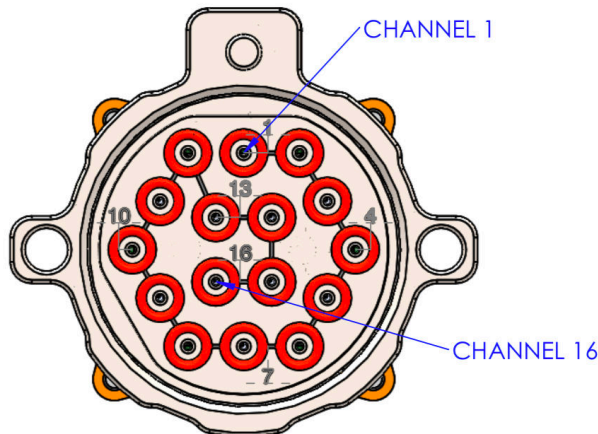
For Details on the SQDC interface, please refer to the SQDC data (SL00914.pdf) sheet and manual (90014723.pdf)

4　Operation of the instrument

4.1　Connecting up the Q-Daq.

The Q-Daq has one connector and cable which supplies the unit with power and also provides CAN (Q-Daq DC only) and Ethernet comms. Ensure all the connections are made before powering up the Q-Daq. **The Q-Daq should not be hot plugged with the power connector. Doing so can cause permanent damage to the unit. Always switch the power at the power supply source.**

Upon power up, the blue LED will light constantly while the Q-Daq boots up. This will typically take around 2 seconds. When the Q-Daq 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).

To connect to the Q-Daq, establish an Ethernet connection to the Q-Daq using the appropriate cables and check that the necessary link lights are lit. The host PC must have an i/p address in the same range as the Q-Daq. For example, if the Q-Daq had an i/p address of 192.168.1.190 then (depending on the subnet mask used) the first three octets of the subnet mask should be the same – i.e. 192.168.1.XXX. Once the connection has been established, the i/p address can be changed and the Q-Daq connected to the user network.

NOTE: If the i/p address is changed, it is very important that a record is made of the new i/p address as it cannot be ascertained without returning the unit to Chell Instruments.

4.2　Configuring the Q-Daq

The Q-Daq is designed to be configured by using the embedded web server. Here all the product variables may be changed including i/p address, CAN i/d, 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 Q-Daq will run using these setting.

The Q-Daq can be configured to output data over CAN (Q-Daq DC only) or Ethernet (TCP/IP or UDP) and, if configured to do so, it will output this data immediately upon power up. The Q-Daq can also accept commands over the Ethernet or CAN networks to configure the majority of the internal setting (with the exception of CAN i/d, i/p address and some lower level functions). Please refer to document 900222 – nanoDaq-LT user programming guide for available CAN and Ethernet commands and the format of the data output stream.

4.3　Re-zeroing the Q-Daq.

It is possible to re-zero the output of the Q-Daq for either absolute or differential measurements.

The Q-Daq 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. See section 5.5.4 for permanently saving the zero values if necessary.

4.4 Hardware Trigger (Q-Daq DC only)

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

4.4.1 Hardware Trigger Input (Q-Daq DC only)

The hardware trigger input is a 5V TTL square wave pulse train. Minimum frequency 2Hz and maximum frequency 180KHz.

4.4.2 Timing Information (Q-Daq DC only)

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 10ms later the second pulse would generate the second set and so on. When the hardware trigger is activated, the Q-Daq 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

4.4.3 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 Q-Daq to stop free-running and wait for the first pulse. The disable command will return the Q-Daq 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

The hardware trigger can also be set to auto enable on power up which means that the Q-Daq 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 actually turn off. This feature can be enabled/disabled from the embedded webserver configuration.

5 Q-Daq Configuration Webserver

5.1 Introduction.

The Q-Daq web Configuration provides the means of setting up and demonstrating the Q-Daq 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 Q-Daq'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 Q-Daq's calibrated output.

'Advanced' provides setup for the 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 Q-Daq.

'**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

5.2 Common Controls Sidebar

Figure 5.1 above shows the first page viewed when navigating to the webserver. It includes the common controls sidebar and the main group of setup parameters. The sidebar provides information on the Q-Daq 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 the subsequent table (Table 5.1)

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

Table 5.1, Common sidebar control functions.

Figure 5.2, Sidebar

5.3 The 'Setup Parameters' Page

5.3.1 Introduction

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

5.3.2 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.
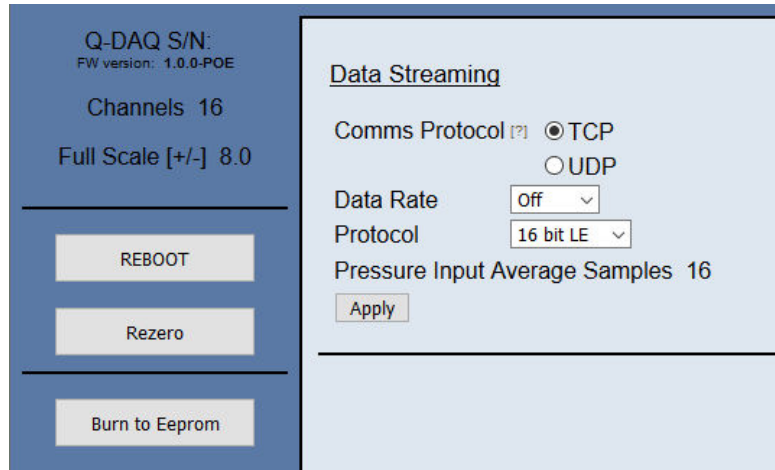

Figure 5.3, Data Streaming group

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 Q-Daq will automatically transmit data after reset. The maximum data rate available will be changed by which Oversampling rate is selected.
'Protocol' option list	Selects the format that the data will be transmitted as, options are 16 bit LE, 16 bit BE for all protocols and eng. units as an extra option for TCP and UDP Comms.
'Apply' button	Applies the changes made to the local settings memory.
Pressure Input Average Samples	Displays the number of samples used for deriving the average pressure.

Table 5.2, Data Streaming settings.

Note that selecting Engineering Units for a protocol will cause the scanner addressing rate to be reduced; it is better to scale calibrated 16 bit data to engineering units within the client software.

It should also be noted that changing the data rate also changes the Pressure input averaging samples to the maximum value that will not have any detrimental effect on the dynamic response of the Q-Daq.

The max measurement per channel per second value is gained from the oversampling rate, so when the oversampling is in high speed mode, this value will be 180 Hz, in low resolution mode it will be 130 Hz, in standard resolution it will be 100 Hz, in high resolution mode it will be 50 Hz and in ultra high resolution it will be 25 Hz. The default oversampling setting is standard resolution.

Averaging required = max measurement per channel / requested data rate

The average required is then dropped to the next value down in the averaging index. An averaging of 1 is equal to off.

So, if the Oversampling is on High resolution and the data rate selected is 5Hz then the Pressure and Temperature input average samples will be 4.

5.3.3 TCP Parameters

The TCP communication protocol parameters are shown in Figure 5.3. This only shows if the TCP radio button is selected in the datastreaming section. The options in this section control the Q-Daq's IP address, subnet mask and Local port.

Figure 5.4, TCP Comms group

'IP Address'	IP address allocated to Q-Daq 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 5.3, TCP Comms group settings

5.3.4 UDP Parameters

The UDP section (figure 5.4) 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 Q-Daq 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.

Note that the Q-Daq's local IP address is the same setting as from the TCP Comms group.

'Local IP address and subnet'	This displays the IP address of the Q-Daq, 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 Q-Daq. If set then the Q-Daq can be set to auto stream data to that remote host on boot up (after initialisation)
'Remote UDP port.'	Port of remote connection to Q-Daq. If set then the Q-Daq 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 5.4, UDP Comms group settings

5.3.5 CAN Parameters (Q-Daq DC only)

The CAN communication settings are shown in Figure 5.5. 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 5.6, CAN Comms group

'CAN First TX Message ID'	Q-Daq 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 0x1A 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 Q-Daq 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 5.5, CAN Comms group settings.

5.4. 'Live Data' Page

Figure 5.6 shows the 'Live Data' page of the webserver, for a 16-channel pressure scanner.
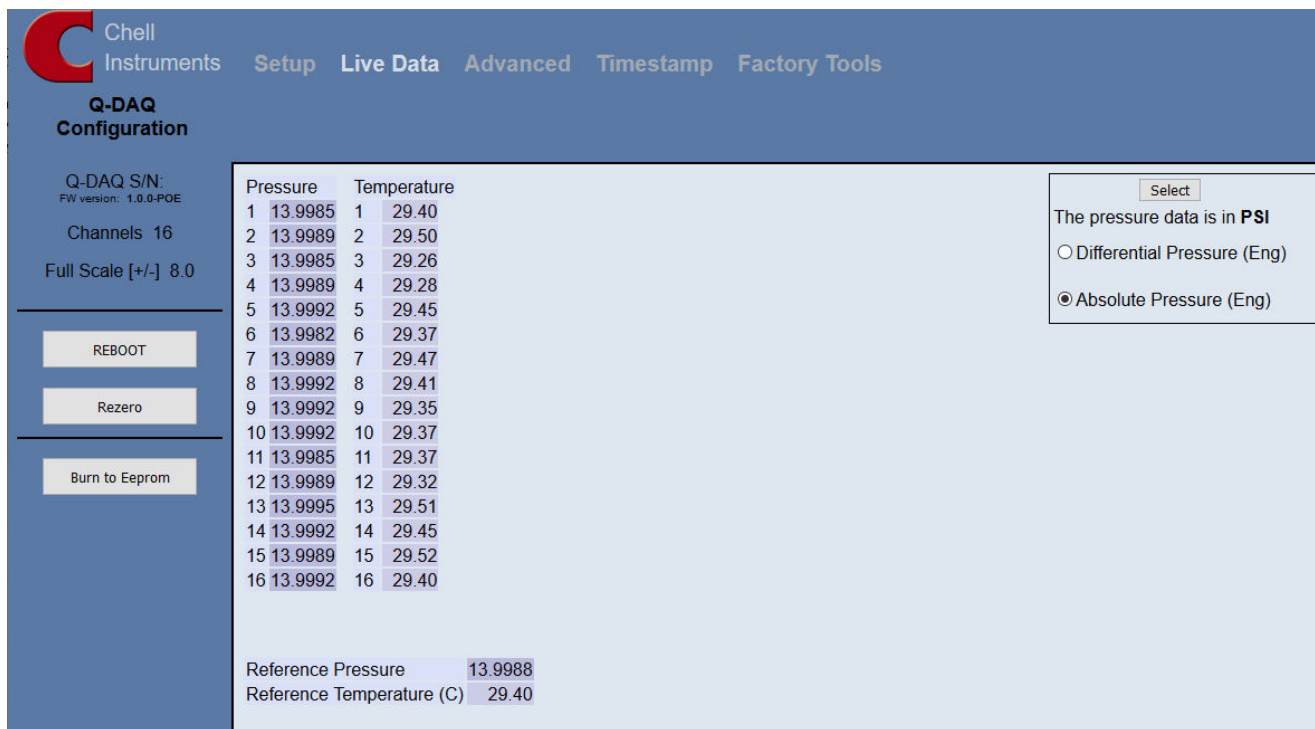

Figure 5.7, Live Data Page

The live data page is a means to demonstrating the correct operation of Q-Daq and testing the unit's calibration. A measurement for pressure and temperature is shown for each channel.

There is also a reference pressure and temperature value at the bottom of the page. This value is a duplicate of the channel selected to be the reference (see section 5.5.2).

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 (selectable between ports 1 and 16).
- Absolute Pressure (Eng)   As above, but represented as an absolute.

Values are updated automatically, once every 500ms, with the default view being Differential Pressure (Eng). Use the Select button to start showing values from one of the other selectable options.

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 section 5.5.2).

5.5 'Advanced' Page

The advanced tab contains extra options that users may find useful for more detailed configuration.

5.5.1 Advanced communication settings

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

Figure 5.8 Advanced comms group

Control	Function
Gateway	Allows the Q-Daq gateway address to be changed.
Enable TCP/UDP User Command Acknowledge	Turns on or off acknowledge bytes from commands sent via TCP or UDP.
Ethernet Initialisation Check Timeouts	At bootup the Ethernet module performs two checks for auto negotiation and link check status. This timeout can be controlled via this text box. If Ethernet comms are not going to be used then this value can be set at 0 to speed up startup time.
Auto Broadcast UDP message on boot	If checked, auto broadcasts a UDP message on port 10001 on startup which details the Q-Daqs 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 (Q-daq DC only)	Register values for the CAN module within the Q-Daqs microcontroller.
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 can be used to save power and reduce device temperature.
CAN power (Q-daq DC only)	Turns the CAN transceiver to 'Off', 'On' or 'Auto'. The can be used to save power and to reduce device temperature.

Table 5.6 Advanced comms settings

5.5.2 Miscellaneous

The remaining parameters are edited via the Miscellaneous group shown in Figure 5.10.

Figure 5.9, Miscellaneous group.

'Auto enable HW trigger on startup' dropdown	If set to anything other than Off, the Q-Daq 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. NOTE : Once this option is enabled, the Q-Daq will power up and wait for a hardware trigger before acquiring any data. The Live data screen will not show live data and the Q-Daq cannot be re-zeroed. The Blue run LED will not flash.
'Pressure unit'	Selects whether the data is in Pa(Pascals), PSI or BAR
'Pressure type'	This selects whether the Q-Daq transmits differential or absolute values.
'Channel to use for reference'	This selects which channel is the reference channel when differential pressure is required. Any channel between 1 and 16 can be used as the reference channel.
'Pressure input impulse filter'	Applies median filter the data – it 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.
'Scanner oversampling'	Select the internal filtering and oversampling of the transducer. This will have an effect on the maximum data rate available. These are: High speed : 180Hz Low resolution : 130Hz Standard resolution : 100Hz High resolution : 50Hz Ultra high resolution : 25Hz
'Heater control on value' 'Heater control off value'	This setting and the one below controls the in-built heater within the Q-Daq. If the 'control on' setting is set to say 20°C then the heater will come on when the reference temperature is below this temperature. The 'control off' value works in a similar way meaning a 'control on' value of 20°C and a 'control off' value of 25°C, the Q-Daq will maintain a temperature between 20 and 25°C
'Apply'	Applies the settings to the local settings memory

Table 5.7, Miscellaneous group settings

5.5.4 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 gained when the device is rezeroed.

Table 5.10 Span and Zero Coefficients group

'Save Rezero'	Saves the Rezero values to the eeprom
'Reset Zero'	Clears the span calibration on all channels

Table 5.8, Zero Coefficients controls

5.6   Timestamp

This page allows the user to edit the timestamp settings of the Q-Daq. This timestamp will allow the user to get millisecond level accuracy timestamps on the data packets. If the timestamp is enabled it will have an effect on the maximum transmission rate.

Figure 5.11, Timestamp

'PTP synchronisation on' checkbox	This allows the user to select whether any timestamps that may be added to the datastream are PTP synchronised or not. Please note this will only work if there is a PTP grandmaster clock on the same network as the Q-Daq.
'Datastream timestamp' dropbox	The user can use this to select where the timestamp is positioned in the datastream, 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 .
'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 has to click apply to send the timestamp to the Q-Daq
'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 Q-Daq.
'last read microDAQ unix time'	The top line shows the current time in the Q-Daq

Table 5.9, Timestamp

6. Service and Calibration

6.1 Service

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

6.2 Calibration

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

6.3 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.

6.4 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.