Chell Instruments Ltd
Folgate House
Folgate Road
North Walsham
Norfolk NR28 0AJ
ENGLAND

Tel: 01692 500555
Fax: 01692 500088

nanoDAQ-LT
Pressure Scanner Acquisition System

INSTALLATION AND OPERATING MANUAL

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

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

900210-1.1

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. : 900210 Issue 1.1
ECO : 03255 Date: 26/04/2018

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 nanoDAQ-LT is a self contained acquisition system and combined pressure scanner that acquires and transmits data to a host via Ethernet or a CAN bus. It is the newest version of the popular Chell microDAQ acquisition system.

The nanoDAQ-LT has 16 channels of acquisition and a reference channel.

The nanoDAQ-LT addresses the scanner at a defined rate, acquires the output and applies a pressure and thermal calibration to derive the engineering units.

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 firmware version 1.0.2

2 Specification

2.1 Power Supply:

Line voltage:	8-24 VDC
Absolute Max. Line voltage	25VDC
Consumption:	Max 1VA

2.2 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 Operating conditions:

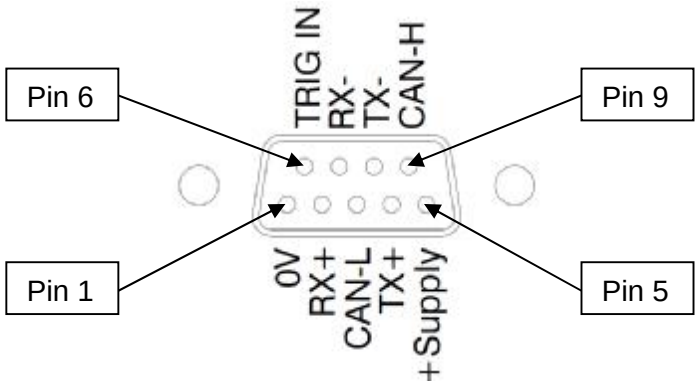
Operating temperature range:	+5°C to +90°C
Storage temperature range:	-20°C to +90°C
Maximum Relative humidity:	95% at 50°C (non condensing)

2.6 Measurement specifications:

System accuracy:	
Differential measurement	
Range = 35kPa / 5 psi	±0.1% FS
Range = 17kPa / 2.5 psi	±0.2% FS
Range = 7kPa / 1 psi	±0.5% FS
Absolute measurement	±35Pa / 0.005 psi
Proof pressure	50 psig
Maximum Measurement Speed:	180 measurements / channel / second

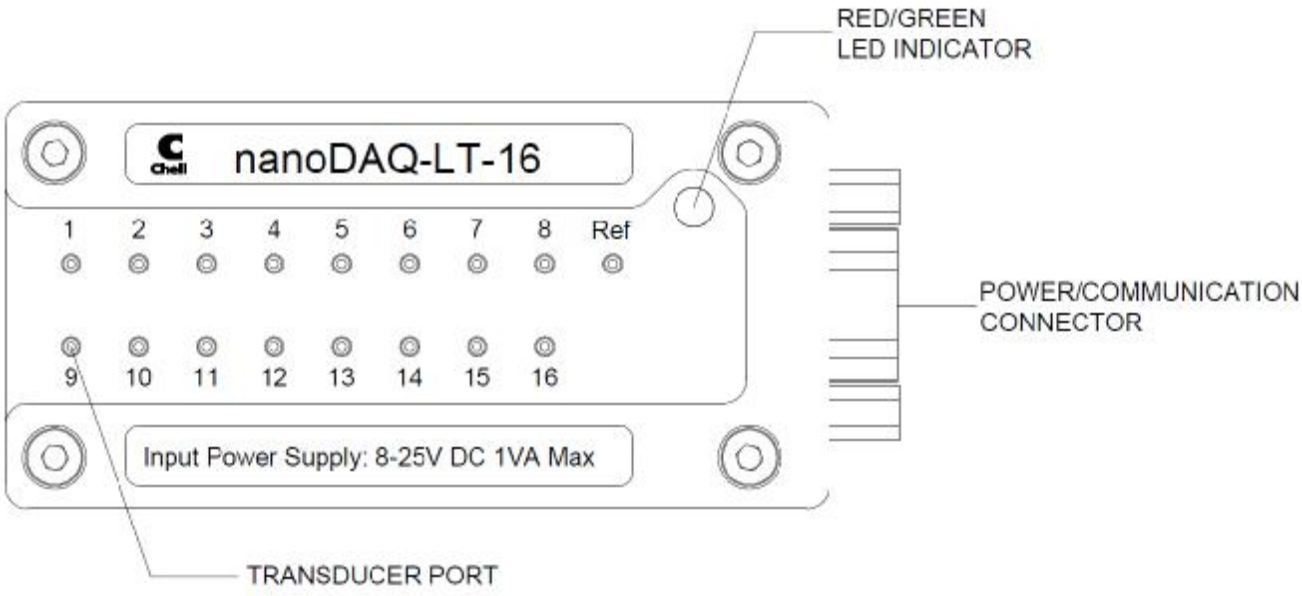
3 Installation and Interconnections

3.1 Connector – Mating connector: 9 way micro-d (Male)



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

3.2 Pneumatic Connection – 1mm bulged tubulation



4 Operation of the instrument

4.1 Connecting up the nanoDAQ-LT.

The nanoDAQ-LT has one connector and cable which supplies the unit with power and also provides CAN and Ethernet comms. Ensure all the connections are made before powering up the nanoDAQ-LT. The nanoDAQ-LT 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 nanoDAQ-LT boots up. This boot-up period will vary depending on the type of scanner and the number of channels. The boot up time is also influenced by the Ethernet initialisation process. This process requires a valid network connection to perform auto negotiation and link check status. If there isn't a valid connection the process waits until either a network is found or the timeout occurs. This timeout is configurable via setup and ranges from 0 to 30 secs per check (2 checks).

When the nanoDAQ-LT 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).

4.3 Re-zeroing the nanoDAQ-LT.

Before any measurements are made, the nanoDAQ-LT should be re-zeroed. The nanoDAQ-LT may need further re-zeroing if the unit or scanner should be subject to significant thermal variations.

The nanoDAQ-LT 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.

4.4 Hardware Trigger

The nanoDAQ-LT features a hardware trigger to enable the user to synchronise multiple nanoDAQ-LT's and to calculate the timing of the measurements made. The hardware trigger takes the form of a pulse train. Each time the nanoDAQ-LT 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.

The hardware trigger input is a 5V TTL square wave pulse train. Minimum frequency 2Hz and maximum frequency 4KHz (32 channel scanner, real world application – theoretical maximum is determined by the preconfigured scanner acquisition frequency and external comms bandwidth, etc.

4.4.2 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 10ms later the second pulse would generate the second set and so on. When the hardware trigger is activated, the nanoDAQ-LT 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. For more details on hardware trigger timing a technical paper is available – Chell document no. 900118 (this paper was developed for the CANdaq but applies to the nanoDAQ-LT as well).

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 nanoDAQ-LT to stop free-running and wait for the first pulse. The disable command will return the nanoDAQ-LT 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 nanoDAQ-LT 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 nanoDAQ-LT Configuration Webserver

5.1 Introduction.

The nanoDAQ-LT web Configuration provides the means of setting up and demonstrating the nanoDAQ-LT 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 nanoDAQ-LT'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 raw readings and nanoDAQ-LT's calibrated output.
'Advanced' provides setup for the all other more advance parameters that may require tweaking on a per application basis.
'Timestamp' provides some options for configuring the timestamping feature of the nanoDAQ-LT.
'Abs Cal' allows the user to calibrate the absolute pressure chips on the device.

'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.

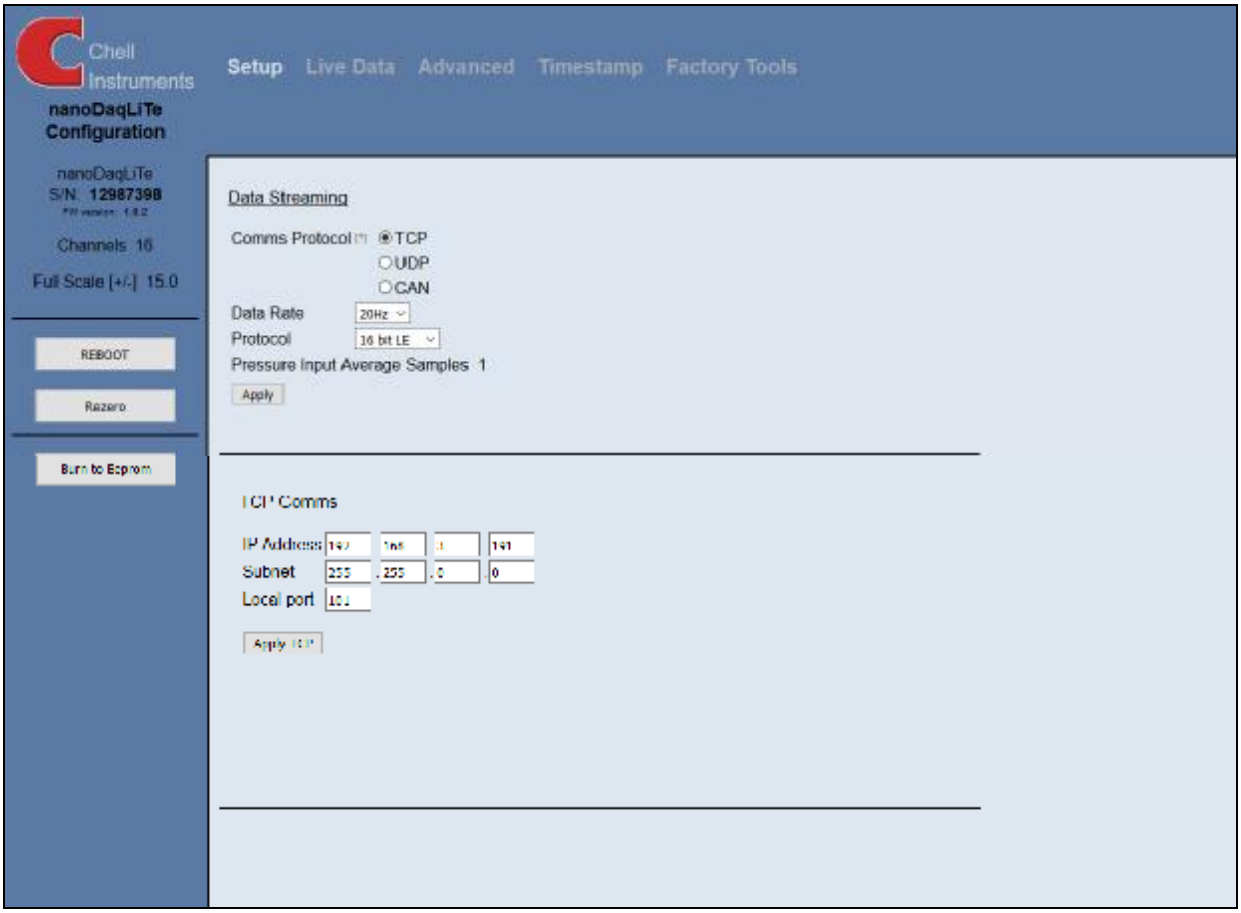


Figure 5.1, Main Setup page

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 nanoDAQ-LT unit and its built in scanners, including serial numbers and current firmware revision along with the configured scanner fullscales and total channels. The function of the common controls is detailed in the subsequent table (Table 5.1)

Figure 5.2, Sidebar

Control	Function
'RESET' button	Resets the nanoDAQ-LT , similar to power cycling the device. Use to activate new settings and/or rebuild calibration tables.
'Rezero' button	Starts a nanoDAQ-LT 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.

5.3 The 'Setup Parameters' Page

5.3.1 Introduction

The 'Setup Parameters' page shows all of the nanoDAQ-LT'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.

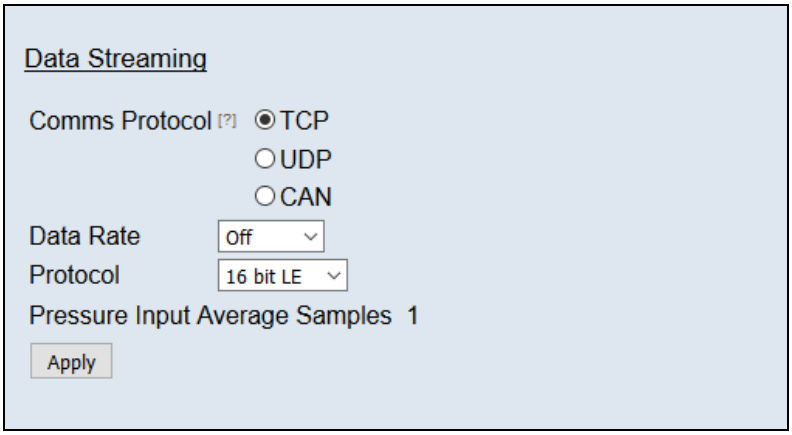


Figure 5.3, Data Streaming group

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 nanoDAQ-LT 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 optimum settings based on the requested data rate.

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 166 Hz, in low resolution mode it will be 125 Hz, in standard resolution it will be 83 Hz, in high resolution mode it will be 50 Hz and in ultra high resolution it will be 25 Hz

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 nanoDAQ-LT's IP address, subnet mask and Local port.

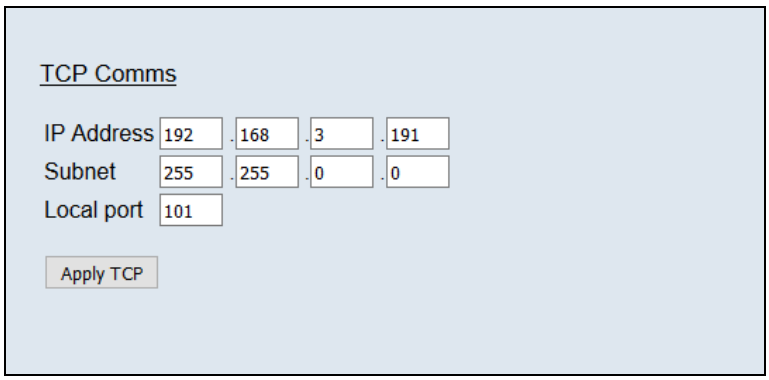


Figure 5.4, TCP Comms group

'IP Address'	IP address allocated to nanoDAQ-LT 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 nanoDAQ-LT 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 nanoDAQ-LT's local IP address is the same setting as from the TCP Comms group.

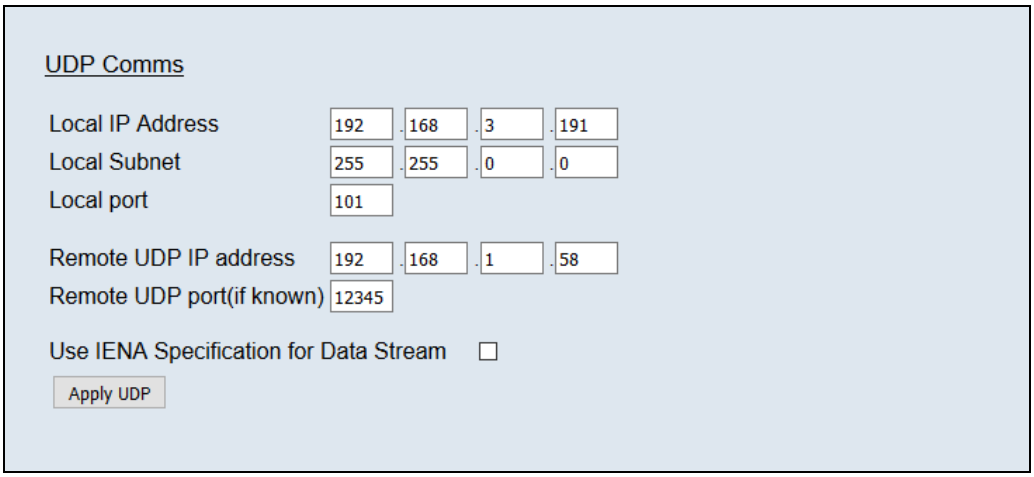


Figure 5.5, UDP Comms group

‘Local IP address and subnet’	This displays the IP address of the nanoDAQ-LT, 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 nanoDAQ-LT. If set then the nanoDAQ-LT can be set to auto stream data to that remote host on boot up (after initialisation)
‘Remote UDP port.’	Port of remote connection to nanoDAQ-LT. If set then the nanoDAQ-LT 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

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.

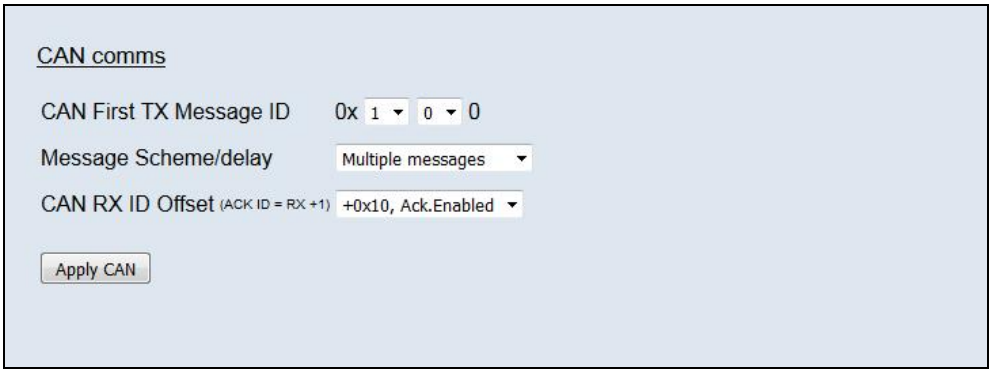


Figure 5.6, CAN Comms group

‘CAN First TX Message ID’	nanoDAQ-LT 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 nanoDAQ-LT 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.

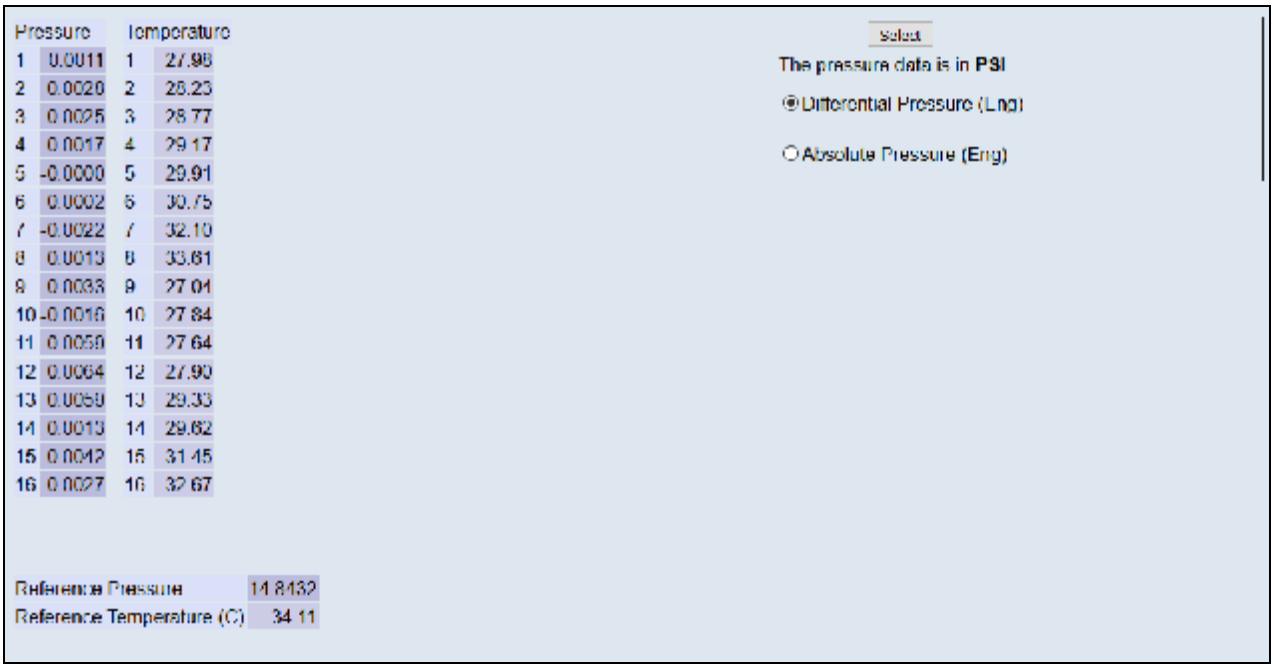


Figure 5.7, Live Data Page

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

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 scanner full scale.
- Absolute Pressure (Eng) — As above, but represented as an absolute pressure, using the reference pressure reading as a base.

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.

5.5 ‘Advanced’ Page

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

5.5.1 Advanced communication settings

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

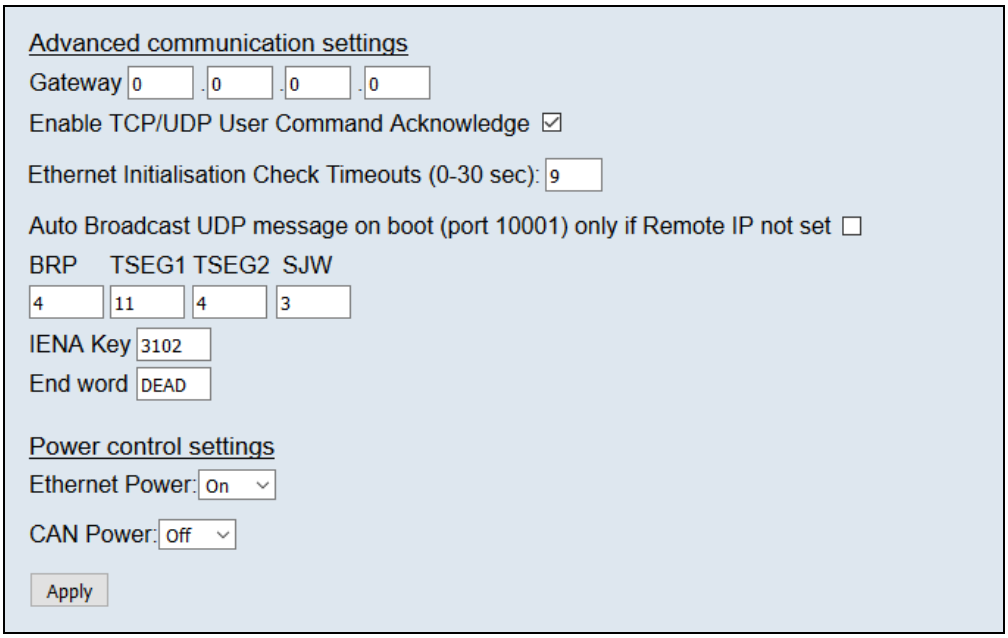


Figure 5.8 Advanced comms group

Control	Function
Gateway	Allows the nanoDAQ-LT 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 nanoDAQ-LTs 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 nanoDAQ-LTs 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	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. The nanoDAQ-LT allows the user to change the pressure unit and type output in the data stream

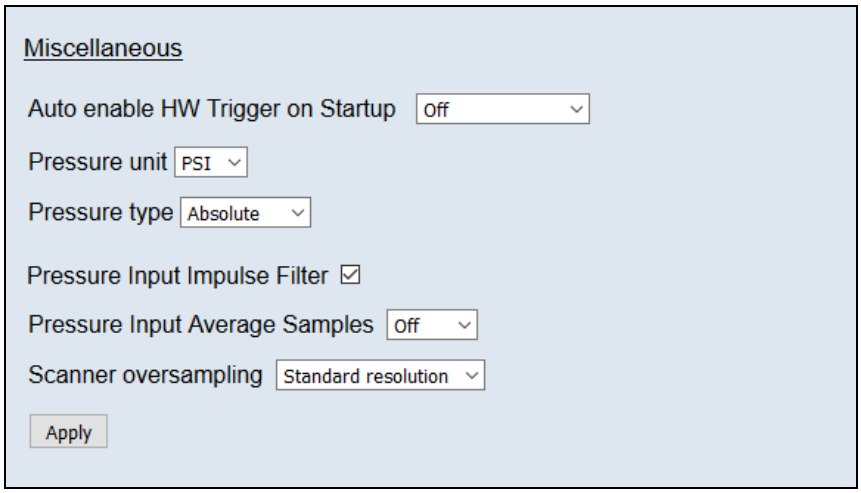


Figure 5.9, Miscellaneous group.

'Auto enable HW trigger on startup' dropdown	If set to anything other than Off, the nanoDAQ-LT 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 unit'	Selects whether the data is in Pa(Pascals), PSI or BAR
'Pressure type'	Currently this setting determines whether a 16bit scaled absolute pressure value is attached to the start of a data stream cycle.
'Pressure input impulse filter'	Applies impulse 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.
'Scanner oversampling'	Select the resolution of the scanner sampling.
'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.

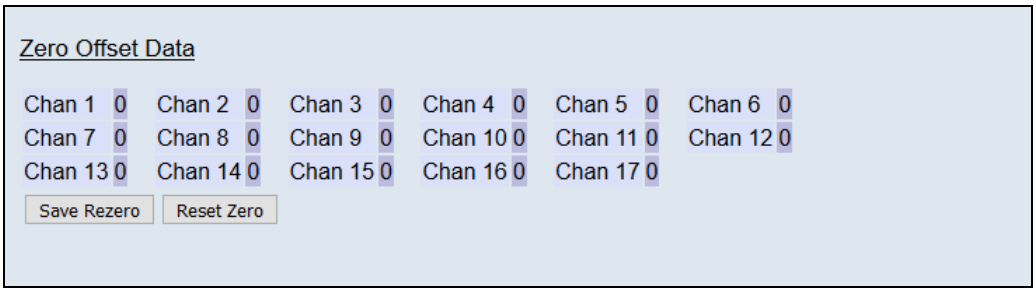


Table 5.10 Span and Zero Coefficients group

‘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 nanoDAQ-LT. 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.

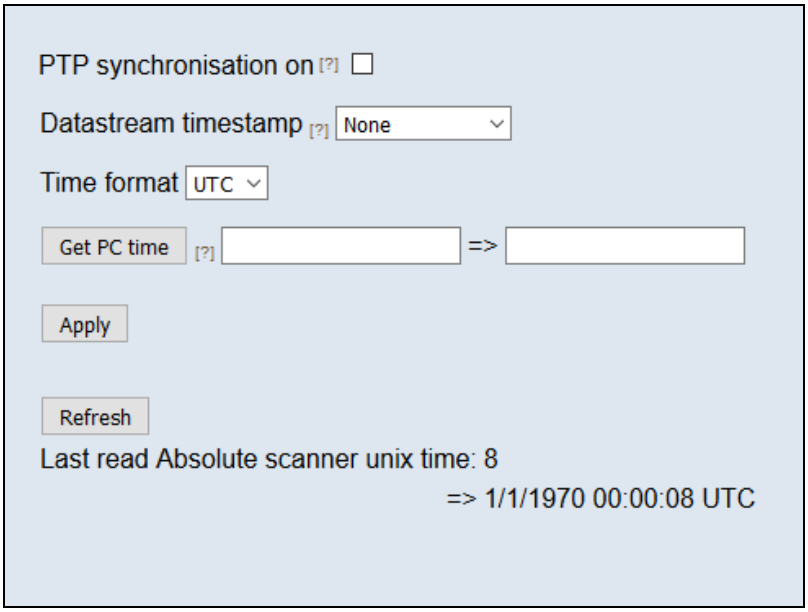


Figure 5.11, Timestamp

'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 on the same network as the nanoDAQ-LT.
'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 datastream.
'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 nanoDAQ-LT
'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 nanoDAQ-LT.
'last read microDAQ unix time'	The top line shows the current time in the nanoDAQ-LT

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 nanoDAQ-LT, 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.