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microCAT

Pressure Scanner Acquisition System

With EtherCAT communications

INSTALLATION
AND
OPERATING MANUAL

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

900190-1.1

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.

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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 microCAT is a self contained acquisition system and combined pressure scanner that acquires and transmits data to a host, primarily via the EtherCAT protocol. It also has the capability to transmit via USB (at slow rates) or via a CAN bus. The microCAT is based on the current microDAQ acquisition system but designed specifically for use as a slave device in an EtherCAT network.

The microCAT comes in several variants to accommodate both conventional HD series scanners and Digital Thermal Compensation (DTC) scanners with 32 and 64 channels.

The microCAT can be configured via the USB port using the supplied front end software, and can also be configured from an EtherCAT master using the supplied ESI (EtherCAT Slave Information) file, in XML format.

The microCAT addresses the scanner at a defined rate, acquires the output and applies a pressure and thermal calibration to derive the engineering units. The data output rate is controlled from the EtherCAT master using SM (Sync Manager) or DC (Distributed Clock) synchronisation.

This manual revision covers firmware version 2.0.7. Some of the functions and options detailed here may not be available in earlier firmware versions.

2 Specification

2.1 Power Supply:

Line voltage:	8-24 VDC
Absolute Max. Line voltage	25VDC
Consumption:	Max 5VA
With a 64 channel scanner:	

2.2 CAN specifications:

CAN type	2.0B
CAN baudrate	Configurable (by internal switch) 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

2.3 Serial specifications:

USB2.0 (micro)	57600 baud, no parity, 8 data bits and 1 stop bit.

2.4 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)

2.5 Measurement specifications:

System accuracy:	±0.25% FS for conventional scanners ±0.06% FS for DTC scanners ±0.06% FS for I-Daq scanners
Resolution:	16 Bit
Maximum Measurement Speed:	Dependant on scanner header generation and number of channels. See table below:

Number of Scanner channels Acquired		
	32	64
Speed (Gen1)	600	300
Speed (Gen2)	1200	600

All measurements are in measurements / channel / second.

3 Installation and Interconnections

3.1 Bus In Connector – Mating connector: DEUTSCH ASDD606-09SN-HE

Bus Out Connector – Mating connector: DEUTSCH ASDD606-09SN-HE

Pin Number	Designation
1	TX+
2	RX+
3	TRIGGER IN (TTL)
4	+8~25V SUPPLY
5	0V
6	CAN_H
7	CAN_L
8	TX-
9	RX-

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

3.2 USB Connector – Mating connector: Micro B

Pin Number	Designation
1	+5v USB transceiver supply
2	USBDM
3	USBDP
4	N/C
5	0V

3.3 Scanner Connector – Internal micro miniature ‘D’ type, female.

Pin number	Signal
1	Address line A0
2	Address line A1
3	Address line A2
4	Address line A3
5	Address line A4
6	+12VDC
7	-12VDC
8	+5VDC (Vs)
9	+5VDC RTN
10	Ground
11	Output
12	Address line A5
13	Ov sense
14	Not used
15	Temperature signal

4 Operation of the instrument

4.1 Connecting up the microCAT.

The microCAT has two connectors which can supply the unit with power and also provides CAN and EtherCAT comms. This allows for several microCAT units to be connected together in an EtherCAT network. The upstream device should be connected to the bus IN connector and the downstream device should be connected to the bus OUT connector.

An industry standard micro USB (typeB) connector is provided to allow for RS232 connection. This can be used for changing setup parameters and debugging of the unit, although typically the setup parameters are changed through the EtherCAT master.

Ensure all the connections are made before powering up the microCAT. The microCAT 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 microCAT boots up. This boot-up period will vary depending on the type of scanner and the number of channels.

When the microCAT has finished booting, the blue LED will flash at a constant rate to show that the system is running.

4.1.1. USB driver installation

If a USB cable is connected to the microCAT, the host PC will require the user to install the driver for the USB controller on the microCAT board. This driver may install automatically if already on the PC, but if not it can be found under the Serial Port Driver directory on the CD/USB stick provided.

Note that if another microCAT is attached to the same USB port at a different time then the PC will once again ask for driver installation and will automatically assigned a different COM port number to that new microCAT. This is because each USB controller chip has a unique serial number associated with it internally. When several microCATs are being connected in this way this can be lead to a large number of COM ports being assigned which can become unwieldy. To avoid this there is a Windows registry modification that can be made so that the PC assigns the same driver instance and COM port for several microCAT connections to that one USB port.
To do this, add the following Binary value and set it to 01:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\UsbFlags\IgnoreHWSerNum04036001

4.2 Installing the software.

The microCAT comes with 4 ESI files which provides the device descriptions for the unit depending on the scanner in the device. These should be placed in the appropriate directory on the EtherCAT master (this varies depending on the type of EtherCAT master being used, e.g. TwinCAT and is beyond the scope of this document).

Also provided is the microDAQSetup front end interface software. This allows for configuration setup via the USB serial port. Simply run the appropriate setup.exe on the CD/USB stick provided. Note that it is not necessary to install this software to configure the device because the typical user settings can be changed using the EtherCAT master.

4.3 LED indication

LED	LED Status	Description
STAT	Off	INIT (EtherCAT state) & no error.
	Green (blinking) [*1]	PREOP (EtherCAT state)
	Green (single flash) [*2]	SAFEOP (EtherCAT state)
	Green (on)	OP (EtherCAT state)
	Red (blinking) [*1]	General EtherCAT configuration error
	Red (single flash) [*2]	Slave device application has changed EtherCAT state autonomously, due to local error
	Red (double flash) [*3]	Application watchdog timeout, Sync Manager watchdog timeout or communication timeout occurred.
	Red (on)	Critical communication or application controller error has occurred. Application controller is not responding anymore (PDI Watchdog Timout).
L/A (IN)	Off	Port closed or not connected, no activity
	Green (blinking)	Port open and connected with activity
	Green (on)	Port open and connected, no activity
L/A (OUT)	Off	Port closed or not connected, no activity
	Green (blinking)	Port open and connected with activity
	Green (on)	Port open and connected, no activity

Blue (Run)	On	microCAT initialising, building calibration table (if Function LED on as well) or in Setup operating mode
	Flashing (@ 1Hz)	microCAT in Run operating mode
Red (Function)	On	microCAT building calibration table (if Run LED on as well), performing rezero or span operation, DTC excitation read error.
	Single flash	Performing DTC excitiation update

STAT LED timings (as indicated in ETG.1300 Indicator and Labeling Specification)

[*1] blinking: 200ms on, 200ms off

[*2] single flash: 200ms on, 1000ms off

[*3] double flash: 200ms on, 200ms off, 200ms on, 1000ms off

5 EtherCAT Object Structure

What follows is a description of the CoE (CANopen over EtherCAT) Object Dictionary used in the microCAT.

5.1 Object Dictionary Structure

The object dictionary contains object that are mapped for cyclic communication in PDOs and also objects for configuration of microCAT parameters using SDO services.
Each object is addressed using a 16-bit index and an 8-bit subindex.

The overall layout of a standard Object Dictionary is as follows:

Index (hex.)	Object dictionary area	
0000 – 0FFF	Data Type Area	
1000 – 1FFF	Communciation area	
2000 – 5FFF	Manufacturer specific area	
6000 – 6FFF	Profile Specific Area	Input area
7000 – 7FFF		Output area
8000 – 8FFF		Configuration area
9000 – 9FFF		Information area
A000 – AFFF		Diagnosis area
B000 – BFFF		Service Transfer area
C000 – EFFF		Reserved area
F000 – FFFF		Device area

5.2 Object table abbreviations

All object tables contain various abbreviations, as follows:

Abbreviation	Description	
CoE	CANopen over EtherCAT	
Index	Object Index addess (hex)	
NV	Non-volatile – attribute value is maintained through a power cycle	
PDO	Process Data Object – structure for mapping parameters containing data entries	
PM	PDO Mapping – object can be mapped into an *rx* or *tx* PDO	
RO	Read Only – SDO access	
RW	Read/Write – SDO access	
RxPDO	Receive PDO – a PDO received by the EtherCAT slave	
TxPDO	Transmit PDO – a PDO sent from the EtherCAT slave	
SI	Subindex – sub address of an object (hex)	
SDO	Service Data Object – mailbox communications where all objects can be read & written	
Type	Data Types	
	BOOL	1 bit. Boolean (‘0’ = False, ‘1’ = True)
	BITn	n bit.
	BYTE	8 bit. Unsigned Byte
	USINT	8 bit. Unsigned Short Integer
	UINT	16 bit. Unsigned Integer
	UDINT	32 bit. Unsigned Long Integer
	STRING(n)	8*n bit. Visible String of n characters
	REAL	32 bit. Floating point value

5.3 Communication Area

The objects in this area describe the basic EtherCAT properties of the microCAT common to all EtherCAT slaves that use the CoE protocol

Index	SI	Data Type	NV	Access	PM	Description
1000		UDINT		RO		Device Type
1001		USINT		RO		Error Register
1008		STRING(11)		RO		Device Name
1009		STRING(4)		RO		Hardware Version
100A		STRING(4)		RO		Software Version
1018				RO		Identity
	0x01	UDINT		RO		Vendor ID
	0x02	UDINT		RO		Product Code
	0x03	UDINT		RO		Revision
	0x04	UDINT		RO		Serial number

5.4 Process Data Objects

These objects describe the data mappings for the microCAT

Index	SI	Data Type	NV	Access	PM	Description
1A00				RO		Analogue Input Pressure TxPDO mapping
	0x01	UDINT		RO		Pressure Channel 1 mapping
	...					...
	0x20	UDINT		RO		Pressure Channel 32 mapping
	...					...
	0x40	UDINT		RO		Pressure Channel 64 mapping

If using a conventional scanner:

1A02				RO		Analogue Input Temperature TxPDO mapping
	0x01	UDINT		RO		Temperature mapping

If using a DTC scanner:

1A02				RO		Analogue Input Temperature TxPDO mapping
	0x01	UDINT		RO		Temperature Channel 1 mapping
	...					...
	0x20	UDINT		RO		Temperature Channel 32 mapping
	...					...
	0x40	UDINT		RO		Temperature Channel 64 mapping
1C00	0x01 0x02 0x03	USINT		RO		Sync Manager type
1C12	0x01 0x02	UINT		RO		TxPDO assign
1C33	0x01 ... 0x20					Sync Manager parameters

5.5 Input Area

These are the input data objects that can be read by an EtherCAT master, to report the pressures and temperature acquired by the microCAT. They are mapped in the TxPDOs described previously.

Index	SI	Data Type	NV	Access	PM	Description
6000	0x01	UINT		RO	tx	Channel 1 calibrated pressure (16bit)
	...					...
	0x20	UINT		RO	tx	Channel 32 calibrated pressure (16bit)
	...					...
	0x40	UINT		RO	tx	Channel 64 calibrated pressure (16bit)

If using a conventional scanner:

6020	0x01	UINT		RO	tx	Scanner temperature (16bit)

If using a DTC scanner:

6020	0x01	UINT		RO	tx	Channel 1 temperature (16bit)
	...					...
	0x20	UINT		RO	tx	Channel 32 temperature (16bit)
	...					...
	0x40	UINT		RO	tx	Channel 64 temperature (16bit)

5.6 Configuration Area

The microCAT setup values are configured using the objects in this area. The available objects are a subset of the total setup parameters available for configuration via the microDAQSetup configuration tool (see section 6). It is the intention to make all setup parameters available in this area, in future versions of the microCAT firmware.

Index	SI	Data Type	NV	Access	PM	Description
8000						Signal settings
	0x01	BOOL		RW		Pressure Input Impulse Filter - Removes single impulse noise events (spikes) from the pre-calibrated pressure data
	0x02	BOOL		RW		Temperature Input Impulse Filter - Removes single impulse noise events from the temperature data
	0x04	UDINT		RW		Pressure Input Average Samples - Number of samples for moving average of pre-calibrated pressure data Representation is an index ‘n’: n = 0 **à** Off n = 1 to 16 **à** 2^n samples
	0x05	UDINT		RW		Temperature Input Average Samples - Number of samples for moving average of temperature data Representation is an index ‘n’: n = 0 **à** Off n = 1 to 16 **à** 2^n samples

	0x06	UDINT		RW		Pressure Output Average Samples - Number of samples for moving average of post-calibrated pressure data Representation is an index 'n': n = 0 **à** Off n = 1 to 16 **à** 2^n samples
	0x07	BIT2		RW		Temperature Compensation - 0 = Off 1 = Continuous – rebuild the calibration data continuously on a channel by channel basis without interrupting data flow 2 = *Historical/Reserved*
	0x09	UINT		RW		Rezero Samples - Number of samples to use in the average for calculating a new zero pressure offset. Representation is an index 'n': n = 0 to 12 **à** $2^{(n+4)}$ samples

Index	SI	Data Type	NV	Access	PM	Description
8010						Miscellaneous Settings
	0x01	STRING(8)		RO		microCAT unit serial number
	0x02	STRING(8)		RO		Scanner serial number
	0x03	STRING(8)		RO		Scanner Fullscale
	0x04	BYTE		RO		Scanner Type - 0 = Conventional 1 = DTC 2 = *I-daq (not currently supported by microCAT)* 3 = *T-daq (not currently supported by microCAT)*
	0x06	BOOL		RW		Use DTC Calibration - On power up, use the calibration coefficients from the attached DTC scanner to build the microCAT calibration table
	0x07	BOOL		RW		All DTC Channels Active - Use the number of channels reported by the attached DTC scanner as the microCAT channel count.
	0x08	BOOL		RW		Span Calibration to DTC Full Scale - Use the full scale value reported by the attached DTC scanner as the microCAT full scale engineering value.
	0x09	BOOL		RW		Use raw calibration for I-daq - *Reserved for future use – not currently supported by microCAT*

	0x0A	BOOL		RW		Sensistor in circuit - Keep the sensistor in a DTC scanner in circuit – for normal use this should be set to off
	0x0B	BOOL		RW		DTC Gain - Select the deranging feature of the attached DTC scanner (nominal range / 3)

5.7 Command Area

These are command data objects that can be sent by an EtherCAT master, to command the microCAT to rezero or to set a channel as a data offset reference.

5.7.1 Rezero Command

Performs a rezero operation on the microCAT (same as the Rezero button in microDAQSetup)

Index	SI	Data Type	NV	Access	PM	Description
FB50						Rezero
	0x01	USINT		RW		Command
	0x02	USINT		RO		Status
	0x03	INT		RO		Response

SubIndex 0x01:

Command	
Byte 0	0x00: Rezero function
Byte 1	Unused

SubIndex 0x02:

Status	
Byte 0	Last command completed, no errors, no reply available

SubIndex 0x03:

Response	
Byte 0	See SubIndex 0x02
Byte 1	Unused

5.7.2 Data Offset channel

Sets a channel to use as an alternative data offset reference. The reading from the selected channel is used to calculate an offset from zero which is then subtracted from the readings for all other channels.

Index	SI	Data Type	NV	Access	PM	Description
FB51						Data Offset channel
	0x01	USINT		RW		Command
	0x02	USINT		RO		Status
	0x03	INT		RO		Response

SubIndex 0x01:

Command	
Byte 0	0x00: Data Offset function
Byte 1	Channel to be used as offset, set to 0x00 to disable the function (this is the power on default).

SubIndex 0x02:

Status	
Byte 0	Last command completed, no errors, no reply available

SubIndex 0x03:

Response	
Byte 0	See SubIndex 0x02
Byte 1	Unused

6 ‘microDAQ Setup’ Configuration Software

6.1 Introduction.

microDAQSetup is provided for an alternative method of setting upthe microCAT unit. It includes facilities for calibrating and demonstrating the microCAT that may not be available from the EtherCAT ESI file. Please note that it is the intention to transfer all user setup and calibration facilities to EtherCAT with future revisions of firmware. The microCAT version of microDAQSetup only differs from the microDAQ version by its internal serial comms connection protocol – in all other respects it is identical to the microDAQ version and hence some setup sections exist that are not relevant (and are therefore ignored) when used with the microCAT.

The software is divided by tabs into five areas of functionality, namely 'Setup Parameters', 'Live data', 'Calibration', 'DTC Information’ and ‘Tools’

'Setup Parameters' provides the means to set microCAT’s operating parameters and its identification information. The unit's function may be checked and demonstrated using 'Live Data' to show attached pressure scanner raw readings and microCAT’s calibrated output. 'Calibration' gives access to microCAT's existing on board, non DTC calibration coefficients, the tools for performing a new calibration, namely calculating and downloading new coefficients, and the means to managing calibration data. Data from the calibration procedure and resulting coefficients may be loaded, stored and exported for filing, reuse and examination in other packages. 'DTC Information' provides a means for interrogating a DTC variant of the microCAT, the user having access to identification information, the current status of the calibration shuttle valve and both excitation and temperature voltages. ‘Tools’ provides some functionality to read DTC coefficients and current scanner values. This tab is not readily available to everyone and further detail is beyond the scope of this document.

6.2. The 'Setup Parameters' Tab.

6.2.1 Introduction.

The 'Setup Parameters' tab allows the reading and writing of all of microCAT’s operating settings to its on board non volatile EEPROM. The operator may upload the current settings from microCAT, edit them, and then download them back into the unit. A submenu of tabs divides the available setup parameters into different categories by function, and each category is detailed separately in the following. Figure 6.1 shows the common controls and the 'Signal' group of parameters. The function of the common controls is detailed in the subsequent table.

6.2.2 Signal Parameters.

The microCAT has settings to allow the user flexible control over the data throughput of the device. Averaging options allow the preference of noise reduction over time domain response, the frequency of calibration temperature compensation renewal may be chosen as may be the size of the average (and hence time taken) for the rezero routine. Table 6.1 details the function of the signal parameter option controls.

Control	Function
'Pressure Input Impulse Filter'	Check box to apply impulse filter to pre calibration data - will remove single impulse noise events in the pressure data.
'Temperature Input Impulse Filter'	As above but with temperature data.
'Pressure input average samples'	Selects the number of samples for a moving average of pre calibration pressure data.
'Temperature input average samples'	As above but with temperature data.
'Pressure output average samples'	Selects the number of samples for a moving average of post calibration pressure data.
'Reset average on output'	Overrides the rolling pressure output filter. When checked, the unit builds a fresh post calibration average between each data delivery event.
'Temperature Compensation'	Selects the temperature compensation scheme for the calibration. 'Continuous' repeatedly rebuilds the calibration data on a channel by channel basis without interrupting the flow of data. 'With zero only' permits the use of a designated user command to request a rezero.
'No Rezero samples'	The number of samples in the average to calculate a new pressure zero offset.

Table 6.1, Function of the 'Signal' parameter controls

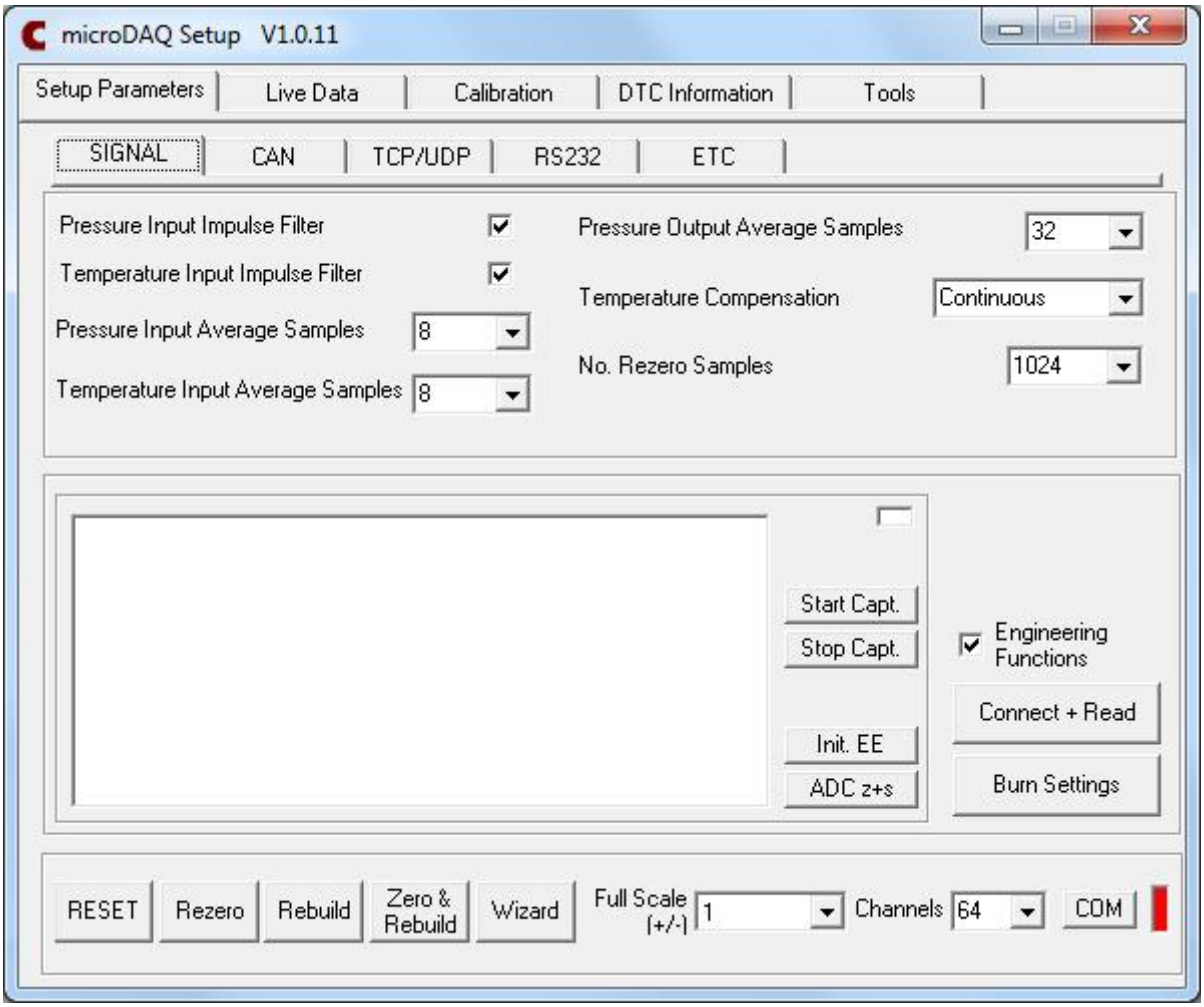

Figure 6.1, Contents of the 'Setup Parameters' tab, Signal Tab and Engineering Functions Selected.

Control	Function
Common Functions	
'Connect and Read' button	Retrieves all setup data from microCAT including software version, setup parameter values and identification. Diagnostic information may be seen in the central listbox.
'Burn Settings' button	Downloads setup values and identification strings to microCAT, and then writes them into the EEPROM. Diagnostic information may be seen in the central listbox.
'Rezero' button	Starts a microCAT rezero operation.
'RESET' button	Resets the microCAT, similar to power cycling the device. Use to activate new settings and/or rebuild calibration tables.
'Channels' dropdown	The number of channels on the attached scanner should be chosen from the 'Channels' drop down. It is important that this number is correct when performing any calibration or reading data from microCAT.
'Full Scale' dropdown	This dropdown is the only means of selection of the scanner's full scale operating pressure. The value affects the display of live engineering values and the generation of calibration coefficients.
'Wizard' button	Start the setup wizard for a simple way to apply common settings to the microCAT.
'Rebuild' button	Force a calibration table rebuild.
'Zero & Rebuild' button	As above but performs a rezero operation first.
'Start Capt.' button	Start capturing characters received on the serial port / TCP socket to the text file microDAQCapture.log and display on the engineering screen.
'Stop Capt.' button	Stop capture of serial characters.
'Engineering Functions' checkbox	Show or hide the engineering functions panel.
For calibration file management controls, see the calibration section.	

Table 6.2, Common setup control functions.

6.2.3 CAN Parameters.

The optional CAN communication parameter controls are shown in figure 6.2. Options control the CAN bus baudrate, the rate of data delivery, the number of channels enabled and the data format. Additionally the base message number may be selected, as can 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. Additionally the single message ID scheme can be modified to increment the ID after every block of 16 channels until all channels for a scanner have been transmitted.

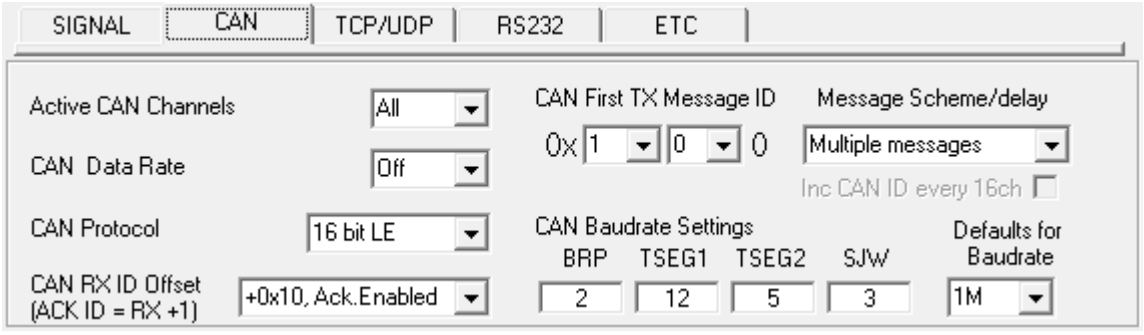

Figure 6.2, CAN parameters within the setup data.

'CAN baudrate'	Shows the setting of the four register values required to set up the CAN bus timing in microCAT's microcontroller. Selecting a CAN baudrate from the combo box sets different register values to achieve one of a number of preset baudrates. The user is free to set their own preference in consultation with the appropriate datasheet. Note the internal CAN peripheral clock runs at 60Mhz. All register values should be calculated based on that clock frequency.
'CAN First TX Message ID'	microCAT 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.
'Inc CAN ID every 16ch' checkbox	Becomes available for the single ID message scheme and allows for incrementing the CAN message ID after every 16 channels until all channels have been transmitted.
'Active CAN channels'	Allows the selection of a subset of total scanner channels to be active.
'CAN data rate'	The delivery rate of data for each channel
'CAN protocol'	The data format delivered by the CAN module. Can be 16 bit data, as two bytes (either big or little ended).
'CAN RX ID Offset'	Selects the hex offset from the base message ID where microCAT 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
BRP, TSEG1, TSEG2, SJW	Register values for the CAN module within microCAT's microcontroller.

Table 6.3, CAN parameter control functions.

6.2.4 TCP/UDP Parameters.

The TCP/UDP section is not relevant for use with the microCAT.

6.2.5 RS232 Parameters.

The data delivery options of CAN are repeated for the RS232 interface, in addition to a baudrate selection allowing user configuration of microCAT's baudrate on powerup. The baudrate selected is valid for both data delivery functions, and communication to the setup software.

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.

Figure 6.3, RS232 parameters within the setup data.

'RS232 baudrate'	microCAT communication baudrate for both data streaming and user interface
'Active RS232 channels'	Allows the selection of a subset of total scanner channels to be active.
'RS232 data rate'	The delivery rate of data for each channel
'RS232 protocol'	The data format delivered by the RS232 module. Can be 16 or 14 bit data, as two bytes (either big or little ended) or engineering units.
'Enable User Command Acknowledgement'	If checked, returns acknowledgement to incoming user RS232 commands.

Table 6.4, RS232 parameter control functions.

6.2.6 Remaining Sundry Parameters.

The remaining parameters are edited via the 'ETC' tab, shown in figure 6.4. Scanner and microCAT identification strings may be written 'as is' to the device, as may a date. If the microCAT is a DTC variant and DTC mode is to be used, the 'Use DTC' checkbox should be checked. The DTC scanner's options of sensistor and gain configuration may also be selected from this tab. 'All DTC Channels Active', defaults the number of active channels to all on a DTC scanner, overriding the number in the setup. The scanner type should always be set to the type of scanner installed in the microCAT to ensure proper operation of the system. The ‘Trig In’ line on the Autosport connector can be configured to be used for Hardware Trigger or Mute/Rezero. There are currently no plans to produces a microCAT version with an I-daq scanner so the ‘use raw calibration’ checkbox for applying a linear calibration function on boot up, is irrelevant and ignored.

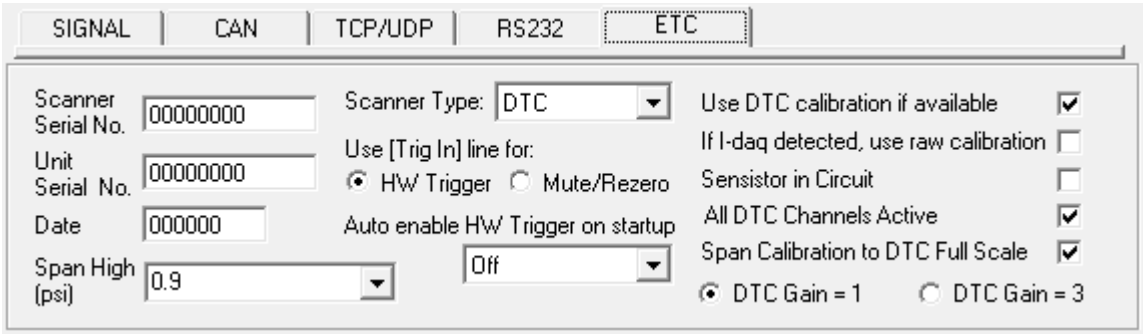

Figure 6.4, Remaining ('ETC') parameters within the setup data.

'Scanner ID'	Provision for a scanner serial number.
'CANdaq ID'	Provision for the microCAT serial number
'Date'	Provision for a date field – used for date of manufacture
'Use DTC calibration if available'	On powerup, uses the DTC scanners internal calibration coefficients to build the microCAT’s internal calibration data table.
'Sensistor in circuit'	If checked, keeps the sensistor in circuit for a DTC scanner. In normal operation this control should be left unchecked.
'DTC gain = 1/3'	Selects the deranging function of the DTC scanner if the '3' option is selected, otherwise defaults to the standard range of the scanner.
'All DTC Channels Active'	If checked, defaults microCAT to setting the number of active channels to the number read from the DTC scanner header
'Span Calibration to DTC Full Scale'	If checks, defaults the span of the calibrated output to the full scale read from the DTC scanner header.
'Span High'	Sets the value of pressure for the 'high' point in the linear span and zero calibration. Valid values range from 0.144PSI (3”WC) to 90PSI. Typically this value should be set to 90% of the scanners full scale value, if possible.
Scanner Type	Sets the type of scanner installed into the microCAT (Conv, DTC)
[Trig In] line options	Selects the use of the [Trig In] hardware line on the Autosport connector.
‘Auto enable HW trigger on startup’ dropdown	If set to anything other than Off, the microCAT 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.

Table 6.5, Remaining ('ETC') parameters within the setup data.

6.2.7 The COM Frame.

The 'COM' button towards the bottom right of the main from, toggles the frame it sits in between the ‘COMMANDS’ frame as seen in figure 6.1 and the 'PING' frame, as seen in figure 6.5 below. Access to the communications settings and the ping function to determine the current software version of the microCAT, is from this alternate frame. The red indicator shows the software is connected to the serial port. Again TCP & UDP connection is irrelevant for use with the microCAT.

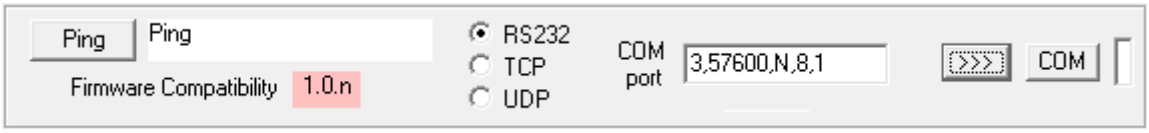

Figure 6.5, The alternate 'PING' frame with RS232 comms settings, accessed from the 'COM' button.

'Ping' button	To confirm that the attached microCAT is alive and communicating, clicking the ping button retrieves the current software version string from the device and displays it in the label next to the button.
COM port parameters	The software defaults to the last used microCAT communications operating settings, though these settings may be overwritten by selecting the chosen setup comms protocol and by typing the appropriate desired settings into the text boxes and clicking the '>>>' button. NOTE: for RS232 comms ensure the USB cable is connected to the microCAT before clicking the ‘>>>’ button to connect and ALWAYS click the ‘<<<’’ button to disconnect before disconnecting the USB cable from the microCAT.

Table 6.6, Functions within the alternate 'PING' frame accessed from the 'COM' button.

6.3. 'Live Data'.

Figure 6.6 shows the 'Live Data' tab of the software selected for a 64 channel pressure scanner.

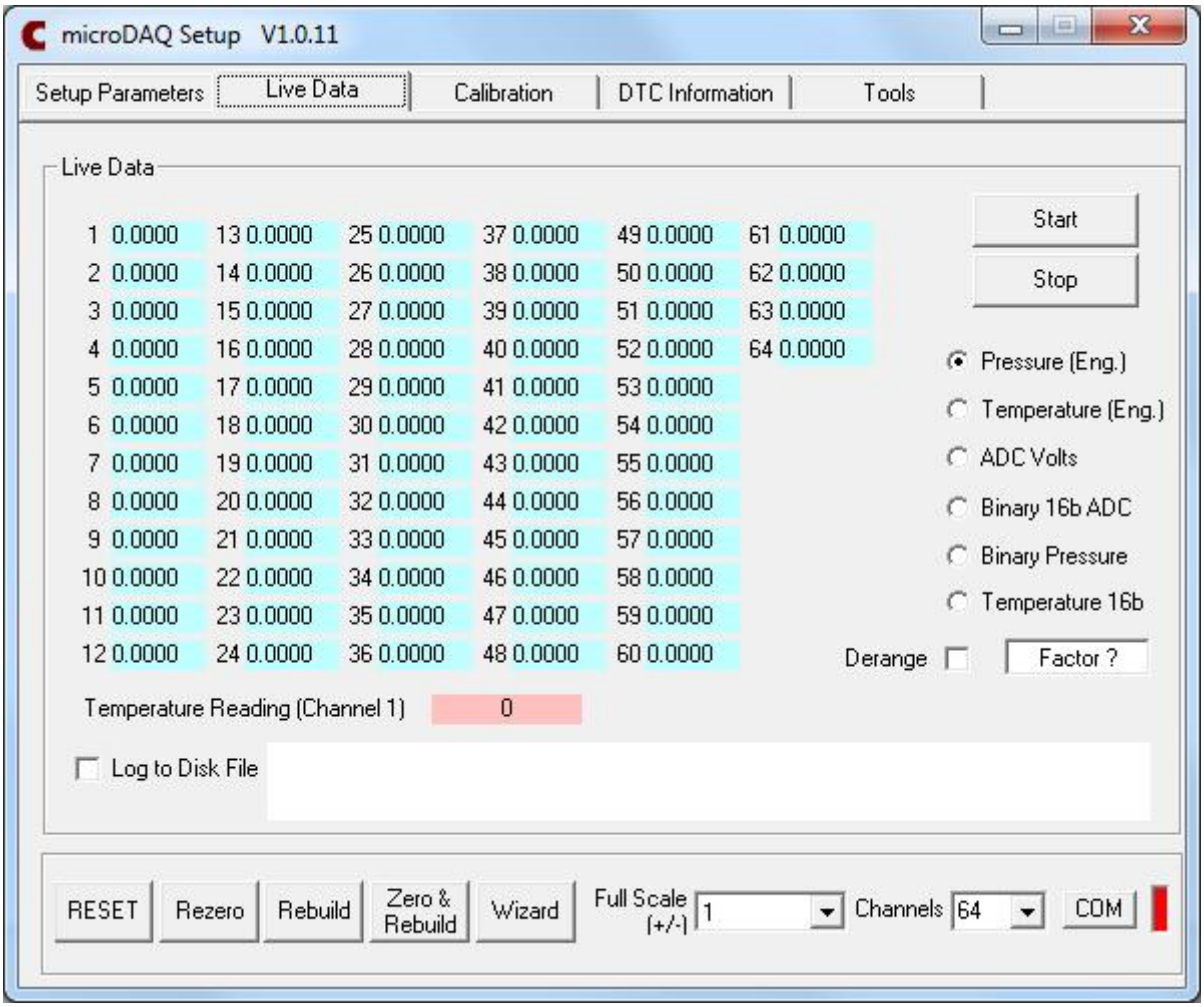

Figure 6.6, Contents of the Live Data Tab

The live data tab is a means to demonstrating the correct operation of microCAT and testing the unit's calibration. By selecting the correct number of channels for the attached scanner, the software shows a data label dedicated to each. The type of value shown in the label may be selected by means of the option buttons to the right of the frame, the user selecting between raw (decimal 16 bit unsigned), calibrated (decimal 16 bit unsigned) and engineering units or voltage scaled to the known full scales. Also for DTC scanners, the temperature values as raw unsigned 16 bit and calibrated engineering units may be displayed. For non DTC scanners, the temperature value read from the scanner is displayed in the Temperature Reading label. Once a type is selected, clicking the start button causes continuous reads of microCAT until the stop button is pressed. Clicking the start button will cause most of the function buttons within the software to be disabled, preventing their operation until the 'Stop' button is pressed.

The 'Derange' checkbox allows the application of a constant to the data in the case of the DTC deranging function being active - the value of this constant may either be typed into the text box, or reading the DTC header will automatically fill in this value

The live data may be logged to a comma delimited file by checking the 'Log to Disk File' checkbox. Checking the file causes a new file to be opened in the current data directory, with a filename of the form 'microDAQlive_DDMMYY_n.csv' (where DDMMY is the current date and n is a number incremented with each checking of the checkbox). Each time a set of live values is read from microCAT they are written in the current selected format to the disk file. Unchecking the checkbox

causes the current file to be closed. The name of the last file generated is shown in the white text box on the form.

6.4. 'Calibration'.

The 'Calibration' tab allows access to microCAT's existing non DTC calibration coefficients and provides a means to acquiring live calibration data and calculating new coefficients. The loading, saving and export of both tests and coefficients is also possible from this tab.

Calibrations may either be 3 temperature based for a temperature calibration, or by unchecking the 'Temperature Cal.' checkbox, a non temperature calibration may be performed at a single temperature. Figure 6.7 shows the 'Calibration' tab controls which are further explained in table 6.7.

The software maintains two sets of coefficients - those uploaded from microCAT and a local set, which is either loaded from the file of a previous calibration, or calculated from live or reloaded test data. Either of the two sets may be examined by choosing which is viewed via the 'Remote' or 'Local' tab, and selecting the channel from the dropdown box. The compare button may be used to compare the local set with the microCAT upload set to confirm a successful burning of new coefficients.

Other controls include the 'Send and Burn' button which writes the current local coefficients to microCAT EEPROM. The 'Clear' button sets all local coefficients to zero. The 'Actions' buttons may be seen in figure 6.8.

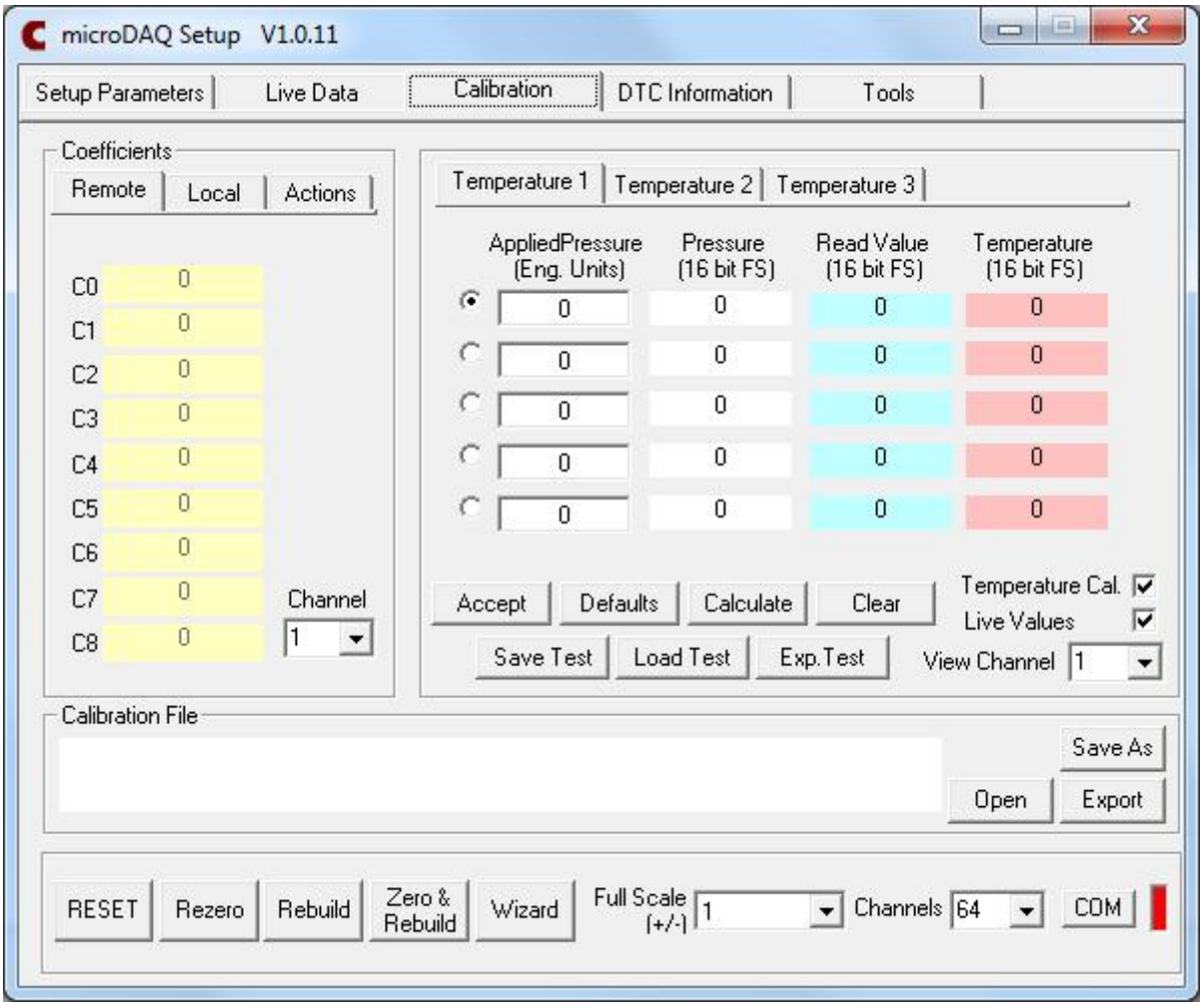

Figure 6.7, Contents of the Calibration Tab.

Control	Function
Temperature tabs	Select at which temperature the unit is currently been calibrated
Applied Pressure	The engineering units pressure setpoints - user entered, or set to standard values (+/- FS, +/-0.5FS, 0) by clicking 'Defaults'
Pressure 16 bit	The 16 bit unsigned representation of the pressure setpoints, calculated by the software
Read value 16 bit	The raw value read by microCAT from the pressure scanner for the pressure setpoint
Temperature 16 bit	The temperature value read by microCAT from the pressure scanner at that pressure setpoint
Accept button	Clicking 'Accept' stores the current read value as the calibration point, and moves on to the following setpoint
Defaults	Sets the default calibration points as +/- full scale, +/- 0.5 full scale and zero
Calculate	Takes the acquired data and calculates the derived calibration coefficients - will not proceed unless there is no more than one zero in the applied pressure text boxes
Clear	Clear the current calibration test data to zeroes, also clears the calibration controls
Save Test	Save the current calibration test data to a file - defaults to the current data directory
Load Test	Load the test data from a previous calibration - defaults to the current data directory
Exp. Test	Export the current calibration test data to a comma delimited text file
Temperature Cal.	When checked enables temperature tabs 2 and 3 for a 3 temperature calibration. Unchecked only temperature tab 1 is available to the user and the software will calculated coefficients for a non temperature calibration
Live Values	Unchecked, the live values from microCAT are inhibited from overwriting existing values in the calibration controls. Use when loading a previous test for examination or recalculation of coefficients
View channel	Select the channel that supplies the values displayed in the calibration controls
Remote Coefficients	
C0 – C8	Calibration coefficients uploaded from microCAT for the selected channel
Channel	Select the channel to view its current calibration coefficients
Local Coefficients	
C0 – C8	Calibration coefficients last calculated from a calibration test or loaded from a previous calibration
Channel	Select the channel to view its local calibration coefficients
Calibration Load/Save	
Calibration file	Shows the path and filename of a calibration file if loaded
Open	Load a file of coefficients from a previous calibration - defaults to the calibration file directory
Save As	Save the current local calibration coefficients to a file - defaults to the calibration file directory
Export	Export the current local calibration coefficients to a comma delimited text file - defaults to the current data directory

Table 6.7, 'Calibration' Tab Control Functions.

Figure 6.8 , 'Calibration' tab 'Action' buttons.

Control	Function
'Read Remote'	Upload the calibration coefficients currently stored in microCAT, to the software.
'Compare to Local'	Compare the values of coefficients uploaded from microCAT to those in the local memory, ie those either newly calculated or copied from another microCAT.
'Send + Burn'	Download the coefficients in the local memory to microCAT and burn them into EEPROM.
'Copy Remote'	Copy the coefficients over from the microCAT memory to the local memory.
'Clear Local'	Set all the local coefficients to zero.
'Check Cal.'	Compare the local and microCAT calibrations held in memory, and confirm if identical.
'Set Span'	Set the span of the linear calibration – confirms the value of pressure that has been set up as the span value is being applied to the sensor.
'Reset Linear Cal.'	Resets the linear calibration to (+ 0) x1 ie no offset, unity gain. Applies ONLY to the current linear calibration, ie the DTC calibration if using a DTC scanner.

Table 6.8 , 'Calibration' tab 'Action' button functions.

6.5. 'DTC Information.

The 'DTC Functions' tab gives the user access to an amount of information regarding the attached DTC scanner. The scanner voltages for temperature and excitation may be read and the position of the calibration shuttle valve determined as either being in 'RUN' or 'CAL.' mode. Also, the information contained in the scanner header may be uploaded and displayed. Note that the value of the parameter read from the scanner (ie temperature, excitation voltage and particularly valve position) is valid only for the time that it is read. To reduce the likelihood of a misleading reading being displayed, the displays are cleared after a number of seconds.

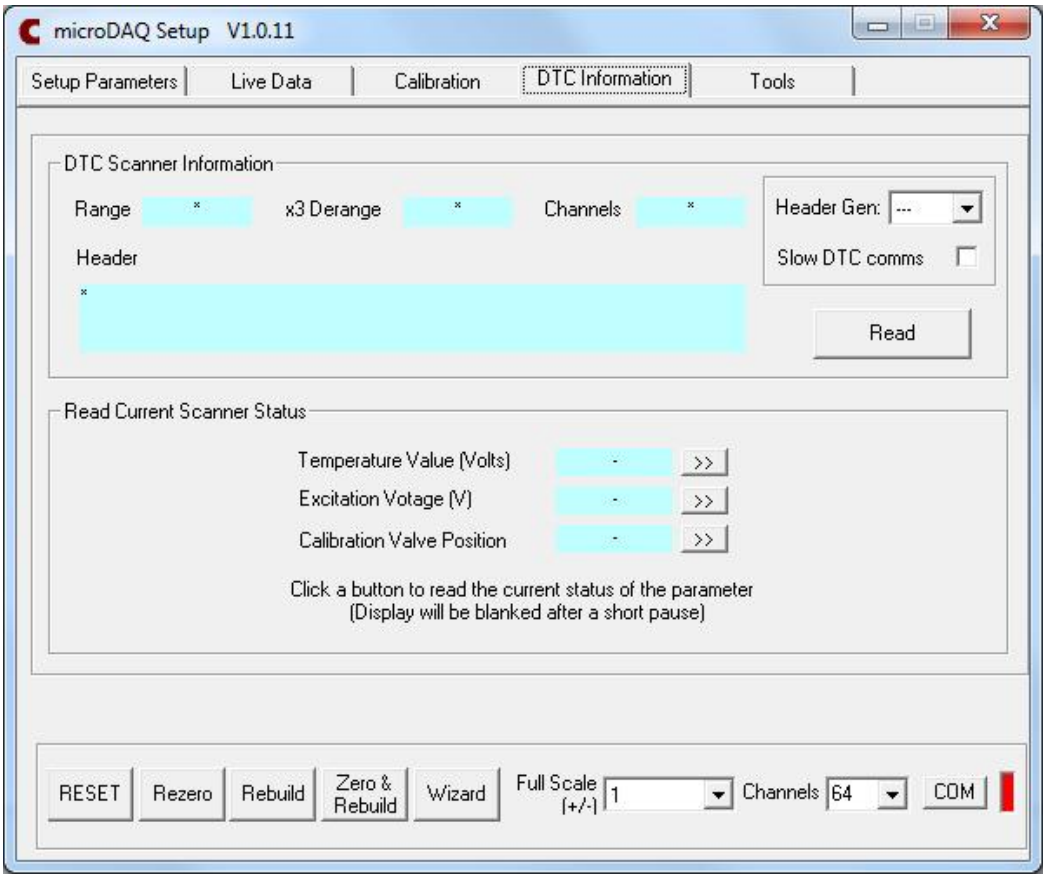

Figure 6.9, 'DTC Information' tab.

Control	Function
'Temperature (V)'	Click '>>' to read the current temperature voltage from the scanner.
'Excitation (V)'	Click '>>' to read the current excitation voltage from the scanner.
Calibration Valve Position	Click '>>' to read the valve position as 'RUN' or 'CAL'.
'Range'	Shows the floating point value for the range contained within the scanner.
'x3 derange'	Shows the floating point value for the sensitivity derange constant contained within the scanner.
'Channels'	Shows the floating point value for number of scanner channels.
'Read'	Uploads the data header from the DTC scanner, splits out the information and displays scanner full scale, the number of channels and the deranging factor. Also shown are the scanner model, serial number and date of manufacture.
Header Gen	Used to set the header generation of the attached scanner. Scanners with Gen2 headers do not require as much settling time between channel multiplexing and can hence acquire data faster.
Slow DTC comms	Retained from CANdaq Mk3 for historical purposes – not currently used

Table 6.9, 'DTC Functions' tab control functions.

7. Service and Calibration

7.1 Service

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

7.2 Calibration

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

7.3 Adjustment

There are no user adjustments inside the instrument. Adjustment is possible using the software provided. Contact Chell Instruments for advice and training. Removing the instrument covers may impare the users protection and may result in permanent product damage and invalidate the product Warranty.

7.4 Cleaning

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

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