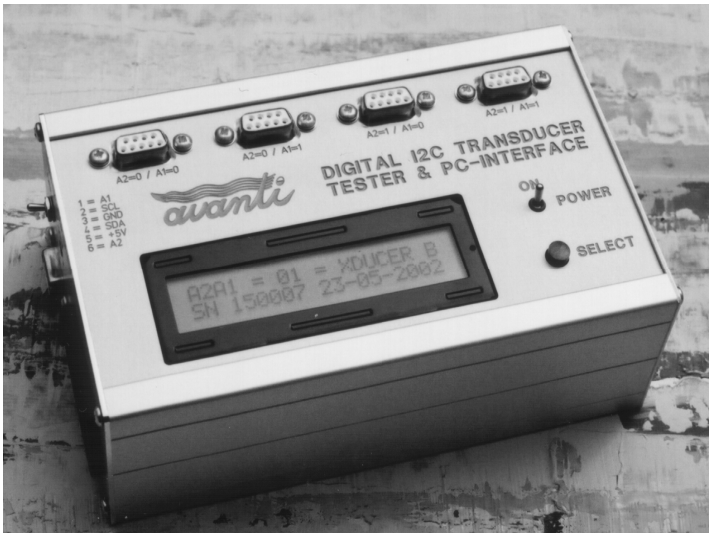
1. GENERAL

The Avanti I²C Transducer Tester and PC-Interface (AVA-03) is a standalone device for accessing pressure/temperature transducers, which are equipped with a two-wire serial I²C interface. It was designed to be compatible with Quartzdyne's range of digital quartz pressure transducers, including their V4.02 enhancements (checksum etc). Up to 4 transducers can be connected simultaneously and their readings are displayed on a backlit LCD. There is also an RS232 port provided, which allows to access readings and calibration coefficients from a PC.

2. HARDWARE DESCRIPTION

The AVA-03 I²C Transducer Tester is housed in an aluminium enclosure measuring 168 x 103 x 56mm.



Transducer Socket Pinout	
Pin-1	A1
Pin-2	SCL
Pin-3	GND
Pin-4	SDA
Pin-5	+5V
Pin-6	A2
Pin-7/8/9	NC

RS-232 Socket Pinout	
Pin-2	RX (of PC)
Pin-3	TX (of PC)
Pin-5	GND
Pin-1/4/6/7/8/9	NC

There are four 9-way D-type sockets (A...D) for connecting up to four I²C transducers. The connectors carry +5V, GND, SCL, SDA and two address lines A2 and A1. The address lines are either open (1) or grounded (0) and are coded differently at each socket: The first socket sets A2=0/A1=0, the second socket sets A2=0/A1=1, the third socket sets A2=1/A1=0 and the fourth socket sets A2=1/A1=1. This means that different I²C addresses are allocated automatically for each socket, provided the address pins are wired through to the transducers, see the examples shown in fig. 1 and fig. 2 below.

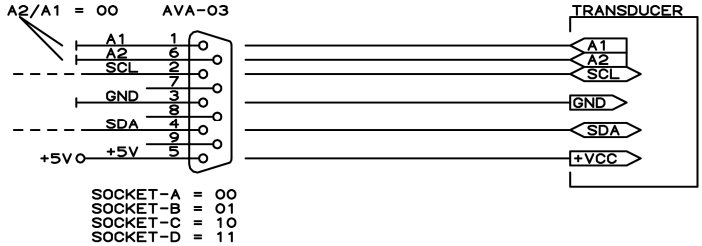


Figure 1: 6-wire connection, I²C address coded by the AVA-03 socket.

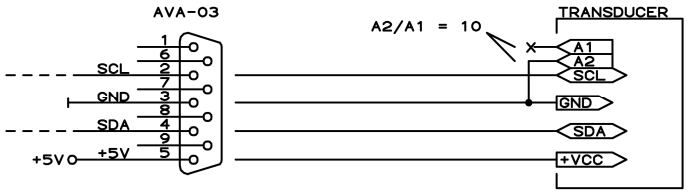


Figure 2: 4-wire connection, I²C address coded at the transducer.

Important: Some versions of Quartzdyne transducers are terminated with a D-type plug but with a different pin-out. Never plug directly into an AVA-03 socket! Use a cross-over cable and double check for correct wiring.
Avanti Elektronik Ltd assumes no responsibility and shall not be liable for any damage to the transducer that might occur due to incorrect wiring.

The AVA-03 I²C Transducer Tester contains a 2 x 20 character backlit LCD for displaying readings and status information. A push-button is provided to step through different display options. A further 9-way D-Type socket is located at the side for connecting to the RS232 port of a PC.

The I²C Transducer Tester runs on either the built-in 9V battery or on an external 12V supply. Note that the external supply voltage must be higher than the battery voltage in order to prevent the battery from inadvertently sourcing current. Current consumption is approximately 5mA when the backlight is off and approximately 125mA when the backlight is on.

3. LCD DISPLAY

After power on, the AVA-03 I²C Transducer Tester displays its version number and prompts the user to press the push-button to step through the available display options.

After pressing the button, the tester displays the I²C address of the first transducer (the transducer with the lowest address) together with its serial number and calibration date. A single character (A...D) is shown as an identifier in the top right corner, according to the current I²C address:
A for A2=0/A1=0, B for A2=0/A1=1, C for A2=1/A1=0 and D for A2=1/A1=1.
This identifier remains visible while stepping through the following displays, making it easy to keep track of multiple transducers.

After pressing the button, raw pressure and temperature counts are displayed as returned by the transducer. The counts are shown as 32bit hexadecimal values. The transducers are polled at a rate of once every 1.5 seconds by default, but the rate can be changed through a serial command, see paragraph 7 below. Note that the identifier letter in the top right corner briefly blinks whenever the display is refreshed.

Pressing the button once more advances to the frequency display. Pressure and temperature frequencies are displayed in Hz, under the assumption that the transducer's internal reference frequency is exactly 7.200MHz.

The next display shows pressure in psi (or bar) and temperature in °C (or °F) using the calibration coefficients held in the transducer's EEPROM memory.

Pressing the button again advances to the first display of the next transducer, i.e. the transducer with the next higher I²C address, showing again serial number and calibration date. Repeatedly pressing the button allows stepping through all available transducers in sequence:

LCD Display:	Description:
PRESS BUTTON TO STEP THROUGH OPTIONS	1. Start-up Screen
A2A1 = 00 = XDUCER A SN 000123 13-02-2022	2. Status Screen of the first transducer (lowest I²C address)
RAW-P = 0x00B60B61 A RAW-T = 0x01C71C72	3. Raw Values
PF = 20000.000 Hz A TF = 50000.000 Hz	4. Equivalent Frequencies
P = 11111.222 psi A T = 111.222 degC	5. Calculated P/T Values
A2A1 = 01 = XDUCER B SN 000456 14-02-2022	6. Status Screen of next transducer, if connected. Otherwise back to Status Screen of first transducer.

4. BACKLIGHT

The I²C Transducer Tester contains a backlit LCD. The backlight is permanently on when running on an external 12V supply. However, when running on the internal battery, the backlight is switched off after 30 seconds with no key press, in order to reduce the current consumption. The backlight is switched on again by simply pressing the button. In this case the display option remains unchanged and a second key press is required to advance to the next option.

5. CONFIGURATION

The AVA-03 I²C Transducer Tester can be configured for different display options. The configuration is held in non-volatile memory. To change the configuration, the tester must be switched off and then switched on again, while the push-button is being pressed down. This starts the tester in configuration mode.

There are 12 different options available, which can be selected in turn by repeatedly pressing the push-button:

1: BAR-ABS/DEGC	Absolute pressure is displayed in bar and temperature in °C.
2: BAR-GAUGE/DEGC	Gauge pressure (see paragraph 6.1) is displayed in bar and temperature in °C.
3: PSI-ABS/DEGC	Absolute pressure is displayed in psi and temperature in °C. **This is the default setup.**
4: PSI-ABS/DEGF	Absolute pressure is displayed in psi and temperature in °F.
5: PSI-GAUGE/DEGC	Gauge pressure (see paragraph 6.1) is displayed in psi and temperature in °C.
6: PSI-GAUGE/DEGF	Gauge pressure (see paragraph 6.1) is displayed in psi and temperature in °F.
7: BAR-ABS/DEGF	Absolute pressure is displayed in bar and temperature in °F.
8: BAR-GAUGE/DEGF	Gauge pressure (see paragraph 6.1) is displayed in bar and temperature in °F.
9: PSI/DEGC/DUAL-P	Absolute pressure is displayed in psi and temperature in °C. Initial screen shows pressure values of 2 transducers together (see paragraph 6.2).
10: PSI/DEGF/DUAL-P	Absolute pressure is displayed in psi and temperature in °F. Initial screen shows pressure values of 2 transducers together (see paragraph 6.2).
11: BAR/DEGC/DUAL-P	Absolute pressure is displayed in bar and temperature in °C. Initial screen shows pressure values of 2 transducers together (see paragraph 6.2).
12: BAR/DEGF/DUAL-P	Absolute pressure is displayed in bar and temperature in °F. Initial screen shows pressure values of 2 transducers together (see paragraph 6.2).

Once the desired configuration is shown on the screen, the tester is simply switched off. The tester remembers and applies this configuration when powered up again in the normal way.

6.1 ABSOLUTE / GAUGE PRESSURE

The AVA-03 I²C Transducer Tester can be configured to display absolute or gauge pressure (see paragraph 5 above). When gauge pressure is selected, the sequence of screens is as follows:

LCD Display:	Description:
PRESS BUTTON TO STEP THROUGH OPTIONS	1. Start-up Screen
A2A1 = 00 = XDUCER A SN 000123 04-12-2007	2. Status Screen
RAW-P = 0x00B60B61 A RAW-T = 0x01C71C72	3. Raw Values
PF = 20000.000 Hz A TF = 50000.000 Hz	4. Equivalent Frequencies
ATMOSPHERIC PRES: A P = 14.500 psi	5. Tare Screen: When the button is pressed again, the last pressure value displayed is captured and applied as an atmospheric offset until the unit is powered down.
P = 0.000 psig A T = 25.000 degC	6. Calculated pressure / temperature with atmospheric offset of -14.5 psi applied.

The tare screen is shown once only after power-up. The atmospheric offset remains valid until the tester is powered down. To change the atmospheric offset, the tester must be switched off and on again. In case of multiple transducers, the transducer with the lowest I²C address is used to determine the atmospheric offset. The same offset is then applied to all transducers.

6.2 DUAL PRESSURE DISPLAY

The AVA-03 I²C Transducer Tester can be configured to display two pressures together on the same screen (see paragraph 5 above). When dual-pressure is selected, the sequence of screens is as follows:

LCD Display:	Description:
`P1 = 11111.222 psi A` `P2 = 12222.333 psi B`	1. First screen after power up: Calculated pressures P1 and P2 of two transducers (shown here with addresses A2/A1 = 00 = A and A2/A1 = 01 = B)
`A2A1 = 00 = XDUCER A` `SN 000123 13-02-2022`	2. Status Screen of the first transducer
`RAW-P = 0x00B60B61 A` `RAW-T = 0x01C71C72`	3. Raw P/T values
`PF = 20000.000 Hz A` `TF = 50000.000 Hz`	4. Equivalent Frequencies
`P = 11111.222 psi A` `T = 111.222 degC`	5. Calculated P/T Values
`... B` `... B` `... B` `... B`	6. as above for the second transducer 7. 8. 9.
`P1 = 11111.222 psi A` `P2 = 12222.333 psi B`	10. Dual pressure screen again

P1 is allocated to the transducer with the lowest I²C address and P2 to the transducer with the second lowest I²C address. If more than two transducers are connected, the ones with higher I²C addresses are ignored and not displayed on the LCD. However their readings remain available through the RS232 interface (see paragraph 7 below).

7. RS232 INTERFACE

The Avanti I²C Transducer Tester & PC-Interface contains an RS232 port for direct connection to a Personal Computer via a 9-way D-type extension lead, where pins 2,3 and 5 are wired one-to-one. The tester communicates at 19200 baud with 1 start-bit, 8 data-bits and 1-stop bit.

All commands and responses are ASCII, so that simple terminal emulation software (e.g. Hyperterminal) can be used. All valid command characters are echoed. Invalid command characters produce a 0x07 (beep) instead and the command is aborted. Note that the command characters are case sensitive.

In order to prevent any command characters from being lost due to inherent delays (for instance when writing to the transducer's EEPROM), it is good practice to send command characters one by one and to wait for the echo before sending the next

character. This of course is irrelevant when manually typing commands using terminal emulation software.

The following commands are implemented:

HELP AND GENERAL INFO				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
??		Help request	2	??
	??	Echo	2	??
<CR> (0x0D)		Carriage return	1	<CR>
	<CR> (0x0D)	Echo	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

This command causes the I²C Transducer Tester to output a list of all implemented RS232 commands, plus the FPGA identifier and status of all connected transducers.

GET A RAW PRESSURE READING (COUNTS)				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
P		Pressure request	1	P
	P	Echo	1	P
A...D		Transducer address	1	A
	A...D	Echo	1	A
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	00000000... FFFFFFFF	32bit pressure count as 8 digit hex value	8	016C16C1
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line Feed	1	<LF>

GET A RAW TEMPERATURE READING (COUNTS)				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
T		Temperature request	1	T
	T	Echo	1	T
A...D		Transducer address	1	A
	A...D	Echo	1	A
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	00000000... FFFFFFFF	32bit temperature count as 8 digit hex value	8	01C71C72
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line Feed	1	<LF>

GET A CALCULATED PRESSURE READING (PSI OR BAR)				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
p		Pressure request (lower case p)	1	p
	p	Echo	1	p
A...D		Transducer address	1	A
	A...D	Echo	1	A
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	0.000 ... 99999.999	Pressure in psi or bar as a 5.3 floating point number	9	1234.567
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line Feed	1	<LF>

GET A CALCULATED TEMPERATURE READING (°C OR °F)				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
t		Temperature request (lower case t)	1	t
	t	Echo	1	t
A...D		Transducer address	1	A
	A...D	Echo	1	A
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	0.000 ... 99999.999	Temperature in °C or °F as a 5.3 floating point number	9	123.456
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line Feed	1	<LF>

CHANGE THE UPDATE RATE (TRANSDUCER POLLING RATE)				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
UR		Change update rate request	2	UR
	UR	Echo	2	UR
<CR> (0x0D)		Carriage return	1	<CR>
	<CR> (0x0D)	Echo	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

This command is only available in firmware versions 3.4 and later. It prompts the user to enter a new update rate (the rate at which the transducers are polled) in the range of 200ms to 1500ms in steps of 50ms, i.e. valid entries are 200ms, 250ms, 300ms ... 1500ms.

The new update rate is stored in non-volatile memory and remains valid when powered down. The refresh rate of the LCD display is not affected and remains at around 1.5s (nearest multiple of the chosen update rate) so that the display remains easy to read.

The currently applied update rate is shown on the LCD startup screen together with the firmware revision code. It can also be checked with the "??" help command.

READ FROM EEPROM				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
R		Read EEPROM request	1	R
	R	Echo	1	R
A...D		Transducer address	1	A
	A...D	Echo	1	A
0000...1FFF		Start address	4	0100
	0000...1FFF	Echo	4	0100
00...FF		Number of bytes to read (00 = 256)	2	0A
	00...FF	Echo	2	0A
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	00...FF	First data byte	2	8A
	...	...	...	...
	00...FF	Last data byte	2	E7
	< > (0x20)	Space	1	< >
	OK or NO	Result of operation	2	OK
	< > (0x20)	Space	1	< >
	0000...FFFF	Checksum over all data bytes	4	0171
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

WRITE TO EEPROM				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
W		Write to EEPROM request	1	W
	W	Echo	1	W
A...D		Transducer address	1	A
	A...D	Echo	1	A
0000...1FFF		Start address	4	0100
	0000...1FFF	Echo	4	0100
	< > (0x20)	Space	1	< >
00...FF		First data byte to write	2	8A
	00...FF	Echo	2	8A
...	...	...	...	... ...
00...FF		Last data byte to write	2	E7
	00...FF	Echo	2	E7
<CR> (0x0D)		Carriage return	1	<CR>
	< > (0x20)	Space	1	< >
	OK or NO	Result of operation	2	OK
	< > (0x20)	Space	1	< >
	0000...FFFF	Checksum over all data bytes	4	0171
	<CR> (0x0D)	Carriage return	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

SET SERIAL NUMBER AND CALIBRATION DATE				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
SN		Set serial number request	2	SN
	SN	Echo	2	SN
<CR> (0x0D)		Carriage return	1	<CR>
	<CR> (0x0D)	Echo	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

This command prompts the user to enter a new serial number and calibration date. The user can choose to keep the contents of all other EEPROM locations or to fill them with zeroes. Once acknowledged, the firmware writes to EEPROM and updates the checksum. The firmware writes the serial number and calibration date into 4 redundant locations, as introduced by Quartzdyne in Jan 2010.

COPY EEPROM CONTENTS				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
EC		EEPROM copy request	2	EC
	EC	Echo	2	EC
<CR> (0x0D)		Carriage return	1	<CR>
	<CR> (0x0D)	Echo	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

This command reads the EEPROM contents of one transducer and writes it to a second transducer. The user is prompted to choose the source and the destination transducer. Once acknowledged, the firmware copies EEPROM locations from 0x0000 to 0x00FF into 4 redundant blocks (0x0000-0x00FF / 0x0100-0x1FF / 0x0200-0x2FF / 0x0300-0x3FF), as introduced by Quartzdyne in Jan 2010.

START CONTINUOUS OUTPUT MODE				
PC SENDS	**TESTER RESPONDS**	**DESCRIPTION**	**BYTES**	**EXAMPLE**
CM		Continuous Mode request	2	CM
	CM	Echo	2	CM
<CR> (0x0D)		Carriage return	1	<CR>
	<CR> (0x0D)	Echo	1	<CR>
	<LF> (0x0A)	Line feed	1	<LF>

This command prompts the user to enter the required output rate in seconds (2, 4, 6 ... 300s), which transducer addresses to consider (ABCD) and the data type required (raw, calculated or both). The I²C Transducer Tester then starts sending data records together with elapsed time at the rate specified, which can be logged to file using Hyperterminal or similar PC software. Once started, continuous mode can only be stopped by switching the I²C Transducer Tester off and on again.

While continuous mode is active, the rate at which transducers are polled (and the LCD is refreshed) is reduced to once per 2.0sec. There will also be a slight delay noticeable when stepping through display options.

8. THIRD PARTY LOGGING/CHARTING SOFTWARE

As described above, all RS232 commands and responses contain only ASCII characters, allowing full access with standard terminal software like Hyperterminal. For basic data logging the AVA-03 can be put into continuous output mode with the "CM" command.

If more complex data logging or display/charting functions are required, there is a low-cost 3rd-party software available that runs on Windows PCs (see www.windmill.co.uk). Windmill-7 data logging software includes a user configurable parser that can be set up to suit the AVA-03 command set. Setup can be a bit tricky, but once configured the software is easy to use. Please note however, that this is 3rd-party software and beyond control of Avanti Elektronik Ltd. No guarantee can be given regarding its suitability and no support will be provided.

Below are some screenshots obtained with Windmill-7 software.

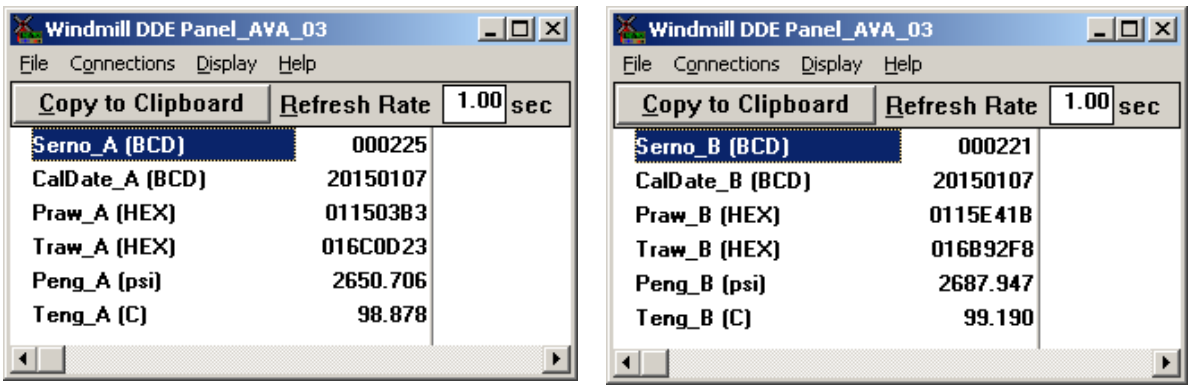


Figure 3: Windmill Data Display Panels showing 2 Transducers (A and B).

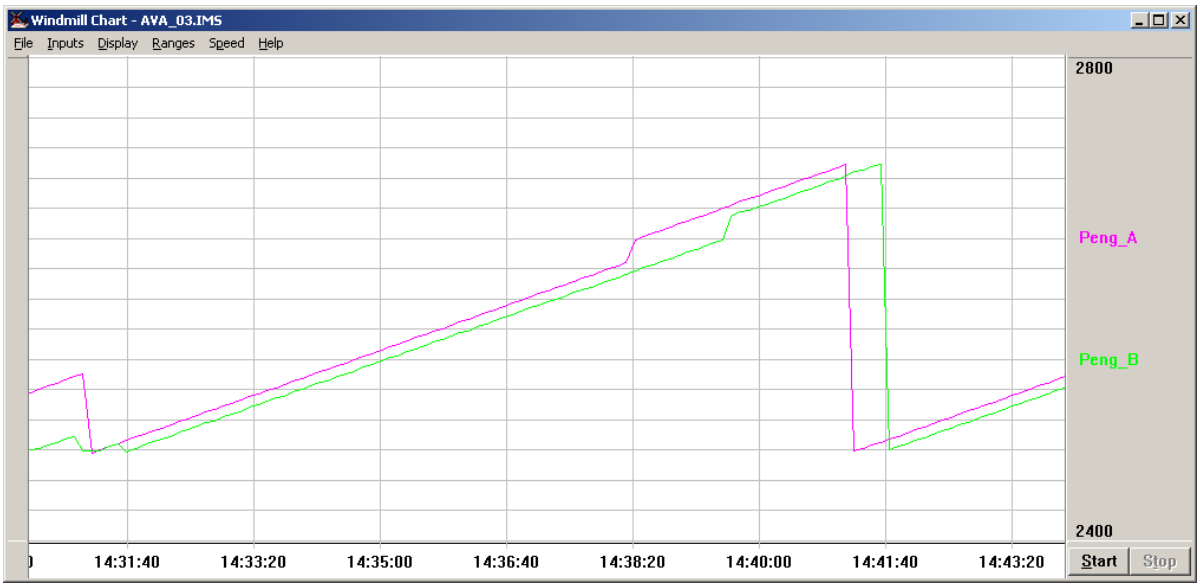


Figure 4: Windmill Charting Module displaying 2 Pressures (A and B)

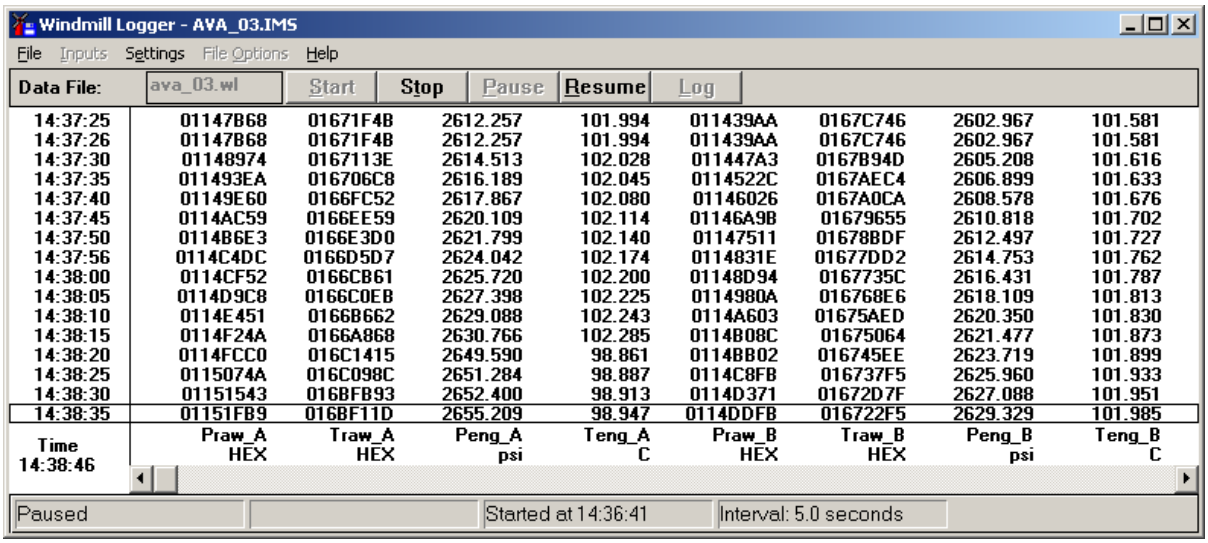


Figure 5: Windmill Data Logging Module writing raw and engineering values to file.

9. ACKNOWLEDGEMENTS AND FURTHER INFORMATION

Quartzdyne is a trademark of Quartzdyne Inc.
Information on their range of digital pressure transducers can be downloaded from their web-site at http://www.quartzdyne.com
The following documents are of particular interest:
DigitalTransSpec.pdf - Digital Quartz Pressure Transducer Specifications
DigitalTransProg.pdf - Digital Transducer Programming Manual

I²C is a trademark of NXP Semiconductors (formerly Philips).
Specifications and application notes can be downloaded from their web-site at http://www.nxp.com
For I²C bus specifications refer to the following document:
i2c.bus.specification.pdf (I²C Specification and User Manual Rev.03 / 2007)

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Model No.	AVA-03
Serial Number	
Firmware Revision	
Date Tested	
Signature	