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 I²C Transducer Tester is housed in an aluminium enclosure measuring 168 x 103 x 56mm. There are four 9-way D-type sockets for connecting 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. **Note that Quartzdyne transducer cables that are terminated with a D-type plug have a different pin-out.**

The I²C Transducer Tester contains a 2 x 20 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.

Transducer Socket Pinout	
Pin-1	A1
Pin-2	SCL
Pin-2	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

3. DISPLAY OPTIONS

After power on, the 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. Note that the identifier letter in the top right corner briefly blinks whenever the display is updated.

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 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.

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. ENGINEERING UNITS

The I²C Transducer Tester can be configured to display pressure in psi or bar (absolute or gauge) and temperature in °C or °F. 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 8 different options available, which can be selected in turn by repeatedly pressing the push-button. 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. ABSOLUTE / GAUGE PRESSURE

The I²C Transducer Tester can be configured to display absolute or gauge pressure. When gauge pressure is selected, the sequence of screens is as follows:

LCD Display:	Description:
PRESS BUTTON TO STEP THROUGH OPTIONS	Start-up Screen
A2A1 = 00 = XDUCER A SN 000123 04-12-2007	Status Screen
RAW-P = 0x00B60B61 A RAW-T = 0x01C71C72	Raw Values
PF = 20000.000 Hz A TF = 50000.000 Hz	Equivalent Frequencies
ATMOSPHERIC PRES: A P = 14.500 psi	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	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.

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>

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, 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 updated) is reduced from once per 1.5sec 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. No guarantee can be given regarding its suitability and no support will be provided.

Below are some screenshots obtained with Windmill-7 software.

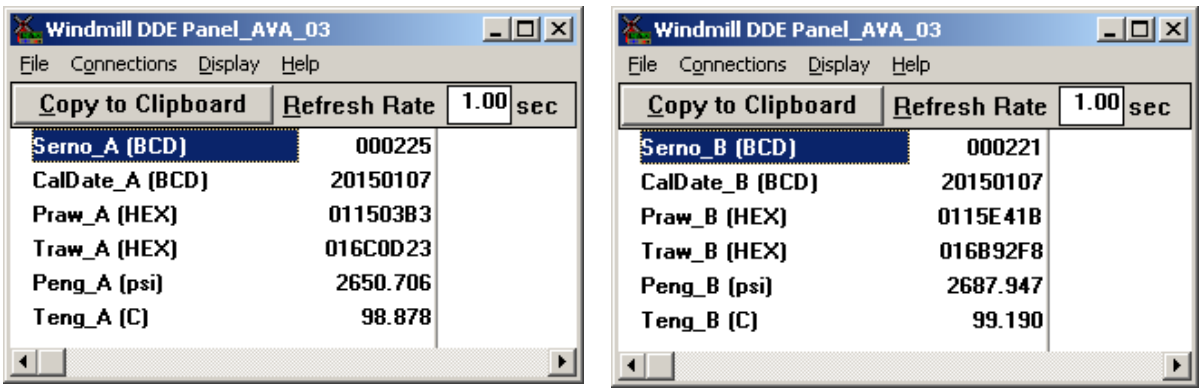

Figure 1: Windmill Data Display Panels showing 2 Transducers (A and B).

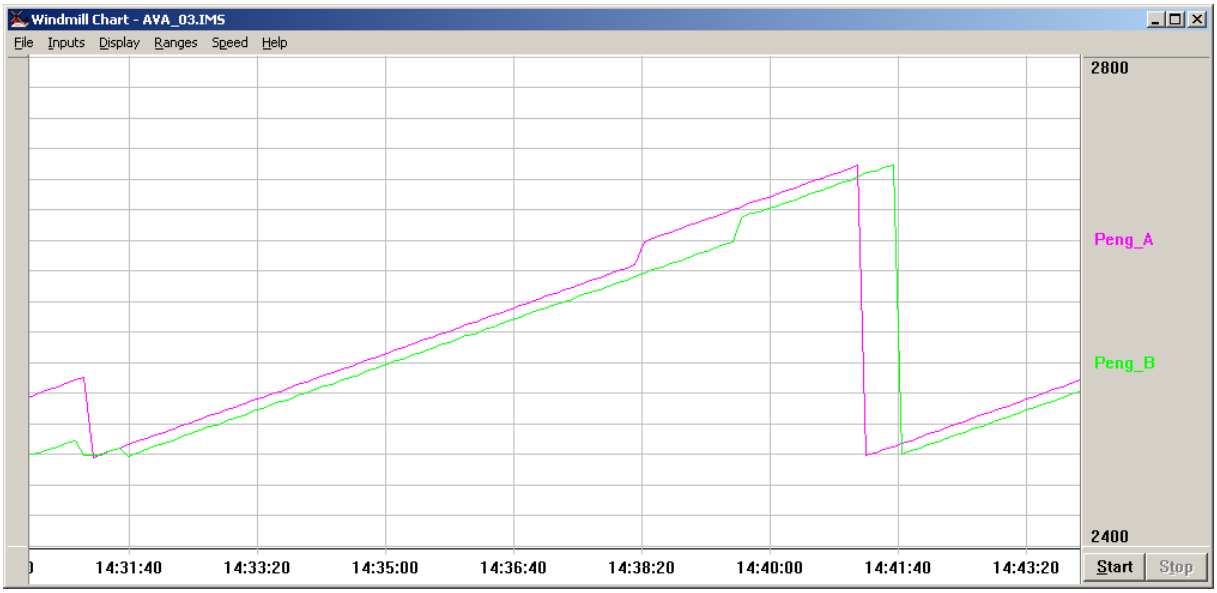

Figure 2: Windmill Charting Module displaying 2 Pressures (A and B)

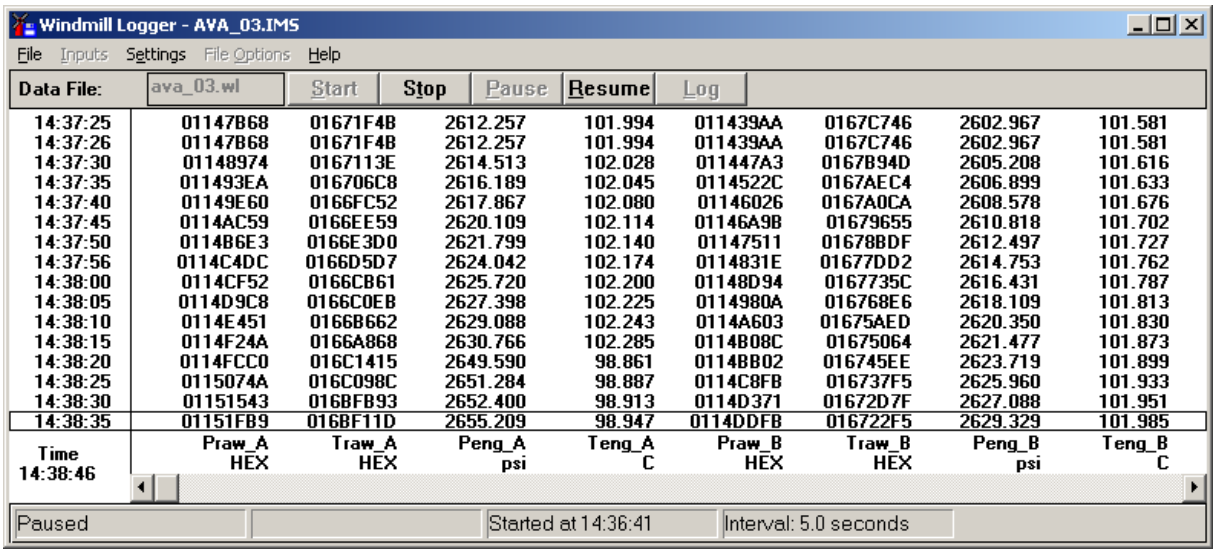

Figure 3: Windmill Data Logging Module writing raw and engineering values to file.

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	