1. INTRODUCTION

Quartz pressure/temperature transducers are widely used in the oil industry for measuring downhole pressure and temperature with very high accuracy. Quartzdyne (www.quartzdyne.com) is the leading manufacturer of quartz transducers, of which there are two categories: Analog and Digital transducers (although the term 'analog' is slightly misleading here, but commonly used).

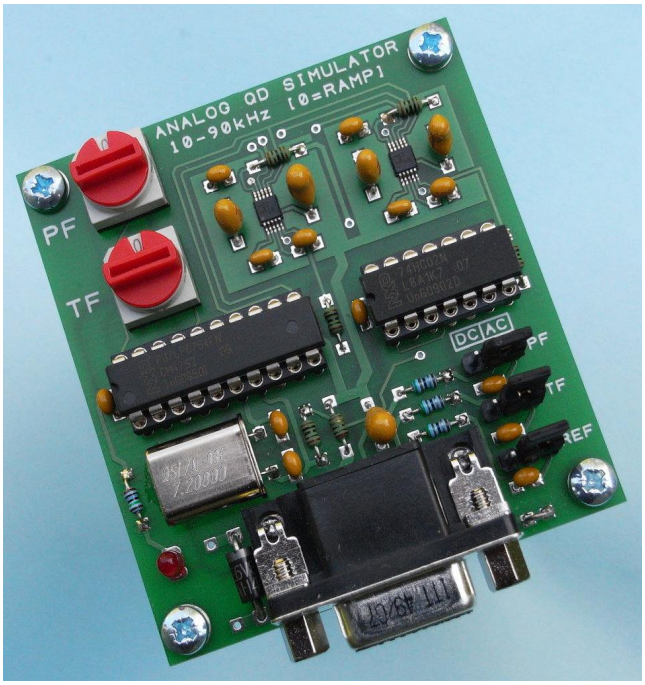
Analog transducers have frequency outputs, i.e. they produce frequency signals that are proportional to pressure and temperature. They also output a reference frequency, to be used as a timebase for measuring the pressure and temperature frequencies externally.

Digital transducers operate in the same way, but include circuitry for counting pressure and temperature frequencies internally. The converted frequency values can be accessed via a digital two wire interface (I²C), hence the name 'digital'.

Avanti offers simulators for both types of transducers. The AVA-06, which is the subject of this document, is a low cost analog (i.e. frequency output) simulator. An alternative analog simulator with extended features is also available (AVA-01). The third in the range is the AVA-02, which is a digital simulator with I²C interface. For details see the Avanti website (www.avanti.clara.net).

Transducer simulators (sometimes also called dummy transducers) allow testing and characterising of data acquisition systems in the absence of a real transducer. Due to its low cost, the AVA-06 is particularly suited for production testing of downhole boards.

2. FUNCTIONAL DESCRIPTION

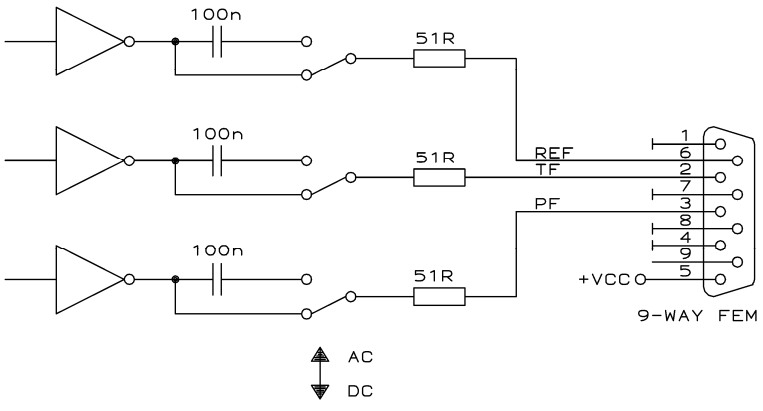


The AVA-06 simulator consists of a small standalone PCB (60x65mm), containing a micro-controller clocked by a 7.2MHz reference crystal and two DDS chips for generating pressure and temperature frequencies. Since all three frequencies are derived from the same crystal, the signals are ratiometric. Drifts in the 7.2MHz crystal have no effect on the pressure/temperature measurement, provided the reference frequency is used as the counting reference.

Pressure and temperature frequencies can be selected independently by means of two rotary switches, labelled PF and TF. Each switch has 9 fixed frequency settings from 10kHz to 90kHz, plus one setting, which produces a linear frequency ramp (saw tooth).
All three signals are buffered by standard 74HC gates with 51R series resistors and optional 100nF series capacitors. Jumper links are provided to select between DC-coupling (51R), AC-coupling (51R + 100nF) or signal off (jumper link removed).

The simulator operates with supply voltages between 3V and 5V. A status LED is provided, which lights up as soon as the simulator outputs are activated. There is a deliberate start-up delay of 500ms after power up, in order to simulate the worst-case oscillator start-up time of a real transducer.

Current consumption is similar to that of a real transducer, but depends on the loading of the signals. Connections are made via a 9way D-Type socket. The pinout is shown below. The pinout is also printed on the bottom side of the circuit board. **Note that Quartzdyne transducer cables that are terminated with a D-type plug have a different pinout.**



Pin-1	GND
Pin-2	TF
Pin-3	PF
Pin-4	GND
Pin-5	+VCC (3...5V)
Pin-6	REF
Pin-7	GND
Pin-8	GND
Pin-9	Not Connected

3. OUTPUT FREQUENCIES

Pressure and temperature frequencies can be set independently by means of two rotary switches. For positions 1...9 the returned value is the switch position multiplied by 10kHz, i.e. 10...90kHz. In switch position 0 a ramp is generated, which is repeated every 10 minutes. The pressure ramp starts at 30kHz and ramps upwards at a rate of 1Hz per second. The temperature ramp starts at 40kHz and ramps downwards at a rate of -1Hz per second.

Switch Position	PF (nominal)	TF (nominal)
1	10000 Hz	10000 Hz
2	20000 Hz	20000 Hz
3	30000 Hz	30000 Hz
4	40000 Hz	40000 Hz
5	50000 Hz	50000 Hz
6	60000 Hz	60000 Hz
7	70000 Hz	70000 Hz
8	80000 Hz	80000 Hz
9	90000 Hz	90000 Hz
0	Ramp (value updated every 20ms): 30000...30600 Hz at +1Hz/sec => Sawtooth edge every 10 minutes	Ramp (value updated every 20ms): 40000...39400 Hz at –1Hz/sec => Sawtooth edge every 10 minutes

Note that the frequency values in the table above are nominal values. PF and TF are derived by Direct Digital Synthesis (DDS) from the 7.2MHz reference crystal. The reference crystal is not trimmed and may therefore vary by up to ±100ppm. This means that PF and TF may also be off their nominal values by up to ±100ppm. PF and TF may also show jitter of ±1 reference cycles (138ns). However, if the 7.2Mhz signal is used as the counting reference (or timebase) for the PF/TF measurement, none of these inaccuracies have any effect on the conversion result. The result is always the nominal value ±0.0067Hz (0.0134Hz being the smallest step size of the DDS chips).

4. SPECIFICATION

Supply Voltage	2.7V – 5.3V (absolute maximum)
Supply Current (outputs not loaded)	4.6mA – 4.9mA @ 3.0V 8.1mA – 8.4mA @ 5.0V depending on output frequencies generated
Reference Frequency	7.2MHz ±100ppm
Pressure / Temperature Frequency	10kHz – 90kHz (±100ppm)
Pressure / Temperature Frequency Jitter	<138ns
Accuracy of Pressure / Temperature Frequency relative to Reference Frequency	±0.0067Hz
Update Rate when Ramping	20ms
Signal Output	74HC with 51R series resistor + optional 100nF series capacitor
Startup Delay (from power-on until outputs enabled)	500ms
Connector	9-way D-Type socket (female)
Circuit Board Dimensions	60mm x 65mm (excluding D-Type socket)

5. CAUTION

- Double check wiring before powering up.
- Do not exceed the maximum supply voltage of 5.3V. Use a current limited power source if possible.
- Use AC coupling if possible, since this provides better protection of the simulator outputs in case of a wrongly wired connector.
- Avoid touching component pins and PCB pads to minimise the risk of damage through electrostatic discharge (ESD). Also, the surface mount DDS chips are very delicate and could easily be damaged mechanically.

Avanti Part Number: AVA-06 Avanti Serial Number: 0001

Tested: