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LVDT/Voice Coil Electronics/Geophone

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Abstract

Read out and driver Electronics for the SAS tower, this includes
LVDT readout and voice coil drivers and Geophone pre amplifiers

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Contents

1 :LVDT input module

The Read out and conditioning electronics, its basically a synchronic demodulator build around the AD630 from analog. As first the signal from the LVDT coil is feed through a common mode filter to suppress RFI. Then amplified with a instrument op amp. Then fed to the demodulator. The demodulated signal is filtered with a low pass filter.

On the board are pot meters to adjust the gain, and drive levels for the primary coil of the LVDT.On the front of the module are high precision foil pot meters to adjust the phase for the reference signal The reference signal is fed to the demodulator. A signal copy of the reference signal is available on the front of the module

The output signals are fed through the 96 pin DIN connector to the backplane

1.1 LVDT input module pin out

Description connects LVDT input module

- LVDT_X_X Input module
- LVDT_EXT_X_X Primary coil

Table 1 LVDT Input module SUB D 0

Pin	Function
1	LVDT_0_P
2	LVDT_1_P
3	LVDT_2_P
4	LVDT_3_P
5	GND
6	LVDT_0_N
7	LVDT_1_N
8	LVDT_2_N
9	LVDT_3_N

Table 2 LVDT Input module SUB D 0

Pin	Function
1	LVDT_EXT_0_P
2	LVDT_EXT_1_P
3	LVDT_EXT_2_P
4	LVDT_EXT_3_P
5	GND
6	LVDT_EXT_0_N
7	LVDT_EXT_1_N
8	LVDT_EXT_2_N
9	LVDT_EXT_3_N

1.2 Power supply equipments

Table 3 Power requirements for LVDT input module

Voltage [V]	Current [mA]
+18V	154
-18V	154

1.3 Adjustment points

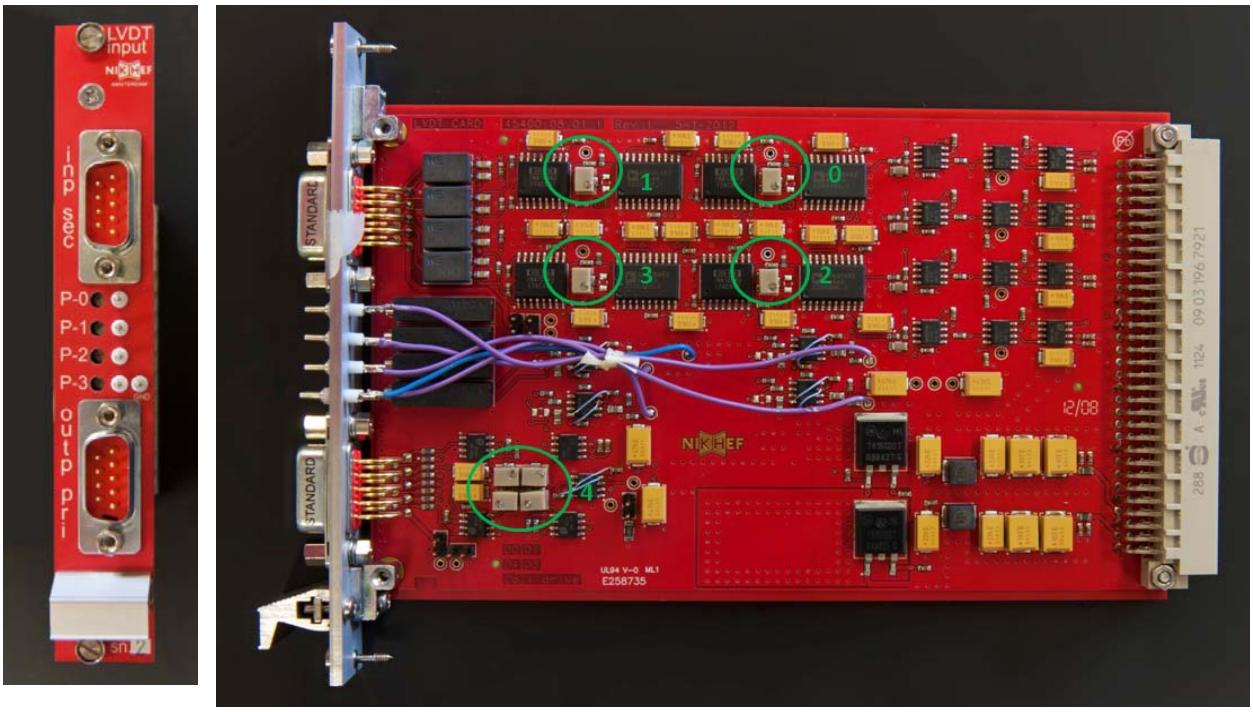

Figure 1 Board and adjustment point shown.right the board, at the left the front.

In Figure 1 is a photo shown of a LVDT input module. The adjustment points are marked. In Table 1 is the function shown. For phase adjustment the test point and adjustment pot meter are available on the front.

Table 4 Location adjustment points

Number	Funtion
0	Gain channel 0 and test point
1	Gain channel 1 and test point
2	Gain channel 1 and test point
3	Gain channel 1 and test point
4	Drive levels primary coil

1.4 Test results

For all test the driving level of the reference signal is 10Vpeak @ 10KHz. The output of the LVDT is loaded with a 600 Ohm resistor. Over this resistor are the measurement performed.

With the aid of a FFT Analyzer (Agilent 35670A) the output spectrum of the LVDT card measured, in Figure 2 the output spectrum shown.

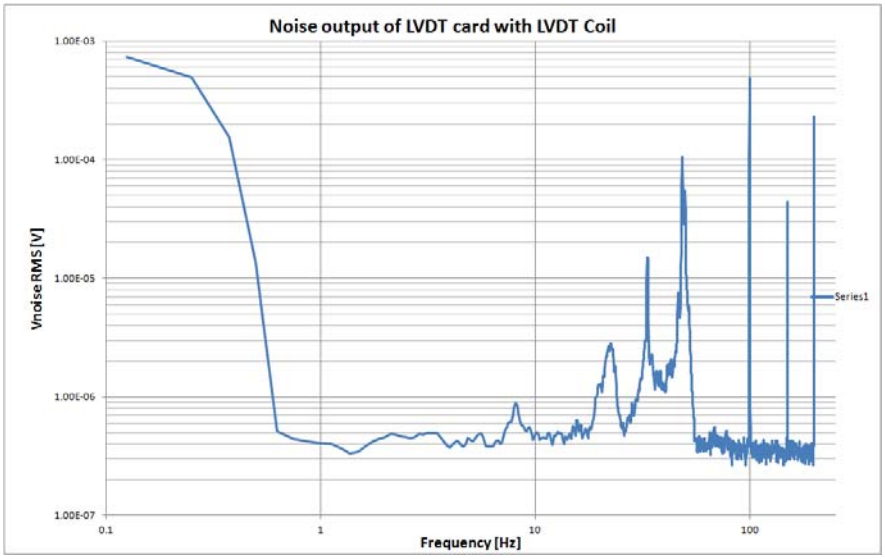

Figure 2 Output of the LVDT Input module with LVDT connected to the inputs.

In Figure 6 is a photo shown of the test setup
In the next Figure 3 is the result shown where the input of LVDT input module is terminated with 50 Ohm. This gives a noise level of 360nV√Hz @ 10Hz.

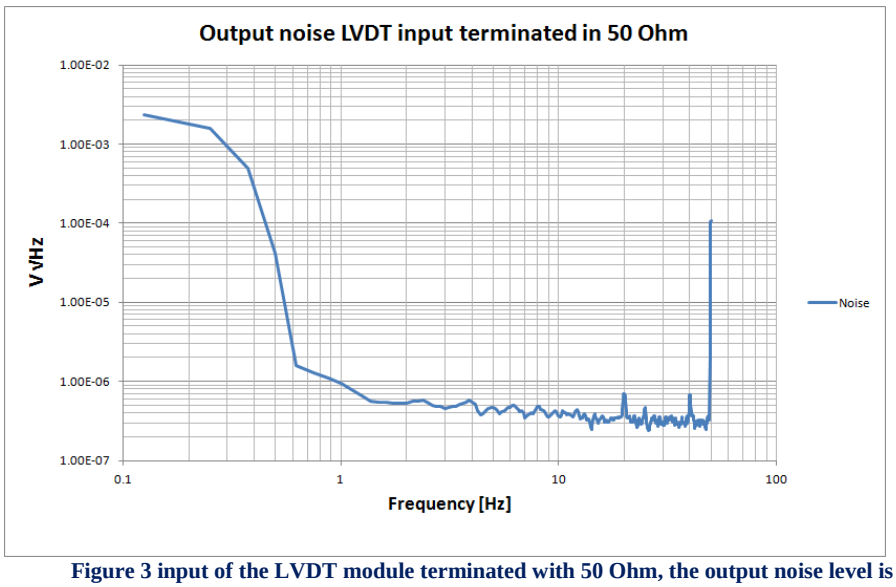

Figure 3 input of the LVDT module terminated with 50 Ohm, the output noise level is shown

As next the DC level was measured of the LVDT card. This was done by short the input with 50 Ohm. Whit the aid of a Agilent 3458a Multimeter the DC output voltage is measured. In Figure 4 is the result shown.

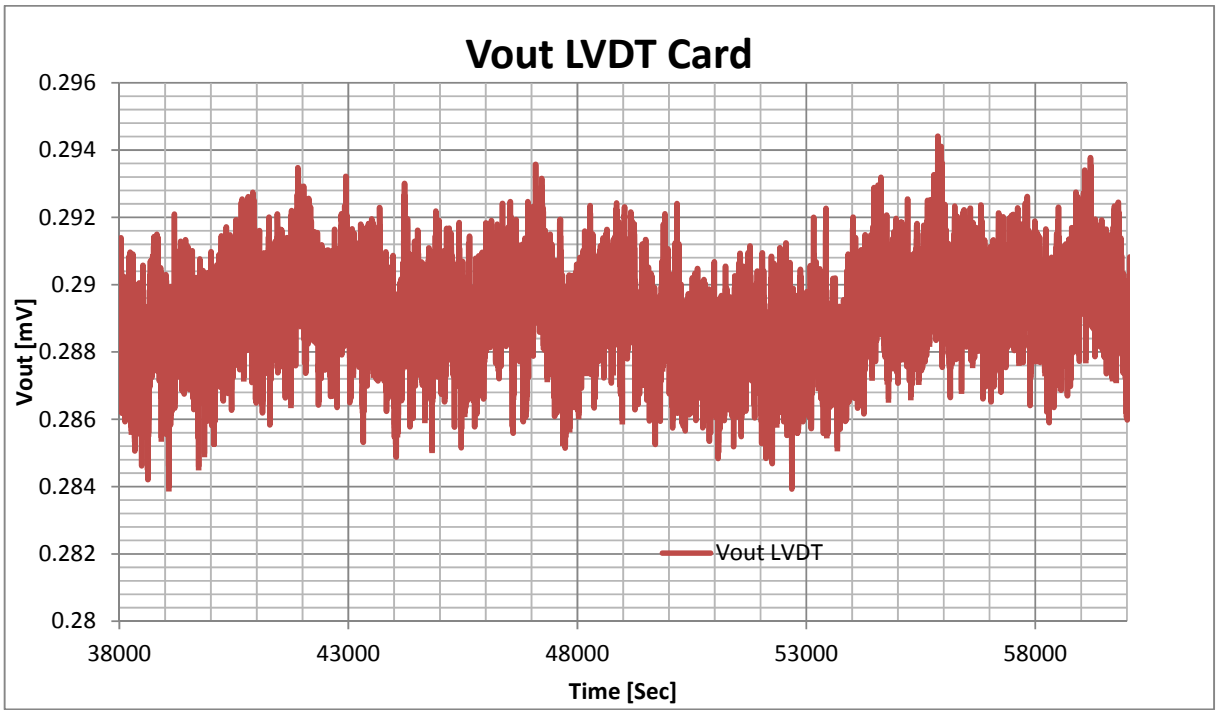

Figure 4 Measured DC stability ofthe LVDT CARD over 22000 Seconds.

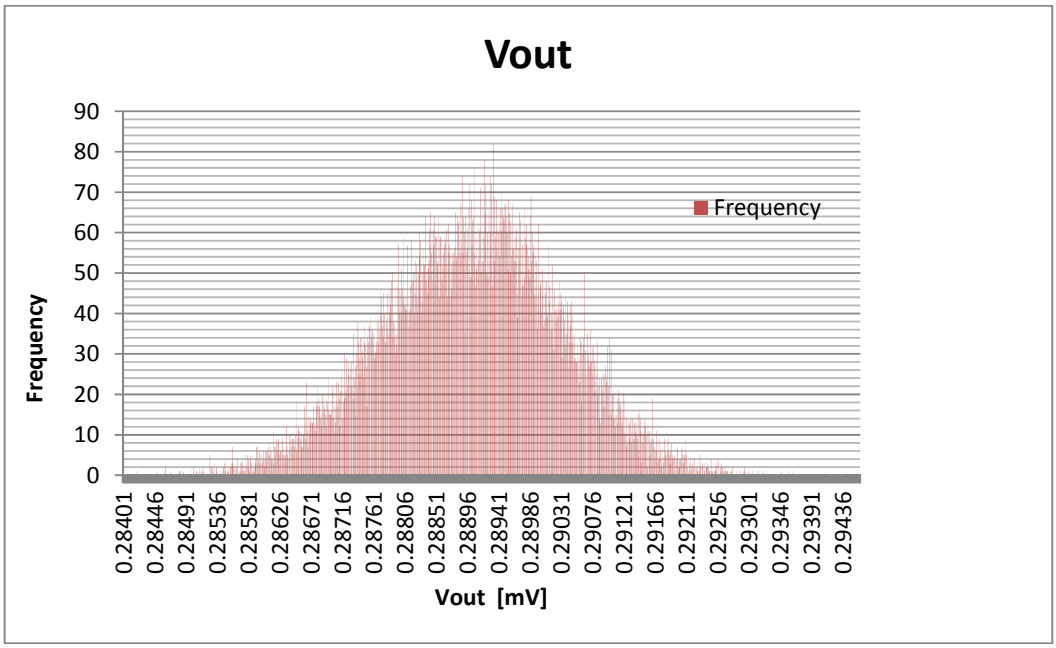

Figure 5 Histogram of the DC output voltage when the input is terminated with 50 Ohm

Table 5

Parameter		Unit
Mean output voltage	289.0335	uV
Devation	1.2888	uV

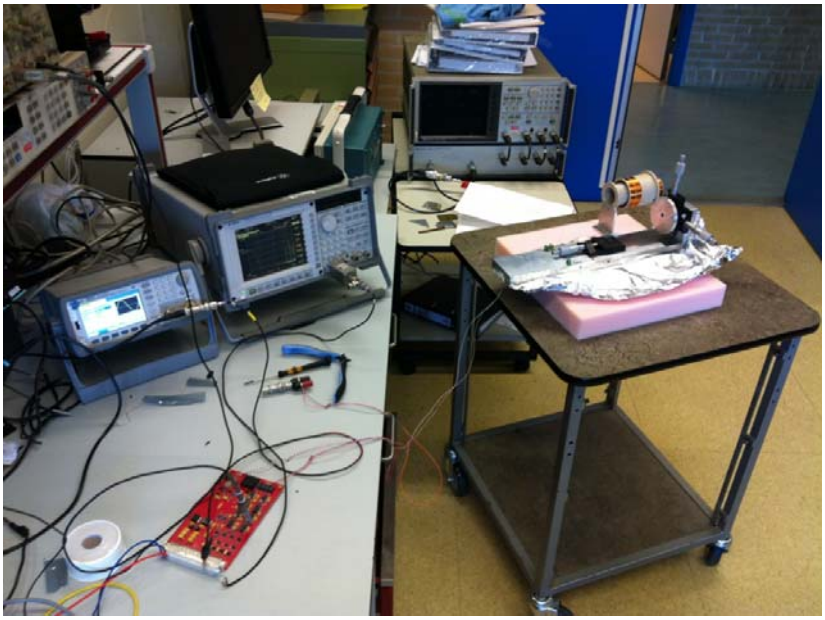

Figure 6 Test setup.

1.5 Schematic name/location

45400_08011_LVDT_INPUT_MODULE.pdf

2 VoCo (Voice Coil Driver)

It is basically a voltage to current convertor. Where the output is buffered with a power opamp. This module accepts differential signals via a backplane connector. Per Voice coil channel the drive level can be adjusted by means of a attenuator. -12 dB of -8 dB. The drive current through the coil is measured and made available on the front of the module. The sensitivity is settable by means of a jumper 10V per A of 22V per A

2.1 VoCo Pinout

Table 6 To Voice Coil (Output)

Pin	Function
1	COIL_0_P
2	COIL_1_P
3	COIL_2_P
4	COIL_3_P

5	GND
6	COIL_0_N
7	COIL_1_N
8	COIL_2_N
9	COIL_3_N

Table 7 Voice coil feed back to ADC (Monitor)

Pin	Function
1	COIL_0_P_F
2	COIL_1_P_F
3	COIL_2_P_F
4	COIL_3_P_F
5	GND
6	COIL_0_N_F
7	COIL_1_N_F
8	COIL_2_N_F
9	COIL_3_N_F

2.2 Power supply requirements

Table 8

Voltage [V]	Current [mA] no load
+18V	81
-18V	81

2.3 Photo PCB and adjustment points

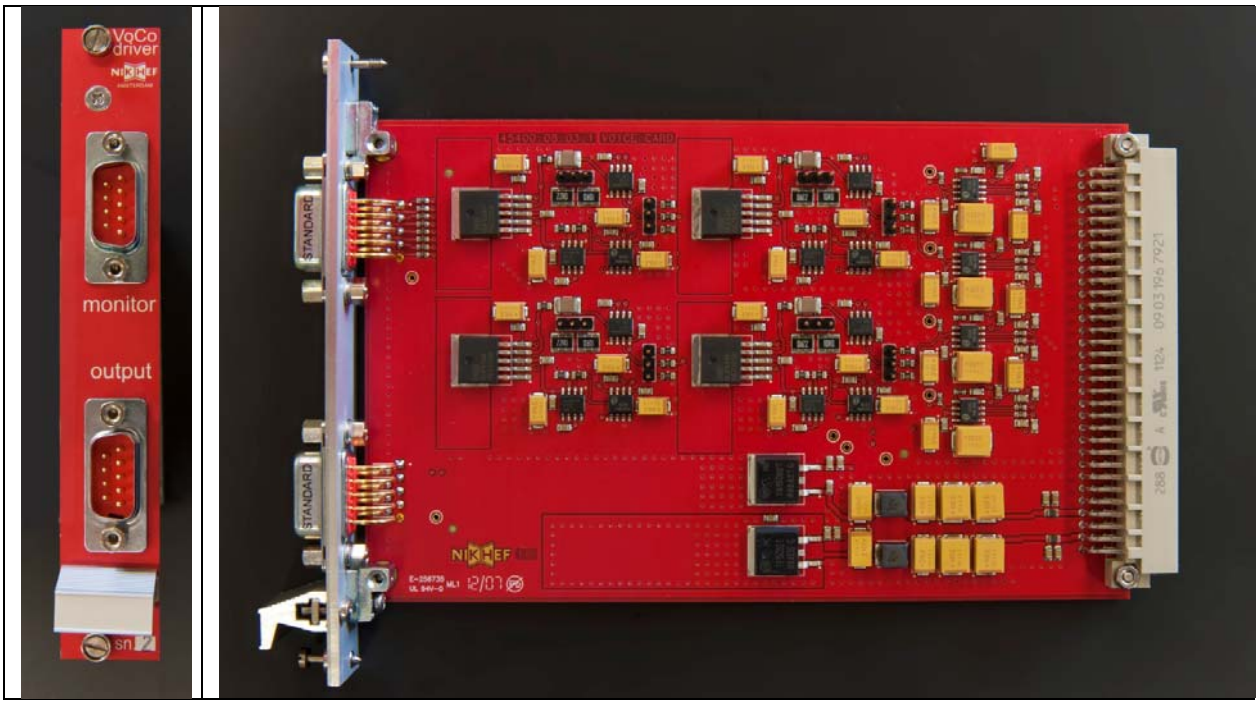

Figure 7 Board and front shown of a Voice coil drive module.

In Figure 7 is a photo shown of the VoCo drive module in Figure 8 is a close up shown of one channel in Table 9 is a description shown of the jumpers

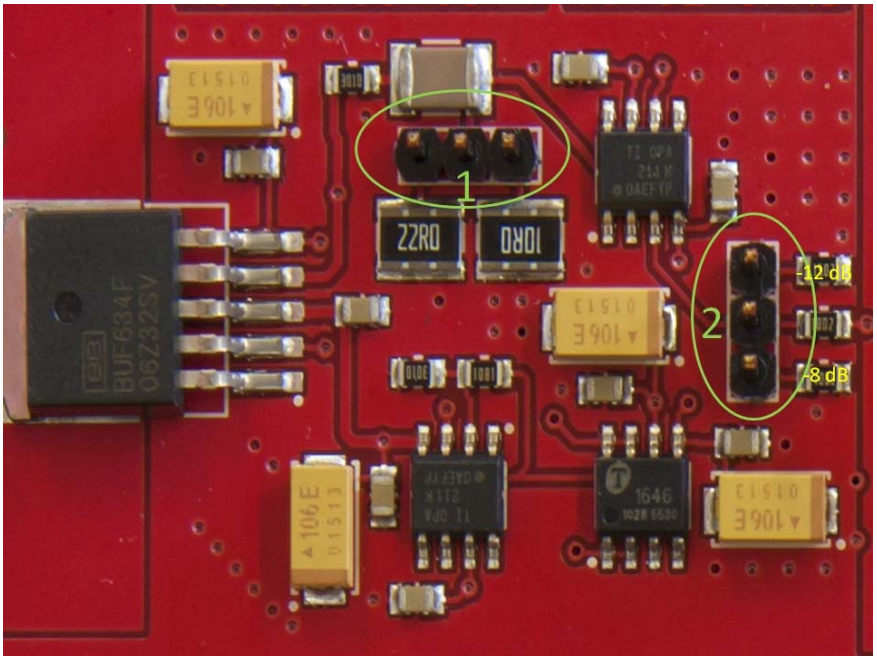

Figure 8 Close up of one voice coil channel.

Table 9 Function of the jumpers

Number	Function
1	Sensitivity monitor coil current
2	attenuator.

2.4 Schematic/location name

45400_08031_VOICE_CARD_MODULE.pdf

3 LVDT Main Module

The function of the LVDT main module is to split the reference signals to the LVDT modules. Future more the module extracts the signals of the LVDT modules from the backplane and provide it to the front connectors. The AD797 op amps are changed to a other type the OPA211. Reason for this the AD797 op amps was oscillating, around 20 MHz This was not solvable on the board. The OPA211 has more of less noise performance. But has a lower gain bandwidth product.

One drawback of this type op amp this one is not capable to drive a 50 Ohm load. Only the first main module should be terminated. The loop out to next module, should not be terminated! (on the module). In a next revision of the module a other op amp is planned to drive a 50 Ohm load.

3.1 LVDT input module pin out

Table 10 Sub D LVDT module 0

Pin	Function
1	DAC_LVDT_0_P
2	DAC_LVDT_1_P
3	DAC_LVDT_2_P
4	DAC_LVDT_3_P
5	GND
6	DAC_LVDT_0_N
7	DAC_LVDT_1_N
8	DAC_LVDT_2_N
9	DAC_LVDT_3_N

Table 11 Sub D LVDT module 1

Pin	Function
1	DAC_LVDT_4_P
2	DAC_LVDT_5_P
3	DAC_LVDT_6_P
4	DAC_LVDT_7_P
5	GND
6	DAC_LVDT_7_N
7	DAC_LVDT_7_N
8	DAC_LVDT_7_N
9	DAC_LVDT_7_N

3.2 Power supply requirements

Table 12

Voltage [V]	Current [mA]
+18V	81
-18V	81

3.3 Photo LVDT Main Module

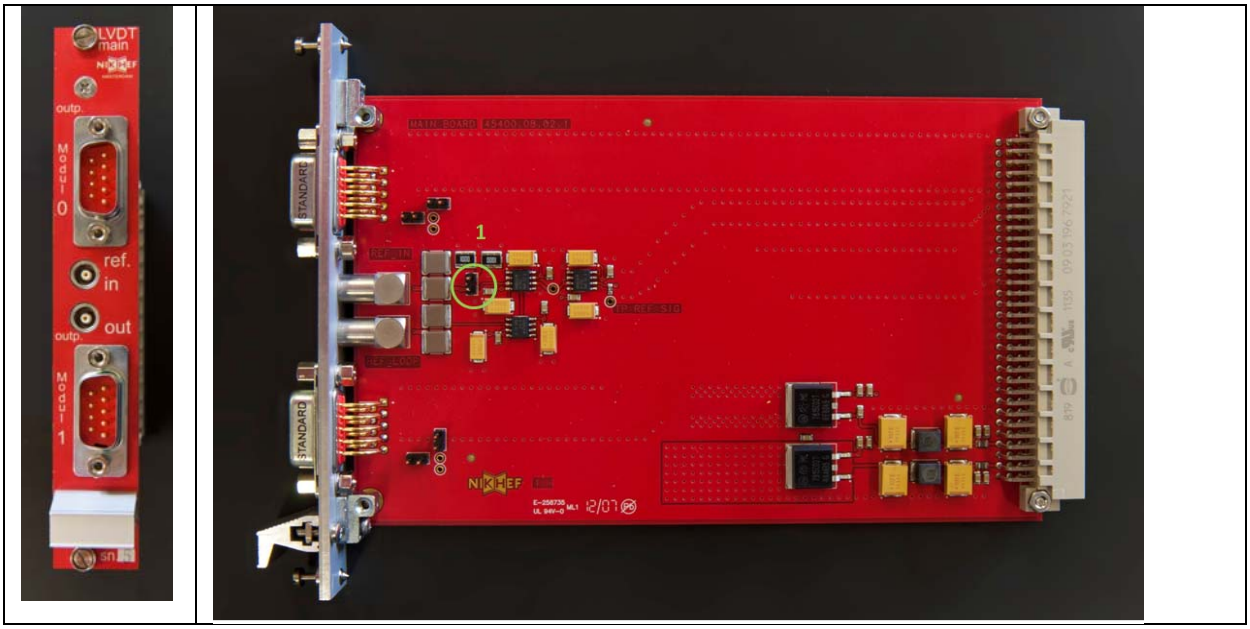

Figure 9 LVDT main module. PCB and front shown.

In Figure 1 is the LVDT main module shown.

Table 13 funtion of the jumper.

Number	Function
1	Jumper for 50 Ohm terminator

The module where the reference is feed by the output of a other module The input should not be terminated, Only if the input is driven by a function generator! If the loop out is loaded by 50 Ohm the waveform is distorted!

3.4 Test results LVDT main module

The signal to noise ratio of the LVDT Main module is measured with the aid of the 35670A FFT analyzer. The module was drive by 10 KHz 1Vrms signal. Signal to noise level is around 95 dB. The THD (Total Harmonic distortion) is 0.0091 %

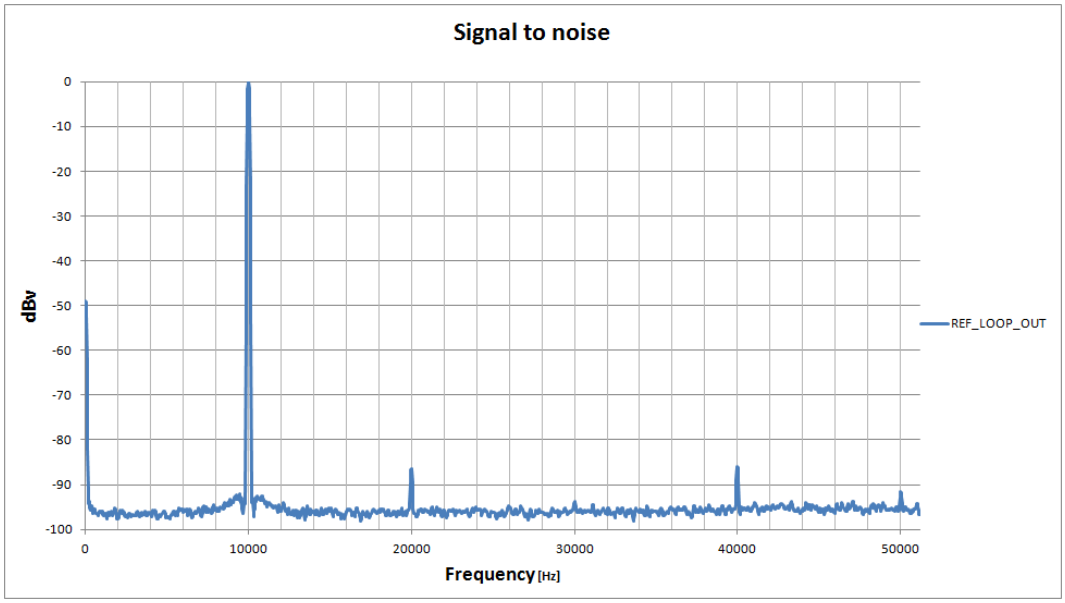

Figure 10 Signal to noise ratio of LVDT main module, measured at ref loop out.

3.5 Schematic/location name

45400_08021_LVDT_MAN_MODULE.pdf

4 VoCo Main module (Voice Coil Main Module)

This module is complete passive, the purpose of this card. To provide the connections from the front Sub D connectors, to the backplane.

4.1 Photo Main

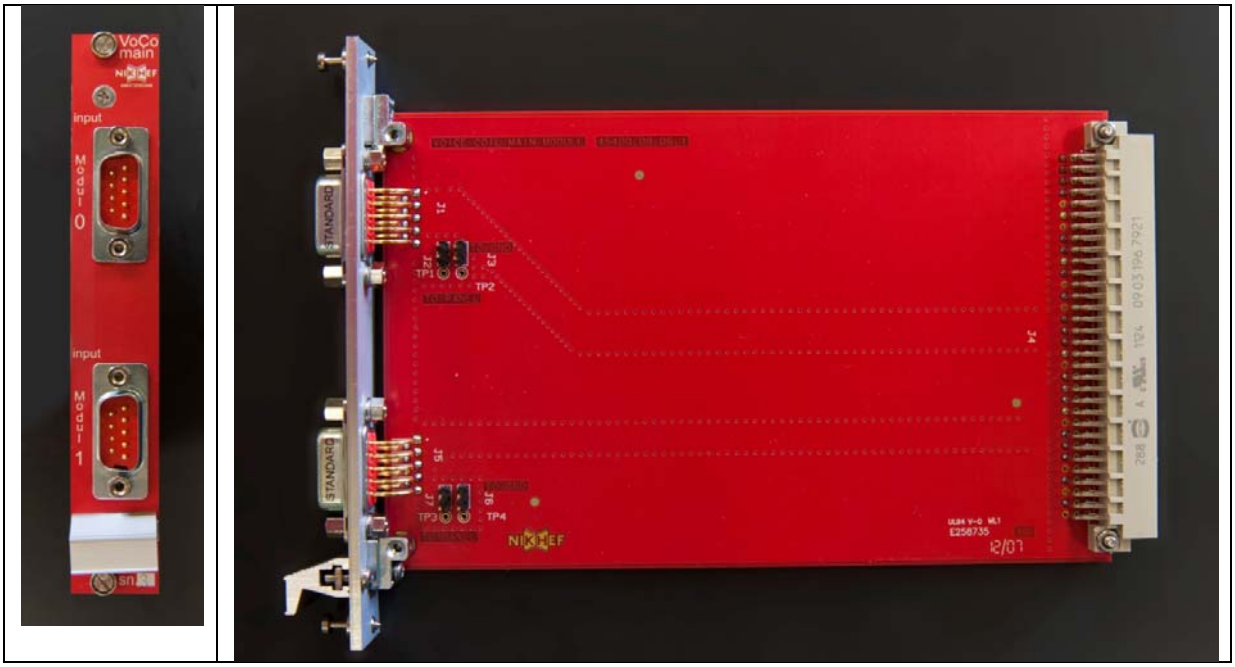

Figure 11 Photo of the VoCo main module, Front and PCB shown.

4.2 Schematic/location name

45400_08041_VOICE_COIL_MAIN_MODULE.pdf

5 The Electronics Crate

All the modules are installed in a crate, The power and signals between the cards via a backplane. On the backplane there is a screw terminal to connect the power supply.

The power is filtered by means of a common mode filters, There are also some extra buffer caps. The extra filters and caps, are necessary when a long DC power cable is used (longer than 3 meter)

5.1 Photo of the crate.

Phote plakken.

6 Preamp Geophone

The geophone build around the CS3002 Low noise op amp. It is a chopper stabilized op amp with low1/f noise 6nV/ √Hz at 0.5 Hz in one Hz bandwidth

The gain is set at 51 dB.(375 times) The single output in converted to a balanced signal. With the aid of a balanced op amp THS4131 this stage provide also some gain (10 dB)

The line driver and the CS3002 have their own linear low noise regulators. The power entry is cleaned by a common mode filter.

6.1 Geophone connections

The Geophone pre amp is directly attracted. to the vacuum feed through. By means of contact sockets(031-9074-002, 20 Socket KPSE). The pin are the arranged as in a MIL C 26482 connector. The sockets slide over the pins of the vacuum feed through see Figure 12 for a drawing of the feed through

Table 14 Connections Geophone a MIL C 26482 layout

Pin Name	Function
A	Power Neg 14V (23mA
B	SIGNAL_RTN
C	Power_RTN
D	Power POS 14V (23mA)
E	OUT_P
F	OUT_N

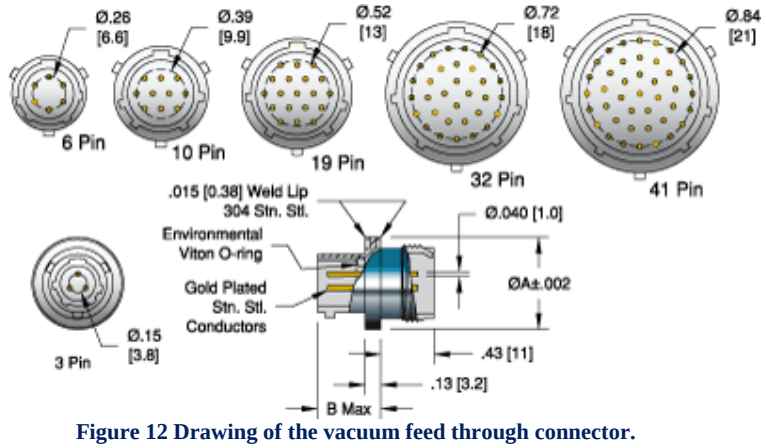

Figure 12 Drawing of the vacuum feed through connector.

6.2 Measure results

Al measurement performed with a symmetrical power supply of 14V

Parameter	Measured	Condition
Clipping level at in put	2.4 mV/rms	Test tone @ 90 Hz
Clipping Level at output	9.1 V/rms	Test tone @ 90 Hz (2.4 mV/rms)
T.H.D	0.017 %	Test tone @ 90 Hz (500 µV/rms)
Noise (input)	6 nV @ 10 Hz	Input terminated in 50 Ohm

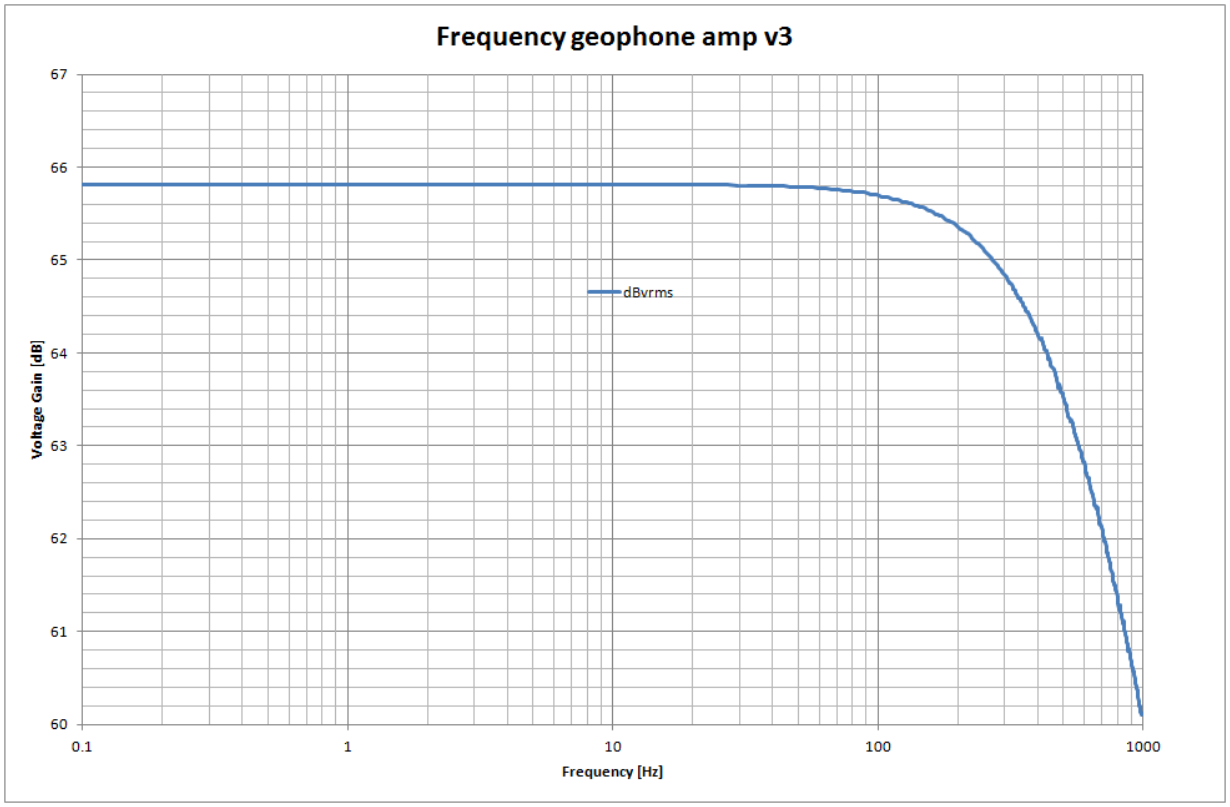

Figure 13 Frequency response of the Geophone pre amp.

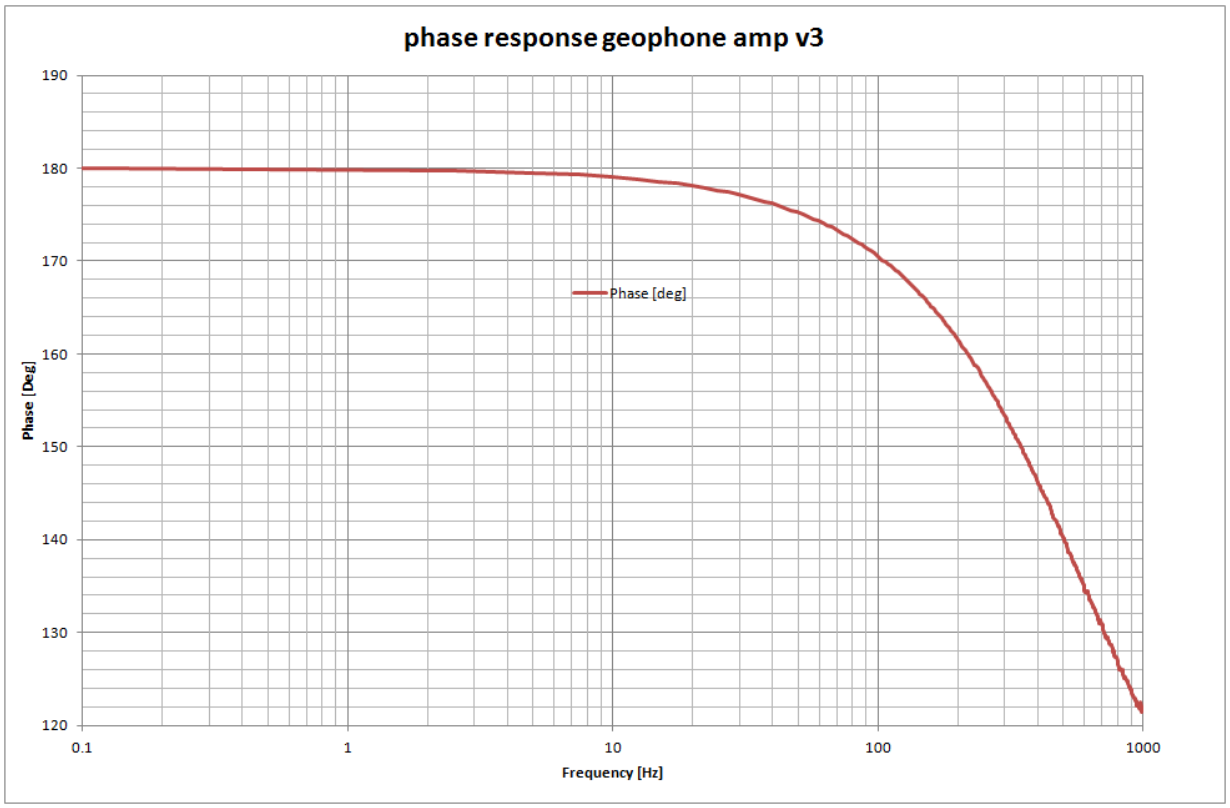

Figure 14Phase response Geo phone amplifier.

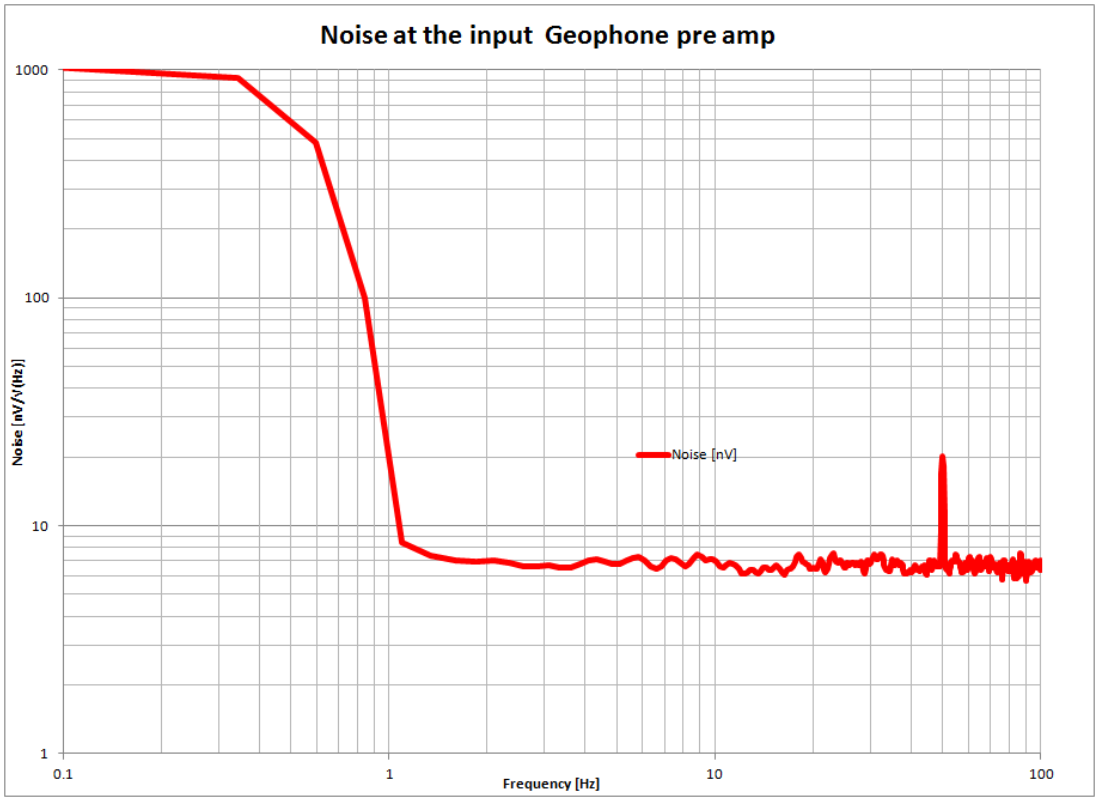

Figure 15 Input noise of the Geophone amplifier.

6.3 Photo of the Geophone pre amp.

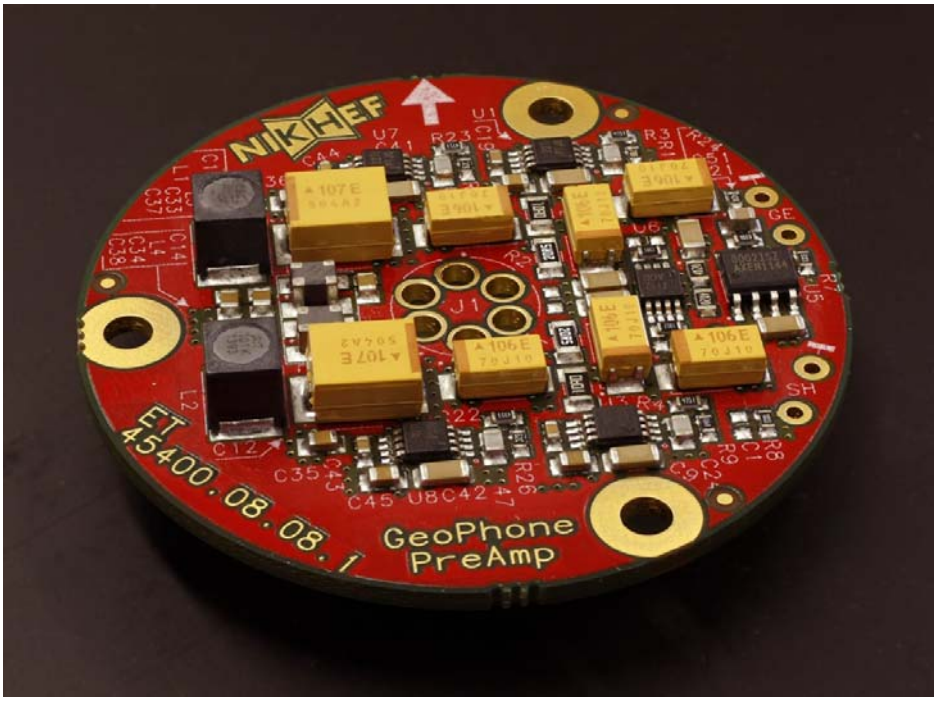

Figure 16 photograph of the Geophone preamp.

6.4 Schematic/location name

GS-1_GeoPhone_PreAmp_v3.pdf