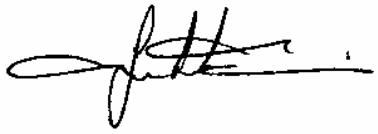
CHANNEL CALIBRATION PROCEDURE

FOR

SFSI TEST STRUCTURE SYSTEM

MODEL RTMS-2001RN

CUSTOMER	University Of California Santa Barbara Crustal Studies Department
SYSTEM LOCATION	GVDA
SYSTEM S/N	207
DATE OF TEST	September 13, 2008
PERFORMED BY (Print)	Dan Radulescu
SIGNATURE	

CHANNEL CALIBRATION PROCEDURE
FOR
SFSI TEST STRUCTURE SYSTEM

MODEL RTMS-2001RN

1.0 PURPOSE

The purpose of this procedure is the determination of the calibration factors for the entire system as described in the proposal No: DCR2006-001. The main components of the system will be checked for functionality and when needed a calibration factor will be determined. The sensors and the entire system shall be tested such that they respond within a specified range and accuracy to an input traceable to the National Bureau of Standards or an acceptable physical constant, (e.g., tilt testing of an accelerometer within the earth's gravitational field). This calibration will require temporary removal of the sensors from their normal location.

2.0 DESCRIPTION

The RTMS-2001RN system is a multi-channels Data Acquisition system which is capable of locally recording events and continuously streaming data to multiple remote clients using TCP/IP protocol. The system has a total of 32 channels with a 24-bit resolution for each channel. A total of 28 different sensors are connected to the system. First 24 channels are connected directly to the A/D input and the last 8 channels are connected to the output of an Signal conditioning module Model 163 MK manufactured by CALEX. Table A1 in Appendix A shows the correspondence between the channel number and the sensor type, Model, and Manufacturer.

3.0 REFERENCES

- Digitexx SFSI Monitoring System – System Manual
- Applied Mems Calibration Data Card
- ATA Sensors Calibration Data Card
- Entran Calibration Data Card
- Scientific Technologies Inc. Calibration Data Card
- Calex Operating Manual for 163mk Signal Conditioning

It is recommended that this calibration be performed every 12 months

4.0 SYSTEM PERFORMANCE NOTES

- Because this procedure is intended to be used by a qualified person, step-by-step instructions are not given
- Test sequence may be changed as needed for safety and /or efficiency.
- Items for which quantitative measurements cannot or need not to be made shall be reported in a qualitative mode (e.g. Yes/No).
- Any activities performed outside the normal scope of this procedure shall be documented.
- When a deficiency is observed, the technician may undertake additional testing and install factory authorized and/or factory calibrated replacement parts to restore the proper operation of the instrument.
- Calibration readings are equally valid using either the internal batteries (>11.5 VDC under load) or using an external power supply (between 12.0 and 13.0 VDC.

5.0 TEST EQUIPMENT

Instrument Type	Manufacturer	Model	Range
Digital Voltmeter	FLUKE	189.	2V & 20VDC
Bubble Level	Pro Products Inc	PRO INCLINOMETER	0° - 180°
Tilt Table	Ready Project	TT-1	0° - 360°

* VOLTAGE GENERATOR, TIME ELECTR 1017 ±1V, ±5V, ±9V,

NOTE: INCLINOMETER ACCURACY : ±1/2°

USED TO LEVEL TILT TABLE

* USED TO CHECK A/D CHANNELS.

6.0 PRE-TEST CONDITIONS

- Notify the End user that the system will be taken out of normal operation conditions

(Initials) _____

- Check the overall system functionality and appearance. Document any observed anomaly. If a subassembly is not functional, document the findings, perform the repair first (if possible), and continue with the calibration

(Initials) _____

NOTES: SYSTEM FOUND OPERATIONAL

AS FOUND EVENT : DXKSW207_20080913_050033.dxw

AC POWER ON

SENSOR POWER SUPPLY OPERATIONAL

(Initials) _____

7.0 SYSTEM TEST

7.1 UNINTERRUPTIBLE POWER SUPPLY

a) Check the battery charging Indicator.
Mark FULL or indicate in % FULL (Initials) [signature]

b) Disconnect the AC power cord and wait 10 minutes.
The intermittent Battery operation sound should be present.
The battery charging indicator shall stay on the same range.

(Initials) [signature]

c) Reconnect the AC (Initials) [signature]

d) Document when the battery has been installed (dd/mm/yy) 9/13/2008

NOTES: WESD PROVIDED NEW BATTERY
NEW BATTERY INSTALLED.
UPS MODEL: SMART UPS 2200 2U

7.2 SENSOR POWER SUPPLY

a) Check the front LEDs to be ON (Y/N) YES

b) Check the battery voltage with AC connected (>12.5V) 12.95 (V)

c) Measure the output voltage on +12V side (+12V +/- 0.1) +12.05 (V)

d) Measure the output voltage on -12V side (-12V +/-0.1) -12.05 (V)

e) Disconnect the AC and check the battery voltage (>12.3) 12.48 (V)

f) Reconnect the AC (Initials) JR

NOTES: DAN RADUCESCU TO BUY TWO NEW BATTERIES TO BE INSTALLED DURING NEXT VISIT (MAINTENANCE) DUE TO MAIN UPS AND AG AUTOMATIC GENERATOR, THE SENSOR POWER SUPPLY HAS ENOUGH REDUNDANCY.

7.3 PC INDUSTRIAL COMPUTER

a) Check the overall functionality (Initials) JR

b) Check the Server software for proper functionality (Initials) JR

c) Check the Hard Disk Space 62,285 (MB)

d) Download all recorded events on a memory stick (Initials) JR ←

e) Check for OS updates and perform the OS update (Initials) JR

f) Simulate AC power Loss and observe that the System comes UP and is operational (Initials) JR

NOTES: ← DOWNLOADED ALL SEPTEMBER INCLUDING CALIBRATION GENERATED.

7.4 A/D CALIBRATION CHECK

Using a voltage reference source, check the A/D reading connecting the source to each channel. Record in the table bellow the value read by each channel

CHANNEL #	VOLTAGE REFERENCE [V]	A/D READING [V]	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			

NOTES: SEE APPENDIX B FOR DETAILED VALUES. THIS TIME I USED THREE VALUES ON BOTH SIDES (POSITIVE AND NEGATIVE) TO VERIFY SYMETRY.

7.5 SENSOR CALIBRATION

ACCELEROMETERS

CHANNEL #	SENSOR MODEL	SENSOR S/N	CALIBRATION [V/g]	
			AS FOUND	AS LEFT
1	Triaxial Accelerometer X-axis	254	1.224	1.224
2	Triaxial Accelerometer Y-axis	254	1.222	1.222
3	Triaxial Accelerometer Z-axis	254	1.209	1.209
4	Triaxial Accelerometer X-axis	255	1.190	1.190
5	Triaxial Accelerometer Y-axis	255	1.205	1.205
6	Triaxial Accelerometer Z-axis	255	1.192	1.192
7	Uniaxial Accelerometer Z-axis	312	1.217	1.217
8	Uniaxial Accelerometer Z-axis	316	1.228	1.228
9	Uniaxial Accelerometer X-axis	314	1.200	1.200
10	Uniaxial Accelerometer Z-axis	312	1.208	1.208
11	Uniaxial Accelerometer Z-axis	318	1.200	1.200
12	Uniaxial Accelerometer X-axis	320	1.205	1.205
13	Uniaxial Accelerometer X-axis (Shaker)	321 *	1.185	1.185
14	Triaxial Downhole Accclerometer X-axis	0101**	1.204	1.204
15	Triaxial Downhole Accelerometer Y-axis	0101**	1.237	1.237
16	Triaxial Downhole Accelerometer Z-axis	0101**	1.242	1.242

NOTES: * NOT CALIBRATED COULD NOT REMOVE FROM SHAKER
REPORTED VALUE IS FROM LAST CALIBRATION.

** DOWNHOLE NOT CALIBRATED
REPORTED VALUES ARE FROM INITIAL FACTORY CAL

THREE (3) SPARE UNI-AXIAL ACCELEROMETERS.

S/N 313: S = 1.2069 V/g

S/N 316: S = 1.2116 V/g

S/N 319: S = 1.2028 V/g.

THESE SENSORS CANNOT BE ADJUSTED.

ROTATION

CHANNEL #	SENSOR MODEL	SENSOR S/N	CALIBRATION [DEGREE/SEC]	
			AS FOUND	AS LEFT
17	ARS-09			
18	ARS-09			
19	ARS-09			

NOTES: SENSOR NOT REMOVED TO KEEP STATISTICAL RECORDS CONSISTENT DURING LAST MAINTENANCE AND NOW SHOWS FUNCTIONAL

PORE PRESURE

CHANNEL #	SENSOR MODEL	SENSOR S/N	CALIBRATION [ ]	
			AS FOUND	AS LEFT
20				

NOTES: NOT CALIBRATED

MEAN VALUE OF THIS CHANNEL IS:

$MEAN_{[V]} = 3.408\ V$ JR

SOIL PRESURE

CHANNEL #	SENSOR MODEL	SENSOR S/N	CALIBRATION [mV/PSI]	
			AS FOUND	AS LEFT
25	EPX-V01-100P	04E04EM-D28	1.2393	1.2393
26	EPX-V01-100P	04A037F05-K10	1.5969	1.5969
27	EPX-V01-100P	04A037F05-K09	1.3403	1.3403
28	EPX-V01-100P	04E04E11-D27	1.1244	1.1244

NOTES: FUNCTIONALITY CHECKED ONLY.
VALUES RECORDED REPRESENTS FACTORY CALIBRATION
CH. 25 SHOWS FULLSCALE SENSOR OUTPUT TO HIGH FOR A BOARD AMPLIFIER WITH GAIN 50
CHANNEL CHECK FILE: DKA-SN204-20080913-131832.DKA.

RELATIVE DISPLACEMENT

CHANNEL #	SENSOR MODEL	SENSOR S/N	CALIBRATION [V/inch]	
			AS FOUND	AS LEFT
29	DT-30-B	03-2823	0.0665	0.0665
30	DT-30-B	03-2826	REPAIRED AND INSTALLED.	0.0718
31	DT-30-B	03-2824	0.0656	0.0656
32	DT-30-B	03-2825	0.0649	0.0649.

NOTES: SENSOR CONNECTED TO CH. 30 HAS BEEN REPAIRED AND RE-INSTALLED.

CALIBRATION FILE: SXL SN202_20080913_131210.SXL

8.0 FINAL STEPS

- Change the batteries from the UPS and SENSOR POWER SUPPLY if they are three (3) years old or more. If the batteries are not purchased, make a note and change them at the first maintenance visit.

  (Initials) DK

- Return the system to functional state (Initials) DK
- Attach Final record to this document (Initials) DK
- List all test equipment (Initials) DK
- Inform the end user that the system is functional (Initials) DK
- Prepare the site (close the hat and the equipment) (Initials) DK

NOTES: ~~A~~ UPS BATTERY CHANGED
SENSOR BATTERIES TO BE PURCHASED BY DAN RABULESCU AND INSTALLED DURING NEXT MAINTENANCE VISIT.

9.0 SUMMARY (Comments, Parts replaced, Deficiencies, etc.)

SYSTEM LEFT FULLY FUNCTIONAL

UPS BATTERY REPLACED
DISPLACEMENT SENSOR (CH #3) REPAIRED AND RE-INSTALLED
UCSB TO CHECK PRESSURE (PORE) SENSOR.

DK

10.0 CERTIFICATION

All items included in this procedure have been performed unless noted above and were found or have been adjusted to be within the range required by this procedure.

(yes/no) YES

(Signature)

DAN RADUCESCU

(Print)

11.0 ACTION REQUIRED (IF ANY)

UCSB TO CHECK PORE PRESSURE SENSOR
SOIL PRESSURE SENSOR CONNECTED TO CH 25 TO BE CHECKED.
SENSOR POWER SUPPLY BATTERIES TO BE PURCHASED
BY DANR. AND INSTALLED DURING NEXT
MAINTENANCE VISIT

APPENDIX A

Correspondence between the channel number and sensor type

Table A1

Channel #	Sensor Type	Model / Manufacturer
1	Triaxial Accelerometer X-axis	SF3000 / AppliedMems
2	Triaxial Accelerometer Y-axis	SF3000 / AppliedMems
3	Triaxial Accelerometer Z-axis	SF3000 / AppliedMems
4	Triaxial Accelerometer X-axis	SF3000 / AppliedMems
5	Triaxial Accelerometer Y-axis	SF3000 / AppliedMems
6	Triaxial Accelerometer Z-axis	SF3000 / AppliedMems
7	Uniaxial Accelerometer Z-axis	SF3000 / AppliedMems
8	Uniaxial Accelerometer Z-axis	SF3000 / AppliedMems
9	Uniaxial Accelerometer X-axis	SF3000 / AppliedMems
10	Uniaxial Accelerometer Z-axis	SF3000 / AppliedMems
11	Uniaxial Accelerometer Z-axis	SF3000 / AppliedMems
12	Uniaxial Accelerometer X-axis	SF3000 / AppliedMems
13	Uniaxial Accelerometer X-axis (Shaker)	SF3000 / AppliedMems
14	Triaxial Downhole Accelerometer X-axis	D110-DH / Digitexx
15	Triaxial Downhole Accelerometer Y-axis	D110-DH / Digitexx
16	Triaxial Downhole Accelerometer Z-axis	D110-DH / Digitexx
17	Rotation Sensor X-X	ARS-09 / ATA Sensors
18	Rotation Sensor Y-Y	ARS-09 / ATA Sensors
19	Rotation Sensor Z-Z	ARS-09 / ATA Sensors
20	Pore Pressure	
21	Spare channel	
22	Spare channel	
23	Spare channel	
24	Spare channel	
25	Soil Pressure Z-axis *	EPX-V01-100P / ENTRAN
26	Soil Pressure Z-axis *	EPX-V01-100P / ENTRAN
27	Soil Pressure Z-axis *	EPX-V01-100P / ENTRAN
28	Soil Pressure Z-axis *	EPX-V01-100P / ENTRAN
29	Relative Displacement Transducer Z-axis *	DT-30-B / STI
30	Relative Displacement Transducer Z-axis *	DT-30-B / STI
31	Relative Displacement Transducer Z-axis *	DT-30-B / STI
32	Relative Displacement Transducer Z-axis *	DT-30-B / STI

NOTE:

- Connected to the A/D Input through a Signal Conditioning board Model 163MK manufactured by CALEX

APPENDIX B

Recommended Calibration Methods

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF3000L / 254 X-axis ch. 1

The following readings shall be taken in the indicated order:

1. Horizontal +0.027 [V]
2. tilt to +30 degrees + 0.631 [V]
3. tilt to +90 degrees + 1.256 [V]
4. tilt back to horizontal + 0.029 [V]
5. tilt to -30 degrees − 0.581 [V]
6. tilt to -90 degrees − 1.192 [V]
7. tilt back to horizontal + 0.027 [V]

CALIBRATION FACTOR 1.224 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF3000L/254/Y-axis CH. 2

The following readings shall be taken in the indicated order:

1. Horizontal -0.022 [V]
2. tilt to +30 degrees +0.593 [V]
3. tilt to +90 degrees +1.211 [V]
4. tilt back to horizontal -0.019 [V]
5. tilt to -30 degrees -0.609 [V]
6. tilt to -90 degrees -1.238 [V]
7. tilt back to horizontal -0.020 [V]

CALIBRATION FACTOR 1.222 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____[V]
2. tilt to +30 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. tilt back to horizontal _____[V]
5. tilt to -30 degrees _____[V]
6. tilt to -90 degrees _____[V]
7. tilt back to horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF3000L/254/Z 4x/s ch. 3.

The following readings shall be taken in the indicated order:

1. Horizontal +1.261 [V]
2. tilt to +60 degrees +0.629 [V]
3. tilt to +90 degrees +0.051 [V]
4. Continue to Horizontal -1.152 [V]

CALIBRATION FACTOR 1.209 [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF3000L / 255 / X-axis CH. 4.

The following readings shall be taken in the indicated order:

1. Horizontal + 0.055 [V]
2. tilt to +30 degrees + 0.620 [V]
3. tilt to +90 degrees + 1.249 [V]
4. tilt back to horizontal + 0.060 [V]
5. tilt to -30 degrees - 0.538 [V]
6. tilt to -90 degrees - 1.131 [V]
7. tilt back to horizontal + 0.059 [V]

CALIBRATION FACTOR 1.190 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF 3000 L/25E/ Yaxis CH. 5

The following readings shall be taken in the indicated order:

1. Horizontal +0.024 [V]
2. tilt to +30 degrees +0.636 [V]
3. tilt to +90 degrees +1.228 [V]
4. tilt back to horizontal +0.026 [V]
5. tilt to -30 degrees -0.544 [V]
6. tilt to -90 degrees -1.182 [V]
7. tilt back to horizontal +0.027 [V]

CALIBRATION FACTOR 1.206 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____[V]
2. tilt to +30 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. tilt back to horizontal _____[V]
5. tilt to -30 degrees _____[V]
6. tilt to -90 degrees _____[V]
7. tilt back to horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF B0002/255 Z axis ch.6

The following readings shall be taken in the indicated order:

1. Horizontal + 1.168 [V]
2. tilt to +60 degrees + 0.582 [V]
3. tilt to +90 degrees + 0.002 [V]
4. Continue to Horizontal – 1.216 [V]

CALIBRATION FACTOR 1.192 [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF 3000 2 / 317 UNI AXIAL CH. 7

The following readings shall be taken in the indicated order:

1. Horizontal +0.091 [V]
2. tilt to +30 degrees + 0.698 [V]
3. tilt to +90 degrees +1.319 [V]
4. tilt back to horizontal +0.096 [V]
5. tilt to -30 degrees −0.521 [V]
6. tilt to -90 degrees −1.116 [V]
7. tilt back to horizontal +0.091 [V]

CALIBRATION FACTOR 1.217 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF3000L/316 UNIAXIAL CH.8

The following readings shall be taken in the indicated order:

1. Horizontal +0.091 [V]
2. tilt to +30 degrees +0.713 [V]
3. tilt to +90 degrees +1.322 [V]
4. tilt back to horizontal +0.096 [V]
5. tilt to -30 degrees -0.53 [V]
6. tilt to -90 degrees -1.134 [V]
7. tilt back to horizontal +0.094 [V]

CALIBRATION FACTOR 1.228 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal N/A _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER BF 3000 L / 314 UNIAXIAL CH. 9

The following readings shall be taken in the indicated order:

1. Horizontal -0.028 [V]
2. tilt to +30 degrees +0.601 [V]
3. tilt to +90 degrees +1.171 [V]
4. tilt back to horizontal -0.027 [V]
5. tilt to -30 degrees -0.629 [V]
6. tilt to -90 degrees -1.229 [V]
7. tilt back to horizontal -0.029 [V]

CALIBRATION FACTOR 1.200 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

N/A

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF 3000 L / 312 UNIAXIAL CH. 10

The following readings shall be taken in the indicated order:

1. Horizontal −0.049 [V]
2. tilt to +30 degrees +0.548 [V]
3. tilt to +90 degrees +1.158 [V]
4. tilt back to horizontal −0.051 [V]
5. tilt to -30 degrees −0.649 [V]
6. tilt to -90 degrees −1.258 [V]
7. tilt back to horizontal −0.046 [V]

CALIBRATION FACTOR 1.208 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER SF 3000 L/318 Was 1000 at @ff .11

The following readings shall be taken in the indicated order:

1. Horizontal +0.001 [V]
2. tilt to +30 degrees +0.603 [V]
3. tilt to +90 degrees +1.201 [V]
4. tilt back to horizontal +0.002 [V]
5. tilt to -30 degrees -0.600 [V]
6. tilt to -90 degrees -1.200 [V]
7. tilt back to horizontal -0.001 [V]

CALIBRATION FACTOR 1.200 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

N/A

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER ~~SF 3000 L~~ /320 UNIAXIAL CH. 12

The following readings shall be taken in the indicated order:

1. Horizontal +0.227 [V]
2. tilt to +30 degrees +0.836 [V]
3. tilt to +90 degrees +1.430 [V]
4. tilt back to horizontal +0.231 [V]
5. tilt to -30 degrees +0.381 [V]
6. tilt to -90 degrees -0.981 [V]
7. tilt back to horizontal +0230 [V]

CALIBRATION FACTOR 1.206 [V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____ [V]
2. tilt to +60 degrees _____ [V]
3. tilt to +90 degrees _____ [V]
4. Continue to Horizontal _____ [V]

CALIBRATION FACTOR _____ [V/g]
Read 3 – Read 1

N/A

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER 315 UNIAXIAL SPARE

The following readings shall be taken in the indicated order:

1. Horizontal -0.0156 [V]
2. tilt to +30 degrees -0.643 [V]
3. tilt to +90 degrees -1.236 [V]
4. tilt back to horizontal -0.090 [V]
5. tilt to -30 degrees +0.588 [V]
6. tilt to -90 degrees +1.192 [V]
7. tilt back to horizontal -0.017 [V]

CALIBRATION FACTOR _____[V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER N/A

The following readings shall be taken in the indicated order:

1. Horizontal _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER 313 UNIAXIAL SPARE

The following readings shall be taken in the indicated order:

1. Horizontal 0.0078 [V]
2. tilt to +30 degrees -0.6226 [V]
3. tilt to +90 degrees -1.2107 [V]
4. tilt back to horizontal 0.0017 [V]
5. tilt to -30 degrees +0.6038 [V]
6. tilt to -90 degrees +1.2331 [V]
7. tilt back to horizontal 0.0231 [V]

CALIBRATION FACTOR _____[V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER N/A

The following readings shall be taken in the indicated order:

1. Horizontal _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

ACCELEROMETERS

Each unit (uniaxial or triaxial that can be removed temporarily for calibration will be calibrated using a tilt table).

For the horizontal axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER 319 UNIAXIAL SPARE

The following readings shall be taken in the indicated order:

1. Horizontal +0.1149 [V]
2. tilt to +30 degrees -0.5099 [V]
3. tilt to +90 degrees -1.0956 [V]
4. tilt back to horizontal -0.1127 [V]
5. tilt to -30 degrees +0.2137 [V]
6. tilt to -90 degrees +1.3101 [V]
7. tilt back to horizontal +0.1146 [V] +0.1143

CALIBRATION FACTOR _____[V/g]
{(Read3 – Read1) + (Read6 – Read4)} / 2

For the vertical axis:

The unit shall be placed on a tilt table which has been leveled and checked with a mechanical angular device.

MODEL / SERIAL NUMBER _____

The following readings shall be taken in the indicated order:

1. Horizontal _____[V]
2. tilt to +60 degrees _____[V]
3. tilt to +90 degrees _____[V]
4. Continue to Horizontal _____[V]

CALIBRATION FACTOR _____[V/g]
Read 3 – Read 1

RELATIVE DISPLACEMENT

MODEL / SERIAL NUMBER DT-30-B/03-2823 CH.29

Take a metallic pin with the Diameter = 0.316"

Measure the exact diameter of the pin
using the caliper **[D1]** 0.357 [in]

Start the system to take a record
Filename of the record Data SN207-20080913_131210.Data.

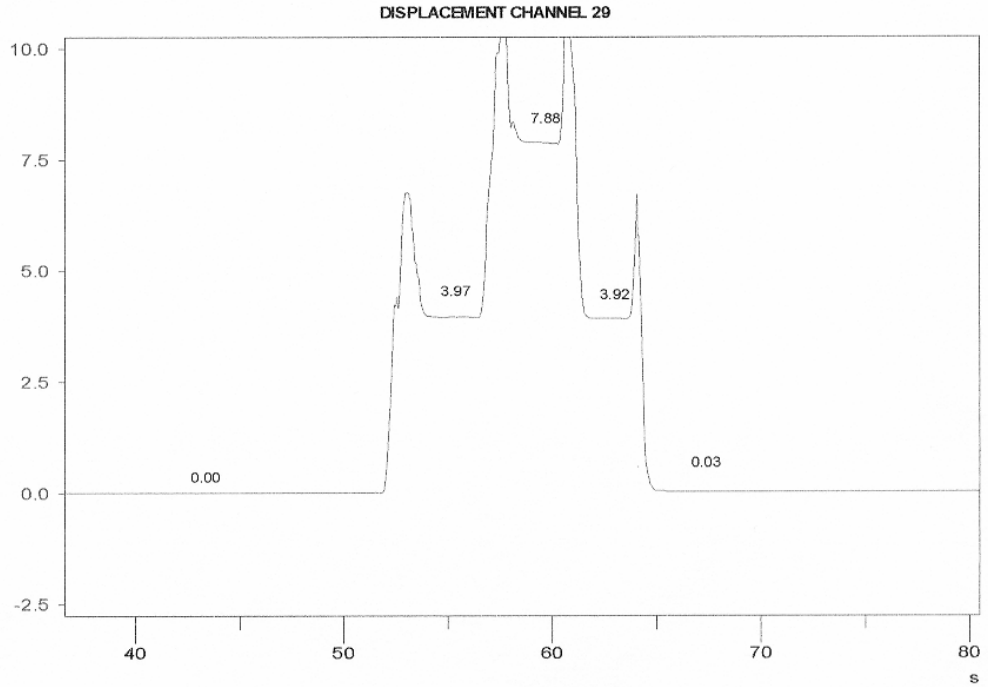
Turn the string (wire) of the sensor once
Around the metal pin and wait 10 seconds (Initials) R

Turn the string (wire) of the sensor one more turn
Around the metal pin and wait 10 seconds (Initials) R

Un-wind one turn of the wire from the metal pin
and wait 10 seconds (Initials) R

Un-wind the last turn of the wire from the metal pin
Wait 10 seconds and stop the recording (Initials) R

Typical record should look like this:



REAL RECORD FOR CH.29

Starting from the left we have five readings (READ1, READ2, READ3, READ4, READ5.

RECORD The overall Channel amplification factor **AF =** 50.36

COMPUTE: **OUT [V] = ((READ2 – READ1) + (READ3 – READ1)/2) / (2 * AF)**

COMPUTE THE CIRCLE LENGTH OF THE PIN
L [IN] = PI * (D1 + D2) (where D2 is the diameter of the wire) 1.184

CAL FACTOR [V/inch] = OUT[V] / L[in]) 0.0665 V/IN.

Print a separate page for each sensor THIS IS FOR CH. 29.

RELATIVE DISPLACEMENT

SENSOR REPAIRED & RE-INSTALLED

MODEL / SERIAL NUMBER DF-30-B/03-2826. CH. 30

Take a metallic pin with the Diameter = 0.316"

Measure the exact diameter of the pin using the caliper **[D1]** 0.357 [in]

Start the system to take a record
Filename of the record Dxx-SN207_20080913_131210. Dxx

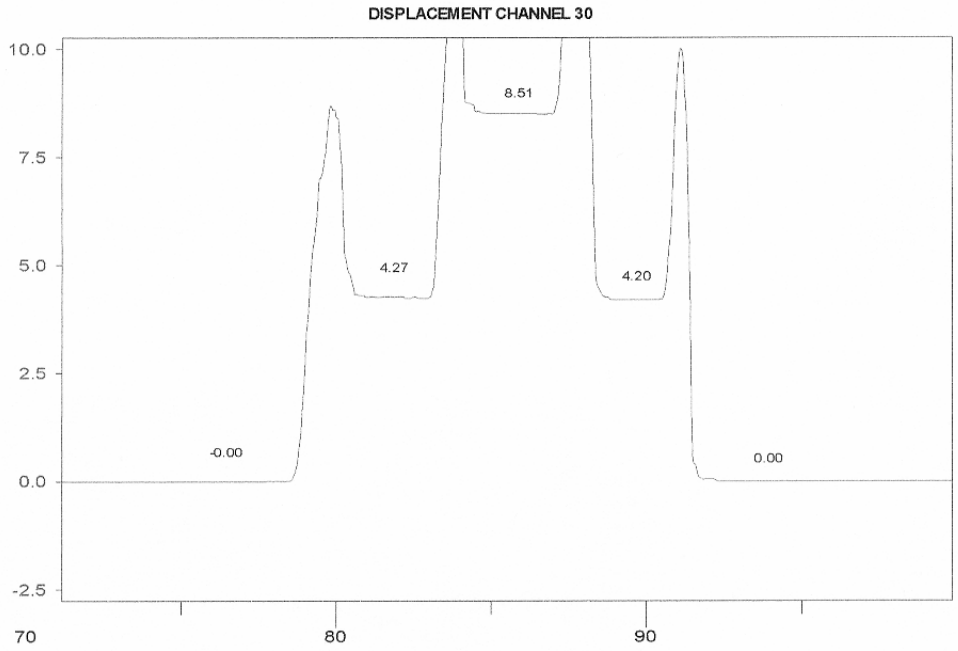
Turn the string (wire) of the sensor once
Around the metal pin and wait 10 seconds (Initials) DK

Turn the string (wire) of the sensor one more turn
Around the metal pin and wait 10 seconds (Initials) DK

Un-wind one turn of the wire from the metal pin
and wait 10 seconds (Initials) DK

Un-wind the last turn of the wire from the metal pin
Wait 10 seconds and stop the recording (Initials) DK

Typical record should look like this:



THIS IS REAL RECORD FOR CH. 30.

Starting from the left we have five readings (READ1, READ2, READ3, READ4, READ5.

RECORD The overall Channel amplification factor **AF** = 50.10

COMPUTE: **OUT [V] = ((READ2 – READ1) + (READ3 – READ1)/2) / (2 * AF)**

COMPUTE THE CIRCLE LENGTH OF THE PIN
L [IN] = PI * (D1 + D2) (where D2 is the diameter of the wire) 1.184"

CAL FACTOR [V/inch] = OUT[V] / L[in]) 0.0718 V/IN

Print a separate page for each sensor

CH.30 AFTER REPAIR.

RELATIVE DISPLACEMENT

MODEL / SERIAL NUMBER DT-30_B/03-2824.

Take a metallic pin with the Diameter = 0.316"

Measure the exact diameter of the pin using the caliper **[D1]** 0.357 [in]

Start the system to take a record
Filename of the record DRA_SN207_20080913-131210.DRA .

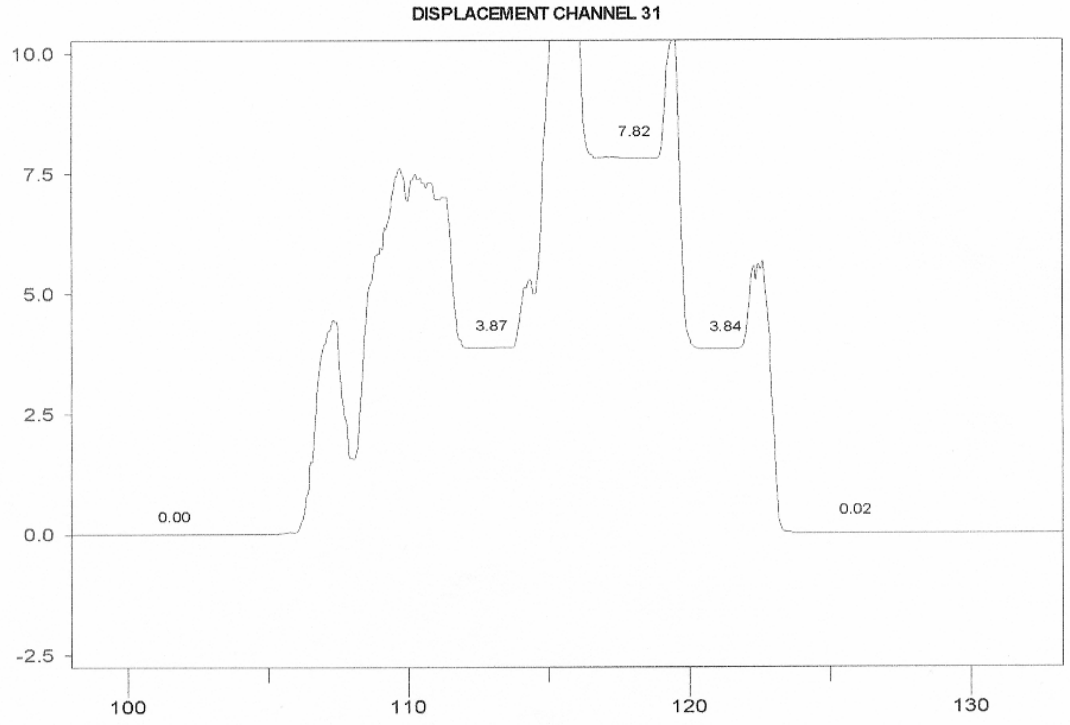
Turn the string (wire) of the sensor once
Around the metal pin and wait 10 seconds (Initials) DR

Turn the string (wire) of the sensor one more turn
Around the metal pin and wait 10 seconds (Initials) DR

Un-wind one turn of the wire from the metal pin
and wait 10 seconds (Initials) DR

Un-wind the last turn of the wire from the metal pin
Wait 10 seconds and stop the recording (Initials) DR

Typical record should look like this:



THIS IS REAL RECORD FOR CH. 31

Starting from the left we have five readings (READ1, READ2, READ3, READ4, READ5.

RECORD The overall Channel amplification factor **AF =** 50.05

COMPUTE: **OUT [V] = ((READ2 – READ1) + (READ3 – READ1)/2) / (2 * AF)**

COMPUTE THE CIRCLE LENGTH OF THE PIN
L [IN] = PI * (D1 + D2) (where D2 is the diameter of the wire) 1.184"

CAL FACTOR [V/inch] = OUT[V] / L[in]) 0.0656 V/in.

Print a separate page for each sensor

CH. 31

RELATIVE DISPLACEMENT

MODEL / SERIAL NUMBER DT-30-B/03-2825

Take a metallic pin with the Diameter = 0.316"

Measure the exact diameter of the pin
using the caliper **[D1]** 0.357 [in]

Start the system to take a record
Filename of the record DxxSN207-20080913_131210.Axx .

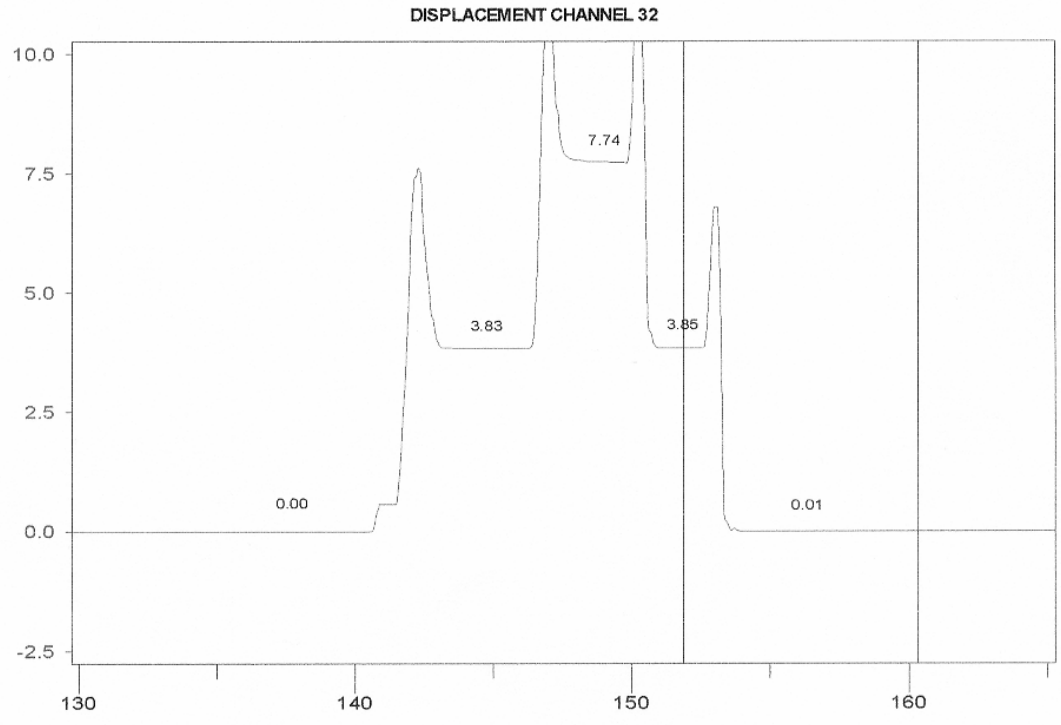
Turn the string (wire) of the sensor once
Around the metal pin and wait 10 seconds (Initials) DR

Turn the string (wire) of the sensor one more turn
Around the metal pin and wait 10 seconds (Initials) DR

Un-wind one turn of the wire from the metal pin
and wait 10 seconds (Initials) DR

Un-wind the last turn of the wire from the metal pin
Wait 10 seconds and stop the recording (Initials) DR

Typical record should look like this:



REAL RECORD FOR CH.32

Starting from the left we have five readings (READ1, READ2, READ3, READ4, READ5.

RECORD The overall Channel amplification factor **AF =** 50.05

COMPUTE: **OUT [V] = ((READ2 – READ1) + (READ3 – READ1)/2) / (2 * AF)**

COMPUTE THE CIRCLE LENGTH OF THE PIN
L [IN] = PI * (D1 + D2) (where D2 is the diameter of the wire) 1.184"

CAL FACTOR [V/inch] = OUT[V] / L[in])

Print a separate page for each sensor 0.0649 V/IN

CH.32.

A/D CHANNEL CALIBRATION

Use one calibrated digital voltmeter and a reference voltage source. Remember that the A/D is set for +/-10V full-scale and it is a 24-bit resolution. This calibration is relative since the calibrated source must be one order of magnitude higher than the device to be calibrated. In our case we check each channel for correct functionality. The reading taken with a regular Digital Voltmeter will have the mV precision and the A/D shall have the same reading up to milivolts. A+/-2mV is acceptable due to possible electrical noise during reading. The unit is calibrated under field conditions not under laboratory conditions.

For first 24 channels of the system, disconnect the existing sensor cable from the connector panel and connect the voltage source between PIN A and PIN B. Take a reading with the Digital Voltmeter and with the A/D Server software (set the calibration factor temporarily to 981. so the reading will be in volts. Record both readings in the table below:

REFERENCE ±1.0021 ±5.0016 ±9.001

Channel #	Zero Reading	1V IN ±10mV		5V IN ±10mV		9V IN ±10mV		Comments
		REF	A/D	REF	A/D	REF	A/D	
1	0.0006	-1.002	+1.004	-5.007	+5.008	-9.01	+9.01	
2	-0.0005	-1.006	+1.005	-5.017	+5.016	-9.028	+9.027	
3	0.0018	-0.997	+1.0007	-4.984	+4.988	-8.971	+8.974	
4	0.0003	-1.0004	+1.001	-4.994	+4.995	-8.988	+8.989	
5	0.0006	-0.991	+0.993	-4.979	+4.972	-8.910	+8.915	
6	0.0003	-0.992	+0.993	-4.953	+4.954	-8.914	+8.915	
7	0.0024	-0.9986	+1.0032	-4.993	+4.998	-8.987	+8.992	
8	0.0017	-1.0006	+1.004	-5.001	+5.004	-9.0009	+9.004	
9	-0.0002	-1.000	+0.9997	-4.991	+4.991	-8.982	+8.982	
10	0.0011	-0.997	+0.999	-4.980	+4.982	-8.963	+8.965	
11	0.003	-0.994	+0.9997	-4.973	+4.978	-8.951	+8.957	
12	0.0015	-0.996	+0.999	-4.976	+4.979	-8.956	+8.959	
13	0.0011	-0.9966	+0.9987	-4.978	+4.980	-8.959	+8.961	
14	0.001	-0.997	+0.999	-4.979	+4.981	-8.9617	+8.9637	
15	0.0008	-0.9942	+0.996	-4.965	+4.966	-8.936	+8.937	
16	0.0011	-0.996	+0.994	-4.968	+4.966	-8.939	+8.937	
17	0.0009	-0.9974	+0.993	-4.981	+4.979	-8.965	+8.967	
18	0.000	-0.997	+0.997	-4.975	+4.975	-8.953	+8.9534	
19	0.0001	-0.9972	+0.997	-4.9766	+4.9764	-8.9557	+8.9555	
20	0.0006	-0.9962	+0.9973	-4.974	+4.975	-8.952	+8.953	
21	0.0003	-0.9965	+0.997	-4.975	+4.976	-8.953	+8.954	
22	0.0008	-0.9961	+0.9977	-4.975	+4.976	-8.953	+8.955	
23	0.0009	-0.996	+0.998	-4.975	+4.976	-8.953	+8.955	
24	0.0004	-0.997	+0.998	-4.978	+4.979	-8.960	+8.9604	

THIS TIME VALUES WERE TAKEN FOR (+) AND (-) TO CHECK A/D SYMETRY

Initials

A/D CHANNEL CALIBRATION

For channels 25 through 32, connect the reference voltage source to the second Connector Panel at the BNC connector for each channel located at the top of the panels. Record the readings in the table bellow
For this channels check the amplification factor of the 163MK Signal conditioning

REFERENCE 1.002 5.0016 9.001

Channel #	Zero Reading	1V IN ±10mV		5V IN ±10mV		9V IN ±10mV		Comments
		REF	A/D	REF	A/D	REF	A/D	
25	-0.0014	-0.9972	+0.9972	-4.987	+4.985	-8.974	+8.971	
26	0.0004	-0.997	+0.998	-4.982	+4.981	-8.973	+8.970	
27	-0.0002	-1.002	+1.002	-5.004	+5.0032	-9.004	+9.0037	
28	0.0007	-1.003	+1.004	-5.009	+5.01	-9.015	+9.016	
29	0.0006	-0.998	+0.999	-4.983	+4.984	-8.968	+8.969	
30	0.0011	-0.997	+0.999	-4.980	+4.982	-8.964	+8.978	
31	0.0004	-0.998	+0.998	-4.982	+4.982	-8.966	+8.967	
32	0.0004	-0.9972	+0.9972	-4.978	+4.978	-8.958	+8.958	

Initials

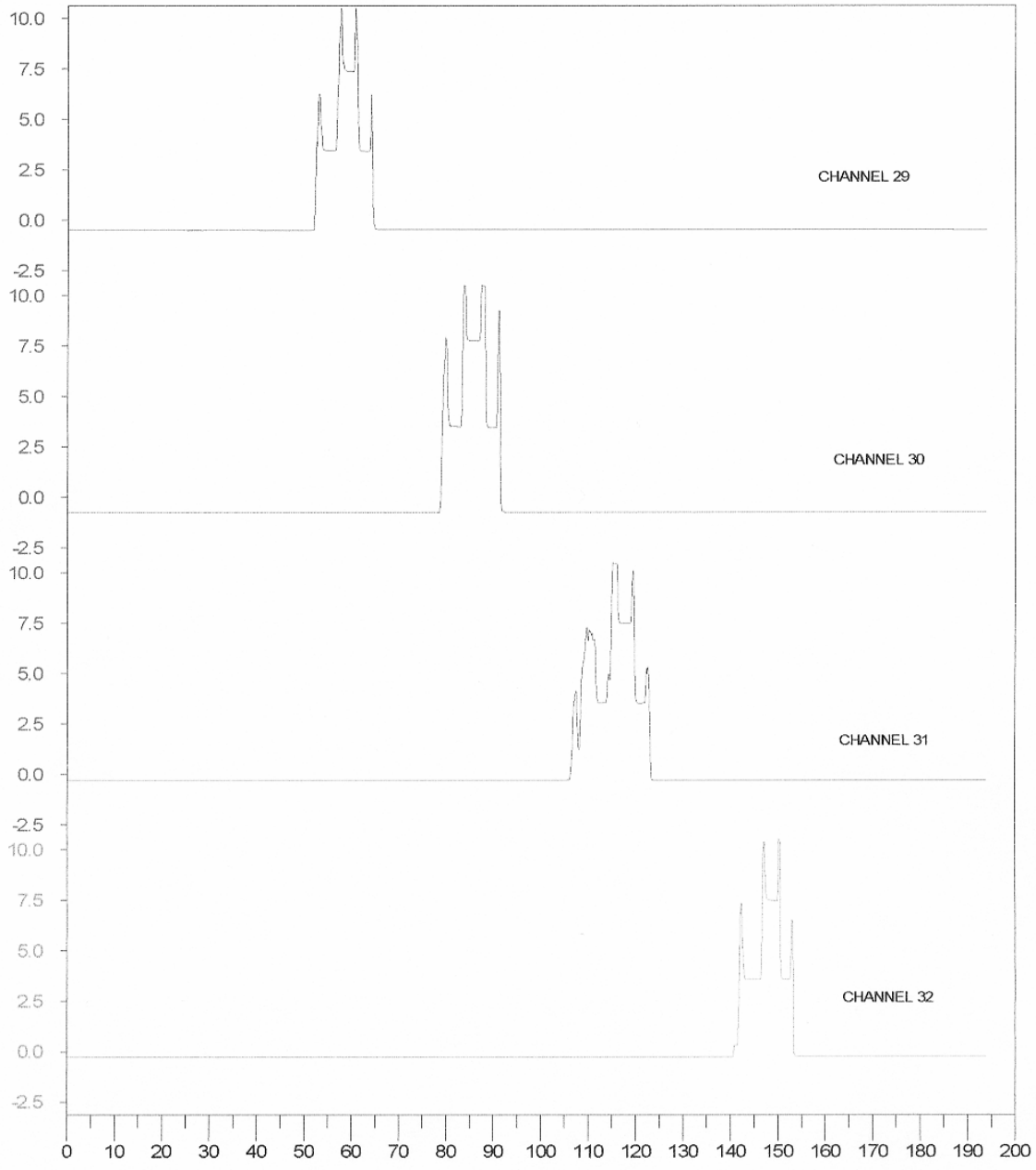
163MK Amplification Factor

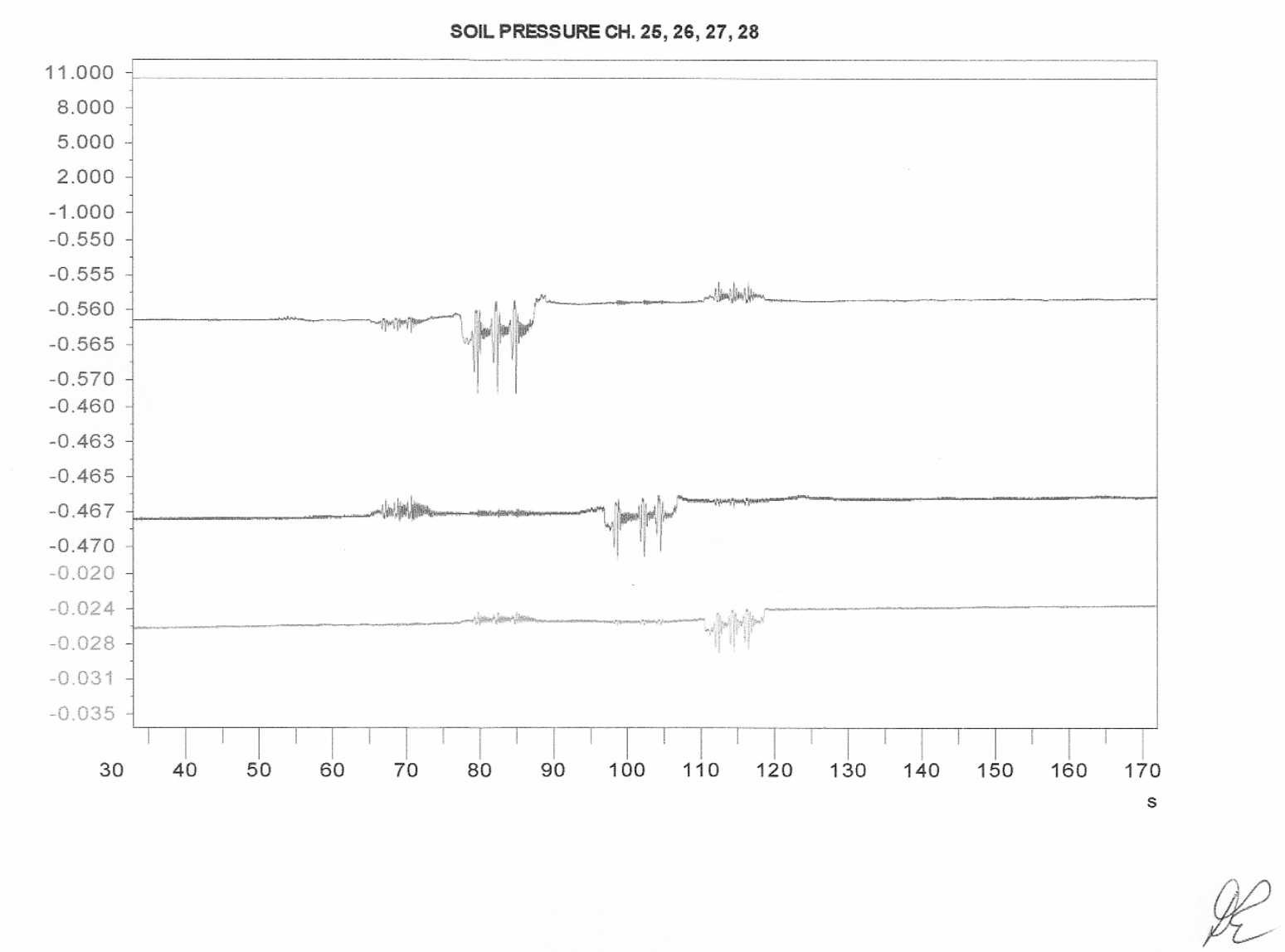
Channel #	INPUT VOLTAGE [mV]	OUTPUT VOLTAGE [mV]	GAIN	COMMENTS
25	~~0.0~~ 12	605.07	50.42	Ch. good. Source has to be offset.
26	12	593.5	49.46	
27	12	600.1	50.01	
28	12	593.1	49.93	
29	12	604.3	50.36	
30	12	601.2	50.10	
31	12	600.6	50.05	
32	12	600.6	50.05	

Initials

OVERALL DISPLACEMENT CALIBRATION FILE

DISPLACEMENT CHANNELS




SOIL PRESSURE CH. 25, 26, 27, 28
11.000
8.000
5.000
2.000
-1.000
-0.550
-0.555
-0.560
-0.565
-0.570
-0.460
-0.463
-0.465
-0.467
-0.470
-0.020
-0.024
-0.028
-0.031
-0.035
30
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120
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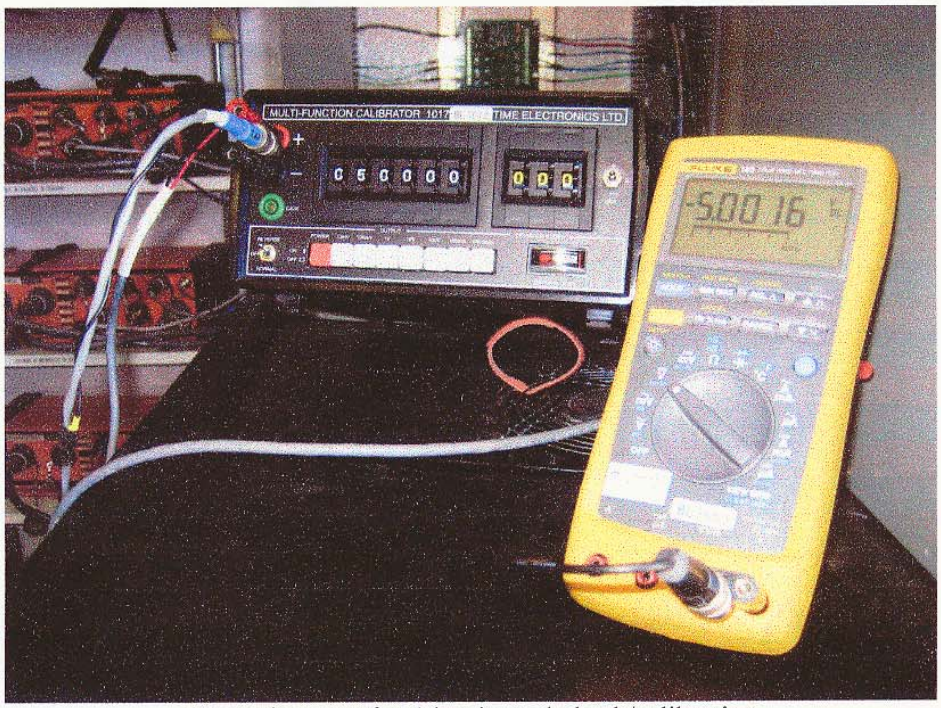
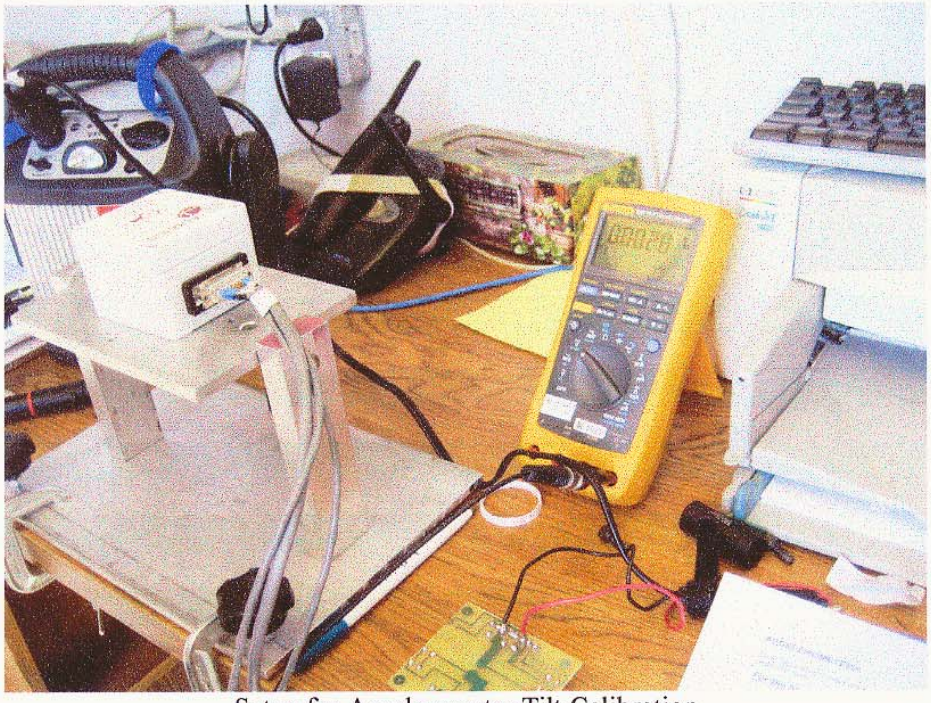
160
170
s

General Site View



Measuring stup for A/D channel check/calibration



Setup for Accelerometer Tilt Calibration