CMG-1T CALIBRATION SHEET

WORKS ORDER:	12802	DATE:	12-Mar-2013
SERIAL NUMBER:	T1077	TESTED BY:	S. Goddard

	Velocity Output V/m/s (Differential)	Mass Position Output (Acceleration output) $V/m/s^2$	Feedback Coil Constant $Amp/m/s^2$
VERTICAL	2 x 1489	2084	0.0138
NORTH/SOUTH	2 x 1496	1450	0.0145
EAST/WEST	2 x 1494	1419	0.01419

Power Consumption: 60mA @ +12V input
Calibration Resistor: 51000

NOTE: A factor of 2 x must be used when the sensor outputs are used differentially (also known as push-pull or balanced output). Under no conditions should the negative outputs be connected to the signal ground. A separate signal ground pin is provided.

POLES AND ZEROS TABLE

WORKS ORDER NUMBER: 12802

SENSOR SERIAL NO: T1077

Velocity response output, Vertical Sensor:

POLES (HZ)	ZEROS HZ
$-1.964 \times 10^{-3} \pm j1.964 \times 10^{-3}$	0
-30.0529±j31.1211	0
-41.2564±j114.535	

Normalizing factor at 1 Hz: A = 27.7×10^{6}

Sensor Sensitivity: See Calibration Sheet.

Velocity response output, Horizontal Sensors:

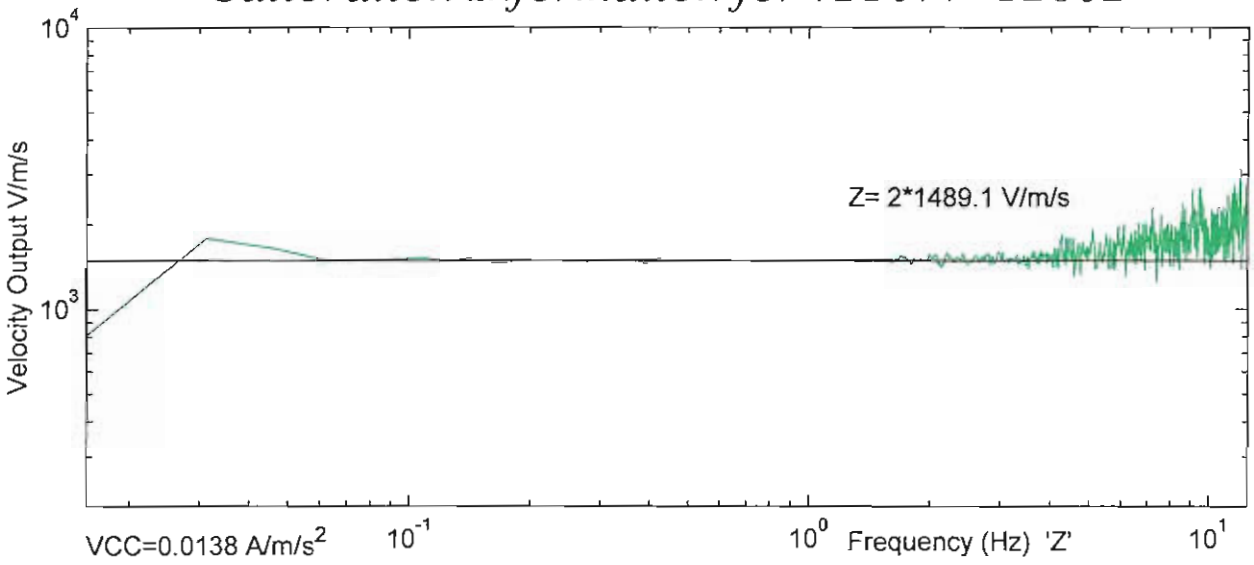
POLES (HZ)	ZEROS (HZ)
$-1.964 \times 10^{-3} \pm j1.964 \times 10^{-3}$	0
-30.0529±j31.1211	0
-41.2564±j114.535	

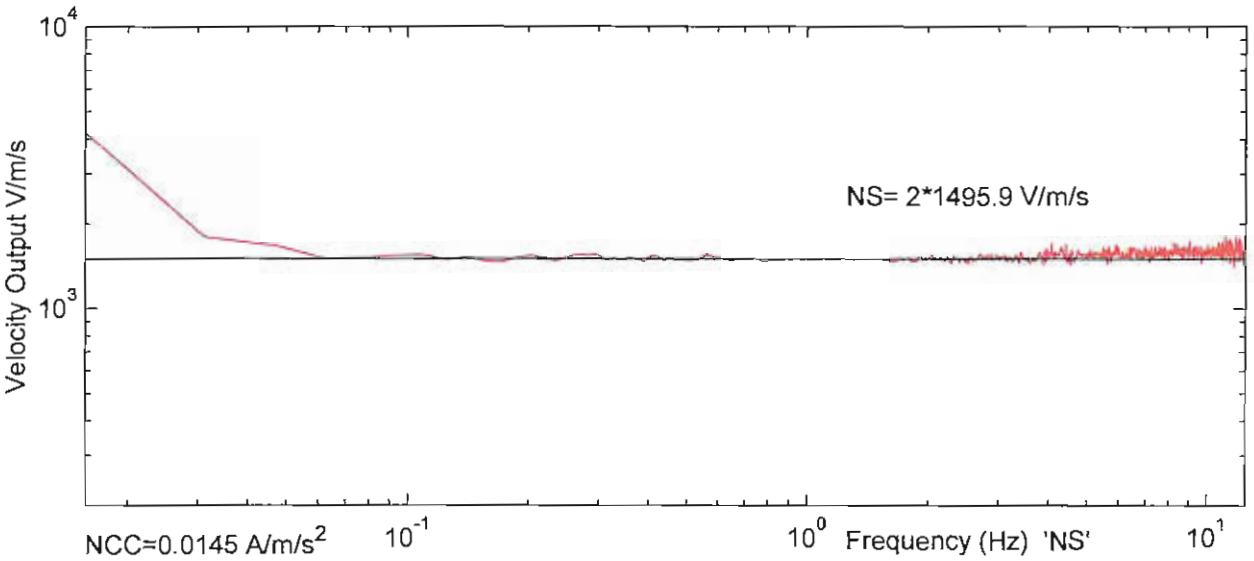
Normalizing factor at 1 Hz: A = 27.7×10^{6}

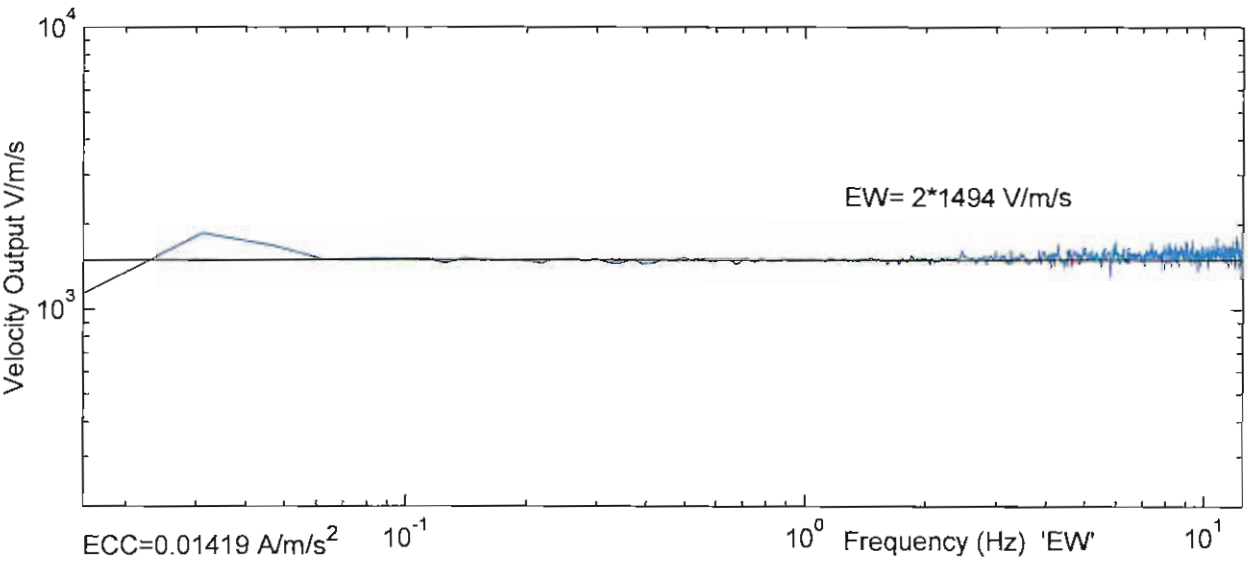
Sensor Sensitivity: See Calibration Sheet.

NOTE: The above poles and zeros apply to the vertical and the horizontal sensors and are given in units of Hz. To convert to Radian/sec multiply each pole or zero with 2π. The normalizing factor A should also be recalculated.

Calibration Information for :T1077 12802



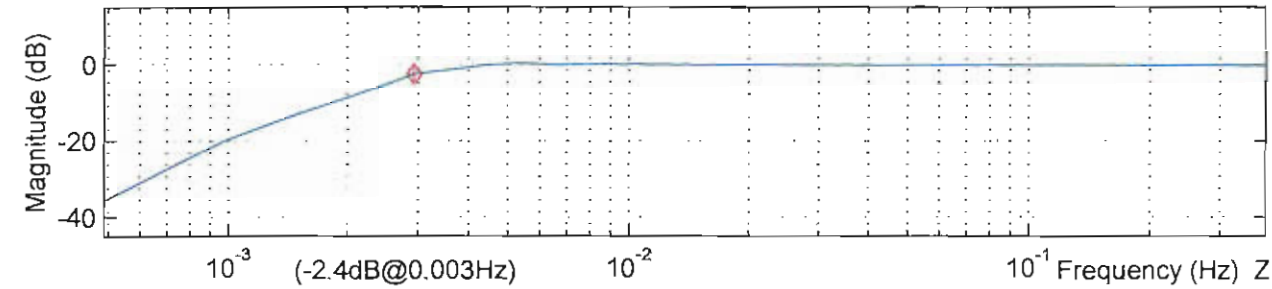


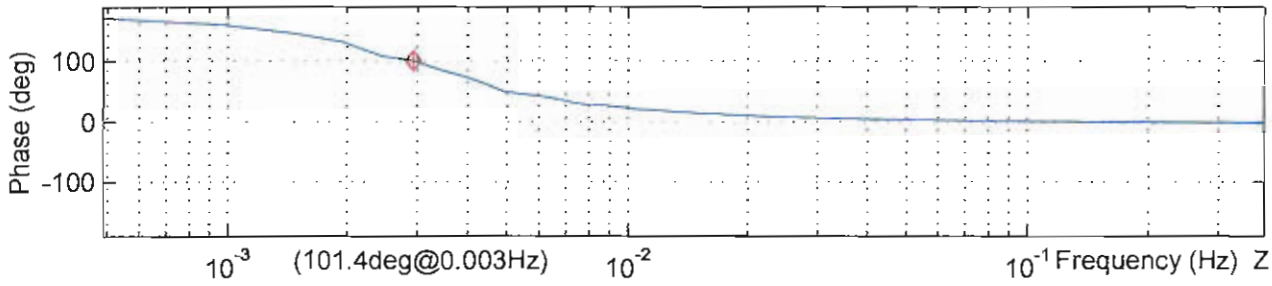


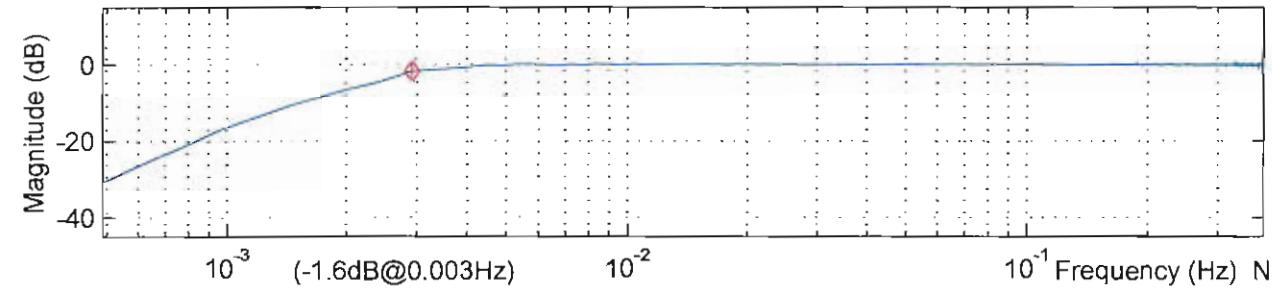
RCal =51000 Ohms

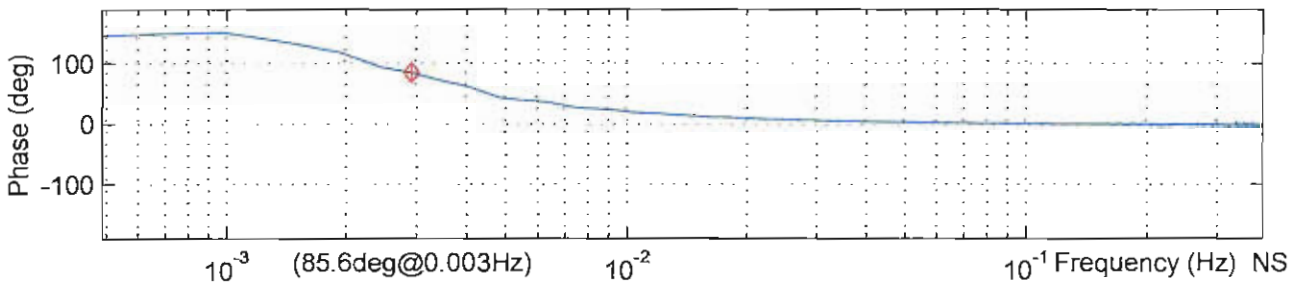
12-Mar-2013

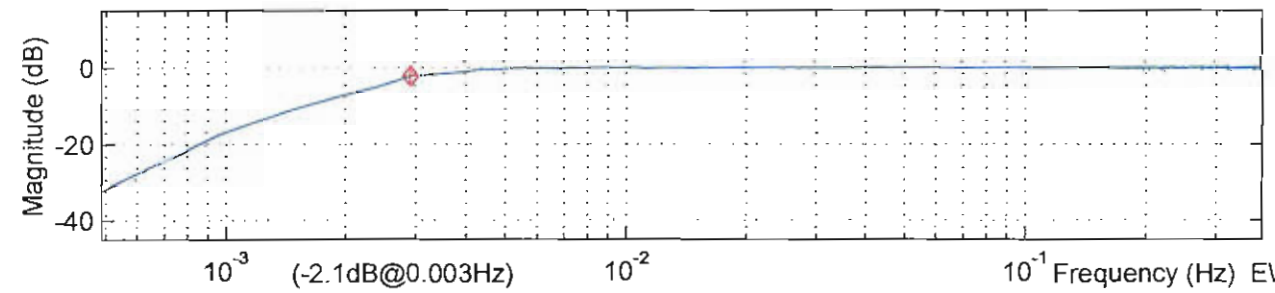
Normalized Frequency Response for :T1077, 12802

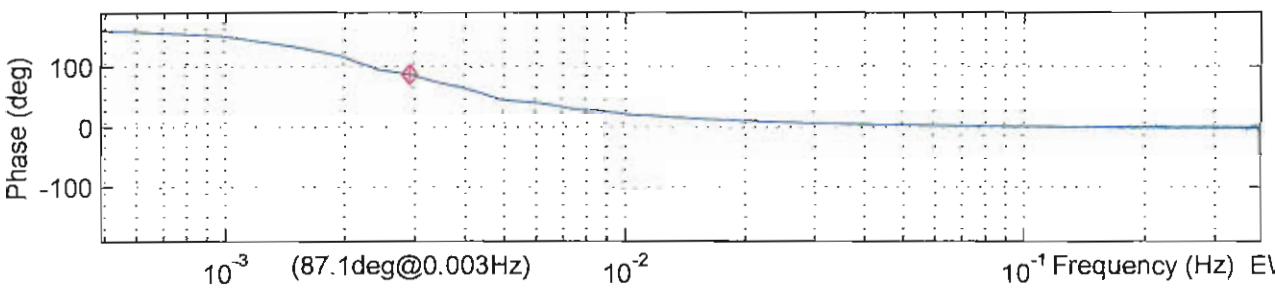






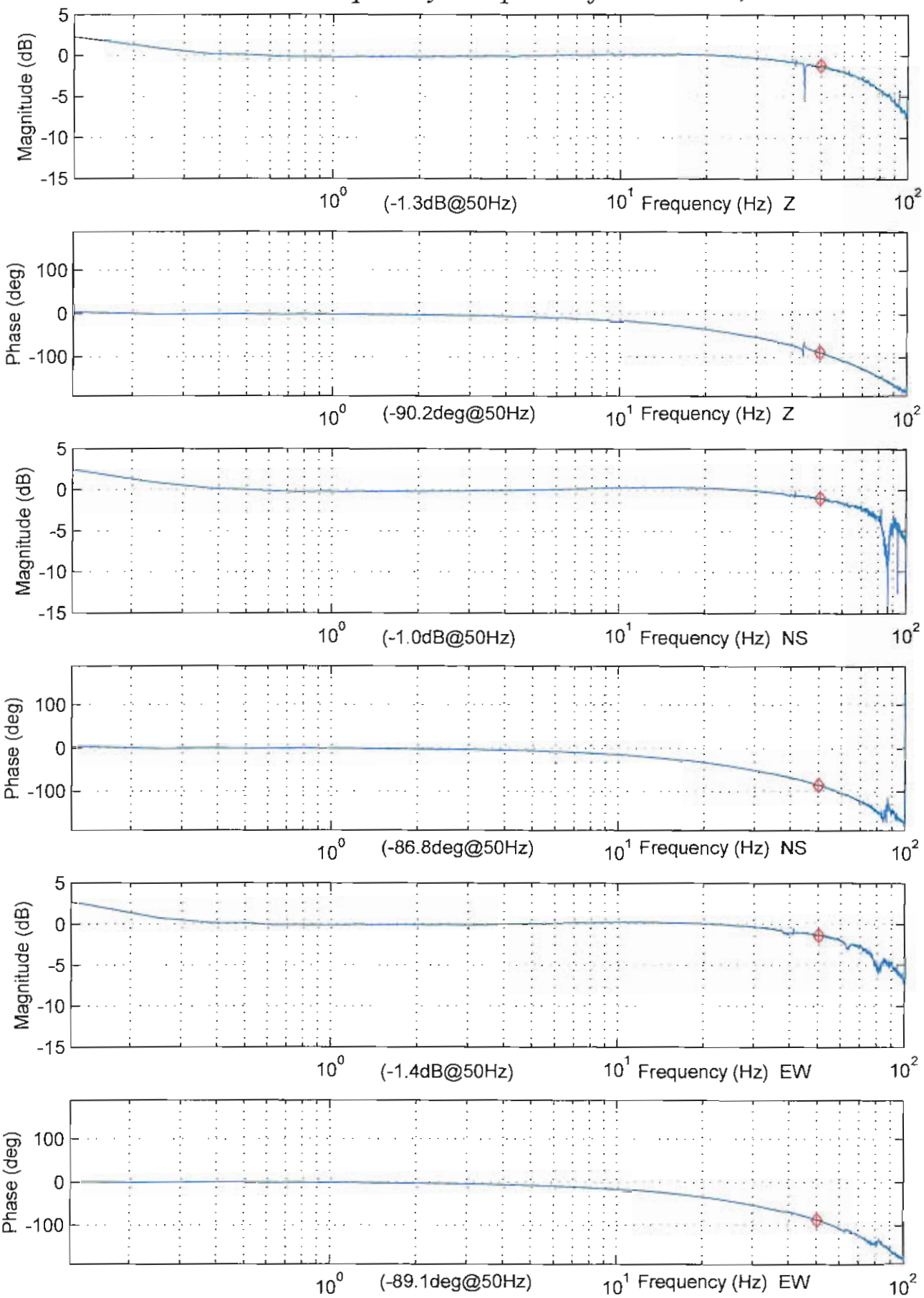






12-Mar-2013

Normalized Frequency Response for :T1077, 12802



12-Mar-2013

GURALP SYSTEMS

Guralp Systems Limited, 3 Midas House, Calleva Park,
Aldermaston, Reading, RG7 8EA, UK.
Telephone: +44 118 9819056 Fax: +44 118 9819943
sales@guralp.com

CMG-5T/TD/U Instrument Quality Certificate

This certificate identifies the tests and inspection carried out.

Sensor Serial Number.	T5CQS
	Pass
Sensor Noise Coherence.	
Frequency response. Document attached.	✓
Calibration. Document attached.	✓
Cable Lengths & Ancillaries as per customer order?	N/A

Final Quality Approval. APS

On behalf of Guralp Systems. Date 31/1/13

CMG-5T ABSOLUTE CALIBRATION
(ACCELERATION OUTPUTS)

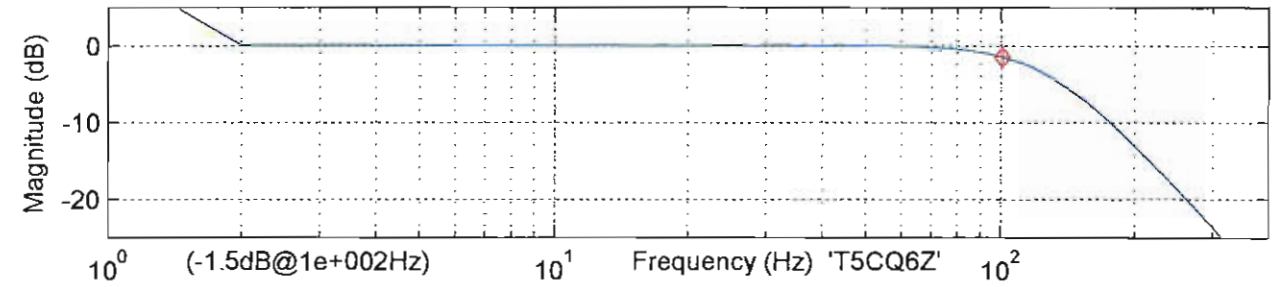
WORKS ORDER:	12802	DATE:	7/02/2013
SERIAL NUMBER:	T5CQ6	TESTED BY:	SH
		OUTPUT at 1g	5 volts

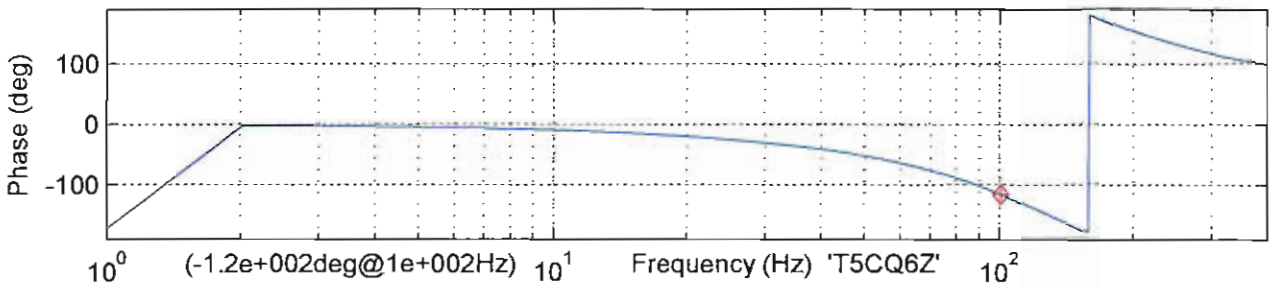
	Acceleration Response $V/m/s^2$
VERTICAL	2 x 0.509
NORTH/SOUTH	2 x 0.510
EAST/WEST	2 x 0.509

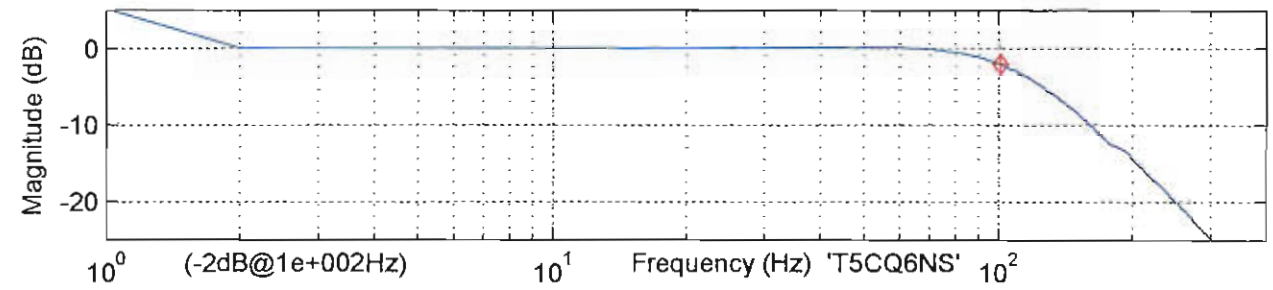
Vertical component equivalent acceleration from calibration signal of:	1 Volt = $0.982 m/s^2$
North/South component equivalent acceleration from calibration signal of:	1 Volt = $0.980 m/s^2$
East/West component equivalent acceleration from calibration signal of:	1 Volt = $0.982 m/s^2$
Calibration enable signal polarity:	Active Low
Typical Current Consumption:	
This sensor operates from:	10 to 36 Volts

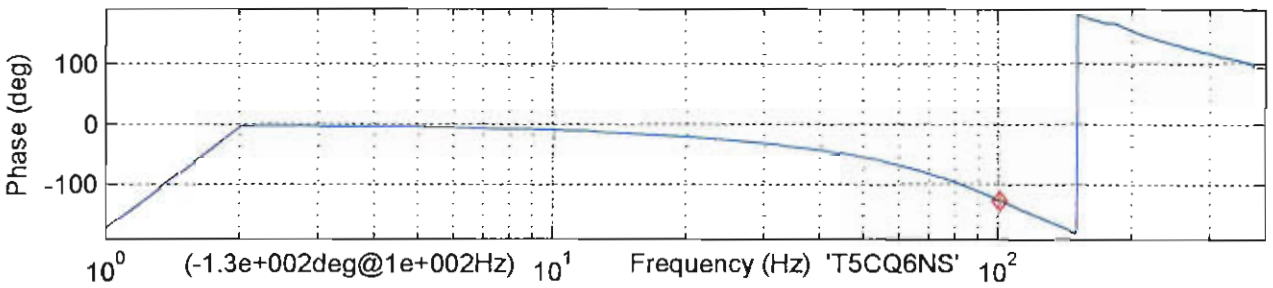
NOTE: A factor of 2 x must be used when the sensor outputs are used differentially (also known as push-pull or balanced output). Under no conditions should the negative outputs be connected to the signal ground. A separate signal ground pin is provided.

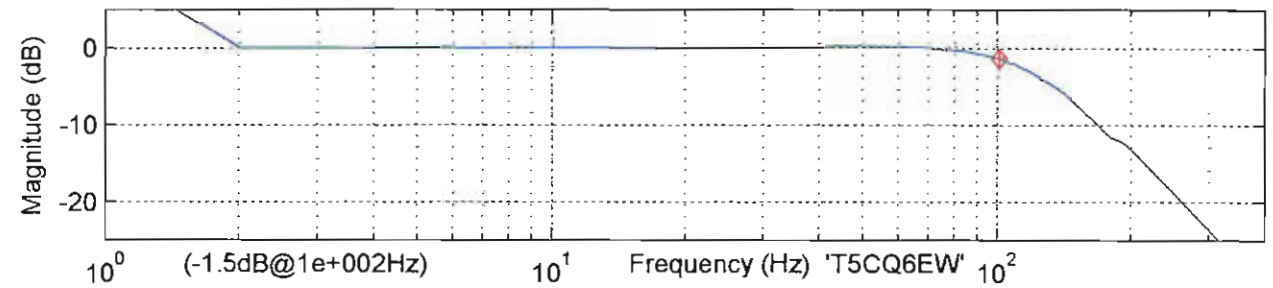
Frequency Response for :T5CQ6 'WO12474'

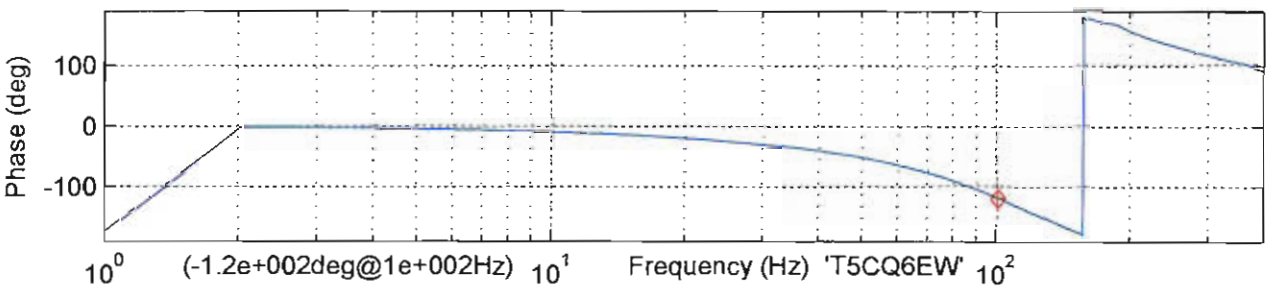












HIGH TECH, INC.

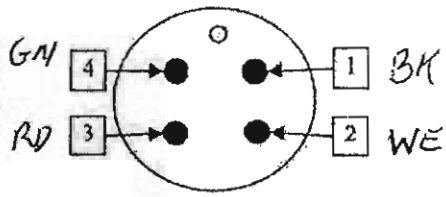
21120 Johnson Road
Long Beach, MS 39560

Tel. (228) 868-6632
Fax (228) 868-6645
hightechinc@att.net

299/1/57 Hydrophone Information 03/04/13
Model# HTI-90-U/Diff
Connector: Subconn IL-4-M & DLSA-M

Connector Pinout

Pin 1	+12VDC
Pin 2	12VDC Return / Signal Gnd
Pin 3	Signal + Output
Pin 4	Signal - Output



Test Data

Serial Number	Hydrophone Sensitivity dB re: 1V/uPa	Current mA
299463	-174.8	2.22
299464	-174.1	2.23
299465	-173.9	2.21
299466	-174.2	2.24
299467	-174.0	2.22
299468	-174.5	2.23
299469	-174.4	2.2
299470	-174.6	2.22
AVG	**-174.3**	**2.22**
VAR	**0.1**	**0.00**
STD	**0.3**	**0.01**
MAX	**-173.9**	**2.24**
MIN	**-174.8**	**2.20**
DIF	**0.9**	**0.04**

5m cable

Sensitivity was measured using the comparison method
Reference hydrophone = 999901
Measurements traceable to USRD Newport, RI

Hydrophones listed on this page:
- Leaked less than 0.1uA @ 27VDC after 1hr @ 100PSI hydrostatic pressure
- Passed shield integrity test
- Have the same Polarity Response

BSS 2/28/13

Voltage	12VDC
Preamp Mode	Voltage
Source Capacitor	800pF
Termination Resistor	-

Expected Gain	12dB
Response High (-3dB)	20kHz
Response Low (-3dB)	2Hz

	Gain (dB)								
Preamp#	2Hz	5Hz	50Hz	100Hz	1KHz	5KHz	10KHz	20KHz	30KHz
1	9.62	11.83	12.42	12.42	12.42	12.42	12.43	12.44	12.47
2	9.60	11.83	12.43	12.44	12.44	12.44	12.44	12.46	12.49
3	9.55	11.81	12.42	12.42	12.42	12.42	12.43	12.44	12.47
4	9.57	11.80	12.42	12.43	12.43	12.43	12.43	12.45	12.48
5	9.58	11.83	12.42	12.42	12.42	12.42	12.43	12.44	12.47
6	9.54	11.84	12.41	12.42	12.42	12.42	12.42	12.44	12.47
7	9.57	11.83	12.43	12.43	12.43	12.43	12.44	12.45	12.48
8	9.68	11.84	12.41	12.42	12.42	12.42	12.42	12.44	12.47
AVG	9.59	11.82	12.42	12.43	12.43	12.43	12.43	12.45	12.47
VAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STD	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MAX	9.68	11.84	12.43	12.44	12.44	12.44	12.44	12.46	12.49
MIN	9.54	11.80	12.41	12.42	12.42	12.42	12.42	12.44	12.47
DIF	0.14	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02

	Phase (deg)								
Preamp#	2Hz	5Hz	50Hz	100Hz	1KHz	5KHz	10KHz	20KHz	30KHz
1		-159.7	-177.9	-179.0	179.9	178.9	177.8	175.6	173.4
2		-159.5	-177.8	-179.0	179.9	178.9	177.8	175.6	173.4
3		-159.9	-177.9	-179.0	179.8	178.9	177.8	175.5	173.4
4		-159.7	-177.9	-179.0	179.9	178.9	177.8	175.6	173.4
5		-159.7	-177.9	-179.0	179.9	178.9	177.8	175.6	173.4
6		-159.6	-177.9	-179.0	179.9	178.9	177.8	175.6	173.4
7		-159.4	-177.8	-179.0	179.9	178.9	177.8	175.6	173.4
8		-159.9	-177.9	-179.0	179.9	178.9	177.8	175.5	173.4
AVG		-159.7	-177.9	-179.0	179.8	178.9	177.8	175.6	173.4
VAR		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STD		0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAX		-159.4	-177.8	-179.0	179.9	178.9	177.8	175.6	173.4
MIN		-159.9	-177.9	-179.0	179.8	178.9	177.8	175.5	173.4
DIF		0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DM24 CALIBRATION

WORKS ORDER:12802 **DIGITISER SERIAL NUMBER:**A4277

SYSTEM ID:4277 CPLD:A0.E1
UNIT ID:VEL1, ACC1 BOOTLOADER:MK3BOOT302.IMG
OUTPUT DATA FORMAT:GCF DSP SOFTWARE:DSP1090.BIN
BAUD RATE: 115200 SYSTEM: DMNET107b10.IMG

VELOCITY CHANNELS

Channel:	VEL1Z2	Vertical	3.227 µV/Count
	VEL1N2	North/South	3.225 µV/Count
	VEL1E2	East/West	3.222 µV/Count
	ACC1Z2	Vertical	3.228 µV/Count
	ACC1N2	North/South	3.223 µV/Count
	ACC1E2	East/West	3.224 µV/Count

MASS POSITION CHANNELS

Sample Rate: 4 samples/sec (Default)

Channel:	VEL1M8	Vertical	291.55 µV/Count
	VEL1M9	North/South	291.80 µV/Count
	VEL1MA	East/West	292.31 µV/Count

CAL SIGNAL MONITOR

VEL1X2/ VEL1C2 3.230 µV/Count

GPS RECEIVER

PWM: 8000 Counts
At Temperature Reading: 23°C

POWER CONSUMPTION

Digitiser Power Consumption	80mA @ 12v
GPS Power Consumption	28mA @ 12v

AUXILIARY CHANNELS

Sample Rate: 4 samples/sec (Default)

Channel:		
	VEL1MB	290.50 μV/Count
	VEL1MC	291.84 μV/Count
	VEL1MD	291.82 μV/Count
	VEL1ME	291.49 μV/Count
	VEL1MF	292.02 μV/Count

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Oceanography Centre
University of Southampton Waterfront Campus
European Way, Southampton SO14 3ZH
United Kingdom

Pressure Test Lab +44 (0) 23 8059 6309
http://noc.ac.uk

Date: 30/10/13

Purchase Order; 29508

HYDROSTATIC TEST REPORT

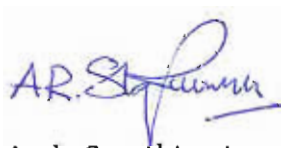
Company: Guralp Systems Limited

Address: 3 Midas House
Calleva Park
Aldermaston
Reading
RG7 8EA

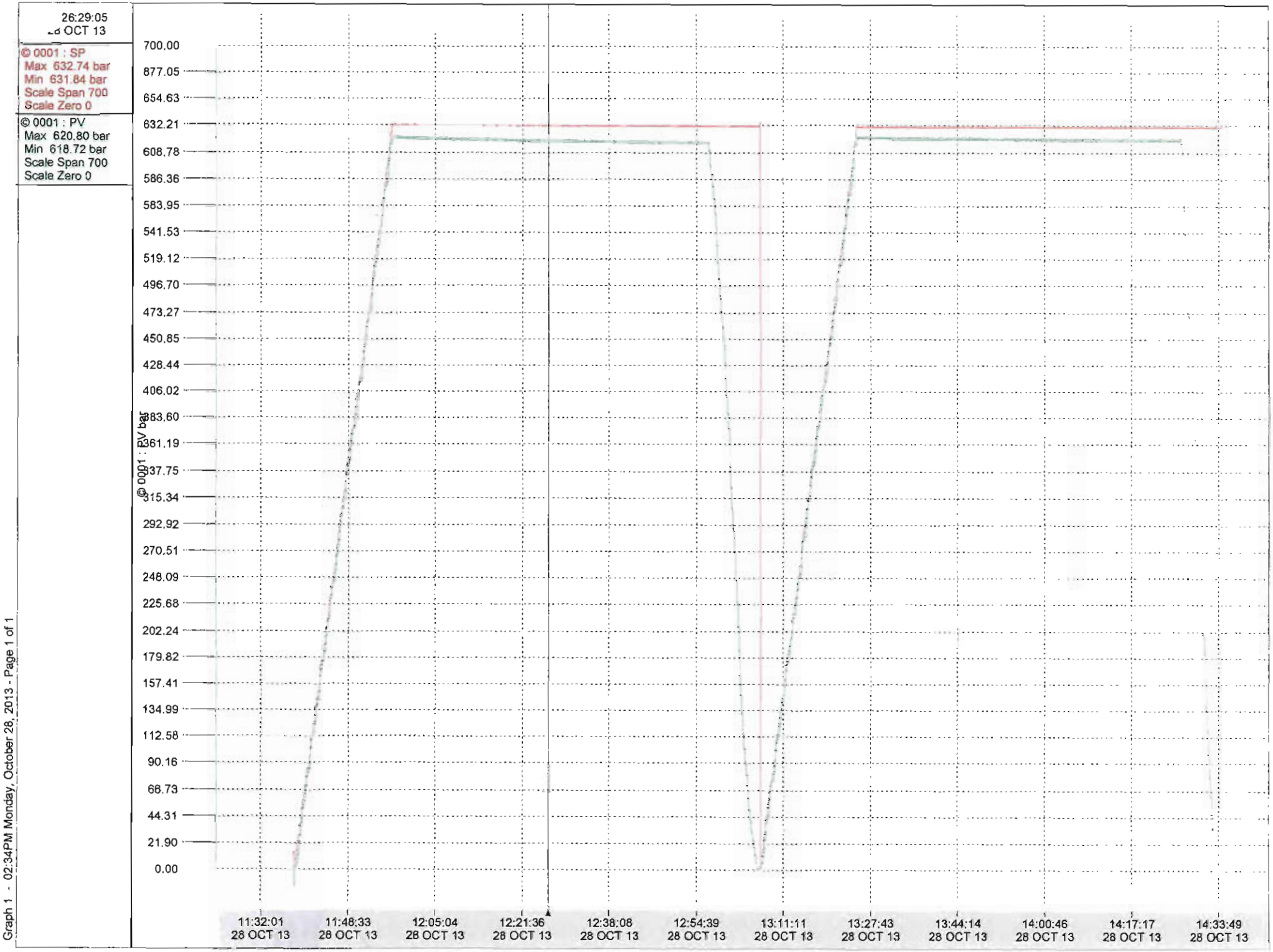
Equipment: 1 x ITOBS Sphere
Serial No; 58328-00004

Schedule: 620 bar hold for 1 hour, 2 cycles

Comments: No visual signs of leaks or damage.



Andy Staszkiewicz
023 8059 6309



Graph 1 - 02:34PM Monday, October 28, 2013 - Page 1 of 1