ISTITUTO DI FISICA DELLO SPAZIO INTERPLANETARIO

Datasheet GRAV.1

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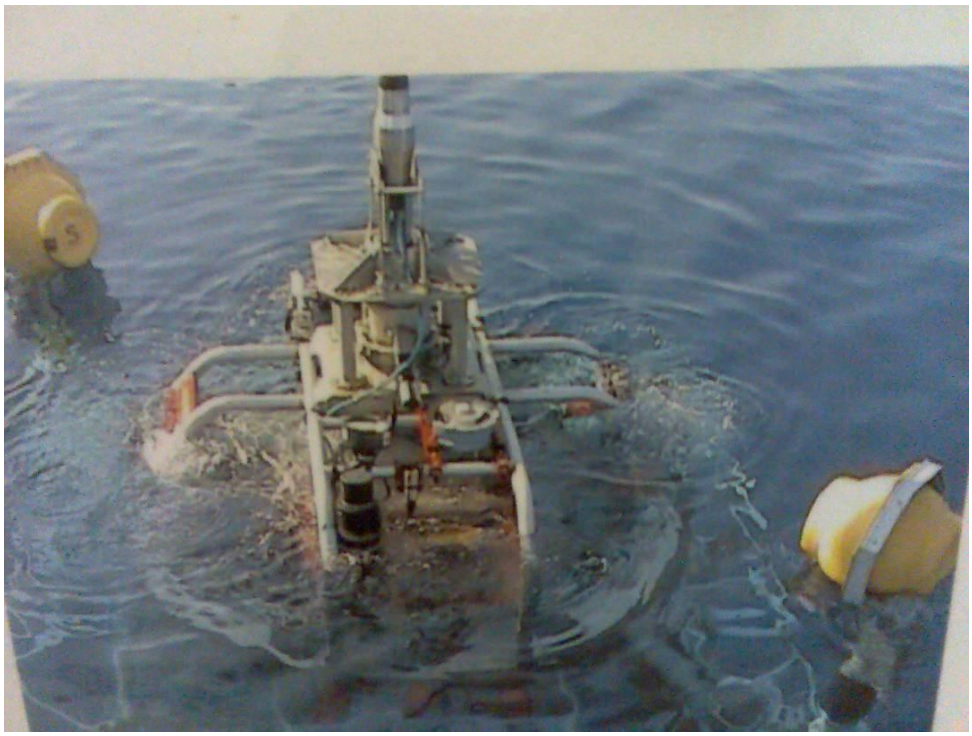

Gravimeter

Grav-1 is a second-order oscillator system, with resonance frequency of 15 Hz.

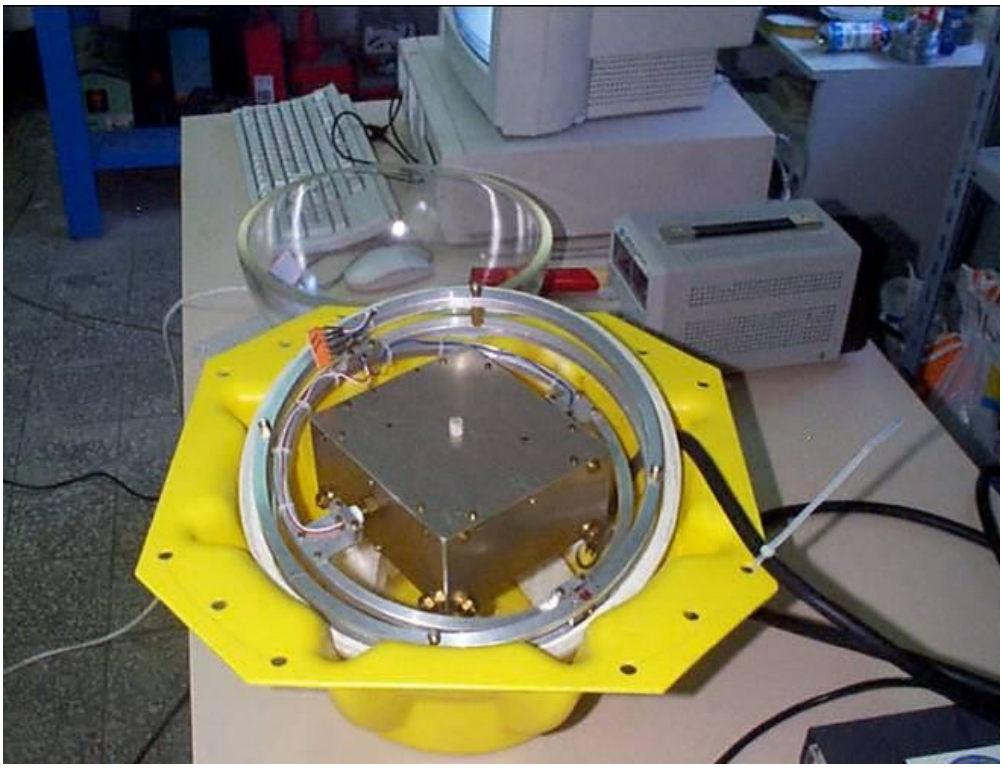

Figure 1. Gravimeter installed inside the bentos sphere by means of the gimbals suspension.

It is conceived to measure the vertical component of gravitational field variation and of seismic waves and it is able to operate in extreme environments (deep sea level) for a long period, without remote control.

The gravimeter is suspended inside a special spherical deep-see glass housing(benthos vacuum sphere), by means of a gimbals system, permitting it to recover the local vertical at the moment of the deployment of the observatory at the bottom of the Sea.

The instrument is an evolution of those successfully operated in the GEOSTAR observatory.

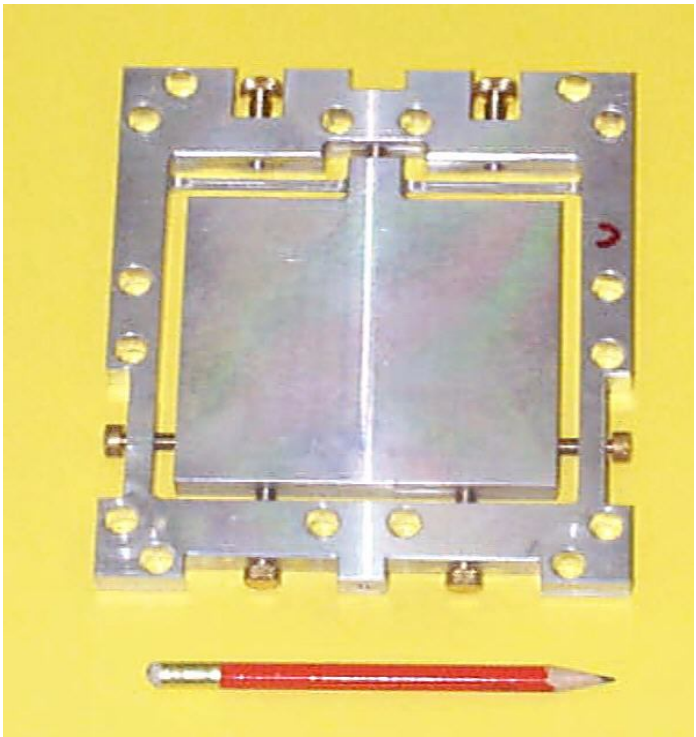

Figure-2 ***Mechanical part of the gravimeter .***

The principal part of the gravimeter is the mechanical oscillator with frequency of 15Hz, shown in Figure-2. It is obtained machining a single piece of Al 5056. The proof mass is connected to a rigid frame by two torsional arms. The piece is machined so that, when it is in horizontal position, under the action of the gravity, the proof mass face is coplanar with the rigid frame face. If a vertical acceleration acts on this proof mass a change of its equilibrium position occurs. A capacitive bridge transducer detects these displacements.

Two sensing capacitors C_1 *and* C_2 are inserted in a capacitance bridge, together with two fixed capacitors C_a *and* C_b; the bridge is driven at $f_p = \Omega / 2\pi = 10kHz$.

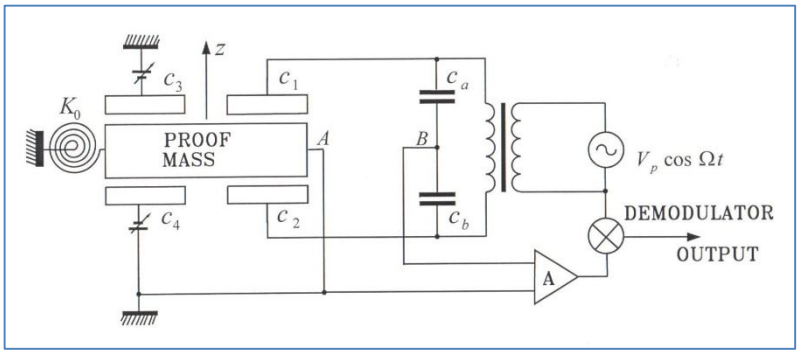

Figure-3 ***Simple scheme of the gravimeter read out system.***

K_o represents the torsional elastic constant, ***z*** *the sensitive axis.*

A low frequency signal produces an unbalancing at the exit of the bridge (points A and B), seen like a modulation of the driven voltage. In this way the signal is transferred from low to high frequency (10KHz).

As a result of this transferring, the amplifier works at high frequency, where its *1/f* noise is lower. After amplification the signal is demodulated and acquired at low frequency.

A 10KHz voltage drives the gravimeter transducer by a high stability quartz oscillator. The signal, after the low noise AC amplifier is sent to a demodulator, which uses as reference a signal coming to the some oscillator. Demodulated signal is sent to a 24-bit A/D converter. A micro controller device, every one sec, gives the start to the converter, read the data and sent it to the RS232 serial port. Trough this port the GEOSTAR DACS (Data Acquisition Control System) collects the data. The DACS can also give a signal for synchronising the gravimeter acquisition with other instruments.

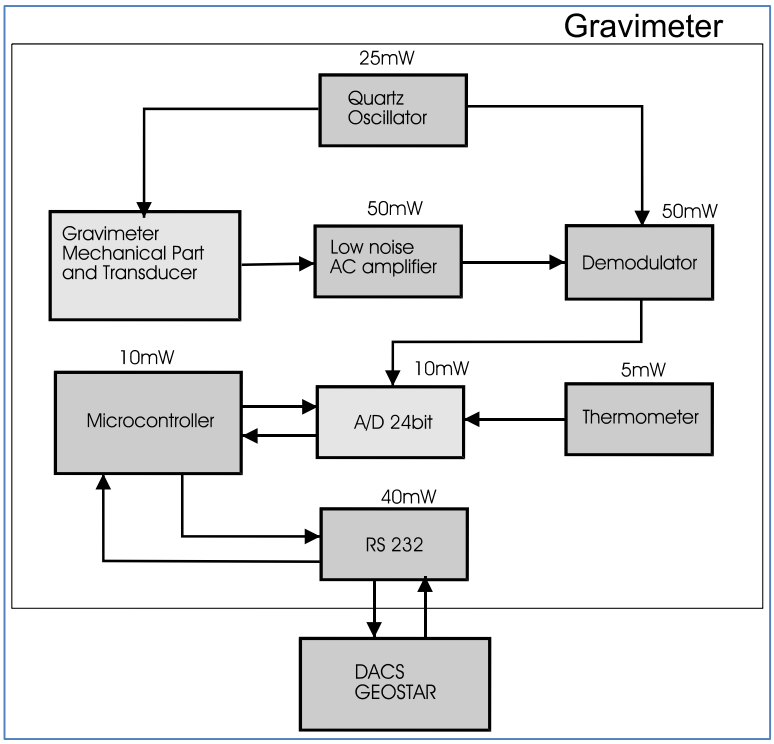

Figure-4 shows the scheme of the whole system

The noise voltage of the amplifier limits sensitivity of the system. The main points are its thermal stability and dynamics necessary to operate for six months without change of its parameters.

Table 1. Grav-1 main characteristics

Sensitivity	$10^{-9} g/\sqrt{Hz}$
Frequency range	$10^{-5} - 10^{-1} Hz$
Power dissipation	<300mW
Volume	10X10X10 cm
Weight	2Kg

POWER AND DATA FORMAT

Power supply: 5 Vdc ± 0.1V
Data transmission via RS232 three-wire (TX RX GND) and Protocol 9600 N 8 1.
The instrument provides a string of data per second.
The data string has the following format:
AAAAAA, TTTTTT <CR>
It is 16 bytes:
- The first is a hash mark (0x23) identification string beginning;
- A 6 characters are hexadecimal digits 0, ..., 9, A, B, C, D, E, F with capital letters to encode acceleration in counts
- A comma (0x2C) separates the acceleration on the temperature;
- T 6 characters are hexadecimal digits 0, ..., 9, A, B, C, D, E, F with capital letters to encode the temperature in counts
- The couple <CR> (0x0D, 0x0A) is the string terminator.

At Power up the device starts to send a string of serial measurement per second.
To synchronize data is provided a 'p' command to send to the Rx line of the instrument. Upon receipt of the 'p' command (0x70 question of a lowercase p), the instrument synchronizes the activity of acquiring and sends the data to the serial port.

CONTAINER AND ELECTRICAL CONNECTION

The instrument is mounted in a spherical deep-Sea glass housing(benthos vacuum sphere) of
13 "diameter (Model 2040-13H) equipped with a" titanium vacuum port ".
On the upper hemisphere is mounted (by the supplier of the bentosfera) a connector model Seacon ALL WET FAWL-5S-BC-R / A.
The connector wiring is:

Pin	***Signal***
1	+ 5 VDC
2	Power ground
3	RS 232 Rx
4	RS 232 Tx
5	RS 232 GND