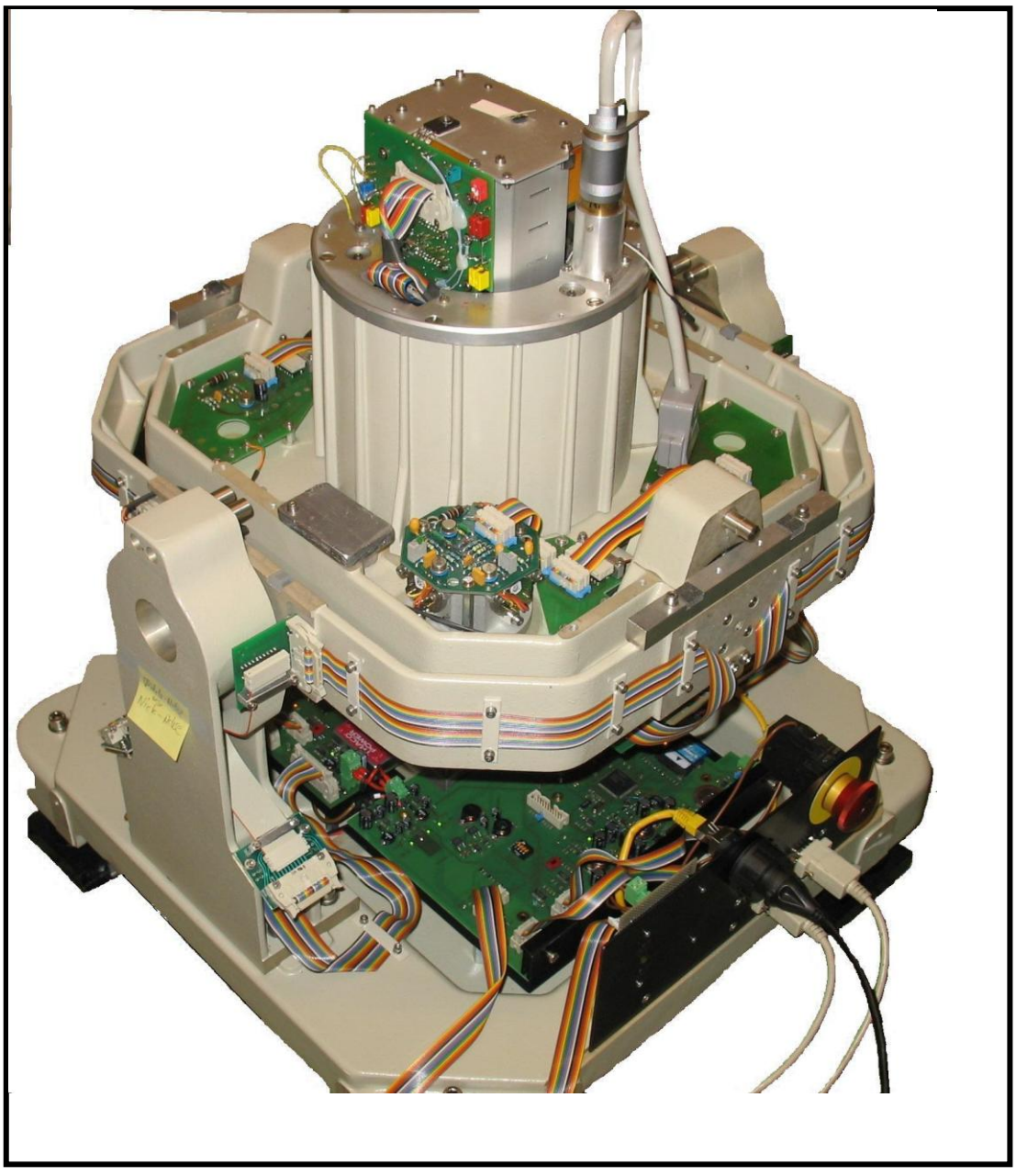
Handout

and

brief description

of

Marine Gravity Meter KSS 32- M



KSS32-M
Marine Gravity Meter
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Introduction

The Marine Gravity Meter KSS32-M is a high performance instrument designed for marine geophysical research projects, including oil prospecting and basic research worldwide.

Straight line technology together with the best precision mechanics and state of the art electronics enable highly accurate gravity measurements. As a marine Gravity Meter it is free from any Cross-Coupling errors.

The KSS32-M Gravity Meter comes in a rugged housing, containing the following components:

- Gyro stabilized platform
- Gravity sensor
- Control electronics
- Power supply
- Shock absorbing mounts

Several embedded microprocessors together with sophisticated software programmes provide very easy handling. Important corrections, like Eötvös-effect and curve compensation can be applied in real time.

Data from the ship's navigation system can be fed into the Gravity Meter by interfaces.

The instrument is furnished with a variety of interfaces to connect to other instruments and to have their data stored.

The software includes a number of digital filters to apply to the data.

The software offers corrections of the free-air and Bouguer anomalies.

In case of a problem the entire system will be turned off and arrested to protect the measuring system even in severe sea conditions.

Operational Capabilities

The Bodensee Gravity Meter KSS32-M offers many advantages:

- High precision instrument. Accuracy better than 0.5 mGal.
- Very low drift
- Worldwide measuring range
- Straight line sensor without Cross-Coupling effect.
- Possibility of highly accurate and linearized measurements for up to 0.23 g. (230 000 mGal) of vertical acceleration.
- Short recovery after profile changes if navigation data are available.
- Valuable readings during turn-manoeuvre if accurate navigation data are available.
- Operation at different sea states will be ensured by selection of appropriate filtering. Measurements are made possible even at rough sea conditions.
- Safety precautions for sensor and gyro platform in case of power breakdown.

The entire system can be operated and controlled via a standard notebook and a set of manufacturer owned software:

- Start-up procedure
- Run-down procedure
- Safety routines
- Application of parameters
- Permanent system tests
- Graphics on the notebook to monitor data and status
- NMEA-link to navigation and other marine instruments
- Data from echo-sounder (if available)
- Data from magnetometer (if available)

Technical Data

Accuracy, during straight course

Vertical Acceleration	Dynamical[1] (RMS)	Effective [2] (RMS)
< 15.000 mGal	0,5 mGal	0,2 mGal
15.000 – 80.000 mGal	1,0 mGal	0,4 mGal
80.000 – 250.000 mGal	2,0 mGal	0,8 mGal

Accuracy, during turning manoeuvre

Vertical Acceleration	Dynamical[1] (RMS)	Effective [2] (RMS)
< 15.000 mGal	2,5 mGal	2,5 mGal

[1] Accuracy without data processing
[2] Accuracy after data processing

Sampling	1 reading per second
Drift rate	< 3 mGal/month
Range	10.000 mGal (worldwide)
Accuracy of Scale Factor	< 0.5%
Angle of Platform	Roll +/- 40° Pitch +/- 40°
Power Supply	100 -230 Vac / 50 - 60Hz
Power rating	400 VA max.
Environment	Temperature +10°C to +35°C Gradient of Temperature <2°C per hour Humidity 30% to 70 %

Description of Modules and Subsystems

The Gravity Meter KSS32-M consists of a number of subsystems and electronic modules:

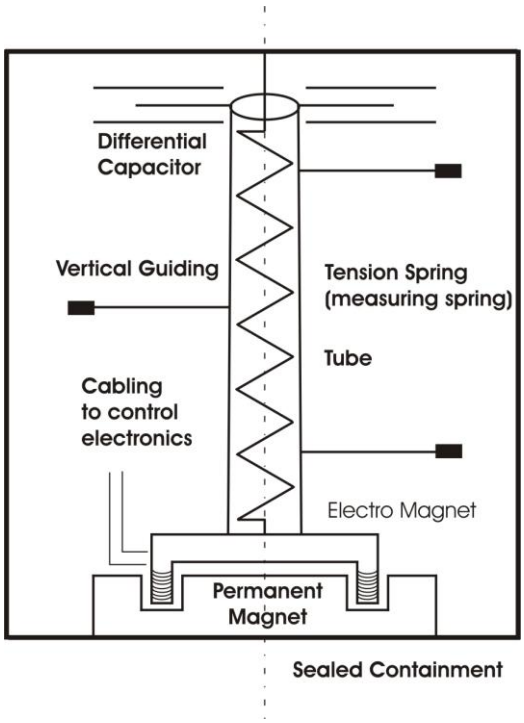
- Sensor Subsystem
- Stabilisation Subsystem
- Power Module
- Notebook
- Data Handling

Inside the stabilisation subsystem there are two electronic modules, to be described below.

Sensor Subsystem

The measuring system of the KSS32-M is based on the principle of a vertical sensor.

The sensor is non-astatized and the motion of the sensor's mass is limited to one degree of freedom in vertical direction. The main gravity acceleration g_0 is compensated by a mechanical spring, whereas gravity changes are detected by an electromagnetic feedback system.



Spring and mass system together with magnetic compensation

Stabilisation Subsystem

Gravity measurements on board a ship have to be carried out on a stabilized platform in order to eliminate the effects of roll and pitch.

Bodensee Gravity Systems has designed a gyro-stabilized platform which meets the requirements for the dynamic accuracy of their Gravity Meter. It consists of a gimbal mounting comprising two frames. One frame is placed inside the other by means of roller bearings. Each frame is made for one axis of rotation, i.e. pitch and roll respectively. The sensor itself is placed exactly in the middle of the two gimbal axes.

A special gyro together with a biaxial horizontal accelerometer provides correction signals to be fed into two motors. The motors quickly rotate the frames back to their horizontal position.

Both frames of the gimbal mounting are furnished with limiters, which reduce the angle of pitch and roll to +/-40°.

Special precautions have been made to safely operate the stabilisation subsystem in case of a failure or break-down. If the gyro enhanced stabilisation should fail the two frames together with the sensor are endangered to swing freely. In this case an emergency programme starts. It is designed to move the frames and the sensor into a position where they can be secured. This is done by arresting the outer housing of the sensor. A small bolt can be pushed into a ring under the sensor containment to hold it.

Stabilising system in operation on a swivel platform

Built-In Protection Devices

Most of the delicate parts of the sensor are inside a special containment, a Dewar-vessel, to protect them against sudden temperature changes. A grid of heating wires is attached to the Dewar-vessel, which together with control-electronics keeps the internal temperature at a constant level of approximately 50°C. Provisions are in place to reduce the temperature shift to less than 0.01°C.

In order to reduce magnetic disturbances coming from external fields an extra magnetic shielding is installed.

In addition a pressure-sealed case is provided to prevent changes in air-pressure from entering the system.

Caging the Sensor

A clamping device has been designed to hold the spring and the mass in a safe position, if the sensor has to be carried about.

During a survey the caging-function will be under the control of the notebook.

The caging-device will also be activated in a case of emergency or power failure.

Caging the Gimbal Mounting

Another safety feature has been designed to protect the gimbal and the sensor. There is a ring and a bolt beneath the sensor. The bolt can secure the sensor when resting inside the ring. A small motor is used to activate the bolt.

The caging-device will also be activated in a case of emergency or power failure.

Ball Calibration

The sensor has been furnished with a special testing device, which is intended to simulate a change of gravity. A small extra mass will be added to the normal mass of the system, thus forcing the system to react with an increase of current to re-balance the spring. Whenever the mass is added, the gravity will increase for about 1000 mGal. The exact value is provided in this manual and can be used for overall-test of the instrument.

Notebook

A notebook together with a library of manufacturer owned programmes is another essential part of the KSS32-M Marine Gravity Meter.

Notebook type: **hp® probook 6550**

The notebook serves as an operator's console. Any operation as Start/Stop, Parameter Setting, Data Handling, Display of Gravity readings, Maintenance etc. will be carried out by means of the Notebook.

There are almost no switches, buttons and displays on the Gravity Meter.

Data handling via Notebook

The Gravity Meter KSS32-M is designed to perform all data exchange by means of the external Notebook. Any standard Notebook is equipped with several sockets to provided data Input and Output.

The Notebook for the Gravity Meter KSS32-M uses 4 types of connectors:

1. LAN connector
2. PCMCIA port
3. USB 2.0 socket

The **LAN** port is linking the Gravity Meter to the Notebook. Not intended for customer port.

The **PCMCIA** port runs a Quad serial interface card. Four independent RS232 devices (COM4 – COM7) can be connected to the Notebook. They are integrated into the BGGS software "DACQS" and intended to connect different external devices to the Gravity Meter such as:

- GPS
- Other navigation systems
- Echosounder
- Magnetometer

Any kind of external instrument can be connected if it is running under NMEA protocol. The BGGS software can handle any given NMEA set of data.

All **USB** ports are free for customer use.

Data handling via Gravity Meter

There are three data ports on the front plate of the Gravity Meter.

1. LAN port
2. RS232 NMEA Navigation
3. RS232 Service and Test

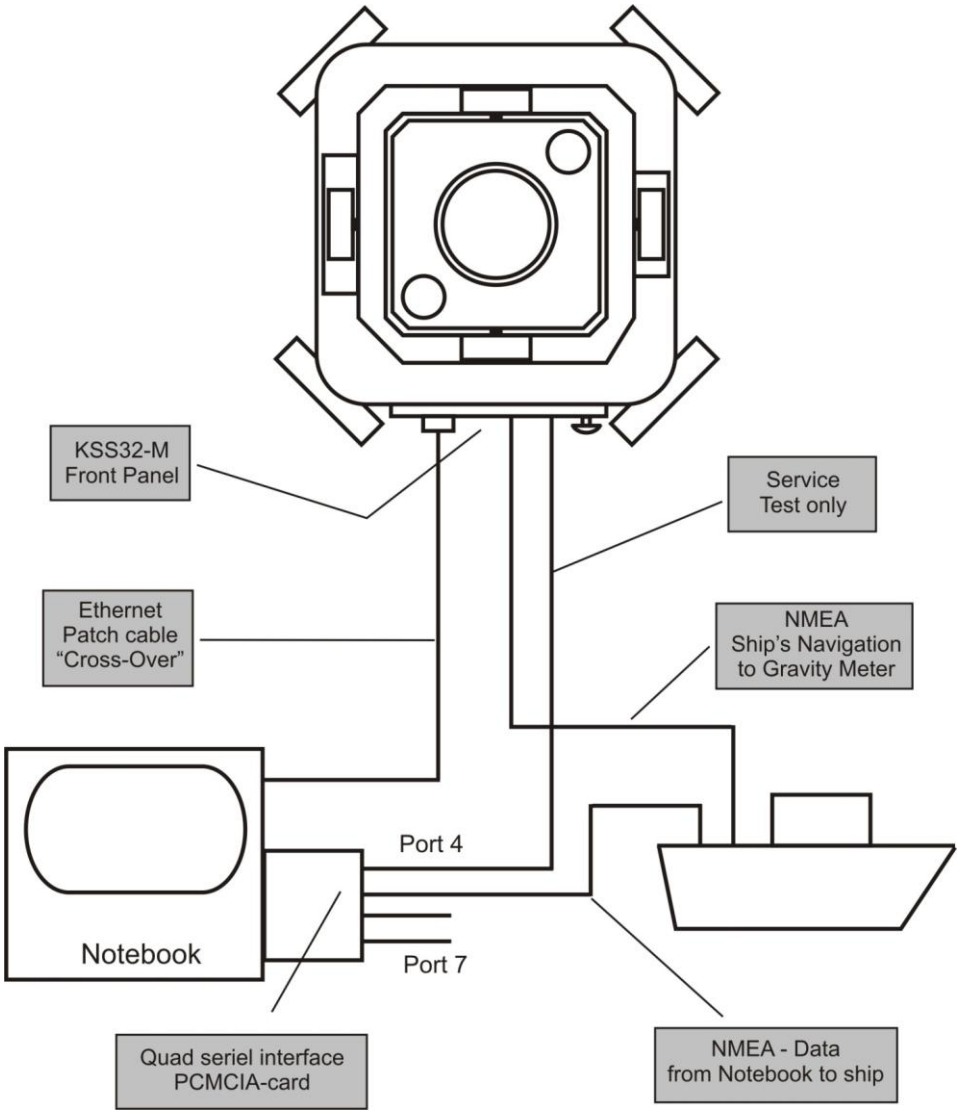
The **LAN** connector is linking the Gravity Meter to the Notebook. It is not designed for customer data acquisition systems.

RS232 **NMEA** can be used to receive a GPS-Navigation protocol from the research vessel.

NMEA **Service and Test** is for factory maintenance only.

Real Time data

If the customer wishes to run his own data acquisition system, the RS232 NMEA (2) connector can be used to either receive navigation data from the ship or send “REAL TIME” gravity data to the vessel.



Cabling of Gravity Meter System on Board a Survey Vessel

Overview

Parameter Set-Up

Various parameters can be entered into the system by means of a special programme running on the notebook.

Scale factor

The scale factor is very important for the internal calculation, in order to maintain exact gravity readings in mGal. The correct scale factor can be determined in the factory only because it requires special instruments. Each sensor has its own scale factor.

Seastate

While cruising, gravity values will be disturbed due to ship's motions. The influence of heaving in particular generates a strong signal. Digital filtering will be applied in order to separate distortion signals from the real gravity. (Refer to Theory of gravity).

The customer can choose from a variety of filters, their coefficients and delay times and thus design his own digital filter. (Refer to § Notebook).

In general the digital filters will be called "SEASTATE". The manufacturer has a set of predesigned filters according to the list. The customer may decide which SEASTATE meets his requirements.

Seastate	Type of filter	Delay time
Seastate 0	Bessel 4^{th} order	66 sec
Seastate 1	Bessel 4^{th} order	110 sec
Seastate 2	Bessel 4^{th} order	175 sec
Seastate 3	Bessel 4^{th} order	245 sec
Seastate 4	Bessel 3^{th} order	471 sec
Seastate 5	Bessel 4^{th} order	33 sec

Seastate	Conditions
Seastate 0	Use only in laboratory. For testing purposes only.
Seastate 1	Use in extremely quiet sea conditions only.
Seastate 2	Standard Seastate. Suitable for most sea conditions during survey.
Seastate 3	For extreme rough sea conditions.
Seastate 4	For extreme rough sea conditions.
Seastate 5	Restricted to very high horizontal accelerations only.

System Test and Maintenance

In addition to monitoring the status of the Gravity Meter (see above) the system is designed to perform several system tests during operation. They are also intended to conveniently carry out maintenance.

Monitoring Status of Operation

All vital conditions of the Gravity Meter are under permanent surveillance of the software. The following information is stored in special files:

- Temperature
- Heating current
- System Voltages
- Horizontal Acceleration
- Roll- and Pitch Angles
- Status of Caging
- Seastate
- External Information (depth, heading, speed, course, velocity)

Ball Test

A special device, the BALL TEST has been designed to run an over-all test of the entire system.

With the ball applied to the internal mass the sensor will show an increase in gravity of about 1000 mGal. The exact value slightly depends on geographical latitude and must been determined in the harbour. It can be found in the appendix.

The computer programme will provide a selectable test to run the BALL TEST. It is recommended to perform this test onshore only, because the sensor m u s t n o t move at all.

After this test has been performed the customer is advised to check the effect on the gravity display. The difference in gravity must show the same value as listed in the appendix. Residuals must be less than +/- 1 mGal.

If the error exceeds 10 mGal the manufacturer should be informed.

About Us

In case of problems kindly contact the Service and Support section of Bodensee Gravitymeter Geosystem GmbH.

Service and Support

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