

# ZLS Corporation

EXCELLENCE IN GRAVITY METERS

## ZLS Dynamic Meter™

- Highest Quality
- Most Precise
- Most Rugged
- Most Reliable

### Applications

- Eliminates damper adjustments
- Eliminates cross-coupling errors
- Smaller residual imperfection errors
- Liquid damping
- Eliminates “slope error”

### Models

- Marine
- Airborne (optional Configuration)



## ZLS Dynamic Meter™ for Marine Applications

### ZLS Dynamic Meter™

#### Introduction

After nearly three years of research and development ZLS has introduced a meter for marine applications. The ZLS Dynamic Meter™ is a completely new meter designed to eliminate inherent cross-coupling errors, frequent damper adjustments, and vibration sensitivity problems associated with beam-type gravity meters (L&R Air/Sea Meter).



#### Features of the ZLS Dynamic Meter™

The new sensor eliminates the cross-coupling errors inherent in older beam-type gravity meters by constraining the proof mass to vertical linear motion.

Damper adjustments are no longer required.

The new sensor utilizes liquid damping that virtually eliminates the sensitivity to vibration common in air-damped sensors.

Residual imperfection errors, due to minute variations in manufacture of the system are typically three to five times smaller than those for beam type sensors. Unlike beam type meters, imperfection errors are stable with time and do not require regular testing to track changes.

The new design eliminates the “slope error” prevalent in beam meters that causes reading errors with beam position under dynamic conditions.

## ZLS Dynamic Meter™

- *Hand Crafted*
- *Proven Metal Zero Length Spring Suspension*
- *Liquid Damped*
- *Eliminates Cross-Coupling*
- *Fully Digital*
- *Proven Design*

### UltraSys™ is Fully Digital

Transducer outputs are digitized with little additional analog processing. The ZLS system digitizes input signals 200 times a second. All processing, including filtering, is done digitally. All control-loop algorithms, for both the platform and gravity sensor, are performed digitally by an embedded computer. Eliminating analog circuits enhances reliability and simplifies servicing.

### A Mature System

Herbert D. Valliant, co-founder of ZLS Corporation, developed the prototype at the Geological Survey of Canada (Geophysics, 50, 840-845, 1985.)

### How UltraSys™ Functions

UltraSys™ utilizes an embedded processor to perform all of the platform and sensor control functions. The power module may be located anywhere within 3 meters of the platform. A host computer, connected to the control module with a serial cable, completes the system.

The embedded processor is connected to a host computer through a serial port. Using ZLS-supplied software, the host computer processes the data as required for high resolution or standard marine operations and archives the final data.

Raw data from the accelerometers, gyros, and gravity transducer are digitized 200 times a second with a 16-bit A/D converter and processed by the embedded computer. Analog signal outputs to control the motor and gyros are provided by a 16-bit D/A converter, which is also updated at 200 Hz. Slightly filtered data are transmitted to the host computer once per second.

The host computer stores all data on hard disk and can simultaneously direct data to the video monitor, serial port, and printer in a variety of formats. Either a numerical or graphical format may be selected for display on the printer. In high-resolution marine and airplane modes, raw data are recorded once per second, allowing the user to custom filter the data for specific applications. In marine mode the data are filtered in appropriate manner for marine data and recorded at 10-second intervals.

Additional external data may be appended to the gravity data. The system accommodates up to four analog channels and a 24-bit digital channel. The system is fully automatic and will start unattended after a power interruption. Operation is as simple as turning on the switch. However, all system functions can be controlled manually through menu selections. All keystrokes are logged in a separate file for a complete record of system activity. System functions are continuously monitored and UltraSys™ will automatically shut down and activate an external alarm signal in the event of a serious malfunction.

### Improved Accuracy and Enhanced Reliability

- Damper Adjustments no longer required.
- Eliminates the cross-coupling errors inherent in older beam-type gravity meters.
- Residual imperfection errors are typically three to five times smaller than beam meters.
- Liquid damping virtually eliminates the sensitivity to vibration common in air-damped sensors.
- Eliminates the “slope error” prevalent in beam meters.
- The system utilizes the field proven ZLS FogPack.
- The system utilizes the ZLS UltraSys control system that is the standard of the industry. ZLS has upgraded approximately 75% of currently operating Model S gravity meters with its control systems.

## ZLS Dynamic Meter™

- *High Reliability*
- *Fully Automatic System*
- *200 Hz Data Sample Rate*
- *Self-Contained Precision Gyro Power Supply*
- *2 Year Warranty*

## Features of UltraSys™ Controller System

- Digital techniques replace analog hardware, eliminating electronic drift and enhancing system reliability.
- Fully automatic system will start and function unattended after a power interruption.
- Full manual control through menu selection.
- 200 Hz data sample rate accurately digitizes sensor, gyro and accelerometer signals assuring no loss of signal information.
- 200 Hz update of platform feedback loops provides superior platform control.
- Simultaneous data output to video monitor, hard disk, serial port, and printer.
- Graphic or digital format may be selected for printer output.
- Alarm function shuts down system and provides a remote alarm signal in the event of a serious system malfunction.
- Keyboard log records all keyboard activity for review.
- Complete testing and final adjustment using the ZLS test facility.
- Self-contained precision gyro power supply and servo amplifiers.
- Two-year limited warranty.

## Deliverables

- ZLS Dynamic Sensor
- ZLS Stabilized Platform
- System Control Module: attaches to the platform frame
- Universal Worldwide Power Supply: freestanding
- Host Software: processes data for high resolution or standard marine operations
- Comprehensive User's Manual
- Limited two-year warranty

## Accuracy of the Operating System

The accuracy of a marine gravity meter is difficult to specify as it is dependent on the characteristics of the ship, the sea-state, and accuracy of navigation.

ZLS's full digital control system enhances overall system accuracy by eliminating the gain and offset drifts that are inherent with analog electronics. It permits the platform and sensor control parameters to be set more precisely. In analog systems, these parameters are adjusted by changing electronic components, whereas, in digital systems, they are adjusted by simply entering a number in the computer.



## ZLS Dynamic Meter™

- *Worldwide 7000 mGal*
- *Drift: Approx. 3.0 mGal or less per month after aging*
- *Stabilized Platform: Pitch +/- 25 degrees, Roll +/- 30 degrees*

### Weight:

- *Stabilized Platform and Sensor: 185 lb. +/- 5 lb. (83.9 kg. +/- 2.3 kg.)*
- *System Control Module: 6 lb. (2.7 kg.)*
- *Power Supply Module (Desktop Package): 36 lb. (16 kg.)*

### Dimensions:

- *Stabilized Platform and Sensor: 27 in wide; 22 in deep; 25 in high (70 cm wide; 55 cm deep; 64 cm high)*
- *System Control Module: 19 in. wide; 5.5 in. deep; 3.5 in. high (48 cm. wide; 14 cm. deep; 9 cm. high)*
- *Power Supply Module (Desktop Package): 21 in. wide; 18 in. deep; 7 in. high (53 cm. wide; 46 cm. deep; 18 cm. high)*

## Specifications

### Sensor

Type: Metal Zero-Length Spring  
Hardened metal micrometer screw

Range: Standard: Worldwide 7,000 mGal Marine  
Temperature range: -15 to +50 C  
Drift: 3 mGals or less per month after aging  
Static Repeatability: <0.1 mGal

### Stabilized Platform

Pitch: +/- 25 degrees  
Roll: +/- 30 degrees  
Period: Standard 4 minute, Optional 16 minute  
Damping: 0.707 of critical

### Accuracy At Sea

Accuracy of the ZLS Dynamic meter is difficult to specify, as it is dependent on the characteristics of the ship, the sea-state, and accuracy of navigation (typically 1 mGal).

### Control System

Power Requirements: 87 to 270 Vac 47 to 63 Hz single phase  
Power Consumption: Operation: 1 A\*, Maximum: 2.5 A\*  
\* measured at 117 Volts 60 Hz.  
Resolution of Recorded Data: 0.01 mGal  
Clock and Gyro Power Source: Frequency: 200Hz  
Temperature stability: 5 ppm -20C < T < +70C  
Short term aging: 1 X 10<sup>-9</sup>/sec  
Adjustability: sufficient for 5 years of aging.

### External Inputs

Digital: 24 bit TTL compatible input  
Analog: 4 channels, 16 bit resolution, Gains of 1, 2, 4, or 8 may be selected by menu

Sample rate 200 Hz

### WindowsXP

Minimum clock rate: 900  
Minimum RAM: 128 Mb  
External Storage: CD ROM  
One Serial Port:\* RS\_232

\* A second serial port is required to transmit data serially. A USB to serial adapter is acceptable.

## Dimensions and Weights (Outside Dimensions)

### Dimensions:

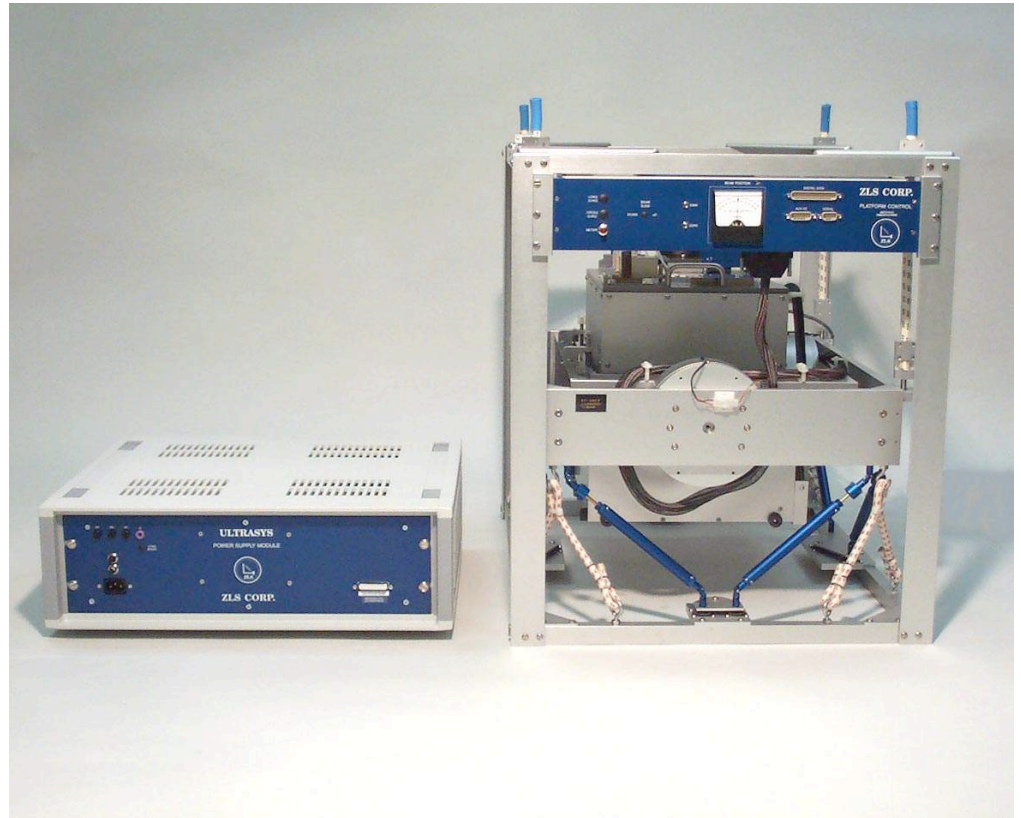
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EXCELLENCE IN GRAVITY METERS

## ZLS Dynamic Meter™ Control System

- Highest Quality
- Most Precise
- Most Rugged
- Most Reliable

### Highlights

- Upgrade for L&R Air/Sea Meters
- High Resolution Marine and Airplane Modes
- New DC Heater Control Circuit
- Fully Digital Control System

### Models

- Marine
- Airborne



## ZLS Dynamic Meter Control System, UltraSys™

The ZLS Control System for L&R Air/Sea Gravity Meter Improves Accuracy, Increases Efficiency, and Enhances Reliability



### UltraSys™ Highlights

- Large (55 conductor) main cable eliminated.
- High resolution marine and airplane modes.
- New DC heater control circuit.
- Smallest and lightest system available.
- Completely automatic.
- Greatest precision.
- Fully digital control system.
- 200 Hz sample rate. 32 bit processor; 16-bit A/D and D/A.

## ZLS Dynamic Meter™ Control System

- *High Reliability*
- *Fully Automatic System*
- *200 Hz Data Sample Rate*
- *Self-Contained Precision Gyro Power Supply*
- *2 Year Warranty*

### UltraSys™ is Fully Digital

Transducer outputs are digitized with little additional analog processing. The ZLS system digitizes input signals 200 times a second. All processing, including filtering, is done digitally. All control-loop algorithms, for both the platform and gravity sensor, are performed digitally by an embedded computer. Eliminating analog circuits enhances reliability and simplifies servicing.

### A Mature System

ZLS has updated well over 50 L&R Air/Sea meters and all of them are still in service today. The system is very mature with its origins dating back to 1985. Herbert D. Valliant, co-founder of ZLS Corporation, developed the prototype at the Geological Survey of Canada (Geophysics, 50, 840-845, 1985.)

### How UltraSys™ Functions

UltraSys™ utilizes an embedded processor to perform all of the platform and sensor control functions. The power module may be located anywhere within 3 meters of the platform. A host computer, connected to the control module with a serial cable, completes the system.

The embedded processor is connected to a host computer through a serial port. Using ZLS-supplied software, the host computer processes the data as required for high resolution or standard marine operations and archives the final data.

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Additional external data may be appended to the gravity data. The system accommodates up to four analog channels and a 24-bit digital channel. The system is fully automatic and will start unattended after a power interruption. Operation is as simple as turning on the switch. However, all system functions can be controlled manually through menu selections. All keystrokes are logged in a separate file for a complete record of system activity. System functions are continuously monitored and UltraSys™ will automatically shut down and activate an external alarm signal in the event of a serious malfunction.

### ZLS Upgrades the Sensor and Platform

#### The Gimbal Assembly

The gimbal mechanism is completely disassembled and cleaned. All moving parts are examined and replaced as necessary. Bearings, shock cords, shock mounts, level adjusters and damaged frame members are replaced. All metal fittings are replaced with stainless steel counterparts. The gimbal cable is replaced with a new, more flexible cable manufactured from materials resistant to oil and salt water.

## ZLS Dynamic Meter <sup>TM</sup> Control System

- *Upgrade to Sensor and Platform*
- *Sensor is Fully Tested and Adjusted for Optimum Performance*
- *Platform is Completely Disassembled and Cleaned*
- *Self-Contained Precision Gyro*

### The Sensor

The sensor is fully tested and adjusted for optimum performance using the ZLS test facility. All moving parts are examined, cleaned, lubricated, and replaced when necessary. All internal work is done in the ZLS clean room. Original point-to-point wiring is replaced with printed circuit boards. The optical beam position sensor is replaced with a capacitance position transducer. The synchro motor is replaced with a stepping motor. Anomalous heat sources near the sensor are removed to provide better temperature control. An improved sealing system featuring metal tubing and backfilling with dry nitrogen eliminates the need for pressure equalization at sea. This prevents the accumulation of contaminants in the sensor and assures greater reliability and accuracy.



### Features of UltraSys<sup>TM</sup>

- Digital techniques replace analog hardware, eliminating electronic drift and enhancing system reliability.
- Fully automatic system will start and function unattended after a power interruption.
- Full manual control through menu selection.
- 200 Hz data sample rate accurately digitizes sensor, gyro and accelerometer signals assuring no loss of signal information.
- 200 Hz update of platform feedback loops provides superior platform control.
- 25 Hz computation of cross-coupling monitors assures accuracy.
- Simultaneous data output to video monitor, hard disk, serial port, and printer.
- Graphic or digital format may be selected for printer output.
- Alarm function shuts down system and provides a remote alarm signal in the event of a serious system malfunction.
- Keyboard log records all keyboard activity for review.
- Complete testing and final adjustment using the ZLS test facility for vertical, horizontal circular and ramp testing.
- Self-contained precision gyro power supply and servo amplifiers.
- Two-year limited warranty.



## ZLS Dynamic Meter <sup>TM</sup> Control System

- *Upgrade Controller System*
- *Host Computer and Software*
- *Complete Calibration of Cross-Coupling Parameters*
- *Upgraded Gimbal Assembly*
- *Service and Sealing of Sensor*
- *Comprehensive Manual*
- *2 Year Warranty*

### Deliverables

- System control module – attaches to the platform frame.
- Universal worldwide power supply – freestanding.
- Host computer software – processes data for high resolution or standard marine operations.
- Dot-matrix color printer (optional).
- Complete calibration of cross-coupling parameters.
- Host computer (optional).
- Upgrade of gimbal assembly.
- Upgraded junction box – attaches to sensor.
- Sealing of the gravity sensor and backfilling with dry nitrogen.
- Comprehensive manual.
- Limited two-year warranty.

### Service after the Sale

ZLS stands behind its products with an industry leading 2 year warranty against any defects in parts or craftsmanship.\* ZLS lead the way by introducing the 2 year warranty which was unheard of at the time ZLS introduced it back in 1992. Not only does ZLS stand behind its products and services, it also has continued to support its products with repairs and upgrades for over 20 years. As a result of this dedication to our customers, all of our updates are still in service today.

### Accuracy of the Operating System

The accuracy of a marine gravity meter is difficult to specify as it is dependent on the characteristics of the ship, the sea-state, and accuracy of navigation.

ZLS's full digital control system enhances overall system accuracy by eliminating the gain and offset drifts that are inherent with analog electronics. It permits the platform and sensor control parameters to be set more precisely. In analog systems, these parameters are adjusted by changing components, whereas, in digital systems, they are adjusted by simply entering a number in the computer.

Users of the ZLS system have reported accuracies (rms differences from ground-truth data measured with a bottom gravity meter) substantially better than one mGal.

### Dimensions and Weights (Outside Dimensions)

#### Dimensions:

Stabilized Platform and Sensor 27 in. Wide; 22 in. deep; 25 in. high  
(70 cm. wide; 55 cm. deep; 64 cm. high)

System Control Module: 19 in. wide; 5.5 in. deep; 3.5 in. high  
(48 cm. wide; 14 cm. deep; 9 cm. high)

#### Weight:

Stabilized Platform and Sensor: 185 lb. +/- 5 lb.  
(83.9 kg. +/- 2.3 kg.)

System Control Module: 6 lb. (2.7 kg.)

Power Supply Module (Desktop Package): 36 lb. (16 kg.)

**ZLS Dynamic Meter™  
Control System**

**Power Requirements:**

87 to 270 Vac 47 to 63 Hz single phase

**Power Consumption:**

Operation: 1 A

\*Maximum: 2.5 A

\*\* measured at 117 Volts 60 Hz.

Resolution of Recorded Data: 0.01 mGal

**Clock and Gyro Power Source:**

Frequencies available: 200, 400 and 800 Hz

Temperature stability: 5 ppm -20C < T < +70C

Short term aging: 1 X 10<sup>-9</sup>/sec

Optional Rubidium Time Standard available

**External Inputs:**

Digital: 24 bit TTL compatible input

Analog: 4 channels, 16 bit resolution, Gains of 1, 2, 4, or 8 may be selected by menu

Sample rate 200 Hz

**Minimum Host Computer Requirements:**

**Windows XP**

Minimum Clock Rate: 900

Minimum RAM: 128 Mb

External Storage: CD ROM

One Serial Port:\* RS\_232

\* A second serial port is required to transmit data serially. A USB to serial adapter is acceptable.

**Limited Warranty**

A two year warranty including parts and labor is provided on all ZLS services and parts. Exceptions include new original equipment, such as the computer and the gyros, where original warranties are passed on to the purchaser. The warranty does not include damage or other faults due to negligence. As cross-coupling parameters are subject to rough handling during shipment, ZLS does not warrant the cross-coupling calibration. ZLS will, however, perform cross-correlation analysis free of charge during the warranty period and, if necessary, supply revised cross-coupling coefficients based on this analysis. Any software updates issued by ZLS during the warranty period will be supplied free of charge.

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