



LaCoste & Romberg

The first name in gravity since 1939

ALIOD 100 Electronic Beam Nulling

ALIOD100 UPGRADE USER'S MANUAL

(revision 2.1)



**11002 Metric Blvd., Ste 100
Austin, TX 78758 USA**

**phone: (512)-346-0077
fax: (512)-346-0088
email: info@lacosteromberg.com
www.lacosteromberg.com**

The Aliod100 Upgrade.

LaCoste & Romberg's Aliod 100 linear electronic feedback system features a new level of accuracy, precision, and reliability. The Aliod 100 incorporates a new user-friendly interface that enhances customer convenience. No longer is there any need for a KFactor lookup table as this new system displays the gravity directly in mGal on an easy to read LCD display.

The new Aliod 100 feedback system has a range of approximately 100 mGal (+/- 50) with a resolution of 0.01, or 0.001 mGal for the 100x**. The Aliod 100 also outputs a stream of ASCII data, which can be displayed and recorded using Gravlog for the Palm® OS or any terminal program on a PC with a RS232C port. The Aliod 100 includes our standard warranty, printed at the back of this manual.

New Meter Hardware:

The new hardware for this upgrade on a G or D meter consists of an added LCD display on meter lid, a power/system board in small black metal box on left side of meter, feedback and level electronics inside meter, and an additional switch on the lid. After 10/2003 the extra switch is on the black box on the side. Electronic levels are required on all meters with this upgrade.

Palm handheld computer:

In addition to standard Palm features and accessories, Lacoste & Romberg includes a full featured data logger to record the output of the Aliod100 in either field or laboratory conditions. The gravity logging software, **GravLog**, allows input of station name, elevation, latitude, longitude, and counter for each station. It can perform automatic tide corrections (if correct Lat, Long, and GMT time are entered). The user can either manually record single data points per station or set it to record continuously at the selected time interval. All data including time gets recorded to the solid state memory for later transfer to a PC. A cable to connect the Palm to the serial port on the Aliod100 box on the side of the meter is included. The black and white Palms use the standard Palm to PC serial transfer cable with a L&R supplied null modem/gender changer(M/M) adapter to connect to the Aliod100. If you have a color Palm with a rechargeable battery then a custom L&R Serial cable is supplied that connects directly to the Aliod100 and allows the Palm to run off of the G (or D) meter battery, charge the internal Palm battery, and acquire data at the same time. (In addition to the standard Palm to PC USB cradle.) This cable is useful for those long field days and for continuous data logging for days at a time. A Null modem/Gender changer (F/F) is provided to allow this cable to transfer data to PC.

ALIOD100 SYSTEM SPECIFICATIONS:

Electronic System:

Principle :	Linear electrostatic feedback
Data Resolution:	0.01 mGal or 0.001 for Aliod 100x**
Range:	approximately 100 mGal
Repeatability:	In field conditions 0.01 to 0.02 mGal
Linearity:	Better than 0.01% Full Scale
Electronic Drift:	<0.001 mGal /1000 hr. (does not include sensor drift)
Calibration factor:	Set at factory in Flash memory

User Interface:

Digital Display:	2x16 character LCD with backlight. LCD heater for use below -15°C
Output:	RS-232C Serial Port with continuous data output
Data Format:	ASCII text, comma delimited

Power Consumption:

Current:	0.190 Amp @12 Volts (LCD Heater off)
Meter Input Voltage:	10-15 VDC input range usable.
Battery life for meter:	Greater than 15 hours. (At 22°C, with Aliod100 on.)

* Electronic Liquid Levels required. **Export License required for sale some countries.
Specifications are subject to change. Palm is trademark of Palm, Inc.

USING YOUR ALIOD100

Power.

There is an small toggle switch on the meter lid that turns the **Aliod100** electronics on and off. It is usually on the right side of the lid. Most meters built after April 2003 have a three position switch. The **center** position is off. The **up** position turns on the Aliodd100 only. The **down** position turns on the Aliod100 system and the LCD heater. The heater enables the LCD display to function in temperatures below -15° C but draws extra power and is not needed above -15° C. The meter and feedback system will drift less if the Aliod100 switch is left on all day while surveying. With a good battery you should get a full day of use out of your meter even with the Aliod100 on constantly unless it is very cold.

Display information.

The LCD panel on the top of the meter has two lines of information. The first line displays the feedback system gravity in mGals. This value can be from +50 to -50 mGals. The Aliod100 displays two decimal digits (xx.xx) and the Aliod100x displays three digits (xx.xxx) of gravity. If the feedback system is out of range to the negative side then a small arrow "<" appears to the left of the number. If the feedback system is out of range to the positive side then a small arrow ">" appears to the left of the number.



The second line of the display shows meter temperature in degrees Celsius and the battery voltage in Volts. The meter temperature should remain constant at the "nose" temperature for that meter, somewhere between 48 and 58 C. In extreme ambient conditions the temperature will vary 0.1 degrees normally. The battery needs to be replaced or re-charged when the voltage gets below about 10.6 Volts.

The LCD is an extended temperature version and is specified to work from ambient temperatures of -20° C to +50° C. The other meter electronics will function over this range of temperatures also. The LCD heater when turned on allows use of the meter down to -40°. We suggest it be turned on below -15°C.

Do not store the meter below -20°C with power off because permanent damage to the LCD can occur. If there is power to the meter and the Aliod100

power switch is set in the down position so that power to the LCD heater is on then there is no problem.

At higher temperatures new meters are rated to work up to 45 C. However most will continue to function **up to** about 3-4 degrees C **below** the "nose" temperature (usually 50-55 C for new meters) before excessive drift is possible. Older meters that are upgraded may have a significantly lower "nose" temperature and will only function up to 3-4 degrees below whatever their set temperature is.

The LCD has a small back-light that is on all the time to allow viewing in darkness.

Electronic system.

The Aliod100 upgrade is composed of a linear feedback system with approximately 100 mGals range and a microprocessor controlled 24 bit A/D system. The electronics have extremely high gain and electronic damping which means the meter is now more noise resistant than a standard meter.

There is a 40 second digital FIR low pass filter applied to the gravity data before it is displayed. This long filter is necessary to average out the natural background seismic noise present at nearly any location; the meter itself and the electronics have a very low noise floor and would not need nearly as much filtering. The temperature and battery voltages are acquired with less accuracy and filtering but they are more than adequate for the purpose. The display is updated two times a second.

All the data on the display and additional information is sent out the serial port on the side of the meter. This Aliod100 serial data can be recorded by the included Palm™ handheld and Gravlog software using a special cable provided. The Palm™ also comes with a serial cable for transferring recorded data to a PC. See the **Gravlog** documentation and the "**Serial Data Output Information**" section for more information on this system.

Acquiring data.

The power switch for the Aliod100 should be left on during your survey. This is the inner switch of the pair in the lower right corner of the meter lid.

All gravity meters are fragile instruments. Data quality (repeatability and accuracy) is dependent on how carefully the meter is handled during your survey. Minimize any bumping, shaking, or tilting during the survey. Be sure to check the vertical settings for both levels before starting your survey or any time the meter receives a large shock.

Level the meter using the cross and long galvos on the lid by turning black knobs until both indicator needles are centered. See G meter manual for more details. Be sure to **unlock the counter** using the small clamp screw below the dial before moving the counter dial. Be sure to **lock the counter** using the small clamp

screw below the dial after moving the counter. This keeps the counter from moving between readings.

If the survey range is less than 100 mGals:

If you are at roughly the middle of your survey gravity range then the counter should be adjusted until the gravity indicated in the LCD is close to zero. If you are at roughly the lowest gravity of your survey range then the counter should be adjusted until the gravity indicated in the LCD is close to -50. If you are at roughly the highest gravity of your survey range then the counter should be adjusted until the gravity indicated in the LCD is close to +50. This will allow you to use the full feedback range without moving the counter/screw.

If the survey range is more than 100 mGals you have two choices:

- 1.) Record "tie" stations on the fly. When the gravity displayed on the LCD is close to being out of range make two readings at the same station with different counter settings. If you get out of range go back to the last station that was in range. The first reading should be at the old counter setting; then re-range the counter to make the LCD displayed gravity zero (0.0) or close to the opposite end is also useful in some situations. The difference between these two readings (in mGals) is an offset that will have to be added to all subsequent readings in processing the survey. If you are performing a high accuracy survey you may want to perform this procedure twice independently; clamp and unclamp the meter after the first set of readings and then perform another set of readings at the same two counter values. Then continue on with the survey at the new counter setting as long as possible. In a large survey you will end up with a large number of these offsets. Keep careful track of them. The Palm and Gravlog data-logger software will make this easier.
- 2.) You can break your survey up into sections that can be measured using one counter setting. Then tie those sections together with base stations that are readable with counter settings from two survey sections and still be within the feedback range.

It should be noted that the Screw Kfactor table is set up for optical readings and can be off slightly (< 0.5%) when moving the counter for re-ranging purposes while using the feedback system level settings. If possible you should use the LCD gravity readout to tie sections together; it will be more accurate than using the counter. Or if there is a large gravity difference (>100 mGals) then do a base station tie (using the bubble levels if present) and optical system only and convert counter readings to gravity with the K Factor table for that meter. (Reading the meter like an old optical G-Meter)

Level information.

Lacoste & Romberg G or D meters with the Alid100 upgrade must be equipped with electronic levels. All new upgrades use the ceramic/liquid type that are very

robust and stable. It is possible to use the pendulum type if they have been previously installed but the digital level data output may not be valid if the upgrade was done before 2003. The user should level the meter with the long and cross *galvonometers* ("galvos") when using the Aliod100 electronic feedback system. The cross and long level readout galvo needles indicate level when they are centered. The old *bubble* levels (if present – newer meters may not have them) are adjusted for manual (optical 10=10 sensitivity) readout at the factory and this is how we suggest you keep it set up (see regular Model G & D manual).

The maximum gravity accuracy with electronic feedback is obtained with the long level galvo adjusted not to the old optical sensitivity setting of 10=10, but to maximum gravity as indicated in the LCD readout. This is how the long galvo is adjusted at the factory and the gravity calibration for the digital readout will only be correct if the meter is adjusted to this sensitivity (which is maximum gravity).

Adjusting Levels with Feedback:

The meter should have been on heat for a long time (for minimal drift) and the Aliod 100 switched on for at least 1 hour. Level the meter using the galvos. Adjust counter screw till Aliod100 LCD display is reading close to zero (0.0) gravity. Note this gravity value. Turn the single level knob on the right side of the meter (long direction) so that the long galvo needle is about ½ division off center; direction doesn't matter. Let stabilize for 45 seconds and read gravity off the LCD display. Is it higher or lower than the original reading?

CORRECT DIRECTION: If gravity is higher, then your original setting was wrong and you are now moving in the correct direction. Turn long level leg again so galvo needle moves another ½ division in the same direction. Wait 45 seconds again then take a gravity reading from the LCD. If it is higher then keep repeating these steps until the gravity value starts to decrease. Then back up just slightly.

WRONG DIRECTION: If the gravity reading from the LCD is lower than the previous reading then you went in the wrong direction and need to turn the leveling leg knob in the opposite direction. The level galvo needle should move back in the opposite direction also. Now follow directions under "CORRECT DIRECTION".

These steps will get you to a maximum value for gravity. You should repeat the test using even smaller movements of the level galvos for increased accuracy. Next you need to mechanically re-zero the level so the galvo needle is centered. With a small screwdriver loosen screw on "long adj" coverplate. Turn the cover out of the way but do not remove. Using the long hex key (sometimes called allen wrench or key) provided put it into hole vertically and locate the correct adjustment screw. Make sure the allen wrench is properly seated then turn slightly. Note which direction the galvo needle moved in. If the direction of movement of the galvo needle was correct (towards the center) then keep turning the adjustment wrench until the galvo needle is centered, otherwise reverse the

direction. You should not have to move it very far (less than 1 turn). The long level galvo is adjusted properly now.

The same procedure may be used to adjust the cross galvo, just substitute "cross" for "long" in the above directions. The only complication is that when you move one of the knobs on the LEFT side of the meter (Cross legs) to change the cross level setting, the long level changes also. You will have to re-level the long level direction every time you move in the cross direction also.

Rotate the small covers to close back up the openings for the level adjustment and **lightly** tighten the small screws.

The cross bubble and cross galvo readouts should indicate the same position as they are both adjusted to maximum gravity anyway. Only the long (sensitivity) axis may have different settings for the galvo and the bubble levels.

It should be noted that the Screw Kfactor table is set up for optical readings and can be off slightly (< 1%) when moving the counter for re-ranging purposes while using the feedback system.

Serial Data Output Information.

ASCII serial data is always sent out the female DB9 port on the side of the upgrade box. A special serial to Palm cable is provided for the Palm. If you have a Palm with internal rechargeable batteries this cable will power and charge the Palm from the gravity meter power also. Optionally a straight-thru 9 pin serial cable (male one end, female other end) will connect the meter to any standard PC serial port . This data can be recorded using any standard terminal or communications program. (L&R can provide an unsupported Labview Windows program that can filter, display, and record the data at arbitrary intervals for those customers who need this capability.)

The serial port settings are: 4800, N,8,1 (4800 baud, No parity, 8 bit data, 1 stop bit)

The data packets are sent out at a **2 Hz** rate.

The overall packet format is: Sync (1 byte), Data (35 bytes), End (2 bytes) or 38 bytes total in each data packet. For example:

<SYN>3423.122, 31289, 32001, 53.8, 12.6,<CR><LF>

where <> (brackets) are around unprintable ASCII codes, and are not part of the actual characters in the packet

Sync:

- 1 character, ASCII "SYN" 22 decimal or 16 Hex, not printable

Data is divided as follows:

Mgals - 4 numeric characters+period+3 numeric characters+comma+space
"2637.978, "
Long Level - 5 numeric characters+comma+space "32195, "
Cross Level - 5 numeric characters+comma+space "33422, "
Meter Temp - 2 numeric characters+period+1 numeric char.+comma+space
"51.9, "
Battery Volts - 2 numeric characters+period+1 numeric char.+comma "12.9,"

Numeric characters are ASCII 48 – 57 dec. which are:

"0", "1", "2", "3", "4", "5", "6", "7", "8", and "9".

Period is ASCII 14 dec. Comma is ASCII 12 dec. Space is ASCII 32 dec.

End:

- 2 characters, <CR>+<LF>
which are ASCII 13 dec (D hex) + ASCII 10 dec (A hex)

Notes:

A few early upgrades had the <CR><LF> reversed.

On meters with pendulum levels the level data in the serial output is not valid and can be any random number.

Connector Hardware:

Standard 9 pin Female DB9 (Sub-Minature) connector on meter:

Pin 1 = NC
Pin 2 = Transmitted data (from Aliod100 to PC)
Pin 3 = Received data (from PC to Aliod100)
Pin 5 = Ground

Internal to the Aliod100 the following connections are made:

Pins 1 + 4 + 6 (DTR, DSR, DCD) are tied together.

Pins 7 + 8 (CTS, RTS) are tied together.

Before May, 2003

Pin 9 = NC

After May, 2003

Pin 9 = +5 volts for Palm. Before connecting directly to a PC please check electrical compatibility!

Most people making custom data cables only need to connect up pins 2 and 5.

Gravlog v2.0 L&R Gravity Data Acquisition Software for the Palm OS™



PROGRAM DESCRIPTION

This datalogger for the Palm™ handheld captures the serial output of L&R G-meters upgraded with the Aliod100 feedback system. It stores the data in an internal database on the handheld. You can examine the data using the build-in database browser. The data can also be transferred to a PC for further analysis. A backup copy of the program on floppy disk is provided with each system.

FEATURES

Large data capacity

User data entry:

- Automatic or manual Station Name entry

- Elevation

- Latitude and Longitude

- Counter Value

Automatic tide corrections

Continuous data logging at user selected interval

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SETUP

You should be warned that there are at least 2 different (and incompatible) connectors on various Palms so you need to match the serial cable to your particular Palm. The correct one was sent from the factory.

On black and white Palms™ (like m100™ or m105™ with 10 pin connector) you can use the standard Palm™ serial PC data cable to connect to a PC serial port for data transfers. The same cable is used with the short 2 part null

modem adapter/gender changer(M/M) which L&R provides to connect the Palm to the Aliod100 box. Connect the female DB9 (serial connection) to the two short adapters and then the male DB9 to the Aliod100 and the other end, which is a larger black 10 pin connector, to the Palm.



Figure 1. Null modem adapter/gender changer

On color Palms with fixed internal rechargeable battery you will need the special L&R provided Aliod100 serial to Palm cable which has a male DB9 connector on it. Connect the male DB9 to the Aliod100 and the other end, a larger black 16 pin connector, to the Palm.

Warning: This special L&R cable with the male DB9 serial and Palm connectors should not be connected to a PC serial port unless pin 9 is disconnected as it has +5 Volts on it. This cable allows the Palm to run off the meter's much larger battery and charger.



Figure 2 Special Serial Cable with Male DB 9 and Null modem/Gender changer adapter.

Warning: Completely discharging your Palm batteries (and meter batteries on Color Palms) will result in the loss of the data on the Palm!

STARTUP

The button at the top center of the Palm is the on/off button. Press it. Find the Gravlog program icon on the home screen of your Palm. If you don't see icons then press the home icon in the lower left below the display screen. The GravLog icon is L&R with GravLog beneath it. Use the stylus to start it. Then press START on the main GravLog screen to open the serial port, enabling the incoming data to be captured and displayed. The menus at the top will change to DATA and OPTIONS.

L&R
STATION NAME ▾ NEXT
◆ LINE1-0001-GRV
DATE: 2003-04-28
TIME: 13:16:27
ELEV: 00000.00
COUNTER: 0000.00
GRAVITY: * PUSH *
T.C. Grav: * START *
START

DATA LOGGING

When you are ready to save the data, press the SAVE button to store the current data values into the database. This is the manual mode. You can enter continuous data logging mode by pressing the center button which also displays the data logging interval in seconds, in this case, 60.

Data Options
STATION NAME ▾ NEXT
◆ LINE1-0002-GRV
DATE: 2003-04-28
TIME: 13:37:01
ELEV: 00110.00
COUNTER: 2791.09
GRAVITY: -0.021
T.C. Grav: -0.034
SAVE 60 s STOP

An active serial port draws a large amount of battery power. After a series of readings have been taken at a station, it is recommended that you close the serial port by pressing STOP. You can re-open the serial port again at the next station by pressing START.

STATION NAMING

The station name consists of 3 parts. The first section is the station prefix. Five prefixes are stored in the program. You can select the desired prefix from the list of station prefixes by pressing on the up/down arrows just before the actual station name. The second part is the station number. It is a 4-digit number. The third part of the station name is the suffix. You can leave the suffix blank if you want.

Station Name ⓘ
STATION NAME
LINE1-0001-GRV
PREFIX ▾ LINE1-
VALUE ▾ 1
INCR ▾ 1
SUFFIX: -GRV
CANCEL ACCEPT

Each time you press the NEXT button on the main form, the station number is incremented automatically. The updated station name will be displayed.

Open the STATION NAME form to interactively change the station prefix, the station number, the station number increment and the station suffix. Open the Station Name form by pressing the small down arrow/triangle between STATION NAME and NEXT on the main screen of GravLog.

Station Name ⓘ
STATION NAME
LINE1-0001-GRV
PREFIX ▾ LINE1-
VALUE ▾ LINE1-BASE1-
INCR ▾ BASE2-TOP-BOTTOM-
SUFFIX: -GRV
CANCEL ACCEPT

ITEMS UNDER DATA MENU

Many user entry and data management functions are under the main Data menu (select L&R, then Data). From this menu you can Browse Data, enter Counter value, enter Elevation, enter Lat/Long, view Earth Tide data, change the record Data Interval (manual or periodic), and upload data to PC.

Data	Options
Browse Data	<input type="button" value="NEXT"/>
Counter Value	
Elevation	
Lat/Long	04-28
Earth Tide	
Data Interval	:31
Upload to PC	1.00
Delete Database	00
GRAVITY: * PUSH *	
T.C. Grav: * START *	
<input type="button" value="START"/>	

BROWSE DATA

You can initiate the data browser by selecting the L&R menu, Data, then Browse Data function. The most current data record will be displayed. You can scroll through the data by clicking the left and right arrow. Note that record 1 contains the most recent data.

You can delete an individual record from the database by selecting DELETE.

Database		<input type="button" value="i"/>
◀ 1 of 3 ▶		
Station	LINE1-0004-GRV	
Date	2003-04-28	
Time	13:38:37	
Gravity	-0.023 -0.035	
Counter	2791.09	
Elev	00110.00	
Levels	31082, 31800	
Temp/V	49.9 12.5	
<input type="button" value="OK"/>		<input type="button" value="DELETE"/>

COUNTER

Enter the counter by selecting the L&R menu, Data, Counter. Use the up and down arrows to cycle thru the numbers for each digit. Then press accept. This must be manually performed each time the counter is moved. It will get recorded with each data point for later processing (Kfactor correction, etc.).

Counter Value
Update the Counter Value
0 0 0 0 . 0 0
<input type="button" value="CANCEL"/> <input type="button" value="ACCEPT"/>

ELEVATION

You can enter an elevation value by selecting the L&R menu, Data, Elevation. Use the up and down arrows to cycle thru the numbers for each digit. Then press accept. This must be manually performed each time you want to change the elevation.

Elevation
Enter the elevation:
0 0 0 0 0 . 0 0
<input type="button" value="CANCEL"/> <input type="button" value="ACCEPT"/>

LAT/LONG

You must enter Latitude and Longitude information for the tide corrections to be correct. For small survey areas it is OK to leave this fixed.

LatLong
LATITUDE
30 d 23 m 20.70 s N
LONGITUDE
97 d 42 m 37.40 s W
<input type="button" value="Cancel"/> <input type="button" value="OK"/>

EARTH TIDE

Displays the actual tide value, time, latitude, and longitude. The time set on the Palm must be set to GMT (or UTM) for the tide calculation to be correct. Change the time from the main Palm Home icon on lower left of display by pressing on the time. You can introduce errors up to 0.6 mGals if the time, lat, or long is not correct!

The screenshot shows the 'Earth Tide' screen. It displays the following information: Latitude (Lat) as 30d 23m 20.70s N, Longitude (Long) as 097d 42m 37.40s W, and Time as 2003 Apr 28 13:24 GMT. Below this, it shows 'EARTH TIDE: 0.023 mGal'. At the bottom right, there is a 'Dismiss' button.

DATA INTERVAL

This sets the continuous data logging interval from a number of choices. This number is displayed on the main GravLog screen at the bottom between SAVE and STOP in the continuous data logging button. Push this button on the main screen to start continuous logging.

The screenshot shows the 'Continuous Read' screen. It prompts the user to 'Select the Data Interval'. The interval is set to 0060 Seconds. At the bottom, there are 'CANCEL' and 'ACCEPT' buttons.

UPLOAD TO PC

This is the data transfer function. The field data are stored in an internal database. The data can be uploaded to a PC via the standard **serial** HotSync[®] cable (B&W Palm) or, for color Palms, use the special serial cable with a male DB9 connector and the provided gender changer(F/F) and null modem adapter (see Figure 2). Alternatively, a standard aftermarket Palm Serial cable will work – just make sure you get the correct one – with no adapters needed.

The screenshot shows the 'Upload to PC' screen. It provides instructions for the PC: '1. Set Serial Port to 4800, N, 8, 1.' and '2. Start terminal program.' For the Palm, it says 'Press START.' It also indicates '4 records in database.' At the bottom, there are 'START' and 'CANCEL' buttons.

To transfer the data to the PC, start a terminal/communications program on the PC. This can be Hyperterminal which comes with Windows (usually installed under Accessories) or any other 3rd party communications program. The transfer protocol is just ASCII text. Set the serial port setting to 4800, 8, N, 1. You can store the data in a file on the PC by selecting the option on the terminal program to capture the incoming text.

(In Hyperterminal select "Transfer" then "Capture Text".)

Connect the Palm to the PC using the correct **serial** cable. Press the START button to initiate the transfer. You will be prompted when the data transfer is finished. Close your terminal program down – you may have to "disconnect" first, depending on what program you are using.

If your PC only has USB ports you will have to get a USB to Serial port adapter which are available at most computer stores. Install the driver and connect it up to the PC USB port and the serial connector from the Palm. Proceed as above.

DATA FORMAT ON PC

The data records are comma-delimited. If you save the file on your PC with the extension *.CSV then any spreadsheet (like Excel) can import the file directly. The data fields in each record for version 20 software are:

Station Name, Date, Time, Gravity, Tide Corrected Gravity, Tide, Latitude, Longitude, Elevation, Long Level, Cross Level, Sensor Temperature, Battery Voltage, Counter Value

And it looks like:

```
BOT-0004-GRV,4/23/2003,18:30:50,10.002,9.99,0.012,30.389083,-97.710389, 807,31523,31365,51.3,12.4,2892.3
TOP-0004-GRV,4/23/2003,18:37:00,-7.106,-7.117,0.011,30.389083,-97.710389,4807,31523,31365,51.3,12.4,2892.3
BOT-0005-GRV,4/23/2003,18:43:15,10.005,9.994,0.011,30.389083,-97.710389,4807,31522,31365,51.3,12.5,2892.3
TOP-0005-GRV,4/23/2003,18:49:14,-7.109,-7.119,0.01,30.389083,-97.710389,4807,31522,31366,51.3,12.5,2892.3
BOT-0006-GRV,4/23/2003,18:56:48,10.019,10.01,0.009,30.389083,-97.710389,4807,31522,31365,51.3,12.4,2892.3
TOP-0006-GRV,4/23/2003,19:04:59,-7.099,-7.106,0.007,30.389083,-97.710389,4807,31522,31366,51.3,12.3,2892.3
```

UNITS

Gravity and Tide are in mGals, Lat Long are in decimal degrees, levels are arbitrary numbers between 0 and 60000. Level should be roughly around the middle or 30000. Temperature is in degrees Centigrade. Battery voltage is in Volts.

Older Data Formats:

The version 1.1 software put out data in the following format which you may run across sometime:

Station Name, Date, Time, Gravity, Long Level, Cross Level, Sensor Temperature, Battery Voltage, Counter Value

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and it looks like:

```
BOTTOM-0001-GRV,2002-06-11,13:09:05,9.870,31336,31242,48.8,12.1,2761.00
TOP-0001-GRV,2002-06-11,13:19:18,-7.192,31057,31418,48.8,12.1,2761.00
BOTTOM-0002-GRV,2002-06-11,13:29:59,9.852,31204,31396,48.8,12.0,2761.00
TOP-0002-GRV,2002-06-11,13:40:02,-7.216,31198,31492,48.8,12.0,2761.00
```

An even older version of the software omitted the counter value at the end.

WARRANTY

All LaCoste and Romberg gravity meters and upgrades are guaranteed for a period of two year after delivery. At the purchaser's request, LaCoste and Romberg will make all necessary adjustments, repairs and parts replacements. All parts will become the property of LaCoste and Romberg on an exchange basis. This guarantee will not apply if such adjustments, repair or parts replacement are required because of abuse, accident, neglect, misuse, operation on improper power, transportation or causes other than ordinary use. All necessary adjustments, repair or parts replacement will be made at no charge to the purchaser provided that the purchaser pays all transportation cost to and from the LaCoste and Romberg laboratory in Austin, Texas. The period of the guarantee is extended by the length of time that the gravity meter is in transit and in the laboratory for repairs. The guarantee is void if the internal sensing element is opened by an unauthorized person. The foregoing guarantee is in lieu of all other guarantees expressed or implied, and all obligations or liabilities on the part of LaCoste and Romberg LLC for damages, including but not limited to consequential damages arising out of or in connection with the use or performance of the meter.