Stratomaster UL
MKII
Owner's Manual

E-mail: Rainier@Iafrica.com
Web: Http://www.MGLAvionics.co.za

1. INTRODUCTION

The Stratomaster UL is a digital multifunction instrument intended for small aircraft.
The following functions are included in one easy to use package:

- Altitude to 20.000 ft calibrated, 10ft dynamic resolution
- Airspeed (ASI) to 120 mph
- RPM to 9999 revs
- Glide Ratio
- QNH 960 to 1060 mb
- QNE 1013 mb quick select
- VSI +/- 2000 ft/minute
- Hobbs meter
- Flight Timer

2. SPECIFICATIONS:

2.1 General specifications

Size: 224x64 mm. Mounting depth 65mm (including connectors and wiring). Panel cutout 204x54 mm.

Weight: 380 grams.

Power supply requirements: 12V DC nominal. Range 7.5V DC to 18V DC.
Internally protected to 30 V DC.

Current consumption: 40 mA without backlight, 140 mA with backlight.

Rev counter input: High impedance. Accepts signals up to 100V RMS.
Maximum frequency 10 Khz. Internally protected against over voltage.

2.2 Technical specifications

2.2.1 Altimeter

Range 0-20.000 ft, 10ft dynamic resolution. Dynamic resolution applies with the aircraft in flight. Dynamic resolution is measured by mathematically evaluating the turbulence created around the aircraft.

Basic accuracy at 20 degrees C (68 degrees F) +/- 30 ft (9 m) based on calibration to mercury manometer at +/- 1 mb.

Maximum theoretical error factor +/- 1.5% over temperature range 0-40 degrees C (104 degrees F). Typical error factor over temperature range 0-40 degrees C (104 degrees F) is less than 0.5%

2.2.2 Airspeed indicator

Range 0-120 mph, 1 mph resolution. Theoretical accuracy 1% at 20 degrees C (68 degrees F), subject to installation of pitot tube and airflow pattern around aircraft. Minimum speed for indication: 16 mph.

2.2.3 VSI

Range +/- 2000 ft. Resolution truncated to 10 ft/minute. Internally 1 ft/minute. Accuracy +/-5 %, Please note: The VSI is compensated for altitude.

2.2.4 Rev counter

Range 0 to 9999 revs. Resolution is dependant on rev counter setup in instrument. Example resolutions: Rotax DCDI: 20 revs, Rotax Points ignition: 60 revs. Accuracy: +/- 0.0005% + resolution.

2.2.5 Power supply

The Stratomaster UL unit is optimized and intended for operation on a 12V DC supply such as a motorcycle battery. However, it can be operated on any power supply down to about 7 volts to a maximum of 18V.

Current consumption may vary slightly between units but is typically in the region of 40 mA without display backlight and 140 mA with display backlight.

The unit is internally protected against temporary over voltage loads such as can be produced by a cranking starter motor.

It is advised to power the unit via a fuse or circuit breaker. A fuse rating of 500 mA (slow blow) is recommended.

3. FUNCTIONS

3.1 Altitude

Altitude is displayed in feet.

Altitude can be measured up to 20 000 ft. Altitudes higher than this result in a "OVER" display.

Altitude can be measured in a resolution of 10 ft while in flight (Dynamic resolution).

Altitude is displayed permanently during flight and the display field is updated twice a second.

3.2 ASI (Airspeed indicator)

Airspeed is displayed in Miles per hour (Mph) and can be measured up to 120 Mph. The resolution is1 Mph with a minimum speed of 16 mph.

ASI is displayed permanently and the display field is updated twice a second.

2.2 RPM (Revolutions per minute)

A maximum of 9999 RPM can be displayed.

The resolution in which RPM will be displayed is dependant on the type of ignition E.g. A Rotax engine with a Ducati ignition generates 6 pulses per second, which will result in RPM being displayed in a resolution of 20 revs. A Rotax engine with a points ignition generates 2 pulses per second which will result in RPM being displayed in a resolution of 60 revs.

Should engine revs be higher than 3500 rpm it is displayed permanently. Should the revs fall to below 3500 while in flight, the unit will display glide ratio in this field if you are descending.

3.4 GLIDE RATIO

Glide ratio can be measured up to 1:99.

Glide ratio will only be displayed once the engine revs drops below 3500 RPM and you are descending. The data is be updated twice a second.

Glide ratio is measured as a ratio between forward movement of the aircraft vs. vertical sink rate. Please note that the forward movement of the aircraft is not synonymous with horizontal forward movement relative to the earth surface but is a function of airspeed.

3.5 QNH / QNE

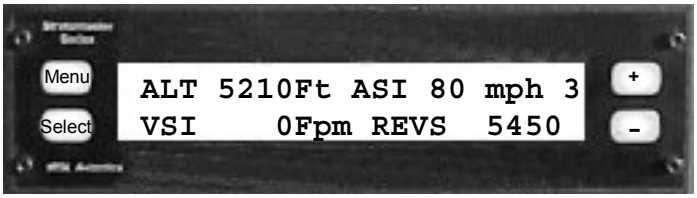
QNH / QNE is displayed in millibar.

QNH can be adjusted between 960 - 1 060 millibar.

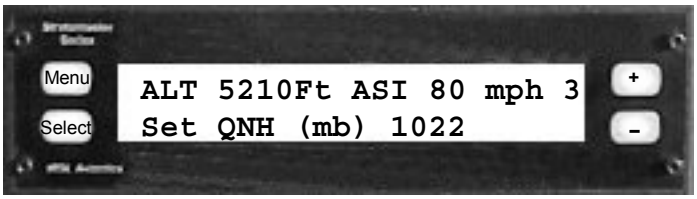
Your current QNH setting is displayed if either the + or the - is pressed while on the flight data display.

To change QNH:

Step one: Press either the + or the – key from the main flight display.



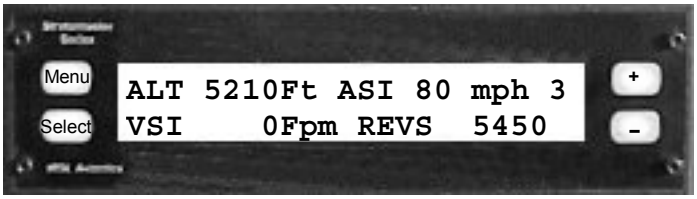
Step two: Press + to increase or - to decrease the QNH. Altitude reading will be updated as you change the setting.



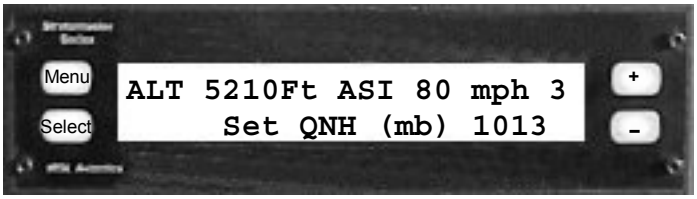
The Stratomaster UL will return automatically to the flight data display after a few seconds or press the select or menu key.

To select QNE:

Step one: From the main flight display press the + or the - key



Step two: Press the + and the – simultaneously



The Stratomaster UL will automatically set QNH to 1013.2 Millibar (QNE).

3.6 VSI/min (Vertical speed indicator)

VSI is displayed in feet per minute (fpm) to a maximum of 2 000 fpm.

VSI/min is displayed permanently while in flight, excluding QNH setting.

The VSI has been given a dead-band of +\- 20 ft (range where the instrument will read zero – 0 ft/min). Resolution is 10 ft/min.

The VSI is a very sensitive and fast reacting instrument. It does not have the lag typically found with conventional instruments. It can be used by the skilled flyer to locate thermals.

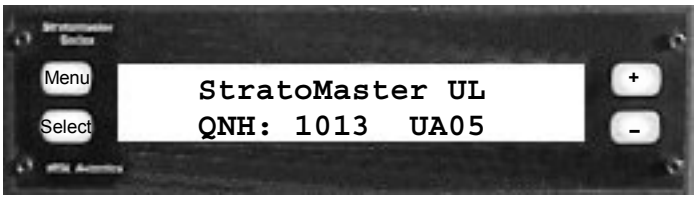
3.7 Hobbs meter

Total engine running time is reflected as hours and minutes.

Operation of the hobbs meter requires a rev counter input to the unit.

Hobbs meter is only displayed while the engine is not running.

To prevent accidental clearing of the Hobbs meter the menu option "Zero Hobbs" meter is not normally available.
Should you wish to reset the hobbs meter (set the hour and minute count to zero), press the + and – keys at the same time after you switch the unit on and you see the following display:



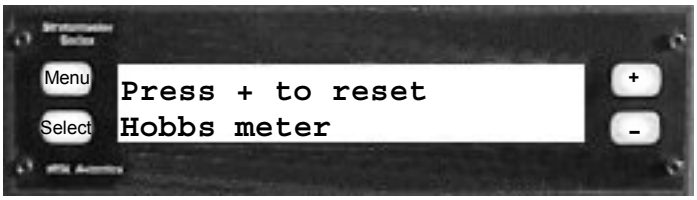
The steps for resetting the hobbs meter are:

Step one: Press Menu

Step two: Press plus until the following appears

Step three: Press plus to reset to zero

(Note: Should you at this point wish to exit without resetting press any key other than the plus).



Step four: Press Menu to confirm and exit.

3.8 Timer

This is a general purpose timer that counts minutes up whenever the engine is running (revs > 2000).

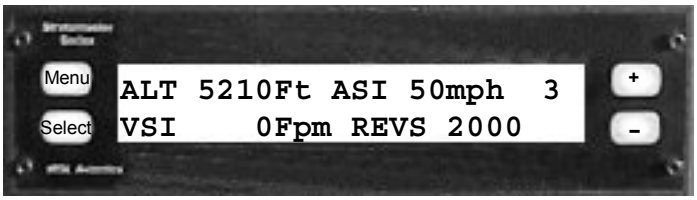
Time is displayed to a maximum of 999 minutes.

Operation of the timer meter requires a rev counter input to the unit.

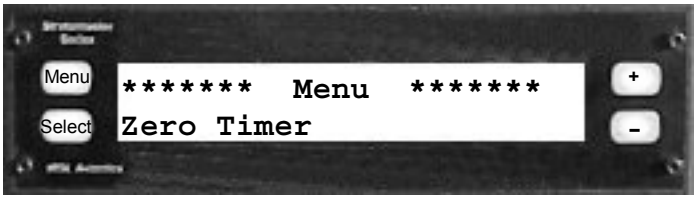
The timer is reset to zero manually. Resetting the Hobbs meter will automatically reset the timer to zero as well.

The steps for resetting the timer are:

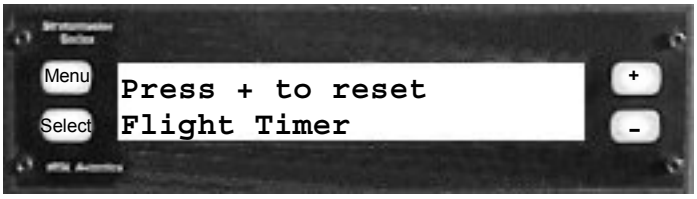
Step one: Press Menu



Step two: Press Select



Step three: Press plus to reset to zero



(Note: Should you at this point wish to exit without resetting press any key other than the plus).

Step four: Press Menu to confirm and exit.

3.9 Display backlight

Stratomaster UL units from serial number UB01 onwards have the ability to switch the display backlight on and off from the front panel.
Switching the display backlight is done whenever you see the main display using the "Select" button.
The instrument will remember the last setting (on or off) during power off periods.
Switching the backlight off can conserve battery power should you be operating on a limited power supply.

4. SETUP INSTRUCTIONS

4.1 Set ASI gain

The Stratomaster UL will allow you to correct the ASI for the speed reading error caused by the placement of the pitot tube and/or static port on the aircraft.

It should be remembered that if you enter an incorrect adjustment here all airspeed readings would reflect this error. It is thus important that the amount of error be determined accurately.

Firstly you should determine how large your error is. One often used method is to use a GPS receiver on a day with no wind.
You need to work our your true airspeed. True airspeed (TAS) is your indicated airspeed (ASI) compensated for altitude and temperature. As altitude and temperature increases, so does your airspeed reading decrease as the pressure in the pitot tube decreases. This is due to reduced air density.
The following examples show a convenient method you can use to calculate true airspeed from your indicated airspeed which you can then compare to your GPS speed reading.

A rough method which produces a quite accurate result with temperatures in which we tend to fly our aircraft is:

Add 1.75% of the ASI reading per 1000 ft altitude.
Example: ASI is reading 60 mph. You are at 5000 ft.
1.75% of 60 mph is 1.05
TAS is 1.05 x 5 (5000ft) + 60 mph
TAS = 65.25 mph

Examples:

Stratomaster UL under reading

TAS as calculated	= 53 mph
Ground speed as indicated by GPS	= 55 mph
Difference	= 2 mph

Express difference as a % of TAS.

(2*100)/53 = 3.77 % rounded to 4 %

Enter (100+4) = 104 under SPD Correct.

Stratomaster UL over reading

TAS as calculated	= 60 mph
Ground speed as indicated by GPS	= 55 mph
Difference	= 5 mph

Express difference as a % of TAS.

(5*100)/60 = 8.3 % rounded to 8 %

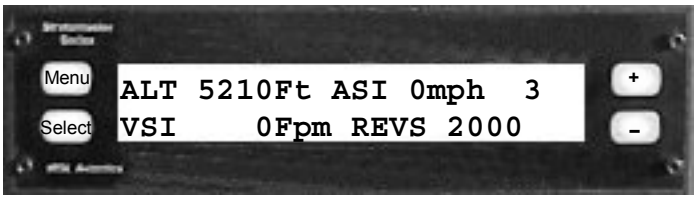
Enter (100-8) = 92 under SPD Correct.

Stratomaster UL reading correct

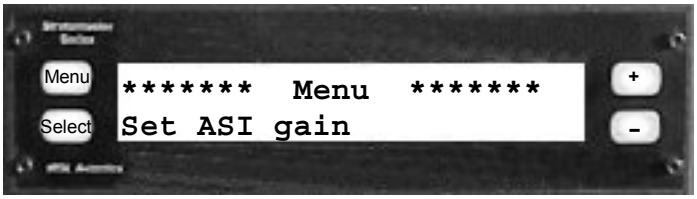
Enter 100 under SPD Correct.

The steps for entering the SPD Correct are:

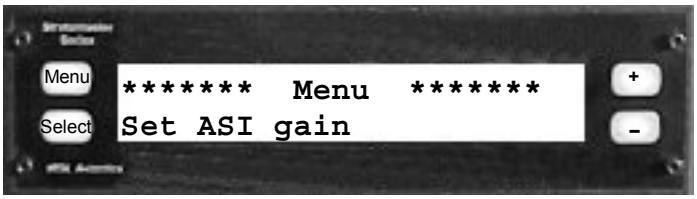
Step one: Press Menu



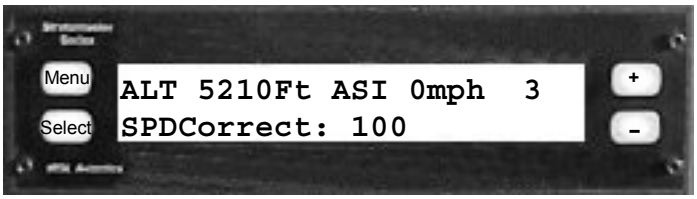
Step two: Press Plus until the following is displayed



Step three: Press Select



Step four: Press plus or minus to change



Step five: Press Menu to confirm and exit

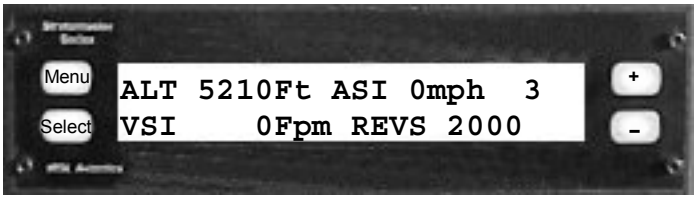
4.2 Zero ASI, VSI

This is a calibration function which is only to be used on the ground and whilst the aircraft is not moving. Its purpose is to reset the ASI and VSI readings to zero. We recommend that the pitot tube be covered at the time of calibration unless you have zero wind speed at the time.

Even the best instruments will drift slightly over time as materials age. Due to the very high sensitivity of the Stratomaster UL sensors you should zero the readings from time to time. You will find that you will use this function occasionally while your instrument is still new. As your instrument ages the need for zeroing becomes less and less.
You will find similar functions on good quality analogue (dail type) ASI and VSI instruments. Usually you will zero these by means of using a small screwdriver.

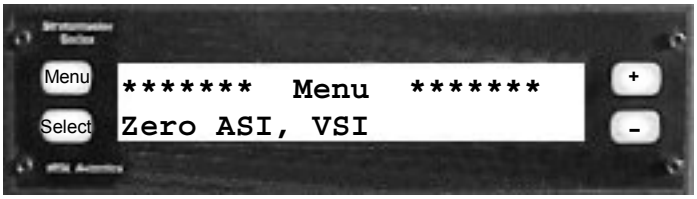
The following steps should be followed:

Step one: Press Menu



Step two: Press Plus until the following is displayed

Step three: Press Select to calibrate



(Note: Should you not wish to calibrate press any key other than the Select key to exit).

Step four: Press Menu to return to flight data display

4.3 Set altimeter

This function was used by MGL to calibrate your Stratomaster UL at the time of manufacture. Changes should not be made to this setting as this would cause the altitude to be inaccurate.

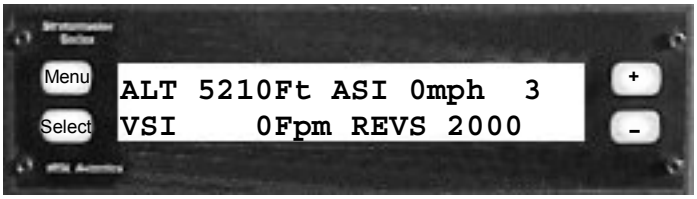
If you have a very accurate altitude reference available and know the local QNH accurately you can use this function to calibrate your altimeter.
Please be careful, many airfields may not be able to give you accurate enough QNH readings. You may find the Stratomaster instruments more accurate than the reference your airfield is using. We calibrate our instruments relative to a mercury manometer which is the most accurate pressure measuring reference available.

MGL Recommendation = Leave setting unchanged.

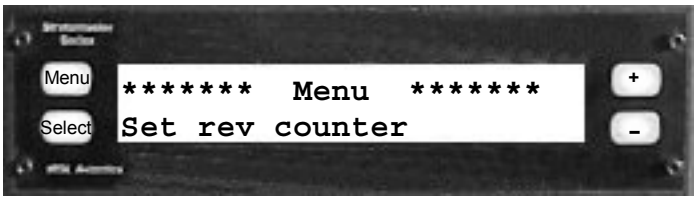
4.4 Rev Counter

The Stratomaster UL determines RPM by counting the number of pulses generated by the ignition systems for every 10 revs. Your Stratomaster UL would have been set to 60 pulses at the time of purchase, which is the number of pulses generated by the Ducati ignition system which is used in the majority of Rotax engines today. You have to ensure that this setting is correct for your engine. If not the setting can be changed by the following steps:

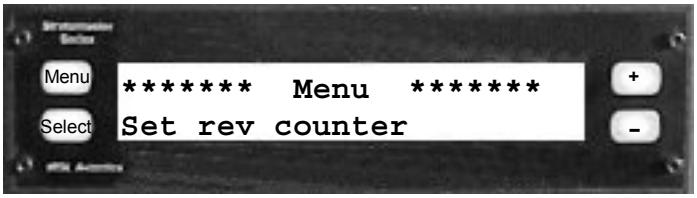
Step one: Press Menu



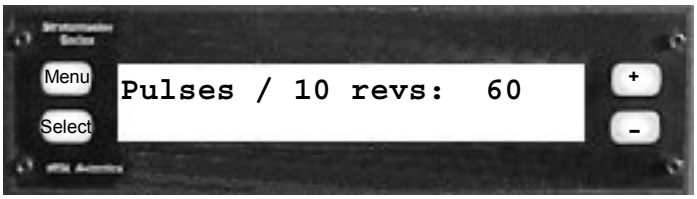
Step two: Press Plus until the following is displayed



Step three: Press Select



Step four: Press plus or minus to change

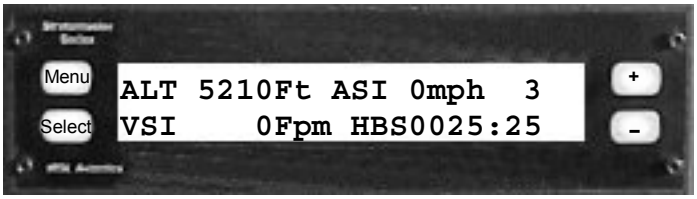


Step five: Press Menu to confirm and exit

5. DISPLAYS

Altitude in feet, airspeed in miles and timer in minutes
VSI in feet per minute and engine Revs

Altitude in feet, airspeed in miles and timer in minutes
VSI in feet per minute and glide ratio



Altitude in feet, airspeed in miles and timer in minutes
VSI in feet per minute and hobbs meter in hours and minutes

(Note: Hobbs meter is only displayed when the engine is not running)

6. MENU TREE

Bold text like this means function is a factory test or setup function and should be treated with care. It may be possible to invalidate the calibration of your instrument by unqualified entries to these functions.

Menu
Zero Timer
  Press + to reset Flight timer
Set ASI Gain
  SPD Correct: xxx
Zero ASI, VSI
Set Altimeter
  ALT Correct: xxx
Set rev counter
  Pulses/10 revs: xxx
Zero Hobbs
  Press + to reset Hobbs meter

7. CARING FOR THE STRATOMASTER UL

7.1 Pitot tube

Dust etc. can cause a blockage in the pitot tube. Such blockage will effect the operation of the pitot tube which will in turn effect the accuracy of the ASI readings. We recommend that the pitot tube be covered when the aircraft is not in operation.

7.2 Cleaning

The Stratomaster UL can be cleaned by wiping it with a damp cloth. A mild soap may be used if necessary.

Take care not to wet the instrument excessively.

Do not use chemicals e.g. petrol, spirits, turpentine when cleaning the instrument.

7.3 Calibration

The Stratomaster UL instrument does not require recalibration if it is used in normal operation.

Stratomaster Instruments used as references to calibrate other instruments may be sent in for periodic calibration to MGL Avionics. For this application we recommend a two year calibration interval. Please contact MGL Avionics for details.

8. Altimetry

This section is intended to clarify how an altimeter works and what determines its accuracy in simple terms.

As you know an altimeter is a simple absolute pressure gauge. This means it measures the pressure of the surrounding air relative to absolute vacuum as you would find in outer space.

Ordinary, well made altimeters are intricate mechanical devices that can achieve very good performance. However, these are subject to a whole host of influences that introduce errors in the readings. Vibrations tend to wear out the tiny gears, temperature has an effect on the elasticity of the materials used and therefor has a direct influence on the reading. The quality of the vacuum has a direct bearing on errors and the maximum altitude the instrument can indicate with a reasonable error.

The Stratomaster UL is based on a silicon pressure sensor. In principle, these sensors are subject to many of the problems that affect ordinary mechanical instruments and many digital altimeters have poor accuracy and resolution.

What is different in the Stratomaster UL ?

The Stratomaster UL employs the most accurate absolute pressure sensor available. This sensor is not cheap or simple. It starts with a tiny cavity in a silicon chip. This cavity is about ¼ mm^3 in size and contains a near perfect vacuum. It is sealed with a very thin membrane that is only a few thousand atoms thick. The air pressure on the one side of this membrane bends the membrane towards the vacuum cavity. This introduces tiny changes in the electrical properties of the membrane.
These changes are measured. Temperature effects on the membrane are taken into account by measuring the temperature on the membrane and compensating for known effects. During manufacture of this sensor, the membrane is exposed to a focused electron beam that, atom by atom removes material from the membrane until the sensor reads exactly the correct value.
The Stratomaster UL then converts this reading into digital form. But the results are not taken for granted. The Stratomaster UL attempts to measure the signal to levels below those created by thermal noise. This electrical noise is caused by the vibration of atoms. The Stratomaster UL knows the characteristics of this unwanted signal and eliminates errors caused by this signal.

Once the pressure of the surrounding air has been accurately determined, how does one calculate the altitude ? Is atmospheric pressure not supposed to change with the local weather as well ?

Well, there you have it: All this accuracy and then a storm comes in and all is lost.

Back in the beginning of flight, (sometime after the Wright Brothers did the silly thing of inventing powered flight), it was thought that it would be a good idea to have some indication as to how high one was flying. Early, primitive altimeters where based on principles much like we use today but were very crude and what was more disturbing, they depended on each manufacturers interpretation as to how pressure changes with altitude.

We all know that pressure gets less as we increase our altitude. But by how much ? The American National Standards Institute and other standards bodies came up with the idea of simply dictating how the atmosphere behaves. So ANSI created the "standard atmosphere" which was valid on a

"standard day". The "standard day" was decreed to be a day at mean sea level with a temperature of 15 degrees Celsius (59 degrees Fahrenheit). Further to this it was decided that the temperature would decrease at a certain rate as we increased our altitude. All of this and a portion of maths would now determine how our altimeter should work. Of course, suitable "fudge factors" were used to make the maths agree with what could be implemented using a bunch of mechanical gears.

So, the formulae to use became:

P=P_0*(1-6.8755856*10^6*H)^5.2558797

Were:

P= pressure
P_0= pressure at sea level (1013.25 mb on the "standard day")
H= height in feet above mean sea level

This formulae is used to a level of 36.000 ft (10975 m) . Above that a different formulae is used.

Now what does all of this mean to you ?

It means to have an exceedingly accurate altimeter that implements the ANSI standard in detail. It does not mean that your altitude is correct as indicated !

Your local pressure is determined by many factors, temperature and weather are only a few. All of these influence your altitude reading. Place your Stratomaster UL on the ground and run it for a whole day. Notice slight changes in the altitude (perhaps up to 60 ft (18 m) or even more ?). These are caused by local changes of atmospheric pressure.

These are some of the reasons the altimeter has a QNH setting. This is simply a correction factor that is entered into your altimeter to correct for current local atmospheric conditions. As long as all altimeters use the same QNH they should all read the same altitude. This is all that aviation requires.

Should you be interested in your actual altitude, we recommend using a GPS. It is probably the most accurate method available today. However, it is not suitable for use on an aircraft due to the inability to display altitude according to ANSI standards and local QNH settings. It is important that all aircraft fly to common altitude references **even if they are not correct**.

9. WARRANTY

The Stratomaster UL is guaranteed against faulty workmanship on the part of MGL Avionics for a period of 12 months from date of purchase. MGL Avionics may at their discretion decide to either repair or replace the instrument. MGL Avionics will provide free labor and parts. Courier costs or postage costs will be for the account of the purchaser.

Please note: Certain parts are subject to breakage by misuse or external influences that cannot be covered by any warranty.

In particular the following possible damages are excluded:

- LCD display – glass cracked due to mechanical damage or freezing of the liquid crystal. The LCD must not be exposed to temperatures below –20 degrees Celsius (-4 degrees Fahrenheit) or above +80 degrees Celsius (176 degrees Fahrenheit).

- Any damage due to unusual events e.g. aircraft crashes, hard landings, dropping the instrument, excessive G forces, excessive vibration.
- Exposing the instrument to incorrect power supply voltages, such as connecting the instrument to mains power supply, any voltage in excess of 30 volts DC, and any AC voltage.
- Connection of unqualified or incorrect devices. Please contact us before you connect anything unusual to this instrument.
- Destruction of the air-talk link due to connecting the unit to PC's with unconnected earth leads or leaky power supplies.
- Damage due to excessive static discharge.
- Damage due to lightning strike.
- Damage due to overpressure of any sensors, in particular ruptured silicon diaphragms due to overpressure or mechanical action.

Any signs of opening the instrument or tampering with any of the internal parts will invalidate the warranty.

MGL Avionics endeavors to repair any faulty unit whether inside or outside of the warranty period speedily and at the lowest possible cost. Your first stop in case of a malfunction should be the dealer were you bought the instrument. It may be possible to repair your instrument without it having to be shipped to us.

10. DISCLAIMER

MGL Avionics cannot be held responsible for incidents or damage by whatsoever nature caused by incorrect readings, displays, installation or operation of the instrument.

Operation of the Stratomaster UL instrument is the responsibility of the pilot in command of the aircraft. The pilot in command has to make himself/herself familiar with the operation and limitations of the Stratomaster UL instrument before commencing ground or flight operations as well as all other aspects of operation.

The Stratomaster UL intended for operation by a licensed pilot who is the holder of a MPL (Micro light pilot license) or PPL (Private Pilot license) or the equivalent thereof. The pilot should further be rated on the aircraft type on which the Stratomaster UL is being operated.

The Stratomaster UL not been submitted to the CAA or FAA or any of its agencies for any form of certification. Operation and installation of this instrument is subject to the relevant rules and regulations of your country and flight authority.

If any of the above is not acceptable to the pilot in command he/she must refrain from operating the aircraft or remove the Stratomaster UL from the aircraft before commencing aircraft operations.