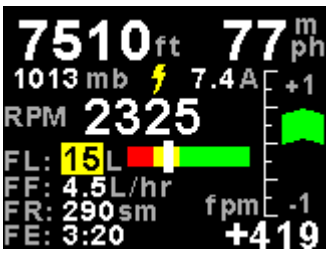
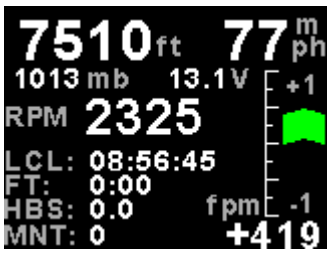
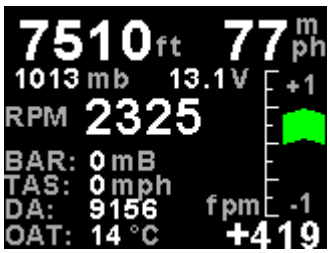
Blaze FLIGHT-3

Primary Flight Instrument

Operating Manual – English 1.02







Introduction

The Blaze FLIGHT-3 is a compact, multifunction complete primary flight system intended as a main flight instrument on smaller aircraft or as a backup / secondary flight instrument in larger aircraft. This 3 1/8" (80mm) instrument provides many functions from an altimeter, airspeed indicator, VSI indicator, fuel level, fuel flow, RPM, volts, current display and many more. The FLIGHT-3's light weight, small size and high level of functionality makes it an excellent choice for many applications.

The FLIGHT-3 makes an ideal companion to the Blaze EMS-2 universal engine monitor for a compact, low cost yet highly functional and complete cockpit solution.

The FLIGHT-3 has the following features:

Altimeter
The altimeter contains an internal high accuracy 24 bit digital altitude sensor which calculates altitude from -1500 ft up to a maximum of +35000 ft. The FLIGHT-3 outputs various formatted RS232 serial data protocols compatible with serial input transponders such as that from Garmin, Magellan, Northstar, Trimble, Microair etc. The altimeter can display altitude in feet or meters and local pressure can be set in millibars or inches of mercury. The FLIGHT-3 also provides a parallel Gillham code interface when used in conjunction with the MGL Avionics CNV-ALT.

ASI (Airspeed Indicator)
Airspeed can be indicated in statute miles per hour (mph), kilometers per hour (km/h) or nautical miles per hour (kts). The FLIGHT-3 also provides a programmable Vs and Vne airspeed alarm output. ASI sensitivity can be calibrated by the user to cater for errors caused by pitot tube placement.

The FLIGHT-3 can measure airspeed from 20mph to 250mph (Version 1), 20mph to 350mph (Version 2) and 20mph to 320mph for the FLIGHT-3HS (High Speed version). All are well suited to slower aircraft due to very good sensitivity and linearity at low air speeds.

VSI (Vertical speed indicator)
The VSI indicator can be displayed in either feet/minute (ft/min) or meters/second (m/s). The VSI can be calibrated by the user once the instrument has been installed in the aircraft.

RPM Display
The FLIGHT-3 can measure engine and/or rotor RPM.

Fuel Computer
Full functionality is available with a fuel flow and level sender or only with a fuel flow sender using calculated fuel levels based on fuel usage. Fuel injector systems are also supported. Standard automotive fuel level senders can be used, even with odd shaped tanks due to a comprehensive, multi-point calibration system. Most fuel flow senders can be used as the K-factor of the sender can be entered into the system for simple calibration. Fuel flow can be displayed in l/Hr or in G/hr.

MGL Avionics supplies a lightweight dual range fuel flow sender that is ideally suited for the FLIGHT-3. Fuel flow senders from other manufactures are equally suitable.

In addition, the FLIGHT-3 can use the actual ground speed from a RS232 NMEA enabled GPS receiver to determine fuel range.

Local Time display
The FLIGHT-3 is capable of displaying time to facilitate ordinary ATC time reporting. Time is maintained by an internal lithium battery which can be replaced by the user.

Battery Voltage, *Current and Charge display
The FLIGHT-3 can be used to monitor your aircraft's battery power supply. The FLIGHT-3 is very useful in determining your battery's health, charging status, as well as the current load consumption of your aircraft. The FLIGHT-3 can be used in both 12V and 24V aircraft and can measure voltages up to 30V DC.

The FLIGHT-3 uses the MGL Avionics Magnetic Closed Loop Current Sensor to measure the aircrafts current load. The FLIGHT-3 contains a programmable low/high voltage alarm to automatically detect bad batteries and alternator failures.

OAT display
OAT can be shown in either degrees Celsius or degrees Fahrenheit. The FLIGHT-3 also contains a programmable low/high OAT alarm.

Flight Timer & Flight log
The FLIGHT-3 provides a 50 entry flight log that stores the start time and duration of each of the last 50 flights. The flight timer can either be started using the front push button or automatically from RPM and airspeed.

*** Requires the MGL Avionics Magnetic Closed Loop Current Sensor (sold separately)**

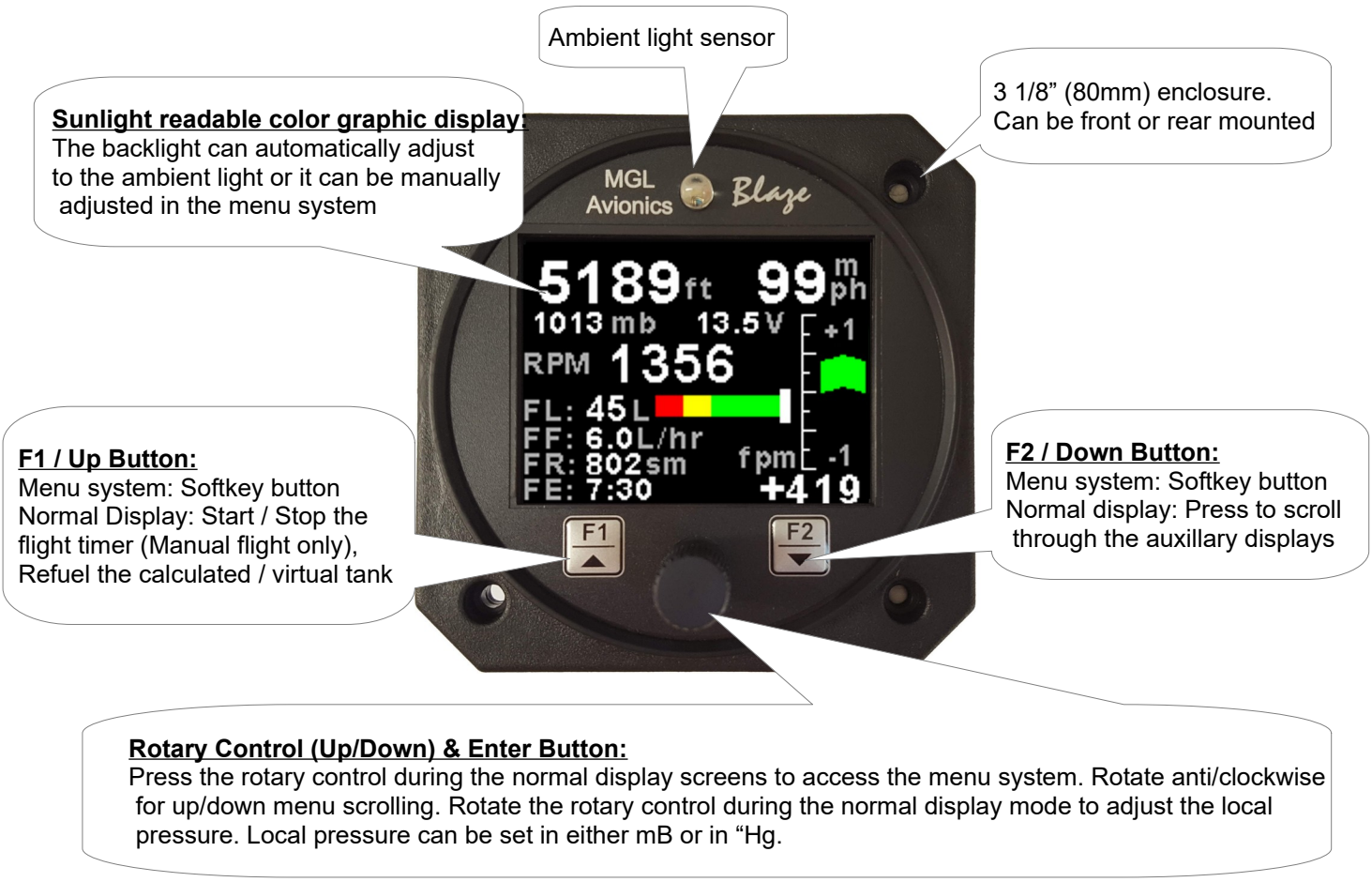
Please note that the FLIGHT-3 Version 2 replaces both the FLIGHT-3 Version 1 and the FLIGHT-3HS (High speed) unit.

1 Features

- Large 2.6” high resolution 320x240, IPS (fully viewable in all directions), sunlight readable color LCD display
- An internal high accuracy 24 bit digital altitude sensor calculates altitude from –1500 ft up to a maximum of 35000 ft (-457m to 10668m)
- The FLIGHT-3 outputs various formatted RS232 serial data protocols compatible with serial input transponders such as that from Garmin, Magellan, Northstar, Trimble, Microair etc.
- Provides a parallel Gillham code interface for transponders when used in combination with the MGL Avionics CNV-ALT
- Built in altitude encoder test function
- The altimeter can display altitude in feet or meters
- Local pressure can be set in millibars or inches of mercury
- Contains a wide range VSI indicator from +/-20 ft/min to as high as +/-10000 ft/min
- VSI units can be in feet/minute (ft/min) or in meters/second (m/s)
- The FLIGHT-3 measures airspeed from 20mph to 250mph (Version 1)
- The FLIGHT-3 measures airspeed from 20mph to 350mph (Version 2)
- The FLIGHT-3HS (High Speed version) measures airspeed from 20mph to 320mph
- Both units are well suited to slow aircraft due to very good sensitivity and linearity at low air speeds
- Includes a flight timer since takeoff
- Airspeed units can be set to miles per hour (mph), kilometer per hour (km/h) or nautical miles per hour (kts)
- Contains a programmable Vs and Vne airspeed alarm output
- RPM display with readout in RPM or percentage
- Includes a settable Hobbs meter which can be password protected
- Includes a programmable maintenance timer for scheduled routine engine maintenance
- Can connect to a flow sender or fuel injector system to measure fuel flow
- Standard automotive fuel level senders can be used, even with odd shaped tanks due to a comprehensive, multi-point calibration system
- The FLIGHT-3 has the ability to connect to a NMEA enabled RS232 GPS receiver for range based calculations.
- Fuel range based on TAS or GPS-NMEA input
- Fuel endurance based on TAS or GPS-NMEA input
- Capable of displaying time
- Time is maintained by an internal lithium battery which can be replaced by the user
- Can measure voltages up to 30V (compatible with both 12V and 24V aircraft supplies)
- Contains a programmable low/high voltage alarm to automatically detect alternator failures and bad batteries
- Uses the MGL Avionics Magnetic Closed Loop Current Sensor to measure the aircrafts current load.
- *Contains a charge status indicator
- OAT can be shown in degrees Celsius or degrees Fahrenheit
- Contains a programmable low / high OAT alarm
- Includes a Density altimeter display
- Includes a Barometer (actual local pressure) display
- Includes a True airspeed (TAS display)
- Includes a RS232 serial output for interfacing to external equipment e.g dataloggers etc.
- Optional external RDAC (Remote Data Acquisition Computer) interfacing via the CAN bus for RPM, fuel flow and fuel level
- Standard 3 1/8” (80mm) aircraft enclosure (can be front or rear mounted)
- The LED backlight can automatically adjust to the ambient light, or it can be manually adjusted in the menu system
- Rotary control plus 2 independent buttons for easy menu navigation and user input
- Wide input supply voltage range of 8 to 30V DC
- 1 year limited warranty

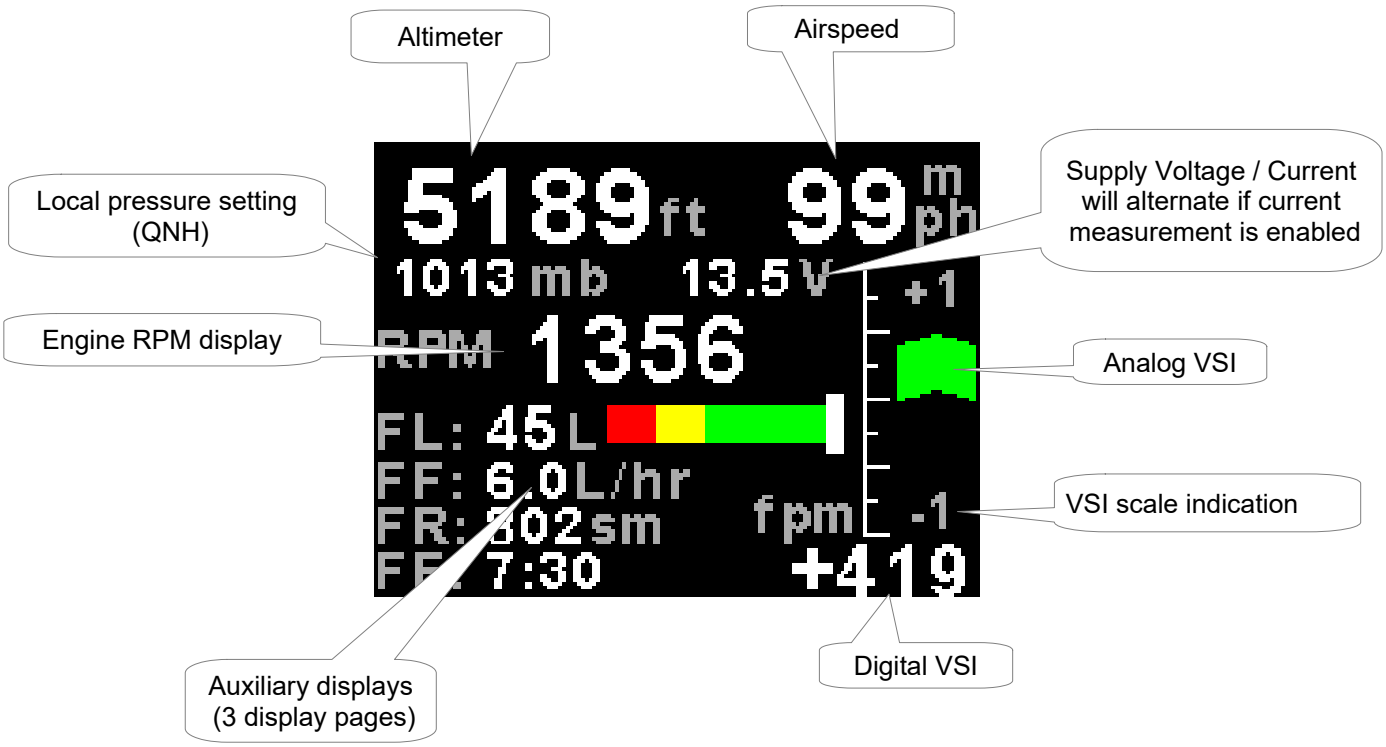
* Requires the MGL Avionics Magnetic Closed Loop Current Sensor (sold separately)

2 Layout


Ambient light sensor
3 1/8” (80mm) enclosure.
Can be front or rear mounted
Sunlight readable color graphic display:
The backlight can automatically adjust to the ambient light or it can be manually adjusted in the menu system
MGL Avionics
Blaze
5189 ft
99 mph
1013 mb
13.5 V
+1
RPM 1356
FL: 45 L
FF: 6.0L/hr
FR: 802 sm
FE: 7:30
fpm
-1
+419
F1
F2
F1 / Up Button:
Menu system: Softkey button
Normal Display: Start / Stop the flight timer (Manual flight only), Refuel the calculated / virtual tank
F2 / Down Button:
Menu system: Softkey button
Normal display: Press to scroll through the auxillary displays
Rotary Control (Up/Down) & Enter Button:
Press the rotary control during the normal display screens to access the menu system. Rotate anti/clockwise for up/down menu scrolling. Rotate the rotary control during the normal display mode to adjust the local pressure. Local pressure can be set in either mB or in “Hg.

3 Main Display

The bottom left of the main display is arranged in three auxiliary flight information displays.



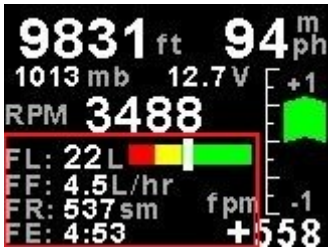
Note:

The voltage display will alternate with the current measurement display if the current measurement is enabled.

The FE: (Fuel Endurance) will alternate with the GPS NMEA speed value if enabled. The text color will turn magenta if receiving valid NMEA GPS data.

3.1 Auxiliary display 1

This page displays all the fuel related information. Fuel level, flow, range and endurance is shown.



FL: (Fuel Level)
Fuel level is displayed numerically and as a bargraph. The fuel level can be from a physical fuel level sender mounted in a fuel tank or by calculation as a virtual fuel tank.

FF: (Fuel Flow)
Fuel flow can be from a fuel flow sender or from a fuel injected system.

FR: (Fuel Range)
Fuel range is only shown if fuel level and fuel flow is enabled.

FE: (Fuel Endurance)
Fuel endurance is only shown if fuel level and fuel flow is enabled. The fuel endurance will alternate with the GPS NMEA speed value if enabled. The text color will turn magenta if receiving valid NMEA GPS data.

3.1.1 Enter starting level of the fuel tank

Press the F1 key during the main display screen to manually enter your current fuel level after fueling or defueling your aircraft. This function is only available if you have selected fuel level is calculated from fuel flow. Press the F2 key as a “quick fill button” to the full level.

Note: It is good airmanship to take into account a “silent” fuel reserve. For example, if you have a 50 Litre tank and you fill it, enter 40 or 45 Litres as your available fuel.

3.2 Auxiliary display 2

This page displays all the time related information. Local time, Flight time, Hobbs and Maintenance timer is shown.

LCL: (Real Time Clock)

Local time normally includes an offset from UTC time. The time offset can be setup in the *"TIMERS SETUP"* menu. Time of day is often displayed as UTC or Greenwich time as it required by ATC.

FT: (Flight time)

The flight time can either be started automatically by airspeed and RPM or manually via a push button. The flight time is automatically reset to zero when a new flight is started. The ":" will flash when a flight is active. The flight timer can be started manually by pressing the F1/UP key.

HBS: (Hobbs timer)

The FLIGHT-3 contains a password protected Hobbs timer. The Hobbs time can be set to the current known engine time in the *"TIMERS SETUP"* menu. The Hobbs timer will only increment when the RPM is greater then the *"HOBBS RPM".*

MNT: (Maintenance Timer)

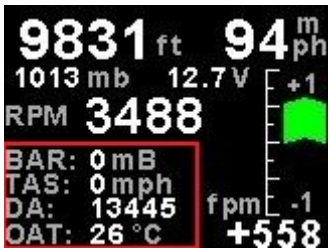
This timer is set in engine hours and it will count down to zero when the engine RPM is greater then the *"HOBBS RPM"* value as set in the *"TIMERS SETUP"*. A good use for this function is to set the hours until your next spark plug change or engine inspection.

The purpose of this function is to assist you in determining remaining hours until maintenance will be required. It is not intended as a replacement for the aircraft's maintenance log. It is therefore important that the aircraft's maintenance log be maintained in the normal manner. You should further use your own discretion in performing maintenance earlier than indicated should any aircraft performance problems arise.

A maximum of 999 hours can be entered as a maintenance interval. A reminder message will appear on startup when zero hours are remaining. The reminder message will disappear after the pilot presses any key. Engine running time for the purpose of the maintenance timer is defined as the run time where the engine RPM is greater than the *"HOBBS RPM"* value as set in the *"TIMERS SETUP"*.

3.3 Auxiliary display 3

This page displays auxiliary related information. Barometer, TAS, Density altitude and OAT is shown.



BAR: (Barometer)

Ambient pressure can be displayed in either millibar or Inches of Mercury (Inch/Hg).

TAS: (True Airspeed)

What is TAS and how is it calculated ?

TAS is indicated airspeed (ASI) compensated for altitude and temperature. Often pilots ignore the effect of temperature and only take altitude into account when converting ASI to TAS. For practical purposes this is quite accurate and gives a good reflection on your true airspeed. Keeping in mind that ASI measurement is subject to errors caused by airflow around your aircraft, there seems little point in taking this calculation to absolute resolution.

Again, we have decided to use a formula often used by pilots. This way the instrument reading will agree with what pilots are used to.

Add 1.75% of IAS per 1000 ft (304.9 m) increase in altitude above sea level.
We assume here that IAS = RAS (rectified air speed).

DA: (Density Altitude)

Density altitude is a perceived altitude that pertains to your current altitude and temperature (and to a lessor extent on your current moisture content of the air). Density altitude is relevant for performance calculations of your aircraft. Density altitude affects the performance of your engine, propeller and airfoils. The most noticeable affects of density altitude are length of take-off and landing runs and the ability of your aircraft to carry weight. There are several methods to calculate density altitude, all result in readings that are very close to each other. We decided to implement a popular formula that is often used by pilots to calculate density altitude at their location.

DA = SA + 118.6 * (T-T_s)

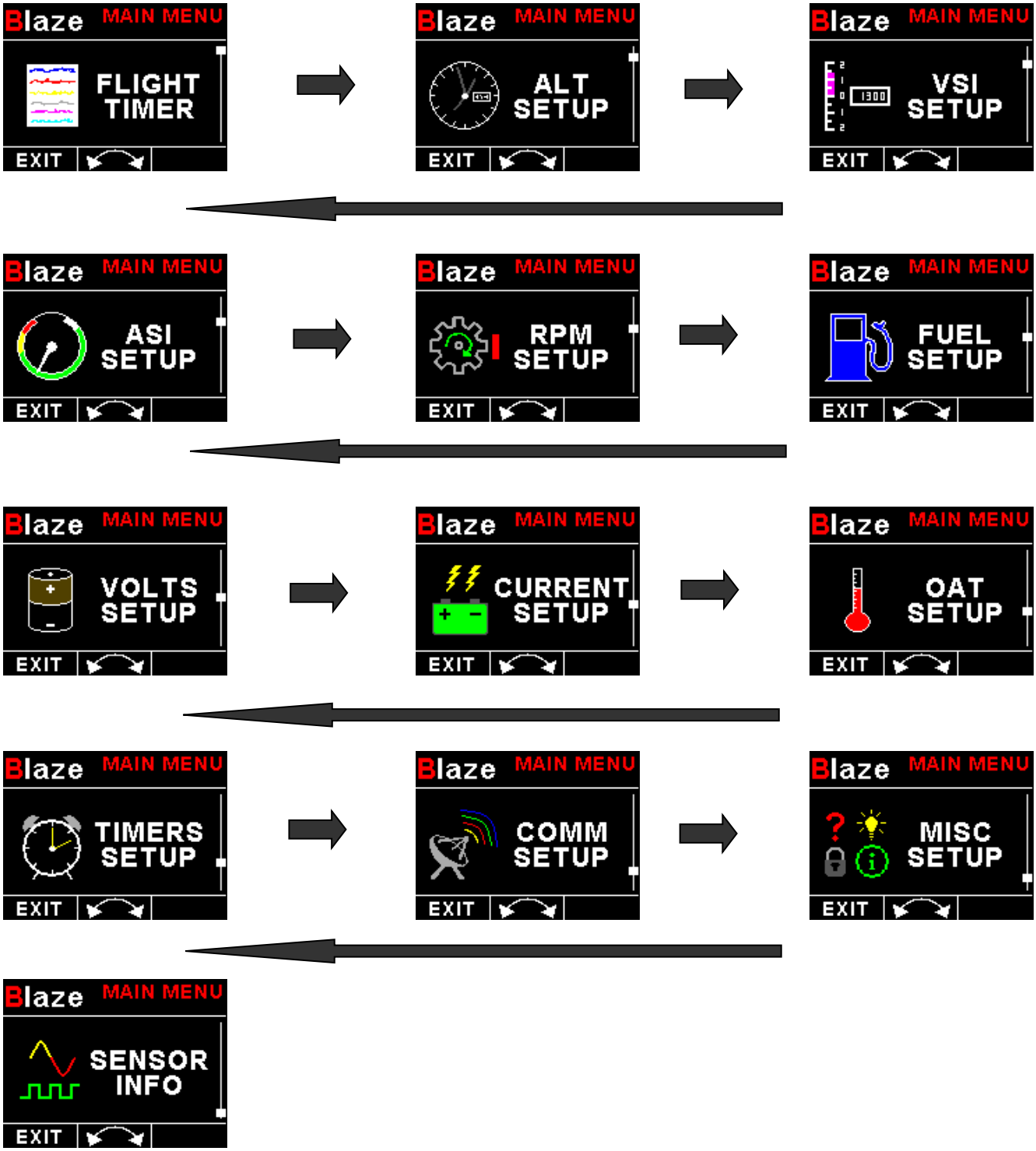
Where:
DA = Density Altitude in feet MSL
SA = Station Altitude in feet MSL for where the DA is being calculated
T = Actual air temperature (° K) at SA
T_s = Standard temperature (° K) at SA

OAT: (Outside Air temperature)

Outside air temperature can be measured using the external temperature probe. OAT can be shown in degrees Celsius or degrees Fahrenheit.

4 Menu System

Press the rotary control button during the normal display mode to enter the menu system. Use the rotary control to navigate through the menu system.



4.1 Exiting the menu system

Press the F1/Up button to exit the menu system when the “EXIT” soft key is shown. All changes made during navigation of the menu system will be saved in non-volatile memory upon exiting. The instrument will not save any changes if you remove power before exiting the menu system.

4.2 Flight Timer

View Flight Log:

Use the rotary control to view the next flight log entry.

Erase Flight Log:

Use this function to erase the flight log stored in the FLIGHT-3.

FLIGHT:

Select whether you want the FLIGHT-3 to automatically detect a flight or whether the pilot must press the F1/Up button to start/stop a flight. We recommend you select automatic flight detection.

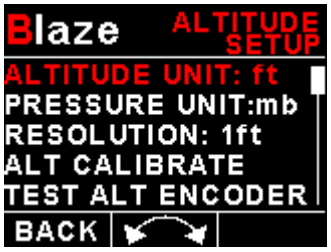
T/O RPM:

This menu option is only shown if the “DETECT” flight mode is selected. Enter the RPM take off threshold that you want the flight timer to start incrementing.

T/O AIRSPEED:

This menu option is only shown if the “DETECT” flight mode is selected. Enter the takeoff airspeed threshold that you want the flight timer to start incrementing.

4.3 ALT Setup (Altitude Setup)



Altitude Unit:
Select if you want the altitude displayed in ft (feet) or m (meters).

Pressure Unit:
Select if you want the local pressure displayed in mb (millibars) or “Hg (inches of mercury).

Resolution:
Select the resolution of the altitude value, a selection of 1,10,25 or 100 ft or m can be selected.

ALT Calibrate
This section allows for the calibration and fine tweaking of the altitude value. Before you begin, ensure that your calibrated and certified reference is set to the local pressure of 1013.25mB (29.92”Hg). The FLIGHT-3 altitude value in ft (referenced to 1013.25mB (29.92”Hg)) is displayed in the top right hand corner of the display. All calibration must be done in feet.

The combined adjustments cater for both the altitude sensors offset and gain. Only start the calibration sequence once the instrument has been running for a minimum of 10 minutes.

Start the altitude calibration with the “CAL FACTOR” and make sure the “CAL GAIN” value is set to 100.00%.

Cal Factor:
This is the pressure sensor offset in 0.1mB increments. Adjust your static pressure to be close to sea level pressure. The exact altitude is not important and can be up to several hundred feet. Adjust the calibration factor so the altitude readout in the top right hand corner of the display agrees with your pitot static test set.

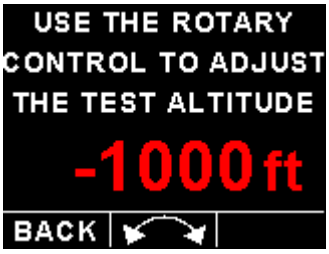
Cal Gain:

Once you are satisfied that the low level altitude “CAL FACTOR” is correct, apply a static pressure that will result in an altitude between 20000 and 30000 ft. Adjust the “CAL GAIN” until the altitude readout in the top right hand corner of the display agrees with your pitot static test set

NOTE: Adjusting the “CAL GAIN” also changes the low level altitude calibration achieved when adjusting the “CAL FACTOR”. Please recheck your low level altitude calibration and adjust if necessary. Recheck your altitude readout at the higher altitude, and if needed slightly adjust the “CAL GAIN” again. Repeat the process until you are satisfied with both the “CAL FACTOR” altitude and the “CAL GAIN” altitude.

Test Alt Encoder (Only shown if the comm out has been enabled):

This is a handy function to test the FLIGHT-3 transponder interface once the installation has been completed. The serial output will output specific altitudes which can then can be used to test the serial RS232 output and the parallel gillham output if using a CNV-ALT converter. The FLIGHT-3 will resume the normal output of the indicated altitude upon exiting the test function.



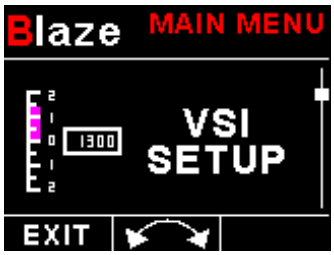
The following codes are outputted:

Altitude	D4	A1	A2	A4	B1	B2	B4	C1	C2	C4
-1000ft	0	0	0	0	0	0	0	0	1	0
-900ft	0	0	0	0	0	0	0	1	1	0
-700ft	0	0	0	0	0	0	1	1	0	0
-400ft	0	0	0	0	0	0	1	0	1	1
-200ft	0	0	0	0	0	1	1	0	0	1
800ft	0	0	0	0	1	1	0	0	0	1
2800ft	0	0	0	1	1	0	0	0	0	1
6800ft	0	0	1	1	0	0	0	0	0	1
14800ft	0	1	1	0	0	0	0	0	0	1
30800ft	1	1	0	0	0	0	0	0	0	1

Each altitude reporting code line must be tested for integrity of connection if at any time the aircraft connections to the transponder or altitude data source have been removed and reconnected. Integrity of the connections may be verified by performing a test of mode C function of the transponder system.

Warning: Do not use this function while in flight as incorrect altitude information will be sent to the transponder.

4.4 VSI Setup (Vertical Speed Indicator Setup)



VSI Unit:
Select if you want the VSI to be displayed in *"ft/min"* (feet/minute) or *"m/s"* (meters/second).

Scale:
Select the VSI scale most suited for your aircraft.

VSI Cal:
This is a function that is used to calibrate your VSI to read exact rates of climb or decent. This function works as a percentage of initial reading. The default setting for this function is 100%. Increasing this value increases the VSI reading and decreasing the value decreases the reading.

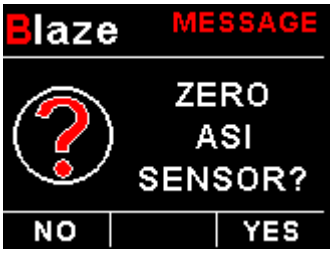
Suggested VSI calibration method
After you have installed the instrument, perform a calibration flight. This should be done in very calm conditions. Turbulence and thermal activity will make accurate calibration impossible. Many areas have ideal conditions during early mornings or late afternoons. Place the instrument in ft/min for ease of calibration. Take your aircraft to a few thousand feet above ground and start a glide with a low power setting. Take a stopwatch and when the glide is stable (stable VSI reading) start the stopwatch. Take note of your altimeter reading at the same time. Continue the stable glide for one minute exactly. After the minute has finished, take another reading of your altimeter.

Example:
VSI reading during stable glide: -400 ft/min
Start altitude: 2500 ft.
End altitude: 2050 ft.
In the above example the VSI is under reading by about 12%. Set your VSI calibration to 112% to cancel out the error.

4.5 ASI Setup (Airspeed Setup)

Zero ASI Sensor:

This setup allows your instrument to measure the zero airspeed reading of the airspeed sensor and set a calibration value internally for this. This is equivalent to some mechanical airspeed indicators that have an adjustment to set the needle to zero when the aircraft is not moving. You would use this function occasionally if you see an airspeed reading when the aircraft is at rest. This may be caused by aging of the built in pressure sensor or related electronics. When this function is performed make sure that there is no air flow into the pitot tube as this would result in an incorrect internal calibration.



ASI Unit:

Select if you want the ASI to be displayed in mph (statute miles per hour), km/h (kilometers per hour) or kts (nautical miles per hour).

ASI Filter:

This function can be used to select the signal filter time constant. Selections are *"NONE"*, *"FAST"* or *"SLOW"*. This selection influences the rate at which your ASI can change its reading. If you have an installation that suffers from strong turbulence at the pitot tube, select "slow". If you have a very clean airflow in front of the pilot tube you can select "fast" which will give you a faster response to airspeed changes.

Vne Speed: (Max Exceed Speed)
Enter you maximum speed you aircraft should not exceed.

Vno Speed: (Max Maneuvering Speed)
Enter your maximum maneuvering speed.

Vfe Speed: (Max Flap Speed)
Enter the maximum speed that is permissible with the flaps extended.

Vs1 Speed: (Min Safe Speed, Normal)
Enter your minimum safe speed for normal flight of your aircraft

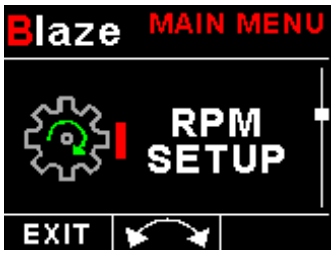
Vs0 Speed: (Min Safe Speed, Landing)
Enter your minimum safe speed for landing your aircraft

Vs Alarm:
This enables or disables Vs Alarm.

Vne Alarm:
This enables or disables the VNE alarm.

Cal:
During the factory calibration a factor has been determined and entered here that will give you accurate airspeed, provided your pitot tube is not influenced by pressure effects caused by airflow around your airframe. The calibration is displayed in % of the reading, you can increase or decrease the reading if required to help cancel out under or over reading of the airspeed indicator on your aircraft.

4.6 RPM Setup



Display:
Select if you want the RPM to be displayed in *"RPM", "PERCENT"* or *"OFF"* to disable it.

RPM 100%:
Select the maximum value that you want the RPM to correlate to 100%. This is only shown if *"Percent"* is selected for display.

High Alarm:
This enables or disables the RPM high alarm.

High Alarm:
Enter the RPM threshold for when the high alarm must be activated. Any RPM value above this value will activate the alarm.

High Caution:
Enter the RPM value for the high caution. This is the lower value of the upper yellow band.

Low Caution:
Enter the RPM value for the low caution. This is the upper value of the lower yellow band.

Low Alarm:
This enables or disables the RPM low alarm.

Low Alarm:
Enter the RPM threshold for when the low alarm must be activated. Any RPM value below this value will activate the alarm.

Pulses/Rev:

Enter the number of pulses per RPM. For engines with an uneven number of cylinders like three cylinder four stroke engines you can enter values containing fractions (usually 1.5 in this example). Most four stroke engines would generate one pulse for every two revolutions per cylinder. A four cylinder automotive four stroke engine would thus generate 2 pulses per revolution. A typical Rotax DCDI two stroke engine would generate 6 pulses per revolution. The well known Rotax 912/914 engine generates one pulse per revolution.

Increment:

Select the step size between successive RPM values eg. if the RPM value is 4003 RPM and the “RPM INCREMENT” is 5 then the actual value shown is 4005 RPM.

Label:

Enter a label to suit your RPM so you can identify it easily.

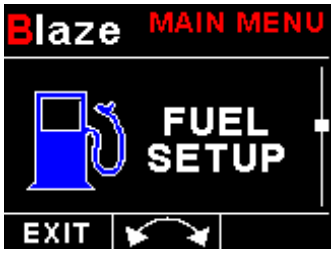
Data:

Select the data source of the RPM signal. Options include internal (using the internal electronics within the FLIGHT-3) or from an optional external RDAC unit.

RDAC Address:

Select the CAN address of the RDAC unit.

4.7 Fuel Setup



Unit:
Select your desired units for distance and fuel quantity. The following options are available:
L/sm: Litres and statute miles
G/sm: U.S. Gallons and statute miles
L/nm: Litres and nautical miles
G/nm: U.S. Gallons and nautical miles
L/km: Litres and kilometers
G/km: U.S. Gallons and kilometers

Fuel Flow:
Select if there is a fuel flow sender connected to the fuel flow input.

K-Factor:
The K-Factor is the number of pulses generated by the fuel flow sender for one Litre of fuel. The dual range fuel flow sender supplied by MGL Avionics has a K-Factor of 7000 in the low flow mode (jet installed) and 1330 for the high flow mode (no jet installed). You can use the K-Factor to calibrate your fuel flow sender. See the installation section for more details on how to calibrate and install the fuel flow sender.

Mode:
Select if you want to measure fuel flow using a fuel flow sender or by using fuel injectors.

Injector:
Select whether the FLIGHT-3 fuel flow input is connected to the high or low side fired fuel injector.

Fuel Tank Setup:
Select this menu item to setup the fuel level for the fuel tank. See below for more details.

NMEA Baud:
Select the baud rate of your NMEA GPS receiver. Serial Comms must be enabled for the NMEA GPS to work.

Data:
Select the data source of the fuel signals. Options include internal (using the internal electronics and Blaze connector) or from an optional external RDAC unit.

RDAC Address:
Select the CAN address of the external RDAC unit.

4.7.1 Fuel Tank Setup menu

Tank:
Select if the fuel tank has a physical fuel level sender connected to it or if the FLIGHT-3 must use a calculation based virtual fuel tank. If you do not want any fuel level information then set this parameter to off.

Tank Size:
Enter the size of the fuel tank in your system. It is recommended to choose a size that is slightly less than actual size so you can compensate for sender inaccuracies and give you a measure of reserve fuel.

Low Caution:
Enter the fuel level value for your fuel caution. Note that the fuel caution level will be displayed as a yellow bar on your fuel level display.

Low Alarm:
Select whether to turn the fuel tank 1 low level alarm on or off.

Low Alarm:
Enter your desired minimum fuel value that you would like to trigger the fuel low alarm. The fuel low alarm will result in the flashing of the fuel level display and remaining fuel readout. You can also connect a warning lamp to the external alarm output (see installation diagram). Note that the fuel low level will be displayed as a red bar on your fuel level display. This level is over and above your “silent” fuel reserve.

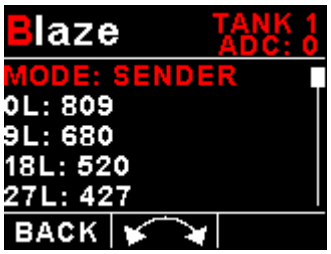
Add To Range:
Select whether this tank adds to the fuel range calculation

Calibrate Tank:
See section 4.7.2 on how to calibrate the fuel level senders.

Tank Filter:
Select the damping factor for the fuel level. A selection of none, low, med or high can be made.

Litre Res:
Select the resolution of the Litre unit. 1L or 0.1L

4.7.2 Calibrating the fuel level sender



The fuel level sender needs to be calibrated before it can be used with this system. The calibration allows the system to learn the shape of your tank as well as any errors your fuel level sender or installation has.

Regardless of your use of a fuel flow sender, you can install a fuel level sender into your fuel tank. These level senders are inexpensive and are available as after market replacement fittings from a car spares outlet. We recommend the senders available from VDO.

Be aware that some makes of cheap level senders can prove troublesome, as the lever arms tend to be sticky. This prevents the floats from floating on the surface of the fuel at all times. As a consequence, this will lead to incorrect fuel level indication.

Adjusting calibration points automatically

Select “SENDER” for the mode menu item. Once you have installed a fuel level sender into your tank, make sure the float can travel all the way from empty to full position without hindrance of any kind. The calibration procedure should be carried out with your aircraft in flight attitude. This means you need to lift the tail if you have a tail-dragger or lift the nose wheel if you have a weight shift trike.

Calibration procedure

- Start the calibration procedure with an empty tank.
- Add five Litres of fuel (our reserve quantity) using a suitable measure. Make sure the measure is suitably accurate. This is now the “level sender reading at 0 Lt” position. Move the highlight to this position and wait until the sender reading has stabilized (You will see the sender ADC reading at the top). This could take up to a minute so have patience.

  ENSURE THAT THE FLOAT IS NOT SUBMERGED AND IS FLOATING ON TOP OF THE FUEL LEVEL.

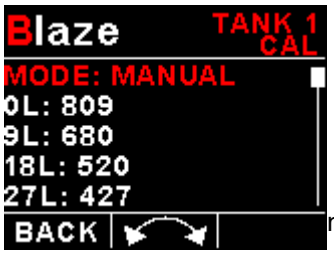
  Should this number not react to changes of your level sender position, then you have a problem. Please check your wiring according to the installation section of this manual. You should expect the number to change in the region of at least 20 to 60 counts per calibration position. If the number does not change with fuel level or only changes a very small amount – check your installation. Something is not right!
- If you see the number changing then everything is well. Once it has stabilized and the highlight is on the 0 L position, press the rotary control to transfer the reading from the sender to the calibration point.
- Now you are ready for the next step. Add the required amount of fuel to get to the next level (In our case 9 Lt – this is 20% tank capacity). Once done, wait for the reading to stabilize and press the rotary control again after you have moved the highlight to the “9 L” position.
- Proceed in a similar manner until you have reached the last calibration position at 100% tank capacity.

You are done!

To finish your calibration, exit the calibration function.

The instrument uses the 6 calibration points to work out a correction curve that takes into account the tolerances of your fuel level sender and the shape of your fuel tank. This results in an incredibly accurate and usable fuel level display that far exceeds that available from ordinary dial type gauges.

Adjusting calibration points manually



You may want to set individual calibration points manually. For example you may find that your fuel level is over reading at a specific fuel level. Correcting the tank level reading for this area can be simply done by adjusting the calibration point. You can do this by moving the float level with your hands to the desired position and then performing the calibration as outlined above, or you can use the manual option.

Select *"MANUAL"* for the mode menu item. Then highlight the point you want to change manually and press the rotary control. Use the up or down keys or the rotary control to adjust the value. Press the rotary control when done.

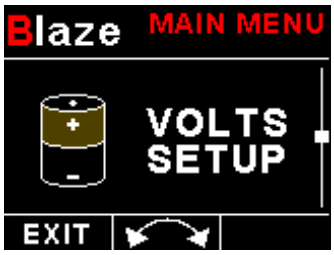
Note: The calibration positions may be edited by using the rotary control. This allows you, in theory, to copy calibration settings from one instrument to another. We however recommend that you do go though the calibration procedure even if the two aircraft are identical in all respects. Tolerances do exist and the calibration cancels these out. Accurate fuel level displays are a vital safety factor for an aircraft and a very useful feature for peace of mind during cross county flights.

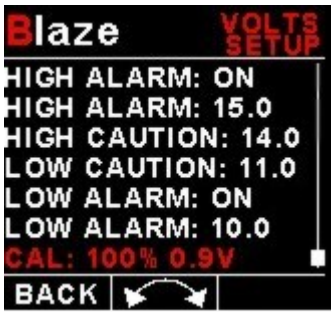
Notes on Slope error

Sender value is a value determined by the FLIGHT-3. It is used to calculate fuel level, fuel endurance estimate and current range estimate. The fuel tank setup sender value can either increase in value as fuel is added or decrease in value if fuel is added. This is dependent on the type of fuel level sender used. However should the second reading be larger than the first reading all readings will have to be larger than the previous readings. Likewise should the second reading be smaller than the first reading all readings will have to be smaller than the previous reading.

If this is not the case the wording "Slope error" will be displayed. This could happen when fuel was removed instead of added between steps, no fuel was added between steps or when the fuel level sender was moved in the wrong direction e.g. moving the fuel level sender manually when it is not inserted in to the fuel tank. Determine the cause of the error if you should get a slope error message. If you do not know the cause of your error it is best to start from scratch. It should be remembered that accuracy in the fuel tank calibration is extremely important to enable your FLIGHT-3 to display the correct data.

4.8 Volts Setup





High Alarm:
This enables or disables the volts high alarm.

High Alarm:
Enter the voltage threshold for when the high alarm must be activated. Any voltage above this value will activate the alarm.

High Caution:
Enter the voltage for the high caution. This is the lower value of the upper yellow band.

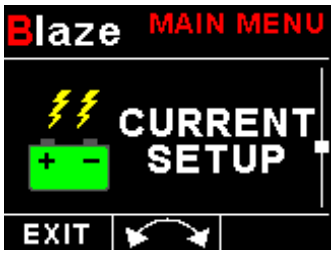
Low Caution:
Enter the voltage for the low caution. This is the upper value of the lower yellow band.

Low Alarm:
This enables or disables the volts low alarm.

Low Alarm:
Enter the voltage threshold for when the low alarm must be activated. Any voltage below this value will activate the alarm.

Cal:
Measure the battery voltage with a multimeter and then adjust this value to match that of the multimeters volts reading.

4.9 Current Setup (MGL Avionics Magnetic Closed Loop current Sensor required)



Current Disp:
Select to enable or disable the current display.

High Alarm:
This enables or disables the current high alarm.

High Alarm:
Enter the current threshold for when the high alarm must be activated. Any current above this value will activate the alarm.

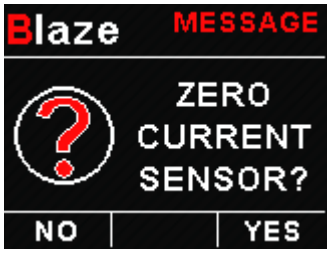
High Caution:
Enter the current value for the high caution.

Low Caution:
Enter the current value for the low caution.

Low Alarm:
This enables or disables the current low alarm.

Low Alarm:
Enter the current threshold for when the low alarm must be activated. Any current below this value will activate the alarm.

Zero Sensor:

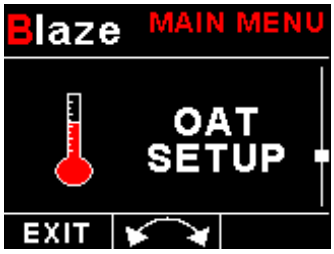


Select this function to indicate to the FLIGHT-3 that zero current is flowing through the MGL Avionics Closed Loop Current sensor. This is best done with the MGL Closed Loop Current sensor disconnected from the main current supplying conductor.

Gain:

Adjust the gain factor until the current is reading correctly. It will be best if a multimeter can be inserted in series with the current supplying conductor and the gain calibration adjusted until the FLIGHT-3 matches that of the multimeter. Please see the MGL Avionics Closed Loop Current Sensor documentation for more information.

4.10 OAT (Outside Air Temperature) Setup



OAT Display:
Select to enable or disable the OAT display.

Temp Unit:
Select whether you want the OAT to be displayed in degrees Celsius (ºC) or in degrees Fahrenheit (ºF).

High Alarm:
This enables or disables the OAT high alarm.

High Alarm:
Enter the temperature threshold for when the high alarm must be activated. Any temperature above this value will activate the alarm.

High Caution:
Enter the temperature for the high caution. This is the lower value of the upper yellow band.

Low Caution:
Enter the temperature for the low caution. This is the upper value of the lower yellow band.

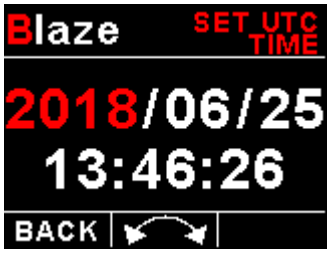
Low Alarm:
This enables or disables the OAT low alarm.

Low Alarm:
Enter the temperature threshold for when the low alarm must be activated. Any temperature below this value will activate the alarm.

OAT Cal:
During the factory calibration a factor has been determined and entered here that will give you an accurate OAT reading. If you find this value is incorrect then adjust the calibration factor until the FLIGHT-3 OAT matches that of a precision thermometer. Calibration can only be done in Celcius (ºC).

4.11 Timers Setup

Set UTC Time:



This function is used to set the internal real time clock. The time to be entered must be UTC in order for the system to operate correctly. Do not enter local time (unless it is the same as UTC).

UTC is the same as Greenwich Mean Time (GMT) or Zulu time.

UTC Offset:

Enter the UTC offset for your location. The UTC offset can be adjusted in half an hour increments.

RTC Trim:

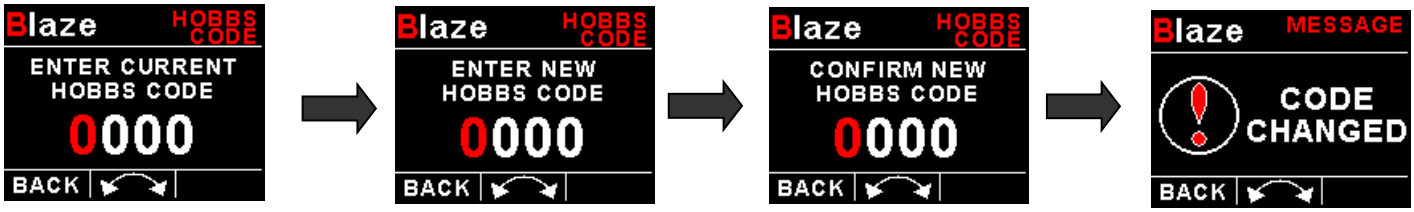
This allows you to adjust a trimming factor that will increase the accuracy of the built in clock.

SET HOBBS TIME:

This function allows you to set the engine Hobbs meter to any value. Typically, you would use this function to set the Hobbs meter to the current known engine time. Use the rotary control to change the value. Press the rotary control to accept and exit the menu option. If the Hobbs code is set to another value beside zero, then the pilot will be prompted to enter the Hobbs access code before allowing him to change the Hobbs time. This feature is useful for charted and flying school planes.

HOBBS CODE:

This menu option allows you to change the Hobbs access code. You will first be prompted to enter the current code followed by entering in a new code followed by re-entering the new code. If the new code and the re-entered code is the same, then the Hobbs access code will be changed. Default code is 0000.



HOBBS HOUR:

Select if you would like the hour to be displayed in decimal fractions or minutes.

SET MAINT TIMER:

This function allows you to set an engine maintenance timer. This timer is set in engine hours and it will count down to zero when the engine RPM is greater then the "*HOBBS RPM*". A good use for this function is to set the hours until your next spark plug change or engine inspection. Use the rotary control to change the value.

H/M Start:

Select what source will start the Hobbs and Maintenance timers. A selection between Power or RPM can be made. Power selection will start the Hobbs and Maintenance timers when the instrument powers up.

HOBBS RPM:

Enter the RPM limit in which the Hobbs timer/Maintenance timer must start incrementing.

4.12 COMM Setup (Communication Setup)

Serial Out:
Select “ON” to enable the RS232 serial output.

Unit Address:
Enter the unit address.

Baud Rate:
Select the desired baud rate of the serial output.

Prot:
Select the protocol of the serial RS232 output message. The protocol can be selected between GARMIN AT, Magellan, Northstar / Garmin, Trimble / Garmin, MGL Avionics and Microair UAV. Please note that the baud rate is automatically adjusted according to which protocol is selected. The output format is as follows. The message contains the current pressure altitude with a fixed reference to 1013.25mB (29.92 inches mercury). All protocols use 8 databits, no parity, and 1 stop bit. The message is outputted once a second.

Protocol	Baud Rate	Message format	Example
Garmin AT	1200	#AL, space, +/-, five altitude digits right justified zero padded, T+25, checksum, carriage return The checksum is a simple modulo 256 sum of the binary values of the individual characters. The checksum is sent as two characters in hexadecimal format	#AL +02372T+25DF[CR]
Magellan	1200	#MGL, +/-, five altitude digits right justified zero padded, T+25, checksum, carriage return The checksum is a simple modulo 256 sum of the binary values of the individual characters. The checksum is sent as two characters in hexadecimal format	$MGL+02372T+2513[CR]
Northstar, Garmin	4800	ALT, space, five altitude digits right justified zero padded, carriage return	ALT 02372[CR]
Trimble,	9600	ALT, space, five altitude digits right justified	ALT 02372[CR]

Garmin GTX327, GTX328, GTX330 (Set on Icarus)		zero padded, carriage return	
MGL Avionics	9600	ALT, +/-, five altitude digits right justified zero padded ,1013.25mB (29.92”Hg) referenced, C, +/-, five altitude digits right justified zero padded (corrected to local pressure), L, local pressure setting in millibars, +/-, four digit VSI reading right justified zero padded in ft/min, X, checksum, carriage return The checksum is a simple modulo 256 sum of the binary values of the individual characters. The checksum is sent as two characters in hexadecimal format	ALT+02372C+02372L1013+0000XCA[CR]
Microair UAV	9600	STX,a,=, five altitude digits right justified zero padded, ETX	[STX]a=02372[ETX]
Infiniteq	57600	See Infiniteq protocol format below	
STX=0x02 ETX=0x03 CR=0x0D			

Infiniteq protocol format:

STX, Address, Message type, Length, Data payload, Checksum, ETX

STX: Start of text (0x02)

Address: unsigned char (8bit),

Message Type: unsigned char (8bit), (0x0c)

Length: unsigned char (8bit), Length of the data payload (does not include the STX, Address, message type, checksum or ETX), (33)

Data payload:

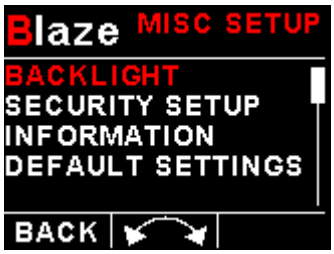
Local Time:	Unsigned Long (32 bit), Time is seconds since 1 January 1970
Hobbs Hours:	Unsigned Int (16 bits), Hobbs hours
Hobbs Minutes:	Unsigned char (8 bits), Hobbs decimal minutes
Maintenance Time:	Unsigned Int (16 bits), Maintenance time in hours
Altitude:	Signed Long (32 bit), Altitude in feet (Referenced to 1013.25mB)
Vertical Speed:	Signed Int (16 bit), Vertical Speed in ft/min
Airspeed:	Unsigned Int (16 bit), Airspeed in mph
RPM:	Unsigned Long (32 bit), RPM value
RPM (%):	Unsigned Int (16 bit), RPM value in percentage
Fuel Flow:	Unsigned Int (16 bits), Fuel Flow in 0.1Liters per Hour
Fuel Level:	Unsigned Int (16 bits), Fuel Level in Liters
Volts:	Unsigned Int (16 bits), Volts in 0.1V
Current:	Signed Int (16 bits), Current in 0.1A
OAT:	Signed Int (16 bits), OAT temperature in Degrees Celsius

Checksum: unsigned char (8bit), XOR of all bytes starting from the unit address to the end of the data payload. The checksum is seeded with 0xa5. (does not include the STX or ETX)

ETX: End of text (0x03)

Output Rate=1Hz

4.13 MISC Setup (Miscellaneous Setup)



Backlight:

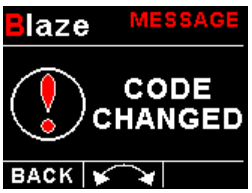
Select manual or automatic backlight control.

Use the rotary control in manual mode to adjust the backlight brightness.

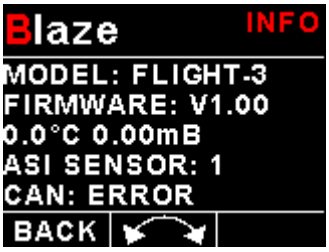
Allow 3 seconds for the display to adjust to the ambient lighting conditions when using the automatic backlight mode. The display will set the backlight to the dim setting if the ambient light is less then the threshold setting, alternatively the display will set the backlight to the bright setting if the ambient light is greater then the threshold setting. The ambient light received is shown as the ADC value in the top header. Use this value to set the threshold value.

Security Setup:

Select this menu option if you want to password protect the menu system.

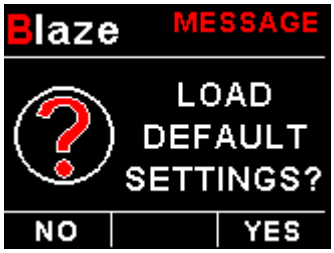


Information:



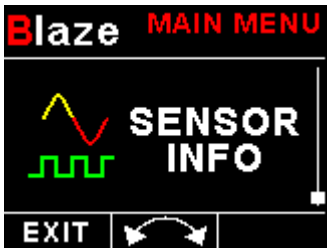
This menu option displays information about the unit.

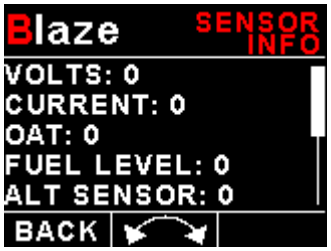
Default Settings:



Select this menu option to reset all the settings to factory defaults.

4.14 Sensor Info





This menu displays information about the altitude and airspeed sensors.

5 Loading factory default settings

Press and hold the F1/Up button and rotary control during power up to load the pre-programmed factory default settings. The following screen will be displayed:

Factory default settings can also be loaded in the Miscellaneous setup menu.

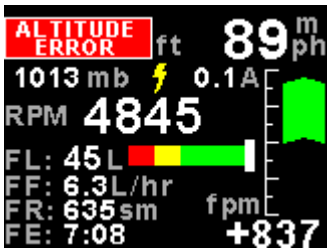
6 Error Messages

Unit settings CRC error. Load default settings to restore to factory defaults. If the error message still persists then it could possibly be a non-volatile memory failure in which case the instrument will then have to be returned to the factory.

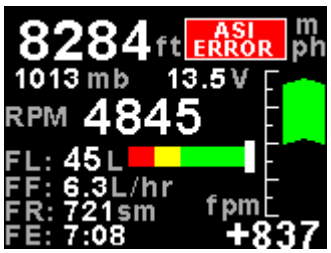
Internal flash CRC error. The instrument does a firmware check on the program when power is applied to the instrument . If the program is corrupt in any way then the internal flash CRC error will be displayed. Reload the instruments firmware and load default settings. If the error message still persists then it could possibly be an internal flash memory failure in which case the instrument will then have to be returned to the factory.

Hobbs / Maintenance Timer CRC error. Try entering new values for the Hobbs meter and Maintenance timer and see if the error message disappears. If the error message still persists then it could possibly be a non-volatile memory failure in which case the instrument will then have to be returned to the factory.

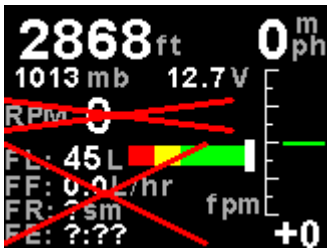
Calibration constants CRC error. The instrument could possibly have a non-volatile memory failure in which case the instrument will then have to be returned to the factory.



Altitude sensor error. The instrument could have a faulty altitude sensor in which case the instrument will then have to be returned to the factory.



Airspeed sensor error. The instrument could have a faulty airspeed sensor in which case the instrument will then have to be returned to the factory. (Digital airspeed sensor models only)



The red cross over the displays means that the FLIGHT-3 has lost communications with the external RDAC unit. Check the wiring between the FLIGHT-3 instrument and the RDAC unit. This error message is only shown when the external RDAC is selected as the data source.

7 Specifications

Operating Temperature Range	-10ºC to +55ºC (14ºF to 131ºF)
Storage Temperature Range	-20ºC to 80ºC (-4ºF to 176ºF)
Humidity	<85% non-condensing
Power Supply	10 to 30Vdc
Current Consumption	Approx. 150mA @ 12V (backlight highest setting), 65mA @12V (backlight lowest setting)
Display	2.6” 320x240 IPS color LCD display Minimum 600cd/m2 brightness Sunlight readable with anti-glare coating LED Backlight can be set to automatic or can be manually adjusted
Alarm Output	Open collector transistor switch to ground Maximum rating 0.25A
Dimensions	see Blaze series dimensional drawing
Enclosure	3 1/8” (80mm) ABS, black in color, front or rear mounting. Flame retardant.
Weight	Approx. 160 grams (Instrument excluding cables)
Non-volatile memory storage	100000 write cycles
Altitude	
Altitude sensor ADC resolution	24 bit
Altimeter range	-1500ft to 35 000ft (-457m to 10668m)
Altitude units	ft or m
Baro Correction Range (inHg)	28.00 to 31.00 “Hg
Baro Correction Range (mB)	946 to 1050 mb
Pressure units	“Hg or mb
VSI	
VSI range	+-20ft/min to +-10000ft/min
VSI units	ft/min or m/s
Airspeed	
Airspeed ADC resolution	FLIGHT-3 Version 1: 12 bit FLIGHT-3 Version 2: 24 bit FLIGHT-3HS: 13.5bit
Airspeed range	FLIGHT-3 Version 1: 20mph to 250mph FLIGHT-3 Version 2: 20mph to 350mph FLIGHT-3HS (High Speed version): 20mph to 320mph
Airspeed resolution	1 mph
Measurement accuracy	+/- 2mph
RPM Input	
RPM inputs	Range: 0-99999 RPM. Minimum signal for stable display: 5Vpp. Fully A/C coupled, maximum voltage +/- 40V. RF noise filter plus Schmitt trigger based input
Fuel Flow Input	
Fuel Flow input	RF noise filter plus Schmitt trigger based input External pull up resistor may be required
Fuel Level Sender Input	
Fuel level input	Maximum voltage: 5V, 5mA maximum current
Fuel level senders supported	Any resistive type with common ground and capacitive probes with active voltage outputs up to 5V level (push pull or pull up).
Fuel level input pull up resistor	1k (Can be disabled via the internal dip switches)

Current Sensor	
Current Sensors	MGL Avionics Closed Loop Current Sensor
Volts	
Voltage measurement range	Up to 32Vdc
Voltage resolution	0.1V
OAT Probe	
OAT Temperature Sender type	Semiconductor LM335 (ON Semiconductor)
RTC	
Internal battery type	CR2032
Sensor Output Voltage	+5Vdc. Max 50mA
Calibration interval	1 Year

As with any instrument, regular zeroing is suggested to achieve maximum performance.

8 Operating the alarms

The alarm output can be used to switch an external alarm indicator. The external alarm switch is an open collector transistor switch to ground with a maximum rating of 0.25A DC. It is possible to wire the alarm contacts of several Stratomaster instruments in parallel should this be desired. To avoid false activation of the alarms, the alarm function is only active 10 seconds after the instrument has powered up.

9 Firmware Upgrading

The FLIGHT-3 can be upgraded in the field by connecting the RS232 port to a PC and running the firmware update program. **Note that only the RS232 port can be used to upgrade the firmware.**

Please see the Blaze firmware upgrading document for more information.

10 Installation

10.1 Altimeter installation

Connect the static port to a suitable static air pressure line. If you have a slow aircraft or an aircraft where the internal cabin pressure does not change during flight and is equivalent to the outside air pressure you may find that it is not required to connect a static port.

Most small aircraft such as ultralights or microlights do not require a connection to a static port. In these cases, simply leave the static port open. Ensure however that the static port does not receive pressurized air due to the forward movement of the aircraft. Be especially critical of your pod or panel if you do not use a static port. Any build up of a pressure differential due to ram air or suction can lead to large errors of the indicated airspeed and altitude. Static ports are usually mounted at a strategic position on the rear side of the aircraft fuselage for faster, pressurized aircraft.

10.2 Airspeed installation

Connect a pitot tube to the “pressure port” and if required connect the static port.

The FLIGHT-3 allows you to calibrate the airspeed reading. This is done under the “AIRSPEED SETUP” menu item. The main reason for this is to be able to remove errors introduced due to the airflow around your aircraft which may have an effect on your pitot tube pressure.

The FLIGHT-3 pressure ports take 4mm ID tubing. Use hose clamps to fasten the hose onto the FLIGHT-3 pitot and static ports.

10.3 Fuel flow sender installation

The fuel flow sender allows the FLIGHT-3 to provide instantaneous readouts of hourly fuel usage, and both time and distance estimates on remaining fuel in flight. You can also verify the performance of your fuel pump during the pre-takeoff engine run up – a very valuable check! Further, it is possible to set up the instruments to calculate fuel remaining by subtracting fuel used from a value entered when you filled your tank(s). In this case you may omit the installation of the optional fuel level sender. **Please note that the installation of the fuel Flow sender should be done in such a fashion that dirt or debris from the fuel tank cannot lodge inside the flow sender. These will not block you fuel flow but may lead to the impeller inside the sender jamming. It is usually sufficient to mount the flow sender AFTER the fuel filter but before the fuel pump. It is a good idea to provide a small reservoir such as a primer bulb between the flow sender and the fuel pump.**

As indicated in the recommended installation drawing, it can be of advantage to install the flow sender in such a fashion that the inlet points slightly down and the outlet points slightly up. This prevents vapor from forming a bubble inside the flow sender. We strongly recommend mounting the flow sender in such a fashion that the impeller rests on only one bearing. This is achieved if you mount the sender such that the surface with the arrow faces upwards. Mounting the sender like this results in the best performance at low flow rates as only very little friction is present. The flow sender is delivered with a small jet that can be installed in the flow sender inlet. Installation of this jet is recommended for engines with fuel flow rates lower than about 30 Litres per hour. This would apply to most small two and four stroke engines. The FLIGHT-3 is shipped with the fuel flow sender calibration set for the jet installed. In a good installation you can expect about +/- 3% maximum flow reading error with this factor. You can calibrate the flow sender yourself to a higher degree of accuracy if you so desire.

Recommended procedure to calibrate the fuel flow sender:

Note: You must disable the fuel level sender if you have one installed, and enable the calculated fuel level sender.

1. Fill your tank exactly to a known level (for example 50 Litres).
2. Set your fuel level to 50 Litres.
3. Fly your aircraft for a period that you know will use approximately 20 Litres of fuel. The exact fuel burn is not important; just burn about 20 Litres of your fuel. At the end of your flight the instrument should give you a reading of how much fuel you have left – the reading should be about 30 Litres left.
4. Now place your aircraft in exactly the same position that you used when you first filled the tank and refill the tank to 50 Litres using a measuring jug. You should find that you need 20 Litres of fuel to refill to 50 Litres.
5. If you find that the instrument under or over reads the fuel used, you should perform a simple adjustment of the fuel flow sender calibration factor.

Example:

Actual fuel used: 21.5 Litres, FLIGHT-3 fuel burn calculated 29.7 Litres left in the tank. This means the FLIGHT-3 measured 50-29.7 = 20.3 Litres. We are under reading by 1.2 Litres.

Default calibration factor in Fuel setup menu = 7000.

Let the corrected calibration factor be X.
X = (20.3 * 7000) / 21.5
X = 6609.3

The closest setting you can enter as factor is 6609. Enter it into the unit and you are done!

Repeat the above procedure to verify that your flow sender is now reading correctly.

Please note:

Before you calibrate the flow sender ensure there are no problems with your installation. We find the senders are very accurate if everything is installed and working properly. If your fuel burn indication is out by a large amount you have a problem that you should not attempt to fix by fiddling with the calibration factor! Please ensure that no fuel vapor can be trapped inside the sender housing in the form of bubbles. Due to the low fuel flow rates the bubbles will prevent the tiny impeller from turning freely, you can verify the turning of the impeller. You should notice three dark spots that are just visible in the inside of the fuel flow sender. These are small magnets that are attached to the impeller. With fuel flowing you should see the magnets turning. The best defense against vapor bubbles is to install the flow sender in such a way that the bubbles can escape. The easiest way is to point the outlet slightly upwards and the inlet (with the jet) slightly downwards. Another possible problem is the fuel sender jet. When you install it, do not damage it. Use a drill bit of suitable diameter (5.5mm) to push the jet all the way, the opening of the jet must be just in front of the impeller.

YOU NEED TO APPLY SOME FORCE TO INSERT THE JET ALL THE WAY (about 24mm). THE JET MUST BE LOCATED RIGHT IN FRONT OF THE IMPELLER. YOU CANNOT PUSH THE JET TOO FAR.

Using other Flow Senders

It is quite possible to use flow senders other than the MGL Avionics fuel flow sender. In this case ensure that the sender outputs a 5V TTL square wave or a similar signal. The FLIGHT-3 interface electronics will adapt to a variety of different voltages and pulse shapes as it contains a Schmitt-trigger input stage. The calibration factor can be entered in a wide range making the unit particularly suited to other flow senders. The supply output terminal for the sender provides a positive, regulated 5 volt output. This may be used to power the flow sender provided the sender will not draw more than 40 mA of current. Should your sender require a higher voltage or more current, you must supply the sender from a different power source. Exceeding the rating on the MGL Avionics fuel flow sender supply terminal can affect the operation on the unit negatively or even damage it. Some senders require a pull-up resistor to the 12V supply line. We find most installations of these senders require a 4K7 pull-up resistor.

Recommended Calibration Factors for the MGL Avionics dual range flow sender:

With jet installed = 7000. Recommended for flow rates below 30 Litres/hour maximum
Without jet installed = 1330. Recommended for flow rates above 30 Litres/hour

Please refer to the leaflet included with the flow sender for information on pressure drop versus flow rate, wetted materials etc.

It is your responsibility to ensure that the flow sender used is compatible with the fuels you intend using. We have found the MGL Avionics fuel flow sender to be very compatible with automotive fuels used in South Africa, many of which contain methanol. 100LL AVGAS also appears not to harm the sender in any way. We have exposed a sender continuously to our automotive fuels for the duration of two years without any noticeable ill effect on the sender. However, despite this MGL Avionics or its appointed agents cannot assume responsibility for any incident or damage, even loss of life by whatsoever cause connected with the fuel flow sender or the FLIGHT-3 instrument. Usage of this or other senders is your own sole responsibility.

If you do not agree with the above statement you must not use the fuel flow sender.

Note to Pilots: (Even though this is the installation manual)
You must always have a visual indication of the fuel level available, either by means of a sight glass, direct tank observation or a known, reliable secondary fuel level gauge. Fuel level indication by means of calculated fuel burn is subject to errors both by entering incorrect starting fuel levels as well as mechanical problems causing the flow sender impeller to turn too slowly, resulting in under reading fuel burn and thus over reading remaining fuel. As pilot in command of an aircraft it is your responsibility to ensure that you have sufficient fuel to reach your intended destination. Always ensure that you have a generous amount of reserve fuel and never use your reserve fuel except in an emergency if it is unavoidable.

10.4 Fuel injector systems

Should you want to monitor fuel flow directly by means of measuring the fuel injector opening time, the connection as in the diagram below can be used. You can use either high or low fired injectors (most systems are low side fired as shown below). After you have connected the system as shown below you can proceed to set up the system. (don't forget that you need a connection from the FLIGHT-3 ground terminal to the engine block (at the same potential as the battery negative).

- Select high or low side fired injector in the Fuel Setup menu.
- Enable the flow sender in the Fuel Setup menu.
- Select a suitable K-factor in the calibration menu to give you correct rate of flow. A good starting value may be in the 1500-2000 range. Increase to lower indicated flow and decrease to have a larger indicated flow.

Flow through the injectors may not be 100% linear with switching times due to various effects. However, it is possible to obtain very good performance from this flow monitoring system if you keep the following in mind: Calibrate the K-factor so flow indication is accurate during cruise, the period your engine spends most of its active time at. Ensure that you have a correctly working fuel pressure regulator. The more constant your fuel pressure, the more accurate the flow indication.

Never use this or any other flow system as your only fuel level indication. This is not the intended purpose of a flow measuring system and this can be dangerous if for whatever reason incorrect flow is indicated.

10.5 Fuel level sender installation

The FLIGHT-3 permits the connection of one or two standard automotive fuel level senders. These senders can be obtained at automotive spares outlets at reasonable cost. When you choose a float level sender, ensure that you select a model that is sturdy and promises reliable and long lifetime. In particular, select a model that does not have any metal parts that can rust. The FLIGHT-3 can interface to a large variety of these fuel level senders. It does not matter if the sender resistance increases or decreases with the fuel level as long as it changes. The calibration procedure outlined in the “Fuel Setup” section describes in great detail the procedure to follow.

In essence, the calibration procedure will measure the resistance of the fuel level sender at various fuel levels and then work out the readings in between those known settings. Typical fuel level senders that can be used with the FLIGHT-3 have resistance ranges in the region of 100 ohms to 500 ohms. Connect the flange of the sender to the negative supply (ground). You can connect capacitive senders as well. These generally come in two types: The first emulates a normal resistive probe and is simple to connect and use as a result. The second type has a voltage level output. These can be used if the voltage can be set to a range of about 0-5V. Higher voltage levels will result in the instrument assuming a problem. The FLIGHT-3 supports one or two fuel tank level senders. You need to enable these in the “Fuel Setup” menu.

We recommend using VDO float based fuel level senders. Capacitive types can be used provided they have a voltage output not exceeding 5V. The level terminal has an internal 1K resistor pull-up to 5V. Please note that capacitive senders may exhibit large errors as they are very sensitive to the composition of the fuel used. We do not recommend using capacitive senders with automotive fuels for this reason.

Safety Hazard! Please take note:

Be careful when installing fuel level senders into fuel tanks. Ensure that the fuel tank is completely empty when you proceed with the installation. Ensure that the fuel tank is well ventilated and does not contain any fuel vapors – these are highly explosive when mixed with air. Ensure that at all times the ground connection (the connection of the fuel level sender mounting flange) is securely connected to the aircraft frame (in case of a metal frame) and to the negative terminal of the battery. In addition the negative terminal of the battery must at all times be connected to the supply ground terminal of the FLIGHT-3. Please note – this wiring is critical and must never break in flight. It would be possible to create electrical sparks in the fuel tank if your wiring is faulty or incorrect. The consequences of this can be imagined. This has nothing to do with the FLIGHT-3 itself but is a general hazard for any automotive fuel level sender installation. If you have no experience with electrical wiring, **PLEASE** delegate the task to a qualified automobile electrician or electronics technician. If you need to remove the FLIGHT-3, please first disconnect and secure the fuel level sender wire before disconnecting anything else.

10.6 RPM installation

The RPM input is quite universal. The RPM input can be used with signals from about 5Vpp to as much as 100Vpp. The input is also AC coupled for easy installation. A noise filter is included that results in the input ignoring any high frequency noise signals as long as this is below the detection threshold of about 2.5Vpp (Please see dipswitch settings below)

The input impedance of the rev counter input is approximately 10Kohm. You can use series resistors as well as load resistors for applications that have unusual signals.

The 220Ohm ballast resistor can be connected across the RPM input to ground to reduce noise or secondary pulses on the RPM line (This is often used with Rotax engines). The ballast resistor must not be inserted for direct magneto pickups as the magneto pulse may have low energy in particular at idle.

After you have connected the RPM input terminals to the signal sources you will need to set the number of pulses per revolution under the “RPM SETUP” menus. The calibration itself depends on your engine and rotor type and what kind of signal you are using.

Please see the engine RPM connection guide for connecting popular engine types to the FLIGHT-3.

Adjusting RPM sensitivity

The FLIGHT-3 has a sensitivity adjustment trimmers at the rear of the instrument. Adjust this trimmer using a small screwdriver such that you get stable RPM readings over the entire RPM band of your engine. If your sensitivity is too high, you may get unstable RPM readings (usually at higher RPM as electrical noise in the ignition system increases). If the sensitivity is too low the RPM reading may remain at zero. Fully clockwise = maximum sensitivity.

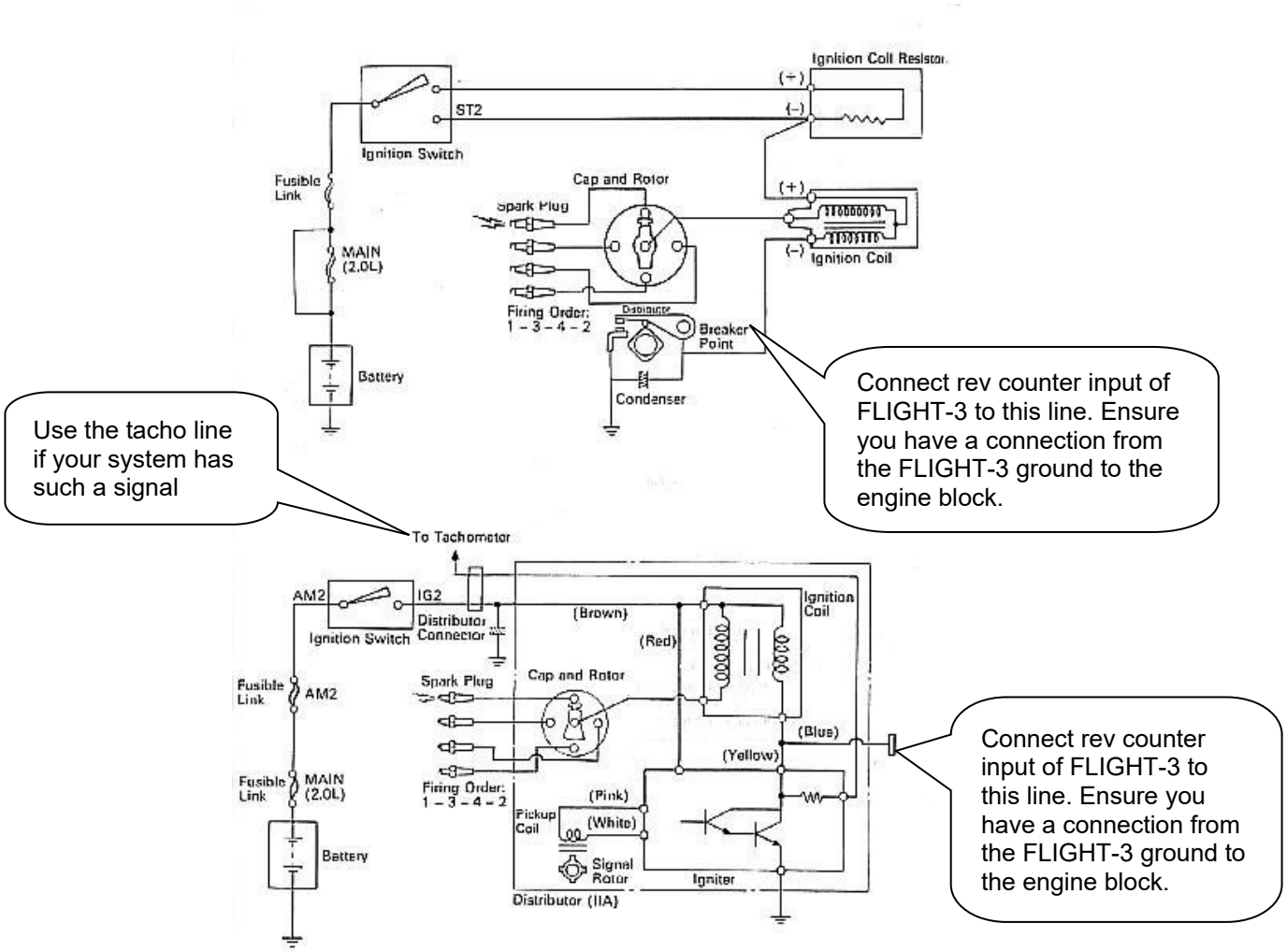
10.7 Engine RPM connection guide

Engine	Connection / Sensor	Pulses per revolution	220 Ohm Ballast resistor
Rotax 447	Connect the grey wire from the engine to the RPM input	6	Certain installations, see note below
Rotax 503	Connect the grey wire from the engine to the RPM input	6	Certain installations, see note below
Rotax 582	Connect the grey wire from the engine to the RPM input	6	Certain installations, see note below
Rotax 618	Connect the grey wire from the engine to the RPM input	6	Certain installations, see note below
Rotax 912 (S)	Connect the rev counter wires (blue/yellow and white/yellow). One of the two wires needs to be connected to ground (engine block) and the other to the RPM input.	1	Insert ballast resistor
Rotax 914	Connect the rev counter wires (blue/yellow and white/yellow). One of the two wires needs to be connected to ground (engine block) and the other to the RPM input.	1	Insert ballast resistor
Engines with magnetos	UMA Tach Sensor T1A9-1 (Slick) T1A9-2 (Bendix) Connect the red or orange/white wire to 12V, the black or blue/white and braid to ground. Connect the white (signal) to the RPM input	1 pulse per revolution on 4-cylinder, 2 pole magne-tos 1.5 pulses per revolution on 6-cylinder, 2 pole mag-netos	Certain installations
HKS engine	Connect the orange wire from the CDI unit to the RPM input	1	no
MTH engine	Connect the green wire from ignition sensor to the RPM input	2	no
Werner engine	Connect the yellow wire from ignition sensor to the RPM input	2	no
UL Power	Connect the ECU pin 9 to the RPM input	2	no

Note: Some Rotax engines may require that a 220 ohm ballast resistor is fitted between the rpm input and the ground terminal. This resistor should be fitted if you cannot obtain stable RPM throughout the range regardless of any setting of the rpm counter sensitivity adjustment.

10.8 Connecting the FLIGHT-3 to automotive engines

Conventional contact breaker ignition system

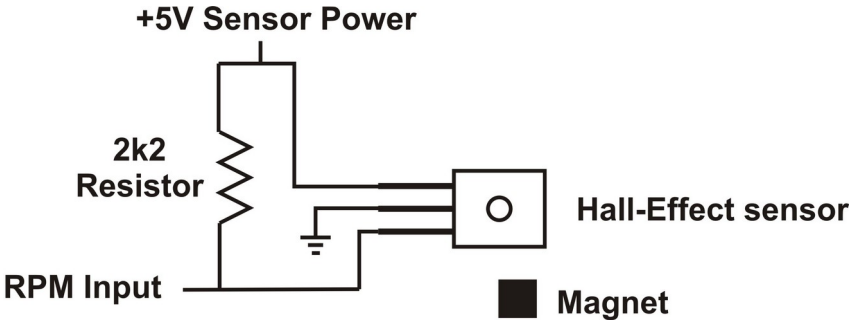


Electronic ignition system with conventional ignition coil

10.9 Various other pickup / sensor installation possibilities

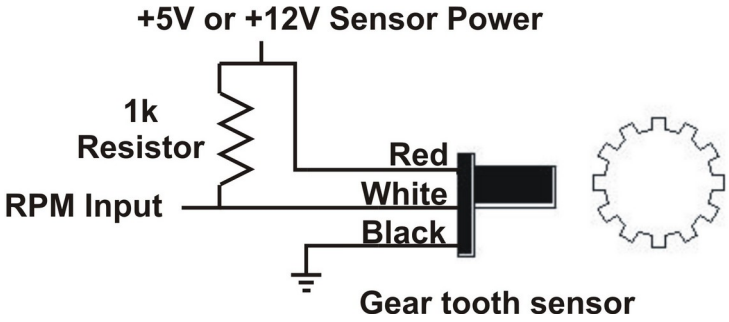
10.9.1 Hall-effect sensor

Typical hall effect sensor installation detects the passing of a magnet suitably fixed to prop flanges or shafts.



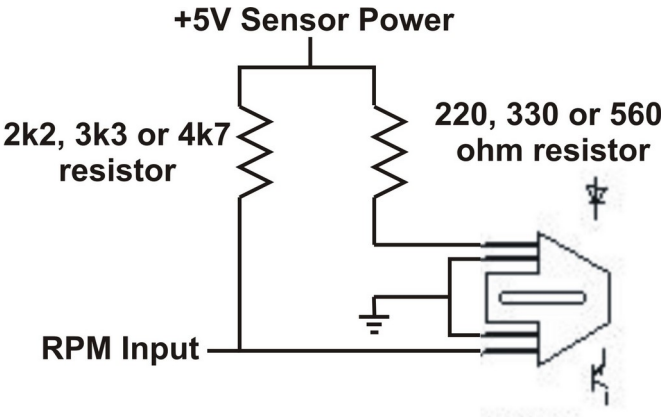
10.9.2 Gear tooth sensor

The gear tooth sensor is a popular pickup used on the pre-rotation gear of a gyro plane (rotor speed indication).



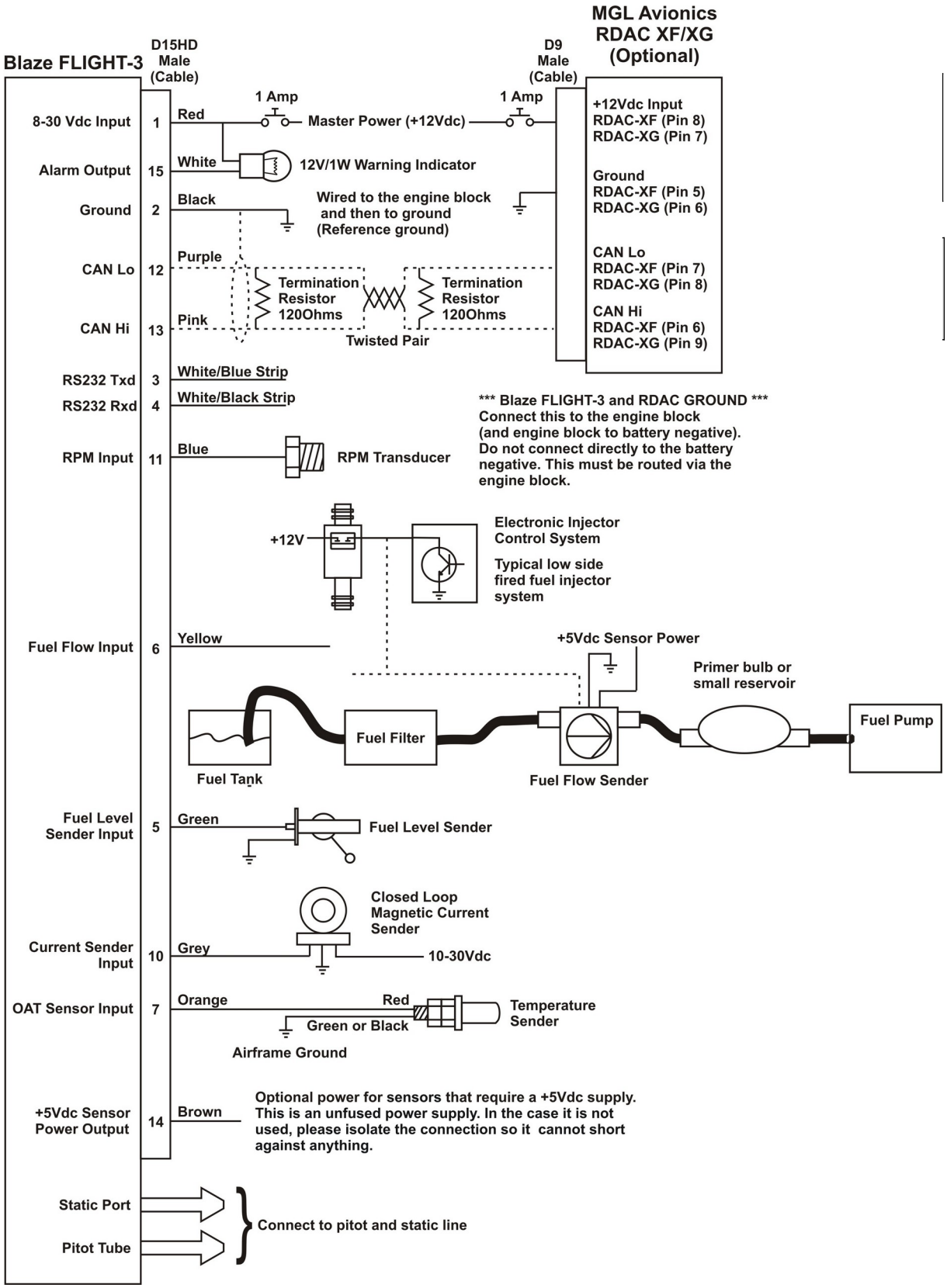
10.9.3 Optical Reflective Pickup

The optical reflective pickup can provide a simple means of contactless RPM sensing in difficult installations.



10.10 Connection Diagram

The use of an external 1A fuse is recommended. Connect the supply terminals to your aircrafts power supply. The FLIGHT-3 can be used on both 12V and 24V without the use of any pre-regulators. Ensure that the supply voltage will not drop below 8V during operation as this may result in incorrect readings.



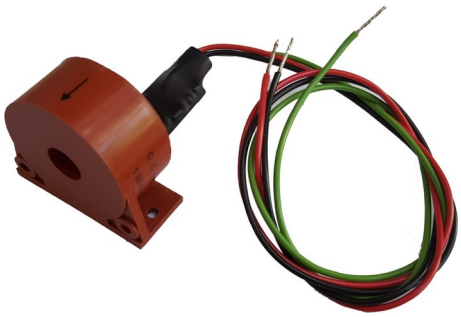
10.11 OAT Probe

Connect the OAT probe red wire to the FLIGHT-3 analog input and the black or green wire to ground.

10.12 External RDAC (Remote Data Acquisition Computer) Connection (Optional)

The FLIGHT-3 can use an external RDAC unit as the source for the RPM, fuel flow and fuel level signals. Using an external RDAC may be beneficial as it will reduce the wiring from the engine compartment to the cockpit. Only the CAN High and CAN Low connections need to be made between the RDAC unit and the FLIGHT-3 in order for this to work. Select *"RDAC"* for the data source in the "RPM SETUP" or "FUEL SETUP" menus if using the external RDAC option. The RDAC unit is optional and is purchased separately.

10.13 Closed Loop Current Sensor

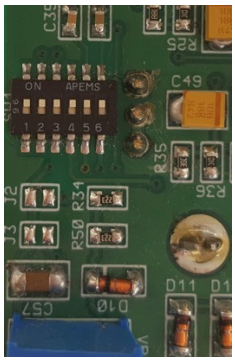


The MGL Avionics magnetic closed loop current sensor provides a 0.5V to 4.5Vdc output voltage which is proportional to a 50A bi-directional input current.

Advantages of closed loop current sensors over conventional current measurements techniques is that they provide the highest accuracy, are ideal for noisy electrical environments and they provide complete electrical isolation from the current carrying conductor.

Please see the MGL Avionics Closed Loop Current Sensor manual for connection information

10.14 Dipswitch settings



Dipswitch 1 (OAT Input)
MUST be On

Dipswitch 2 (Fuel Level)
Some fuel level senders require a supply voltage. In those case the fuel level pull up resistor dipswitch must be in the “OFF” position.

Dipswitch 3 (Current input)
MUST be OFF

Dipswitch 5 (RPM Filter)
Setting this dipswitch to the “ON” position (default) enables a high frequency filter in the RPM signal path.

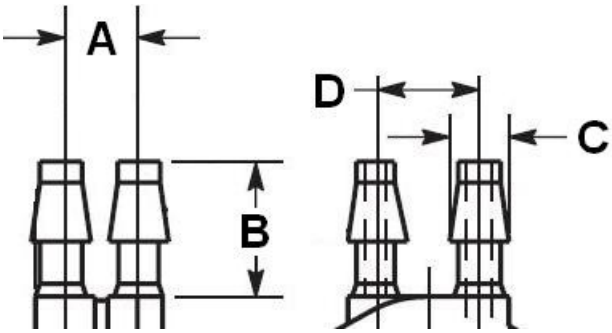
Some installations (direct coupling to a Magneto device for example) will require this to be switched “OFF”.

Dipswitch 6 (Fuel Flow input filter capacitor)
MUST be On

Dipswitch 1 is the closest switch to the edge of the PCB.

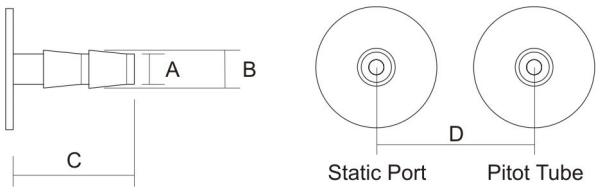
10.15 Pressure Port Dimensions

Version 1 pressure ports (Plastic)



	Inches		Millimeters	
	Min	Max	Min	Max
A	0.248	0.278	6.30	7.06
B	0.420	0.440	10.67	11.18
C	0.182	0.194	4.62	4.93
D	0.310	0.330	7.87	8.38

Version 2 pressure ports (Brass)



	Inches	Millimeters
A	0.157	4
B	0.197	5
C	0.63	16
D	0.79	20

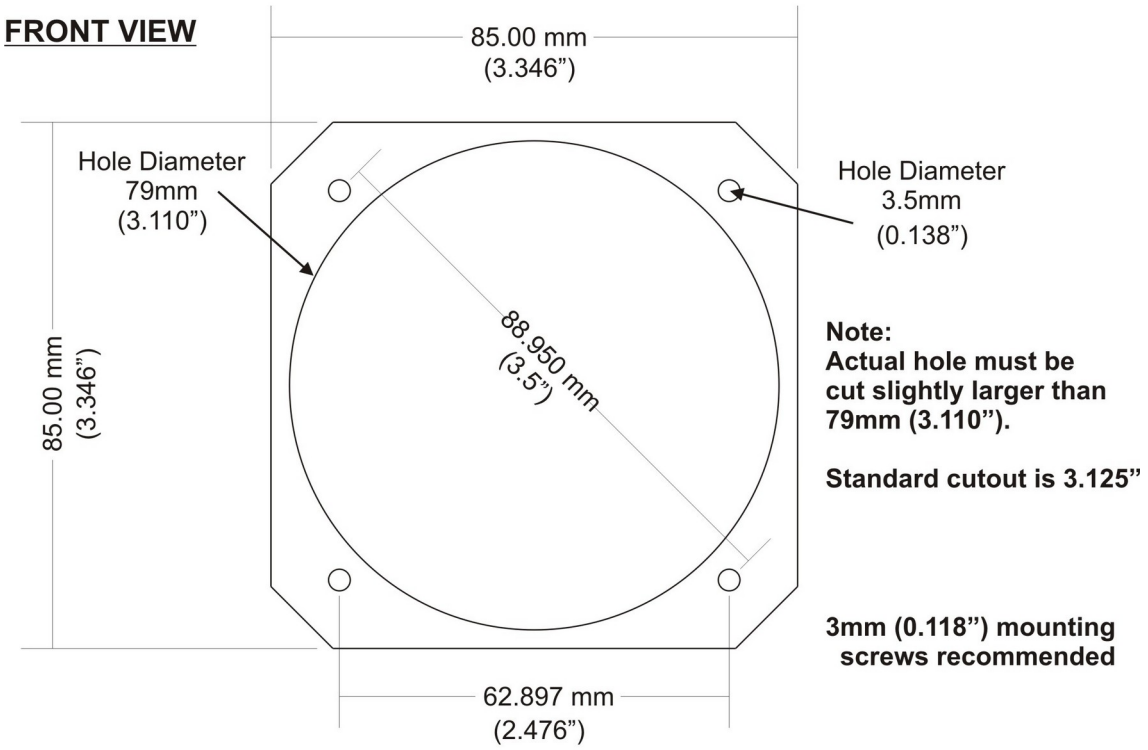
10.16 Cable connections

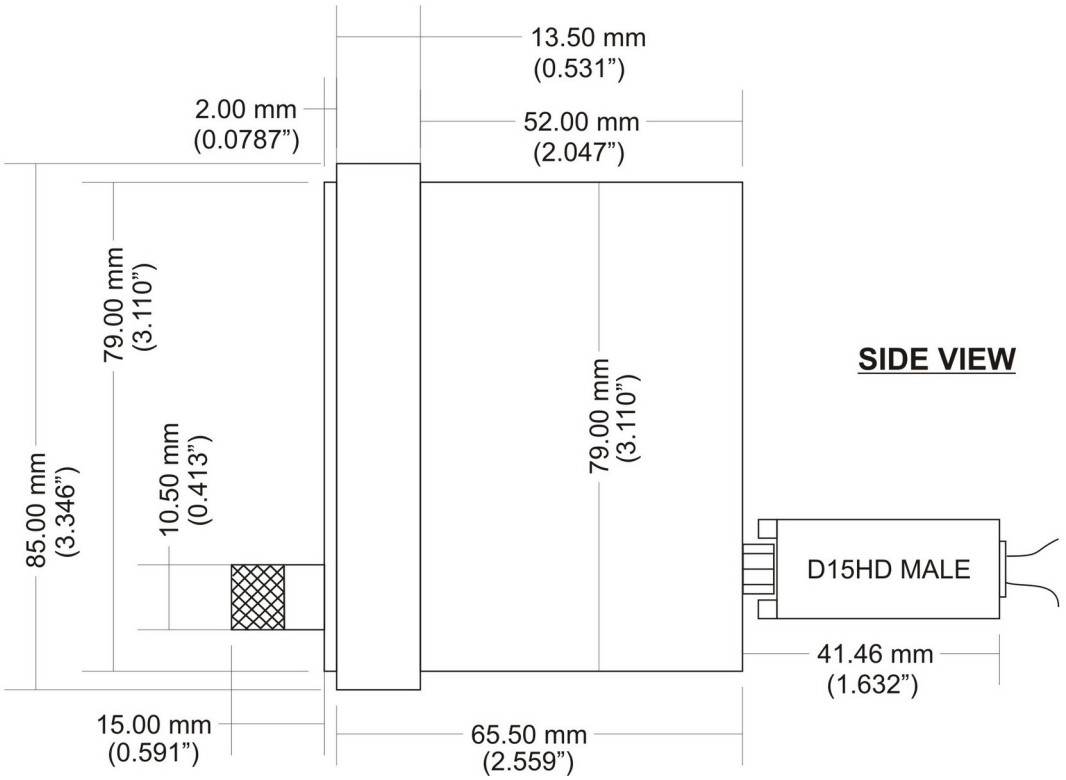
Main connector (D15HD connector: Unit Female, Cable Male)

D15HD Pin	Color	Function
1	Red	8-30Vdc power via power switch / circuit breaker and fuse.
2	Black	Ground. Connect the ground to the engine block, and the engine block to the battery negative. Do not connect the FLIGHT-3 ground directly to the battery negative. This must be routed via the engine block.
3	White/Blue Stripe	RS232 Transmit data (Firmware upgrading)
4	White/Black Stripe	RS232 Receive data (Firmware upgrading)
5	Green	Fuel Level Input
6	Yellow	Fuel flow Input
7	Orange	OAT Input
9	Red/White Stripe	Not Used
10	Grey	Current
11	Blue	RPM Input
12	Purple	CAN Low (Used for optional external RDAC)
13	Pink	CAN High (Used for optional external RDAC)
14	Brown	+5Vdc Power out Sensor power
15	White	Alarm Output (Open collector)

11 Dimensions

Stratomaster Blaze 3.125” (80mm) Dimensions





12 Cleaning

The unit should not be cleaned with any abrasive substances. The screen is very sensitive to certain cleaning materials and should only be cleaned using a clean, damp cloth.

Warning: The FLIGHT-3 is not waterproof, serious damage could occur if the unit is exposed to water and/or spray jets.

13 Warranty

This product carries a warranty for a period of one year from date of purchase against faulty workmanship or defective materials, provided there is no evidence that the unit has been mishandled or misused. Warranty is limited to the replacement of faulty components and includes the cost of labor. Shipping costs are for the account of the purchaser.

Note: Product warranty excludes damages caused by unprotected, unsuitable or incorrectly wired electrical supplies and or sensors, and damage caused by inductive loads.

14 Disclaimer

Operation of this instrument is the sole responsibility of the purchaser of the unit. The user must make themselves familiar with the operation of this instrument and the effect of any possible failure or malfunction.

This instrument is not certified by the FAA. Fitting of this instrument to certified aircraft is subject to the rules and conditions pertaining to such in your country. Please check with your local aviation authorities if in doubt. This instrument is intended for ultralight, microlight, home built and experimental aircraft. Operation of this instrument is the sole responsibility of the pilot in command (PIC) of the aircraft. This person must be proficient and carry a valid and relevant pilot's license. This person has to make themselves familiar with the operation of this instrument and the effect of any possible failure or malfunction. Under no circumstances does the manufacturer condone usage of this instrument for IFR flights.

IMPORTANT NOTICE:
You must make your own determination if the products sold by MGL Avionics are safe and effective for your intended applications. MGL Avionics makes no representations or warranties as to either the suitability of any of the products we sell as to your particular application or the compatibility of any of the products we sell with other products you may buy from us or anywhere else, and we disclaim any warranties or representations that may otherwise arise by law. Also, we offer no specific advice on how to install any of the products we sell other than passing along anything that may have been provided to us by the manufacturer or other issues. If you are in need of further information or guidance, please turn to the manufacturer, FAA Advisory Circulars and guidance materials, the Experimental Aircraft Association, or other reputable sources.

Continuing development sometimes necessitates specification changes without notice.

Other instruments in the *Stratomaster Blaze* series

AHRS-2	Artificial Horizon and Magnetic Compass Indicator
AHRS-4	Self contained Artificial Horizon and Magnetic Compass Indicator
ALT-6	Altimeter and Vertical Speed Indicator (VSI)
ALT-7	Altimeter and Vertical Speed Indicator (VSI) with a transponder compatible RS232 & parallel Gillham code output
ASI-5	Airspeed Indicator (ASI)
ASV-2	Altimeter, Airspeed (ASI) and Vertical Speed Indicator (VSI)
EMS-2	Engine Monitoring System
FF-5	Fuel Computer
FLIGHT-3	Primary Flight Instrument
INFO-2	Information Display (G-Force meter, UTC and Local Time, Slip Indicator, Outside Air Temperature (OAT), Battery Voltage, Current and charge display, Flight Timer & Flight Log, Stopwatch, Countdown Timer and Alarm)
MAG-2	Magnetic Compass Indicator
MAP-4	Manifold Pressure and RPM Indicator
RPM-2	Universal Engine / Rotor RPM Indicator
TC-5	4 Channel Thermocouple (EGT/CHT) Indicator
TC-6	12 Channel Thermocouple (EGT/CHT) Indicator
TP-4	4 Channel Universal Analog Input (Pressure/Temperature/Current/Volts) Indicator