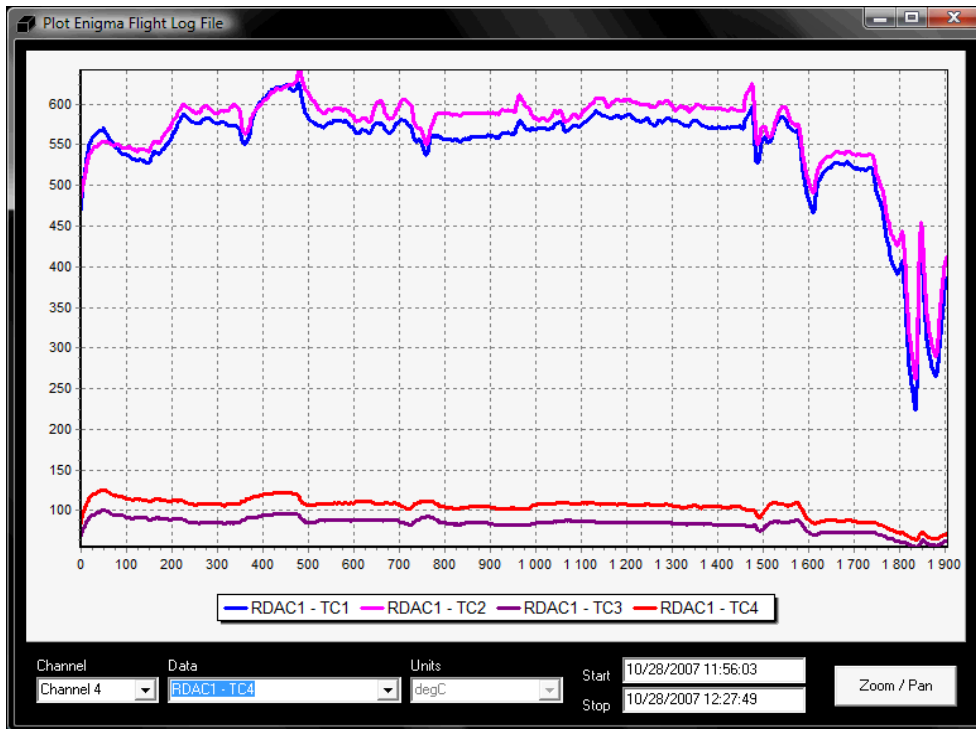# Stratomaster Enigma

Black Box Viewer

Version date: 30 October 2007

Version: 0.0.6.1 (Beta)

Introduction

About this guide

This guide provides an overview of how to use the Stratomaster Enigma Black Box Viewer utility. The Stratomaster instruments make use of a binary file type (REC) to record data during flights. The file format was defined by MGL Avionics and the definition is available via the company website. The size of the REC file on the SD memory card is fixed during project setup. It acts as a circular storage buffer.

The Enigma Black Box Viewer performs 2 primary functions:

1) Decodes and unpacks a Enigma Recording File into multiple files of the selected output type, and

2) Displays Enigma Flight Log files (which is one of the output types of the utility).

The Black Box Viewer application can also be used to convert an Enigma Flight Log file (EFL) into a different format.
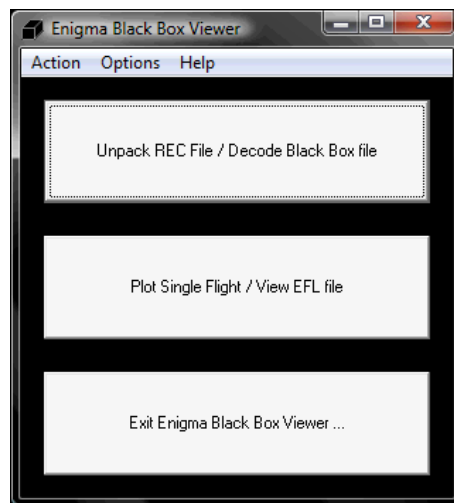
Figure 1: Main Menu

Other Decoding Utilities

Craig Payne developed a utility called "Enigma Log Dump" to decode Enigma Recording (REC) and Enigma Flight Log (EFL) files into Comma-Separated Value (CSV) files. The full source code for the Enigma Log Dump utility is available. Due to minor difference in how irregularities are handled, users might find slight differences between the number of packets that the Enigma Log Dump tool and the Enigma Recording Decoding and Playback utility produces.

The Enigma Log Dump utility is available from the web site

http://www.stratomaster.eu/download/mgl/Enigma/EnigmaLogDump_FR.exe

Enigma Recording REC Files

Recording File Overview

During user setup of the Stratomaster instruments, a blank recording file (Engima.REC) is defined using the Enigma Simulator and Display Designer. This file is copied onto the removable disk (SD/MMC Card). The file has a constant size - anywhere from 1 to 500 mega bytes. Depending on how many channels are selected for storage, this file can be used to store anything from 30 min to 1000 hours of data.

The Enigma.REC file created using the Enigma Simulator and Display Designer application can typically be found in the directory:

C:\Program Files\Enigma Tools\Enigma SIM\MMC\Enigma.REC

Using Enigma firmware 1.0.0.8 and later, a new recording file of either 10 or 50 MB can be created using only the Enigma hardware – no PC required. It is recommended that users upgrade their Enigma's firmware to the latest version available (free of charge) from the website ([http://www.stratomaster.eu)](http://www.stratomaster.eu)

The process of recording data

To ensure that data is being recorded to the Enigma.REC file on the SD/MMC Card, check the follow:

1) Ensure that the appropriate size recording file (Enigma.REC) exists on the SD/MMC Card

2) Ensure that the SD/MMC Card is plugged into the unit and mounted (The Enigma Disk Tool is a useful tool to check that the SD/MMC card is mounted and that the Enigma.REC file exists.)

3) Enable data recording and select the data structures to be recorded. The Primary Flight Data (altitude, airspeed, vertical speed, etc) do not need to be selected – if recording is enable, these parameters are automatically included.

4) Ensure that the start and end of flights are being detected (either manually or through automatic flight detect)

The process of capturing data is also simulated in the Enigma Simulator and Display

Designer. The user can set the data recording up in the simulator and test the decoding.

Consult your Stratomaster instrument user manual for more information regarding the setup of on board data recording.

Decoding a REC file

Once the Enigma.REC file has been copied from the SD/MMC Card onto a PC, the flight data can be extracted/decoded into the format of choice. The user will be ask to specify where the Black Box Viewer should find the REC file. The Enigma.REC file can also be renamed once it is located on the PC.

Since the Enigma.REC file is a fixed size binary file, it is not a very efficient longterm PC storage format if, for example, the recording file only contains one or two flights. It is recommended that the individual flights are extracted into the EFL format and the Enigma.REC file are deleted from the PC. Alternatively a compression tool (like WinZip or other) can be used to compress the renamed Enigma.REC files for longterm storage.

Output file formats

Supported Output File Types

The utility currently supports 3 basic file output types:

1) EFL: Enigma Flight Log (single flight MGL REC format file)
2) KML: Keyhole Markup Language / Google Earth
3) CSV: Comma-Separated Value

EFL Files

The basic file used by MGL Avionics software is the Enigma Flight Log (EFL) file. The Enigma Flight Log file is essentially an Enigma Recording (REC) file that contains the data from one flight (unwrapped). The encoding format is exactly the same as for the REC files.

This implies that other third party tools that operate on REC files can also be used to view and translate EFL files into other formats.

The advantage of the EFL file over REC files is that the data integrety has been validated and is significantly smaller in size for longterm use. A REC file is fixed in length. A EFL file only contains valid data. No valid data or accuracy is lost when extracting a REC file into multiple EFL files. Once all of the data has been extracted from a REC file, there is no real value in retaining the REC file.

The default Enigma units (that apply to REC files) also apply to EFL files. The units are fixed.
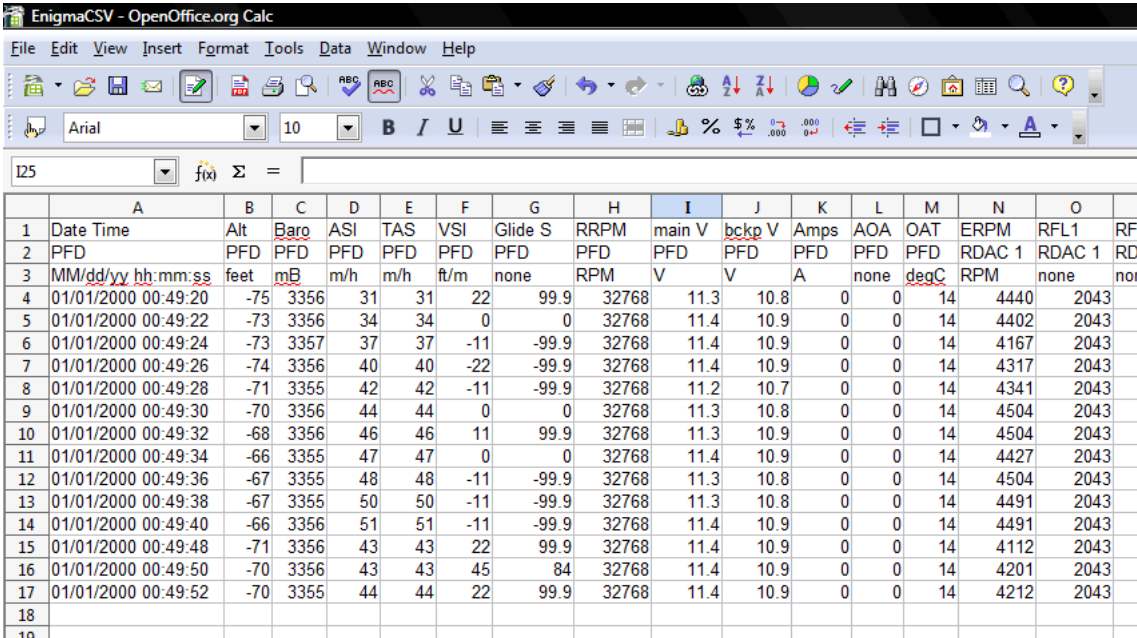
CSV Files

The Comma-Separated Value (CSV) file format is a very commonly found file format. The files can typically be opened using spreadsheet software (like Microsoft Office Excel or OpenOffice.org Calc) or scientific analysis tools (like MathWorks Matlab or GNU Octave).

CSV files use one of three characters to separate the data fields.

1) Comma delimited (most common delimiter)

2) Space delimited

3) Tab delimited

The user can specify which delimiter character to be used.

One of the advantages of the EFL file over a CSV file is that the typical EFL is significantly smaller than the CSV file containing the same data. However, tools like Excel and Calc do not understand the Enigma log file recording format! But EFL (like REC) files can be converted to CSV, KML or other formats.

Figure 2: CSV file opened in OpenOffice.org Calc Spreadsheet

KML / Google Earth Files

Keyhole Markup Language (KML) is an XML-based language for describing 3D geospatial data and the display of this data in application programs. KML was developed for use with Google Earth, which was originally named Keyhole. The Google Earth utility can be download free of charge from:

http://earth.google.com/download-earth.html

The Enigma Black Box Viewer utility can output GPS data into the KML format. Viewing the flight profile using the Google Earth utility serves as a quick reminder when it is difficult to recollect the flight from other data channels.

Important note: GPS data recording needs to be enabled on the Stratomaster unit to be able to create a KML file.
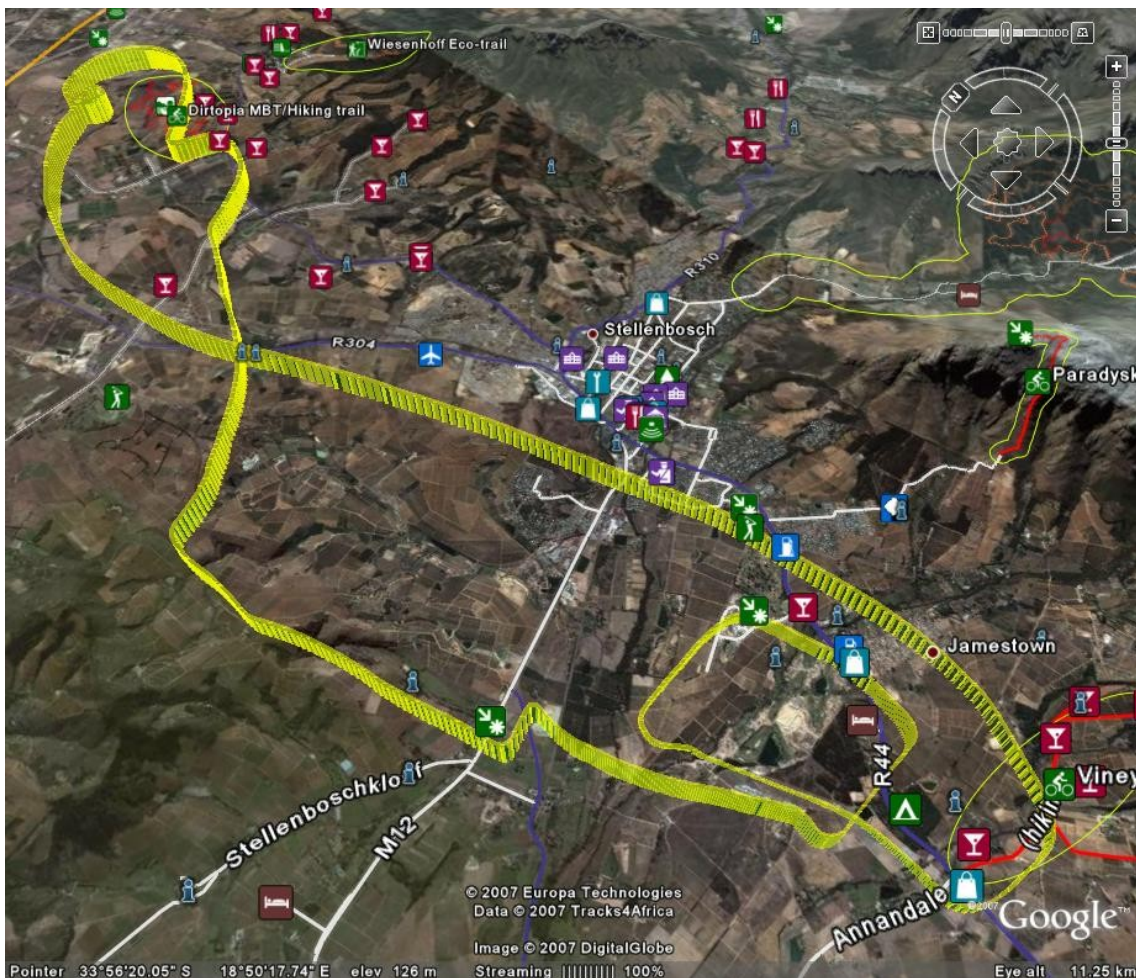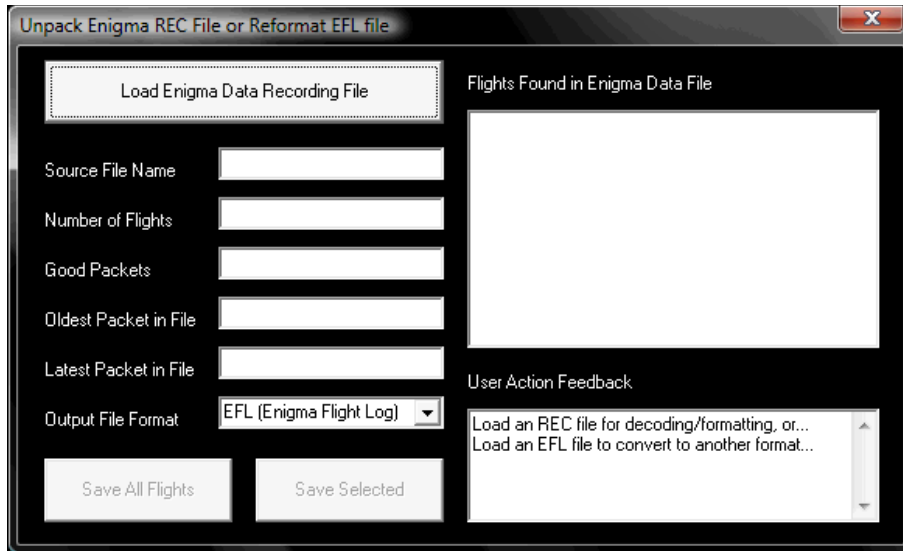

Figure 3: Flight path plotted using Google Earth

Loading a REC file

The first step to decode a recording (REC) file is to load one! Click the button that reads "Load Enigma Data Recording File". All other functions on the form will be disabled until a recording file that contains valid data has been loaded.

Figure 4: Load a recording (REC) or EFL file.

The utility will list all of the flights that have been found in the recording file. The user can then either save a single file or multiple files to the output format of choice. Once the REC file has been decoded, it can be deleted.

Saving files

If the user selects only one file, the utility will ask for a file name for the file to be saved. The name that the user specifies will be the complete file name (other than the extension).

If the user selects more than one file, the utility will ask for the file name. However, this time the name will only be the base for the multiple files to be stored. The utility will concatenate the date and time of each of the selected flights to the selected filename, and save these files to the selected disk space.

To select all files to be saved, a shortcut button exists: "Select All Flights"

Converting from EFL format to another format

The process for converting an EFL file into another format is exactly the same as for an REC file that contains a single flight. Once the EFL file is open, there should one be one flight listed. The user can now select the output format (for example CSV or KML).
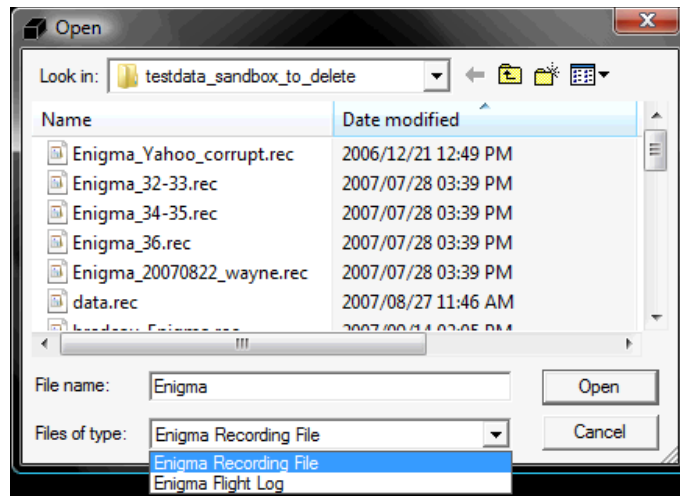
Figure 5: Can select EFL input format filter

Important note: the default file name extension filter type is the REC format. Select the EFL filter to be able to select the desired EFL file.
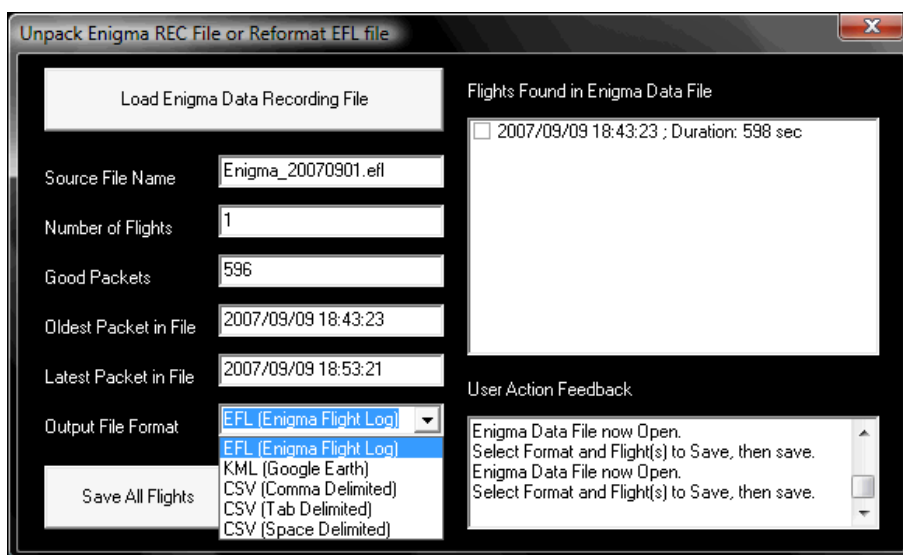

Figure 6: Convert EFL file into another output type

Viewing Enigma Flight Log data

Plotting EFL file data using Black Box Viewer

Only data contained in an EFL file can be viewed using the Black Box series plotting tool. See section 1 on how to generate an EFL file.

To view the content of an EFL file, click the "Plot Single Flight" button. Then select the EFL file to be viewed.
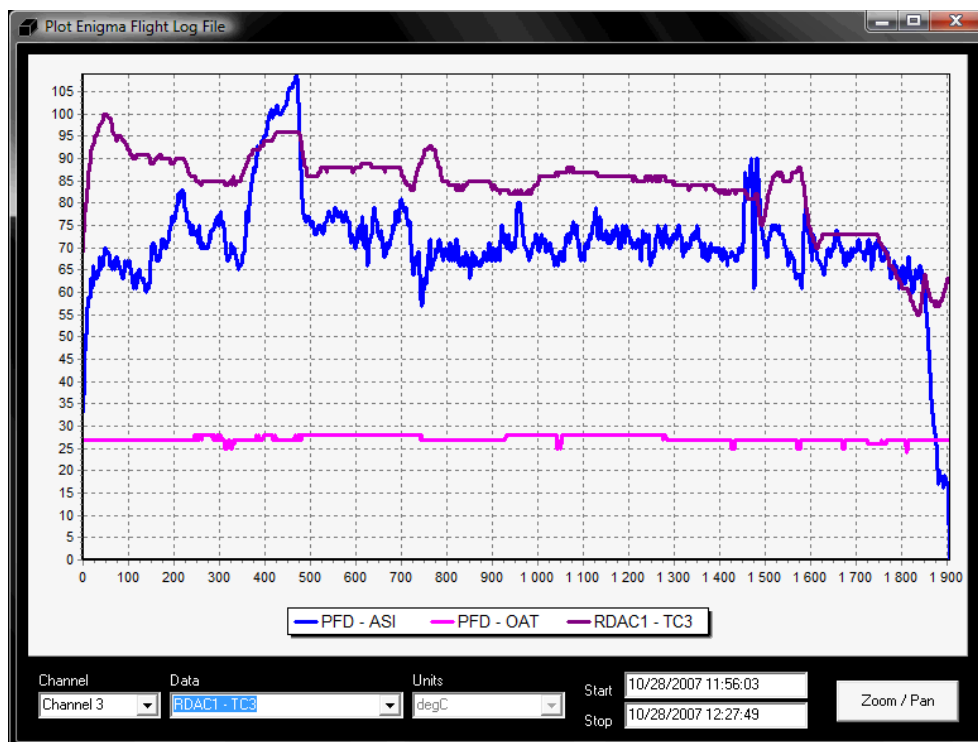
Figure 7: ASI, OAT and CHT1 on the same chart

Adding and removing data to/from the chart

The units for the horizontal/bottom/X axis of the chart is time in seconds since the start of the flight. The time and date stamp of the first and last packet logged during the flight is displayed at the bottom of the chart. Up to 12 channels of data can be displayed simultaneously on the chart. The size of the window can be adjusted to the screen size available.

When the viewer is initialized, channel 1 is automatically selected. To add the first data channel, selected the desired data (using the mouse or up and down cursors). The data will be added to the chart and the legend updated. The units will be displayed in the

inactive drop down list. Future versions will offer the user the option of converting to the desired units. For now, the units are fixed to the native units used by the Stratomaster instruments.

To add a second channel of data, select data channel 2 from the leftmost drop down list. Then select the data to be associated with channel 2 using the data drop down list.

To remove data from the chart, select the channel that you would like to remove. Then select the "None" option from the data drop down list (the last option). You will see the legend being updated and the series removed from the chart.

Only data was recorded during the flight will be available for selection using the data drop down list. If it is not available on the list, it was not recorded!

Controlling Zoom and Pan

To zoom in, move the mouse pointer to the top left corner of the desired chart area, left click and hold the left mouse and, drag to bottom right and release the mouse button.

To zoom out (restore the zoom to the full area), left click and hold the left hand mouse button, and move the mouse cursor towards the top left corner of the chart, and release the mouse button.

To pan (drag) the chart around, right click and hold the mouse right hand mouse button while moving the mouse. The chart will be panned based on the mouse movement. Release the mouse button once the desired panning has been achieved.

Appendix A: Enigma REC and EFL file format

To be added.

Appendix B: List of Acronyms

A/C   aircraft

AC   alternating current

ADC   analog to digital converter

AGL   above ground level

AHRS   attitude and heading reference system

ALT   altitude

AOA   angle of attack

API   application programming interface

ARS   attitude reference system

ASI   airspeed indicator

ASL   above sea level

ATC   air traffic control

CDI   course-deviation indicator / capacitor discharge ignition

CEP   circular error probability

CG   center of gravity

CHT   cylinder head temperature

COM   communications

DA   density altitude

DME   distance measuring equipment

DCDI   Ducati double CDI

EFIS   electronic flight instrument system

EGNOS   European Geostationary Navigation Overlay Service

EGT   exhaust gas temperature

EIS   engine indication system

EPR   engine pressure ratio

ETA   estimated time of arrival

ETD   estimated time of departure

ETE   estimated time en route

FAA	Federal Aviation Administration
FE	fuel endurance
FF	fuel flow
FIR	flight information region
FL	fuel level / flight level
FR	fuel range
FT	flight time
GLS	GPS ILS
GMT	Greenwich Mean Time
GPS	Global Positioning System
GTA	ground track angle
HITS	highway-in-the-sky
HSI	horizontal situation indicator
HUD	head-up display
IFR	instrument flight rules
ILS	instrument landing system
IMC	Instrument meteorological conditions
IMU	inertial measurement unit
INS	inertial navigation system
IOX	Input/Output Extender
ISA	International Standard Atmosphere
MAP	manifold pressure
MHA	minimum holding altitude
MIA	minimum IFR altitudes
MSA	minimum safe altitude
MSL	mean sea level
NMEA	National Marine Electronics Association
NOTAM	notice to airmen
NTC	negative temperature coefficient
NTCA	non-type certified aircraft

OAT	outside air temperature
OM	outer marker
PIC	pilot in command
QNH	Queens Nautical Height / Atmospheric Pressure (Q) at Nautical Height
QNE	1013.25 Mb Altimeter Subscale Setting (ISA)
RDAC	remote data acquisition computer
RPM	revolutions per minute
RTC	real time clock
RTOS	real time operating system
SBAS	Satellite Based Augmentation System (example WAAS and EGNOS)
SP	sensor package
STOL	short take-off and landing
TAE	track angle error
TAS	true airspeed
TC	thermocouple
TCAS	traffic alert and collision avoidance system
TTFF	time to first fix
UTC	Coordinated Universal Time
VFR	visual flight rules
VMC	visual meteorological conditions
VNE	velocity never exceed
VOR	VHF omnidirectional range
VSI	vertical speed indicator
W&B	weight and balance
WAAS	Wide Area Augmentation System
WYPT	waypoint

Sources of acronyms:

http://acronyms.thefreedictionary.com/
http://www.gps.tc.faa.gov/glossary.html
http://www.faa.gov/airports_airtraffic/airports/resources/acronyms/