

# Precision GPS Time Video Overlay Unit



GPSBOXSPRITE3

The precision GPS time video overlay unit is designed to meet the needs of people who require a precision time and date display combined with GPS position. Unlike conventional video time and date generators which base their time on an internal oscillator this unit uses the precision one pulse per second (1PPS) timebase from an integrated GPS receiver to drive its display. In addition to the usual display of time and date each video frame is time stamped with the time in milliseconds since the last UTC second. In this way each frame can be easily referenced to the UTC time generated by the GPS receiver.

## Connecting the unit



Front panel connectors and serial cable

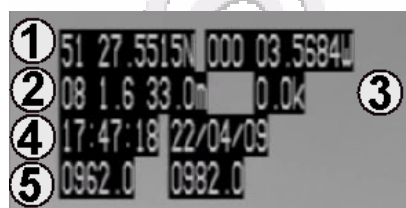
The GPSBOXSPRITE front panel connectors are all clearly labelled. Video in and video out connections should be made before powering the system up. The GPS active antenna supplied should be attached to the connector marked “GPS in” on the front panel. The antenna itself should be situated in a location with a relatively clear view of the sky. If testing the unit indoors this should be at least a window sill, preferably south facing. Optimal positional accuracy will result from the antenna being placed on a metal surface with a clear 360° view of the sky. The output of the 3.5mm jack socket connector labelled “GPS out” is standard NMEA 0183 RS232 serial data. Please note that the 19200 baud rate is non-standard. The format is 8 data bits, no parity, 1 stop bit with a once per second update rate. Only the GPRMC, GPWGA and GPVTG data sentences are transmitted and the unit cannot be configured to transmit any others. This output can be connected to a laptop, PDA or other device that requires GPS data for data logging or satellite navigation by using the female DB9 serial cable supplied. For USB only laptop PCs without a serial port use a USB adapter. The red select button controls the display.

The unit requires a 9 - 12V DC regulated power supply connected via the 2.1mm power connector at the top left of the unit. Press the power button below the power connector to switch the unit on or off.

**WARNING!** It is important to ensure correct connection of the video text overlay unit to the power supply or battery. Failure to observe correct power supply connection polarity may result in the electronic failure of the unit or in the battery bursting to cause personal injury and damage. The power supply must have a regulated output. Connection to a non-regulated power supply, in particular direct connection to the cigar lighter socket of a vehicle, can cause the unit to fail. Your warranty is void in such a case.

## Operating the Precision GPS Time Overlay

When the precision GPS time overlay is switched on the display will appear after approximately 5 seconds. Initially, when the unit does not have a valid GPS fix, the display will show the message "GPS BAD" and the frame times. The time taken by the unit to achieve a valid GPS fix depends on a number of factors including the time and distance moved since the unit was last powered, antenna placement and satellite visibility. In the worst case with visible satellites, but no internal data, the time to first fix will be approximately 5 minutes and it will take a further 16 minutes for the time data to be valid. We recommend that you allow a minimum of 21 minutes after setting up the unit before accepting the time as valid. Allowing as long a set up time as possible is advised. When a valid fix is achieved the "GPS BAD" message will be replaced by the GPS data and time as previously selected.



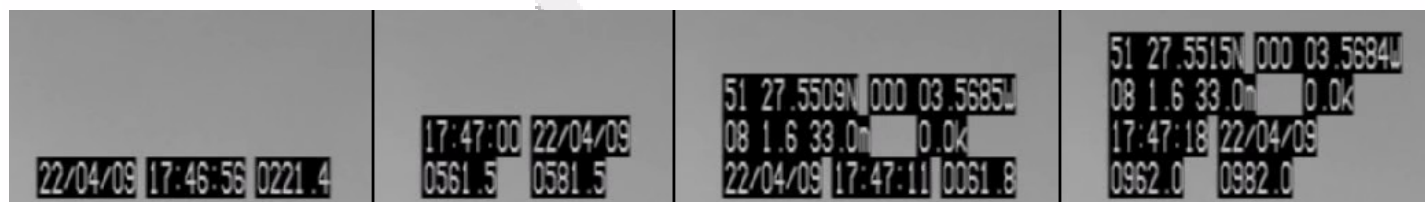
### GPS Display data types

- 1 Latitude and Longitude (datum WGS84)
- 2 Number of satellites in view, horizontal dilution of precision (HDOP) & altitude in metres
- 3 Speed over ground in kilometres per hour
- 4 UTC time and date
- 5 Time in milliseconds from the last 1PPS signal to the current frame / field VSYNC

The higher the number of satellites in view and the lower the value of HDOP, the better the GPS fix. Four satellites are the minimum required. HDOP should be less than 3.0. These values will vary, becoming better over time as the GPS receiver develops a better solution for the position fix. The unit will not register position changes where the speed of movement is less than 4.3mph or 6.9kph.

While the unit has a fix the display can be switched between one, two, three or four lines by pressing and holding the unit's red select button. Please note that the button must be pressed and held, not simply pressed. The background setting will also be toggled on / off after each complete cycle through the four displays.

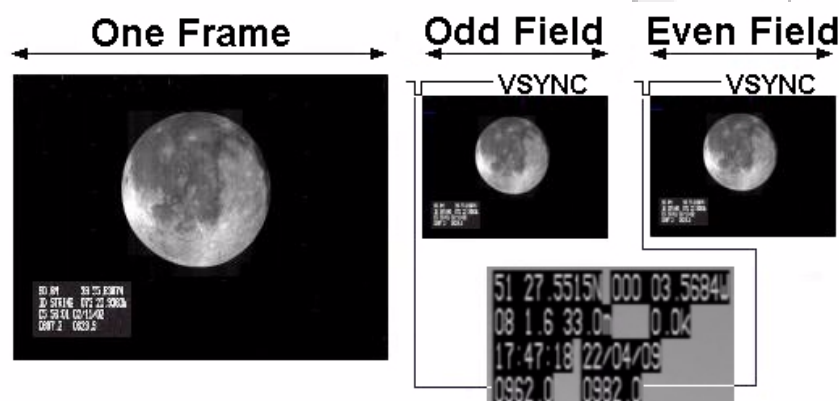
If the external video is removed, the unit will generate its own blue screen background. The message "NO VIDEO" will be replace the data display until video is reconnected.



The display can be switched between 1, 2, 3, & 4 lines using the select button.

## Understanding the time display

A camera's composite video signal is composed of a series of frames. Each frame is made up of two fields which are interlaced when the video signal is displayed. Each field is effectively the exposure snap shot made by the camera. After a field has been exposed it is transmitted as part of the composite video signal. At the start of the transmission of each field the camera generates a vertical synchronisation signal, VSYNC. The precision time video overlay marks each field with the precise UTC time at which this signal occurs. This time is derived from the 1PPS signal and NMEA data provided by the unit's GPS receiver. The correct UTC time is provided by the NMEA data, advanced on the UTC second by the 1PPS. A 10 kHz oscillator drives a counter which is reset by each 1PPS signal. This counter provides the millisecond count which is latched by each VSYNC to give the field time since the last 1PPS. As the 10 kHz oscillator is not locked to the 1PPS signal the millisecond count is accurate to  $\pm 0.1$  milliseconds over each second. As an error check the lead character of the millisecond count is should always be zero. If it is not this indicates that the 1PPS signal is not being generated or is unstable.



For PAL video signals there are 25 frames and 50 fields per second. The interval between frames is therefore 40 milliseconds, between fields 20 milliseconds. For NTSC video signals the intervals are 33.3 milliseconds and 16.7 milliseconds respectively. Not all video recording equipment will allow the display of each individual field in playback. Some recorders will display each interlaced frame, others only one field from each successive frame. When stepping through a recording made with the precision time overlay,

the known frame / field interval time will tell you the resolution of your recording and provide a simple check on the accuracy of the system.

The bottom line of the two line and four line display shows the time in milliseconds from the last 1PPS signal for each field in the frame. The odd field time is shown on the left, the even field time on the right. The difference between the two displayed times will always be the field interval time. The higher time will be the VSYNC time at which the field was transmitted from the camera, the lower time from the previous field. These two times bracket the interval during which the camera exposure will have taken place. If your recorder displays each individual field then the higher field time will alternate from left to right, advancing by the field interval. If your recorder displays only one field from each frame the field times will maintain the same relationship, each advancing by the frame interval with each step. When an interlaced frame is displayed, one of the field times will appear corrupted. The uncorrupted time is the start of transmission of the first field in the frame and the start of exposure of the second frame. It therefore represents the mid point of the frame.

When the one or three line display is selected, only one field time is displayed. This represents the start of transmission of the field from the camera. Subtract the field time interval from the displayed time to get the nominal start of exposure.

### **Timing Accuracy and Suitability**

It is important to ensure that the GPS receiver has time, at least 21 minutes, to establish a valid fix prior the start of any timing. The longer the unit has to establish a position fix the more accurate the fix will be. The 1PPS signal is specified accurate to within 1  $\mu$ s of UTC as long as the GPS receiver has reported a valid and accurate fix for at least the previous 4 seconds. Under these conditions the time displayed is accurate to  $\pm 0.1$  milliseconds. Although the GPS receiver will continue to output the 1PPS signal when its position fix is lost, its performance when there is no position fix is not specified. Due to changes in satellite configuration and signal reception the GPS receiver can produce invalid NMEA data or in some cases fail to provide a 1PPS. In such cases the time displayed by the precision GPS time overlay unit will be incorrect for as long as this error condition continues.

Some error conditions may cause the time display to halt for a period of 1 - 2 seconds before correctly updating. It is therefore important to review critical sections of any timing record to ensure that the time updates consistently. The millisecond count over each second allows the 1PPS second duration to be verified at the same time as the frame / field interval of the video signal allows the millisecond count to be verified when any recording is reviewed. Therefore any application must include an examination of the recorded timings immediately prior to an event to ensure the event time is valid. The precision GPS time overlay is not suitable if you need to simply read the time off the screen rather than reviewing a recording. Please ensure you are aware of the limitations of the GPS system.

The UTC time and date are taken from the NMEA data sentences. If invalid GPS data is indicated by the data sentence's quality markers then the display of time and data is cleared and the message "GPS BAD" is displayed until good data is received again. The time and date display is advanced by the 1PPS signal. If no 1PPS signal is present or it is out of sequence with the rest of the data, the time and date will be cleared to read 00:00:00 01/01/01, regardless of the NMEA data input. The time and date will be reset to the correct UTC time when the 1PPS and NMEA data are correct.

### **GPSBOXSPRITE Precision GPS time video overlay unit.**

Compatible with colour and mono composite video signals. 1Vp-p. PAL or NTSC\*

Dimensions 110 x 110 x 45mm LxWxH

Power supply 9 - 12DC regulated

Power consumption 200mA with antenna

Operating Temp. 0° - 85°C

\*By default the unit will be supplied compatible with the video standard of the country from which you make your order.

### **Integral GPS receiver**

Ublox NEO-6M

50 parallel channels

Position Accuracy to 10m

Active antenna with 3m cable

Datum WGS84

### **WARRANTY**

The BlackBoxCamera™ Company Ltd. warrants its products to be free of defects in materials and workmanship under normal use and service for a period of twelve months from the date of original purchase. The obligations of The BlackBoxCamera™ Company shall be limited within the warranty period, at its option, to repair or replace the product or any part thereof. The company shall not be responsible for dismantling and/or installation charges. To exercise the warranty the product must be returned carriage paid and insured. Under this limited warranty the maximum liability of The BlackBoxCamera™ Company shall not in any case exceed the purchase price of the product, which shall be fixed as liquidated damages and not as a penalty, and shall be the complete and exclusive remedy against The BlackBoxCamera™ Company. **This warranty does not apply in the following cases:** Improper installation, misuse, failure to follow installation and operating instructions, alteration, abuse, accident or tampering, and repair by anyone other than The BlackBoxCamera™ Company.

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