

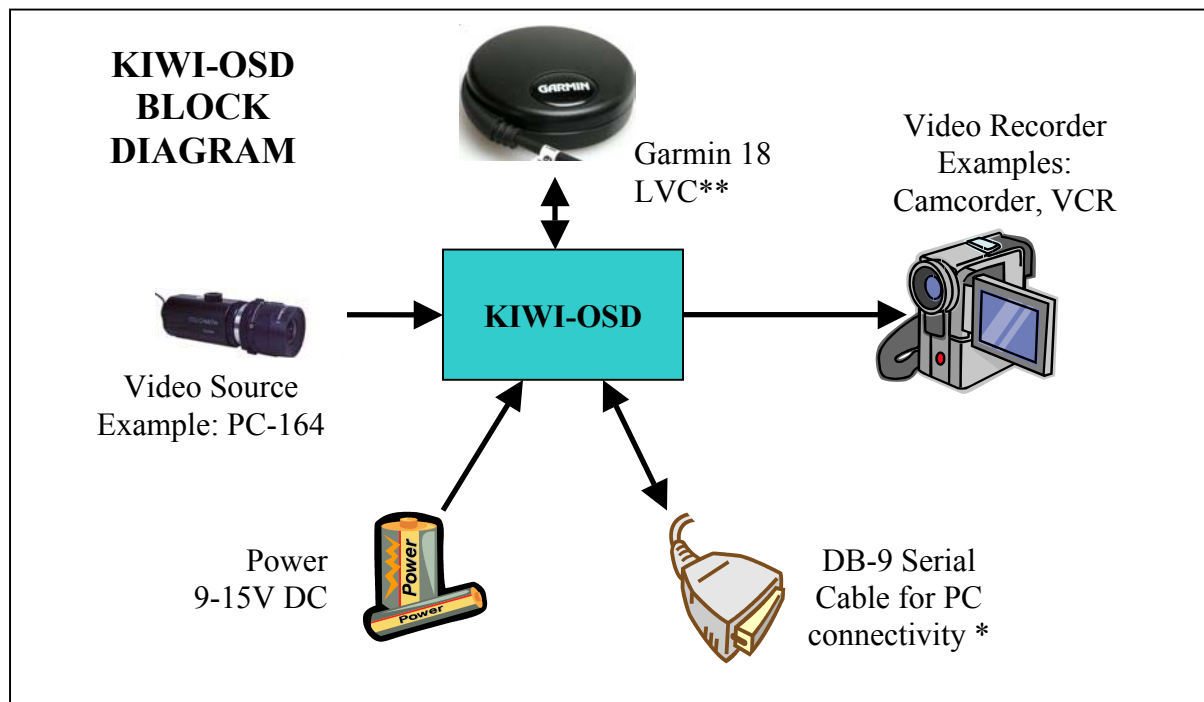
# KIWI-OSD USERS MANUAL

PFD Systems, LLC  
5900 Rudyard Dr  
Bethesda, MD 20814-2234  
kiwiosd@pfdsystems.com

This document describes how to setup and use a KIWI-OSD video time inserter. To borrow from a cliché; it is easier to hook up and use than a VCR! Ironically, you may want to use a VCR to record events that you time using the KIWI-OSD, so you will also be required to understand the operation of your VCR as well.

Humor aside, the KIWI-OSD is very easy to use, especially for those with previous experience with other models of video time inserters.

Below is a block diagram showing how various components connect to a KIWI-OSD.



\* Not needed for normal operation

\*\* The only model of GPS currently supported by PFD Systems.

## Identifying the KIWI-OSD Version

Look at the photo to the right. If the side of the KIWI-OSD has a small white plug, then your KIWI-OSD is version 41, if not, then it is a version 40. The differences are slight between the two versions and those differences are discussed below where appropriate. The yellow button is the “info” button, common to all KIWI-OSDs.

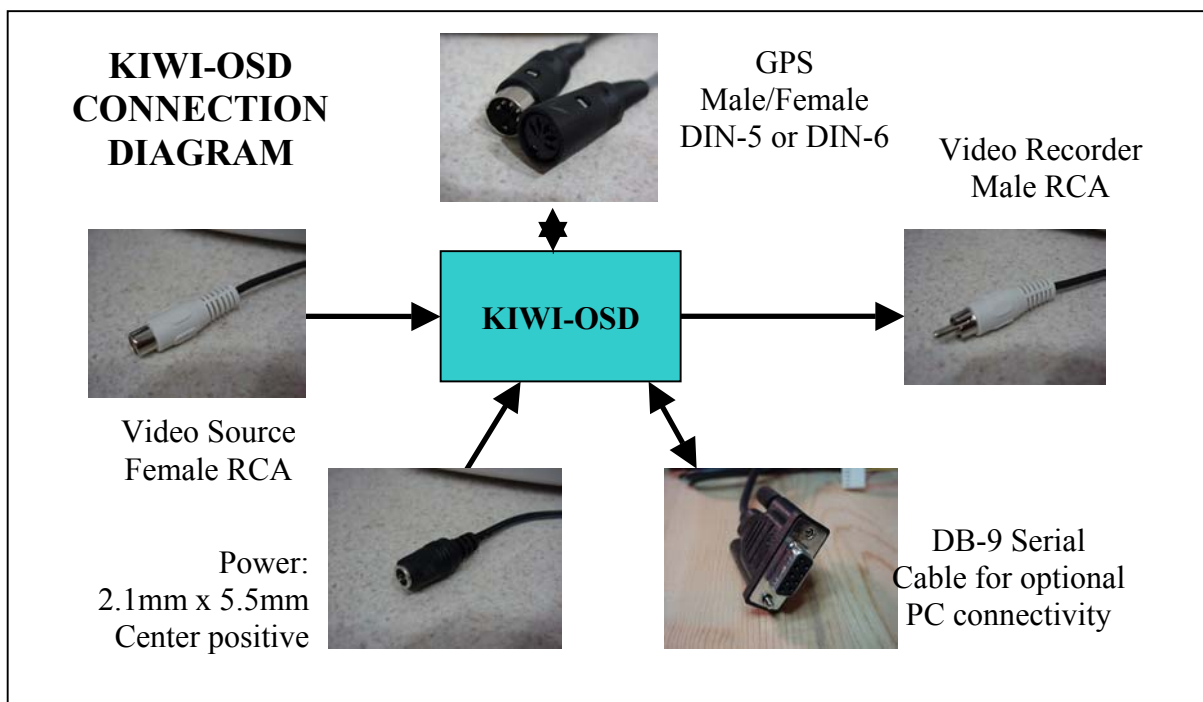


## KIWI-OSD Quick Start Connection Guide

If you already have a KIWI-OSD and a KIWI-GPS, follow the quick steps below to get them up and running. The diagrams below shows the cables and connectors that are used to connect the camera, recording device, power, and the GPS to the KIWI-OSD.

If the KIWI-OSD has cables, refer to the diagram directly below. The diagram for the new KIWI-OSD-2 “cable-less” model is shown below that.

### Connection Diagram for any model KIWI-OSD with a cable



## Connection Diagram for a “cable-less” KIWI-OSD-2 model



The following steps apply to all versions of the KIWI-OSD (with differences noted).

1. Camera: Attach an NTSC, PAL, SECAM, or MESECAM video source to the:
  - Female RCA cable (all models with cables)
  - Red RCA jack (labeled “C” on the KIWI-OSD. Reference “Camera” on the above diagram for the V41 KIWI-OSD-2 model)

*Note: an interface adapter might be required to convert the output connector from your video camera to the RCA cable or jack.*
2. Attach a respective video recorder (must match the format of the video source) to the
  - Male RCA cable (all models with cables)
  - Black RCA jack (labeled “R” on the KIWI-OSD. Reference “Recorder” on the above diagram for the V41 KIWI-OSD-2 model)

Hint: It is a good idea to monitor what is being recorded. If using a camcorder, then use the built-in preview screen or attach a small TV monitor to the video “out” of your recording device.

*Note: an interface adapter might be required to convert the input connector on the recording device to an RCA jack or cable.*

3. Connect a power supply (9V DC to 15V DC, 12V DC recommended) to the:

- Power cable with the barrel jack (all models with cables)
- The jack labeled “Power” on the above diagram (V41 KIWI-OSD-2 model)

The power cable must be “center positive” and it’s size must be 2.1mm x 5.5mm.

Once power is applied the message “KIWI OSD V3 FIX WAIT” will be visible on the bottom of the video screen. The message "RS232 OR 1PPS ABSENT" may appear after a few seconds. The red LED inside the KIWI-OSD may/may not be illuminated.

4. Attach the KIWI-GPS (with male DIN-5 connector) to the KIWI-OSD by means of the:

- Cable with the Female DIN-5 connector (all models with cables)
- The connector labeled “GPS” on the above diagram (V41 KIWI-OSD-2 model)

The red LED may flash and then go dark. The message on the screen may change to "RS232 OR 1PPS ABSENT" and will remain that way until a good “fix” is acquired by the GPS.

5. Place the GPS where it can “see” the sky clearly, but keep it near the observing site (for accurate geo-coordinates). The GPS receiver requires a clear view of the sky in order to communicate with satellites. Placing the GPS on the tray under your telescope is not recommended.

*Note: the base of the KIWI-GPS is magnetic so be careful placing it on or near magnetic sensitive devices such as 3 ½” diskettes or external hard drives.*

6. Now WAIT! It might take five or more minutes for the GPS to acquire enough satellites to get a valid “fix” although this time will be shorter if you have recently acquired a “fix” beforehand. Once the GPS has acquired a “fix”, the red LED in the KIWI-OSD will begin to flash once a second. The message on the screen will immediately display the latitude and longitude of the observing site followed by another message that displays additional GPS information including the elevation (see the “GPS Details” section for a detailed explanation of this information). Next a message that displays the UTC date is shown and finally a series of messages will cycle starting with “KIWI OSD V3 FIX WAIT 1” through “9”. After that, the unit will begin to display the running UTC time along with the millisecond time-stamps that represent the beginning and end of the

optical exposure. On the lower right is the field counter incrementing 59.94 times a second for NTSC, or 50 times a second for PAL.

7. Leave the KIWI-OSD running until the event(s) are recorded. After you have finished the timing run, press the "info" (square yellow) button. This requests that the KIWI-OSD wait for the first valid GPS fix – at which time it compares its internal clock to the GPS. If they agree, a message "PREVIOUS TIMES OK" is displayed on screen. If GPS does not agree, "ERROR: USE FIELD COUNT" is displayed, alerting the user that there has been a previous GPS glitch, and to use the video field count to extract timing information. Pressing the "info" button again after reading the above summary, gives the KIWI-OSD chip a RESET, and so another timing run is started beginning with the GPS information.
8. Once your timing run is completed, disconnect the KIWI-OSD from the power supply, unplug the video source and video recording devices, and unplug the GPS unit.

Interpreting the results of a recording run is described in another section below.

## Detailed Description of the External Device Connections

There are only four connections required to get the KIWI-OSD up and running. There is also one other connector, a DB-9 RS-232 serial cable that isn't needed for normal operation but is available as a pass-thru between the GPS and a computer. It is also used to configure the GPS, if necessary. See the section below, "DB-9 Serial Cable" for further information.

*Note: Beginning with version 41, all KIWI-OSDs are shipped without an attached Serial Cable. A small notch in the side of the box is provided allow the Serial Cable to be attached if it becomes necessary or desirable to do so. Details on how to connect the Serial Cable to the KIWI-OSD are described in a section below.*

The four required connections are as follows:

- A video source (NTSC, PAL, SECAM, or MESECAM), such as a video camera
- A video recording device (NTSC, PAL, SECAM, or MESECAM), such as a VCR or camcorder.
- A Garmin 18 LVC GPS unit (only the Garmin 18 LVC model is recommended for use with the KIWI-OSD)
- A 9V-15V DC power source.

### Video Source

The KIWI-OSD can operate with a NTSC, PAL, SECAM, or MESECAM video source. The only caveat is that the "video out" recording device must match the "video in" device. So, NTSC-



PAL or PAL-NTSC is not allowed. The KIWI-OSD will NOT do a conversion.

The video source attaches to the KIWI-OSD by way of the Female RCA cable (for KIWI-OSD models with cables) or by plugging the video source cable into the red RCA jack (on the KIWI-OSD-2 model).

*Note: Some video source devices might use a different connector or different gendered cable that isn't directly compatible with the KIWI-OSD. In these cases, a suitable adapter must be used. A couple of such adapters are available on the KIWI-OSD web site. They convert BNC camera connectors (common on commercially available video cameras) to RCA plugs or jacks. As with most video equipment, the center pin of the connector carries the signal while the outer portion of the connector is the ground.*

## Video Output

The video output from the KIWI-OSD is provided through the male RCA cable (for those KIWI-OSD models with cables) or via the black RCA jack (on the KIWI-OSD-2 model). The KIWI-OSD can be plugged directly into a video recording device, such as a video camcorder or a VCR. As with the video source cable, the output signal is carried on the center pin while the outer casing is ground. A suitable adapter or "extension" cable may be required to connect to your specific video recording device.



## GPS Interface

All models of the KIWI-OSD are wired with either a DIN-5 cable or connector (depending on the model) that is directly plug-and-play compatible with the KIWI-GPS unit that is available from PFD Systems. Connect the KIWI-OSD and the KIWI-GPS by mating the two DIN-5 connectors together.



## Power Supply

The KIWI-OSD requires a direct current (DC) power supply operating between 9V-15V (12V



recommended). The current requirements of the KIWI-OSD are very small. Without a GPS attached the KIWI-OSD draws ~15ma while with the KIWI-GPS attached ~70ma. A battery pack made from 6 D-cells is a suitable power source as can a rechargeable 9.6V or 12V





DC power pack. The power cable of the KIWI-OSD requires an industry standard 2.1mm x 5.5mm barrel connector with a center positive pin (see image on the left). Many wall transformers (AC to DC adapters) use this configuration and may be used with the KIWI-OSD. PFD Systems offers a suitable 120V AC to 12V DC adapter on the KIWI-OSD web site. Users in countries where the power is not 120V AC should use the battery option or obtain a suitable AC/DC adapter locally. The power plug connects into the barrel connector (on KIWI-OSD models with cables) or into the power jack (on the KIWI-OSD-2 model).

*Note: although the KIWI-OSD is designed to prevent a reverse polarity condition from damaging the unit, please insure that the proper voltage and current requirements are met.*

## DB-9 Serial Cable

KIWI-OSD models are equipped with a serial cable that provides the means for the GPS to communicate with a Personal Computer (PC).

*Important Note: that if you plan to attach the GPS to a PC you will also have to provide power to the KIWI-OSD unit as the GPS is not a static device and requires a power source.*



For normal operations of the KIWI-OSD the serial cable is not needed.

Version 40 models of the KIWI-OSD ship with a hard-wired Serial cable. This cable is removable on version 41 models and is shipped disconnected. Instructions on how to attach the Serial cable on version 41 models of the KIWI-OSD follow.

## Attaching/Un-attaching the Serial Cable on Version 41 Models of the KIWI-OSD

Locate the Serial cable and note the strain relief. It has a groove that slides into the slot on the KIWI-OSD enclosure.



Remove the translucent cover of the enclosure using a small Phillips head screwdriver. Retain the screws.

Locate the white hole plug and slide it up and off of the enclosure.

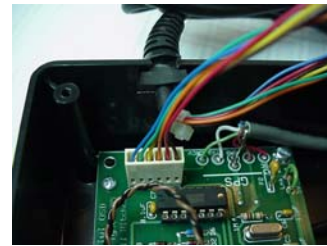


Slide the Serial cable down into the slot in the enclosure making sure that the flat portion of the strain relief is facing upward and is oriented horizontal with the top of the enclosure.



*Note: the strain relief will not be at the top of the enclosure but will be recessed down slightly to allow the translucent cover to fit properly on the KIWI-OSD enclosure.*

Engage the end of the Serial cable onto the Molex connector inside the enclosure just below the strain relief. The connector is keyed and can only be inserted one way.



Replace the translucent lid on the enclosure and secure with the previously removed screws. Be sure not to over tighten the screws.

The Serial cable is now ready to attach to your computer.

To remove the Serial cable, reverse the procedure, ending with reinserting the white hole plug as the last step.



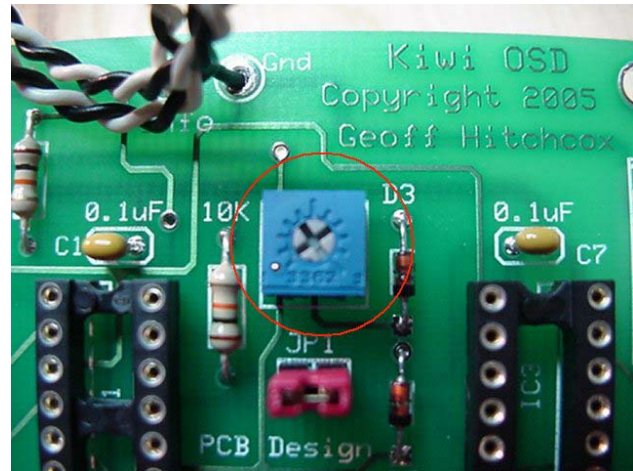


## KIWI-OSD Configuration Settings

There are two or three configuration settings for the KIWI-OSD (depending on version) and they only need to be done once (under normal conditions). They are:

- Video Intensity Setting (factory set to minimum intensity)
- 1PPS Edge Detection jumper (factory set to work with the KIWI-GPS)
- Translucent Text Background jumper (factory set to disabled) and only available on version 41 models of the KIWI-OSD

**Video Intensity Setting.** The Video intensity setting is factory set to its lowest setting. This setting is the safest setting since it does not create an over-saturation condition on the video out signal. Unless directed by a technician at PFD Systems, do not adjust this setting. A change to the setting is made by way of a potentiometer on the PCB inside the KIWI-OSD. The photo to the right shows the position of the potentiometer on the PCB. Turning the pot clockwise increases the overlay brightness; counter-clockwise reduces the brightness.



**1PPS Edge Detection.** The use of this jumper is to control the behavior of how the KIWI-OSD responds to the 1PPS signal coming from the GPS. If the 1PPS signal generates a LOW to HIGH pulse, then the jumper must be in place, if the GPS generates a HIGH to LOW pulse, then the jumper must be removed. The Garmin 18 LVC that ships from PFD Systems generates a LOW to HIGH pulse and therefore the jumper must be in place for proper operation with this GPS. The Garmin 16 LVS and HVS units also generate a LOW to HIGH pulse, as an example.

**Translucent Text Background.** This new feature is only available in version 41 models of the KIWI-OSD. The default setting is to behave the same as in the original version 40 models of the KIWI-OSD. The photos on the right show the jumper (JP2) disabled (top photo) and enabled (bottom photo). To enable this feature, the red jumper must cover BOTH pins.



When enabled, the area behind the text is darker, thus making it easier to read against a bright image such as the full moon.

*Note: Use this option with care since it has been shown to prevent the video signal from locking properly with some video monitor. This has only been reported on one piece of equipment, but it is mentioned here as a disclaimer.*

## Sharing one GPS with more than one KIWI-OSD

One feature of the KIWI-OSD is its ability to continue timing even if the signal from the GPS is lost. This feature can be extended to allow multiple KIWI-OSDs to share one GPS unit.

To use this feature, a user would connect their video equipment and the GPS to their first observing station and start recording until the KIWI-OSD displays the relevant data (position, altitude, GPS quality and date) and then the UTC time on the screen. At this time the GPS can be removed.

This will cause the UTC time on the video to freeze; however the "field counter" (derived from the video camera quartz crystal) now becomes the "clock" as it continues accurately counting.

The same process is then applied to the 2nd station, the video gear and GPS are attached to the KIWI-OSD and the as above - then remove the GPS.

This process can be repeated for each additional station. On the last station, the GPS unit does not need to be removed.

When reviewing tapes 1 and 2, you will need to do a bit of simple math to recover the true UTC time (described in a section below). Once the cameras have been calibrated (can be done afterwards), you can do precision timing (to the millisecond) even though no GPS receiver was present at the time of the event.

## Interpreting the Results

For now we refer you to the definitive work on this topic. It is located at:

[http://www.geocities.com/kiwi\\_36\\_nz/kiwi\\_osd/example.htm](http://www.geocities.com/kiwi_36_nz/kiwi_osd/example.htm)

At some point in the future the information there will be republished here.

## GPS Details

The GPS of choice for use with the KIWI-OSD is the Garmin 18 LVC. For information why this model (alone) is the GPS of choice, please refer to the following web page:

[http://www.geocities.com/kiwi\\_36\\_nz/kiwi\\_osd/kiwi\\_osd.htm](http://www.geocities.com/kiwi_36_nz/kiwi_osd/kiwi_osd.htm)



Specifications of the GPS can be found here:

<http://www.garmin.com/products/gps18oem/spec.html>

## GPS Configuration

If you purchase a KIWI-GPS (Garmin 18 LVC) from PFD Systems, it is shipped pre-configured for use with a KIWI-OSD. The GPS stores configuration information that is modifiable using a Windows utility available from Garmin. This utility can read and write information to/from the GPS. A copy of the configuration file that is used to configure the Garmin 18 LVC GPS is located on the KIWI-OSD web page. The utility can be downloaded from Garmin at the following location:

<http://www.garmin.com/support/collection.jsp?product=010-00321-05>

This software only works with the Garmin OEM line of GPSs.

*Note: any modifications to the GPS configuration may result in the KIWI-OSD not working properly or not working at all. This information is given in the case where existing customers may need to modify the GPS software under the recommendation of PFD Systems.*

## Calculating Your Camera's Field Rate

To make use of the backup timing system of the KIWI-OSD, we need to know the 'field rate' of the camera as accurate as possible. This is easily achieved to parts per million, using the method describe below. At this level of precision, we are measuring below the temperature coefficient of the camera quartz crystal - so make sure the temperature you measure at is similar to the temperature it will be used at.

To get to parts per million, we need to time the camera for at least 1 million milliseconds (approx 17 minutes). Set up the KIWI-OSD and record the screen for about 17 minutes. Stop the recording and play back the final few seconds and write down the ending UTC time of the last field and the field number. Rewind the tape back to the beginning and note the starting UTC time of the first field (when the field counter is 1).

We now use the formula:

$$\text{Field Rate} = (\text{Ending Field Count} - \text{Starting Field Count}) / (\text{End Time} - \text{Start Time})$$

Here is an example:

Temperature: 22C

Camera: PC164C

<b>TIME</b>	<b>FIELD COUNT</b>	<b>COMMENTS</b>
09:36:53.239	65470	after approximately 18 minutes of recording
09:18:41.004	00001	Initial reference start time
=====		
00:18:12.235	65469	Diff = 1,092.235 seconds

Field rate = 65,469 / 1,092.235 = 59.940397 fields per second.

This number, (59.9404) can be whenever the same PC164C camera is operated at approximately the same temperature reading.

Although a single (at one temperature) 'camera rate' is often good enough, to gain an insight into the behavior of the camera quartz crystal with respect temperature - the following extra tests are recommended.

Do the same timing runs at different temperatures and calculate the field rate for each. See the following table as an example.

TEMPERTURE	FIELD RATE (fields per second)	PPM COMPARED TO NTSC (59.94) (parts per million)	PPM COMPARED TO REFERENCE TEMPERTURE (22C) (parts per million)
11C ( 51.8F)	59.940393	6.55 ppm fast	-0.08
22C ( 71.6F)	59.940397	6.63 ppm fast	0.00
44C (111.2F)	59.940432	7.20 ppm fast	+0.57

These results tell us much about the quartz crystal in the PC164C camera - it is a perfect 'AT' cut quartz crystal with extremely low frequency change over normal temperatures.

For a detailed understanding of the camera's temperature coefficient, you should make 3 measurements centered on 25C (77F) which is the inflection point of an 'AT' cut quartz crystal. Then repeat the measurements 10C (59F) above and below 25C (95F). Using the procedure above, you can use the difference in ppm numbers to determine the 'delta angle' your crystal is cut to, by referring to the diagram located at:

<http://www.ecliptek.com/crystals/glossary.html>

The curve that best matches your 3 readings can be used to predict the temperature behavior of the camera.

The above example is for a NTSC camera, the same method can be used for a PAL camera - except the field rate should be very close to 50.000 fields per second.

### **Calculating your Camera's Personal Equation (PE)**

The following procedure allows you to determine that the KIWI-OSD timestamps do correctly relate to referenced optical events.

On the circuit board of KIWI-OSD there is a LED that flashes once per second. This is driven directly from the 1PPS signal from the GPS, so the instant it turns ON is the beginning of a new UTC second (accurate to a millionth of a second). A normal CCD camera takes 2 fields to process an image, the first field is where the photons are collected and integrated over 17mS (20mS for PAL). Just before the end of this first field, electrons (converted from photons) are quickly transferred to a memory storage area in the camera. It is during the "next" field that the electrons contained in the memory are read out at the normal video rate to display or record.

To test that your camera behaves in the above-mentioned way, make a short recording of the LED flashing, along with timestamps from KIWI-OSD. On replay of the video, determine what time the LED first comes on. For a conventional video camera you should get a time that is within 10mS of a "second" changing. This will show you that the KIWI-OSD is correctly "time stamping" your camera, by using a known referenced optical event.

## Using Other GPS Models

We recommend only using a Garmin 18 (must be LVC model). The Garmin 18 LVC is the only GPS model that is available from PFD Systems.

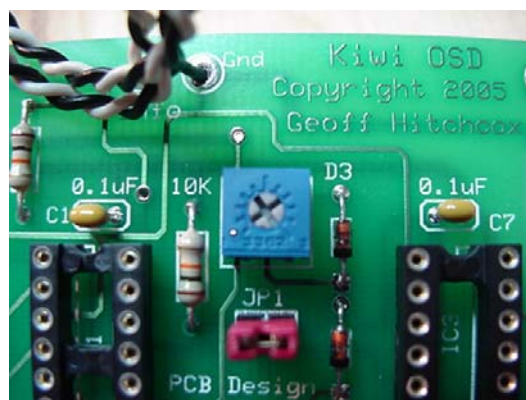
Other models have been tested and work with the KIWI-OSD but all suffer to some degree with problems and limitations.

The KIWI-OSD has been tested with a Trimble SV6 module (in NMEA mode) and the Motorola GT+. The KIWI-OSD will also detect the current known problems with the Garmin 16 and Garmin 35 issues.

The KIWI-OSD design is such that "nearly" any GPS with 4800 NMEA and 1PPS can be used. The order of the NMEA sentences does not matter. It will operate with just the GGA sentence being present (as in older TRIMBLE modules). If the RMC sentence is missing, it just means there is no date shown. The code also handles GGA sentences that use fractional seconds (as in the case of Motorola and Evermore chipsets).

*Please Note: There are GPS's that should NOT be used for doing timing in NMEA mode (even though they may have very good specifications)!*

Because the NMEA standard allows for variable length data, the KIWI-OSD allows for this - so latitude and longitude is displayed to whatever resolution the GPS transmits. This also applies to the display of number of satellites used, HDOP (Horizontal Dilution of Precision) and height data.



HINT: Reducing the number of sentences to the bare minimum (GGA and RMC only) improves the timing quality of the GPS over having all NMEA sentences enabled.

Because the software requires 10 self-consistent times from the GPS, the code does not use the NMEA checksum, so the checksum can either be present or not, and not affect the KIWI-OSD.

Which edge of the 1PPS is aligned to UTC, can be selected allowing either LOW to HIGH (most common) or HIGH to LOW (less common) as the 1PPS reference for timing.

The KIWI-OSD comes configured in the LOW to HIGH (jumper enabled) to work with the Garmin 18 LVC. The photo on the right shows the JP1 selection block, located just below the blue potentiometer with the red jumper in place. If another GPS is used that requires the HIGH to LOW edge detection then the jumper should be removed.



## Terms & Definitions

TERM	DESCRIPTION
GPS	Global Positioning Satellite. Usually refers to the receivers used on the ground.
PCB	Printed Circuit Board. A thin board to which electronic components are fixed by solder.