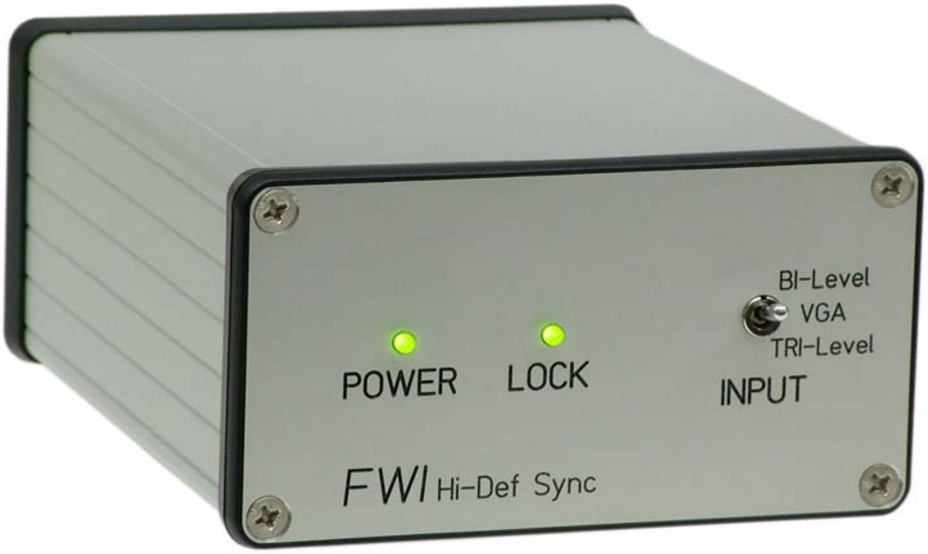
Users Manual – FWI HiDef Sync Stripper



- Allows "legacy" motion control and film synchronizing equipment to work with modern HDTV cameras and monitors providing Tri-Level sync signals.

- Generates a film-camera type sync from virtually all Composite, Component, HDTV and VGA video formats...

  Tri-Level
  - 720P (59.97/60)
  - 1080I (24 / 25 / 29.97 / 30 / 48 / 50 / 59.97 / 60)
  - 1080P (24 / 25 / 29.97 / 30 / 50 / 59.97 / 60)

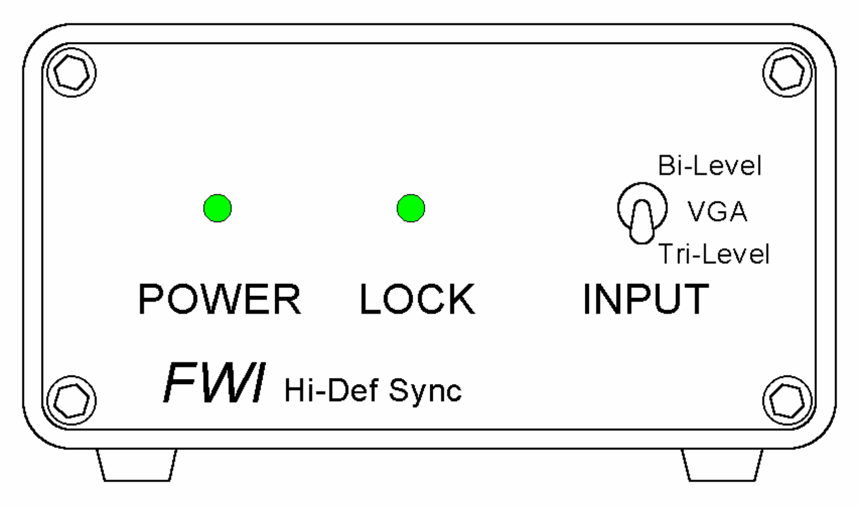
  Bi-Level
  - 525 NTSC / 625 PAL / 625 SECAM (comp*, YC*, Y/Pb/Pr , R, G+S, B)
  - 480I EDTV (24 / 25 / 29.97 30)
  - 480P EDTV (59.97/60)
  - 576P (50)

  VGA
  - Most standards below 115Khz line rate

- Equipped with a universal 100-240V power supply for operation anywhere.

- Video inputs and sync outputs are isolated from ground and each other to minimize ground loop issues.

Front Panel



Input select switch

Selects which input to use and what type of sync signal to expect

- Tri-Level; Typical high definition type signals with tri level sync pulses, 720P, 1080I/Y. H.D. Y and sync only signals.

- Bi-Level; Typical standard and extended definition type signals with bi level sync pulses, NTSC, PAL, SECAM, ED480/576, all comp or YC formats, S.D. Y & G+S signals.

- VGA; Signals from the VGA connector

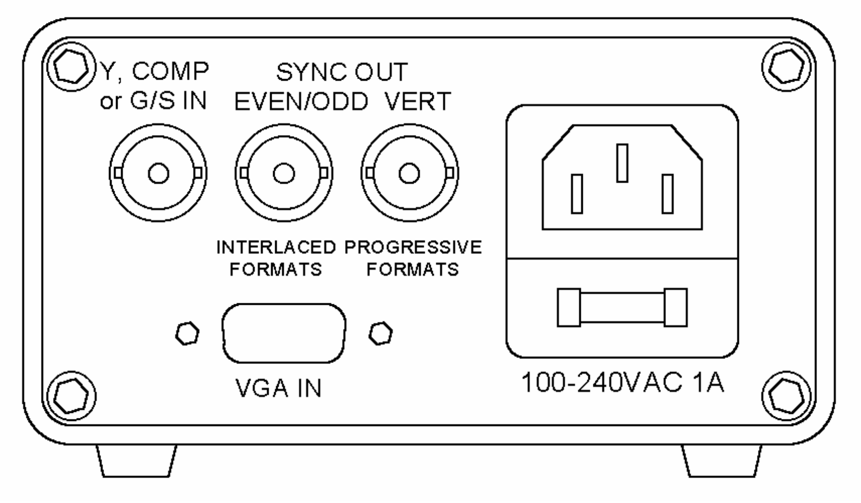
Lock

Green LED indicates to indicate good signal lock, and to indicate that the unit is now outputting sync pulses

Power

Green LED indicates both main and isolated power supplies are working normally.

Rear panel



Comp / Y in

Main video input, accepts Composite or Component (Y) analog video signals. Also accepts standard sync signals such a Tri-level, Sync-On-Green or Black Burst. This input has a standard 75Ω impedance, and like all professional video signals, it should be fed from its own source, not T'd off. This input is isolated from both the AC supply and from the sync outputs.

VGA in

Standard analog VGA type input for computer monitor-type signals, and some Prosumer HD applications. This input uses only the VGA H and V sync lines, and has a standard 75Ω impedance. Note that while the signals themselves are isolated from the case ground, in keeping with EIA standards, the connector shell is grounded.

Even/Odd sync out

This is a once-per-frame signal for interlace scan formats. A 5V TTL type signal, the rising edge corresponds to line 1. This output is isolated from both the AC supply and the video inputs.

Vert sync out

This is a once-per-frame signal for progressive scan formats. A 5V TTL type signal, it's a .5mS positive going pulse, starting at the beginning of vertical sync. This output is isolated from both the AC supply and the video inputs.

AC in

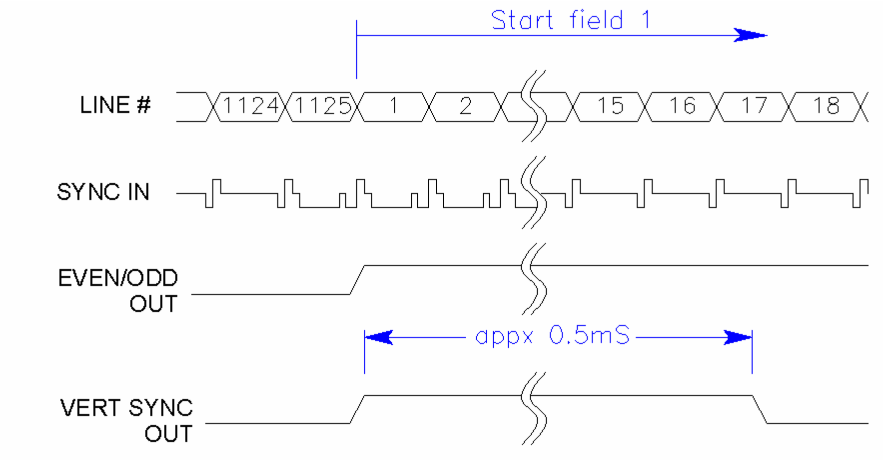
"Universal input" 100-240 VAC/DC power in, uses a standard IEC type power cable. Case is connected to the ground (earthing) pin. The power inlet also contains a fuse holder with an integral spare. The proper fuse is a standard 1A 5x20mm type.

Interfacing to a sync system

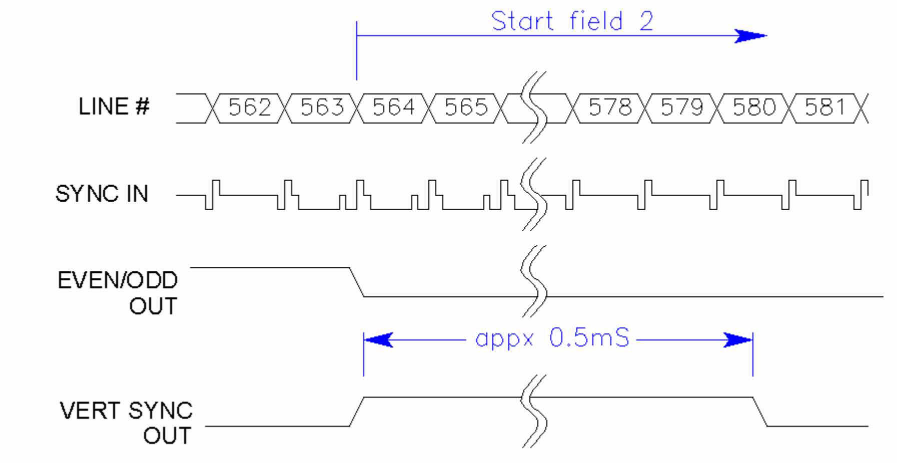
Typically, a motion control system, like the Kuper, or a film camera synchronizer, like the Cinema Electronics “Barton Box”, requires a once-per frame signal to synchronize with outside devices.

This sync stripper produces such signal from both interlaced and progressive scanned signals.

Typical operation with a 1080I / 30 fps signal would look like this.



Start of field 1 (lines 1 thru 563)



Start of field 1 (lines 564 thru 1125)

In this case, the input signal is interlaced, so the even/odd signal transitions once per frame, and is a good sync signal for synchronizing external devices. Since there are two vertical sync intervals in an interlaced frame, the vertical sync signal give an output pulse once per *field*, twice per *frame*.

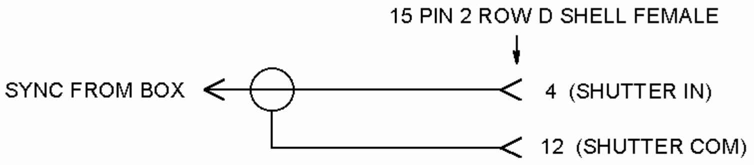
If the input signal was a progressive scan signal, there would only be one vertical sync interval, so only one vertical sync pulse.

In short, the even/odd signal is for interlaced formats, the vertical sync pulse is for progressive formats.

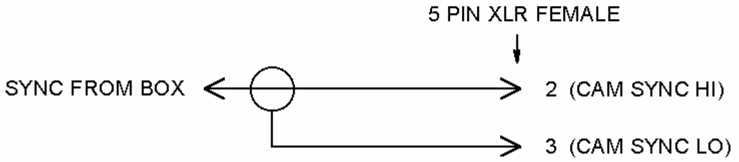
Cabling and connectors

The output signal from the sync box is a robust TTL level signal driven by an RS422 type line-driver chip. As such it should drive most loads easily.

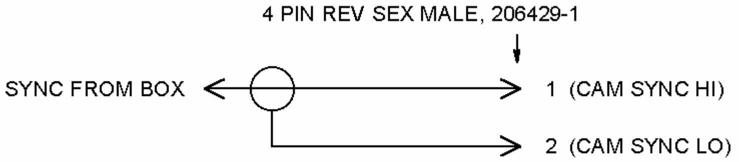
It will directly interface to Barton Box type synchronizers (use the camera setting) and motion control systems expecting a camera pulse, but most motion control systems will need an interface cable, probably one of these…



Interface cable for Kuper 15 pin accessory connector



Systems using Point Blank style 5 pin XLR connector



Lynx systems using AMP CPC 206430-1 connector

Phasing to a Kuper system

Back in the dark days of video, when dinosaurs roamed the earth (that is, till the late 90's) video cameras were fairly straightforward devices that did little image processing. Basically, they scanned the image off the tube face, and directly output the signal, with minimal processing delay. If you were receiving an active scan line, the camera was exposing the shot.

Even very advanced cameras had only basic 2-D processing that delayed the image, at most, a couple of lines.

That has changed. Even simple cameras now do substantial digital processing before outputting an imaging, and it is impossible to tell, without testing, what the delays between framing an image and outputting a signal are going to be.

For all the reasons why it used to be important to phase live action film cameras to a motion control system, it is equally important now to phase video cameras.

Fortunately, we don't care about the actual number of frames of delay, which can be substantial, just the phase of the output signal relative to the actual scanning time.

This we can measure, and once we have measured it, we can feed it into the Kuper and have it treated exactly like the phase angle of a motion picture camera.

Shutter time is a funny thing in video cameras. Many video cameras have no shutter at all, for example tube cameras effectively have a 360 degree (or more) shutter. They simply integrate all the time.

Most CCD cameras, however, have at least some shutter angle, if for no other reason than they electronically need a little bit of dead time to move the accumulated pixel charge out of the cells that form the "collection buckets" and into the readout array.

Many of the more professional cameras will have an additional electronic shutter to produce an image that more closely approximates film. Some will even incorporate a spinning mirror shutter for operational reasons.

In any case, just like with film cameras, for good data, and repeatable results across multiple setups, it's important to properly phase a motion control system with its video camera.

There are two good methods, one, using a step-motor phase clock, similar to what we used to do with film cameras, and another using an LED rigged as a sort of timing light.

Method #1, Finding the camera phase with a motor

More mechanical bits than method #2, but conceptually very similar to phase clocking a film camera.

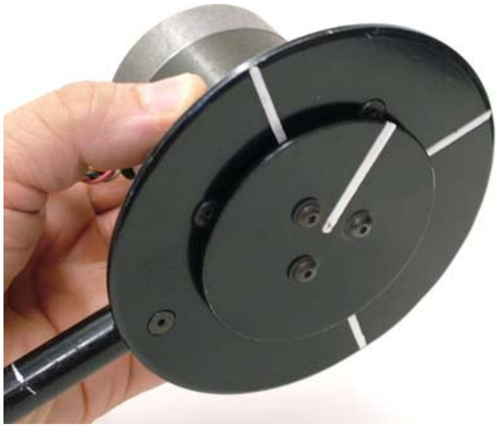
The Basic Idea

A phase clock is basically a step motor with a 2 inch black disk on the shaft. The disk has a heavy white line on it. We will crate a move that has the motor turn exactly one time for each frame. Since the shutter is only open for part of a frame, the white line will define an exposure arc, which we can examine on the video image. The position of this arc tells use the relative phase of the camera and Kuper.

This is the same familiar technique used for phasing film cameras through the eyepiece, except that we have to account for the fact that an electronic finder operates in phase with the sensor, while a film camera finder works 180º opposite the gate.

1) Make a phase clock

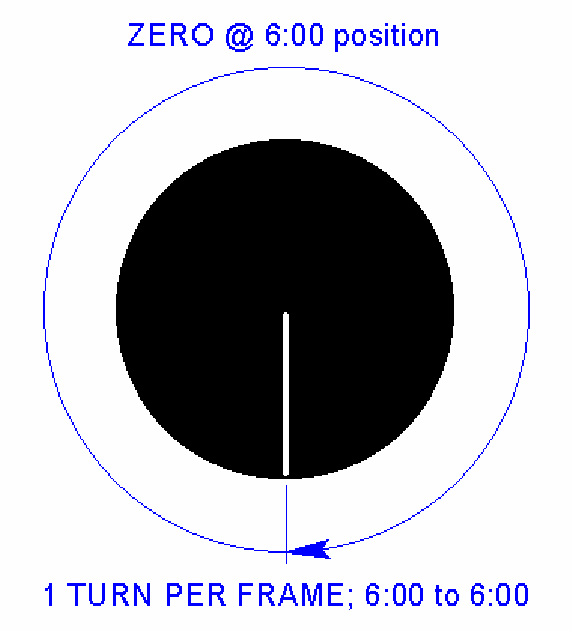
A phase clock looks like this…



It's mainly a step motor with a 2 inch black disk on the shaft. The disk has a heavy white line, and is sturdy enough to spin at 24 rotations per second. You shouldn't really have to make one, they were very common in the camera rooms of any facility that did motion control with live-action cameras, a little digging should turn up someone who has one.

2) Set up a linear move

Calibrate the motor channel so that one unit is *exactly* one motor turn. With the microstep drivers we use, this is usually a nice, even multiple of 200, typically 800, 1600, 2000, 3200 or 5000 steps (for 4, 8, 10, 16 and 25 microstep drives). Precision is important, so double check carefully. Zero the motor with the indicator line at the 6:00 position.



Create move file 10000 frames long, and using EditKeys, create a linear move on the motor channel where the motor turns one complete revolution per frame. Use only two keyfames and, for accuracy, manually enter the values in the keyframe editor screen. Your two keyframes should look like this…

0.0	0.0000
10000	10000.0000

Rotation direction does not matter.

3) Set up the test

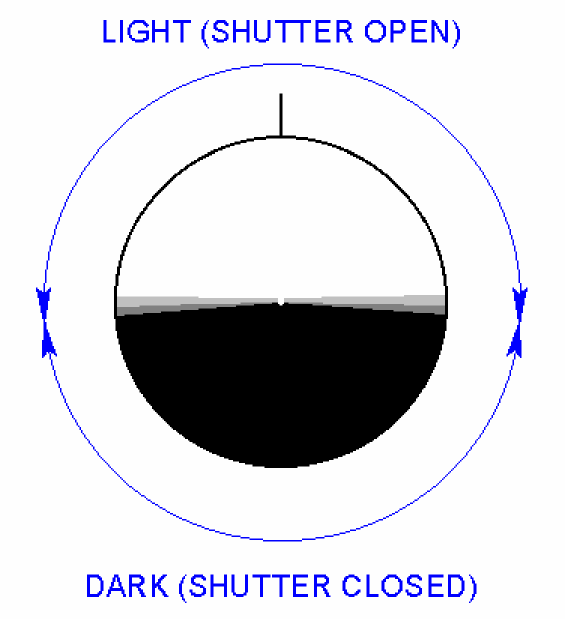
Run the video signal into the sync box, and connect the appropriate sync box output signal to the Kuper shutter sync in. Note that you will select “film camera” not “video” as an external sync source. Enter your frame rate. Make sure the Kuper has sync lockup.

Place the phase clock so that it occupies about 15% of the video frame, right in the center, and light the face of the clock brightly. It is important that you use a continuous light source (like tungsten or the sun) and not a discharge lamp, which will strobe.

4) Run the move

To an observer watching the disk from outside the camera, when the motor starts spinning the line will disappear into a blur, but since the video camera is only exposing for a fraction of the frame time. It only “sees” a part of the motion.

On the video, you should see an image like this, with a distinct light arc on a dark face.



The angular width of the arc is dependant on the shutter angle (exposure time) of the camera, and the angular position of the arc is dependant on the Kuper phase.

Adjust the Kuper target phase angle until the light arc is centered on 12:00, as in the image above. Stop the move, and using the mouse jog, drive the disk to the nearest whole turn, to make sure it didn’t stall. If it stalled, adjust your acceleration and current, and do the test again till you complete the procedure with a good zero

Many video cameras expose different parts of the imager at different times, explore this possibility by placing the clock in the top of the image, and in the bottom of the image.

Note that this test should be run on a video output, or a video eyepiece. If you’re on one of the very high-end cameras with an actual mirror shutter *do not* use the optical eyepiece or you’ll be 180º out of phase with the sensor.

Write down your final phase angle number, since you will have to re-enter it every time you open the software. The phase angle is not saved as part of the move file.

Method #2, Finding the camera phase with an LED

Mechanically easier than the phase clock, but it does involve some math.

The Basic Idea

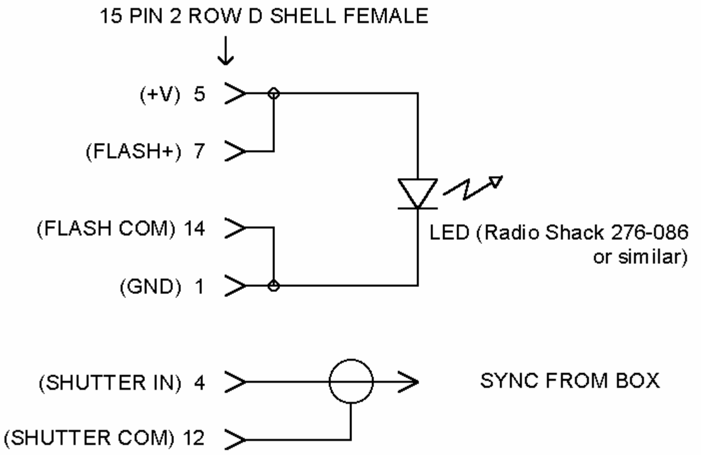
The Kuper provides an interface signal on its 15 pin accessory connector called “flash out”. This signal, normally used to trigger a photographic strobe once per frame, can be adjusted for duration and position within a frame with great accuracy.

We will attach an LED to this signal, then program the signal to turn the LED on during the times we think the shutter should be closed. We will place the LED in front of the video camera, and adjust the Kuper phase angle until the LED disappears.

1) Make this LED timing light

First, we need to make up a test LED to connect to the flash signal on the Kuper accessory port. Wire up this 15 pin connector to attach to the Kuper accessory connector.

An LED connected like this goes *on* while the flash out is *idle*, and *off* when the flash out is *active*. Thus the LED can be made to go *dark* in the middle of the active frame for a user selectable time.



2) Do the Math

You will need three numbers, the frame rate, the exposure time, and the delay till shutter open. The first two are usually given, the third you will have to calculate.

We will work an example assuming a 24 FPS progressive scan camera, at a 1/48th second exposure time.

Frame rate is easy, and usually obvious. But if in doubt, drive a sync signal into the Kuper and read the frame rate off the external sync display. We need the number in terms of frame time in milliseconds. In this case…

1 sec / 24 frames = 0.0416 seconds or 41.6 milliseconds

Exposure time is usually given in a fraction (1/48sec) or a shutter angle (180 degrees) Again, we'll need it in milliseconds.

Given a fraction, the formula is…

1/48 = 0.0208 seconds or 20.8 milliseconds

Given a shutter angle, the formula is…

angle / 360° X frame time = exposure time

or…

180° / 360° X 41.6 milliseconds = ½ X 41.6 = 20.8 milliseconds

Either way you get the number, be generous, and pad the exposure time by adding two extra milliseconds, in this case

20.8 milliseconds + 2 milliseconds = 22.8 milliseconds

This represents the time that we actually expect the shutter to be open, plus a small safety margin, ideally centered halfway into the Kuper frame.

Next, calculate the ideal delay between the start of the Kuper frame and the beginning of the exposure time using this formula…

delay = (frame time – padded exposure time) / 2

In this case

(41.6 – 22.8) / 2 = 18.8 / 2 = 9.4 milliseconds

3) Enter the numbers into Kuper

Enter the frame rate into the Kuper FPS box.

Set up the flash output using the “fs” command with the delay and duration numbers you have just calculated; 9.4mS of delay, and 22.8 mS of duration. Note that Kuper commands are case sensitive and you must use lower case letters.…

```
fs <space> 9.4 <space> 22.8 <return>
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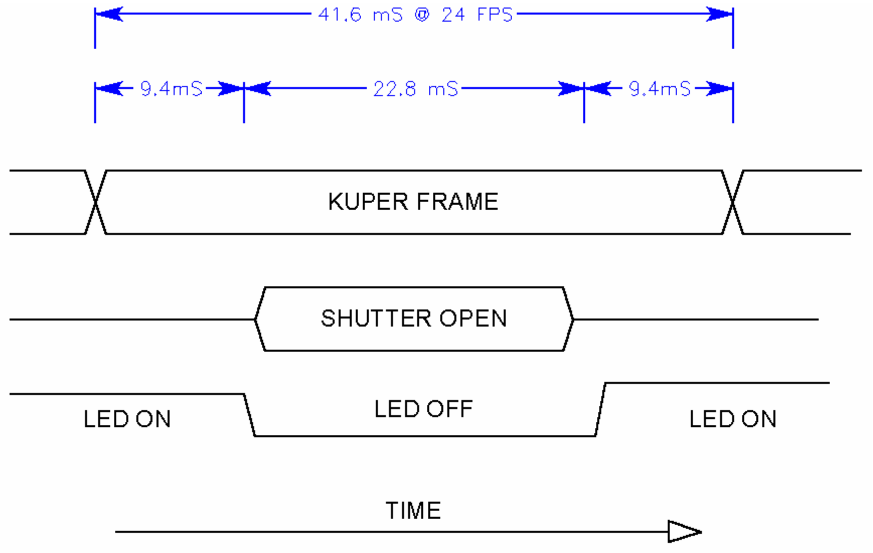
Now run the move. The LED should flicker at 24Hz, and should be going out in the middle of the frame, where the camera shutter should be open. Ideally, the timing in the system should look like this



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Place the LED so that it occupies about 5% of the video frame, right in the center, and adjust the Kuper target phase until the LED goes *out* in the video image. Many video cameras expose different parts of the imager at different times, explore this possibility by placing the LED in the top of the image, and in the bottom of the image.

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