Substituting a TAOS TSL12S-LF light sensor for better low light performance

(Syncheck and SyncheckII)

Who may benefit from this substitution?

You may see a benefit if you are currently unable to use Syncheck in your video projector installation, where it is determined there is not enough light reflection from the screen to trigger Syncheck's light sensor. Because circumstances vary from one installation to another it is possible you will not see a significant improvement after substitution.

Who should not perform this substitution?

We do not recommend this substitution unless you specifically experience low video brightness problems while using Syncheck. There is no benefit from substitution other than increased low light sensitivity, but it is possible to experience less satisfactory performance in high ambient lighting conditions or around fluorescent or other pulsating industrial lighting. We are not aware of any situation other than dark room projection where this modification is potentially helpful.

Background

Syncheck and SyncheckII use an identical photo sensor IC (with a integrated amplifier) that has relatively broad visible light sensitivity with peak sensitivity in the green-yellow wavelengths, batch-to-batch uniformity, side-shooter design, low current draw, fast "on" time, and a relatively slow "off" time (around a millisecond or so). These characteristics allow Syncheck to operate in a wide range of ambient lighting conditions. Low-light performance is quite good but more sensitive sensors are available. Unfortunately, most of them operate best with infrared wavelengths.

Some customers require Syncheck operation primarily or exclusively in very low light conditions. An example is a video projector installation where moderate lumen output is cast onto a reasonably large screen. Very affordable projectors are now being manufactured for home theater use that are being adopted by video professionals in low to moderate cost screening applications. These projectors are designed for good picture quality and low acoustic noise operation. In order to keep fan noise to a minimum, and improve dark image contrast performance, the raw light lumens from these projector's lamps are often restricted to 1500 or less. The resulting images are high contrast and very satisfying when viewed in controlled ambient light settings. The overall light bounce from a perforated screen with these projectors is much lower than from traditional direct-view video monitors but since the human eye is extremely adaptable, we see a very pleasing image. When such a projector is combined with a large screen it is possible that there will not be enough light reflected from the screen to fully activate Syncheck's sensor. Syncheck becomes "blind" to our test signal's video flashes. The user may try to move Syncheck closer to the screen in an effort to get a useable reading. Moving closer increases the amount of light hitting the sensor from a given point on the screen but at the same time, the amount of screen area visible to the sensor is reduced. Gain from reduced distance is roughly cancelled by less visible reflective area and Syncheck's sensor still fails. One workaround is to hold Syncheck directly in the projector's beam, pointed toward the projector lens. This usually allows plenty of "on" light, much more than is necessary, and in most circumstances the sensor is not overwhelmed and can still detect dark between flashes. If this technique works for you, you are a candidate for this modification.

How does changing the sensor help?

It is possible to swap the original photo sensor IC for a different part. A **TAOS TSL12S-LF** light-to-voltage converter can provide somewhat improved low light performance. (The "-LF" extension denotes the ROHS-compliant version.) The part is currently (2008) available from Mouser Electronics as part number 856-TSL12S-LF and is rather inexpensive. It is a 3 pin device similar to the original but with a different pin out. Electrically it can replace the original part. This document shows a suggested lead bend and dressing to allow a successful substitution.

It should be noted that while the TAOS part can provide slightly improved low light performance, its use should not be considered an "upgrade" but rather a trade in compromises. The TAOS part's characteristics will allow Syncheck to operate in some low light conditions that it could not previously respond in. (The differences in wavelength sensitivities and projector color balances make improvements hard to quantify.) It can also result in compromises of performance in other situations. The TAOS part is quite sensitive to visible light however it is most sensitive to infrared wavelengths. The original part has peak sensitivity near the center of the visible spectrum. Some video monitors emit considerable infrared energy that can overload the TAOS part more easily than the original part. The TSL12S-LF part is more sensitive to visible red than the original part while blue light performance is no better than equal. The TAOS part has fast "on" and "off" times. The fast "off" time can cause increased sensitivity to pulsating light such as from fluorescent ambient lighting. This is why it may not work as well in a brightly lit shop as the original part, for instance. For most users, particularly those in traditional editing and mixing rooms, there will be no significant change in performance and either part will work satisfactorily. Timing measurements will be identical with either part.

Opening the case

1. Remove the two toggle switch mounting nuts. To avoid scratching the case, use a hollow 5/16 inch hex wrench.

2. Remove 4 screws from the case bottom and separate the case halves. Note how the microphone is mounted and its approximate location through the case. You will restore this placement when done.

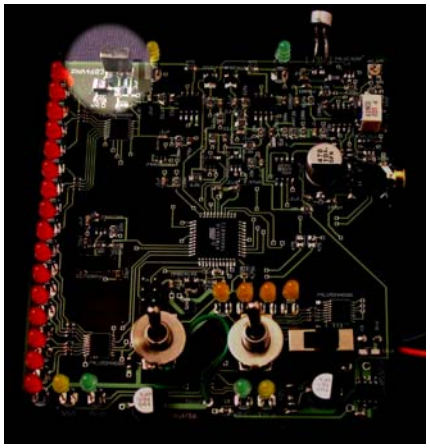
3. The circuit board can now be removed. Carefully pry the line input jack free from the case. It will pop free.

4. Grasp the front and rear of the board and gently rock it free from the case. The microphone mounting wires will bend and allow the pc board to come free.

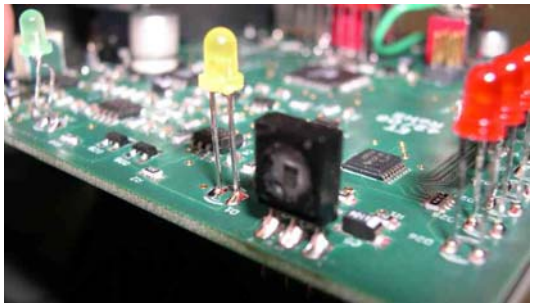
5. Both switches have a washer installed under the case, one of them is attached by a wire and the other will be loose. You may want to remove the loose washer until reassembly.

Remove the old light sensor

6. Locate the part to extract. Refer to the photos below. It is a 3-pin device. Note the approximate position of the part. The new part must mount along the same horizontal and vertical axis. The sensor's back and sides are painted black. You will want to apply paint to the new part in a similar fashion. Refer to step 11.



6A Locate the part to be replaced



6B. Original sensor, note H and V axis

7. Remove the sensor. We recommend cutting the 3 leads, and then extract each pin separately with a soldering iron. Clear the holes with a solder sucker or desoldering aid.

Prepare the new part

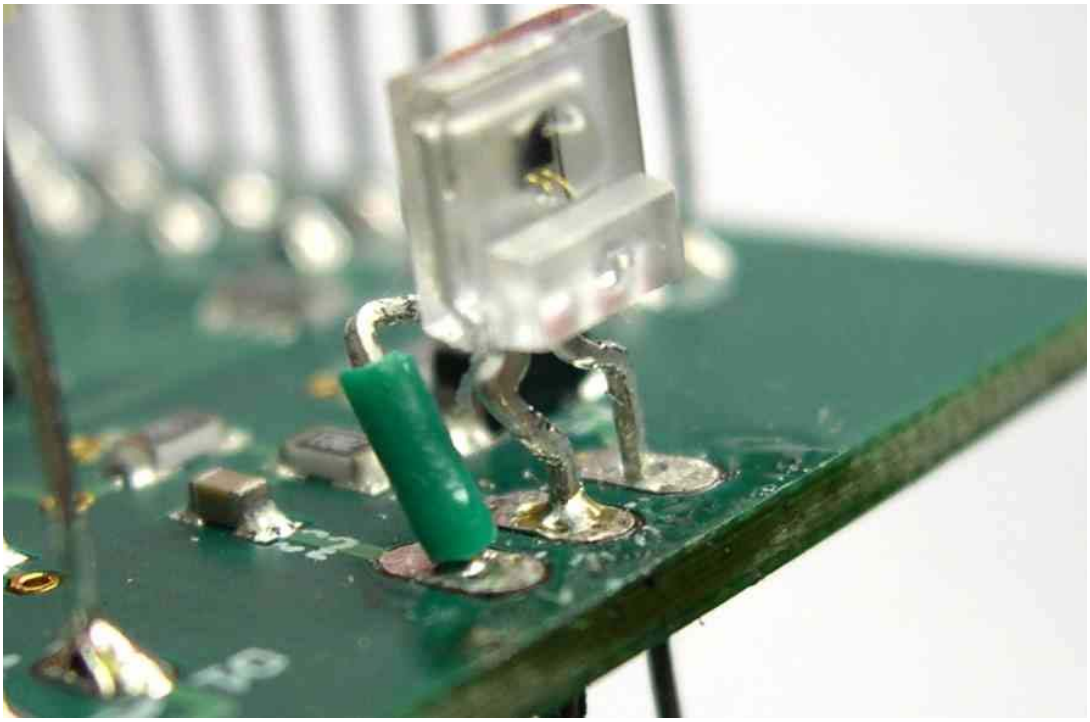
8. Because the new TAOS part uses a different signal pinout than the original part, its leads must be formed to connect properly while physically placing the device on the same axis as the original. Refer to the following photos. TAOS Pin 3 must be connected as pin 1, the other two pins move over by one. A small piece of plastic insulation prevents shorts. The bends are close to the body to reduce mounted height.

8A. TAOS TSL12S-LF FRONT view, pin 3 is bent around to connect as pin 1, other pins take new positions.

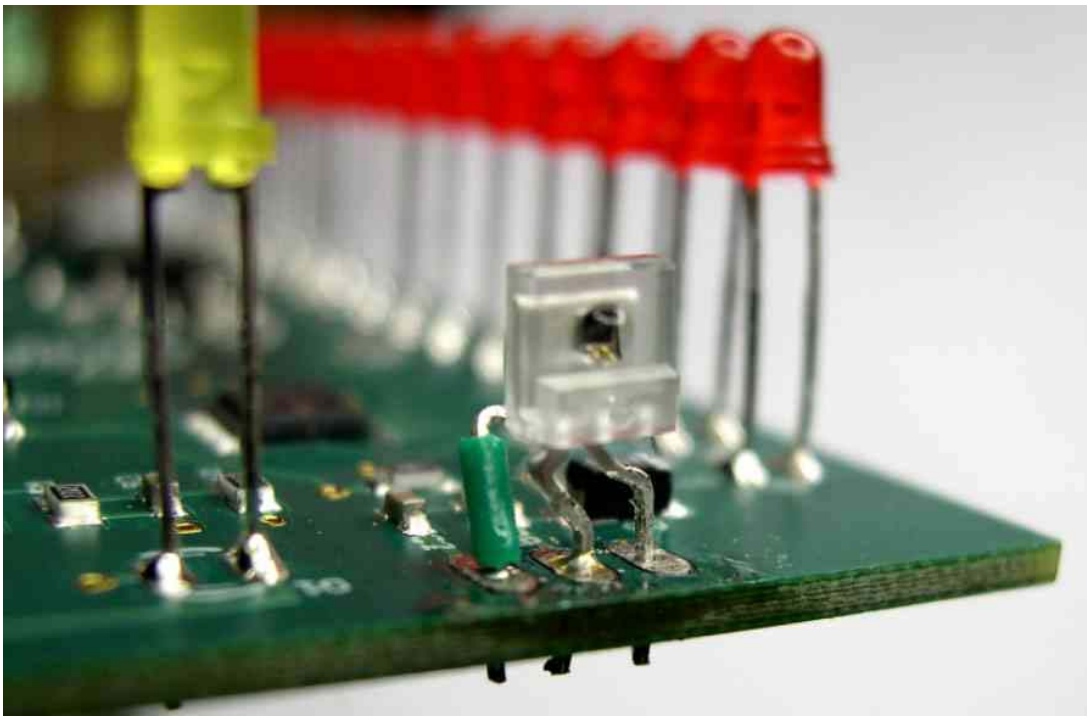
8B. TAOS TSL12S-LF rear view, pin 3 bent behind with insulator to ensure no shorts

Place the new part

9. Insert the TAOS part on the pc board, taking care that it inhabits the same horizontal and vertical position as the original part. Solder the center lead, check placement, then solder the other two leads



9A. Tack solder center pin to allow easy reposition before complete solder



9B. Ready to solder in place

Test and Paint

10. Test the new part. In a darkened room, connect a battery and interrupt light to the sensor by waving your hand in front of the sensor. Verify the “V” LED indicates the interrupted light. There is no adjustment.

11. Before reassembling the case, it is highly recommended to dab paint or thick, dark fingernail polish on the TAOS part’s back and sides. Examine the removed part as an example. Be certain the front lens area is untouched and perfectly clear. Because the new part is very sensitive to red light and is mounted near several red display LEDs, there can be unwanted interaction. A thick coat of paint will block enough light spill from the nearby LEDs to ensure no interaction. A second coat should be applied if the corners are not covered.

Close

12. Be sure the loose toggle switch washer is replaced on the mode switch.

13. Angle the microphone into its mounting hole in the case top and guide the toggle switches through the case. Rock the case down and fully seated onto the board. If the line input jack is not fully seated in the case, press it down with your finger until it snaps into position. Install the lock washers and nuts. Tighten securely (with your fingers only!) with a hollow 5/16” hex wrench. Do not over tighten or the case will eventually crack.

14. Check the microphone position. If required, use long-nosed pliers to grab the wire leads just behind the microphone and position it almost flush with the outer case wall. It is best to position just slightly behind the case wall to provide a bit of protection against rubbing.

15. Assemble the case halves and reinstall the four screws.