ERRATA
TO THE TSB15LV01 DATA SHEET
(TEXAS INSTRUMENTS LITERATURE NO. SLLS438B, SEPTEMBER 2004)

This document contains corrections and additions to the TSB15LV01 data sheet (TI Literature Number SLLS425A, September 2002).

1. Intermittent Blackout

Problem:

Under certain conditions, the TSB15LV01 will spontaneously stop sending isochronous video data. All other functions continue to operate, including all CCD and AFE drive pulses and response to asynchronous control packets. Full operation resumes when device power has been cycled. This problem occurs when a) auto-exposure is activated, b) the STAT2_CNTL register is not configured as a motor control, and c) the IRIS_CNTL register is either set to a value of ’000’, or its on/off field is set to ’off’.

Cause:

According to the specification, the IRIS_CNTL register is used to control a motorized mechanism, presumably one for controlling the camera iris. However, if this function is not enabled via the STAT2_CNTL register, it functions as an unsupported testmode. For production use, this test mode was intended to be de-activated by setting the on/off field of the IRIS_CNTL register to ’off’. However, due to an error, turning the test mode off can cause the aforementioned problem. The same effect occurs when the IRIS_CNTL register is turned ’on’, but the value is set to ’000’.

Workaround:

If STAT2_CNTL is configured such that the IRIS_CNTL register is used for motorized control, then the problem does not occur, and no action needs to be taken. If STAT2_CNTL is configured for a function other than motorized control, the following actions must be applied to the default ROM script:

1. IRIS_INQ should indicate that the feature is unavailable. This tells the host that it should not attempt to change the value of the IRIS_CNTL register. Also, the minimum and maximum values in the inquiry register should both be set to ’004’.
2. The on/off field of the IRIS_CNTL register must be set to ’on’.
3. The value field of the IRIS_CNTL register must be set to ’004’. This setting is another method of de-activating the test mode.

2. Dropping Cycle Start Packets

Problem:

If a cycle start packet is received such that reception of the ”Source ID” field is completed in the clock period that occurs prior to the TSB15LV01 cycle timer rollover, the packet will not be recognized by the device, and no isochronous data will be transmitted.

Workaround:

1. The alignment of these two events is governed by two parameters: the length of cycle start data prefix and the timer value transmitted inside the cycle start packet. As a general rule, however, the problem will be avoided if the cycle start data prefix is 270 ns or greater. The threshold may be slightly higher or lower, depending on the cycle start packet value.

   The length of the data prefix is dependent upon characteristics of both the PHY and link of the cyclemaster node. TI PHYs are designed to provide relatively long data prefixes, but if combined with a link that has a shortening effect on data prefix, the total prefix may still be short enough to provoke the error condition.

   A TI PHY in conjunction with a TI OHCILynx link provides a data prefix of approximately 300 ns, sufficient to avoid the error condition. The TSB15LV01 + TSB41LV01 (PHY) camera has been used with a variety of host link/PHY combinations, and this error has been reported with only one of these combinations. More recent versions of that vendor’s PHY contain changes that eliminated the problem in that situation. No other occurrences of this problem have ever been reported.

2. The errata item does not occur if the camera’s PHY clock is fast relative to the host. The PHY clock can be measured on pin 58, ”SCLK”, of the TSB15LV01 device. It has a frequency of 49.152 MHz and is sourced by the PHY device. It originates at the crystal oscillator circuit attached to the PHY, which contains a 24.576 MHz crystal.

   The 1394 standard defines the tolerance of the PHY clock to be ±100 parts per million. This calculates as 49.1471 MHz to 49.1569 MHz. The frequency of the PHY’s oscillator circuit can be ”bent” from the nominal frequency to match the 1394 requirements. This is done by adding or reducing the load capacitance on the circuit (adding capacitance slows the clock; reducing accelerates the clock). See the document *Selection and Specification of Crystals for Texas Instruments IEEE 1394 Physical Layers* (literature number SLLA051) for more information.

   The errata item occurs when the cycle start packet arrives before the TSB15LV01’s internal cycle timer rolls over. When the camera’s clock is accelerated, it reduces the amount of time it takes for the timer to roll over. Causing it to run somewhat more quickly than the host’s clock can reduce or eliminate occurrences of the problem when interfacing to a host with short data prefixes. Given this relationship, the workaround is to run the camera faster than 49.1569 MHz, the fastest clock that should be encountered on host PCs.

   Note that this causes the camera to be non-compliant with the 1394 standard. Caution is advised. Compliance-testing is not mandatory within the 1394 community, so this will not prevent a vendor from marketing their product. However, the 200 ppm clock speed restriction is in place for a good reason: when clocks of two communicating nodes are too far apart, large packets can be ”dropped” by the receiving node because it falls out of sync with the transmitting node. TI has tested this workaround in a worst-case scenario, and no problems have been found.

   When using a camera that contains this modification in conjunction with a host that provokes the errata, be aware that there is a limitation in the number of repeaters that can be used between the host and the camera. Repeaters add delay to packet transmission, and therefore counteract the workaround. The choice of connections depends on the extent to which you accelerate your clock:

Table 1. Recommended Clock Speed Increases

CONNECTION	SPEED	PPM BEYOND 49.152 MHZ
Direct connection; no repeater	49.1595 MHz	152 ppm
One repeater between Powerbook and camera	49.1650 MHz	264 ppm
Two repeaters between Powerbook and camera	49.1710 MHz	387 ppm

The vast majority of camera applications will consist of either direct connections or single-repeater situations.

The other limitation to be aware of is that this workaround should only be implemented on cameras with a single 1394 port. If it has two or more ports, it can be used as a repeater. As a repeater that is not spec-compliant, it could interfere with the operation of other 1394 devices on the bus. The fact that the TSB15LV01 cameras are typically single-port; have a known, fixed output; and cannot serve as cyclemaster enable us to offer this workaround as an reasonably safe option.

Even for vendors that choose not to use PHY clocks beyond the allowances of the 1394 standard, it is very important that the PHY clock speed be at or near the top allowed speed (49.1569 MHz). The slower the clock speed of the TSB15LV01 camera, the more likely that it will have incompatibilities with host PCs.

3. Missing Histogram Values

Problem:

There is an error TSB15LV01's video processing that causes the histogram to have a "comb" shape. Generally speaking, the problem only becomes an issue when image chrominance is low or zero.

The most extreme case is when TSB15LV01 is configured to produce a greyscale (black and white) image. When a histogram of the resulting image is analyzed, pixel values in which the second least significant bit is high do not occur in the video data. For example, decimal values 44, 45, 48, 49, 52, and 53 are displayed by TSB15LV01. Values 42, 43, 46, 47, 50, and 51 are not. Effectively, therefore, the image is 7-bit rather than 8-bit at the pixel level (that is, 21-bit rather than 24-bit at the RGB level).

In full-color situations, this degradation is largely unnoticeable in the histogram. As chrominance is decreased, however, the effect becomes more noticeable in the histogram.

The phenomena occurs in all greyscale images transferred from TSB15LV01, whether invoked by use of the monochrome transfer mode, a zero saturation value while using a color transfer mode, use of a black and white sensor, or setting the color_bw bit of the VIDEO_OPTIONS_CNFG register to 0.

Workaround:

Most people will not be able to see the problem by viewing the video image, no matter if the image is color or greyscale. The omitted/reduced values are evenly distributed throughout the histogram, so no obvious image artifacts exist. For consumer-grade applications, this errata item should not pose a problem.

For industrial/scientific applications which depend on complete, 24-bit greyscale accuracy, this errata item could pose a problem. The camera designer who wants to better understand the phenomena should obtain a TSB15LV01 camera and analyze the image using software capable of generating a histogram.

As a general workaround, using a color transfer mode and a moderate amount of saturation makes the problem nearly nonexistent in the image histogram. The RGB transfer mode provides the best performance.

4. One-Shot Feature Doesn’t Work Properly

Problem:

The TSB15LV01 provides a ”one-shot” feature by which the device transmits a single frame immediately after the feature is activated. Activation occurs when the bit in the ONE_SHOT_CNTL register (F0F0 061Ch) is set. However, the one-shot image data is corrupted.

Workaround:

There is no workaround to this problem. The only workaround candidate is to activate isochronous streaming by setting the ISO_EN_CTRL register (F0F0 0614h) and having the host capture one frame only. However, the time delta between the setting of this bit and the transmission of the first frame is variable. In most cases, this will not be a valid workaround.

5. color_bw Bit Cannot Be Configured for Monochrome Operation

Problem:

The camera works properly when the color_bw bit in the VIDEO_OPTIONS_CNFG register (0F22h) is set to ”1”, indicating that the TSB15LV01 is to assume the CCD is a color CCD and process it accordingly. However, if set to ”0”, the resulting image has a ”cross-hatched” appearance.

Workaround:

As a result of this problem, TSB15LV01 cannot be used with a monochrome sensor. It only works with the Sony or Sharp color sensors. If a monochrome image is desired, the monochrome transfer mode can be used. Note that with this setting, the image from the sensor is processed as a color image—including interpolation of a presupposed Bayer pattern—and then only the luminance data is transmitted to the host.

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