**Introduction**

This application note will examine a variety of sync formats and a method for removing the sync pulse from component video signals (see Figure 1). The EL8102 is a single supply Video Op Amp with rail to rail output stage that is ideal for video signal amplification and sync stripping functions. This product was developed for video design engineers who need to remove sync from component RGB (red, green, blue) and monochrome RS-170 video data (see Figure 7). Recently the term RGB has been turned around and called GBR (green, blue, red) as video distribution systems normally put green on channel 1, blue on channel 2 and red on channel 3. This is consistent with the hook-up of the color difference standards.

**TABLE 1. RGB STANDARDS SPECIFICATIONS (BROADCAST ENGINEERING 11/94)**

<table>
<thead>
<tr>
<th></th>
<th>SMPTE/EBU N10</th>
<th>NTSC (NO SETUP)</th>
<th>NTSC (SETUP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>700mV</td>
<td>714mV</td>
<td>714mV</td>
</tr>
<tr>
<td>Min</td>
<td>0mV</td>
<td>0mV</td>
<td>54mV</td>
</tr>
<tr>
<td>Range</td>
<td>700mV</td>
<td>714mV</td>
<td>660mV</td>
</tr>
<tr>
<td>Sync</td>
<td>-300mV</td>
<td>-286mV</td>
<td>-286mV</td>
</tr>
<tr>
<td>Peak-To-Peak</td>
<td>1V</td>
<td>1V</td>
<td>1V</td>
</tr>
</tbody>
</table>

Table 1 lists standards specifications for SMPTE and NTSC video signals. All have 1V_{P-P} signals with sync signals ranging from -286mV to -300mV. A typical 1V_{P-P} video signal consists of up to +700mV of active video on top of a -300mV sync pulse. The application circuit shown in Figure 2 will strip off the sync pulse and transmit only the positive video data. See the Intersil Application Note AN9514 titled “Video Amplifier with Sync Stripper and DC Restore” for additional details on this circuit. This circuit is useful in a variety of video processing applications such as: RGB video digitizing, RGB video distribution amplifiers for workstations and PC networks, and RGB monitor preamplifiers. When digitizing RGB video it is not necessary to digitize the sync pulse, so removing sync allows the full dynamic range of the A/D converter to be used on just the video data, resulting in a 30% increase in image resolution. In video distribution amplifiers, which are driving a number of video channels, it is undesirable to require separate switching channels for the sync signals. Sync is generally combined with the video signal, resulting in lower system costs by minimizing the total number of switching channels required. Certain applications, such as some RGB monitors, can't handle sync on the video signal and it must be stripped off, usually by a stage on the output of the distribution amplifier. Now that we know some of the applications where sync removal is important, let's look at why and where sync signals are used.

Transmitting two-dimensional moving pictures electronically requires the handling of a large amount of information and this is done by slicing the 2-D picture into horizontal strips of video and sending them sequentially. At the receiving end, or video monitor, the video information is recreated in scan lines on the display screen. This process continues until all of the scan lines needed for the picture are complete. Each complete picture refresh is called a frame, and typical frame refresh rates vary from 25 to 30 frames/s for broadcast video up to 72 frames/s in high performance video systems.

Sync signals are used to ensure that the scan lines are correctly placed on the display screen. A horizontal sync pulse is used to indicate the end of each scan line and signals the monitor to return to the left edge of the screen to begin the next scan line, below the one just completed. A vertical sync pulse is used to tell the monitor that the bottom of the picture has been reached, and that the next scan line will start at the top again. This is similar to a carriage return on a typewriter, where a scan line is equivalent to a single line of text and a frame of video is equivalent to a complete page of text (see Figure 3).
The scan lines are formed by moving a spot of light, scanning left to right and top to bottom, in a pattern called a raster. As the spot traces out the raster pattern, it is modulated by the video signal to form the picture. Monochrome (black and white) systems require just one video signal, plus the horizontal (H) and vertical (V) sync pulses, for a total of three signals. Color computer systems require one signal each for red, green and blue, plus V and H sync pulses for a total of five signals. There are a variety of techniques used to reduce the number of wires needed to transmit these five signals.

**Computer Systems**

In computer systems the monitor is generally located close to the CPU and separate wires can be used for Red, Green, Blue and Horizontal and Vertical sync signals. It is common for monitors to be hooked up using a single connector housing the five separate wires. This approach is referred to as RGBHV. As the distance between the monitor and the computer increases, it is more convenient and less costly to use fewer wires. Combining both the horizontal and vertical sync into a single composite sync signal results in a four wire system, eliminating single wire. This approach is referred to as RGBS, where S is the composite sync signal. RGBS system monitors contain circuits to recreate the horizontal and vertical sync signals from the composite sync. Another wire can be eliminated by combining sync with a video channel. This is possible because sync pulses only occur between scan lines (horizontal sync) and between frames (vertical sync), when video signals are not present. Typically the composite sync is carried by the green channel and this 3-wire system is referred to as RGBS, where S is the composite sync signal. RGBS system monitors contain circuits to separate the two color difference signals again. This new sync signal must be included so the video monitor can separate the two color difference signals again. New sync information is called color burst, and is added to the chrominance, “C”, just after each horizontal sync pulse. The “Y” channel carries the composite sync information.

S-VHS videotape is the most popular YC format.

**Television Broadcast Systems**

Television Broadcast Systems must take the five original signals (R, G, B, H, and V) and transmit them through a single transmitter. Here luminance “Y” and chrominance “C” are combined into a single video signal called composite video. Broadcast video systems are required to be compatible with monochrome and color receivers, and black and white receivers only need to process the Y portion of the signal. The broadcast standard in North and Central America, Korea, Taiwan and Japan is called NTSC and uses a 3.575MHz color subcarrier. Europe, Australia and the Middle East use PAL while France and Russia use SECAM, both 4.43MHz color subcarriers (Figures 5 and 6). Note that the application circuit for video sync stripping, shown in Figure 2, is not useful for composite video applications, as some of the color information (blue) resides below the black level (Figures 7 and 8) and would be lost by the sync stripping function.
References

[1] Intersil Corporation, High Speed Signal Processing Seminar, 1994 (Publication #BR-043A)


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