Application Report
SLEU044 - October 2003

TVP5150A Quick Start Guide

Digital Audio/Video

ABSTRACT

The TVP5150A is a low-power NTSC/PAL/SECAM decoder in a small 32-pin TQFP package. It is a highly programmable device suitable for a broad range of video applications, but is designed for maximum ease of use. This document includes information to help the user design with the TVP5150A and understand some of its capabilities and requirements.

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TVP5150A Example Application

Figure 1 shows an example of how to connect the TVP5150A in a simple application. The example application shows how external analog switches can be used to allow multiple inputs on each of the two analog video input pins of the TVP5150A. The example shows how the GPCL output of the TVP5150A can be used to select between the inputs to the analog switches. (The state of the GPCL output can be programmed using the I^2C interface to the TVP5150A.) Optional antialias filters are also shown in the example.

The TVP5150A in the example is configured to output embedded synchronization signals in the video data stream on the YOUT[7:0] pins. This output format is described in the ITU-R BT.656 standard and does not require the use of the discrete synchronization signals on pins VSYNC, HSYNC, FID, AVID. These discrete synchronization signals can optionally be enabled and connected for applications requiring them.

The TVP5150A I^2C base address selected with pulldown resistor R7 is B8.

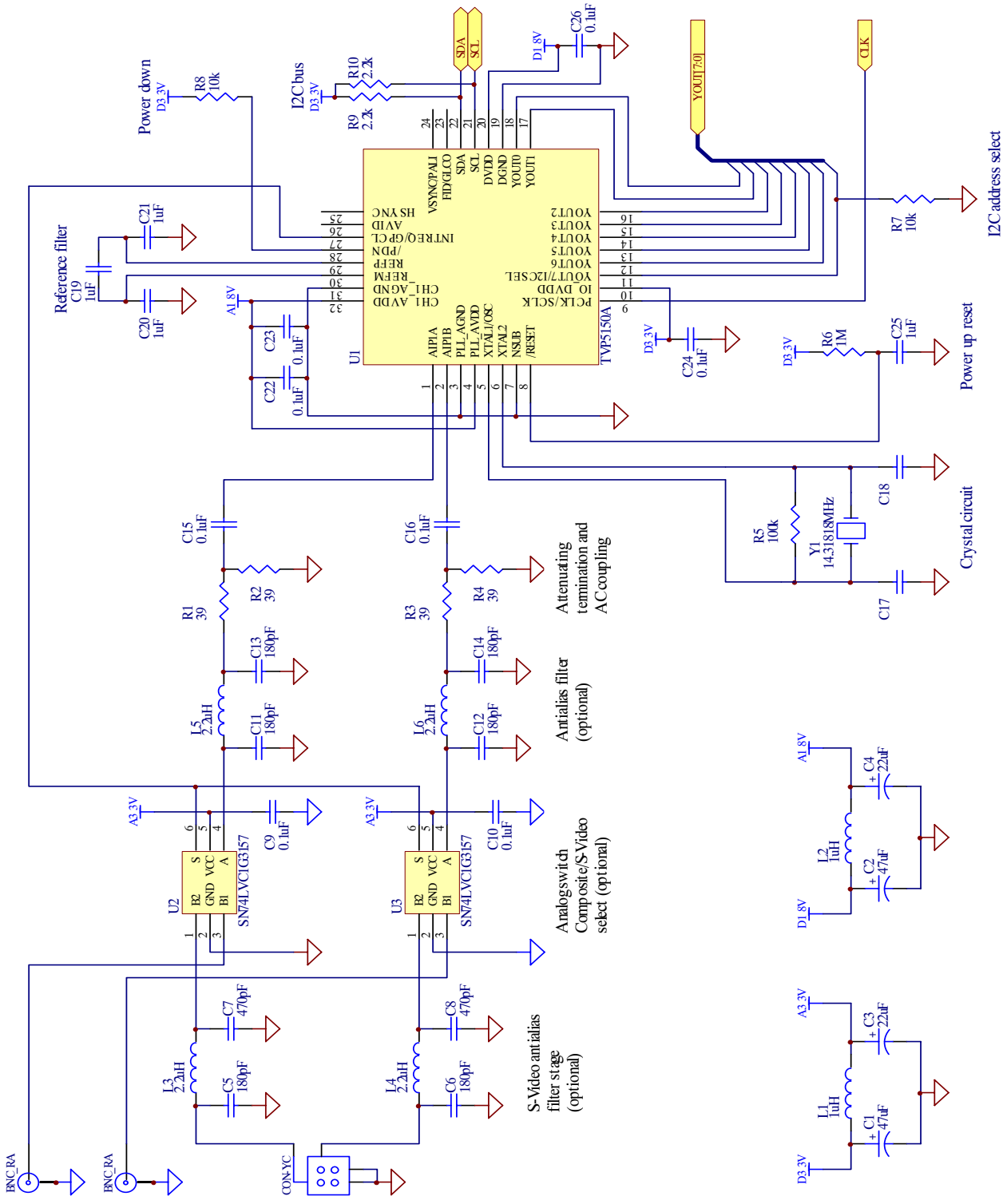

Figure 1. TVP5150A Example Application

TVP5150A Input Termination and Gain Range

Figure 2 shows a standard composite video signal with maximum allowable chroma excursion, terminated with a standard 75-Ω load. Maximum chroma excursion is demonstrated with a 100% amplitude, 100% saturation color bar test pattern. The maximum amplitude for a signal terminated by 75 Ω is 1.24 V, which exceeds the TVP5150A maximum input level of 0.75 V.

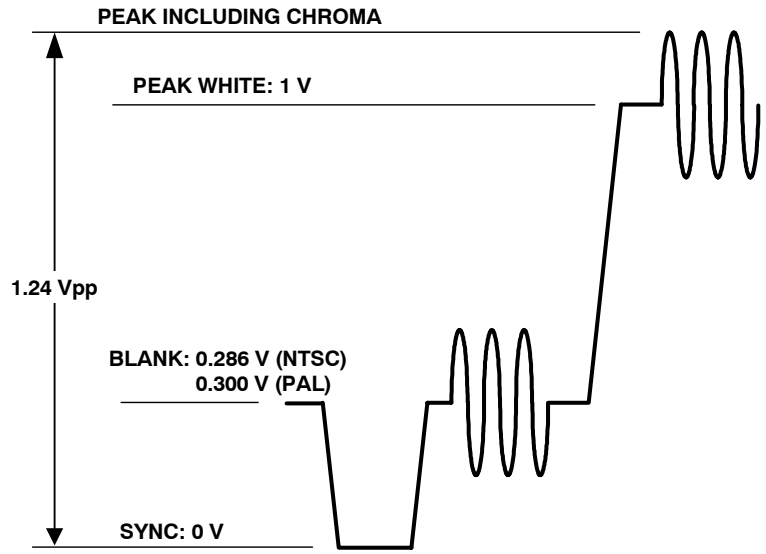

Figure 2. 75-Ω Terminated Composite Signal Amplitude

Figure 3 shows the recommended input termination circuit for the TVP5150A. A resistor divider network is used to attenuate the input signal while still providing a termination of approximately 75 Ω. Recommended attenuation is 50%, achieved with two commonly available 39-Ω resistors. The recommended ac-coupling capacitor value is 0.1 μF.

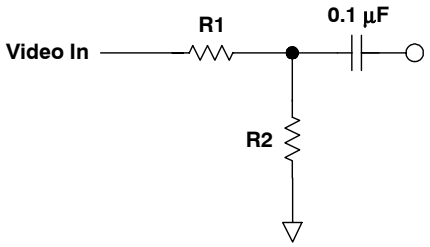

Figure 3. TVP5150 Input Termination

The automatic gain control of the TVP5150A properly scales inputs with amplitudes of approximately 30-135% amplitude when the recommended resistor-divider termination is used. Other resistor-divider pairs are possible, which result in different effective ranges for automatic gain control. Table 1 shows how the AGC range changes for different termination pairs.

NOTE: Due to the 0.75-Vp-p input limit, the upper end of each amplitude range includes certain signals (example: 100% amplitude, 100% saturation color bars), which exceed the range of the TVP5150A input circuit.

Table 1. AGC Range for Common Resistor-Divider Terminations

Resistor Pair R1:R2	Attenuation	Approx. AGC Range	Notes
56:18	24%	65-280%	Worse SNR
56:22	28%	55-240%	
47:27	36%	45-185%	
39:33	46%	35-145%	
39:39	50%	30-135%	Recommended termination
33:39	54%	30-125%	
27:47	64%	25-105%	Better SNR

Antialias Filtering

Antialias filtering may be required if out-of-band noise is present on the inputs to the TVP5150A. Figure 4 shows two example filters with good cost/performance characteristics for typical applications. A different filter is shown for S-video because the TVP5150A sample rate for each S-video component is 13.5 MHz, compared to 27 MHz for composite video. Similarly effective noise attenuation therefore requires a steeper rolloff and a higher-order filter.

The example S-video filter is shown in a form which can be implemented in two stages, separated by a switch so that only the second stage is used for composite video input. If a two-stage approach is not desired then the 470-pF/180-pF capacitor pair can be replaced in the design with a single 680-pF capacitor.

Figure 5 and Table 2 show amplitude and group delay characteristics for the example filters of Figure 4.

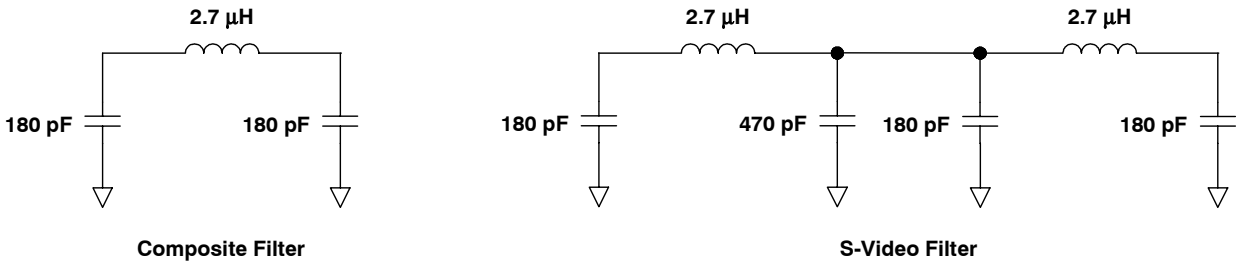

Figure 4. Example Antialias Filters for Composite and S-Video

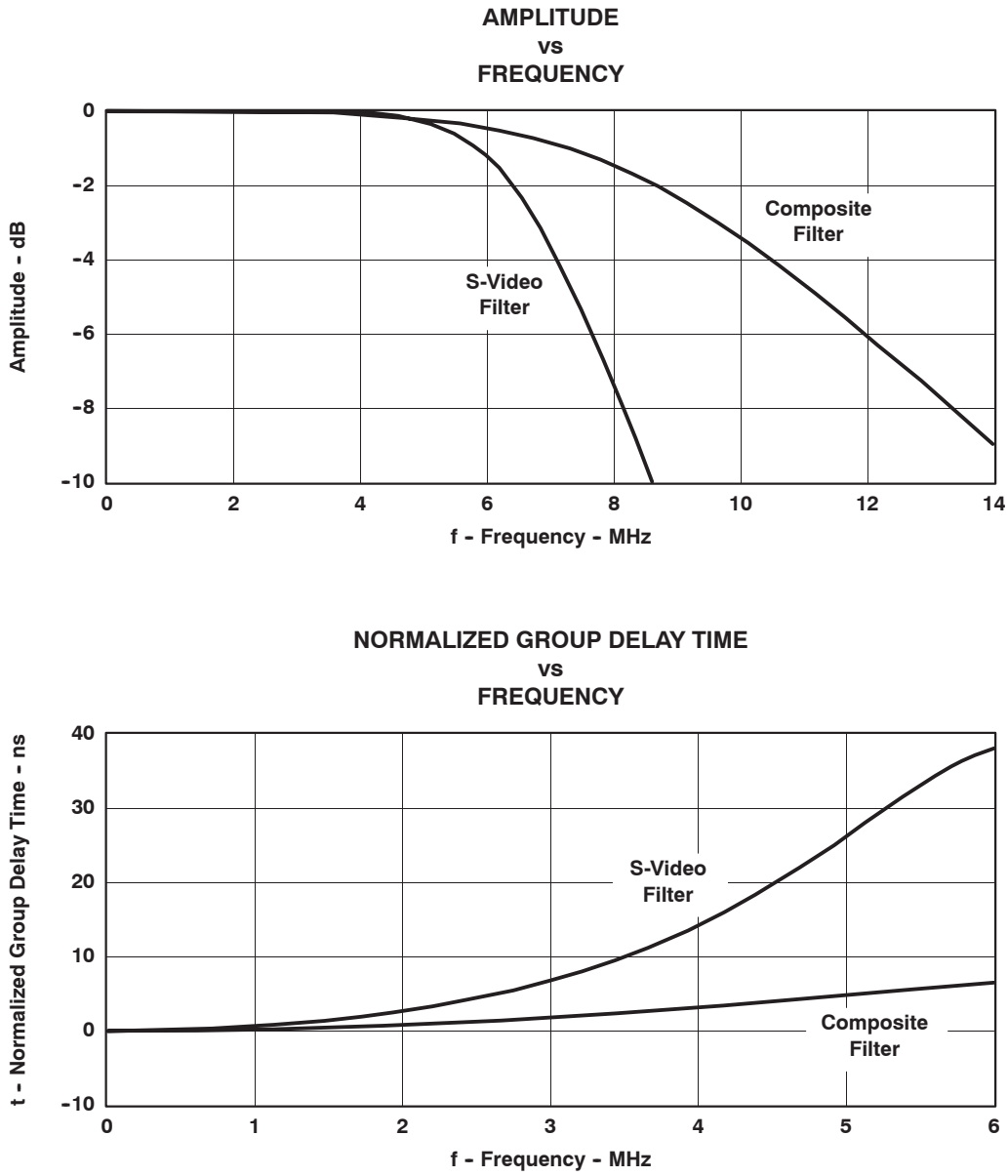

Figure 5. Example Antialias Filter Characteristics

Table 2. Example Antialias Filter Characteristics (Detail)

Frequency (MHz)	Composite Filter		S-Video Filter		Notes
	Amplitude	Delay	Amplitude	Delay	
3.58		3 ns		11 ns	NTSC color subcarrier
4.2	-0.1 dB	4 ns	-0.1 dB	16 ns	NTSC bandwidth
4.43		4 ns		19 ns	PAL color subcarrier
6.0	-0.5 dB	7 ns	-1.3 dB	38 ns	PAL-D bandwidth
7.5	-1.1 dB		-5.4 dB		PAL sampled image for S-video
9.3	-2.7 dB		-13 dB		NTSC sampled image for S-video
21.0	-18 dB		-47 dB		PAL sampled image for composite
22.8	-20 dB		-51 dB		NTSC sampled image for composite

Crystal Circuit Design

Figure 6 shows an example reference clock circuit for the TVP5150A. Special care must be taken when using a crystal circuit to generate the reference clock for the TVP5150A. Small variations in reference clock frequency cause color to become intermittent or to go away altogether. Use the following guidelines to ensure correct reference clock operation:

- Use the right frequency crystal. The correct frequency is 14.31818 MHz. Tolerance should be 50 ppm or better.
- Use a parallel-resonant crystal. A series-resonant crystal oscillates in a parallel circuit, but at an incorrect frequency**.**
- Know the C_{load} for the crystal part number selected. The values of capacitors C1 and C2 must be matched to the C_{load} for the specific crystal part number in the userís system. Use the following formula:

  $C1 = C2 = 2C_{load} - C_{stray}$ where C_{stray} is 3-8 pF, depending on board traces

  Example: C_{load} = 20 pF. $C1$ = 33 pF, $C2$ = 33 pF

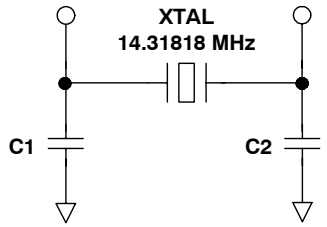

Figure 6. Crystal Circuit

Minimum Register Initialization

The TVP5150A is highly programmable; however, the device can be fully operational for most applications with very few register initializations. Table 3 shows a complete required register initialization to support the example application in Figure 1. The register settings in Table 3 (along with the default settings in all other registers) configure the example TVP5150A application to:

- Select the composite video input connected through the analog switch to TVP5150A input AIP1A
- Support automatic switching between multiple input standards
- Use embedded syncs in the output data stream (ITU-R BT.656)

No other register accesses are required to use the example application in this mode. All other registers can be left in their default states.

Table 3. Example Register Initialization of TVP5150A

Address	Data	Note
0x03	0x29	YUV output enable, GPCL output enable
0x0F	0x0A	Pin 27 is GPCL (for controlling external analog switch)

References

1. *TVP5150A Ultralow-Power NTSC/PAL/SECAM Video Decoder With Robust Sync Detector* data manual, SLES087

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