Latency In Simple SPDIF DACs

There is a noticeable trend in TV video equipment, where traditional analogue audio RCA output sockets are being replaced with digital SPDIF outputs. This would imply, that on the receiving end, the amplification system is equipped with SPDIF input and is decoding either stereo (2.0) or surround sound (5.1) channels.

If you need to gain access to each individual channel for DSP audio processing, you may consider two options:

1. For stereo (2.0) signals, you could use sound card with SPDIF (or AES/EBU) input, and connect the SPDIF TV output directly to the sound card. An example of such sound card is LynxAES16.

2. If not, you could use an external SPDIF decoder, for example A3199 http://www.altronics.com.au/index.asp?area=item&id=A3199#

3. For surround (5.1) channels system, the AES16 will not decode the SPDIF stream into the 6-channel arrangement. Therefore an external decoding needs to take place. The resulting 5.1 analogue channels are connected to Delta1010LT analogue inputs, thus giving you once again – full access to DSP audio processing on these channels. The example decoder is AC1634 http://www.jaycar.com.au/productView.asp?ID=AC1634

A quick internet research is also advised, as there may be other compatible devices available on the market.

So, assuming that you opted for an external decoder – what is the DAC's latency, that will be inserted into the audio chain?. The reason for this question is that maximum tolerable latency is 185ms, and acceptable latency is 150ms. If you use UE5 in "Linear-Phase Mode", you will incur 145ms latency. If you use "Minimum-Phase Mode" you will incur 65ms latency (not readily noticeable). I have constructed a very simple test shown on the diagram below.

Test Description

Reference audio is provided by the Sony Bravia 70” TV taken from headphone output. This signal is connected to Channel 1 of a HP54600B Digital Storage CRO. The SPDIF output from the TV is connected to either Stereo DAC or Surround Sound DAC. The analogue output from the DAC is connected to Channel 2 of the CRO.

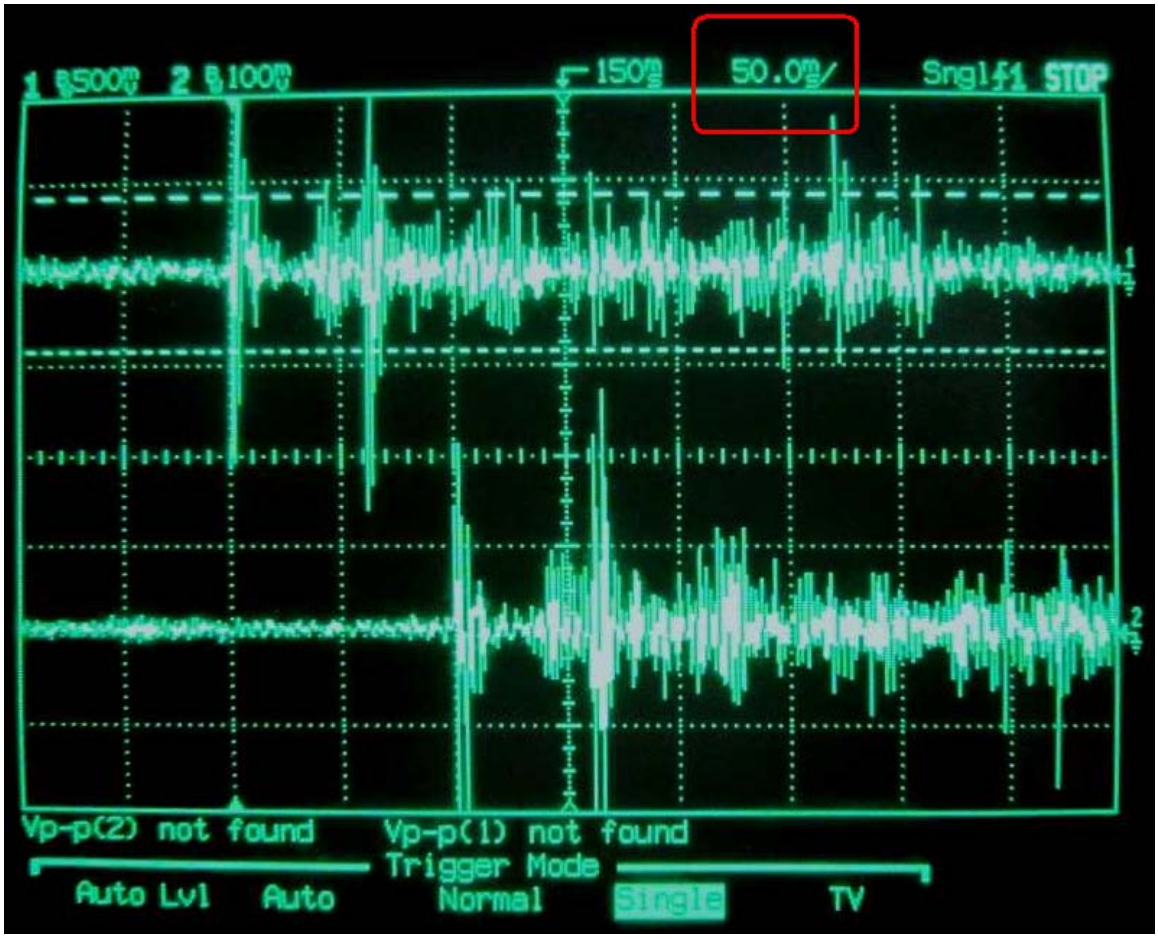
Triggering level is set such a way, that a loud sound will trigger Channel 1 and both channels will be captured on the screen.

I used background sound provided by Australian Open tennis tournament. This is because transmission from the tennis venue provided me with short, impulsive sounds (player hits the ball on serve), clearly visible on the CRO’s screen as an impulse.

5.1 SPDIF Decoder

http://www.jaycar.com.au/productView.asp?ID=AC1634

Specifications:
- 24-bit Audio DSP
- 96kHz Digital Receivers and 192kHz/24-bit AND and DAC
- Supports Dolby Digital AC-3 Dolby Pro-logic, DTS, PCM and other digital audio formats
- Multi channel audio Input: 2 x SPDIF, 1 x RCA Coaxial, 1 x 3.5mm stereo
- Outputs: 5.1 Channel Analogue (6 x RCA) or stereo



Measured latency is ~100ms.

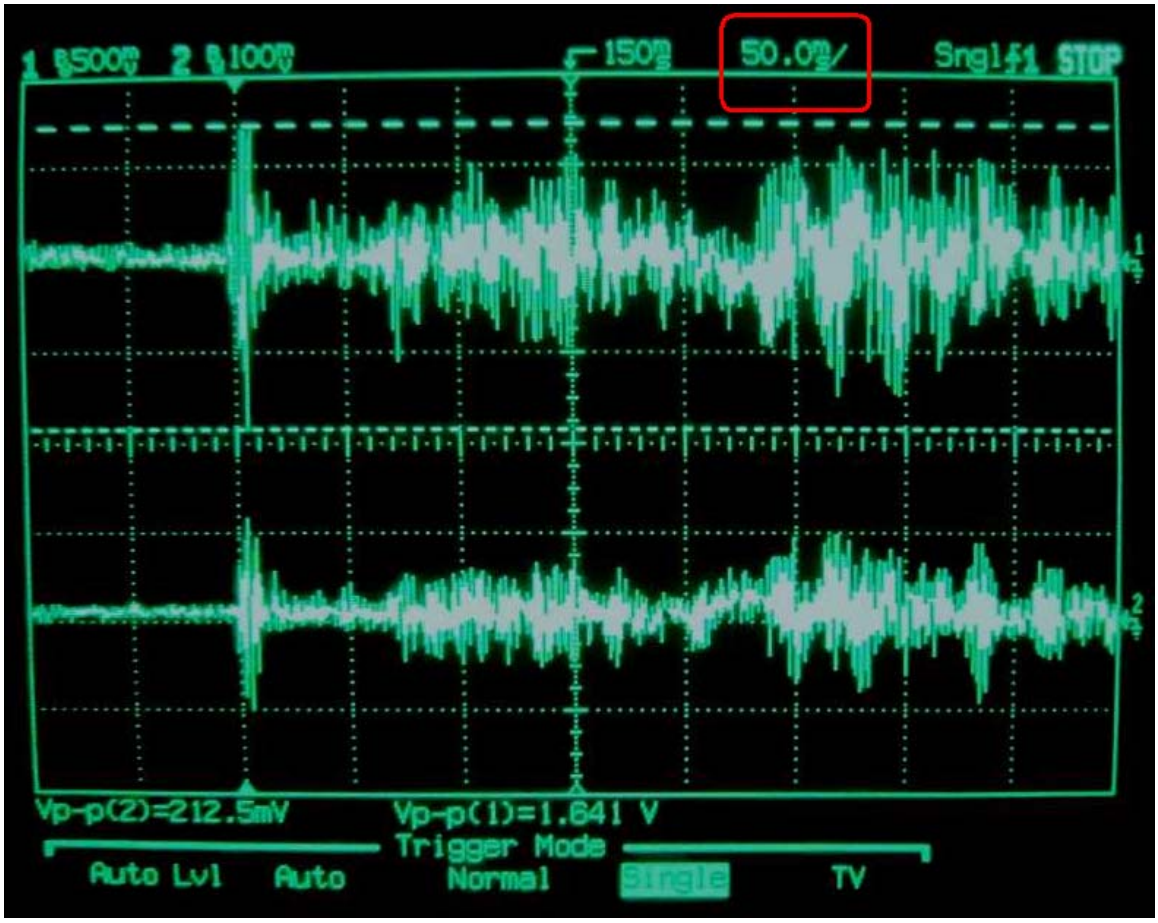
2.0 SPDIF Decoder

The second SPDIF DAC tested in this project is a low-cost converter available from Altronics in Melbourne, Australia for $AUD59
http://www.altronics.com.au/index.asp?area=item&id=A3199#

A quick eBay search is also very advisable, as perhaps cheaper alternatives can be found readily. The module has the following characteristics:

- input: SPDIF coaxial or Toslink
- Audio format: LPCM
- Input impedance: 75ohms
- Minimum load impedance: 10kohms
- Loopout function: yes
- Sampling rates: 44.1-192kHz/24bit
- Supply: +12VDC (power supply included)
- Dimensions: 7cm x 6cm (without cover)

The module will deliver 3.2 Vpp of analogue signal for full DAC swing.



Measured latency is negligible (~0ms).

The noise past the initial impulse is Maria Sharapova.

Conclusions

Data captured by the oscilloscope screen clearly indicates, that:

5.1 SPDIF decoder introduces approximately 100ms latency.
2.0 SPDIF decoder introduces approximately 0ms latency (negligible).

Given that UE5 in “Linear-Phase Mode” will incur 145ms latency and “Minimum-Phase Mode” you will incur 65ms latency (not readily noticeable), implications for UE Technology system would be as follows:

Using 5.1 SPDIF decoder:

Linear-Phase will result in 100ms + 145ms = 245ms latency. This is way beyond tolerable level. In this case, you may consider running the UE system in Minimum-Phase Mode, and accept 100ms + 65ms = 165ms latency, which is within tolerable range.

Using 2.0 SPDIF decoder:

Linear-Phase will result in 0ms + 145ms = 145ms latency. This is well within tolerable level. Minimum-Phase will result in 0ms + 65ms = 65ms. This is excellent.

Thank you for reading

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