Properly Terminating Video Op Amps

Introduction

When a transmission path is improperly terminated the energy is reflected and re-reflected from these discontinuities until it eventually shows up as linear distortion in the signal. This application note describes how to properly terminate a video amplifier such that distortion is minimized while maintaining the ability to measure the input/output impedance, and forward gain of the amplifier.

1. Output Termination

When terminating the low impedance output of a video amplifier, there are basically three choices.

Option 1 (Figure 1**)** – The transmission line is connected directly to the amplifier output. This configuration is ideal for measuring the devices output impedance, since a network analyzer can be connected directly to the output. However, the device must be capable of driving a low impedance (50Ω or 75Ω) since Z_L must equal Z_O to avoid reflections at the load. Forward gain can also be measured in this configuration; however, it provides limited control over the load impedance seen by the device.

Option 2 (Figure 2**)** – The output is back-terminated with a series resistor Z_1. This configuration doubles the devices effective load impedance (100Ω or 150Ω) and minimizes distortion, since any reflected energy from Z_L mismatches is absorbed by Z_1 (assuming Z_1 equals Z_o and $Z_{OUT} << Z_1$). However, the overall forward gain is reduced by a factor of two since Z_1 and Z_o form a divider network.

Option 3 (Figure 3**)** – A resistive back-termination network consisting of Z_1 and Z_2 is used. This configuration gives control over the amplifiers load impedance while maintaining a good match to the transmission line. Assuming $Z_L = Z_o$, the load impedance seen by the video amplifier is:

$$Z_1 + Z_2 \parallel Z_0$$

The source impedance seen by the cable is:

$$Z_1 \parallel Z_2$$

For example, if Z_1 = 900Ω and $Z_2 = Z_o = Z_L$ = 50Ω, then the load impedance seen by the amplifier is 925Ω. The impedance seen by the cable is approximately 50Ω (50Ω||900Ω), which provides a near-perfect match.

The trade-off in this topology is attenuation of the forward gain, given by:

$$\frac{Z_2 \parallel Z_0}{Z_1 + Z_2 \parallel Z_0}$$

For the example shown, the attenuation factor is 25/925.

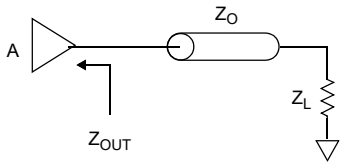

Figure 1. Direct Connection of Transmission Line to Video Amplifier Output

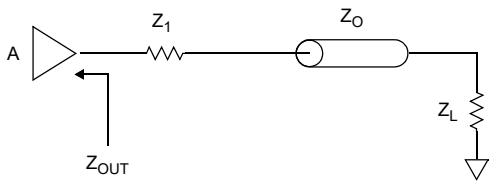

Figure 2. Back-Terminated Output with Matched Series Resistor

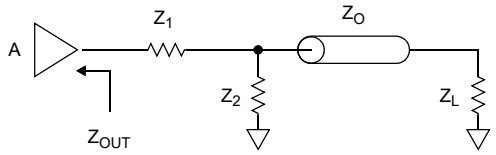

Figure 3. Dual-Resistor Back-Termination for Load Control and Line Matching

2. Input Termination

When terminating the high impedance input of a video amplifier, two primary configurations are commonly used.

Option 1 (Figure 4**)** – The transmission line is terminated to ground with resistor Z_1. Assuming $Z_1 = Z_0$, the mismatch between $Z_1||Z_A$ and Z_o is minimal because the amplifier input impedance Z_A is typically very large. If Z_A is capacitive, the match may degrade with frequency. However, any reflected energy is completely absorbed by R_G provided that $R_G = Z_o$. If there is a mismatch between R_G and Z_o, some of the reflected energy will be re-reflected from the source and travel back towards the amplifier, appearing as distortion.

Distortion at the amplifier input can be further reduced by keeping the transmission line electrically short relative to the signal wavelength. That is, the less the phase shift between the re-reflected energy and the incident energy, the less the signals constructively and destructively combine.

Option 2 (Figure 5**)** – The input is left unterminated. This configuration is preferred when measuring the amplifier input impedance, since Z_A would otherwise be difficult to measure accurately due to the parallel combination with the much smaller resistor Z_1.

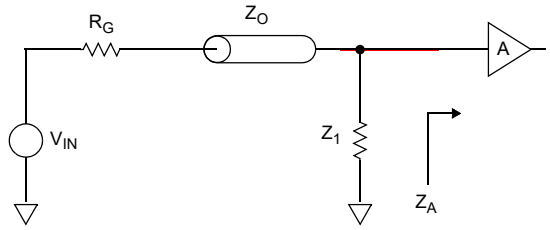

Figure 4. Shunt-Terminated Input with Matched Resistor

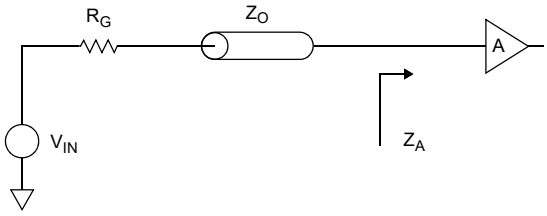

Figure 5. Unterminated High-Impedance Input for Impedance Measurement

3. Revision History

Revision	Date	Description
3.00	Jun 10, 2026	▪ Applied latest template. ▪ Added Rev History section. ▪ Updated sections.
2.00	Sep 24, 2004	Removed HFA1105, HFA1109, HFA1135 from title
1.00	Mar 1998	Initial release

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