Video Cable Drivers Save Board Space, Increase Bandwidth (HFA1112, HFA1114)

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Designing video cable drivers seems to be a fairly simple task. Just buy an amplifier with enough bandwidth, high output current, a gain of two or greater (eliminating most buffers) to counteract attenuation from back-terminating the cable, and good video specifications (gain flatness if you are designing for component video; differential gain and phase if you are designing for composite video), and you're in business.

Of course, picking a current feedback amplifier adds a few additional worries such as choosing the optimum feedback resistor, and minimizing the capacitance on both the summing node (-Input) and output. Still another problem is achieving the desired performance at typical video loads (≤75Ω if driving multiple back-terminated cables).

Choosing dual or quad amplifiers and/or SOIC packaging complicates the equation even further. How does the engineer find a way to optimally place eight gain-setting resistors, not to mention termination resistors, around a quad amplifier in an SOIC package? There is no easy solution. Compromises must be made, which usually result in inadequate terminations or long trace lengths.

Specialized ICs can simplify the task of cable driver design and board layout. However, even the best cable driver can't solve all problems.

A common complaint when working with long cables involves a particular type of image degradation. The display in question exhibits bright horizontal lines but gray vertical lines. Since it is well known that narrow vertical lines require higher bandwidth to be displayed properly, the bandwidth obviously is being limited somewhere in the system. Invariably, substituting a shorter cable dramatically improves the image quality, leading to the hypothesis that the cable driver's performance degrades when driving long cables. This hypothesis requires some scrutiny.

It's true that circuit performance changes when driving cables, but is it really the cable driver that is at fault? Figure 1 illustrates the performance of Intersil's HFA1112 amplifier driving 100 feet of back-terminated cable. It shows that the amplifier's 550MHz bandwidth decreases to 40MHz over the measured range, lending credence to the previous hypothesis. But what's really happening?

Many engineers forget that all electrical elements have finite bandwidth. Cables are usually taken for granted, but long cables can limit system bandwidth to surprisingly low frequencies. For example, a comparison of the frequency response of the HFA1112 driving the same 100 feet of cable to the response of the cable alone shows that the problem isn't the cable driver, but rather the cable itself (see Figure 2).

It is abundantly clear from Figure 2 that the cable performance itself limits the system performance for most of the frequency range. Throwing a higher bandwidth driver at the cable will, in fact, gain the engineer designing the system nothing, because you can't get more bandwidth than the cable allows.

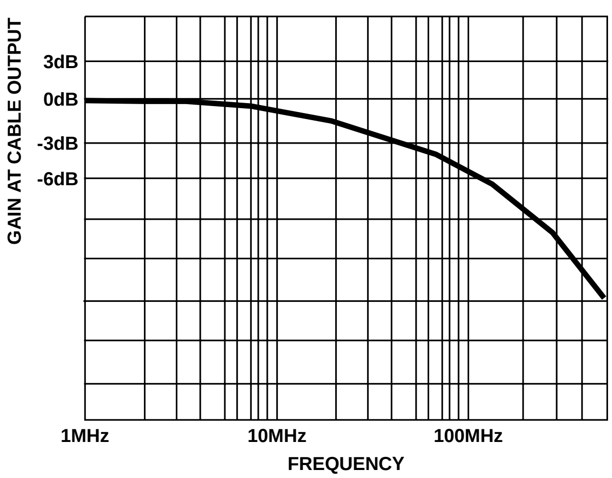

FIGURE 1. PERFORMANCE RESULTS INDICATE THAT THE HFA1112 AMPLIFIER'S 550MHz BANDWIDTH DECREASES TO 40MHz WHEN DRIVING 100 FEET OF BACK-TERMINATED CABLE. THIS SUPPORTS THE HYPOTHESIS THAT A CABLE DRIVER'S PERFORMANCE DEGRADES WHEN DRIVING LONG CABLES.

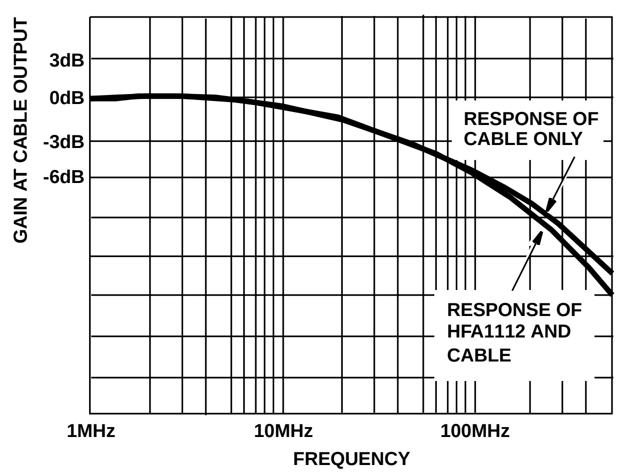

FIGURE 2. ALTHOUGH USUALLY TAKEN FOR GRANTED, LONG CABLES CAN LIMIT SYSTEM BANDWIDTH TO LOW FREQUENCIES, AS IS EVIDENT IN THIS COMPARISON BETWEEN THE FREQUENCY RESPONSE OF THE HFA1112 DRIVING THE CABLE AND THE RESPONSE OF THE CABLE ALONE.

Upgrading to a higher performance cable, such as a Belden 8281 or equivalent, is one solution to boosting system bandwidth. There are at least two downsides to this option, however. The first is that it introduces significantly higher cable costs. The second is problems presented to technicians who have to work with more rigid cables.

A better solution may be to use a cable driving buffer such as Intersil's HFA1114. The driver's frequency response is tunable for a specific cable length via components connected to the summing node (see Figure 3). By shunting R_1, R_C acts to increase the amplifier's gain while C_C controls the cut-in frequency of the compensation.

These three components peak the amplifier's frequency response to counteract the cable's roll-off characteristic. By squeezing more bandwidth out of a given cable, higher-performance cables aren't needed.

An unexpected but welcome side effect of this particular solution is that using the on-chip gain-setting resistors frees up board space for the compensation components.

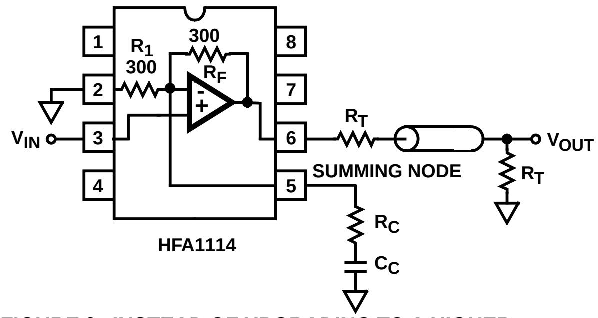

FIGURE 3. INSTEAD OF UPGRADING TO A HIGHER PERFORMANCE CABLE TO INCREASE SYSTEM BANDWIDTH, A CABLE DRIVER LIKE THE HFA1114 CAN BE EMPLOYED. THE DRIVER'S FREQUENCY RESPONSE IS TUNABLE FOR A SPECIFIC CABLE LENGTH VIA THE COMPONENTS CONNECTED TO THE SUMMING NODE.

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