

## Application Note

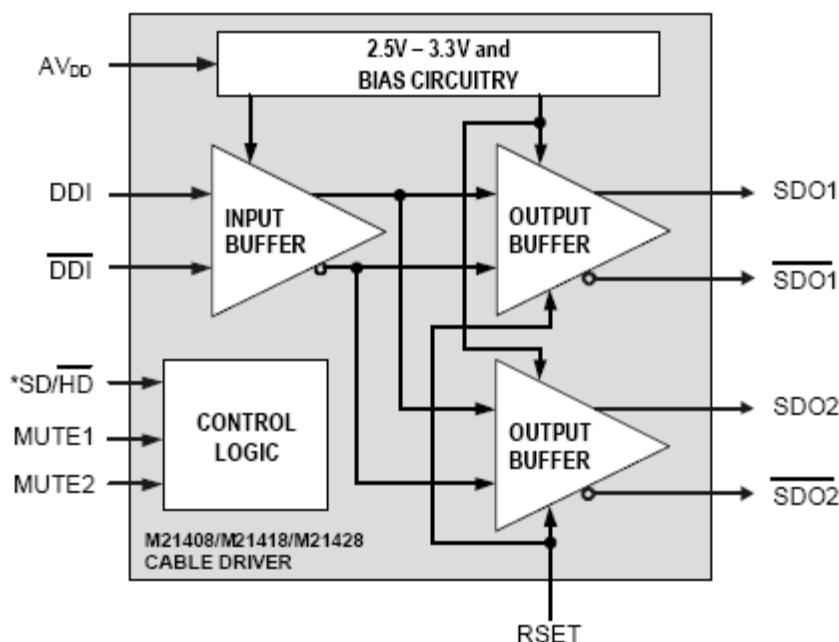
# Using the M21428 Cable Driver in Tandem Mode, to Provide High Output Swing

### Introduction

The M21428 is a high-performance 3 Gbps cable driver for transmitting digital video signals over long lengths of coaxial cable. It is designed to conform to SMPTE 292, 259M, 344M and 424M specifications that require an 800 mV single ended launch voltage. Some system applications require a larger output as the signal is split or has an attenuator in series with it. For example, one output may drive a midplane trace at 1600 mV, which at the far end is split into two 75Ω, 800 mV outputs.

In standard configuration, the M21428 will output up to and over 1600 mV. However, for 3 Gbps applications (SMPTE 424), a rise/fall time of 135 ps (20/80%) is required, at 1600 mV, the output voltage of the device is marginal on meeting this SMPTE fall time specification. This application note describes a novel way of overcoming this limitation. The M21428 has two differential outputs. By coupling each 1P/2P and 1N/2N together, the output drive current is doubled, thus improving the fall time to well within the SMPTE specification.

**Figure 1. M21428 Block Diagram**



## Tandem Connections

Figure 2 shows how the standard cable driver board is connected. Each output has its own 75Ω pull-up (R6 and R8) and matching network (L3/R9, R7/L2).

Figure 2. Standard Connections

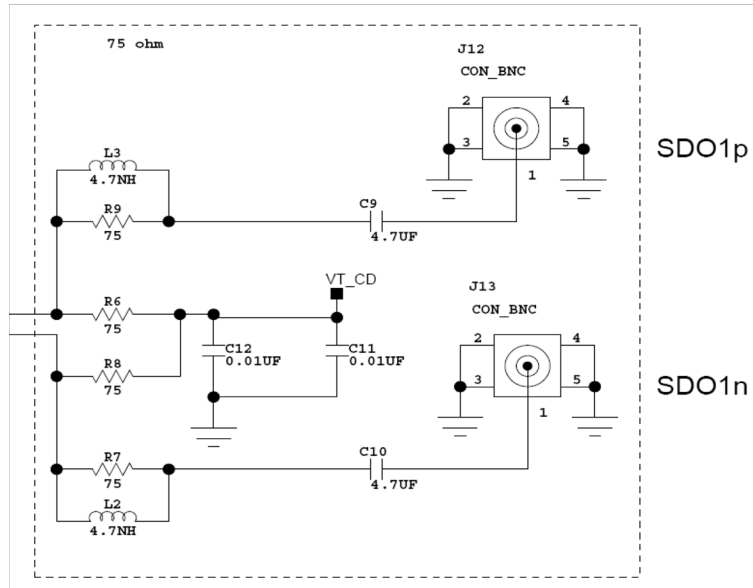
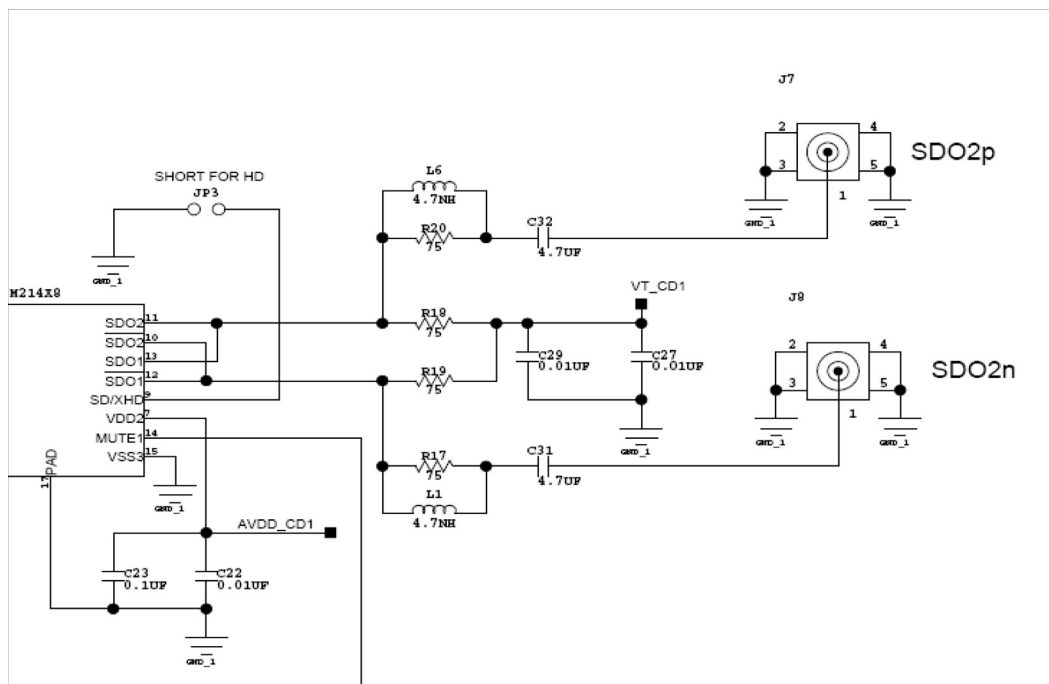


Figure 3. Tandem Connections



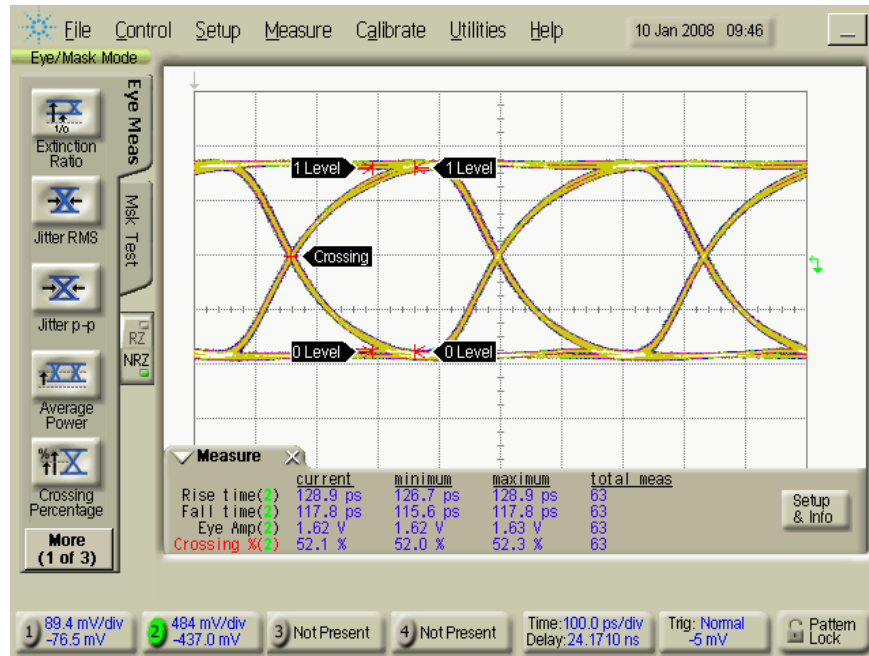
Both P outputs and both N outputs are connected together and one 75Ω pull up resistor is used for each pair of outputs and one matching network.

## Eye Diagrams for Tandem Configuration

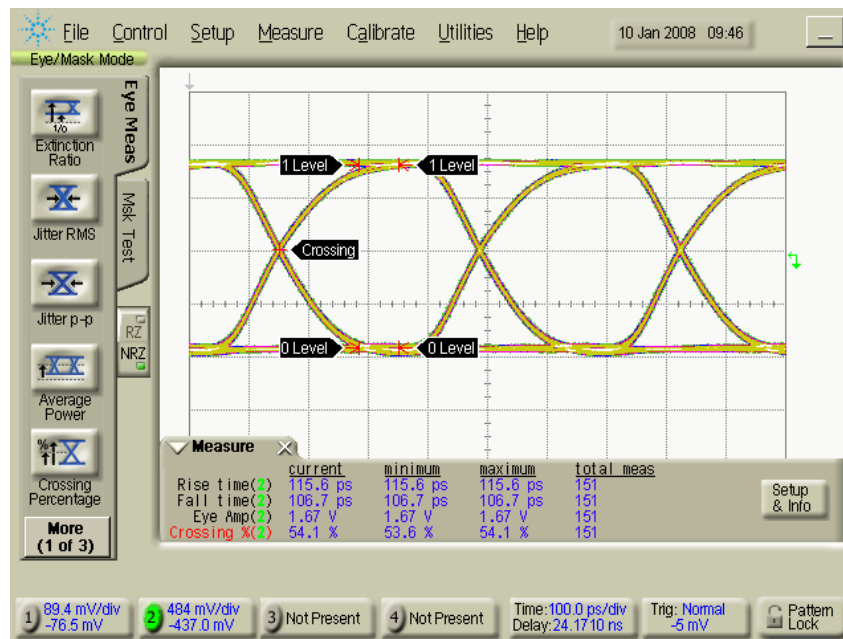
### 3 Gbps Eyes

Figures 4 and 5 show the 3 Gbps eyes of the tandem board outputs.

**Figure 4. Eye for Positive Output**



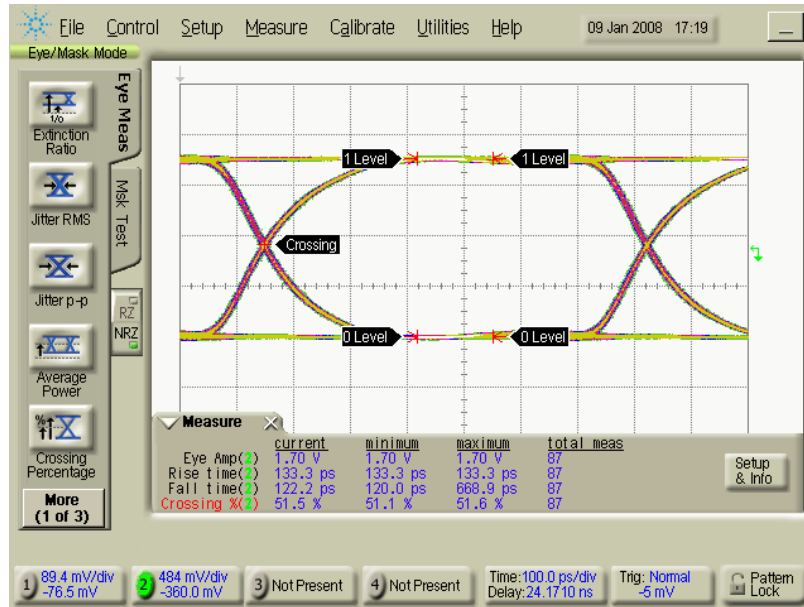
**Figure 5. Eye for Negative Output**



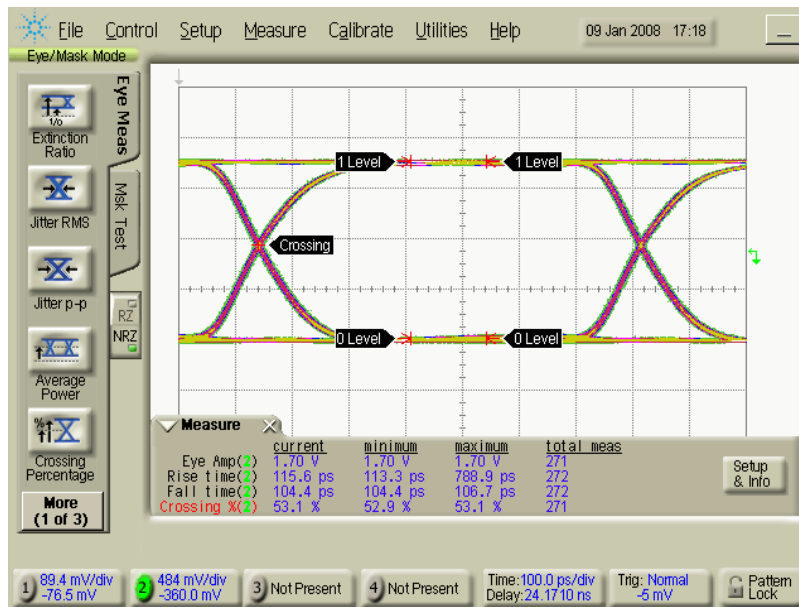
## HD Eyes

Figures 6 and 7 show the HD rate eyes of the tandem board outputs.

**Figure 6. Eye for Positive Output**



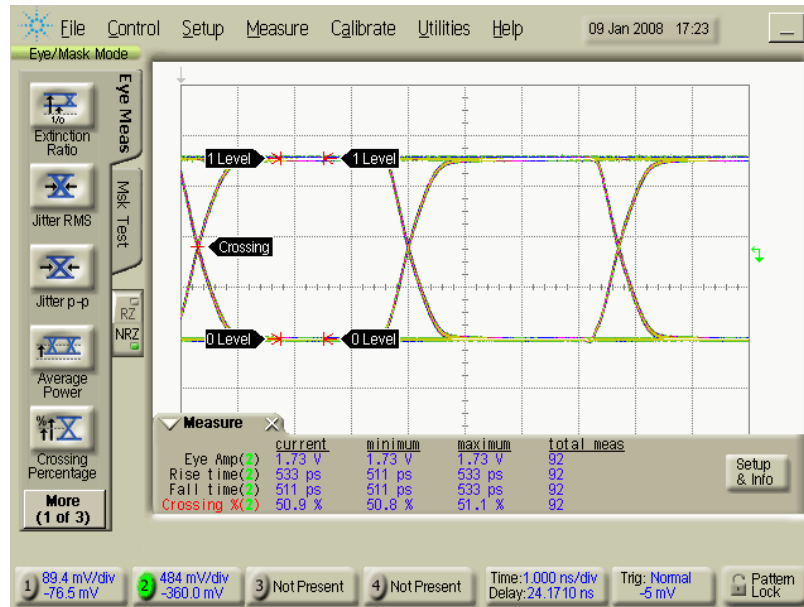
**Figure 7. Eye for Negative Output**



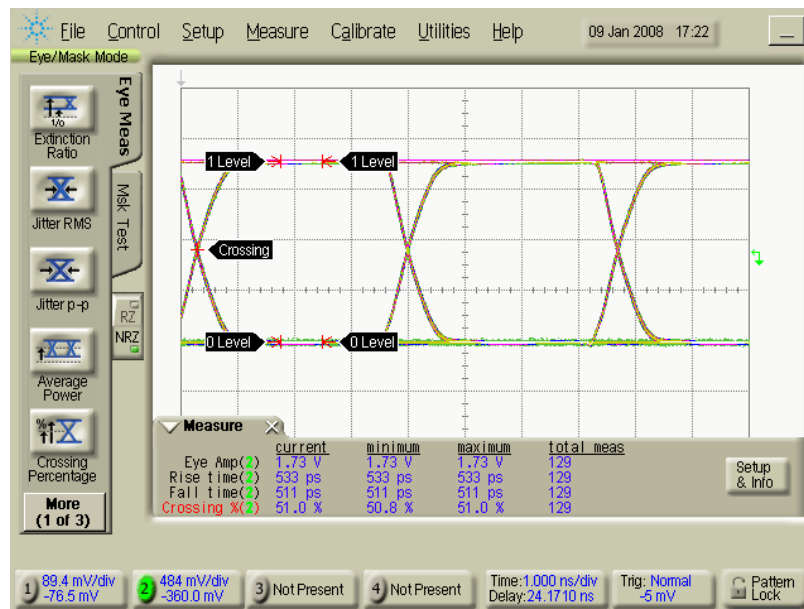
## SD Eyes

Figures 8 and 9 show the SD rate eyes of the tandem board outputs.

**Figure 8. Eye for Positive Output**



**Figure 9. Eye for Negative Output**



The N output has consistently better rise and fall times than the P output; this partly due to the fact that the board interconnection on the P output has to negotiate the corner of the device package, causing extra parasitics. It is recommended that the N be used and to correct polarity the P/N inputs should swapped to correct the inversion, so that the N output provides a true signal. This is important for DVB applications but not for SMPTE.

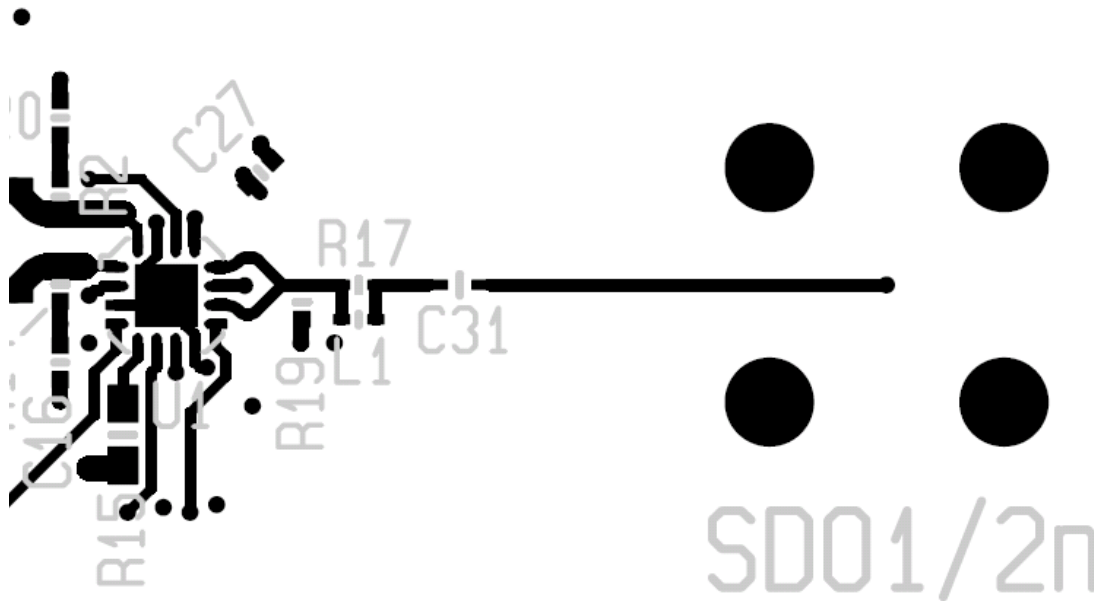
Using a matching network of  $L = 2.7\text{nH}$  and  $R = 75\Omega$  in parallel gives the best rise and fall times.

## Output Return Loss

### Board Layout

Below is the test board layout for the PCB layer connecting the N outputs together. This is cleaner than the P outputs that require two vias to connect them together, reducing the performance, which results in poorer return loss and slower eye diagrams. For this reason it is recommended that the N outputs be used to drive the cable.

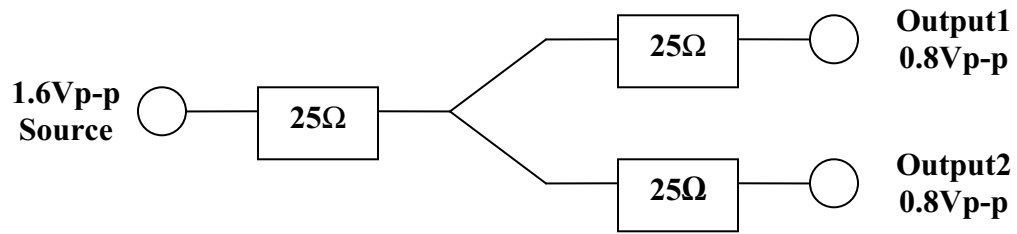
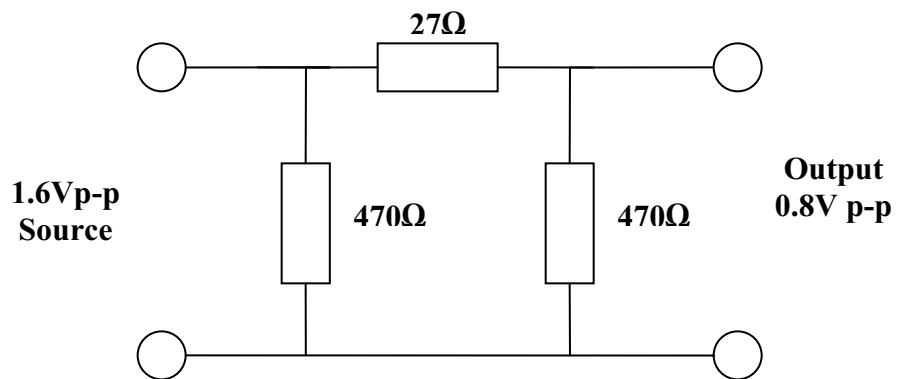
**Figure 10. Layout Showing Coupling of Negative Output**



### Matching Network and Attenuator/Splitters

A matching network, L1 and R17, above, is used to cancel some the effects of the parasitics and this is adequate for the single coupled output. However, because the tandem outputs have nearly twice the parasitics of the single outputs, the return loss is not as good as the single coupled output. To meet or exceed the SMPTE specification of -10dB at 3 GHz, some isolation is required. This is in the form of an attenuator or a splitter/combiner, circuits for a 75Ω splitter and a 6 dB attenuator are shown in Figures 11 and 12.

Note that if a 6 dB attenuator or splitter is used, the improvement in return loss is double that, i.e. nearly a 12 dB improvement can be obtained.

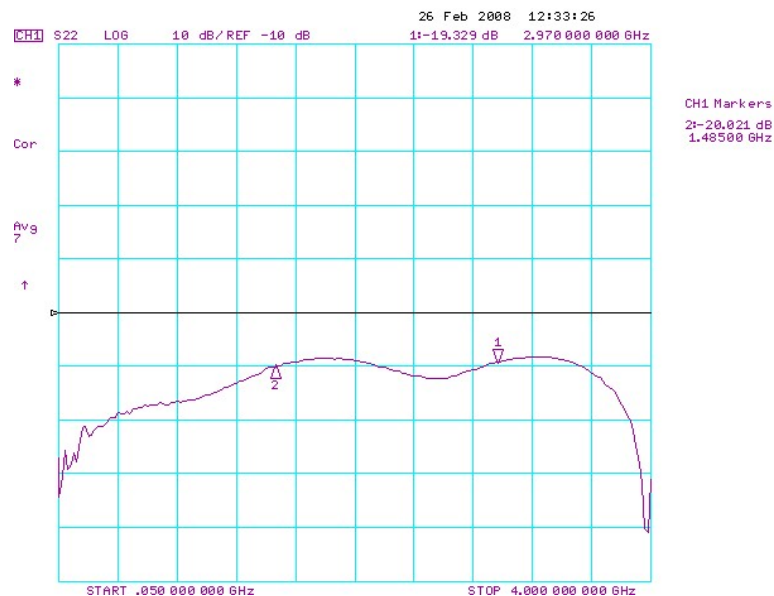
**Figure 11. 75  $\Omega$  Splitter/Combiner Circuit****Figure 12. 75  $\Omega$  6dB Attenuator**

## S22 Network Analyzer Plots

**Figure 13.  $S_{22} = -8.4\text{dB}$  @ 3 GHz, with 0dB output attenuator,  $L_{\text{match}} = 2.7\text{nH}$**



**Figure 14.  $S_{22} = -19.3\text{ dB}$  @ 3 GHz, with 6dB output attenuator,  $L_{\text{match}} = 2.7\text{nH}$**



## Conclusion

Coupling together the twin outputs of the M21428 cable driver is an effective way to achieve the higher output swing of 1600 mV and meet the SMPTE rise/fall time specification of 135 ps. This can be used to drive a splitter network or an attenuator, where it achieves the SMPTE output return loss of 10 dB with good margin. Best results are obtained with the N outputs, due to the layout constraints of the P outputs. It also provides simple digital control of amplitude; by muting the second output, the level will revert to the standard 800 mVp-p.



## References

M21428 Data Sheet

SMPTE 424, 259M, 292, 344M