

Application Brief

3.3V Cable Driver And Equalizer Drive Mega-Bits @ Many Meters

Application Brief 105

Gary Melchior

Transmitting data over long distances is necessary in a wide range of applications. These include telecom and video electrical interfaces running at data rates of up to 400 Mbps over appreciable distances. Long-haul data transmission is easily accomplished with existing devices. The new CLC001 cable driver, CLC012 cable equalizer, and CLC016 data retiming PLL form a robust serial digital interface that transmits megabits of data over hundreds of meters. *Figure 1* shows a typical SDI application.

The 3.3V Cable Driver

The CLC001 is a 3.3V cable driver ideal for high-speed data transmission over long distances. It drives 75Ω transmission lines (Belden 8281 or equivalent) at data rates up to 622 Mbps. Its versatile input stage allows for a wide range of input levels, including direct LVDS and LVPECL connections. Rise and fall times are typically 400 ps. Its two complementary outputs may be used single-ended or differentially and are adjustable from 800 mV_{p-p} to 1.0 V_{p-p}.

The Cable Equalizer is the most important element in serial digital interfaces.

The cable equalizer has the task of recovering the signal from a seemingly worthless waveform [See *Figure 2(b)*] and restoring it to its proper voltage levels. The CLC012 adaptive cable equalizer does just that. It automatically compensates for attenuation in cable corresponding to up to 300 meters of Belden 8281 coaxial cable or 120 meters of Category 5 UTP. The CLC012 approximates the reciprocal of the cable loss characteristic and supplies 40 dB of gain at 200 MHz. Jitter performance is 180 ps_{p-p} for 270 Mbps data that has passed through 200 meters of Belden 8281 cable. A Loss of Signal output and an output mute function are also provided.

The Data Retimer cleans up jitter.

The CLC016 data retimer re-establishes proper bit widths and their correct relationship to the serial clock edges, in addition to extracting a clock from the signal. Auto-rate select circuitry allows the CLC016 to recognize up to four data rates between 40 and 400 Mbps and

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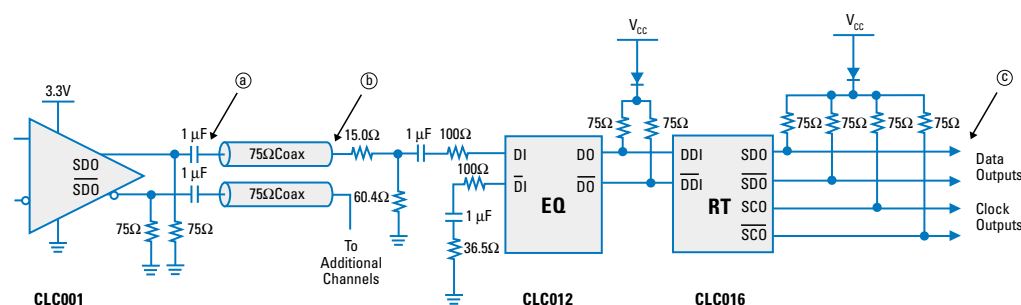


Figure 1. Typical SDI Long-haul Application

*Note: (a), (b), and (c) represent the location of eye diagrams in *Figure 2*. This simplified schematic shows only the major signal path. For more detailed schematics, please refer to the datasheets online at www.national.com/appinfo/interface

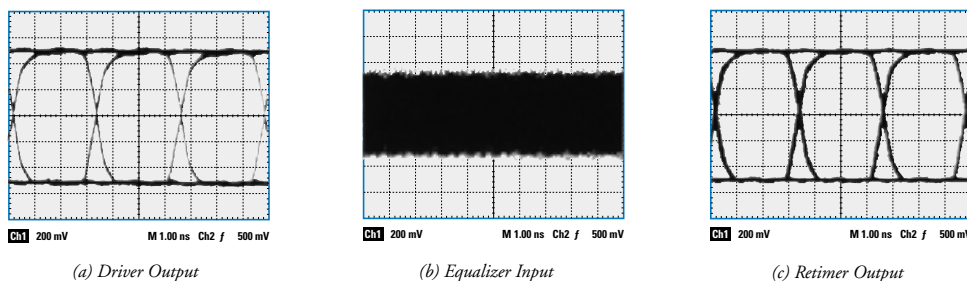


Figure 2. Eye Diagrams at (a) Driver Output, (b) Equalizer Input, and (c) Retimer Output

automatically adjust to provide accurate, low-jitter clock and data recovery. Output jitter is only 130 ps_{p-p} at 270 Mbps.

The circuit in *Figure 1* was tested at a data rate of 311 Mbps. The signal source is a PRBS pattern generated by a Tektronix GigaBERT 700. The CLC001 drives 250 meters of Belden 8281 cable with a 1.0 V_{p-p} output level. The signal at the CLC001 output is shown in *Figure 2(a)*. After passing through the cable, signal amplitude has fallen to about 700 mV and the signal appears to be worthless [*Figure 2(b)*].

A usable signal can be recovered by the CLC012 after up to 300 meters of cable. The signal is recovered and the data is retimed by the CLC012 and CLC016, respectively. The resultant signal is buffered by another CLC001 to drive the line to the scope and is shown in *Figure 2(c)*.

As can be seen from these waveforms, the CLC012 and CLC016 are very effective at restoring data after hundreds of meters of cable. SDI Interface devices can be used for a wide variety of digital video, datacom, and telecom applications.

Serial Digital Interface Selection Guide

Part Number	Description	Data Rate	Jitter (ps)
CLC001	3.3V Cable Driver with Adjustable Outputs	DC to 622 Mbps	25
CLC005	ITU Cable Driver with Adjustable Outputs	DC to 400 Mbps	25
CLC006	Cable Driver with Adjustable Outputs	DC to 400 Mbps	25
CLC007	Cable Driver with Dual Complementary Outputs	DC to 400 Mbps	25
CLC012	Adaptive Cable Equalizer (ITU)	40 to 650 Mbps	180
CLC014	Adaptive Cable Equalizer (SDV)	40 to 650 Mbps	180
CLC016	Data Retiming PLL with Auto Rate Selection	40 to 400 Mbps	130
CLC018	8X8 Digital Crosspoint Switch	DC to 1.485 Gbps	50

National Semiconductor
2900 Semiconductor Dr.
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