Application Report
SNLA075A–October 2005–Revised April 2013

AN-1399 Enabling Redundancy in Multi-Gigabit Links With DS40MB200 Mux/Buffer

ABSTRACT

The DS40MB200 is a new signal conditioning mux/buffer in TI's high-speed product portfolio. It enables redundancy and acts as a repeater in high-speed backplanes and cables. It features programmable pre-emphasis and fixed input equalization, enabling error free data links to 4 Gbps. It can also be used as a signal conditioning driver to provide equalization to FR4 board traces as well as cables, shielding host ASIC, FPGA or SerDes from dealing with the impairments of the transmission medium.

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1 Introduction

In a communication system, redundancy is an important feature to maintain reliable operation and prevent down time caused by unexpected failures. Implementing redundancy in large scale ASIC or SerDes components significantly increases the pin-count of the component packages and, very often, carries the penalty of performance degradation. The DS40MB200 mux/buffer, a new addition to Texas Instruments high-speed product portfolio, is designed to enable redundancy in data links to 4 Gbps. The DS40MB200 has built-in signal conditioning features to enable error-free data transmission over FR4 backplanes or high-speed cables.

2 Redundancy

The DS40MB200 is a dual bi-directional multiplexor and repeater available in a small leadless LLP-48 package. Each port of the DS40MB200 consists of a transmit signal path through a 1:2 repeater, sending data to two redundancy cards. The receive path consists of a 2:1 multiplexor that selects the communication link between the host card and one of the two redundancy cards. Figure 1 shows the block diagram of the DS40MB200 illustrating its functions.

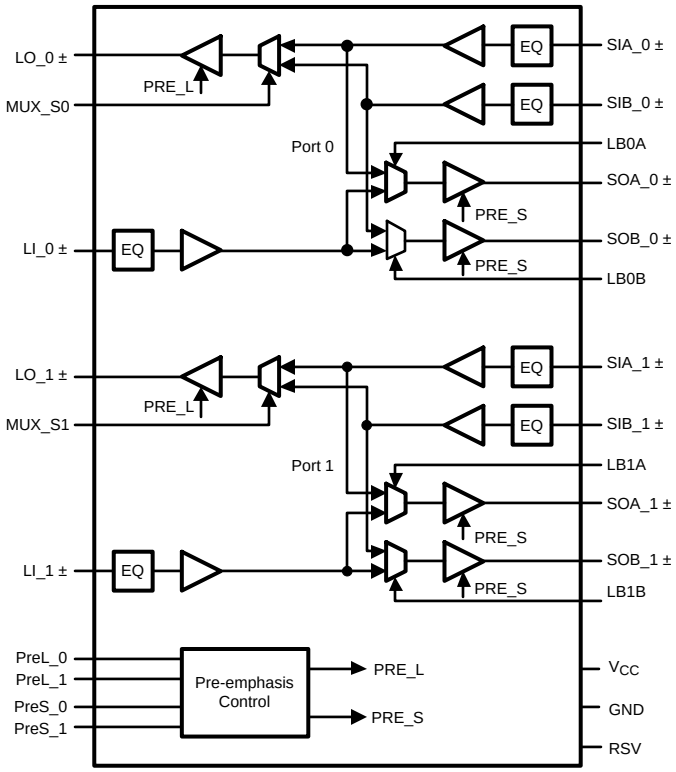

Figure 1. Functional Block Diagram of the DS40MB200

System designers can choose to place the DS40MB200 on an active or passive backplane to support redundancy. Figure 2 illustrates the use of the DS40MB200 in an active backplane. With the signal conditioning features built into the DS40MB200, this arrangement allows system designers to extend the span of the backplane traces. Many system designers implement redundancy on the host card. Figure 3 illustrates the use of the DS40MB200 in a passive backplane.

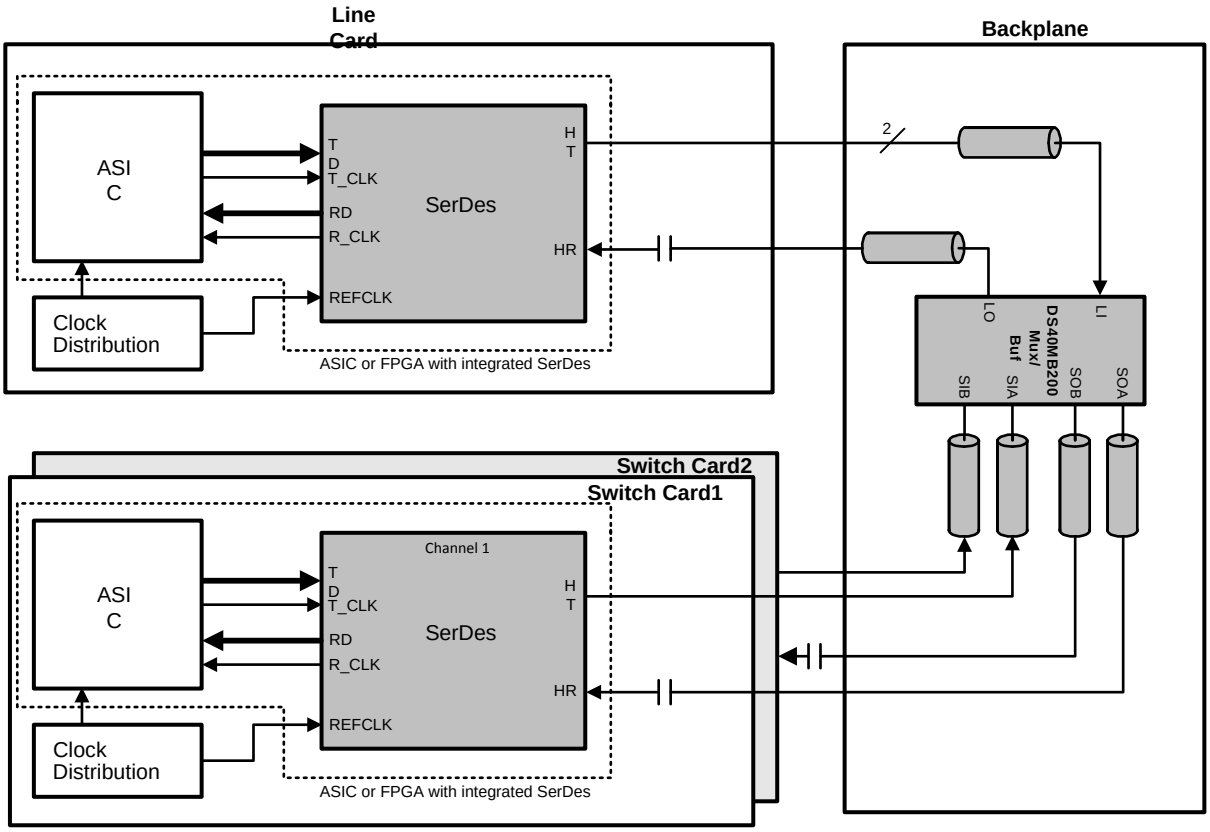

Figure 2. DS40MB200 in an Active Backplane

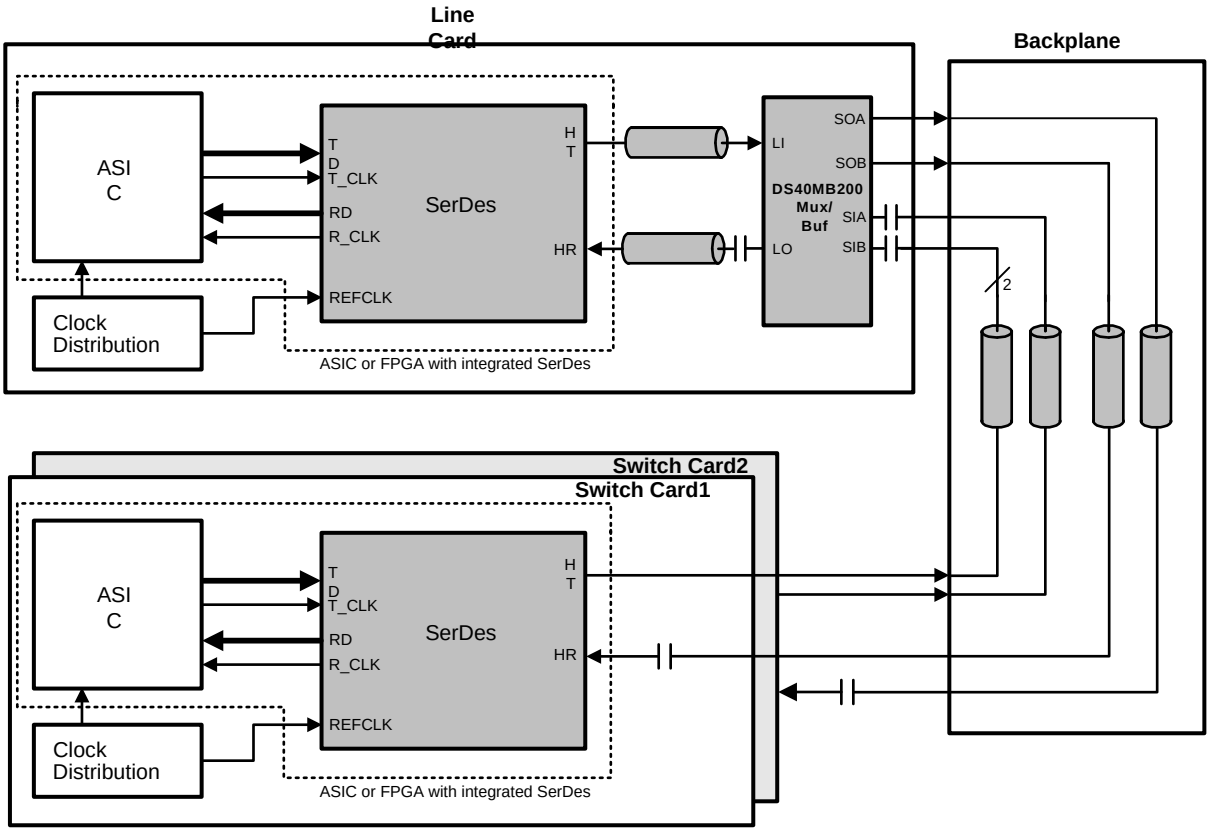

Figure 3. DS40MB200 in a Passive Backplane

3 Signal Conditioning

In implementing the redundancy function in either a passive or an active backplane, the DS40MB200 mux/buffer is designed to interface with the transmission medium directly. Each signal path of the DS40MB200 is designed with signal conditioning features that equalize transmission loss and reduce jitter caused by the transmission medium.

Each output driver of the DS40MB200 has pre-emphasis to compensate the transmission loss disparity of the transmission medium that it is driving. Whenever there is a transition of logic state, the driver sends the first data bit with its full amplitude. Because of lower transmission loss from the transmission medium, the driver sends the subsequent data bits of the same logic state with reduced amplitude. Effectively, the driver conditions the output signal amplitude such that the lower and higher frequency pulses reach approximately the same amplitude at the receiving end of the transmission medium. Figure 4 illustrates the pre-emphasis waveforms before and after a lossy transmission line.

Pre-emphasis minimizes the deterministic jitter caused by amplitude disparity of the transmission line. The DS40MB200 provides four steps of pre-emphasis ranging from 0, 3, 6 and 9 dB to handle different amount of transmission losses. These four pre-emphasis steps are user-selectable through two logic control pins.

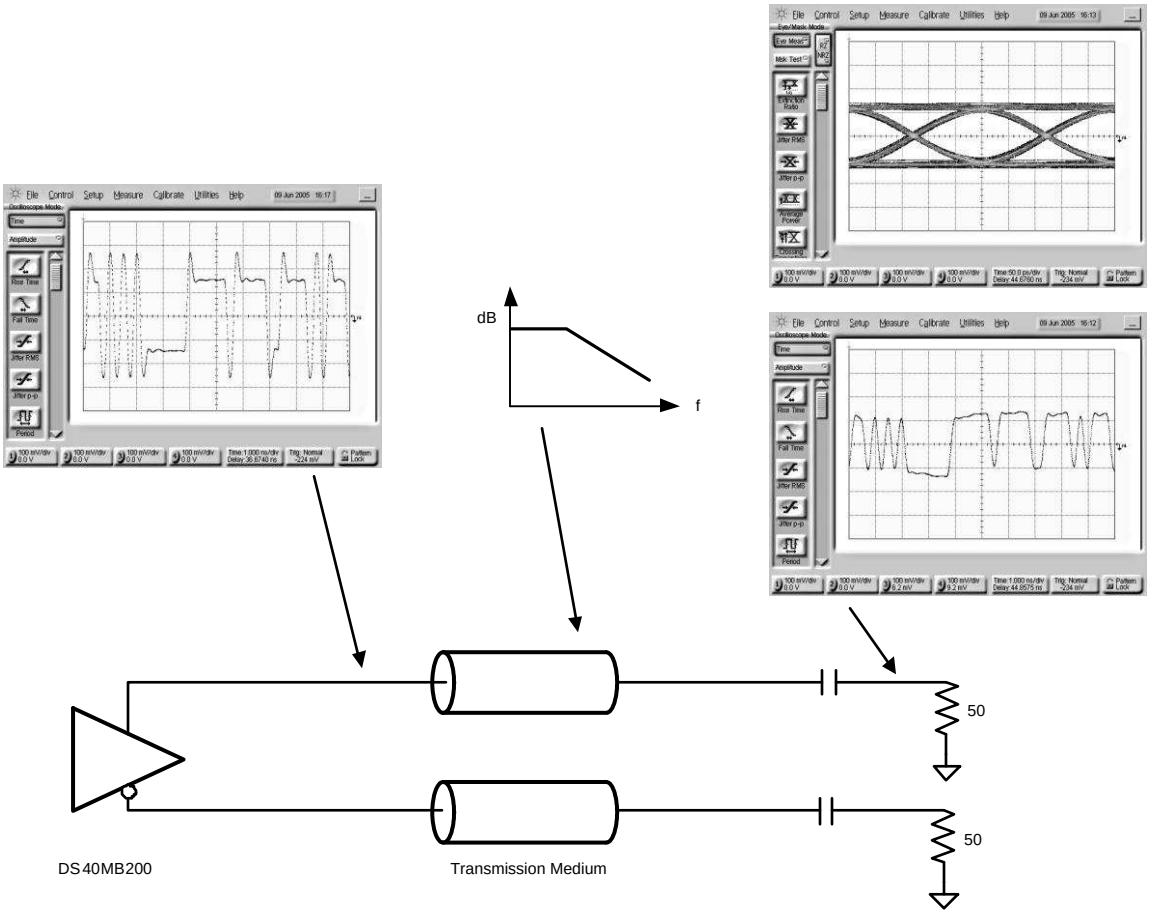

Figure 4. Pre-Emphasis Waveforms Before and After a Lossy Transmission Line

Each input stage of the DS40MB200 has a fixed equalizer followed by a limiting amplifier and driver. The input equalizer provides a boost to higher frequency signals that are attenuated by the transmission loss of the input board trace. The fixed equalizer is designed to equalize about 5 dB of transmission loss disparity from the input transmission line at 4 Gbps. The input equalizer is capable of providing jitter reduction of about 30 ps caused by a 5 dB transmission loss.

The input equalizer provides secondary equalization to clean up the deterministic jitter caused by the input transmission line. The driver re-shapes and re-transmits the bit stream with pre-emphasis, compensating for loss caused by the transmission medium. With the DS40MB200 on both ends of the transmission medium, system designers can handle up to 14 dB of transmission loss and enable error free data transmission to 4 Gbps.

4 DS40MB200 as a Driver-Side Equalizer

In addition to its redundancy function, the DS40MB200 can be used as an external equalizer, shielding the host ASIC or FPGA from the job of handling the transmission impairments from the interconnecting transmission medium. The DS40MB200 supports a high output amplitude of 1200 mV_{P-P} with fast edge rates of about 80 ps. Using an external equalizer, such as the DS40MB200, provides system designers the option of using a lower cost ASIC or FPGA, and distributes signal conditioning devices at critical locations to improve signal integrity. Figure 5 illustrates the use of DS40MB200 with an ASIC/FPGA.

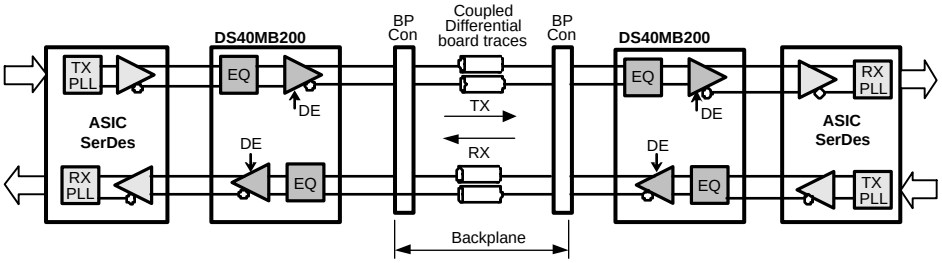

Figure 5. DS40MB200 as an Equalizer Used With ASIC/SerDes

5 DS40MB200 as a Cable Equalizer

The DS40MB200 provides equalization for transmission media such as FR4 board traces, backplanes, or cables. With programmable pre-emphasis, it can handle transmission losses from different cable lengths by setting the proper pre-emphasis steps of 0, 3, 6 or 9 dB through control pins. Figure 6 depicts the use of DS40MB200 as a cable equalizer. Figure 7, Figure 8, and Figure 9 show data eye patterns with the DS40MB200 driving a CAT7 cable.

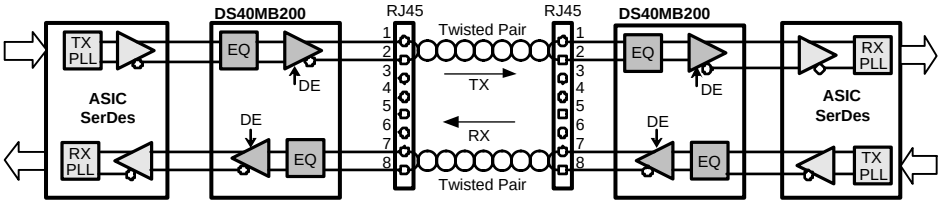

Figure 6. DS40MB200 as a Cable Equalizer

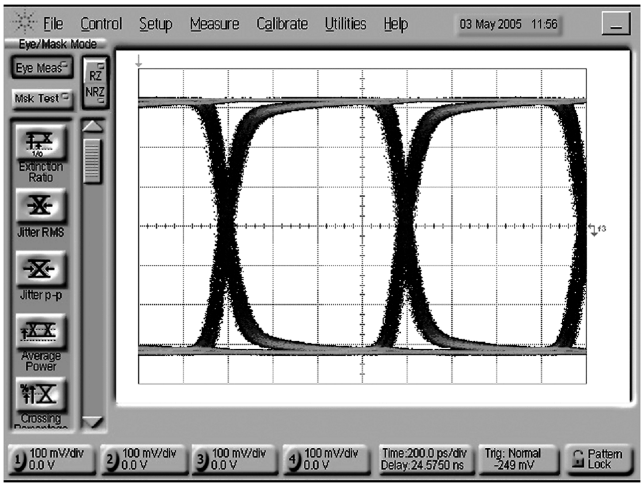

Figure 7. Data Eye Pattern After a 10-Meter CAT7 Cable at 1.25 Gbps

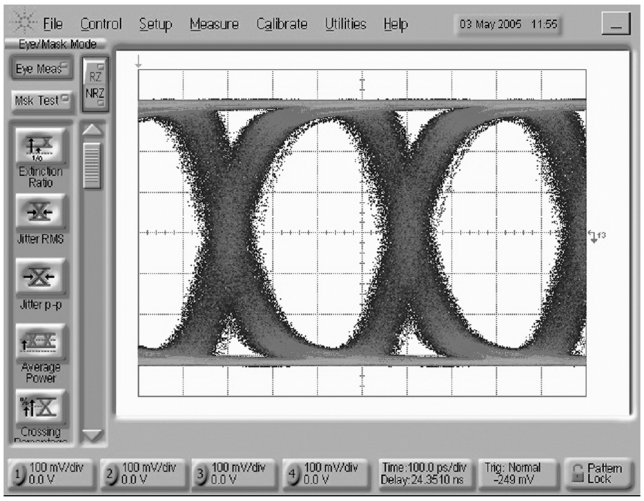

Figure 8. Data Eye Pattern After a 10-Meter CAT7 Cable at 2.5 Gbps

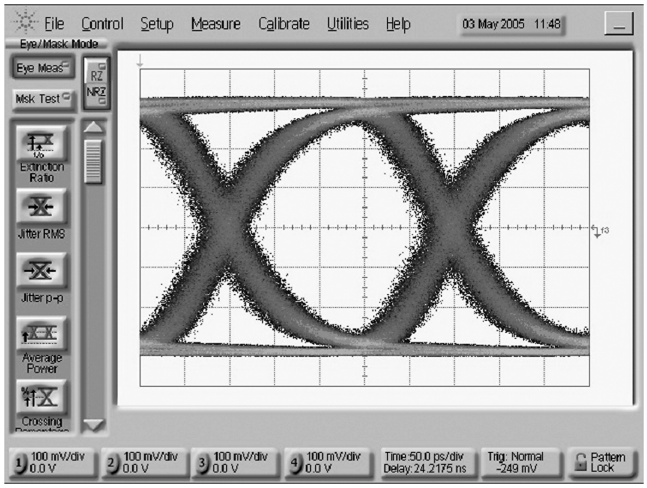

Figure 9. Data Eye Pattern After a 5-Meter CAT7 Cable at 4 Gbps

6 References

- *Dual 4.0 Gbps 2:1/1:2 CML Mux/Buffer With Transmit Pre-Emphasis and Receive Equalization* (SNLS144)
- *AN-1389 Setting Pre-Emphasis Level for DS40MB200 Dual 4Gb/s Mux/Buffer* (SNLA073)

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