25 G/s Passive Current Board Design of PRBS Generator

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Abstract— The 25 Gb/s BER test set comprises a signal generator that drives an passive current board including micro-strip line (R6C) through Gennum GN2426A IC and SEMTECH GN2426A chip generated with a Pseudo Random Binary Sequence (PRBS) of digital 1's and 0's, representing a random data stream. The simple 25 Gb/s testing of passive current board converts the PRBS data stream from electrical to optical components. The R6C's price for 25 Gb/s passive current board of a PRBS generator is almost 1/400 times than the measuring equipment price. R6C board is a structure for four layers. Its feature of eye diagram is a jitter of 12.614 ps, a bit rate of 25.35 Gb/s, a fall time of 14.5 ps and a rise time of 12.5 ps. R6C has a useful role under mass production. It is very cheap and simple high speed testing for 25 Gb/s.

1. INTRODUCTION

Today short reach optical communications development require low cost and high speed transceivers. Internet and consumer electronics products flourish, and promote the development of cloud computing and processing large data [1–3]. Enhance the data processing speed and high capacity optical transport network (OTN) is the current trend, Therefore, the development of 100 Gb/s transfer several times even faster optic transceiver [4]. Using vertical cavity surface emitting lasers (VCSEL) coupled to multimode fibers (MMF) are best solution [5]. The high-frequency signal transceiver used micro-strip circuit will be necessary to be matched with dependent resistant and then operate under the reliable communication [6]. PRBS can be considered of the well suited to the bit error rate (BER) testing and eye diagram analysis in communications system [7, 8].

Between chip and printed-circuit-board (PCB) bit rates and frequency are increased. Testing the signal integrity effect of PRBS as well as validating the impedance matching of micro-strip is important when using micro-strip transmission line and connector. Micro-strip is measure impedance by time domain measurement. Also, the communication system measurement costs are high since PRBS equipment is expensive and bulky. The authors proposed a 25 Gb/s PRBS generator circuit board.

The PRBS generator chip connects the PCB using micro-strip transmission line to achieve high-speed bit rates. PRBS circuit board was combine two micro-strip type, one is the differential micro-strip, and another is the single-end. Hence, using the micro-strip and PRBS generator IC, it is possible to Performance the signal integrity property at 25 Gbps. This paper is organized as follows. In Section 2, In Section 3, the test PRBS circuit board is demonstrated to property the signal integrity. The Section 4 is conclusion.

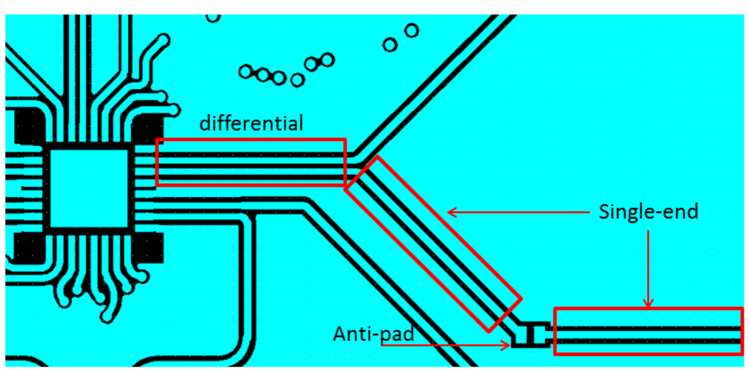

Figure 1: Micro-strip layout of top-layer.

2. DESIGN AND EXPERIMENT

In a dual-channel, each channel 25∼28 Gb/s programmable PRBS generator is designed at R6C generator, and the circuit is used to ATMEGA 328P microcontroller unit to control GN 2426A

Chip. The program is written by ATMEGA 328P or the usage of the computer trigger in GN 2426A chip generates a PRBS signal. GN 2426A chip is operated at reference free clock and data recovery (CDR) [9] and PRBS generator and PRBS signal length is up to $2^9 - 1$. GN 2426A chip is two input and output, and each port is connected with the differential and single-end output shown in Figure 1 [10].

R6C board is used four-layer PCB, and reduced two-layer than standard evaluation board (EB-GN2426A). R6C board volume at a wide of 6.35 cm and height of 6.7 cm. Table 1, which R6C circuit board structure of four layers, and each layer was Top-layer, Ground-layer, Vcc-layer and Bottom-layer, between the IC and K-type connector transmit the signal by micro-strip. Micro-strip is layout on the Top-layer. The GN 2426A chip transmits Serial data by differential output, and the signal-end connects R6C board and K-type connector. Using Rogers 4350B PCB in top-layer due to the required of best transmission efficiency. Micro-strip width and impedance calculate by Polar software. The micro-strip transmission line width was 9.9 mils in differential and 12 mils in single-end, which the micro-strip width was very close proximity provides better impedance matching and reduced interconnection losses. Micro-strip impedance calculate differential of 99.94 ohm, single-end of 49.85 ohm and Anti-pad of 50.47 ohm. The R6C micro-strip is impedance matching.

3. MEASURING RESULTS

Figure 3 shows the measured results of micro-strip impedance by Time-Domain Reflectometry (TDR). Compare the R6C board with standard evaluation board (EB-GN2426A) in the 25 Gb/s. The R6C board micro-strip impedance curve is smooth and approximation to 50 ohm. Figure 4 shows the 25.35 Gb/s bit rate of the R6C board. The eye diagram shows a clear eye opening and width of 29.1 ps, height of 70 mV, jitter of 12.614 ps, fall time of 14.8 ps and rise time of 12.5 ps. System reaches for 25.35 Gb/s passive current board of a PRBS generator has been successfully demonstrated.

Table 1: R6C circuit board structure of four layers.

Layer	Material	Thickness	Dielectric Constant	Dielectric Loss Tangent
Top	Cu 0.5 ounce(oz.)	0.03 mm	1	0
	Rogers 4350B	6.6 mils	3.66	0.004
Ground	Cu 0.5 oz.	0.017 mm	1	0
	PP	10 mils	4.2	0.017
Vcc	Cu 0.5 oz.	0.017 mm	1	0
	FR4	6 mils	4.2	0.02
Bottom	Cu 0.5 oz.	0.017 mm	1	0

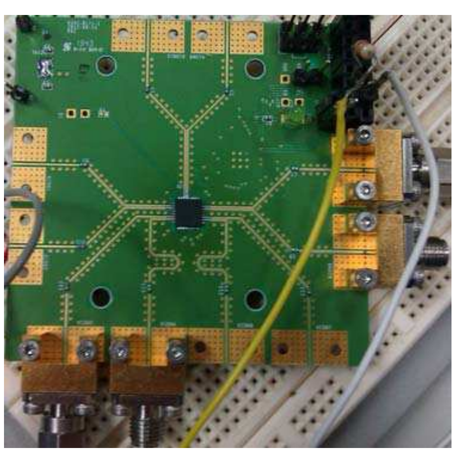

Figure 2: Passive current board of R6C.

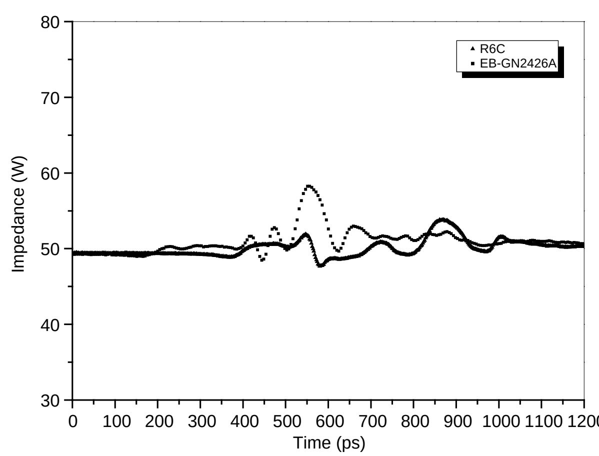

Figure 3: Comparing R6C board to a standard evaluation board (EB-GN2426A) of the measurement of impedance and time using a 25 Gb/s for time-domain reflectometry (TDR).

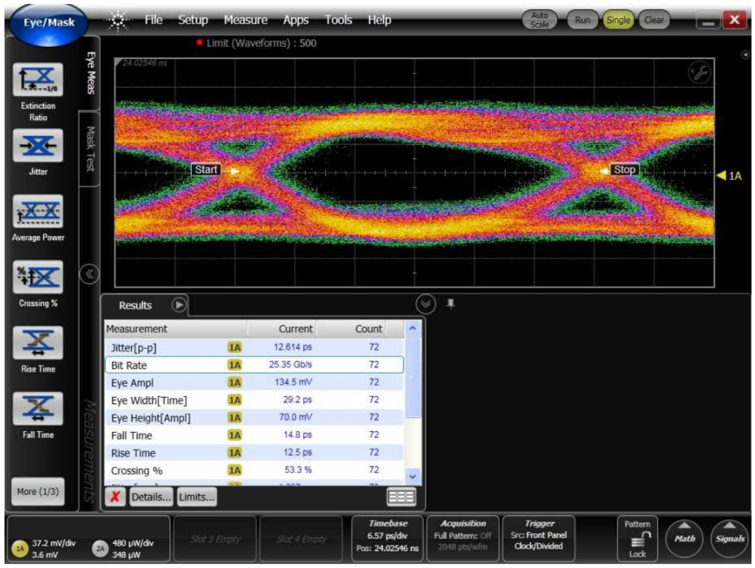

Figure 4: Eye diagram in R6C circuit board gets the bit rate of 25.35 Gb/s.

4. CONCLUSION

This paper uses differential, anti-pad, single-and and via layout impedance matching techniques match almost 50 ohm. The price of R6C board for 25 Gb/s passive current board of a PRBS generator was almost 1/400 times than the measuring equipment price and 1/4 times than the standard evaluation board (EB-GN2426A) price. R6C circuit board dimension was smaller than the standard evaluation board (EB-GN2426A). The R6C board has better eye diagram at 25.35 Gb/s bit rate, and its Jitter of 12.614 ps. A PRBS generator was up to $2^9 - 1$ R6C has a useful role under mass production. It is very cheap and simple high speed testing for 25 Gb/s.

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