

AN12: Application block diagrams for 40G BER test systems

Centellax designs and manufactures a collection of low-cost instruments and test accessories that can be combined to generate a low-featureset, extremely cost-effective modular 22-44Gbps Bit Error Rate (BER) test system.

The 40G test system can be used for a collection of signal integrity applications as listed below:

1. Pattern generator for use with oscilloscope
2. Lowest-cost 40G BER tester for use with a simple electrical DUT
3. Low-cost multi-rate BER tester with external synthesizer
4. Four-channel 40G BER tester for simultaneous 'every-bit' testing

Each application is discussed in detail with block diagrams below. For more information, please contact support@centellax.com.

Components used in 40G BER test system

TG1P4A: 40G PRBS Generator, <http://www.centellax.com/?TG1P4A>

- 21-44Gbps operating rates
- Internal fixed half-rate clock, or external half-rate clock
- Differential outputs; half-rate clock trigger output

TG1B1-A: 10G BERT, <http://www.centellax.com/?TG1B1-A>

- 0.5-12.5Gbps operating rates
- Internal programmable full-rate clock, or external full-rate clock
- Differential inputs and outputs; full-rate and clock/16 trigger outputs

MD1S4V2M: 56G Demultiplexer, <http://www.centellax.com/?MD1S4V2M>

- 2.6-56Gbps operating rates
- External half-rate clock
- Differential inputs, four single-ended outputs

TD20MCA: 23GHz Divider, <http://www.centellax.com/?TD20MCA>

- 1-23GHz operating rates
- Single-ended input, three simultaneous single-ended outputs

TA0L30VA, 50GHz Amplifier, <http://www.centellax.com/?TA0L30VA>

- 30kHz-30+GHz bandwidth
- Single-ended input and output

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1. Pattern generator for use with oscilloscope

Several components used in the 40G BER test system can be used as a high-performance pseudo-random bit sequence (PRBS) generator. This application is ideally suited for measuring the eye performance of the DUT, including 'eye mask' measurements.

A simple PRBS generator block diagram is shown in Figure 1. The 19.9GHz half-rate clock output from the generator is divided by the TD20MCA divide-by-8 output down to ~2.5GHz, within the oscilloscope trigger input range.

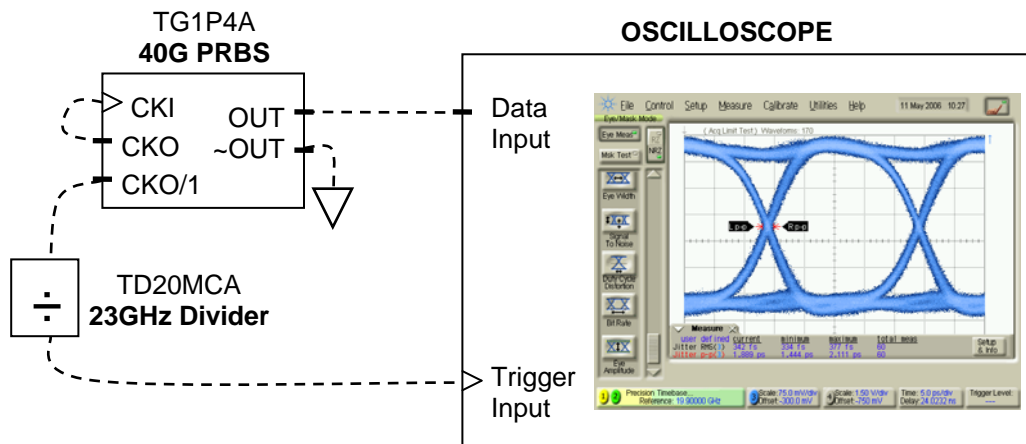


Figure 1 – block diagram – performance verification with oscilloscope

This setup is used to characterize the 40G source for rise/fall times, RMS and p-p jitter, output amplitude, eye height, signal-to-noise ratio, etc, a common application is to measure the performance of a DUT, shown in Figure 2.

In this case, we are using the 'precision timebase', a high-precision trigger input on the oscilloscope. This trigger input can accept a higher frequency rate trigger signal, and is connected to the half-rate (~20GHz) clock/1 output from the PRBS.

Even though we are using a more precise method of triggering the oscilloscope, the performance of the DUT is slowing down the transition times and increasing RMS jitter. The scope is shown making an 'eye-mask' measurement.

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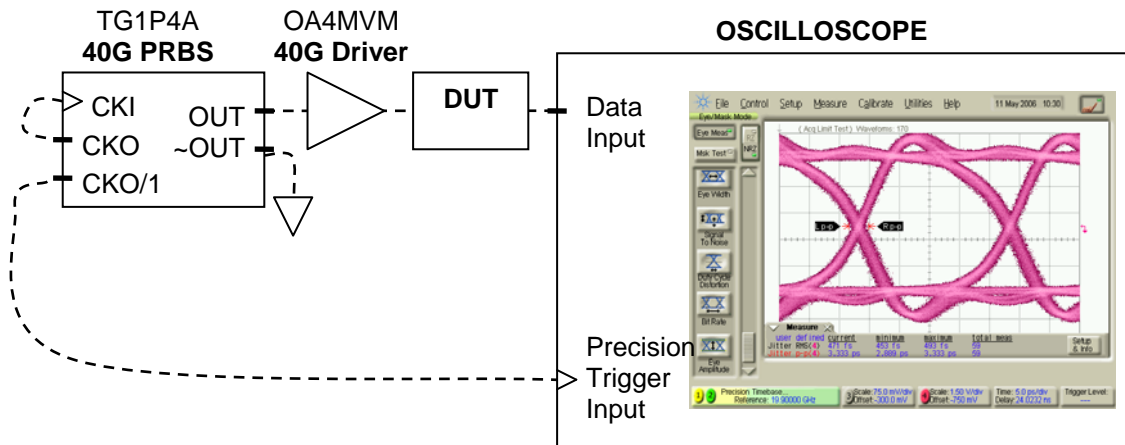


Figure 2 – block diagram – DUT eye-mask measurement with oscilloscope

Parts List

TG1P4A: 40G PRBS Generator, <http://www.centellax.com/?TG1P4A>

- 21-44Gbps operating rates
- Internal fixed half-rate clock, or external half-rate clock
- Differential outputs; half-rate clock trigger output

TD20MCA: 20GHz Programmable Divider, <http://www.centellax.com/?TD20MCA>

- DC-26+GHz operating range
- Programmable divide by 1, 2, 4, or 8
- Differential inputs and outputs (can be used single-ended)

OA4MVM: 40G 8V LN Modulator Driver, <http://www.centellax.com/?OA4MVM>

- 100kHz-65+GHz bandwidth, 8Vpp output amplitude
- Very low added jitter; fast rise/fall times

TE1B: Bias Board, <http://www.centellax.com/?TE1B>

- Bias board for modulator driver module

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2. Lowest-cost 40G BER tester for use with a simple electrical DUT

The 40G BER test system is ideally suited for a simple low-cost all-electrical test of a 38-44Gbps DUT, illustrated in Figure 3.

This test method uses one 10G BERT to measure one in four bits of the 40G bitstream. To test for pattern dependencies and to make a true 40G BER measurement, the 10G BERT should be switched to each of the four outputs of the demultiplexer and a time-controlled measurement of a bitstream with multiple complete PRBS patterns must be made.

The internal factory-set 19.9GHz half-rate clock from the 40G PRBS generator is used as our system clock. This clock is used to trigger the half-rate 40G demultiplexer, and is also divided to trigger the full-rate 10G BERT.

An OA4MVM 40G driver amplifier is used to amplify the 40G PRBS output to 8Vpp. This may or may not be required, based on the input sensitivity of the DUT. The block diagram shows a single-ended DUT with no phase-matched cables required.

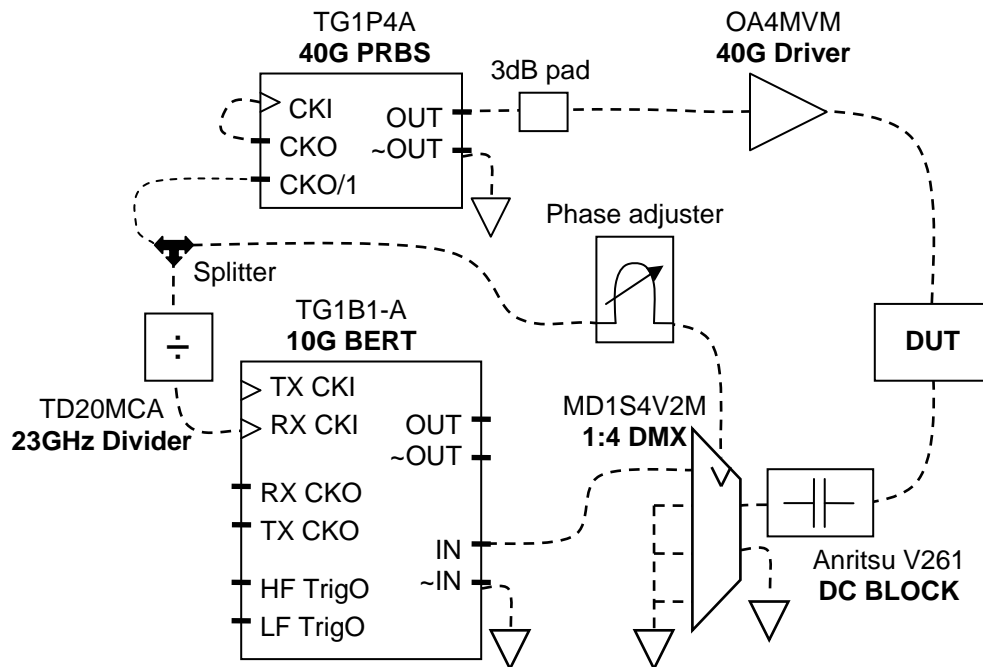


Figure 3 – block diagram – lowest-cost 40G BER test system

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Parts List

SB40: Modular 40G BER Test System, <http://www.centellax.com/?SB40>

- Includes TG1P4A, TG1B1-A, MD1S4V2M, and TD20MCA with discount

TG1P4A: 40G PRBS Generator, <http://www.centellax.com/?TG1P4A>

- 21-44Gbps operating rates
- Internal fixed half-rate clock, or external half-rate clock
- Differential outputs; half-rate clock trigger output

TG1B1-A: 10G BERT, <http://www.centellax.com/?TG1B1-A>

- 0.5-12.5Gbps operating rate with external clock, 9.85-11.35Gb/s intclk
- Differential inputs and outputs; full-rate and clock/16 trigger outputs

MD1S4V2M: 56G Demultiplexer, <http://www.centellax.com/?MD1S4V2M>

- 1-56Gbps operating rates
- External half-rate clock
- Differential inputs, four single-ended outputs

TD20MCA: 20GHz Progr. Divider, <http://www.centellax.com/?TD20MCA>

- DC-26+GHz operating range
- Programmable divide by 1, 2, 4, or 8
- Differential inputs and outputs (can be used single-ended)

-OPTACC SB40: + Accessory Package for SB40 BER Test System

- Accessories for use with the SB40 system, one required for each system
- Power splitter, trombone-style phase shifter, V-connector DC block, (2) V-connector 50ohm terminations, (6) SMA 50ohm terminations, (6) K and V connector cables, (6) K and V-connector adaptors, (2) K-connector attenuators

OA4MVM: 40G 8V LN Modulator Driver, <http://www.centellax.com/?OA4MVM>

- 100kHz-65+GHz bandwidth, 8Vpp output amplitude
- Very low added jitter; fast rise/fall times

TE1B: Bias Board, <http://www.centellax.com/?TE1B>

- Bias board for modulator driver module

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3. Low-cost multi-rate BER tester with external synthesizer

The 40G BER test system is ideally suited for a simple low-cost all-electrical test of a DUT from 21-44Gbps, as illustrated in 4.

This test method uses one 10G BERT to measure one in four bits of the 40G bitstream. To test for pattern dependencies and to make a true 40G BER measurement, the 10G BERT should be switched to each of the four outputs of the demultiplexer and a time-controlled measurement of a bitstream with multiple complete PRBS patterns must be made.

An external 10.5-22GHz clock signal is used as our system clock; it triggers the half-rate 40G PRBS generator, half-rate 40G demultiplexer, and is also divided to trigger the full-rate 10G BERT. The synthesizer must deliver +16dBm to the TG1P4A input, so an external amplifier may be required before the first power splitter.

The block diagram shows a differential DUT connected to the PRBS generator and the demultiplexer with phase-matched cables.

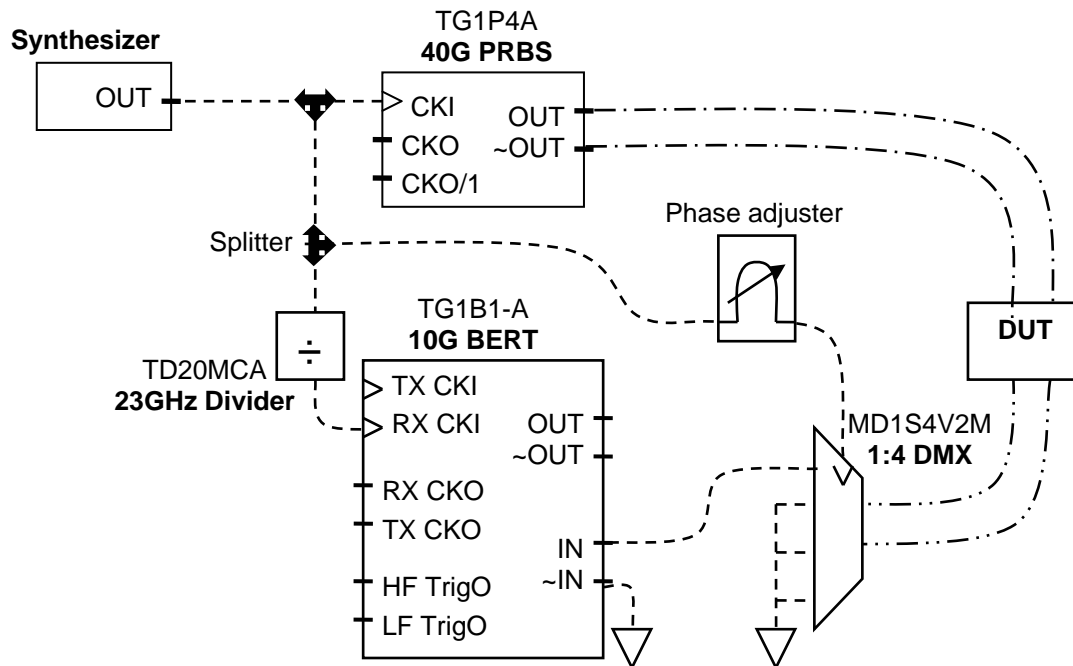


Figure 4 – block diagram – low-cost 40G BER test system with external synthesizer

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Parts List

SB40: Modular 40G BER Test System, <http://www.centellax.com/?SB40>

- Includes TG1P4A, TG1B1-A, MD1S4V2M, and TD20MCA with discount

TG1P4A: 40G PRBS Generator, <http://www.centellax.com/?TG1P4A>

- 21-44Gbps operating rates
- Internal fixed half-rate clock, or external half-rate clock
- Differential outputs; half-rate clock trigger output

TG1B1-A: 10G BERT, <http://www.centellax.com/?TG1B1-A>

- 0.5-12.5Gbps operating rate with external clock, 9.85-11.35Gb/s intclk
- Differential inputs and outputs; full-rate and clock/16 trigger outputs

MD1S4V2M: 56G Demultiplexer, <http://www.centellax.com/?MD1S4V2M>

- 1-56Gbps operating rates
- External half-rate clock
- Differential inputs, four single-ended outputs

TD20MCA: 20GHz Progr. Divider, <http://www.centellax.com/?TD20MCA>

- DC-26+GHz operating range
- Programmable divide by 1, 2, 4, or 8
- Differential inputs and outputs (can be used single-ended)

-OPTACC SB40: + Accessory Package for SB40 BER Test System

- Accessories for use with the SB40 system, one required for each system
- Power splitter, trombone-style phase shifter, V-connector DC block, (2) V-connector 50ohm terminations, (6) SMA 50ohm terminations, (6) K and V connector cables, (6) K and V-connector adaptors, (2) K-connector attenuators

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4. Four-channel 40G BER tester for simultaneous 'every-bit' testing

The 40G BER test systems detailed above are suitable for low-cost measurements, but the 10G BERT must be switched between each of the four outputs from the demultiplexer to measure every bit.

For time-sensitive measurements where all four channels must be measured simultaneously, or for convenience purposes, four 10G BERTs can be used to fully characterize the 40G bitstream, as shown in Figure 5.

This test method measures each individual bit; the total system BER is the sum of the four individual BER measurements made. Each channel must be measured for the same amount of time, and most accurate results are obtained when measuring multiple complete PRBS patterns.

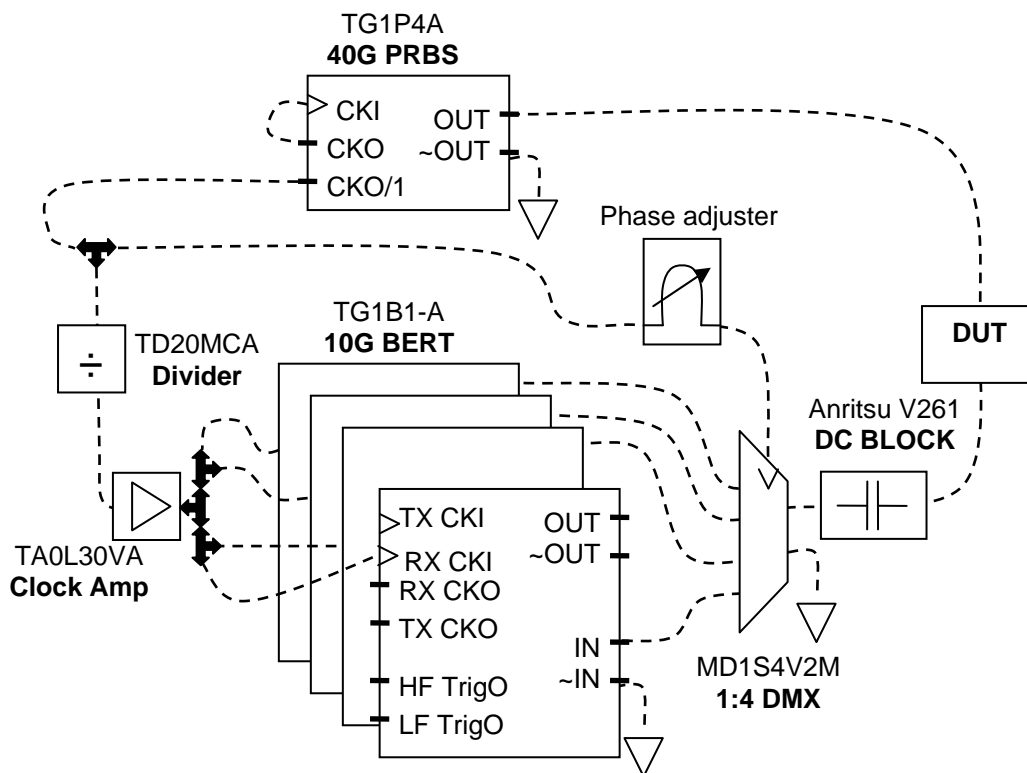


Figure 5 – block diagram – four-channel BER tester for simultaneous 'every-bit' testing

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Parts List

SB40: Modular 40G BER Test System, <http://www.centellax.com/?SB40>

- Includes TG1P4A, TG1B1-A, MD1S4V2M, and TD20MCA with discount

TG1P4A: 40G PRBS Generator, <http://www.centellax.com/?TG1P4A>

- 21-44Gbps operating rates
- Internal fixed half-rate clock, or external half-rate clock
- Differential outputs; half-rate clock trigger output

TG1B1-A: 10G BERT, <http://www.centellax.com/?TG1B1-A>

- 0.5-12.5Gbps operating rate with external clock, 9.85-11.35Gb/s intclk
- Differential inputs and outputs; full-rate and clock/16 trigger outputs

MD1S4V2M: 56G Demultiplexer, <http://www.centellax.com/?MD1S4V2M>

- 1-56Gbps operating rates
- External half-rate clock
- Differential inputs, four single-ended outputs

TD20MCA: 20GHz Progr. Divider, <http://www.centellax.com/?TD20MCA>

- DC-26+GHz operating range
- Programmable divide by 1, 2, 4, or 8
- Differential inputs and outputs (can be used single-ended)

-OPTACC SB40: + Accessory Package for SB40 BER Test System

- Accessories for use with the SB40 system, one required for each system
- Power splitter, trombone-style phase shifter, V-connector DC block, (2) V-connector 50ohm terminations, (6) SMA 50ohm terminations, (6) K and V connector cables, (6) K and V-connector adaptors, (2) K-connector attenuators

-OPTAC1 SB40: + Accessory Package to enable multi-channel BER testing

- Accessories required for 2-, 3-, or 4-channel testing
- TA0L30VA power amplifier, K-connector adaptor, (3) K-connector attenuators

-OPTAC2 SB40: + Accessory Package required for each additional channel

- Accessories required for each channel (ie: 1 required for a 2-ch system)
- (2) K-connector cables, power splitter