Using a Waveform Generator to Generate a Pseudo Random Binary Sequence (PRBS) Signal

Application Brief

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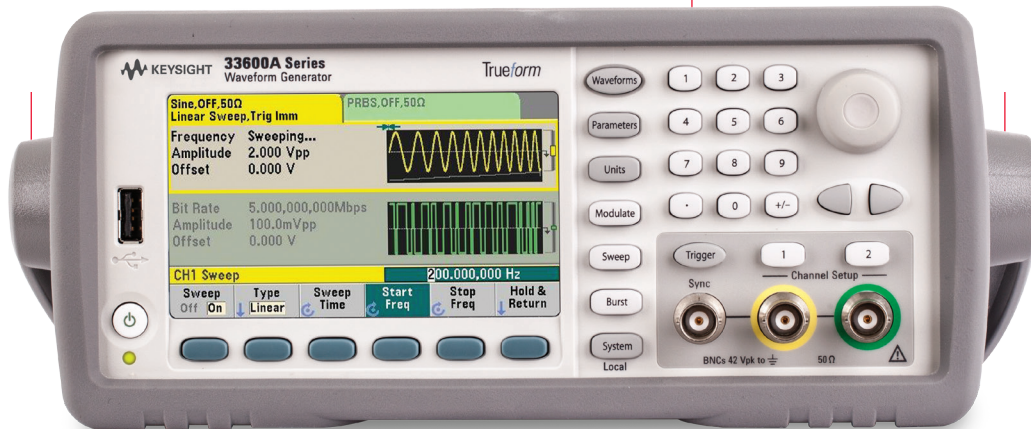
Using a Waveform Generator to Generate a PRBS Signal

Test challenge examples:	**How True*form* technology can help:**
– Testing a transmission line – Acoustic testing – Noise simulation – Generating an eye-pattern stimulus	– Built-in PRBS functions – PN3 through PN32 – Up to 200-Mbps bit rate – Jitter at < 1 ps – Synchronized output for external clocking – 2-channel coupling

Pseudo Random Binary Sequence (PRBS) signals are very useful in digital communication testing. They may be generated by a Linear Feedback Shift Register (LFSR) like the one shown in Figure 1. Note that in the figure the branches after register cells 5 and 9 are called taps. The configuration of the LFSR and its taps determines the PRBS waveform.

The Keysight 33600A Trueform waveform generators can easily generate PRBS signals for use in a range of applications. See our test challenge examples below to learn how PRBS signals and Trueform technology can help you.
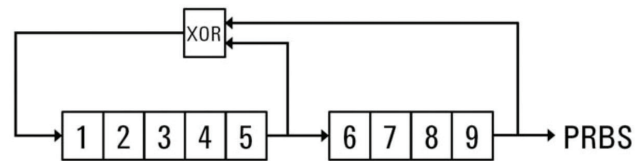

Figure 1. A linear feedback shift register.

Testing a transmission line

When testing the integrity of a digital transmission system you need to determine if your system is robust enough to transmit at your data rates. The industry accepted method involves using a PRBS to test the integrity of your link. The PRBS signal has random and autocorrelation properties that help determine if your connection is acceptable. If your design does not include a signal source capable of generating this test signal you can purchase an instrument to simulate the test signals for you. However, a dedicated PRBS generator can be very expensive. The 33600A Series of Trueform waveform generators is less than half the cost of a dedicated PRBS generator. Moreover, it generates PRBS signals ranging from PN3 to PN32, and features best-in-class accuracy and jitter performance.

Noise simulation

Do you want to simulate noise on your digital line? One way to simulate generated broadband digital noise is using a PRBS signal. PRBS signals can simulate white noise as N, the number of stages, becomes large. They may also be constructed to cover a wide range of frequency bands that can be adjusted by sequence size and bit rate. If you need to calculate auto-correlation functions, PRBS signals are ideal since their binary nature helps simplify the process. The 33600A Trueform waveform generators make generating PRBS signals simple. Once generated, change the parameters to vary sequence size and bit rate to simulate noise in a variety of bandwidths.

Acoustic testing

You need to test the acoustics of a structure. That structure could be a room, a cavity or the inside of a speaker box. To test the acoustics, you use a speaker and microphone pair. A PRBS test signal may be sent through the speaker to simulate white noise in a deterministic manner. The microphone is then connected to a scope that reads the signal and helps determine the loss through the structure. With the 33600A Series Trueform waveform generator, generating that PRBS signal is now easier than ever before. Its' built-in PRBS signals may be easily accessed and configured via the front panel, programmatic interface or Web user interface.

Generating an eye-pattern stimulus

One of the most important ways to determine the quality of a digital transmission system is to measure its Bit-Error-Ratio (BER). BER is calculated by comparing the transmitted sequence of bits to the received bits, and counting the number of errors. The ratio of how many bits received in error over the number of total bits received is the BER. This measured ratio is affected by many factors including: signal-to-noise, distortion and jitter. Using a PRBS signal allows you to determine dropped bits. Its random properties also allow you to test for weaknesses in your system. The 33600A Trueform waveform generators offer built-in PRBS signal generation, which makes generating test signals simple. With their incredible jitter performance, less than 1 ps, they can easily help you isolate your signal source errors from transmission errors.

PRBS generation

The 33600A Series is the latest addition to the versatile family of Trueform waveform generators, which feature traditional built-in waveforms (sine, square, triangle, ramp, pulse, arb, and triangle) and the ability to generate both noise and PRBS signals.

The 33600A Series' PRBS signals have a maximum bit rate of 200 Mbps and allow you to specify a signal's falling- and rising-edge transition times down to 2.9 ns. An amplitude range of 1 mVpp to 10 Vpp, enables the waveform generators to generate signals for a wide variety of applications.
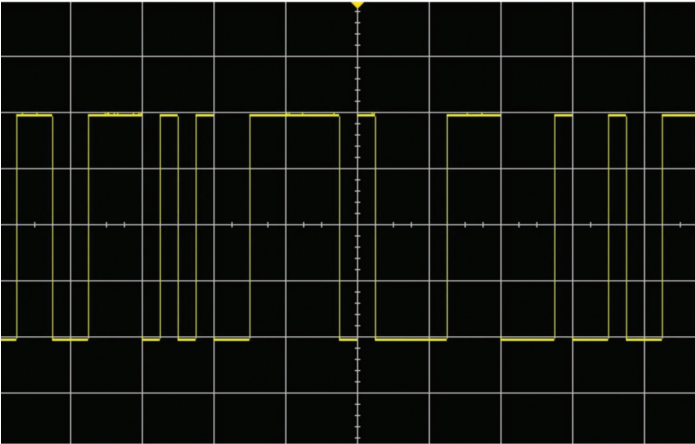

Figure 2. A PRBS signal.

The 33600A Series generates PRBS signals with polynomial functions 23-1 through 232-1, otherwise known as PN3 through PN32. The signals comply with CCITT (ITU O-Series) recommendations, which are common in digital transmission testing. Varying the bit rate and polynomial function allows you to generate noise with different frequency content. The 33600A Series also has a stand-alone noise function if you want to generate analog noise.
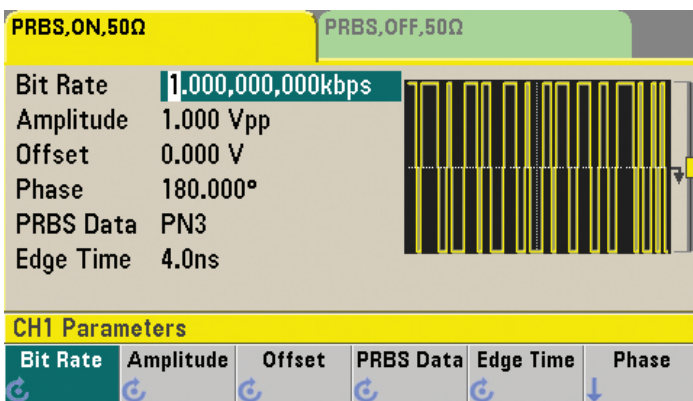

Figure 3. Varying the PRBS signals' bit rate and polynomial function.

To aid transmission analysis, Trueform waveform generators have a sync output that can be used as an external clock reference. This is especially useful for jitter analysis or the construction of eye diagrams. All that's required is to connect the sync output of the generator to your measurement device and ensure that the sync output is enabled.

Due to the patented technology in Trueform waveform generators, the 33600A Series offers incredible jitter stability at less than 1 ps! Having a stable signal source is tremendously beneficial for your system analysis.

For dual-channel 33600A Series' models (33612A and 33622A), you can also couple the channels for dual PRBS outputs. To do this, you simply turn on the channel tracking, which will output the same signal on both channels or invert the polarities. Trueform also easily couples the amplitude or bit rate. For example, you can build a relationship between the two channels so that the amplitudes on channel 2 is twice as large as channel 1. Then, when you change the amplitude on one channel the other channel will remain at twice the amplitude.
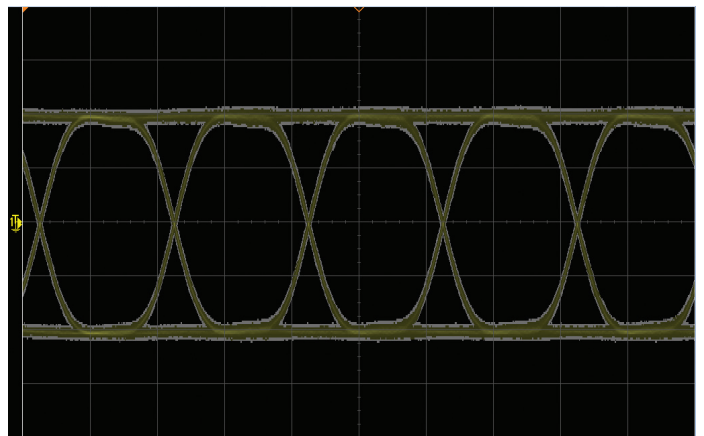

Figure 4. Simple eye diagram for the 33600A Series waveform generator.

Summary

PRBS signals are used industry-wide to qualify digital transmission systems. The 33600A Series Trueform waveform generators can generate PRBS signals up to 200 Mbps. By sending a near random bit stream through your digital network, you can simulate many conditions to look for weaknesses. Other 33600A Series features that help simplify PRBS signal generation include a jitter of less than 1 ps, sync output, and a dual-channel tracking capability.

See the True*form* waveform generator test challenge web site for additional topics such as:

– Generating a waveform with many points
– Simulating signals with the highest integrity
– Effortlessly couple or synchronize two signals on a waveform generator
– Creating a differential signal with a waveform generator
– Enable your arbitrary waveform to do more

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