Application Note

MP1800A 28G/32G
Generate Stairstep Test Waveform for PAM4

MP1800A Series
Signal Quality Analyzer

This application note describes how to generate TX stair-step test waveform for PAM4 by using the MP1800A Signal Quality Analyzer.

TX stair-step test waveform is recommended in the **PAM4 TX Specification for IEEE 802.3 100Gb/s Backplane and Copper Cable Task Force,** please see Figure 1 below. On the MP1800A, users can get the Tx stairstep waveform by setting PPG Channel Synchronization mode, users' data patterns, and the data output amplitude of one channel is half of the other channel on the PPG.

A Proposed TX Stairstep Test Waveform for PAM4:

- PAM4 test waveform is period 80T with stair steps up, stair steps down, and full swing transitions.
- Each transmitted level is of duration 8 Baud periods.

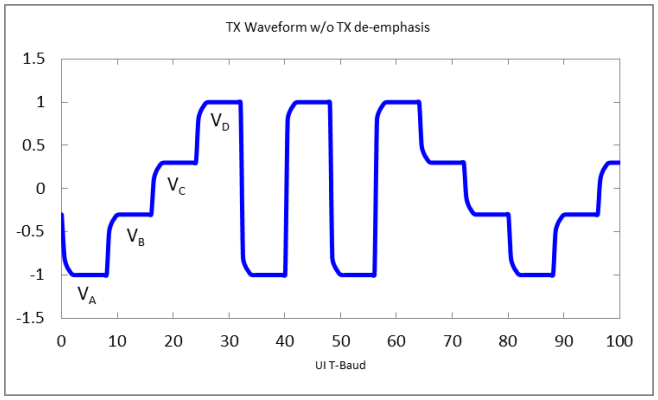

Figure 1. Tx staristep test waveform is recommended in the PAM4 TX Specification for IEEE 802.3 100Gbps over backplane & copper cable task force

Equipment (minimum):

- MU183020A 28/32Gb/s 2- channel PPG
- MU181000A/B Synthesize
- PAM4 converter MZ1834A or MZ1834B

Connections and configurations:

Please connect External clock input on PPG with the clock output of a synthesizer MU18100A/B (or thru jitter card MU181500B), and install a PAM4 converter MZ1834A/B on the PPG. Set the two channels of PPG to "Channel Synchronization mode", please refer to Figure 2 below, and set the data output amplitude of one channel is half of the other channel on the PPG, for example, Channel 1 (Data1) with 3.5Vpp, and Channel 2 (Data2) with 1.75Vpp, please see Figure 3 and Figure 4 below.

Then configure the data patterns:

- PPG1 80bits 0000 FFFF 00FF 00FF FF00
- PPG2 80bits 00FF 00FF 00FF 00FF 00FF

Please refer to Figure 5 and Figure 6.

Turn on the data output ON the PPG of MP1800A.

The MZ1834A/B is a PAM4 converter, that has attenuators and power dividers inside.

As we can see, users can generate the Tx stairstep waveform quickly by using the MP1800A, which can be used to measure the signal levels for PAM4, and test the loss and distortion on a DUT by using an oscilloscope as required in the IEEE standards, please see comment "**TX Specification for PAM4 Levels**" below.

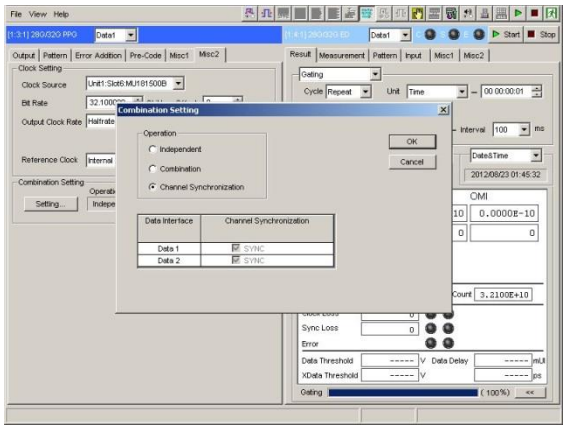

Figure 2. click "Setting" at Misc2 on the PPG, to set Data1 and Data2 to Channel Synchronization mode

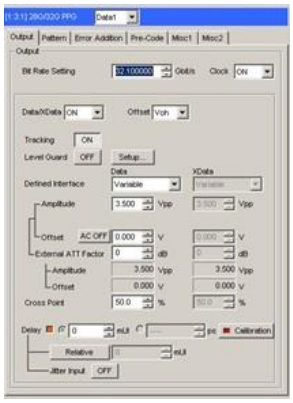

Figure 3. set amplitude of Data1 output on PPG with 3.5Vpp

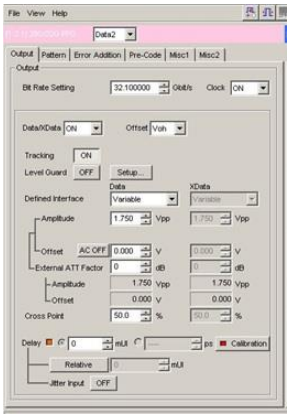

Figure 4. set amplitude of Data2 output on PPG with 1.75Vpp

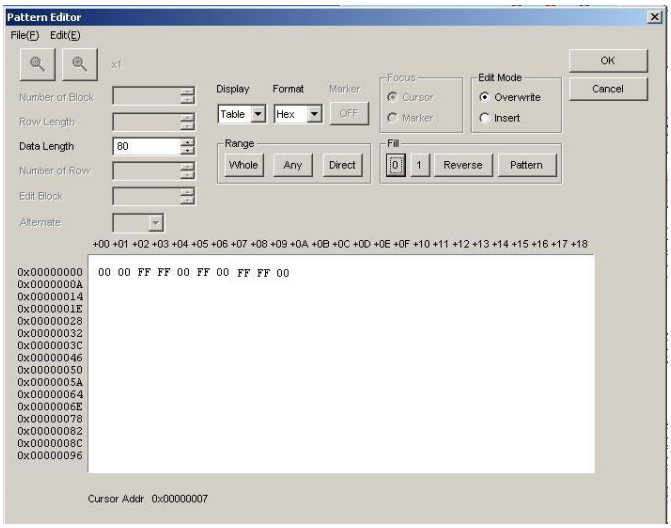

Figure 5. set the data pattern on Data1 of PPG

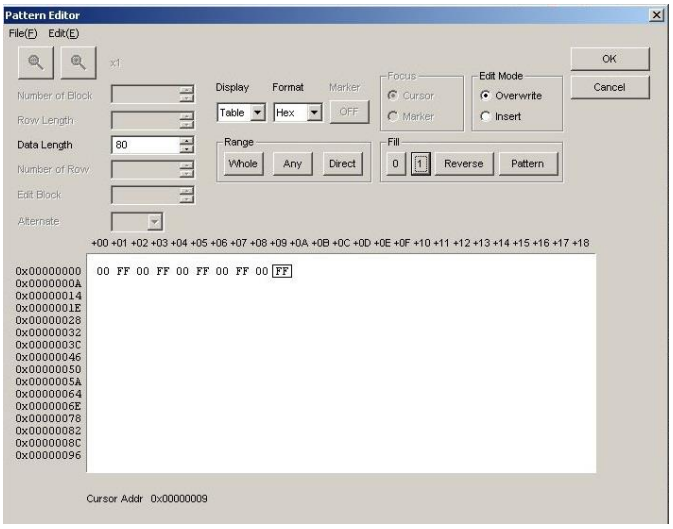

Figure 6. set the data pattern on Data2 of PPG

TX Specification for PAM4 Levels*:

- The most important specification for PAM4 is that the four levels (w/o TX de-emphasis) are approximately equally spaced, else low frequency Signal to Distortion Ratio (SDR) suffers
  - Define $V_{LOW} = (V_C - V_B)/2$
  - Define $V_{HIGH} = (V_D - V_A)/6$
  - Define $V_{AVG} = (V_{HIGH} + V_{LOW})/2$
  - Spec $|V_{HIGH} - V_D/3| < 0.06\ V_{AVG}$
  - Spec $|V_{HIGH} + V_A/3| < 0.06\ V_{AVG}$
  - Spec $|V_{LOW} - V_C| < 0.06\ V_{AVG}$
  - Spec $|V_{LOW} + V_B| < 0.06\ V_{AVG}$
- More specification can be tested with the single proposed waveform and capture.
  - Symmetry between ‘up’ and ‘down’ steps
    - Rise and fall times
    - Duty cycle
  - Symmetry between steps of magnitude 2 and steps of magnitude 6
    - Rise and fall times the same

V_{AVG} is the amount of noise voltage at the slicer that will cause an error.

*TX specification for PAM4 levels, proposed in IEEE 802.3 100Gbps over backplane and copper cable task force

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Specifications are subject to change without notice.

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