

2.5G/5.0G Transmit Linearity Test with Link-Partner Signal as Disturber

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January 5, 2016

Background

- 1000BASE-T defined Transmit Linearity test with far-end signal superimposed to stress Tx driver as in real link
- 10GBASE-T defined Transmit Linearity 2-Tone test without a signal superimposed to emulate far-side PHY
 - The far-side signal is either heavily attenuated in long cables or has high PBO levels ($\sim 10\text{dB}$) used in short links
- Similar argument can be used for 5GBASE-T given PBO requirement for short cables is 8-10dB
- 2500BASE-T has a maximum PBO of 2dB, so proper to consider similar Transmit test condition to 1000BASE-T
 - However, to simplify the test compared to 1000BASE-T, we propose to use tones as test signal and not random data

Worst Case for Tx Linearity in 2500BASE-T

- Goal: For lengths < 100m, relax far-end Tx linearity so that:
 Shorter Cable Received SNR \geq 100m Received SNR
 - PBO switches to 2dB ~45m \rightarrow Worst Case: DUT=2dB & LKP=0dB

Cable Length	DUT PBO	Received Power by LKP	LKP Required PHY SNR (Alien xtalk SNR: 30dB)	DUT Transmit Linearity Offset
100m	0dB	-8.8dBm	35.2dB	0dB
45m	0dB	-4.3dBm	32.4dB	-11dB
45m	2dB	-6.3dBm	34.4dB	-8dB*
1m	2dB	0.0dBm	30.5dB	-22dB

A. DUT Tx PBO=2dB & Disturber Amplitude=-4.3dBFS

\rightarrow Effective Peak Amplitude at Tx= \sim 1.44x Full scale

B. DUT Tx PBO=0dB & Disturber Amplitude=-7dBFS**

\rightarrow Effective Peak Amplitude at Tx= \sim 1.44x Full scale (same stress as “A”)

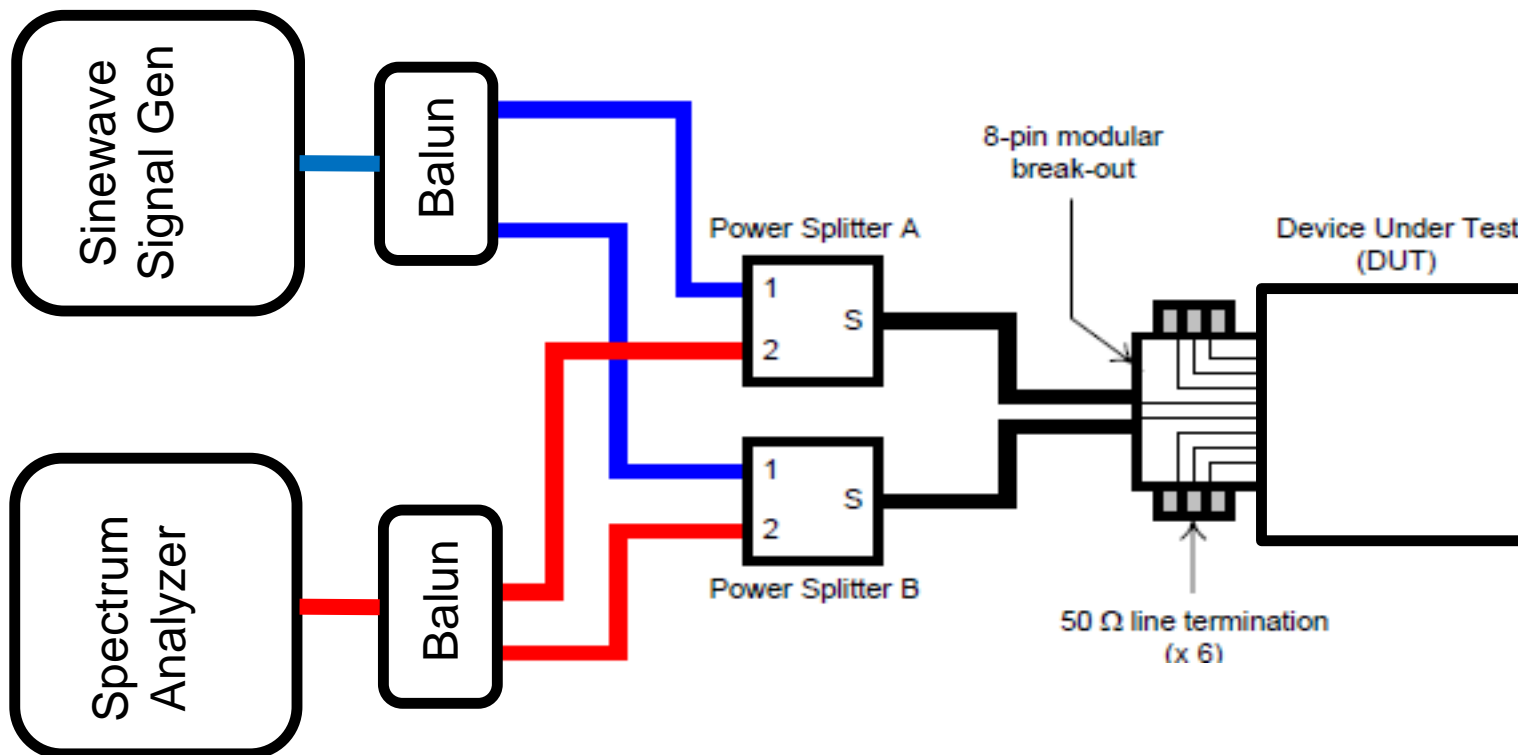
\rightarrow Same PBO \rightarrow Eliminates the need to add new test mode bits

Tx Linearity Test for 2500BASE-T

- Define two conditions for Test mode 4 in 2.5G with same 2-tones as in Table 126-14
 1. Original: 2-tone signals as defined in standard text
 - **$SFDR \geq 2.5 + \min \{ 52, 58 - 20 \log_{10}(f/25) \}$**
 2. NEW: Same 2-tone test signals plus a 45MHz tone to represent far-end signal stress, but with relaxed specs
 - **$SFDR \geq (2.5 - 8) + \min \{ 52, 58 - 20 \log_{10}(f/25) \}$**
 - **45MHz Stress signal at -7dB peak amplitude of the 2-tone**

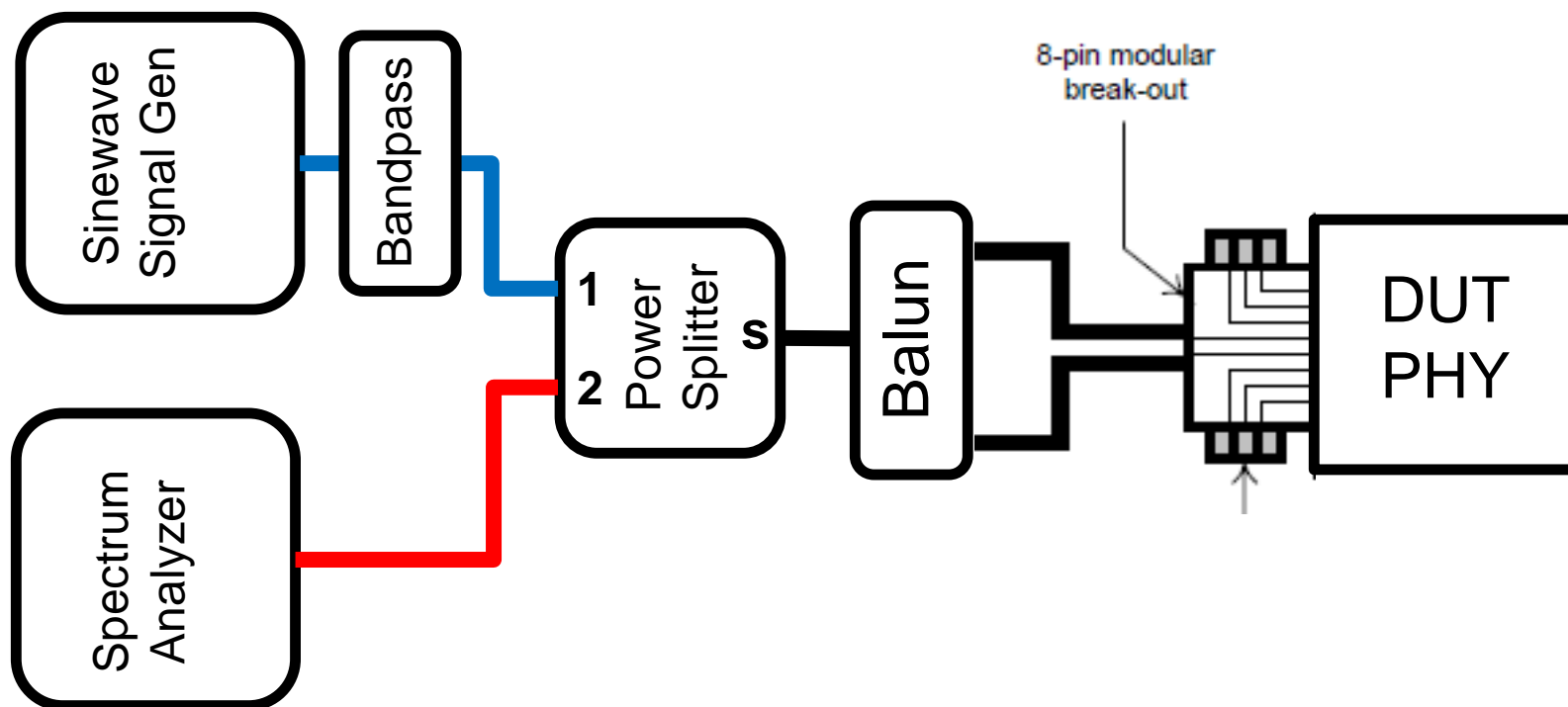
Setup for New Proposed Test Mode 4

- A similar setup to UNH (see backup) but using tones & Spectrum Analyzer instead of random data & Scope
 - No complex timing synchronization & post processing



Setup for New Proposed Test Mode 4

- A simpler test setup with one Balun & one Power Splitter
- Add a bandpass filter to eliminate Signal Generator spurs
- Disturber amplitude at DUT pads to be **7dB** below peak



Conclusion

- Same 2-tones as in Table 126-14, with 2 different tests
 1. No Disturber: Original 2-tone test defined in standard
 - **Linearity Spec: SFDR $\geq 2.5 + \min \{ 52, 58-20\log_{10}(f/25) \}$**
 2. With Disturber: Original 2-tone plus a 45MHz disturber tone at 7dB below Tx peak amplitude as in Slide 6
 - **Linearity Spec: SFDR $\geq -5.5 + \min \{ 52, 58-20\log_{10}(f/25) \}$**

Table 126-14

$S \times (400/1024) \times 47, S \times (400/1024) \times 53$
$S \times (400/1024) \times 101, S \times (400/1024) \times 103$
$S \times (400/1024) \times 179, S \times (400/1024) \times 181$
$S \times (400/1024) \times 277, S \times (400/1024) \times 281$
$S \times (400/1024) \times 397, S \times (400/1024) \times 401$

BACK UP SLIDES

Test Setup for 1000BASE-T

- UNH used the following setup for 1000BASE-T to ensure reliable & consistent results

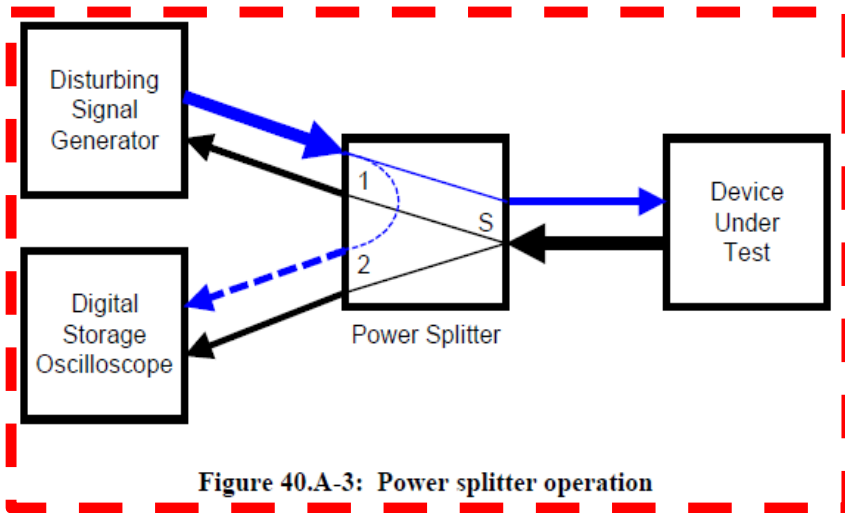


Figure 40.A-3: Power splitter operation

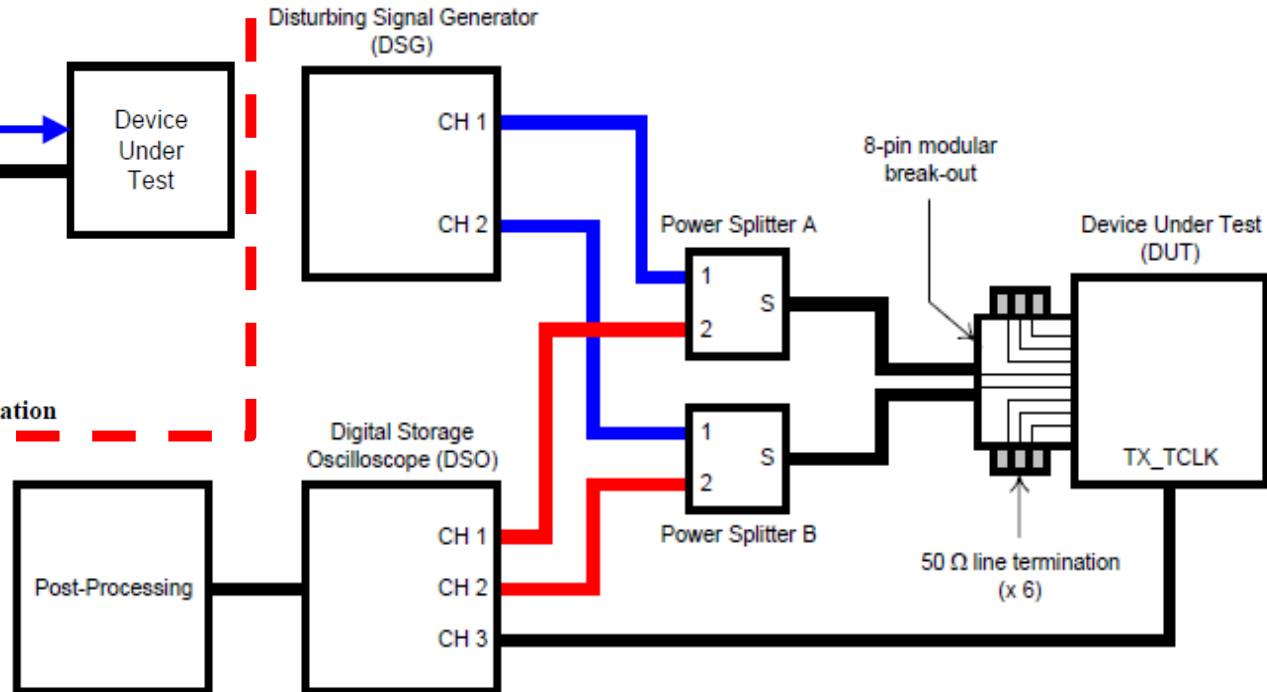
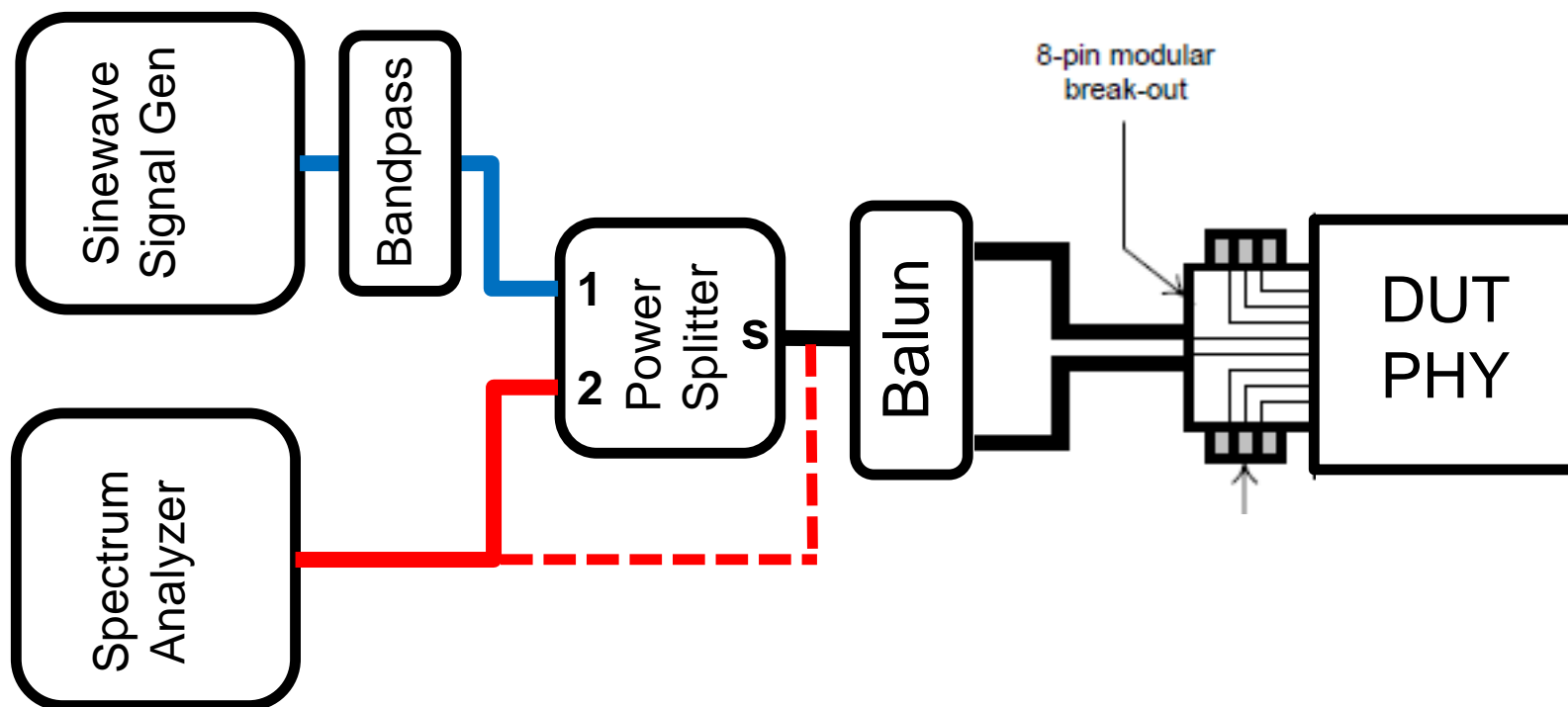


Figure 40.A-1: Test setup block diagram

Setup for New Proposed Test Mode 4

- Same test setup as proposed in Slide 6 can be used to perform original linearity test by turning off the Signal Generator (or bypassing the Splitter)



Sample Plots

