yellow highlighted text indicates refinement is needed
turquoise highlighted text indicates where the text was original pulled from

The text of this section was pulled from clause 72.7

128.7 2.5GBASE-KX electrical characteristics

128.7.1 Transmitter characteristics

Transmitter characteristics at TP1 are summarized in Table 128–6 and detailed in 128.7.1.1 through 128.7.1.11.

Table 128-6-Transmitter characteristics for 2.5GBASE-KX

Parameter	**Sub clause reference**	**Value**	**Unit**
Signaling speed	128.7.1.3	3.125±100 ppm	GBd
Differential peak to peak output voltage(max)	128.7.1.4	1200	mV
Differential peak to peak output voltage when TX is disabled		30	mV
Common mode Voltage Limits	128.7.1.4	0 to 1.9	V
Differential output return loss (min)	128.7.1.5	See the equation 128-4 and equation 128-5	dB
Differential output template	128.7.1.6	See the figure 128-6	dB
Transition time (20%-80%)	128.7.1.7	30 to 100	ps
Max output jitter (peak-to-peak) Random Jitter Deterministic Jitter Duty Cycle Distortion Total jitter	128.7.1.9	 0.20 0.12 0.035 0.35	 UI UI UI UI

Jitter is specified at BER 10^-12
Duty Cycle Distortion is considered part of deterministic jitter distribution

128.7.1.1 Test fixture

The test fixture of Figure 128–7 or its functional equivalent, is required for measuring the transmitter Specifications described in 128.7.1, with the exception of return loss.

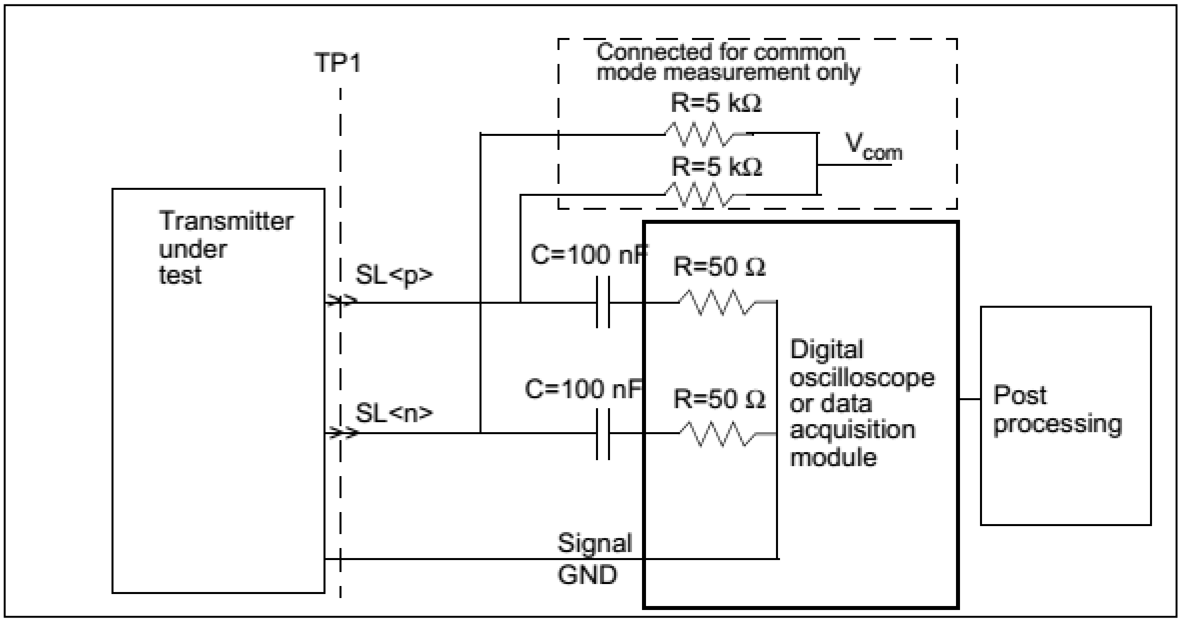


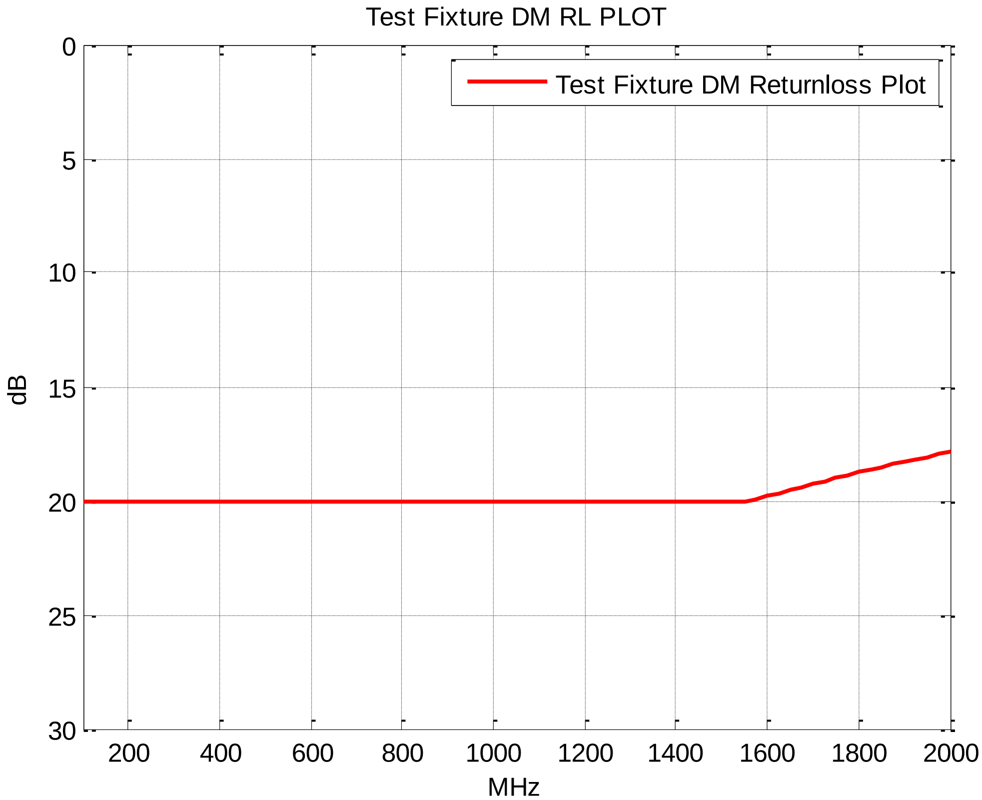
Figure 128-7-Transmitter test fixture for 2.5GBASE-KX

128.7.1.2 Test fixture impedance

The differential load impedance applied to the transmitter output by the test fixture depicted in Figure 128–7 shall be 100 Ω. The differential return loss, in dB with *f* in MHz, of the test fixture shall meet the requirements of Equation (128–2) and Equation (128–3).

$RL(f) \geq RL_{min} = 20$
For $100\text{MHz} \leq f < 1562.5\text{MHz}$ (128-2)

$RL(f) \geq RL_{min} = 20 - 20\log10(f/1562.5\text{MHz})$
For $1562.5\text{MHz} \leq f < 2000\text{MHz}$ (128-3)



128.7.1.3 Signaling speed

The 2.5GBASE-KX signaling speed shall be 3.125 GBd ± 100ppm

128.7.1.4 Output amplitude

The differential output voltage is constrained via the transmitter output waveform requirements specified in 128.7.1.10. For a 1010 pattern, the peak-to-peak differential output voltage shall be less than 1200 mV. The transmitter output voltage shall be less than 30mV peak-to-peak, when disabled. The differential output voltage test pattern shall consist of no fewer than eight symbols of alternating polarity.

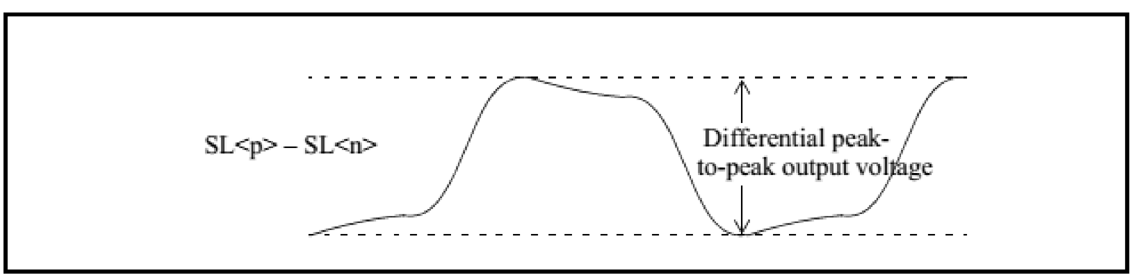


FIGURE-128-8-Transmitter peak-to-peak output voltage definition

NOTE 1—See Figure 128–8 for an illustration of the definition of differential peak-to-peak output voltage. DC-referenced voltage levels are not defined since the receiver is AC-coupled. The common-mode voltage of SL<p> and SL<n> shall be between 0 and 1.9V with respect to signal ground as measured at Vcom in Figure 128–7.

For EEE capability, the transmitter's differential peak-to-peak output voltage shall be less than 30 mV within 500 ns of tx_mode being set to QUIET and remain so while tx_mode is set to QUIET. Furthermore, the transmitter's differential peak-to-peak output voltage shall be greater than 720 mV within 500 ns of tx_mode being set to ALERT. The transmitter output shall be fully compliant within 5s after tx_mode is set to DATA. During LPI mode, the common-mode shall be maintained to within ± 150 mV of the pre-LPI value.

128.7.1.5 Differential output return loss

For frequencies from 100 MHz to 2000 MHz, the differential return loss, in dB with *f* in MHz, of the transmitter shall meet the requirements of Equation (128–4) and Equation (128–5). This output impedance requirement applies to all valid output levels. The reference impedance for differential return loss measurements shall be 100 Ω.

RL (f) ≥ RL min = 10
For 100 MHz ≤ f < 625MHz (128-4)

RL (f) ≥ RL min = 10 -10log10 (f/625MHz)
For 625MHz ≤ f ≤ 2000MHz (128-5)

The minimum differential output return loss is shown in Figure 128–9.

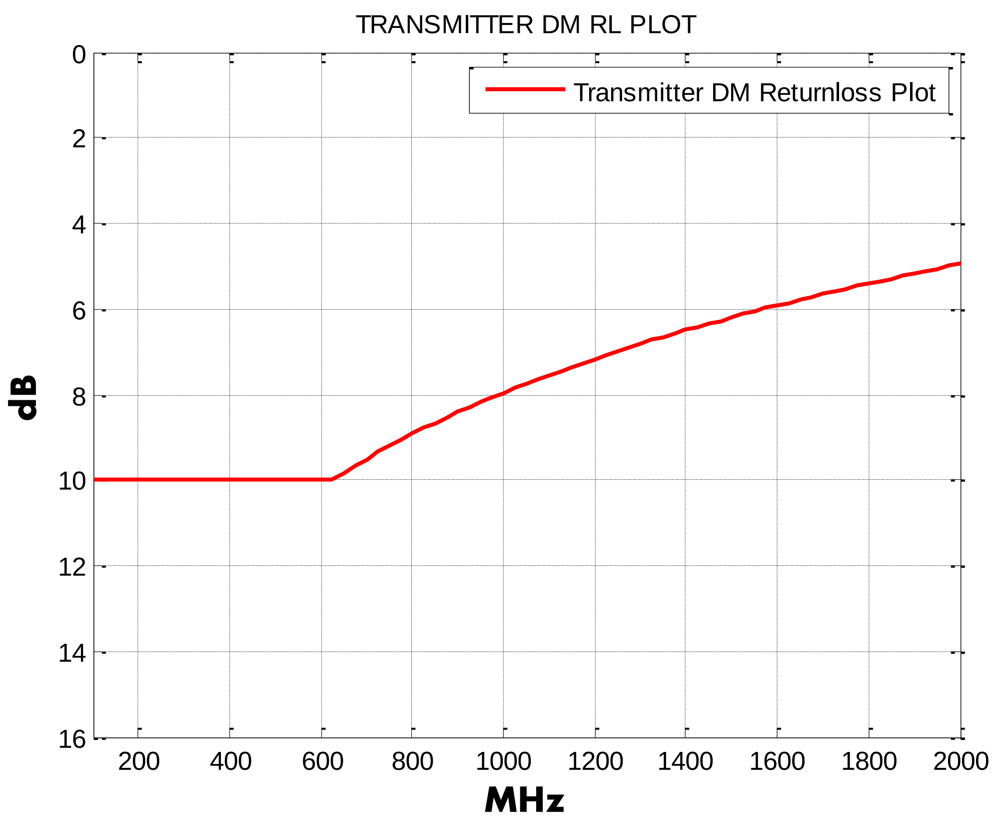


Figure 128-9: Transmit output differential mode return loss

128.7.1.6 Common-mode output return loss

The transmitter common-mode return loss shall meet the requirements of Equation (128–6) and Equation (128–7). The reference impedance for common-mode return loss measurements is 25Ω.

RL (f) ≥ RL min = 7
For 100 MHz ≤ f < 625MHz (128-6)

RL (f) ≥ RL min = 7 -10log10 (f/625MHz)
For 625MHz ≤ f ≤ 2000MHz (128-7)

The minimum common-mode output return loss is shown in Figure 128–10.

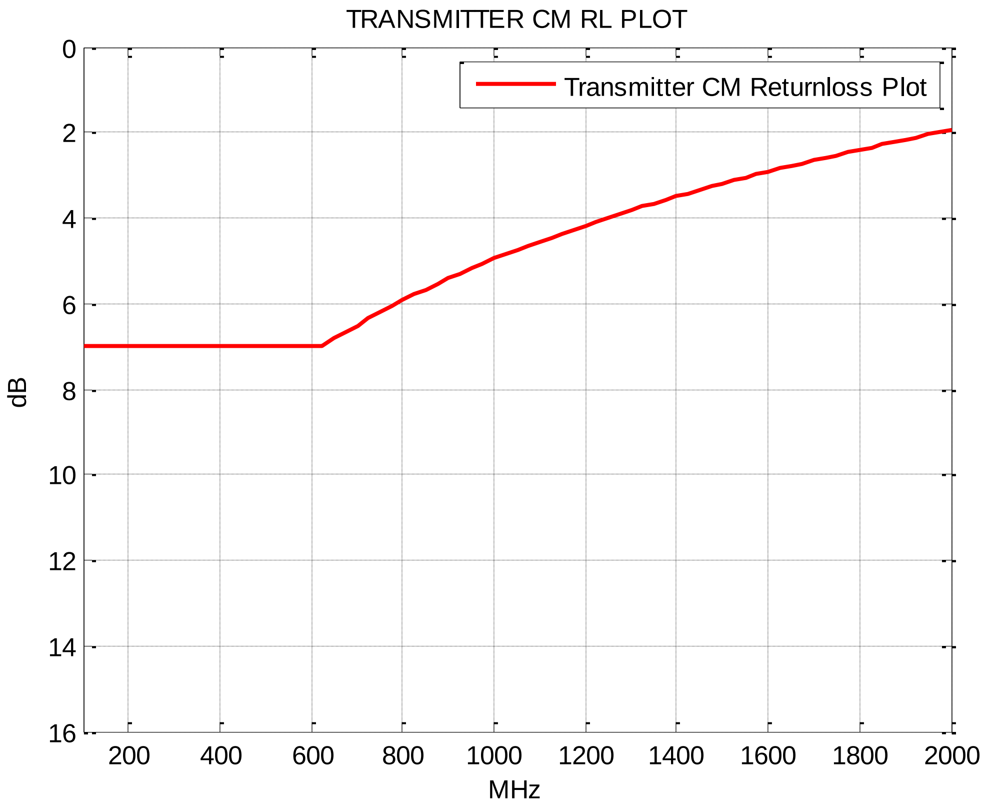


Figure 128-10-Transmit Common mode output return loss

128.7.1.7 Transition time

The rising-edge transition time shall be between 30ps and 100ps as measured at the 20% and 80% levels of the peak-to-peak differential value of the waveform using the high-frequency test pattern of 128B.1. The falling edge transition time shall be between 30ps and 100ps as measured at the 80% and 20% levels of the peak-to-peak differential value of the waveform using the high-frequency test pattern of 128B.1

128.7.1.8 Transmit jitter test requirements

Transmit jitter is defined with respect to a test procedure resulting in a BER bathtub curve such as that described in Annex 48B.3. For the purpose of jitter measurement, the effect of a single-pole high-pass filter with a 3 dB point at 1.875MHz is applied to the jitter. The data pattern for jitter measurements shall be test patterns 2 or 3 as defined in 52.9.1.1. Crossing times are defined with respect to the mid-point (0V) of the AC-coupled differential signal. The duty cycle distortion test pattern shall consist of no fewer than eight symbols of alternating polarity.

128.7.1.9 Transmit jitter

The transmitter shall have a maximum total jitter of 0.35 UI peak-to-peak, composed of a maximum deterministic Component of 0.12 UI peak-to-peaks and a maximum random component of 0.20UI peak-to-peak. Duty cycle distortion (DCD) is considered a component of deterministic jitter and shall not exceed 0.035 UI peak-to-peak. The peak-to-peak duty cycle distortion is defined as the absolute value of the difference in the mean pulse width of a 1 pulse or the mean pulse width of a 0 pulse (as measured at the mean of the high- and low-voltage levels in a clock-like repeating 0101 bit sequence) and the nominal pulse width. Jitter specifications are specified for BER 10^{-12}. Transmit jitter test requirements are specified in 128.7.1.8.

128.7.1.10 Transmitter output waveform

The test pattern for the transmitter output waveform is the square wave test pattern defined in 52.9.1.2, with a run of at least eight consecutive ones. The transmitter output waveform test is based on the voltages *v*1 and v2, which shall be measured as shown in Figure 128–11 and described below

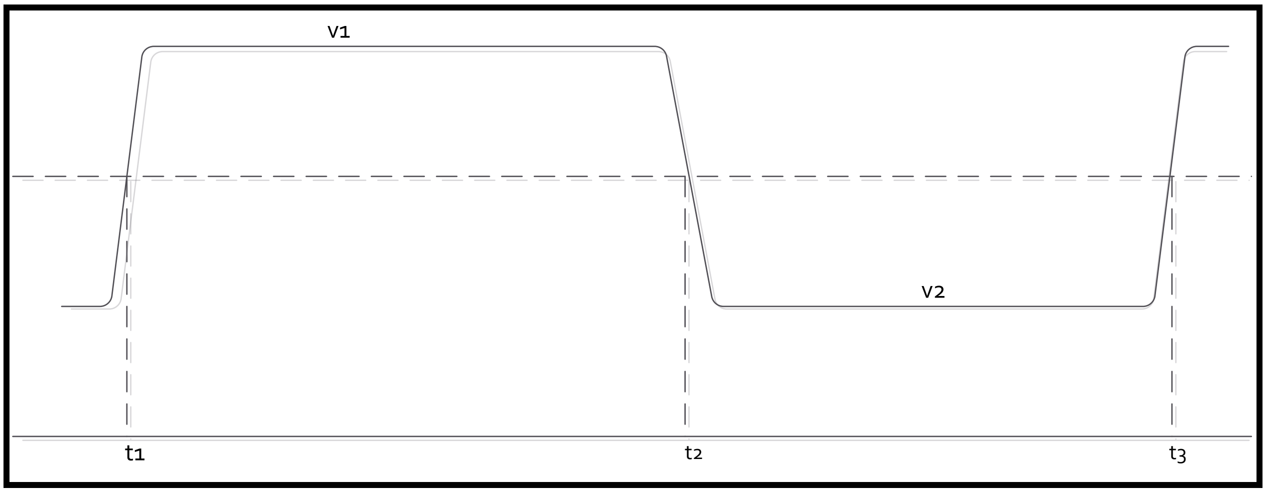


Figure- 128-11: Transmitter Output waveform

T = Symbol period

t1 = zero crossing of the first rising edge of AC coupled signal

t2 = Zero crossing of the falling edge of the AC coupled signal

t3 = Zero crossing of the second rising edge of the AC coupled signal

v1 = positive steady state voltage measured as the average voltage in the interval t1 to t2

v2 = negative steady state voltage measured as the average voltage in the interval of t2 to t3

128.7.2 Receiver characteristics

Receiver characteristics at TP4 are summarized in Table 128–9 and detailed in 128.7.2.1 through 128.7.2.5.

Table 128–9-Receiver characteristic of 2.5GBASE-KX

Parameter	SubClause Reference	Value	Units
Bit Error Ratio	128.7.2.1	10^-12	
Signaling speed	128.7.2.2	3.125±100 ppm	GBd
Receiver coupling	128.7.2.3	AC	
Differential input peak to peak amplitude(maximum)	128.7.2.4	1200[a]	mV
Return loss differential (minimum)[b]	128.7.2.5	See equation	

a:The receiver shall tolerate amplitudes up to 1600mV without permanent damage
b:Relative to 100 ohm differential

128.7.2.1 Receiver interference tolerance

The receiver interference tolerance shall consist of the test as described in Annex 128B with the Parameters specified in Table 128–10. The data pattern for the interference tolerance test shall be the test patterns 2 or 3 as defined in 52.9.1.1. The receiver shall satisfy the requirements for interference tolerance specified in Annex 128B for the test.

Table 128–10- 2.5GBASE-KX Interference Tolerance Parameter

Parameter	Test 1 Values	Units
Target BER	10^-12	
Mtc (min)	1.0	
Amplitude of broadband noise (min. RMS)	10.2	mV
Applied Transition time	100	ps
Applied Sinusoidal jitter (min peak to peak)	0.12	UI
Applied Random Jitter(min. peak to peak)	0.2	UI
Applied Duty Cycle Distortion (min. peak-to-peak)	0.035	UI

Mtc is defined in equation (128B-6) of Annex 128B
Applied random jitter is specified at a BER of 10^-12

128.7.2.2 Signaling speed range

A 2.5GBASE-KX receiver shall comply with the requirements of Table 128–9 for any signaling speed in the range 3.125GBd ± 100 ppm.

128.7.2.3 AC-coupling

The 2.5GBASE-KX receiver shall be AC-coupled to the backplane to allow for maximum interoperability between various 2.5 GB/s components. AC-coupling is considered to be part of the receiver for the purposes of this specification unless explicitly stated otherwise. It should be noted that there may be various methods for AC-coupling in actual implementations.

NOTE— It is recommended that the maximum value of the coupling capacitors be limited to 100nF. This will limit the inrush currents to the receiver that could damage the receiver circuits when repeatedly connected to transmit modules with a higher voltage level.

128.7.2.4 Input signal amplitude

2.5GBASE-KX receivers shall accept differential input signal peak-to-peak amplitudes produced by compliant transmitters connected without attenuation to the receiver, and still meet the BER requirement specified in 128.7.2.1. Note that this may be larger than the 1200 mV differential maximum of 128.7.1.4 due to the actual transmitter output and receiver input impedances. The input impedance of a receiver can cause the minimum signal into a receiver to differ from that measured when the receiver is replaced with a 100 ohm test load. Since the channel is AC-coupled, the absolute voltage levels with respect to the receiver ground are dependent on the receiver implementation.

128.7.2.5 Differential input return loss

For frequencies from 100 MHz to 2000 MHz, the differential return loss, in dB with f in MHz, of the receiver shall be greater than or equal to Equation (128–4) and Equation (128–5). This return loss requirement applies at all valid input levels. The reference impedance for differential return loss measurements is 100 Ω.