

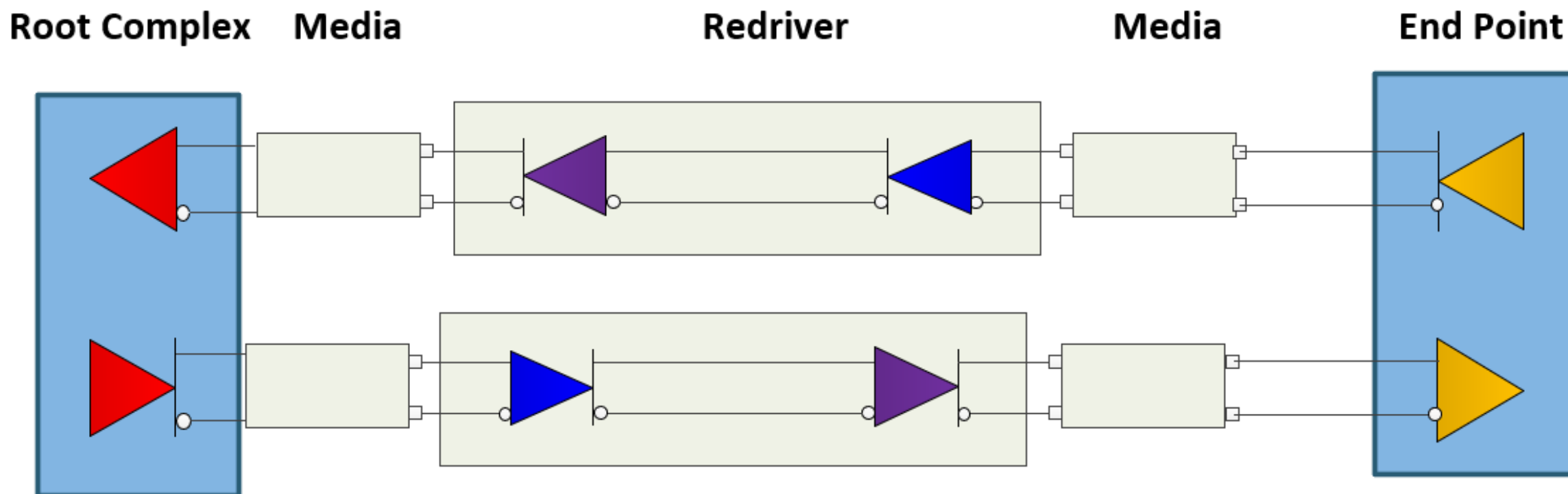
Retimer vs. Redrivers in PCIe

TI Precision Labs – PCIe

Presented by Nicholas Malone

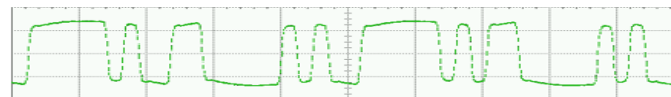
Prepared by Nasser Mohammadi

How does a linear redriver work?



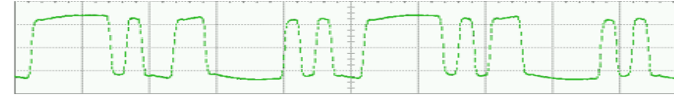
How does a linear redriver work?

Signal waveform before transmission media

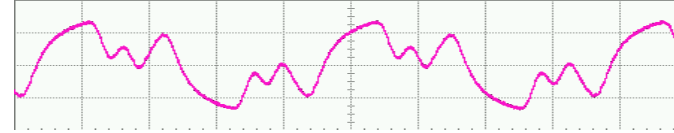


How does a linear redriver work?

Signal waveform before transmission media

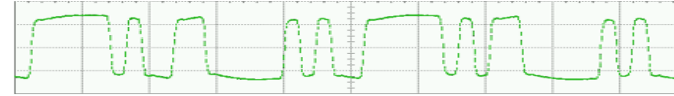


Signal waveform at the end of the transmission media

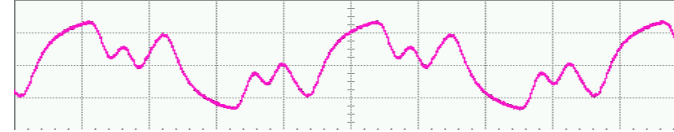


How does a linear redriver work?

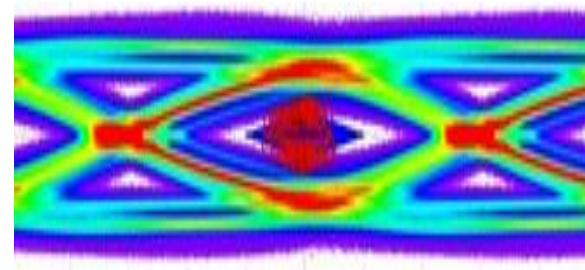
Signal waveform before transmission media



Signal waveform at the end of the transmission media

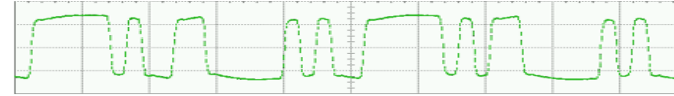


Eye closure at the end of the transmission media

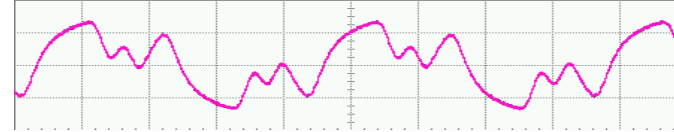


How does a linear redriver work?

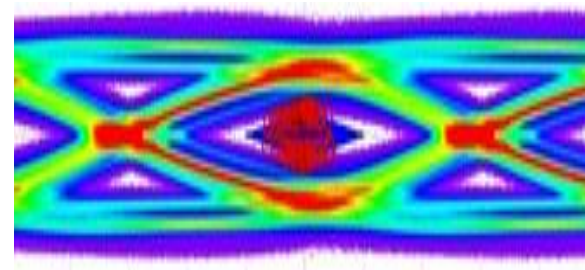
Signal waveform before transmission media



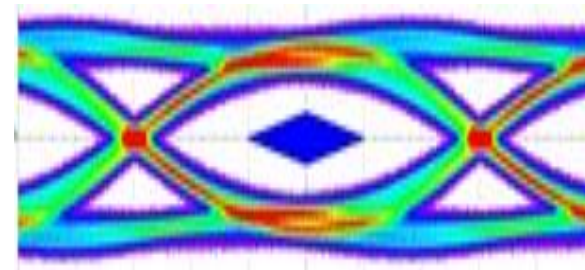
Signal waveform at the end of the transmission media



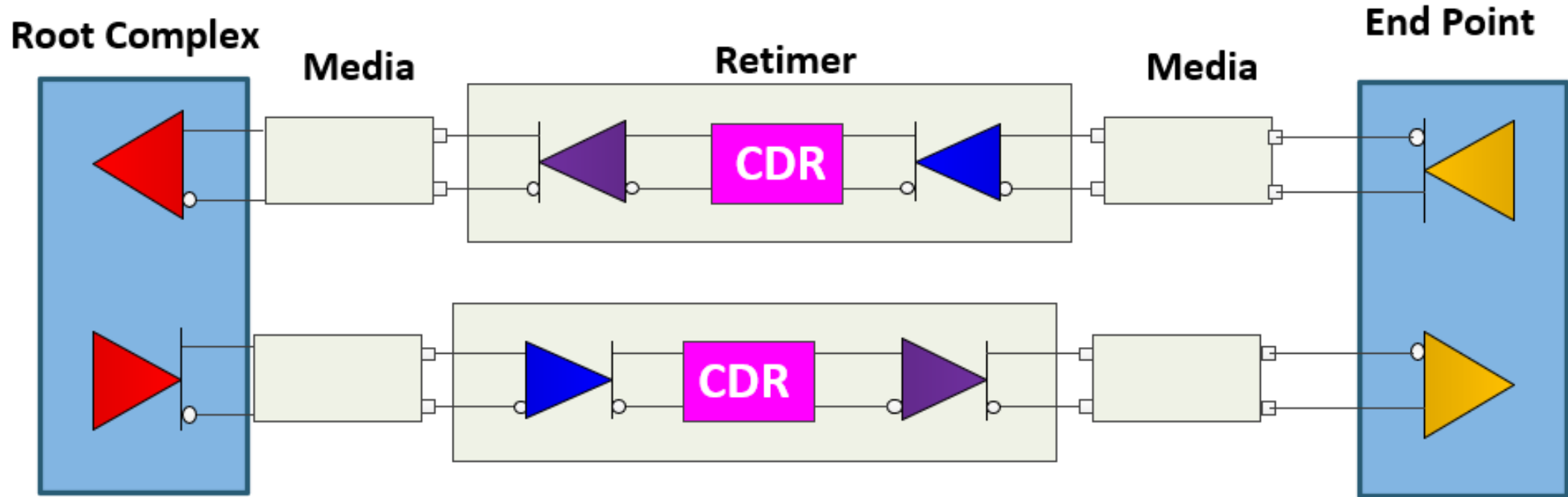
Eye closure at the end of the transmission media



Equalized eye diagram

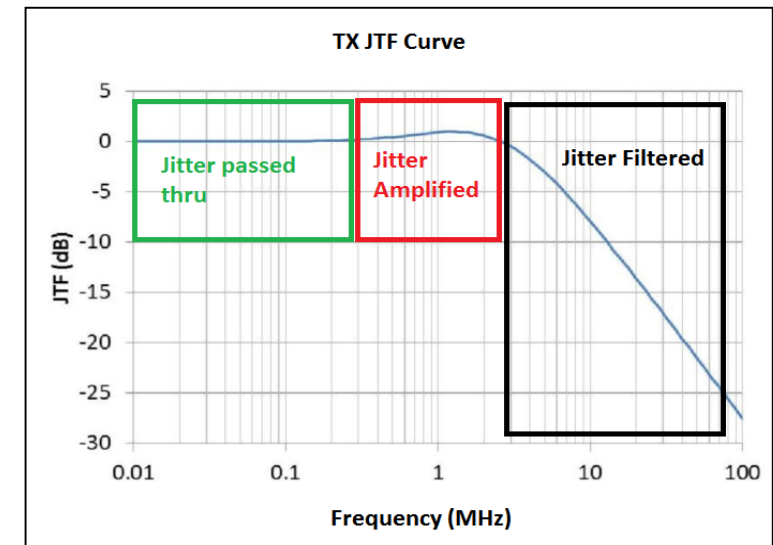
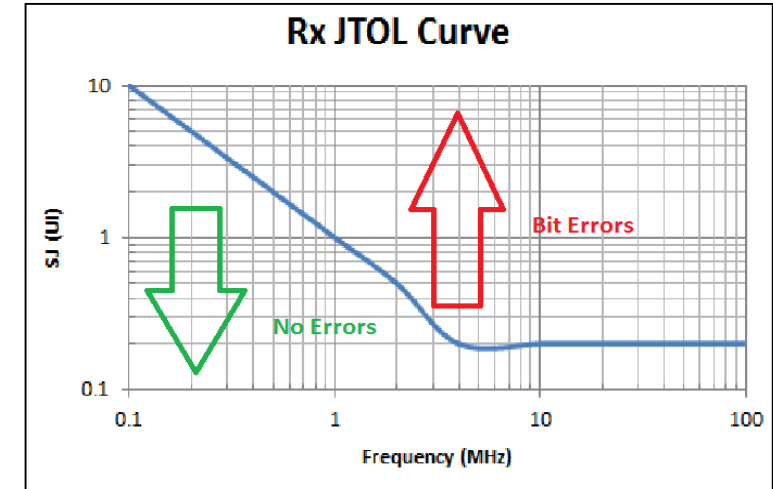


How does a retimer work?



Retimer jitter tolerance

- Retimers compensate for random and deterministic:
 - Too much random jitter will result in bit errors
 - Retimer periodic and sinusoidal jitter tracking capability: Too much P_j/S_j will also produce errors
- Retimer's output is not jitter free
 - There will be some random jitter. If the retimer's own jitter is not superior to the source, it may cause link issues
 - Jitter Transfer Function
 - There will be some deterministic jitter from input passed to output
 - It is possible for jitter to be amplified

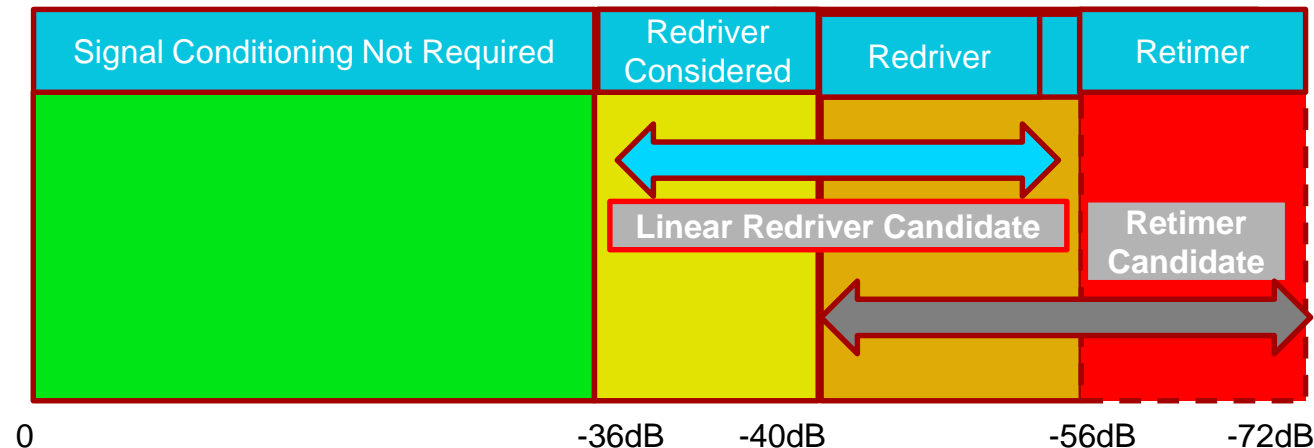


Redrivers vs Retimers implementations

Feature	Redriver	Retimer	Comments
Board design/ implementation cost	Low	High	<ul style="list-style-type: none"> Redriver is a simple component acting like wire in the link Retimer higher cost, requires reference clock, and larger footprint Retimer may require thermal management to meet long term reliability
Random jitter (RJ) cleaning	No	Yes	<ul style="list-style-type: none"> Redrivers can not clean RJ and thus does not reset jitter budget Retimers can clean RJ and should to have superior performance compared to source
Deterministic jitter (DJ) cleaning	Yes (ISI)	Yes	<ul style="list-style-type: none"> Redrivers typically only clean ISI (optionally cleans DCD & PJ with analog DFE) Retimer cleans ISI, DCD & PJ
Real life functional Inter-op	Good	Mixed	<ul style="list-style-type: none"> Linear redriver's simplistic ISI jitter cleaning provides best inter-op Retimer provides very powerful signal integrity tools but often its complexity brings inter-op issues Retimers and linear redrivers work well with end-to-end DP link training
Latency	Low	High	<ul style="list-style-type: none"> High latency can cause inter-op issues

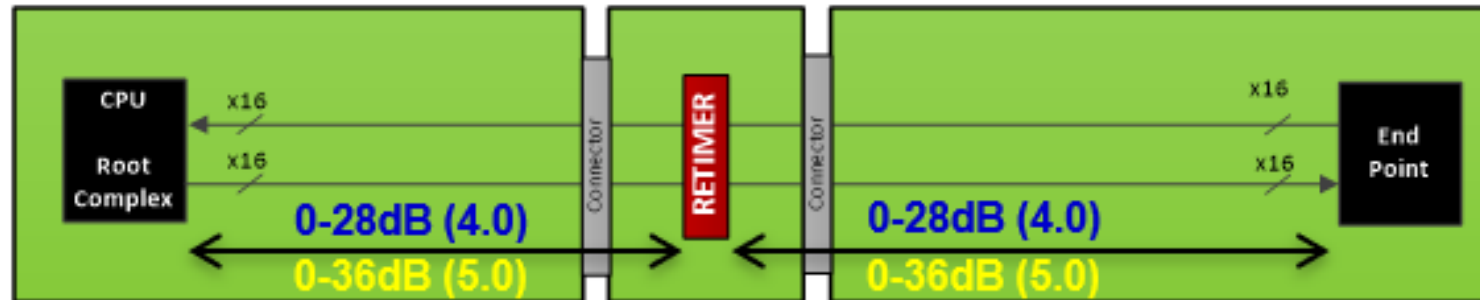
Gen5 Link Budget Feasibility

- Per PCIe specification, root complex and end point should be able to achieve Gen5 error free operation at up to -36dB total channel loss
- In some cases total channel loss is higher than recommended (-36dB)
- Many applications have a total channel loss between (-40 to -56dB)
- In a case where we have over -56dB loss, a retimer could be the only option



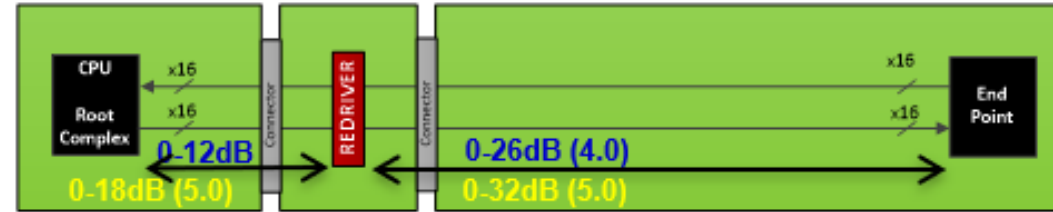
Retimer placement guideline

- Per PCIe specification:
 - At Gen4, retimer should be able to compensate for 28dB Nyquist signal loss
 - At Gen5, retimer should be able to compensate for 36dB Nyquist signal loss



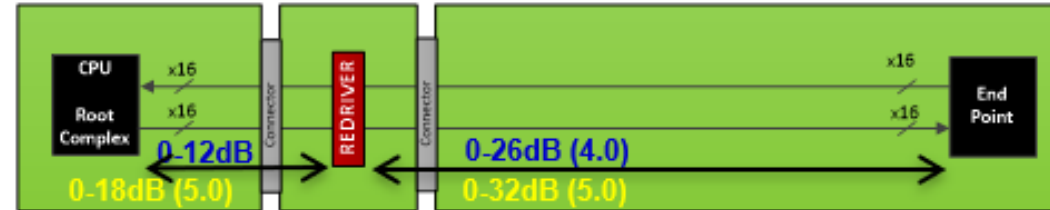
Placement options for redriver placement

- Near root complex redriver

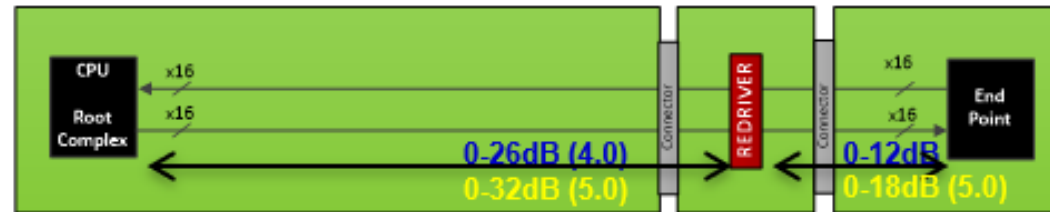


Placement options for redriver placement

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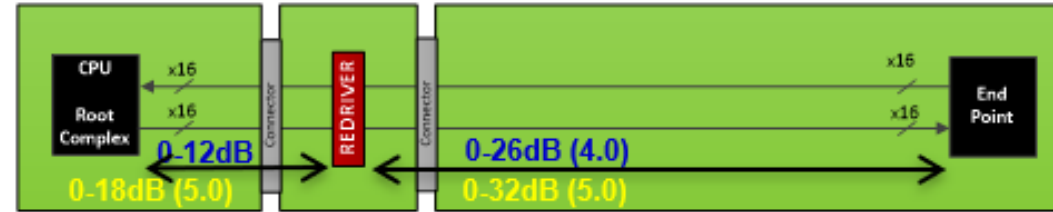


- Near end point redriver

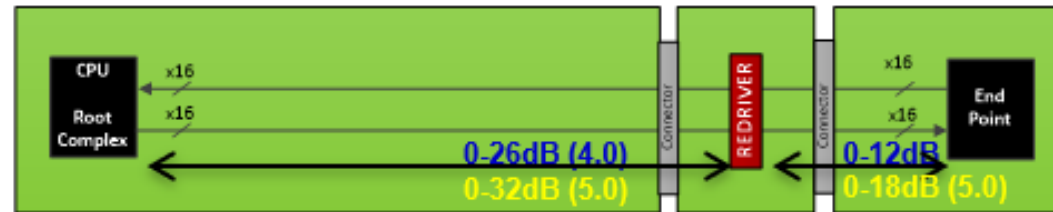


Placement options for redriver placement

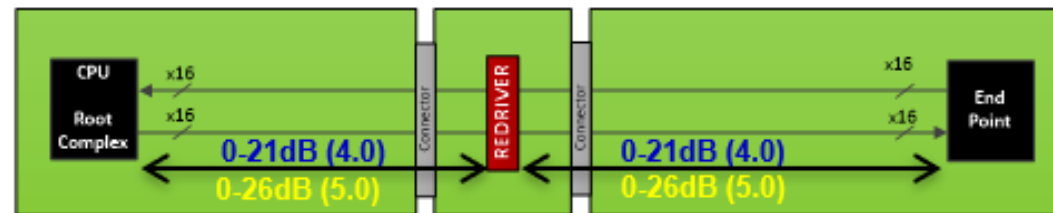
- Near root complex redriver



- Near end point redriver

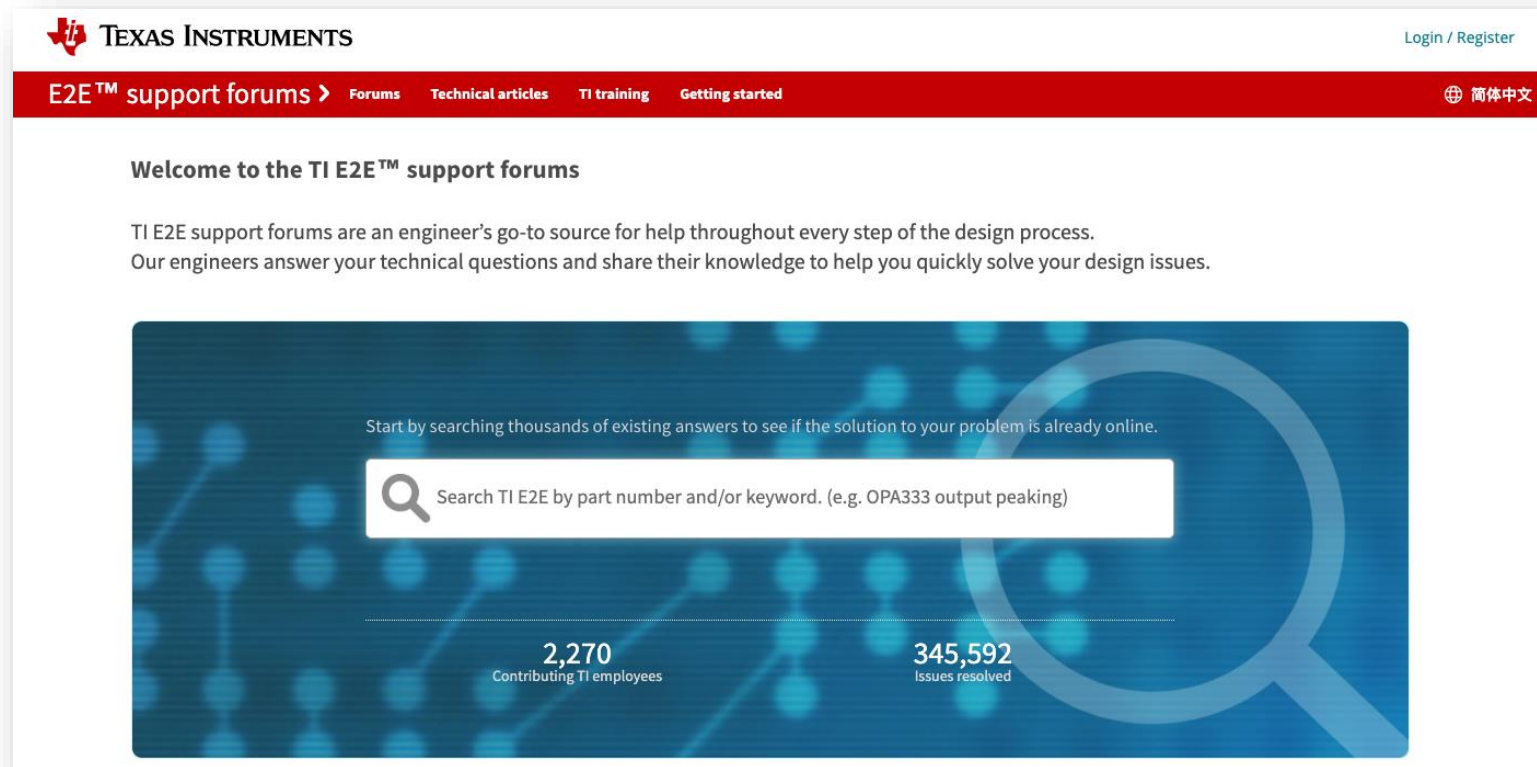


- Mid-link placement



Thank you

- [Texas Instruments Precision Labs Website](#)



The screenshot shows the Texas Instruments E2E support forums homepage. At the top left is the Texas Instruments logo. To the right of the logo is the text "TEXAS INSTRUMENTS". In the top right corner, there are links for "Login / Register". Below the logo is a red navigation bar with the text "E2E™ support forums" and a dropdown arrow, followed by links for "Forums", "Technical articles", "TI training", and "Getting started". On the far right of the navigation bar is a globe icon and the text "简体中文".

The main content area features a heading "Welcome to the TI E2E™ support forums". Below this is a paragraph: "TI E2E support forums are an engineer's go-to source for help throughout every step of the design process. Our engineers answer your technical questions and share their knowledge to help you quickly solve your design issues."

Below the paragraph is a large blue banner with a search bar. The search bar contains the text "Search TI E2E by part number and/or keyword. (e.g. OPA333 output peaking)". Above the search bar is the text "Start by searching thousands of existing answers to see if the solution to your problem is already online." Below the search bar are two statistics: "2,270 Contributing TI employees" and "345,592 Issues resolved".



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