Magnetics for 10GBase-T

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Topics of discussion

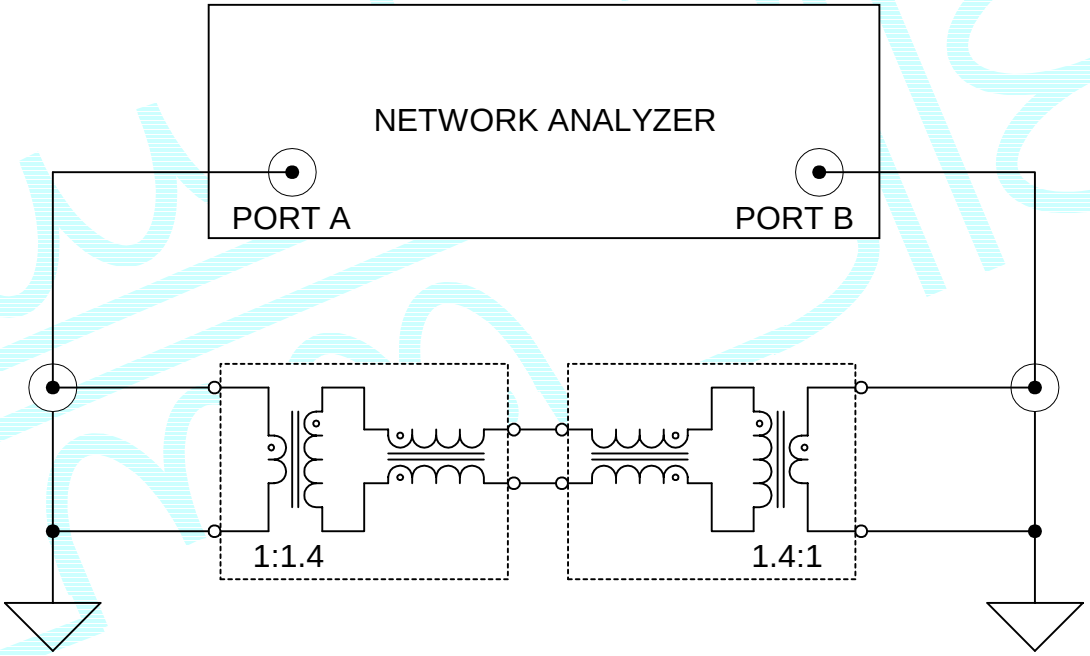
- Design example 1
- Test set ups
- Test results
- Design example 2
- Test results
- Summary

10GBase-T magnetics design example1

- Transformer:
  - 1:1.4 turns ratio for 50Ω:100Ω impedance matching. No center taps on transformer.
  - Insulation to meet 1500 VAC
  - Lower inductance than traditional 10/100 magnetics (about 100 uH)
  - Not packaged (wires soldered to test fixture pads)
- Common-mode choke
  - Typical wide-band common-mode noise suppression material

Test set up, example 1

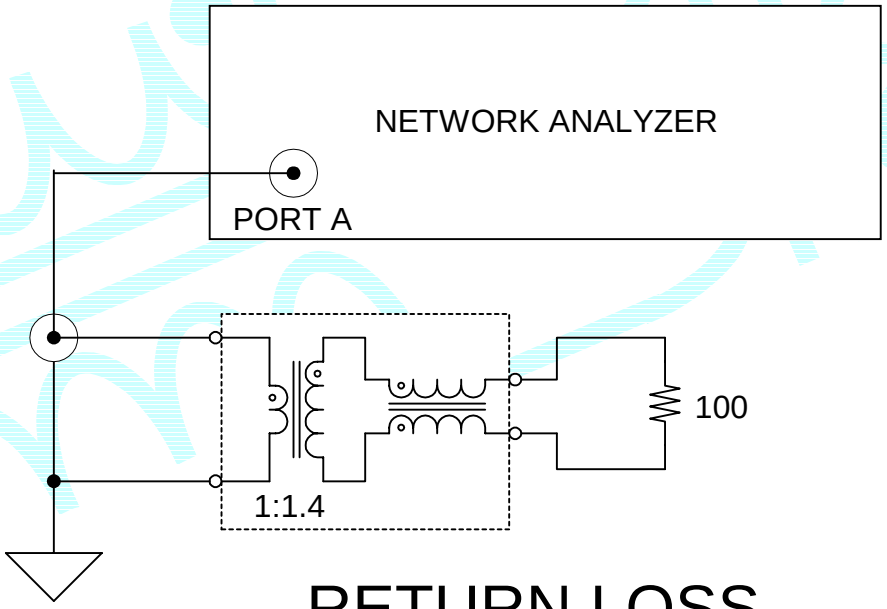
- Back-to-back test set up in Insertion Loss (S21) to minimize number of interface levels



INSERTION LOSS
TEST SET UP

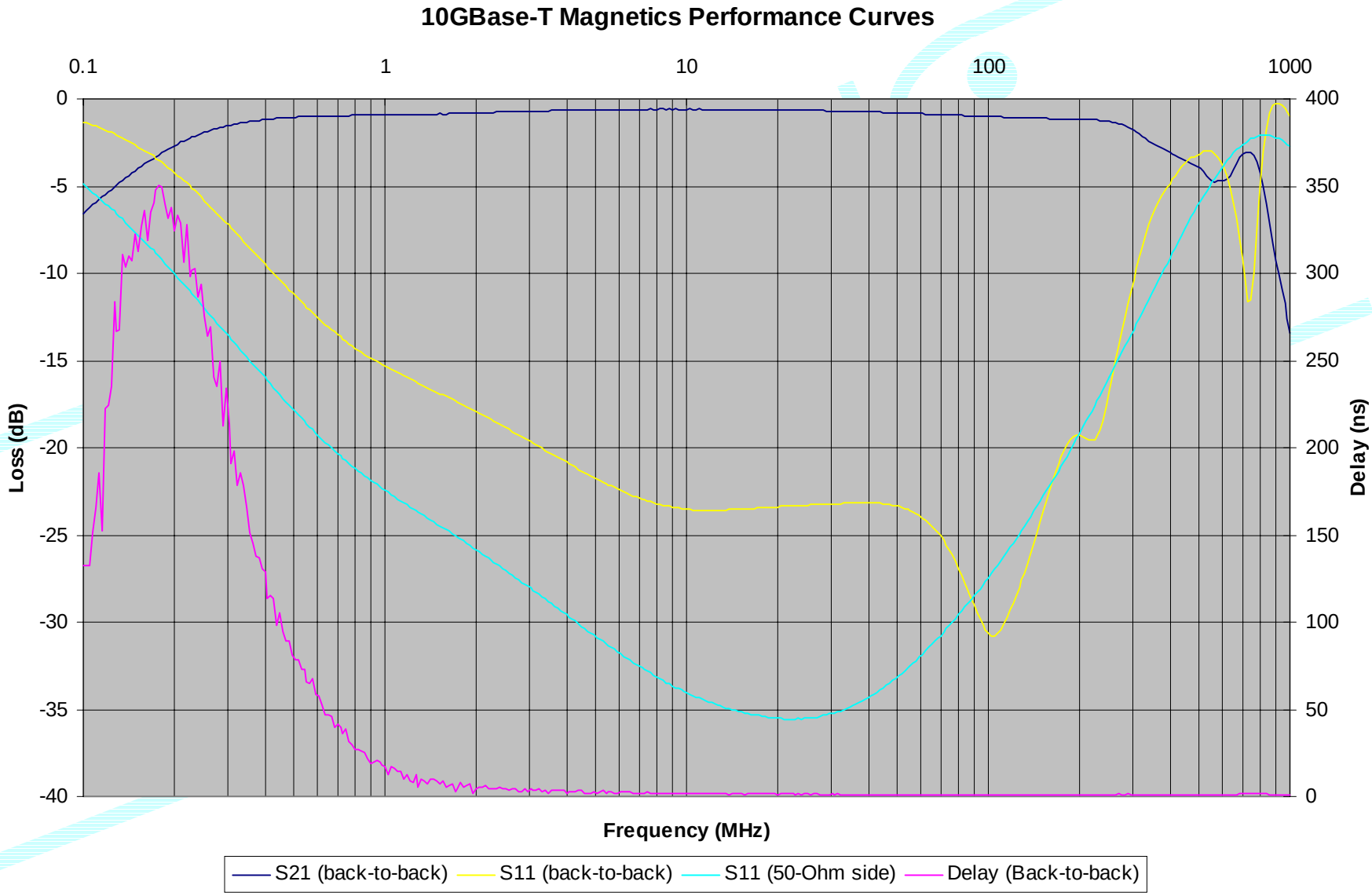
Test set up, example 1 (continued)

- Return loss was tested from the driver side to eliminate need for wide-band 50Ω:100Ω balun



RETURN LOSS
TEST SET UP

Test results, example 1



Test results, example 1 (continued)

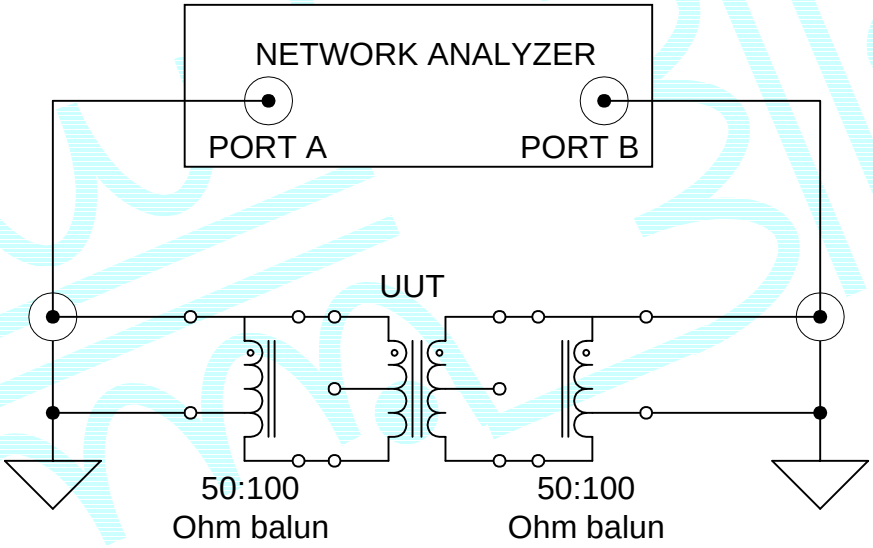
- Insertion Loss
  - 6-dB bandwidth (back-to-back) spans from around below 100 kHz to above 600 MHz
  - Delay stays relatively flat from 2 MHz and beyond
- Return Loss
  - Better than 6 dB from 100 kHz to 500 MHz
  - Better than 10 dB from 200 kHz to 375 MHz

10GBase-T magnetics design example2

- Transformer:
  - 1:1 turns ratio for 100Ω:100Ω impedance matching.
  - Insulation to meet 1500 VAC
  - Lower inductance than traditional 10/100 magnetics (about 80 uH)
  - Has a center tap on each side
  - In a surface-mount plastic package
- No common-mode choke

Test set up, example 2

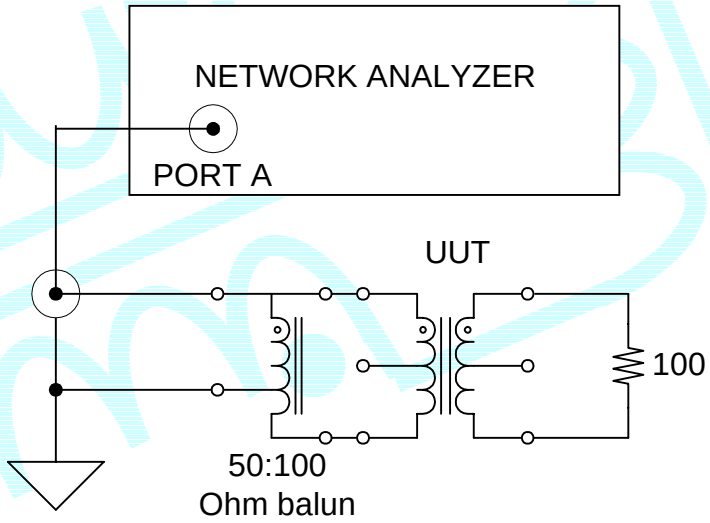
- Use non-isolated 50:100-Ohm baluns to interface with network analyzer



INSERTION LOSS
TEST SET UP

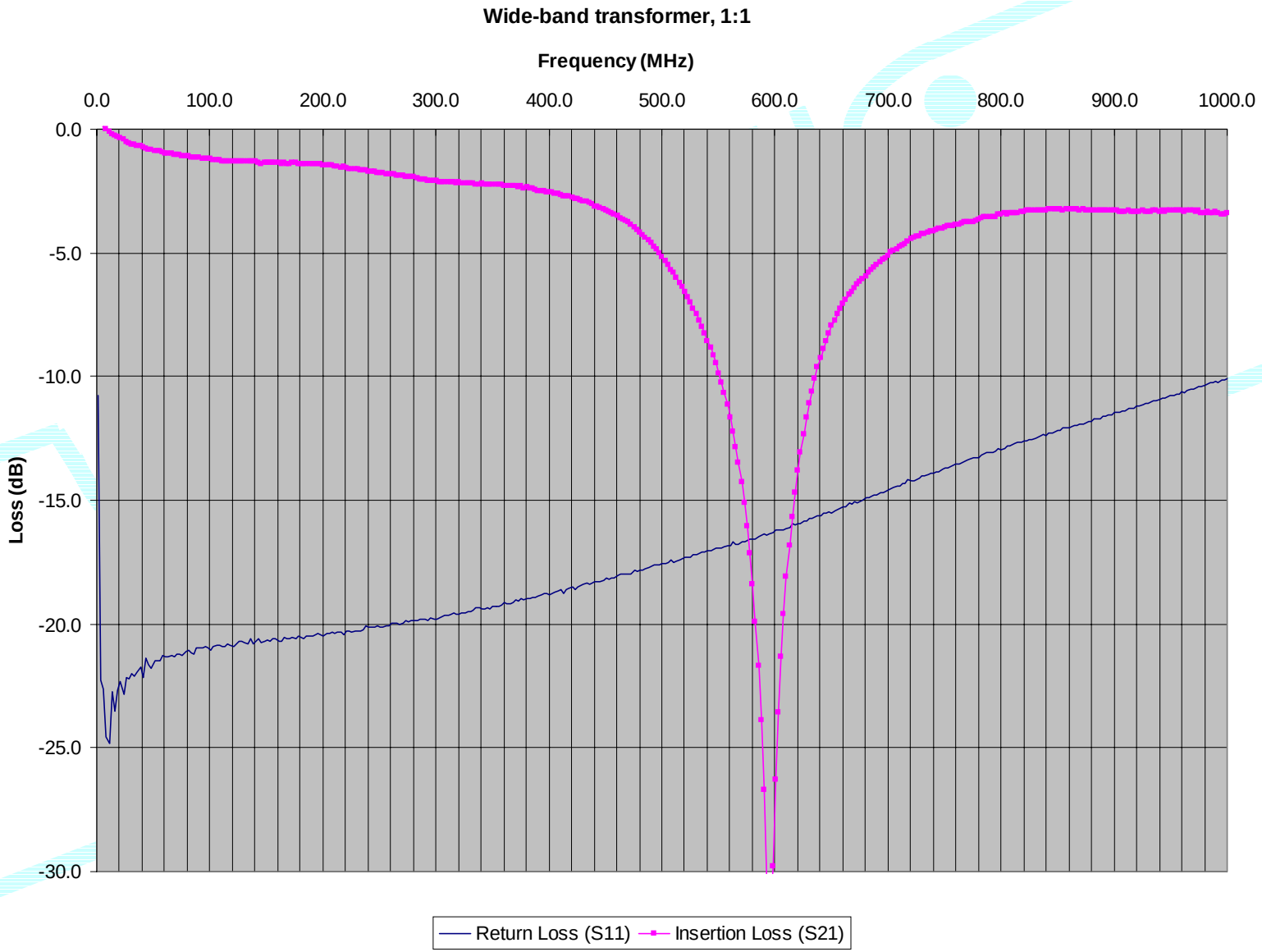
Test set up, example 2 (continued)

- Use a non-isolated 50:100-Ohm balun to interface with network analyzer



RETURN LOSS
TEST SET UP

Test results, example 2



Test results, example 2 (continued)

- Insertion Loss
  - 3-dB bandwidth spans from around below 200 kHz to about 430 MHz
- Return Loss
  - Better than 10 dB from 1 MHz to 1 GHz
  - Better than 15 dB from 3 MHz to above 600 MHz

Summary

- Performance at high frequencies are very sensitive to package size and whether center taps on the transformer are needed.
- Bandwidth (3dB) from less than 200 kHz to more than 400 MHz is feasible.
- Since the numbers of turns will be small, odd turns ratios such as 1:1.4, 1:1.15, etc. may be difficult to implement, especially if center taps are needed.