Transmit Amplitude Reduction “Green-T”: The path to a “greener” 10BASE-T

Presenter
Mandeep Chadha
Vitesse Semiconductor Corp.

Contributors
Jim McElwee
Dan Stiurca

Supporters

- Mandeep Chadha (Vitesse)
- Geoff Thompson (Nortel)

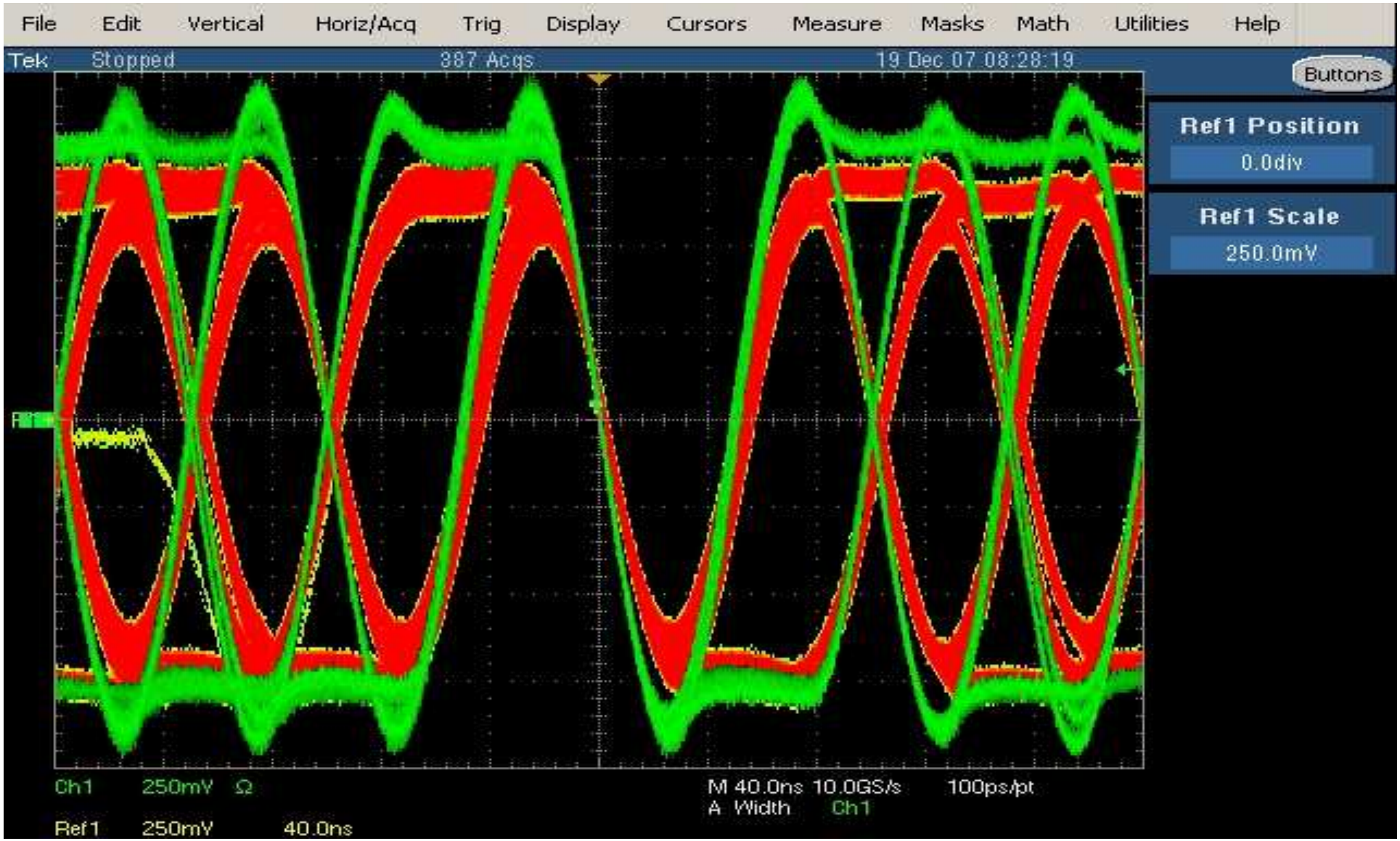
Motivation and Goals

- 10BASE-T is not the lowest power Ethernet technology, largely because it is constrained by legacy requirements for transmit voltage.
- Goal is to modernize 10BASE-T to:
  - Align with modern on-chip voltages (eliminate barriers to new implementations, such as additional power supplies or on-chip converters)
  - Specifically, use of lower analog and I/O voltages to track process improvements.
  - Get 10Base-T power consumption more appropriately in line with its speed.
  - Be able to take more advantage of 10BASE-T very low duty cycle in IDL for “Green” requirements.
- While:
  - Maintaining compatibility with legacy 10BASE-T receivers.
  - Maintaining 100 meter reach over Cat5 or better
- But sacrificing:
  - 100-180 meter reach over Cat5 (beyond scope of 802.3)
  - 65-100 meter reach on Cat3 and DIW.

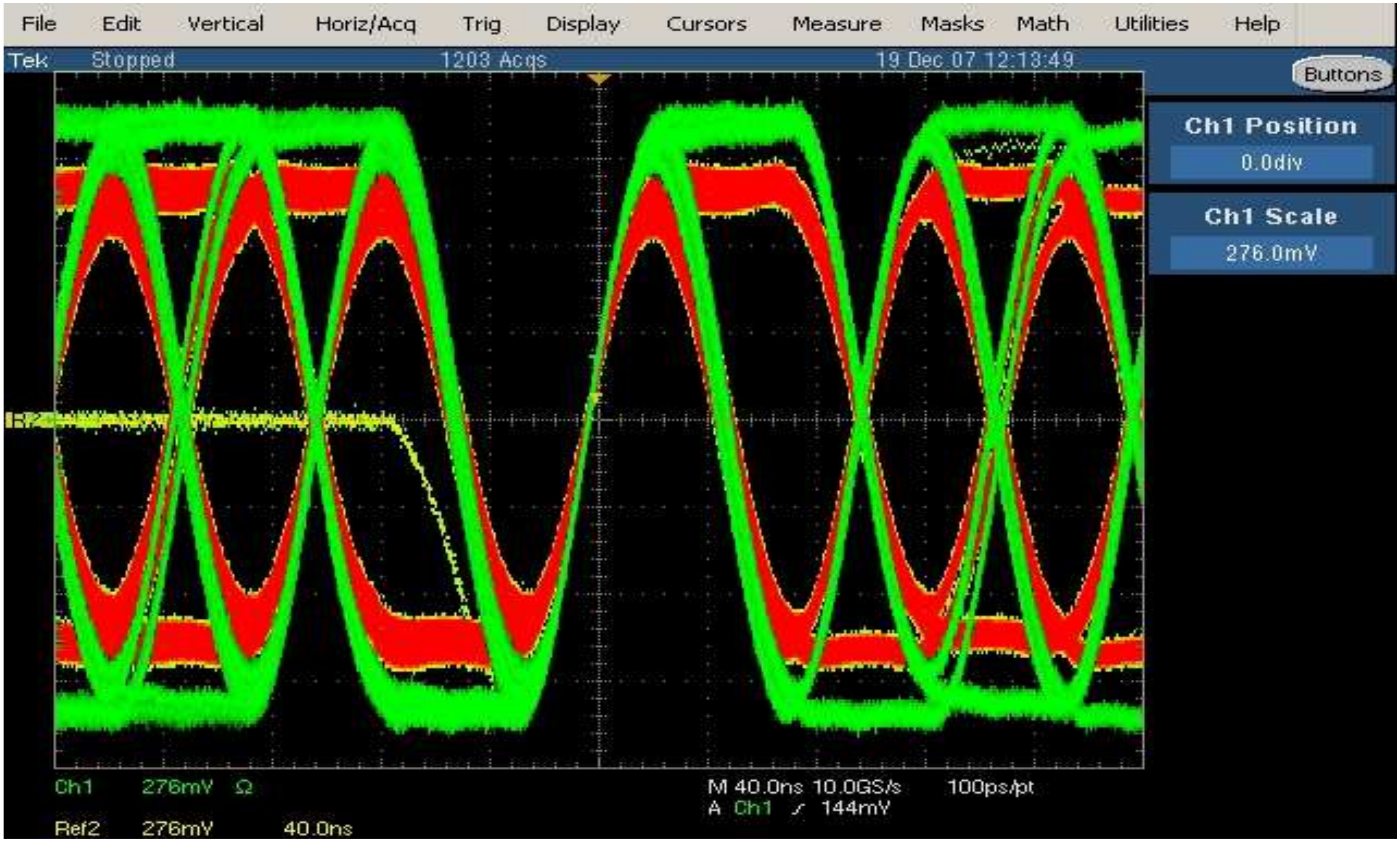
Background: Existing 10BT specifications

- Existing 10BT amplitude spec: 2.2Vp to 2.8Vp with random data sequence into 100ohm load.
- 2.5Vp specification resulted from factors that are no longer significant concerns in modern LANs– e.g. telephone pulse, switch-hook and mechanical ringer interference to data pairs in a shared sheath cable with poor cross-talk specs.
- Twisted pair model is based on DIW/Cat3 model that is no longer common. (DIW was “D-inside-wire”, i.e.AT&T voice grade UTP)
- Loop reach with existing 10BT implementation is >180m Cat5.
- The following plots on pages 5,6 show performance of existing amplitude requirements applied to the 802.3 twisted-pair-model as well as 140m typical Cat5 cable. (Note vertical scale difference between plots on next two pages).

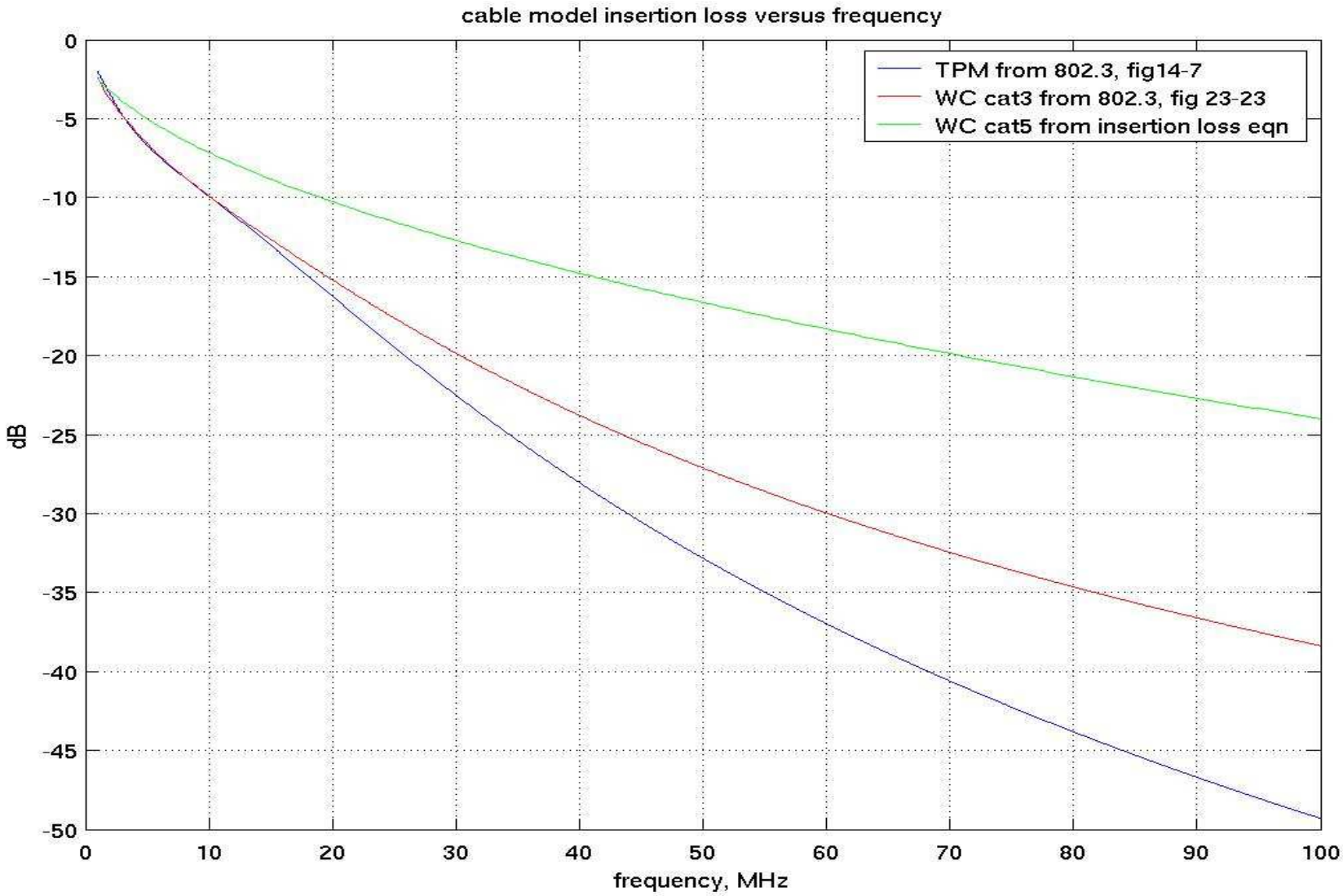
10BT over Cat5 (optimized for 802.3 TPM)



10BT waveforms (adjusted for 140m Cat5)



Comparison of cable insertion loss

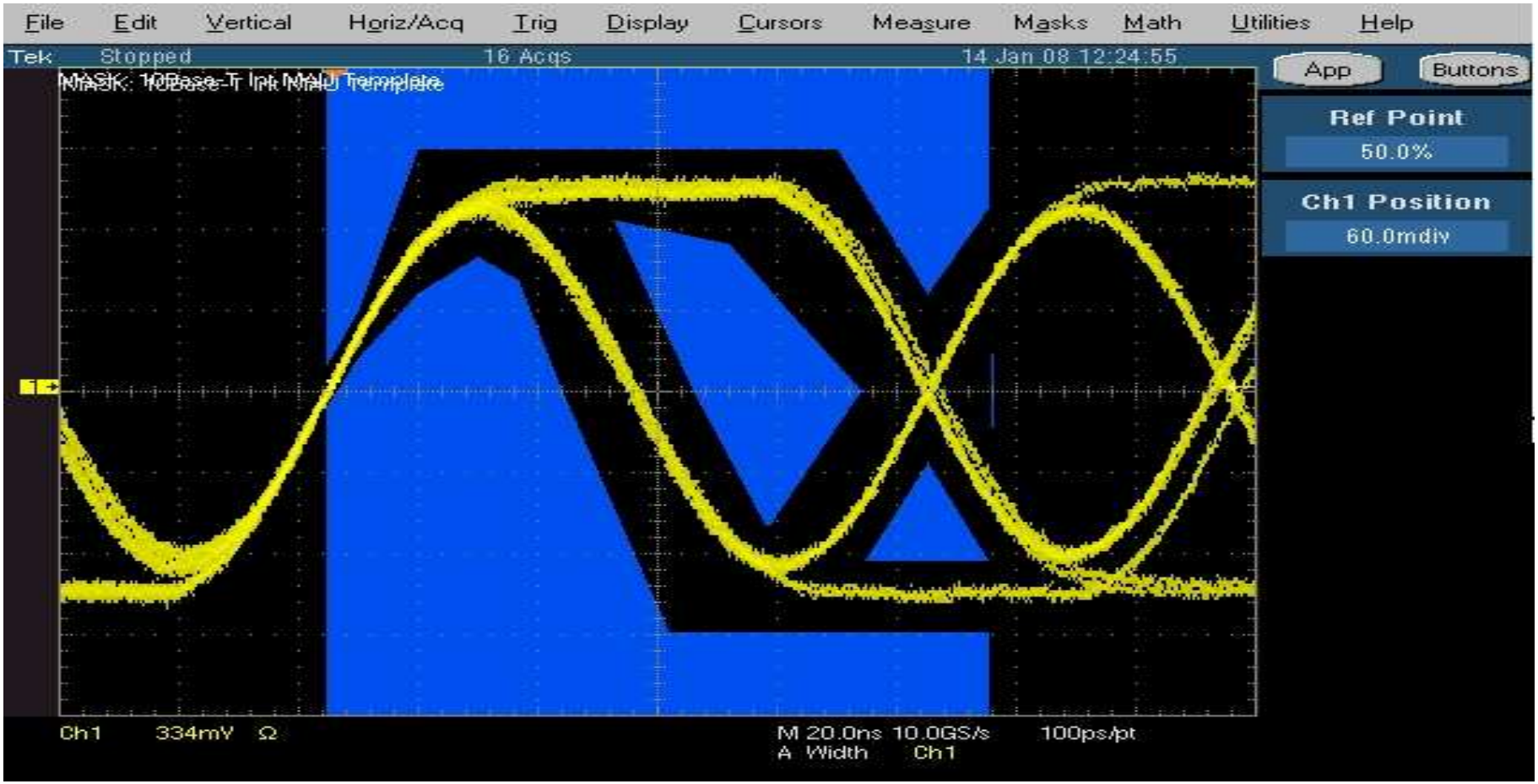


Proposal: Amplitude reduction

- Scope plots indicate Cat5 amplitude is 1.25-1.3x greater than the resulting TPM output waveform.
- Frequency domain insertion loss plots indicate similar difference between TPM/Cat3 and Cat5
  - ~2 dB delta at 5MHz
  - ~3 dB delta at 10MHz
- Propose amplitude reduction of ~30% based on previous plots -> ~1.75V

Performance with proposed amplitude

- 100m worst-case Cat5 (7.2dB atten. @ 10MHz)
- Transmit amplitude, ~1.75Vp
- Mask scaling 1.0 (centered)
- Transmit waveforms (de-emphasis) adjusted for w.c. Cat5 channel



Proposal: System considerations

- Autoneg functionality would remain the same. No new autoneg states are implied.
- Link pulses would be reduced in amplitude, which would not cause problems on modern cabling with compliant PHY link partners.
- MAU voltage template (figure 14-9) implications:
  - One solution is to derive a TPM that better approximates a worst-case Cat5/5e channel. Modified de-emphasis could then be used, in conjunction with lowered amplitude, on the transmit waveform to remain compliant with figure 14-9 (preferred).
  - Or, keep existing TPM, but modify MAU template, using figure 14-9 as a starting point.
- A part may contain both “Green 10BT” and traditional 10BT capability, and be configured (by pin or register settings) to either mode.

Expected Impact/Benefit

- + Power savings are realized by line-driver circuitry, as well as all other analog functionality on the PHY sharing the line driver's supply. This addresses the 10BT PHY blocks that generally consume the most power.
- + Ability to scale with process and IO voltages. As systems support lower IO voltages, fewer special power supplies are required.
- + It becomes more attractive to include 10Mb/s in modern multi-speed implementations because of reduced requirements for specialized power.