To: T10 Technical Committee
From: Barry Olawsky, HP (barry.olawsky@hp.com)
Date: 5 January 2005
Subject: T10/05-025r0 SFF8470 Crosstalk Study

**Revision History**

Revision 0 (5 January 2005) First revision

**Related Documents**

sas1r07 - Serial Attached SCSI 1.1 revision 7
T10/05-007r0 - SAS-1.1 External Cable Electrical Specification

**Overview**

Provide technical data (electrical) to evaluate the feasibility of proposal 05-007r0. Specifically, demonstrate crosstalk summation and provide analysis to support necessary changes.

**Reference Information**

Included below

# SSF8470 Crosstalk Study

Prepared by Barry Olawsky
Hewlett Packard
January, 2005

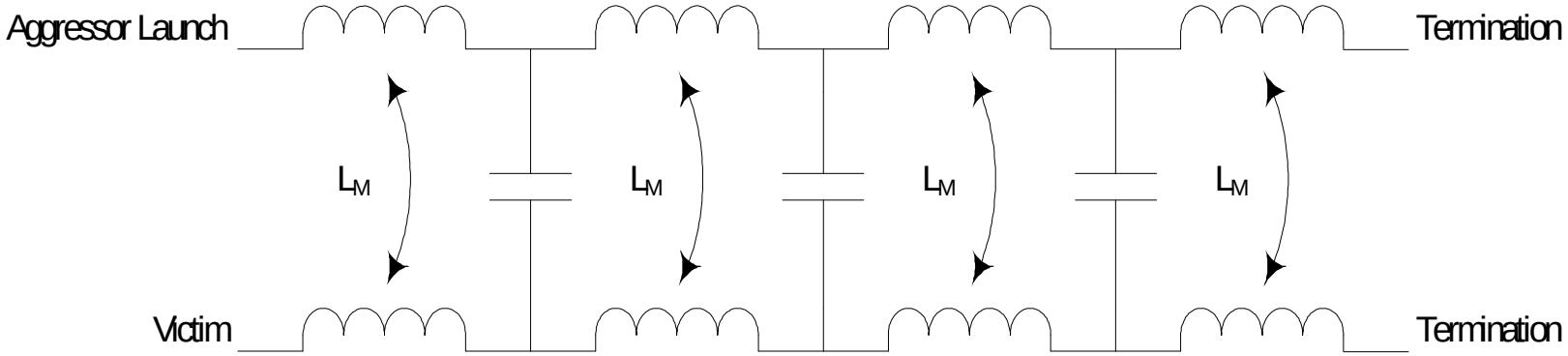
# Topics

- Demonstrate multi-lane SFF8470 near-end crosstalk is additive
- Review crosstalk spec in proposal 05-007r0
- Effects of crosstalk with spectral content above fundamental
- Proposed levels

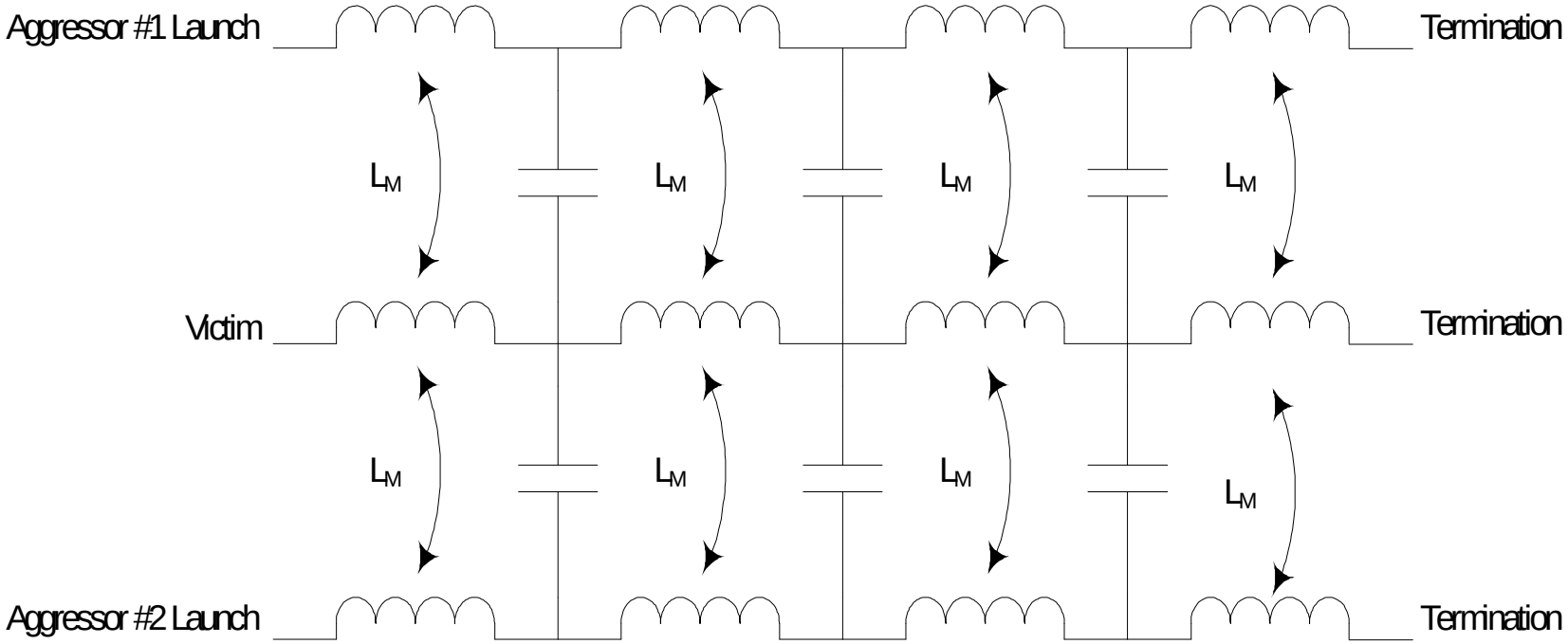
# Multi-Aggressor Crosstalk Assertion

- Near-end inductively coupled crosstalk is additive. At a frequency of interest, crosstalk magnitude at the victim is a summation of the amplitude due to each aggressor. The phase offset of the two aggressors, observed at the victim, is a parameter in the summation.

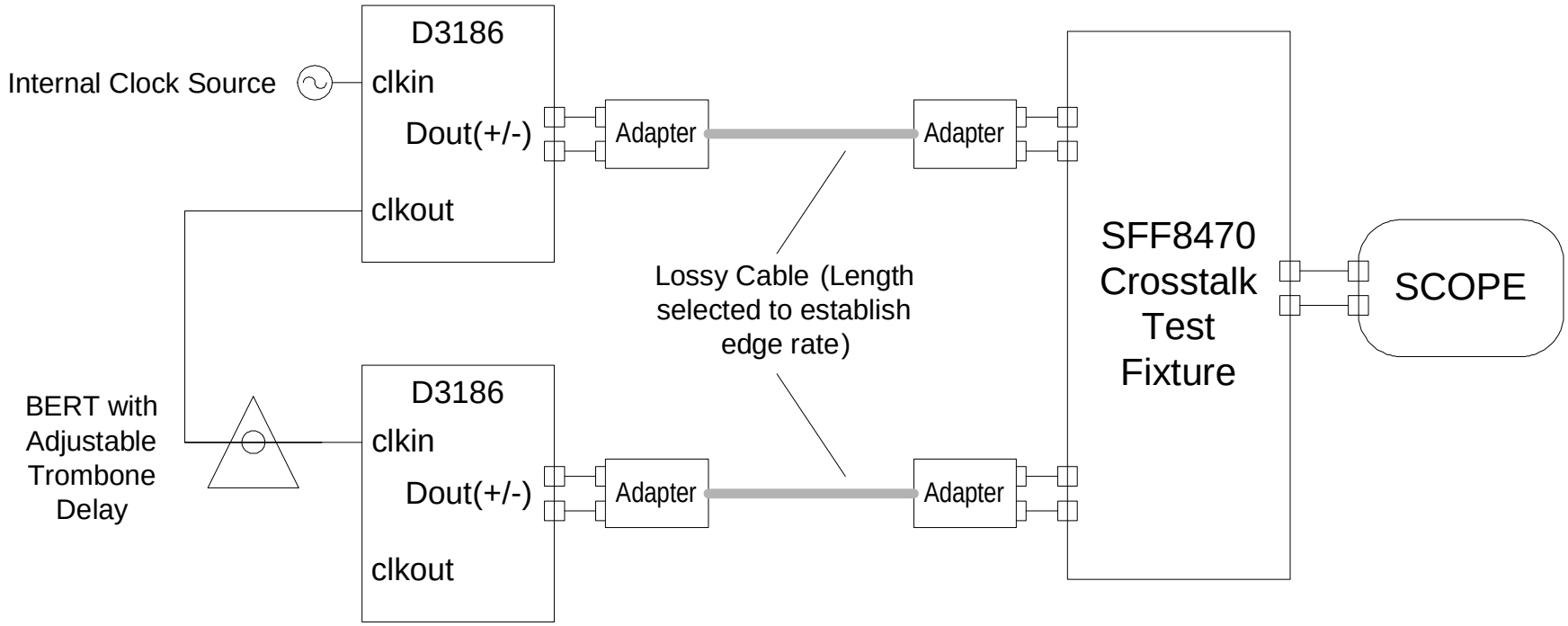
# Near-End Crosstalk Model



# Multi-Aggressor Near-End Crosstalk Model

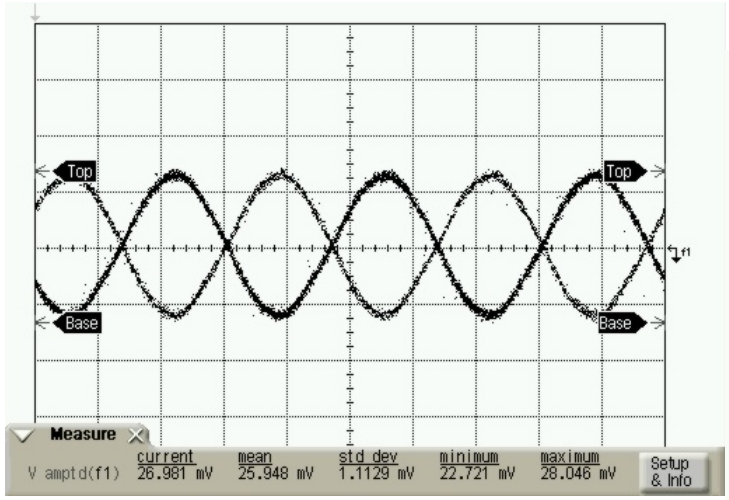


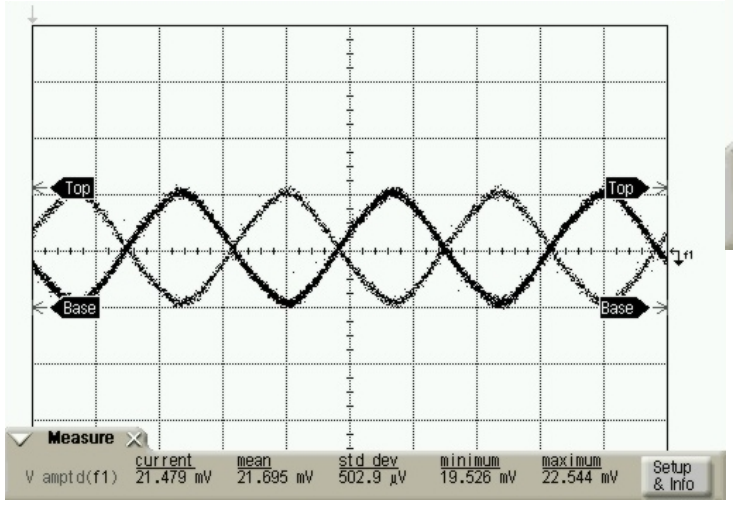
# Differential NEXT Test Fixture Setup

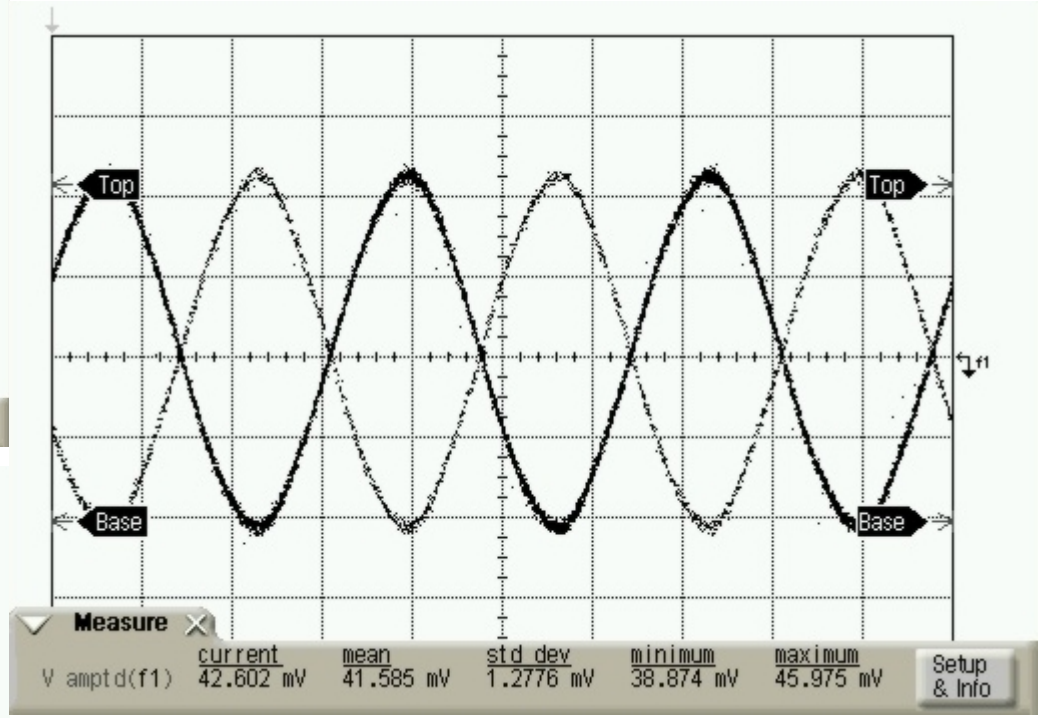



D10.2 used. BERT varies phase offset between aggressors.

# NEXT at Victim (Aggressor edge rare of 120ps), UI: 333ps

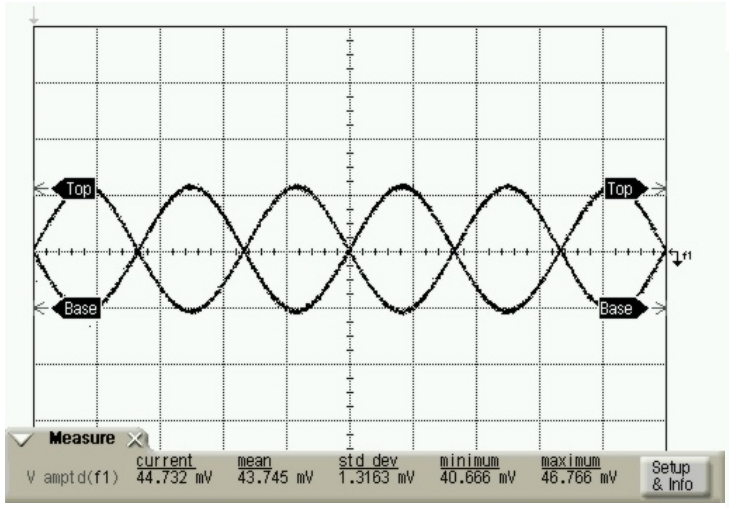


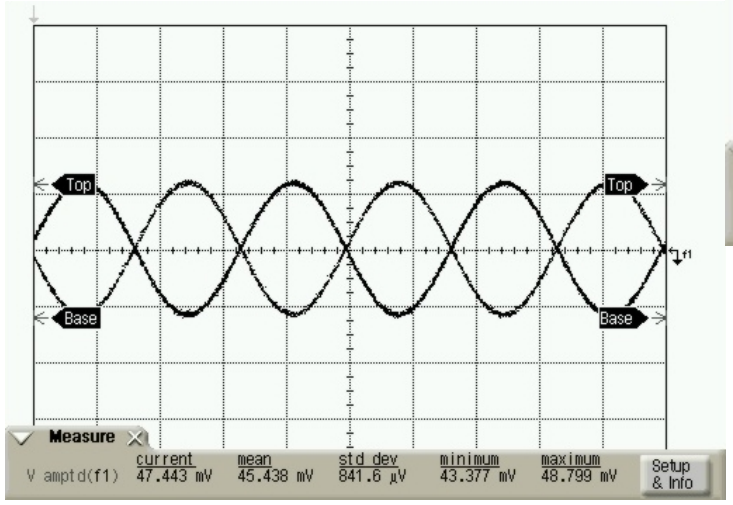



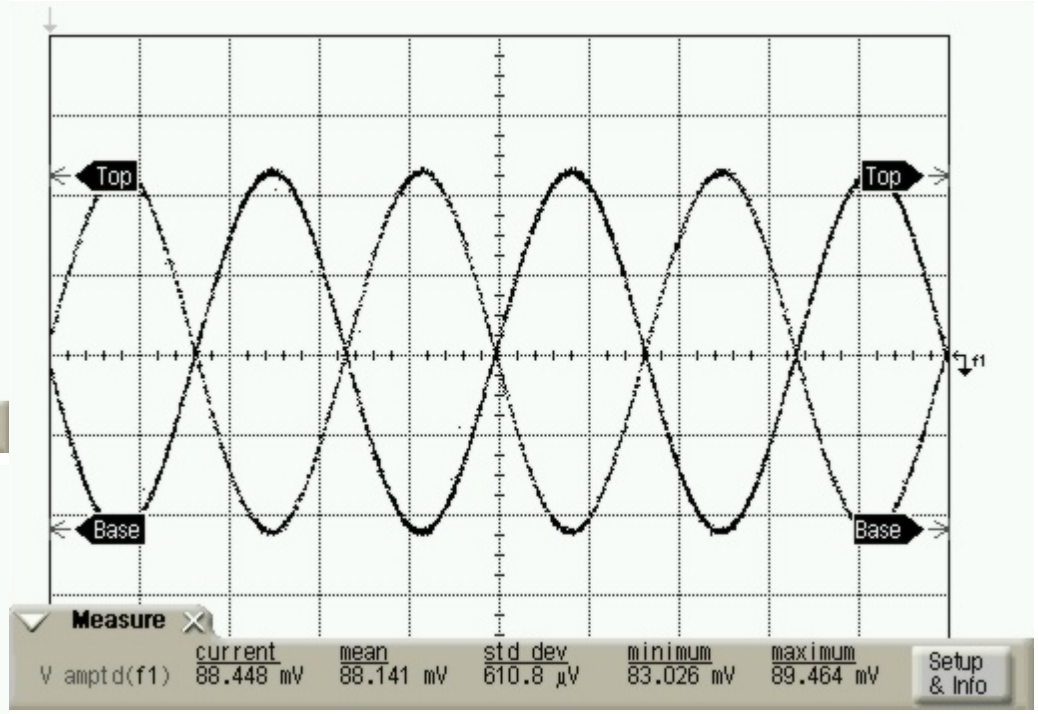




Aggressor 1: 26mV
Aggressor 2: 22mV
In-phase Summation: 42mV

# NEXT at Victim
# (Aggressor edge rare of 60ps), UI: 167ps

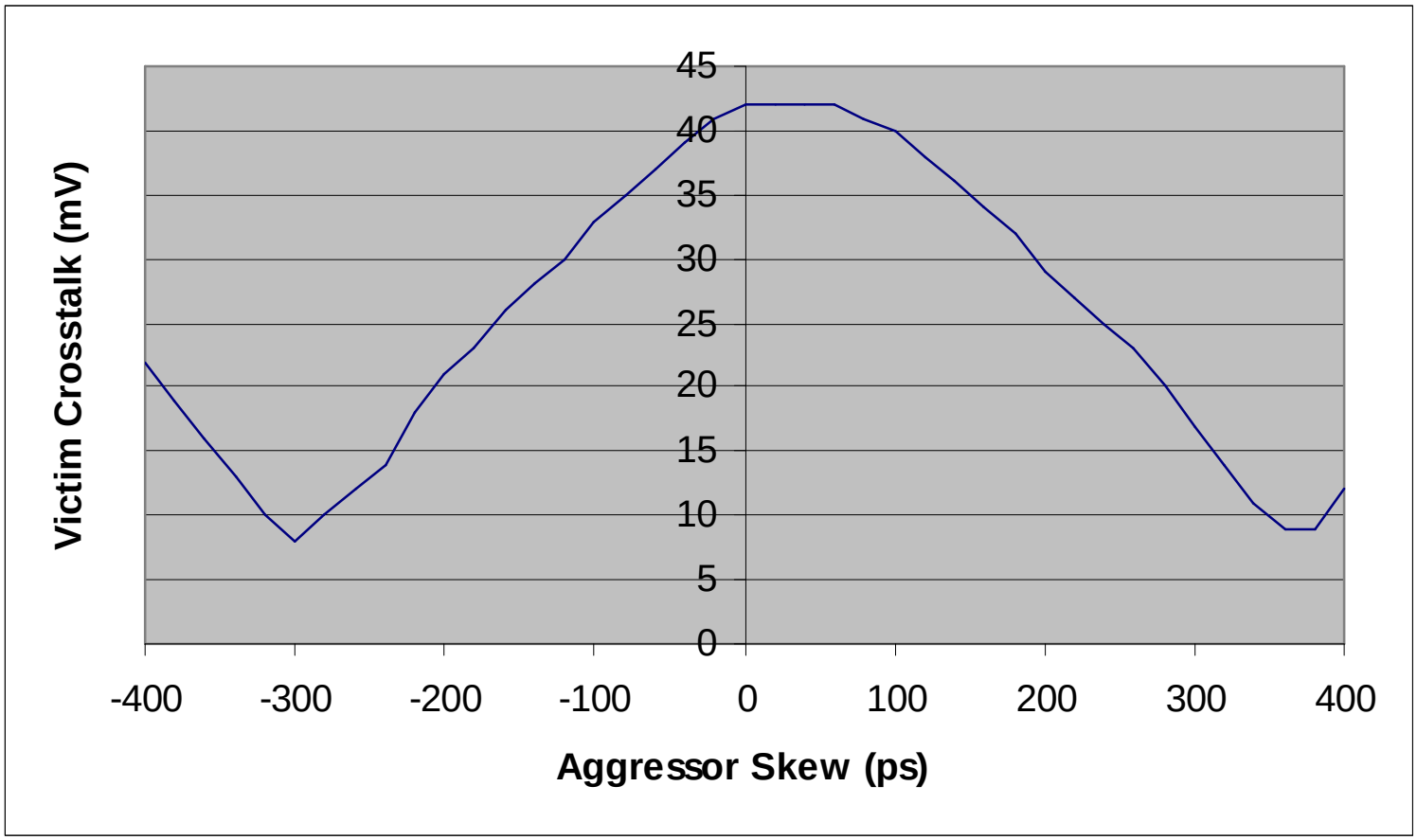


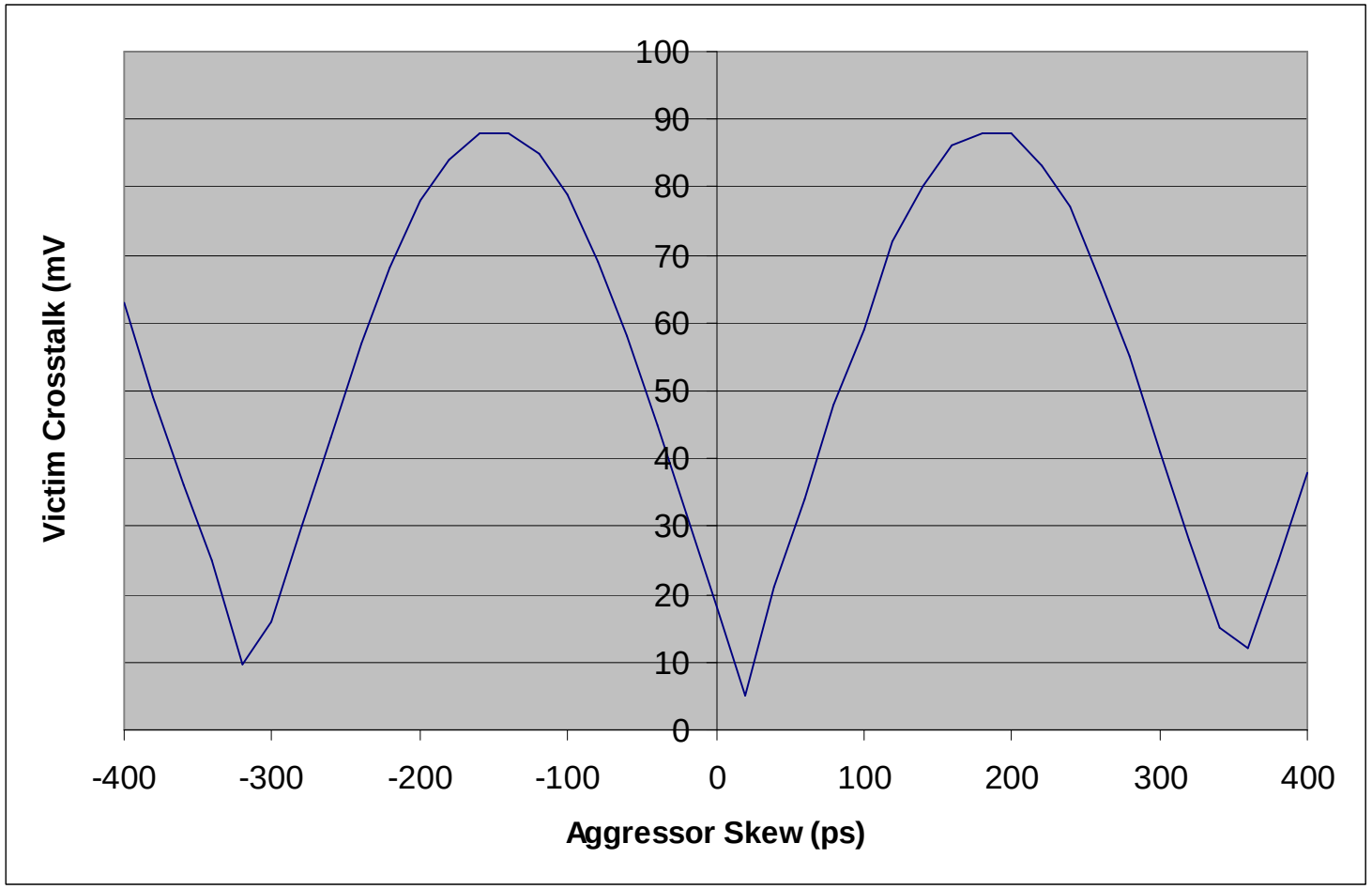




Aggressor 1: 44mV
Aggressor 2: 45mV
In-phase Summation: 88mV

# Multi-Aggressor Crosstalk Amplitude vs. Aggressor Pair Skew, UI: 333ps, ER: 120ps



# Multi-Aggressor Crosstalk Amplitude vs. Aggressor Pair Skew, UI: 167ps, ER: 60ps



# Summary of Test Results

- Screen captures show additive property of multi-aggressor NEXT using D10.2 pattern at the above documented edge and data rates
- Amplitude variation with respect to aggressor skew is further evidence of additive property

# Review of 05-007r0

- Proposal specifies NEXT of -30dB (3.2%) for single pair from 10 to 4500MHz.
- Combining crosstalk from different pairs could yield value that is much larger than 5%.
- Previous sample measurements have demonstrated NEXT amplitudes in excess of 3.2% above 2GHz for most samples tested.

# Proposed Changes to 05-007r0

- Consider reducing allowable crosstalk at fundamental such that multi-aggressor sum is less than or near 5%
- Crosstalk isolation required above the fundamental may possibly be reduced. Crosstalk of energy at harmonics must be appropriately accounted for in crosstalk budgeting.