

Field Testing Update

Mark Johnston
Director of Technology Development
Microtest



Developments in Field Testing

- ◆ Several new field testers on the market
- ◆ Many of the new measurements are now supported
- ◆ Dynamic range over 100 dB supported
- ◆ Vector (magnitude and phase) measurements in two products
- ◆ Bandwidths up to 300 MHz supported
- ◆ Some interesting new measurements expected within 12 months
- ◆ Some interesting new measurements at least 3 years away



Cat 5E Field Testing Support Today

Measurement (1-100 MHz)	Supported
Delay	D, F, M, S, W
Delay Skew	D, F, M, S, W
PS NEXT	D, F, M, S, W
Return Loss	F, M, S, W
ELFEXT	M, S, W
PS ELFEXT	M, S, W

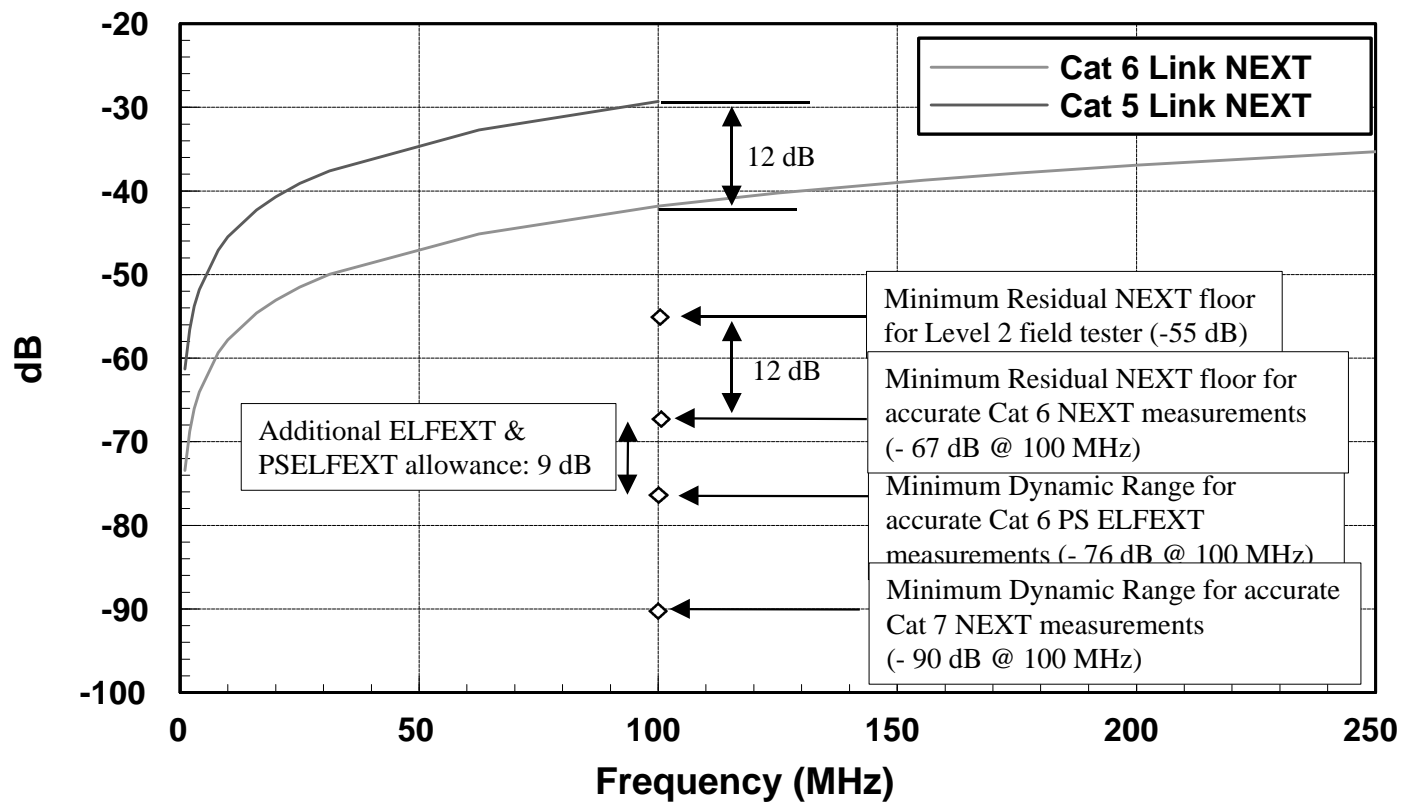


Cat 6/Class E Field Testing Support

Measurement (1-250 MHz)	Supported
Delay	D, F, M, S, W
Delay Skew	D, F, M, S, W
PS NEXT	D, M
Return Loss	M
ELFEXT	M
PS ELFEXT	M



The Importance of Dynamic Range



Cat 6/Class E Field Testing Issues

- ◆ Need three fundamental capabilities:
 - ◆ **Measurements** (PS NEXT, Return Loss, ELFEXT, PS ELFEXT)
 - ◆ **Bandwidth** (250 MHz)
 - ◆ **Dynamic Range** (76+ dB)
- ◆ Suppliers using proprietary NEXT cancellation techniques
 - Supplier A plug + supplier A jack = Cat 6 performance
 - Supplier B plug + supplier B jack = Cat 6 performance
 - Supplier A plug + supplier B jack = Cat 5 performance
- ◆ Impact: Need supplier-specific test cords for Cat 6 field testing



Cat 7/Class F Field Testing Issues

- ◆ Cat 7 Measurements: 3 field testers support them
- ◆ Cat 7 Dynamic Range: 1 field tester supports it
- ◆ 600 MHz: No field tester supports it (300 MHz max)
- ◆ Proprietary connecting hardware (BKS, Telesafe, IBM/T&B, others)
- ◆ Pairs can be used for multiple simultaneous applications
- ◆ SSTP cabling has much higher common mode to differential conversion - Output signal balance of baluns critical to getting repeatable measurements in different test environments



EMC/Screening Issues

- ◆ Two key issues are balance and shielding

UTP proponents will say: “An ounce of twist is worth a pound of shielding”

Shielding proponents will say: “No twisted pair cable is perfectly balanced. Screening is necessary to minimize EMI”

- ◆ EN50081-1 & EN55022 specify limits for free space emission beyond 30 MHz
- ◆ TIA PN-3193 Draft 15 specifies ScTP cabling requirements including transfer impedance



Status of New Measurements in the Field

- ◆ Return Loss - well supported. Third generation field testers provide best results
- ◆ Input impedance - mathematically equivalent to return loss; return loss used instead
- ◆ Characteristic Impedance - not a link measurement; return loss used instead
- ◆ PS NEXT - well supported
- ◆ ELFEXT & PSELFEXT - limited support. Dynamic range challenges accuracy in second generation testers



Possible Future Measurements

- ◆ Attenuation Deviation
 - ◆ Alien Crosstalk
- ◆ Transfer Impedance
 - ◆ LCL
 - ◆ LCTL
- ◆ Coupling Attenuation

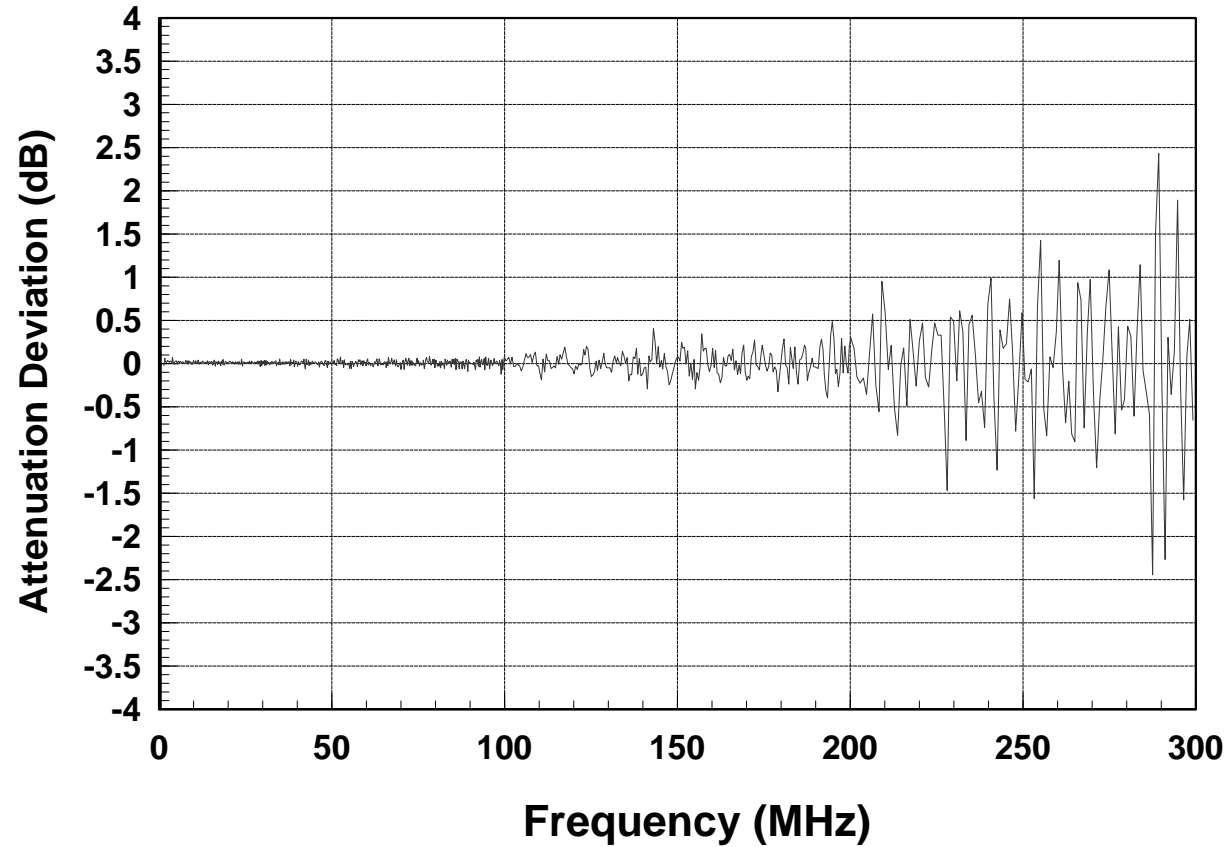


Attenuation Deviation

- ◆ Measure of deviation of attenuation from expected fitted curve
- ◆ Return loss reflections (variation of input impedance) at high frequencies cause a ripple in attenuation performance, especially above 100 MHz. Connectors often influence it highly.
- ◆ Alternative to return loss - a through measurement provides potential for higher dynamic range
- ◆ TP-PMD spec stipulates attenuation deviation requirement
- ◆ Under review in TIA as possible future test requirement
- ◆ No TIA limits proposed or set



Attenuation Deviation



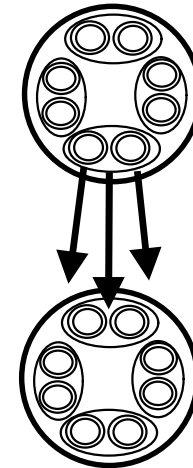
M I C R O T E S T

Alien Crosstalk



Alien Crosstalk

- ◆ Radiated energy from one cable affecting an adjacent cable
- ◆ Unpredictable, uncancellable noise source
- ◆ Measurement requires synchronizing two sets of test instruments
- ◆ No limits proposed or set



Transfer Impedance

- ◆ Defined as the ratio of the voltage measured along the conductors enclosed by a shield to the surface currents on the outside of the shield
- ◆ Specifies efficiency of shielding for shielded cables. The lower the transfer impedance, the lower will be emissions, and the better will be susceptibility.
- ◆ Specified in PN-3193 draft 15
- ◆ Not a field test



LCL, LCTL

- ◆ LCL Longitudinal conversion loss (Attenuation unbalance, or simply 'balance')
 - ◆ LCL determines the differential to common mode conversion at the near end, which determines the impairment of EMC performance of a system by the cabling (previously measured 1 - 30 MHz, to be extended to 250 MHz).
 - ◆ Signal injected and measured at the same end
 - ◆ Measured according to EN 50289-9
 - ◆ Link limits proposed for a laboratory environment
- ◆ LCTL (Longitudinal conversion transfer loss)
 - ◆ Determines the level of differential noise that is coupled into the receiver from external sources
 - ◆ CM Signal injected at one end and DM signal measured at the other



LCL, LCTL Field Measurement Challenges

- ◆ Field testing challenges:
 - ◆ balance of field test equipment must be >> balance to be measured
 - ◆ lack of controlled ground reference in the field causes large variability in measurements
 - ◆ challenges remain in getting consistent agreement in a lab environment



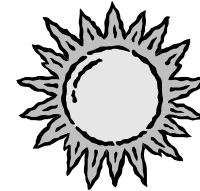
Coupling Attenuation

- ◆ Relationship between the transmitted power through the conductors and the maximum radiated peak power, conducted and generated by common mode currents.
- ◆ Characterizes EMC performance at higher frequencies (30 MHz - 1 GHz)
- ◆ Measured according to EN50289-6D (currently a lab measurement)
- ◆ Draft limits proposed for a laboratory environment
- ◆ No field tests yet envisioned or proposed

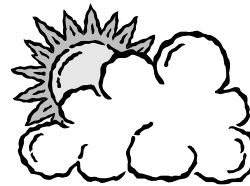


Field Testing Forecast

Delay, Delay skew,
PS NEXT, Return Loss



ELFEXT, PS ELFEXT



Attenuation Deviation



Alien Crosstalk



LCL, LCTL, Coupling
Attenuation, Transfer Impedance

