MiNi-HAC

Hearing aid compatibility test system

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ALSAS-10U

ALSAS-10U :- APREL Laboratories SAR Assessment System

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EM-ISight

Near Filed scanning system for magnetic and electric fields

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Technology Overview

- Fully automated system
- 5 or 6 axis Denso robotic control using advanced kinematics
- Positioning uncertainty of less than 0.02mm
- Bench top system for easy location and integration into laboratory
- 120 or 220V operation
- Dynamic touch detection system incorporating “easy scan”
- H-Field antenna probes with 0.035mm substrate thickness (E-Field Probe available)
- Working envelope up to 1200mm X & Y and 1100mm Z
- True 3D kinematics for more complex device analysis
- 2D, 3D and 4D graphical interface and data output
- Fully customizable test reports implementing user “click and select” for data importation into MS Word report
- Remote access to system
- Noise floor measured at better than -145dBm (dependent on spectrum analyzer)
- Pre compliance tool / correlate data to traditional methods (OATS, 10m etc)

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Key benefits of EM-ISight

- ✓ 10kHz to 20GHz **single probe solution** > **40GHz Q3**
- ✓ Sensitivity of -165dBm
- ✓ Measurement area of standard system is X = 400mm Y = 350mm Z = 300mm
- ✓ Dynamic touch for multi layer testing up to 300mm in Z height with up to 10 layers over same area
- ✓ Automated test reporting, with user defined limit lines which can be automatically exported to an MS word report
- ✓ 3D and 4D graphical interface for visualization of measured fields

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Key benefits of EM-ISight

- ✓ Fully calibrated probes and micro Stripline.
- ✓ System certified to ISO/IEC-17025.
- ✓ Probe resolution of 20µm, and minimum step resolution of 20µm in X, Y, and Z.
- ✓ Fully compatible with Tektronix RSA spectrum analyzers.
- ✓ Conduct receiver sensitivity testing
- ✓ Can operate as receiver or transmitter

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Applications

Certified to ISO/IEC-17025

IEC-61967-6
Integrated circuits –
Measurement of electromagnetic
emissions, 150 kHz to 1 GHz

IEC-61967-1-6 VCCI/CISPR 22/FCC Pt 15/22 EN55022 CISPR 12
FCC Pt 18/EN55011/ EN60555/VDE0871 EN55024/EN6100-6-4
GR-1089-CORE ITU-T/ETS300/IEC-6100-3

Aviation
Defense and Aerospace
Automotive
Consumer Electronics
Research and Development

APPROVED

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10kHz to 20GHz Single Probe Solution Characterization

- The probe and stripline simulations were conducted to allow for frequency extension
- By simulating both the probe and stripline we were able to optimize and improve the design of the probe and stripline
- Identified key elements based on sound scientific design principles
- Complete characterization of the probe and stripline from 10kHz to 20GHz

Simulation

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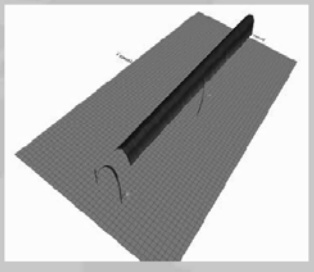
Probe Characterization Experimental

- Stripline calibration method is now well established
- Standing waves on stripline have been eliminated
- Results show extremely good correlation
- All data can be traced back to the IEC 61967 standard
- This method allows for easy ISO/IEC-17025 laboratory certification



4D Plot of Stripline Taken from EM-ISight

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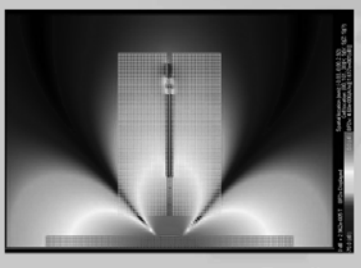
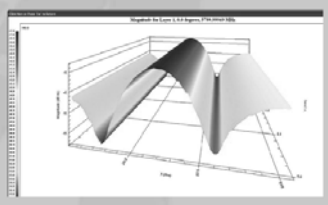
Probe Calibration

Simulation Results



Experimental Results



Excellent Correlation

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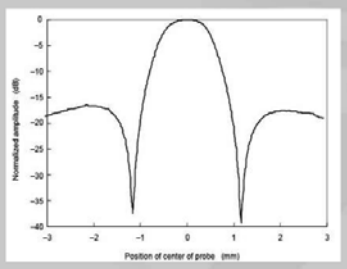
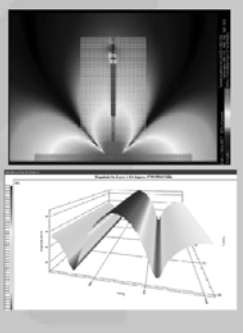
Probe Calibration





IEC-61967 Part 6

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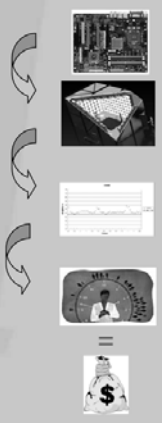
EM-ISight Application

Customer:
Electronics design/development
Application:
Real-Time EMI analysis and debug of what goes wrong after integration of a new design
Open Ended question:
How are you validating new parts or applications you integrate into your device?
Design pain point:
Time to market is always to SHORT.
Full chamber is expensive, requires a lot of time to operate, validate/qualify each new design, and does not always provide useful results
Device needs government certification:
How do I know that I am ready?



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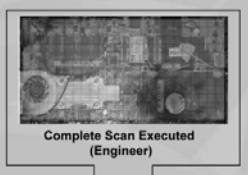
Complete Analysis



Complete Scan Executed (Engineer)

Pass Data to Stake Holders (Team Leaders)

PCB (layout) | Video | Storage (HDD) | Digital (SD, RAM etc) | Camera

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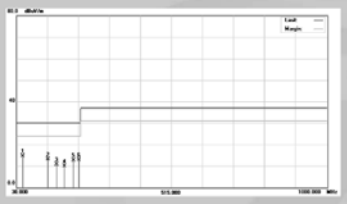
Radiated Spurious Emissions



- Typically don't bother to look further when results do not highlight any problems
- The “no problem here” approach can have a significant effect on other areas of a radio/system design
- Problems can hide way below the normative noise floor of an RSE/Intentional emission measurement

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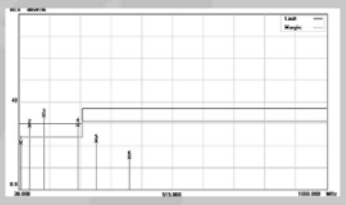
Radiated Spurious Emissions

- When we observe measurements that fail then we need to “find the source”
- In these situations where a problem has been observed it can help us when we look further up the frequency spectrum for sources that can effect a receiver sensitivity
- The dynamic range of the measurement then becomes important when problems may be observed at -100dBm or lower



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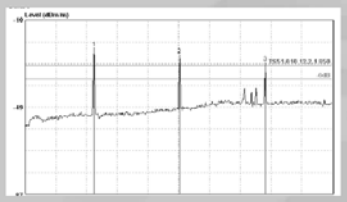
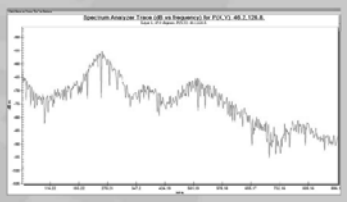
Noise Floor





Factor of 2 Higher

Factor of 2 Lower

Typical measurements for spurious have a significantly higher noise floor than those which we use to find a noise source that will effect a receivers sensitivity.
For this type of analysis we would not use an Open Area Test site.
Even some 10M chambers have a noise floor greater than what is required.

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Potential Sources of Noise 3G

Device	Fundamental Frequency (MHz)	Harmonic	Downlink Frequency Effected (MHz)
NAND	33.33	26/28/55/56/58/59/64/65	Multiple
USB 2	480	2	960
LVDS Clock	71.64	13/26/27/30	Multiple
Video Memory	390	5	1950
Video Memory	397	5	1985
Video Memory	396	5	1980
GPU	396.18	5	1980.9
Nvidia Tegra 250 AP20H	300	7	2100
HDMI	350	6	2100

Up-Link Band	Frequency (MHz)
Cellular 850	869-894
EGSM	925-960
DCS	1805-1880
PCS	1930-1990
3G/4G AWG	2110-2155

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Potential Sources of Noise GPS

Device	Fundamental Frequency (MHz)	Harmonic	Downlink Frequency Effected (MHz)
NAND	33.33	47	1566.651
1394 Serial Bus	24.576	64	1572.86
LVD (Low Voltage Differential) Signaling	71.64	22	1576.08
LVD (Low Voltage Differential) Signaling	72	22	1584
PCI (Docking)	33.3333	47	1566.67
Video Memory	396	4	1584
GPU (Performance Mode)	396.18	4	1584.72

GPS RECEIVE BAND: 1565-1585MHz (with guard band)

Type of bus interface is not known until analysis is performed by EM-ISight

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Method of Analysis

- Planer scans were executed to see what dominant fundamentals/spurs could be found
- Based on the analysis of these spurs we could then decide what locations we wanted to conduct high resolution scans
- We identified 7 key areas of interest
- These areas and fundamental frequencies were then assessed to see what could be effected

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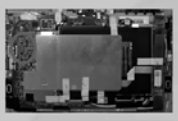
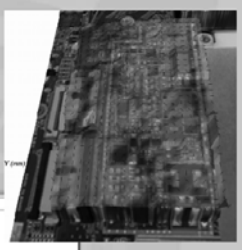
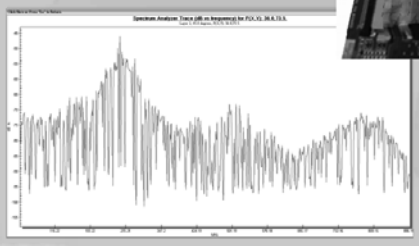
Power Circuit (4)

Measured = -46dBm
First Harmonic 260MHz
Second = 22.5dBm down
Third = 4dBm from 2nd

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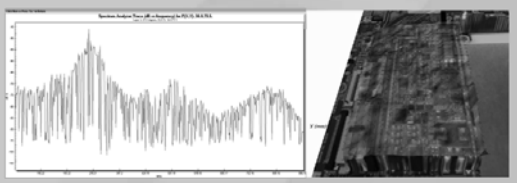
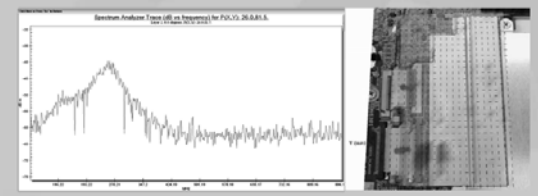
Adding a Shield

No Shield

With Shield

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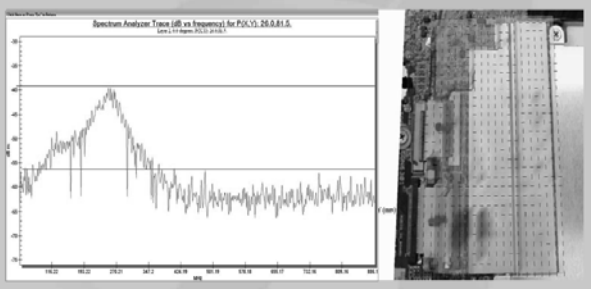
Shield Effect



Dropped the second and third harmonics by 22dBm
Shifted the fields away from the GPS/Wireless location

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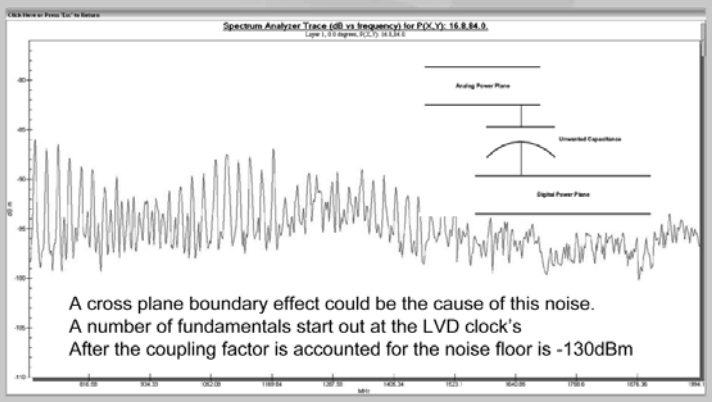
Reason for Noise



A cross plane boundary effect could be the cause of this noise.
A number of fundamentals start out at the LVD clock's
After the coupling factor is accounted for the noise floor is -130dBm

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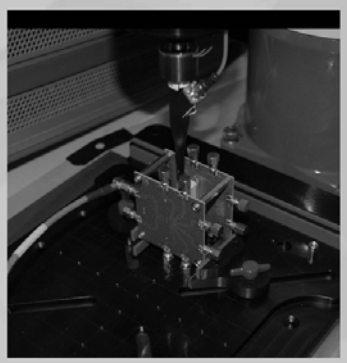
High Speed Connector



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Test Conditions

- Noise floor below -165dBm
- Frequency span of 10kHz
- Center frequency 5GHz, 10GHz, 15GHz & 20GHz
- APREL H-Field Probe
- Located within shielded room
- Multiple scans of high speed connector interface
- Feed power set at 0dBm
- Modulated signal of 50/50 Duty Cycle

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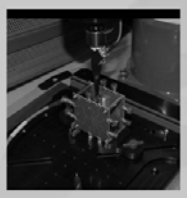
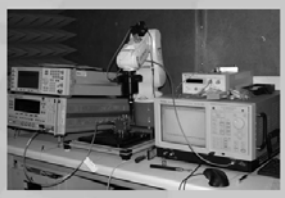
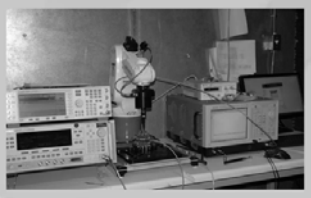
Device Under Test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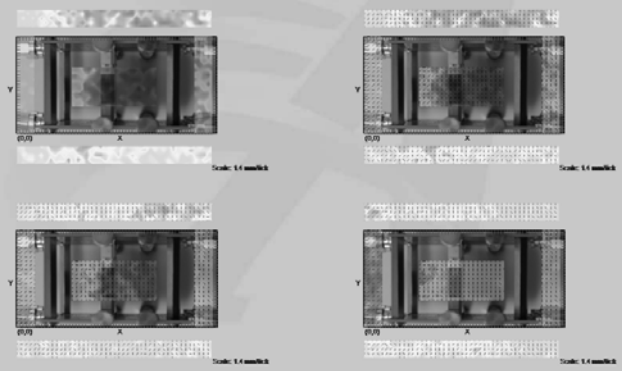
Results



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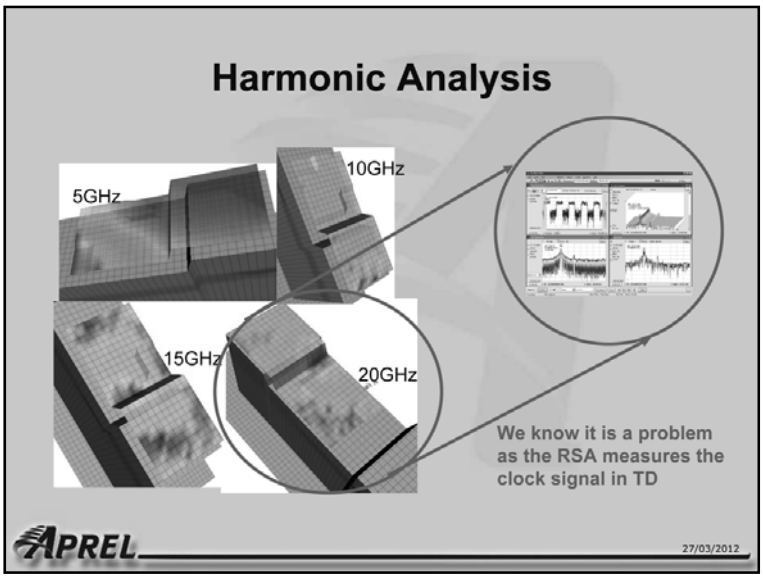
Harmonic Analysis
5GHz
10GHz
15GHz
20GHz
We know it is a problem as the RSA measures the clock signal in TD
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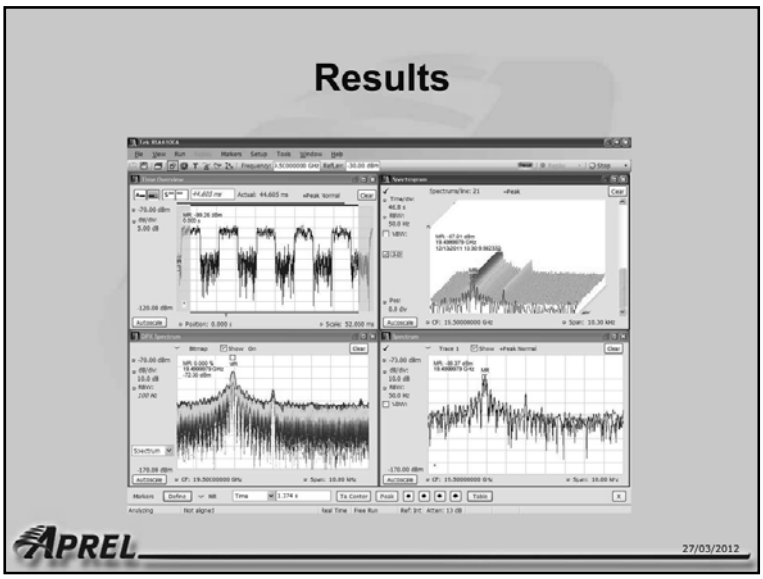
Results
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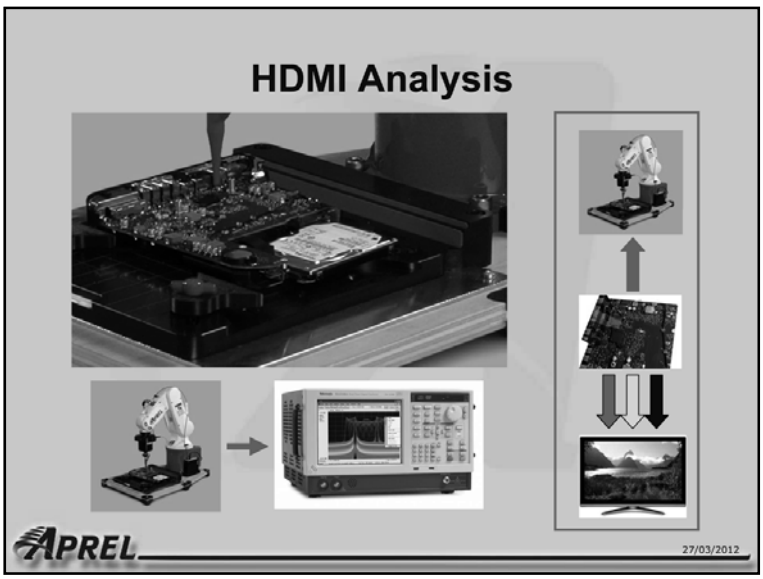
HDMI Analysis
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HDMI Analysis

- Defined a fixed scan area over HDMI port on a computer
- Control measurement to assess the fundamental frequency with no video passing through
- Measurement conducted with video passing through (DVD)
- Standard 480P video up-scaled to 1080i

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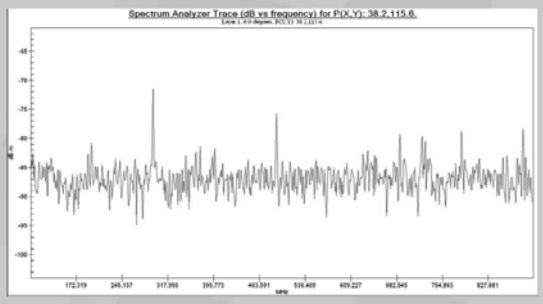
HDMI Analysis



Controlled measurement

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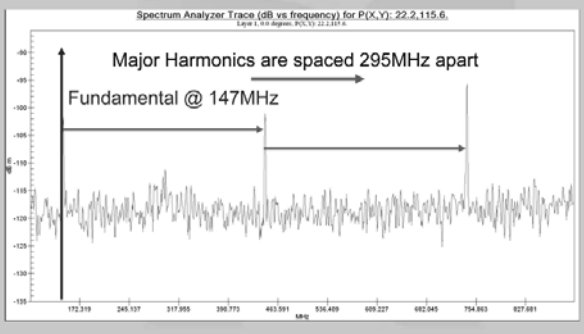
HDMI Analysis



Low Frequency Analysis

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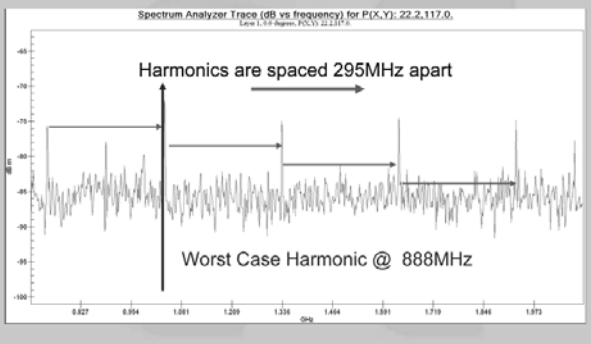
HDMI Analysis



High Frequency Analysis

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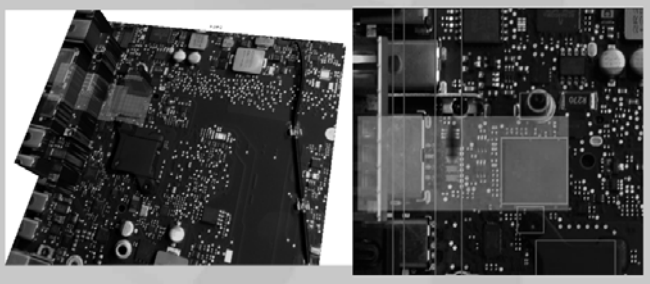
HDMI Peak Location



4D Plot

2D Overlay

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Implications on WWAN

- Issues could result from isotropic sensitivity at some bands
- High value of -34.06 dBm* at 888MHz (cellular 850)

Up-Link Band	Frequency (MHz)
Cellular 850	869-894
EGSM	925-960
DCS	1805-1880
PCS	1930-1990
3G/4G AWG	2110-2155

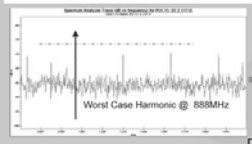
Spectrograph Shows Data Due to Movie Playing

APREL *Corrected for probe coupling factor 27/03/2012

Bands Effected

WWAN Up-Link

Up-Link Band	Frequency (MHz)
Cellular 850	869-894
EGSM	925-960
DCS	1805-1880
PCS	1930-1990
3G/4G AWG	2110-2155



OTA Chamber

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EM-ISight identifies the problem in real-time, allows the user to bypass **expensive OTA chamber to identify the source of noise**

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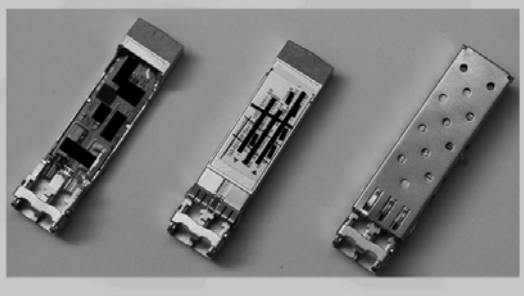
High Speed Optical Transceivers



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Purpose of Analysis

- Investigate the effectiveness of shield
- One size fits all? External design
- As frequency increases does the effectiveness of the shields attenuation improve?
- Can lessons be learned from near field analysis
- As the technology improves what would the legacy be for the external shield design?
- Can the far-field be predicted accurately based on the near field analysis

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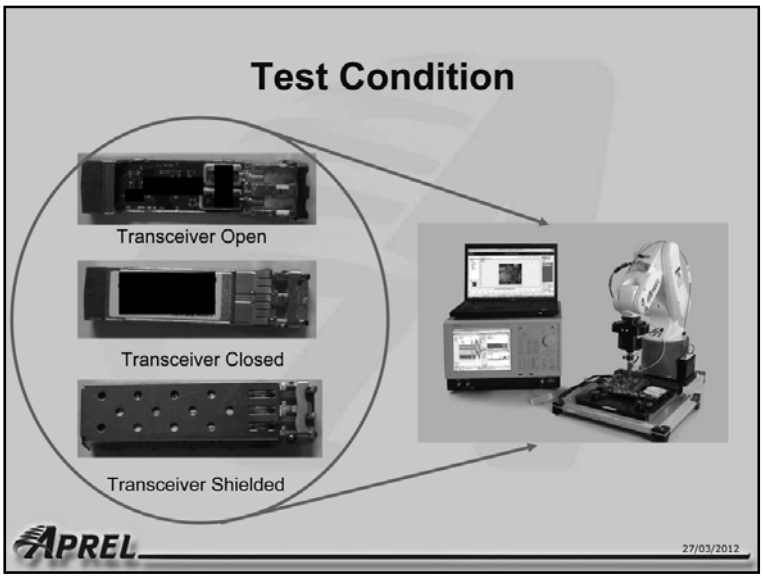
Test Condition
Transceiver Open
Transceiver Closed
Transceiver Shielded
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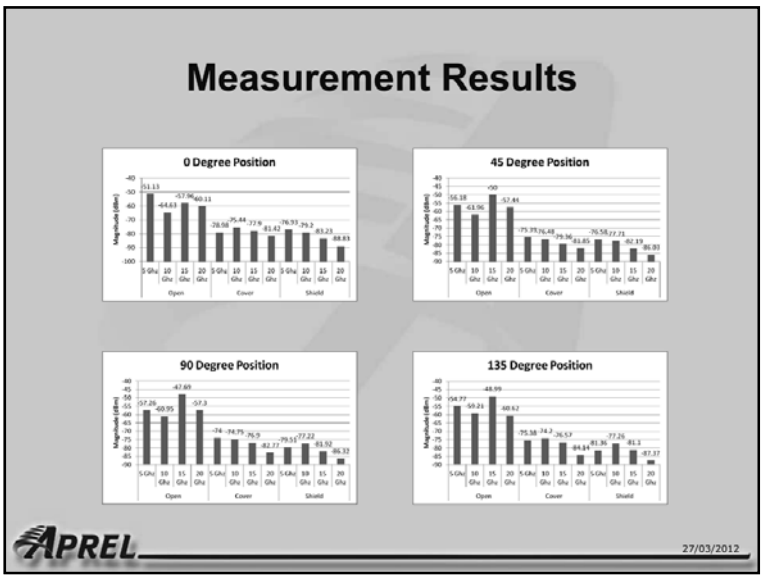
Measurement Results
0 Degree Position
45 Degree Position
90 Degree Position
135 Degree Position
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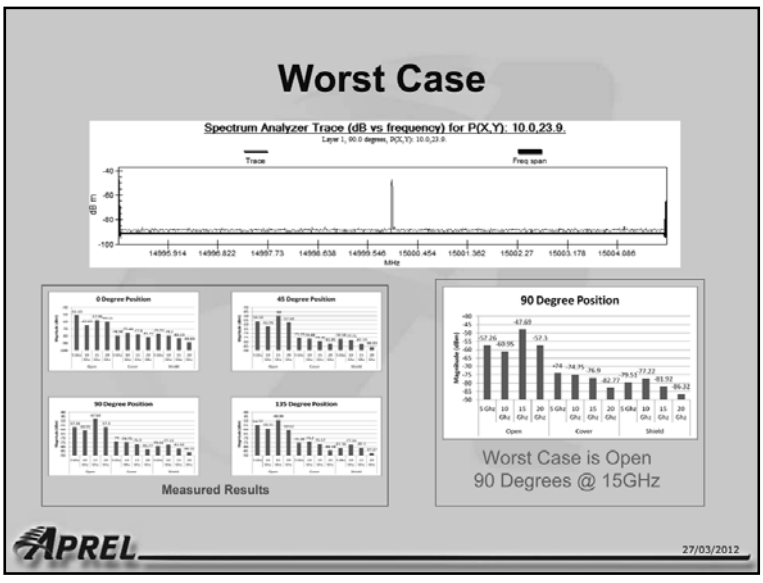
Worst Case
Spectrum Analyzer Trace (dB vs frequency) for P(X,Y): 10.0,23.9
Trace
Freq span
dB m
MHz
90 Degree Position
Measured Results
Worst Case is Open
90 Degrees @ 15GHz
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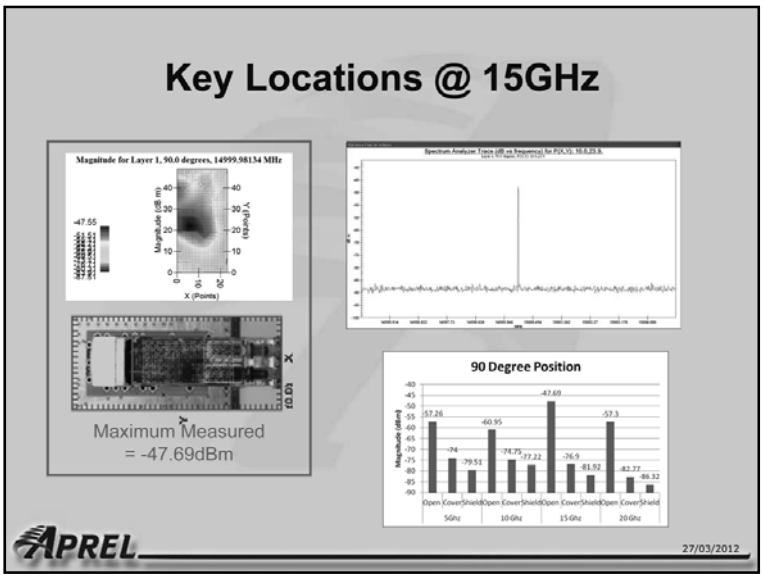
Key Locations @ 15GHz
Magnitude for Layer 1, 90.0 degrees, 14999.98134 MHz
-47.55
Magnitude (dB m)
X (Points)
Y (Points)
Spectrum Analyzer Trace (dB vs frequency) for P(X,Y): 50.0,20.0:
90 Degree Position
-57.26
-74
-79.51
-60.95
-74.75
-77.22
-47.69
-76.9
-81.92
-57.3
-82.77
-89.32
Open Cover Shield Open Cover Shield Open Cover Shield Open Cover Shield
5Ghz
10Ghz
15Ghz
20Ghz
Maximum Measured
= -47.69dBm
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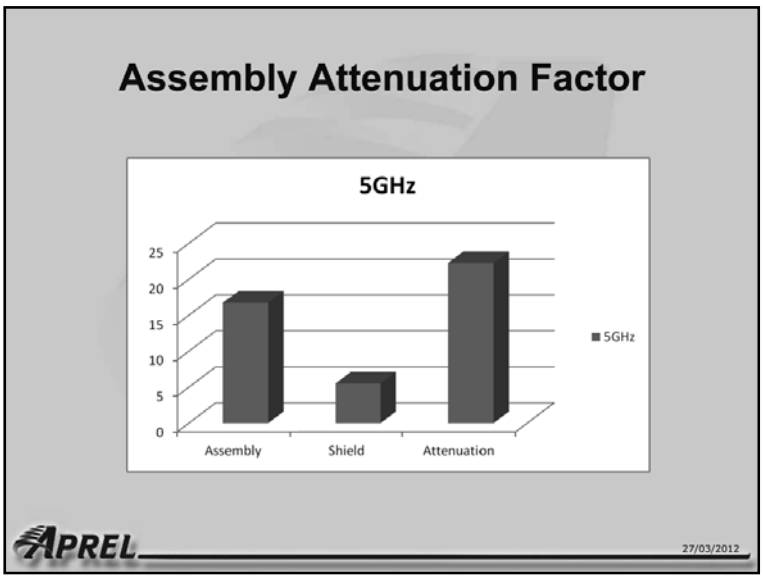
27/03/2012


Assembly Attenuation Factor
5GHz
25
20
15
10
5
0
Assembly
Shield
Attenuation
5GHz
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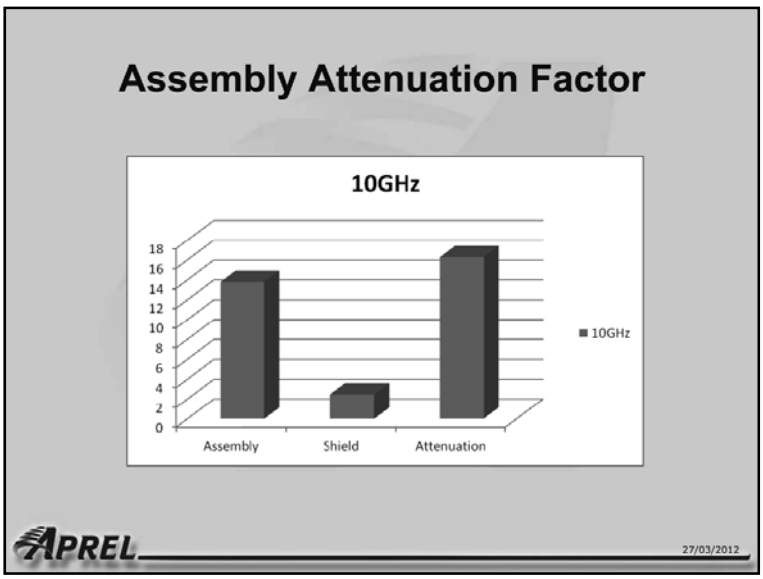
27/03/2012


Assembly Attenuation Factor
10GHz
18
16
14
12
10
8
6
4
2
0
Assembly
Shield
Attenuation
10GHz
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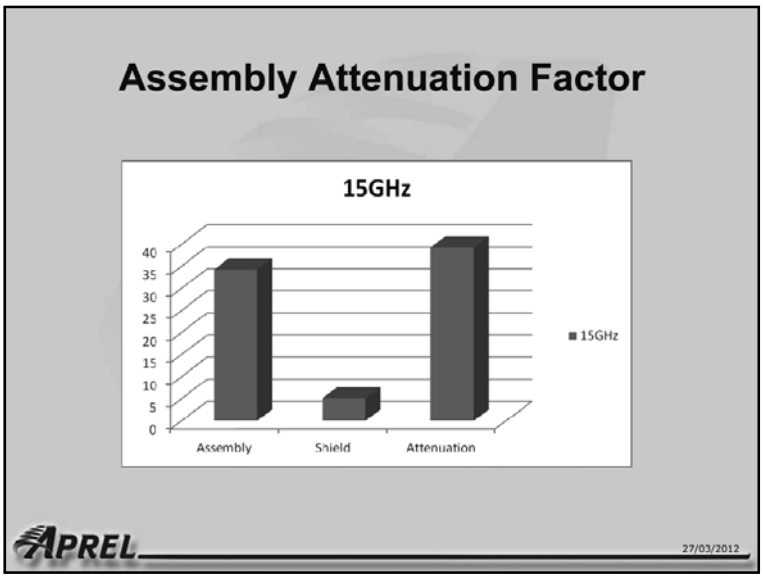
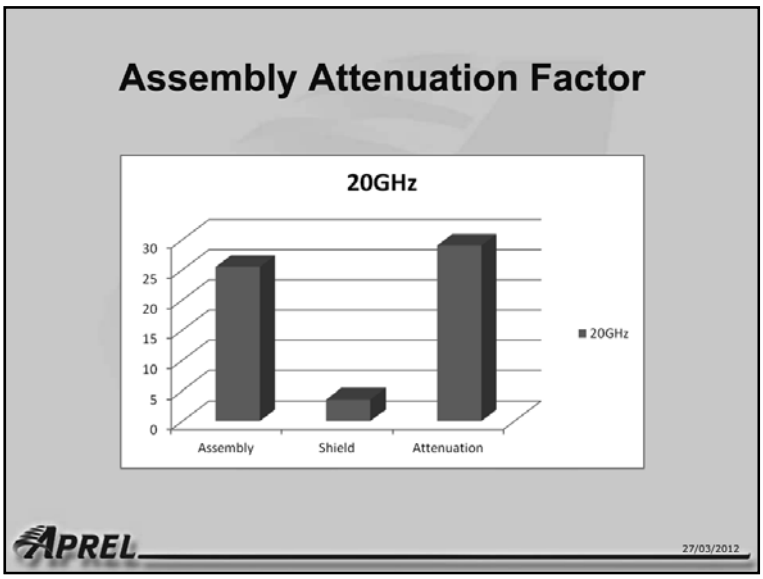

Assembly Attenuation Factor
15GHz
40
35
30
25
20
15
10
5
0
Assembly
Shield
Attenuation
15GHz
APREL
27/03/2012


Assembly Attenuation Factor
20GHz
30
25
20
15
10
5
0
Assembly
Shield
Attenuation
20GHz
APREL
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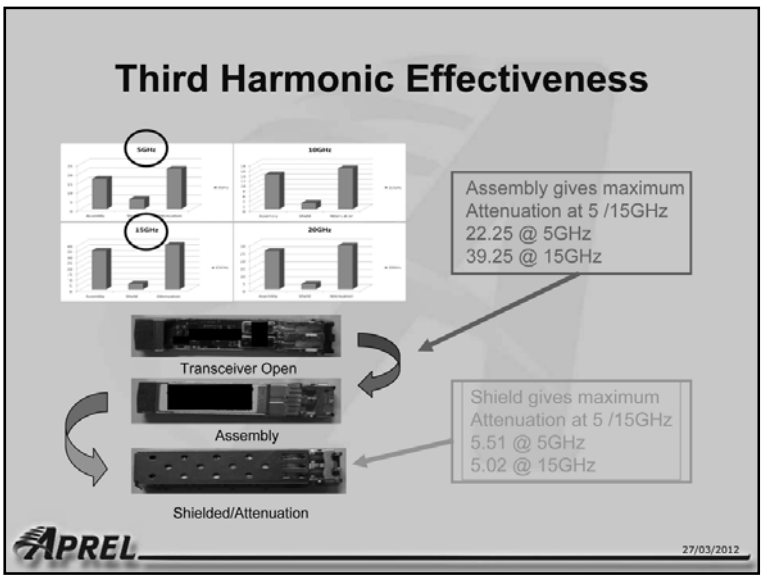
Third Harmonic Effectiveness
Assembly gives maximum
Attenuation at 5 /15GHz
22.25 @ 5GHz
39.25 @ 15GHz
Transceiver Open
Assembly
Shielded/Attenuation
Shield gives maximum
Attenuation at 5 /15GHz
5.51 @ 5GHz
5.02 @ 15GHz
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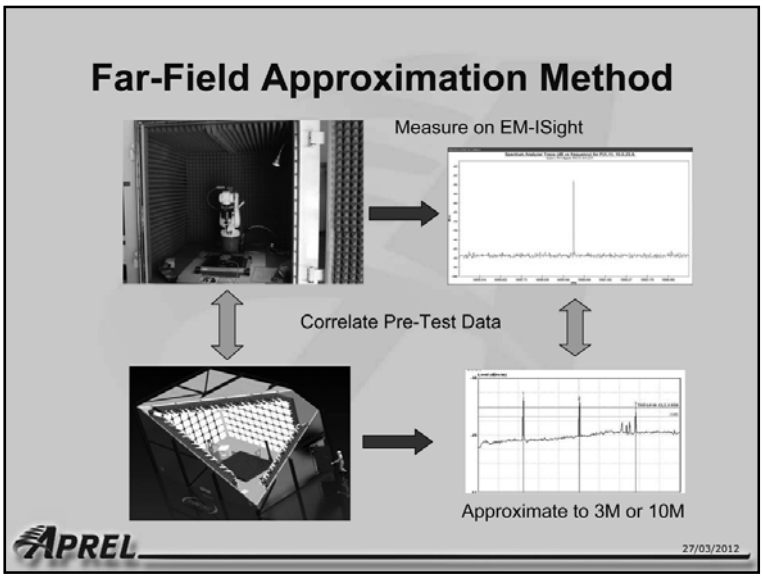
Far-Field Approximation Method
Measure on EM-ISight
Correlate Pre-Test Data
Approximate to 3M or 10M
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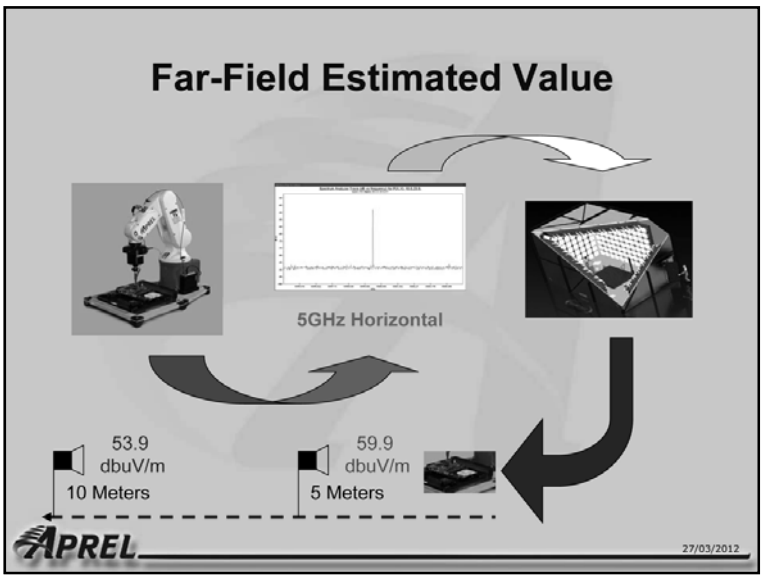
Far-Field Estimated Value
5GHz Horizontal
53.9
dbuV/m
10 Meters
59.9
dbuV/m
5 Meters
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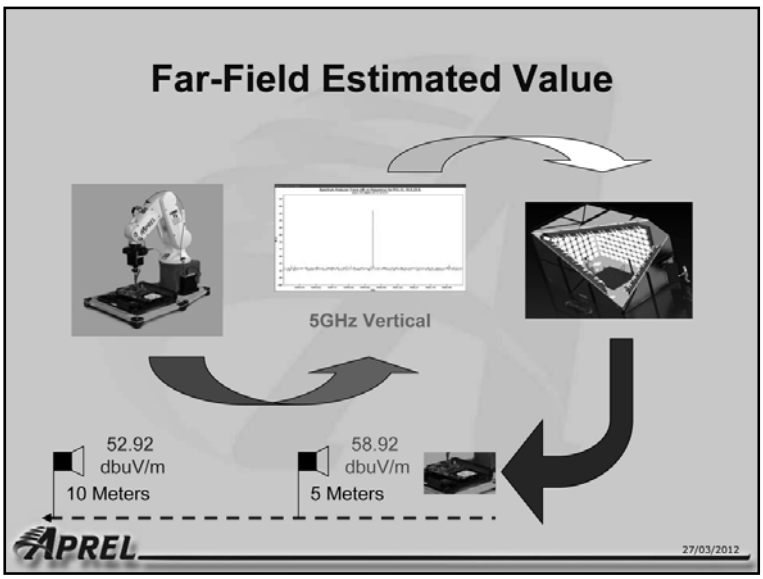
Far-Field Estimated Value
5GHz Vertical
52.92
dbuV/m
10 Meters
58.92
dbuV/m
5 Meters
APREL
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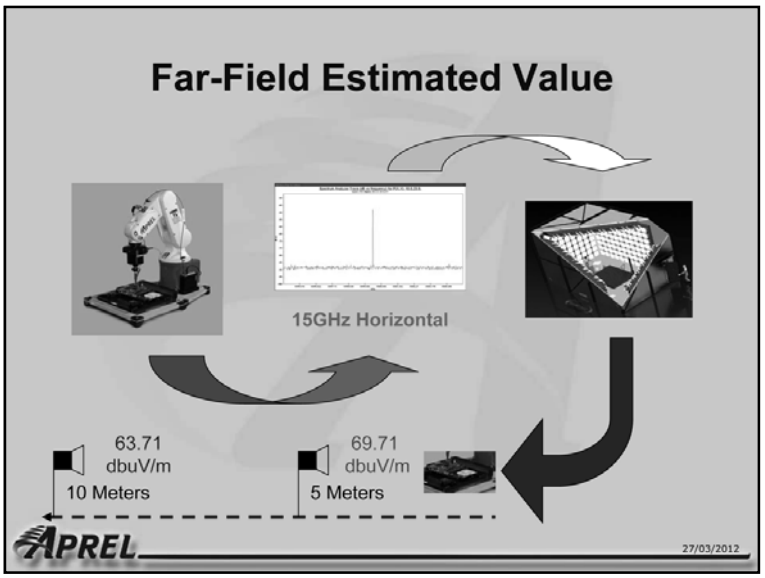
Far-Field Estimated Value
15GHz Horizontal
63.71
dbuV/m
10 Meters
69.71
dbuV/m
5 Meters
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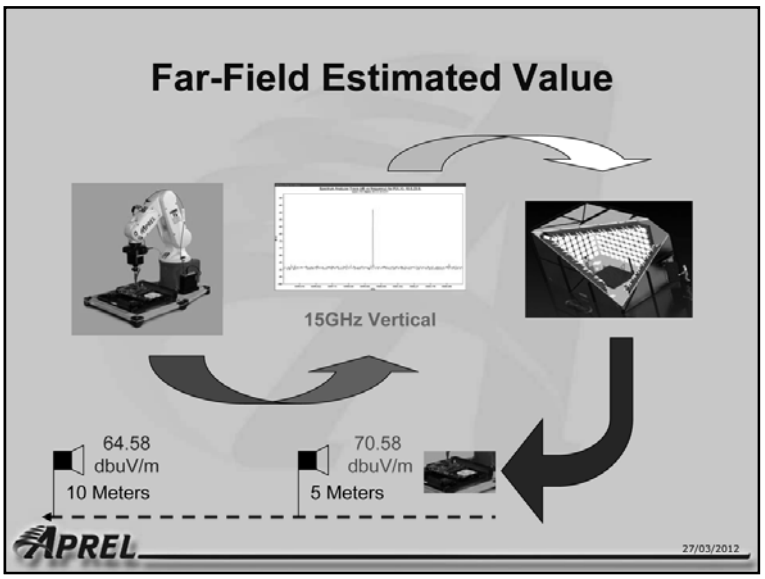
Far-Field Estimated Value
15GHz Vertical
64.58
dbuV/m
10 Meters
70.58
dbuV/m
5 Meters
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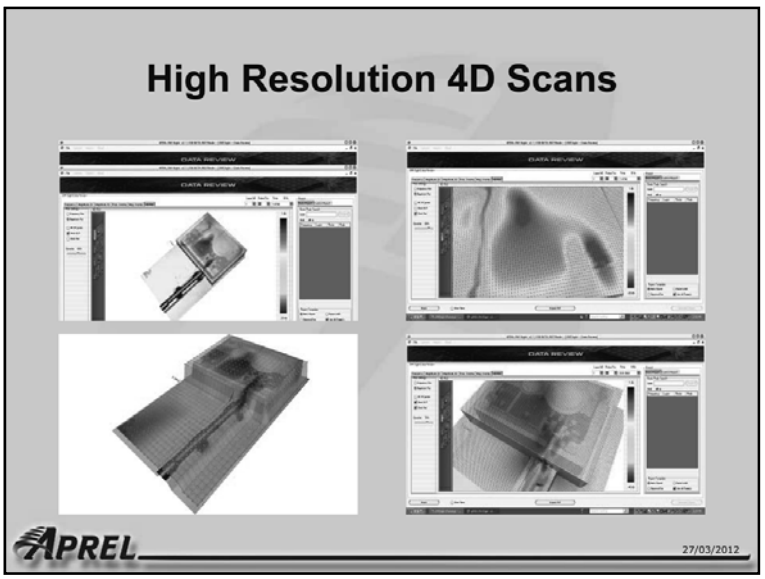
High Resolution 4D Scans
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Tektronix RSA

- 9kHz to 20GHz preferred option
- Full implementation of DPX features
- Time Overview
- DPX Spectrum
- Spectrogram
- Trace oversampling
- Complete control over RSA via EM-ISight GUI

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Unique Tektronix Features

- Full capability operation of the RSA series spectrum analyzers
- DPX mode/ Real time mode
- Conventional spectrum mode
- Spectrogram
- Frequency mask triggering
- All features can be captured from RSA and then automatically included into the final word report produced by EM-ISight

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Other Analyzers

- APREL have coded for the IVI platform
- So all Agilent Analyzers through E4xxx series to the N9xxx series (IVI)
- So all Rhode and Schwartz Analyzers FSG, FSL, FSP, FSQ, FSU and FSV are supported
- APREL have coded for Anritsu MS2xxxA through to MS2xxxE

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Differentiators

- Real Time analysis and DPX
- Faster scan time up to 5x faster compared to other competitors economic models
- R&S are fixed in their approach to measurement so a lot of features cant be automated e.g. trigger etc
- Anritsu are slowest models for scan times
- Agilent have good features and comparable with time for scan completion
- Agilent have best economical models with good speed
- MDO model not yet been tested by APREL

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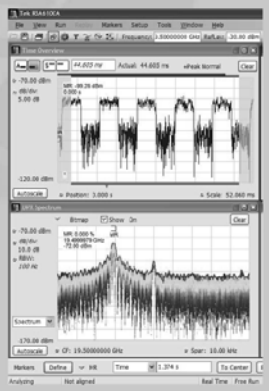
Key Topic (Time Domain)

- Frequency domain is good start point but shows only half of the picture
- When multiple problems are identified it is good to look at the shape of the signal
- This allows engineers in real time to identify the source
- When the problem is a digital issue in the frequency domain real time cuts a lot of the assessments down
- Looking in the spectrograph allows for quick decisions



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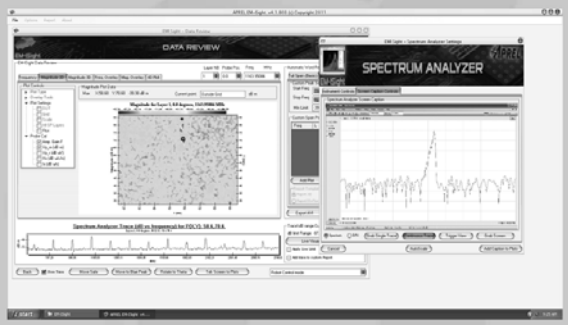
Data Review (advanced)



Advanced Feature for Tektronix DPX Mode

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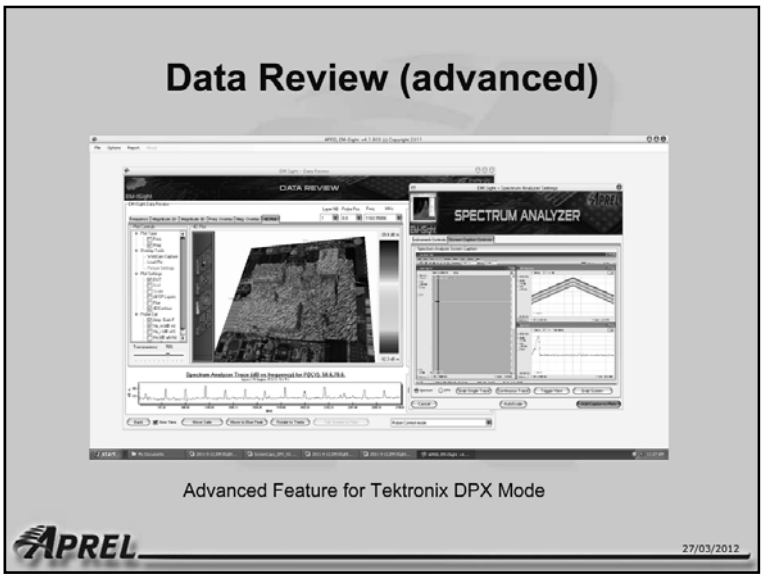
Data Review (advanced)
DATA REVIEW
SPECTRUM ANALYZER
Advanced Feature for Tektronix DPX Mode
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